STORMWATER MANAGEMENT REPORT

PROPOSED

HAMDEN SOLAR

SOLAR PROJECT

360 GAYLORD MOUNTAIN ROAD
HAMDEN, CONNECTICUT
NEW HAVEN COUNTY

Prepared for:

Gaylord Mountain Solar Project 2019, LLC
200 Harborside Drive, Suite 200
Schenectady, NY 12305

Prepared by:

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567 Vauxhall Street Extension, Suite 311
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August 2020

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Introduction

At the request of Distributed Solar Operations, LLC, All-Points Technology Corporation, P.C. ("APT") has undertaken analysis of and design to address stormwater impacts resulting from development of a proposed 1.9 MW alternating current (AC) solar electric generating facility in Hamden, Connecticut (the "Project"). The Project, known as the Hamden Solar project, involves the installation of solar panels and associated equipment at 360 Gaylord Mountain Road in Hamden, Connecticut ("Site"). The Project will be specifically located along the eastern portion of the existing Site, which will herein be referred to as "Project Area".

The purpose of this report is to provide an analysis of the potential stormwater drainage impacts associated with the Project, as well as a description of the design to mitigate such potential stormwater drainage impacts. The design is intended to be in full compliance with the State and Town regulations while taking prevailing site conditions and practical factors into account.

Existing Site Conditions

The Site is a privately-owned irregular shaped parcel located at 360 Gaylord Mountain Road in Hamden, Connecticut, that consists of approximately 33.88± acres of mostly undeveloped land. The parcel is bisected by an existing utility right-of-way ("ROW") running in the north south direction. Additionally, an existing telecommunications tower is located on the northwestern corner of the property with an existing access road that ties into the property from the north. The Project Area will be isolated to the portion of the Site to the east of the existing ROW.

The Site's existing topography generally slopes downward from west to east. A sizable portion of watershed potentially drains to the Site property from the southwest due to the existing gravel access roads and swales within the ROW. Within the Project Area, the topography includes slopes that range from approximately 0 to 35 percent throughout. Elevations within the Site range from approximately 435 feet AMSL near the eastern portion of the Site to approximately 605 feet AMSL along the ROW that bounds the Project Area to the west.

Developed Site Conditions

The Project will be constructed in the eastern area of the Site, west of the existing ROW. Permanent access to the Site will be provided via a proposed gravel access road off of Gaylord Mountain Road near the southeastern corner of the Site. The Project includes the installation of 6,292 solar panels (Q Peak Duo L-G5.3 modules) and associated fencing, access road, utility and stormwater management features, within 12.31± acres of the Site. Of the 12.31± acres, 10.33± acres within existing woods will require clearing and grubbing for the Project. The remaining 1.98± acres within the Project limits of disturbance will require tree clearing only, with stumps to remain and minimal ground disturbance.

The proposed solar panels will be installed on a ground screw ground mounted racking system, with minimal changes to the existing grades. The panel array orientation has been designed and rotated to match the existing slope to the extent practicable to facilitate meeting the existing time of concentration path. As a result, the post-development site conditions will mimic the pre-

developed site conditions. Areas of clearing and grubbing and any existing ground cover that is disturbed during construction will be hydroseeded with tackifier to promote quick stabilization. Additional compost filter sock will be installed along existing contours in a maximum of 100' intervals and maintained throughout construction within the array area to break up potential channeling flow paths. In order to account for the change in ground cover and time of concentration, a stormwater management basin is proposed along the eastern portion of the proposed Project Area.

Stormwater Management

Analysis Methodology

The hydrologic analysis was performed using the HydroCAD stormwater modeling system computer program developed by HydroCAD Software Solutions, LLC.

Hydrographs for each watershed were developed using the SCS Synthetic Unit Hydrograph Method with a Type III rainfall distribution. Hydrographs were developed for the NOAA Atlas 14, Volume 10, Version 2 Precipitation 2-, 25-, 50-, and 100-year storm event with rainfall depths of 3.57, 6.77, 7.67, and 8.66 inches respectively.

The existing and proposed drainage areas used in the calculations are illustrated on the Existing and Proposed Drainage Area Plans (EDA-1 & PDA-1). These maps and the corresponding HydroCAD output are attached.

Utilizing Appendix I, Stormwater Management at Solar Array Construction Projects, provided by Connecticut Department of Energy & Environmental Projection ("CT DEEP"), this hydrologic analysis will reflect a reduction of the Hydrologic Soil Group ("HSG") present on-site by one (1) step (e.g. soils of HSG B shall be considered HSG C). This reduction, as indicated by CT DEEP, is intended to account for the compaction of soils that results from extensive machinery traffic during construction of the array. The Water Quality Volume ("WQV") for the site will be calculated assuming that the solar panels, roadways, gravel surfaces, and transformer pads are effectively impervious cover. See Appendix E.

Existing Drainage Patterns

The proposed Project area drains from the west to the east, ultimately to the wetland system adjacent to Gaylord Mountain Road and an existing culvert across same.

The Site was modeled at one (1) Analysis Points ("AP-1"). AP-1 is along the existing wetland adjacent to Gaylord Mountain Road. Peak discharges have been computed at the point of study for the 2-, 25-, 50-, and 100-year storm events.

The project site soils identified by the United States Department of Agriculture (USDA) Natural Resources Conservation Service consist of Map Unit Symbol 78C, named "Holyoke-Rock outcrop complex, 3 to 15 percent slopes", 78E, named "Holyoke-Rock outcrop complex, 15 to

45 percent slopes", 64C, named "Cheshire-Holyoke complex, 3 to 15 percent slopes, very rock", 77D, named "Cheshire-Holyoke complex, 15 to 35 percent slopes, very rocky", 87C, named Wethersfield loam, 8 to 15 percent slopes", 89C, named Wethersfield loam, 3 to 15 percent slopes, extremely stony", and 87D, named Wethersfield loam, 15 to 25 percent slopes". Map Unit Symbols 64C and 77D are classified in the HSG rating of "B", 87C, 87D, and 89C are classified in the HSG rating of "C", and 78C and 78E are classified in the HSG rating of "D". The pre-developed discharges at the Analysis Point are tabulated in Table 1-1.

Table 1-1

Analysis Point	**Pre-developed Peak Storm Runoff (Q), cubic feet per second (cfs)**			
	2-year	**25-year**	**50-year**	**100-year**
AP-1	23.01	86.91	107.27	130.15

Proposed Drainage Patterns

The Project will require clearing and grubbing, although minimal, in the immediate area for the proposed solar installation, including the necessary utilities, access road, and stormwater management features, resulting in approximately 12.31± acres of disturbance. Overall, hydrologically, the post-developed condition is designed to mimic the pre-developed condition.

To manage the increase in post-development runoff due to the change in cover type associated with converting woods to meadow and the reductions in one full HSG within the proposed limit of disturbance, one (1) stormwater management basin is proposed along the eastern portion of the Project Area. Additionally, one (1) rip-rap lined swale is proposed to facilitate flow to the proposed basin. Using twin outlet control structures with a low flow orifice and grate top the basin, as needed, the basin is designed to provide the necessary water quality treatment volume for the additional impervious area, as recommended by CT DEEP Appendix I. See calculations attached. A rip-rap swale and level spreader are also proposed along the southwestern corner to intercept potential flows from an existing culvert within the ROW and promote shallow concentrated flows down the existing slope.

Since the proposed development mimics the existing conditions, the post-development condition was modeled using the same Analysis Points. Peak discharges have been computed at the point of study for the 2-year, 25-year, 50-year, and 100-year storm events. The post-development discharges at each point of study are tabulated in Table 1-2.

Table 1-2

Analysis Point	**Post-developed Peak Storm Runoff (Q), cubic feet per second (cfs)**			
	2-year	**25-year**	**50-year**	**100-year**
AP-1	17.20	79.98	92.23	123.85

Conclusion

The stormwater management for the proposed site has been designed such that the post-development peak discharges to the waters of the State of Connecticut for the 2-, 25-, 50-, and 100- year storm events are less than the pre-development peak discharges. As a result, the proposed solar array will not result in any adverse conditions to the surrounding areas and properties.

APPENDIX A: NRCS SOIL SURVEY

Map Scale: 1:6,690 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 300 600 1200 1800

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N 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 1:12,000.

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: State of Connecticut
Survey Area Data: Version 19, Sep 13, 2019

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

Date(s) aerial images were photographed: Oct 22, 2018—Nov 1, 2018

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
6	Wilbraham and Menlo soils, 0 to 8 percent slopes, extremely stony	C/D	2.2	1.2%
37C	Manchester gravelly sandy loam, 3 to 15 percent slopes	A	1.7	0.9%
41B	Ludlow silt loam, 2 to 8 percent slopes, very stony	C	10.4	5.6%
42C	Ludlow silt loam, 2 to 15 percent slopes, extremely stony	C	14.4	7.8%
63B	Cheshire fine sandy loam, 3 to 8 percent slopes	B	6.6	3.6%
64C	Cheshire fine sandy loam, 8 to 15 percent slopes, very stony	B	7.8	4.2%
77C	Cheshire-Holyoke complex, 3 to 15 percent slopes, very rocky	B	3.3	1.8%
77D	Cheshire-Holyoke complex, 15 to 35 percent slopes, very rocky	B	19.2	10.4%
78C	Holyoke-Rock outcrop complex, 3 to 15 percent slopes	D	23.2	12.5%
78E	Holyoke-Rock outcrop complex, 15 to 45 percent slopes	D	28.4	15.4%
87C	Wethersfield loam, 8 to 15 percent slopes	C	16.7	9.1%
87D	Wethersfield loam, 15 to 25 percent slopes	C	18.0	9.7%
88B	Wethersfield loam, 3 to 8 percent slopes, very stony	C	6.4	3.4%
88C	Wethersfield loam, 8 to 15 percent slopes, very stony	C	8.9	4.8%
89C	Wethersfield loam, 3 to 15 percent slopes, extremely stony	C	17.6	9.5%
Totals for Area of Interest			**184.8**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX B: EXISTING DRAINAGE AREA MAP (EDA-1) & HYDROLOGIC COMPUTATION (HYDROCAD)

EXISTING DRAINAGE AREAS

	TOTAL AREA (ACRES)	COMPOSITE CN	TC (MINS.)
EDA-1	40.864	68	29.8

EXISTING CONDITION PEAK FLOWS

ANALYSIS POINT	2-YEAR (CFS)	25-YEAR (CFS)	50-YEAR (CFS)	100-YEAR (CFS)
AP-1	23.01	86.91	107.27	130.15

1 EDA-1 **EXISTING DRAINAGE AREA MAP**
SCALE : 1" = 100'-0"

100 0 50 100 200
(IN FEET) 1 inch = 100 ft.

GAYLORD MOUNTAIN SOLAR PROJECT 2019, LLC

200 HARBORSIDE DRIVE SUITE 200 SCHENECTADY, NY 12305

ALL-POINTS TECHNOLOGY CORPORATION
567 VAUXHAUL STREET EXTENSION - SUITE 311
WATERFORD, CT 06385 PHONE: (860)-663-1697
WWW.ALLPOINTSTECH.COM FAX: (860)-663-0935

PERMIT SET

NO	DATE	REVISION
0	08/07/20	ISSUED FOR PERMIT: BJP
1		
2		
3		
4		
5		
6		

DESIGN PROFESSIONAL OF RECORD

PROF: BRADLEY J. PARSONS P.E.
COMP: ALL-POINTS TECHNOLOGY CORPORATION
ADD: 567 VAUXHAUL STREET EXTENSION - SUITE 311 WATERFORD, CT 06385

OWNER: VERTICAL BRIDGE LANCO LLC
ADDRESS: 750 PARK OF COMMERCE DR S200 BOCA RATON, FL 33487

HAMDEN SOLAR

SITE ADDRESS: 360 GAYLORD MOUNTAIN RD HAMDEN, CT

APT FILING NUMBER: CT619100

DRAWN BY: JT

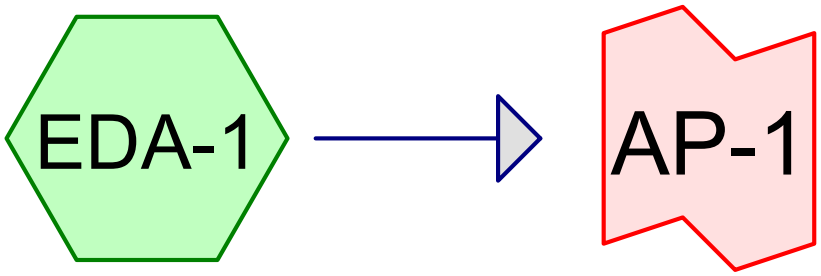
DATE: 08/07/20 CHECKED BY: BJP

SHEET TITLE:

EXISTING DRAINAGE AREA MAP

SHEET NUMBER:

EDA-1



EDA-1 AP-1

Subcat Reach Pond Link

Routing Diagram for Hamden - EX - Rev0
Prepared by Microsoft, Printed 7/7/2020

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
4.370	56	Brush, Fair, HSG B (EDA-1)
0.768	70	Brush, Fair, HSG C (EDA-1)
0.061	77	Brush, Fair, HSG D (EDA-1)
8.037	55	Woods, Good, HSG B (EDA-1)
11.837	70	Woods, Good, HSG C (EDA-1)
15.791	77	Woods, Good, HSG D (EDA-1)
40.864	**68**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
12.407	HSG B	EDA-1
12.605	HSG C	EDA-1
15.852	HSG D	EDA-1
0.000	Other	
40.864		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	4.370	0.768	0.061	0.000	5.199	Brush, Fair	EDA-1
0.000	8.037	11.837	15.791	0.000	35.665	Woods, Good	EDA-1
0.000	**12.407**	**12.605**	**15.852**	**0.000**	**40.864**	**TOTAL AREA**	

Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment EDA-1: EDA-1 Runoff Area=40.864 ac 0.00% Impervious Runoff Depth=0.94"
Flow Length=2,539' Tc=29.8 min CN=68 Runoff=23.01 cfs 3.208 af

Link AP-1: AP-1 Inflow=23.01 cfs 3.208 af
Primary=23.01 cfs 3.208 af

Total Runoff Area = 40.864 ac Runoff Volume = 3.208 af Average Runoff Depth = 0.94"
100.00% Pervious = 40.864 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment EDA-1: EDA-1

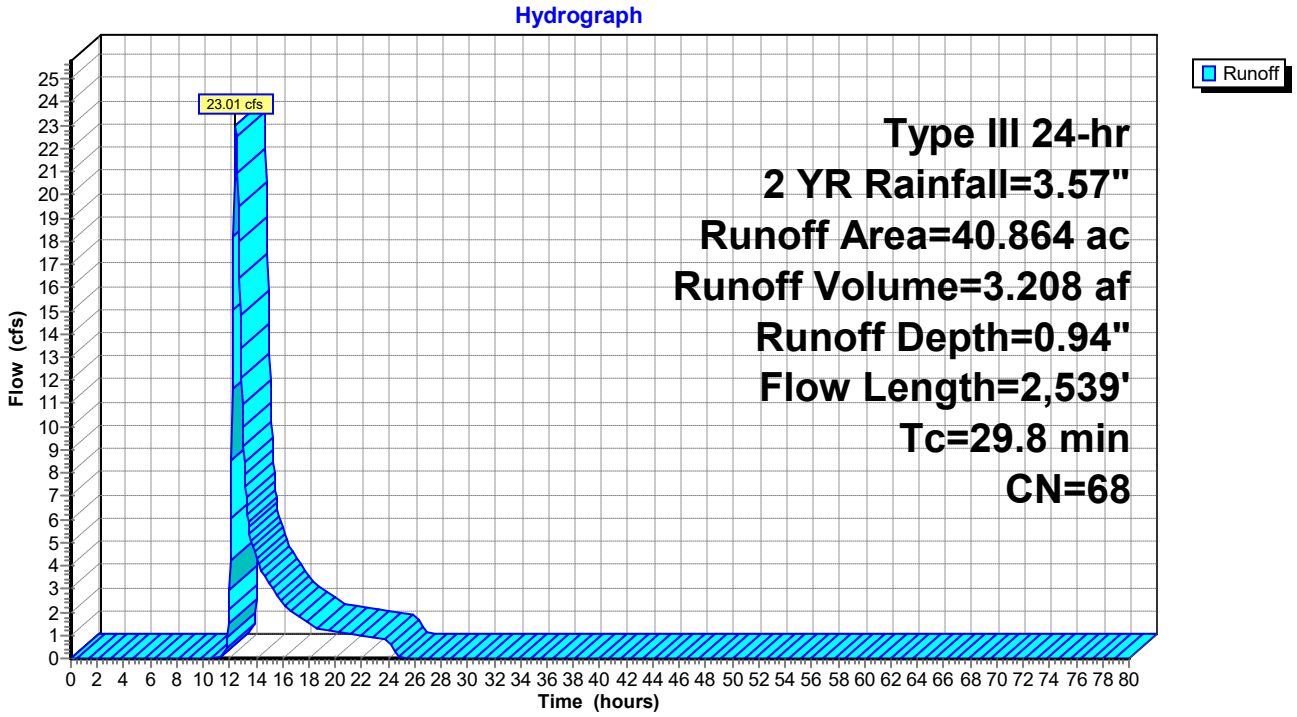
Runoff = 23.01 cfs @ 12.47 hrs, Volume= 3.208 af, Depth= 0.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 YR Rainfall=3.57"

Area (ac)	CN	Description
8.037	55	Woods, Good, HSG B
4.370	56	Brush, Fair, HSG B
11.837	70	Woods, Good, HSG C
0.768	70	Brush, Fair, HSG C
15.791	77	Woods, Good, HSG D
0.061	77	Brush, Fair, HSG D
40.864	68	Weighted Average
40.864		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	100	0.0478	0.12		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.57"
5.2	384	0.0598	1.22		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
1.6	1,068	0.0960	10.92	65.51	**Channel Flow, C-D** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.030 Earth, grassed & winding
8.7	987	0.1438	1.90		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
29.8	2,539	Total			

Subcatchment EDA-1: EDA-1

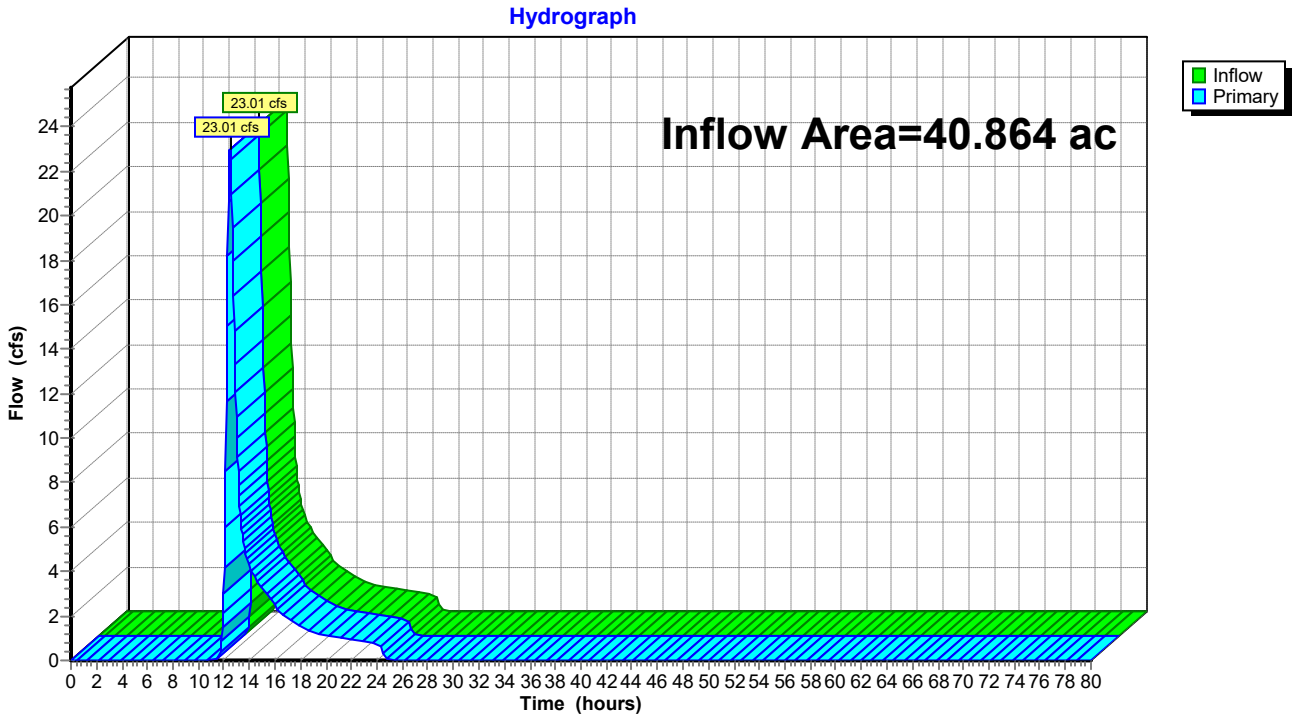


Summary for Link AP-1: AP-1

Inflow Area = 40.864 ac, 0.00% Impervious, Inflow Depth = 0.94" for 2 YR event
Inflow = 23.01 cfs @ 12.47 hrs, Volume= 3.208 af
Primary = 23.01 cfs @ 12.47 hrs, Volume= 3.208 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Link AP-1: AP-1



Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment EDA-1: EDA-1 Runoff Area=40.864 ac 0.00% Impervious Runoff Depth=3.23"
Flow Length=2,539' Tc=29.8 min CN=68 Runoff=86.91 cfs 10.982 af

Link AP-1: AP-1 Inflow=86.91 cfs 10.982 af
Primary=86.91 cfs 10.982 af

Total Runoff Area = 40.864 ac Runoff Volume = 10.982 af Average Runoff Depth = 3.23"
100.00% Pervious = 40.864 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment EDA-1: EDA-1

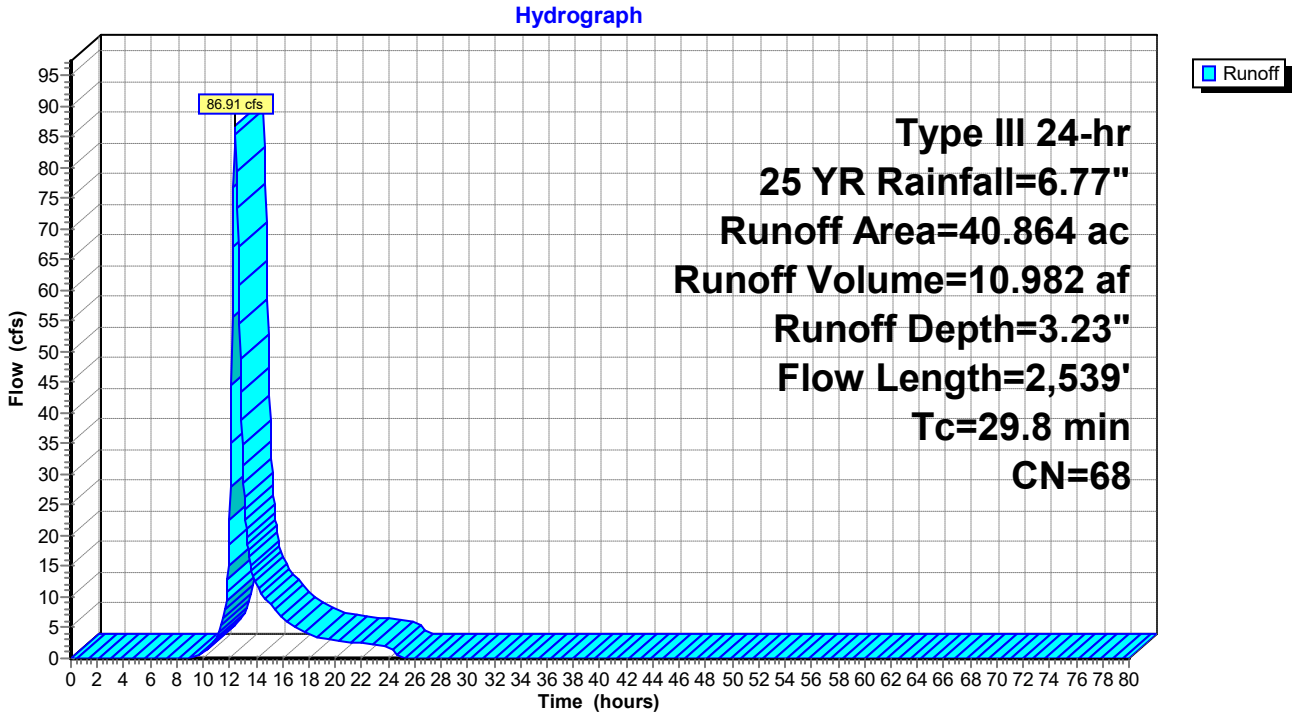
Runoff = 86.91 cfs @ 12.43 hrs, Volume= 10.982 af, Depth= 3.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 YR Rainfall=6.77"

Area (ac)	CN	Description
8.037	55	Woods, Good, HSG B
4.370	56	Brush, Fair, HSG B
11.837	70	Woods, Good, HSG C
0.768	70	Brush, Fair, HSG C
15.791	77	Woods, Good, HSG D
0.061	77	Brush, Fair, HSG D
40.864	68	Weighted Average
40.864		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	100	0.0478	0.12		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.57"
5.2	384	0.0598	1.22		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
1.6	1,068	0.0960	10.92	65.51	**Channel Flow, C-D** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.030 Earth, grassed & winding
8.7	987	0.1438	1.90		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
29.8	2,539	Total			

Subcatchment EDA-1: EDA-1

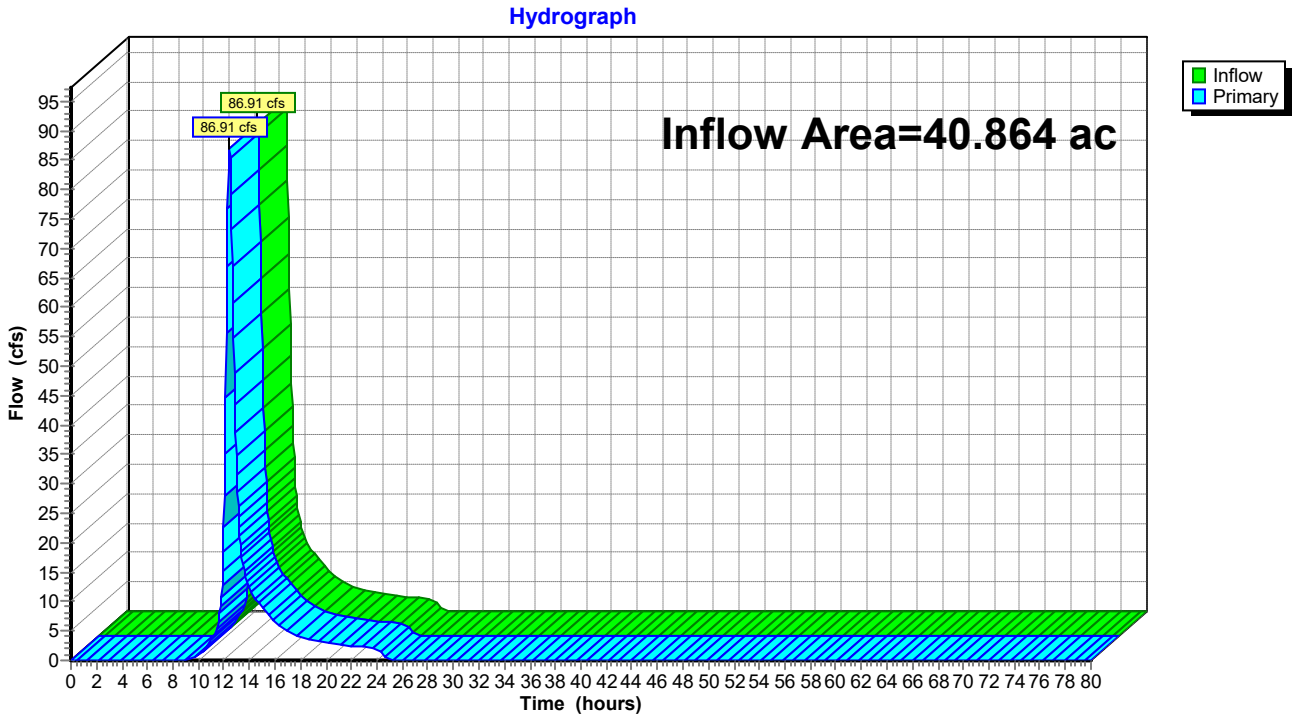


Summary for Link AP-1: AP-1

Inflow Area = 40.864 ac, 0.00% Impervious, Inflow Depth = 3.23" for 25 YR event
Inflow = 86.91 cfs @ 12.43 hrs, Volume= 10.982 af
Primary = 86.91 cfs @ 12.43 hrs, Volume= 10.982 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Link AP-1: AP-1



Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment EDA-1: EDA-1 Runoff Area=40.864 ac 0.00% Impervious Runoff Depth=3.96"
Flow Length=2,539' Tc=29.8 min CN=68 Runoff=107.27 cfs 13.484 af

Link AP-1: AP-1 Inflow=107.27 cfs 13.484 af
Primary=107.27 cfs 13.484 af

Total Runoff Area = 40.864 ac Runoff Volume = 13.484 af Average Runoff Depth = 3.96"
100.00% Pervious = 40.864 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment EDA-1: EDA-1

