Chittenden County, Vermont
Multi-Jurisdictional
All-Hazards Mitigation Plan
2016-2021

Draft for Public Review, issued June 22, 2016

Send comments by July 11, 2016 to Dan Albrecht, CCRPC Senior Planner at dalbrecht@ccrpcvt.org or contact at 802-846-4490, *29

Prepared by

Celebrating Fifty Years 1966 - 2016
CHITTENDEN COUNTY RPC
Communities Planning Together
110 West Canal Street, Suite 202
Winooski, Vermont 05404
(802) 846-4490
www.ccrpcvt.org

Approved by FEMA Region One, effective _____

Executive Summary

The Chittenden County Regional Planning Commission (CCRPC) was founded in 1966 to promote the mutual cooperation of its 19 member municipalities and to facilitate the appropriate development and preservation of the physical and human resources in Chittenden County. The CCRPC provides planning and technical assistance in the areas of community development, transportation, agriculture, natural resources, housing, economic development, and emergency management to the 19 municipalities in the County and to the public. The collaboration between the CCRPC, the municipalities and other related resource agencies results in the development and implementation of plans that support sustainable development and improve the region's environment and quality of life.

The CCRPC has been actively engaged in hazard mitigation planning since 2003 and worked with its municipalities to craft the region's first hazard mitigation plan, the *Chittenden County Vermont Multi-Jurisdicational All-Hazards Mitigation Plan* approved by FEMA Region I in August 2005. The Plan includes as annexes, the official Local All-Hazards Mitigation Plans for all 19 of the municipalities in the County. The CCRPC prepared an update to this plan which was approved by FEMA Region I in August 2011 and worked to prepare this most current update which was approved by FEMA Region I in Month 2016.

Hazard Mitigation is a sustained effort to permanently reduce or eliminate long-term risks to people and property from the effects of reasonably predictable hazards. The purposes of this plan are to:

- Identify specific natural, technological and societal hazards that impact the communities of Chittenden County;
- Prioritize hazards for mitigation planning;
- Recommend regional level goals and strategies to reduce any losses from those hazards; and
- Establish a coordinated process to implement the plan, taking advantage of a wide range of resources.

This document represents the 3rd version of this Plan. This Plan along with the individual All-Hazards Mitigation Plans for the community's 19 municipalities seeks to further define and focus mitigation actions and incorporate lessons learned from actiual events. Starting in 2011, the County and its municipalities have experience have experienced more frequent flooding, fluvial erosion and intense rain storms compared to recent decades, many resulting in formally declared Federal disasters. These include the extensive Lake Champlain flooding in the spring of 2011, flooding and fluvial erosion in its upland towns in September 2011 as part of Tropical Storm Irene, and intensive rain storms and localized winter, ice storms in 2013 and 2015.

Compared to the 2005 and 2011 plans which included elements that were more aspirational, this Plan focuses more clearly on identifying strategies and projects that are considered likely to be implanted in the 2016-2021 timeframe. Therefore, this Plan identifies strategies and projects that are 1) anticipated to be, or highly likely to be, funded or 2) considered long-standing work program items. This Plan is also more cohesive as it was developed after the formal merger of the CCRPC with its former sister planning agency, the Chittenden County Metropolitan Planning Organization, the Federally-designated transportation planning agency for the region. The results

of this cohesion are best reflected in the inclusion of strategies jointly addressing transportation infrastructure and hazard mitigation. Last but not least, while the previous plans often included Prevention, Response and Recovery strategies, based upon guidance from FEMA, this Plan focuses almost exclusively on Mitigation strategies.

Development and adoption of the Chittenden County, Vermont, Multi-Jurisdictional All-Hazards Mitigation Plan and the Local All-Hazards Mitigation Plans that are attached as annexes flow from the *Federal Disaster Mitigation Act of 2000,* which authorizes a program for pre-disaster mitigation. Implementing regulations are found at *Title 44 Code of Federal Regulations Part 201 - Mitigation Planning.* Per Federal regulation, a local mitigation plan is a representation of the municipality's commitment to reduce risks from hazards and serves as a guide for decision makers as they commit resources to reducing the effects of hazards.

In order to become eligible to receive various forms of Federal hazard mitigation grants, a Chittenden County municipality must formally adopt this Multi-Jurisdictional All-Hazards Mitigation Plan along with that municipality's Local All-Hazards Mitigation Plan Annex, or develop and adopt an independent, stand-alone Local All-Hazards Mitigation Plan.

Section 1: Introduction and Purpose explains the purpose, benefits, implications, and goals of this plan. This section also describes the county and its municipalities. It discusses issues identified in the development of this plan, and describes the planning process used to develop the plan.

Section 2: Hazard Identification discusses potential hazards in the County and the risks associated with these hazards. These include Natural Hazards, Technological Hazards and Societal Hazards.

Section 3: Risk Assessment profiles likely hazards with known and designated geographical distribution, such as flood hazard areas, and then reviews previous federally-declared disasters as a means to identify what risks are likely in the future. A hazard risk assessment for the county as a whole is presented which identifies the most significant and most likely hazards. These profiled hazards, in order of severity of risk by category are as follows

Natural Hazards

- Winter Storm
- Severe Rainstorm
- Flooding
- Extreme Temperatures
- Fluvial Erosion
- Wildfire

Technological Hazards

- Hazardous Materials Incident
- Water Pollution
- Power Loss
- Multi-Structure Fire
- Invasive Species
- Major Transportation Incident
- Sewer Service Loss
- Water Supply Loss

- Natural Gas Service Loss
- Telecommunications Failure
- Other Fuel Service Loss

Societal Hazards

- Economic Recession
- Terrorism
- Crime
- Epidemic
- Civil Disturbance
- Key Employer Loss

Section 4: Vulnerability Assessment discusses buildings, critical facilities and infrastructure in designated hazard areas and the issue of estimating potential losses as well as addressing vulnerable populations. It also examines land use and development trends related to mitigation.

Section 5: Mitigation Strategies is the heart of this All-Hazards Mitigation Plan. This section begins with an overview of goals and policies of the Chittenden County Regional Planning Commission that support hazard mitigation. This is followed by an extensive analysis of existing municipal level actions that support hazard mitigation such as planning and zoning, emergency services and public works. The section presents the following seven All-Hazards Mitigation Plan Goals:

1) Hazard mitigation planning should take into account the multiple risks and vulnerabilities of the significant hazards in the County due to its mixed urban-suburban-rural nature, its economic importance to the State and its significant presence of public and private infrastructure.
2) Promote awareness amongst municipalities, residents and business in the county of the linkages between the relative frequency and severity of disaster events and the design, development, use and maintenance of infrastructure such as roads, utilities and stormwater management and the planning and development of various land uses.
3) Ensure that regionally-initiated mitigation measures are consistent with municipal plans and objectives and the capacity of municipalities to implement them.
4) Encourage municipalities to formally incorporate their individual Local All-Hazards Mitigation Plan into their municipal plan as described in 24 VSA, Section 4403(5), as well as incorporate their proposed mitigation actions into their various bylaws, regulations and ordinances, including, but not limited to, zoning bylaws and subdivision regulations and building codes.
5) Encourage municipalities to formally incorporate elements of their Local All-Hazards Mitigation Plan, particularly their recommended mitigation strategies, into their municipal operating and capital plans & programs, especially, but not limited to, as they relate to public facilities and infrastructure, utilities, highways and emergency services.
6) Educate regional entities on the damage to public infrastructure resulting from all hazards and work to further incorporate hazard mitigation planning into the regional land use and transportation planning program conducted by the Chittenden County Regional Planning Commission.

7) Maintain existing mechanisms, develop additional processes, or explore funding mechanisms and sources to foster regional cooperation in hazard mitigation, specifically and emergency management planning, generally.

#1- Assist municipalities with development of plans, policies and land development regulations that mitigate against the following Hazards [Severe Rainstorm; Flooding; Fluvial Erosion and Water Pollution] and their associated Vulnerabilities [Damage to public infrastructure; Temporary road and bridge closure; Temporary power or telecommunication loss; Temporary isolation of vulnerable individuals and Budgetary impacts].

#2 Promote hazard mitigation projects in Tactical Basin Plans and flood resiliency planning to mitigate against the following Hazards [Severe Rainstorm; Flooding; Fluvial Erosion and Water Pollution] and their associated Vulnerabilities [Damage to public infrastructure; Temporary road and bridge closure; Temporary power or telecommunication loss; Temporary isolation of vulnerable individuals and Budgetary impacts].

#3 Assist municipalities to develop and improve infrastructure that mitigates the following Hazards [Severe Rainstorm; Flooding; Fluvial Erosion and Water Pollution] and their associated Vulnerabilities [Damage to public infrastructure; Temporary road and bridge closure; Temporary power or telecommunication loss; Temporary isolation of vulnerable individuals and Budgetary impacts].

#4 Assist municipalities in protecting people, building and facilities where development already exists in vulnerable areas to mitigate against the following Hazards [Flooding and Fluvial Erosion] and their associated Vulnerabilities [Damage to private homes and businesses].

#5 Assist municipalities in promoting growth in appropriate locations and transportation infrastructure planning to mitigate against the following Hazard [Economic Recession] and its associated Vulnerabilities [Increased unemployment and Decreased tax base].

#6 Assist municipalities in meeting standards to minimize required municipal share towards FEMA Public Assistance project costs to mitigate against the Vulnerability of Budgetary Impacts incurred when FEMA Public Assistance projects are implemented.

These strategies are intended to assist municipalities in both mitigating against likely natural, technological and societal hazards and addressing the weaknesses present at both the regional and municipal level which hinder effective mitigation.

Section 6: Plan Maintenance outlines how the plan will be adopted and how it will be reviewed and updated over the next five years.

The Appendices include:

- Adoption and approval documentation,

- A summary of potential mitigation funding sources for various hazards, and
- A glossary of useful websites and references.

The Annexes include all of the Municipal All-Hazards Mitigation Plans adopted as of MONTH, DAY, 2016.

Acknowledgements

[Update as needed in summer 2016]: The preparation of this *2016 Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan* would not have been possible without funding support and the efforts and assistance of many people.

The Chittenden County Regional Planning Commission (CCRPC) wishes to acknowledge the funding provided by the Federal Emergency Management Agency (FEMA) through the Vermont Department of Emergency Management and Homeland Security (VDEMHS) (HMGP Grant #), with supplemental funding from an emergency management planning grant funding from DEMHS (EMPG Grant) and FY16 and FY17 Regional Block Grants from the Vermont Agency of Commerce & Community Development.

CCRPC acknowledges the numerous municipal officials and staff who provided information and reviewed the Multi-Jurisdictional All-Hazards Mitigation Plan and the Municipal Annexes. Useful information was also provided from staff of the Vermont Agency of Transportation, the Vermont Agency of Natural Resources, and the US Coast Guard. Thanks go to CCRPC Commissioners and members of the Local Emergency Planning Committee #1 who reviewed and provided comments. CCRPC appreciates the advice and critique provided by Lauren Oates at DEMHS and Holly Dominie, Marilyn Hilliard, Nan Johnson and _____ at FEMA Region 1.

Special thanks go to the members of the Plan Review/Update Committee who meet several times in 2015 and 2016 and provided strategic review and comments throughout the process. Members of the Committee were as follows:

MUNICIPALITY	MEMBER
Bolton	Sharon Murray
Buel's Gore	Ryan McLaren
Burlington	Seth Lasker
Charlotte	Jeannine McCrumb, Daryl Benoit
Colchester	Sarah Hadd
Essex	Gregory Duggan
Essex Junction	Robin Pierce
Hinesburg	Al Barber
Huntington	Everett Marshall
Jericho	Todd Odit
Milton	Roger Hunt
Richmond	Clare Rock
St. George	Barbara Young
Shelburne	
South Burlington	Paul Conner
Underhill	Rachel Fifield
Westford	Melissa Manka
Williston	Ken Belliveau
Winooski	Dave Bergeron

ORGANIZATION	MEMBER
Local Emergency Planning Committee #1	Al Barber
Chittenden County RPC	Chris Shaw
Vermont Agency of Natural Resources	Staci Pomeroy
Vermont Dept. of Emergency Management & Homeland Security	Ray Doherty / Lauren Oates

Primary CCRPC staff responsible for preparing the *2016 Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan and the 18 annexed municipal AHMPs* included Dan Albrecht, Senior Planner, who served as project manager and Lee Krohn, Senior Planner and Emily Nosse-Leirer, Planner. Other CCRPC staff contributed towards completion of the plan as well. GIS analysis and maps were prepared by Pam Brangan, GIS Data and IT Manager and Melanie Needle, Senior Planner. Regina Mahony, CCRPC Planning Program Manager and Charlie Baker, CCRPC Executive Director, provided overall supervision.

Table of Contents

List of Tables

List of Maps

(to be finalized after VDEMS& FEMA review and public comment)

Appendices

Annexes

Municipal All-Hazard Mitigation Plans

Annex #	Municipality
1	Bolton (Town)
2	Buels Gore (Gore)
3	Burlington (City)
4	Charlotte (Town)
5	Colchester (Town)
6	Essex (Town) / Essex Junction (Village)
7	Hinesburg (Town)
8	Huntington (Town)
9	Jericho (Town)
10	Milton (Town)
11	Richmond (Town)
12	St. George (Town)
13	Shelburne (Town)
14	South Burlington (City)
15	Underhill (Town)
16	Westford (Town)
17	Williston (Town)
18	Winooski (City)

SECTION 1 INTRODUCTION AND PURPOSE

1.1 Purpose and Scope of this Plan

The purpose of this *Multi-Jurisdictional All-Hazards Mitigation Plan (MJAHMP)* is to assist municipalities in Chittenden County with identification of the diverse hazards facing their community and with the identification of strategies and actions to reduce the impact of those hazards. Detailed goals and mitigation strategies for the county as a whole are presented in Section 5 of this document.

The goal of this plan is provide hazard mitigation strategies to aid creation of disaster resistant communities throughout Chittenden County. There are nineteen individual municipalities in the County. However, for the purposes of creation of a Local All-Hazards Mitigation Plan, the communities of Essex and Essex Junction are adopting the same document. The local AHMPs are attached as Annexes to this Plan.

Table 1-1 Municipalities of Chittenden County and Plan annex number

Municipality	Annex # to MJAHMP
Town of Bolton	1
Buels Gore	2
City of Burlington	3
Town of Charlotte	4
Town of Colchester	5
Town of Essex / Village of Essex Junction	6
Town of Hinesburg	7
Town of Huntington	8
Town of Jericho	9
Town of Milton	10
Town of Richmond	11
Town of Shelburne	12
Town of St. George	13
City of South Burlington	14
Town of Underhill	15
Town of Westford	16
Town of Williston	17
City of Winooski	18

Changes in 2016 Update

It is important to note that this MJAHMP along with it annexed local AHMPs constitute an Update to the 2011 Plans. By and large, this 2016 MJAHMP and the local AHMPs follow the same format as the 2011 Plan. Therefore, most of the updates were to statistical data, tabular data and to maps based upon the best available information in 2015 and 2016 while this work was being done. However, based upon FEMA feedback as well as the desires of CCRPC and its municipalities, substantial improvements and/or changes were made to key sections as follows:

Table 1-1 Sections of Plan with substantial changes (table to be updated after initial comment by VDEMHS)

Section with substantial improvement or changes	Comments
Page	
Page 5	Added geography
Page 3xx	Describe changes in hazard definition
Page	Clarified text regarding Fluvial Erosion hazards and River Corridors
Page	

1.2 Hazard Mitigation

The *2013 Vermont State All-Hazards Mitigation Plan* defines and describes hazard mitigation as

> any sustained action that reduces or eliminates long-term risk to people and property from natural and human-caused hazards and their effects. Based on the results of previous efforts, FEMAand state agencies have come to recognize that it is less expensive to prevent disasters than to repeatedly repair damage after a disaster has struck. This plan recognizes that communities have opportunities to identify mitigation strategies and measures during all of the other phases of emergency management:preparedness, mitigation, response, and recovery. Hazards cannot be eliminated, but it is possible to determine what the hazards are, identify where the hazards are most severe, and identify actions that can be taken to reduce the severity of the hazard.

This *Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan* accepts this definition of hazard mitigation.

Hazard mitigation strategies and measures can reduce or eliminate the frequency of a specific hazard, lessen the impact of a hazard, modify standards and structures to adapt to a hazard, or limit development in identified hazardous areas.

1.3 Hazard Mitigation Planning Required by the Disaster Mitigation Act of 2000

Hazard mitigation planning is the process that analyzes a community's risk from natural hazards, coordinates available resources, and implements actions to reduce risks. According to 44 CFR Part 201, Hazard Mitigation Planning, this planning process establishes criteria for State and local hazard mitigation planning authorized by Section 322 of the Stafford Act as amended by Section 104 of the *Disaster Mitigation Act of 2000*. Effective November 1, 2003, local governments must have an approved local mitigation plan in order to receive approval of a local mitigation project funded through federal Pre-Disaster Mitigation funds. Furthermore, the State of Vermont is required to adopt a State Pre-Disaster Mitigation Plan in order for Pre-Disaster Mitigation funds or grants to be released for either a state or local mitigation project after November 1, 2004.

There are several implications if this All-Hazards Mitigation Plan is not adopted.

- After November 1, 2004, Hazard Mitigation Grant Program (HMGP) funds will be available only to communities in states that have approved mitigation plans.
- After November 1, 2004, Flood Mitigation Assistance Grant Program (FMAGP) funds will be available only to communities that have adopted a local Plan
- For disasters declared after November 1, 2004, a community without a plan is not eligible for HMGP project grants but may apply for planning grants under the 7% of HMGP available for planning.
- For the Pre-Disaster Mitigation (PDM) program, a community may apply for PDM funding but must have an approved plan in order to receive a PDM project grant.
- Effective in November 2014, the State covers only 7.5% of a community's Public Assistance disaster costs, via the Emergency Relief Assistance Funds, to a community without an approved AHMP compared to 12.5% to 17.5% for those communities that do have an approved AHMP.

1.4 Benefits

Adoption and maintenance of this Plan will:

- Make certain funding sources available to complete the identified mitigation initiatives that would not otherwise be available if the plan was not in place.
- Maximize the contribution from the State to municipalities under the Emergency Relief Assistance Fund.
- Ease the receipt of post-disaster state and federal funding because the list of mitigation initiatives is already identified.
- Support effective pre- and post-disaster decision making efforts.
- Lessen each local government's vulnerability to disasters by focusing limited financial resources to specifically identified initiatives whose importance has been ranked.

- Connect hazard mitigation planning to municipal comprehensiveplanning and municipal emergency management planning where possible.

1.5 Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan Goals

The Chittenden County Regional Planning Commission (CCRPC) staff, in conjunction with its Commissioners and Local Emergency Planning Committee (LEPC) #1, developed the following regional-level goals to guide hazard mitigation for the county as a whole and for its municipalities. These goals were first developed for the 2005 plan continued in the 2010 plan and, after being reviewed by the Review Update Committee, have been minimally changed for this 2016 update.

1) Hazard mitigation planning should take into account the multiple risks and vulnerabilities from the most significant hazards in the County due to its mixed urban-suburban-rural nature, economic importance to the State and the significant presence of public and private infrastructure.
2) Promote awareness amongst municipalities, residents and business in the county of the linkages between the relative frequency and severity of disaster events and the design, development, use and maintenance of infrastructure such as roads, utilities and stormwater management and the planning and development of various land uses.
3) Ensure that regionally-initiated mitigation measures are consistent with municipal plans and objectives and the capacity of municipalities to implement them.
4) Encourage municipalities to formally incorporate their individual Local All-Hazards Mitigation Plan into their municipal plan as described in 24 VSA, Section 4403(5), as well as incorporate their proposed mitigation actions into their various bylaws, regulations and ordinances, including, but not limited to, zoning bylaws and subdivision regulations and building codes.
5) Encourage municipalities to formally incorporate elements of their Local All-Hazards Mitigation Plan, particularly their recommended mitigation strategies, into their municipal operating and capital plans & programs, especially, but not limited to, as they relate to public facilities and infrastructure, utilities, highways and emergency services.
6) Educate regional entities on the damage to public infrastructure resulting from all hazards and work to incorporate hazard mitigation planning into regional land use and transportation planning, such as the 2018 update to the Chittenden County Regional Plan,
7) Maintain existing mechanisms, develop additional processes, and explore funding mechanisms and sources to foster regional cooperation in hazard mitigation, specifically and emergency management generally.

1.6 Characteristics of Chittenden County

Chittenden County is Vermont's most populous county. It serves as the economic center for northwest Vermont with numerous large and small businesses. It is home to the state's largest

medical facility, Fletcher Allen; the largest employer, IBM; the largest educational facility, the University of Vermont, and the largest cultural facilities and visitor services. The combination of cultural, social, economic and political forces at work here is perhaps the most complex in Vermont and has led to considerable change in the county.

The County is also geographically diverse. (See Map X) Its western border is formed by Lake Champlain, which is…….. The Lake is a linchpin to the regional tourism industry attracting domestic and foreign visitors interested in experiencing its natural beauty and history and its recreational opportunities. The Lake also serves as the primary source of drinking water for a large portion of the county. The other major defining features are the Winooski River and the Lamoille River that flow east to west across the County before empyting into Lake Champlain. Both of these rivers originate in northeast Vermont totaling respectively xxxx and xxxx miles long. The flow of both is restricted by various private electricity generating dams. Flowing into these two major rivers as well as directly into Lake Champlain are tributaries and smaller rivers such as the Browns River, the Huntington River and the LaPlatte River as well as numerous streams and creeks.

The communities along the Lake from Milton south to Charlotte are relatively flat in general although localized topography is often more variable. Moving eastward the landscape shifts with only the areas of river bottom being flat with the foothills of the Green Mountains becoming the defining feature. The easternmost communities of Bolton, Huntington, Buels Gore along with portions of Hinesburg, Underhill and Jericho are part of the Green Mountains and therefore these "uplands" or "hill country" are visibly emblematic of "postcard Vermont."

While Lake Champlain, local waterways, agriculture lands, forests and the Green Mountains provide natural and aesthetic value to the region, they also set the stage for the types of natural hazards common in the County. Inundation from flooding occurs along Lake Champlain and the major rivers while fluvial erosion occurs not only along the major rivers but on numerous smaller rivers, creeks and streams that are widely distributed throughout the County. Severe rainstorms and severe winter storms can occur anywhere. However, their effects are most dramatic in the upland communities as gravel roads can be easily washed out by the sudden influx of rain or closed by downed, ice-heavy branches and trees or massive snowloads.

These natural resources especially Lake Champlain and local rivers and streams also represent a responsibility to the municipalies and its residents and businesses. Proper long term management towards sustainability of these resources can be and are threatened by technological, man-made hazards such as water pollution or hazardous materials.

Map 1-1 illustrates the diversity of land uses in the county. Residential, commercial, industrial and institutional uses are concentrated in the core urban and suburban communities of Burlington, Winooski, South Burlington, Williston, Shelburne, Essex, Essex Junction, Colchester and Milton. *Map 1-2* shows the distribution of housing and businesses in the county. Rural populations are scattered along the road system with limited pockets of density at village locations. Farming operations (dairy, beef, horse, vegetables, etc.) are distributed throughout the County although they are more prevalent in the towns of Milton, Colchester, Westford, Charlotte, Richmond, Hinesburg, Huntington, Jericho and Underhill.

Over the past 45 years, residents have seen the area around Burlington transform from farmlands to an urban and suburban landscape supported by a service and manufacturing economic base; however, according to the National Land Cover Datasets, over 80 percent of the county still remains as undeveloped forests and farmland.

Map X depicts the planning areas identified in the 2013 Chittenden County Regional Plan, also known as the ECOS – Environment, Community, Opportunity, and Sustainability.

> *The ECOS Plan uses the Planning Areas concept to identify places that share similar existing features and future planning goals. The Planning Areas reflect current municipal zoning. In addition, the scenario exercise described in Section 3.1 showed public support for growth in line with these Planning Areas. The Planning Areas aim to describe the appropriate type of future growth expected in each Planning Area; however the exact uses and densities allowable are determined by local ordinances. The Planning Areas also aim to illustrate a regional picture of future land use policies in the County necessary to promote a regional conversation about land use in Chittenden County municipalities. The six Planning Areas are depicted on the Future Land Use Plan Map. They are Center, Metro, Suburban, Village, Rural, and Enterprise.*
>
> ***Center Planning Areas** are intended to be regional centers or traditional downtowns that serve the County and beyond and contain a mix of jobs, housing, and community facilities. Center Planning Areas also contain the County's highest density and largest-scale developments with residential densities generally ranging from 7 to more than 60 dwelling units per acre. Center Planning Areas may contain a state designated New Town Center, Growth Center, Tax Increment Financing District, or high density Village Center. Development in downtown centers primarily happens through infill development of underutilized vacant land and adaptive reuse of older structures whereas, development in municipal growth centers occurs in targeted areas that will accommodate future anticipated growth. These land uses are locally planned and managed to coexist successfully with neighborhoods and natural areas. Places within Center Planning Areas are served by wastewater facilities, other infrastructure, and offer a variety of transportation options, including non-motorized modes*
>
> ***Metro Planning Areas** are areas where local zoning authorizes places to accommodate jobs and housing in a compact development pattern that supports transit service and encourages pedestrian activity and are within the sewer service area. Commercial land uses found in the Metro Planning Area are intended to serve the nearby residential area. Existing densities within Metro Planning Areas are typically higher than those found in the Suburban, Rural, Village, and Enterprise Planning Areas and generally range between 4 and 20 dwelling units per acre. Future development in the metro area should be encouraged to occur at the higher end of this range to ensure that there are adequate housing and jobs in these areas.*
>
> ***Suburban Planning Areas** are areas near a Center Planning Area, Metro Planning Area, Village Planning Area, or Enterprise Planning Area where local*

zoning authorizes future development to occur at scales, densities, and uses compatible with existing development and with general residential densities greater than 1 and less than 4.5 dwelling units per acre. Many parts of the Suburban Planning Area already have been developed, often in suburban styles of development and are predominantly within the sewer service area. Future development and redevelopment in this Planning Area should be publicly sewered, minimize adverse impacts on natural resources, and protect strategic open space.

Enterprise Planning Areas *are areas where local zoning authorizes a future concentration of employment uses that attract workers from the County and multi-county region. Development in these Planning Areas should have adequate wastewater capacity and access to transit or be near these services. Typically, this area encompasses major employers or a cluster of single employers and has current or planned transit service.*

Village Planning Areas *are areas where local zoning authorizes a variety of future residential and nonresidential development at densities and scales in keeping with the character of a Vermont village, generally between 2 and 12 dwelling units per acre if sewered and between 0.2 and 4 units per acre if not sewered. Village Planning Areas are compact areas of mixed-use activities that maintain the character of a Vermont village. This type of Planning Area is intended to serve its local surroundings as a place where people can live, work, shop and recreate.*

Rural Planning Areas *are areas where regional and town plans promote the preservation of Vermont's traditional working landscape and natural area features. The Rural Planning Area also provides for low density commercial, industrial, and residential development (generally 1 dwelling unit per acre or less) that is compatible with working lands and natural areas so that these places may continue to highlight the rural character and self-sustaining natural area systems. Development in the rural planning areas is typically outside the sewer service area.*

Tables 1-2 and *1-3* show selected demographic characteristics and trends for Chittenden County.

Table 1-2 Total county population, median age and percentage of elderly and youth, 2010 US Census

Category	Amount	%
Total Population	156,545	--
Median Age	36.2 years	--
Population age 65 years and over	17,685	11.3
Population (and %) under 18 years old	31,313	20
Population (and %) in group quarters	9,795	6.3

Table 1-3 Housing unit composition in Chittenden County, Vermont Housing Data 2010 US Census

Category	Number	%
Total Housing Units	65,722	--
Occupied housing units	61,827	94
Vacant housing units	3,895	5.9
Vacant housing units used for seasonal, recreational or occasional use	1,779	2.7
Detached 1-unit housing units (check American Fact Finder	xxxx	55.8
Housing units with 5 or more units in structure (switch to 3 units)	XXXX	15.6
Mobile homes	2,484	3.7
Housing structures built in 1939 or earlier	12,355	21.0

1.7 Characteristics of Chittenden County Municipalities

The characteristics of each of Chittenden County's municipalities reflect varying urban, suburban and rural landscapes and associated population densities. Table *1-4* shows the population distribution of municipalities in the county.

Table 1-4 Chittenden County population by municipality,US Census count and estimates

	1960	1970	1980	1990	2000	2010	2014
BOLTON	237	427	715	971	971	1,182	1,191
BUEL'S GORE	0	10	9	2	12	30	30
BURLINGTON	35,531	38,633	37,712	39,127	39,815	42,417	42,211
CHARLOTTE	1,271	1,802	2,561	3,148	3,569	3,754	3,856
COLCHESTER	4,718	8,776	12,629	14,731	16,986	17,067	17,384
ESSEX*	7,090	10,951	14,392	16,498	18,626	19,587	20,724
HINESBURG	1,180	1,775	2,690	3,780	4,340	4,396	4,497
HUNTINGTON	1,425	748	1,161	1,609	1,861	1,938	1,986
JERICHO	1,425	2,343	3,575	4,302	5,015	5,009	5,074
MILTON	2,022	4,495	6,829	8,404	9,479	10,352	10,667
RICHMOND	1,303	2,249	3,159	3,729	4,090	4,081	4,129
SHELBURNE	1,805	3,728	5,000	5,871	6,944	7,144	7,736
SO. BURLINGTON	6,903	10,032	10,679	12,809	14,888	17,904	18,743
ST. GEORGE	108	477	677	705	698	674	708
UNDERHILL	730	1,198	2,172	2,799	2,980	3,016	3,067
WESTFORD	680	991	1,413	1,740	2,086	2,029	2,085
WILLISTON	1,484	3,187	3,843	4,887	7,650	8,698	9,215
WINOOSKI	7,420	7,309	6,318	6,649	6,561	7,267	7,228
COUNTY	75,332	99,131	115,534	131,761	146,571	156,545	160,531
* Essex and Essex Junction, combined							
April 1 Census Counts for 1960, 1960, 1980, 1990, 2000 and 2010.							
July 1 Estimates for 2014.							

Larger municipalities such as Burlington, Winooski, Colchester, Essex, Essex Junction, Milton, Shelburne, South Burlington and Williston have relatively large professional staffs and provide a wide range of municipal services such as planning and zoning, recreation, highways, libraries, water, sewer, fire, rescue and police. In contrast, small rural municipalities such as Bolton, Buels Gore, and St. George support only a very few part-time employees such as a municipal clerk and road foreman, and often contract for other services. Municipal government in the remaining communities commonly consist of a few full-time employees such as a municipal clerk, an administrative aide for the selectboard and a highway foreman and small crew, supplemented by part-time or seasonal employees for activities such as recreation programs or the municipal library.

This variation is particularly apparent in regards to Emergency Services. *Map 1-4* illustrates the location of emergency services facilities (fire stations, police stations, EMS/rescue stations, etc). Personnel for most of the county's Fire Departments are volunteers, who may or may not receive a small wage while actually responding to a call. Almost every municipality has a locally-based fire department, but only half have police departments. Even fewer have their own emergency medical services. Many of the smaller municipalities receive primary police services from the Vermont State Police (VSP) on an "as-needed" basis, but must "rent" traffic enforcement services from the Chittenden County Sheriff's office or from the VSP. These smaller municipalities may also receive responses from the police departments of neighboring municipalities depending upon the seriousness of the incident. *Table 1-5* below details how each of the County's municipalities receives their fire, police and EMS services:

Table 1-5 Provision of fire, police and EMS for municipalities within Chittenden County, Vermont, June 2015

Municipality	**Fire**	**Police**	**EMS**
Bolton	Bolton VFD; Underhill-Jericho FD	VT State Police	Richmond Rescue
Buels Gore	Starksboro VFD*	VT State Police	Richmond Rescue; Bristol Rescue*; Mad River/Waitsfield Rescue*
Burlington	Burlington FD	Burlington PD	Burlington FD/EMS; UVM Rescue
Charlotte	Charlotte VFD	VT State Police	Charlotte Rescue
Colchester	Colchester VFC, Mallets Bay VFD, St. Michael's Fire	Colchester PD	Colchester Rescue (inc. Colchester Tech. Rescue); St. Michael's Rescue
Municipality	**Fire**	**Police**	**EMS**
Essex	Essex VFD	Essex PD	Essex Rescue
Essex Junction	Essex Junction VFD	Essex PD	Essex Rescue
Hinesburg	Hinesburg VFD	Hinesburg PD	Hinesburg FD 1st Response; St. Michael's Rescue
Huntington	Huntington VFD	VT State Police	Huntington FD 1st Response; Richmond Rescue
Jericho	Underhill-Jericho FD	VT State Police	Essex Rescue; Richmond Rescue in south Jericho; Williston Rescue
Milton	Milton VFD	Milton PD	Milton Rescue
Richmond	Richmond VFD	Richmond PD	Richmond Rescue, UVM Rescue
St. George	Hinesburg VFD	VT State Police	Hinesburg FD 1st Response; St.

			Michael's Rescue
Shelburne	Shelburne VFD	Shelburne PD	Shelburne Rescue, UVM Rescue
South Burlington	S. Burlington FD	S. Burlington PD	S. Burlington FD/EMS, UVM Rescue
Underhill	Underhill-Jericho FD	VT State Police	Essex Rescue
Westford	Westford VFD	VT State Police	Essex Rescue; Fairfax Rescue*
Williston	Williston FD	Williston PD	St. Michael's Rescue & Williston FD/EMS
Winooski	Winooski VFD	Winooski PD	St. Michael's Rescue, UVM Rescue

**Service located outside Chittenden County Source: Municipal and Department Websites*

1.8 Chittenden County: relation to hazards

Chittenden County is the population and economic center for northwest Vermont. Due to the density of settlement and development relative to the rest of the state it has the highest number of residents and businesses that are vulnerable to various hazards. The most common natural hazards are annual severe rainstorms which regularly damage culverts and roads followed by either lake or river flooding which tend to impact homes and businesses.

In 2014 Chittenden County had a resident population of 160,531, which is about 25% of the state's total. Based upon an analysis of 2009-2013 American Community Survey data, during weekday work hours the county's population swells by approximately 22,000 additional workers from the 13 other counties in Vermont and two neighboring counties in New York.

In addition, Chittenden County is the most vulnerable to *societal hazards* due again to its relatively dense population and to its social and economic diversity. Finally, with the exception of Windham County, the site of the Vermont Yankee nuclear power plant, Chittenden County is the most likely to suffer damage to life and property from *technological hazards* due to the high number of residents dependent upon municipal and regional water, sewer, power, telephone and gas lines, as well as the high number of commercial and industrial facilities and their attendant storage for hazardous materials.

Chittenden County's position as Vermont's most populous county, and the county with the highest combined value of properties and buildings, is reflected in the most recent data available for the amount of public assistance funds provided by the Federal Emergency Management Agency to municipalities in response to Federally-declared disasters. **From January 1990 through June 2016 Chittenden County municipalities received more than $12,000,000 for public assistance from FEMA.** The funds were provided in response to sixteen disasters during that time period (see Section 3.3 for additional information on these disasters). Other incidents that did not rise to the level of a Federally-declared disaster have collectively caused hundreds of thousands to millions of dollars in damage to the county's municipalities. Some of these costs are detailed in tables in the Hazard Identification section of this plan.

1.9 Issues Encountered in the Development of the Plan

The diversity in municipal staffing also makes crafting a countywide Multi-Jurisdictional All-Hazards Mitigation Plan a significant challenge. Designated municipal Emergency Management Coordinators either serve in a volunteer capacity (especially Fire Chiefs) in addition to their

regular non-municipal job, or are paid municipal employees who have many other responsibilities. Due to these obligations, it is difficult to find time to address less pressing issues such as hazard analysis, database management and planning

Using grant funds, CCRPC is able to assist the county's municipalities by developing a multi-jurisdictional plan with municipal annexes consistentwith the desired 5-year updated schedule. However, CCRPC does not have sustained annual funding to conduct hazard mitigation planning or to conduct extensive analysis. Because of the major coordination issues required for Chittenden County's multi-jurisdictional emergency planning effort, a shortage of resources, and the volume of data that could be analyzed, the CCRPC is not able to conduct the level of analysis possible in Vermont's more rural, sparsely populated regions.

For example, Vermont Emergency Management identifies more than 300 distinct sites where hazardous materials are produced or stored in Chittenden County. Roughly 200 of these sites are known to store "Extremely Hazardous Substances", primarily toxic chemicals used for commercial and industrial purposes. The 2010 US Census identified more than 65,722 housing units in Chittenden County. To generate hypothetical loss estimates to structures from hypothetical toxic chemical releases would require weeks of staff time that exceed the CCRPC's current capacity. Therefore this plan does not engage in a "Potential Loss" analysis due to a hypothetical hazardous materials incident such as a train derailment or an industrial facility with a toxic chemicals fire, or hypothetical mass casualty incident such as a jetliner crash at Burlington International Airport.

1.10 Process for Preparing this Plan

1.10.1 Development of the 2005 & 2011 Chittenden County Multi-Jurisdictional All Hazards Mitigation Plans

Development of a hazard mitigation plan for Chittenden County and its 19 communities first began in 2003. Using FEMA and State funds, the CCRPC developed a Multi-Jurisdictional All Hazards Mitigation Plan for the County along with Local All Hazards Mitigation Plans for the 19 communities attached as annexes. This first plan was approved by FEMA Region One on June 8, 2005. Using a FEMA and State funds, the CCRPC prepared an update of the Multi-Jurisdictional All Hazards Mitigation Plan from 2009 to 2011 and this Plan was approved by FEMA Region One on August 8, 2011.

1.10.2 Development of the 2016 Chittenden County Multi-Jurisdictional All Hazards Mitigation Plan

1.10.2.1 Staffing and funding complications

After adoption of the Plan by FEMA in August 2011, little action took place with regards to Plan maintenance due in large part to fluctuations in staffing at the CCRPC and the lack of dedicated funding for hazard mitigation planning. The two primary staff persons who had worked on the 2011 Update, Julie Potter and Clare Leonard, left the CCRPC in 2013 and 2014, respectively. CCRPC did have an Emergency Management Planner on staff, Paul Luciano, however his position was only funded to 20 hours per week and his duties focused on management of the county's Local Emergency Management Planning Committee (LEPC-#1), development of

Emergency Operations Plans and Hazardous Materials Emergency Plans and assistance to homeowners impacted by various disasters.

In 2013, CCRPC belatedly began efforts to monitor progress on the 2011 Plan. Staff distributed copies of the Strategies section of each 2011 local AHMP to municipal staff and asked them to report progress on each task from their respective annex. Only five of eighteen municipalities responded.

However, well in advance of the August 2016 expiration, CCRPC, began to plan for the 2016 update and indeed submitted a PDM grant application to FEMA in October 2013. The grant proposed an extensive updated process to be completed over a 2-year period. The grant was initially awarded by FEMA however in early 2014 FEMA announced they would not allow CCRPC's indirect costs to be covered with the grant.

Following this news, VDEMHS worked in the summer of 2014 with FEMA to obtain one large HMGP grant and then subcontract with individual RPCs as sole source vendors. This grant application was approved by FEMA Region One on December 29, 2014. This would have allowed CCRPC and other RPCs to cover their indirect costs. However in May 2015, FEMA Region expressed concerns over the "subgrantee" versus "contractor/subcontractor" relationship between VDEMHS and the RPCs. Additionally, in June 2015, the State of Vermont indicated that it had concerns of that an audit would not allow the 25% match requirement to have to be covered by the RPCs, aka the contractors. This chain of events finally led the State to reapply for Hazard Mitigation Grant Program funds and then subcontract with each individual RPC. However, the RPCs including CCRPC have had to absorb their indirect costs which in the case of CCRPC amounted to about 70-80 cents on the dollar. Fortunately, the State of Vermont agreed to cover the 25% match requirement so the financial impact to the RPCs was not made worse.

1.10.2.2 Preparation of 2016 Plan

This grant (FEMA Project Number: 02140-34000-106B) finally became active in July 2015 (albeit with an Advance Notice to Proceed effective April 1, 2015) and work began in earnest in the summer of 2015 on the process of updating the *Chittenden County Multi-Jurisdictional All Hazards Mitigation Plan*. CCRPC staff followed a similar process to the 2011 Plan in preparing this update.

CCRPC was first fortunate to obtain an informal review by Holly Dominie of FEMA Region I of the old 2011 Plan in May and June 2015 which offered several useful recommendations. CCRPC staff collected updated data, where available, for all tables and in-text factual information. Much of this data gathering exercise was carried out by Grant Troester, a summer intern provided by the University of Vermont's Rubenstein's School of Environmental and Natural Resources. The availability of updated GIS data for the maps was also assessed at this time. This data gathering effort included review of recent plans and studies, including:

- *2013 Vermont State All-Hazards Mitigation Plan*
- *2013 Chittenden County Regional Plan, aka the "ECOS" Plan*
- Current municipal plans and zoning bylaws

- Data from Federally-declared disasters
- Data from various sources such as the U.S. Census and the National Climate Data Center

1.10.2.3 Activities of Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan Update Committee.

In the spring of 2015, CCRPC re-established a Review/Update Committee. The Committee included representatives appointed by the governing body of each municipality and LEPC #1, along with representatives from Vermont Department of Emergency Management and Homeland Security and the Vermont Agency of Natural Resources. See the Acknowledgements for a list of members. [Update as needed in summer 2016]:

May 5, 2015	Winooski, VT	CCRPC offices
September 9, 2015	Winooski, VT	CCRPC offices
November 5, 2015	Winooski, VT	CCRPC offices
February 10, 2016	Winooski, VT	CCRPC offices
June 8, 2016	Winooski, VT	CCRPC offices
MONTH XX, 2016	Winooski, VT	CCRPC offices

Public notice of all of these meetings, pursuant to the Vermont Open Meetings Law, was provided on the CCRPC website at:

http://www.ccrpcvt.org/our-work/emergency-management/hazard-mitigation-plan/

In addition to the agenda, materials for the meeting were also posted in advance of the meeting and meeting minutes were posted within 5 business days. (See appendices for copies of the minutes).

Over the course of these Committee meetings, members addressed the following:

-reviewed the list of Risk Assessed hazards from 2011 and made additions, deletions and in some cases combined hazards

-reviewed the Risk Estimation matrices from 2011 and affirmed a general process of identifying and ranking hazards, then assess vulnerabilities and then develop strategies to deal with the hazards.

-debated and fine-tuned Risk Estimation for Natural, Technological and Societal Hazards.

-reviewed the strategies from the 2011 Plan, culled out strategies that are more properly considered Preparednesss, Response or Recovery and then developed strategies for the new Plan.

-reviewed and discussed feedback received from VDEMHS and FEMA

1.10.2.4 Activities of other County-based committees

In addition to the extensive discussion at the meetings of the broad-based AHMP Committee, this Plan, as well as to a lesser degree the template for the local AHMPs, were also discussed at Board meetings of the Chittenden County Regional Planning Commission, other CCRPC Committees beyond the AHMP Committee and other regional entities such as LEPC-#1. These meetings included the following:

CCRPC Board meetings @Winooski, CCRPC office (plus public access television)
April 15, 2015*
Month, XX 2016

* Included news story broadcast by local Fox44 TV station

CCRPC Committees (beyond AHMP Update Committee) @ Winooski, CCRPC office

March 11, 2015	Planning Advisory Committee
April 7, 2015	Transportation Advisory Commitee

Other entities

April 2, 2015	Chittenden County Mutual Aid	@ Town of Shelburne
April 14, 2015	Local Emergency Planning Committee #1	@ Winooski, CCRPC office
May 10, 2016	Local Emergency Planning Committee #1	@ Winooski, CCRPC office

Open public meetings were also held on:

June 29, 2016

Month Day 2016

1.10.2.4 Development of Local All-Hazards Mitigation Plans

In July 2015, CCRPC staff also began the process of updating the Local All-Hazards Mitigation Plans for the County's 19 municipalities. This direct work was split among three staff: Dan Albrecht, Lee Krohn and Emily Nosse-Leirer. Between July 2015 and extending into MONTH 2016, these staff carried out the following activities to produce various drafts of each local AHMP.

- CCRPC staff first provided copies to relevant municipal staff of the 2011 local plan along with separate copies of the Risk Estimation matrices from the Plan and the table showing 2011 strategies. These matrices and strategies were used to spark a conversation to (a) revisit the risk estimations (b) discuss hazard events since 2011 and (c) update the proposed strategies. Municipalities were also made aware of changes made by the Update Committee to the list of hazards.
- CCRPC staff consulted with municipal officials by email, telephone or in meetings to seek clarification and fill in any information gaps. These officials typically included managers/administrators, planners, public works, fire chiefs and police chiefs.

- CCRPC staff incorporated updated information from the municipalities in the draft municipal annex updates.
- Initial drafts of the municipal annexes were provided to appropriate municipal for review, followed by email, telephone and/or in-person discussion. Revisions were made based on this input.
- As requested by municipal staff, presentations were made as needed to municipal governing bodies and/or boards.

  Note: Details on who participated in each municipality's planning process is detailed in the respective local AHMP.

1.10.2.5 Opportunities for involvement in the planning process and formal public review

The CCRPC is a public agency and therefore is obligated to provide opportunities for the general public, neighboring communities, local, regional and state agencies, development regulation agencies and other interests to be involved in the development of this Plan and of the individual 18 annexed Local AHMPs.

With regard to this Multi-Jurisdictional All-Hazards Plan, the public, neighboring communities, agencies and interests named above were provided public notice of all the meetings noted in Section 1.10.2.3 above (with the exception of the Chittenden County Mutual Aid meeting) via the CCRPC website, www.ccrpcvt.org and via the CCRPC monthly newsletter. This newsletter is issued in the 3rd week of every month via Constant Contact ® to 1,700 email contacts consisting of approximately 600 municipal contacts (e.g. staff, members of local governing bodies, boards and commissions) and 1,100 others such as state and federal government agency staff, state and federal legislators, consultants, organizations and the general public.

Commencing with the June 29, 2016 evening public meeting held at the CCRPC and continuing through the Month Day, 2016, the CCRPC repeatedly advertised to the public the opportunity to submit comments by email, by mail or by phone on the draft Chittenden County Multi-Jurisdictional AHMP. Advertisements, notices included press releases, public service announcements, CCRPC's monthly newsletter and postings to the electronic bulletin board known as Front Porch Forum which is active in every one of the County's municipalities.

