DRAFT
ENERGY PLAN

FOR THE
TOWN OF WOODBURY

VERSION CONTROL

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PREPARED BY:

The Central Vermont Regional Planning Commission
24 Main Street, Suite #4
Montpelier, Vermont 05602
802.229.0389

EDITED BY:

THE WOODBURY PLANNING COMMISSION

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Executive Summary & Introduction

With the passage of Act 174 in 2016, Towns have been allowed a higher level of deference in the Section 248 proceedings if they meet specific planning standards, which would allow Woodbury an opportunity to reexamine the actions its community is taking to meets its energy goals.

Through Act 174, three primary planning areas are identified and need to be met satisfactorily for successful compliance. These sections include Analysis & Targets; Pathways & Implementation Actions; and Mapping. All three sections include an evaluation of energy sectors that include thermal (heating), electrical, and transportation.

Section I: Analysis & Targets

This section provides a baseline of information for where a municipality currently stands in terms of energy and identifies the trajectories and pace of change needed to meet targeted reductions and conservation of energy. It includes information on current electricity use for residential and non-residential uses; existing and potential renewable resource generation; and current transportation energy use information. Additionally, targets are established to provide milestones for thermal efficiency, renewable energy use, and conversion of thermal and transportation energy from fossil fuels to renewable resources. These milestones are intended to help the municipality measure progress towards the overall goals and are not identified as requirements. Targets are established for the years 2025, 2035, and 2050 which coincide with the State Comprehensive Energy Plan.

Specific information in this section notes that Woodbury currently uses approximately 5,589 megawatt hours of electricity on an annual basis across the identified sectors. By comparison, Woodbury's share of new renewable energy generation needed to meet the state's goal is approximately 5,831 megawatt hours. Based on the mapping and resource data (Section III), Woodbury has resources available to generate approximately 4,276,321 megawatt hours of energy.

Other analysis includes 2050 targets for fuel switching of vehicles from fossil based to alternative power, and conversion or installation of high efficiency heating systems for residential and commercial structures. Specific targets for Woodbury include over 1,200 alternative powered vehicles and approximately 212 heating system changeovers. The specific 2050 targets for transportation and heating renewable use in Woodbury are 90.2% and 93.1% respectively. It's important to note that the targets for alternative powered vehicles listed in Section One are based on maintaining current land use and transportation policies. Transit, ride sharing, telecommuting, or similar policies may be prioritized by the Town which would impact these targets and reduce dependency on individual vehicle needs.

Section II: Pathways & Implementation Actions

Section II provides the basis for how Woodbury will meet their target year goals as noted in Section I. The implementation actions are categorized by:

1. Conservation & efficient use of energy
2. Reducing transportation demand and single occupancy vehicles trips, and encouraging the use of renewable sources for transportation
3. Patterns and densities of land use likely to result in conservation of energy
4. The siting of renewable energy generation

The implementation actions that are identified in this section focus primarily in areas where the Town of Woodbury is already working to support its residents and businesses through local land use, transportation, and environmental planning activities.

To this end, the current Woodbury Town Plan was first reviewed and implementation actions that pertained to any of the above-mentioned sections were noted. These implementation items were carried forward for inclusion in the energy plan to establish consistency with the two documents. To ensure all the categories for implementation as noted above were adequately addressed, guidance from the Department of Public Service related to implementation was utilized.

The implementation actions identify who will be responsible for completing each action, the timeframe for when it should be completed, and an anticipated outcome that will help provide a measure of success. This section will serve as the basis for how energy planning will be incorporated into local activities. The implementation actions that were included are based on Woodbury's ability to lead the action. This will create consistency regarding implementation and put the responsibility for action on the Town. Other partners are listed when appropriate to indicate which groups will be engaged to support the successful completion of the identified actions.

Section III: Mapping

The mapping section allows the Town of Woodbury to visually identify where renewable energy generation is most suitable. This section combines resource information with specific known and possible constraints to the development of renewable energy generation. The mapping section also allows the opportunity to identify preferred locations for renewable energy development and areas that are unsuitable for development of any kind. In addition, the maps identify existing infrastructure to support renewable energy development.

In general, the mapping information looks at state-level data and breaks it down to a municipal perspective. From there, an analysis was done (as noted in Section I) regarding the potential renewable energy generation that might be possible based on resource areas and constraints.

This information is useful to visualize what geographies throughout Central Vermont are most ideally suited or best to avoid regarding renewable energy siting.

This section also contains specific information regarding the development and siting of renewable energy resources that are reflected on the maps. The Regional Planning Commission did, however, identify additional possible constraints to be considered. These include elevations above 2,500 feet, slopes greater than 25%, municipally owned lands, and lakeshore protection buffer areas of 250 feet. The decision was made to include these resources as possible constraints to allow for further analysis by the region or the municipalities to determine if development of renewable energy generation facilities may be appropriate based on specific conditions.

Appendices

There are two appendices included with this plan. Appendix A provides definitions for the known, possible, and regional constraints that are included on the maps and discussed in Section III. These definitions include source information and, in several instances, provide insight as to why the resource is listed as a known, possible, or regional constraint. Appendix B includes the specific resource and constraint maps. Included in the resource mapping is data specific to wind, solar, hydrological, and woody biomass. All these maps also include information regarding three-phase power and transmission lines; roads; and other relevant data used to assist with siting of renewable energy development.

How This Plan Will Be Used

The Woodbury Energy Plan will establish the policies that will help the Town achieve its share of the state's goal of 90% of the state's energy coming from renewable sources by 2050, as outlined in the 2016 State Comprehensive Energy Plan. For this document to have standing, it will need to receive a Determination of Energy Compliance (DOEC) from the Central Vermont Regional Planning Commission (CVRPC). This determination will give the Woodbury Town Plan "substantial deference" before the PUC during their review of applications for Certificates of Public Good related to renewable energy generation facilities. Once a DOEC has been issued, the Woodbury Town Plan will be used to establish a position in proceedings before the PUC if warranted. Additionally, where applicable, the Town Plan will be used during Act 250 proceedings before the District 5 Environmental Commission.

Additional Energy Generation Technology

The general premise of the Woodbury Energy Plan is based on the idea that generation of energy will be achieved using more renewable sources and less fossil fuel-based resources. To this end, the focus for generation of energy is primarily based on existing technologies such as solar, wind, and hydroelectric. Additionally, the plan notes woody biomass and biogas as renewable forms of energy generation when developed in a sustainable manner. This direction is taken from the State's Comprehensive Energy Plan which focuses on electrification of the grid

with alternative energy generation in order to meet their goals of 90% of the state's energy use coming from renewable sources by 2050.

The sources of renewable energy generation that are identified in this plan include current technologies that are known and supported in Vermont. Advances in the development of renewable energy technologies may result in generation measures or techniques that are not currently considered in this plan but may be more efficient or effective. As such, this plan will consider renewable generation technologies that do not have an adverse impact on the Town of Woodbury, the Central Vermont Region, or the policies that guide the Planning Commission and not be limited exclusively to the generation techniques and technologies noted herein.

Analysis & Targets

In order to adequately determine if the Town of Woodbury is on the right path to meeting its share of the state's goal of 90% of the energy used being produced by renewable resources, an identification and analysis of current energy use is necessary. To this end, the following questions have been identified to help determine current energy use and targets moving forward.

1. Does the plan estimate current energy use across transportation, heating, and electric sectors?
2. Does the plan establish 2025, 2035, and 2050 targets for thermal and electric efficiency improvements, and use of renewable energy for transportation, heating, and electricity?
3. Does the plan evaluate the amount of thermal-sector conservation, efficiency, and conversion to alternative heating fuels needed to achieve these targets?
4. Does the plan evaluate transportation system changes and land use strategies needed to achieve these targets?
5. Does the plan evaluate electric-sector conservation and efficiency needed to achieve these targets?

These five questions and their respective responses serve as the basis for identifying where the Town of Woodbury is now, where it needs to go, and how it will get there in terms of its energy future.

1. **Estimates of current energy use across transportation, heating, and electric sectors.**

Transportation

Transportation is a large consumer of energy in Woodbury. Transportation typically consists of passenger vehicles, light duty trucks, and heavy-duty trucks. It may also include transportation related to public transit, rail, or air service; however, these uses are minimal and trips may not originate within the municipality. As such, this section focuses primarily on vehicles, however rail, air, and public transit are addressed in other sections of the energy plan and throughout the municipal plan. Table 1 provides an overview of the current energy usage in Woodbury related to transportation.

Table 1
Current Transportation Energy Use

Transportation Data	Municipal Data
Total # of Vehicles (ACS 2011-2015)	744
Average Miles per Vehicle (VTrans)	12,500
Total Miles Traveled	9,300,000
Average Gallons Used per Vehicle per Year (VTrans)	576
Total Gallons Use per Year	500,000

Transportation BTUs (Billion)	60
Average Cost per Gallon of Gasoline (RPC)	2.31
Gasoline Cost per Year	$1,155,000.00

This table uses data from the American Community Survey (ACS) and Vermont Agency of Transportation (VTrans) to calculate current transportation energy use and energy costs.

Electricity

In 2016, Woodbury's electricity usage was split at 17% by commercial and industrial customers, and 83% by residential customers. Utility rates are regulated by the Vermont Public Utility Commission. In 2018, the U.S. Energy Information Administration reported the average cost per kilowatt hour in Vermont was approximately 15 cents and approximately 18 cents for all New England. Woodbury's current electricity usage can be found in Table 2, below:

Table 2 Current Electricity Use	
Use Sector	Current Electricity Use
Residential (Efficiency Vermont) (kWh)	4,618,193
Commercial and Industrial (kWh)-Hardwick Electric	128,000
Commercial and Industrial (kWh)-Washington Electric	5,278
Total (kWh)	4,751,471

This table displays current electricity use within the municipality. Commercial and Industrial (kWh) data was verified by Woodbury's serving electrical providers. Residential usage data is available from Efficiency Vermont (EVT).

Home Heating

2015 American Community Survey (ACS) Data indicate that approximately 14.6% (60) of homes in Woodbury are heated with fuel oil. The number of homes heated with propane and other bottled fuel oils has only decreased slightly from 96 in 2010 to 81 in 2015. Electric heat has increased from 0 in 2010 to 10 in 2015, and wood heat has dramatically increased from 133 in 2010 to 240 in 2015.

Municipal Energy Use:

Table 3 provides a breakdown of the fuel sources used for residential heating in Woodbury while Table 4 lists the current commercial energy use.

Table 3 **Current Municipal Residential Heating Use**				
Fuel Source	Municipal Households (ACS 2011-2015)	Municipal % of Households	Municipal Square Footage Heated	Municipal BTU (in Billions)
Natural Gas	0	0.0%	0	0.00
Propane	81	19.7%	141,648	8.50
Electricity	10	2.4%	18,160	1.09
Fuel Oil	60	14.6%	85,352	5.12

Coal	0	0.0%	0	0.00
Wood	240	58.4%	415,864	24.95
Other (Includes Solar)	20	4.9%	36,320	2.18
No Fuel	0	0.0%	0	0.00
Total	**411**	**100%**	**697,344**	**41.84**

This table displays data from the ACS that estimates current municipal residential heating energy use.

Table 4 Current Commercial Energy Use			
	Commercial Establishments in Municipality (VT DOL)	Estimated Thermal Energy BTUs per Commercial Establishment (in Millions) (VDPS)	Estimated Thermal Energy BTUs by Commercial Establishments in Municipality (in Millions)
Municipal Commercial Energy Use	10	394	3,940

This table uses data available from the Vermont Department of Labor (VT DOL) and the Vermont Department of Public Service (DPS) to estimate current municipal commercial establishment energy use in the municipality.

