DRAFT
ENERGY PLAN

FOR THE
TOWN OF MIDDLESEX

PREPARED BY:

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Executive Summary & Introduction

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

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

Section I: Analysis & Targets

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

Specific information in this section notes that Middlesex currently uses approximately 10,682 megawatt hours of electricity on an annual basis across the identified sectors. By comparison, Middlesex's share of new renewable energy generation needed to meet the state's goal is approximately 11,140 megawatt hours. Based on the mapping and resource data (Section III), Middlesex has resources available to generate approximately 1,424,868 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 Middlesex include approximately 2,416 alternative powered vehicles and approximately 407 heating systems. The specific 2050 targets for transportation and heating renewable use in Middlesex are 90.2% and 92.5% 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 Middlesex 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 Middlesex is already working to support its residents and businesses through local land use, transportation, and environmental planning activities.

To this end, the current Middlesex 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 Middlesex'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 Middlesex 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 Middlesex 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 Middlesex 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

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

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

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

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

Transportation

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

Table 1

Current Transportation Energy Use[1]

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

Transportation Data	Municipal Data
Total # of Vehicles (ACS 2011-2015)	1,478
Average Miles per Vehicle (Vtrans)	12,500
Total Miles Traveled	18,475,000
Average Gallons Used per Vehicle per Year (VTrans)	576
Total Gallons Use per Year	993,280
Transportation BTUs (Billion)	120
Average Cost per Gallon of Gasoline (RPC)	2.31
Gasoline Cost per Year	$2,294,476.00

Electricity

In 2016, Middlesex's electricity usage was split at 51% by commercial and industrial customers, and 49% by residential customers. Utility rates are regulated by the Vermont Public Utility Commission. In 2018, the U.S. Energy Information Administration reported the average cost per kilowatt hour in Vermont was approximately 15 cents and approximately 18 cents for all of New England. Middlesex's current electricity usage can be found in Table 2, below:

Table 2 Current Electricity Use[2]	
Use Sector	Current Electricity Use
Residential (Efficiency Vermont) (kWh)	5,245,430
Commercial and Industrial (kWh)	5,437,045
Total (kWh)	10,682,475

Home Heating

2015 American Community Survey Data indicate that approximately 38.4% (269) of homes in Middlesex are heated with fuel oil. The number of homes heated with propane and other bottled fuel oils has increased from 144 in 2010 to 196 in 2015. Electric heat has increased from 0 in 2010 to 3 in 2015, and wood heat has increased from 186 in 2010 to 283 in 2015.

Municipal Energy Use:

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

[2] This table displays current electricity use within the municipality. This data is available from Efficiency Vermont (EVT).

Table 3 Current Municipal Residential Heating Use[3]				
Fuel Source	Municipal Households (ACS 2011-2015)	Municipal % of Households	Municipal Square Footage Heated	Municipal BTU (in Billions)
Natural Gas[4]	3	0.4%	5,952	0.36
Propane	196	25.4%	368,302	22.10
Electricity	3	0.4%	5,952	0.36
Fuel Oil	269	34.8%	522,074	31.32
Coal	0	0.0%	0	0.00
Wood	283	36.6%	537,334	32.24
Other (Includes Solar)	19	2.5%	30,544	1.83
No Fuel	0	0.0%	0	0.00
Total	**557**	**100%**	**1,470,158**	**88.21**

Table 4 Current Commercial Energy Use[5]			
	Commercial Establishments in Municipality (VT DOL)	Estimated Thermal Energy BTUs per Commercial Establishment (in Millions) (VDPS)	Estimated Thermal Energy BTUs by Commercial Establishments in Municipality (in Millions)
Municipal Commercial Energy Use	56	572	32,032

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

[3] This table displays regional data from the ACS that is extrapolated to estimate current municipal residential heating energy use.
[4] The data used for this table is extrapolated from statewide American Community Survey data, which includes a measure for Natural Gas. There is currently no natural gas infrastructure present in Middlesex as of 2020.
[5] This table uses data available from the Vermont Department of Labor (VT DOL) and the Vermont Department of Public Service (DPS) to estimate current municipal commercial establishment energy use in the municipality.

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 Middlesex, 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[6]

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

In order for Middlesex 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

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

Middlesex's targets for renewable energy use and Table 7 identifies the targeted renewable energy generation.

