



PROJECT NARRATIVE  
VICTORY DRIVE RD SOLAR  
LSE OPHIUCHUS LLC

Prepared on October 9th, 2020

Revised January 15th, 2021

Dear Commission Members:

Lodestar Energy, an experienced solar developer who has developed, as well as owns and operates over 30 energy facilities throughout New England, by and through its affiliate, LSE Ophiuchus LLC, (“Lodestar”) submits this project summary to the Cape Cod Commission (the “Commission”), of the subject project site (the “Project”).

Pursuant to the referral made by the Town of Sandwich Planning Board to the Commission for its review of a Development of Regional Impact, Lodestar is applying to the Commission pursuant to Sections 2, 3 and 5 of Chapter A of the Enabling Regulations of the Code of the Cape Cod Commission Regulations of General Application.

The Project is a culmination of a partnership between Lodestar, an experienced regional solar developer, and the Housing Assistance Corporation of Cape Cod (“HAC”), a vital resource in the region and the owner of the project parcels. HAC originated the idea to develop the property with a solar facility after this location was determined to not be ideal for a planned housing development. The lease revenue from the Project will support HAC’s operations throughout the region, while the site will benefit from a more suitable use in ground-mounted solar. More detailed information on the history of the project site is provided below.

The subject property consists of several placetypes, including Natural Area, Industrial Activity Center, and Suburban Development Area, according to the Commission’s Regional Policy Plan Data Viewer and the site characteristics. Lodestar is proposing to address the Commission’s open space requirements of the Commission through placement of on-site, adjacent land surrounding the Project into permanent conservation.

Lodestar believes that the Project will provide many local and regional benefits, particularly through its a) support of HAC’s operations providing low-income housing in the region b) development of a site in a largely industrial area with substantially cleared acreage already in place c) providing low-impact development that fits in well with the suburban region to the Projects south and east and d) improving and minimizing usage of local infrastructure while creating little traffic. Furthermore, the Project addresses several of the Cape’s stated goals in its Regional Policy Plan, including combating climate change, providing infrastructure for expanding development, and, adding to the supply of year-round housing matching income levels of Cape Cod residents.

### **Updates to Original Submission**

Our site plans, stormwater management plan and this narrative have all been updated after discussion with Cape Cod Commission staff and the Massachusetts Department of Fish and Wildlife (“DPW”). Our site plan has been updated to remove panels from proximity to the transmission right-of-way at the northern edge of the Project. This request was made after recommendations from DPW, given that this area serves as vital habitat for the Eastern Box Turtle. Our site plan shifts some of the array to the east, while maintaining a 350’ buffer between any potential vernal pool and any permanent construction. A shade mitigation area has been

included to ensure annual performance while also providing edge habitat in this area. The total impact is a decrease in the Project's development area.

Additionally, we have included further details on our drainage plan to specify the construction method for our infiltration basin and the seed mix to be used there. We have added a side-view of our vegetated screening method to highlight the limited visual impact of the project to any abutters. We have updated our screening vegetation to a white spruce, rather than the non-native Serbian spruce. We have updated reduced our fenced area from 14.1 to 13.8 acres in order to allow the vegetative screening area to remain outside of the proposed conservation restriction. Finally, we have included correspondence from the Massachusetts Historic Commission documenting that this project is unlikely to affect significant historic or archaeological resources.

## **Project Overview**

Lodestar Energy is proposing the construction of a 2.125 MW/AC ground mounted solar photovoltaic electric generating facility at property located off of Victory Drive in Sandwich, Massachusetts, consisting of three separate parcels known as assessor's parcel #28-042, 28-048 and 28-041 (collectively the "Site"). The Site is comprised of approximately 46.09± acres and is currently owned by HAC. As shown on the plans submitted, approximately 4.03 acres of the site are already disturbed.

Lodestar Energy entered into an option agreement with HAC on June 19, 2019 to lease a portion of Site needed for solar, with the remainder to be placed into conservation. The Project will consist of approximately 12.0 acres of solar panels within a 13.8-acre sized fenced area which comprises the entire leased acreage. Access to the Project will be via a new gravel entrance drive off the existing cul-de-sac at the end of Victory Drive.

Project equipment is expected to consist of 17 SunGrow SG125HV inverters, approximately 11,480 solar panels, and a fixed-tilt racking system from RBI Solar. The Project will also include an energy resilience facility to ensure greater grid reliability. The Site abuts residential properties along Windsor Road, Kensington Drive and Castle Road to the southwest and southeast; additional land of the Housing Assistance Corporation to the northeast including a transmission power line; and developed industrial properties off of Victory Drive and Jan Sebastian Drive to the west and northwest.

Almost all of the proposed solar array will be located in the area previously approved for the development of single-family homes. In addition to the areas previously proposed for the housing development, the solar array will extend slightly to the south (approximately 100 feet), east (approximately 50 feet) and northwest (at the interconnection point for underground trenching) into wooded areas in order to accommodate the solar field, utility interconnection, and a one-time tree cut to prevent shading of the panels. Approximately eleven (11) acres of forest will be cleared and grubbed, with an additional four (4) acres to be converted to transition habitat under our Solar Operations and Maintenance Plan. Vegetation includes scrub pine, native and invasive shrub and other tree species -- the project is located in order to minimize these acres. Approximately four (4) acres will be redeveloped from various existing states of development. Furthermore, in order to minimize areas of disturbance, some vegetation outside of the proposed

security fence, including low growth and any stumps, will not be removed unless it interferes with the installation of the utility connections. Details are included in the Solar Operations and Maintenance Plan.

All disturbed areas will be seeded with a pollinator seed mix to stabilize soils. The planned vegetation in the array is a meadow which is typically seeded with a pollinator friendly wildflower and low-height grass mix. Local species will be used, and no invasive species will be included. No pesticides or chemicals of any kind will be used to manage the meadow. The project maintains a 200ft non-disturbance buffer from the smaller isolated wetlands to the northeast and a 350ft vegetated buffer from the eastern wetlands with potential to be a vernal pool.

The proposed activities associated with the proposed Project do not involve the withdrawal of water, nor the storage or use of oil or hazardous materials (other than what is present in the construction equipment). Thus, the proposed Project is not anticipated to have an impact on any surrounding drinking water supplies. The project lies just outside of the Zone II Wellhead Protection Line and Water Resource Overlay from the Town of Sandwich Zoning.

The Project's location is ideally situated for construction access, as the route along Jan Sebastian is already trafficked by industrial vehicles. The site's access is consistent with RPP plans to improve safety and eliminate hazards for all users of Cape Cod's transportation system. Expected construction timeframe is 4-5 months, during which time construction vehicles will enter and exit the property on most weekdays. Approximately 20-30 tractor-trailer trips will be needed for equipment delivery. Post-construction, traffic will only consist of light-duty pick-up trucks for electric and vegetative maintenance 3-4 times per year. The Project will be permanently accessed via a new driveway off of the cul-de-sac at the end of Victory Drive. The current gravel driveway will be utilized during construction, but will be removed prior to project completion.

The electricity generated at the Site will be transferred via a combination of underground conduits and poles with overhead wires to connect to the existing distribution lines to the north at the cul-de-sac at the end of Jan Sebastian Drive. The Project's delivery of electricity will comply with two RPP objectives, supporting renewable energy development that is context-sensitive and increasing resiliency of energy generation and delivery. Solar naturally produces power at the times of higher system demand during warm summer months. The battery system can handle large output adjustments, allowing it to stabilize the frequency of the local distribution network in the event of a spike or sudden dip in demand. The project will participate in the Community Solar program, which allows households and small commercial businesses in the same utility territory to benefit from the project through electricity-bill savings. This will allow the Project to benefit Cape Cod residents who do not have access to roof-top solar.

The solar panels will be mounted on racks supported by galvanized steel piles that are driven into the ground. Other work associated with the construction of the solar arrays will include creation of an interior gravel access road, installation of utility pads, associated electrical equipment, electrical conduit, conduit supports, electrical poles, overhead wire, and security

fencing. Based on the existing topography, re-grading of the Site will not be required, and the foundation systems can be installed with minimal disturbance. As a result, the existing drainage patterns, which consist of sheet flow to the surrounding depression, will be preserved.

## **Site History**

Almost all of the proposed solar array will be located in the area previously approved for the development of single-family homes by HAC. This involved the construction of 62 housing units, a community garden, market garden, and a mixture of livestock areas were to be constructed. This plan underwent study by the Executive Office of Energy & Environmental Affairs-Division of Conservation Services ("EEA-DCS"). Approximately 30.1 acres of the approximately +/-45.6 acre site was to be protected in perpetuity as open space and State-listed species habitat through an EEADCS-approved Conservation Restriction. A Conservation and Management Permit (the "Permit") was issued to condition the previously-proposed housing development and the project was found to provide a long-term Net Benefit to Eastern Box Turtle (*Terrapene carolina*) through the long-term open space preservation and the protection measures to be taken during construction and maintenance.

HAC's planned housing development in this area would have provided year-round, affordable housing for the Cape Cod's residents. Unfortunately, this project faced opposition and hurdles, and eventually it was determined that this site was not suitable for a housing project. In 2019, HAC made the strategic decision that this site would be better served as a solar development. A solar development addresses several of the concerns that arose during the housing development's planning, including:

- Concerns over residential traffic using Jan Sebastian Drive, which is in an industrial area that may be incompatible with the residential traffic. In contrast, post-construction, the Project will be accessed only 3-4 times per year.
- Concerns from residential abutters to the South and East, who had concerns about noise levels and viewsheds from their backyards. The solar Project will have no noise impacts post-construction, and the permanently conserved vegetated buffer that Lodestar has planned will address any viewshed concerns. The planned setbacks between the Project's boundaries and any housing is similar to that of the surrounding neighborhood's yard-to-yard setbacks, while the arrays have lower heights than most residential structures. Finally, evergreen screening will provide year-round additional viewshed benefits.
- Concerns over use of town infrastructure. Rather than using sewage, electric or gas infrastructure, the Project will provide a benefit through its electric grid stabilization capabilities. As already described, traffic impacts will also be minimal, and much less than the housing proposal.

Not only is a solar field a suitable use for the property, it provides HAC with support for its operations. HAC and Lodestar note the following section of the RPP:

“High demand for housing, by both year-round residents and second-home owners, and low average wages on Cape Cod results in a housing market that is unaffordable for many year

round residents... ...Despite the enactment of Chapter 40B, on average, only 5.3% of the Cape's housing inventory is affordable.”

Here, the lease revenue generated from the Project will enable HAC to better address the housing inventory issues in the region. HAC issued a Request for Proposals from solar developers to competitively bid on the project and maximize benefits to HAC. Lodestar was eventually selected in late 2018, and HAC and Lodestar have been partnering on the project since then.

In addition to the above benefits, this solar array will also maintain the same acreage of open space under the Conservation Restriction as was previously approved under the Permit. Furthermore, Lodestar is coordinating with EEADCS to develop a plan that incorporates the measures from the previous proposal, with adjustments as necessary for a solar field. All of this means that the Project will still result in a net benefit to the Eastern Box Turtle.

### **Open Space Overview**

The Project's location is surrounded on the North by transmission lines and forest, on the East and South by single-family housing, and on the West by industrial facilities. Approximately 1.9 acres of the site is designated as part of one of the Cape's eight Industrial Activity Centers, and just under half of the total site is zoned FLEX under the Town of Sandwich Zoning Bylaw. Another 6.7 acres is designated as a Natural Area placetype. The remainder of the 14 acres of proposed developed is logically classified as Suburban Development areas, given this is the acreage that is in closest proximity to single-family housing along the site's southern and eastern boundaries.

Lodestar's site-plan maintains the Project's boundaries as close to the industrial center as possible, while minimizing the impact on the Natural Areas and encroachment on the surrounding houses. The following is a breakdown of the placetypes and required open space per the technical bulletin:

- **Industrial Activity Center:** 1.61 acres impacted, 1.61 acres open space required
- **Natural Area:** 5.49 developed, 16.47 acres open space required
- **Suburban Development Area:** 4.27 developed, 4.27 acres open space required

The total open space requirement is therefore 22.35 acres. As described above, Lodestar will maintain approximately 30.1 acres of open space under a Conservation Restriction. The majority of this preserved space will be in Natural Areas to the north and northeast of the Project, which lies entirely within NHESP Priority Habitat. A smaller portion of the open space will be allocated to the south and southeast, which will maintain a large natural resource area and a buffer between the Project and its residential abutters.

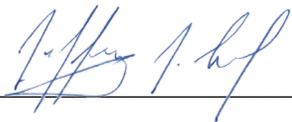
Appendices attached to this narrative are:

- A – Review of Goals and Objectives of the Regional Policy Plan
- B – Natural Resource Inventory, Turtle Management Plan, Operations and Maintenance Plan, and Invasive Species Management Plan

- C – Site Plans and Open Space Plan
- D – Stormwater Report
- E – Filing Fee Calculation
- F – List of Permits and Approvals
- G – Proof and Copy of Submission to Massachusetts Historic Commission
- H – Redacted Lease between Application and HAC, Copy of Deeds
- I – HAC’s “Community Green” Housing Development Plans
- J – Mass Historical Commission Approval

We appreciate your timely attention to this matter, and look forward to working together with you. If you have any questions, please feel free to contact the Project Coordinator, Dan Watson, who can be reached at 405-973-8767 or [dwatson@lodestarenergy.com](mailto:dwatson@lodestarenergy.com).