2. **2025, 2035, and 2050 targets for thermal and electric efficiency improvements, and use of renewable energy for transportation, heating and electricity.**

Energy efficiency is commonly viewed as the most effective and lowest-cost option for reducing energy consumption for electricity, heat, and transportation. Energy efficiency and conservation efforts such as improved insulation and weatherization of new and existing structures; improvements in building design; and the use of high-efficiency vehicles often have a dramatic impact on reducing fuel consumption. These methods are supported and encouraged by the town. In a challenging economy and at a time of increasing concern for the impacts of climate change, steps to reduce fuel use, fuel expenditures, and to shrink emissions make good sense for the pocketbook and the environment.

For the purposes of this section, thermal and electric efficiency will be defined as overall improvements or reductions in the amount of energy used to run mechanical systems or provide climate control for structures. To effectively identify efficiency improvements for Woodbury, the Central Vermont Regional Planning Commission has provided targets for efficiency improvements for each of the target years. These improvements relate to residential, commercial, and overall electric efficiency. The target number may seem to be skewed towards the later years, however there is an expectation that efficiencies will increase with technological advances and occur over time regardless of additional actions being taken. The thermal efficiency targets for residential and commercial improvements are noted in Table 5.

Table 5 Targets for Thermal Efficiency Improvements			
Year	2025	2035	2050
Residential – Increased Efficiency and Conservation (% of municipal households to be weatherized)	20%	42%	92%
Commercial - Increased Efficiency and Conservation (% of commercial establishments to be weatherized)	22%	33%	61%

This table displays targets for thermal efficiency for residential and commercial structures based on a methodology developed by DPS using data available from the regional Long-range Energy Alternatives Planning (LEAP) analysis and ACS. The data in this table represents the percentage of municipal households and commercial businesses that will need to be weatherized in the target years.

For Woodbury to help support the state's goals of 90% of the energy used being derived from renewable sources by 2050, the Central Vermont Regional Planning Commission allocated megawatt hour targets for the years 2025, 2035, and 2050. This municipal target is based on an allocation from a region-wide target for renewable energy generation. Table 6 notes Woodbury's targets for renewable energy use and Table 7 identifies the targeted renewable energy generation.

Table 6 Targets for Renewable Energy Use			
Year	2025	2035	2050
Renewable Energy Use - Transportation	9.6%	31.3%	90.2%
Renewable Energy Use - Heating	51.0%	65.9%	93.1%

This data displays targets for the percentage of transportation and heating energy use coming from renewable sources during each target year. This data was developed using the LEAP analysis.

Table 7 Targets for Renewable Energy Generation			
Year	2025	2035	2050
Total Renewable Generation Target (in MWh)	1,457	2,332	5,831

Renewable generation targets for municipalities were developed by the regional planning commission.

Groups to Support Energy Planning

State and local support for energy planning makes identifying energy related actions and implementing energy objectives a more manageable task. Several groups exist that fill this role. A brief overview of these groups is noted below including some of the accomplishments that benefit the Town of Woodbury.

Efficiency Vermont

Efficiency Vermont helps all Vermonters to reduce energy costs, strengthen the local economy, and protect the environment by making homes and businesses energy efficient. A volumetric charge on electric customers' bills supports energy-efficiency programs.

Efficiency Vermont provides technical assistance, rebates, and other financial incentives to help Vermont households and businesses reduce their energy costs with energy-efficient equipment, lighting, and approaches to construction and major renovation. Additionally, it partners extensively with contractors, suppliers, and retailers of efficient products and services throughout the state.

It is operated by a private nonprofit organization, the Vermont Energy Investment Corporation, under an appointment issued by the Vermont Public Utility Commission.

3. **Evaluation of the amount of thermal-sector conservation, efficiency, and conversion to alternative heating fuels needed to achieve these targets.**

Energy Audits and Energy Efficiency Measures

The Environmental Protection Agency estimates that half of the energy used in most buildings is for heating and cooling. Much of this energy is lost -seeping through cracks in windows and doors for instance -which wastes energy and money and makes homes and businesses less comfortable.

Weatherization is the practice of modifying a building to protect its interior from the elements, to reduce energy consumption, and to optimize energy efficiency. Investing in thermal efficiency improvements -primarily air sealing, insulation, and heating system replacements--can dramatically reduce a home's heating energy use and an owner's fuel bills. Vermonters' 2010 fuel bills were nearly twice as much as those of a decade earlier.

An estimated 62,000 single and multi-family homes in Vermont will require energy efficient improvements by 2020. The state's volatile weather conditions play a critical role in how buildings can cost-effectively be heated and that most of the economic benefit of money Vermonters spend on fossil fuel accrues outside the state. At current fuel prices home energy efficiency investments can save Vermont residents approximately $1,000 per year.

As a result, the task force suggests "comprehensive and rapid weatherization" of Vermont's buildings to:

- Reduce the vulnerability of Vermont ratepayers to fuel market volatility and dramatic weather fluctuations.
- Ensure that more of the money spent on energy will stay within the Vermont economy.

One of the most important goals in the 2016 Vermont Comprehensive Energy Plan is for the state to use energy audits, weatherization, and other tools to substantially improve the energy fitness of 25% of the state's housing stock by 2020.

After weatherization, the next step to increasing home heating efficiency is replacing outdated or inefficient home heating systems with high efficiency units. In general, this conversion would typically include replacing a system that used fossil fuel such as oil with an electric heat pump, wood burning system, or other renewable based heating systems. Specifically, Table 8 identifies

the number of new efficient wood heating systems or heat pumps needed in each target year to meet Woodbury's portion of the state's comprehensive energy goals.

Table 8 Thermal Sector Conversions Per Target Year (Residential and Commercial)			
Year	2025	2035	2050
New Efficient Wood Heat Systems (in units)	1	0	8
New Heat Pumps (in units)	42	107	204

This table provides a target for new wood heating systems and new cold climate heat pumps for residential and commercial structures in the municipality for each target year. This target was calculated using data from LEAP and ACS.

The Town of Woodbury is significantly forested, and recognizes the importance of supporting the local logging businesses and regional economy. The Town would like to exceed the proposed targets for New Efficient Wood Heat Systems, as these systems would provide a larger benefit to the Town in the energy and economic sectors. The Town will still pursue and support the transition to cold climate heat pumps, but would like to see more new efficient wood heat systems in the future (beyond 8).

A building energy audit is a service where the energy efficiency of a structure is evaluated by a person using professional equipment (e.g., blower doors, infrared cameras) to identify best ways to improve energy efficiency in heating and cooling the house. The goals are to:

- Evaluate the building's overall thermal performance.
- Identify cost effective ways to improve the comfort and efficiency of the building.
- Estimate the potential savings in fuel and expenses for the proposed changes.

Many building and energy contractors in Central Vermont offer home and business energy audits for a fee (typically ranging from $300-$500). Depending on income, some families or individuals may qualify for free audits or energy efficiency grants from Efficiency Vermont or other organizations.

4. **Evaluation of transportation system changes and land use strategies needed to achieve these targets.**

Transportation Efficiency

According to the 2016 Vermont Comprehensive Energy Plan, transportation accounts for approximately one third of the overall energy use in Vermont, at 33.7%. Nationally, transportation represents 28.6% of overall energy use. This difference is a result of Vermont's higher dependence on automobile transportation due to the state's rural character, more dispersed population, as well as a relatively small industrial base.

Gasoline and diesel account for more than a quarter of all energy consumed in Vermont across all energy sectors. Gasoline and diesel consumption are twice that of fuel oil and kerosene used

for heating. Petroleum combustion in the transportation sector is also the state's largest contributor to greenhouse gas emissions.

Fuel prices are typically higher in northern than in southern New England. Significant increases in the costs of gasoline, diesel fuel, and heating fuel have occurred over the last decade. Price spikes in recent years highlight our area's heavy reliance on limited sources and types of fuel and leave the local population, particularly low-income residents, vulnerable to fuel shortages and price fluctuations.

One component of reducing fossil fuel-based energy used in the transportation sector is to convert or replace older vehicles with alternative fuel vehicles such as electric or biodiesel. Table 9 identifies the targets for the number of new electric or biodiesel vehicles over each of the target years to help Woodbury reduce its transportation energy consumption to a point that will help meet the state's comprehensive energy planning goals. Again, this information assumes efficiency and improved technologies will be included in the development of vehicular fuel technology.

It should be noted that another consideration is to reduce the total number of vehicles overall. This can be done through the creation of compact development patterns, increased transit opportunities, or alternative transportation options such as bicycles or walking. The Town should evaluate additional objectives that will promote a shift away from vehicle use rather than rely on the conversion of vehicles to renewable fuels.

Table 9 Transportation Fuel Switching Targets			
Year	2025	2035	2050
Electric Vehicles	64	442	882
Biodiesel Vehicles	111	206	335

This tables displays a target for switching from fossil fuel-based vehicles (gasoline and diesel) to electric vehicles and biodiesel vehicles. This target is calculated by using LEAP and ACS data.

5. **Evaluation of electric sector conservation and efficiency needed to achieve these targets.**

Conservation and efficiency of electricity is a key component to achieving the state's comprehensive energy planning goals. Over time, advancements in technology will provide a degree of the needed efficiency and conservation measures to achieve these goals, but also, efforts can be taken now to ensure the Town of Woodbury is on track to meet its conservation and efficiency targets. Table 10 outlines the electric efficiency improvements needed for each of the three target years. Additionally, information related to more proactive ways to achieve these efficiencies are also noted below.

Table 10 Targets for Electric Efficiency Improvements			
Year	2025	2035	2050
Increase Efficiency and Conservation	1.5%	7.3%	15.2%

Data in this table displays a target for increased electricity efficiency and conservation during the target years. These targets were developed using regional LEAP analysis.

Energy Efficient Design

It is much more time-and cost-effective to plan, design and build a structure and its systems with energy efficiency in mind at the outset than to perform weatherization activities after the building has been constructed.

Leadership in Energy and Environmental Design (LEED) consists of a suite of rating systems for the design, construction and operation of high-performance green buildings, homes and neighborhoods. Developed by the U.S. Green Building Council, LEED is intended to provide building owners and operators a concise framework for identifying and implementing practical and measurable green building design, construction, operations, and maintenance solutions.

Across Vermont, in 2012 nearly one-third of new homes were EnergyStar rated. The 2016 Vermont Comprehensive Energy Plan sets a goal of 60% by 2020.

School Energy Efficiency

Schools are one of the largest consumers of energy in most Vermont communities. Because they are such large consumers of a variety of energy sources, they often offer significant opportunities for saving fuel and taxpayer expenditures. There have been local efforts to save schools, and local taxpayers, fuel and funds.

The Woodbury Elementary School converted its heating system to a wood pellet system. It also underwent weatherization improvements that resulted in a higher-than-average energy efficiency rating. These improvements resulted in the school receiving an award for their achievement.

Local Food

Woodbury's location is in within twenty (20) miles robust COOP food stores in Hardwick, Montpelier and Morrisville. These farmer to consumer markets afford Woodbury residents access to locally grown vegetables and animal products and strengthens the relationships between food producers and consumers. Buying direct from COOPS or at local farmer's markets ensures residents receive fresh, healthy food at a competitive price without incurring excessive transportation costs.

Woodbury residents may choose to shop at large grocery chain stores where he average food item in the average grocery store travels between 1,000 and 1,500 miles to reach the table. Food transportation consumes a considerable amount of energy, and the related emissions

contribute to climate change. A typical meal bought from a conventional supermarket chain – including some meat, grains, fruit and vegetables – consumes 4 to 17 times more petroleum for transport than the same meal using local ingredients.

Renewable Energy

The Town of Woodbury actively supports the use and development of renewable energy. Specifically, through 2016 renewable energy generation installations create approximately 234 megawatt hours of energy each year. This includes a mix of solar and wind. This allocation of renewable energy generation will help the Town meet their renewable energy goals. The specific breakdown of renewable energy generation is outlined in Table 11. Table 14 also provides a breakdown of existing renewable energy generation and identifies those sources generating 6 kW or more.

