REVIEW DRAFT

Solar Resource and Infrastructure Assessment

for

the Town of Westhampton

June 30, 2020

Prepared by

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Clean Energy Extension

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Executive Summary

This report is a solar resource and infrastructure assessment for the town of Westhampton, Massachusetts. The assessment was funded through the National Renewable Energy Laboratory, Solar Energy Innovation Network (NREL SEIN) Solar in Rural Communities Program, as part of a project to develop a Community-Informed Proactive Solar Siting and Financing Model. As a first step, the project lead organization, UMass Clean Energy Extension prepared an assessment of existing infrastructure, resources, and potential solar development opportunities in participating municipalities, including Westhampton. This assessment was designed to describe relevant bylaws and infrastructure within the town, identify the types of solar facilities that could be developed, and quantify the total space available for each type of facility.

In this report, we reviewed existing electricity grid infrastructure, and the potential to interconnect additional solar facilities. At the present time, both distribution lines providing electricity to Westhampton are over-saturated with authorized and proposed solar projects, and cannot accommodate additional solar projects to interconnect to the grid. Future upgrades could potentially free up additional capacity for new, large projects. Meanwhile, most three-phase lines could likely accommodate additional small-to-medium scale projects (under 200 kW), and most single-phase lines could likely accommodate additional projects under 50 kW in size. This description represents the local grid infrastructure as it is – planning for future scenarios of development could include recommendations for areas of grid infrastructure improvement to allow siting of distributed generation in locations preferred by the community. Future scenarios may also include the addition energy storage and other "non-wires alternatives."

Potential sites to consider for solar arrays coupled with energy storage systems include Hampshire Regional High School, Westhampton Elementary School, and the Westhampton Woods Senior Housing Complex. Other potential sites for solar identified in this report include the municipal landfill and adjacent Highway Garage, the Public Safety Complex roof and paved area, and any inactive gravel pits in town. There is also significant potential for additional solar arrays on residential rooftops and properties, businesses, and farms.

Depending on the restrictions imposed, there are still a number of large parcels in Westhampton which could be appropriate for large-scale, commercial development of solar. Given the extent of forest land cover throughout the town, however, it may be difficult to identify sites where large arrays could be built without significant clearing of trees, or replacement of agricultural production.

A summary of solar technical potential for different site types is provided in Section 5.8 of this document.

This draft report will be made available to NREL SEIN and the full project team for feedback and revision, before a final public version of the document is issued.

Terminology

The following terms, abbreviations, and acronyms are used in this report.

Terms

Photovoltaic, or "PV," systems are solar arrays composed of panels that generate electricity from sunlight. These panels are a different type of technology than the types of panels used in "solar hot water" or "solar thermal" systems.

Voltage of an electric power line can be thought of as the equivalent of pressure in a water line. The voltage of transmission and distribution power lines is typically measured in kilo-volts (kV). One kilo-volt is equivalent to 1000 volts (V). In residential use in the United States, electrical wires within a household carry electricity at 120 V.

Capacity of a solar array is a description of the instantaneous power output of the panels at top production (i.e, in full sun). It is typically measured in kilowatts (kW) or megawatts (MW). A residential-size solar system is typically 5-10 kW in capacity. Commercial-scale solar arrays are typically 1 MW or greater in size. An average 1 MW array would cover approximately 4-5 acres of land.

Annual generation of a solar array is a measure of the yearly energy output produced by the panels. It is typically measured in kilowatt-hours (kWh) or megawatt-hours (MWh). In New England, annual generation is approximately equal to the array's capacity (in DC) *14% * 8760 hours per year.

DC is the abbreviation for direct current, the type of electricity produced by solar panels. The DC capacity of a solar array is a good indication of its size, and footprint on the landscape.

AC is the abbreviation for alternating current, the type of electricity flowing into the grid from a solar array, after it has gone through a transformer. In the absence of energy storage, a typical DC to AC ratio for solar array capacity is about 1.25:1. However, with energy storage, that ratio can be significantly higher (close to 2:1), since excess electricity can be stored in batteries during the day, and released into the grid during the night, when the panels are not generating electricity.

Solar facility size terms used in this report are in line with current state solar incentive program categories (not with municipal bylaws). That is:

- **Small** systems are 25 kW or less.
- **Medium** systems are 25-500 kW.
- **Large** systems are over 500 kW (0.5 MW) in size.

SMART is the abbreviation for the current state solar energy incentive program (the Solar Massachusetts Renewable Target program). This program replaced earlier solar incentive programs, commonly known as "SREC" programs, in November of 2018, and was further updated through an emergency regulation in April 2020. The SMART regulation includes incentives for projects up to 5 MW AC in size. Additional incentives are available for projects located on buildings, parking lot canopies, landfills, brownfields, and "dual-use" solar and agriculture projects, as well as certain types of projects that benefit public entities, like municipalities. The updated regulation places restrictions on what types of large, ground-mounted projects can receive incentives, if they are sited on undeveloped land designated as BioMap2 Critical Natural Landscapes or Core Habitat, by the state MassWildlife Natural Heritage and Endangered Species Program.

Abbreviations & Acronyms

CEE - UMass Clean Energy Extension
DOER - Massachusetts Department of Energy Resources
FRCOG - Franklin County Regional Council of Governments, the regional planning authority for Franklin County, MA
kV - kilo-volt
kW - kilowatt
kWh - kilowatt-hour
MDAR - Massachusetts Department of Agricultural Resources
MVP - Municipal Vulnerability Preparedness plan, a municipal planning document
MW - megawatt
MWh - megawatt-hour
NREL - National Renewable Energy Laboratory
OSRP - Open Space and Recreation Plan, a municipal planning document
PV – photovoltaic, the type of solar panels that generate electricity from sunlight
PVPC - Pioneer Valley Planning Commission, the regional planning authority for Hampden and Hampshire Counties, MA
SEIN - Solar Energy Innovation Network, a program of the National Renewable Energy Laboratory
sf - square feet

1. INTRODUCTION

This report is a solar resource and infrastructure assessment for the town of Westhampton. Westhampton is a small, rural community located in the foothills along the western edge of the Connecticut River Valley in Hampshire County, Massachusetts. The town has a total land area of 17,530 acres (27.4 square miles). Estimates based on the 2010 census would suggest the town currently has a population of approximately 1,825 residents, living in a total of 760 households. Westhampton became a designated Green Community in 2018, joining other municipalities across the state in setting ambitious goals for energy use reduction and encouraging renewable energy development[1].

This assessment was funded through the National Renewable Energy Laboratory Solar Energy Innovation Network (NREL SEIN) Solar in Rural Communities Program, as part of a project to develop a Community-Informed Proactive Solar Siting and Financing Model. The overall goals of the project include development of actionable, site-specific solar development plans for three rural municipalities, as well as development of a series of clear protocols, tools and templates to support implementation of this model in rural communities across the Northeast. The project team includes UMass Clean Energy Extension (CEE), the UMass Department of Environmental Conservation, the Massachusetts Department of Energy Resources (DOER), the Massachusetts Department of Agricultural Resources (MDAR), the Pioneer Valley Planning Commission (PVPC), the Franklin Regional Council of Governments (FRCOG), the Western Massachusetts Community Choice Energy Task Force, UMassFive College Credit Union, Northeast Solar, PV Squared, Co-op Power, and the Towns of Blandford, Wendell and Westhampton.

As a first step, the project lead organization, CEE, prepared an assessment of existing infrastructure, resources, and potential solar development opportunities in each participating municipality, in consultation with a subset of project partners (DOER, PVPC, FRCOG, municipal representatives). This assessment was designed to describe relevant bylaws and infrastructure within the town, identify the types of solar facilities that could be developed, and quantify the total space available for each type of facility.

In this report, we review and describe:

- Existing electricity grid infrastructure, and the potential to interconnect additional solar facilities
- Current municipal solar zoning bylaws and the solar overlay district
- Town conservation priorities and conservation land
- Existing renewable energy facilities
- Priority energy storage sites
- Sites with potentially moderate to heavy electricity use
- Areas available for development on:
    - Residential rooftops and properties
    - Medium to large-scale rooftops
    - Parking lots
    - Landfills and brownfields
    - Other previously developed sites
    - Farms
    - Undeveloped land suitable for commercial development

This draft report will be made available to NREL SEIN and the full project team for feedback and revision, before a final public version of the document is issued.

[1] For more information, see the DOER Green Communities Division website (https://www.mass.gov/green-communities-designation-grant-program).

