TETRA TECH

Letter of Transmittal

To: Mr. James Bradbury, Planning Board Chair
Town of Pelham Planning Board
351 Amherst Road, Pelham, MA 01002

Date:	August 20, 2026
Project:	**"Tower Road Solar Project"**
Re:	Special Permit Application Submittal

We Are Sending You:

☒ Attached ☐ Samples ☐ Specifications
☐ Shop drawings ☐ Prints
☐ Copy of letter ☐ Change order ☐ Under Separate Cover

Copies	Date	No.	Description
12	08/20/2026	1	Cover Letter and Project Narrative
12	08/20/2026	1	Special Permit Application and Supporting Documentation
12	08/20/2026	1	Site Plans
12	06/30/2026	1	Stormwater Management Report
1	06/30/2026	1	Thumb drive with electronic copy of submittal

Items Are Transmitted As Checked Below:

☒ For approval ☐ Approved as submitted ☐ Resubmit ☐ Copies for approval
☐ For your use ☐ Approved as noted ☐ Submit ☐ Copies for distribution
☐ As requested ☐ Returned for correction ☐ Return ☐ Corrected prints
☒ For review ☐ For bids due ☐ Prints returned after loan to us

Remarks:

Please find attached submittal materials in support of the Tower Road Solar Project's request for a Special Permit from the Town of Pelham Planning Board. The $5,150 application fee will be provided directly by the applicant PureSky. Please call if you have any questions or need additional information.
Sean (508) 786-2230

Signed:

Sean P. Reardon, P.E.,
Vice President

100 Nickerson Road, Marlborough, MA 01752
Tel 508.786.2200 Fax 508.786.2201 tetratech.com

TETRA TECH

August 20, 2026

James Bradbury, Chair
Pelham Planning Board
351 Amherst Road
Pelham, MA 01002

Re: Application for Special Permit and Project Narrative
ASD Tower MA Solar LLC
Tower Road, Pelham, MA
Parcel ID: 14-1

Dear Mr. Bradbury:

This letter along with the attached supporting documentation and the application fee payment (to be provided by the applicant) comprise our application for a Special Permit for a 4.4 MW Solar Energy System at the above-referenced site (the Project) pursuant to Section 125-18.2 of the Zoning Bylaw (Solar Bylaw). The site location is shown on the attached Project Locus Map.

This application is being submitted on behalf of ASD Tower MA Solar LLC (the Applicant) and in cooperation with the existing landowner (WD Cowls, Inc.).

The Project qualifies as a Large-Scale Ground-Mounted Solar Electric Installation as defined in the Solar Bylaw and includes installation of just under 8 acres of solar panels setback nearly 2,000 feet from Packardville Road. The panels and all mechanical cabinets/enclosures will be located within a 24-acre fenced area and accessed via Tower Road. Power generated from the facility will be conveyed underground from the inverter to a series of standard "interconnect" poles arranged along the project driveway entrance off Tower Road. The Project's key features are summarized below, and additional detail is provided in the narrative that follows and on the Site Plans included with the application.

Key Features

- *Address: Tower Road (off Packardville Road)*
- *Tax Parcel ID: 14-1*
- *Parcel Area: 64 acres*
- *Generation Capacity: 4.4 MW*
- *Panel Area (max ground area covered by panels): 7.7 acres*
- *Fenced Area: 23.4 acres*
- *Panel Setback from Packardville Road: >1,900 feet*
- *Minimum Panel Setback from rear/side lot line: 100 feet*

Project Narrative

The Applicant's vision is to provide renewable energy solutions that invigorate progress, enhance lives, and leave a legacy of environmental stewardship through building, owning, and operating community solar farms that empower energy consumers across the US with the ability to choose local, affordable, clean energy.

The Project proponent proposes clearing approximately 34 acres of a 64-acre managed wood lot to construct a 4.4 MW solar energy facility. The project will utilize tracking panels oriented in a north/south configuration that rotate with the sun to maximize light exposure. Tracker panels are more efficient than static panel installations. As such, they require fewer panels, can produce the same power from a smaller footprint, and eliminate the stationary drip edge and the associated erosion risk of stationary panels. The array will be arranged in two sections to maintain the existing path (Cemetery Road) that currently traverses the site. This

Infrastructure Northeast
Marlborough Technology Park, 100 Nickerson Road, Marlborough, MA 01752
Tel 508.786.2200 Fax 508.786.2201 tetratech.com

path is routinely used by skiers and hikers who prefer its gentle slope over much steeper alternative paths that bypass the property. Each array section will be surrounded by a fence as required by electric code. In the interest of maintaining the rural character, the perimeter fence will be an 8-foot agricultural-style fence which is less visible and has a less industrial appearance compared to a typical chain link fence.

The project will also include battery storage systems to further increase facility production by enabling the most efficient use of available electric infrastructure. The storage systems will be located near the project center as required in the Pelham Solar Bylaw and 285 feet from the nearest tree line. The Project will include installation of a 20,000-gallon, frost-protected water storage tank that will serve as a water source the Pelham Fire Department can use when responding to an issue at the site or elsewhere in the surrounding community.

The system components have been arranged to minimize impacts to native-American ceremonial stone piles and other historic features identified on site. The ceremonial stone piles and historic building features have been documented, and their locations are shown on the Site Plans. Required cultural studies and copies of project communication with indigenous tribes is included with the application materials.

The Project meets applicable “Requirements” (Section 125-18.2 D.), “Design and Performance Standards” (Section 125-18.2 E.), and “Safety and Environmental Standards” (Section 125-18.2 F.) described in the Zoning Bylaw, except for the six (6) waivers described below. Based on our interpretation of the bylaw, some of the requested waivers may not be required. However, to ensure our application is complete and out of an abundance of caution, all six are being requested. The Project meets the standard for approval for all requested waivers and Criteria described in Section 125-26 D(5) of the Zoning Bylaw.

Project Benefits

The following is a summary of benefits offered by the project.

Sustainable Renewable Power

First and foremost, power generated from the project will offset power that would otherwise be generated by burning fossil fuels, eliminating a substantial pollution source. A project this size can avoid generation of more than 2,500 tons CO2/year that would otherwise be discharged to the atmosphere were the power generated from traditional fossil fuels. The facility is expected to generate enough power to supply approximately 750 households, which puts Pelham in a category of Towns capable of generating as much power from sustainable sources as they consume.

Increased Habitat Diversity

Groundcover at the site will be maintained as an open wildflower meadow, a habitat which is generally in short supply in western Massachusetts. Early-successional habitats (meadows, shrublands, grasslands) have declined sharply in western Massachusetts as abandoned farmland has reverted to forest. Maintaining the site as a 34-acre pollinator meadow will provide valuable habitat to native bees, grassland and shrubland birds, butterflies and moths, small mammals, and reptiles that avoid the forest habitat. Many of these species cannot survive in the closed-canopy woodlands that now dominates the region.

Historical/Archaeological Engagement

The Project site includes several historical/archaeological/cultural points of interest, including remnant foundations of the Johnson/O’Brien Estate, the Ruben Allen/Johnson Family burial place, and several stone features with suspected ceremonial significance to indigenous tribes. The Project will preserve and protect these resources and improve access to and engagement with them as part of the Project. Improvements will include clearing and maintenance of areas around the remnant foundations and cemetery, and construction of a gravel pull out. Copies of related studies are included with the application materials.

Reliable Tax Revenue

The town can reasonably expect to receive more than $70,000/year in annual tax revenue from the Project with annual escalation in the range of 2-2.5%. This represents nearly $2.5 million in stable tax revenue for the Town as opposed to the nominal amount of revenue (less than $500/year) that would otherwise be generated if the property were left in its current state.

Waiver Requests

To the extent they may be required, we request the following waivers from the Solar Bylaw (Chapter 125 Section 18.2) as provided for at 125-18.2, C, (4) to allow the project to be built as shown on the Site Plans, given the Project meets the standard for approval set forth in 125-18.2, C, (4). (a) and (b) as described below.

125-18.2, D, (2), (a): (frontage on a public way) - The subject parcel exists and surrounds the Town of Pelham's Adam Cemetery parcel. The parcel is occupied by a radio tower and control room and is traversed by Tower Road and Cemetery Drive (Woods Road) with more than 1,000 feet of frontage on Tower Road - an improved private gravel road which we believe exceeds minimum frontage requirements of 125-6. However, to the extent the Planning Board determines a waiver is required, we request such a waiver to allow the project to be constructed as shown on the Site Plans on the subject parcel as it currently exists.

(a) Special Circumstances: The site's history and position relative to other built environments as well as its location proximate to existing power infrastructure traversing the property comprises special circumstances which negate the need for imposition of any additional frontage requirements.

(b) No Derogation of Intent: Granting the requested waiver will in no way derogate from the intent as the parcel currently exists and includes an existing non-occupied use consistent with the proposed use, and its location removed from the road is consistent with the bylaw goal of reducing visual impact as described in125-18.2, E, (4).

125-18.2, D, (2), (b): (driveway limited to 1,000 feet) - The subject parcel is located off a private road that was once a public way and which currently serves as the sole means of access to the Town of Pelham's Adam Cemetery parcel as well as to the structures and other improvements on Mount Lincoln suggesting the existing access road leading from Packardville Road to the site would not be considered a "driveway" subject to the 1,000-foot limitation. However, to the extent the Planning Board determines a waiver is required, we request such a waiver to allow the project to be constructed as shown on the Site Plans with its proposed access from Tower Road.

(a) Special Circumstances: The site is already served by an existing road which serves other nearby uses and will be used similarly for the proposed project.

(b) No Derogation of Intent: Granting the requested waiver will in no way derogate from the intent of the bylaw as the access road currently exists and the Project seeks only to utilize roads and trails that already exist and currently serve similar uses on-site and nearby.

125-18.2, D, (2), (c), (i): (Large-Scale Installations defined as more than 1.5 acres and no greater than 15 acres) - To the extent this section was intended to prohibit projects occupying more than 15 acres and to the extent that "occupying" applies to portions of the project site not occupied by structures or impervious surfaces, a waiver is requested to allow the project to be constructed as shown on the Site Plans which includes less than one (1) acre of permanent impervious ground coverage with 7.7 acres of periodic cover from the elevated panels within a 23.4-acre fenced area.

(a) Special Circumstances: The site's remote location and proximity to existing power infrastructure traversing the property are special circumstances which make the site an ideal candidate for a solar facility of the size proposed.

(b) No Derogation of Intent: Granting the requested waiver will in no way derogate from the intent of the bylaw as the site is in a remote location visible only from private roads, approximately half of the 64-acre site will remain undisturbed and there will be less than 1 acre of new impervious cover.

125-18.2, D, (2), (d): (Setbacks for Large-Scale Installations) - To the extent the Planning Board determines "Front street setback" is measured to the Tower Road easement line rather than the Packardville Road right-of-way or that "setback" is measured to something other than "a building or feature thereof" as defined in Article VIII of the bylaw; and the Planning Board determines a waiver is required, we request a waiver to allow the project to be constructed as shown on the Site Plans which maintains at least 100 feet between all property lines and the edge of solar panels.

(a) Special Circumstances: The site's remote location and the desire to maintain the existing Cemetery Road hiking/skiing trail through the center of the property are special circumstances which require efficient use of the available footprint to minimize overall impact.

(b) No Derogation of Intent: Granting the requested waiver will in no way derogate from the intent of the bylaw as the closest occupied structure is more than 1,000 feet away from the project and the 100-foot setback is met for the panels and equipment.

125-18.2, F, (2), (d): (10% Slope Limit) - The project site includes land whose pre-development grades exceed 10%. A waiver is requested to allow the project to be constructed as shown on the Site Plans.

(a) Special Circumstances: Areas where existing grades exceed 10% are scattered throughout the site which is typical for most properties in Pelham given 45% of the Town's land area exceeds 10% slope (see attached Slope Analysis figure).

(b) No Derogation of Intent: Granting the requested waiver will in no way derogate from the intent of the bylaw as most of the site will be maintained as vegetated ground cover and almost half of the wooded areas on-site will be undisturbed. Less than 3% of the 64-acre site will be re-graded and only where necessary and to the extent required to meet equipment tolerances. The Project will obtain coverage under the USEPA NPDES Construction General Permit for Stormwater Discharges from Construction Activity (CGP), no land disturbance is proposed within 100 feet of a bordering vegetated wetland, and no hazardous materials will be stored on site. As such, the Project poses no risk or could reasonably be expected to negatively impact adjacent resource areas or water supplies.

125-18.2, F, (3), (b): (Core Habitat and Critical Natural Landscape) - The northeast corner of the Project Site extends into area mapped as Critical Natural Landscape (CNL), but no portion of the site is within area mapped as Core Habitat. To the extent this section was intended to limit development in such areas despite language suggesting the stated prohibition applies to areas which are both Core Habitat "and" CNL, a waiver is requested to allow the project to be constructed as shown on the Site Plans.

(a) Special Circumstances: The site's remote location and proximity to existing power infrastructure traversing the property are special circumstances which make the site an ideal candidate for a solar facility of the size proposed.

(b) No Derogation of Intent: Granting the requested waiver will in no way derogate from the intent of the bylaw as half of the Project site will remain undisturbed and will be maintained almost entirely in a vegetated condition well-suited as habitat for a wide range of native wildlife particularly pollinators. Less than 10 acres of the project is located within CNL which constitutes less than 0.1% of the 16,000 acres of CNL in Pelham (81% of Town). None of the Project is located within Core Habitat while almost one quarter of the land area in Pelham is within Core Habitat. The project site is not located within any of the other areas listed under this section.

The Project otherwise complies with all applicable requirements and conditions, and the attached submittals comprise all information required.

Enclosed please find twelve (12) copies of the Special Permit application materials including all applicable information listed in Section 125-18.2 of the Zoning Bylaws.

Please contact me with any questions or to discuss any related process. I can be reached by email at sean.reardon@tetratech.com or by telephone at 508.786.2230. We thank you for your attention and are prepared to present the Project to the Planning Board and address comments/questions at its earliest convenience.

Very truly yours,



Sean P. Reardon, P.E.,
Vice President

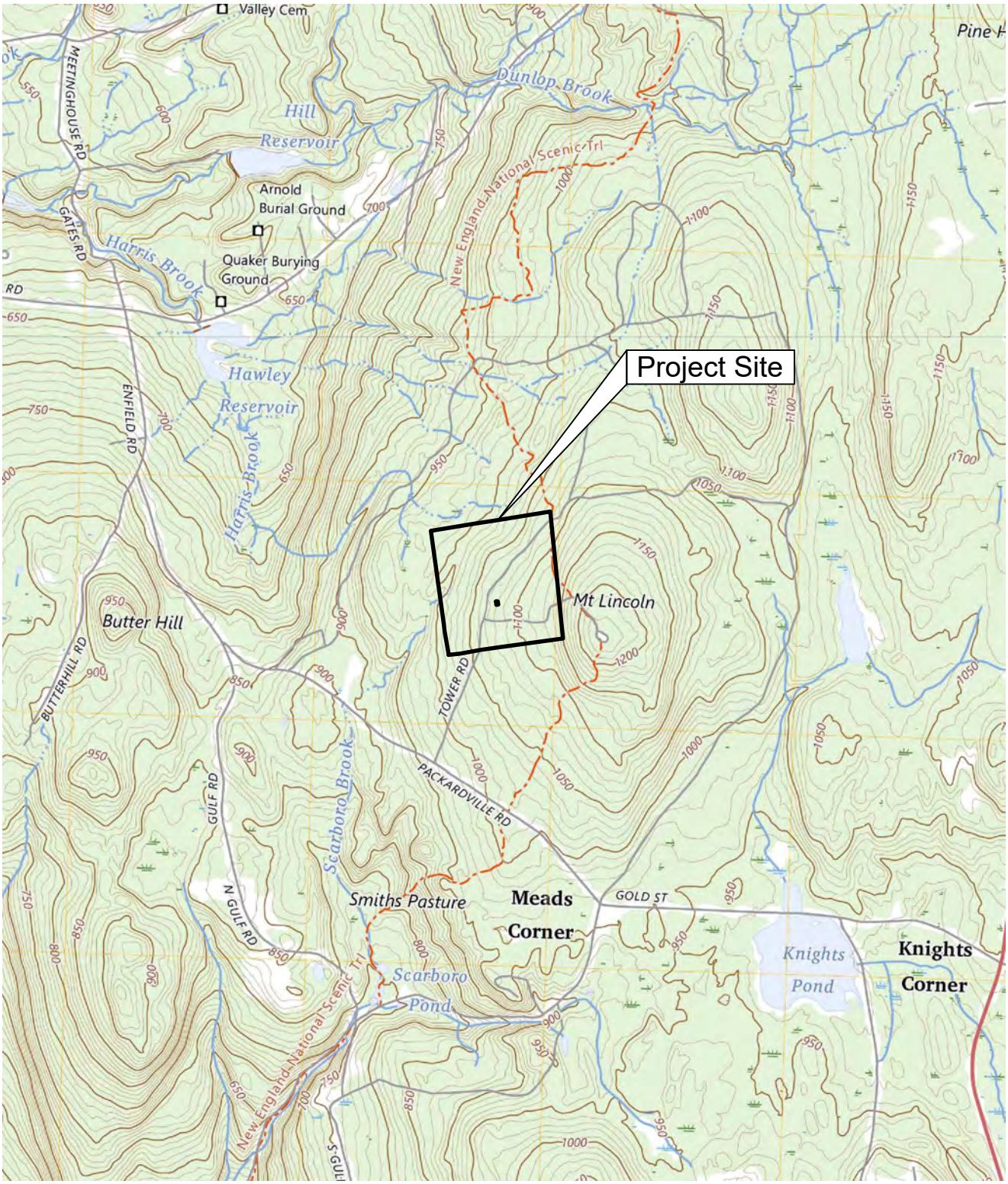
Attachments:

Locus Map
Pelham 10% Slope Figure
Applications
Attachment A – Special Permit Plans (reduced)
Attachment B – Pre-Submission Documents
Attachment C – Figures
Attachment D – Stormwater Management Report
Attachment E – Equipment Specifications and Materials
Attachment F – One-Line Electrical Diagram
Attachment G – Site Control Documentation
Attachment H – Operation and Maintenance Plan
Attachment I – Decommissioning Plan and Bond Estimate
Attachment J – Evidence of Utility Company Agreement
Attachment K – Proof of Liability Insurance
Attachment L – Noise Assessment
Attachment M – Water Analysis

P:\620765\143-620765-24013\DOCS\SPECIAL PERMIT\2026-08-20 (SP LETTTER).DOCX

INFORMATION BASED ON:

1. USGS MAP OF SHUTESBURY, MASSACHUSETTS, DATED 2024
2. USGS MAP OF BELCHERTOWN, MASSACHUSETTS, DATED 2024



TETRA TECH

www.tetratech.com

100 Nickerson Road
Marlborough, MA 01752
Phone: 1 (508) 786-2200 | Fax: 1 (508) 786-2201

ASD Tower MA Solar LLC

Tower Road
Pelham, Massachusetts 01002

0 1000' 2000'

SCALE: 1" = 2000'

Site Locus Map

Project No.:	143-620765-24013
Date:	June 30, 2026
Designed By:	JDA
Figure	1

Bar Measures 1 inch

Copyright: Tetra Tech

6/3/2026 2:45:41 PM - P:\620765\143-620765-24013\CAD\SHEETFILES\SPECIAL PERMIT APPLICATION\FIGURE 1 - SITE LOCUS.DWG - AHERN, JOHN

C:\Pelham_Slope\Pelham\Pelham.aprx- Layout Template 07/20/26 CS



Tower Road Solar Project

TOWN OF PELHAM, MA SLOPE ANALYSIS

TETRA TECH

Slope

>10%

Notes:
1) 45% of land in Pelham is greater than 10% slope.

2) Elevation Data: USGS, 20211109, 1/3 Arc Second, n43w073

3) Imagery MassGIS, MassDOT - Highway Division, MassDEP, MWRA, Earthstar Geographics, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community

N

0 0.5 1

Miles

Town of Pelham Planning Board
351 Amherst Road, Pelham, Massachusetts 01002
Town Office: 413-253-7129 | Town Clerk: 413-253-7129 x4

SPECIAL PERMIT APPLICATION

ASD TOWER MA SOLAR LLC
Applicant

Rick Kilbourne

518 17th St, Suite 950, Denver CO, 80202
Address

rick.kilbourne@pureskyenergy.com
Telephone/email

W.D Cowls Inc.
Property owner if other than applicant

P.O. Box 9677

North Amherst, MA 01059
Address

413-549-1403
Telephone/email

Sean Reardon, P.E. (Tetra Tech)
Attorney/Engineer/Architect (if any)

100 Nickerson Road, Marlborough, MA, 01752
Address

sean.reardon@tetratech.com
Telephone/email

Planning Board Use Only

Application received by PB (date):_____
Application complete date:_____
Referred to other boards date: _____
Boards referred to:_____
Public Hearing date (within 65 days of submission):_____
Public Hearing Notice date (at least 14 days prior to Hearing Date):_____
Continued Public Hearing date (if applicable):_____
Final PB decision date (within 90 days of Public Hearing date):_____
PB Decision Filing date w/Town Clerk (within 14 days):_____
PB Decision Recording date w/Registry of Deeds (following 20-day appeal period):_____

Name and Brief Description of Project (attach additional sheets if necessary)

Tower Road Solar Project. See Cover Letter.

(over to page 2)

Is site plan review part of this special permit application? X **Yes** **No** ____

Is this an amendment to a previously granted special permit? ____ **Yes** **No** X

Property Address Tower Road Pelham

Assessor Map/Parcel #s 14-1

Property Deed Book/Page #s 1213/346, 484/373, 617/195, 729/368, 785/299

Zoning District Residential

Applicable Bylaw Section 125-18.2, 125-26

Justification for Waivers of Required Information (see Zoning Bylaw Section 125-26 and any other applicable bylaw sections) :

Please refer to Pages 3-5 of the Cover Letter under the section titled "Waiver Requests".

Site Planning or Mitigation Measures (attach additional materials/plans as necessary):

Please refer to Pages 1-2 of the Cover Letter under the section titled "Project Narrative", as well as the Special Permit Plans provided in Attachment A.

Signature of Applicant **Signature of Property Owner(s)**

Town Hall and Planning Board Office Use Only

12 Copies filed with Town Clerk on: _____ **Appropriate fee paid:** _____ **(Yes/No)**

Transmitted to Planning Board: _____ **(Date)**

Signature of Town Clerk or Planning Board _____ **(Date)**



Town of Pelham

Board of Assessors ♦351 Amherst Road ♦Pelham MA 01002
Phone-413-253-0734♦Fax 413-253-0847
pelhamassessor@comcast.net

MAP/BLOCK/PARCEL: 14-1

APPLICANT: ASD Tower MA Solar LLC

DATE: June 17, 2026

BOARD: CONSERVATION PLANNING SELECTBOARD ZONING

CERTIFIED LIST OF ABUTTORS

The Assessor's Office, Town of Pelham, hereby certifies the attached list of names and addresses. This list reflects the current names and addresses as they appear in our records as of January 1, 2020

This list is only valid for a period of thirty (30) days from the date of certification by the Assessor.

Lori J Turati

LORI J. TURATI

APPLICANT
ASSESSORS
CONSERVATION
PLANNING
SELECTBOARD
ZONING

JOHN J AHERN III
414 RACE HILL RD
MADISON, CT 06443-1665

194
51-57/119 CT
18467

06/09/2026
Date

Pay to the Order of Town of Pelham $ 25.00

Twenty Dollars and Zero Cents Dollars

Photo Safe Deposit® Details on back

Bank of America

ACH R/T 011900571

For Request for Certified Abutters

MP

⑆011900571⑆ 385014500004⑈0194

PELHAM BOARD OF ASSESSORS
REQUEST FOR CERTIFIED LIST OF ABUTTERS

Note: THE ASSESSORS OFFICE REQUIRES 10 BUSINESS DAYS TO PREPARE AN ABUTTERS LIST. WE THEREFORE ADVISE YOU NOT TO SCHEDULE A HEARING UNTIL YOU HAVE THIS LIST.

$25.00 Fee
Checks Payable to:
Town of Pelham

Tower Road
STREET ADDRESS

14 MAP

1 PARCEL

W.D. Cowls Inc.
OWNER'S NAME

PO Box 9677
STREET

North Amherst, MA 01059
CITY ST

ASD Tower MA Solar LLC
APPLICANT'S NAME

518 17th Street, Suite 950
STREET

Denver, CO 80202
CITY STATE ZIP

Manjoor Vahora (302) 332-6376
CONTACT PERSON & PHONE #

Please note that if requesting abutters lists for two different departments for the same parcel, you must fill out separate abutters request forms.

Please circle type of permit or variance requested:

A: Liquor License – Immediate abutters, also 500' from all borders for churches/hospitals/public & private schools.

B: Planning Board – Subdivision or Special Permit - 300'

C: Zoning: - Special Permit or Variance Appeals - 300'

D: Conservation: -Wetland Hearing - 300'

E: Planning - Site Plan Review 300'

F: Selectboard - 300'

NOTE: THE ABUTTERS LIST IS ONLY OFFICIAL FOR A PERIOD OF 30 DAYS FROM THE DATE OF CERTIFICATION BY THE ASSESSOR. AFTER 30 DAYS, YOU WOULD NEED TO REAPPLY FOR A NEW LIST.

RECEIVED

(ASO002)

14-1
COWLS W D INC
Po Box 9677
North Amherst, MA 01059-9677

14-1.A
PELHAM TOWN OF
351 Amherst Rd Rhodes Bldg
Pelham, MA 01002

14-2
COMMONWEALTH OF MASS
C/O OFFICE OF COMMUNITY RELATION
390 Whitmore Hall, Umass
Amherst, MA 01003-9313

Tower Rd discontinued March 10, 1902!

6-34
AULT HOLLY K
123 Packardville Rd
Pelham, MA 01002

6-35
PELHAM TOWN OF
STEVENS CEMETARY
351 Amherst Rd Rhodes Bldg
Pelham, MA 01002

6-36-2
CANNON MEGAN C M & FERULLO ROBER
133 Packardville Rd
Pelham, MA 01002

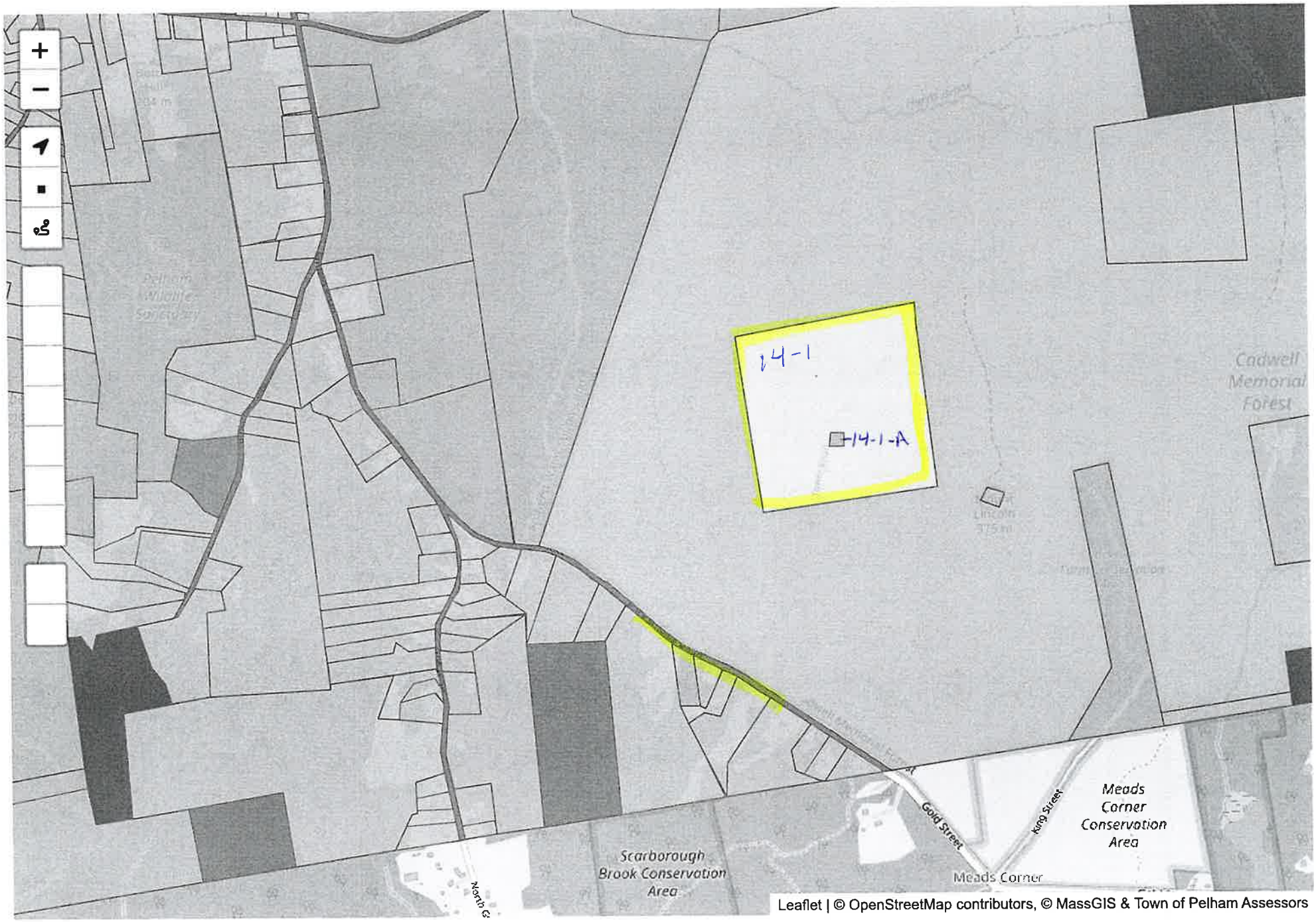
6-36.A
METHOT MARY E
135 Packardville Rd
Pelham, MA 01002

6-38
COUTURE, WESLEY & MATTEAU, PAMEL
139 Packardville Rd
Pelham, MA 01002

6-39
PRATT LEONARD H
137 Packardville Rd
Pelham, MA 01002

14-2
COMMONWEALTH OF MASS
C/O OFFICE OF COMMUNITY RELATION
390 Whitmore Hall, Umass
Amherst, MA 01003-9313

Pelham Maps[Beta!]



Attachment A

Special Permit Plans (reduced)

(Full sized plans provided under separate cover)

Site Plans
Special Permit
Tower Road, Pelham MA

100 Nickerson Road
Marlborough, MA 01752
(508) 786-2200
www.tetratech.com

TETRA TECH



SHEET NO.	SHEET TITLE
- - -	COVER SHEET
- - -	BOUNDARY SURVEY
C-1	EXISTING CONDITIONS AND DEMOLITION PLAN
C-2	SITE PLAN
C-3	CONSTRUCTION DETAILS

PROJECT LOCATION:

Tower Road (MAP ID 14-1)
Pelham, Massachusetts 01002

LAND OWNERS:

W.D. Cowls, Inc.
134 Montague Road
North Amherst, MA 01059-9677
(413) 549-1403

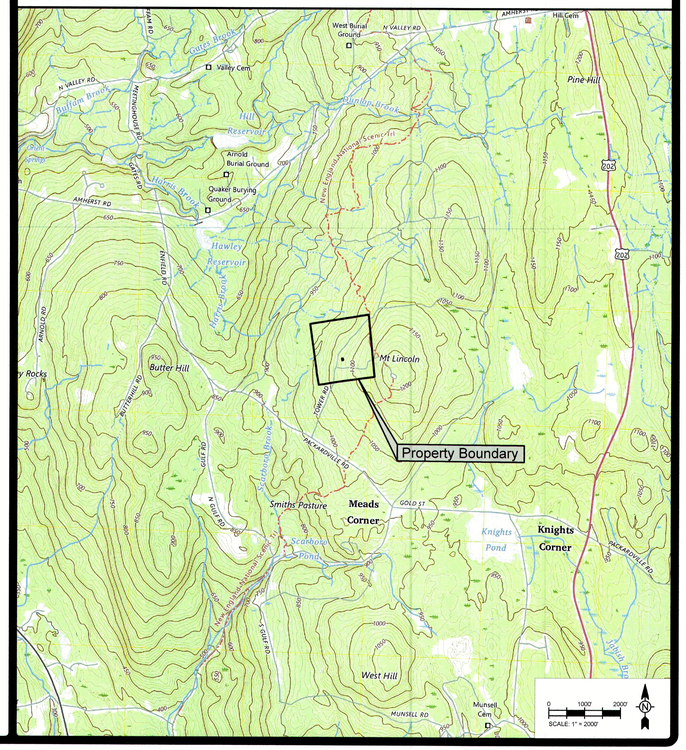
APPLICANT:

ASD Tower MA Solar LLC
518 17th Street, Suite 950
Denver, CO 80202
(877) 267-8727

ISSUED:

AUGUST 20, 2026 - SPECIAL PERMIT APPLICATION

LOCUS MAP:



LEGEND

N/F	NOW OR FORMERLY
A.G.	ABOVE GROUND
B.G.	BELOW GROUND
□	STONE BOUND/FIELD STONE
O IP	IRON PIPE
O IR	IRON ROD
	BLAZED DECIDUOUS TREE
	BLAZED CONIFEROUS TREE
	UTILITY POLE
	GUY WIRE
	PROPERTY LINE
	ABUTTER LINE
	EASEMENT LINE
	RECORD DEED/PLAN LINE
	INTERIOR LOT LINE
	SETBACK LIMIT
OHU	OVERHEAD WIRES
	STONEWALL
	GRAVEL
	TRAIL/WOODS ROAD
1042	ONE FOOT CONTOUR
1040	FIVE FOOT CONTOUR

GRID NORTH
MASSACHUSETTS STATE PLANE
MAINLAND ZONE (NAD83)

SCHEDULE OF DIMENSIONAL CONTROLS

ZONING DISTRICT: RESIDENTIAL (R)

REQUIREMENT	
FRONT YARD:	50 FT.
SIDE YARD:	30 FT.
REAR YARD:	30 FT.

GROUND MOUNTED SOLAR (LARGE SCALE)

REQUIREMENT	
FRONT YARD:	100 FT.
SIDE YARD:	100 FT.
REAR YARD:	100 FT.

VARIANCE GRANTED BY TOWN OF PELHAM BOARD OF APPEALS, 1976, BK. 1935, PG. 86

RECORD OWNER:

WD COWLS, INC.
P.O. BOX 9677
NORTH AMHERST, MA 01059

DEED BOOK 1213, PAGE 346, DATED 1956

SEE ALSO:
DEED BOOK 484, PAGE 373
DEED BOOK 617, PAGE 195
DEED BOOK 729, PAGE 368
DEED BOOK 785, PAGE 299

PLAN REFERENCES:

1. SKETCH PLANS SHOWING CADWELL AND COWLS LOTS, TITLE AND PREPARED UNKNOWN, UNRECORDED.
2. "PLAN OF LAND, ON HALF ACRE, ON SUMMIT OF MT. LINCOLN, PELAM, MASSACHUSETTS" DATED 1935, RECORDED IN PLAN BOOK 20, PAGE 5.

CADWELL
MEMORIAL FOREST
COMMONWEALTH OF MASSACHUSETTS
MAP 14, LOT 2

"STAKE & STONES" (495/223)
2.5" IRON PIPE FOUND
24" A.G.
IN STONE PILE
(HELD)

N 80°36'06" E
726.37'

1.0'

2" IRON PIPE
30" A.G.

(96 RODS OR 1584' TOTAL – BK. 495, PG. 223) (1652' MEAS.)

N 81°22'41" E
330.79'

"STAKE & STONES" (290/289)
1.5" IRON PIPE FOUND
24" A.G.
IN STONE PILE
(HELD)

"STAKE & STONES" (290/289)
2" IRON PIPE FOUND
30" A.G.
IN STONE PILE
(HELD)

N 80°37'51" E
595.26'

1.5" IRON PIPE
24" A.G.

"CHESTNUT TREE" (495/223)
2.5" IRON PIPE FOUND
24" A.G.
IN STONE PILE
(HELD)

"EAST COWLS LOT"
BK. 484, PG. 373
±5 1/2 AC.

6.5'

1.5"
IRON PIPE
24" A.G.

BK. 729, PG. 368
"JOHNSON LOT"
BK. 290, PG. 289
2ND PARCEL
±5 AC. 20 RODS

MATCH LINE

1.5" IRON PIPE
36" A.G.

0.6'

HUB STAKE
FOUND

1.5"
IRON PIPE
24" A.G.

8.5'

(100 RODS OR 1650' TOTAL – BK. 495, PG. 223) (1742' MEAS.)

S 5°38'55" E
1741.88'

WOODED
AREA

N 5°25'22" W
1285.10'

1.5" IRON PIPE
24" A.G.

7.4'

"ALLEN LOT"
BK. 617, PG. 195
BK. 495, PG. 223

AREA
=63.94± ACRES

1.5"
IRON PIPE
24" A.G.

"CEMETERY DRIVE"
WOODS ROAD
(RIGHTS TO OTHERS MAY EXIST)

WOODED
AREA

RIGHT OF WAY
FRANK A. CADWELL
TO AMHERST MOUNTAIN CLUB
BK. 910, PG. 217

CADWELL
MEMORIAL FOREST
COMMONWEALTH OF MASSACHUSETTS
MAP 14, LOT 2

TOWN OF PELHAM
"ALLEN CEMETERY"

GATE

9.1'

1.5" IRON PIPE
36" A.G.
(LOOSE)

EASEMENT
FOR RADIO TOWER
NOT FOUND

2" IRON PIPE
36" A.G.

RADIO
TOWER
CONTROL
ROOM

RADIO
TOWER

SHED

GRAVEL ROAD

CADWELL
MEMORIAL FOREST
COMMONWEALTH OF MASSACHUSETTS
MAP 14, LOT 2

EASEMENT
FOR POWERLINES
NOT FOUND

RIGHTS RESERVED TO
INHABITANTS OF THE
TOWN OF PELHAM

3' WIDE
PATH

ABANDONED
POLE LINE

N 5°21'37" W
84.97'

1.5" IRON PIPE
24" A.G.
IN STONEWALL
(HELD)

S 10°40'09" W
328.25'

"STAKE & STONES" (495/223)
2.5" IRON PIPE FOUND
24" A.G.
IN STONE PILE
(HELD)

STONEWALL
HELD AS EVIDENCE
OF OCCUPATION

155.93'
S 83°54'53" W

276.88'
S 79°48'50" W

2" IRON PIPE
24" A.G.
IN STONEWALL

2" IRON PIPE
24" A.G.
IN STONEWALL
(HELD)

233.19'
S 81°56'25" W

3.9'

1 1/4" IRON PIPE
24" A.G.

908.25'
S 82°04'29" W

3.0'

1.5" IRON PIPE
24" A.G.

"STAKE & STONES" (495/223)
2.5" IRON PIPE FOUND
24" A.G.
IN STONE PILE
(HELD)

(96 RODS OR 1584' TOTAL – BK. 495, PG. 223) (1574' MEAS.)

MOUNT LINCOLN

TOWER

OBSERVATION
TOWER

N/F
COMMONWEALTH OF
MASSACHUSETTS
PARCEL 13–1
BK. 1804, PG. 291
(REF. BK. 910, PG. 217)
(PLAN REF. 2)

USGS
BENCHMARK

RADIO
TOWER

CADWELL
MEMORIAL FOREST
COMMONWEALTH OF MASSACHUSETTS
MAP 14, LOT 2

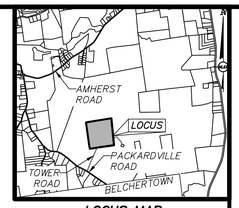
TOWER ROAD
(PRIVATE)

GATE

PACKARDVILLE
ROAD
(PUBLIC)

MATCH LINE

GRAPHIC SCALE
SCALE: 1"= 100'
50 0 50 100 200 400



LOCUS MAP:

(NOT TO SCALE)

NOTES:

1. BOUNDARY INFORMATION DEPICTED HEREON WAS OBTAINED FROM AN SURVEY–GRADE RTK GPS INSTRUMENT SURVEY CONDUCTED ON THE GROUND BY NORTHERN SURVEY ENGINEERING, LLC, 41 CHURCH ROAD, BRUNSWICK, MAINE 04011, UNDER THE DIRECTION OF SEAN P. PIERCE, MA PLS #53106, IN JUNE 2021. THE SITE WAS REVISITED AND THE PLAN VERIFIED BY MERIDIAN ASSOCIATES INC. (MAI) ON SEPTEMBER 3, 2025
2. THE SURFACE DEPICTED HEREON WAS OBTAINED FROM AN AERIAL LIDAR SURVEY CONDUCTED BY BLUESKY ON APRIL 8, 2021.
3. BOOK AND PAGE REFERENCES SHOWN HEREON ARE TO THE HAMPSHIRE COUNTY REGISTRY OF DEEDS (H.C.R.D.).
4. THE SUBJECT PROPERTY IS LOCATED IN THE RESIDENTIAL DISTRICT (R).
5. THE SUBJECT PROPERTY IS DEPICTED AS PARCEL 14–1 ON TOWN OF PELHAM ASSESSOR'S MAPPING.
6. THE LOCATION OF ALL UNDERGROUND UTILITIES SHOWN ARE APPROXIMATE AND ARE BASED UPON A PARTIAL FIELD SURVEY AND COMPILATION OF PLANS OF RECORD. MERIDIAN ASSOCIATES, INC. DOES NOT WARRANTY NOR GUARANTEE THE LOCATION OF ALL UTILITIES DEPICTED OR NOT DEPICTED. THE CONTRACTOR, PRIOR TO COMMENCEMENT OF CONSTRUCTION, SHALL VERIFY THE LOCATION OF ALL UTILITIES AND CONTACT DIG SAFE AT 1–888–344–7233.
7. THIS PLAN DOES NOT SHOW ANY UNRECORDED OR UNWRITTEN EASEMENTS WHICH MAY EXIST. A REASONABLE AND DILIGENT ATTEMPT HAS BEEN MADE TO OBSERVE ANY APPARENT, VISIBLE USES OF THE LAND; HOWEVER, THIS DOES NOT CONSTITUTE A GUARANTEE THAT NO SUCH EASEMENTS EXIST.
8. BEARINGS ARE IN REFERENCE TO GRID NORTH, MASSACHUSETTS STATE PLANE COORDINATE SYSTEM, MAINLAND ZONE, NAD83. THE ELEVATIONS DEPICTED HEREON WERE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), AS DERIVED FROM GPS OBSERVATIONS.
9. PACKARDVILLE ROAD IS A PUBLIC WAY AND WAS NOT INCLUDED IN THIS SURVEY. ACCESS TO PUBLIC ROAD IS BY TOWER ROAD, A PRIVATE WAY, WITH A RIGHT OF WAY RESERVED TO THE INHABITANTS OF THE TOWN OF PELHAM, AND ALSO TO THE AMHERST MOUNTAIN CLUB FOR THE TOWER LOT, NOW OWNED BY COMMONWEALTH OF MASSACHUSETTS. NO WIDTH IS GIVEN.
10. ORIGINAL DEED CALLS ARE NOTED HEREON, AND COURSES BETWEEN CORNERS OF THE SUBJECT PARCEL ARE DESCRIBED AS STRAIGHT LINES WITH NO MENTION OF OTHER INTERMEDIATE MONUMENTS. CORNER MONUMENTS ARE HELD TO FIX STRAIGHT PROPERTY LINES, AND IRON PIPES FOUND ALONG THESE LINES AS SHOWN ARE CONSIDERED SECONDARY EVIDENCE. RIGHTS BY ACQUIESCENCE MAY EXIST.
11. NO CONVEYANCE WAS FOUND FOR THE OVERHEAD UTILITY LINES SHOWN. A FORWARD SEARCH WAS COMPLETED FOR ANY GRANTED RIGHTS BACK TO 1897. BASED ON HISTORICAL IMAGERY, THE LINE WAS BUILT BETWEEN 1938 AND 1962.
12. THE SUBJECT PREMISES IS NOT LOCATED IN A FLOOD ZONE PER DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT FEDERAL INSURANCE ADMINISTRATION FLOOD HAZARD BOUNDARY MAP 8 FOR THE TOWN OF PELHAM, DATED DECEMBER 10, 1976.

REVISIONS		
DATE	DESCRIPTION	BY

COMMONWEALTH OF MASSACHUSETTS
KEVIN E. DANAHY
No. 39683
PROFESSIONAL LAND SURVEYOR

ASD TOWER SOLAR LLC
BOUNDARY SURVEY
LOCATED IN
PELHAM, MA
HAMPSHIRE COUNTY
PREPARED FOR
PURESKY ENERGY

MERIDIAN ASSOCIATES
500 CUMMINGS CENTER, SUITE 5950
BEVERLY, MASSACHUSETTS 01915
TELEPHONE: (978) 646-1445
69 MILK STREET, SUITE 302
WESTBOROUGH, MASSACHUSETTS 01581
TELEPHONE: (508) 871-7030
WWW.MERIDIANASSOC.COM

DESIGNED BY: NORSE
CHECKED BY: MAI

DATE:
SEPTEMBER 12, 2025

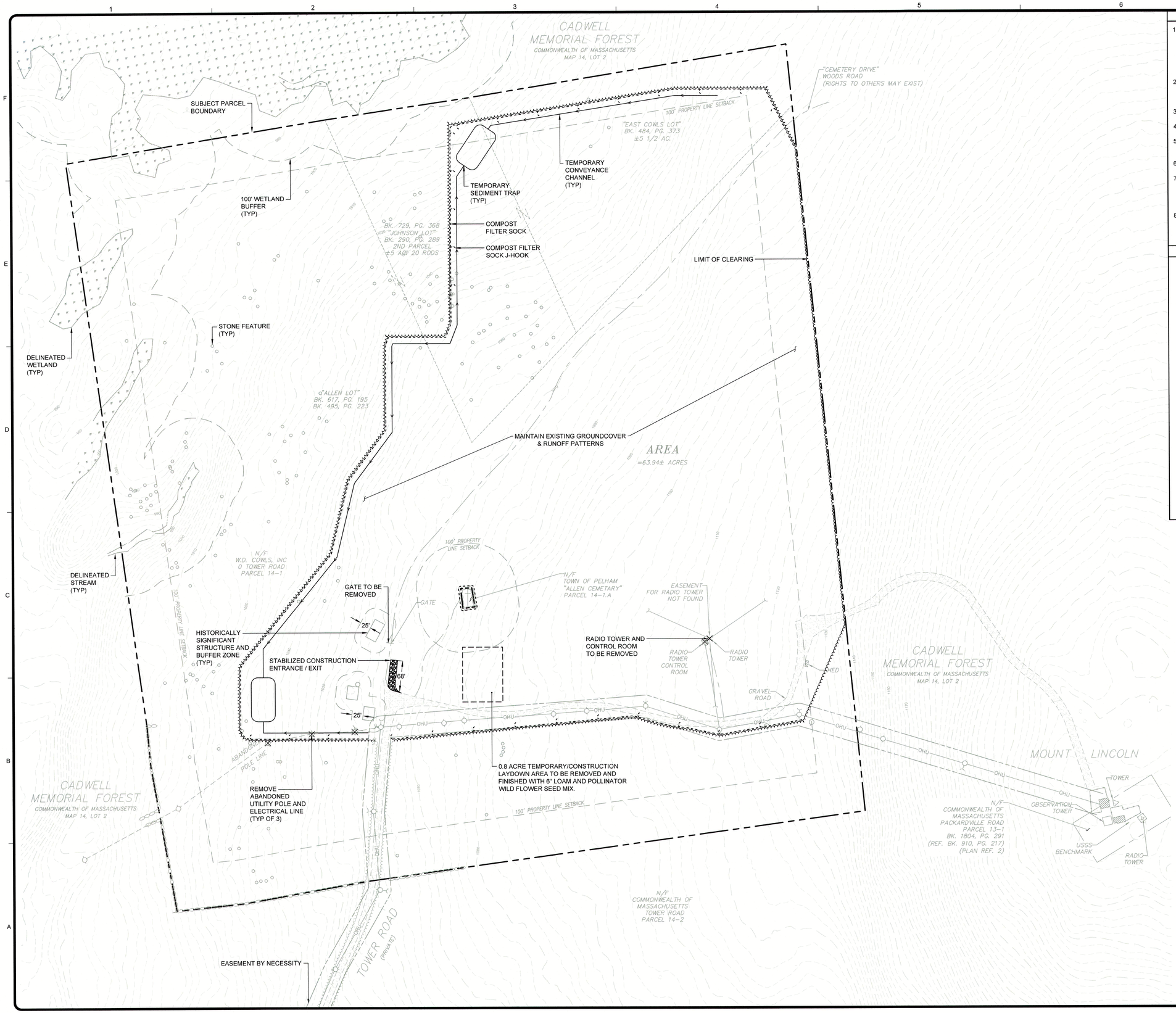
SCALE:
1"=100'

SHEET No.
1 OF 1

PROJECT No.
6394–7

DWG. No. 6394–7 REC (NORSE).DWG

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NOTES

1. EXISTING CONDITIONS IS COMPILED FROM A SURVEY TITLED "ASD TOWER SOLAR LLC BOUNDARY SURVEY" BY MERIDIAN ASSOCIATES, DATED JULY 1, 2021, NOAA DATA ACCESS VIEWER, AND AERIAL IMAGERY. ALL INFORMATION PROVIDED ON THIS PLAN SHALL BE CONSIDERED APPROXIMATE ONLY. FINAL LOCATION OF ALL EXISTING SITE FEATURES SHALL BE FIELD VERIFIED FOR ACCURACY.
2. WETLAND AND STREAM INFORMATION ARE FROM AN ORDER OF RESOURCE AREA DELINEATION APPROVED BY THE TOWN OF PELHAM CONSERVATION COMMISSION, DATED MAY 9, 2021.
3. THE HORIZONTAL DATUM IS NAD83 (FEET).
4. THE VERTICAL DATUM IS NAVD88 (FEET).
5. SUBJECT PARCEL IS WITHIN THE RESIDENTIAL ZONING DISTRICT ACCORDING TO THE TOWN OF PELHAM ZONING MAP.
6. THE PROJECT HAS A NAMEPLATE CAPACITY OF 4.4 MWac.
7. PRIOR TO LAND DISTURBANCE ACTIVITIES EROSION AND SEDIMENTATION CONTROLS SHALL BE IMPLEMENTED PER THE STORMWATER POLLUTION PREVENTION PLAN PREPARED IN ACCORDANCE WITH THE NPDES CONSTRUCTION GENERAL PERMIT.
8. CONTRACTOR MAY SUBSTITUTE WOOD CHIP BERM FOR COMPOST FILTER TUBE AT LOCATIONS APPROVED BY ENGINEER. CONTRACTOR REMAINS RESPONSIBLE FOR PREVENTING MIGRATION OF SEDIMENTS OFF-SITE.

LEGEND

- SUBJECT PARCEL BOUNDARY
- ABUTTER PROPERTY LINE
- SETBACK LINE
- STREAM
- WETLAND
- EXISTING MAJOR CONTOUR (500)
- EXISTING MINOR CONTOUR
- EXISTING OVERHEAD LINE (OHU)
- EXISTING UTILITY POLE
- EXISTING GRAVEL ROAD
- COMPOST FILTER SOCK
- COMPOST FILTER SOCK J-HOOK
- TEMP SEDIMENT TRAP
- TEMP CONVEYANCE CHANNEL
- TEMP LAYDOWN AREA
- CONSTRUCTION ENTRANCE
- TREELINE

TETRA TECH
www.tetratech.com
100 Nickerson Road
Marlborough, MA 01752
PHONE: (508) 786-2200 FAX: (508) 786-2201

COMMONWEALTH OF MASSACHUSETTS
JOSEPH A. SLOCUM
REGISTERED PROFESSIONAL ENGINEER

MARK	DATE	DESCRIPTION
-	08/20/26	SPECIAL PERMIT APPLICATION

BY JJA

ASD Tower MA Solar LLC
Tower Road
Pelham, MA 01002

Existing Conditions, Demolition Plan & Erosion Control Plan

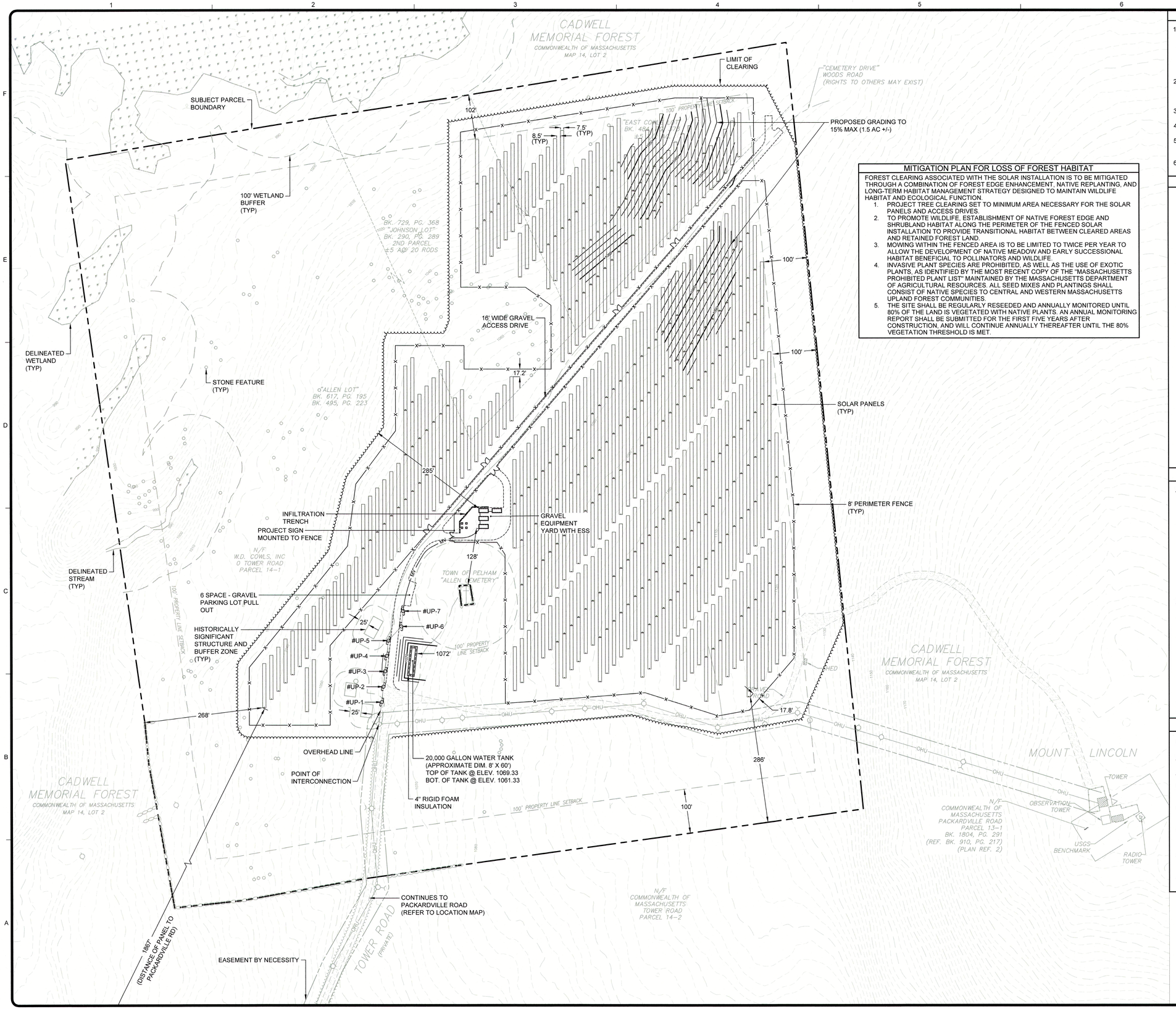
PROJ:	143-620765-24013
DESN:	JJA
DRWN:	JJA
CHKD:	SPR

C-1

Copyright: Tetra Tech

Bar Measures 1 inch, otherwise drawing not to scale

8/20/2026 1:00:02 PM - P:\620765\143-620765-24013\CAD\SHEETFILES\SPECIAL PERMIT APPLICATION\C-1 EXISTING CONDITIONS & DEMOLITION PLAN.DWG - FOSTER, ALEX



MITIGATION PLAN FOR LOSS OF FOREST HABITAT

FOREST CLEARING ASSOCIATED WITH THE SOLAR INSTALLATION IS TO BE MITIGATED THROUGH A COMBINATION OF FOREST EDGE ENHANCEMENT, NATIVE REPLANTING, AND LONG-TERM HABITAT MANAGEMENT STRATEGY DESIGNED TO MAINTAIN WILDLIFE HABITAT AND ECOLOGICAL FUNCTION.

1. PROJECT TREE CLEARING SET TO MINIMUM AREA NECESSARY FOR THE SOLAR PANELS AND ACCESS DRIVES.
2. TO PROMOTE WILDLIFE, ESTABLISHMENT OF NATIVE FOREST EDGE AND SHRUBLAND HABITAT ALONG THE PERIMETER OF THE FENCED SOLAR INSTALLATION TO PROVIDE TRANSITIONAL HABITAT BETWEEN CLEARED AREAS AND RETAINED FOREST LAND.
3. MOWING WITHIN THE FENCED AREA IS TO BE LIMITED TO TWICE PER YEAR TO ALLOW THE DEVELOPMENT OF NATIVE MEADOW AND EARLY SUCCESSIONAL HABITAT BENEFICIAL TO POLLINATORS AND WILDLIFE.
4. INVASIVE PLANT SPECIES ARE PROHIBITED, AS WELL AS THE USE OF EXOTIC PLANTS, AS IDENTIFIED BY THE MOST RECENT COPY OF THE "MASSACHUSETTS PROHIBITED PLANT LIST" MAINTAINED BY THE MASSACHUSETTS DEPARTMENT OF AGRICULTURAL RESOURCES. ALL SEED MIXES AND PLANTINGS SHALL CONSIST OF NATIVE SPECIES TO CENTRAL AND WESTERN MASSACHUSETTS UPLAND FOREST COMMUNITIES.
5. THE SITE SHALL BE REGULARLY RESEEDED AND ANNUALLY MONITORED UNTIL 80% OF THE LAND IS VEGETATED WITH NATIVE PLANTS. AN ANNUAL MONITORING REPORT SHALL BE SUBMITTED FOR THE FIRST FIVE YEARS AFTER CONSTRUCTION, AND WILL CONTINUE ANNUALLY THEREAFTER UNTIL THE 80% VEGETATION THRESHOLD IS MET.

NOTES

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2. WETLAND AND STREAM INFORMATION ARE FROM AN ORDER OF RESOURCE AREA DELINEATION APPROVED BY THE TOWN OF PELHAM CONSERVATION COMMISSION, DATED MAY 9, 2021.
3. THE HORIZONTAL DATUM IS NAD83 (FEET).
4. THE VERTICAL DATUM IS NAVD88 (FEET).
5. SUBJECT PARCEL IS WITHIN THE RESIDENTIAL ZONING DISTRICT ACCORDING TO THE TOWN OF PELHAM ZONING MAP.
6. THE PROJECT HAS A NAMEPLATE CAPACITY OF 4.4 MWac.

LEGEND

- SUBJECT PARCEL BOUNDARY
- ABUTTER PROPERTY LINE
- SETBACK LINE
- STREAM
- WETLAND
- EXISTING MAJOR CONTOUR (500)
- EXISTING MINOR CONTOUR
- EXISTING OVERHEAD LINE (OHU)
- EXISTING UTILITY POLE
- EXISTING GRAVEL ROAD
- MEDIUM VOLTAGE LINE (MV)
- UTILITY POLE
- GRAVEL DRIVE
- SOLAR PANELS
- PERIMETER FENCE
- TREE LINE
- PROPOSED MAJOR CONTOUR (1070)
- PROPOSED MINOR CONTOUR

ZONING SUMMARY TABLE

RESIDENTIAL DISTRICT REGULATIONS PER § 125-6

	REQUIRED	PROPOSED
MINIMUM BUILDING LOT	80,000 FT	2,748,295 FT
MINIMUM FRONTAGE	200 FT	> 1,300 FT
FRONT SETBACK	50 FT	286 FT
SIDE SETBACK	30 FT	100 FT
REAR SETBACK	30 FT	102 FT
MAXIMUM BUILDING HEIGHT	35 FT	0 FT
MAXIMUM BUILDING COVERAGE	5%	0%
MINIMUM OPEN SPACE	90%	96.4%

SOLAR ELECTRIC INSTALLATIONS REGULATIONS PER § 125-18.2.D.2

	REQUIRED	PROPOSED
MAXIMUM ACCESS DRIVE LENGTH	1,000 FT	568 FT
LOT SIZE		
MINIMUM	1.5 ACRES	25.3 ACRES*
MAXIMUM	15 ACRES	25.3 ACRES*
MINIMUM FRONT STREET SETBACK	500 FT	N/A*
MINIMUM PROPERTY LINE SETBACK	100 FT	100 FT
ESS FROM SOLAR PANELS (MAX.)	100 FT	< 100 FT
ESS BUFFER TO FORESTED LAND	100 FT	285 FT

* WAIVER REQUESTED

UTILITY POLE DETAILS

- UP #1: NEW UTILITY POLE MOUNTED GANG OPERATED LOAD BREAK SWITCH.
- UP #2: NEW UTILITY POLE WITH POLE MOUNTED UTILITY RECLOSER.
- UP #3: NEW UTILITY POLE WITH POLE MOUNTED PRIMARY METERING.
- UP #4: NEW UTILITY POLE WITH LOAD BREAK SWITCH, GANG OPERATED AND POINT OF COMMON COUPLING.
- UP #5: CUSTOMER POLE WITH LOAD BREAK SWITCH, GANG OPERATED AND 24/7 ACCESS BY UTILITY.
- UP #6: CUSTOMER POLE WITH POLE MOUNTED G&W ELECTRIC VIPER-S SOLID DIELECTRIC RECLOSER AND SEL-651R PROTECTIVE RELAY.
- UP #7: CUSTOMER POLE WITH POLE MOUNT METERING AND UNDERGROUND RISER
- NOTE: COMPONENTS FOR FINAL CONNECTION TO EXISTING POWER GRID TO BE DETERMINED BY UTILITY COMPANY.

N

0 50' 100' 200'
SCALE: 1" = 100'

Bar Measures 1 inch, otherwise drawing not to scale

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100 Nickerson Road
Marlborough, MA 01752
PHONE: (508) 786-2200 FAX: (508) 786-2201

MARK	DATE	DESCRIPTION	BY
-	08/20/26	SPECIAL PERMIT APPLICATION	JJA

ASD Tower MA Solar LLC
Tower Road
Pelham, MA 01002

Site Plan

PROJ:	143-620765-24013
DESN:	JJA
DRWN:	JJA
CHKD:	SPR

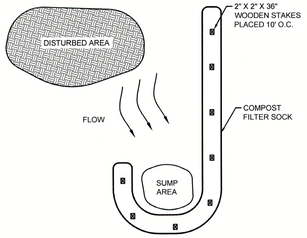
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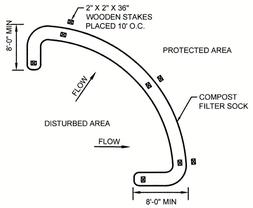
8/20/2026 1:04:17 PM - P:\620765\143-620765-24013\CAD\SHEETFILES\SPECIAL PERMIT APPLICATION\C-2 SITE PLAN.DWG - FOSTER, ALEX

EROSION PREVENTION AND SEDIMENT CONTROL NOTES

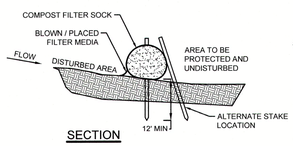
1. THE BEST MANAGEMENT PRACTICES PROVIDED HEREIN REPRESENT THE MINIMUM MEASURES TO BE EMPLOYED DURING EACH PHASE OF CONSTRUCTION. SPECIFIC SEQUENCING PLANS WILL BE DEVELOPED FOR EACH PHASE OF CONSTRUCTION AS DESIGN IS ADVANCED.
2. THE CONTRACTOR MUST PERFORM ACTIVITIES IN ACCORDANCE WITH THE REQUIREMENTS OF THE GENERAL PERMIT FOR DISCHARGES FROM CONSTRUCTION ACTIVITIES.
3. THESE EROSION AND SEDIMENTATION PLANS ARE PART OF THE STORMWATER POLLUTION PREVENTION PLAN.
4. NO LAND CLEARING, GRUBBING OR GRADING ACTIVITIES, EXCEPT THAT REQUIRED FOR INSTALLATION OF THE CONSTRUCTION EXIT, SHALL BEGIN UNTIL PERIMETER SEDIMENT CONTROL MEASURES AND STORMWATER MANAGEMENT PRACTICES ARE CONSTRUCTED AND STABILIZED.
5. TEMPORARY STABILIZATION PRACTICES MUST BE INITIATED AS SOON AS PRACTICABLE ON PORTIONS OF THE SITE WHERE CONSTRUCTION ACTIVITIES HAVE TEMPORARILY OR PERMANENTLY CEASED, BUT IN NO CASE MORE THAN 14 DAYS AFTER CONSTRUCTION ACTIVITY IN THAT PORTION OF THE SITE HAS TEMPORARILY OR PERMANENTLY CEASED.
6. SEDIMENT MUST BE REMOVED FROM TRAPS OR PONDS WHEN THE DESIGN CAPACITY HAS BEEN REDUCED BY 50%.
7. SEDIMENT MUST BE REMOVED FROM A SILT FENCE, COMPOST FILTER SOCK OR STRAW WATTLE WHEN IT REACHES 50% OF THE ABOVE-GROUND HEIGHT.
8. ADDITIONAL EROSION AND SEDIMENT CONTROL MEASURES WILL BE INSTALLED BY THE CONTRACTOR IF DEEMED NECESSARY BY ON- SITE INSPECTION.
9. IF ADDITIONAL EROSION OR SEDIMENT CONTROL MEASURES ARE NECESSARY, THEY MUST BE IMPLEMENTED BEFORE THE NEXT STORM EVENT WHENEVER PRACTICABLE. IF NOT PRACTICABLE BEFORE THE NEXT STORM EVENT, THEY MUST BE IMPLEMENTED AS SOON AS POSSIBLE.
10. OFF SITE SEDIMENT TRACKING MUST BE MINIMIZED. SEDIMENT TRACKED ONTO ADJACENT PUBLIC WAYS MUST BE SWEPT BY THE END OF THE SAME WORK DAY.
11. STORMWATER RUNOFF FROM EXPOSED SURFACES MUST BE DIVERTED, RETAINED/DETAINED TO MINIMIZE THE DISCHARGE OF POLLUTANTS.
12. VELOCITY DISSIPATION DEVICES MUST BE INSTALLED AT DISCHARGE LOCATIONS OF ANY OUTFALL TO PROVIDE NON-EROSIVE FLOW VELOCITY.
13. PREVENT LITTER, CONSTRUCTION DEBRIS AND CONSTRUCTION CHEMICALS THAT COULD BE EXPOSED TO STORMWATER FROM BECOMING A POLLUTANT SOURCE IN STORMWATER DISCHARGES.



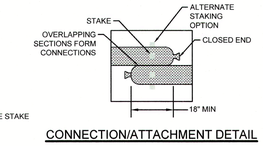
J-HOOK PLACEMENT



PLAN VIEW



SECTION



CONNECTION/ATTACHMENT DETAIL

NOTES:

1. PREFABRICATED COMPOST SOCK SHALL BE FILTREXX SOXX OR APPROVED EQUAL.
2. MATERIAL FOR SOCKS SHALL CONSIST OF SANITIZED MATURE COMPOST, FREE OF VIABLE WEED SEEDS AND FOREIGN DEBRIS SUCH AS GLASS AND PLASTIC. COMPOST SHALL BE IN SHREDDED OR GRANULAR FORM AND FREE FROM HARD LUMPS. IN ADDITION, NO KILN-DRIED WOOD OR CONSTRUCTION DEBRIS SHALL BE ALLOWED. CONTRACTOR SHALL REFER TO MASSDOT SPECIFICATIONS M1.06.0 FOR MATERIAL SPECIFICATIONS.
3. SOCK SHALL CONSIST OF JUTE MESH OR OTHER APPROVED BIODEGRADABLE MATERIAL.

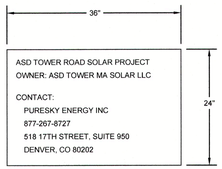
PRACTICE: COMPOST FILTER SOCK. A COMPOST FILTER SOCK IS A TYPE OF CONTAINED COMPOST FILTER BERM CONSISTING OF A MESH TUBE FILLED WITH COMPOSTED MATERIAL THAT IS PLACED PERPENDICULAR TO SHEET-FLOW RUNOFF TO RETAIN SEDIMENT FROM DISTURBED AREAS. THE COMPOST FILTER SOCK ACTS AS A FILTER TO RETAIN SEDIMENT AND OTHER POLLUTANTS (E.G., SUSPENDED SOLIDS, NUTRIENTS) WHILE ALLOWING THE WATER TO FLOW THROUGH IT. COMPOST QUALITY MUST MEET AASHTO 2010 SPECIFICATIONS.

INSTALLATION: ONCE THE FILTER SOCK IS FILLED AND PUT IN PLACE, IT SHOULD BE ANCHORED TO THE SLOPE BY STAKES THROUGH THE CENTER OR OUTER EDGE OF THE SOCK AT REGULAR INTERVALS; ALTERNATIVELY, STAKES CAN BE PLACED ON THE DOWNSTREAM SIDE OF THE SOCK. THE ENDS OF THE FILTER SOCK SHOULD BE DIRECTED UPSLOPE, TO PREVENT STORMWATER FROM RUNNING AROUND THE END OF THE TUBE. THERE SHOULD BE NO GAPS BETWEEN SEGMENTS AND THE SOCK ENDS MUST OVERLAP A MINIMUM OF 6 INCHES.

MAINTENANCE: SOCKS MUST BE INSPECTED FOR SEDIMENT ACCUMULATION. IF THERE IS EXCESSIVE PONDING BEHIND THE FILTER SOCK OR ACCUMULATED SEDIMENT REACHES THE TOP OF THE SOCK, AN ADDITIONAL SOCK SHOULD BE ADDED ON TOP OR IN FRONT OF THE EXISTING FILTER SOCK IN THESE AREAS. AN ADEQUATE RESERVE OF SOCKS MUST BE KEPT ON SITE AT ALL TIMES FOR EMERGENCY AND/OR ROUTINE REPLACEMENT. SOCKS SHALL BE REMOVED ONLY AFTER EXPOSED SOILS IN THE CONTRIBUTING DRAINAGE AREA ACHIEVE FINAL STABILIZATION. SEDIMENT ACCUMULATION MUST BE REMOVED ONCE IT HAS REACHED ½ OF THE EXPOSED HEIGHT OF THE SOCK.

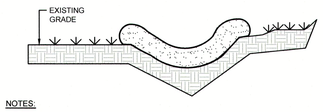
COMPOST FILTER SOCK

N.T.S.



PROJECT SIGN

N.T.S.

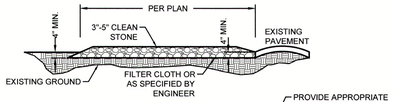


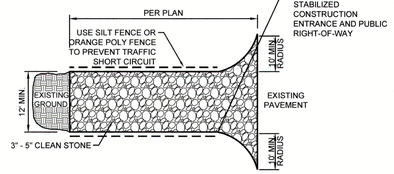
NOTES:

1. FILTER SOCK TO BE PLACED WITHIN EXISTING DITCHES AND TEMPORARY CONVEYANCE CHANNELS AS NEEDED TO PREVENT EROSION.
2. CENTER 6" LOWER THAN BANKS SPAN; EXTEND ENDS TO PREVENT BYPASS AROUND EDGES.

COMPOST FILTER SOCK FOR CHECK DAMS

N.T.S.





NOTES:

1. STONE - USE COARSE AGGREGATE (3"-5" STONE).
2. LENGTH - AS EFFECTIVE, BUT NOT LESS THAN 50 FEET.
3. THICKNESS - NOT LESS THAN EIGHT (8) INCHES.
4. WIDTH - NOT LESS THAN FULL WIDTH OF ALL POINTS OF INGRESS OR EGRESS.
5. WASHING - WHEN NECESSARY, WHEELS SHALL BE CLEANED TO REMOVE SEDIMENT PRIOR TO ENTRANCE ONTO PUBLIC RIGHT-OF-WAY. WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON AN AREA STABILIZED WITH CRUSHED STONE WHICH DRAINS INTO AN APPROVED SEDIMENT TRAP OR SEDIMENT BASIN. ALL SEDIMENT SHALL BE PREVENTED FROM ENTERING ANY STORM DRAIN, DITCH, OR WATERCOURSE THROUGH USE OF SAND BAGS, GRAVEL, BOARDS OR OTHER APPROVED METHODS.
6. MAINTENANCE - THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHT-OF-WAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ONTO ADJACENT PAVED ROAD SURFACES MUST BE REMOVED IMMEDIATELY.

PRACTICE: STABILIZED CONSTRUCTION EXIT POINTS. IN ORDER TO MINIMIZE TRACK OUT FROM VEHICLES, STABILIZED CONSTRUCTION EXIT(S) MUST BE INSTALLED AT THE LOCATIONS WHERE VEHICLES WILL EXIT THE SITE. THE CONTRACTOR MUST RESTRICT VEHICLE USE TO THE PROPOSED DESIGN EXIT LOCATIONS. ADDITIONAL CONTROLS TO REMOVE SEDIMENT FROM TIRES MAY BE REQUIRED IF TRACKING OCCURS; SUCH METHODS MAY INCLUDE WHEEL WASH STATIONS, RUMBLE STRIPS OR RUMBLE PLATES. NO VISIBLE SIGNS OF SOIL TRACKING FROM VEHICLES SHOULD BE PRESENT ON PUBLIC ROADWAYS EXITING THE SITE.

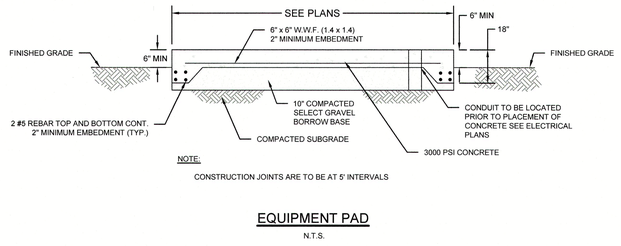
INSTALLATION. THE STABILIZED CONSTRUCTION EXIT(S) WILL CONSIST OF AN 8 INCH LAYER OF THREE TO FIVE INCH (3"-5") STONE, PLACED OVER A LAYER OF GEOTEXTILE FABRIC (IN ORDER TO PROVIDE SEPARATION FROM THE UNDERLYING SOIL AND PREVENT THE STONE FROM BEING GROUND DOWN INTO THE SOIL). THE STABILIZED CONSTRUCTION EXIT MUST BE WIDE ENOUGH TO COVER THE ENTIRE WIDTH OF THE EXIT AND IT SHOULD BE FLARED WHERE IT MEETS THE ROADWAY TO ACCOMMODATE LONGER CONSTRUCTION VEHICLES. THE STABILIZED CONSTRUCTION EXIT MUST BE LONG ENOUGH TO ALLOW MUD AND SEDIMENT TO BECOME DISLODGED FROM VEHICLE TIRES, AND/OR A MINIMUM OF FIFTY FEET (50') IN LENGTH.

MAINTENANCE. DURING THE COURSE OF CONSTRUCTION THE STABILIZED CONSTRUCTION EXIT WILL BECOME FILLED WITH ACCUMULATED SEDIMENT AND/OR THE STONE WILL BECOME COMPACTED. THE CONTRACTOR MUST REPAIR THE EXIT AS NECESSARY BY REMOVING ACCUMULATED SEDIMENT, REPLACING THE STONE OR BACK-BLADING THE STONE TO REFRESH IT. IF TRACKING OF SEDIMENT OCCURS, THE CONTRACTOR MUST REMOVE DEPOSITED SEDIMENT BY COMPLYING WITH THE FOLLOWING REQUIREMENTS:

- WHERE TRACK-OUT OF SEDIMENT OCCURS FROM THE SITE ONTO OFF-SITE STREETS, SIDEWALKS, AND OTHER PAVED AREAS, DEPOSITS MUST BE SWEPT, SHOVELED, OR VACUUMED TO REMOVE TRACK-OUT MATERIAL OR OTHER SEDIMENT DEPOSITS BY THE END OF THE SAME WORK DAY IN WHICH THE TRACK OUT IS DISCOVERED.
- HOSING OR SWEEPING TRACKED-OUT SEDIMENT INTO ANY STORMWATER CONVEYANCE, (UNLESS IT IS CONNECTED TO A SEDIMENT BASIN, SEDIMENT TRAP, OR SIMILARLY EFFECTIVE CONTROL), STORM DRAIN INLET, OR SURFACE WATER IS PROHIBITED.

STABILIZED CONSTRUCTION ENTRANCE / EXIT

N.T.S.

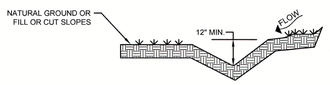


NOTE:

CONSTRUCTION JOINTS ARE TO BE AT 5' INTERVALS

EQUIPMENT PAD

N.T.S.



CHANNEL

PRACTICE: CONSTRUCTED STORMWATER CONVEYANCE CHANNELS: STORMWATER CONVEYANCE CHANNELS, OR DIVERSION DITCHES, ARE A RUNOFF CONTROL MEASURE CONSISTING OF A CHANNEL OR EXCAVATION INSTALLED AS A MEANS OF DIVERTING CONCENTRATED FLOWS TO STABILIZED AREAS. VEGETATIVE LINED CHANNELS SLOW DOWN CONCENTRATED RUNOFF. THE TEMPORARY CONVEYANCE CHANNELS WILL CONTAIN VELOCITY DISSIPATION DEVICES INCLUDING STONE CHECK DAMS TO ENHANCE RUNOFF STORAGE, IMPROVE POLLUTANT REMOVAL AND DECREASE FLOW RATES.

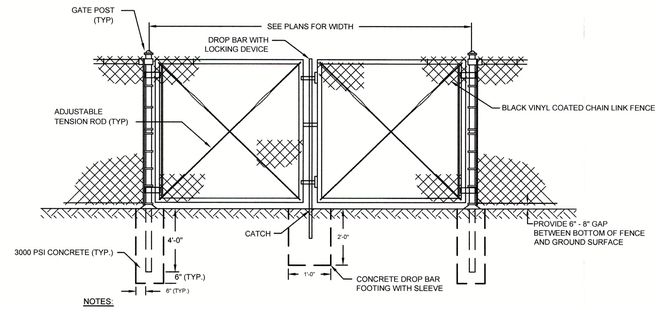
OUTLET FLOW FROM THE CHANNEL WILL BE STABILIZED WITH A NON-EROSIVE FLOW VELOCITY DISSIPATOR WHICH INCLUDES A RIP RAP APRON, VEGETATIVE AND NON-VEGETATIVE STABILIZATION TECHNIQUES INCLUDE CHANNEL LINERS, ROLLED EROSION CONTROL PRODUCTS (E.G., EROSION CONTROL BLANKETS FOR CHANNEL INSTALLATION AND TURF REINFORCEMENT MATS), RIPRAP, GEOTEXTILES, OR OTHER ARMORING MATERIALS THAT ARE SUITABLE FOR USE IN AREAS WITH CONCENTRATED OR CHANNELIZED FLOW. THE STORM WATER RUNOFF FROM THE CHANNEL MUST BE CONVEYED TO THE TEMPORARY SEDIMENT BASINS/TRAPS OR OTHER SEDIMENT CONTROL PRACTICE. TEMPORARY CHANNELS MAY BE CONSTRUCTED AS NEEDED AT LOCATIONS OTHER THAN THOSE INDICATED ON THE EROSION AND SEDIMENTATION CONTROL PLANS TO ACCOUNT FOR CHANGING ON-SITE FIELD CONDITIONS.

INSTALLATION REQUIREMENTS: THE CONVEYANCE CHANNEL SIDE-SLOPES AND BOTTOM MUST BE APPROPRIATELY STABILIZED PRIOR TO CONVEYING RUNOFF TO IT.

MAINTENANCE REQUIREMENTS: CLOGGING WITH SEDIMENT AND DEBRIS REDUCES THE EFFECTIVENESS OF GRASS-LINED CHANNELS FOR STORMWATER CONVEYANCE. THE CHANNELS MUST BE INSPECTED AND LITTER AND SEDIMENT ACCUMULATIONS REMOVED. EVIDENCE OF EROSION AT THE INLET AND OUTLET MUST BE REPAIRED.

TEMPORARY CONVEYANCE CHANNEL

N.T.S.

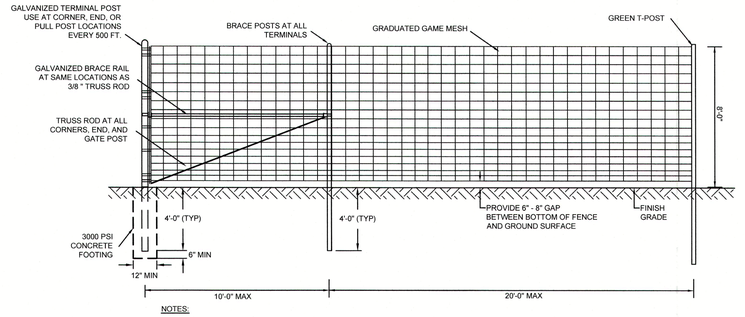


NOTES:

1. THIS DETAIL IS FOR REFERENCE ONLY. CONTRACTOR SHALL COORDINATE WITH MANUFACTURER FOR FINAL DESIGN OF GATES AND FENCE.

DOUBLE SWING FENCE GATE

N.T.S.

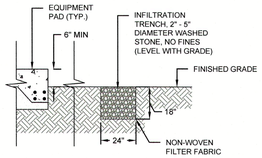


NOTES:

1. THIS DETAIL IS FOR REFERENCE ONLY. CONTRACTOR SHALL COORDINATE WITH MANUFACTURER FOR FINAL DESIGN OF GATES AND FENCE.

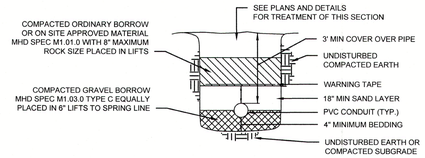
PERIMETER FENCE

N.T.S.



INFILTRATION TRENCH

N.T.S.

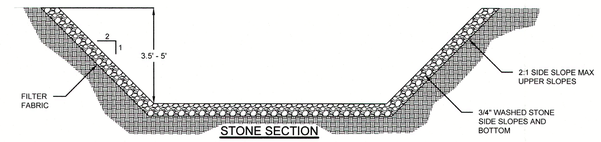


NOTES:

1. TRENCH EXCAVATION WIDTH TO ALLOW FOR FREE TRAVEL OF COMPACTION EQUIPMENT.
2. ALL COMPACTION TO A MINIMUM 95 PERCENT DRY DENSITY DETERMINED BY ASTM D1557 SEE SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.
3. AVOID HEAVY EQUIPMENT LOADS OVER PIPE DURING CONSTRUCTION.

ELECTRIC TRENCH

N.T.S.



STONE SECTION

NOTES:

CONTRACTOR TO DEWATER THE SEDIMENT TRAP WITHIN 72 HOURS. PUMP INTAKE SHALL BE LOCATED AS CLOSE TO THE TOP OF THE WATER COLUMN AND WATER SHALL NOT BE DRAWN FROM THE BOTTOM OF THE BASIN. DEWATERING FLUIDS MUST BE VISIBLY CLEAR OF SEDIMENT, OTHERWISE CONTRACTOR MUST TREAT DISCHARGES WITH A SEDIMENT CONTROL MEASURE PRIOR TO DISCHARGE.

PRACTICE: SEDIMENT TRAPS. TEMPORARY SEDIMENT TRAPS ARE A SEDIMENT CONTROL PRACTICE AND STORMWATER MANAGEMENT PRACTICE THAT CONSIST OF AN EXCAVATED OR NATURAL DEPRESSION THAT DETAINS/RETAINS STORM WATER RUNOFF ALLOWING SEDIMENTS TO SETTLE OUT OF SUSPENSION PRIOR TO DISCHARGE VIA SUITABLY STABILIZED OUTLET.

EFFECTIVE IMPLEMENTATION OF EROSION CONTROL PRACTICES ON EXPOSED SOILS LOCATED UPSLOPE WITHIN THE CONTRIBUTING DRAINAGE AREA WILL SIGNIFICANTLY REDUCE MAINTENANCE REQUIREMENTS. PROPERLY CONSTRUCTED AND MAINTAINED TEMPORARY SEDIMENT TRAPS ARE VERY EFFECTIVE AT TREATING SEDIMENT-LADEN STORM WATER RUNOFF. THE SIZE OF THE TEMPORARY TRAP MUST BE DETERMINED BY THE CONTRACTOR. 3,600 CUBIC FEET PER ACRE DRAINED.

INSTALLATION REQUIREMENTS: CONSTRUCTION OF THE TRAPS MUST OCCUR BEFORE EARTH DISTURBANCE ACTIVITIES COMMENCE. THE SIDE SLOPES AND BOTTOMS OF THE TEMPORARY TRAP MUST BE APPROPRIATELY STABILIZED PRIOR TO DIRECTING RUNOFF TO THEM.

MAINTENANCE REQUIREMENTS: REMOVE ACCUMULATED SEDIMENT BEFORE IT REACHES ½ OF THE CAPACITY OF THE SEDIMENT TRAP IN ORDER TO MAXIMIZE SEDIMENT SETTLING POTENTIAL AND MINIMIZE THE POSSIBILITY OF SEDIMENT WASHOUT DURING HIGH INTENSITY/LONG DURATION STORM EVENTS. INSPECT TRAPS AFTER EACH STORM EVENT TO ENSURE PROPER DRAINAGE AND DETERMINE THE NEED FOR REPAIRS. REPLACE ERODED MATERIAL AND REMOVE DISLODGED STONES FROM EARTHEN EMBANKMENTS.

TEMPORARY SEDIMENT TRAP

N.T.S.

TETRA TECH
www.tetratech.com
100 Nickerson Road
Marlborough, MA 01752
PHONE: (508) 786-2200 FAX: (508) 786-2201

MARK	DATE	DESCRIPTION
-	08/20/26	SPECIAL PERMIT APPLICATION

BY: JJA

ASD Tower MA Solar LLC
Tower Road
Pelham, MA 01002

Construction Details

PROJ:	143-620765-24013
DESN:	JJA
DRWN:	JJA
CHKD:	SPR

C-3

Copyright Tetra Tech

Bar Measures 1 inch, otherwise drawing not to scale

8/20/2026 1:04:33 PM - P:\620765\143-620765-24013\CAD\SHEETFILES\SPECIAL PERMIT APPLICATION\C-3 CONSTRUCTION DETAILS.DWG - FOSTER, ALEX

Attachment B

Pre-Submission Documents

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

PROJECT NOTIFICATION FORM

Project Name: ASD Tower MA Solar, LLC

Location / Address: Off Tower Road

City / Town: Pelham, MA

Project Proponent

Name: AMP Solar Development, Inc c/o Lee Morrison

Address: 1550 Wewatta Street, Floor 4 C/O

City/Town/Zip/Telephone: Denver, CO 80202 303.598.7192

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	Type of License or funding (specify)
U.S. EPA	National Pollutant Discharge Elimination System (NPDES)

Project Description (narrative):

ASD Tower MA, Solar LLC (ASD) proposes to construct a solar electrical generation facility on the approximately 63.4-acre property off Tower Road in Pelham MA. The property (Parcel ID 41-1) is zoned as residential. The site is currently undeveloped woodland. There are several footpaths and two sheds on the property. Also, within the site is the Ruben Allen Cemetery (also known as Johnson Family Burial Place), which includes approximately 20 graves. The layout for the solar facility is still in the design process, however, the Project will be designed to avoid the cemetery.

Does the project include demolition? If so, specify nature of demolition and describe the building(s) which are proposed for demolition. The project does not include demolition

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.
The Project does not include the rehabilitation of existing buildings.

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

The Project will include the installation of arrays of solar, photovoltaic panels mounted on metal racks. Electrical equipment including transformers and inverters will be mounted on concrete pads. To the extent practicable, electrical conduits within the site will be underground. The solar arrays will be accessed by a gravel driveway connected to Tower Road.

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.

There are no historic properties on the Project site. Historic properties within approximately 1 mile of the project site are listed in Table 1, below.

What is the total acreage of the project area?

Woodland	63.4 acres	Productive Resources:	
Wetland	acres	Agriculture	acres
Floodplain	acres	Forestry	acres
Open space	acres	Mining/Extraction	acres
Developed	acres	Total Project Acreage	63.4 acres

What is the acreage of the proposed new construction? <63.4* acres

*Project layout is still in design phase. Project to be designed to avoid cemetery.

What is the present land use of the project area?

Undeveloped wooded land.

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

See Figure 1

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

Signature of Person submitting this form: Date: 4/22/2021

Name: Jeff Brandt

Address: TRC Environmental Corporation, 650 Suffolk Street

City/Town/Zip: Lowell, MA 01854

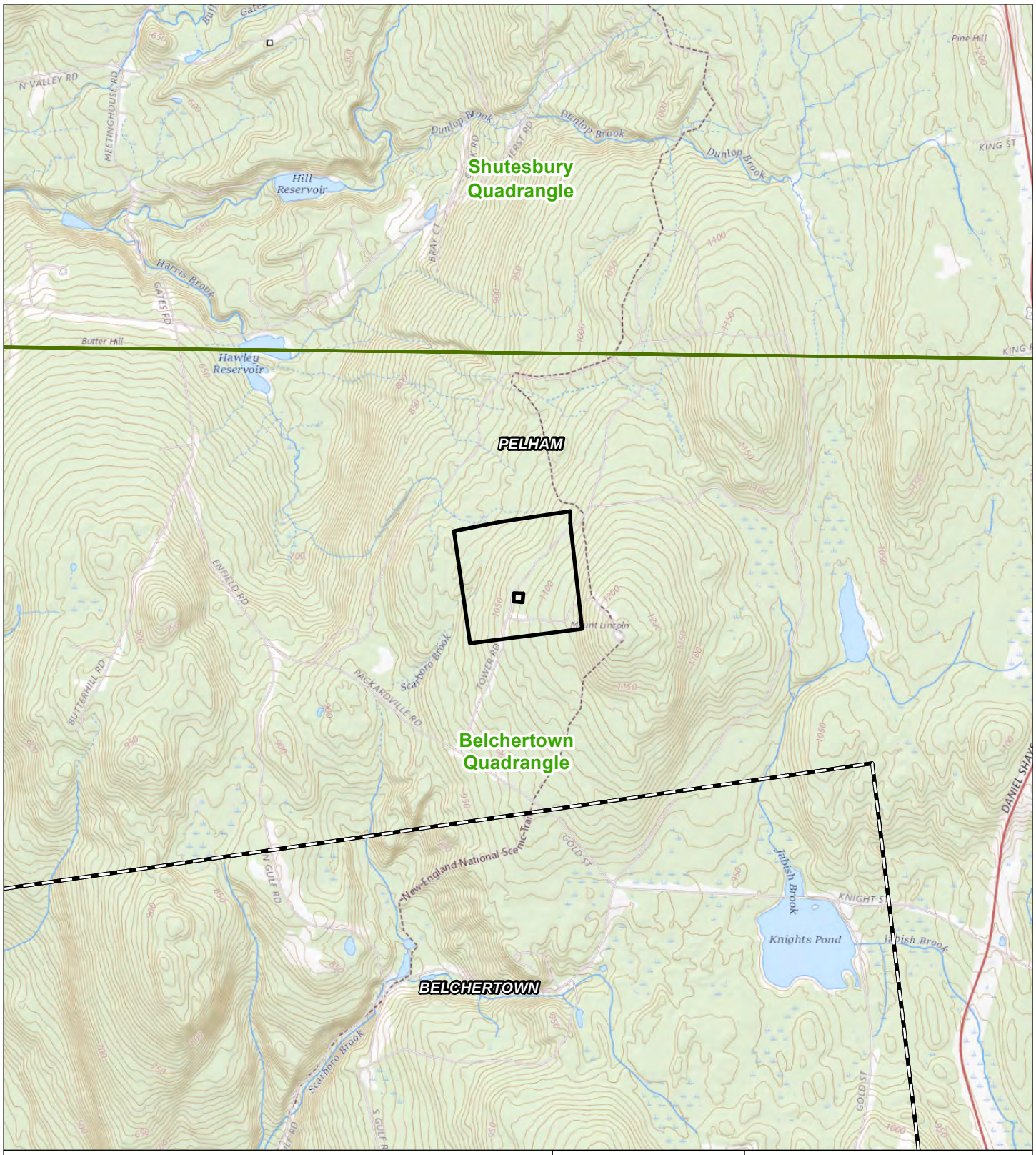
Telephone: 978-656-3662

REGULATORY AUTHORITY

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

Table 1: Historic Properties Identified within 1-mile of the Project Site

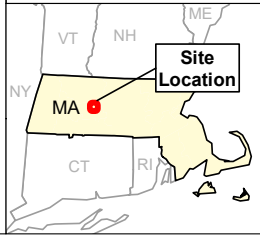
MACRIS #	Historic Name	Address	Designations
BLC.274	Brown, Able - Caulkins, George S. House	730 Gulf Rd Belchertown	None
PEL.14	Cook, Ziba and Sally House	7A Gulf Rd Pelham	None
PEL.801	Allen, Ruben Cemetery	Cemetery Rd Base of Mount Lincoln Tower and Cemetery Rd Pelham	None
PEL.807	Stevens Cemetery	179 Packardville Rd Pelham	None



Project Area
USGS 24k Quadrangle
Town Boundary

N

0 1,000 2,000
Feet



Data Sources: TRC, MassGIS, Esri
Base Map: The National Map, "USGSTopo" Service Layer

TRC
Wannalancit Mills
650 Suffolk Street
Lowell, MA 01854
(978) 970-5600

PROJECT LOCATION

TOWER ROAD
PELHAM, MA

FIGURE 1 | APRIL 2021

S:\1-PROJECTS\AMP\387920_TowerHill\5-MXD\Fig 1 TowerHill_USGS_8x11.mxd

Photo Log



Photo 1: Typical conditions looking towards center of site.



Photo 2: Ruben Allen Cemetery near center of property.



Photo 3: Shed with antenna on property.



Photo 4: Shed on property on east side of Tower Road



Photo 5: Typical conditions west side of property.

518, 17th Street, Suite 950
Denver, CO 80202
amp.energy United States T +1 303.653.9805

July 12, 2022

Dear Ms. Simon,
State Historic Preservation Officer
State Archaeologist
Executive Director
Massachusetts Historical Commission

Amp Solar Development ("Amp") has conducted archaeological reconnaissance surveys for two proposed solar projects, ASD Shutesbury MA Solar LLC and ASD Tower MA Solar LLC, as requested by the Massachusetts Historical Commission ("MHC"). Amp was granted permission to conduct surveys for the specified projects separately from Amp's larger portfolio in a letter dated January 6, 2022, from MHC.

Amp contracted with Christopher Donta with SWCA Environmental Consultants ("SWCA") to conduct the archaeological reconnaissance surveys, attached.

Attached you will also find a document titled "Survey of Stone Features, Amp Energy Proposed Solar Project, Tower Road, Pelham, Mass.". Amp worked with Ceremonial Landscapes Research ("CLR") in consultation with the Tribal Historic Preservation Office of the Wampanoag Tribe of Aquinnah to conduct a survey of features of Native American concern on the site, to satisfy Town of Pelham bylaw requirements.

CLR recorded several stone features across the property that the Wampanoag recognize as significant ceremonial stones of Native American importance. The survey conducted by CLR and SWCA's archaeological reconnaissance drew differing conclusions about the origin of these stone features.

We are hoping that you would be able to provide us with your input for the property and the origin of these stone features. The guidance of the MHC on this sensitive matter would be appreciated as we try to determine the most appropriate path forward.

We would be happy to provide more information on this matter and/or answer any questions that you may have. Thank you for your time.

Sincerely,

Andrew Chabot

Andrew Chabot
Director, Development
978.339.9195
achabot@amp.energy

The Commonwealth of Massachusetts
William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

August 18, 2022

Christopher L. Donta
Cultural Resources Team Lead
SWCA Environmental Consultants
15 Research Dr
Amherst, MA 01002

RE: AMP Solar Developments in Pelham and Amherst, MA:
ASD Tower MA Solar LLC, off Tower Road, Parcel 41-1, Pelham, **MHC #RC.69690**.
ASD Shutesbury MA Solar LLC, 0 Shutesbury Road, Parcels 9B-11, 9B-12, and 9D-27, Amherst, **MHC #RC.69691**.

Staff of the Massachusetts Historical Commission (MHC) have reviewed the two reports, *Archaeological Reconnaissance Survey for the ASD Tower MA Solar Project, Pelham, Massachusetts*; and *Archaeological Reconnaissance Survey for the ASD Shutesbury Solar Project, Amherst, Massachusetts,* prepared by SWCA Environmental Consultants for the two projects referenced above.

To complete the reporting for the investigations, please provide the MHC with one additional copy of each of the two reports, and two CD-ROMs each with a Word file listing the reports authors, date, title, page count, and including the archaeological abstract.

These comments are offered to assist in compliance with the Secretary of the Interior's *Standards and Guidelines for Archeological Documentation* (48 *Fed. Reg.* 190, September 29, 1983: 44734-44737) and M.G.L. c. 9, ss. 26A and 27C (950 CMR 70).

Sincerely,

Edward L. Bell
Deputy State Historic Preservation Officer
Senior Archaeologist
Massachusetts Historical Commission

220 Morrissey Boulevard, Boston, Massachusetts 02125
(617) 727-8470 • Fax (617) 727-5128
www.state.ma.us/sec/mhc

The Commonwealth of Massachusetts

William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

August 18, 2022

Andrew Chabot
Director, Development
AMP
518, 17th Street, Suite 950
Denver, CO 80202

RE: AMP Solar Development, ASD Shutesbury MA Solar LLC, 0 Shutesbury Road, Parcels 9B-11, 9B-12, and 9D-27, Amherst, MA. MHC #RC.69691.

Dear Mr. Chabot:

Staff of the Massachusetts Historical Commission (MHC) have reviewed the report, *Archaeological Reconnaissance Survey for the ASD Shutesbury Solar Project, Amherst, Massachusetts*, prepared by SWCA Environmental Consultants for the project referenced above.

The archaeological reconnaissance survey report indicates that the project area is unlikely to contain any significant archaeological deposits and features. The MHC agrees with the report recommendations that no further archaeological survey is recommended for the project as proposed.

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966 as amended (36 CFR 800) and M.G.L c. 9, ss. 26-27C (950 CMR 71). If you have any questions, please contact me.

Sincerely,

Edward L. Bell
Deputy State Historic Preservation Officer
Senior Archaeologist
Massachusetts Historical Commission

xc:
Kenneth W. Moraff, EPA Region 1
Michael Stover, EPA Region 1
Bettina Washington, Wampanoag Tribe of Gay Head (Aquinnah)
Amherst Historical Commission
Christopher Donta, SWCA Environmental Consultants

220 Morrissey Boulevard, Boston, Massachusetts 02125
(617) 727-8470 • Fax: (617) 727-5128
www.state.ma.us/sec/mhc

August 18, 2022

The Commonwealth of Massachusetts

William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

Andrew Chabot
Director, Development
AMP
518, 17th Street, Suite 950
Denver, CO 80202

RE: AMP Solar Development, ASD Tower MA Solar LLC, off Tower Road, Parcel 41-1, Pelham, MA.
MHC #RC.69690.