Table 11
Existing Renewable Energy Generation

Renewable Type	MW	MWh
Solar	1.09	122.9
Wind	0.00	0.00
Hydro	0.00	0.00
Biomass	0.00	0.00
Other	0.00	0.00
Total Existing Generation	**1.09**	**122.9**

This table shows existing renewable generation in the municipality, in MW and MWh, based on information available from the Vermont Department of Public Service.

Hydroelectric

In the past, local waterways powered numerous mills and provided small-scale electricity across Vermont. Today, power from in-state and out-of-state hydroelectric dams (most notably Hydro Quebec) supply approximately 40% of Vermont's annual power needs.

Woodbury is home to several dams. Two were used to generate electricity, one located on Nichol's Pond and the other located on East Long Pond. Both were built in the early 1900's as a backup water supply. Today, these dams are historic, and there are no plans to convert these areas to hydroelectric usage, considering the lack of cost-effectiveness.

Currently, there are no hydroelectric facilities in Woodbury. However, due to the environmental impact of damming these sites for the small generation boost, there are no plans in place currently to develop hydroelectricity in Woodbury.

Solar

Converting radiation from the sun into electricity is a clean, renewable energy source. Solar photovoltaic (PV) cells convert sunlight into electricity for homes and businesses, while solar

thermal arrays provide hot water for domestic use and may even be designed to augment a household's heating system.

Advances in technology have improved solar efficiency and solar arrays are becoming more affordable. The cost to install one kilowatt of PV in Vermont fell by nearly 40% from 2004 to 2011. Federal and state incentives and leasing programs have improved financial accessibility to the technology.

As of 2018, solar collectors were installed at 18 sites in Woodbury with a total photovoltaic (PV) capacity of 109 kW. This number derives from numerous, dispersed residential scale solar projects. Table 13 lists the number of PV sites by the serving electric company.

Woodbury has made great strides to incorporate solar energy into its energy portfolio. According to the Energy Action Network's Energy Dashboard, Woodbury ranks 128th among Vermont municipalities in total solar installation with 18 sites. Several south-facing roofs and slopes provide the potential for even greater use of the technology, although some roofs may need to be retro-fitted to support solar panels.

[1]In 2014, the Legislature enacted Act 99, an Act relating the self-generating and net metering, which increased the Net-Metering program's cumulative capacity cap to 15% of each utility's peak capacity. As the amount of distributed renewable energy in Vermont has grown significantly over the past several years, the cost of installing solar generation has also decreased dramatically. Financial incentives for net-metered solar, however, have remained high, making it the most expensive of Vermont's renewable energy programs. Solar net-metering systems receive up to 18.9 cents per kilowatt-hour (kWh) compared to solar prices under the State's standard-offer program of 10-13 cents and roughly similar prices for power purchase agreements and utility-built systems.

At the same time, the rapid buildout of distributed generation has caused important changes in the state's electric system. One positive effect of this development, particularly as a result of increased solar capacity, has been that Vermont's system peak is no longer occurring during mid-day, which means that Vermont avoids regional capacity charges. On the other hand, the expansion of distributed generation has led to stress on some portions of the distribution grid, necessitating costly investments to interconnect additional generation.

A majority of Woodbury residents are served by Hardwick Electric Department, HED, which has expressed the problem of grid constraints being able to handle solar electricity being fed onto the grid. As such, HED has imposed limits on how much solar the utility is willing to allow to connect to the grid through net-metering. This forced constraint greatly limits Woodbury's ability to achieve the State's 2050 renewable energy goals.

According to the Vermont Energy Atlas, Woodbury has the capability to produce 565 megawatt hours on rooftop solar alone. There is also the possibility of 995,136 megawatt hours from

[1] State of Vermont Public Utility Commission Case no. 18-0086-INV

ground mounted solar as well. Additional information on potential generation is noted in Table 12 and is reflected on the maps in Appendix B.

Commercial leasing programs now allow households and companies access to solar energy at fixed costs that often are less than their current electricity bills. Further advances in technology will likely improve the efficiency, and lower the cost, of solar panels. Finding space for additional solar arrays remains an issue in Woodbury, particularly for residents and businesses lacking south-facing rooftops or land.

Wind

Improvements in turbine technology in combination with federal and state subsidies have recently made investments in wind power more attractive across the country as well as in Vermont. The Vermont Energy Atlas identifies the possibility of generating 3,280,620 megawatt hours of wind in Woodbury. The primary wind production area sits on the western ridgeline in Woodbury, with additional generation possible in the northern-center of Town. However, these locations also are highest priority forest blocks for connectivity, as well as some agricultural soils. Specific suitability for wind resources is noted in the mapping section. The wind maps identify where wind speeds are appropriate for smaller scale wind generation and do not include large industrial scale wind suitability.

In the past, a wind development was proposed on land previously used for logging. In assessing community support for this project, the Town of Woodbury's residents were decidedly opposed to the development of wind in that location. Since this proposal, the Town of Woodbury has not had any large-scale wind developers proposing new locations in Town.

In order to support large-scale wind projects, it is believed that projects must meet certain criteria to ensure that they do not cause undue negative impacts on natural, recreational, and aesthetic resources. Woodbury plans to establish clear and specific guidelines that can be used when evaluating proposed large-scale wind projects. Also, the current Central Vermont Regional Energy Plan limits wind generation facilities to hub height of 125 feet and restricts development above 2,500 feet in elevation. Woodbury will work to maintain consistency with these regional limits.

Wood

Historically, wood has been Vermont's, and Woodbury's, most abundant local energy source. Statewide residential firewood consumption grew from 275,000 cords per year in 1997 to 315,000 cords in 2008, a nearly 15% increase. Current use of cordwood for heating in Woodbury is unknown. In addition to firewood, wood biomass heating, in the form of woodchips and pellets, is becoming more popular.

Woodbury is significantly forested, and the Woodbury Planning Commission recognizes the importance of supporting the local logging businesses and regional economy. The Commissioners would like to exceed the proposed targets for New Efficient Wood Heat Systems,

as these systems would provide a larger benefit to the Town in the energy and economic sectors.

[2]More specifically, the 2016 State Comprehensive Energy Plan, CEP, calls for doubling the use of wood heating in Vermont. Expanded use of advanced wood heat will help Vermont make measurable progress toward several key goals. Developing local demand for cordwood, wood chips, and pellets will help create vital markets for low-grade timber from managed forests. Heating with local wood fuels reduces the economic drain on Vermont's economy. Factoring that only 22 cents of every dollar spent on heating oil or propane are likely retained in the local economy, and 80 cents of every dollar spent on wood are likely retained in the local economy,1 an estimated net $70 million was retained in the Vermont economy in 2016 by Vermonters choosing to heat with wood rather than fossil fuels. Wood heat lowers and stabilizes energy costs and keeps dollars circulating in the local economy. Wood heat also creates and supports jobs in the forestry, wood processing, and transportation sectors.

Approximately 37% of Vermont's households utilize biomass (including cord wood and wood pellets) to heat at least a portion of their homes.

There are potential negative side effects to extensive wood harvesting and burning, among them habitat impairment, soil erosion, sedimentation, and water pollution if forests are not properly managed, as well as the degradation of air quality and an increase risks of accidental fires. These are, however, easily manageable risks. Best forest management practices, as outlined by the state and independent forest certification groups, can reduce the adverse impacts of harvesting while regular maintenance of wood stoves and adherence to fire codes lessens the risk of accidental fires.

According to the Vermont Department of Public Service, the efficiency factor for biomass is between 60% and 80%. Use of wood for heating is calculated as carbon-neutral; that is, the carbon sequestered by a tree during its lifetime balances with the carbon emitted during its burning.

If factoring in the fossil fuels used to cut and haul wood/wood biomass, as well as the inefficiencies of current biomass burning, wood may not be fully carbon neutral. More efficient burning of woody biomass would greatly improve biomass's potential for wider adoption as a local power source. This could be supported by converting to high-efficiency wood heating systems as noted in Table 8.

<u>Other Local Renewable Energy Sources</u>

Other potential local renewable energy sources include geothermal energy, which uses the temperature differential in water taken from deep wells to heat and cool buildings.

[2] Expanded Use of Advanced Wood Heating in Vermont March 2018-Biomass Energy Resource Center

Siting

An analysis of existing land and renewable resource potential will help determine the amount of local renewable energy that could be developed within the Town of Woodbury. Table 7 identifies the amount of renewable energy generation (in megawatt hours) that the Town of Woodbury would need to generate by 2050 to help meet their share of the Region's total renewable energy generation.

The information in Table 12 includes an analysis of the renewable energy generation potential and will be complemented by information and maps that are in Appendix B of the plan. There is adequate land area available for Woodbury to accommodate renewable energy generation that can meet their share of the region's renewable energy allocation. It should be noted, however, that not all renewable energy generation is appropriate at the same scale. For example, wind may be appropriate in the Town of Woodbury at a residential scale, but not at a commercial scale as detailed in the Mapping Section, in Appendix "A", and as illustrated on both the Known and Possible Constraints Maps, and the Wind Resources Map. Local objectives will need to be established to address these issues. Also, it should be noted that not all areas are appropriate for development of renewable energy and more detailed analysis may be needed to identify appropriate locations for renewable energy development.

One final factor to consider is efficiency of renewable resources and their ability to generate energy. Since not all sources of renewable energy generation provide the same level of capacity, it is important to understand the efficiency differences between the common types of renewable generation. Simply put, the sun doesn't always shine and the wind won't always blow therefore these renewable generators are not always producing energy. These efficiency factors will allow the municipality to utilize whatever renewable resource is most appropriate for the specific circumstances.

Table 12
Potential Renewable Energy Generation

Renewable Type	MW	MWh
Rooftop Solar	0.46	565
Ground-mounted Solar	811.43	995,136
Wind	1,070.00	3,280,620
Hydro	0.00	0
Biomass and Methane	0.00	0
Other	0.00	0
Total Renewable Generation Potential	**1,881.89**	**4,276,321**

Renewable generation potential is based on mapping completed by the regional planning commission that is based on the Municipal Determination Standards and associated guidance documents developed by DPS. The renewable generation potential is expressed in MW and MWh by the type of renewable resource (solar, wind, hydro, etc.).

Table 13

Existing Renewable Solar Energy Generation in Woodbury based on existing Certificates of Public Good			
Renewable Resource Type	Utility	Capacity kW	Number of Sites
Solar	Hardwick Electric Department	98.3 kW	16
Solar	Washington Electric Coop	10.3 kW	2

This table represents information found through Certificates of Public Good issued by the Public Utility Commission. More information can be found at the Vermont Community Energy Dashboard.

Conclusion

As noted throughout this section, the Town of Woodbury faces challenges like the rest of the state regarding its energy future including the need for conservation, renewable energy development, and changing habits and attitudes towards renewable technology and land use choices. All these components need to work together in order to ensure a collective and comprehensive approach to energy planning is initiated.

The information provided in this section has shown that Woodbury can shape its energy future within the spectrum of the avenues that it can control. The unknown component is whether the changes and development will occur and when. The State Comprehensive Energy Plan has set a goal of 90% renewable energy by the year 2050. This goal is achievable if all stakeholders including the state, the region, the municipalities, the energy developers, the private land owners, the special interest groups, and the interested citizens come together to discuss the issues and work collectively to identify the outcomes that satisfy the needs of the whole to the best of their ability.

This plan primarily explores renewable energy related to the production of electricity and electrification of the grid. In addition to the resources noted herein, it's important to consider other forms or technologies that could contribute to our renewable energy future. With advancements in safety, efficiency, and technology, the Region's energy future could look vastly different in the next five or ten years. This will not only impact the generation of energy, but the delivery and infrastructure to support distribution of energy.