2. GRID INFRASTRUCTURE ASSESSMENT

2.1 Introduction

In this section, we provide a description of the existing electricity grid infrastructure serving the town, and the potential for new solar arrays to connect to existing circuits. Through this description, we hope to provide a general understanding of how the electricity grid functions, as well as to provide a snapshot of current conditions. Existing grid infrastructure plays a major role in where large solar arrays are built. The cost of connecting solar facilities to the grid varies widely in different locations, and hence is a primary decision-making factor in where solar developers propose to site projects.

It is important to note that while existing grid infrastructure may currently constrain the types of solar projects that can be developed cost-effectively in some locations, the electricity grid is in a constant state of change, and grid components are constantly being upgraded. This description of the current state of the grid may be most relevant to situations in which the town or community members have an interest in the development of a particular site for medium to large-scale solar in the near future. The current state of grid infrastructure within the town may be less relevant to long-term planning. In fact, we suggest that significant town-level planning around solar energy could potentially drive the location of electricity grid upgrades, to allow development in places where community members would prefer to see solar facilities sited.

2.3 Grid Infrastructure Basics

The New England electricity grid is overseen by ISO New England, the regional transmission organization that serves the states of Massachusetts, Maine, New Hampshire, Vermont, Connecticut, and Rhode Island. This non-profit organization is charged with ensuring grid reliability – that is, to continuously balance electricity supply and demand, in Massachusetts and throughout the region. The electricity grid consists of transmission lines, high-voltage lines which carry electricity over long distances, and distribution lines, lower voltage lines which distribute power to individual communities and households. Most transmission lines in Massachusetts are owned by the two major electricity utilities which operate in the state - Eversource (formerly NSTAR and WMECO) and National Grid. Distribution lines are typically owned by the local electricity provider, which could be Eversource, National Grid, Unitil, or a municipal utility. Transmission lines range in voltage from 69-345 kV. When these lines reach a substation, electricity is "stepped down" to a lower voltage, and distributed along 13-34 kV distribution lines.

The "interstate highways" of the electrical grid are 345 kV transmission lines. In western Massachusetts, one 345 kV line runs north-south, east of, but approximately paralleling, the Connecticut River (see **Figure 1** next page). This line connects the pumped storage facility in Northfield with the Stonybrook Power Plant, an oil and natural gas facility, in Ludlow. A second 345 kV line runs west from the Northfield pumped storage facility, through Ashfield, Plainfield, and Pittsfield, and ultimately across the state line into New York.

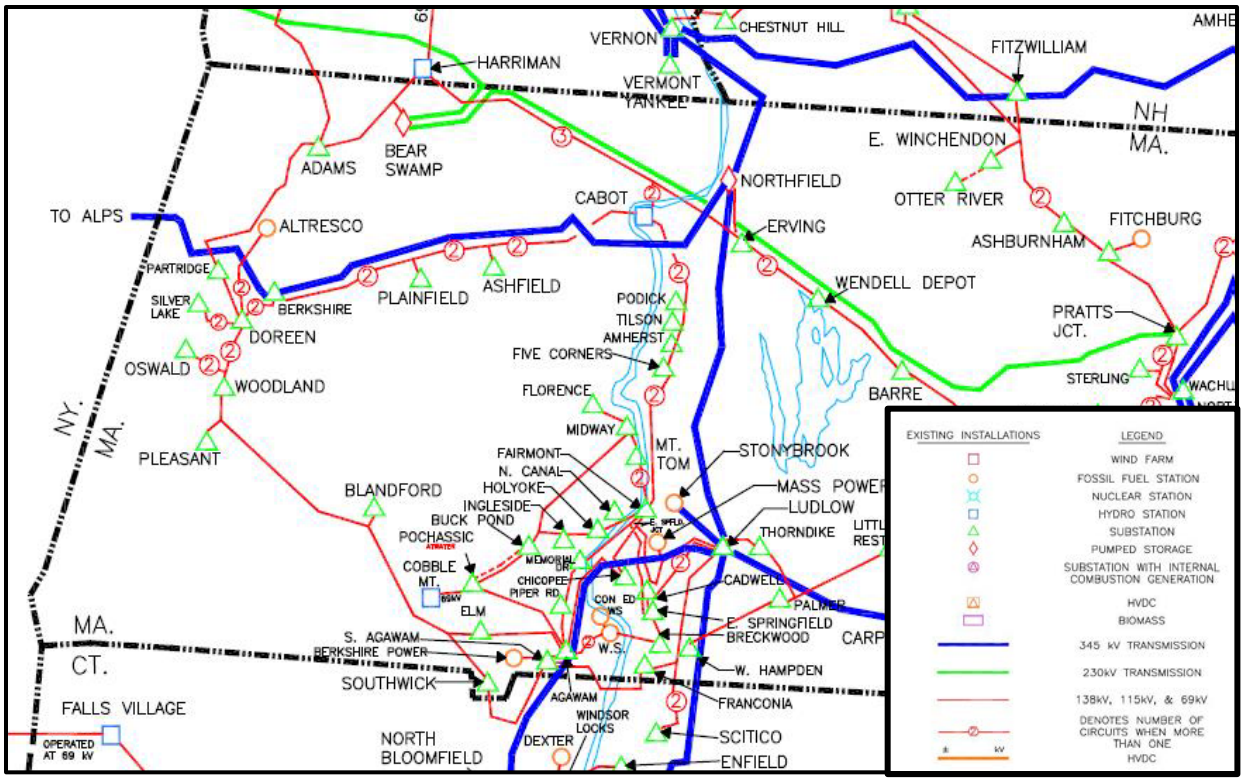
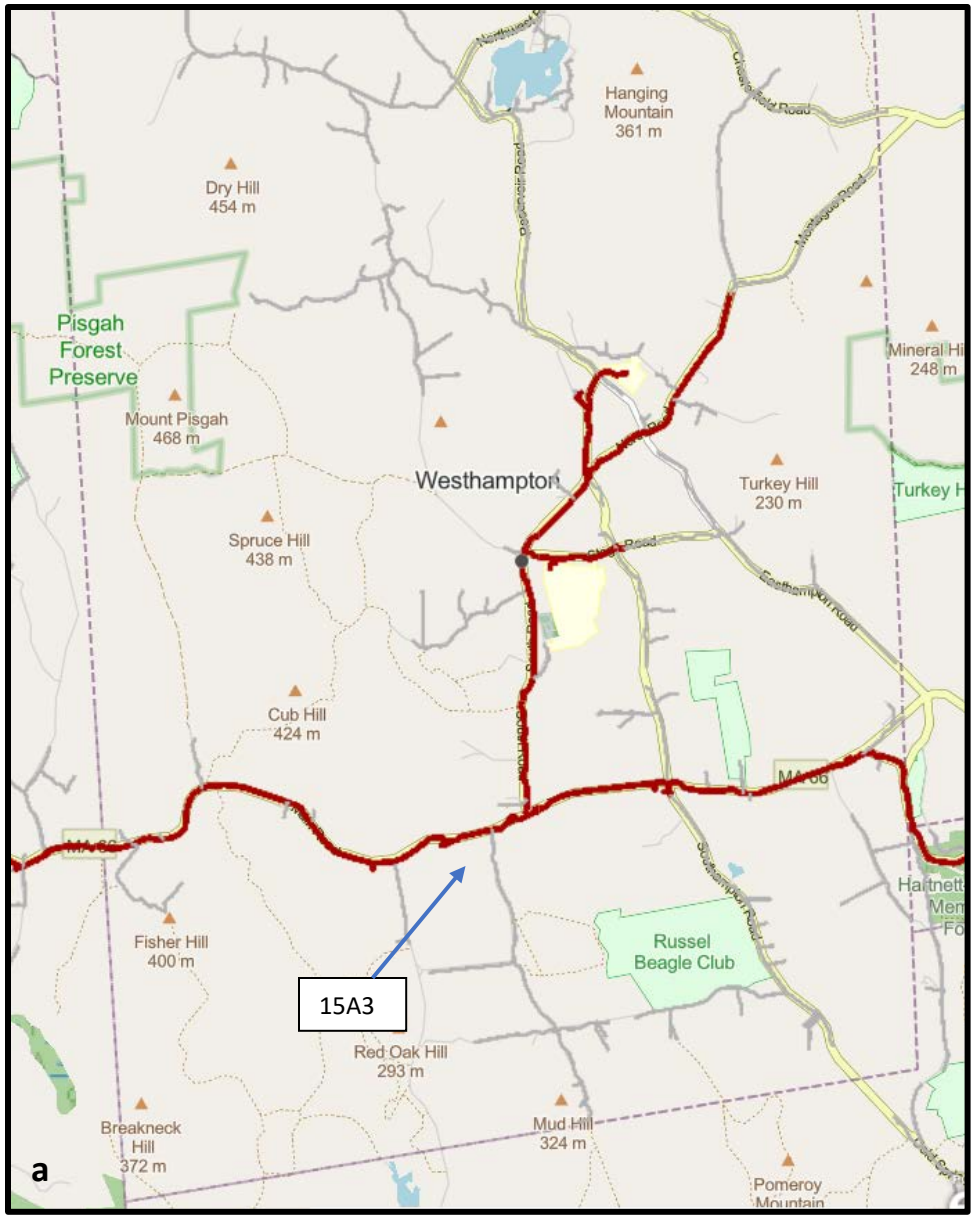