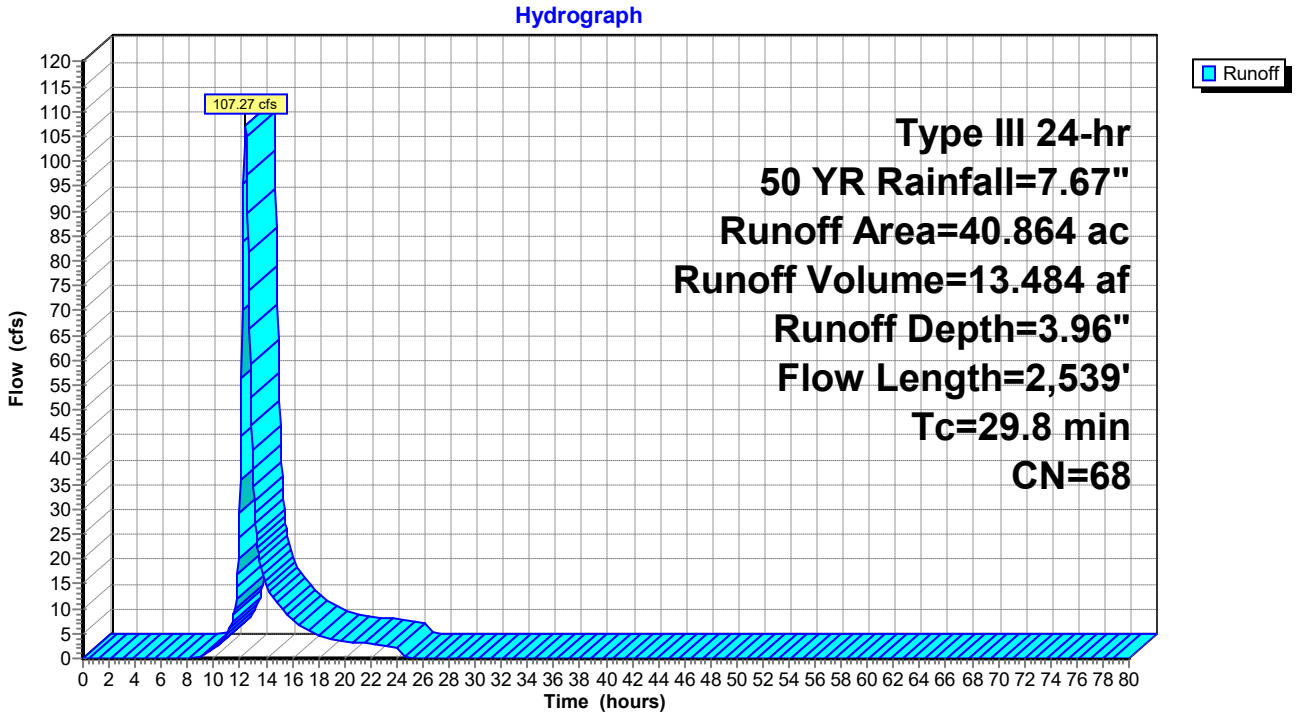
Runoff = 107.27 cfs @ 12.42 hrs, Volume= 13.484 af, Depth= 3.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 YR Rainfall=7.67"

Area (ac)	CN	Description
8.037	55	Woods, Good, HSG B
4.370	56	Brush, Fair, HSG B
11.837	70	Woods, Good, HSG C
0.768	70	Brush, Fair, HSG C
15.791	77	Woods, Good, HSG D
0.061	77	Brush, Fair, HSG D
40.864	68	Weighted Average
40.864		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	100	0.0478	0.12		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.57"
5.2	384	0.0598	1.22		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
1.6	1,068	0.0960	10.92	65.51	**Channel Flow, C-D** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.030 Earth, grassed & winding
8.7	987	0.1438	1.90		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
29.8	2,539	Total			

Subcatchment EDA-1: EDA-1

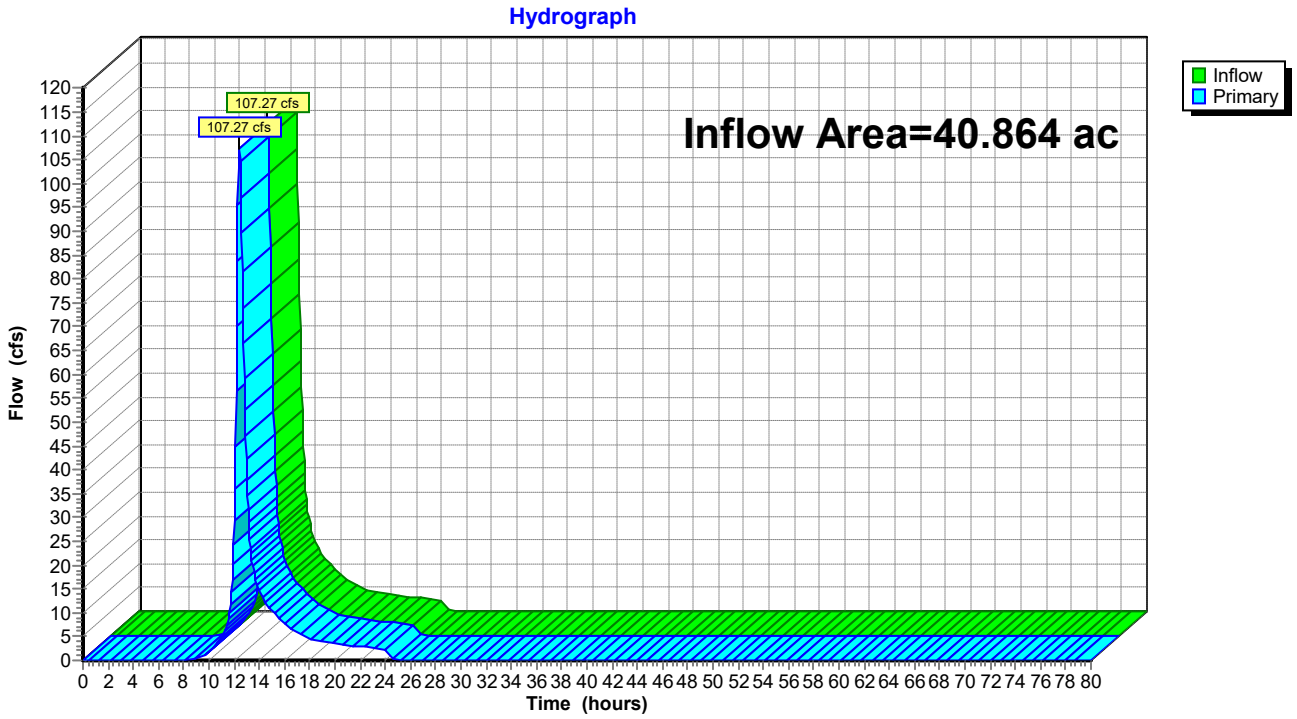


Summary for Link AP-1: AP-1

Inflow Area = 40.864 ac, 0.00% Impervious, Inflow Depth = 3.96" for 50 YR event
Inflow = 107.27 cfs @ 12.42 hrs, Volume= 13.484 af
Primary = 107.27 cfs @ 12.42 hrs, Volume= 13.484 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Link AP-1: AP-1



Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment EDA-1: EDA-1 Runoff Area=40.864 ac 0.00% Impervious Runoff Depth=4.80"
Flow Length=2,539' Tc=29.8 min CN=68 Runoff=130.15 cfs 16.330 af

Link AP-1: AP-1 Inflow=130.15 cfs 16.330 af
Primary=130.15 cfs 16.330 af

Total Runoff Area = 40.864 ac Runoff Volume = 16.330 af Average Runoff Depth = 4.80"
100.00% Pervious = 40.864 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment EDA-1: EDA-1

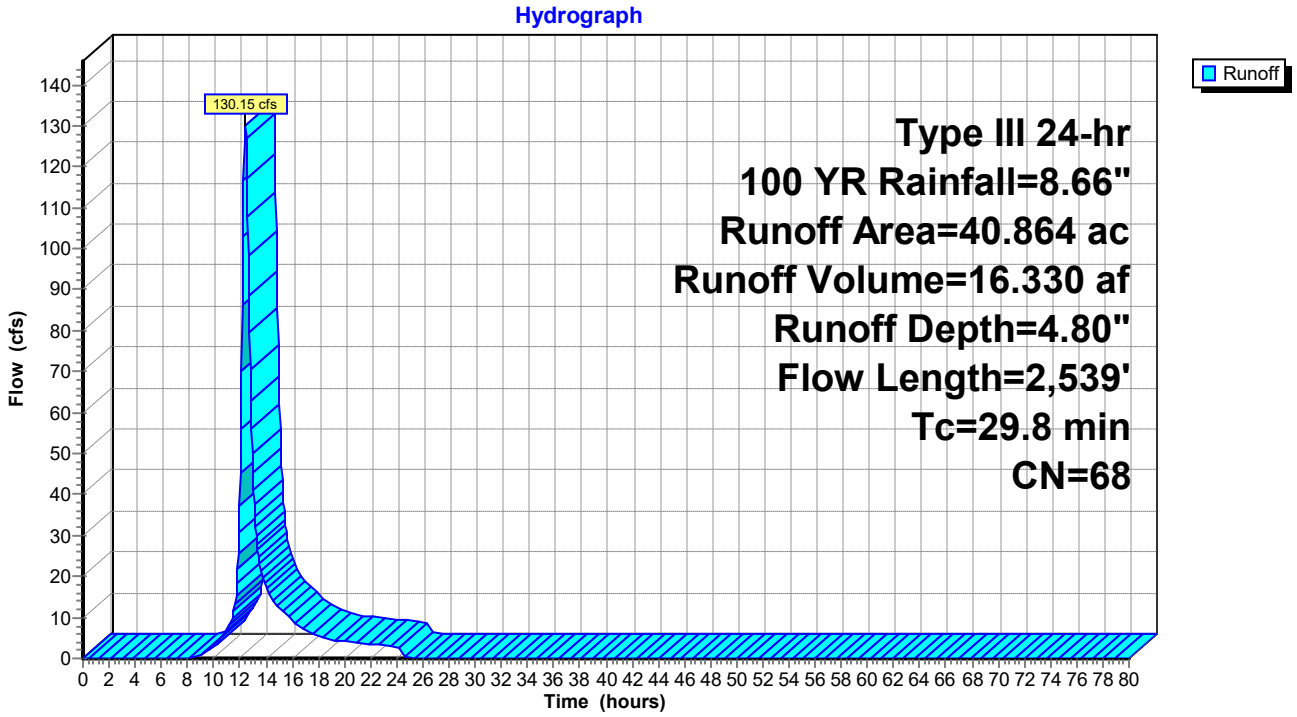
Runoff = 130.15 cfs @ 12.42 hrs, Volume= 16.330 af, Depth= 4.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 YR Rainfall=8.66"

Area (ac)	CN	Description
8.037	55	Woods, Good, HSG B
4.370	56	Brush, Fair, HSG B
11.837	70	Woods, Good, HSG C
0.768	70	Brush, Fair, HSG C
15.791	77	Woods, Good, HSG D
0.061	77	Brush, Fair, HSG D
40.864	68	Weighted Average
40.864		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	100	0.0478	0.12		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.57"
5.2	384	0.0598	1.22		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
1.6	1,068	0.0960	10.92	65.51	**Channel Flow, C-D** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.030 Earth, grassed & winding
8.7	987	0.1438	1.90		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
29.8	2,539	Total			

Subcatchment EDA-1: EDA-1

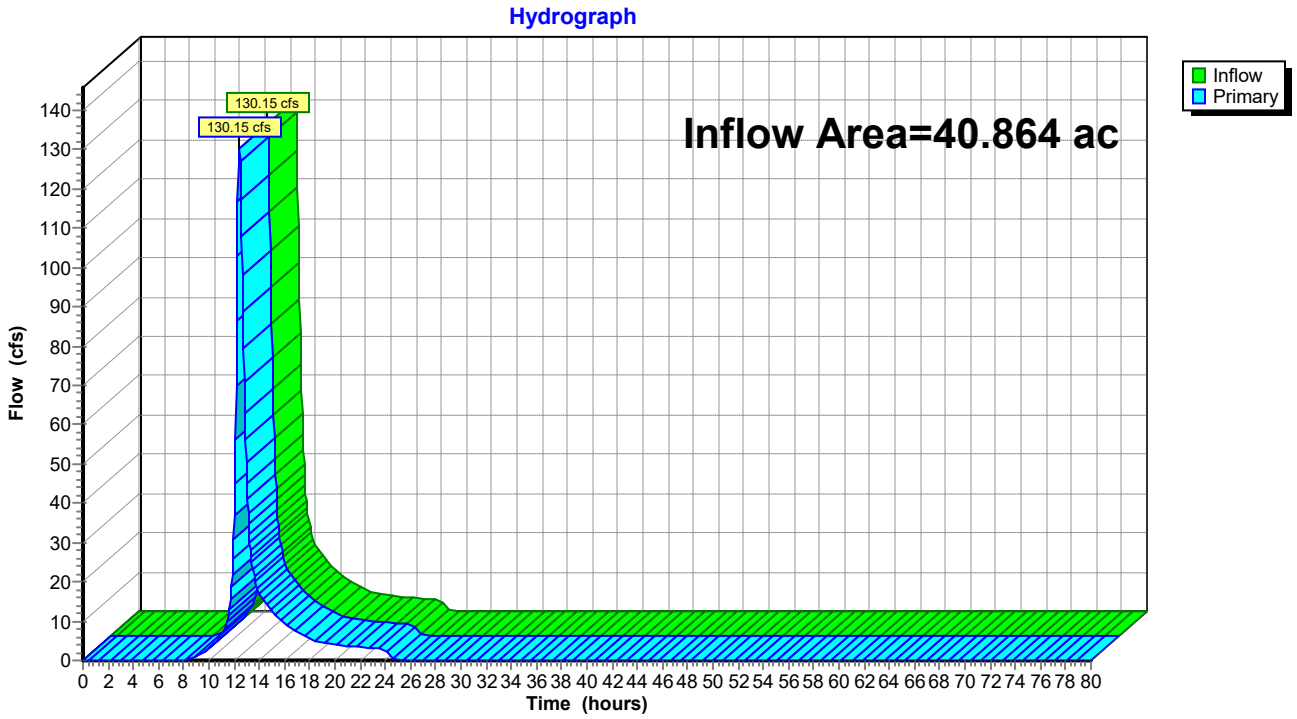


Summary for Link AP-1: AP-1

Inflow Area = 40.864 ac, 0.00% Impervious, Inflow Depth = 4.80" for 100 YR event
Inflow = 130.15 cfs @ 12.42 hrs, Volume= 16.330 af
Primary = 130.15 cfs @ 12.42 hrs, Volume= 16.330 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Link AP-1: AP-1



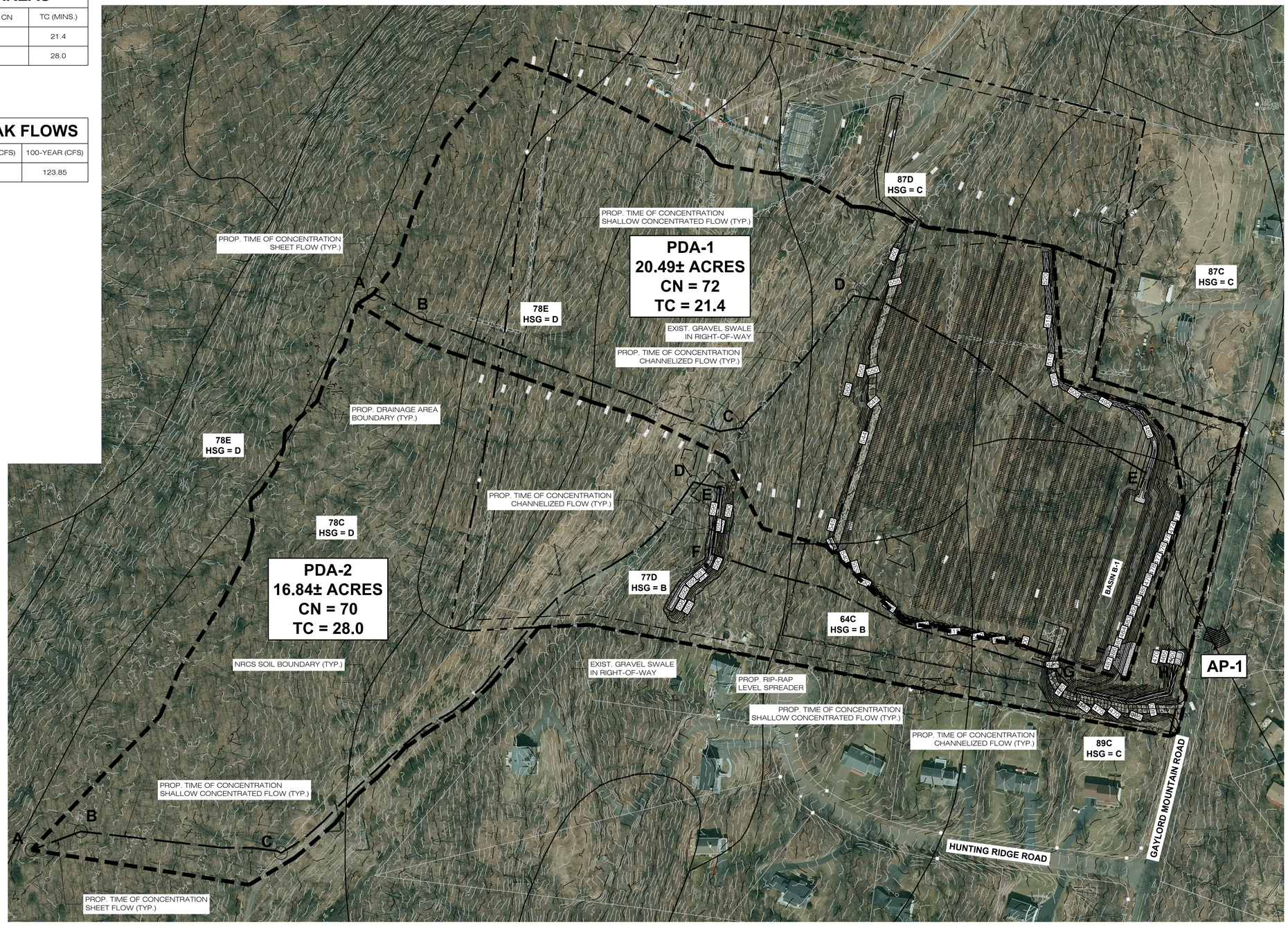
APPENDIX C: PROPOSED DRAINAGE AREA MAP (PDA-1) & HYDROLOGIC COMPUTATION (HYDROCAD)

PROPOSED DRAINAGE AREAS

	TOTAL AREA (ACRES)	COMPOSITE CN	TC (MINS.)
PDA-1	20.49	72	21.4
PDA-2	16.84	70	28.0

PROPOSED CONDITION PEAK FLOWS

ANALYSIS POINT	2-YEAR (CFS)	25-YEAR (CFS)	50-YEAR (CFS)	100-YEAR (CFS)
AP-1	17.20	79.98	92.23	123.85



1 PDA-1 **PROPOSED DRAINAGE AREA MAP**
SCALE : 1" = 100'-0"

100 0 50 100 200
(IN FEET) 1 inch = 100 ft.

GAYLORD MOUNTAIN SOLAR PROJECT 2019, LLC

200 HARBORSIDE DRIVE SUITE 200 SCHENECTADY, NY 12305

ALL-POINTS TECHNOLOGY CORPORATION

567 VAUXHAUL STREET EXTENSION - SUITE 311
WATERFORD, CT 06385 PHONE: (860)-663-1697
WWW.ALLPOINTSTECH.COM FAX: (860)-663-0935

PERMIT SET

NO	DATE	REVISION
0	08/07/20	ISSUED FOR PERMIT: BJP
1		
2		
3		
4		
5		
6		

DESIGN PROFESSIONAL OF RECORD

PROF: BRADLEY J. PARSONS P.E.
COMP: ALL-POINTS TECHNOLOGY CORPORATION
ADD: 567 VAUXHAUL STREET EXTENSION - SUITE 311 WATERFORD, CT 06385

OWNER: VERTICAL BRIDGE LANCO LLC
ADDRESS: 750 PARK OF COMMERCE DR S200 BOCA RATON, FL 33487

HAMDEN SOLAR

SITE ADDRESS: 360 GAYLORD MOUNTAIN RD HAMDEN, CT

APT FILING NUMBER: CT619100

DRAWN BY: JT

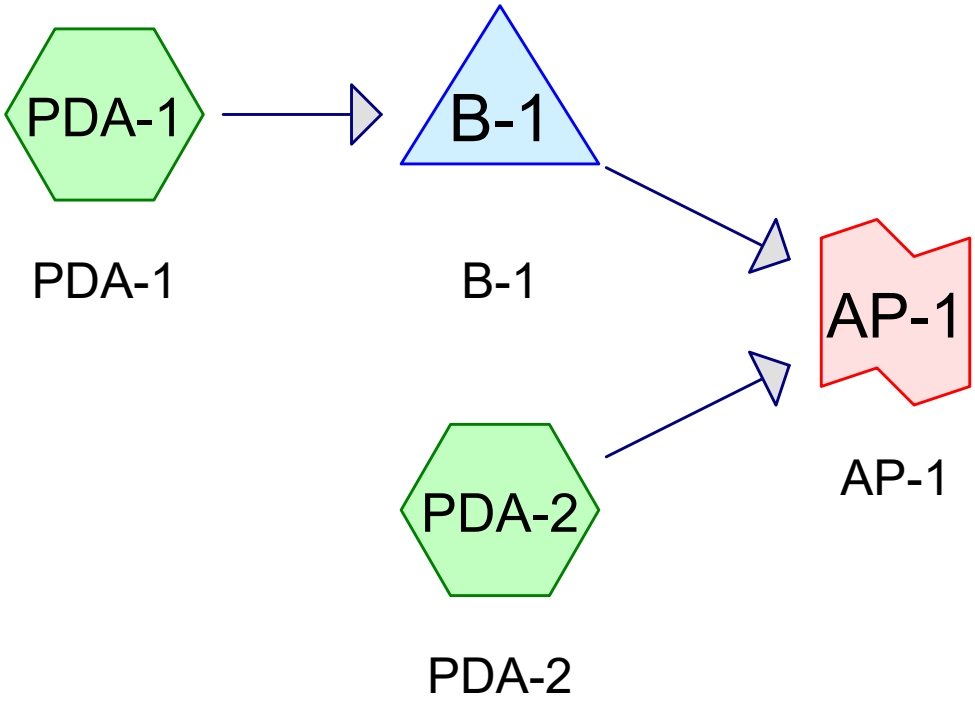
DATE: 08/07/20 CHECKED BY: BJP

SHEET TITLE:

PROPOSED DRAINAGE AREA MAP

SHEET NUMBER:

PDA-1



Subcat Reach Pond Link

Routing Diagram for Hamden - PR - Rev0
Prepared by Microsoft, Printed 8/5/2020

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
4.370	56	Brush, Fair, HSG B (PDA-1, PDA-2)
0.750	70	Brush, Fair, HSG C (PDA-1)
0.310	77	Brush, Fair, HSG D (PDA-2)
0.240	96	Gravel surface, HSG D (PDA-1)
0.870	71	Meadow, non-grazed, HSG C (PDA-1)
7.360	78	Meadow, non-grazed, HSG D (PDA-1)
0.010	98	Unconnected pavement, HSG D (PDA-1)
0.500	98	Water Surface, HSG D (PDA-1)
5.870	55	Woods, Good, HSG B (PDA-1, PDA-2)
1.510	70	Woods, Good, HSG C (PDA-1, PDA-2)
15.540	77	Woods, Good, HSG D (PDA-1, PDA-2)
37.330	**71**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
10.240	HSG B	PDA-1, PDA-2
3.130	HSG C	PDA-1, PDA-2
23.960	HSG D	PDA-1, PDA-2
0.000	Other	
37.330		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	4.370	0.750	0.310	0.000	5.430	Brush, Fair	PDA-1, PDA-2
0.000	0.000	0.000	0.240	0.000	0.240	Gravel surface	PDA-1
0.000	0.000	0.870	7.360	0.000	8.230	Meadow, non-grazed	PDA-1
0.000	0.000	0.000	0.010	0.000	0.010	Unconnected pavement	PDA-1
0.000	0.000	0.000	0.500	0.000	0.500	Water Surface	PDA-1
0.000	5.870	1.510	15.540	0.000	22.920	Woods, Good	PDA-1, PDA-2
0.000	**10.240**	**3.130**	**23.960**	**0.000**	**37.330**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	B-1	482.00	481.00	43.0	0.0233	0.013	24.0	0.0	0.0
2	B-1	482.00	481.00	43.0	0.0233	0.013	24.0	0.0	0.0

Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PDA-1: PDA-1 Runoff Area=20.490 ac 2.49% Impervious Runoff Depth=1.17"
Flow Length=1,742' Tc=21.4 min CN=72 Runoff=17.30 cfs 1.993 af

Subcatchment PDA-2: PDA-2 Runoff Area=16.840 ac 0.00% Impervious Runoff Depth=1.05"
Flow Length=2,671' Tc=28.0 min CN=70 Runoff=11.17 cfs 1.476 af

Pond B-1: B-1 Peak Elev=484.66' Storage=34,751 cf Inflow=17.30 cfs 1.993 af
Outflow=8.62 cfs 2.395 af

Link AP-1: AP-1 Inflow=17.20 cfs 3.871 af
Primary=17.20 cfs 3.871 af

Total Runoff Area = 37.330 ac Runoff Volume = 3.468 af Average Runoff Depth = 1.11"
98.63% Pervious = 36.820 ac 1.37% Impervious = 0.510 ac

Summary for Subcatchment PDA-1: PDA-1

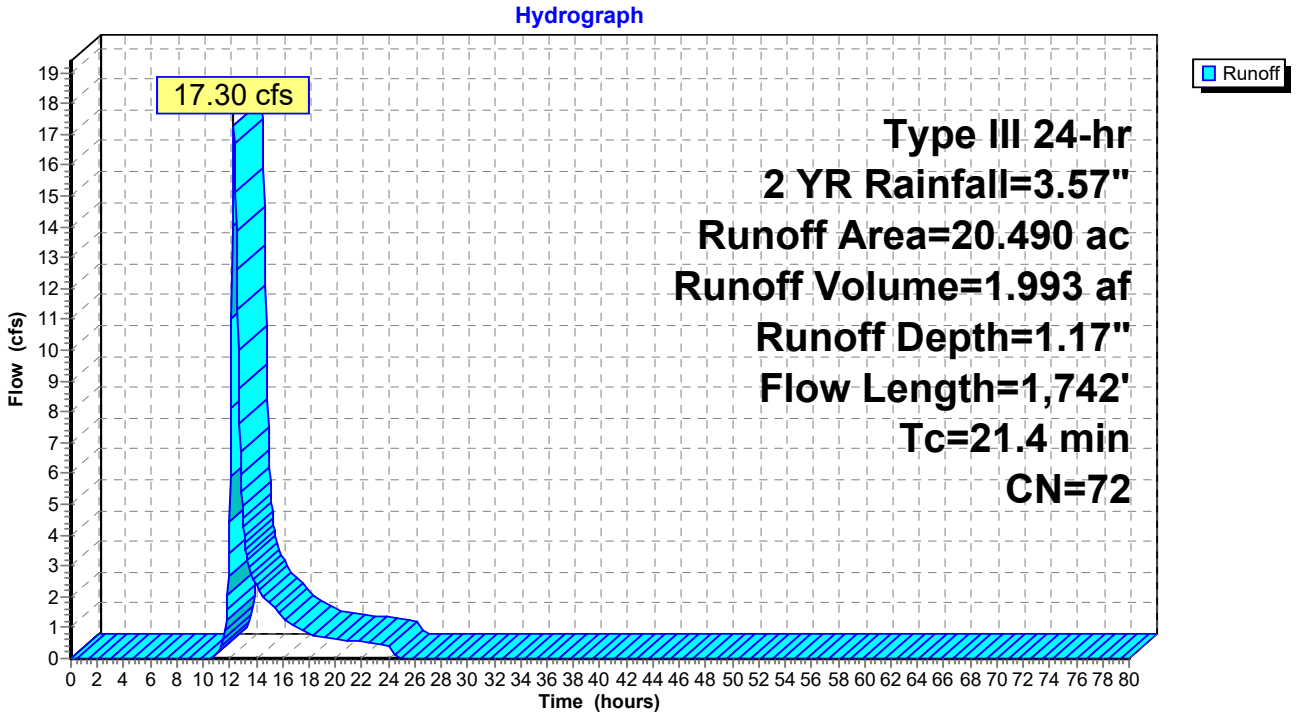
Runoff = 17.30 cfs @ 12.32 hrs, Volume= 1.993 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 YR Rainfall=3.57"

Area (ac)	CN	Description
2.860	55	Woods, Good, HSG B
1.990	56	Brush, Fair, HSG B
1.000	70	Woods, Good, HSG C
0.750	70	Brush, Fair, HSG C
4.910	77	Woods, Good, HSG D
0.870	71	Meadow, non-grazed, HSG C
7.360	78	Meadow, non-grazed, HSG D
0.240	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
0.500	98	Water Surface, HSG D
20.490	72	Weighted Average
19.980		97.51% Pervious Area
0.510		2.49% Impervious Area
0.010		1.96% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	100	0.0830	0.14		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.57"
4.8	655	0.2100	2.29		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.6	329	0.0730	9.52	57.12	**Channel Flow, C-D** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.030 Earth, grassed & winding
4.5	658	0.1200	2.42		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
21.4	1,742	Total			

