DRAFT

ENERGY PLAN

FOR THE
TOWN OF WATERBURY

PREPARED BY

The Central Vermont
Regional Planning Commission

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EXECUTIVE SUMMARY & INTRODUCTION

The Town of Waterbury has for a long time taken a comprehensive and thoughtful approach to energy planning. The Town has had a strong commitment to becoming one of the greenest towns in Vermont and helping local residents save money and energy. The passage of Act 174 in 2016, which allows towns a higher level of deference in Section 248 proceedings if they meet specific planning standards, offers an opportunity for Waterbury to reexamine the actions the community is taking to meet its energy goals. As with previous plans, this means looking comprehensively at how we use energy, and ways to reduce energy use.

The Waterbury Energy Plan represents the efforts of the Planning Commission, Waterbury LEAP, and assistance from the Central Vermont Regional Planning Commission to develop a plan that will receive a Determination of Energy Compliance (DOEC). A DOEC will give the Waterbury Energy Plan "substantial deference" before the PUC for applications that seek to receive a Certificate of Public Good.

The 2016 State Comprehensive Energy Plan identified a goal to have 90% of the state's energy needs derived from renewable sources by 2050. As part of this goal, the Vermont State Legislature passed Act 174 in 2016. Act 174 provides an avenue for regions and municipalities to have increased input in PUC determinations for Certificates of Public Good regarding renewable energy generation facilities. As such, Act 174 identified standards that need to be met in support of the state's goal of 90% renewable energy by 2050 in order to have a plan receive a DOEC and have "substantial deference". Otherwise, a plan will receive "due consideration" in the Section 248 review process. Act 174 is categorized as enhanced energy planning and goes beyond what is outlined in 24 VSA 117 Section §4348a and §4382 respectively.

Through Act 174, three primary planning areas are identified and need to be met satisfactorily in order 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.

<u>Section I: Analysis & Targets</u>

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 incudes 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 Waterbury currently uses approximately 42,000 megawatt hours of electricity on an annual basis across the identified sectors. By comparison, Waterbury's share of new renewable energy generation needed to meet the state's goal is approximately 33,000 megawatt hours. Based on the mapping and resource data (Section III), Waterbury has resources available to generate approximately 1,800,000 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 Waterbury include approximately 6,500 alternative powered vehicles and approximately 1,200 heating systems. The specific 2050 targets for transportation and heating renewable use in Waterbury are 90.2% and 92.1% 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 Waterbury 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 Waterbury is already working to support its residents and businesses through local land use, transportation, and environmental planning activities.

To this end, the current Waterbury 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 Waterbury's ability to lead the action. This will create consistency with regard to 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 Waterbury 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 particular 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 of 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 Waterbury 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. In order 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 Waterbury 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 Waterbury 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 Waterbury 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 Waterbury, 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 Waterbury are on the right path to meeting it's share of the state's goal of 90% of the energy used being produced by renewable sources, 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 for moving forward.

I. *Does the plan estimate current energy use across transportation, heating, and electric sectors?*

II. *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?*

III. *Does the plan evaluate the amount of thermal-sector conservation, efficiency, and conversion to alternative heating fuels needed to achieve these targets?*

IV. *Does the plan evaluate transportation system changes and land use strategies needed to achieve these targets?*

V. *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 Waterbury is now, where it needs to go, and how it will get there in terms of its energy future.

The information needed to answer the five questions listed above was procured from various sources. This includes information from the American Community Survey (as part of the U.S. Census), The Vermont Agency of Transportation, the Vermont Department of Labor, the Vermont Department of Public Service, Efficiency Vermont, the Vermont Energy Investment Corporation (VEIC), and the Central Vermont Regional Planning Commission. A significant portion of the data related to targets was provided by the VEIC through a process known as Long-Range Energy Alternatives Planning or LEAP. This modeling factors in a significant number of data points and has been used extensively throughout the world for energy planning such as this.

The data that is used throughout this section was developed using a top down approach. In some cases, data was provided at a regional level and thus was allocated to each municipality based on a methodology appropriate for that particular dataset. In other cases, information was provided at the municipal level and then aggregated to identify the regional total; then reallocated to each municipality. Based on this process anomalies in the information may have been created. To that end, it is important to note that the data provided herein is only a starting point and should be used to establish a general direction, not a required outcome. This data is presented as a way to gauge Waterbury's overall progress towards achieving 90% of its energy uses produced from renewable sources. As new or better data is provided or developed, these tables should be updated to reflect the changes.

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

In order to effectively evaluate where the Town of Waterbury needs to go in terms of their energy future, the community needs to understand how it is using and generating energy. This section outlines the estimates of current energy use for the community. This information is based on best available data and may change over time as new information is provided.

Transportation

Transportation is one of the largest consumers of energy in Waterbury. 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 those 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 Waterbury related to transportation.

TABLE 1
CURRENT TRANSPORTATION ENERGY USE

DATA CATEGORY	INFORMATION
Total number of vehicles	3,945 vehicles
Average miles traveled per vehicle	12,500 miles
Total annual miles traveled	49,312,500 miles
Average gallons of fuel used per vehicle per year	576 gallons (21.7 mpg)
Total gallons of fuel used per year	2,651,209
Transportation energy used per year (in Billions)	319 BTUs
Average regional cost per gallon of fuel	$2.95
Fuel costs per year	$7,821,067

Notes:
1. Total vehicles provided by the American Community Survey.
2. Average miles traveled & Average gallons of fuel used per vehicle provided by VTrans.
3. Average cost per gallon of fuel provided by the CVRPC—June 2018.
4. Information related to public transit is not included in this table.
5. Total gallons of fuel is based on fuel efficiency of 21.7 miles per gallon.

Electricity

In 2012, Waterbury's energy use was split at 67% by commercial and industrial customers and 33% by residential customers. Waterbury's commercial and industrial consumption has grown about 4% annually since 2005, and residential consumption has grown about 2% annually since 2005. The Vermont Public Utility Commission regulates utility rates. In 2018, the U.S. Energy Information Administration reported the average cost per kilowatt hour (kWh) in Vermont was approximately 15 cents and approximately 18 cents for all of New England. ~~In 2009 Green Mountain Power's average rate for all electricity delivered was 12 cents per kilowatt-hour (kWh), compared with a New England average of 16 cents per kWh.~~ Waterbury's current electricity use is noted in Table 2.

TABLE 2 CURRENT ELECTRICITY USE	
USE SECTOR	**CURRENT ELECTRICITY USE**
Residential	14,648 megawatt hours
Commercial & Industrial	27,962 megawatt hours
TOTAL	**42,610 megawatt hours**

Notes:
1. Information provided by Efficiency Vermont thru 2016.

Home Heating

2015 American Community Survey data indicate that approximately 51% of homes in Waterbury are heated with fuel oil, which represents an increase from 42% in 2010 but a decrease from 53% in 2000. The percentage of homes heated with propane or bottled gas increased from less than 30% in 1990 to approximately 36% in 2015. The percentage of homes in Waterbury heated with electricity has remained at approximately 1%. Finally, the percentage of homes heating with wood increased from approximately 4% in 2010 to almost 11% in 2015.

Municipal Energy Use

Together the town spent approximately $328,859 on energy for municipal operations in calendar year 2012: 52% on electricity; 33% on gasoline and diesel fuel; and 15% on heating fuel.

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

TABLE 3 CURRENT RESIDENTIAL HEATING ENERGY USE				
FUEL SOURCE	**NUMBER OF HOUSEHOLDS**	**PERCENT OF HOUSEHOLDS**	**HEATED SQUARE FOOTAGE**	**BTUs (in Billions)**
Propane or Natural Gas	814	35.8%	1,281,076	76.86
Electricity	26	1.14%	25,046	1.5
Fuel Oil	1,170	51.45%	1,914,031	114.8
Coal	0	0.0%	0	0
Wood	246	10.82%	478,224	28.7
Other (includes solar)	18	.79%	14,130	0.8
No Fuel	0	0.0%	0	0
TOTAL	**2,274**	**100%**	**3,712,507**	**222.8**

Notes:
1. Data provided by the American Community Survey, 2015.

TABLE 4 CURRENT COMMERCIAL ENERGY USE		
COMMERCIAL ESTABLISHMENTS	**AVERAGE THERMAL ENERGY USED PER ESTABLISHMENT**	**TOTAL COMMERCIAL THERMAL ENERGY USED**
288	686	197,502

Notes:
1. Thermal energy use is expressed in Millions of BTUs.
2. Information provided by the Vermont Department of Labor and the Department of Public Service.

II. 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 Waterbury, 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			
SECTOR TYPE	**2025**	**2035**	**2050**
Residential Thermal Efficiency	20%	42%	92%
Commercial Thermal Efficiency	22%	33%	61%

Notes:
1. Information derived from VEIC LEAP Modeling.

In order for Waterbury 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 Waterbury's targets for renewable energy use and Table 7 identifies the targeted renewable energy generation.

TABLE 6 TARGETS FOR RENEWABLE ENERGY USE			
SECTOR TYPE	**2025**	**2035**	**2050**
Transportation Renewables	9.6%	31.3%	90.2%
Heating Renewables	52.5%	67.1%	92.1%

Notes:
1. Information derived from VEIC LEAP Modeling.

TABLE 7 TARGETS FOR RENEWABLE ENERGY GENERATION			
SECTOR TYPE	**2025**	**2035**	**2050**
Electricity Renewables (in megawatt hours)	8,148	13,036	32,590

Notes:
1. Information provided by The Department of Public Service

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 Waterbury.

Waterbury LEAP

Waterbury LEAP (Local Energy Action Partnership) is a local non-profit organization with a mission to "promote energy efficiency and the use of renewable resources, and to engage our community in reducing carbon emissions in Waterbury, Vermont and the surrounding area."

LEAP is one of more than 100 Vermont municipal energy committees, and is widely considered one of the most active and productive such organizations in the state.[1] Waterbury LEAP is the only energy committee in Vermont to become a 501(c)(3) non-profit. It took that step because its stated goal is "to help turn Waterbury into the greenest town in Vermont by 2020."