Dear Mr. Chabot:

Staff of the Massachusetts Historical Commission (MHC) have reviewed the report, *Archaeological Reconnaissance Survey for the ASD Tower MA Solar Project, Pelham, Massachusetts*, prepared by SWCA Environmental Consultants for the project referenced above.

The archaeological reconnaissance survey identified a 19th to 20th-century historical archaeological site designated the Johnson/O'Brien Estate within the project area boundaries. The MHC agrees with SWCA's report recommendations that project planners in consultation with SWCA should consider project layout alternatives to avoid and protect the historical archaeological site.

When they are developed, please provide the MHC with scaled project plans showing existing and proposed conditions, and which indicate the location and boundaries of the Johnson/O'Brien Estate archaeological site. Plans provided to the MHC should measure no larger than 11" x 17".

Your letter indicates that the additional report that you provided, *Survey of Stone Features, Amp Energy Proposed Solar Project, Tower Road, Pelham, Mass.*, prepared by Ceremonial Landscapes Research in consultation with the Tribal Historic Preservation Office of the Wampanoag Tribe of Gay Head (Aquinnah), was a survey of features of Native American concern that was undertaken to satisfy Town of Pelham bylaw requirements. The MHC has no role in the Town of Pelham's bylaw requirements for the project. Any matters of interest to the Tribe are appropriately discussed with the Tribe. The involved federal agency has a unique responsibility to consult with Native American Tribes about federal agency undertakings (36 CFR 800.2(c)(2)).

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966 as amended (36 CFR 800) and M.G.L c. 9, ss. 26-27C (950 CMR 71). If you have any questions, please contact me.

Sincerely,

Edward L. Bell
Deputy State Historic Preservation Officer
Senior Archaeologist
Massachusetts Historical Commission

xc:
Kenneth W. Moraff, EPA Region 1
Michael Stover, EPA Region 1
Bettina Washington, Wampanoag Tribe of Gay Head (Aquinnah)
Pelham Historical Commission
Christopher Donta, SWCA Environmental Consultants

220 Morrissey Boulevard, Boston, Massachusetts 02125
(617) 727-8470 • Fax: (617) 727-5128
www.state.ma.us/sec/mhc

NIPMUCK COUNCIL OF CHAUBUNAGUNGAMAUG
41 Cooper Rd.
FISKDALE, MA 01518
508-347-7829
nipmuck.org

June 19, 2021

AMP Solar Development, Inc.
Mr. Andrew Chabot
Senior Manager

Dear Mr. Chabot:

Thank you for corresponding with our tribe requesting assistance with AMP's permitting process connected with Solar Energy installations in the towns of Shutesbury and Pelham, MA. Unfortunately, because of our geographical location in the northeast part of Massachusetts, we are not familiar with "Areas of potential effect" or "Traditional Cultural Properties" within these locations. Local Historians or residents with Native American ties to these locations would be of more help to AMP.

The Chaubungamaug Nipmuck Indian Tribe is a Massachusetts State Acknowledged Tribe and request that the tribe be considered an interested party throughout the permitting process

Thanking you in Advance,

Elizabeth Santana Kiser

Elizabeth Santana Kiser
657 Worcester Street
Apt. 1603
Southbridge, MA. 01550
Coldwindnipmuc@icloud.com

20 Black Brook Road
Aquinnah, MA 02535

Tribal Historic Preservation Office
Wampanoag Tribe of Gay Head (Aquinnah)

Office (508)645-9265
Cell (508)560-9014

February 15, 2023

Andrew Chabot

Re: Tower Road, Pelham Solar

Dear Andrew,

The Wampanoag Tribe of Gay Head (Aquinnah) (WTGHA) Tribal Historic Preservation Office (THPO) has been presented for the construction of the solar panels on Tower Road in Pelham. The goal of the plan was to avoid the stone features that are present at the site, unfortunately it is not possible to avoid all the features.

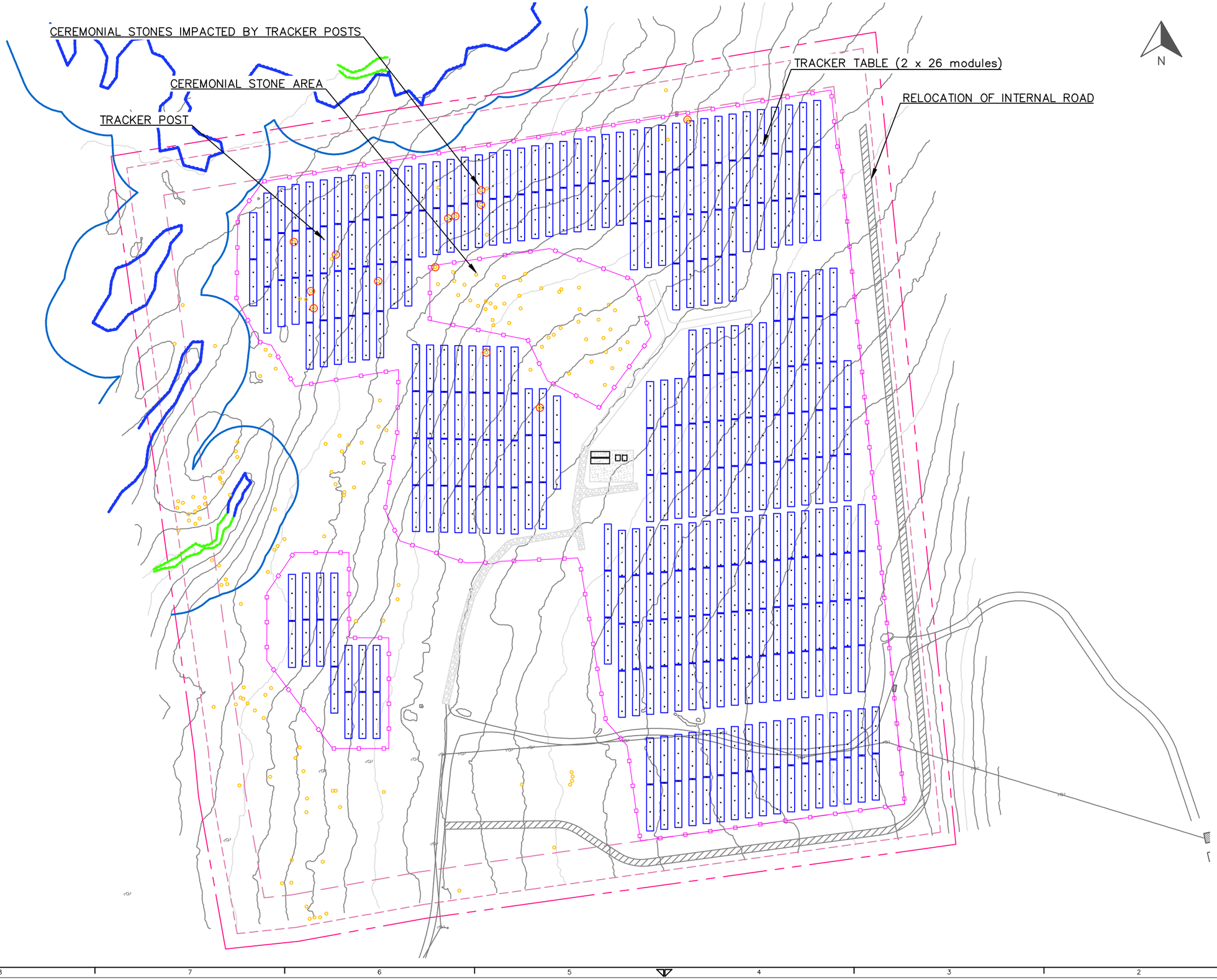
The site and stone features have been GIS mapped and presented to the Tribe for our review and the Tribe concurs with the proposed plan.

Should additional cultural features or artifacts be exposed, or there are changes in the plan or work methods, please contact the THPO Officer at 508-560-9014.

We appreciate your cooperation with the Tribe.

In the spirit of Preservation,

Bettina M. Washington
Tribal Historic Preservation Officer



PROJECT #: XXX

NOT FOR CONSTRUCTION

LYT Revision #: 1111

ERL Revision #: 00 Option #: 00

SITE SUMMARY	
AC POWER	4.400MW
DC POWER	9.720MWp
DC/AC RATIO	2.21
PV INVERTERS	2 x SMA SC2660UP (DERATED TO 2,200kW)
PV MODULES	17,836 (VIKRAM 545Wp BIFACIAL)

DEVELOPER

amp

301-31 Lakeshore Road East
Port Credit, ON
L5G 4V5
tel: 905-271-7800
fax: 905-271-7801
www.amp.energy

CLIENT

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REV	DESCRIPTION	DATE DD/MM/YY	BY
00	ISSUED FOR REVIEW	28/04/22	JC
01	ADDITIONAL LAND + GRADING	20/07/22	JC
02	MAX DC SIZE	22/07/22	JC
03	MAX DC SIZE REVISED	22/09/13	JC
04b	RELOCATE ROAD/MV LINE	22/10/05	JC

CLIENT:

ASD TOWER MA SOLAR LLC

PROJECT ADDRESS:

0 TOWER ROAD
PELHAM MA, 01002

DRAWING TITLE:

2P SAT
OPTION 2 - ROAD/MV LINE RELOCATION

DRAWING NO.

E-00

DRAWN:	JC	DATE:	28/04/22	SHEET: 1 of 1
CHECKED:		DATE:		

May 27, 2021

Dear Tribal Historic Preservation Officer,

Amp Solar Development, Inc., a renewable energy infrastructure owner, developer, and manager is proposing to construct five ground-mounted solar energy installations in Shutesbury, MA and one ground-mounted solar energy installation in Pelham, MA.

Project Proponent

Name:	AMP Solar Development, Inc.	Attn: Andrew Chabot
Address:	1550 Wewatta Street, Floor 4 C/O	
City/Town/Zip/Telephone:	Denver, CO 80202	978.339.9195

Permitting for these projects are forthcoming. In preparation of our site plans, we are requesting your assistance in locating any known, mapped, or suspected Native American archaeological sites or sites of Native American ceremonial activity within these parcels. A prepaid envelope has been included here with this letter.

We respectfully request written comments from your office upon review of this project within 35 days of receipt of this letter. If you have any questions or concerns regarding the proposed project, please reach out to me via my contact information below.

I look forward to hearing from you.

Sincerely,

Andrew Chabot
Senior Manager
T. 978.339.9195
achabot@amp.energy

(Please see following pages for corresponding parcels and initial site plans)

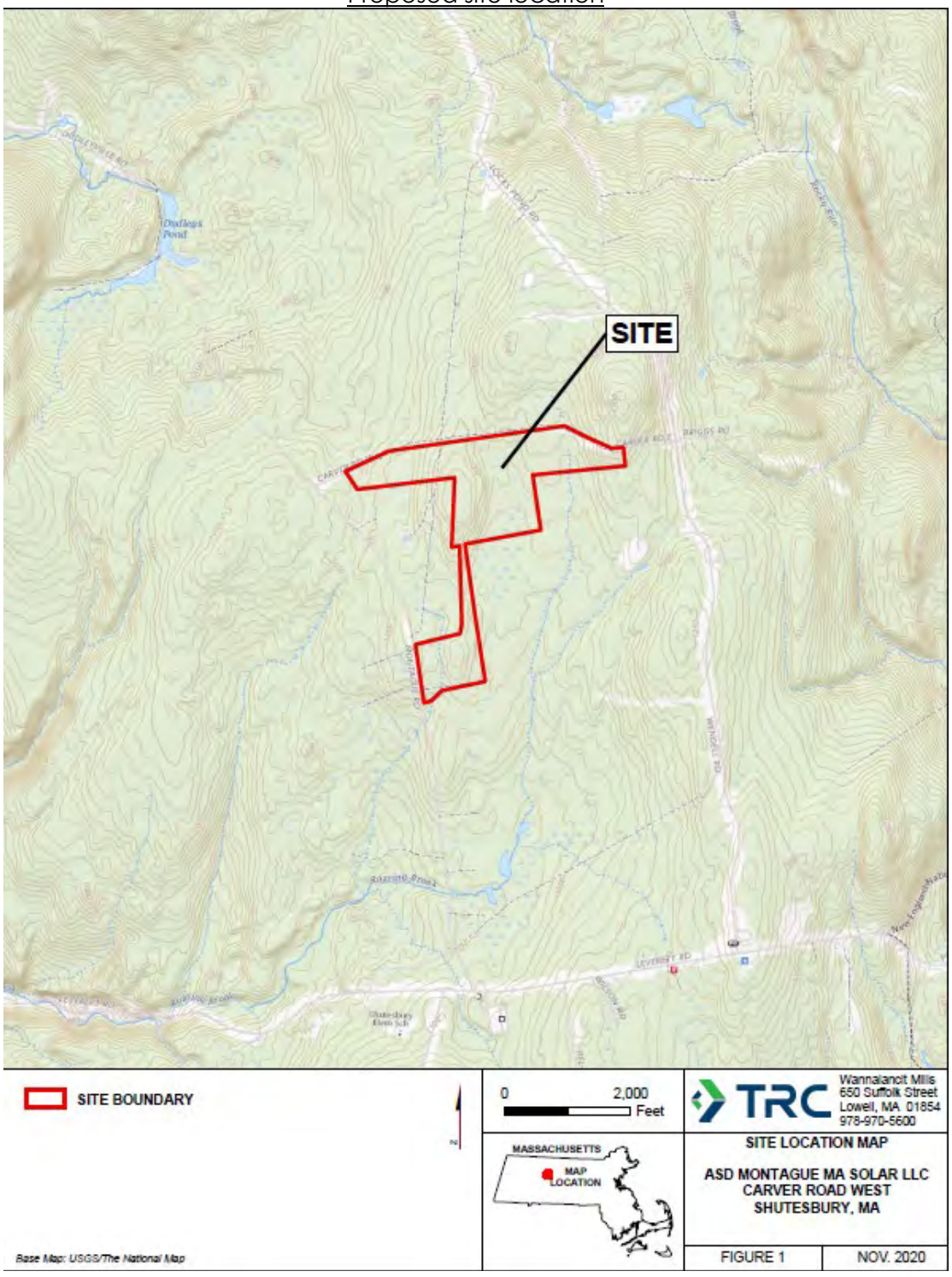
Shutesbury Parcel ID: ZD-37

Project Description (narrative): Proposing to construct a solar electrical generation facility on the approximately 60 acres of a 263-acre property on Montague Road in Shutesbury MA. The property (Parcel ZD-37) is zoned as forest conservation district. The site is currently undeveloped woodland. The Project will include the installation of arrays of solar, photovoltaic panels mounted on metal racks. Electrical equipment including transformers and inverters will be mounted on concrete pads. To the extent practicable, electrical conduits within the site will be underground. The solar arrays will be connected to Montague Road by a gravel access driveway.

Proposed site design



Proposed site location



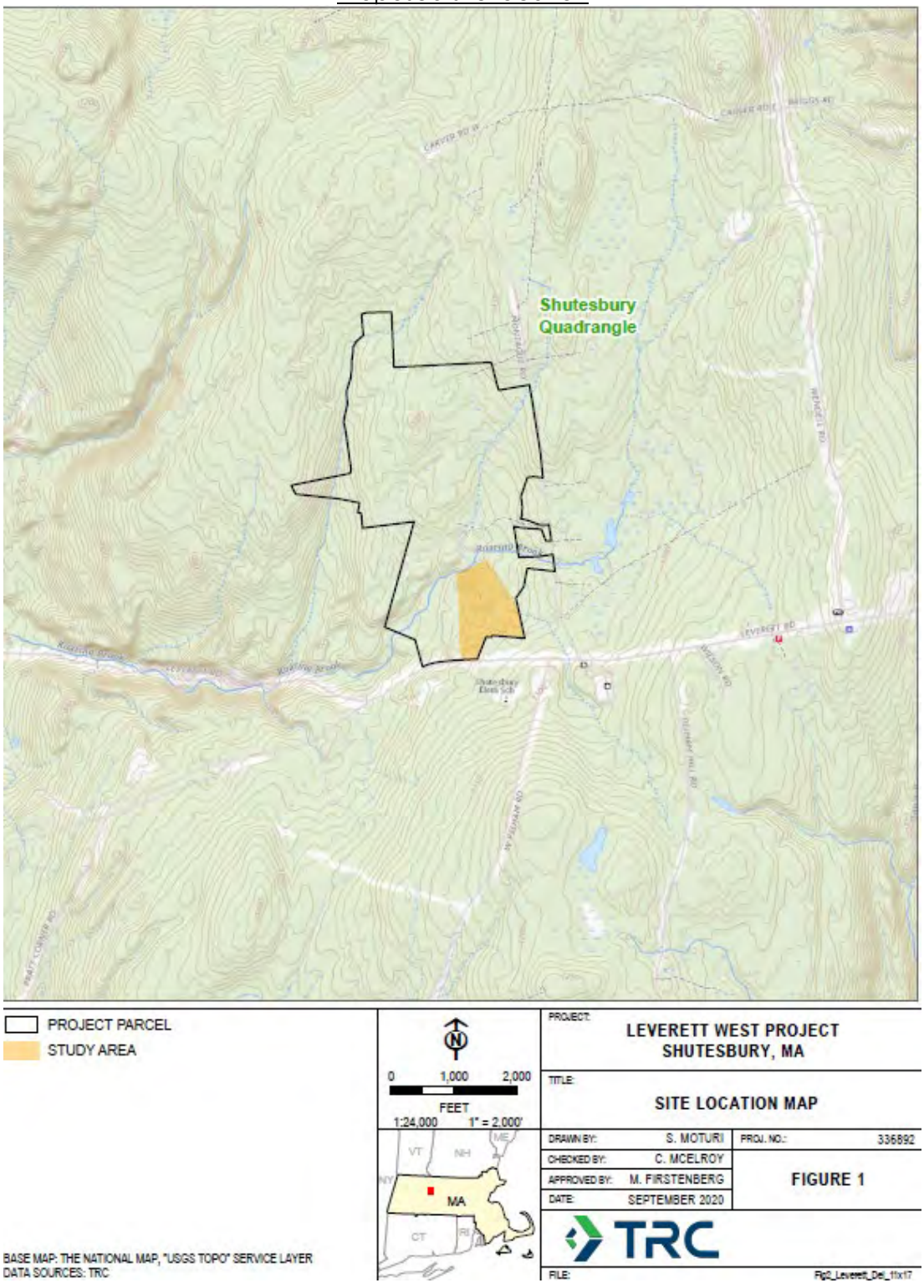
Shutesbury Parcel ID: ZF-15

Project Description (narrative): Proposing to construct a solar electrical generation facility on the approximately 25 acres of the 296-acre property off Leverett Road in Shutesbury MA. The property (Parcel ZF-15) is in the forested conservation zoning district. The site is currently undeveloped woodland. The Project will include the installation of arrays of solar, photovoltaic panels mounted on metal racks. Electrical equipment including transformers and inverters will be mounted on concrete pads. To the extent practicable, electrical conduits within the site will be underground. The solar arrays will be accessed by a gravel driveway connected to Leverett Road.

Proposed site design



Proposed site location



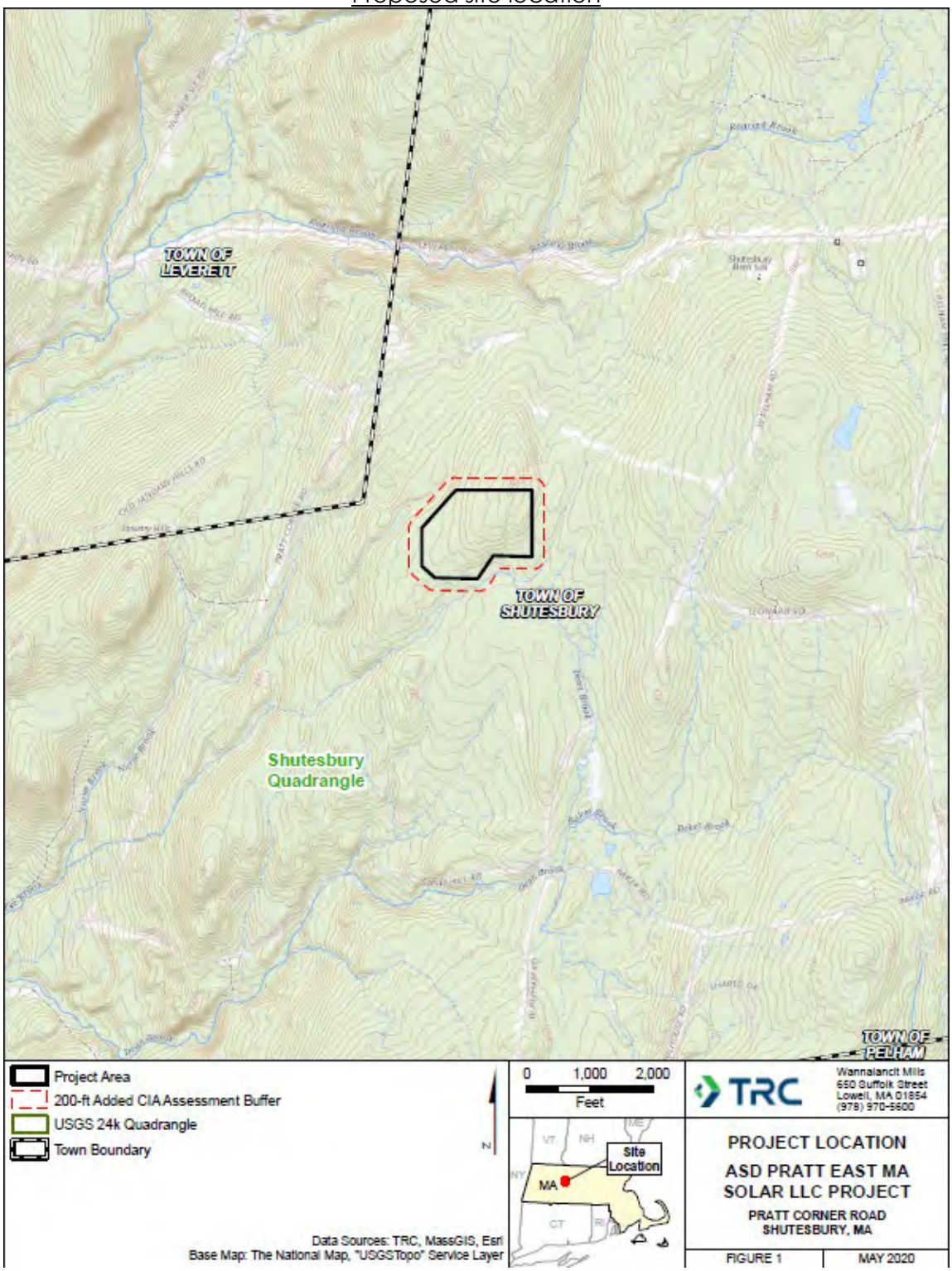
Shutesbury Parcel ID: ZG-2

Project Description (narrative): Proposing to construct a solar electrical generation facility on approximately 44 acres of the 829-acre property at 0 Pratt Corner Road in Shutesbury, MA. The property (Parcel ZG-2) is zoned as forest conservation district. The site is currently undeveloped woodland with an access trail running roughly north to south across the property. The Project will include the installation of arrays of solar, photovoltaic panels mounted on metal racks. Electrical equipment including transformers and inverters will be mounted on concrete pads. To the extent practicable, electrical conduits within the site will be underground. The solar arrays will be connected to the electric lines at Pratt Corner Road.

Proposed site design



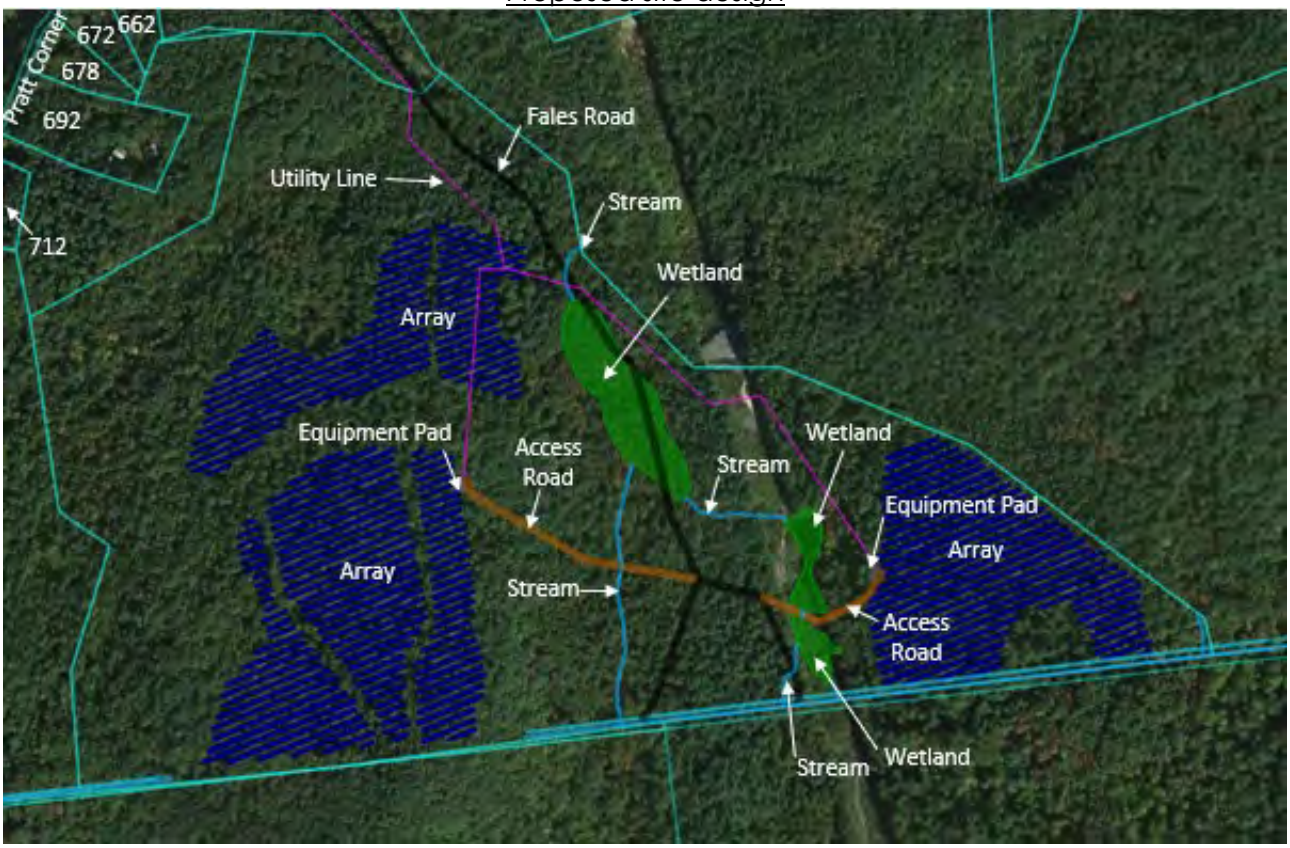
Proposed site location



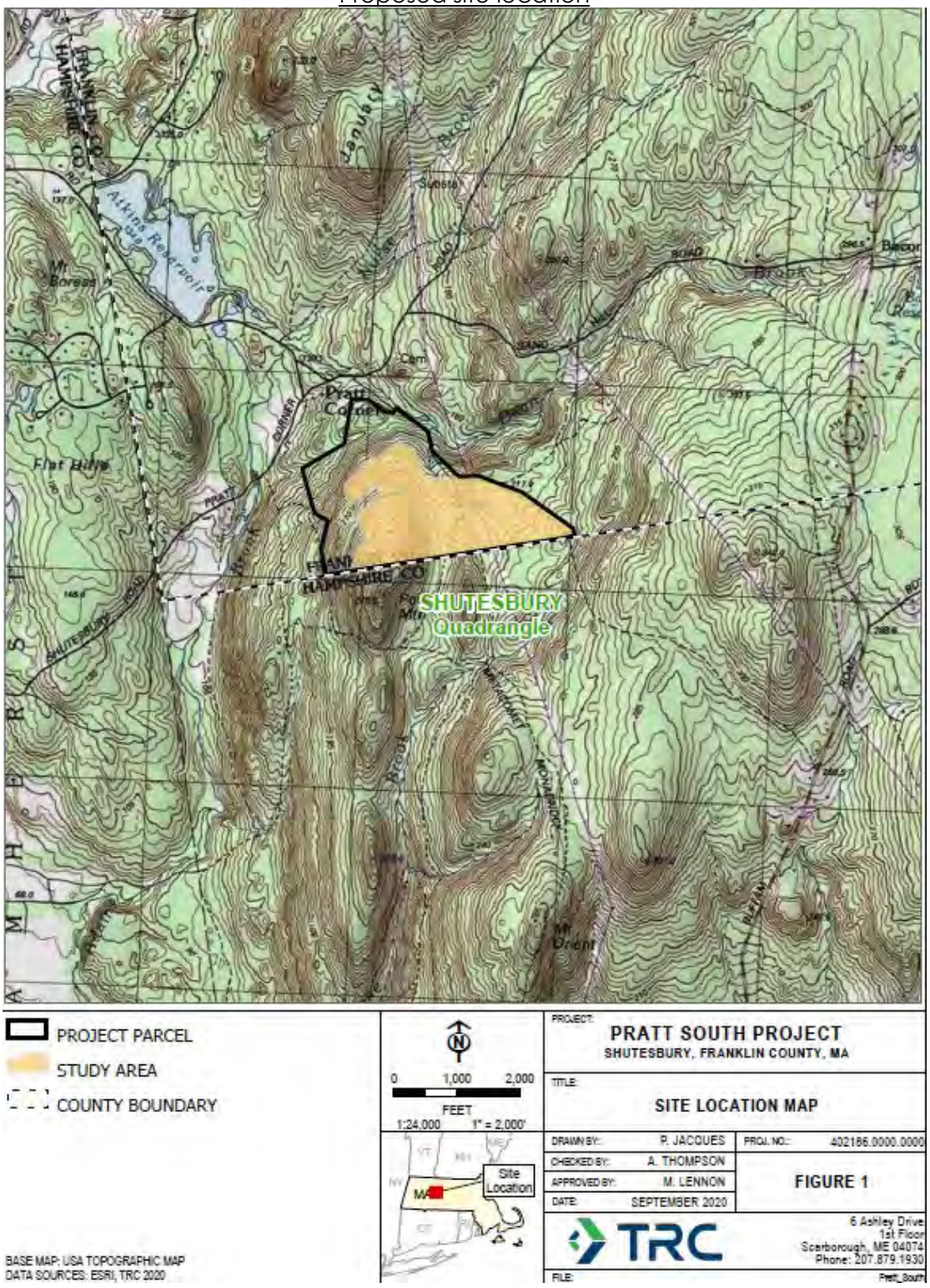
Shutesbury Parcel ID: ZU-2

Project Description (narrative): Proposing to construct a solar electrical generation facility on the approximately 90 acres of 120-acre property south of Pratt Corner Road in Shutesbury MA. The property (Parcel ZU-2) is in Forest Conservation zoning district. The site is currently undeveloped woodland. An electrical transmission ROW traverses the property from north to south in the eastern portion of the site. The Project will include the installation of arrays of solar, photovoltaic panels mounted on metal racks. Electrical equipment including transformers and inverters will be mounted on concrete pads. To the extent practicable, electrical conduits within the site will be underground. The solar arrays will be connected to Pratt Corner Road by a gravel access driveway.

Proposed site design



Proposed site location



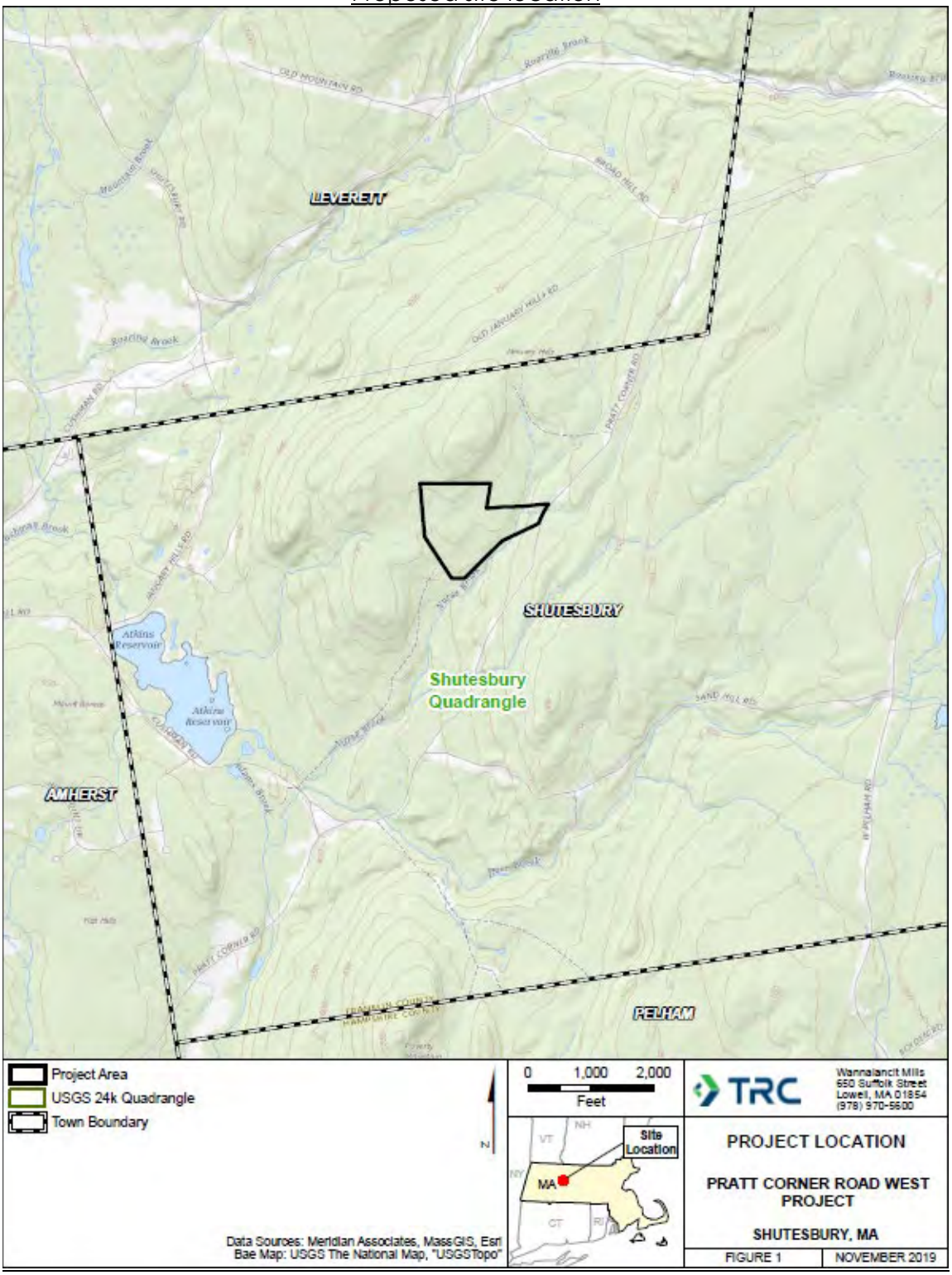
Shutesbury Parcel ID: ZW-6

Project Description (narrative): Proposing to construct a solar electrical generation facility on approximately 40 acres of the 389-acre property at 0 Pratt Corner Road in Shutesbury, MA. The property (Parcel ZW-6) is zoned as forest conservation district. The site is currently undeveloped woodland with power transmission lines running along the western boundary The Project will include the installation of arrays of solar, photovoltaic panels mounted on metal racks. Electrical equipment including transformers and inverters will be mounted on concrete pads. To the extent practicable, electrical conduits within the site will be underground. The solar arrays will be connected to Pratt Corner Road by a gravel access road.

Proposed site design



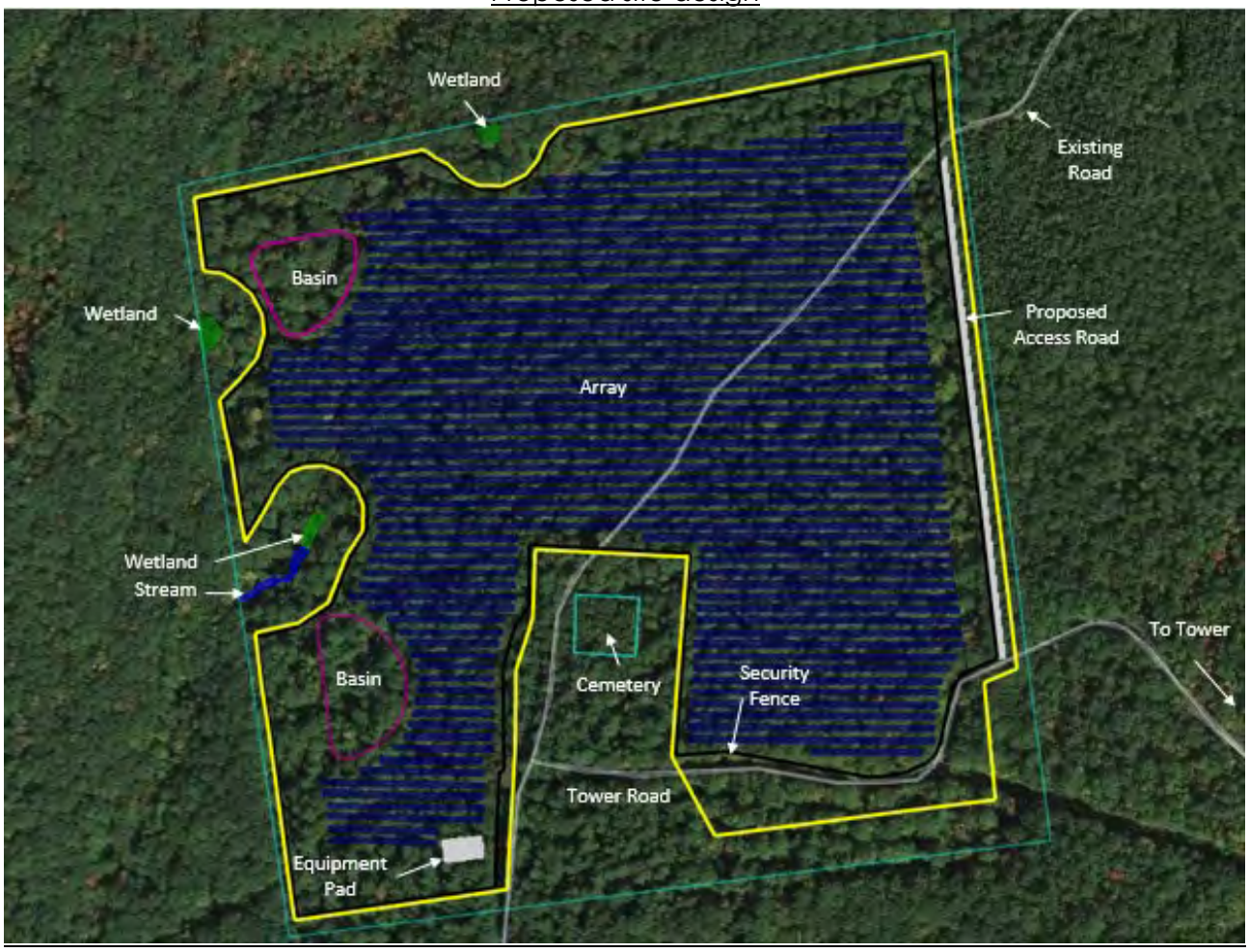
Proposed site location



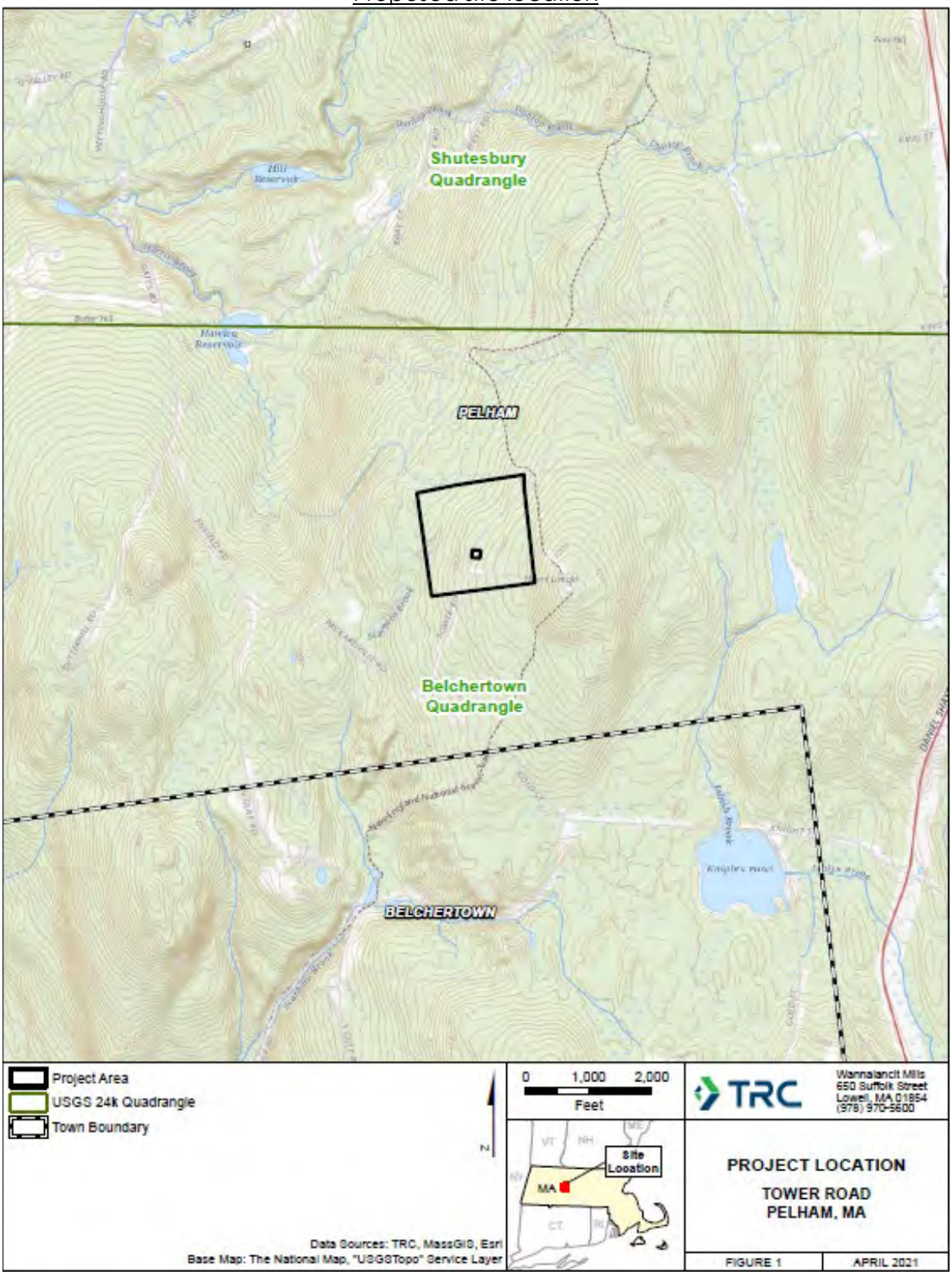
Pelham Parcel ID: 14-1

Project Description (narrative): Proposing to construct a solar electrical generation facility on the approximately 63.4-acre property off Tower Road in Pelham MA. The property (Parcel 41-1) is zoned as residential. The site is currently undeveloped woodland. There are several footpaths and two sheds on the property. Also, within the site is the Ruben Allen Cemetery (also known as Johnson Family Burial Place), which includes approximately 20 graves. The layout for the solar facility is still in the design process, however, the Project will be designed to avoid the cemetery. The Project will include the installation of arrays of solar, photovoltaic panels mounted on metal racks. Electrical equipment including transformers and inverters will be mounted on concrete pads. To the extent practicable, electrical conduits within the site will be underground. The solar arrays will be accessed by a gravel driveway connected to Tower Road.

Proposed site design



Proposed site location



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3 of 4

Archaeological Reconnaissance Survey for the ASD Tower MA Solar Project, Pelham, Massachusetts

JUNE 2022

PREPARED FOR

AMP Solar Development, Inc.

PREPARED BY

SWCA Environmental Consultants

ARCHAEOLOGICAL RECONNAISSANCE SURVEY FOR THE ASD TOWER MA SOLAR PROJECT, PELHAM, MASSACHUSETTS

THIS REPORT CONTAINS CONFIDENTIAL INFORMATION
NOT FOR PUBLIC DISTRIBUTION

Prepared for

AMP Solar Development, Inc.
1550 Wewatta Street, Floor 4
Denver, Colorado 80202
Attn: Andrew Chabot

Prepared by

Christopher Donta, Ph.D., and Nadia Waski, M.A.

SWCA Environmental Consultants
15 Research Drive
Amherst, Massachusetts 01002
(413) 256-0202
www.swca.com

SWCA No. 69472

SWCA Cultural Resources Report No. 22-295

June 2022

ABSTRACT

SWCA Environmental Consultants (SWCA) conducted a background research and archaeological reconnaissance survey in support of the proposed AMP Solar Development, Inc., ASD Tower MA Solar Project (project) in southern Pelham, Massachusetts. The project includes approximately 48 acres on Parcel 14-1 situated northeast of Packardville Road and south of Amherst Road and is accessed via Tower Road. No recorded archaeological sites are within the project area. However, two recorded historic archaeological sites are in the vicinity of the project area: The Packardville Road Foundation (PEL.HA.3) and the Monk's Cave site (PEL.HA.4). The Ruben Allen/Johnson Family Burial Place (PEL.801), reportedly established in 1837, is located on project parcel 14-1A. The review of the historical documents and mapping shows that the project area was occupied by the Johnson/O'Brien family beginning in the early 1800s. During the field reconnaissance survey, SWCA staff identified two historical foundations, a well, and stone walls associated with the foundations, west of Tower Road and southwest of the cemetery. No evidence of Native American activity was found. SWCA recommends avoidance and protection of the Johnson/O'Brien Estate historic archaeological site. If avoidance is not feasible, an archaeological site examination survey is recommended.

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INTRODUCTION

SWCA Environmental Consultants (SWCA) conducted a site file check, background literature review, and an archaeological reconnaissance survey on behalf of AMP Solar Development, Inc. (AMP), in support of the proposed project. AMP provided the Massachusetts Historical Commission (MHC) with a Project Notification Form on April 22, 2021, to which the MHC responded in a letter dated May 10, 2021, asking for scaled plans. Upon receipt of the plans, MHC requested an archaeological reconnaissance survey of the project on June 11, 2021.

The proposed project consists of the construction of a solar array in the southern part of the town of Pelham, Massachusetts, just to the north of the Belchertown border. The area lies northeast of Packardville Road and south of Amherst Road and is accessed via Tower Road. It is located on the western side of Mount Lincoln, which is one of a series of hills that demarcate the eastern side of the Connecticut River valley, running north-south in this area through Shutesbury, Pelham, and Belchertown. The peak of Mount Lincoln is at 377 meters (m), with the project area ranging from 300 to 347 m in elevation (Figure 1 and Figure 2).

The project parcel is surrounded by Cadwell Memorial Forest, which was established in 1952 and is owned and managed by the University of Massachusetts Department of Environmental Conservation. Lot 14-1 is an inholding within this forest boundary that is also forested. Tower Road, running northeast from Packardville Road, passes through the property to the summit of Mount Lincoln, where a number of radio and transmission structures are located.

Project plans include an access road, tree clearing, utility lines, panels, fencing, detention basin, and equipment pad. The proposed limit of clearing measures approximately 48 acres of woodlands. The project area is rural and largely undeveloped, in a remote wooded area. Dispersed residences line the southern side of Packardville Road, 500 m to the south at the closest point to the project. Aside from Tower Road, several wood roads cross through the project area. An overhead transmission line runs northwest to southeast 1.1 kilometers (km) to the northeast.

SWCA completed background research the 48.5-acre project area itself, as well as the surrounding town lands in Amherst, Pelham, and Shutesbury. The project requires permitting from the U.S. Environmental Protection Agency (EPA) for a National Pollutant Discharge Elimination System (NPDES) General Construction Permit and therefore requires compliance with Section 106 of the National Historic Preservation Act (NHPA). The NHPA requires consultation with the appropriate State Historic Preservation Office (SHPO), which in this case is the MHC. The MHC recommended that an archaeological reconnaissance survey be completed within the APE to determine whether cultural resources would be affected by the project.

SWCA conducted the archaeological investigation in compliance with federal and state regulations. Procedures were in compliance with legislation and regulations concerning the impact to archaeological properties from federally funded or permitted activities. These include the NHPA of 1966, amended 1992 (54 United States Code [USC] 300101); the National Environmental Policy Act of 1969 (Public Law [PL] 91 990, 42 USC 4321); Executive Order 11593, 1971 (16 USC 470); Procedures for the Protection of Historic and Cultural Properties (36 Code of Federal Regulations 800); and the Archaeological and Historic Preservation Act of 1974 (PL 93 291). State legislation dealing with the protection of historic and archaeological resources includes Massachusetts General Laws (MGL) Chapter 9, Sections 26-27C, and the Massachusetts Environmental Policy Act (MGL, Chapter 30, amended by Chapter 947 of the Acts of 1977). Projects involving the discovery of human remains or cemeteries are conducted in compliance with MGL Chapter 7, Section 38A; Chapter 38, Section 6; Chapter 9, Subsections 26A and 27C; and Chapter 114, Section 17, all as amended). Massachusetts archaeological permit regulations are outlined in 950 Code of Massachusetts Regulations (CMR) 70.00. This survey was conducted under State Archaeologist's Permit No. 4168.

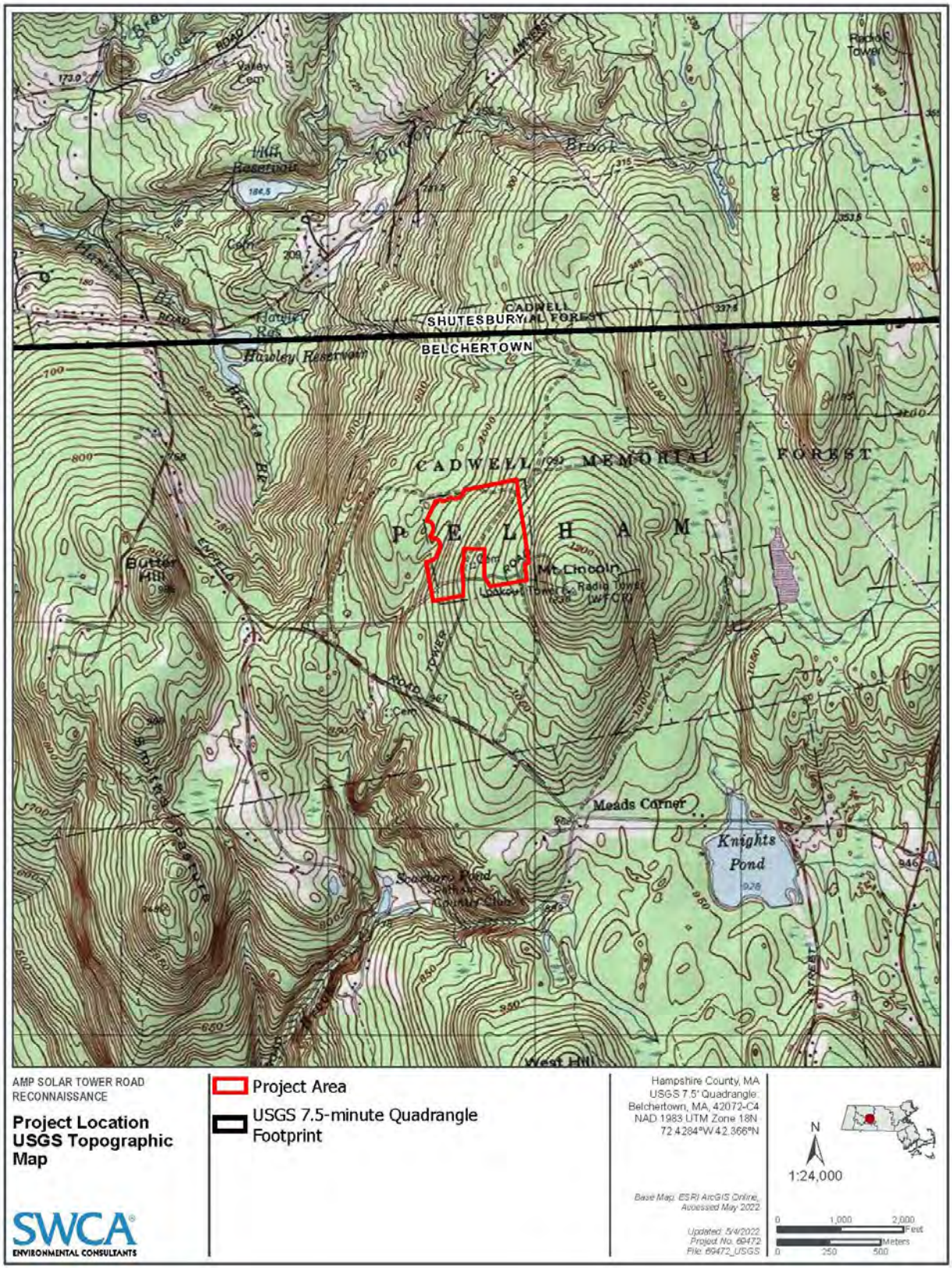


Figure 1. Location of the project area on the Belchertown Quadrangle (U.S. Geological Survey [USGS]).



Figure 2. Location of the project area in Pelham overlain on aerial imagery.

This report is divided into five main sections. Following this introduction is a discussion of the methodology used for this survey. The third section presents the survey results, including the background research and the field survey. The report concludes with a recommendations section and references cited. Christopher Donta, Ph.D., served as project manager for the project, conducted the field survey, and contributed to the report. Nadia Waski, M.A., served as principal investigator and co-authored the report. Steve Anderson completed the graphics for the report.

METHODOLOGY

Background Research

The analysis included a review of the MHC site files for archaeological sites and architectural resources. The MHC compiles and maintains a database known as the *Inventory of Historic and Archaeological Assets of the Commonwealth* (the Inventory). The Inventory is maintained in computer files, paper files, maps, and ancillary reports, which are located at the office of the MHC in Boston, Massachusetts, and on the online Massachusetts Cultural Resources Information System (MACRIS) database (MHC 2022). The Inventory is maintained pursuant to MGL Chapter 9, Section 26A(1) and is not a public record. In addition, MHC maintains a *Bibliography of Archaeological Survey and Mitigation Reports* (MHC 2021). The MHC (2021) bibliography entries summarize archaeological report submissions to its office. Additional entries include significant discoveries, innovative methodologies, and research accomplishments in Massachusetts archaeology.

Native American sites are identified according to a national system developed by the Smithsonian Institution in the first half of the twentieth century. Each state is assigned a number based on alphabetic sorting, from 1 to 48, with Massachusetts being nineteenth (Alaska and Hawaii were added after they became states, as 49 and 50, respectively). Sites found within each state are divided by county and then numbered in sequence within that county. For example, Native American site number 19-HS-8 represents the eighth site recorded within Hampshire County in the Commonwealth of Massachusetts. Historical archaeological sites in Massachusetts are numbered according to the town where they are located and the sequence of their inclusion in the state site files. A three-letter code is used for the town name.

The MACRIS database (MHC 2022) was searched for recorded Native American and Historic period archaeological sites in or near the project area in Pelham. Locational information from the files was cross-checked against MHC maps, and those locations were confirmed using Google Earth (2022) imagery. Those sites appearing to provide context for the project area were researched, including copying of site forms at the MHC offices. The MACRIS database also maps out the location of previous archaeological surveys, which were also researched, and copies were made of those thought to be of use for this project.

SWCA searched for historical mapping relative to the project area. In Massachusetts, state surveys were conducted in the 1790s and 1830s, providing some of the earliest detailed mapping of towns in the state. Later in the nineteenth century, private enterprises mapped towns in more detail, such as the Walling and Beers atlases of the 1850s and 1870s. The USGS began mapping in the 1880s, switching to a larger scale map in the 1930s, which provides significant detail about changes in the landscape. Most of these maps are available on the USGS Topoview website (USGS 2022). Additional background research included research into maps of the project area dating from the 1790s, 1830s, 1850s, 1870s, and USGS topographic maps from the 1880s to present. Aerial photographs and satellite imagery are another source of information, with imagery from the past 20 to 30 years becoming easily accessible through Google Earth (Google Earth 2022).

SWCA also researched written histories of importance to the project area, including the MHC town reconnaissance for Pelham (MHC 1982), and the regional summary for the Connecticut River Valley (MHC 1984). Town histories can sometimes be of use, such as Parmenter (1898), as are county (Copeland 1902) and regional histories (Everts 1879; Holland 1855; Wright 1949).

SWCA used the research to develop contexts for any Native American sites and sites of the Historic period, as well as to develop a land use history of the project area.

Archaeological Reconnaissance Survey

The reconnaissance survey was completed by SWCA staff walking systematic transects across the project limits of disturbance. The purpose of the survey was to look for any evidence of archaeological sites, such as Native American occupation or more recent Historic period domestic and agricultural use of Tower Road. The survey was also conducted to evaluate the overall archaeological potential of the project area in order to develop recommendations for subsurface testing at the intensive (locational) survey level, if warranted. SWCA staff looked for evidence of human use, standing structures, archaeological sites, or areas of disturbance. All mapping was completed with a tablet and Geode GPS device, using the ArcGIS Collector application.

All project materials were processed in in SWCA's Amherst office. This includes field data and records, mapping, and report files. Original copies of paperwork are maintained in the Amherst office, supported by an automatic server backup procedure. Further duplicate records of all Amherst records are also backed up at the corporation headquarters in Phoenix. SWCA is permanently curating all paper and digital records related to this project in our Amherst office, with backup copies in our headquarters office in Phoenix.

SURVEY RESULTS

Background Research

Historic Contexts and Land Use History

Pelham is located on the eastern side of the Connecticut River valley, generally 9 to 18 km east of the river. Its eastern boundary is defined by the western arm of the Quabbin Reservoir, the former West Branch of the Swift River. The topography in Pelham is hilly, cut by a few small drainages, including Buffam and Harris Brooks draining to the west into Amethyst Brook, and Purgee Brook and Cadwell Creek draining to the east into the Quabbin.

The Connecticut River valley was the traditional home of the Pocumtuc or "River Indians" prior to colonization by European settlers in the seventeenth century. The Pocumtuc are Algonquian-speaking peoples, closely related to the Abenaki to the north and the Nipmuc to the east (Salwen 1978), whose ancestors inhabited all of New England since the last ice age. Beginning in the seventeenth century, European settlers began to spread out across the Connecticut River valley, beginning in Hadley in 1661, and spreading eastward into what is now Amherst by about 1703 (MHC 1984). Pelham was formed as Stoddard Town in 1738, and incorporated as the town of Pelham in 1742, with its boundaries with Shutesbury and Belchertown established in 1761, except for the annexation of Packardville from Belchertown in 1788 (MHC 1982).

The project area lies away from any major early transportation arteries. What is now the Daniel Shays Highway (Route 202) formed as the major north-south route in the eighteenth century along with Amherst Road running west from the town center (MHC 1982). Additional roads include North Valley Road to Orient Springs and continuing via Buffam Road to Shutesbury; Gates Road and Enfield/Packardville Road running to the south into Belchertown; and Harkness Road along the Amherst border.

The earliest map of the town (Anonymous 1795) shows only Amherst Road in the western part of the town, while by 1830, all of the major town roads are accurately depicted (Cook and Parmenter 1830). The project area is shown on early maps as a wooded area with no road access. By 1854, a house of "Mrs. Johnson" is indicated northeast of Enfield Road, but Tower Road itself is not yet shown (Barker 1854). An 1860 map adds some detail as to the topography, showing Mount Lincoln, with a "Johnson Est" indicated in the approximate project area (Walling 1860). Tower Road is first shown on the map of 1873 (Beers 1873), running northeast from Enfield Road to the "P. O'Brien Est." with Mount Lincoln to its north. The earliest USGS map series also shows Tower Road approaching the west side of Mount Lincoln, with two houses at the end of the road, but little else (USGS 1887). The first higher resolution USGS map of 1942 shows a more exact route for Tower Road to the summit of Mount Lincoln, as well as the cemetery and trails between the roads, but no houses along Tower Road (USGS 1942). Later maps continue to show the area as wooded with no development except for the cemetery (USGS 1950, 1966, 1979). No houses are shown on the road following the USGS old series of maps (1880s). The houses that were indicated along Tower Road look to have been well southwest outside of the project area.

Based on the references to "Mrs. Johnson" in 1854 and the "Johnson Est" in 1860, the Johnson Family Burial Place must have been established in the back fields behind the Johnson house by 1837 and maintained from thereon.

No indications of development, other than that of the Johnson family, or other uses of the project area were found during SWCA's preliminary research. Given the upland hillside, this area has likely been little used in the past except as a wooded lot, in which the Johnson family resided and the small family cemetery was built.

The property is currently owed by a forestry company that is actively managing timber harvests in the area.

Previous Archaeological Surveys

Research of MHC site files and reports was conducted online on October 8, 2021, and in person on October 13, 2021. According to the MACRIS Maps (MHC 2022) portal, no previously conducted archaeological surveys encompass any part of the project area or come within 1 km of the project area. The nearest previous survey appears to be over 1.1 km away. In 1988, background research and a field reconnaissance were conducted for a proposed natural gas pipeline route through Leverett, Shutesbury and Pelham along the existing National Grid E5/F6 transmission line that runs across Pelham from northwest to southeast, east of the project area (Rainey 1989). Slightly further away to the east, a study was conducted of the Quabbin watershed, which included mostly the portion of Pelham east of Route 202, approximately 2.2 km to the east of the project area (Bowers et al. 1986).

Archaeological Sites

Native American Sites

No Native American archaeological sites have been recorded anywhere in the vicinity of the project area. The nearest Native American site appears to be the Pelham Hills site (19-HD-256), located approximately

3.8 km to the northwest of the project area, near the Amherst town border. This is the only Native American site recorded within the town of Pelham to date. A number of Native American sites are recorded in Amherst along Heatherstone and Amethyst Brooks, but little is currently known about Native American use of the uplands in Pelham.

Historic Period Sites

Two recorded Historic period archaeological sites are located in the general vicinity of the project area. The Packardville Road Foundation (PEL.HA.3) is located approximately 450 m to the southwest of the southwestern edge of the project area, on the north side of Packardville Road, west of its junction with Tower Road. This is a nineteenth-century house foundation of fieldstone. Abandoned house sites are common in the hill towns in this area, found along or set back from roadways, often including a cellar hole, barn foundation, well, and domestic midden. Although many such sites are known to exist, only a few sites of this type have been documented in Amherst, Pelham, Shutesbury, and Leverett.

The second Historic period site is the Monk's Cave site (PEL.HA.4), located behind the house at 123 Packardville Road. "Monk's Caves" are known from the hill towns, with a number still in existence in Shutesbury, other towns in the area, and this one in Pelham. They are stone-lined subterranean chambers, most likely root cellars for storing food in the cool ground, used prior to the development of mechanical refrigeration.

Soils

The project area consists almost entirely of Gloucester gravelly fine sandy loams, very stony or extremely stony, slopes of 3 to 25 percent (Natural Resources Conservation Service [NRCS] 2022). These are soils derived from glacial till on hill slopes. Although this soil series is well drained, it is not frequently associated with the presence of Native American sites, probably because of the high stone content.

Archaeological Potential

Based on the background research, the project area is located in an upland hillside area that was never developed, except for dispersed residential settlement and a small family cemetery (PEL.801). Tower Road appears to be an extension of a nineteenth century farm road. The area is unlikely to have Native American site potential, as it is located in upland, sloping, rocky soils. However, it does appear to have Historical site potential, as Pelham and other nearby towns have numerous undocumented farmsteads with archaeological traces and this location includes a historical town road, cemetery, and nearby residence shown on maps dating to the nineteenth century (Figure 3).

Aboveground Historical Resources

NATIONAL REGISTER PROPERTIES

No recorded National Register of Historic Places (NRHP) properties are within or near the project area. The only NRHP property in Pelham is the Pelham Town Hall Historic District (PEL.A), listed in 1971, located approximately 3.2 km to the northeast of the project area.

HISTORIC PROPERTIES

The only historical property within or near the project area is the Ruben Allen Cemetery (PEL.801), also known as the Johnson Family Burial Place, which the project is designed around (see Figure 3). No historic districts are within or near the project area.

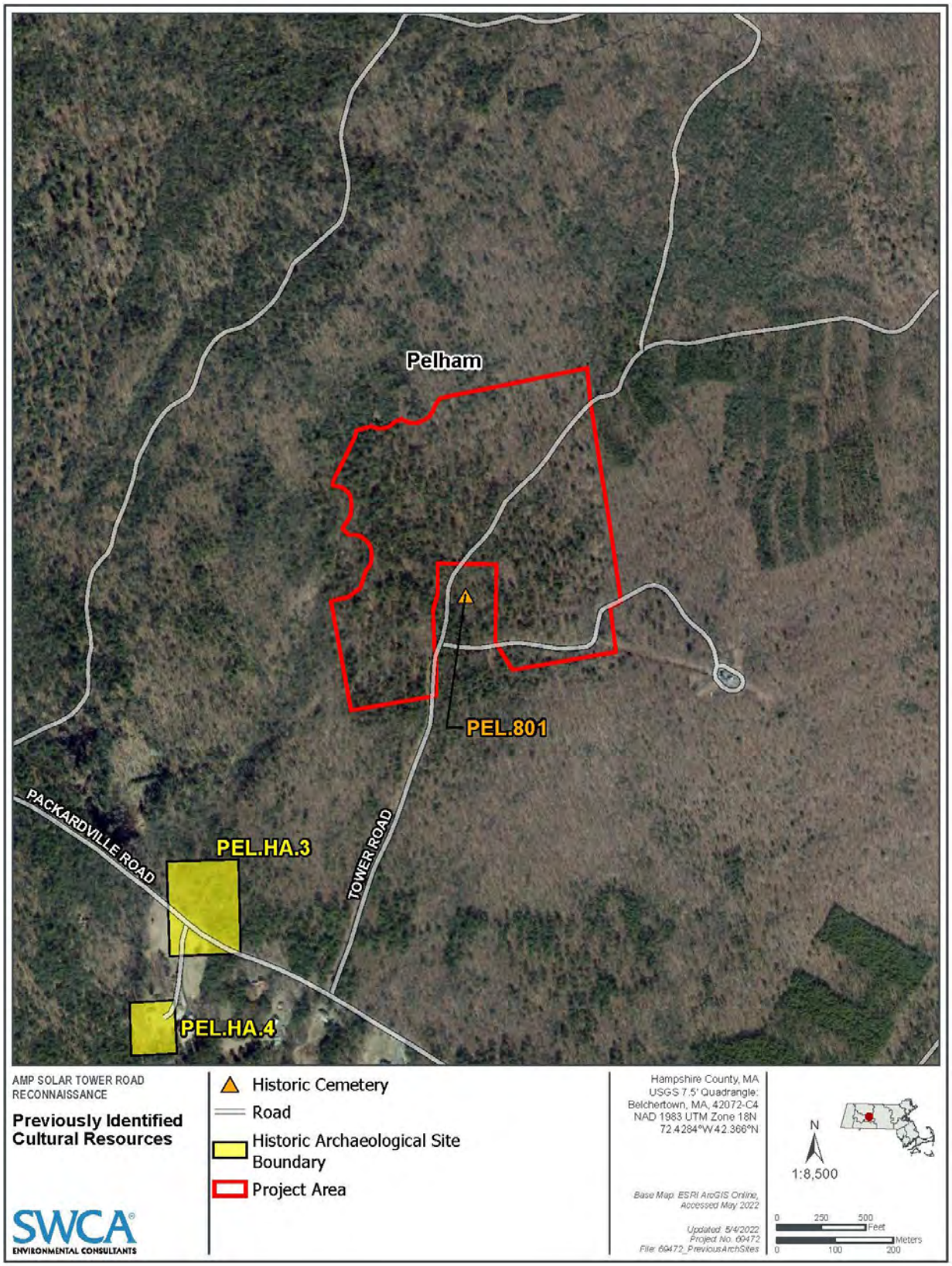


Figure 3. Relationship of the project area to recorded site locations and cemetery on a satellite photograph.

Cemeteries

The Ruben Allen/Johnson Family Burial Place (PEL.801), reportedly established in 1837, is located on parcel 14-1A. Parcel 14-1A is an inset around which the project parcel 14-1 is situated. The cemetery is located on the west slope of Mount Lincoln, in a small, rectangular, low stone-walled clearing in the woods.

According to the cemetery form, only three headstones are recorded on the cemetery form recorded in 1973 (PEL.801), dating from 1837 to 1853, although no specific ages are assigned to the three listed burials. A statement on the form says that about 20 burials are present in the cemetery (MHC 2022). Some more information was found on FindaGrave.com, where five burials are listed, dating from 1853 (George Johnson), 1888 (Patrick Bailey), and 1904 (Charlotte Johnson Allen), along with two other undated burials (Find a Grave 2021). It is not clear how the 1837 date was established, because neither the form nor Find a Grave (2021) report any headstones with that date. A statement from the cemetery form says that "burial was refused in the public burial places when a daughter's child died of what was thought to be smallpox. Mr. Johnson buried his grandchild upon this plot of land near his home. A few square rods of land was walled in and about twenty burials of his family and relatives have been made within this enclosure." (MHC 2022). A number of questions arise from this statement, as to which Mr. Johnson they are talking about, and are they referring to a specific daughter and grandchild who had smallpox? Clearly additional graves are present that were either not marked or their headstones lost. Fortunately, based on photographs, the cemetery boundaries appear to be very distinct (Figure 4 to Figure 6).



Figure 4. Ruben Allen/Johnson Family cemetery (PEL.801) on parcel 14-1A, outside the project area, facing south.



Figure 5. Grave marker of Patrick Bailey of the 27th Mass. Infantry (d. 1888).



Figure 6. Grave Marker of George Johnson, unknown if marker is Lt. George Johnson of 25th Mass. Infantry or George Johnson (d. 1853).

Consultations

Section 106 of the NHPA requires that federal undertakings include consultation with interested parties that might be affected by the project. The lead federal agency is obligated to identify and engage with consulting parties. This includes the SHPO, Native American tribes, local governments, and other individuals and organizations with a demonstrated interest in the project area. With this document, SWCA is providing information to the Massachusetts SHPO, which is responsible for assessing impacts to recorded and/or undocumented archaeological and other cultural resources within the Commonwealth. As the representative of the U.S. federal government for this project, the EPA has the responsibility to conduct government to government consultations with concerned Native American tribes. However, as part of the NHPA Section 106 process, on behalf of the EPA, AMP sent letters, in May 2021, to multiple tribal agencies, including the Wampanoag Tribe of Gay Head (Aquinnah), the Mashpee Wampanoag Tribe, the Narragansett Indian Tribe, the Schaghticoke Tribal Nation, the Mohegan Tribe, the Mashantucket (Western) Pequot Tribal Nation, the Elnu Abenaki Tribe, the Nipmuc Nation, the Chaubunagungamaug Band of the Nipmuck Nation, and the United South and Eastern Tribes requesting their input regarding the review of the project. In June of 2021, Elizabeth Santana Kiser of the Chaubungamaug Nipmuck Indian Tribe replied to indicate that her tribe is not familiar with any cultural resources in this area. In August 2021, AMP successfully contacted the Pelham Historical Commission who provided their comments.

Archaeological Reconnaissance Survey

Research Design

To effectively survey the project area, the project limits of disturbance were stratified (ranked) according to their potential to contain archaeological resources on the basis of landform, paleo environment, distance to water, soil, slope, and proximity to known sites. Historic resource ranking was determined on the basis of documentary research in combination with topographic factors.

NATIVE AMERICAN SITES

Evidence of ancient Native American sites is seldom documented. Therefore, Native American sites were predicted on the basis of an environmental model that uses geological, soil and climatic maps, known site locations in the southern New England region, and expected Native American site locational behavior. The archaeological record of ancient Native American sites in the region shows that the majority are situated on well drained ground in the vicinity of a water supply, areas of high population, or natural resources.

In considering the potential to contain Native American sites, the project area is stratified (ranked) into zones of high, moderate, and low potential to contain archaeological properties, according to soil matrix, landform and distance to water and other subsistence and raw material resources, as defined below. The location of such resources is based upon paleo environmental reconstruction as well as modern environmental data.

- Areas less than 300 m from water (or potential ancient water sources), on undisturbed, level (0 to 5 percent slopes), dry, well-drained soil (especially near a second water source) are considered areas of high potential. Within this stratum, areas within 75 m of the water have the highest potential. Areas with the highest potential to contain sites are expected to be located along brooks and/or rivers, near stream confluences and abandoned stream channels. Some areas have high potential because of their strategic vantage points or proximity to sources of raw materials (e.g., lithic sources such as rhyolites, quartz, quartzite, and steatite).

- Areas that are more than 300 m but less than 600 m from a water source, but are on undisturbed, level to slightly sloping, dry, well-drained soil are considered areas of moderate potential. In addition, areas within 300 m from water, on dry soils, but on slopes of 5 to 10 percent are classified as moderate potential.
- Areas that are poorly drained, are on steep slopes (10 percent or greater), or that have been significantly disturbed, are considered to have low potential.

HISTORIC PERIOD SITES

Similarly, for historic period sites, the project area is ranked for potential, but based primarily on documentary information, as defined below.

- Areas less than 100 m from a historic site, property, or community center, are considered of high potential. In addition, areas within 50 m of historic roads and railroads or running streams are also considered of high potential.
- Areas within 50 to 100 m of roads are considered of moderate potential.
- Areas well away (100 m or more) from any type of historic features or streams are considered of low potential.

Field Results

On March 14, 2022, SWCA staff conducted the reconnaissance survey by walking systematic transects across the project limits of disturbance.

The project area is entirely wooded and the secondary forest growth is indicative of logging episodes on the property (Figures 7 to 9). W.D. Cowls, Inc. has long overseen the timber harvesting in the project area and continues to actively manage this area for forestry. The western part of the project area has some relatively flat sections, with a steep drop just outside the project limits. Outside of the western edge of the project area is a steep drop, which is relatively flat to the east. This area is dominated by pine and oak, with scattered birch, hemlock, maple, and beech trees. The southwestern corner was identified by blaze marks on trees and a Historic period stone wall running north-south from the southwest corner of the property. The northwest corner slopes down to the west on a small grade. In this area, the ground coverage is sparse. Vegetation includes some saplings, scattered Mountain Laurel, and wintergreen. The northeast corner also slopes down a fair grade to the west. There is a path running from the northeast corner, southwest towards the Johnson Family Burial Ground (PEL.801). The east central portion of the project area contains thicker sapling growth and fewer large trees. This suggests that there was a recent logging episode. Reports by the W.D. Cowls Land Company indicate their logging operations occurred on the property between 1978 and 1982, 1987 and 1990, and again in 2006.

Small push piles exist next to the roads that run through parts of the property. The western portion of the parcel contains some piles of rotting, cut stumps. Stone piles of varying sizes were observed across the project area. There are very few large erratic boulders across the property landscape.

SWCA did not map or record all stone walls and stone piles within the project area, as these features are not typically recorded in the MHC site files. While some of them are certainly cultural features, such as probable Historic period stone walls that served as field fences and field clearing piles for agriculture, others are likely naturally deposited rock clusters originating from glacial processes. SWCA did not attempt to discern whether any of the stone walls or piles could possibly be of Native American origin as there currently is no generally accepted method to do so and in most cases, these features are associated with Historic period farmsteads.

The project research design included possible soil coring to assess areas of disturbance and to look at soils. The very to extremely stony nature of the soils in the project area does match the soil classifications mapped by the NRCS (2022). Plowed soils were observed in the vicinity of the historic site. Coring was not conducted systematically across the project area, because the soil data from NRCS is accurate and soils were found to be very gravelly, and there was very little evidence of disturbance, except directly adjacent to Tower Road. A cell tower and maintenance building were observed in the southeastern portion of the property (see Figure 10).

A nineteenth century historical homestead, the Johnson/O'Brien Estate, was also identified in the southwestern part of the project area (Figure 11). The absence of stone walls and piles in the eastern part of the project area is likely indicative of tilling and the probable location of the family's agricultural fields. Observed extant Historic period stone walls are remnants of former pasture areas.



Figure 7. Project overview near the western boundary of project area, facing east.



Figure 8. Project overview in northwest corner of project area, facing east.



Figure 9. Project overview in northeastern part of the project area, facing west.



Figure 10. Cell Tower building in southeastern area of project.

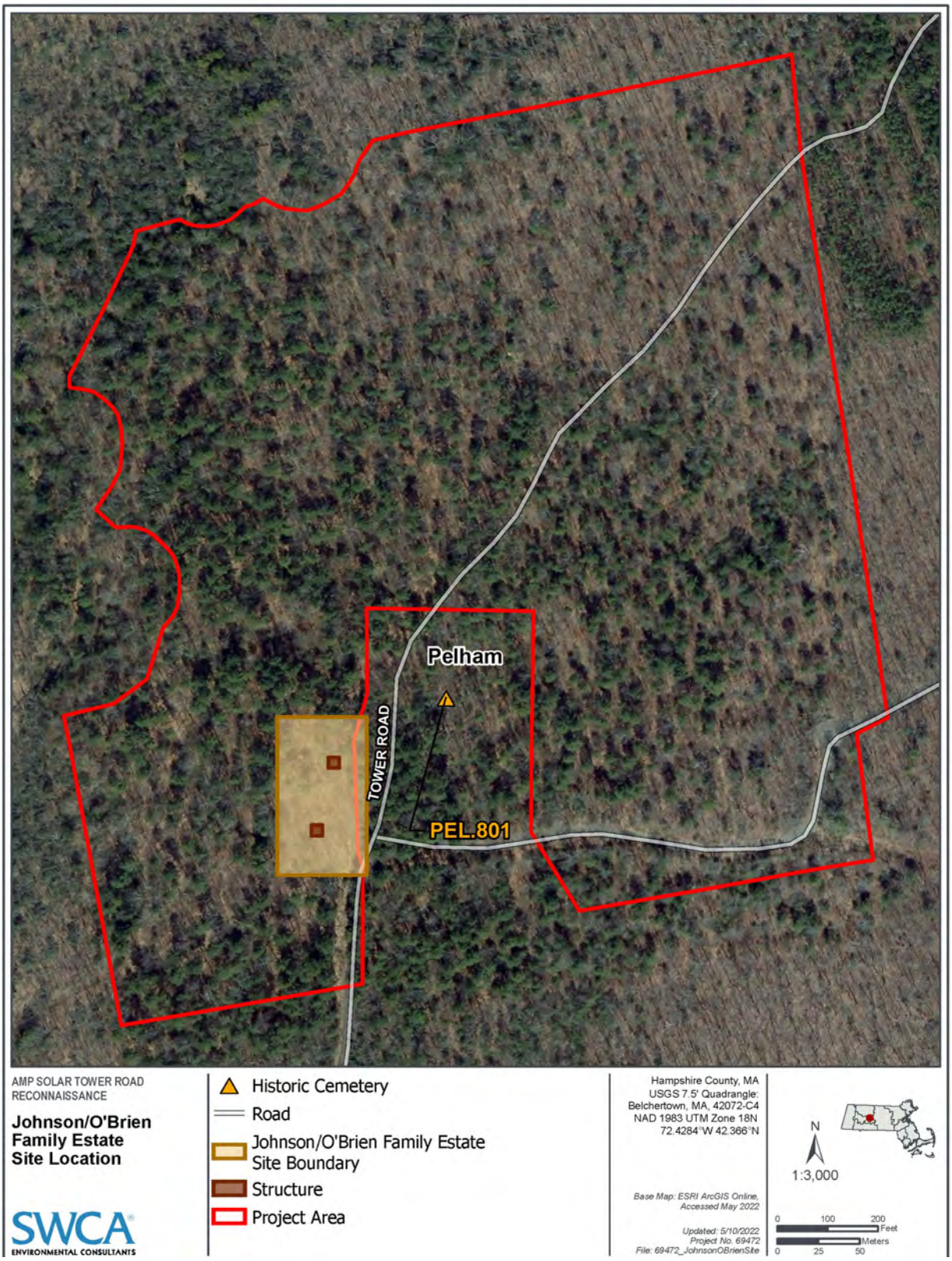


Figure 11. Location of the Johnson/O'Brien Family Estate site in relation to the project area and the Ruben Allen/Johnson Family Burial Place (PEL.801).

JOHNSON/O'BRIEN FAMILY ESTATE SITE

A historical house foundation (Figure 12), second foundation (Figure 13), well (Figure 14), and associated property lines of dry-stacked Historic period stone were identified west of Tower Road, southwest of the Johnson Family Burial Ground (see Appendix A). A depression with a few pieces of barrel hoop fragments and unidentifiable metal is located east of the second foundation. This likely represents a third, possibly older foundation. Evidence of artifact clustering by vocational collectors was observed, revealing some disturbance has occurred at the site (Figure 15).

A review of historical maps and documentary research indicates that the two historical foundations, well, and depression identified during the survey are likely associated with the Johnson/O'Brien Estate. Historical documents indicate that James Clapp of Belchertown sold the current 60-acre parcel to George Johnson/Johnston in October 1837 (Hampshire Registry of Deeds, Book 81: 254). Census records from 1850 list George Johnson and his wife, Jane, as living on the premises along with their daughters Mary and Charlotte (Hampshire Registry of Deeds, Book 203: 178). Johnson's farm included 40 acres of improved land, with 20 acres unimproved. He owned a horse, two milk cows, one swine, and one other cattle. He provided rye, Indian corn, and Irish potatoes. In 1855, only one household is listed on the property. The 1860 Walling map indicates the property as the "Johnson Est." (Figure 16). When George Johnson passed in 1853, his daughter Charlotte, unmarried at the time, purchased 10 acres of the original 60-acre property in the northwest portion, from her father's estate. In 1855, Charlotte married Patrick O'Brien and he is listed as head of household in 1860. Patrick Bailey, of the 27th Massachusetts Infantry, was listed in 1855 as a laborer on the property. However, by 1865, Patrick O'Brien and Patrick Bailey are listed as separate households. The second foundation on the property is possibly associated with the Bailey household that was built between 1860 and 1865. The Hampshire County 1873 Beers map indicates the presence of the "P. O'Brien Est." in the same area where the Johnson Estate was previously annotated (Figure 17) (Beers 1873).

In 1871, Patrick O'Brien died of intemperance. Charlotte eventually married Reuben Allen, an immigrant farmer in 1879. Allen used the slope of Mount Lincoln to cultivate his farmland. Historical records indicate Allen raised potato and corn, as well as gathered hay to keep his horse and two cows (Parmenter 1898: 472). He sold butter and eggs to his customers in Amherst on Saturdays and carried back home groceries and other necessities for the coming weeks. Charlotte died in 1904 at age 76 and Reuben Allen passed in 1911 at age 78.

Accounts describe the family and homestead's association with the cemetery:

> "High up on the west slope of Mt. Lincoln and within half a mile of the summit George Johnson, a protestant Irishman from Dundalk, Ireland, settled in the year of 1837. Here he lived and brought up his family of girls. One married John Gardner and a child by his marriage sickened and died of what was thought to be small-pox. Consequently burial was refused in the public burial places and Mr. Johnson buried his grandchild upon a plot of land near his home. A few square rods of land is walled in and fifteen or twenty burials of his family and relatives have been made within the little enclosure. George Johnson the ancestor of the family was buried in 1853 and among the graves are those of two soldier sons-in-law, Lieutenant George Johnson of the 25th Mass. and Patrick Bailey of the 27th Mass. and each Memorial Day flags are planted above them which float in the wind until worn out by the blasts that career about Mt. Lincoln." (Parmenter 1898: 477).



Figure 12. Historical house foundation identified in southwest area of project boundary, facing north.



Figure 13. Second historical foundation identified in southwest area of project boundary, facing north.



Figure 14. Well on eastern side of historical house foundation with recent cap collapse.



Figure 15. Historical artifact surface finds identified by avocational collectors in southwest area of project boundary near historical house foundation.

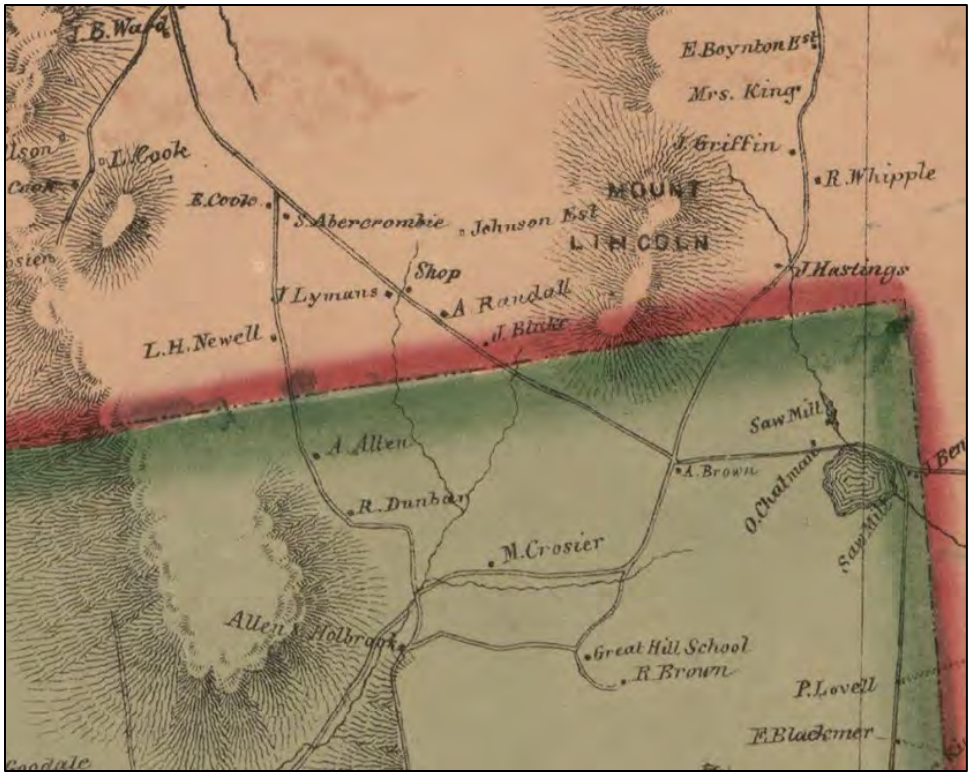


Figure 16. Walling 1860 map of location of Johnson Estate.

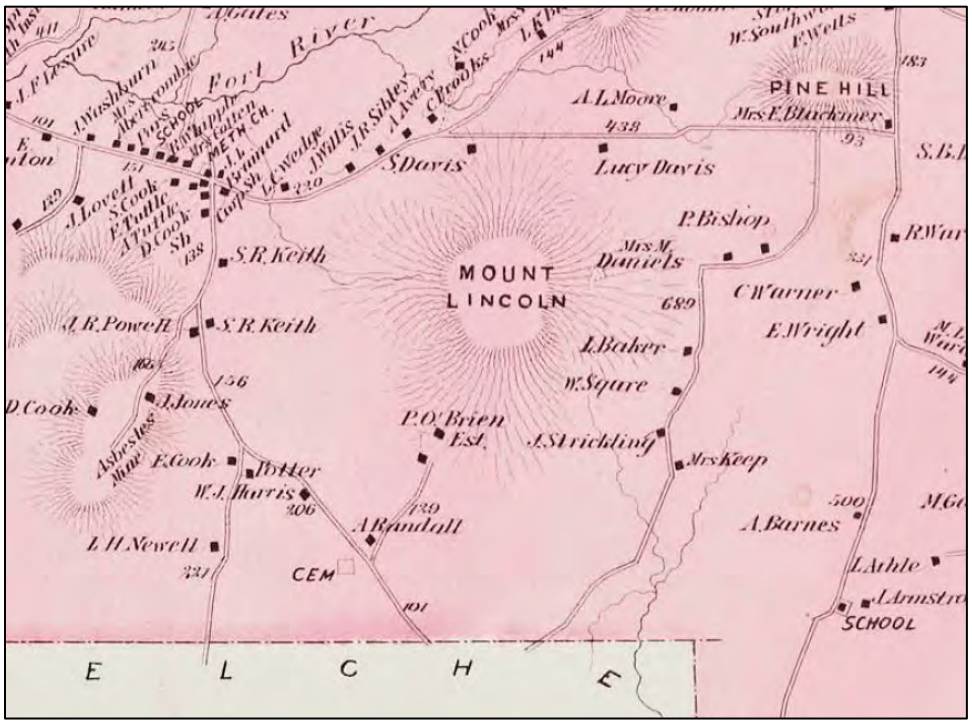


Figure 17. "P. O'Brien Est." on Beers 1873.

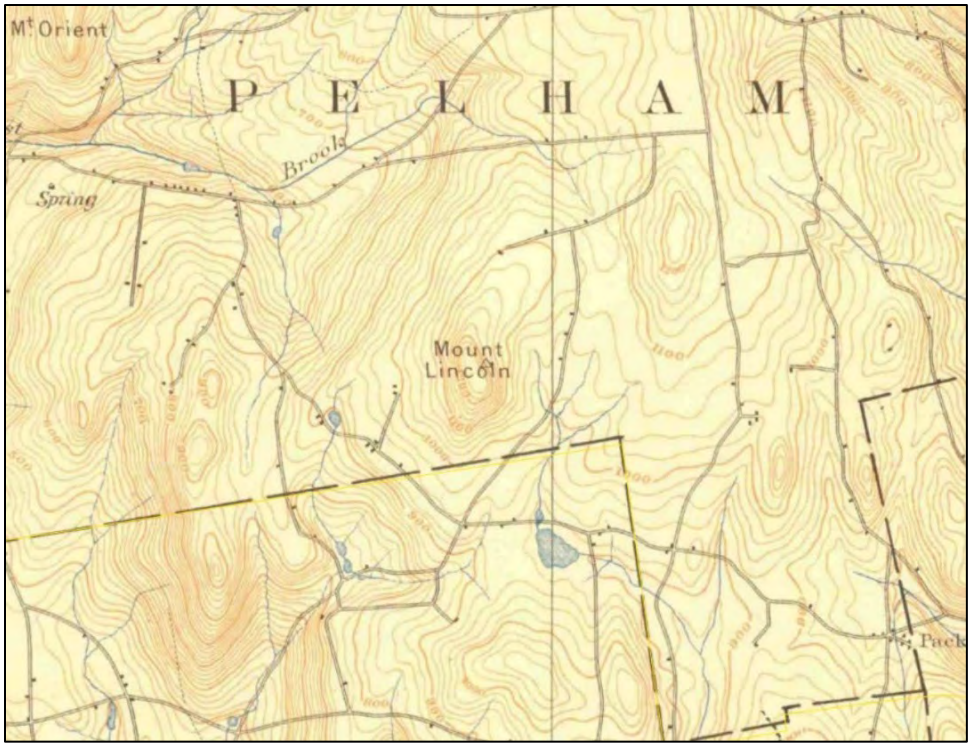


Figure 18. Topographic map of Pelham with two buildings at location of Johnson Estate (USGS 1887)

The 10 acres of land sold by Charlotte Johnson O'Brien to the Cowles brothers in 1866 was sold to WD Cowls in 1917 (Hampshire Registry of Deeds, Book 729: 368). The original 60 acres owned by George Johnson was consolidated once again when the remaining 50-acre parcel was sold to Cowls in 1922 (Hampshire Registry of Deeds, Book 758: 299). The deed indicates that no houses were present on the property during the sale, which is corroborated by topographic maps in 1939 and historical aerials from the 1940s.

CONCLUSIONS AND RECOMMENDATIONS

On behalf of AMP Solar Development, SWCA conducted a site file check, background literature review, and an archaeological reconnaissance survey for the proposed ASD Tower MA Solar Project in Pelham, Massachusetts. No recorded archaeological sites are located within the project area. However, two recorded historic archaeological sites are in the vicinity of the project area: the Packardville Road Foundation (PEL.HA.3) and the Monk's Cave site (PEL.HA.4). The Ruben Allen/Johnson Family Burial Place (PEL.801), reportedly established in 1837, is located on parcel 14-1A, around which the project is designed on parcel 14-1.

No evidence of Native American activity was found. Environmental parameters used to assess the likelihood of Native American sites indicate that the project area has a low potential to contain Native American sites.

Although the area is presently wooded mainly in mature trees, there is evidence of previous logging efforts in the project area. SWCA staff identified two historical foundations, a well, a depression, and associated property lines of dry-stacked stone during the field reconnaissance survey, west of Tower Road and southwest of the cemetery. A review of historical documents and mapping shows that the project area

was occupied by the Johnson/O'Brien family beginning in the early 1800s. The 60-acre parcel was used for agricultural purposes, until it was sold in 1922.

Initial investigations by SWCA staff observed that portions of the nineteenth-century historical foundations and well remain intact. Based on the age and available information, the Johnson/O'Brien Family Estate site may be of historic significance. Because there have been no previous excavations or documentation of this site, SWCA recommends avoidance and protection of the Johnson/O'Brien Family Estate historic archaeological site. If avoidance is not feasible, it is recommended that further survey in the form of an archaeological site examination be conducted to define the site boundaries and to assess the significance of this site.

Because of the unfavorable environmental parameters and lack of any direct evidence of sites, no further survey is recommended for Native American archaeological sites for this project.

