

**CITY OF BURLINGTON, Vermont
2017 All-Hazards Mitigation Plan**

Annex 3

**to the
2017 Chittenden County Multi-Jurisdictional
All-Hazards Mitigation Plan**

Prepared by:

The Chittenden County Regional Planning Commission

and the

City of Burlington, Vermont

*Adopted by the Burlington City Council on
October 16, 2017*

Approved by FEMA on November 6, 2017



FEMA

NOV 06 2017

Lauren Oates
State Hazard Mitigation Officer
Vermont Department of Public Safety
45 State Drive
Waterbury, Vermont 05671-1300

Dear Ms. Oates:

We would like to acknowledge the participating jurisdictions and the State of Vermont for their dedication and commitment to mitigation planning. The Department of Homeland Security (DHS), Federal Emergency Management Agency (FEMA) Region I Mitigation Planning Team has completed its review of the 2017 Chittenden County, Vermont Multi-Jurisdictional All-Hazards Mitigation Plan and determined it meets the requirements of 44 C.F.R. Pt. 201. This plan approval includes the following participating jurisdictions that provided a copy of their resolution adopting the plan. The newly approved jurisdictions are highlighted in **bold**.

Bolton	Buel's Gore	Burlington	Colchester
Essex Town	Essex Junction Village	Hinesburg	Huntington
Jericho	Milton	Richmond	Saint George
Shelburne	South Burlington	Underhill	Westford
Williston	Winooski		

With this plan approval, the communities above are eligible to apply to the Vermont Division of Emergency Management & Homeland Security for mitigation grants administered by FEMA. Requests for mitigation funding will be evaluated individually according to the specific eligibility requirements identified for each of these programs. A specific mitigation activity or project identified in your community's plan may not meet the eligibility requirements for FEMA funding; even eligible mitigation activities or projects are not automatically approved.

Approved mitigation plans are eligible for points under the National Flood Insurance Program's Community Rating System (CRS). Complete information regarding the CRS can be found at <http://www.fema.gov/national-flood-insurance-program-community-rating-system>, or through your local floodplain administrator.

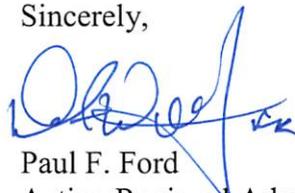
Lauren Oates
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NOV 06 2017

The 2017 Chittenden County, Vermont Multi-Jurisdictional All-Hazards Mitigation Plan must be reviewed, revised as appropriate, and resubmitted to FEMA for approval within **five years of the plan approval date of March 6, 2017** in order to maintain eligibility for mitigation grant funding. We encourage Chittenden County Regional Planning Commission communities to continually update the plan's assessment of vulnerability, adhere to its maintenance schedule, and implement, when possible, the mitigation actions proposed in the plan.

Once again, thank you for your continued dedication to public service demonstrated by preparing and adopting a strategy for reducing future disaster losses. Should you have any questions, please do not hesitate to contact Josiah "Jay" Neiderbach at (617) 832-4926.

Sincerely,



Paul F. Ford
Acting Regional Administrator

PFF: jn

cc: Ben Rose, Recovery and Mitigation Section Chief, VT DEMHS
Stephanie Smith, Hazard Mitigation Planner, VT DEMHS

Enclosure

Resolution Relating to

RESOLUTION 7.22

ADOPTION OF 2017 CHITTENDEN COUNTY MULTI-JURISDICTIONAL ALL-HAZARDS MITIGATION PLAN AND ANNEX #3, THE 2017 CITY OF BURLINGTON ALL-HAZARDS MITIGATION PLAN

Sponsor(s): Public Safety Committee
Introduced: 10/16/17
Referred to: _____
Action: adopted
Date: 10/16/17
Signed by Mayor: 10/19/17

CITY OF BURLINGTON

In the year Two Thousand Seventeen

Resolved by the City Council of the City of Burlington, as follows:

1 That WHEREAS, the CITY OF BURLINGTON has historically experienced severe damage from natural
2 hazards and it continues to be vulnerable to the effects of the hazards profiled in the 2017 Chittenden County
3 Multi-Jurisdictional All-Hazards Mitigation Plan and Annex #3, the 2017 CITY OF BURLINGTON All-
4 Hazards Mitigation Plan, which result in loss of property and life, economic hardship, and threats to public
5 health and safety; and

6 WHEREAS, the CITY OF BURLINGTON has developed and received conditional approval from the
7 Federal Emergency Management Agency (FEMA) for the 2017 Chittenden County Multi-Jurisdictional All-
8 Hazards Mitigation Plan and Annex #3, the CITY OF BURLINGTON All-Hazards Mitigation Plan (the
9 “Plan”), under the requirements of 44 CFR 201.6; and

10 WHEREAS, the Plan specifically addresses hazard mitigation strategies, and Plan maintenance
11 procedures for the CITY OF BURLINGTON; and

12 WHEREAS, the Plan recommends several hazard mitigation actions (projects) that will provide
13 mitigation for specific natural hazards that impact the CITY OF BURLINGTON with the effect of protecting
14 people and property from loss associated with those hazards; and

15 WHEREAS, adoption of this Plan will make the CITY OF BURLINGTON eligible for funding to
16 alleviate the impacts of future hazards; and

17 WHEREAS, the Public Safety Committee reviewed and approved the adoption of this Plan at its
18 meeting on September 25, 2017 and recommended approval by the City Council;

19 NOW, THEREFORE, BE IT RESOLVED that the 2017 Chittenden County Multi-Jurisdictional All-
20 Hazards Mitigation Plan and Annex #3, the 2017 CITY OF BURLINGTON All-Hazards Mitigation Plan
21 (Plan) is hereby adopted as an official plan of the CITY OF BURLINGTON; and

22 BE IT FURTHER RESOLVED that the respective officials identified in the mitigation action plan of the Plan
23 are hereby directed to pursue implementation of the recommended actions assigned to them; and

* * * * *

ORIGINAL

DISTRIBUTION:

I hereby certify that this resolution has been sent to the following department(s) on

RESOLUTION RELATING TO

.....
.....
.....

Adopted by the City Council

....., 20.....

..... Clerk

Approved....., 20.....

..... Mayor

Attest:

Vol. Page

* * * * *

ADOPTION OF 2017 CHITTENDEN COUNTY MULTI-JURISDICTIONAL ALL-HAZARDS MITIGATION PLAN AND ANNEX #3, THE 2017 CITY OF BURLINGTON ALL-HAZARDS MITIGATION PLAN

24 BE IT FURTHER RESOLVED that future revisions and Plan maintenance required by 44 CFR 201.6
25 and FEMA are hereby adopted as part of this resolution for a period of five (5) years from the date of this
26 resolution; and

27 BE IT FURTHER RESOLVED that an annual report on the process of the implementation elements of
28 the Plan will be presented to the City Council by the Emergency Management Director or Coordinator.

29
30 lb/RWH/Resolutions 2017/Fire – Adoption of 2017 All-Hazards Mitigation Plan
31 10/5/17

* * * * *

ORIGINAL

DISTRIBUTION:

I hereby certify that this resolution has been sent to the following department(s) on

Chief Locke

RESOLUTION RELATING TO

Adoption of 2017 Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan and Annex #3, The 2017 City of Burlington All-Hazards Mitigation Plan

Adopted by the City Council

October 16, 2017

Clerk

Approved October 19, 2017

Mayor

Attest:

Lori Olberg
Licensing, Voting and Records Coordinator

Page

* * * * *

Executive Summary

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 updated Local All-Hazards Mitigation Plan are to:

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

This plan is a local annex to the *Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan*. **In order to become eligible to receive various forms of Federal hazard mitigation grants, a Chittenden County municipality must formally adopt its Local All-Hazards Mitigation Plan along with the *Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan*, 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 municipal demographics and development characteristics, and describes the planning process used to develop this plan.

Section 2: Hazard Identification expands on the hazard identification in the *Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan* with specific municipal-level details on selected hazards.

Section 3: Risk Assessment discusses identified hazard areas in the municipality and reviews previous federally-declared disasters as a means to identify what risks are likely in the future. This section presents a hazard risk assessment for the municipality, identifying the most significant and most likely hazards which merit mitigation activity. The top three hazards by type with the most risk in Burlington are:

Natural Hazards: Severe Winter Storm; Severe Rainstorm; Flooding

Technological Hazards: Multi-Structure Fire; Water Pollution; Major Transportation Incident

Societal Hazards: Epidemic; Civil Disturbance; Economic Recession

Section 4: Vulnerability Assessment discusses buildings, critical facilities and infrastructure in designated hazard areas, vulnerable populations and the issue of estimating potential losses.

Section 5: Mitigation Strategies is the heart of this All Hazards Mitigation Plan. This section begins with an overview of goals and policies in the 2014 Burlington Municipal Development Plan that support hazard mitigation. This is followed by an analysis of existing municipal actions that support hazard mitigation, such as planning and zoning and public works. This section presents the following all-hazards mitigation goals:

- 1) Reduce at a minimum, and prevent to the maximum extent possible, the loss of life and injury resulting from all hazards.
- 2) Mitigation financial losses and environmental degradation incurred by municipal, educational, residential, commercial, industrial and agricultural establishments due to various hazards.
- 3) Maintain and increase awareness amongst the town's residents and businesses of the damages caused by previous and potential future hazard events as identified specifically in this Local All-Hazards Mitigation Plan and as identified generally in the Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan.
- 4) Recognize 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.
- 5) Maintain existing municipal plans, programs, regulations, bylaws and ordinances that directly or indirectly support hazard mitigation.
- 6) 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/town's bylaws, regulations and ordinances, including, but not limited to, zoning bylaws and subdivision regulations and building codes.
- 7) Consider formal incorporation of this Local All-Hazards Mitigation Plan, particularly the recommended mitigation actions, into the municipal/town operating and capital plans and infrastructure, utilities, highways and emergency services.

This section also identifies and provides a detailed discussion of the following Mitigation Actions:

Category A: Implement Public Works projects to mitigate Severe Rainstorms, Flooding, Fluvial Erosion and Water Pollution

- Action A-1: Implement projects to address Combined Sewer Overflows
- Action A-2: Upgrade collection system and outfall pipes

Category B: Operate an effective Stormwater Management System to mitigate Severe Rainstorms, Fluvial Erosion and Water Pollution

- Action B-1: Catch basin cleaning & street sweeping
- Action B-2: Land development proposal review & regulation
- Action B-3: Begin implementation of Flow Restoration Plans
- Action B-4: Develop Integrated Water Quality Plan

Finally, this section includes an Implementation Matrix to aid the municipality in implementing the Mitigation Actions and annual monitoring and evaluation of this Plan.

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[Note: See appendices of Chittenden County Multi-Jurisdictional AHMP for weblinks to the various data sources used to generate many of the tables noted above.]

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SECTION 1: INTRODUCTION AND PURPOSE

1.1 Purpose and Scope of this Plan

The purpose of this Local All-Hazards Mitigation Plan is to assist this municipality in identifying all hazards facing the community and in identifying strategies to begin to reduce the impacts of those hazards. The plan also seeks to better integrate and consolidate efforts of this municipality with those outlined in the *Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan* as well as efforts of quasi-governmental organizations such as Local Emergency Planning Committee, District #1 and the Chittenden County Regional Planning Commission. The University of Vermont and Champlain College, both located in Burlington, are discussed in their respective appendices to this annex.

This annex, when used with the appropriate sections of the Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan, constitutes an All-Hazards Mitigation Plan for the City of Burlington. Community planning can aid significantly in reducing the impact of expected, but unpredictable natural and human-caused events. The goal of this plan is provide hazard mitigation strategies to aid in creating disaster resistant communities throughout Chittenden County.

1.2 Hazard Mitigation

The *2013 Vermont State All-Hazards Mitigation Plan* defines 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. The Federal Emergency Management Agency (FEMA) and state agencies recognize that it is less expensive to prevent disaster or mitigate its effects 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, where they are most severe, and identify actions that can be taken to reduce the severity of the hazard.

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 now have to have an approved local mitigation plan prior to the 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 the plan is not adopted.

- Flood Mitigation Assistance Grant Program (FMAGP) funds will be available only to communities that have adopted a local Plan
- 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.
- Under Vermont's Emergency Relief Assistance Fund rules, contributions from the State to cover the non-Federal share of a municipality's FEMA Public Assistance project costs varies depending on whether a community has a plan. A community without a plan would have to cover 17.5% of the overall project cost, but a community with a plan would have to cover only 7.5% to 12.5% of the cost.

1.4 Benefits

Adoption and maintenance of this Hazard Mitigation 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.
- 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 community planning where possible such as in emergency operations plans, comprehensive plans (aka "town plans"), capital improvement plans and budgeting, open space plans, and stormwater management plans.

1.5 All-Hazards Mitigation Plan Goals

The *Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan* establishes the following general goals for the county as a whole and its municipalities:

- 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 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 and 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 or develop additional processes to foster regional cooperation in hazard mitigation, specifically and emergency management planning, generally.

1.6 City of Burlington: Population and Housing Characteristics

The City of Burlington (*cf. Figure-1.1*) is located along the eastern shore of Lake Champlain. It is bordered by the Town of Colchester and the City of Winooski to the north, and by the City of South Burlington to the south and east. It encompasses 10.31 square miles.

Based on U.S. Census data, the University of Vermont’s Center for Rural Studies reports a municipal population of 42,417 people in 2000. Selected population characteristics are as follows:

Table 1-1 City of Burlington, selected population characteristics, 2010 Census

Category	Number	%
Total Population	42,417	--
Median Age	26.5	--
Population age 65 years and over	3,986	9.4
Population (and %) under 10 years old	3,295	7.8
Population (and %) in group quarters	7,060	16.6

U.S. Census Bureau, 2010 Census of Population and Housing, Population and Housing Unit Counts

The following shows the types of housing within Burlington, also based on the 2010 U.S. Census data:

Table 1-2 City of Burlington, selected housing unit data, 2010 Census

Category	Number	%
Total Housing Units	16,897	--
Occupied housing units	16,119	95.4
Vacant housing units	778	4.6
Vacant housing units used for seasonal, recreational or occasional use	250	1.5
Detached 1-unit housing units	5,588	34.1
Housing units with 5 or more units in structure	4,675	28.6
Mobile homes	125	0.8
Housing structures built in 1939 or earlier	6,356	38.8

U.S. Census Bureau, 2010 Census of Population and Housing, Population and Housing Unit Counts

Burlington’s population and development are concentrated in two distinct clusters (*cf. Figure 1.2*): the downtown core, which is east and south of the New England Central Railroad, and the New North End, northwest of the North Avenue exit off of VT Route 127 (the Beltline). The several thousand students at the University of Vermont and Champlain College reside mostly in the city’s eastern heights.

As the State’s employment hub, the City has seen steady growth over the last 50 years.

Table 1-3 City of Burlington, Population Growth, 1960-2014

Year	Population
1960	35,531
1970	38,633
1980	37,712
1990	39,127
2000	39,815
2010	42,417
2014	42,211

April 1 census counts for 1960, 1970, 1980, 1990, 2000 and 2010; July 1 estimates for 2014

1.7 Summary of Planning Process

As noted above the update of this municipal All Hazard Mitigation Plan (AHMP) was part of the planned update of the Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan and the municipal AHMPs that are annexes to the Multi-Jurisdictional Plan. The CCRPC, with funding provided by the State of Vermont via a FEMA Hazard Mitigation Grant, began this update process in the spring of 2015.

1.7.1 Development of the 2017 Burlington All Hazards Mitigation Plan

CCRPC staff met several times with various City staff and official during the course of the development of this plan. Initial Meetings focused on the following issues:

1. Reviewing the matrix used in 2011 to identify and prioritize hazards facing the City, and determining whether the overall scoring still makes sense
2. Discussing any newly significant hazards in the City and identifying any new actions that could be taken to address them.
3. Discussing any progress that has been made on the strategies and tasks from the 2011 plan.

These first set of meetings were held on:

- August 3, 2015 with Fire Department Chief Seth Lasker and Rob Green, Public Works, Assistant Director
- February 4, 2016 with Chapin Spencer, Public Works Director; Rob Green, Public Works, Assistant Director and Megan Moir, Stormwater Program Manager;

In addition, the following materials were reviewed:

1. City of Burlington Land Development Regulations
2. City of Burlington Comprehensive Plan
3. FEMA information on prior disasters
4. The 2013 Vermont All-Hazards Mitigation Plan
5. Information from Vermont Agency of Natural Resources on fluvial erosion hazards and flood hazards
6. Information from the Vermont Agency of Transportation on city roads, bridges, culverts and high crash locations.
7. Information from the Vermont Department of Emergency Management and Homeland Security on prior disaster and hazardous materials reporting.

1.7.2 Opportunities for involvement in the planning process and formal public review and governing body approval

Emergency management planners are 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 review and development of Hazard Mitigation Plans. Additionally, the CCRPC, as a public agency is obligated to provide public notice and opportunities for input into its programming and processes. With regard for public involvement in the develop of the first drafts of this Municipal AHMP *prior to release of public drafts*, there was no formal solicitation process to recruit or invite the public to come to staff level meetings wherein the first process of updating data in the old 2011 Plan. That being said, however, the public has been free to review the 2011 Plans on the CCRPC website since they were first posted in 2011. Additionally as noted in Section 1.10.2.4 of the Multi-Jurisdictional AHMP, in the

period before the first municipal draft AHMPs were publicly released in August 2016 (see below) there were twelve public meetings held by the CCRPC Board and the Plan Update Committee wherein the overall Hazard Mitigation planning process was discussed including the content and purpose of the local, Municipal AHMPs as well as the planned timeline for their development starting in 2015 and extending well into 2016. [Opportunities for public review and development of the Multi-Jurisdictional AHMP are described in Section 1.10.2 of that document.]

Commencing with an August 5, 2016 press release and with a comment deadline of August 19, 2016, the CCRPC issued a press release and also posted to all of the electronic bulletin boards of Front Porch Forum in every municipality in the County to solicit and receive comments on the first drafts of this City of Burlington All-Hazards Mitigation Plan as well as the AHMPs of the other 18 municipalities in the County. On August 5, 2016, emails to state agency staff and executive directors of neighboring Regional Planning Commissions (see Section 1.7.2 of Multi-Jurisdictional AHMP for details), were also sent to encourage their review and comment. The public, agency staff and RPC staff were directed to provide comments to Dan Albrecht, Senior Planner at the CCRPC.

With regard to opportunities for public involvement and input from neighboring communities in development of individual Local All-Hazards Mitigation Plans including this Plan for the **City of Burlington**, opportunities were as follows:

- a) On August 5, 2016, the CCRPC posted all the first drafts of the 18 local AHMPs on the CCRPC website and via various means (press release, electronic newsletter, etc) made the public aware of the opportunity to comment. The public was advised to send comments directly to Dan Albrecht, CCRPC Senior Planner by August 19, 2016.
- b) On August 5, 2016 the CCRPC staff sent direct emails to the Agency staff noted above notifying them as well of the opportunity to review the 18 local AHMPs posted on the CCRPC website and encouraging them to send any comments directly to Dan Albrecht, CCRPC Senior Planner by August 19, 2016.
- c) On August 5, 2016 direct emails were also sent to the municipal Mayors/ Managers/ Administrators and/or Clerks of the abutting 12 communities outside of Chittenden County (South Hero, Georgia, Fairfax, Cambridge, Stowe, Waterbury, Duxbury, Fayston, Lincoln, Starksboro, Monkton and Ferrisburgh) that about the County, notifying them of the opportunity to review the 18 local AHMPs posted on the CCRPC website and encouraging them to send any comments directly to Dan Albrecht, CCRPC Senior Planner by August 19, 2016.

No comments were received directly on the draft City of Burlington AHMP prior to the August 19th deadline. Additionally, no inquiries were received concerning this AHMP after August 19th through December 31, 2016 while the Plan was posted on the CCRPC website.