LEAP is tracking its progress and guiding its efforts through the use of a number of measurable indicators that will show Waterbury's progress and allow the town to have friendly challenges with other communities. Some recent LEAP initiatives include:

- Hosting a free LEAP Energy Fair each April that has become one of the largest in the state with 600+ attendees and 70+ exhibitors on many energy-related topics.
- Raising the funds and placing solar PV panels on Thatcher Brook Primary School and Crossett Brook Middle School.
- Initiating the Waterbury/Duxbury Solar Year in April 2012 and in 11 months helping to double local residential solar capacity in those two towns.

1. See www.waterburyleap.org.

» Participating in the Vermont Home Weatherization Challenge in 2013 with the target of weatherizing 3% of the homes within our community in one year.
» Assisting the Town of Waterbury and Crossett Brook Middle School evaluate the possibility of establishing solar orchards that would help to meet a significant portion of the electrical needs of the municipal buildings and the school.

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.

III. 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.[2]

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.

2. Thermal Efficiency Task Force Report, 2013

» 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 Waterbury's portion of the state's comprehensive energy goals.

TABLE 8
THERMAL SECTOR CONVERSIONS PER TARGET YEAR
(RESIDENTIAL & COMMERCIAL)

SYSTEM TYPE	2025	2035	2050
New Efficient Wood Heat Systems	13	14	94
New Heat Pumps	231	598	1,129

Notes:
1. Information derived from VEIC LEAP Modeling.
2. Heat pumps includes both space heating and hot water heating.

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.

In 2008 and 2009, Waterbury LEAP partnered with Efficiency Vermont to provide free building energy audits to almost a dozen local businesses and to all Waterbury municipal buildings. Many of the audit recommendations were acted upon in the following year.

As noted above, in January 2013 Waterbury LEAP joined the Vermont Home Energy Challenge and aimed to have an additional 3% of Waterbury homes weatherized by the end of the year. Our community will need to continue on the pace of weatherizing 2-3% of our homes per year to reach a goal of weatherizing 25% of the housing stock by 2020.

IV. 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 is 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.

Waterbury has witnessed an ongoing growth in commuter traffic, due largely to the increasing number of families in which both parents work, the number of residents who are employed in Montpelier and Burlington, and the I-89 Exit 10 interchange which brings commuters through Waterbury from outlying areas. As a result, traffic on the state roads through Waterbury has continued to increase. Traffic on Route 2 has increased by around 30% between 1990 and 2010.

The percentage of Waterbury's employed residents driving alone to work has remained at around 70% since 1990. In 2010, the American Community Survey reported that only 14% of working residents carpooled and only 1% took public transportation. Within the downtown core, 11% walked to work.

There is currently one commuter parking lot in Waterbury. Limited public transit services are provided through Green Mountain Transit, a nonprofit transportation provider serving the central Vermont. Waterbury and its residents would benefit from programs and facilities to encourage increased ridesharing, use of mass transit, walking and biking, and an overall reduction on our community's dependence on the automobile.

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 Waterbury 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			
FUEL TYPE	**2025**	**2035**	**2050**
Electric Vehicles	339	2,341	4,675
Biodiesel Vehicles	591	1,095	1,776

Notes:
1. Information derived from VEIC LEAP Modeling.

V. Evaluate 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 Waterbury 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			
SECTOR TYPE	**2025**	**2035**	**2050**
Electric Efficiency	1.5%	7.3%	15.2%

Notes:
1. Information derived from VEIC LEAP Modeling.

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.

In 2010, a team of students at Crossett Brook Middle School conducted a research project and proposed specific steps the school could take to replace older, less efficient lighting with more energy-efficient technology. They presented their recommendations to the Waterbury-Duxbury School Board and the plan was unanimously accepted. Thanks to their work, local taxpayers, are saving approximately $6,000 per year in energy costs.

During the 2012/2013 school year, Harwood Union High School participated in the Vermont Whole School Challenge organized by Efficiency Vermont and the School Energy Management Program. Over the course of the school year students and teachers, with assistance from outside groups such as Efficiency Vermont and Waterbury LEAP, are striving to cut the school's overall electric use by 10%.

Local Food

The 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.

The Waterbury-Duxbury Food Council is a local volunteer group with a mission to strengthen community by supporting and building a sustainable, local healthy food system. In 2012, the group conducted an assessment of current assets, including natural resources, manufactured assets, financial assets, human assets, and community assets. The assessment found that the Waterbury area has:

- A favorable growing climate, abundant water, land available to grow on, some of which has prime soils and soils of statewide distinction.
- A centralized location at the crossroads of a well-developed state highway system linked to a well-maintained local road network.
- At least 25 small producers with experience growing/raising various products.
- One of the few commercial-scale composting operations in Vermont as a source of grower inputs.
- 18 processors making very popular specialty products.
- A vibrant restaurant community with 22 establishments from coffee shops to fine dining, most with a demonstrated willingness to use local ingredients.
- At least 16 retailers of different sizes who recognize the consumer demand for local product.
- A knowledgeable consumer base seeking to meet their food demands more locally and willing to support food-related endeavors with their time, energy and money.
- Numerous home producers which serve a great portion of our meals extending into "micro-scale" sale or bartering to friends and neighbors.
- An active mid-week farmers market featuring local products.

Renewable Energy

The Town of Waterbury actively supports the use and development of renewable energy. Specifically, through 2016 renewable energy generation installations create approximately 50,000 megawatt hours of energy each year. This includes a mix of solar, wind, hydroelectric, and biomass. 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 10 kW or more.

TABLE 11
EXISTING RENEWABLE ENERGY GENERATION

RESOURCE TYPE	MEGAWATTS	MEGAWATT HOURS
Solar	2.4	2,943.36
Wind	<.01	3.07
Hydroelectric	13.60	47,654.4
Biomass	0	0
Other	0	0
Total Existing Renewable Energy Generation	16	50,600.8

Notes:
1. Information provided by the Department of Public Service
2. Due to rounding, totals may not be accurate.

Waterbury has several renewable energy resources available, most notably hydropower, solar, wind and wood. Development of these non-fossil fuel resources supports local jobs and economies by keeping energy expenditures and investments in state. Since 1998, the state has allowed "net metering." Under net metering, a household or business can use small-scale renewable energy to generate power for their own use and sell any excess back to the utilities. State tax credits and incentives further encourage the use of renewable energy.

Hydroelectric

In the past, local waterways powered numerous mills and provided small-scale electricity across Vermont. Remnants of Waterbury's water-powered past can still be seen in Colbyville and Mill Village. Today, power from in-state and out-of-state hydroelectric dams (most notably Hydro Quebec) supply approximately 40% of Vermont's annual power needs.[3]

One hydroelectric dam remains in operation in Waterbury. The Little River #22 facility at the Waterbury Reservoir is owned by Green Mountain Power (GMP) and produces 15,500 megawatt hours of power per year. The DeForge Hydroelectric Station at Bolton Falls, located in both Waterbury and Duxbury, is also owned by GMP and produces 25,800 megawatt hours per year.[4]

3. Vermont Department of Public Service , 2016 Comprehensive Energy Plan
4. Vermont Energy Atlas

No new potential sites for large-scale hydroelectric facilities have been identified in Waterbury. Small upland tributaries may offer feasible micro-hydro sources of power for individual homes but careful planning will be needed to ensure aquatic habitat or river corridors are not adversely impacted.

One innovative hydroelectric option has been incorporated in Waterbury. In 2017 the Sewer and Water District installed an in-line hydroelectric generator in the 12 inch water main supplying Waterbury Village. The facility is on Guptil Road and generates approximately _____. This is one example of an innovative option for renewable energy generation.

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. Green Mountain Power's willingness to pay a small premium for solar energy (the "solar adder") has also helped to support the burgeoning solar industry. In 2014, the State of Vermont ranked nationally in the top ten in solar installations.[5]

As of 2018, solar collectors were installed at approximately 180 sites in Waterbury with a total photovoltaic capacity of 2.2 megawatts. A small number of commercial sites account for the majority of this installed generation, however residential scale use is increasing. Waterbury has included a solar array at the public water supply well field along Sweet Farm Road and incorporated solar panels on the roof of the Fire Department showing leadership by example for installation of renewable generation. Table 15 lists the existing sites in Waterbury with an installed generation capacity of 10 kW or more.

Waterbury has made great strides to incorporate solar energy into its energy portfolio. According to the Energy Action Network's Energy Dashboard, Waterbury ranks 43rd among Vermont municipalities in total solar installation with 187 sites. A number of 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.

According to the Vermont Energy Atlas, there are over 2,100 potential rooftop solar sites in Waterbury with a potential capacity of nearly 2.9 megawatts. There are also over 3,200 acres of potential solar sites suitable for ground-mounted solar arrays, 1,672 acres of which are not classified as agricultural soils. Additional information on potential generation is noted in Table 13 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 Waterbury, particularly for residents and businesses lacking south-facing rooftops or land.

5. Vermont Department of Public Service, 2016 Comprehensive Energy Plan

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 two potential industrial scale wind energy sites in Waterbury that receive sustained winds averaging more than 20 mph. Several hundred residential (30 meters high), small commercial (50 meters high), and large commercial (70 meters high) sites with moderate wind speeds of 15-20 mph have also been identified. Almost all sites are located on ridge lines in the Worchester Range and in the Green Mountain range. 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.

The 2013 Community Survey indicated that there is less local support for wind farms for utility energy production than other types of renewables. The survey results suggest that many worry about the impacts large -scale wind may have on our natural and scenic resources, particularly Waterbury's forested ridgelines.

In order to support large-scale wind projects, we believe that projects must meet certain criteria to ensure that they do not cause undue negative impacts on natural, recreational, and aesthetic resources. Waterbury 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. Waterbury will work to maintain consistency with these regional limits.

Wood

Historically, wood has been Vermont's, and Waterbury'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.[6] Current use of cordwood for heating in Waterbury is unknown. In addition to firewood, wood biomass heating, in the form of woodchips and pellets, is becoming more popular.

Approximately 37% of Vermont's households utilize biomass (including cord wood and wood pellets) to heat at least a portion of their homes.[7] According to the Vermont Energy Atlas, Waterbury's forests have the ability to produce 5,765 tons of low grade wood material per year, equivalent to an electric capacity of 2,719 megawatts.