With regards to opportunities for involvement in development of individual Local All-Hazards Mitigation Plans, the general public was provided public notice of all public meetings held by municipal bodies such as governing bodies (selectboards, city councils, trustees) and planning and/or conservation committees as per the standard procedure of each municipality. With regards to input from neighboring communities and various relevant state and federal agencies, when feasible, CCRPC staff sent copies of municipal website links to the appropriate email contacts

1.10.2.6 Submission of drafts to VDEMHS and FEMA Region One

In the spring of 2016, CCRPC began the formal process of submission of first drafts to VDEHMS and to FEMA in order to obtain feedback on needed improvements. Drafts were also submitted well in advance of the August 8, 2016 expiration date in order to maintain compliance with the State's ERAF funding standards and FEMA's requirement that AHMPs are approved or in the process of being reviewed by FEMA to maintain eligibility for certain grants. Timelines of submission were as follows: [Update as needed in summer 2016]:

Table 1-x Submission dates of initial drafts of Multi-Jurisdictional and Local AHMPs

Date of Submission to VDEMHS	Document	Date comments received from VDEMHS
3/18/2016	Westford AHMP, 1st draft	4/18/2016
5/11/2016	Chittenden County MJAHMP, 1st draft	

Upon receipt of comments from VDEMHS, CCRPC staff worked to make the required changes and then submitted revised drafts to FEMA Region I on the following schedule:

[Update as needed in summer 2016]:

Table 1-x Submission dates of revised drafts of Multi-Jurisdictional and Local AHMPs

Date of Submission to FEMA Region I	Document	Date comments received from FEMA Region I
e.g. 6/x/2016	Westford AHMP, 2nd draft	7/x/2-16

1.10.2.6 Final adoption process

In Month 2016, CCRPC submitted the revised Chittenden County Multi-Jurisdictional All Hazards Mitigation Plan and municipal annexes to VDEMHS and the Federal Emergency Management Agency Region 1 office for approval pending adoption.

CCRPC staff provided each municipal governing body member and the municipal clerk with a copy of the final draft Plan and appropriate municipal annex for consideration at a properly warned, regularly scheduled governing body meeting, CCRPC staff also provided draft language for a resolution of adoption. CCRPC staff made presentations to LEPC #1 and the full Chittenden County Regional Planning Commission.

Upon adoption by CCRPC, LEPC #1 and a majority of municipalities, the final adopted plan and all of the municipal annexes was submitted to DEMHS and FEMA Region I, along with documentation of adoption.

SECTION 2 HAZARD IDENTIFICATION

The purpose of this Hazard Identification is to describe hazards generally so as to set the stage for a Risk Estimation and Vulnerability Assessment of the most likely hazards, aka "profiled" hazards. This 2016 Plan further refines the analysis done in the 2005 and 2011 Plans especially with regards to natural hazards in that some new hazards are identified while other hazards are combined. The following table shows which hazards are described and which are profiled relative to the 2011 Plan and the 2013 State Plan.

Table 2- Profiled Hazards relative to 2013 State AHMP and 2011 County AHMP

Hazards in 2013 State Plan	Profiled in 2011 Plan	Described in 2016 Plan	Profiled in 2016 Plan
Severe Rainstorm	No	Yes	**Yes, New**
Invasive Species	no		**Yes, New**
Extreme Temperatures	Drought only	Yes	**Yes, New**
Flooding	Yes	Yes	**Yes**
Fluvial Erosion	Yes	Yes	**Yes**
Terrorism	Yes	Yes	**Yes**
Infectious Disease Outbreak (Epidemic)	Yes	Yes	**Yes**
Wildfires	Yes	Yes	**Yes**
Severe Winter Storm	Yes	Yes	**Yes**
Drought	Yes	Yes	Consolidated with Extreme Temperatures
Hail	Yes	Yes	Consolidated with Severe Rainstorm
Earthquakes	No	Yes	No
Hurricanes/Tropical Storms	No	Yes	Consolidated with Flooding
Tornadoes	No	Yes	No
Nuclear Power Plant Failure	No	No	No
Landslides/Rockslides	Yes	Yes	No
Dam Failure	No	Yes	Consolidated with Flooding
Ice Jams	No	Yes	Consolidated with Flooding
Rock Cuts	No	No	No
Other hazards in 2011 Plan			
Telecommunications Failure	Yes	Yes	**Yes**
Loss of Electrical Serivce	Yes	Yes	**Yes**
Loss of Sewer Service	Yes	Yes	**Yes**
Loss of Water Service	Yes	Yes	**Yes**
Loss of Gas Service	Yes	Yes	**Yes**
Haz Mat Incident	Yes	Yes	**Yes**
Major Transportation Incident	Yes	yes	**Yes**

Crime	Yes	Yes	**Yes**
Civil Disturbance	Yes	Yes	**Yes**
Epidemics	Yes	Yes	**Yes**
Economic Recession	Yes	Yes	**Yes**
Key Employer Loss	Yes	Yes	**Yes**
Multi-Structure Urban Fire	Yes	Yes	**Yes but renamed to Multi-Structure Fire**
Loss of Other Fuels	No	Yes	**Yes, New**
Water Pollution	No	Yes	**Yes, New**
Invasive Species	No	Yes	**Yes, New**
High Winds	Yes	Yes	Consolidated with Severe Rainstorm
Lightning	Yes	Yes	Consolidated with Severe Rainstorm
Military Ordinance Incident	Yes	Yes	consolidated with Haz Mat Incident
Radiological (natural)	Yes	No	Removed
Mass Casualty Incident	No	Yes	Consolidated with Epidemic
Climate Change	No	Yes	No
Food Supply Crisis	No	Yes	No

The definitions of each hazard, along with historical occurrence and impact, are described. Hazards have been grouped into three broad categories:

Natural Hazards

Profiled Hazards		
Severe Winter Storm	Severe Rainstorm	Flooding
Fluvial Erosion	Extreme Temperatures	Wildfire
Other Hazards		
Tropical Storms / Hurricanes	Landslides	Earthquakes

Technological Hazards

Profiled Hazards		
Hazardous Materials Incident	Water Pollution	Major Transportation Incident
Multi-Structure Fire	Invasive Species	Power Loss
Natural Gas Service Loss	Telecommunications Failure	Water Service Loss
Sewer Service Loss	Other Fuel Service Loss	
Other Hazards		

Societal Hazards

Profiled Hazards		
Crime	Terrorism	Epidemic
Civil Disturbance	Economic Recession	Key Employer Loss
Other Hazards		
Food Supply Crisis	Climate Change	

2.1 Natural Hazards

The following discussion on natural hazards is based upon information from several sources. General descriptions are based upon the *2013 Vermont State Hazard Mitigation Plan*, as well as an article by the Vermont State Climatologist (Dupigny-Giroux, L.A., 2002. "Climate Variability and Socioeconomic Consequences of Vermont's Natural Hazards: A Historical Perspective." *Vermont History 70 (Winter/Spring 2002),* 19-39.). Frequency of events is presented based upon online data available from the National Climatic Data Center, although the reader is cautioned that many storm events prior to 1993 are not recorded in this database and some after 1993 are missing.

2.1.1 Profiled Hazards

This Plan profiles six (6) Natural Hazards: Severe Winter Storm, Flooding, Fluvial Erosion, Severe Rainstorm, Extreme Temperatures and Wildfire**.** Prior to this discussion of Hazards and the subsequent analysis of Risk and Vulnerability, it will be first helpful to summarize the general state of knowledge regarding Location, Extent and Impact in Chittenden County for these hazards in the following table:

	Location	**Extent**	**Impact**
Severe Winter Storm	No, occurs county-wide and not mapped	*Yes but only long-term data is at single point of National Weather Service station in South Burlington	Yes, if FEMA declares disaster. See 3.3 below.
Flooding	Yes, 100 & 500 year flood areas delineated	*Yes but only at a few discrete locations with gauge data such as U.S. Army Corps of Engineers for Lake Champlain	Yes, if FEMA declares disaster but co-mingled with fluvial erosion and severe rainstorm hazards events. See 3.3 below.
Fluvial Erosion	Yes, fluvial erosion hazards areas (now termed river corridor protection areas) are mapped	Though fluvial erosion is considered a significant hazard in the town, the number of feet-acres	Yes, if FEMA declares disaster but data co-mingled with flood and severe rainstorm events. See

		of soil lost in any one event has not been recorded nor is there a record with such data.	3.3 below.
Severe Rainstorm	No, occurs county-wide and not mapped. Damage locations are mapped but damages can just as easily be a function of poorly designed road and/or driveway drainage as it is a function of heavy rain.	*Yes but only long-term data is at single point of National Weather Service station in South Burlington.	Yes, if FEMA declares disaster but data co-mingled with flood and fluvial erosion events. See 3.3 below.
Extreme Temperatures	No, occurs county-wide and not mapped.	*Yes but only at single point of National Weather Service station in South Burlington	†Data not systematically collected on impacts.
Wildfire	No, occurs county-wide and not mapped.	Some compiled data on a countwide basis as shown on page X. No systematic data collected after 2010.	‡Data not systematically collected on impacts.

** It is useful to note that while this NWS data is reliable it represents one discrete location in a county that has an area of 620 square miles in area. Likewise, while there are likely other systematic point-specific records being collected by individuals, business or organizations these data do not appear to be easily accessible. Finally, even if such data were accessible, only if the data was collected by mutually compatible means would it be useful.*

†An intensive search of municipal public works records may reveal documentation of some prior repair or labor costs associated with frozen or burst sewer and/or water pipes caused by Extreme Cold. However, such analysis would show where past events happened not the location of inadequately buried pipes which might be vulnerable to future events.

‡ *An intensive search of fire department records may reveal documentation of locations and acres burned caused by Wildfire. However, such analysis would show where past events happened but would not show the location of areas susceptible to future events (warnings by the US Forest Service and local fire departments are not location-specific) nor the location of individuals who are likely to unwisely burn trash or leaves or fail to extinguish a campfire during dry conditions.*

2.1.1.1 Severe Winter Storm

Chittenden County experiences lake-effect and lake-enhanced snows due to its proximity to Lake Champlain, mountain-induced events, nor'easters and blizzards, and frontal events. As with rainstorms producing flash floods, winter storm frequency and distribution varies from year to year depending on the climatological patterns. Because such storms are expected during a Vermont winter, municipalities are generally well-equipped to deal with snow removal and

traffic incidents. The most damaging types of snowstorms in the county are ice-storms caused by heavy wet snow or rain followed by freezing temperatures. This leads to widespread and numerous power and telephone outages as lines either collapse due to the ice weight or are brought down by falling trees and branches.

According to the *2013 Vermont State All-Hazards Mitigation Plan*:

> A winter storm can range from moderate snow to blizzard conditions. A heavy winter storm deposits seven or more inches of snow during a 24-hour period. . A blizzard is a snowstorm with sustained winds of 35 miles per hour or more with heavy falling or blowing snow, cold temperatures, and visibility of ¼ a mile. An ice storm involves rain, which freezes upon impact. Ice coating at least one-fourth inch in thickness is heavy enough to damage trees, overhead wires, and similar objects and to produce widespread power outages.

The National Climatic Data Center lists 97 winter storm events that occurred in Chittenden County between January 1996 and February 2015. These include snowstorms, freezing rain and minor ice storms, and mixes of snow, ice, and rain. Winter storms with snowfall of over 10 inches or significant damage from ice and freezing rain are listed below.

Table 2-4 Significant snow and ice events, Chittenden County, 2/2000 – 6/2015

Event Type	Date	Damage	Notes
Winter Storm	2/13/2000	$30,000	About 10 inches of snow
Winter Storm	4/9/2000	$30,000	8-16 inches of snow.
Winter Storm	12/31/2000	$20,000	Generally 8-15 inches, 22" in Underhill.
Winter Storm	3/5/2001	$100,000	15-30 inches of snow, injury in Milton.
Winter Storm	3/22/2001	$50,000	7-25 inches of wet snow, power outages.
Winter Storm	1/31/2002	$10,000	Up to 10 inches of snow, some ice on top.
Winter Storm	11/17/2002	$5,000	8-12 inches of snow, power outages.
Winter Storm	1/4/2003	$40,000	12-18 inches of snow, major injury due to traffic accident.
Winter Weather/mix	2/22/2003	$15,000	Snow and freezing rain, death from traffic accident in Shelburne
Winter Weather/mix	4/3/2003	$60,000	Wintery mix countywide, I-89 closed briefly.
Winter Storm	12/6/2003	$20,000	12-18 inches of snow in western portion of county.
Winter Storm	12/15/2003	$100,000	Heavy snowfall countywide, 15-21 inches.
Winter Storm	12/18/2003	$50,000	Wintery mix and snow, 8-15 inches accumulation.
Winter Weather/mix	12/31/2004	$70,000	Freezing rain, parts of 1-89 closed.
Winter Weather/mix	1/2/2005	$140,000	Freezing rain, parts of 1-89 closed.
Winter Storm	2/10/2005	$160,000	7-12 inches of snow, new daily snowfall record in Burlington
Winter Weather/mix	10/25/2005	$100,000	Wet snow with foliage still on trees-- limbs down, power outages resulted.
Winter Storm	3/4/2006	$35,000	Up to 14 inches of snow in parts of county.
Heavy Snow	2/14/2007	$75,000	Record-setting heavy snow, 24-31 inches.
Winter Storm	3/16/2007	$5,000	9-12 inches of snow accumulation.
Winter Storm	12/2/2007	$10,000	6-14 inches of snow.

Winter Storm	12/16/2007	$10,000	8-18 inches of snow, gusty winds.
Winter Storm	2/6/2008	$5,000	10-17 inches of snow.
Winter Storm	2/26/2008	$5,000	6-12 inches of snow, gusty winds.
Winter Storm	3/4/2008	$10,000	Snow and freezing rain, gusty winds.
Winter Storm	3/7/2008	$20,000	Snow and freezing rain, downed limbs and power outages.
Winter Storm	12/19/2008	$5,000	6-12 inches of snow.

Source: National Climatic Data Center
Note: Damages may include damage that took place outside Chittenden County.

A winter storm of unusual magnitude occurred in February 2007. According to the National Climatic Data Center, a weather station in South Burlington reported a record 25.3 inches of snow in 24 hours. Some parts of Chittenden County received over 30 inches of snow. Snow-blocked furnace vents caused a number of carbon monoxide incidents. Traffic accidents and barn roof collapses were also reported. There was no severe power loss; however, snow removal operations took over a week in some parts of the county. While there were no notable injuries associated with this storm, severe winter weather has resulted in two major injuries and one death in Chittenden County since 2000, all from traffic accidents.

Ice storms occur less frequently than snow events, but cause severe damage when they do occur. The most recent severe ice storm to affect Chittenden County was in January 1998 (DR-1201). This storm caused power outages for several days, devastating the Champlain Valley and the higher elevations of the Green Mountains (*Map* X). The estimated total damage for the storm (not just in Chittenden County) was $5,800,000. For a detailed analysis of the Ice Storm refer to the Army Corps of Engineers' Cold Regions Research and Engineering Laboratory report titled: *An Evaluation of the Severity of the January 1998 Ice Storm in Northern New England* (Report for FEMA Region I), April 1998.

Elsewhere in New England and upstate New York (including parts of Vermont), a similarly devastating ice storm occurred in December 2008, causing massive power outages that in some places took over a week to fix. Four fatalities were associated with this storm, three from carbon monoxide poisoning. Chittenden County was largely unaffected by this recent storm, but events of this magnitude could affect the county in the future.

2.1.1.2 Severe Rainstorm

The CCRPC has decided to create and profile the Hazard of Severe Rainstorm to encapsulate one of the most common and damaging hazards in the County. We are making this distinction because:

First, and most importantly, to capture the Hazards and Vulnerabilities caused by Severe Rainstorms to the areas outside of the Floodplain and to the areas outside of the areas vulnerable to Fluvial Erosion, known as the River Corridor Protection Area or River Corridor.

Second, we also regard Severe Rainstorms as distinct from Flooding and Fluvial Erosion due to the regularly documented damages, especially to roads, caused by the intense precipitation associated with Severe Rainstorms.

Last and least, using the commont term of Severe Thunderstorm, is not appropriate as many Severe Rainstorms in the County do not include te thunder, lightning, high winds or lightning commonly associated with thunderstorms and these Severe Rainstorms can occur almost on year-round basis in the County rather than during periods of warm weather.

2.1.1.3 Flooding

Regarding flooding, the *2013 Vermont State All-Hazards Mitigation Plan* states that:

> Flooding is the most common recurring hazard event in the state of Vermont. In recent years, flood intensity and severity appear to be increasing. It is highly likely that flooding will continue in both the short-term and long-term. There are three main types of flooding that occur in Vermont: flooding from rain or snow melt, flash flooding, and urban flooding. Flooding has also been known to occur as a result of ice jams in rivers adjoining developed towns and cities. Flood damages are associated with inundation and fluvial erosion hazards (FEH). Data indicate that greater than 75 percent of flood damages in Vermont, measured in dollars, are associated with fluvial erosion. These events may result in widespread damage in major rivers' floodplains or localized flash flooding caused by unusually large rainstorms over a small area. The effects of all types of events can be worsened by ice or debris dams and the failure of infrastructure (especially culverts), private dams, and beaver dams.

Winter and spring thaws, occasionally exacerbated by ice jams, are significant source of flooding. Much of this flooding is flash flooding, occurring within hours of a rainstorm or other event. Flash flooding, as opposed to flooding with a gradual onset, causes the largest amount of damage to property and infrastructure. Floods cause two major types of damage: water damage from inundation, and erosion damage to property and infrastructure. As our climate begins to change, flooding is likely to become more frequent.

The *2013 Vermont State All-Hazards Mitigation Plan* discusses flooding extensively. While that plan is concerned with all of Vermont, the information on flooding is all relevant to Chittenden County. The state plan writes that:

> *Recent studies have shown that most flooding in Vermont occurs in upland streams and road drainage systems that fail to handle the amount of water they receive. Due to steep gradients, flooding may inundate these areas severely, but only briefly. Flooding in these areas generally has enough force to cause erosion capable of destroying roads and collapsing buildings. These areas are often not mapped as being flood prone and property owners in these areas typically do not have flood insurance (DHCA, 1998). Furthermore, precipitation trend analysis suggests that intense local storms are occurring more frequently. Additionally, irresponsible land use and development will exacerbate the preexisting vulnerability. Urban flooding usually occurs when drainage systems are overwhelmed and damages homes and businesses. This flooding happens in all urban areas, but specifically in Burlington where the downtown area is located at the bottom of a gradient, which adds to the intensity of this localized flooding. …*
>
> *…Over the past two decades, flood damage costs have risen dramatically in Vermont due to increasing occurrences of flooding and increases in vulnerability associated with unwise land use development in flood plains or within stream corridors. The geography and topography are right for a significant localized storm with extreme damage at almost any location in Vermont. Heavy rains with previous ground saturation, which causes runoff, are a significant part of the flooding formula in Vermont. Steep topography and narrow, inhabited, stream and river valleys further increase the dangerous nature of this hazard. Furthermore, precipitation trend analysis*

suggests that intense, localized storms that can cause flash flooding are occurring with greater frequency. While flooding will continue, planning and other mitigation measures can help minimize damages.

All of Vermont's major rivers have inhabited flood plains. While residents in mountain valleys are at risk, they may not be aware of the danger or may choose to ignore it. There are many reasons property owners are reluctant to relocate to less flood prone ground, not the least of which is the lack of personal experience of flooding. In addition, many communities originated beside rivers and streams; some of the most attractive property is located in vulnerable areas.

Lakeshore property in Vermont is vulnerable to flooding from high water levels, either by surface water erosion or flooding. Occasionally, water-saturated ground and high water tables cause flooding to basements and other low lying areas. Lakeshore property is highly desirable and valuable, making the development of lakeshore areas very likely, even with the high potential for flooding. Restrictions on lakeshore property development have significant negative economic and tax revenue impacts that must be carefully weighed against the gains in personal safety and protection of property.

Lake Champlain has reached flood stage during the spring months several times in the last fifteen years, notably in 2001 and 2007 and 2011, inundating low-lying areas including lakeside homes and infrastructure such as the King Street Ferry Dock in Burlington.

With regards to flash flooding from rainfall, urbanization and expansion of impervious cover (both significant issues in parts of Chittenden County) tend to promote more frequent and more severe floods. Flash flooding can cause significant damage to stream banks and undercut infrastructure, especially in places with undersized culverts. A flash flood in Williston in 2005 resulted in the closure of US Route 2, among other roads, due to washouts. Flooding can also cause environmental damage, if it results in wastewater overflow or inundation of manure ponds.

Vermont experienced major floods long before Federal disaster assistance became available. The most destructive recorded event was in NovemberDEMHSber of 1927. In the month before the flood, rains in excess of 150% of normal precipitation fell after the ground had frozen. The flood itself was precipitated by 10 inches of rain falling over the course of a few days. The flood inundated parts of many towns and damaged or destroyed numerous bridges in the county. As the history of the flooding cited above bears out, the geography and topography are right for a significant localized storm with extreme damage at almost any location in Vermont.

Several recent floods have resulted in Presidentially-declared disasters and an influx of federal disaster assistance. The federal disaster assistance each municipality received for floods since 1990 is shown in *Table 3-1*.

Table 2-5 Chittenden County Floods, 1/2001 – 3/2010 (to be updated)

Event Type	Date	Location	Damage	Notes
Flood	4/23/2001	Municipalities adjacent to Lake Champlain	$21,000	Lakeshore flooding, continued into May
Flood	4/23/2001	Western portion of county	$1,000	Winooski River exceeded banks
Flood	4/23/2001	Richmond, Williston, Essex, Essex Junction	$5,000	Winooski River exceeded flood stage, low land flooding from Richmond to Essex.

Flood	5/1/2001	Municipalities adjacent to Lake Champlain	$17,000	Lakeshore flooding due to snowmelt.
Flood	6/12/2002	Western portion of county	$5,000	Heavy rainfall caused flooding in fields, streams, mostly in higher elevation areas.
Flood	10/29/2003	Countywide, particularly along Browns River (Jericho, Underhill, Essex, Westford)	$10,000	Heavy rainfall resulted in flooding on Browns River.
Flood	11/20/2003	Countywide, particularly in Essex Junction	$2,000	Heavy rainfall resulted in flooding in low-lying areas, particularly along Indian Brook.
Flood	7/23/2004	Burlington, South Burlington, Williston	$20,000	Thunderstorms caused flooding on roads.
Flood	8/30/2004	Milton, Colchester, Essex, South Burlington	$50,000	Flooding due to rain. School in S. Burlington sustained damage.
Flash Flood	6/29/2005	Essex, Essex Junction, Williston	$25,000	Roads washed out in Williston.
Flood	1/18/2006	Countywide, particularly Hinesburg	$40,000	Ice jammed culverts caused flooding in Hinesburg. Local state of emergency declared.
Flood	5/19/2006	Countywide	$50,000	Road, field, and culvert flooding.
Event Type	**Date**	**Location**	**Damage**	**Notes**
Lakeshore Flood	4/20/2007	Municipalities adjacent to Lake Champlain	$20,000	Lakeshore flooding due to snowmelt, lasted through the end of April.
Flood	1/26/2010	Richmond, Essex	$0	Ice jam on Winooski River resulted in road flooding.
Flood	3/24/2010	Essex, Williston	$2,000	Winooski River left banks and flooded roads.

Source: National Climatic Data Center
Note: Damages may include damage that took place outside Chittenden County

Ice Jams

Ice jams, which can cause rapid and catastrophic flooding, are considered increasingly hazardous in parts of Vermont. In addition to the inundation damage they cause, ice jams can block infrastructure such as roads and culverts. Ice and debris-blocked culverts after a winter rainstorm resulted in considerable flooding in Hinesburg in January 2006. A local state of emergency was declared in that incident. Although ice jams are not as much of concern in Chittenden County as elsewhere in Vermont, Richmond has been identified as particularly vulnerable. A list of historic ice jams, including municipalities and streams, is maintained by the Vermont Division of Emergency Management and the Vermont Agency of Natural Resources. The US Army Corps of Engineers Cold Regions Research and Engineering Laboratory maintains a specific database of ice jams, which includes 980 events in Vermont. The most recent ice jam in Chittenden County found in this database was on the Hanson River in Colchester in March of 2015.

Table 2-6 Historic ice jam locations in Chittenden County.

River	Location
Lamoille River	West Milton, Milton,
Browns River	Westford, Jericho, Underhill Center
Winooski River	Burlington/Winooski, Colchester, North Williston, Richmond, Jonesville
Mill Brook	Jericho
Huntington River	Huntington
LaPlatte River	Shelburne

Source: 2013 Vermont State Hazard Mitigation Plan

High Hazard Dams According to the 2013 Vermont State All-Hazards Mitigation Plan, "The VT Agency of Natural Resources (ANR) Dam Safety Program maintains an inventory of 1240 dams (including 90 ANR owned dams) with impoundments greater than 500,000 cubic feet". Forty-one of these dams are located in Chittenden County. Details on each of these dams are presented in the appropriate municipal annex. Failure of any of these dams could result in significant downstream flooding. Dams located outside Chittenden County could also have an effect on county municipalities, as they are located downstream. Several dams in the county, while not at risk for failure, would have a large impact on populated areas if they did fail. Dams are inspected by the Dam Safety Program on a rotating basis and a hazard rating is assigned. There are 61 high hazard dams on the dam inventory, none of which are considered at significant risk for failure. Only one of these dams is located in Chittenden County. Details on this dam are listed below.

Table 2-7 High hazard dams in Chittenden County.

ID	Dam Name	Municipality	Stream	Normal Storage (In Acre-Feet)	Length (In Feet)	Height (In Feet)
69.05	Essex No. 19	Essex Junction	Winooski River	6,000	584	65
128.02/2205	Peterson	Milton	Lamoille River			

Source: Vermont State Hazard Mitigation Plan, 2013

This high-hazard dam is owned by Green Mountain Power, which is required by their permit from the Federal Energy Regulatory Commission to inspect and maintain the dam, annually update emergency plans, communicate with emergency response organizations of municipalities located downstream of each dam, and maintain and periodically update inundation maps.

The other significant high-hazard dam of note is the Waterbury Reservoir, which is owned by the Vermont Agency of Natural Resources (VT ANR). This dam feeds into the Winooski River, upriver from the Town of Bolton. VT ANR has inundation maps for this dam.

The *2013 Vermont State All-Hazards Mitigation Plan* also CHECK expresses concern regarding the *"hundreds of non-engineered small, private in-stream impoundments in small watersheds which frequently fail during flash flood events generating significant flood surges and destroying private property and public infrastructure downstream"*. An unknown number of these dams are located in Chittenden County, as neither the county nor the state maintains a formal inventory. There is no state-level permit process or maintenance requirement for private dams.

Hydroelectric facilities, water supply sources, water distribution systems, and wastewater treatment systems are also at risk for flood damage. These critical facilities are often located in floodplains. The Source Protection Plans (SPP) required by public water systems should address

risks, provide mitigation strategies, and contain contingency plans for water source problems, including floods.

Inundation, Floodplains, and the NFIP Regarding flood inundation issues, the *2013 Vermont State All-Hazards Mitigation Plan* states:

> While inundation-related flood loss is a significant component of flood disasters, the predominant mode of damage is associated with the dynamic, and oftentimes catastrophic, physical adjustment of stream channel dimensions and location during storm events due to bed and bank erosion, debris and ice jams, structural failures, flow diversion, or flow modification by man made structures. Channel adjustments with devastating consequences have frequently been documented wherein such adjustments are linked to historic channel management activities, flood plain encroachments, adjacent land use practices and/or changes in watershed hydrology associated with conversion of land cover and drainage activities.
>
> The 100-year, or "base" floodplain is the national standard for floodplain management. The area is shown on town Flood Insurance Rate Maps (FIRMs) as issued by FEMA. The 100-year floodplain has one chance in a hundred of being flooded in any given year. The probability that a 100-year flood will occur is a statistical determination based on past flooding in an area. This is not to say that a flood of such magnitude cannot occur two years in a row or twice in the same year. The term only means that in any given year, the odds are 1% that the area will be flooded. The same logic holds true for defining a 500- year flood. In this case, a flood of the 500-year magnitude has a 0.2% chance of occurring in a year.
>
> Much flood damage in Vermont occurs along upland streams, damaging private property and infrastructure such as bridges, roads, and culverts. The failure of beaver dams, private ponds and public and private culvert crossings contributes to flood surges and to often dramatically increased damage downstream. Homes and other private investments along these streams are generally not recognized as a flood area on FEMA maps of flood hazard zones and, thus, are not typically identified as being vulnerable to flooding or erosion. Town plans and zoning regulations have generally not identified these stream corridors as areas needing protective setbacks for development or zoning.

In Chittenden County, all municipalities except St. George and Buel's Gore are enrolled in the National Flood Insurance Program (NFIP). Buel's Gore does not contain any designated flood hazard areas, so enrollment in the NFIP is not relevant. The only identified flood hazard area in St. George is at least a quarter mile from the nearest structure, and development in the floodplain is highly unlikely. Starting in 2015 and as of the drafting of this Plan in the summer of 2016, the Town of St. George was exploring the option of participating in the NFIP.

Detailed flood studies have not been performed for most waterways. The *2013Vermont State All-Hazards Mitigation Plan* contains the following discussion of the NFIP and flood plain mapping: check if definition concurs with 2013 plan

> *The National Flood Insurance Act of 1968 was enacted by Congress to provide homes and businesses in disaster-prone areas with federally subsidized flood insurance through the National Flood Insurance Program (NFIP). To minimize future damage and resulting financial liabilities, participation in the program has been limited to local governments that adopt regulations to restrict development in FEMA-identified floodplains. Every participating town in the NFIP has been mapped by FEMA, with a FIRM (Flood Insurance Rate Map) map developed for each.*

Map XX shows the Special Flood Hazard Areas in Chittenden County.

Note that all Chittenden County municipalities (with the exception of the mountain community of Buel's Gore) have Digital Flood Insurance Rate maps (aka DFIRM) which were finalized between 2011 and 2014. Resident and business rates of NFIP-polices is fairly robust as shown int the following table:

According to the latest FEMA definitions, nine multiple-loss NFIP properties exist in Chittenden County. Repetitive loss properties are public or private buildings insured under the National Flood Insurance Program that have made at least two insurance claims of more than $1,000 each during a ten year period. Lauren: my old text from 2011 says, "Four of the six properties have been mitigated. However, now it says there 9 properties but none have been mitigated? I'm confused.

Table 2-8 Repetitive loss properties in Chittenden County

Community Name	Address	Dt of Loss	Occupancy	Zone	Firm
COLCHESTER, TOWN OF	COLCHESTER POINT R	4/26/1996	SINGLE FMLY	C	N
COLCHESTER, TOWN OF	HORIZON VW	9/9/2011	SINGLE FMLY	C	Y
JERICHO, TOWN OF	CILLEY HILL RD	5/23/2013	ASSMD CONDO	A08	N
MILTON, TOWN OF	RAINBOW PL	4/28/2011	SINGLE FMLY	A06	Y
MILTON, TOWN OF	101102 201	4/27/2011	2-4 FAMILY	A	N
RICHMOND, TOWN OF	COCHRAN RD	1/12/2014	SINGLE FMLY	A08	Y
RICHMOND, TOWN OF	JONES MILL RD	1/12/2014	SINGLE FMLY	A	N
RICHMOND, TOWN OF	E MAIN ST	2/12/1981	OTHR-NONRES	EMG	N
UNDERHILL, TOWN OF	ROARING BRK	5/23/2013	SINGLE FMLY	X	N
The Dt of Loss is the most recent claim.					
Firm...I believe is whether the structure is post or pre FIRM...but I am checking on that.					
The Zone is the zone at the time of the claim.					

Source: NFIP Web Data Exchange, 2/2/2016, obtained from VT ANR River Management Program

Flooding is a significant hazard in Chittenden County, a fact that is unlikely to change. Protecting river systems as a preventative measure, protecting property, and protecting human health and safety remain priorities for flood-related hazard mitigation and response in the state and Chittenden County.

2.1.1.4 Fluvial Erosion

Erosion occurs on a consistent, but small-scale, basis within the riparian corridor of the county's streams and rivers. This is a part of normal natural processes and as such is necessary for the proper functioning of the ecosystem of these waterways. However, fluvial erosion on a large scale can damage stream banks and undercut infrastructure such as roads, bridges and culverts as well as agricultural land and structures, causing severe damage. area is identified as hazardous through a fluvial geomorphic assessment and a river corridor plan, these landslide vulnerable areas have not been identified as hazardous because these areas are located well above the elevation that would be designated as hazardous under FEMA flood hazard area maps. The landside mapping protocol is intended to address this shortcoming..

Most damage recorded as "flood" damage is actually associated with fluvial erosion rather than inundation. The *2013 Vermont State All-Hazards Mitigation Plan* contains the following discussion of fluvial erosion, which is relevant to Chittenden County:

> *Vermont's landscape has historically contributed greatly to the widespread practice of the channelization of rivers and streams in order to maximize agricultural land uses and facilitate the development of transportation infrastructure.*
>
> *Channelization, in combination with widespread flood plain encroachment, has contributed significantly to the disconnection of as much as 70% of Vermont's streams from their flood plains. In this unsustainable condition and when energized by flood events, catastrophic adjustments of the channel frequently occur, usually with consequent fluvial erosion damage to adjacent or nearby human investments.*
>
> *All areas of the state suffer equally from fluvial erosion hazards. Some areas have suffered more than others simply because of the location of storm tracks. Transportation infrastructure and agricultural property are the most frequently endangered types of human investment affected by fluvial erosion hazards. Residential, commercial, utility infrastructure and other municipal properties are also frequently endangered.*
>
> *Changes in watershed hydrology that significantly influence fluvial stability are commonly associated with urbanization or with silvicultural practices. However, watershed scale hydrologic changes have been observed in Vermont as a localized phenomenon either in small, highly urbanized watersheds such as… Morehouse Brook in Winooski, and Centennial Brook and Bartlett Brook in South Burlington; or in small, rural sub watersheds where clear cutting of a large percentage of the watershed land area has recently occurred.*
>
> *Stream geomorphic assessments and a fluvial geomorphic database maintained by the Agency of Natural Resources have identified main stem rivers typically channelized from 60-95% of their lengths. When human investments and land use expectations include all the land in the valley up to the river banks, there results extreme public interest in maintaining this unsustainable morphological condition despite its great cost and resultant hazard to public safety.*

Map X shows the extent of geomorphic assessments and the identified fluvial erosion hazard areas (now termed River Corridor Protection Areas) in Chittenden County.

Some water supply source and distribution systems are also endangered by fluvial erosion. Water distribution systems can involve buried pipes that cross streams, which are vulnerable to fluvial erosion. Damage to water supply mains is a common consequence of flooding. In Chittenden County, the Jericho-Underhill Water District has made an effort to address channel stability in the Browns River to prevent fluvial erosion hazards.

2.1.1.5 Extreme Temperatures

Previous versions of this AHMP only addressed drought or extreme heat. In light of the significant damage incurred by the County's municipalities in early 2015 to repair frozen and burst water and sewer pipes, this plan now addresses extreme cold in addition to drought.

Extreme Temperatures are discussed in the 2013 Vermont State All-Hazards Mitigation Plan as follows:

One of the noteworthy characteristics of Vermont's climate is the tendency to stray above or below expected temperature values, a statement that was as true in 1922 as it is today. Extremes in temperature and the seasonality of these extremes are important to both individuals as well as economic activities. During the summer, both extreme cold and extreme heat can be observed. The former is associated with frost, which can be detrimental during the growing season. Extremely high temperatures can occur when a high-pressure system (under which air is descending toward the Earth's surface) develops and intensifies over the state. Under such conditions, the potential for a heat wave exists. A heat wave is a period of three or more consecutive days during which the diurnal maximum temperature meets or exceeds 90°F.

To gather data on extreme temperatures, CCRPC contacted the Vermont State Climatologist who queried their database and sent several tables of information current as of early February 2016.

Extreme Cold

We have decided to present multiple tables as they are many different ways to present such temperature data.

Minimum 3-Day Mean Min Temperature for Burlington Area, VT (ThreadEx)

Click column heading to sort ascending, click again to sort descending.

Rank	Value	Ending Date	Missing Days
1	-27.3	1979-02-12	0
2	-25.0	1957-01-15	0
3	-24.7	1979-02-13	0
-	-24.7	1933-12-30	0
5	-24.3	1968-01-11	0
6	-24.0	1968-01-12	0
-	-24.0	1917-12-30	1
8	-23.3	1934-02-10	0
9	-22.7	1979-02-11	0
-	-22.7	1943-02-16	0
Last value also occurred in one or more previous years.			
Period of record: 1884-01-01 to 2016-02-11			

Minimum 7-Day Mean Min Temperature for Burlington Area, VT (ThreadEx)

Click column heading to sort ascending, click again to sort descending.

Rank	Value	Ending Date	Missing Days
1	-21.6	1979-02-15	0
2	-20.3	1968-01-14	0
3	-20.1	1979-02-16	0
4	-19.9	1968-01-13	0
5	-19.3	1979-02-17	0
6	-19.0	1979-02-18	0
7	-18.9	1968-01-12	0
8	-18.3	1979-02-14	0
9	-17.8	1918-01-03	1
-	-17.8	1918-01-02	1
Period of record: 1884-01-01 to 2016-02-11			

Number of Consecutive Days Min Temperature <= 0 for Burlington Area, VT (ThreadEx)

Click column heading to sort ascending, click again to sort descending.

Rank	Run Length	Ending Date
1	12	1979-02-20
2	11	1981-01-18
-	11	1920-01-22
4	10	1989-12-30
-	10	1987-02-21
-	10	1970-01-09
-	10	1968-01-14
8	9	1994-01-23
-	9	1974-02-10
-	9	1968-02-27
-	9	1958-02-18
-	9	1948-02-11
-	9	1935-02-01
-	9	1934-02-10
15	8	1996-01-09
-	8	1981-01-06
-	8	1959-02-26
-	8	1907-03-01
-	8	1886-01-14
20	7	2007-01-31
Last value also occurred in one or more previous years.		
Period of record: 1884-01-01 to 2016-02-11		

A prolonged period of extremely cold temperatures can potentially cause significant impacts to providers of utilities especially water and sewer services. Prolonged cold can result in pipe and water main breaks, which can cause severe damage. Cold weather resulted in a sprinkler system break at UVM in 2004, which caused $100,000 worth of damage. If a period of extreme cold is associated with power outages (after an ice storm, for example), EMS services may become strained as emergency responders try to relocate people who have no way to heat their homes.

In early 2015, Chittenden County experienced several weeks of below freezing temperatures including several days below zero Fahrenheit. Several municipalities incurred substantial damages in terms of labor and equipment costs to repair frozen and/or broken sewer and water

pipes. CCRPC staff surveyed these municipalities and came up with estimates in the hundreds of thousands of dollars of expenses.

Table 2-x Estimated damages to sewer/water systems from freezing temperatures, 2015

Service Provider	**Location**	**Expenses**
Burlington City	Burlington	183,000
Charlotte	Charlotte	20,000
Colchester Fire District # 1	Colchester	4,000.00
Colchester Fire District # 2	Colchester	48,000
Champlain Water District- Malletts Bay Water Co.	Colchester	15,000
Essex	Essex	72,500
Essex Junction	Essex Junction	162,500
Hinesburg	Hinesburg	25,000
Jericho Village	Jericho	25,000
Milton	Milton	83,636
Richmond	Richmond	23,000
Shelburne	Shelburne	135,500
South Burlington	South Burlington	60,000
Underhill-Jericho Water District	Underhill	3,250
Williston	Williston	105,000
Winooski	Winooski	174,088

Source: correspondence with municipalities and service operators, CCRPC, 2015

It is interesting to note that this most recent 2015 event does not show up on the tables provided by the State Climatologist.

Extreme Heat

Will add some intro text here

Maximum 3-Day Mean Max Temperature for Burlington Area, VT (ThreadEx)

Click column heading to sort ascending, click again to sort descending.

Rank	Value	Ending Date	Missing Days
1	98.7	1911-07-05	0
2	97.3	1911-07-04	0
3	97.0	1949-07-29	0
4	96.7	2001-08-09	0
5	96.3	1988-07-10	0
-	96.3	1975-08-03	0
-	96.3	1975-08-02	0
-	96.3	1944-08-16	0
9	96.0	1944-08-15	0
10	95.7	1988-07-09	0
Last value also occurred in one or more previous years.			
Period of record: 1883-12-01 to 2016-02-11			

Maximum 7-Day Mean Max Temperature for Burlington Area, VT (ThreadEx)

Click column heading to sort ascending, click again to sort descending.

Rank	Value	Ending Date	Missing Days
1	95.9	1944-08-16	0
2	95.6	1944-08-17	0
3	94.9	1944-08-15	0
4	94.0	1884-08-22	6
-	94.0	1884-08-21	6
-	94.0	1884-08-20	6
-	94.0	1884-08-19	6
8	93.4	1963-07-29	0
9	93.0	1897-07-09	0
10	92.9	1944-08-14	0
Period of record: 1883-12-01 to 2016-02-11			

Drought

Fortunately, extreme heat is relatively rare in Chittenden County. However, if extreme heat occurs in conjuction with already-existing dry conditions (due to a light snowpack and/or minimal spring and summer rains), this can lead to a drought.

The 2013 *Vermont State All-Hazards Mitigation* Plan defines drought as:

> *a water shortage with reference to a specified need for water in a conceptual supply and demand relationship. It is a complex phenomenon that is difficult to monitor and assess because it develops slowly and covers extensive areas, as opposed to other disasters that have rapid onsets and obvious destruction. Also unlike most disasters, the effects of drought can linger long after the drought has ended. It is an inherent, cyclical component of natural climatic variability and can occur at any place at any time. It is difficult to determine the onset, duration, intensity, and severity of a drought, all of which affect the consequences and mitigation techniques. High winds, low humidity, and extreme temperatures can all amplify the severity of the drought. There are four types of drought:*

meteorological, agricultural, hydrological, and socioeconomic. Meteorological drought is defined as a reduction in rainfall from a normal precipitation pattern in regard to the amount, intensity, or timing of the event as well changes in the temperature, humidity, and wind patterns. Agricultural drought is defined by deficient moisture conditions that cause a lasting effect on crops and non-natural vegetation. It is dependent on rainfall, temperature, topography, evapotranspiration, permeability, and porosity of soils, precipitation effectiveness, and vegetative demand. Hydrological drought is related to the effects of decreased precipitation on surface or subsurface water supply. It is the last stage of drought and is lagged behind meteorological and agricultural drought because water infiltrates down to the groundwater during the latter portion of the hydrological cycle. Socioeconomic drought is what happens when the consequences of the drought start to affect the socioeconomic sector. It occurs when the demand for an economic good is greater than the available supply due to weather-related drought.

The severity of a drought depends on the duration, intensity, and geographic extent of the water shortage as well as the demands on the area's water supply. The USDA rates droughts from D0–D4, depending on the severity of the drought, the amount of time it will take for vegetation to return to normal levels, and the possible effects of the drought on vegetation and water supply.

Drought has not been a major concern in Chittenden County. The county, like the rest of Vermont, generally has abundant water. The only recorded drought event for Chittenden County at the National Climatic Data Center for the period since 1950 was in August 1995. However, significant dry spells characterized as droughts have occurred most recently in 1998, 1999, 2001, 2003, and 2012. Farmers in Chittenden County suffered corn production losses of $29,586 in 1999. For the most part, dollar losses from drought conditions are not quantified. Drought has occurred in almost every Chittenden County municipality, but aside from farm losses, impacts are generally limited to individual house wells or community wells serving a particular subdivision running dry in the summer for a week or two.

2.1.1.6 Wildfire

Due to its climate and primary vegetation types, Vermont is not considered to be at serious risk for large-scale wildfires. Despite not having had a major wildfire in the last 50 years, fire suppression systems are in place at the local level. These involve burn permits, burn restrictions, prevention, and detection of fires. Wildfire is an even less serious threat in parts of Chittenden County that are relatively urbanized, especially the Burlington area. Isolated homes with single access roads are more vulnerable to wildfires than more heavily populated areas, and the threat is increased during dry periods, especially in the late summer and fall.

The primary forms of wildland fire in Chittenden County are brush and grass fires accidentally started by persons burning trash, leaves or brush. Wildfire statistics for Chittenden County from the *2010 Fire Marshall Report* are as follows:

Table 2-11 Wildfires in Chittenden County

Year	# Fires	Acres
2003	3	8
2004	3	9
2005	20	19.31
2006	7	2.64

2007	5	3.96
2008	12	11.08
2009	4	4
2010	9	23.95
TOTAL	**38**	**42.91**
AVERAGE	***7.60***	***8.58***

Most years had fewer than ten wildfires and burned fewer than ten acres. Many fires burned about an acre or less. Unfortunately the data shown in the table above was no longer included in the State Fire Marshal Report after 2010.

Sporadic wildfires still occur but have remained localized events with little significant damage to persons or property other than the grassland or woodland consumed. During times of dry weather coupled dry grass, twigs and leaves, so called "red flag" warnings are occassionaly issued by local and state authorities. Fires are not limited to "wild" areas. Indeed, as recently as April 2016, a small brush fire occurred in South Burlington, emblematic of the County's "suburban" towns. According to the Burlingon Free Press (4/16/16) when firefighters arrived on the scene an area about the size of a football field was burning. About thirty firefighters from the City of South Burlington and three other agencies worked to contain and extinguish the blaze. This spring was preceded by a winter with very little snowfall in the County.

2.1.2 Non-profiled Hazards

The CCRPC does not consider the following hazards to be significant hazards relative to other hazards in the County. For ease of analysis, the CCRPC has also decided to combine the hazards and vulnerabilities inherent in High Winds, Lightning and Hail within the overall category of Severe Rainstorm. Also last but not least some hazards cannot be readily profiled as the likely locations of such events cannot be mapped, data collection is sporadic and damage records are inconsistent.