Pathways and Implementation Actions

The following goals and implementation actions outline the specific pathways for the region to consider in order to effectively support the State of Vermont's goals that are outlined in the 2016 Comprehensive Energy Plan. These goals are intended to cover a variety of pathways that address land use and siting of developments (including renewable energy generation); efficiency of building construction and weatherization; and fuel switching from fossil-based fuels to more sustainable and renewable options.

A. Conservation and Efficiency

Objective A-1: Increase conservation of energy by individuals and organizations.

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Formally identify an Energy Coordinator and post their contact information on the Town Website.	Planning Commission, Town Administration	High 1 – 2 Years	Energy Coordinator is identified and contact information is shared to community members.
2	Hold public meetings and invite industry professionals to present on weatherization and fuel switching options for residents.	Planning Commission	High/ Sustained 1 – 2 Years	Meetings are held and presentations are given on energy improvements residents can make.

Objective A-2: Promote energy efficiency in the design, construction, renovation, operation, location and retrofitting of systems for buildings and structures.

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Revise Zoning Bylaws to include references to Statewide Residential and Commercial Building Energy Standards.	Planning Commission	High 1 – 4 Years	Zoning Bylaws are revised to include information on residential and commercial building standards.
2	Distribute information on energy standards and efficiency options to residents and local developers.	Zoning Administrator	High/ Sustained 1 – 2 Years	Zoning Administrator is provided information to distribute with permit applications and to interested residents.

Objective A-3: Identify ways to decrease the use of fossil fuels for heating.

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Host a presentation of alternative heating fuels, their cost to implement, and available incentives for residents of Town.	Planning Commission, Efficiency Vermont, Industry Professionals.	Medium 1 -5 Years	A presentation is held with industry professionals to showcase alternative heating options.

Objective A-4: Demonstrated municipal leadership by example regarding efficiency of municipal buildings.

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Conduct baseline energy audits of all municipal buildings and structures, including the school.	Planning Commission, Efficiency Vermont	Medium 1 – 5 Years	Baseline energy use for all municipal buildings is measured and logged.

B. Reducing Transportation Energy Demand, Single Occupancy Vehicle Use, and Encouraging Renewable or Lower-Emission Energy Sources for Transportation

Objective B-1: Encourage increased use of transit as a primary method to complete daily trips and reduce demands on existing infrastructure such as roads and parking.

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Identify challenges and opportunities for small-scale transit in Woodbury.	Planning Commission	Medium 1 – 5 Years	Planning Commission will hold at least two meetings to discuss the desires of transit in Woodbury and understand the challenges present.
2	Explore alternative trips that Woodbury may be able to take advantage of beyond the current service from Rural Community Transportation.	Planning Commission, Selectboard, Rural Community Transportation, Green Mountain Transit.	Medium 1 – 5 Years	Planning Commission will work with local transit providers to identify any opportunities for new routes, and work with Selectboard to leverage funding for these services.

Objective B-2: Promote the shift away from single-occupancy vehicle trips to reduce congestion, impacts to local facilities, and support alternative options for transportation needs.

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Identify possible locations for a formal park-and-ride lot in Woodbury.	Planning Commission	High 1 – 3 Years	A list of 4 possible existing lots will be created and discussed at a public meeting.
2	Identify any barriers to telecommuting such as internet connectivity or speed.	Planning Commission	Medium 3 – 6 Years	Planning Commission will devote a public meeting to discussing the telecommunication needs of the community and the opportunities to improve access.
3	Promote the Go Vermont webpage on the official Woodbury website.	Website Administrator	High 1 Year	A link to the Go Vermont webpage is added to Woodbury's municipal website.

Objective B-3: Promote the shift away from gas/diesel vehicles to electric or non-fossil fuel transportation options to reduce dependency on non-renewable fuel sources for transportation.

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Consider the implementation and possible locations for an EV charging station.	Planning Commission, Selectboard	Medium 1 – 6 Years	Locations for possible EV charging infrastructure are identified and grant opportunities are considered.
2	Partner with Drive Electric Vermont to invite them to community events to showcase electric vehicle options.	Planning Commission	Medium 1 – 6 Years	Woodbury hosts one electric car focused event during the term of this plan.

Objective B-4: Facilitate the development of walking and biking infrastructure to provide alternative transportation options for the community.

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Hold a public hearing to identify key areas for pedestrian and bike improvements, whether in neighborhoods, between neighborhoods, or in the Village.	Planning Commission, Selectboard, Highway Department	Medium 1 – 6 Years	A public hearing is held to discuss the pros and cons of integrating more walking and biking infrastructure and

Objective B-5: Demonstrated municipal leadership with respect to efficiency of municipal transportation to show an on-going commitment on behalf of the Town of Woodbury.

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Identify possible municipal properties to take on EV charging stations.	Planning Commission	Medium 1 – 6 Years	At public meeting to discuss EV charging infrastructure, identify a list of municipal properties that may be suitable for EV charging.
2	Continue to inventory municipal vehicles and maintain records for at least seven years, in order to best consider efficiency in the replacement of these vehicles.	Selectboard	High/ Sustained 1 – 2 Years	Inventory of municipal vehicles is maintained.
3	Prioritize efficiency of vehicles when considering the purchase of a new vehicle, and consider the switch to biodiesel for municipal vehicles.	Planning Commission, Selectboard.	High/ Sustained 1 – 8 Years	In decision-making regarding purchase of new vehicles, fuel efficiency and biodiesel use will be considered.

C. Patterns and Densities of Land Use Likely to Result in Conservation of Energy

Objective C-1: The Town of Woodbury is committed to reducing sprawl and minimizing low-density development by encouraging density in areas where infrastructure exists or is planned to support growth.

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Revise Zoning bylaws to incorporate greater densities in the Village District, South Woodbury, and other neighborhoods planned for development in the Future Land Use map.	Planning Commission, CVRPC	High 1 – 4 Years	Zoning bylaws are revised, adopted, and include changes to density requirements.

Objective C-2: Strongly prioritize development in compact, mixed-use centers when feasible and appropriate and identify ways to make compact development more feasible throughout the Town of Woodbury.

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Apply for a Village Center Designation for Woodbury's villages though the State Designation Program.	Planning Commission, Selectboard, and CVRPC	Medium 1-5 Years	Woodbury receives at least one village center designation in the term of this plan.
2	Identify buildings in those areas planned for development, such as the older school building, that may be repurposed for centralized housing facilities.	Planning Commission, Selectboard.	Medium 1 – 3 Years	A list of possible buildings to be converted into multi-family or other housing options is created.

D. Development and Siting of Renewable Energy Resources

Objective D-1: Evaluate generation from existing renewable energy generation including the identification of constraints, resource areas, and existing infrastructure by energy type.

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	In the Development of the 2020 Woodbury Town Plan, include this plan as an attachment and hold a public meeting to discuss any concerns from the public.	Planning Commission	High 1 – 2 Years	One meeting is held by the Planning Commission to discuss energy siting and constraints.
2	Hold a survey focusing on current thoughts on where solar is located, and what constraints may be considerable. Revisit and reassess at another interval in the term of this plan.	Planning Commission	High/ Sustained	A survey is distributed to residents and results are tabulated and posted online.

Objective D-2: Evaluate generation from potential renewable energy generation including the identification of constraints, resource areas, and existing infrastructure by energy type.

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	At the public meeting held to discuss energy in the development of the 2020 Woodbury Town Plan, identify constraints to add into this plan, as well as possible preferred areas.	Planning Commission	High 1 – 2 Years	Unsuitable and preferred areas for renewable energy generation are identified, and the consideration of municipal renewable energy are included in this plan ahead of adoption in 2021.
2	Hold a public meeting halfway through the plan's duration (4 years from adoption) to assess constraints, and make any changes necessary to adapt to changing conditions in Woodbury.	Planning Commission	Medium 4 Years	A public meeting is held 4 years from adoption of this plan to discuss any changes to preferred or constrained areas.

Mapping

The siting and generation of renewable resources is a critical part to identifying whether the region can meet its share of the state's renewable energy goals by 2050. Furthermore, this analysis is important to determine where resources are available throughout the region to ensure no one municipality is unduly burdened with supporting more than should be reasonably anticipated. Finally, this information will better position the Town of Woodbury to evaluate the renewable energy generation options that are available to meet these goals.

To this end, maps were created for the Town of Woodbury that identifies resources related to solar, wind, hydroelectric, and woody biomass. Maps were also created to identify constraints that may limit the overall area of possible resource development within the town. The following information will address the evaluation of current and future generation potential within the Town of Woodbury.

Existing Renewable Resource Generation

As noted in the Analysis and Targets section, Tables 11 (p. 15) and 13 (p. 18-19) identify the existing renewable generation for the Town of Woodbury. Information on existing generation is a representation of all projects that were issued a Certificate of Public Good by the Public Service Board through 2019. Projects that are currently under review are not included in these numbers therefore additional renewable energy generation may be developed that will not be noted in the total generation represented in Table 11 or 13.

Potential Renewable Energy Generation

Table 12 (p. 18) in the Analysis and Targets section identifies potential generation of renewable energy for Woodbury. This information is based on mapping data provided by the Vermont Center for Geographic Information (VCGI) and the Department of Public Service. This information includes specific data related to prime resource areas for solar and wind development which is an indication of where the conditions are most ideal for generation of the specific resource. Also included with this data is information regarding constraints to be considered when evaluating areas for renewable energy development. Additional detail regarding known and possible constraints is discussed below.

Constraints

As part of this effort, the Central Vermont Regional Planning Commission has identified information for each municipality related to renewable energy generation that includes an analysis and evaluation of resource areas within each municipality and how those resource areas are impacted by statewide and regionally identified constraints. In order to determine the impacts, an understanding of the constraints needs to be discussed.

For the purpose of this plan, constraints are separated into two main categories; known and possible. Known constraints are those areas where development of a renewable resource are

very limited and therefore are not likely to occur. Known constraints that have been identified include:

- Vernal Pools (confirmed or unconfirmed)
- River Corridors as identified by the Vermont Department of Environmental Conservation
- Federal Emergency Management Agency Identified Floodways
- State-significant Natural Communities and Rare, Threatened, and Endangered Species
- National Wilderness Areas
- Class 1 and Class 2 Wetlands (as noted in the Vermont State Wetlands Inventory or Advisory Layers)
- Regionally or Locally Identified Critical Resources

Similarly, the state has identified a list of possible constraints to be considered. Possible constraints identify areas where additional analysis will need to occur in order to determine if development of renewable energy resources is appropriate. In some cases, conditions may be prohibitive, but in others the conditions may be suitable for renewable energy development. The possible constraints include:

- Agricultural Soils
- Federal Emergency Management Agency Special Flood Hazard Areas
- Protected Lands (State fee lands and private conservation lands)
- Act 250 Agricultural Soil Mitigation Areas
- Deer Wintering Areas
- Vermont Agency of Natural Resources Conservation Design Highest Priority Forest Blocks
- Hydric Soils
- Regionally or Locally Identified Resources

In addition to the items listed above, the Regional Planning Commission, through its Regional Energy Committee, has identified additional constraints to be included for all the municipalities that were noted as being regionally significant. For the purposes of this mapping exercise, all the regional constraints are considered possible constraints. This is because the Regional Energy Committee determined that, like the statewide possible constraints, conditions could be such that developing renewable energy resources in these locations could occur but should be studied further at the municipal level to determine if the specific conditions regarding these locations are suitable. The possible regional constraints that were identified include:

- Elevations above 2,500 feet
- Slopes greater than 25%
- Municipally Owned Lands
- Lakeshore Protection Buffer Areas of 250 feet

Methodology

With all the known and possible constraints identified, this information was overlaid on the resources maps for solar and wind resources. Where known constraints existed the resource areas were deleted. Where possible constraints existed, the resource areas were shaded. The resulting areas included those lands where prime resources exist without any constraints and prime resource areas with possible constraints. The total area within these two categories served as the basis to determine the amount of resource that is available for potential development within the Town of Woodbury.