Use of wood biomass in the Waterbury area for heating is unknown, but two examples are Harwood Union High School and the Green Mountain Club:

» In the fall of 2008, Harwood installed a woodchip-fired heating system for its 170,000 square foot facility with a grant through the Vermont Fuels for Schools Program. During its first heating season, the system consumed 900 green tons of woodchips (replacing 35,000 gallons of heating oil) and saved the school over $34,000 in heating costs.[8]

6. Vermont Department of Forests, 2009
7. Vermont Department of Public Service , 2016 Comprehensive Energy Plan
8. Biomass Energy Resource Center, 2010

» The Green Mountain Club on Route 100 in Waterbury Center installed a wood gasification boiler in 2011. The boiler provides all the heat and hot water for the club's seasonal staff building and is fired by sustainably harvested wood from club lands in Lowell, Vermont.

» The State of Vermont installed a woodchip-fired heating system for the entire Waterbury State Office complex in 2015.

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%. This is noted in Table 13. 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.

Other Local Renewable Energy Sources. Other potential local renewable energy sources include:

» Methane recovery systems that convert farm manure or landfill gases into electricity
» Bio-fuels produced from green crops such as soy beans, or from waste vegetable oil
» Geothermal energy, which uses the temperature differential in water taken from deep wells to heat and cool buildings

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 Waterbury. Table 7 identifies the amount of renewable energy generation (in megawatt hours) that The Town of Waterbury 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. Table 13 notes the amount of generation that could occur if all the areas identified as prime or secondary resources were developed with renewable energy, specifically for solar and wind. By comparing the two tables, it becomes clear that there is adequate land area available for Waterbury 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 Waterbury at a residential scale, but not at a commercial scale. 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.

TABLE 12 POTENTIAL RENEWABLE ENERGY GENERATION		
RESOURCE TYPE	**MEGAWATTS**	**MEGAWATT HOURS**
Rooftop Solar	3.71	4,555
Ground-mounted Solar	725.06	889,210
Wind	302.95	928,837
Hydroelectric	.01	28
Biomass & Methane[9]	Unknown	unknown
Other	0	0
Total Potential Regional Renewable Energy Generation	1,031.73	1,822,630

Notes:
1. Information calculated by the CVRPC based on data provided by the Vermont Center for Geographic Information and efficiency factors provided by the Department of Public Service.

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 13 notes the efficiency factors for common types of renewable energy generation.

TABLE 13 RENEWABLE GENERATION OUTPUTS & CAPACITY FACTORS		
RESOURCE TYPE	**CAPACITY FACTOR**	**ANNUAL MEGAWATT HOUR OUTPUT PER INSTALLED MEGAWATT**
Solar	14% - 16%	1,300
Small Wind	20% - 25%	2,000
Utility Scale Wind	25% - 35%	2,600
Methane	60% - 90%	6,600
Biomass	60% - 80%	6,100
Small Hydroelectric	40% - 60%	4,400

Notes:
1. Information provided by the Vermont Department of Public Service.
2. "Capacity Factor" indicates the percent of time an identified resource is actively producing electricity.

9. Biomass and methane are not restricted by resource locations and should be sited accordingly to provide maximum benefit to the greatest number of end users or to meet municipal needs. Siting will be more dependent on local regulatory controls and should be planned for accordingly.

TABLE 14 EXISTING RENEWABLE ENERGY GENERATION GREATER THAN 10 kW BASED ON EXISTING CERTIFICATES OF PUBLIC GOOD					
Category	**Sub Category**	**Name**	**Electricity Type**	**Utility**	**Capacity *(in kW)***
Hydro	Hydropower	Bolton Falls No. 1	Grid	Green Mountain Power	7,550
Hydro	Hydropower	Little River No. 22	Grid	Green Mountain Power	5,800
Solar	Ground-mounted PV	Village of Waterbury Solar I, LLC	Group Net Metered	Green Mountain Power	500
Solar	Ground-mounted PV: Tracker	The Cold Hollow Cider Mill	Net Metered	Green Mountain Power	139.3
Solar	Roof-Mounted PV	Sun CSA, LLC	Group Net Metered	Green Mountain Power	135
Solar	Roof-Mounted PV	Peck Electric Co.	Group Net Metered	Green Mountain Power	115
Solar	Roof-Mounted PV	Keurig Green Mountain	Net Metered	Green Mountain Power	95.1
Solar	Ground-mounted PV	Ivy Computer, Inc.	Net Metered	Green Mountain Power	80
Solar	Roof-Mounted PV	USINE, LLC	Group Net Metered	Green Mountain Power	50
Solar	Ground-mounted PV	The Energy Mill	Net Metered	Green Mountain Power	37.1
Solar	Roof-Mounted PV	Alchemy Holdings, LLC	Group Net Metered	Green Mountain Power	32.4
Solar	Roof-Mounted PV	Waterbury Fire Station	Net Metered	Green Mountain Power	32
Solar	Ground-mounted PV: Tracker	Green Mountain Club	Net Metered	Green Mountain Power	30.2
Solar	Roof-Mounted PV	Chris Noyes	Net Metered	Green Mountain Power	20
Solar	Ground-mounted PV: Tracker	Evergreen Gardens Of Vermont	Net Metered	Green Mountain Power	16
Solar	Ground-mounted PV	Wilford Sayah	Net Metered	Green Mountain Power	15.8
Solar	Ground-mounted PV: Tracker	Martha Staskus	Net Metered	Green Mountain Power	15
Solar	Roof-Mounted PV	Matthew Abair	Net Metered	Green Mountain Power	13.2
Solar	Roof-Mounted PV	Grant & Mona Eckfeldt	Net Metered	Green Mountain Power	12
Solar	Roof-Mounted PV	Jay Provencher	Net Metered	Green Mountain Power	11.4
Solar	Roof-Mounted PV	Amy & Michael Marshall-Carney	Net Metered	Green Mountain Power	11.4
Solar	Roof-Mounted PV	Crestone Acoustical Solutions	Group Net Metered	Green Mountain Power	11.4
Solar	Roof-Mounted PV	Duane Peterson	Group Net Metered	Green Mountain Power	11.4
Solar	Roof-Mounted PV	Lindsey & Corey Barrett	Net Metered	Green Mountain Power	11.4

TABLE 14 (continued) EXISTING RENEWABLE ENERGY GENERATION GREATER THAN 10 kW BASED ON EXISTING CERTIFICATES OF PUBLIC GOOD					
Category	**Sub Category**	**Name**	**Electricity Type**	**Utility**	**Capacity *(in kW)***
Solar	Roof-Mounted PV	John Hynes	Net Metered	Green Mountain Power	10
Solar	Ground-mounted PV	Krister and Clarissa Adams	Net Metered	Green Mountain Power	10
Solar	Roof-Mounted PV	Mark Frier	Net Metered	Green Mountain Power	10
Solar	Roof-Mounted PV	Dorothy Goulet	Net Metered	Green Mountain Power	10
Solar	Roof-Mounted PV	Shayna Partridge	Net Metered	Green Mountain Power	10
Solar	Roof-Mounted PV	Stacey Ambler	Net Metered	Green Mountain Power	10

Notes:

1. Information provided by the Department of Public Service via the Energy Action Network's Energy Dashboard. Complete information on existing generation from the Energy Action Network can be found at: https://www.vtenergydashboard.org/my-community/waterbury/statistics

Conclusion

As noted throughout this section, the Town of Waterbury face challenges similar to 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 of 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 Waterbury has the ability to shape its energy future within the spectrum of the avenues that it can control. The unknown component is whether or not 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 & 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.

Conservation of energy is a key component to achieving the State's goals of 90% energy derived from renewable sources by 2050. Conservation of energy in-turn will reduce the amount of energy needed to support the existing and future systems thus allowing small increases in generation to support more uses overall.

	IMPLEMENTATION ACTION	RESPONSIBILITY	PRIORITY/ TIMELINE	MEASURE OF SUCCESS
1	Incorporate energy efficiency and conservation when conducting residential and economic planning, and when creating local zoning regulations.	Municipality	High 1 to 3 years	Energy issues considered during planning and permitting process
2	Increase education on renewable energy and energy efficiency including weatherization through activities such as workshops or community forums.	Municipality, Regional Partners, LEAP	Medium 3 to 5 years	Workshops or outreach activities completed
3	Work with LEAP, to encourage local residences and businesses to have energy audits and perform weatherization work to the greatest extent possible.	Municipality, LEAP	Medium 3 to 5 years	Weatherization of structures increases annually
4	Identify and promote additional incentives (e.g., tax credits, property tax exemptions) and other regulatory mechanisms to encourage businesses and residents to undertake weatherization, efficiency or renewable energy projects.	Municipality	~~Low~~ ~~5 to 10 years~~ Medium 3 to 5 years	Incentives identified and promoted

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

Energy efficient building designs provide benefits to the owners and occupants by reducing the amount of energy needed to heat, cool, and maintain the mechanical systems within the building. Establishing and promoting energy efficiency in design, construction, retrofits, ~~and~~ renovations, as well as location will ensure new buildings and building practices will be more efficient into the future. These efficiencies can also lead to conservation of energy which can promote cost savings and affordability for owners and renters.

	IMPLEMENTATION ACTION	RESPONSIBILITY	PRIORITY/ TIMELINE	MEASURE OF SUCCESS
1	Support local organizations (including LEAP, Waterbury in Motion, Waterbury Farmer's Market and Food Council) in their efforts to assess, plan, finance, and promote specific efforts to meet the energy efficiency, conservation, and sustainability goals and objectives.	Municipality, local partners/organizations	High On-going	Support provided to local organizations
2	Partner with existing organizations to provide education and assistance on the development of "stretch codes"[10] for residential and commercial building standards.	Municipality, LEAP, Vermont Energy Investment Corporation	Medium 3 to 5 years	New regulations established as appropriate
3	Review zoning bylaws to consider including incentives for buildings that utilize a south-facing orientation.	Municipality	Medium 3 to 5 years	Bylaws reviewed and amended as appropriate to include incentives
4	Identify community organizations or existing businesses to develop or disseminate information regarding the use of landscaping for energy efficiency including the importance of tree canopies, pervious surfaces, and similar design practices.	Municipality, LEAP, local landscape companies	Low 5 to 10 years	Organizations identified and information distributed ~~available for distribution~~
5	Identify information or develop new materials that promote the use of Vermont's residential building energy label/score to inform the community of the importance of energy efficiency in building design and construction.	Municipality	Low 5 to 10 years	Materials developed and distributed ~~available for distribution~~

10. Vermont has Residential Building Energy Standards (RBES) and Commercial Building Energy Standards (CBES). Stretch energy codes are those that achieve greater energy savings than the base RBES and CBES by including more stringent requirements for design and evaluation of energy efficiency.