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Appendix A

Historic Archaeological Site Form

FORM D - HISTORIC RESOURCES SURVEY **HISTORIC ARCHEOLOGICAL SITES** Massachusetts Historical Commission Office of the Secretary State House, Boston	FOR MHC OFFICE USE ONLY Town MHC NO. UTM / / / / / / ZONE EASTING NORTHING QUAD NR[ ]ACT [ ]ELIG. [ ]NO DISTRICT [ ]YES [ ]NO

1. SITE NAME(S) Johnson/O'Brien Estate MAS NO. OTHER NO.

2. TOWN/CITY Pelham COUNTY Hampshire

3. STREET & NUMBER (IF NOT AVAILABLE, GIVE DETAILED DESCRIPTION OF HOW TO REACH SITE)
Off Tower Road, south of Reuben Allen Cemetery (PEL.801)

4. OWNER(S) AND ADDRESS(ES)
W.D. Cowls Land Company [ ]Public [☒]Private

5. SITE LOCATED BY [☒]CRM Survey [ ]Avocational Collector [ ]Field School [ ]Other (Specify)
Describe Sampling Strategy used to Locate Site: Archaeological reconnaissance survey

6a. PERIOD(S) (Check all applicable boxes) [ ]17th C. [☒]18th C. [☒]19th C. [ ]20th C. [ ]Unknown

6b. ESTIMATED OCCUPATION RANGE ca. 1837 to 1917

7. DATING METHOD	MAPS	TITLE SEARCH	ADDITIONAL DOCUMENTS
	Beers 1873; Walling 1860	[☒] yes [ ]no	See attached.
	COMPARATIVE MATERIALS		OTHER

8a. SITE TYPE [☒]Agrarian [☒]Residential [ ]Industrial [ ]Commercial [ ]Military [ ]Unknown [ ]Other (Specify)
8b. DESCRIBE

9. DESCRIBE SIZE, HORIZONTAL AND VERTICAL BOUNDARIES	10. STRATIGRAPHY Surface Indicators: [☒]Standing ruins [☒]Surface finds [ ]Markers [☒]Cellar Hole	Stratigraphy: [ ]Stratified [ ]NOT Stratified

11. SOIL	USDA Soil Series 441B Gloucester gravelly fine sandy loam	Contour Elevation	% Slope of Ground [☒]0-5 [☒]5-15 [ ]15-25 [ ] over 25
	Acidity 1_____ 7 _____14 (Acid) (Base)		12. TOPOGRAPHY [ ] Flat [☒] Gentle undulation [ ] Rolling Hills [☒] Mountains

13. WATER	NEAREST WATER SOURCE	SIZE AND SPEED	DISTANCE FROM SITE	SEASONAL AVAILABILITY
	Quabbin Reservoir		2.2 km east	Year round

14. VEGETATION	PRESENT Wooded: primarily pine and oak	PAST Agricultural field, logged

15. SITE INTEGRITY	IF DISTURBED, DESCRIBE DISTURBANCE
[ ]Undisturbed [☒]Good [ ]Fair [ ]Destroyed	Evidence of avocational collectors

16. SURROUNDING ENVIRONMENT
[ ]Open Land [☒]Woodland [ ]Eroded Soils [☒]Residential
[ ]Scattered Buildings visible from Site
[ ]Commercial [ ]Industrial [ ]Rural
[ ]Coastal [ ]Isolated

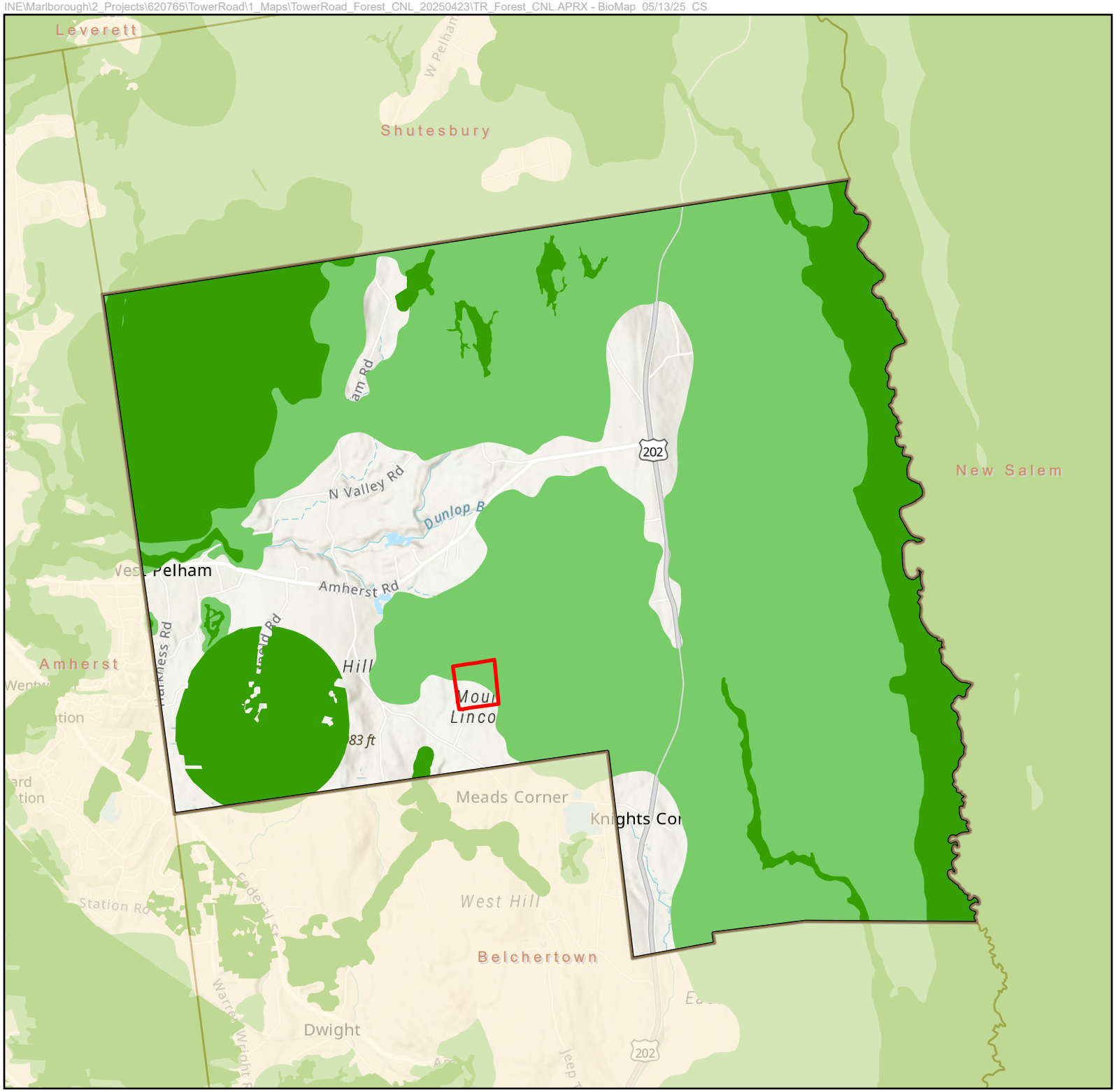
17. ANY THREATS TO SITE [☒]yes [ ]no DESCRIBE POTENTIAL THREATS: Solar array development on parcel

18. ACCESSIBILITY TO PUBLIC [☐]Free Access [☐]Need Owner Permission [☒]Restricted [☐]No Access		
19. PREVIOUS WORK [☐]Surface Collected	BY WHOM/AFFILIATION	DATE
[☐]"Pot hunted"	BY WHOM/AFFILIATION	DATE
[☐]Tested	BY WHOM/AFFILIATION	DATE
[☐]Excavation	BY WHOM/AFFILIATION	DATE
20. PRESENT LOCATION OF MATERIALS (INCLUDE ADDRESSES)		
21. REFERENCES/REPORTS 2022. Waski, Nadia, and Christopher Donta. Archaeological Reconnaissance Survey for the ASD Tower MA Solar Project, Pelham, Massachusetts.		
22. RECOVERED DATA (Identify in DETAIL, including structures, related outbuildings, landscape features, etc.) A. Documentary: Historical documents indicate that James Clapp of Belchertown sold the current 60-acre parcel to George Johnson/Johnston in October 1837 (Hampshire Registry of Deeds, Book 81: 254). Census records from 1850 list George Johnson and his wife Jane as living on the premises along with their daughters Mary and Charlotte (Hampshire Registry of Deeds, Book 203: 178). Johnson's farm included 40 acres of improved land, with 20 acres unimproved. He owned a horse, two milk cows, one swine, and one other cattle. He provided rye, Indian corn, and Irish potatoes. In 1855, only one household is listed on the property. The 1860 Walling map indicates the property as the "Johnson Est." When George Johnson passed in 1853, his daughter Charlotte, unmarried at the time, purchased 10 acres of the original 60-acre property in the northwest portion, from her father's estate. In 1855 Charlotte marries Patrick O'Brien and he is listed as head of household in 1860. Patrick Bailey, of the 27th Massachusetts Infantry, was listed in 1855 as a laborer on the property. However, by 1865, Patrick O'Brien and Patrick Bailey are listed as separate households. In 1871 Patrick O'Brien died of intemperance. Charlotte eventually married Reuben Allen, an immigrant farmer in 1879. Allen used the slope of Mount Lincoln to cultivate his farmland. In 1917, the 10 acres of land sold by Charlotte Johnson O'Brien to the Cowles brothers in 1866 was sold to WD Cowls in 1917 (Hampshire Registry of Deeds, Book 729: 368). The original 60 acres owned by George Johnson was consolidated once again when Cowls was sold the remaining 50-acre parcel in 1922 (Hampshire Registry of Deeds, Book 758: 299). B. Archaeological: Two historical foundations (one house and one outbuilding), a well, and unidentified depression remain. Dry stacked stone walls are in the vicinity of these foundations and likely represent property boundaries. Surface finds of historical cultural material include barrel hoops, unidentifiable sheet metal, stoneware jug shoulder, burnt brick, assorted glass (window and bottle), whiteware and other ceramic sherds.		
23. ARCHAEOLOGICAL OR HISTORICAL SIGNIFICANCE George Johnson purchased land originally granted to those individuals who initially settled in the town of Pelham (Samuel Thomas, William Thornton, and Adam Patterson). The Johnson/O'Brien family were part of the farming community and known in the Hampshire County area from the late 1830s to early 1900s. The family has an associated burial ground (PEL.801), located northeast from the site. Members of the family associated with the two historic foundations are buried there. The site appears to be in fair condition, with minimal threat from avocational collectors, but threatened by the proposed solar development project. Avoidance is recommended, but excavations could provide information on farming and rural traditions of the early to mid-nineteenth century in Pelham.		
24. ATTACH TO THIS FORM PORTION OF USGS QUAD WITH SITE AREA MARKED		
25. SKETCH PLAN OF SITE *See attached map.* Scale:		26. PHOTOS: Attach if available. Label each with date of photo, photographer, view shown, name of site
REPORTED BY:	NAME Nadia Waski, M.A.	ADDRESS 15 Research Drive, Amherst MA, 01002
	ORGANIZATION SWCA Environmental Consultants	DATE 5/2/22
FOR OFFICE USE ONLY		
FIELD EVALUATION		

COMMENTS

Attachment C

Figures



ASD Tower MA Solar
0 Tower Road
Pelham, MA 01002

NHESP/TNC BioMap

TETRA TECH

Legend

- Pelham Town Boundary
- Site Boundary

NHESP/TNC BioMap

- Core Habitat
- Critical Natural Landscape

Figure 2

BioMap Data: MassWildlife, MassGIS, The Nature Conservancy. November 22, 2022

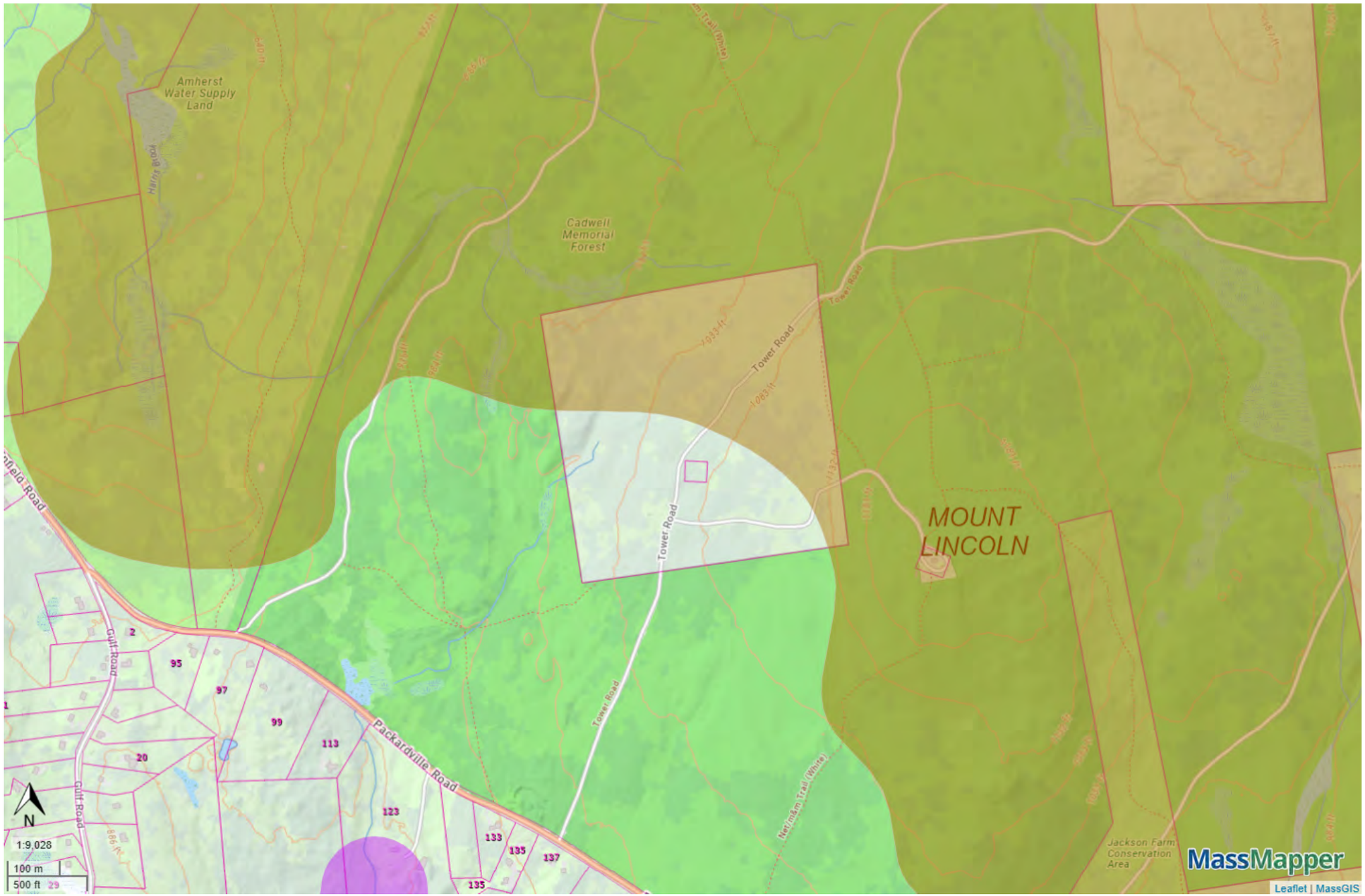
Topographic Map: Esri, NASA, NGA, USGS, FEMA, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community

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Miles

BioMap 3 Site Plan



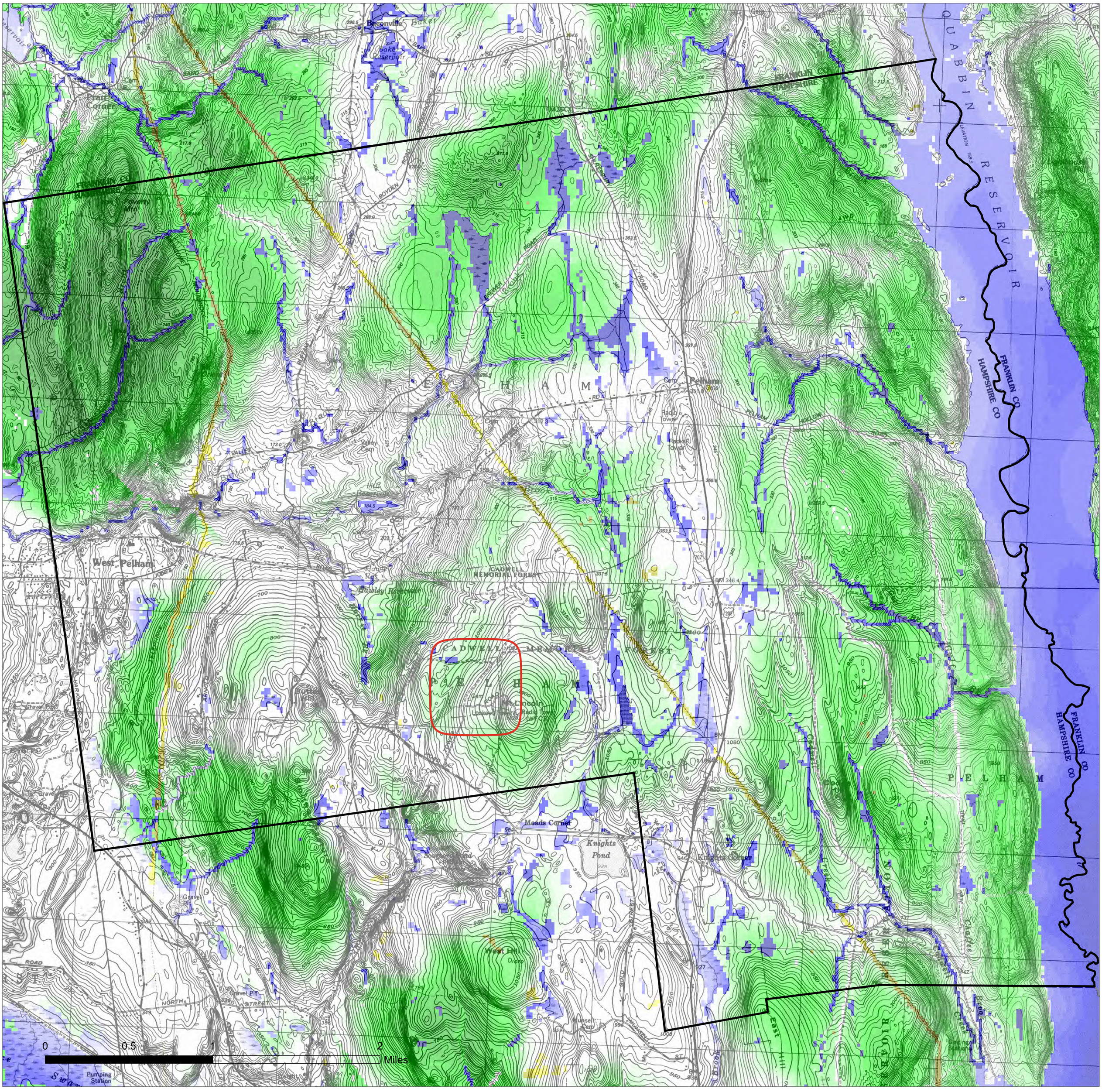
BioMap Critical Natural Landscape Components: Landscape Blocks

BioMap Core Habitat Components: Rare Species Core

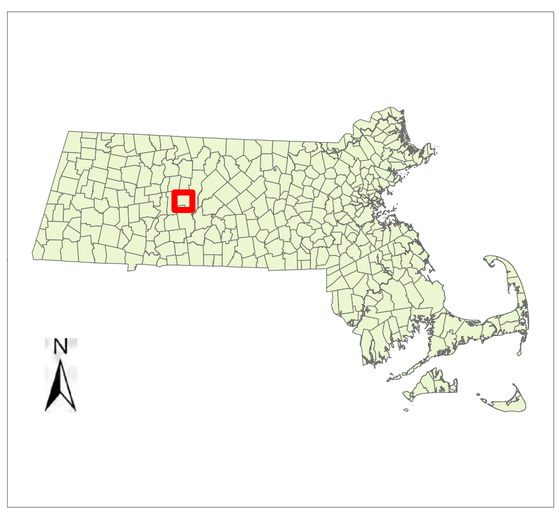
Property Tax Parcels

Figure 3

CAPS Index of Ecological Integrity (IEI)
Town of PELHAM, MA



Updated January 9, 2024



IEI, Index of Ecological Integrity
Top 50% of the Landscape

Figure 4

- Forests
- Shrublands
- Coastal Upland
- Freshwater Wetland & Aquatic
- Coastal Wetland & Aquatic

50-60 60-70 70-80 80-90 90-100%

UMass Amherst

UMass Extension
CENTER FOR AGRICULTURE

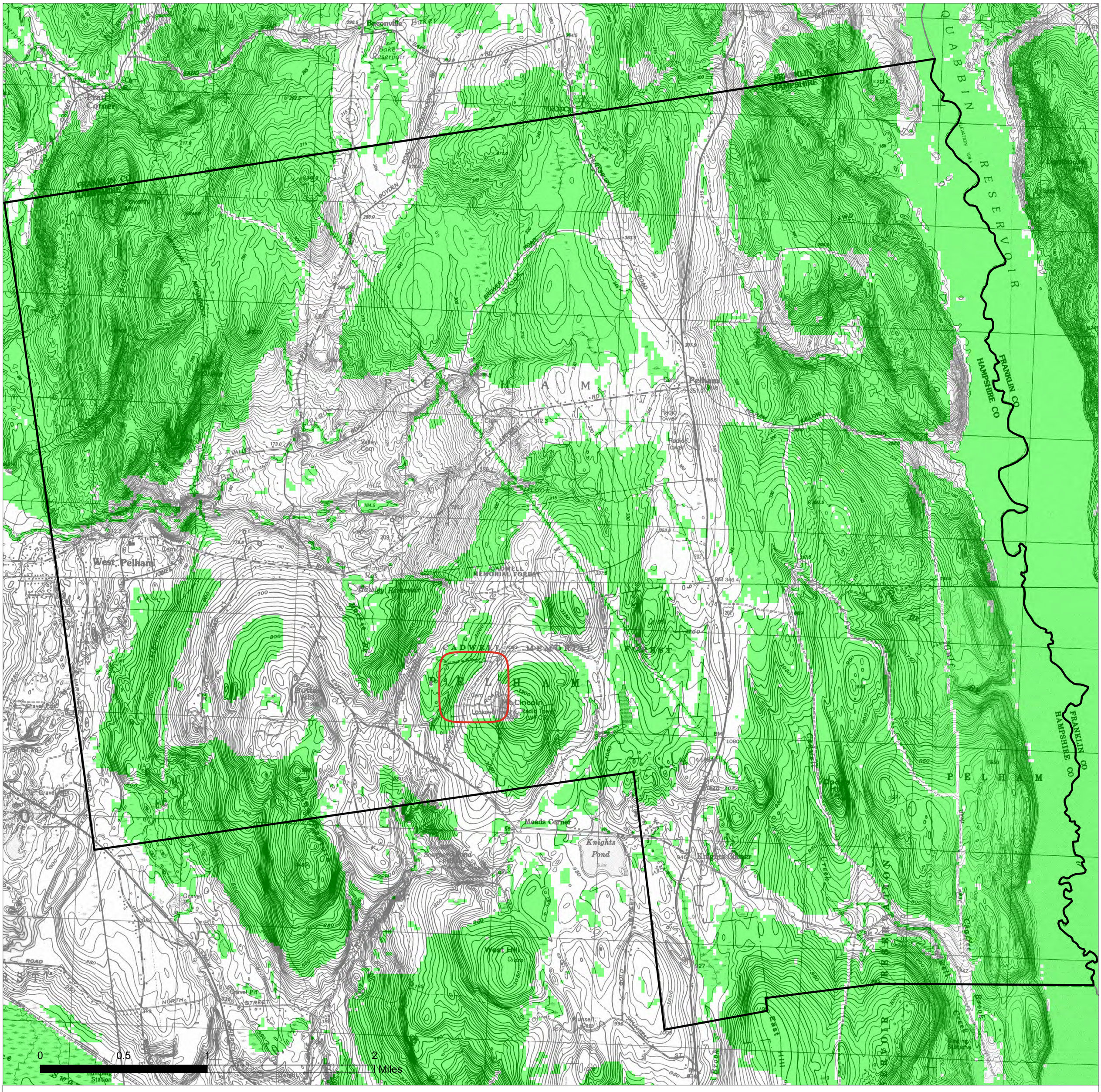
CAPS is an approach to prioritizing land for conservation based on the assessment of ecological integrity for various ecological communities (e.g. forest, shrub swamp, headwater stream) within an area. The Index of Ecological Integrity (IEI) delineates the relative wildlife habitat and biodiversity value of any point on the landscape based on principles of landscape ecology and expert opinion.

With a computer base map depicting various classes of developed and undeveloped land, we evaluate a variety of landscape-based variables ("metrics") for every point in the landscape. A metric may take into account the microclimatic alterations associated with "edge effects," intensity of road traffic in the vicinity, nutrient loading in aquatic ecosystems, or the effects of human development on landscape connectivity. Various metrics are applied to the landscape and then integrated in weighted linear combinations as models for assessing ecological integrity. This process results in a final Index of Ecological Integrity (IEI) for each point in the landscape based on models constructed separately for each ecological community.

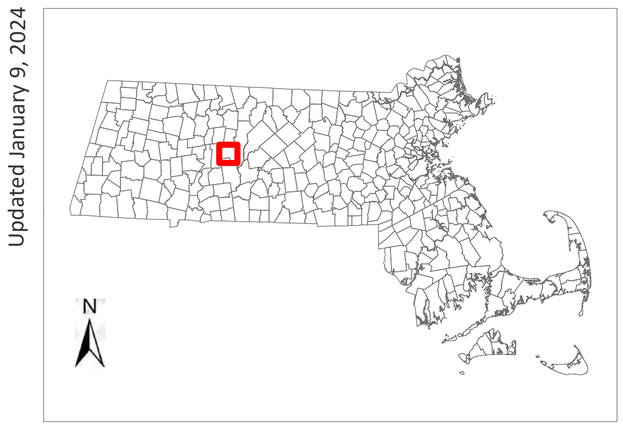
Depicted on this map are those areas representing 50% of the undeveloped landscape with the highest IEI values; the darker the color the higher the ecological integrity value. Coastal beaches and mudflats are included as Coastal Wetland and Aquatic. For more information see: http://www.umasscaps.org.

These maps were prepared by the University of Massachusetts Amherst, with funding from the Massachusetts Department of Environmental Protection and the Renewable Resources Extension Act (RREA).

Habitat of Potential Regional or Statewide Importance
Town of PELHAM, MA



Habitat of Potential Regional or Statewide Importance



Updated January 9, 2024

MassDEP's Massachusetts Wildlife Habitat Protection Guidance for Inland Wetlands (June 2006) adopted a new approach for assessing wildlife habitat impacts associated with work in wetlands. This approach utilizes maps developed at the University of Massachusetts Amherst using the Conservation Assessment and Prioritization System (CAPS). The maps depict Habitat of Potential Regional or Statewide Importance that may trigger more intensive review under the MA Wetlands Protection Act. For more information on how to assess wildlife habitat impacts, see Section III of the Guidance document: https://www.mass.gov/doc/massachusetts-wildlife-habitat-protection-guidance-for-inland-wetlands/download.

CAPS is an approach to prioritizing land for conservation/protection based on the assessment of ecological integrity for various ecological communities (e.g. forested wetland, shrub swamp, headwater stream) within an area. The CAPS model assesses ecological integrity of the Massachusetts landscape as influenced by environmental stressor metrics (e.g. pollution, fragmentation). It relies on data that are broadly available across Massachusetts. Ecological features which are not consistently surveyed or uniformly available, such as certified vernal pools, rare species habitat, and contamination sites are not included in the CAPS analysis. When available, this more specific ecological information may be used in conjunction with the CAPS outputs to better understand particular sites in Massachusetts and support informed conservation decision-making. For more information on the statewide maps produced by the CAPS model, see: http://www.umasscaps.org. These maps were prepared by the University of Massachusetts Amherst, with funding from the Massachusetts Department of Environmental Protection.

Figure 5

UMass Amherst

MassDEP

UMass Extension
CENTER FOR AGRICULTURE



PELHAM

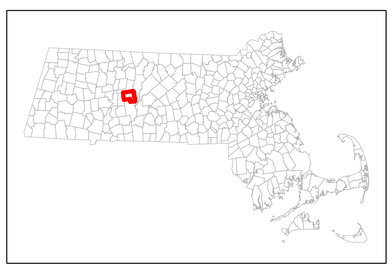
Priority Habitats and Estimated Habitats

Priority Habitats, for use with the MA Endangered Species Act Regulations (321 CMR 10)

Estimated Habitats, for use with the MA Wetlands Protection Act Regulations (310 CMR 10)

Effective August 1, 2021

Figure 6



Priority Habitat of Rare Species

Project or Activity falls within Priority Habitat only:
- You must file directly with NHESP pursuant to Massachusetts Endangered Species Act (MESA)

Examples of projects: single family home, subdivision, commercial building, widening of driveway/road, beaver dam removal, etc.

Some projects or activities may be exempt from MESA filing: see 321 CMR 10.14

Priority Habitat of Rare Species and also Estimated Habitat of Rare Wildlife

Project or Activity is within BOTH Estimated Habitat and Priority Habitat:
- Is a Notice of Intent (NOI) under wetlands regulations required?
  - -Yes
    Send copy of NOI to NHESP and must also file under MESA (streamlined MESA-NOI filing option available)
  - -No
    MESA filing only (see 'Priority Habitat' details at left)

For more information, see our website at www.mass.gov/nhesp

Certified Vernal Pools (as of July 20, 2021)

Town Boundary

Transportation:
- Interstate
- U.S. Highway
- State Route
- Non-numbered Route
- Railroad

Natural Heritage & Endangered Species Program
1 Rabbit Hill Road, Westborough, MA 01581
tel: (508) 389-6360; fax: (508) 389-7890

Data Sources:

Priority Habitats and Estimated Habitats: created by NHESP in 2021.
Certified Vernal Pools: created by NHESP, July 20, 2021.
Town Boundaries: 1:25,000 community boundary data, from MassGIS (updated March, 2017).
Roads: MassDOT roads, from MassGIS (updated 2018).
Digital Orthophoto: 15cm resolution, taken in 2019, from MassGIS.

Commonwealth of Massachusetts — Charlie Baker, Governor; Karyn Polito, Lt. Governor
Executive Office of Energy & Environmental Affairs — Kathleen A. Theoharides, Secretary

Attachment D

Stormwater Management Report

(Provided under separate cover)

Attachment E

Equipment Specifications and Materials

PureSky Energy – Energy Storage System Risk Mitigation Strategy

March 2026

Introduction

PureSky Energy (PSE) is committed to meeting or exceeding all local, state, and federal fire requirements for energy storage systems. PSE's energy storage equipment is chosen based on safety, quality, and efficiency standards and will be installed in a way that minimizes the risk of fire and subsequent damages. This document explains potential safety concerns and their mitigation strategies. A key focus for PSE is to collaborate with the local fire department to ensure the system design and operation is acceptable and well understood by first responders.

Technology

PSE's Energy Storage Systems ("ESS") utilize state-of-the-art lithium-ion battery technology contained in secure, controlled enclosures. The ESS solution employs a factory-built LFP energy storage solution that includes explosion prevention and fire safety features.

These ESS enclosures include the following equipment:

- Battery cells – solid-state lithium-ion cells from a tier-one battery cell supplier,
- Battery Management System ("BMS") – used to monitor battery cell state of charge, cell health, and is capable of shutting off any battery cell experiencing unusual conditions,
- Power conversion equipment – used to regulate the power supplied by the battery modules for optimum operation,
- Security system – used to deter unauthorized access and theft,
- Thermal Management system – used to control the temperature inside the enclosures for optimum battery performance and safety,

PSE uses battery cells from leading cell manufacturers and collaborates with leading battery system integrators to build safe and reliable ESS installations that comply with all relevant electrical and mechanical engineering standards, including Underwriters Laboratories ("UL") battery cell certifications. During the procurement and detailed design of the ESS, PSE consults with the local fire department in order to incorporate specific local requirements for fire safety. Once the system is installed, PSE can facilitate site visits by the fire department to inspect the system and better understand the safety

systems and operation. PSE can provide additional information as required and involve the ESS equipment supplier as needed.

Siting of Energy Storage Systems

The objective of PSE ESS installations is to harvest the maximum amount of clean solar energy. The ESS will be co-located with the solar energy inverters in safe sites with sufficient separation from other buildings. Following the Standard on Explosion Prevention Systems (NFPA 69), National Electrical Code (NFPA 70), Safety requirements for secondary lithium cells and batteries for use in industrial applications (IEC62619) and Standard for the Installation of Stationary Energy Storage Systems (NFPA 855), PSE ESS sites will maintain safe distances (more than 5 ft) from lot lines, public ways, buildings, and other combustibles as well as the necessary 2-hour fire barriers required by NFPA Codes.

Possibility of Thermal Runaway

Thermal runaway is an infrequent situation when the battery cell temperatures rise so high that the cells become unstable. This situation only occurs when the cells are operated outside of their normal temperature range without being cooled by a thermal management system. Runaway temperatures of typical battery chemistries vary from 302°F to 518°F [1]. Given that all these battery chemistries have high thermal runaway temperatures, Lithium-ion cells are thermally stable in the range of normal ambient temperature variations.

Mitigation of Thermal Runaway

Battery packs are fitted with separation walls to stop the failing cell from spreading to neighbouring cells. The BMS monitors and controls the batteries to ensure they remain in acceptable performance and safe operating conditions. The BMS monitors abnormal conditions of each battery cell and takes active preventive measures. Each PSE ESS is also equipped with a dedicated thermal management system, which operates automatically at abnormal temperatures. PSE projects are developed with advanced Energy Management Systems ("EMS") to optimize the energy dispatch between the ESS and the PV system. The EMS ensures battery cells are not stressed or abused during normal operation, which could lead to thermal runaway.

Possibility of Fire:

The chance of a fire caused by the ESS is very low. Lithium-ion battery electrolytes contain different solvents, which may be flammable [2]. However, flashpoints (burn temperature) of

these electrolytes are very high, and they have been sealed in air-tight cell pouches. Since all the batteries are also contained in a NEMA-rated enclosure, the possibility of cell damage due to impact and exposure of flammable solvents to catch fire is very low.

Accumulation of Combustible Gases:

A thermal runaway event can produce combustible gases. Accumulation of such gases should be vented out to mitigate possible explosions. PSE ESS enclosures are equipped with gas detectors. When gas accumulations are detected, the thermal management system vents out such gases. Due to this safety design, the possibility of gas accumulation is considerably low with PSE ESS enclosures.

Possibility of Electrolyte Spills

Lithium-ion batteries contain electrolytes that are semi-solid or gel, depending on their solvent characteristics [2], and have very high melting points, so the risk of spillage is very low during normal operating conditions. Electrolytes used in PSE cells are nonaqueous materials [3] and do not easily mix with water. With different layers of packaging, the risk of water contamination is very low.

Spill Mitigation

PSE ESS has several layers of packaging. All the cells with electrolytes are packaged in air-tight pouches. Then these cells are packaged as battery modules within battery racks. All the battery racks are contained within a NEMA-rated enclosure. Considering these different layers of packaging, it is very unlikely that a spill will occur outside of the ESS. The electrolyte in these LFP cells is largely absorbed in the electrodes within the individual cells (which are individually wrapped and contained in trays). In practical terms, there is no freely flowing liquid electrolyte in PSE ESS units that can easily leak out into the environment, even in the event of cell damage. Furthermore, PSE battery enclosures will be installed on elevated equipment pads for added containment.

Possibility of Gas Emissions

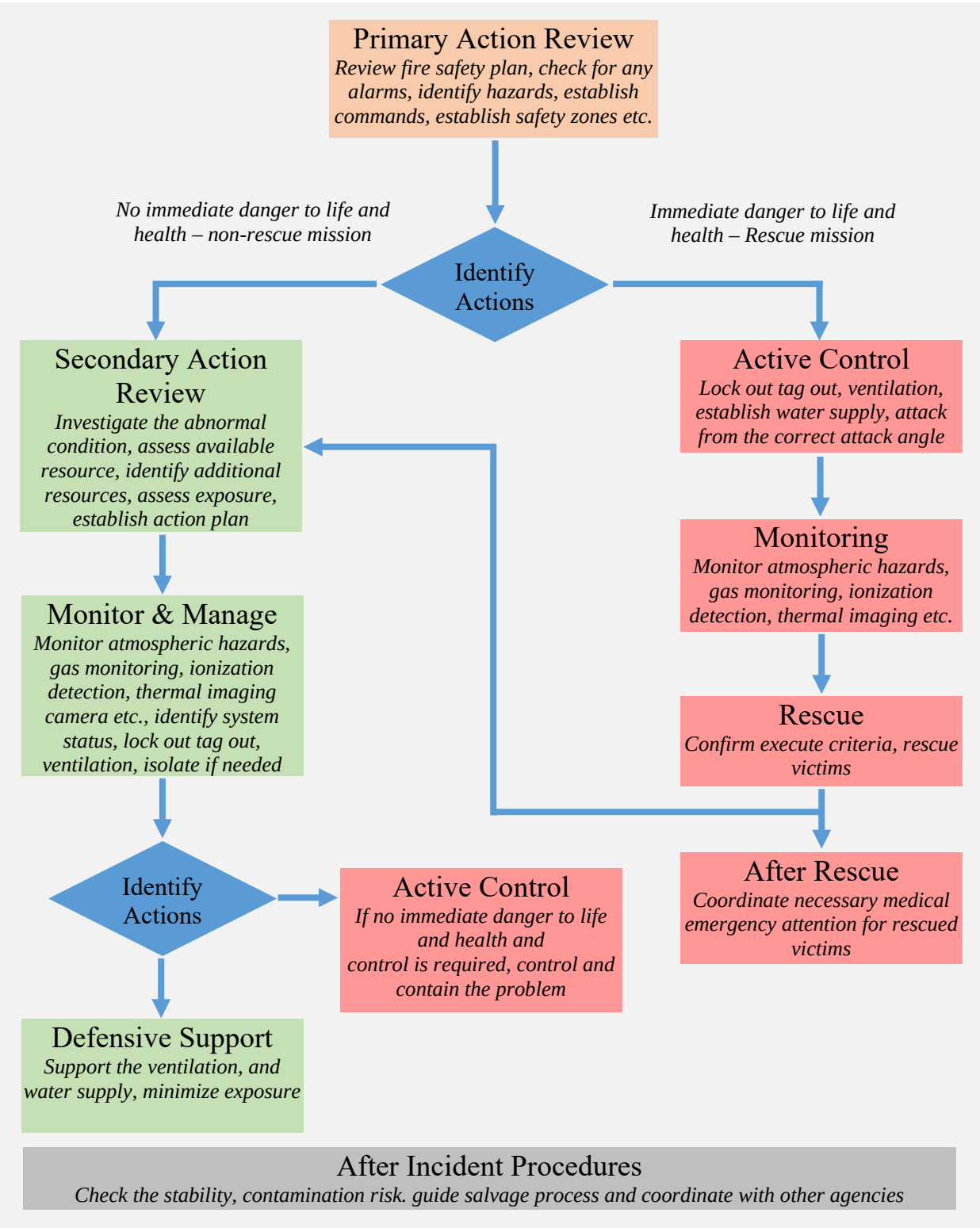
Lithium-ion batteries do not produce measurable gas emissions while they are under normal operation [4]. In an unlikely event of a battery fire, different toxic gases could be emitted based on the battery cells and packaging materials [5]. However, the possibility of a fire and subsequent gas emission is very low due to fire prevention measures.

Risk of Lightning:

In PSE ESS projects, batteries are placed in NEMA outdoor-rated enclosures, which are electrically grounded using stable grounding grids. Therefore, enclosures could never be electrically energized in any situation. Even though the risk of lightning cannot be mitigated, the damage due to lightning has been mitigated with these actively grounded enclosures. These enclosures act as "Faraday Cage" during lightning events and protect all the contents from electrical damage.

Fire Safety Plan

PSE selects battery cell technology for each project based on the battery operation requirements. The chemical compositions of these cell technologies vary from project to project. The following fire safety procedure forms the basis for initial discussions with the local fire department and can be updated for each project based on additional requirements.


Primary Action Review
Review fire safety plan, check for any alarms, identify hazards, establish commands, establish safety zones etc.
No immediate danger to life and health – non-rescue mission
Immediate danger to life and health – Rescue mission
Identify Actions
Secondary Action Review
Investigate the abnormal condition, assess available resource, identify additional resources, assess exposure, establish action plan
Active Control
Lock out tag out, ventilation, establish water supply, attack from the correct attack angle
Monitoring
Monitor atmospheric hazards, gas monitoring, ionization detection, thermal imaging etc.
Rescue
Confirm execute criteria, rescue victims
Monitor & Manage
Monitor atmospheric hazards, gas monitoring, ionization detection, thermal imaging camera etc., identify system status, lock out tag out, ventilation, isolate if needed
After Rescue
Coordinate necessary medical emergency attention for rescued victims
Identify Actions
Active Control
If no immediate danger to life and health and control is required, control and contain the problem
Defensive Support
Support the ventilation, and water supply, minimize exposure
After Incident Procedures
Check the stability, contamination risk. guide salvage process and coordinate with other agencies

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e-STORAGE

A subsidiary of Canadian Solar

UTILITY-SCALE ENERGY STORAGE





SolBank 3.0

ENERGY STORAGE SYSTEM

S-5016-2H-NA|S-5016-4H-NA

Capacity: 5.0 MWh

e-STORAGE, a subsidiary of **Canadian Solar**, is a world-class energy storage solution provider, specializing in storage system design, manufacturing, and integration of battery energy storage systems for utility-scale applications.

The company offers value-added system consulting and turnkey EPC services, in addition, we provide customers with our proprietary LFP battery solution SolBank.

Together, we are building a brighter, greener future for all.

SolBank 3.0 Highlights

- **Cutting-Edge Technology**: SolBank 3.0 features high-density LFP cells, an active balancing BMS, and an innovative liquid cooling TMS, ensuring optimal safety.

- **Compliance and Certifications**: SolBank 3.0 adheres to all industry standards: NFPA855, NFPA69, NFPA72, NFPA70E, and optional NFPA68. Certified under UL1973, UL9540, UL9540A, UN38.3/UN3536, ensuring rigorous safety and performance criteria.

Key Features

Enhanced Energy Density

- Utilizes 314 Ah battery cells and compact integration, increases single container energy density up to 45%
- Reduces land cost by up to 35% in a 100MWh project

Safety

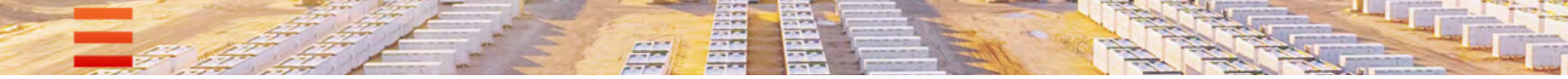
- IP67-rated pack design
- Up to 20% faster detection of abnormal and automatic protection
- Advanced pack thermal isolation, electrical redundancy protection, and multi-level fire protection, effectively minimize potential issues

Intelligent Control

- Liquid cooling cuts auxiliary consumption up to 30%
- Active balance and string-level management, guarantee high efficiency and availability

Compatibility & Installation

- Supports various PCS topologies
- Turn-key integration and stationery certification, reduce project schedule risks by up to 40%
- Plug-and-play setup for streamlined commissioning



SolBank 3.0
System Parameter

e-STORAGE
A subsidiary of Canadian Solar

General		
Product Model	CSI-SolBank-S-5016-2h-NA	
	CSI-SolBank-S-5016-4h-NA	
Battery Chemistry	Lithium Iron Phosphate (LFP)	
Pack Configuration	1P104S (104 Cells)	
Rack Configuration	1P416S (4 Packs)	
System Configuration	12P416S (12 Racks)	
Nominal DC Voltage	1331.2 V	
Operation DC Voltage Range	1164.8 V ~ 1497.6 V	

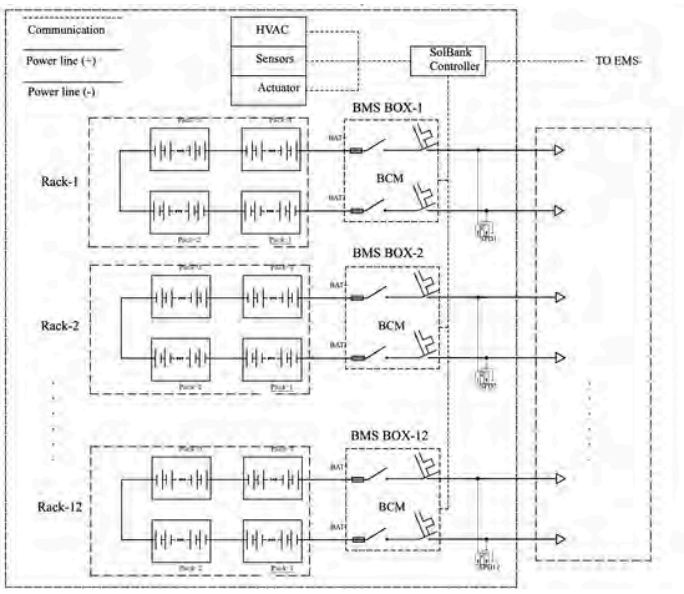
Performance		
Charging/Discharging Mode	0.5 P / 0.5 P	0.25 P / 0.25 P
Rated DC Power	2350 kW	1200 kW
Initial Storage Capacity	4700 kWh	4800 kWh
Duration @Rated DC Power	2hrs	4hrs
Round Trip Efficiency (RTE)	93%	94%
Auxiliary Load (Standby/Peak)	1.5 kVA / 50 kVA	1.5 kVA / 22 kVA
Max. Short Circuit Current	10 kA*12	10 kA*12
Operating Temperature (Ambient)	-30 °C to 55 °C (derating from 45°C to 55°C)	
Relative Humidity	≤95% (non-condensing)	
Altitude	≤4000 m (derating from 2000 m to 4000 m)	
Noise Sound Pressure Level (LPA) at 1 meter distance	≤75 dB(A)	

Auxiliary Systems	
Auxiliary Power Interface	AC480 V / 60 Hz, 3P5W
Thermal Management System	Smart liquid cooling/heating
External Communication Interface	Ethernet connection, Modbus TCP/IP protocol

Mechanical	
Enclosure	20ft. high-cube container
Dimensions (L*W*H)	6058*2438*2896 mm (238.50*95.98*114.02 in)
Weight (Battery Included)	43,000 kg (94,800 lbs)
Enclosure Ingress Rating	IP55 / NEMA 3R
Painting/Coating	RAL9003 / C4 Coating
Seismic Parameter	Zone 4

Safety	
Fire Detection and Alarm	Fire alarm panel, heat and smoke detection, alarm bell and strobe
Explosion Prevention	Combustible gas detector with active ventilation
Uninterrupted Power Reserve	Container level UPS for 2-hr control system backup; dedicated fire safety UPS for 24-hr fire alarm backup
Emergency Stop/Automatic Shut-off	Local and Remote
Fire Suppression Options	Aerosol-based suppression system. Dry pipe sprinkler system.

SolBank 3.0
Circuit Diagram



Notes

1. The unit is rated at 1164.8V~1497.6V for optimized product performance, the maximum voltage range for the battery system is 1060.8V~1497.6V
2. Rated DC Power is measured at the product DC terminal, the Rated DC Power and Initial Storage Capacity is limited to the use of two SolBank 3.0 units connected in parallel
3. Initial Storage Capacity is the usable product capacity at FAT, contact e-STORAGE for capacity at COD per project schedule
4. DC RTE is measured during capacity test at Rated DC Power, refer to the product warranty document for the complete procedure

Due to ongoing innovation, improvements, and product enhancements, the technical specifications in this document are subject to change and are not guaranteed. Canadian Solar reserves the right to update or change its products or this technical data without prior notice and customers should not rely upon these or any technical specifications which are not made part of a definitive binding agreement.

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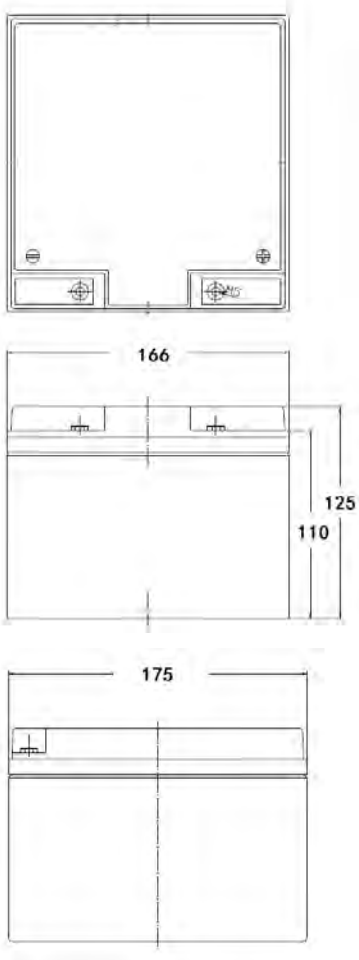
NP24-12H

产品特点　Product Features

- 电池内部无游离酸，气体复合效率高，使用安全性高。
- 特殊板栅合金，合适的电解液比重，充分保证寿命。
- 极板采用双面涂膏技术，确保电池性能一致优越。
- 汤浅经典设计，使用广泛，用户认可度极高。
- No free acid inside battery，high efficient gas recombination, high operation safety。
- Special alloy of grid, adequate specific gravity of electrolyte secures the battery life。
- Two-sided plating technology,more advantage battery function。
- Classic design,extensive application,high recognition of users。



外形尺寸（mm）Dimension



电池特征 Battery Characteristics

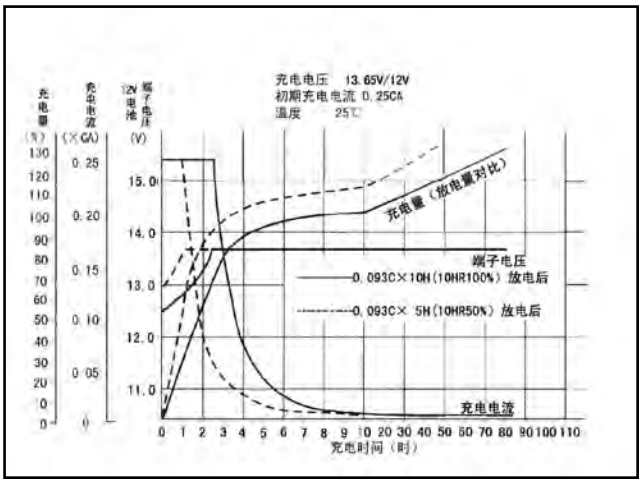
标 称 电 压（V）Nominal Voltage		12
容量 Capacity （25℃）	20 小时率	25Ah
	10 小时率	24Ah
	5 小时率	22Ah
	1 小时率	15.5Ah
外观尺寸 Dimension	长 L（mm）	175
	宽 W（mm）	166
	高 H（mm）	125
	总高 OH（mm）	125
不同环境温度下的放置期限 Storage period at various temperature	25℃以下	6 个月
	30℃以下	4 个月
	35℃以下	3 个月
	40℃以下	2 个月
运行温度 OperatingTemp Range	放 电 Discharge	-15℃～50℃
	※充 电 Charge	-15℃～40℃
	存 储 Storage	-15℃～40℃
推荐温度 Nominal OperatingTemp Range		25℃
※ 当温度偏离 25℃时,要用温度补偿后的电压充电 If the temperature variesy from 25℃, Charge with voltage after temperature compensation		
重量 Weight		约 8.0 kg
端子 Terminal		铜芯(M5)
池壳材料 Container material		ABS
内阻 （完全充电） IR，fully charged（25℃）		约 8~12 mΩ
浮充使用期充电方法 Charging method for floating use （25℃）		定电压 13.65V 限流 2.4~6A
设计浮充寿命 Designed float life		6 年(25℃)

广东汤浅蓄电池有限公司

YUASA Battery （Guangdong）Co.,Ltd

电池限流恒压充电特性

Charge Characteristics Constant Voltage with Current Limit



放电电流和终止电压的关系

Relationship of Discharge Current to FinalDischarge Voltage Allowed

放 电 电 流 Discharge current	放电允许最低终止电压 Lowest Discharge Final Voltage Allowed
0.2CA 未满	1.75V/单格
0.2CA 以上 0.5CA 未满	1.70V/单格
0.5CA 以上 1.0CA 未满	1.55V/单格
1.0CA 以上	1.30V/单格

定功率放电表 Constant Wattage Discharge Characteristics (25℃ 瓦特/单格 watts/Cell)

终止电压	10min	15min	20min	30min	40min	45min	60min	1.5h	2h	3h	4h	5h	10h
1.65V	96.8	77.0	63.6	48.4	39.3	35.0	29.3	21.8	18.2	13.3	10.5	8.3	4.6
1.67V	95.3	75.9	62.7	47.9	38.8	34.6	28.8	21.5	18.0	13.2	10.4	8.2	4.6
1.70V	93.2	74.1	61.4	47.2	38.1	34.0	28.2	21.1	17.6	12.9	10.2	8.0	4.5
1.75V	88.4	70.3	58.3	44.9	36.4	32.6	27.2	20.4	17.0	12.5	9.8	7.7	4.3
1.80V	83.3	66.1	55.1	42.4	34.5	31.0	26.0	19.4	16.2	11.9	9.4	7.4	4.2

充电注意：

当温度偏离 25℃时,请按每变化 1℃,浮充使用按-3mV/单格进行修正,均充按-4mV/单格进行修正。

Charging Recommendations

If the operating temperature varies significantly from the center value (25℃), temperature compensation for the charging voltage is recommended. The recommendation is -3mV/℃/cell for float use, and -4mV/℃/cell for cyclic use.

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http://www.gdyuasa.com

认证标识：**Approval indication**

FM 45770 EMS 99952 OHS750241

资料如有更改，恕不另行通知。

2023 年 3 月 第 1 版



Accurate and versatile

- Power and energy production monitoring provides a high level of accuracy
- Measures voltage, current, power, import energy, export energy, total energy, and net energy

Perfect alignment

- Designed for integration with the SMA DC-DC Converter
- Custom meter kit mounts inside the SMA DC-DC Converter

Pre-Prepared

- Preassembled kit reduces installation time
- Measurements integrated into DC-DC Converter Modbus map

SMA DPS-500 HIGH ACCURACY DC METERING KIT

Extreme accuracy when it counts

SMA DPS-500 High Accuracy DC Metering Kit makes the SMA DC-DC Converter capable of providing power and energy measurements with a 0.5% degree of accuracy. The kit may be installed on either port of the DC-DC Converter. It consists of a voltage transducer, current transducer, DC power meter, and all necessary components for integration within the DC-DC Converter enclosure. Measurements from the high accuracy meter are integrated into the Modbus map of the DC-DC Converter and can be accessed without need of a dedicated communication link to the meter. Measurements provided include voltage, current, power, import energy, export energy, total energy, and net energy.

Technical Data	DPS-500 High Accuracy DC Metering Kit KIT-7-DPS500100
General data	
Compatible DC-DC converter models	SMA DPS-500
Compatible DC-DC converter firmware	version 500-1-15 and above
Power and energy measurement accuracy	0.5%
Datalogging	1 minute interval; up to 4 months
Operating voltage range	0 - 1500 V DC
Measurement type	Voltage Hall Effect Sensor
Power supply	100-240 V_{AC}
Power consumption, typical	<3 VA
Dimensions, HxWxD	72 x 72 x 64.5 mm (2.835 x 2.835 x 2.539 in)
Weight	5 kg (11 lbs)
Temperature range, operating	-25°C to +70°C (-13°F to +158°F)
Temperature range, standby	-40°C to +85°C (-40°F to +185°F)
Relative humidity (non-condensing)	5 to 95%
DC measurement port (battery side / inverter side)	● / ○
Warranty	5 years
Supported communication interfaces	Modbus TCP/IP over ethernet
Compliance	
Certifications	UL 1741, UL 62109-1, CSA C22.2 #107.1, and IEC 62109-1
EMC	IEC 55011,IEC 61000-6-2, IEC 61000-3-2, and IEC 61000-3-3
Safety	IEC 61010-1
Communications	Modbus TCP/IP
Meter type	Accuenergy AcuDC 243-5V-A3-P1-X5-C-D-0.2
● Standard features ○ Optional features	
Type designation	KIT-7-DPS500100

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SMA America, LLC

E-STORAGE
ENERGY STORAGE SOLUTION

FIRE SAFETY SYSTEM AND BMS OVERVIEW

SEPTEMBER 2023

CanadianSolar
MAKE THE DIFFERENCE

e-STORAGE
A subsidiary of Canadian Solar

PRODUCT HIGHLIGHTS

MODULAR, ALL IN ONE, HIGH DENSITY



Extended Battery Life

We use durable, high cycling capacity LFP battery cell with proven long life track record and up to 20 years warranty.

- Active balancing BMS on cell level ensures a balance between all batteries during daily operation.
- A hybrid liquid + air cooling system maintains optimal temperature and humidity throughout the lifetime of the project.

Thorough Safety Design

Built to meet the latest fire and safety codes in the U.S., China, UK and Australia markets. SolBank units include:

- Complete fire propagation verification from cell, module (pack) to unit level based on the latest UL 9540A: 2019 (4th Edition).
- Explosion prevention systems via gas detection, active venting and passive pressure relief.

With integrated multi-level fire detection, units provide:

- Timely fire detection.
- Reporting of fire incidents.
- Linked actions with other system components.

Reduced Onsite Work

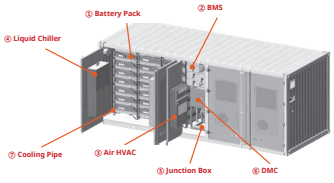
- All components are shipped with the product after factory testing, simplifying the installation and commissioning process onsite.
- All external wirings are available in a central location at the bottom of the enclosure.

Modular

- Scalable modular design from 1.5 hour to 6+ hour duration with high density and back-to-back installation;
- One standard platform for multiple power/duration applications, designed to meet global market performance and safety requirements.

SOLBANK

BATTERIES SHIP IN ENCLOSURE, 3 PRODUCT LINES



* BMS: Battery Management System
DMC: Distribution Management System

Parameter-Model	SolBank-S-2967-4h	SolBank-S-2967-2h	SolBank-S-2967-1.5h
System Configuration	8P414S (8 Racks)	8P414S (8 Racks)	6P414S (6 Racks)
Rated DC Voltage Range	1159.2V~1490.4 V		
Rated DC Power	700 kW	1375 kW	1300 kW
Nominal Capacity	2967 kWh	2967 kWh	2225 kWh
DC Usable Capacity (FAT)	**2800 kWh**	**2750 kWh**	**1950 kWh**
Constant Power (CP) Rate	**0.25P (4 hours)**	**0.5P (2 hours)**	**0.67P (1.5 hours)**
DC Round Trip Efficiency (RTE)	94%	93%	91%

Thermal Management System	Liquid cooling/heating for battery system, air cooling for electrical components and humidity control
Enclosure Ingress Rating	IP55 / NEMA 3R
Dimensions (L*W*H)	6058*2438*2896 mm (238.50*95.98*114.02 in)
Enclosure	20ft. high-cube container
Weight (Battery Included)	29,800 kg (65,700 lbs) / 24,900 kg (54,895 lbs)
Seismic Parameter	Zone 4
Noise @1m distance	≤75 dB

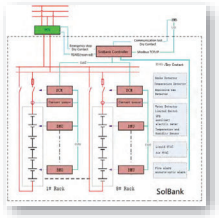
CONTROL AND MONITORING

Battery Management System (BMS)

- Monitors battery status to cell level in real time, including temperature, voltage, power level, fault and alarms, protections
- Report any faults, alarms to the control and monitoring system (BCI and EMS)
- Built in UPS for monitoring during power outage

Battery Control Interface (BCI)

- Control the inverter and SolBank in real time, coordinate behaviors between these components
- Stop all inverter and SolBanks within the same energy station when there is a fire alarm, minimize fault impact





Energy Management System

- Monitors status of all BESS equipment and report any fault detected to the operator
- Allow service team to read and analyze operating data of the equipment, to optimize system health and identify issues from early stage

PRIMARY BESS CODES & STANDARDS

Installation Codes and Standards

- **NFPA 855 Standard for the Installation of Energy Storage Systems (2023 Edition)**
- **2021 International Fire Code (IFC) Chapter 12 – Section 1207**

**Required code / standard and editions may vary based on state or jurisdiction.*



Listings / Certifications for ESS and Associated Equipment:

- **UL 9540**: Standard for Energy Storage Systems and Equipment

  Includes:
  - UL 1973 for cell, battery, rack
  - UL 1741 for inverters

Large-Scale Fire Testing:

- **UL 9540A**: Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems

INTEGRATED SAFETY SYSTEM

Certification-Standard

- Battery Cell, Module and Rack – **UL1973, IEC62619, UL1642**
- SolBank - **UL9540, UL9540A** (cell, module, unit level), **UN38.3**
- SolBank Explosion Prevention System – **NFPA69**
- Inverter – **UL1741**
- Integrated system – **UL9540**

Independent Engineering Report

- SolBank product review - DNV

Owner Support under Long Term Service Agreement (LTSA)

- 24*7 monitoring of the system through CSI remote operation center
- O&M service with preventive maintenance and corrective maintenance of the equipment
- Onsite and remote training to ensure adequate professionalism of O&M team members

Site Specific Materials

- Site specific Emergency Response Plan (ERP)
- Site specific Hazard Mitigation Analysis (HMA)

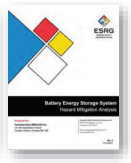
UL 1973, Edition 3



UL 9540, Edition 2







UL9540A LARGE-SCALE FIRE TESTING

UL 9540A Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems:

Developed to better understand safety risks, demonstrate compliance with codes and standards

▪Testing performed at multiple levels:
- Cell
- Module
- Unit
- Installation*

▪Test results inform system design and installation requirements
-Fire mitigation and protection
-Ventilation
-Incident management

Test Level	Reported Information / Performance Criteria
Cell	• Can cell exhibit thermal runaway? • Thermal runaway characteristics • Flammability / composition of vent gas
Module	• Thermal runaway containment / characteristics • Flammability / composition of vent gas • Heat and gas release rates
Rack / Unit	• Evaluation of fire / thermal runaway spread • Heat and gas release rates • Deflagration and re-ignition behavior
Installation	• Effectiveness of fire protection systems • Heat and gas release rates • Deflagration and re-ignition behavior

UL9540A REPORTS

UL 9540A, Edition 4

Test Result high level summary

UL9540A – Unit level

- Cell to cell propagation was happened in the initiating model.

  Note: It is forced cell to cell propogation introduced purposely to complete the UL9540A test on unit level.
- Module to module propagation was not observed.
- No flying debris or explosive discharge of gases observed during test.
- No sparks, electrical arcs, or other electrical events observed during test.
- No external flaming was observed during test.

Note: Please refer to the reports for more details.



UL9540A-Cell level

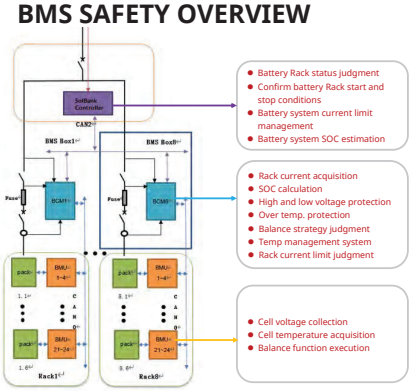


UL9540A-Module level



UL9540A-Unit level

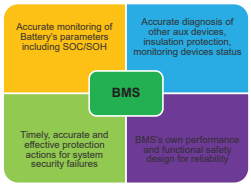
BMS SAFETY OVERVIEW



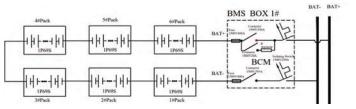
- Battery Rack status judgment
- Confirm battery Rack start and stop conditions
- Battery system current limit management
- Battery system SOC estimation

- Rack current acquisition
- SOC calculation
- High and low voltage protection
- Over temp. protection
- Balance strategy judgment
- Temp management system
- Rack current limit judgment

- Cell voltage collection
- Cell temperature acquisition
- Balance function execution

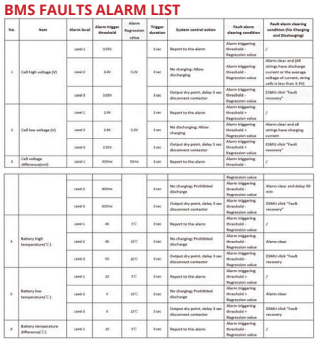


BMS SAFETY OVERVIEW

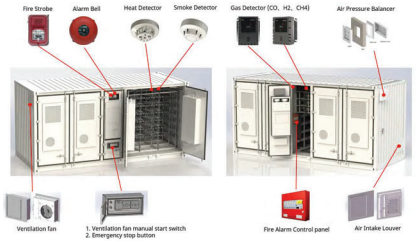


Level	Safety design
Rack level	1. Battery string short circuit protection (fuse)
	2. Dual Fuse redundancy design
	3. The relay is allowed to open under load under abnormal conditions
	4. Battery string switch allows disconnection under load
	5. DC insulation monitoring function
	6. Software meets UL60730 functional safety design requirements

BMS FAULTS ALARM LIST



FIRE PROTECTION SYSTEM SAFETY - EQUIPMENT



Safety features

- Fire detection (smoke + heat detectors)
- Fire alarm (remote and local)
- Explosion prevention (combustible gas detection, active ventilation)
- Emergency shutdown (E-Stop)
- Non-walk-in container design with open door sensors
- Lockable disconnect switch for LOTO

Redundancy designs

- Two sets of smoke, heat detectors, trigger of any will report fire alarm
- Two gas detectors, trigger of any will report gas alarm
- Built in UPS for battery monitoring, ventilation, fire detection and alarming
- Backup aux power supply for fire safety system

Fire Detection	Heat and Smoke detection (2 Sets)
Explosion Prevention & Mitigation	Gas detection (2 Units), passive pressure relief system, active air intake and venting
Fire Alarm	Strobes and bells - UPS Backup. Fire alarms monitored by both fire panel and BMS
Local Emergency Stop	Yes
Coolant Leak Detection	Yes
Interface with External Fire Panel	Available with options to network

FIRE PROTECTION SYSTEM SAFETY - EQUIPMENT

POTTER The Symbol of Protection



Fire Panel Features

- NFPA 72 Compliant Smoke Sensitivity Test Built-In
- Dedicated Alarm, Supervisory and Trouble Relays
- NFPA, 12, 12A, 13, 15, 16, 17, 17A, 70, 72, 92, 720 ,750, and 2001

Macurco



Gas Detector Features

- Designed for low-level detection, mitigation, and notification
- Gas Type: Propane (LP) Methane (NG) Hydrogen (H2)
- Gas Range: 0-50% LEL
- ELT Listed

POTTER The Symbol of Protection



Smoke Detector Features

- Wide selectable sensitivity range of 1.0 to 3.7%/foot
- UL listed smoke calibration and sensitivity
- UUKL Listed for Smoke Control

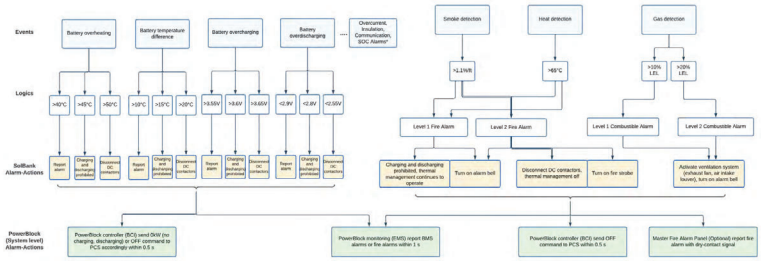
POTTER The Symbol of Protection



Heat Detector Features

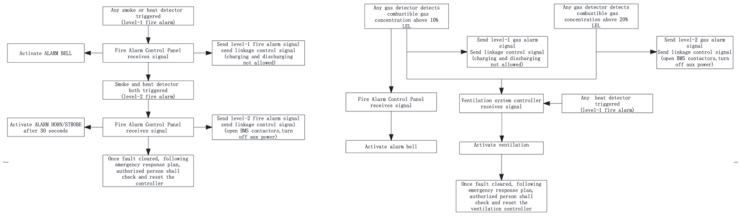
- Selectable Rate of Rise and/or Fixed Heat Detector
- UUKL Listed for Smoke Control

FIRE PROTECTION SYSTEM SAFETY - LOGIC MAP



- Note: *This overview has included examples for BMS alarms, for complete list of alarms and monitoring datapoints, please refer to BMS alarm list.
- For charge and discharge cell voltage limits, SolBank strictly follows Cell Supplier recommendations. *For details, please refer to EVE LF280K cell datasheet.*
- Charge limit for cell spec: 3.65V, SolBank charge limit alarm starts from 3.55V, no charge on 3.6V.
- Discharge limit for cell spec: 2.5V, SolBank discharge limit alarm starts from 2.9V, no discharge on 2.8V.
- Accuracy and delay of BMS detection: BMS voltage accuracy 5 mv; Current accuracy 0.5 %; Temperature accuracy 1°C. BMS components use CAN bus for communication internally, which has a delay of less than 0.5s (CAN 2.0 communication).

FIRE PROTECTION SYSTEM SAFETY - FIRE CONTROL FLOW CHART



EVENT TIMELINE DESCRIPTION

Prevention of Event: Phase 1

- Tightly designed control system: no violation of battery operation limit (voltage deviation, duty cycle, etc)
- SolBank BMS detects abnormal battery in early stage, report status to trigger warning or alarm
- SolBank auxiliary system reports abnormal status of aux components (i.e. HVAC failure, and report issue through BMS-EMS)
- 24*7 monitoring and corrective maintenance: ensure issues got identified and addressed timely

Limit Extent of Event: Phase 2

- SolBank with fault will be stopped: including level 1 fire alarm, level 1 gas alarm, over temperature, high/low SOC
- SolBank with critical fault will be disconnected: including level 2 fire alarm, level 2 gas alarm, severe high/low voltage or SOC
- Any detection of combustible gas to a certain level will trigger linkage control signal to start active ventilation
- Any communication issue with SolBank, PCS or EMS will be reported, and impacted equipment will be stopped.

Conclude Event: Phase 3

- Initiation of emergency response shall be activated per current protocol. If there is any threat or potential threat to life or safety, 911 shall be called immediately to summon the aid of public safety responders.
- With a confirmed fire alarm, the site should be evacuated with all staff to the the primary muster point per Emergency Response Plan (ERP)
- Subject Matter Expert (SME) shall be informed to provide advice to first responder based on the site-specific information per Emergency Response Plan (ERP)
- O&M team continues to monitor equipment status of impacted unit and units next to it through EMS remotely

SOLBANK FIRE SAFETY SOLUTION ADVANCEMENTS

Sr.	Standard Requirement	SolBank Advancement
1	NFPA855 requirement on ventilation states: *"9.6.5.1.4* Natural Exhaust Ventilation. Exhaust ventilations shall be designed to limit the maximum concentration of flammable gas to 25 percent of the lower flammable limit (LFL) of the total volume of the outdoor cabinet during the worst-case event of simultaneous "boost" charging of all the batteries, in accordance with nationally recognized standards."*	SolBank complies with NFPA855 requirements and exceeds the minimum condition by lowering the gas concentration detection limit LFL to 10%
2	NFPA855 requirement on smoke and fire detection states: *"9.6.1 Smoke and Fire Detection. Areas containing ESS systems located within buildings or structures shall be provided with a smoke detection or radiant energy-sensing system in accordance with Section 4.8, unless modified by this chapter."*	SolBank complies with NFPA855 requirements and exceeds the minimum condition by including Smoke detector as well as Heat detector in the SolBank.

BESS FAILURE AND FIREFIGHTING

- SolBank does not require a suppression system to make it a safer product. However, in the unlikely event of fire, we can adopt "let it burn" fire safety approach. An on-site water reservoir is agreed upon early in the project with the local fire department to manage the spread of fires to the adjacent areas.

- Suppression, however, will likely be defensive in nature, protecting adjacent enclosures while the effected system burns itself out

  - Testing has not shown electrical leakage to be an issue at the voltages ESS operates for firefighting safety
  - Testing on water runoff is on-going but has so far not been overly negative
  - Water can be used as fire suppression agent for surrounding area.
  - Foam is more conductive, has not performed well in the field
  - Other water-based agents have not shown they perform better than water
  - Alternative agents (non-water based) don't provide the cooling of water





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FIRST RESPONDER TRAINING AND SITE FAMILIARIZATION



Available service from e-STORAGE through fire safety expert:

- On-site First Responder Training and Site Familiarization Drills
  - Industry best practices based on Emergency Response Plan and Full-Scale Fire Test experience
  - Developed by former/current First Responders and Engineers
- Subject Matter Expert (SME) availability
  - Providing direction and support to Incident Commander (IC) during event

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SolBank 3.0
Safety Manual

V1.1

CSI Energy Storage Co., Ltd.

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1 Preface

1.1 Document Purpose and Scope

The purpose of this document is to provide an overview of the electrical, chemical, and fire hazards that exist within the SolBank modular Energy Storage System (ESS). The scope of this document is limited only to equipment contained within the SolBank and does not include an analysis of all hazards existing at an ESS site. Topics covered include an overview of comprehensive site safety planning processes, SolBank safety systems and features, SolBank hazards, emergency response options, and other important system safety precautions.
This document should be made available to all field personnel participating in the design, installation, operation, and maintenance of the SolBank energy storage system in addition to project safety personnel and local emergency first responders.

This manual is to be considered supplemental to a project specific Environmental Health and Safety (EHS) plan, Failure Mode Effects Analysis (FMEA) and Hazard Mitigation Analyses (HMA), and Emergency Response Plan (ERP). Please read and understand all aspects of this document prior to initiating SolBank installation, commissioning, and operation.

Should any questions arise, please contact e-STORAGE support:
- By telephone at +1-519-837-1881.

1.2 Applicable Models

This manual covers the following models only:
- CSI-SolBank-S-5016-2h-NA
- CSI-SolBank-S-5016-4h-NA
- CSI-SolBank-S-5016-2h-EU
- CSI-SolBank-S-5016-4h-EU
- CSI-SolBank-S-5016-2h-AUS
- CSI-SolBank-S-5016-4h-AUS

1.3 Reference Documents

The SolBank Installation Manual exists as part of library of product specific documents. Please consult the following documents to ensure a comprehensive understanding of SolBank attributes.
- SolBank3.0 Installation Manual
- SolBank3.0 User Manual
- SolBank3.0 Safety Manual
- SolBank3.0 Maintenance Manual
- SolBank3.0 Commissioning Manual
- SolBank3.0 Decommissioning Manual
- SolBank3.0 Transportation Instruction Document

1.4 Version Control

This is the initial release of the SolBank Safety Manual. As part of e-STORAGE's continuous improvement process, e-STORAGE reserves the right to make technology and document changes.

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Please contact e-STORAGE support to verify this manual reflects the most recent release or to report omissions or inaccuracies.

Version	Description	Date of Issuance
V1.0	Initial release	May 15th, 2024
V1.1	Add Applicable Models	August 1th, 2024

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1.5 Document Safety Notices

Throughout this manual the below indicated labels are used to convey hazards associated with specific tasks and procedures. These safety notices do not represent all hazards present when performing a given task. Installers and operators of the SolBank should adhere to industry safety best practices; site specific Environmental, Health and Safety plans; and local safety requirements and regulations. ***Only properly trained and qualified personnel should be permitted to complete the installation procedures identified in this manual.***

Labels	Explanation
	CE mark of conformity.
	Indicates a hazardous situation which, if not avoided, could result in death or serious injury. Indicators are not used for property damage hazards unless personal injury risk appropriate to this level is also involved.
	Label the product as inflammable and explosive, and do not involve open flame.
	Electrical hazard sign, non-professional personnel do not approach. Professional personnel are required to perform maintenance and operation.
	Do not discard randomly
	Recycling equipment

1.6 SolBank Primary Hazards

This section summarizes the primary hazards associated with the SolBank. These hazards are discussed in detail within this guide, in addition to other notable hazards. For further guidance, please refer to the remainder of this manual, the documents identified in Section 1.3, and a project/site specific EHS plan, Hazard Analysis, and Emergency Response Plan.

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1.6.1 Electrocution Hazard



Personnel will be exposed to voltages of max 1500 VDC from the SolBank's battery packs. Battery packs cannot be de-energized. Low and medium voltage AC is also present – exposure levels will depend on site specific conditions. Risk of arc flash and electrocution is omnipresent at an ESS site. e-STORAGE encourages full compliance with the practices and procedures indicated in NFPA 70E including use of Personal Protective Equipment (PPE) sufficient to mitigate any hazards identified in a site-specific arc flash study. Emergency Response Personnel should rely on Standard Operating Procedures (SOP) for responding to incidents at electrical generating facilities.

1.6.2 Fire and Explosion Hazard



The SolBank system contains adequate ignition sources and sufficient oxygen that may result in propagation of fire during a thermal runaway event. Fire and other sources of extreme heat, if not properly mitigated, can lead to battery cascading thermal runaway and the release of combustible gases. **These combustible gases, if present in sufficient concentrations, pose a risk of explosion.** If a fire, or other indications of thermal runaway are present within the SolBank or at the ESS site, first responders are advised to maintain a safe perimeter until it can be verified that entry into the ESS site is safe per the ERP and SOP and subject matter experts are available to lead the effort.

1.6.3 Chemical Exposure Hazard



The SolBank contains the following hazards: LFP battery electrolyte, lead acid batteries, R410a refrigerant, and Ethylene Glycol coolant. **These chemicals can be hazardous to both health and environment.** Please refer to the Safety Data Sheets (SDS) contained within Attachment A of this document for hazards and precautions specific to each chemical.

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1.7 Product Certification and Compliance

The SolBank is compliant with the standards, regulations, and requirements identified in Table 1

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Table 1: SolBank 3.0 Standards Compliance

Classification		Regions	Standards
System	Design regulations	ALL	NEC – National Electrical Code® IEEE C84.1 – Standard Preferred Voltage Ratings for Alternating-Current Electrical Systems IEEE 693 – Recommended Practice for Seismic Design of Substations IEEE 1584-2018 – Guide for Performing Arc-Flash Hazard Calculations NFPA 855 – Installation of Energy Storage Systems NFPA 70E® – Standard for Electrical Safety in the Workplace® NFPA 72 – National Fire Alarm and Signaling Code IEC62933-5-2 – Safety requirements for grid-integrated EES systems - Electrochemical-based systems AS3000 - Electrical installations "Wiring Rules"
	Product certification	NA	IEC 60529 – Degrees of protection provided by enclosure UL 60730-1 – Standard for safety: Automatic Electrical Controls – Part 1:General Requirements NFPA 69® – Standard on Explosion Prevention Systems NFPA 68® – Standard on Explosion Protection by Deflagration Venting UL9540A – Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems UL1973 – Standard for safety: Batteries For Use In Stationary And Motive Auxiliary Power Applications UL9540 – Standard For safety: Energy Storage Systems And Equipment UN38.3 – Recommendations on the Transport of Dangerous Goods: Manual of Tests and Criteria

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	Product certification	EU	IEC62619 – Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications IEC63056 – Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries for use in electrical energy storage systems IEC/EN 62477-1 – Safety requirements for power electronic converter systems and equipment - Part 1: General IEC/EN 61000 – Electromagnetic compatibility (EMC)
Fire Protection and Safety	Design regulation	NA	NFPA 2001 – Standard on Clean Agent Fire Extinguishing Systems NFPA 15 – Standard for Water Spray Fixed System for Fire Protection NFPA 2-2023 – Hydrogen technologies code
		EU	BS 5839-1 – Fire detection and fire alarm systems for buildings BS 7273 -1 – Code of practice for the operation of fire protection measures BS EN 54 Pt1- 21 – series for equipment BS EN 15004-1:-2019 – Fixed firefighting systems. Gas extinguishing systems. Design, installation and maintenance. BS EN 15004-2:2020 – Fixed Firefighting Systems-Gas Extinguishing Systems FK-5-1-12 BS 6266:2011 – Fire protection for electronic equipment installations– Code of practice BS EN 12094-1:2003 – Fixed firefighting systems. Components for gas extinguishing systems Requirements and test methods for electrical automatic control and delay devices
		AUS	AS 4487-2013 – Condensed aerosol fire extinguishing systems – Requirements for system design, installation and commissioning and test methods for components AS 7240– Fire Detection and Alarm Systems

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			AS1670 – Fire detection, warning, control and intercom systems – System design, installation and commissioning AS 1851-2012 – Routine service of fire protection systems and equipment

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3 Acronyms and Abbreviations

AC – Alternating Current
AHJ – Authority Having Jurisdiction
BMS – Battery Management System
BOL – Beginning of Life
DC – Direct Current
SolBank Controller – LOCAL Energy Management System (Battery system)
EOR – Engineer of Record
ESS – Energy Storage System
COG – Center of Gravity

IFC - Issued for Construction
LFP – Lithium Iron Phosphate
LOTO – Lock-Out-Tag-Out
NFPA – National Fire Protection Association
PCS – Power Conversion System
PPE – Personnel Protective Equipment
SPD – Surge Protection Device
UPS – Uninterruptible Power Supply
EPC – Engineering, Procurement and Construction contractor
CapEx - Capital Expenditures

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4 Introduction

4.1 Comprehensive Site Safety and Emergency Response

Development of effective and comprehensive safety procedures and emergency response guidelines requires, among other things, i) analysis of project specific ESS architecture and all components within, ii) site specific risks and hazards, iii) engagement with project stakeholders, iv) and a clear understanding of both customer and fire department Standard Operating Procedures (SOP). e-STORAGE has provided this Safety Manual as an input to these processes and the development of the below recommended project specific documents.

- Environmental, Health, and Safety (EHS) Plan: A living project safety plan which serves as an instructional tool for personnel working on a project, notifying them of hazards as well as procedures required to ensure personnel safety and environmental protections in consideration of such hazards.
- Failure Modes and Effects Analysis (FMEA): A bottom-up analysis which identifies the worst-case effect of component (software and hardware) failure on system performance and safety. An FMEA is similar to a Hazard Analysis. Reference International Electrotechnical Commission (IEC) 60812 for guidelines on how to perform an FMEA.
- Emergency Response Plan (ERP): An ERP leverages the FMEA, EHS Plan, SOPs, and other inputs to develop a project specific plan which dictates the actions to be taken by key project stakeholders in response to an emergency at an ESS site. A copy of the ERP should be kept at the ESS site, at a location accessible to emergency first responders.

4.2 System Overview

The SolBank 3.0 System integrates all power electronics, controls, and safety features required to support the DC side of a battery energy storage system. An overview of the SolBank 3.0 layout and key features is shown in Figure 1 and further described in Table 2.



Figure 1: Layout and features of the SolBank 3.0

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Table 2: Description of SolBank 3.0 Safety Equipment and Features

NO.	Name	Remarks
1	Standard Enclosure and Rack	All models of the SolBank3.0 utilize a standard IP55 rated 20'ft HC container and battery rack design allowing for enhanced system modularity.
2	Pack	The SolBank3.0 contains 48 Lithium Iron Phosphate (LFP) battery packs, each consisting of 104 series wired battery cells.
3	Fire Protection System	The SolBank3.0 combines heat, smoke and gas detection with an deflagration and ventilation system.
4	BMS Box	The SolBank3.0 contains 12 BMS boxes. These are easily accessed for installation and maintenance within the middle line of the container. The BMS ensure optimal battery functionality and safety.
5	Liquid Cooling piping	The liquid-cooling piping connecting the chiller to the packs.
6	Cable & Wire	High-voltage connection and low-voltage communication power cable.
7	DMC	The Distribution and Control Cabinet houses all aux power distribution equipment including 2-hour backup UPS; system communication, control, and monitoring hardware including network switch, and Local EMS,and all required customer communication, signal, and aux power interfaces.
8	Chiller	The SolBank3.0's liquid cooling/heating system facilitates improved battery temperature management efficiency relative to traditional forced air systems. Each battery pack is liquid cooled, allowing for greater heat dissipation and uniform cell temperature management. During charge and discharge, cell temperature is maintained between 20°C - 35°C.

5 SolBank 3.0 Safety Systems and Features

5.1 Battery Pack Chemistry and Design

The SolBank contains 48 Lithium Iron Phosphate (LFP) battery packs, each containing 104 LFP cells. During transportation and maintenance, the power harness in series between the battery packs needs to be disconnected. When the power harness is disconnected, the DC voltage in the battery box is only 332.8V, which greatly reduces the risk of fatal electric shock. Note that during normal operation and fully installed, the battery pack nominal voltage can exceed 1331.2Vdc.

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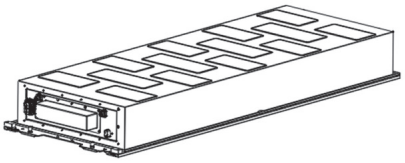


Figure 2: SolBank battery pack. Each battery pack contains 104 battery cells.

5.2 Battery Management System

The SolBank's battery packs are wired as 12 strings of 4 packs, as shown in Figure 3. Each string is controlled and monitored by a dedicated Battery Management System (BMS). The BMS constantly monitors cell and pack level voltage, temperature, State of Charge (SOC), and other parameters to ensure early detection of pre fault conditions, and immediate detection of fault events. Should any parameter exceed a permissible value, the BMS will disconnect the effected string and surface an alarm to the site EMS.

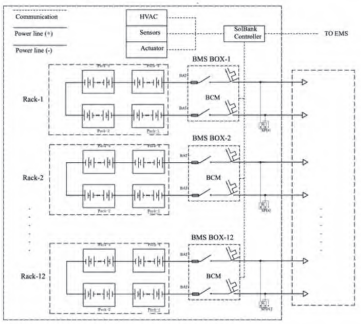


Figure 3: SolBank String Wiring. Each string consists of 4 battery packs and a single BMS.

5.3 Access Door Travel Switch

The external access door on the SolBank has integrated position sensors. When the external access door is opened during system operation, the SolBank will immediately shut down and all BMS will isolate their battery strings from the main system bus.

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Figure 4: The position of external access door

5.4 F-Stop

Each SolBank contains two F-Stop buttons on each end of the enclosure. When pushed, the SolBank will immediately commence shut down, and all BMS will isolate their battery strings from the main system bus. See Figure 7 and Section 7.1.1 for additional details.

5.5 Fire Detection and Alarming

The SolBank is equipped with smoke and heat detectors calibrated to detect early signs of fire within the SolBank. The spot-type smoke detector is calibrated to 3.5%/ft. The temperature threshold of the heat detector is 85℃. Both detectors are ceiling mounted as indicated in Figure 7. The SolBank contains both an audible fire alarm and visual fire strobe. If the smoke and heat detectors are triggered, both alarms will activate, and corresponding alarms will be sent to the ESS EMS.
The fire alarm logic is shown in the Table 3.
The SolBank is equipped with combustible gas detection sensor and two off-gassing valves. The combustible gas detector is calibrated to 10%-20% LEL. If the combustible gas sensor is triggered, both alarms will activate, and the two off-gassing valves will be opened for exhaust. Corresponding alarms will be sent to the EMS.

Combustible gas level 1 alarm	Combustible gas level 2 alarm	Smoke detector alarm	Heat detector alarm	ventilation Fan	Alarm Bell	Alarm Horn-Strobe	Aerosol Based Fire Suppression[2]	Running status of the energy storage system
×	×	×	×	Close	Close	Close	Close	No fire alarm, the system runs normally

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√	×	×	×	Open	Open	Close	Close	Combustible level 1 alarm, the system does not charge and discharge, auxiliary AC switch and DC contactor are closed
√	√	×	×	Open	Open	Close	Close	Combustible level 2 alarm, the system does not charge and discharge, auxiliary AC switch and DC contactor are disconnected
×	×	√	×	Close	Open	Close	Close	Fire alarm level 1, the system does not charge and discharge, auxiliary AC switch and DC contactor are closed
√	×	√	×	Open	Open	Close	Close	Combustible, fire alarm level 1, the system is prohibited to charge and discharge, auxiliary AC switch and DC contactor are closed
√	√	√	×	Open	Open	Close	Close	Combustible alarm level 2, fire alarm level 1, the system is forbidden to charge and discharge, auxiliary AC switch and DC contactor are disconnected
×	×	×	√	Close	Open	Close	Close	Fire alarm level 1, the system does not charge and discharge, auxiliary AC switch and DC contactor are closed
√	×	×	√	Open	Open	Close	Close	Combustible, fire alarm level 1, the system is prohibited to charge and discharge, auxiliary AC switch and DC contactor are closed
√	√	×	√	Open	Open	Close	Close	Combustible alarm level 2, fire alarm level 1, the system is forbidden to charge and discharge, auxiliary AC switch and DC contactor are disconnected
×	×	√	√	Close	Open	Open	Open	Fire alarm level 2, the system does not charge and discharge, auxiliary AC switch and DC contactor are disconnected

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√	×	√	√	Open	Open	Open	Close	Combustible level 1, fire level 2 alarm, the system forbid charging and discharging, auxiliary AC switch and DC contactor are disconnected
√	√	√	√	Open	Open	Open	Close	Combustible level 2, fire level 2 alarm, the system forbid charging and discharging, auxiliary AC switch and DC contactor are disconnected

Table 3: Fire alarm Sequence of Operations

Note: (1) Applicable to aerosol solution only

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6 SolBank Hazards

The primary hazards associated with installation and operation of the SolBank are indicated in Table 4 and discussed in the following sections.

Table 4: SolBank primary hazards

Classify	HAZARD	DESCRIPTION	QUANTITY	RISK
Electrical hazards	DC voltage	Primary voltage of storage system	1500VDC	Electrocution
	AC voltage	Primary voltage of auxiliary power supply	480VAC(US) 400VAC(EU)	Electrocution
Chemical hazards	Ethylene Glycol	Coolant used in battery liquid cooling system	200L (52.8gal)	See Attachment
	R134a(R513a optinal) Refrigerant	Refrigerant used in Chiller system	8kg (17.6lbs) of R134a (R513a optional) refrigerant	See Attachment
	Li-ion Electrolyte	Battery electrolyte used in LFP battery cells	4575L (1208.6gal)	See Attachment
	Lead Acid Electrolyte	Battery electrolyte used in UPS	0.3L(0.079gal)	See Attachment
Fire & Explosion Hazards	Electrical Fire	Fire caused by cable fault or component failure		Fire
	Thermal Runaway	Thermal runaway from battery fault or heat		Fire, off-gassing
	Battery off-gassing	Off-gassing resulting from thermal runaway		Explosion

6.1 Electrical Hazards

Please refer to site level arc flash study and arc flash label for site specific details. Following with product generic notes.

6.1.1 DC Voltage

Hazard: Exposure to 1500VDC
As shown in Figure 3, the SolBank's 48 battery packs are wired as 12 strings of 4 packs. Each SolBank pack has a maximum DC voltage of 379.6 VDC. When wired in a series string of 4 packs, the total voltage increases to 1331.2 VDC. Charging voltage can be as high as 1500VDC. Risk of electrocution exists.
Location: When system is shutdown, high DC voltage is present at the terminals of each battery and BMS. When the system is started or on-line, each BMS will close the string disconnect, and energize the main DC bus of the SolBank. If the system primary disconnect is closed, the conductors between the SolBank and DC terminals of the PCS will also be energized.

6.1.2 AC Voltage

Hazard: Exposure to 480VAC (400VAC(EU))
The SolBank's auxiliary power system, which includes Chiller systems, control systems, and other system support equipment, operates of 480VAC(400VAC(EU)). Risk of electrocution exists.
Location: 480VAC(400VAC(EU)). aux power feed is routed into the bottom of the SolBank Distribution

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Management Cabinet shown in Figure 1. 480VAC supplies Chiller loads contained in the Chiller cabinet as well as a 480VAC/277VAC step-down transformer, which in turn supplies other loads through the SolBank.

6.2 Chemical Hazards

6.2.1 Ethylene Glycol Coolant

Hazard: Exposure to hazardous chemicals
The SolBank's liquid cooling and heating system circulates an Ethylene Glycol solution from the Chiller cabinet to each battery pack in the system. The solution consists of 40% water and 60% Ethylene Glycol. which is not combustible but does pose a health risk when exposed to personnel in sufficient quantity. See the safety data sheet (SDS) contained in Attachment for further details.
Location: Ethylene Glycol circulates throughout the supply and return lines shown in Figure 5.

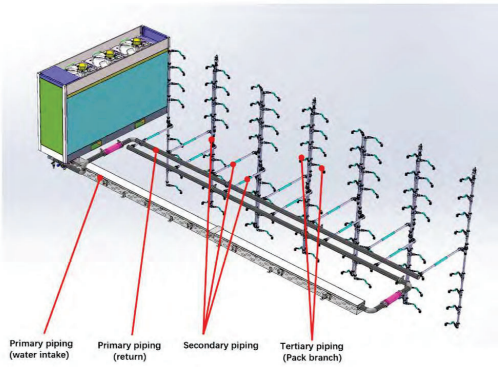


Figure 5: Coolant distribution schematic

6.2.2 R134a (R513a optional) Refrigerant

Hazard: Exposure to hazardous chemicals
The SolBank's air conditioning system circulates R134a (R513a optional) refrigerant to the entire Chiller system. R134a (R513a optional) can be combustible under certain circumstances and does pose a health risk when exposed to personnel in sufficient quantity. See the safety data sheet (SDS) contained in Attachment A for further details.

Location: R134a (R513a optional) circulates throughout the Chiller shown in Figure 6. Compressor and other supporting equipment can be found in the Chiller cabinet.

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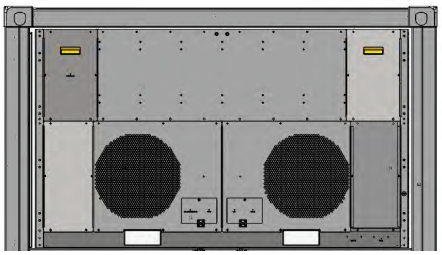


Figure 6: SolBank's Chiller system

6.2.3 Lithium-Ion Electrolyte

Hazard: Exposure to hazardous chemicals
The electrolyte contained within the SolBank battery packs consist of a volatile hydrocarbon-based liquid and a dissolved lithium salt such as lithium hexafluorophosphate. The electrolyte solution can be combustible under certain circumstances and does pose a health risk when exposed to personnel. See the safety data sheet (SDS) contained in Attachment for further details. Additional materials used in the construction of the LFP battery pack are indicated in Table 5.

Location: 4575L (1208.6gal) of electrolyte is contained within the SolBank's 48 battery packs (4992 battery cells). The battery packs are located within the 6 steel racks shown in Figure 1.

Table 5: Non-electrolyte materials incell

No.	Materials/Ingredients	Approx. % by wt.
1	Carbon	12%
2	Lithium Iron Phosphate	40%
3	Aluminum	3%
4	Copper	7%

6.2.4 Lead Acid Electrolyte

Hazard: Exposure to hazardous chemicals
The electrolyte contained within the SolBank's UPS and fire panel consist of a sulfuric acid electrolyte. The electrolyte solution does not combust easily but does pose a health risk when exposed to personnel. See the safety data sheet (SDS) contained in Attachment for further details.
Location: The Lead Acid Electrolyte is contained within the SolBank's UPS and fire panel which is in the electrical cabinet.

6.3 Fire & Explosion Hazards

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6.3.1 Electrical Fire

As a result of short circuit, failed OCPD (over-current protection device), or other electrical component failure, electrical fires are possible within the SolBank.

6.3.2 Thermal Runaway and Battery Fire

Due to excessive heat build-up from external sources (i.e. electrical fire), or internal cell failure, it is possible that one, or many of the SolBank's LFP cells may be pushed into a state of thermal runaway. Once this occur, the design of the LFP cell and battery pack is designed to reduce the propagation of thermal runaway to adjacent cells, a process called "cascading thermal runaway."

6.3.3 Explosion of Battery Off Gas

When Li-ion batteries go into thermal runaway, toxic and combustible gases are released in a process called off-gassing. During cascading thermal runaway events, when many cells are consumed, sufficient gas can build up within a confined space to create conditions sufficient for explosion.

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7 Emergency Response

7.1 Emergency System Shutdown

In the event of an emergency on site, the SolBank can be shut down locally, or remotely. A system shutdown will result in electrical isolation of the battery strings and cessation of battery charging or discharging. A system shutdown will not de-energize the battery bank, nor will it guarantee that a fault or thermal runaway event has been stopped. Do not open the SolBank until deemed safe to do so by an individual qualified to direct such decision.
Procedures for shutdown of the site and isolation from the grid should be dictated within the ERP.

7.1.1 Local Emergency Shutdown

If safe to approach the SolBank (See the symptom described in 7.2.1), as agreed upon by all stakeholders and per the project Emergency Response Plan, SOPs, Emergency Incident Commander, or other qualified on-site personnel, the F-stop button located on either end of the SolBank can be pushed. See Figure 7 for the location of the F-stop buttons. This should only be done if remote shutdown is not possible.
When the F-stop is pushed, the SolBank BMSs will disconnect all battery strings from the main system bus, thereby stopping all charging and discharging. Simultaneously, the plant PCS will shut down if properly configured to do so.

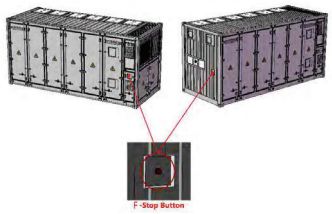


Figure 7: Location of F-stop, fire sensing, and alarms.

Pressing the F-stop while charging and discharging places considerable stress on the system. Only use the F-Stop to stop the system during an emergency. Before restarting the system, the F-stop must be pulled out to its original position.
If indications of a fire within the SolBank exists, such as smoke emanating from the SolBank, or activation of the fire alarm strobe, it is recommended to immediately evacuate the area and maintain a safe perimeter. System shut down should be attempted remotely as described in Section 7.1.2. Do not open the SolBank access doors.

7.1.2 Remote System Shutdown

During normal operation, the SolBank will be under the control of a site Energy Management System (EMS). The EMS in turn will communicate with, and be controlled by, an offsite fleet controller, SCADA operations center, or other third-party dispatch and monitoring entity. SolBank alarms will be forwarded to such remote operations, and in turn, remote operations personnel can shut down the SolBank if determined to be necessary.
On-site personnel witnessing an emergency should not however assume automated alarms have

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reached the EMS or that they have been passed onto remote operations. Such personnel are advised to first call 911, and then contact remote operations directly in addition to other key stakeholders identified in the ERP.

7.2 Fire Alarm Response

7.2.1 Initial Indications of fire

If any of the below is observed, personnel should immediately evacuate the area, contact 911, and notify all stakeholders as defined within the ERP. **Do not open the SolBank access doors under any circumstance.**

- Acrid burning or sweet smell
- Excessively hot access door handles or outer surfaces
- Unusual sounds indicating electrical arcing, cell venting (popping), or combusting materials Triggered audible or visual fire alarm
- Smoke emanating from the SolBank

7.2.2 Establish Secure Perimeter and Monitor

In the event of a fire, or indication of a fire within the SolBank, e-STORAGE recommends that first responders establish a secure perimeter, monitor, and approach only when determined safe to do so by an incident commander or other qualified authority. **No direct suppression tactics are advised by e-STORAGE.**

7.2.2.1 Establish a Perimeter

The circumference of such perimeter should be calculated as part of a project specific ERP. Variables analyzed should include, wind direction, proximity to other buildings and sensitive areas (schools, etc), and the potential blast radius should a cascading thermal runaway result in accumulation and ignition of explosive gases.

7.2.2.2 Monitor

In the absence of a justified reason to enter the site (i.e. entrapment of personnel), it is advised that emergency first responders not take direct action to suppress the fire. A communication link should be established with the remote system operator to obtain data regarding system status if available. Battery/cell status, temperature, and voltage trends should be observed to quantify scope of event and conditions within the affected and adjacent SolBanks. IR cameras can also be used to evaluate hot spots and decreasing/increasing temperatures. Note, a battery fire may continue for 24 hours or longer and can re-ignite later due to a number of reasons.

If deemed appropriate and safe to do so by the incident commander, water can be applied to the SolBank and adjacent structures to prevent fire spread. Such processes should be clearly indicated in the ERP and incorporated into fire department and customer SOPs.

7.2.2.3 Direct Suppression

It is outside the scope of this manual to advise on means and methods for direct suppression of Li-ion fires. Again, e-STORAGE does not advise direct firefighting tactics. e-STORAGE does however offer the following general information for consideration should it be necessary to take a direct suppression approach:

- Foam and other chemical agents will not be effective. Foam suppressants may trap heat and increase rate of propagation.
- Ventilation of internal areas of the SolBank is essential to ensuring the absence of accumulated explosive gases. Firefighters are advised to not open access doors until it can be confirmed that combustible gas have been reduced to a safe value, the exhaust valve has been opened and the

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exhaust fans have reduced the concentration to below flammable limits. All stakeholders should agree to this action.

- Approaching the SolBank from the sides without access doors may minimize injury in the event of explosion.
- Testing on similar batteries has shown that under some conditions, fogging patterns from fire hoses may be effective at managing off-gas clouds from the batteries, especially in conditions where the offgas is lazy, hugging the ground, or not dispersing well on it's own.
- A large amount of water is used to cool the fire point. At the same time, a large amount of water is used to cool and isolate the surrounding of the fire point.

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8 Other System Precautions

8.1 Storage Precautions

Should the SolBank or Li-ion battery pack require storage for extended periods of time, the following is advised:

1. Storage temperature shall be between -20°C and 45°C. Elevated temperatures can result in increased capacity degradation and/or fire danger. Contact e-STORAGE if short duration storage is anticipated to exceed the above limits for reasons outside the installer/owner's control.
2. Batteries should be stored at a humidity <85% and protected from moisture, condensation, and flooding.
3. Batteries should be stored between 25%-60% SOC to prevent accelerated capacity degradation.
4. Battery system, and sub-assemblies should be stored in approved packaging.
5. Storage facility should be compliant with the appropriate local fire code requirements.
6. Acceptable storage density of battery packs and storage height of battery packs shall be defined by the local authority having jurisdiction (AHJ). Requirements and limits will be based upon a number of factors including the structural and fire protection characteristics of the storage area and recommendations for fire protection promulgated by the National Fire Protection Association (NFPA).

8.2 Installation, Operation, and Maintenance Precautions

Numerous safety hazards exist during the installation, operation, and maintenance of the SolBank. Please refer to the relevant manuals identified in Section 1.3 for further details.

8.3 Handling, Storage, and Transportation of Damaged Goods

If a battery pack has been damaged (battery enclosure has been dented or broken), it is possible that heating is occurring that may eventually lead to a fire. Damaged cells/batteries can result in the release of combustible vapors, and propagation of thermal runaway reactions to neighboring packs.

The damaged battery pack must be isolated with a space of 5 meters free of inflammable and explosive materials.Please contact e-STORAGE Service team.

A damaged battery pack should be monitored during storage for evidence of smoke, flame, leakage of electrolyte or signs of heat. If full-time monitoring of the damaged product is not possible (for example during extended storage), the damaged product should be moved to a safe storage location.

A safe storage location for a damaged battery pack will be free of combustible materials, accessible only by trained professionals. Do not store a damaged battery pack adjacent to undamaged products.

8.4 Disposal Procedures

Batteries at the end of their service life should be disposed of or recycled in accordance with local, state, and federal regulations. Note that regulations regarding disposal of batteries vary by jurisdiction. In the United States, batteries are classified as "Universal Waste", and in addition, many individual states have specific regulations regarding disposal of battery packs. For example, in California, all batteries must be taken to a Universal Waste handler or authorized recycling facility.

e-STORAGE Lithium-ion Batteries contain recyclable materials. e-STORAGE lithium-ion batteries do not contain heavy metals such as lead, cadmium, or mercury. e-STORAGE strongly encourages recycling. Please consult with local, state and/or federal authorities on the appropriate methods for

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disposal and recycling.

8.5 Transportation Information

Lithium-ion batteries are regulated as Class 9 Miscellaneous dangerous goods (also known as "hazardous materials") pursuant to the International Civil Aviation Organization (ICAO) Technical Instructions for the Safe Transport of Dangerous Goods by Air, International Air Transport Association (IATA) Dangerous Goods Regulations, the International Maritime Dangerous Goods (IMDG) Code, European Agreements concerning the International Carriage of Dangerous Goods by Rail (RID) and Road (ADR), and applicable national regulations such as the USA's hazardous materials regulations. These regulations contain very specific packaging, labeling, marking, and documentation requirements. The regulations also require that individuals involved in the preparation of dangerous goods for transport be trained on how to properly package, label, mark and prepare shipping documents.