As noted in Table 12 of the Analysis and Targets section, based on the solar, wind, and hydroelectric potential within Woodbury, approximately 4,155,059 megawatt hours of energy could be produced, well above the town's allocation of 7,999 megawatt hours by 2050 as noted in Table 7. The potential energy generation for the Town of Woodbury increases when other sources of renewable energy generation such as biomass, biogas, and methane are included. No specific generation numbers are listed in Table 12 for these types of energy generation as their siting is not specifically tied to the availability of a resource, therefore calculating a potential for generation would be difficult.

Transmission Infrastructure

In addition to identifying and calculating possible generation of renewable energy based on resources and constraints, the mapping included in this plan also incorporates the existing three phase power infrastructure throughout the municipality. This is important to include because renewable energy generation needs three phase power to provide energy generation back to the grid. Without three phase power, renewable energy generation would be limited to scales necessary to serve uses in close proximity that would not require transmission infrastructure.

Like limits on three phase power are potential limitations on existing transmission infrastructure and the ability to transmit energy from its point of generation to the possible users. As noted previously, the mapping includes three phase power, but it also includes information on current transmission infrastructure. This is another component to consider when identifying where specific generation types should be located to ensure the transmission capacity exists within the grid or to identify areas where upgrades may be needed before development of renewable energy generation can occur. Based on the factors noted above, it may be appropriate for mapping to identify areas where significant energy loads are currently occurring or anticipated based on future land use and zoning.

Preferred & Unsuitable Siting Locations

The Town of Woodbury recognizes the preferred locations that have been identified by the State of Vermont's Net Metering Rules. Additional preferred locations may be identified after

an analysis of the needs with the community have been conducted. The state preferred locations include but are not limited to:

- Parking lots
- Gravel pits
- Brownfield sites
- Landfills
- Rooftop installations

As seen on the attached map, Woodbury has a few quarry sites and a gravel pit that may be suitable for a State Preferred Site. Parking lots are not shown on the map. As of drafting this plan in 2019, there are no mapped brownfield sites or landfills in Woodbury.

Local Mapping

To provide a more specific visual representation of resources and constraints, mapping was developed by the Central Vermont Regional Planning Commission that includes:

- Solar Resource Areas
- Wind Resource Areas
- Hydroelectric Resource Areas
- Known Constraints
- Possible Constraints
- Woody Biomass Resource Area
- Existing Renewable Generation Sites
- Statewide Preferred Generation Sites

These maps should be used as a starting point to determine what areas may exhibit characteristics consistent with conditions that would support renewable energy development. More detailed review and analysis should be conducted to determine specific boundaries for resource areas or constraints. These maps can be found in Appendix B.

APPENDIX A

KNOWN & POSSIBLE CONSTRAINT DEFINITIONS AND DESCRIPTIONS

The following is a list of the known, possible, and regional constraints that were used and referenced in the mapping section of this document. A definition of the constraint including source of the data is provided.

Known Constraints

Vernal Pools (confirmed and unconfirmed layers)
Source: Vermont Fish and Wildlife, 2009- present

Vernal pools are temporary pools of water that provide habitat for distinctive plants and animals. Data was collected remotely using color infrared aerial photo interpretation. "Potential" vernal pools were mapped and available for the purpose of confirming whether vernal pool habitat was present through site visits. This layer represents both those sites which have not yet been field-visited or verified as vernal pools, and those that have.

Department of Environmental Conservation (DEC) River Corridors -
Source: DEC Watershed Management District Rivers Program, January 2015

River corridors are delineated to provide for the least erosive meandering and floodplain geometry toward which a river will evolve over time. River corridor maps guide State actions to protect, restore and maintain naturally stable meanders and riparian areas to minimize erosion hazards. Land within and immediately abutting a river corridor may be at higher risk to fluvial erosion during floods.

River corridors encompass an area around and adjacent to the present channel where fluvial erosion, channel evolution and down-valley meander migration are most likely to occur. River corridor widths are calculated to represent the narrowest band of valley bottom and riparian land necessary to accommodate the least erosive channel and floodplain geometry that would be created and maintained naturally within a given valley setting.

Federal Emergency Management Agency (FEMA) Floodways-
Source: FEMA Floodway included in Zones AE- FEMA Map Service Center

These are areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. A "Regulatory Floodway" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

State-significant Natural Communities and Rare, Threatened, and Endangered Species-
Source: Vermont Fish and Wildlife, National Heritage Inventory

The Vermont Fish and Wildlife Department's Natural Heritage Inventory (NHI) maintains a database of rare, threatened and endangered species and natural (plant) communities in Vermont. The Element Occurrence (EO) records that form the core of the Natural Heritage Inventory database include information on the location, status, characteristics, numbers, condition, and distribution of elements of biological diversity using established Natural Heritage Methodology developed by NatureServe and The Nature Conservancy.

An Element Occurrence (EO) is an area of land and/or water in which a species or natural community is, or was, present. An EO should have practical conservation value for the Element as evidenced by potential continued (or historical) presence and/or regular recurrence at a given location. For species Elements, the EO often corresponds with the local population, but when appropriate may be a portion of a population or a group of nearby populations (e.g., metapopulation).

National Wilderness Areas-
Source: United States Department of Agriculture Forest Service

A parcel of Forest Service land congressionally designated as wilderness.

Class 1 and Class 2 Wetlands-
Source: Vermont Significant Wetland Inventory (VSWI) and advisory layers

The State of Vermont protects wetlands which provide significant functions and values and protects a buffer zone directly adjacent to significant wetlands. Wetlands in Vermont are classified as Class I, II, or III based on the significance of the functions and values they provide. Class I and Class II wetlands provide significant functions and values and are protected by the Vermont Wetland Rules. Any activity within a Class I or II wetland or buffer zone which is not exempt or considered an "allowed use" under the Vermont Wetland Rules requires a permit.

Class I wetlands have been determined to be, based on their functions and values, exceptional or irreplaceable in its contribution to Vermont's natural heritage and, therefore, merits the highest level of protection. All wetlands contiguous to wetlands shown on the VSWI maps are presumed to be Class II wetlands, unless identified as Class I or III wetlands, or unless determined otherwise by the Secretary or Panel pursuant to Section 8 of the Vermont Wetland Rules.

Possible Constraints

Agricultural Soils -
Source: Natural Resources Conservation Service (NRCS)

Primary agricultural soils" are defined as "soil map units with the best combination of physical and chemical characteristics that have a potential for growing food, feed, and forage crops,

have sufficient moisture and drainage, plant nutrients or responsiveness to fertilizers, few limitations for cultivation or limitations which may be easily overcome, and an average slope that does not exceed 15 percent. Present uses may be cropland, pasture, regenerating forests, forestland, or other agricultural or silvicultural uses.

The soils must be of a size and location, relative to adjoining land uses, so that those soils will be capable, following removal of any identified limitations, of supporting or contributing to an economic or commercial agricultural operation. Unless contradicted by the qualifications stated above, primary agricultural soils include important farmland soils map units with a rating of prime, statewide, or local importance as defined by the Natural Resources Conservation Service of the United States Department of Agriculture.

FEMA Special Flood Hazard Areas -

The land area covered by the floodwaters of the base flood is the Special Flood Hazard Area (SFHA) on NFIP maps. The SFHA is the area where the National Flood Insurance Program's (NFIP's) floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies.

Protected Lands -

Include State fee land and private conservation lands. Other state level, non-profit and regional entities also contribute to this dataset. The Vermont Protected Lands Database is based on an updated version of the original Protected Lands Coding Scheme reflecting decisions made by the Protected Lands Database Work Group to plan for a sustainable update process for this important geospatial data layer.

Act 250 Ag Mitigation Parcels -
Source: Vermont Department of Agriculture

All projects reducing the potential of primary agricultural soils on a project tract are required to provide "suitable mitigation," either "onsite or offsite," which is dependent on the location of the project. This constraint layer includes all parcels in the Act 250 Ag Mitigation Program as of 2006.

Deer Wintering Areas (DWA)-
Source: Vermont Department of Fish and Wildlife

Deer winter habitat is critical to the long-term survival of white-tailed deer (Odocoileus virginianus) in Vermont. Being near the northern extreme of the white-tailed deer's range, functional winter habitats are essential to maintain stable populations of deer in many years when and where yarding conditions occur. Consequently, deer wintering areas are considered under Act 250 and other local, state, and federal regulations that require the protection of important wildlife habitats. DWAs are generally characterized by rather dense softwood (conifer) cover, such as hemlock, balsam fir, red spruce, or white pine. Occasionally DWAs are

found in mixed forest with a strong softwood component or even on found west facing hardwood slopes in conjunction with softwood cover. The DWA were mapped on mylar overlays on topographic maps and based on small scale aerial photos.

Vermont Conservation Design include the following Highest Priority Forest Blocks: Connectivity, Interior, and Physical Landscape Diversity -
Source: Vermont Department of Fish and Wildlife

The lands and waters identified in this constraint are the areas of the state that are of highest priority for maintaining ecological integrity. Together, these lands comprise a connected landscape of large and intact forested habitat, healthy aquatic and riparian systems, and a full range of physical features (bedrock, soils, elevation, slope, and aspect) on which plant and animal natural communities depend.

Hydric Soils -
Source: Natural Resources Conservation Service

A hydric soil is a soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part. This constraint layer includes soils that have hydric named components in the map unit.

Regional Constraints

Elevations above 2500 feet-

This constraint uses USGS contours over 2500 feet.

Lake Shore Protection Buffers (250 Foot and 800 Foot in Calais Only)-

For this constraint, CVRPC selected Vermont Hydrologic Dataset lakes and ponds greater than 10 acres and then buffered those by 250 feet and use the Town of Calais Land Use Regulations for shore lands in Calais.

Slopes Greater Than 25%-

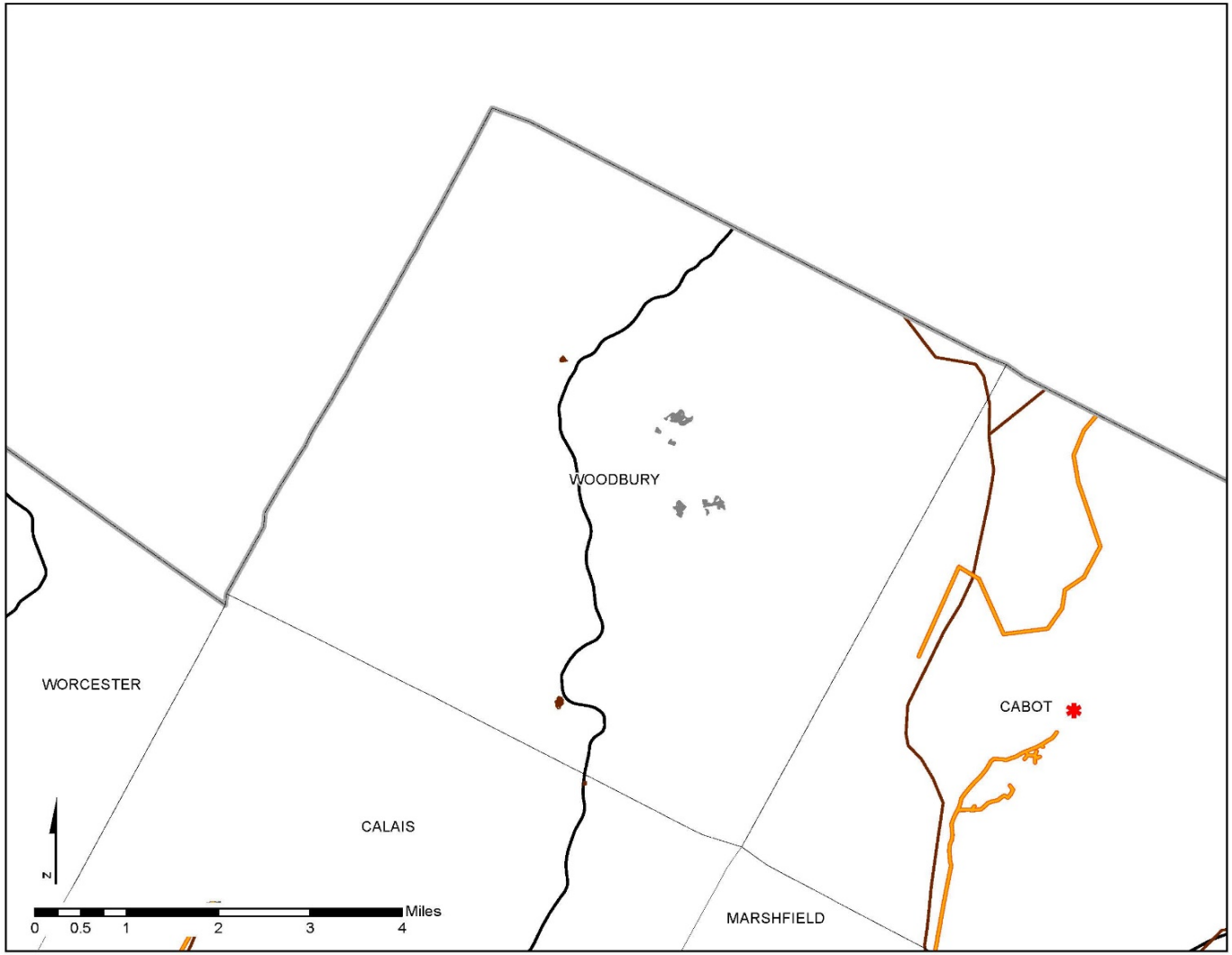
For this constraint, CVRPC performed a slope analysis using a 10-meter Digital Elevation Model.