1.7.3 Review and adoption process

On June 29, 2016 the first draft of this local City of Burlington AHMP was sent to the Vermont Department of Emergency Management and Homeland Security (VDEMHS) for review. Comment and required revisions were received from VDEMHS on August 8, 2016.

CCRPC staff, working in concert with municipal staff, then made revisions to the Plan to address the required revisions. Additional revisions were made in early 2017 in response to requests from VDEMHS and FEMA staff. In early June 2017 CCRPC staff distributed a proposed final draft to numerous City staff for final review prior to final submission as detailed below.

On June 27, 2017, the revised final draft annex was submitted to VDEMHS for review and forwarding to FEMA for formal review and approval pending municipal adoption

On July 26, 2017 FEMA Region One issued a notice that the City of Burlington AHMP was approved pending adoption by the relevant municipal governing body.

On July 28, 2017, CCRPC staff provided the final versions of the Multi-Jurisdictional Plan and this Municipal Annex to the Mayor and relevant City staff for distribution to the City of Burlington City Council members and also provided draft language for a resolution of adoption to be discussed at a regularly scheduled and properly warned City of Burlington City Council meeting

On October 16, 2017 the revised annex was adopted by the City Council and a copy of the resolution sent to VDEMHS and FEMA Region One on October 24, 2017.

On November 6, 2017 FEMA issued a letter that the City of Burlington's Plan was approved.

1.7.4. Monitoring, Evaluation and Updating of the Plan

Section 6 of the Multi-Jurisdictional AHMP document provides extensive details on the role each municipality and the Chittenden County RPC will play to be certain that progress on the implementation of this local AHMP is monitored and evaluated and that the AHMP is updated as needed and no later than its expiration in March 2022. In short, the City of Burlington will:

- in the fall of 2017 and each fall thereafter, the municipal departments as noted in Section 5.5 as the conclusion of this document shall respond to CCRPC's questionnaire seeking information on the status (progress, problems if any, etc.) of each identified mitigation strategy detailed in Section 5;
- in the fall of 2018 and the fall of 2018, provide information to aid CCRPC in its more comprehensive review of the Multi-Jurisdictional AHMP and this local AHMP which will address issues such as goals, risks, resources, implementation problems, and partners; in partnership with the municipalities, the CCRPC will make the public aware of the availability of these review documents (via press releases, posting on the CCRPC website, electronic newsletters, one formal announcement in a paper of general circulation in the County, and other mechanisms) and provide detailed instructions on how to provide comment on these reviews;
- provide at least one representative of the City to participate as a member of the Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan Update and Review

Committee which, after the current Plan update process is completed, to resume meeting in 2018; and

- participate in the Plan update process (assumed to commence in 2020 and conclude by early 2022).

Finally, it should be reemphasized that the City of Burlington 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 opportunities during the 5-year life cycle of their single jurisdiction plan.

SECTION 2: HAZARD IDENTIFICATION

Detailed descriptions of the natural, technological, and societal hazards affecting the municipalities of Chittenden County are contained in the Multi-Jurisdictional All-Hazards Mitigation Plan. Designated and non-designated hazard areas are described in Section 3 of this annex. Vulnerability of structures and infrastructure to hazards is also described in Section 4 and depicted in Figure 4.1

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 the City for these hazards:

Hazard (section of MJAHP where discussed)	Are Location data available?	Are Extent data available?	Are Impact data available?
Severe Winter Storm (2.1.1.1)	No, occurs across the municipality and not mapped.	No, only long-term data is at single point of National Weather Service station in South Burlington. Data may or not be applicable to the City of Burlington.	Yes, if FEMA declares disaster. See 3.3 below.
Flooding (2.1.1.3)	Yes, 100 & 500 year flood areas delineated in the municipality. <i>See Figure 2.1.</i>	*Yes but only at a few discrete locations with gauge data such as USGS gauge on Winooski River <u>upstream</u> of the City. Additionally, consistent and long-term data on Lake Champlain water levels are maintained at Burlington by the U.S. Army Corps of Engineers. See Figure 2.2	Yes, if FEMA declares disaster but co-mingled with fluvial erosion and severe rainstorm hazards events. See 3.3 below.
Fluvial Erosion (2.1.1.4)	Yes, fluvial erosion hazards areas (now termed river corridor protection areas) are mapped in the municipality. <i>See</i>	Though fluvial erosion is considered a significant hazard in the municipality, the number of feet-acres of soil lost in	Yes, if FEMA declares disaster but data co-mingled with flood and severe rainstorm events. See 3.3 below.

	<i>Figure 2.1.</i>	any one event has not been recorded nor is there a record with such data.	
Severe Rainstorm (2.1.1.2)	No, occurs across the municipality and not mapped. Damage locations are mapped but damages can just as easily be a function of aging infrastructure as it is a function of heavy rain exceeding infrastructure capacity.	*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 (2.1.1.5)	No, occurs across the municipality and not mapped.	*Yes but only at single point of National Weather Service station in South Burlington	‡Data not systematically collected on impacts.
Wildfire (2.1.1.6)	No, can occur across the municipality and not mapped.	Some compiled data on a countywide basis as shown in the Multi-Jurisdictional Plan but 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.

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 the City for these hazards:

Hazard (section of MJAHP)	Are Location data available?	Are Extent data available?	Are Impact data available?
-------------------------------------	-------------------------------------	-----------------------------------	-----------------------------------

where discussed)			
Water Pollution (2.2.1)	Impaired streams that lack adequate biota are identified. The following streams are identified as “impaired” by the VT-DEC: Centennial Brook; Englesby Brook; Potash Brook The City is subject to the requirements of a Municipal Separate Storm Sewer System (MS4) Permit as well as the Vermont Clean Water Act which require mitigation of these impairments.	Phosphorus-loading for general locations is known but non-point sources are varied and dispersed. Road segments that could discharge runoff into local streams have been identified and will be formally inventoried in 2017.	Annual budgetary impacts to individual municipalities are significant but vary depending upon location and whether they are an MS4-permitted community which Burlington is.
Hazardous Materials Incident (2.2.2)	Storage locations are known (see listing below of addresses). Incidents occurring during transportation could occur anywhere.	Rough estimates of spill amounts are recorded.	No formal data readily available on cleanup costs.
Power Loss (2.2.3)	Outage locations not mapped	During an actual outage some data is recorded on duration although typically this is stated as “x,000 customers within the power company’s service area”.	Outage data is broad and refers to total customers within a county.
Invasive Species (2.2.4)	Several species known to occur in Lake Champlain but no systematic	No formal damage has been documented to date	No formal damage has been documented to date

	mapping has taken place.		
Multi-Structure Fire (2.2.5)	Could happen anywhere within the more developed portions of the municipality	Data not formally collated across agencies	Data not formally collated across agencies
Major Transportation Incident (2.2.6)	Depending upon type of incident, could happen anywhere	No formal database of damages.	Varies depending upon type of incident.
Water Supply Loss (2.2.7)	Water distribution systems are mapped (<i>cf. Figure 1.4</i>). Specific locations of temporary service outages are mapped by the City.	Data not formally collated across agencies. Water supply loss is generally resolved withing 4-6 hours and is related to aging water infrastructure	Data not formally collated across agencies. Water supply loss is generally resolved withing 4-6 hours and is related to aging water infrastructure
Sewer Service Loss (2.2.8)	Sewer lines are mapped (<i>cf. Figure 1.4</i>). Specific locations of temporary service outages are not known to be mapped.	Data not formally collated across agencies	Data not formally collated across agencies
Natural Gas Service Loss (2.2.9)	Vermont Gas provides services to most all areas of the City. Specific locations of service outages are not recorded.	Information for this rare occurrence not publicly available.	No formal damage has been documented to date.
Telecommunications Failure (2.2.10)	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 (2.2.11)	Distribution points of fuels such as firewood, fuel oil and propane are individual addresses and not mapped nor publicly available.	No formal loss of service has been documented.	No formal damage has been documented to date

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.

Hazard (section of MJAHP where discussed)	Are Location data available?	Are Extent data available?	Are Impact data available?
Crime (2.3.1.1)	Significant incidents could happen anywhere in the municipality.	Data collection is not standardized across municipalities.	Significant socio-economic impacts
Economic Recession (2.3.1.2)	Would occur across the community.	Historic data on unemployment levels & poverty rates	Longer lasting impacts hard to measure below county level
Terrorism (2.3.1.3)	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 (2.3.1.4)	Numerous locations throughout the City could be areas where such an event could take place. The likelihood of an event may not be geographically likely but rather related to the type of event (political event, sporting event, protest, etc.).	No formal damage has been documented to date	No formal damage has been documented to date
Epidemic (2.3.1.5)	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 (2.3.1.6)	Depending upon type of employer	No formal database of damages.	No formal database of key employer loss is maintained

SECTION 3: RISK ASSESSMENT

3.1 Mapped Hazard Areas

3.1.1 Flood Hazard Areas

According to the *2006 Burlington Municipal Development Plan*, lands in the 100-year floodplain along the following drainages have been designated flood hazard areas:

- Portions of the shoreline of Lake Champlain;
- The Winooski River Intervale;
- The banks of Englesby Brook west of Pine St. between Maple St. and Lakeside Ave.; and
- The banks of Potash Brook in the southeast corner of the City.

These flood hazard areas are shown in *Figure 2.1*. The City's Flood Hazard Areas Zoning Regulations restrict development in these flood hazard areas.

A simple GIS intersection analysis reveals that portions of City roads are located within the 100-year floodplain, as are bridges and utility poles. Unfortunately, this level of analysis does not take into account fluvial geomorphology (volume, velocity, direction, etc.) and does not factor in the elevation of the road 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 might be lost during a flood event. The farmland in the Intervale, which lies in the 100-year floodplain, is a source of local food for the City of Burlington. Loss of crops due to flooding could have a significant economic impact on the city.

Figure 2.1 shows the current extent of the FEMA-FIRM flood hazard area in Burlington, as well as structures, infrastructure, and critical facilities located in the flood hazard area. The only systematic data on river flow in the municipality is collected on the Winooski River at a gauge downstream of Richmond at a location straddling South Burlington and Essex Junction (cf. Section 2.1.1.3 of the MJAHMP). While the data has been collected since the massive 1927 flood, once dams were constructed by the mid-1930s, water flows became more tightly regulated for flood control and electricity generation and therefore recorded peak flows may not accurately measure total rainfall or total discharge.

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 102.0 feet while flood stage established by the National Weather Service is 100 ft. These stages are defined as follows:

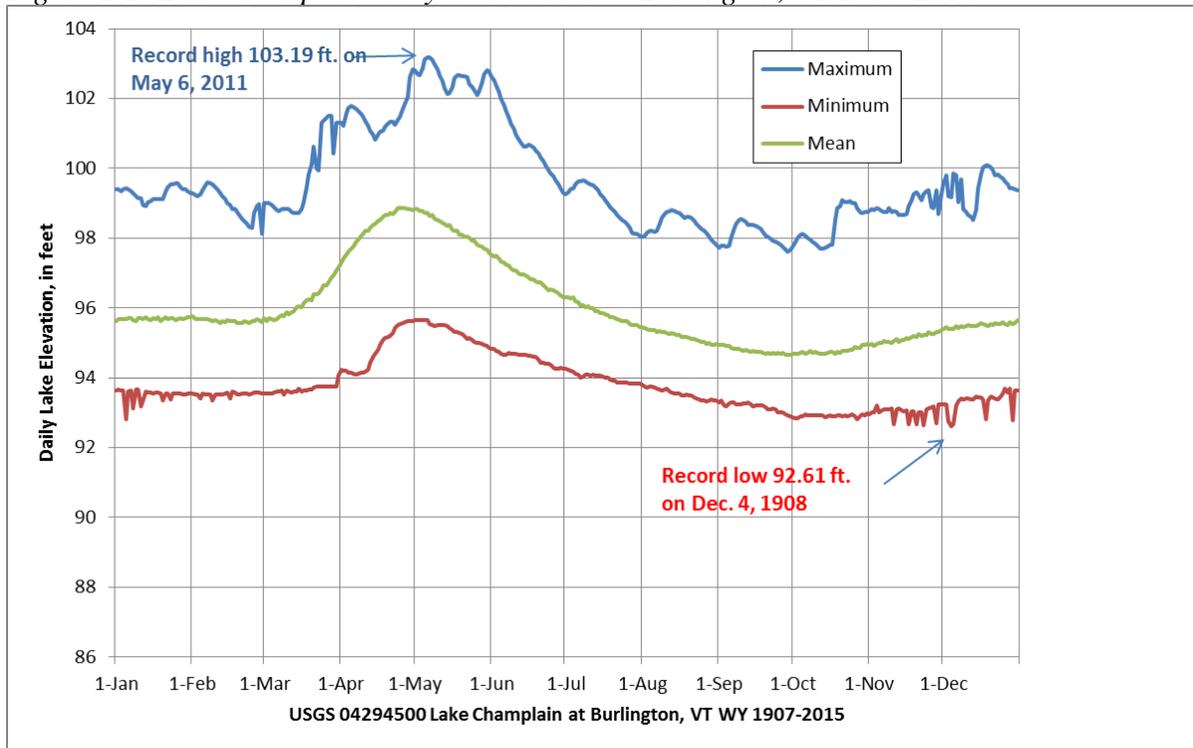
100 ft. Water begins to enter some lake front properties. Water also begins to threaten low lying roads, piers, and docks. Wave action can compound flooding on windward facing shorelines.

101. Flooding becomes serious, and wave erosion on windward shores becomes a problem. If lake ice is present, structural damage can occur.

102 ft. Severe flooding occurs, with widespread inundation of lake side properties, and closure of low lying roads.

The following graph shows the water levels measured along the Burlington waterfront.

Figure 2.2. Lake Champlain daily water levels at Burlington, VT 1907-2015



The winter of 2015-2016 experienced relatively little snowfall and the summer of 2016 (as of July 31, 2016) has been relatively dry in terms of rainfall. Water levels in Lake Champlain dropped quite low in the fall of 2016 almost matching the record low of 1908 with a peak trough of 93.26 ft. on both October 16th and October 17th before climbing back to 94 ft. on October 31st.

3.1.2 Fluvial Erosion Hazard and River Corridor 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 Fluvial Erosion Hazard (FEH) Areas through the analytical lens of Stream Geomorphic Assessment (SGA). The SGA approach is still used by the Vermont Agency of Natural Resources but the Vermont General Assembly adopted two related terms that are now used in managing fluvial erosion hazards. ANR now identifies and maps:

- *River Corridor* which is 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.
- *River Corridor Protection Area* 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 a riparian buffer to serve the functions of bank stability and slowing flood water velocities in the near-bank region .

In Burlington, water drains directly into the lake in many areas. Some level of geomorphic assessment has been completed for most of the streams that run through Burlington. Fluvial Erosion Hazard and River Corridor protection areas have been identified for some of these waterways. *Figure 2.1* shows the progress of geomorphic assessments and identified Phase 2 SGA based River Corridor Protection Areas (RCPA) in the City. Additional portions of streams that did not have Phase 2 SGA work, but have a watershed area greater than 2 sq. miles would also be included in the River Corridor Protection Area and/or River Corridor.

3.1.3 Repetitive Loss Properties

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. According to the National Flood Insurance Program, there are no repetitive loss properties located in the City.

The status of the City’s participation in the National Flood Insurance Program is as follows:

Initial Flood Hazard Boundary Map	Initial Flood Insurance Rate Map	Current effective Map Date	Date of joining Regular NFIP	Date of most recent Community Assistance Visit
07/19/74	11/15/78	07/18/11	11/15/78	09/13/16

The City’s Administrative Officer and the City’s Development Review Board (DRB) monitor compliance with the National Flood Insurance Program. The DRB reviews and adjudicates applications for development within the floodplain including any proposed new construction in the SFHA which is highly regulated. The City also works with DEC to respond to any local requests for Floodplain identification including questions about mapping.

3.2 Other Information

The following hazards are not formally analyzed nor mapped due to the random nature of where such damage occurs. However, they occur with some frequency and therefore are discussed here.

3.2.1 1998 Ice Storm Damage

The following day summaries are excerpts from the BED Spring 1998 Outlets Customer Newsletter, and give an indication of the severity of power outages during the 1998 Ice Storm.

Wednesday / 01-07 - Main power line serving North End went down in late evening leaving 500 customers without power.

Thursday / 01-08 - By 2:30 AM nearly half of BED 18,000 customers were without power. The core of BED system was failing, limbs and lines were down throughout the City. By nightfall customer calls included reports of flashes and explosions as trees continued to fall on power lines. Out-of-state line crews began to arrive from Massachusetts. About 95% of BED

customers were affected at one time or another by the storm but only 60% of the City was dark all at once.

(Power crews from several companies cleared lines only to find the same lines out again from falling ice. Sometimes tree limbs that had fallen below power lines sprang back up when they shed their ice, knocking out lines again. Burlington Free Press, January 9, 1998)

Friday / 01-09 – Line crews worked through the evening to restore power to about 5,000 customers, but outages continued to occur. Ice on tree limbs and power lines made restoration very dangerous, and several sections of main lines were in need of major reconstruction. By evening 1-2,000 customers remained without power. BED had its core system restored and was able to have line crews work on minor substations and secondary lines.

Saturday / 01-10 – The bulk of the customer service restoration work was done. Fewer than 1,000 customers were without power but a main line feeding two UVM buildings was still down and students returning from holiday break were asked to delay their return.

Sunday / 01-11 – By morning approximately 300 customers remained without power. The more severe problems at this point included broken poles and downed primary lines in wooded areas.

3.2.2 Severe Rainstorms

In prior versions of this Annex and the County Plan, damage to roads, culverts and bridges from thunderstorm events was discussed as either the result of flooding or fluvial erosion. It was assumed that overflowing nearby streams, rivers or lakes were the cause of the damage. Analysis has shown that this damage is caused by intense, localized thunderstorms which cause excessive and rapid water flows on and over paved and gravel roads, roadside ditches, driveway culverts, stormwater systems, etc. In many cases, damaged infrastructure is located nowhere near a formally mapped Floodplain or Fluvial Erosion Hazard Area or River Corridor. This was the case in more recent FEMA-declared disasters in the summer of 2013 and 2015. Because of this new information, CCRPC has decided to add “Severe Rainstorm” to the 2016 Update to the County Plan and its annexed local AHMPs. While past damage locations can sometimes be mapped (depending upon the degree and accuracy of data collection efforts) this may or may not provide any degree of predictability of the potential locations for future events.

While the City’s paved roads are not as susceptible to washout as are the County’s gravel roads, the City stormwater management systems can become overwhelmed.

High Winds and Lightning: Due to the density of residences and businesses within the City, property damage and damage to utility lines are common during windstorms and snowstorms.