Table 6 Targets for Renewable Energy Use			
	2025	2035	2050
Renewable Energy Use - Transportation	9.6%	31.3%	90.2%
Renewable Energy Use - Heating	52.4%	66.6%	92.5%

Table 7 Targets for Renewable Energy Generation[7]			
	2025	2035	2050
Total Renewable Generation Target (in MWh)	2,785	4,456	11,140

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 Middlesex.

Efficiency Vermont

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

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

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

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

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

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.

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

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

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

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

After weatherization, the next step to increasing home heating efficiency is replacing outdated or inefficient home heating systems with high efficiency units. In general, this conversion would typically include replacing a system that used fossil fuel such as oil with an electric heat pump, wood burning system, or other renewable based heating systems. Specifically, Table 8 identifies the number of new efficient wood heating systems or heat pumps needed in each target year to meet Middlesex's portion of the state's comprehensive energy goals.

Table 8 Thermal Sector Conversions Per Target Year[8]

[8] This table provides a target for new wood heating systems and cold climate heat pumps for residential and commercial structures in the municipality for each target year. This target

(Residential and Commercial)			
	2025	2035	2050
New Efficient Wood Heat Systems (in units)	3	1	23
New Heat Pumps (in units)	79	202	384

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

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

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

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

Transportation Efficiency

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

Gasoline and diesel account for more than a quarter of all energy consumed in Vermont across all energy sectors. Gasoline and diesel consumption 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.

was calculated using data from LEAP and ACS.

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

One component of reducing fossil fuel based energy used in the transportation sector is to convert or replace older vehicles with alternative fuel vehicles such as electric or biodiesel. Table 9 identifies the targets for the number of new electric or biodiesel vehicles over each of the target years to help Middlesex 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[9]

	2025	2035	2050
Electric Vehicles	127	877	1,751
Biodiesel Vehicles	221	410	665

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

Conservation and efficiency of electricity is a key component to achieving the state's comprehensive energy planning goals. Over time, advancements in technology will provide a degree of the needed efficiency and conservation measures to achieve these goals, but also, efforts can be taken now to ensure the Town of Middlesex 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.

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

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

Energy Efficient Design

It is much more 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.

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.

Renewable Energy

The Town of Middlesex actively supports the use and development of renewable energy. Specifically, through 2016 renewable energy generation

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

installations create approximately 345 megawatt hours of energy each year. This includes a mix of solar and wind. This allocation of renewable energy generation will help the Town meet their renewable energy goals. The specific breakdown of renewable energy generation is outlined in Table 11. Table 13 also provides a breakdown of existing renewable energy generation and identifies those sources generating 8 kW or more.

Table 11 Existing Renewable Energy Generation[11]		
Renewable Type	MW	MWh
Solar	0.518	673.4[12]
Wind	0.095	190[13]
Hydro	0.933	4,105.2[14]
Biomass	0.00	0.00
Other	0.00	0.00
Total Existing Generation	**1.546**	**4,968.6**

Hydroelectric

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

There is currently one hydroelectricity facility located at the Wrightsville Beach Recreation District in Middlesex. The dam has a capacity of 933 kW and was installed in December of 1982, primarily as a means of flood control for the City of Montpelier. The dam is currently operated by Washington Electric Cooperative, since their lease in 1989. This dam provides the area municipalities with hydroelectric power, and additional recreation activities such as boating, paddling, swimming and disc golf at Wrightsville Beach.

[11] This Table shows existing renewable generation in the municipality, in MW and MWh, based on information available from the Vermont Department of Public Service.
[12] Generation capacity from VT Community Energy Dashboard, output calculated assuming a 14-16% capacity factor and a 1,300:1 MWh to installed MW capacity for solar, as issued by the PUC.
[13] Generation capacity from VT Community Energy Dashboard, output calculated assuming a 20-25% capacity factor and a 2,000:1 MWh to installed MW capacity for small wind, as issued by the PUC.
[14] Generation capacity from VT Community Energy Dashboard; Output calculated assuming a 40-60% capacity factor and 4,400:1 MWh to installed MW capacity for small hydro, as issued by the PUC.

Due to the environmental impact of damming these sites for the small generation boost, there are no plans in place at this time to develop further hydroelectricity in Middlesex.

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.

As of 2018, solar collectors were installed at approximately 72 sites in Middlesex with a total photovoltaic capacity of 518 kW. This number derives from numerous, dispersed residential scale solar projects.