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

Reliance on fossil fuels such as oil, kerosene, or propane for heating is an unsustainable practice. Fossil fuels are non-renewable therefore they will eventually be depleted to a point where they are too expensive or too rare to be viable. Establishing alternative sources of renewable fuels for heating or conversions to heating from electric sources (which can be generated through renewable methods) will promote a more sustainable thermal energy future.

	IMPLEMENTATION ACTION	RESPONSIBILITY	PRIORITY/ TIMELINE	MEASURE OF SUCCESS
1	Identify funding programs or partners that can assist with conversion of heating sources from fossil fuels to renewable based systems for homes and businesses.	Municipality, CVRPC, regional partners, state agencies	High 1 to 3 years	List of funding sources established & maintained
2	Identify technologies such as cold climate heat pumps, ground source heat pumps, district heating[11], or high efficiency combustion wood stoves that would be suitable for home and business conversions and educate users on their advantages.	Municipality, CVRPC industry experts	High 1 to 3 years	Information sessions conducted bi-annually
3	Improve the thermal efficiency of homes, businesses and public buildings through greater use of energy audits and design efficiency.	Municipality, local partners	High On-going	Increased energy audits and greater design efficiency achieved
4	Identify potential locations throughout the community that could benefit from district heating projects based on building density, proximity to resources such as biomass, or status as a use by right where applicable.	Municipality	~~Low~~ ~~5 to 10 years~~ Medium 3 to 5 years	Locations identified and mapped

11. District heating is a system for distributing heat generated in a centralized location for two or more homes and/or buildings' heating requirements.

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

Leading by example is the most effective way to show the municipality is committed to implementing the actions that will support a renewable energy future. Municipalities typically own multiple buildings that can benefit from energy efficiency measures. This could include adding solar panels to the municipal center, town highway garage, or replacing outdated oil burning heating systems with high efficiency heat pumps.

	IMPLEMENTATION ACTION	RESPONSIBILITY	PRIORITY/ TIMELINE	MEASURE OF SUCCESS
1	~~Encourage new municipal and other town buildings to meet LEED standards and encourage current structures to become more energy efficient.~~ Update municipal policies to require that new municipal buildings meet LEED or comparable standards, and that any maintenance and upgrades to existing buildings incorporate efficiency measures through design and materials.	Municipality, LEAP	High 1 to 3 years	LEED standards are incorporated into new municipal building designs
2	Promote municipal solar, school solar, and community solar or other renewable energy projects on town, village, or state land and take steps to help viable projects move forward.	Municipality, school district, state agencies	High 1 to 3 years	Renewable energy projects installed as appropriate
3	Encourage the placement of any new municipal buildings in existing, compact centers as appropriate.	Municipality	Medium On-going	New buildings are located in existing centers when appropriate

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

To this end, Waterbury will encourage greater transportation efficiency by supporting the expansion of public transportation, carpooling, and bike/ pedestrian access and to encourage greater use of electric and more fuel efficient vehicles. By 2025, Waterbury aims to reduce the use of fossil fuels for transportation by 20%.

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.

Public transit offers communities the ability to move multiple persons utilizing existing roadway or railway infrastructure. Convenient, reliable and efficient public transit provides an alternative mode for individuals that might otherwise choose to drive alone. Public transit has the ability to reduce the need for parking, provide more walkability in communities, and reduce congestion on local roads.

	IMPLEMENTATION ACTION	RESPONSIBILITY	PRIORITY/ TIMELINE	MEASURE OF SUCCESS
1	Identify and support actions that will increase utilization of Green Mountain Transit, Vermont Transit, Amtrak rail service, ride sharing, and taxis thereby reducing reliance on automobiles.	Municipality, GMT, VTrans, CVRPC, regional partners	High 1 to 3 years	Actions identified and supported
2	Participate actively in the regional transportation planning process to ensure that regional plans support the goals, objectives, and actions of this plan.	Municipality	High On-going	Active participation maintained
3	Promote multi-modal transportation systems that will integrate (and facilitate transfer among) rail, bus, taxi, pedestrian, and bicycle traffic throughout Waterbury and specifically in activity centers such as schools, downtown, or villages.	Municipality, GMT, VTrans, CVRPC, transportation providers	High On-going	Multi-modal system integration continues to be a priority

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.

Due to the rural nature of Central Vermont, single-occupancy vehicle trips are a common occurrence. While many people rely on their vehicle to perform general day-to-day tasks, reducing the rate of these trips can improve congestion on local roads; reduce conflicts with vehicles and pedestrians; and provide more support for ride shares, public transit, or similar multi-occupancy trips.

	IMPLEMENTATION ACTION	RESPONSIBILITY	PRIORITY/ TIMELINE	MEASURE OF SUCCESS
1	Work with utility companies to inventory and map infrastructure such as fiber optic cable to identify gaps that may prohibit information accessibility or telecommuting options.	Municipality, utility providers	High On-going	Identify gaps and prioritize needs
2	Support local carpooling and car-sharing initiatives, mass transit, bike and pedestrian efforts to improve transportation efficiency and reduce emissions.	Municipality	Medium On-going	Municipal support provided
3	Work with transit providers to identify possible future park & ride locations that will support areas with current or future development density.	Municipality, GMT, VTrans, CVRPC,	Medium On-going	Potential park & ride locations identified

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.

Reducing the dependency on fossil fuels and other non-renewable fuels is a key pathway to achieving the state's energy planning goals. Switching to electric or non-fossil fuel based vehicles will help reduce greenhouse gas emissions and promote cleaner fuel alternatives.

	IMPLEMENTATION ACTION	RESPONSIBILITY	PRIORITY/ TIMELINE	MEASURE OF SUCCESS
1	Identify businesses in the municipality that operate large fleets of vehicles to provide assistance evaluating the possibility of integrating electric or non-fossil fuel based vehicles into their fleets.	Municipality, business community	~~Medium~~ ~~3 to 5 years~~ High 1 to 3 years	Businesses inventoried and contacts established
2	Inventory existing locations of electric vehicle charging stations to identify where gaps may exist and develop a long-term plan for new stations to provide greater access for electric vehicle owners.	Municipality, Drive Electric Vermont, state agencies	Medium On-going	Inventory of locations mapped & potential gaps prioritized for future installations
3	Facilitate the construction of electric vehicle charging stations at appropriate locations throughout the Town.	Municipality, Green Mountain Power, Drive Electric Vermont	Medium On-going	Charging stations installed

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

Walking and biking provide valuable alternatives to motorized vehicle travel. Ensuring a safe, efficient, and convenient infrastructure exists to promote walking and biking is essential to the future growth and sustainability of Waterbury.

	IMPLEMENTATION ACTION	RESPONSIBILITY	PRIORITY/ TIMELINE	MEASURE OF SUCCESS
1	Ensure that the design of Waterbury's Main Street follows Vermont's Complete Streets guidelines.	Municipality, VTrans	High 1 to 3 years	Complete Streets guidelines followed
2	Develop a comprehensive way-finding signage system for Downtown Waterbury to orient visitors and residents and provide, where appropriate, directional and information signage for pedestrian crossings, parking, schools, etc.	Municipality	High 1 to 3 years	Way-finding system developed and implemented
3	Require a minimum width of five feet, and wider where appropriate, for downtown sidewalks.	Municipality, VTrans	High 1 to 3 years	Sidewalks widened where appropriate

	IMPLEMENTATION ACTION	RESPONSIBILITY	PRIORITY/ TIMELINE	MEASURE OF SUCCESS
4	Where possible, widen shoulders to facilitate pedestrian and bicycle traffic along higher speed roadways.	Municipality, VTrans	Medium On-going	Roads widened and designated for bicycle or pedestrian use
5	Encourage and facilitate multi-modal transportation in the locally defined growth areas, including the provision and maintenance of adequate pedestrian and bike facilities.	Municipality	Medium On-going	Pedestrian and bike facilities incorporated into growth areas
6	Extend sidewalks and other types of bicycle and pedestrian facilities to under-served areas and areas of new development within and adjacent to Downtown Waterbury.	Municipality, VTrans, CVRPC	Medium 3 to 5 years	New facilities established to identified areas
7	Take steps to improve and expand the municipality's system of alternative and recreational pedestrian/bike paths, including the provision of signage to facilitate its use. In addition, encourage "pedestrian friendly" new development. Evaluate and propose changes to the by-laws that will give greater effect to this action.	Municipality, local partners	Medium On-going	Recreational paths are improved and by-laws updated as necessary

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 Waterbury.

The Town of Waterbury can lead by example through their decisions to purchase or lease energy efficient or alternative fuel vehicles for use in the daily operations of the municipality. This will signal a commitment to the community at large and mark a positive step towards reduced dependency on fossil based fuels.

	IMPLEMENTATION ACTION	RESPONSIBILITY	PRIORITY/ TIMELINE	MEASURE OF SUCCESS
1	Encourage, to the extent possible, the use of energy efficient municipal vehicles.	Municipality	Medium 3 to 5 years	Vehicles purchased as needed to replace fleet
2	Continue to install electric vehicle charging stations when development or redevelopment of municipally owned property occurs.	Municipality, Schools	Medium On-going	Charging stations installed

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

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

Land use policies that work to limit the proliferation of large lot development in favor of small lots in a compact area help communities address conditions that create sprawl, or the outward pattern of development that is characterized by auto-centric uses in an expanded geography. By limiting conditions that lead to sprawling development patterns, Waterbury can more effectively support energy independence.