**LSE OPHIUCHUS LLC**

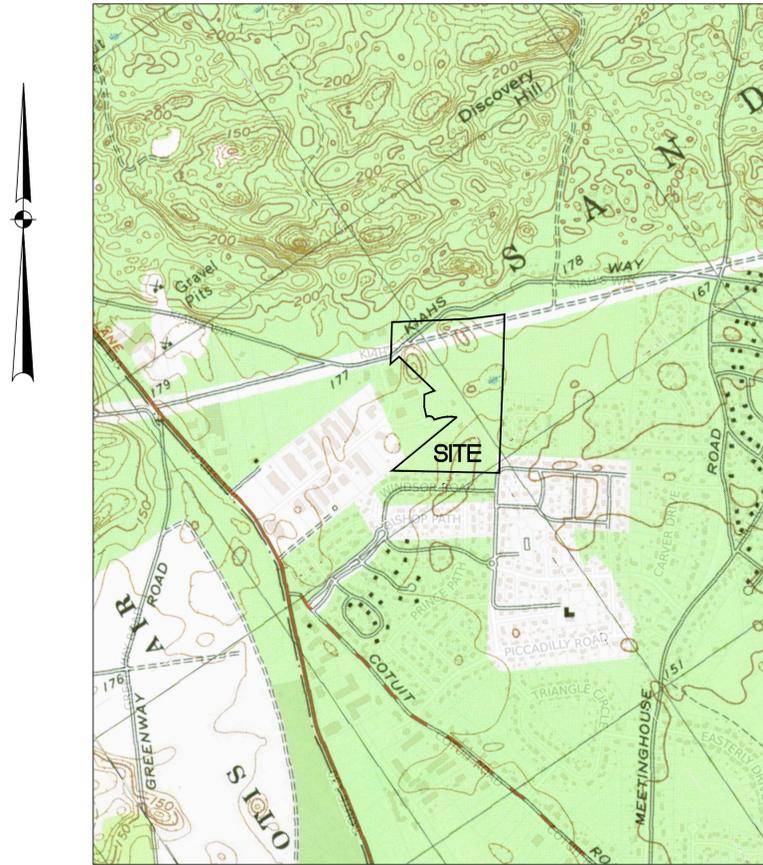
By: 

Jeffrey J. Macel, Manager

Lodestar Energy LLC  
40 Tower Lane, Suite 201  
Avon, CT 06001

# Victory Drive Solar

9 Victory Drive, 0 & 144 Kiah's Way  
Sandwich, MA 02563



SITE LOCUS MAP

1"=1,000'

*Owner*  
**Housing Assistance Corporation**  
460 West Main Street  
Hyannis, MA 02601

*Applicant*  
**Lodestar Energy LLC**  
140 Tower Lane, Suite 145  
Avon, CT 06001



*Prepared By*

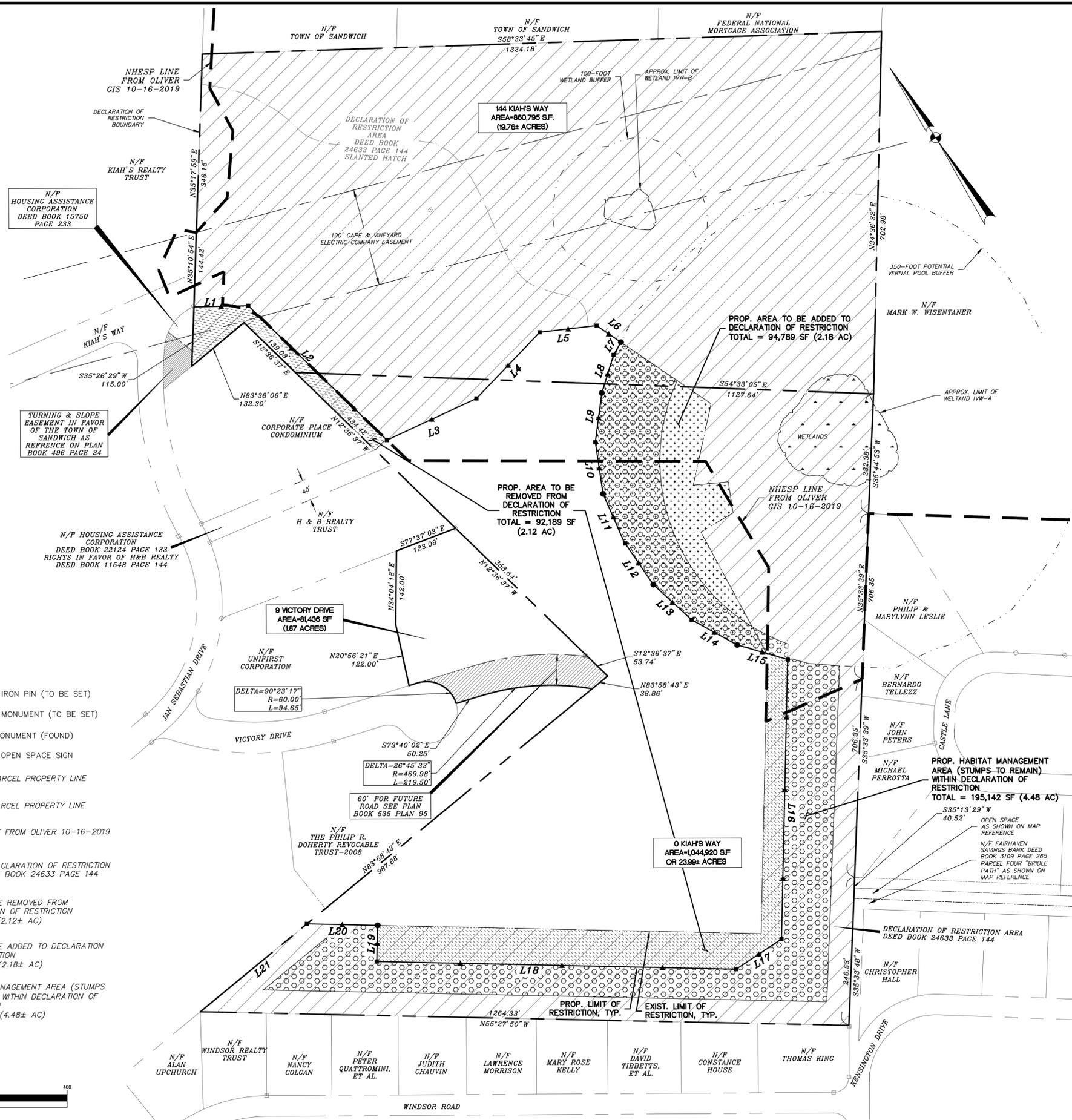


DRAWING INDEX		
SHEET TITLE	SHEET NO.	LATEST REVISION
CIVIL		
COVER SHEET	1 of 7	12-08-20
EXISTING CONDITIONS PLAN	2 of 7	10-2-20
OVERALL SITE PLAN	3 of 7	12-08-20
DEMOLITION PLAN	4 of 7	12-08-20
PROPOSED AMENDMENT TO DFW PERMIT & RESTRICTION	5 of 7	12-08-20
SITE PLAN	6 of 7	12-08-20
DETAILS	7 of 7	12-08-20









**PLAN REFERENCES:**

PLAN BOOK	PAGE
51	103
145	113
250	39
274	3 AND 4
326	63
380	48
389	50
446	64
460	60
496	24
522	57
535	95

PLAN FOUND ON PAGE 263 OF DEED BOOK 24633-144

CERTIFIED PLOT PLAN FOR PROPOSED BARN AT 9 VICTORY DRIVE PREPARED FOR HOUSING ASSISTANCE CORPORATION SANDWICH MASSACHUSETTS JANUARY 27, 2016 BY ATLANTIC DESIGN ENGINEERS, INC.

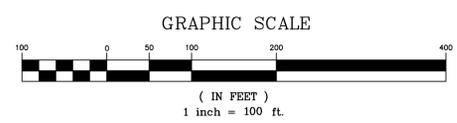
COMMUNITY GREEN PHASE 2 50% DESIGN DEVELOPMENT PLANS SANDWICH MASSACHUSETTS EXISTING CONDITIONS MARCH 2011 SHEET C-3 BY ATLANTIC DESIGN ENGINEERS, LLC

**DEED REFERENCES:**

DEED BOOK	PAGE
13428	191
13431	139
15750	233
24633	144

**LEGEND**

- PROPOSED IRON PIN (TO BE SET)
- PROPOSED MONUMENT (TO BE SET)
- EXISTING MONUMENT (FOUND)
- ▲ PROPOSED OPEN SPACE SIGN
- SUBJECT PARCEL PROPERTY LINE
- ABUTTER PARCEL PROPERTY LINE
- NHESP LINE FROM OLIVER 10-16-2019
- [Diagonal Hatching] EXISTING DECLARATION OF RESTRICTION AREA, DEED BOOK 24633 PAGE 144
- [Cross-hatching] AREA TO BE REMOVED FROM DECLARATION OF RESTRICTION 92,189 SF (2.12± AC)
- [Dotted Pattern] AREA TO BE ADDED TO DECLARATION OF RESTRICTION 94,789 SF (2.18± AC)
- [Stippled Pattern] HABITAT MANAGEMENT AREA (STUMPS TO REMAIN) WITHIN DECLARATION OF RESTRICTION 195,142 SF (4.48± AC)



**CONSERVATION RESTRICTION TABLE**

SEGMENT	BEARING	DISTANCE
L1	S57°53'22"E	105.88'
L2	S12°42'21"E	375.35'
L3	S51°28'55"E	192.27'
L4	N77°10'33"E	178.14'
L5	S63°16'30"E	111.41'
L6	S22°28'46"E	57.29'
L7	S63°29'38"W	28.43'
L8	S50°35'01"W	77.42'
L9	S40°49'01"W	96.12'
L10	S24°53'11"W	101.41'
L11	S09°30'14"W	101.21'
L12	S01°09'50"E	101.19'
L13	S14°14'10"E	101.24'
L14	S27°55'53"E	101.09'
L15	S40°36'30"E	102.33'
L16	S34°35'49"W	542.47'
L17	S90°00'00"W	106.04'
L18	S55°23'24"W	700.18'
L19	N34°33'36"E	70.00'
L20	N55°26'24"W	137.84'
L21	S63°58'43"W	268.76'

TOTAL AREA = 1,313,732 S.F. (30.16 AC.)

- NOTES:**
- The purpose of this plan is to identify the existing lines of NHESP Habitat from Oliver (10/16/2019) and the lines of the existing Declaration of Restriction recorded in Bk 24633, Pg 144, as well as the proposed tree-clearing areas and additional land to be placed under the Restriction as shown hereon;
  - Horizontal datum = NAD83 Massachusetts Mainland;
  - Parcel is not located in a Special Flood Hazard Zone per Flood Insurance Rate Map panel 25001C0526J effective date 7-16-2014;
  - Portion of parcel lies in inland wetlands as shown on Reference Mapping.

RUSSO  
SURVEYORS & ENGINEERS  
SERVING CT & MA

J.R. Russo & Associates, LLC  
11Shaham Rd East Windsor CT 06088 - CT 860.663.0599 - MA 483.780.1858  
www.jrusso.com - jr@jrusso.com

LODESTAR ENERGY

REVISIONS

BY:	CHK:	DATE	DESCRIPTION
RLS	JEU	12-08-20	ADDRESS CCC COMMENTS
		10-2-20	ADDRESS NHESP COMMENTS
		9-23-20	ADJUST FOR 350' POTENTIAL VERNAL POOL SETBACK

PLAN PREPARED FOR

**Lodestar Energy**

LAND OF

**HOUSING ASSISTANCE CORPORATION**

9 VICTORY DR, 0 & 144 KIAH'S WAY

SANDWICH MASS.

TAX ASSESSOR MAP 28 LOTS 41, 42 & 48

PROPOSED

AMENDMENT TO

DFW PERMIT &

RESTRICTION

DATE

2-06-20

SCALE

1"=100'

JOB NUMBER

2019-063

SHEET

5 of 7



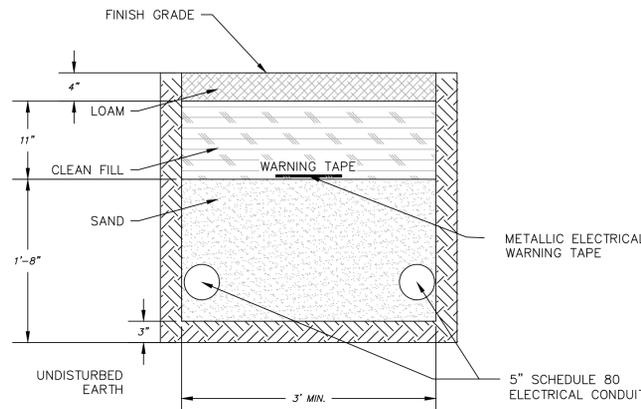
**PROJECT NARRATIVE AND CONSTRUCTION SEQUENCE**

This project is located at the end of Victory Drive in Sandwich, Massachusetts. The proposed activity is the construction of a 2.5± MW AC ground mounted photovoltaic solar facility. The suggested schedule of construction is as follows:

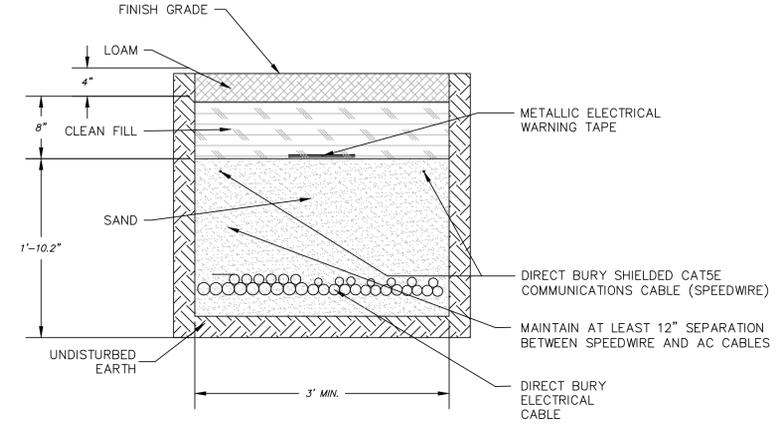
1. Contact the Town of Sandwich prior to the start of construction activities to schedule a pre-construction meeting.
2. Attend a pre-construction meeting to educate the Contractor and on-site personnel on how to identify the eastern box turtle, and measures to be taken if encountered.
3. Install perimeter exclusionary silt fence around the construction envelope as shown on the project plans.
4. Contractor to perform an initial sweep for turtles within the construction envelope and remove turtles found outside of the envelope. Similar sweeps along the perimeter fence shall be conducted by the contractor each day prior to the start of work.
5. Install construction entrance.
6. Stake clearing limits designating areas outside of security fence where stumps are to remain.
7. Clear trees. Grub stumps within proposed security fence. Stumps outside of security fence to remain. Fill stump holes as necessary. Remove brush and debris from the site.
8. Install access roads.
9. Install foundations and solar panels.
10. Install electrical equipment and distribution lines.
11. Install security fence.
12. Seed all disturbed areas with pollinator seed mix to stabilize soils as soon as practical.
13. Remove silt fence after site is fully stabilized.

Construction of this site is anticipated to begin in the Spring of 2020, pending approvals. Site work is anticipated to be completed by November 2020. Temporary erosion control measures shall be installed prior to any soil disturbance and maintained throughout construction until soils have been stabilized with permanent vegetation.

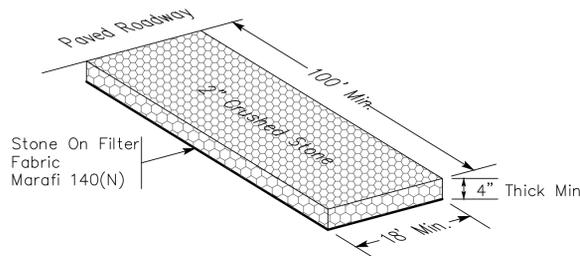
The Contractor shall keep the area of disturbance to a minimum and establish vegetative cover on exposed soils as soon as practical. The developer shall be responsible for the repair/replacement/maintenance of all erosion control measures until all disturbed areas are stabilized. Sediment deposits shall be periodically removed from the upstream sides of silt fence, at a minimum when it reaches a height of six inches. This material is to be spread and stabilized in areas not subject to erosion, or to be used in areas which are not to be paved or built on. Silt fences are to be replaced as necessary to maintain proper filtering action. Silt fence shall remain in place and shall be maintained to insure efficient sediment capture until all areas above the erosion checks are stabilized and vegetation has been established.