High Winds and Severe Thunderstorms

The National Climatic Data Center recorded a total of 291 high wind events (below hurricane strength) in Chittenden County during the period from January 1950 through May 2015. They define a high wind event as: *Sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer or winds (sustained or gusts) of 50 knots (58 mph) for any duration (or otherwise locally/regionally defined), on a widespread or localized basis. In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.*Note however, that the first entry in the database was in July 1960 so it is likely that events in the prior 10 years were not recorded. As high wind events can be highly localized, local officials believe that other unrecorded events have occurred. Forty-five (or 15.4%) of the recorded events did not cause any reported property damage. Two hundred and eleven (or 72.5%) caused between $1,000 and $49,000 in reported property damage. Thirty-five (or 12%) caused property damage valued at $50,000 or more.
The following table details the thirty-five wind events that caused $50,000 or more in damage:

Table 2-3 Recorded high wind (non-hurricane) events with over $50,000 property damage, Chittenden County, 1/1950 – 6/2015

Location	Date	Time	Type	MPH	Property Damage
34 VTZ004 - 005	1/24/1993	0545	High Winds	no data	$50,000
38 Charlotte	8/24/1993	1640	Thunderstorm Wind	no data	$50,000
55 VTZ003 - 005>009 – 011 - 012 - 014	10/20/1995	2000	High Winds	no data	$130,000
56 VTZ002 - 003 - 005>008 - 010>014	11/11/1995	1100	High Wind	no data	$80,000
Western Chittenden County	1/27/1996	1000	High Wind	no data	$50,000
58 VTZ005	7/19/1996	2045	High Wind	46.04	$50,000
61 VTZ003 - 005 - 007>009 - 012	2/22/1997	1000	High Wind	57.55	$80,000
63 Milton	7/17/1997	1635	Thunderstorm Wind	no data	$50,000
77 Burlington	7/29/1998	0251	Thunderstorm Wind	69.06	$90,000
78 Charlotte	8/24/1998	1300	Thunderstorm Wind	no data	$50,000
80 VTZ005	12/22/1998	0100	High Wind	no data	$100,000
86 VTZ005	9/17/1999	0330	High Wind	48.342	$150,000
89 VTZ005	3/28/2000	0800	High Wind	70.211	$50,000
92 Shelburne	7/18/2000	1130	Thunderstorm Wind	no data	$50,000
96 VTZ005	2/10/2001	0630	High Wind	no data	$50,000
124 VTZ002 - 005 - 008 - 016>017	6/26/2004	1550	Strong Wind	46	$60,000
Richmond	8/1/2005	1650	Thunderstorm Wind	80.5	$100,000
141 VTZ001 - 005 - 017	9/29/2005	0500	High Wind	42.6	$200,000
146 VTZ001>002 - 005	2/17/2006	1100	High Wind	40.3	$100,000
176 Milton	8/16/2007	000	Thunderstorm Wind	63.3	$75,000
178 Westford	8/16/2007	000	Thunderstorm Wind	63.3	$75,000
185 Miltonboro	6/10/2008	000	Thunderstorm Wind	69.06	$50,000
Western Chittenden County	12/01/10	1000	High Wind	72.4	$1,250,000
Essex Center	5/26/2010	1928	Thunderstorm Wind	63.3	$100,000
Essex Center	7/21/2010	1405	Thunderstorm Wind	63.3	$50,000
Jericho Center	7/21/2010	1410	Thunderstorm Wind	69.06	$150,000
Eastern Chittenden County	12/01/2010	1000	High Wind	72.5	$1,250,000
Western Chittenden County	12/01/2010	1200	High Wind	59.8	$500,000
Essex Center	7/06/2011	1415	Thunderstorm Wind	63.3	$50,000
Western Chittenden County	8/28/2011	1400	High Wind	57.5	$200,000
Burlington	7/04/2012	1808	Thunderstorm Wind	69.06	$185,000
South Burlington	7/04/2012	1818	Thunderstorm Wind	69.06	$50,000
Eastern Chittenden County	12/21/2012	1000	High Wind	72.5	$75,000
Burlington Airport	7/08/2014	2035	Thunderstorm Wind	69.06	$500,000
Burlington	7/08/2014	2035	Thunderstorm Wind	63.3	$50,000

Source: National Climatic Data Center. As wind events are localized and often brief, data on wind speed is not available for all the recorded events

Strong Wind: Non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage. Consistent with regional guidelines, mountain states may have higher criteria. A peak wind gust (estimated or measured) or maximum sustained wind will be entered.

Thunderstorm Wind: Winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph), or winds of any speed (non-severe thunderstorm winds below 50 knots) producing a fatality, injury, or damage. Maximum sustained winds or wind gusts (measured or estimated) equal to or greater than 50 knots (58 mph) will always be entered. Events with maximum sustained winds or wind gusts less than 50 knots (58 mph) should be entered as a Storm Data event only if they result in fatalities, injuries, or serious property damage. Storm Data software permits only one event name for encoding severe and non-severe thunderstorm winds. The Storm Data software program requires the preparer to indicate whether the sustained wind or wind gust value was measured or estimated.

The 2013 *Vermont State All-Hazard Mitigation Plan* has this is say about Severe thunderstorms:

> Severe thunderstorms are capable of producing high winds (including downdrafts), large hail, lightning, flooding, rains, and tornadoes. Thunderstorm winds are generally short in duration, involving straight-line winds and/or gusts in excess of 50 mph. Thunderstorm winds tend to affect areas of Vermont with significant tree stands as well as areas with exposed property and infrastructure and aboveground utilities. Thunderstorm winds can cause power outages, transportation and economic disruptions, and significant property damage, and pose a high risk of injuries and loss of life.

Through January of 2015, the National Climatic Data Center Storm Events Database has recorded 207 thunderstorm wind events resulting in a total of 3 injuries and 3.2 million dollars in property damages. These events occurred all over the planning area (i.e. the county) and have not been mapped as discrete events.

Lightning

The National Climatic Data Center has recorded a total of seventeen lightning events and one associated injury in Chittenden County during the period from January 1950 through August 2015; however, these seventeen recorded events all happened after 1996. Recorded lightning events occurred in every year from 1996 through 2012, with the exception of 2000, 2001, 2004 and 2008. Recorded lighting events occurred from May through September plus the month of November. All but two events caused at least $1,000 in property damage, and four events caused an estimated $50,000 in damages. The two highest damages were $200,000 and $1,000,000. Both of these involved a lightning-caused fire that leveled a structure. Cumulative damages for the seventeen events noted was $1,520,000 and one person injured. This data may be incomplete-- fire department officials have indicated that lightning has caused many more fires than are recorded in the National Climatic Data Center database. Local officials also note that a single storm could result in multiple lightning strikes and subsequent fires. Another possible problem associated with lightning is the impact on communications, especially communications between emergency responders, from lightning striking communications infrastructure.

Hail

The 2013 *Vermont State All-Hazard Mitigation Plan* defines hail as:

> *Hail is a form of precipitation composed of spherical lumps of ice. Known as hailstones, these ice balls typically range from 5–50 mm in diameter on average, with much larger hailstones forming in severe thunderstorms. The size of hailstones is a direct function of the severity and size of the*

thunderstorm that produces it. Hail causes$1 billion dollars in damage to crops and property in the United States each year. An example of the economic destruction a hailstorm can cause is one that struck the Kansas City area in 2001 caused an estimated $1.5 billion dollars in damage. No matter the size, hail can damage property, young and tender plants, and cause bodily harm to those unfortunate enough to be caught outside.

The National Climatic Data Center recorded a total of 117 hail events in Chittenden County during the period from January 1950 through June 2015. Hail events only occurred from May through September, but most occurred in summer storms from June through August. 21 of the 117 events recorded hail larger than 1-inch in diameter. Municipal officials do not consider hail a significant hazard. Total property damage for Chittenden County in those 65 years is $106,000 and the total crop damage is $165,000. Hailstorms can have devastating effects on local farmers though rarely do in Vermont.

These hail events occurred all over the planning area (i.e. the county) and have not been mapped as discrete events.

Tropical Storms and Hurricanes

According to the 2013 *Vermont State All-Hazards Mitigation Plan*:

A hurricane is a tropical cyclone with sustained winds that have reached speed of 74 mph or higher. A storm reaches hurricane status only after strengthening over a period of days or even weeks. A tropical storm has a maximum sustained one-minute wind speed of 39–73 mph. The National Hurricane Center through the NWS names a tropical cyclone once it reaches tropical storm status. As a hurricane moves toward the coast, it loses wind speed and may be downgraded to a tropical storm. This is the case in many of the tropical storms that have reached Vermont.

No formal hurricane events are recorded for Chittenden County. Hurricane force winds are defined by the National Climatic Data Center as winds that reach a velocity of at least 74 miles per hour (64 knots per hour). Five such wind events are recorded in the National Climatic Data Center Storm Event Database.

Details on these five hurricane-force wind events are as follows:

Table 2-1 Recorded hurricane-force winds in Chittenden County, 1950 -2014

Event	Date	Time	Wind Speed	Property Damage
Hurricane-force winds	01/27/1996	0900	95.53 mph	$220,000
Hurricane-force winds	01/04/2000	0330	81.72 mph	$10,000
Hurricane-force winds	8/1/2005	1650	80.6 mph	$100,000
Hurricane-force winds	6/10/2008	1900	80.6 mph	$20,000
Hurricane-force winds	12/9/2009	1400	**87.45 mph**	**$20,000**
			TOTAL>>	**$370,000**

Sources: National Climatic Data Center;

While several named tropical storms have affected Vermont, such as Irene in 2011 and Floyd in 1999, the National Climatic Data Center has no tropical storms on record in Chittenden County due to the technical definition listed above. These storms instead come up as major flooding and

flashfloods events which will be covered in section 2.1.2. Even though the NCDC defined it as flooding and flash flooding events, FEMA granted the county over $400,000 in relief for *Tropical Storm Irene* which went to fixing the flood damage. Heavy rains dropped by tropical storm Irene caused rivers to flood due to the fast runoff from the Green Mountains located just east of the county.

Tornadoes

The 2013 Vermont State All-Hazards Mitigation Plan defines a Tornado as:

> *A tornado is a violently rotating column of air extending from a thunderstorm to the ground. The most violent tornadoes are capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be in excess of 1 mile wide and 50 miles long. Tornado season in Vermont runs ordinarily from March through August; however, tornadoes can strike at any time of the year if the essential conditions are present.*

The National Climatic Data Center has recorded a total of five tornadoes in Chittenden County during the period from 1950 through 2014. A sixth tornado event on June 11, 1973 was also noted by The Tornado Project. Tornado damage tends to be localized. The strongest recorded tornado touched down in Colchester on August 8, 1983.

Table 2-2 Recorded tornadoes in Chittenden County, 1950 - 2014

Event	Date	Time	Magnitude	Property Damage
Tornado	06/21/1953	1600	F1	$500-$5,000
Tornado	06/11/1973	1845	F1	$50,000-$500,000
Tornado	06/22/1973	2000	F1	-$0-
Tornado	08/08/1983	1400	F2	$500,000-5M
Tornado	08/07/1986	1640	F0	$50-$500
Tornado	05/31/1987	1200	F0	$5,000-$50,000
			TOTAL>>	$555,550-$5.5M

Sources: National Climatic Data Center; The Tornado Project
Note: According to the Tornado Project, tornados are ranked according to the Fujita Scale which ranks tornado intensity (as F0, F1, F2, F3, or F4) by examining the damage caused by the tornado after it has passed over a man-made structure. F0-scale events are termed "gale tornados", attain wind speeds of 40-72 mph and can cause some damage to chimneys, break branches off trees, push over shallow-rooted trees, and can damage sign boards. F1-scale events are called "moderate tornados", attain wind speeds of 73-112 mph, and can peel off roof surfaces, push mobile homes off their foundations or overturn them, push moving autos off the road or destroy attached garages. F2-scale events are noted as "significant tornados", reach wind speeds of 113-157 mph and cause considerable damage such as tearing roofs off of frame houses, demolishing mobile homes, pushing train boxcars over, snapping or uprooting large trees, and generating light object missiles. F3-scale events are termed "severe tornados" and reach speeds of 158-206 mph. F4-scale events are termed "devastating tornados" and reach speeds of 207-260 mph.

Landslides

Landslides—sudden failures of steep slopes—can cause significant damage to streams, infrastructure, and property. Landslides can be caused by fluvial processes, as discussed above. Landslides can also be caused by slope steepening due to non-fluvial erosion, increased loading on the top of a slope, or pore-water issues. Landslides can destroy or damage structures and infrastructure that lie either above or below the slope. The *Vermont State All-Hazard Mitigation Plan* notes as follows:

> *Overall, the state of Vermont has had a moderate to low incidence of landslides. The USGS defines susceptibility to landslides as the probable degree of response of rocks and soils to natural or artificial cutting or loading of slopes, or to anomalously high precipitation.*
>
> *The U.S. Geological Survey has produced a map entitled "Map showing slope failures and slope-moDEMHSent-prone areas in Vermont" (Baskerville and Ohlmacher, 2001, 1:250,000 scale). This map identifies about 2.8% of the land area of Vermont as having evidence of slope moDEMHSents. This corresponds to a moderate susceptibility as a low incidence is defined as less than 1.5% of the land area involved.*
>
> *The map serves to broadly identify some of the areas susceptible to landslides and the included text provides an excellent description of the types of slides found in the state, but the map is not detailed enough to meet current needs. The map generally does not identify slope failures in unconsolidated material in the valley bottoms. As an example, it does not delineate the site of the Jeffersonville landslide, even though there was an historic record of an earlier slide on the same slope…*
>
> *…areas along Lake Champlain and the Green Mountains show a high susceptibility and moderate incidence. A moderate incidence is defined as 1.5%-15% of the area is involved. On the national map, none of the significant landslide events in the United States have occurred in Vermont.*

However, according to the Vermont State Geologist, a detailed geologic study is necessary before a landslide coverage map, accurate at the municipal level, could be produced.

The landslide map created by the Vermont Geological Survey shows that Chittenden County, which covers only the westernmost slopes of the Green Mountains, has fewer historic landslides than more mountainous areas of Vermont. Landslides are not limited to mountain slopes, however. A large landslide occurred near the Winooski River in Burlington in 1955, destroying part of Riverside Avenue and displacing a home.

To address this issue, the Vermont State Geologcal Survey obtained an FY09 FEMA Pre-Disaster Mitigation grant to begin development of landslide assessment protocol. The Executive Summary of the Report, completed in December 2012 stated as follows:

Executive Summary

> *The purpose of this project is to advance the state of landslide mapping and landslide hazard assessment in Vermont by developing and testing a protocol to map potential hazard areas. The results of this project will be incorporated into the State Hazard Mitigation Plan, which will be updated in 2013.*
>
> *This project was divided into three phases. Phase 1 involved set up of the project, creation of a landslide database, and selection of test sites. Phase 2 involved development of the protocol. Phase 3 involved preparing the protocol for incorporation in the State Hazard Mitigation Plan.*

Seven site areas were selected in an attempt to represent conditions throughout the state because the protocol will be applied throughout the state. The outcome was that all but one site area are in Chittenden County, because of the lidar coverage there. The bare-earth lidar 3.2m DEM is the best elevation data in the state, however it is only available in some parts of Vermont at this time. The USGS 10m DEM is available throughout the state and can be used with the protocol if lidar is unavailable, but the results would not be expected to be as accurate as the results with lidar. Other considerations in site area selection included map coverage, geology, elevation, types of terrain, urban disturbance, and types of landslides expected. The site areas range in size from 1.28 to 12.58 km^2 for a total of 41.3 km^2. Site areas include parts of Alder Brook in Essex, Bartlett Brook in South Burlington, Clay Point in Colchester, Indian Brook in Colchester, Joiner Brook in Bolton, La Platte River in Shelburne, and Smugglers Notch in Cambridge.

Data collection included a literature review, photo interpretation, and field reconnaissance. Landslide characteristics were collected using a field data sheet developed as part of this project. Data were input into an ArcGIS project for each site area.

Thirteen potential parameters were considered as to their affect on landslide hazard. These included location with respect to the marine limit of the Champlain Sea, aspect, distance to stream, elevation, hydrologic group, NDVI, profile curvature, roughness, slope angle, slope height, soil type, stream power index, surficial geology, and topographic wetness index.

A frequency ratio model was used to analyze the site areas and the landslides identified there. At most site areas, the most important parameters were determined to be slope angle and roughness, although soil type and topographic wetness index are also important at some site areas. Slope and distance to stream/lake were found to be the most important parameters along Lake Champlain shoreline. The important parameters were then combined to produce a landslide susceptibility map. These results were verified with field checking.

A heuristic method was used to complete the delineation of areas sensitive to landslide hazard. This included consideration of the frequency ratio maps, surficial geology, slope angle, profile curvature, topographic contours, outcrops, and mass failure sites identified by the DEC Rivers Management Program during their Stream Geomorphic Assessments.

A protocol was written for how to analyze landslide hazards at other sites using this method. This process was found to work best for translational landslides. Based on the results of the frequency ratio analysis, the most important parameters for identifying translational landslides are slope angle and roughness, although soil type and topographic wetness index are also important at some site areas. Slope and distance to stream/lake were found to be the most important parameters along Lake Champlain shoreline.

Low-angle rotational landslides were found to be difficult to identify using this protocol. Frequency ratio analysis indicated that the most important parameters for the low-angle rotational slides were soil type and topographic wetness index, although surficial geology will likely prove to be important too. The biggest problem is that there

are not many of these types of slides available to study. Debris flows were also not conducive to this type of analysis.

Based on the results of this study, it is suggested that in most parts of Vermont, areas of 25 to 50 sq. km. will probably yield enough landslides for a robust analysis. Alternatively is the site of interest is smaller, the best results occurred when the following criteria were met.

- *There is a minimum of one landslide per square kilometer in the site area.*
- *The average size of the landslides is at least 400 square meters.*
- *At least 30% of the landslides are greater than 400 square meters.*

However, if the landslides are small in area, then it becomes critical that the GPS locations are done using a mapping-grade GPS with at least sub-meter accuracy after post-processing.

As noted, the study sites included several in Chittenden County, namely parts of Alder Brook in Essex, Bartlett Brook in South Burlington, Clay Point in Colchester, Indian Brook in Colchester, Joiner Brook in Bolton and the La Platte River in Shelburne. Several of the study sites had evidence of past landslides associate with fluvial erosion. See Appendix D for a copy of the report.

Earthquakes

The risk of earthquake is quite low in Vermont, though the northwest part of the state, including Chittenden County, is slightly more at risk than the rest of Vermont. This risk is low enough, however, that it is not prudent to invest in mitigation for earthquakes. Within Chittenden County, earthquakes do occasionally occur, but have not caused any significant damages or loss of life. The most recent earthquake felt in Chittenden County occurred in June 2010. This 5.0 magnitude earthquake was centered north of Ottawa, Canada. No significant damages were noted by the news media.

Based on information provided by the Vermont Geological Survey, Department of Environmental Conservation, and the Agency of Natural Resources, the following damage estimates were generated for various earthquake scenarios using the HAZUS modeling program. All of the earthquake scenarios are 500-year events.

Table 2-9 Modeled earthquake damage estimates for Chittenden County, Vermont

	Modeled Epicenter		
	Montreal, QE	**Goodnow, NY**	**Middlebury, VT**
Earthquake Magnitude	6.8	6.6	5.7
Buildings Moderately Damaged	1,012	636	594
Buildings Extensively/ Completely Damaged	113	60	59
Building Damage Estimated Cost	$77.45 million	$49.82 million	$62.69 million
Business Interruption Losses	$18.71 million	$11.60 million	$9.13 million

Utility/Transportation Losses	$19.65 million	$14.31 million	$36.22 million
Persons Requiring Medical Attention*	118	69	60
Persons Requiring Hospitalization	14	8	7
Fatalities	3	0	0

Source: Vermont Geological Survey
** Includes persons requiring hospitalization and fatalities.*

Due to the composition of underlying sediment, Burlington is particularly at risk for damage in the event of an earthquake.

Buildings made of wood or unreinforced masonry and manufactured housing would be the most likely to suffer damage in an earthquake. Transportation repair costs would be mostly for bridges and airport facilities. Utility system repairs would be primarily for wastewater facilities and electrical power facilities. Estimates of generated debris or fire starts were low in all scenarios.

Climate Change

In recent years, it has become evident that human activities—mostly associated with the combustion of fuel—have added to the natural concentration of greenhouse gases in the atmosphere and are contributing to rapid climate change on a global scale. While projections of the effects of climate change vary, it is generally predicted that Vermont will have warmer temperatures year-round, with wetter winters and drier summers. An increase in the size and frequency of storms is also predicted. As a result, climate change in the next century will likely increase the likelihood of the above weather-related hazards occurring. An increase in precipitation may also result in increased flooding and fluvial erosion. Drier summers may increase the chance of drought and wildfire. A warmer climate may also result in the influx of diseases and pests that cold winters previously prevented. The severity of climate change is also difficult to predict, though the effects may be mitigated somewhat if greenhouse gas emissions are reduced in the near future. The Chittenden County Climate Action Guide published in May of 2014 goes into more detail about the possible challenges and actions associated with climate change.
It is worth noting that this AHMP does address the Hazards potentially cause by climate changes especially Severe Rainstorms, Flooding and Fluvial Erosion.

Radiation (Naturally Occurring)

Radon gas, a naturally occurring radioactive substance that can build up in homes and can cause health problems, is enough of a concern in Chittenden County that health officials recommend home testing. The average indoor concentration of radon gas in Chittenden County is higher than the national average, but lower than that of most of Vermont. An estimated 14% of homes in Chittenden County may have elevated levels of radon. The most common strategy for dealing with a radon problem is venting of basement areas.

The Vermont Geological Survey has documented areas of several county municipalities, notably Milton and Colchester, which have elevated levels of radiation in the water supply. As with radon, this radiation is naturally occurring and based on the local geology. Public water supplies are regularly tested. The Vermont Department of Health recommends mitigation steps be taken based on the type of radiation.

2.2 Technological Hazards

The following discussion on technological hazards is based upon information from several sources. General descriptions are based upon the *2013 Chittenden County Regional Plan* and information from private utility companies.

This Plan profiles several Technological Hazards. Prior to this discussion of Hazards and the subsequent analysis of Risk and Vulnerability, it will be first helpful to summarize the general state of knowledge regarding Location, Extent and Impact in Chittenden County for these hazards in the following table:

	Location	**Extent (Severity)**	**Impact**
Water Pollution	Impaired streams that lack adequate biota are identified.	Phosphorus-loading for general locations is known but non-point sources are varied and dispersed	Annual budgetary impacts to individual municipalities are significant but vary depending upon location.
Hazardous Materials Incident	Storage locations are known. Incidents occurring during transportation could occur anywhere.	Rough estimates of spill amounts are recorded.	No formal readily available on cleanup costs.
Power Loss	Outage locations not mapped	During an actual outage some data is recorded on duration.	Outage data is broad and refers to total customers within a county.
Invasive Species	Known to occur in lake	No formal damage has been documented to date	No formal damage has been documented to date
Multi-Structure Fire	Could happen anywhere	Data not formally collated across agencies	Data not formally collated across agencies
Major Transportation Incident	Depending upon type of incident, could happen anywhere	No formal database of damages.	Varies depending upon type of incident.
Water Supply Loss	Water distribution	Data not formally	Data not formally

	systems are mapped	collated across agencies	collated across agencies
Sewer Service Loss	Sewer lines are mapped	Data not formally collated across agencies	Data not formally collated across agencies
Natural Gas Service Loss	General areas of services are known but specific locations of loss not recorded	Information for this rare occurrence not publicly available.	No formal damage has been documented to date.
Telecommunications Failure	Depending upon type of incident, could happen anywhere	Information for this rare occurrence not publicly available.	No formal damage has been documented to date
Other Fuel Service Loss	Distribution points are individual addresses	No formal loss of service has been documented.	No formal damage has been documented to date

2.2.1 Water Pollution

The CCRPC has decided to create and profile the Hazard of Water Pllution to encapsulate a growing hazard to water quality in the County. We are adding this hazard in order to:

- capture the threat posed to the water quality of Lake Champlain from increased levels of phosphorus;
- capture the long-standing impacts of excess stormwater on local streams;
- capture the existing and growing regulatory and financial burden on Chittenden County municipalities to comply with state and federal laws regarding water quality.

Finally, we regard this hazard as we have defined it as distinct from the hazard of a fuel or chemical spill into water, which is more appropriately considered a Hazardous Materials Incident.

Lake Champlain is a cornerstone of the county's economy by drawing commerce and visitors to the region. Water pollution can pose a threat to the health, economic well being, and overall quality of life of the region's residents. Water resources often cross town, county, state, and national borders. A watershed's water quality can only be protected or enhanced through the cooperation of the municipalities and landowners that live, work, and play in the watershed.

Residents, municipalities and businesses are also concerned about the health and economic impacts of occurrences of algal blooms in Lake Champlain. Blue-green algae blooms occur in Lake Champlain in the summer, as a result of overabundant phosphorous in the water. In some cases, neurotoxins in the algae blooms have caused health problems and beach closures. If such blooms become a daily or weekly problem along the lakeshore communities this could ultimately affect resident and visitor perceptions of the ecological health of the lake ecosystem. If not addressed this could lead to reduced tourism traffic and reduced property values.

Lake Champlain Total Maximum Daily Load
Wil add text here

Vermont Clean Water Act
Will add text here

MS-4 Permit The Vermont Department of Environmental Conservation provides a useful summary of the MS-4 (or municipal separate stormwater system).

> *A municipal separate storm sewer system is a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains): Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, stormwater, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or a designated and approved management agency under Section 208 of the CWA that discharges to waters of the State and waters of the United States….Designed or used for collecting or conveying stormwater; Which is not a combined sewer; and Which is not part of a publicly owned treatment works.*

In Chittenden County, there are nine municipalities and three organizations that must have an MS-4 permit. These twelve permitees are considered "small MS-4s" and are automatically designated as follows: *Automatic designation - Small MS4s located within the boundaries of a Census Bureau-defined Urbanized Area (UA) based on the 2000 Census or any subsequent decennial census. Urbanized Areas include areas with populations of at least 50,000 people with an overall population density of at least 1,000 people per square mile. These communities are Burlington, Colchester, Essex, Essex Junction, Milton, Shelburne, South Burlington, Williston, and Winooski (emphasis added). Three publicly owned 'non-traditional' separate storm sewer systems were also designated. These systems are owned or operated by the University of Vermont, Burlington International Airport and the Vermont Agency of Transportation. The regulations apply to areas served by each MS4 that are located either within the UA or watersheds that are principally impaired by stormwater.*

Since their designation in 2003, these nine municipalities have had to spend millions of dollars to comply with their permit and the cost of this compliance is projected to grow. These permitees must annually implement six minimum measures as follows: (1) Public Education and Outreach, (2) Public Participation/Involvement, (3) Illicit Discharge Detection and Elimination, (4) Construction Site Runoff Control, (5) Post-Construction Runoff Control and (6) Pollution Prevention/Good Housekeeping. In addition starting in October 2016, municipalities that discharge to stormwater impaired waters must begin to implement Flow Restoration Plans (FRP) over the next twenty years for their portion of each stormwater impaired watershed in their community. While these plans have not yet been formally published costs – in the form of retrofits of stormwater ponds, new stormwater detention and infiltration facilities and other measures- are anticipated to total in the tens of millions of dollars for each plan.

2.2.2 Hazardous Materials Incident

Hazardous Material Storage and Release A major Superfund Amendments and Reauthorization Act (SARA) provision is Title III, also referred to as or SARA Title III or the Emergency Planning and Community Right-to-Know Act (EPCRA). EPCRA establishes guidelines for Federal, State and local governments and industry regarding emergency planning and providing communities with information on hazardous chemicals within their jurisdiction. The State of Vermont's implementation of its SARA requirements was approved by the Legislature in 1994. Chittenden County was designated as an emergency planning district and Vermont Emergency Management established a Local Emergency Planning Committee, known as LEPC #1, for the county. The function of the LEPC is to carry out duties proscribed in SARA Title III. In addition, Vermont statute dictates that the LEPC shall insure that the local emergency response plan has been implemented upon notification of a release of hazardous chemical or substance, consult and coordinate with municipal emergency service providers, DEMHS and the managers of all HAZMAT facilities within Chittenden County regarding the facility plan, and review and evaluate requests for funding. Farmers are not required to report agricultural chemicals stored on their properties, but they do not typically store and keep large amounts of these chemicals.

Currently there are more than 300 hazardous materials storage sites registered with the state and the LEPC #1. Of these, about 120 contain Extremely Hazardous Substances (EHS) and about 200 have fuel storage exceeding 10,000 pounds (1,500 gallons). The University of Vermont campus has numerous labs and research facilities. Individual locations of EHS and large-capacity fuel storage are identified in each municipal annex.

DEMHS categorizes hazardous materials release incidents according to nine nationally standardized categories. TRYING TO UPDATE: DEMHS reported the following numbers of incidents per class as follows:

Table 2-12 Recorded hazardous material release, Chittenden County, Vermont, 6/2000 – 7/2008

Class of Hazardous Materials	# of events
Class 1 – Explosives	13
Class 2 – Gases	37
Class 3 – Flammable liquids and combustible liquids	245
Class 4 – Flammable solids; Spontaneously combustible materials; and Dangerous when wet materials	0
Class 5 – Oxidizers and Organic peroxides	0
Class 6 – Toxic Materials and infectious substances	9
Class 7 – Radioactive materials	1
Class 8 – Corrosive materials	5
Class 9 – Miscellaneous dangerous goods	4
Unclassed	144
TOTAL	**458**

Source: Vermont Emergency Management
Notes: Unclassed includes some gasoline/petroleum product spills, many instances of suspicious white powder, some unknown substances, etc. One entry in the duty officer log is described as "various", and refers to a May 2007 fire in a UVM Geology lab, where a number of different chemicals were released. The Saputo Cheese Factory

fire in September 2008 is not included in the timeframe shown here, but also resulted in the release of various chemicals.

In September 2008, a warehouse at the Saputo Cheese Factory in Hinesburg caught fire. Hazardous cleaning chemicals stored at the site, including sodium hydroxide, became airborne and caused half a million dollars worth of damage to firefighting equipment. The incident has raised awareness and concern among county emergency responders regarding Hazmat capabilities.

With regards to radiological hazards, small amounts of radioactive material are stored at individual medical and research facilities in Chittenden County. As noted in *Table 2-8* above, only one minor release of such materials has occurred in recent years. Date??

Hazardous Waste Sites A significant potential for severe pollution impacts to water and ecosystems exists from hazardous waste sites. The future likelihood of such an event, however, is unquantifiable. Lee working to update this. There are 250 hazardous waste locations in Chittenden County, according to a database maintained by Vermont ANR. These sites are areas where groundwater or soil contamination from sources such as underground fuel storage tanks has been identified. Many of the sites have been or are in the process of being cleaned up. Others are at the assessment stage or are awaiting funding for cleanup. This list includes only sites that have been voluntarily reported to the state; other unknown hazardous waste sites may exist.

Table 2-13 Active hazardous waste sites, Chittenden County, February 2016 (update)

Municipality	Hazardous Waste Sites
Bolton	3
Buels Gore	0
Burlington	70
Charlotte	10
Colchester	22
Essex/Essex Jct.	20
Hinesburg	9
Huntington	4
Jericho	5
Milton	14
Richmond	4
Shelburne	13
South Burlington	46
St. George	0
Underhill	2
Westford	1
Williston	18
Winooski	9
TOTAL	**250**

Source: Vermont Agency of Natural Resources, Waste Management Division, http://www.anr.state.vt.us/dec/wastediv

Two of the above locations are EPA-designated Superfund sites. One, located at an industrial site on Commerce St. in Williston, is contaminated with heavy metals and industrial solvents, which have resulted in water and air quality problems at nearby residences. The groundwater contamination has the potential to affect the water supplies of over 1,500 people living within four miles. The other Superfund site, the Pine St. Barge Canal in Burlington, was the site of an early 20th century gas works, and is contaminated with hydrocarbons, volatile organic compounds, and heavy metals. The water at this site drains directly into nearby Lake Champlain. Numerous businesses and residences are located within one mile of the site. The other hazardous waste sites in the county are smaller in scale and severity.

No data was available or obtained beyond the hazardous materials release data summarized in *Table 2-8*. Data on reported hazardous materials spills collected by DEMHS was reviewed. However, a closer review showed that the location of the spills by municipality contained some inaccuracies and the amounts spilled were recorded in different units. This data shows that nearly all such hazardous materials spill incidents consist of accidental discharges of gasoline, diesel or fuel oil when customers or delivery personnel are pumping these products. The majority of spills were in quantities of less than 5 gallons.

The U.S. Coast Guard Station in Burlington maintains data on fuel spills in Lake Champlain that it has responded to. In 2002 they responded and assisted one small pleasure boat that was leaking gas. In 2003 they responded to a 200-300 gallon fuel oil spill near St. Albans in Franklin County, Vermont that was then responded to by the local fire department. That same year, a marine fuel gas spill of approximately 10 gallons occurred at the Shelburne Shipyard that was then responded to by the HAZMAT team of the Shelburne Volunteer Fire Department. In summer 2008, a small craft sank in Burlington harbor and leaked fuel. In summer 2009, a Vermont Air National Guard aircraft dropped a fuel tank into the lake. Being updated????

Military Ordnance Several military facilities are located in Chittenden County, operated by the Vermont National Guard, the Army Reserve, and the Coast Guard. As part of military operations, military ordnance is stored within the county. The ordnance is considered well secured and is regularly inspected. Potential exists for an ordnance incident, but the Vermont National Guard has Explosive Ordnance Disposal teams equipped to deal with the ordnance stored in the county. These teams also have mutual aid agreements with emergency officials in the surrounding municipalities that could be called upon in the case of an incident.

2.2.3 Power Loss

Electrical services in the City of Burlington are provided by the Burlington Electric Department. Green Mountain Power Corporation provides electrical distribution services for most of the remaining municipalities with the exception of certain sections of Milton, Westford, Underhill and Jericho, which are served by Central Vermont Public Service Corporation. Vermont Electric Co-op based in Johnson also has service territory in Chittenden County. Service outages are a common problem in the eastern portions of Chittenden County due to the greater frequency of high winds, heavy snow, and lightning strikes, though most such outages are under two hours in duration.

The most significant disruptions to electrical services are events which cause outages lasting more than a day and those which affect a wide area. This was the case during the January 1998

ice storm and some severe storms in 2003. While it is fortunate that no major high voltage electric transmission lines came down in Chittenden County during the 1998 Ice Storm, these did come down dramatically in other parts of the northeast and Canada. Update with info about nfo about 2008 hinesburg outage and dec 2014 outage

While there are some power generation facilities in Chittenden County, the county is largely reliant on electricity generated elsewhere in Vermont or out of state. The failure or incapacitation of any of the high-voltage transmission lines that carry electricity into and through the county could cause a significant outage.

Peak electricity use has been on the rise in Chittenden County, especially in summer. This strain on the transmission system could result in brownouts or power outages. Due to the low energy production in the county, up to 90% of northwest Vermont's electricity at summer peak times comes through the VELCO (Vermont Electric Power Company) Transmission System. Since 2003, VELCO has been working on upgrading its transmission system from Rutland to Burlington as part of the Northwest Reliability Project. Along with the upgrade of the transmissions system, efforts are being made in the county to reduce peak electricity use through energy efficiency measures. It is worth noting that temporary Power Loss is often a consequence of Severe Winter Storms and occasionally of Severe Rainstorms.

2.2.4 Invasive Species

The populations of invasive species, in the form of aquatic invasives such as zebra mussels, alewives, and Eurasian watermilfoil or tree pests such emerald ash borer, Asian longhorned beetle or hemlock wooly adelgid, have not yet reached crisis proportions. However, given their hypothetical impacts to the natural resources valued in the county, the CCRPC felt it appropriate to begin to include it as a distinct profiled Hazard in the Plan. As with the hazard of Water Pollution, if the management of invasive species requires substantial programmatic efforts, the impacts to the budgets of municipalities, service providers (such as water service operators) and taxpayers could be significant.

Given the importance of Lake Champlain to the County, aquatic invasive species are the most significant with regards to this Plan. The Lake Champlain Basin Program notes:

Aquatic invasive species (AIS) include include plants, animals, and pathogens that may be intentionally or unintentionally introduced to the Basin. Nonnative species—species that were not present at the time of European settlement—were first documented in Lake Champlain as early as 1840. As of 2014, 50 known aquatic non-native and invasive species have been identified. The Lake Champlain Basin Program was a key partner in the development of the 2005 Lake Champlain Basin Aquatic Nuisance Species Management Plan, along with the states and many other groups. The plan sets priorities for AIS control and management and is eligible for U.S. Fish and Wildlife Service funding to support programs such as water chestnut control and boat launch stewardship. Of the known 50 invasive species in the Lake, several are high management priorities in the management plan (including) Alewife, Asian Clam, Eurasion Watermilfoil, Japanese Knotweed, Purple Loosestrife, Water Chestnut and Zebra Mussel

2.2.5 Multi-Structure Fire

According to the *2007?2013?? Vermont State All-Hazards Mitigation Plan,*

> Vermont has one of the highest per capita death rates from fire in the nation. This is the deadliest form of disaster throughout the state. In 2000, there were 831 structural fires in the state, 12 of which resulted in 22 civilian deaths. 20 of those deaths occurred at residences. Although there have been requirements for smoke detectors in rental housing for over 20 years, and requirements for smoke detectors in single family dwellings since 1994, only one building involved in the fatal fires in 2000 had working smoke alarms. For some remote locations, access to water for emergency vehicles has been a factor in controlling an outbreak of fire.

The Fire Marshall Report of 2014 estimated property loss of over $40 million dollars a year due to fires statewide.

In September 2008, the Saputo Cheese Factory warehouse in Hinesburg caught fire, necessitating a response from multiple fire departments. The company subsequently decided to close the facility, a decision that has resulted in serious economic consequences for Hinesburg.

Of concern to the more urbanized portions of Chittenden County are multi-structure fires that destroy multiple homes and businesses, even entire downtown areas. Although Burlington and Williston have had significant structural fires in recent years, no town in Chittenden County has lost a significant portion (at least several blocks) of its downtown area to fire.

In describing major urban fire events, CCRPC considered only the frequency of multi-structure fires. Many of the county's municipalities are at reduced risk for this type of event, as their population is mostly dispersed in single-family homes in rural areas. Regarding multi-structure fire, the *2007 2013 Vermont State All-Hazards Mitigation Plan* states that: "Even in their village or downtown areas, most lot sizes are at least an acre in size, which limits the likelihood of a multi-structure fire. The municipalities where there is a theoretical likelihood of a significant multi-structure fire are those communities with denser urban residential or mixed-use areas, large apartment buildings, condominiums, or small lot mobile home parks."

The frequency of non-EMS fire department responses for 2005 - 2007 is noted below in the following table along with the Insurance Service Organization (ISO) mitigation rating for each fire department.

Table 2-10 State of Vermont's Fire Marshal's report for 2012-2014 and Public Protection Class rating for fire departments operating in Chittenden County.

Dept. / FDID	ISO Rating	Year	Service Good Intent	False Alarm	Hazardous Condition	Structural Fire	Other	Sub-total	Total Calls	Dept. Avg.
Bolton - 04069	7/9	2012				2	1	3		
		2013	18	12	5	10	23	68		
		2014	7	11	10	2	6	36		
Burlington - 04114	3	2005	495	779	207	125	99	1705	1732	**1777**
		2006	473	710	156	139	90	1568	1599	
		2007	599	851	253	127	121	1951	2000	
Dept. /	**ISO Ratin**	**Year**	**Service Good**	**False**	**Hazardous**	**Structural**	**Other**	**Sub-**	**Total**	**Dept.**

FDID	g		Intent	Alarm	Condition	Fire		total	Calls	Avg.
Charlotte -04138	9/10	2005	4	26	45	16	11	102	102	**70**
		2006	2	12	19	10	9	52	53	
		2007	7	13	28	3	3	54	54	
Colchester - 04153	3	2005	130	170	150	8	20	478	552	**527**
		2006	130	136	153	13	16	448	502	
Essex - 04207	5/9	2005	56	104	116	36	35	347	364	**320**
		2006	83	124	132	32	28	399	416	
		2007	23	59	68	14	13	177	181	
Essex Junction - 04208	4	2006	27	75	78	37	32	249	274	**291**
		2007	44	86	82	31	27	270	307	
Hinesburg - 04294	6/9	2005	16	15	23	5	10	69	88	**80**
		2006	16	14	30	11	8	79	95	
		2007	7	9	24	6	4	50	56	
Huntington - 04303	9/10	2005				2			2	**19**
		2006	5	4	18	5	1	33	33	
		2007	1	4	15	3		23	23	
IBM - 04806		2005		1	4		7	12	12	**11**
		2006		2	5	1	4	12	12	
.		2007	5		2		2	9	9	
Mallets Bay - 04808	5	2005	19	49	31	15	18	132	334	**316**
		2006	17	43	29	17	23	129	304	
		2007	21	70	25	13	7	136	310	
Milton - 04396	5/9	2005	17	21	38	11	32	119	128	**137**
		2006	21	28	35	14	27	125	139	
		2007	24	37	39	16	17	133	145	
Richmond - 04519	6/9									
St. George	9									
Shelburne - 04582	6/9	2005	31	81	71	7	9	199	209	**198**
		2006	32	86	44	8	7	177	185	
		2007	42	63	69	6	12	192	199	
S. Burlington - 04600	4	2005	202	276	219	59	71	827	836	**833**
		2006	194	276	181	75	68	794	808	
		2007	237	330	154	74	47	842	856	
Dept. / FDID	**ISO Ratin**	**Year**	**Service Good**	**False Alarm**	**Hazardous Condition**	**Structural Fire**	**Other**	**Sub-total**	**Total Calls**	**Dept. Avg.**

	g		Intent							
Underhill-Jericho - 04660	5/9	2005	33	28	39	11	11	122	122	**125**
		2006	22	27	49	14	9	121	124	
		2007	44	35	22	11	15	127	128	
Westford - 04720	9/10	2005	1	3	9	4	8	25	28	**29**
		2007	4	4	12	5	4	29	30	
Williston - 04759	5/9	2006	216	110	240	26	24	616	626	**616**
		2007	246	171	143	16	25	601	605	
Winooski -04774	4	2005	62	40	27	9	8	146	146	**200**
		2006	108	35	48	26	11	228	228	
		2007	93	62	41	21	9	226	227	
TOTAL			3809	5069	3173	1082	1002	14133	15183	

Sources: State of VT Report of the Fire Marshal; Vermont Dept. of Banking, Insurance, Securities, and Health Care Administration.

Notes: Population cited in table is from most recent Fire Marshall's report, where available. Not all towns reported data in 2005-2007. "Other" includes vehicle, outdoor, wildland, and other fires. Omitted categories "Cancelled Enroute" and "other calls" make up the discrepancy between subtotal and total calls.

ISO Rating see (http://www.isomitigation.com): ISO collects information on municipal fire-protection efforts in communities throughout the United States. In each of those communities, ISO analyzes the relevant data using our Fire Suppression Rating Schedule (FSRS). We then assign a Public Protection Classification from 1 to 10. Class 1 represents exemplary public protection, and Class 10 indicates that the area's fire-suppression program doesn't meet ISO's minimum criteria. By classifying communities' ability to suppress fires, ISO helps the communities evaluate their public fire-protection services. …. A community's PPC depends on: fire alarm and communication systems, including telephone systems, telephone lines, staffing, and dispatching systems; the fire department, including equipment, staffing, training, and geographic distribution of fire companies; and the water supply system, including the condition and maintenance of hydrants, and a careful evaluation of the amount of available water compared with the amount needed to suppress fires…..When ISO develops a single Public Protection Classification (PPCTM) for a community, all of the community's properties receive that classification. In many communities, ISO develops a split classification (for example, 5/9). Generally, the first class, (Class 5 in the example) applies to properties within five road miles of a fire station and within 1,000 feet of a fire hydrant. The second class (Class 9 in the example) applies to properties within five road miles of a fire station but beyond 1,000 feet of a hydrant. ISO generally assigns Class 10 to properties beyond five road miles.

2.2.6 Major Transportation Incident

Air Transportation Incident The presence of the Burlington International Airport and the Vermont National Guard in the City of South Burlington raises the potential for a crash of a passenger, cargo or military plane or helicopter. Assessing the likelihood and potential damages from such incidents is a difficult endeavor. The CCRPC does not have the resources to complete this kind of analysis in order to calculate potential damages and casualties. There is no history of large aircraft crashing in Chittenden County, though emergency landings have taken place at the airport. A small plane approaching the airport crashed in Williston in Novemberber 2005, resulting in a single fatality. Local officials indicate that other small aircraft crashes have taken place in the past.

Actively mitigating against air incidents is currently a multiparty endeavor. The airport is managed by the City of Burlington, and the terminal is patrolled by officers with the Burlington Police Department. The Federal Transportation Security Administration handles passenger and cargo screening and perimeter security. Air crashes, both civilian and military, are the joint responsibility of the South Burlington Fire Department and the Air National Guard.

An Emergency Phase Response Plan mutual aid agreement was completed for Burlington International Airport in 2005 and signed by all agencies that respond to the airport in an emergency.

Marine Incident Another potential transportation incident is the grounding or sinking of a commercial passenger/car ferry or excursion/cruise vessel in Lake Champlain. There are two passenger/car ferry routes in Chittenden County, both operated by the private Lake Champlain Transportation Company. The first route is a one-hour crossing from the waterfront in Burlington to Port Kent, New York. Serving primarily tourists, it operates from Memorial Day weekend through mid-October. The second route is a 20-minute crossing from the terminus of Ferry Road in Charlotte to Essex, New York. It operates year-round and serves primarily commuting workers.

An incident with a Lake Champlain Transportation Company ferry occurred in Grand Isle in January 2009. A ferry hit a dock, damaging the dock and causing three injuries, none serious. An event of this sort in the more crowded Burlington harbor would likely cause significantly more damage, but the risk of this has not been evaluated.

Several companies, all operating from the Burlington waterfront, operate excursion or cruise vessels during the tourist season. The Lake Champlain Transportation Company operates the vessel, *Northern Lights*, capable of accommodating up to 150 guests. Lake Champlain Shorelines Cruises operates the 500-passenger vessel, *The Spirit of Ethan Allen III.* The Whistling Man Schooner Company operates a 17-passenger sailing sloop, the *Friend Ship*. No data concerning the likelihood of such vessels grounding or sinking was available.

Collision, grounding, or sinking of small, non-commercial watercraft can also occur and cause loss of life. Response to these maritime incidents is the responsibility of the Coast Guard.

Rail Transportation Incident The potential crash of a freight or passenger train is another hazard worth consideration. Two rail lines transit the county, the New England Central Railroad and Vermont Railway. Both lines rely on freight traffic for their primary income. Serious rail accidents in Vermont are rare. The worst train disaster in Chittenden County in recent memory took place in 1984, when a train derailment in Williston resulted in 5 deaths and over 200 injuries. Emergency response in that incident was hindered by the lack of road access to the accident site. Local officials have some concern over the status of rail infrastructure, as erosion undermining tracks caused a freight train derailment in Middlebury (in neighboring Addison County) in 2007. In that incident, concerns about hazardous materials resulted in parts of Middlebury being evacuated. Burlington officials note that almost all of the fuel oil delivered to Chittenden County arrives by rail and is off-loaded along the Burlington waterfront. A rail incident that halts fuel oil delivery, even for a few days, would affect the ability of residences and businesses to maintain heat and hot water.

New England Central Railroad originates in East Alburg near the Canadian border and then proceeds through Swanton and St. Albans in Franklin County before it heads south through Milton and Colchester and then continues southwest to a station in Essex Junction wherein the line heads due east along the Winooski River through Williston, Richmond and Bolton and thence to Montpelier and White River Junction and then south along the Vermont/New Hampshire border. The Railroad also operates the short "Winooski subdivision" line from Essex Junction into the Burlington yard of the Vermont Railway. The primary commodities carried by this line in recent years are lumber, paper and steel. The risk of a hazardous material spill as a result of a railway accident has not been evaluated, but is of concern to officials in towns along the railroad right-of-way.