Municipal Lands -

For this constraint, CVRPC used the Vermont Center for Geographic Information's Protected Lands Database.

Local Constraints

APPENDIX B MUNICIPAL RESOURCE MAPS



Central Vermont
Regional Planning Commission
Preferred Sites

WOODBURY

Key

- Brownfields Sites
- Moretown Landfill
- Sand and Gravel Pits
- Quarries
- Substations
- 3 Phase Power Lines
- Transmision Lines
- Major Roads

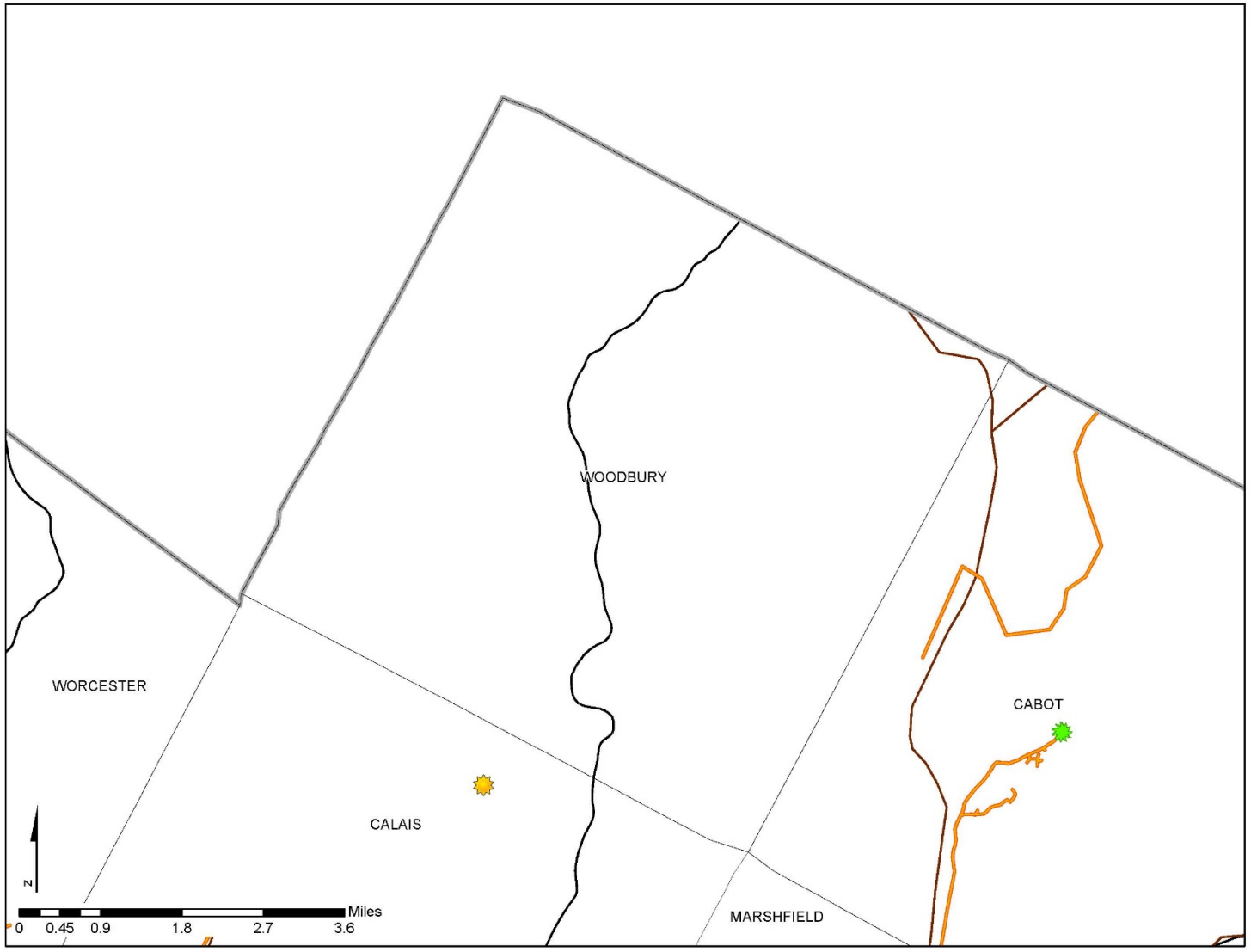
CVRPC
CENTRAL VERMONT REGIONAL PLANNING COMMISSION

Data:

Brownfields: VT ANR, VCGI.
Sand and Gravel Pits, Quarries:
CVRPC, 2013 disgitized from 1998 imagery.

This map was created as part of a Regional Energy Planning Initiative being conducted by the Bennington County Regional Commission, and the Vermont Public Service Department.

Created: November 2017 by CVRPC GIS.



Central Vermont Regional Planning Commission
Existing Renewable Energy Generation
WOODBURY

Key

- Biomass for Heat - Current Sites
- Wind Generation - Current Sites

Solar Sites - Current Generation > 15 KW

- Ground-mounted PV
- Roof-Mounted PV
- Substations
- 3 Phase Power Lines
- Transmision Lines
- Major Roads

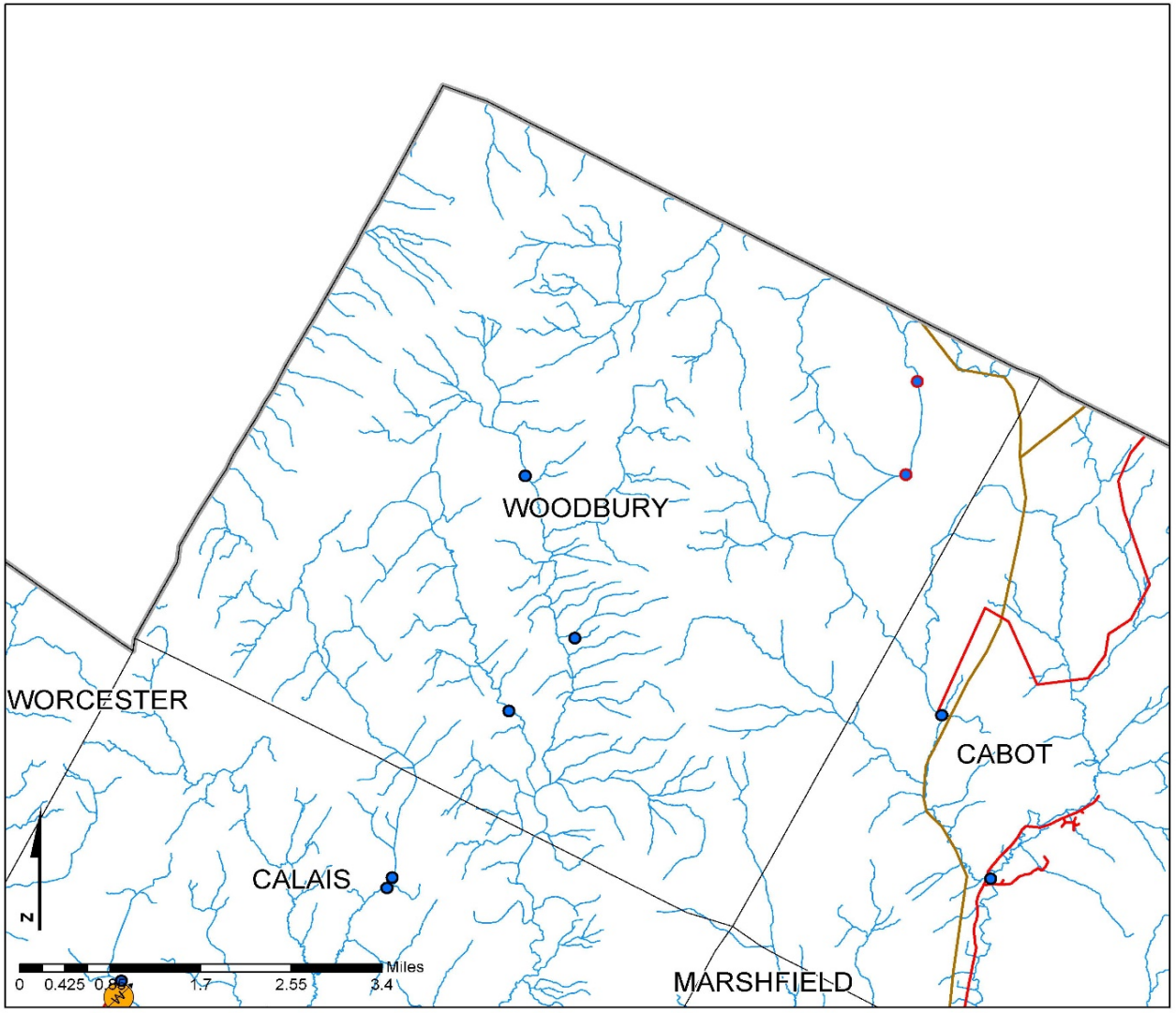
CVRPC
CENTRAL VERMONT REGIONAL PLANNING COMMISSION

Data:

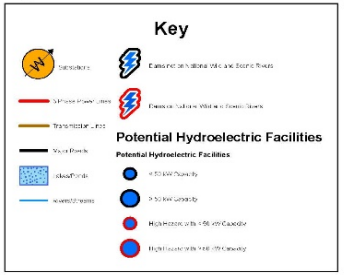
Wind and Biomass generation:
VT Energy Dashboard
Solar Sites: VT Energy Dashboard

This map was created as part of a Regional Energy Planning Initiative being conducted by the Bennington County Regional Commission, and the Vermont Public Service Department.

Created: November 2017 by CVRPC GIS.



WOODBURY
Hydroelectric Resources Map



Methodology

This map shows areas of resource potential for renewable energy generation from hydroelectric , i.e., dams that could be converted in to hydroelectric facilities as well as active hydroelectric sites. Existing hydroelectric dam information was extracted from the Vermont Dam Inventory, while potential hydroelectric sites were derived from a study conducted by Community Hydro in 2007.1 Based on estimates conducted within the report, this map categorizes dams based on their potential hydroelectric generation capacity, and the downstream hazard risk that would be involved in hydroelectric production at each site.