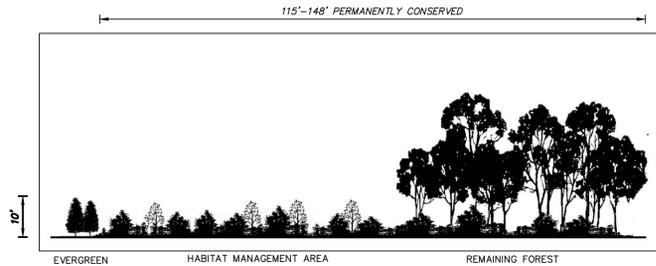
**MEDIUM VOLTAGE CABLE TRENCH DETAIL (MV)**  
NOT TO SCALE



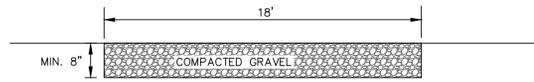
**INVERTER POWER & COMMS CABLE TRENCH DETAIL (INV/C)**  
NOT TO SCALE



**CONSTRUCTION ENTRANCE**  
NOT TO SCALE

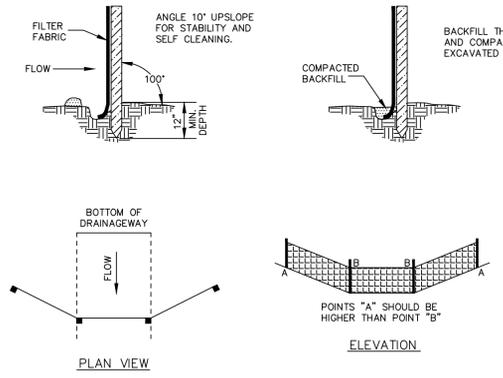


**TYPICAL VEGETATED SECTION**  
NOT TO SCALE



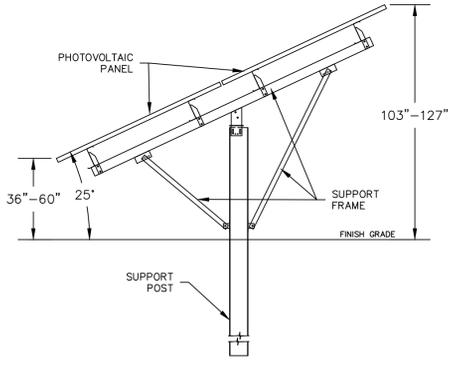
- NOTES:**
1. SUBGRADE SHALL BE EVALUATED IN THE FIELD FOR STABILITY. WHERE SUBGRADE IS WET OR CANNOT BE PROOF ROLLED WITHOUT SIGNIFICANT RUTTING OR MOVEMENT, ADDITIONAL STABILIZATION MEASURES WILL BE REQUIRED AND MAY INCLUDE EXCAVATION & INSTALLATION OF ADDITIONAL GRAVEL AND/OR INSTALLATION OF A GEOTEXTILE AS DIRECTED BY THE ENGINEER.
  2. FINISH GRADE SHALL BE SET SO AS TO MAINTAIN EXISTING SHEET FLOW ACROSS THE DRIVEWAY.

**DRIVEWAY DETAIL**  
NOT TO SCALE



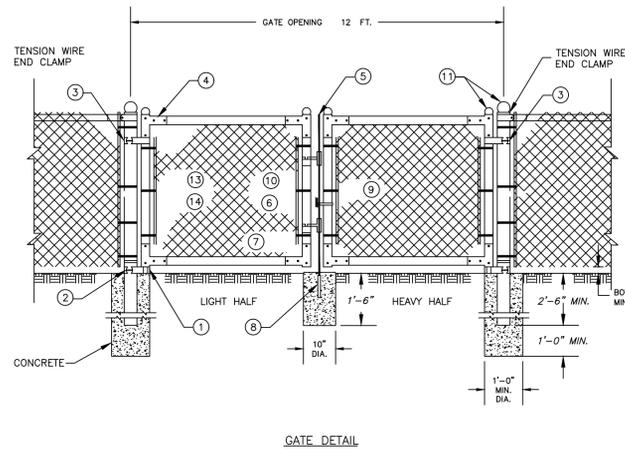
SOURCE: U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, STORRS, CONNECTICUT

**GEOTEXTILE SILT FENCE**  
NOT TO SCALE



NOTE: NOT FOR CONSTRUCTION. SEE SPECIFIC POST & RACKING SYSTEM PLANS BY OTHERS.

**TYPICAL RACKING ELEVATION**  
NOT TO SCALE

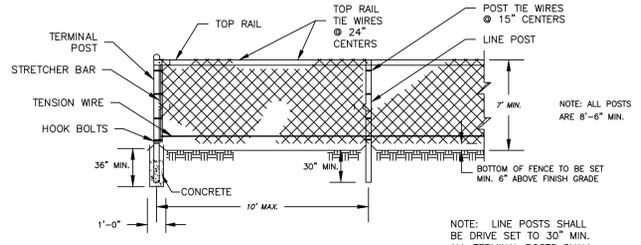


**LEGEND**

PART NO.	DESCRIPTION	QUANTITY
1	STRAIGHT PLUG	2
2	BOTTOM HINGE	2
3	TOP HINGE	2
4	CORNER ELBOW	8
5	PLUNGER ROD	1
6	LATCH FORK	2
7	FORK CATCH	2
8	PLUNGER ROD CATCH	1
9	LOCK KEEPER GUIDE	1
10	LOCK KEEPER	1
11	ORNAMENTAL TOPS	6
12	TRUSS RODS	4
13	STRETCHER BAR	4
14	HOOK BOLTS	12

NOTE: THE FENCING SHALL BE #9 GAGE FENCE FABRIC, STANDARD 2-INCH CHAIN LINK DIAMOND MESH.

**CHAIN LINK FENCE DETAIL**  
NOT TO SCALE



**SHAPE, SIZE AND WEIGHT REQUIREMENTS FOR FENCE POSTS AND RAILS**

ITEM	SHAPE	OUTSIDE DIMENSIONS INCHES	WEIGHT LBS./LIN. FT.
**	ROUND	2.375	3.65
TERMINAL POSTS	*ROUND	2.375	3.12
LINE POSTS	ROUND	1.90	2.72
POSTS	*ROUND	1.90	2.28
TOP & BRACE RAILS	*ROUND	1.66	2.27
	*ROUND	1.66	1.84

\* GRADE B HIGH STRENGTH STEEL  
\*\* INCLUDES END, CORNER, ANGLE, INTERSECTION AND INTERMEDIATE BRACED POSTS

**GATE FRAME MEMBERS SIZE AND WEIGHT**

GATE FRAME	OUTSIDE DIMENSIONS INCHES	WEIGHT LBS./LIN. FT.
ROUND	1.66	2.27
*ROUND	1.66	1.84

\* GRADE B HIGH STRENGTH STEEL

**GATE POST SIZE AND WEIGHT**

GATE LEAF WIDTH OF 6 FT. OR LESS	OUTSIDE DIMENSIONS INCHES	WEIGHT LBS./LIN. FT.
ROUND	2.875	5.79
*ROUND	2.875	4.64

\* GRADE B HIGH STRENGTH STEEL

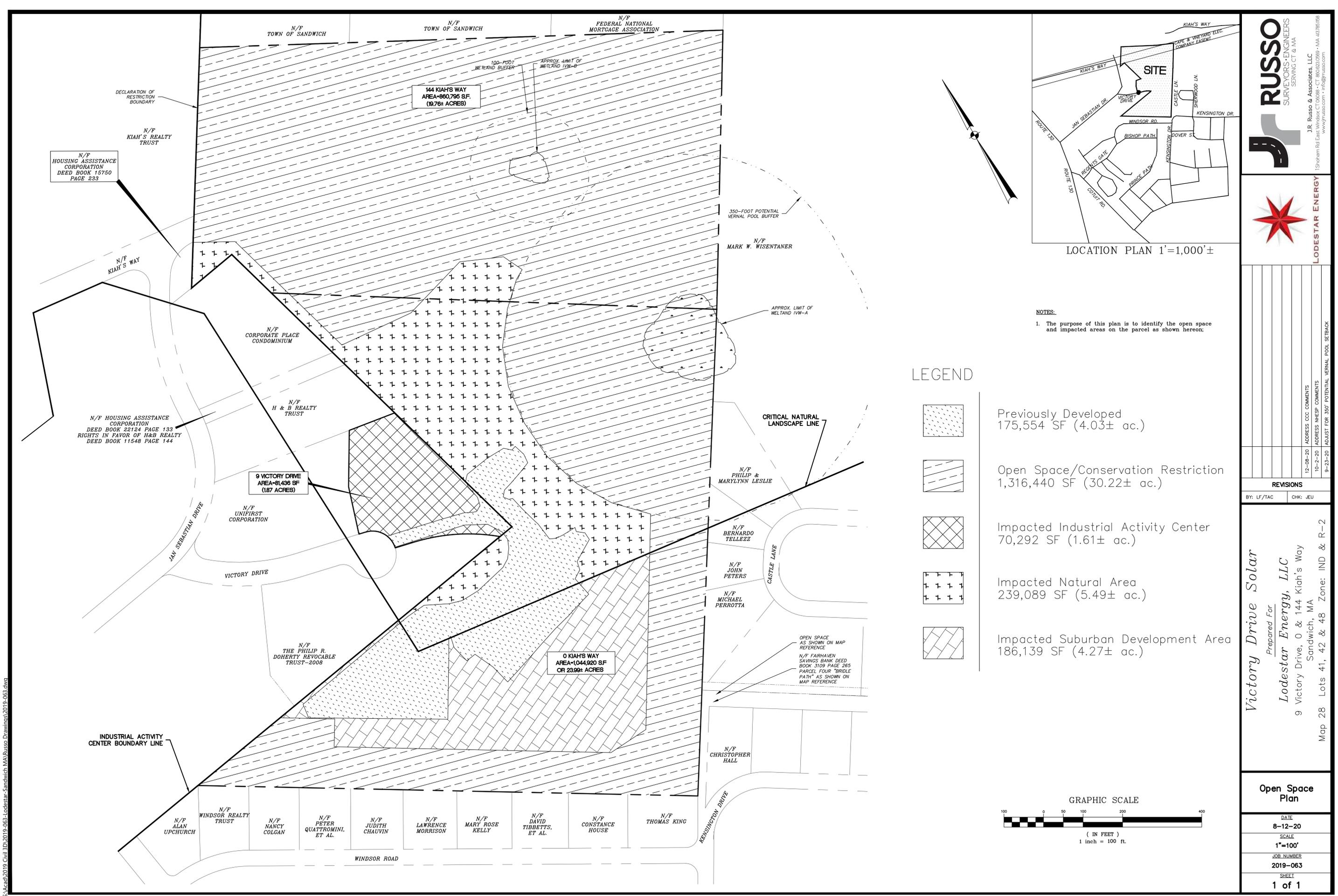
- CONSTRUCTION NOTES**
1. MATERIALS AND WORKMANSHIP NOT SHOWN ON THIS DRAWING SHALL CONFORM TO THE MANUFACTURER'S SPECIFICATIONS.
  2. ALL POSTS SHALL BE INSTALLED VERTICALLY. WHERE POSTS ARE INSTALLED ON AN INCLINED SURFACE, THE ANGLE OF THE POST SHALL BE ADJUSTED SO THAT THE POST WILL BE VERTICAL.
  3. THE FENCING SHALL BE #9 GAGE FENCE FABRIC, STANDARD 2-INCH CHAIN LINK DIAMOND MESH.

**REVISIONS**

NO.	DATE	DESCRIPTION
12-08-20	9-23-20	ADDRESS CCC COMMENTS
9-23-20		6" GAP UNDER FENCE

BY: LF/TAC CHK: JEU

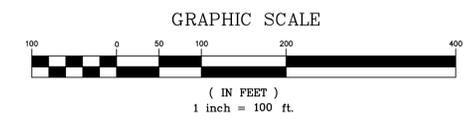
**Victory Drive Solar**  
Prepared For  
**Lodestar Energy, LLC**  
9 Victory Drive, 0 & 144 Kian's Way  
Sandwich, MA  
Map 28 Lots 41, 42 & 48 Zone: IND & R-2



NOTES:  
 1. The purpose of this plan is to identify the open space and impacted areas on the parcel as shown hereon;

LEGEND

-  Previously Developed  
175,554 SF (4.03± ac.)
-  Open Space/Conservation Restriction  
1,316,440 SF (30.22± ac.)
-  Impacted Industrial Activity Center  
70,292 SF (1.61± ac.)
-  Impacted Natural Area  
239,089 SF (5.49± ac.)
-  Impacted Suburban Development Area  
186,139 SF (4.27± ac.)



REVISIONS
12-08-20 ADDRESS CCC COMMENTS
10-2-20 ADDRESS NHEEP COMMENTS
9-23-20 ADJUST FOR 350' POTENTIAL VERNAL POOL SETBACK

BY: LF/TAC    CHK: JEU

Prepared For  
**Victory Drive Solar**  
**Lodestar Energy, LLC**  
 9 Victory Drive, 0 & 144 Kiah's Way  
 Sandwich, MA  
 Map 28 Lots 41, 42 & 48 Zone: IND & R-2

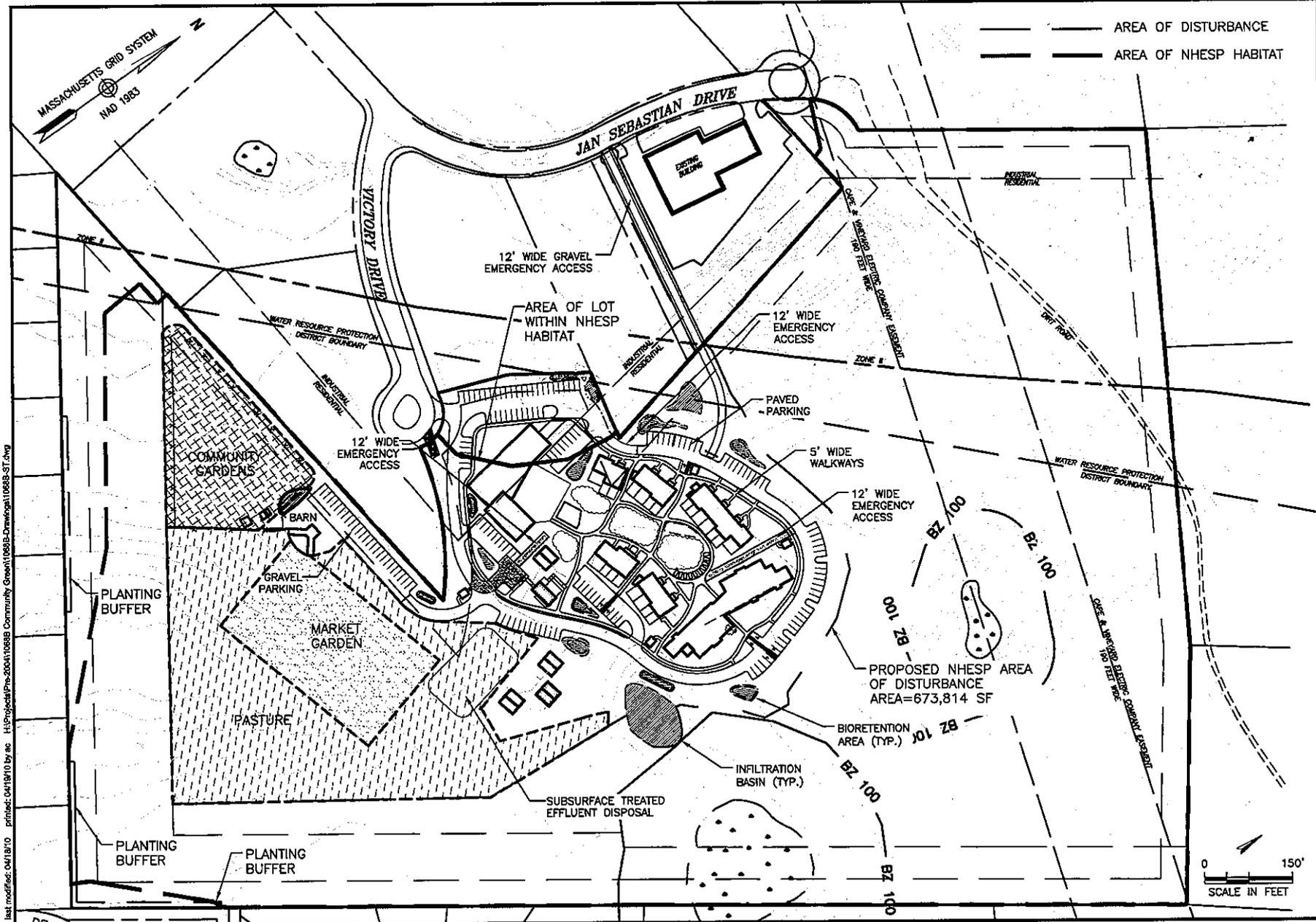
<b>Open Space Plan</b>
DATE 8-12-20
SCALE 1"=100'
JOB NUMBER 2019-063
SHEET 1 of 1