Figure 1 Major electricity transmission lines and substations in western Massachusetts.
Source: ISO New England 2019

2.4 Existing Grid Infrastructure

Westhampton is primarily served via a 115 kV transmission line, sections of which run through Florence and Easthampton. The 115 kV voltage is stepped down to 23 kV at the Gunn 15A substation on Phelps and Line Streets in Easthampton. This 23 kV "feeder" circuit, known as 15A3, enters Westhampton via Loudville (**Figure 2a**, next page). One section runs east-west along Route 66 into Huntington, another branches off north, running up South Road, through the center of town, and up North Road as far as the intersection of North Road and Montague Road. Side branches also serve Stage Road, Perry Hill Road, the southern end of Perry Hill Road Extension, and the Westhampton Elementary School. These areas are served by three-phase distribution lines. The remainder of town has 4.8 or 23 kV single-phase distribution lines.

A small section along Northwest Road in the northwestern corner of town is served via a different 23 kV "feeder" circuit, known as 19J1, which runs from Blandford north through Huntington and into Chesterfield. The 23 kV feeder circuit does not enter Westhampton, but a 23 kV single-phase offshoot runs down South St in Chesterfield and along Northwest Road, almost as far as Shop Brook (**Figure 2b**, next page).



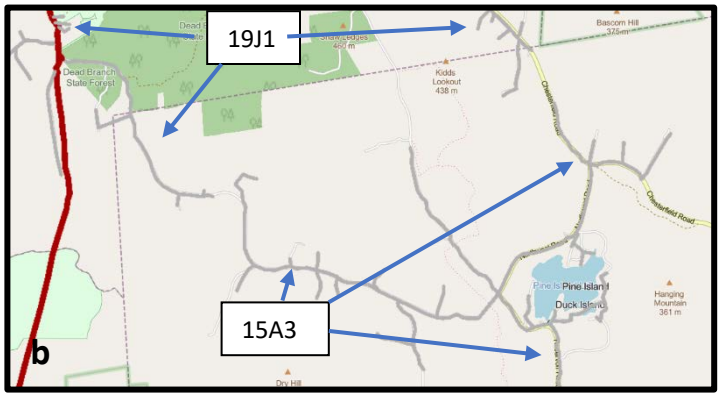


Figure 2 a) Feeder circuit 15A3 provides most of Westhampton with three-phase power (red lines) or single-phase power (gray lines); b) feeder circuit 19J1 (red line), running through Chesterfield, provides single-phase power to the NW corner of town (gray lines).
Source: Distributed Generation Hosting Capacity Map, Eversource 2020

2.5 Existing Hosting Capacity

Historically, distribution lines in the electricity grid were designed as somewhat akin to one-way streets, supplying power to homes and businesses from large power plants connected to high-voltage transmission lines. With the addition of solar and wind resources, there are now many energy-generating facilities that seek to interconnect to the grid via distribution lines. These "distributed generation" electricity sources require that distribution lines act as two-way streets instead, allowing for energy to flow into the grid via distribution lines, while still allowing energy to continue to flow outward into individual homes and businesses. Balancing this two-way flow can represent a challenge for ensuring reliability and safety of the grid. This is especially true where distributed generation electricity sources are renewable sources, such as wind and solar energy, which supply electricity to the grid in an intermittent and variable manner. In order to ensure that generation facilities can be connected safely, developers are required to obtain written permission from the local utility company before interconnecting these systems to the electricity grid.

The "hosting capacity" of an electric power line identifies its ability to incorporate distributed generation electricity sources, such as wind and solar. In most places, including those served by single-phase distribution lines, small solar systems of up to 50 kW can be incorporated without adverse impacts on the grid's reliability. In areas served by three-phase power lines, solar systems of up to 200 kW can typically be interconnected without significant challenges. However, for larger systems, it is necessary to ensure there is sufficient capacity available on the distribution line before these facilities can be built and interconnected. Otherwise, power lines or substations may require upgrades before additional distributed generation sources can be interconnected without compromising reliability. While not true across the board, an industry 'rule-of-thumb' is that 6 MW can be connected safely for every 13.8 kV distribution line. In western Massachusetts, where many towns are served by one or a few low-voltage feeder circuits, the local grid can quickly become "saturated," such that there is not sufficient hosting capacity to incorporate additional medium to large solar arrays.

The state of Massachusetts now requires that utilities provide publicly-available maps and data regarding the available hosting capacity of distribution lines, and the level of saturation of individual feeder circuits. This public information lists all projects greater than 25 kW in capacity connected to three-phase lines, and all projects greater than 10 kW connected to single-phase lines. If circuits are currently saturated, it does not mean that no more distributed generation systems can be added to the circuit, but does suggest that upgrades are needed before additional projects can be interconnected. Upgrades may involve significant costs, which the energy facility developer is typically expected to pay for, as a condition of interconnection. Previously, interconnection applications were considered on a project-by-project basis, but recently, ISO New England has determined that multiple projects may be considered together as one group for the purposes of interconnection, in what are known as "Affected System Operator," or Group, studies. This change is anticipated to streamline the review of interconnection requests for projects "queued" up to connect to each circuit. Even if areas currently appear saturated on the map, they may not remain so. Companies developing large, more lucrative solar projects may be able and willing to support significant upgrades to these circuits (either individually or in groups with cost sharing). New upgrades may then open up new hosting capacity.

A listing of distributed generation projects authorized or in process on Westhampton feeder circuits is provided in **Table 1.** The 15A3 feeder circuit serving the majority of Westhampton has a total potential hosting capacity of 5,000 kW (5 MW) to interconnect distributed generation electricity sources. Of that total capacity, 42% has already been allocated, primarily to a 2 MW solar facility operating in Easthampton, as well as several small (12.9-26.4 kW) systems in Westhampton and Easthampton. An additional two large solar facilities (4.9 MW and 2.5 MW) proposed for Westhampton have sent interconnection applications to Eversource, and received an interconnection agreement to sign. If interconnected, these systems would more than saturate the existing host capacity for large projects on the main circuit providing electricity to Westhampton.

The 19J1 circuit, feeding the northwestern corner of Westhampton, also has a maximum hosting capacity of 5,000 kW (5 MW). This circuit has no large distributed generation facilities currently authorized to interconnect, but three large systems (of 495 kW, 990 kW, and 4,980 kW) are in process in Russell and Huntington. If these systems are authorized to interconnect, they will over-saturate the existing circuit. Given that only single-phase lines enter Westhampton from this circuit, significant upgrades would be required to interconnect a large solar facility to this line in Westhampton.

Circuit Name	Municipality	Capacity (kW)	Facility Type	Status of Project	Complete Application Date	Interconnection Agreement Sent Date	Authorization to Interconnect Date
15A3	Easthampton	2000	Solar	Authorized	3/16/2011	10/21/2011	6/1/2012
	Easthampton	26	Solar	Authorized	5/11/2012	9/12/2012	10/4/2012
	Easthampton	27	Solar	Authorized	8/10/2015	11/10/2015	12/18/2015
	Westhampton	34	Solar	In Process	9/11/2019		
	Easthampton	133	Solar	In Process	2/28/2020		
	Easthampton	500	Solar	In Process	2/28/2020		
	Easthampton	1000	Solar	In Process	7/31/2019		
	Westhampton	2500	Solar	In Process	4/18/2018	1/27/2019	
	Westhampton	4980	Solar	In Process	12/15/2017	4/13/2018	
19J1	Russell	495	Solar	In Process	6/13/2018		
	Huntington	990	Solar	In Process	6/20/2018		
	Huntington	4980	Solar	In Process	6/21/2018		

Table 1 Medium and large-scale (> 25 kW) distributed generation projects authorized or in process on the feeder circuits which serve Westhampton. Source: DOER Circuit Analysis Pre-Screen Tool, April 2020.