Table 6: Transportation of SolBank

UN Number	3536
Proper Shipping Name	Lithium-ion Batteries
Hazard Classification	Class 9 Miscellaneous
Packing Group	N/A

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Attachment: Safety Data Sheets (SDSs)

Please refer to applicable Safety Data Sheets (SDSs) as part of the UN38.3 reports per specific product model used for each project or application.

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MCM Technology & Service

Technology & Service

Guangzhou MCM Certification & Testing Co.,Ltd

中国认可
国际互认
检验
INSPECTION
CNAS IB0551

Report No.:
报告编号：CCB20230810MSDS01

MATERIAL SAFETY DATA SHEET

材料安全数据表

Product 产品	Lithium-ion Cell 锂离子电芯
Type/Model 型号	LFP71173207/314Ah
Issue Date 签发日期	2023-09-13
Validity 有效期	2023-09-13 ～ 2023-12-31
Compiler 编写	Jinxing Hao
Reviewer 审核	Chen Huang
Approver 批准	Haojun Xu

广州邦禾检测技术有限公司

Guangzhou MCM Certification & Testing Co., Ltd.

Material Safety Data Sheet

材料安全数据表

SECTION 1 - CHEMICAL AND COMPANY IDENTIFICATION
第1节—化学品和公司标识

Product 产品	Lithium-ion Cell 锂离子电芯
Type/Model: 型号	LFP71173207/314Ah
Parameter 参数	3.2V, 314Ah, 1004.8Wh
Usage 用途	☐ Used in Portable Equipment 用于便携式设备 ☐ Used in Electric Vehicle 用于电动车辆 ☑ Used in Energy Storage System 用于储能系统 ☒ Others 其他
Company 公司	Xiamen Hithium Energy Storage Technology Co., Ltd. 厦门海辰储能科技股份有限公司
Address 地址	201-1, Comprehensive Building 5, No. 11, Butang Middle Road, Industrial Base Of Xiamen Torch High Tech Zone (Tongxiang), Xiamen, Fujian, P.R. China 中国福建厦门火炬高新区（同翔）产业基地布塘中路11号5#综合楼201-1
Fax 传真	/
Zip code 邮编	361100
E-mail 电子邮箱	Bob@hithium.cn
Emergency Telephone 紧急联系电话	0592-5513735
Manufacturer 制造单位	Xiamen Hithium Energy Storage Technology Co., Ltd. 厦门海辰储能科技股份有限公司
Address 制造单位地址	201-1, Comprehensive Building 5, No. 11, Butang Middle Road, Industrial Base Of Xiamen Torch High Tech Zone (Tongxiang), Xiamen, Fujian, P.R. China 中国福建厦门火炬高新区（同翔）产业基地布塘中路11号5#综合楼201-1
Factory 生产单位	Xiamen Hithium Energy Storage Technology Co., Ltd. 厦门海辰储能科技股份有限公司
Address 生产单位地址	Northwest of the intersection of Guoshan south 2nd Road and Tongxiang Avenue, 12-12 Hongtang north area, Tongxiang high tech industrial base, Tong'an District, Xiamen City, Fujian, P.R. China 中国福建省厦门市同安区同翔高新技术产业基地12-12洪塘北片区郭山南二路与同翔大道交叉口西北侧地

SECTION 2 - HAZARDS IDENTIFICATION
第2节—危害识别

Classification 分类：

This chemical is not considered hazardous by the Regulation (EC) No 1272/2008 (CLP). This product is an article which is a sealed battery and as such does not require an SDS per the Regulation (EC) No 1272/2008 (CLP) unless ruptured. The hazards indicated are for a ruptured battery.

该化学品不被法规(EC) No.1272/2008 (CLP)认为是危险的。本产品为密封电池，因此，除非破裂，不需要SDS (EC) No.1272/2008 (CLP)。以下提到的危险是电池破裂造成的。

Acute toxicity – Oral 急性毒性-口服	Category 4 第4类
Acute toxicity - Dermal 急性毒性-皮肤	Category 4 第4类

Skin corrosion/irritation 皮肤腐蚀/刺激	Category 1B 第1B类
Serious eye damage/eye irritation 严重眼睛损失/眼睛刺激	Category 2 第2类
Skin sensitization 皮肤致敏	Category 1 第1类
Carcinogenicity 致癌性	Category 1B 第1B类
Carcinogenicity 致癌性	Category 1A 第1A类
Carcinogenicity 致癌性	Category 2 第2类
Specific target organ toxicity (repeated exposure) 特异性靶器官毒性（重复暴露）	Category 1 第1类

Label elements 标签要素：

Hazard pictograms 危害象形图



This product is an article which contains a chemical substance. Safety information is given for exposure to the article as solid. Intended use of the product should not result in exposure to the chemical substance, This is a battery. In case of rupture: the above hazards exist.

这个产品是一种含有化学物质的物品。安全信息是为了固体物质的暴露而提供。这是一个电池，本产品的预期用途不应导致化学物质暴露。万一破裂，上述危害存在。

Signal Word 信号词:
Danger 危险

Hazard Statements 风险声明

H302	Harmful if swallowed. 吞食有害
H312	Harmful in contact with skin. 与皮肤接触有害
H314	Causes severe skin burns and eye damage 会造成严重的皮肤灼伤和眼睛损伤
H332	Harmful if inhaled. 吸入有害
H318	Causes serious eye damage. 对眼睛造成严重损害
H317	May cause an allergic skin reaction. 可能导致皮肤过敏反应
H350	May cause cancer. 可能致癌
H351	Suspected of causing cancer 涉嫌致癌
H371	May cause damage to organs. 可能对器官造成损害
H372	Causes damage to organs 对器官造成损害
H335	May cause respiratory irritation. 可能引起呼吸道刺激

Precautionary Statements – Prevention
预防说明—预防

P201	Obtain special instructions before use. 在使用前获得特殊说明
P202	Do not handle until all safety precautions have been read and understood. 阅读和理解安全注意事项后再操作
P281	Use personal protective equipment as required. 按要求使用个人防护装备
P264	Wash face, hands and any exposed skin thoroughly after handling. 处理后彻底清洗脸、手和任何暴露的皮肤
P272	Contaminated work clothing should not be allowed out of the workplace. 不应让受污染的工作服离开工作场
P210	Keep away from heat/sparks/open flames/hot surfaces –no smoking. 远离热源/火花/明火/热表面——禁止吸烟
P270	Do not eat, drink or smoke when using this product. 使用本品时请勿吃、喝、吸烟

Precautionary Statements – Response
预防声明—响应

P301+ P330+ P308	If exposed or connected: Get medical advice/attention. Specific treatment (see supplemental first aid/instruction on this label). 如果暴露或接触：求医/就医。特殊治疗 （见标签上的补充急救/说明） Skin: If on skin: wash with plenty of soap and water. Take off contaminated clothing and water before reuse, if skin irritation or rash occurs: get medical advice/attention if feel unwell. 皮肤：如不慎接触皮肤，请用大量清水和肥皂冲洗。如果出现皮肤刺激或皮疹，在重复使用前脱下受污染的衣服和水:如果感觉不适，请就医/成诊。 Eye: If in eyes: Rinse cautiously with water for several minutes, remove contact lenses, if present and easy to do. Continue rinsing. Call a POISON CENTER or doctor/physician if you feel unwell. 眼睛：如不慎入眼，请马上用清水冲洗几分钟，取下隐形眼镜，如果存在且容易做到，继续冲洗；如果你感觉不舒服，打电话给中毒中心或医生/医生 Inhalation: If inhalation: if breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing. If experiencing respiratory symptoms: Call a POISON CENTER or doctor/physician if you feel unwell. 吸入：如不慎吸入，并出现呼吸困难，请将患者转移到空旷位置，并保持舒适的姿势以呼吸新鲜空气；如果出现呼吸道症状，如果感觉不适，呼叫解毒中心或医生/内科医生。 Ingestion: If swallowed: rinse mouth, do not induce vomiting, Call a POISON CENTER or doctor/physician if you feel unwell. 食入：如不慎吞食，请马上冲洗口腔并不要引起呕吐。如果感觉不适，呼叫解毒中心或医生/内科医生。

Precautionary Statements – Storage
预防声明—存储

P405	Store locked up 加锁存储

Precautionary Statements – Disposal
预防声明—处置

P501	Dispose of contents/container to an approved waste disposal plant. 内容物/容器处理到经批准的废物处理工厂

Hazards not otherwise classified (HNOC) 未分类的危险
Not applicable 不适用

Other information 其他信息
Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
对水生生物有害，可能对水生环境造成长期不利影响。

Interactions with other chemicals 与其他化学物质的相互作用
Use of alcoholic beverages may enhance toxic effect.
使用酒精饮料可能会增强毒性作用

SECTION 3 - COMPOSITION/INFORMATION ON INGREDIENT
第3节—成分信息

Ingredient 成分	Molecular formula 分子式	CAS No. CAS 号	Weigh 含量
Graphite /石墨	$C_{24}X_{12}$	7782-42-5	10~25%
Lithium Iron Phosphate /磷酸铁锂	$LiFePO_4$	15365-14-7	35~50%
Lithium Hexafluorophosphate /六氟磷酸锂	$LiPF_6$	21324-40-3	0~5%
Acetylene Black /乙炔黑	C	1333-86-4	0~5%
4-Fluoro-1,3-Dioxolan-2-One /氟代碳酸乙烯酯	$C_3H_3FO_3$	114435-02-8	0~5%
Ethyl Methyl Carbonate /碳酸甲乙酯	$C_4H_8O_3$	623-53-0	0~20%
Ethylene Carbonate /碳酸乙烯酯	$C_3H_4O_3$	96-49-1	0~20%
Dimethyl Carbonate /碳酸二甲酯	$C_3H_6O_3$	616-38-6	0~20%

SECTION 4 - FIRST AID MEASURES
第4节—急救措施

Eye Exposure 眼睛接触:
In case of contact with eyes, flush with copious of water for at least 15 minutes. Assure adequate flushing by separating the eyelids with fingers. Call a physician.
如果与眼睛接触，用大量的水冲洗至少15分钟。用手指分开眼睑，确保充分的冲洗。寻求医生。

Skin Exposure 皮肤接触:
If the internal battery materials of an opened battery cell come into contact with skin, immediately flush with plenty of water or soap.
如果打开的电池的内部电池材料接触到皮肤，立即用大量的水或肥皂冲洗。

Inhalation Exposure 吸入:
In case of inhaling gas volatilized from inside of the battery, seek immediate medical attention.
如果吸入了电池内部挥发的气体，请立即就医。

Ingestion Exposure 吞咽:
If swallowed, seek medical attention. Do not induce vomiting unless directed to do so by medical personnel.
如果吞咽，请就医。除非医务人员指示，否则不要催吐。

SECTION 5 - FIRE FIGHTING MEASURES
第5节—消防措施

Danger characteristic 危险特性:
Exposure to excessive heat can cause venting of the liquid electrolyte.
暴露在过热的环境中会导致液体电解质的释放。
Battery may burst and release hazardous decomposition products when exposed to a fire situation.
当暴露在火灾环境中时，电池可能会爆裂并释放出危险的分解产物。

Hazardous combustion products 有害危险产物:
Corrosive and toxic gas may be emitted during fire.
着火期间可能会排放腐蚀性和有毒气体。

Fire-Fighting method 灭火措施:
The staff must equip with filtermask (full mask) or isolated breathing apparatus.
员工必须配备过滤器面罩或隔离式呼吸器。
The staff must wear the clothes which can defense the fire in the upwind direction.
工作人员必须穿能在逆风方向防火的衣服。
Remove the container to the open space as soon as possible.
尽快将容器移到空地上。
Spray water on the containers in the fireplace to keep them cool until finish extinguishment.
把水喷在壁炉里的容器上，使其降温，直到熄灭。

Fire-Fighting media 灭火介质:
Plenty of water, dry chemical powder or carbon dioxide.
大量的水，干粉或二氧化碳。

SECTION 6 - ACCIDENTAL RELEASE MEASURES
第6节—意外泄漏措施

Emergency treatment 紧急处理:
If the battery material is released, remove personnel from area until the batteries cool down and fumes dissipate.
如果电池材料被释放，请将人员从该区域撤离，直到电池冷却和烟雾消散。
Provide maximum ventilation to clear out hazardous gases and avoid skin and eye contact or inhalation of vapors.
提供最大的通风以清除有害气体和避免皮肤和眼睛接触或吸入蒸汽。
Remove spilled liquid with absorbent and incinerate waste.
用吸收剂除去溢出的液体并焚烧废物。

SECTION 7 - HANDLING AND STORAGE
第7节—处理和储存

Handling 处理:
1. Do not allow battery terminates to contact each other, or contact with other metals.
   不要让电池端子相互接触或与其他金属接触。
2. Do not put the cell or battery into a fire or heat it. Do not solder the cell directly. Do not use or leave the cell or battery in a place near fire or heaters.
   不要将电芯或电池放入火中或加热。不要直接焊接电池。不要将电芯或电池放在靠近火源或加热器等地方。
3. Do not expose the battery to excessive physical shock or vibration.
   不要让电池受到过度的物理冲击或振动。
4. Do not immerse, throw, and wet a battery in water.
   不要将电池浸入水中、投掷或弄湿。
5. Short-circuiting should be avoided. Short circuit will reduce the life of the battery and can lead to ignition of surrounding materials. Physical contact with to short- circuited battery can cause skin burn.
   应避免短路。短路会降低蓄电池的寿命，并可能导致周围材料着火。与短路电池的物理接触会导致皮肤灼伤。
6. The batteries should not be opened, destroyed or incinerate, since they may leak or rupture and release to

the environment the ingredients that they contain in the hermetically sealed container.
不应打开、销毁或焚烧电池，因为电池可能泄漏或破裂，并将密封容器中的成分释放到环境中。
7. Place the cell beyond the child packing and container.
   将电池放置在儿童触及不到的地方。
8. Do not connect the battery directly to an electric outlet or cigarette socket in a car.
   不要将电池直接连接到汽车的电源插座或香烟插座上。
9. Be sure to use the specified charger for battery, and follow the charging instructions correctly.
   请务必使用指定的蓄电池充电器，并正确遵循充电说明。
10. Do not mix old and new batteries together, neither with Ni-Cd, dry batteries or another manufacturer batteries or product.
    不要将新旧电池混合在一起使用，也不要与镍镉电池、干电池或其他制造商的电池或产品混合使用。

Storage 储存:
1. Batteries should be separated from other materials and stored in a noncombustible, well ventilated, sprinkler-protected structure with sufficient clearance between walls and battery stacks.
   电池应与其他材料分开，并存放在不燃、通风良好、有洒水装置保护的结构中，墙壁和电池堆之间应有足够的间隙。
2. Keep the sample in the cool, dry and well-ventilated place (temperature: -20~30 ºC, humidity: 45~85%). Do not exposure to direct sunlight for long periods. Keep away from fire and heating sources. Don't keep the samples with oxidizer and acid.
   将样品置于阴凉、干燥、通风良好的地方（温度-20~30℃，湿度：45~85%）。不要长时间暴露在阳光直射下。远离火源和热源。不要用氧化剂和酸保存样品。
3. Equip with relevant types and quantities of the extinguishment instruments. The storage place should be equipped with suitable shelter materials for divulgence handling.
   配备相应种类和数量的灭火器材。储存场所应配备适当的掩蔽材料，以便进行泄漏处理。
4. For rechargeable battery, charge the battery every 6 months to the amount specified by the manufacture, even if the battery is not used.
   对于可充电电池，即使不使用电池，也应每6个月将电池充电至制造商规定的电量。

SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION
第8节—暴露控制与个人防护措施

Engineering Control 工程控制:
Keep away from heat and open flame. Supply with sufficient partial air exhaust. Store in a cool, dry place.
远离热源和明火。提供足够的局部排气。存放在阴凉干燥的地方。

Respiratory Protection 呼吸保护:
Not necessary under conditions of normal use. Wear self-contained breathing filtermask if the density exceed in the air. Wear breathing apparatus under the condition of emergency rescue or evacuation.
在正常使用条件下不需要。如果环境内气体密度超过空气中的密度，请佩戴自给式呼吸过滤器。在紧急救援或疏散的情况下，佩戴呼吸器。

Eyes Protection 眼睛保护:
Not necessary under conditions of normal use. Wear protective glasses if handling a leaking or ruptured battery.
在正常使用条件下不需要。如果处理泄漏或破裂的电池，请戴上防护眼镜。

Skin and Body Protection 皮肤和身体保护:
Not necessary under conditions of normal use. Wear fireproofing, gas defense clothes in case of handling a leaking or ruptured battery.
在正常使用条件下不需要。在处理泄漏或破裂的电池时，穿上防火防毒服。

Hands Protection 手部保护:
Not necessary under conditions of normal use. Wear chemical resistant rubber glove.
在正常使用条件下不需要。耐磨耐化学腐蚀橡胶手套。

Other Protections 其他保护:
No smoking, dining and drinking water in the workplace. Keep good habit of hygiene.
工作场所禁止吸烟、就餐和饮水。保持良好的卫生习惯。

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES
第9节—理化性质

Appearance 外观:	Blue 蓝色
Physical state 状态:	Solid 固体
Form 形状:	Prismatic 棱柱形
Odor 气味:	Odorless 无味
Solubility 溶解度:	Insoluble in water 不溶于水

SECTION 10 - STABILITY AND REACTIVITY
第10节—稳定性与反应性

Stability 稳定性:
Stable under normal temperature and pressure.
常温常压下稳定。

Distribution of Ban 禁配物:
Explosives, inflammables, strong oxidants and corrosives.
爆炸品、易燃物、强氧化剂和腐蚀剂。

Conditions to Avoid 应避免的条件:
Fire source, heating source, disassemble, external short circuit, crushes, deformation, high temperature above 100°C, direct sunlight and high humidity, immerse in water or overcharge.
火源、热源、拆卸、外部短路、压碎、变形、100°C 以上高温、阳光直射、高湿度、浸水或过充。

Hazardous Polymerization 危险聚合:
Will not occur.
不会发生。

Hazardous Decomposition Products 有害分解产物:
Metal oxides, carboxyl compound such as CO, CO_2, etc.
金属氧化物，碳化合物例如一氧化碳、二氧化碳，等等。

SECTION 11 - TOXICOLOGICAL INFORMATION
第11节—毒理学信息

Acute Toxicity 急性毒性:
No information is available.
没有可用的信息。

Sub-acute and Chronic Toxicity 亚急性和慢性毒性:
No information is available.
没有可用的信息。

Irritation Data 刺激性数据:
The internal battery materials may cause irritation to eyes and skin.
电池内部材料可能会对眼睛和皮肤造成刺激。

Sensitization 致敏作用:
The liquid in the battery may cause sensitization to some person.
电池中的液体可能会对某些人造成敏化。

Mutagenicity 致突变性:
No information is available.
没有可用的信息。

Carcinogenicity 致癌性:
No information is available.
没有可用的信息。

Others 其他:
Since the materials in this battery are sealed in the can, the potential for exposure to the components of the battery is negligible, when the battery is used as directed. However technical or electrical abuse of the battery may result in the release of battery contents.
由于该电池中的材料密封在罐体中，当按照指示使用电池时，接触电池组件的可能性可以忽略不计。但是，电池的技术或电气滥用可能会导致蓄电池内容物的释放。

SECTION 12 - ECOLOGICAL INFORMATION
第12节—生态信息

Eco-toxicity 生态毒性:
No information is available.
没有可用的信息。

Biodegradable 生物降解性:
No information is available.
没有可用的信息。

Mobility in soil 土壤流动性:
No information is available.
没有可用的信息。

Bioconcentration or biological accumulation 生物浓缩或生物积累:
No information is available.
没有可用的信息。

Other harmful effects 其他有害影响:
Don't abandon the battery into environment, may cause water or soil pollution.
不要将电池扔进环境中，可能造成水或土壤污染。

SECTION 13 - DISPOSAL CONSIDERATIONS
第13节—处置注意事项

Appropriate Method of Substance 物质处理方法:
The battery should be completely discharged prior to disposal in order to prevent short circuit.
为了防止短路，在处理前应将蓄电池完全放电。
The battery contains recyclable materials, and it is suggested recycle.
电池含有可回收材料，建议回收利用。
Refer to National or Local regulations before handling.
操作前请参阅国家或地方法规。
Disposal of the battery should be performed by permitted, professional disposal firms knowledgeable in National or Local regulations of hazardous waste treatment and hazardous waste transportation.
电池的处理应由获得国家或地方法规的许可的具有危险废物处理和危险废物运输的专业处理公司进行。

SECTION 14 - TRANSPORT INFORMATION
第14节—运输信息

The battery has passed the test items of UN Manual of Test and Criteria Section 38.3, and Report No.: CCB20230810U01.
电池已通过联合国《试验和标准手册》第38.3节的测试项目，报告编号：CCB20230810U01。

General packaging requirement 一般包装要求:

1. The cells or batteries must be protected so as to prevent short circuits.
电芯或电池必须加以保护，以防止短路。
2. The cells or batteries or equipment must be packed in suitable strong outer packaging.
电芯或电池或设备必须包装在合适的坚固的外包装中。
3. If batteries contained in equipment, equipment must be secured against movement within the outer packaging and be packed so as to prevent accidental activation.
如果电池包含在设备中，设备必须在外包装内固定，防止移动，并进行包装，以防止意外激活。

No. 序号	**UN numbers & Proper Shipping Name**, if applicable 联合国编号及运输专用名，如适用		
(1)	**UN 3480, LITHIUM ION BATTERIES** **UN 3480，锂离子电池组**		
(2)	**UN 3481, LITHIUM ION BATTERIES PACKED WITH EQUIPMENT** **UN 3481，锂离子电池组同设备包装在一起**		
(3)	**UN 3481, LITHIUM ION BATTERIES CONTAINED IN EQUIPMENT** **UN 3481，锂离子电池安装在设备中**		
(4)	**UN 3171, BATTERY-POWERED VEHICLE** **UN 3171，电池驱动的车辆**		
(5)	**UN 3166, VEHICLE, FLAMMABLE LIQUID POWERED** **UN 3166，易燃液体驱动的车辆**		
No. 序号	**Hazard Class** 危险等级	**Packing Group** 包装组	**Packaging requirement** 包装要求
☒	**Air transportation, according to IATA-DGR 64th Edition (Effective 1 January-31 December 2023)** 空运，依据IATA-DGR第64版（2023年1月1日至12月31日生效）		
(1)	Class 9	II	PACKING INSTRUCTION 965, section IA 包装说明965 IA节
(2)~(5)	--	--	--
☒	**Maritime transportation, according to IMO IMDG Code (Amend 41-2022)** 海运，依据IMO IMDG Code (Amend 41-2022)		
(1)	Class 9	II	Package instruction P903 包装说明P903
(2)~(5)	--	--	--
☒	**Road transportation, according to ADR-2023** 公路运输，依据ADR-2023		
(1)	Class 9	II	Package instruction P903 包装说明P903
(2)~(5)	--	--	--
Remark 备注	In "Hazard Class", "Class 9" means "Class 9 dangerous goods", and "Not restricted" means that they are not restricted "危险等级"中"Class 9"表示"第九类危险货物"，"Not restricted"表示不受限制 In "Packing Group", "II" means "Packing Group II" and "NIL" means "No requirement" "包装组"中"II"表示"二级包装"，"NIL"表示"无要求"		

SECTION 15 - REGULATORY INFORMATION
第15节—监管信息

Dangerous Goods Regulation (DGR)
Recommendations on the Transport of Dangerous Goods Model Regulations
International Maritime Dangerous Goods (IMDG)
Occupational Safety and Health Act (OSHA)
Toxic Substances Control Act (TSCA)
Code of Federal Regulations (CFR)
Technical Instructions for the Safe Transport of Dangerous Goods
California Proposition 65
Superfund Amendments and Reauthorization Act Title III (302/311/312/313) (SARA)
Globally Harmonized System of Classification and Labeling of Chemicals(GHS)
In accordance with all Federal, State and local laws. 符合所有联邦、州和地方法律。

SECTION 16 - ADDITIONAL INFORMATION
第16节—附加信息

According standard 标准依据:
GB/T 16483-2008 Safety data sheet for chemical products Content and order of sections
ISO 11014:2009(E) Safety data sheet for chemical products – Content and order of sections

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2023-09-06

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Other Information 其他信息:
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Sample Reference Photo
样品照片

Model: LFP71173207/314Ah, 3.2V, 314Ah, 1004.8Wh



--End of the report/ 报告结束--

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product information

Trade name	:	Solstice® 513A
Number	:	000000022892
Recommended use of the chemical and restrictions on use	:	Refrigerant
Manufacturer or supplier's details	:	Honeywell International Inc. 115 Tabor Road Morris Plains, NJ 07950-2546 USA
For further information, please contact:	:	800-522-8001 +1-973-455-6300 (Monday-Friday, 9:00am-5:00pm) In China: 021-28942149
In case of emergency call	:	**Medical: 1-800-498-5701 or +1-303-389-1414**
	:	**Transportation (CHEMTREC): 1-800-424-9300 or +1-703-527-3887**
		In China: 4001-204937 or +86 532-83889090

2. HAZARDS IDENTIFICATION

Emergency Overview	:	Contains gas under pressure; may explode if heated. Harmful to aquatic life.

Classification of the substance or mixture

Classification of the substance or mixture	:	Gases under pressure, Liquefied gas Short-term (acute) aquatic hazard, Category 3

GHS Label elements, including precautionary statements

Symbol(s) :



Signal word : Warning

Hazard statements	:	Contains gas under pressure; may explode if heated. Harmful to aquatic life.
Precautionary statements	:	**Prevention:** Avoid release to the environment. **Storage:** Protect from sunlight. Store in a well-ventilated place. **Disposal:** Dispose of contents/ container to an approved waste disposal plant.
Other hazards which do not result in classification	:	May cause cardiac arrhythmia. May cause frostbite. May cause eye and skin irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical nature : Mixture

Chemical name	CAS-No.	Concentration
2,3,3,3-Tetrafluoroprop-1-ene 2,3,3,3-Tetrafluoroprop-1-ene	754-12-1	56.00 %
1,1,1,2-Tetrafluoroethane 1,1,1,2-Tetrafluoroethane	811-97-2	44.00 %

4. FIRST AID MEASURES

Inhalation	:	Move to fresh air. If breathing is irregular or stopped, administer artificial respiration. Use oxygen as required, provided a qualified operator is present. Call a physician. Do not give drugs from adrenaline-ephedrine group.
Skin contact	:	After contact with skin, wash immediately with plenty of water. If there is evidence of frostbite, bathe (do not rub) with lukewarm (not hot) water. If water is not available, cover with

		a clean, soft cloth or similar covering. If symptoms persist, call a physician.
Eye contact	:	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. In case of frostbite water should be lukewarm, not hot. If symptoms persist, call a physician.
Ingestion	:	Unlikely route of exposure. As this product is a gas, refer to the inhalation section. Do not induce vomiting without medical advice. Call a physician immediately.
Notes to physician	:	Because of the possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, should be used with special caution and only in situations of emergency life support. Treatment of overexposure should be directed at the control of symptoms and the clinical conditions. Treat frost-bitten areas as needed.

5. FIREFIGHTING MEASURES

Suitable extinguishing media	:	The product is not flammable. Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide. Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Specific hazards during firefighting	:	Contents under pressure. This product is not flammable at ambient temperatures and atmospheric pressure. However, this material can ignite when mixed with air under pressure and exposed to strong ignition sources. Container may rupture on heating. Cool closed containers exposed to fire with water spray. Do not allow run-off from fire fighting to enter drains or water courses. Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing. In case of fire hazardous decomposition products may be produced such as: Hydrogen halides Hydrogen fluoride Carbon monoxide Carbon dioxide (CO_2) Carbonyl halides

Special protective equipment for firefighters	:	In the event of fire and/or explosion do not breathe fumes. Wear self-contained breathing apparatus and protective suit. No unprotected exposed skin areas.
Further information	:	Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	:	Immediately evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Wear personal protective equipment. Unprotected persons must be kept away. Remove all sources of ignition. Avoid skin contact with leaking liquid (danger of frostbite). Ventilate the area. After release, disperses into the air. Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing. Avoid accumulation of vapours in low areas. Unprotected personnel should not return until air has been tested and determined safe. Ensure that the oxygen content is >= 19.5%.
Environmental precautions	:	Prevent further leakage or spillage if safe to do so. The product evaporates readily.
Methods and materials for containment and cleaning up	:	Ventilate the area.

7. HANDLING AND STORAGE

Handling

Precautions for safe handling	:	Handle with care. Avoid inhalation of vapour or mist. Do not get in eyes, on skin, or on clothing. Wear personal protective equipment. Use only in well-ventilated areas. Pressurized container. Protect from sunlight and do not expose to temperatures exceeding 50 °C. Follow all standard safety precautions for handling and use of compressed gas cylinders. Use authorized cylinders only.

Protect cylinders from physical damage.
Do not puncture or drop cylinders, expose them to open flame or excessive heat.
Do not pierce or burn, even after use. Do not spray on a naked flame or any incandescent material.
Do not remove screw cap until immediately ready for use.
Always replace cap after use.

Advice on protection against fire and explosion : The product is not flammable.
Can form a combustible mixture with air at pressures above atmospheric pressure.

Storage

Conditions for safe storage, including any incompatibilities : Pressurized container: protect from sunlight and do not expose to temperatures exceeding 50 °C. Do not pierce or burn, even after use.
Keep containers tightly closed in a dry, cool and well-ventilated place.
Storage rooms must be properly ventilated.
Ensure adequate ventilation, especially in confined areas.
Protect cylinders from physical damage.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Components	CAS-No.	Value	Control parameters	Update	Basis
2,3,3,3-Tetrafluoroprop-1-ene 2,3,3,3-Tetrafluoroprop-1-ene	754-12-1	TWA : Time weighted average	(500 ppm)	03 15 2010	Honeywell:Limit established by Honeywell International Inc.
		STEL : Short term exposure limit	(1,500 ppm)	03 15 2010	Honeywell:Limit established by Honeywell International Inc.

		TWA : Time weighted average	(500 ppm)	2009	WEEL:US. OARS. WEELs Workplace Environmental Exposure Level Guide, as amended
1,1,1,2-Tetrafluoroethane 1,1,1,2-Tetrafluoroethane	811-97-2	TWA : Time weighted average	(1,000 ppm)		Honeywell:Limit established by Honeywell International Inc.
		TWA : Time weighted average	4,240 mg/m3 (1,000 ppm)	2007	WEEL:US. OARS. WEELs Workplace Environmental Exposure Level Guide, as amended

Appropriate engineering controls

General room ventilation is adequate for storage and handling.
Perform filling operations only at stations with exhaust ventilation facilities.

Individual protection measures, such as personal protective equipment

Respiratory protection : In case of insufficient ventilation, wear suitable respiratory equipment.
Wear a positive-pressure supplied-air respirator.
Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.
For rescue and maintenance work in storage tanks use self-contained breathing apparatus.

Hand protection : Leather gloves
In case of contact through splashing:
Protective gloves
Neoprene gloves
Polyvinyl alcohol or nitrile- butyl-rubber gloves

Eye protection : Wear as appropriate:
Safety glasses with side-shields
If splashes are likely to occur, wear:
Goggles or face shield, giving complete protection to eyes

Skin and body protection : Avoid skin contact with leaking liquid (danger of frostbite).
Wear cold insulating gloves/ face shield/ eye protection.

Hygiene measures : Handle in accordance with good industrial hygiene and safety practice.
Ensure adequate ventilation, especially in confined areas.
Avoid contact with skin, eyes and clothing.
Remove and wash contaminated clothing before re-use.
Keep working clothes separately.

Protective measures : Do not breathe vapour.
Avoid contact with skin, eyes and clothing.
Ensure that eyewash stations and safety showers are close to the workstation location.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state : Liquefied gas

Colour : clear colourless

Odour : slight ether-like

Odour Threshold : Note: No data available

pH : Note: Not applicable

Melting point/range : Note: No data available

Boiling point/boiling range : -29.2 °C

Flash point : Note: Not applicable

Flammability : The product is not flammable.

Lower explosion limit : Note: None

Upper explosion limit : Note: None

Vapour pressure : 0.637 MPa
at 21.1 °C(70.0 °F)

Vapour density : 3.83
Note: (Air = 1.0)

Density : 1.15 g/cm3 at 21.1 °C

Water solubility : Note: No data available

Partition coefficient: n-octanol/water : Note: No data available

Ignition temperature : Note: No data available

Auto-ignition temperature : > 750 °C

Decomposition temperature : > 250 °C
Note: To avoid thermal decomposition, do not overheat.

Viscosity, dynamic : Note: No data available

Viscosity, kinematic : Note: No data available

10. STABILITY AND REACTIVITY

Chemical stability : Stable under normal conditions.

Possibility of hazardous reactions : Hazardous polymerisation does not occur.

Conditions to avoid : Pressurized container. Protect from sunlight and do not expose to temperatures exceeding 50 °C.
Decomposes under high temperature.
Some risk may be expected of corrosive and toxic decomposition products.
Can form a combustible mixture with air at pressures above atmospheric pressure.
Do not mix with oxygen or air above atmospheric pressure.

Incompatible materials to avoid	:	Potassium Calcium Powdered metals Finely divided aluminium Finely divided magnesium Zinc
Hazardous decomposition products	:	Halogenated compounds Hydrogen fluoride Carbonyl halides Carbon oxides

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure	:	Inhalation, Eye contact, Skin contact
Acute oral toxicity	:	Note: Not applicable study technically not feasible
Acute inhalation toxicity	:	LC50: > 500000 ppm Exposure time: 4 h Species: Rat Test substance: 1,1,1,2-tetrafluoroethane (HFC-134a)
Acute dermal toxicity	:	Note: No data available
Skin corrosion/irritation	:	Note: Not applicable study technically not feasible
Serious eye damage/eye irritation	:	Note: Not applicable study technically not feasible
Skin sensitisation 2,3,3,3-Tetrafluoroprop-1-ene	:	Note: Not applicable, as this product is a gas. study technically not feasible
Respiratory sensitisation 1,1,1,2-Tetrafluoroethane	:	Cardiac sensitization Species: dogs Note: No-observed-effect level 50 000 ppm Lowest observed effect level 75 000 ppm
Repeated dose toxicity 2,3,3,3-Tetrafluoroprop-1-ene	:	Species: Rat Application Route: Inhalation Exposure time: (2 Weeks) No-observed-effect level: 50000 ppm Method: OECD Test Guideline 412 Species: Rat Application Route: Inhalation Exposure time: (4 Weeks) NOAEL (No observed adverse effect level): 50000 ppm Method: OECD Test Guideline 412 Species: Rat Application Route: Inhalation Exposure time: (13 Weeks) NOAEL (No observed adverse effect level): 50000 ppm Method: OECD Test Guideline 413 Species: Rabbit, male Application Route: Inhalation Exposure time: (28 d) No-observed-effect level: 500 ppm Method: OECD Test Guideline 412 There are no observed toxicological effects, which result in classification as a specific target organ toxicant. Species: Rabbit, female Application Route: Inhalation Exposure time: (28 d) No-observed-effect level: 1000 ppm Method: OECD Test Guideline 412 There are no observed toxicological effects, which result in classification as a specific target organ toxicant. Species: Mini-pig Application Route: Inhalation Exposure time: (28 d) NOAEL (No observed adverse effect level): 10000 ppm highest exposure tested
1,1,1,2-Tetrafluoroethane	:	Species: Rat NOEL: 40000 ppm
Germ cell mutagenicity 2,3,3,3-Tetrafluoroprop-1-ene	:	Test Method: Ames test Result: positive negative
1,1,1,2-Tetrafluoroethane	:	Note: In vitro tests did not show mutagenic effects
	:	Test Method: Chromosome aberration test in vitro Cell type: Human lymphocytes Result: negative Method: OECD Test Guideline 473 Note: Dose 760,000 ppm
Germ cell mutagenicity 2,3,3,3-Tetrafluoroprop-1-ene	:	Test Method: Unscheduled DNA synthesis Dose: up to 50,000 ppm (4 weeks) Method: OECD Test Guideline 486 Result: negative
	:	Species: Rat Cell type: Micronucleus Dose: up to 50,000 ppm (4 weeks) Method: OECD Test Guideline 474 Result: negative
Carcinogenicity 2,3,3,3-Tetrafluoroprop-1-ene	:	Species: Rat Note: Not classified as a human carcinogen. Substance not expected to be a carcinogen based on available data.
Reproductive toxicity 2,3,3,3-Tetrafluoroprop-1-ene	:	Species: Rat Application Route: Inhalation exposure Exposure time: Two-generation reproductive toxicity NOAEL,parent: 50,000 ppm NOAEL,F1: 50,000 ppm NOAEL,F2: 50,000 ppm
Teratogenicity 2,3,3,3-Tetrafluoroprop-1-ene	:	Species: Rat Dose: NOAEL (No observed adverse effect level) - 50,000 ppm Species: Rabbit Dose: NOAEL (No observed adverse effect level) - 4,000 ppm
Specific target organ toxicity - single exposure	:	Note :No data available
Specific target organ toxicity - repeated exposure	:	Note :No data available
Aspiration toxicity	:	No data available
Further information	:	Note: Rapid evaporation of the liquid may cause frostbite. Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing. Handle in accordance with good industrial hygiene and safety practice.

12. ECOLOGICAL INFORMATION

Aquatic and ecotoxicity

Toxicity to fish	:	LC50: 10 - 100 mg/l Species: not specified Test substance: 2,3,3,3-Tetrafluoroprop-1-ene Method: The guidelines for the testing of chemicals 203: fish acute toxicity test
Toxicity to daphnia and other aquatic invertebrates 2,3,3,3-Tetrafluoroprop-1-ene	:	EC50: > 83 mg/l Exposure time: 48 h Species: Daphnia magna (Water flea) Method: OECD Test Guideline 202
Toxicity to algae 2,3,3,3-Tetrafluoroprop-1-ene	:	EC50: > 100 mg/l Species: Scenedesmus capricornutum (fresh water algae) Method: OECD Test Guideline 201

Persistence and degradability

Biodegradability 2,3,3,3-Tetrafluoroprop-1-ene	:	Result: Not readily biodegradable. Method: OECD Test Guideline 301F

Bioaccumulative potential

Bioaccumulation 2,3,3,3-Tetrafluoroprop-1-ene	:	Note: Due to the distribution coefficient n-octanol/water, accumulation in organisms is not expected.

Mobility in soil

Mobility	:	Note: No data available

Other adverse effects

Additional ecological information	:	Accumulation in aquatic organisms is unlikely.

Ecotoxicology Assessment

Results of PBT assessment
This substance is not considered to be persistent, bioaccumulating and toxic (PBT)., This substance is not considered to be very persistent and very bioaccumulating (vPvB).

13. DISPOSAL CONSIDERATIONS

CN HW China. National Catalogue of Hazardous Wastes	:	Hazardous waste
Disposal methods	:	In accordance with local and national regulations.

14. TRANSPORT INFORMATION

CNDG

UN/ID No.	:	UN 3163
Description of the goods	:	LIQUEFIED GAS, N.O.S. (R-1234yf, 1,1,1,2-TETRAFLUOROETHANE)
Class	:	2.2
Labels	:	2.2

IATA

UN/ID No.	:	UN 3163
Description of the goods	:	Liquefied gas, n.o.s. (R-1234yf, 1,1,1,2-Tetrafluoroethane)
Class	:	2.2
Labels	:	2.2
Packing instruction (cargo aircraft)	:	200
Packing instruction (passenger aircraft)	:	200

IMDG

UN/ID No.	:	UN 3163
Description of the goods	:	LIQUEFIED GAS, N.O.S. (R-1234yf, 1,1,1,2-TETRAFLUOROETHANE)
Class	:	2.2
Labels	:	2.2
EmS Number 1	:	F-C
EmS Number 2	:	S-V
Marine pollutant	:	no

15. REGULATORY INFORMATION

National regulatory information

: Refer to the following regulations: Dangerous Chemicals Management Ordinance, the State Council Order No. 591; GB16483-2008 MSDS content and order of items; GB-T 17519-2013 Material Safety Data Sheet written rules; GB12268-2012 Name List of dangerous goods; GB6944-2012 and the name of dangerous goods classification number; GB13690-2009 chemical formula for risk classification and General; GBZ 2.1-2019 workplace hazards Part 1 occupational exposure limit chemical hazards; GB30000.2~29-2013 classification of chemicals, warning labels and warning statements of safety norms

Other international regulations

Notification status

US. Toxic Substances Control Act	:	On TSCA Inventory
Australia. Inventory of Industrial Chemicals (AIIC), as amended	:	On the inventory, or in compliance with the inventory
Canada. Canadian Environmental Protection Act (CEPA). Domestic Substances List (DSL)	:	All components of this product are on the Canadian DSL
Japan. Kashin-Hou Law List	:	On the inventory, or in compliance with the inventory
Korea. Existing Chemicals Inventory (KECI)	:	On the inventory, or in compliance with the inventory
Philippines. Inventory of Chemicals and Chemical Substances (PICCS)	:	Not in compliance with the inventory
China. Inventory of Existing Chemical Substances (IECSC)	:	On the inventory, or in compliance with the inventory, or has been registered as new substance
New Zealand. Inventory of Chemicals (NZIoC), as published by ERMA New Zealand	:	Not in compliance with the inventory
Taiwan Chemical Substance Inventory (TCSI)	:	On the inventory, or in compliance with the inventory

16. OTHER INFORMATION

		HMIS III	NFPA
Health hazard	:	1	2
Flammability	:	1	1
Physical Hazard	:	0	
Instability	:		0

Hazard rating and rating systems (e.g. HMIS® III, NFPA): This information is intended solely for the use of individuals trained in the particular system.

Further information

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text. Final determination of suitability of any material is the sole responsibility of the user. This information should not constitute a guarantee for any specific product properties.

Changes since the last version are highlighted in the margin. This version replaces all previous versions.
Previous Issue Date: 01/02/2020
Revision Date: 09/16/2022
Version 1.1
Issuing date 01/02/2020
Prepared by Honeywell Performance Materials and Technologies Product Stewardship Group

Version	Revision Date:	SDS Number:	Date of last issue: 2021-04-20
1.1	2022-8-16	SY-TD-MSDS-035	Date of first issue: 2021-04-20

1. PRODUCT AND COMPANY IDENTIFICATION

Product name : SY1 ANTIFREEZE COOLANT

Product model : -40℃RED

Product code : SY1-R3-40

Manufacturer or supplier's details

Company : Shanghai Yinbang New Materials Co., Ltd

Address : No. 4 Dongdi Science Park, No. 3666 Sichen Road, Songjiang District, Shanghai

Telephone : 13918338120

Emergency telephone number : 13918338120

E-mail : 504720811@qq.com

Recommended use of the chemical and restrictions on use

Recommended use : Antifreeze、Coolant

2. HAZARDS IDENTIFICATION

Emergency Overview

Appearance : liquid
Colour : red
Odour : alcohol-like
Harmful if swallowed. May cause damage to organs through prolonged or repeated exposure.

GHS Classification

Acute toxicity (Oral) : Category 4

Specific target organ toxicity - repeated exposure : Category 2

GHS label elements

Hazard pictograms :



Signal word : Warning

Hazard statements : H302 Harmful if swallowed.
H373 May cause damage to organs through prolonged or re_x0002_peated

Precautionary statements : **Prevention:**
P260 Do not breathe mist or vapours.
P264 Wash skin thoroughly after handling.
P270 Do not eat, drink or smoke when using this product.
Response:
P301 + P312 + P330 IF SWALLOWED: Call a POISON CENTER/ doctor if you feel unwell. Rinse mouth.
P314 Get medical advice/ attention if you feel unwell.
Disposal:
P501 Dispose of contents/ container to an approved waste disposal plant.

Physical and chemical hazards

Not classified based on available information.

Health hazards

Harmful if swallowed. May cause damage to organs through prolonged or repeated exposure.

Environmental hazards

SAFETY DATA SHEET
according to GB/T 16483 and GB/T 17519
SY1 ANTIFREEZE COOLANT（-40℃RED）

Not classified based on available information.

Other hazards which do not result in classification

None known.

3.COMPOSITION/INFORMATION ON INGREDIENTS

Substance / Mixture : Mixture

Components

Chemical name	CAS-No.	Concentration (% w/w)
Ethylene glycol	107-21-1	50-60%
Water	7732-18-5	35-37%
Additive	N/A	3-5%

4.FIRST AID MEASURES

General advice : In the case of accident or if you feel unwell, seek medical advice immediately.
When symptoms persist or in all cases of doubt seek medical advice.

If inhaled : If inhaled, remove to fresh air.
Get medical attention if symptoms occur.

In case of skin contact : Wash with water and soap as a precaution.
Get medical attention if symptoms occur.

In case of eye contact : Flush eyes with water as a precaution.
Get medical attention if irritation develops and persists.

If swallowed : If swallowed, DO NOT induce vomiting unless directed to do so by medical personnel.
Get medical attention.
Rinse mouth thoroughly with water.
Never give anything by mouth to an unconscious person.

Most important symptoms and effects, both acute and delayed : Harmful if swallowed.
May cause damage to organs through prolonged or repeated exposure.

Protection of first-aiders : First Aid responders should pay attention to self-protection, and use the recommended personal protective equipment when the potential for exposure exists (see section 8).

Notes to physician : Treat symptomatically and supportively.

5. FIREFIGHTING MEASURES

Suitable extinguishing media : Water spray
Alcohol-resistant foam
Carbon dioxide (CO2)
Dry chemical

Unsuitable extinguishing media : None known.

Specific hazards during firefighting : Exposure to combustion products may be a hazard to health.

Hazardous combustion products : Carbon oxides

Specific extinguishing methods : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Use water spray to cool unopened containers.
Remove undamaged containers from fire area if it is safe to do so.
Evacuate area.

Special protective equipment for firefighters : In the event of fire, wear self-contained breathing apparatus.
Use personal protective equipment.

SAFETY DATA SHEET
according to GB/T 16483 and GB/T 17519
SY1 ANTIFREEZE COOLANT（-40℃RED）

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures : Use personal protective equipment.
Follow safe handling advice (see section 7) and personal protective equipment recommendations (see section 8).

Environmental precautions : Avoid release to the environment.
Prevent further leakage or spillage if safe to do so.
Prevent spreading over a wide area (e.g. by containment or oil barriers).
Retain and dispose of contaminated wash water.
Local authorities should be advised if significant spillages cannot be contained.

Methods and materials for containment and cleaning up : Soak up with inert absorbent material.
For large spills, provide dyking or other appropriate containment to keep material from spreading. If dyked material can
be pumped, store recovered material in appropriate container.
Clean up remaining materials from spill with suitable absorbent.
Local or national regulations may apply to releases and disposal of this material, as well as those materials and items
employed in the cleanup of releases. You will need to determine which regulations are applicable.
Sections 13 and 15 of this SDS provide information regarding

7. HANDLING AND STORAGE

Handling

Technical measures : See Engineering measures under EXPOSURE CONTROLS/PERSONAL PROTECTION section.

Local/Total ventilation : Use only with adequate ventilation.

Advice on safe handling : Do not breathe mist or vapours.
Do not swallow.
Avoid contact with eyes.
Avoid prolonged or repeated contact with skin.
Wash skin thoroughly after handling.
Handle in accordance with good industrial hygiene and safety practice, based on the results of the workplace exposure assessment
Do not eat, drink or smoke when using this product.
Take care to prevent spills, waste and minimize release to the environment.

Avoidance of contact : Oxidizing agents

Storage

Conditions for safe storage : Keep in properly labelled containers.
Store in accordance with the particular national regulations.

Materials to avoid : Do not store with the following product types:
Strong oxidizing agents

Packaging material : Unsuitable material: None known.

8.EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Components	CAS-No.	Value type (Form of exposure)	Control parameters / Permissible concentration	Basis
Ethylene glycol	107-21-1	PC-TWA	20 mg/m³	CN OEL
		PC-STEL	40 mg/m³	CN OEL
		TWA (Vapour)	25 ppm	ACGIH
		STEL (Vapour)	50 ppm	ACGIH
		STEL (Inhalable fraction, Aerosol only)	10 mg/m³	ACGIH

SAFETY DATA SHEET
according to GB/T 16483 and GB/T 17519
SY1 ANTIFREEZE COOLANT（-40℃RED）

Engineering measures : Ensure adequate ventilation, especially in confined areas.
Minimize workplace exposure concentrations.

Personal protective equipment

Respiratory protection : If adequate local exhaust ventilation is not available or exposure assessment demonstrates exposures outside the recommended guidelines, use respiratory protection.

Filter type : Organic vapour type

Eye/face protection : Wear the following personal protective equipment:
Safety glasses
Always wear eye protection when the potential for inadvertent eye contact with the product cannot be excluded.
Please follow all applicable local/national requirements when selecting protective measures for a specific workplace.

Skin and body protection : Skin should be washed after contact.

Hand protection
Material : butyl-rubber
Glove thickness : 0.5 mm

Remarks : Wash hands before breaks and at the end of workday.
Choose gloves to protect hands against chemicals depending on the concentration and quantity of the hazardous sub_x0002_stance and specific to place of work. For special applications, we recommend clarifying the resistance to chemicals of the aforementioned protective gloves with the glove manufacturer. Wash hands before breaks and at the end of workday.
Breakthrough time is not determined for the product. Change gloves often!

Hygiene measures : If exposure to chemical is likely during typical use, provide eye flushing systems and safety showers close to the working place.
When using do not eat, drink or smoke.
Wash contaminated clothing before re-use.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance : liquid

Colour : red

Odour : alcohol-like
Odour Threshold : No data available

pH : 8.3 - 8.8 (20℃)

Melting point/freezing point : ≤-40℃

Initial boiling point and boiling range : ≥108.0℃

Flash point : No flash point was obtained, but the product may release flammable vapour.

Evaporation rate : No data available

Flammability (solid, gas) : Not applicable

Flammability (liquids) : No data available

Upper explosion limit / Upper flammability limit : 15.3 %(V)

Lower explosion limit / Lower flammability limit	:	3.2 %(V)
Vapour pressure	:	No data available
Relative vapour density	:	2.14
Relative density	:	1.070 - 1.080 (20℃)
Density	:	1.070 - 1.080 g/cm³ (20℃)(as liquid)
Solubility(ies)		
Water solubility	:	soluble in cold water(20℃)
Partition coefficient: noctanol/water	:	Not applicable
Auto-ignition temperature	:	No data available
Decomposition temperature	:	No data available
Viscosity		
Viscosity, kinematic	:	No data available
Explosive properties	:	Not explosive
Oxidizing properties	:	The substance or mixture is not classified as oxidizing.
Particle size	:	Not applicable

10.STABILITY AND REACTIVITY

Reactivity	:	Not classified as a reactivity hazard.
Chemical stability	:	Stable under normal conditions.
Possibility of hazardous reactions	:	Can react with strong oxidizing agents.
Conditions to avoid	:	None known.
Incompatible materials	:	Oxidizing agents
Hazardous decomposition products	:	No hazardous decomposition products are known.

11.TOXICOLOGICAL INFORMATION

Exposure routes : Inhalation
Skin contact
Ingestion
Eye contact

Acute toxicity
Harmful if swallowed.
Product:

Acute oral toxicity : Acute toxicity estimate: 1,191 mg/kg
Method: Calculation method

Components:
Ethylene glycol:
Acute oral toxicity : Acute toxicity estimate: 500 mg/kg
Method: Expert judgement

Acute inhalation toxicity : LC50 (Rat): > 2.5 mg/l
Exposure time: 6 h
Test atmosphere: dust/mist

Acute dermal toxicity : LD50 (Mouse): > 3,500 mg/kg

Skin corrosion/irritation
Not classified based on available information.
Components:
Ethylene glycol:
Species : Rabbit
Result : No skin irritation

Serious eye damage/eye irritation
Not classified based on available information.
Components:
Ethylene glycol:
Species : Rabbit
Result : 无皮肤刺激

Respiratory or skin sensitisation

Skin sensitisation
Not classified based on available information.
Respiratory sensitisation
Not classified based on available information.
Components:
Ethylene glycol:
Test Type : Maximisation Test
Exposure routes : Skin contact
Species : Guinea pig
Result : negative

Germ cell mutagenicity
Not classified based on available information.
Components:

Ethylene glycol:
Genotoxicity in vitro : Test Type: Bacterial reverse mutation assay (AMES)
: Method: OECD Test Guideline 471
: Result: negative

Carcinogenicity
Not classified based on available information.

Components:

Ethylene glycol:
Species : Mouse
Application Route : Ingestion
Exposure time : 2 Years
Result : negative

Reproductive toxicity
Not classified based on available information.
STOT - single exposure
Not classified based on available information.
STOT - repeated exposure
May cause damage to organs through prolonged or repeated exposure.
Components:

Ethylene glycol:
Exposure routes : Ingestion
Target Organs : Kidney
Assessment : Shown to produce significant health effects in animals at concentrations of >10 to 100 mg/kg bw.

Repeated dose toxicity

Components:

Ethylene glycol:
Species : RatRat
NOAEL : 150 mg/kg
Application Route : Ingestion
Exposure time : 2 years

Species : Dog
NOAEL : 2,200 - 4,400 mg/kg
Application Route : Skin contact
Exposure time : 4 Weeks
Method : OECD Test Guideline 410

Aspiration toxicity
Not classified based on available information.

12. ECOLOGICAL INFORMATION

Ecotoxicity

Components:

Ethylene glycol:
Toxicity to fish : LC50 (Pimephales promelas (fathead minnow)): 72,860 mg/l
Exposure time: 96 h

Toxicity to daphnia and other : EC50 (Daphnia magna (Water flea)): > 100 mg/l

aquatic invertebrates
Exposure time: 48 h
Method: OECD Test Guideline 202

Toxicity to algae/aquatic plants : EC50 (Pseudokirchneriella subcapitata (green algae)): 6,500 -13,000 mg/l
Exposure time: 96 h

Toxicity to fish (Chronic toxicity) : NOEC (Pimephales promelas (fathead minnow)): 15,380 mg/l
Exposure time: 7 d

Toxicity to daphnia and other aquatic invertebrates (Chron_x0002_ic toxicity) : NOEC (Ceriodaphnia dubia (water flea)): 8,590 mg/l
Exposure time: 7 d

Persistence and degradability

Components:

Ethylene glycol:
Biodegradability : Result: Readily biodegradable.
Biodegradation: 90 - 100 %
Exposure time: 10 d
Method: OECD Test Guideline 301A

Bioaccumulative potential

Components:

Ethylene glycol:
Bioaccumulation : Species: Leuciscus idus (Golden orfe)
Bioconcentration factor (BCF): 10

Partition coefficient: noctanol/water : log Pow: -1.93

Mobility in soil
No data available

Other adverse effects
No data available

13.DISPOSAL CONSIDERATIONS

Disposal methods
Waste from residues : Dispose of in accordance with local regulations.

Contaminated packaging : Empty containers should be taken to an approved waste handling site for recycling or disposal.
If not otherwise specified: Dispose of as unused product.

14.TRANSPORT INFORMATION
International Regulations
UNRTDG
UN number : Not applicable

Proper shipping name	:	Not applicable
Class	:	Not applicable
Subsidiary risk	:	Not applicable
Packing group	:	Not applicable
Labels	:	Not applicable

IATA-DGR

UN/ID No.	:	Not applicable
Proper shipping name	:	Not applicable
Class	:	Not applicable
Subsidiary risk	:	Not applicable
Packing group	:	Not applicable
Labels	:	Not applicable
Packing instruction (cargo aircraft)	:	Not applicable
Packing instruction (passenger aircraft)	:	Not applicable

IMDG-Code

UN number	:	Not applicable
Proper shipping name	:	Not applicable
Class	:	Not applicable
Subsidiary risk	:	Not applicable
Packing group	:	Not applicable
Labels	:	Not applicable
EmS Code	:	Not applicable
Marine pollutant	:	Not applicable

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable for product as supplied.

National Regulations

GB 6944/12268

UN number	:	Not applicable
Proper shipping name	:	Not applicable
Class	:	Not applicable
Subsidiary risk	:	Not applicable
Packing group	:	Not applicable
Labels	:	Not applicable

Special precautions for user

Not applicable

15.REGULATORY INFORMATION

National regulatory information
Law on the Prevention and Control of Occupational Diseases

16.OTHER INFORMATION

Further information

Sources of key data used to compile the Safety Data Sheet	:	Internal technical data, data from raw material SDSs, OECD eChem Portal search results and European Chemicals Agen_x0002_cy, http://echa.europa.eu/
Date format	:	yyyy-mm-dd

Full text of other abbreviations

ACGIH	:	USA. ACGIH Threshold Limit Values (TLV)
CN OEL	:	Occupational exposure limits for hazardous agents in the workplace - Chemical hazardous agents.
ACGIH / TWA	:	8-hour, time-weighted average
ACGIH / STEL	:	Short-term exposure limit
CN OEL / PC-TWA	:	Permissible concentration - time weighted average
CN OEL / PC-STEL	:	Permissible concentration - short term exposure limit

AIIC - Australian Inventory of Industrial Chemicals; ANTT - National Agency for Transport by Land of Brazil; ASTM - American Society for the Testing of Materials; bw - Body weight; CMR -Carcinogen, Mutagen or Reproductive Toxicant; DIN - Standard of the German Institute for Standardisation; DSL - Domestic Substances List (Canada); ECx - Concentration associated with x% response;ELx - Loading rate associated with x% response; EmS - Emergency Schedule; ENCS - Existing and New Chemical Substances (Japan); ErCx - Concentration associated with x% growth rate response; ERG - Emergency Response Guide; GHS - Globally Harmonized Sys_x0002_tem; GLP -Good Laboratory Practice; IARC - International Agency for Research on Cancer; IATA - International Air Transport Association; IBC - International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk; IC50 - Half maximal inhibitory con centration; ICAO - International Civil Aviation Organization; IECSC - Inventory of Existing Chemi cal Substances in China; IMDG - International Maritime Dangerous Goods; IMO - International Maritime Organization; ISHL - Industrial Safety and Health Law (Japan); ISO - International Or ganisation for Standardization; KECI - Korea Existing Chemicals Inventory; LC50 -Lethal Con centration to 50 % of a test population; LD50 - Lethal Dose to 50% of a test population (Median Lethal Dose); MARPOL - International Convention for the Prevention of Pollution from Ships; n.o.s. - Not Otherwise Specified; Nch - Chilean Norm; NO(A)EC - No Observed (Adverse) Effect Concentration; NO(A)EL - No Observed (Adverse) Effect Level; NOELR - No Observable Effect Loading Rate; NOM - Official Mexican Norm; NTP - National Toxicology Program; NZIoC - New Zealand Inventory of Chemicals; OECD - Organization for Economic Co-operation and Development; OPPTS - Office of Chemical Safety and Pollution Prevention; PBT -Persistent, Bioaccumu lative and Toxic substance; PICCS - Philippines Inventory of Chemicals and Chemical Substanc es; (Q)SAR - (Quantitative) Structure Activity Relationship; REACH - Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning the Registration, Evalua tion, Authorisation and Restriction of Chemicals; SADT - Self-Accelerating Decomposition Tem perature; SDS - Safety Data Sheet; TCSI - Taiwan Chemical Substance Inventory; TDG - Trans portation of Dangerous Goods; TECI - Thailand Existing Chemicals Inventory; TSCA - Toxic Sub stances Control Act (United States); UN - United Nations; UNRTDG - United Nations Recom mendations on the Transport of Dangerous Goods; vPvB - Very Persistent and Very Bioaccumu lative; WHMIS -Workplace Hazardous Materials Information System

Disclaimer

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CN / EN

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PARADEA

HIGH EFFICIENCY BI-FACIAL GLASS-GLASS PV MODULES

525-550W

MAXIMUM EFFICIENCY %	POSITIVE POWER TOLERANCE WP	CELLS	MODULE TECHNOLOGY
21.33	0~+4.99	M10 144	**HALF CUT & MICRO GAP DESIGN** WITH IMPROVED SHADE TOLERANCE



- **RELIABILITY IS IMPROVED** with minimum exposure to corrosion from sand & salt mist with low risk of module warping & micro cracking
- Bifacial gain of **UP TO 25%** with dual glass module, capable of energy generation with both direct and reflected sunlight
- Additional Power yield with **30 YEARS OF PERFORMANCE LIFE** with 0.5% annual power degradation
- **LCOE IS CUT BACK** with **LESS BOS COST** which improves value proposition of the product with competitive **ROI**
- **TWO PEAK PERFORMANCE TIME**, during sun rise and sun set with optimum utilization of dual facial generation
- Hassle-free installation with ability to **INSTALL VERTICALLY IN EAST WEST DIRECTION**, with improved soiling resistant
- Implementation of bypass diodes in split JB series-parallel connections enable the module to perform in **PARTIAL SHADOW CONDITIONS** with respect to full-cell module
- **LOWER INTERNAL RESISTANCE** boosts module power helping to achieve minimal power loss with respect to previous variant modules

FRAME	SUPERSTRATE	SUBSTRATE
SILVER	GLASS	GLASS

DCR CONTENT MODULE AVAILABLE

APPLICATIONS

- On-grid large scale utility systems
- On-grid rooftop industrial and commercial systems
- Rooftop residential systems

Monocrystalline Solar PV Modules, Bifacial, MBB, M10 Half-Cell, PARADEA VSMDH.72.AAA.05

vikramsolar
CREATING CLIMATE FOR CHANGE

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TECHNICAL DATA

PARADEA 525-550W

THIS DATASHEET IS APPLICABLE FOR: **PARADEA VSMDH.72.AAA.05 (AAA=525-550)**

Electrical Data[1,2]

All data refers to STC (AM 1.5, 1000 W/m², 25°C)

Peak Power P_{max} (Wp)	525	530	535	540	545	550
Maximum Voltage V_{mpp} (V)	41.4	41.5	41.6	41.7	41.8	41.9
Maximum Current I_{mpp} (A)	12.69	12.78	12.87	12.95	13.04	13.13
Open Circuit Voltage V_{oc} (V)	49.2	49.3	49.4	49.5	49.6	49.7
Short Circuit Current I_{sc} (A)	13.4	13.48	13.56	13.64	13.73	13.82
Module Efficiency (%)	20.37	20.56	20.76	20.95	21.14	21.33

1) STC:1000 W/m² irradiance, 25°C cell temperature, AM1.5g spectrum according to EN 60904-3. | 2) Power measurement uncertainty is within +/- 2%.

Electrical Parameters at NOCT[3]

Power (W)	391.4	393	397	399	402	407
V@P_{max} (V)	38.2	38.3	38.4	38.5	38.6	38.7
I@P_{max} (A)	10.25	10.29	10.34	10.37	10.43	10.52
V_{oc} (V)	45.8	45.9	46	46.1	46.2	46.3
I_{sc} (A)	10.83	10.89	10.96	11.03	11.09	11.15

3) NOCT irradiance 800 W/m², ambient temperature 20°C, wind speed 1 m/sec

Equivalent Bifacial Output

Bifacial Gain	Overall Power output (W)					
5%	551	557	562	567	572	578
10%	578	583	589	594	600	605
15%	604	610	615	621	627	633
20%	630	636	642	648	654	660
25%	656	663	669	675	681	688

Temperature Coefficients (Tc) permissible operating conditions

Tc of Open Circuit Voltage (β)	-0.27%/°C
Tc of Short Circuit Current (α)	0.050%/°C
Tc of Power (γ)	-0.35%/°C
Maximum System Voltage	1500V
NOCT	45°C ± 2°C
Temperature Range	-40°C to + 85°C

Mechanical Data

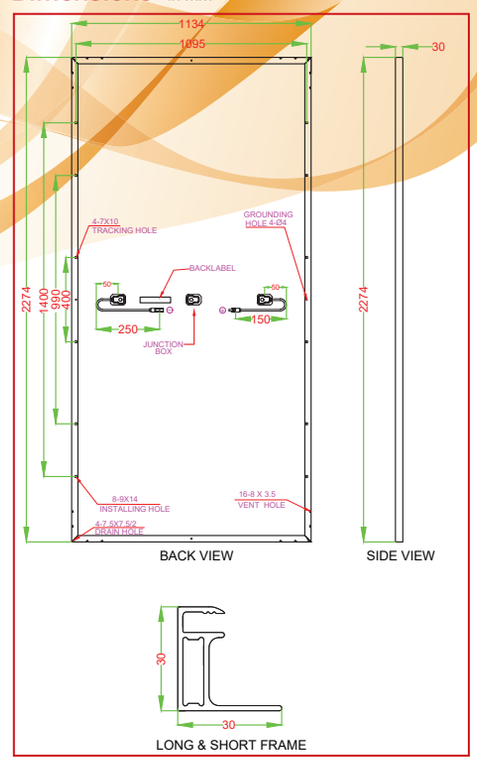
Length × Width × Height	2274 × 1134 × 30mm (89.52 × 44.65 × 1.18 inches)
Weight	33 Kg (72.75 lbs)
Junction Box	IP68, Split Junction Box with individual bypass diodes
Cable & Connectors#	200 mm (+ve terminal) and 300 mm (-ve terminal) length cables,MC4 Compatible
Application Class	Class A (Safety class II)
Superstrate##	2.0 mm (0.098 inches) high transmission low iron content, semi-tempered glass, AR coated
Cells	72 Mono PERC (144 half-cells) P-Type Bifacial solar cells
Substrate	2.0 mm (0.098 inches) high transmission low iron content, heat strengthened glass
Frame	Anodized aluminium frame with twin wall profile
Mechanical Load Test	5400 Pa (Snow load), 2400 Pa (Wind load)
Cell Encapsulant	Polyolefin (POE)/ EPE
Maximum Series Fuse Rating	25 A

Power measurement uncertainty is within ±2mm.

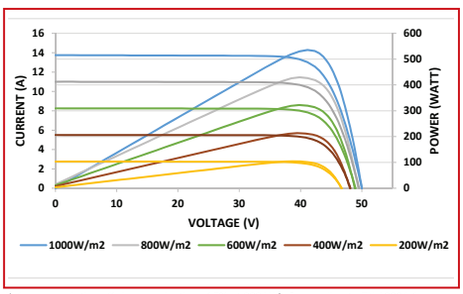
Warranty and Certifications

Product Warranty**	12 years
Performance Warranty**	Linear Power Warranty for 30 years with 2% for 1st year degradation and 0.5% from year 2 to year 30
Approvals and Certificates^	IEC 61215 : 2016, IEC 61730 : 2016, IEC 61701, IEC 62716, IEC 60068-2-68, IS/IEC 61730, IS 14286, IEC 62804, CE, CEC (California), UL 61215, UL 61730, CAN-CSA

Dimensions in mm

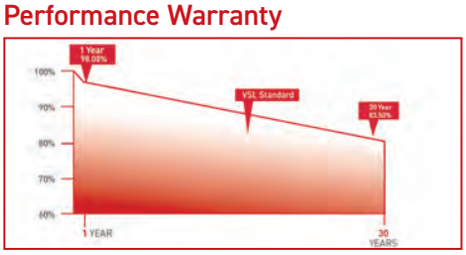


Typical I-V Curves[4]



4) Average relative efficiency reduction of 5% at 200 W/m² according to EN 60904-1.

Performance Warranty



Packaging Information

Quantity /Pallet	36
Pallets/Container (40'HC)	20
Quantity/Container (40'HC)	720

^ All (^) certifications under progress. | ** Refer to Vikram Solar's warranty document for terms and conditions. | * 400mm(15.75 inches), 1000mm(39.37 inches),1200mm (47.24 inches) cable lengths are also available | ## Anti-glare Glass is also available | *As per applicable product

CAUTION: READ SAFETY AND INSTALLATION MANUAL BEFORE USING THE PRODUCT.

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sales@vikramsolar.com www.vikramsolar.com



Efficient

- Up to 4 inverters can be transported in one standard shipping container
- Overdimensioning up to 150% is possible
- Full power at ambient temperatures of up to 35°C

Robust

- Intelligent air cooling system OptiCool for efficient cooling
- Suitable for outdoor use in all climatic ambient conditions worldwide

Flexible

- Conforms to all known grid requirements worldwide
- Q on demand
- Available as a single device or turnkey solution, including Medium Voltage Power Station

Easy to Use

- Improved DC connection area
- Connection area for customer equipment
- Integrated voltage support for internal and external loads

SUNNY CENTRAL
2660 UP-US / 2800 UP-US / 2930 UP-US / 3060 UP-US

The new Sunny Central: more power per cubic meter

With an output of up to 3060 kVA and system voltages of 1500 V DC, the SMA central inverter allows for more efficient system design and a reduction in specific costs for PV power plants. A separate voltage supply and additional space are available for the installation of customer equipment. True 1500 V technology and the intelligent cooling system OptiCool ensure smooth operation even in extreme ambient temperature as well as a long service life of 25 years.

SUNNY CENTRAL 2660 UP-US / 2800 UP-US

Technical data*	SC 2660 UP-US	SC 2800 UP-US
Input (DC)		
MPP voltage range V_{DC} (at 35 °C / at 50 °C)	880 to 1325 V / 1100 V	921 to 1325 V / 1100 V
Min. input voltage $V_{DC, min}$ / Start voltage $V_{DC, Start}$	849 V / 1030 V	891 V / 1071 V
Max. input voltage $V_{DC, max}$	1500 V	
Max. input current $I_{DC, max}$ / with DC coupling	3200 A / 4800 A	
Max. short-circuit current $I_{DC, sc}$	6400 A	
Number of DC inputs	24 double pole fused (32 single pole fused)	
Number of DC inputs with optional DC coupling of battery	18 double pole fused (36 single pole fused) for PV, 6 double pole fused for batteries	
Max. number of DC cables per DC input (for each polarity)	2 x 800 kcmil, 2 x 400 mm²	
Integrated zone monitoring	○	
Available PV fuse sizes (per input)	200 A, 250 A, 315 A, 350 A, 400 A, 450 A, 500 A	
Available DC-DC converter fuse size (per input)	750 A	
Output (AC)		
Nominal AC power at cos φ =1 (at 35°C / at 50°C)	2667 kVA / 2400 kVA	2800 kVA / 2520 kVA
Nominal AC power at cos φ =0.8 (at 35°C / at 50°C)	2134 kW / 1920 kW	2240 kW / 2016 kW
Nominal AC current $I_{AC, nom}$ (at 35°C / at 50°C)	2566 A / 2309 A	
Max. total harmonic distortion	< 3% at nominal power	
Nominal AC voltage / nominal AC voltage range[1) 8)]	600 V / 480 V to 720 V	630 V / 504 V to 756 V
AC power frequency / range	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz	
Min. short-circuit ratio at the AC terminals[9)]	> 2	
Power factor at rated power / displacement power factor adjustable[8) 10)]	1 / 0.8 overexcited to 0.8 underexcited	
Efficiency		
Max. efficiency[2)] / European efficiency[2)] / CEC efficiency[3)]	98.7%* / 98.6%* / 98.5%*	98.7%* / 98.6%* / 98.5%*
Protective Devices		
Input-side disconnection point	DC load break switch	
Output-side disconnection point	AC circuit breaker	
DC overvoltage protection	Surge arrester, type I	
AC overvoltage protection (optional)	Surge arrester, class I	
Lightning protection (according to IEC 62305-1)	Lightning Protection Level III	
Ground-fault monitoring / remote ground-fault monitoring	○ / ○	
Insulation monitoring	○	
Degree of protection	NEMA 3R	
General Data		
Dimensions (W / H / D)	2815 / 2318 / 1588 mm (110.8 / 91.3 / 62.5 inch)	
Weight	< 3400 kg / < 7500 lb	
Self-consumption (max.[4)] / partial load[5)] / average[6)])	< 8100 W / < 1800 W / < 2000 W	
Self-consumption (standby)	< 370 W	
Internal auxiliary power supply	○ Integrated 8.4 kVA transformer	
Operating temperature range[8)]	−25°C to 60°C / −13°F to 140°F	
Noise emission[7)]	67.0 dB(A)*	
Temperature range (standby)	−40°C to 60°C / −40°F to 140°F	
Temperature range (storage)	−40°C to 70°C / −40°F to 158°F	
Max. permissible value for relative humidity (condensing / non-condensing)	95% to 100% (2 month/year) / 0% to 95%	
Maximum operating altitude above MSL[8)] 1000 m / 2000 m	● / ○ (earlier temperature-dependent derating)	
Fresh air consumption	6500 m³/h	
Features		
DC connection	Terminal lug on each input (without fuse)	
AC connection	With busbar system (three busbars, one per line conductor)	
Communication	Ethernet, Modbus Master, Modbus Slave	
Communication with SMA string monitor (transmission medium)	Modbus TCP / Ethernet (FO MM, Cat-5)	
Enclosure / roof color	RAL 9016 / RAL 7004	
Supply transformer for external loads	○ (2.5 kVA)	
Standards and directives complied with	UL 62109-1, UL 1741 (Chapter 31, CDR 6I), UL 1741-SA, UL 1998, IEEE 1547, MIL-STD-810G	
EMC standards	FCC Part 15 Class A	
Quality standards and directives complied with	VDI/VDE 2862 page 2, DIN EN ISO 9001	
● Standard features ○ Optional * preliminary		

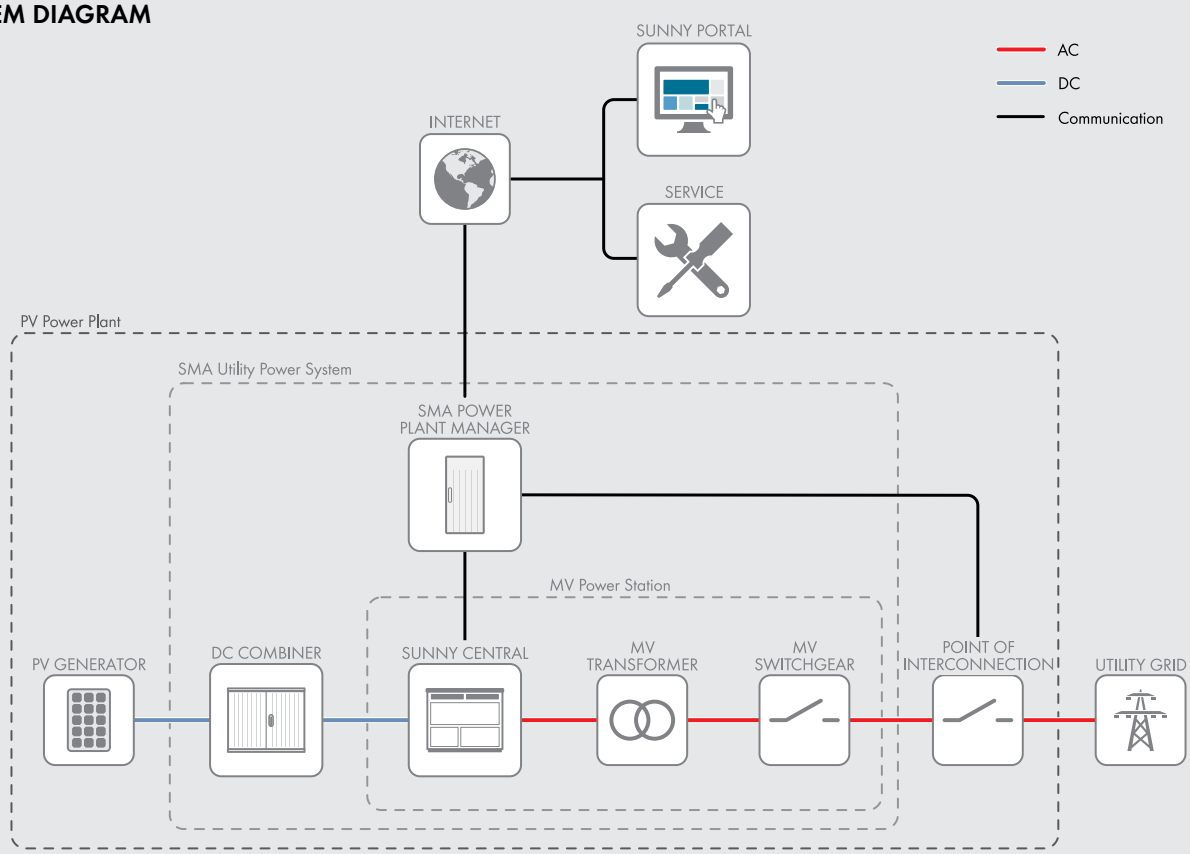
1) At nominal AC voltage, nominal AC power decreases in the same proportion
2) Efficiency measured without internal power supply
3) Efficiency measured with internal power supply
4) Self-consumption at rated operation
5) Self-consumption at < 75% Pn at 25°C
6) Self-consumption averaged out from 5% to 100% Pn at 25°C
7) Sound pressure level at a distance of 10 m
8) Values apply only to inverters. Permissible values for SMA MV solutions from SMA can be found in the corresponding data sheets.
9) A short-circuit ratio of < 2 requires a special approval from SMA
10) Depending on the DC voltage

SUNNY CENTRAL 2930 UP-US / 3060 UP-US

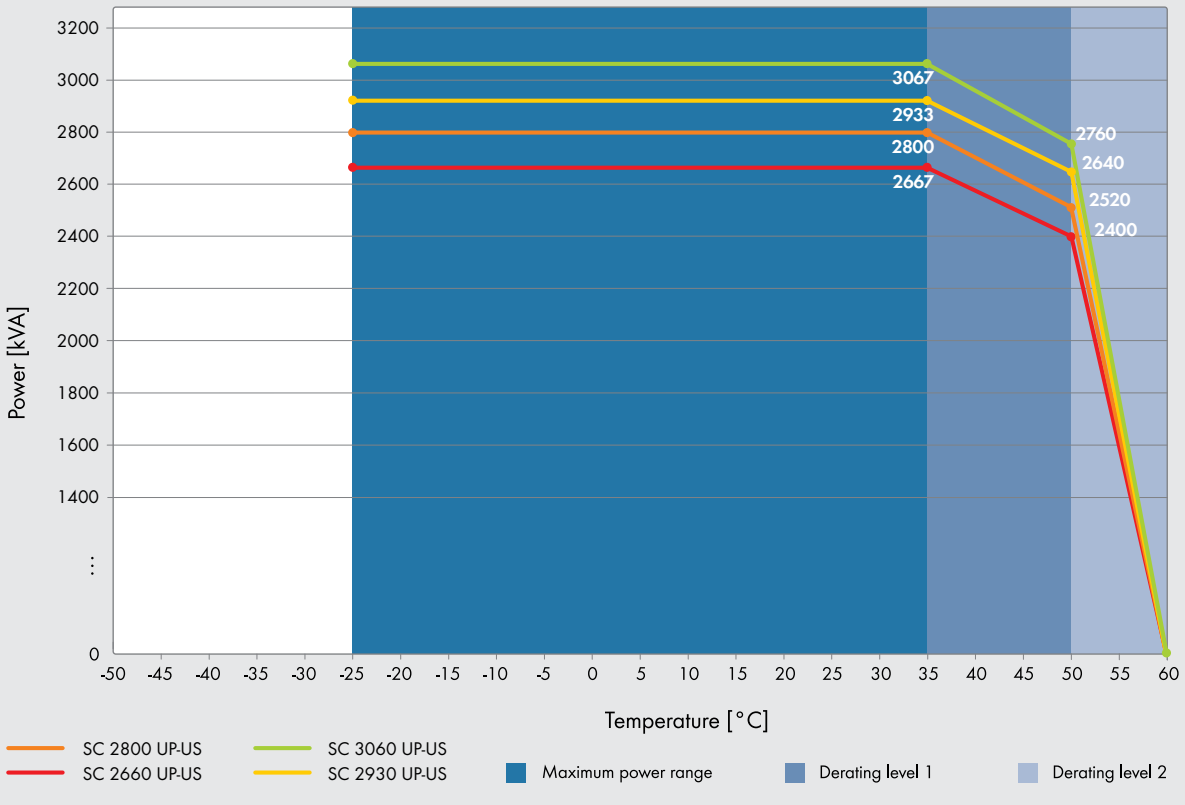
Technical data*	SC 2930 UP-US	SC 3060 UP-US
Input (DC)		
MPP voltage range V_{DC} (at 35 °C / at 50 °C)	962 to 1325 V / 1100 V	1003 to 1325 V / 1100 V
Min. input voltage $V_{DC, min}$ / Start voltage $V_{DC, Start}$	934 V / 1112 V	976 V / 1153 V
Max. input voltage $V_{DC, max}$	1500 V	
Max. input current $I_{DC, max}$ / with DC coupling	3200 A / 4800 A	
Max. short-circuit current $I_{DC, sc}$	6400 A	
Number of DC inputs	24 double pole fused (32 single pole fused)	
Number of DC inputs with optional DC coupling of battery	18 double pole fused (36 single pole fused) for PV, 6 double pole fused for batteries	
Max. number of DC cables per DC input (for each polarity)	2 x 800 kcmil, 2 x 400 mm²	
Integrated zone monitoring	○	
Available PV fuse sizes (per input)	200 A, 250 A, 315 A, 350 A, 400 A, 450 A, 500 A	
Available DC-DC converter fuse size (per input)	750 A	
Output (AC)		
Nominal AC power at cos φ =1 (at 35°C / at 50°C)	2933 kVA / 2640 kVA	3067 kVA / 2760 kVA
Nominal AC power at cos φ =0.8 (at 35°C / at 50°C)	2346 kW / 2112 kW	2454 kW / 2208 kW
Nominal AC current $I_{AC, nom}$ (at 35°C / at 50°C)	2566 A / 2309 A	
Max. total harmonic distortion	< 3% at nominal power	
Nominal AC voltage / nominal AC voltage range[1) 8)]	660 V / 528 V to 759 V	690 V / 552 V to 759 V
AC power frequency / range	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz	
Min. short-circuit ratio at the AC terminals[9)]	> 2	
Power factor at rated power / displacement power factor adjustable[8) 10)]	1 / 0.8 overexcited to 0.8 underexcited	
Efficiency		
Max. efficiency[2)] / European efficiency[2)] / CEC efficiency[3)]	98.7%* / 98.6%* / 98.5%*	98.7%* / 98.6%* / 98.5%*
Protective Devices		
Input-side disconnection point	DC load break switch	
Output-side disconnection point	AC circuit breaker	
DC overvoltage protection	Surge arrester, type I	
AC overvoltage protection (optional)	Surge arrester, class I	
Lightning protection (according to IEC 62305-1)	Lightning Protection Level III	
Ground-fault monitoring / remote ground-fault monitoring	○ / ○	
Insulation monitoring	○	
Degree of protection	NEMA 3R	
General Data		
Dimensions (W / H / D)	2815 / 2318 / 1588 mm (110.8 / 91.3 / 62.5 inch)	
Weight	< 3400 kg / < 7500 lb	
Self-consumption (max.[4)] / partial load[5)] / average[6)])	< 8100 W / < 1800 W / < 2000 W	
Self-consumption (standby)	< 370 W	
Internal auxiliary power supply	○ Integrated 8.4 kVA transformer	
Operating temperature range[8)]	−25°C to 60°C / −13°F to 140°F	
Noise emission[7)]	67.0 dB(A)*	
Temperature range (standby)	−40°C to 60°C / −40°F to 140°F	
Temperature range (storage)	−40°C to 70°C / −40°F to 158°F	
Max. permissible value for relative humidity (condensing / non-condensing)	95% to 100% (2 month/year) / 0% to 95%	
Maximum operating altitude above MSL[8)] 1000 m / 2000 m	● / ○ (earlier temperature-dependent derating)	
Fresh air consumption	6500 m³/h	
Features		
DC connection	Terminal lug on each input (without fuse)	
AC connection	With busbar system (three busbars, one per line conductor)	
Communication	Ethernet, Modbus Master, Modbus Slave	
Communication with SMA string monitor (transmission medium)	Modbus TCP / Ethernet (FO MM, Cat-5)	
Enclosure / roof color	RAL 9016 / RAL 7004	
Supply transformer for external loads	○ (2.5 kVA)	
Standards and directives complied with	UL 62109-1, UL 1741 (Chapter 31, CDR 6I), UL 1741-SA, UL 1998 IEEE 1547, MIL-STD-810G	
EMC standards	FCC Part 15 Class A	
Quality standards and directives complied with	VDI/VDE 2862 page 2, DIN EN ISO 9001	
● Standard features ○ Optional * preliminary		

1) At nominal AC voltage, nominal AC power decreases in the same proportion
2) Efficiency measured without internal power supply
3) Efficiency measured with internal power supply
4) Self-consumption at rated operation
5) Self-consumption at < 75% Pn at 25°C
6) Self-consumption averaged out from 5% to 100% Pn at 25°C
7) Sound pressure level at a distance of 10 m
8) Values apply only to inverters. Permissible values for SMA MV solutions from SMA can be found in the corresponding data sheets.
9) A short-circuit ratio of < 2 requires a special approval from SMA
10) Depending on the DC voltage

SYSTEM DIAGRAM



TEMPERATURE BEHAVIOR (at 1000 m)



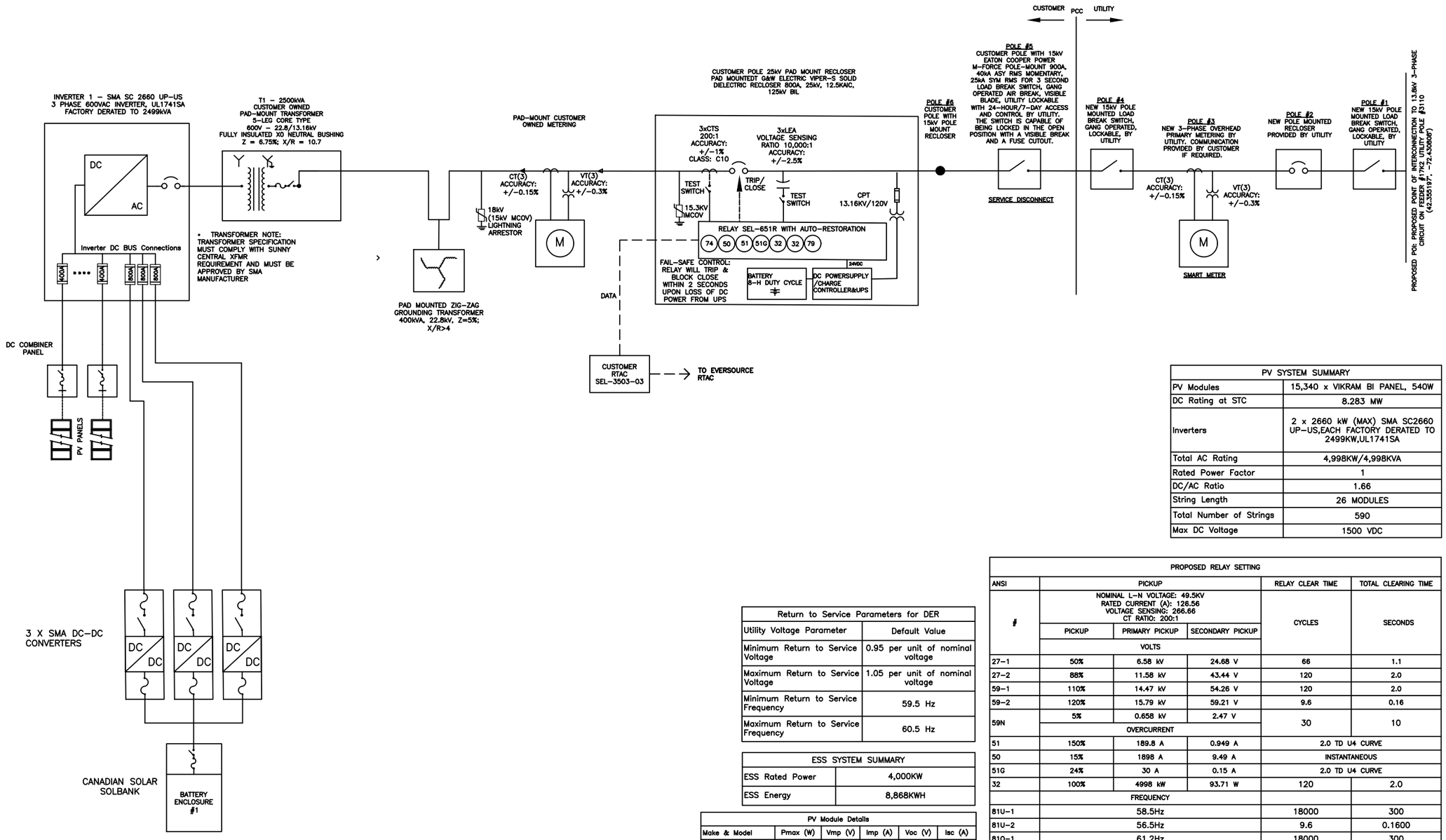
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Toll Free +1 888 4 SMA USA
www.SMA-America.com

SMA America, LLC

Attachment F

One-Line Electrical Diagram



NOTE: THE BESS IS A CONCEPT DESIGN. THE DETAILED DESIGN OF THE BESS INCLUDING THE WIRING CONNECTIONS AND QUANTITY OF THE COLLECTION SEGMENTS SHALL BE PROVIDED BY POWIN DURING CONSTRUCTION PHASE.

PV SYSTEM SUMMARY	
PV Modules	15,340 x VIKRAM BI PANEL, 540W
DC Rating at STC	8.283 MW
Inverters	2 x 2660 kW (MAX) SMA SC2660 UP–US,EACH FACTORY DERATED TO 2499KW,UL1741SA
Total AC Rating	4,998KW/4,998KVA
Rated Power Factor	1
DC/AC Ratio	1.66
String Length	26 MODULES
Total Number of Strings	590
Max DC Voltage	1500 VDC

Return to Service Parameters for DER	
Utility Voltage Parameter	Default Value
Minimum Return to Service Voltage	0.95 per unit of nominal voltage
Maximum Return to Service Voltage	1.05 per unit of nominal voltage
Minimum Return to Service Frequency	59.5 Hz
Maximum Return to Service Frequency	60.5 Hz

ESS SYSTEM SUMMARY	
ESS Rated Power	4,000KW
ESS Energy	8,868KWH

PV Module Details					
Make & Model	Pmax (W)	Vmp (V)	Imp (A)	Voc (V)	Isc (A)
VIKRAM, PARADEA VSMDH.72.540.05 (540W)	540	41.70	12.96	49.50	13.64

INVERTER SETTINGS		
ANSI	PICKUP	TOTAL CLEARING TIME
#	(%V / VL–L, Hz)	(CYCLES : SECONDS)
27–1	V<50% /300.0V	66 : 1.1
27–2	V>88% /528.0V	120 : 2.0
59–1	V>110% /660.0V	120 : 2.0
59–2	V>120% /720.0V	9.6 : 0.16
81O–1	F>61.2Hz	18000 : 300
81O–2	F>62Hz	9.6 : 0.16
81U–1	F>56.5Hz	18000 : 300
81U–2	F>58.5Hz	9.6 : 0.16

PROPOSED RELAY SETTING					
ANSI	PICKUP			RELAY CLEAR TIME	TOTAL CLEARING TIME
#	NOMINAL L–N VOLTAGE: 49.5KV RATED CURRENT (A): 126.56 VOLTAGE SENSING: 266.66 CT RATIO: 200:1			CYCLES	SECONDS
	PICKUP	PRIMARY PICKUP	SECONDARY PICKUP		
	VOLTS				
27–1	50%	6.58 kV	24.68 V	66	1.1
27–2	88%	11.58 kV	43.44 V	120	2.0
59–1	110%	14.47 kV	54.26 V	120	2.0
59–2	120%	15.79 kV	59.21 V	9.6	0.16
59N	5%	0.658 kV	2.47 V	30	10
	OVERCURRENT				
51	150%	189.8 A	0.949 A	2.0 TD U4 CURVE	
50	15%	1898 A	9.49 A	INSTANTANEOUS	
51G	24%	30 A	0.15 A	2.0 TD U4 CURVE	
32	100%	4998 kW	93.71 W	120	2.0
	FREQUENCY				
81U–1	58.5Hz			18000	300
81U–2	56.5Hz			9.6	0.1600
81O–1	61.2Hz			18000	300
81O–2	62Hz			9.6	0.1600
	RETURN TO SERVICE				
79	0.9170	12.07 kV	45.26 V	18000	300
	1.05	13.82 kV	51.83 V	18000	300
	59.5 Hz – 60.1 Hz			120	2.0000

RELAY NOTES:
1. TOTAL CLEARING TIME INCLUDES 3 CYCLES ESTIMATE CONTACTOR OPENING TIME (0.05 SEC).
2. THE RELAY WILL BE PROGRAMMED TO TRIP THE MAIN DISCONNECT WITHIN 2–SEC WHEN LOSS OF AC SUPPLY VOLTAGE, THE BATTERY TEST FAILS OR WHEN THERE IS A RELAY HARDWARE FAILURE.
3. RETURN TO SERVICE SCHEME: RELAY PROGRAMMING LOGIC WILL RESTORE THE INTERCONNECTION UPON THE STABILIZATION OF THE UTILITY VOLTAGE AND FREQUENCY IN THE ABSENCE OF ANY LOCKOUT CONDITIONS. VOLTAGE AND FREQUENCY WILL BE SUPERVISED BY 27, 81, AND 59 ELEMENTS FOR A FIVE–MINUTE DURATION BEFORE CLOSE COMMAND IS INITIATED.DURING THIS DURATION, MANUAL CLOSE WILL BE BLOCKED. THE ACCEPTABLE VOLTAGE AND FREQUENCY IS AS DEFINED IN IEEE1547–2018 SECTION4.10.
4. LOCKOUT SCHEME: RELAY WILL LOCK OUT AUTO RESTORATION AND REQUIRES MANUAL INTERVENTION IF ANY OF THE 50/51 OVERCURRENT ELEMENTS CAUSES A TRIP. IN ADDITION, AUTO–RESTORATION IS LOCKED–OUT IF THE CIRCUIT BREAKER IS MANUALLY OPENED, OR IF THE BATTERY ALARM IS ASSERTED, OR 32 TRIP

NOT FOR CONSTRUCTION

STAMP:

DEVELOPER
PureSky Energy
518 17th Street, Suite 950,
Denver, CO 80202
United States
tel: +1 303 653 9805
www.pureskyenergy.com
CLIENT

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REV	DESCRIPTION	DATE DD/MM/YY	BY
00	ISSUED FOR REVIEW	29/08/24	MZ

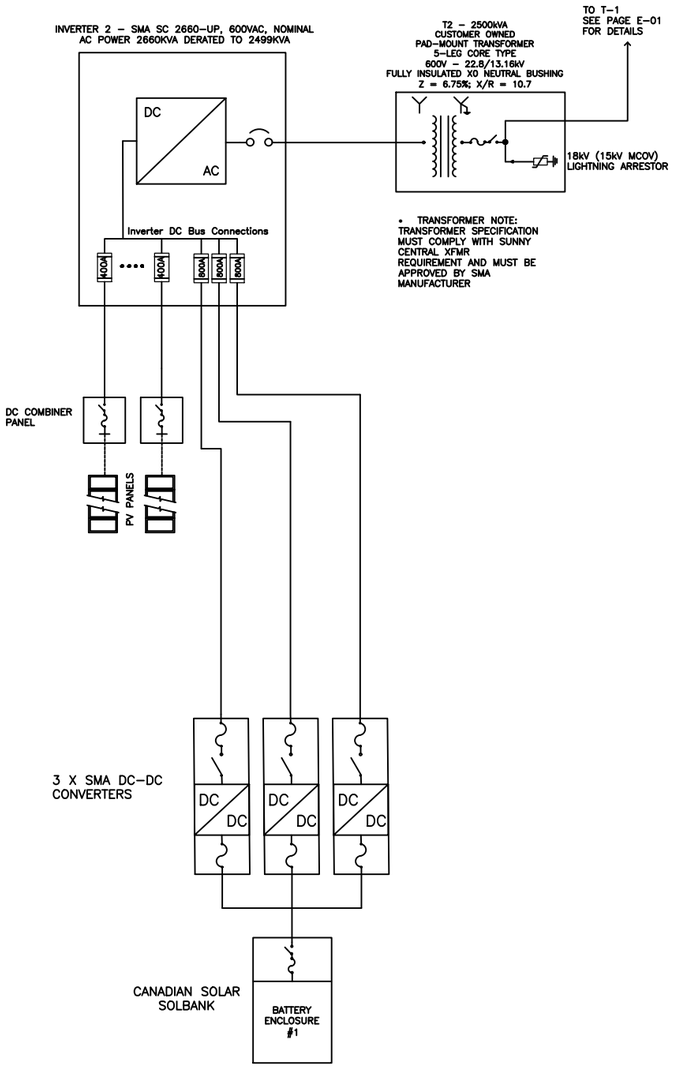
CLIENT:
PSE TOWER MA SOLLAR LLC

PROJECT ADDRESS:
PELHAM, MA 01002

DRAWING TITLE:
SINGLE LINE DIAGRAM

DRAWING NO.
E-01

DRAWN:	MZ	DATE:	29/08/24	SHEET: 2 of 4
CHECKED:		DATE:		



INVERTER VOLTAGE TRIP RIDE THROUGH SETTINGS
FROM INVERTER SOURCE REQUIREMENT DOCUMENT OF ISO NEW ENGLAND (ISO–NE) 02/08/2018

VOLTAGE RANGE (p.u.)	VOLTAGE RANGE (V LL = 600V)	OPERATING MODE/RESPONSE	MINIMUM RIDE–THROUGH TIME(S) (DESIGN CRITERIA)	MAXIMUM RESPONSE TIME(S) (DESIGN CRITERIA)
V > 1.20	V > 720	CEASE TO ENERGIZE	N/A	1.16
1.175 < V ≤ 1.20	705 < V ≤ 720	PERMISSIVE OPERATION	0.2	N/A
1.15 < V ≤ 1.175	690 < V ≤ 705	PERMISSIVE OPERATION	0.5	N/A
1.10 < V ≤ 1.15	660 < V ≤ 690	PERMISSIVE OPERATION	1.0	N/A
0.88 ≤ V ≤ 1.10	528 ≤ V ≤ 660	CONTINUOUS OPERATION	INFINITE	N/A
0.65 ≤ V < 0.88	390 ≤ V < 528	MANDATORY OPERATION	T_VRT= 3 + 8.7s * (V – 0.65pu)	N/A
0.45 ≤ V < 0.65	270 ≤ V < 390	PERMISSIVE OPERATION	0.32	N/A
0.30 ≤ V < 0.45	180 ≤ V < 270	PERMISSIVE OPERATION	0.16	N/A
V < 0.30	V < 180	CEASE TO ENERGIZE	N/A	1.16

a. IN THE PERMISSIVE OPERATION REGION ABOVE 0.5 p.u., INVERTERS SHALL RIDE–THROUGH IN MANDATORY OPERATION MODE, AND
b. IN THE PERMISSIVE OPERATION REGION BELOW 0.5 p.u., INVERTERS SHALL RIDE–THROUGH IN MOMENTARY CESSATION MODE WITH A MAXIMUM RESPONSE TIME OF 0.083 SECONDS.