Subcatchment PDA-1: PDA-1



Summary for Subcatchment PDA-2: PDA-2

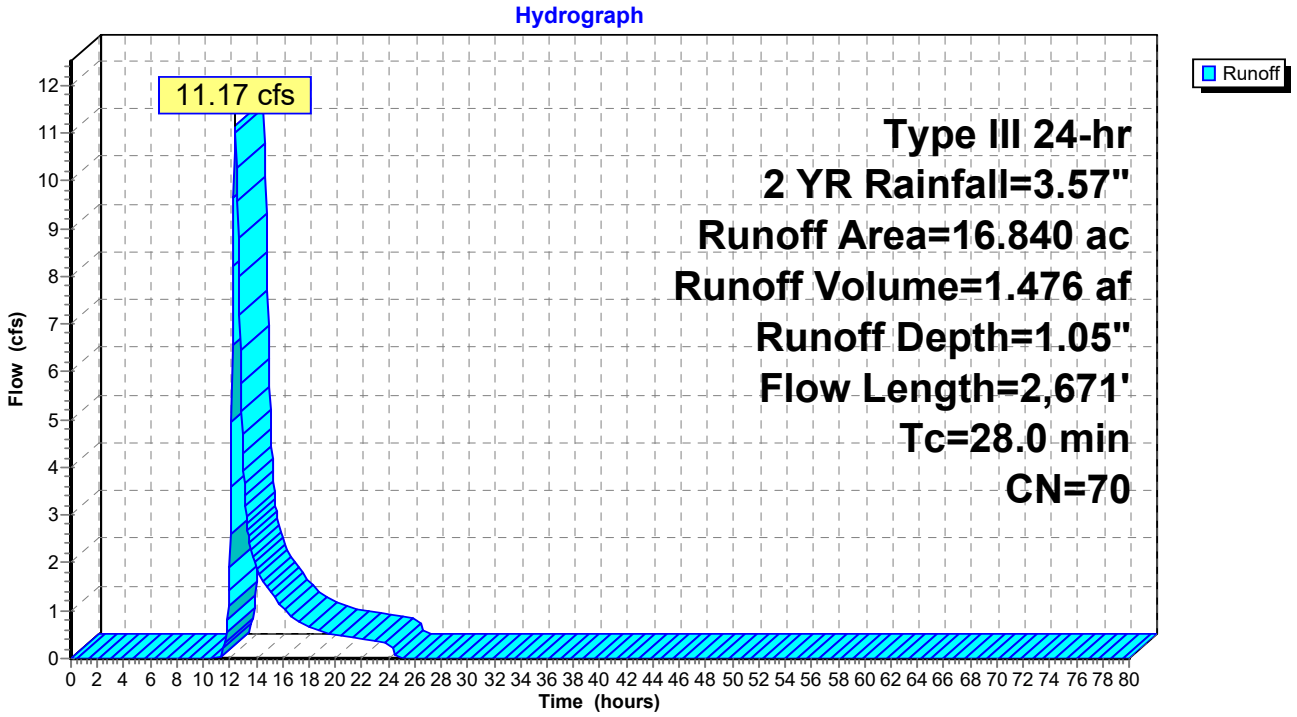
Runoff = 11.17 cfs @ 12.43 hrs, Volume= 1.476 af, Depth= 1.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 YR Rainfall=3.57"

Area (ac)	CN	Description
3.010	55	Woods, Good, HSG B
2.380	56	Brush, Fair, HSG B
0.510	70	Woods, Good, HSG C
10.630	77	Woods, Good, HSG D
0.310	77	Brush, Fair, HSG D
16.840	70	Weighted Average
16.840		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	100	0.0478	0.12		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.57"
5.2	384	0.0598	1.22		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
1.6	1,068	0.0960	10.92	65.51	**Channel Flow, C-D** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.030 Earth, grassed & winding
0.2	34	0.1820	2.99		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
0.3	106	0.0200	5.71	114.24	**Channel Flow, E-F** Area= 20.0 sf Perim= 17.0' r= 1.18' n= 0.041 Riprap, 2-inch
5.9	688	0.1490	1.93		**Shallow Concentrated Flow, F-G** Woodland Kv= 5.0 fps
0.5	291	0.1500	9.99	59.91	**Channel Flow, G-H** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.041 Riprap, 2-inch
28.0	2,671	Total			

Subcatchment PDA-2: PDA-2



Summary for Pond B-1: B-1

Inflow Area = 20.490 ac, 2.49% Impervious, Inflow Depth = 1.17" for 2 YR event
Inflow = 17.30 cfs @ 12.32 hrs, Volume= 1.993 af
Outflow = 8.62 cfs @ 12.71 hrs, Volume= 2.395 af, Atten= 50%, Lag= 23.3 min
Primary = 8.62 cfs @ 12.71 hrs, Volume= 2.395 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Starting Elev= 483.50' Surf.Area= 13,386 sf Storage= 17,798 cf
Peak Elev= 484.66' @ 12.71 hrs Surf.Area= 15,942 sf Storage= 34,751 cf (16,953 cf above start)

Plug-Flow detention time= 358.4 min calculated for 1.986 af (100% of inflow)
Center-of-Mass det. time= 237.7 min (1,113.6 - 875.9)

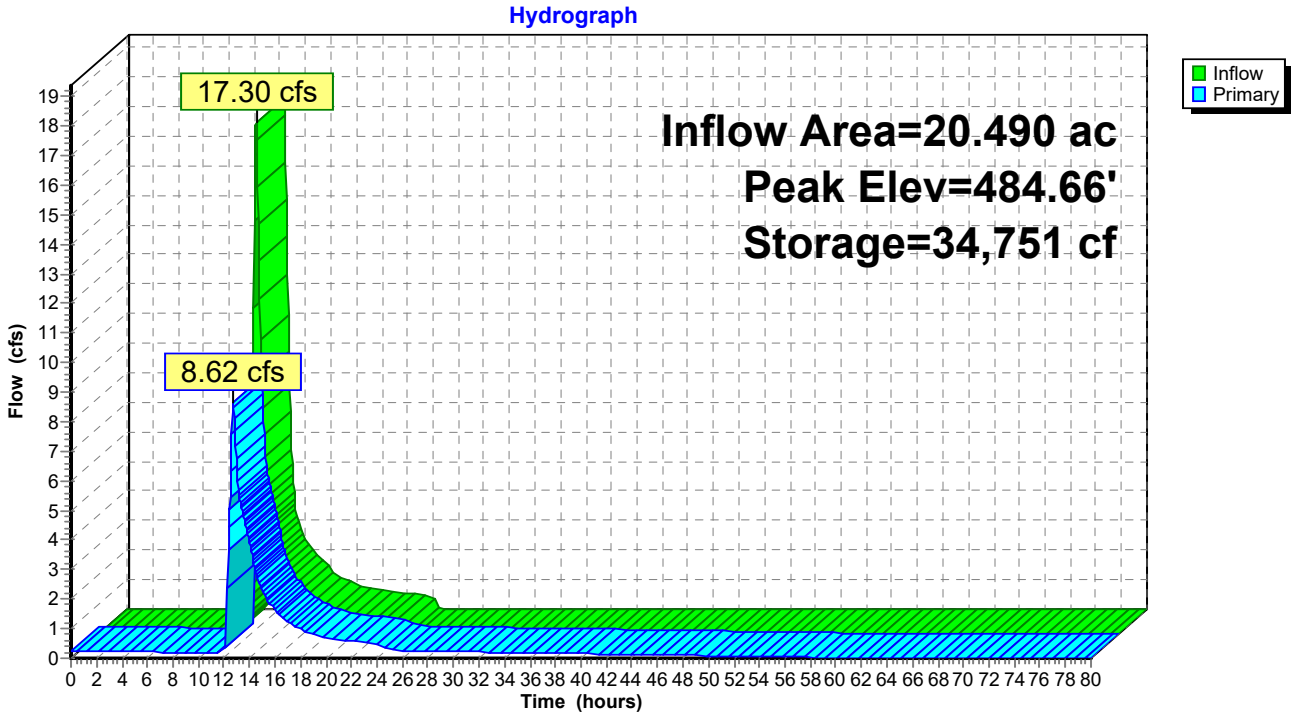
Volume	Invert	Avail.Storage	Storage Description
#1	482.00'	78,989 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
482.00	10,407	712.1	0	0	10,407
487.00	21,795	806.4	78,771	78,771	22,418
487.01	21,795	806.4	218	78,989	22,426

Device	Routing	Invert	Outlet Devices
#1	Primary	482.00'	**24.0" Round Culvert** L= 43.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 482.00' / 481.00' S= 0.0233 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Primary	482.00'	**24.0" Round Culvert** L= 43.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 482.00' / 481.00' S= 0.0233 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#3	Device 1	482.00'	**2.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	482.00'	**2.0" Vert. Orifice/Grate** C= 0.600
#5	Device 1	483.50'	**15.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600
#6	Device 2	483.50'	**15.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600
#7	Device 1	484.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#8	Device 2	484.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#9	Primary	486.50'	**30.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=8.59 cfs @ 12.71 hrs HW=484.66' TW=0.00' (Dynamic Tailwater)
- **1=Culvert** (Passes 4.30 cfs of 15.37 cfs potential flow)
  - **3=Orifice/Grate** (Orifice Controls 0.17 cfs @ 7.72 fps)
  - **5=Orifice/Grate** (Orifice Controls 2.86 cfs @ 4.57 fps)
  - **7=Orifice/Grate** (Weir Controls 1.27 cfs @ 1.29 fps)
- **2=Culvert** (Passes 4.30 cfs of 15.37 cfs potential flow)
  - **4=Orifice/Grate** (Orifice Controls 0.17 cfs @ 7.72 fps)
  - **6=Orifice/Grate** (Orifice Controls 2.86 cfs @ 4.57 fps)
  - **8=Orifice/Grate** (Weir Controls 1.27 cfs @ 1.29 fps)
- **9=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond B-1: B-1

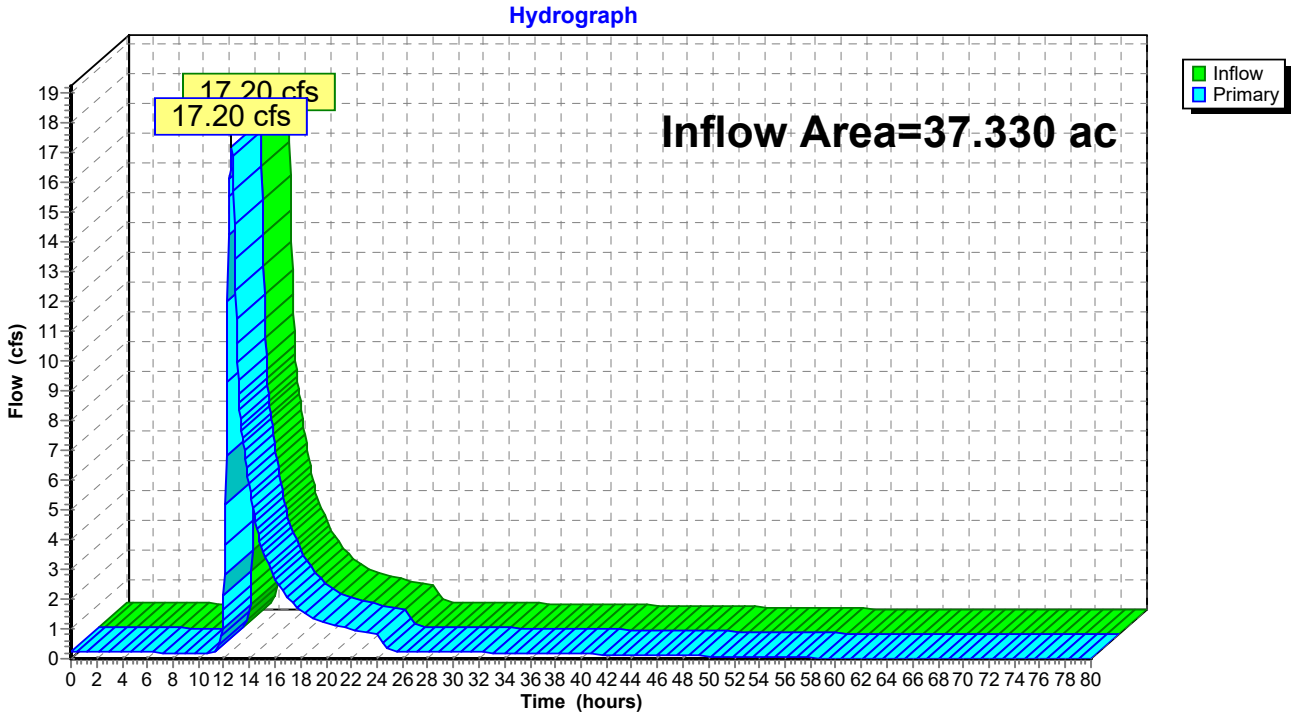


Summary for Link AP-1: AP-1

Inflow Area = 37.330 ac, 1.37% Impervious, Inflow Depth > 1.24" for 2 YR event
Inflow = 17.20 cfs @ 12.63 hrs, Volume= 3.871 af
Primary = 17.20 cfs @ 12.63 hrs, Volume= 3.871 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Link AP-1: AP-1



Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PDA-1: PDA-1 Runoff Area=20.490 ac 2.49% Impervious Runoff Depth=3.63"
Flow Length=1,742' Tc=21.4 min CN=72 Runoff=57.03 cfs 6.205 af

Subcatchment PDA-2: PDA-2 Runoff Area=16.840 ac 0.00% Impervious Runoff Depth=3.43"
Flow Length=2,671' Tc=28.0 min CN=70 Runoff=39.28 cfs 4.811 af

Pond B-1: B-1 Peak Elev=486.00' Storage=58,255 cf Inflow=57.03 cfs 6.205 af
Outflow=41.35 cfs 6.607 af

Link AP-1: AP-1 Inflow=79.98 cfs 11.418 af
Primary=79.98 cfs 11.418 af

Total Runoff Area = 37.330 ac Runoff Volume = 11.016 af Average Runoff Depth = 3.54"
98.63% Pervious = 36.820 ac 1.37% Impervious = 0.510 ac

Summary for Subcatchment PDA-1: PDA-1

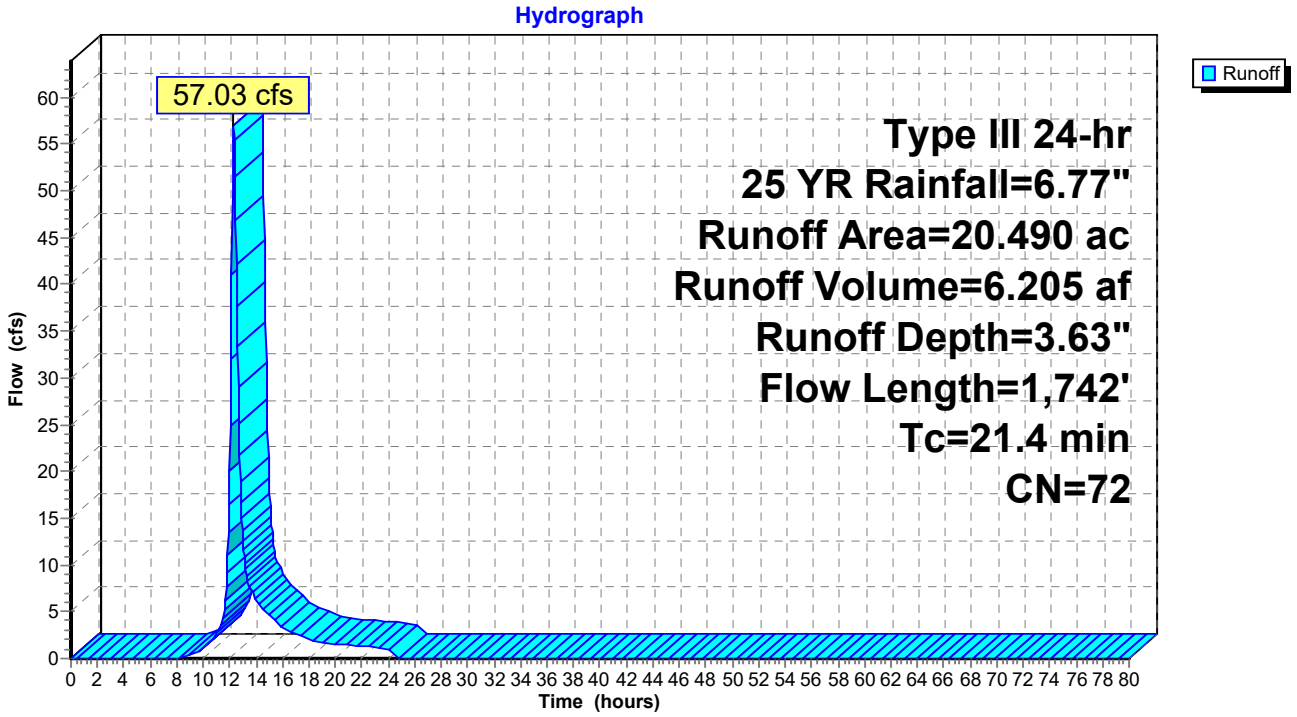
Runoff = 57.03 cfs @ 12.30 hrs, Volume= 6.205 af, Depth= 3.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 YR Rainfall=6.77"

Area (ac)	CN	Description
2.860	55	Woods, Good, HSG B
1.990	56	Brush, Fair, HSG B
1.000	70	Woods, Good, HSG C
0.750	70	Brush, Fair, HSG C
4.910	77	Woods, Good, HSG D
0.870	71	Meadow, non-grazed, HSG C
7.360	78	Meadow, non-grazed, HSG D
0.240	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
0.500	98	Water Surface, HSG D
20.490	72	Weighted Average
19.980		97.51% Pervious Area
0.510		2.49% Impervious Area
0.010		1.96% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	100	0.0830	0.14		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.57"
4.8	655	0.2100	2.29		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.6	329	0.0730	9.52	57.12	**Channel Flow, C-D** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.030 Earth, grassed & winding
4.5	658	0.1200	2.42		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
21.4	1,742	Total			

Subcatchment PDA-1: PDA-1



Summary for Subcatchment PDA-2: PDA-2

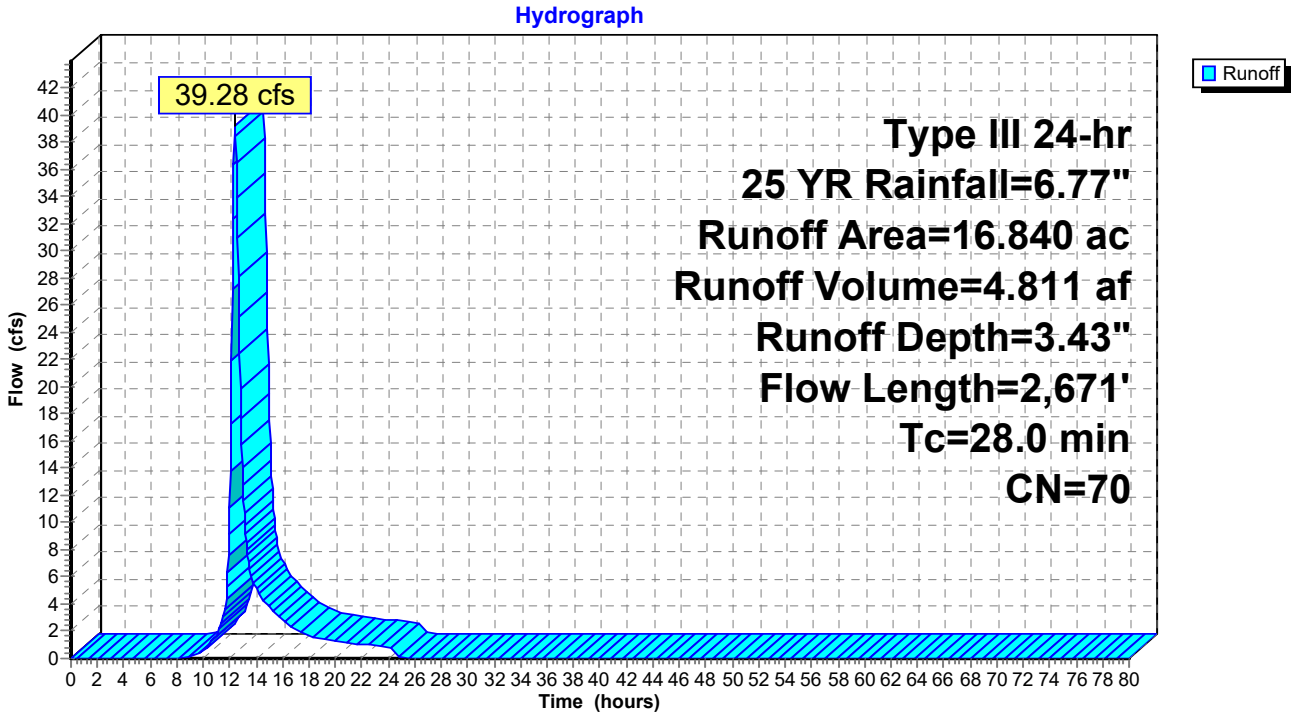
Runoff = 39.28 cfs @ 12.40 hrs, Volume= 4.811 af, Depth= 3.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 YR Rainfall=6.77"

Area (ac)	CN	Description
3.010	55	Woods, Good, HSG B
2.380	56	Brush, Fair, HSG B
0.510	70	Woods, Good, HSG C
10.630	77	Woods, Good, HSG D
0.310	77	Brush, Fair, HSG D
16.840	70	Weighted Average
16.840		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	100	0.0478	0.12		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.57"
5.2	384	0.0598	1.22		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
1.6	1,068	0.0960	10.92	65.51	**Channel Flow, C-D** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.030 Earth, grassed & winding
0.2	34	0.1820	2.99		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
0.3	106	0.0200	5.71	114.24	**Channel Flow, E-F** Area= 20.0 sf Perim= 17.0' r= 1.18' n= 0.041 Riprap, 2-inch
5.9	688	0.1490	1.93		**Shallow Concentrated Flow, F-G** Woodland Kv= 5.0 fps
0.5	291	0.1500	9.99	59.91	**Channel Flow, G-H** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.041 Riprap, 2-inch
28.0	2,671	Total			

Subcatchment PDA-2: PDA-2



Summary for Pond B-1: B-1

Inflow Area = 20.490 ac, 2.49% Impervious, Inflow Depth = 3.63" for 25 YR event
Inflow = 57.03 cfs @ 12.30 hrs, Volume= 6.205 af
Outflow = 41.35 cfs @ 12.51 hrs, Volume= 6.607 af, Atten= 27%, Lag= 12.6 min
Primary = 41.35 cfs @ 12.51 hrs, Volume= 6.607 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Starting Elev= 483.50' Surf.Area= 13,386 sf Storage= 17,798 cf
Peak Elev= 486.00' @ 12.51 hrs Surf.Area= 19,179 sf Storage= 58,255 cf (40,456 cf above start)

Plug-Flow detention time= 138.3 min calculated for 6.198 af (100% of inflow)
Center-of-Mass det. time= 108.6 min (950.8 - 842.2)

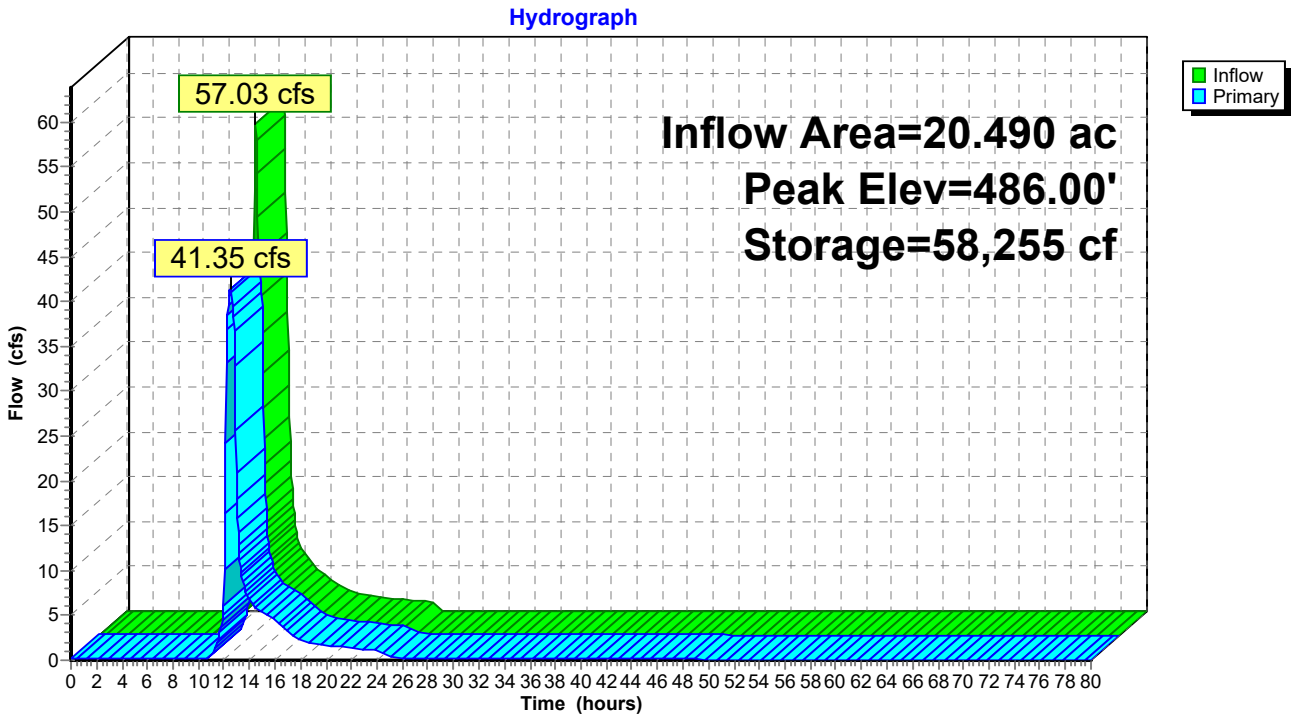
Volume	Invert	Avail.Storage	Storage Description
#1	482.00'	78,989 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
482.00	10,407	712.1	0	0	10,407
487.00	21,795	806.4	78,771	78,771	22,418
487.01	21,795	806.4	218	78,989	22,426

Device	Routing	Invert	Outlet Devices
#1	Primary	482.00'	**24.0" Round Culvert** L= 43.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 482.00' / 481.00' S= 0.0233 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Primary	482.00'	**24.0" Round Culvert** L= 43.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 482.00' / 481.00' S= 0.0233 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#3	Device 1	482.00'	**2.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	482.00'	**2.0" Vert. Orifice/Grate** C= 0.600
#5	Device 1	483.50'	**15.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600
#6	Device 2	483.50'	**15.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600
#7	Device 1	484.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#8	Device 2	484.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#9	Primary	486.50'	**30.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=41.33 cfs @ 12.51 hrs HW=485.99' TW=0.00' (Dynamic Tailwater)
- **1=Culvert** (Inlet Controls 20.67 cfs @ 6.58 fps)
  - **3=Orifice/Grate** (Passes < 0.21 cfs potential flow)
  - **5=Orifice/Grate** (Passes < 4.51 cfs potential flow)
  - **7=Orifice/Grate** (Passes < 18.49 cfs potential flow)
- **2=Culvert** (Inlet Controls 20.67 cfs @ 6.58 fps)
  - **4=Orifice/Grate** (Passes < 0.21 cfs potential flow)
  - **6=Orifice/Grate** (Passes < 4.51 cfs potential flow)
  - **8=Orifice/Grate** (Passes < 18.49 cfs potential flow)
- **9=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond B-1: B-1

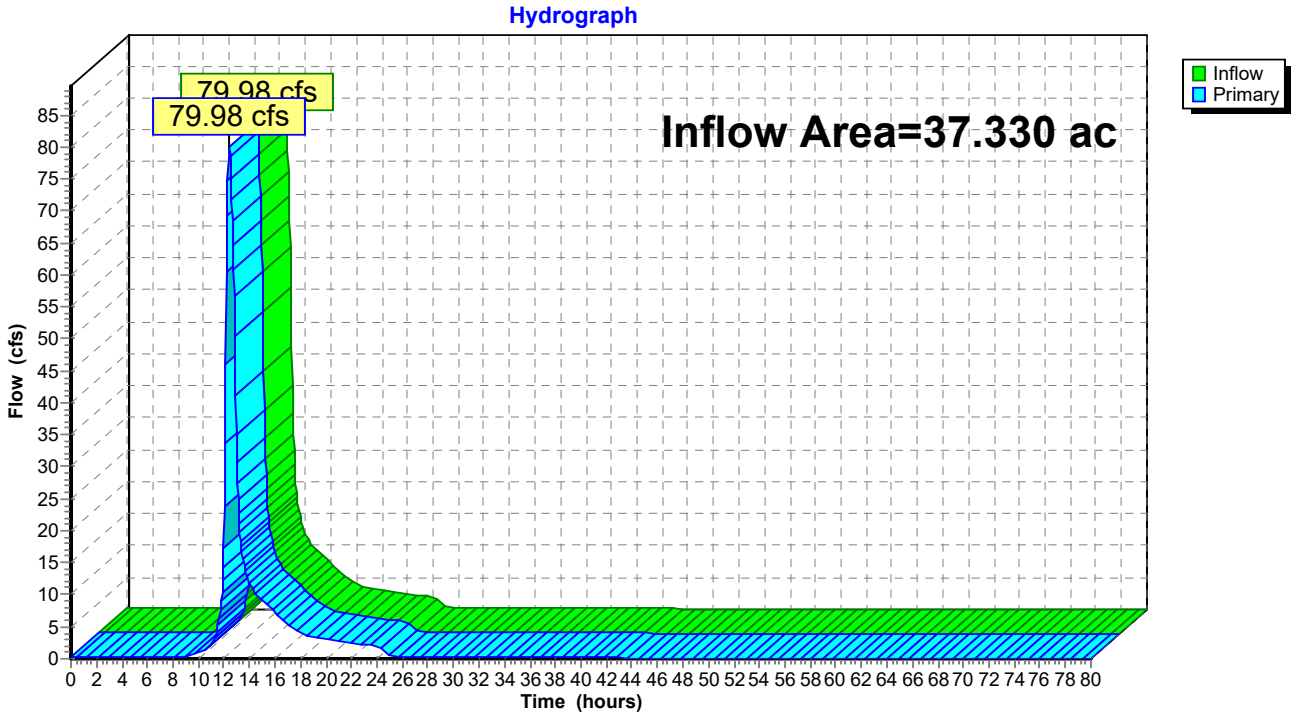


Summary for Link AP-1: AP-1

Inflow Area = 37.330 ac, 1.37% Impervious, Inflow Depth = 3.67" for 25 YR event
Inflow = 79.98 cfs @ 12.42 hrs, Volume= 11.418 af
Primary = 79.98 cfs @ 12.42 hrs, Volume= 11.418 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Link AP-1: AP-1



Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PDA-1: PDA-1 Runoff Area=20.490 ac 2.49% Impervious Runoff Depth=4.41"
Flow Length=1,742' Tc=21.4 min CN=72 Runoff=69.20 cfs 7.523 af

Subcatchment PDA-2: PDA-2 Runoff Area=16.840 ac 0.00% Impervious Runoff Depth=4.18"
Flow Length=2,671' Tc=28.0 min CN=70 Runoff=48.04 cfs 5.869 af

Pond B-1: B-1 Peak Elev=486.60' Storage=70,246 cf Inflow=69.20 cfs 7.523 af
Outflow=47.80 cfs 7.926 af

Link AP-1: AP-1 Inflow=92.23 cfs 13.794 af
Primary=92.23 cfs 13.794 af

Total Runoff Area = 37.330 ac Runoff Volume = 13.392 af Average Runoff Depth = 4.31"
98.63% Pervious = 36.820 ac 1.37% Impervious = 0.510 ac

Summary for Subcatchment PDA-1: PDA-1

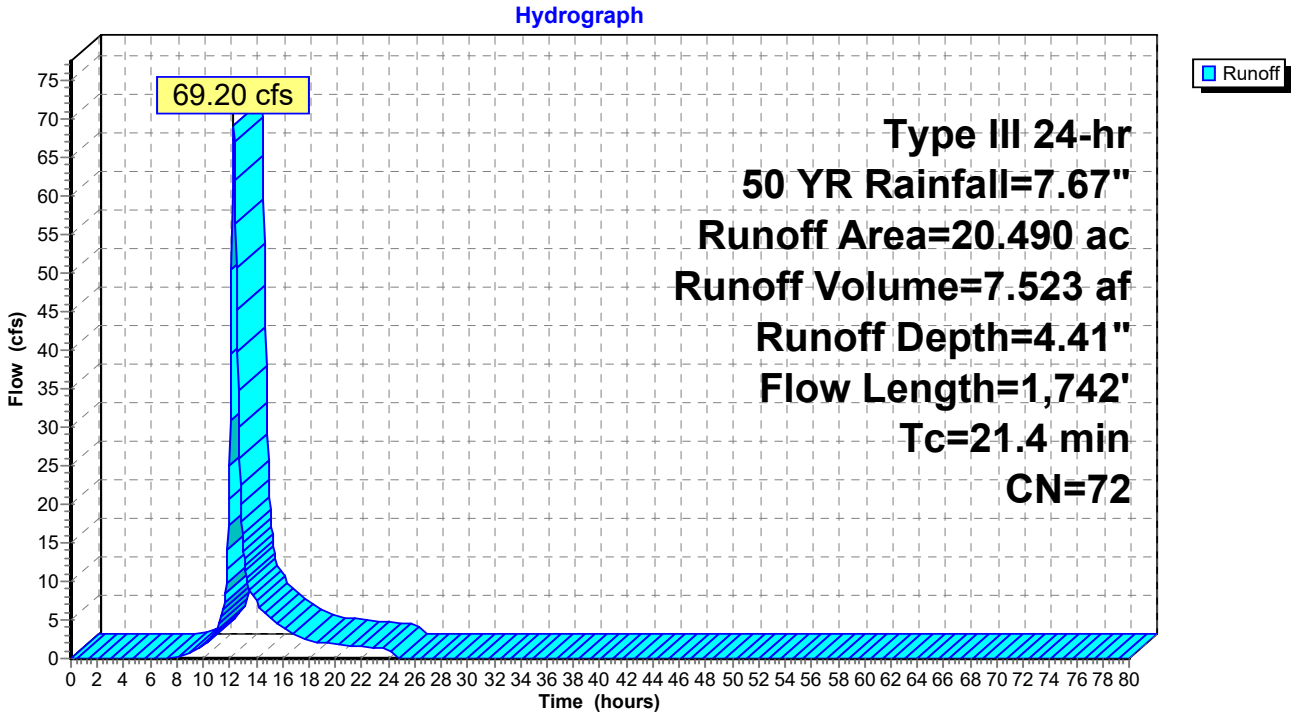
Runoff = 69.20 cfs @ 12.30 hrs, Volume= 7.523 af, Depth= 4.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 YR Rainfall=7.67"

Area (ac)	CN	Description
2.860	55	Woods, Good, HSG B
1.990	56	Brush, Fair, HSG B
1.000	70	Woods, Good, HSG C
0.750	70	Brush, Fair, HSG C
4.910	77	Woods, Good, HSG D
0.870	71	Meadow, non-grazed, HSG C
7.360	78	Meadow, non-grazed, HSG D
0.240	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
0.500	98	Water Surface, HSG D
20.490	72	Weighted Average
19.980		97.51% Pervious Area
0.510		2.49% Impervious Area
0.010		1.96% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	100	0.0830	0.14		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.57"
4.8	655	0.2100	2.29		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.6	329	0.0730	9.52	57.12	**Channel Flow, C-D** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.030 Earth, grassed & winding
4.5	658	0.1200	2.42		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
21.4	1,742	Total			

Subcatchment PDA-1: PDA-1



Summary for Subcatchment PDA-2: PDA-2

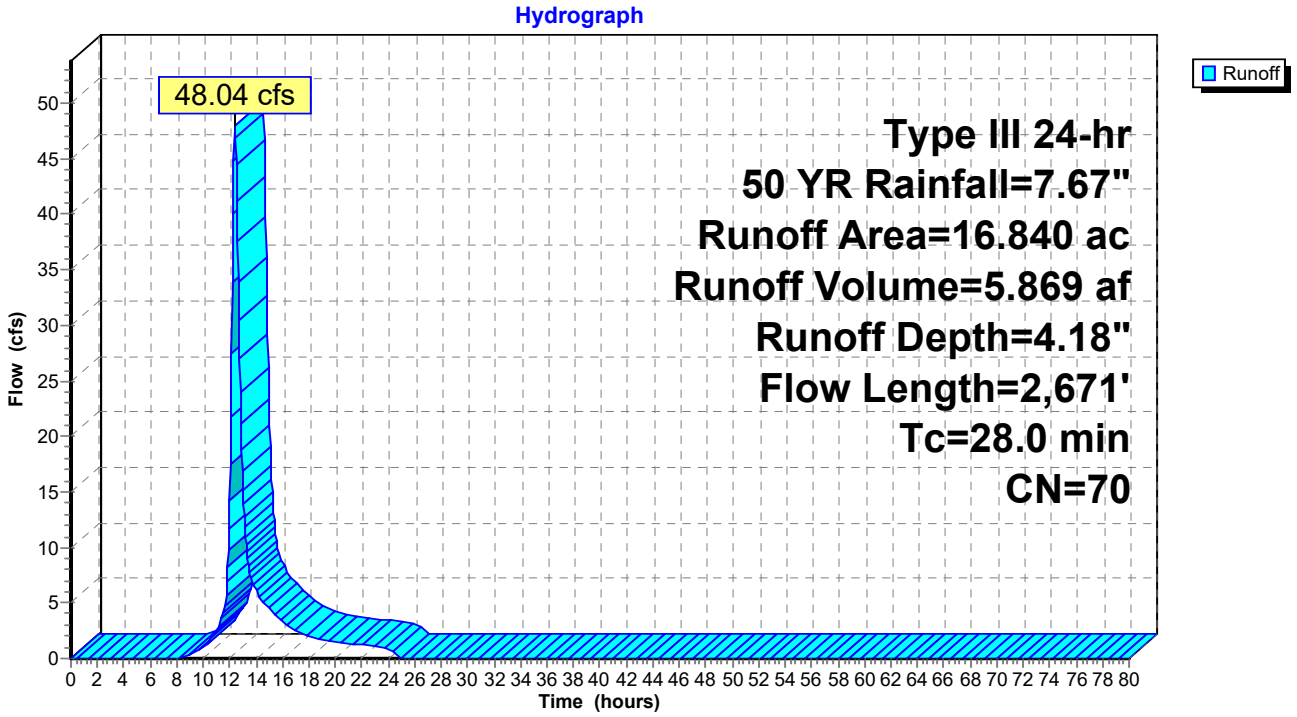
Runoff = 48.04 cfs @ 12.39 hrs, Volume= 5.869 af, Depth= 4.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 YR Rainfall=7.67"

Area (ac)	CN	Description
3.010	55	Woods, Good, HSG B
2.380	56	Brush, Fair, HSG B
0.510	70	Woods, Good, HSG C
10.630	77	Woods, Good, HSG D
0.310	77	Brush, Fair, HSG D
16.840	70	Weighted Average
16.840		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	100	0.0478	0.12		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.57"
5.2	384	0.0598	1.22		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
1.6	1,068	0.0960	10.92	65.51	**Channel Flow, C-D** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.030 Earth, grassed & winding
0.2	34	0.1820	2.99		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
0.3	106	0.0200	5.71	114.24	**Channel Flow, E-F** Area= 20.0 sf Perim= 17.0' r= 1.18' n= 0.041 Riprap, 2-inch
5.9	688	0.1490	1.93		**Shallow Concentrated Flow, F-G** Woodland Kv= 5.0 fps
0.5	291	0.1500	9.99	59.91	**Channel Flow, G-H** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.041 Riprap, 2-inch
28.0	2,671	Total			

Subcatchment PDA-2: PDA-2



Summary for Pond B-1: B-1

Inflow Area = 20.490 ac, 2.49% Impervious, Inflow Depth = 4.41" for 50 YR event
Inflow = 69.20 cfs @ 12.30 hrs, Volume= 7.523 af
Outflow = 47.80 cfs @ 12.53 hrs, Volume= 7.926 af, Atten= 31%, Lag= 13.9 min
Primary = 47.80 cfs @ 12.53 hrs, Volume= 7.926 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Starting Elev= 483.50' Surf.Area= 13,386 sf Storage= 17,798 cf
Peak Elev= 486.60' @ 12.53 hrs Surf.Area= 20,728 sf Storage= 70,246 cf (52,447 cf above start)

Plug-Flow detention time= 118.4 min calculated for 7.512 af (100% of inflow)
Center-of-Mass det. time= 96.0 min (932.7 - 836.7)

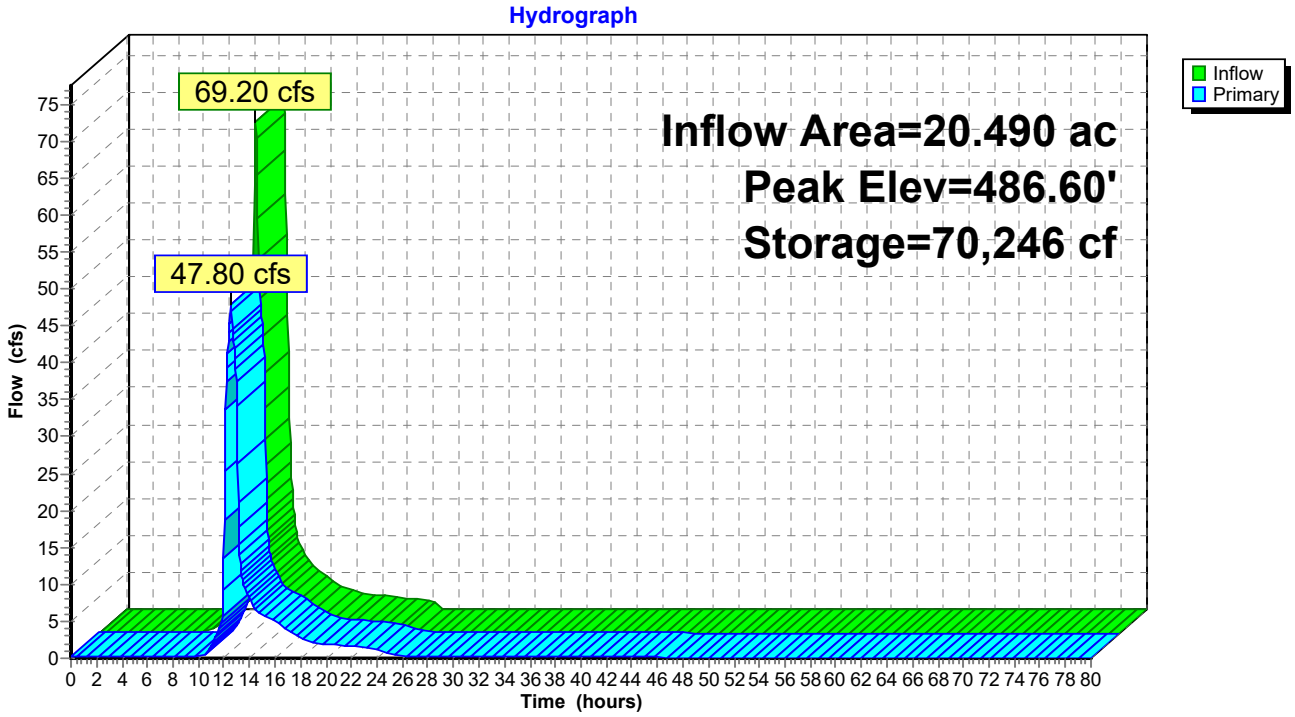
Volume	Invert	Avail.Storage	Storage Description
#1	482.00'	78,989 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
482.00	10,407	712.1	0	0	10,407
487.00	21,795	806.4	78,771	78,771	22,418
487.01	21,795	806.4	218	78,989	22,426

Device	Routing	Invert	Outlet Devices
#1	Primary	482.00'	**24.0" Round Culvert** L= 43.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 482.00' / 481.00' S= 0.0233 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Primary	482.00'	**24.0" Round Culvert** L= 43.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 482.00' / 481.00' S= 0.0233 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#3	Device 1	482.00'	**2.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	482.00'	**2.0" Vert. Orifice/Grate** C= 0.600
#5	Device 1	483.50'	**15.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600
#6	Device 2	483.50'	**15.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600
#7	Device 1	484.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#8	Device 2	484.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#9	Primary	486.50'	**30.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=47.60 cfs @ 12.53 hrs HW=486.59' TW=0.00' (Dynamic Tailwater)
- **1=Culvert** (Inlet Controls 22.64 cfs @ 7.21 fps)
  - **3=Orifice/Grate** (Passes < 0.22 cfs potential flow)
  - **5=Orifice/Grate** (Passes < 5.07 cfs potential flow)
  - **7=Orifice/Grate** (Passes < 21.89 cfs potential flow)
- **2=Culvert** (Inlet Controls 22.64 cfs @ 7.21 fps)
  - **4=Orifice/Grate** (Passes < 0.22 cfs potential flow)
  - **6=Orifice/Grate** (Passes < 5.07 cfs potential flow)
  - **8=Orifice/Grate** (Passes < 21.89 cfs potential flow)
- **9=Broad-Crested Rectangular Weir** (Weir Controls 2.32 cfs @ 0.82 fps)

Pond B-1: B-1

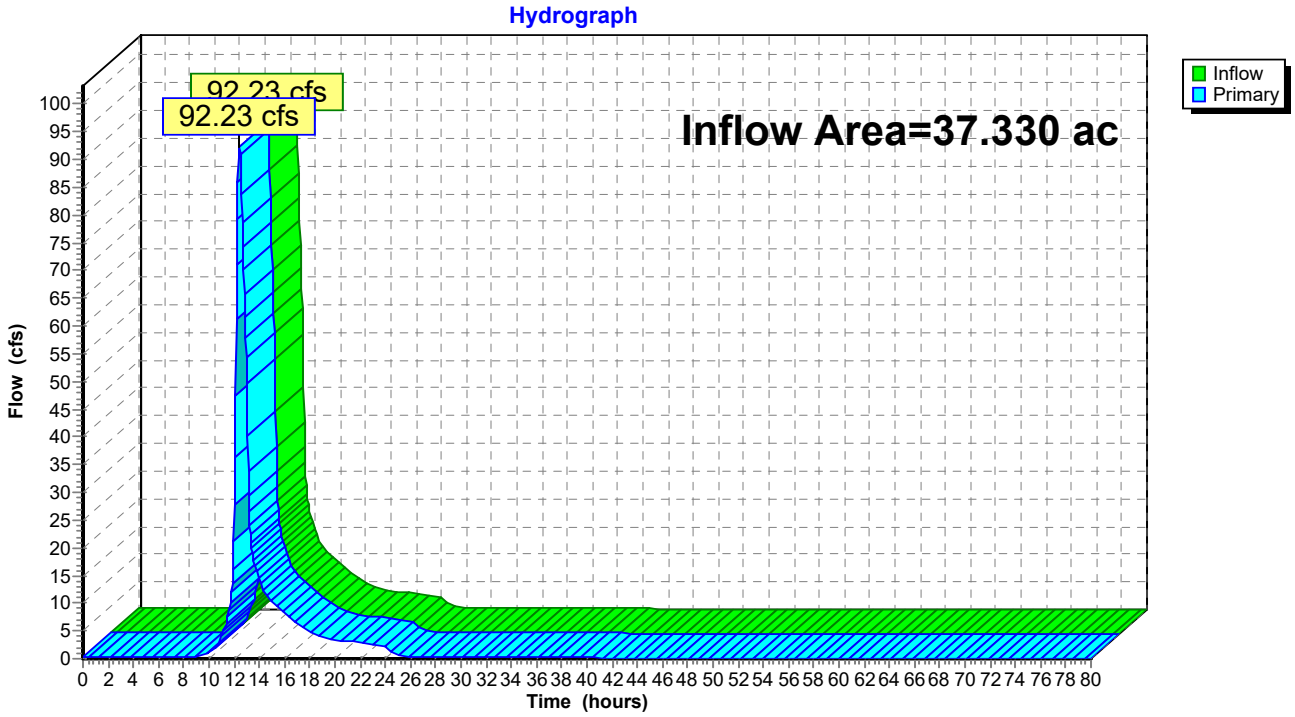


Summary for Link AP-1: AP-1

Inflow Area = 37.330 ac, 1.37% Impervious, Inflow Depth = 4.43" for 50 YR event
Inflow = 92.23 cfs @ 12.44 hrs, Volume= 13.794 af
Primary = 92.23 cfs @ 12.44 hrs, Volume= 13.794 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Link AP-1: AP-1



Time span=0.00-80.00 hrs, dt=0.05 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PDA-1: PDA-1 Runoff Area=20.490 ac 2.49% Impervious Runoff Depth=5.28"
Flow Length=1,742' Tc=21.4 min CN=72 Runoff=82.81 cfs 9.012 af

Subcatchment PDA-2: PDA-2 Runoff Area=16.840 ac 0.00% Impervious Runoff Depth=5.04"
Flow Length=2,671' Tc=28.0 min CN=70 Runoff=57.88 cfs 7.068 af

Pond B-1: B-1 Peak Elev=486.90' Storage=76,524 cf Inflow=82.81 cfs 9.012 af
Outflow=67.34 cfs 9.415 af

Link AP-1: AP-1 Inflow=123.85 cfs 16.482 af
Primary=123.85 cfs 16.482 af

Total Runoff Area = 37.330 ac Runoff Volume = 16.080 af Average Runoff Depth = 5.17"
98.63% Pervious = 36.820 ac 1.37% Impervious = 0.510 ac

Summary for Subcatchment PDA-1: PDA-1

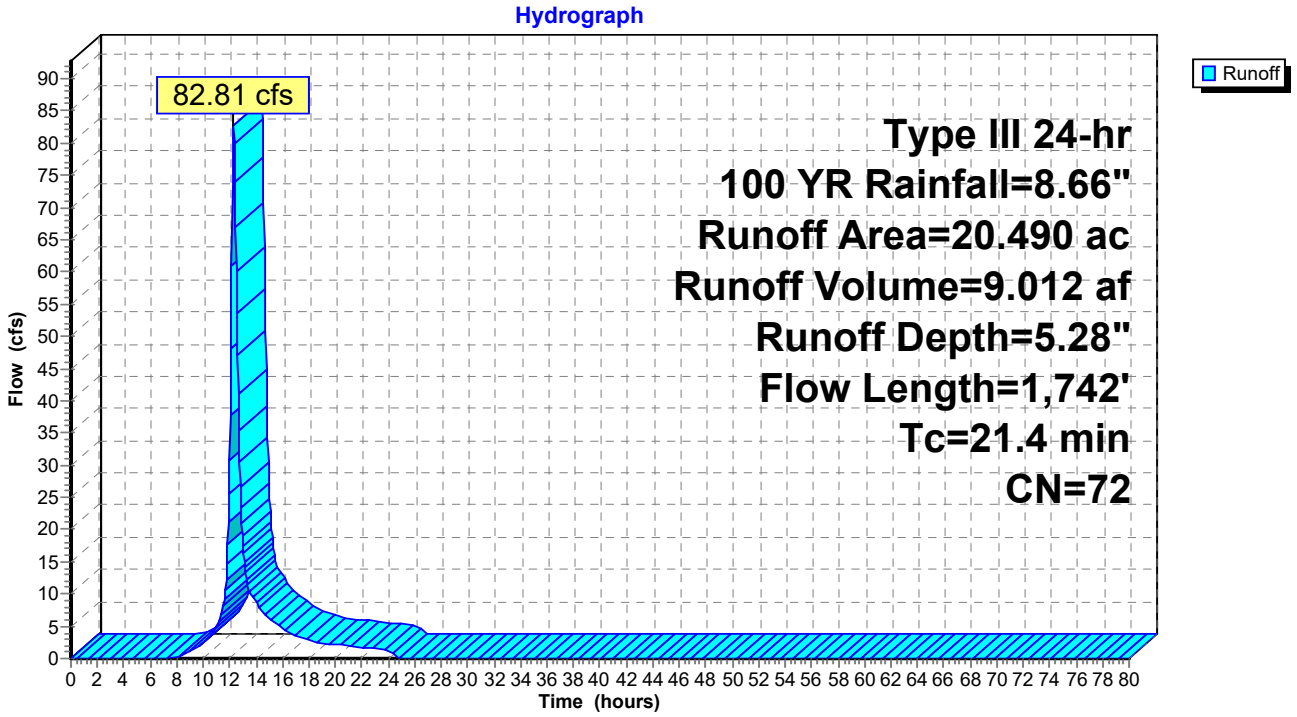
Runoff = 82.81 cfs @ 12.30 hrs, Volume= 9.012 af, Depth= 5.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 YR Rainfall=8.66"

Area (ac)	CN	Description
2.860	55	Woods, Good, HSG B
1.990	56	Brush, Fair, HSG B
1.000	70	Woods, Good, HSG C
0.750	70	Brush, Fair, HSG C
4.910	77	Woods, Good, HSG D
0.870	71	Meadow, non-grazed, HSG C
7.360	78	Meadow, non-grazed, HSG D
0.240	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
0.500	98	Water Surface, HSG D
20.490	72	Weighted Average
19.980		97.51% Pervious Area
0.510		2.49% Impervious Area
0.010		1.96% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	100	0.0830	0.14		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.57"
4.8	655	0.2100	2.29		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.6	329	0.0730	9.52	57.12	**Channel Flow, C-D** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.030 Earth, grassed & winding
4.5	658	0.1200	2.42		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
21.4	1,742	Total			

Subcatchment PDA-1: PDA-1



Summary for Subcatchment PDA-2: PDA-2

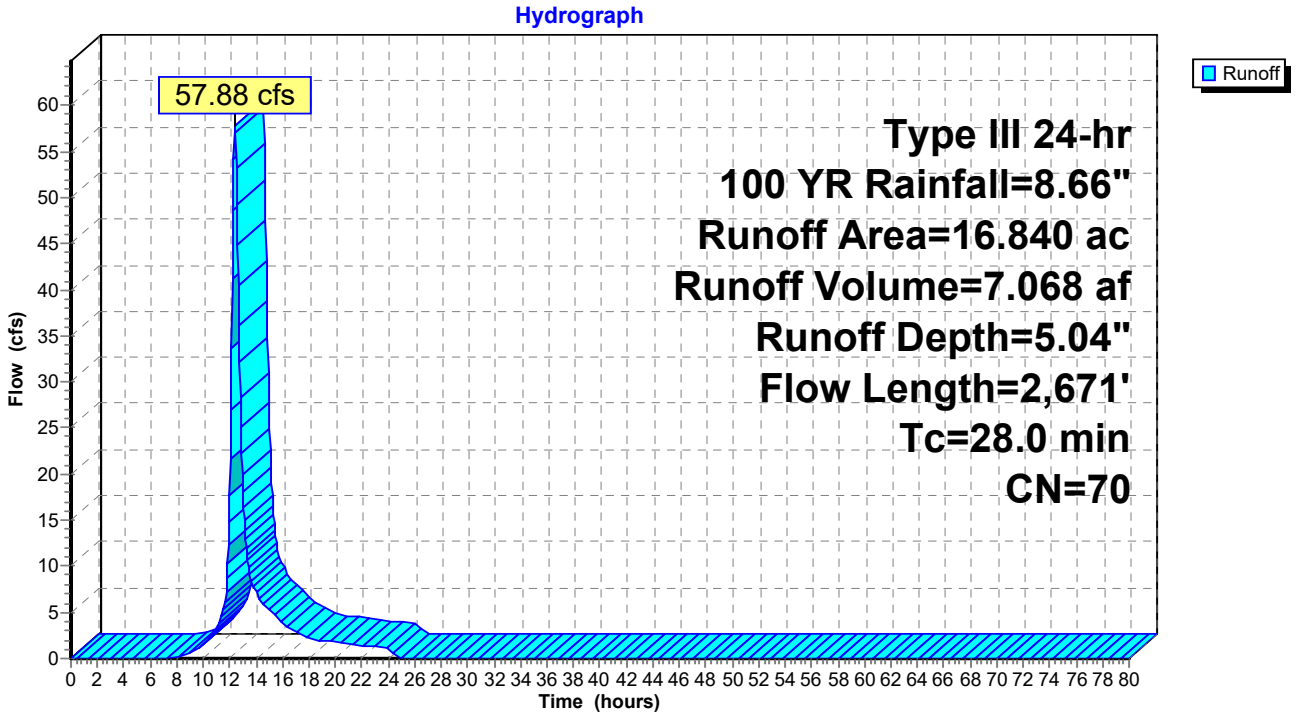
Runoff = 57.88 cfs @ 12.39 hrs, Volume= 7.068 af, Depth= 5.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 YR Rainfall=8.66"

Area (ac)	CN	Description
3.010	55	Woods, Good, HSG B
2.380	56	Brush, Fair, HSG B
0.510	70	Woods, Good, HSG C
10.630	77	Woods, Good, HSG D
0.310	77	Brush, Fair, HSG D
16.840	70	Weighted Average
16.840		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	100	0.0478	0.12		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.57"
5.2	384	0.0598	1.22		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
1.6	1,068	0.0960	10.92	65.51	**Channel Flow, C-D** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.030 Earth, grassed & winding
0.2	34	0.1820	2.99		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
0.3	106	0.0200	5.71	114.24	**Channel Flow, E-F** Area= 20.0 sf Perim= 17.0' r= 1.18' n= 0.041 Riprap, 2-inch
5.9	688	0.1490	1.93		**Shallow Concentrated Flow, F-G** Woodland Kv= 5.0 fps
0.5	291	0.1500	9.99	59.91	**Channel Flow, G-H** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.041 Riprap, 2-inch
28.0	2,671	Total			

Subcatchment PDA-2: PDA-2



Summary for Pond B-1: B-1

Inflow Area = 20.490 ac, 2.49% Impervious, Inflow Depth = 5.28" for 100 YR event
Inflow = 82.81 cfs @ 12.30 hrs, Volume= 9.012 af
Outflow = 67.34 cfs @ 12.46 hrs, Volume= 9.415 af, Atten= 19%, Lag= 9.6 min
Primary = 67.34 cfs @ 12.46 hrs, Volume= 9.415 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs
Starting Elev= 483.50' Surf.Area= 13,386 sf Storage= 17,798 cf
Peak Elev= 486.90' @ 12.46 hrs Surf.Area= 21,516 sf Storage= 76,524 cf (58,726 cf above start)

Plug-Flow detention time= 105.1 min calculated for 9.006 af (100% of inflow)
Center-of-Mass det. time= 85.0 min (916.5 - 831.5)

