Draft
Community Solar Action Plan

for

the Town of Deerfield

Photo Credit: *Paul Franz*

July 27, 2023
Prepared by

Samantha Curnyn & Ariel Waldman
UMass Clean Energy Extension

UMass Clean Energy Extension

209 Agricultural Engineering
250 Natural Resources Way
Amherst, MA 01003-9295
413.545.8510

energyextension@umass.edu
https://ag.umass.edu/clean-energy

Completed using the *Community Planning for Solar* Toolkit available at
https://ag.umass.edu/solarplanning

UMassAmherst | Clean Energy Extension

Executive Summary

The intent of this *Community Solar Action Plan* is to help guide future solar development within the Town of Deerfield by providing specific actions town residents and officials can take to develop solar on municipal properties, promote solar on residential and commercial properties, encourage solar development on locations preferred by the community, and adopt bylaw amendments and permitting processes in line with resident preferences. This Action Plan is a result of a thorough planning process, which included an assessment of community solar resources and infrastructure, distribution of a community solar survey, and based on these activities, development of this Plan. This process followed the steps outlined in the *Community Planning for Solar* Toolkit which is available on the UMass Clean Energy Extension website (http://ag.umass.edu/solarplanning).

Deerfield residents are highly supportive of solar development on previously disturbed and developed sites, while supporting little or no development of agricultural land and natural, undeveloped spaces. This Action Plan is based around a goal of achieving community self-sufficiency from solar, which would require roughly 94 MW of solar capacity, as well as exploring additional solar development to help meet state goals. Community self-sufficiency could largely be accomplished through development of previously disturbed and developed spaces; helping to meet state goals would require limited development of farmland and/or undeveloped land. Deerfield has some large, disturbed sites, particularly near the railyard in the northeastern corner of town. It also has large sections of electricity transmission ROW which could be explored for solar development. Major solar assets also include large rooftops and parking lots owned by businesses, institutions, and farms, most of which are located near three-phase lines and could safely connect to the grid. Residential rooftops and yards could also contribute a significant fraction (as much as one-quarter) of the town's future electricity needs. Deerfield has major roads – Interstate 91, Route 5 & 10, and Route 116 – running through it, and residents are supportive of development along these routes.

This Action Plan calls for outreach to residents, businesses, institutions, and farms to encourage solar development on rooftops and parking areas, as well as bylaw updates to streamline development of solar on disturbed sites and ROWs. Deerfield has language in its bylaw which discourages development of agricultural and natural lands, but this language could be made more specific to further direct siting and solar development towards locations and practices preferred by the community. Deployment of solar plus storage at municipal sites is recommended to provide the town with energy savings, as well as more effective emergency operations and shelter sites in case of a power outage.

Terms, Abbreviations, and Acronyms used in the Plan

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

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.

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
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
sf - square feet

Table of Contents

1. INTRODUCTION

1.1 Purpose

The intent of this *Community Solar Action Plan* is to help guide future solar development, municipal bylaw amendments, and solar permitting decisions within the Town of Deerfield. This plan also includes recommendations regarding specific activities to develop solar on municipal properties, campaigns to promote solar on residential or commercial properties, and next steps to encourage solar development on locations preferred by the community.

1.2 Planning Process

This draft *Community Solar Action Plan* was composed for the Town of Deerfield by UMass students Samantha Curnyn and Ariel Waldman and UMass Clean Energy Extension staff, as part of a two-semester, service-learning class at the University of Massachusetts Amherst, in which UMass undergraduates partnered with local communities to conduct a proactive, community-oriented solar planning process.

The draft *Community Solar Action Plan* developed through this project is the result of a thorough planning process, which included 1) an assessment of community solar resources and infrastructure, 2) development of town-specific alternative solar development alternatives, 3) distribution of a community solar survey and analysis of survey results, and finally, based on these activities, 4) development of this draft *Community Solar Action Plan*. This process followed the steps outlined in the *Community Planning for Solar* Toolkit which is available on the UMass Clean Energy Extension website (http://ag.umass.edu/solarplanning).

Before the *Community Solar Action Plan* is finalized, it will undergo review by municipal representatives involved in the project through the Solar Planning Committee and members of other relevant municipal boards (e.g., Connecting Community Initiative, Energy Committee, Select Board, Planning Board, Conservation Commission). It will be presented to community residents at a community forum, with the opportunity for residents to provide feedback. These review processes are expected to result in revisions which will improve the clarity, content, and implementation of the plan. The planning process was initiated in September 2022, the community survey was conducted in March-May 2023, and the community forum is expected to occur in late summer or early fall 2023.

Because Deerfield is one of the first towns to complete this planning process via collaboration with UMass students and staff, **we welcome and encourage comments not only on the town-specific content contained within this draft *Community Solar Action Plan*, but also on the scope, organization, and readability of information contained within this plan**. This more general feedback will help us to develop final deliverables and examples that provide greater clarity and utility for municipal representatives and community residents in towns across the state.

1.3 Community Goals & Plan Structure

Deerfield residents are motivated to combat climate change and strongly supportive of solar development. Based on the *Community Solar Survey*, 88% of residents are "extremely" or "moderately" concerned about climate change, and 93% reported they have a "positive" or "very positive" attitude towards solar energy.

Deerfield residents are most supportive of solar development on already developed spaces like roofs and parking lots: 81% indicated support for a community goal of developing all available roofs, parking lots, and previously disturbed lands for solar. Meanwhile, residents are concerned about conservation of undeveloped natural and agricultural lands within town and showed little support for developing large portions of these landscapes for solar. A majority of respondents (54% and 64% respectively) indicated that they would prefer to see no agricultural and natural lands developed for solar; the average of all responses was 16% and 13% development on farmland and natural lands respectively. A large majority of residents were also supportive (73%) or neutral (17%) regarding a goal of solar development sufficient to meet community needs, which could be accomplished without development of undeveloped lands. However, there was majority support for solar development to meet anticipated regional (75%) energy goals and state (58%) energy goals; the latter goal would require some development of undeveloped land.

With these results in mind, this Plan focuses on strategies and actions designed to aid in development of currently developed spaces and disturbed lands for solar to meet a goal of community self-sufficiency, as well as exploring additional solar development to aid in state goals for solar development. Based on our analysis, community self-sufficiency might ultimately require approximately 94 MW of solar development in Deerfield, 7x the current amount of solar installed. This estimate is based on future projections of energy use by 2050, including a transition from fossil fuel-powered vehicles to electric cars, and from traditional heating sources to renewable sources. Our estimates suggest this could be accomplished through extensive deployment of solar on developed and disturbed sites, or a combination of solar on disturbed/developed areas and limited deployment on undeveloped land. To help support state electricity needs, Deerfield would need to develop 170 MW, including 325-600 acres of currently undeveloped land. *[Note that these are estimates based on rough projections of future electricity needs and electricity sources. Future technological advances, land use decisions, and changes in population, community infrastructure, or energy use can be expected to lead to modifications to these estimates. It is anticipated that this plan and the calculations included herein will be revisited and updated regularly.]*

Meeting a goal of community self-sufficiency or supporting state electricity needs will require active efforts to deploy solar on developed spaces, disturbed lands, and other sites acceptable to the community. This plan is designed to help guide these efforts.

Discussions of solar development options are divided into five categories – residential, municipal, local business/institution, on-farm, and large, ground-mounted solar on private land. Within each category, we discuss the current status of existing solar capacity, community perspectives, the future potential for solar development, potential next steps, and specific action items.

Following the sections addressing solar development options is a section addressing the existing solar bylaw and how the bylaw and permitting processes could be updated to better reflect community attitudes expressed in the solar survey.

Finally, the plan concludes with a summary of action items and the anticipated timeline for when this plan will be revisited and revised.

1.4 Planning Process Documents

The final *Community Solar Action Plan* will be made available as an example on the UMass Clean Energy Extension website.

The *Community Solar Action Plan* will also be made available on the town website. Additional documents developed as part of the planning process (e.g. the *Solar Resource & Infrastructure Assessment*, the *Community Solar Survey Results Summary*) will also be made available on the town website.

MUNICIPAL SOLAR

This section addresses solar on municipal building rooftops, municipal parking lots, and municipal properties, including public schools located within the community.

2.1 Current Status

Existing Infrastructure & Electricity Use

Deerfield has nine municipal buildings which are currently listed in the town's Mass Energy Insight (MEI) account. The largest electricity users, from highest to lowest, are the South Deerfield Wastewater Treatment Plant, Deerfield Elementary School, the Town Hall, the Old Deerfield Wastewater Treatment Plant, the (new) Highway Department Building, the Frontier Senior Center, Tilton Library, and the Transfer Station. Additional municipal infrastructure that uses electricity includes streetlights, the pumping station, and the town clock.

Deerfield uses 1,078 MWh of electricity per year on average to supply municipal buildings and facilities (including streetlights and the town clock). The amount of solar capacity which would be needed to generate this amount of electricity is 829 kW.

Frontier Regional High School is located in Deerfield and serves Deerfield and surrounding towns. Deerfield shares responsibility for energy use in this building with Sunderland, Whately, and Conway. Energy use for this school is not included here because it is not available through Deerfield's town MEI account.

In Deerfield, the town currently has one municipally owned solar array, which is located at the Old Deerfield Wastewater Treatment Plant and has a 35 kW capacity (generating roughly 4% of annual electricity use). Nexamp, a solar developer, is contracted with the town to put solar on the former municipal landfill located at 42 Lee Rd. Construction will start in the fall of 2023 due to a lag in the permitting process. This project is projected to have approximately 2.95 megawatt (MW) direct current (DC) ground-mounted solar photovoltaic and 1.3 MW alternating current (AC) battery energy storage system.

Current Regulatory Status

Solar systems owned by the municipality or located on land owned by the municipality are defined as "Municipal Solar Energy Systems" in Deerfield's bylaw. In any configuration, they are allowed by right in all zoning districts, with a building permit and subject to appropriate property line setbacks and height restrictions.

Community Perspectives

Deerfield residents showed strong support for solar development on municipal buildings and properties. In the *Community Solar Survey,* 89% of residents indicated they felt the town should invest in solar development on municipal buildings and parking lots to meet municipal needs. In addition, 68% of *Solar Survey* respondents indicated support for town investment in solar projects to meet community resident electricity needs. In both questions, a number of respondents (4% and 21% respectively) indicated support that

depended on a number of factors. The most common important attributes mentioned were system ownership, financial costs and benefits, and potential impacts on the town budget or taxes.

Additional results relevant for municipal solar considerations:

- Most *Solar Survey* respondents are very likely (59%) or likely (21%) to support solar providing back-up power for critical facilities and emergency shelter locations, like the South Deerfield Fire Department.
- Most *Solar Survey* respondents support (33%) or strongly support (59%) development on former landfills.
- Most *Solar Survey* respondents strongly support (7%), support (27%), or are neutral to (29%) solar development near Deerfield's town center, where many town buildings are located.

2.2 Future Potential

Future Electricity Use

Based on current fossil fuel use (heating oil, propane, and natural gas) to heat town buildings, we estimate roughly 661 MWh of electricity would be needed to heat municipal buildings with air-source heat pumps. In addition, if all municipal vehicles were to be converted to electric, an additional 295 MWh is estimated to be needed as an alternative to gas and diesel. Under this scenario, municipal electricity use would roughly double, to 2,034 MWh, necessitating 1,564 kW (1.5 MW) of total solar capacity to meet municipal needs.

Note that this total does not include Frontier Regional, or potential future electricity use by school buses, which are currently owned and fueled by a private company. Both the state (https://www.masscec.com/program/notice-intent-accelerating-clean-transportation-school-bus-actbus) and federal government (https://www.epa.gov/cleanschoolbus) have recently begun providing competitive funding and/or technical support for the deployment of electric school buses.

Potential Energy Storage Locations

Several municipal sites could be good locations for energy storage systems. Frontier Regional High School, Deerfield Elementary School, and the South Deerfield Fire Department are all identified as potential emergency shelters in Deerfield's MVP Plan, and could benefit from energy storage in the face of outages and extreme weather events. The Solar Planning Committee has indicated that there is already a back-up generator at the South Deerfield Fire Department. The other sites do not have an energy storage system in place already.

The Town Hall was also identified as a site for potential energy storage; it is centrally located, within walking distance of downtown South Deerfield, and houses the Police Department, a vital emergency service. Energy storage could allow municipal functions to continue during an outage.

In addition, the Wastewater Treatment Plants in South Deerfield and Old Deerfield provide important services to the town, and could be considered as good sites for energy storage to supply power during an outage.

Municipal Rooftops & Parking Lots

The largest roofs on public buildings are at Frontier Regional, Deerfield Elementary School, and the Town Hall (**Table 1**).

Structure	**Street Address**	**Total Roof Area** (sq ft)	**Estimated Rooftop Technical Solar Potential** (kW)
Frontier Regional High School	113 North Main St	92,531	908
Deerfield Elementary School	21 Pleasant St	79,643	781
Town Hall	8 Conway St	17,915	130
Highway Department (DPW)	9 Merrigan Way	15,352	112
South Deerfield Fire Station	84 Greenfield Rd	13,157	96
DPW Garage *why separate	9 Merrigan Way	5,976	44

Table 1. Publicly owned properties with large areas of roof available for solar.