INVERTERS FREQUENCY RIDE–THROUGH CAPABILITY
FROM INVERTER SOURCE REQUIREMENT DOCUMENT OF ISO NEW ENGLAND (ISO–NE) 02/06/2018

FREQUENCY RANGE (Hz)	OPERATING MODE	MINIMUM–TIME(S) (DESIGN CRITERIA)
f > 62	NO RIDE–THROUGH REQUIREMENTS APPLY TO THIS RANGE	
61.2 < f ≤ 61.8	MANDATORY OPERATION	299
58.8 ≤ f ≤ 61.2	CONTINUOUS OPERATION	INFINITE
57.0 ≤ f < 58.8	MANDATORY OPERATION	299
f < 57.0	NO RIDE–THROUGH REQUIREMENTS APPLY TO THIS RANGE	

NOT FOR CONSTRUCTION

STAMP:

DEVELOPER
PureSky Energy
518 17th Street, Suite 950,
Denver, CO 80202
United States
tel: +1 303 653 9805
www.pureskyenergy.com

CLIENT

THIS DRAWING IS AN INSTRUMENT OF PROFESSIONAL SERVICE FOR USE EXCLUSIVELY ON THIS PROJECT. RE-USE OF ANY PORTION OF THIS DOCUMENT IS PROHIBITED.

REV	DESCRIPTION	DATE DD/MM/YY	BY
00	ISSUED FOR REVIEW	29/08/24	MZ

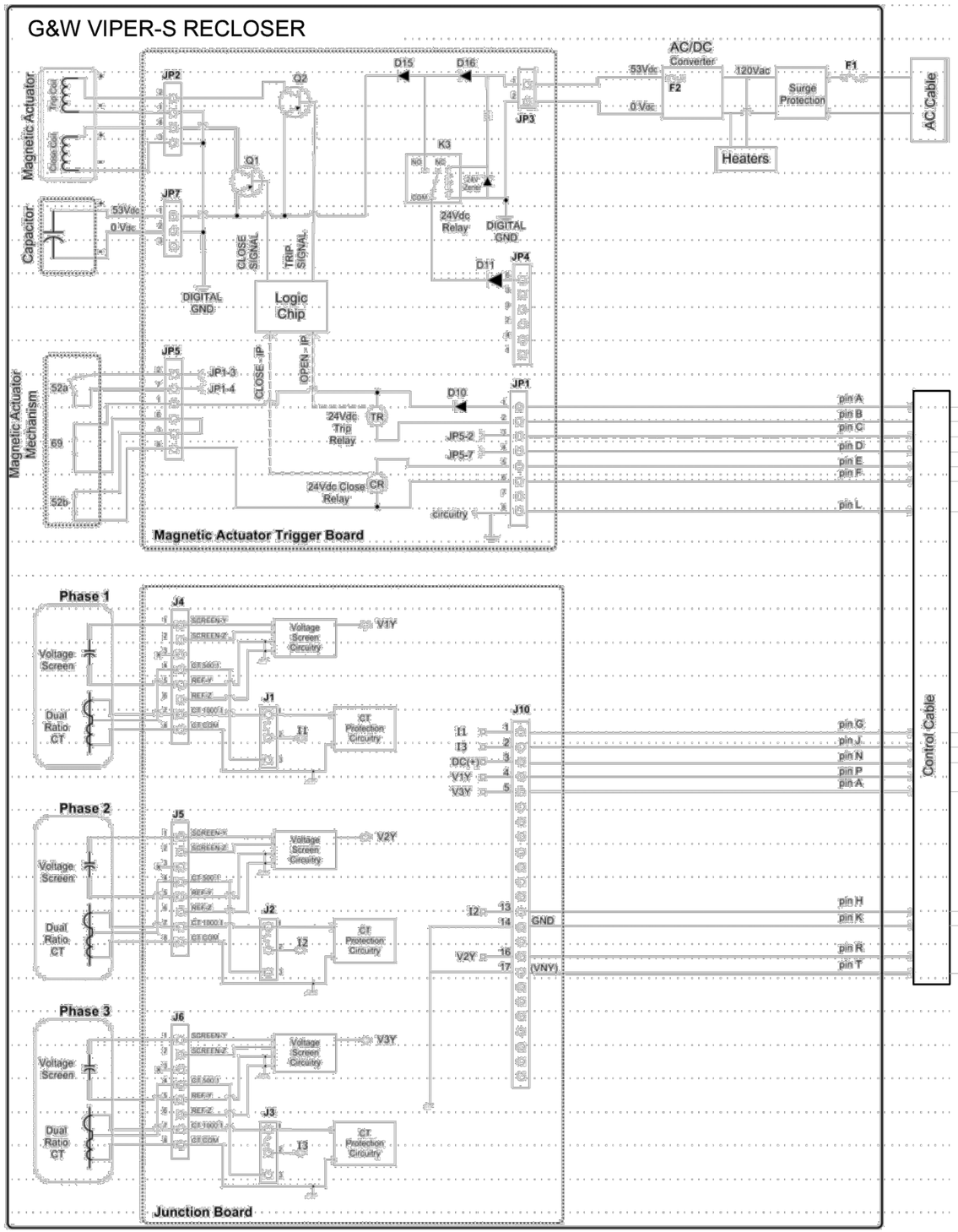
CLIENT:
PSE TOWER MA SOLLAR LLC

PROJECT ADDRESS:
PELHAM, MA 01002

DRAWING TITLE:
SINGLE LINE DIAGRAM

DRAWING NO.
E-02

DRAWN:	MZ	DATE:	29/08/24	SHEET: 3 of 4
CHECKED:		DATE:		



NOT FOR CONSTRUCTION

STAMP:

DEVELOPER

PureSky Energy

518 17th Street, Suite 950,
Denver, CO 80202
United States
tel: +1 303 653 9805
www.pureskyenergy.com

CLIENT

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REV	DESCRIPTION	DATE DD/MM/YY	BY
00	ISSUED FOR REVIEW	29/08/24	MZ

CLIENT:
PSE TOWER MA SOLLAR LLC

PROJECT ADDRESS:
PELHAM, MA 01002

DRAWING TITLE:
CONTROL SCHEMATIC DIAGRAM

DRAWING NO.
E-03

DRAWN:	MZ	DATE:	29/08/24	SHEET: 4 of 4
CHECKED:		DATE:		

Attachment G

Site Control Documentation

Hampshire County Registry of Deeds

Electronically Recorded Document

This is the first page of the document—Do not remove

Document Number	: 17249
Document Type	: NOT
Recorded Date	: November 01, 2023
Recorded Time	: 02:55:15 PM
Recorded Book and Page	: 14999 / 302
Number of Pages(including cover sheet)	: 5
Receipt Number	: 420464
Recording Fee	: $105.00

Hampshire County Registry of Deeds
Mary Olberding, Register
60 Railroad Avenue
Northampton, MA 01060
413-584-3637
www.Masslandrecords.com

0 Tower Road
Pelham, MA
Assessor's Parcel 014.0_0000_0001.0

NOTICE OF LEASE OPTION AGREEMENT

NOTICE IS HEREBY GIVEN of the following described Lease Option Agreement:

OWNER: W.D. Cowls, Inc., a Massachusetts corporation, having an address of 134 Montague Road, Amherst, Massachusetts 01002

DEVELOPER: ASD Tower MA Solar LLC, a Delaware limited liability company, having an address of 518 17th Street, Suite 950, Denver, Colorado 80202

LEASE OPTION AGREEMENT: That certain Lease Option Agreement, dated effective as of September 30, 2022, by and between Owner and Developer (the "Option Agreement").

OPTION GRANTED: The exclusive option to lease the Property, as described below, on the terms and conditions set forth in the Option Agreement (the "Option").

PROPERTY: A parcel of real property located at 0 Tower Road, Pelham, MA, with property 014.0_0000_0001.0 on the Tax Assessor's Maps for the Town of Pelham, Massachusetts, as more particularly described on Schedule A attached hereto (the "Property").

OPTION PERIOD; EXERCISE NOTICE: Developer may exercise the Option by giving writtennotice to Owner (the "Exercise Notice") in accordance with the Option Agreement, provided that,unless required by the Option Agreement to be given sooner, the Exercise Notice must be given nolater than September 30, 2025.

TEXT ENDS HERE
Signature Page(s) Follow

For further reference see Book 617, Page 195; Book 484, Page 373; Book 729, Page 368

Owner's Initials: _____ **Developer's Initials:** NL

0 Tower Road
Pelham, MA
Assessor's Parcel 014.0_0000_0001.0

OWNER:

W.D. Cowls, Inc.

By: _____
Name: _____
Title: _____

Cinda H. Jones, President and Treasurer

COMMONWEALTH OF MASSACHUSETTS

County of Hampshire, ss.

On this 14th day of [September], before the undersigned notary public, personally appeared Cinda H. Jones, Pres & Treas, proved to me through satisfactory evidence of identification, which was ☐ photographic identification with signature issued by a federal or state governmental agency, or ☑ personal knowledge of the undersigned [CHECK ONE], to be the person whose name is signed on the preceding document, and acknowledged to me that s/he signed it as [President and Treasurer] of [W.D. Cowls, Inc.], voluntarily for its stated purpose.

_____
Notary Public
Print Name of Notary: _____
My commission expires: _____

THOMAS R. REIDY
Notary Public
Commonwealth of Massachusetts
My Commission Expires
November 28, 2025

Owner's Initials: _____ **Developer's Initials:** NL

D Tower Road
Pelham, MA
Assessor's Parcel 014.0_0000_0001.0

DEVELOPER:

ASD Tower MA Solar LLC

By: PureSky Development Inc.

Its: Manager Nicole Leblanc

Date: 9/26/2023

STATE OF COLORADO }
} ss.:
COUNTY OF JEFFERSON }

On the 26th day of SEPTEMBER, in the year 2023, before me, the undersigned, personally appeared NICOLE LEBLANC, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name(s) is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s) or the person upon behalf of which the individual(s) acted, executed the instrument, and that such individual made such appearance before the undersigned in the JEFFERSON COUNTY, COLORADO, USA,
(add the city or political subdivision and the state or country or other place the acknowledgement was taken).

Notary Public

CARSON K. BROWN
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20224025342
MY COMMISSION EXPIRES 06/29/2026

Owner's Initials: _____ Developer's Initials: _____

0 Tower Road
Pelham, MA
Assessor's Parcel 014.0_0000_0001.0

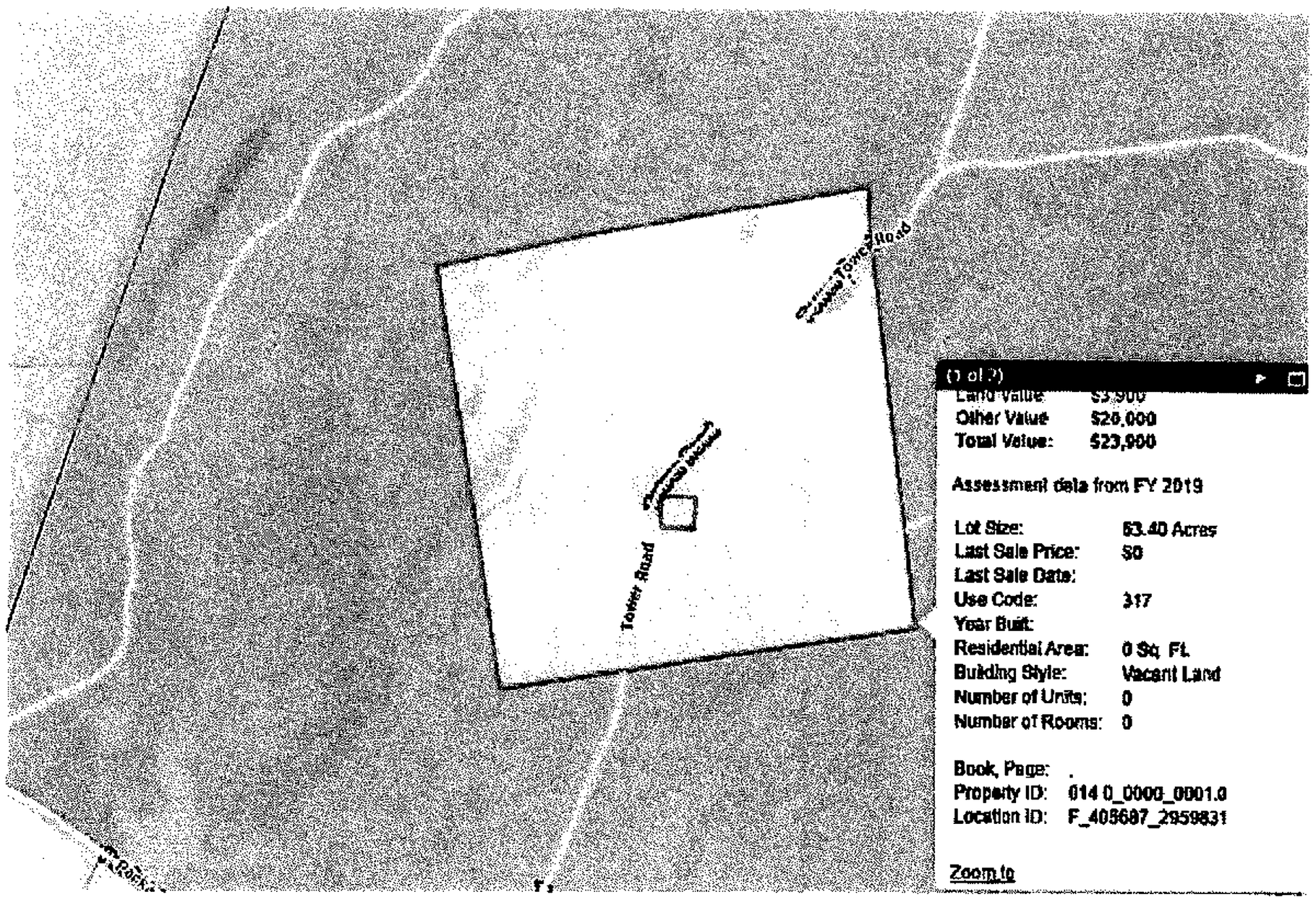
SCHEDULE A
to
Notice of Lease
Option Agreement

W.D. Cowls, Inc.
ASD Tower MA Solar LLC

LEGAL DESCRIPTION OF PROPERTY

The Option Property: The entirety of the property located at 0 Tower Road, Pelham, Massachusetts, consisting of property 014.0_0000_0001.0, and further depicted below.

[Full legal description of the Owner's Premises and the Option Property to be provided]



Owner's Initials: _____ **Developer's Initials:** NL

Attachment H

Operation and Maintenance

Operation & Maintenance Plan
ASD Tower MA Solar LLC, PV Array and BESS
Pelham, MA

The following is an Operation and Maintenance Plan for the Solar PV Array located off Tower Road in Pelham, Massachusetts.

The PV Array and BESS consists of paved access drives, gravel perimeter maintenance drives, perimeter fencing, earthen berms for development screening, stormwater management controls with infiltration, PV Array racking, and grass pollinator meadow areas.

Responsible Parties

The array owner, ASD Tower MA Solar LLC, is responsible for the long-term operation and maintenance of the solar array and all BMP's described in this Plan.

ASD Tower MA Solar LLC c/o Puresky Development Inc.
518 17th St., Suite 950
Denver, CO 80202
303-598-7192
AssetManagement@PureskyEnergy.com

1. **During Construction**

Sediment & Erosion Control Plans have been prepared and included within the permit drawing set to outline measures designed to address all facets of sediment, erosion control and site work phasing during construction. Some of the measures included in these plans are as follows:

- Silt fence Erosion Control Barriers
- Erosion Control Matting
- Construction entrance
- Dust control
- Temporary seeding for stabilization of exposed soils
- Temporary sediment traps
- Temporary conveyance channels

During construction, the access road shall be inspected twice monthly and after a 2-year storm event. No less than weekly or after significant daily build up, the driveway apron and roadway along Tower Road shall be cleared of mud caused by construction operations.

During Construction, construction debris and litter removal over the entire property shall take place no less than weekly and, in any circumstance, promptly upon request by a local authority.

2. Long Term Maintenance

a. Litter Control

Routinely walk or drive the site to pick up and remove construction debris and litter from the area, perimeter greenspace areas and around the perimeter fencing. This maintenance requirement is in addition to the seasonal grass mowing operations.

b. Stormwater BMP Inspection

All stormwater related operations and maintenance is included in Appendix E of the Stormwater Management Report prepared by Tetra Tech dated June 2026.

c. Access Road Maintenance and Inspection

No less than twice annually, and after every major storm event, the entire length of the access road and internal roads shall be inspected for erosion and sufficient gravel covering. The inspections shall initially take place in the fall and spring to ensure that the access road is in the appropriate condition before and after snow season. The array owner will promptly repair the access road to maintain proper emergency vehicle access.

After every significant snowfall, the access road shall be plowed to maintain proper access. Specific attention shall be paid to ensure that no significant amount of gravel is pushed beyond the edge of the proposed driveway during plowing that extends beyond the proposed edge of the gravel drive, and the twice annual inspections shall properly remove any gravel deposits in and around the wetland setbacks.

d. Security Features

To ensure the safety and security of the facility, a comprehensive set of measures has been implemented. A perimeter fence encloses the entire site with any gates secured with chains and padlocks, designed to deter unauthorized entry. We also provide either a Knox lock or Knox box to provide emergency responders with access in case of emergency. Additionally, a state-of-the-art camera is installed as part of the Data Acquisition System (DAS), located on the equipment pad.

This camera is capable of 360-degree rotation, providing an unobstructed view of the entire area. The camera system is integrated into the DAS with automatic alerts and motion recordings. The EMS associated with the Battery system has door alarms which send real-time alerts in the event of unauthorized door openings as well as automatic safety responses disconnecting the battery cells from being charged or discharged. The camera feed can be accessed through multiple options, either directly through the DAS or via standalone network-accessible cameras. We also install solar powered cameras connected via cell service to the

cloud to provide additional angles or coverage to other areas of the site. These security features are inspected and tested regularly to ensure their efficacy and reliability.

e. Panel, Racking, Foundation, Fence Inspection

Twice annually visually inspect all racking equipment damage and panel to panel connections. Annually inspect panels for hotspots, weather damage, and module degradation. Replace panels as necessary.

Inspect all foundation points for signs of erosion and apply erosion control materials as necessary. Annually, inspect the perimeter fence for damage. Ensure the fence maintains an approximate 6-inch gap for wildlife passage.

f. Meadow Areas and Vegetation control

The wildflower pollinator meadows that comprise the majority of the array area shall be mowed multiple times in the initial years of the project as the pollinator meadow is being established.

In later years, mowing is only expected to take place as the pollinator species do not reach the height and bulk of the traditional grasses. No Massachusetts Prohibited Plant List species will be used. No pesticides or other chemicals will be used for vegetation management or module cleaning.

Areas of the array with a higher volume of grass will be mowed regularly to limit the amount of combustible material potentially available

Attachment I

Decommissioning Plan and Bond Estimate

Decommissioning Plan

Tower Road Solar Project
Tower Road
Pelham, MA 01002

Prepared for:

ASD Tower MA LLC
518 17th Street, Suite 950
Denver, CO 80202

Prepared by:

Tetra Tech, Inc.
100 Nickerson Road
Marlborough, MA 01752



TETRA TECH

June 2026

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2.2 Discontinuance of Operations 1

2.3 Abandonment 1

3.0 DECOMMISSIONING ACTIVITIES AND SCHEDULE 1

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LIST OF ATTACHMENTS

Attachment A – Decommissioning Bond Estimate

Attachment B – NYSERDA – New York Solar Guidebook: Section 7 (reduced)

1.0 INTRODUCTION

ASD Tower MA Solar LLC (the Operator/Owner) has prepared this Decommissioning Plan for the Tower Road Solar Project (the Facility), which has a rated capacity of approximately 4.4 megawatts alternating current (MWac). The Facility will be located on the 63.9-acre plot of land at Tower Road, Pelham, Massachusetts. The intent of this Decommissioning Plan is to provide a general scope of decommissioning work and related assurance.

2.0 IMPLEMENTATION OF DECOMMISSIONING PLAN

The Decommissioning Plan shall be implemented upon expiration of property rights, discontinuance of operations at the Facility, or abandonment, as defined herein, and issuance of written notice by the Town of Pelham (the Town) to the Owner/Operator. The Owner/Operator shall notify the Town of Pelham Zoning Enforcement Officer of any interruption of operations that exceeds or is scheduled to exceed thirty (30) continuous days. The time periods stated herein may be extended with mutual written consent of the Town and the Owner/Operator.

2.1 EXPIRATION OF PROPERTY RIGHTS

Expiration of property rights shall mean when the land lease between the Owner/Operator and landowner ends.

2.2 DISCONTINUANCE OF OPERATIONS

Discontinuance of operations shall mean a twelve (12) month period during which at least seventy-five percent (75%) of the photovoltaic solar panels are not producing commercially useful electricity and where such inactivity is not the result of a casualty, equipment problem or upgrade, permitting matter, natural disaster, interconnection with the local utility, upgrade by the utility company, or financial matter that the Owner/Operator is in good faith attempting to remedy.

2.3 ABANDONMENT

Abandonment shall mean an twenty-four (24) month period has elapsed since the commencement of construction and the Facility is not yet completed and functioning or has been damaged and will not be repaired and where such lack of completion is not the result of a casualty, equipment problem, permitting matter, natural disaster, interconnection with the local utility, upgrade by the utility company, or financial matter that the Owner/Operator is in good faith attempting to remedy.

3.0 DECOMMISSIONING ACTIVITIES AND SCHEDULE

In the event the Facility meets any of the above-referenced implementation of decommissioning plan definitions, the Owner/Operator, as provided for in its lease with the landowner, is responsible for restoring the property to the condition as it existed before the Facility was installed (excluding tree cover which will be allowed to re-propagate naturally), within one-hundred and fifty (150) days.

The Owner/Operator is to notify the Town of Pelham Planning Board by certified mail, of the proposed date of discontinued operations and plans for removal.

The Owner/Operator will coordinate with Eversource to determine schedule and procedure for disconnecting infrastructure from the point of interconnection, as well as removal and proper disposal of all utility-owned structures and equipment.

The Owner/Operator will have its qualified contractor(s) remove and properly dispose of all operator-owned above ground structures (equipment, concrete, conduits, structures, fencing, and foundations) and underground utilities if less than 48-inches deep. All concrete piers, footers, or other supports will be removed to a minimum depth of 48-inches below the soil surface. Electric conductors located at the respective range of depth below the ground surface will meet the following requirements:

- 48-inches plus: All underground electric conduits and direct buried conductors will be abandoned in place. Applicable conduit risers will be removed, and abandoned conduit will be sealed or capped to avoid a potential to direct subsurface drainage onto neighboring land uses.
- Less than 48-inches: All underground direct buried electric conductors and conductors in conduit and associated conduit with less than 48-inches of cover will be removed by means of causing the least amount of disturbance as possible.

The Owner/Operator will have its qualified contractor(s) remove any solid and hazardous waste caused by the Facility in accordance with local, state, and federal waste disposal regulations.

The Owner/Operator will have its qualified contractor(s) remove all graveled areas and access drives installed specifically for the Facility unless the landowner requests in writing for it to remain.

Decommissioning and restoration will be performed in accordance with applicable Massachusetts laws, regulations, and guidance, and all applicable local requirements.

4.0 DECOMMISSIONING ASSURANCE

Prior to the issuance of a building permit, the Owner/Operator shall enter into a mutually acceptable security agreement (form, sufficiency, and manner of execution) with the Town, which shall require a surety to be issued by a bonding or surety company licensed and authorized to do business in the State of Massachusetts or as otherwise approved by the Town.

4.1 FORM OF DECOMMISSIONING ASSURANCE

The Owner/Operator shall provide financial security in the form of a surety bond (or other mutually acceptable form) naming the Town of Pelham as Obligee to guarantee that funds and access to the property are available for the decommissioning of the facility should the Owner/Operator fail to decommission the facility as required.

Although the Owner/Operator, currently ASD Tower MA Solar LLC, intends to perform the decommissioning required, unforeseen circumstances are possible. In the event ASD Tower MA Solar LLC declares bankruptcy, goes out of business, or sells, transfers or assigns its right to another entity, it's successor shall be required by such sale, transfer or assignment to assume the obligations to decommission the facility in accordance with this Decommissioning Plan and to keep the surety in full force and effect during the useful life of the Facility.

4.2 AMOUNT OF DECOMMISSIONING ASSURANCE

A decommissioning bond estimate, which was prepared by a qualified engineer using unit costs taken from the New York State Energy Research and Development Authority (NYSERDA) New York Solar Guidebook for Local Governments, is included as Attachment A.

A reduced version of the NYSERDA New York Solar Guidebook for Local Governments is included as Attachment B.

The Owner/Operator shall provide decommissioning assurance in this amount prior to issuance of a building permit. The decommissioning bond estimate shall be reviewed periodically, but no more than once every ten (10) years, to ensure the adequacy of the amount.

4.3 USE OF DECOMMISSIONING ASSURANCE

The Town of Pelham shall have the right to make a claim against the decommissioning assurance in the event that the Owner/Operator fails to undertake decommissioning activities within twenty-four (24) months of expiration of property rights, discontinuance of operations at the Facility, or abandonment, as defined herein, and issuance of written notice by the Town to the Owner/Operator.

Attachment A

Decommissioning Bond Estimate

Decommissioning Bond Estimate
Tower Road Solar Project
Tower Road
Pelham, Massachusetts

Tetra Tech
June, 2026

Item No.	Task		Project Size (MW)	Unit Cost ($/MW)	Cost
Reclamation					
001	Pre-Decommissioning Activities		4.4	$5,696	$25,062
002	Dismantling & Disposal Activities		4.4	$28,741	$126,460
003	Site Restoration & Remediation Activities		4.4	$13,519	$59,484
				Subtotal	$211,006
				Contingencies (15%)	$242,657
				Bond Value (cost after 20 years at 2.5% inflation)	**$397,622**

Note: Unit Cost taken from NYSERDA guidance on decommissoning solar panel systems

Attachment B

NYSERDA - New York Solar Guidebook: Section 7 (reduced)

Section 7

Decommissioning Solar Panel Systems

Information for local governments and landowners on the decommissioning of large-scale solar panel systems.



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2. **Introduction S7.4**
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   - What is included in a decommissioning plan? S7.10
   - What are New York State requirements for decommissioning? S7.11
   - What are typical decommissioning costs? S7.12
   - What are the financial mechanisms used to ensure decommissioning activities take place? S7.14
   - What are the non-financial mechanisms used to ensure decommissioning activities take place? S7.15
   - What happens to dismantled renewable energy equipment? S7.16
5. **Repowering Projects S7.22**
   - What are the opportunities associated with repowering? S7.23
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6. **Conclusion S7.24**

Appendix A: Inflation Primer S7.25

Decommissioning is a critical step in returning land to its original state, considered the state prior to construction. ORES regulations allow project owners to negotiate the conditions of the land at the end of the project life. The advantage of renewable energy projects over fossil fuel energy is that they do not emit harmful airborne or leak-prone pollutants where they generate energy. So, when decommissioning is completed, land that was once residential, or even arable agricultural land, can be more easily returned to that purpose.

The decommissioning estimate must include the removal of all project components up to four feet below grade in agricultural land or three feet below grade in non-agricultural land and the removal and restoration of access road locations, if appropriate.[20]

The ORES website contains several valuable resources on permitting for renewable energy projects, from application guidance, webinars, and presentations on submitting permit applications to the new streamlined procedure.[21] Local governments and developers can access their site to learn more about applications and the permitting process. They also publish application status updates on their website, which can provide valuable insight into decommissioning opportunities and challenges.[22]

Finally, it is important to note that the precise decommissioning requirements may vary for solar, wind, and battery storage energy projects, depending on the local jurisdiction.

What are typical decommissioning costs?

Decommissioning plans require a cost estimate that is project specific, as each renewable energy project will have unique characteristics that result in variations in cost estimates. All costs and renewable energy capacities noted here are in alternating current (ac), unless otherwise noted. The following cost estimates were produced from an examination of over 100 solar decommissioning cost estimates produced within New York between 2021-2024 for projects exceeding 1 MW-ac. The average decommissioning cost estimate, prior to contingencies or salvage value, for solar projects was approximately $50,000 (2024$) per MW-ac.[23] The average inflation rate for these projects was 2.1% with the range between 10% and 25%.

*Table 3 | Breakdown of Typical Decommissioning Costs for Solar Projects, 2024$/MW**

	Low[24]	Median	Average	High[25]
Pre-Decommissioning Activities	$254	$1,823	$5,696	$30,572
Dismantling & Disposal Activities	$2,787	$24,257	$28,741	$60,126
Site Restoration & Remediation Activities	$1,581	$11,732	$13,519	$32,056
Total Decommissioning Costs, Excluding Contingency & Salvage Value	**$4,547**	**$41,548**	**$47,823**	**$98,149**
Contingencies	$2,539	$17,768	$28,422	$78,536
Salvage Value	$5,047	$19,143	$27,949	$59,146
Total Decommissioning Costs, Including Contingency & Salvage Value	**$1,094**	**$41,860**	**$51,383**	**$117,260**

**Values in bolded rows will not sum since they represent percentile values, not totals*

[20] 16 NYCRR Part 1100
[21] Resources | Office of Renewable Energy Siting (ny.gov)
[22] Permit Applications | Office of Renewable Energy Siting (ny.gov)
[23] Original source for this data is a NYSERDA internal database
[24] The low estimate used in the analysis are representative of the 5th percentile for cost estimates.
[25] The high estimate used in the analysis are representative of the 95th percentile for cost estimates.

Attachment J

Evidence of Utility Company Agreement

EVERSOURCE

6A4306-2019, ASD Shutesbury MA Solar LLC
Option A: 4,400 kW PV & 4,400 kW DC-Coupled BESS
Option B: 3,300 kW PV & 3,300 kW DC-Coupled BESS
Option C: 2,200 kW PV & 2,200 kW DC-Coupled BESS
Interconnection Impact Study

Distribution System Impact Study:
Steady State Analysis & Dynamic Analysis

Mark Bentson

Final Report

MA DER Planning
06/29/2023

Prepared by Mark Bentson

Revision History

Date	Rev.	Description
12/20/2022	A	Final Report
06/29/23	B	Additional cost included for conductor relocation near POI per Customer's request.

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Executive Summary

This report consists of Distribution System Impact Study that was performed for the distributed generation interconnection application submitted by ASD Shutesbury MA Solar LLC (Interconnecting Customer) for the following three options which is located at 0 Tower Road, Pelham, MA, 01002 (Eversource Energy ID 6A4306-2019)

- Option A is a 4,400 kW PV & 4,400 kW DC-Coupled BESS
- Option B is a 3,300 kW PV & 3,300 kW DC-Coupled BESS
- Option C is a 2,200 kW PV & 2,200 kW DC-Coupled BESS

The project is proposed to be interconnected on 13.8 kV distribution feeder 17K2, which is fed from Amherst 17K Substation. The steady state and dynamic analyses are documented in Appendix I and Appendix II respectively. Appendix III includes the latest available one-line of the project.

Note: There was a design change occurred when performing the dynamic study. This design change did not affect the Power Flow results in the steady state report and are valid and no re-study is required. Additionally, **the short circuit and effective grounding results are re-evaluated in dynamic study and suitable mitigations are proposed**. Please see below for the design changes summary. Therefore, for Power flow results please refer to Appendix-I and for short circuit analysis and effective grounding please refer to Appendix II.

Item	Design used in System Impact Study	Design used for Dynamic Study
System size	Option A is a 4,400 kW PV & 4,400 kW DC-Coupled BESS	Same as System Impact Study
	Option B is a 3,300 kW PV & 3,300 kW DC-Coupled BESS	
	Option C is a 2,200 kW PV & 2,200 kW DC-Coupled BESS	
Inverter	Two (2) Power Electronics HEMK FS2000K inverters for Option A	Two (2) Power Electronics FS3190K inverters for Option A, both derated to 2,200 kW
	One (1) Power Electronics HEMK FS3000K inverter for Option B	Two (2) Power Electronics FS2125K inverters for Option B, both derated to 1,650 kW
	One (1) Power Electronics HEMK FS2000K inverter for Option C	One (1) Power Electronics FS3190K inverter for Option C derated to 2,200 kW

GSU	Two (2) 13,800/600 V grounded wye-wye step-up transformers, rated at 2,200 kVA for Option A	Two (2) 13,800/600 V grounded wye-wye step-up transformers, rated at 2,200 kVA for Option A
	One (1) 13,800/600 V grounded wye-wye step-up transformer, rated at 3,300 kVA for Option B	Two (2) 13,800/600 V grounded wye-wye step-up transformers rated at 1,650 kVA for Option B
	One (1) 13,800/600 V grounded wye-wye step-up transformer, rated at 2,200 kVA for Option C	One (1) 13,800/600 V grounded wye-wye step-up transformer, rated at 2,200 kVA for Option C
Grounding	A 260 kVA primary side grounding transformer at 4%Z and X/R=4 for Option A	Same as System Impact Study
	A 200 kVA primary side grounding transformer at 4%Z and X/R=4 for Option B	
	A 130 kVA primary side grounding transformer at 4%Z and X/R=4 for Option C	

Steady State Analysis Summary Results for all options:

- Considering all PV-DG in the area of circuits 17K1, 17K2, 17K3, and 17K4 operation at maximum power output, the steady state power flow analysis indicates that there is reverse power flow at the substation transformer. The existing substation transformer does not have the capability to handle the reverse power flow.
  - **Mitigations**
    - Install 3V0 and replace existing Beckwith M 0067E with one new Beckwith M2001D control. 3V0 and LTC upgrades are currently being installed for a capital project. This customer will have to wait until these capital projects are completed before interconnecting.
- Due to protection concerns, the fuses on Pole 1/8 and Pole 1/66 must be upgraded to three phase reclosers and roughly 7,526 ft (1.43 mi) of three phase 1/0 AAC backbone conductor between Pole 1/8 and the lateral interconnecting of the Project (radial tap on Enfield Rd) must be upgraded to 556 AL for all three Options.
- Power flow analysis indicates that there are thermal, voltage, and flicker concerns at light and peak load conditions for all three Options.
  - **Mitigations**
    - The 2,692 ft (0.51 mi) of two spans of #4 ACSR from Pole 10/20 to Synergi section 261744902_0_1 near the lateral interconnecting the Project must be upgraded to 1/0 AAC.

  - The distribution step-down transformer located on the lateral interconnecting the Project at Pole 10/20 must be removed in order to interconnect the Project. All load serving transformers beyond the step-down transformer must be upgraded to accommodate the new voltage level.
  - The 1,200 kVAR capacitor on Pole 103/16 must be taken out of service in order to meet voltage criteria.
  - All three Options are required to run at a fixed leading power factor to address flicker concerns. The Project is required to operate at 94% leading power factor for Option A, 95% leading power factor for Option B, and 97% leading power factor for Option C.
  - The substation LTC must have a set point of 123 V for Option A and 123.5 V for Options B and C with a bandwidth of 1.5 V.
  - The regulator on Pole 1/B62 must have a set point of 122 V and a bandwidth of 2 V for all three Options.
- Fault contribution from the proposed site indicates that project contribution is greater than 10% for Option A 3LG at the Project PCC and less than 10% for all the three options at the Amherst 17K A3 Bus. The maximum available through fault duty at the beginning of 17K2 Circuit is 1,472 A when the project is off-line and 1,643 A for option A, 1,597 A for option B and 1,554 A for option C when the project is on-line. These values are below the 10kA limit utilized by Eversource for distribution interruption capability of distribution equipment in the circuit. Since the fault current level is low, Eversource determined that no mitigation is required.
- Effective grounding is not achieved by the initial customer design. The below mitigations are proposed to achieve proper grounding. A revised Project one-line will need to be submitted to show these changes. Please refer to Appendix II for more details.
  - **Mitigations**
    - **Option A:** Project is required to install a 75 kVA, zig-zag grounding transformer on 13.8 kV (Primary Side) with %Z=4, X/R = 4, to meet Eversource effective grounding criteria.
    - **Option B:** Project is required to install a 45 kVA, zig-zag grounding transformer on 13.8 kV (Primary Side) with %Z=3.5, X/R = 4, to meet Eversource effective grounding criteria.
    - **Option C:** Project is required to install a 30 kVA, zig-zag grounding transformer on 13.8 kV (Primary Side) with %Z=3.5, X/R = 4, to meet Eversource effective grounding criteria.
- Based on the SANDIA Suggested Guidelines for Anti-Islanding Screening and Eversource DER screening for Risk of Islanding assessment, all Options pass ROI evaluations. However, the Project fails TOV screening for all three Options. Therefore, a further study has been performed to determine if the inverters react appropriately and do not cause TOV violations. See the Dynamic Analysis Summary Results below.

Dynamic Analysis Summary Results:

- Effective grounding is revaluated in the dynamic study and it is not achieved by the initial customer design. The below mitigations are proposed to achieve proper grounding. A revised Project one-line will need to be submitted to show these changes. Please refer to Appendix III for more details.
  - **Mitigations**
    - **Option A:** Project is required to install a 112.5 kVA, zig-zag grounding transformer on 13.8 kV (Primary Side) with %Z=5, X/R = 3.39, to meet Eversource effective grounding criteria.
    - **Option B:** Project is required to install a 112.5 kVA, zig-zag grounding transformer on 13.8 kV (Primary Side) with %Z=5, X/R = 3.39, to meet Eversource effective grounding criteria.
    - **Option C:** Project is required to install a 45 kVA, zig-zag grounding transformer on 13.8 kV (Primary Side) with %Z=4, X/R = 2.9, to meet Eversource effective grounding criteria.
- Fault contribution from the proposed site is revaluated in the dynamic study and it indicates that project contribution is greater than 10% for Option A and Option B for both 3LG and 1LG faults at the Project PCC and less than 10% for all the three options at the Amherst 17K A3 Bus. The maximum available through fault duty at the beginning of 17K2 Circuit is 1,472 A when the project is off-line and 1,715 A for option A, 1,721 A for option B and 1,591 A for option C when the project is on-line. These values are below the 10kA limit utilized by Eversource for distribution interruption capability of distribution equipment in the circuit. Since the fault current level is low, Eversource determined that no mitigation is required.
- Based on the study performed with the PSCAD models created by RLC and the data provided by Eversource Energy and the project developer, analysis results indicate:
  - The Project passed the Time Domain Study load rejection overvoltage (LROV) evaluation **provided that the inverter TrOV / Self Protection Over Voltage (SPOV) protection setting is enabled and set to 1.35 PU for 1 ms.**
  - The Project passed the Time Domain Study ground fault overvoltage (GFOV) evaluation. Therefore, no associated upgrades are required.
  - The Project passed the Time Domain Study Risk of Islanding (ROI) evaluation. Therefore, no associated upgrades are required.

Summary of System Upgrades and Cost Estimates:

The +/-25% estimate for the distribution upgrades, 13.8 kV lateral tap, recloser, primary metering package and primary disconnect at the Point of Common Coupling (PCC) is **$2,947,099**

Distribution Costs (for all 3 Options)

COST ESTIMATE			
0 Tower Road, Pelham, MA	Material	Labor	Total
Off Site - Distribution System Upgrades - Substation to Site			
1. Install 7550 ft of 556 AL TW. 2. Install 2692 ft of 1/0 AL TW 3. Replace four fuses with reclosers 4. Three stepdown bank installs 5. Capacitor bank removal	$1,590,540	$744,793	$ 2,335,333
1. Conductor relocation near POI per Customer's request.	$50,643	$74,157	$124,800
On-Site - Interconnection Work			
1. One NOVA Recloser 2. One OH primary meter 3. 336 Poly/ 3 phase line extension	$83,500	$23,750	$107,250
Subtotal	$1,724,683	$842,700	$2,567,383
Tax Adder			
CIAC (14.79%)	$255,081	$124,635	$379,716
Total Distribution Cost			
Total	$1,979,764	$967,335	**$2,947,099**

The +/- 25% estimated cost includes the facilities required to interconnect the proposed Generating Facility to Eversource distribution system but does not include any in-plant facilities constructed, owned, and operated by the applicant.

The interconnection of this distributed generation application is queued behind other applicants which may require system upgrades to the Eversource system, and the cost for those upgrades has been included as a requirement in their respective Interconnection Services Agreement(s).

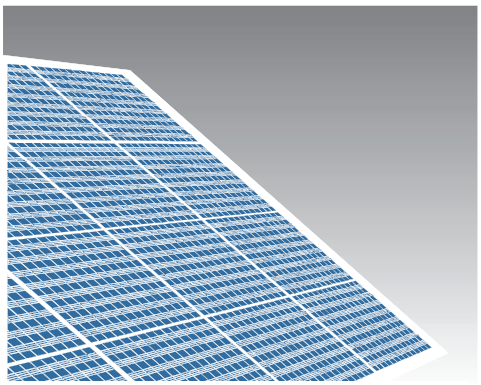
If a prior applicant should dequeue or withdraw for any reason, the system conditions permitting the interconnection of succeeding applicant(s) may change. Upon the withdrawal of previously queued applicants, succeeding applicant(s) may become responsible for some or all of the system upgrades that were required for the prior applicants, and Eversource may have to reassess system conditions to determine if the applicant currently under study would trigger the same upgrades.

Appendix I:

Distribution Impact Study – Steady State Analysis Report

DRAFT REPORT
Revision B

Distribution System Impact Study



ASD Tower MA Solar (6A4306-2019)

Three Option Study:

- Option A – 4,400 kW + BESS Photovoltaic Project
- Option B – 3,300 kW + BESS Photovoltaic Project
- Option C – 2,200 kW + BESS Photovoltaic Project

July 24, 2020

Prepared by:

RLC ENGINEERING

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Revision History

Rev.	Date	Revised by	Reason
A	7/24/2020	GSS	Original Draft Release
B	6/28/2022	AM	Eversource Review
C	6/29/23	MJB	Additional cost included for conductor relocation near POI per Customer's request.

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EXECUTIVE SUMMARY

On behalf of NSTAR Electric Company (NSTAR) DBA Eversource Energy (Eversource), RLC Engineering, LLC (RLC) conducted a Distribution Impact Study (the "Study") on a proposed solar facility (the "Project") interconnecting to the Eversource utility system. The Study ensured the Project is in accordance with NSTAR Electric Company Tariff M.D.P.U. No. 55, *"Standards for Interconnection of Distributed Generation"* (the "Tariff"). As listed in Table 0-1, the Project proposes to interconnect to the 17K2 Eversource feeder, which is served from Eversource's Amherst 17K Substation.

Application #	Address	Developer	Maximum Output (kW / kVA)
6A4306-2019	0 Tower Rd, Pelham, MA	ASD Tower MA Solar	Option A: 4,400 / 4,400
			Option B: 3,300 / 3,300
			Option C: 2,200 / 2,200

Table 0-1: Project Interconnecting on the 17K2 Feeder

The primary focus of this Study is to:

1. Assess compliance of the proposed Project design with requirements of distributed generation interconnecting to the Eversource system according to the Tariff and applicable standards.
2. Assess the steady state and short-circuit impacts of the proposed Project on the distribution systems served from the Amherst 17K2 feeder.
3. Identify distribution system and substation upgrades that may be necessary to complete the interconnection of the Project.

This Study includes a design review, voltage flicker analysis, short circuit analysis, effective grounding analysis, load flow analysis, risk of islanding evaluation, N-1 analysis, thermal analysis and cost estimate required for the interconnection of the Project.

Conceptual Design of Solar Photovoltaic (PV) Facility

The Project proposes to interconnect to the Eversource 13.8 kV distribution system via the 17K2 feeder, which originates at the Eversource Amherst 17K Substation. ASD Tower MA Solar (the "Developer" or "Customer") has proposed three (3) Options to construct a solar generation facility:

- Option A is a 4,400 kWac / 12,000 kWdc PV / 4,400 kW BESS inverter generation facility
- Option B is a 3,300 kWac / 9,500 kWdc PV / 3,300 kW BESS inverter generation facility
- Option C is a 2,200 kWac / 6,000 kWdc PV / 2,200 kW BESS inverter generation facility

Option A
Two (2) Power Electronics HEMK FS2000K inverters connect to the utility distribution system through two (2) new 13,800/600 V grounded wye-wye step-up transformers, rated at 2,200 kVA. A 260 kVA primary side grounding bank at 4%Z and X/R=4 was proposed. The proposed inverters have been certified as UL 1741 and indicate compliance with IEEE 1547.

Option B
One (1) Power Electronics HEMK FS3000K inverters connect to the utility distribution system through a new 13,800/600 V grounded wye-wye step-up transformer, rated at 3,300 kVA. A 200 kVA primary side grounding bank at 4%Z and X/R=4 was proposed. The proposed inverters have been certified as UL 1741 and indicate compliance with IEEE 1547.

Option C
One (1) Power Electronics HEMK FS2000K inverters connect to the utility distribution system through a new 13,800/600 V grounded wye-wye step-up transformer, rated at 2,200 kVA. A 130 kVA primary side grounding bank at 4%Z and X/R=4 was proposed. The proposed inverters have been certified as UL 1741 and indicate compliance with IEEE 1547.

Compliance with MDPU # 55

The proposed interconnection complies with the requirements detailed in M.D.P.U. No. 55, provided all recommendations of this report are met.

Study Findings

The Project was modeled from zero to full active power output to simulate the full spectrum of generation and loading scenarios. The short circuit, effective grounding, load flow, risk of islanding, and thermal analyses were the primary impact assessments performed in this Study. It must be noted that this Study evaluated the Power Electronics HEMK FS2000K (Options A & C) and Power Electronics HEMK FS3000K (Option B) inverters as provided by the Customer. A new application and study will be required if more inverters are added to the Project or other changes are made.

Due to protection concerns, the fuse on Pole 1/8 must be upgraded to a three phase recloser and roughly 7,526 ft (1.43 mi) of three phase 1/0 AAC backbone conductor between Pole 1/8 and the lateral interconnecting of the Project (radial tap on Enfield Rd) must be upgraded to 556 AL for all three Options. Due to thermal, voltage, and flicker concerns, 2,692 ft (0.51 mi) of two spans of #4 ACSR from Pole 10/20 to Synergi section 261744902_0_1 near the lateral interconnecting the Project must be upgraded to 1/0 AAC. Additionally, the distribution step-down transformer located on the lateral interconnecting the Project at Pole 10/20 must be removed in order to interconnect the Project. The 1,200 kVAR capacitor on Pole 103/16 also must be taken out of service in order to meet voltage criteria. The substation LTC must have a set point of 123 V for Option A and 123.5 V for Options B and C with a bandwidth of 1.5 V to meet voltage criteria. The regulator on Pole 1/B62 must have a set point of 122 V and a bandwidth of 2 V for all three Options.

Short Circuit Analysis

Short circuit analysis was conducted with all feeder generation served by the Amherst 17K-3X generation online, as this results in the greatest fault currents. The Project was dispatched with all

inverters at full output (4,400 kW for Option A, 3,300 kW for Option B, 2,200 kW for Option C) injecting into the 17K2 feeder. The short circuit contribution from the Project inverters is not listed in the datasheet, so a 110% fault current contribution was assumed for all Options. As reported in Table 0-2, the greatest fault current measured near the Point of Common Coupling (PCC) increased by approximately 11.62% (Option A), 8.54% (Option B), and 5.58% (Option C) with the respective grounding devices specified in Table 0-3.

Three phase and single-phase faults were simulated pre- and post-Project to evaluate the fault current increase at the Project PCC. The increase in ground fault current as seen in Table 0-2 shows Option A does not meet the requirements of the M.D.P.U. No. 55, which state that the proposed facility will not contribute more than 10% to the distribution feeder's maximum fault current at the PCC. The failure of this requirement indicates that the Project's fault current contribution may have a significant impact on the distribution feeder's protective devices. Eversource will make the final determination as to whether the increase in fault current will adversely affect existing protection settings or equipment. Options B and C both comply with the requirements of the M.D.P.U. No. 55.

Project PCC Fault Duty					
Eversource Project #	Option	Fault Type	Pre-Project Fault Current	Post-Project Fault Current	Change
6A4306-2019	A	3LG	1,472	1,643	11.62%
		1LG	1,018	1,109	8.94%
	B	3LG	1,472	1,597	8.54%
		1LG	1,018	1,082	6.29%
	C	3LG	1,472	1,554	5.58%
		1LG	1,018	1,061	4.22%

Table 0-2: Fault Duty at 6A4306-2019 PCC

Effective Grounding Analysis

New 13,800/600 V grounded wye-wye step-up transformers, rated at 2x 2,200 kVA (Option A) / 3,300 kVA (Option B) / 2,200 kVA (Option C) were studied. Effective grounding criteria was satisfied with the step-up transformer configured as grounded wye primary and wye secondary with the primary side grounding transformer as specified in Table 0-3.

Eversource Project #	Option	Effective Grounding Device
6A4306-2019	A	75 kVA grounding transformer @ 4%Z installed on the low side of the GSU transformer
	B	45 kVA grounding transformer @ 3.5%Z installed on the low side of the GSU transformer
	C	30 kVA grounding transformer @ 3.5%Z installed on the low side of the GSU transformer

Table 0-3: Grounding Transformer Required for Effective Grounding

Voltage Regulation and Fault Duty

The power produced by the Project reduces local losses when generating and raises voltage at and in the general vicinity of the Project. The individual Project is not expected to have a significant effect on the operation of the Amherst 17K-3X distribution transformer LTC.

Eversource has witnessed cases where inverter based PV facilities have operated above the normal utility operating voltage range of +5%, especially at light load periods and full output of the generation facility. If this occurs and causes power quality issues for the Customer with generation or for other customers, the Project will need to be offline until the issue is resolved at the Interconnecting Customer's expense.

Reactive Power Requirements

Based on the electrical specifications, the inverters are designed to operate at unity power factor to achieve full active power output. The Power Electronics FS2000K and FS3000K inverters have the capability to operate from a 0.5 leading to a 0.5 lagging power factor. Since active power output slightly raises the voltage on the distribution system, producing reactive power would only raise the voltage further; and consuming reactive power would reduce the voltage and lead to greater power consumption on the circuit. Therefore, Eversource requires the operation of the inverters at unity power factor unless fixed leading power factor operation is required to mitigate voltage concerns. In this case, the Project must operate at a fixed 94% (Option A) / 95% (Option B) / 97% (Option C) leading power factor to mitigate voltage and flicker concerns.

Switching and Transfer Trip Requirements

The Project exceeds Eversource's 200 kW AC screening criterion, thus a risk of islanding (ROI) evaluation was required.

All three Options passed Eversource's ROI evaluation, and Sandia Screening. All three Options also showed concern for load rejection overvoltage. A dynamic risk of islanding study (D-ROI) is recommended to further evaluate the LROV concerns. If the D-ROI results are acceptable, the ROI mitigation will be waived.

Cost Estimates

The cost impacts to the Eversource distribution system are those associated with the requirements for a new primary service and any construction or equipment modifications to the interconnecting feeder.

Section 3.18 of this report addresses the projected costs related to the interconnection. The high-level ± 25% estimated cost, including CIAC, is shown in Table 0-4. A Detailed Study will be required to design the system modifications and construction schedule. If an early Interconnection Service Agreement (ISA) is not requested, Eversource will refine the estimated costs to +/- 10% during the Detailed Study for inclusion in the Interconnection Service Agreement.

Eversource Project #	Option	Total Project Cost Estimate
6A4306-2019	A	$2,947,099
	B	$2,947,099
	C	$2,947,099

Table 0-4: Cost Estimate Summary

1 BACKGROUND

1.1 Study Objective

The Study objective is to assess the impacts to the Eversource distribution system resulting from the interconnection of solar photovoltaic (PV) and a battery energy storage system (BESS) generation.

The Project proposes to interconnect to the Eversource 13.8 kV distribution system via the 17K2 feeder, which originates at the Eversource Amherst 17K Substation. The Study will evaluate the impact of the Project to the feeder and the proposed area of interconnection to identify upgrades that may be necessary to complete the interconnection pursuant to NSTAR Electric Company Tariff M.D.P.U. No. 55, *"Standards for Interconnection of Distributed Generation."* This Study will address the following items:

- Design Review – Verify the proposed designs include all design components required to meet Eversource's design requirements.
- Impedance model – Develop a model of the distribution system and the proposed Project (PV) reflecting interconnection to the Amherst 17K Substation. Assess voltage and fault current levels pre- and post-Project at minimum and maximum feeder load conditions.
- Conduct a system impact analysis, including short circuit, load flow, thermal and ground fault coordination to determine that each interconnection is effectively grounded and meets over-voltage requirements.
- Identify modifications necessary at the PCC and the substation to accommodate interconnection.
- Develop a cost estimate with an accuracy of ± 25% from the utility related components of the proposed PV interconnection based upon the Project interconnection request and required system enhancements.

Eversource provided the following information to RLC to complete the Study:

- Interconnection Applications – a copy of the completed interconnection application as well as a one-line of the proposed interconnection showing the configuration of all generating facility equipment, current and potential circuits and protection and control schemes.
- Detailed Circuit Maps – the maps include equipment and distances along with the line construction types of the interconnecting circuit.
- Existing Substation One-lines – diagrams showing the model numbers of the substation equipment and the system boundary equivalent at the high side of the distribution transformer.
- Other DG at the substation.
- The Project DG equipment specifications.
- Synergi Model – Eversource provided a GIS based Synergi Electric model of Circuit 17K2.

1.2 Project Description

The Project proposes to interconnect PV generation to the Eversource 13.8 kV distribution system as listed in Table 1-1.

Application #	Address	Developer	Maximum Output (kW/kVA)
6A4306-2019	0 Tower Rd, Pelham MA	ASD Tower MA Solar	Option A: 4,400 / 4,400
			Option B: 3,300 / 3,300
			Option C: 2,200 / 2,200

Table 1-1: Project Interconnecting on the 17K2 Feeder

The proposed Project inverters and GSU transformer data are shown in Table 1-2. The inverter datasheet and certificate show that they are UL 1741 certified and indicate compliance with UL 1741 SA and IEEE 1547. Additional inverter information can be found in Appendix C.

Application #	Option	Step Up Transformer	Inverter(s)	Number of Units
6A4306-2019	A	(2) - 13.8 kV Grounded Wye – 600 V Wye 3 phase, 2,200 kVA, 5.75%Z	Power Electronics HEMK FS2000K	2
	B	(1) - 13.8 kV Grounded Wye – 600 V Wye 3 phase, 3,300 kVA, 5.75%Z	Power Electronics HEMK FS 3000K	1
	C	(1) - 13.8 kV Grounded Wye – 600 V Wye 3 phase, 2,200 kVA, 5.75%Z	Power Electronics HEMK FS2000K	1

Table 1-2: Project Inverter and Transformer Equipment

The Project is proposed as a new installation, and interconnects to the Amherst 17K Substation, 17K2, 13.8 kV feeder. The Project stated primary side protection, which due to the size of the Project is required for all Options. Any Project primary equipment is required to have a 15 kV voltage class rating and a 95 kV BIL rating. A disconnect switch is proposed and must be located at the PCC. The utility primary revenue meter is required to be located near the PCC. The Project primary protection is listed in Table 1-3.

Application #	PCC Switch	Primary Breaker	Primary Relay
6A4306-2019	15 kV Eaton Cooper Power Gang Operated Air Break, Visible Blade, 24/7 Utility Accessible, Lockable	G&W Electric Viper-S Recloser	SEL-651R

Table 1-3: Project Disconnects and Protection Equipment

The Project one-line diagrams are included in Appendix A. The Project Interconnection Applications are included in Appendix B.

1.3 Amherst 17K Substation

The Amherst 17K Substation is a 115/13.8 kV distribution substation located in Amherst, Massachusetts. As illustrated in the one-line diagram in Appendix D, Amherst 17K is configured to be served from two 115 kV lines (Line 1134, Fairmont-Five Corners-Amherst and Line 1044,

Montague-Tillson-Amherst), which feed two 115/13.8 kV delta – grounded wye distribution transformers (17K-3X and 17K-4X). The 17K-3X transformer serves the 13.8 kV A3 Bus with four (4) distribution circuits (17K1, 17K2, 17K3, and 17K4) and the 17K-4X transformer serves the 13.8 kV A4 Bus with four (4) distribution circuits (17K5, 17K6, 17K7 and 17K8).

1.4 Amherst 17K2 Feeder

The 17K2 feeder serves local and commercial customers. There are currently three reclosers (Table 1-4) and one capacitor (Table 1-5) located on this feeder.

Recloser Number	Synergi Section	Pole Number
17K2-60R	429671298_0_2	127/4
17K2-70S	320118466_0_1	9/23
Recloser Pole_1/8	261747455_0_2	1/8

Table 1-4: Amherst 17K2 Reclosers

Synergi Name	Voltage (kV)	Rating (kVAR)	Control	Setting 1 (Close)	Setting 2 (Trip)	Pole Number
CAP_1200_kvar_103/16	13.8	1,200	Voltage	120	126	103/16

Table 1-5: Amherst 17K2 Capacitors

Table 1-6 provides a summary of the Eversource feeder loads that are served from the Amherst 17K-3X distribution transformer. The minimum load values used in the Study model are 30% of the peak load values.

Amherst 17K-3X Loading Summary		
Feeder	Peak Load Reading (kVA)	Minimum Load Reading (kVA)
17K1	3,035	911
17K2	4,524	1,357
17K3	1,099	330
17K4	4,310	1,293
Total	**12,968**	**3,890**

Table 1-6: Amherst 17K-3X Load Breakdown

1.5 Loop Schemes

The scope of this Study focuses on the Project operating on the 17K2 distribution feeder. The Project has not been studied on any other circuits and will not operate on any other circuits. Eversource shall ensure Protection and an SOG are in place to prevent the Project from operating on another circuit.

2 INTERCONNECTION TARIFF REQUIREMENTS

Based upon the criteria defined in the NSTAR Electric Company (NSTAR) DBA Eversource Energy (Eversource) Interconnection Schedule (M.D.P.U. No. 55), the proposed Project is classified as a Group 2 Project (not qualifying for Simplified Interconnection). The proposed Project is expected to comply with the standards for interconnection of distributed generation listed below:

- M.D.P.U. No. 55, "Standards for Interconnection of Distributed Generation"
- Eversource DG Standard, "Information and Technical Requirements For the Interconnection of Distributed Energy Resources (DER)", March 24, 2017
- IEEE Standard 1547-2003, "IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems"
- UL Standard 1741, "Inverters, Converters and Charge Controllers for Use in Independent Power Systems"

2.1 M.D.P.U. No. 55 Requirements

2.1.1 General Design Considerations

New voltage and frequency settings are required after March 1, 2018 to meet the new low voltage ride through (LVRT) criteria. The following are requirements based upon the Project application submittal after March 1, 2018. See the following application table for the results summary of the general design considerations review:

Application #	M.D.P.U. 55 Section 4.1 Requirements				
	4.1.1	4.1.2	4.1.3	4.1.4	4.1.5
	Transient Voltage Conditions	Noise and Harmonics	Frequency Adjustable Settings	Voltage Levels Match Utility	Inverter Reactive Capability
6A4306-2019	None Created	< 3%	Yes	Yes	0.5 Lead/Lag

Table 2-1: General Design Considerations Review Results

2.1.2 Protection Requirements – M.D.P.U. No. 55

This section provides ISO-NE NPCC criteria evaluation in accordance with the Tariff. The requirements of this section are taken from M.D.P.U. No. 55, which contains application details on integrating distributed resources impacts on the ISO-NE Bulk Power System. Table 2-2 provides the results of the application design details review.

Application #	M.D.P.U. No. 55 Section 4.2 Requirements				
	4.2.3.2.1a	4.2.3.2.1b	4.2.3.2.1b	4.2.3.2.1c	4.2.3.2.1d
	Non-export Power	NPCC Relay Requirements	NPCC Under Frequency Load Shed	Disconnect Switch	Transfer Trip
6A4306-2019	Intend to Export – N/A	Connected to Distribution Only – N/A	Ensure Eversource Required Frequency Settings Are Met	Yes	See Section 3.11 of this report

Table 2-2: Protection Requirements – MDPU Tariff No. 55

2.2 Protection Requirements – IEEE 1547

The remaining requirements of this section are taken from IEEE 1547, which contains general requirements on integrating distributed resources into the utility electric power system. Note that Eversource has not approved IEEE 1547-2018 for use, consequently, the 2003 version has been applied in this Study along with Eversource's LVRT requirements. Table 2-3 provides the results of the application design review.

IEEE 1547-2003 Requirements – Application 6A4306-2019		
Paragraph	Description	Details
4.1.1	Voltage Regulation	No Active Regulation
4.1.2	Integration with AREA EPS Grounding	See Section 3.4
4.1.3	Synchronization	Yes
4.1.4	Distribution Network	Connecting into Existing 13.8 kV Distribution Circuit
4.1.5	Inadvertent Energization of the Area EPS	A Dynamic ROI study is recommended for further evaluation
4.1.6	Monitoring Provisions	Utility Owned Primary Metering
4.1.7	Isolation Device	Visible Break needs to be verified
4.1.8.2	Surge Withstand Performance	Verify BIL Ratings and Surge Protection
4.2.2	Area EPS Reclosing Coordination	Will not Reclose Until Utility Parameters are Correct
4.2.3	Voltage	Ensure Eversource Required LVRT Settings: 50% @ 1.1s, 88% @ 2s, 110% @ 2s, 120% @0.16s
4.2.4	Frequency	Eversource Required LVRT Settings: 56.5 Hz @ 0.16s, 58.5 Hz @ 300s, 61.2 Hz @ 300s and 62 Hz @ 0.16s
4.2.5	Loss of Synchronism	Inverter Based Generation - N/A
4.2.6	Reconnection of Area EPS	Will not Reclose Until Utility Parameters are Correct
4.3.1	Power Quality	UL 1741 and IEEE 1547 Compliant
4.3.2	Limitation of Flicker Induced by the DR	See Section 3.8
4.3.3	Harmonics	UL 1741 Compliant
4.4.1	Unintentional Islanding	A Dynamic ROI study is recommended for further evaluation

Table 2-3: Protection Requirements – IEEE 1547-2003

2.3 Solar Inverter

Table 2-4 summarizes the design of the proposed inverters based on the manufacturer information provided.

Option	Inverter Manufacturer/Model	Harmonics <3%	UL1741 and IEEE 1547 Certified	Maximum Current	Operating Voltage Range	Inverter Anti-Islanding
A & C	Power Electronics HEMK FS2000K	Yes	Yes	2,120 A	90-110%	Yes
B	Power Electronics HEMK FS3000K	Yes	Yes	3,175 A	90-100%	Yes

Table 2-4: Inverter Design Review Information

3 SYSTEM IMPACT ASSESSMENTS

3.1 System Analysis

The Project was studied on the 17K2 feeder served by the 17K-3X transformer. The peak daytime loading on the 17K-3X was measured to be approximately 12,968 kVA. The minimum daylight loading was assumed to be approximately 30% of the peak load, or 3,890 kVA. The feeder has 1,105 kW of completed PV generation and an aggregate of 7,945 kW (Option A) / 6,845 kW (Option B) / 5,745 kW (Option C) of in-process PV generation, which includes the Project.

Table 3-1 provides a list of all generation, including the Project, compared to the loading on the Amherst 17K-3X transformer.

Amherst 17K-3X Loading and Generation Summary				
Feeder	Total Generation (kW)		Peak Load Reading (kVA)	Minimum Load Reading (kVA)
	Existing	Proposed		
17K1	7,741	1,000	3,035	911
17K2	1,105	Option A: 6,905 Option B: 5,805 Option C: 4,705	4,524	1,357
17K3	185	0	1,099	330
17K4	2,344	40	4,130	1,293
Total	**6,571**	**Option A: 7,945** **Option B: 6,845** **Option C: 5,745**	**12,968**	**3,890**

Table 3-1: Amherst 17K-3X Transformer Loading Compared to Generation Output

Based on the total generation as compared to load, a transmission system load flow analysis may be necessary for the Project. Eversource's Transmission Planning Department will review the analysis and make this determination.

3.2 Short Circuit Analysis

The Synergi model was used to create an aggregate feeder model in CYME, which was used for short circuit analysis since Synergi lacks the capability to accurately perform short circuit simulations. The fault contribution from the Project inverters was assumed to be 110%.

The purpose of this evaluation is to determine the impact to the electric power distribution system. Short circuit analysis was conducted with all generation served by the 17K-3X transformer online, as this results in the greatest fault currents. To determine the greatest amount of fault current, the Project was dispatched at full output 4,400 kW (Option A) / 3,300 kW (Option B) / 2,200 kW (Option C) injecting into the feeder. Three phase and single phase fault currents were tested for the pre- and post-Project conditions. The pre- and post-fault duties in Table 3-2 demonstrate the Project fault duty contribution at the Project PCC. Table 3-3 gives the pre- and post-Project fault duty at the Amherst 17K 13.8 kV A3 Bus (for maximum contribution).

Project PCC Bus Fault Duty					
Eversource Project #	Option	Fault Type	Pre-Project Fault Current	Post-Project Fault Current	Change
6A4306-2019	A	3LG	1,472	1,643	11.62%
		1LG	1,018	1,109	8.94%
	B	3LG	1,472	1,597	8.54%
		1LG	1,018	1,082	6.29%
	C	3LG	1,472	1,554	5.58%
		1LG	1,018	1,061	4.22%

Table 3-2: Fault Duty at Project PCC of Amherst 17K2 Feeder

Amherst 17K 13.8 kV A3 Bus Fault Duty					
Location	Option	Fault Type	Pre-Project Fault Current	Post-Project Fault Current	Change
Amherst 17K 13.8 kV A3	A	3LG	7,740	7,920	2.32%
		1LG	8,437	8,521	1.00%
	B	3LG	7,740	7,876	1.75%
		1LG	8,437	8,500	0.75%
	C	3LG	7,740	7,831	1.17%
		1LG	8,437	8,479	0.50%

Table 3-3: Fault Duty at Amherst 17K 13.8 kV A3 Bus

3.3 Ground Fault Coordination

Table 3-2 shows with the Project interconnecting an increase in single line to ground fault current at the PCC to be approximately 8.94% (Option A) / 6.29% (Option B) / 4.22% (Option C) and the increase in three phase fault current to be approximately 11.62% (Option A) / 8.54% (Option B) / 5.58% (Option C). Option A does not meet the requirements of the M.D.P.U. No. 55, which state that the proposed facility will not contribute more than 10% to the distribution feeder's maximum fault current at the PCC. The failure of this requirement indicates that the Project's fault current contribution may have a significant impact on the distribution feeder's protective devices. Eversource will make the final determination as to whether the increase in fault current will adversely affect existing protection settings or equipment. Options B and C both comply with the requirements of the M.D.P.U. No. 55.

Table 3-3 shows with the Project interconnecting an increase in single line to ground fault current at the Amherst 17K 13.8 kV A3 Bus to be approximately 1.00% (Option A) / 0.75% (Option B) / 0.50% (Option C) and the increase in three phase fault current to be approximately 2.32% (Option A) / 1.75% (Option B) / 1.17% (Option C), showing that the maximum fault current contribution from the Project is minimal at the Amherst 17K Substation. However, due to the fault current

increase at the PCC from Option A, Eversource will make the final determination as to whether or not the Project will cause an adverse impact to distribution feeder's protective devices.

3.4 Distribution Circuit Grounding

It is intended for the utility distribution circuit to remain effectively grounded in any configuration to limit the unfaulted phase voltages to less than or equal to 125% of nominal phase-to-ground circuit voltage. To ensure effective grounding criteria is met, Eversource requires that the X0/X1 ratio at the PCC be between 2 and 3 and that the R0/X1 ratio at the PCC be between 0 and 1.

With the 13,800/600 V step-up transformer(s) rated at 2x 2,200 kVA (Option A) / 3,300 kVA (Option B) / 2,200 kVA (Option C) configured as grounded-wye primary and wye secondary, effective grounding criteria was satisfied with the primary side grounding transformers specified in Table 3-4.

Option	6A4306-2019 PCC Project Effective Grounding				
	Parameter	PU Impedance	Criteria		Notes
A	X1	21.48	2<X0/X1<3	Pass	75 kVA grounding transformer @ 4%Z (X/R = 4)
	X0	50.40			
	R0	12.63			
	X0/X1	2.35			
	R0/X1	0.59	0<R0/X1<1	Pass	
B	X1	28.44	2<X0/X1<3	Pass	45 kVA grounding transformer @ 3.5%Z (4 X/R)
	X0	72.63			
	R0	18.22			
	X0/X1	2.55			
	R0/X1	0.64	0<R0/X1<1	Pass	
C	X1	41.92	2<X0/X1<3	Pass	30 kVA grounding transformer @ 3.5%Z (4 X/R)
	X0	106.94			
	R0	26.87			
	X0/X1	2.55			
	R0/X1	0.64	0<R0/X1<1	Pass	

Table 3-4: Grounding Transformer Required for Effective Grounding

3.5 Steady State Analysis

3.5.1 Short Circuit Stiffness Ratio

The system stiffness is the ability of an Area EPS to resist voltage deviations caused by distributed generation or loading. The stiffness ratio is generally used as an indicator for PCCs. The stiffness ratio is the relative strength of the area EPS at the PCC compared with the Project. Taking into account the utility's short circuit contribution and the Project contributions, the stiffness ratio can be determined for this application with the following equation from IEEE 1547.2-2008:

$$Stiffness\ ratio = \frac{SC\ kVA(Area\ EPS)}{Nameplate(DR)} + 1$$

Interconnection Stiffness Ratio						
Eversource Project Number	Feeder Voltage (kV)	Options	3LG Fault Current (All Gen. Off)	SC kVA Area EPS	Project Nameplate Output (Max kW / kVA)	Stiffness Ratio
6A4306-2019	13.8	A	1,454	34,758	4,400	**8.9**
		B	1,454	34,758	3,300	**11.5**
		C	1,454	34,758	2,200	**16.8**

Table 3-5: Project Stiffness Ratio

Table 3-5 shows the system strength is not large compared to the individual Project for all three Options. Typically, with stiffness ratios greater than 20, it can be assumed that feeder voltages will be minimally affected. Further analysis proved the Project did not maintain the required voltage tolerance under all feeder load conditions.

3.5.2 Load Flow Analysis

Load flow analysis was performed using Synergi distribution simulation software. Eversource provided a GIS model of the Amherst 17K2 distribution feeder. Load flow simulations were based upon the projected maximum and minimum loading of the circuits. The 17K2 distribution feeder modeled in Synergi has a peak load of approximately 4,524 kVA. The minimum daylight loading was assumed to be approximately 30% of the peak load, or 1,357 kVA. In general, Eversource models large loads (generally greater than or equal to 1,000 kW) based upon peak-metered data for that facility. Smaller loads (generally less than 1,000 kW) were modeled based upon peak metered data for the feeder and apportioned using the Connected kVA load allocation methodology.

Upon receiving the models, RLC reviewed and adjusted the voltage regulator (VR) settings and VAR-controlled capacitor settings to align with Eversource standard settings.

VR and Distribution Transformer LTC Settings	
Mid-Point	124.5 V
Bandwidth	1.5 V

Table 3-6: Voltage Regulator and Distribution Transformer LTC Settings

VAR-Controlled Capacitor Settings	
Close	⅔ · (Phase-rating)
Open	(Close Setting) - 1.25 · (Phase-rating)

Table 3-7: VAR-Controlled Capacitor Settings

The Study objective is to assess the impacts to the Eversource distribution system resulting from the interconnection of solar photovoltaic (PV) generation. Peak and light load scenarios were tested with PV generation scaled between 0-100% both pre- and post-Project to determine the impact of the Project on feeder voltages. The load flows were completed to observe minimum and maximum

loading conditions. With the Project interconnected and operating at unity power factor, Eversource voltage criteria (95% - 105%) was not maintained in the Synergi model provided for any of the three Options. Further analysis showed that Eversource voltage criteria was maintained after reconductoring and making adjustments to circuit equipment.

Due to protection concerns, the fuses on Pole 1/8 and Pole 1/66 must be upgraded to three phase reclosers and roughly 7,526 ft (1.43 mi) of three phase 1/0 AAC backbone conductor between Pole 1/8 and the lateral interconnecting of the Project (radial tap on Enfield Rd) must be upgraded to 556 AL for all three Options. Due to thermal, voltage, and flicker concerns, 2,692 ft (0.51 mi) of two spans of #4 ACSR from Pole 10/20 to Synergi section 261744902_0_1 near the lateral interconnecting the Project must be upgraded to 1/0 AAC. Additionally, the distribution transformer located on the lateral interconnecting the Project at Pole 10/20 must be removed in order to interconnect the Project. The 1,200 kVAR capacitor on Pole 103/16 also must be taken out of service in order to meet voltage criteria. All three Options are required to run at a fixed leading power factor to address flicker concerns, but some additional adjustments to the substation LTC and regulator on Pole 1/B62 are needed in order to meet voltage criteria as shown in Table 3-8.

17K2 Regulator Settings				
Option	**Substation LTC Set Point**	**Substation LTC Bandwidth**	**REG 1/B62 Set Point (All Phases)**	**REG 1/B62 Bandwidth (All Phases)**
A	123 V	1.5 V	122 V	2 V
B	123.5 V	1.5 V	122 V	2 V
C	123.5 V	1.5 V	122 V	2 V

Table 3-8: New Regulator Settings

Figure 3-1 shows a comparison of pre- and post-Project voltages with the Project interconnecting under peak load and 100% PV output conditions for Option A. Under light load conditions, voltages as high as 110.33% were seen on the feeder due to the interconnection of the Project. With the upgrades and settings changes mentioned above and the Project operating at 94% leading power factor to meet flicker criteria, voltages along the feeder are within Eversource criteria. Figure 3-2 shows a comparison of the Project from pre- to post-Project under light load and 100% PV output conditions for Option A.

Figure 3-3 shows a comparison of pre- and post-Project voltages with the Project interconnecting under peak load and 100% PV output conditions for Option B. Under light load conditions, voltages as high as 108.58% were seen on the feeder due to the interconnection of the Project. With the equipment and settings changes mentioned above and the Project operating at 95% leading power factor to meet flicker criteria, voltages along the feeder are within Eversource criteria. Figure 3-4 shows a comparison of the Project from pre- to post-Project under light load and 100% PV output conditions for Option B.

Figure 3-5 shows a comparison of pre- and post-Project voltages with the Project interconnecting under peak load and 100% PV output conditions for Option C. Under light load conditions, voltages as high as 107.25% were seen on the feeder due to the interconnection of the Project. With the equipment and settings changes mentioned above and the Project operating at 97% leading power factor to meet flicker criteria, voltages along the feeder are within Eversource criteria. Figure 3-6

shows a comparison of the Project from pre- to post-Project under light load and 100% PV output conditions for Option C.

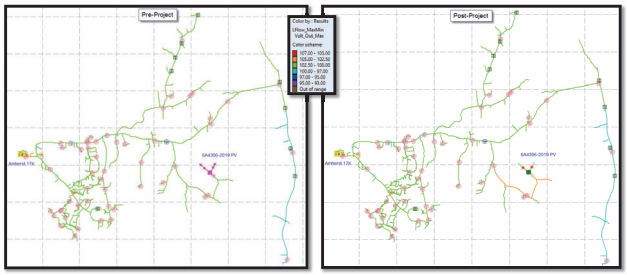


Figure 3-1: Synergi Electric Voltage Diagram: Peak Load, PV 100% Output Voltages (Option A)

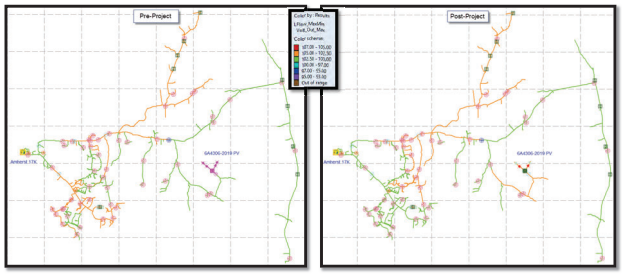


Figure 3-2: Synergi Electric Voltage Diagram: Light Load, PV 100% Output Voltages (Option A)

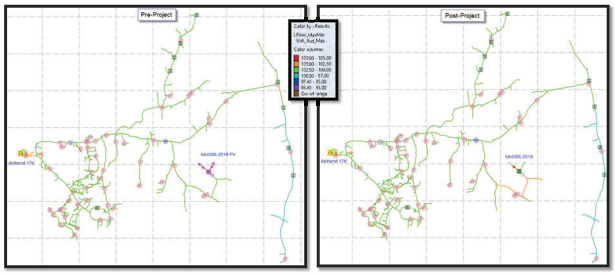


Figure 3-3: Synergi Electric Voltage Diagram: Peak Load, PV 100% Output Voltages (Option B)

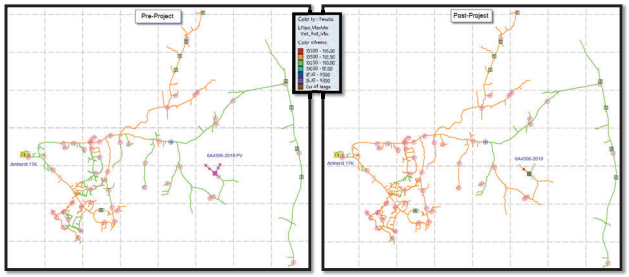


Figure 3-4: Synergi Electric Voltage Diagram: Light Load, PV 100% Output Voltages (Option B)

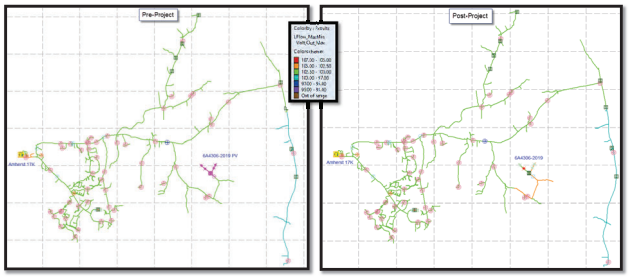


Figure 3-5: Synergi Electric Voltage Diagram: Peak Load, PV 100% Output Voltages (Option C)

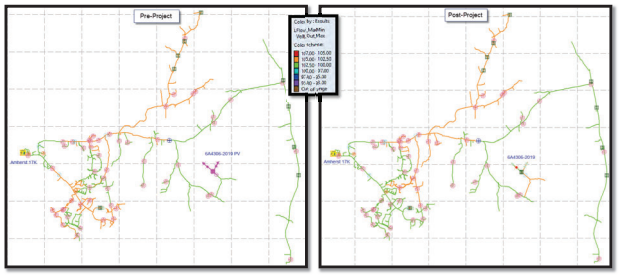


Figure 3-6: Synergi Electric Voltage Diagram: Light Load, PV 100% Output Voltages (Option C)

Table 3-9 summarizes the pre- and post-Project system voltages at the Project PCC and Substation's 13.8 kV A3 Bus for all three Options.

LTCs Adjusting					
Option	Loading	Measurement	Voltages (%) PV Online at Max Pre-Project	Voltages (%) PV Online at Max Post-Project	Voltage Change
A	Peak	PCC	101.44	103.86	2.42
		Substation's 13.8 kV A3 Bus	103.35	102.54	-0.81
	Light	PCC	101.58	104.22	2.63
		Substation's 13.8 kV A3 Bus	102.42	102.20	-0.22
B	Peak	PCC	101.44	103.49	2.05
		Substation's 13.8 kV A3 Bus	103.35	102.83	-0.52
	Light	PCC	101.58	103.54	1.96
		Substation's 13.8 kV A3 Bus	102.42	102.50	0.08
C	Peak	PCC	101.44	103.08	1.63
		Substation's 13.8 kV A3 Bus	103.35	103.08	-0.27
	Light	PCC	101.58	103.48	1.89
		Substation's 13.8 kV A3 Bus	102.42	102.78	0.37

Table 3-9: Synergi Electric 17K2 Load Flow Results

As shown in Table 3-9, voltage levels on the 17K2 feeder meet Eversource criteria.

Under peak load conditions, the pre- to post-Project voltage change at the PCC is 2.42% (Option A), 2.05% (Option B), and 1.63% (Option C). The pre- to post-Project voltage change at the Substation is -0.81% (Option A), -0.52% (Option B), and -0.27% (Option C).

Under light load conditions, the voltage change from pre- to post-Project is 2.63% (Option A), 1.96% (Option B), and 1.89% (Option C) at the PCC, and -0.22% (Option A), 0.08% (Option B), and 0.37% (Option C) at the substation. Voltages at the PCC are within the IEEE 1547 limits of ± 5% under both peak and light load conditions.

Voltages were also observed under a nighttime loading scenario (15% of Peak) with all battery generation at full output (Option A: 4,400 kW, Option B: 3,300 kW, Option C: 2,200 kW). All voltage criteria were maintained under the nighttime loading scenario. A scenario with the batteries charging under peak load with all PV generation offline was not examined since they will not be permitted to charge from the grid.

Table 3-10 shows the LTC operation of the substation transformer and Table 3-11 shows the tap operation of the circuit regulator on Pole 1/B62. These tables show that when the Project drops from 100% to 5% output, the tap positions of the regulating equipment do not change by more than one position under both peak and light load scenarios.

Regulator Name	Option	Tap Positions: Peak Load, 100% Output			Peak Load, 5% Output			Light Load, 100% Output			Light Load, 5% Output		
		A	B	C	A	B	C	A	B	C	A	B	C
Substation Transformer	A	-6	x	x	-7	x	x	-8	x	x	-9	x	x
	B	-6	x	x	-6	x	x	-8	x	x	-9	x	x
	C	-6	x	x	-6	x	x	-8	x	x	-9	x	x

Table 3-10: LTC Operation

Regulator Name	Option	Tap Positions: Peak Load, 100% Output			Peak Load, 5% Output			Light Load, 100% Output			Light Load, 5% Output		
		A	B	C	A	B	C	A	B	C	A	B	C
REG_1/B62	A	0	0	-1	0	1	-1	-2	-1	-1	-2	-1	-2
	B	-1	0	-1	-1	0	-2	-3	-2	-2	-2	-1	-2
	C	-1	-1	-2	-1	0	-2	-3	-2	-2	-2	-1	-2

Table 3-11: Circuit Regulator Operation

3.6 Voltage Regulation / LTC Backfeed

IEEE 1547 states the voltage fluctuation at the PCC should not be greater than +/-5% of the prevailing voltage upon synchronization of the parallel generator. As can be observed from the load flows provided in Section 3.5.2, voltages are adequately maintained across the feeder with the necessary upgrades.

Eversource has seen cases where inverter based PV facilities have operated above the normal utility operating voltage range of +5%. If this occurs and causes power quality issues for the Customer with generation or for other customers, the Project will need to be offline until the issue is resolved at the Interconnecting Customer's expense.

3.7 N-1 Assessment

There is one sectionalizing device on feeder 17K2 that does not island the Project, recloser 17K2-70S. An N-1 load flow analysis was performed for the sectionalizing devices and no voltage criteria violations were observed under simulated loading conditions.

3.8 Voltage Flicker Assessment

The voltage flicker assessment examined the impact of fluctuating PV generation on circuit voltages. Cloud cover was simulated as a 100% to 5% step change in PV output, with taps fixed. Eversource requires that the maximum voltage delta on the feeder be less than 2% for PV interconnections.

With the Project operating at unity power factor, and all PV generation within a 0.25 mile radius of the Project ramping from 100% to 5% output simultaneously, the Project fails Eversource flicker criteria for all three Options. In order to meet flicker criteria, the Project must operate at a fixed leading power factor of 94% (Option A) / 95% (Option B) / 97% (Option C). With the Project operating at a fixed leading power factor, the greatest voltage change on the feeder was simulated to be 1.88% (Option A), 1.88% (Option B), and 1.88% (Option C), satisfying Eversource's flicker criteria.

3.9 Thermal Ratings

Eversource has established a requirement that generation amounts should not exceed 95% of the substation transformer's maximum thermal rating. If this limit is exceeded, the Customer may be required to upgrade or replace the substation transformer. The total generation served by the 17K-3X is 19,321 kVA (Option A) / 18,221 kVA (Option B) / 17,121 kVA (Option C). The maximum rating of the Amherst 17K-3X substation transformer is 47,000 kVA. Thus, the generation to transformer maximum ratings ratio is 41.11% (Option A) / 38.77% (Option B) / 36.43% (Option C), which is within the Eversource limit of 90%. Table 3-12 summarizes these results.

Distribution Transformer	Option	Maximum Rating (kVA)	Total Generation (kVA)	Percent of Maximum Transformer Rating
17K-3X	A	47,000	19,321	41.11%
	B		18,221	38.77%
	C		17,121	36.43%

Table 3-12: Thermal Rating Analysis

Power flows were observed with all PV offline during peak loading conditions as well as with all PV operating at full capacity during minimum loading conditions. There is 2,692 ft (0.51 mi) of two spans of #4 ACSR conductor between Pole 10/20 and Synergi section 261744902_0_1 on the lateral interconnecting the Project that violates Eversource's 90% loading criteria for Options A and B. This must be upgraded to 1/0 AAC to alleviate the loading violations and is recommended to be upgraded for all three options since it also helps to alleviate voltage and flicker concerns. Table 3-13 contains the results for the highest loaded sections for all three Options under both peak and light conditions with the 1/0 AAC upgrade. The highest loading was 78% (Option A) / 60% (Option B) / 42% (Option C) under light load conditions and 40% (Option A, B and C) under peak load conditions, showing that there are no thermal violations on the 17K2 feeder.

Section ID	Option	Length (ft)	Conductor Type	Section Rating (A)	Peak Load, No Generation: Power Flow (A)	Peak Load, No Generation: % of Rating	Minimum Load, Peak Generation: Power Flow (A)	Minimum Load, Peak Generation: % of Rating
320106471_0_1	Option A	470.1	1/0 ACSR	250	95	38%	196	78%
321094572_0_1	Option A	228.3	336 ACSR	535	214	40%	283	53%
320106471_0_1	Option B	470.1	1/0 ACSR	250	95	38%	151	60%
321094572_0_1	Option B	228.3	336 ACSR	535	214	40%	239	45%
320106471_0_1	Option C	470.1	1/0 ACSR	250	95	38%	106	42%
321094572_0_1	Option C	228.3	336 ACSR	535	214	40%	194	36%

Table 3-13: Transmission Element Loading

3.10 Reactive Power

The Project is required to operate at a fixed leading power factor of 94% (Option A) / 95% (Option B) / 97% (Option C) in order to mitigate voltage and flicker concerns. As shown in Table 3-14, the Project increases the reactive demand of Circuit 17K2 by 2,194 kVAR (Option A) / 1,480 kVAR (Option B) / 796 kVAR (Option C). Eversource will make the final determination as to whether reactive compensation is required.

17K2 Reactive Power Flow			
Option	Pre-Project (kVAR)	Post-Project (kVAR)	Difference
A	955	3,149	2,194
B	955	2,435	1,480
C	955	1,751	796

Table 3-14: Reactive Power Analysis

3.11 Risk of Islanding Evaluation

The Eversource Risk of Islanding (ROI) evaluation follows the guidelines set forth in the following documents:

- Eversource's DSEM 19.028, "Risk of Islanding Screening Process"
- Sandia Report, "Suggested Guidelines for Anti-Islanding Screening"
- Eversource's DER Briefing Sheet, "Risk of Islanding Evaluations"

Because the Project exceeds Eversource's 200 kW AC screening criterion, a ROI evaluation is required. One circuit interrupting device bounds the Project PCC, substation breaker 17K2-2. The ROI evaluation is first conducted considering the substation breaker. If the ROI evaluation fails for the 17K2-2 breaker, a direct transfer trip (DTT) or other control and protection remediation scheme may be required from the Project PCC to the substation breaker. A failure of this evaluation triggers the need for a dynamic ROI evaluation or a control and protection remediation scheme from the Project PCC to the bounding device. Two additional 3-ph gang operated reclosers be introduced to replace single phase fuse banks on Pole 1/8 and Pole 1/66. If the feeder breaker passes, the next bounding device would need to be evaluated.

3.11.1 Eversource Risk of Islanding Screening and Sandia Screen

Figure 3-7 shows a flowchart outlining Eversource's ROI process, which aids in the determination of whether DTT or other anti-islanding remediation will be required for proposed DG projects greater than 200 kW. The Project, which is a 4,400 kW (Option A) / 3,300 kW (Option B) / 2,200 kW (Option C) facility, requires an ROI evaluation.

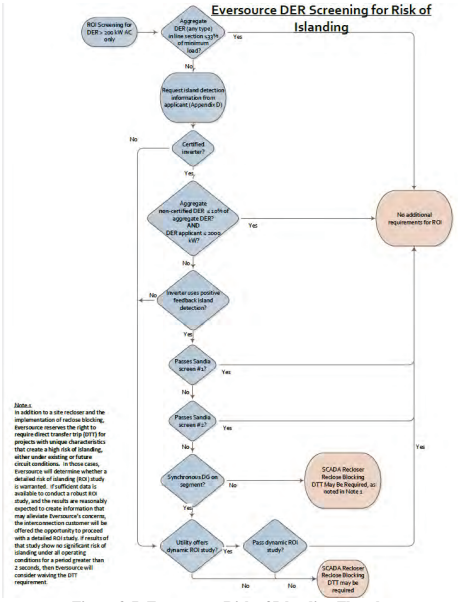


Figure 3-7: Eversource Risk of Islanding Flowchart

Figure 3-7 summarizes the results of the Eversource ROI screening process. Failure of Sandia Screen Step 2 or 3 triggers the requirement for either a dynamic ROI evaluation or a DTT scheme.

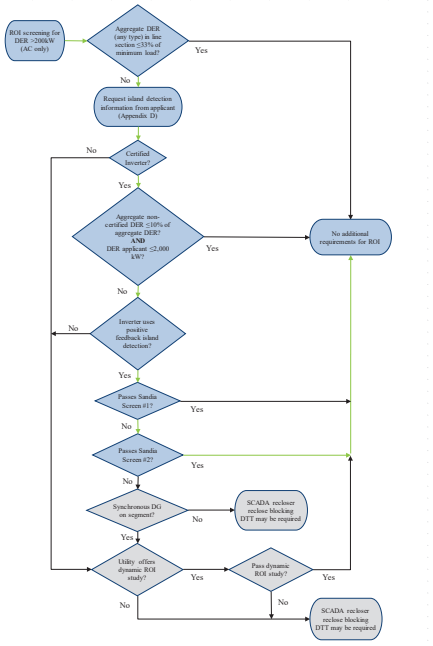


Figure 3-8: Eversource ROI Screening Results (Option A)

The Project's maximum output for Option A (4,400 kW) exceeds the 2,000 kW DER applicant size, but Option A passes Eversource's ROI evaluation.

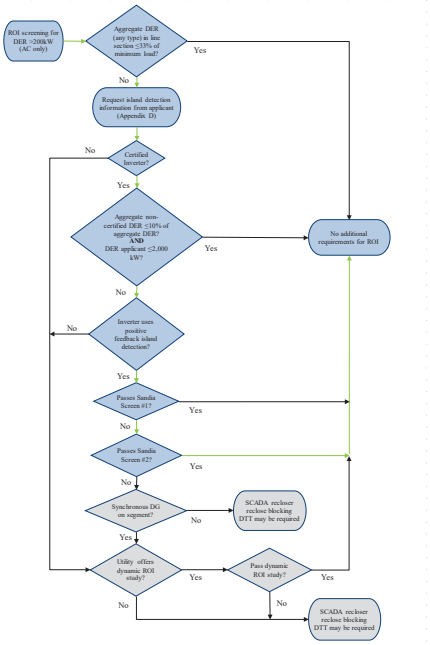


Figure 3-9: Eversource ROI Screening Results (Option B)

The Project's maximum output for Option B (3,300 kW) exceeds the 2,000 kW DER applicant size, but Option B passes Eversource's ROI evaluation.

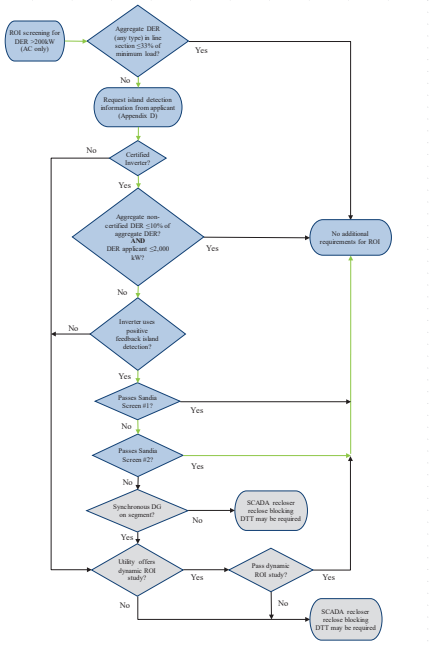


Figure 3-10: Eversource ROI Screening Results (Option C)

The Project's maximum output for Option C (2,200 kW) exceeds the 2,000 kW DER applicant size, but Option C passes Eversource's ROI evaluation.

3.11.1 Positive Feedback Island Detection

The inverters for all three Options use positive feedback island detection, so the Project passes this step of the evaluation. Thus, additional steps must be evaluated.

3.11.2 Sandia Screen Step 1 – Real Power Balance

The aggregate AC ratings for generation within the isolated feeder sections, excluding DER equipped with DTT, is greater than 67% of the minimum daylight feeder load for all three Options. Thus, Step 1 of the Sandia Screen fails, and Step 2 must be evaluated.

3.11.3 Sandia Screen Step 2 – Reactive Power Balance

Under both Peak and Light load scenarios, the power factor at the substation does not exceed 99% for any of the three Options, so all three Options pass this step.

3.11.4 Synchronous DG

There is no synchronous DG on the feeder.

3.12 Load Rejection Overvoltage Screening

Generation-to-load ratios of 2 or greater indicate a potential for load rejection overvoltage (LROV) concerns. Furthermore, a statement of compliance with HECO Rule 14 Appendix I may mitigate concerns for ratios up to 10.

Evaluated Area	Scenario	Quantity (kVA)	Ratio	Pass/Fail
Substation	Total Generation	19,321	5.0	Fail
	Minimum Daytime Load	3,890		
Feeder	Total Generation	8,010	5.9	Fail
	Minimum Daytime Load	1,357		
Smallest Bounded Section (Behind Fuse on Pole 19/12)	Total Generation	4,400	107.3	Fail
	Minimum Daytime Load	41		

Table 3-15: LROV Screening Option A

Evaluated Area	Scenario	Quantity (kVA)	Ratio	Pass/Fail
Substation	Total Generation	18,221	4.7	Fail
	Minimum Daytime Load	3,890		
Feeder	Total Generation	6,910	5.1	Fail
	Minimum Daytime Load	1,357		
Smallest Bounded Section (Behind Fuse on Pole 19/12)	Total Generation	3,300	80.5	Fail
	Minimum Daytime Load	41		

Table 3-16: LROV Screening Option B

Evaluated Area	Scenario	Quantity (kVA)	Ratio	Pass/Fail
Substation	Total Generation	17,121	4.4	Fail
	Minimum Daytime Load	3,890		
Feeder	Total Generation	5,810	4.3	Fail
	Minimum Daytime Load	1,357		
Smallest Bounded Section (Behind Fuse on Pole 19/12)	Total Generation	2,200	53.7	Fail
	Minimum Daytime Load	41		

Table 3-17: LROV Screening Option C

It can be seen that the Project fails screening criteria and causes LROV concerns for all three Options. An additional Time Domain Study is recommended to further evaluate these concerns.

3.13 Risk of Islanding Conclusion

Since each Project Option is > 200 kW, all three Options will require an Eversource ROI evaluation.

For all three Options, the Project at full output (4,400 kW / 3,300 kW / 2,200 kW) passes both the Eversource ROI screening and Sandia Screens 1 and 2 at the substation breaker. The new reclosers on Pole 1/8 and Pole 1/66 were also evaluated, and the Project passes the ROI evaluation at both locations for all three Options.

There is no synchronous DG on the feeder. As shown in Table 3-15, Table 3-16, and Table 3-17 there is concern for load rejection overvoltage. A dynamic ROI study is recommended for all three Options, since all three Options show LROV concerns.

The Project will only operate on the normal configuration of the 17K2 feeder. Operating in an alternate switched configuration will not be permitted. Eversource will write a Special Operating Guideline, which will address operation of the distribution system and the proposed Project.

3.14 Substation Modifications

There are no substation modifications identified as being necessary to accommodate the addition of the Project.

3.15 Circuit Modifications

Due to protection concerns, the fuses on Pole 1/8 and Pole 1/66 must be upgraded to three phase reclosers and roughly 7,526 ft (1.43 mi) of three phase 1/0 AAC backbone conductor between Pole 1/8 and the lateral interconnecting of the Project (radial tap on Enfield Rd) must be upgraded to 556 AL for all three Options. Due to thermal, voltage, and flicker concerns, 2,692 ft (0.51 mi) of two spans of #4 ACSR from Pole 10/20 to Synergi section 261744902_0_1 near the lateral interconnecting the Project must be upgraded to 1/0 AAC. Additionally, the distribution step-down transformer located on the lateral interconnecting the Project at Pole 10/20 must be removed in order to interconnect the Project. The 1,200 kVAR capacitor on Pole 103/16 also must be taken out of service in order to meet voltage criteria. The substation LTC must have a set point of 123 V for Option A and 123.5 V for Options B and C with a bandwidth of 1.5 V. The regulator on Pole 1/B62 must have a set point of 122 V and a bandwidth of 2 V for all three Options.

3.16 Interconnecting Primary Service

A new primary 13.8 kV service is required to interconnect the Project in the Study. This Project will require necessary poles, primary revenue metering, conductor or cable, and a three phase recloser. The Customer will be required to install and maintain communications with the revenue metering.

3.17 Interconnecting Customer Owned Protection

As currently proposed, the Project has a Customer owned primary side recloser, which is required. The proposed relay protection settings are shown on the Project one-lines (Appendix A). All primary side equipment is required to have a 15 kV voltage class rating and a 95 kV BIL rating.

3.18 Cost Estimates

The +/-25% estimate for the distribution upgrades, 13.8 kV lateral tap, recloser, primary metering package and primary disconnect at the Point of Common Coupling (PCC) is **$2,947,099**

Distribution Costs (for all 3 Options)

COST ESTIMATE			
0 Tower Road, Pelham, MA	Material	Labor	Total
Off Site - Distribution System Upgrades - Substation to Site			
1. Install 7550 ft of 556 AL TW. 2. Install 2692 ft of 1/0 AL TW 3. Replace four fuses with reclosers 4. Three stepdown bank installs 5. Capacitor bank removal	$1,590,540	$744,793	$ 2,335,333
1. Conductor relocation near POI per Customer's request.	$50,643	$74,157	$124,800
On-Site - Interconnection Work			
1. One NOVA Recloser 2. One OH primary meter 3. 336 Poly/ 3 phase line extension	$83,500	$23,750	$107,250
Subtotal	$1,724,683	$842,700	$2,567,383
Tax Adder			
CIAC (14.79%)	$255,081	$124,635	$379,716
Total Distribution Cost			
Total	$1,979,764	$967,335	**$2,947,099**

The +/- 25% estimated cost includes the facilities required to interconnect the proposed Generating Facility to Eversource distribution system but does not include any in-plant facilities constructed, owned, and operated by the applicant.