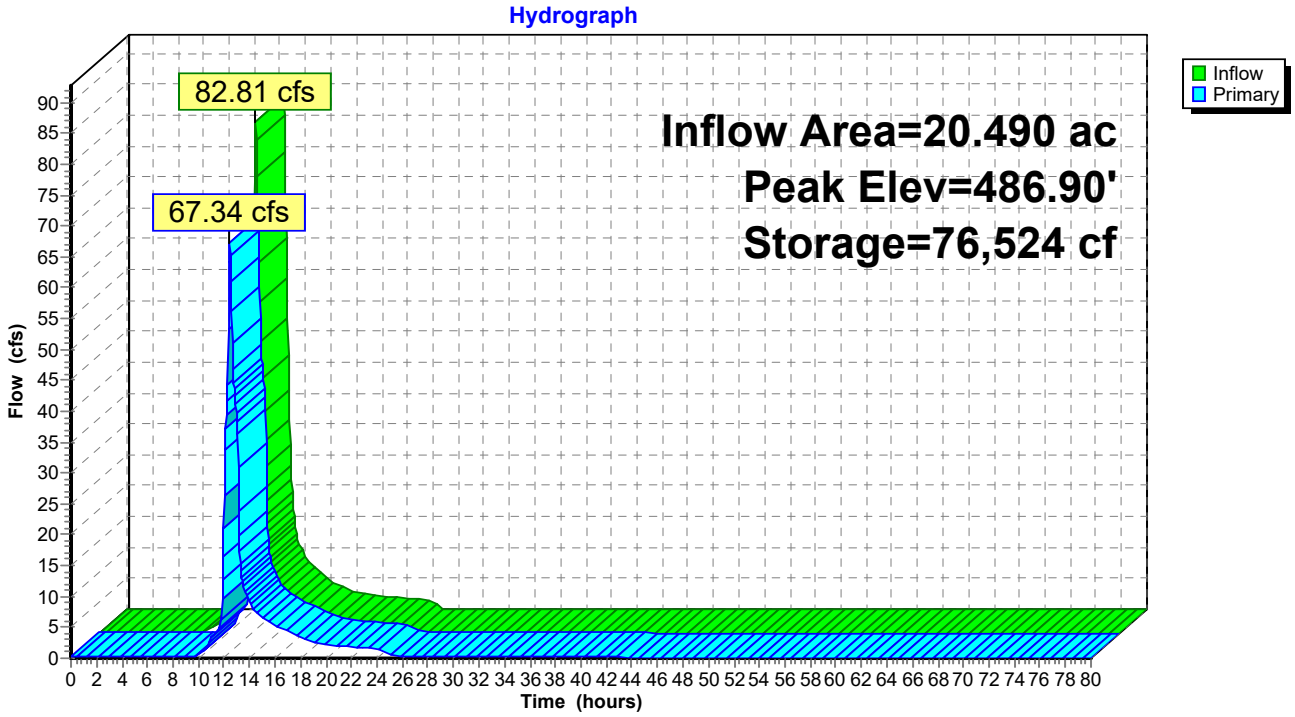
Volume	Invert	Avail.Storage	Storage Description
#1	482.00'	78,989 cf	**Custom Stage Data (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
482.00	10,407	712.1	0	0	10,407
487.00	21,795	806.4	78,771	78,771	22,418
487.01	21,795	806.4	218	78,989	22,426

Device	Routing	Invert	Outlet Devices
#1	Primary	482.00'	**24.0" Round Culvert** L= 43.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 482.00' / 481.00' S= 0.0233 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Primary	482.00'	**24.0" Round Culvert** L= 43.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 482.00' / 481.00' S= 0.0233 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#3	Device 1	482.00'	**2.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	482.00'	**2.0" Vert. Orifice/Grate** C= 0.600
#5	Device 1	483.50'	**15.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600
#6	Device 2	483.50'	**15.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600
#7	Device 1	484.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#8	Device 2	484.50'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#9	Primary	486.50'	**30.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=67.07 cfs @ 12.46 hrs HW=486.89' TW=0.00' (Dynamic Tailwater)
- **1=Culvert** (Inlet Controls 23.56 cfs @ 7.50 fps)
  - **3=Orifice/Grate** (Passes < 0.23 cfs potential flow)
  - **5=Orifice/Grate** (Passes < 5.33 cfs potential flow)
  - **7=Orifice/Grate** (Passes < 23.40 cfs potential flow)
- **2=Culvert** (Inlet Controls 23.56 cfs @ 7.50 fps)
  - **4=Orifice/Grate** (Passes < 0.23 cfs potential flow)
  - **6=Orifice/Grate** (Passes < 5.33 cfs potential flow)
  - **8=Orifice/Grate** (Passes < 23.40 cfs potential flow)
- **9=Broad-Crested Rectangular Weir** (Weir Controls 19.95 cfs @ 1.69 fps)

Pond B-1: B-1

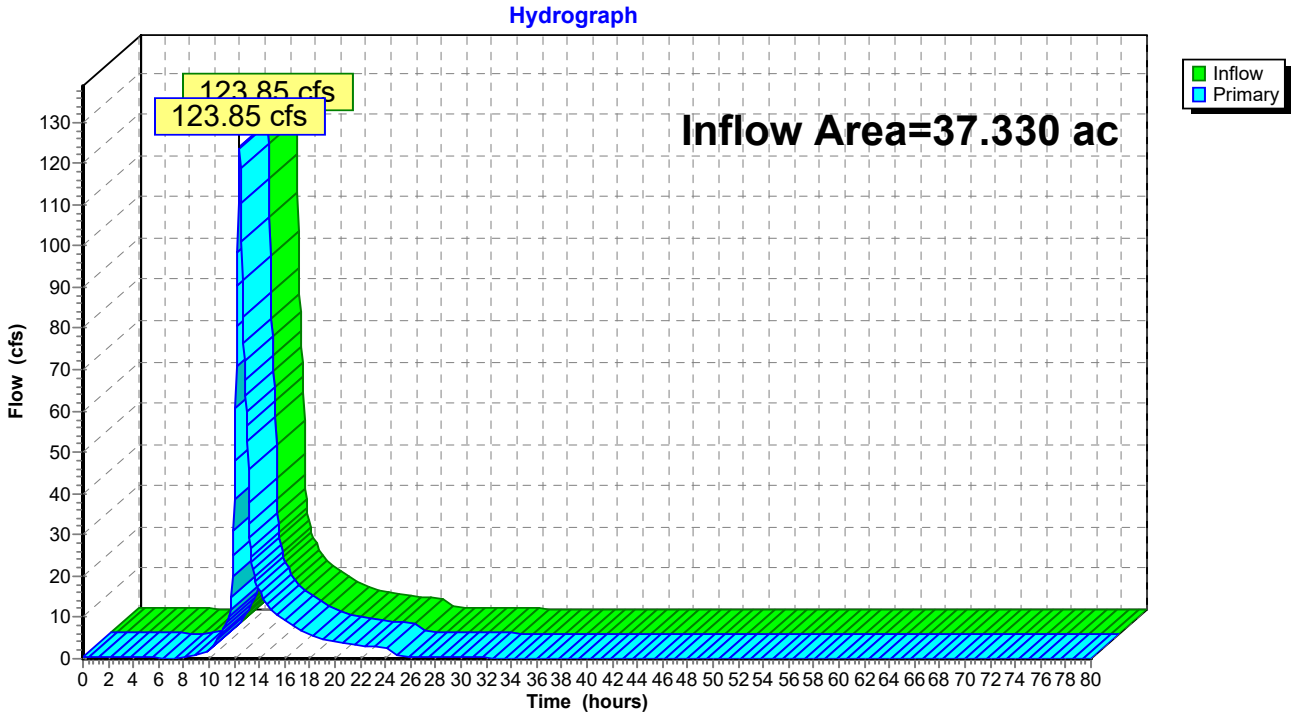


Summary for Link AP-1: AP-1

Inflow Area = 37.330 ac, 1.37% Impervious, Inflow Depth = 5.30" for 100 YR event
Inflow = 123.85 cfs @ 12.44 hrs, Volume= 16.482 af
Primary = 123.85 cfs @ 12.44 hrs, Volume= 16.482 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.05 hrs

Link AP-1: AP-1



APPENDIX D: NOAA ATLAS 14 PRECIPITATION FREQUENCY TABLE

NOAA Atlas 14, Volume 10, Version 3
Location name: Hamden, Connecticut, USA*
Latitude: 41.4317°, Longitude: -72.9434°
Elevation: 514.28 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	0.346 (0.269-0.436)	0.418 (0.324-0.526)	0.534 (0.412-0.676)	0.631 (0.484-0.803)	0.763 (0.568-1.02)	0.863 (0.631-1.18)	0.968 (0.687-1.38)	1.09 (0.731-1.59)	1.26 (0.813-1.91)	1.40 (0.883-2.17)
10-min	0.491 (0.381-0.618)	0.591 (0.458-0.746)	0.756 (0.584-0.956)	0.893 (0.686-1.14)	1.08 (0.805-1.45)	1.22 (0.892-1.67)	1.37 (0.973-1.95)	1.54 (1.03-2.25)	1.78 (1.15-2.70)	1.98 (1.25-3.07)
15-min	0.577 (0.448-0.727)	0.696 (0.539-0.877)	0.890 (0.687-1.13)	1.05 (0.808-1.34)	1.27 (0.947-1.70)	1.44 (1.05-1.97)	1.61 (1.15-2.30)	1.81 (1.22-2.65)	2.09 (1.36-3.18)	2.33 (1.47-3.61)
30-min	0.797 (0.618-1.00)	0.958 (0.743-1.21)	1.22 (0.944-1.55)	1.44 (1.11-1.84)	1.74 (1.30-2.33)	1.97 (1.44-2.70)	2.21 (1.57-3.15)	2.48 (1.67-3.62)	2.87 (1.86-4.36)	3.19 (2.02-4.95)
60-min	1.02 (0.788-1.28)	1.22 (0.946-1.54)	1.56 (1.20-1.97)	1.83 (1.41-2.33)	2.22 (1.65-2.96)	2.50 (1.83-3.43)	2.80 (1.99-4.00)	3.15 (2.12-4.60)	3.64 (2.36-5.53)	4.05 (2.56-6.29)
2-hr	1.34 (1.05-1.68)	1.60 (1.24-2.00)	2.01 (1.56-2.53)	2.36 (1.82-2.98)	2.84 (2.12-3.76)	3.19 (2.35-4.34)	3.57 (2.55-5.05)	4.00 (2.70-5.80)	4.61 (3.00-6.95)	5.12 (3.25-7.89)
3-hr	1.56 (1.22-1.94)	1.85 (1.45-2.31)	2.34 (1.82-2.92)	2.73 (2.12-3.44)	3.28 (2.47-4.34)	3.69 (2.72-5.00)	4.13 (2.95-5.82)	4.62 (3.13-6.68)	5.34 (3.48-8.02)	5.93 (3.77-9.10)
6-hr	1.99 (1.57-2.46)	2.37 (1.87-2.94)	3.00 (2.36-3.73)	3.52 (2.75-4.41)	4.24 (3.21-5.57)	4.77 (3.54-6.43)	5.34 (3.85-7.50)	6.00 (4.08-8.62)	6.96 (4.55-10.4)	7.76 (4.95-11.8)
12-hr	2.47 (1.96-3.03)	2.98 (2.36-3.66)	3.81 (3.01-4.71)	4.50 (3.54-5.60)	5.45 (4.15-7.13)	6.16 (4.60-8.26)	6.92 (5.02-9.69)	7.82 (5.33-11.2)	9.16 (6.00-13.6)	10.3 (6.59-15.6)
24-hr	2.91 (2.32-3.55)	3.57 (2.85-4.36)	4.64 (3.69-5.70)	5.54 (4.38-6.84)	6.77 (5.19-8.82)	7.67 (5.77-10.3)	8.66 (6.35-12.1)	9.87 (6.75-14.0)	11.7 (7.71-17.3)	13.3 (8.57-20.1)
2-day	3.29 (2.64-3.99)	4.10 (3.29-4.98)	5.43 (4.34-6.61)	6.53 (5.19-8.00)	8.04 (6.22-10.5)	9.15 (6.95-12.2)	10.4 (7.70-14.6)	11.9 (8.20-16.9)	14.4 (9.50-21.1)	16.6 (10.7-24.8)
3-day	3.57 (2.88-4.31)	4.47 (3.60-5.40)	5.93 (4.76-7.20)	7.14 (5.71-8.73)	8.82 (6.84-11.4)	10.0 (7.65-13.4)	11.4 (8.48-16.0)	13.1 (9.03-18.5)	15.9 (10.5-23.2)	18.4 (11.8-27.3)
4-day	3.83 (3.10-4.62)	4.78 (3.87-5.77)	6.34 (5.11-7.68)	7.63 (6.11-9.30)	9.41 (7.32-12.2)	10.7 (8.18-14.2)	12.2 (9.06-17.0)	14.0 (9.64-19.6)	16.9 (11.2-24.7)	19.5 (12.6-29.0)
7-day	4.58 (3.73-5.48)	5.63 (4.58-6.75)	7.35 (5.96-8.85)	8.78 (7.07-10.6)	10.8 (8.39-13.8)	12.2 (9.34-16.1)	13.8 (10.3-19.0)	15.8 (10.9-22.0)	18.9 (12.5-27.4)	21.6 (14.0-32.0)
10-day	5.31 (4.34-6.34)	6.42 (5.24-7.68)	8.24 (6.70-9.88)	9.75 (7.87-11.8)	11.8 (9.24-15.1)	13.4 (10.2-17.5)	15.0 (11.2-20.6)	17.1 (11.8-23.7)	20.2 (13.4-29.1)	22.9 (14.9-33.7)
20-day	7.58 (6.24-8.99)	8.78 (7.21-10.4)	10.7 (8.78-12.8)	12.4 (10.0-14.8)	14.6 (11.4-18.3)	16.3 (12.5-20.9)	18.0 (13.4-24.2)	20.0 (14.0-27.5)	22.9 (15.3-32.8)	25.4 (16.5-37.0)
30-day	9.47 (7.82-11.2)	10.7 (8.83-12.7)	12.7 (10.5-15.1)	14.4 (11.8-17.2)	16.7 (13.1-20.8)	18.5 (14.2-23.5)	20.3 (15.0-26.8)	22.2 (15.6-30.4)	24.9 (16.7-35.4)	27.0 (17.6-39.3)
45-day	11.8 (9.79-13.9)	13.1 (10.8-15.4)	15.2 (12.5-17.9)	16.9 (13.9-20.1)	19.3 (15.2-23.9)	21.1 (16.2-26.7)	23.0 (16.9-30.0)	24.8 (17.4-33.8)	27.2 (18.3-38.5)	29.0 (18.9-42.0)
60-day	13.8 (11.4-16.1)	15.1 (12.5-17.7)	17.2 (14.2-20.3)	19.0 (15.6-22.5)	21.4 (16.9-26.4)	23.3 (17.9-29.3)	25.2 (18.6-32.7)	27.0 (19.0-36.5)	29.2 (19.7-41.1)	30.7 (20.1-44.4)

[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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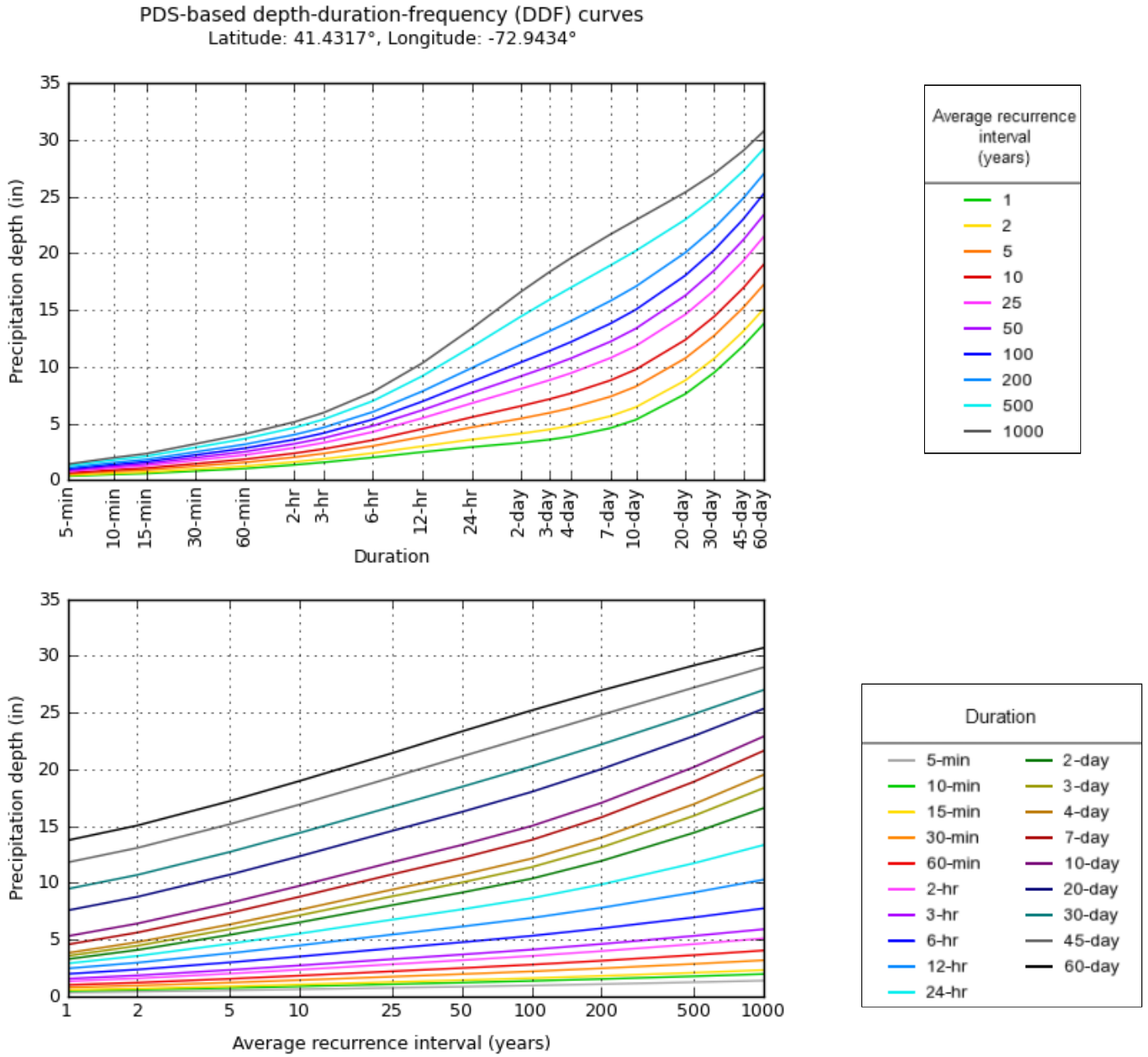
PF graphical



NOAA Atlas 14, Volume 10, Version 3

Created (GMT): Wed Mar 18 13:48:57 2020

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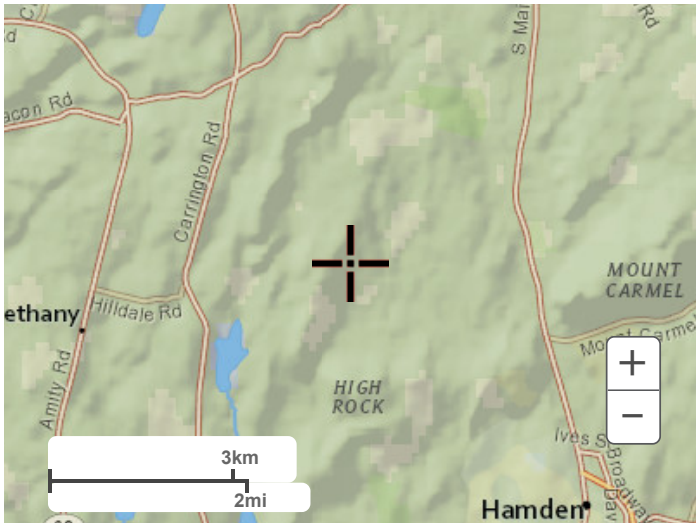
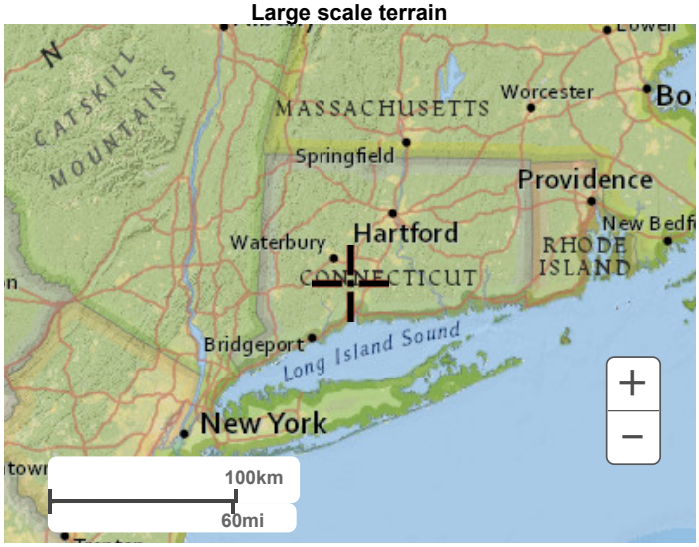
Maps & aerials

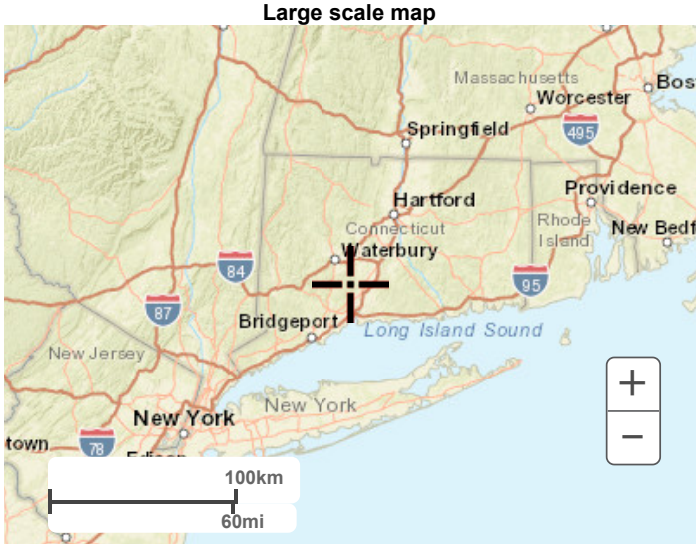
Small scale terrain



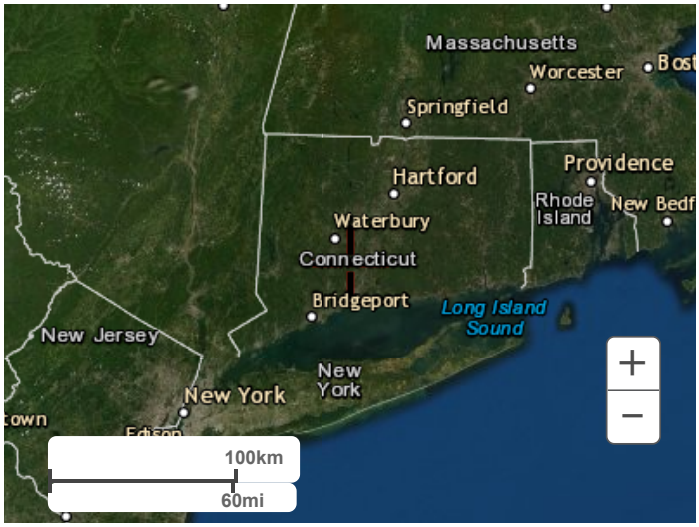
Large scale terrain



Large scale map



Large scale aerial



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

Disclaimer

APPENDIX E: WATER QUALITY VOLUME CALCULATIONS

WATER QUALITY VOLUME CALCULATIONS
FOR
HAMDEN SOLAR
100 SAND ROAD, NORTH CANAAN, CT 06018

$$WQV = \frac{(1")(R)(A)}{12}$$

where: WQV = water quality volume (ac-ft)
R = volumetric runoff coefficient = 0.05+0.009(I)
I = percent impervious cover
A = site area in acres

$V=WQV+((P)(A_b)/12)$

V=required basin storage volume (ac-ft)
WQV=Water Quality Volume (ac-ft)
P= design water quality precipitation (in)
A_b=basin surface area (ac)

	Area (ac)	Pervious (ac)	Imperv. (ac)	I	R	WQV (ac-ft)	P (in)	Ab (ac)	V (ac-ft)	Total V Req. (cyd)	V Provided (cyd)
Basin 1	20.49	17.17	3.32	16%	0.20	0.33	1	0.50214	0.38	607.20	659.00
								Overal Total V Required =		607.20	cyd
								Overal Total V Provided =		659.00	cyd

Stage-Area-Storage for Pond B-1: B-1

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
482.00	10,407	0
482.10	10,594	1,050
482.20	10,783	2,119
482.30	10,973	3,207
482.40	11,165	4,313
482.50	11,359	5,440
482.60	11,554	6,585
482.70	11,751	7,750
482.80	11,949	8,935
482.90	12,150	10,140
483.00	12,352	11,365
483.10	12,555	12,611
483.20	12,761	13,877
483.30	12,968	15,163
483.40	13,176	16,470
483.50	13,386	17,798
483.60	13,598	19,147
483.70	13,812	20,518
483.80	14,027	21,910
483.90	14,244	23,323
484.00	14,463	24,759
484.10	14,683	26,216
484.20	14,905	27,695
484.30	15,129	29,197
484.40	15,354	30,721
484.50	15,581	32,268
484.60	15,809	33,837
484.70	16,040	35,430
484.80	16,272	37,045
484.90	16,505	38,684
485.00	16,740	40,347
485.10	16,977	42,032
485.20	17,216	43,742
485.30	17,456	45,476
485.40	17,698	47,233
485.50	17,942	49,015
485.60	18,187	50,822
485.70	18,434	52,653
485.80	18,682	54,509
485.90	18,933	56,389
486.00	19,184	58,295
486.10	19,438	60,226
486.20	19,693	62,183
486.30	19,950	64,165
486.40	20,209	66,173
486.50	20,469	68,207
486.60	20,731	70,267
486.70	20,994	72,353
486.80	21,260	74,466
486.90	21,526	76,605
487.00	**21,795**	**78,771**

APPENDIX F: GEOTECHNICAL REPORT

DOWN TO EARTH CONSULTING, LLC
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERING

GEOTECHNICAL ENGINEERING REPORT
PROPOSED SOLAR ARRAY
HAMDEN SOLAR ONE
360 GAYLORD MOUNTAIN ROAD
HAMDEN, CONNECTICUT

Prepared for:

All-Points Technology Corporation, P.C.
567 Vauxhaul Street Extension – Suite 311
Waterford, Connecticut 06385

Prepared by:

Down To Earth Consulting, LLC
122 Church Street
Naugatuck, Connecticut 06770

File No. 0032-032.00
May 2020

DOWN TO EARTH CONSULTING, LLC
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERING

May 22, 2020
File No. 0032-032.00

Mr. Bradley J. Parsons, PE
All-Points Technology Corporation
567 Vauxhaul Street Extension – Suite 311
Waterford, Connecticut 06385

Via email: bparsons@allpointstech.com

Re: Geotechnical Engineering Report
Hamden Solar One
360 Gaylord Mountain Road, Hamden, Connecticut

Down To Earth Consulting, LLC (DTE) is pleased to submit this geotechnical engineering report for the Hamden Solar One Project that will be located on Gaylord Mountain Road in Hamden, Connecticut (Site) for All-Points Technology Corporation (Client). Our services were completed in general accordance with our current Master Services Agreement. We appreciate this opportunity to work with you and look forward to our continued involvement. Please call if you have any questions.

Sincerely,

Down To Earth Consulting, LLC

Raymond P. Janeiro, P.E.
Principal

TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION

Down To Earth Consulting, LLC, completed a subsurface exploration program and geotechnical engineering evaluation for the proposed solar array foundations. Our geotechnical engineering services included: reviewing provided project plans, completing borings and soils testing, characterizing subsurface conditions within the proposed solar array limits, performing geotechnical engineering analyses, and providing geotechnical design and construction recommendations for the project. Refer to Figures 1 and 2 (in Appendix 1) for an area plan and site plan, respectively. Our services were based, in part, on a provided *Concept Plan*, prepared by the Client, revision dated April 3, 2020.

2.0 BACKGROUND

The Hamden Solar One project is generally bordered by Gaylord Mountain Road to the east, a residential development to the south, powerlines to the west, and undeveloped land to the north. A proposed ground-mount solar array will be constructed that will consist of about 7,000 modules. Nominal cuts on the order of 2-feet or less are anticipated to achieve design grades, as the solar array structures will generally conform to existing Site topography. We understand that deeper cuts will be required to accommodate proposed detention basins. Refer to Figure 2 (Appendix 1) for existing site features and the proposed solar array location.

3.0 SUBSURFACE DATA

3.1 GENERAL SITE GEOLOGY

Published surficial and bedrock geological map data (*1:125,000 scale, Surficial Materials Map of Connecticut, Janet Radway Stone, 1992 and 1:125,000 scale, Bedrock Geological Map of Connecticut, John Rodgers, 1985*) was reviewed. The Site surficial material is mapped as a variable mixture of gravel, sand, silt, and clay that is intermixed with cobbles and boulders (Glacial Till). The underlying bedrock is classified as reddish-brown New Haven Arkose (a.k.a. brownstone) to the northeast and dark-gray West Rock Dolerite (a.k.a. traprock) to the southwest.

3.2 TEST BORINGS

We observed and logged six test borings (B-1 through B-6) drilled by our subcontractor General Borings, Inc. on April 21, 2020. Boring locations are depicted on Figure 2 (Appendix 1) and the logs are included in Appendix 2. Borings were located in the field by taping/pacing from existing site features, thus their locations should be considered approximate.

The borings were drilled to explore the soil, bedrock, and groundwater conditions in the proposed solar array areas. Hollow-stem auger drilling methods were used to advance borings to depths ranging from approximately 6 to 10.5 feet below existing grades. Each boring was advanced until encountering drilling and/or sampling refusal on inferred bedrock.