Other town buildings include Tilton Library, the Frontier Senior Center, Wastewater Treatment Plant facilities, and the Transfer Station. These sites have smaller rooftops which may not be economically viable for solar production but could still be considered in an on-site evaluation of municipal buildings.

A number of municipal locations also have paved areas that could be appropriate for solar. The sites with the largest parking lots are Deerfield Elementary, the Town Hall, and Frontier Regional School. There is also a large, paved area around the Transfer Station. This site is not a formal parking lot and may not be able to have solar installed on most of the site, since vehicles need to be able to come through to access recycling and trash drop-off locations at the facility. Parking lots can have a packing density of approximately 263 kW per acre; estimates of the technical potential provided below are based on this value.

Location	Street Address	Approximate Area (sf)	Estimated Solar Technical Potential (kW)
Frontier Regional High School	113 North Main St	2.5	642
Transfer Station	42 Lee Road	1.3	339
Deerfield Elementary	21 Pleasant St	1	271
Town Hall	8 Conway St	0.7	171

Table 2. Municipal properties with large paved areas available for solar.

Our estimate of total technical potential on these roofs (2,071 kW) and parking lots (1,423 kW) is roughly 3,494 kW (3.5 MW). However, this is the technical potential. This estimate does not take into account roof condition, driveways, logistics, economic considerations, or other considerations, and hence is likely a significant overestimate of actual potential. All of these locations would require on-site evaluations to understand use patterns, available space, and actual solar potential.

Solar arrays over 50 kW in size often must connect to three-phase electricity distribution lines in order to interconnect to the electricity grid safely. Conveniently, all of the large municipal rooftops and parking lots listed in Tables 1 and 2 are located near three-phase lines.

Ground-Mounted Solar

One additional municipal site identified as of interest for solar development is the former landfill located at 42 Lee Rd. However, this site is already under contract to be developed for solar by Nexamp (see Section 2.1).

Financial Considerations

Development of solar on municipal buildings and land can be simpler in some ways than development on private land because town boards have the greatest control over determining whether these projects proceed. However, towns do not always have funding available to pay for large solar projects.

Financial costs and benefits of municipal solar are dependent on many factors, including system size, system cost, electricity rates, solar incentives, federal and state tax credits, loan amount, and loan terms (interest rate, term). All of these items are site-dependent, and subject to change over time. Historically, municipal governments were unable to receive federal or state tax credits for solar development, which could make these projects more challenging from a financial perspective. However, with the recent passage of the federal Inflation Reduction Act, organizations and individuals that do not owe taxes now are eligible for a "direct payment" option, which can cover 30% of the costs of a new solar installation. This change will make small to medium-size municipally-owned solar projects more financially viable. Depending on the size, location, and type of system, new solar arrays may also be eligible for solar incentives through the state SMART program on a fixed $/kWh basis; this program has a specific additional incentive for "public" projects owned,

operated, or benefitting the municipality. Alternatively, the town can earn Renewable Energy Credits for each MWh of solar energy that is generated. Some financial institutions offer loans which can be applied to solar projects or may offer specific solar loans designed to cover the costs of new solar arrays. UMass CEE can assist the town with calculations of the costs and savings associated with specific municipal solar projects.

2.3 Next Steps & Action Items

Potential next steps for municipal solar development include:

- Work with school staff, FRCOG, and Energy Committees in neighboring towns to compile, analyze, and review energy usage at Frontier Regional.
- Conduct on-site evaluations of solar potential on rooftops at Frontier Regional, Deerfield Elementary School, the Town Hall, the South Deerfield Fire Station, and the Highway Department building and DPW Garage, with the assistance of a solar installer. Also conduct on-site evaluations at parking lots at Frontier Regional, Deerfield Elementary School, and the Town Hall. Evaluations should include rough quotes for installation cost and identify potential obstacles to development (e.g., roof warranties, roof structure, interconnection). The evaluations at Frontier Regional, Deerfield Elementary School, and the Town Hall should include energy storage options to support emergency shelters at these facilities.
- Consider whether other, smaller municipal buildings should be included in the evaluations above, such as Tilton Library or the Frontier Senior Center.
- Conduct on-site evaluations of roof, small ground-mounted, or floating solar systems at Deerfield's two wastewater treatment plants, with the assistance of a solar installer. Include assessments of energy storage potential.
- Explore potential options to support solar development aside from direct use of town funds (e.g., ARPA funds, MVP grants, solar loans).
- Carry out financial analyses to understand costs and benefits of specific solar options (UMass CEE can assist).
- Complete a table to plan for future development, e.g.:

Building/ Location	Address	Solar Potential	Rough Cost ($)	Roof Warranty Information	Roof Structural Needs/ Cost	Energy Storage Needs?	Funding Sources ?	Anticipated Year for Development?

- Explore potential for electric buses and associated charging needs for Deerfield Elementary School and Frontier Regional.

Action Items

Commented [ZD1]: This table is to be filled out by the Energy Committee and other town boards/committees, depending on the tasks and timeline they want to take on. This table is partially filled out, as an example. Subsequent tables are blank but can be filled out based on Next Steps. CEE can help the town with this process if desired - but doesn't want to dictate a timeline or priority action items.

Action	Lead Entity (or Entities)	Supporting Entities	Start Year/ Annually?
Conduct on-site solar evaluations on roofs and parking lots	Deerfield Energy Committee	Solar Installer, school staff	
Review energy usage data for Frontier Regional	Deerfield Energy Committee, FRCOG, school staff	Energy Committees neighboring towns; Green Communities Program	
Explore solar and energy storage potential at wastewater treatment plants	Deerfield Energy Committee, municipal staff	Select Board	
Explore solar funding options for municipal projects	Deerfield Energy Committee	Finance Committee, FRCOG	
Carry out financial analyses	UMass Clean Energy Extension	Energy Committee, Finance Committee	
Create a timeline for future municipal solar development	Deerfield Energy Committee	Finance Committee, Select Board	
Explore opportunities for electric bus use & charging needs at Elementary School	Deerfield Energy Committee, School Committee	school staff, EPA, MassCEC, bus companies	
Explore opportunities for electric bus use & charging needs at Frontier Regional	Deerfield Energy Committee, School Committee	Energy Committees (Conway, Whately, Sunderland); School Committee; school staff; MassCEC, bus companies	

2. RESIDENTIAL SOLAR

This section addresses solar on residential properties, including solar on house rooftops or in residential yards.

3.1 Current Status

Existing Infrastructure & Regulatory Status

Currently, Deerfield has 209 residential solar systems, with an average size of 8.46 kW, and representing a total of 1,768 kW of solar capacity. Roughly 6% of households have a residential solar system.

Residential-scale solar systems are most likely to be regulated as roof-mounted or small-scale ground-mounted solar energy systems in Deerfield. Both types of systems are permitted by right with a building permit in all zoning districts. Ground-mounted systems that exceed 1,000 sf (roughly 15 kW) could be classified as medium-scale ground-mounted systems, which are also allowed by right in all zoning districts, but subject to Site Plan Review.

Community Perspectives

In the *Community Solar Survey*, Deerfield residents indicated strong support for solar development on residential roofs and in residential yards. Out of all respondents, 82% felt "positive" or "very positive" about solar installed on residences, and 70% felt "positive" or "very positive" about solar in residential yards.

At total of 45% of residents that did not currently have solar installed at their residences were interested in doing so. An additional 28% were not sure. Major reasons residents cited for not already having a system installed were upfront cost (49%), not knowing enough about their options (31%), distrust of solar developers (28%), and having a shaded property (27%). Several respondents that chose "other" cited concerns about aesthetics and age/condition of the roof.

3.2 Future Potential

Solar Potential on Residential Rooftops & Yards

Potential residential solar capacity in Deerfield can be estimated through several different methods. If solar were installed on all small building roofs in town, the total technical potential would be 21 MW. However, installing solar on many roofs may not be technically or economically feasible, due to shading, roof structures, and economies of scale (i.e., installing scattered, small systems on very small roofs may not make financial sense). Based on estimates of shading on residential properties, it may be more reasonable to assume about 69% of residential properties in Deerfield have roofs or unshaded yard space available for solar (see *Solar Infrastructure and Resource Assessment* for more details). Currently, the average size of a residential solar PV system in Deerfield is 8.46 kW. If 69% of homes were to install a solar PV system of this size, it could provide about 12.6 MW of electricity generation capacity. This would be equivalent to about 13% of the electricity generation capacity anticipated to be needed in the future to support 100% of the community's electricity needs with solar power.

Residential solar PV systems are typically sized to generate enough electricity to cover current household electricity needs. A 5.5 kW residential solar PV system can generate what works out to an average of 600 kWh of electricity per month (the average household monthly electricity use in Massachusetts), with higher solar generation occurring in summer months and lower generation during the winter. Average monthly electricity use in Deerfield households is 717 kWh, which is somewhat higher than the state average. The average size of a household solar PV system in Deerfield is 8.5 kW (average of roughly 920 kWh generation per month), which suggests current solar systems in town are located on houses with higher-than-average electricity use or are designed to meet more than current electricity needs.

As personal vehicles and home heating systems are converted to electricity-based systems, we predict average household electricity use in Deerfield could increase by roughly 2.5x, necessitating a system of roughly 16.5 kW to offset future household electricity demand. Ultimately, if 69% of households were to install a 16.5 kW system to meet future electricity needs, residential systems could contribute 24.6 MW of solar. This is equivalent to 26% of the estimated 94 MW of solar capacity needed to offset Deerfield's anticipated future electricity demand.

While some of this technical potential is captured in the values discussed above, it is worth noting that as a community with a long history of farming, Deerfield has many barns, some of which are in commercial use (see Sections 4 and 5), but others of which are on residential properties. From a desktop analysis, it is not always clear which barns are being used for agriculture or other commercial uses, as opposed to residential use. There are some 32 properties with large houses (over 5,000 sf), houses attached to large barns, or stand-alone barns on residential properties. These total over 200,000 sf of roof space and nearly 1,480 kW of solar capacity.

Financial Considerations

Financial costs and benefits of a residential solar are dependent on a number of factors, including the system size, system cost, electricity rates, solar incentives, federal and state tax credits, loan amount, and loan terms (interest rate, term). All of these items are site-dependent, and subject to change over time. Despite high interest rates and minimal solar incentives, our estimates suggest that residential solar systems are nevertheless currently a financially feasible option for Deerfield residents, because the cost of a monthly electricity bill is at this time higher than the cost of a solar loan payment, so a resident with a new solar system installed could pay less per month for electricity than one without, and after the loan is repaid, the solar system will continue to generate free electricity.

For example, UMass Five College Credit Union currently offers solar loans at a rate of 7.24% for 10 years or 7.49% for 15 years. Currently, there is a federal tax credit rebate of 30% of the cost of an installed solar system, in addition to a $1,000 tax credit available for Massachusetts state taxes. Solar incentives through the state SMART program have dropped to $0 for residential systems (<25 kW) in Deerfield. However, as an alternative to the SMART program, residents can earn Renewable Energy Credits for each MWh of solar energy that is generated; RECs currently can be sold for about $34 per REC, although that number is expected to decrease over time, and our estimates use an average value of $22

per REC. With federal tax credits, state tax credits, and solar incentive payments, the monthly payment on a 15-year loan on the remaining balance for an 8.5 kW system priced at $3.59/kW (the Franklin County average according to MassCEC) is below the monthly cost of electricity generated by a system of that size that would appear on an Eversource electricity bill. For a 10-year loan, there is significant cost to the customer over the first 10 years ($250-$550 per year), but the net value is positive due to avoided electricity costs ($41,000 over 25 years, not adjusted for the opportunity cost of not investing the money elsewhere). The resident would likely need to replace the inverter for the system after about 10-12 years, but would still make money over the course of the PV system lifespan.

The financial balance could be more challenging for low-income residents. However, there are some potentially feasible options available. The nonprofit Capitol Good Fund last year began offering "DoubleGreen" solar loans at a fixed rate of 3.1%-4.2% for 25-year terms for low-income ratepayers in Rhode Island, which if offered in Massachusetts could make solar PV systems economical for low-income residents here. Through the passage of the federal Inflation Reduction Act, low-income residents who do not owe taxes are now eligible for a direct payment equal to 30% of the installed cost of a new residential solar system. In addition, low-income residents are currently eligible for an approximately $0.009 per kWh state solar incentive, or the REC payment of $34/MWh described above. Affording a solar loan might still be challenging for some low income (R-2) customers, who are eligible for reduced electricity rates to begin with, and therefore might have difficulty obtaining a monthly loan payment that is lower than their reduced electricity bill. UMass CEE can assist in estimating the specific financial costs and benefits for Deerfield residents.

3.3 Next Steps & Action Items

Potential Next Steps

Since there is strong interest in and support for residential solar, there is potential for a large increase in solar capacity on residential roofs and in residential yards. The major barriers to overcome appear to be 1) lack of knowledge of options regarding solar PV systems, 2) financial concerns, 3) lack of trust of solar developers, and 4) logistical challenges with locating solar PV systems on some shaded residential properties.