The interconnection of this distributed generation application is queued behind other applicants which may require system upgrades to the Eversource system, and the cost for those upgrades has been included as a requirement in their respective Interconnection Services Agreement(s).
If a prior applicant should dequeue or withdraw for any reason, the system conditions permitting the interconnection of succeeding applicant(s) may change. Upon the withdrawal of previously queued applicants, succeeding applicant(s) may become responsible for some or all of the system upgrades that were required for the prior applicants, and Eversource may have to reassess system conditions to determine if the applicant currently under study would trigger the same upgrades.

*NOTE: The CIAC rate in place at the time the Interconnection Service Agreement is sent out for signature will be applied to the distribution system modifications. Currently the CIAC is 14.53% and is subject to change monthly.

The Interconnecting Customer is separately responsible for procuring and installing non-Company owned items including Interconnecting Customer owned fuses, switches, utility grade multifunction protective relaying, PTs and CTs for protection, and production metering equipment required for a Class II or III and net metering facility.

The estimate is for work to be conducted by the Company for distribution system modifications required to interconnect the Project. The Customer is responsible for contacting other pole attachments (such as telephone company, cable television, etc.) to determine what costs they will incur for their work.

A cell meter will be installed for this Project. If the cellular communication is not reliable, the Customer is responsible for obtaining communication (dedicated analog telephone or Ethernet) to the revenue meter and for the ongoing monthly cost for such communication. These costs are not included in the cost estimate above.

This is an Eversource Energy set pole area.

A Detailed Study will be required to write the construction work orders. The cost of the Study is not included in the above estimate.

If the Customer requests a Dynamic Study, this cost is not included in the above estimate.

The Customer is responsible for CIAC which at this time is 14.53% and is subject to charge monthly. The Internal Revenue Code of 1986 (Tax Reform Act of 1986) mandates that "Contribution In Aid of Construction" (CIAC) Tax Liability Gross Up for reimbursable Customer work is considered taxable income to the receiving utility. This means that Eversource is required to pay federal income tax on all Customer contributions (reimbursable Customer work). The Commonwealth of Massachusetts also has a corporate income tax which is based on the federal taxable income. Therefore, Eversource pays both a federal and a state income tax on contributions received from

customers. Eversource is required under present laws to pay federal and state taxes on CIAC payments. All customers are subject to tax liability, including non-profit "tax-exempt" organizations. Churches, schools, town halls, even the National Guard are subject to tax liability.

4 CONCLUSIONS and RECOMMENDATIONS

The primary objective of this Study is to assess the impacts on the Amherst 17K Substation, the 17K2 distribution feeder, and to identify distribution system modifications that may be necessary to complete the interconnection of the Project. As a result of the assessment the following conclusions are made:

1. The Project is compliant with the requirements detailed in M.D.P.U. No. 55 provided items from the initial review as well as additional requirements below are met by the Interconnecting Customer.
2. Due to protection concerns, the fuses on Pole 1/8 and Pole 1/66 must be upgraded to three phase reclosers and roughly 7,526 ft (1.43 mi) of three phase 1/0 AAC backbone conductor between Pole 1/8 and the lateral interconnecting of the Project (radial tap on Enfield Rd) must be upgraded to 556 AL for all three Options.
3. Due to thermal, voltage, and flicker concerns, 2,692 ft (0.51 mi) of two spans of #4 ACSR from Pole 10/20 to Synergi section 261744902_0_1 near the lateral interconnecting the Project must be upgraded to 1/0 AAC.
4. The distribution step-down transformer located on the lateral interconnecting the Project at Pole 10/20 must be removed in order to interconnect the Project. All load serving transformers beyond the step-down transformer must be upgraded to accommodate the new voltage level.
5. The 1,200 kVAR capacitor on Pole 103/16 must be taken out of service in order to meet voltage criteria.
6. The substation LTC must have a set point of 123 V for Option A and 123.5 V for Options B and C with a bandwidth of 1.5 V.
7. The regulator on Pole 1/B62 must have a set point of 122 V and a bandwidth of 2 V for all three Options.
8. The Project protective relay design shows the required test switch for the PT and CT inputs and the PT ratios.
9. (Option A) PV facility will be fed via two new 13,800/600 V grounded wye-wye 2,200 kVA transformers. The Project is required to install a 75 kVA @ 4%Z primary side grounding transformer to meet Eversource effective grounding criteria. The grounding transformer requires a positive interlock to be installed with the inverters so that if it is removed from the circuit, the inverters cannot operate. The interlock must be fail safe, such that any circuit or device failure will result in a safe mode of operation. A revised Project one-line will need to be submitted to show these changes.
10. (Option B) PV facility will be fed via a new 13,800/600 V grounded wye-wye 3,300 kVA transformer. The Project is required to install a 45 kVA @ 3.5%Z primary side grounding transformer to meet Eversource effective grounding criteria. The grounding transformer

requires a positive interlock to be installed with the inverters so that if it is removed from the circuit, the inverters cannot operate. The interlock must be fail safe, such that any circuit or device failure will result in a safe mode of operation. A revised Project one-line will need to be submitted to show these changes.

11. (Option C) PV facility will be fed via a new 13,800/600 V grounded wye-wye 2,200 kVA transformer. The Project is required to install a 30 kVA @ 3.5%Z primary side grounding transformer to meet Eversource effective grounding criteria. The grounding transformer requires a positive interlock to be installed with the inverters so that if it is removed from the circuit, the inverters cannot operate. The interlock must be fail safe, such that any circuit or device failure will result in a safe mode of operation. A revised Project one-line will need to be submitted to show these changes.
12. It is recommended that all three options undergo a Dynamic ROI study to further evaluate LROV concerns.
13. The Project is required to operate at 94% leading power factor for Option A, 95% leading power factor for Option B, and 97% leading power factor for Option C.
14. If this Project is participating in the SMART program, the SMART meter is required to be installed next to the utility revenue meter at ground level.
15. The Customer shall ensure BIL ratings of Project equipment are sufficient to coordinate with the utility system and the applicant should apply sufficient surge protection at locations such as risers and transformers. The 13.8 kV system is considered a 15 kV voltage class requiring a BIL of at least 95 kV unless other environmental conditions warrant increased values.
16. Eversource's Transmission Planning Department will review the risk of reverse power under minimum load conditions and determine if a transmission study is required.
17. Once the Project one-lines are fully updated, they are required to be electrical MA PE Stamped and resubmitted.
18. A MA PE stamped Project three-line drawing consistent with the one-line drawing is required for the protection review if the installed equipment is not part of a manufactured assembly.
19. The high level +/- 25% estimate for construction including CIAC which is estimated at 14.53% is:

Eversource Project #	Option	Total Project Cost Estimate
6A4306-2019	A	$2,940,423
	B	$2,940,423
	C	$2,940,423

20. Estimates for system modifications does no not include any costs for equipment which may be required by ISO-NE or for the future SMART Program if the Customer elects to participate in that program.
21. This is an Eversource Energy Pole set area.
22. A Detailed Study is required to engineer the distribution system modifications, develop the construction schedule, and if an early ISA is not requested, refine the interconnection cost to +/- 10% for inclusion in the Interconnection Service Agreement. The cost of the Detailed Study is not included in the high level estimate for construction.
23. The Project must notify Eversource if they will enter any wholesale markets through ISO-NE (such as selling energy, capacity or frequency).
24. ISO-NE notification is required.
25. A Witness Test Procedure and subsequent Witness Test will be required.

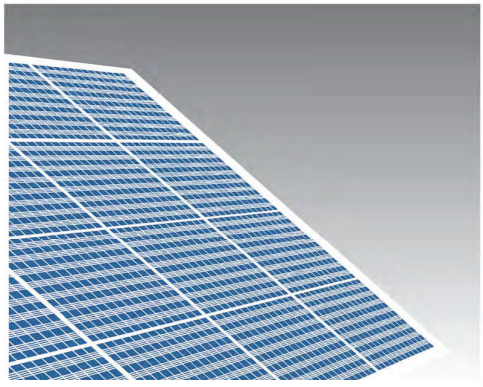
Note: The customer needs to update the existing one-line in Appendix-III of the final combined report considering the mitigations for Short Circuit and Effective Grounding mentioned in Appendix-II of the final combined report.

Appendix II:

Distribution Impact Study – Dynamic Analysis Report

DRAFT REPORT
Revision 1

Time Domain Study



ASD Tower MA Solar (6A4306-2019)

Three Option Study:

- **Option A – 4,400 kW + BESS Photovoltaic Project**
- **Option B – 3,300 kW + BESS Photovoltaic Project**
- **Option C – 2,200 kW + BESS Photovoltaic Project**

August 10, 2021

Prepared by:

RLC ENGINEERING

EMPOWERING ENERGY SOLUTIONS
for the future…today

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Revision History

Rev.	Date	Revised by	Reason
0	8/10/2021	LMT/GSS	Original Draft Release
1	6/27/2022	AM	Eversource Review

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EXECUTIVE SUMMARY

On behalf of NSTAR Electric Company (NSTAR) DBA Eversource Energy (Eversource), RLC Engineering, LLC (RLC) conducted a time domain study for the proposed solar facility (the "Project") interconnecting to Eversource utility system listed in Table 0-1. The Project will interconnect to the 17K2 Eversource feeder, which is served from Eversource's Amherst 17K Substation.

Application #	Address	Developer	Maximum Output (kW / kVA)
6A4306-2019	0 Tower Rd, Pelham, MA	ASD Tower MA Solar	Option A: 4,400 / 4,400
			Option B: 3,300 / 3,300
			Option C: 2,200 / 2,200

Table 0-1: Project Interconnecting on the 17K2 Feeder

The primary focus of this Study is to:

1. Assess compliance with the design modifications proposed by the Project.
2. Assess the short circuit and effective grounding impacts with the proposed Project design on the distribution system served from the Amherst 17K2 feeder.
3. Identify distribution system and substation upgrades that may be necessary to complete the interconnection of the Project with the design modifications.
4. Identify time domain impacts on the system with the proposed Project design.

This Study includes a short circuit analysis and effective grounding analysis. Additionally, a time domain study was performed to evaluate the following items: load rejection overvoltage analysis, ground fault overvoltage analysis, risk of islanding evaluation, and underfrequency load shed impact assessment.

Conceptual Design of Solar Photovoltaic (PV) and DC Coupled Energy Storage System (ESS) Interconnection Facility

The Time Domain Study was performed with a new 4,400 (Option A) / 3,300 (Option B) / 2,200 (Option C) kW PV and BESS Project design. The Project was previously studied with Power Electronics FS2000K and FS3000K inverter models. The previous design also included a single 3,300 kVA GSU transformer for Option B.

The new Project PV design studied is as follows:

- Project utilizes the following inverter configurations:
  - Option A: Two Power Electronics FS3190K inverters, both derated to 2,200 kW.
  - Option B: Two Power Electronics FS2125K inverters, both derated to 1,650 kW.
  - Option C: One Power Electronics FS3190K inverter derated to 2,200 kW.
- 4,440 kW (Option A) / 3,300 kW (Option B) / 2,200 kW (Option C) maximum of additional generation was supplied by the following transformer configurations:

  - Option A: Two Customer owned, 2,200 kVA, 13.8 kV Grounded Wye – 600 V Wye, 3 phase transformers with Z=5.75% and X/R = 7.5.
  - Option B: Two Customer owned, 1,650 kVA, 13.8 kV Grounded Wye – 600 V Wye, 3 phase transformers with Z=5.75% and X/R = 7.5.
  - Option C: One Customer owned, 2,200 kVA, 13.8 kV Grounded Wye – 600 V Wye, 3 phase transformer with Z=5.75% and X/R = 7.5.
- The new design proposed a primary side (13.8 kV) Zig-Zag 260 (Option A) / 200 (Option B) / 130 (Option C) kVA grounding transformer with 4%Z and X/R=4.

Study Findings

The short circuit, effective grounding, and time domain analyses were the primary impact assessments performed in this Study. It must be noted that this Study evaluated the Power Electronics FS2125K and FS3190K inverters as provided by the Customer. A new application and study will be required if more inverters are added to the Project or other changes are made.

Short Circuit Analysis

Short circuit analysis was conducted with all 17K1, 17K2, 17K3, and 17K4 feeder generation online, as this results in the greatest fault currents. The Project was dispatched with PV inverters at full output injecting into the feeder.

Table 0-2 shows the greatest increase in fault current at the PCC to be 16.94% utilizing the adjusted grounding configuration (required to meet Eversource effective grounding criteria) as discussed in Table 0-3. This increase in fault current does not meet the requirements of the M.D.P.U. No. 55, which state that the proposed facility will not contribute more than 10% to the distribution feeder's maximum fault current at the PCC. This requirement ensures the Project's fault current contribution will not have a significant impact on the distribution feeder's protective devices. Eversource shall determine if there are any adverse impacts to substation or line equipment fault duty ratings due to the Project's increase in fault current.

Project PCC Bus Fault Duty					
Eversource Project #	Option	Fault Type	Pre-Project Fault Current	Post-Project Fault Current	Change
6A4306-2019	A	3LG	1,472	1,715	16.50%
		1LG	1,018	1,133	11.29%
	B	3LG	1,472	1,721	16.94%
		1LG	1,018	1,134	11.39%
	C	3LG	1,472	1,591	8.10%
		1LG	1,018	1,076	5.71%

Table 0-2: Fault Duty at 6A4306-2019 PCC

Effective Grounding Analysis

The Customer proposed the following grounding configurations:

- Option A: Two 13,800/600 V grounded wye primary and wye secondary step-up transformers, both rated at 2,200 kVA, with a primary side zig-zag grounding transformer rated at 260 kVA with 4%Z and X/R=4.
- Option B: Two 13,800/600 V grounded wye primary and wye secondary step-up transformers, both rated at 1,650 kVA, with a primary side zig-zag grounding transformer rated at 200 kVA with 4%Z and X/R=4
- Option C: One 13,800/600 V grounded wye primary and wye secondary step-up transformer, rated at 2,200 kVA, with a primary side zig-zag grounding transformer rated at 130 kVA with 4%Z and X/R=4

These configuration do not meet Eversource's effective grounding criteria (2<X0/X1<3). The devices listed in Table 0-3 satisfy Eversource's effective grounding criteria.

6A4306-2019 Project Grounding		
Option	**Grounding Bank Details**	**Qty.**
A	112.5 kVA, 13.8 kV (Primary Side), 5%Z, X/R = 3.39, Zig-Zag	1
B	112.5 kVA, 13.8 kV (Primary Side), 5%Z, X/R = 3.39, Zig-Zag	1
C	45 kVA, 13.8 kV (Primary Side), 4%Z, X/R = 2.9, Zig-Zag	1

Table 0-3: Grounding Devices Required

Time Domain Study Results Summary

The Time Domain Study evaluated the Amherst 17K Substation and 17K2 to identify Project impacts. A summary of all simulation results and network upgrades necessary to mitigate adverse impacts caused by the Project can be seen in Table 0-4.

Analysis Type	Criteria	Results	Upgrades	Notes
Load Rejection Overvoltage	Compliant w/ IEEE 1547-2018 Section 7.4.2	Violations observed	Enable inverter TrOV protection and set to 1.35 PU and 1 ms	All subsequent inverter firmware updates must maintain the TrOV setting
Ground Fault Overvoltage	Compliant w/ IEEE 1547-2018 Section 7.4.2	No violations	None	
Risk of Islanding	Project trips off within 2s under islanded condition	No violations	None	
Underfrequency Load Shed	Project does not cause UFLS nuisance tripping	No violations	None	

Table 0-4: Time Domain Study Results Summary

1 SYSTEM IMPACT ASSESSMENTS

1.1 System Analysis

The 17K2 distribution feeder has a peak load of approximately 4,524 kVA, 475 kW of completed PV generation and an aggregate of 6,905 kW (Option A) / 5,805 kW (Option B) / 4,705 kW (Option C) of in-process PV generation, which includes the Project. The minimum daylight loading was assumed to be approximately 30% of the peak load, or 1,357 kVA. Table 1-1 provides a list of all generation on the 17K feeders served by the 17K-3X transformer, including proposed Project, compared to the loading at the Amherst 17K Substation.

Amherst 17K-3X Loading and Generation Summary				
Feeder	**Total Generation (kVA)**		**Peak Load Reading (kVA)**	**Minimum Load Reading (kVA)**
	Existing	**Proposed**		
17K1	7,741	1,000	3,035	911
17K2	1,105	Option A: 6,905 Option B: 5,805 Option C: 4,705	4,524	1,357
17K3	185	0	1,099	330
17K4	2,344	40	4,130	1,293
Total	**6,571**	**Option A: 7,945** **Option B: 6,845** **Option C: 5,745**	**12,968**	**3,890**

Table 1-1: Amherst 17K-3X Transformer Loading Compared to Generation Output

1.2 Distribution Circuit Grounding

It is intended for the utility distribution circuit to remain effectively grounded in any configuration to limit the unfaulted phase voltages to less than or equal to 125% of nominal phase-to-ground circuit voltage. To ensure effective grounding criteria is met, Eversource requires that the X0/X1 ratio at the PCC be between 2 and 3.

The customer-proposed design includes a primary side (13.8 kV) Zig-Zag 260 (Option A) / 200 (Option B) / 130 (Option C) kVA grounding transformer with 4%Z and X/R=4. The proposed grounding configuration does not meet Eversource's effective grounding criteria (2<X0/X1<3) as presented in Table 1-2.

Option	6A4306-2019 PCC Project Effective Grounding				
	Parameter	**PU Impedance**	**Criteria**		**Notes**
A	X1	14.74	2<X0/X1<3	Fail	260 kVA grounding transformer @ 4%Z (X/R = 4)
	X0	14.93			
	R0	3.73			
	X0/X1	1.01			
	R0/X1	0.25	0<R0/X1<1	Pass	
B	X1	14.40	2<X0/X1<3	Fail	200 kVA grounding transformer @ 4%Z (X/R = 4)
	X0	19.40			
	R0	4.85			
	X0/X1	1.35			
	R0/X1	0.34	0<R0/X1<1	Pass	
C	X1	29.62	2<X0/X1<3	Fail	130 kVA grounding transformer @ 4%Z (X/R = 4)
	X0	29.85			
	R0	7.46			
	X0/X1	1.01			
	R0/X1	0.25	0<R0/X1<1	Pass	

Table 1-2: Effective Grounding Criteria – Customer Proposed Design

The updated Project grounding configuration required changes to the sizes and impedances of the proposed grounding banks. The updated grounding configuration meets Eversource's effective grounding criteria (2<X0/X1<3) as presented in Table 1-3.

Option	6A4306-2019 PCC Project Effective Grounding				
	Parameter	**PU Impedance**	**Criteria**		**Notes**
A	X1	14.74	2<X0/X1<3	Pass	112.5 kVA grounding transformer @ 5%Z (X/R = 3.39)
	X0	42.63			
	R0	12.57			
	X0/X1	2.89			
	R0/X1	0.85	0<R0/X1<1	Pass	
B	X1	14.40	2<X0/X1<3	Pass	112.5 kVA grounding transformer @ 5%Z (X/R = 3.39)
	X0	42.63			
	R0	12.57			
	X0/X1	2.96			
	R0/X1	0.87	0<R0/X1<1	Pass	
C	X1	29.62	2<X0/X1<3	Pass	45 kVA grounding transformer @ 4%Z (X/R = 2.90)
	X0	84.03			
	R0	28.98			
	X0/X1	2.84			
	R0/X1	0.98	0<R0/X1<1	Pass	

Table 1-3: Effective Grounding Criteria – RLC Proposed Design

1.3 Short Circuit Analysis

A short-circuit model was developed from the 115 kV system impedance data at the Amherst 17K Substation Bus. The 17K2 distribution feeder between the Amherst 17K Substation and the Project was modeled according to information provided. The fault contributions of the inverters is 227.1% for the FS2125K and 160.5% for the FS3190K according to fault current data provided by Power Electronics.

The purpose of this evaluation is to determine the impact of the Project to the electric power distribution system. This assessment was conducted with all other generation online at full output. Three-phase and single-phase fault currents were observed for the pre- and post-Project conditions using the RLC proposed grounding transformer configurations. The pre- and post-Project fault duties in Table 1-4 demonstrate the Project fault duty contribution at the PCC and Table 1-5 shows contributions at the Amherst 17K 13.8 kV A3 Bus with the required grounding devices specified in Table 1-3.

Project PCC Bus Fault Duty					
Eversource Project #	**Option**	**Fault Type**	**Pre-Project Fault Current**	**Post-Project Fault Current**	**Change**
6A4306-2019	A	3LG	1,472	1,715	16.50%
		1LG	1,018	1,133	11.29%
	B	3LG	1,472	1,721	16.94%
		1LG	1,018	1,134	11.39%
	C	3LG	1,472	1,591	8.10%
		1LG	1,018	1,076	5.71%

Table 1-4: Fault Duty at PCC of Amherst 17K2 Feeder with Required Configuration

Amherst 17K 13.8 kV A3 Bus Fault Duty					
Location	**Option**	**Fault Type**	**Pre-Project Fault Current**	**Post-Project Fault Current**	**Change**
Amherst 17K 13.8 kV A3	A	3LG	7,740	7,985	3.16%
		1LG	8,437	8,548	1.32%
	B	3LG	7,740	7,990	3.22%
		1LG	8,437	8,550	1.34%
	C	3LG	7,740	7,869	1.66%
		1LG	8,437	8,496	0.70%

Table 1-5: Fault Duty at Amherst 17K Bus A3 with Required Configuration

Short circuit analysis was conducted with all 17K1, 17K2, 17K3, and 17K4 feeder generation online, as this results in the greatest fault currents. The Project was dispatched with PV at full output injecting into the feeder. Table 1-4 shows an increase in ground fault current at the PCC to be 16.50% (Option A) / 16.94% (Option B) / 8.10% (Option C). This does not meet the requirements of the M.D.P.U. No. 55, which state that the proposed facility will not contribute more than 10% to the distribution feeder's maximum fault current at the PCC. This requirement ensures the Project's fault current contribution will not have a significant impact on the distribution feeder's protective devices. Table 1-5 shows that the maximum fault contribution from the Project does not

significantly affect the fault currents at the substation. The failure of this requirement indicates that the Project's fault current contribution may have a significant impact on the distribution feeder's protective devices. Eversource shall determine if there are any adverse impacts to substation or line equipment fault duty ratings due to the Project's increase in fault current.

2 TIME DOMAIN STUDY ASSESSMENTS

2.1 PSCAD System Modeling

A PSCAD model of the 17K2 feeder fed from the Amherst 17K substation was created based on parameters extracted from the CYME model used in the Standard Study. A high level description of this network can be found in Section 1.1.

A proprietary PSCAD model of the Power Electronics FS2125K and FS3190K inverter was provided by the Customer. The following validation tests were performed on this model to ensure proper operation:

- Initialization – The inverter model should reach steady-state user-supplied terminal conditions within five simulation seconds.
- Inverter Protection – The inverter model is supplied with Project-specific voltage and frequency protection settings. OV/UV and OF/UF events are simulated and the inverter protection is monitored.
- Operating Modes – Project-specific operating modes (e.g. fixed PF, Volt/Var, etc.) are tested under controlled system conditions to ensure proper operation.
- Snapshot Feature – A snapshot is created from the sample implementation case provided by the Customer and a simulation is started from the snapshot. The simulation should run without error.
- Multiple Instances Test – A second inverter model instance is created in the sample implementation case provided by the Customer. The simulation should run without error.

It was found that the inverter model performed as expected and was thus used for Project testing in subsequent sections.

Appendix B, C, and D contains an exported diagram of the PSCAD model with the Project inverter model and other applicable modeling implemented.

2.2 Load Rejection Overvoltage Analysis

A Load Rejection Overvoltage (LROV) analysis was conducted on multiple feeder conditions with the purpose of evaluating compliance with IEEE 1547-2018 Section 7.4.2 "Limitation of cumulative instantaneous overvoltage". A graphical representation of these requirements can be seen in Figure 2-1.

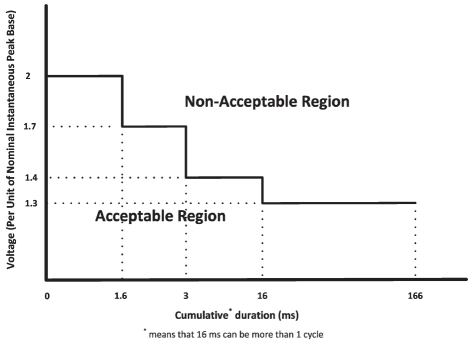


Figure 2-1: IEEE 1547-2018 Section 7.4.2 Transient Overvoltage Limits

The LROV analysis was conducted on all breakers and reclosers bounding the Project, including the Amherst 17K substation breaker. All LROV simulations were conducted at light load, peak generation scenarios as higher generation-to-load ratios present the most conservative results. Note that voltage measurements were taken at both the Project PCC and the respective point of disconnection being tested.

2.2.1 Scenario A

A cumulative LROV duration plot for the substation breaker open condition can be seen in Figure 2-2.

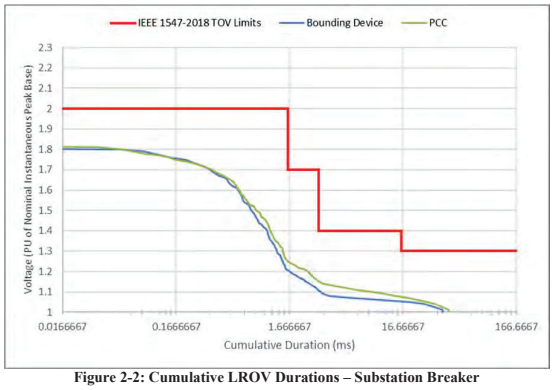


Figure 2-2: Cumulative LROV Durations – Substation Breaker

It can be seen that the Project passed criteria and is not cause for LROV concerns at the substation level.

A cumulative LROV duration plot for the feeder breaker open condition can be seen in Figure 2-3.

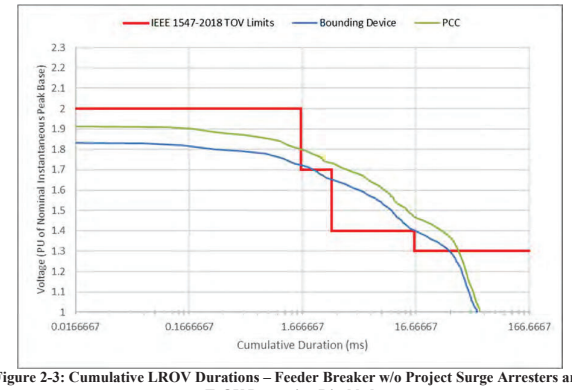


Figure 2-3: Cumulative LROV Durations – Feeder Breaker w/o Project Surge Arresters and TrOV Protection Disabled

It can be seen that the Project failed criteria and is cause for concern at the feeder level. However, the Project design includes two sets of 10.2 kV MCOV rated surge arresters. The LROV for the feeder breaker open condition evaluation was performed again with the surge arresters explicitly modeled.

A cumulative LROV duration plot for the feeder breaker open condition can be seen in Figure 2-4.

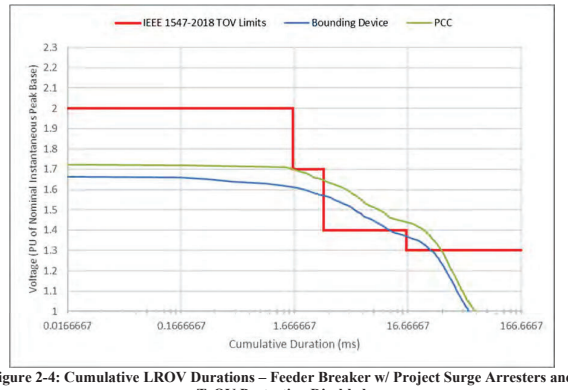


Figure 2-4: Cumulative LROV Durations – Feeder Breaker w/ Project Surge Arresters and TrOV Protection Disabled

It can be seen that the Project failed criteria and is cause for concern at the feeder level. However, the Power Electronics FS2125K and FS3190K inverters have a TrOV protection feature which is disabled by default. The LROV evaluation was performed again with the TrOV feature enabled and set to its highest allowable setting of 1.35 PU and 1 ms.

A cumulative LROV duration plot for the feeder breaker open condition can be seen in Figure 2-5.

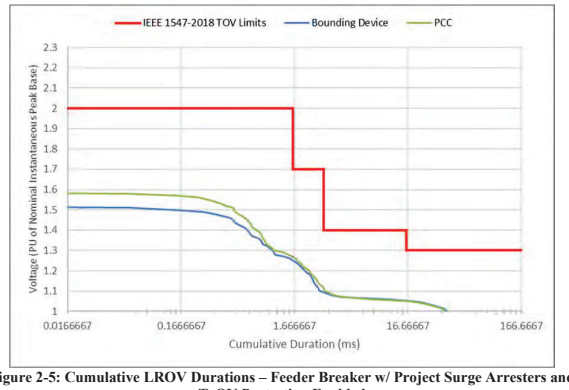


Figure 2-5: Cumulative LROV Durations – Feeder Breaker w/ Project Surge Arresters and TrOV Protection Enabled

It can be seen that the Project passed criteria and is not cause for LROV concerns at the feeder level provided the Power Electronics FS2125K and FS3190K inverters have their TrOV protection enabled and set to 1.35 PU and 1 ms.

A cumulative LROV duration plot for the recloser 1_66 open condition can be seen in Figure 2-6.

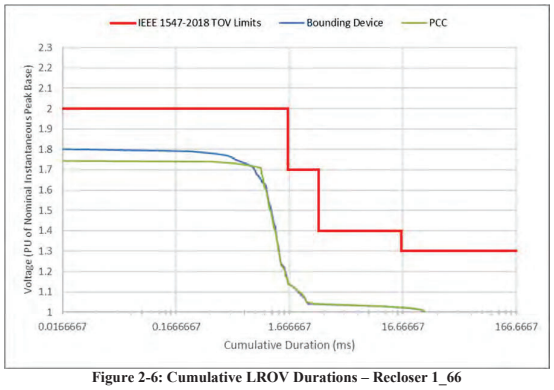


Figure 2-6: Cumulative LROV Durations – Recloser 1_66

It can be seen that the Project passed criteria and is not cause for LROV concerns at the recloser 1_66 level.

Based on these results, the Project does not present LROV violations provided the Power Electronics FS2125K and FS3190K inverters have their TrOV protection enabled and set to 1.35 PU and 1 ms.

2.2.1 Scenario B

A cumulative LROV duration plot for the substation breaker open condition can be seen in Figure 2-2.

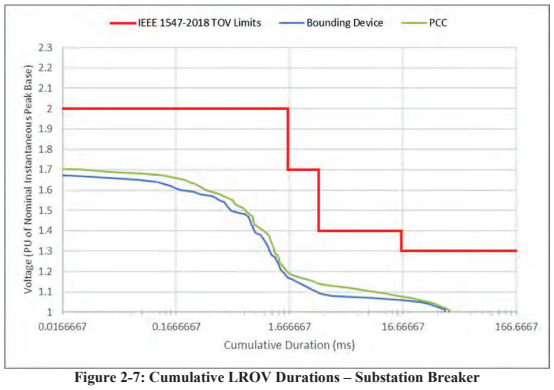


Figure 2-7: Cumulative LROV Durations – Substation Breaker

It can be seen that the Project passed criteria and is not cause for LROV concerns at the substation level.

A cumulative LROV duration plot for the feeder breaker open condition can be seen in Figure 2-8.

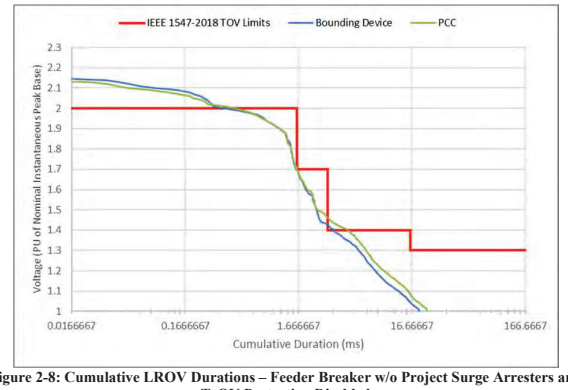


Figure 2-8: Cumulative LROV Durations – Feeder Breaker w/o Project Surge Arresters and TrOV Protection Disabled

It can be seen that the Project failed criteria and is cause for concern at the feeder level. However, the Project design includes two sets of 10.2 kV MCOV rated surge arresters. The LROV for the feeder breaker open condition evaluation was performed again with the surge arresters explicitly modeled.

A cumulative LROV duration plot for the feeder breaker open condition can be seen in Figure 2-9.

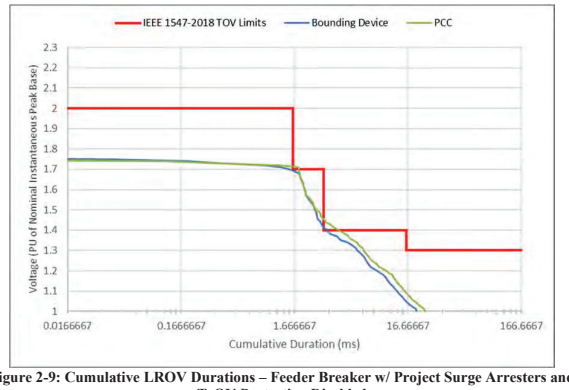


Figure 2-9: Cumulative LROV Durations – Feeder Breaker w/ Project Surge Arresters and TrOV Protection Disabled

It can be seen that the Project failed criteria and is cause for concern at the feeder level. However, the Power Electronics FS2125K and FS3190K inverters have a TrOV protection feature which is disabled by default. The LROV evaluation was performed again with the TrOV feature enabled and set to its highest allowable setting of 1.35 PU and 1 ms.

A cumulative LROV duration plot for the feeder breaker open condition can be seen in Figure 2-10.

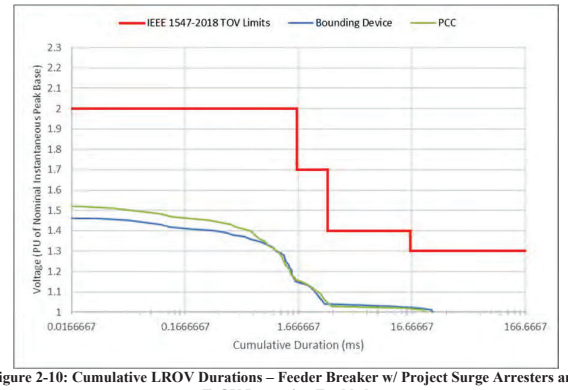


Figure 2-10: Cumulative LROV Durations – Feeder Breaker w/ Project Surge Arresters and TrOV Protection Enabled

It can be seen that the Project passed criteria and is not cause for LROV concerns at the feeder level provided the Power Electronics FS2125K and FS3190K inverters have their TrOV protection enabled and set to 1.35 PU and 1 ms.

A cumulative LROV duration plot for the recloser 1_66 open condition can be seen in Figure 2-11.

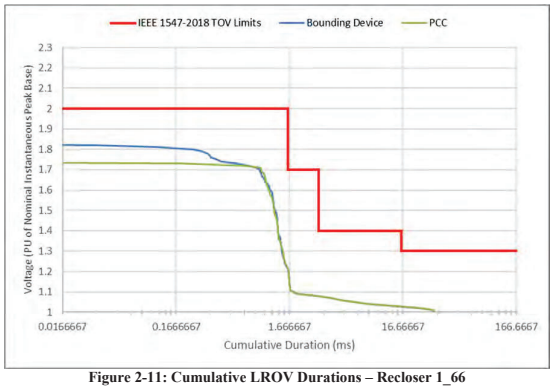


Figure 2-11: Cumulative LROV Durations – Recloser 1_66

It can be seen that the Project passed criteria and is not cause for LROV concerns at the recloser 1_66 level.

Based on these results, the Project does not present LROV violations provided the Power Electronics FS2125K and FS3190K inverters have their TrOV protection enabled and set to 1.35 PU and 1 ms.

2.2.1 Scenario C

A cumulative LROV duration plot for the substation breaker open condition can be seen in Figure 2-2.

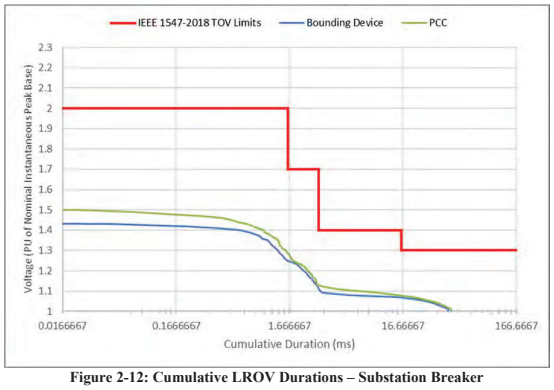


Figure 2-12: Cumulative LROV Durations – Substation Breaker

It can be seen that the Project passed criteria and is not cause for LROV concerns at the substation level.

A cumulative LROV duration plot for the feeder breaker open condition can be seen in Figure 2-13.

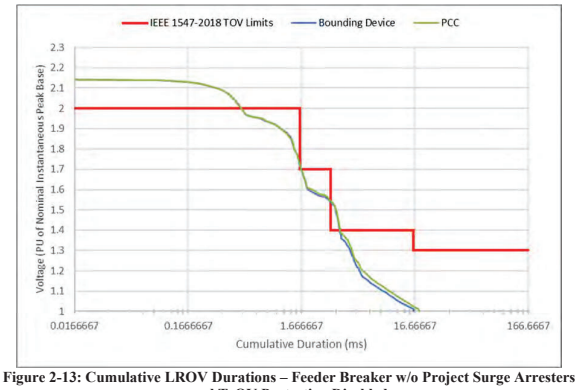


Figure 2-13: Cumulative LROV Durations – Feeder Breaker w/o Project Surge Arresters and TrOV Protection Disabled

It can be seen that the Project failed criteria and is cause for concern at the feeder level. However, the Project design includes two sets of 10.2 kV MCOV rated surge arresters. The LROV for the feeder breaker open condition evaluation was performed again with the surge arresters explicitly modeled.

A cumulative LROV duration plot for the feeder breaker open condition can be seen in Figure 2-14.

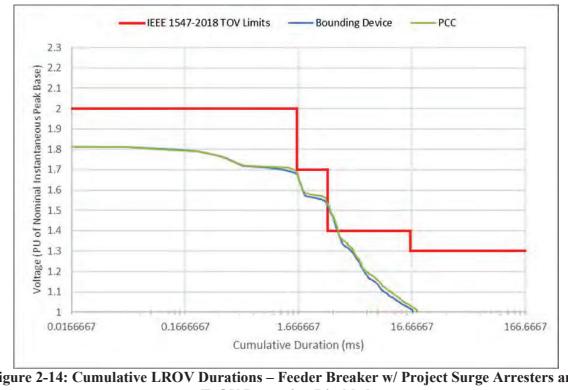


Figure 2-14: Cumulative LROV Durations – Feeder Breaker w/ Project Surge Arresters and TrOV Protection Disabled

It can be seen that the Project failed criteria and is cause for concern at the feeder level. However, the Power Electronics FS2125K and FS3190K inverters have a TrOV protection feature which is disabled by default. The LROV evaluation was performed again with the TrOV feature enabled and set to its highest allowable setting of 1.35 PU and 1 ms.

A cumulative LROV duration plot for the feeder breaker open condition can be seen in Figure 2-15.

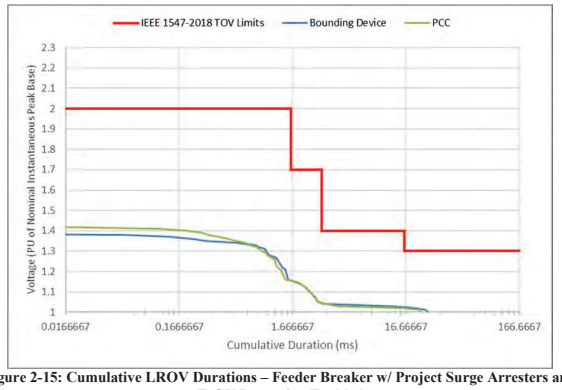


Figure 2-15: Cumulative LROV Durations – Feeder Breaker w/ Project Surge Arresters and TrOV Protection Enabled

It can be seen that the Project passed criteria and is not cause for LROV concerns at the feeder level provided the Power Electronics FS2125K and FS3190K inverters have their TrOV protection enabled and set to 1.35 PU and 1 ms.

A cumulative LROV duration plot for the recloser 1_66 open condition can be seen in Figure 2-16.

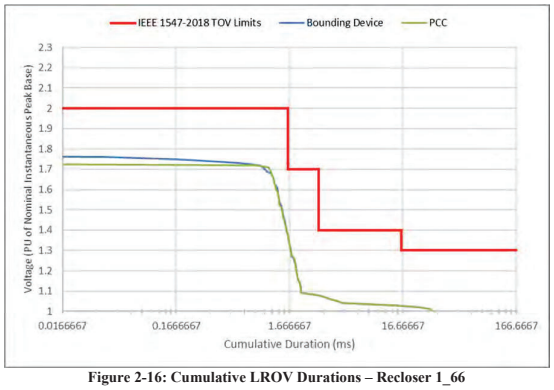


Figure 2-16: Cumulative LROV Durations – Recloser 1_66

It can be seen that the Project passed criteria and is not cause for LROV concerns at the recloser 1_66 level.

Based on these results, the Project does not present LROV violations provided the Power Electronics FS2125K and FS3190K inverters have their TrOV protection enabled and set to 1.35 PU and 1 ms.

2.3 Ground Fault Overvoltage Analysis

A Ground Fault Overvoltage (GFOV) analysis was conducted on multiple feeder conditions with the purpose of evaluating compliance with IEEE 1547-2018 Section 7.4.2 as discussed in Section 2.2 (see Figure 2-1).

All GFOV simulations were conducted at light load, peak generation scenarios as higher generation-to-load ratios present the most conservative results. The GFOV analysis was performed by placing a single line to ground (SLG) fault at the Project PCC on phase A, opening the closest bounding recloser after five cycles, capturing voltage magnitudes and durations for two seconds following onset of the fault, and evaluating for compliance. The analysis was then repeated for SLG faults on phases B and C, with the worst-case TOV results reported here. Note that voltage measurements were taken at both the Project PCC and the bounding recloser.

2.3.1 Scenario A

Cumulative GFOV duration plots for light loading can be seen in Figure 2-17.

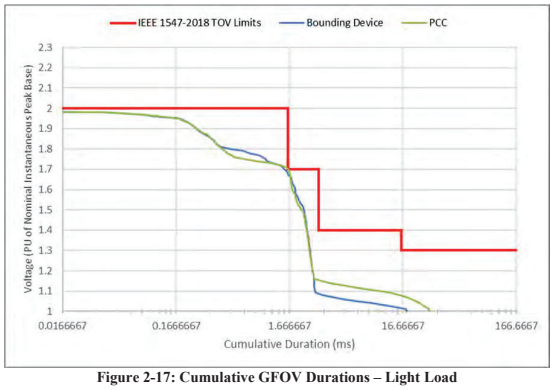


Figure 2-17: Cumulative GFOV Durations – Light Load

Based on these results, the Project does not present GFOV violations and requires no related upgrades or design changes.

2.3.1 Scenario B

Cumulative GFOV duration plots for light loading can be seen in Figure 2-18.

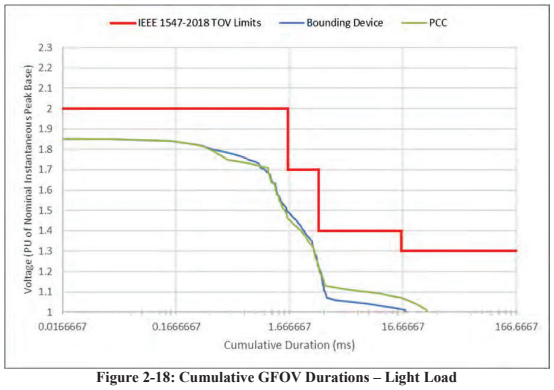


Figure 2-18: Cumulative GFOV Durations – Light Load

Based on these results, the Project does not present GFOV violations and requires no related upgrades or design changes.

2.3.1 Scenario C

Cumulative GFOV duration plots for light loading can be seen in Figure 2-19.

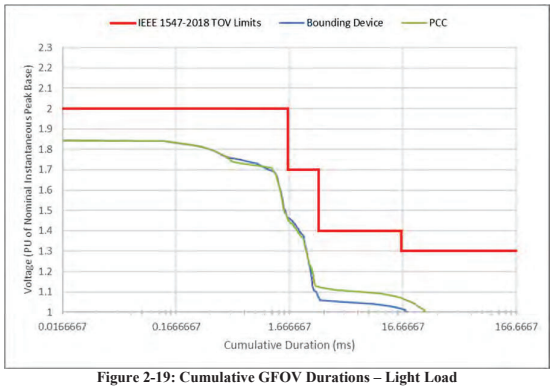


Figure 2-19: Cumulative GFOV Durations – Light Load

Based on these results, the Project does not present GFOV violations and requires no related upgrades or design changes.

2.4 Risk of Islanding Evaluation

A Risk of Islanding (ROI) evaluation was conducted with the purpose of evaluating compliance with IEEE 1547-2018 Section 8.1 "Unintentional islanding". This section dictates that the Project must trip offline within two seconds of the formation of an island.

The ROI analysis was performed by evaluating project performance in all potential island configurations. These configurations included opening the following devices:

- Amherst 17K substation breaker
- 17K2 feeder breaker
- Recloser 1_66

An unintentional island is most likely to occur when a Project-bounding device opens during a generation/load scenario in which active and/or reactive power flow across the bounding device is zero on each phase. In such a scenario, power generated within the island is balanced with the power consumed by the island. Various loading and generation scenarios were postured in the PSCAD model for each of the potential islands in order to achieve power balance, if possible. The following tables present the scenarios tested as well as the results of the analysis:

Table 2-1: ROI Analysis – Substation Breaker

Scenario	Project Output	Flows Through Opening Device		Project Trip Times (s)	Result
		P (kW)	Q (kVAR)		
A	100%	*-6,597	*4,067	0.2	Passed
	3%	*-2,913	*1,835	0.2	Passed
	2%	*-2,867	*1,801	0.2	Passed
	1%	*-2,824	*1,798	0.2	Passed
B	100%	*-5,736	*3,285	0.2	Passed
	3%	*-2,878	*1,809	0.2	Passed
	2%	*-2,847	*1,802	0.2	Passed
	1%	*-2,812	*1,796	0.2	Passed
C	100%	*-4,835	*2,566	0.2	Passed
	3%	*-2,846	*1,804	0.2	Passed
	2%	*-2,825	*1,796	0.2	Passed
	1%	*-2,802	*1,794	0.2	Passed

*Represents a loading scenario which did not achieve power balance due to respecting the light load lower limits.

Table 2-2: ROI Analysis – Feeder Breaker

Scenario	Project Output	Flows Through Opening Device		Project Trip Times (s)	Result
		P (kW)	Q (kVAR)		
A	100%	*-1,557	*2,853	0.2	Passed
	30%	0	*1,309	0.2	Passed
	25%	0	*1,211	0.2	Passed
	20%	0	*1,117	0.2	Passed
B	100%	*-693	*2,170	0.2	Passed
	75%	*-195	*1,810	0.2	Passed
	50%	0	*1,413	0.2	Passed
	25%	0	*1,068	0.2	Passed
C	100%	*-18	*1,502	0.2	Passed
	95%	0	*1,482	0.2	Passed
	90%	0	*1,436	0.2	Passed
	85%	0	*1,390	0.2	Passed

*Represents a loading scenario which did not achieve power balance due to respecting the light load lower limits.

Table 2-3: ROI Analysis – Recloser 1_66

Scenario	Project Output	Flows Through Opening Device		Project Trip Times (s)	Result
		P (kW)	Q (kVAR)		
A	100%	*-3,870	*1,920	0.2	Passed
	3%	*-68	*68	0.2	Passed
	2%	*-36	*52	0.2	Passed
	1%	*-15	*37	0.2	Passed
B	100%	*-2,950	*1,310	0.2	Passed
	3%	*-42	*53	0.2	Passed
	2%	*-22	*43	0.2	Passed
	1%	*-12	*32	0.2	Passed
C	100%	*-2,010	*716	0.2	Passed
	3%	*-21	*37	0.2	Passed
	2%	*-13	*32	0.2	Passed
	1%	0	*26	0.2	Passed

*Represents a loading scenario which did not achieve power balance due to respecting the light load lower limits.

Based on these results, the Project does not present ROI violations and requires no related upgrades or design changes.

2.5 Underfrequency Load Shed Impact Assessment

An Underfrequency Load Shed (UFLS) impact assessment was conducted on multiple feeder conditions with the purpose of evaluating potential for the Project to cause issues on existing Versant UFLS schemes at the Amherst 17K substation and its feeders. Versant provided the feeder UFLS scheme settings, which can be seen in Table 2-4.

Table 2-4: Amherst 17K UFLS Scheme Settings

Feeder	Pickup Setting (Hz)	Pickup Time (s)	Voltage Block (120 V)
UF1	59.5	0.11	84
UF2	59.1	0.11	84

The UFLS impact assessment was performed by islanding the Amherst 17K substation and determining if the Project resulted in any feeder UFLS scheme activating in the time before the Project's anti-islanding protection tripped it offline.

Various loading and generation scenarios were postured in the PSCAD model for the substation islanding condition. Table 2-5 presents the scenarios tested as well as the results of the analysis:

Table 2-5: UFLS Impact Assessment

Scenario	Project Output	Flows Through Opening Device		UFLS Pickup Time (s)	Result
		P (kW)	Q (kVAR)		
A	1%	-2,822	1,810	N/A	Passed
		-2,825	1,803	N/A	Passed
		-2,822	1,810	N/A	Passed
		-2,822	1,806	N/A	Passed
		-2,825	1,807	N/A	Passed
B	1%	-2,814	1,800	N/A	Passed
		-2,811	1,796	N/A	Passed
		-2,811	1,803	N/A	Passed
		-2,811	1,800	N/A	Passed
		-2,813	1,798	N/A	Passed
C	1%	-2,800	1,790	N/A	Passed
		-2,801	1,789	N/A	Passed
		-2,802	1,791	N/A	Passed
		-2,801	1,787	N/A	Passed
		-2,801	1,769	N/A	Passed

Based on these results, the Project does not impact the underfrequency load shed (UFLS) protection settings; however, to meet ISO-NE requirements for automatic shedding load (which is not effective during generation operation), the point of load shedding will be relocated from the feeder breaker to beyond the Project PCC. Versant Power will install a SCADA controlled recloser with UFLS protection on the feeder downstream of the PCC.

2.6 Results Summary

The Time Domain Study evaluated the Amherst 17K substation and 17K2 to identify Project impacts. A summary of all simulation results and network upgrades necessary to mitigate adverse impacts caused by the Project can be seen in Table 2-6.

Table 2-6: Time Domain Study Results Summary

Analysis Type	Criteria	Results	Upgrades	Notes
Load Rejection Overvoltage	Compliant w/ IEEE 1547-2018 Section 7.4.2	Violations observed	Enable inverter TrOV protection and set to 1.35 PU and 1 ms	All subsequent inverter firmware updates must maintain the TrOV setting
Ground Fault Overvoltage	Compliant w/ IEEE 1547-2018 Section 7.4.2	No violations	None	
Risk of Islanding	Project trips off within 2s under islanded condition	No violations	None	
Underfrequency Load Shed	Project does not cause UFLS nuisance tripping	No violations	None	

3 CONCLUSIONS and RECOMMENDATIONS

The primary objective of this Study is to assess the impacts on the Amherst 17K Substation, the 17K2 distribution feeder, and to identify distribution system modifications that may be necessary to complete the interconnection of the PV Project. As a result of the assessment the following conclusions are made:

1. Option A: It is required that the Project utilize a 112.5 kVA, 5%Z, X/R=3.39 zig-zag grounding transformer connected to the primary side.
2. Option B: It is required that the Project utilize a 112.5 kVA, 5%Z, X/R=3.39 zig-zag grounding transformer connected to the primary side.
3. Option C: It is required that the Project utilize a 45 kVA, 4%Z, X/R=2.9 zig-zag grounding transformer connected to the primary side.
4. Eversource will make the final determination as to whether the 16.50% (Option A) / 16.94% (Option B) increase to fault current reported will adversely impact the existing equipment and protection schemes.
5. The Time Domain Study was conducted in PSCAD using the Power Electronics HEMK FS2125K and FS3190K version v1008 to represent the Project inverters. According to the manufacturer, this version of the PSCAD model is representative of firmware version 2.2.3 or higher. The Customer shall ensure that this version is an accurate representation of the Project inverter firmware with the manufacturer.
6. The Project passed the Time Domain Study load rejection overvoltage (LROV) evaluation provided that the inverter TrOV protection is enabled and set to 1.35 PU for 1 ms.

7. The Project passed the Time Domain Study ground fault overvoltage (GFOV) evaluation. Therefore, no associated upgrades are required.
8. The Project passed the Time Domain Study Risk of Islanding (ROI) evaluation. Therefore, no associated upgrades are required.

Appendix A - Project One-Line Diagram

Appendix B - PSCAD System Model Scenario A

Appendix C - PSCAD System Model Scenario B

Appendix D - PSCAD System Model Scenario C

Appendix III:

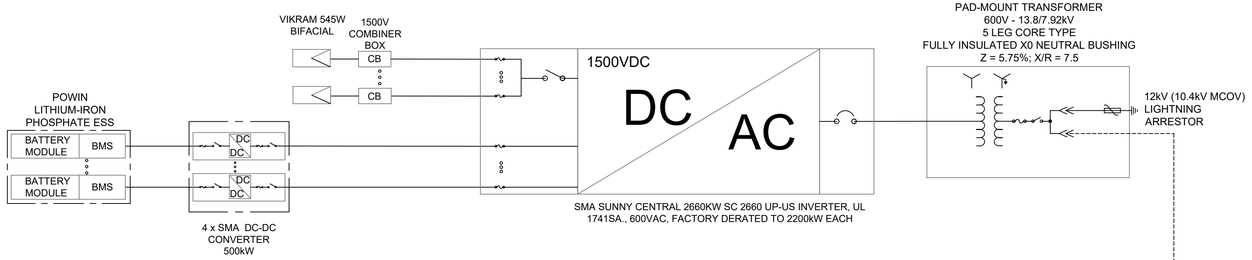
Latest Site Plan & One-Line

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ESS System Specifications	
BATTERY MODULES	24 X POWIN STACK 750E LITHIUM-IRON PHOSPHATE (LFP)
BATTERY RATING	17,904kWh - 4000kW DC
DC-DC CONVERTERS	8 X SMA DC-DC 500kW CONVERTERS

PV System Specifications	
PV Modules	16,016 x VIKRAM 545W BIFACIAL
DC Rating at STC	8.729MW
Inverters	2 x SMA 2660 UP-US UL1741SA (EACH FACTORY DERATED TO 2.20MW)
SYSTEM AC Rating	4.4MW - 4.4MVA PF=1
DC/AC Ratio	1.98

NOTE:
BATTERY CANNOT AND WILL NOT CHARGE FROM THE UTILITY NETWORK



BESS NOTE :

1. ESS BATTERY WILL NOT BE CHARGED OFF THE UTILITY EPS. PLEASE REFER TO THE UNIDIRECTIONAL POWER OUTPUT VERIFICATION LETTER FROM SMA. 6

2. INTEGRATION OF ENERGY STORAGE SYSTEM INTO THE PV INVERTER DC INPUT SHALL BE:
- BY PRODUCT LISTING OF FULL SYSTEM BY A NATIONALLY RECOGNIZED TESTING LABORATORY, OR
- BY FIELD TESTING OF THE FULL SYSTEM BY A NATIONALLY RECOGNIZED TESTING LABORATORY, OR
- BY WRITTEN VARIANCE PROVIDED BY THE AUTHORITY HAVING JURISDICTION.

INVERTER SETTINGS

ANSI	PICKUP	DELAY
#	(%V / V_{L-L}, Hz)	(CYCLES : SECONDS)
27	50% / 300.0V	66 : 1.1
27	88% / 528.0V	120 : 2.0
59	110% / 660.0V	120 : 2.0
59	120% / 720V	9.6 : 0.16
59	135% / 810V	0.06 : 0.001
81/U	56.5Hz	9.6 : 0.16
81/U	58.5Hz	18000 : 300
81/O	61.2Hz	18000 : 300
81/O	62.0Hz	9.6 : 0.16

1. SET LOW VOLTAGE AND FREQUENCY RIDE-THROUGH PER ISO-NE SRD.
2. THE INVERTER SHALL NOT CONNECT OR RETURN TO SERVICE FOLLOWING A TRIP UNTIL DETECTING 5 MINUTES OF HEALTHY UTILITY VOLTAGE AND FREQUENCY.

PROPOSED PROTECTIVE RELAY SETTING

#	PICKUP			RELAY CLEAR TIME / TIME DIAL / TCC CURVE	
	Vphase, A, Hz V_{Nom} = 29.88V_{L-N}; I_{RATED} = 184.1A-Pri; PTR=266.67; CT=200:1			Cycles	Seconds
	PER UNIT	V/A Primary	V/A Secondary		
51G	0.22	41.00A	0.205A	TD 1 U5	
50	15	2762A	13.8A	INSTANTANOUS	
51	1.4	257.7A	1.29A	TD 2 U4	
32	-	4400kW	82.50kW	120	2.0

6

RELAY NOTES:
1. ESTIMATE CONTACTOR OPENING TIME IS 3 CYCLES (0.05 SEC).
2. THE RELAY WILL BE PROGRAMMED TO TRIP THE MAIN DISCONNECT WITHIN 2-SEC WHEN LOSS OF AC SUPPLY VOLTAGE, THE BATTERY TEST FAILS OR WHEN THERE IS A RELAY HARDWARE ALARM.

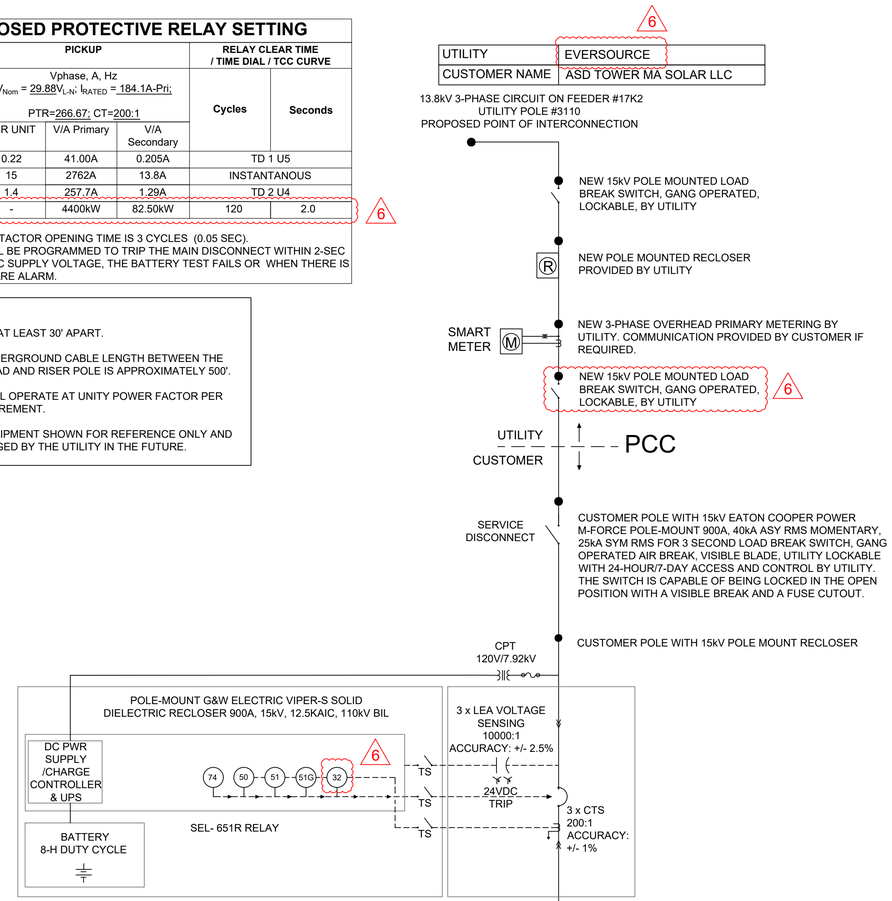
NOTES :

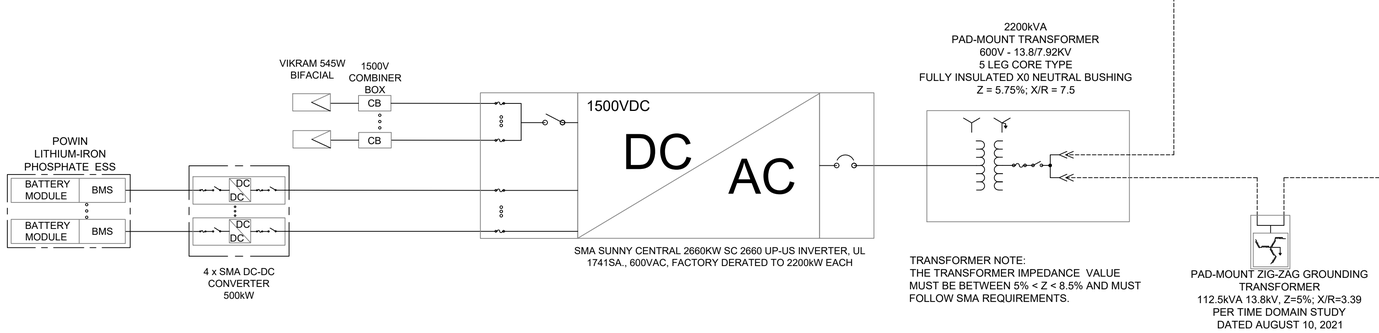
1. POLES ARE AT LEAST 30' APART.

2. THE MV UNDERGROUND CABLE LENGTH BETWEEN THE EQUIPMENT PAD AND RISER POLE IS APPROXIMATELY 500'.

3 .SYSTEM WILL OPERATE AT UNITY POWER FACTOR PER UTILITY REQUIREMENT.

4. UTILITY EQUIPMENT SHOWN FOR REFERENCE ONLY AND MAY BE CHANGED BY THE UTILITY IN THE FUTURE.





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REVISIONS

REV	DESCRIPTION	DATE	DESIGN	REVIEWED
6	UPDATE PER UTILITY COMMENTS	11-16-2022	AS	JB
5	UPDATE EQUIPMENT	10-04-2022	AT	JB
4	UPDATES PER AMP COMMENTS	04-09-2022	GA	JB
3	EQUIPMENT UPDATE	03-30-2021	AS	JB
2	ADD SMART METER	03-17-2020	SJ	JB
1	ISSUED FOR UTILITY SUBMISSION	07-08-2019	RW	JB

NEO Virtus Engineering, Inc. Since 2001
LITTLETON, MASSACHUSETTS

JAMES M. BING

ASD TOWER MA SOLAR LLC
TOWER RD
PELHAM, MA 01002

DWG NAME: AC 1-LINE

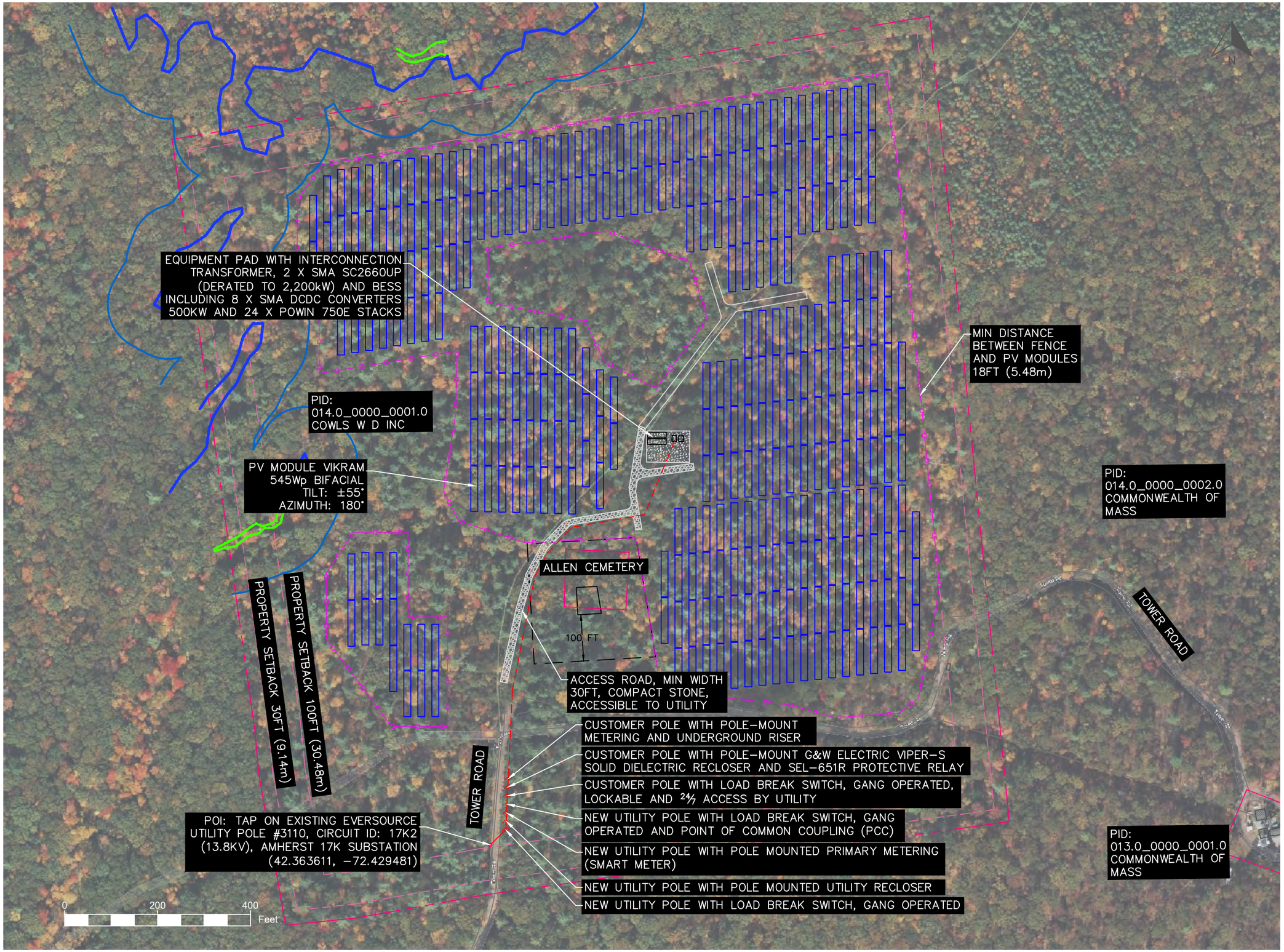
DWG NO.: E-1.0

SIZE: D

SCALE: AS-NOTED

DATE: 06-05-2019

NOT FOR CONSTRUCTION



NOT FOR CONSTRUCTION

SITE SUMMARY	
AC POWER	4.400MW
DC POWER	8.729MWp
DC/AC RATIO	1.98
PV INVERTERS	2 x SMA SC2660UP (DERATED TO 2,200kW)
PV MODULES	16,016 (VIKRAM 545Wp BIFACIAL)
BESS POWER CAPACITY	8 X SMA DCDC CONVERTERS 500KW (4,000KW)
BESS ENERGY CAPACITY	24 X POWIN 750E STACKS (17,904KWH)
SITE COORDINATES	42.365817°, -72.428292°

LEGEND	
PARCEL BUFFER	
FENCE	
GRAVELED ROAD	
PV MODULE ARRAY	
EXISTING UTILITY LINE	
WETLAND BUFFER	
UG MV CABLE OH MV CABLE	
POLE	

DEVELOPER

amp

301-31 Lakeshore Road East
Port Credit, ON
L5G 4V5
tel: 905-271-7800
fax: 905-271-7801
www.amp.energy

CLIENT

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REV	DESCRIPTION	DATE DD/MM/YY	BY
00	ISSUED FOR REVIEW	28/04/22	JC
01	ADDITIONAL LAND + GRADING	20/07/22	JC
02	MAX DC SIZE	22/07/22	JC
03	UPDATE EQUIPMENT	04/10/22	JC

CLIENT:
ASD TOWER MA SOLAR LLC

PROJECT ADDRESS:
0 TOWER ROAD
PELHAM MA, 01002

DRAWING TITLE:
IX SITE PLAN

DRAWING NO.
E-00

DRAWN:	JC	DATE:	28/04/22	SHEET: 1 of 1
CHECKED:	CL	DATE:	04/10/22	

Attachment K

Proof of Liability Insurance

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY): 08/04/2025

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must have ADDITIONAL INSURED provisions or be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER
McGriff, a Marsh & McLennan Agency LLC Company
2000 International Park Drive
Suite 600
Birmingham, AL 35243

CONTACT NAME:
PHONE (A/C, No, Ext): 1-800-476-2211 **FAX (A/C, No):**
E-MAIL ADDRESS:

INSURER(S) AFFORDING COVERAGE	NAIC #
INSURER A : Great Northern Insurance Company	20303
INSURER B : Federal Insurance Company	20281
INSURER C :	
INSURER D :	
INSURER E :	
INSURER F :	

INSURED
PSE Renewables Group LLC including ASD Tower MA Solar LLC
518 17th St., Suite 950
Denver, CO 80202

COVERAGES **CERTIFICATE NUMBER:** HJ6PUVQF **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS		
A	X **COMMERCIAL GENERAL LIABILITY** ☐ CLAIMS-MADE ☒ OCCUR ☐ ☐ GEN'L AGGREGATE LIMIT APPLIES PER: ☐ POLICY ☒ PRO-JECT ☐ LOC ☐ OTHER:			36075881	08/01/2025	08/01/2026	EACH OCCURRENCE	$	1,000,000
							DAMAGE TO RENTED PREMISES (Ea occurrence)	$	1,000,000
							MED EXP (Any one person)	$	10,000
							PERSONAL & ADV INJURY	$	1,000,000
							GENERAL AGGREGATE	$	2,000,000
							PRODUCTS - COMP/OP AGG	$	2,000,000
								$	
B	**AUTOMOBILE LIABILITY** ☐ ANY AUTO ☐ OWNED AUTOS ONLY ☐ SCHEDULED AUTOS ☒ HIRED AUTOS ONLY ☒ NON-OWNED AUTOS ONLY ☐			73629020	08/01/2025	08/01/2026	COMBINED SINGLE LIMIT (Ea accident)	$	1,000,000
							BODILY INJURY (Per person)	$	
							BODILY INJURY (Per accident)	$	
							PROPERTY DAMAGE (Per accident)	$	
								$	
	☐ **UMBRELLA LIAB** ☐ OCCUR ☐ **EXCESS LIAB** ☐ CLAIMS-MADE ☐ DED ☐ RETENTION $						EACH OCCURRENCE	$	
							AGGREGATE	$	
								$	
B	**WORKERS COMPENSATION AND EMPLOYERS' LIABILITY** Y / N ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? ☐ **(Mandatory in NH)** If yes, describe under DESCRIPTION OF OPERATIONS below	N / A		71839563	08/01/2025	08/01/2026	☒ PER STATUTE ☐ OTH-ER		
							E.L. EACH ACCIDENT	$	1,000,000
							E.L. DISEASE - EA EMPLOYEE	$	1,000,000
							E.L. DISEASE - POLICY LIMIT	$	1,000,000
								$ $ $ $ $	

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)

CERTIFICATE HOLDER

Town of Pelham
351 Amherst Road
Pelham, MA 01002

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE



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Attachment L

Noise Assessment

Environmental Sound Study



Solar Generating and Storage Facility

Pelham, Massachusetts

June 6, 2025

Prepared For:

Pure Sky Energy
518 17th Street, Suite 950
Denver, CO 80202

Prepared By:

Modeling Specialties
30 Maple Road
Westford, MA 01886

Environmental Sound Assessment
ASD Tower MA Solar, LLC

Background

ASD Tower MA Solar, LLC. proposes to install and operate a solar generating and storage facility in Pelham, Massachusetts. While solar-electric conversion using photovoltaic (PV) panels is inherently a silent operation, the facility will require some equipment that can emit sound. This analysis evaluates the existing environment in the rural project area and potential sounds generated by the construction and operation of the facility. The study is based on the equipment configuration provided by the project engineers and potential equipment manufacturers. The assessment is based on the criteria provided by Massachusetts Department of Environmental Protection (MassDEP) as directed by the Pelham Code Section 125.18.2.G.(2)(k). The code also requires the evaluation of construction sound which is also provided in this report.

Existing sound levels in the area are very low consistent with the site being on a 65-acre large forested parcel surrounded by an even much larger Cadwell Memorial Forest (State of Massachusetts). The whole area is surrounded by low volume rural roadways. Observed sounds are limited to roadways in the vicinity of each receptor, local activities and nature sounds. The receptors in varied directions are between 2050 feet to nearly a mile away from the project sources. Sources at that distance have little potential to effect site sound levels, just as project sounds will have little effect at any receptor. This is consistent with conditions that were observed in the area during an informal visit on May 8, 2025.

Overview of Project and Site Vicinity

The Project site is located in Pelham, MA. The community has a history of agricultural farming and forest management. The site and surrounding area are currently mostly forested. Occasional parcels along Amherst Road and Enfield Road have been developed as residential use. The graphical overview in Figure 1 shows the site, local roadways and existing residences. Figure 2 shows more detail related to the project site. The project will include solar trackers and battery storage to optimize delivery of renewable electrical energy into the existing utility electric grid. Figure 2 shows site clearing that is simulated in areas that are indicated on the plans by Tetra-Tech dated May 16, 2025. The project parcel includes several protected wetlands and their buffers, a historic cemetery and the planned PV array to be developed.

The following study is abbreviated somewhat due to the isolated nature of the project site, quiet operation of facility with all support equipment located roughly in the center of the large parcel. Nevertheless, the project sources are described and quantified at the source and at representative receptors. Sound levels from the proposed equipment were estimated based on vendor design and measured levels at similar equipment. Sound level modeling techniques were used to estimate the potential impacts at project property lines and also at existing residences in the area.

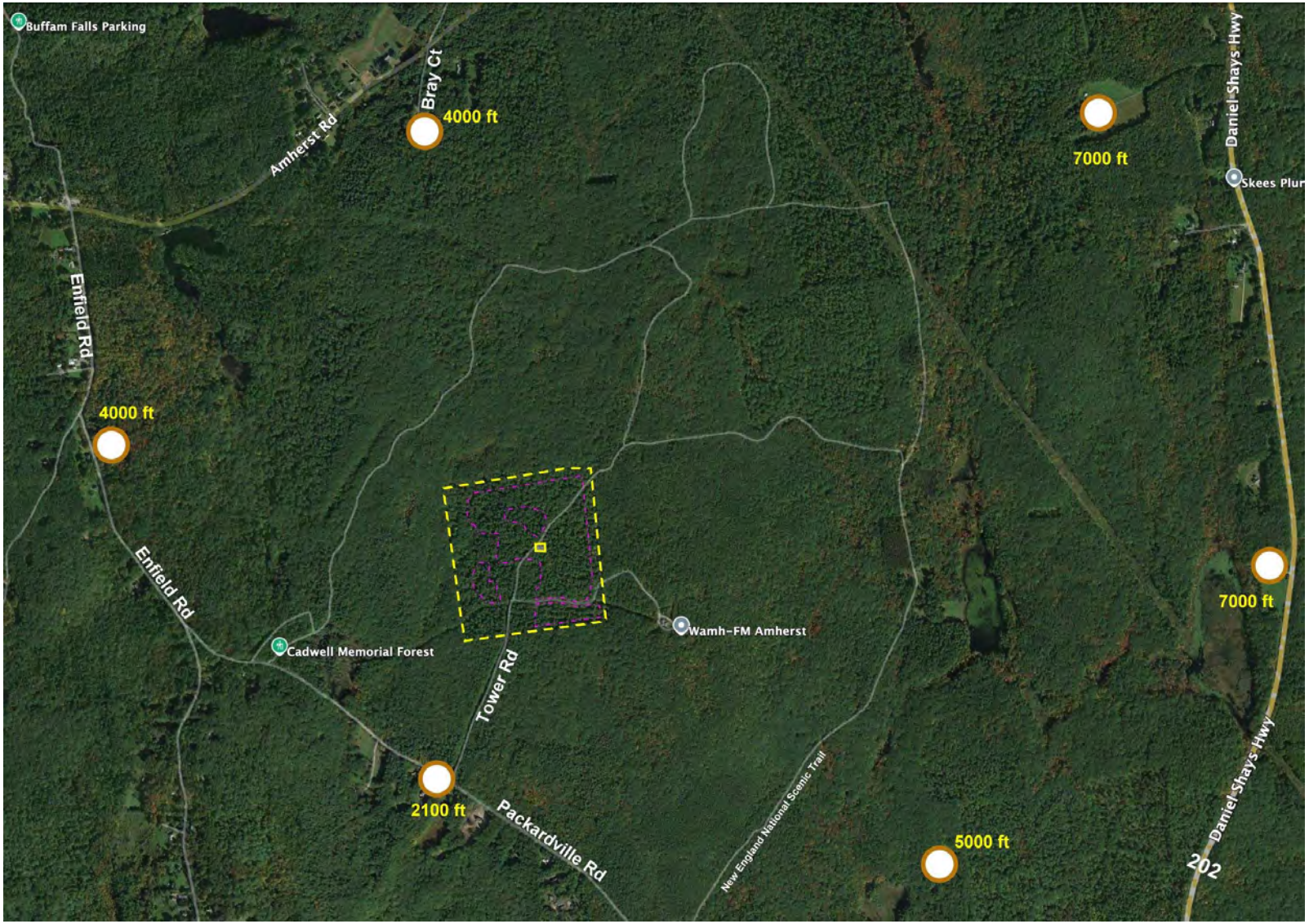


Figure 1: View from Google Earth Showing the Relative Isolation of the Site Equipment Pad from Nearest Residential Receptors

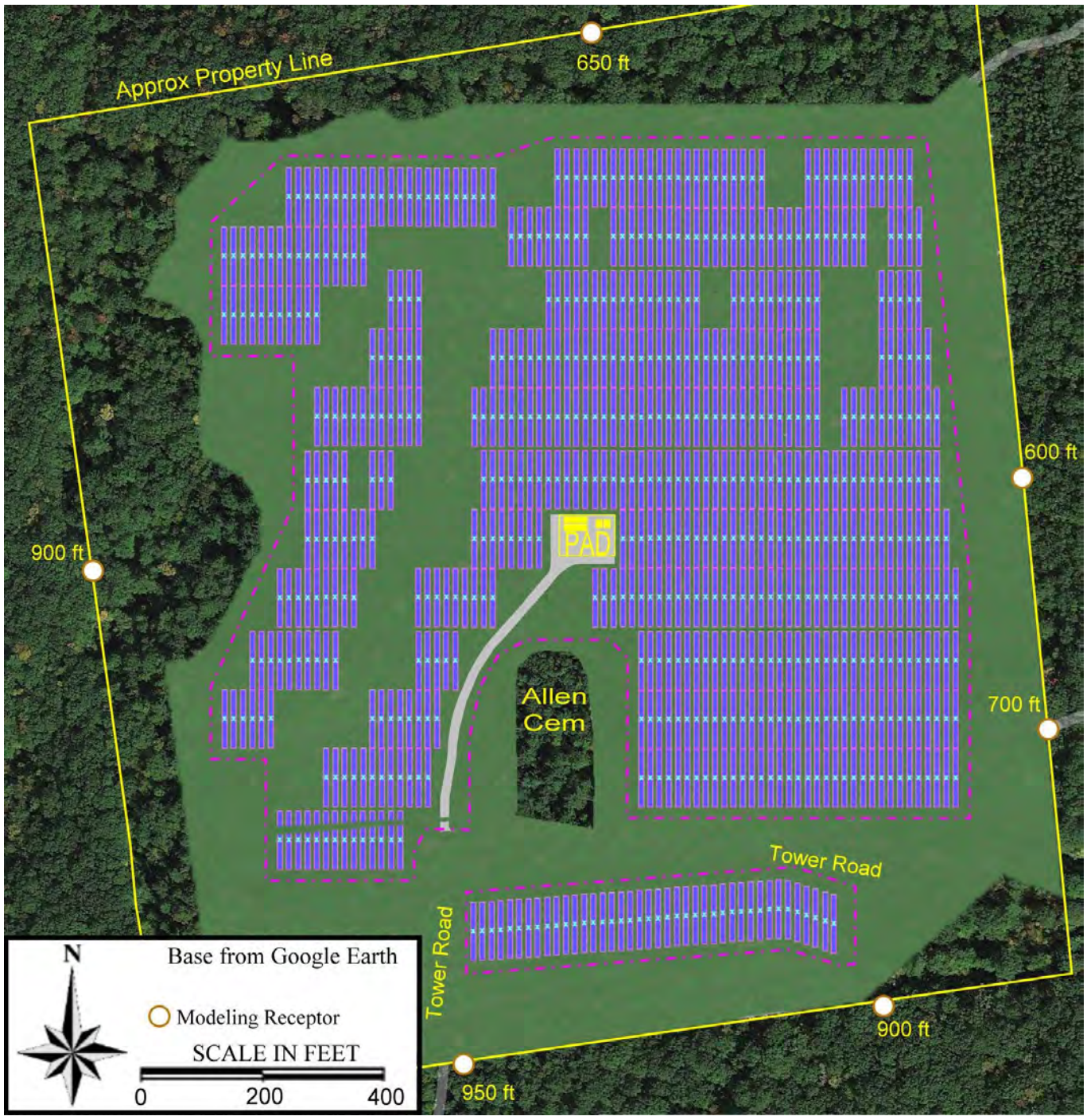


Figure 2: Project Area Overlaid with Approx. Property Lines and Analysis Locations

Discussion of Analysis Methods

There are a number of ways in which sound (noise) levels are measured and quantified. All of them use the logarithmic decibel (dB) scale. Following is a brief introduction to the sound measurement terminology used in this assessment.

Acoustic Metrics

The Sound Level Meter used to measure sound is a standardized instrument.[1] It contains "weighting networks" to adjust the frequency response of the instrument to approximate that of the human ear under various circumstances. One of these is the *A-weighting* network. A-weighted sound levels emphasize the middle frequency sounds and de-emphasize lower and higher frequency sounds; they are reported in decibels designated as "dBA." Figure 3 illustrates typical sound levels produced by sources that are familiar from everyday experience.

The sounds in our environment usually vary with time so they cannot simply be described with a single number. Two methods are used for describing variable sounds. These are *exceedance levels* and *equivalent levels.* Both are derived from a large number of moment-to-moment A-weighted sound level measurements. Exceedance levels are designated L_n, where "n" can have any value from 0 to 100 percent. For example:

- L_{90} is the sound level in dBA exceeded 90 percent of the time during the measurement period. The L_{90} is close to the lowest sound level observed. It is essentially the same as the *residual* sound level, which is the sound level observed when there are no loud, transient sounds.
- L_{50} is the median sound level; in dBA, that is exceeded 50 percent of the time during the measurement period.
- L_{10} is the sound level in dBA exceeded only 10 percent of the time. It is close to the maximum level observed during the measurement period. The L_{10} is sometimes called the *intrusive* sound level because it is caused by occasional louder sounds like those from passing motor vehicles. By using exceedance levels, it is possible to separate prevailing, steady sounds (L_{90}) from occasional, louder sounds (L_{10}) in the environment.
- The *equivalent level* is the level of a hypothetical steady sound that has the same energy as the actual fluctuating sound observed. The equivalent level is designated L_{eq}, and is also A-weighted. The equivalent level is strongly influenced by occasional loud, intrusive sounds.

When a steady sound is observed, all of the Ln and Leq are equal. Both the L90 and Leq are used in this study, L90 representing the background sound and Leq to characterize the equipment sounds. All broadband levels represented in this study are weighted using the A-weighting scale.

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[1] *American National Standard Specification for Sound Level Meters*, ANSI S1.4-1983, published by the Standards Secretariat of the Acoustical Society of America, Melville, NY.

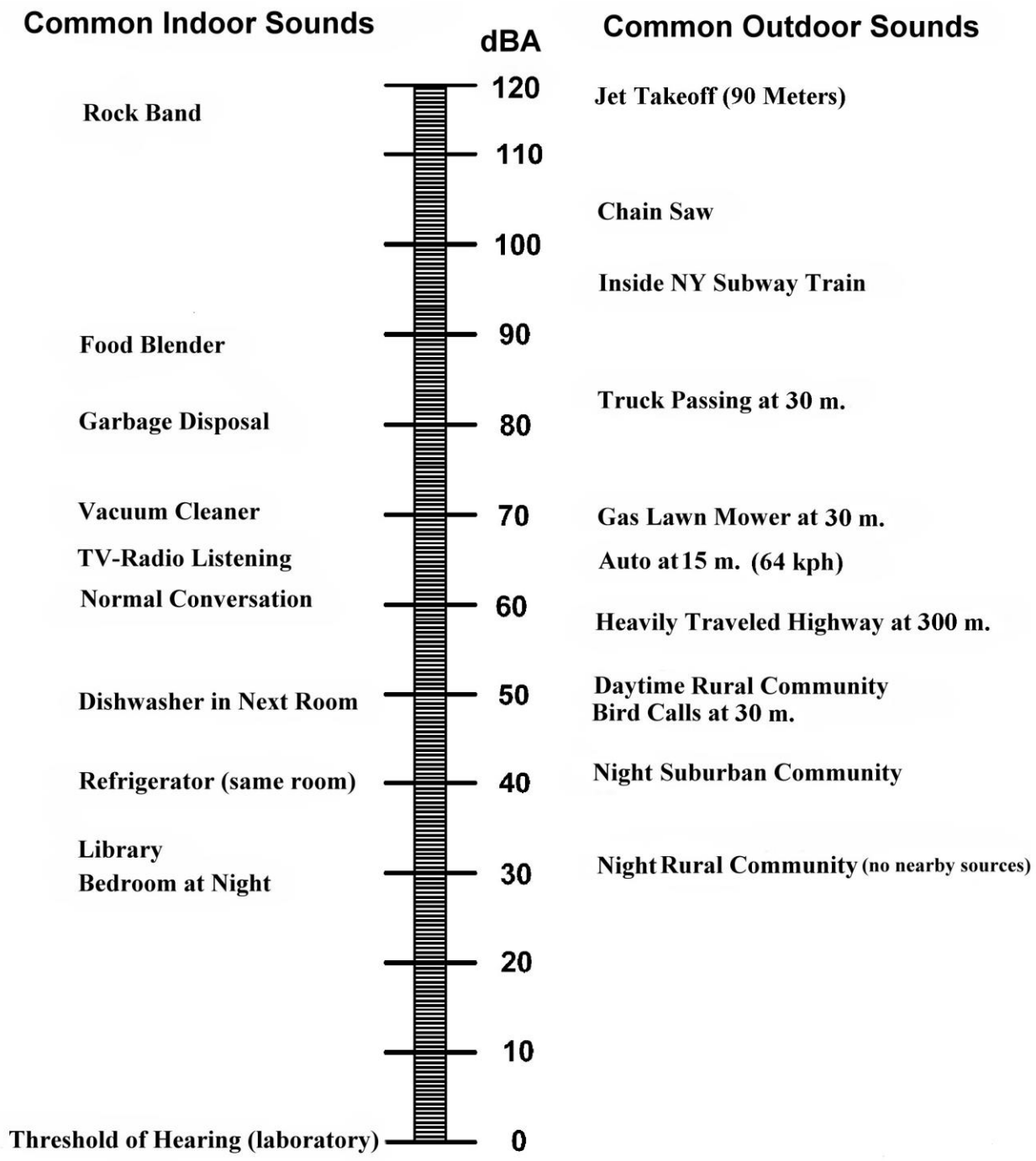


Figure 3: Typical Sound Levels from Everyday Experience

In the evaluation of sound fields, it is essential to know something about the frequency spectrum of the sound. Noise control treatments do not function like the human ear, so simple A-weighted levels are not useful for noise-control design or the identification of tones. The frequency spectra of sounds are usually stated in terms of *octave band sound pressure levels*, in dB, with the octave frequency bands being those established by standard.[2] The sound survey included measurements in 1/3 octave bands. The sounds expected as a result of this project were evaluated with respect to the full octave band levels as well as the A-wtd equivalent sound levels. For simplicity they are summarized in this report in terms of the single-value A-weighted level.

Noise Regulations and Criteria

Sound compliance is judged on the extent to which governmental regulations or guidelines are met and the extent to which it is estimated that the community is protected from excessive sound levels. The governmental regulations that may be applicable to sound produced by activities at the Site are summarized below.

Federal

- Occupational noise exposure standards: 29 CFR 1910.95. This regulation restricts the noise exposure of employees at the workplace as referred to in OSHA requirements. Those requirements provide requirements for hearing protection or mitigation when the long-term sound exposure is 80 dBA or higher. This protects workers from hearing damage, which is the same concern for any persons and animals at an off-site location. Additional Department of Transportation criteria regulate sound level from vehicles used in interstate transportation. Construction sounds are evaluated using these criteria as they are designed to protect hearing.

State

- In Massachusetts, noise is regulated as an air pollutant. 310 CMR §7.10 U qualitatively prohibits "unnecessary emissions from [a] source of sound that may cause noise". This is interpreted quantitatively by MassDEP's Form BWP AQ SOUND and their DAQC Policy 90-001 (Noise Policy). It is further interpreted on the DEP website in various technical summaries.

  The MassDEP's Noise Policy states that a new sound intrusion may not increase the broadband sound level by more than 10 dBA over the pre-existing L_{90} ambient level. Tonal sounds, defined as any octave band level that exceeds the levels in adjacent octave bands by 3 dB or more, are also prohibited. This policy addresses the sound levels, both at the property lines and at the nearest residences. While the criteria don't change, the MassDEP acknowledge the varied sensitivity based on land use (Residential).

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[2] *American National Standard Specification for Octave, Half-octave and Third-octave Band Filter Sets*, ANSI S1.11-1966 (R1975).

Local

- The Town of Pelham regulates Solar Electric Installations at **Section 125-18.2**". In the Planning Board review of the project plans, the Town requires that the project use the criteria and procedures that are used in State reviewed projects. The project does not require a MassDEP review, but this evaluation will be based on the same regulatory requirements stated above. Pelham is a farm friendly community. The site is located in a Residential District, whose stated purpose is to ***"promote agriculture, forestry, recreation and land conservation, as well as well as compatible open space and rural uses…"*** per Section 125-3, B (1).

This sound analysis will identify the equipment and activities in construction and operation of the proposed project in the context of equipment and operational sounds used in agricultural, forestry and recreational activities.

Existing Community Sound Levels

An informal site area survey was conducted on May 8, 2025. The survey was limited to identifying the nearest residential areas in representative directions from the proposed equipment. Based on aerial imagery, the nearest residences are on Packardville Road at distance of almost half mile. The modest sounds from equipment used in solar production has no potential to affect such distant neighbors (as demonstrated by this study). Another purpose of the survey was to observe the forest depth and general area terrain. Rural outdoor sound sources include some nature sounds like birds and light wind, but is usually dominated by traffic on local roads. The enormous size of the nearby Cadwell Memorial Forest and Mount Lincoln serves to isolate (acoustically) the project from the community. The rural character of Pelham results in low volumes of traffic on the distant roads. Consequently, the sound levels were observed to be very low. Typical ambient sound levels under such conditions are daytime in the 40's dBA and nighttime 30 dBA or lower. These conservative values will be used in the study to represent existing conditions. Ambient sound level measurements at site property lines is not appropriate due to ANSI requirements (required distance from trees and foliage).

The Massachusetts DEP studies are based on background sound levels in the L90 metric. Most of the observed sound in the project area is from transient events that are only captured by other metrics. There were intrusions like air traffic, occasional vehicle pass-byes, distant dog barking and birds that caused the levels to momentarily be raised substantially higher than the background level. The modeling to support DEP studies uses equipment sound levels that are usually provided in the Leq metric.

Analysis of Construction Sound Levels

The human ear does not judge sound in absolute terms, but instead senses one sound in comparison to other sounds. The effect of sound is also affected by the receptor sensitivity. Residences during sleeping hours tends to be the most sensitive. Daytime exposure is less sensitive because of other sources that are present during the daytime. Even in rural environments there is more traffic during the daytime. The sound levels from passing vehicles varies widely, but is commonly 70 dBA or more as the car passes a residence. Commercial yard care (string trimmers, lawnmowers and backpack blowers) tend to be limited to 80 dBA at 50 feet from the activity. This represents the sound exposure from a neighbor's yard care. Home lawn care often uses the same equipment as commercial contractors but it is also common for homeowner equipment to be powered by smaller engines and designed around 65-75 dBA at 50 feet. These are levels from short-term activities that are routine for residences.

The project construction activities will be limited to daytime periods. Almost all construction equipment operates intermittently. Equipment is, at times, inactive but kept on site for use when necessary. Even when operating, much construction equipment may be idling or otherwise not producing its highest noise levels. The estimated equivalent levels account for the construction activities necessary for a major construction effort such as the proposed solar facility. A standard reference distance of 50 feet is used in this analysis, which represents a typical residential setback from roadway work. However, this project will have the construction equipment operating at distances well beyond 50 feet from the lot line or residences.

Construction noise is highly variable. The EPA has published data on noise produced by typical construction machinery. A summary of these data is from Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances, EPA Document NTID300.1, December, 1971. These data were updated in 1999 as part of the Central Artery/Tunnel project in Boston. They are documented in NCHRP Synthesis 218 (National Cooperative Highway Research Program). It provides equipment sound levels for newer Tier III and Tier IV equipment. Many construction machines operate intermittently and the types of machines in use at a construction site change with the construction phase. The EPA document referenced above includes a model for predicting energy-average construction noise levels based upon typical construction practices in the United States. The model distinguishes between type of construction ("housing," "office building," "industrial," and "public works") and between construction phase ("site clearing," "excavation," "foundations," "erection" and "finishing"). The model is based upon:

- the number of each item of equipment typically present for a site phase of construction;
- the length of the duty cycles of this equipment; and
- the average noise levels from the equipment during operation.

The model provides typical equivalent levels at a distance of 50 feet from the noise source for two conditions: "all pertinent equipment present at site," and "minimum required equipment

present at site." The EPA levels for the worst of these two conditions for construction of industrial facilities are listed in the middle column of Table 2.

The nearest existing residence is south of the site at a distance of about 2000 feet. The calculated equivalent levels at this nearest residence range from 46 to 57 dBA, and is listed in the final column of Table 2. At more distant residences, the noise from construction will be less because sound level decreases with distance from the source of the sound. These levels are well below levels from typical residential activities like gardening or lawn care.

Table 2 shows the highest noise levels expected by typical construction activities. In addition to the normal construction activities, steam and air blows will occur in the final phases of construction. These processes use high pressure air or steam to clean out all debris from the plant steam line piping. While steam blows are loud, the process is relatively short in duration, and occurs sporadically during the day over a short period. This noise source is normally addressed by public notification to neighbors, and/or the use of temporary portable noise mufflers especially used for this purpose.

Table 2: Equivalent Levels of Construction Sound (Leq) at 50 feet and at the Nearest Residence (2000 feet)

Construction Activity	50 Feet from Source (Leq)	At Packardville Road (Leq)
Generator	80	48
Ground Clearing	84	52
Excavation	89	57
Trenching	85	53
Foundation (Pad)	78	46
Post Driving (Leq)	83	51
Post Driving (peak)	96	- -
Equip. Installation	85	53

Construction Noise Mitigation

A reasonable effort will be made to minimize the noise impact of construction activities. Mitigation measures will include:

* Maintain forested buffer between the developed site area and the property line. There are huge forested buffers between the equipment and the nearest community residences.

* Using equipment with appropriate mufflers and providing ongoing maintenance of intake and exhaust mufflers.

* Maintaining muffling enclosures on continuously operating equipment, such as air compressors, generators and welding units.

* Replacing specific construction operations and techniques by less noisy ones where feasible (e.g., mixing concrete off-site instead of on-site or using vibration pile driving instead of impact driving if practical).

* Selecting the quietest of alternate items of equipment (e.g., electric instead of diesel-powered equipment).

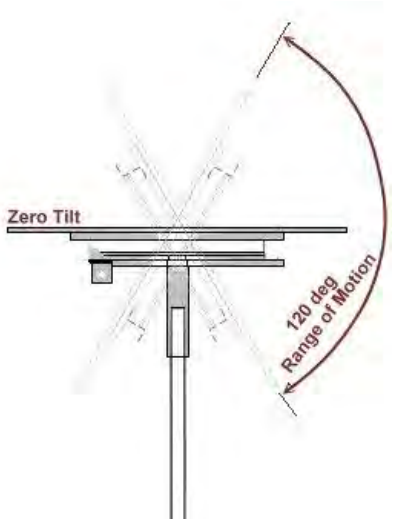
* Scheduling equipment operations to keep average levels low, to synchronize noisiest operations with times of highest ambient levels, and to maintain relatively uniform noise levels.

* Turn off idling equipment.

* Locating noisy equipment at locations that protect sensitive locations by shielding or distance.

Analysis of Operational Sounds from the Proposed Facility

The facility is based on the conversion of solar energy using a PV panel array which is essentially silent. The panel segments will track the sun to optimize the conversion which will require actuators that are a minor source of momentary sound. A single tilt mechanism is located in the center of each tracker span of up to 300 feet. That puts its only source of sound at a distance from the property line of 100 to 300 feet. Each adjustment requires a momentary activation of the gear. The short-term sound is not expected to affect the MDEP background level (L_{90}) metric. The only exception is that at the end of the solar day, the gear will be active for a single longer period to return the tilt to its "morning" position.



The facility electrical output is processed by electronics to match the available public utility system. The typical facility sound is limited to cooling of the electrical processing equipment and storage. While the equipment will be available 24/7 in all seasons, the sound emissions are significantly affected by environmental conditions. The fundamental components of the facility are sketched in Figure 4. The PV production is only during the day, but the storage system will deliver power to the grid during other times. The battery storage and DC/DC converter provides for a smoother power output than a passive solar system. The converter controls the ramp rate at which power is injected into the grid, and thus reduces the impact of rapid power fluctuations due to sudden or transient conditions experienced by the PV array. However, the sound is generally based on cooling that is only required for the safety of the equipment. It will be active as needed, but is expected to be a significant source only during the daytime in the summer. These limited periods of cooling are the basis of this analysis.