High hazard potential dams are those where failure or mis-operation will probably cause loss of human life. The other rankings were grouped together and their failure or mis-operation results in no probable loss of human life, but could cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns. These dams are often located in predominately rural or agricultural areas, but could be located in areas withpopulation and significant infrastructure.

This map was created as part of a Regional Energy Planning Initiative being conducted by the Bennington County Regional Commission, and the Vermont Public Service Department.

Created: December 2016 by CVRPC GIS.
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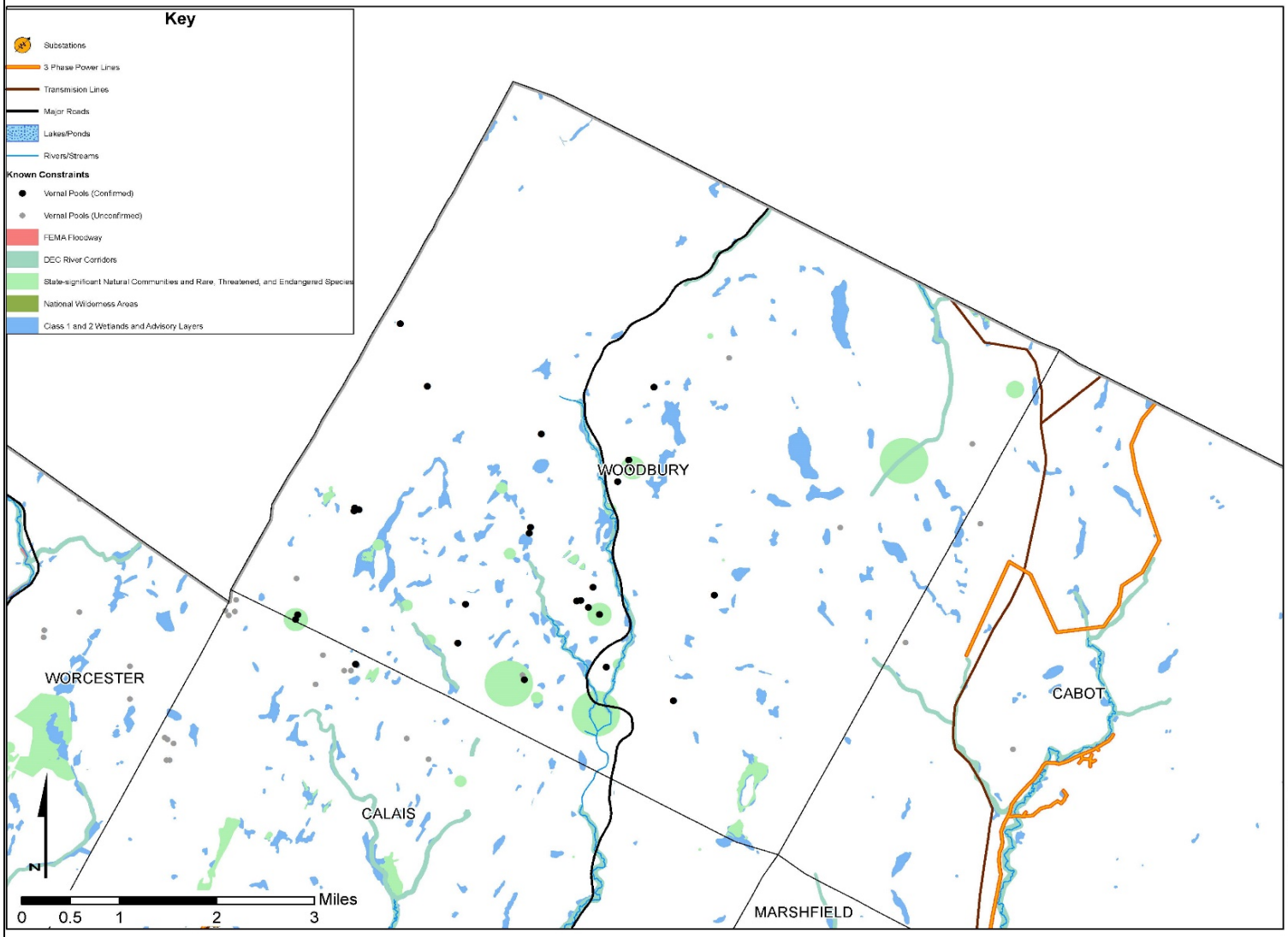

WOODBURY
Known Constraints Map

Known Constraints

These constraints signal likely, though not absolute, unsuitability for development based on statewide or local regulation or designated critical resources.

Link to Data -
http://vcgi.vermont.gov/opendata/act174

Known Constraints
Vernal Pools incuding confirmed and unconfirmed -
Vermont Fish and Wildlife
DEC River Corridors -
DEC WSMD Rivers Program 1/2/15
FEMA Floodway included in Zones AE -
FEMA Map Service Center
State-significant Natural Communities and Rare, Threatened, and Endangered Species -
Vermont Fish and Wildlife, Natural Heritage Inventory
National Wilderness Areas -
USDA Forest Service
Class 1 and Class 2 Wetlands (VSWI) and Advisory Layers - VT Watershed Management Division

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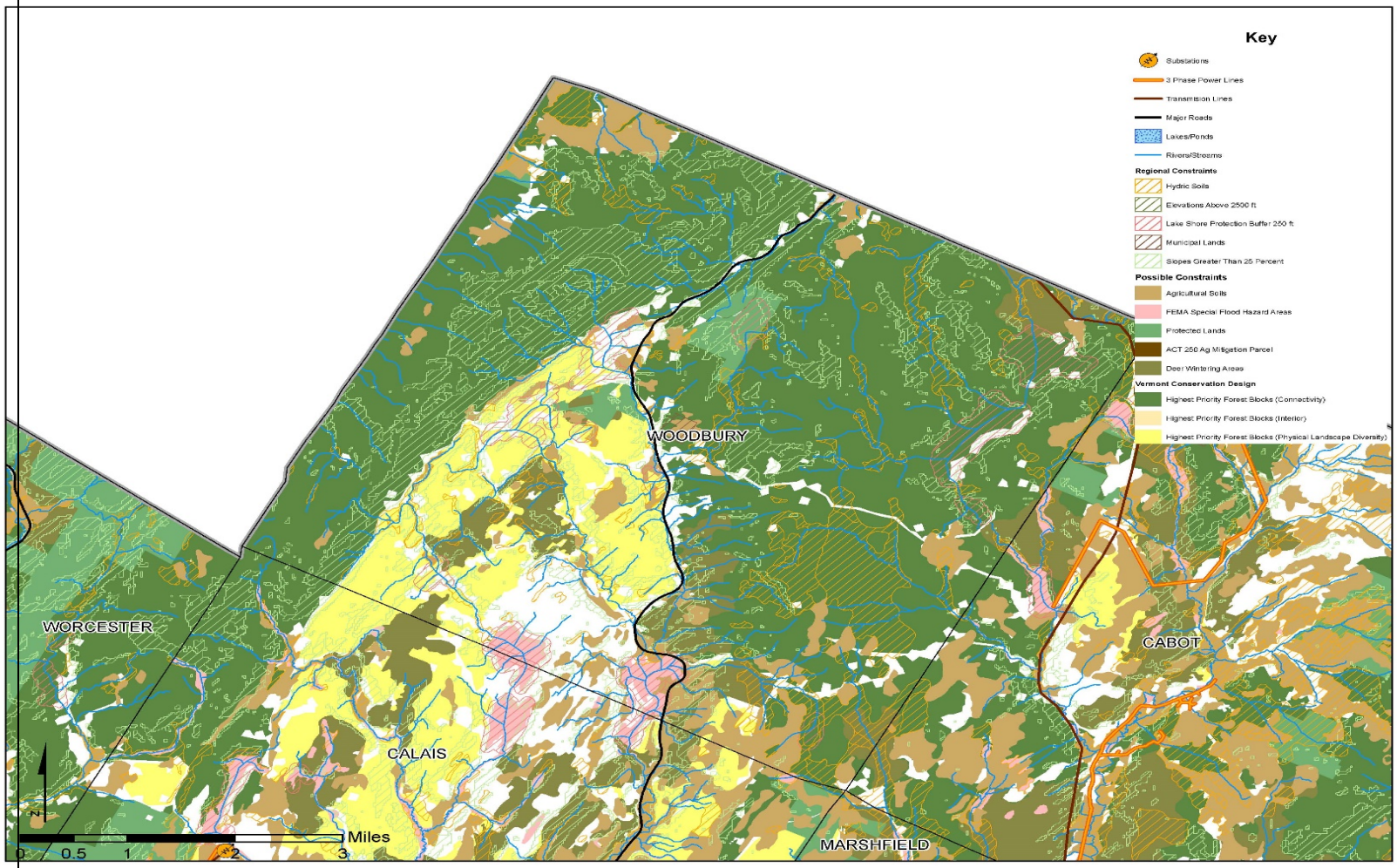

WOODBURY
Possible Constraints Map

Possible Constraints

These constraints signals conditions that would likely require mitigation, and which may prove a site unsuitable after site-specific study, based on statewide or regional/ local policies that are currently adopted or in effect.

Link to Data - http://vcgi.vermont.gov /opendata/act174

Possible Constraints Data Sources
Agricultural Soils include local, prime and statewide classifications - NRCS
FEMA Special Flood Hazard Areas include Zones A and AE - FEMA Map Service Center
Protected Lands - Include State fee lands and private conservation lands - VCGI
Act 250 Ag Mitigation Parcels include parcel as of 2006 - VT Dept. of Ag
Deer Wintering Areas - VT Fish and Wildlife
Vermont Conservation Design include the following Highest Priority Forest Blocks: Connectivity, Interior, and Physical Landscape Diversity) - VT Fish and Wildlife
Hydric Soils include soils that have hydric named components in the map unit - NRCS

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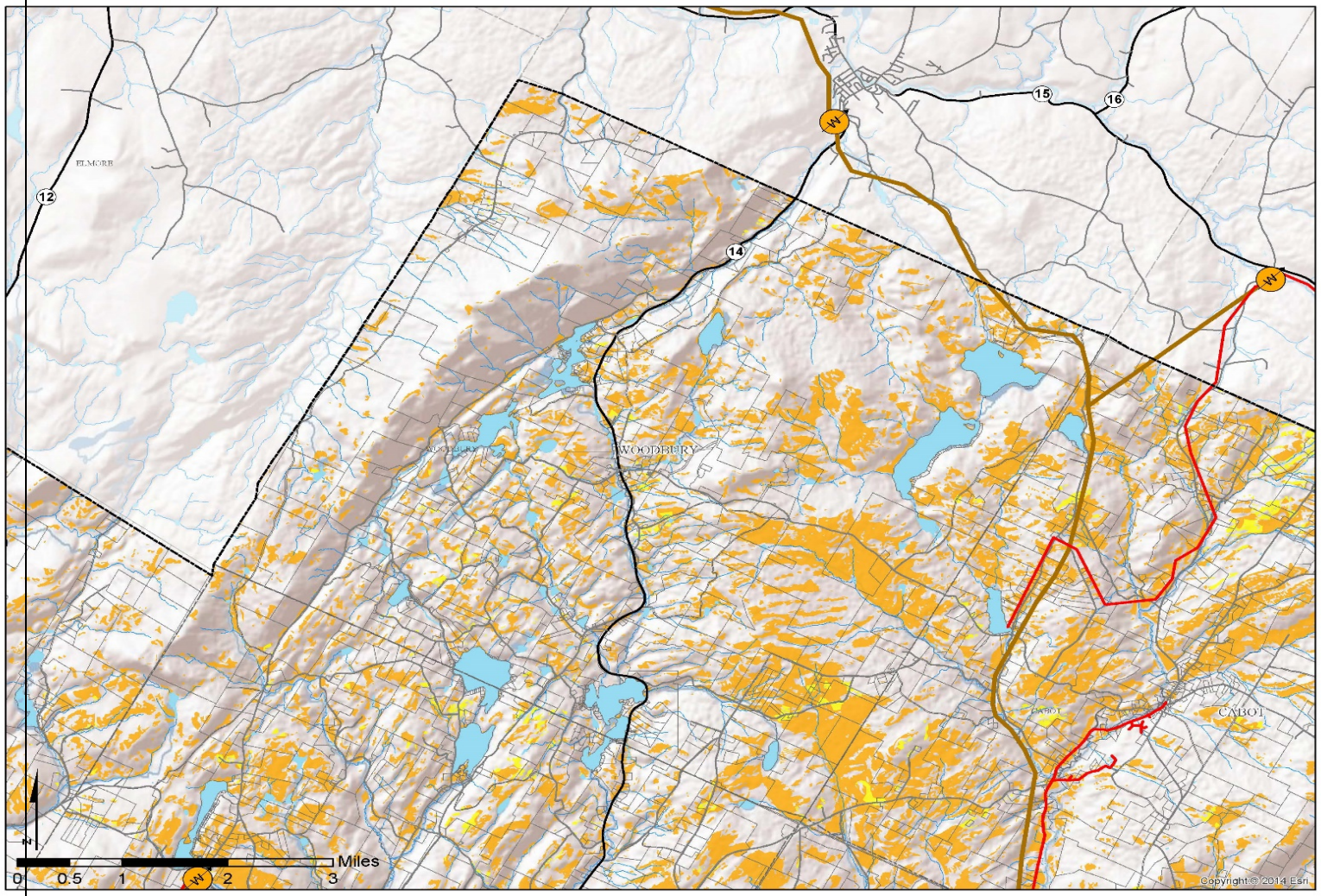