New England Central Railroad operates its entire line on land owned by one of the largest railroads in North America, Canadian National, which also owns the line between East Alburg and Montreal. The Railroad also hosts Amtrak passenger service, the Vermonter, which runs once a day, southbound in the morning and northbound in the afternoon between St. Albans, New York City's Penn Station and Union Station in Washington, D.C.

Vermont Railway originates in Burlington and heads due south through South Burlington, Shelburne and Charlotte in a corridor located between the shore of Lake Champlain and U.S. Route 7. The line continues down to Middlebury, then to Rutland and terminates in Hoosick Junction, New York.

Road Transportation Incident The most common form of transportation incident or accident is an automotive accident. The Vermont Agency of Transportation has identified the following High Crash Locations (HCLs) in Chittenden County. The listing here of HCLs is mostly intersections, though the report also lists numerous sections of road with high accident rates. They are not included here because they are identified in the report by mileage, which makes colloquially describing their locations difficult. These road segments are identified in the municipal annexes.

Table 2-14 High crash locations in Chittenden County, 2008-2012

Route	Town	Mileage	Crashes	Severity Index ($/Accident/1.)
US-2, I-89	Colchester	1.830 - 2.030	38	$49,692
US-2, I-89	Colchester	2.040 - 2.150	16	$35,706
US-2, S PROSPECT ST., BURLINGTON, <T0000>	Burlington	0.220 - 0.240	73	$27,014
US-2, DORSET ST., SOUTH BURLINGTON	South Burlington	0.490 - 0.500	106	$15,756
US-2, WHITE ST., SOUTH BURLINGTON	South Burlington	0.860 - 0.880	57	$20,109
US-2, PATCHEN ROAD, SOUTH BURLINGTON, VT-116	South Burlington	0.990 - 1.010	61	$14,930
US-2, AIRPORT DRIVE, SOUTH BURLINGTON, SO. BURLINGTON (FAP 121-1 KENNEDY DRIVE)	South Burlington	1.880 - 1.910	74	$20,492
US-2, INDUSTRIAL AVE., WILLISTON	Williston	0.250 - 0.270	29	$16,448
US-2, VT-2A	Williston	1.420 - 1.440	79	$19,097

US-2, FAS 0209	Richmond	2.690 - 2.770	26	$11,592
VT-2A, MARSHALL AVE., WILLISTON	Williston	3.320 - 3.340	61	$15,931
VT-2A, INDUSTRIAL AVE., WILLISTON, MT. VIEW ROAD, WILLISTON	Williston	4.780 - 4.800	46	$21,461
VT-2A, EAST ROAD, COLCHESTER, MILL POND ROAD, COLCHESTER	Colchester	1.430 - 1.510	27	$27,048
US-7, FAS 0208, TOWN ROAD 0003	Charlotte	3.360 - 3.520	21	$33,505
US-7, HARBOR ROAD, SHELBURNE, TOWN ROAD 0002	Shelburne	1.970 - 1.990	32	$15,741
US-7, <0189>, SWIFT ST., SOUTH BURLINGTON	South Burlington/Burlington	1.720 - 0.010	66	$13,142
US-7, MAIN ST., BURLINGTON, US-2	Burlington	2.110 - 2.130	74	$21,558
US-7, PEARL ST., BURLINGTON	Burlington	2.420 - 2.440	58	$27,617
US-7, BURLINGTON (ALTERNATE US-7)	Burlington	3.050 - 3.070	32	$22,303
US-7, W. ALLEN ST., WINOOSKI CITY, VT-15, E. CANAL ST., WINOOS, W. CENTER ST., WINOO, <T0000>	Winooski City	0.040 - 0.230	152	$19,266
US-7, E SPRING ST., WINOOSKI CITY, W SPRING ST., WINOOSKI CITY	Winooski City	0.430 - 0.450	38	$36,095
US-7, I-89	Colchester	0.170 - 0.230	36	$20,814
US-7, VT. 127 TH, COLCHESTER, SEVERANCE ROAD, COLCHESTER	Colchester	1.940 - 2.040	50	$32,190
US-7, VT-2A	Colchester	3.580 - 3.650	54	$23,819
VT-15, DION ST., WINOOSKI CITY	Winooski City	0.570 - 0.590	31	$17,932
VT-15, I-89	Winooski City	0.700 - 0.720	39	$23,487
VT-15, SUSIE WILSON RD.,ESSEX JUNCTION VILLAGE	Essex	0.510 - 0.660	77	$17,429
VT-15, WEST ST. EXT., ESSEX JUNCTION VILLAGE	Essex	0.960 - 1.080	33	$26,679
VT-116, FAS 0210	Hinesburg	5.410 - 5.510	31	$20,190
VT-116, CHEESEFACTORY RD., SOUTH BURLINGTON	South Burlington	0.160 - 0.320	14	$40,807
VT-117, FAS 0213	Richmond	0.650 - 0.750	13	$14,285
BURLINGTON (ALTERNATE US-7), MAIN ST., BURLINGTON	Burlington	0.990 - 1.010	101	$16,788
BURLINGTON (ALTERNATE US-7), PEARL ST., BURLINGTON	Burlington	1.310 - 1.330	58	$27,464
BURLINGTON (ALTERNATE US-7), NORTH ST., BURLINGTON	Burlington	1.620 - 1.640	22	$24,809
SO. BURLINGTON (FAP 121-1 KENNEDY DRIVE), DORSET ST., SOUTH BURLINGTON, I-89	South Burlington	0.000 - 0.010	40	$12,400
COLCHESTER AVE., BURLINGTON, BARRETT ST., BURLINGTON	Burlington	0.990 - 1.010	24	$82,233
BATTERY ST., BURLINGTON, MAIN ST., BURLINGTON	Burlington	0.220 - 0.240	52	$23,879
VT. 127 BELTLINE, BURLINGTON, <5009>	Burlington	1.340 - 1.500	7	$72,714
VT. 127 BELTLINE, BURLINGTON, <5042>	Burlington	3.360 - 3.470	10	$91,240
COLCHESTER AVE., BURLINGTON, EAST AVE., BURLINGTON	Burlington	0.430 - 0.450	41	$22,559
MAIN ST., BURLINGTON, ST. PAUL ST., BURLINGTON	Burlington	0.250 - 0.270	34	$68,900
NORTH AVE., BURLINGTON, PLATTSBURG AVE., BURLINGTON	Burlington	3.090 - 3.100	16	$22,025

NORTH ST., BURLINGTON, N CHAMPLAIN ST., BURLINGTON	Burlington	0.220 - 0.240	26	$22,362
N UNION ST., BURLINGTON, S UNION ST., BURLINGTON, <T0000>	Burlington	0.000 - 0.010	14	$23,900
PARK ST., BURLINGTON, NORTH ST., BURLINGTON	Burlington	0.280 - 0.300	20	$22,900
PARK ST., BURLINGTON, MANHATTAN DRIVE, BURLINGTON, VT. 127 BELTLINE, BURLINGTON	Burlington	0.480 - 0.490	39	$21,692
PEARL ST., BURLINGTON, <T0000>, S PROSPECT ST., BURLINGTON, COLCHESTER AVE., BURLINGTON	Burlington	0.930 - 0.940	44	$31,982
W. ALLEN ST., WINOOSKI CITY, MALLETTS BAY AVE., WINOOSKI CITY, <T0000>, W. CENTER ST., WINOO	Winooski City	0.000 - 0.010	7	$8,900
PATCHEN ROAD, SOUTH BURLINGTON, WHITE ST., SOUTH BURLINGTON	South Burlington	0.080 - 0.100	29	$23,997
SUSIE WILSON RD., ESSEX, KELLOGG ROAD, ESSEX	Essex	0.480 - 0.500	51	$11,645
VT. 127 TH, COLCHESTER, PORTER POINT RD., COLCHESTER	Colchester	0.860 - 0.940	25	$26,056
VT. 127 TH, COLCHESTER, W. LAKESHORE DR., COLCHESTER	Colchester	2.170 - 2.230	22	$52,691
VT. 127 TH, COLCHESTER, E. LAKESHORE DR., COLCHESTER	Colchester	3.170 - 3.250	24	$17,650
CHURCH RD., COLCHESTER, PORTER POINT RD., COLCHESTER	Colchester	0.000 - 0.040	10	$15,900
MIDDLE ROAD, MILTON, RAILROAD STREET, MILTON	Milton	2.960 - 3.020	11	$47,891
VT. 127 BELTLINE, BURLINGTON, <5042>	Burlington	3.360 - 3.470	10	$91,240
BURLINGTON (ALTERNATE US-7), MAIN ST., BURLINGTON	Burlington	0.990 - 1.010	101	$16,788
VT. 127 BELTLINE, BURLINGTON, <5009>	Burlington	1.340 - 1.500	7	$72,714
US-7, W. ALLEN ST., WINOOSKI CITY, VT-15, E. CANAL ST., WINOOS, W. CENTER ST., WINOO, <T0000>	Winooski City	0.040 - 0.230	152	$19,266
NORTH ST., BURLINGTON, N CHAMPLAIN ST., BURLINGTON	Burlington	0.220 - 0.240	26	$22,362
US-2, I-89	Colchester	1.830 - 2.030	38	$49,692
US-2, FAS 0209	Richmond	2.690 - 2.770	26	$11,592
US-7, MAIN ST., BURLINGTON, US-2	Burlington	2.110 - 2.130	74	$21,558
SUSIE WILSON RD., ESSEX, KELLOGG ROAD, ESSEX	Essex	0.480 - 0.500	51	$11,645
US-2, DORSET ST., SOUTH BURLINGTON	South Burlington	0.490 - 0.500	106	$15,756
MAIN ST., BURLINGTON, ST. PAUL ST., BURLINGTON	Burlington	0.250 - 0.270	34	$68,900
BATTERY ST., BURLINGTON, MAIN ST., BURLINGTON	Burlington	0.220 - 0.240	52	$23,879
US-2, S PROSPECT ST., BURLINGTON, <T0000>	Burlington	0.220 - 0.240	73	$27,014
VT-15, SUSIE WILSON RD.,ESSEX JUNCTION VILLAGE	Essex	0.510 - 0.660	77	$17,429
COLCHESTER AVE., BURLINGTON, BARRETT ST., BURLINGTON	Burlington	0.990 - 1.010	24	$82,233
US-7, VT-2A	Colchester	3.580 - 3.650	54	$23,819
PARK ST., BURLINGTON, NORTH ST., BURLINGTON	Burlington	0.280 - 0.300	20	$22,900
COLCHESTER AVE., BURLINGTON, EAST AVE., BURLINGTON	Burlington	0.430 - 0.450	41	$22,559
VT-116, FAS 0210	Hinesburg	5.410 - 5.510	31	$20,190

BURLINGTON (ALTERNATE US-7), NORTH ST., BURLINGTON	Burlington	1.620 - 1.640	22	$24,809
PATCHEN ROAD, SOUTH BURLINGTON, WHITE ST., SOUTH BURLINGTON	South Burlington	0.080 - 0.100	29	$23,997
PEARL ST., BURLINGTON, <T0000>, S PROSPECT ST., BURLINGTON, COLCHESTER AVE., BURLINGTON	Burlington	0.930 - 0.940	44	$31,982
VT-2A, INDUSTRIAL AVE., WILLISTON, MT. VIEW ROAD, WILLISTON	Williston	4.780 - 4.800	46	$21,461
US-2, PATCHEN ROAD, SOUTH BURLINGTON, VT-116	South Burlington	0.990 - 1.010	61	$14,930
VT. 127 TH, COLCHESTER, W. LAKESHORE DR., COLCHESTER	Colchester	2.170 - 2.230	22	$52,691
US-7, E SPRING ST., WINOOSKI CITY, W SPRING ST., WINOOSKI CITY	Winooski City	0.430 - 0.450	38	$36,095
VT-2A, MARSHALL AVE., WILLISTON	Williston	3.320 - 3.340	61	$15,931
US-7, BURLINGTON (ALTERNATE US-7)	Burlington	3.050 - 3.070	32	$22,303
US-7, FAS 0208, TOWN ROAD 0003	Charlotte	3.360 - 3.520	21	$33,505
SO. BURLINGTON (FAP 121-1 KENNEDY DRIVE), DORSET ST., SOUTH BURLINGTON, I-89	South Burlington	0.000 - 0.010	40	$12,400
US-2, WHITE ST., SOUTH BURLINGTON	South Burlington	0.860 - 0.880	57	$20,109
BURLINGTON (ALTERNATE US-7), PEARL ST., BURLINGTON	Burlington	1.310 - 1.330	58	$27,464
VT-15, WEST ST. EXT., ESSEX JUNCTION VILLAGE	Essex	0.960 - 1.080	33	$26,679
US-2, I-89	Colchester	2.040 - 2.150	16	$35,706
US-7, PEARL ST., BURLINGTON	Burlington	2.420 - 2.440	58	$27,617
US-7, <0189>, SWIFT ST., SOUTH BURLINGTON	South Burlington/Burlington	1.720 - 0.010	66	$13,142
US-2, VT-2A	Williston	1.420 - 1.440	79	$19,097
US-2, INDUSTRIAL AVE., WILLISTON	Williston	0.250 - 0.270	29	$16,448
VT. 127 TH, COLCHESTER, PORTER POINT RD., COLCHESTER	Colchester	0.860 - 0.940	25	$26,056
US-7, HARBOR ROAD, SHELBURNE, TOWN ROAD 0002	Shelburne	1.970 - 1.990	32	$15,741
VT-2A, EAST ROAD, COLCHESTER, MILL POND ROAD, COLCHESTER	Colchester	1.430 - 1.510	27	$27,048
N UNION ST., BURLINGTON, S UNION ST., BURLINGTON, <T0000>	Burlington	0.000 - 0.010	14	$23,900
NORTH AVE., BURLINGTON, PLATTSBURG AVE., BURLINGTON	Burlington	3.090 - 3.100	16	$22,025
US-2, AIRPORT DRIVE, SOUTH BURLINGTON, SO. BURLINGTON (FAP 121-1 KENNEDY DRIVE)	South Burlington	1.880 - 1.910	74	$20,492
PARK ST., BURLINGTON, MANHATTAN DRIVE, BURLINGTON, VT. 127 BELTLINE, BURLINGTON	Burlington	0.480 - 0.490	39	$21,692
VT. 127 TH, COLCHESTER, E. LAKESHORE DR., COLCHESTER	Colchester	3.170 - 3.250	24	$17,650
MIDDLE ROAD, MILTON, RAILROAD STREET, MILTON	Milton	2.960 - 3.020	11	$47,891
VT-117, FAS 0213	Richmond	0.650 - 0.750	13	$14,285
VT-116, CHEESEFACTORY RD., SOUTH BURLINGTON	South Burlington	0.160 - 0.320	14	$40,807
CHURCH RD., COLCHESTER, PORTER POINT RD., COLCHESTER	Colchester	0.000 - 0.040	10	$15,900

VT-15, DION ST., WINOOSKI CITY	Winooski City	0.570 - 0.590	31	$17,932
US-7, VT. 127 TH, COLCHESTER, SEVERANCE ROAD, COLCHESTER	Colchester	1.940 - 2.040	50	$32,190
US-7, I-89	Colchester	0.170 - 0.230	36	$20,814
W. ALLEN ST., WINOOSKI CITY, MALLETTS BAY AVE., WINOOSKI CITY, <T0000>, W. CENTER ST., WINOO	Winooski City	0.000 - 0.010	7	$8,900
VT-15, I-89	Winooski City	0.700 - 0.720	39	$23,487

Source: Vermont Agency of Transportation

Road Infrastructure Failure Another form of transportation incident is road infrastructure failure. The flooding in 1927 washed out many of the bridges in the county, and significant flooding could have similarly devastating impacts on road infrastructure now. The Winooski River essentially bisects Chittenden County, stretching for approximately 40 miles, forming the town line between several towns and passing through others. There are only eight bridges on public roads crossing the Winooski River, and the incapacitation of even one could create lengthy detours and problems for emergency responders.

The Bridge Street Bridge over the Winooski River in Richmond was found to be structurally deficient in 2007 and restricted to single-lane traffic, and was closed briefly in the fall of 2008 to all but pedestrians and bicycles. Though the bridge was repaired in spring 2009, the six-week closure forced all automotive traffic to take an approximately eight mile detour. The bridge closure also had a significant negative impact on local emergency response capability and businesses in downtown Richmond. While the likelihood of a catastrophic bridge failure has not been evaluated for Chittenden County, the situation in Richmond has shown that even a non-catastrophic bridge closure can have a large impact on the community.

Another bridge that closes periodically due to Natural Hazards is the North Williston Road bridge over the Winooski River between Essex and Williston. During high water and flood events the roads leading to the bridge span itself become inundated and must be closed by the respective Town police departments. Closures typically only last a day or two but some commuter and truck traffic is impacted.

The Vermont Agency of Transportation regularly inspects bridges. In terms of vulnerabilities to Natural Disasters bridges are most suspectible to damage or failure from floods and fluvial erosion. One mechanism to assess potential vulnerability is to assess potential damage from "scouring". In addition to examining decking, load and other feature of a bridge, the inspection also assigns a "Scour Critical" rating. Bridges receiving a score of 3 or lower are considered Scour Critical. Of the 225 bridges inspected below, only 9 received this rating.

Table 2-x State bridges inspected in Chittenden County

TownName	BridgeType	FeaturesIn	ScourCriti
BOLTON	R.C. BOX CULVERT	I 89 OVER TH NO 4	N
BOLTON	5 SP CONT WELDED PL	I 89 OVER U.S.2	
BOLTON	6 SP CONT WELDED PL	I 89 OVER U.S.2	
BOLTON	4 SPN CONT WGIR/RB	I 89 OVER US2&JOINER BK	8
BOLTON	5 SPN CONT WGIR/RB	I 89 OVER US2&JOINER BK	8
BOLTON	CONCRETE T-BEAM	JOINER BROOK	3

BOLTON	ROLLED BEAM	JOINER BROOK	8
BOLTON	ROLLED BM W TMBR DK	MILL BROOK	8
BOLTON	ROLLED BEAM	PRESTON BROOK	U
BURLINGTON	3 SP CABLE STAYED	BIKE PATH OVER VT127	
BURLINGTON	STEEL PONY TRUSS	BURLINGTON BIKEPATH	
BURLINGTON	CONT. WELDED GIRDER	E A PKY OVER VT 127	N
BURLINGTON	CONT. WELDED GIRDER	E A PKY OVER VT127	
BURLINGTON	WELDED PLATE GIRDER	FAU TH 11 OVER VT 127	
BURLINGTON	WELDED PLATE GIRDER	FAU TH11 OVER VT127	N
BURLINGTON	2 SP CONT. WLD PL GD	I189 UNDER US 7	
BURLINGTON	ROLLED BEAM	N.E.C.R.R.	N
BURLINGTON	PED.TIMBER THRU ARCH	PED BRG OVER VT127	
BURLINGTON	CONT. WELDED GIRDER	US 7 OVER I 189	N
BURLINGTON	WELDED GIRDER	VERMONT RAILWAY	
BURLINGTON	ROLLED BEAM	VERMONT RAILWAY	N
BURLINGTON	CONT. RIVETED GIRDER	WINOOSKI RIVER	8
BURLINGTON	3-SP CONT.HNCH PL GR	WINOOSKI RIVER	8
CHARLOTTE	TIED ARCH COV BR	HOLMES CREEK	U
CHARLOTTE	ROLLED BEAM	LAPLATTE RIVER	8
CHARLOTTE	ROLLED BEAM	LAPLATTE RIVER	8
CHARLOTTE	ROLLED BM/FLR BEAM	LAPLATTE RIVER	8
CHARLOTTE	ARCH/KINGPOST COV BR	LEWIS CREEK	U
CHARLOTTE	GAL ROLLED BM/COV BR	LEWIS CREEK	U
CHARLOTTE	RIVETED THRU GIRDER	VERMONT RAILWAY	
COLCHESTER	ROLLED BEAM	COLCHESTER POND BRK.	8
COLCHESTER	REINFORCED CONC. BOX	I 89 OVER CAMP ROAD	N
COLCHESTER	3-SP CONT. STEEL BM	I 89 OVER TH NO 1	
COLCHESTER	3-SP CONT. ROLLED BM	I 89 OVER TH NO 1	
COLCHESTER	3-SP CONT. ROLLED BM	I 89 OVER TH NO 1	N
COLCHESTER	3 SP CONT ROLLED BM	I 89 OVER TH NO 1	N
COLCHESTER	3-SP ROLLED BEAM	I 89 OVER U.S.7	
COLCHESTER	3-SP ROLLED BEAM	I 89 OVER U.S.7	
COLCHESTER	3 SPAN ROLLED BEAM	I 89 OVER US 7	N
COLCHESTER	3 SPAN ROLLED BEAM	I 89 OVER US 7	N
COLCHESTER	4-SP ROLLED BEAM	I 89 UNDER TH NO 9	
COLCHESTER	4-SPAN ROLLED BEAM	I 89 UNDER US 2	
COLCHESTER	4-SP ROLLED BEAM	I 89 UNDER US 2	N
COLCHESTER	2-SP CONCRETE SLAB	INDIAN BROOK	8
COLCHESTER	PRECAST CONC ARCH	INDIAN BROOK	8
COLCHESTER	T BM WIDEN W ROLL BM	MALLETTS CREEK	8
COLCHESTER	3-SP CONT ROLLED BM	MALLETT'S CREEK	8
COLCHESTER	3-SP CONT ROLLED BM	MALLETT'S CREEK	8
COLCHESTER	PREFAB PONY TRUSS	PED BRG OVER I89	
COLCHESTER	4-SP ROLLED BEAM	TH NO 9 OVER I 89	N
ESSEX	TWIN CELL RC BOX	ALDER BROOK	8
ESSEX	TWIN CELL RC BOX	ALDER BROOK	8
ESSEX	TWO ROLLED BEAM	BROWNS RIVER	5
ESSEX	ROLLED BEAM	BROWNS RIVER	8
ESSEX	ROLLED BEAM	BROWNS RIVER	8
ESSEX	PRESTRESS CONC. SLAB	NEW ENGLAND CENTRAL RR	N

ESSEX	CONT. WELDED GIRDER	RAMP A OVER NEC RR	N
ESSEX	CONT. WELDED GIRDER	RAMP D OVER NEC RR	N
ESSEX	WELDED CURVED GIRDER	TH 95 OVER VT 289	N
ESSEX	WELDED GIRDER	VT 15 OVER VT 289	
ESSEX	WELDED GIRDER	VT 15 OVER VT 289	N
ESSEX	WELDED CURVED GIRDER	VT 289 UNDER TH 95	
ESSEX	2-SP CONT. WELDED GR	WINOOSKI RIVER	8
ESSEX VILLAGE	TIMBER STRINGER	INDIAN BROOK	U
HINESBURG	CONCRETE T-BEAM	HOLLOW BRK	8
HINESBURG	ROLLED BEAM	HOLLOW BROOK	8
HINESBURG	PRESTRESS CONC. SLAB	HOLLOW BROOK	U
HINESBURG	ROLLED BM W TMBR DK	LAPLATTE RIVER	5
HINESBURG	ROLLED BEAM	LAPLATTE RIVER	8
HINESBURG	MULTI PLATE ARCH	LAPLATTE RIVER	8
HINESBURG	ROLLED BEAM	LEWIS CREEK	7
HINESBURG	ROLLED BEAM	LEWIS CREEK	8
HINESBURG	ROLLED BEAM	LEWIS CREEK	9
HUNTINGTON	ROLLED BM W TMBR DK	BRUSH BROOK	3
HUNTINGTON	ROLLED BM W TMBR DK	BRUSH BROOK	3
HUNTINGTON	ROLLED BEAM	BRUSH BROOK	7
HUNTINGTON	CONCRETE SLAB	BRUSH BROOK	7
HUNTINGTON	CONC SLAB	BRUSH BROOK	8
HUNTINGTON	CONCRETE SLAB	BRUSH BROOK	8
HUNTINGTON	ROLLED BEAM	BRUSH BROOK	8
HUNTINGTON	CONCRETE SLAB	COBB BROOK	3
HUNTINGTON	ROLLED BM W TMBR DK	COBB BROOK	3
HUNTINGTON	ROLLED BEAM	HUNTINGTON RIVER	5
HUNTINGTON	ROLLED BEAM	HUNTINGTON RIVER	8
HUNTINGTON	CONCRETE T-BEAM	HUNTINGTON RIVER	8
HUNTINGTON	3 SPAN ROLLED BEAM	HUNTINGTON RIVER	8
HUNTINGTON	GALV STL PONY TRUSS	HUNTINGTON RIVER	8
HUNTINGTON	ROLLED BEAM	HUNTINGTON RIVER	8
HUNTINGTON	PRESTRESS VOID SLAB	HUNTINGTON RIVER	8
HUNTINGTON	2SPN CONT CUR GIR	HUNTINGTON RIVER	8
HUNTINGTON	WELDED PLATE GIRDER	HUNTINGTON RIVER	9
HUNTINGTON	ROLLED BM W TMBR DK	JONES BROOK	8
HUNTINGTON	ROLLED BEAM	TEXAS HILL BROOK	8
JERICHO	RIVETED TWO GIRDER	BROWNS RIVER	8
JERICHO	ROLLED BEAM	BROWNS RIVER	8
JERICHO	RIVETED TWO GIRDER	BROWNS RIVER	8
JERICHO	ROLLED BEAM	BROWNS RIVER	8
JERICHO	TWO ROLLED BEAM	BROWNS RIVER	8
JERICHO	2 RIVETED BOX GIRDER	LEE RIVER	3
JERICHO	ROLLED BEAM	LEE RIVER	8
JERICHO	CONCRETE T-BEAM	LEE RIVER	8
JERICHO	WELDED PLATE GIRDER	LEE RIVER	8
JERICHO	ROLLED BEAM	LEE RIVER	8
JERICHO	ROLLED BEAM	MILL BROOK	2
JERICHO	ROLLED BEAM	MILL BROOK	8
JERICHO	CONCRETE T-BEAM	MILL BROOK	8

JERICHO	ROLLED BEAM	MILL BROOK	8
JERICHO	ROLLED BEAM	MILL BROOK	8
JERICHO	WELDED CURVED GIRDER	MILL BROOK	8
JERICHO	PS/PT CONC SLAB	MILL BROOK	8
JERICHO	PRESTRESS CONC. SLAB	MILL BROOK	8
JERICHO	CONCRETE SLAB	MILL BROOK	8
JERICHO	CONC. ARCH CULVERT	THE CREEK	8
MILTON	REINFORCED CONC. BOX	I 89 OVER TH NO 12	N
MILTON	4-SPAN ROLLED BEAM	I 89 UNDER TH NO 3	
MILTON	2 SP CONT PLT GIRDER	I 89 UNDER TH NO 6	
MILTON	2-SP CONT WELD GRD.	LAMOILLE RIVER	3
MILTON	3SPN CONT TWO GIRDER	LAMOILLE RIVER	8
MILTON	3 SP GIR W/ PIN&LINK	LAMOILLE RIVER	8
MILTON	WELDED PLATE GIRDER	LAMOILLE RIVER	8
MILTON	3 SP RVTD TWO GIRDER	NEW ENGLAND CENTRAL RR	
MILTON	4 SPAN ROLLED BEAM	TH NO 3 OVER I 89	N
MILTON	2SPN CONT PLT GIRDER	TH NO 6 OVER I 89	N
RICHMOND	CONCRETE T-BEAM	DONAHUE BROOK	U
RICHMOND	2- SP CONT ROLLED BM	HUNTINGTON RIVER	3
RICHMOND	2 SP CONT. ROLLED BM	HUNTINGTON RIVER	8
RICHMOND	4 SPAN ROLLED BEAM	I 89 OVER NECRR & BROOK	N
RICHMOND	4 SPAN ROLLED BEAM	I 89 OVER NECRR & BROOK	N
RICHMOND	3 SPAN ROLLED BEAM	I 89 OVER TH NO 14	N
RICHMOND	3 SPAN ROLLED BEAM	I 89 OVER TH NO 14	N
RICHMOND	3-SP ROLLED BEAM	I 89 OVER TH NO 4	
RICHMOND	3-SP ROLLED BEAM	I 89 OVER TH NO 4	
RICHMOND	3 SPAN ROLLED BEAM	I 89 OVER TH NO 4	N
RICHMOND	3 SPAN ROLLED BEAM	I 89 OVER TH NO 4	N
RICHMOND	3 SPAN ROLLED BEAM	I 89 OVER TH NO 8	N
RICHMOND	3 SPAN ROLLED BEAM	I 89 OVER TH NO 8	N
RICHMOND	3 SP ROLLED BEAM	I 89 OVER U.S.2	
RICHMOND	3 SP ROLLED BEAM	I 89 OVER U.S.2	
RICHMOND	3 SP ROLLED BEAM	I 89 OVER US 2	
RICHMOND	3 SPAN ROLLED BEAM	I 89 OVER US 2	N
RICHMOND	3 SPAN ROLLED BEAM	I 89 OVER US 2	N
RICHMOND	3 SPAN ROLLED BEAM	I 89 OVER US 2	N
RICHMOND	3 SPAN ROLLED BEAM	I 89 OVER US 2	N
RICHMOND	3 SP ROLLED BEAM	I 89 OVER US NO 2	
RICHMOND	3 SP CONT (2) GIRDER	I 89 OVER WIN. RIV.+TH16	8
RICHMOND	3 SP CONT (2) GIRDER	I 89 OVER WIN. RIV.+TH16	8
RICHMOND	8 SPAN ROLLED BEAM	I 89 UNDER US 2	
RICHMOND	8 SP ROLLED BEAM	I 89 UNDER US 2	N
RICHMOND	CONCRETE T BEAM	SNIPE ISLAND BROOK	8
RICHMOND	3 SP ROLLED BEAM	US 2 OVER NECRR	N
RICHMOND	2 SP CONT WLD PL GIR	WINOOSKI RIVER	5
RICHMOND	STEEL THRU TRUSS	WINOOSKI RIVER	8
RICHMOND	STEEL THRU TRUSS	WINOOSKI RIVER	8
S. BURLINGTON	ROLLED BEAM	I 189 OVER FARRELL	N
S. BURLINGTON	ROLLED BEAM	I 189 OVER FARRELL	N
S. BURLINGTON	ROLLED BEAM	I 189 OVER SPEAR ST	

S. BURLINGTON	3 SPAN ROLLED BEAM	I 189 OVER SPEAR ST	
S. BURLINGTON	3 SP ROLLED BEAM	I 189 OVER SPEAR ST	N
S. BURLINGTON	3 SPAN ROLLED BEAM	I 189 OVER SPEAR ST	N
S. BURLINGTON	4 SP ROLLED BEAM	I 189 WB OVER I 89	N
S. BURLINGTON	3-SP ROLLED BEAM	I 89 OVER DORSET ST	
S. BURLINGTON	3-SP ROLLED BEAM	I 89 OVER DORSET ST	
S. BURLINGTON	3 SPAN ROLLED BEAM	I 89 OVER DORSET ST	N
S. BURLINGTON	3 SPAN ROLLED BEAM	I 89 OVER DORSET ST	N
S. BURLINGTON	3 SPAN ROLLED BEAM	I 89 OVER EB I189	N
S. BURLINGTON	3 SPAN ROLLED BEAM	I 89 OVER EB I189	N
S. BURLINGTON	3 SPAN ROLLED BEAM	I 89 OVER I 189	
S. BURLINGTON	ROLLED BEAM	I 89 OVER I 189	
S. BURLINGTON	4 SPAN ROLLED BEAM	I 89 UNDER I 189 WB	
S. BURLINGTON	4 SPAN ROLLED BEAM	I 89 UNDER PATCHEN RD	
S. BURLINGTON	4 SPAN ROLLED BEAM	I 89 UNDER US 2	
S. BURLINGTON	4 SPN ROLLED BEAM	I 89 UNDER US 2	N
S. BURLINGTON	4 SPAN ROLLED BEAM	I 89 UNDER VT 116	
S. BURLINGTON	4-SP ROLLED BEAM	I 89 UNDER VT 116	N
S. BURLINGTON	4-SP ROLLED BEAM	PATCHEN RD OVER I 89	N
S. BURLINGTON	3 SPAN ROLLED BEAM	RAMP D UNDER RAMP E	
S. BURLINGTON	3 SPAN ROLLED BEAM	RAMP E OVER RAMP D	N
S. BURLINGTON	7 SP CONT WLD PL GIR	WINOOSKI RIVER	8
S. BURLINGTON	7 SP CONT WLD PL GIR	WINOOSKI RIVER	8
S. BURLINGTON	OPEN SPAN CONC ARCH	WINOOSKI RIVER & NECRR	8
SHELBURNE	3 SP CONT CUR PL GIR	LAPLATTE RIVER	8
SHELBURNE	ROLLED BEAM	LAPLATTE RIVER	8
SHELBURNE	ROLLED BEAM	LAPLATTE RIVER	8
SHELBURNE	WELDED PLATE GIRDER	VERMONT RAILWAY	N
SHELBURNE	RIVETED TWO GIRDER	VTRR OVER BAY ROAD	
UNDERHILL	ROLLED BM W TMBR DK	BROOK	8
UNDERHILL	ROLLED BEAM	BROWNS RIVER	8
UNDERHILL	PS/PT CONC BOX BEAM	BROWNS RIVER	8
UNDERHILL	CONCRETE SLAB	BROWNS RIVER	8
UNDERHILL	ROLLED BEAM	ROARING BROOK	8
UNDERHILL	GLUE LAM. TIMBER BM	ROARING BROOK	8
UNDERHILL	CONCRETE SLAB	SEYMOUR BROOK	8
UNDERHILL	CONCRETE T-BEAM	SEYMOUR RIVER	U
UNDERHILL	CONCRETE SLAB	STEVENSVILLE BROOK	8
UNDERHILL	ROLLED BEAM	THE CREEK	8
WESTFORD	T BM WIDEN W/ SLAB	BEAVER BROOK	5
WESTFORD	ROLLED BEAM	BROWNS RIVER	8
WESTFORD	ROLLED BEAM	BROWNS RIVER	8
WESTFORD	CONCRETE SLAB	ROGERS BROOK	8
WILLISTON	ROLLED BEAM	ALLEN BROOK	8
WILLISTON	ROLLED BEAM	ALLEN BROOK	8
WILLISTON	CONCRETE SLAB	ALLEN BROOK	8
WILLISTON	3 SPAN ROLLED BEAM	I 89 OVER VT 2A	N
WILLISTON	3 SPAN ROLLED BEAM	I 89 OVER VT 2A	N
WILLISTON	3-SP ROLLED BEAM	I 89 OVER VT.2A	
WILLISTON	3-SP ROLLED BEAM	I 89 OVER VT.2A	

WILLISTON	6 SPAN ROLLED BEAM	I 89 UNDER TH NO 1	
WILLISTON	4 SPAN ROLLED BEAM	I 89 UNDER TH NO 3	
WILLISTON	ROLLED BEAM	MUDDY BROOK	8
WILLISTON	ROLLED BEAM	MUDDY BROOK	8
WILLISTON	PRESTRESS CONC SLAB	MUDDY BROOK	8
WILLISTON	CONCRETE SLAB	MUDDY BROOK	8
WILLISTON	ROLLED BEAM	TH NO 1 OVER I 89	N
WILLISTON	4 SPAN ROLLED BEAM	TH NO 3 OVER I 89	N
WILLISTON	CONT. CURVED GIRDER	WINOOSKI RIVER	8
WINOOSKI CITY	3 SPAN ROLLED BEAM	I 89 OVER LAFOUNTAIN	N
WINOOSKI CITY	3 SPAN ROLLED BEAM	I 89 OVER LAFOUNTAIN	N
WINOOSKI CITY	3 SPAN ROLLED BEAM	I 89 OVER NECRR	N
WINOOSKI CITY	3 SPAN ROLLED BEAM	I 89 OVER NECRR	N
WINOOSKI CITY	3 SPAN ROLLED BEAM	I 89 OVER VT 15	N
WINOOSKI CITY	3 SPAN ROLLED BEAM	I 89 OVER VT 15	N
WINOOSKI CITY	3-SP ROLLED BEAM	I 89 OVER VT15	
WINOOSKI CITY	3-SP ROLLED BEAM	I 89 OVER VT15	
WINOOSKI CITY	CONCRETE ARCH	NEW ENGLAND CENTRAL RR	N
WINOOSKI CITY	CONCRETE SLAB	US 7 OVER N.E.C. RR	N

Source: Vermont Agency of Transportation

Code Description
N Bridge not over waterway.
U Bridge with "unknown" foundation that has not been evaluated for scour. Since risk cannot be determined, flag for monitoring during flood events and, if appropriate, closure.
T Bridge over "tidal" waters that has not been evaluated for scour, but considered low risk. Bridge will be monitored with regular inspection cycle and with appropriate underwater inspections. ("Unknown" foundations in "tidal" waters should be coded U.)
9 Bridge foundations (including piles) on dry land well above flood water elevations.
8 Bridge foundations determined to be stable for assessed or calculated scour conditions; calculated scour is above top of footing.
7 Countermeasures have been installed to correct a previously existing problem with scour. Bridge is no longer scour critical.
6 Scour calculation/evaluation has not been made. (Use only to describe case where bridge has not yet been evaluated for scour potential.)
5 Bridge foundations determined to be stable for calculated scour conditions; scour within limits of footing or piles.
4 Bridge foundations determined to be stable for calculated scour conditions; field review indicates action is required to protect exposed foundations from effects of additional erosion and corrosion.
3 Bridge is scour critical; bridge foundations determined to be unstable for calculated scour conditions:
- Scour within limits of footing or piles.
- Scour below spread-footing base or pile tips.
2 Bridge is scour critical; field review indicates that extensive scour has occurred at bridge foundations. Immediate action is required to provide scour countermeasures.
1 Bridge is scour critical; field review indicates that failure of piers/abutments is imminent. Bridge is closed to traffic.
0 Bridge is scour critical. Bridge has failed and is closed to traffic.

2.2.7 Loss of Water Service

In 2016, Chittenden County's current public water services supply water to over 135,000 people. The Champlain Water District (CWD) is the county's largest water supplier, serving 75,000 people with a total of 25,000 metered connections within CWD's twelve served municipal water system's 70 square mile county service area. The CWD is a municipally chartered, consolidated water district, serving South Burlington, Shelburne, Williston, Essex Town, Village of Essex Junction, Winooski, Colchester Town, Colchester Fire District #1, Colchester Fire District #3, Milton, Village of Jericho, and the Mallets Bay Water Company.

The Burlington Department of Public Works (BPW) serves more than 40,000 people with about 10,000 connections within the City of Burlington and Colchester Fire District #2. Lake

Champlain is the source for both the CWD and the BPW water systems. Additional municipal water systems provide water service in Jericho, Underhill, Richmond, and Hinesburg, each serving about 300 connections.

In 2003, the Vermont Department of Environmental Conservation (DEC) revised its Water Supply Rule to incorporate several federal and state initiatives. These include requirements to strengthen protection against microbes, while instituting standards to minimize health risks from disinfectants; increased standards for operator certification; and the implementation of a source water assessment program by which source water protection areas are delineated. In addition, the revised Water Supply Rule requires every community system to provide its customers with an annual water quality report.

Loss of water service to several customers or users at one time is a generally rare occurrence. Loss of water service in even a small area could affect firefighting capabilities, so the issue is of concern to local officials. During extreme cold, some customers are occasionally without service for several hours if the cold causes a pipe to burst (see discussion above concerning Extreme Temperatures). Outside of the CWD and municipal water systems, residents and businesses obtain water through individual wells or through a community well, which serves a small cluster of users. Well-users in certain discrete locations in the county suffer occasional water shortages due to a low water table. Users may contract with water haulers or a municipality may ask the National Guard to provide "water buffalo" tankers to replenish individual wells during these spot droughts.

2.2.8 Loss of Sewer Service

There are 12 wastewater treatment facilities serving South Burlington, Colchester Town, Colchester Fire District #1, Burlington, Williston, Essex Town, Village of Essex Junction, Winooski, Hinesburg, Milton, Richmond, and Shelburne. These facilities have a permitted collective capacity to treat 20.32 million gallons per day of discharge and have an average annual flow 9.56 millions/gallons/day. As of 2016, together these facilities provide wastewater treatment to approximately 52,000 households and commercial, industrial and institutional uses with an estimated 84,000 employees.

Table 2-xx Wastewater treatment facilities in Chittenden County

Name	Owner	Dwelling Units/ Households	Population	Employees
Burlington Riverside	City of Burlington	3,905	9,216	6,237
Burlington Main	City of Burlington	14,907	35,181	26,037
Burlington North	City of Burlington	4,509	10,641	1,026
Colchester FD#1	Town of Colchester	1,385	3,269	892
Colchester Town	Town of Colchester	456	1,076	4,271
Essex Town	Town of Essex	1,918	4,526	2,118
Essex Junction	Village of Essex Junction	4,321	10,198	2,720
Fort Ethan Allen (PVT)	Fort Ethan Allen (PVT)	662	1,562	590
Hinesburg	Town of Hinesburg	467	1,102	872
Milton	Town of Milton	1,515	3,575	2,500
Richmond	Town of Richmond	376	887	370

Shelburne1	Town of Shelburne	1,023	2,414	1,621
Shelburne2	Town of Shelburne	1,712	4,040	1,764
South Burlington Bartlett Brook	City of So. Burlington	2,567	6,058	5,822
South Burlington Airport Parkway	City of So. Burlington	5,908	13,943	13,470
Camp Johnson	City of So. Burlington	0	0	65
Williston	Town of Williston	2,707	6,389	11,458
Winooski Water Pollution Control Facilty	City of Winooski	3,661	8,640	2,543
	TOTALS	**51,999**	**122,717**	**84,376**

Locations outside of sewer service areas rely on individual septic systems to treat wastewater. Some newer, rural subdivisions use a community septic system. Loss of sewer service to several customers or users at one time is a rare occurrence throughout the county.

2.2.9 Loss of Gas Service

Vermont Gas Company provides piped, natural gas service to more than 50,000 residential and commercial customers in Chittenden County and Franklin County, with Chittenden County having the majority of customers (see Map X). Gas supplies originate in Canada, are brought south from Franklin County through transmission lines and then, (after passing through measuring and regulating stations where the pressure is reduced) are fed through distribution lines buried immediately to the side of the road. Service areas in Chittenden County presently include most of Burlington, South Burlington, Winooski and Essex Junction and significant portions of Milton, Colchester, Essex, Williston and Shelburne. Underhill, Hinesburg, Richmond and Jericho also have some gas service, though not in a wide area. Loss of gas service is a rare occurrence in Chittenden County. Most losses of service typically only impact a few homes or businesses.

2.2.10 Telecommunications System Failure

Land-line telecommunications services in Chittenden County are largely provided by Fairpoint Communications, Waitsfield/Champlain Valley Telecommunications, and Burlington Telecom. Collectively, these companies are responsible for operation, maintenance and repair of telecommunications facilities. Service outages are a common problem in the eastern portions of Chittenden County due to the greater frequency of high winds, heavy snow and lightning strikes. Distribution of phone lines generally follows the same corridor as roads. Weather or other problems interrupting services outside of Chittenden County or even outside the State of Vermont have the potential to disrupt service in the County. Service outages that affect emergency communications are of concern to local officials. Several providers of cellular phone service operate in the County. Due to the varying terrain in the County, there are several locations in the County where it can be difficult for a user to obtain a signal.

Also of concern to some county officials is the prospect of a computer virus that could propagate and shut down computer systems, public and private, across the county. The likelihood of such

an occurrence has not been evaluated, however, and there is no reason to believe that Chittenden County is any more vulnerable to such a problem than any other place in the state or country.

2.2.11 Loss of other fuel service

With regard to sources of building heat, prior versions of this Plan only referenced Natural Gas Service. The CCRPC felt it appropriate to also list other sources of such as Heating Oil, Propane and Wood. Heating oil, usually in the form of #2 diesel and kerosene, is the most commonly used of these services as this, along with coal, was the fuel of choice prior to the development of natural gas. Many homes and businesses within the geographic area served by Vermont Gas still use heating oil to power furnaces as do most homes and businesses not served by Vermont Gas. Use of firewood for home heating, along with wood pellet stoves, is very common throughout the county, especially rural areas. Many homes in all areas of the county often use both furnaces and woodstoves interchangeably. Propane is used in some rural areas mostly as a means to provide fuel for gas stoves. Most losses of services for these fuels typically only impact one home or business at a time primarily due to human error or financial difficulties that allow existing supplies to run out before the next delivery.

2.2.3 Non-Profiled Hazards

Air Pollution

A less visible but long-term concerns is air pollution water pollution. According to the *2006 Chittenden County Regional Plan*, air quality in Chittenden County is generally quite good. The U.S. Environmental Protection Agency (EPA) sets nationwide air quality standards for ozone, sulfur dioxide, carbon monoxide, nitrogen dioxide, particulate matter, and lead. Chittenden County's air complies with these federal quality standards. Particulates and ozone are the two pollutants of most concern in Chittenden County. In recent years, Chittenden County has had only one day (in 2002) in which particulates and ozone exceeded federal standards, and an air quality advisory for the general population was issued. However, there have been several other days in that time frame in which air quality advisories were issued for the elderly and people with respiratory and heart ailments. Most of the measured pollutants, including ozone, are generated predominantly by motor vehicles and out-of-state sources. Some of these include pollution from coal-burning power plants located in the Midwest. Scientists believe that acid rain is caused by the emissions from these power plants.

2.3 Societal Hazards

The following discussion of societal hazards is based upon qualitative information from discussions with Chittenden County law enforcement professionals as well as quantitative data

from the State of Vermont. The 2007 Vermont State All-Hazards Mitigation Plan was also referenced.

	Location	Extent (Severity)	Impact
Crime	County-wide. Significant incidents could happen anywhere	Data collection is not standardized across municipalities.	Significant socio-economic impacts
Economic Recession	County-wide	Historic data on unemployment levels & poverty rates	Longer lasting impacts hard to measure below county level
Terrorism	The FBI does not share a list of potential targets.	Unknown but assumed to be significant if incident occurs	Unknown but assumed to be significant if incident occurs
Civil Disturbance	County-wide. Significant incidents can happen anywhere	No formal damage has been documented to date	No formal damage has been documented to date
Epidemic	Could happen anywhere	Data not formally collated across agencies	Other than 1917 Influenza epidemic no formal damage has been documented to date
Key Employer Loss	Depending upon type of employer	No formal database of damages.	No formal database o key employer loss is maintained

2.3.1 Profiled Hazards

2.3.1.1 Crime

The Vermont Crime Report for the year 2007, prepared by the Vermont Department of Public Safety, reported the following:

Table 2-15 Vermont Crime Report, actual counts and crime rate per thousand, for Chittenden County municipalities, 2007.