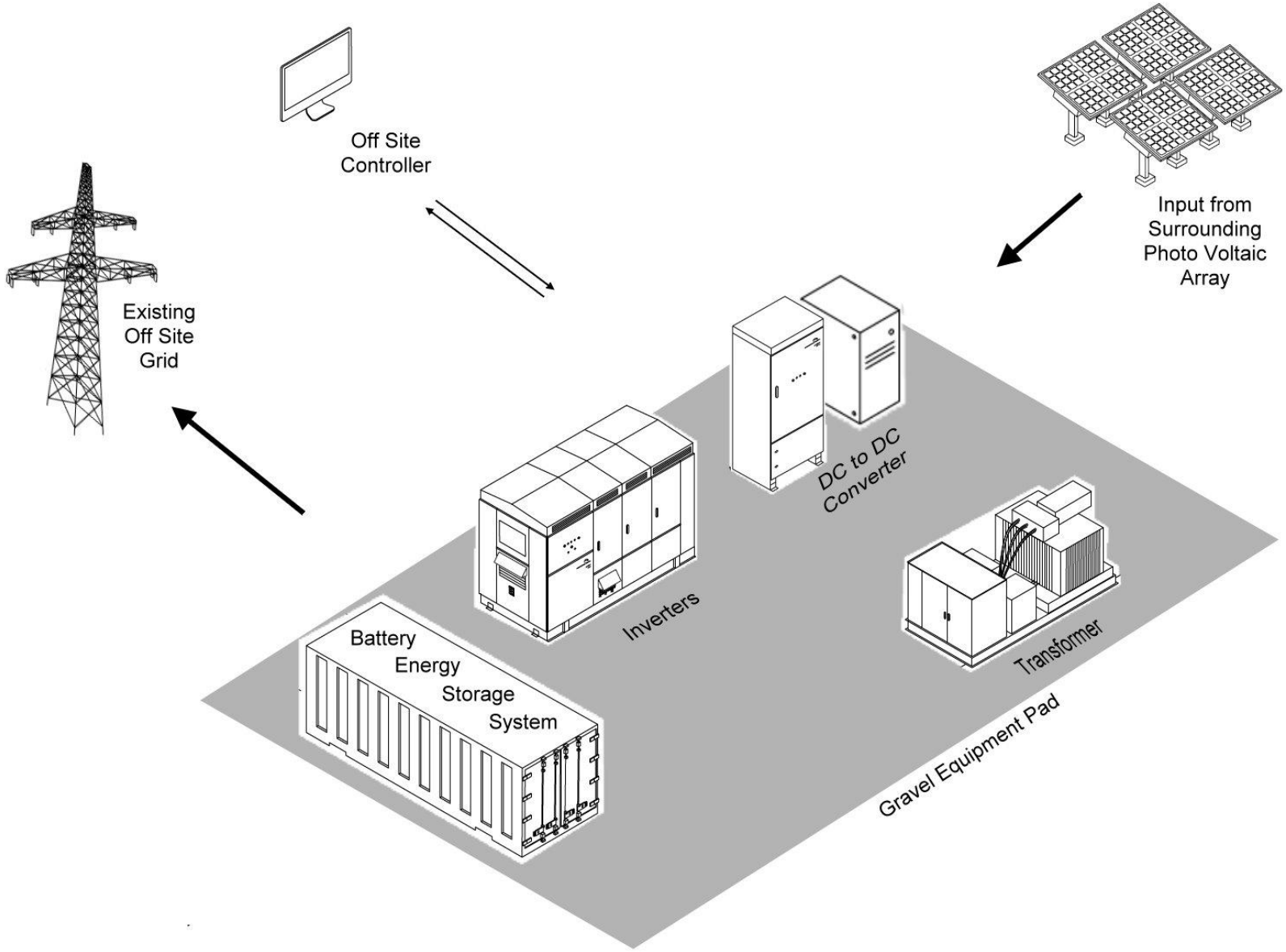


Figure 4: Conceptual Sketch of Required Components of the Proposed Facility

Operational Sound Level Modeling

The acoustical modeling for this project was conducted with CADNA, a computer software program from DataKustik GmbH. The outdoor sound propagation model is based on ISO 9613, Part 1: Calculation of the absorption of sound by the atmosphere, (1993) and Part 2: General method of calculation, (1996). Each sound emission source was modeled based on its emission pattern. Sources are expressed in sound power level (Lw). Sound prediction modeling was performed under downwind weather conditions as assumed in the standard ISO 9613-2. The modeling assumes sound propagation in a stable atmospheric condition which can also enhance the propagation. Figure 1 showed the community receptors. Figure 2 showed the equipment layout in the context of the property line receptors. Table 3 summarizes the modeling input parameters.

Table 3: CADNA Modeling Input Parameters

Item	Modeling Input and Description
Terrain	Flat Terrain assumed
Temperature	10ºC
Relative Humidity	70%
Weather Condition	6.5 mph, directly from facility to receptor*
Ground Attenuation	0.2, hard surface (0.5 = soft ground, 0.0 = pure reflection)
Atmospheric Inversion	CONCAWE – Category F**
# of Sound Reflections	2
Receptor Height	1.5 meter above ground level

** Propagation calculations incorporate the adverse effects of certain atmospheric and meteorological conditions on sound propagation, such as gentle breeze of 1 to 5 m/s (ISO 1996-2: 1987) from source to receiver.*

*** Category F represents a stable atmosphere that promotes noise propagation.*

The modeling analysis is based on the contributions of individual sources and propagation losses from each source to its corresponding analyzed receptor. The equipment pad is essentially the acoustic center of the facility. The tracking source(s) are distributed throughout the extended PV array. Source values were developed based on the equipment manufacturers data.

Site property line receptors were placed where the highest sound level is expected in each general direction. This study is intended to address the MassDEP criteria as required by the Pelham zoning code. The results of the compliance evaluation for the MassDEP standards are shown in Table 4. The expected sound levels are well below the standards at property line locations. A graphical summary of the property line modeling results is provided in Figure 5. The modeling indicates that the facility will make no numerical contribution at any residential location.

Table 4: Summary of Sound Compliance Evaluation for the MassDEP Standards

Receptor*	Dist. (ft)	Ambient D (dBA)	Project (dBA)	Combined (dBA)	Increase (dB)
Property Line N	`650	40	34	41	+1
Property Line, E1	`600	40	36	41	+1
Property Line, E2	`700	40	34	41	+1
Property Line, SE	`900	40	33	41	+1
Property Line, S	`950	40	32	41	+1
Property Line, W	`900	40	33	41	+1
Residence, NE	`7000	40	14	42	0
Residence, E	`7000	40	14	42	0
Residence, SE	`5000	40	17	42	0
Residence, SW	`2100	40	25	42	0
Residence, W	4000	40	19	41	0
Residence, N	4000	40	19	41	0
*Forest and terrain were not considered in this study but will further reduce the sound					

Conclusions

The existing sound baseline was established by the literature because the site is deep within a large forested area. While the facility will be well isolated from the community, all potential sources of sound from the facility were identified and quantified. The equipment pad is located roughly in the center of the 65-acre parcel. Sound level modeling techniques were employed to estimate the sound levels at the property lines and also at the nearest community receptor locations. The MassDEP evaluation was applied at the site property line locations where the expected sound from the facility is greatest. The results of the modeling indicate that the facility levels will meet the MassDEP sound performance criteria at all project property lines. Separately, modeling was conducted to estimate the sound that would be expected at distant residential properties in representative directions and found to make no numerical contribution. Since sound decreases with distance, the sound will be even lower at more distant locations than were analyzed.

Construction sources are handled separately from the operational sources. The construction process will use equipment that is similar to logging, farming and construction activities that are familiar in this community. It was evaluated to identify the potential levels at residential locations during the construction period. The modeling analysis shows that with the proposed sound sources and noise abatement, the sound increases at most property line locations and all residences will be minor (less than +5). Therefore, the project is expected to comply with the MassDEP sound level requirements at all times during construction and operation of the facility.

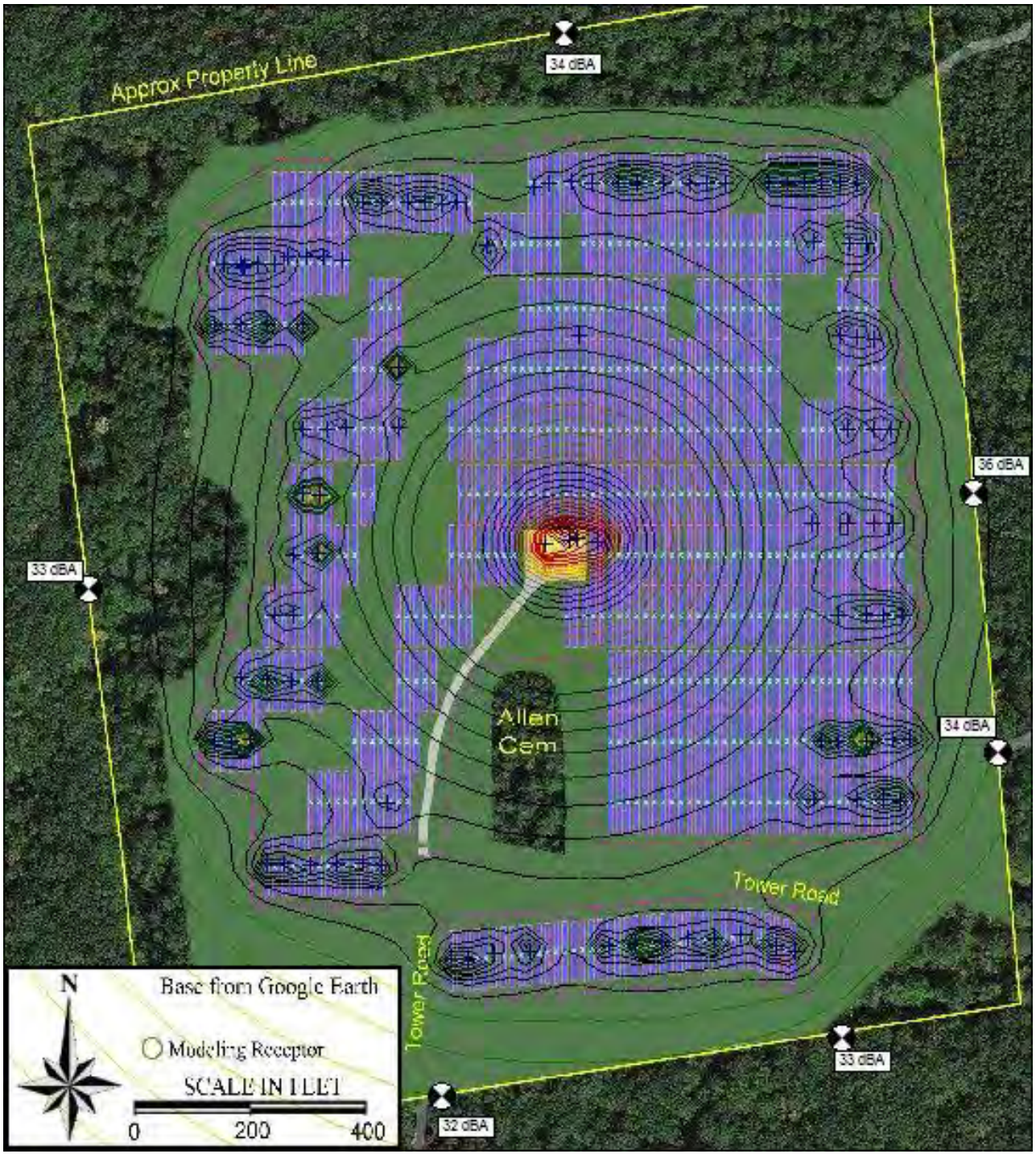


Figure 7: Graphical Summary of the Predicted Daytime Operational Sound Levels

I certify that the analysis of sound levels is accurate and consistent with methods that are common to the acoustic analysis of such sources. I am qualified to make this statement based on training and experience in conducting analyses of environmental sounds. I am a Certified Consulting Meteorologist with more than 20 years' experience conducting environmental analyses in the technical areas of air quality, noise, and visual aesthetics. I have published refereed papers on various aspects of environmental noise. I have analyzed the noise emissions of major industrial projects such as power plants, wastewater treatment plants and manufacturing facilities. Related to these analyses, I have testified as a technical expert before the Energy Facility Siting Boards of Massachusetts, Connecticut and Rhode Island. I have also testified before many regional and municipal approval boards in Massachusetts, Rhode Island, New Hampshire, Maine, New York, Michigan, Illinois, and California.

Respectfully,

Modeling Specialties



Douglas L. Sheadel, CCM
Principal

Attachment M

Water Analysis

186 Granite Street, Suite 3A
Manchester, NH 03101

May 27, 2025

Cory McCandless
Puresky Energy
518 17th Street
Denver, CO 80202
Corina.mccandless@puresky.com

RE: Water Resources Impact Evaluation
Tower Road, Pelham, Massachusetts
Verdantas Project 34316

Dear Ms. McCandless:

Verdantas LLC (Verdantas) is pleased to provide Puresky Energy (Puresky) with this letter summarizing findings regarding risks posed by a proposed solar and battery energy storage system (BESS) facility at Tower Road in the town of Pelham, Massachusetts (Figure 1). Consistent with activities outlined in our April 14, 2025, scope of services, Verdantas reviewed documents in order to evaluate potential risks to private water supplies from the proposed construction of a solar facility within 400 feet of the project site property lines.

BACKGROUND

It is our understanding that Puresky is proposing the development of a solar energy facility in southern Pelham on Tower Road. The facility is located at Tax Map 14, Lot 1, approximately 63.4-acres of undeveloped land and is surrounded by Cadwell Memorial Forest which is considered Protected Open Space by Massachusetts Department of Environmental Protection (MassDEP), refer to Figure 2 for the proposed development location and Appendix A. Cadwell Memorial Forest is a 1,200-acre property owned and managed by the University of Massachusetts Amherst Department of Environmental Conservation. It primarily serves as an outdoor laboratory and research activities for the university, sustainable forestry, and recreational trails.

The proposed development site is located within the Manhan River Connecticut River Watershed, which is approximately 243,428.16 acres. The primary land usage within this watershed is deciduous and evergreen forests as shown in Figure 1. The proposed project site also consists of deciduous and evergreen forests with two brooks, Scarboro Brook and Harris Brook, running along the western and northern boundaries, respectively. The proposed project will convert approximately 63.4 acres of forest to meadow. Effects of this alteration are anticipated to be mitigated by PureSky by maintaining forested/vegetated buffer zones of a minimum of 100 feet along the streams and associated wetland areas.

Drinking water wells are not known to exist within 400 feet of the proposed development. However, the facility anticipates utilizing SolBank 3.0 Energy Storage Systems and there is a concern whether these and the solar facility are a threat to groundwater quality and recharge of the nearby existing residential wells on Packardville Road.

The following documents received from Puresky on May 8, 2025 were reviewed (refer to Appendix B):

- SMA Central Inverter Units (DPS-500 High Accuracy DC Metering Kit) Sheet
- Sunny Central 2660 UP-US / 2800 UP-US / 2930 UP-US / 3060 UP-US Sheet
- SolBank 3.0 Energy Storage System Sheet
- A draft plan titled “Racking Layout” prepared by Polar Racking dated April 16, 2025
- Paradea High Efficiency Bi-Facial Glass-Glass PV Modules Sheet
- A plan titled “Conceptual Site Plan” prepared by Tetra Tech dated March 21, 2025
- Sol-X Utility Scale Single Acis Tracker Sheet

In addition, several emails were exchanged, and telephone conversations took place between the undersigned and Cory McCandless at Puresky between March 18, 2025, and May 8, 2025.

FINDINGS AND CONCLUSIONS

Potential sources of water contamination associated with the solar facility and BESS could include, but are not limited to, construction activities, battery leakage, and chemical runoff. The use of heavy machinery and construction materials can introduce pollutants into the soil and groundwater. This includes oils, fuels, and other chemicals. Construction activities will involve minimal grading primarily for the gravel access road, vegetated conveyance ditch, culverts, and equipment pad. Blasting is not expected during the development of the solar facility. A pollinator friendly perennial seed mix is currently proposed for the ground surface beneath the solar panels, although some areas may contain exposed ledge.

Stormwater will be managed using low-impact development practices, including a vegetated conveyance ditch, plunge pools, and qualifying pervious areas that take advantage of the existing slope and vegetation. Construction is not anticipated to present significant alteration to the natural flow of groundwater therefore should not affect the local water table and the availability of water to nearby wells.

Batteries used in BESS typically contain hazardous materials such as lithium, lead, and other heavy metals. If not properly managed, leaks or spills could contaminate groundwater. Chemicals used for cleaning and maintaining solar panels and the land around them could potentially seep into the groundwater and affect water quality.

The listed equipment provided by PureSky above and their potential hazards are described as follows. The Central Inverter Units are high efficiency, utility-scale inverters designed to convert DV electricity from solar panels into AC electricity for grid use. They are enclosed in weatherproof, sealed housings, and are not reported to contain hazardous materials that could leach into the soil or groundwater. The high accuracy DC Metering Kit is a non-intrusive monitoring device for performance tracking. It does not interact with the ground or water systems. The SolBank 3.0 Energy Storage System is a fully enclosed, modular lithium iron phosphate (LFP) battery system. It includes multiple layers of containment, fire suppression, and leak detection systems. LFP chemistry is among the most stable and environmentally benign battery types, without free-flowing

liquids or heavy metals that could pose a groundwater contamination risk under normal or emergency conditions. The Sol-X Utility Scale Single Axis Tracker rotates the solar panels to follow the sun and are mounted on driven piles. The installation depth is shallow and should not reach aquifer levels. The mechanical components are above ground and would not pose contamination risk. The equipment listed is not reported to involve chemical storage or discharge. Components are either above ground or shallowly embedded and sealed.

The SolBank 3.0 BESS includes multiple safety systems to prevent leaks or thermal events. In the unlikely event of a failure, the system is designed to contain and isolate any incident without environmental release. Based on the equipment specifications, site design, and regulatory compliance, it is likely the proposed solar development, and BESS will not adversely affect the quality or yield of nearby private wells.

Verdantas reviewed the Energy and Environmental Affairs (EEA) Search Well Database and Massachusetts Well Location Viewer Web Map on Esri ArcGIS Online (ArcGIS) which displays the location depictions of Well Completion Reports submitted to the MassDEP Well Driller Program. The databases included nine wells on Packardville Road within a half mile of the proposed project boundary. The domestic wells on Packardville Road were installed between 1976 and 2000. The locations of these wells are depicted on Figure 2. A summary of well details is included in Table 1 and Well Completion Reports are included in Appendix C.

These bedrock wells ranged in depth from 125 feet to 550 feet with an average of 338.3 feet. The EEA database did not include yields, however the ArcGIS database did and was subsequently added to the summary included in Table 1. The minimum well yield was 0.5 gallons per minute (gpm), the maximum was 50 gpm with an average yield of 15.2 gpm. The well at 95 Packardville Road was deepened from 275 feet to 530 feet in 1984 suggesting inadequate yield at that location prior to 1984. The average depth to water was listed as 49.6 feet below ground surface.

Wells drilled into bedrock obtain water from fractures within the underlying fractured bedrock aquifer. The amount of water these wells can produce depends on several factors, including the number of fractures encountered, the width of those fractures, and how well they are connected to each other and to nearby recharge areas or surface water sources. Domestic wells typically yield between 300 and 500 gallons per day, with most producing less than ten gallons per minute. MassDEP Private Well Guidelines suggests single-family homes have a minimum well yield of 5 gpm. Wells that cannot sustain a yield of 5 gpm or greater during peak water demand (morning and evening) are recommended to take other measures to ensure adequate supply of water throughout the day. This includes reducing peak water use or increasing storage within the water system.

Well information from EEA and ArcGIS databases documents that average well yields (15.2 gpm) of the private bedrock wells along Packardville Road are well above minimum yields needed for residential drinking water supplies. The median yield of these same wells is considered low to moderate (4.5 gpm). While it is recommended that residential homes with low yielding wells take measures to ensure the suggested yield (5 gpm) as described above, it is not likely that the wells along Packardville Road will be influenced by the construction or operations of the proposed solar facility.

Most water quality concerns in bedrock wells stem from naturally occurring elements in the rock such as iron, manganese, arsenic, and lead. However, contamination from anthropogenic activities can also occur involving substances like road salt, volatile organic compounds, per- and polyfluorinated compounds, pesticides, herbicides, and blasting agents containing perchlorate. Verdantas recommends minimizing the use of de-icing agents on access roads and ensuring any potential herbicide or pesticide applications for vegetation control are minimized and carried out by a licensed professional.

LIMITATIONS

Verdantas completed this hydrogeologic study in a manner consistent with similar consultants completing similar studies. Verdantas did not conduct field work in association with this project and our study was limited to review and evaluation of data provided by others. Conclusions and recommendations are based on limited data over a limited time frame. Verdantas makes no warrantee or guarantee regarding the impact to nearby wells. Additional studies could reveal information that contradicts the findings provided in this letter.

If you have any questions regarding this report, please feel free to contact us at the numbers below.

Sincerely,
VERDANTAS, LLC

Sarah G. Carlson
Staff Scientist
(978) 506-5073
sgcarlson@verdantas.com

David G. Harwood, P.G.
Senior Hydrogeologist
(978) 506-5064
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CC: Manjoor Vahora, manjoor.vahora@pureskyenergy.com

Attachments:
Table 1 – Well Database Search
Figure 1 – Site Locus & Watershed Areas Map
Figure 2 – Site Plan
Appendix A – MassDEP – Phase I Site Assessment Map
Appendix B – Supporting Documents
Appendix C – Well Completion Reports

TABLE

TABLE 1
WELL DATABASE SEARCH
TOWER ROAD, PELHAM, MA

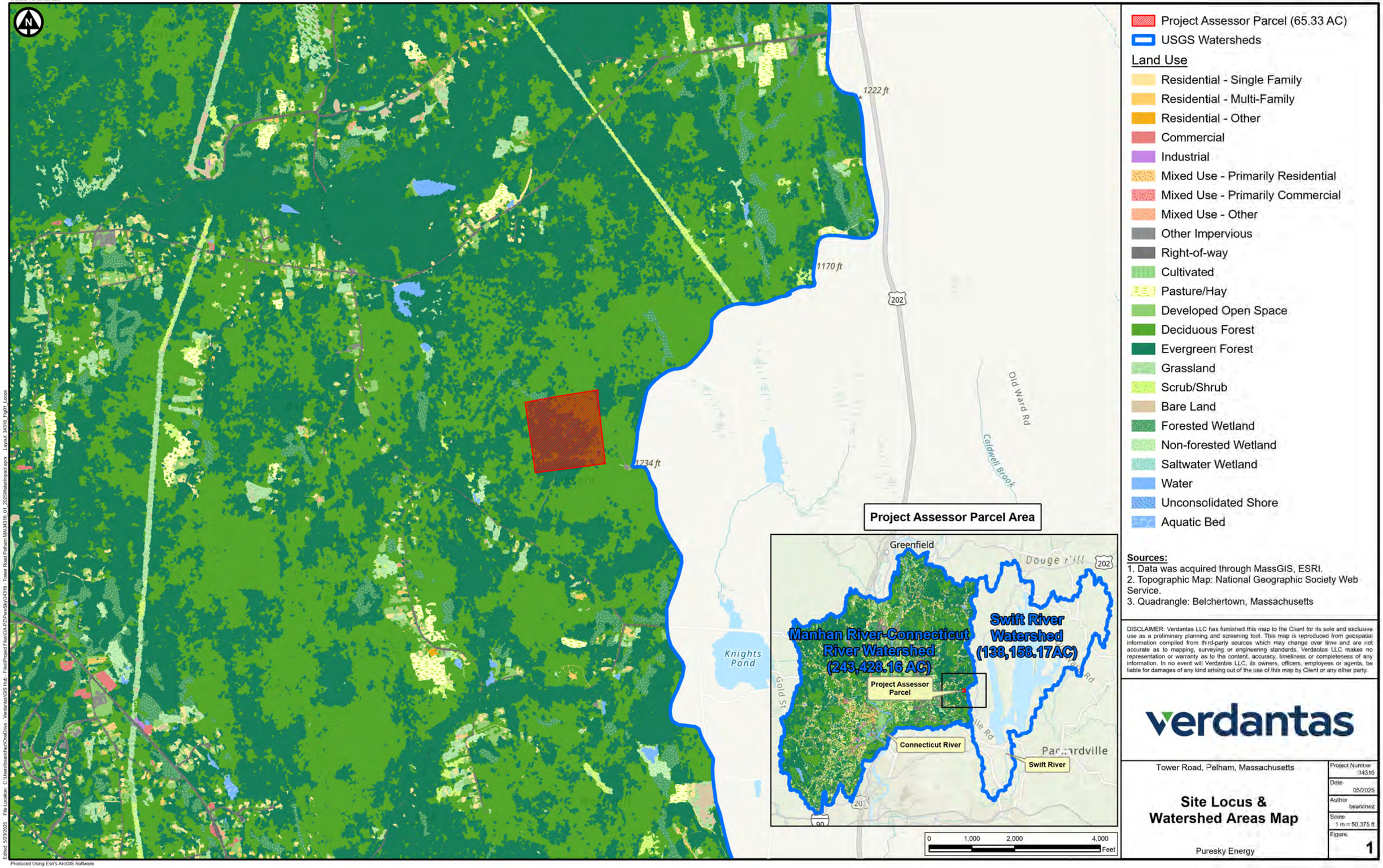
Well ID	Town	Latitude	Longitude	Street Number	Street Name	Date Complete	Well Type	Work Performed	Total Well Depth	Depth to Bedrock	Yield	Depth to Water
									feet	feet	gpm	feet
644376	PELHAM	42.362207	-72.439982	95	Packardville Road	12/07/1984	Domestic	Deepen	530.0	0.0	2.0	235.0
644476	PELHAM	42.362005	-72.438696	97	Packardville Road	11/05/1976	Domestic	New Well	400.0	8.0	4.5	20.0
644465	PELHAM	42.361620	-72.438338	99	Packardville Road	07/20/1978	Domestic	New Well	450.0	11.0	4.5	35.0
644405	PELHAM	42.359290	-72.433130	133	Packardville Road	01/01/1984	Domestic	New Well	320.0	24.0	5.0	30.0
644415	PELHAM	42.358682	-72.432830	135	Packardville Road	07/01/1983	Domestic	New Well	150.0	32.0	25.0	0.0
644460	PELHAM	42.358759	-72.431847	137	Packardville Road	12/01/1978	Domestic	New Well	550.0	60.0	0.5	40.0
8334	PELHAM	42.357951	-72.430572	139	Packardville Road	11/30/2000	Domestic	Unknown	280.0	58.0	50.0	20.0
644419	PELHAM	42.35744	-72.429773	141	Packardville Road	11/01/1982	Domestic	New Well	125.0	10.0	---	---
644237	PELHAM	42.356761	-72.427925	147	Packardville Road	08/04/1993	Domestic	New Well	240.0	6.0	30.0	17.0
								MIN	125.0	0.0	0.5	0.0
								MAX	550.0	60.0	50.0	235.0
								MEAN	338.3	23.2	15.2	49.6
								MEDIAN	320.0	11.0	4.8	25.0

NOTES:

1. gpm = gallons per minute.
2. Data is summarized from the Energy and Environmental Affairs Search Well Database and Massachusetts Well Location Viewer Web Map on Esri ArcGIS Online.
3. --- = data not available/measured.

FIGURES

© 2025, Verdantas LLC



- Project Assessor Parcel (65.33 AC)
- USGS Watersheds

Land Use

- Residential - Single Family
- Residential - Multi-Family
- Residential - Other
- Commercial
- Industrial
- Mixed Use - Primarily Residential
- Mixed Use - Primarily Commercial
- Mixed Use - Other
- Other Impervious
- Right-of-way
- Cultivated
- Pasture/Hay
- Developed Open Space
- Deciduous Forest
- Evergreen Forest
- Grassland
- Scrub/Shrub
- Bare Land
- Forested Wetland
- Non-forested Wetland
- Saltwater Wetland
- Water
- Unconsolidated Shore
- Aquatic Bed

Sources:

1. Data was acquired through MassGIS, ESRI.
2. Topographic Map: National Geographic Society Web Service.
3. Quadrangle: Belchertown, Massachusetts

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Tower Road, Pelham, Massachusetts

Site Locus & Watershed Areas Map

Puresky Energy

Project Number	34316
Date	05/2025
Author	bsanchez
Scale	1 in = 50,375 ft
Figure	1

Edited: 5/23/2025 File Location: C:\Users\bsanchez\OneDrive - Verdantas\GIS Hub - Files\Project Files\OA-P2\PureSky\34316 - Tower Road Pelham MA\34316_01_2025\Waterlinepart.aprx Layout: 34316_Fig01 Locus

Produced Using Esri's ArcGIS Software

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Harris Brook

Map Parcel
14-1

Tower Road

Scarboro Brook

Tower Road

Packardville Road

Manhan River-Connecticut River Watershed (243,428.16 AC)

Swift River Watershed (138,158.17 AC)

95 PACKARDVILLE ROAD
Well Depth: 530

97 PACKARDVILLE ROAD
Well Depth: 400

99 PACKARDVILLE ROAD
Well Depth: 450

133 PACKARDVILLE ROAD
Well Depth: 320

135 PACKARDVILLE ROAD
Well Depth: 150

137 PACKARDVILLE ROAD
Well Depth: 550

137 PARKARDVILLE ROAD
Well Depth: 280

141 PACKARDVILLE ROAD
Well Depth: 125

147 PACKARDVILLE ROAD
Well Depth: 240

0 250 500 1,000 Feet

- Project Assessor Parcel (65.33 AC)
- USGS Watersheds
- 400-foot Buffer
- Massachusetts Property Tax Parcels
- Stream / River
- Private Well Within 1/2 Mile of Project Assessor Parcel

Sources:
1. Data was acquired through MassGIS, USGS
2. Aerial Imagery: Esri Imagery Web Service dated 2023.

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verdantas

Tower Road, Pelham, Massachusetts

Site Plan

Puresky Energy

Project Number	34316
Date	05/2025
Author	bsanchez
Scale	1 in = 500 ft
Figure	2

Edited: 5/23/2025 File Location: C:\Users\bsanchez\OneDrive - Verdantas\GIS Hub - Files\Project Files\OA P2\PureSky\34316 - Tower Road Pelham MA\34316_01_2025\Waterimpact.aprx Layout: 34316_Fig02_Layout

Produced Using Esri's ArcGIS Software

APPENDICES

APPENDIX A	MASSDEP – PHASE I SITE ASSESSMENT MAP
APPENDIX B	SUPPORTING DOCUMENTS
APPENDIX C	WELL COMPLETION REPORTS

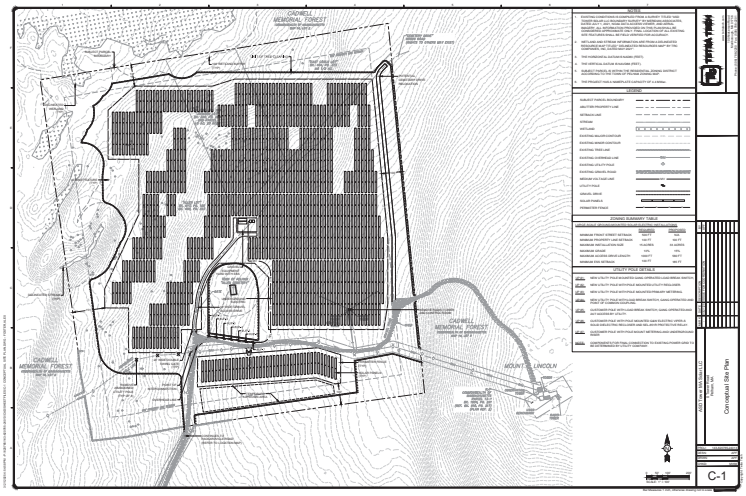
APPENDIX A

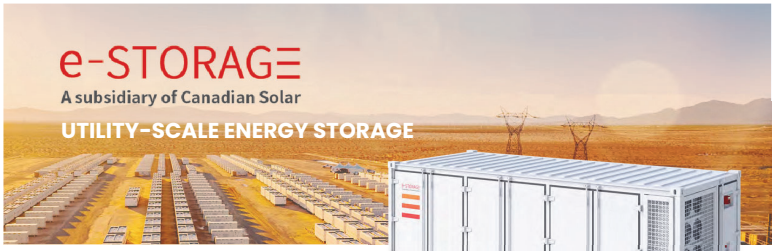
MASSDEP – PHASE I SITE ASSESSMENT MAP



APPENDIX B

SUPPORTING DOCUMENTS





SolBank 3.0

ENERGY STORAGE SYSTEM
S-5016-2H-NA|S-5016-4H-NA
Capacity: 5.0 MWh

e-STORAGE, a subsidiary of **Canadian Solar**, is a world-class energy storage solution provider, specializing in storage system design, manufacturing, and integration of battery energy storage systems for utility-scale applications.

The company offers value-added system consulting and turnkey EPC services, in addition, we provide customers with our proprietary LFP battery solution SolBank.

Together, we are building a brighter, greener future for all.

SolBank 3.0 Highlights

- **Cutting-Edge Technology**: SolBank 3.0 features high-density LFP cells, an active balancing BMS, and an innovative liquid cooling TMS, ensuring optimal safety.
- **Compliance and Certifications**: SolBank 3.0 adheres to all industry standards: NFPA855, NFPA69, NFPA72, NFPA70E, and optional NFPA68. Certified under UL1973, UL9540, UL9540A, UN38.3/UN3536, ensuring rigorous safety and performance criteria.

Key Features

Enhanced Energy Density
- Utilizes 314 Ah battery cells and compact integration, increases single container energy density up to 45%
- Reduces land cost by up to 35% in a 100MWh project

Safety
- IP67-rated pack design
- Up to 20% faster detection of abnormal and automatic protection
- Advanced pack thermal isolation, electrical redundancy protection, and multi-level fire protection, effectively minimize potential issues

Intelligent Control
- Liquid cooling cuts auxiliary consumption up to 30%
- Active balance and string-level management, guarantee high efficiency and availability

Compatibility & Installation
- Supports various PCS topologies
- Turn-key integration and stationery certification, reduce project schedule risks by up to 40%
- Plug-and-play setup for streamlined commissioning



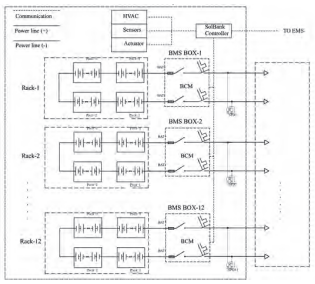
SolBank 3.0
System Parameter

e-STORAGE
A subsidiary of Canadian Solar

General		
Product Model	CSI-SolBank-S-5016-2h-NA	
	CSI-SolBank-S-5016-4h-NA	
Battery Chemistry	Lithium Iron Phosphate (LFP)	
Pack Configuration	1P104S (104 Cells)	
Rack Configuration	1P416S (4 Packs)	
System Configuration	12P416S (12 Racks)	
Nominal DC Voltage	1331.2 V	
Operation DC Voltage Range	1164.8 V ~ 1497.6 V	
Performance		
Charging/Discharging Mode	0.5 P / 0.5 P	0.25 P / 0.25 P
Rated DC Power	2350 kW	1200 kW
Initial Storage Capacity	4700 kWh	4800 kWh
Duration @Rated DC Power	2hrs	4hrs
Round Trip Efficiency (RTE)	93%	94%
Auxiliary Load (Standby/Peak)	1.5 kVA / 50 kVA	1.5 kVA / 22 kVA
Max. Short Circuit Current	10 kA*12	10 kA*12
Operating Temperature (Ambient)	-30 °C to 55 °C (derating from 45°C to 55°C)	
Relative Humidity	≤95% (non-condensing)	
Altitude	≤4000 m (derating from 2000 m to 4000 m)	
Noise Sound Pressure Level (LPA) at 1 meter distance	≤75 dB(A)	
Auxiliary Systems		
Auxiliary Power Interface	AC480 V / 60 Hz, 3P5W	
Thermal Management System	Smart liquid cooling/heating	
External Communication Interface	Ethernet connection, Modbus TCP/IP protocol	

Mechanical	
Enclosure	20ft. high-cube container
Dimensions (L*W*H)	6058*2438*2896 mm (238.50*95.98*114.02 in)
Weight (Battery Included)	43,000 kg (94,800 lbs)
Enclosure Ingress Rating	IP55 / NEMA 3R
Painting/Coating	RAL9003 / C4 Coating
Seismic Parameter	Zone 4
Safety	
Fire Detection and Alarm	Fire alarm panel, heat and smoke detection, alarm bell and strobe
Explosion Prevention	Combustible gas detector with active ventilation
Uninterrupted Power Reserve	Container level UPS for 2-hr control system backup; dedicated fire safety UPS for 24-hr fire alarm backup
Emergency Stop/Automatic Shut-off	Local and Remote
Fire Suppression Options	Aerosol-based suppression system. Dry pipe sprinkler system.

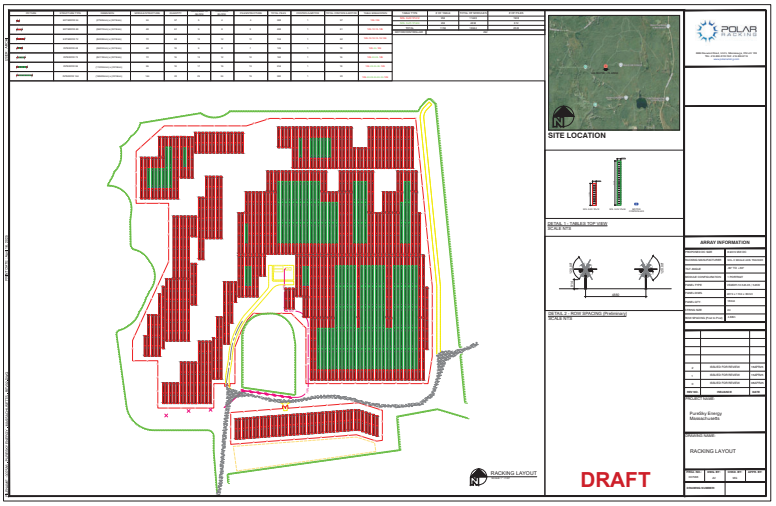
SolBank 3.0
Circuit Diagram



Notes
1. The unit is rated at 1164.8V~1497.6V for optimized product performance, the maximum voltage range for the battery system is 1060.8V~1497.6V
2. Rated DC Power is measured at the product DC terminal, the Rated DC Power and Initial Storage Capacity is limited to the use of two SolBank 3.0 units connected in parallel
3. Initial Storage Capacity is the usable product capacity at FAT, contact e-STORAGE for capacity at COD per project schedule
4. DC RTE is measured during capacity test at Rated DC Power, refer to the product warranty document for the complete procedure

Due to ongoing innovation, improvements, and product enhancements, the technical specifications in this document are subject to change and are not guaranteed. Canadian Solar reserves the right to update or change its products or this technical data without prior notice and customers should not rely upon these or any technical specifications which are not made part of a definitive binding agreement.

SolBank 3.0 Datasheet. Version 1.4 June, 2024



SMA

SMA DPS-500 HIGH ACCURACY DC METERING KIT



Accurate and versatile
- Power and energy production monitoring provides a high level of accuracy
- Measures voltage, current, power, import energy, export energy, total energy, and net energy

Perfect alignment
- Designed for integration with the SMA DC-DC Converter
- Custom meter kit mounts inside the SMA DC-DC Converter

Pre-Prepared
- Preassembled kit reduces installation time
- Measurements integrated into DC-DC Converter Modbus map

SMA DPS-500 HIGH ACCURACY DC METERING KIT

Extreme accuracy when it counts

SMA DPS-500 High Accuracy DC Metering Kit makes the SMA DC-DC Converter capable of providing power and energy measurements with a 0.5% degree of accuracy. The kit may be installed on either port of the DC-DC Converter. It consists of a voltage transducer, current transducer, DC power meter, and all necessary components for integration within the DC-DC Converter enclosure. Measurements from the high accuracy meter are integrated into the Modbus map of the DC-DC Converter and can be accessed without need of a dedicated communication link to the meter. Measurements provided include voltage, current, power, import energy, export energy, total energy, and net energy.

Technical Data	DPS-500 High Accuracy DC Metering Kit KIT-7-DPS500100
General data	
Compatible DC-DC converter models	SMA DPS-500
Compatible DC-DC converter firmware	version 500-1.15 and above
Power and energy measurement accuracy	0.5%
Datalogging	1 minute interval; up to 4 months
Operating voltage range	0 - 1500 V DC
Measurement type	Voltage Hall Effect Sensor
Power supply	100-240 V_{ac}
Power consumption, typical	<3 VA
Dimensions, HxWxD	72 x 72 x 64.5 mm (2.835 x 2.835 x 2.539 in)
Weight	5 kg (11 lbs)
Temperature range, operating	-25°C to +70°C (-13°F to +158°F)
Temperature range, standby	-40°C to +85°C (-40°F to +185°F)
Relative humidity (non-condensing)	5 to 95%
DC measurement port (battery side / inverter side)	● / ○
Warranty	5 years
Supported communication interfaces	Modbus TCP/IP over ethernet
Compliance	
Certifications	UL 1741, UL 62109-1, CSA C22.2 #107.1, and IEC 62109-1
EMC	IEC 55011,IEC 61000-6-2, IEC 61000-3-2, and IEC 61000-3-3
Safety	IEC 61010-1
Communications	Modbus TCP/IP
Meter type	Accuenergy AcuDC 243-5V-A3-P1-X5-C-D-0.2
● Standard features ○ Optional features	
Type designation	KIT-7-DPS500100

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PARADEA

HIGH EFFICIENCY BI-FACIAL GLASS-GLASS PV MODULES

525-550W

MAXIMUM EFFICIENCY %	POSITIVE POWER TOLERANCE WP	CELLS	MODULE TECHNOLOGY
21.33	0~+4.99	M10 144	HALF CUT & MICRO GAP DESIGN WITH IMPROVED SHADE TOLERANCE



- **RELIABILITY IS IMPROVED** with minimum exposure to corrosion from sand & salt mist with low risk of module warping & micro cracking
- Bifacial gain of **UP TO 25%** with dual glass module, capable of energy generation with both direct and reflected sunlight
- Additional Power yield with **30 YEARS OF PERFORMANCE LIFE** with 0.5% annual power degradation
- **LCOE IS CUT BACK** with **LESS BOS COST** which improves value proposition of the product with competitive **ROI**
- **TWO PEAK PERFORMANCE TIME**, during sun rise and sun set with optimum utilization of dual facial generation
- Hassle-free installation with ability to **INSTALL VERTICALLY IN EAST WEST DIRECTION**, with improved soiling resistant
- Implementation of bypass diodes in split JB series-parallel connections enable the module to perform in **PARTIAL SHADOW CONDITIONS** with respect to full-cell module
- **LOWER INTERNAL RESISTANCE** boosts module power helping to achieve minimal power loss with respect to previous variant modules

FRAME	SUPERSTRATE	SUBSTRATE
SILVER	GLASS	GLASS

DCR CONTENT MODULE AVAILABLE

APPLICATIONS

- On-grid large scale utility systems
- On-grid rooftop industrial and commercial systems
- Rooftop residential systems

Monocrystalline Solar PV Modules, Bifacial, MBB, M10 Half-Cell, PARADEA VSMDH.72.AAA.05

VSL/ENG/SC/290-R05 | www.vikramsolar.com

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CREATING CLIMATE FOR CHANGE

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TECHNICAL DATA

PARADEA 525-550W

THIS DATASHEET IS APPLICABLE FOR: PARADEA VSMDH.72.AAA.05 (AAA=525-550)

Electrical Data[1,2]

All data refers to STC (AM 1.5, 1000 W/m², 25°C)

Peak Power P_{max} (Wp)	525	530	535	540	545	550
Maximum Voltage V_{mp} (V)	41.4	41.5	41.6	41.7	41.8	41.9
Maximum Current I_{mp} (A)	12.69	12.78	12.87	12.95	13.04	13.13
Open Circuit Voltage V_{oc} (V)	49.2	49.3	49.4	49.5	49.6	49.7
Short Circuit Current I_{sc} (A)	13.4	13.48	13.56	13.64	13.73	13.82
Module Efficiency (%)	20.37	20.56	20.76	20.95	21.14	21.33

1) STC:1000 W/m² irradiance, 25°C cell temperature, AM1.5g spectrum according to EN 60904-3. | 2) Power measurement uncertainty is within +/-3%.

Electrical Parameters at NOCT[3]

Power (W)	391.4	393	397	399	402	407
V@P_{max} (V)	38.2	38.3	38.4	38.5	38.6	38.7
I@P_{max} (A)	10.25	10.29	10.34	10.37	10.43	10.52
V_{oc} (V)	45.8	45.9	46	46.1	46.2	46.3
I_{sc} (A)	10.83	10.89	10.96	11.03	11.09	11.15

3) NOCT irradiance 800 W/m², ambient temperature 20°C, wind speed 1 m/sec

Equivalent Bifacial Output

Bifacial Gain	Overall Power output (W)					
5%	551	557	562	567	572	578
10%	578	583	589	594	600	605
15%	604	610	615	621	627	633
20%	630	636	642	648	654	660
25%	656	663	669	675	681	688

Temperature Coefficients (Tc) permissible operating conditions

Tc of Open Circuit Voltage (β)	-0.27%/°C
Tc of Short Circuit Current (α)	0.050%/°C
Tc of Power (γ)	-0.35%/°C
Maximum System Voltage	1500V
NOCT	45°C ± 2°C
Temperature Range	-40°C to + 85°C

Mechanical Data

Length × Width × Height	2274 × 1134 × 30mm (89.52 × 44.65 × 1.18 inches)
Weight	33 Kg (72.75 lbs)
Junction Box	IP68, Split Junction Box with individual bypass diodes
Cable & Connectors*	200 mm (+ve terminal) and 300 mm (-ve terminal) length cables,MC4 Compatible
Application Class	Class A (Safety class II)
Superstrate**	2.0 mm (0.098 inches) high transmission low iron content, semi-tempered glass, AR coated
Cells	72 Mono PERC (144 half-cells) P-Type Bifacial solar cells
Substrate	2.0 mm (0.098 inches) high transmission low iron content, heat strengthened glass
Frame	Anodized aluminium frame with twin wall profile
Mechanical Load Test	5400 Pa (Snow load), 2400 Pa (Wind load)
Cell Encapsulant	Polyolefin (POE)/ EPE
Maximum Series Fuse Rating	25 A

Power measurement uncertainty is within ±3%

Warranty and Certifications

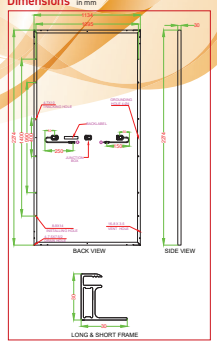
Product Warranty**	12 years
Performance Warranty**	Linear Power Warranty for 30 years with 2% for 1st year degradation and 0.5% from year 2 to year 30
Approvals and Certificates*	IEC 61215 : 2016, IEC 61730 : 2016, IEC 61701, IEC 62716, IEC 60068-2-68, IS/IEC 61730, IS 14286, IEC 62804, CE, CEC (California), UL 61215, UL 61730, CAN-CSA

CAUTION: READ SAFETY AND INSTALLATION MANUAL BEFORE USING THE PRODUCT.

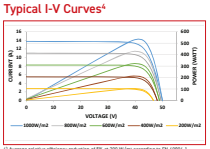
Specifications included in this datasheet are subject to change without notice. Electrical data without guarantee. Please confirm your exact requirement with the company representative while placing your order.

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Dimensions in mm

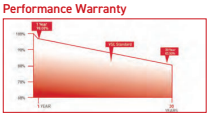


Typical I-V Curves[4]



4) Average relative efficiency reduction of 5% at 200 W/m² according to EN 60904-1.

Performance Warranty



Packaging Information

Quantity /Pallet	36
Pallets/Container (40'HC)	20
Quantity/Container (40'HC)	720

* All (*) certifications under progress. | ** Refer to Vikram Solar's warranty document for terms and conditions. | * 40mm(1.5.75 inches), 1000mm(39.37 inches), 1200mm (47.24 inches) cable lengths are also available | * Anti-glare Glass is also available | *As per applicable product

sales@vikramsolar.com www.vikramsolar.com



KEY PRODUCT BENEFITS

Flexibility & Adaptability
- Adaptable table lengths results in increased coverage of the site, increased system capacity, and more design

Superior True Terrain-Following
- Modular design accomodates slopes up to 30%

Pre-Assembly/Assembly Efficiencies
- Light-weight components require no heavy or specialized equipment to handle
- Fewest components out of all trackers on the market
- Fewer electrical components are required due to long rows of up to 180 modules
- Reduced labor through simple design that allows pre-assembly



SOL-X T-Assembly Ready to Ship!

Advanced Tracking Algorithm
- 3D Backtracking
- Hail Protection Strategy
- Overcast strategy
- iStow

Simple Design, High Impact
- Higher density, longer rows, and minimal gaps
- Independent rows reduces O&M cost
- Compatible with all foundation types: Driven Posts or I-Beams, Groundscrews, Helicals, and Ballasted
- No dampeners required, eliminating a high risk failure point
- Less steel required because of reduced module loads and no torsional dynamic forces
- Easy to install driveshaft design

Bankability
- Bankability report is complete by third part and available upon request

Quality and Lifetime Value
- Every component has been tested in rigorous automotive testing standard
- Certified to UL 2703 and UL 3703 standards

Suitable for Agrivoltaics

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GENERAL AND MECHANICAL

ROW LENGTH	Up to 180 individual 72-cell modules driven per controller/motor
TABLE LENGTH	6-24 modules per independent table connected by a driveshaft
DRIVE UNIT	Rugged design for 30-year field life in harsh environmental climates
TERRAIN FOLLOWING	Accomodates slopes up to 30% Up to +/- 10% grade within every table, limited to 8% grade change between tables
WIND SPEED DESIGN	Wind speed fully configurable, up to 150 mph (240 kmh), 3-second gust per ASCE7-10
ROTATIONAL RANGE (EAST / WEST)	60 degrees - 60 degrees
GROUND COVERAGE RATIO	Fully configurable by customer, typically between 0.20-0.65
DC CAPACITY	Up to 90kWp per tracker row
CODES AND STANDARDS	ETL certified, UL 3703, UL 2703 & ULC ORD 1703 (mechanical, electrical)
SENSORS	Wind Sensor and Snow sensor to protect the tracker
SYSTEM VOLTAGE	Compatible with 1,000V and 1,500V module circuits
MODULE ATTACHMENT	UL-listed top clamps and direct bolts, compatible with all module types
BIFACIAL FEATURES	High-rise module mounting rails
MATERIALS	Galvanized steel G90-G245
FOUNDATIONS	• Driven Piles • Ground Screws • Helical Piles • Ballast Options
POSTS PER TABLE AND MODULE	Up to 3 posts per table Up to 3 posts per 24 modules
WARRANTY	20 years for structural components • 10 years for drive unit • 5 years for motor and controller • Additional coverage available

ELECTRICAL AND CONTROLS

SYSTEM	Compatible with 1,000V and 1,500V module circuits
CONTROLLER	Self-powered with battery backup AC-powered 115V-240V
OPERATING TEMPERATURE	AC power: -40°C to +70°C (-40°F to +158°F) Self power: -30 C to +50 C (-22 F to +122 F)
TRACKING METHOD	Time and location-based algorithm with backtracking
REMOTE COMMUNICATION	Secure monitoring and control tracker array in real-time via an encrypted cloud portal and compatible with SCADA solution available
MOTOR TYPE	24V DC motor
COMMUNICATION	Zigbee wireless communications to all tracker rows and weather stations through network control unit
ADVANCED ALGORITHM	Severe Weather Protection System, 3D Backtracking, Overcast, iStow and Agrivoltaics stow strategies

SERVICES

INSTALLATION	Available upon request
GEOTECHNICAL AND FOUNDATION DESIGN	PE and P. Eng stamped Available upon request
DESIGN AND ENGINEERING	Complimentary site layouts Sealed and stamped structural engineering drawings (Canada, USA, and Caribbean)
CONSTRUCTION SUPPORT	Complimentary on-site installation training and commissioning

This document does not create any express warranty by Polar Racking or about its products or services. Polar Racking's sole warranty is contained in the written product manual for each product. The end-user documentation shipped with Polar Racking's products constitutes the sole specifications referred to in the product warranty. The customer is solely responsible for verifying the suitability of Polar Racking's product for each use. Subject to change without notice. Last updated in September 2024.

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SUNNY CENTRAL
2660 UP-US / 2800 UP-US / 2930 UP-US / 3060 UP-US



Efficient
- Up to 4 inverters can be transported in one standard shipping container
- Overdimensioning up to 150% is possible
- Full power at ambient temperatures of up to 35 °C

Robust
- Intelligent air cooling system OptiCool for efficient cooling
- Suitable for outdoor use in all climatic ambient conditions worldwide

Flexible
- Conforms to all known grid requirements worldwide
- Q on demand
- Available as a single device or turnkey solution, including Medium Voltage Power Station

Easy to Use
- Improved DC connection area
- Connection area for customer equipment
- Integrated voltage support for internal and external loads

SUNNY CENTRAL
2660 UP-US / 2800 UP-US / 2930 UP-US / 3060 UP-US

The new Sunny Central: more power per cubic meter

With an output of up to 3060 kVA and system voltages of 1500 V DC, the SMA central inverter allows for more efficient system design and a reduction in specific costs for PV power plants. A separate voltage supply and additional space are available for the installation of customer equipment. True 1500 V technology and the intelligent cooling system OptiCool ensure smooth operation even in extreme ambient temperature as well as a long service life of 25 years.

SUNNY CENTRAL 2660 UP-US / 2800 UP-US

Technical data*	SC 2660 UP-US	SC 2800 UP-US
Input (DC)		
MPP voltage range V_{DC} (at 35 °C / at 50 °C)	880 to 1325 V / 1100 V	921 to 1325 V / 1100 V
Min. input voltage $V_{DC\ min}$ / Start voltage $V_{DC\ Start}$	849 V / 1030 V	891 V / 1071 V
Max. input voltage $V_{DC\ max}$	1500 V	
Max. input current $I_{DC\ max}$ / with DC coupling	3200 A / 4800 A	
Max. short-circuit current $I_{DC\ sc}$	6400 A	
Number of DC inputs	24 double pole fused (32 single pole fused)	
Number of DC inputs with optional DC coupling of battery	18 double pole fused (36 single pole fused) for PV, 6 double pole fused for batteries	
Max. number of DC cables per DC input (for each polarity)	2 x 800 kcmil, 2 x 400 mm²	
Integrated zone monitoring	○	
Available PV fuse sizes (per input)	200 A, 250 A, 315 A, 350 A, 400 A, 450 A, 500 A	
Available DC-DC converter fuse size (per input)	750 A	
Output (AC)		
Nominal AC power at cos φ =1 (at 35 °C / at 50 °C)	2667 kVA / 2400 kVA	2800 kVA / 2520 kVA
Nominal AC power at cos φ =0.8 (at 35 °C / at 50 °C)	2134 kW / 1920 kW	2240 kW / 2016 kW
Nominal AC current $I_{AC\ nom}$ (at 35 °C / at 50 °C)	2566 A / 2309 A	
Max. total harmonic distortion	< 3% at nominal power	
Nominal AC voltage / nominal AC voltage range[1] [8]	600 V / 480 V to 720 V	630 V / 504 V to 756 V
AC power frequency / range	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz	
Min. short-circuit ratio at the AC terminals[9]	> 2	
Power factor at rated power / displacement power factor adjustable[8] [10]	1 / 0.8 overexcited to 0.8 underexcited	
Efficiency		
Max. efficiency[2] / European efficiency[2] / CEC efficiency[2]	98.7%* / 98.6%* / 98.5%*	98.7%* / 98.6%* / 98.5%*
Protective Devices		
Input-side disconnection point	DC load break switch	
Output-side disconnection point	AC circuit breaker	
DC overvoltage protection	Surge arrester, type I	
AC overvoltage protection (optional)	Surge arrester, class I	
Lightning protection (according to IEC 62305-1)	Lightning Protection Level III	
Ground-fault monitoring / remote ground-fault monitoring	○ / ○	
Insulation monitoring	○	
Degree of protection	NEMA 3R	
General Data		
Dimensions (W / H / D)	2815 / 2318 / 1588 mm (110.8 / 91.3 / 62.5 inch)	
Weight	< 3400 kg / < 7500 lb	
Self-consumption (max.[4] / partial load[5] / average[6])	< 8100 W / < 1800 W / < 2000 W	
Self-consumption (standby)	< 370 W	
Internal auxiliary power supply	○ Integrated 8.4 kVA transformer	
Operating temperature range[8]	–25°C to 60°C / –13°F to 140°F	
Noise emission[7]	67.0 dB(A)*	
Temperature range (standby)	–40°C to 60°C / –40°F to 140°F	
Temperature range (storage)	–40°C to 70°C / –40°F to 158°F	
Max. permissible value for relative humidity (condensing / non-condensing)	95% to 100% (2 month/year) / 0% to 95%	
Maximum operating altitude above MSL[8] 1000 m / 2000 m	● / ○ (earlier temperature-dependent derating)	
Fresh air consumption	6500 m³/h	
Features		
DC connection	Terminal lug on each input (without fuse)	
AC connection	With busbar system (three busbars, one per line conductor)	
Communication	Ethernet, Modbus Master, Modbus Slave	
Communication with SMA string monitor (transmission medium)	Modbus TCP / Ethernet (FO MM, Cat-5)	
Enclosure / roof color	RAL 9016 / RAL 7004	
Supply transformer for external loads	○ (2.5 kVA)	
Standards and directives complied with	UL 62109-1, UL 1741 (Chapter 31, CDR 6I), UL 1741-SA, UL 1998, IEEE 1547, MIL-STD-810G	
EMC standards	FCC Part 15 Class A	
Quality standards and directives complied with	VDI/VDE 2862 page 2, DIN EN ISO 9001	

● Standard features ○ Optional * preliminary

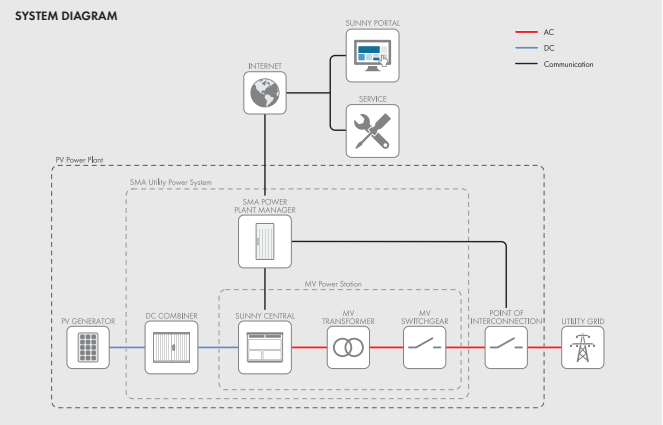
1) At nominal AC voltage, nominal AC power decreases in the same proportion
2) Efficiency measured without internal power supply
3) Efficiency measured with internal power supply
4) Self-consumption at rated operation
5) Self-consumption at < 75% Pn at 25 °C
6) Self-consumption averaged out from 5% to 100% Pn at 25 °C
7) Sound pressure level at a distance of 10 m
8) Values apply only to inverters. Permissible values for SMA MV solutions from SMA can be found in the corresponding data sheets.
9) A short-circuit ratio of < 2 requires a special approval from SMA
10) Depending on the DC voltage

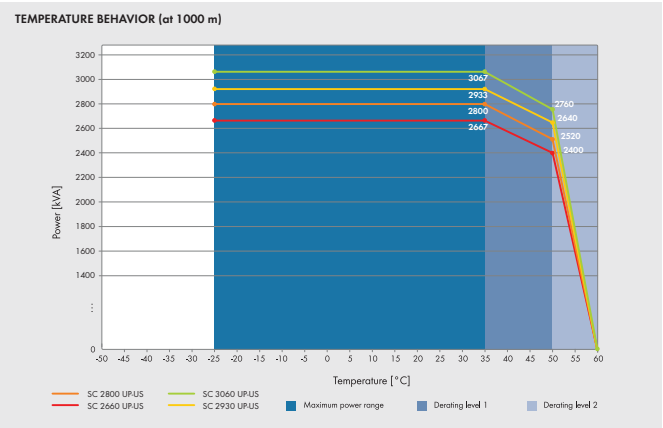
SUNNY CENTRAL 2930 UP-US / 3060 UP-US

Technical data*	SC 2930 UP-US	SC 3060 UP-US
Input (DC)		
MPP voltage range V_{DC} (at 35 °C / at 50 °C)	962 to 1325 V / 1100 V	1003 to 1325 V / 1100 V
Min. input voltage $V_{DC\ min}$ / Start voltage $V_{DC\ Start}$	934 V / 1112 V	976 V / 1153 V
Max. input voltage $V_{DC\ max}$	1500 V	
Max. input current $I_{DC\ max}$ / with DC coupling	3200 A / 4800 A	
Max. short-circuit current $I_{DC\ sc}$	6400 A	
Number of DC inputs	24 double pole fused (32 single pole fused)	
Number of DC inputs with optional DC coupling of battery	18 double pole fused (36 single pole fused) for PV, 6 double pole fused for batteries	
Max. number of DC cables per DC input (for each polarity)	2 x 800 kcmil, 2 x 400 mm²	
Integrated zone monitoring	○	
Available PV fuse sizes (per input)	200 A, 250 A, 315 A, 350 A, 400 A, 450 A, 500 A	
Available DC-DC converter fuse size (per input)	750 A	
Output (AC)		
Nominal AC power at cos φ =1 (at 35 °C / at 50 °C)	2933 kVA / 2640 kVA	3067 kVA / 2760 kVA
Nominal AC power at cos φ =0.8 (at 35 °C / at 50 °C)	2346 kW / 2112 kW	2454 kW / 2208 kW
Nominal AC current $I_{AC\ nom}$ (at 35 °C / at 50 °C)	2566 A / 2309 A	
Max. total harmonic distortion	< 3% at nominal power	
Nominal AC voltage / nominal AC voltage range[1] [8]	660 V / 528 V to 759 V	690 V / 552 V to 759 V
AC power frequency / range	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz	
Min. short-circuit ratio at the AC terminals[9]	> 2	
Power factor at rated power / displacement power factor adjustable[8] [10]	1 / 0.8 overexcited to 0.8 underexcited	
Efficiency		
Max. efficiency[2] / European efficiency[2] / CEC efficiency[2]	98.7%* / 98.6%* / 98.5%*	98.7%* / 98.6%* / 98.5%*
Protective Devices		
Input-side disconnection point	DC load break switch	
Output-side disconnection point	AC circuit breaker	
DC overvoltage protection	Surge arrester, type I	
AC overvoltage protection (optional)	Surge arrester, class I	
Lightning protection (according to IEC 62305-1)	Lightning Protection Level III	
Ground-fault monitoring / remote ground-fault monitoring	○ / ○	
Insulation monitoring	○	
Degree of protection	NEMA 3R	
General Data		
Dimensions (W / H / D)	2815 / 2318 / 1588 mm (110.8 / 91.3 / 62.5 inch)	
Weight	< 3400 kg / < 7500 lb	
Self-consumption (max.[4] / partial load[5] / average[6])	< 8100 W / < 1800 W / < 2000 W	
Self-consumption (standby)	< 370 W	
Internal auxiliary power supply	○ Integrated 8.4 kVA transformer	
Operating temperature range[8]	–25°C to 60°C / –13°F to 140°F	
Noise emission[7]	67.0 dB(A)*	
Temperature range (standby)	–40°C to 60°C / –40°F to 140°F	
Temperature range (storage)	–40°C to 70°C / –40°F to 158°F	
Max. permissible value for relative humidity (condensing / non-condensing)	95% to 100% (2 month/year) / 0% to 95%	
Maximum operating altitude above MSL[8] 1000 m / 2000 m	● / ○ (earlier temperature-dependent derating)	
Fresh air consumption	6500 m³/h	
Features		
DC connection	Terminal lug on each input (without fuse)	
AC connection	With busbar system (three busbars, one per line conductor)	
Communication	Ethernet, Modbus Master, Modbus Slave	
Communication with SMA string monitor (transmission medium)	Modbus TCP / Ethernet (FO MM, Cat-5)	
Enclosure / roof color	RAL 9016 / RAL 7004	
Supply transformer for external loads	○ (2.5 kVA)	
Standards and directives complied with	UL 62109-1, UL 1741 (Chapter 31, CDR 6I), UL 1741-SA, UL 1998 IEEE 1547, MIL-STD-810G	
EMC standards	FCC Part 15 Class A	
Quality standards and directives complied with	VDI/VDE 2862 page 2, DIN EN ISO 9001	

● Standard features ○ Optional * preliminary

1) At nominal AC voltage, nominal AC power decreases in the same proportion
2) Efficiency measured without internal power supply
3) Efficiency measured with internal power supply
4) Self-consumption at rated operation
5) Self-consumption at < 75% Pn at 25 °C
6) Self-consumption averaged out from 5% to 100% Pn at 25 °C
7) Sound pressure level at a distance of 10 m
8) Values apply only to inverters. Permissible values for SMA MV solutions from SMA can be found in the corresponding data sheets.
9) A short-circuit ratio of < 2 requires a special approval from SMA
10) Depending on the DC voltage





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United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Hampden and Hampshire Counties, Massachusetts, Eastern Part

Tower Road, Pelham, Massachusetts 01002



March 14, 2025

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

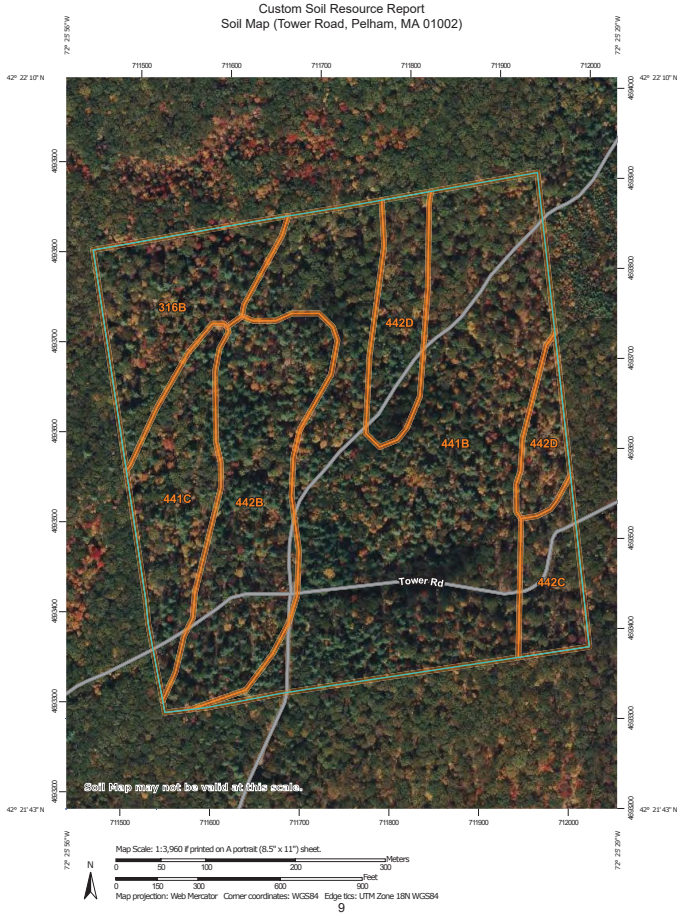
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.



MAP LEGEND

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

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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: Hampden and Hampshire Counties, Massachusetts, Eastern Part
Survey Area Data: Version 19, Aug 27, 2024

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

Date(s) aerial images were photographed: Oct 15, 2020—Oct 31, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend (Tower Road, Pelham, MA 01002)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
316B	Scituate fine sandy loam, 3 to 8 percent slopes, very stony	6.7	10.5%
441B	Gloucester gravelly fine sandy loam, 3 to 8 percent slopes, very stony	31.8	49.8%
441C	Gloucester gravelly fine sandy loam, 8 to 15 percent slopes, very stony	6.1	9.6%
442B	Gloucester gravelly fine sandy loam, 3 to 8 percent slopes, extremely stony	11.0	17.1%
442C	Gloucester gravelly fine sandy loam, 8 to 15 percent slopes, extremely stony	2.8	4.4%
442D	Gloucester gravelly fine sandy loam, 15 to 25 percent slopes, extremely stony	5.5	8.6%
Totals for Area of Interest		**63.9**	**100.0%**

Map Unit Descriptions (Tower Road, Pelham, MA 01002)

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different

management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Hampden and Hampshire Counties, Massachusetts, Eastern Part

316B—Scituate fine sandy loam, 3 to 8 percent slopes, very stony

Map Unit Setting
National map unit symbol: vhy4
Elevation: 360 to 1,200 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Scituate and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Scituate

Setting
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Friable coarse-loamy eolian deposits over dense sandy lodgment till derived from granite and gneiss

Typical profile
H1 - 0 to 5 inches: fine sandy loam
H2 - 5 to 27 inches: fine sandy loam
H3 - 27 to 65 inches: very gravelly loamy sand

Properties and qualities
Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 18 to 46 inches to densic material
Drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.5 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C/D
Ecological site: F144AY037MA - Moist Dense Till Uplands
Hydric soil rating: No

Minor Components

Canton
Percent of map unit: 4 percent
Hydric soil rating: No

Paxton
Percent of map unit: 4 percent
Hydric soil rating: No

Montauk
Percent of map unit: 4 percent
Hydric soil rating: No

Woodbridge
Percent of map unit: 4 percent
Hydric soil rating: No

Ridgebury
Percent of map unit: 4 percent
Landform: Depressions
Hydric soil rating: Yes

441B—Gloucester gravelly fine sandy loam, 3 to 8 percent slopes, very stony

Map Unit Setting
National map unit symbol: vht9
Elevation: 310 to 1,150 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Gloucester and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Gloucester

Setting
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable sandy eolian deposits over friable sandy and gravelly basal till derived from granite and gneiss

Typical profile
H1 - 0 to 5 inches: gravelly fine sandy loam
H2 - 5 to 15 inches: gravelly sandy loam
H3 - 15 to 65 inches: very gravelly loamy sand

Properties and qualities
Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F144AY032NH - Dry Till Uplands
Hydric soil rating: No

Minor Components

Essex
Percent of map unit: 5 percent
Hydric soil rating: No

Charlton
Percent of map unit: 5 percent
Hydric soil rating: No

Montauk
Percent of map unit: 5 percent
Hydric soil rating: No

Ridgebury
Percent of map unit: 2 percent
Landform: Depressions
Hydric soil rating: Yes

Scituate
Percent of map unit: 2 percent
Hydric soil rating: No

Woodbridge
Percent of map unit: 1 percent
Hydric soil rating: No

441C—Gloucester gravelly fine sandy loam, 8 to 15 percent slopes, very stony

Map Unit Setting
National map unit symbol: vhtd
Elevation: 210 to 1,120 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Gloucester and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Gloucester

Setting
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable sandy eolian deposits over friable sandy and gravelly basal till derived from granite and gneiss

Typical profile
H1 - 0 to 5 inches: gravelly fine sandy loam
H2 - 5 to 15 inches: gravelly sandy loam
H3 - 15 to 65 inches: very gravelly loamy sand

Properties and qualities
Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F144AY032NH - Dry Till Uplands

Hydric soil rating: No

Minor Components

Essex
Percent of map unit: 5 percent
Hydric soil rating: No

Montauk
Percent of map unit: 5 percent
Hydric soil rating: No

Charlton
Percent of map unit: 5 percent
Hydric soil rating: No

Woodbridge
Percent of map unit: 2 percent
Hydric soil rating: No

Scituate
Percent of map unit: 2 percent
Hydric soil rating: No

Ridgebury
Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

442B—Gloucester gravelly fine sandy loam, 3 to 8 percent slopes, extremely stony

Map Unit Setting
National map unit symbol: vhtg
Elevation: 300 to 1,210 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Gloucester and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Gloucester

Setting
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear

Across-slope shape: Convex
Parent material: Friable sandy eolian deposits over friable sandy and gravelly basal till derived from granite and gneiss

Typical profile
H1 - 0 to 5 inches: gravelly fine sandy loam
H2 - 5 to 15 inches: gravelly sandy loam
H3 - 15 to 65 inches: very gravelly loamy sand

Properties and qualities
Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: F144AY032NH - Dry Till Uplands
Hydric soil rating: No

Minor Components

Charlton
Percent of map unit: 4 percent
Hydric soil rating: No

Essex
Percent of map unit: 4 percent
Hydric soil rating: No

Montauk
Percent of map unit: 4 percent
Hydric soil rating: No

Ridgebury
Percent of map unit: 3 percent
Landform: Depressions
Hydric soil rating: Yes

Scituate
Percent of map unit: 3 percent
Hydric soil rating: No

Woodbridge
Percent of map unit: 2 percent
Hydric soil rating: No

442C—Gloucester gravelly fine sandy loam, 8 to 15 percent slopes, extremely stony

Map Unit Setting
National map unit symbol: vhtj
Elevation: 300 to 1,230 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Gloucester and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Gloucester

Setting
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable sandy eolian deposits over friable sandy and gravelly basal till derived from granite and gneiss

Typical profile
H1 - 0 to 5 inches: gravelly fine sandy loam
H2 - 5 to 15 inches: gravelly sandy loam
H3 - 15 to 65 inches: very gravelly loamy sand

Properties and qualities
Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: F144AY032NH - Dry Till Uplands

Hydric soil rating: No

Minor Components

Essex
Percent of map unit: 5 percent
Hydric soil rating: No

Charlton
Percent of map unit: 5 percent
Hydric soil rating: No

Montauk
Percent of map unit: 5 percent
Hydric soil rating: No

Woodbridge
Percent of map unit: 2 percent
Hydric soil rating: No

Scituate
Percent of map unit: 2 percent
Hydric soil rating: No

Ridgebury
Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

442D—Gloucester gravelly fine sandy loam, 15 to 25 percent slopes, extremely stony

Map Unit Setting
National map unit symbol: vhtn
Elevation: 280 to 1,200 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Gloucester and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Gloucester

Setting
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear

Across-slope shape: Convex
Parent material: Friable sandy eolian deposits over friable sandy and gravelly basal till derived from granite and gneiss

Typical profile
H1 - 0 to 5 inches: gravelly fine sandy loam
H2 - 5 to 15 inches: gravelly sandy loam
H3 - 15 to 65 inches: very gravelly loamy sand

Properties and qualities
Slope: 15 to 25 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: F144AY032NH - Dry Till Uplands
Hydric soil rating: No

Minor Components

Charlton
Percent of map unit: 5 percent
Hydric soil rating: No

Montauk
Percent of map unit: 5 percent
Hydric soil rating: No

Essex
Percent of map unit: 5 percent
Hydric soil rating: No

Woodbridge
Percent of map unit: 3 percent
Hydric soil rating: No

Scituate
Percent of map unit: 2 percent
Hydric soil rating: No

Soil Information for All Uses

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

Soil Physical Properties

This folder contains a collection of tabular reports that present soil physical properties. The reports (tables) include all selected map units and components for each map unit. Soil physical properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Engineering Properties (Tower Road, Pelham, MA 01002)

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Hydrologic soil group is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These

properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

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

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

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

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

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Percentage of rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Absence of an entry indicates that the data were not estimated. The asterisk "*" denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Engineering Properties–Hampden and Hampshire Counties, Massachusetts, Eastern Part

Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
316B—Scituate fine sandy loam, 3 to 8 percent slopes, very stony														
Scituate	80	C/D	0-5	Fine sandy loam	ML, SM	A-1, A-2, A-4	0- 0- 0	10-15-20	70-80-90	60-73-85	35-58-80	20-43-65	15-18 -20	NP-2 -4
			5-27	Fine sandy loam, loam, sandy loam	ML, SM	A-1, A-2, A-4	0- 0- 0	0-13- 25	70-83-95	60-75-90	35-60-85	20-43-65	15-18 -20	NP-2 -4
			27-65	Gravelly loamy fine sand, gravelly loamy coarse sand, very gravelly loamy sand	SM	A-1, A-2	0- 0- 0	0-13- 25	65-75-85	50-63-75	30-48-65	12-21-30	15-15 -15	NP-1 -2
441B—Gloucester gravelly fine sandy loam, 3 to 8 percent slopes, very stony														
Gloucester	80	A	0-5	Gravelly fine sandy loam	SM, SW-SM	A-1, A-2, A-4	0- 0- 0	10-15-20	70-83-95	60-75-90	30-53-75	10-28-45	15-18 -20	NP
			5-15	Gravelly sandy loam, sandy loam, fine sandy loam	SM, SW-SM	A-1, A-4	0- 0- 0	5-18- 30	60-68-75	40-58-75	20-35-50	10-25-40	0-5 -10	NP
			15-65	Very gravelly loamy coarse sand, gravelly sandy loam, very gravelly loamy sand	GM, GW-GM, SM, SW-SM	A-1	0- 0- 0	15-28-40	40-55-70	20-40-60	10-25-40	5-15- 25	0-5 -10	NP

Engineering Properties–Hampden and Hampshire Counties, Massachusetts, Eastern Part

Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
441C—Gloucester gravelly fine sandy loam, 8 to 15 percent slopes, very stony														
Gloucester	80	A	0-5	Gravelly fine sandy loam	SM, SW-SM	A-1, A-2, A-4	0- 0- 0	10-15-20	70-83-95	60-75-90	30-53-75	10-28-45	15-18 -20	NP
			5-15	Gravelly sandy loam, sandy loam, fine sandy loam	SM, SW-SM	A-1, A-2, A-4	0- 0- 0	5-18- 30	60-68-75	40-58-75	20-35-50	10-25-40	0-5 -10	NP
			15-65	Very gravelly loamy coarse sand, gravelly sandy loam, very gravelly loamy sand	GM, GW-GM, SM, SW-SM	A-1	0- 0- 0	15-28-40	40-55-70	20-40-60	10-25-40	5-15- 25	0-5 -10	NP
442B—Gloucester gravelly fine sandy loam, 3 to 8 percent slopes, extremely stony														
Gloucester	80	A	0-5	Gravelly fine sandy loam	SM, SW-SM	A-1, A-2, A-4	0- 0- 0	15-25-35	60-75-90	55-73-90	25-50-75	10-28-45	15-18 -20	NP
			5-15	Gravelly sandy loam, sandy loam, fine sandy loam	SM, SW-SM	A-1, A-2, A-4	0- 0- 0	5-18- 30	60-68-75	40-58-75	20-35-50	10-25-40	0-5 -10	NP
			15-65	Very gravelly loamy coarse sand, gravelly sandy loam, very gravelly loamy sand	GM, GW-GM, SM, SW-SM	A-1	0- 0- 0	15-28-40	40-55-70	20-40-60	10-25-40	5-15- 25	0-5 -10	NP

Engineering Properties–Hampden and Hampshire Counties, Massachusetts, Eastern Part														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			in				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
442C—Gloucester gravelly fine sandy loam, 8 to 15 percent slopes, extremely stony														
Gloucester	80	A	0-5	Gravelly fine sandy loam	SM, SW-SM	A-1, A-2, A-4	0- 0- 0	15-25-35	60-75-90	55-73-90	25-50-75	10-28-45	15-18 -20	NP
			5-15	Gravelly sandy loam, sandy loam, fine sandy loam	SM, SW-SM	A-1, A-2, A-4	0- 0- 0	5-18- 30	60-68-75	40-58-75	20-35-50	10-25-40	0-5 -10	NP
			15-65	Very gravelly loamy coarse sand, gravelly sandy loam, very gravelly loamy sand	GM, GW-GM, SM, SW-SM	A-1	0- 0- 0	15-28-40	40-55-70	20-40-60	10-25-40	5-15- 25	0-5 -10	NP
442D—Gloucester gravelly fine sandy loam, 15 to 25 percent slopes, extremely stony														
Gloucester	80	A	0-5	Gravelly fine sandy loam	SM, SW-SM	A-1, A-2, A-4	0- 0- 0	15-25-35	60-75-90	55-73-90	25-50-75	10-28-45	15-18 -20	NP
			5-15	Gravelly sandy loam, sandy loam, fine sandy loam	SM, SW-SM	A-1, A-2, A-4	0- 0- 0	5-18- 30	60-68-75	40-58-75	20-35-50	10-25-40	0-5 -10	NP
			15-65	Very gravelly loamy coarse sand, gravelly sandy loam, very gravelly loamy sand	GM, GW-GM, SM, SW-SM	A-1	0- 0- 0	15-28-40	40-55-70	20-40-60	10-25-40	5-15- 25	0-5 -10	NP

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American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

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APPENDIX C

WELL COMPLETION REPORTS

MassDEP

Well Completion Report ID: 644376

eDEP Transmittal Number:

WELL LOCATION

GPS North: 42.362207 **GPS West:** -72.439982 **Assessors Map:**

Address: 95 Packardville Road **Assessors Lot:**

Sub Division: **Permit Number:**

City/Town: PELHAM **Date Issued:**

Board Of Health Permit Obtained:

Work Performed	Well Type	Drilling Method Overburden	Drilling Method Bedrock
Deepen	Domestic	Air Hammer	Air Hammer

ADDITIONAL WELL INFORMATION

Developed:

Disinfected:

Total Well Depth: 530.00

Fracture Enhancement:

Well Seal Type:

Depth to Bedrock:

PERMANENT PUMP (IF AVAILABLE)

Pump Description:

Type:

Nominal Pump Capacity:

Intake Depth:

Horsepower:

Comments: Gravel Pack Well: N
Diameter:

Bedrock on Log of Formations left blank, therefore lithology unknown.

Deepened well from 275' to 530'.

Grey Rock listed as water-bearing rock, however water-bearing zones unknown.

CASING

From(ft)	To(ft)	Type	Thickness	Diameter

SCREEN

From(ft)	To(ft)	Type	slotsize	Diameter

WELL SEAL / FILTER PACK / ABANDONMENT MATERIAL

From(ft)	To(ft)	Material Description	Purpose

STATIC WATER LEVEL(ALL WELLS)

Date Measured	Depth Below Ground Surface
12/07/1984	235.00

WELL TEST DATA (ALL SECTIONS MANDATORY FOR PRODUCTION WELLS)

Date	Method	Yield(GPM)	Time Pumped (hrs & min)	Pumping Level (Ft. BGS)	Time To Recover (Hrs & min)	Recovery
12/07/1984	Air Blow with Drill Stem	2.00	4:00	500	24:00	235

OVER BURDEN

From(ft)	To(ft)	Lithology	Color	Comment	Water Zone	Loss / Add of Fluid	Drill Stem Drop	Drill Rate

BEDROCK

From(ft)	To(ft)	Lithology	Comment	Water Zone	Drill Stem Drop	Extra Large	Drill Rate	Rust Stain	Loss / Add Of Fluid	# of Fract Per Ft

MassDEP

Well Completion Report ID: 644476

eDEP Transmittal Number:

WELL LOCATION

GPS North: 42.362005 **GPS West:** -72.438696 **Assessors Map:**

Address: 97 Packardville Road **Assessors Lot:**

Sub Division: **Permit Number:**

City/Town: PELHAM **Date Issued:**

Board Of Health Permit Obtained:

Work Performed	Well Type	Drilling Method Overburden	Drilling Method Bedrock
New Well	Domestic	Air Hammer	Air Hammer

ADDITIONAL WELL INFORMATION

Developed:

Disinfected:

Total Well Depth: 400.00

Fracture Enhancement:

Well Seal Type:

Depth to Bedrock: 8.00

PERMANENT PUMP (IF AVAILABLE)

Pump Description:

Type:

Nominal Pump Capacity:

Intake Depth:

Horsepower:

Comments: Water-bearing rock/unconsolidated material Description: Grey Granite

Gravel Pack Well: N
Diameter:

Steel Casing Type 19.45lbs.

CASING

From(ft)	To(ft)	Type	Thickness	Diameter
0.00	21.00	Steel		

SCREEN

From(ft)	To(ft)	Type	slotsize	Diameter

WELL SEAL / FILTER PACK / ABANDONMENT MATERIAL

From(ft)	To(ft)	Material Description	Purpose

STATIC WATER LEVEL(ALL WELLS)

Date Measured	Depth Below Ground Surface
11/05/1976	20.00

WELL TEST DATA (ALL SECTIONS MANDATORY FOR PRODUCTION WELLS)

Date	Method	Yield(GPM)	Time Pumped (hrs & min)	Pumping Level (Ft. BGS)	Time To Recover (Hrs & min)	Recovery
11/05/1976	Bailing	4.50	4.00	200	40:00	20

OVER BURDEN

From(ft)	To(ft)	Lithology	Color	Comment	Water Zone	Loss / Add of Fluid	Drill Stem Drop	Drill Rate
0.00	2.00			Top Soil				
2.00	8.00	Gravel						

BEDROCK

From(ft)	To(ft)	Lithology	Comment	Water Zone	Drill Stem Drop	Extra Large	Drill Rate	Rust Stain	Loss / Add Of Fluid	# of Fract Per Ft
8	108	Granite								
108	208	Granite								
208	308	Granite								
308	400	Granite								

MassDEP

Well Completion Report ID: 644465

eDEP Transmittal Number:

WELL LOCATION

GPS North: 42.361620 **GPS West:** -72.438338 **Assessors Map:**

Address: 99 Packardville Road **Assessors Lot:**

Sub Division: **Permit Number:**

City/Town: PELHAM **Date Issued:**

Board Of Health Permit Obtained:

Work Performed	Well Type	Drilling Method Overburden	Drilling Method Bedrock
New Well	Domestic	Air Hammer	Air Hammer

ADDITIONAL WELL INFORMATION

Developed:

Disinfected:

Total Well Depth: 450.00

Fracture Enhancement:

Well Seal Type:

Depth to Bedrock: 11.00

PERMANENT PUMP (IF AVAILABLE)

Pump Description:

Type:

Nominal Pump Capacity:

Intake Depth:

Horsepower:

Comments: Water-bearing rock/unconsolidated material Description: Grey Granite

Gravel Pack Well: N
Diameter:

Steel Casing Type 19.45lbs.

CASING

From(ft)	To(ft)	Type	Thickness	Diameter
0.00	22.00	Steel		

SCREEN

From(ft)	To(ft)	Type	slotsize	Diameter

WELL SEAL / FILTER PACK / ABANDONMENT MATERIAL

From(ft)	To(ft)	Material Description	Purpose

STATIC WATER LEVEL(ALL WELLS)

Date Measured	Depth Below Ground Surface
07/20/1978	35.00

WELL TEST DATA (ALL SECTIONS MANDATORY FOR PRODUCTION WELLS)

Date	Method	Yield(GPM)	Time Pumped (hrs & min)	Pumping Level (Ft. BGS)	Time To Recover (Hrs & min)	Recovery
07/20/1978	Bailing	4.50	4:00	250	4:00	35

OVER BURDEN

From(ft)	To(ft)	Lithology	Color	Comment	Water Zone	Loss / Add of Fluid	Drill Stem Drop	Drill Rate
0.00	5.00	Gravel						
5.00	11.00			Hard Pan				

BEDROCK

From(ft)	To(ft)	Lithology	Comment	Water Zone	Drill Stem Drop	Extra Large	Drill Rate	Rust Stain	Loss / Add Of Fluid	# of Fract Per Ft
11	111	Granite								
111	211	Granite								
211	311	Granite								
311	411	Granite								
411	450	Granite								

MassDEP

Well Completion Report ID: 644405

eDEP Transmittal Number:

WELL LOCATION

GPS North: 42.359290 **GPS West:** -72.433130 **Assessors Map:**

Address: 133 Packardville Road **Assessors Lot:**

Sub Division: 191-83 **Permit Number:**

City/Town: PELHAM **Date Issued:**

Board Of Health Permit Obtained:

Work Performed	Well Type	Drilling Method Overburden	Drilling Method Bedrock
New Well	Domestic	Air Hammer	Air Hammer

ADDITIONAL WELL INFORMATION

Developed:

Disinfected:

Total Well Depth: 320.00

Fracture Enhancement:

Well Seal Type:

Depth to Bedrock: 24.00

PERMANENT PUMP (IF AVAILABLE)

Pump Description:

Type:

Nominal Pump Capacity:

Intake Depth:

Horsepower:

Comments: Gravel Pack Well: N
Diameter:

CASING

From(ft)	To(ft)	Type	Thickness	Diameter
0.00	38.00			

SCREEN

From(ft)	To(ft)	Type	slotsize	Diameter

WELL SEAL / FILTER PACK / ABANDONMENT MATERIAL

From(ft)	To(ft)	Material Description	Purpose

STATIC WATER LEVEL(ALL WELLS)

Date Measured	Depth Below Ground Surface
01/01/1984	30.00

WELL TEST DATA (ALL SECTIONS MANDATORY FOR PRODUCTION WELLS)

Date	Method	Yield(GPM)	Time Pumped (hrs & min)	Pumping Level (Ft. BGS)	Time To Recover (Hrs & min)	Recovery
01/01/1984	Bailing	5.00				

OVER BURDEN

From(ft)	To(ft)	Lithology	Color	Comment	Water Zone	Loss / Add of Fluid	Drill Stem Drop	Drill Rate
0.00	20.00	Gravel		& Boulders				
20.00	24.00	Gravel		& Boulders				

BEDROCK

From(ft)	To(ft)	Lithology	Comment	Water Zone	Drill Stem Drop	Extra Large	Drill Rate	Rust Stain	Loss / Add Of Fluid	# of Fract Per Ft
24	124		Rock							
124	224		Rock							
224	320		Rock							

MassDEP

Well Completion Report ID: 644415

eDEP Transmittal Number:

WELL LOCATION

GPS North: 42.358682 **GPS West:** -72.432830 **Assessors Map:**

Address: 135 Packardville Road **Assessors Lot:**

Sub Division: **Permit Number:**

City/Town: PELHAM **Date Issued:**

Board Of Health Permit Obtained:

Work Performed	Well Type	Drilling Method Overburden	Drilling Method Bedrock
New Well	Domestic	Air Hammer	Air Hammer

ADDITIONAL WELL INFORMATION

Developed:

Disinfected:

Total Well Depth: 150.00

Fracture Enhancement:

Well Seal Type:

Depth to Bedrock: 32.00

PERMANENT PUMP (IF AVAILABLE)

Pump Description:

Type:

Nominal Pump Capacity:

Intake Depth:

Horsepower:

Comments: Gravel Pack Well: N
Diameter:

CASING

From(ft)	To(ft)	Type	Thickness	Diameter
0.00	41.00			

SCREEN

From(ft)	To(ft)	Type	slotsize	Diameter

WELL SEAL / FILTER PACK / ABANDONMENT MATERIAL

From(ft)	To(ft)	Material Description	Purpose

STATIC WATER LEVEL(ALL WELLS)

Date Measured	Depth Below Ground Surface

WELL TEST DATA (ALL SECTIONS MANDATORY FOR PRODUCTION WELLS)

Date	Method	Yield(GPM)	Time Pumped (hrs & min)	Pumping Level (Ft. BGS)	Time To Recover (Hrs & min)	Recovery
07/01/1983	Bailing	25.00				

OVER BURDEN

From(ft)	To(ft)	Lithology	Color	Comment	Water Zone	Loss / Add of Fluid	Drill Stem Drop	Drill Rate
0.00	20.00	Sand and Gravel						
20.00	32.00	Clay						

BEDROCK

From(ft)	To(ft)	Lithology	Comment	Water Zone	Drill Stem Drop	Extra Large	Drill Rate	Rust Stain	Loss / Add Of Fluid	# of Fract Per Ft
32	132		Rock							
132	150		Rock							

MassDEP

Well Completion Report ID: 644460

eDEP Transmittal Number:

WELL LOCATION

GPS North: 42.358759 **GPS West:** -72.431847 **Assessors Map:**

Address: 137 Packardville Road **Assessors Lot:**

Sub Division: **Permit Number:**

City/Town: PELHAM **Date Issued:**

Board Of Health Permit Obtained:

Work Performed	Well Type	Drilling Method Overburden	Drilling Method Bedrock
New Well	Domestic	Air Hammer	Air Hammer

ADDITIONAL WELL INFORMATION

Developed:

Disinfected:

Total Well Depth: 550.00

Fracture Enhancement:

Well Seal Type:

Depth to Bedrock: 60.00

PERMANENT PUMP (IF AVAILABLE)

Pump Description:

Type:

Nominal Pump Capacity:

Intake Depth:

Horsepower:

Comments: Water-bearing rock/unconsolidated material Description: Grey Rock
Gravel Pack Well: N
Diameter:

CASING

From(ft)	To(ft)	Type	Thickness	Diameter
0.00	70.00	Steel		

SCREEN

From(ft)	To(ft)	Type	slotsize	Diameter

WELL SEAL / FILTER PACK / ABANDONMENT MATERIAL

From(ft)	To(ft)	Material Description	Purpose

STATIC WATER LEVEL(ALL WELLS)

Date Measured	Depth Below Ground Surface
12/01/1978	40.00

WELL TEST DATA (ALL SECTIONS MANDATORY FOR PRODUCTION WELLS)

Date	Method	Yield(GPM)	Time Pumped (hrs & min)	Pumping Level (Ft. BGS)	Time To Recover (Hrs & min)	Recovery
12/01/1978	Air Blow with Drill Stem	0.50	6:00	500	24:00	40

OVER BURDEN

From(ft)	To(ft)	Lithology	Color	Comment	Water Zone	Loss / Add of Fluid	Drill Stem Drop	Drill Rate
0.00	2.00			Top Soil				
2.00	6.00	Gravel						
6.00	26.00			Hard Pan				
26.00	46.00			Hard Pan				
46.00	60.00			Hard Pan				

BEDROCK

From(ft)	To(ft)	Lithology	Comment	Water Zone	Drill Stem Drop	Extra Large	Drill Rate	Rust Stain	Loss / Add Of Fluid	# of Fract Per Ft
60	160		Rock							
160	260		Rock							
260	360		Rock							
360	460		Rock							
460	550		Rock							

MassDEP

Well Completion Report ID: 8334

eDEP Transmittal Number:

WELL LOCATION

GPS North: 42.357951 **GPS West:** -72.430572 **Assessors Map:**

Address: 139 Packardville Road **Assessors Lot:**

Sub Division: **Permit Number:**

City/Town: PELHAM **Date Issued:**

Board Of Health Permit Obtained: Y

Work Performed	Well Type	Drilling Method Overburden	Drilling Method Bedrock
	Domestic		

ADDITIONAL WELL INFORMATION

Developed: No

Disinfected: No

Total Well Depth: 280.00

Fracture Enhancement: No

Well Seal Type:

Depth to Bedrock: 58.00

PERMANENT PUMP (IF AVAILABLE)

Pump Description:

Type:

Nominal Pump Capacity:

Intake Depth:

Horsepower:

Comments:

CASING

From(ft)	To(ft)	Type	Thickness	Diameter
	72.00	Steel		6

SCREEN

From(ft)	To(ft)	Type	slotsize	Diameter

WELL SEAL / FILTER PACK / ABANDONMENT MATERIAL

From(ft)	To(ft)	Material Description	Purpose

STATIC WATER LEVEL(ALL WELLS)

Date Measured	Depth Below Ground Surface
11/30/2000	20.00

WELL TEST DATA (ALL SECTIONS MANDATORY FOR PRODUCTION WELLS)

Date	Method	Yield(GPM)	Time Pumped (hrs & min)	Pumping Level (Ft. BGS)	Time To Recover (Hrs & min)	Recovery
	Air Blow with Drill Stem	50.00	00:45:00	280	00:20:00	

OVER BURDEN

From(ft)	To(ft)	Lithology	Color	Comment	Water Zone	Loss / Add of Fluid	Drill Stem Drop	Drill Rate

BEDROCK

From(ft)	To(ft)	Lithology	Comment	Water Zone	Drill Stem Drop	Extra Large	Drill Rate	Rust Stain	Loss / Add Of Fluid	# of Fract Per Ft

MassDEP

Well Completion Report ID: 644419

eDEP Transmittal Number:

WELL LOCATION

GPS North: 42.357440 **GPS West:** -72.429773 **Assessors Map:**

Address: 141 Packardville Road **Assessors Lot:**

Sub Division: 84-82 **Permit Number:**

City/Town: PELHAM **Date Issued:**

Board Of Health Permit Obtained:

Work Performed	Well Type	Drilling Method Overburden	Drilling Method Bedrock
New Well	Domestic	Air Hammer	Air Hammer

ADDITIONAL WELL INFORMATION

Developed:

Disinfected:

Total Well Depth: 125.00

Fracture Enhancement:

Well Seal Type:

Depth to Bedrock: 10.00

PERMANENT PUMP (IF AVAILABLE)

Pump Description:

Type:

Nominal Pump Capacity:

Intake Depth:

Horsepower:

Comments: Gravel Pack Well: N
Diameter:

CASING

From(ft)	To(ft)	Type	Thickness	Diameter
0.00	21.00			

SCREEN

From(ft)	To(ft)	Type	slotsize	Diameter

WELL SEAL / FILTER PACK / ABANDONMENT MATERIAL

From(ft)	To(ft)	Material Description	Purpose

STATIC WATER LEVEL(ALL WELLS)

Date Measured	Depth Below Ground Surface

WELL TEST DATA (ALL SECTIONS MANDATORY FOR PRODUCTION WELLS)

Date	Method	Yield(GPM)	Time Pumped (hrs & min)	Pumping Level (Ft. BGS)	Time To Recover (Hrs & min)	Recovery

OVER BURDEN

From(ft)	To(ft)	Lithology	Color	Comment	Water Zone	Loss / Add of Fluid	Drill Stem Drop	Drill Rate
0.00	3.00	Sand and Gravel						
3.00	6.00	Boulders						
6.00	10.00	Gravel						

BEDROCK

From(ft)	To(ft)	Lithology	Comment	Water Zone	Drill Stem Drop	Extra Large	Drill Rate	Rust Stain	Loss / Add Of Fluid	# of Fract Per Ft
10	110		Rock							
110	125		Rock							

MassDEP

Well Completion Report ID: 644237

eDEP Transmittal Number:

WELL LOCATION

GPS North: 42.356761 **GPS West:** -72.427925 **Assessors Map:**

Address: 147 Packardville Road **Assessors Lot:**

Sub Division: **Permit Number:**

City/Town: PELHAM **Date Issued:**

Board Of Health Permit Obtained: NR

Work Performed	Well Type	Drilling Method Overburden	Drilling Method Bedrock
New Well	Domestic	Air Rotary	Air Rotary

ADDITIONAL WELL INFORMATION

Developed:

Disinfected:

Total Well Depth: 240.00

Fracture Enhancement:

Well Seal Type:

Depth to Bedrock: 6.00

PERMANENT PUMP (IF AVAILABLE)

Pump Description:

Type:

Nominal Pump Capacity:

Intake Depth:

Horsepower:

Comments: Geographic Description

Well is located 75ft W of Enfield Road, .2 mi S of intersection with Butterhill Road

Water-bearing rock/unconsolidated material Description: Brown Rock

CASING

From(ft)	To(ft)	Type	Thickness	Diameter
0.00	20.00	Steel	17#	

SCREEN

From(ft)	To(ft)	Type	slotsize	Diameter

WELL SEAL / FILTER PACK / ABANDONMENT MATERIAL

From(ft)	To(ft)	Material Description	Purpose

STATIC WATER LEVEL(ALL WELLS)

Date Measured	Depth Below Ground Surface
08/09/1993	17.00

WELL TEST DATA (ALL SECTIONS MANDATORY FOR PRODUCTION WELLS)

Date	Method	Yield(GPM)	Time Pumped (hrs & min)	Pumping Level (Ft. BGS)	Time To Recoover (Hrs & min)	Recovery
08/09/1993	Air Blow with Drill Stem	30.00	00:30	240	00:35	17

OVER BURDEN

From(ft)	To(ft)	Lithology	Color	Comment	Water Zone	Loss / Add of Fluid	Drill Stem Drop	Drill Rate
0.00	6.00			Hard Pan				

BEDROCK

From(ft)	To(ft)	Lithology	Comment	Water Zone	Drill Stem Drop	Extra Large	Drill Rate	Rust Stain	Loss / Add Of Fluid	# of Fract Per Ft
6	35		White/Grey Rock							
35	36		Yellow Rock							
36	136		White/Grey Rock							
136	200		White/Grey Rock							
200	201		Brown Rock	Yes						
201	218		White/Grey Rock							
218	219		Brown Rock	Yes						
219	240		White/Grey Rock							

Stormwater Management Report

Tower Road Solar Project
Tower Road
Pelham, MA 01002

Prepared for:

ASD Tower MA Solar LLC
518 17th Street, Suit 950
Denver, CO 80202

Prepared by:

Tetra Tech, Inc.
100 Nickerson Road
Marlborough, MA 01752



TETRA TECH

June 2026

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1.0 INTRODUCTION

This Stormwater Management Report, prepared in accordance with Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards (the Standards), summarizes the Stormwater Management Plan and associated analyses for the proposed ground-mounted solar electric system and appurtenant components (the Project) on 63.9-acres of land with access via Tower Road (private way) located along Packardville Road in Pelham, Massachusetts (the Project Site). A United States Geological Survey (USGS) Locus Map is provided as Figure 1 in Appendix A.