S:\Acad\2019 Civil 3D\2019-063-Lodestar-Sandwich MA Russo Drawings\2019-063.dwg

## **Attachment 1**

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“Community Green, Sandwich, Massachusetts, Proposed Conditions”  
(dated February 2010, revised 4/16/2010, prepared by Horsley Witten  
Group, Inc.)



last modified: 04/18/10 printed: 04/18/10 by: ec H:\Projects\10688B Community Green\10688B-Drawings\10688B-ST.dwg

<p><b>Revisions</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 5%;">No.</th> <th style="width: 45%;">Description</th> <th style="width: 10%;">Date</th> <th style="width: 10%;">By</th> <th style="width: 10%;">Appr.</th> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </table>	No.	Description	Date	By	Appr.						<p><b>Horley Witten Group, Inc.</b>                  Massachusetts Environmental Solutions                  200 Main Street, Suite 200                  Sandwich, MA 02563                  Phone: 508-888-1000                  Fax: 508-888-1001</p>
No.	Description	Date	By	Appr.							
<p><b>COMMUNITY GREEN</b>                  SANDWICH, MASSACHUSETTS</p>											
<p><b>PROPOSED CONDITIONS</b></p>											
<p><b>Project Name:</b>                  Community Green</p> <p><b>Project Location:</b>                  Sandwich, Massachusetts</p> <p><b>Project No.:</b>                  10688B</p> <p><b>Scale:</b>                  1" = 150'</p>	<p><b>Project No.:</b>                  10688B</p> <p><b>Scale:</b>                  1" = 150'</p> <p><b>Sheet No.:</b>                  1 of 1</p>										

**Attachment 3**

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"Community Green, Permitting Plans, Sandwich, Massachusetts,  
Land Subject to Conservation Restriction" (dated June 17, 2010,  
prepared by Horsley Witten Group, Inc.)





950 CMR: OFFICE OF THE SECRETARY OF THE COMMONWEALTH

APPENDIX A  
MASSACHUSETTS HISTORICAL COMMISSION  
220 MORRISSEY BOULEVARD  
BOSTON, MASS. 02125  
617-727-8470, FAX: 617-727-5128

PROJECT NOTIFICATION FORM

Project Name: Victory Drive Solar  
Location / Address: 9 Victory Drive / 0 Kiah's Way  
City / Town: Sandwich  
Project Proponent  
Name: LSE Ophiuchus LLC  
Address: 40 Tower Lane, Suite 201  
City/Town/Zip/Telephone: Avon, CT 06001 Tel: 405-973-8767

After review of MHC files and the materials you submitted, it has been determined that this project is unlikely to affect significant historic or archaeological resources.

RC. 68807

[Signature] 10/23/20  
Date  
Jonathan K. Patton  
Archaeologist / Preservation Planner  
Massachusetts Historical Commission  
XC: Sara Korjett, CCC

Agency license or funding for the project (list all licenses, permits, approvals, grants or other entitlements being sought from state and federal agencies).

Agency Name Cape Cod Commission  
Type of License or funding (specify)  
Development of Regional Impact

**Project Description (narrative):**

The construction of a 2.125 MW/AC ground mounted solar photovoltaic electric generating facility with energy storage. Site comprised of approximately 46.09± acres. Approximately 14 acres of solar panels within a fenced area and an additional 5 acres of tree clearing. Site is largely wooded, with approximately 4-acres disturbed for a single-family home and community gardens.

**Does the project include demolition? If so, specify nature of demolition and describe the building(s) which are proposed for demolition.**

The project will require the movement, not demolition, of a portable modular single-family residence that was constructed in the last 10 years as a "demonstration" site. Photos are provided.

**Does the project include rehabilitation of any existing buildings? If so, specify nature of rehabilitation and describe the building(s) which are proposed for rehabilitation.**

No.

**Does the project include new construction? If so, describe (attach plans and elevations if necessary).**

See plans. Construction of 14 acres of solar panels and an energy storage system.

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APPENDIX A (continued)

To the best of your knowledge, are any historic or archaeological properties known to exist within the project's area of potential impact? If so, specify.

None.

What is the total acreage of the project area?

Woodland	<u>15</u>	acres	Productive Resources:		
Wetland	<u>0</u>	acres	Agriculture	<u>2</u>	acres
Floodplain	<u>0</u>	acres	Forestry	<u>0</u>	acres
Open space	<u>0</u>	acres	Mining/Extraction	<u>0</u>	acres
Developed	<u>1</u>	acres	Total Project Acreage	<u>18</u>	acres

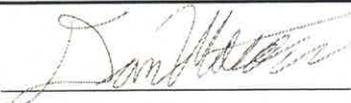
What is the acreage of the proposed new construction? 14 acres

What is the present land use of the project area?

Site is largely wooded, with approximately 15 acres of forested land, none of which is actively used in productive forestry. There are approximately 4-acres disturbed for a single-family home and community gardens.

Please attach a copy of the section of the USGS quadrangle map which clearly marks the project location.

This Project Notification Form has been submitted to the MHC in compliance with 950 CMR 71.00.

Signature of Person submitting this form:  Date: 10/5/2020

Name: Dan Watson

Address: 40 Tower Lane, Suite 201

City/Town/Zip: Avon, CT 06001

Telephone: (405) 973-8767

REGULATORY AUTHORITY

950 CMR 71.00: M.G.L. c. 9, §§ 26-27C as amended by St. 1988, c. 254.

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# STORMWATER REPORT

Victory Drive Solar  
9 Victory Drive & 0 Kiah's Way  
Sandwich, MA

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*Revised December 8, 2020*

*Prepared for:*

***Lodestar Energy***

6 Ridgebury Road  
Avon, CT 06001

*Prepared by:*

**J.R. RUSSO & ASSOCIATES, LLC**

**Land Surveyors & Professional Engineers**

**Timothy Coon, P.E.**

P.O. Box 938

East Windsor, Connecticut 06088

Phone: (860) 623-0569, Fax: (860) 623-2485

J.R. Russo Project No. 2019-063

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- Appendix 2: Soils Information
- Appendix 3: Hydrologic Analysis (HydroCAD)

STORMWATER REPORT  
VICTORY DRIVE SOLAR

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***II. INTRODUCTION/NARRATIVE***

**A. Project Description**

Lodestar Energy is proposing the construction of a 2.125 MW/AC ground mounted solar photovoltaic electric generating facility at property located off of Victory Drive in Sandwich, Massachusetts. (Figure 1, Site Locus in Appendix 1). The facility will consist of approximately 12 acres of solar panels within a 14 acre fenced area. Access to the project site will be via a new gravel entrance drive off of the existing cul-de-sac at the end of Victory Drive.

**B. Existing Topography and Land Uses**

The subject site consists of approximately 25.86 acres comprised of two parcels identified as 9 Victory Drive and 0 Kiah's Way owned by the Housing Assistance Corporation. The site is located east of Victory Drive. The site abuts residential properties along Windsor Road, Kensington Drive and Castle Road to the southwest and southeast; additional undeveloped land of the Housing Assistance Corporation to the northeast; and developed industrial properties off of Victory Drive and Jan Sebastian Drive to the northwest. The majority of the subject site consist of undeveloped woodland. However, the western portion of the site is developed with a single-family home as well as approximately 2 acres utilized for community gardens. A cleared utility line easement also runs across the northern portion of the parcel.

The eastern portion of the site is currently mapped by the Natural Heritage and Endangered Species Program as a Priority Habitat of Rare Species and an Estimated Habitat of Rare Wildlife. Two isolated wetlands have been identified within this area to the east of the development area. The larger wetland also appears to be a potential vernal pool. As part of the approval of a prior residential development at the site (which was never built), the southeastern, southwestern and norther portions of the site have been placed within a conservation restriction negotiated with the Massachusetts Department of Fish and Wildlife to protect the habitat of the eastern box turtle. These resource areas are shown on the Site Plans.

The area surrounding the site contains several isolated depressions within the topography. Two such depressions create the isolated wetlands to the east of the development area. Other depressions, not found to contain wetland resources, are located at the northern end of the site, the southwestern edge of the site, and to the northwest of the site. Runoff from the site currently appears to sheet flow toward these five depressions.

STORMWATER REPORT  
VICTORY DRIVE SOLAR

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**C. Soils**

Based on review of the Natural Resources Conservation Service (NRCS) WebSoil Survey for Barnstable County, Massachusetts, the soil type identified at the project site is limited to Enfield silt loam (see Appendix 2). The NRCS Soil Survey defines groups of soils into Hydrologic Soil Groups (HSG) according to their runoff-producing characteristics. Soils are assigned to four groups (A, B, C, and D Groups). In group A, are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They typically are deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a hardpan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other nearly impervious material. The classification of Enfield silt loam is HSG B, a well drained soil.

**D. Proposed Development**

The proposed development involves the construction of a 2.125 MW/AC ground mounted photovoltaic system for the generation of electricity. The project will consist of approximately 12 acres of solar panels located within approximately 14 acres of security fencing. Much of the solar field will be located in the area previously developed for the single-family home and community gardens. However, the development will extend to the south, east and north into wooded areas in order to accommodate the solar fields, utility interconnection, and prevent shading of the panels. Approximately 15 acres of trees are proposed to be cleared. However, within areas outside of the proposed security fence, low vegetation and stumps will not be removed unless they interfere with the installation of the utility connections. A 350 foot vegetated buffer will be maintained around the potential vernal pool to the east. No disturbance is proposed within 200 feet or the watershed of the smaller isolated wetland to the northeast. All disturbed areas will be seeded with a pollinator seed mix to stabilize soils as soon as feasible.

The site will be accessed via a new driveway off of the cul-de-sac at the end of Victory Drive. The existing gravel road will be utilized during construction, but ultimately removed. The electricity generated at the site will be transferred via a combination of underground conduits and poles with overhead wires to connect to the existing distribution lines to the north at the cul-de-sac at the end of Jan Sebastian Drive.

The solar panels will be mounted on racks supported by steel piles that are driven into the ground. Other work associated with the construction of the solar arrays will include creation of gravel access roads, installation of utility pads and associated electrical equipment, installation of electrical conduit, conduit supports, electrical poles, and overhead wire, and security fencing. Based on the existing topography, re-grading of the site will not be required, and the foundation systems can be installed with minimal

STORMWATER REPORT  
VICTORY DRIVE SOLAR

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disturbance. As a result, the existing drainage patterns, which consist of sheet flow to the surrounding depression, will be preserved.

**III. STORMWATER STANDARDS**

**A. Low Impact Development (LID) Measures**

The most significant LID measure to be implemented at the site will be the establishment of vegetation and maintenance of the natural hydrologic conditions beneath the solar panels. Because the proposed fixed panel solar arrays are installed on elevated racks, they provide adequate height above the ground to promote vegetative growth and allow for infiltration underneath the panels. As a result, all of the area beneath the solar arrays will remain pervious and will be seeded to establish a permanent vegetated cover. It will be maintained as a vegetated meadow. Water that flows off of the panels will essentially have the full surrounding area for sheet flow, infiltration, evaporation, etc. As a result, the areas surrounding the solar panels is categorized as Qualifying Pervious Areas providing the availability of LID Site Design Credits when fulfilling stormwater standards 3 and 4.

**B. No Untreated Discharges to Wetlands (Standard #1)**

The Massachusetts Department of Environmental Protection (MADEP) Stormwater Management Policy (SMP) states that no new stormwater outfalls may discharge untreated stormwater directly to or cause erosion in wetlands or water of the Commonwealth. As discussed above, the existing sheet flow drainage patterns at the site will be maintained and no new stormwater outfalls are proposed.

**C. Peak Rate Attenuation (Standard #2)**

**1. Design Criteria**

To meet Standard #2, stormwater controls must be developed to insure no increase in runoff from the site during the 2-year and 10-year, 24-hour storm events. Similarly, the 100-year 24-hour storm event must be evaluated to demonstrate that there will not be increased flooding impact offsite upon completion of construction.

For the purpose of this analysis, rainfall depths were derived from Technical Paper No. 40 published by the National Weather Service. The 24-hour precipitation/rainfall amounts for the design storms are as follows:

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VICTORY DRIVE SOLAR

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**Table 2: 24-hour Rainfall Depths**

Storm	Depth (in.)
2-year	3.4
10-year	4.8
100-year	7.0

## 2. Methodology

Using the listed rainfall depths, peak runoff flow rates and runoff volumes were determined for pre- and post-development conditions using Applied Microcomputer System's HydroCAD™ Stormwater Modeling System. This computer software employs the SCS Technical Release 55 and 20 (TR-55 & TR-20) methodology. The potential stormwater impacts were evaluated for the 2-yr, 10-yr, and 100-yr; 24-hour storm events.

The drainage analysis has been limited to the project site and a small portion of off-site area that contributes drainage across the project site. Based on the present and proposed drainage patterns, four design points were selected for the analyses. The design points correspond with the depressions that surround the site where runoff from the proposed development area collects and infiltrates back into the ground. Design Point #1 (DP1) is the depression at the eastern corner of the site that forms the large isolated wetland/potential vernal pool. Design point #2 (DP2) is the depression at the northern corner of the site. Design Point #3 is the small depression at the northwest corner of the site. Design Point #4 is the large depression in the southwestern portion of the site. The design points are shown on the Drainage Area Maps in Appendix 1.

## 3. Results

As discussed above, the existing site is a combination of woods and areas developed for a single-family home and community gardens. The gardens were modeled in the pre-development analysis as small grain crops. In the post development condition, the area under the solar panels will be vegetated and maintained as a meadow. Gravel roads were modeled as impervious surfaces. Using these site characteristics for the project area, the pre- and post development peak discharge rates and runoff volumes were calculated for the design storms. The HydroCAD data sheets are provided in Appendix 3. The resulting peak discharges for the design storms are summarized in the Table below.

The results indicate minor increases in peak discharge at Design Points 1 and 2 for all of the design storms. However, all increases in peak discharge are less than 1 cfs, even for the 100-year design storm. At DP1, although there is an increase in the peak rate of runoff, there is no increase in the runoff volume. Thus, there is essentially no impact to the isolated wetland which is the design point. At DP-2, the increase in runoff volume during the 100-year design storm is 0.051 ac-ft or 2,222 cubic feet. Spreading this

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volume of additional water in the base of the existing depression at DP2 (bottom area = 5,290 square feet) results in an increase in the water surface elevation of approximately 5" during the 100-year design storm. As a result, the depression at DP2 appears to be sufficient to accommodate the minor increase in runoff without impacting downstream properties. In order to mitigate the increase in runoff at DP3, the existing shallow depression will be excavated deeper in order to provide an additional 8,142 cubic feet below the existing 162 contour. This will result in a net decrease in the peak discharge and runoff volume to DP3. The peak discharge and runoff volume at DP4 will also decrease. Based on these results, the proposed development will not negatively impact downstream properties.