Public Information Sessions

In order to overcome general hesitancy, address concerns, and increase resident knowledge, Deerfield residents could benefit from annual or semi-annual public information sessions about residential solar, highlighting state and federal incentives and solar loan options, addressing safety concerns, and elucidating the range of options available. Some recommendations regarding these sessions include:

- **Speakers and content**. Given some residents' lack of trust of solar companies, it would be preferable to have the majority of information presented by a neutral party rather than a company with a vested interest in solar development. It would be helpful to include participation by town residents who have had solar installed, and who could speak to the benefits and any challenges associated with installing a residential solar array. This session could include specific financial information (see below), as well as opportunities for neighbors to coordinate on solar installations.

Financial analysis of residential systems. CEE is happy to work with Deerfield to provide a simple calculator to help residents at a public forum estimate the costs and benefits of a solar system that meets their needs and specifications.

Specific solar loan programs available through financial institutions. CEE plans to compile a list of institutions involved in solar financing around the state, and specific solar loan programs, which could be addressed included the public forum. The state's Mass Solar Loan program is no longer active. If revived, it would be helpful to include information about this program as well.

Handouts and Factsheets

In addition to information sessions, factsheets/handouts with content similar to that provided at Public Information Sessions could be distributed at annual Town Meeting or other local events.

Assisting Residents with Shaded Properties

Forested residential properties, as are common in Deerfield, may not be appropriate for solar. Residents may in some cases choose to cut some trees to provide an opening for solar, but this is not always possible or preferred. Creative approaches are necessary to provide residents of shaded properties the benefits of solar. Solutions to give residents living on shaded properties access to solar include:

Neighbors helping neighbors. Residents with properties that could host solar have the opportunity to install a larger system that meets more than their current needs. There are not clear financial models available at present to have neighbors jointly own a small array and share in tax credit benefits. However, there are straightforward pathways for net metering agreements between community residents to share in the benefits of solar generation. In this situation, a resident with a large roof might install and own a system larger than that necessary to meet their own needs, then net-meter electricity credits over to a different community member's account through a form known as a Schedule Z. It is possible (and common) to establish a legal contract which could guarantee the price per net metering credit - providing the project host/owner a known income each year - and such an agreement could include a commitment to pay a portion of upfront installation costs.

Community solar array. If about one-third of residential properties in Deerfield cannot host solar, there is likely to be appetite for community solar for people who own shaded properties. It is worth considering whether there are properties where a community-owned project on public or private land could be owned by a group of local residents. The town could work to identify locations where a small community solar array could be sited in different parts of town.

Residential Solar Campaign

The town Energy Committee or a committed group of residents could conduct a Solarize Mass-style campaign to encourage multiple households to install residential solar PV systems at the same time. The Solarize Mass program is no longer active, but the campaign tools developed as part of the program are still available. The benefits of such a campaign include neighbor support in the purchasing of a solar array and the opportunity to work through challenges together, as well as the feeling of participation in a collective,

community effort. In addition, residential solar campaigns can lead to lower installation costs, due to economies of scale associated with the solar installer working on multiple projects in one location.

Specific Next Steps

Based on the above, specific potential next steps for residential solar development include:

- Organize and hold a community solar forum once annually to discuss options for residential solar development.
- Design and distribute flyers/handouts to explain residential solar development options, highlighting their financial feasibility, and including a description of how to arrange a net metering agreement with a neighbor to share solar electricity generation.
- Research sites around town which could be potential sites for community-shared solar facilities.
- Conduct a residential solar campaign once annually, with a goal of recruiting 50 households per campaign.

Action Items

Action	Lead Entity (or Entities)	Supporting Entities	Start Year/Annually?
Organize and hold a community solar forum	Deerfield Energy Committee	CEE, Solar Installers, Financial Institutions	
Design and distribute a residential solar handout			
Research sites around town which could support community-shared solar facilities			
Conduct a residential solar campaign			

3. SOLAR FOR BUSINESSES AND INSTITUTIONS

This section addresses solar on commercial and institutional buildings and parking lots.

4.1 Current Status

Existing Infrastructure

There are a number of large buildings and large paved areas on commercial and institutional properties which might be suitable for solar (see *Future Potential*).

There are several small solar arrays associated with private schools in Deerfield: the Bement School has a 22 kW solar array, Eaglebrook School has three solar arrays totaling 213 kW, and Deerfield Academy has eight arrays totaling 137 kW.

Current Regulatory Status

Solar systems on commercial and institutional roofs and parking lots could fall under one of several categories in Deerfield's bylaw. Roof-mounted solar energy systems, small-scale ground-mounted solar energy systems, and solar canopies are all allowed by right with a building permit in all zoning districts in Deerfield. Ground-mounted systems that exceed 1,000 sf (roughly 15 kW) could be classified as medium-scale ground-mounted systems, which are also allowed by right in all zoning districts, but subject to Site Plan Review.

Community Perspectives

Out of all survey respondents, 49% indicated that knowing an organization or business uses solar energy makes them feel more positively towards that organization and 22% said it makes them more likely to purchase goods from that organization. Only one respondent said that the presence of solar makes them feel more negatively about an organization.

Three-quarters of survey respondents indicated support for solar development of 80% or more of large rooftop space – such as those on businesses and institutions.

4.2 Future Potential

Commercial & Institutional Rooftops

Rooftops can provide roughly 1.5 kW of solar per 100 sf of suitable roof space. On medium roofs (5,000-25,000 sf), about 49% of the roof area is suitable for solar. On large roofs (over 25,000 sf), about 66% of roof area is suitable for solar.

There are a total of 133 medium and large roofs owned by businesses or institutions in Deerfield. These roofs total 3.09 million sf in area and 27.6 MW of technical solar potential. The complete list of these roofs is provided in Appendix A.

Locations with the greatest potential for roof-mounted solar on businesses or institutions are summarized in **Tables 3 and 4**. The institutions with the largest roof area are all private schools – Deerfield Academy, Eaglebrook, and the Bement School. Among the businesses with the largest roofs are Yankee Candle, AFI Furnishings, and the Treehouse Brewing Company. All of these roofs would require on-site evaluations to review the underlying roof structure, identify any shading concerns from adjacent vegetation, identify roof-mounted equipment that could interfere with the placement of solar panels, and determine actual solar potential.

The largest 90 institutional and commercial rooftops in Deerfield could potentially host a solar array over 50 kW in size. Solar arrays over 50 kW in size often must connect to three-phase electricity distribution lines in order to interconnect to the electricity grid safely. Out of these 90 rooftops, nearly all are located near three-phase lines. For large rooftops not located near three-phase lines, the size of the system may be limited to less than 50 kW by local grid infrastructure, or local infrastructure may need to be upgraded to accommodate larger projects. Alternatively, integration of an energy storage system with the solar array may allow a larger solar array to be interconnected to the grid. Solar arrays under 50 kW in size can typically safely connect to single-phase or three-phase electricity distribution lines.

Captions for following pages:

Table 3. A total of 39 privately owned roofs over 5,000 sf are owned by Deerfield Academy, Eaglebrook, or the Bement School. A complete list of privately owned roofs over 5,000 sf is included in Appendix A.

Table 4. Businesses with one or more roofs totaling 250 kW of solar capacity, or more. A complete list of privately owned roofs over 5,000 sf is included in Appendix A.

Institution	Street Address	Roof Area (sf)	Estimated Technical Solar Potential (kW)
Deerfield Academy	27 ALBANY RD	129,220	1,267
		44,750	439
		18,254	133
		11,769	86
		9,612	70
		7,050	51
		6,181	45
	36 OLD MAIN ST	12,223	89
	4 LITTLE MEADOW RD	26,632	261
		12,366	90
		12,302	90
		6,948	51
		5,193	38
	518 RIVER RD	6,180	45
	612 GREENFIELD RD	9,967	73
	70 A OLD MAIN ST	17,405	127
		11,356	83
		11,249	82
		9,847	72
		9,391	68
		6,961	51
		5,084	37
Eaglebrook	0 RICES FERRY RD	14,189	103
	11 COUNTY RD	34,095	334
	283 PINE NOOK RD	25,004	245
		15,905	116
		14,844	108
		14,671	107
		10,888	79
		8,243	60
		7,085	52
		6,647	48
		5,633	41
		5,007	36
Bement School	100 OLD MAIN ST	8,755	64
		5,959	43
		9,148	67
	142 OLD MAIN ST	6,661	48
		6,449	47

Business	Street Address	Roof Area (sf)	Estimated Technical Solar Potential
Yankee Candle	27 YANKEE CANDLE WAY	259,090	2,541
	25 GREENFIELD RD	121,286	1,190
	1 PLAIN RD EAST	62,292	611
	5 NORTH ST	51,751	508
	16 YANKEE CANDLE WAY	32,037	314
	25 GREENFIELD RD	14,596	106
Hardigg Industries	147 NORTH MAIN ST	277,288	2,720
AFI Furnishings	5 INDUSTRIAL DRIVE WEST	246,764	2,420
Warehouse	10 GREENFIELD RD	171,956	1,686
Business	14 INDUSTRIAL DRIVE WEST	139,806	1,371
Treehouse Brewing Co	1 COMMUNITY PL	91,102	893
CSX Transportation	16 RAILROAD YARD RD	47,162	463
O'Leary/Vicunas LLC	20 INDUSTRIAL DRIVE EAST	25,894	254
		24,260	177
Pro Pel Plastics	4 INDUSTRIAL DRIVE EAST	38,652	379
	378 LONG PLAIN RD	32,791	322
Red Roof Inn	9 GREENFIELD RD	36,608	359
Harris ReBar	73 OLD STATE RD	35,300	346
Ideal Movers & Storage - Self Storage	247 GREENFIELD RD	16,022	117
		10,056	73
		8,010	58
		7,703	56
Nutrien Ag Solutions	25 ELM ST	22,101	161
		15,264	111
Magic Wings Butterfly Conservancy	281 GREENFIELD RD	28,980	284
Deerfield Railyard	6 RAILROAD YARD RD	26,374	259
Habitat Post & Beam	19 ELM ST	15,781	115
		13,344	97
		5,290	39

Commercial & Institutional Parking Lots

Deerfield also has many organizations with large parking lots. Potential sites for solar parking canopies on businesses or institutions are summarized in **Table 5**. All parking lots 0.5 acres or greater are shown. Parking lots can have a packing density of approximately 263 kW per acre[1], but because the paved areas noted here in some cases include driveways, estimates of technical potential based purely on acreage are likely to be overestimates. All of these locations would require on-site evaluations to understand use patterns, available space, and actual solar potential.

Location/Ownership Status	**Street Address**	**Approximate Area**	**Estimated Solar Technical Potential** (kW)
Railroad Yard	32 Railroad Yard Rd	7.5	1,983
MassDOT South Deerfield Depot	93 Route 116	5.8	1,525
Yankee Candle	25 Greenfield Rd	5.3	1,394
Deerfield Industrial Park East	20 Industrial Dr E	4.6	1,210
Pelican & Hardigg	147 North Main St	3.4	894
Douglas Auctioneers	241 Greenfield Rd	2.7	710
MassDOT Pan Am Railways	236 Greenfield Rd	2.3	605
Tree House Brewery	1 Community Pl	1.7	434
YDC	10 Mill Village Rd	1.5	395
Deerfield Academy	7 Boyden Ln	1	263
Aromatic	241 Greenfield Rd	0.9	237
Deerfield Pharmacy/ Golden China Restaurant	45 S Main St	0.8	218
Magic Wings Butterfly Conservatory	281 Greenfield Rd	0.6	158
Berkshire Brewing Company	12 Railroad St	0.6	158
The Belmont School	94 Old Main St	0.5	137
Wolfies Family Dining	52 S Main St	0.5	132
New England Meetinghouse Design	222 Greenfield Rd	0.5	132

Table 5. Commercial and institutional parking lots with 0.5 acres or more of paved area.

Solar arrays over 50 kW in size often must connect to three-phase electricity distribution lines in order to interconnect to the electricity grid safely. Conveniently, all of the parking lots listed in **Table 5** are located adjacent to or in the near vicinity of three-phase lines.

Financial Considerations

Financial costs and benefits of commercial and institutional solar are dependent on many factors, including system size, system cost, electricity rates, solar incentives, federal and state tax credits, loan amount, and loan terms (interest rate, term). All of these items are site-dependent, and subject to change over time. Currently, there is a federal tax credit of 30% of the cost of an installed solar system, in addition to a $1,000 tax credit available for Massachusetts state taxes. Through the passage of the federal Inflation Reduction Act, non-profit organizations who do not owe taxes are now eligible for a direct payment equal to 30% of the installed cost of a new solar system. Depending on the size, location, and type of system, new solar arrays may also be eligible for solar incentives through the state SMART

program on a fixed $/kWh basis; alternatively, businesses and institutions can earn Renewable Energy Credits for each MWh of solar energy that is generated. Solar canopies can earn additional SMART incentive adders.