Representative soil samples were obtained in the borings for soil classification and laboratory testing by split barrel sampling procedures in general accordance with ASTM D-1586. The split-spoon sampling procedure utilizes a standard 2-inch O.D. split-barrel sampler that is driven into

the bottom of the boring with a 140-pound hammer falling a distance of 30 inches. The number of blows required to advance the sampler the middle 12-inches of a normal 24-inch penetration is recorded as the Standard Penetration Resistance Value (N). The blows (i.e., "N-Value") are indicated on the boring logs at their depth of occurrence and provide an indication of the relative consistency of the material.

Groundwater levels were measured using a weighted tape in open drill holes and/or inferred from wet soil samples during drilling.

4.0 SUBSURFACE CONDITIONS

4.1 SUBSURFACE PROFILE

The generalized subsurface profile, as inferred from the subsurface data, consists of Subsoil overlying Glacial Till Deposits and Bedrock. An approximate 8- to 12-inch layer of Topsoil/Forest Debris was encountered at the surface of the explorations. The following is a more detailed description of the subsurface materials encountered:

4.1.1 Subsoil

Subsoil was encountered at each of the boring locations directly below the Topsoil/Forest Debris. This stratum ranged in thickness from about 1 to 2 feet and generally consisted of loose, orange-brown/brown, silt with varying amounts of fine to medium sand (about 35 to 60%) and trace to little amounts (0% to 20%) of fine gravel. The subsoil did not have an organic odor, but trace (0 to 5%) amounts of organic material (e.g., rootlets) was observed in many samples.

4.1.2 Glacial Till

Glacial Till was observed below the Subsoil in the borings and ranged in thickness from about 3 to 7 feet. This material generally consisted of dense to very dense, red-brown, fine to coarse sand with varying amounts (10% to 60%) of silt and fine to coarse gravel. In some instances, the presence of cobbles and boulders were inferred by "rig chatter" and refusal during drilling and sampling.

4.1.3 Weathered Rock

Weathered Rock was observed in split spoon samples at most borings (except B-3 and B-5) at about 5 to 10 feet below existing grades. Bedrock was inferred from split spoon and/or auger refusal at depths ranging from about 6 to 10.6 feet below existing grades.

4.2 GROUNDWATER

Groundwater was measured in the boreholes during drilling or inferred from wet soil samples and ranged from about 1.5 to 5 feet below existing grades. Groundwater levels measured in the boreholes may not have had sufficient time to stabilize and should be considered approximate. Groundwater levels will vary depending on factors such as temperature, season, precipitation, construction activity, and other conditions, which may be different from those at the time of these measurements.

5.0 SOILS TESTING

5.1 LABORATORY TESTING

Soils laboratory testing was completed on samples obtained from the borings. A soil sample was collected within the proposed southeastern detention basin for grain size distribution testing. This data was used to estimate hydraulic conductivity values for the sampled materials (see Section 5.2).

Soil samples were also collected from 0 to 4 feet below grade at Borings B-4 and B-6 to evaluate the corrosivity potential of sampled soils. Samples were analyzed for pH, Sulfates, Chlorides, and Electrical Resistivity. Based on the laboratory test results, the soil samples are not considered to be corrosive. A soil sample was also collected at 3 feet below grade at the Boring B-2 location for Thermal Resistivity testing. The results of the laboratory testing are included in Appendix 3.

5.2 ESTIMATED HYDRAULIC CONDUCTIVITY

Kozeny-Carman methodology was used to estimate the hydraulic conductivity (permeability) of the soil sample submitted for gradation testing. The estimated hydraulic conductivity of the sample was estimated at 8e-4 feet per day. Details of the analyses are provided in Appendix 4. Note that the Kozeny-Carman methodology provides estimated hydraulic conductivity values; field infiltration tests may be required to obtain a more accurate permeability estimate of subsurface soils.

5.3 SOIL RESISTIVITY TESTING

On April 20, 2020, DTE field personnel conducted in-situ soil resistivity testing in accordance with accepted engineering practices using the Wenner electrode configuration. Electrodes were spaced at 5, 10, 20, 30, and 40 feet. One set of two approximately perpendicular resistivity lines were completed in the general vicinity of the proposed solar array area. The approximate locations and orientations of the resistivity lines are shown on the attached Figure 2. The results of the resistivity tests are as follows:

	Resistivity (ohm-cm)	
Electrode Spacing (ft)	Line 1	Line 2
5	262,068	265,227
10	222,140	240,332
20	144,774	123,326
30	114,038	105,823
40	36,845	31,176

Field resistivity results may be influenced by boulders, shallow groundwater, and bedrock. Resistivity results will fluctuate depending on the degree of compaction, moisture content, constituent solubility, and temperature. Field resistivity values may also vary depending upon season, precipitation, and other conditions that may differ from those at the time of testing.

6.0 ENGINEERING IMPLICATIONS OF SUBSURFACE CONDITIONS

Subsurface conditions generally consist of dense glacial till soils, containing cobbles and boulders, over relatively shallow bedrock. Due to the presence of obstructions (e.g., cobbles, boulders, and shallow bedrock), pile driving refusal should be expected throughout the limits of the proposed solar array. The presence of obstructions may also cause the piles to be driven out of tolerance as piles deflect off obstructions during driving.

In areas of pile driving difficulties, predrilling of pilot holes (up to 2/3 of the pile diameter) may be required to accommodate pile installation. The pilot holes would then be backfilled with drill cuttings (absent any cobble-sized material) prior to driving piles. If piles still cannot penetrate soils sufficiently, drilling of oversized holes backfilled with grout may be required. Ground screws (e.g., Krinner) may also be used to support the racking systems, but similarly we recommend predrilling a pilot hole to accommodate ground screw installation.

Piles will need to be designed to resist compression, tension, and lateral loads. Preliminary geotechnical design parameters are provided below. The pile design capacities will need to be verified in the field based on the results of pile load testing completed at the Site.

7.0 GEOTECHNICAL ENGINEERING RECOMMENDATIONS

We offer the following geotechnical design recommendations based on the subsurface conditions encountered at the Site, available project information, and the proposed construction.

7.1 SEISMIC DESIGN

The site class is “B” per the Building Code. Based on the standard penetration test results, visual soil classification, and design peak ground acceleration at this locale, the site soils are not susceptible to liquefaction.

7.2 DRIVEN PILE FOUNDATIONS

The proposed racking systems may be supported on driven steel piles end bearing in natural Glacial Till Deposits, Weathered Rock, or Bedrock. The steel piles should conform to ASTM A 572, Grade 50 and have hardened pile tips (e.g., pile driving shoes) to minimize pile damage on potential obstructions (e.g., boulders and bedrock). A minimum steel section corrosion loss of 1/16-inch all around the piles should be used. DTE recommends the following preliminary static design parameters for a driven pile foundation alternative:

DESCRIPTION	VALUE
Maximum Net Allowable Bearing Capacity[1] Glacial Till/Weathered Rock Bedrock	 6 kips per square foot (ksf) 10 ksf
Ultimate Skin Friction Value[2] Glacial Till (>3.5 fbg)	 750 pounds per square foot (psf)

Modulus of Lateral Subgrade Reaction[3]	
Glacial Till (>3.5 fbg) – dry	225 pounds per cubic inch (pci)
Glacial Till (>3.5 fbg) – wet	175 pci
Weathered Rock	225 pci
Angle of Internal Friction	
Glacial Till	36
Weathered Rock	40
Total Soil Unit Weight	
Glacial Till	135 pounds per cubic foot (pcf)
Weathered Rock	140 pcf

1. End-bearing should be neglected for uplift calculations. Provided value assumes a factor of safety of 3.
2. Contribution to pile capacity within the frost depth (i.e., above depths of 3.5 feet) should be ignored. The uplift capacity should be based on the dead weight of the pile and side resistance provided by the subsurface soils (i.e., end bearing should be neglected).
3. To analyze foundation under lateral loading (e.g., Ensoft LPILE).
4. All values provided in this table are preliminary and must be verified in the field by load testing.

Center-to-center pile spacing should not be less than 30 inches or 3 pile diameters. Final pile order lengths should be established based on the results of pile testing and the contractor should be prepared to increase anticipated pile lengths as conditions are exposed in the field.

Piles should be installed to a minimum ultimate geotechnical axial capacity of the structural load multiplied by 2 (assuming load testing is performed). Based on the recommended pile type, bearing material, and anticipated loads, we estimate negligible pile settlements. We recommend an adfreeze stress of 500 psf be considered when determining frost heave load on the piles. The box perimeter of the pile acting over the recommended frost depth of 3.5 feet should be considered when determining the frost heave load on a pile.

The lateral capacity of the upper 30 inches of soil should be neglected due to loss of strength from frost action and the presence of loose surficial soils. Appropriate lateral capacity reductions associated with group effects should be used for piles having a center-to-center spacing of less than 5 times their largest cross-sectional dimension.

7.2.1 Load Testing and Drivability

Tension and lateral load tests should be performed on test piles to finalize foundation design for uplift and lateral load capacity. Compression load tests should also be completed if end bearing capacity of piles is used. Load tests should be completed near the boring explorations in order to corroborate the load test and subsurface exploration data and develop final design recommendations. The testing results should be provided to DTE to reevaluate the above design parameters.

We recommend that a drivability analysis (i.e., Wave Equation Analysis for Piles (WEAP)) be performed for the site-specific conditions and selected pile driving hammer to evaluate the proposed pile driving equipment and development of stresses in the piles. The maximum allowable driving stress in both tension and compression should not exceed 45 ksi, which is based on applying a reduction factor of 0.9 to the yield strength of Grade 50 Steel.

7.3 DRILLED PIER FOUNDATIONS

DTE recommends the following static design parameters for a drilled pier foundation alternative:

DESCRIPTION	VALUE
Maximum Net Allowable Bearing Capacity[1]	
Glacial Till/Weathered Rock	6 kips per square foot (ksf)
Sound Bedrock	10 ksf
Allowable Bond Value[2]	
Glacial Till/Weathered Rock (>3.5 feet)	7 pounds per square inch (psi)
Sound Bedrock	35 psi
Lateral Loading Analysis[3]	
Glacial Till (>3.5 feet) dry - k_{py}	225 pounds per cubic inch (pci)
Glacial Till (>3.5 feet) wet - k_{py}	175 pci
Weathered Rock - k_{py}	225 pci
Sound Bedrock – k_{rm}	0.0005
Angle of Internal Friction	
Glacial Till	36
Weathered Rock	40
Bedrock	45
Total Soil Unit Weight	
Glacial Till	135 pounds per cubic foot (pcf)
Weathered Rock	140 pcf
Bedrock	145 pcf
Minimum Embedment	3.5 feet

1. The allowable end bearing capacity assumes a factor of safety of 3 and that loose, disturbed soil/rock has been removed from the base of the pier.
2. Grout-to-ground values are provided (i.e., no permanent casing is assumed). Allowable values are based on a factor of safety of 2 assuming a successful load test is performed. Contribution to pier capacity from soil above a depth of 3.5 feet should be ignored. The uplift capacity should be based on the dead weight of the pier and side resistance provided by the subsurface soils.
3. To analyze foundation under lateral loading (e.g., Ensoft LPILE).

We anticipate that the design length of the piers will be primarily dependent on the embedment/lateral capacity required to resist live loading. The pier will be subject to tension loads and therefore should have reinforcing steel that extends through the entire length of the pier.

Tension and lateral load tests should also be performed on test piers to finalize foundation design for uplift and lateral load capacity. Load tests should be completed near available boring explorations in order to corroborate the load test and subsurface exploration data and develop final design recommendations. The testing results should be provided to DTE to reevaluate the above design parameters.

7.4 GROUND SCREW FOUNDATION ALTERNATIVE

The proposed racking systems may also be supported on a ground screw foundation system (Krinner or similar) that derive their capacity in the natural Glacial Till Deposits and/or Weathered

Rock. Tension and lateral load tests should also be performed if a ground screw foundation system is selected to assess uplift and lateral capacities. Ground screw foundations are typically designed by a design-build contractor.

7.5 EQUIPMENT FOUNDATIONS

The proposed accessory structures may be designed as mat foundations bearing on a base course of at least 12-inches of Compacted Granular Fill (CGF) or Crushed Stone overlying proof-rolled natural Glacial Till deposits, or CGF or Crushed Stone placed above a proof-rolled natural soil subgrade. Soils with appreciable organic content (i.e., Topsoil) are not considered suitable bearing materials and must be excavated from foundation areas during site preparation.

When CGF is used beneath the foundations (e.g., in fill areas, if needed), we recommend that it be placed one foot beyond the edge of the foundations and at a one horizontal to one vertical slope away and down from the bottom outside edge of the foundations (i.e., foundation zone of influence). Crushed Stone can be used in place of CGF as it is much easier to compact.

We recommend a maximum allowable design bearing pressure of six kips per square foot (6 ksf) for foundations bearing on the recommended bearing materials. Shallow foundations should be embedded 42-inches below finished grades to account for frost. Based on the recommended bearing strata and anticipated loads, we anticipate that foundations will undergo less than one inch of total settlement and less than a half inch of differential settlement. Settlements will occur as the loads are applied and are expected to be complete at the end of construction.

We recommend an ultimate coefficient of sliding friction of 0.45. A factor of safety of at least 1.5 should be applied to calculated sliding resistance.

8.0 MATERIALS RECOMMENDATIONS

8.1 COMPACTED GRANULAR FILL

Compacted Granular Fill (CGF) for use as structural fill shall consist of inorganic soil free of clay, loam, ice and snow, tree stumps, roots, and other organic matter; graded within the following limits:

Sieve Size	Percent finer by weight
4-inches	100%
No. 10	30 - 100
No. 40	10 - 90
No. 200	0 - 12*

* To be considered non-frost susceptible, granular fill should have a maximum of 3 percent of particles by weight smaller than 0.02mm in effective diameter.

8.2 CRUSHED STONE

Crushed Stone for use below foundations shall consist of sound, tough, durable, rock that is graded within the following:

Sieve Size	Percent finer by weight
5/8-inches	100%
1/2-inch	85 - 100
3/8 inch	15 - 45
No. 4	0 - 15
No. 8	0 - 5

8.3 COMPACTION REQUIRMENTS

CGF should be placed in loose lifts not exceeding 8-inches in depth and compacted to at least 95 percent of its maximum dry density, and within 2% of optimum moisture content, as determined by ASTM D1557, Method C (Modified Proctor) below foundations and other structures.

Crushed Stone is considered to be "self-compacting" and would negate the need to run laboratory proctor testing and have field density testing of in-place lifts. The crushed stone should be plate compacted to "chink up" the working surface in lifts. We recommend placing Crushed Stone in maximum 12-inch lifts and compacting the lifts with a minimum of four passes with a vibratory plate compactor weighing a minimum of 1,000 pounds and with a minimum centrifugal force of 10,000 pounds.

9.0 CONSTRUCTION RECOMMENDATIONS

9.1 DRIVEN PILES

Technical specifications should be prepared by the design team that require detailed material and construction submittals and proof of experience in pile installation. The installation method or combination of methods selected by the contractor should be submitted for review by the design team, prior to mobilization of equipment. Specifications should include provisions for removing encountered cobbles, boulders, and other obstructions as a contingency. Any pile driving refusal remedies (pre-drilling, etc.) that are adopted by the Contractor during construction will require that those piles be load tested.

9.2 DRILLED PIERS

Technical specifications should be prepared by the design team that require detailed material and construction submittals and proof of experience in drilled pier installation by the specialty Contractor. Again, the drilling method or combination of methods selected by the contractor should be submitted for review by the geotechnical engineer, prior to mobilization of drilling equipment.

A section of temporary casing may be required to reduce the likelihood of caving of the side walls of the drill hole. Concrete should be placed by directing the concrete down the center of the shaft to reduce the likelihood of hitting the reinforcing steel and segregating. Groundwater, if encountered in the drill hole, should be removed prior to placing concrete; alternatively, concrete may be placed by tremie methods.

9.3 GROUND SCREW FOUNDATION ALTERNATIVE

Ground screws should be designed and installed by a specialty contractor with a minimum of 5 years of experience with designing and installing ground screw systems. The specialty contractor should also be licensed by the manufacturer of the selected ground screw system. The axial capacity of the ground screws must be confirmed during installation using the designer's recommended torque resistance. Predrilling is anticipated to install the ground screws due to the relative density of Site soils and the presence of cobbles and boulders.

9.4 SHALLOW FOUNDATIONS – EQUIPMENT PADS

The proposed equipment areas should be cleared of existing vegetation and topsoil. Cobbles, boulders, and any identifiable compressible or deleterious materials should be removed. Existing fill (including re-worked parent materials), and other unsuitable materials, must be removed from beneath bearing zones of influence to the top of firm, natural Glacial Till Deposits prior to construction. Over-excavation below bearing areas should include the zone of influence, defined as the area beneath 1 horizontal to 1 vertical (1H:1V) lines extending downward and outward from pad areas. Equipment pads shall bear on a prepared subgrade of firm natural Glacial Till Deposits, or CGF or Crushed Stone (over firm natural soils). Refer to Section 8.0 for material and placement recommendations.

Earthwork should be performed in dry conditions so that disturbance to foundation subgrades is limited. During earthwork, the Contractor should be responsible for protecting subgrades from the elements and maintaining the soils in a suitable state until completion of the project. Backfill should not be placed over a subgrade with standing water or that is frozen. Standing water, if present, should be removed and any soft and yielding soil should be removed prior to backfill placement. Excavations to subgrade levels should be performed using a smooth-edged bucket to minimize possible disturbance to the in-place subgrade soils.

Soil subgrades should be proof-rolled under the observation of a qualified Geotechnical Engineer with at least four (4) passes of a smooth-drum vibratory roller (minimum 8,000 pounds, minimum centrifugal force of 12,500 pounds) or, where approved by the geotechnical engineer, a vibratory plate compactor with a minimum of 2,500 pounds of centrifugal force. Any soft or loose zones identified during proof-rolling should be excavated and replaced with CGF, as necessary, and as required by the Geotechnical Engineer.

9.5 TEMPORARY EXCAVATIONS

The site soils are classified as OSHA Class "C" soil and can be cut at a maximum one vertical to one and a half horizontal (1V:1.5H) slope up to a maximum excavation depth of 20 feet. These maximum slope and excavation depths assume no surcharge load (i.e., stockpiles, construction equipment, etc.) at the top of the excavations or groundwater seepage.

9.6 TEMPORARY GROUNDWATER CONTROL

Based on information obtained from the subsurface exploration program, groundwater may be encountered during construction. We anticipate that water (stormwater, perched water, etc.) can be managed with conventional sump pumps and trenches in the excavations. Stormwater runoff should

not be permitted to accumulate on/within exposed subgrades and the runoff should be directed away from the exposed subgrade areas.

10.0 REVIEW OF FINAL DESIGN, PLANS, AND SPECIFICATIONS

When project plans are finalized, and specifications are available, they should be provided to DTE for review of conformance with our preliminary geotechnical recommendations. If any changes are made to the proposed structure locations or bearing levels, the recommendations provided in this report will need to be verified by DTE for applicability.

11.0 CONSTRUCTION QUALITY CONTROL

We further recommend that DTE be retained during earthwork construction to observe excavation to subgrade, fill placement and compaction, subgrade preparation, and deep foundation installation. The geotechnical engineer in the field should observe the work for compliance with the recommendations in this report, identify changes in subsurface conditions from those observed in the explorations should they become apparent, and assist in the development of design changes should subsurface conditions differ from those anticipated prior to the start of construction.

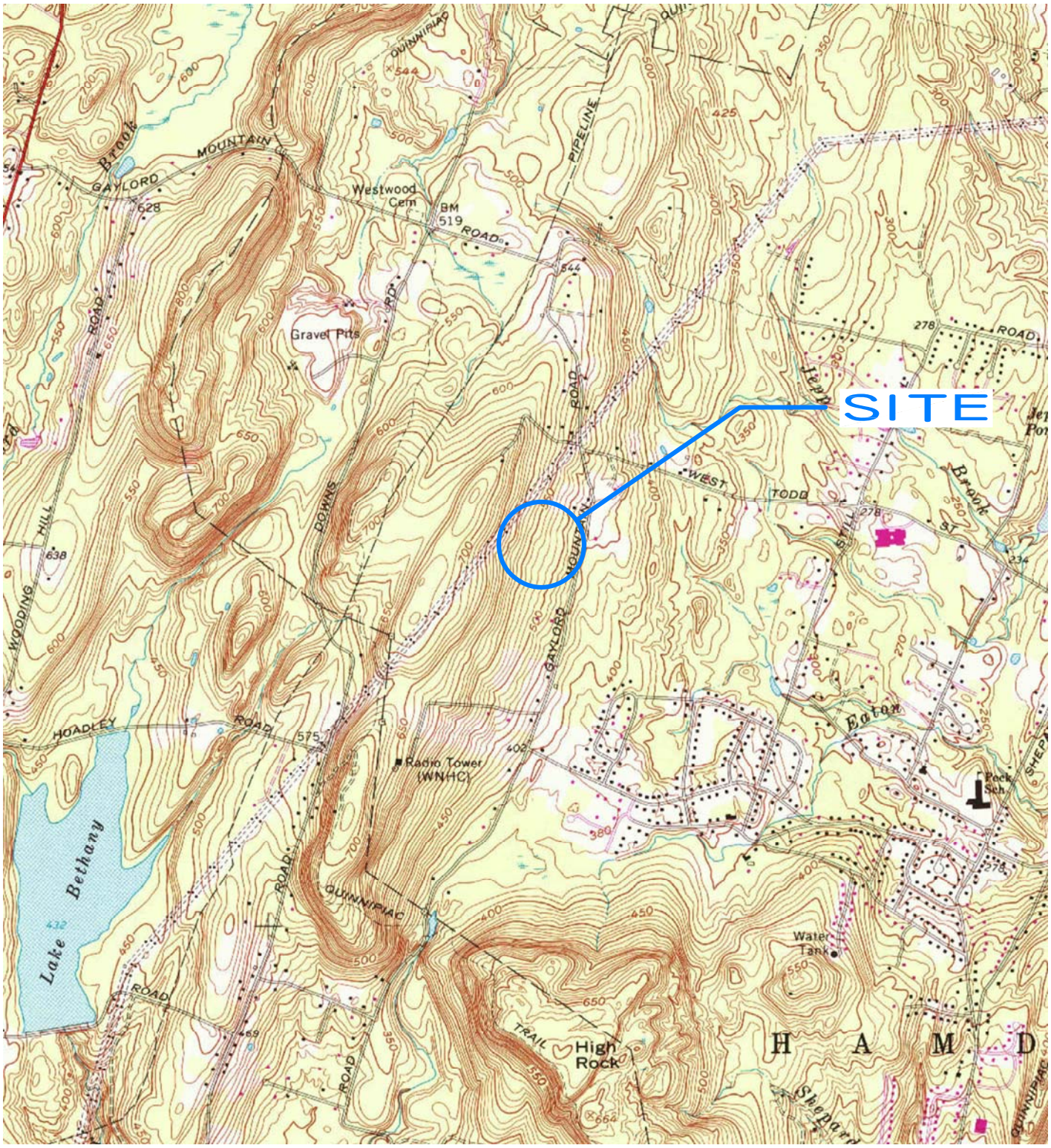
12.0 CLOSURE

We trust the information presented herein is sufficient for your use to progress design of the proposed solar array. We have enjoyed working with you on this project and look forward to our continued involvement. Please do not hesitate to call us if you have any questions.

This report is subject to the limitations included in Appendix 5.

APPENDIX 1 -

FIGURES



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DOWN TO EARTH CONSULTING, LLC
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERING

122 CHURCH STREET
NAUGATUCK, CONNECTICUT 06770

CONNECTICUT

QUADRANGLE LOCATION

AREA PLAN
PROPOSED SOLAR ARRAY
360 GAYLORD MOUNTAIN ROAD
HAMDEN, CONNECTICUT

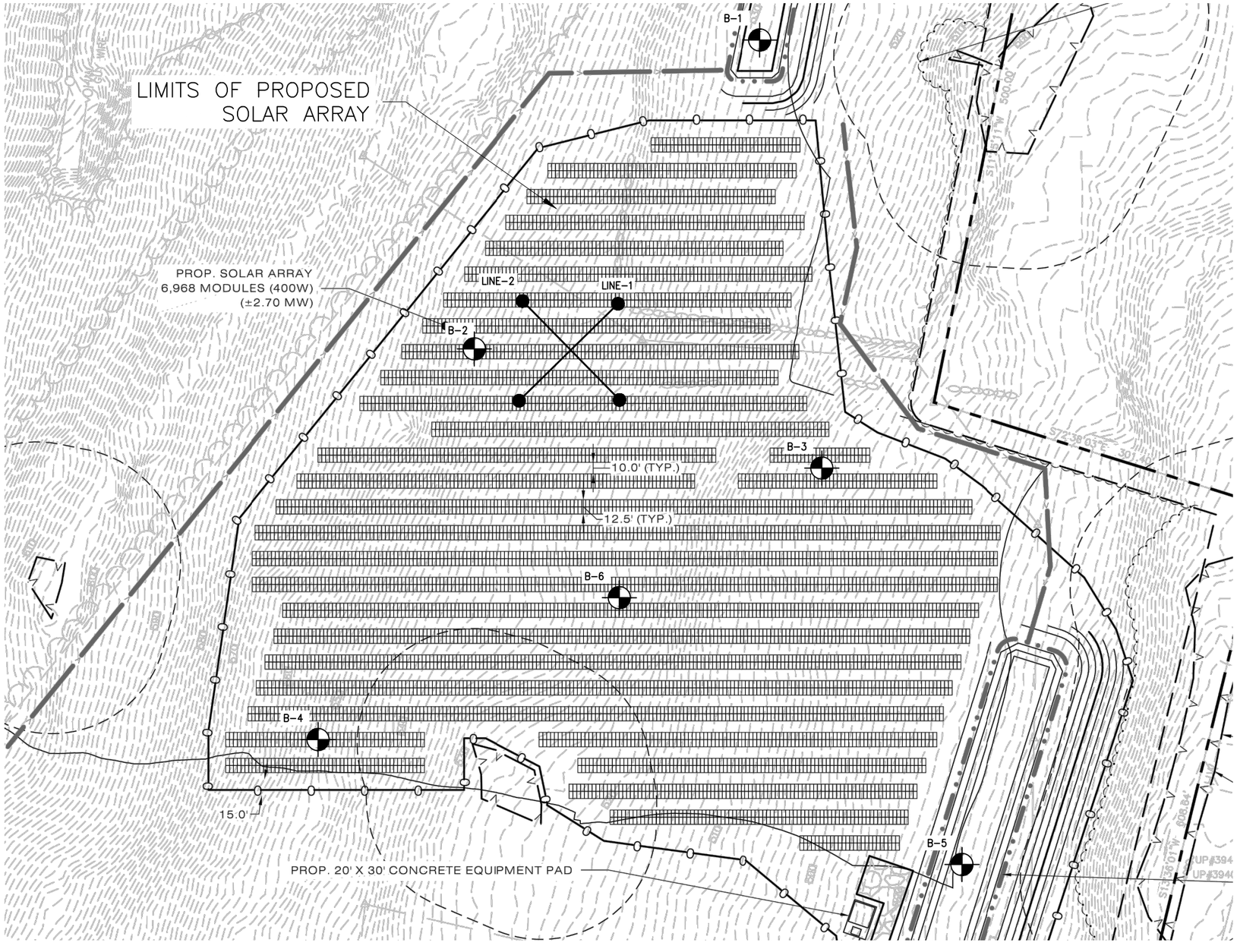
REFERENCE:
USGS TOPOGRAPHIC QUADRANGLE: MOUNT CARMEL, CT

SCALE 1"= 2,000'

2,000' 1,000' 0 2,000'

DRAWN BY: ARB	REVIEWED BY: RPJ

PROJECT NO.	0032-032.00
DATE:	4/30/20
FIGURE NO.	1



LEGEND

B-1 — TEST BORING NO. AND APPROX. LOCATION

LINE-1 — RESISTIVITY TEST LOCATION (TYP.)

NOTES:

1) BASE MAP DEVELOPED FROM AN ELECTRONIC FILE PREPARED BY ALL-POINTS TECHNOLOGY, ENTITLED "CONCEPT PLAN, HAMDEN SOLAR, 360 GAYLORD MOUNTAIN ROAD, HAMDEN, CT", DATED MARCH 18, 2020. ORIGINAL SCALE 1"=80'.
2) BORINGS WERE COMPLETED BY GENERAL BORINGS, INC. AND OBSERVED BY DOWN TO EARTH CONSULTING, LLC.
3) RESISTIVITY TESTING WAS PERFORMED ON APRIL 20, 2020 BY DOWN TO EARTH CONSULTING, LLC.
4) THE LOCATIONS OF THE EXPLORATIONS AND RESISTIVITY TESTING WERE DETERMINED BY TAPING AND VISUAL ESTIMATES FROM EXISTING SITE FEATURES. THESE LOCATIONS SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.