Middlesex has made great strides to incorporate solar energy into its energy portfolio. According to the Energy Action Network's Energy Dashboard, Middlesex ranks 31st among Vermont municipalities in total solar installation with 76 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, Middlesex has the capability to produce 1,291 MWh on rooftop solar alone. There is also the possibility of 1,017,562 MWh from ground mounted solar as well. Considering the goal of 11,140 MWh, Middlesex has sufficient land to meet the goal and keep lands conserved and in their current uses. 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 Middlesex, particularly for residents and businesses lacking south-facing rooftops or land.

Wind

Improvements in turbine technology in combination with federal and state subsidies have recently made investments in wind power more attractive across the country as well as in Vermont. The Vermont Energy Atlas identifies the possibility of generating 406,015 MWh of wind in Middlesex. Almost all sites are located on ridge lines in the western part of Town, which may conflict with the Town's plans for conserving areas on the Worcester 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 Middlesex'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. Middlesex 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. Middlesex will work to maintain consistency with these regional limits.

Wood

Historically, wood has been Vermont's, and Middlesex's, most abundant local energy source. Statewide residential firewood consumption grew from 275,000 cords per year in 1997 to 315,000 cords in 2008, a nearly 15% increase. Current use of cordwood for heating in Middlesex 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.

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

the adverse impacts of harvesting while regular maintenance of wood stoves and adherence to fire codes lessens the risk of accidental fires.

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

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

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 Middlesex. Table 7 identifies the amount of renewable energy generation (in megawatt hours) that the Town of Middlesex 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. It is clear that there is adequate land area available for Middlesex 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 Middlesex 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.

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

Table 12

Potential Renewable Energy Generation[15]

Renewable Type	MW	MWh
Rooftop Solar	1.05	1,291
Ground-mounted Solar	829.71	1,017,562
Wind	132.43	406,015
Hydro	0.00	0
Biomass and Methane	0.00	0
Other	0.00	0
Total Renewable Generation Potential	**963.19**	**1,424,868**

Table 13

Existing Renewable Energy Generation greater than or equal to 8 kW based on existing Certificates of Public Good[16]

Category	Sub Category	Electricity Type	Utility	Capacity kW
Solar	Ground-mounted PV: Tracker	Net Metered	Washington Electric Coop	15
Solar	Roof-Mounted PV	Group Net Metered	Washington Electric Coop	15

[15] Renewable generation potential is based on mapping completed by the regional planning commission that is based on the Municipal Determination Standards and associated guidance documents developed by DPS. The renewable generation potential is expressed in MW and MWh by the type of renewable resource (solar, wind, hydro, etc.).
[16] This data is available and updated regularly on the Vermont Community Energy Dashboard.

Table 13 Existing Renewable Energy Generation greater than or equal to 8 kW based on existing Certificates of Public Good				
Category	Sub Category	Electricity Type	Utility	Capacity kW
Solar	Ground-mounted PV: Tracker	Group Net Metered	Green Mountain Power	15
Solar	Ground-mounted PV	Net Metered	Washington Electric Coop	13.1
Solar	Roof-Mounted PV	Net Metered	Green Mountain Power	11.4
Solar	Roof-Mounted PV	Net Metered	Washington Electric Coop	11.4
Solar	Roof-Mounted PV	Net Metered	Washington Electric Coop	11.4
Solar	Ground-mounted PV	Net Metered	Washington Electric Coop	11.2
Solar	Ground-mounted PV	Net Metered	Green Mountain Power	11.2
Solar	Roof-Mounted PV	Net Metered	Green Mountain Power	11
Solar	Roof-Mounted PV	Net Metered	Washington Electric Coop	10.73
Solar	Ground-mounted PV	Net Metered	Washington Electric Coop	10
Solar	Ground-mounted PV	Net Metered	Washington Electric Coop	10
Wind	Small Wind	Net Metered	Vermont Electric Coop	9.5
Solar	Roof-Mounted PV	Net Metered	Washington Electric Coop	9.3
Solar	Roof-Mounted PV	Net Metered	Washington Electric Coop	8.25

Conclusion

As noted throughout this section, the Town of Middlesex faces 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 Middlesex 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 and Implementation Actions

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

A. Conservation and Efficiency

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

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Form an Energy Committee to supplement the Planning Commission's implementation of this plan and action as the community resource for weatherization needs.	Planning Commission, Selectboard	High 1 – 2 Years	An Energy Committee is created or Energy Coordinator appointed within the term of this plan.