**Table – Summary of Pre- and Post Development Runoff**

	2-year		10-year		100-year	
	Peak (cfs)	Vol (ac-ft)	Peak (cfs)	Vol (ac-ft)	Peak (cfs)	Vol (ac-ft)
DP1:						
Pre	1.62	0.338	5.23	0.841	12.94	1.878
Post	1.64	0.338	5.30	0.841	13.10	1.878
Increase	0.02	0	0.07	0	0.16	0
DP2:						
Pre	0.34	0.085	1.48	0.239	4.21	0.577
Post	0.49	0.103	1.81	0.271	4.76	0.628
Increase	0.15	0.018	0.33	0.032	0.55	0.051
DP3:						
Pre	0.11	0.029	0.49	0.083	1.39	0.199
Post	0	0	0	0	0.13	0.026
Increase	-0.11	-0.029	-0.49	-0.083	-1.26	-0.173
DP4:						
Pre	2.66	0.685	8.54	1.706	21.24	3.809
Post	2.29	0.630	7.80	1.612	19.95	3.662
Increase	-0.37	-0.055	-0.74	-0.092	-1.29	-0.147

**D. Stormwater Recharge (Standard #3)**

As discussed above, the area underneath the solar panels will be vegetated and maintained as a meadow. Thus, the elevated solar panels themselves are not considered an impervious cover. Instead, the area underneath the panels meets the requirements for Qualifying Pervious Area. This leaves the proposed gravel access road and utility pads as the only proposed impervious area associated with the project. However, all runoff from the proposed project will sheet flow into one of four depressions surrounding the

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site where all runoff appears to infiltrate back into the ground. As a result of the recharge of all stormwater, the requirements of Standard #3 are met.

**E. Water Quality (Standard #4)**

Although there appears to be no discharge from the site due to the infiltration in the depressions, runoff to DP1 does discharge to wetlands prior to infiltration. Thus, standard #4 does apply to the runoff to DP1. As discussed in the section above, the area underneath the panels is considered Qualifying Pervious Area and, therefore, is not considered impervious area in the calculation of the Water Quality Volume. The resulting impervious area contributing to the wetland is zero. Thus, the calculated Water Quality Volume is zero, and there is no requirement for stormwater treatment for the project.

As discussed above, the existing grades and sheet flow drainage patterns will be maintained at the site. Runoff from all areas to the surrounding depressions will travel through varying lengths of vegetation (vegetated filter strips) which will provide pretreatment prior to entering the depressions and infiltrating into the ground.

**F. Land Uses with Higher Potential Pollutant Loads (Standard #5)**

The proposed project is not considered a land use with higher potential pollutant loads. The solar array is constructed of glass, aluminum and steel and does not contain oil or hazardous materials that could leach into the environment. Proposed oil-filled electrical equipment at the site contains non-toxic mineral oil dielectric fluid (typically food-grade oil) and is delivered to the site sealed and encased.

**G. Critical Areas (Standard #6)**

There are no Areas of Critical Environmental Concern, Interim Wellhead Protection Areas at the project site. A Zone II Aquifer Protection area is located to the north of the site; however, the only activities in this area associated with the project involve tree clearing and the installation of underground conduits and above-ground poles and wires. These activities are not expected to have any long-term impacts to the Wellhead Protection Area.

**H. Redevelopment (Standard #7)**

The proposed project is considered new development and is designed to comply with the requirements of the Stormwater Management Standards.

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VICTORY DRIVE SOLAR

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**I. Construction Period Controls (Standard #8)**

The following erosion control measures will be implemented during the construction phase of the project:

- A construction entrance shall be installed at the entrance of the existing gravel drive at the end of Victory Drive.
- Installation of an exclusionary silt fence surrounding the project site.
- Maintenance of existing grades to minimize soil disturbance.
- Seeding and stabilization of disturbed areas as soon as possible.

Although the development does not include re-grading of the site, between stump removal, access road construction, and utility trenching, it is anticipated that the proposed development will disturb an area in excess of 1 acre. Thus, the project will be required to obtain coverage under the NPDES Construction General Permit issued by the EPA and prepare a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP will be provided prior to any land disturbance. However, much of the information provided below will also be contained in the SWPPP.

**1. Construction Sequence**

Construction should generally conform to the following sequence:

- Contact the Town of Sandwich prior to the start of construction activities to schedule a pre-construction meeting.
- Attend a pre-construction meeting to educate the Contractor and on-site personnel on how to identify the eastern box turtle, and measures to be taken if encountered.
- Install perimeter exclusionary silt fence around the construction envelope as shown on the project plans.
- Contractor to perform an initial sweep for turtles within the construction envelope and remove turtles found outside of the envelope. Similar sweeps along the perimeter fence shall be conducted by the contractor each day prior to the start of work.
- Install construction entrance.
- Stake clearing limits designating areas outside of security fence where stumps are to remain.
- Clear trees. Grub stumps within proposed security fence. Stumps outside of security fence to remain. Fill stump holes as necessary. Remove brush and debris from the site.
- Install access roads.
- Install foundations and solar panels.
- Install electrical equipment and distribution lines.

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- Install security fence.
- Seed all disturbed areas with pollinator seed mix to stabilize soils as soon as practical.
- Remove silt fence after site is fully stabilized.

**2. Maintenance of Controls**

In the following erosion control practices the specified activities and controls are minimums only. They should be increased as needed to ensure proper functioning and that their intent is met. All erosion and sediment control measures, including vegetation, and all other protective measures identified on the plans, shall be installed and maintained by the General Contractor or his/her designated agent.

- **Minimize Disturbance** – Throughout construction, care shall be taken to ensure that existing vegetation is preserved where attainable and that disturbed portions of the site are stabilized as soon as possible.
- **Perimeter Controls** – Silt fence and/or straw wattles shall be maintained downgradient of work areas and supplemented as necessary. These shall be inspected weekly and after storm events to ensure they are intact. If gaps or tears are found, the sections shall be repaired or replaced immediately. Accumulated sediment shall be removed if it reaches a height of 6 inches.
- **Temporary Stabilization** - Disturbed portions of the site where construction activity temporarily ceases for at least 30 days will be stabilized with temporary seed and mulch no later than 14 days from the last construction activity in that area. The temporary seed shall be Rye (grain) applied at the rate of 120 pounds per acre. If field conditions warrant, the Engineer may require additional control measures such as erosion control blankets, permanent turf reinforcement mats, or sodding for soil stabilization.
- **Permanent stabilization** – Upon completion earth disturbing activities, the site shall be stabilized with permanent seed and mulch in accordance with the project plans no later than 14 days after the last construction activity. In addition, upon completion of the solar panels, the area of the solar field shall be overseeded w/ the specified seed mix.
- **Dust Control** - Dust from the site will be controlled by using a mobile pressure-type distributor truck to apply potable water to disturbed areas as necessary. The mobile unit will apply water at the minimum rate necessary to control dust while preventing runoff and ponding.
- **Anti-tracking Pads** – The construction entrance pad shall be constructed as shown on the design plans and maintained during construction. The purpose of the entrance pad is to prevent sediment from tracking onto the adjacent roadway system. Pads will be inspected weekly and after storm events or heavy use. If excess sediment has clogged the pad, the pad will be top-dressed with new stone

STORMWATER REPORT  
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or replaced if necessary. The pad shall be removed before subgrade of pavement is applied.

- Final Cleaning - Prior to filing for a certificate of compliance, the site shall be cleaned of all debris and rubbish, and all silt fence and accumulated sediment shall be removed. All vegetated areas shall be inspected to verify that they are properly stabilized and that the vegetation is fully established.

**3. Miscellaneous other controls:**

- Waste Disposal - Best Management Practices (BMP's) shall be utilized at the site to ensure that no litter, debris, building materials, or similar materials are discharged to waters of the State. The site shall be kept neat and clean after each workday.
- Waste Materials - All waste will be collected and stored in a securely covered container as provided by a licensed solid waste management company. The containers shall meet all local and state regulations. The containers will be emptied as necessary. No construction waste materials shall be permitted to be buried on-site. All personnel will be instructed regarding the correct procedure for waste disposal. Notices stating these practices will be posted in the site trailer, and the individual who manages the day-to-day on-site operations will be responsible for seeing that these practices are followed.
- Hazardous Waste – Hazardous materials such as petroleum products, paint, and equipment maintenance fluids will be stored in structurally sound and sealed shipping containers, within a specified covered hazardous materials storage area. All hazardous materials shall be labeled in accordance with applicable regulations. All hazardous waste materials will be disposed of in a manner specified by local or state regulations or by the manufacturer. Site personnel will be instructed in these practices, and the individual who manages day to day site operations will be responsible for seeing that these practices are followed.
- Sanitary Waste – The general contractor shall make provisions for temporary sanitary facilities (portable toilet) at the site throughout the construction phase. The toilet(s) will be located away from concentrated traffic flow. All sanitary waste will be collected from the portable units a minimum of three times per week by a licensed sanitary waste management contractor, as required by local regulation.
- Spill Prevention and Control – Vehicles and equipment will be maintained off-site. All vehicles and equipment will be checked daily for leaking oil and fluids and leaks repaired. Vehicles leaking fluids will not be allowed on site. The general contractor or his designated agent shall maintain a spill kit for emergency spills. All spills will be cleaned up immediately upon discovery. Spent absorbent materials and rags will be hauled off-site immediately after a spill is cleaned up and disposed of in accordance with applicable regulations. Spills exceeding DEP established reportable quantities shall be reported to the DEP in accordance with

## STORMWATER REPORT VICTORY DRIVE SOLAR

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the Massachusetts Contingency Plan. Material safety data sheets, a material inventory, and emergency contact information will be prepared by the general contractor and maintained at the on-site job trailer.

#### **4. Inspections During Construction**

The following are the minimum requirements for maintenance and inspection of the above controls to insure they are functioning as intended and to ensure that if additional measures are required that they be installed when the need arises.

- **Qualified Personnel** - The general contractor shall provide a qualified person or persons knowledgeable in the principles and practice of erosion and sediment controls to perform inspections. The qualified person shall possess the skills to assess conditions at the construction site that could impact storm water quality and to assess the effectiveness of any sediment and erosion control measure selected to control the quality of storm water discharges from the construction activity.
- **Frequency of Inspections** –The qualified inspector shall perform inspections at least once every seven calendar days. The frequency of inspection of areas of the site that have been permanently stabilized may be reduced to twice per month for the first month and once per month thereafter. Inspections may also be temporarily suspended in the event that work activities are suspended due to frozen conditions.
- **Areas to be Inspected** - The qualified inspector shall inspect disturbed areas of the construction activity, staging and equipment storage areas, control measures including silt fence, straw wattles, the construction entrance, and all locations where stabilization measures have been implemented. Disturbed areas and areas used for storage of materials that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants discharging from the site. Erosion and sediment control measures shall be observed to ensure that they are operating correctly. Silt barriers will be inspected for depth of sediment, tears, gaps, etc., to see if they are secure. Permanent vegetative cover will be inspected for bare spots, washout, and healthy growth initially as specified in number 1 above and thereafter until fully established. Where discharge locations or points are accessible, they shall be inspected to ascertain whether the erosion control measures are effective in preventing significant impacts to receiving waters.
- **Inspection Logs** - For each inspection, an Inspection Log Sheet be completed. Each inspection log sheet shall be kept on site for inspection by governing authorities.
- **Corrective Actions** - If site inspections reveal that an erosion and sediment control measure is not operating effectively, corrective action (including maintenance, modification or installation of additional BMPs) must be performed as soon as possible before the close of the next business day. An exception to this time

STORMWATER REPORT  
VICTORY DRIVE SOLAR

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frame is when the problem requires a new or replacement control or significant repair, in which case it must be completed within seven (7) calendar days.

**J. Operation and Maintenance Plan (Standard #9)**

The facility operation and maintenance plan (O&M Plan) that follows is to ensure that the Stormwater Management Policy criteria are met during construction and after construction is completed.

**1. Construction Phase**

Refer to Section H of this report which discusses compliance with Standard #8, Erosion and Sedimentation Controls.

**2. Post-Development Phase**

As the proposed project does not include the construction of a formal stormwater management system or post construction BMPs that need to be maintained, the preparation of a separate Post Construction Operation and Maintenance Plan is not deemed necessary. In lieu of a separate plan, the applicant shall be responsible for the following inspections and maintenance after construction is complete:

- a. The potential source of spills is limited to oil-filled electrical equipment and periodic visits by maintenance vehicles:
  - Proposed oil filled electrical equipment at the site contains non-toxic dielectric fluid (typically food-grade oil) and is delivered to the site sealed and encased.
  - Cleaning and storage of maintenance vehicles should be conducted off-site.
- b. The solar modules and racks do not contain oil or hazardous materials that could spill or leach into the environment at the site.
- c. The inspection and maintenance of vegetation (i.e. mowing) at the site should be conducted at least twice per year. Vegetation should be re-seeded as necessary.
- d. No storage of oil or hazardous materials, including herbicide, fertilizers and insecticides, should be conducted on site (other than oil sealed in electrical equipment.)

STORMWATER REPORT  
VICTORY DRIVE SOLAR

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- e. Routine maintenance of the access road and staging area will include inspection, stabilization and repairs as needed. Snow will be physically removed from the road and staging area (i.e. plowed) only if access is necessary. Salt use or other deicing is not anticipated.