DESIGNED BY OTHERS						
DRAWN BY ARB						
CHECKED BY RPJ	NO.	DATE	REVISIONS	DRWN.	CHKD	APPVD
APPROVED BY RPJ						

SCALE 1"= 100'

100' 50' 0 100'

DOWN TO EARTH CONSULTING, LLC
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERING
122 CHURCH STREET
NAUGATUCK, CONNECTICUT 06770

PROJECT
HAMDEN SOLAR ONE
360 GAYLORD MOUNTAIN ROAD
HAMDEN, CONNECTICUT

DWG. TITLE.
SITE AND BORING LOCATION PLAN

FILE NO. 0032-032.00
SCALE AS NOTED
DATE 4/30/20
FIGURE NO. 2

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APPENDIX 2 -

TEST BORING LOGS

DOWN TO EARTH CONSULTING, LLC
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERING

PROJECT
HAMDEN SOLAR ONE
360 GAYLORD MOUNTAIN ROAD
HAMDEN, CONNECTICUT

BORING NO. B-1
SHEET 1 of 1
FILE NO. 0032-032.00
CHKD. BY RPJ

Boring Co.	General Borings, Inc.	Boring Location	See Boring Location Plan		
Driller	Tom McGovern	Ground Surface El.	Not Available	Datum	Not Available
Logged By	Mateusz Fekieta	Date Start	4/21/2020	Date End	4/21/2020

Hammer Type:	Safety Hammer
Sampler Size:	1-3/8" I.D. Split Spoon
Type Drill Rig:	Track
Drilling Method:	3.25-inch I.D. Hollow-Stem Augers

Groundwater Readings (from ground surface)

Date	Time	Depth (ft)	Elev.	Stabilization Time
4/21/20	-	5	-	wet sample
4/21/20	12:00 PM	1.5	-	3 hours (perched)

DEPTH	Casing Blows (ft)	Type & No.	REC/PEN (inches)	DEPTH (feet)	BLOWS PER 6 INCHES	Core Time (min./ft)	SAMPLE DESCRIPTION	STRATA DESCRIPTION
1		S-1	7/24	0 to 2	1-1-1-1		Very loose, Top 3": dark brown TOPSOIL; Bottom 4": orange-brown SILT and fine to medium SAND, trace (-) Roots, moist	12"+/- Topsoil/ Forest Debris SUBSOIL
2								
3		S-2	12/12	2 to 3	33-50/6"		Very dense, reddish brown fine to coarse SAND and fine to coarse GRAVEL, little Silt, moist	GLACIAL TILL
4								
5								
6		S-3	6/6	5 to 5.5	50/6"		Very dense, reddish brown fine to coarse SAND, some fine to coarse Gravel, trace Silt, with decomposed rock fragments at sample tip, wet	
7								DECOMPOSED ROCK
8								
9		S-4	0/0	8.5	50/0"		Very dense, No Recovery	
10							END OF EXPLORATION AT 8.5 FEET BELOW GROUND SURFACE	
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SPT N-Values	SPT N-Values	Proportions	SYMBOL KEY	
0 to 4 - Very Loose	0 to 2 - Very Soft	Trace = 0 to 10%	1. S denotes split-barrel sampler.	7. WH denotes weight of hammer
5 to 10 - Loose	3 to 4 - Soft	Little = 10 to 20%	2. ST denotes 3-inch O.D. undisturbed sample.	8. WR denotes weight of rods
11 to 30 - Medium Dense	5 to 8 - Medium Stiff	Some = 20 to 35%	3. UO denotes 3-inch Osterberg undisturbed sample.	9. PP denotes Pocket Penetrometer.
31 to 50 - Dense	9 to 15 - Stiff	And = 35 to 50%	4. PEN denotes penetration length of sampler.	10. FVST denotes field vane shear test.
Over 50 - Very Dense	16 to 30 - Very Stiff		5. REC denotes recovered length of sample.	11. RQD denotes Rock Quality Designation.
	Over 30 - Hard		6. SPT denotes Standard Penetration Test.	12. C denotes core run number.

FIELD NOTES: 1) Stratification lines represent approximate boundaries between soil types, transitions may be gradual.
2) Water level readings have been made at times and under conditions stated, fluctuations may occur due to other factors.
3) Auger grinding observed from about 5 feet below ground surface on inferred boulders/decomposed bedrock.
4) Auger refusal encountered at 8.5 feet below ground surface on inferred bedrock.

DOWN TO EARTH CONSULTING, LLC
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERING

PROJECT		BORING NO.	B-2
HAMDEN SOLAR ONE		SHEET	1 of 1
360 GAYLORD MOUNTAIN ROAD		FILE NO.	0032-032.00
HAMDEN, CONNECTICUT		CHKD. BY	RPJ

Boring Co.	General Borings, Inc.	Boring Location	See Boring Location Plan		
Driller	Tom McGovern	Ground Surface El.	Not Available	Datum	Not Available
Logged By	Mateusz Fekieta	Date Start	4/21/2020	Date End	4/21/2020

Hammer Type:	Safety Hammer
Sampler Size:	1-3/8" I.D. Split Spoon
Type Drill Rig:	Track
Drilling Method:	3.25-inch I.D. Hollow-Stem Augers

Groundwater Readings (from ground surface)

Date	Time	Depth (ft)	Elev.	Stabilization Time
4/21/20	-	3	-	wet sample (perched)

DEPTH	Casing Blows (ft)	SAMPLE INFORMATION Type & No.	REC/PEN (inches)	DEPTH (feet)	BLOWS PER 6 INCHES	Core Time (min./ft)	SAMPLE DESCRIPTION	STRATA DESCRIPTION
1		S-1	8/24	0 to 2	1-25-3-4		Loose, Top 2": dark brown/black TOPSOIL; Middle 2": red-brown coarse GRAVEL fragments; Bottom 4": red-brown fine to coarse SAND, little fine to coarse Gravel, little Silt, moist	12"+/- Topsoil/ Forest Debris
2								
3		S-2	12/24	2 to 4	8-18-40-50		Very dense, Top 6": brown fine to coarse SAND and SILT, some fine Gravel, wet; Bottom 6": red-brown fine to coarse SAND, some fine to coarse Gravel, little Silt	SUBSOIL
4								
5								GLACIAL TILL
6		S-3	18/23	5 to 6.9	52-62-49-50/5"		Very dense, red-brown fine to coarse SAND and fine to coarse GRAVEL, little Silt	
7								
8								
9		S-4	15/24	8 to 10	35-52-36-56		Very dense, brown fine to coarse SAND, some fine to coarse Gravel, little Silt	
10								
11		S-5	1/1	10.5 to 10.6	50/1"		Very dense, light gray coarse decomposed ROCK fragments	DECOMP. ROCK
12							END OF EXPLORATION AT 10.6 FEET BELOW GROUND SURFACE	
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SPT N-Values	SPT N-Values	Proportions	SYMBOL KEY	
0 to 4 - Very Loose	0 to 2 - Very Soft	Trace = 0 to 10%	1. S denotes split-barrel sampler.	7. WH denotes weight of hammer
5 to 10 - Loose	3 to 4 - Soft	Little = 10 to 20%	2. ST denotes 3-inch O.D. undisturbed sample.	8. WR denotes weight of rods
11 to 30 - Medium Dense	5 to 8 - Medium Stiff	Some = 20 to 35%	3. UO denotes 3-inch Osterberg undisturbed sample.	9. PP denotes Pocket Penetrometer.
31 to 50 - Dense	9 to 15 - Stiff	And = 35 to 50%	4. PEN denotes penetration length of sampler.	10. FVST denotes field vane shear test.
Over 50 - Very Dense	16 to 30 - Very Stiff		5. REC denotes recovered length of sample.	11. RQD denotes Rock Quality Designation.
	Over 30 - Hard		6. SPT denotes Standard Penetration Test.	12. C denotes core run number.

FIELD NOTES: 1) Stratification lines represent approximate boundaries between soil types, transitions may be gradual.
2) Water level readings have been made at times and under conditions stated, fluctuations may occur due to other factors.
3) Auger chatter observed from about 5 to 10.5 feet below ground surface on inferred cobbles/boulders.
5) Auger refusal encountered at about 10.5 feet below ground surface on inferred bedrock.

DOWN TO EARTH CONSULTING, LLC
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERING

PROJECT
HAMDEN SOLAR ONE
360 GAYLORD MOUNTAIN ROAD
HAMDEN, CONNECTICUT

BORING NO. B-3
SHEET 1 of 1
FILE NO. 0032-032.00
CHKD. BY RPJ

Boring Co.	General Borings, Inc.	Boring Location	See Boring Location Plan		
Driller	Tom McGovern	Ground Surface El.	Not Available	Datum	Not Available
Logged By	Mateusz Fekieta	Date Start	4/21/2020	Date End	4/21/2020

Hammer Type:	Safety Hammer
Sampler Size:	1-3/8" I.D. Split Spoon
Type Drill Rig:	Track
Drilling Method:	3.25-inch I.D. Hollow-Stem Augers

Groundwater Readings (from ground surface)

Date	Time	Depth (ft)	Elev.	Stabilization Time
4/21/20	-	2	-	wet sample
4/21/20	-	2	-	end of drilling

DEPTH	Casing Blows (ft)	SAMPLE INFORMATION Type & No.	REC/PEN (inches)	DEPTH (feet)	BLOWS PER 6 INCHES	Core Time (min./ft)	SAMPLE DESCRIPTION	STRATA DESCRIPTION
1		S-1	12/24	0 to 2	1-2-2-2		Very loose, Top 5" dark brown Topsoil Bottom 7" red-brown SILT and fine to medium SAND, trace (-) Roots	12"+/- Topsoil/ Forest Debris
2								SUBSOIL
3		S-2	9/23	2 to 3.9	4-14-29-50/5"		Dense, reddish brown fine to coarse SAND, some fine to coarse Gravel, little Silt	
4								
5								GLACIAL TILL
6		S-3	0/5	5 to 5.4	50/5"		Very dense, No Recovery	
7								
8		S-4	0/0	8 to 8	50/0"		Very dense, No Recovery	
9							END OF EXPLORATION AT 8 FEET BELOW GROUND SURFACE	
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SPT N-Values	SPT N-Values	Proportions	SYMBOL KEY	
0 to 4 - Very Loose	0 to 2 - Very Soft	Trace = 0 to 10%	1. S denotes split-barrel sampler.	7. WH denotes weight of hammer
5 to 10 - Loose	3 to 4 - Soft	Little = 10 to 20%	2. ST denotes 3-inch O.D. undisturbed sample.	8. WR denotes weight of rods
11 to 30 - Medium Dense	5 to 8 - Medium Stiff	Some = 20 to 35%	3. UO denotes 3-inch Osterberg undisturbed sample.	9. PP denotes Pocket Penetrometer.
31 to 50 - Dense	9 to 15 - Stiff	And = 35 to 50%	4. PEN denotes penetration length of sampler.	10. FVST denotes field vane shear test.
Over 50 - Very Dense	16 to 30 - Very Stiff		5. REC denotes recovered length of sample.	11. RQD denotes Rock Quality Designation.
	Over 30 - Hard		6. SPT denotes Standard Penetration Test.	12. C denotes core run number.

FIELD NOTES: 1) Stratification lines represent approximate boundaries between soil types, transitions may be gradual.
2) Water level readings have been made at times and under conditions stated, fluctuations may occur due to other factors.
3) Auger chatter observed from about 5 to 8 feet below ground surface (fbg) on inferred boulders/possible decomposed rock.
4) Auger refusal encountered at about 8 fbg. Boring relocated about 5 feet east and redrilled.
5) Auger refusal encountered again at 8 fbg on inferred boulders/possible bedrock. Boring terminated.

DOWN TO EARTH CONSULTING, LLC
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERING

PROJECT
HAMDEN SOLAR ONE
360 GAYLORD MOUNTAIN ROAD
HAMDEN, CONNECTICUT

BORING NO. B-4
SHEET 1 of 1
FILE NO. 0032-032.00
CHKD. BY RPJ

Boring Co.	General Borings, Inc.	Boring Location	See Boring Location Plan		
Driller	Tom McGovern	Ground Surface El.	Not Available	Datum	Not Available
Logged By	Mateusz Fekieta	Date Start	4/21/2020	Date End	4/21/2020

Hammer Type:	Safety Hammer
Sampler Size:	1-3/8" I.D. Split Spoon
Type Drill Rig:	Track
Drilling Method:	3.25-inch I.D. Hollow-Stem Augers

Groundwater Readings (from ground surface)

Date	Time	Depth (ft)	Elev.	Stabilization Time
4/21/20	5:30 PM	3	-	end of drilling (inferred perched)

DEPTH	Casing Blows (ft)	SAMPLE INFORMATION Type & No.	REC/PEN (inches)	DEPTH (feet)	BLOWS PER 6 INCHES	Core Time (min./ft)	SAMPLE DESCRIPTION	STRATA DESCRIPTION
1		S-1	12/24	0 to 2	1-2-1-1		Very loose, brown SILT and fine to medium SAND, trace fine Gravel, trace (-) Roots	12"+/- Topsoil/ Forest Debris
2								SUBSOIL
3		S-2	8/24	2 to 4	12-15-18-28		Dense, brown fine to coarse SAND and SILT, little fine Gravel, wet	GLACIAL TILL
4								
5								
6		S-3	1/1	5 to 5.1	50/1"		Very dense, one-inch fractured GRAVEL fragment	DECOMP. ROCK
7							END OF EXPLORATION AT 6 FEET BELOW GROUND SURFACE	
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SPT N-Values	SPT N-Values	Proportions	SYMBOL KEY	
0 to 4 - Very Loose	0 to 2 - Very Soft	Trace = 0 to 10%	1. S denotes split-barrel sampler.	7. WH denotes weight of hammer
5 to 10 - Loose	3 to 4 - Soft	Little = 10 to 20%	2. ST denotes 3-inch O.D. undisturbed sample.	8. WR denotes weight of rods
11 to 30 - Medium Dense	5 to 8 - Medium Stiff	Some = 20 to 35%	3. UO denotes 3-inch Osterberg undisturbed sample.	9. PP denotes Pocket Penetrometer.
31 to 50 - Dense	9 to 15 - Stiff	And = 35 to 50%	4. PEN denotes penetration length of sampler.	10. FVST denotes field vane shear test.
Over 50 - Very Dense	16 to 30 - Very Stiff		5. REC denotes recovered length of sample.	11. RQD denotes Rock Quality Designation.
	Over 30 - Hard		6. SPT denotes Standard Penetration Test.	12. C denotes core run number.

FIELD NOTES: 1) Stratification lines represent approximate boundaries between soil types, transitions may be gradual.
2) Water level readings have been made at times and under conditions stated, fluctuations may occur due to other factors.
3) Auger chatter observed from about 3 to 6 feet below ground surface on inferred boulders/possible bedrock.
4) Auger refusal encountered at about 6 feet below ground surface on inferred bedrock.

DOWN TO EARTH CONSULTING, LLC
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERING

PROJECT
HAMDEN SOLAR ONE
360 GAYLORD MOUNTAIN ROAD
HAMDEN, CONNECTICUT

BORING NO. B-5
SHEET 1 of 1
FILE NO. 0032-032.00
CHKD. BY RPJ

Boring Co.	General Borings, Inc.	Boring Location	See Boring Location Plan		
Driller	Tom McGovern	Ground Surface El.	Not Available	Datum	Not Available
Logged By	Mateusz Fekieta	Date Start	4/21/2020	Date End	4/21/2020

Hammer Type:	Safety Hammer
Sampler Size:	1-3/8" I.D. Split Spoon
Type Drill Rig:	Track
Drilling Method:	3.25-inch I.D. Hollow-Stem Augers

Groundwater Readings (from ground surface)

Date	Time	Depth (ft)	Elev.	Stabilization Time
4/21/20	4:30 PM	2	-	end of drilling (perched)

DEPTH	Casing Blows (ft)	SAMPLE INFORMATION Type & No.	REC/PEN (inches)	DEPTH (feet)	BLOWS PER 6 INCHES	Core Time (min./ft)	SAMPLE DESCRIPTION	STRATA DESCRIPTION
1		S-1	13/24	0 to 2	2-1-1-1		Very loose, brown SILT and fine to coarse SAND, trace Roots, moist	12"+/- Topsoil/ Forest Debris
2								SUBSOIL
3		S-2	15/22	2 to 3.8	17-41-58-50/4"		Very dense, red-brown fine to coarse SAND, some Silt, little fine Gravel	
4								GLACIAL TILL
5		S-3	5/5	5 to 5.4	60/5"		Very dense, red-brown fine to coarse SAND and GRAVEL, little Silt, with decomposed rock fragments at sample tip	
6								
7							END OF EXPLORATION AT 6 FEET BELOW GROUND SURFACE	
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SPT N-Values	SPT N-Values	Proportions	SYMBOL KEY	
0 to 4 - Very Loose	0 to 2 - Very Soft	Trace = 0 to 10%	1. S denotes split-barrel sampler.	7. WH denotes weight of hammer
5 to 10 - Loose	3 to 4 - Soft	Little = 10 to 20%	2. ST denotes 3-inch O.D. undisturbed sample.	8. WR denotes weight of rods
11 to 30 - Medium Dense	5 to 8 - Medium Stiff	Some = 20 to 35%	3. UO denotes 3-inch Osterberg undisturbed sample.	9. PP denotes Pocket Penetrometer.
31 to 50 - Dense	9 to 15 - Stiff	And = 35 to 50%	4. PEN denotes penetration length of sampler.	10. FVST denotes field vane shear test.
Over 50 - Very Dense	16 to 30 - Very Stiff		5. REC denotes recovered length of sample.	11. RQD denotes Rock Quality Designation.
	Over 30 - Hard		6. SPT denotes Standard Penetration Test.	12. C denotes core run number.

FIELD NOTES: 1) Stratification lines represent approximate boundaries between soil types, transitions may be gradual.
2) Water level readings have been made at times and under conditions stated, fluctuations may occur due to other factors.
3) Auger chatter observed from about 3 to 6 feet below ground surface on inferred cobbles/boulders.
4) Auger refusal encountered at about 6 feet below ground surface on inferred bedrock.

DOWN TO EARTH CONSULTING, LLC
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERING

PROJECT
HAMDEN SOLAR ONE
360 GAYLORD MOUNTAIN ROAD
HAMDEN, CONNECTICUT

BORING NO. B-6
SHEET 1 of 1
FILE NO. 0032-032.00
CHKD. BY RPJ

Boring Co.	General Borings, Inc.	Boring Location	See Boring Location Plan		
Driller	Tom McGovern	Ground Surface El.	Not Available	Datum	Not Available
Logged By	Mateusz Fekieta	Date Start	4/21/2020	Date End	4/21/2020

Hammer Type:	Safety Hammer
Sampler Size:	1-3/8" I.D. Split Spoon
Type Drill Rig:	Track
Drilling Method:	3.25-inch I.D. Hollow-Stem Augers

Groundwater Readings (from ground surface)

Date	Time	Depth (ft)	Elev.	Stabilization Time
4/21/20	-	5	-	wet rods

DEPTH	Casing Blows (ft)	SAMPLE INFORMATION Type & No.	REC/PEN (inches)	DEPTH (feet)	BLOWS PER 6 INCHES	Core Time (min./ft)	SAMPLE DESCRIPTION	STRATA DESCRIPTION
1		S-1	7/24	0 to 2	1-2-2-4		Very loose, Top 2" dark brown Topsoil Bottom 5" brown fine to coarse SAND and SILT, little fine Gravel, moist	8"+/- Topsoil/ Forest Debris
2								SUBSOIL
3		S-2	0/2	2 to 4	50/2"		Very dense, No Recovery	
4								
5								GLACIAL TILL
6		S-3	12/24	5 to 7	64-51-59-50/3"		Very dense, red-brown fine to coarse SAND, some fine to coarse GRAVEL, trace Silt, moist	
7								
8		S-4	1/1	7.5 to 7.6	50/1"		Very dense, one-inch fractured GRAVEL fragment	DECOMP. ROCK
9							END OF EXPLORATION AT 7.6 FEET BELOW GROUND SURFACE	
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SPT N-Values	SPT N-Values	Proportions	SYMBOL KEY	
0 to 4 - Very Loose	0 to 2 - Very Soft	Trace = 0 to 10%	1. S denotes split-barrel sampler.	7. WH denotes weight of hammer
5 to 10 - Loose	3 to 4 - Soft	Little = 10 to 20%	2. ST denotes 3-inch O.D. undisturbed sample.	8. WR denotes weight of rods
11 to 30 - Medium Dense	5 to 8 - Medium Stiff	Some = 20 to 35%	3. UO denotes 3-inch Osterberg undisturbed sample.	9. PP denotes Pocket Penetrometer.
31 to 50 - Dense	9 to 15 - Stiff	And = 35 to 50%	4. PEN denotes penetration length of sampler.	10. FVST denotes field vane shear test.
Over 50 - Very Dense	16 to 30 - Very Stiff		5. REC denotes recovered length of sample.	11. RQD denotes Rock Quality Designation.
	Over 30 - Hard		6. SPT denotes Standard Penetration Test.	12. C denotes core run number.

FIELD NOTES: 1) Stratification lines represent approximate boundaries between soil types, transitions may be gradual.
2) Water level readings have been made at times and under conditions stated, fluctuations may occur due to other factors.
3) Auger chatter observed from about 2 to 7.5 feet below ground surface on inferred cobbles/boulders.
4) Auger refusal encountered at about 7.5 feet below ground surface on inferred bedrock.

APPENDIX 3 -

LABORATORY TEST RESULTS

THIELSCH ENGINEERING
195 Frances Avenue
Cranston RI, 02910
Phone: (401)-467-6454
Fax: (401)-467-2398
thielsch.com
Let's Build a Solid Foundation

Client Information:
Down to Earth Consulting, LLC
Naugatuck, CT
PM: Ray Janeiro
Assigned By: Ray Janeiro
Collected By: Client

Project Information:
Hamden Solar One
Hamden, CT
DTE Project Number: 0032-032.00
Summary Page: 2 of 2
Report Date: 05.15.2020

LABORATORY TESTING DATA SHEET, Report No.: 7420-E-106 Rev.1

Boring ID	Sample No.	Depth (ft)	Laboratory No.	Identification Tests								Proctor / Thermal Resistivity								Laboratory Log and Soil Description
				As Received Water Content %	LL %	PL %	Gravel %	Sand %	Fines %	Org. %	G_s	Dry unit wt. pcf	Test Water Content %	γ_d MAX (pcf) W_{opt} (%)	γ_d MAX (pcf) W_{opt} (%) (Corr.)	Target Test Setup as % of Proctor	Thermal Resistivity Optimum (°C*cm/W)	Thermal Resistivity Mid Point (°C*cm/W)	Thermal Resistivity Oven Dried (°C*cm/W)	
				D2216	D4318		D6913			D2974	D854			D1557			D5334			
B-2	Grab	3	20-S-1202				5.1	67.9	27.0			128.8	7.4	135.5 / 7.7	NA	95	46.03	64.52	122.43	Red-Brown silty sand
B-2	Grab	3	20-S-1202b									113.7	8.9			85	53.98	62.66	191.61	Red-Brown silty sand
B-5	S-2	2-3.8	20-S-1263				14.2	60.3	25.5											Red-Brown silty sand

Date Received: *05.05.2020*

Reviewed By:

Date Reviewed: *05.15.2020*

THIELSCH ENGINEERING

195 Frances Avenue
Cranston RI, 02910
Phone: (401)-467-6454
Fax: (401)-467-2398
thielsch.com
Let's Build a Solid Foundation

Client Information:
Down to Earth Consulting, LLC
Naugatuck, CT
PM: Ray Janeiro
Assigned By: Ran Janeiro
Collected By: Client

Project Information:
Hamden Solar One
Hamden, CT
DTE Project Number: 0032-032.00
Summary Page: 1 of 1
Report Date: 05.13.2020

LABORATORY TESTING DATA SHEET, Report No.: 7420-E-106

Boring ID	Sample No.	Depth (ft)	Laboratory No.	Identification Tests						Corrosivity Tests								Laboratory Log and Soil Description
				As Received Water Content %	LL %	PL %	Gravel %	Sand %	Fines %	Resitivity (Mohms-cm)	Sulfate (mg/kg)	Chloride (mg/kg)	Sulfide (mg/kg)	Redox Potential (mv)	pH	Electrical Resist. As Received Ohm-cm @ 60°F	Electrial Resist. Saturated Ohm-cm @ 60°F	
				D2216	D4318		D6913			EPA	D4327	D4327	EPA		D4972	G57		
B-4	Grab	0-4	20-S-1200	25.5							19	ND			5.52	68200	64800	Corrosivity Only
B-6	Grab	0-4	20-S-1201	7.9							50	ND			6.82	64200	18600	Corrosivity Only

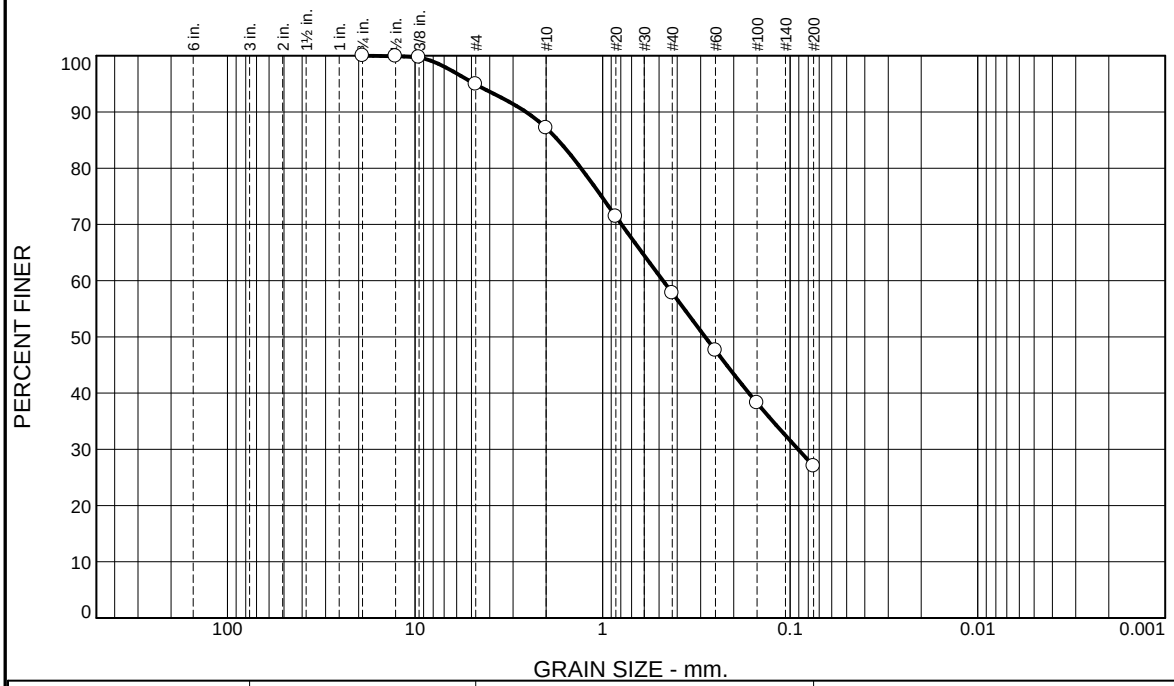
Electrical Resistivity and pH was completed by JM on 05.08.2020

Date Received: *05.05.2020*

Reviewed By:

Date Reviewed: *05.13.2020*

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.1	7.7	29.4	30.8	27.0	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	99.9		
0.375"	99.7		
#4	94.9		
#10	87.2		
#20	71.4		
#40	57.8		
#60	47.6		
#100	38.2		
#200	27.0		

* (no specification provided)

Material Description

Red-Brown silty sand

Atterberg Limits (ASTM D 4318)

PL= 0 **LL=** 0 **PI=** 0

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 2.5584 D_{85}= 1.7266 D_{60}= 0.4761
D_{50}= 0.2837 D_{30}= 0.0907 D_{15}=
D_{10}= C_u= C_c=

Remarks

Sample visually classified as plastic. Sample rolled to 1/4".

Date Received: 05.05.2020 **Date Tested:** 05.08.2020

Tested By: RR / MN

Checked By: Steven Accetta

Title: Laboratory Coordinator

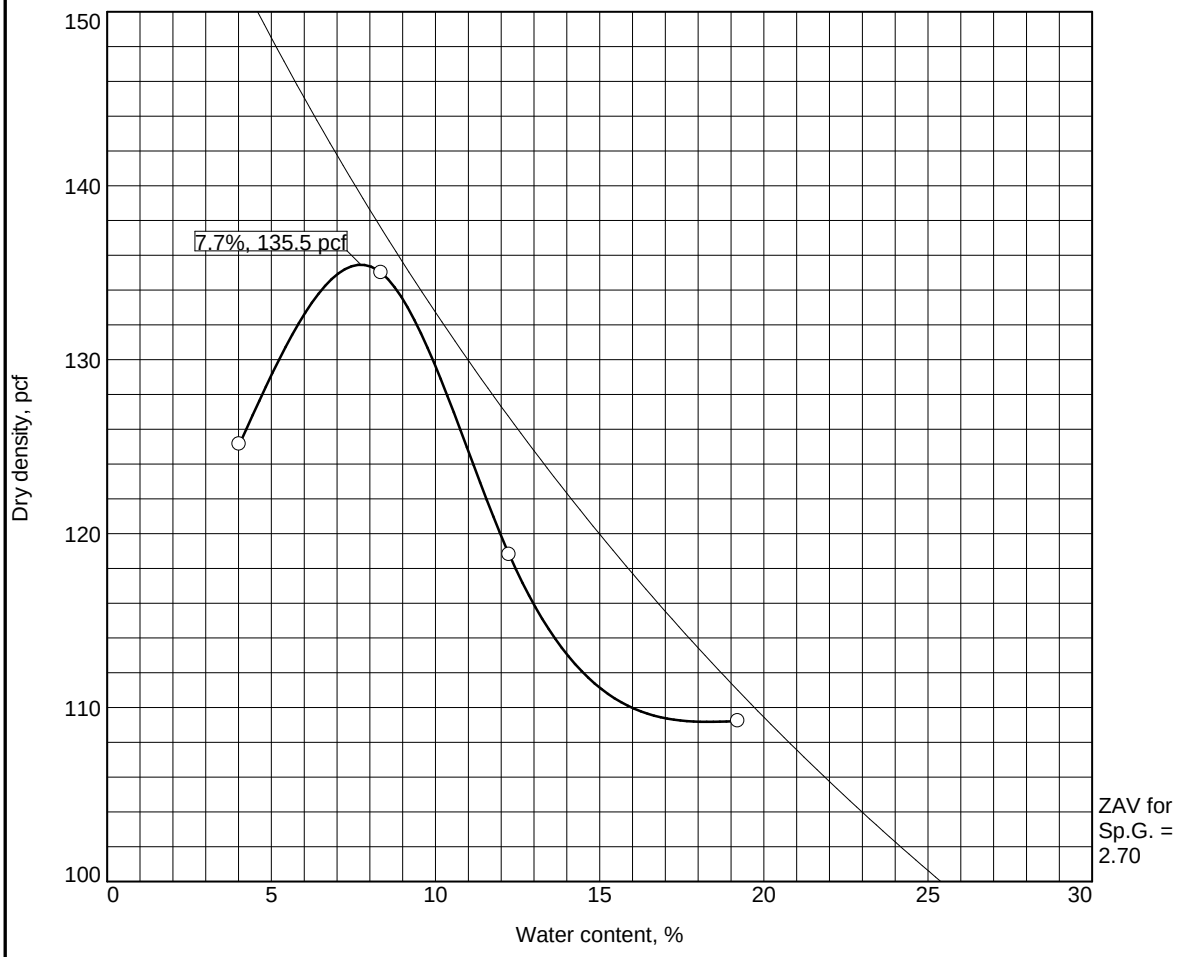
Source of Sample: Boring **Depth:** 3' **Date Sampled:**
Sample Number: B-2

Thielsch Engineering Inc.