3.2.3 High Crash Locations

Burlington experiences high volumes of traffic throughout the City. The following High Crash Locations have been identified by the Vermont Agency of Transportation in the City of Burlington:

Table 3-1 City of Burlington high crash road sections, 2010-2014

Route	System	Mileage	Severity Index (\$/Accident/1.)
BURLINGTON (ALTERNATE US-7), MAIN ST., BURLINGTON	Principal Arterial (u)	0.990 - 1.010	\$19,266
BURLINGTON (ALTERNATE US-7), MAIN ST., BURLINGTON	Principal Arterial (u)	0.990 - 1.010	\$15,756
US-7, MAIN ST., BURLINGTON, US-2	Principal Arterial (u)	2.110 - 2.130	\$15,756
US-7, MAIN ST., BURLINGTON, US-2	Principal Arterial (u)	2.110 - 2.130	\$16,788
US-2, S PROSPECT ST., BURLINGTON, <T0000>	Principal Arterial (u)/Urban Collector (u)	0.220 - 0.240	\$16,788
US-2, S PROSPECT ST., BURLINGTON, <T0000>	Principal Arterial (u)/Urban Collector (u)	0.220 - 0.240	\$19,097
US-7, PEARL ST., BURLINGTON	Principal Arterial (u)/Minor Arterial (u)	2.420 - 2.440	\$19,097
BURLINGTON (ALTERNATE US-7), PEARL ST., BURLINGTON	Principal Arterial (u)/Minor Arterial (u)	1.310 - 1.330	\$17,429
BURLINGTON (ALTERNATE US-7), PEARL ST., BURLINGTON	Principal Arterial (u)/Minor Arterial (u)	1.310 - 1.330	\$17,429
US-7, PEARL ST., BURLINGTON	Principal Arterial (u)/Minor Arterial (u)	2.420 - 2.440	\$20,492
BATTERY ST., BURLINGTON, MAIN ST., BURLINGTON	Principal Arterial (u)	0.220 - 0.240	\$21,558
BATTERY ST., BURLINGTON, MAIN ST., BURLINGTON	Principal Arterial (u)	0.220 - 0.240	\$21,558
PEARL ST., BURLINGTON, <T0000>, S PROSPECT ST., BURLINGTON, COLCHESTER AVE., BURLINGTON	Minor Arterial (u)/Urban Collector (u)	0.930 - 0.940	\$20,492
PEARL ST., BURLINGTON, <T0000>, S PROSPECT ST., BURLINGTON, COLCHESTER AVE., BURLINGTON	Minor Arterial (u)/Urban Collector (u)	0.930 - 0.940	\$27,014
COLCHESTER AVE., BURLINGTON, EAST AVE., BURLINGTON	Minor Arterial (u)	0.430 - 0.450	\$27,014
COLCHESTER AVE., BURLINGTON, EAST AVE., BURLINGTON	Minor Arterial (u)	0.430 - 0.450	\$13,142
PARK ST., BURLINGTON, MANHATTAN DRIVE, BURLINGTON, VT. 127 BELTLINE, BURLINGTON	Freeway/Expressway (u)/Principal Arterial (u)	0.480 - 0.490	\$13,142
PARK ST., BURLINGTON, MANHATTAN DRIVE, BURLINGTON, VT. 127 BELTLINE, BURLINGTON	Freeway/Expressway (u)/Principal Arterial (u)	0.480 - 0.490	\$14,930
MAIN ST., BURLINGTON, ST. PAUL ST., BURLINGTON	Principal Arterial (u)/Urban Collector (u)	0.250 - 0.270	\$15,931
MAIN ST., BURLINGTON, ST. PAUL ST., BURLINGTON	Principal Arterial (u)/Urban Collector (u)	0.250 - 0.270	\$14,930
US-7, BURLINGTON (ALTERNATE US-7)	Principal Arterial (u)	3.050 - 3.070	\$15,931
US-7, BURLINGTON (ALTERNATE US-7)	Principal Arterial (u)	3.050 - 3.070	\$27,617
NORTH ST., BURLINGTON, N CHAMPLAIN ST., BURLINGTON	Principal Arterial (u)/Urban Collector (u)	0.220 - 0.240	\$27,464
NORTH ST., BURLINGTON, N CHAMPLAIN ST., BURLINGTON	Principal Arterial (u)/Urban Collector (u)	0.220 - 0.240	\$27,464
COLCHESTER AVE., BURLINGTON, BARRETT ST., BURLINGTON	Minor Arterial (u)/Urban Collector (u)	0.990 - 1.010	\$27,617
COLCHESTER AVE., BURLINGTON, BARRETT ST., BURLINGTON	Minor Arterial (u)/Urban Collector (u)	0.990 - 1.010	\$20,109
BURLINGTON (ALTERNATE US-7), NORTH ST., BURLINGTON	Principal Arterial (u)/Urban Collector (u)	1.620 - 1.640	\$20,109
BURLINGTON (ALTERNATE US-7), NORTH ST., BURLINGTON	Principal Arterial (u)/Urban Collector (u)	1.620 - 1.640	\$23,819

PARK ST., BURLINGTON, NORTH ST., BURLINGTON	Principal Arterial (u)/Urban Collector (u)	0.280 - 0.300	\$23,819
PARK ST., BURLINGTON, NORTH ST., BURLINGTON	Principal Arterial (u)/Urban Collector (u)	0.280 - 0.300	\$23,879
NORTH AVE., BURLINGTON, PLATTSBURG AVE., BURLINGTON	Minor Arterial (u)	3.090 - 3.100	\$23,879
NORTH AVE., BURLINGTON, PLATTSBURG AVE., BURLINGTON	Minor Arterial (u)	3.090 - 3.100	\$11,645
N UNION ST., BURLINGTON, S UNION ST., BURLINGTON, <T0000>	Principal Arterial (u)	0.000 - 0.010	\$11,645
N UNION ST., BURLINGTON, S UNION ST., BURLINGTON, <T0000>	Principal Arterial (u)	0.000 - 0.010	\$32,190
VT. 127 BELTLINE, BURLINGTON, <5042>	Freeway/Expressway (u)	3.360 - 3.470	\$32,190
VT. 127 BELTLINE, BURLINGTON, <5042>	Freeway/Expressway (u)	3.360 - 3.470	\$21,461
VT. 127 BELTLINE, BURLINGTON, <5009>	Freeway/Expressway (u)	1.340 - 1.500	\$21,461
VT. 127 BELTLINE, BURLINGTON, <5009>	Freeway/Expressway (u)	1.340 - 1.500	\$31,982

3.2.4 Rail Freight Incident

The Vermont Railway brings rail freight shipments into Burlington. Most of the fuel oil shipments into Chittenden County arrive by rail and are offloaded at a terminal in Burlington. A rail incident could temporarily halt rail freight shipments. A hazardous materials incident such as a fuel spill or fire could halt rail freight shipments and endanger surrounding properties. Rail cars delivering wood chips use a railroad spur that runs from Essex to the McNeil Generating Plant in Burlington. An incident on this line could result in difficulty supplying fuel to the plant, which would have an impact on energy generation in Burlington.

3.2.5 Bridge Infrastructure Failure

The Winooski Bridge, on US 7 between Burlington and Winooski, is a high traffic bridge and a high accident road section. Temporary or extended closure of this bridge would cause significant traffic disruption and detours.

Of the 11 bridges inventoried by VTrans for Burlington, four are rated functionally deficient, and none are considered structurally deficient. The functionally deficient rating does not mean that the bridges are in imminent danger of collapse, however. None of the bridges in Burlington are rated Scour Critical with regards to fluvial undermining of bridge structure.

For a listing of culverts identified as “geomorphically-incompatible” either due to inadequate size or improper alignment, see Section 4.2.2.

3.2.6 Multi-Structure Fire

Burlington is the largest city in Chittenden County and the State, and much of the city is developed to urban density. Therefore, the city is more at risk for a multi-structure urban fire than much of the rest of the county. A fire in the downtown core, for example, could easily spread from one building to another. The city has an ISO rating of 3, indicating that all structures are close enough to a fire department that officials could readily respond in an

emergency, and the Burlington Fire Department is well-equipped to handle ordinary emergencies. However, as noted in Table 1-2, a significant amount of the housing stock in Burlington was built in 1939 or earlier. Many of these older houses have been converted into several rental units. Such older structures tend to lack sprinkler systems and other fire-retarding measures. While Burlington has not lost a city block or more to fire in the recent past, a large-scale fire in an urban area could be catastrophic to the city.

3.2.7 Hazardous Substances

Hazardous material release is discussed as a possible hazard in the Multi-Jurisdictional All-Hazards Mitigation Plan. According to VDEMHS, as of May 2016 there are numerous reported hazardous material and petroleum storage sites in Burlington. Sites that contain large amounts of fuel or store what VEM calls Extremely Hazardous Substances are more likely to cause significant problems in a hazardous materials incident. (Note that sites are listed twice in the table below contain both petroleum products and hazardous materials.)

Table 3-2 City of Burlington, Hazardous Materials storage and/or use locations

FacilityName	StreetAddress
208 Flynn Ave	208 Flynn Avenue
280 East Avenue	280 East Avenue
284 East Ave	284 East Avenue
30 University Heights "North"	30 University Heights
90 University Heights "South"	90 University Heights
Aiken Center	81 Carrigan Drive
Angell Lecture Center	82 University Place
Barrett Trujcking Co., Inc	16 Austin Drive
BED SUBSTATION ON UVM CAMPUS	Burlington Electric Department
Bioresearch Laboratories	655 Spear St
Blodgett Oven Company	44 Lakeside Avenue
Buckham Hall	73 Colchester Ave
Burlington Hannaford #8161	1099 North Avenue
Burlington Electric Department	585 Pine Street
BURLINGTON INTERNATIONAL AIRPORT	1250 Airport Drive
Burlington Shell	328 North Avenue
Burlington Subaru and Hyundai	333 shelburne rd
Burlington Subaru and Hyundai	333 shelburne rd
Burlington Sunoco	315 Shelburne Rd
Burlington Sunoco	315 Shelburne Rd
Centennial Field - Baseball Stands	331 Colchester Avenue

Centennial Field - Grounds Garage	50 University Road
Centennial Field - HVAC and Electrical Shop	331 Colchester Ave
Central Heating Plant	187 Carrigan Drive
Central Heating Plant	187 Carrigan Drive
Christie Hall	436 S Prospect St
City of Burlington Main Plant	53 lavalley Lane
City of Burlington Main Plant	53 lavalley Lane
City of Burlington North Plant	North Ave. extension
City of Burlington North Plant	North Ave. extension
Cook Physical Sciences	82 University Place
Coolidge Hall	402 South Prospect Street
Cumberland Farms #8018	661 Pine St.
Cumberland Farms #8018	661 Pine St.
Cumberland Farms #8019	454 Riverside Ave.
Cumberland Farms #8019	454 Riverside Ave.
Delehanty Hall	180 Colchester Ave
Dudley Davis Center	590 Main Street
Edlund Company LLC.	159 Industrial Pkwy
Environmental Safety Facility	667 Spear Street
Fairpoint 500 FT. E AIRPORT DR. WILLISTON RD (HUT) (FPT-VT4741068)	1848 WILLISTON RD
Fairpoint BURLINGTON CO (FPT- VT474107)	266 MAIN ST
Fairpoint BURLINGTON CO (FPT- VT474107)	266 MAIN ST
Fairpoint Little Eagle Bay SLC (FPT- VT4741044)	985 NORTH AVE
Fairpoint RT 1 Pole 109 109 LAKESHORE DR HUT (FPT-VT4741066)	864 LAKESHORE DR
Fleming Museum	61 Colchester Ave
Fletcher Allen Health Care - MCHV Campus	111 Colchester Avenue
Fletcher Allen Health Care - MCHV Campus	111 Colchester Avenue
Fletcher Allen Health Care - UHC Campus	1 South Prospect Street
Fletcher Allen Health Care - UHC Campus	1 South Prospect Street
FLETCHER ALLEN ISE CELL - USID145370	111 COLCHESTER AVENUE DUP1
General Dynamics Armament and Technical Products - Building 41	152 Industrial Parkway
General Dynamics Armament and Technical Products - Building 41	152 Industrial Parkway
Given - Chemical Bunker	89 Beaumont Ave
Given Medical Building	89 Beaumont Ave
Global Companies LLC Burlington Terminal	2 Flynn Avenue

Global Companies LLC Burlington Terminal	2 Flynn Avenue
Handy's Service Station, Inc.	75 South Winooski Ave.
Health Sciences Research Facility	149 Beaumont Ave
Hills Ag Science	105 Carrigan Dr
Jeffords Hall	63 Carrigan Drive
Jeffords Hall	63 Carrigan Drive
John Dewey Hall	2 Colchester Ave
John Dewey Hall	2 Colchester Ave
Joseph C. McNeil Generating Station	111 Intervale Road
Joseph C. McNeil Generating Station	111 Intervale Road
Koffee Kup Bakery Inc	436 riverside Ave
Lake Street Gas Turbine Building	One Lake Street or / same as Penny Lane
Lake Street Gas Turbine Building	One Lake Street or / same as Penny Lane
Level 3 Communications-Burlington-BURLVTKJ	100 Bank Street
Mann Hall	208 Colchester Ave
Marsh Life Sciences and Carrigan Wing	109 Carrigan Dr
Marsh Life Sciences and Carrigan Wing	109 Carrigan Dr
Marsh, Austin, Tupper Complex	31 Spear Street
MCI- BURLVT (VZB- VTBURLVT)	100 BANK ST FL 2
NuCO2 Supply LLC Burlington Depot	#1 Industrial Parkway
Outing Club Shed	8 Colchester Avenue
Patrick / Forbush / Gutterson Complex	97 Spear St
Patrick / Forbush / Gutterson Complex	97 Spear St
Pearl Street Auto, Inc.	281 Pearl Street
Perkins Hall	43 Colchester Ave.
QUEEN CITY PRINTERS INC.	701 PINE STREET
QUEEN CITY PRINTERS INC.	701 PINE STREET
RCC - MACKENZIE	4 ELMWOOD STREET
RCC - REDSTONE - USID102958	703 SOUTH PROSPECT STREET
RCC - VERMONT HOUSE	131 Main Street
Rhino Foods Inc.	79 Industrial Pkwy
Riverside Avenue Wastewater Facility	267.5 Riverside Avenue
Riverside Beverage	500 Riverside Avenue
Rowell Hall	106 Carrigan Dr
Royall Tyler Theatre	116 University Place
Rubenstein Laboratory	1 College Street
S. B. Collins, Inc. - (A-1 Automotive) -Burlington	56 North Winooski Avenue
S. B. Collins, Inc. - (Ethan Allen Mobil) -Burlington	996 No. Ave.
S. B. Collins, Inc. - (Messiers Shell) -Burlington	1316 North Ave

S. B. Collins, Inc. - (North Ave Short Stop) -Burlington	1555 North Ave
S.D. Ireland Concrete	100 Grove Street
S.D. Ireland Concrete	100 Grove Street
Simon's Downtown Quick Stop	93 South Winooski Ave.,
Simon's Park Street Store & Deli	42 Park Street
Southwick Hall	392 South Prospect Street
Southwick Hall	392 South Prospect Street
Southwick Hall	392 South Prospect Street
Stafford Greenhouse	95 Carrigan Drive
Stafford Hall	95 Carrigan Drive
Terrill Building	570 Main Street
Torrey Hall	27 Colchester Ave
TRACKSIDE TERMINAL OIL COMPANY, LLC	267 BATTERY STREET
U.S. Coast Guard Station Burlington	1 Depot Street
U.S. Postal Service Burlington MPO	11 Elmwood Avenue
Ungulate Facility	665 Spear Street
VELCO EAST AVENUE SUBSTATION	74 UNIVERSITY ROAD
Verizon Wireless Brownell Mtn. (ID:57192)	Between Highways 116 & 2A Lincoln Road
Verizon Wireless Burlington 2 (ID:2662494)	128 Lakeside Ave
Verizon Wireless BURLINGTON NORTH VT - New Build (ID:17675206)	1193 North Avenue
Verizon Wireless Burlington Square (ID:52310)	7 Burlington Square Bank Street
Verizon Wireless Medical Center (ID:1264034)	Colchester Ave Fletcher Allen
Vermont Dept. of Health Laboratory	195 Colchester Ave.
Vermont Railway Inc	1 Railway Lane
Vermont Railway Inc	1 Railway Lane
Vermont Railway Inc. - Briggs Street	75 Briggs Street
Votey Hall	33 Colchester Ave
VT Department of BGS	32 Cherry Street
VT Department of BGS	195 Colchester Ave.
VT Department of BGS	32 Cherry Street
VT Department of BGS	195 Colchester Ave.
Waterman Building	85 S Prospect Street
Waterman Building	85 S Prospect Street
Wheeler House	133 S Prospect Street
Williams Hall	72 University Place

3.3 Previous FEMA-Declared Natural Disasters and Snow Emergencies

3.3.1 Public Assistance

Since 1990, Burlington has received public assistance funding from FEMA for the following natural disasters:

Table 3-3 City of Burlington, FEMA-declared disasters and snow emergencies, 1990-2016

Date (FEMA ID#)	Type of Event	Total Repair Estimates
April 1993 (DR 990)	lakeshore flooding	\$177,810
January 1998 (DR 1201)	ice storm	\$1,338,080
July 1998 (DR 1228)	windstorm	\$94,161
April 2001 (EM3167)	snow emergency	\$37,778
June 2011(DR 1995)	flooding	\$721,653
September 2011 (DR 4022)	Tropical Storm	\$14,850

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.

The City of Burlington was reimbursed at a rate of 75 percent by FEMA for the estimated repair costs.

Funds provided in response to these natural disasters were used as follows:

- April 1993: Fire and Police expenses to evacuate homes near mouth of Winooski River affected by high lake levels; Electrical Dept. expenses to inspect wiring systems in homes prior to authorizing occupancy; Public Works expenses to install granite and riprap at Round House Point shoreline to stabilized eroded lakeshore near wastewater plant.
- January 1998: Fire and Police expenses for debris removal and traffic control. The cost to BED for removing trees and limbs and replacing / repairing damaged power lines, poles, transformers, service to homes, switches, underground service and street lighting was \$741,908.
- July 1998: Expenses to various City Department to repair damages and clear debris resulting from high-intensity windstorm affecting North End of City.
- April 2001: Increased contractual costs for snow removal.
- June 2011: Expenses were incurred related to the following types of damages

G - Recreational or Other	Waterfront Park - Waterfront Park
E - Public Buildings	The Perkins Building in Burlington VT - Perkins Building Location
G - Recreational or Other	Leddy Park Beach - Leddy Beach
B - Protective Measures	City Of Burlington, City Wide Protection Methods. - City Hall Burlington
A - Debris Removal	Debris Removal, City of Burlington, North Cove Area. - City Hall, Burlington

G - Recreational or Other Burlington Bike Path South End Damage. - Burlington Bike Path South Begin Repairs
 B - Protective Measures The Moran Building Located on Penny Lane on the City of Burlington's Waterfront . - Moran Building Location
 E - Public Buildings Burlington Electric Department (BED) Facilities & Equipment. - BED Office 585 Pine Street
 G - Recreational or Other Burlington Perkins Pier Dock Systems. - Boathouse Waterfront Location
 G - Recreational or Other Burlington Bike Path South End Damage. - Burlington Bike Path South End Repairs
 E - Public Buildings Sailing Center Building Lake Street Burlington - Sailing Center Location
 G - Recreational or Other Burlington Walking/Bike Path Soldier Pile Retaining Wall. - Damage Area
 G - Recreational or Other North Beach & Camping Area, Burlington Parks & Recreation Department. - North Beach & Camping Area
 A - Debris Removal North Beach Park Debris Removal - Burlington City Hall

September 2011: Expenses were incurred related to the following types of damages

A - Debris Removal City Parks - McNeil Generating Station
 B - Protective Measures VT Department of Health (DOH) - Health Operations Center - Vermont State Department of Health
 A - Debris Removal City Parks - City Hall

See *Figure 3.1.* to see locations where repairs funded in part with FEMA Public Assistance took place for disasters between 2001 and 2015. As the map shows, damage has tended to be concentrated in upland areas. Note that some Debris Removal and Protective Measures locations are shown at the location of the municipal office. This indicates assistance was at various locations throughout the municipality, not that damages were incurred at the office.