	IMPLEMENTATION ACTION	RESPONSIBILITY	PRIORITY/ TIMELINE	MEASURE OF SUCCESS
1	Encourage compact and mixed-use patterns of development that reduce the need for automobile travel.	Municipality	High On-going	Compact and mixed use development created
2	Develop a sewer service plan focused on serving existing compact areas and restricting extensions of infrastructure that will promote sprawl development.	Municipality	High 1 to 3 years	Sewer service plan developed
3	Evaluate municipal regulations to ensure higher density development patterns are located in downtowns or village centers to maintain existing settlement patterns and do not inadvertently promote sprawling development.	Municipality	Medium On-going	Regulations are evaluated as needed and recommendations are included
4	Cluster development to the extent possible based on site conditions to minimize the impact on significant natural resources and scenic lands.	Municipality	Medium On-going	Development occurs consistent with clustering

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 Waterbury.

Compact development patterns create opportunities whereby land uses that support where people live, work, and recreate, are all within close proximity. This not only creates a greater sense of place but it provides opportunities to walk, bike, or utilize public transit as the primary mode of transportation. Additionally, compact development patterns can promote conservation of energy through the redevelopment of underutilized spaces therefore including more energy efficient building designs.

	IMPLEMENTATION ACTION	RESPONSIBILITY	PRIORITY/ TIMELINE	MEASURE OF SUCCESS
1	Evaluate existing regulations and amend as necessary to support and encourage infill development, redevelopment, adaptive reuse of existing buildings such as historic structures, and reuse of "brownfield" sites.	Municipality, CVRPC	High 1 to 3 years	Regulations evaluated and ~~recommendations~~ amendments made as appropriate
2	Inventory and map existing infrastructure such as water and wastewater to evaluate capacity and development potential.	Municipality	Medium 3 to 5 years	Infrastructure mapped and updated as needed
3	Ensure that financial incentives are available for development within locally defined growth centers.	Municipalities, state agencies	Medium 3 to 5 years	Incentives identified
4	Evaluate municipal regulations to determine the viability of reducing or removing the need for parking in established villages, downtowns, or other areas with a compact development pattern.	Municipality	Medium 3 to 5 years	Regulations are reviewed and amended as appropriate
5	Evaluate alternative land use regulations such as form-based codes and identify communities where similar regulations have been successfully implemented to determine effectiveness of creating desired development patterns.	Municipality, CVRPC	Low 5 to 10 years	Evaluations completed

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.

Identifying and mapping existing renewable energy generation facilities throughout the Town will provide a baseline to determine the generation that currently exists. This information can provide a better understanding for where developments are currently being established and can help prioritize assistance that may be needed at the municipal level. Additionally, mapping existing constraints will provide the Town with a better understanding of resources that are available within their community.

	IMPLEMENTATION ACTION	RESPONSIBILITY	PRIORITY/ TIMELINE	MEASURE OF SUCCESS
1	Regularly update maps regarding existing generation facilities to maintain an up-to-date inventory of locations.	CVRPC, Department of Public Service, Municipality	On-going	Updated maps provided as requested
2	Regularly update maps regarding known and possible constraints to ensure consistency with state guidelines on renewable energy siting.	CVRPC, State Agencies, Municipality	On-going	Updated maps provided as necessary
3	Update municipal maps to reflect changes regarding preferred or unsuitable locations for renewable energy generation.	CVRPC, Municipality	On-going	Maps and information updated as necessary
4	Work with state agencies and the Region to map locations of woody biomass or methane generation for possible fuel sources.	CVRPC, State Agencies, Municipality	On-going	Specific locations are identified and mapped

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

Identifying and mapping potential renewable energy generation throughout the Town will provide the municipality with information regarding available land area where renewable energy generation could be located. This information can be used to help the Town prioritize and evaluate where future renewable generation could or should occur based on municipal land use policies and constraints. Additionally, information on potential renewable energy generation will ensure the Town is working to support the state's renewable energy generation goals of 90% of the state's energy needs coming from renewable sources by 2050.

	IMPLEMENTATION ACTION	RESPONSIBILITY	PRIORITY/ TIMELINE	MEASURE OF SUCCESS
1	Evaluate known, possible, regionally, and locally identified constraints to ensure up-to-date information is available for future planning purposes.	CVRPC, State Agencies, Municipality	On-going	Constraints will be evaluated and mapped as necessary
2	Update information on utility infrastructure including existing and proposed transmission facilities to ensure accurate data exists.	CVRPC, Utility Providers, Municipality	On-going	Utility information is updated and mapped as necessary
3	Evaluate and update preferred and unsuitable locations for future renewable energy generation siting as needed based on state, regional, and municipal policies and plans.	CVRPC, Municipality, State Agencies	On-going	Preferred and prohibited locations are evaluated and mapped as necessary
4	Update generation potential based on future land developments, changes to land uses, or updates to priority areas as identified by state, regional, or municipal actions.	CVRPC, Municipality, State Agencies	On-going	Generation potential is updated as necessary
5	Evaluate and prioritize future renewable energy generation technologies and locations to best suit municipal needs and policies.	CVRPC, Municipality	On-going	Locations and technologies will be evaluated and prioritized

MAPPING

The siting and generation of renewable resources is a critical part to identifying whether or not 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 Waterbury to evaluate the renewable energy generation options that are available to meet these goals.

To this end, maps were created for the Town of Waterbury 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 Waterbury.

Existing Renewable Energy Generation

As noted in the Analysis and Targets section, Tables 11 and 14 identify the existing renewable generation for the Town of Waterbury. Information on existing generation is a representation of all projects that were issued a Certificate of Public Good by the Public Service Board through the end of 2016. 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 14.

Potential Renewable Energy Generation

Table 12 in the Analysis and Targets section identifies potential generation of renewable energy for Waterbury. 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[12]

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.

12. Appendix A provides specific definitions for the known and possible constraints.

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 of the regional constraints are considered possible constraints. This is due to the fact that 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

<u>Methodology</u>

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 Waterbury.

As noted in Table 12 of the Analysis and Targets section, based on the solar, wind, and hydroelectric potential within Waterbury, approximately 1,822,000 megawatt hours of energy could be produced, well above the town's allocation of 32,590 megawatt hours by 2050 as noted in Table 7. The potential energy generation for the Town of Waterbury 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.

Similar to 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 Waterbury 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

There are several locations throughout the Town of Waterbury that have been identified as being unsuitable for development. In general, these areas have been identified due to their significance as supporting wildlife habitat. In these locations development may be possible, however the specific siting, scale, and amount of land disturbance will be a critical factor to consider. These areas include:

- Shutesville Hill Wildlife Corridor

The Shutesville Hill Wildlife Corridor is indicated on the Forest Integrity Map which is part of the Waterbury Town Plan and is specifically referenced and discussed in other sections of the Waterbury Town Plan.

Finally, the Waterbury Energy Plan supports the development of renewable energy generation technology that will not adversely impact the built or natural environment or conflict with identified policies. Due to the diverse nature of Waterbury including urban and rural areas, there was no way to develop a consistent policy that would be equitable to all areas, therefore renewable energy generation types (both current and developed through future advances in technology or innovations in the industry) may be considered for application in the Town of Waterbury.

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 & 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 site 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 also 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 –

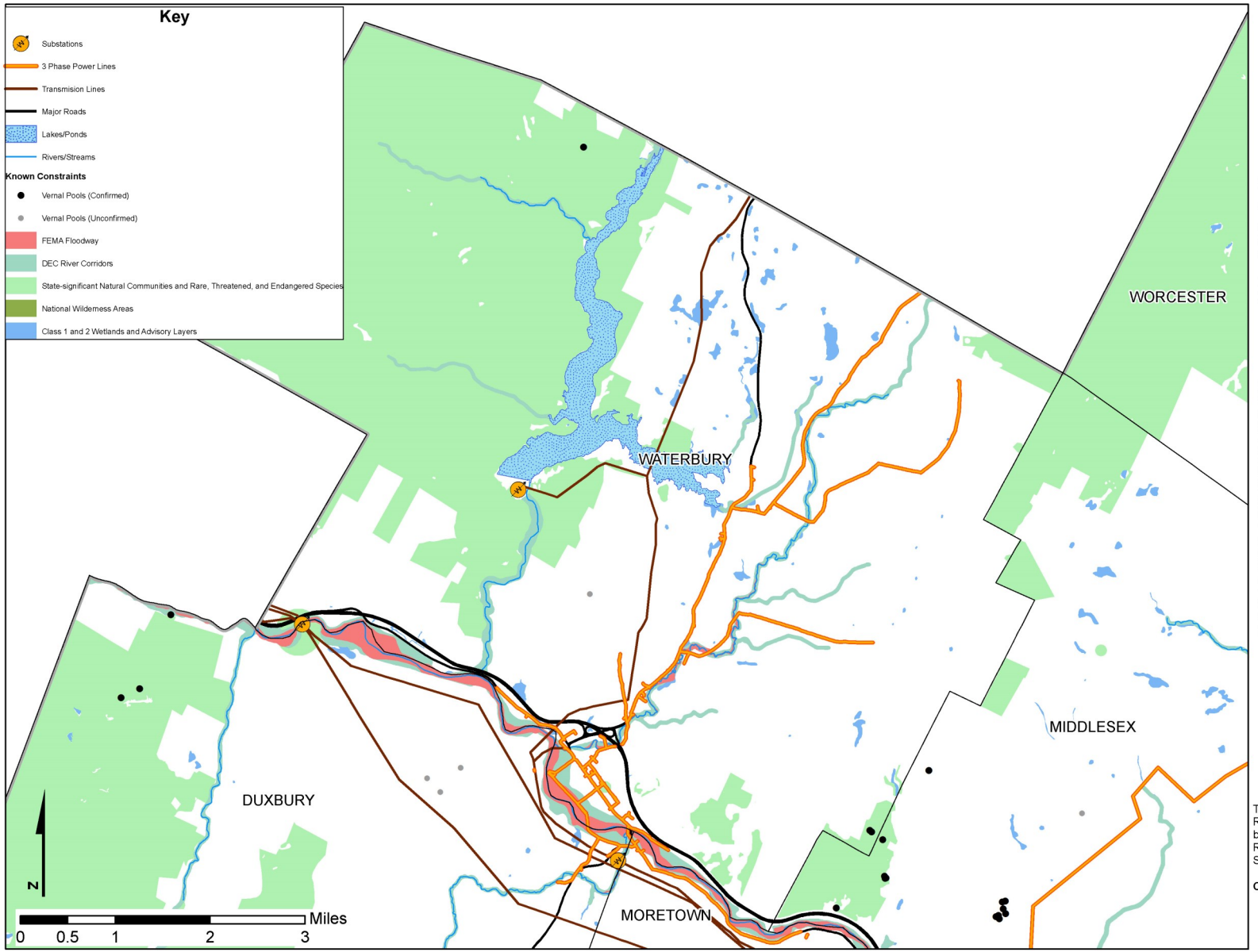
For this constraint, CVRPC used the Vermont Center for Geographic Information's Protected Lands Database.