In summary, the primary feeder circuit serving Westhampton is over-saturated with authorized and in-progress projects. For the immediate future, any new large-scale projects to be proposed would likely require significant upgrades to grid infrastructure. Meanwhile, most three-phase lines could likely accommodate additional small-to-medium scale projects (under 200 kW), and most single-phase lines could likely accommodate additional projects under 50 kW in size. This description represents the local grid infrastructure as it is – planning for future scenarios of development could include recommendations for areas of grid infrastructure improvement to allow siting of distributed generation in preferred locations. Future scenarios may also include the addition of what are known as "non-wires alternatives," which can reduce the needs for grid upgrades. These are technologies like energy storage, energy efficiency, demand-response, and grid software, which reduce the need for additional power lines to be added to the grid.

3. MUNICIPAL PLANNING DOCUMENTS

3.1 Planning Documents & Bylaw Review

We conducted a brief review of relevant planning documents and municipal bylaws, and identified the following:

- The town does not have a Master Plan.
- The town does not have a Municipality Vulnerability Preparedness (MVP) plan.
- The town's zoning bylaws include a section which specifically addresses solar development. These bylaws were updated in May 2018. A brief summary of these bylaws is included in Section 3.2 *Solar Zoning* below.
- The town does not have any municipal wetlands bylaws.
- The town has an Open Space and Recreation Plan (OSRP), which was completed in 2010. A brief summary of town conservation priorities from the plan is provided in Section 3.3 *Open Space and Recreational Planning* below.

3.2 Solar Zoning

Westhampton has one primary zoning district type, Agricultural Residential, and three overlay districts – a Floodplain District, Water Supply Protection District, and Solar Photovoltaic District.

Westhampton's current solar zoning bylaw categorizes solar PV arrays into four types:

1. Roof-mounted
2. Small-scale ground-mounted - less than 2,100 square feet of solar panels (equivalent to a maximum capacity of roughly 40 kW)
3. Medium-scale ground-mounted - 2,100-32,000 square feet of panels (equivalent to a capacity of roughly 40-625 kW)
4. Large-scale ground-mounted - greater than 32,000 square feet of panels (equivalent to a capacity of roughly 625 kW or more)

Roof-mounted systems and small-scale ground-mounted solar energy systems are allowed by-right in all districts, and require review by the Building Inspector before issuance of a building permit.

Within the Solar Photovoltaic Overlay District, medium and large-scale systems are permitted by-right (subject to site plan review) when the lot coverage of all of the arrays, structures and buildings do not exceed an aggregate of 1.5 acres. The solar overlay district comprises the municipal landfill property on Hathaway Road.

Outside of the Solar Photovoltaic Overlay District, medium-scale ground-mounted solar energy systems require a site plan review by the Site Plan Review Authority. Large-scale ground-mounted systems require site plan review and issuance of a special permit from the Planning Board.

Ground-mounted solar facilities can be no higher than 35 feet. All ground-mounted solar facilities require front setbacks of 50 feet, side setbacks of 20 feet, and rear setbacks of 20 feet.

The existing bylaw requires that ground-mounted solar arrays be designed to minimize clearing of natural vegetation, especially in wetlands, minimize tree removal, and minimize the removal of stone walls. No more than 50% of the land parcel utilized for solar array may consist of land requiring clearing of forest. On agricultural and environmentally sensitive sites, no more than 50% of the total land area proposed for the solar array may be occupied by the solar panels, with the remainder of the land remaining as undeveloped open space left in its natural state.

In order to minimize erosion, no installations are allowed on slopes greater than 15% grade.

3.3 Open Space and Recreation Planning

Westhampton's Open Space and Recreation Plan was compiled in 2010, and included a survey of town residents, as well as public comment periods. Primary objectives valued by community members included protecting wildlife habitat, maintaining large blocks of undeveloped land (including forests on Holyoke Water Company Land, Pisgah Road, Reservoir Road, Cub Hill, and Tob Hill), maintaining forest corridors, maintaining natural greenways along brooks and wetlands, and protecting isolated wetlands. Residents valued preserving the town's rural character, and identified particular sites worthy of protection due to the importance attached to them by the community, or their scenic value, including: Hanging Mountain Pond and its associated bog, the Dead Branch of the Westfield River and Bear's Den, the Manhan River waterfalls, Parsons Flats, Tipping Rock, and scenic mountain ridgetops.

A large majority of OSRP survey respondents (92%) wanted Westhampton to determine a way to preserve farmland - the majority of existing farmland was in the Chapter 61A program, and therefore not permanently protected.

4. COMMUNITY INFRASTRUCTURE

4.1 Introduction

In this section, we briefly review community infrastructure of relevance to solar energy development and energy storage. Information included in this section was drawn from a variety of sources, including:

- A brief survey of municipal representatives involved in this project
- Municipal planning documents
- DOER databases of renewable energy generation facilities
- Reference USA database of businesses by zip code
- Community Involved in Sustaining Agriculture Farm Finder
- MassGIS geospatial data layers

Associated maps are provided in Appendix A.

4.2 Existing Renewable Energy Infrastructure

According to DOER, there are approximately 82 residential solar arrays in Westhampton, totaling 663 kW of capacity. The town has one municipally-owned solar array – a 14.5 kW system installed on the town library in 2014.

There is one 24 kW facility serving a town business, and one new 24 kW stand-alone, net-metered facility, which began operation in late 2019. There is one large, commercial, ground-mounted 5.0 MW solar array being constructed on Montague Road.

4.3 Potential Energy Storage Sites

Energy storage systems help to balance differences between electricity demand and generation, and are especially valuable components for intermittent energy sources like wind and solar, which do not produce energy 24 hours a day, and may not be producing during times of peak demand.

Energy storage systems have the potential to allow larger solar facilities to be built in areas where interconnecting a medium or large solar array could otherwise exceed the ability of the local distribution lines to accommodate additional renewable energy capacity. Prices of battery storage are dropping quickly, but energy storage is still a relatively expensive technology. At present, these types of systems typically require loads larger than residential-scale to be economical, where cost is the sole consideration. However, these systems can provide energy reliability during outages, which means that they also provide additional value in terms of public safety and health.

In this section, we briefly review sites where considering energy storage possibilities may be worthwhile.

4.3.1 Hampshire Regional High School

Hampshire Regional High School is a regional middle school and high school serving approximately 750 students from the towns of Chesterfield, Goshen, Southampton, Westhampton, and Williamsburg. Centrally located in Westhampton, it has the potential to serve as an emergency shelter site. Currently, the school has a back-up generator, which can provide running water and lighting in case of a power outage, but no energy storage system. The school has a flat roof with an approximate area of 87,400 square feet, as well as a large parking lot, with an approximate area of 2.6 acres.

The town of Westhampton does not have a large amount of commercial or industrial development, and therefore has few areas which might have high electricity load, and which could therefore benefit from energy storage. This school likely has the highest electricity use in town; however, it is important to note that electricity use drops

significantly during the summer months. CEE will review Mass Energy Insight data to quantify electricity use at the high school.

4.3.2 Westhampton Elementary School

Westhampton Elementary School serves approximately 120 students in pre-kindergarten to grade 6, primarily from Westhampton. The school has the potential to serve as an emergency shelter site. Currently, the school has a back-up generator, which provides lighting in case of emergency, but does not provide power for running water. The school has a pitched roof with an approximate area of 27,000 square feet. There are several paved areas surrounding the school, as well as a back parking lot of approximately 1.2 acres, which is soon to be paved.

The town of Westhampton does not have a large amount of commercial or industrial development, and therefore has few areas which might have high electricity load, and which could benefit from energy storage. This school likely is one of the highest electricity users in town; however, it is important to note that electricity use drops significantly during the summer months. CEE will review Mass Energy Insight data to quantify electricity use at the elementary school.

4.3.3 Senior Housing

Housing in Westhampton is primarily comprised of single-family homes. However, the Westhampton Woods Senior Housing complex (13 Main Road) includes 15 housing units for seniors. This complex is owned and maintained by the Hilltown Community Development Corporation. This site likely has a significantly higher annual electricity use than surrounding single-family housing. In addition, energy reliability may be of greater value to the town's older citizens than to other town residents. This site consists of eight buildings with approximately 2,000 sf of roof area each (total of 16,000 sf).

4.3.4 Town Center

The largest density of houses is in the town center, where a number of municipal buildings, including the Town Hall, Town Offices, and Town Library, are also located. The Westhampton Congregational Church is also in the town center. Hampshire Regional High School is less than a quarter mile from the center of town.

4.3.5 Businesses

The town of Westhampton does not have a large amount of commercial or industrial development, and has few areas which might have high electricity load, and which could therefore benefit from energy storage.