Some financial institutions offer business loans which can be applied to solar projects or may offer specific solar loans designed to cover the costs of new solar arrays. For example, UMass Five College Credit Union currently offers solar loans for up to a 10-year term. More information about financing and other aspects of solar for businesses and institutions can be found at: https://www.masscec.com/resources/commercial-solar-information-hub.

4.3 Next Steps & Action Items

Potential next steps for solar development on at businesses and institutions include:

- Conduct outreach to the businesses in town with the largest roofs and parking lots (Tables 3, 4 and 5) to assess their interest in solar or solar plus energy storage on roofs or over parking lots. Stress solar survey results indicating local support for businesses that use solar energy and potential cost savings.
- South Deerfield has many businesses with significant space on rooftops and parking lots. Conduct a door-to-door campaign to provide on-site solar evaluations and educational resources to businesses in this village.
- Reach out to the three large private schools – Deerfield Academy, Eaglebrook, and the Bement School – to assess their interest in adding additional solar to meet school or community needs. Stress residents' positive response to solar in the *Community Solar Survey* and opportunities to sell electricity to the community.
- Consider whether one of the large private schools could be an appropriate site for a secondary emergency shelter in the more northern part of town, in case a snowstorm or other emergency makes travel to South Deerfield difficult. Bement School and Deerfield Academy could be an appropriate location for a microgrid to provide power during an outage. If these sites are not feasible, reach out to religious institutions, social halls, or nonprofit organizations outside of South Deerfield to assess their interest in serving as local emergency shelters and the feasibility of solar plus battery storage at these locations. More information about local microgrid assessments can be found here: https://www.masscec.com/program/community-microgrids
- Assist interested businesses with estimation of costs and rebates.
- Reach out to owners of multi-unit housing to explore possibilities to grant renters the benefits of solar electricity.

Action Items

[To be filled out based on what Energy Committee and other municipal boards want to take on in the next 3-5 years.]

Action	Lead Entity (or Entities)	Supporting Entities	Start Year/ Annually?

4. ON-FARM SOLAR

This section addresses solar on farms, including solar arrays on farm buildings and greenhouses, solar canopies designed to shelter parked farm vehicles, and ground-mounted solar development on land owned by farm businesses or actively farmed.

5.1 Current Status

Existing Infrastructure

Deerfield has many active farms and significant acreage in agricultural production. Based on Mass GIS Land Cover data, the town has roughly 2,054 acres in cultivation and 1,047 acres in pasture or hay production. 2,120 acres of agricultural land are protected in perpetuity through an Agricultural Preservation Restriction. In addition, at least 172 properties totaling 2,455 acres participate in the Chapter 61A program for the purposes of agricultural production (not including productive woodlots).

Active farms and agricultural businesses in Deerfield include:

- Antonellis Farm (Ciesluk Farm Stand) – 564 Greenfield Road
- Atlas Farm – 218 Greenfield Rd
- Bar-Way Farm – 188 Mill Village Road
- Chang Farm – 301 River Road
- Clarkdale Fruit Farms – 303 Upper Road
- Forest City Farms – 72 River Road
- Galenski Farms – 96 North Main Street
- Karas Farms – 15 Hillside Road
- Kingsbury Farm – 143 Sandgully Road
- Kolakoski Farm Stand – 373 Greenfield Road
- Manheim Farm – 311 River Road
- Mycoterra Farm – 75 Stillwater Farm
- Open Palm Farm – 10 Jones Road
- Pioneer Gardens – 425 Greenfield Road
- River Bard Farm – 194 Lower Road, by the Deerfield River
- Roaming Farm – 80 South Mill Road
- Robariah Farms – 5 Captain Lathrop Drive
- Savage Farms – 128 Lower Road
- Stillwater Meadow Farm – 230 Stillwater Road
- Stockbridge Farm – 18 Stockbridge Road
- Warm Colors Apiary – 2 South Mill River Road

The UMass Amherst Crop and Animal Research and Education Center is also located in South Deerfield, on River Road.

There are many roofs on barns, agricultural buildings, and greenhouses which could be suitable for solar (see *Future Potential*).

Several farms have small or medium solar facilities currently.

- Atlas Farm owns three facilities totaling 98 kW.

- Clarkdale Orchards has a 20 kW facility.
- Savage Farms has a 33 kW facility.

The total capacity of these solar facilities is 151 kW (0.15 MW).

Since 2010, the UMass Amherst Crop and Animal Research and Education Center in South Deerfield has been home to a ground-mounted solar photovoltaic array. The 106-panel, 25 kW "agrivoltaic" system is mounted high enough off the ground to allow sunlight penetration for farming and animal grazing.

In addition, there is an anaerobic methane biodigester at Bar Way Farm with a 1000 kW (1 MW) capacity.

Current Regulatory Status

As discussed in previous sections, roof-mounted solar energy systems and small-scale ground-mounted systems (up to 1,000 sf) are allowed by right in all zoning districts with a building permit. Solar greenhouses are not specifically mentioned in the town's bylaw, but would likely fall under the same category as roof-mounted systems.

Installing medium-scale ground-mounted solar in Deerfield is permitted by right with Site Plan Review in all zoning districts. Medium-scale installations occupy more than 1,000 square feet and less than 5 acres. Ground-mounted systems greater than 5 acres are considered "large-scale." They require a special permit in the Residential-Agricultural, Central Village Residential, Small Business, and Industrial districts, and are not permitted in other districts.

The town solar bylaw recommends avoiding agricultural sites for solar development and encourages utility-scale solar energy systems (medium- and large-scale) to be located on existing building rooftops. Large-scale ground-mounted projects are required to minimize impacts to active farmland.

Community Perspectives

Deerfield residents were generally not supportive of widespread conventional ground-mounted solar development on farmland. A majority wanted to see no solar development on farmland; the average percentage of development preferred was 16%. Residents did respond more favorably to certain types of solar facilities installed on farms. These included:

- Agrivoltaics, or solar projects that are raised above agricultural land to allow farming to continue beneath (11% strongly support/46% support/26% neutral).
- Installations located on the margins of agricultural fields (12% strongly support/39% support/22% neutral).

Residents expressed strong opposition to traditional solar development on land currently in vegetable production (51% strongly oppose/28% oppose) or pasture (42% strongly oppose/28% oppose).

There was somewhat less opposition to development of fallow farmland not currently in production (36% support/20% neutral/44% oppose).

5.2 Future Potential

Rooftops, Greenhouses, and Parking Canopies

Rooftops can provide roughly 1.5 kW of solar per 100 sf of suitable roof space. On medium roofs (5,000-25,000 sf), about 49% of the roof area is suitable for solar and on large roofs (25,000+sf)[2], about 66% of the roof area is suitable for solar.

There are a total of 25 medium roofs and three large roofs owned by farms, orchards, or other agricultural businesses in Deerfield. These roofs total 316,200 sf in area and 2.6 MW of technical solar potential. In addition, there are roughly 170,000 sf of large greenhouses at Atlas and Bar-Way Farms which could be considered for solar installations. There are also several large Quonset huts which were not included in this total because their rounded roofs make installation difficult.

Locations with the greatest potential for roof-mounted solar on agricultural rooftops are summarized in **Table 6.** Note that some barn roofs are probably associated with the farms listed in Section 5.1, but it is always easy to determine ownership based on assessors' records alone. All of these roofs would require on-site evaluations to review the underlying roof structure, identify any shading concerns from adjacent vegetation, identify roof-mounted equipment that could interfere with the placement of solar panels, and determine actual solar potential.

Location	Street Address	Roof Area (sf)	Estimated Technical Solar Potential
Bar-Way Farm	188 MILL VILLAGE RD	49,512	486
	198 MILL VILLAGE RD	13,378	97
	188 MILL VILLAGE RD	11,629	85
UMass Research Farm	63-89 RIVER RD	31,473	309
		6,106	44
		5,078	37
Pioneer Valley Growers Association	20 INDUSTRIAL DRIVE WEST	35,497	348
Mycoterra Farm	75 STILLWATER RD	23,407	170
Galenski Farms	96 NORTH MAIN ST	7,802	57
Pioneer Gardens	423 GREENFIELD RD	7,415	54
Bloody Brook Farm	144 NORTH MAIN ST	6,431	47
Savage Farms	90 LOWER RD	5,947	43
Williams Farms	0 MILL VILLAGE RD	5,916	43
Barn	111 OLD MAIN ST	12,020	88
Barn	331 RIVER RD	9,948	72
Barn	69 SOUTH MILL RIVER RD	9,129	66
Barn	SOUTH MILL RIVER RD	8,734	64
Barn	69 SOUTH MILL RIVER RD	7,175	52
Barn	111 OLD MAIN ST	6,828	50
Barn	123 LOWER RD	6,374	46
Barn	RIVER RD	6,365	46
Barn	PINE NOOK RD	6,185	45
Barn	641 RIVER RD	6,108	44
Barn	123 LOWER RD	5,983	44
Barn	LITTLE MEADOW RD	5,598	41
Barn	RIVER RD	5,559	40
Barn	NORTH HILLSIDE RD	5,424	39
Barn	118 LOWER RD	5,200	38

Table 6. Agricultural rooftops with an area of 5,000 sf or more. A complete list of privately owned roofs over 5,000 sf is included in Appendix A.

The ten largest agricultural rooftops in Deerfield, excluding greenhouses, could potentially host a solar array over 50 kW in size. Solar arrays over 50 kW in size often must connect to three-phase electricity distribution lines to interconnect to the electricity grid safely. Bar-Way Farm, the UMass Research Farm, the Pioneer Valley Growers Association, Pioneer Gardens, and the Galenski Farm barn are all located near three-phase power. The Mycoterra Farm barn on Stillwater Road is not located near three-phase lines. The size of the system may be limited to less than 50 kW by local grid infrastructure, or local infrastructure may need to be upgraded to accommodate larger projects. Alternatively, integration of an energy storage system with the solar array may allow a larger solar array

to be interconnected to the grid. Note that solar arrays under 50 kW in size can typically safely connect to single-phase or three-phase electricity distribution lines.

Ground-Mounted Solar: Agrivoltaic & Conventional Ground-Mounted Systems

Based on *Community Solar Survey* results, residents are less opposed to agrivoltaic systems than traditional ground-mounted systems.

Agrivoltaic Projects
All farms, but particularly those which graze livestock (including dairy cows) or carry out hay production, might be interested in pursuing an agrivoltaic project.

"Agrivoltaic" refers to agricultural production and electricity production from solar PV panels occurring together on the same piece of land. These facilities may also be referred to as agrisolar, "dual-use," or co-location of solar and agriculture. Rows of solar panels in these systems are generally placed further apart and raised higher above the ground to allow agricultural activities to continue to be conducted beneath them, ensure crops receive appropriate sunlight, and make it possible for farm vehicles to easily access all areas in agricultural production.

Agrivoltaic systems are still relatively new, and their economic potential in the temperate Northeast is still being explored. There is currently a lack of robust research and information on (1) the agricultural productivity of these systems, (2) the economic impacts of dual-use systems on farms and farmers, and (3) the effect of these systems on the broader agricultural economy. In general, agronomists are relatively comfortable with the idea that pasture and hay fields can be anticipated to produce reasonable yield of hay or forage, but less is known about the appropriateness of these systems for fruit and vegetable production. UMass Extension is currently working with project partners to better study and understand the agricultural yield and economic aspects of these systems (see https://ag.umass.edu/clean-energy/research-initiatives/dual-use-solar-agriculture/researching-agricultural-economic-impacts-of-dual-use-solar).

Conventional Projects
Residents were supportive of conventional solar projects along the margins of farm fields. There were also mixed perspectives regarding solar development on fallow farmland not currently in agricultural production.

Locations for Ground-Mounted Systems
Smaller agrivoltaic or conventional solar projects could be interconnected to the grid anywhere in town where distribution lines are present. Currently, larger projects (>50 kW) are likely only feasible in areas serviced by three-phase distribution lines, or areas within roughly ½ mile of those lines. As apparent in **Figure 1**, three-phase lines primarily run through central portions of Deerfield. Many agricultural fields located adjacent to these lines are permanently protected, but there are some areas of cultivated land, pasture, and hayfields which are not permanently protected, and which could be considered for agrivoltaic projects.