Local Constraints

One local constraint has been identified which is the Shutesville Hill Wildlife Corridor. This location is shown on the Forest Integrity Map and discussed in several other sections of the Waterbury Town Plan. The Shutesville Hill Wildlife Corridor is a critical connection between the Green Mountains and the Worcester Range. It has been identified as one of the five most important wildlife corridors in the State of Vermont by the Staying Connected Initiative. Development of any kind in this area is highly restricted. Additional guidance on protection of this critical resource is noted throughout the Waterbury Town Plan and local regulations.

APPENDIX B

MUNICIPAL RESOURCE MAPS



WATERBURY
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.

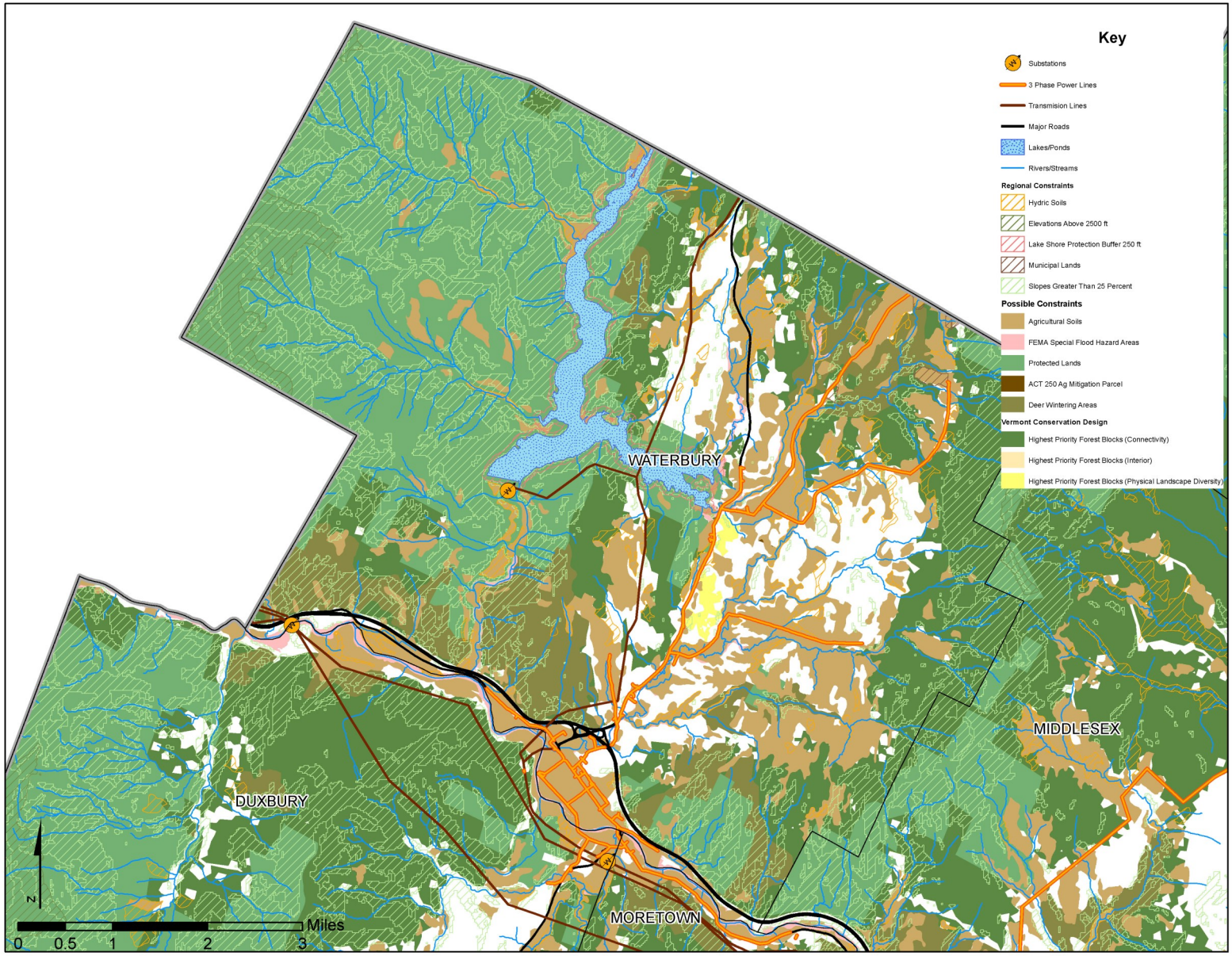
Link to Data -
http://vcgi.vermont.gov/opendata/act174

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

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.

CVRPC



WATERBURY
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.

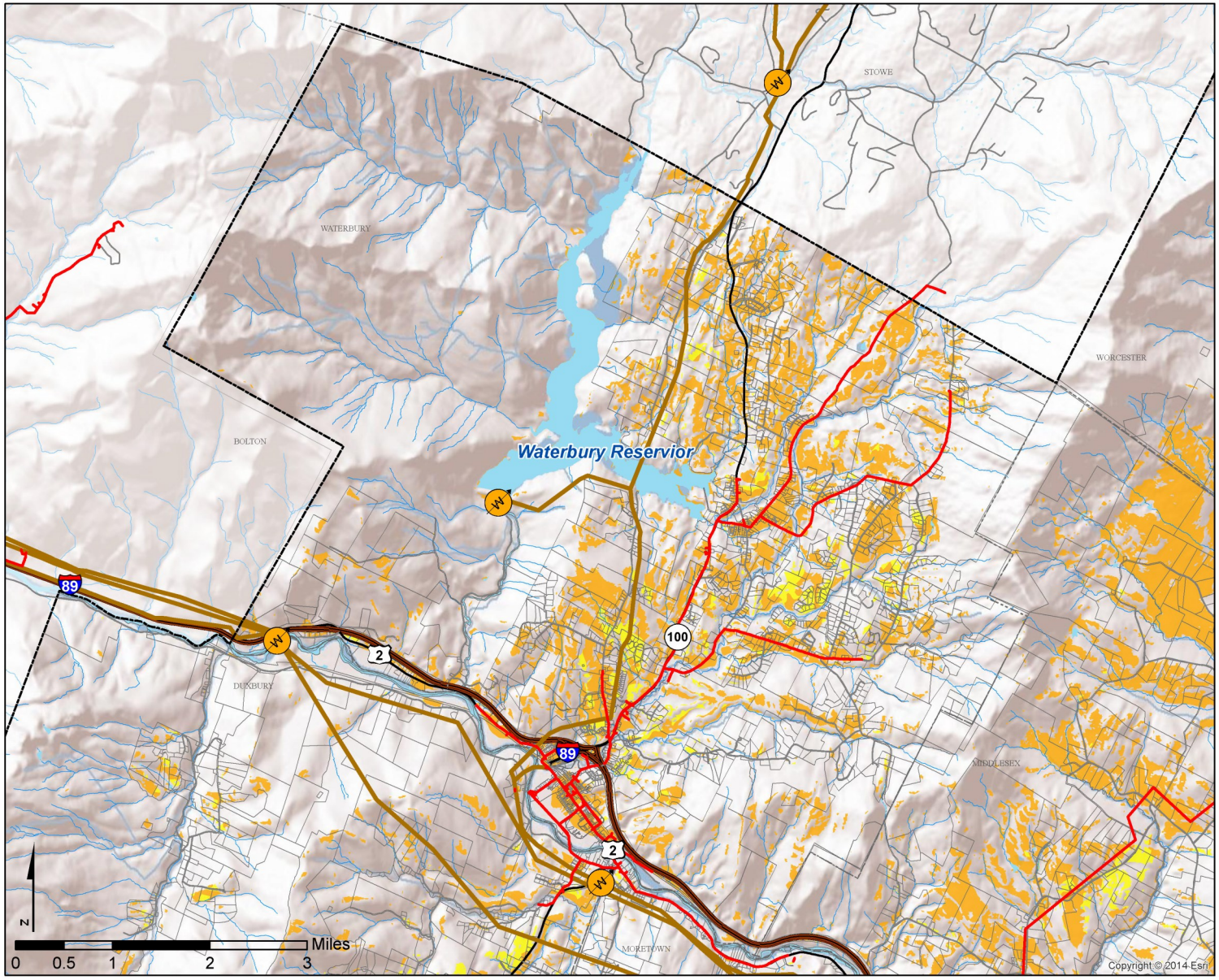
Link to Data - http://vcgi.vermont.gov /opendata/act174

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

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.