3.3.2 Individual Assistance funds

As noted in Section 3.3 of the County Plan, due to privacy concerns, the individual homes or businesses which received Individual Assistance funds in connection with the two Federal disasters in 2011 (Spring flooding and Tropical Storm Irene in September) are not public information. However, the names of the streets of such homes or businesses from which claims are filed is available as are the funds provided. With regards to the City, individual claims were filed at residences or business located on the following streets and shown in *Figure 3.1.1.*

As the data shows, in some cases, on some streets, several properties were damaged in connection with the Spring 2011 flooding:

Table 3-4 City of Burlington, location of individual assistance claims, Spring 2011 flood

Damaged Address Street	Registrations	IHP Amount
ALDER LN	1	\$446.19
APPLETREE POINT RD	1	\$22,343.16
CAYUGA CT	1	\$113.37

CRESCENT BEACH DRIVE	2	\$5,978.22
CURTIS AVE	1	\$3,995.36
DALE ROAD	2	\$6,981.91
EDGEMOOR DR	1	\$354.21
HAYWARD ST	1	\$1,222.65
IRA LN	1	\$199.99
IVY LN	1	\$354.21
JAMES AVE	1	\$5,456.81
JANET CIR	1	\$221.68
KILLARNEY DR	1	\$8,762.70
LAKWOOD PKWY	1	\$2,127.19
LORI LN	1	\$240.84
MORRILL DR	1	\$680.82
N COVE RD	6	\$77,116.70
NORTH AVE	3	\$19,093.24
PINE ST	1	\$113.37
ROSEADE PKWY	1	\$435.01
S CHAMPLAIN ST	1	\$1,777.75
WILDWOOD DR	1	\$1,779.27

A few properties were also damaged as a result of Tropical Storm Irene in September 2011:

Table 3-5 City of Burlington, location of individual assistance claims, Tropical Storm Irene

Damaged Address Street	Registrations	IHP Amount
CONVERSE CT	1	\$879.00
CRESCENT BEACH DR	1	\$2,962.00
HEINEBERG RD	1	\$5,755.10
MATTHEW AVE	1	\$1,489.36
MOORE DR	1	\$2,830.00
S WILLARD ST	1	\$357.85

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 Estimate analysis, which was subsequently reviewed and revised by City officials at various meetings in 2016. 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 consists 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. The highest possible score is 80.

As explained in detail in Section 3.4 of the Multi-Jurisdictional Plan, for the 2011 Plan, the following Hazards were considered to occur or have the potential to occur with sufficient frequency and/or severity to be profiled for Risk Estimation in that Plan:

Natural Hazards:

- Drought
- Flooding
- Fluvial erosion
- High winds
- Landslide
- Lightning
- Multi-structure urban fire
- Radiological (natural)
- Wildfire
- Winter storm

Technological Hazards:

- Gas service loss
- Hazardous materials incident
- Major transportation incident
- Military ordnance incident
- Power loss
- Radiological incident
- Sewer service loss
- Telecommunications failure
- Water service loss

Societal Hazards:

- Crime
- Civil disturbance
- Economic recession
- Epidemic
- Key employer loss
- Terrorism

For the 2017 update, the CCRPC and its All-Hazards Mitigation Plan Update Committee made slight changes to this list by consolidating some hazards or delineating hazards with more specificity as follows:

Natural Hazards:

- Flooding
- Fluvial erosion
- Severe rainstorm
- Wildfire
- Severe winter storm
- Extreme Temperatures

Technological Hazards:

- Hazardous materials incident
- Major transportation incident
- Multi-structure fire
- Natural gas service loss
- Pollution
- Power loss
- Sewer service loss
- Telecommunications failure
- Water service loss
- Other fuel service loss
- Invasive Species

Societal Hazards:

- Crime
- Civil disturbance
- Economic recession
- Epidemic
- Key employer loss
- Terrorism

3.4.1 Natural Hazards

For the 2011 Hazard and Risk Estimation analysis for Burlington, the following natural hazards received the highest risk ratings out of a possible high score of 80:

- Severe Winter Storm (50)
- Multi-Structure Urban Fire (40)
- Fluvial Erosion (20)

For this 2016 update, the following natural hazards received the highest risk ratings out of a possible high score of 80: see table below

- Severe Winter Storm (50)
- Severe Rainstorm (40)
- Flooding (24)

Severe winter storms do not generally cause as much damage as some other hazards but they tend to affect the entire city. Ice storms are a special case of winter storm; they occur less frequently but can cause serious widespread damage to power lines and leave people without power or heat for an extended period of time. Severe rainstorms impact the City's stormwater systems and also raise the overall cost of stormwater management. Flooding has risen in significance given the extensive damages suffered in the prolonged and high flood waters in the Spring of 2011 that exceeded the "100-year" flood.

Table 3-6 Natural hazards risk estimation matrix, Burlington

		Sever Winter Storm	Severe Rainstorm	Flooding	Fluvial Erosion	Extreme Temperatures	Wildfire
Area Impacted							
Key:	0 = No developed area impacted						0
	1 = Less than 25% of developed area impacted		1	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				
Consequences							
<i>Health & Safety Consequences</i>							
Key:	0 = No health and safety impact						0
	1 = Few injuries or illnesses		1	1	1	1	
	2 = Few fatalities or illnesses	2					
	3 = Numerous Fatalities						
<i>Property Damage</i>							
Key:	0 = No property damage						
	1 = Few properties destroyed or damaged	1	1	1	1	1	1
	2 = Few destroyed but many damaged						
	2 = Few damaged and many destroyed						
	3 = Many properties destroyed and damaged						
<i>Environmental Damage</i>							
Key:	0 = Little or no environmental damage					0	
	1 = Resources damaged with short-term recovery	1	1	1	1		1
	2 = Resources damaged with long-term recovery						
	3 = Resources destroyed beyond recovery						
<i>Economic Disruption</i>							
Key:	0 = No economic impact						0
	1 = Low direct and/or indirect costs		1		1	1	
	2 = High direct and low indirect costs			2			
	2 = Low direct and high indirect costs	2					
	3 = High direct and high indirect costs						
Sum of Area & Consequences Scores		10	8	6	5	4	2
Probability of Occurrence							
Key:	1 = Unknown but rare occurrence						
	2 = Unknown but anticipate an occurrence						2
	3 = 100 years or less occurrence						
	4 = 25 years or less occurrence		4	4	4		
	5 = Once a year or more occurrence	5	5				
TOTAL RISK RATING							
	Total Risk Rating =	50	40	24	20	16	4
	Sum of Area & Consequences Scores						
	x Probability of Occurrence						

3.4.2 Technological Hazards

For the 2011 Hazard and Risk Estimation analysis for Burlington, the following technological hazards received the highest risk ratings out of a possible high score of 80:

- Telecommunications Failure (28)
- Water Service Loss (27)
- Major Transportation Incident (24)

For this 2016 update, the following hazards received the highest risk ratings out of a possible high score of 80: see table below

- Multi-Structure Fire (40)
- Water Pollution (30)
- Major Transportation Incident (24)

As much of Burlington is heavily developed and densely populated, the risk and potential damage of a major urban fire is higher than in much of the rest of the county. The high ranking for Water Pollution reflects the significant ongoing and projected financial impacts to City residents and businesses for the City to operate programs to both comply with its existing Municipal Separate Storm Sewer Systems permit, begin to implement multi-million dollar Flow Restoration Plans for the City's impaired streams and likely additional costs related to compliance with the Vermont Clean Water Act of 2015 and the recently-issued Lake Champlain Total Maximum Daily Load regulatory framework coming from EPA.

Transportation incident refers to accidents with a large number of vehicles, boat or rail incidents, or road infrastructure failure. Accidents involving few vehicles are a common occurrence, and tend not to rise to the level of hazard rated here. The presence of a freight rail service in the City as well as the Lake Champlain ferries terminal as well as tourist excursion operations raise the potential for either a fuel spill in the case of the former or a mass casualty incident in the latter.

It is worth noting that Power loss, rated as a significant hazard in much of the county, is less of a problem in Burlington than elsewhere. Burlington is unique in having its own electric department, and the city has a much smaller geographical area than most other municipalities. Also, 45% of the Burlington electric system is located underground, reducing the frequency of storm-related outages. A large part of the system can be back fed quickly, and the distribution system is directly connected to a . Due to redundant systems and service loops, officials at the Burlington Electric Department estimate that even in a catastrophic event such as the 1998 ice storm, the entire city would not lose power for a significant amount of time.

1. There is a smaller geographical area to cover (16 square miles).
2. 45% of their system is underground, thus reducing the frequency of storm related outages.
3. A large part of the system can be back fed quickly via the SCADA system.
4. The distribution system is directly connected to a 20 MW GT that is black start capable.
5. A major event such as the Ice Storm of 1998 is to be considered a "100 year occurrence." compared to more common power outages such as animal contacts, high winds, failed equipment, etc.

Table 3-7 Technological hazards risk estimation matrix, Burlington

	Multi-Structure Fire	Water Pollution	Major Transportation Incident	Hazardous Materials Incident	Telecommunication Failure	Water Service Loss	Sewer Service Loss	Power Loss	Invasive Species	Other Fuel Service Loss	Gas Service Loss
Area Impacted											
Key: 0 = No developed area impacted									0		
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											
4 = Over 75% of developed area impacted											
Consequences											
Health & Safety Consequences											
Key: 0 = No health and safety impact						0	0	0	0		
1 = Few injuries or illnesses		1		1	1					1	1
2 = Few fatalities or illnesses	2		2								
3 = Numerous Fatalities											
Property Damage											
Key: 0 = No property damage		0			0				0		
1 = Few properties destroyed or damaged			1	1		1	1	1		1	1
2 = Few destroyed but many damaged											
3 = Few damaged and many destroyed											
4 = Many properties destroyed and damaged	3										
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										0	
1 = Low direct and/or indirect costs				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	10	6	8	6	4	3	3	3	3	3	4
Probability of Occurrence											
Key: 1 = Unknown but rare occurrence											2
2 = Unknown but anticipate an occurrence											
3 = 100 years or less occurrence			3	3						3	
4 = 25 years or less occurrence	4				4						
5 = Once a year or more occurrence		5				5	5	5	5		
TOTAL RISK RATING											
Total Risk Rating =	40	30	24	18	16	15	15	15	15	9	8
Sum of Area & Consequences Scores											
x Probability of Occurrence											

3.4.3 Societal Hazards

For the 2011 Hazard and Risk Estimation analysis for Burlington, the following societal hazards received the highest risk ratings out of a possible high score of 80:

- Epidemic (27)
- Economic Recession (24)
- Terrorism (22)

For this 2016 update, the following hazards received the highest risk ratings out of a possible high score of 80: see table below:

- Epidemic (24)
- Civil Disturbance (20)

- Economic Recession (16)

The likelihood of an epidemic is difficult to gauge, but its consequences could be severe.

Relative to other municipalities in the County, Burlington is more vulnerable to societal hazards such as civil disturbances. This is due to the presence of major entertainment venues that draw large crowds as well as the fact that it is often the location for political rallies and protests.

Economic recessions can affect the City as well but the effects are less severe due to the varied types of businesses and employers in the city.

Table 3-8 Societal hazards risk estimation matrix, Burlington

		Epidemic	Civil Disturbance	Economic Recession	Crime	Key Employer Loss	Terrorism
Area Impacted							
Key:	0 = No developed area impacted				1		1
	1 = Less than 25% of developed area impacted		2	2		2	
	2 = Less than 50% of developed area impacted						
	3 = Less than 75% of developed area impacted	3					
	4 = Over 75% of developed area impacted						
Consequences							
<i>Health & Safety Consequences</i>							
Key:	0 = No health and safety impact			0		0	
	1 = Few injuries or illnesses		1		1		
	2 = Few fatalities or illnesses	2					2
	3 = Numerous Fatalities						
<i>Property Damage</i>							
Key:	0 = No property damage	0		0		0	
	1 = Few properties destroyed or damaged		1		1		1
	2 = Few destroyed but many damaged						
	3 = Few damaged and many destroyed						
	4 = Many properties destroyed and damaged						
<i>Environmental Damage</i>							
Key:	0 = Little or no environmental damage	0	0	0	0	0	
	1 = Resources damaged with short-term recovery						1
	2 = Resources damaged with long-term recovery						
	3 = Resources destroyed beyond recovery						
<i>Economic Disruption</i>							
Key:	0 = No economic impact						
	1 = Low direct and/or indirect costs		1		1		
	2 = High direct and low indirect costs						
	2 = Low direct and high indirect costs			2		2	2
	3 = High direct and high indirect costs	3					
Sum of Area & Consequences Scores		8	5	4	4	4	7
Probability of Occurrence							
Key:	1 = Unknown but rare occurrence						
	2 = Unknown but anticipate an occurrence						2
	3 = 100 years or less occurrence	3					
	4 = 25 years or less occurrence		4	4	4	4	
	5 = Once a year or more occurrence						
TOTAL RISK RATING							
	Total Risk Rating =	24	20	16	16	16	14
	Sum of Area & Consequences Scores						
	x Probability of Occurrence						

3.4.4 Hazard Summary

According to the risk estimation analysis, the three highest rated hazards by type for Burlington are:

Natural Hazards

- Severe Winter Storm (50)
- Severe Rainstorm (40)
- Flooding (24)

Technological Hazards

- Multi-Structure Fire (40)
- Water Pollution (30)
- Major Transportation Incident (24)

Societal Hazards

- Epidemic (24)
- Civil Disturbance (20)
- Economic Recession (16)

Burlington is similar to other municipalities in its risk for severe winter storms. Since Burlington has more developed urban areas than other municipalities, its risk for major fire is correspondingly larger. Water service is critical for fire fighting, as well as a basic service. Note that the the higher rated natural hazards – Severe Winter Storm and Severe Rainstorms can also be the cause of technological hazards such as Water Pollution and Telecommunications Failure.

SECTION 4: VULNERABILITY ASSESSMENT

As discussed in Section 4 of the County Plan, typical vulnerabilities from the County’s common hazards consist primarily of:

- damage to public infrastructure especially roads and culverts;
- temporary closures of roads and bridges including from debris;
- temporary loss of power and/or telecommunications, and
- temporary isolation of vulnerable individuals such as the elderly or those in poverty.

More specifically, these vulnerabilities typically occur in association with the Profiled Natural Hazards as follows:

Table 4-1 City of Burlington: Natural Hazards and typical vulnerabilities

Hazard	Typical vulnerabilities	Occasional additional vulnerability
Severe Winter Storm	-temporary closures of roads and bridges including from debris; -temporary loss of power and/or telecommunications, and -temporary isolation of vulnerable individuals	-budget impacts from debris cleanup
Flooding	-temporary closures of roads and bridges including from debris; -temporary loss of power and/or telecommunications, and -temporary isolation of vulnerable individuals -damage to public infrastructure	-budget impacts from road/bridge closures and repairs to public infrastructure -damages to individuals’ properties and businesses
Fluvial Erosion	-temporary closures of roads and bridges including from debris; -temporary loss of power and/or telecommunications, and -temporary isolation of vulnerable individuals -damage to public infrastructure	-budget impacts from road/bridge closures and repairs to public infrastructure -damages to individuals’ properties and businesses
Severe Rainstorm	-temporary closures of roads and bridges including from debris; -temporary loss of power and/or telecommunications, and -temporary isolation of vulnerable individuals -damage to public infrastructure - exacerbation of failing collection system infrastructure, causing sink	-budget impacts from road/bridge closures and repairs to public infrastructure -damages to individuals’ properties and businesses

	holes or outfall damage	
Extreme Temperatures	-damage to public infrastructure -loss of water service	-budget impacts due to needed repairs
Wildfire	-damage to private property	

Relative to the County as a whole the City of Burlington has a higher vulnerability to:

- Severe Rainstorms due to its extensive stormwater management system
- Flooding due to its western boundary with Lake Champlain and the transit of the Winooski River that forms its northern boundary.

Vulnerabilities with regard to Technological Hazards are harder to project as these incidents occur with less frequency and less predictability.

Table 4-2 City of Burlington: Technological Hazards and typical vulnerabilities

Hazard	Typical vulnerabilities	Occasional additional vulnerability
Major Transportation Incident	-temporary closures of transportation infrastructure -injuries, deaths	-if major event, potential long term closure of infrastructure.
Power Loss	-temporary loss of electrical service -temporary impacts to vulnerable individuals -damage to public infrastructure	-if extended event, damage to perishable goods or business income. -if extensive loss, potential budget impacts to service providers.
Hazardous Materials Incident	-temporary closures of roads and bridges during cleanup.	-if large event, potential high cleanup costs. -injuries to persons
Water Service Loss	-temporary loss of service -temporary impacts to vulnerable individuals	-if extensive loss, potential budget impacts to service providers.
Gas Service Loss	-temporary loss of service -temporary impacts to vulnerable individuals	-if extensive loss, potential budget impacts to service providers.
Telecommunications Failure	-temporary loss of service -temporary impacts to vulnerable individuals	-if extensive loss, potential budget impacts to service

		providers.
Other Fuel Service Loss	-temporary loss of service -temporary impacts to vulnerable individuals	-if extensive loss, potential budget impacts to service providers.
Sewer Service Loss	-temporary loss of service -temporary impacts to vulnerable individuals	-if extensive loss, potential budget impacts to service providers.
Water Pollution	-ongoing budgetary impacts due to permit requirements.	-if repeat events, impacts to tourism-based businesses
Invasive Species	-small but ongoing cost to monitoring level of occurrence	-unknown at this point.

Relative to the County as a whole the City of Burlington has a slightly higher vulnerability to:

- Major Transportation Incident due to the transit rail through the City
- Hazardous Materials Incident due to the storage of numerous chemicals at the University of Vermont
- Water Pollution due to the presence of two “impaired” streams

With regard to Societal Hazards, vulnerabilities are typically more dispersed among individuals and societal sectors compared to the natural environment and to technology which is fixed.

Table 4-3 City of Burlington: Societal Hazards and typical vulnerabilities

Hazard	Typical vulnerabilities	Occasional additional vulnerability
Crime	-increased demands on police services and social services	-injuries -deaths
Epidemic	-temporary closures of schools, businesses, places of assembly -increased demand on medical services	-if an epidemic is widespread and long-lasting, impact could be severe
Key Employer Loss	-loss of economic activity -loss of portion of tax base -increased demands on social services	-effects increased if employer is of significant size
Economic Recession	-loss of economic activity -increased demands on social services -some loss of tax revenue	-effects increased if event is of extended duration

Civil Disturbance	-injuries to persons -damage to public and private property	-budget impacts to police services depending upon severity of event -deaths
Terrorism	-injuries to persons -damage to public and private property	-budget impacts to police services depending upon severity of event -deaths

Relative to the County as a whole the City of Burlington has a slightly higher vulnerability to:

- Epidemic due to its relatively higher population density
- Civil Disturbance due to the presence of the University of Vermont and the fact that the City often hosts political speeches and rallies and marches related to political issues.

With regard to the vulnerability of critical facilities, infrastructure and vulnerable populations, quantitative and locational data for the Town are available as follows.

4.1 Critical Facilities

The Center for Disaster Management and Humanitarian Assistance defines critical facilities as: “Those structures critical to the operation of a community and the key installations of the economic sector.” *Figure 1.4* shows the geographic distribution of some critical facilities and utilities. The table below identifies critical facilities in Burlington, excluding critical facilities designated as hazardous materials and petroleum storage sites, which are shown in Section 3.2.5. This list includes all critical facilities, not only the facilities located in designated hazard areas.

Critical facilities located on the University of Vermont or Champlain College campuses are listed in the College Appendices to this annex.

Table 4-4 Critical facilities in the City of Burlington

Facility Type	Number of Facilities
Food Production Center	1
Veterinary Hospital / Clinic	2
Education Facility	13
College / University	4
EMS Station	4
Hospital	1
Fire Station	5
Emergency Shelters	8
Emergency Operations Center	1
Energy	5

Government and Military	2
Nursing Homes	2
Information and Communications	3
Police Station	1
Mail and Shipping	4
Public Attractions and Landmark Buildings	3
Transportation Facilities	3
Water Supply and Treatment	5

Source: VCGI

None of these facilities are located in River Corridors or River Corridor Protection Areas. Some public attractions such as Waterfront Park have mapped Flood Hazard Areas and the offices of the private ferry company, Lake Champlain Transportation Company is located within the 100-year floodplain.

4.2 Infrastructure

4.2.1 Town Highways

The following is a statistical overview of roads in the City of Burlington. These tables show the range of road types within the town, from Interstate 89 to unimproved unpaved roads. The different road types have different hazard vulnerabilities. Unpaved roads are more vulnerable to being washed out in a flood or heavy storm, while traffic incidents are more likely to occur on large, arterial roads.

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 City of Burlington.