WOODBURY

Solar Resources Map

Legend
- Substations
- 3 Phase Power Lines
- Distribution Lines

Solar Potential
- Prime (No Constraint)
- Secondary (Possible Constraint)
- Parcels

Roads
- Interstate
- US Highway
- Vermont State Highway
- Town Class 1-3

Known Constraints

Areas not shown on map
Vernal Pools
River Corridors
FEMA Floodways
Natural Communities & Rare, Threatened and Endangered Species
National Wilderness Areas
Wetlands Class 1 and 2

Possible Constraints

VT Agriculturally Important Soils
FEMA Special Flood Hazard Areas
Protected Lands
Act 250 Agricultural Soil Mitigation Areas
Deer Wintering Areas
Highest Priority Forest Blocks
Hydric Soils
Elevations Above 2500Ft
Lake Shore Protection Buffer 250 Ft
Municipal Lands
Slopes Greater Than 25 Percent

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Data is only as accurate as the original source materials.
This map is for planning purposes.
This map may contain errors and omissions

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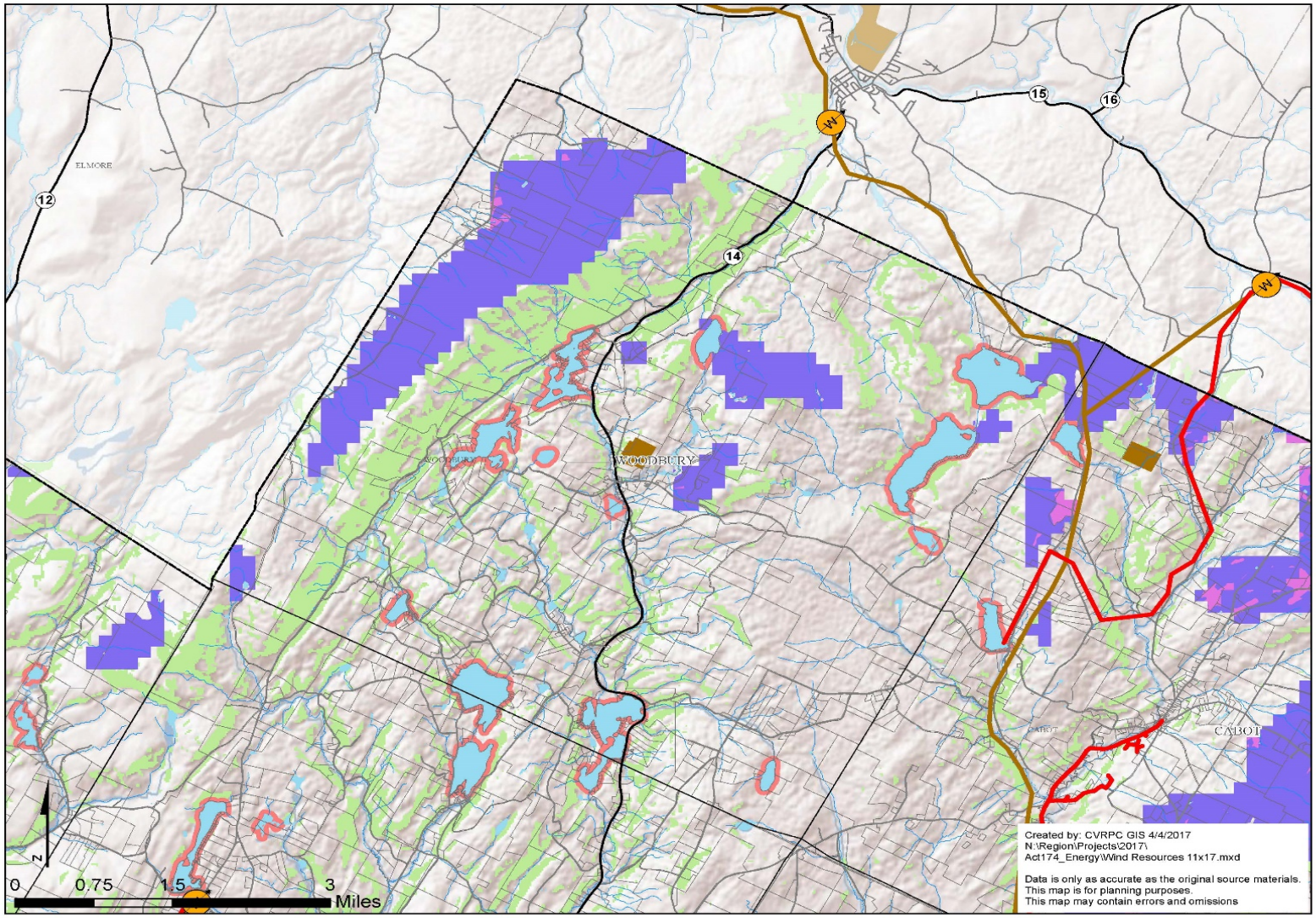

WOODBURY
Wind Resources Map

Legend

Substations
3 Phase Power Lines
Transmission Lines

Wind Potential

Prime Wind (No Constraint)
Hub Height (m)
50 70
Secondary Wind (Possible Constraint)
Hub Height (m)
50 70
Parcels

Roads

Interstate
US Highway
Vermont State Highway
Town Class 1-3

Regional Constraints

Elevations Above 2500 ft
Lake Shore Protection Buffer 250 ft
Municipal Lands
Slopes Greater Than 25 Percent

Known Constraints

Areas not shown on map
Vernal Pools
River Corridors
FEMA Floodways
Natural Communities & Rare, Threatened and Endangered Species
National Wilderness Areas
Wetlands Class 1 and 2

Possible Constraints

VT Agriculturally Important Soils
FEMA Special Flood Hazard Areas
Protected Lands
Act 250 Agricultural Soil Mitigation Areas
Deer Wintering Areas
Highest Priority Forest Blocks
Hydric Soils

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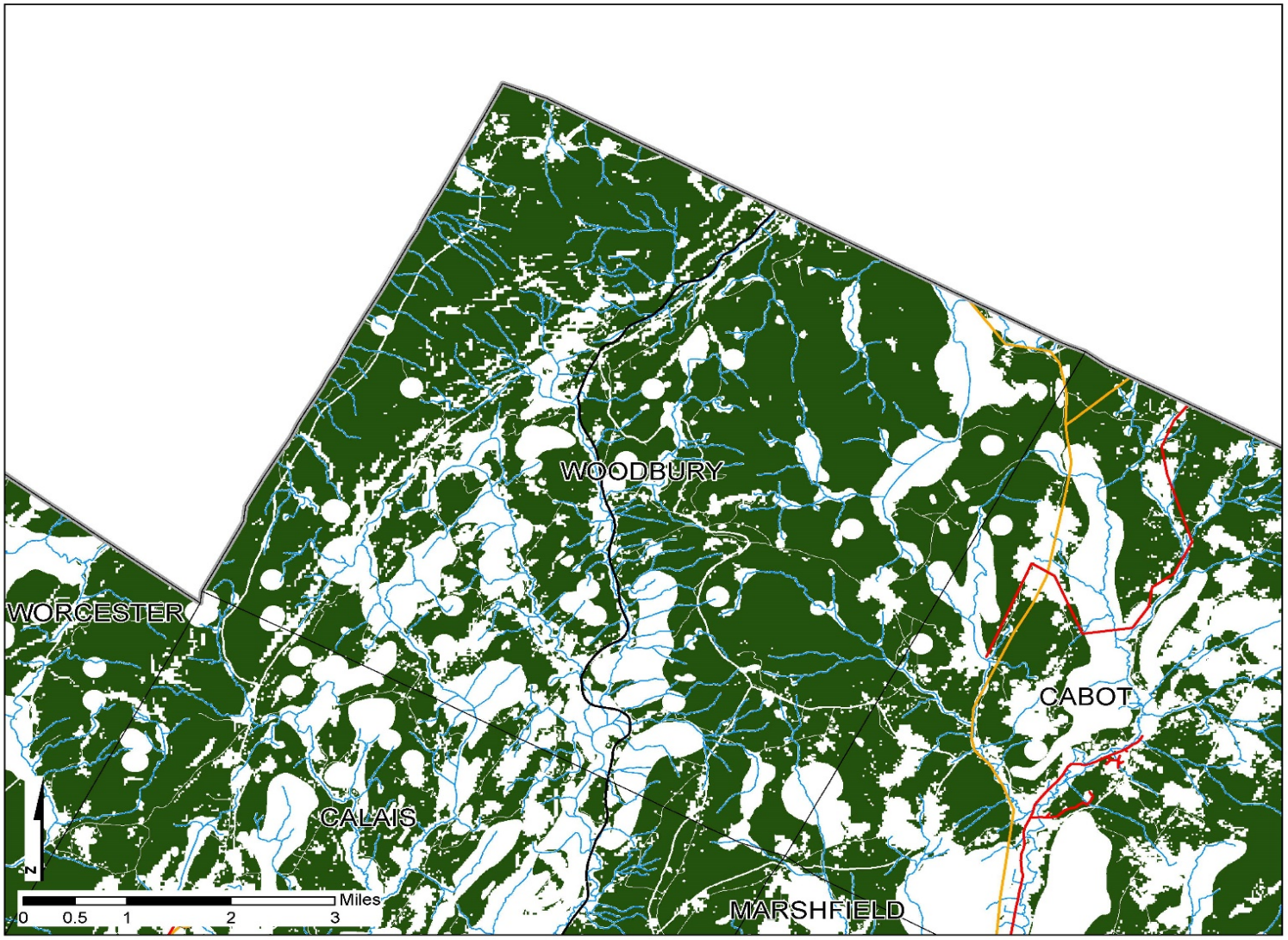

WOODBURY
Woody Biomass Resources Map

Key

- Substations
- 3 Phase Power Lines
- Transmission Lines
- Major Roads
- Lakes/Ponds
- Rivers/Streams
- Woody Biomass

Methodology

This map shows areas of resource potential for woody biomass, i.e., locations where forested areas are. This map also considers various other conditions, such as ecological zones, that may impact the feasibility of renewable energy/alternative heating source. These conditions are referred to as constraints. This map does not include areas where other types of biomass, such as biomass from agricultural residue, could be grown/harvested.

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