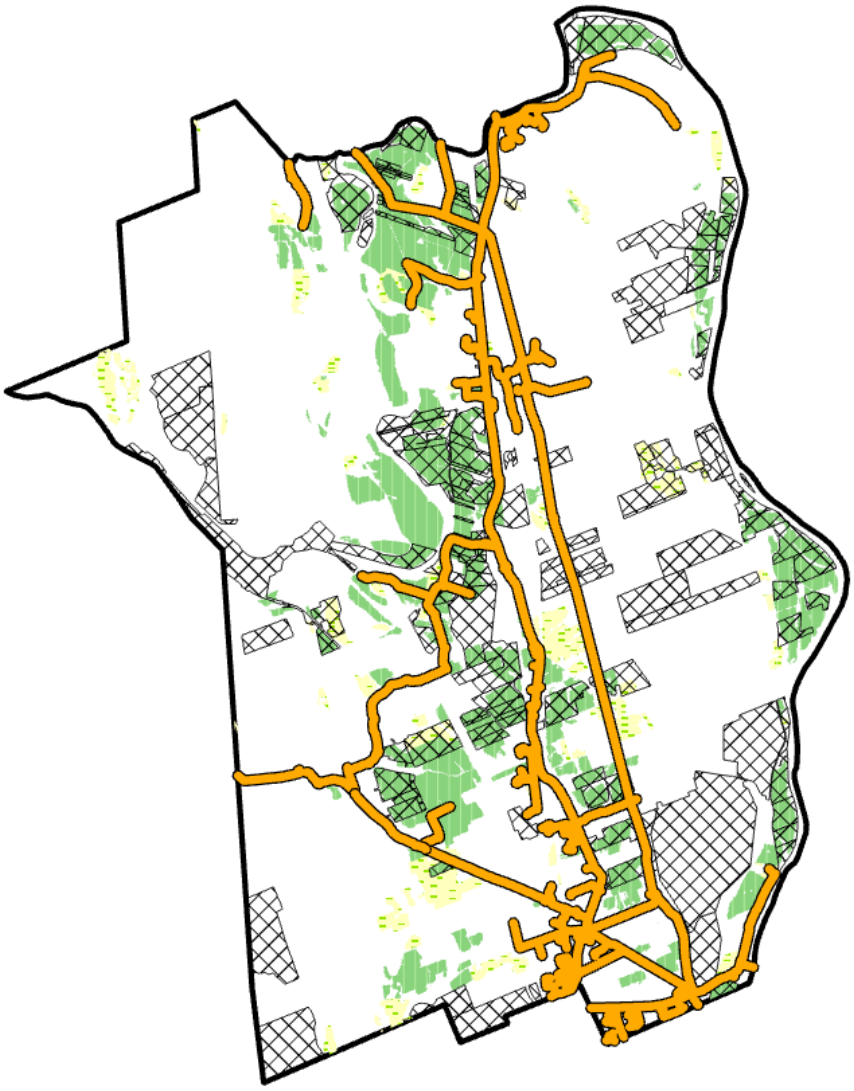

Figure 1. Map showing Deerfield, with three-phase lines in orange, hayfield and pasture in light yellow, cultivated land in light green, and permanently protected land in hatch marks.

Financial Considerations

Financial costs and benefits of rooftop, greenhouse, or parking canopy solar projects on farms are dependent on many factors, including system size, system cost, electricity rates,

solar incentives, federal and state tax credits, loan amount, and loan terms (interest rate, term). All of these items are site-dependent, and subject to change over time. Agricultural projects are eligible for the same federal and state tax credits as other types of systems. These types of projects are also likely to be eligible for SMART solar incentives (on a fixed #/kWh basis) or Renewable Energy Credits (for each MWh of solar energy generated, RECs are sold at auction). Grants to develop solar PV projects that support on-farm energy needs may be available through the state's Agricultural Energy Grant Program.

Agrivoltaic projects may be eligible for an Agricultural adder through the SMART program. In order to qualify for incentives, these projects must be 25 kW in size or larger. To be economical, these projects are often much larger – the average size of standalone dual-use agricultural projects currently in the state program is roughly 3.2 MW DC (~15 acres), although one Agricultural project of 25 kW (~1 acre) has been constructed.

Conventional, ground-mounted solar projects may also be eligible for SMART solar incentives or RECs. Current SMART program regulations place some restrictions on solar development on agricultural land – some large, conventional developments on recently active agricultural land may not be eligible for incentives.

5.3 Next Steps & Action Items

Potential next steps for solar development on farms include:

- Conduct outreach to Bar-Way Farm, Bloody Brook Farm, Galenski Farms, Mycoterra Farm, Pioneer Gardens, the Pioneer Valley Growers Association, Savage Farms, Williams Farms, and the UMass Research Farm to assess their interest in large, roof-mounted solar.
- Conduct outreach to Atlas Farm to assess interest in solar greenhouses.
- Consider outreach to these and other farm owners/operators to assess their interest in small-scale roof- or ground-mounted solar.
- Near three-phase lines (see map) on existing agricultural land, explore landowner and farm operator interest in establishing agrivoltaic operations.
- Assist interested farms with evaluating and applying to grant opportunities for agricultural energy projects, as well as evaluating costs and benefits of other financing structures.
- Encourage entry of farms into the Chapter 61A program to decrease likelihood of conversion to solar and allow for the opportunity of Right-of-First-Refusal if the property is sold.

Action Items

[To be filled out based on what Energy Committee and other municipal boards want to take on in the next 3-5 years.]

Action	Lead Entity (or Entities)	Supporting Entities	Start Year/Annually?

	Agricultural Commission		

5. LARGE, GROUND-MOUNTED SOLAR ON PRIVATE LAND

This section addresses large, ground-mounted solar development on private land, including solar projects sited on previously disturbed sites (e.g. gravel pits, quarries, right-of-ways, private landfills, brownfields) and those sited on undeveloped land (e.g. forest, meadow, shrubland) not addressed under On-Farm Solar.

6.1 Current Status

Existing Infrastructure

Existing Land Use
According to Mass Audubon's *Losing Ground* report, Deerfield contains 4,769 acres (22%) of "open" (primarily agricultural) land and 14,240 acres (66%) of land in "natural" condition (primarily forest). Only 10% (2,240 acres) of the land area of Deerfield is currently developed for housing, businesses, or other purposes. Deerfield ranks 112th in the state in terms of the total amount of protected land, with 4,092 acres (19%) of the town under permanent protection. Deerfield has several disturbed sites, detailed under *Future Potential*.

Despite having a fair percentage of conserved land, the town also has a significant acreage of unprotected "open" land and land in "natural" condition which means the potential for large, ground-mounted solar development on undeveloped land remains.

Solar Infrastructure
There are two large-scale commercial solar facilities in Deerfield. One is a third party-owned facility at the north end of River Road on a quarry property. This site has 1,278 kW (1.3 MW) of capacity. The other facility is off Setright Road, with 2,733 kW (2.7 MW) of capacity.

Grid Infrastructure
There are multiple distribution lines that run through the town of Deerfield. Detailed maps and locations of these lines are provided in the town's *Solar Resource & Infrastructure Assessment*. Broadly speaking, three-phase service is available throughout South Deerfield center and areas along and south of Route 116 where it runs east-west from the Sunderland line to Route 5 & 10. In addition, much of the western portion of Route 116, as well as Lee Road and portions of Mill Village Road, Stillwater Road, and Childs Cross Road are served by three-phase lines. Route 5 & 10 is also largely served by three-phase power, as are portions of side roads that extend off of it.

The remainder of the town is served by single-phase distribution lines, including large portions of the east edge of town (along the Connecticut River) and the west side of town, to either side of I-91.

Current Regulatory Status

Large-scale ground-mounted solar systems are defined as occupying more than 5 acres of land. They are allowed by Special Permit in the Residential-Agricultural, Central Village Residential, Small Business, and Industrial districts. They are not permitted in the Commercial, Planned Industrial, or Expedited Permitting Districts.

For large-scale systems, the bylaw includes general language recommending avoiding development on environmental, agricultural, or historical sites, and suggesting sites should be designed to avoid impacts to rare and endangered species and wildlife habitat on a site, including BioMap Core Habitat and Priority Habitat areas, and to maintain contiguous forested areas. General language about minimizing impacts to forest and active farmland, as well as minimizing fragmentation of open space and vegetation clearing, is also included. Specific environmental requirements are included regarding the maintenance of vegetative cover on steep slopes.

Community Perspectives

In the *Community Solar Survey*, Deerfield residents expressed very little support for widespread solar development on undeveloped land. As noted in the introduction, a majority of respondents indicated they would prefer to see no undeveloped natural lands developed for solar; the average solar development on natural lands preferred by residents was 13%. There was majority support (58%) for development to support state energy goals, which would include limited development of ground-mounted solar, including some development on undeveloped land (4% of land area).

In addition to the preferences regarding solar development on agricultural land discussed above, residents indicated a strong preference for large, ground-mounted solar development on former extraction sites, quarries, and other disturbed sites (52% strongly support/33% support) and powerline right-of-ways (ROWs) (45% strongly support/33% support). For all other types of forested and open natural habitats, 65-86% of residents expressed opposition to development. Among these habitat types, the least opposition expressed was to development of meadows or shrublands (65% opposition). In another portion of the survey, residents also indicated support (29% strongly support/45% support) for solar development along major roads, which in Deerfield would presumably focus along Route 5 & 10 and Interstate 91.

6.2 Future Potential

Constraints on Large, Ground-Mounted Solar Development

Development of large, ground-mounted solar on large private properties in Deerfield is likely to be constrained by a number of factors. For all sites, these factors include 1) opportunities for interconnection to the electricity grid, 2) the locations of property owners willing to lease or sell their land for solar development, 3) potential project scale, and 4) eligibility for state solar incentives. For undeveloped lands, 5) existing conservation restrictions and 6) wetlands protections are also an important factor. While factor 2 cannot be determined without direct consultations with specific landowners, factors 1, 3, 4, 5, and 6 can be assessed in some detail.

Interconnection Opportunities. Large solar facilities require three-phase power lines in order to interconnect to the grid, so in the near-term, large facilities are most likely to be proposed in areas of town served by or adjacent to three-phase power. Areas currently served by three-phase power are described in the *Grid Infrastructure* section above.

Existing Conservation Restrictions. As noted above, roughly 19% of Deerfield's land area is under permanent protection and ineligible for solar development. Additionally, at least 2,455 acres (11%) are in temporary protection due to participation in Chapter 61, 61A, or 61B programs. Participation in these programs does not exclude the possibility of solar development but could make development economically unfavorable if back taxes are required to remove the land from the program or may allow the town right-of-first refusal on any property lease or sale.

Wetlands Restrictions. The presence of wetlands on a property may also limit the extent of development, since solar development is prohibited on wetlands and buffers around a protected wetland are often required. Solar development is regulated within 100 ft of most wetlands and water bodies, and within 200 ft of most perennial streams and rivers.

Eligibility for State Solar Incentives. In addition to the need for interconnection to three-phase lines, in order for solar development to be economically feasible, large-scale projects may need or desire to qualify for state solar incentives. At present, with limited exceptions, the current state solar program (SMART) does not provide incentives for solar facilities sited on land mapped as BioMap2 habitat or for parcels on which more than 50% of the habitat is mapped as BioMap2.

Project Scale. An important aspect of economic viability for solar projects is project scale. Because interconnection costs are high and often fixed, as well as due to economies of scale, the larger the solar project, the more financially feasible it tends to be. With this in mind, the larger the area available for development, the more likely it is to be attractive to solar developers. Large parcels of land (e.g., 5-10 acres or more) are likely to be of greater interest for development, especially if few or no protected land resources are present (e.g., wetlands, water bodies, BioMap2 habitat).

The following sections describe different types of locations where large, ground-mounted solar could potentially be developed, couched within the context of these constraints.

Disturbed Sites

Previously disturbed sites identified in Deerfield are shown in **Table 7**. From aerial imagery, it appears some of these sites may be actively being used. If this is the case, they would not be appropriate for solar development immediately, but future solar development could be considered as part of plans for eventual conversion to another use.

Land Use	**Street Address**	**Total Disturbed Area** (acres)	**Estimated Technical Solar Potential** (MW)	**Proximity to Three-Phase Lines**
Disturbed Area	938 River Road	72.5	15	0 ft
Gravel Pit	194 Lower Rd	71.0	14	3,200 ft
Gravel Pit	6 Railroad Yard	12	2.4	100 ft

Table 7. Previously disturbed sites with some suitability for solar.

Solar arrays over 50 kW in size often must connect to three-phase electricity distribution lines in order to interconnect to the electricity grid safely. The brownfield at 938 River Road and the gravel pit at 6 Railroad Yard are located adjacent to three-phase lines. For the large property not located near three-phase lines, the gravel pit located at 194 Lower Rd, the size of a new system may be limited to less than 50 kW by local grid infrastructure, or local infrastructure may need to be upgraded to accommodate larger projects.

Rights-of-Way

There are two electricity transmission right-of-ways (ROWs) that run through Deerfield **Figure 2**). These are maintained as cleared areas. One ROW is located along the northern border of town and is 4.5 miles long with an estimated width of 200 feet. There is another ROW running east toward I-91 from the Connecticut River that is 6.5 miles long and has an estimated width of 100 feet. The total area is 400 acres. The estimated technical potential of this land is 80 MW.

It is likely that much of this area would not be suitable for solar, due to steep slopes, viewshed considerations in high-elevation portions of the ROW, and bordering trees providing too much shade on the edges of the ROW. The ROW is located immediately under transmission lines, but solar arrays are more typically connected to distribution lines or directly to substations. There are no substations in Deerfield. However, these ROWs do intersect three-phase power at several locations along their lengths, where they could potentially interconnect to the electricity grid.