Jurisdiction	Population (2007 estimate)	Actual Counts: All Offense Types	Actual Counts: Crimes Against Person	Actual Counts: Crimes Against Property	Actual Counts: Crimes Against Society	All Offense Types per 1000 people	Crimes Against Person per 1000	Crimes Against Property per 1000	Crimes Against Society per 1000
USA	301,621,157	11,251,818*				37.304*			
Chittenden County	***151,826***	***9,249***	***1,118***	***7,340***	***791***	***61.63***	***7.45***	***48.91***	***5.27***
Bolton	1,006	56	2	51	3	56.57	2.02	51.52	3.03
Buels Gore	12	1			1	83.33			83.33

Jurisdiction	Population (2007 estimate)	Actual Counts: All Offense Types	Actual Counts: Crimes Against Person	Actual Counts: Crimes Against Property	Actual Counts: Crimes Against Society	All Offense Types per 1000 people	Crimes Against Person per 1000	Crimes Against Property per 1000	Crimes Against Society per 1000
Burlington	38,531	3,707	549	2,907	251	96.64	14.31	75.79	6.54
Charlotte	3,754	48		46	2	13.01		12.47	0.54
Colchester	17,207	1,153	103	937	113	67.11	6.00	54.54	6.58
Essex	19,465	896	114	687	95	46.51	5.92	35.66	4.93
Hinesburg	4,619	138	14	122	2	30.48	3.09	26.95	0.44
Huntington	1,956	22	4	17	1	11.39	2.07	8.80	0.52
Jericho	5,170	84	4	78	2	16.51	0.79	15.33	0.39
Milton	10,539	509	65	390	54	49.19	6.28	37.69	5.22
Richmond	4,171	53	8	42	3	12.85	1.94	10.18	0.73
St. George	690	19	3	16		27.98	4.42	23.56	
Shelburne	7,143	203	24	154	25	28.74	3.40	21.80	3.54
South Burlington	17,445	1,112	84	905	123	65.36	4.94	53.19	7.23
Underhill	3,080	43	2	41		14.14	0.66	13.48	
Westford	2,205	49	4	41	4	22.63	1.85	18.94	1.85
Williston	8,371	536	64	428	44	64.75	7.73	51.70	5.32
Winooski	6,462	620	74	478	68	98.13	11.71	75.66	10.76

Sources: Vermont data compiled from the Vermont State Crime Report at www.dps.state.vt.us. National data available at www.fbi.gov
For USA statistics, totals were computed by adding violent and property crimes.
**The FBI statistics did not count what VCON called "crimes against society", a category that includes drug crimes, which accounts for some of the discrepancy between county crime rates and the national rate.*
Crimes against person, as defined by VCON: Murder, manslaughter, kidnapping, robbery, assault, sexual assault.
Crimes against property, as defined by VCON: Arson, Burglary/B&E, Vandalism, forgery, bribery, embezzlement, extortion, fraud offenses, larceny offenses.
Crimes against society, as defined by VCON: Drug/narcotic offenses, gambling offenses, pornography, prostitution, weapon violation.

As the table illustrates, overall crime rates were below the county and national averages in most municipalities. Burlington and Winooski have the highest crime rates overall. Property crimes are the most common type of crime in the county. Even discounting the "crimes against society" category, which the FBI statistics did not track, the municipalities of Bolton, Burlington, Colchester, Essex, Milton, South Burlington, Williston, and Winooski have more crimes per thousand people than the national rate.

CCRPC is aware that the table above is quite dated. Unfortunately, 2007 was one of the last years that municipality-by-municipality data was available. The CCRPC along with its municipalities, however feel that including a discussion of Crime, especially crime related to drug addication, in this Plan is appropriate due to potential for significant societal impacts.

An April 2016 report by the Vermont Association for Mental Health and Addiction Recovery, "The Scope of the Opiate Crisis in Vermont" provides a useful overview of the issue at hand.

History

OxyContin and other prescription opiates:

- *In the late 2000s, the opiate of choice was OxyContin: more people were prosecuted in federal court in Vermont in 2010 for illicit trafficking in prescription opiates than for any other drug, including marijuana, heroin and cocaine.*
- *Vermont ranked second in the country in per-capita admissions for treatment for addiction to prescription opiates.*
- *The number of Vermonters seeking treatment for opiate addiction in 2010 was up 21 percent from 2008 and up 300 percent from 2005.*

Heroin

- *To combat abuse of prescription opiates, OxyContin's delivery system and regulation was redesigned in 2010, making it highly resistant to being crushed for the purposes of getting a high, and making it far more expensive. However, this made things worse, as users simply switched to heroin, which is more dangerous as it is unregulated, but is also only 1/8 as expensive as OxyContin.*
- *There are claims that heroin is easier to find than marijuana in many parts of Vermont.*
- *In 2014, the state treated 2,258 people for heroin use, a 64 percent increase over 2013 and more than three times the 623 people treated in 2010.*

Statistics

Deaths

- *In 2013, the number of people who have died from heroin overdoses nearly doubled from 2012, according to ADAP.22*
- *More than 50 Vermonters die every year from opioid poisoning.23 •*

Reporting

- *Since 2000, Vermont has seen an increase of more than 770 percent in people seeking treatment for opiate addictions, up to 4,300 people in 2012.24*
- *For people receiving heroin treatment specifically, there was an over 250 percent increase in Vermont between 2000 and 2014, the greatest increase being a nearly 40 percent spike in just 2013.25 o*
- *Rutland also has the highest rate of pregnant women with opiate addiction in the United States.26*

Crime and Prosecution

In 2013, there were twice as many federal indictments against heroin dealers than in the prior two years, and over five times as many as had been obtained in 2010.

Close to 80 percent of the state's inmates "are either addicted or in prison because of their addiction.

……..……..

Motivations in the Current Heroin Crisis

- *Profits for dealers Vermont attracts heroin dealers for its high profit margins – a dealer can buy heroin in Springfield, Massachusetts, for as little as $6 a bag and sell it in Vermont for $30, and they do, for $2 million in heroin is trafficked every week in Vermont.*

- *Convenience for dealers The state has convenient highways that feed directly into big cities such as Montreal, Boston, New York and Philadelphia, so dealers can easily travel a few hours on the interstate to Vermont and sell drugs at a price 500 percent higher than in out-of-state major cities.*

The demand on services can be acute. An October 2015 report in a local newspaper, Seven Days, reported on the situation at the Chittenden Clinic located in South Burlington in the heart of Chittenden County.

There are nearly 300 people on the "active" waiting list for medication assisted treatment at the Chittenden Clinic, despite a doubling of the number of patients the clinic serves, according to Bob Bick, Howard Center CEO. In 2014, the clinic treated 441 patients; today 894 patients receive treatment for opiate addiction at the clinic. More than half of the patients are injection heroin users.

Local police chiefs interviewed during the development of local AHMPs noted the crime fueled by the addiction crisis on one hand and the dealers looking to profit. These crimes include robbery, theft, prostitution, etc.

2.3.1.2 Economic Recession

The United States formally entered a recession in December 2007, which dramatically accelerated in September 2008. While Vermont is not among the states hardest hit by the recession, the state, including Chittenden County, certainly felt the effects of the downturn. According to the Vermont Department of Labor, unemployment in Vermont increased by 2.6% to 6.7% between January 2008 and January 2010, and was above 7% for much of 2009.

The State of Vermont faced severe budget cutbacks, and most municipalities in Chittenden County cut spending in the face of reduced tax revenue. Consumer and business spending was also reduced, and activity slowed in most sectors of the economy, particularly construction. The Economic Base Analysis in the 2013 ECOS Plan states that between 2000 and 2010 the county saw a net decrease in jobs by 2,263 largely coming from the private sector.

Since that time the Vermont unemployment rate has steadily improved to 3.4% as of February 2016. However, the overall labor force participation has dropped more than 4% from 2009 through 2015.

The frequency and severity of future recessions is difficult to determine, but any large-scale recession in the nation or in New England would likely be felt in Chittenden County.

2.3.1.3 Terrorism

Regarding terrorism in Vermont, the *2013 Vermont State All-Hazards Mitigation Plan* states:

> Terrorism and civil hazards include actions intentionally aimed at threatening lives and property. They may range from a single person on a shooting rampage to a cyber attack that harms computer systems, to the organized use of weapons of mass destruction (WMD). WMD events could involve chemical, biological, explosive or radioactive weapons. VEM and Vermont State Police conducted a risk/threat assessment of potential WMD attacks in 2000 that ranked potential targets by State Police district. At that time, no known or suspected terrorists have been identified as operating in Vermont. However, some in the U.S intelligence community believe that radical Islamist/extremist organizations may have small cells in

Montreal and Toronto, not far from the US border. In this regard, Vermont is considered a potential transit point for terrorist organizations operating out of Canada who may travel through the state to reach points to the south.

CCRPC staff has been able to locate no historical data on the occurrence of terrorist events in Chittenden County. It is possible that some isolated bomb threats have been called in to various institutions over the years. Similarly, during the "white powder/anthrax" scare of 2001/2002, Vermont Emergency Management received various reports on suspicious substances, but no cases were confirmed.

Vulnerability studies conducted at the state level have focused on dam security, and have also resulted in security upgrades at Burlington International Airport. The state Department of Homeland Security has a Terrorism Task Force, which is continuing to conduct needs and vulnerability assessments (*Vermont State All-Hazards Mitigation Plan, 2013*).

According to the *2013 Vermont State All-Hazards Mitigation Plan,* the most likely forms of terrorist attack would be "conventional bombing, hijacking, kidnapping or shooting incidents. A WMD attack in Vermont is considered a low probability; however, it is recognized as having the potential for catastrophic consequences. Many state Agencies and Departments have created internal protocols outlining their actions in a terrorism incident, and the Governor has established the State of Vermont Terrorism Task Force to create the statewide plan to deal with terrorism."

Although the chances of a terrorist incident occurring in Chittenden County are low, the county contains numerous critical facilities that could be considered potential targets of terrorism. These include local, state, and federal government buildings, military installations, transportation hubs, large employers, health care facilities, schools and universities, churches and synagogues, major shopping areas, and public gathering places. The Vermont Homeland Security unit of the Department of Public Safety maintains a specific list of possible terrorism targets.

2.3.1.5 Civil Disturbance

CCRPC staff was unable to locate any systematically collected historical data on the occurrences of riots or other forms of civil disturbance. In completion of the 2011 version of the Plan, staff queried municipal officials about instances of such disturbances occurring at municipal events, places of assembly or entertainment or sporting events. Officials with the City of Burlington and the University of Vermont did mention prior incidents of dealing with unruly crowds at local music venues and/or bars and clubs. A concern was also expressed by the City of South Burlington Fire Chief over the potential for civil disturbances at hotels or conference centers during a speech by, or appearance of, a politically controversial figure.

In development of this 2016 Plan, some municipal staff again reaffirmed the potential for a disturbance due to a political event. Even though Burlington is a small city, it can attract high profile figures. In January 2016, Donald Trump held a rally at a downtown theater which attracted about 2,000 supporters and an accompanying crowd of 700 mostly protesters.. Democratic Party Presidental Candidate Bernie Sanders kicked off his campaign in May 2015 with a crowd estimated at 5,500 and in the fall of 2011 the "Occupy Wall Street movement" camped in Burlington's downtown City Hall Park. There have also been protests agains the expansion of Vermont Gas distribution lines with opponents staging a "sit-in" at Vermont Gas's

office in South Burlington and chaining themselves to construction equipment at a site in Essex and Williston.

Several police departments in the county, including the University of Vermont's police services, possess crowd-control gear and other mechanisms. The Vermont National Guard also has crowd control training and equipment.

2.3.6 Key Employer Loss

For the purposes of this Plan, a key employer loss was defined as severe job layoffs or closure of a key employer in a given municipality. The loss of a major employer could cause dramatically increased unemployment, reduce property values due to out-migration of terminated employees, and cause layoffs or facility closures at businesses dependent upon the key employer and its employees.

The closure of the Saputo Cheese Factory as a result of fire in 2008 met this definition. The factory, which employed roughly 80 people, was the third largest employer in the town of Hinesburg. As a result of the closure, Hinesburg experienced a significant revenue loss, both from the factory itself and the affected employees. The site has since been redeveloped.The

Global Foundries operates a facility, purchased from IBM, in Essex Junction and Williston that, employs roughly 3,000 people today down from around 6,000-8,000 when IBM operated the plant in the early 2000s. Other major employers include:

Table 2-x Major employers in Chittenden County, 2015-2016

Name	Location	Primary Business	Employees
UVM Medical Center	Burlington	Physicians & Surgeons	7351
IBM (Global Foundries)	Essex Junction	Computers-Electronic-Manufacturers	4000
University Of Vermont	Burlington	Universities & Colleges Academic	3446
People's United Bank	Burlington	Banks	1000
DEALER.COM	Burlington	Website Hosting	838
Ben & Jerry's Homemade Inc	South Burlington	Ice Cream Parlors	735
GE Healthcare	South Burlington	Computer Services	700
Green Mountain Power Corp	Colchester	Electric Contractors	605
St Michaels College	Colchester	Universities & Colleges Academic	470
Burton Snowboards Mfg Ctr	Burlington	Manufacturers	375
Champlain College	Burlington	Universities & Colleges Academic	310
PC Construction Co	South Burlington	General Contractors	276
Note: Employee counts can include some positions located outside of Chittenden County and			

located in other locations within the County.			
Source: Vermont Business Directory, 2015/2016			

2.3.2 Non-profiled Hazards

Food Supply Crisis Some state and local officials have become concerned with the ability of local and regional food systems to adequately feed the population in the event of a fuel shortage or other emergency that disrupts inter- and intra-state food supply chains. South Burlington is the only municipality in Chittenden County that has comprehensively analyzed all the relevant issues and has developed a food security plan, which include: calorie and food group needs for the forecasted population, current amounts produced of each food group, production surpluses and shortfalls relative to forecasted food group needs, potential for expanded production or new crops to meet forecasted needs, availability of resources required to meet food production needs (e.g., land, water, labor, animal feed, seeds, fertilizer, fuels to support food production and getting food to market, etc.). Such an analysis for the reamianing municipalities is beyond the scope of this All Hazards Mitigation Plan.

A study conducted by the Intervale Center in Burlington compared current food consumption with production in Chittenden and surrounding counties. This study concluded that Chittenden County and the surrounding region produces more fruit (mostly apples) and dairy products than local demand requires, while additional production of meat (beef, pork, poultry, and associated feed grain), wheat, and vegetables would be required to meet current regional food demand.

2.4 Addressing Identified Hazards

The CCRPC considered the hazards described above when crafting this 2016-2021 Multi-Jurisdictional Plan and in working with each of the County's municipalities to develop their respective Local All-Hazards Mitigation Plans. As described in detail at the start of Section 3, for several hazards it was decided that did not warrant their own Risk Assesment as they were really a feature of a larger hazard while conversely some newly identified hazards were considered serious enough to warrant a Risk Assessment.

SECTION 3 RISK ASSESSMENT

For this 2016 Plan update, the CCRPC in consultation with its All Hazards Mitigation Plan Update Committee has made several changes in deciding which hazards to profile for risk and how to define certain hazards.

With regards to Natural Hazards:

first, this Plan "splits" and assesses the commonly understand hazard of "flooding" in three different ways:

1) Flooding: the condition of lakes, streams and rivers experiencing high water levels up to, including and beyond "flood stage" which is defined by the National Weather Service as "an established gage height for a given location above which a rise in water surface level begins to create a hazard to lives, property, or commerce." This can also be termed "inundation" or "the bathtub" effect.
2) Fluvial Erosion: erosion caused by rivers and streams, and can range from gradual bank erosion to catastrophic changes in river channel location and dimension during flood events.
3) Severe Rainstorm: this term encapsulates heavy precipitation outside snow events and inclusive of the common terms of "thunderstorm" or "stormwater" or "runoff." For this 2016 Plan, given that such Severe Rainstorms repeatedly cause damages to public and private infrastructure such as gravel roads even in areas away from waterbodies, CCRPC added this term as a separate hazard deserving of its own Risk Assessment.

Second, the CCRPC decided to subsume two discrete hazards which had been individually assessed in the 2005 and 2001 Plans (High Winds and Lightning) under the Severe Rainstorm category.

Third, the Hazards of Landslide and Natural Radiological Incident were removed from consideration for Risk Assessment. Landslides that do occur in the county are limited in scope and magnitude and those that do occur are typically the result of flooding, fluvial erosion or severe rainstorms. Natural Radiological Incident (aka. 'radon') does occur in a few select locations in the county but not at a level that is considered significant wherin a concerted strategy is warranted.

Fourth, the hazard of Multi-Structure Urban Fire was renamed to Multi-Structure Fire and moved from the Natural Hazards category to the Technological Hazard category as the primary cause of such fire is a technological failure or human error rather than a lightning strike or other natural means. The "urban" designation was removed so as to be more inclusive of small town "downtowns" or villages.

With regards to Technological Hazards, several changes were made as follows:

Two new hazards were added Water Pollution and Invasive Species. The former is the subject of a growing regulatory burden from Federal and State water quality rules with significant

associated costs long borne by municipalities and the development community but now spreading to businesses and residents. The populations of invasive, in the form of aquatic invasives such as zebra mussels, alewives, and Eurasian watermilfoil or tree pests such emerald ash borer, Asian longhorned beetle or hemlock wooly adelgid, have not yet reached crisis proportions. However, given their hypothetical impacts to the natural resources valued in the county, the CCRPC felt it appropriate to begin to include it as a Hazard.

The hazard of Other Fuel Loss was added to address potential shortages of home heating oil and/or propane and firewood which are the most common sources of heat outside the urban and suburban core of the county.

Last but not least, it was decided to subsume the hazard of Military Ordnance Incident under the overall hazard of Hazardous Materials Incident.

No changes were made with regards to Societal Hazards.

As noted above, this Plan profiles six (6) Natural Hazards: Severe Winter Storm, Flooding, Fluvial Erosion, Severe Rainstorm, Extreme Temperatures and Wildfire**. Prior to an analysis of Risk and Vulnerability, it will be first helpful to summarize the general state of knowledge regarding Location, Extent and Impact in Chittenden County for these hazards** in the following tables:

	Location	**Extent**	**Impact**
Severe Winter Storm	No, occurs county-wide and not mapped	*Yes but only at single point of National Weather Service station in South Burlington	Yes, if FEMA declares disaster. See 3.3 below.
Flooding	Yes, 100 & 500 year flood areas delineated	*Yes but only at a few discrete locations with gauge data such as U.S. Army Corps of Engineers for Lake Champlain	Yes, if FEMA declares disaster but co-mingled with fluvial erosion and severe rainstorm hazards events. See 3.3 below.
Fluvial Erosion	Yes, fluvial erosion hazards areas (now termed river corridor protection areas) are mapped	Though fluvial erosion is considered a significant hazard in the town, the number of acres lost in any one event has not been recorded nor is there a record with such data	Yes, if FEMA declares disaster but data co-mingled with flood and severe rainstorm events. See 3.3 below.

Severe Rainstorm	No, occurs county-wide and not mapped. Damage locations are mapped but damages can just as easily be a function of poorly designed road and/or driveway drainage as it is a function of heavy rain.	*Yes but only at single point of National Weather Service station in South Burlington	Yes, if FEMA declares disaster but data co-mingled with flood and fluvial erosion events. See 3.3 below.
Extreme Temperatures	No, occurs county-wide and not mapped	*Yes but only at single point of National Weather Service station in South Burlington	†Data not systematically collected on impacts.
Wildfire	No, occurs county-wide and not mapped	Some compiled data on a countwide basis as shown on page X. No systematic data collected after 2010.	‡Data not systematically collected on impacts.

** It is useful to note that while this NWS data is reliable it represents one discrete location in a county that has an area of 620 square miles in area. Likewise, while there are likely other systematic point-specific records being collected by individuals, business or organizations these data do not appear to be easily accessible. Finally, even if such data were accessible, only if the data was collected by mutually compatible means would it be useful.*

†An intensive search of municipal public works records may reveal documentation of some prior repair or labor costs associated with frozen or burst sewer and/or water pipes caused by Extreme Cold. However, such analysis would show where past events happened not the location of inadequately buried pipes which might be vulnerable to future events.

‡ *An intensive search of fire department records may reveal documentation of locations and acres burned caused by Wildfire. However, such analysis would show where past events happened but would not show the location of areas susceptible to future events (warnings by the US Forest Service and local fire departments are not location-specific) nor the location of individuals who are likely to unwisely burn trash or leaves or fail to extinguish a campfire during dry conditions.*

3.1 Designated Hazard Areas

For the purposes of this Plan, Designated Hazard Areas are defined and formally mapped areas where hazard damage is known to or projected to occur.

For the six Natural Hazards noted above, Designated Hazard Areas are only known for Flooding and Fluvial Erosion.

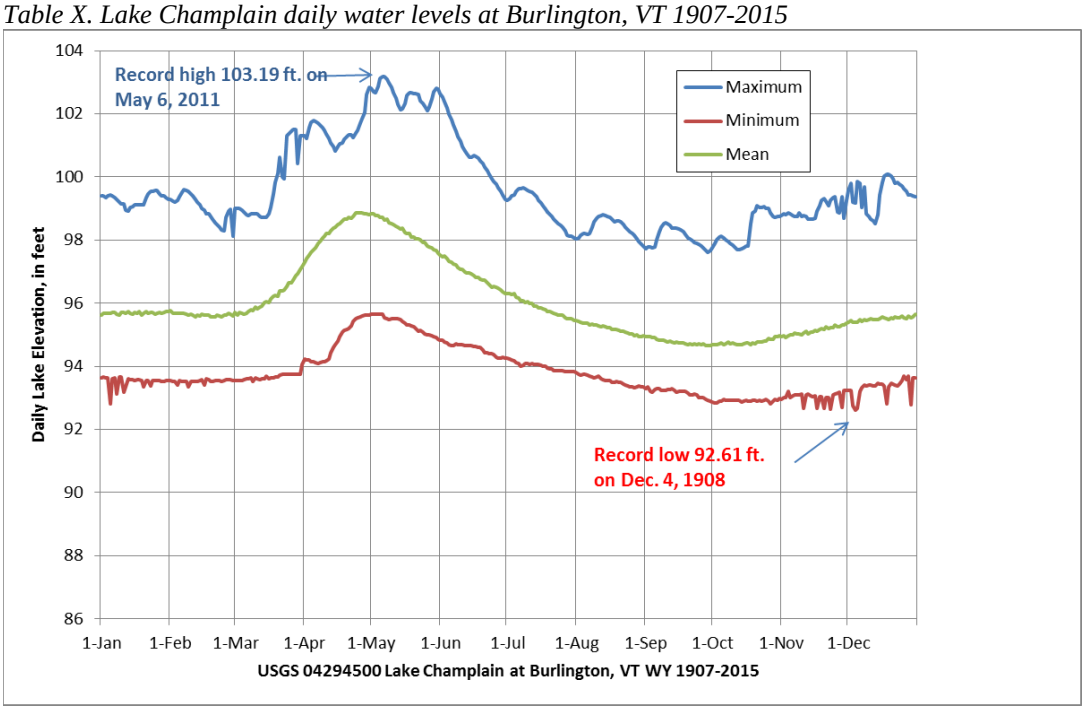
3.1.1 Flood Hazard Areas

Map 2-2 depicts the 100-year floodplain area throughout Chittenden County. Floodplain maps showing structures (primarily residential) in the floodplain are located in the municipal annexes. Significant floodplain areas include the Lamoille, LaPlatte and Winooski Rivers. The identified floodplain does not take into account areas that might be inundated in the case of a dam failure.

Green Mountain Power, which owns several of the dams on the Winooski River, maintains maps of areas that would be inundated in a dam failure, and the state has similar maps for state-owned dams, both in Chittenden County and upstream on the Winooski River. Formal flood hazard areas are designated in all of the county's municipalities with the exception of Buels Gore and St. George, which do not participate in the National Flood Insurance Program.

Note that a good portion of this area consists of the shoreland of Lake Champlain. The Base Flood Elevation of Lake Champlain established by FEMA is 10x.0 feet while flood stage established by the National Weather Service is 100 ft. The following graph shows the water levels measured along the Burlington waterfront over the last 100+ years.

Table X. Lake Champlain daily water levels at Burlington, VT 1907-2015



3.1.2 Fluvial Erosion Hazard and River Corridor Areas

The Chittenden County Regional Planning Commission, in association with Vermont ANR and other entities has spent several years conducting geomorphic assessments of waterways in most of the county's municipalities. Areas identified in these assessement as vulnerable or susceptible to erosion where initially labeled as "fluvial erosion hazard areas." During development and adoption of both the 2005 and 2011 Multi-Jurisdictional Plan and the municipal AHMPs, threats from stream erosion were identified as (FEH) Areas through the analytical lens of Stream Geomorphic Assessment (SGA). The SGA approach is still used by the Vermont Agency of Natural Resources, however, in light of the lessons learned from Tropical Storm Irent in 2011, Vermont ANR now is now defining and mapping fluvial erosion areas in two different ways:

First, a fluvial erosion hazard area is now defined as a River Corridor Protection Area which means:

the area within a delineated river corridor subject to fluvial erosion that may occur as a river establishes and maintains the dimensions, pattern, and profile associated with its dynamic

equilibrium condition and that would represent a hazard to life, property, and infrastructure placed within the area. The river corridor protection area is the meander belt portion of the river corridor without an additional allowance for riparian buffers.

Secondly, going beyond this area ANR has now defined a River Corridor which means

the land area adjacent to a river that is required to accommodate the dimensions, slope, planform, and buffer of the naturally stable channel and that is necessary for the natural maintenance or natural restoration of a dynamic equilibrium condition, as that term is defined in 10 V.S.A. §1422, and for minimization of fluvial erosion hazards, as delineated by the Agency in accordance with the ANR Flood Hazard Area and River Corridor Protection Procedures.

Both Fluvial Erosion (aka River Corridor Protection Areas) and the more expansive River Corridor are illustrated in map X.

3.2 Non-mapped Hazards

3.2.1 Severe Winter Storm Damage

Like other areas of Vermont and New England, major winter storms are a fact of life in Chittenden County. Most Severe Winter Storms consist of heavy snowfall and may be accompanied by high winds or severe temperatures. Typical Severe Winter Storms are readily responded to and managed by municipal and state agencies primarily highway departments which work quickly to make roads driveable. This highway department expense is readily budgeted and planned for in terms of staffing levels, equipment availability and materials such as road salt and sand.

However, if certain conditions exist, a Severe Winter Storm can become an Ice Storm which can have significant impacts in terms of downed trees and limbs which in turn snap power and telephone lines and clogged roadways.

Map X depicts areas in Chittenden County damaged by the January 1998 Ice Storm, a Federally-declared disaster (#DR-1201). The Vermont Agency of Natural resources completed assessments of light or heavy damage in the form of downed trees. The heaviest damage in terms of downed trees occurred in Burlington, in Colchester along the shoreline of Mallets Bay, and in Milton along its western border with Lake Champlain.

In December 2013, an ice storm occurred in northern Vermont. A Federal Disaster was declared (#DR-4207). Exclusive of the expenses of the power and telephone companies to restore services, total FEMA Public Assistance project costs for the municipalities of Essex, Milton and Westford to remove debris was over $66,000.

In December of 2014 a major ice storm hit Vermont in the form of 6-12 inches of wet snow. Green Mountain Power reported thousands of outages across Chittenden County, claiming it was the worst storm they had ever seen. A Federal Disaster was declared (#DR-4163). Over 900 out of state and Canadian workers were hired by the utility to try and get the lights back on for their customers. Over 112,000 Green Mountain Power customers during the two day storm

experienced some sort of outage. Exclusive of the expenses of the power and telephone companies to restore services, total FEMA Public Assistance project costs for the municipalities of Hinesburg, Huntington, Richmond and Westford to remove debris is preliminarily estimated at over $264,000.

It would be inappropriate to designate an official Ice Storm Hazard Area. Official designation of such an area might be possible if first, a damage assessment methodology consistent with that used by VANR in 1998 has been agreed upon and secondly, the damage from a future ice storm event has been assessed using that methodology. Last but not least it is worth noting that ice storm damage is often specific to unique micro-climatic conditions that can cause heavy ice accumulation in one area but a mile or two further away or a shift in elevation or temperature elsewhere can mean either drier and hence lighter snow or rain that is too warm to freeze on branches or power/telephone lines.

[Note: The following section may be deleted as high winds and lightning are now included with Severe Rainstorm.]

3.2.2 High Winds and Lightning

In some of the County's municipalities, high winds capable of toppling several trees and/or ripping off roof shingles were identified as a meaningful hazard. A similar situation applies to lightning, which is relatively more common along high, exposed ridgelines. Severe high winds and significant lightning strikes are relatively more common in those municipalities located at higher elevations in the eastern portion of the county; however, the distribution of areas with frequent high wind damage has never been mapped at the county or town level

3.3 Previous Events

3.3.1 Previous FEMA-declared natural disasters and snow emergencies

As noted above, other than mapped floodplains, there is little formal recording or mapping of areas with an above average frequency of occurrence. One useful method for trying to understand the type and frequency of hazard events is to examine damages occurring in previously declared Federal disasters.

Since 1990 the President of the United States has declared several natural disasters in communities within Chittenden County. The following tables illustrate the total repair costs incurred by municipalities as documented under Public Assistance projects supported by FEMA. We have chosen to separate out this data into three time periods [1990-1999; 2000-2009; 2010-present] both for ease of reading and to illustrate the current nature of disasters in the County

Table 3-1a FEMA-declared disasters in Chittenden County, 1990-1999

	June 1990	March 1992	April 1993	August 1995	January 1996	January 1998	July 1998	
	DR 875	DR 938	DR 990	DR 1063	DR 1101	DR 1201	DR 1228	TOTAL
	flood	flood	lake flood	flood	flood	ice storm	flood	
Burlington			$177,810			$1,338,080	$94,161	$1,610,051
Bolton	$1,282,529				$29,400		$37,435	$1,349,364
Colchester			$336,961		$32,184	$226,747	$124,477	$720,369
Underhill	$55,626			$228,075	$9,434		$357,565	$650,700
Westford	$37,658				$44,494		$389,279	$471,431
Jericho	$313,774				$13,030			$326,804
Milton	$21,399	$21,795			$100,887	$85,384	$29,601	$259,066
Shelburne			$13,115			$171,662	$32,843	$217,620
Richmond	$145,058	$7,124			$31,586		$9,652	$193,420
S. Burlington			$3,070			$141,856	$33,749	$178,675
Charlotte			$5,208		$7,647	$149,603		$162,458
Essex					$88,341	$63,056		$151,397
Winooski						$76,088		$76,088
Hinesburg	$17,275				$13,058	$34,952	$10,152	$75,437
Williston					$12,507	$21,163		$33,670
Essex Jct.						$22,287		$22,287
Huntington	$3,111				$11,333			$14,444
St. George						$2,519		$2,519
Buels Gore								$0
TOTALS	**$,1876,430**	**$28,919**	**$536,164**	**$228,075**	**$393,901**	**$2,333,397**	**$1,118,914**	**$4,639,370**

Sources: Vermont Department of Housing & Community Affairs; Vermont Agency of Transportation.
Dollar value figures represent the total estimated repair costs for damages suffered to municipal resources. This table does not include damage claims submitted to FEMA by non-municipal organizations or by private individuals or businesses.

In this time period, each town has had a declared disaster; however, analysis of this table reveals some interesting differences between different areas of the County. The four non-lakeshore floods from 1990 through 1996 primarily affected the more upland municipalities, the gravel and dirt roads of which were vulnerable to washout. The unique flooding in July of 1998, caused by a rare combination of heavy summer rains falling on ground still saturated from the January ice storm and subsequent snowfall, affected both metropolitan and rural communities. Excluding the two somewhat anomalous events of the lakeshore flooding of 1993 (caused by a confluence of extremely high lake levels and strong onshore winds) and the July 1998 flooding (aggravated by saturated soil from the January Ice Storm), the urban and suburban communities of the county with their paved roads, lack of significant hills or small mountains and more developed stormwater systems, suffer flood damages less often and less severely. The lowland distribution of the 1998 Ice Storm is evident. Municipalities in the hills and mountains of the county had temperatures below the freezing point during that event.

Table 3-1b FEMA-declared disasters in Chittenden County, 2000-2009

	April 2001	Aug. 2004	TOTAL
	EM3167	DR 1559	
	snowstorm	flood	
Essex	$21,076	$136,032	$157,108
Colchester	$27,049	$58,363	$85,412
Westford	$11,050	$70,321	$81,371
Milton	$8,881	$39,221	$48,102
Burlington	$37,778		$37,778
Shelburne	$5,850	$25,699	$31,549
S. Burlington	$11,456	$19,087	$30,543
Winooski	$22,453		$22,453
Williston	$9,529	$11,349	$20,878
Buels Gore	$12,736		$12,736
Underhill	$12,460		$12,460
Hinesburg	$11,703		$11,703
Essex Jct.	$10,404		10404
Jericho	$10,037		$10,037
Richmond	$9,723		$9,723
Charlotte	$9,614		9,614
Huntington	$8,105		$8,105
St. George			$0
Non-Municipal*			$0
Bolton			$0
TOTALS	**$239,904**	**$360,072**	**$599,976**

Sources: Vermont Department of Housing & Community Affairs; Vermont Agency of Transportation.
Dollar value figures represent the total estimated repair costs for damages suffered to municipal resources. This table does not include damage claims submitted to FEMA by non-municipal organizations or by private individuals or businesses.

In this decade, the region incurred very little damage with the exception of assistance from FEMA to help cover excess plowing and snow removal costs. Compared to the time period before and to more recent history, the upland towns suffered no damages from flood or rain events. (data in yellow is preliminary)

Table 3-1c FEMA-declared disasters in Chittenden County, 2010-2016

	10-Dec	11-Jun	11-Sep	13-Jun	13-Aug	Jan. 2015	Feb. 2015	July-15	TOTAL
	DR 1951	DR 1995	DR 4022	DR 4120	DR 4140	DR 4163	DR 4207	DR 4232	
	severe storm	flood	tropical storm	flood	flood	ice storm	ice storm	flooding	
Huntington		$151,252	$128,104		$331,838		140,000	138,232	$889,426
Colchester		$862,089		$4,817					$866,906
Burlington		$721,653	$14,850						$736,503
Westford	$9,053	$5,631		$602,193		$47,350	14000		$678,227
Richmond	$1,113	$52,442	$124,169		$137,906		20000	225,923	$561,553
Bolton		$37,046	$105,950		$25,702			334,128	$502,826
Underhill		$101,217		$312,358	$23,388			4654	$441,617
Williston	$42,343	$43,311	$3,803	$78,415	$245,236				$413,108
Jericho	$4,452	$90,786		$75,342	$237,940				$408,520
Essex	$44,854	$70,669		$260,650	$21,923	$5,114			$403,210
Non-Municipal*	$17,058	$273,363	$10,284	$33,383	$19,191	$1,596			$354,875
Hinesburg	$5,627				$71,871		90000		$167,498
Milton		$16,675	$46,440		$8,959	$14,315		8000	$94,389
S. Burlington		$5,394	$6,032	$57,241	$20,552				$89,219
Shelburne		$39,980							$39,980
Essex Jct.	$1,329								$1,329
Buels Gore									$0
Charlotte									$0
St. George									$0
Winooski									$0
TOTALS	**$125,829**	**$2,471,508**	**$439,632**	**$1,424,399**	**$1,144,506**	**$68,375**	**$264,000**	**$710,937**	$6,649,186

Sources: Vermont Department of Housing & Community Affairs; Vermont Agency of Transportation.
Dollar value figures represent the total estimated repair costs for damages suffered to municipal resources. This table does not include damage claims submitted to FEMA by non-municipal organizations or by private individuals or businesses.

3.4 Future Events

Although estimating the risk of future events is far from an exact science, CCRPC staff used best available data and best professional judgment to conduct an updated Hazards Risk Estimation analysis, which was subsequently reviewed and revised by the Plan Review/Update Committee in 2015 This analysis assigns numerical values to a hazard's affected area, expected consequences, and probability. This quantification allows direct comparison of very different kinds of hazards and their effect on the county, and serves as a rough method of identifying which hazards hold the greatest risk. CCRPC staff applied the following scoring system:

Area Impacted, scored from 0-4, rates how much of the municipality's developed area would be impacted.

Consequences consist of the sum of estimated damages or severity for four items, each of which are scored on a scale of 0-3:

- Health and Safety Consequences
- Property Damage
- Environmental Damage
- Economic Disruption

Probability of Occurrence (scored 1-5) estimates an anticipated frequency of occurrence.

To arrive at the overall risk value, the sum of the Area and Consequence ratings was multiplied by the Probability rating.

For this 2016 Plan, CCRPC staff worked with its Plan Review/Update Committee to update its profiled Hazard Risk Estimation Analysis to reflect recent conditions and experience. As detailed at the start of this Section, changes were also made to add hazards, remove hazards, move hazards to a different category and combined hazards.

For Natural Hazards, the following changes were made:

Drought: This separate category was removed and is now considered under a new Extreme Temperatures category

High Winds: This separate category was removed and is now considered under a new Severe Rainstorm category.

Landslide: This category was removed as it is now not considered a significant or likely hazard.

Lightning: This separate category was removed and is now considered under a new Severe Rainstorm category.

Multi-Structure Urban Fire: This category was moved to the Technological Hazards Analysis.

Radiological: This category was removed as it is now not considered a significant or likely hazard.

Severe Rainstorm: This new category was added to recognize this hazard as being distinct from Flooding and Fluvial Erosion.

For Technological Hazards, the following changes were made:

Other Fuel Service Loss: This new category was added to recognize the use of other fuels besides Natural Gas, such as fuel oil, propane and firewood.

Water Pollution: This new category was added to recognize the growing threat to the environment and the regulatory and accompanying financial burden to municipalities and residents caused primarily by stormwater runoff.

Radiological Incident: This separate category was removed and is now considered under Hazardsous Materials Incident.

Military Ordinance Incident: This separate category was removed and is now considered under Hazardsous Materials Incident.

Invasive Species: This new category was added to recognize the growing threat, primarily from aquatic invasives such as zebra mussels, Eurasion milfoil, etc.

For Societal Hazards,

No changes were recommended

3.4.1 Future Natural Hazard Events

In the 2011 Plan, the following Natural Hazards received the highest scores:

- Winter Storm (45)
- Flooding (32)
- Fluvial Erosion (24)
- Multi-Structure Urban Fire (16)

For this 2016 Plan, Natural Hazards were scored and ranked as follows:

- Winter Storm (45)
- Severe Rain Storm (45)
- Flooding (32)
- Extreme Temperatures (32)
- Fluvial Erosion (24)
- Wildfire (6)

Table 3-2 Natural hazard risk estimation matrix

		Winter Storm	Severe Rain Storm	Flooding	Extreme Temperatures	Fluvial Erosion	Wildfire
Area Impacted							
Key:	0 = No developed area impacted						0
	1 = Less than 25% of developed area impacted			1		1	
	2 = Less than 50% of developed area impacted						
	3 = Less than 75% of developed area impacted						
	4 = Over 75% of developed area impacted	4	4		4		
Consequences							
Health & Safety Consequences							
Key:	0 = No health and safety impact					0	0
	1 = Few injuries or illnesses		1	1	1		
	2 = Few fatalities or illnesses	2					
	3 = Numerous Fatalities						
Property Damage							
Key:	0 = No property damage						
	1 = Few properties destroyed or damaged	1	1		1		1
	2 = Few destroyed but many damaged			2		2	
	2 = Few damaged and many destroyed						
	3 = Many properties destroyed and damaged						
Environmental Damage							
Key:	0 = Little or no environmental damage						
	1 = Resources damaged with short-term recovery	1	1		1	1	1
	2 = Resources damaged with long-term recovery			2			
	3 = Resources destroyed beyond recovery						
Economic Disruption							
Key:	0 = No economic impact						0
	1 = Low direct and/or indirect costs	1			1		
	2 = High direct and low indirect costs		2	2		2	
	2 = Low direct and high indirect costs						
	3 = High direct and high indirect costs						
Sum of Area & Consequences Scores		***9***	***9***	***8***	***8***	***6***	***2***
Probability of Occurrence							
Key:	1 = Unknown but rare occurrence						
	2 = Unknown but anticipate an occurrence						
	3 = 100 years or less occurrence						3
	4 = 25 years or less occurrence			4	4	4	
	5 = Once a year or more occurrence	5	5				
TOTAL RISK RATING							
	Total Risk Rating =	**45**	**45**	**32**	**32**	**24**	**6**
	Sum of Area & Consequences Scores						
	x Probability of Occurrence						

In comparison to the Natural Hazards identified in the 2011 Plan, this 2016 analysis reflects the experience in the last few years of the damage caused by Severe Rainstorms and the potential damage from Extreme Temperatures. The addition of Severe Raintorms represents a key addition as this represents recognition of the damages being suffered even in areas that are not adjacent to streams or lakes. In particular, roads and ditches on upland portions of communities have been washed out in several recent disasters. The addition of the Extreme Temperatures category was made in recognigition of the occurence in early 2015 of several weeks of intense cold. This caused several hundred thousand dollars worth of damage to municipal infrastructure in the form of frozen and burst water system pipes.

Severe winter storms received the highest risk ranking in the 2011 annex. Winter storms are a consistent threat throughout Vermont and there have been no changes in how they are perceived or mitigated. However, in 2011, flooding only received a score of 20 out of 80, and fluvial erosion received a score of 16 out of 80 and was not discussed in the narrative. There are several reasons for the differences in ranking in this plan. A number of large storm events, including Tropical Storm Irene, have occurred since the writing of the 2011 annex. A statewide education program (Flood Ready Vermont) has increased public awareness and dialogue about fluvial erosion and flooding. In addition, the Vermont Clean Water Act, signed into law in the summer of 2015, authorized the development of a new Municipal Roads General Permit to lessen erosion from roads. Especially for rural towns, discussion of this permit has led to an increased focus on fluvial erosion as a hazard.

3.4.2 Future Technological Hazard Events

In the 2011 Plan, the following Technological Hazards received the highest scores:

- Telecommunications Failure (30)
- Power Loss (28)
- Major Transportation Incident (28)

For this 2016 Plan, Technological Hazards were scored and ranked as follows:

- Water Pollution (35)
- Hazardous Materials Incident (28)
- Power Loss (28)
- Multi-Structure Fire (24)
- Invasive Species (25)
- Major Transportation Incident (24)
- Water Supply Loss (20)
- Sewer Service Loss (15)
- Natural Gas Service Loss (15)
- Telecommunications Failure (15)
- Other Fuel Service Loss (4)

Table 3-3 Technological hazard risk estimation matrix

		Water Pollution	Hazardous Materials Incident	Power Loss	Invasive Species	Multi-Structure Fire	Major Transportation Incident	Water Supply Loss	Sewer Service Loss	Natural Gas Service Loss	Telecommunications Failure	Other Fuel Service Loss
Area Impacted												
Key:	0 = No developed area impacted											
	1 = Less than 25% of developed area impacted	1	1		1	1	1	1	1	1		1
	2 = Less than 50% of developed area impacted			2								
	3 = Less than 75% of developed area impacted										3	
	4 = Over 75% of developed area impacted											
Consequences												
Health & Safety Consequences												
Key:	0 = No health and safety impact				0							
	1 = Few injuries or illnesses	1		1				1	1	1	1	1
	2 = Few fatalities or illnesses		2			2	2					
	3 = Numerous Fatalities											
Property Damage												
Key:	0 = No property damage										0	
	1 = Few properties destroyed or damaged	1	1	1	1		1	1	1	1		1
	2 = Few destroyed but many damaged					2						
	3 = Few damaged and many destroyed											
	4 = Many properties destroyed and damaged											
Environmental Damage												
Key:	0 = Little or no environmental damage			0		0		0		0	0	0
	1 = Resources damaged with short-term recovery						1		1			
	2 = Resources damaged with long-term recovery	2	2		2							
	3 = Resources destroyed beyond recovery											
Economic Disruption												
Key:	0 = No economic impact											
	1 = Low direct and/or indirect costs		1		1	1	1		1		1	1
	2 = High direct and low indirect costs							2		2		
	2 = Low direct and high indirect costs	2										
	3= High direct and high indirect costs			3								
Sum of Area & Consequences Scores		***7***	***7***	***7***	***5***	***6***	***6***	***5***	***5***	***5***	***5***	***4***
Probability of Occurrence												
Key:	1 = Unknown but rare occurrence											1
	2 = Unknown but anticipate an occurrence											
	3 = 100 years or less occurrence								3	3	3	
	4 = 25 years or less occurrence		4	4		4	4	4				
	5 = Once a year or more occurrence	5			5							
TOTAL RISK RATING												
	Total Risk Rating =	**35**	**28**	**28**	**25**	**24**	**24**	**20**	**15**	**15**	**15**	**4**
	Sum of Area & Consequences Scores											
	x Probability of Occurrence											

In comparison to the Technological Hazards identified in the 2011 Plan, this 2016 analysis reflects a more refined analysis of the impacts to municipal services (and budgets!). Water Pollution events, although now formally recognized in our mitigation planning process, are a known, significant and growing hazard due to the current and very real fiscal impacts to municipalities of pollution abatement and management efforts. Hazardous materials incidents, though rare, still score high due to their potential extreme impacts if there were to occur in close proximity to people or to the built environment. As discussed in Section 1, large portions of Chittenden County are urban or suburban in nature, and much of its population is dependent upon municipal services such as water and sewer. Losses of these services as well as those provided by private utilities such as electric power and natural gas could therefore deprive many individuals, including vulnerable populations such as the elderly, of basic human needs. Compared to the 2011 Plan, however, this analysis now better reflects an understanding of the impacts of typical "outages" or service losses. For example, service losses of gas, sewer, and

water tend to be limited to discrete neighborhoods or a handful of residences and are repaired quickly.

CCRPC has had limited success in identifying "trouble spots" that have repeated occurrences of service outages or downed lines. VT Department of Public Service requires electric companies to report outage data (day, time, duration, general street location and determined cause. However, an exact location (i.e., near which exact utility pole) is not provided. Therefore, at this time, CCRPC cannot detail the geographic area with repeated service losses nor provide any detailed information on the likely frequency of future events. It is worth noting that squirrels chewing on electric lines.