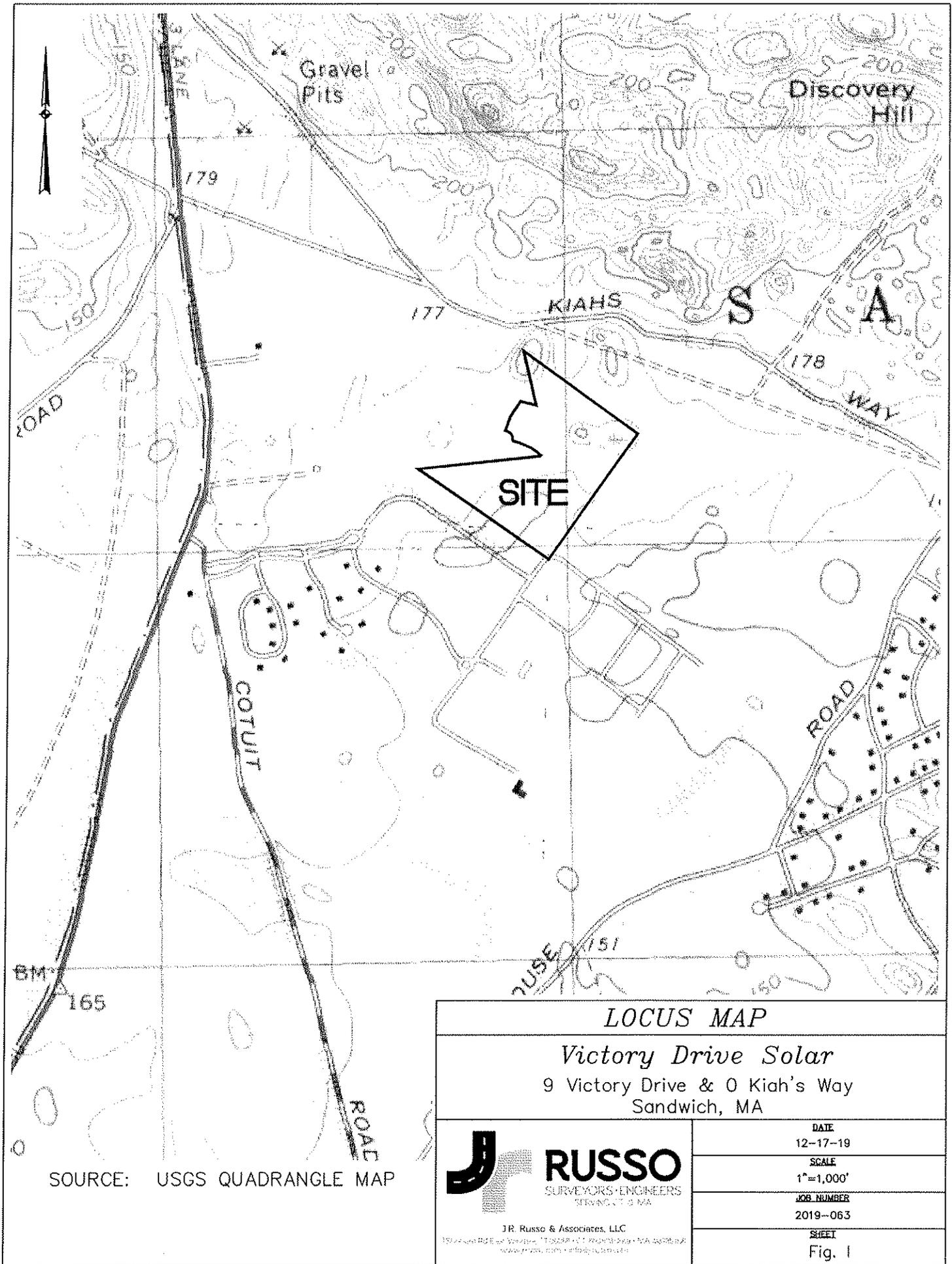
**K. Illicit Discharges to Drainage System (Standard #10)**

As the project does not include a formal stormwater management system, nor the significant potential for sources of pollution, illicit dischargers is not expected.

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VICTORY DRIVE SOLAR

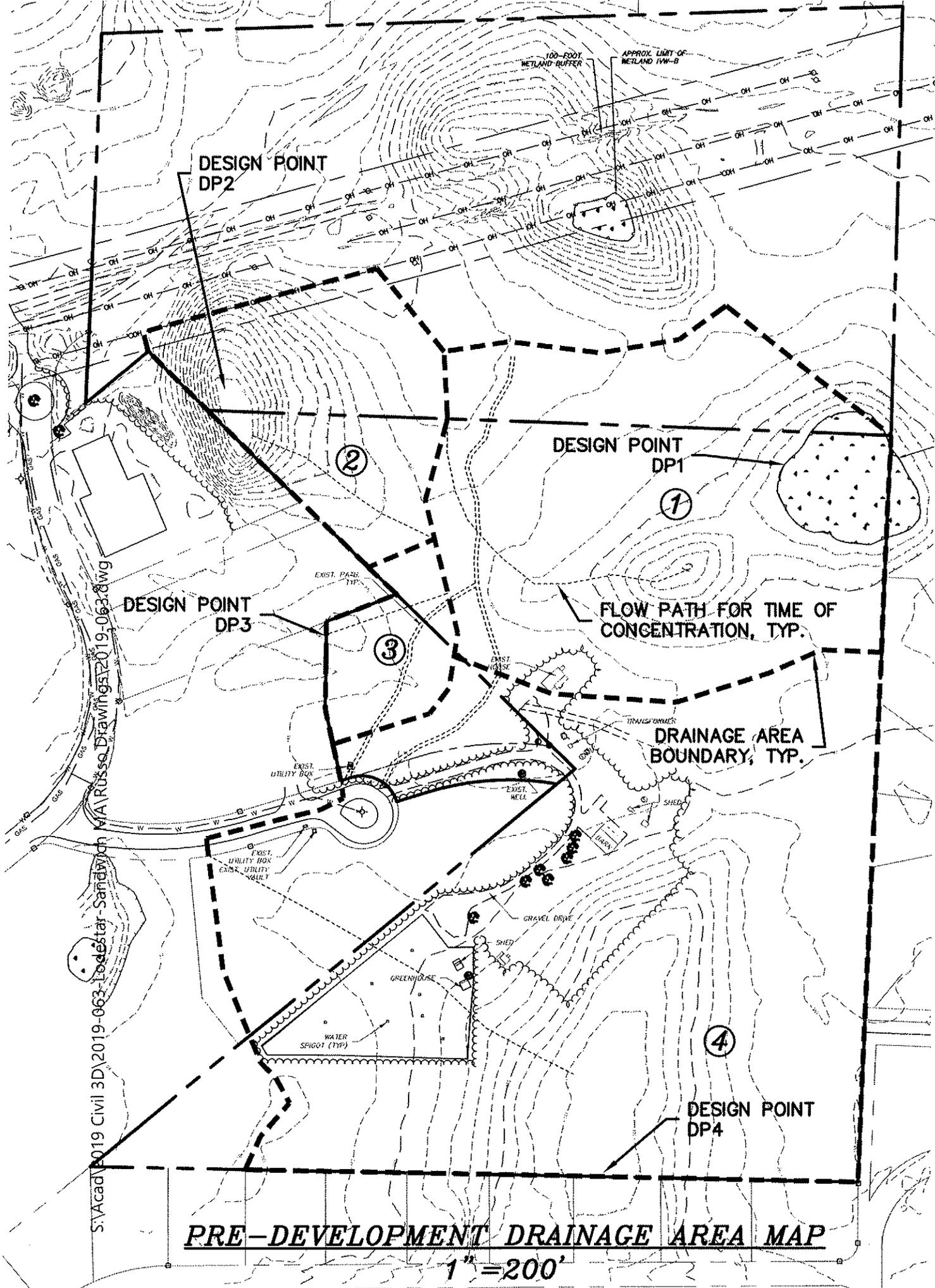
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APPENDIX 1  
FIGURES



SOURCE: USGS QUADRANGLE MAP

<b>LOCUS MAP</b>	
<i>Victory Drive Solar</i>	
9 Victory Drive & 0 Kiah's Way Sandwich, MA	
 <p><b>RUSSO</b> SURVEYORS • ENGINEERS SANDWICH, MA</p> <p>J.P. Russo &amp; Associates, LLC 1304 and 1322 W. Victory, 11000RP • CT. ROUTE 299 • MA 02563 www.russo.com • info@russo.com</p>	DATE 12-17-19
	SCALE 1"=1,000'
	JOB NUMBER 2019-063
	SHEET Fig. 1



DESIGN POINT  
DP2

DESIGN POINT  
DP1

DESIGN POINT  
DP3

FLOW PATH FOR TIME OF  
CONCENTRATION, TYP.

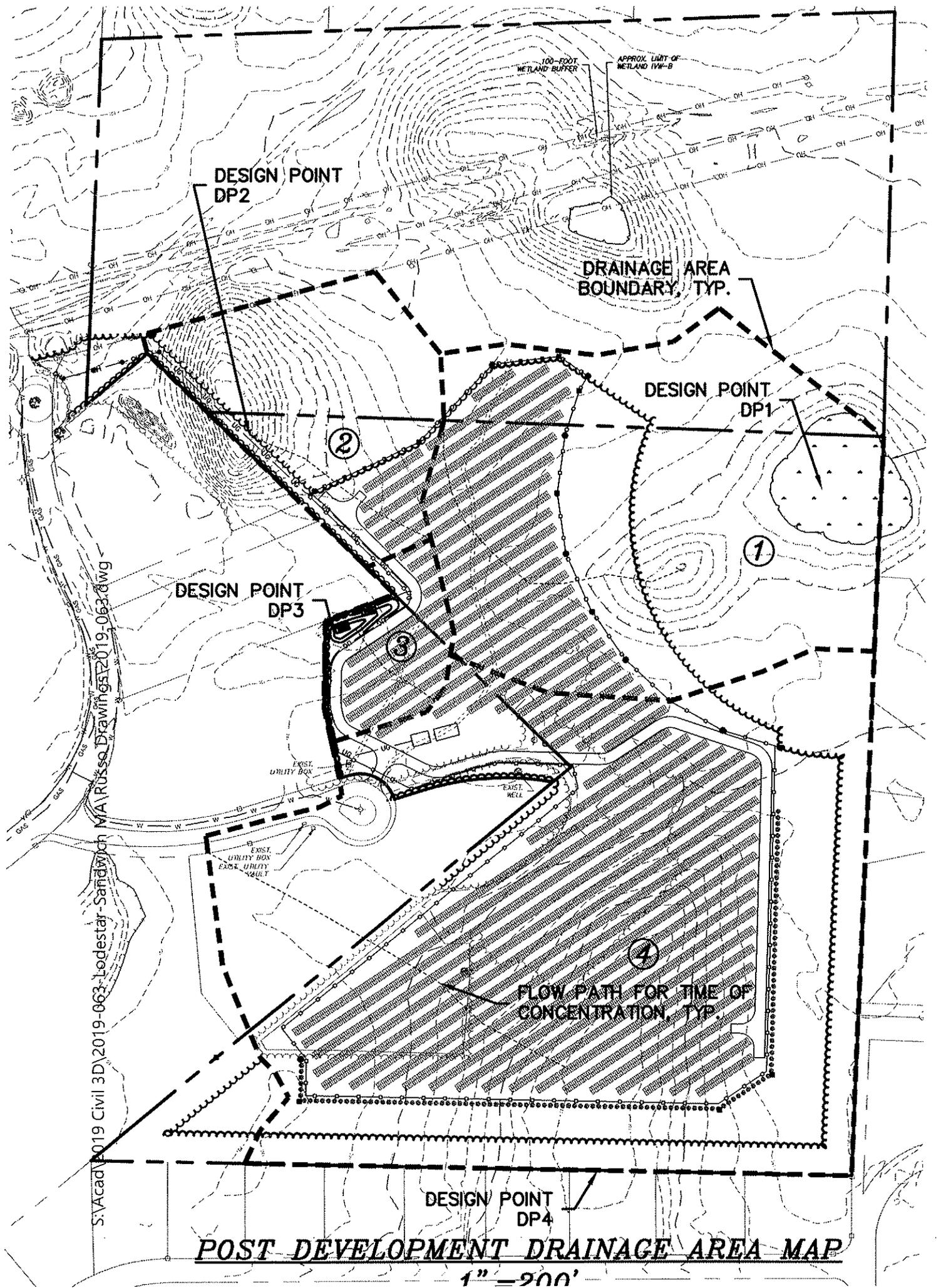
DRAINAGE AREA  
BOUNDARY, TYP.

DESIGN POINT  
DP4

**PRE-DEVELOPMENT DRAINAGE AREA MAP**

1" = 200'

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# POST DEVELOPMENT DRAINAGE AREA MAP

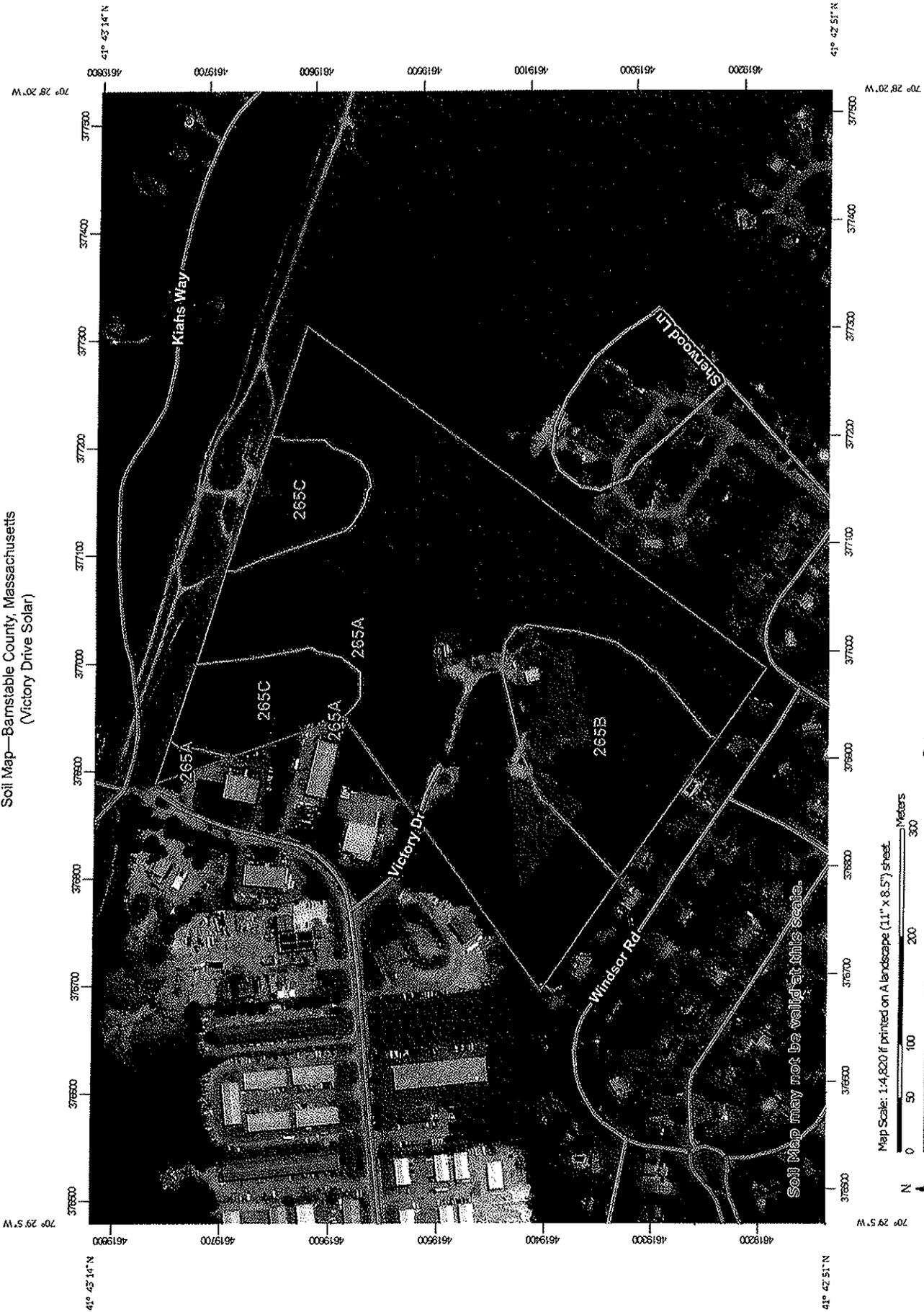
1" = 200'

STORMWATER REPORT  
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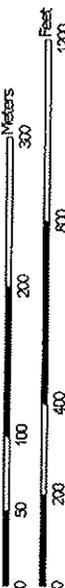
APPENDIX 2  
SOILS INFORMATION

Soil Map—Barnstable County, Massachusetts  
(Victory Drive Solar)



Soil Map may not be valid at this scale.