CVRPC



WATERBURY

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

Created by: CVRPC GIS 4/4/2017
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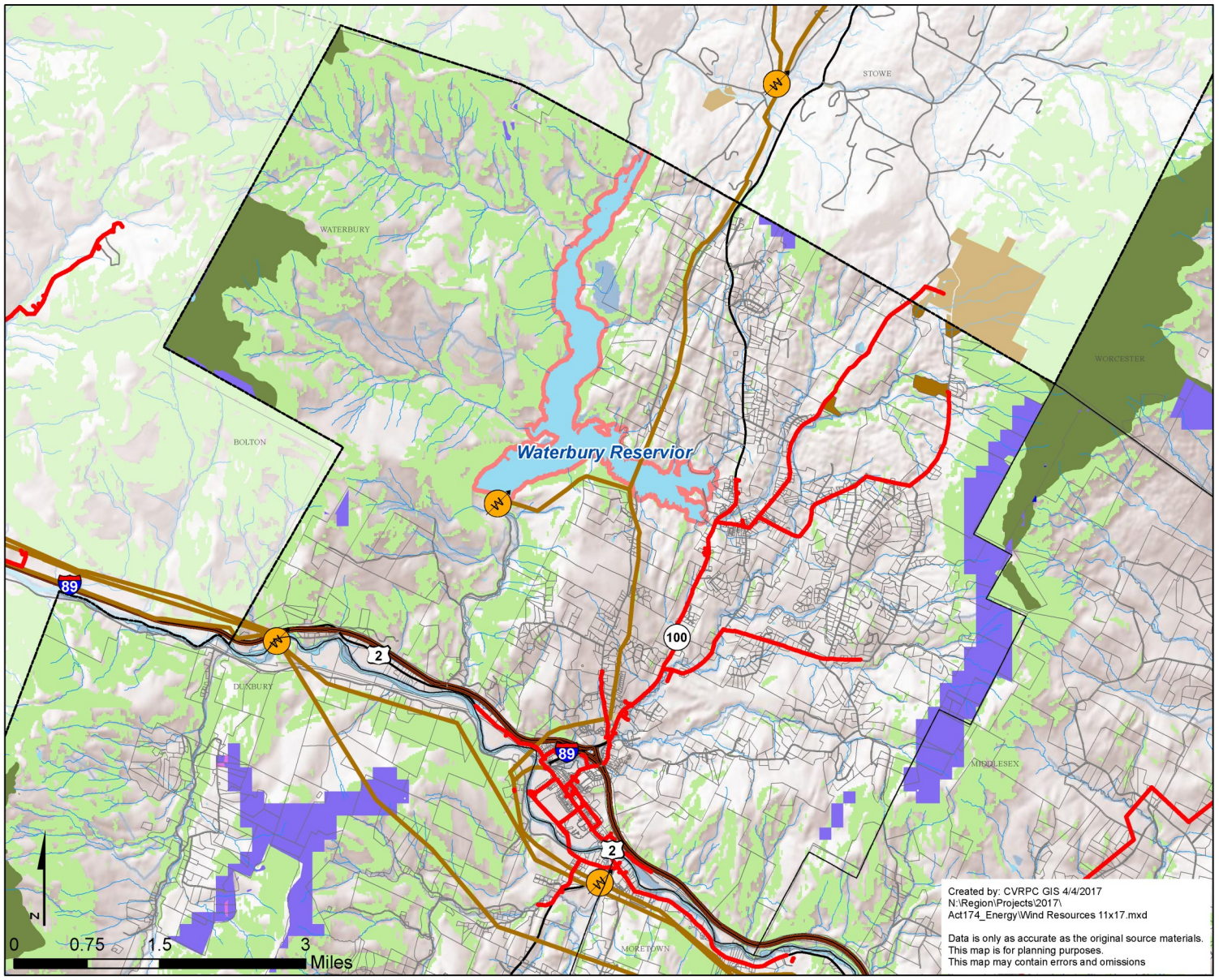
Act174_Energy\Solar Resources 11X17

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

CVRPC
CENTRAL VERMONT REGIONAL PLANNING COMMISSION



WATERBURY
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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Act174_Energy\Wind Resources 11x17.mxd

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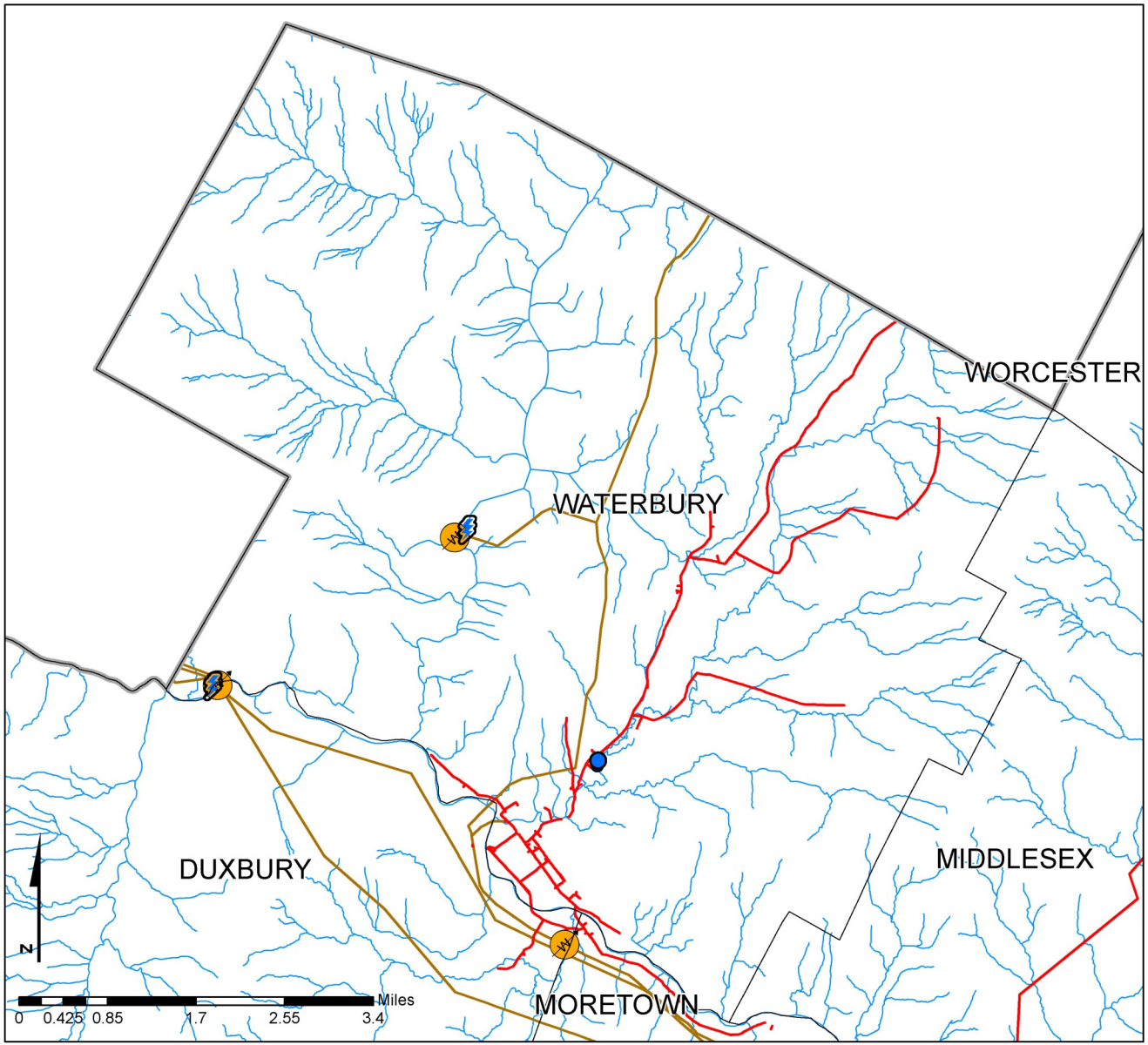
This map may contain errors and omissions

CVRPC
CENTRAL VERMONT REGIONAL PLANNING COMMISSION



WATERBURY
Hydroelectric Resources Map

Key

- Substations
- 3 Phase Power Lines
- Transmission Lines
- Major Roads
- Lakes/Ponds
- Rivers/Streams
- Dams not on National Wild and Scenic Rivers
- Dams on National Wild and Scenic Rivers

Potential Hydroelectric Facilities

Potential Hydroelectric Facilities

- < 50 kW Capacity
- > 50 kW Capacity
- High Hazard with < 50 kW Capacity
- High Hazard with > 50 kW Capacity

Methodology

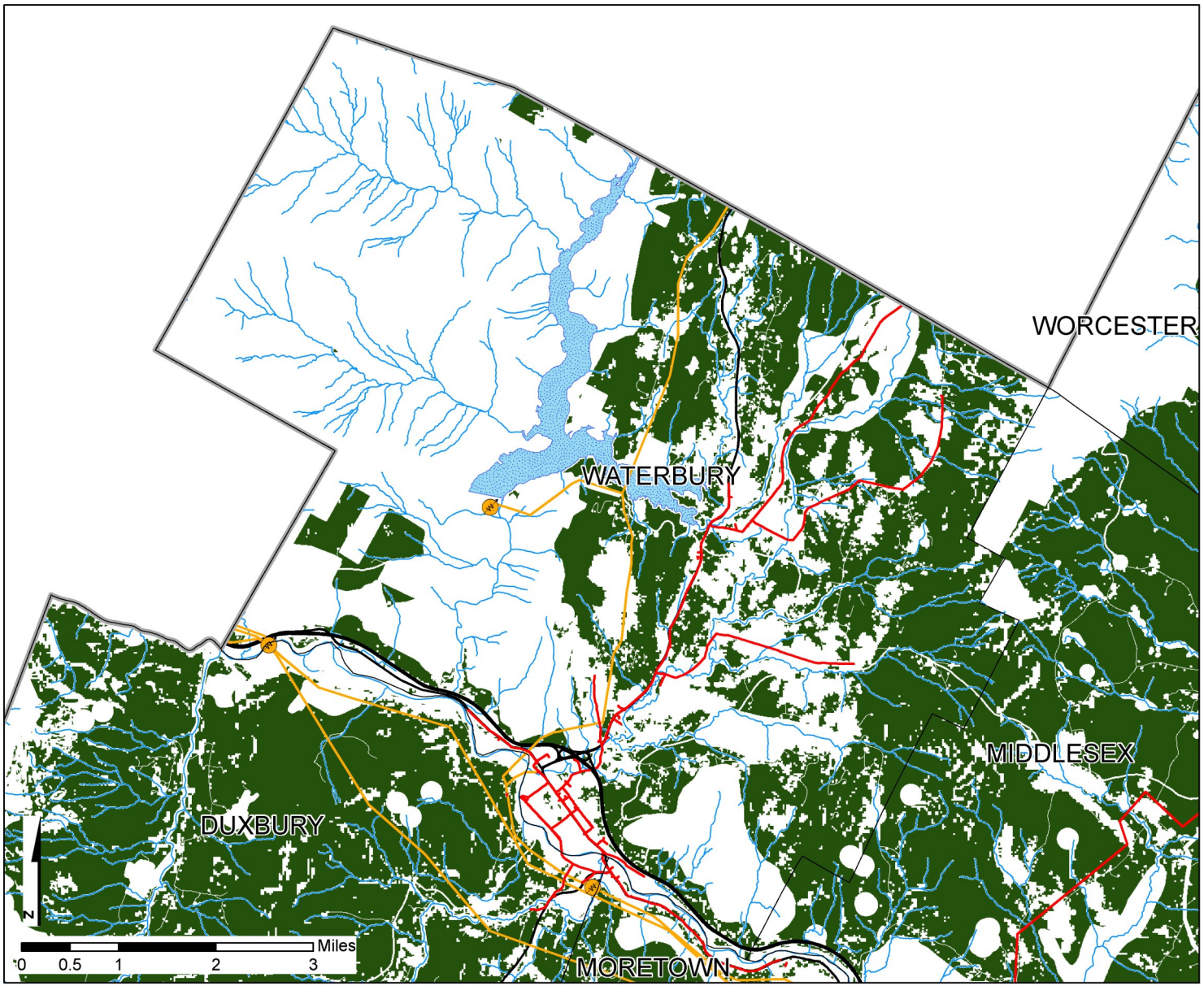
This map shows areas of resource potential for renewable energy generation from hydroelectric , i.e., dams that could be converted in to hydroelectric facilities as well as active hydroelectric sites. Existing hydroelectric dam information was extracted from the Vermont Dam Inventory, while potential 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.
N:\Region\Projects\2017\Act174_Energy\Hydroelectric Resources 11x17.mxd