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

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Provide information at Town Office and to zoning permit applicants on Vermont's Residential and Commercial Building Energy Standards, as well as Efficiency Vermont's promotional materials on data and financial incentives. [Town Plan Strategy 14]	Zoning Administrator, Town Staff	High/ Sustained 1 – 8 Years	Information will be provided at the municipal office and with the issuance of permits.

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

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Evaluate opportunities for landowners to keep lands in forest production use. [Town Plan Strategy 27]	Planning Commission	Medium 3 – 5 Years	Opportunities list is compiled and kept up-to-date, distributed on town website for public knowledge.

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

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Develop a plan to remove/ replace conventional streetlights with LED fixtures. [Town Plan Strategy 54]	Planning Commission and Road Department	High 1 – 3 Years	Planning Commission meets with Road Department to outline feasibility of replacement, and develops plan to implement.
2	Implement recommended upgrades to municipal buildings from completed energy audits. [Town Plan Strategy 55]	Planning Commission, Selectboard	High 1 – 3 Years	List of all upgrades will be compiled in one place, with costs and pay-back periods identified. In term of plan, at least 2 will be implemented.

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

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

Implementation Action		Responsibility	Priority/ Timeline	Measure of Success
1	Evaluate the feasibility of a commuter rail stop in Middlesex, with service to the employment hubs residents are already commuting to. [Town Plan Strategy 68]	Planning Commission	Medium 3 – 5 Years	3 public meetings (standalone or part of other meetings) are held within the term of this plan to invite residents to share their desires of commuter rail, and to meet with landowners in the immediate area.
2	Analyze current data, or conduct an inventory of ridership on the Waterbury Commuter to understand how many Middlesex residents ride it, and how often.	Planning Commission, Green Mountain Transit	Medium 3 – 5 Years	Planning Commission will work with GMT to attain ridership data and hold at least 1 public meeting (standalone or part of other meetings) to discuss this data.

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

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Continue to maintain the Park-And-Ride Facility at I-89 Exit 9. [Objective 35]	Selectboard	Sustained 1 – 8 Years	Park-And-Ride facility is maintained and utilization is kept high.
2	Explore various ways to support carpooling efforts through such campaigns as Way to Go and the Hitching Post.	Planning Commission	High 1 – 3 Years	Planning Commission will invite speakers to discuss options to increase carpooling to meetings.
3	Formalize a park-and-ride facility in the northern part of Town.	Planning Commission, Selectboard	Medium 1 – 6 Years	A park-and-ride facility is formally recognized by the State in the Northern part of Middlesex.
4	Reduce road extensions and upgrades from Class 4 roads through avenues appropriate to Middlesex.	Planning Commission, Selectboard	Medium 1 – 6 Years	Subdivision regulations are revised and adopted, or a road ordinance is adopted, to discourage further development of Class 4 roads.
5	Support regional efforts to bring improved broadband connectivity to Middlesex.	Planning Commission, Selectboard	High 1 – 3 Years	Regional efforts to bring broadband access to Town are supported.

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

Implementation Action		Responsibility	Priority/ Timeline	Measure of Success
1	Expand access to EV charging near the I-89 Exit 9 area, to incentivize electric vehicle use and economic development. [Town Plan Strategy 81]	Planning Commission, Selectboard	High 1 – 3 Years	EV charging is kept available in village, and expanded to 2 more stations in the surrounding area.

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

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Identify possible funding sources to pursue for road improvements that include bike/ped linkages between major hubs. [Town Plan Strategy 47]	Planning Commission, Selectboard	High/ Sustained 1 – 8 years	A list of possible funding sources is identified and funding is pursued on at least two projects during the term of this plan.
2	Consider the needs of the entire community and identify and expand possible off-road linkages for bike/ped travel in Middlesex. [Town Plan Strategy 49]	Planning Commission, Selectboard, Conservation Commission	Medium 1 – 5 Years	At least two public meetings are held during the term of this plan to identify the linkages missing in Middlesex and inventory outcomes for future use.

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 Middlesex.

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Collect data annually on current municipal vehicle fuel efficiency and incorporate these figures when considering the purchase of a new municipal vehicle.	Selectboard, Planning Commission, Energy Team	High 1 – 3 Years	Efficiency Standards will be a priority for the Selectboard when purchasing a new vehicle.

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

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

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Refine zoning bylaws to encourage increased density in the village center areas and to promote less development north of I-89. [Strategy 15]	Planning Commission, Zoning Administrator	Medium 3 – 5 Years	Zoning bylaws are amended and readopted to include language of increased density in the Village.

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 Middlesex.