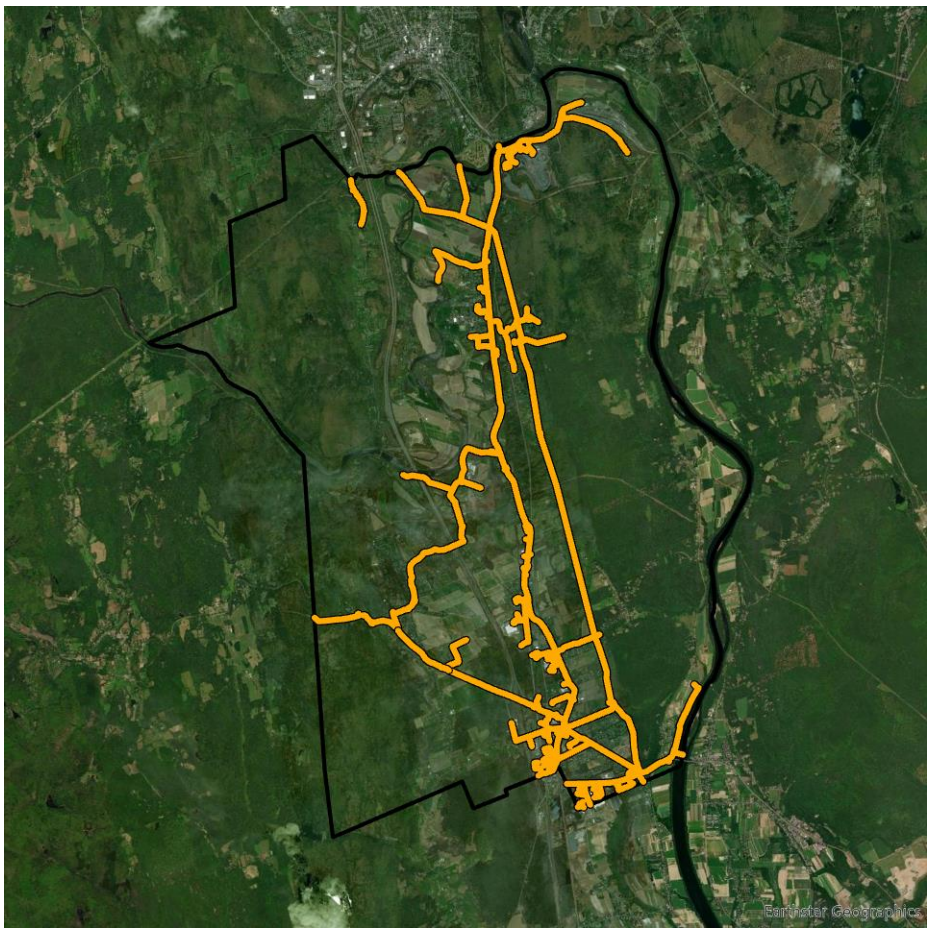

Figure 2. Map showing transmission ROWs running through Deerfield. Town borders are shown in black, three-phase lines are shown in orange; the ROWs appear in satellite imagery as pale, tan lines against green forest and other land uses.

A major challenge in developing ROWs is that there is not a common practice of developing electricity transmission ROWs for solar. Utility companies typically prefer to keep these areas clear to allow for easy maintenance of transmission lines as well as underlying vegetation. However, this land area represents a potentially untapped resource for solar across Massachusetts.

Parcels Adjacent to Major Roads

Residents showed some support for solar development along major roads. Routes 5 & 10 and 116 run through parts of town and have three-phase powerlines overhead along most of their lengths. Additionally, Interstate 91 runs through the town as well. The highway is

adjacent to multiple three-phase lines at the north and south ends of town, and is criss-crossed by three-phase lines at several locations through the central portion of town (see **Figure 3**).

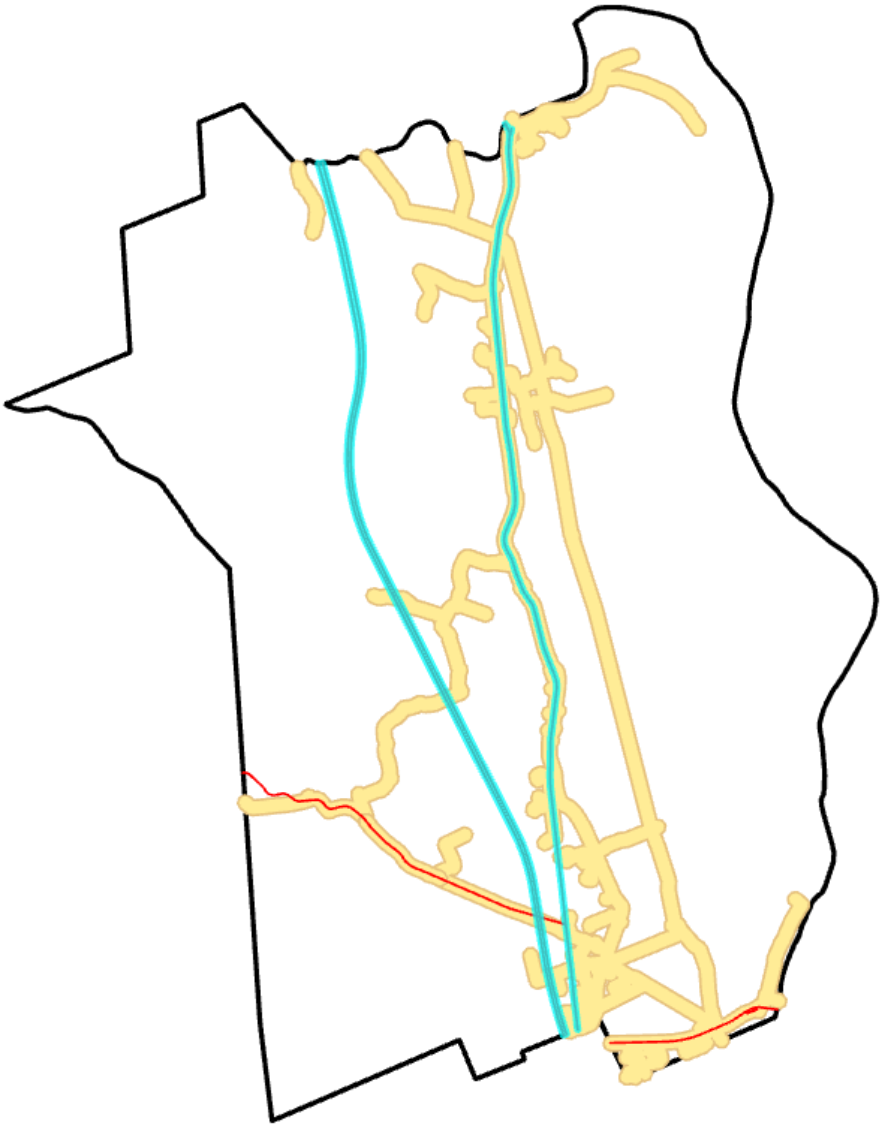

Figure 3. Map showing Deerfield, with three-phase lines in beige and major roads in red to emphasize overlap. Note that Route 5 &10 has three-phase power along much of its length.

As evident in **Figure 4**, much of the eastern portions of Deerfield (near the Connecticut River), as well as the southwest corner consist of priority wildlife habitat, which is not preferred for development by Deerfield residents, or permanently protected land, which is not eligible for solar development. Nevertheless, there are many parcels in other portions of town that are not mapped as priority habitat and not permanently protected. These are mostly located through the central portion of town, including along Route 5 & 10, as well as on the north side of Route 116.

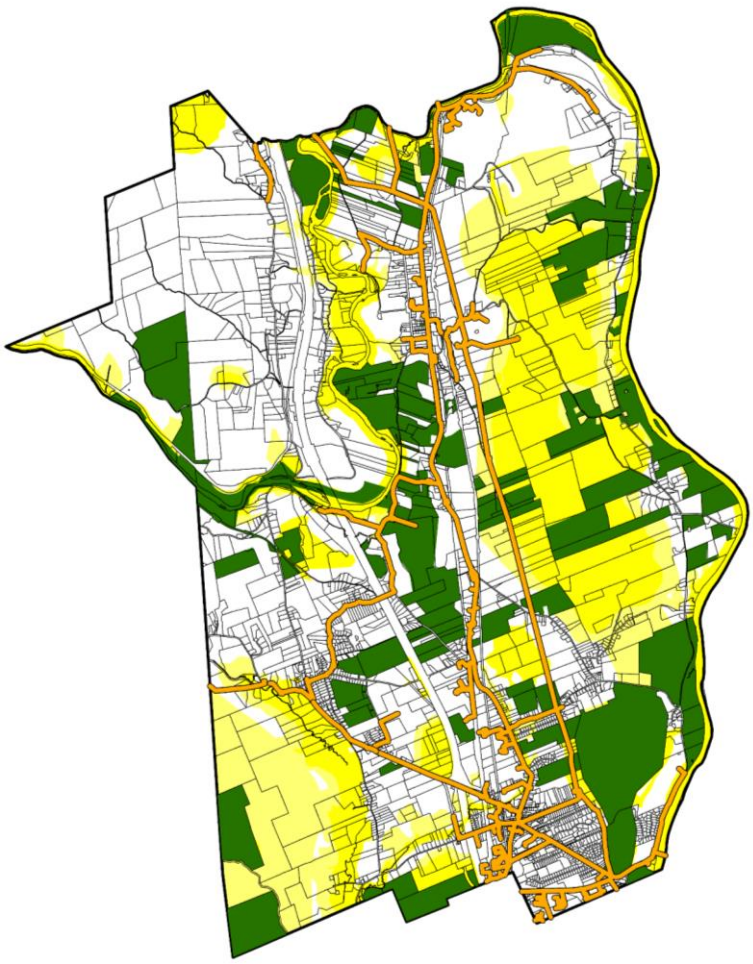

Figure 3. Map showing Deerfield, with three-phase lines in orange, BioMap2 core habitat and critical natural landscapes in dark and light yellow respectively, and permanently protected land in green.

Financial Considerations

Financial costs and benefits of solar projects on disturbed sites are dependent on many factors, including system size, system cost, electricity rates, solar incentives, federal and state tax credits, ownership structure, financing, and, importantly, any environmental or liability concerns associated with the development of a site with potentially hazardous materials. All of these items are site-dependent and may be subject to change over time. Solar projects on previously disturbed sites are eligible for the same federal and state tax credits as other types of systems. These types of projects are also likely to be eligible for SMART solar incentives (on a fixed #/kWh basis) or Renewable Energy Credits (for each MWh of solar energy generated, RECs are sold at auction).

The Commonwealth of Massachusetts is strongly supportive of solar development on former landfill sites. Projects on former landfills and brownfield sites are eligible for additional SMART incentive "adders" over and above base compensation rates, on the order of 3-4 cents per kWh.

6.3 Next Steps & Action Items

- Reach out to the owners of disturbed sites in the northeastern corner of town near the railroad yard to consider whether solar development might be a possibility now or in the future.
- Reach out to Eversource (with CEE assistance) regarding community interest in development of ROWs.
- Reach out to owners of large parcels along Route 5 & 10 and Route 116 that are not mapped as priority wildlife habitat, not in an active agricultural production, and not permanently protected, to explore their interest in large-scale solar development.
- Work with Franklin Land Trust or other land conservation organizations to identify at-risk parcels near three-phase lines of high conservation and recreation value and preserve them.
- Implement bylaw updates in line with resident preferences around development (see next section).

Action Items

[To be filled out based on what Energy Committee and other municipal boards want to take on in the next 3-5 years.]

Action	Lead Entity (or Entities)	Supporting Entities	Start Year/ Annually?

6. MUNICIPAL ZONING, BYLAWS, & PERMITTING

7.1 Current Status

State Law regarding Solar Zoning Bylaws

Local zoning laws are regulated by Massachusetts General Law Chapter 40A Section 3. The section relevant to solar zoning states that "*No zoning ordinance or by-law shall prohibit or unreasonably regulate the installation of solar energy systems or the building of structures that facilitate the collection of solar energy, except where necessary to protect the public health, safety or welfare*." There has been much debate over what constitutes regulations that are necessary to protect public welfare, and whether this might include restrictions imposed to protect environmental or agricultural resources of value to the general public. In a recent case, *Tracer Lane II Realty, LLC v. City of Waltham*, the Massachusetts Supreme Judicial Court ruled that the City of Waltham could not impose a restriction that effectively limited large-scale solar development to no more than 2% of the municipality's area. However, it did not address what would be an area reasonable to exclude from large-scale solar development. This limitation on local zoning is important to keep in mind when reviewing or updating the town's bylaw. Law firms that commonly work with municipalities recommend basing updates on extensive planning efforts (such as this one) and ensuring that any restriction is grounded in an easily articulated reason related to public health, safety, or welfare. Always check with Town Counsel before implementing any changes.

Municipal Bylaws & Permitting Processes

Deerfield's solar bylaw was updated in October 2021. The bylaw's purpose is to facilitate the creation or expansion of Solar Energy Systems by providing standards for the placement, design, construction, operation, monitoring, modification, and removal of such installations that address public safety, minimize impacts on environmental, scenic, natural, and historic resources, and to provide adequate financial assurance for the eventual decommissioning of such installations.