Map Scale: 1:4,820 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge lbs: UTM Zone 18N WGS84

## MAP LEGEND

 Area of Interest (AOI)	 Spoil Area
 Soils	 Stony Spot
 Soil Map Unit Polygons	 Very Stony Spot
 Soil Map Unit Lines	 Wet Spot
 Soil Map Unit Points	 Other
 Special Point Features	 Special Line Features
 Blowout	 Water Features
 Borrow Pit	 Streams and Canals
 Clay Spot	 Transportation
 Closed Depression	 Rails
 Gravel Pit	 Interstate Highways
 Gravelly Spot	 US Routes
 Landfill	 Major Roads
 Lava Flow	 Local Roads
 Marsh or swamp	 Background
 Mine or Quarry	 Aerial Photography
 Miscellaneous Water	
 Perennial Water	
 Rock Outcrop	
 Saline Spot	
 Sandy Spot	
 Severely Eroded Spot	
 Sinkhole	
Slide or Slip	
Sodic Spot	

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Barnstable County, Massachusetts  
Survey Area Data: Version 16, Sep 12, 2019

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

Date(s) aerial images were photographed: Jul 10, 2018—Nov 17, 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.

## Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
265A	Enfield silt loam, 0 to 3 percent slopes	27.1	68.5%
265B	Enfield silt loam, 3 to 8 percent slopes	6.9	17.5%
265C	Enfield silt loam, 8 to 15 percent slopes	5.6	14.1%
<b>Totals for Area of Interest</b>		<b>39.5</b>	<b>100.0%</b>

## Barnstable County, Massachusetts

### 265A—Enfield silt loam, 0 to 3 percent slopes

#### Map Unit Setting

*National map unit symbol:* 98qs  
*Elevation:* 0 to 1,000 feet  
*Mean annual precipitation:* 40 to 50 inches  
*Mean annual air temperature:* 45 to 55 degrees F  
*Frost-free period:* 140 to 240 days  
*Farmland classification:* All areas are prime farmland

#### Map Unit Composition

*Enfield and similar soils:* 80 percent  
*Minor components:* 20 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Enfield

##### Setting

*Landform:* Outwash plains  
*Landform position (two-dimensional):* Summit  
*Landform position (three-dimensional):* Tread  
*Down-slope shape:* Convex  
*Across-slope shape:* Convex  
*Parent material:* Silty, friable loamy eolian deposits over loose sandy glaciofluvial deposits

##### Typical profile

*H1 - 0 to 12 inches:* silt loam  
*H2 - 12 to 31 inches:* silt loam  
*H3 - 31 to 64 inches:* gravelly coarse sand

##### Properties and qualities

*Slope:* 0 to 3 percent  
*Depth to restrictive feature:* 16 to 40 inches to strongly contrasting textural stratification  
*Natural drainage class:* Well drained  
*Runoff class:* Low  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.60 to 2.00 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* Moderate (about 7.4 inches)

##### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 1  
*Hydrologic Soil Group:* B  
*Hydric soil rating:* No

### **Minor Components**

#### **Merrimac**

*Percent of map unit:* 10 percent

*Hydric soil rating:* No

#### **Hinckley**

*Percent of map unit:* 5 percent

*Hydric soil rating:* No

#### **Carver**

*Percent of map unit:* 5 percent

*Hydric soil rating:* No

### **Data Source Information**

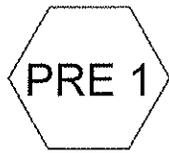
Soil Survey Area: Barnstable County, Massachusetts

Survey Area Data: Version 16, Sep 12, 2019

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APPENDIX 3  
HYDROCAD ANALYSIS



PRE 1



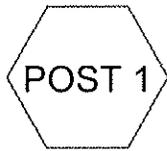
PRE 2



PRE 3



PRE 4



POST 1



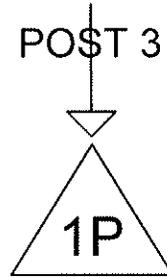
POST 2



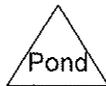
POST 3



POST 4



Basin 1



**2019-063 Sandwich**

Type III 24-hr 2-year Rainfall=3.40"

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Time span=2.00-72.00 hrs, dt=0.05 hrs, 1401 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>Subcatchment POST 1: POST 1</b>	Runoff Area=391,729 sf 7.82% Impervious Runoff Depth=0.45" Flow Length=587' Tc=36.4 min CN=59 Runoff=1.64 cfs 0.338 af
<b>Subcatchment POST 2: POST 2</b>	Runoff Area=141,899 sf 2.53% Impervious Runoff Depth=0.38" Flow Length=347' Tc=29.5 min CN=57 Runoff=0.49 cfs 0.103 af
<b>Subcatchment POST 3: POST 3</b>	Runoff Area=49,009 sf 14.33% Impervious Runoff Depth=0.66" Flow Length=184' Tc=29.6 min CN=64 Runoff=0.40 cfs 0.061 af
<b>Subcatchment POST 4: POST 4</b>	Runoff Area=794,458 sf 4.15% Impervious Runoff Depth=0.41" Flow Length=701' Tc=56.4 min CN=58 Runoff=2.29 cfs 0.630 af
<b>Subcatchment PRE 1: PRE 1</b>	Runoff Area=391,729 sf 8.06% Impervious Runoff Depth=0.45" Flow Length=590' Tc=37.3 min CN=59 Runoff=1.62 cfs 0.338 af
<b>Subcatchment PRE 2: PRE 2</b>	Runoff Area=141,899 sf 0.00% Impervious Runoff Depth=0.31" Flow Length=350' Tc=30.9 min CN=55 Runoff=0.34 cfs 0.085 af
<b>Subcatchment PRE 3: PRE 3</b>	Runoff Area=49,009 sf 0.00% Impervious Runoff Depth=0.31" Flow Length=210' Slope=0.0150 '/' Tc=33.9 min CN=55 Runoff=0.11 cfs 0.029 af
<b>Subcatchment PRE 4: PRE 4</b>	Runoff Area=794,458 sf 3.34% Impervious Runoff Depth=0.45" Flow Length=700' Tc=55.1 min CN=59 Runoff=2.66 cfs 0.685 af
<b>Pond 1P: Basin 1</b>	Peak Elev=159.58' Storage=1,791 cf Inflow=0.40 cfs 0.061 af Discarded=0.02 cfs 0.061 af Primary=0.00 cfs 0.000 af Outflow=0.02 cfs 0.061 af

**Summary for Subcatchment POST 1: POST 1**

Runoff = 1.64 cfs @ 12.66 hrs, Volume= 0.338 af, Depth= 0.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-year Rainfall=3.40"

Area (sf)	CN	Description
* 30,615	98	Wetland
122,721	58	Meadow, non-grazed, HSG B
238,393	55	Woods, Good, HSG B
391,729	59	Weighted Average
361,114		92.18% Pervious Area
30,615		7.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.4	150	0.0200	0.09		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 3.40"
3.5	254	0.0300	1.21		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
3.5	183	0.0300	0.87		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
36.4	587	Total			

**Summary for Subcatchment POST 2: POST 2**

Runoff = 0.49 cfs @ 12.60 hrs, Volume= 0.103 af, Depth= 0.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-year Rainfall=3.40"

Area (sf)	CN	Description
103,007	55	Woods, Good, HSG B
35,296	58	Meadow, non-grazed, HSG B
* 3,596	98	Impervious
141,899	57	Weighted Average
138,303		97.47% Pervious Area
3,596		2.53% Impervious Area

**2019-063 Sandwich**

Type III 24-hr 2-year Rainfall=3.40"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.0	135	0.0200	0.08		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 3.40"
0.3	15	0.0200	0.97		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.40"
0.5	40	0.0300	1.21		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
1.7	157	0.1000	1.58		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
29.5	347	Total			

**Summary for Subcatchment POST 3: POST 3**

Runoff = 0.40 cfs @ 12.50 hrs, Volume= 0.061 af, Depth= 0.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-year Rainfall=3.40"

Area (sf)	CN	Description
41,985	58	Meadow, non-grazed, HSG B
* 7,024	98	Impervious
49,009	64	Weighted Average
41,985		85.67% Pervious Area
7,024		14.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.4	150	0.0200	0.09		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 3.40"
0.1	18	0.0200	2.87		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.1	16	0.3333	4.04		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
29.6	184	Total			

**Summary for Subcatchment POST 4: POST 4**

Runoff = 2.29 cfs @ 12.99 hrs, Volume= 0.630 af, Depth= 0.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-year Rainfall=3.40"

**2019-063 Sandwich**

Type III 24-hr 2-year Rainfall=3.40"

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Area (sf)	CN	Description
*	32,972	98 Impervious
	378,398	58 Meadow, non-grazed, HSG B
	380,956	55 Woods, Good, HSG B
	2,132	61 >75% Grass cover, Good, HSG B
	794,458	58 Weighted Average
	761,486	95.85% Pervious Area
	32,972	4.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
43.9	150	0.0070	0.06		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.40"
6.0	150	0.0070	0.42		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
6.5	401	0.0420	1.02		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
56.4	701	Total			

**Summary for Subcatchment PRE 1: PRE 1**

Runoff = 1.62 cfs @ 12.68 hrs, Volume= 0.338 af, Depth= 0.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-year Rainfall=3.40"

Area (sf)	CN	Description
*	30,615	98 Wetland
*	948	98 Impervious
	5,856	61 >75% Grass cover, Good, HSG B
	354,310	55 Woods, Good, HSG B
	391,729	59 Weighted Average
	360,166	91.94% Pervious Area
	31,563	8.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.8	150	0.0200	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.40"
8.5	440	0.0300	0.87		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
37.3	590	Total			

**Summary for Subcatchment PRE 2: PRE 2**

Runoff = 0.34 cfs @ 12.66 hrs, Volume= 0.085 af, Depth= 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-year Rainfall=3.40"

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Type III 24-hr 2-year Rainfall=3.40"

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Area (sf)	CN	Description
141,899	55	Woods, Good, HSG B
141,899		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.8	150	0.0200	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.40"
2.1	200	0.1000	1.58		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
30.9	350	Total			

**Summary for Subcatchment PRE 3: PRE 3**

Runoff = 0.11 cfs @ 12.71 hrs, Volume= 0.029 af, Depth= 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-year Rainfall=3.40"

Area (sf)	CN	Description
49,009	55	Woods, Good, HSG B
49,009		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.3	150	0.0150	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.40"
1.6	60	0.0150	0.61		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
33.9	210	Total			

**Summary for Subcatchment PRE 4: PRE 4**

Runoff = 2.66 cfs @ 12.95 hrs, Volume= 0.685 af, Depth= 0.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-year Rainfall=3.40"

Area (sf)	CN	Description
* 26,543	98	Impervious
70,737	61	>75% Grass cover, Good, HSG B
613,626	55	Woods, Good, HSG B
83,552	75	Small grain, straight row, Good, HSG B
794,458	59	Weighted Average
767,915		96.66% Pervious Area
26,543		3.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
43.9	150	0.0070	0.06		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.40"
6.4	160	0.0070	0.42		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
2.3	200	0.0250	1.42		<b>Shallow Concentrated Flow,</b> Cultivated Straight Rows Kv= 9.0 fps
2.5	190	0.0630	1.25		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
55.1	700	Total			

**Summary for Pond 1P: Basin 1**

Inflow Area = 1.125 ac, 14.33% Impervious, Inflow Depth = 0.66" for 2-year event  
 Inflow = 0.40 cfs @ 12.50 hrs, Volume= 0.061 af  
 Outflow = 0.02 cfs @ 21.37 hrs, Volume= 0.061 af, Atten= 94%, Lag= 531.9 min  
 Discarded = 0.02 cfs @ 21.37 hrs, Volume= 0.061 af  
 Primary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
 Peak Elev= 159.58' @ 21.37 hrs Surf.Area= 1,551 sf Storage= 1,791 cf

Plug-Flow detention time= 982.0 min calculated for 0.061 af (100% of inflow)  
 Center-of-Mass det. time= 981.8 min ( 1,897.4 - 915.6 )

Volume #1	Invert	Avail.Storage	Storage Description
	158.00'	10,701 cf	<b>Custom Stage Data (Prismatic) Listed below (Recalc)</b>
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
158.00	723	0	0
160.00	1,774	2,497	2,497
161.00	2,391	2,083	4,580
162.00	4,734	3,563	8,142
162.50	5,500	2,559	10,701

Device	Routing	Invert	Outlet Devices
#1	Discarded	158.00'	<b>0.520 in/hr Exfiltration over Surface area</b> Conductivity to Groundwater Elevation = 152.00'
#2	Primary	162.00'	<b>8.0' long x 9.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

**Discarded OutFlow** Max=0.02 cfs @ 21.37 hrs HW=159.58' (Free Discharge)  
 ↑1=Exfiltration ( Controls 0.02 cfs)

**Primary OutFlow** Max=0.00 cfs @ 2.00 hrs HW=158.00' (Free Discharge)  
 ↑2=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

Time span=2.00-72.00 hrs, dt=0.05 hrs, 1401 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>Subcatchment POST 1: POST 1</b>	Runoff Area=391,729 sf 7.82% Impervious Runoff Depth=1.12" Flow Length=587' Tc=36.4 min CN=59 Runoff=5.30 cfs 0.841 af
<b>Subcatchment POST 2: POST 2</b>	Runoff Area=141,899 sf 2.53% Impervious Runoff Depth=1.00" Flow Length=347' Tc=29.5 min CN=57 Runoff=1.81 cfs 0.271 af
<b>Subcatchment POST 3: POST 3</b>	Runoff Area=49,009 sf 14.33% Impervious Runoff Depth=1.45" Flow Length=184' Tc=29.6 min CN=64 Runoff=1.01 cfs 0.136 af
<b>Subcatchment POST 4: POST 4</b>	Runoff Area=794,458 sf 4.15% Impervious Runoff Depth=1.06" Flow Length=701' Tc=56.4 min CN=58 Runoff=7.80 cfs 1.612 af
<b>Subcatchment PRE 1: PRE 1</b>	Runoff Area=391,729 sf 8.06% Impervious Runoff Depth=1.12" Flow Length=590' Tc=37.3 min CN=59 Runoff=5.23 cfs 0.841 af
<b>Subcatchment PRE 2: PRE 2</b>	Runoff Area=141,899 sf 0.00% Impervious Runoff Depth=0.88" Flow Length=350' Tc=30.9 min CN=55 Runoff=1.48 cfs 0.239 af
<b>Subcatchment PRE 3: PRE 3</b>	Runoff Area=49,009 sf 0.00% Impervious Runoff Depth=0.88" Flow Length=210' Slope=0.0150 '/ Tc=33.9 min CN=55 Runoff=0.49 cfs 0.083 af
<b>Subcatchment PRE 4: PRE 4</b>	Runoff Area=794,458 sf 3.34% Impervious Runoff Depth=1.12" Flow Length=700' Tc=55.1 min CN=59 Runoff=8.54 cfs 1.706 af
<b>Pond 1P: Basin 1</b>	Peak Elev=160.94' Storage=4,438 cf Inflow=1.01 cfs 0.136 af Discarded=0.04 cfs 0.127 af Primary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.127 af

**Summary for Subcatchment POST 1: POST 1**

Runoff = 5.30 cfs @ 12.58 hrs, Volume= 0.841 af, Depth= 1.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-year Rainfall=4.80"