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. However, pursuant to Vermont State Statutes, municipalities are not responsible for maintenance of Class 4 town highways. These are generally closed during the winter and minimally maintained and almost exclusively dirt.

Table 4-5 Town highway mileage by class, City of Burlington

Class 1	Class 2	Class 3	Class 4	State Hwy	Fed Hwy	Interstate	Total 1, 2, 3, State Hwy
7.131	20.097	63.470	0.410		0.017		90.698

Source: data derived from VTrans TransRDS GIS data – surface class and arc length

Table 4-6 Town highway mileage by surface type, City of Burlington

Paved	Gravel	Soil or Graded	Unimproved	Impassable	Unknown	Total
95.003	0.13	0	0	0.41	0.108	95.651

Total Known	Total Unpaved	% Paved	% Unpaved
95.543	0.54	99.43%	0.57%

Source: data derived from VTrans TransRDS GIS data – surface class and AOTmiles

4.2.2 Bridges, Culverts, and Dams

There are a variety of bridges, culverts and dams located in the municipality.

As noted in Section 4 of the County Plan, a large portion of the County’s stream have had detailed Phase II Stream Geomorphic Assessments conducted. With regards to Burlington studies identify specific stream reaches where fluvial erosion is a concern as well as where infrastructure, primarily culverts, as noted in the table below (and illustrated in Figure 2.1) is at risk

Table 4-7 Culverts with a geomorphic compatibility rating of “Mostly Incompatible” or “Incompatible”

Bankfull Width	Compatibility Score	Town	Location	GisRoadName	StreamName
39.22	4	Burlington	Center of road latitude = 44.45718, longitude - - 73.20767	PROSPECT PKWY	Englesby Brook
50.00	5	Burlington		CATAMOUNT DR	Tributary to Centennial Brook
44.44	6	Burlington	Downstream end of	PROSPECT PKWY	Englesby Brook

30.77	6	Burlington	Burlington Country Club By House #25	CRESCENT RD	Unnamed
31.25	7	Burlington	Cart path in Burlington Country Club - Upstream of Prospect Pkwy.	Cart Path	Englesby Brook
33.75	7	Burlington	Burlington Country Club - Cart path below UVM Redstone Campus	Carth Path	Englesby Brook
30.77	8	Burlington	Jct w/ VT-7	PROSPECT PKWY	Unnamed
33.33	8	Burlington	By House #757	S PROSPECT ST	Unnamed
36.36	10	Burlington		CRESCENT RD	Englesby Brook
44.12	10	Burlington	"Inlet end (44.45696, - 73.20805)		
Outlet end (44.45676, - 73.21001)"	SHELBURNE RD	Englesby			

Mostly incompatible $5 < GC < 10$
% Bankfull Width + Approach Angle scores < 2

Fully incompatible $0 < GC < 5$
% Bankfull Width + Approach Angle scores < 2 AND Sediment
Continuity + Erosion and Armoring scores < 2

Structure mostly incompatible with current form and process, with a moderate to high risk of structure failure. Re-design and replacement planning should be initiated to improve geomorphic compatibility.
Structure fully incompatible with channel and high risk of failure. Re-design and replacement should be performed as soon as possible to improve geomorphic compatibility.

Information on dams is available from two sources: a database of dams regulated by the Vermont Department of Environmental Conservation and the National Dam Inventory maintain by the U.S. Army Corps of Engineers. Information from the DEC is as follows:

Table 4-8 Dams under the jurisdiction of VT Department of Environmental Conservation

DamName	StateID	Location (Town)	Hazard Class	Owner
Howe Farm WMA	38.03	Burlington	Low	State of Vermont - DFW

Burlington Electric WMA	38.04	Burlington	Low	State of Vermont - DFW
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Dams under the jurisdiction of VT Department of Environmental Conservation (DEC) pursuant to 10 VSA Chapter 43 §1081 and subject to 10 VSA Chapter 43 §1082 Authorization (i.e. dams capable of impounding more than 500,000 cubic feet of water or other liquid.

*Hazard Class is defined as follows: High Hazard – High probability of loss of life and damage to infrastructure; Significant Hazard – Significant probability of loss of life and damage to infrastructure
Low Hazard – Low probability of loss of life and damage to infrastructure*

The National Dam Inventory identifies three dams located in Burlington

Table 4-9 Dams located in the City of Burlington

Name	Owner	River	Description	Maximum Storage (acre/feet)	Hazard Potential
Winooski One	Burlington Electric Department	Winooski River	Concrete gravity dam built in 1876, originally for Mill Power and now used for hydroelectricity generation.	0	Significant-no probable loss of human life but can cause significant economic or environmental damage and disrupt lifeline concerns.
Chace Mills No. 21	No information provided.	Winooski River	No information provided.	0	No information provided.
No information provided	No information provided.	Winooski River	Unknown type of dam built in 1985 for wildlife purposes. Current purpose unknown.	500	Low-losses limited to owner's property.

Source: National Dam Inventory

4.2.3 Water, Wastewater and Natural Gas Service Areas

Nearly all residences and businesses are connected to the City of Burlington water and sewer service. A handful of homes in isolated areas may still use individual wells and septic systems. Vermont Natural Gas provides service throughout most of the city (*cf. Figure 1.4*).

4.2.4 Electric Power Transmission Lines and Telecommunications Land Lines

High tension power lines transmission lines enter the City from three locations (*cf. Figure 1.4*): from Colchester across the Intervale wetlands to the McNeil generating station; from Winooski and South Burlington to a power substation northeast of the UVM campus, and from South Burlington to a substation near Queen City Park Road.

4.3 Estimating Potential Losses in Designated Hazard Areas.

A simple GIS intersection of esite data with the FIRM floodplain data indicates the following with regards to structures located in mapped flood hazard areas:

- There are a total of 12,364 structures within the municipality.
- There are twenty-one residential structures and seven commercial/industrial structures located within the 100-year floodplain
- Based on 2015 median grand list value, the estimated potential losses due to a major flood event inundating the floodplain and destroying all of these structures is \$2,453,955.
- Note that this estimate only takes structures into account, however. It does not account for loss of building contents or business losses.

A simple GIS intersection of esite data with the 2016 River Corridor Protection Area (RCPA) data indicates the following with regards to structures vulnerable to Fluvial Erosion.

- There are a total of 12,364 structures within the municipality.
- There are twenty-six residential structures and three commercial/industrial structures located in the RCPA. Based on 2015 median grand list value, the estimated potential losses due to a major stream erosion event in the area destroying all of these structures is \$4,725,846.
- Note that this estimate only takes structures into account, however. It does not account for personal property or business losses.

At this time, a more detailed analysis of potential losses to infrastructure, and agricultural lands cannot be made. Such an analysis would require individual site visits and analysis conducted by both river geomorphologists and structural engineers which is beyond the capacity of the CCRPC due to funding limitations.

4.4 Vulnerable Populations

Demographic information on the relative percentages of vulnerable populations is as follows:

Table 4-10 Vulnerable populations, Burlington

	Burlington	Chittenden County	Vermont	National
Percent Minority (non-white)	12.7 %	7.7%	4.8%	26.7%
Children <18 in poverty	22.1 %	11.1%	14.8%	21.6%
Families w/children in poverty	22.5 %	10.5%	13.4%	17.8%
Families w/ female householder, no husband present w/children in poverty	40.4 %	37.0%	37.4%	40%
Population, age 65+ in poverty	9.5 %	6.5%	7.5%	13.4%

Unlike other municipalities in the County, Burlington has a high enough population that several census tracts are delineated. Census tracts 3 and 4 in the City, located to the north and west of downtown have higher percentages of poverty and minorities and other indices than the City as a whole. However, these census tracts are not located in any designated or mapped or likely hazard area. Additionally, with regards to the highest-ranked Natural Hazards and Technological Hazards discussed above, these vulnerable populations are not considered to be significantly more at risk than the average resident in Burlington. Populations in these census tracts could be considered to be more vulnerable to Societal Hazards however they are numerous local, state and federal programs aimed to address these vulnerable populations that including a dedicated action task within this Mitigation Plan is unnecessary at this time.

Additionally, a useful analysis known as a Social Vulnerability Analysis has been prepared by the Vermont Department of Health. Data for the Town is shown in *Figure 4.1*.

The Social Vulnerability Index (SVI) draws together 16 different measures of vulnerability in three different themes: socioeconomic, demographic, and housing/transportation. The 16 individual measures include poverty, unemployment, per capita income, educational attainment, health insurance, children/elderly, single parent households, disability, minority, limited English, location of apartment buildings, mobile homes, crowding, no vehicle access, and population living in group quarters. The measures are combined to create relative vulnerability index. For every vulnerability measure, census tracts above the 90th percentile, or the most vulnerable 10%, are assigned a flag. The vulnerability index is created by counting the total number of flags in each census tract. It is important to remember that this Social Vulnerability Index is just a first step in screening for populations that may be more or less vulnerable to a variety of hazard. Depending on the situation, different measures could be more or less important and should be looked at more closely. These data are NOT saying that one census tract is more vulnerable than another. Rather it is saying that there is a higher concentration of various vulnerable populations living within a tract and seeks to identify the conditions that make a population vulnerable.

4.5 Land Use and Development Trends Related to Mitigation

As noted at the introduction of this appendix, Burlington's land use is primarily residential. Significant portions of the city are conserved lands, however. An analysis of GIS data shows the following percentages for land use and the percentages of land allocated to each zoning district.

Table 4-8 Structures compared to zoning, City of Burlington

Burlington Structures	Esite Count	Percent	Burlington Zoning	Area (mi ²)	Percent
Residential	10524	85.12%	Battery Street Transition	0.012656	0.11%
Commercial	742	6.00%	Downtown	0.115997	1.05%
Industrial	29	0.23%	Downtown Transition	0.079693	0.72%
Institutional / Infrastructure	203	1.64%	Downtown Waterfront	0.031046	0.28%
Mass Assembly	34	0.27%	Downtown Waterfront - Public Trust	0.059197	0.54%
Leisure / Recreation	0	0.00%	Enterprise - Agricultural Processing and Energy	0.103778	0.94%
Natural Resources	0	0.00%	Enterprise - Light Manufacturing	0.443776	4.02%
Total:	11532	93.27%	Institutional	0.767931	6.96%
			Neighborhood Activity Center	0.093544	0.85%
			Neighborhood Activity Center - Riverside	0.097261	0.88%
			Neighborhood Mixed Use	0.080654	0.73%
			RCO - Agriculture	1.145904	10.39%
			RCO - Conservation	1.690876	15.33%
			RCO - Recreation/Greenspace	1.633432	14.81%
			Residential - Low Density	2.860854	25.94%
			Residential - Medium Density	0.533147	4.83%
			Residential - High Density	0.18419	1.67%
			Urban Reserve	0.083347	0.76%
			Waterfront Residential - Low Density	0.934966	8.48%
			Waterfront Residential - Medium Density	0.077829	0.71%
Total Esites:	12364		Total Area:	11.03008	

Source: 2015 e911 Data and Burlington Zoning Regulations, Note: The structure categories relate to the Land Based Classification System (LBCS) used in the 2011 AHMP not E-911 site types. E-911 site types were assigned to each LBCS category to create synergy between the 2011 AHMP and 2017 AHMP.

4.5.1 Conserved or Undevelopable Parcels

While Burlington has the largest population of any municipality in Vermont, topography and fluvial geomorphology have combined to prevent development of some very large areas in the city. Low-lying floodplain is prevalent along the west bank of the Winooski River as it meanders towards Lake Champlain. Steep bluffs prevent development in this riparian area as well as in other discrete locations. Other portions of the City have been preserved for Recreation, Conservation and Open Space. Formal statistics on conserved lands are as follows:

Table 4-9 City of Burlington, acres of conserved land

Acres of Public Land	Percent Public	Acres of Conserved Land	Percent Conserved	Total Public & Conserved	Percent Conserved Land
942.85	14%	278.34	4%	1,221.33	18%

4.4.2 Recent and Future Development

The City's current development pattern is expected to continue. New residential construction will likely occur on in-fill lots and via multi-unit apartment construction. Population growth is

difficult to predict, as an aging demographic and rising housing costs work against growth, while cultural and economic opportunities attract potential residents.

As the municipality participates in the NFIP, zoning bylaws heavily regulate development in designated flood hazard areas. However, Burlington does allow new construction in the floodplain as a “conditional use.” However, little to no new development is likely to take place in flood hazard areas especially given recent experience with the Spring 2011 lakeshore flooding. Additionally, water quality setbacks in the City’s zoning bylaws also restrict development close to other waterways. As a result, little to no development is likely to take place in flood hazard areas or river corridor protection areas. These zoning requirements effectively mitigate damages from Flood and Fluvial Erosion hazards to future structures.

This projection is affirmed by recent statistics on actual construction. As shown in *Figure 4.2*, from 2011 through 2014, the municipality has seen 282 new housing units (in single family and multi-family structures) and five new commercial/industrial buildings constructed. **None** of these newly constructed housing units or new buildings are located in the SFHA, River Corridor or River Corridor Protection Area.

As best can be ascertained based upon data maintained by the Chittenden County RPC and the City of Burlington, since the adoption of the last municipal AHMP in 2011, development activity in the Town has not significantly increased vulnerability. Additionally, through at least 2021, there is no known or projected development of new buildings or infrastructure anticipated to be constructed in areas known to be particularly vulnerable to Natural Hazards.

SECTION 5: MITIGATION STRATEGY

The City considered a range of mitigation actions across the categories of Planning and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, and Education and Awareness Programs. As is demonstrated in the discussion that follows the City carries out numerous efforts as part of its day-to-day operations that fit within these categories and address and serve to mitigate the impacts of various hazards. The section concludes within an analysis of which vulnerabilities need additional attention and therefore stipulates discrete tasks to be carried out by the City during the 5-year period this Plan is in effect to address these vulnerabilities.

5.1 Existing 2014 City of Burlington Master Plan policies that Support Hazard Mitigation

The following selected excerpts illustrate how mitigation planning and activities are formally promoted and supported through the City's Master Plan

[Land use policies]

- *Protect natural areas from harmful and incompatible development, and maintain the integrity of natural systems.*
- *Encourage the adaptive reuse and historically sensitive redevelopment of underutilized sites and buildings.*
- *Target new and higher density development into the Downtown, Downtown Waterfront, Enterprise District, Institutional Core Campuses, and the Neighborhood Activity Centers.*

[Natural Environment policies]

- *Work toward a sustainable relationship with the natural environment.*
- *Protect its natural resources from degradation, including: air, water, soils, plant and animal life, agricultural lands, forests, geologic features, and scenic areas.*
- *Maintain or increase the existing ratio of publicly owned or permanently protected natural areas to developed land.*
- *Protect and preserve natural areas and open spaces of local, regional, and statewide significance for the benefit of future generations.*
- *Protect, maintain, and enhance the City's urban forest, including both large patches of woods and wooded corridors/treebelts that provide places of refuge and travel corridors for wildlife and people.*
- *Protect the shorelines and waters of Lake Champlain, the Winooski River, and other water sources from damage and degradation.*
- *Maintain and improve the integrity of natural and recreational systems within the City.*
- *Guide a higher proportion of future development into the city center and neighborhood activity centers.*

- *Ensure long-term stewardship and appropriate public access to natural areas and open space, including improved opportunities for pedestrian access and interaction throughout the City.*

[Community Facilities and Services policies]

- *Make the most effective and efficient use of existing services, buildings, utilities, and facilities before adding new capacity, or initiating new construction.*
- *Coordinate land use and development with the availability and capacity of public services, facilities, and utilities, in order to ensure a high level of service.*
- *Ensure that existing public property, buildings, and capital facilities receive regular maintenance, and any upgrade, re-placement, or expansion of these facilities be based on approved standards.*
- *Place appropriate fiscal burden of facilities and utilities on the users.*
- *Protect its natural environment - including Lake Champlain and the Winooski River - from damage and degradation caused by public infrastructure and utilities.*

[Energy Plan policies]

- *Optimize overall energy efficiency, reduce energy requirements, and minimize the need for new energy resources on a citywide basis.*
- *Continue to aggressively pursue the transition to renewable sources, cogeneration, and district heating.*
- *Educate its citizens regarding energy efficiency, the benefits of public utility ownership, renewable electric generation, and conservation to ensure that citywide resource allocation decisions in years to come will reflect the wishes of an informed citizenry.*
- *Make tangible efforts to reduce greenhouse gas emissions through the implementation of the Climate Action Plan.*

[Housing Plan policies]

- *Support the development of additional housing opportunities within the city, with concentrations of higher-density housing within neighborhood activity centers, the downtown and institutional core campuses.*
- *Support and implement programs to preserve and upgrade the existing housing stock to ensure that residents do not live in substandard conditions.*
- *Enforce ordinances, such as inclusionary zoning and minimum housing, which promote housing opportunities, safety, and affordability.*

5.2 Existing City of Burlington Actions that support Hazard Mitigation

The following table illustrates how mitigation activities and plans are carried out by various municipal departments, and whether such capabilities are adequate to address hazard vulnerabilities and whether the department, if needed, has the ability to improve policies and programs and programs to unmitigated vulnerabilities.

Table 5-1 Existing municipal capabilities addressing hazard mitigation, City of Burlington

Types of Programs & Policies	Description / Details	1) Adequacy of municipal capabilities to address hazards 2) and ability to expand upon or improve policies & programs
Public Works	Burlington Department of Public Works handles roads, water, sewer and stormwater	1) Generally adequate with regard to mitigating the impacts of common hazards. 2) However, the Public Works Department, through the strategies noted below is taking on a stronger role to mitigate against damages caused by Severe Rainstorm, Fluvial Erosion and Water Pollution.
Public Works Personnel	22 FTE right-of-way field personnel handle roads, water and sewer 1 FTE Stormwater Program Manager; 1 FTE GIS/SW Technicians; 1 FTE Water Resources Engineer	1) Generally adequate with regard to mitigating the impacts of common hazards. 2) However, the Public Works Department, through the strategies noted below is taking on a stronger role to mitigate against damages caused by Severe Rainstorm, Fluvial Erosion and Water Pollution.
Planning and Zoning personnel	3 FTE Planners, 5 FTE Zoning administrators	1) Generally adequate with regard to mitigating the impacts of common hazards.. 2) No need to expand upon or improve policies & programs with regard to hazards under its purview.
Electric Department	Burlington Electric Department	1) Generally adequate with regard to mitigating the impacts of common hazards.
Electric Department Personnel	25 FTE field personnel	2) No need to expand upon or improve policies & programs with regard to hazards under its purview.

Residential Building Code / Inspection	Yes, BOCA/NFPA 4 FTE Building Inspectors Plus Burlington Fire Department inspection The City of Burlington Department of Public Works has been delegated the authority to inspect all construction within the City's Jurisdiction, with assistance from the Fire Department to inspection Fire Alarm and Suppressions Systems as a sub-trade.	1) Generally adequate with regard to mitigating the impacts of common hazards.. New construction must obtain a zoning permit. 2) No need to expand upon or improve policies & programs with regard to hazards under its purview. 3) All class of buildings under the inspection authority of the City of Burlington are permitted and inspected to meet or exceed the requirements established within the State of Vermont's current " Fire and Safety Building Code". Though there are numerous structures built originally in the late 1930's there is significant continued reinvestment in the housing stock of the City and as projects are advanced they are being built to a standard that protects the occupants from the structure and limits risk of fire with modern fire rated materials, massing requirements, alarm and fire suppression systems.
Town / Municipal Comprehensive Plan	2014	1) As noted at the start of Section 5, several elements of the municipal Comprehensive Plan promote Hazard Mitigation. An extensive re-write and update of the Plan was recently completed in 2014. More detailed plans for each sub-area of the City are consistently being developed on an annual basis 2) The City will be reference this 2017 AHMP where appropriate.
Zoning Bylaws and Subdivision Regulations	2014	1) Generally adequate with regard to mitigating the impacts of common hazards. 2) No need, at this time, to expand upon or improve policies & programs with regard to hazards under its purview.
Hazard Specific Zoning (slope, wetland, conservation, industrial, etc.)	Water, Agricultural / Open Land, Industrial	1) Generally adequate with regard to mitigating the impacts of common hazards.. 2) No need at this time, to expand upon current flood hazard bylaws.
Participation in	Yes / Yes	1) New DFIRMS adopted in 2011.