We identified the following commercial entities active in town, which 'could' have higher electricity use than local single-family residences:

- Two autobody shops – Country Automotive (91a Southampton Road), and Big B's Autobody (47 Northwest Road)
- Berkshire Biological (264 Main Road) – a live animal supply for classrooms
- Grinning Dog, LLC (250 Southampton Road) - a dog kennel with day and overnight boarding opportunities, which already has a 24 kW solar array, installed in 2018.
- Hathaway Construction Corp. – 41 Perry Hill Road
- Hathaway Construction – 128 North Road
- It's Pawsible Dog Training – 60 Main Road
- Meehan Construction – 40 Perry Hill Road
- North Country Landscapes & Garden Center – 1 Main Road
- Windy Acres Campground – 139 South Road

4.4 Other Relevant Infrastructure

4.4.1 Parking Lots

As noted above, both Hampshire Regional High School and Westhampton Elementary School have relatively large parking lots, which could potentially incorporate a solar parking canopy. There is a small parking lot (0.25 acres) in the town center, and a paved area around the municipal Highway Garage comprising approximately 2.75 acres.

4.4.2 Landfills and Brownfields

The Massachusetts Department of Environmental Protection does not list any identified brownfields within the town of Westhampton. According to the 2010 OSRP, there are no known hazardous waste sites in town, although there is a solid waste stump dump in the northwest section of town, and a former junkyard on Main Road.

The town municipal landfill property (58 Hathaway Road) comprises the town's solar overlay district. The slope on the capped landfill is steep, but the town is interested in considering the site for solar. In addition, according to the 2010 OSRP, there is an uncapped landfill on a 1 acre plot on Southampton Road on town-owned land. The only town-owned plot we identified on this road is 0.69 acres in area. According to the OSRP, there were no contaminants found in testing at that site in 2010.

4.4.3 Municipal Buildings

The Highway Garage (58 Stage Road) is located on the same property as the capped municipal landfill, and is included within the town's solar overlay district. There is the potential to incorporate solar on the roof and paved area surrounding the building, as well as on the adjacent landfill.

The new Public Safety Complex will hopefully include a solar array on the roof, but space is expected to be limited to approximately a 30 kW system.

4.4.4 Farms

There are a number of agricultural and horticultural enterprises in town, which could be approached regarding their interest in agriculturally-related energy projects. These include:

- Bridgmont Farm – 71 Chesterfield Road
- Demarey Gardens – 20 South Road
- Fuller Horse Facility/Infinity Equestrian – 64 Southampton Road
- Hanging Mountain Farm – 188 North Road
- Intervale Farm – 106 South Road
- Mayval Farm – 137 Easthampton Road
- Mycoterra Farm – 248 Northwest Road
- Outlook Farm – 136 Main Road
- Parsons Farm – 149 Easthampton Road
- Runnymede Farm – 109 South Road

At least one farm in town has considered the possibility of installing a solar array in the past, but was dissuaded due to high interconnection costs to the electricity grid.

Westhampton farms have shown a strong interest in energy efficiency – 5 farms in town have received grants through the Massachusetts Department of Agricultural Resources Farm Energy program, for high-efficiency evaporators for maple sugaring, energy-efficient refrigeration equipment, and an energy-efficient wood boiler.

5. SOLAR RESOURCE ASSESSMENT

5.1 Introduction

In this section, we identify, summarize, and attempt to quantify the available solar resources in the town of Westhampton. We identify a number of different types of potential resources in this assessment, including:

- Residential-scale solar resources (roof-mounted and small ground-mounted systems)
- Medium to large-scale roofs (greater than 5,000 sf)
- Parking lots
- Landfills and brownfields
- Other previously developed land
- Undeveloped land suitable for commercial-scale solar development

This analysis was a desktop analysis, incorporating publicly-available geospatial data layers downloaded from MassGIS, the state's Bureau of Geographic Information. It is important to recognize that information contained within these data layers may be out-of-date, inaccurate, or include irregularities that reduce the accuracy of this analysis. For example, tax parcel data included in this analysis was last updated in 2018. Boundaries of conserved land outlined in the MassGIS Protected and Recreational Open Space data layer do not appear to line up perfectly with tax parcel boundaries. This should be considered as a preliminary analysis, providing direction regarding where more in-depth site assessments can be conducted.

5.2 Residential-Scale Resources

We are currently working with National Renewable Energy Laboratory (NREL) experts on a detailed analysis of rooftop solar potential on small buildings in Westhampton. This nuanced analysis will be based on lidar (light detection and ranging) data, a remote-sensing technique that uses laser light to densely sample surfaces, providing detailed information about roof pitch, aspect, and shading by trees. This analysis will be included in the final report to the town. In the current analysis, we provide several rough estimates of solar potential, based on MassGIS structures data, and NREL solar potential estimates for small buildings. For this analysis, we follow NREL's definition of a "small building" as one with a roof area of 5,000 sf or less.

Based on MassGIS Structures data, the town of Westhampton has a total of 1,483 small buildings, totaling 2,017,700 sf in roof area. The majority of these buildings are residential structures, including houses, garages, and sheds, although some small businesses and farm outbuildings are included in this total. The National Renewable Energy Laboratory (NREL) estimates that nation-wide, an average of 26% of the roof area of small buildings is suitable for solar[2]. Therefore, we could project a total technical solar resource of 524,600 sf available, equivalent to 8,394 kW (8.4 MW) of solar. Of course, this is the *technical* resource available. It is not feasible to connect solar panels to electric lines at all locations, some roofs may not have the structural integrity necessary to support solar panels, and it is not cost-effective to install panels in locations where the available space is small.

NREL provides additional data and estimates regarding small building roof space in western Massachusetts[2]. Data is not available for Westhampton, but in neighboring Chesterfield, 75% of small buildings have some roof space suitable for solar, in Southampton, 76% of small roofs have some solar suitability. Of small buildings in western Massachusetts with some potential for solar, approximately half have at least 10 m^2 (roughly 100 sf) of roof available for solar. If we assume 75% of small buildings in Westhampton have some space available for solar, and

[2] Gagnon, P., Margolis, R., Melius, J., Phillips, C. and Elmore, R., 2016. *Rooftop solar photovoltaic technical potential in the United States. A detailed assessment* (No. NREL/TP-6A20-65298). National Renewable Energy Lab.(NREL), Golden, CO (United States).

50% of those have at least 10 m^2 available, we can estimate that about 556 buildings could support at least 10 m^2 of solar (at least 1.75 kW). Let us consider this the maximum number of buildings which could economically support solar in town. The average roof area of a small building in Westhampton is 1,426 sf. If we assume half of that roof space has the proper aspect for solar, and multiply the average roof space by the number of buildings, we arrive at a slightly more conservative estimate of residential solar potential – 6,346 kW (6.3 MW).

A third, and perhaps more practical, estimate of residential-scale solar potential can be derived by considering the potential for roof-mounted OR small-scale ground-mounted arrays to support residential use. Westhampton has a total of about 760 households. If 75% of them were to install solar at their residences, either on a rooftop, or as a ground-mounted system, the town would ultimately have 570 residential systems. The average size of a residential solar system in Westhampton currently is 8.08 kW. By this method, we can estimate a potential residential solar capacity of 4,605 kW (4.6 MW).

5.3 Medium to Large-Scale Rooftops

Table 2 (next page) provides a list of the 25 largest roofs in Westhampton. This list includes two schools (Hampshire Regional HS and Westhampton ES), eight barns associated with farms, one farm barn/eatery, seven other barns, two businesses, and two municipal buildings.

The two municipal buildings included in the list are the Library and Highway Garage. The current Public Safety Complex also has a relatively large roof (5181 sf).

As described above, we are currently working with NREL on a more detailed analysis of rooftop solar potential using lidar data. The numbers provided in the table reflect a rough estimate of technical potential, based on nationwide data from NREL. NREL's analysis suggests that virtually all medium and large-scale buildings have a roof plane suitable for solar, and that on average, approximately 49% of area on medium-scale roofs is available[2]. Our technical estimates are based on this statistic. As described above, this technical potential is not reflective of roof structural integrity or economic viability, and an on-the-ground assessment would need to be conducted. Note, for example, that our analysis suggests a 48 kW system could be installed on the Westhampton Memorial Library. The installed system is only 14.5 kW.

Our estimate of total technical potential on medium to large-scale roofs is 2,368 kW (2.4 MW).