Small scale transportation incidents—accidents involving a small number of vehicles—occur with relative frequency in Chittenden County, and can result in fatalities. However, the transportation incident rating in the risk estimation matrix concerns rarer, large-scale events. These could include an airline crash, an incident with a passenger ferry or large boat, a rail incident, a roadway accident involving a large number of vehicles, or major road infrastructure failure. Although the potential impacts are high, the rarity of such transportation events makes it difficult to identify specific geographic areas where such large transportation accidents are likely to occur.

3.4.3 Future Societal Hazard Events

According to the Hazard Risk Estimation analysis (*Table 3-4*), the following societal hazards received the highest risk ratings out of a possible high score of 80:

In the 2011 Plan, the following Societal Hazards received the highest scores:

- Epidemic (21)
- Crime (16)
- Civil Disturbance (16)

For this 2016 Plan, the following Societal Hazards received the highest scores:

- Crime (30)
- Economic Recession (28)
- Terrorism (24)
- Epidemic (24)
- Civil Disturbance (20)
- Key Employer Loss (16)

For the most part, the risk of Societal Hazards is less than that of Natural and Technological Hazards. For this 2016 Plan, Crime has risen to the top in recognition of the impacts caused by drug addictions. In the case of Chittenden County, addiction to herion and opiates is the most common problem which leads to increased fatalities and illnesses from overdoses, petty crime and demands on polic and medical services. Economic recessions of course are known to occur and definitely have impacts in terms of unemployment, lower wages, lower tax revenues, etc. At this point in time an act of terrorism or an epidemic is a possible event but the relative impact and frequency represents a "best guess" at this point.

Table 3-4 Societal hazard risk estimation matrix

		Crime	Economic Recession	Terrorism	Epidemic	Civil Disturbance	Key Employer Loss
Area Impacted							
Key:	0 = No developed area impacted						
	1 = Less than 25% of developed area impacted	1		1		1	1
	2 = Less than 50% of developed area impacted						
	3 = Less than 75% of developed area impacted				3		
	4 = Over 75% of developed area impacted		4				
Consequences							
Health & Safety Consequences							
Key:	0 = No health and safety impact						
	1 = Few injuries or illnesses		1				1
	2 = Few fatalities or illnesses	2			2	2	
	3 = Numerous Fatalities			3			
Property Damage							
Key:	0 = No property damage		0		0		0
	1 = Few properties destroyed or damaged	1				1	
	2 = Few destroyed but many damaged			2			
	3 = Few damaged and many destroyed						
	4 = Many properties destroyed and damaged						
Environmental Damage							
Key:	0 = Little or no environmental damage	0	0	0	0	0	0
	1 = Resources damaged with short-term recovery						
	2 = Resources damaged with long-term recovery						
	3 = Resources destroyed beyond recovery						
Economic Disruption							
Key:	0 = No economic impact						
	1 = Low direct and/or indirect costs					1	
	2 = High direct and low indirect costs			2			2
	2 = Low direct and high indirect costs	2	2				
	3 = High direct and high indirect costs				3		
Sum of Area & Consequences Scores		***6***	***7***	***8***	***8***	***5***	***4***
Probability of Occurrence							
Key:	1 = Unknown but rare occurrence						
	2 = Unknown but anticipate an occurrence						
	3 = 100 years or less occurrence			3	3		
	4 = 25 years or less occurrence		4			4	4
	5 = Once a year or more occurrence	5					
TOTAL RISK RATING							
	Total Risk Rating =	**30**	**28**	**24**	**24**	**20**	**16**
	Sum of Area & Consequences Scores						
	x Probability of Occurrence						

3.4.4 Summary of Future Hazard Events

To recap, the highest rated hazards (the top third in each category) for Chittenden County are:

Natural Hazards: Winter Storm, Severe Rainstorm

Technological Hazards: Water Pollution. Hazardous Materials Incident, Power Loss

Societal Hazards: Crime, Economic Recession

Table 3-5 shows the distribution of the highest hazards for each municipality based upon the Risk Estimation matrices contained in the annexed Local All-Hazards Mitigation Plans (table to be filled in after municipal plans are completed)

Table 3-5 Significant hazards, by municipality, Chittenden County, Vermont.

Hazards listed top to bottom in order of significance for County ⇩	BOLTON	BUEL'S GORE	BURLINGTON	CHARLOTTE	COLCHESTER	ESSEX / ESSEX JNCTN.	HINESBURG	HUNTINGTON	JERICHO	MILTON	RICHMOND	ST. GEORGE	SHELBURNE	SOUTH BURLINGTON	UNDERHILL	WESTFORD	WILLISTON	WINOOSKI
	" x " denotes hazards in top third of category type for municipality																	
Natural Hazards																		
Winter Storm	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Severe Rainstorm																		
Flooding																		
Extreme Temperatures																		
Fluvial Erosion																		
Wildfire																		
Technological Hazards																		
Water Pollution																		
Hazardous Materials Incident																		
Power Loss																		
Invasive Species																		
Multi-Structure Fire																		
Major Transportation Incident																		
Water Supply Loss																		
Sewer Service Loss																		
Natural Gas Service Loss																		
Telecommunications failure																		
Other Fuel Service Loss																		
Societal Hazards																		
Crime																		
Economic Recession																		
Terrorism																		
Epidemic																		
Civil Disturbance																		
Key Employer Loss																		

Note that this table represents the opinion of officials from each municipality, either based on direct municipal input or on the highest-rated hazards from the municipal annex. As a result, this assessment of relative risk and/or significance is not directly comparable from community to community. However, the table does illustrate which issues are of most importance to each municipality.

SECTION 4 VULNERABILITY ASSESSMENT

4.1 Buildings, Critical Facilities, and Infrastructure in Designated Hazard Areas

For the purposes of this Plan, Designated Hazard Areas are defined as formally-mapped areas where hazard damage is known to, and likely to, occur.

At this time, formally designated hazard areas in the county are primarily limited to the Flood Hazard Areas defined by the 100-year floodplain also know as Special Flood Hazard Areas aka the "100-year" floodplain and River Corridor Protection Areas (RCPA) formerly known as fluvial erosion hazard areas.

Individual residences are the most common buildings located in the floodplain, particularly older homes and vacation "camps" built prior to the implementation of local zoning bylaws. A simple GIS intersection analysis revealed that portions of municipal, state or federal roads are also located within the 100-year floodplain and the RCPA as well as culverts, bridges, and utility poles.

Unfortunately, this level of analysis does not take into account the fluvial geomorphology (volume, velocity, direction, etc.) nor most critically does not factor in the elevation of this infrastructure relative to flood elevation. Analysis also reveals farmland located within the floodplain, however, without an accurate fluvial geomorphology assessment at each location it is not currently possible to predict how many cubic yards of productive soils would be a net loss during a flood event. Additionally, many of these buildings and roads are actually located below large flood control and hydropower dams at several locations on the Winooski and Lamoille Rivers, thus making significant property destruction unlikely as long as the dams are functional.

Map X shows the distribution of designated Flood Hazard Areas and River Corridor Protection Areas in the County. Buildings, critical facilities and infrastructure located in these designated hazard areas are depicted in maps contained in the individual municipal annexes.

As illustrated in *Table 3-1*, frequent floods and, to a lesser degree, winter storms have been the primary significant hazards affecting the County's municipalities since 1990. Riverine flooding and stormwater runoff have been severe enough to cause damage to roads and culverts, but have not led to large-scale destruction of residences or businesses.

4.1.1 Flooding, fluvial erosion and Critical Infrastructure

Municipal highways, bridges and dams are well mapped in Chittenden County. The following three tables show the diversity of municipal highways and road surface in the county.

The Vermont Agency of Transportation divides municipal (town) highways into various classes as follows:
Class 1 town highways are subject to concurrent responsibility and jurisdiction between the municipality and VTrans. Class 1 town highways are state highways in which a municipality has assumed responsibility for most of the day to day maintenance (pot hole patching, crack filling, etc.). The state is still responsible for scheduled surface maintenance or resurfacing. In Chittenden County Class 1 highways are generally paved.

Class 2 town highways are primarily the responsibility of the municipality. The state is responsible for center line pavement markings if the municipality notifies VTrans of the need. The municipality designates highways as Class 2 with approval from VTrans. These are generally speaking the busier roads in a given town second to Class 1. In Chittenden County, most Class 2 highways are generally paved although in the more isolated areas these are gravel roads.

Class 3 town highways are the responsibility of and designated by the municipality. These are to be maintained to an acceptable standard and open to travel during all seasons. In Chittenden County, Class 3 roads are both paved or gravel.
.

Class 4 town highways are all other highways and the responsibility of the municipality. These are generally closed during the winter and minimally maintained and almost exclusively dirt.

Table 4-1 Municipal highway mileage: Chittenden County municipalities, combined

Class 1	Class 2	Class 3	Class 4	Federal Highway& Interstate	State Highway	Total Class 1, 2, 3 & Highway
16.409	287.510	714.66	37.27	47.46	174.514	1,193.093

Source: Derived from VTrans TransRDS GIS data, 2015 – road class and AOT Mileage.

As noted at the Introduction to this Plan, Chittenden County has three distinct land use patterns: urban, suburban, and rural. As such there are a large number of paved roads but also numerous gravel and soil/graded roads.

Table 4-2 Municipal highway paved and unpaved road mileage: Chittenden County municipalities combined

Paved	Gravel	Soil/Graded	Unimproved	Impassable	Unknown	Total
690.19	266.1	46.62	6.37	16.88	0	1026.2

Total Known	Total Unpaved	% Paved	% Unpaved
1026.2	336.01	67.26%	32.74%

Source: Derived from VTrans TransRDS GIS data, 2015 – surface class and AOT Mileage for highways under municipal jurisdiction

From a damage mitigation standpoint, the County is fortunate that most of its municiaplties' road mileage is paved (67.26%) and very little (5.16%) is soil/graded or unimproved.

Table 4-3 Paved and unpaved road mileage by municipality, Chittenden County, 2015

Municipality	Unpaved	% Unpaved	Paved	% Paved	Total known	Paved as % of County	Unpaved as % of County
Underhill	43.48	68.51%	19.99	31.49%	63.47	2.24%	12.93%
Westford	38.67	76.55%	11.85	23.45%	50.52	1.32%	11.50%
Jericho	35.01	48.59%	37.05	51.41%	72.06	4.15%	10.41%
Huntington	33.9	73.68%	12.11	26.32%	46.01	1.35%	10.08%
Charlotte	33.67	41.67%	47.14	58.33%	80.81	5.28%	10.01%
Essex	28.48	20.05%	110.81	79.55%	139.29	12.43%	8.47%
Hinesburg	26.62	47.41%	29.54	52.59%	56.16	3.31%	7.91%
Richmond	25.26	38.74%	39.95	61.26%	65.21	4.48%	7.51%
Milton	20.6	26.54%	104	83.46%	124.6	11.66%	6.12%
Colchester	15.46	13.35%	100.39	86.65%	115.85	11.26%	4.59%
Williston	11.65	12.44%	82	87.56%	93.65	9.19%	3.46%
Bolton	10.63	33.13%	21.46	66.87%	32.09	2.41%	3.16%
Shelburne	2.39	4.05%	56.73	95.95%	59.12	6.36%	0.71%
St. George	1.81	29.01%	4.43	70.99%	6.24	0.49%	0.53%
South Burlington	0.75	0.77%	96.88	99.23%	97.63	10.86%	0.22%
Burlington	0.54	0.57%	95	99.43%	95.54	10.66%	0.16%
Winooski	0.04	0.22%	18.82	99.78%	18.86	2.11%	0.09%
Buels Gore	0	0.00%	3.19	100.00%	3.19	0.35%	0.00%
Total	328.96	26.96%	891.34	73.04%	1220.3		

Source: Derived from VTrans TransRDS GIS data, 2015 – AOT Mileage and surface class.Data includes roads under state and municipal jurisdiction

As *Table 4-3* illustrates, unpaved roads comprise a significant portion of the total road mileage in the County. In general, the outlying and higher elevation municipalities have the highest percentages, but even some of the more rapidly developing mixed rural/suburban municipalities have significant amounts of unpaved roads. As noted in the discussion of previous disasters, some of the highest damage totals suffered were to gravel and dirt roads and culverts due to the inability of this type of infrastructure to handle large volumes of snowmelt, stormwater runoff, or rising stream waters. More urban municipalities, by contrast, suffered only minor damage from such flooding. However, it would be simplistic to argue that paving gravel roads in the outlying municipalities by itself would adequately mitigate against the effects of future flooding. Paving programs must also be combined with systematic upgrading of culverts and other measures to adequately handle excessive water volumes. In some cases, upgrading gravel road construction, culverts, and drainage may be preferable to paving.

4.2 Buildings, Critical Facilities and Infrastructure in Non-Designated Hazard Areas

[Note: these two subsections may be deleted.]

There are, of course, other hazards identified at both the regional and municipal level. For the purposes of this Plan, however, they are not considered designated Hazard Areas because they are not mappable with sufficient geographic accuracy and/or a long-term database with information on the frequency and the severity of that hazard does not exist. With regard to some hazards, such as fires, mapping past occurrences would not be useful in predicting future incidents, so there is little need in filling gaps in these data.

As noted in the analysis of Future Events, flooding, severe winter storms, severe rainstorms are the most significant natural hazards in the County. The effects of severe winter storms are widespread in the County, but do not generally cause significant damage to buildings, critical facilities and infrastructure. Snow loads do not often reach such high levels as to cause severe damage to structure elements, except to the roofs of older barns. The primary damages caused by severe winter storms are temporary road closures and increased snow removal costs.

The likely locations of future major multi-structure fires cannot be mapped with any degree of precision. In theory, any areas with an extremely high density of residences or businesses per acre could be vulnerable; however, it is not possible to predict the frequency of a major fire in such an area.

Some critical facilities such as government buildings, schools, churches, emergency services buildings, etc. are identified and, in some cases, mapped in each individual municipal annex.

4.2.1 Water, Wastewater and Natural Gas Service Areas

Water, wastewater and natural gas service areas are mapped in the individual municipal annexes as well as *Map 2-4* of this Multi-Jurisdictional AHMP. In the unlikely event of large-scale and lengthy service outages it would be these more densely populated areas that would be most vulnerable. At present, water service outages are the only type of these three service problems that occurs, but even that is only on a limited basis-- such as a frozen, burst pipe-- and is usually repaired within eight hours or less.

4.2.2 Electric Transmission Lines and Telecommunication Land Lines

High tension electric power transmission lines are mapped in the municipal annexes. Data on street to street distribution lines was both unavailable and inappropriate to map. Based on discussions with municipal officials, power and telephone outages seem to be more common in the more rural municipalities, particularly those at higher elevations in the eastern portion of the county.

4.3 Estimating Potential Losses in Designated Hazard Areas

Potential losses are estimated in each municipal annex based upon the current number of residential and commercial/industrial structures, located in the hazard area. E911 point data, which allows for identification of both residential and commercial/industrial structures, was used to determine the number of structures in three discrete areas: 1) the DFIRM100-year floodplain; 2) the River Corridor Protection Area previously known as the Fluvial Erosion Hazard Area and 3) the River Corridor.

Estimated residential and commercial/industrial losses were created by multiplying the number of vulnerable structures in the designated hazard area by the median of the assessed improent

values for properties in that municipality (from grand list data). Besides taking into account commercial as well as residential structures, this method allowed estimates based on the value of the structures themselves, excluding the value of the surrounding land. Data for estimating loss is only available for structures, however. Losses of personal or public property, environmental damage, and loss to business revenue could not be enumerated with available data.

4.3.1 Potential losses in the Special Flood Hazard Area

As shown in Map X, designated SFHAs are located along the Lake Champlain shoreline and along the Lamoille and Winooski Rivers and their tributaries. Many of the structures located in the SFHA were constructed before the adoption of local zoning codes let the mapping and designation of SFHAs. Table X-X below presents an estimate of the potential losses in the SFHA.

Table 4-4a Estimated potential losses in Special Flood Hazard Areas by municipality

Municipality		Structures Located in SFHA		Median 2014 Grand List Value of Structures in SFHA			Estimated Potential Loss in SFHA	
	Total E-sites	Residential	Commercial/ Industrial/ Other	Residential	Commercial/ Industrial/ Other	CLA Ratio	Residential	Commercial/ Industrial/ Other
Bolton	539	28	6	$176,700	$215,300	1.0257	$5,074,753	$1,324,999
Buels Gore	16	0	0				$0	$0
Burlington	12364	21	7	$160,400	$400,600	0.8751	$2,947,687	$2,453,955
Charlotte	2158	35	3	$506,500	$1,308,650	1.0507	$18,626,284	$4,124,996
Colchester	6434	67	14	$84,900	$173,100	0.9847	$5,601,269	$2,386,322
Essex	7427	7	10	$255,600	$1,225,000	1.0052	$1,798,504	$12,313,700
Hinesburg	1891	27	3	$237,000	$112,800	0.9204	$5,889,640	$311,463
Huntington	1093	15	0	$214,100		1.0264	$3,296,284	$0
Jericho	2023	10	3	$246,300	$3,094,900	0.9874	$2,431,966	$9,167,713
Milton	4687	49	3	$189,090	$51,946,800	1.0532	$9,758,330	$164,131,109
Richmond	1757	117	15	$222,800	$155,600	0.9925	$25,872,093	$2,316,495
St. George	330	0	0			0.9854	$0	$0
Shelburne	3231	3	4	$753,900	$224,600	0.964	$2,180,279	$866,058
So. Burlington	6875	0	1		$5,602,250	0.9898	$0	$5,545,107
Underhill	1255	18	1	$222,250	$132,900	1.0181	$4,072,909	$135,305
Westford	1263	1	0	$190,400		1.0157	$193,389	$0
Williston	4359	10	5	$465,580	$234,200	0.9382	$4,368,072	$1,098,632
Winooski	1882	1	2	$11,419,900	$4,019,200	0.9834	$11,230,330	$7,904,963
County total:	59584	409	77	$15,168,720	$68,630,600		$103,341,788	$214,080,818
Total Structures in Floodplain:			486	Total Estimated Potential Loss:			$317,422,605	

Note: Residential includes apartment buildings; also sheds, campers, etc. that are located on residential land

It is important to note that this data does not include home elevation data or show which homes have floodproofing practices in place. Therefore, this estimated loss analysis presents a truly worse-case scenario wherein flood levels substantially exceed the SFHA.

4.3.2 Potential losses in the River Corridor ProtectionArea

As shown in Map X, mapped areas suspectible to fluvial erosion (now named River Corridor Protection Areas) are located along numerous small and large waterways throughout the County.. As with structures in the SFHA, many of the structures located within the RCPA were constructed prior to the adoption of zoning bylaws and likely before the adoption of municipal stream setback regulations in those same bylaws. Table X-X below presents an estimate of the potential losses in the RCPA.

Table 4-4b Estimated potential losses in River Corridor Protection Areas by municipality

Municipality	Total Structures	Structures Located in River Corridor Proctection Area (RCPA)		Median 2014 Grand List Value of Structures in RCPA			Estimated Potential Loss in RCPA	
		Residential	Commercial / Industrial/ Other	Residential	Commercial/ Industrial/ Other	CLA Ratio	Residential	Commercial/ Industrial/ Other
Bolton	539	0	0	$0	$0	1.0257	$0	$0
Buels Gore	16	0	0	$0	$0		$0	$0
Burlington	12364	26	3	$166,150	$360,150	0.8751	$3,780,344	$945,502
Charlotte	2158	6	0	$408,650	$0	1.0507	$2,576,211	$0
Colchester	6434	4	2	$98,400	$237,700	0.9847	$387,578	$468,126
Essex	7427	15	6	$338,600	$447,200	1.0052	$5,105,411	$2,697,153
Hinesburg	1891	16	2	$158,000	$860,800	0.9204	$2,326,771	$1,584,561
Huntington	1093	51	2	$211,800	$198,300	1.0264	$11,086,968	$407,070
Jericho	2023	25	3	$264,600	$448,400	0.9874	$6,531,651	$1,328,250
Milton	4687	1	0	$400,000	$0	1.0532	$421,280	$0
Richmond	1757	12	0	$244,450	$0	0.9925	$2,911,400	$0
St. George	330	0	0	$0	$0	0.9854	$0	$0
Shelburne	3231	2	2	$511,850	$331,750	0.964	$986,847	$639,614
So. Burlington	6875	4	3	$234,000	$732,200	0.9898	$926,453	$2,174,195
Underhill	1255	14	1	$222,400	$114,900	1.0181	$3,169,956	$116,980
Westford	1263	1	0	$269,400	$0	1.0157	$273,630	$0
Williston	4359	1	2	$187,350	$47,800	0.9382	$175,772	$89,692
Winooski	1882	0	1	$0	$648,000	0.9834	$0	$637,243
sub-totals		178	27					
County total:	*59584*	Total	205					

It is important to note that this data does not include an analysis of the relative suspectibility to erosion of the individual stream reaches wherein a structure is located.

Therefore, this estimated loss analysis presents a truly worse-case scenario wherein flood levels substantially exceed the SFHA. It is worth noting that until recent years, Vermont DEC mapping of fluvial erosion hazard areas including ratings indicating relative vulnerability as follows:

… the width of a FEH area is scaled to the size of a stream. Smaller tributaries have a narrower FEH area associated with them. The width of an FEH area also depends upon its sensitivity. For example, a steep, headwater stream with a bed made up mostly of boulders is very stable (Very Low sensitivity), limiting its FEH area to the width of the channel. In contrast, a meandering, lowland stream with fine substrate is much more prone to lateral migration and sensitive to disturbance (Very High sensitivity rating). In this case, the FEH area, based on the stream meander belt, would be six to eight channel widths wide.

4.3.1 Potential losses of transportation infrastructure

It is worth repeating that based upon the everyday experience in the County along with the history of actual Federally-declared disasters, that the most common and likely losses are damages to transportation infrastructure, primarily roads and culverts. **Unfortunately, unlike damages to structures, estimating potential losses/damages to this type of infrastructure is extremely challenging for several reasons**. First, there are no standardized replacement costs for culverts and bridges as costs are unique to each location and each type of culvert. Second, with regards to road damages there is no way to predict, for example, how many linear feet of roadway would eroded by adjacent streams let alone the linear feet washed away by an excess volume of rain flowing down a poorly constructed roadside ditch on an upland road.

As seen in Map X, each municipality has at least several culverts that are considered, to be inadequate. Each local AHMP also documents potentially problematic culverts (in terms of geomorphic incompatability) that have been identified through actual field investigations conducted using a Bridge and Culvert Analytical tool as part of a so-called Phase II Fluvial Erosion Hazard Assessment. In practice, however, culvert damage can sometimes be a random event unique to that location for example if it were to become plugged through an excess of debris.

Bridges, Culverts, and Dams

There are a variety of bridges, culverts and dams located in the county. The following bridges are contained in an inventory maintained by VCGI, VTrans and the CCRPC. A GIS intersection was performed to determine which bridges are located in the designated flood hazard area (aka Special Flood Hazard Area or 100-year floodplain.) and /or the River Corridor Protection Area (aka Fluvial Erosion Hazard Area) .

Table 4-X Bridges located in Special Flood Hazard Area and/or River Corridor Protection Area

TownName	BridgeType / Number	Location	Mile-point	Route Name	Year Built	SFHA ?	RCPA ?	Stream
BOLTON	ROLLED BM W TMBR DK	0.1 MI TO JCT W CL2 TH3	000000	C3014	1919	No	Yes	Mill Brook RMPSFEH 091210
BOLTON	CONCRETE T-BEAM	0.08 MI TO JCT W US2	000000	C3015	1919	Yes	Yes	Joiner Brook RMPSFEH 011409

BOLTON	ROLLED BEAM	6.4 MI W JCT VT.100 N	002879	US2	1961	Yes	Yes	Joiner Brook RMPSFEH 011409
BOLTON	4 SPN CONT WGIR/RB	6.8 MI N EXIT 10	070582	I89	1961	No	Yes	Joiner Brook RMPSFEH 011409
BOLTON	5 SP CONT WELDED PL	6.5 MI W JCT VT 100 N	002835	US2	1961	No	Yes	Joiner Brook RMPSFEH 011409
BURLINGTON	CONT. RIVETED GIRDER	0.2 MI S JCT. VT.15	004193	US7	1928	Yes	Yes	Lower Winooski RMPSFEH 031710
BURLINGTON	3-SP CONT.HNCH PL GR	3.43 MI N MANHATTAN DRIVE	000020	VT127	1983	Yes	Yes	Lower Winooski RMPSFEH 031710
BURLINGTON CITY	R. C. BOX CULVERT	2.0 MI S JCT US 2	000130	US7	1935	Yes	Yes	Potash Brook RMPSFEH 031810
CHARLOTTE	ROLLED BEAM	0.2 MI TO JCT W CL3 TH12	008061	C2001	1957	No	Yes	LaPlatte RMPSFEH 050610
CHARLOTTE	TIED ARCH COV BR	0.2 MI TO JCT W CL3 TH43	000000	C3009	1898	Yes	No	
CHARLOTTE	ARCH/KINGPOST COV BR	0.01 MI TO JCT W C3 TH28	000000	C3039	1849	Yes	Yes	Lewis Creek RMPSFEH 031912
CHARLOTTE	GAL ROLLED BM/COV BR	0.01 MI TO JCT W CL2 TH1	000000	C3036	1849	Yes	Yes	Lewis Creek RMPSFEH 031912
CHARLOTTE	ROLLED BEAM	0.52 MI TO JCT W CL2 TH1	000000	C3014	1956	No	Yes	LaPlatte RMPSFEH 050610
CHARLOTTE	ROLLED BM/FLR BEAM	0.2 MI TO JCT W CL3 TH14	000000	C2009	1939	No	Yes	LaPlatte RMPSFEH 050610
CHARLOTTE	RC BOX CULVERT	6.5 MI N JCT VT 22A	000651	US7	1929	No	Yes	Direct Drainage RMPSFEH 032509
COLCHESTER	PRECAST CONC ARCH	0.04 MI TO JCT US7	001354	C2001	1992	Yes	Yes	Indian_rmpsfeh_040412
COLCHESTER	ROLLED BEAM	0.16 MI TO JCT W C3 TH17	000000	C3015	1960	Yes	No	
COLCHESTER	T BM WIDEN W ROLL BM	1.0 MI N JCT. VT.2A	004696	US7	1924	Yes	No	
COLCHESTER	2-SP CONCRETE SLAB	0.24 MI TO JCT W VT2A	001350	MILL POND ROAD	1940	Yes	Yes	Indian_rmpsfeh_040412
COLCHESTER	R. C. BOX CULVERT	0.1 MI.S JCT VT2A S & TH1	003370	US7	1929	Yes	Yes	Indian_rmpsfeh_040412
COLCHESTER	CONCRETE SLAB	2.0 MI N JCT VT 2A	005408	US7	1924	Yes	No	
COLCHESTER	3-SP CONT ROLLED BM	1.3 MI S EXIT 17	096566	I89	1964	Yes	No	
COLCHESTER	STEEL CULVERT	1.5 MI N EXIT 16 I89	092950	I89	1964	Yes	Yes	Sunderland Brook RMPSFEH 012009
COLCHESTER	CGMPP/ALUM SLEEVE	2.7 MI S EXIT 17 I89	095183	I89	1964	Yes	No	
COLCHESTER	B10					Yes	Yes	Indian_rmpsfeh_040412

ESSEX	TWO ROLLED BEAM	0.1 MI TO JCT W VT128	000000	C3044	1967	Yes	Yes	Browns River-21111
ESSEX	ROLLED BEAM	2.1 MI E JCT. VT.128	007386	VT15	1968	Yes	Yes	Browns River-21111
ESSEX	TWIN CELL RC BOX	0.9 MI E VT 15	010446	VT289	1993	Yes	Yes	AlderrBrkRMPSFEH071912
ESSEX	TWIN CELL RC BOX	2.0 MI E JCT VT 15	011464	VT289	1993	No	Yes	AlderrBrkRMPSFEH071912
ESSEX	ROLLED BEAM	1.0 MI N JCT. VT.15	001040	VT128	1940	Yes	Yes	Browns River-21111
ESSEX	2-SP CONT. WELDED GR	0.34 MI TO JCT W VT117	000001	N. WILLISTON RD	1993	Yes	No	
ESSEX	R.C. BOX	1.4 MI E VT 2A	003556	VT15	1919	Yes	Yes	Indian_rmpsfeh_040412
ESSEX	MULTI PLATE PIPE	0.1 MI E JCT VT 128	005466	VT15	1979	No	Yes	AlderrBrkRMPSFEH071912
ESSEX	CGMPP	0.1 MI N JCT VT 15	000077	VT128	1948	Yes	Yes	AlderrBrkRMPSFEH071912
ESSEX	RC BOX	0.8 MI N JCT VT 15	000806	VT128	1919	Yes	No	
ESSEX	CONCRETE BOX	2.1 MI N JCT VT 15	002065	VT128	1919	Yes	Yes	Browns River-21111
ESSEX	R. C. BOX	0.6 MI N VT 15	001302	VT2A	1936	Yes	Yes	Indian_rmpsfeh_040412
ESSEX	CGMPPA	2.4 MI E JCT VT 15&2A	002419	VT117	1993	Yes	Yes	AlderrBrkRMPSFEH071912
ESSEX	CONCRETE SLAB	0.3 MI E VT 2A	002611	VT15	1929	Yes	Yes	Indian_rmpsfeh_040412
ESSEX	CGMPP	3.0 MI N JCT VT 117	009103	VT289	1993	Yes	No	
ESSEX	B34					Yes	Yes	Indian_rmpsfeh_040412
ESSEX	B33					Yes	Yes	Indian_rmpsfeh_040412
ESSEX VILLAGE	TIMBER STRINGER	0.08 MI S JCT W VT15	000000	C3HUB	1997	Yes	Yes	Indian_rmpsfeh_040412
HINESBURG	ROLLED BM W TMBR DK	0.25 MI S OF JCT TH9 CL2		C3008	1995	Yes	Yes	LaPlatte RMPSFEH 050610
HINESBURG	PRESTRESS CONC. SLAB	0.2 MI TO JCT W VT116	000000	C2008	1949	Yes	Yes	Lewis Creek RMPSFEH 031912
HINESBURG	ROLLED BEAM	0.17 MI S OF JCT TH27	000000	C3023	1954	Yes	Yes	Lewis Creek RMPSFEH 031912
HINESBURG	ROLLED BEAM	0.04 MI TO JCT W C3 TH28	000000	C3029	1995	Yes	Yes	Lewis Creek RMPSFEH 031912
HINESBURG	CONCRETE T-BEAM	9.8 MI N JCT. VT.17 E	000692	VT116	1936	Yes	Yes	Lewis Creek RMPSFEH 031912
HINESBURG	ROLLED BEAM	0.1 MI S JCT. VT.116	003270	FAS 0199	2011	Yes	Yes	LaPlatte RMPSFEH 050610

HINESBURG	ROLLED BEAM	3.1 MI S JCT. VT.116	000290	FAS 0199	1940	Yes	Yes	Lewis Creek RMPSFEH 031912
HINESBURG	MULTI PLATE ARCH	0.2 MI W JCT. VT.116	002410	FAS 0208	1948	Yes	Yes	LaPlatte RMPSFEH 050610
HINESBURG	ROLLED BEAM	0.5 MI E VT.116	000500	FAS 0212	1940	Yes	Yes	Lewis Creek RMPSFEH 031912
HINESBURG	2 MULTI PLATE CGMP	4.4 MI S JCT VT 2A	003173	VT116	1949	No	Yes	LaPlatte RMPSFEH 050610
HINESBURG	REINFORCED CONC. BOX	2.8 MI S JCT VT 2A	004780	VT116	1985	No	Yes	LaPlatte RMPSFEH 050610 - Removed Admin Modificat*
HINESBURG	REINFORCED CONC. BOX	2.8 MI S JCT VT 2A	004780	VT116	1985	No	Yes	LaPlatte RMPSFEH 050610 - Removed Admin Modificat*
HINESBURG	REINFORCED CONC. BOX	2.5 MI S JCT VT 2A	005047	VT116	1919	No	Yes	LaPlatte RMPSFEH 050610
HINESBURG	B23					No	Yes	LaPlatte RMPSFEH 050610
HINESBURG	B5					Yes	No	
HUNTINGTON	GALV STL PONY TRUSS	0.1 MI E TO JCT TH1	000000	C3003	2000	Yes	Yes	Huntington River RMPSFEH 120209
HUNTINGTON	ROLLED BM W TMBR DK	0.2 MI TO JCT W CL2 TH1	000000	C3029	1914	Yes	No	
HUNTINGTON	ROLLED BM W TMBR DK	0.7 MI TO JCT W CL3 TH21	000000	C3022	1925	No	Yes	Huntington River RMPSFEH 120209
HUNTINGTON	CONCRETE SLAB	0.03 MI TO JCT W C3 TH21	000000	C3022	1992	Yes	Yes	Huntington River RMPSFEH 120209
HUNTINGTON	CONCRETE SLAB	0.01 MI TO JCT W C3 TH22	000000	C3021	2004	Yes	Yes	Huntington River RMPSFEH 120209
HUNTINGTON	ROLLED BEAM	0.01 MI TO JCT W CL2 TH1	000000	C3028	1977	Yes	Yes	Huntington River RMPSFEH 120209
HUNTINGTON	ROLLED BEAM	0.01 MI TO JCT W CL2 TH1	000000	C3020	1980	Yes	Yes	Huntington River RMPSFEH 120209
HUNTINGTON	PRESTRESS VOID SLAB	0.01 MI TO JCT W CL2 TH1	000000	C3031	1963	Yes	Yes	Huntington River RMPSFEH 120209
HUNTINGTON	ROLLED BEAM	0.39 MI TO JCT W CL2 TH1	000000	C3004	1976	Yes	Yes	Huntington River RMPSFEH 120209
HUNTINGTON	2SPN CONT CUR GIR	0.2 MI TO JCT W CL2 TH1	000000	C3004	2007	Yes	Yes	Huntington River RMPSFEH 120209
HUNTINGTON	ROLLED BEAM	3.9 MI N JCT. VT.17	002420	FAS 0211	1934	Yes	Yes	Huntington River RMPSFEH 120209
HUNTINGTON	CONCRETE T-BEAM	2.6 MI N JCT. VT.17	001220	FAS 0211	1929	Yes	Yes	Huntington River RMPSFEH 120209
HUNTINGTON	ROLLED BEAM	6.5 MI N JCT VT.17	005020	FAS 0211	1976	Yes	Yes	Huntington River RMPSFEH 120209

HUNTINGTON	WELDED PLATE GIRDER	5.0 MI S JCT. U.S.2	009580	FAS 0211	2001	Yes	Yes	Huntington River RMPSFEH 120209
HUNTINGTON	3 SPAN ROLLED BEAM	7.0 MI N JCT. VT.17	005540	FAS 0211	1939	Yes	Yes	Huntington River RMPSFEH 120209
HUNTINGTON	CONCRETE SLAB	4.4 MI N JCT. VT.17	002970	FAS 0211	1976	Yes	No	
JERICHO	ROLLED BEAM	0.4 MI TO JCT W CL3 TH28	000000	C2003	1949	Yes	Yes	Mill Brook RMPSFEH 091210
JERICHO	ROLLED BEAM	JCT OF CL2 TH3 & CL3 TH27	000000	C2003	1939	Yes	Yes	Mill Brook RMPSFEH 091210
JERICHO	ROLLED BEAM	JCT OF CL2 TH3 & CL3 TH26	000000	C2003	1939	Yes	Yes	Mill Brook RMPSFEH 091210
JERICHO	WELDED PLATE GIRDER	0.15 MI TO JCT W CL2 TH1	000000	C2002	1941	Yes	Yes	Browns River-21111
JERICHO	WELDED CURVED GIRDER	0.13 MI TO JCT W CL2 TH3	000000	C3029	1995	Yes	Yes	Mill Brook RMPSFEH 091210
JERICHO	PS/PT CONC SLAB	0.04 MI TO JCT W CL2 TH1	000000	C3035	2002	Yes	Yes	Mill Brook RMPSFEH 091210
JERICHO	PRESTRESS CONC. SLAB	0.1 MI TO JCT W CL2 TH4	000000	C3033	1992	Yes	Yes	Mill Brook RMPSFEH 091210
JERICHO	ROLLED BEAM	0.25 MI TO JCT W CL2 TH2	000000	C2006	1968	Yes	Yes	Browns River-21111
JERICHO	RIVETED TWO GIRDER	0.2 MI TO JCT W VT15	000000	C3009	1964	Yes	Yes	Browns River-21111
JERICHO	2 RIVETED BOX GIRDER	0.01 MI TO JCT W CL2 TH2	000000	C3020	1914	No	Yes	Browns River-21111
JERICHO	ROLLED BEAM	0.5 MI TO JCT W VT15	000000	C3013	1993	Yes	Yes	Browns River-21111
JERICHO	TWO ROLLED BEAM	0.2 MI TO JCT W VT15	000000	C3017	1928	Yes	Yes	Browns River-21111
JERICHO	CONCRETE SLAB	0.3 MI TO JCT W CL2 TH3	000000	C3028	1982	Yes	Yes	Mill Brook RMPSFEH 091210
JERICHO	CONC. ARCH CULVERT	0.17 MI TO JCT W C3 TH13	000000	C3059	2005	Yes	Yes	Browns River-21111
JERICHO	RIVETED TWO GIRDER	3.3 MI E JCT. VT.128	000387	VT15	1929	Yes	Yes	Browns River-21111
JERICHO	ROLLED BEAM	6.0 MI E JCT. VT.128	003063	VT15	1982	Yes	Yes	Browns River-21111
JERICHO	CONCRETE T-BEAM	3.3 MI N JCT. U.S.2	001060	FAS 0209	1927	Yes	Yes	Mill Brook RMPSFEH 091210
JERICHO	ROLLED BEAM	2.1 MI S JCT. VT.15	003860	FAS 0209	1941	Yes	Yes	Browns River-21111
JERICHO	ROLLED BEAM	5.8 MI E JCT. VT.15&2A	001328	VT117	1979	Yes	Yes	Mill Brook RMPSFEH 091210

JERICHO	CONCRETE T-BEAM	0.1 MI TO JCT W CL2 TH2	000094	FAS 0326	1952	Yes	Yes	Browns River-21111
JERICHO	CGMP	5.0 MI E JCT VT 15	000564	VT117	1957	Yes	No	
JERICHO	CGMPP	6.0 MI E JCT VT 15	001544	VT117	1957	Yes	No	
MILTON	2-SP CONT WELD GRD.	@ JCT W CL2 TH6	000000	C2007	1997	Yes	No	
MILTON	3 SP GIR W/ PIN&LINK	2.1 MI W JCT. U.S.7 N	003686	US2	1980	Yes	No	
MILTON	WELDED PLATE GIRDER	5.7 MI N JCT. U.S.2 W	005137	US7	1998	Yes	No	
MILTON	3SPN CONT TWO GIRDER	3.7 MI N EXIT 17	101632	I89	1967	Yes	No	
MILTON	B6	near guardrails				Yes	No	
RICHMOND	2- SP CONT ROLLED BM	0.01 MI TO JCT W C3 TH30	003359	C2003	1937	Yes	Yes	Huntington River RMPSFEH 120209
RICHMOND	2 SP CONT WLD PL GIR	0.02 MI TO JCT W US2	000000	C2003	2002	Yes	No	
RICHMOND	STEEL THRU TRUSS	0.3 MI S JCT. U.S.2	004800	FAS 0209	1928	Yes	No	
RICHMOND	STEEL THRU TRUSS	0.2 MI W JCT. VT.117	000702	US2	1929	Yes	No	
RICHMOND	CONCRETE T BEAM	4.2 MI E JCT VT 117	005150	US2	1929	Yes	No	
RICHMOND	CGMPPA	0.7 MI W JCT US 2	000081	VT117	1957	Yes	No	
RICHMOND	CONCRETE SLAB	5.1 MI E JCT VT 117	006068	US2	1925	Yes	No	
RICHMOND	4 SPAN ROLLED BEAM	0.1 MI N EXIT 11	078535	I89	1964	Yes	Yes	Richmond Tribs RMPSFEH 061209
RICHMOND	4 SPAN ROLLED BEAM	0.1 MI N EXIT 11	078535	I89	1964	Yes	Yes	Richmond Tribs RMPSFEH 061209
RICHMOND	3 SP CONT (2) GIRDER	0.3 MI N EXIT 11	078719	I89	1962	Yes	No	
RICHMOND	3 SP CONT (2) GIRDER	0.3 MI N EXIT 11	078719	I89	1962	Yes	No	
RICHMOND	2 SP CONT. ROLLED BM	4.6 MI S JCT. U.S.2	000350	FAS 0211	1946	Yes	Yes	Huntington River RMPSFEH 120209
RICHMOND	CGMPP/ LINED	4.8 MI S EXIT 11 I89	073571	I89	1964	Yes	No	
RICHMOND	B6	mailbox 2540				Yes	Yes	Johnnie Brook RMPSFEH 051211
RICHMOND	B4	1397				Yes	Yes	Johnnie Brook RMPSFEH 051211
RICHMOND	B3	telephone pole 76				Yes	No	
RICHMOND	B22	telephone pole 80340				Yes	No	

RICHMOND	B5	near mailbox 2447				Yes	No	
RICHMOND	B11	between Huntington rd and Johnny Brooke rd but cannot be accessed by vehicle so could not be assessed				Yes	No	
S. BURLINGTON	OPEN SPAN CONC ARCH	0.2 MI S JCT VT 15 ON TH4	001340	FAU5206 LIME KN	2006	Yes	No	
S. BURLINGTON	CONCRETE FRAME	3.4 MI N JCT VT 2A	000417	VT116	1934	Yes	Yes	Muddy Brook RMPSFEH 072309
S. BURLINGTON	ALUM PIPE	0.5 MI W JCT VT 116	000186	VT998	2006	Yes	Yes	Potash Brook RMPSFEH 031810
S. BURLINGTON	R. C. BOX CULVERT	1.9 MI E JCT VT 116	002908	US2	1922	Yes	Yes	Muddy Brook RMPSFEH 072309
S. BURLINGTON	7 SP CONT WLD PL GIR	1.3 MI N EXIT 14	090008	I89	1962	Yes	Yes	Lower Winooski RMPSFEH 031710
S. BURLINGTON	7 SP CONT WLD PL GIR	1.3 MI N EXIT 14	090008	I89	1962	Yes	Yes	Lower Winooski RMPSFEH 031710
S. BURLINGTON	7 SP CONT WLD PL GIR	1.3 MI N EXIT 14	090008	I89	1962	Yes	Yes	Lower Winooski RMPSFEH 031710
S. BURLINGTON	7 SP CONT WLD PL GIR	1.3 MI N EXIT 14	090008	I89	1962	Yes	Yes	Lower Winooski RMPSFEH 031710
S. BURLINGTON	MULTIPLATE PIPE ARCH	0.9 MI S EXIT 13 I89	086727	I89	1963	Yes	Yes	Potash Brook RMPSFEH 031810
S. BURLINGTON	CGMPP	0.9 MI S EXIT 13 I89	086681	I89	1963	Yes	Yes	Potash Brook RMPSFEH 031810
S. BURLINGTON	CONCRETE CULVERT	0.2 MI S EXIT 13 I89	087327	I89	1962	Yes	Yes	Potash Brook RMPSFEH 031810
S. BURLINGTON	SEG BOX	0.7 MI S EXIT 14 I89	088106	I89	2007	No	Yes	Potash Brook RMPSFEH 031810
S. BURLINGTON	CGMPP	0.4 MI N EXIT 14 I89	089218	I89	1962	No	Yes	Centennial Brook RMPSFEH 030310
S. BURLINGTON	REF. CONC. BOX	0.1 MI E JCT US 7	000183	I189	1962	Yes	Yes	Potash Brook RMPSFEH 031810
S. BURLINGTON	CGMP	0.7 MI E JCT US 7	000789	I189	1962	No	Yes	Potash Brook RMPSFEH 031810

S. BURLINGTON	CGMPP	0.9 MI E JCT US 7	000965	I189	1962	Yes	Yes	Potash Brook RMPSFEH 031810
S. BURLINGTON	RC BOX	1.4 MI E JCT US 7	001434	I189	1962	Yes	Yes	Potash Brook RMPSFEH 031810
SHELBURNE	ROLLED BEAM	1.0 MI TO JCT W US7	000650	BAY ROAD	1948	Yes	No	
SHELBURNE	ROLLED BEAM	1.2 MI E JCT. U.S.7	000450	FALLS ROAD	1988	Yes	No	
SHELBURNE	R. C. BOX CULVERT	3.8 MI N JCT S.A.F.5	000646	US7	1956	No	Yes	LaPlatte RMPSFEH 050610
SHELBURNE	PRECAST SEG BOX	6.8 MI N JCT S.A.F.5	003727	US7	2005	Yes	Yes	Monroe Brook RMPSFEH 032509
UNDERHILL	CONCRETE SLAB	0.01 MI E JCT W TH1	000000	C3037	1998	Yes	Yes	Browns River-21111
UNDERHILL	ROLLED BM W TMBR DK	0.12 MI TO JCT CL2 TH1	000000	C3048	1990	Yes	Yes	Browns River-21111
UNDERHILL	ROLLED BEAM	7.1 MI E JCT. VT.128	000547	VT15	1938	Yes	Yes	Browns River-21111
UNDERHILL	ROLLED BEAM	7.3 MI E JCT. VT.128	000783	VT15	1938	Yes	No	
UNDERHILL	CONCRETE T-BEAM	5.6 MI S JCT. VT.108	007690	FAS 0233	1927	Yes	No	
UNDERHILL	ROLLED BEAM	3.0 MI E JCT. VT.15	002540	FAS 0233	1957	Yes	Yes	Browns River-21111
UNDERHILL	PS/PT CONC BOX BEAM	2.6 MI E JCT. VT.15	002150	FAS 0233	2001	Yes	Yes	Browns River-21111
UNDERHILL	R.C. BOX	7.6 MI W JCT VT 104	002148	VT15	1925	Yes	No	
UNDERHILL	B4					Yes	Yes	Browns River-21111
UNDERHILL						Yes	Yes	Browns River-21111
UNDERHILL						Yes	Yes	Browns River-21111
UNDERHILL	B24					Yes	Yes	Browns River-21111
UNDERHILL						Yes	Yes	Browns River-21111
UNDERHILL	B28					Yes	Yes	Browns River-21111
UNDERHILL	B26					No	Yes	Browns River-21111
UNDERHILL						Yes	No	
UNDERHILL	B38					Yes	No	
UNDERHILL						Yes	No	

UNDERHILL	B16					Yes	No	
UNDERHILL						Yes	No	
UNDERHILL	B20					Yes	No	
UNDERHILL						Yes	No	
WESTFORD	ROLLED BEAM	0.07 MI TO JCT W VT.128	000062	C2003	1966	Yes	Yes	Browns River-21111
WESTFORD	ROLLED BEAM	2.7 MI S JCT. VT.104	003684	VT128	1930	Yes	Yes	Browns River-21111
WILLISTON	PRESTRESS CONC SLAB	0.7 MI WEST OF TH 3	000000	C3017	2000	Yes	Yes	Muddy Brook RMPSFEH 072309
WILLISTON	CONCRETE SLAB	1.0 MI TO JCT W VT2A	000000	C3006	1996	Yes	Yes	Allen Brook RMPSFEH 092409
WILLISTON	CONCRETE SLAB	1.1 MI TO JCT W VT2A	000000	C3006	1996	Yes	Yes	Muddy Brook RMPSFEH 072309
WILLISTON	ROLLED BEAM	0.8 MI NO. JCT. U.S.2	004558	VT2A	1936	Yes	Yes	Allen Brook RMPSFEH 092409
WILLISTON	CONT. CURVED GIRDER	2.2 MI N JCT. U.S.2	005940	VT2A	1987	Yes	Yes	Lower Winooski RMPSFEH 031710
WILLISTON	ROLLED BEAM	INDUSTRIAL AVE	000790	INDUS	1932	Yes	Yes	Allen Brook RMPSFEH 092409
WILLISTON	CGMPPA	2.4 MI N VT 116	000424	VT2A	1947	Yes	Yes	SuckerBr072012
WILLISTON	MULTI PL PIPE ARCH	2.5 MI N VT 116	000527	VT2A	1947	Yes	Yes	SuckerBrTrib072012
WILLISTON	CONCRETE SLAB	2.5 MI E JCT VT 2A	003873	US2	1917	Yes	Yes	Allen Brook RMPSFEH 092409
WILLISTON	MULTI PLATE PIPE	1.1 MI W JCT VT 117	005752	US2	1917	Yes	No	
WILLISTON	ROLLED BEAM	1.0 MI N EXIT 12	084991	I89	1963	Yes	Yes	Muddy Brook RMPSFEH 072309
WILLISTON	ROLLED BEAM	1.0 MI N EXIT 12	084991	I89	1963	Yes	Yes	Muddy Brook RMPSFEH 072309
WILLISTON	PRECAST SEG. BOX	2.5 MI S EXIT 12 I89	081540	I89	1993	No	Yes	Allen Brook RMPSFEH 092409
WILLISTON	CGMP	2.5 MI S EXIT 12 I89	081535	I89	1963	No	Yes	Allen Brook RMPSFEH 092409
WILLISTON	B5					Yes	Yes	Allen Brook RMPSFEH 092409
WILLISTON	B16					Yes	Yes	Muddy Brook RMPSFEH 072309

4.4 Land Use and Development Trends Related to Mitigation

Table 4-6 below shows the percentage of land use versus the percentage of land by zoning category for the county as a whole.. Land use is visually depicted in *Map X*.