National Flood Insurance Program (NFIP) and Floodplain/Flood Hazard Area Ordinance		The City's Zoning Administrator and the City's Development Review Board (DRB) monitor compliance with the National Flood Insurance Program. The DRB reviews and adjudicates applications for development within the floodplain. 2) No need at this time to expand upon NFIP participation
Open Space Plans; Conservation Funds	Yes to both. Conservation Fund established in 2004, has funded significant land conservation. Rate is \$0.02 per \$1,000 assessed.	1) Yes 2) Municipality considers regulatory programs and voluntary conservation efforts as adequate to address any hazard mitigation concerns. However, various areas may be conserved in the future by the use of the Fund but as of now, specific parcels conducive to hazard mitigation have not yet been targeted.

The following table illustrates how Emergency Preparedness, Response & Recovery actions are carried out in the City.

Table 5-2 Existing municipal emergency services & plans, City of Burlington

Type of Existing Protection	Description /Details/Comments
Emergency Services	Emergency response personnel may have overlapping responsibilities with other town response organizations.
Police Services	Burlington Police Department
Police Department Personnel	~100 paid FTE officers, ~40 paid FTE admin/dispatch
Fire Services	Burlington Fire Department
Fire Department Personnel	~79 FTE firefighters (cross-trained as EMS) ~1 FTE admin
Fire Department Mutual Aid Agreements	South Burlington, Mallets Bay, VT Air Guard, State of Vermont, Colchester Tech Rescue
EMS Services	Burlington Fire Department, EMS Division
EMS Personnel	~79 FTE personnel (cross-trained as firefighters)
EMS Mutual Aid Agreements	various through VT EMS District #3
Emergency Plans	
Local Emergency Operations Plan (LEOP)	2017 Overall City EOP includes a Continuity of Government/Operations Plan. Burlington has also developed a pandemic flu response plan to implement

	in case of an epidemic.
School Emergency/Evacuation Plan(s)	Yes; Contact information for schools updated annually as part of re-adoption of LEOP.
Municipal HAZMAT Plan	Annex to the 2009 municipal EOP
Shelter, Primary	Due to its large population, Burlington has numerous emergency shelters, none of which is designated as the “primary” shelter.
Replacement Power, backup generator	Some shelters have backup power generators, but others do not.

5.3 City of Burlington All-Hazards Mitigation Goals

The following goals were listed in the 2005 and 2011 versions of this Plan and re-approved by City of Burlington officials during the development of this 2017 annex.

- 1) Reduce at a minimum, and prevent to the maximum extent possible, the loss of life and injury resulting from all hazards.
- 2) Mitigate financial losses and environmental degradation incurred by municipal, educational, residential, commercial, industrial and agricultural establishments due to various hazards.
- 3) Maintain and increase awareness amongst the town’s residents and businesses of the damages caused by previous and potential future hazard events as identified specifically in this Local All-Hazards Mitigation Plan and as identified generally in the *Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan*.
- 4) Recognize 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.
- 5) Maintain existing municipal plans, programs, regulations, bylaws and ordinances that directly or indirectly support hazard mitigation.
- 6) 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/town’s bylaws, regulations and ordinances, including, but not limited to, zoning bylaws and subdivision regulations and building codes.
- 7) Consider formal incorporation of this Local All-Hazards Mitigation Plan, particularly the recommended mitigation actions, into the municipal/town operating and capital plans & programs especially, but not limited to, as they relate to public facilities and infrastructure, utilities, highways and emergency services.

With regard to a more formal process by which the City will integrate the requirements of this mitigation plan into the City’s Comprehensive Plan, as required by Vermont law, municipalities must update their Comprehensive Plans every eight years. During any update process undertaken while this Plan document is in effect, the City will review the recommended Actions detailed

below to see if formal incorporation within the Comprehensive Plan (or any Plan implementation tasks) is warranted as is updated.

Additionally, as the CCRPC is tasked with also reviewing and approving each such municipal comprehensive plan for consistency with various requirements in state statute and consistency with the Chittenden County Regional Plan (aka the ECOS 2013 Plan). This review includes a detailed staff critique with recommendations for improvement. This CCRPC review provides another opportunity to formally integrate elements of this local AHMP into the City’s Comprehensive Plan.

With regard to a more formal process by which the City will integrate the requirements of this mitigation plan while developing the City’s annual capital improvement plans/budgets, for periods , the Town will review the recommended Actions detailed below to see if formal incorporation within these annual capital plans is warranted prior to annual review and voting by Town residents. Additionally, CCRPC staff can assist the town with drafting grant applications to fund mitigation projects.

5.4 Mitigation Actions

The table below records the strategies from the 2011 Plan and progress on their implementation. This table also encapsulates the City’s decision making with regards to which Actions to continue, which to establish as new actions and which to discontinue. During the development of this Municipal AHMP and its parent 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 actions and devising action for this 2017 local AHMP CCRPC and municipal staff thought it would be best to focus on known and likely actions with a high likelihood of implementation versus consideration of more expansive but largely aspirational strategies.

Table 5-3 Progress on the Strategies of the 2011 Burlington All-Hazards Mitigation Plan

Action Primary Responsible Entity	Task	Brief Description	Progress since 2011 and recommendations for 2017 Plan
#1 Investigate and develop options to increase usage of smoke detectors and installation of sprinkler systems.			
Burlington Fire Chief, Burlington Fire Marshal	Residential Sprinkler Installation	Develop loan/grant program for resident or property owner purchase and installation of fire alarm and/or sprinkler systems.	City continues to explore the potential of such a program. NOT A MITIGATION ACTION. REMOVE FROM 2017 PLAN
Burlington Fire Chief, Burlington Fire Marshal	School Sprinkler Installation	Research costs for installation of sprinkler systems in schools.	City is continuing discussions with Burlington School District. NOT A MITIGATION ACTION. REMOVE FROM 2017 PLAN.
#2 Investigate and develop options to further improve mitigation against disruptions to electrical service from severe winter storms and high winds.			
Burlington Electric Department General Manager	Tree Trimming and Maintenance	Continue tree trimming and vegetation management coupled with maintaining adequate Distribution System	Burlington Electric Department and Parks & Recreation Department continue to implement this action on an ongoing basis. However, since it is

Burlington Electric Department General Manager		construction and maintenance capabilities and a skilled workforce.	primarily a maintenance level action, albeit with significant mitigation benefits, it is best to REMOVE FROM 2017 PLAN.
	East Avenue Upgrade	Complete the East Avenue Loop Distribution System upgrade in conjunction with the completion of VELCO's statewide Northwest Reliability Project.	Completed. REMOVE FROM 2017 PLAN.
#3 Investigate and develop options to quickly alert City residents and visitors in the event of a significant emergency or threat.			
Burlington Police Chief, Burlington Fire Chief	Reverse 911 System	Explore feasibility and availability of funding to implement a "Reverse 911" Auto-dial notification system as means to alert the public in the event of an emergency.	City participates in and promotes VT-Alert to residents and businesses. NOT A MITIGATION ACTION. REMOVE FROM 2017 PLAN.
Burlington Police Chief, Burlington Fire Chief	Emergency Information Dissemination	Continue to work with local radio and television stations to develop agreements and protocol for use of stations to help disseminate critical emergency information.	City communicates regularly with local radio and TV stations. City also uses Facebook, Twitter, Front Porch Forum. City also participates in NIXLE, an open communication and engagement platform. NOT A MITIGATION ACTION. REMOVE FROM 2017 PLAN.
Burlington Police Chief, Burlington Fire Chief	Telecommunications Partnerships	Explore feasibility and availability of funding for developing agreements with cell phone service providers and internet providers for use of services to disseminate critical emergency information	No formal work conducted on this task. NOT A MITIGATION ACTION. REMOVE FROM 2017 PLAN.
Burlington Police Chief, Burlington Fire Chief	Additional Implementation	Continue to lobby for government and legal support to implement additional methods of communicating critical information in an emergency.	The City does not lobby for such funds. NOT A MITIGATION ACTION. REMOVE FROM 2017 PLAN.
#4 Raise public awareness of hazards, hazard mitigation and disaster preparedness.			
Burlington Police Chief, Burlington Fire Chief	School Programs	Continue school programs to raise student awareness of hazards, safety, preparedness and prevention.	Such programming continues on an annual basis. NOT A MITIGATION ACTION. REMOVE FROM 2017 PLAN.
Burlington Police Chief, Burlington Fire Chief	Family Programs	Continue family programs, such as car safety seat and bike safety programs, to raise family awareness of hazards, safety, preparedness and prevention.	Such programming continues on an annual basis. NOT A MITIGATION ACTION. REMOVE FROM 2017 PLAN.
Burlington Police Chief, Burlington Fire Chief	Fire Prevention Programs	Continue National Fire Prevention Week and other programs to raise public awareness of fire hazards, safety, preparedness and prevention.	As commercial buildings and apartment buildings undergo annual Fire Safety inspections, the City conducts limited actions of this type. NOT A MITIGATION ACTION. REMOVE FROM 2017 PLAN.
Burlington Police Chief, Burlington Fire Chief	Other hazard awareness programs	Develop public awareness programs, based on all-hazards needs. Programs to address pandemic hazards,	No formal public awareness programming in this regard is undertaken. With regards to pandemic hazards, actions addressing

		preparedness and mitigation may be appropriate given the risks posed by the H1N1 flu virus.	this are dormant at present however the City does consult with Vermont Department of Health and staff of the UVM Medical Center regarding mass casualty incidents. NOT A MITIGATION ACTION. REMOVE FROM 2017 PLAN.
#5 Evaluate capabilities of public shelters. Review and modify evacuation and sheltering plans based on the results of drills / exercises or procedures implemented in an actual incident			
Burlington Fire Chief, Burlington Police Chief	Existing Shelters	Maintain relationships with existing designated Red Cross shelters and hotels that have provided free shelter in the past.	City communicates with Red Cross on a regular basis and provides information to updated the Red Cross Shelter Inventory. NOT A MITIGATION ACTION. REMOVE FROM 2017 PLAN.
Burlington Fire Chief, Burlington Police Chief	Potential Shelters	Investigate capabilities of other buildings sufficient to serve as smaller shelters.	No formal action has been undertaken. The City works with the Red Cross to shelter residents displaced by incidents such as a building fire. NOT A MITIGATION ACTION. REMOVE FROM 2017 PLAN.
Burlington Fire Chief, Burlington Police Chief	Shelter Generators	Continue to work with schools and other shelters to assist in obtaining shelter generators.	No formal progress to date. NOT A MITIGATION ACTION. REMOVE FROM 2017 PLAN.
Burlington Fire Chief, Burlington Police Chief	Evacuation and Sheltering Exercises	Conduct evacuation drills or exercises and evaluate performance.	An exercise with the American Red Cross exercise was conducted between 2011-2015. NOT A MITIGATION ACTION. REMOVE FROM 2017 PLAN.
Burlington Fire Chief, Burlington Police Chief	Evacuation and Sheltering Plans	Review evacuation, sheltering, and relocation plans based on results of drills, exercises, and actual incidents.	City conducts the action mostly on the basis of actual incidents supplemented by the occasional tabletop exercise. NOT A MITIGATION ACTION. REMOVE FROM 2017 PLAN.
#6 Maintain adequate measures to mitigate against hazards affecting City of Burlington roads and bridges, wastewater systems, stormwater management, and water systems.			
Burlington Public Works Director	Maintain Public Works Capabilities	Continue to maintain adequate public works capabilities in order to be able to continue to mitigate against hazards affecting public infrastructure	Public Works budget, staffing and operations are stable. NOT A MITIGATION ACTION. REMOVE FROM 2017 PLAN.
Burlington Public Works Director	Combined Sewer System	The combined Stormwater and Sanitary systems in Burlington are undersized in various locations. Significant rain events lead to overflowing manholes and potential public health concerns. Remediation efforts could include reducing stormwater inputs to the combined sewer system or slowing the delivery of stormwater to the combined sewer system through storage.	New retrofits since 2011: - infiltration of combined sewer stormwater (runoff from ~3.5 impervious acres) throughout Old North End neighborhood to reduce CSO frequency at Manhattan and North Champlain and Manhattaan and Park Street and improve capacity downstream at Battery Street -various right of way stormwater rain garden implementation on Grant, North and Hyde Streets. -Storage cisterns/tanks were also installed in the past in the Main Plant System. <u>NEW PROJECTS FOR 2017 PLAN:</u> Similar types of projects will implemented at various locations

Burlington Public Works Director			throughout the City. Locations will be identified through Integrated Stormwater/Wastewater Planning (due end of 2018).
	Collection System Pipes and Outfalls	The separate stormwater system has places with stormwater outfalls on steep slopes. Pipes sometimes break causing substantial slope erosion. City wants to mitigate this steep slope erosion by replacing the galvanized metal pipe (or relining) with modern materials less prone to breakage. Additionally, aging and failing subsurface pipes can cause sinkholes to form in roadways	Re-lined culverts or installed new culverts at: Englesby Brook culvert at Crescent Road (road was collapsing into galvanized pipe) Manhattan Drive (Eastside) outfall erosion repaired. Manhattan Drive (Westside) erosion of head of outfall improved. Little Eagle Bay: improve stormwater outfalls to minimize erosion. <u>NEW PROJECTS FOR 2017 PLAN</u> <u>Gazo Avenue</u> : planned for CY 2017, repair outfall erosion to protect home and yard. <u>Dale Road</u> : outfall still needs improvement <u>Long-term planning</u> to assess all pipes and identify failing pipes and then reline or replace pipes. This will prevent sinkholes under roads.
#7 Maintain sufficient emergency service capabilities to address likely terrorism threats and/or civil disturbances.			
Burlington Police Chief, Burlington Fire Chief	Maintain and Improve Capabilities	Maintain adequate levels of planning, staffing, training and equipment to mitigate against likely terrorism threats. Coordinate planning and training activities with State and other Chittenden County municipal resources to assure an efficient and effective response to an event that requires assistance outside of the City of Burlington.	City continues to develop and maintain its own capabilities as well as maintain relationships with outside agencies. NOT A MITIGATION ACTION. REMOVE FROM 2017 PLAN.
#8 Complete fluvial geomorphology assessment and develop strategies in response to identified risk.			
CCRPC, VT ANR	Fluvial Geomorphic Assessments	Conduct Phase I and Phase II fluvial geomorphic assessments on streams and waterways in Burlington.	Completed. REMOVE FROM 2017 PLAN.
CCRPC, VT ANR	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 2017 PLAN.
TBD, determined by funding.	River Corridor Management Plans	Where Phase I and II assessments are complete, develop a River Corridor Management Plan.	Formal Corridor Management Plans not seen as critical need. City is required to develop Flow Restoration Plans as part of stormwater permits. These plans incorporate several projects which should serve to reduce erosion. REMOVE FROM 2017 PLAN.
Director of Planning & Zoning; Director of Public	Fluvial Erosion Hazard Mitigation	Develop strategies to mitigate losses from identified fluvial	Blanchard Beach: A constructed wetland was installed

Works	Implementation	erosion hazards.	that will also slow erosion and improve water quality TRANSITION TO RELATED NEW TASK: Implementation of new Flow Restoration Plans for impaired streams will slow erosion and improve water quality.
Director of Planning & Zoning; Director of Public Works	Flood Insurance Rating Map Updates	Review draft FIRM data. Develop strategies to mitigate losses from identified flood hazards.	DFIRM adopted. City may consider changes to floodplain bylaws but not at the level of a distinct mitigation task. COMPLETED. REMOVE FROM 2017 PLAN.
#9 Complete landslide hazard assessments, and develop strategies in response to identified risk.			
Vermont Geological Survey	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. COMPLETED. REMOVE FROM 2017 PLAN.
Vermont Geological Survey, other appropriate entities TBD.	Landslide Hazard Assessment and Mapping	Funding available, landslide hazards should be assessed and mapped in participating municipalities.	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
Director of Planning and Zoning, Director of Public Works	Landslide Hazard Mitigation Implementation	Develop strategies to mitigate losses from identified landslide hazards.	Yes, see work above noted for Manhattan Drive. NO DISCRETE TASK NEEDED. REMOVE FROM PLAN.
#10 Ensure City and school emergency plans are fully coordinated; maintain operation of a School Safety Committee.			
Burlington Fire Chief, Burlington School Superintendent	Emergency Plan Coordination	Continue coordination of city and school emergency plans.	No information provided NOT A MITIGATION ACTION. REMOVE FROM 2017 PLAN.
Burlington Fire Chief, Burlington School Superintendent	School Safety Committee	Maintain a school safety committee.	No information provided NOT A MITIGATION ACTION. REMOVE FROM 2017 PLAN.
Burlington Fire Chief, Burlington School Superintendent	Information and Media Centers	Plan for Information Center and Media Center to handle information requests in an emergency.	No information provided NOT A MITIGATION ACTION. REMOVE FROM 2017 PLAN.

5.4.1 Current Capabilities and Need for Mitigation Actions

The Municipal Development Plan’s policies and programs that support hazard mitigation, and the progress noted above demonstrate the variety of policies and actions forming the foundation of this All Hazards Mitigation Plan. As detailed in the table below, generally, the City considers its existing capabilities, regulatory structure and programs as adequate to address its vulnerabilities however continuation of existing mitigation actions or the implementation of new actions are warranted for the 5-year period this 2017 Plan is in effect

Table 5-4 Town of City of Burlington: Capabilities to address vulnerabilities from natural hazards

Hazard	Adequacy of Municipal Capabilities to address associated vulnerabilities (Excellent, Good, Average, Below Average)	Additional expansion or improvement in policies & programs needed to address hazard given long-term vulnerability
Severe Winter Storm	Excellent	No. The City regards its current hazard mitigation efforts carried out by their various departments as adequate to address most winter storms. Ice storms are harder to predict and mitigate, with more damaging potential impacts from loss of power and people being without power and heat for extended periods of time. Burlington Electric Department (BED) has aggressively implemented tree-trimming measures to mitigate power losses due to winter storms.
Flooding	Excellent	Yes, see actions below.
Fluvial Erosion	Good	Yes, see actions below
Severe Rainstorm	Good	Yes, see actions below.
Extreme Temperatures	Good	No, rare occurrence and extent, impact & vulnerabilities are limited.
Wildfire	Excellent	No, rare occurrence and extent, impact & vulnerabilities are limited.