Structure	Street Address	Total Roof Area (sq ft)	Estimated Technical Solar Potential (kW)
Hampshire Regional High School	19 Stage Road	87,409	685
Westhampton Elementary School	37 Kings Highway	27,114	213
Barn - at Mayval Farm	149 Easthampton Road	14,981	117
Barn - at Fuller Horse Facility	64 Southampton Road	14,325	112
Barn	80 Easthampton Road	12,852	101
Barn - at Bridgmont Farm	61 Chesterfield Road	12,565	99
Barn - at Runnymede Farm	109 South Road	12,016	94
Barn & Eatery - at Outlook Farm	138 Main Road	9,436	74
Municipal Highway Garage	58 Hathaway Road	8,934	70
Hathaway Construction Corp.	41 Perry Hill Road	8,186	64
Barn	86 Main Road	7,976	63
Barn - at Intervale Farm	106 South Road	7,588	59
Private Residence	10 Blueberry Hills	7,577	59
Barn - at It's Pawsible! Dog Training	60 Main Road	6,729	53
Private Residence	48 North Road	6,638	52
Barn	11 Loudville Road	6,227	49
Barn - at Hanging Mountain Farm	188 North Road	6,213	49
Westhampton Memorial Library	1 North Road	6,147	48
Private Residence	135 Southampton Road	5,870	46
Barn - at Mayval Farm	150 Easthampton Road	5,848	46
Barn	264 Main Road	5,812	46
Barn	56 Montague Road	5,507	43
Private Residence	160 North Road	5,445	43
Barn - at Outlook Farm	138 Main Road	5,375	42
Barn	59 Main Road	5,302	42

Table 2 A list of the 25 largest roofs identified in Westhampton.

5.4 Parking Lots

We identified sites with at least 0.25 acres of parking lot in town. Hampshire Regional High School has a total paved area of about 4.5 acres, but the most practical site for a solar parking canopy would be in the lot behind the school, which totals 2.5 acres. A smaller system could potentially be installed over parking spaces along the east side of the school. Westhampton Elementary School has a total paved area of about 2.5 acres, but much of this consists of a driveway and ball courts, where solar canopy installation would not be practical. However, there is a back parking lot of 1.2 acres which is expected to be paved in coming years, which could host a solar parking canopy. There is also a small 0.25 acre parking lot adjacent to the town center.

In addition to the three formal parking lots listed above, two municipal sites, the Highway Department Garage, and Public Safety Complex, have 2.75 and 1 acres of pavement, respectively. Solar canopies could potentially be installed over portions of each site, providing protection from the elements for municipal vehicles when not in use.

Potential sites for parking canopies are summarized in **Table 3**. Technical estimates are based on a packing density of 263 kW per acre[3]. Our estimate of total technical potential on existing parking lots – not including additional impervious surfaces - is 1,055 kW (1.1 MW).

Location	**Approximate Area** (acres)	**Estimated Solar Technical Potential** (kW)
Hampshire Regional HS	2.5	675
Westhampton ES	1.2	315
Town Center Parking	0.25	65
Highway Garage	2.75	725
Public Safety Complex	1	260

Table 3 Parking lots and paved surfaces identified in Westhampton.

5.5 Landfills and Brownfields

As previously noted, there are no identified brownfields or hazardous waste sites in Westhampton.

The town landfill property doubles as the town's solar overlay district. This parcel has a total lot size of 33 acres, including 2.75 acres of pavement and the town's Highway Garage. The slope of the capped landfill is somewhat steep, but could be evaluated for solar development.

5.6 Other Previously Developed Land

Westhampton is home to several businesses involved in gravel extraction, leading to the development of a number of large gravel pit sites around town. Based on this desktop analysis, it is not possible to differentiate between active and inactive gravel pits. However, for inactive sites, it would be useful to assess the solar potential, since the land area involved can be significant (see examples in **Table 4**).

Location	**Individual Areas** (acres)	**Total Area** (acres)
off Hooker Road	2.9, 4.25, 5.5, 11.6	24.25
off Perry Hill Road	3.25	3.25
off South Road (near Intervale Farm)	3, 5.6	8.6

Table 3 Examples of large gravel pits in Westhampton.

[3] Krishnan, Ram. 2016. *Technical solar photovoltaic potential of large scale parking lot canopies*. Dissertation, Michigan Technological University.

5.7 Agricultural Resources

Westhampton has a number of large and active farms, and significant acreage in agricultural production. Based on MassGIS Land Cover data, some 610 acres are in pasture, hay production, or cultivation. Thirty-nine properties totaling 1,356 acres currently are included in the Chapter 61a program for the purposes of agricultural production (this figure does not include productive woodlots). A total of 56 acres are protected in perpetuity by an Agricultural Preservation Restriction.

Opportunities are available to site solar projects on barn roofs. Other types of solar development – such as systems designed to support on-farm electricity use, solar parking canopies to protect farm equipment, or dual-use systems developed to allow continued use of the land underneath the panels for agriculture – may be appropriate for some sites. On-farm solar potential can be further explored in conjunction with the Massachusetts Department of Agricultural Resources.

5.8 Commercial-Scale Development Sites

As a final step in this analysis, we explored the potential for large-scale commercial solar development. Significant portions of the town are currently undeveloped. Mass Audubon's analysis from *Losing Ground* indicates 15,755 acres (90%) are in a "natural" condition, 1,103 acres (7%) are "open" land, and 539 acres (3%) are developed. Fifty-eight acres were developed over the 5-year period between 2012 and 2017 – relative to its land area, Westhampton ranked 218 out of 351 municipalities, in terms of its pace of development over that time period. Between 2005 and 2013, 37 acres were developed (rank: 251 out of 351). Between 1999 and 2005, 63 acres of natural land were converted to development, and the town ranked 299 out of 351 municipalities, again, relative to its size.

A total of 3,646 acres (21%) of land in town are permanently conserved, placing Westhampton 133th in the state in terms of conserved land, relative to its size. A total of 1,253 acres were conserved in Westhampton between 2012 and 2019, including 644 acres of BioMap2 Core Habitat, 925 acres of BioMap2 Critical Natural Landscape, and 99 acres of land ranked by The Nature Conservancy as "resilient."

For our analysis, we considered properties with a minimum lot size of 5 acres – equivalent to approximately 1 MW of solar development. In Westhampton, there are 398 "large" parcels with an area of 5 acres or more, totaling some 14,110 acres. After removing permanently protected land, land unlikely to be developed (e.g. cemeteries), wetland areas, and a minimum 25 ft buffer zone around them, yields a total area of 11,200 acres available for development across 400 parcels (Scenario 1).

The current state solar incentive program does not provide incentives for solar development on land identified in state databases as important habitat conservation land – designated either as BioMap2 Core Habitat or Critical Natural Landscapes – or for development on parcels on which more than half of property receives this designation. Further excluding these parcels, and BioMap2 habitat on developable parcels, yields a total of 232 parcels with 5 or more acres available for development, totaling 4,629 acres (Scenario 2).

Westhampton's current bylaw prohibits development on slopes of greater than 15% grade. Eliminating locations with a steeper grade, while still maintaining at least 5 acres available for development, yields a total of 202 parcels, totaling 3,458 (Scenario 3).

Eliminating properties on which a structure worth more than $25,000 currently sits leaves a total of 88 parcels available for development, totaling 1,606 acres (Scenario 4).

In sum, approximately 11% of all land contained in large (> 5 acre parcels) is available for development, once existing legal protections, habitat protection standards, slope considerations, and siting off of properties that may already contain houses, are considered.

These values do not include additional considerations of existing land cover. Westhampton's current bylaws call for avoiding forest clearing on more than 50% of a parcel identified for solar development. Only 31 of the 398 large parcels identified in this assessment had less than 50% forest cover. Among the 88 parcels that met other criteria used in this analysis, 31 parcels had at least 2.5 acres of unforested land, suggesting at least 5 acres could be developed without clearing more than half the site of forest. However, for at least a third of these sites, a significant proportion of the remaining land is in agricultural production. Our estimates suggest that 21 parcels, totaling 538 acres, could be developed, without more than half of the parcel being cleared of forest or stripped of agricultural production.