CVRPC
CENTRAL VERMONT REGIONAL PLANNING COMMISSION



WATERBURY
Woody Biomass Resources Map

Key

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

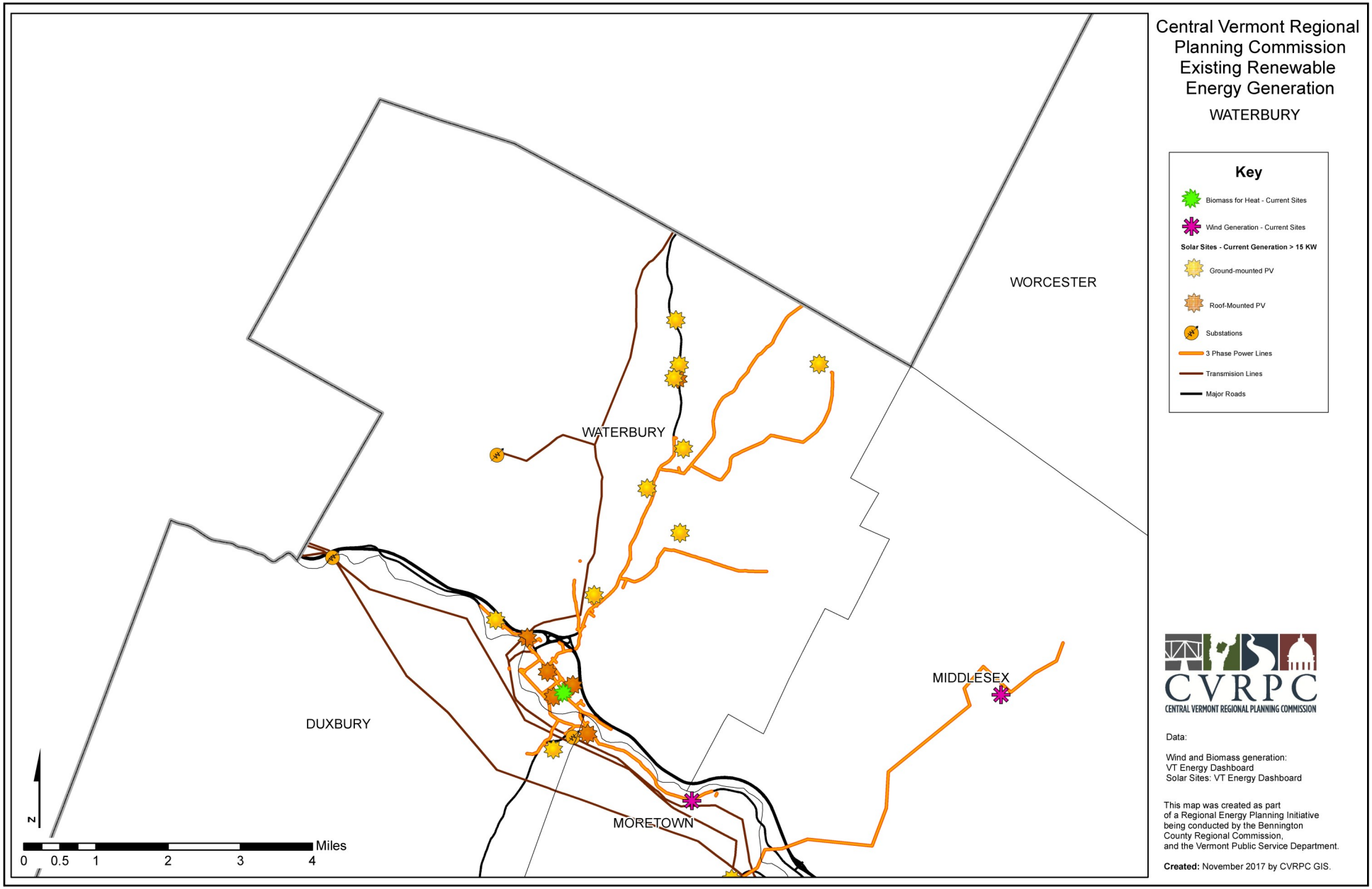
Methodology

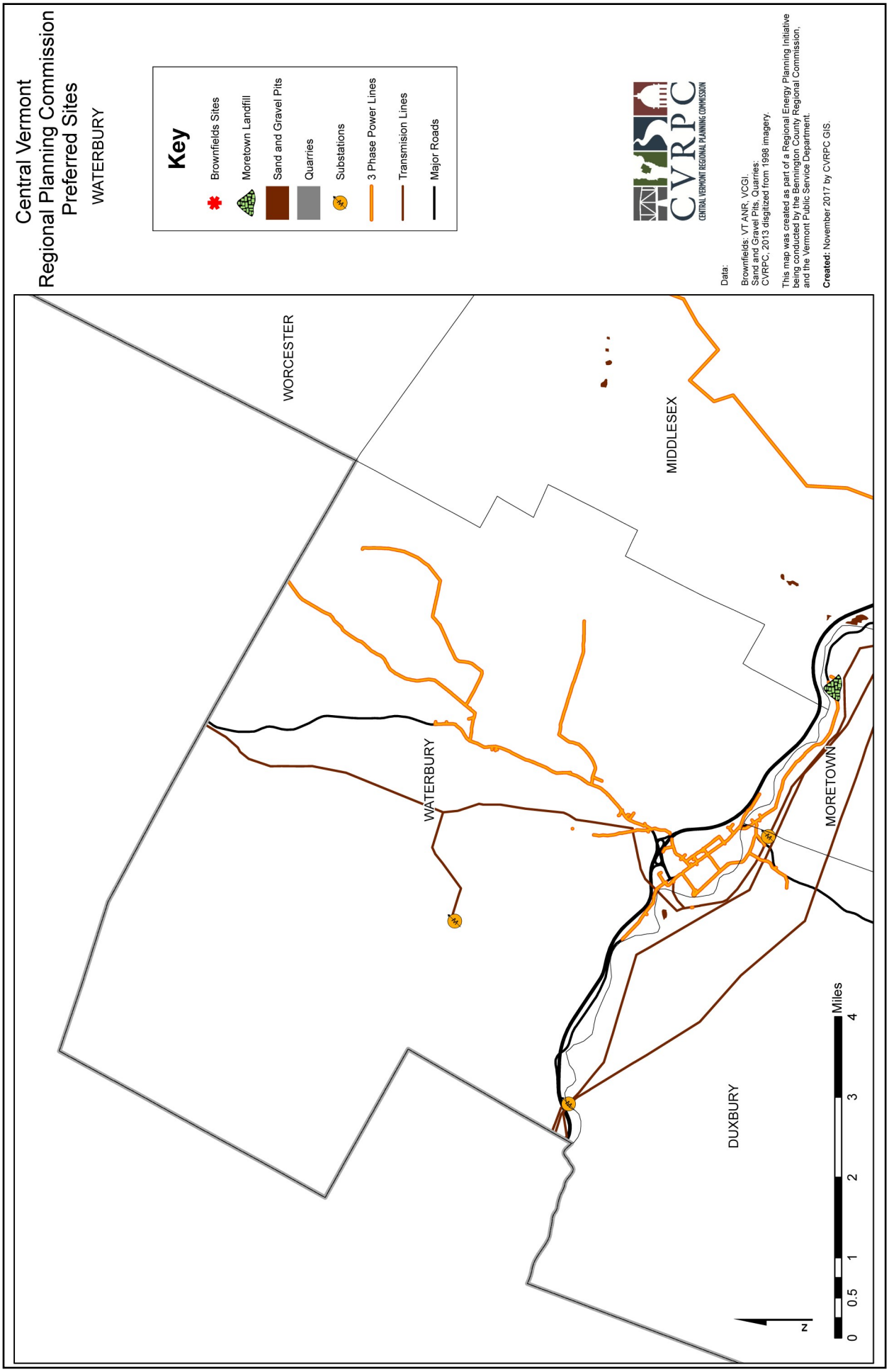
This map shows areas of resource potential for woody biomass, i.e., locations where forested areas are. This map also considers various other conditions, such as ecological zones, that may impact the feasibility of renewable energy/alternative heating source. These conditions are referred to as constraints.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

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.

CVRPC
CENTRAL VERMONT REGIONAL PLANNING COMMISSION


Central Vermont Regional Planning Commission
Existing Renewable Energy Generation
WATERBURY
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
WORCESTER
WATERBURY
DUXBURY
MIDDLESEX
MORETOWN
N
0 0.5 1 2 3 4
Miles
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.


Central Vermont
Regional Planning Commission
Preferred Sites
WATERBURY
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.
WORCESTER
MIDDLESEX
WATERBURY
MORETOWN
DUXBURY
N
0 0.5 1 2 3 4
Miles