Table 4-6 Land use compared to zoning, Chittenden County.

Planning Area	Residential	Commercial	Industrial	Institutional / Infrastructure	Mass Assembly	Leisure / Recreation	Natural Resources	Dwelling Units	Com/Ind Total Area (ft^2)	Com/Ind Total Area (acres)
Center	2051	972	11	176	28	1	0	11356	8,046,988	184.73
Enterprise	204	689	134	60	5	0	4	264	13,379,880	307.16
Metro	18241	927	60	201	60	5	4	29822	20,470,576	469.94
Rural	16052	253	65	94	75	14	117	16114	1,166,632	26.78
Suburban	10408	187	22	51	31	4	7	12153	13,655,509	313.49
Village	4803	372	22	89	100	4	5	5645	34,641,988	795.27
Total:	51759	3400	314	671	299	28	137	75354	91,361,573	2097.37

4.4.2 Development Trends

Disaster planning in Chittenden County is characterized by concerns of public safety because a) it is the most populous county in Vermont and is growing and b) also has the densest road network. With regards to assessing vulnerability, the question becomes "has development increased the vulnerability of persons and property to hazards?"

4.4.2.1 Development from 2011 to 2014

To answer this question, CCRPC first investigated development in mapped hazard areas: the Special Flood Hazard Area (SFHA); the River Corridor Protection Area (RCPA) and the River Corridor (RC). RCPAs and RCs are being actively promoted for municipal use by the State however only SFHA's exist in regulation as of 2016.

The following table contrasts development activity that occurred between 2011 through 2014 compared to a baseline of 2010:

Table X. Housing Unit Growth, 2010-2014

	Housing Units		Change	
Area	**2010**	**2014**	units	% of total growth
Metro	28,938	29,822	884	41.6%
Center	10,968	11,356	388	18.3%
Suburban	11,795	12,153	358	16.8%
Village	5,469	5,645	176	8.3%
Enterprise	263	264	1	0.0%
Rural	15,796	16,114	318	15.0%
Total	75,239	77,368	2,125	100.0%
Special Flood Hazard Area	585	588	3	0.1%
River Corridor Protection Area	187	247	60	2.8%
River Corridor	612	683	71	3.3%
** Special Flood Hazard Area + RCPA*	*42*	*43*	*1*	0.0%
Source: CCRPC Housing Database 2014				

As the table demonstrates, growth in the SFHA sinc the last AHMP was adopted in 2011 is negligible. Indeed it is possible, that the additional 3 units are not actually "new" units but are an artifact of more accurate record-keeping or an update of the e-911 database. Two of the three new units are in Underhill (which does allow some new construction as a conditional use in the SFHA) while one is in Hinesburg.

There has been some growth (60 units out of 2,125 constructed in the County during the 4 year period) in River Corridor Protection Areas, however, 56 of these units were constructed as part of a single condominium complex in Winooski. This complex, part of a larger, Federally-supported mixed-use development to invigorate this City's downtown, although it is located in the Area, has no occupied living space on its ground floor which consists mostly of a parking area wherein water could flow freely if necessary. Three of the remaining four, new units are located in Charlotte (which although it does have mapped RCPA, none of its mapped areas have a high erosion sensitivity rating) while the last was constructed in Underhill.

With regards to the newly-created and expansive River Corridor, the first thing to remember is that this designation also includes the area of the RCPA. This means that in the period from 2011 through 2014, 11 units were constructed beyond the 60 noted as built in the RCPA. These eleven were built in Charlotte (4); Williston (3) plus one (1) each in Essex, Jericho, Richmond, South Burlington.

4.4.2.2 Projected Development

For 2016 and beyond, new construction within the SFHA is anticipated to be very slight to non-existent. As 14 of the County's 19 municipalities do not allow any new structures at all plus one community (Buel's Gore) has no floodplain while another (St. George) only has limited floodplain area that overlaps within an area of undevelopable wetland. Three additional communities (Burlington, Huntington and Underhill) do allow some new structures in the floodplain but only as a conditional use.

For 2016 and beyond, new construction within the River Corridor Protection Area is also anticipated to be very slight. Within River Corridor Protection Areas (formally termed Fluvial Erosion Hazard areas), in most cases water quality setbacks or buffers established by the municipalities overlap with or exceed the size of these Protection Areas. For 2016 and beyond, it is anticipated that some level of new units will be constructed within the River Corridor as in some cases the Corrider exceeds the area not covered by municipal water quality setbacks. The CCRPC anticipates that some municipalities will adopt RCPAs or RCs to achieve a higher State match of ERAF funds and preclude future development in riverine areas not covered by their own municipal water quality setbacks. In some cases, it is possible that municipalities will adopt hybrid protections against Fluvial Erosion that include both the smaller RCPAs in areas zoned for development such as their village centers and the larger RCs in zoning districts designated for lower density use such as agricultural, natural resources or rural residential districts.

4.4.2.3 Projected use of County road network

Many people desire urban or suburban housing so as to live close to work, school and shopping. However, a significant number of people also desire more rural locations. Complicating matters is the high cost of housing, due to a shortage of both rental units and or single-family homes in the county. This has forced many people to live in the county's outlying municipalities or even outside the county itself. A growth pattern of this nature necessitates a transportation system that supports people's mobility and a utility system that allows a certain standard of living to which people have become accustomed. Unfortunately, transportation and utility systems are vulnerable to natural disasters and any interruption is likely to have adverse affects on the health and safety of people in Chittenden County.

Flooding, fluvial erosion and severe rainstorm damage to roads and culverts is now more common as new access roads, driveways and subdivision roads are built in both steeper and more rural terrain and formerly quiet country roads become commuter routes. Stormwater management has become a growing concern in the county in recent years not only due to these damages but also due to non-point pollution runoff that has degraded water quality and habitat in several small streams in the county's urban and suburban areas. Additionally as noted above, with the passage of the Vermont Clean Water Act in 2015 and its attendant requirement for implementation of Municipal Roads General Permit, all municipalities in the County will have to begin implementation of various projects to slow erosion and flow off roads.

Transportation infrastructure, not homes and businesses, are the most commonly threatened and damaged property in the County. As the reader review the mitigation strategies in Section 5, it will be evident of this Plan's clear focus on addressing the impact of common County hazards of Severe Rainstorm, Flooding and Fluvial Erosion on transportation infrastructure and their accompanying vulnerabilities.

SECTION 5 MITIGATION STRATEGY

5.1 Existing Chittenden County Regional Plan Goals and Policies that Support Hazard Mitigation

As described in the individual municipal annexes and in the following excerpts from the *2006 Chittenden County Regional Plan*, hazard mitigation policies (although not explicitly defined as such) are in place at both the regional and local level. These policies are embedded within local level zoning bylaws, subdivision regulations and local and regional comprehensive plans.

The following strategies and selected actions that support hazard mitigation are excerpts from the *2013 Chittenden County Regional Plan*, known as the "ECOS Plan" formally adopted on June 19, 2013. (Note that the Public Safety Policies drew heavily from the *2011 Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan*.)

5.1.1 Land Use Goals

Encourage future growth in the Center, Metro, Enterprise, Suburban, and Village Planning Areas to maintain Vermont's historic settlement pattern and respect working natural landscapes

Strategy: Strive for 80% of new development in areas planned for growth, which amounts to 15% of our land area

Actions:

Invest in Areas Planned for Growth –

Establish wastewater, water infrastructure and public transit in areas currently developed and/or planned for growth.

Target reuse, rehabilitation, redevelopment, infill, and brownfield investments to the nonrural Planning Areas.

Retrofit existing buildings to reduce energy use and greenhouse gas emissions.

Improve design quality of high density areas, and allow flexibility for creative solutions.

Municipal Planning and Zoning - Strengthen and direct development toward areas planned for growth through infill development and adaptive reuse of existing buildings through municipal plan and bylaw revisions and state designation programs.

Municipal Development Review Regulations should be revised to improve the mix of uses, shared parking, support for transit, access to a variety of services (for example restaurants, grocery stores, parks, entertainment) via active transportation, energy efficiency, renewable energy and the affordability of housing. A particular emphasis is needed on providing for affordable rental housing.

[…….]

Integrate capital planning and budgeting in planning efforts to provide the right mix of infrastructure over time. Official maps can also be a useful tool to drive infrastructure improvements in the areas planned for growth.

Health Impact Assessments (HIA) provide a tool to use at the regional, municipal, agency, and organizational level to assure that planning decisions maintain or improve the public health. Access can be improved by co-locating public facilities, in particular, medical and mental health facilities in areas with easy access via active transportation and public transit. Town health officers should be encouraged to participate in community planning efforts.

Empower local officials through trainings and education on strategies to achieve the above plan and bylaw amendments, and implementation of them during development review. This could include how to effectively analyze development costs and benefits, and select appropriate multi-modal congestion mitigation measures.

State/Local Permitting Coordination & Improvement

Support changes to the local and state permitting process to make the two more coordinated and effective. Participate in the Agency of Commerce and Community Development's (ACCD) process to improve the State's designation programs designed to encourage development in appropriately planned places and discourage development outside of those areas. This program could be improved with regulatory and/or fiscal incentives. These could include expedited permitting processes for projects in areas that are: a) designated for growth; and, b) where a community has a robust plan, regulations and staff capacity; and reduction of redundancies such as delegation of permitting for certain local and state reviews (such as exemption from Act 250). In conjunction with delegation it may be appropriate to develop more stringent standards and thresholds for development review in rural areas.

Collaborate with stakeholders to ensure local and state regulations, bylaws and plans encourage transparency, predictability and timely review of sustainable and environmentally sound development applications.

Develop a transportation assessment process that supports existing and planned land use densities and patterns in Center, Metro, Suburban, Village, and Enterprise Planning Areas to allow for more congestion and greater mode choice than allowed by current standards. The CCRPC will collaborate with the Vermont Agency of Transportation (VTrans), the Natural Resources Board, and other state and local stakeholders to develop a process that evaluates the transportation impact from a multi-modal perspective rather than just a traffic flow standpoint. Policies and planning studies that are adopted as part of this ECOS Plan and subsequent amendments will guide CCRPC's position in permit proceedings.

<u>Strategy: Improve and Strengthen the Economic Systems of our Region to increase opportunities for Vermont employers and Employees</u>

Actions

Industrial Site Locations – With only a few years supply of existing buildings or permitted sites left for high wage industrial or manufacturing businesses in the region, additional sites need to be identified and carefully planned to ensure a smooth permitting process to be ready for employers' needs for expansion or relocation in Chittenden County. The most likely employment sectors with this need are high wage, technology-based and other types of manufacturing. The best opportunities for these sites are on vacant portions of land owned by current major employers, within close proximity to - or already connected to - existing infrastructure services for long term efficiency.

[…….]

Working Lands - Support value-added foods, farms and forest products through the work of Farm to Plate by Vermont Sustainable Jobs Fund and Working Lands Enterprise Board. See Strategy 4 for more details.

<u>5.1.2 Natural Resource Goals</u>

Design and maintain a strategically planned and managed green infrastructure network composed of natural areas, working lands, wildlife habitat, scenic views and air quality that help

to conserve ecosystem values and functions (including climate change adaptation and mitigation), and provide associated benefits to our community.

<u>Strategy: Increase investment in and decrease subdivision of working lands and significant habitats and support local food systems</u>
Actions
Habitat Preservation - Protect forests, wetlands and agricultural lands from development, and promote vegetative landscaping in urban areas in order to maintain natural habitats, natural storm water management and carbon sequestration. This will keep people and infrastructure out of harm's way and allow for natural flood attenuation areas. a.
Inventory - Conduct on the ground surveys and inventories of significant habitats (include wetlands), connectivity corridors, scenic resources and locations of invasive species and map this information. Incorporate this data into municipal and regional plan text and maps and establish specific policies that address and protect these resources.
[……]
Municipal Development Review Regulations - Develop clear definitions of the resources to be protected and establish standards to describe how to protect these resources within zoning and subdivision regulations.
Education - Educate engineers, developers, real estate professionals, planners and the public regarding resources and methods for restoration and protection.
Non-regulatory Protection - Support non-regulatory conservation and/or preservation through public and land trust investments. Establish invasive plant removal management plans, implement the plans and include long-term monitoring.
Working Lands Implementation – To preserve the soul of Vermont, as well as move forward into the future with resiliency, Vermont needs to protect the farmland and forestland we have and support existing and new operations (including, but not limited to, un-intensive urban and suburban home gardens and mini-homesteads). Support implementation of the Farm to Plate Strategic Plan and the VT Working Landscape Partnership Action Plan.
Municipal Development Review Regulations - Develop clear definitions of working lands to be protected and establish zoning and subdivision standards to describe how to protect these areas from development so that they may be retained and accessible as "working" lands. Maintain access and scale of working lands to ensure viability after subdivision in the rural landscape (including but not limited to protection of log landings of previously logged forested parcels, zoning techniques such as fixed area ratio zoning to separate lot size from density, conservation zoning and homeowners association bylaws that allow for farming on the open space lots, etc.) while promoting urban agriculture in areas planned for growth. While farming is generally exempt from municipal zoning, some structures such as farm houses, processing facilities, the generation of energy for on-farm use, and on-farm retail and related enterprises may be regulated. The economic viability of farm enterprises can often depend on these facilities so municipal regulation should not impede reasonable farm related improDEMHSents.
Infrastructure & Systems – support establishment of food processing industries, value-added product markets, workforce training, etc to help support the viability of these industries.
[……..]
Support non-regulatory conservation and/or preservation through public and land trust investments (including but not limited to municipal land conservation funds).

Conserve, protect and improve the health of native species habitats, water quality and quantity, and air quality.

<u>Strategy: Improve the safety, water quality, and habitat in our rivers, streams, wetlands lakes in each watershed</u>

Actions
River Hazard Protection – Develop and implement adaptation strategies to reduce flooding and fluvial erosion hazards. While supporting planned growth, ensure that growth is evaluated in terms of preparedness for a changing climate – particularly wetlands, rivers, lakeshore, and other areas where extreme weather can cause flooding.
Identify problem locations - Conduct on the ground inventories and map flow and sediment attenuation locations and problematic infrastructure (undersized culverts, eroding roadways, "vulnerable infrastructure" - infrastructure subject to repeat damage and replacement, etc.).
Revise bridge/culvert designs - Revise public works and zoning ordinances with culvert and bridge design specifications that allow for wildlife passage and moDEMHSent of floodwater and debris during high intensity events. Implement culvert and bridge designs that produce stable structure in river channels (i.e. fluvial geomorphology).
Protect river corridors & ensure enforcement – Existing bylaws protect the majority of Fluvial Erosion Hazard (FEH) areas with stream setbacks and floodplain regulations; improve bylaws to protect the FEH hazard zones not currently protected and enforce these bylaws. Continue protection of river corridors including non-regulatory protection measures such as stream re-buffering and culvert and bridge replacements.
Support non-regulatory conservation and/or preservation of vulnerable areas through public and land trust investments.
Non-point Source Pollution - While we have addressed point sources of pollution, non-point sources are still contributing pollutants to our water bodies.
Assemble data – Work from existing data collected and further identify the locations that are contributing to water quality pollution such as flow, sediment, pathogen and nutrient. Where needed, conduct on-the-ground inventories of water quality and biological assessments (instream), wetlands, sub-watersheds, river corridors (buffered or not) and geomorphology. Map the existing and new data on one regional map.
Revise Plans and Bylaws and Ensure Enforcement -- Incorporate the above data into municipal plans; establish specific statements that protect these resources; develop clear standards for how to protect these resources within zoning regulations; and initiate on-going enforcement of the regulations. Encourage low impact development techniques, and shared storm water control programs to maximize land development in areas planned for growth. Incentivize best management practices for agricultural uses; and encourage the Agency of Agriculture to better enforce their accepted agricultural practices.
Implement Non-regulatory approaches - Identify and implement non-regulatory approaches to nutrient, pathogen and sediment pollution management. Under new MS4 permit requirements, municipalities will be developing flow restoration plans to achieve the total maximum daily load requirements for impaired streams, rivers, and Lake Champlain. These plans may require additional public investment in storm water facilities or investments or actions by individual property owners. Support watershed organizations.
[……..]

Support and promote the use of more holistic, less chemical dependent and less energy intensive effluent management efforts whenever possible (for example, composting toilets, localized grey water systems, passive grey water and black water septic systems, rain water harvesting and storage, etc.)

Strategy: Develop financing and governance systems to make the most efficient use of taxpayer dollars and reduce costs
Action
Clean water Financing – Monitor and participate in state financing reform such as the 2012 Vermont Legislatures Act 138 study which the Agency of Natural Resources is leading to make recommendations on how to implement and fund the remediation or improvement of water quality. Ensure that stormwater regulation and requirements do not financially burden or penalize dense and compact development in the areas planned for growth.
Conserve, protect and improve valued scenic, recreational, and historic resources and opportunities.

[……..]

5.1.2 Economic Goals
Build the region's capacity for shared and sustainable improvements in the economic wellbeing of the community through support of both local and globally competitive initiatives
[……..]

5.1.3 Housing Goals
[……..]

5.1.4 Infrastructure Goals
Ensure adequate infrastructure and facilities (i.e. water supply, wastewater treatment, stormwater treatment, broadband coverage, and solid waste recovery and recycling) to support areas planned for growth while conserving resources
Make public and private investments in the built environment to minimize environmental impact, maximize financial efficiency, optimize social equity and benefits, and improve public health

5.1.5 Energy Policies
Reduce Chittenden County's consumption of energy and reliance on non-renewable energy.
Improve the cost-effectiveness, efficiency and reliability of the energy production, transmission, and distribution system.
Strategy: See the first strategy in section 5.1.1
Action
Energy
Reduce Energy Consumption - Education and outreach to key sectors regarding weatherization, life cycle fuel costs, and behavioral adjustments will be essential elements for reducing energy use and costs over time.

Decrease greenhouse gas emissions, to support the State's goal of reducing greenhouse gas emissions 50% from 1990 levels by 2028.
Encourage individual homes and businesses to include electric and thermal energy efficiency in building and/or retrofitting. Weatherization should be promoted and executed as a first step to reduce overall energy consumption before investing in renewable energy systems. There is a need for focused study to determine solutions for vermiculite removal as it relates to weatherization, in particular low income weatherization. Vermiculite was used as an insulator for decades (1960-1990) – and was mined with asbestos thus any home with vermiculite is assumed to be contaminated.
Provide alternatives to fossil fuels for heating.
Reduce fossil fuel consumption in the transportation sector.
Increase resilience to potential interruptions of grid power, especially for maintaining essential services (including water supply and sewage disposal) without electrical power. Such services need, in the short term, backup power with at least a week's supply of stored fuel. In the long term, redesign these services in a more resilient way.
Increase Renewable Energy Generation, to support the State's goal of 90% renewable energy by 2050.
Determine appropriate sites for community-level renewable energy generation.
Encourage individual homes and businesses to include renewable energy options in building and/or retrofitting

Strategy: See the second strategy under the second goal in section 5.2.1
Action
Energy Investment – Encourage property assessed clean energy (referred to as PACE) efforts, weatherization, tax incentives and other financing opportunities for investments in energy efficiency and renewable energy.

5.1.6 Public Safety Policies
Improve the safety of the public including the loss of life and property from natural and manmade hazards

5.2 Existing Municipal Level Actions that Support Hazard Mitigation

It is important to stress that hazard mitigation was and is being primarily carried out at the municipal level. The following table summarizes the existing Emergency Management actions (Preparedness, Response, Recovery and Mitigation) across all of the County's municipalities and highlights some concerns and issues that need to be addressed in order to implement more effective mitigation.

Table 5-1 Summary of existing mitigation actions and related non-mitigation actions

Type of Existing Protection	Description /Details/Comments	Issues or Concerns
Emergency Response		

Police Services	The following municipalities fund and provide their own police services: Burlington, Colchester, Essex/Essex Junction, Hinesburg, Milton, Richmond, Shelburne, South Burlington, Williston and Winooski. The remaining municipalities are served by the Vermont State Police's Troop A, which has its barracks adjacent to Exit 12 of I-89 in Williston. See Table 1-5 for details.	Vermont State Police and sometimes police from abutting municipalities provide services to several of the County's outlying municipalities. Any disaster event especially in the outlying municipalities that do not have their own police departments has the potential to overwhelm VSP and municipal law enforcement resources located within the County. A municipal PD is primarily responsible for public safety within its boundaries. There exists no formal mechanism to coordinate police services in the event of a county-wide emergency or disaster. There are informal and unwritten mutual aid agreements amongst neighboring departments. * There are no issues with regards to mitigation as this activity primarily occurs within the Preparedness and/or Response phase.
Police Department Personnel	Number of FTE police officers varies by municipality	Recruitment and retention of officers is a concern given that salaries and benefit packages for officers may not be able to compete with those in larger cities outside the State. Officers with long-standing experience in the community are particularly valuable especially if they have strongly developed working relationships with local fire, EMS, and highway departments. * There are no issues with regards to mitigation as this activity primarily occurs within the Preparedness and/or Response phase.
Fire Services	All of the municipalities have their own locally-based fire departments with the exception of Underhill-Jericho, which share a department, St. George, which is served by the Hinesburg Fire Department, and Buels Gore, which is served by the Starksboro Fire Department from northern Addison County.	* There are no issues with regards to mitigation as this activity primarily occurs within the Preparedness and/or Response phase.
Fire Department Personnel	Most Fire Departments are staffed by volunteers Burlington has paid officers and crew. South Burlington and Williston have paid chiefs and a mix of paid and volunteer crew. Underhill-Jericho is all-volunteer except for a paid duty officer.	Fire officials in some growing municipalities are concerned with recruiting and retaining enough volunteer firefighters to maintain adequate service. Some shifts are harder to staff than others. * There are no issues with regards to mitigation as this activity primarily occurs within the Preparedness and/or Response phase.
Fire Department Mutual Aid Agreements	Common throughout county	May be based on verbal agreement only. Mutual aid functions quite well between clusters of abutting municipalities. However, there exists no formal mechanism to coordinate fire services county-wide. * There are no issues with regards to mitigation as this activity primarily occurs within the Preparedness and/or Response phase.
EMS Services	Dedicated Rescue services include Charlotte, Essex, Shelburne, St. Michael's College, UVM, Milton, Colchester, Williston, Burlington FD-EMS, and Richmond Rescue.	A mass casualty incident has the potential to overwhelm the limited number of ambulances serving the region as well overwhelm the emergency room at the one hospital in the County, Fletcher Allen Health Care in Burlington. * There are no issues with regards to mitigation as this activity primarily occurs within the Preparedness and/or Response phase.
EMS Personnel	Most are staffed by volunteers but some EMS/Rescue Services have had to hire at least some full-time EMTs, especially to cover weekday shifts.	Issues remain concerning having sufficient recruitment and retention to cover all shifts. * There are no issues with regards to mitigation as this activity primarily occurs within the Preparedness and/or Response phase.
EMS Mutual Aid Agreements	EMS providers have worked out discrete service boundaries in their District, known as Vermont Emergency Services, District #3. A District "response list" details the primary, secondary and third through eighth ambulance to call depending upon the location of the incident.	The EMS community is tight-knit and is used to covering for each other as the volume of calls ebbs and flows in a community. However, no centralized dispatch is in place to assure effective coordination in the event of a county-wide disaster or mass casualty event. * There are no issues with regards to mitigation as this activity primarily occurs within the Preparedness and/or

		Response phase.
Other Municipal Services		
Highway Services	Sixteen municipalities have their own highway or road departments. In Buels Gore, the only public road is VT Route 17, which is maintained by the state. Both the Town of Charlotte and the Town of St. George contract out for road maintenance services.	After an average snowfall most municipalities can plow all of their municipal roads in four to twelve hours. Highway departments also must handle Stormwater management through the maintenance, repair and replacement of culverts, storm drains and drainage ditches. With regards to mitigation, as detailed in the new Strategies for this plan, highway services are taking on stronger role to mitigate against damages caused by Severe Rainstorm and Water Pollution.
Type of Existing Protection	**Description /Details/Comments**	**Issues or Concerns**
Highway personnel	Number of FTE highway personnel varies by municipality.	With regards to mitigation, as detailed in the new Strategies for this plan, highway services are taking on stronger role to mitigate against damages caused by Severe Rainstorm and Water Pollution.
Water / Sewer Department	Several municipalities have their own departments. South Burlington also has a stormwater utility.	Community wells and community septic systems serving discrete rural subdivisions are maintained by contractors hired by homeowners associations. With regards to mitigation, as detailed in the new Strategies for this plan, highway services are taking on stronger role to mitigate against damages caused by Severe Rainstorm and Water Pollution.
Public Works Personnel	Number of FTE public works / water / sewer personnel varies by municipality	With regards to mitigation, as detailed in the new Strategies for this plan, Public Works personnel are taking on stronger role to mitigate against damages caused by Severe Rainstorm and Water Pollution.
Planning	Most municipalities have only one part-time or full time land use planner. Larger municipalities have two or more staff in their planning department	No municipality has any dedicated part-time or full-time staff engaged in emergency management planning. This makes it difficult for municipal or volunteer fire or EMS departments or municipal police departments to consistently maintain plans, conduct exercises and other trainings or to seek funding to implement hazard mitigation projects. However, with regards to mitigation, as detailed in the new Strategies for this plan, highway services are taking on stronger role to mitigate against damages caused by Severe Rainstorm and Water Pollution through promotion of effective plans and regulations. Note that effective July 2015, municipalities who are updating and re-adopting their Town Plans (aka "Comprehensive Plan") must also include a Flood Resiliency element.
Zoning	Smaller municipalities have no dedicated zoning administrator. In these cases, these duties are often part of those assigned to the planner or town administrator. Other municipalities are generally limited to one part-time or full-time zoning administrator who may or may not have dedicated clerical support	No significant issues with regards to mitigation as all Chittenden County communities have zoning in place with 17 of the 18 communities that have designated floodplain, also having Floodplain zoning bylaws in effect and participating in the NFIP. The respective Zoning Administrator / Administrative Officer in each of the 17 communities is responsible for continued compliance with NFIP requirements.
Residential Building Code / Inspection	Only the large municipalities of Burlington, Winooski, Colchester and South Burlington have adopted the Building Officials & Code Administrators (BOCA) National Building Code and have allotted some payroll expenses towards building inspection duties.	The BOCA Code establishes minimum requirements for materials and methods of construction, addresses loads and stresses, fire protection, special uses, lighting and ventilation, and means of egress. Homeowners, both current and prospective, must rely solely on the professionalism of builders and contractors to use sufficient standards in new

		home construction, remodeling, installation and repairs.
Building Inspectors	Building inspection duties are generally assigned to municipal fire chiefs and zoning administrators.	No issues.
Emergency Plans		
Local Emergency Operations Plan (EOP)	All of the county's municipalities have adopted an LEOP.	EOP's need regular updating and field testing. With regards to mitigation, since adoption of a LEOP is required to receive a good ERAF reimbursement rate for PA repairs, municipalties are now reviewing and updating their LEOPs more frequently.
School Emergency/Evacuation Plan(s)	Schools and school districts develop their own emergency/evacuation plans, and have varying degrees of coordination with municipal officials.	Such plans should be familiar to local and regional emergency service providers. Annual tabletop and/or field exercises should be implemented to ensure effective coordination and communication between emergency service providers and school officials. * There are no issues with regards to mitigation as this activity primarily occurs within the Preparedness and/or Response phase.
Shelter, Primary	All municipalities except Buel's Gore have an identified Red Cross shelter.	A Red Cross directory details for each shelter contact information, power replacement options such as on-site generator or a transfer switch (hookup) for portable generators, contacts to open building, available shelter space, and kitchen capabilities. * There are no issues with regards to mitigation as this activity primarily occurs within the Preparedness and/or Response phase.
Replacement Power, backup generator	Few of the Red Cross shelters have an on-site generator or transfer switch to enable a portable generator to power a facility.	The lack of sufficient power replacement at the County's designated shelters is a serious concern especially if widespread and long-lasting power outages were to occur during periods of extreme cold temperatures. * There are no issues with regards to mitigation as this activity primarily occurs within the Preparedness and/or Response phase.
Shelter, Secondary:	Some of the larger municipalities have more than one designated shelter.	All municipalities have other public and quasi-public buildings (e.g. town hall, churches, etc.) that could at least serve as temporary shelters but without shower and/or kitchen facilities.
Replacement Power backup generator	Few of the shelters listed in the directory have an on-site generator or transfer switch.	The lack of sufficient power replacement at the County's designated shelters is a serious concern especially if widespread and long-lasting power outages were to occur during periods of extreme cold temperatures. * There are no issues with regards to mitigation as this activity primarily occurs within the Preparedness and/or Response phase.
Type of Existing Protection	**Description /Details/Comments**	**Issues or Concerns**
Municipal Plans		
Town / Municipal Comprehensive Plan	All 19 municipalities have an approved municipal plan and an adoption of an updated plan. All municipal plans are reviewed and approved by the Chittenden County Regional Planning Commission.	Municipal plans do not specifically address hazard mitigation. However, various goals and policies in these plans related to land use and development result in mitigation such as floodplain bylaws, water quality setbacks or buffers, river corridor bylaws, natural resources conservation, and infrastructure construction.
Zoning Bylaws and Subdivision Regulations	All 19 municipalities have adopted or interim zoning bylaws. Most of the 19 municipalities have adopted a discrete set of detailed Subdivision Regulations as well.	Zoning bylaws detail permitted uses, conditional uses and prohibited uses of a parcel and establish design standards in order to reduce the likelihood and/or degree of harm caused by hazards.

Hazard Specific Zoning (slope, wetland, conservation, industrial, etc.)	Many municipalities have established zoning districts for river, wetlands, conservation, lakeshore, water resources overlay districts, viewshed or open space. These types of zoning districts offer some form of hazard mitigation in that development (residential, commercial, etc.) is either completely prohibited or highly regulated.	Other commonly established zoning districts include rural residential, residential, village center (mixed use), commercial, industrial, and agricultural that indirectly mitigate hazards by separating and segregating activities, such as separating industrial uses from residential. With regards to mitigation, as noted above 17 of the County's 18 municipalities have mapped and regulated Special Flood Hazards Areas. 18 of the County's municipalities have water quality buffers or stream setbacks as part of their zoning bylaws. Two municipalities, Jericho and Hinesburg, have incorporated Fluvial Erosion Hazards Areas into their bylaws. The remaining 19th municipality (Buels Gore) is located at a high mountain elevation and has no mapped floodplain.
Participation in National Flood Insurance Program (NFIP) and Floodplain/Flood Hazard Area Ordinance	17 of the county' municipalities participate in the NFIP and have designated Flood Hazard Areas. The Town of St. George, and Buels Gore do not participate in the NFIP however St. George will be considering adoption in FY2017.	The County's previously only paper versions of floodplain maps were converted to digital Flood Inusrance Rates Maps in 2011. Maps are therefore more readily available to the average person through online viewers hosted by FEMA, by the State, by the CCRPC and in some cases, individual municipalities.
Open Space Plans; Conservation Funds	The municipalities of Burlington, Charlotte, Colchester and Williston have formally adopted Open Space Plans. The municipalities of Bolton, Charlotte, and South Burlington have instituted Conservation or Open Space Funds that raise money through annual municipal property tax levies. The municipalities of Hinesburg, Huntington, Jericho, Shelburne and Williston have similar funds, but the amount of the funding is set as a line item in the municipal budget.	Funds are commonly used by municipalities to purchase fee simple title to a parcel, to purchase conservation easements (i.e. purchase the development rights attached to a parcel) or to raise funds to support maintenance of municipal- owned open space. Some of the land conserved is farm or forest lands adjacent to streams and rivers. Prevention of the development of these lands enables the land to function to slow or retain floodwaters thus reducing velocity and volume during heavy rain or snowmelt events.

5.2.1 Participation in National Flood Insurance Program

As noted earlier, 18 of the county's 19 municipalities have mapped floodplain, the lone exception being the upland unincorporated community of Buels Gore. St. George has mapped floodplain but does not currently participate in the NFIP. Details on NFIP participation, repetitive losses and insurance rates are as follows:

Table 5-x NFIP participation information by municipality

Municipality	FIRM Date	Structures Located in SFHA				
		Residential	Commercial/ Industrial/ Other	# of policies	LOMC	# of rep. losses
Bolton	8/4/2014	28	6	9	4	
Buels Gore	N/A	0	0	N/A		N/A
Burlington	7/18/2011	21	7	47	4	
Charlotte	7/18/2011	35	3	12	7	
Colchester	7/18/2011	67	14	45	42	4
Essex	7/18/2011	7	10	21	21	
Hinesburg	8/4/2014	27	3	10	8	
Huntington	8/4/2014	15	0	27	10	
Jericho	8/4/2014	10	3	17	15	2
Milton	7/18/2011	49	3	24	5	6
Richmond	8/4/2014	117	15	63	64	6

St. George	8/4/2014	0	0	N/A	N/A	N/A
Shelburne	7/18/2011	3	4	15	4	
So. Burlington	7/18/2011	0	1	21	20	
Underhill	7/18/2011	18	1	16	20	2
Westford	7/18/2011	1	0	2	4	
Williston	8/4/2014	10	5	20	9	
Winooski	7/18/2011	1	2	4	2	
County total:		409	77			
			486	77	239	20

Data current as of February 1, 2016

As the table demonstrates, a relatively low percentage of properties located within the SFHA have NFIP insurance policies. The most likely reason for this is that most properties were constructed before floodplain districts were created and the mortage has long since been paid off. In the case of structures located in the SFHA of the Lake Champlain shoreline, many structures were originally constructed as summer vacation homes –known colloquially as "camps." Many of these have substantial stone, concrete or metal armoring to protect them from damage. As with the analysis of potential structural losses, it is hard to know how many of these homes are elevated above the Base Flood Elevation or have other flood protection measures in place.

5.2.2 Conserved Lands

One very effective ways to achieve mitigation is to simply preclude development in certain areas. Throughout the County there are numerous parcels that are conserved for their scenic beauty, views, farming purposes, recreation, wildlife habitat, etc. As the table below shows, this conservation effort is significant. As noted above, many municipalities dedicated an annual portion of their tax revenue towards conservation/open space funds. In addition, there are several organizations, large and small, in the State that purchase or or donated conservation easements on key parcel. Major organizations active in the county in this role include the following: Vermont Housing & Conservation Board, Vermont Land Trust, The Nature Conservancy, Winooski Valley Parks District, Lake Champlain Land Trust and Vermont River Conservancy.

Table 5-x Conserved lands by municipality

Town Name	Acres	Acres of Public Land	Percent Public	Acres of Conserved Land	Percent Conserved	Total Public & Conserved	Percent Conserved Land
Bolton	26,982.39	11,603.08	43%	4,242.35	16%	15,845.86	59%
Buels Gore	3,201.53	1,942.62	61%			1,943.23	61%
Burlington	6,776.11	942.85	14%	278.34	4%	1,221.33	18%
Charlotte	26,505.21	987.80	4%	7,883.33	30%	8,871.16	33%
Colchester	23,807.65	3,024.16	13%	690.46	3%	3,714.74	16%
Essex	22,255.79	962.71	4%	524.99	2%	1,487.74	7%
Essex	2,973.90	79.70	3%	12.75	0%	92.47	3%

Junction							
Hinesburg	25,398.79	2,463.22	10%	2,202.53	9%	4,665.85	18%
Huntington	24,526.57	6,339.16	26%	1,046.73	4%	7,386.15	30%
Jericho	22,725.65	6,580.51	29%	1,084.17	5%	7,664.96	34%
Milton	33,950.20	2,464.07	7%	1,266.17	4%	3,730.31	11%
Richmond	21,063.02	2,173.75	10%	699.96	3%	2,873.81	14%
Shelburne	15,984.69	1,146.37	7%	2,275.29	14%	3,421.73	21%
South Burlington	10,597.64	340.93	3%	308.54	3%	649.50	6%
St. George	2,353.59		0%			0.00	0%
Underhill	32,820.98	9,681.19	29%	1,717.78	5%	11,399.26	35%
Westford	25,044.46	183.28	1%	800.30	3%	983.58	4%
Williston	19,894.39	650.78	3%	1,177.09	6%	1,827.90	9%
Winooski	941.96	164.87	18%		0%	165.04	18%
County	**347,804.53**	**51,731.02**	**15%**	**26,210.76**	**8%**	**77,944.63**	**22%**

5.3 Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan Goals

As detailed above, various forms of hazard mitigation are already being carried out at the municipal level. Well-developed, long-standing categories of local action that include basic mitigation measures include:

Given these current strengths and weaknesses, and estimates of the most likely significant hazards for the county, this Plan presents the following multi-jurisdictional goals for hazard mitigation planning in Chittenden County:

1) Hazard mitigation planning should take into account the multiple risks and vulnerabilities of the significant hazards in the County due to its mixed urban-suburban-rural nature, its economic importance to the State and its significant presence of public and private infrastructure.
2) Promote awareness amongst municipalities, residents and business in the county of the linkages between the relative frequency and severity of disaster events and the design, development, use and maintenance of infrastructure such as roads, utilities and stormwater management and the planning and development of various land uses.
3) Ensure that regionally-initiated mitigation measures are consistent with municipal plans and objectives and the capacity of municipalities to implement them.
4) Encourage municipalities to formally incorporate their individual Local All-Hazards Mitigation Plan into their municipal plan as described in 24 VSA, Section 4403(5), as well as incorporate their proposed mitigation actions into their various bylaws, regulations and ordinances, including, but not limited to, zoning bylaws and subdivision regulations and building codes.
5) Encourage municipalities to formally incorporate elements of their Local All-Hazards Mitigation Plan, particularly their recommended mitigation strategies, into their

municipal operating and capital plans & programs, especially, but not limited to, as they relate to public facilities and infrastructure, utilities, highways and emergency services.

6) Educate regional entities on the damage to public infrastructure resulting from all hazards and work to incorporate hazard mitigation planning into the regional land use and transportation planning program conducted by the Chittenden County Regional Planning Commission.
7) Maintain existing mechanisms, develop additional processes, or explore funding mechanisms and sources to foster regional cooperation in hazard mitigation, specifically and emergency management planning, generally.

5.3.1 Incorporation into Existing Planning Mechanisms

The primary mechanism for incorporation of the mitigation plan requirements is through each jurisdiction's comprehensive municipal plans process and its day-to-day municipal operations especially its public works functions. Each municipality in Chittenden County has adopted such a plan (commonly called a town plan, municipal plan, development plan or comprehensive plan) that is either approved by the voters or the governing body. Each plan must also be reviewed and approved by the Chittenden County Regional Planning Commission. By Vermont statute, these municipal plans – as well as the Chittenden County Regional Plan – must be re-adopted at least every eight years after a public review and comment process.

Therefore, each local Mitigation Plan includes the following Goal: Consider formal incorporation of this Local All-Hazards Mitigation Plan into the municipal comprehensive plan as described in 24 VSA, Section 4403(5), as well as incorporation of proposed new mitigation actions into the municipality's bylaws, regulations and ordinances, including, but not limited to, zoning bylaws and subdivision regulations and building codes.

The other common planning process potentially available is termed "open space" planning, where the municipality engages in a public planning process to identify key natural, scenic, historical, etc. areas that should not be developed. This is particularly the case for those municipalities that have tax revenues or municipal line items dedicated to purchasing land (fee simple or easement) for conservation or open space purposes.

Other implementation mechanisms include: municipal capital improvement plans, municipal zoning bylaws and subdivision regulations and miscellaneous municipal regulations and ordinances. All of Chittenden counties municipalities have zoning bylaws and various municipal regulations and ordinances. The existing zoning restrictions on development in hazard areas will apply to all new structures in these hazard areas. In May 2010, the state Legislature passed Act 110 which requires the Agency of Natural Resources to offer municipalities with grants or pass-through funding to adopt shoreland and river corridor best management practices in local zoning bylaws. With the exception of Bolton, Buels Gore, Charlotte, St. George, Underhill and Westford, all of the county's municipalities have an annual capital improvements budget, although those with relatively low tax bases may have difficulty funding capital purchases of significant size. Strictly speaking, at the regional or county level, there are no equivalent mechanisms to bylaws, regulations and ordinances that have governmental authority.

The State incentives resilience planning through the Emergency Relief and Assistance Funds (ERAF) program. There are a number of steps a municipality can take to improve the local match requirement for FEMA post-disaster relief funds. Generally, in the event of a Federal-

disaster declaration FEMA covers 75% of the cost of "Public Assistance" projects, typically repairs to roads and culverts and debris cleanup. The remaining 25% must be matched by the State and municipal government. Four requirements are needed for the State to provide half of that requirement, 12.5% match assistance.

As of June 2016, nearly all of Chittenden County's municipalities have met these four benchmarks as follows:

1. adopt an annual Local Emergency Operation Plans– [18 of 19 communities]
2. adopt the Town Road and Bridge Standards that meet or exceed the VTrans 2013 standards – [18 of 19 communities. Bolton is considering adoption of these standards.
3. participate in the National Flood Insurance Program – 17 communities participate. St. George is considering adoption in FY17 while Buel's Gore has no mapped floodplain. and
4. adopt a FEMA-approved Local Hazard Mitigation Plan – since 2005, all 19 municipalities have had an approved LHMP.

Table 5-x Compliance of municipalities with ERAF standards

Chittenden County Progress Tracking: ERAF Requirements; updated as of ***5/31/16*** by CCRPC staff

Municipality	1 Adopted 2013 VAOT standards	2 NFIP Participation	3 Approved AHMP	4 Adopted LEOP (between town meeting day and May 1 each year)	5. a. / b. CRS particip. or FEH Bylaw or equi	ANR River Corridor Eligiblity Criteria: FEH and/or robust SFHA protections adopted?	ANR River Corridor Eligiblity Criteria: Setbacks Adopted	ANR River Corridor Eligiblity Criteria: ERAF Early Adopter	Progress towards 5% bonus: Option 1: CRS designation plus prohibit structures in FHAs	Progress towards 5% bonus: Option 2 (Adopt RC or RC Protection Area for streams > 2 sq. mi. + 50' setback' for streams < 2 sq. mi. + FEH protections)
BOLTON	Plans to adopt	Yes	8/3/11	4/18/16	early adopt	Y	Y	Y		
BUELS GORE	10/8/13	No	8/3/11	5/19/14		N	N	N		
BURLINGTON	4/12/13	Yes	8/3/11	4/18/16		N	Y	N		
CHARLOTTE	3/18/13	Yes	8/3/11	4/25/16	early adopt	Y	Y	Y		
COLCHESTER	2/25/14	Yes	8/3/11	3/22/16	early adopt	Y	Y	Y	Yes, 2016	
ESSEX	1/7/14	Yes	8/3/11	4/18/16	early adopt	Y	Y	Y		
ESSEX JUNCTION	2/11/14	Yes	8/3/11	4/26/16	early adopt	Y	Y	Y		
HINESBURG	10/20/14	Yes	8/3/11	4/20/15 approved but not signed?	early adopt	Y *	Y	N		has an FEH Overlay District
HUNTINGTON	2/18/13	Yes	8/3/11	5/16/16		N	Y	N		
JERICHO	2/21/13	Yes	8/3/11	4/7/16	early adopt	Y*	Y	N		incorporated into River District
MILTON	11/3/14	Yes	8/3/11	5/18/15	early adopt	Y	Y	Y		
RICHMOND	2/19/2013	Yes	8/3/11	5/2/16	early adopt	Y	Y	Y		
SHELBURNE	1/28/14	Yes	8/3/11	5/24/15	early adopt	Y	Y	Y		
SOUTH BURLINGTON	9/2/2014	Yes	8/3/11	4/18/16	early adopt	Y	Y	Y		
ST. GEORGE	8/20/15	No	8/3/11	4/21/16		N	Y	N		
UNDERHILL	10/8/14	Yes	8/3/11	4/26/16		N	Y	N		
WILLISTON	4/14/13	Yes	8/3/11	3/21/16	early adopt	Y	Y	Y		
WINOOSKI	2/25/13	Yes	8/3/11	4/20/15	early adopt	Y	Y	Y		
WESTFORD	4/10/14	Yes	8/3/11	4/27/16	early adopt	Y	Y	Y		Considering adoption

5.4 Multi-Jurisdictional Mitigation Strategies

It is important to note that the prior Plan, although it was adopted in 2011, was essentially fully drafted in 2010. Now, in 2016 the primary hazards and primary vulnerabilities remain the same. Flooding, fluvial erosion and severe rainstorms in the spring, summer and fall and winter storms with excessive ice or wind that downs trees and limbs continue to the be most common hazards. Damage to public infrastructure especially to roads, temporary road and bridge closures and

power losses, temporary isolation of vulnerable individuals and budgetary impacts to municipalities are the dominant vulnerabilities.