5.8 Summary

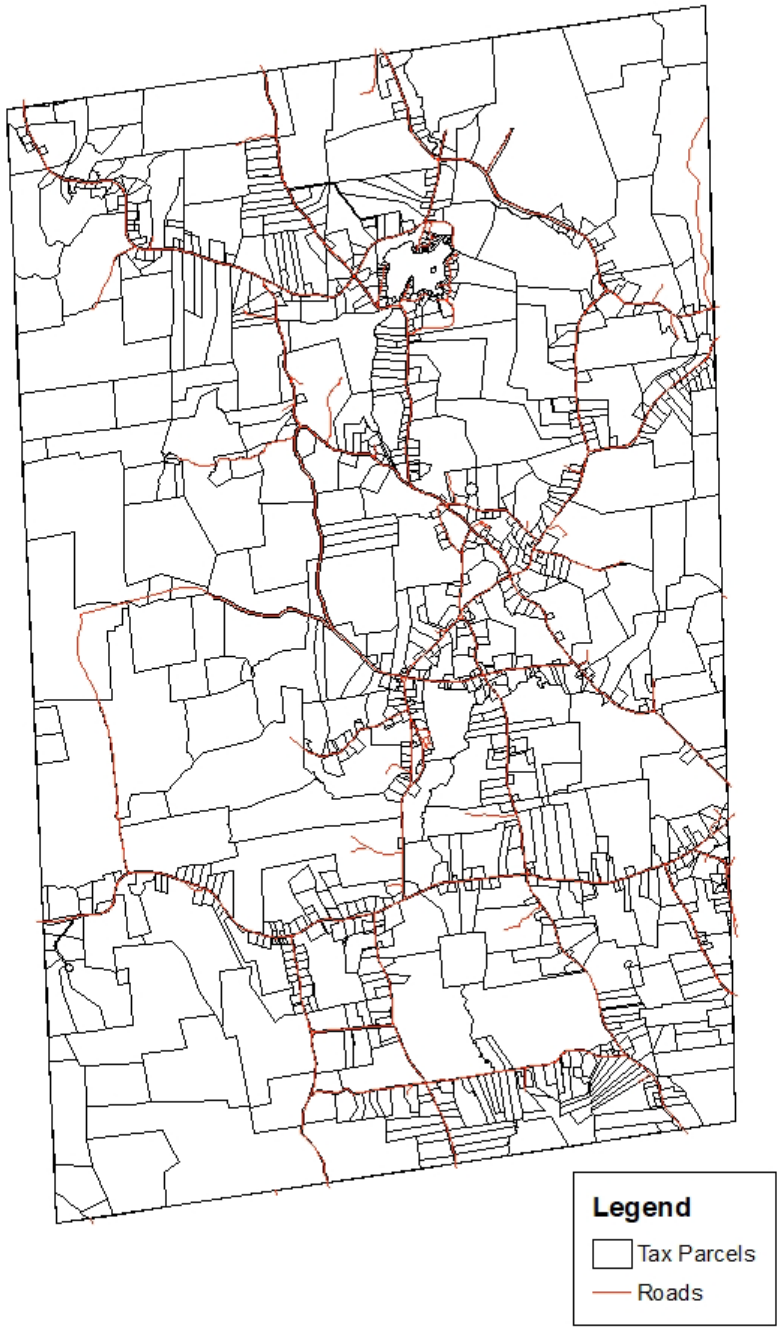
Table 5 below provides a summary of solar resources identified in this assessment.

Resource Type	**Approximate Area**	**Estimated Technical Potential**
Residential-Scale Solar	- Estimated 524,000 sf of small building roof space suitable for solar - Estimated 1,112 buildings (75%) could support some solar - Estimated 556 buildings (35%) could support at least 1.75 kW of solar - Senior Housing Complex on Main Road totals 16,000 sf of roof space	At least 4.6 MW, if 75% of households can install a roof or ground-mounted system* **More detailed assessment forthcoming*
Medium to Large Scale Roofs	-Estimated 158,400 sf of large building roof space suitable for solar	Estimated at 2.5 MW
Parking Lots	- 3.95 acres across three parking lots (HRHS, Westhampton ES, Town Center) '-Additional 3.75 acres of paved surfaces at municipal Highway Garage and Public Safety Complex	1.0 MW on existing parking lots, Potential for 1.0 MW additional on other municipally-owned, paved surfaces
Landfills and Brownfields	- 33-acre municipal property includes capped landfill, Highway Garage, and 2.75 acres of pavement	TBD
Gravel Pits	- At least 36 acres of large gravel pits, not clear which are currently active	Up to 7 MW, if all large sites identified were no longer active
Agricultural Resources	- At least 10 farms - At least 14 barns with large roofs - Estimated 610 acres in agricultural production - Approximately 1,385 acres in Chapter 61a program for agriculture	Dependent on project type
Undeveloped Land	- 88 large land parcels have at least 5 acres that are not protected, meet current state solar incentive criteria, municipal slope requirements, and do not have a structure worth more than $25,000 on the property = 1,606 acres - 21 large land parcels could be developed without clearing more than half the site of forest or displacing agriculture from more than half of the property = 538 acres	Approximately 1 MW per 5 acres: 1,606 acres = 321 MW 538 acres = 108 MW *It is not expected that all undeveloped land available would be built out for solar development.*

Appendix A – Maps of Solar Resources and Infrastructure

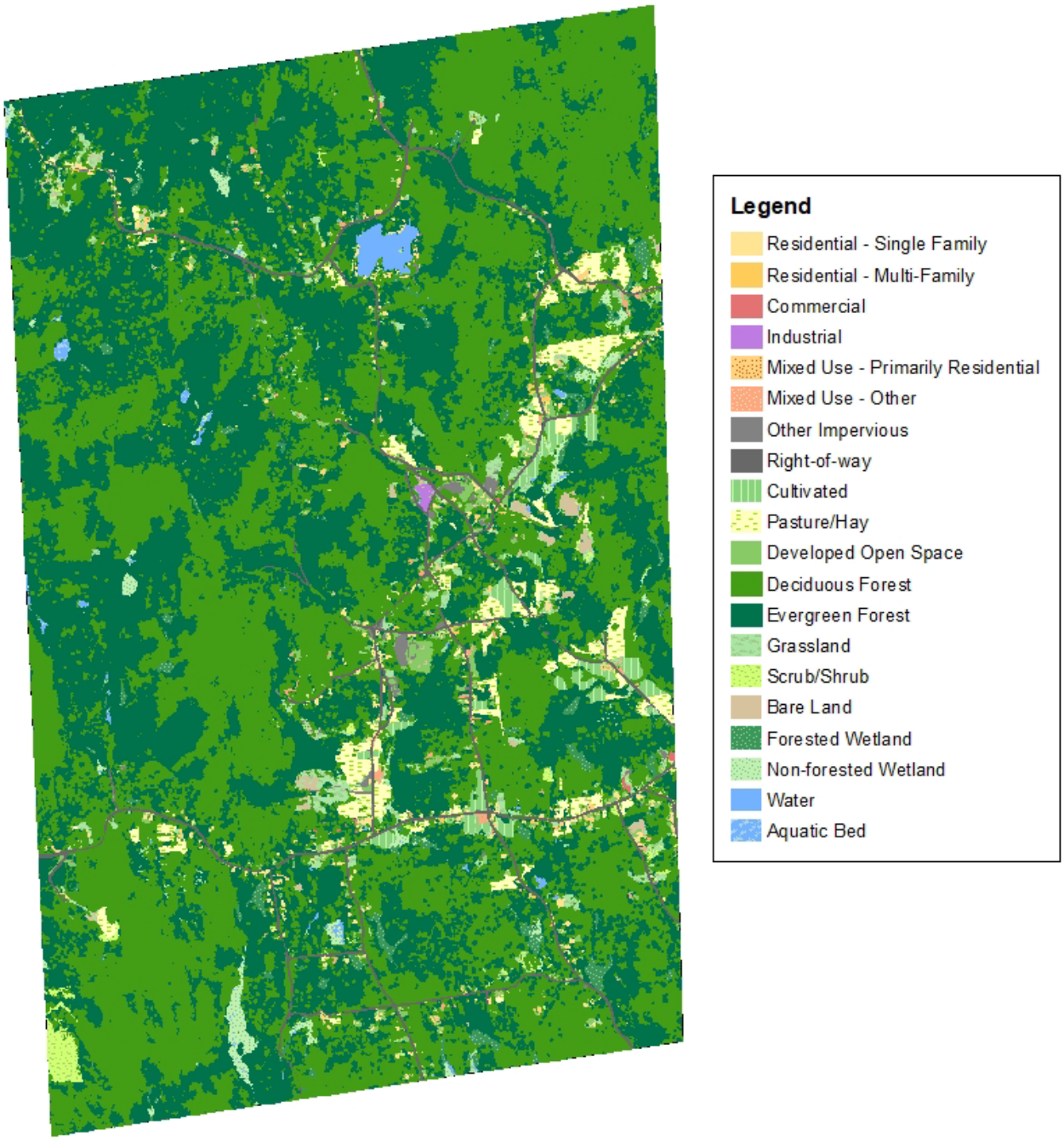
A.1 Roads and Property Lines

Data from MassGIS Tax Parcel data (https://docs.digital.mass.gov/dataset/massgis-data-standardized-assessors-parcels) and MassDOT roads (https://docs.digital.mass.gov/dataset/massgis-data-massachusetts-department-transportation-massdot-roads).