Area (sf)	CN	Description
* 30,615	98	Wetland
122,721	58	Meadow, non-grazed, HSG B
238,393	55	Woods, Good, HSG B
391,729	59	Weighted Average
361,114		92.18% Pervious Area
30,615		7.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.4	150	0.0200	0.09		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 3.40"
3.5	254	0.0300	1.21		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
3.5	183	0.0300	0.87		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
36.4	587	Total			

**Summary for Subcatchment POST 2: POST 2**

Runoff = 1.81 cfs @ 12.49 hrs, Volume= 0.271 af, Depth= 1.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-year Rainfall=4.80"

Area (sf)	CN	Description
103,007	55	Woods, Good, HSG B
35,296	58	Meadow, non-grazed, HSG B
* 3,596	98	Impervious
141,899	57	Weighted Average
138,303		97.47% Pervious Area
3,596		2.53% Impervious Area

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Type III 24-hr 10-year Rainfall=4.80"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.0	135	0.0200	0.08		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 3.40"
0.3	15	0.0200	0.97		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.40"
0.5	40	0.0300	1.21		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
1.7	157	0.1000	1.58		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
29.5	347	Total			

**Summary for Subcatchment POST 3: POST 3**

Runoff = 1.01 cfs @ 12.45 hrs, Volume= 0.136 af, Depth= 1.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-year Rainfall=4.80"

Area (sf)	CN	Description
41,985	58	Meadow, non-grazed, HSG B
* 7,024	98	Impervious
49,009	64	Weighted Average
41,985		85.67% Pervious Area
7,024		14.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.4	150	0.0200	0.09		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 3.40"
0.1	18	0.0200	2.87		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.1	16	0.3333	4.04		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
29.6	184	Total			

**Summary for Subcatchment POST 4: POST 4**

Runoff = 7.80 cfs @ 12.87 hrs, Volume= 1.612 af, Depth= 1.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-year Rainfall=4.80"

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Type III 24-hr 10-year Rainfall=4.80"

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Area (sf)	CN	Description
* 32,972	98	Impervious
378,398	58	Meadow, non-grazed, HSG B
380,956	55	Woods, Good, HSG B
2,132	61	>75% Grass cover, Good, HSG B
794,458	58	Weighted Average
761,486		95.85% Pervious Area
32,972		4.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
43.9	150	0.0070	0.06		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.40"
6.0	150	0.0070	0.42		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
6.5	401	0.0420	1.02		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
56.4	701	Total			

**Summary for Subcatchment PRE 1: PRE 1**

Runoff = 5.23 cfs @ 12.60 hrs, Volume= 0.841 af, Depth= 1.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-year Rainfall=4.80"

Area (sf)	CN	Description
* 30,615	98	Wetland
* 948	98	Impervious
5,856	61	>75% Grass cover, Good, HSG B
354,310	55	Woods, Good, HSG B
391,729	59	Weighted Average
360,166		91.94% Pervious Area
31,563		8.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.8	150	0.0200	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.40"
8.5	440	0.0300	0.87		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
37.3	590	Total			

**Summary for Subcatchment PRE 2: PRE 2**

Runoff = 1.48 cfs @ 12.53 hrs, Volume= 0.239 af, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-year Rainfall=4.80"

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Type III 24-hr 10-year Rainfall=4.80"

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Area (sf)	CN	Description
141,899	55	Woods, Good, HSG B
141,899		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.8	150	0.0200	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.40"
2.1	200	0.1000	1.58		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
30.9	350	Total			

**Summary for Subcatchment PRE 3: PRE 3**

Runoff = 0.49 cfs @ 12.58 hrs, Volume= 0.083 af, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-year Rainfall=4.80"

Area (sf)	CN	Description
49,009	55	Woods, Good, HSG B
49,009		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.3	150	0.0150	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.40"
1.6	60	0.0150	0.61		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
33.9	210	Total			

**Summary for Subcatchment PRE 4: PRE 4**

Runoff = 8.54 cfs @ 12.85 hrs, Volume= 1.706 af, Depth= 1.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-year Rainfall=4.80"

Area (sf)	CN	Description
* 26,543	98	Impervious
70,737	61	>75% Grass cover, Good, HSG B
613,626	55	Woods, Good, HSG B
83,552	75	Small grain, straight row, Good, HSG B
794,458	59	Weighted Average
767,915		96.66% Pervious Area
26,543		3.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
43.9	150	0.0070	0.06		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.40"
6.4	160	0.0070	0.42		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
2.3	200	0.0250	1.42		<b>Shallow Concentrated Flow,</b> Cultivated Straight Rows Kv= 9.0 fps
2.5	190	0.0630	1.25		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
55.1	700	Total			

**Summary for Pond 1P: Basin 1**

Inflow Area = 1.125 ac, 14.33% Impervious, Inflow Depth = 1.45" for 10-year event  
 Inflow = 1.01 cfs @ 12.45 hrs, Volume= 0.136 af  
 Outflow = 0.04 cfs @ 22.50 hrs, Volume= 0.127 af, Atten= 96%, Lag= 602.5 min  
 Discarded = 0.04 cfs @ 22.50 hrs, Volume= 0.127 af  
 Primary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
 Peak Elev= 160.94' @ 22.50 hrs Surf.Area= 2,354 sf Storage= 4,438 cf

Plug-Flow detention time= 1,376.8 min calculated for 0.127 af (93% of inflow)  
 Center-of-Mass det. time= 1,342.5 min ( 2,230.7 - 888.2 )

Volume #1	Invert	Avail.Storage	Storage Description
	158.00'	10,701 cf	<b>Custom Stage Data (Prismatic) Listed below (Recalc)</b>
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
158.00	723	0	0
160.00	1,774	2,497	2,497
161.00	2,391	2,083	4,580
162.00	4,734	3,563	8,142
162.50	5,500	2,559	10,701

Device	Routing	Invert	Outlet Devices
#1	Discarded	158.00'	<b>0.520 in/hr Exfiltration over Surface area</b> Conductivity to Groundwater Elevation = 152.00'
#2	Primary	162.00'	<b>8.0' long x 9.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

**Discarded OutFlow** Max=0.04 cfs @ 22.50 hrs HW=160.94' (Free Discharge)  
 ↑1=Exfiltration ( Controls 0.04 cfs)

**Primary OutFlow** Max=0.00 cfs @ 2.00 hrs HW=158.00' (Free Discharge)  
 ↑2=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

Time span=2.00-72.00 hrs, dt=0.05 hrs, 1401 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>Subcatchment POST 1: POST 1</b>	Runoff Area=391,729 sf 7.82% Impervious Runoff Depth=2.51" Flow Length=587' Tc=36.4 min CN=59 Runoff=13.10 cfs 1.878 af
<b>Subcatchment POST 2: POST 2</b>	Runoff Area=141,899 sf 2.53% Impervious Runoff Depth=2.31" Flow Length=347' Tc=29.5 min CN=57 Runoff=4.76 cfs 0.628 af
<b>Subcatchment POST 3: POST 3</b>	Runoff Area=49,009 sf 14.33% Impervious Runoff Depth=3.00" Flow Length=184' Tc=29.6 min CN=64 Runoff=2.21 cfs 0.281 af
<b>Subcatchment POST 4: POST 4</b>	Runoff Area=794,458 sf 4.15% Impervious Runoff Depth=2.41" Flow Length=701' Tc=56.4 min CN=58 Runoff=19.95 cfs 3.662 af
<b>Subcatchment PRE 1: PRE 1</b>	Runoff Area=391,729 sf 8.06% Impervious Runoff Depth=2.51" Flow Length=590' Tc=37.3 min CN=59 Runoff=12.94 cfs 1.878 af
<b>Subcatchment PRE 2: PRE 2</b>	Runoff Area=141,899 sf 0.00% Impervious Runoff Depth=2.12" Flow Length=350' Tc=30.9 min CN=55 Runoff=4.21 cfs 0.577 af
<b>Subcatchment PRE 3: PRE 3</b>	Runoff Area=49,009 sf 0.00% Impervious Runoff Depth=2.12" Flow Length=210' Slope=0.0150 '/' Tc=33.9 min CN=55 Runoff=1.39 cfs 0.199 af
<b>Subcatchment PRE 4: PRE 4</b>	Runoff Area=794,458 sf 3.34% Impervious Runoff Depth=2.51" Flow Length=700' Tc=55.1 min CN=59 Runoff=21.24 cfs 3.809 af
<b>Pond 1P: Basin 1</b>	Peak Elev=162.03' Storage=8,287 cf Inflow=2.21 cfs 0.281 af Discarded=0.07 cfs 0.220 af Primary=0.13 cfs 0.026 af Outflow=0.20 cfs 0.246 af

**Summary for Subcatchment POST 1: POST 1**

Runoff = 13.10 cfs @ 12.54 hrs, Volume= 1.878 af, Depth= 2.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-year Rainfall=7.00"

Area (sf)	CN	Description
* 30,615	98	Wetland
122,721	58	Meadow, non-grazed, HSG B
238,393	55	Woods, Good, HSG B
391,729	59	Weighted Average
361,114		92.18% Pervious Area
30,615		7.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.4	150	0.0200	0.09		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 3.40"
3.5	254	0.0300	1.21		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
3.5	183	0.0300	0.87		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
36.4	587	Total			

**Summary for Subcatchment POST 2: POST 2**

Runoff = 4.76 cfs @ 12.45 hrs, Volume= 0.628 af, Depth= 2.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-year Rainfall=7.00"

Area (sf)	CN	Description
103,007	55	Woods, Good, HSG B
35,296	58	Meadow, non-grazed, HSG B
* 3,596	98	Impervious
141,899	57	Weighted Average
138,303		97.47% Pervious Area
3,596		2.53% Impervious Area

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Type III 24-hr 100-year Rainfall=7.00"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.0	135	0.0200	0.08		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 3.40"
0.3	15	0.0200	0.97		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 3.40"
0.5	40	0.0300	1.21		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
1.7	157	0.1000	1.58		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
29.5	347	Total			

**Summary for Subcatchment POST 3: POST 3**

Runoff = 2.21 cfs @ 12.43 hrs, Volume= 0.281 af, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-year Rainfall=7.00"

Area (sf)	CN	Description
41,985	58	Meadow, non-grazed, HSG B
* 7,024	98	Impervious
49,009	64	Weighted Average
41,985		85.67% Pervious Area
7,024		14.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.4	150	0.0200	0.09		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 3.40"
0.1	18	0.0200	2.87		<b>Shallow Concentrated Flow,</b> Paved Kv= 20.3 fps
0.1	16	0.3333	4.04		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
29.6	184	Total			

**Summary for Subcatchment POST 4: POST 4**

Runoff = 19.95 cfs @ 12.82 hrs, Volume= 3.662 af, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-year Rainfall=7.00"

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Type III 24-hr 100-year Rainfall=7.00"

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Area (sf)	CN	Description
* 32,972	98	Impervious
378,398	58	Meadow, non-grazed, HSG B
380,956	55	Woods, Good, HSG B
2,132	61	>75% Grass cover, Good, HSG B
794,458	58	Weighted Average
761,486		95.85% Pervious Area
32,972		4.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
43.9	150	0.0070	0.06		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.40"
6.0	150	0.0070	0.42		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
6.5	401	0.0420	1.02		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
56.4	701	Total			

**Summary for Subcatchment PRE 1: PRE 1**

Runoff = 12.94 cfs @ 12.55 hrs, Volume= 1.878 af, Depth= 2.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-year Rainfall=7.00"

Area (sf)	CN	Description
* 30,615	98	Wetland
* 948	98	Impervious
5,856	61	>75% Grass cover, Good, HSG B
354,310	55	Woods, Good, HSG B
391,729	59	Weighted Average
360,166		91.94% Pervious Area
31,563		8.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.8	150	0.0200	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.40"
8.5	440	0.0300	0.87		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
37.3	590	Total			

**Summary for Subcatchment PRE 2: PRE 2**

Runoff = 4.21 cfs @ 12.47 hrs, Volume= 0.577 af, Depth= 2.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-year Rainfall=7.00"

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Type III 24-hr 100-year Rainfall=7.00"

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Area (sf)	CN	Description
141,899	55	Woods, Good, HSG B
141,899		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.8	150	0.0200	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.40"
2.1	200	0.1000	1.58		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
30.9	350	Total			

**Summary for Subcatchment PRE 3: PRE 3**

Runoff = 1.39 cfs @ 12.52 hrs, Volume= 0.199 af, Depth= 2.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-year Rainfall=7.00"

Area (sf)	CN	Description
49,009	55	Woods, Good, HSG B
49,009		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.3	150	0.0150	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.40"
1.6	60	0.0150	0.61		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
33.9	210	Total			

**Summary for Subcatchment PRE 4: PRE 4**

Runoff = 21.24 cfs @ 12.80 hrs, Volume= 3.809 af, Depth= 2.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-year Rainfall=7.00"

Area (sf)	CN	Description
* 26,543	98	Impervious
70,737	61	>75% Grass cover, Good, HSG B
613,626	55	Woods, Good, HSG B
83,552	75	Small grain, straight row, Good, HSG B
794,458	59	Weighted Average
767,915		96.66% Pervious Area
26,543		3.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
43.9	150	0.0070	0.06		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.40"
6.4	160	0.0070	0.42		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
2.3	200	0.0250	1.42		<b>Shallow Concentrated Flow,</b> Cultivated Straight Rows Kv= 9.0 fps
2.5	190	0.0630	1.25		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
55.1	700	Total			

**Summary for Pond 1P: Basin 1**

Inflow Area = 1.125 ac, 14.33% Impervious, Inflow Depth = 3.00" for 100-year event  
 Inflow = 2.21 cfs @ 12.43 hrs, Volume= 0.281 af  
 Outflow = 0.20 cfs @ 15.66 hrs, Volume= 0.246 af, Atten= 91%, Lag= 193.9 min  
 Discarded = 0.07 cfs @ 15.66 hrs, Volume= 0.220 af  
 Primary = 0.13 cfs @ 15.66 hrs, Volume= 0.026 af

Routing by Stor-Ind method, Time Span= 2.00-72.00 hrs, dt= 0.05 hrs  
 Peak Elev= 162.03' @ 15.66 hrs Surf.Area= 4,781 sf Storage= 8,287 cf

Plug-Flow detention time= 1,195.3 min calculated for 0.246 af (87% of inflow)  
 Center-of-Mass det. time= 1,136.9 min ( 2,003.1 - 866.1 )

Volume #1	Invert	Avail.Storage	Storage Description
	158.00'	10,701 cf	<b>Custom Stage Data (Prismatic) Listed below (Recalc)</b>
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
158.00	723	0	0
160.00	1,774	2,497	2,497
161.00	2,391	2,083	4,580
162.00	4,734	3,563	8,142
162.50	5,500	2,559	10,701

Device	Routing	Invert	Outlet Devices
#1	Discarded	158.00'	<b>0.520 in/hr Exfiltration over Surface area</b> Conductivity to Groundwater Elevation = 152.00'
#2	Primary	162.00'	<b>8.0' long x 9.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

**Discarded OutFlow** Max=0.07 cfs @ 15.66 hrs HW=162.03' (Free Discharge)  
 ↑1=Exfiltration ( Controls 0.07 cfs)

**Primary OutFlow** Max=0.10 cfs @ 15.66 hrs HW=162.03' (Free Discharge)  
 ↑2=Broad-Crested Rectangular Weir (Weir Controls 0.10 cfs @ 0.43 fps)