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Consider State Designation Programs and other density-focused programs to target 80% of new housing in the Mixed Use, Medium Density Residential, and Village Zoning Districts (such as a Neighborhood Development Area). [Strategy 18]	Planning Commission, Selectboard, Zoning Administrator, and residents	High 1 – 4 Years	4 Public Meetings (standalone or part of other meetings) will be held on the topic of housing density, and where to accommodate growth. A list of options will be maintained.

D. Development and Siting of Renewable Energy Resources

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

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Hold a public meeting and invite current landowners with solar facilities to discuss the process of installing solar on their land, to inform future policies.	Planning Commission, Energy Team?	High 1 – 2 Years	List of landowners with solar is identified and invitations are sent to them; a meeting is held during the duration of this plan.

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

	Implementation Action	Responsibility	Priority/ Timeline	Measure of Success
1	Hold joint meetings with the Conservation Commission and other community groups to discuss important resources to protect in Middlesex.	Planning Commission, Conservation Commisison	High 1 – 3 Years	At least two meetings are held during the term of this plan to discuss locally important constraints.
2	With support from the regional planning commission, hold meetings to identify those qualities that make a site preferred in Middlesex.	Planning Commission, CVRPC (if needed)	High 1 – 4 Years	At least one meeting is held during the duration of this plan to get public engagement on sites appropriate for renewable energy generation.

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 Middlesex to evaluate the renewable energy generation options that are available to meet these goals.

To this end, maps were created for the Town of Middlesex that identify 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 Middlesex.

Existing Renewable Resource Generation

As noted in the Analysis and Targets section, Tables 11 and 13 identify the existing renewable generation for the Town of Middlesex. 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 2018. Projects that are currently under review are not included in these numbers therefore additional renewable energy generation may be developed that will not be noted in the total generation represented in Table 11 or 13.

Potential Renewable Energy Generation

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

Constraints

As part of this effort, the Central Vermont Regional Planning Commission has identified information for each municipality related to renewable energy

generation that includes an analysis and evaluation of resource areas within each municipality and how those resource areas are impacted by statewide and regionally identified constraints. In order to determine the impacts, an understanding of the constraints needs to be discussed.

For the purpose of this plan, constraints are separated into two main categories; known and possible. Known constraints are those areas where development of a renewable resource are very limited and therefore are not likely to occur. Known constraints that have been identified include:

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

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

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

In addition to the items listed above, the Regional Planning Commission, through its Regional Energy Committee, has identified additional constraints to be included for all the municipalities that were noted as being regionally significant. For the purposes of this mapping exercise, all 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

Methodology

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

As noted in Table 12 of the Analysis and Targets section, based on the solar, wind, and hydroelectric potential within Middlesex, approximately 1,424,868 megawatt hours of energy could be produced, well above the town's allocation of 11,140 megawatt hours by 2050 as noted in Table 7. The potential energy generation for the Town of Middlesex 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.

In order to generate the Town’s allocation of 11,140 MWh by 2050, the Town can plan for certain amounts of land needed to satisfy the goal. For example, if the Town chose to pursue solar as the primary generation type for the 2050 goal, they would need to install 8.57 MW of solar capacity in the Town. Figures provided by the Public Service Department suggest a conversion factor of 8 acres per installed megawatt, but recommend planning for 60 acres per installed megawatt to accommodate for landowners who may not wish to install solar. This provides Middlesex a range between 68.56 acres (0.2% of all land) and 514.2 acres (2.01% of all land) that would need to be utilized for solar production in order to meet the 2050 goal.

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 Middlesex 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

In October 2019, the Middlesex Planning Commission expressed a desire to protect those ridgelines that provide a scenic aesthetic in the western portion of Town. The Planning Commission has recognized the current constraints in place (State Protected Lands, Slopes Greater than 25%, Highest Priority Forest Block (Connectivity) and Hydric Soils) will discourage development on the Worcester Range. At this time, the Planning Commission is not identifying any additional local constraints, however it does intend to

plan for local constraints in the coming years, shortly after development of this plan is complete.

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 DEFINTIONS AND DESCRIPTIONS

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

Known Constraints

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

Vernal pools are temporary pools of water that provide habitat for distinctive plants and animals. Data was collected remotely using color infrared aerial photo interpretation. "Potential" vernal pools were mapped and available for the purpose of confirming whether vernal pool habitat was present through site visits. This layer represents both those 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

No local constraints have been identified as of the 12/13/2019 draft of this plan.