Table 5-5 City of Burlington Capabilities to address vulnerabilities from technological hazards

Hazard	Adequacy of Municipal Capabilities to address vulnerabilities (Excellent, Average, Below Average)	Additional expansion or improvement needed to address hazard given long-term vulnerability
Major Transportation Incident	Good + State agencies provide support	No, rare occurrence and extent, impact & vulnerabilities are limited. The City has several high accident locations where a major transportation incident might occur. Maintaining and improving transportation infrastructure is addressed in the City's Capital Plan.
Multi-Structure Fire	Good + other local Fire Departments provide	No. The City regards Fire Department capabilities as adequate to respond to

	support	fires. Given the age and density of the City's housing stock, mitigation through widespread adoption of residential fire alarms and sprinkler systems is a priority. The newly-amended Burlington Fire Code requires that smoke detectors be installed in every residential building, in compliance with the Vermont Fire and Building Safety Code. New buildings must have interconnected, wired smoke alarm systems.
Power Loss	Excellent. Burlington Electric Department.	No given that events are limited in duration and vulnerabilities are short-lived. Additionally, BED's tree trimming program is ongoing. BED uses in house employees, the Burlington Parks and Recreation Department as well as qualified contractors to perform this function. BED's construction and maintenance program addresses a variety of system issues such as age of equipment, outage experience of system components and environmental exposure such as road salt, acidic soils, etc. BED continues to maintain a workforce that has the appropriate level of skills and experience to match the demands of our customer base and electrical distribution system.
Hazardous Materials Incident	Good + State agencies provide support	No, rare occurrence and extent, impact & vulnerabilities are limited.
Water Service Loss	Excellent.	No, rare occurrence and extent, impact & vulnerabilities are limited. Lake Champlain is the City's only source of water. The City has redundant systems and an emergency plan for maintaining water service, and regards the capabilities of the Department of Public Works as adequate to respond to water service loss.
Gas Service Loss	Average. Private utility is primarily responsible.	No, rare occurrence and extent, impact & vulnerabilities are limited.
Telecommunications Failure	Private utilities are primarily responsible	No, rare occurrence and extent, impact & vulnerabilities are limited. Telecommunications Failure is the responsibility of the service providers

		which own and operate these utilities. As with power loss, tree trimming and vegetation management coupled with maintaining adequate repair vehicles and personnel are the primary mitigation means used by the telephone companies.
Other Fuel Service Loss	Private businesses are primarily responsible	No, rare occurrence and extent, impact & vulnerabilities are limited.
Sewer Service Loss	Excellent.	No, rare occurrence and extent, impact & vulnerabilities are limited. Disruptions to sewer service are not common occurrences. However, due to the City's large resident population, as well as its large number of businesses, even a relatively minor incident can cause significant problems. The City has an emergency plan for maintaining water service, and regards the capabilities of the Department of Public Works as adequate to respond to sewer service loss.
Water Pollution	Good	Yes, see actions below
Invasive Species	Average	No, rare occurrence and extent, impact & vulnerabilities are limited.

Table 5-6 City of Burlington: Capabilities to address vulnerabilities from societal hazards

Hazard	Adequacy of Municipal Capabilities to address vulnerabilities (Excellent, Average, Below Average)	Additional expansion or improvement in policies & programs needed to address hazard given long-term vulnerability
Crime	Good +State agencies provide support.	No. Municipality participates in programs lead by regional and state entities.
Economic Recession	Good +State Agencies provide support	No Diversity of county economy mitigates vulnerabilities. The City considers its municipal plan as also supportive of the goal of economic diversification.
Terrorism	Good +State & Federal agencies provide support	No, rare occurrence.
Civil Disturbance	Good + State agencies provide	No, rare occurrence

	support. If muni has no p.d., note that and do not “grade”	
Epidemic	Average +State & Federal agencies provide support	No, rare occurrence. Burlington has done more planning for an epidemic than other communities in Chittenden County. The City was selected as one of nine communities nationwide to take part in the “Take the Lead” program in 2008. This program took the form of a public outreach campaign to educate city leaders and residents about pandemic preparation. City officials in Burlington have also created a pandemic flu response plan to implement in case of an epidemic. It is difficult to gauge the City’s actual preparedness for an epidemic, but steps are actively being taken to mitigate this hazard.
Key Employer Loss	Good +State agencies provide support	No. Diversity of employers in municipality mitigates vulnerabilities.

Note that this Plan does not recommend a discrete mitigation action regarding “future development.” Our justification for this is as follows:

- The municipality’s regulations, programming and staffing have prevented and will prevent new buildings and infrastructure being constructed in areas vulnerable to hazards. As documented in detail in section 4.6.2, despite active residential and commercial development, no structures and infrastructure subject to municipal regulation, have been constructed in either the Special Flood Hazard Areas or mapped River Corridor Protection Areas.
- For the next five years, there are NO known or anticipated plans for the construction of municipal infrastructure in areas vulnerable to hazards.
- There is no evidence that unwise or poorly regulated development in the municipality has been a significant contributor to putting people or property in harm’s way.

Therefore, the reader will note that the proposed Mitigation Actions for the next five years represent a much more focused and achievable list of actions focused on those hazards (e.g. Severe Rainstorm, Flooding, Fluvial Erosion, Water Pollution, etc.) that cause more frequent if less dramatic damages. It is these more mundane damages of erosion along road beds, damaged small culverts and the ongoing struggle to maintain and improve water quality (which cost the municipality and its taxpayers both time and money) that deserve the most attention rather than hazards that could hypothetically cause damage but which are rare and wherein the benefit-to-cost ratio for potential mitigation actions is weak (e.g. Major Transportation Incident, Hazardous Material Incident, Terrorism). No new discrete action is recommended with regard to Education & Awareness as the Town does not have adequate funds

or staff to undertake such an effort nor is such an effort warranted given the identified vulnerabilities. **Lastly, it is also worthwhile to note that in comparison to the 2011 Plan the priorities for this 2017 Plan have not changed. The hazards and vulnerabilities remain the same as well. Indeed, the only real change is that there is a more heightened awareness due to the severity of recent disasters starting in 2011 to the present.**

5.4.2 Specific Mitigation Actions

The City plans to conduct the following mitigation actions during the 5 year period this Plan is in effect.

CATEGORY A: Implement Public Works projects

Hazards Addressed: Flooding, Fluvial Erosion, Severe Rainstorm, Water Pollution

Vulnerabilities Addressed: damage to public infrastructure especially roads and culverts; temporary closures of roads and bridges including from debris; temporary loss of power and/or telecommunications and temporary isolation of vulnerable individuals such as the elderly or those in poverty.

Status:Ongoing

Primary Responsible Entity: Department of Public Works Director

Timeframe: Month 2017 through March 5, 2022 (update after FEMA approval date)

Funding Requirements and Sources: Operating and Capital budgets if sufficient; various FEMA or VEM hazard mitigation grants; FHWA grants; VTrans grants; Municipal Operating and Capital budgets only if sufficient. Contingent on available resources and funding.

Rationale / Cost-Benefit Review:

Thunderstorms, winter thaw events, and spring snowmelt all contribute to stormwater that can severely tax current systems. Over the long-term, urban stormwater runoff causes damage to the ecological integrity of the City's streams and Lake Champlain.

Specific Identified Actions:

Action A-1: Implement project to address Combined Sewer Overflows

The combined Stormwater and Sanitary systems in Burlington are undersized in various locations. Significant rain events lead to overflowing manholes and potential public health concerns. Remediation efforts could include reducing stormwater inputs to the combined sewer system or slowing the delivery of stormwater to the combined sewer system through storage. Locations will be identified through Integrated Stormwater/Wastewater Planning.

Anticipated projects include

- infiltration basins,
- improved surcharge capabilities
- installation of storage cisterns

Action A-2: Upgrade Pipe and Outfall Infrastructure

The separate stormwater system has places with stormwater outfalls on steep slopes. Pipes sometimes break causing substantial slope erosion. City wants to mitigate this steep slope erosion by replacing the galvanized metal pipe (or relining) with modern materials less prone to

breakage. Additionally, aging and failing subsurface pipes can cause sinkholes to form in roadways.

New project locations for this 2017 Plan include

Gazo Avenue: reline culvert to protect home and yard.

Long-term planning to assess all outfalls, pipes and identify failing outfalls and pipes and then reline or replace pipes. This will prevent sinkholes under roads.

CATEGORY B: Operate an effective Stormwater Management System

Hazards Addressed: Severe Rainstorm, Fluvial Erosion, Water Pollution

Vulnerabilities Addressed: Damage to public infrastructure; Temporary road and bridge closure and Budgetary impacts

Status: Ongoing

Primary Responsible Entity: Public Works Department; Planning & Zoning Department

Timeframe: Month 2017 through March 5, 2022 (update after FEMA approval date)

Funding Requirements and Sources: FEMA or other hazard mitigation grants; FHWA grants; VTrans grants; Vermont DEC grants; Municipal Operating and Capital budgets only if sufficient

Rationale / Cost-Benefit Review: Operation of City stormwater management systems and implementation of two Flow Restoration Plans will assure that the City remains in compliance with its MS4 permit and that various programs and projects will be implanted to better detain, infiltrate and treat runoff during severe rainstorm events. This will act to reduce overall water levels and velocity. These actions will also reduce pollutant and phosphorus loads into local streams and Lake Champlain.

Specific Identified Actions:

Action B-1: Street sweeping and catch basin cleaning

Catch basin cleaning & street sweeping removes materials and pollutants which would otherwise cause damages to the ecosystem, to municipal infrastructure and result in the municipality not achieving compliance with its MS-4 permit which in turn would force the municipality to spend more money on personnel, equipment and projects to meet compliance. This is an effective, if low-profile, mitigation action.

Action B-2: Land development proposal review and regulation

Review of such proposals by municipal utility staff, municipal Planning & Zoning staff and the municipality's Development Review Board which issues permits assures that land development is sited appropriately and that adequate stormwater controls are required to reduce the amount of runoff from private residential and commercial properties into the municipal road and stormwater infrastructure and in to local streams and Lake Champlain. While broad zoning measures set limits on such measures as units per acre, lot coverage, etc, the attention to detail given at the permit review and application phase is key to mitigating against the vulnerabilities from Severe Rainstorms and Water Pollution which can be exacerbated by poorly sited land development. Additionally, the City's Chapter 26 ordinance provides for stormwater management review for projects that would otherwise not trigger State stormwater review thresholds.

Action B-3: Begin implementation of Flow Restoration Plans.

Begin implementation of Flow Restoration Plans for the following impaired streams: Centennial Brook, Potash and Englesby Brook. These Plans were filed in late 2016 by the City with the State's Agency of Natural Resources. These plans are part of the city's obligations under its National Pollutant Discharge Elimination System (NPDES) Municipal Separate Stormwater Sewer Systems (MS4) permit. In keeping with the details of the Plan, the City will seek to implement the Best Management Practices (i.e., new projects and retrofits) identified in detail in the Plan such as bump-outs, green gutters, pond retrofits, infiltration basins. The projects will be completed over the next 20 years. At this time it is not known which exact projects will be implemented over the next 5 years.

Action B-4: Develop Integrated Water Quality Plan

Develop and begin to implement plans to address all Clean Water Act water pollution obligations including Flow Restoration for the Stormwater Impaired Waters, reduction of overall loading of phosphorus from within municipal boundaries that is eventually discharged into Lake Champlain and reduction of combined sewer overflows.

5.4.3 Prioritization of Mitigation Strategies

The above mitigation actions were listed in order of priority. Descriptions of specific projects, where available, are listed in Section 5.4.2 and in Table 5-3 below. Because of the difficulties in quantifying benefits and costs, it was necessary to utilize a simple “Action Evaluation and Prioritization Matrix” in order to effect a simple prioritization of the mitigation actions identified by the jurisdiction. The following list identifies the questions (criteria) considered in the matrix so as to establish an order of priority. Each of the following criteria was rated according to a numeric score of “1” (indicating poor), “2” (indicating below average or unknown), “3” (indicating good), “4” (indicating above average), or “5” (excellent).

- Does the action respond to a significant (i.e. likely or high risk) hazard?
- What is the likelihood of securing funding for the action?
- Does the action protect threatened infrastructure?
- Can the action be implemented quickly?
- Is the action socially and politically acceptable?
- Is the action technically feasible?
- Is the action administratively realistic given capabilities of responsible parties?
- Does the action offer reasonable benefit compared to its cost of implementation?
- Is the action environmentally sound and/or improve ecological functions?

The ranking of these criteria is largely based on best available information and best judgment, as many projects are not fully scoped out at this time. The highest possible score is 45.

It is anticipated that, as municipalities begin to implement the goals and actions of their Mitigation Strategies, they will undertake their own analysis in order to determine whether or not the benefits justify the cost of the project. Also, all proposed FEMA mitigation projects will undergo a benefit-cost analysis using a FEMA BCA template and approved methodology.

Based on feedback from FEMA, CCRPC Staff have concluded that several strategies previously identified in 2011 by the City of Burlington as mitigation strategies are more accurately classified as preparedness, response and recovery strategies. These strategies are not intended to mitigate against the hazards identified in Section 3, and should not be evaluated as such.

Other than the reclassification of some strategies as non-mitigation strategies, there have not been significant changes in the prioritization of strategies between 2011 and now, with one notable exception. Strategies related to landslide assessment have been removed from the plan. CCRPC staff, in consultation with FEMA, have concluded that landslides are not a discrete threat in Chittenden County and are adequately captured in the plan’s discussion of fluvial erosion. Additionally, further work on the development of a Vermont-specific landslide risk estimation protocol has not progressed making landslide-specific strategies inappropriate at this time for inclusion in the County plan and its annexes.

Note that these priorities are within categories as this is more appropriate rather than ranking project that address different hazards.

Table 5-7 Burlington action evaluation and prioritization matrix

Mitigation Category & Actions	Responds to significant (likely or high risk) hazard	Likelihood of funding	Protect threatened infrastructure	Implemented quickly	Socially / Politically acceptable	Technically Feasible	Administratively Realistic	Reasonable cost to benefit	Environmentally sound	TOTAL SCORE
CATEGORY A: Implement Public Works Projects										
Action A-1: Implement projects to address Combined Sewer Overflows	5	5	5	5	5	5	5	5	5	45
Action A-2: Upgrade collection system & outfall pipes	4	5	5	4	5	5	5	5	5	43
CATEGORY B: Operate an effective Stormwater Management System										
Action B-1: Catch basin cleaning and street sweeping	4	5	4	5	5	5	5	4	5	42
Action B-2: Land development proposal review & regulation	4	5	5	4	4	5	5	4	5	41
Action B-3: Implement Flow Restoration Plans for Englesby, Centennial & Potash Brooks	4	5	3	3	4	4	4	4	4	35
Action B-4: Develop Integrated Water Quality Plan	4	3	2	3	3	3	3	2	4	27
5 = Excellent; 4=Good; 3=Average; 2=Below Average or Unknown; 1=Poor										

5.5 Implementation and Monitoring of Mitigation Strategies

The following Table is intended to aid municipal officials in implementing their mitigation actions and to facilitate the annual monitoring & evaluation of the plan as outlined in Section 1.7.4 above.

Table 5-8 City of Burlington Mitigation Actions: Implementation Monitoring Worksheet

CATEGORY A: Implement Public Works projects to mitigate Severe Rainstorm, Water Pollution, Flooding and Fluvial Erosion and their associated vulnerabilities of:	
<ul style="list-style-type: none"> • Damage to new/existing public infrastructure and buildings • Temporary road and bridge closure • Temporary isolation of vulnerable individuals • Budgetary impacts 	
Action (Primary Responsible Entity)	Report on Progress since Plan adoption
<u>Action A-1: Implement projects to address Combined Sewer Overflows</u> (Public Works Dept. Director)	-note month/year/location of implementation of related projects such as infiltration basins, improved surcharge capabilities and installation of storage cisterns
<u>Action A-2: Upgrade collection system pipes and outfalls</u> City Water Resources Division Head & Stormwater Program Manager	-note month/year/location of implementation of related projects such as pipe replacement, pipe relining, manhole repairs especially at locations identified in this Plan: -Gazo Avenue: repair outfall erosion to protect home and yard.

CATEGORY B: Operate an effective Stormwater Management System to mitigate Severe Rainstorm, Water Pollution and Fluvial Erosion and their associated vulnerabilities of:	
<ul style="list-style-type: none"> • Damage to new/existing public infrastructure and buildings • Temporary road and bridge closure • Temporary isolation of vulnerable individuals • Budgetary impacts 	
Action (Primary Responsible Entity)	Report on Progress since Plan adoption
<u>Action B-1: Catch basin cleaning & street sweeping</u> (Public Works Dept. Director)	-annual # basins cleaned -annual # street miles swept
<u>Action B-2: Review of land development proposals</u> (City Planning and Zoning Director; City Water Resources Division Head & Stormwater Program Manager)	-note major projects reviewed or inspected with regards to stormwater management and/or number of land development project applications
<u>Action B-3: Begin implementation of Flow Restoration Plans</u> (City Water Resources Division Head & Stormwater Program Manager)	project types and locations and year constructed/installed for: -Centennial Brook FRP -Potash Brook FRP -Englesby Brook FRP
<u>Action B-4: Develop Integrated Water Quality Plan</u> (City Water Resources Division Head & Stormwater Program Manager)	-progress on development of Integrated Plan including Phosphorus Control elements

**University of Vermont
2017 All-Hazards Mitigation Plan**

Appendix

**to the
City of Burlington
2017 All-Hazards Mitigation Plan**

Prepared by:

**The Chittenden County Regional Planning Commission
the
City of Burlington, Vermont
and
The University of Vermont**

Adopted October 16, 2017 by the Burlington City Council

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SECTION 1: INTRODUCTION AND PURPOSE

1.1 Purpose and Scope of this Plan

The purpose of this appendix to the Burlington All-Hazards Mitigation Plan is to assist the City of Burlington in identifying the specific hazards facing the University of Vermont and in identifying strategies to begin to reduce the impacts of those hazards. This plan also seeks to better integrate and consolidate efforts of the University with those outlined in the Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan and the Burlington Annex, as well as efforts of quasi-governmental organizations such as Local Emergency Planning Committee, District #1 and the Chittenden County Regional Planning Commission.

1.2 All-Hazards Mitigation Plan Goals

The 2017 Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan sets forth general goals for the county as a whole and its municipalities. Of these, the following goals are relevant to the University of Vermont community:

- 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 local plans and the capacity of municipalities and other entities to implement them.
- 4) Encourage municipalities and other entities to formally incorporate elements of their Local All-Hazards Mitigation Plan, particularly their recommended mitigation strategies, into their 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 planning and transportation planning program conducted by the Chittenden County Regional Plan,
- 7) Maintain existing mechanisms or develop additional processes to foster regional cooperation in hazard mitigation, specifically and emergency management planning, generally.

1.3 University of Vermont: Demographics and Development Characteristics

The University of Vermont is Vermont's only public university. The University's main campus is located in eastern Burlington, Vermont. The campus covers 460 acres, abutting the South Burlington town line to the east, and Burlington's hill section neighborhood to the west. The

University of Vermont Campus is divided into four main parts. The Main Campus, which contains most of the school's academic and administrative buildings as well as research laboratories, is roughly bordered by S. Prospect St, Main St, Colchester Ave, and the University of Vermont Medical Center. Trinity Campus, which is mostly residential but contains a few academic buildings, is located on the northern side of Colchester Ave, northeast of the main campus. Another section of campus, containing the Living Learning Center, residential halls, and athletic facilities, is located south of Main St. Redstone Campus, which is mostly residential, is located further south, east of S. Prospect St. Aside from the main campus in Burlington, the University owns a research park, four research farms, nine natural areas, and a research laboratory building. Most of these are located outside of Burlington.

Roughly 12,800 students, including undergraduates, graduate students, medical students, certificate students, and non-degree students attend the University of Vermont. Many of these students live in one of the 39 residence halls on campus, but a large number also live in off-campus housing. 66% of undergraduate students come from out of state.

The university employs over 3,700 people, including roughly 1,300 full and part-time faculty, making it the third largest employer in Chittenden County.

1.4 Summary of Planning Process

In June 2016 and January 2017 consulted with UVM staff. Specific sources, plans, and reports reviewed include:

- *Public Safety at the University of Vermont: A Guide for Students, Faculty, and Employees, 2008-2009*
- *University of Vermont Emergency Response and Recovery Basic Plan*
- University of Vermont website (for general information)
- University of Vermont Police Services website (for public safety report)
- University of Vermont Emergency Management website (for emergency response plan, pandemic planning)
- *2014 City of Burlington Municipal Development Plan*

A draft was submitted to VDEM and FEMA on July 27, 2017. On July 26, 2017 FEMA Region One issued a notice that the City of Burlington AHMP was approved pending adoption by the relevant municipal governing body.

The appendix, along with the Burlington Annex and the Multi-Jurisdictional All-Hazards Mitigation Plan, were adopted by the Burlington City Council on October 16, 2017 and subsequently approved by FEMA Region One on November 6, 2017.

SECTION 2: HAZARD IDENTIFICATION

Detailed descriptions of the natural, technological, and societal hazards affecting the municipalities of Chittenden County are contained in the *Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan*. A few of the hazards identified in the multi-jurisdictional plan are presented in more detail for this appendix. College campuses have unique characteristics not shared by municipalities as a whole, and are thus susceptible to different kinds of hazards.