However, although the hazards and vulnerabilities have remained the same, the frequency of natural disasters has increased significantly. As detailed above since 2010 through Month 2016) when this 2016 Plan was completed, the County has experienced a total of eight formally-declared disasters in less than six years comprised of three winter ice storms, three heavy rain events and the devastating twin events in the 2011 of spring Lake Champlain floods (DR#-1995) and Tropical Storm Irene (DR#- 4022) in the fall.

In response, therefore, this Plan focuses on ways for the CCRPC and its municipalities to better coordinate and implement processes and programs so as to speed the implementation of mitigation projects. In other words, no "new" mechanisms are spelled out. Rather the Plan seeks to more explicitly promote existing measures to achieve "on-the-ground" mitigation.

5.4.1 Rationale and Cost-Benefit Review

As noted in Section 3.3 above, the highest rated hazards (the top third in each category) for Chittenden County are:

Natural Hazards: Winter Storm, Severe Rainstorm
Technological Hazards: Water Pollution. Hazardous Materials Incident, Power Loss
Societal Hazards: Crime, Economic Recession

Chittenden County is ill-equipped to address these hazards on a regional basis. Mutual-aid arrangements between neighboring fire departments and between neighboring police departments serve to address emergency response at the sub-regional level (such as a cluster of three to four municipalities). However, there is currently no legal authority on a regional or county basis for the following types of activity: emergency management planning, law enforcement, fire response, EMS response, road maintenance, watershed management, hazardous materials response, etc. Consequently, current and future mitigation actions and projects in Chittenden County are and will be carried out primarily at the municipal level. Actions and projects are detailed in the individual Local All-Hazards Mitigation Plans for each municipality that are attached as separate annexes to this document.

Few of the municipalities have a specific project (e.g., replace a bridge) where construction costs are already detailed. The local actions endorse general mitigation actions (keep replacing culverts, gradually upgrade roads, make sure shelters are functional, etc). It could take upwards of 20 hours to generate an accurate and current estimate for even one hypothetical engineering or construction project.

It is also impossible at present to adequately gauge impacts even for the one of the more common and long-researched hazards, namely flooding. Unlike other regions of the United States, there exists no data at all in Chittenden County measuring 10-year or 50-year flood event (riparian) water levels in rivers and streams nor systematic flow gauges located on the County's smaller rivers and streams not managed by dams which could be linked to rainfall data.

Furthermore, there is no systematic, mapped data on Severe Rainstorms that occurs due to heavy rains washing out dirt, gravel or asphalt substrate or culverts on rural roads usually on a steep grade. Therefore, given the complexity of the Chittenden County region, past PDM planning grants received by the CCRPC as well as the current HMGP grant were inadequate to fund the necessary research hours to produce a detailed Benefit-Cost Analysis (BCA) of the various strategies outlined in this Multi-Jurisdictional Plan or in its annexed Local All-Hazards Mitigation Plans.

Therefore, a detailed Benefit-Cost Analysis, will be primarily conducted only on a case-by-case individual project basis as the municipalities implement the actions specified in their plans.

5.4.1.1 Prioritizing Multi-Jurisdictional Mitigation Strategies

Given the lack of county government, regional projects in Chittenden County require a multi-municipality endeavor. Therefore, the county's municipalities and individual organizations, either through their own efforts or working with regional organizations such as the CCRPC or LEPC #1, could engage in various regional mitigation strategies.

Note that the ***2011 Multi-Jurisdictional All-Hazards Mitigation Plan*** were as follows:

- Strategy #1: Develop mechanisms and plans for coordination and cooperation between municipal, non-profit and private emergency services providers.
- Strategy #2: Complete fluvial geomorphology assessments and develop strategies in response to identified risk.
- Strategy #3: Evaluate the capabilities of existing road and stormwater management infrastructure.
- Strategy #4: Develop a regional climate action guide with goals and strategies to help reduce energy consumption, reduce greenhouse gas emissions and mitigate climate change.
- Strategy #5: Complete landslide hazard assessments and develop strategies in response to identified risk.
- Strategy #6: Identify data gaps that affect all-hazards mitigation planning and develop multi-partner research projects to address identified data needs.
- Strategy #7: Develop and implement multi-partner public communications, outreach and education projects to improve the capacity of the general public and the private sector to mitigate the effects of, and endure hazard events.

During the development of this 2016 Multi-Jurisdictional AHMP, FEMA staff indicated to the CCRPC a need to separate out or remove strategies which are more properly considered to be Preparedness, Response or Recovery strategies rather than Mitigation. Additionally, upon revisiting and reviewing the 2011 strategies, CCRPC staff, in concert with the CCRPC's All-Hazards Mitigation Plan Update Committee, realized that it would be best to tie the new proposed 2016 Strategies more directly into CCRPC's known or anticipated future work program elements.

5.4.2 Progress on the 2011 Strategies and recommendations for the 2016 Plan

The following table details progress made on the strategies in the 2011 Plan and recommendations for strategies in the 2016 Plan.

Table 6-1 Progress reporting on the 2011 Plan and Recommendations for 2016 Plan

Mitigation Strategy	Primary Responsible Entity	Task	Brief Description	Progress since 2011 and Recommendation for 2016 Plan
#1 Develop mechanisms and plans for coordination and cooperation between municipal, non-profit and private emergency service providers.	LEPC #1, CCRPC	Basic EOP Preparation/Update Workshops	Sponsor workshops to help municipalities prepare and update their Basic Emergency Operation Plan.	Staffing inadequate to organize workshops. CCRPC staff work on annual basis to remind municipalities to complete Local Emergency Operations Plan (LEOP) document which have supplanted BEOP. **NOT A MITIGATION ACTION. REMOVE FROM 2016 PLAN.**
	LEPC #1	LEPC #1 Resource Preparedness Guide	Update the resource guide for emergency responders dealing with hazardous materials.	In discussions at spring 2015 Chittenden County Fire Mutual Aid meeting, it was recommended this be removed for 2016 plan. **NOT A MITIGATION ACTION. REMOVE FROM 2016 PLAN.**
	CCRPC, VLCT, municipalities	Regional Police and Dispatch Services Study	Study feasibility of regional policing and dispatching for Chittenden County.	CCRPC staff have had informal discussions with municipalities regarding regional policing and individual municipalities may explore cost sharing mechanisms. **NOT A MITIGATION ACTION. REMOVE FROM 2016 PLAN.**
	LEPC #1, CCRPC	Continued Efforts and New Strategies	Continue to develop and enhance domestic preparedness and emergency planning in Chittenden County.	Since Tropical Storm Irene in 2011, CCRPC has a formal MOU with VT DEMHS to assist in staffing of State EOC and now regularly collects data on damages in towns during hazards events to forward to VTDEMHS. This is a Response and Recovery effort. **NOT A MITIGATION ACTION. REMOVE FROM 2016 PLAN. RETAIN IN 2016 PLAN AS NON-MITIGATION STRATEGY.**
#2 Complete fluvial geomorphology assessments and	VT ANR, CCRPC	Fluvial Geomorphic Assessments	Continue Phase I and Phase II fluvial geomorphic	COMPLETED. **REMOVE FROM 2016 PLAN**

develop strategies in response to identified risk.			assessments on streams and waterways in Chittenden County.	
	VT ANR, CCRPC	Fluvial Erosion Hazard Mapping	Rate the fluvial erosion hazard for each assessed reach and develop a fluvial erosion hazard map for the waterway using SGAT. Create map of all assessed reaches. Submit to VT ANR for QA/QC.	COMPLETED. **REMOVE FROM 2016 PLAN.**
	TBD, determined by funding.	River Corridor Management Plans	Where Phase I and II assessments are complete, develop a river corridor management plan.	COMPLETED. River Corridor Plans and/or reach-by-reach project ideas have been developed for numerous streams throughout the County. **REMOVE FROM 2016 PLAN.**
	Municipalities (see annex for specific responsible entity)	Fluvial Erosion Hazard Mitigation Implementation	**Develop strategies to mitigate losses from identified fluvial erosion hazards**.	Municipalities are incorporating discussions of FEH and Flood Resiliency in their comprehensive plans and working to formally address FEH and River Corridor Protections in their bylaws and updated hazard mitigation plan annexes. **Continued in 2016 Plan (see Strategy 3)**

Mitigation Strategy	Primary Responsible Entity	Task	Brief Description	Progress since 2011 and Recommendation for 2016 Plan
#2, continued.	CCRPC, VT ANR	Flood Insurance Map Updates	Assist ANR in conducting outreach to municipalities on the Draft FIRM data, solicit input to the final revisions, and provide assistance to municipalities in updating floodplain regulations and zoning bylaws.	COMPLETED. **REMOVE FROM 2016 PLAN.**
#3 Evaluate capabilities of existing road and stormwater infrastructure	VT ANR, VTrans, CCRPC, CCMPO	Infrastructure Assessment for Stormwater Vulnerability	Assess the vulnerability and operational capability of municipal-owned roads, culverts and other stormwater infrastructure in areas with recurring stormwater and snowmelt problems**.**	CCRPC is working on an analytical tool to collate information from various data sources to facilitate prioritization of repair and/or replacement **Continued in 2016 Plan (see Strategy 3)**
	VT ANR, VTrans, CCRPC, CCMPO	Infrastructure Assessment for	Assess the vulnerability and operational	CCRPC is working on an analytical tool to collate

		Fluvial Erosion/Landslide Vulnerability	capability of municipal-owned roads, culverts, bridges and other infrastructure to fluvial erosion and landslide events.	information from various data sources to facilitate prioritization of repair and/or replacement **Continued in 2016 Plan (see Strategy 3)**
#4 Develop a regional climate action guide with goals and strategies to help reduce energy consumption, reduce greenhouse gas emissions and mitigate climate change	CCMPO; CCRPC	Energy and Climate Action Guide	Research and develop an Energy and Climate Action Guide for Chittenden County and its municipalities.	COMPLETED. **REMOVE FROM 2016 PLAN.** **Related recommendations incorporated into 2016 Plan.**
#5 Complete landslide hazard assessments and develop strategies in response to identified risks.	VGS, CCRPC	Landslide Hazard Assessment Protocol	Develop a landslide hazard protocol to evaluate county slopes and waterways.	Completed by Vermont Geological Survey with CCRPC as partner. Protocol development testing included the towns of Essex, South Burlington, Colchester, Bolton and Shelburne. **REMOVE FROM 2016 PLAN.**
	CCRPC, VGS	Landslide Hazard Assessment and Mapping	Assess landslide hazards and prepare landslide hazard maps.	Other than the testing mapping described in the previous row, no funding has been secured to prepare additional maps. No funding identified for future research and not considered as significant hazard. **REMOVE FROM 2016 PLAN**

Mitigation Strategy	Primary Responsible Entity	Task	Brief Description	Progress since 2011 and Recommendation for 2016 Plan
#6 Identify hazardous materials transport information and train for transportation-related hazardous materials incidents.	CCRPC, LEPC #1	Hazardous Materials Transportation	Identify recent studies and current state databases to help identify hazardous materials transport and transportation-related hazardous materials incidents.	Participate in the development of the state wide hazardous commodities flow study planned for FFY16-FFY17. **RETAIN IN 2016 PLAN AS NON-MITIGATION STRATEGY.**
	CCRPC, LEPC #1	Hazard Mitigation Planning by Other Entities	Identify hazard mitigation planning being done by other entities in Chittenden County.	No such plans identified. Other entities related planning typically includes response plans, safety plans, emergency operations plans, disaster/incident plans and capital plans. **REMOVE FROM 2016 PLAN.**

	CCRPC, LEPC #1	Identify Unmet Mitigation Data Needs	Determine emergency organizations' and municipalities' data needs for hazard mitigation planning.	No formal action to date. This action will continue through development of CCRPC's annual work program but given its lack of specificity with regards to a discrete mitigation task will be removed from 2016 Plan. **REMOVE FROM 2016 PLAN.**
	CCRPC, LEPC #1	Determine Data Development Feasibility	Determine which data gaps are feasible to fill given time and financial constraints.	No formal action to date. This action will continue through development of CCRPC's annual work program but given its lack of specificity with regards to a discrete mitigation task will be removed from 2016 Plan. **REMOVE FROM 2016 PLAN.**
	CCRPC, LEPC #1	Data Development	Identify partners for data development process. Plan projects to address data needs. Seek funding for research projects.	No formal action to date. This action will continue through development of CCRPC's annual work program but given its lack of specificity with regards to a discrete mitigation task will be removed from 2016 Plan. **REMOVE FROM 2016 PLAN.**
#7 Develop multi-partner public communications, outreach and education projects to improve the capacity of the general public and private sector to mitigate the effects of and endure hazards.	LEPC #1, CCRPC	Shelter-in-Place Workshops	Develop and conduct Shelter-in-Place information workshops for schools, businesses, early childhood education centers and nursing homes.	Some initial workshops were conducted in 2009 however no formal action to date since 2011 and this information is best disseminated by other agencies. **REMOVE FROM 2016 PLAN.**
	LEPC #1, VT 2-1-1	Coordination with Vermont 2-1-1	Strengthen coordination and partnerships with Vermont 2-1-1, in order to better communicate information to the public in an emergency.**)**	Vermont 2-1-1 is a regular participant at LEPC#1 meetings. However this is primarily a response and recovery task.**. REMOVE FROM 2016 PLAN.**
	LEPC #1, CCRPC	Communications, Outreach & Education	Identify and implement projects to coordinate communications, outreach and education for emergency management and hazard mitigation.	No formal action to date. This action will continue through development of CCRPC's annual work program but given its lack of specificity with regards to a discrete mitigation task will be removed from 2016 Plan. **REMOVE FROM 2016 PLAN.**

5.4.3 2016-2021 Mitigation Strategies

Strategy #1 Assist municipalities with development of plans, policies and zoning regulations

Priority: Medium

Status: Ongoing

Hazard Addressed: Severe Rainstorm; Flooding; Fluvial Erosion; Water Pollution

Vulnerabilities Addressed: Damage to public infrastructure; Temporary road and bridge closure**;** Temporary power or telecommunication loss**;** Temporary isolation of vulnerable individuals; Budgetary impacts

Primary Responsible Entities: CCRPC and Municipalities

Potential Partner Entities: Lake Champlain Sea Grant, ANR-DEC

Timeframe: Month, 2016 to Month, 2021 (update after FEMA adoption)

Funding Requirements and Sources: primarily various Federal and State grants; municipal funds only if sufficient

Specific Identified Tasks

Task	Brief Description
Flood Resilience Planning	Provide assistance with drafting of required Flood Resiliency chapters in municipal plans including language and maps regarding fluvial erosion/river corridors and flooding, and references to the All Hazard Mitigation Plans and Tactical Basin Plans.
River Corridor Protection	As requested, provide assistance with mapping and development of regulatory language to preclude or minimize development within mapped River Corridors or River Corridor Protection Areas (aka fluvial erosion hazard areas).
Water Quality Bylaws	Provide outreach, mapping and technical assistance to municipalities concerning adoption of zoning bylaws and other measures to improve water quality. Promote the use of Low Impact Development principles and Green Stormwater Infrastructure techniques in municipal Land Development Regulations to restore or maintain pre-development ecological and hydrological function through the protection, enhancement, or mimicry of natural processes.
Storm Water Master Planning	Outreach and education to municipalities on benefits of stormwater master planning, and assistance in securing grants for this planning, in concert with Tactical Basin Planning (see Figure X).
Private Green Infrastructure	Provide information to assist property owners in incorporation of Green Stormwater Infrastructure techniques. Delivery primarily via websites and programming of Chittenden County Regional Stormwater Education Program / Chittenden County Stream Team. Participate in Vermont Green Infrastructure Roundtable

Rationale / Cost-Benefit Review:

Development of appropriate language in municipal comprehensive plans and in municipal land development regulations is one of the simplest and most cost-effective ways to assure that people and property are not placed in harm's way.

Strategy #2: Promote hazard mitigation projects in Tactical Basin Plans and flood resiliency planning

Priority: Medium

Status: Ongoing

Hazard Addressed: Severe Rainstorm; Flooding; Fluvial Erosion; Water Pollution

Vulnerabilities Addressed: Damage to public infrastructure; Temporary road and bridge closure**;** Temporary power or telecommunication loss**;** Temporary isolation of vulnerable individuals; Budgetary impacts

Primary Responsible Entities: CCRPC and Municipalities

Potential Partner Entities: Vermont DEC

Timeframe: Month, 2016 to Month, 2021 (update after FEMA adoption)

Funding Requirements and Sources: primarily various Federal and State grants; municipal funds only if sufficient

Specific Identified Tasks

Task	Brief Description
Hazard Mitigation Project Prioritization Process	CCRPC will assist municipalities in prioritizing Basin Plan projects in conjunction with ANR and municipalities in concert with Tactical Basin Planning (see Figure X). Lamoille River (Planning-2016; Monitoring & Assessment-2018-2019): towns of Milton, Colchester, Jericho, Underhill, Westford and Essex. Winooski River (Planning-2017-2018; Monitoring & Assessment-2020-2021): Burlington, Colchester, Essex, Hinesburg, Huntington, Jericho, Shelburne, South Burlington, Richmond, Williston and Winooski. Northern Lake Champlain (Monitoring & Assessment-2016-2017; Planning-2018-2019): Burlington, Colchester, Essex, Hinesburg, Milton, Richmond, Shelburne, South Burlington and Westford.
Incorporation of hazard mitigation projects into Tactical Basins Plans and Flood Resiliency elements of municipal comprehensive plans.	prepare tables characterizing flood and fluvial erosion hazard mitigation projects and draft language for how the tables would be incorporated into the resiliency elements of town plans and cross-referenced as stream stability and water quality improvement projects into tactical basin plans, using existing: 1. river corridor plans, 2. bridge and culvert inventories, 3. dam inventories, 4. road and river assessments developed using State methodologies, 5. risk / vulnerability assessments of other public infrastructure, facilities, and economic assets, including those identified in Local Hazard Mitigation Plans. The intent is not to recreate an existing mitigation plan, but rather to

	fold high priority specific project recommendations, or develop more specific projects, from mitigation plans into flood resiliency elements and the state tactical basin planning project tracking system.

Rationale / Cost-Benefit Review:

Tactical Basin Plans are taking on prominence within the State as a primary reference tool and guiding document to describe and detail the numerous suite of projects that are needed to improve water quality throughout the State. By working to include projects that have the benefits of water quality improvement and hazard mitigation

Strategy #3: Assist municipalities to develop & improve road infrastructure

Priority: Medium

Status: Ongoing

Hazard Addressed: Severe Rainstorm; Flooding; Fluvial Erosion; Water Pollution

Vulnerabilities Addressed: Damage to public infrastructure; Temporary road and bridge closure**;** Temporary power or telecommunication loss**;** Temporary isolation of vulnerable individuals; Budgetary impacts

Primary Responsible Entities: CCRPC and Municipalities

Potential Partner Entities: Vermont Agency of Transportation, ANR-DEC

Timeframe: Month, 2016 to Month, 2021 (update after FEMA adoption)

Funding Requirements and Sources: primarily various Federal and State grants; municipal funds only if sufficient

Specific Identified Tasks

Task	Brief Description
Assist municipalities with development and implementation of Road Stormwater Management Plan consistent with pending Vermont Municipal Roads General Permit (MRGP) to mitigate the following hazards and address atttendant vulnerabilities: Hazards Mitigated • Severe Rainstorm • Fluvial Erosion	Assist municipalities as needed with Inventory of Priority Road Segments (PRS) both currently meeting and not meeting MRGP standards. The inventory will include a map of segments meeting and not meeting the MRGP standards and include total mileage of road segments in each category by road type. The inventory will include a remediation plan (capital budget) for each site not currently meeting standards that will be addressed within the 5 year implementation schedule. This inventory will be updated every 5 years. The MRGP standards must be implemented on all priority road segments as soon as possible, but no later than 20 years from permit issuance.

• Water Pollution Vulnerabilities Addressed: • Damage to public infrastructure • Impairments to local waterways and Lake Champlain • Budgetary Impacts	
Transportation Infrastructure Mitigation Project Scoping	Assist with finding funds to develop conceptual design & construction cost estimates for transportation infrastructure upgrade or replacement such as culverts, bridges, ditches, grading, etc. to reduce damages from hazard events.

Rationale / Cost-Benefit Review:

Implementation of projects detailed in MRGPs will work to slow road runoff resulting in reduced damages from hazards.

Strategy #4 Assist municipalities in protecting people, buildings and facilities where development already exists

Priority: Medium

Status: Ongoing

Hazard Addressed: Flooding; Fluvial Erosion

Vulnerabilities Addressed: Damages to private homes and businesses

Primary Responsible Entities: CCRPC and Municipalities

Potential Partner Entities: VDEMHS; VDEC; VDCED

Timeframe: Month, 2016 to Month, 2021 (update after FEMA adoption)

Funding Requirements and Sources: primarily various Federal and State grants; municipal funds only if sufficient

Specific Identified Tasks

Task	Brief Description
Reduce Future Flooding Risk for Existing Development	Assist municipalities with identifying vulnerable and/or repetitively damaged structures and provide assistance in securing assistance or funding to either a) elevate properties above BFE, b) relocate structures or c) buying out structures.
Create New Flood Storage Capacity	Assist municipalities in identifying and planning for locations where new flood storage capacity may be created. These opportunities could include: creating parks and other open space in vulnerable locations, replacing a vertical wall along a river bank with a more gradual slope to create more room in the river channel for rising water, creating a shallow depression in the lawn that can accommodate inundation, or redesigning buildings to enable

	the first floor or basement to flood rather than armoring the buildings to repel rising waters.

Rationale / Cost-Benefit Review:

Implementation of these types of projects will reduce the likelihood of future damages.

Strategy #5: Assist municipalities in promoting growth in appropriate locations and with transportation infrastructure planning

Priority: Medium

Status: Ongoing

Hazard Addressed: Economic Recession; Key Employer loss

Vulnerabilities Addressed: Increased unemployment; Decreased tax base

Primary Responsible Entities: CCRPC and Municipalities

Potential Partner Entities: ANR-DEC

Timeframe: Month, 2016 to Month, 2021 (update after FEMA adoption)

Funding Requirements and Sources: primarily various Federal and State grants; municipal funds only if sufficient

Specific Identified Tasks

Task	Brief Description
ECOS Strategy 3.2.2 Strive for 80% of new development in areas planned for growth, which amounts to 15% of our land area.	Implement Action Item 1: Invest in Areas Planned for Growth especially a. Establish wastewater, water infrastructure and public transit in areas currently developed and/or planned for growth. b. Target reuse, rehabilitation, redevelopment, infill, and brownfield investments to area currently developed and/or planned for growth.
	Implement Action Item 6: Metropolitan Transportation Plan Investments especially: a. Adequately fund the maintenance and preservation of our existing transportation assets including roads, bridges, rail, transit, walking/biking facilities, and transportation demand management (TDM) programs and facilities. b. New transportation system investment should focus on the highest priority transportation projects as detailed in the ECOS/Metropolitan Transportation Plan (MTP) Project List. In the next five years, these projects will primarily be those that are included in the Transportation Improvement Program (TIP), as may be amended. The TIP projects are considered FUNDED VITAL PROJECTS for the purposes of the Comprehensive Economic Development Strategy (CEDS).

Rationale / Cost-Benefit Review:

As with municipal land use plans and regulations, appropriate regional land use and transportation planning efforts can aid in ensuring that land development occurs outside hazard areas

#6 Assist municipalities in meeting standards to minimize required municipal share towards FEMA Public Assistance project costs to mitigate against the Vulnerability of Budgetary Impacts.

Priority: Medium

Status: Ongoing

Hazard Addressed: All hazards for which FEMA could provide PA funds

Vulnerabilities Addressed: Budgetary Impacts

Primary Responsible Entities: CCRPC and Municipalities

Potential Partner Entities: ANR-DEC; DEMHS; AOT

Timeframe: Month, 2016 to Month, 2021 (update after FEMA adoption)

Funding Requirements and Sources: EMPG grants and DCED funds to CCRPC; municipal funds

Specific Identified Tasks

Task	Brief Description
Facilitate municipal adoption of four Base standards for ERAF	The State has incentivized flood resilience planning through the Emergency Relief and Assistance Funds (ERAF) program. There are a number of steps a municipality can take to improve the local match requirement for FEMA post-disaster relief funds. Generally, in the event of a Federal-disaster declaration FEMA covers 75% of the cost of "Public Assistance" projects, typically repairs to roads and culverts and debris cleanup. The remaining 25% must be matched by the State and municipal government. Four requirements are needed for the State to provide half of that requirement, 12.5% match assistance. As of Month 2016, nearly all of Chittenden County's municipalities have met these four benchmarks as follows: 1. adopt an annual Local Emergency Operation Plans– [18 of 19 communities] 2. adopt the Town Road and Bridge Standards that meet or exceed the VTrans 2013 standards – [18 of 19 communities. Bolton is considering adoption of these standards. 3. participate in the National Flood Insurance Program – 17 communities participate. St. George is considering adoption in FY17 while Buel's Gore has no mapped floodplain. and 4. adopt a FEMA-approved Local Hazard Mitigation Plan – since 2005, all 19 municipalities have had an approved LHMP.

	CCRPC staff will annually assist, upon request, municipalities that need assistance in completion of these benchmarks, primarily adoption of the annual LEOP.
Faciliate municipal adoption of bonus ERAF measures	In addition, there is an opportunity for the State to provide 17.5% of the match, if the municipality protects river corridors. Currently 14 of our municipalities have received 'early adopter status' for river corridor protection due to having strong municipal water quality buffers and floodplain regulations. However, the threshold for river corridor protection has been raised and municipalities will need to adopt more stringent standards in order to be eligible for the 17.5% match. Municipalities will have two years to adopt these new protections, once the State incorporates the more accurate Fluvial Erosion Hazard areas into the published River Corridor map. There are two options: receive FEMA's Community Rating System (CRS) designation and prohibit structures in Flood Hazard Areas; or Adopt River Corridor or River Corridor Protection Area regulations for streams draining over 2 square miles, and a setback of 50' from top of bank for streams draining under 2 square miles that cannot be waived, and Fluvial Erosion Hazard protections. Colchester is the only municipality with CRS designation. CCRPC staff will assist interested in municipalities in pursuing either CRS desigination and/or the development of River Corridor or River Corridor Protection Area regulations

Rationale / Cost-Benefit Review:

Implementation of this assistance will provide a discreet and known reduction of impacts to municipal budgets in the event of the distribution of ERAF monies.

SECTION 6 PLAN MAINTENANCE

6.1 Monitoring and Evaluating the Plan

6.1.1 Annual Questionnaire to municipalities

Commencing in the fall of 2017 and each fall thereafter, CCRPC staff will send a questionnaire to officials from each of the county's municipalities inquiring about the status of the identified mitigation strategies outlined in the municipality's All-Hazard Mitigation Plan. The questionnaire will address:

- Whether any grants were applied for or funding sought;
- Whether any grants or funding were received;
- What progress was made with each mitigation strategy;
- How mitigation strategies have been incorporated into other planning mechanisms.

CCRPC staff will complete a similar implementation status report for mitigation strategies in the Multi-Jurisdictional All Hazards Mitigation Plan. CCRPC staff will compile the results of completed questionnaires. Table 6-1 (see section 6.5) will be used to compile progress information.

6.1.2 Biennial Review

In conjunction with plan monitoring, CCRPC staff will, in the fall of 2018 and the fall of 2020, conduct a more through review of this Multi-Jurisdictional Plan and all the municipal annexes and assess whether:

- The goals and objectives address current and expected conditions;
- The nature, magnitude, and/or type of risks have changed;
- The current resources are appropriate to implement the plan;
- There are implementation problems (e.g., technical, political, legal, fiscal, or coordination issues);
- The outcomes have occurred as expected; and
- The agencies and other partners participated as originally proposed.

6.1.3 Summary Monitoring and Evaluation Report

CCRPC staff will prepare two draft Summary Monitoring and Evaluation Reports, one in early 2019 and again in early 2021. The intent of the evaluation processes outlined above is to regularly focus attention on the plan and its implementation between the five-year updates.

A copy of the draft reports will be posted on CCRPC's website, along with public notice of availability and the opportunity for public comments.

A copy will also be provided to DEMHS, LEPC #1, and the participating municipalities. After a two-week comment period, public comments will be summarized and attached to the report. The CCRPC will then prepare a Final Summary Monitoring and Evaluation Report for final review and approval by a majority vote of the AHMP Plan Review and Update Committee.

A copy of the Report will be sent to LEPC #1, the Vermont State Hazard Mitigation Officer, and the municipalities. Depending on the evaluation results, CCRPC or a municipality may initiate a Plan update prior to the scheduled five-year update in late 2021.

6.1.4 Operation of the All Hazards Mitigation Plan Update Committee

CCRPC recognizes that in the past, it did not carry out a robust annual process of monitoring and evaluating the Plan. In order to rectify this, one of CCRPC's first steps will be to actively maintain and support its All Hazards Mitigation Plan Update Committee. The CCRPC will plan to convene the committee, at minimum, for meetings on the following, rough schedule in order to review the results of the annual questionnaires and the biennial reports and as 2021 draws closer plan for the next 5 year update.

- January 2018; January 2019, January 2020; June 2020; December 2020; January 2021

This annual review is contingent upon funding availability.

6.2 Continued Public Involvement in Plan Maintenance

Planned public involvement in the monitoring and evaluation process is described in the previous section. Additional public involvement opportunities are expected to include:

- The adopted and approved Multi-Jurisdictional All Hazards Mitigation Plan and municipal annexes will be posted on CCRPC's website on an on-going basis, along with a link to submit comments and suggestions for improvement.
- Public involvement activities related to the 2018 update to the *Chittenden County Regional Plan*, which includes a section on public safety that draws from the Multi-Jurisdictional All Hazards Mitigation Plan. The Regional Plan update process will include public meetings and opportunities for public comment.
- Any proposed changes to the text of the Multi-Jurisdictional All-Hazards Mitigation Plan (not including the municipal annexes) shall follow the plan updating process described in the next section below.
- Each municipality may review and update their own programs, initiatives and projects more often by working directly with the State Hazard Mitigation Officer (SHMO) based on changing local needs and priorities. Formal changes to individual municipal annexes may be made at any time by each municipality's governing body in order to reflect changing conditions, priorities, and opportunitites during the 5-year life cycle of their single jurisdiction plan.

6.3 Updating the Chittenden County Multi-Jurisdictional All Hazards Mitigation Plan and Municipal Annexes

FEMA regulations require that the All Hazards Mitigation Plan be updated, adopted and approved every five years in order for jurisdictions to maintain eligibility for pre-disaster

mitigation funding. This five-year update cycle helps ensure that the plan remains current and relevant.

CCRPC anticipates that the following plan update procedure will be followed:

1. CCRPC will seek FEMA grants or other grants to fund the plan update.
2. CCRPC will begin to convene its All-Hazards Mitigation Plan Update Committee within at least 12 months of the Plan's expiration date. As is currently the case, membership will include representatives appointed by each municipality's governing body, one or more representatives appointed by LEPC #1 and one or more commissioner representatives of CCRPC. As is currently the case, *ex-officio* officials from Vermont DEMHS and Vermont ANR will be invited to serve on the committee.
3. The Plan Update Committee will review the Summary Monitoring and Evaluation Reports. The Committee will also review the Plan's identified hazards, the hazard evaluation process, and the multi-jurisdictional mitigation strategies to determine whether they are still appropriate, or whether modifications or additions are needed based on current knowledge and conditions.
4. Based on Committee input, CCRPC staff will update relevant data in the Plan and prepare a draft Plan update. CCRPC will convene a second meeting of the Review/Update committee to review the draft Plan update. The Committee will reach consensus on changes to the draft Plan update and the format of the municipal annexes. In the event no consensus is reached, a vote by a simple majority of the Committee voting members present will decide.
5. CCRPC will incorporate the changes as recommended by the Committee and then work with municipal staff and officials to update their individual annexes to accurately reflect the municipality's current hazard mitigation concerns and recommended municipal goals and actions.
6. CCRPC will schedule a public presentation to each municipal governing body in order to formally present the draft update of the Multi-Jurisdictional Plan and to the municipal annex. Each governing body may provide, if it chooses, recommendations for further changes to the updated Multi-Jurisdictional Plan and to its individual annex.
7. The public may observe the presentations and provide comments, if desired, on the Multi-Jurisdictional Plan and the individual municipal annexes. The draft updated plans will be posted on the CCRPC website for public review and comment.
8. CCRPC staff will incorporate the public and municipal comments into the Multi-Jurisdictional Plan and the individual municipal annexes.
9. CCRPC may submit the Multi-Jurisdictional Plan and municipal annexes to FEMA Region I for approval pending adoption.
10. CCRPC staff will finalize the changes to the Multi-Jurisdictional Plan and the annexes and distribute these to CCRPC, LEPC #1, and municipal governing bodies for consideration of a resolution of re-adoption. Upon adoption by CCRPC, LEPC#1 and within three months of the time that the CCRPC has finished presentations to all of the municipal governing bodies, CCRPC will submit the updated Plan to FEMA Region I along with copies of the annexes adopted to date.

A municipality may choose not to re-adopt the updated Multi-Jurisdictional Plan and its respective local annex, recognizing that they may no longer use the updated Plan and annex to be eligible for FEMA hazard mitigation grants. A municipality may choose to develop, adopt and submit its own Local All-Hazards Mitigation Plan to FEMA Region I, consistent with the requirements of the *Disaster Mitigation Act of 2000* and regulations contained in *44CFR201 & 206* in order to maintain eligibility.

6.4 Incorporation into Existing Planning Mechanisms

The All-Hazards Mitigation Plan was used as a source when updating the Chittenden County Regional Plan in 2006. The 2006 Regional Plan contained a new Public Safety chapter, the text and stated goals of which relied heavily on the All-Hazards Mitigation Plan.

The mitigation strategies contained in this Plan can be incorporated into CCRPC's future planning mechanisms in two primary ways:

The Chittenden County Regional Plan – CCRPC's process for updating the *Chittenden County Regional Plan or ECOS Plan* will consider and incorporate as appropriate the data, analyses and mitigation strategies of this All Hazards Mitigation Plan.

The CCRPC annual Work Program – CCRPC will consider and incorporate mitigation strategies and actions into its annual Work Program, contingent on sufficient resources being available.

Opportunities exist for municipalities and other entities to incorporate this Plan's mitigation strategies into their own planning mechanisms, including but not limited to:

- Municipal comprehensive plans
- Municipal capital budgets
- Municipal zoning bylaws and subdivision regulations
- Open space preservation programs

Some of the mitigation strategies in this Multi-jurisdictional All Hazards Mitigation Plan and the municipal annexes specifically identify actions to incorporate mitigation strategies into other planning mechanisms. Other opportunities may become apparent when the strategies are implemented. The ability of municipalities and other entities to incorporate this Plan's mitigation strategies into other planning mechanisms is contingent on adequate funding and staffing resources.

6.5 Implementation and Monitoring of Mitigation Strategies

The following table will aid responsible entities in implementing the mitigation actions for Chittenden County, and facilitate annual monitoring of the plan.

Table 6-1 Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan Implementation Matrix

Mitigation Strategy & Hazards and Vulnerabilities Addressed	Task (Primary Responsible Entities)	Brief Description	Progress Since 2016
#1 Assist municipalities with development of plans, policies and zoning regulations that mitigate against the following: **Hazards** • Severe Rainstorm • Flooding • Fluvial Erosion • Water Pollution **Vulnerabilities** • Damage to public infrastructure • Temporary road and bridge closure • Temporary power or telecommunication loss • Temporary isolation of vulnerable individuals • Budgetary impacts	Flood Resilience Planning (CCRPC ANR Municipalities)	Provide assistance with drafting of required Flood Resiliency chapters in municipal plans including language and maps regarding fluvial erosion/river corridors and flooding, and references to the All Hazard Mitigation Plans and Tactical Basin Plans.	
	River Corridor Protection (CCRPC ANR Municipalities	As requested, provide assistance with mapping and development of regulatory language to preclude or minimize development within mapped River Corridors or fluvial erosion hazard areas.	
	Water Quality Bylaws CCRPC (ANR LC SeaGrant Municipalities)	Provide outreach, mapping and technical assistance to municipalities concerning adoption of zoning bylaws and other measures to improve water quality. Promote the use of Low Impact Development principles and Green Stormwater Infrastructure techniques in municipal Land Development Regulations to restore or maintain pre-development ecological and hydrological function through the protection, enhancement, or mimicry of natural processes.	
	Storm Water Master Planning (CCRPC ANR LC SeaGrant Municipalities)	Outreach and education to municipalities on benefits of stormwater master planning, and assistance in securing grants for this planning, in concert with Tactical Basin Planning	
	Private Green Infrastructure (CCRPC ANR LC SeaGrant Municipalities)	Provide information to assist property owners in incorporation of Green Stormwater Infrastructure techniques. Delivery primarily via websites and programming of Chittenden County Regional Stormwater Education Program / Chittenden County Stream Team.	

Mitigation Strategy & Hazards and Vulnerabilities Addressed	Task (Primary Responsible	Brief Description	Progress since 2016

	Entities)		
#2 Promote hazard mitigation projects in Tactical Basin Plans and flood resiliency planning to mitigate against the following: **Hazards** • Severe Rainstorm • Flooding • Fluvial Erosion • Water Pollution **Vulnerabilities** • Damage to public infrastructure • Temporary road and bridge closure • Temporary power or telecommunication loss • Temporary isolation of vulnerable individuals • Budgetary impacts	Hazard Mitigation Project Prioritization Process	CCRPC will assist municipalities in prioritizing Basin Plan projects in conjunction with ANR and municipalities in concert with Tactical Basin Planning (see Figure X). Lamoille River (Planning-2016; Monitoring & Assessment-2018-2019): towns of Milton, Colchester, Jericho, Underhill, Westford and Essex. Winooski River (Planning-2017-2018; Monitoring & Assessment-2020-2021): Burlington, Colchester, Essex, Hinesburg, Huntington, Jericho, Shelburne, South Burlington, Richmond, Williston and Winooski. Northern Lake Champlain (Monitoring & Assessment-2016-2017; Planning-2018-2019): Burlington, Colchester, Essex, Hinesburg, Milton, Richmond, Shelburne, South Burlington and Westford.	
	Incorporation of hazard mitigation projects into Tactical Basins Plans and Flood Resiliency elements of municipal comprehensive plans.	prepare tables characterizing flood and fluvial erosion hazard mitigation projects and draft language for how the tables would be incorporated into the resiliency elements of town plans and cross-referenced as stream stability and water quality improvement projects into tactical basin plans, using existing: 1. river corridor plans, 2. bridge and culvert inventories, 3. dam inventories, 4. road and river assessments developed using State methodologies, 5. risk / vulnerability assessments of other public infrastructure, facilities, and economic assets, including those identified in Local Hazard Mitigation Plans. The intent is not to recreate an existing mitigation plan, but rather to fold high priority specific project recommendations, or develop more specific projects, from mitigation plans into flood resiliency elements and the state tactical basin planning project tracking system.	

Mitigation Strategy & Hazards Addressed	Task (Primary Responsible Entities)	Brief Description	Progress since 2016
#3 Assist municipalities to develop & improve infrastructure that mitigates the following **Hazards** • Severe Rainstorm • Flooding • Fluvial Erosion • Water Pollution **Vulnerabilities** • Damage to public infrastructure • Temporary road and bridge closure • Temporary power or telecommunication loss • Temporary isolation of vulnerable individuals • Budgetary impacts	Municipal Roads General Permit (CCRPC ANR AOT Municipalities)	Assist municipalities with compiling existing inventories of stormwater infrastructure, stream geomorphic information, culvert inventories, road erosion inventories and capital budgets, and Road Erosion Risk Analysis maps to assist in developing implementation priorities under the municipal roads general permit. In concert with Tactical Basin Planning (see Figure X). Lamoille River (Planning-2016; Monitoring & Assessment-2018-2019): towns of Milton, Colchester, Jericho, Underhill, Westford and Essex Winooski River (Planning-2017-2018; Monitoring & Assessment-2020-2021): Burlington, Colchester, Essex, Hinesburg, Huntington, Jericho, Shelburne, South Burlington, Richmond, Williston and Winooski. Northern Lake Champlain (Monitoring & Assessment-2016-2017; Planning-2018-2019): Burlington, Colchester, Essex, Hinesburg, Milton, Richmond, Shelburne, South Burlington and Westford.	
	Transportation Infrastructure Mitigation Project Scoping (CCRPC ANR AOT Municipalities)	Assist, as requested by municipalities, with finding funds to develop conceptual design & construction cost estimates for transportation infrastructure upgrade or replacement such as culverts, bridges, ditches, grading, etc. to reduce damages from hazard events.	

Mitigation Strategy & Hazards Addressed	Task (Primary Responsible Entities)	Brief Description	Progress since 2016
#4 Assist municipalities in protecting people, buildings and facilities	Reduce Future Flooding Risk for Existing Development	Assist municipalities with identifying vulnerable and/or repetitively damaged structures and provide assistance in securing assistance or funding to either a) elevate properties above BFE, b) relocate structures or	

where development already exists in vulnerable areas to mitigate against: **Hazards** • Flooding • Fluvial Erosion **Vulnerabilities** • Damage to private homes & businesses	(CCRPC Municipalities)	c) buying out structures.	
	Create New Flood Storage Capacity (CCRPC Municipalities)	Assist municipalities in identifying and planning for locations where new flood storage capacity may be created. These opportunities could include: creating parks and other open space in vulnerable locations, replacing a vertical wall along a river bank with a more gradual slope to create more room in the river channel for rising water, creating a shallow depression in the lawn that can accommodate inundation, or redesigning buildings to enable the first floor or basement to flood rather than armoring the buildings to repel rising waters (Vermont SGIA Guidance Document.	

Mitigation Strategy & Hazards Addressed	Task	Brief Description	Progress since 2016
#5 Assist municipalities in <u>promoting growth in appropriate locations and transportation infrastructure planning to mitigate</u> **Hazards** • Economic Recession **Vulnerabilities** • Increased unemployment • Decreased tax base	ECOS Strategy 3.2.2 Strive for 80% of new development in areas planned for growth, which amounts to 15% of our land area. (CCRPC Municipalities)	Implement Action Item 1: <u>Invest in Areas Planned for Growth especially</u> c. Establish wastewater, water infrastructure and public transit in areas currently developed and/or planned for growth. d. Target reuse, rehabilitation, redevelopment, infill, and brownfield investments to area currently developed and/or planned for growth.	
		Implement Action Item 6: <u>Metropolitan Transportation Plan Investments especially:</u> c. Adequately fund the maintenance and preservation of our existing transportation assets including roads, bridges, rail, transit, walking/biking facilities, and transportation demand management (TDM) programs and facilities. d. New transportation system investment should focus on the highest priority transportation projects as detailed in the ECOS/Metropolitan Transportation Plan (MTP) Project List. In the next five years, these projects will primarily be those that are included in the Transportation ImproDEMHSent Program (TIP), as may be amended. The TIP projects are considered FUNDED VITAL PROJECTS for the purposes of the Comprehensive Economic	

		Development Strategy (CEDS).	
Mitigation Strategy & Hazards Addressed	**Task**	**Brief Description**	**Progress since 2016**
#6 Assist municipalities in meeting standards to minimize required municipal share towards FEMA Public Assistance project costs to mitigate against the **Vulnerability** • Budgetary Impacts	Facilitate municipal adoption of four Base standards for ERAF	The State has incentivized flood resilience planning through the Emergency Relief and Assistance Funds (ERAF) program. There are a number of steps a municipality can take to improve the local match requirement for FEMA post-disaster relief funds. Generally, in the event of a Federal-disaster declaration FEMA covers 75% of the cost of "Public Assistance" projects, typically repairs to roads and culverts and debris cleanup. The remaining 25% must be matched by the State and municipal government. Four requirements are needed for the State to provide half of that requirement, 12.5% match assistance. As of Month 2016, nearly all of Chittenden County's municipalities have met these four benchmarks as follows: 1. adopt an annual Local Emergency Operation Plans– [18 of 19 communities] 2. adopt the Town Road and Bridge Standards that meet or exceed the VTrans 2013 standards – [18 of 19 communities. Bolton is considering adoption of these standards. 3. participate in the National Flood Insurance Program – 17 communities participate. St. George is considering adoption in FY17 while Buel's Gore has no mapped floodplain. and 4. adopt a FEMA-approved Local Hazard Mitigation Plan – since 2005, all 19 municipalities have had an approved LHMP. CCRPC staff will annually assist,	

		upon request, municipalities that need assistance in completion of these benchmarks, primarily adoption of the annual LEOP.	
	Faciliate municipal adoption of bonus ERAF measures	In addition, there is an opportunity for the State to provide 17.5% of the match, if the municipality protects river corridors. Currently 14 of our municipalities have received 'early adopter status' for river corridor protection due to having strong municipal water quality buffers and floodplain regulations. However, the threshold for river corridor protection has been raised and municipalities will need to adopt more stringent standards in order to be eligible for the 17.5% match. Municipalities will have two years to adopt these new protections, once the State incorporates the more accurate Fluvial Erosion Hazard areas into the published River Corridor map. There are two options: receive FEMA's Community Rating System (CRS) designation and prohibit structures in Flood Hazard Areas; or Adopt River Corridor or River Corridor Protection Area regulations for streams draining over 2 square miles, and a setback of 50' from top of bank for streams draining under 2 square miles that cannot be waived, and Fluvial Erosion Hazard protections. Colchester is the only municipality with CRS designation. CCRPC staff will assist interested in municipalities in pursuing either CRS desigination and/or the development of River Corridor or River Corridor Protection Area regulations	

APPENDICES

Appendix A: Plan Adoption and Approval Documentation

Appendix B: Potential Mitigation Funding Sources

Appendix C: Sources and References

ANNEXES

Municipal All-Hazard Mitigation Plans

Annex #	Municipality	Plan Adoption Date
1	Bolton	
2	Buel's Gore	
3	Burlington	
4	Charlotte	
5	Colchester	
6	Essex / Essex Junction	
7	Hinesburg	
8	Huntington	
9	Jericho	
10	Milton	
11	Richmond	
12	St. George	
13	Shelburne	
14	South Burlington	
15	Underhill	
16	Westford	
17	Williston	
18	Winooski	