Solar systems in Deerfield are defined based on type, size, and ownership:

- **Roof-Mounted Systems, Small-Scale Ground-Mounted Energy Systems,** (less than 1,000 sf), **Solar Canopies,** and **Municipal Solar Energy Systems** are all permitted by right (with a building permit) in all zoning districts. In the bylaw, Municipal systems are defined as systems owned by the town or built on municipal land.
- **"Medium" Ground-Mounted Systems** occupy more than 1,000 sf but less than 5 acres. They are allowed by right with Site Plan Review in all districts.
- **"Large" Ground-Mounted Systems** occupy more than 217,800 sf (5 acres). They are allowed by special permit in the Residential-Agricultural, Central Village Residential, Small Business, and Industrial districts. They are not permitted in the Commercial, Planned Industrial, or Expedited Permitting Districts.

General requirements for solar facilities include compliance with laws, bylaws, and regulations; building permit and building inspection; and payment of appropriate fees. Specific property line setbacks and maximum height requirements are defined for different types and sizes of system.

For projects subject to Site Plan Review, documentation must be provided about proposed hazardous materials, major system components, installer contact information, project applicants, co-applicants, abutters, and other relevant information. General language about minimizing impacts to forest and active farmland, as well as minimizing fragmentation of open space and vegetation clearing, are included. Specific environmental requirements are included regarding the maintenance of vegetation cover on steep slopes. The bylaw recommends avoiding any environmental, agricultural, or historical sites for solar development.

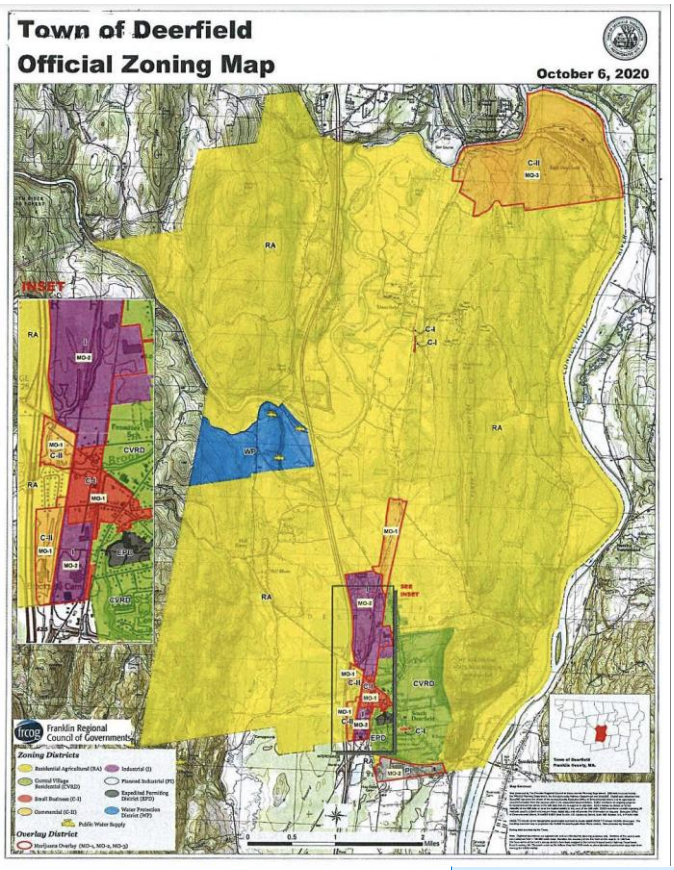

Figure 4. Deerfield Zoning Map as of October 2020. An updated zoning map will be available soon.

Commented [ZD2]: Is a new map available?

Community Perspectives

Based on the *Community Solar Survey*, residents provided the following information regarding their preferences for town permitting policies and processes relative to solar:

- A significant majority (69%) of residents believe solar should be allowed and promoted in appropriate circumstances.
- A majority (53%) of residents are unsure or unaware of the solar development process in Deerfield thus far.
- Residents expressed an interest in having a say in permitting decisions regarding large solar development projects. The forms most favored by respondents included:
    - Information should be shared at public meetings (85% interest)
    - Community members should have the opportunity to review and comment on the siting and design. (80% interest)
    - Community members should have the opportunity to purchase reduced-price electricity from a solar project. (73% interest)
    - Community members should be involved in deciding where the best place in town is for a solar project. (66% interest)

A majority of residents were also "very likely" to support solar projects that provided reduced electricity rates for all residents or low-income residents, direct payments that reduced property taxes or supported town budget needs, back-up power to emergency shelters or other critical infrastructure, an option for local ownership for residents who couldn't install solar on their homes, or job opportunities for local residents.

7.2 Next Steps & Action Items

As noted above, a majority of residents are unsure or unaware of the solar permitting process in Deerfield. It would be beneficial to provide information on the town's website and distribute information about the permitting process, perhaps as a part of sharing information about this solar planning process.

Deerfield's bylaw aligns well with resident preferences in multiple respects, including the streamlining of permitting for rooftop solar, solar parking canopies, and municipal projects, as well as considerations and recommendations regarding historical, agricultural, and environmental sites. The town's permitting process, in conforming to state Opening Meeting Law, meets residents' desires for information-sharing at public meetings and an opportunity to comment on siting and design of large solar arrays. However, there are some aspects of the bylaw which could be updated to better align with community preferences as identified in the *Community Solar Survey*, as well as to clarify requirements.

With review by Town Counsel, the town may wish to consider the following updates to the solar bylaw:

Solar Canopies. Solar canopies are defined as "elevated structures that host solar panels and provide shade," but are not described in detail. Since agrivoltaic systems are often also elevated, and since other types of solar systems might also be arguably included under this category (since the height of elevation is not defined), it might be appropriate to more clearly define what is meant by these types of systems. Because they are allowed by right with a building permit only, defining the limits of what would fall under this category is important.

Definition of Small-Scale Solar. As discussed in Section 3 of this Plan, residents are strongly supportive of residential-scale solar development. In order to support future electricity needs (for electric vehicles, mini-splits, etc.) it is anticipated that the average size of a residential solar array will need to increase. In addition, in order to provide solar electricity to neighbors with shaded yards, residents with space for solar may choose to over-size residential-scale systems relative to their current needs. To facilitate these types of projects and reduce costs associated with their development, the town may wish to increase the size of array eligible for a streamlined (Building Permit only) permitting process – for example, to roughly 25 kW (the state cut-off for a "small" solar system) roughly equivalent to 1,700 sf. Currently, in limiting small-scale systems to 1,000 sf, Deerfield's bylaw effectively limits these systems to roughly 15 kW.

Review Process for Municipal Solar. Currently, municipal solar projects of any size, including large-scale systems, are allowed by right with a building permit. Given residents' interest in having opportunities for public comment on siting and design, it is important to establish a clear process for the review of large-scale solar projects owned by the town or installed on municipal land. The project being constructed on the former town landfill site would not require any kind of public permitting process under the current bylaw. Abutters and other interested residents should have the opportunity to weigh in regarding siting and design of large, ground-mounted systems, even if owned by the town or constructed on municipal land.

Zoning District Restrictions. Large-scale, ground-mounted systems are currently not allowed at all in the C-II (Commercial) district. This zoning district applies in the railyard vicinity - an excellent place for solar, with a large area of disturbed land identified as a potential solar development site in this review. There is already one large solar array located within or adjacent to this area. As with most other districts, large-scale solar should be allowed in this district by Special Permit.

Pesticide Use. The restriction in the town's current bylaw on herbicide use may conflict with Massachusetts Department of Agricultural Resources (MDAR) authority over pesticide use. The town may wish to check with Town Counsel. In addition, it is worth noting that the permeable pavers noted as an alternative are likely to create an effectively ecologically dead space, and may be a worse alternative, environmentally speaking, as compared to encouraging mowing or allowing limited herbicide use.

Environmental and Agricultural Restrictions. The town's bylaw provides general language relevant to encouraging minimizing impacts to forest and active agricultural land and avoiding fragmentation of open space. However, aside from restrictions on vegetation clearing on steep slopes, these stipulations are relatively vague and not clearly defined or easily enforceable. Given residents' opposition to conventional development of solar on active farmland and to development in priority wildlife habitat, the town may wish to develop stronger language, while remaining cognizant of avoiding over-reach under Massachusetts state law. For example, the town may wish to consider siting restrictions for large (not medium) solar projects on agricultural land, given residents' opposition to large-scale solar development on active farmland. The town could consider requiring agrivoltaic projects if large-scale solar is being developed on active farmland or off-set preservation of farmland elsewhere in town in exchange for farmland lost to solar. Given that a majority of

town is mapped as BioMap2 habitat, it is not recommended to completely block large-scale solar on this type of land. However, the town could restrict large-scale development on BioMap Core habitat or another limited category of wildlife habitat. The exact language for identifying a limited subset of important forest habitats for restrictions could be honed through discussions with Mass Audubon, local land trusts, FRCOG, and UMass.

Electricity Transmission ROWs. The *Community Solar Survey* showed strong support from residents regarding solar development in transmission ROWs. These areas represent a tremendous resource which could help the town meet state solar goals without developing undisturbed natural areas. The town should consider streamlining solar development in electricity transmission ROWs, for example, by allowing large-scale development in these areas by right with Site Plan Review, rather than by Special Permit only. The town could also consider applying streamlined permitting to other types of previously disturbed sites.

Wetlands. The town may wish to increase buffers around wetlands and bodies of water to restrict solar development or to restrict development more generally via a wetlands bylaw. *Community Solar Survey* results indicate a large majority of residents oppose development near waterbodies and wetlands.

Potential Next Steps

- Review bylaw recommendations; potentially proposing bylaw amendments at a subsequent town meeting.
- Provide accessible information on the town's website about the solar planning process and how large solar projects are reviewed and permitted.
- Compile a list of standard practices to 1) advertise public hearings regarding large solar projects widely, 2) advertise public hearings regarding proposed solar bylaw amendments widely, 3) identify resident interest in reduced electricity rates to solar project proponents, and 4) negotiate appropriate PILOT payments.

Action Items

[To be filled out based on what Energy Committee and other municipal boards want to take on in the next 3-5 years.]

Action	Lead Entity (or Entities)	Supporting Entities	Start Year/ Annually?

7. SUMMARY

8.1 Summary

This section provides a summary of the Action Items noted throughout this Plan.

8.2 Plan Review

This plan will be reviewed and updated in [5?] years by the Energy Committee in consultation with the Planning Board, Conservation Commission, and Select Board. Updates will consider progress made since the original plan was developed, and may require revisiting steps of the *Community Planning for Solar* process, including the *Solar Resource & Infrastructure Assessment* and *Community Solar Survey*.

Commented [ZD3]: This timeline is up to the town to decide upon. For guidance in determining an appropriate timeline and revision steps, see the CEE factsheet *Monitoring, Evaluating, and Updating your Community Solar Action Plan* on the Solar Planning toolkit website.

8.3 Action Items

This section will provide a table of Action Items, summarizing briefly each item, indicating which municipal board, committee, or group of residents is responsible for taking the lead on next steps, and indicating the projected timeline (calendar dates). The table will also include the anticipated timeline for action plan review and revision.

Commented [ZD4]: This list will be drawn from the Next Steps identified above, but town boards and committees will have to identify the timeline over which they want to take it on.