Cranston, RI

Client: Down To Earth
Project: Hamden Solar One
Hamden, Ct
Project No: 0032-032.00 **Figure** 20-S-1202

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method B Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
3'	SM	A-2-4(0)		2.7	0	0	0.3	27.0

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 135.5 pcf Optimum moisture = 7.7 %	Red-Brown silty sand

Project No. 0032-032.00 **Client:** Down To Earth
Project: Hamden Solar One
Hamden, Ct
○**Source of Sample:** Boring **Sample Number:** B-2

Thielsch Engineering Inc.

Cranston, RI

Remarks:

Figure 20-MC-1202

Tested By: MN **Checked By:** Steven Accetta

THIELSCH ENGINEERING

195 Frances Avenue
Cranston RI, 02910
Phone: (401)-467-6454
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Client Information
Down to Earth Consulting, LLC
Naugatuck, CT
Ray Janeiro
ray@downtoearthconsulting.com

Determination of Thermal Conductivity of Soil by Thermal Needle Probe Procedure

ASTM D5334-14

Project Name:	Hamden Solar One	**Thermal Meter:**	TEMPOS
Project Number:	0032.032.00	**Calibration:**	08.09.18
Lab Number:	20-S-1202	**Thermal Probe:**	TR-3 000143
Sample Number:	B-2	**Calibration:**	05.11.2020
Material Source:	Hamden, CT	**Specimen Prep:**	Reconstituted Specimen
Depth:	3"	**Mold Type:**	"B" Proctor
Date:	05.15.2020	**Tested by:** RR	**Reviewed by:** sa

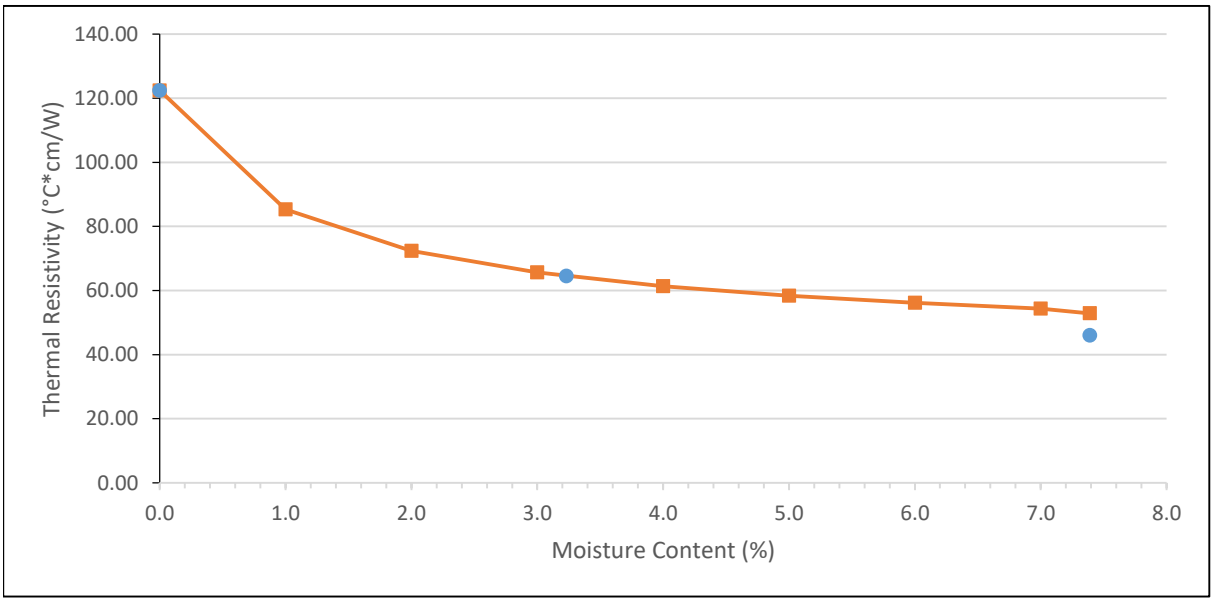
Compaction & Moisture Content Information

Soil Description:	Red-Brown silty sand		
Oversized Material (%):	0.0	Passing #200 Sieve (%):	27.0
Proctor Method:	ASTM D1557 B	Requested % Compaction:	85.00
Maximum Dry Density (pcf):	135.5	Opt. Moisture Content (%):	7.7
Remolded Dry Density (pcf):	128.8	In-situ Moisture Cont. (%):	

Thermal Resistivity Test Results

Moisture Content (%)	Thermal Conductivity (W/m*K)	Thermal Resistivity (°C*cm/W)
3.2	1.5498	64.52
7.4	2.1726	46.03
0.0	0.8168	122.43

Thermal Resistivity Dryout Curve



Test Notes:

Optimum, Mid-Point, and Oven-Dried Test Conditions provided for Dryout Curve.
Maximum particle size used for reconstituted sample was 3/8".

THIELSCH ENGINEERING
195 Frances Avenue
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http://www.thielsch.com

Client Information
Down to Earth Consulting, LLC
Naugatuck, CT
Ray Janeiro
ray@downtoearthconsulting.com

Determination of Thermal Conductivity of Soil by Thermal Needle Probe Procedure
ASTM D5334-14

Project Name:	Hamden Solar One	**Thermal Meter:**	TEMPOS
Project Number:	0032.032.00	**Calibration:**	08.09.18
Lab Number:	20-S-1202b	**Thermal Probe:**	TR-3 000143
Sample Number:	B-2	**Calibration:**	05.11.2020
Material Source:	Hamden, CT	**Specimen Prep:**	Reconstituted Specimen
Depth:	3"	**Mold Type:**	"B" Proctor
Date:	05.15.2020	**Tested by:** RR	**Reviewed by:** sa

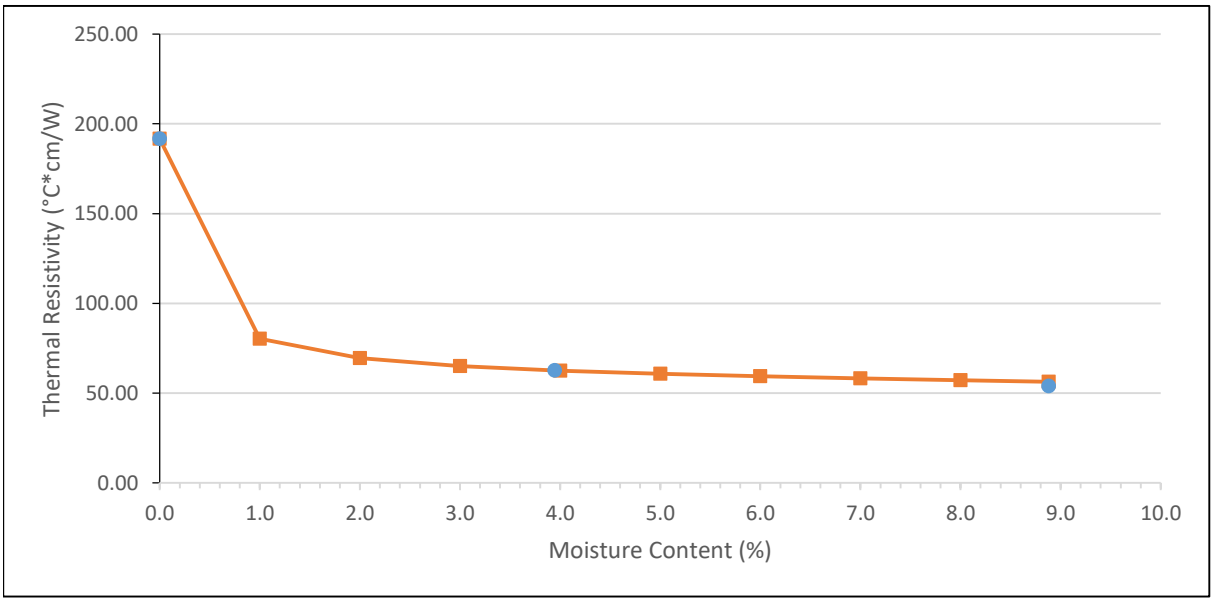
Compaction & Moisture Content Information

Soil Description:	Red-Brown silty sand		
Oversized Material (%):	0	Passing #200 Sieve (%):	27.0
Proctor Method:	ASTM D1557 B	Requested % Compaction:	85.00
Maximum Dry Density (pcf):	135.5	Opt. Moisture Content (%):	7.7
Remolded Dry Density (pcf):	113.7	In-situ Moisture Cont. (%):	

Thermal Resistivity Test Results

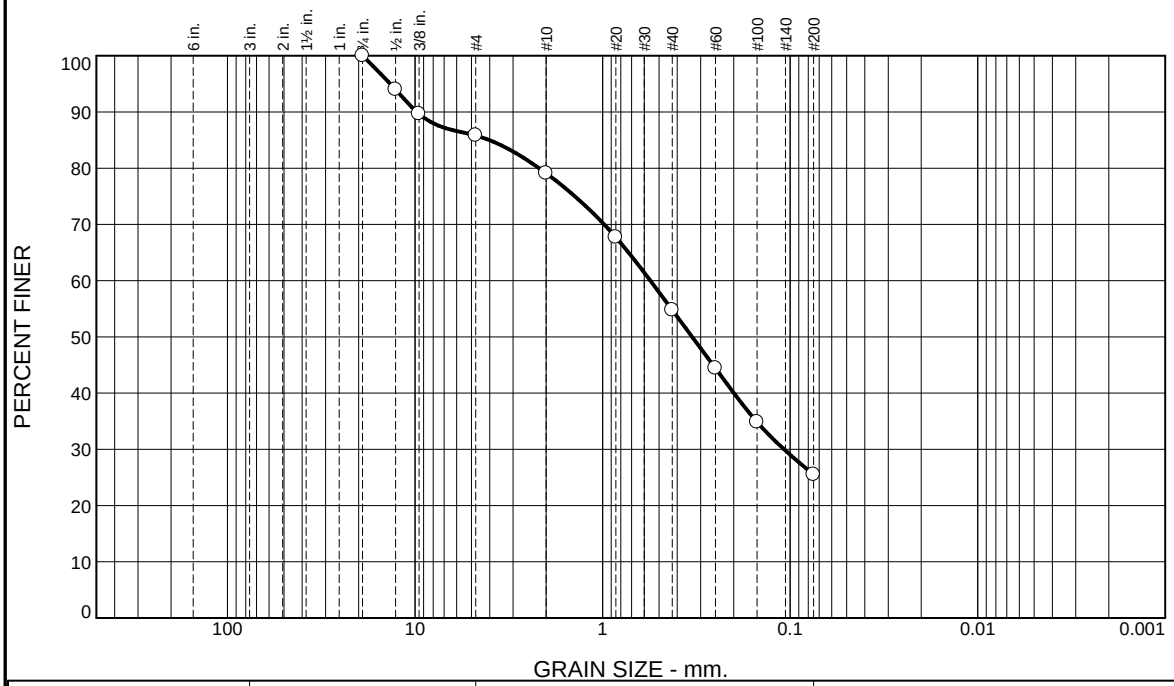
Moisture Content (%)	Thermal Conductivity (W/m*K)	Thermal Resistivity (°C*cm/W)
3.9	1.5958	62.66
8.9	1.8524	53.98
0.0	0.5219	191.61

Thermal Resistivity Dryout Curve



Test Notes:
Optimum, Mid-Point, and Oven-Dried Test Conditions provided for Dryout Curve.
Maximum particle size used for reconstituted sample was 3/8".

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	14.2	6.7	24.3	29.3	25.5	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	94.0		
0.375"	89.7		
#4	85.8		
#10	79.1		
#20	67.7		
#40	54.8		
#60	44.4		
#100	34.9		
#200	25.5		

* (no specification provided)

Material Description

Red-Brown silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 9.7896 D_{85}= 4.0136 D_{60}= 0.5561
D_{50}= 0.3329 D_{30}= 0.1078 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 05.07.2020 **Date Tested:** 05.11.2020

Tested By: JM

Checked By: Steven Accetta

Title: Laboratory Coordinator

Source of Sample: Boring **Depth:** 2-3.8' **Date Sampled:**
Sample Number: B-5 / S-2

Thielsch Engineering Inc.

Cranston, RI

Client: Down To Earth

Project: Hamden Solar One
Hamden, Ct

Project No: 0032-032.00 **Figure** 20-S-1263

CERTIFICATE OF ANALYSIS

Steve Accetta
Thielsch Engineering, Inc.
195 Frances Avenue
Cranston, RI 02910

RE: Hamden Solar One Down to Earth (0032-032.00)
ESS Laboratory Work Order Number: 20E0076

This signed Certificate of Analysis is our approved release of your analytical results. These results are only representative of sample aliquots received at the laboratory. ESS Laboratory expects its clients to follow all regulatory sampling guidelines. Beginning with this page, the entire report has been paginated. This report should not be copied except in full without the approval of the laboratory. Samples will be disposed of thirty days after the final report has been delivered. If you have any questions or concerns, please feel free to call our Customer Service Department.

Laurel Stoddard
Laboratory Director

REVIEWED
By ESS Laboratory at 1:44 pm, May 12, 2020

Analytical Summary
The project as described above has been analyzed in accordance with the ESS Quality Assurance Plan. This plan utilizes the following methodologies: US EPA SW-846, US EPA Methods for Chemical Analysis of Water and Wastes per 40 CFR Part 136, APHA Standard Methods for the Examination of Water and Wastewater, American Society for Testing and Materials (ASTM), and other recognized methodologies. The analyses with these noted observations are in conformance to the Quality Assurance Plan. In chromatographic analysis, manual integration is frequently used instead of automated integration because it produces more accurate results.

The test results present in this report are in compliance with TNI and relative state standards, and/or client Quality Assurance Project Plans (QAPP). The laboratory has reviewed the following: Sample Preservations, Hold Times, Initial Calibrations, Continuing Calibrations, Method Blanks, Blank Spikes, Blank Spike Duplicates, Duplicates, Matrix Spikes, Matrix Spike Duplicates, Surrogates and Internal Standards. Any results which were found to be outside of the recommended ranges stated in our SOPs will be noted in the Project Narrative.

CERTIFICATE OF ANALYSIS

Client Name: Thielsch Engineering, Inc.
Client Project ID: Hamden Solar One Down to Earth

ESS Laboratory Work Order: 20E0076

SAMPLE RECEIPT

The following samples were received on May 05, 2020 for the analyses specified on the enclosed Chain of Custody Record.

The client did not deliver the samples in a cooler.

Lab Number	Sample Name	Matrix	Analysis
20E0076-01	B-4 20-S-1200 0-4ft	Soil	D4327
20E0076-02	B-6 20-S-1201 0-4ft	Soil	D4327

CERTIFICATE OF ANALYSIS

Client Name: Thielsch Engineering, Inc.
Client Project ID: Hamden Solar One Down to Earth ESS Laboratory Work Order: 20E0076

PROJECT NARRATIVE

No unusual observations noted.

End of Project Narrative.

DATA USABILITY LINKS

To ensure you are viewing the most current version of the documents below, please clear your internet cookies for www.ESSLaboratory.com. Consult your IT Support personnel for information on how to clear your internet cookies.

Definitions of Quality Control Parameters

Semivolatile Organics Internal Standard Information

Semivolatile Organics Surrogate Information

Volatile Organics Internal Standard Information

Volatile Organics Surrogate Information

EPH and VPH Alkane Lists

CERTIFICATE OF ANALYSIS

Client Name: Thielsch Engineering, Inc.
Client Project ID: Hamden Solar One Down to Earth

ESS Laboratory Work Order: 20E0076

CURRENT SW-846 METHODOLOGY VERSIONS

Analytical Methods

1010A - Flashpoint
6010C - ICP
6020A - ICP MS
7010 - Graphite Furnace
7196A - Hexavalent Chromium
7470A - Aqueous Mercury
7471B - Solid Mercury
8011 - EDB/DBCP/TCP
8015C - GRO/DRO
8081B - Pesticides
8082A - PCB
8100M - TPH
8151A - Herbicides
8260B - VOA
8270D - SVOA
8270D SIM - SVOA Low Level
9014 - Cyanide
9038 - Sulfate
9040C - Aqueous pH
9045D - Solid pH (Corrosivity)
9050A - Specific Conductance
9056A - Anions (IC)
9060A - TOC
9095B - Paint Filter
MADEP 04-1.1 - EPH
MADEP 18-2.1 - VPH

Prep Methods

3005A - Aqueous ICP Digestion
3020A - Aqueous Graphite Furnace / ICP MS Digestion
3050B - Solid ICP / Graphite Furnace / ICP MS Digestion
3060A - Solid Hexavalent Chromium Digestion
3510C - Separatory Funnel Extraction
3520C - Liquid / Liquid Extraction
3540C - Manual Soxhlet Extraction
3541 - Automated Soxhlet Extraction
3546 - Microwave Extraction
3580A - Waste Dilution
5030B - Aqueous Purge and Trap
5030C - Aqueous Purge and Trap
5035A - Solid Purge and Trap

SW846 Reactivity Methods 7.3.3.2 (Reactive Cyanide) and 7.3.4.1 (Reactive Sulfide) have been withdrawn by EPA. These methods are reported per client request and are not NELAP accredited.

CERTIFICATE OF ANALYSIS

Client Name: Thielsch Engineering, Inc.
Client Project ID: Hamden Solar One Down to Earth
Client Sample ID: B-4 20-S-1200 0-4ft
Date Sampled: 05/05/20 12:00
Percent Solids: 80

ESS Laboratory Work Order: 20E0076
ESS Laboratory Sample ID: 20E0076-01
Sample Matrix: Soil

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Chloride	**WL** ND (6)		D4327		1	EEM	05/06/20 13:44	mg/kg dry	DE00616
Sulfate	**WL 19** (6)		D4327		1	EEM	05/06/20 13:44	mg/kg dry	DE00616

CERTIFICATE OF ANALYSIS

Client Name: Thielsch Engineering, Inc.
Client Project ID: Hamden Solar One Down to Earth
Client Sample ID: B-6 20-S-1201 0-4ft
Date Sampled: 05/05/20 12:00
Percent Solids: 93

ESS Laboratory Work Order: 20E0076
ESS Laboratory Sample ID: 20E0076-02
Sample Matrix: Soil

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Chloride	**WL** ND (5)		D4327		1	EEM	05/06/20 14:34	mg/kg dry	DE00616
Sulfate	**WL 50** (5)		D4327		1	EEM	05/06/20 14:34	mg/kg dry	DE00616

CERTIFICATE OF ANALYSIS

Client Name: Thielsch Engineering, Inc.
Client Project ID: Hamden Solar One Down to Earth

ESS Laboratory Work Order: 20E0076

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch DE00616 - General Preparation										
Blank										
Chloride	ND	0.5	mg/kg wet							
Sulfate	ND	0.5	mg/kg wet							
LCS										
Chloride	10		mg/L	10.00		97	85-115			
Sulfate	10		mg/L	10.00		98	80-120			

CERTIFICATE OF ANALYSIS

Client Name: Thielsch Engineering, Inc.
Client Project ID: Hamden Solar One Down to Earth ESS Laboratory Work Order: 20E0076

Notes and Definitions

WL	Results obtained from a deionized water leach of the sample.
U	Analyte included in the analysis, but not detected
ND	Analyte NOT DETECTED at or above the MRL (LOQ), LOD for DoD Reports, MDL for J-Flagged Analytes
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
MDL	Method Detection Limit
MRL	Method Reporting Limit
LOD	Limit of Detection
LOQ	Limit of Quantitation
DL	Detection Limit
I/V	Initial Volume
F/V	Final Volume
§	Subcontracted analysis; see attached report
1	Range result excludes concentrations of surrogates and/or internal standards eluting in that range.
2	Range result excludes concentrations of target analytes eluting in that range.
3	Range result excludes the concentration of the C9-C10 aromatic range.
Avg	Results reported as a mathematical average.
NR	No Recovery
[CALC]	Calculated Analyte
SUB	Subcontracted analysis; see attached report
RL	Reporting Limit
EDL	Estimated Detection Limit
MF	Membrane Filtration
MPN	Most Probably Number
TNTC	Too numerous to Count
CFU	Colony Forming Units

CERTIFICATE OF ANALYSIS

Client Name: Thielsch Engineering, Inc.
Client Project ID: Hamden Solar One Down to Earth

ESS Laboratory Work Order: 20E0076

ESS LABORATORY CERTIFICATIONS AND ACCREDITATIONS

ENVIRONMENTAL

Rhode Island Potable and Non Potable Water: LAI00179
http://www.health.ri.gov/find/labs/analytical/ESS.pdf

Connecticut Potable and Non Potable Water, Solid and Hazardous Waste: PH-0750
http://www.ct.gov/dph/lib/dph/environmental_health/environmental_laboratories/pdf/OutofStateCommercialLaboratories.pdf

Maine Potable and Non Potable Water, and Solid and Hazardous Waste: RI00002
http://www.maine.gov/dhhs/mecdc/environmental-health/dwp/partners/labCert.shtml

Massachusetts Potable and Non Potable Water: M-RI002
http://public.dep.state.ma.us/Labcert/Labcert.aspx

New Hampshire (NELAP accredited) Potable and Non Potable Water, Solid and Hazardous Waste: 2424
http://des.nh.gov/organization/divisions/water/dwgb/nhelap/index.htm

New York (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: 11313
http://www.wadsworth.org/labcert/elap/comm.html

New Jersey (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: RI006
http://datamine2.state.nj.us/DEP_OPRA/OpraMain/pi_main?mode=pi_by_site&sort_order=PI_NAMEA&Select+a+Site:=58715

United States Department of Agriculture Soil Permit: P330-12-00139

Pennsylvania: 68-01752
http://www.dep.pa.gov/Business/OtherPrograms/Labs/Pages/Laboratory-Accreditation-Program.aspx

ESS Laboratory Sample and Cooler Receipt Checklist

Client: Thielsch Engineering, Inc - ESS

Shipped/Delivered Via: Client

ESS Project ID: 20E0076
Date Received: 5/5/2020
Project Due Date: 5/12/2020
Days for Project: 5 Day

1. Air bill manifest present? No
   Air No.: NA
2. Were custody seals present? No
3. Is radiation count <100 CPM? Yes
4. Is a Cooler Present? No
   Temp: 20.4 Iced with: Ice
5. Was COC signed and dated by client? Yes
6. Does COC match bottles? Yes
7. Is COC complete and correct? Yes
8. Were samples received intact? Yes
9. **Were labs informed about short holds & rushes?** Yes / No (NA)
10. Were any analyses received outside of hold time? Yes (No)

11. Any Subcontracting needed? Yes / (No)
    ESS Sample IDs:
    Analysis:
    TAT:
12. Were VOAs received? Yes / (No)
    a. Air bubbles in aqueous VOAs? Yes / No
    b. Does methanol cover soil completely? Yes / No / NA
13. Are the samples properly preserved? (Yes) / No
    a. If metals preserved upon receipt: Date: Time: By:
    b. Low Level VOA vials frozen: Date: Time: By:

Sample Receiving Notes:

14. Was there a need to contact Project Manager? Yes / (No)
    a. Was there a need to contact the client? Yes / No
    Who was contacted? Date: Time: By:

Sample Number	Container ID	Proper Container	Air Bubbles Present	Sufficient Volume	Container Type	Preservative	Record pH (Cyanide and 608 Pesticides)
1	38737	Yes	N/A	Yes	8 oz jar	NP	
2	38738	Yes	N/A	Yes	8 oz jar	NP	

2nd Review
Were all containers scanned into storage/lab? Initials ~~SA~~
Are barcode labels on correct containers? (Yes) / No
Are all Flashpoint stickers attached/container ID # circled? Yes / No / NA
Are all Hex Chrome stickers attached? Yes / No / NA
Are all QC stickers attached? Yes / No / NA
Are VOA stickers attached if bubbles noted? Yes / No / NA

Completed By: Date & Time: 5/5/20 1541
Reviewed By: Date & Time: 5/5/20 1559
Delivered By: 5/5/20 1559

ESS Laboratory

Division of Thielsch Engineering, Inc.
185 Frances Avenue, Cranston, RI 02910-2211
Tel. (401) 461-7181 Fax (401) 461-4486
www.esslaboratory.com

CHAIN OF CUSTODY

ESS LAB PROJECT ID: 2002076

Turn Time: Standard X Rush _____ Approved By: _____

Reporting Limits -

State where samples were collected: CT

Is this project for any of the following: (please circle)
MA-MCP CT-RCP RGP DOD Other_____

Electonic Deliverable Yes_X_ No____
Format: Excel___ Access___ PDF_X_ Other_____

Project Manager: Steve Accetta
Company: Thielsch Engineering
Address: 195 Frances Ave
Cranston, RI 02910

Project # 0032-032.00

Project Name / Client Name:
Hamden Solar One
Down to Earth

Contract Pricing __x___
Special Pricing WO#: _____

ESS Lab Sample ID	Date	Collection Time	Grab -G Composite-C	Matrix	Sample Identification	# of Container	Analysis: Sulfate (D4327)	Analysis: Chloride (D4327)									Comment #
1	05.05.2020	12:00	G	S	B-4, 20-S-1200, 0-4'	1	X	X									
2	05.05.2020	12:00	G	S	B-6, 20-S-1201, 0-4'	1	X	X									
Preservation Code: 1-NP, 2-HCl, 3-H2SO4, 4-HNO3, 5-NaOH, 6-MeOH, 7-Asorbic Acid, 8-ZnAct, 9-_CH_3OH____							1	1									
Container Type: P-Poly G-Glass AG-Amber Glass S-Sterile V-VOA							AG	AG									

Matrix: S-Soil SD-Solid D-Sludge WW-Wastewater GW-Groundwater SW-Surface Water DW-Drinking Water O-Oil W-Wipes F-Filter

Cooler Present _____Yes __V__No
Seals Intact _____Yes _____No NA: V
Cooler Temperature: 20.4

Sampled by : J. McDaniel

Comments: Please send report to: Rroth@thielsch.com, Saccetta@thielsch.com, mcolman@thielsch.com

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
05.05.2020		5/5/20 1436			

Please E-mail all changes to Chain of Custody in writing.

Page ____ of ____

APPENDIX 4 -

KOZENY-CARMAN ANALYSES

Table 1
Kozeny - Carman Analyses
to Estimate Hydraulic Conductivity

Hamden Solar One
Hamden, Connecticut
Project Number: 0032-032.00

Test Boring No.	Sample No.	Sample Depth (ft.)	D_{10} (mm)	Descriptive Density	Est. Relative Density (%)	in-situ void ratio e	in-situ porosity n	Coefficient of Permability k (cm/sec)	Coefficient of Permability k (ft/day)
B-2	S-2	2'-3.8'	0.005	Very Dense	100	0.140	0.12	2.83E-07	8.02E-04

SPT (bl/ ft)	Descriptive Density	Relative Density (%)
0 to 4	Very loose	0 to 15
4 to 10	Loose	15 to 35
10 to 30	Medium Dense	35 to 65
30 to 50	Dense	65 to 85
50 +	Very dense	85 to 100

e_{min}	e_{max}
0.14	0.85

APPENDIX 5 -

LIMITATIONS

LIMITATIONS

Explorations

1. The analyses and recommendations submitted in this report are based in part upon the data obtained from subsurface explorations by Down To Earth Consulting, LLC (DTE) and others. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report.

2. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretations of widely spaced explorations and samples; actual soil transitions are probably more erratic. For specific information, refer to the boring logs.

3. Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, tidal, temperature, and other factors occurring since the time measurements were made.

Review

4. In the event that any changes in the nature, design or location of the proposed solar arrays are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by DTE. It is recommended that this firm be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications.

Construction

5. It is recommended that this firm be retained to provide soil engineering services during construction of the earthworks and foundation phases of the work. This is to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to start of construction.

Use of Report

6. This report has been prepared for the exclusive use of All-Points Technology Corporation, PC for specific application to the project noted in this geotechnical report in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made.

7. This soil and foundation engineering report has been prepared for this project by DTE. This report is for design purposes only and is not sufficient to prepare an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to design considerations only.

8. This report may contain comparative cost estimates for the purpose of evaluating alternative foundation schemes. These estimates may also involve approximate quantity evaluations. It should be noted that quantity estimates may not be accurate enough for construction bids. Since DTE has no control over labor and materials cost and design, the estimates of construction costs have been made on the basis of experience. DTE does not guarantee the accuracy of cost estimates as compared to contractor's bids for construction costs.