The purpose of the Stormwater Management Plan is to provide a comprehensive framework for the long-term protection of natural resources on and around the Project Site from degradation resulting from stormwater discharges.

The following sections describe the specific stormwater management strategies and expected performance of the Stormwater Management Plan to be implemented at the Project Site and summarizes compliance with applicable stormwater regulations.

1.1 EXISTING CONDITIONS

The Project Site includes 63.9 acres of land with access via Tower Road in Pelham, Massachusetts. The parcel assemblage is currently occupied by a managed forest, along with a radio tower and control room building in the southeast quadrant of the site. The Project Site contains four wetland resources areas which are in the western and northwestern portions of the site. A gravel road meanders through the southern and southeastern portion of the Project Site which leads to an observation tower and radio tower located on the abutting parcel to the east.

The Project Site is bounded in all directions by Massachusetts state owned forest land identified as Cadwell Memorial Forest. The Project Site encompasses a small town of Pelham owned parcel, which is the location of Allen Cemetery.

Project Site topography generally slopes from east to west-northwest ranging from a high elevation of 1138 near the southeast corner of the parcel to a low elevation of 981 at a wetland resource area within the woodland area in the northwest quadrant, referenced to the North American Vertical Datum of 1988 (NAVD 88). Stormwater runoff from the Project Site flows predominantly to the west-northwest where it discharges overland to several wetland resource areas. The remainder of the Project Site flows overland to the southwest in the direction of Tower Road.

No part of the Project Site is located within the 100-year floodplain according to the most recent Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map; Map No. 250168A; Effective Date December 10, 1976. No base flood elevation has been determined. The referenced FEMA Flood Insurance Rate Map is provided as Figure 2 in Appendix A.

1.2 PROPOSED CONDITIONS

The Project footprint is roughly 33 acres of the 63.9-acre Project Site. Proposed infrastructure is limited and includes installation of ground-mounted solar tracking systems that allow the solar panels to follow the path of the sun throughout the day to maximize electricity production, gravel access drive, perimeter security fencing, equipment pads, as well as pole-mounted and underground electrical lines.

The Project is designed to avoid placing solar tracking systems on slopes greater than 3H:1V, minimize disturbance of topography to maintain existing drainage patterns and characteristics, preserve topsoil to maintain existing vegetation cover, space solar tracking systems in a manner that allows sunlight penetration sufficient to support vegetation under, and adjacent to, the solar tracking systems that provides adequate infiltration and minimizes surface water runoff, and avoid stormwater outfalls.

An infiltration trench is proposed along the downward slope of the gravel equipment yard to provide the required stormwater recharge for the proposed impervious surfaces. The proposed gravel access drive and gravel equipment yard is expected to be used once or twice a year for routine site maintenance, and is not to be considered compacted gravel, nor an impervious surface.

2.0 STORMWATER MANAGEMENT

2.1 METHOD OF CALCULATION

The hydrologic model was created and calculated with HydroCAD®, Version 10.20-7a software, developed by HydroCAD® Software Solutions LLC, to analyze the hydrology of the Project Site.

2.2 SOURCES OF DATA

The following sources of data were used for the hydrologic and hydraulic calculations.

- Soil Conservation Service (SCS) Technical Release No. 20 (TR-20)
- Soil Conservation Service (SCS) Technical Release No. 55 (TR-55)
- United States Department of Commerce, Technical Paper No. 40 (TP-40), Rainfall Frequency Atlas of the United States
- Intensity Duration Frequency (IDF) Curves for the Pelham, Massachusetts Area

2.3 RAINFALL DEPTHS

In accordance with MassDEP Stormwater Management Policy the 2-, 10-, and 100-year, 24-hour storm events were analyzed. Table 1 indicates the rainfall depths, interpolated from TP-40 Rainfall Frequency Atlas of the United States (per MassDEP), used for each storm event.

Table 1 – Rainfall Depths

Storm Event	TP-40
2-Year, 24-Hour	2.90”
10-Year, 24-Hour	4.45”
100-Year, 24-Hour	6.42”

2.4 SOIL CONDITIONS

Review of the Natural Resources Conservation Service (NRCS) Web Soil Survey for Hampden and Hampshire Counties, Massachusetts, Eastern Part, indicates the following soil series mapped on the Project Site. A NRCS Soils Map is provided in Appendix B.

Table 2 – NRCS Soil Data

Map Unit Symbol	Map Unit Description	Hydrologic Soil Group	Percent of Site
316B	Scituate fine sandy loam, 3 to 8% slopes, very stony	C/D	10.5%
441B	Gloucester gravelly fine sandy loam, 3 to 8% slopes, very stony	A	49.8%
441C	Gloucester gravelly fine sandy loam, 8 to 15% slopes, very stony	A	9.6%
442B	Gloucester gravelly fine sandy loam, 3 to 8% slopes, extremely stony	A	17.1%
442C	Gloucester gravelly fine sandy loam, 8 to 15% slopes, extremely stony	A	4.4%
442D	Gloucester gravelly fine sandy loam, 15 to 25% slopes, extremely stony	A	8.6%

Hydrologic Soil Groups are based on estimates of runoff potential. Soils are assigned one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. Soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D) and are defined by the Soil Conservation Service (SCS) as follows:

- Group A: Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
- Group B: Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately find texture to moderately coarse texture. These soils have a moderate rate of water transmission.
- Group C: Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a later that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
- Group D: Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

For soils assigned to a dual hydrologic group, the first letter is for drained areas and the second letter is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes. For areas where drainage status is unknown, the more conservative soil classification is assumed.

2.5 EXISTING CONDITIONS

2.5.1 Existing Watershed

Under existing conditions, the Study Area is divided into three (3) Design Points and three (3) Subcatchment Areas. The Study Area is 85.8 acres of predominately managed forest, and an approximate 1,500-foot-long gravel drive which services a radio tower, a small radio tower control room building, and a small shed. The Design Points and Subcatchment Areas are described below and shown on Figure 3 in Appendix A.

Design Point

- Design Point 1 (DP-1) – Wetland at northern boundary of the Study Area.
- Design Point 2 (DP-2) – Natural drainageway at western boundary of the Study Area.
- Design Point 3 (DP-3) – Hillside at southern boundary of the Study Area.

Subcatchment Area

- Subcatchment E-1 – Stormwater runoff travels overland in a west-northwest direction and discharges to a wetland located at the northern boundary of the Study Area. (Design Point DP-1)
- Subcatchment E-2 – Stormwater runoff travels overland in a westerly direction and discharges offsite where it converges to a natural drainageway at the western boundary of the Study Area. (Design Point DP-2)
- Subcatchment E-3 – Stormwater runoff travels overland in a west-southwest direction and discharges offsite to a hillside at the southern boundary of the Study Area. (Design Point DP-3)

2.5.2 Existing Runoff Calculations

To determine the peak rate of discharge for existing conditions, runoff hydrographs were generated for the storm events using the SCS TR-20 method. In accordance with MassDEP Stormwater Management Policy the 2-, 10-, and 100-year, 24-hour storm events were analyzed. Table 3 summarizes existing discharge rates using TP-40 rainfall depths for each storm event.

Table 3 – Existing Peak Runoff Rates

Point of Analysis	Peak Runoff (cubic feet per second)		
	2-Year Storm	10-Year Storm	100-Year Storm
DP-1	0.00	0.59	7.46
DP-2	0.00	0.19	3.66
DP-3	0.00	0.01	0.27

2.6 PROPOSED CONDITIONS

2.6.1 Proposed Watershed

Under proposed conditions, the Study Area is divided into three (3) Design Points and three (3) Subcatchment Areas. The Study Area is 85.8 acres of meadow fields and ground-mounted solar tracking

systems (formerly a managed forest), along with wooded forest, ground-mounted solar tracking systems, perimeter security fencing, gravel access drive, and equipment pads, as well as the previously described existing infrastructure. The Design Points and Subcatchment Areas are described below and shown on Figure 4 in Appendix A.

Design Point

- Design Point 1 (DP-1) – Wetland at northern boundary of the Study Area.
- Design Point 2 (DP-2) – Natural drainageway at western boundary of the Study Area.
- Design Point 3 (DP-3) – Hillside at southern boundary of the Study Area.

Subcatchment Area

- Subcatchment P-1 – Stormwater runoff travels overland in a west-northwest direction and discharges to a wetland located at the northern boundary of the Study Area. (Design Point DP-1)
- Subcatchment P-2 – Stormwater runoff travels overland in a westerly direction and discharges offsite where it converges to a natural drainageway at the western boundary of the Study Area. (Design Point DP-2)
- Subcatchment P-3 – Stormwater runoff travels overland in a west-southwest direction and discharges offsite to a hillside at the southern boundary of the Study Area. (Design Point DP-3)

2.6.2 Proposed Runoff Calculations

To determine the peak rate of discharge for existing conditions, runoff hydrographs were generated for the storm events using the SCS TR-20 method. In accordance with MassDEP Stormwater Management Policy the 2-, 10-, and 100-year, 24-hour storm events were analyzed. Table 4 summarizes proposed discharge rates using TP-40 rainfall depths for each storm event.

Table 4 – Proposed Peak Runoff Rates

Point of Analysis	Peak Runoff (cubic feet per second)		
	2-Year Storm	10-Year Storm	100-Year Storm
DP-1	0.00	0.59	7.14
DP-2	0.00	0.19	3.60
DP-3	0.00	0.01	0.27

3.0 MASSDEP STORMWATER MANAGEMENT STANDARDS

The Project has been designed in accordance with the ten (10) MassDEP Stormwater Management Standards as outlined in the Massachusetts Stormwater Handbook. The following sections summarize the Project's compliance with the Stormwater Management Standards.

3.1 STANDARD 1 – NO NEW UNTREATED DISCHARGES

The Project complies with Standard 1. No new point source discharges of untreated stormwater to or causing erosion in resource areas are proposed as part of the Project. Existing drainage patterns will be maintained in the post-development condition and new outfalls are not proposed.

3.2 STANDARD 2 – PEAK RATE ATTENUATION

The Project complies with Standard 2. The Project is designed so that post-development peak discharge rates do not exceed pre-development discharge rates for the 2-year and 10-year, 24-hour storm event, and so that there will not be increased flooding impacts off-site for the 100-year, 24-hour storm event.

To determine the peak rate of discharge for existing and proposed conditions, runoff hydrographs were generated for the storm events using the SCS TR-20 method. In accordance with MassDEP Stormwater Management Policy the 2-, 10-, and 100-year, 24-hour storm events were analyzed using TP-40 Rainfall Frequency Atlas of the United States rainfall depths. HydroCAD input/output data for existing and proposed conditions are provided in Appendix C. Table 5 summarizes the pre- and post-development peak runoff discharge rates determined in the hydrologic/hydraulic analyses performed for the Study Area.

Table 5 – Comparison of Peak Runoff Rates

Point of Analysis	Peak Runoff (cubic feet per second)								
	2-Year Storm			10-Year Storm			100-Year Storm		
	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ
DP-1	0.00	0.00	0.00	0.59	0.59	0.00	7.46	7.14	(0.32)
DP-2	0.00	0.00	0.00	0.19	0.19	0.00	3.66	3.60	(0.06)
DP-3	0.00	0.00	0.00	0.01	0.01	0.00	0.27	0.27	0.00

3.3 STANDARD 3 – RECHARGE

The Project complies with Standard 3. The Project is designed to plant and maintain native vegetative cover under, and adjacent to, ground-mounted solar tracking system components that provide adequate infiltration and minimizes surface water runoff.

The Project also includes an infiltration trench along the downward slope of the gravel equipment yard to capture stormwater runoff and provide the required stormwater recharge for the proposed impervious surfaces. The supporting stormwater recharge calculations are provided in Appendix D.

3.4 STANDARD 4 – WATER QUALITY

The Project complies with Standard 4. The Project does not contain impervious surfaces which require Total Suspended Solid (TSS) treatment. The proposed gravel access drive and gravel equipment yard are not to be considered compacted gravel nor an impervious surface due to the low vehicular travel frequency of once or twice a year for routine site maintenance.

3.5 STANDARD 5 – LAND USES WITH HIGHER POTENTIAL POLLUTANT LOADS

The Project does not qualify as a Land Use with Higher Potential Pollutant Loads and therefore Standard 5 is not applicable.

3.6 STANDARD 6 – CRITICAL AREAS

The Project complies with Standard 6. The Project does not discharge stormwater within the Zone II or Interim Wellhead Protection Area of a public water supply, or near or to a Critical Area as defined in the Standards. Although Fort River is designated as a cold-water fishery it is located more than 200 feet south of the Project. Cold-water fisheries are waters in which the mean of the maximum daily temperature over a seven-day period generally does not exceed 68°F and are capable of supporting a year-round population of cold-water stenothermal aquatic life. Stormwater runoff from the Project will continue to travel overland through existing dense vegetation, including designated Qualifying Pervious Areas, that provides adequate infiltration and minimizes surface water runoff prior to reaching Fort River.

3.7 STANDARD 7 – REDEVELOPMENT PROJECTS

Standard 7 is not applicable to the Project, as it does not qualify as a redevelopment or other project subject to the Standards only to the maximum extent practicable.

3.8 STANDARD 8 – CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION AND SEDIMENTATION CONTROL

The Project complies with Standard 8. The Project will result in the disturbance of greater than one acre of land and requires coverage under the U.S. EPA National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges from Construction Activities. In support of coverage, a project-specific Storm Water Pollution Prevention (SWPPP) will be prepared, and a Notice of Intent will be submitted to the EPA prior to commencement of construction activities.

3.9 STANDARD 9 – OPERATIONS AND MAINTENANCE PLAN

The Project complies with Standard 9. An Operations and Maintenance Plan to be implemented by the owner and its responsible operations and maintenance staff to ensure that stormwater management systems function as designed is provided in Appendix E.

3.10 STANDARD 10 – PROHIBITION OF ILLICIT DISCHARGES

The Project complies with Standard 10. There are no known or designed illicit discharges on the Project Site. An Illicit Discharge Compliance Statement is provided in Appendix F.

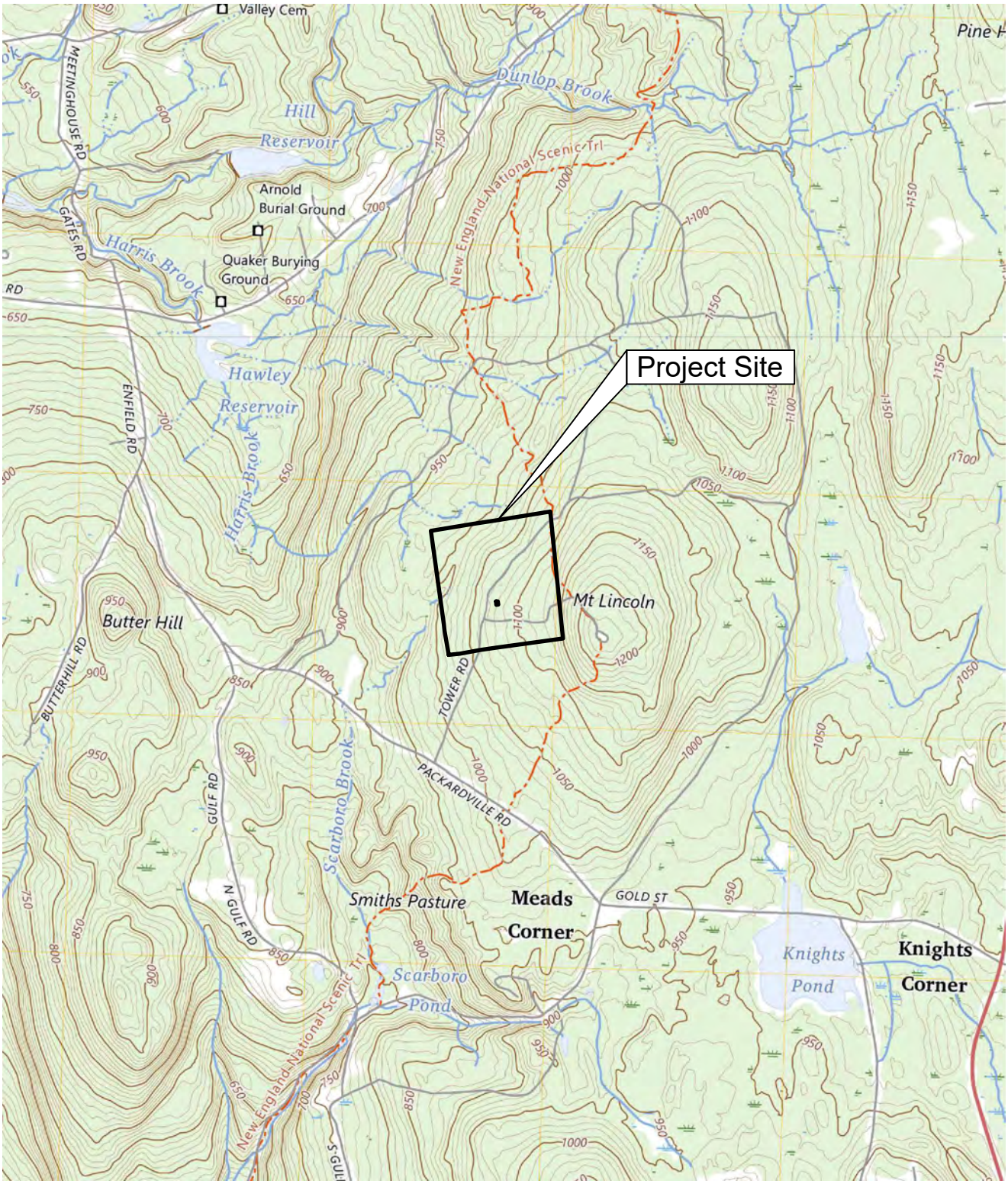
4.0 CONCLUSION

The Project conforms to the ten (10) MassDEP Stormwater Management Standards and utilizes several MassDEP recognized Low Impact Development techniques that will provide long-term protection of natural resources on and around the Project Site from degradation resulting from stormwater discharges.

Appendix A
Figures

INFORMATION BASED ON:

1. USGS MAP OF SHUTESBURY, MASSACHUSETTS, DATED 2024
2. USGS MAP OF BELCHERTOWN, MASSACHUSETTS, DATED 2024



TETRA TECH

www.tetratech.com

100 Nickerson Road
Marlborough, MA 01752
Phone: 1 (508) 786-2200 | Fax: 1 (508) 786-2201

ASD Tower MA Solar LLC

Tower Road
Pelham, Massachusetts 01002

0 1000' 2000'

SCALE: 1" = 2000'

Site Locus Map

Project No.:	143-620765-24013
Date:	June 30, 2026
Designed By:	JDA
Figure	1

Bar Measures 1 inch

Copyright: Tetra Tech

6/3/2026 2:45:41 PM - P:\620765\143-620765-24013\CAD\SHEETFILES\SPECIAL PERMIT APPLICATION\FIGURE 1 - SITE LOCUS.DWG - AHERN, JOHN

JOINS 05

JOINS 07

JOINS 09

JOINS 10

CALDWELL MEMORIAL FOREST

CALDWELL MEMORIAL FOREST

ENFIELD

TOWER RD

TOWER RD

RD

ZONE A

ZONE A

ZONE A

ZONE A

ZONE A

ZONE A

ZONE A

CORPORATE LIMITS

CORPORATE LIMITS

US ROUTE 202

US ROUTE 202

QUABBIN RESERVOIR RESERVATION

APPROXIMATE SCALE

1000 0 1000 2000 3000 FEET

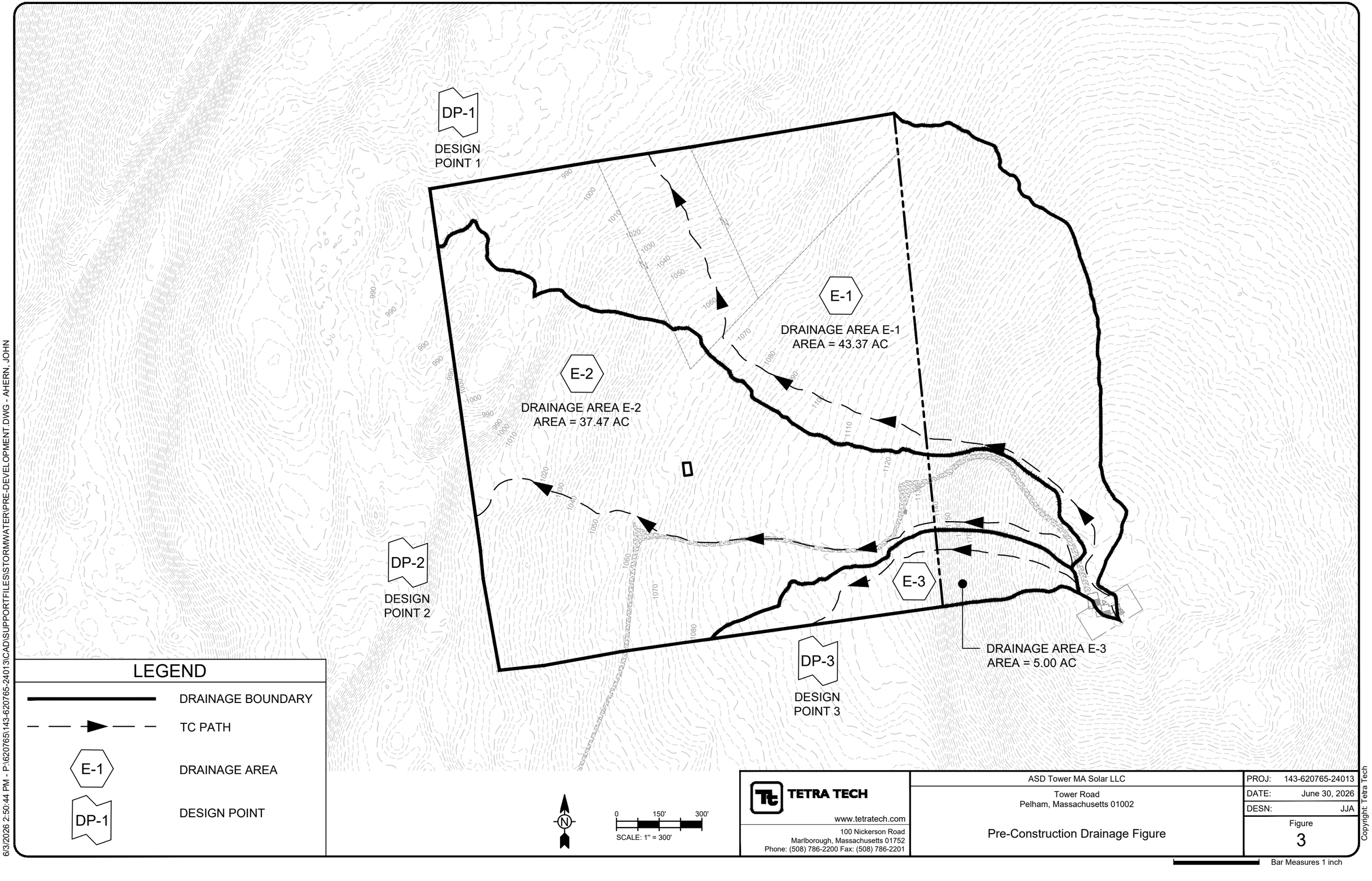
MAP REVISED 12/10/76

FLOOD HAZARD BOUNDARY MAP

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWN OF PELHAM, MA
(HAMPSHIRE CO.)

08



TETRA TECH
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Marlborough, Massachusetts 01752
Phone: (508) 786-2200 Fax: (508) 786-2201

ASD Tower MA Solar LLC

Tower Road
Pelham, Massachusetts 01002

Pre-Construction Drainage Figure

PROJ:	143-620765-24013
DATE:	June 30, 2026
DESN:	JJA

Figure
3

Bar Measures 1 inch

Copyright: Tetra Tech

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DP-1

DESIGN
POINT 1

P-1

DRAINAGE AREA P-1
AREA = 43.37 AC

P-2

DRAINAGE AREA P-2
AREA = 37.47 AC

P-3

DRAINAGE AREA P-3
AREA = 5.00 AC

DP-2

DESIGN
POINT 2

DP-3

DESIGN
POINT 3

LEGEND

- DRAINAGE BOUNDARY
- TC PATH
- P-1 — DRAINAGE AREA
- DP-1 — DESIGN POINT

N

0 150' 300'

SCALE: 1" = 300'

TETRA TECH

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Marlborough, Massachusetts 01752
Phone: (508) 786-2200 Fax: (508) 786-2201

ASD Tower MA Solar LLC

Tower Road
Pelham, Massachusetts 01002

Post-Construction Drainage Figure

PROJ:	143-620765-24013
DATE:	June 30, 2026
DESN:	JJA

Figure
4

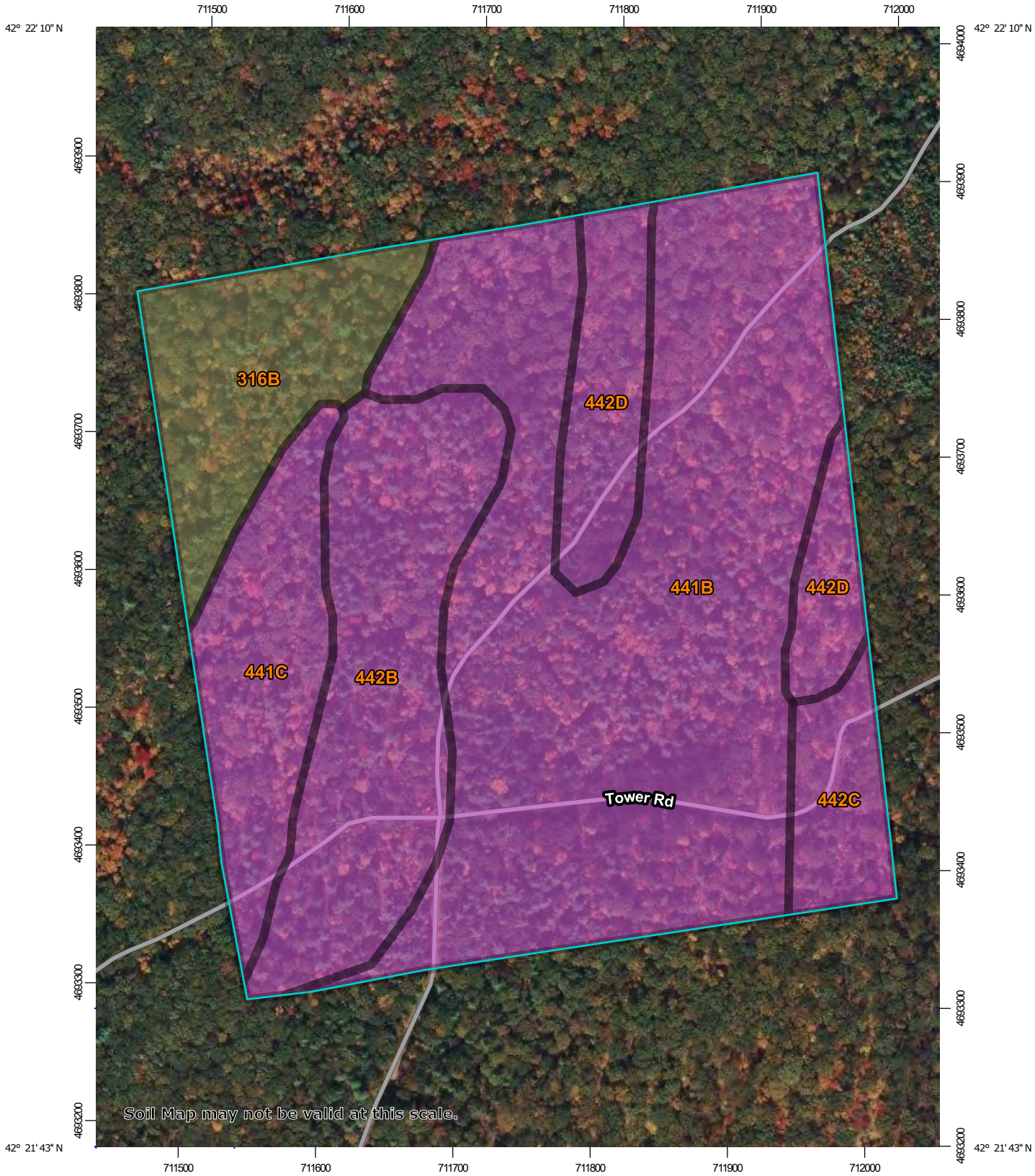
Bar Measures 1 inch

Copyright: Tetra Tech

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Appendix B
NRCS Web Soil Survey

Hydrologic Soil Group—Hampden and Hampshire Counties, Massachusetts, Eastern Part
(ASD Tower MA Solar LLC)



Map Scale: 1:3,960 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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: Hampden and Hampshire Counties, Massachusetts, Eastern Part
Survey Area Data: Version 19, Aug 27, 2024

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

Date(s) aerial images were photographed: Oct 15, 2020—Oct 31, 2020

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
316B	Scituate fine sandy loam, 3 to 8 percent slopes, very stony	C/D	6.7	10.5%
441B	Gloucester gravelly fine sandy loam, 3 to 8 percent slopes, very stony	A	31.8	49.8%
441C	Gloucester gravelly fine sandy loam, 8 to 15 percent slopes, very stony	A	6.1	9.6%
442B	Gloucester gravelly fine sandy loam, 3 to 8 percent slopes, extremely stony	A	11.0	17.1%
442C	Gloucester gravelly fine sandy loam, 8 to 15 percent slopes, extremely stony	A	2.8	4.4%
442D	Gloucester gravelly fine sandy loam, 15 to 25 percent slopes, extremely stony	A	5.5	8.6%
Totals for Area of Interest			**63.9**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

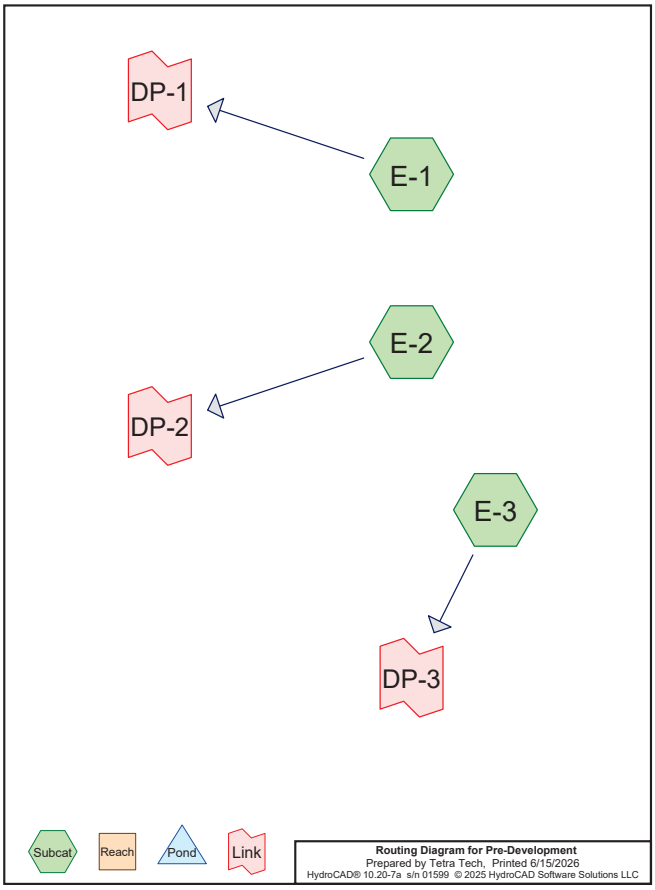
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix C

HydroCAD® Input/Output Data



Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
31,802	96	Gravel surface, HSG A (E-2)
9,969	96	Gravel surface, HSG D (E-1, E-2)
267	98	Roofs, HSG A (E-2)
813	98	Roofs, HSG D (E-1)
3,162,701	30	Woods, Good, HSG A (E-1, E-2, E-3)
533,317	77	Woods, Good, HSG D (E-1, E-2, E-3)
3,738,869	**37**	**TOTAL AREA**

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment E-1: Runoff Area=1,889,209 sf 0.04% Impervious Runoff Depth=0.00"
Flow Length=2,616' Tc=38.1 min CN=39 Runoff=0.00 cfs 0 cf

Subcatchment E-2: Runoff Area=1,632,329 sf 0.02% Impervious Runoff Depth=0.00"
Flow Length=2,343' Tc=28.0 min CN=36 Runoff=0.00 cfs 0 cf

Subcatchment E-3: Runoff Area=217,331 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=1,094' Tc=20.6 min CN=34 Runoff=0.00 cfs 0 cf

Link DP-1: Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link DP-2: Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link DP-3: Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Total Runoff Area = 3,738,869 sf Runoff Volume = 0 cf Average Runoff Depth = 0.00"
99.97% Pervious = 3,737,789 sf 0.03% Impervious = 1,080 sf

Summary for Subcatchment E-1:

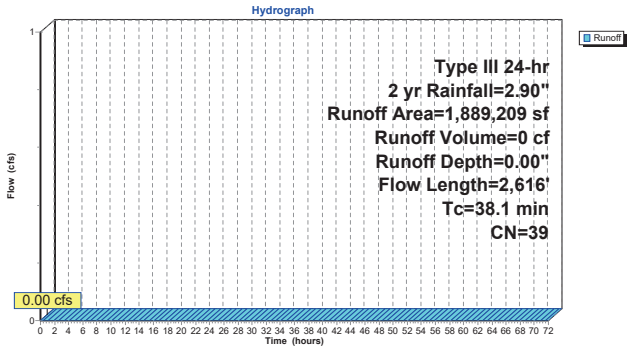
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Link DP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=2.90"

Area (sf)	CN	Description
2,080	96	Gravel surface, HSG D
813	98	Roofs, HSG D
1,518,797	30	Woods, Good, HSG A
367,519	77	Woods, Good, HSG D
1,889,209	39	Weighted Average
1,888,396		99.96% Pervious Area
813		0.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	59	0.0550	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20" Using McCuen-Spiess flow length
1.1	189	0.0309	2.83		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.5	266	0.0382	0.98		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
5.0	577	0.1473	1.92		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.2	1,050	0.0704	1.33		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.9	475	0.1059	1.63		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
38.1	2,616	Total			

Subcatchment E-1:



Summary for Subcatchment E-2:

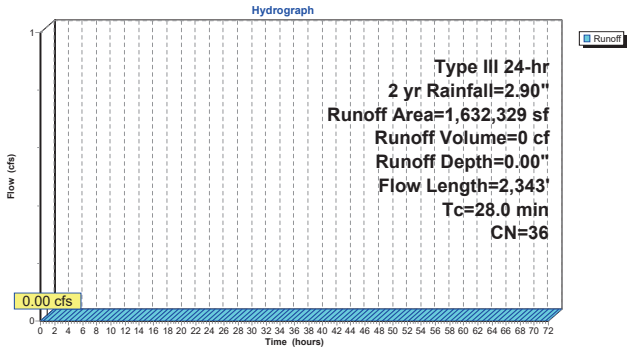
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Link DP-2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=2.90"

Area (sf)	CN	Description
31,802	96	Gravel surface, HSG A
7,889	96	Gravel surface, HSG D
1,445,047	30	Woods, Good, HSG A
147,324	77	Woods, Good, HSG D
267	98	Roofs, HSG A
1,632,329	36	Weighted Average
1,632,062		99.98% Pervious Area
267		0.02% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	43	0.0298	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20" Using McCuen-Spiess flow length
1.3	93	0.0603	1.23		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.9	586	0.1605	2.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.6	878	0.0649	4.10		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.8	240	0.0792	1.41		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.9	213	0.1457	1.91		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.2	290	0.0535	1.16		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
28.0	2,343	Total			

Subcatchment E-2:



Summary for Subcatchment E-3:

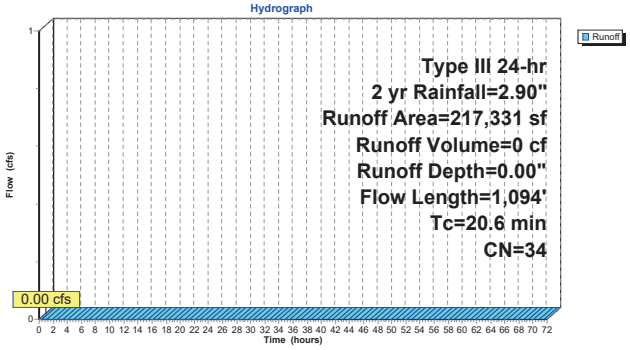
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Link DP-3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=2.90"

Area (sf)	CN	Description
198,857	30	Woods, Good, HSG A
18,474	77	Woods, Good, HSG D
217,331	34	Weighted Average
217,331		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	48	0.0365	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20" Using McCuen-Spiess flow length
3.9	497	0.1850	2.15		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.3	549	0.0622	1.25		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
20.6	1,094	Total			

Subcatchment E-3:

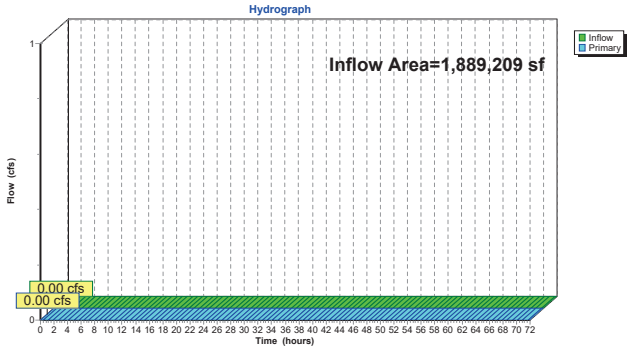


Summary for Link DP-1:

Inflow Area = 1,889,209 sf, 0.04% Impervious, Inflow Depth = 0.00" for 2 yr event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-1:

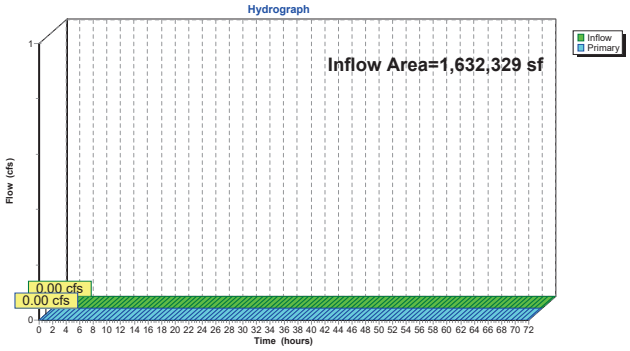


Summary for Link DP-2:

Inflow Area = 1,632,329 sf, 0.02% Impervious, Inflow Depth = 0.00" for 2 yr event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-2:

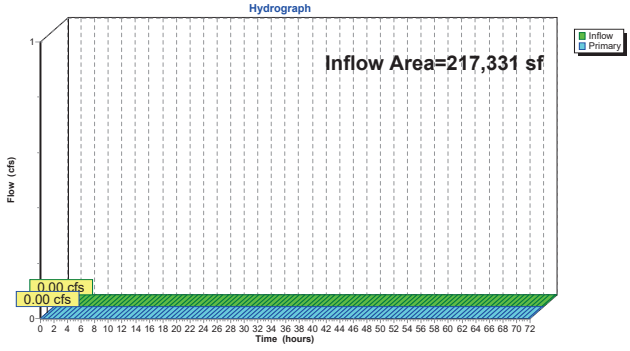


Summary for Link DP-3:

Inflow Area = 217,331 sf, 0.00% Impervious, Inflow Depth = 0.00" for 2 yr event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-3:



Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment E-1: Runoff Area=1,889,209 sf 0.04% Impervious Runoff Depth=0.10"
Flow Length=2,616' Tc=38.1 min CN=39 Runoff=0.59 cfs 16,215 cf

Subcatchment E-2: Runoff Area=1,632,329 sf 0.02% Impervious Runoff Depth=0.04"
Flow Length=2,343' Tc=28.0 min CN=36 Runoff=0.19 cfs 5,828 cf

Subcatchment E-3: Runoff Area=217,331 sf 0.00% Impervious Runoff Depth=0.02"
Flow Length=1,094' Tc=20.6 min CN=34 Runoff=0.01 cfs 292 cf

Link DP-1: Inflow=0.59 cfs 16,215 cf
Primary=0.59 cfs 16,215 cf

Link DP-2: Inflow=0.19 cfs 5,828 cf
Primary=0.19 cfs 5,828 cf

Link DP-3: Inflow=0.01 cfs 292 cf
Primary=0.01 cfs 292 cf

Total Runoff Area = 3,738,869 sf Runoff Volume = 22,336 cf Average Runoff Depth = 0.07"
99.97% Pervious = 3,737,789 sf 0.03% Impervious = 1,080 sf

Summary for Subcatchment E-1:

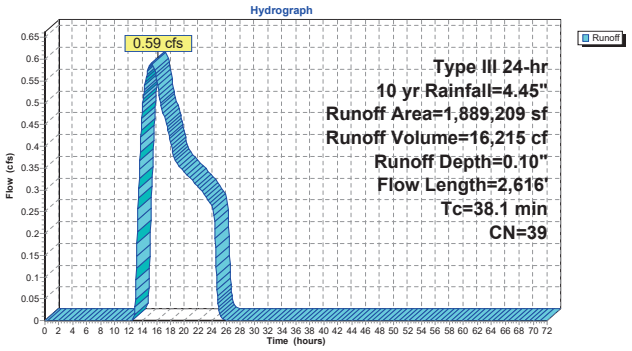
Runoff = 0.59 cfs @ 15.29 hrs, Volume= 16,215 cf, Depth= 0.10"
Routed to Link DP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.45"

Area (sf)	CN	Description
2,080	96	Gravel surface, HSG D
813	98	Roofs, HSG D
1,518,797	30	Woods, Good, HSG A
367,519	77	Woods, Good, HSG D
1,889,209	39	Weighted Average
1,888,396		99.96% Pervious Area
813		0.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	59	0.0550	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20" Using McCuen-Spiess flow length
1.1	189	0.0309	2.83		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.5	266	0.0382	0.98		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
5.0	577	0.1473	1.92		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.2	1,050	0.0704	1.33		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.9	475	0.1059	1.63		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
38.1	2,616	Total			

Subcatchment E-1:



Summary for Subcatchment E-2:

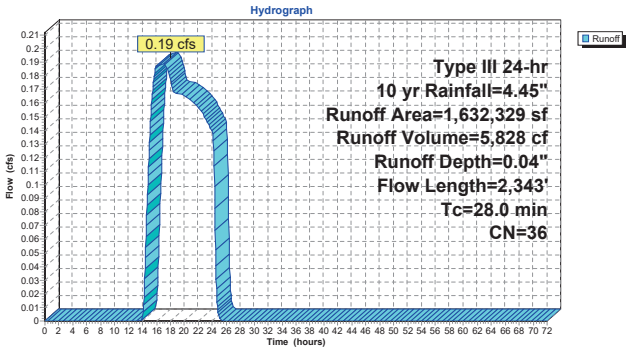
Runoff = 0.19 cfs @ 16.99 hrs, Volume= 5,828 cf, Depth= 0.04"
Routed to Link DP-2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.45"

Area (sf)	CN	Description
31,802	96	Gravel surface, HSG A
7,889	96	Gravel surface, HSG D
1,445,047	30	Woods, Good, HSG A
147,324	77	Woods, Good, HSG D
267	98	Roofs, HSG A
1,632,329	36	Weighted Average
1,632,062		99.98% Pervious Area
267		0.02% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	43	0.0298	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20" Using McCuen-Spiess flow length
1.3	93	0.0603	1.23		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.9	586	0.1605	2.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.6	878	0.0649	4.10		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.8	240	0.0792	1.41		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.9	213	0.1457	1.91		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.2	290	0.0535	1.16		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
28.0	2,343	Total			

Subcatchment E-2:



Summary for Subcatchment E-3:

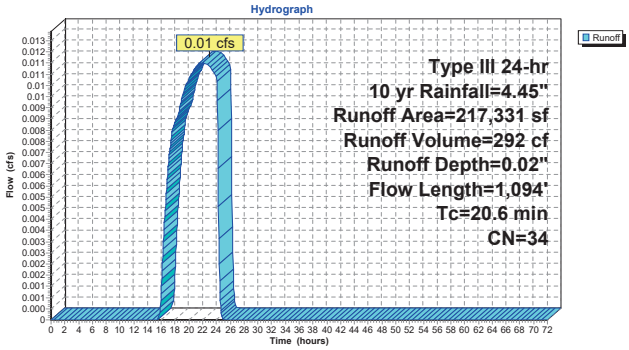
Runoff = 0.01 cfs @ 22.05 hrs, Volume= 292 cf, Depth= 0.02"
Routed to Link DP-3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.45"

Area (sf)	CN	Description
198,857	30	Woods, Good, HSG A
18,474	77	Woods, Good, HSG D
217,331	34	Weighted Average
217,331		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	48	0.0365	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20" Using McCuen-Spiess flow length
3.9	497	0.1850	2.15		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.3	549	0.0622	1.25		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
20.6	1,094	Total			

Subcatchment E-3:

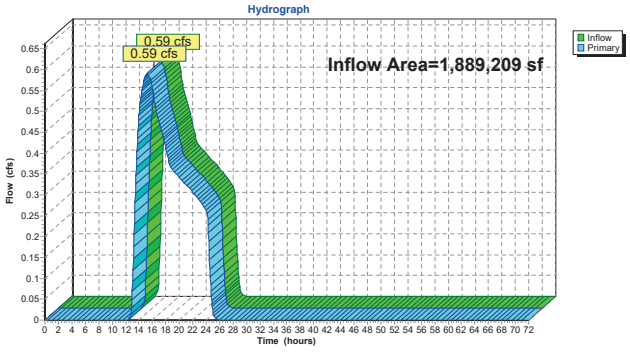


Summary for Link DP-1:

Inflow Area = 1,889,209 sf, 0.04% Impervious, Inflow Depth = 0.10" for 10 yr event
Inflow = 0.59 cfs @ 15.29 hrs, Volume= 16,215 cf
Primary = 0.59 cfs @ 15.29 hrs, Volume= 16,215 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-1:

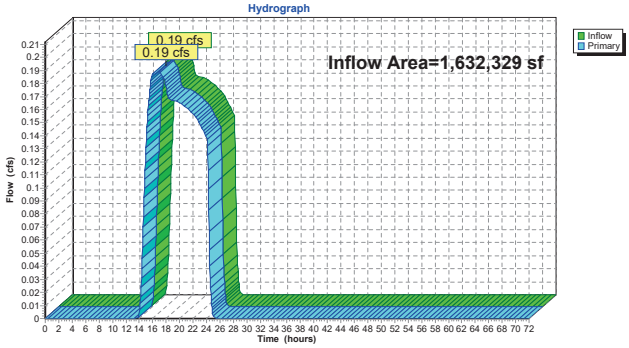


Summary for Link DP-2:

Inflow Area = 1,632,329 sf, 0.02% Impervious, Inflow Depth = 0.04" for 10 yr event
Inflow = 0.19 cfs @ 16.99 hrs, Volume= 5,828 cf
Primary = 0.19 cfs @ 16.99 hrs, Volume= 5,828 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-2:

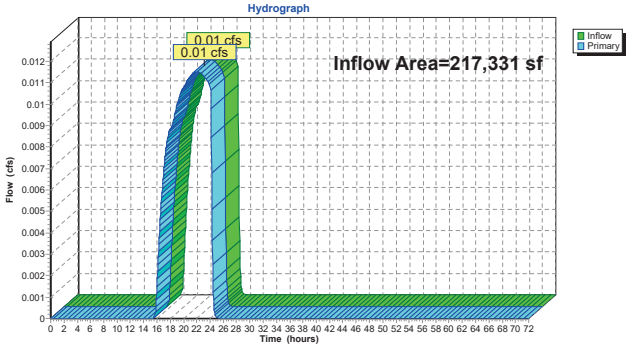


Summary for Link DP-3:

Inflow Area = 217,331 sf, 0.00% Impervious, Inflow Depth = 0.02" for 10 yr event
Inflow = 0.01 cfs @ 22.05 hrs, Volume= 292 cf
Primary = 0.01 cfs @ 22.05 hrs, Volume= 292 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-3:



Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment E-1: Runoff Area=1,889,209 sf 0.04% Impervious Runoff Depth=0.57"
Flow Length=2,616' Tc=38.1 min CN=39 Runoff=7.46 cfs 90,105 cf

Subcatchment E-2: Runoff Area=1,632,329 sf 0.02% Impervious Runoff Depth=0.40"
Flow Length=2,343' Tc=28.0 min CN=36 Runoff=3.66 cfs 54,069 cf

Subcatchment E-3: Runoff Area=217,331 sf 0.00% Impervious Runoff Depth=0.29"
Flow Length=1,094' Tc=20.6 min CN=34 Runoff=0.27 cfs 5,313 cf

Link DP-1: Inflow=7.46 cfs 90,105 cf
Primary=7.46 cfs 90,105 cf

Link DP-2: Inflow=3.66 cfs 54,069 cf
Primary=3.66 cfs 54,069 cf

Link DP-3: Inflow=0.27 cfs 5,313 cf
Primary=0.27 cfs 5,313 cf

Total Runoff Area = 3,738,869 sf Runoff Volume = 149,488 cf Average Runoff Depth = 0.48"
99.97% Pervious = 3,737,789 sf 0.03% Impervious = 1,080 sf

Summary for Subcatchment E-1:

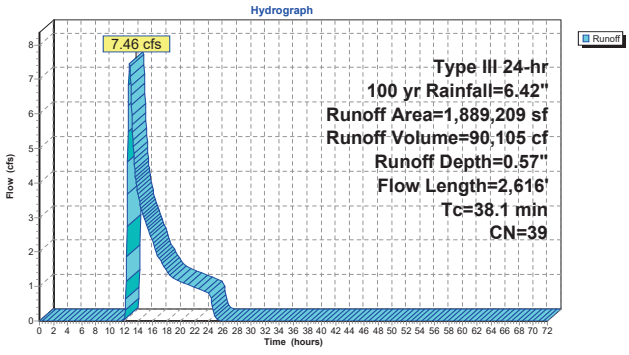
Runoff = 7.46 cfs @ 12.77 hrs, Volume= 90,105 cf, Depth= 0.57"
Routed to Link DP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.42"

Area (sf)	CN	Description
2,080	96	Gravel surface, HSG D
813	98	Roofs, HSG D
1,518,797	30	Woods, Good, HSG A
367,519	77	Woods, Good, HSG D
1,889,209	39	Weighted Average
1,888,396		99.96% Pervious Area
813		0.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	59	0.0550	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20" Using McCuen-Spiess flow length
1.1	189	0.0309	2.83		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.5	266	0.0382	0.98		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
5.0	577	0.1473	1.92		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.2	1,050	0.0704	1.33		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.9	475	0.1059	1.63		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
38.1	2,616	Total			

Subcatchment E-1:



Summary for Subcatchment E-2:

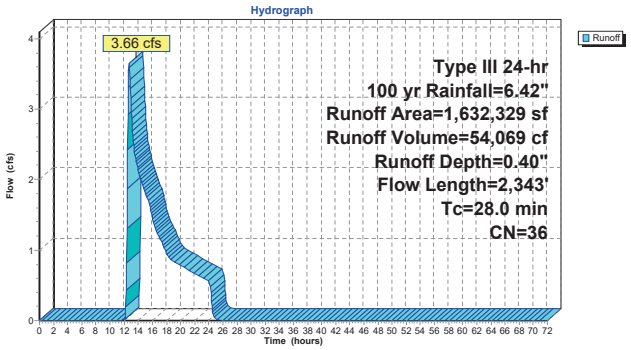
Runoff = 3.66 cfs @ 12.72 hrs, Volume= 54,069 cf, Depth= 0.40"
Routed to Link DP-2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.42"

Area (sf)	CN	Description
31,802	96	Gravel surface, HSG A
7,889	96	Gravel surface, HSG D
1,445,047	30	Woods, Good, HSG A
147,324	77	Woods, Good, HSG D
267	98	Roofs, HSG A
1,632,329	36	Weighted Average
1,632,062		99.98% Pervious Area
267		0.02% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	43	0.0298	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20" Using McCuen-Spiess flow length
1.3	93	0.0603	1.23		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.9	586	0.1605	2.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.6	878	0.0649	4.10		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.8	240	0.0792	1.41		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.9	213	0.1457	1.91		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.2	290	0.0535	1.16		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
28.0	2,343	Total			

Subcatchment E-2:



Summary for Subcatchment E-3:

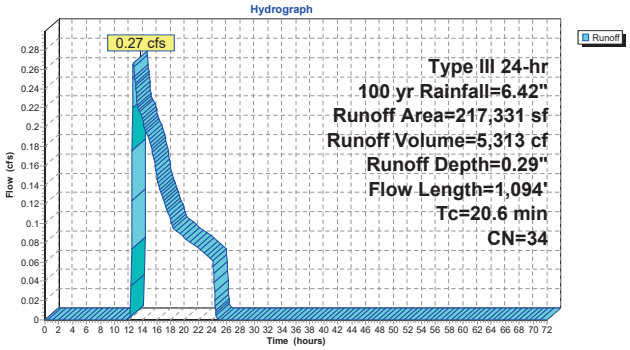
Runoff = 0.27 cfs @ 12.69 hrs, Volume= 5,313 cf, Depth= 0.29"
Routed to Link DP-3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.42"

Area (sf)	CN	Description
198,857	30	Woods, Good, HSG A
18,474	77	Woods, Good, HSG D
217,331	34	Weighted Average
217,331		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	48	0.0365	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20" Using McCuen-Spiess flow length
3.9	497	0.1850	2.15		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.3	549	0.0622	1.25		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
20.6	1,094	Total			

Subcatchment E-3:

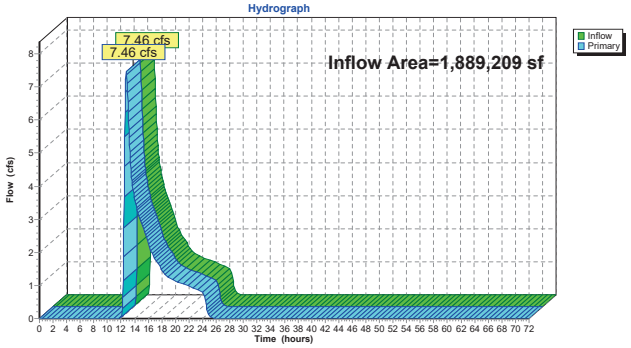


Summary for Link DP-1:

Inflow Area = 1,889,209 sf, 0.04% Impervious, Inflow Depth = 0.57" for 100 yr event
Inflow = 7.46 cfs @ 12.77 hrs, Volume= 90,105 cf
Primary = 7.46 cfs @ 12.77 hrs, Volume= 90,105 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-1:

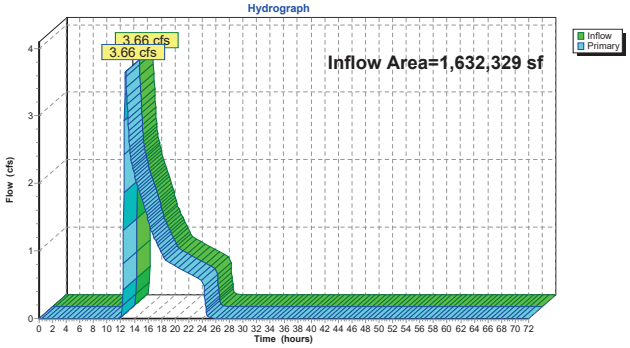


Summary for Link DP-2:

Inflow Area = 1,632,329 sf, 0.02% Impervious, Inflow Depth = 0.40" for 100 yr event
Inflow = 3.66 cfs @ 12.72 hrs, Volume= 54,069 cf
Primary = 3.66 cfs @ 12.72 hrs, Volume= 54,069 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-2:

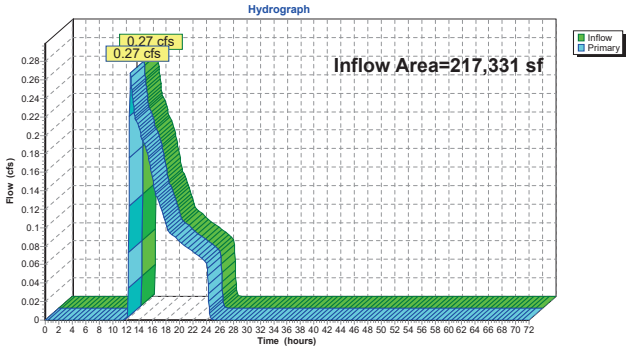


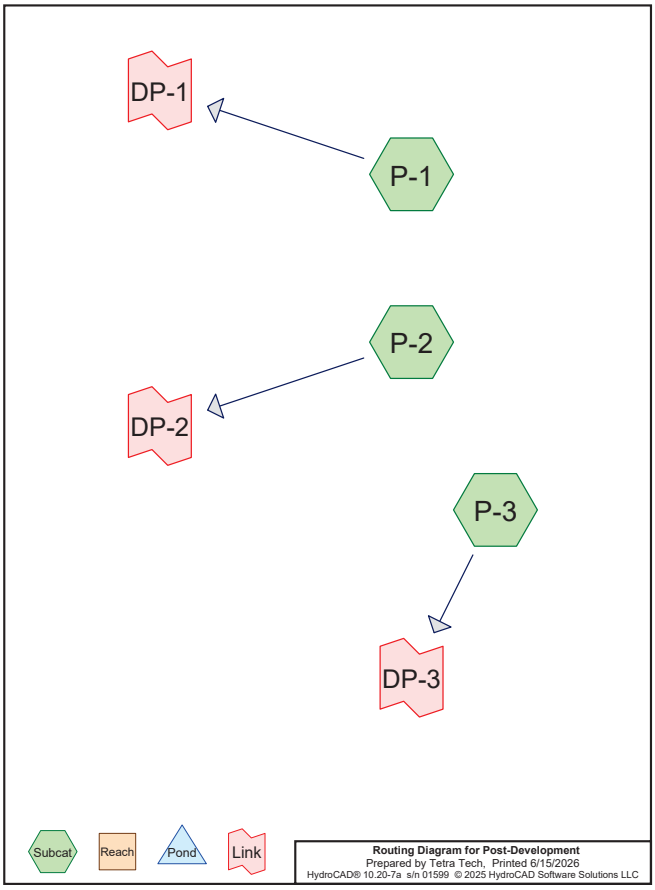
Summary for Link DP-3:

Inflow Area = 217,331 sf, 0.00% Impervious, Inflow Depth = 0.29" for 100 yr event
Inflow = 0.27 cfs @ 12.69 hrs, Volume= 5,313 cf
Primary = 0.27 cfs @ 12.69 hrs, Volume= 5,313 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-3:





Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
31,803	96	Gravel surface, HSG A (P-2)
9,969	96	Gravel surface, HSG D (P-1, P-2)
15,370	30	Limited Use Gravel Access Drive, Woods, Good, HSG A (P-1)
21,267	30	Limited Use Gravel Acess Drive, Woods, Good, HSG A (P-2)
1,402,069	30	Meadow, non-grazed, HSG A (P-1, P-2, P-3)
93	98	Roofs, HSG A (P-2)
813	98	Roofs, HSG D (P-1)
945	98	Unconnected pavement, HSG A (P-2)
1,723,223	30	Woods, Good, HSG A (P-1, P-2, P-3)
533,317	77	Woods, Good, HSG D (P-1, P-2, P-3)
3,738,869	**37**	**TOTAL AREA**

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment P-1: Runoff Area=1,889,209 sf 0.04% Impervious Runoff Depth=0.00"
Flow Length=2,616' Tc=41.7 min CN=39 Runoff=0.00 cfs 0 cf

Subcatchment P-2: Runoff Area=1,632,329 sf 0.06% Impervious Runoff Depth=0.00"
Flow Length=2,343' Tc=29.0 min CN=36 Runoff=0.00 cfs 0 cf

Subcatchment P-3: Runoff Area=217,331 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=1,094' Tc=20.6 min CN=34 Runoff=0.00 cfs 0 cf

Link DP-1: Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link DP-2: Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link DP-3: Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Total Runoff Area = 3,738,869 sf Runoff Volume = 0 cf Average Runoff Depth = 0.00"
99.95% Pervious = 3,737,018 sf 0.05% Impervious = 1,851 sf

Summary for Subcatchment P-1:

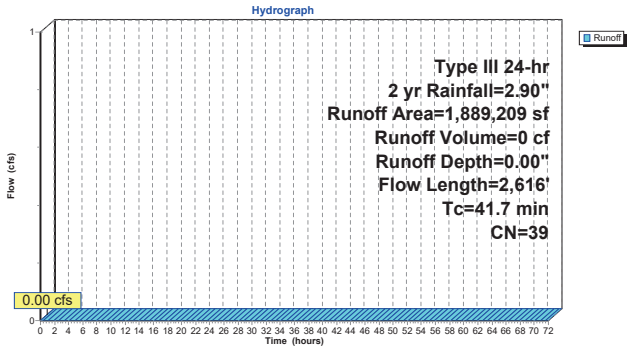
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Link DP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=2.90"

	Area (sf)	CN	Description
	2,080	96	Gravel surface, HSG D
*	15,370	30	Limited Use Gravel Access Drive, Woods, Good, HSG A
	813	98	Roofs, HSG D
	746,941	30	Woods, Good, HSG A
	367,519	77	Woods, Good, HSG D
	756,486	30	Meadow, non-grazed, HSG A
	1,889,209	39	Weighted Average
	1,888,396		99.96% Pervious Area
	813		0.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	59	0.0550	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20" Using McCuen-Spiess flow length
1.1	189	0.0309	2.83		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.5	266	0.0382	0.98		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.9	563	0.1476	1.92		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.3	748	0.0766	1.11		**Shallow Concentrated Flow, Dense Meadow** Kv= 4.0 fps
0.1	16	0.0681	4.20		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.2	593	0.0911	1.21		**Shallow Concentrated Flow, Dense Meadow** Kv= 4.0 fps
2.2	182	0.0755	1.37		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
41.7	2,616	Total			

Subcatchment P-1:



Summary for Subcatchment P-2:

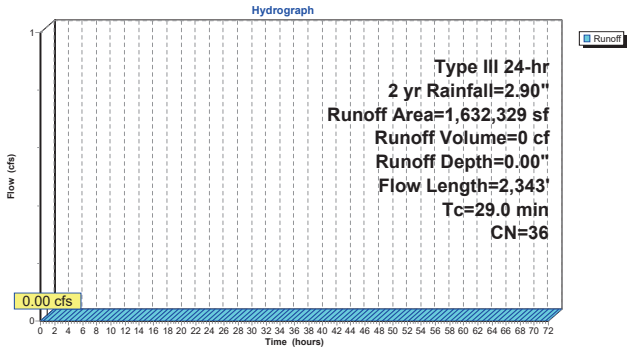
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Link DP-2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=2.90"

	Area (sf)	CN	Description
	31,803	96	Gravel surface, HSG A
	7,889	96	Gravel surface, HSG D
*	21,267	30	Limited Use Gravel Acess Drive, Woods, Good, HSG A
	778,733	30	Woods, Good, HSG A
	147,324	77	Woods, Good, HSG D
	93	98	Roofs, HSG A
	945	98	Unconnected pavement, HSG A
	644,275	30	Meadow, non-grazed, HSG A
	1,632,329	36	Weighted Average
	1,631,291		99.94% Pervious Area
	1,038		0.06% Impervious Area
	945		91.04% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	43	0.0298	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20" Using McCuen-Spiess flow length
1.3	93	0.0603	1.23		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.1	512	0.1753	2.09		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.3	74	0.0571	0.96		**Shallow Concentrated Flow, Dense Meadow** Kv= 4.0 fps
3.6	878	0.0649	4.10		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	56	0.0721	1.07		**Shallow Concentrated Flow, Dense Meadow** Kv= 4.0 fps
0.1	17	0.0676	4.19		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.9	309	0.1112	1.33		**Shallow Concentrated Flow, Dense Meadow** Kv= 4.0 fps
4.5	361	0.0719	1.34		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
29.0	2,343	Total			

Subcatchment P-2:



Summary for Subcatchment P-3:

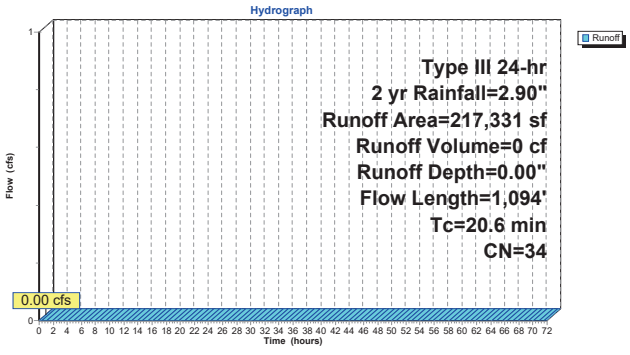
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Link DP-3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=2.90"

Area (sf)	CN	Description
197,549	30	Woods, Good, HSG A
18,474	77	Woods, Good, HSG D
1,308	30	Meadow, non-grazed, HSG A
217,331	34	Weighted Average
217,331		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	48	0.0365	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20" Using McCuen-Spiess flow length
3.9	497	0.1850	2.15		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.3	549	0.0622	1.25		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
20.6	1,094	Total			

Subcatchment P-3:

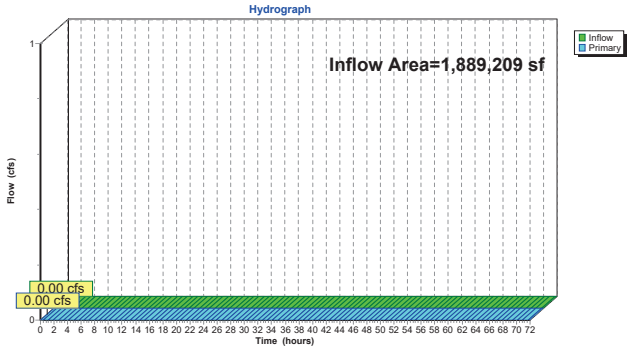


Summary for Link DP-1:

Inflow Area = 1,889,209 sf, 0.04% Impervious, Inflow Depth = 0.00" for 2 yr event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-1:

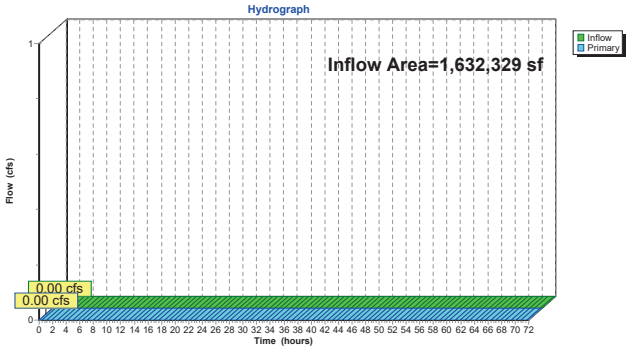


Summary for Link DP-2:

Inflow Area = 1,632,329 sf, 0.06% Impervious, Inflow Depth = 0.00" for 2 yr event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-2:

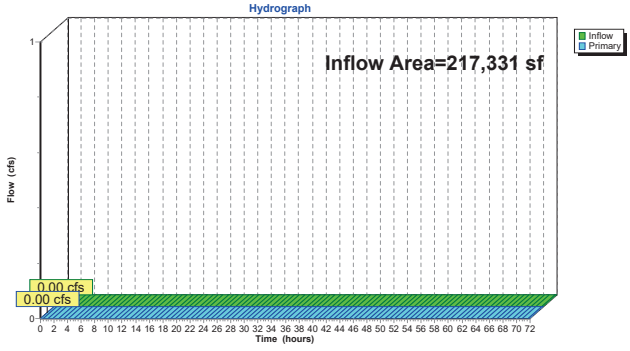


Summary for Link DP-3:

Inflow Area = 217,331 sf, 0.00% Impervious, Inflow Depth = 0.00" for 2 yr event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-3:



Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment P-1: Runoff Area=1,889,209 sf 0.04% Impervious Runoff Depth=0.10"
Flow Length=2,616' Tc=41.7 min CN=39 Runoff=0.59 cfs 16,215 cf

Subcatchment P-2: Runoff Area=1,632,329 sf 0.06% Impervious Runoff Depth=0.04"
Flow Length=2,343' Tc=29.0 min CN=36 Runoff=0.19 cfs 5,828 cf

Subcatchment P-3: Runoff Area=217,331 sf 0.00% Impervious Runoff Depth=0.02"
Flow Length=1,094' Tc=20.6 min CN=34 Runoff=0.01 cfs 292 cf

Link DP-1: Inflow=0.59 cfs 16,215 cf
Primary=0.59 cfs 16,215 cf

Link DP-2: Inflow=0.19 cfs 5,828 cf
Primary=0.19 cfs 5,828 cf

Link DP-3: Inflow=0.01 cfs 292 cf
Primary=0.01 cfs 292 cf

Total Runoff Area = 3,738,869 sf Runoff Volume = 22,336 cf Average Runoff Depth = 0.07"
99.95% Pervious = 3,737,018 sf 0.05% Impervious = 1,851 sf

Summary for Subcatchment P-1:

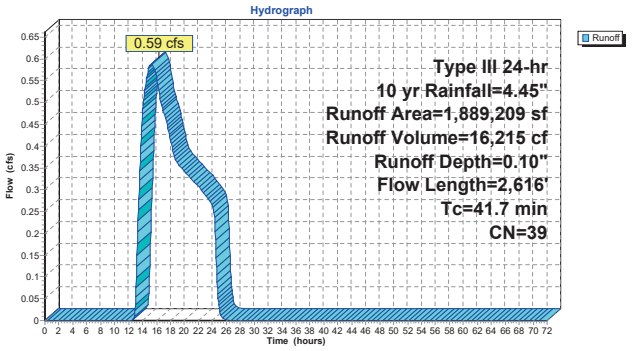
Runoff = 0.59 cfs @ 15.34 hrs, Volume= 16,215 cf, Depth= 0.10"
Routed to Link DP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.45"

	Area (sf)	CN	Description
	2,080	96	Gravel surface, HSG D
*	15,370	30	Limited Use Gravel Access Drive, Woods, Good, HSG A
	813	98	Roofs, HSG D
	746,941	30	Woods, Good, HSG A
	367,519	77	Woods, Good, HSG D
	756,486	30	Meadow, non-grazed, HSG A
	1,889,209	39	Weighted Average
	1,888,396		99.96% Pervious Area
	813		0.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	59	0.0550	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20" Using McCuen-Spiess flow length
1.1	189	0.0309	2.83		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.5	266	0.0382	0.98		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.9	563	0.1476	1.92		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.3	748	0.0766	1.11		**Shallow Concentrated Flow, Dense Meadow** Kv= 4.0 fps
0.1	16	0.0681	4.20		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.2	593	0.0911	1.21		**Shallow Concentrated Flow, Dense Meadow** Kv= 4.0 fps
2.2	182	0.0755	1.37		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
41.7	2,616	Total			

Subcatchment P-1:



Summary for Subcatchment P-2:

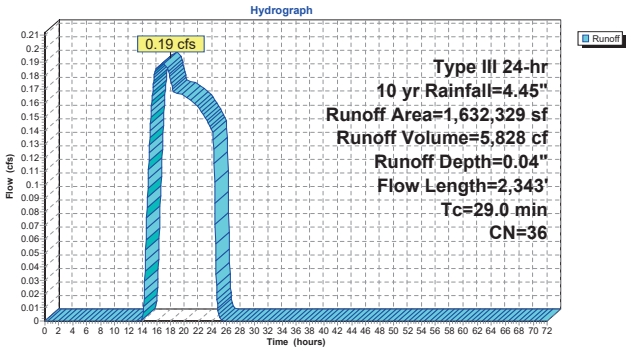
Runoff = 0.19 cfs @ 17.04 hrs, Volume= 5,828 cf, Depth= 0.04"
Routed to Link DP-2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.45"

	Area (sf)	CN	Description
	31,803	96	Gravel surface, HSG A
	7,889	96	Gravel surface, HSG D
*	21,267	30	Limited Use Gravel Acess Drive, Woods, Good, HSG A
	778,733	30	Woods, Good, HSG A
	147,324	77	Woods, Good, HSG D
	93	98	Roofs, HSG A
	945	98	Unconnected pavement, HSG A
	644,275	30	Meadow, non-grazed, HSG A
	1,632,329	36	Weighted Average
	1,631,291		99.94% Pervious Area
	1,038		0.06% Impervious Area
	945		91.04% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	43	0.0298	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20" Using McCuen-Spiess flow length
1.3	93	0.0603	1.23		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.1	512	0.1753	2.09		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.3	74	0.0571	0.96		**Shallow Concentrated Flow, Dense Meadow** Kv= 4.0 fps
3.6	878	0.0649	4.10		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	56	0.0721	1.07		**Shallow Concentrated Flow, Dense Meadow** Kv= 4.0 fps
0.1	17	0.0676	4.19		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.9	309	0.1112	1.33		**Shallow Concentrated Flow, Dense Meadow** Kv= 4.0 fps
4.5	361	0.0719	1.34		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
29.0	2,343	Total			

Subcatchment P-2:



Summary for Subcatchment P-3:

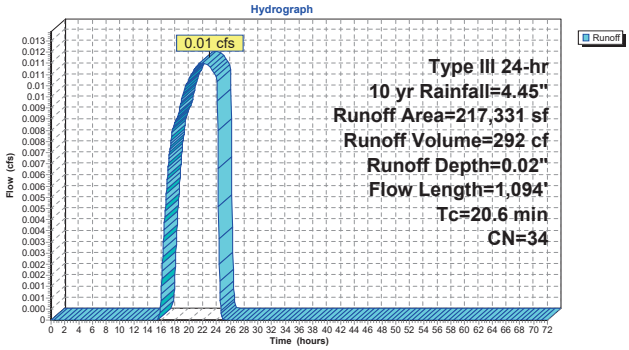
Runoff = 0.01 cfs @ 22.05 hrs, Volume= 292 cf, Depth= 0.02"
Routed to Link DP-3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.45"

Area (sf)	CN	Description
197,549	30	Woods, Good, HSG A
18,474	77	Woods, Good, HSG D
1,308	30	Meadow, non-grazed, HSG A
217,331	34	Weighted Average
217,331		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	48	0.0365	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20" Using McCuen-Spiess flow length
3.9	497	0.1850	2.15		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.3	549	0.0622	1.25		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
20.6	1,094	Total			

Subcatchment P-3:

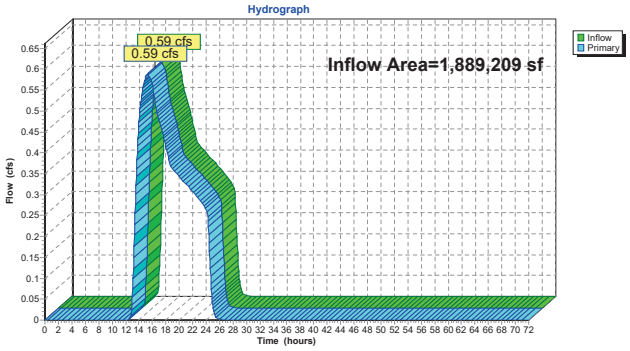


Summary for Link DP-1:

Inflow Area = 1,889,209 sf, 0.04% Impervious, Inflow Depth = 0.10" for 10 yr event
Inflow = 0.59 cfs @ 15.34 hrs, Volume= 16,215 cf
Primary = 0.59 cfs @ 15.34 hrs, Volume= 16,215 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-1:

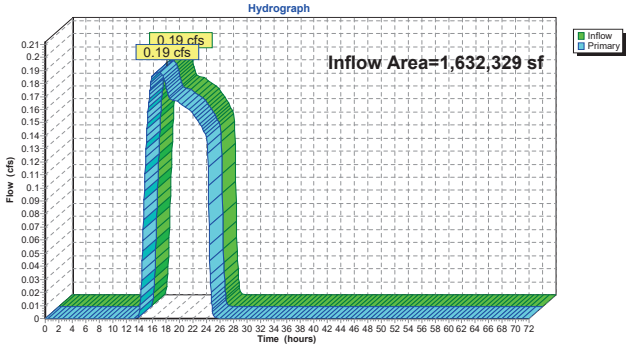


Summary for Link DP-2:

Inflow Area = 1,632,329 sf, 0.06% Impervious, Inflow Depth = 0.04" for 10 yr event
Inflow = 0.19 cfs @ 17.04 hrs, Volume= 5,828 cf
Primary = 0.19 cfs @ 17.04 hrs, Volume= 5,828 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-2:

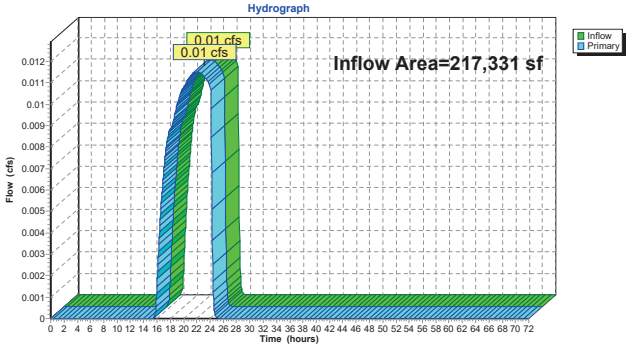


Summary for Link DP-3:

Inflow Area = 217,331 sf, 0.00% Impervious, Inflow Depth = 0.02" for 10 yr event
Inflow = 0.01 cfs @ 22.05 hrs, Volume= 292 cf
Primary = 0.01 cfs @ 22.05 hrs, Volume= 292 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-3:



Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment P-1: Runoff Area=1,889,209 sf 0.04% Impervious Runoff Depth=0.57"
Flow Length=2,616' Tc=41.7 min CN=39 Runoff=7.14 cfs 90,105 cf

Subcatchment P-2: Runoff Area=1,632,329 sf 0.06% Impervious Runoff Depth=0.40"
Flow Length=2,343' Tc=29.0 min CN=36 Runoff=3.60 cfs 54,069 cf

Subcatchment P-3: Runoff Area=217,331 sf 0.00% Impervious Runoff Depth=0.29"
Flow Length=1,094' Tc=20.6 min CN=34 Runoff=0.27 cfs 5,313 cf

Link DP-1: Inflow=7.14 cfs 90,105 cf
Primary=7.14 cfs 90,105 cf

Link DP-2: Inflow=3.60 cfs 54,069 cf
Primary=3.60 cfs 54,069 cf

Link DP-3: Inflow=0.27 cfs 5,313 cf
Primary=0.27 cfs 5,313 cf

Total Runoff Area = 3,738,869 sf Runoff Volume = 149,488 cf Average Runoff Depth = 0.48"
99.95% Pervious = 3,737,018 sf 0.05% Impervious = 1,851 sf

Summary for Subcatchment P-1:

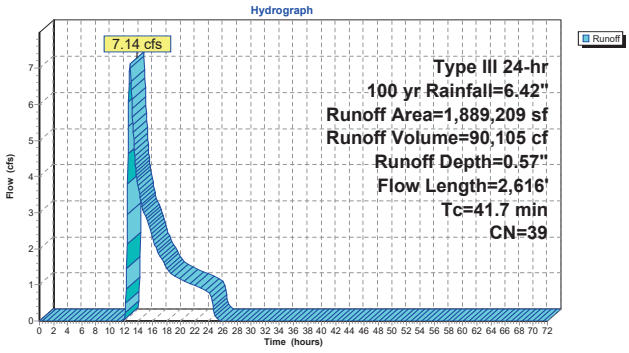
Runoff = 7.14 cfs @ 12.84 hrs, Volume= 90,105 cf, Depth= 0.57"
Routed to Link DP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.42"

	Area (sf)	CN	Description
	2,080	96	Gravel surface, HSG D
*	15,370	30	Limited Use Gravel Access Drive, Woods, Good, HSG A
	813	98	Roofs, HSG D
	746,941	30	Woods, Good, HSG A
	367,519	77	Woods, Good, HSG D
	756,486	30	Meadow, non-grazed, HSG A
	1,889,209	39	Weighted Average
	1,888,396		99.96% Pervious Area
	813		0.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	59	0.0550	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20" Using McCuen-Spiess flow length
1.1	189	0.0309	2.83		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.5	266	0.0382	0.98		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.9	563	0.1476	1.92		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.3	748	0.0766	1.11		**Shallow Concentrated Flow, Dense Meadow** Kv= 4.0 fps
0.1	16	0.0681	4.20		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.2	593	0.0911	1.21		**Shallow Concentrated Flow, Dense Meadow** Kv= 4.0 fps
2.2	182	0.0755	1.37		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
41.7	2,616	Total			

Subcatchment P-1:



Summary for Subcatchment P-2:

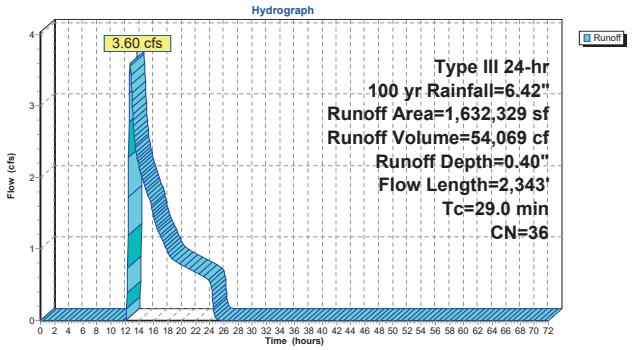
Runoff = 3.60 cfs @ 12.73 hrs, Volume= 54,069 cf, Depth= 0.40"
Routed to Link DP-2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.42"

	Area (sf)	CN	Description
	31,803	96	Gravel surface, HSG A
	7,889	96	Gravel surface, HSG D
*	21,267	30	Limited Use Gravel Acess Drive, Woods, Good, HSG A
	778,733	30	Woods, Good, HSG A
	147,324	77	Woods, Good, HSG D
	93	98	Roofs, HSG A
	945	98	Unconnected pavement, HSG A
	644,275	30	Meadow, non-grazed, HSG A
	1,632,329	36	Weighted Average
	1,631,291		99.94% Pervious Area
	1,038		0.06% Impervious Area
	945		91.04% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	43	0.0298	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20" Using McCuen-Spiess flow length
1.3	93	0.0603	1.23		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.1	512	0.1753	2.09		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.3	74	0.0571	0.96		**Shallow Concentrated Flow, Dense Meadow** Kv= 4.0 fps
3.6	878	0.0649	4.10		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.9	56	0.0721	1.07		**Shallow Concentrated Flow, Dense Meadow** Kv= 4.0 fps
0.1	17	0.0676	4.19		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.9	309	0.1112	1.33		**Shallow Concentrated Flow, Dense Meadow** Kv= 4.0 fps
4.5	361	0.0719	1.34		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
29.0	2,343	Total			

Subcatchment P-2:



Summary for Subcatchment P-3:

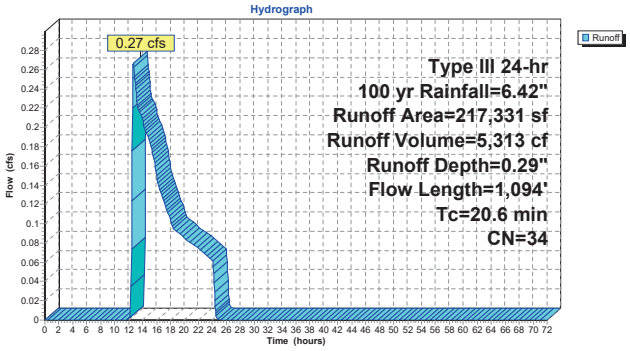
Runoff = 0.27 cfs @ 12.69 hrs, Volume= 5,313 cf, Depth= 0.29"
Routed to Link DP-3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=6.42"

Area (sf)	CN	Description
197,549	30	Woods, Good, HSG A
18,474	77	Woods, Good, HSG D
1,308	30	Meadow, non-grazed, HSG A
217,331	34	Weighted Average
217,331		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	48	0.0365	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20" Using McCuen-Spiess flow length
3.9	497	0.1850	2.15		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.3	549	0.0622	1.25		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
20.6	1,094	Total			

Subcatchment P-3:

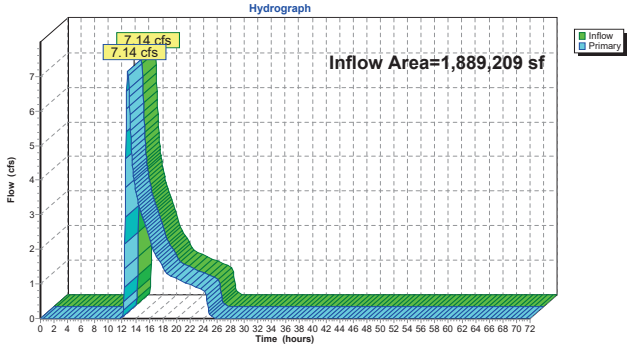


Summary for Link DP-1:

Inflow Area = 1,889,209 sf, 0.04% Impervious, Inflow Depth = 0.57" for 100 yr event
Inflow = 7.14 cfs @ 12.84 hrs, Volume= 90,105 cf
Primary = 7.14 cfs @ 12.84 hrs, Volume= 90,105 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-1:

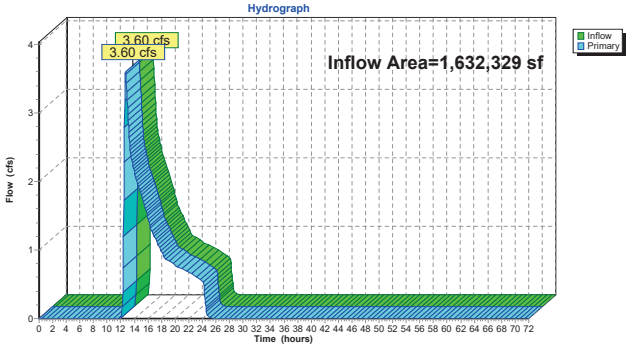


Summary for Link DP-2:

Inflow Area = 1,632,329 sf, 0.06% Impervious, Inflow Depth = 0.40" for 100 yr event
Inflow = 3.60 cfs @ 12.73 hrs, Volume= 54,069 cf
Primary = 3.60 cfs @ 12.73 hrs, Volume= 54,069 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-2:

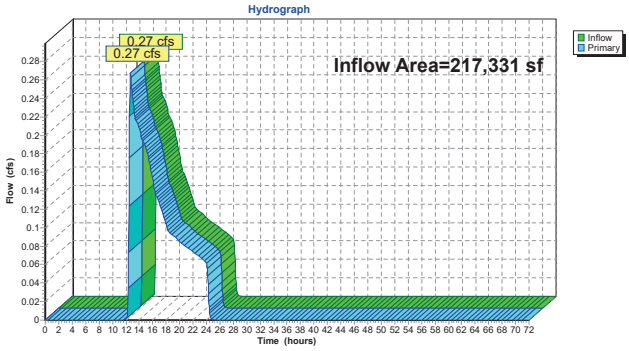


Summary for Link DP-3:

Inflow Area = 217,331 sf, 0.00% Impervious, Inflow Depth = 0.29" for 100 yr event
Inflow = 0.27 cfs @ 12.69 hrs, Volume= 5,313 cf
Primary = 0.27 cfs @ 12.69 hrs, Volume= 5,313 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-3:



Appendix D
Stormwater Recharge Calculations

TETRA TECH

Standard 3 – Stormwater Recharge Calculations

Impervious Area

Equipment Pads for Electrical Equipment

Total Area = 945 ft^2

Required Recharge Volume

R_V = F x (Impervious Area)

R_V = Required Recharge Volume (ft^3)

F = Targe Depth Factor [HSG of A] => F = 0.6-inch

R_V = [(0.6-inch/12-inch) x (1 ft/1-inch)] x (945 ft^2)

R_V = 47.25 ft^3

Required Recharge Volume

Infiltration Trench: 1.5 ft deep, 2.0 ft wide, 104 ft long => (1.5 ft) x (2.0 ft) x (104 ft)

Infiltration Trench = 312 ft^3

Volume => 40% Voids => (312 ft^3) x (0.40)

Infiltration Trench Storage Volume = 124.8 ft^3

124.8 ft^3 > R_V of 47.25 ft^3

Infrastructure Northeast
Marlborough Technology Park, 100 Nickerson Road, Marlborough, MA 01752
Tel 508.786.2200 Fax 508.786.2201 tetratech.com

Standard 3 - Stormwater Recharge Calculations

Impervious Area

Equipment Pads for Electrical Equipment
total area = 945 square feet.

Required Recharge Volume

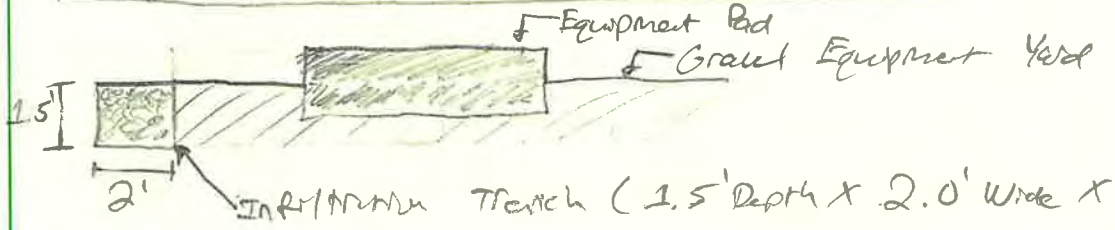
$R_v = F \cdot (\text{Impervious Area})$

R_v = Required Recharge Volume (ft^3)
F = Target Depth Factor [HSG of A] => F = 0.6-inch

$R_v = (0.6\text{-in}/12) \cdot (945 ft^2)$

$\boxed{R_v = 47.25 ft^3}$

Proposed Infiltration Trench



Infiltration Trench = $312 ft^3$

Volume => 40% Voids => $(312 ft^3)(0.40)$

$\boxed{\text{Infiltration Trench Storage Volume} = 124.8 ft^3}$

$\boxed{124.8 ft^3 > R_v \text{ of } 47.25 ft^3}$ ✓

TOPS

Appendix E

Long-Term Pollution Prevention Plan and Stormwater Operation & Maintenance Plan

Long-Term Pollution Prevention and Stormwater Operation & Maintenance Plan

Tower Road Solar Project
Tower Road
Pelham, MA 01002

Prepared for:

ASD Tower MA Solar LLC
518 17th Street, Suite 950
Denver, CO 80202

Prepared by:

Tetra Tech, Inc.
100 Nickerson Road
Marlborough, MA 01752



TETRA TECH

June 2026

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Appendix A – Inspection and Maintenance Log Form

1.0 INTRODUCTION

The Long-Term Pollution Prevention (LTPP) and Stormwater Operation and Maintenance (O&M) Plan shall be implemented at the ASD Tower MA Solar Project located at Tower Road in Pelham, Massachusetts to ensure long-term functioning of the stormwater management system (System), and to provide suitable practices for source control of pollutants.

The System has been designed in accordance with the ten (10) MassDEP Stormwater Management Standards as outlined in the Massachusetts Stormwater Handbook. Preventative maintenance of the System is essential in the protection of the Stormwater Management Standards.

1.1 RESPONSIBLE PARTY

The Owner possesses the primary responsibility for overseeing and implementing the LTPP and Stormwater O&M Plan. When necessary, the Owner shall designate responsibility to a professional engineer or other technical professional with expertise and experience with stormwater management facilities for the proper operation and maintenance of the System.

Operator Name and Address:
ASD Tower MA Solar, LLC
518 17th Street, Suite 950
Denver, CO 80202

1.2 DOCUMENTATION

An Inspection and Maintenance Log and Schedule shall be kept by the Owner or designated responsible party summarizing inspections, maintenance, repairs, and any corrective actions taken. At a minimum, the Inspection and Maintenance Log Forms shall include the date on which each inspection or maintenance task was performed, date and the amount of the last storm event more than 0.1 inches of rain in a 24-hour period, a description of the inspection findings or maintenance completed, and the name of the inspector or maintenance personnel performing the task.

1.3 REFERENCES

The LTPP and Stormwater O&M Plan references the following documents:

Plans:
Plans for ASD Tower MA Solar Project dated June 2026 (or as amended), prepared by Tetra Tech, Inc.

Stormwater Management Report:
Stormwater Management Report for ASD Tower MA Solar Project dated June 2026 (or as amended), prepared by Tetra Tech, Inc.

2.0 OPERATIONS AND MAINTENANCE PROGRAM

The Owner or designated responsible party shall conduct the Stormwater O&M Program set forth in this document, ensure that inspections and record keeping are timely and accurate, and that maintenance is

performed in accordance with the recommended frequency for each System component. The Owner or designated responsible party shall also maintain all System components to function as they were designed to. Estimated annual cost of the Stormwater O&M Program is $2,500.

Inspection and Maintenance Log Forms shall include the date on which each inspection or maintenance task was performed, date and the amount of the last storm event more than 0.1 inches of rain in a 24-hour period, a description of the inspection findings or maintenance completed, and the name of the inspector or maintenance personnel performing the task. Inspection findings shall include items such as physical conditions of the System components, depth of sediment in structures, evidence of overtopping or debris blockage, and maintenance required for each System component. Refer to Appendix A, Inspection and Maintenance Log Form for a sample form.

2.1 INSPECTION AND MAINTENANCE FREQUENCY AND CORRECTIVE ACTIONS

The following areas and System components shall be inspected by the Owner or designated responsible party and maintained as specified below. The inspection and maintenance frequencies described below may be adjusted based on results gathered during inspections. Any adjustments to the below-mentioned inspection and maintenance schedule shall be relayed to the proper authorities having jurisdiction to ensure any reporting requirements are met.

Any identified deficiencies to the following areas and System components shall be corrected upon discovery. Accumulated sediments and debris shall be properly handled and disposed of in accordance with local, state, and federal guidelines and regulations.

2.1.1 Vegetation

Vegetated areas shall be inspected early in the growing season or after heavy rainfall to identify active or potential erosion problems including, but not limited to, checking for bare areas, areas with sparse growth, or signs of erosion. Reseed bare areas or areas with sparse growth. Where erosion is evident, armor area or redirect erosive flows to other on-site areas able to withstand flow.

Areas outside the fenced enclosure shall be allowed to develop into a brush condition with only limited maintenance as needed to prevent shading of the array. Areas within the fenced enclosure shall be maintained as a pollinator meadow and mowed only as needed to maintain system function and site safety.

2.1.2 Mowing

Twice-yearly mowing, or as required by the Owner to ensure vegetative growth does not inhibit access to or function of the solar facility, shall be conducted with grass cut to an adequate height to maintain a healthy and full vegetative cover within the Project's operational limits.

2.1.3 Gravel Access Route

Gravel access routes shall be inspected twice yearly to identify active or potential erosion problems. Inspection shall include checking for signs of erosion. Common corrective actions include restabilizing eroded areas, or if reoccurring erosion is evident armoring the area with larger stone.

2.1.4 Infiltration Trench

Infiltration trench shall be inspected twice yearly and after major storm events to identify sediment buildup, clogging, or standing water. Inspection shall include checking overall system condition and evidence of reduced infiltration. Common corrective actions include removal of accumulated sediment and restoration of the infiltration surface to maintain proper system function.

3.0 PRACTICES FOR LONG-TERM POLLUTION PREVENTION

The Owner or designated responsible party shall implement the LTPP practices set forth in this document.

3.1 GOOD HOUSEKEEPING MEASURES

The Owner or designated responsible party shall implement the following good housekeeping measures to ensure long-term pollution prevention and provide suitable practices for source control of pollutants.

3.1.1 Snow Management Guidelines

Snow shall not be dumped directly into water bodies, wetlands, or surrounding buffer zones. Snow pile sites shall be in areas with relatively level slopes with stabilized groundcover, and a linear sedimentation control barrier shall be placed securely on the downgradient side of a snow pile. At the end of the snow season, debris and accumulated sediment shall be cleared from the snow pile site and properly disposed of in accordance with local, state, and federal guidelines and regulations.

3.1.2 Routine Inspection and Maintenance

Conduct inspection and maintenance in accordance with the Stormwater O&M Program discussed above.

3.1.3 Maintenance of Vegetation

Twice-yearly mowing, or as needed, shall be conducted with grass cut to an adequate height to maintain a healthy and full vegetative cover within the Project's operational limits. Bare areas, areas of sparse growth, and signs of erosion shall be addressed in accordance with the Stormwater O&M Program discussed above.

3.1.4 Maintenance of Gravel Access Route

Signs of erosion shall be addressed in accordance with the Stormwater O&M Program discussed above.

3.1.5 Prohibition of Illicit Discharges

Illicit discharges are discharges that do not entirely consist of stormwater, except for certain specified non-stormwater discharges. There are no known or proposed illicit connections associated with the Project, however if a potential illicit discharge is detected it shall be investigated to determine the nature and source of the discharge, and if required action shall be taken to eliminate the illicit discharge.

Appendix A

Inspection and Maintenance Log Form

ASD Tower MA Solar Project
Tower Road, Pelham, Massachusetts

SAMPLE Inspection and Maintenance Log Form

Inspector or Maintenance Personnel Name: _____ Date: _____

☐ Routine ☐ Response to Rainfall Event (_____ inches) ☐ Other (describe) _____

Project Areas and System Components	Required Inspection Frequency	Maintenance Frequency	Comments	Follow-up Action Required (Yes / No)
Vegetation	Annually; Early in the growing season	As Needed		
Mowing	Twice Yearly	As Needed		
Gravel Access Route	Twice Yearly	As Needed		
Infiltration Trench	Twice Yearly	As Needed		

Appendix F

Illicit Discharge Compliance Statement

TETRA TECH

ILLICIT DISCHARGE COMPLIANCE STATEMENT

Owner: ASD Tower MA Solar LLC
518 17th Street, Suite 950
Denver, CO 80202

Site Address: Tower Road
Pelham, MA 01002

Date: June 30, 2026

This statement is provided in accordance with the provisions of Massachusetts Stormwater Management Standards (the Standards), Standard 10, and the Massachusetts Stormwater Handbook.

To the best of my knowledge, no illicit discharges exist on the Project Site and no illicit discharges are proposed as part of the Project. The facility's Operation & Maintenance Plans are designed to prevent non-stormwater discharge to on-site stormwater Best Management Practices. Any illicit discharges identified during or after construction will be immediately disconnected in accordance with the Standards.

Signed:

Sean P. Reardon, P.E.
Vice President

Marlborough Technology Park
100 Nickerson Road, Marlborough, MA 01752
Tel 508.786.2200 Fax 508.786.2201 tetratech.com