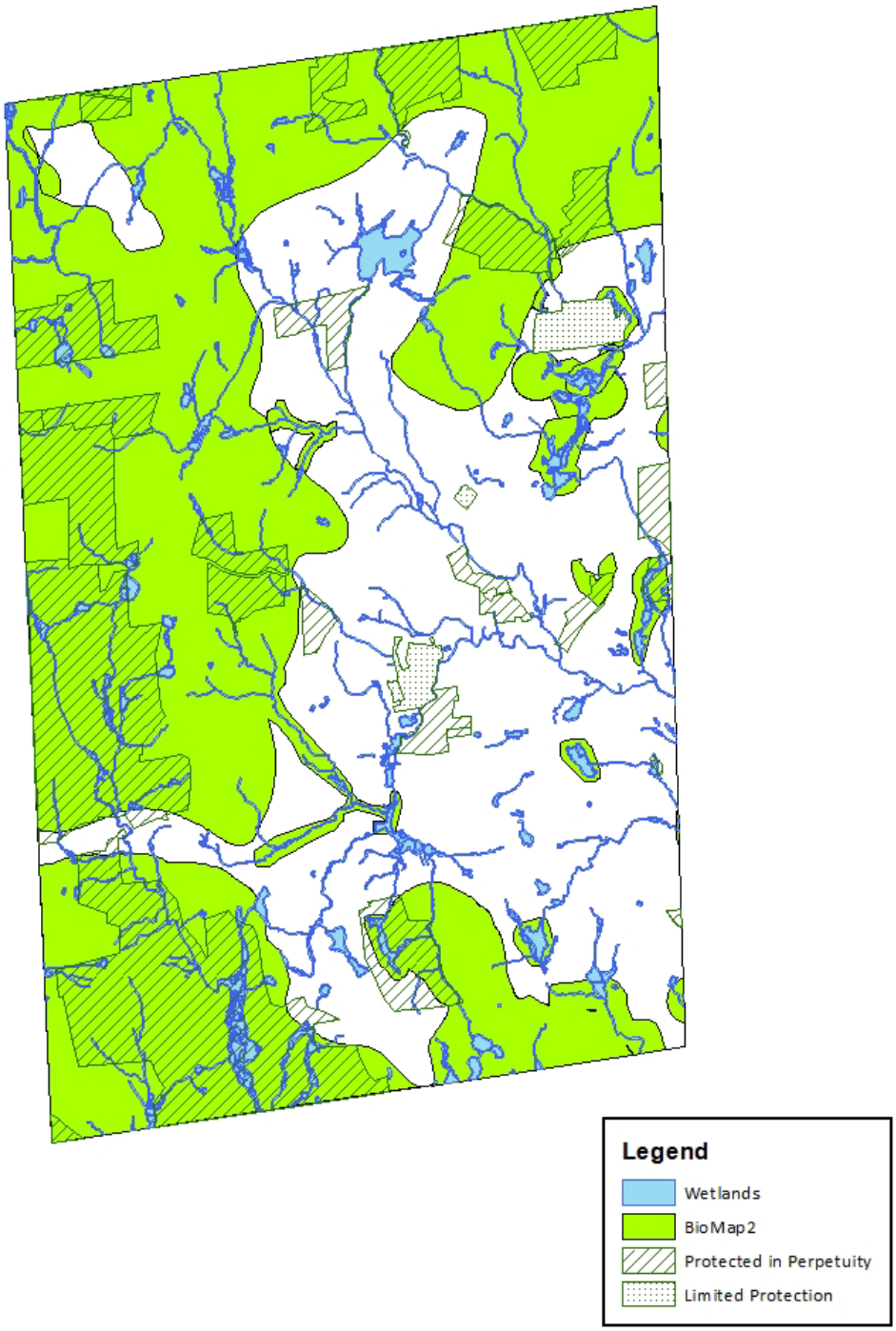
A.2 Land Cover

Land cover data from the MassGIS Land Cover/Land Use data layer, updated in 2016 (https://docs.digital.mass.gov/dataset/massgis-data-2016-land-coverland-use).



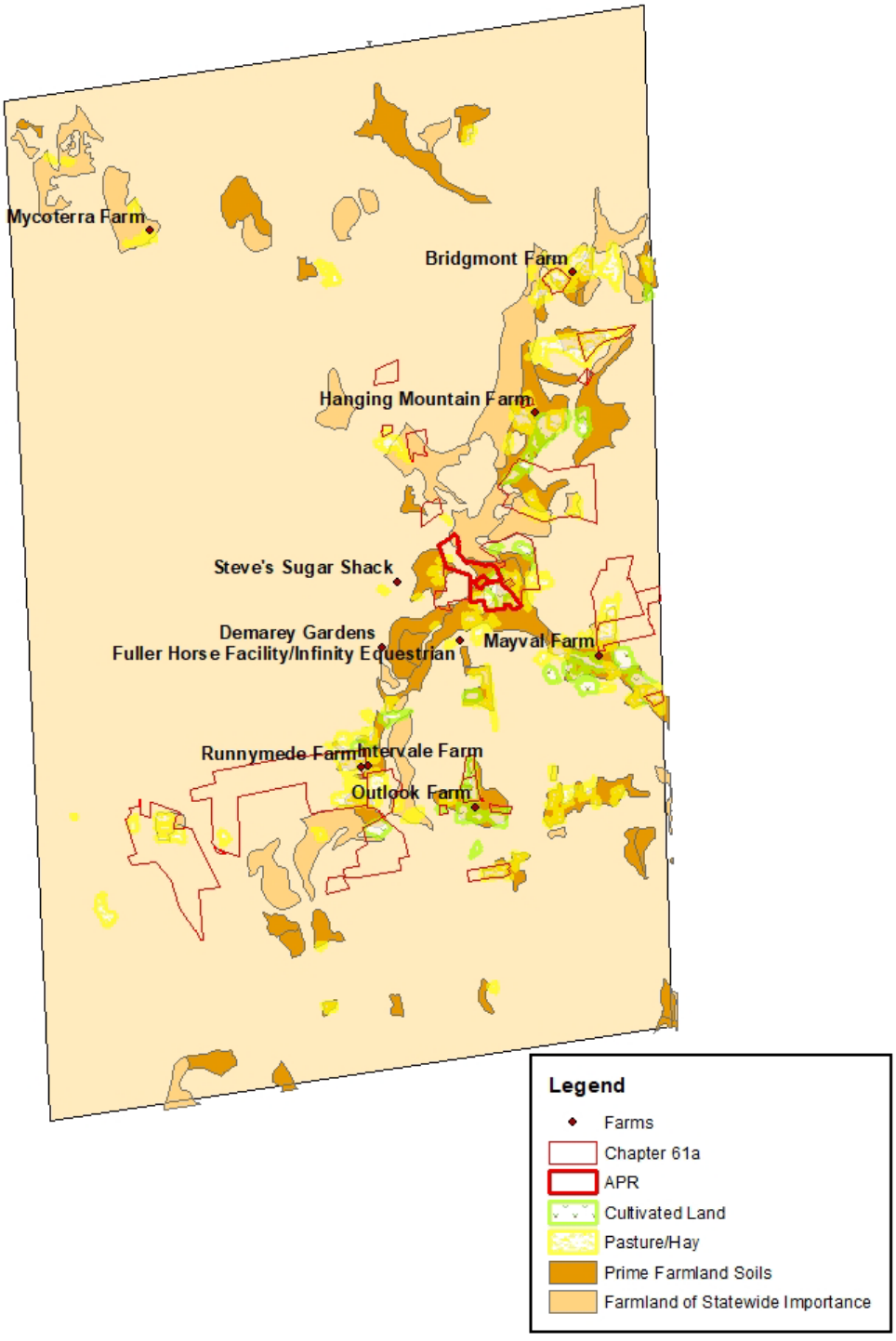
A.3 Conservation Land

Data from MassGIS BioMap2 repository (https://docs.digital.mass.gov/dataset/massgis-data-biomap2), MassGIS Protected Land and Recreational Open Space (https://docs.digital.mass.gov/dataset/massgis-data-protected-and-recreational-openspace), and MassGIS OLIVER DEP wetlands data layer (http://maps.massgis.state.ma.us/map_ol/oliver.php).



A.4 Agricultural Resources

Data from MassGIS Tax Parcel data (https://docs.digital.mass.gov/dataset/massgis-data-standardized-assessors-parcels), MassGIS Land Cover/Land Use data layer (https://docs.digital.mass.gov/dataset/massgis-data-2016-land-coverland-use), and NRCS SSURGO-Certified Soils (https://docs.digital.mass.gov/dataset/massgis-data-nrcs-ssurgo-certified-soils).



A.5 Parcels available for Commercial-Scale Development