Appendix A

Structure/Ownership	Street Address	Roof Area (sf)	Estimated Technical Potential (kW)
Business - Hardigg Industries	147 NORTH MAIN ST	277,288	2,720
Business - Yankee Candle	27 YANKEE CANDLE WAY	259,090	2,541
Business - AFI Furnishings	5 INDUSTRIAL DRIVE WEST	246,764	2,420
Warehouse	10 GREENFIELD RD	171,956	1,686
Business	14 INDUSTRIAL DRIVE WEST	139,806	1,371
Educational - Deerfield Academy	27 ALBANY RD	129,220	1,267
Business - Yankee Candle	25 GREENFIELD RD	121,286	1,190
Greenhouses - Bar-Way Farm	198 MILL VILLAGE RD	115,131	TBD
Frontier Regional High School	113 NORTH MAIN ST	92,531	908
Business - Treehouse Brewing Co	1 COMMUNITY PL	91,102	893
Municipal - Deerfield Elementary School	21 PLEASANT ST	79,643	781
Business - Yankee Candle	1 PLAIN RD EAST	62,292	611
Business - Yankee Candle	5 NORTH ST	51,751	508
Barn - Bar-Way Farm	188 MILL VILLAGE RD	49,512	486
CSX Transportation	16 RAILROAD YARD RD	47,162	463
Educational - Deerfield Academy	27 ALBANY RD	44,750	439
Business - Pro Pel Plastics	4 INDUSTRIAL DRIVE EAST	38,652	379
Business - Red Roof Inn	9 GREENFIELD RD	36,608	359
Warehouse - Pioneer Valley Growers Association	20 INDUSTRIAL DRIVE WEST	35,497	348
Business - Harris ReBar	73 OLD STATE RD	35,300	346
Educational - Eaglebrook	11 COUNTY RD	34,095	334
Business - Pro Pel Plastics	378 LONG PLAIN RD	32,791	322
Business - Yankee Candle	16 YANKEE CANDLE WAY	32,037	314
Barn - UMass	63 89 RIVER RD	31,473	309
Business - Magic Wings Butterfly Conservancy	281 GREENFIELD RD	28,980	284
Educational - Deerfield Academy	4 LITTLE MEADOW RD	26,632	261

Business - Deerfield Railyard	6 RAILROAD YARD RD	26,374	259
Business - O'Leary/Vicunas LLC	20 INDUSTRIAL DRIVE EAST	25,894	254
Educational - Eaglebrook	283 PINE NOOK RD	25,004	245
Business - O'Leary/Vicunas LLC	20 INDUSTRIAL DRIVE EAST	24,260	177
Business	12 RAILROAD ST	23,805	173
Barn - Mycoterra Farm	75 STILLWATER RD	23,407	170
Greenhouses - Atlas Farm	636 RIVER RD	22,309	TBD
Business - Nutrien Ag Solutions	25 ELM ST	22,101	161
Business - Pilot Precision Products	15 MERRIGAN WAY	21,097	154
Business - Douglas Auctioneers	241 GREENFIELD RD	20,317	148
Educational - Deerfield Academy	27 ALBANY RD	18,254	133
Municipal - Deerfield Town Hall, Police Dept, Rec. Dept	8 CONWAY ST	17,915	130
Educational - Deerfield Academy	70 A OLD MAIN ST	17,405	127
Business - Aromatic Cosmetics Store	253 GREENFIELD RD	16,266	118
Self-Storage - Ideal Movers & Storage	247 GREENFIELD RD	16,022	117
Educational - Eaglebrook	283 PINE NOOK RD	15,905	116
Warehouse - Habitat Post & Beam?	19 ELM ST	15,781	115
Warehouse - Sitterly Movers	43 WHATELY RD	15,454	113
Municipal - Deerfield Highway Department	9 MERRIGAN WAY	15,352	112
Business - Nutrien Ag Solutions	25 ELM ST	15,264	111
Greenhouses - Atlas Farm	635 RIVER RD	15,129	TBD
Educational - Eaglebrook	283 PINE NOOK RD	14,844	108
Educational - Eaglebrook	283 PINE NOOK RD	14,671	107
Business - Yankee Candle	25 GREENFIELD RD	14,596	106
Educational - Eaglebrook	0 RICES FERRY RD	14,189	103
Business Complex	54A WHATELY RD	13,846	101
Business - Turkey Plains, LLC	6 NORTH ST	13,830	101
Institutional - Historic Deerfield	OFF OLD MAIN ST	13,675	100

Barn - Bar-Way Farm	198 MILL VILLAGE RD	13,378	97
Business - Gorey Fabrication	8 NORTH ST	13,349	97
Business - Habitat Post & Beam?	19 ELM ST	13,344	97
Church - St. Stanislaw Roman	31 SUGARLOAF ST	13,166	96
Municipal - South Deerfield Fire Station	84 GREENFIELD RD	13,157	96
Business - Whitney Hill Antiques	0 GREENFIELD RD	12,695	92
Industrial Building	20 INDUSTRIAL DRIVE EAST	12,471	91
Institutional - Deerfield Academy Building	4 LITTLE MEADOW RD	12,366	90
Institutional - Deerfield Academy Building	4 LITTLE MEADOW RD	12,302	90
Institutional - Deerfield Academy Building	36 OLD MAIN ST	12,223	89
Barn - Agricultural	111 OLD MAIN ST	12,020	88
Warehouse - Hamshaw	16 ELM ST	11,981	87
Institutional - Deerfield Academy Building	27 ALBANY RD	11,769	86
Barn - Bar-Way Farm	188 MILL VILLAGE RD	11,629	85
Barn - Residential	304 GREENFIELD RD	11,393	83
Institutional - Deerfield Academy Building	70 A OLD MAIN ST	11,356	83
Warehouse - Sitterly Movers	43 WHATELY RD	11,316	82
Institutional - Deerfield Academy Building	70 A OLD MAIN ST	11,249	82
Residential - Mansion	OFF HAWKS RD	11,230	82
Store	226 GREENFIELD RD	11,193	82
Educational - Eaglebrook	283 PINE NOOK RD	10,888	79
Business - Offices	110 NORTH HILLSIDE RD	10,812	79
Restaurant Complex	3 ELM ST	10,600	77
Business Complex	55 NORTH MAIN ST	10,581	77
Business - Repair Garage	4 INDUSTRIAL DRIVE WEST	10,211	74
Business - Deerfield Craft Fairs	10 MEMORIAL ST	10,134	74
Restaurant Complex - Wolfies, Primo Pizza	52 SOUTH MAIN ST	10,064	73
Self Storage	247 GREENFIELD RD	10,056	73
Institutional - Deerfield Academy Building	612 GREENFIELD RD	9,967	73

Barn	331 RIVER RD	9,948	72
Quonset Hut - MassDOT	75 SUNDERLAND RD	9,910	n/a - rounded roof
Institutional - Deerfield Academy Building	70 A OLD MAIN ST	9,847	72
Business - Trew Stone	901 RIVER RD	9,640	70
Institutional - Deerfield Academy Building	27 ALBANY RD	9,612	70
Institutional - Deerfield Academy Building	70 A OLD MAIN ST	9,391	68
Educational - Bement School	100 OLD MAIN ST	9,148	67
Barn	69 SOUTH MILL RIVER RD	9,129	66
Institutional - Bement School	100 OLD MAIN ST	8,755	64
Barn - Agricultural	0 SOUTH MILL RIVER RD	8,734	64
Business - UPS Customer Center	51 WHATELY RD	8,404	61
Museum - Pocumtuck Valley Memorial Association	10 MEMORIAL ST	8,391	61
Institutional - Eaglebrook	283 PINE NOOK RD	8,243	60
Self Storage	247 GREENFIELD RD	8,010	58
Barn - Galenski Farms	96 NORTH MAIN ST	7,802	57
Barn - Residential	45 RIVER RD	7,793	57
Garage - Greg's AutoBody	239 GREENFIELD RD	7,730	56
Self Storage	247 GREENFIELD RD	7,703	56
Church - South Deerfield Congregational	71 NORTH MAIN ST	7,693	56
Business - Greg's Autobody	239 GREENFIELD RD	7,673	56
Residential	4 WELLS CROSS RD	7,436	54
Barn - Pioneer Gardens	423 GREENFIELD RD	7,415	54
Residential - Multi-Family	333 RIVER RD	7,354	54
Garage - MassDOT	75 SUNDERLAND RD	7,179	52
Barn	69 SOUTH MILL RIVER RD	7,175	52
Business	667 RIVER RD	7,103	52
Educational - Eaglebrook	283 PINE NOOK RD	7,085	52
Barn - Residential	GREENFIELD RD (NORTH OF CHILDS CROSS RD)	7,079	52
Institutional - Deerfield Academy Building	27 ALBANY RD	7,050	51
Business Complex - Restaurants, Inn	81 OLD MAIN ST	7,026	51

Institutional - Deerfield Academy Building	70 A OLD MAIN ST	6,961	51
Institutional - Deerfield Academy Building	4 LITTLE MEADOW RD	6,948	51
Warehouse - Hamshaw	16 ELM ST	6,882	50
Residential	97 PINE NOOK RD	6,844	50
Barn - Agricultural	111 OLD MAIN ST	6,828	50
House with barn complex	264 RIVER RD	6,742	49
Business - New England Auctions	222 GREENFIELD RD	6,726	49
Business	5 TINA DR	6,714	49
Residential - Multi-Family	19 MOUNTAIN RD	6,690	49
Institutional - Bement School	142 OLD MAIN ST	6,661	48
Institutional - Eaglebrook	283 PINE NOOK RD	6,647	48
House with barn complex	175 NORTH MAIN ST	6,485	47
Office - Sporting Area	724 GREENFIELD RD	6,474	47
Garage - MassDOT	75 SUNDERLAND RD	6,454	47
Institutional - Bement School	142 OLD MAIN ST	6,449	47
Barn - Bloody Brook Farm	144 NORTH MAIN ST	6,431	47
Institutional - Historic Deerfield	129 A&B OLD MAIN ST	6,417	47
Barn - Residential	2 CHILDS CROSS RD	6,395	47
Barn	123 LOWER RD	6,374	46
Restaurant	6 ELM ST	6,367	46
Barn	0 RIVER RD	6,365	46
Residential	9 HILLCREST AV	6,328	46
Residential	0 HOBBIE RD	6,201	45
Barn - Unknown Farm Business (Pine Nook Road)	PINE NOOK RD	6,185	45
Institutional - UMass	161 RIVER RD	6,185	45
Institutional - Deerfield Academy Building	27 ALBANY RD	6,181	45
Institutional - Deerfield Academy Building	518 RIVER RD	6,180	45
Business	635 RIVER RD	6,161	45
Residential	147 MILL VILLAGE RD	6,121	45
Barn	641 RIVER RD	6,108	44
Barn - UMass	63 89 RIVER RD	6,106	44
Residential - Multi-Family	3A HERITAGE WY	6,086	44
Barn - Residential	76 NORTH HILLSIDE RD	6,051	44
Residential	117 RIVER RD	6,046	44
Business - Mill	8 COATES AV	6,030	44

Warehouse - Business	7 RAILROAD ST	6,006	44
Barn	123 LOWER RD	5,983	44
Garage - Town of Deerfield Property	9 MERRIGAN WAY	5,976	44
Institutional - Bement School	100 OLD MAIN ST	5,959	43
Quonset Hut - Trew Stone	901 RIVER RD	5,949	n/a - rounded roof
Barn - Savage Farms	90 LOWER RD	5,947	43
Barn - Commercial	59 STILLWATER RD	5,934	43
Barn - Williams Farm	0 MILL VILLAGE RD	5,916	43
Business - New England Auctions	222 GREENFIELD RD	5,881	43
Garage - MassDOT	236 GREENFIELD RD	5,875	43
Business - Offices	29 ELM ST	5,871	43
Garage - Fishers Garage	12 SUGARLOAF ST	5,848	43
Residential	83 HILLSIDE RD	5,811	42
Social Hall - Polish American Club	46 SOUTH MAIN ST	5,792	42
Offices	235 GREENFIELD RD	5,738	42
Residential	112 SOUTH MILL RIVER RD	5,722	42
Garage - Business Building	901 RIVER RD	5,719	42
Restaurant Complex	265 GREENFIELD RD	5,708	42
Barn - Residential	2 LOWER RD	5,673	41
Greenhouse	635 RIVER RD	5,666	TBD
Institutional - Eaglebrook	283 PINE NOOK RD	5,633	41
Business Complex	13 ELM ST	5,618	41
Barn	0 LITTLE MEADOW RD	5,598	41
Store - Cowan Auto Supply	93 NORTH MAIN ST	5,583	41
Barn	0 RIVER RD	5,559	40
Residential	9 CRESTVIEW DR	5,543	40
Institution - Prison Dharma Network	595B RIVER RD	5,538	40
Greenhouse	635 RIVER RD	5,516	TBD
House with barn complex	18 SOUTH MILL RIVER RD	5,503	40
Store - Pekarski's Sausage	293 CONWAY RD	5,431	40
Barn - Agricultural	0 NORTH HILLSIDE RD	5,424	39
Residential	21A SNOWBERRY CIRCLE	5,405	39
Greenhouse	635 RIVER RD	5,383	TBD
Institutional - Historic Deerfield	37 OLD MAIN ST	5,352	39
Residential	104 HILLSIDE RD	5,314	39
Post Office - USPS	60 SUGARLOAF ST	5,304	39
Residential	1A GRAY LOCK LN	5,301	39

Residential	13A SNOWBERRY CIRCLE	5,298	39
Residential	31A SNOWBERRY CIRCLE	5,295	39
Store	19 ELM ST	5,290	39
Residential	46A SNOWBERRY CIRCLE	5,216	38
Lodge - Franklin Co Sportsmans Club	721 RIVER RD	5,204	38
Barn	118 LOWER RD	5,200	38
Institutional - Deerfield Academy Building	4 LITTLE MEADOW RD	5,193	38
Residential	36A SNOWBERRY CIRCLE	5,157	38
Quonset Hut - Wiliams Farm	0 MILL VILLAGE RD	5,139	n/a - rounded roof
Residential	96 NORTH MAIN ST	5,127	37
Business - Repair Garage	0 NORTH HILLSIDE RD	5,101	37
Institutional - Deerfield Academy Building	70 A OLD MAIN ST	5,084	37
Barn - Umass	63 89 RIVER RD	5,078	37
Residential	617 RIVER RD	5,034	37
Garage - Doug Automotive	951 RIVER RD	5,024	37
Residential	96 NORTH MAIN ST	5,019	37
Quonset Hut - Agricultural	111 OLD MAIN ST	5,013	n/a - rounded roof
Educational - Eaglebrook	283 PINE NOOK RD	5,007	36