2.1 Utilities

2.1.1 Telecommunications Failure

As a university campus, The University of Vermont relies heavily on electronic communications. Students, faculty, and staff all use electronic means for day-to-day communications. The University of Vermont has an extensive emergency notification system, which sends alerts through text messaging, email, phone, web page updates, radio, and television. A large-scale telecommunications failure could affect most, if not all, of these alert mechanisms.

The University has systematically been trying to eliminate single points for telecommunications failure. A dual-core campus network infrastructure is being implemented that would isolate a communications system failure without affecting the entire campus. The University has a redundant optical fiber ring connecting the campus to Tech Park, which maintains the system in the event of a device failure or fiber cut. This system worked as planned when a telecommunications incident occurred. Redundant, non-coincident Internet connections link the University with the rest of the Internet.

The University's telephone service has a single switch and trunk set connecting off-campus. From a practical point of view, most campus constituents also have cellular phone service with either of two cellular carriers. It is unlikely that landline service and both cellular carriers would experience simultaneous service failures that would leave the University without telephone service. The University's Emergency Operations Groups and Office of Emergency Management have access to GETS/WPS for their cellular phones and an Iridium Satellite phone

The University of Vermont has robust public safety and commercial radio communications systems utilizing P25 digital encrypted public safety radios and Motorola MotoTrbo commercial radios. University of Vermont Police Services and Rescue are currently planning a full upgrade of all radios and repeaters including moving repeaters to a central location on campus to provide better coverage of the University. The University has replaced or upgraded most of the commercial repeaters on campus and departments are upgrading their portables and mobiles to allow the campus to switch entirely to a digital commercial radio system. The University also provides a public safety repeater on Mt. Mansfield that provides communication between area college campuses as well as to the State Emergency Operations Center.

2.2 Hazardous Substances

The University stores and uses a variety of hazardous substances, including materials used in campus operations and substances used in laboratories. The University also operates a permitted facility to store hazardous wastes.

Updated inventories of oil storage vessels are kept in UVM’s Spill Prevention Control and Countermeasures (SPCC) plan and UVM’s Underground Storage Tank inventory. Updated laboratory chemical inventories are maintained and accessible online to University first responders and the Burlington Fire Department. The University also maintains inventories of hazardous materials stored at the Environmental Safety Facility. These inventories are made available to emergency responders.

Based on 2007 data from Vermont Emergency Management, Tables 2-1 and 2-1 identify the campus locations storing fuels over 10,000 lbs, or Extremely Hazardous Substances. The inventories maintained by the university are more up-to-date and likely more comprehensive than this listing, but are not publicly available.

Table 2-1 University of Vermont, fuel storage sites in excess of 10,000 lbs.

Owner / Facility	Type of Substance
THE UNIVERSITY OF VERMONT - CHRISTIE DORMITORY	FUEL OIL, [NO. 2]
THE UNIVERSITY OF VERMONT - DEWEY BUILDING	FUEL OIL, [NO. 2]
THE UNIVERSITY OF VERMONT - GIVEN LABORATORY	FUEL OIL, [NO. 2]
THE UNIVERSITY OF VERMONT - PATRICK GYM	FUEL OIL, [NO. 2]
THE UNIVERSITY OF VERMONT - TUPPER DORMITORY	FUEL OIL, [NO. 2]
THE UNIVERSITY OF VERMONT - WATERMAN BUILDING	FUEL OIL, [NO. 2]

Table 2-2 University of Vermont, Extremely Hazardous Substances storage sites

Owner / Facility	Type of Substance
THE UNIVERSITY OF VERMONT – STEM BUILDING LABORATORIES	LAB CHEMICALS IN SMALL VOLUME (~4 L@) CONTAINERS THAT MAY INCLUDE: CHLOROFORM SULFURIC ACID ETHYLENE OXIDE NITRIC ACID
THE UNIVERSITY OF VERMONT - GIVEN BUILDING LABORATORIES	LAB CHEMICALS IN SMALL VOLUME (~4 L@) CONTAINERS THAT MAY INCLUDE: FORMALIN NITRIC ACID SULPHURIC ACID CHLOROFORM
THE UNIVERSITY OF VERMONT – HEALTH SCIENCE RESEARCH FACILITY LABORATORIES STAFFORD BUILDING LABORATORIES JEFFORDS BUILDING LABORATORIES	LAB CHEMICALS IN SMALL VOLUME (~4 L@) CONTAINERS THAT MAY INCLUDE: CHLOROFORM, FORMALIN

HILLS BUILDING LABORATORIES TERRILL BUILDING MARSH LIFE SCIENCE LABORATORIES DEWEY BUILDING LABORATORIES	SULPHURIC ACID
THE UNIVERSITY OF VERMONT – DELEHANTY HALL LABORATORIES	LAB CHEMICALS IN SMALL VOLUME (~4 L@) CONTAINERS THAT MAY INCLUDE: BERYLIUM NITRIC ACID HYDROFLUORIC ACID
THE UNIVERSITY OF VERMONT – RUBENSTEIN LABORATORIES	LAB CHEMICALS IN SMALL VOLUME (~4 L@) CONTAINERS THAT MAY INCLUDE: NITRIC ACID
THE UNIVERSITY OF VERMONT - ENVIRONMENTAL SAFETY FACILITY	HAZARDOUS WASTE IN 55-GALLON DRUMS AND SMALLER SHIPPING CONTAINERS THAT MAY INCLUDE: WASTE FORMALDEHYDE, SOLUTION, FLAMMABLE, WASTE TITANIUM TETRACHLORIDE, WASTE PHOSPHORUS OXYCHLORIDE, WASTE HYDRAZINE, AQUEOUS SOLUTIONS, WASTE CYANOGEN BROMIDE, WASTE ARSENIC TRIOXIDE, WASTE ACROLEIN, WASTE NITRIC ACID, WASTE SODIUM AZIDE

As the campus is densely populated, especially during the daytime hours, a significant hazardous material incident would have the potential to affect a large number of people. Several minor hazardous material spills have occurred in recent years, notably in 2007, when a fire in a geology lab resulted in concern about chemical exposure to first responders.

See section 5.2.4 for information on the university’s hazardous material planning.

2.3 Transportation Incident

2.3.1 High Accident Locations

Some sections of Main St, Colchester Ave, East Ave, and S. Prospect St. near the University of Vermont campus are considered high-accident locations according to VTrans. The high accident location rating applies to vehicle crashes, but as these streets all carry a high volume of traffic, there is potential for a vehicle to strike a pedestrian or group of pedestrians. Students must cross Main St. and Colchester Ave. to reach certain sections of campus. A high volume of pedestrian traffic crosses these streets, although a tunnel under Main St. has helped matters.

2.4 Crime

The overwhelming majority of crimes reported by University of Vermont Police Services are minor offenses, most commonly drug and liquor law violations. However, as with any community, more serious crimes are a possibility. Mass shootings have occurred in other educational institutions in recent years, although their occurrence is difficult, if not impossible, to predict.

2.5 Civil Disturbance

The University of Vermont contains some of the largest public gathering places in Chittenden County. Guest speakers, some controversial, are frequent. The student population is fairly politically active, so small-scale protests of speakers, university decisions, and political issues are a common occurrence. The majority of these protests are peaceful and lawful. In the rare cases where arrests are made as a result of a protest, they are generally for trespassing or other nonviolent crimes. Protests rarely disturb the university's ability to function. As a result, despite the university's dense population and a history of civil disturbances on college campuses in general, severe civil disturbance as a result of political protest does not seem likely.

Civil disturbances have occurred on campus for other reasons, however. In 2004, students exuberant about a sports team victory staged a minor riot on Redstone Campus. Light poles were toppled, a van was turned over, and small fires were set, amid other property damage. This incident demonstrates the occasional volatility of the student population. However, this is not a serious concern of UVM police officials, as steps toward mitigating this hazard have taken place in recent years.

2.6 Epidemic

Colleges and other residential institutions have challenges not shared by municipalities and governments when it comes to epidemics. At a residential university, large numbers of students live in fairly close quarters, often with shared restroom and dining facilities. Over the course of a day, each student is exposed to several different groups of people in classes, campus activities, and leisure activities. Similarly, faculty members may teach several completely different groups of students each day.

As a result of these factors, infectious disease has the potential to spread rapidly through the entire campus community. Mindful of this, officials at many colleges including UVM have engaged in pandemic planning in recent years, mostly focused on a flu pandemic. If a disease is circulating in the community, officials at a university must decide whether to send students home or keep them on campus. Evacuating the campus could potentially result in students being sent home to areas where the epidemic is more widespread, while keeping them at school runs the risk of disease sweeping through the campus population. University officials must reconcile the

different kinds of risk, and also make plans for continuity of operations should the campus be shut down due to an epidemic.

In addition to pandemic planning, the University has signed an MOA with the Vermont Department of Health to serve as a closed Point of Distribution center to provide staff and students with prophylactic provided by state and federal health agencies.

See section 5.2.3 for information about the University's pandemic flu planning.

SECTION 3: RISK ASSESSMENT

3.1 Mapped Hazard Areas

The University of Vermont campus does not fall within either the 100-year floodplain or a designated River Corridor or River Corridor Protection Area.

3.2 Other Information

University officials did not identify any other areas that are prone to hazards.

3.3 Future Events

University of Vermont officials have created a risk analysis matrix that rates various hazards in terms of impact and probability of occurrence. Two hazards that have very high ratings in terms of impact—Active Shooter/Homicide and On-Campus Airplane Crash—have fairly low probability ratings. Some hazards with higher probability, such as Snow/Ice Emergency and Fire, are likely to have less impact on the campus. A few hazards are rated fairly high in terms of both probability and impact, notably Pandemic and Extended Campus Power Outage. Table 3-1 shows a summary of the highest rated hazards.

Table 3-1 Highest rated hazards in terms of probability and impact, University of Vermont

Rating	Impact	Probability
1	Active Shooter / Homicide	Snow/Ice Emergency
2	Avian Flu / Pandemic	Extended Campus Power Outage
3	Airplane Crash (on-Campus)	Fire
4	Extended Campus Power Outage	Food Borne Infection
5	Water System Failure	Avian Flu / Pandemic

Source: University of Vermont

SECTION 4. VULNERABILITY ASSESSMENT

4.1 Critical Facilities

The University of Vermont campus contains the following critical facilities. This list does not contain critical facilities designated as hazardous materials storage sites, as those are listed in Tables 2-1 and 2-2.

Table 4-1 Critical Facilities located at the University of Vermont

Facility Type	Number of Facilities
Education	1
EMS Station	1
Emergency Shelters	1
Information and Communications	4
Police Station	1
Public Attractions and Landmark Buildings	4
Water Supply and Treatment	2

Source: VCGI

4.2 Estimating Potential Losses

Although no University facilities fall within designated hazard areas, the UVM Risk Management Department conducts assessments of the value of buildings and property on campus for insurance purposes.

SECTION 5: MITIGATION STRATEGY

5.1 Existing 2006 City of Burlington Municipal Development Plan Excerpts Pertaining to the University of Vermont That Support Hazard Mitigation

Land Use

INSTITUTIONS

Burlington's institutions of higher education and health care play an important role in the city's economy and overall vitality. Not only do they provide nearly 30 percent of all jobs in the city, they serve statewide educational and health care needs, attract new and expanded business to the region, and broaden cultural opportunities within the city.

In order to compete in their respective missions, they must continue to change and grow over time. The Institutions do however pose impacts on adjoining residential neighborhoods. Issues such as noise, parking, traffic, housing costs and neighborhood character continue to be of great concern.

A more urban configuration of each core campus, fixed growth boundaries, more efficient use of existing facilities, and cooperative relationships such as CATMA (Campus Area Transportation Management Association) and partnerships such as UVM's Winooski Falls apartments, will help the Institutions develop without further intrusion into the neighborhoods. In recent years, the City, the institutions and the neighborhoods have worked jointly on the creation of Institutional Core Overlay (ICO) Zones that would concentrate development within their respective core campuses. To date core campuses have been adopted for Champlain College, UVM and Fletcher Allen. A separate ICO for UVM's Redstone Campus has been contemplated to concentrate future housing.

As the Institutions focus future growth within these core campuses, a fresh look should be taken at the current University Campus (UC) zoning district boundaries, and allowed densities outside of the core campuses, to ensure both continue to reinforce safe and healthy neighborhoods with vital and growing institutions.

- University of Vermont

The UVM Board of Trustees are considering a new Campus Master Plan for the University's holdings statewide. As would be expected, it focuses primarily on the Main and Redstone campuses found in Burlington and portions of adjacent South Burlington. This plan outlines a number of strategies to concentrate university functions within existing boundaries, improve circulation within and through the various campuses (Academic, Athletic, and Redstone), and make more efficient use of existing sites for future development. Additionally, UVM has entered into a partnership with a private developer to provide housing for students as part of the downtown Winooski revitalization project. This is a good model that should be considered for use in Burlington's City Center as well. Finally, there may be opportunities to create and locate research and development space in the city's enterprise district as a means of supporting new business development and technology transfer. All of these go a long way towards balancing the future development needs of the University with a respect for the surrounding residential neighborhoods.

Perhaps the biggest issue facing the University-City relationship continues to be that of student housing. Students have a tremendous impact on the availability and affordability of housing in the city as well as the quality of life in the residential neighborhoods surrounding the campus.

While not all students who live in rental housing attend the University, it has a dominating influence given its size and the composition of its undergraduate population.

The University and the City have struggled over this issue for decades with little result. As part of a City-University agreement, UVM is working to provide additional on campus housing at University Heights. This is an important and welcomed step, but more will need to be done in coming years to absorb a higher percentage of students who live on-campus. The University currently houses approximately 47% of its degree students on-campus. It is the City's objective that UVM will gradually increase this percentage to no less than 50-52% over the next 3-5 years. Other opportunities for additional on campus housing include the recently acquired Trinity campus and Redstone campus. The University and the City must also continue to address quality-of-life issues faced by the residential neighborhoods surrounding the campus. Problems over noise, traffic, parking, and vandalism threaten the stability and tranquility of these residential areas. The University has also agreed to take action against any off-campus student misconduct.

5.2 Existing University of Vermont Actions That Support Hazard Mitigation

5.2.1 University Emergency Operations Plan

The University has created an all-hazards emergency response plan based on the National Incident Management System (NIMS). NIMS, used by many emergency response organizations at all levels nationwide, is designed to create a clear chain of command in an emergency, so that officials from different jurisdictions (or departments, in the case of the university) can coordinate effectively and efficiently respond to an emergency.

The Emergency Operations Plan identifies different levels of emergency, ranging from minor campus incidents to emergencies that involve the entire campus and greater Burlington community, and lays out a clear chain of command. The plan describes how a pre-designated Emergency Operations Group will establish an emergency operations center to manage logistics, communications, etc. The plan explains the responsibilities of college officials at various levels, from academic deans to physical plant personnel, in an emergency. Annexes have been added to the plan to address specific threats or events that require specialized planning such as winter storms or bomb threats.

The plan also describes the various methods that will be used to communicate emergency information to the university population and wider community. These methods include text messaging, email, voice mail, fax, phone (establishing a call center as well as disseminating information via phone), in-person notification, and local media such as radio, television, and newspapers.

While the plan is concerned with response, not mitigation, the fact that the plan exists and is publicly available should help the relevant college officials to understand their roles in responding to an emergency. Having a comprehensive response plan in place should help mitigate the impact of an emergency on campus.

5.2.2 Excerpts from the Police Services 2008-2009 Report “Public Safety at the University of Vermont” that are Relevant to Hazard Mitigation

5.2.2.1 Police Services Overview

UVM Police Officers have statewide law enforcement authority as enacted by the General Assembly of the State of Vermont: Title 16 VSA § 2283, and must successfully complete the basic training program for full-time police professionals as prescribed by the Vermont Criminal Justice Training Council. On-duty 24 hours/day, 7 days/week, Police Services maintains a state-of-the-art Emergency Communications Center and performs both law enforcement and service functions.

... In addition, as a participant in the State of Vermont’s telecommunications and information systems, Police Services has sophisticated communications and computer systems to provide for instant communication with the National Crime Information Center (NCIC) as well as local law state agencies in times of emergency. In fact, Police Services operates the only non state run E-911 Call Center in accordance with VT E-911 Board policies.

5.2.2.2 Incident Reporting and Response

Students, faculty, and staff are encouraged to immediately report any criminal offense, suspected criminal activity, or other emergency directly to Police Services. This can be done in several ways. The first is to use one of the phones located conveniently about the campus and in various buildings. The second is to dial 9-1-1 from one of the thousands of phones on campus. Dialing 9-1-1 will reach UVM Police Services from every UVM phone exchange, 24 hours a day, 7 days/week. 9-1-1 calls placed from a cellular phone are answered by a Vermont 9-1-1 Call Center and forwarded to Police Services. Police Services protocols require an immediate response to emergency calls.

We work closely with the full range of City and County emergency resources to assure a complete and timely response to all emergency calls. Priority response is given to crimes against persons and personal injuries. In addition to the traditional means of reporting incidents, UVM Police Services offers crime reporting (anonymously) via our Internet web page and/or 656-TIPS phone hotline. Police Services utilizes campus bulletin boards, email lists, web pages, residential life system, and phone trees to communicate timely warnings of crime and issues of interest to the community.

5.2.2.3 Off-Campus Crime

Police Services monitors off-campus criminal activity that may affect the University community so that we may provide timely warnings and advisories. This information is disseminated via campus media, posted bulletins, and through an effective call tree among Residence Hall staff.

...In an effort to provide timely notice and in the event of a serious incident which may pose a threat to members of the UVM community, posted bulletins will be coordinated and distributed by the Director of Police Services to alert the campus community. Posted bulletins are usually distributed for the following classifications: arson, aggravated assault, criminal homicide, robbery, and sex offenses. They may also be distributed for other classifications as deemed appropriate. The Department of Police Services also reports serious incidents to the student newspaper to enhance community awareness of safety issues.

5.2.2.4 Crime Prevention Programs

ORIENTATION & CRIME PREVENTION PROGRAMS

UVM police officers and dispatchers deliver crime prevention training at many employee, student and parent orientation programs. These include programs on personal protection, violence in the workplace, alcohol laws, and theft prevention. During the 2007 academic year, Police Services provided regular crime prevention presentations each month.

UNIVERSITY POLICIES

The departments of Police Services, Residential Life, Student Activities and Human Resources incorporate security procedures and practices into their campus-wide programs. Examples of such programs are workshops for the orientation of new employees, students and hall staff; Residence hall meetings & presentations; Special programming; “Operation Identification,” a program to mark University and personal property with unique owner-applied identification numbers; hands-on workshops provided by UVM Police instructors on personal defense techniques and sexual assault awareness.

CRIME PREVENTION SERVICES

UVM Police and Service Officers perform security audits for employees, students, and other organizations or departments upon request, including recommendations for access and surveillance systems.

5.2.2.5 Access to Facilities

The University issues keys or access cards to faculty, staff and resident students for their designated work and/or living areas. The University has professional locksmiths designated to repair and maintain the integrity of the key and lock system. The departments of Physical Plant, Police Services and Residential Life, in a coordinated effort, regulate key systems, lighting improvements, shrubbery control and hardware systems. Based upon occupant requirements, UVM facilities are opened and closed at various times. Once the exterior doors are locked, Police Services personnel conduct random patrols to recheck the security of the facility. In Residential Life areas, designated hall staff provides additional patrols. Facilities and landscaping are maintained in a manner that minimizes hazardous conditions. The Department of Police Services personnel regularly patrol the campus and report malfunctioning lights and other unsafe physical conditions to the Department of Physical Plant for correction. Other members of the University community are helpful when they report equipment problems to Police Services or to Physical Plant.

5.2.3 Pandemic Planning

The University of Vermont has, in recent years, taken pandemic planning very seriously. In 2007, University officials created an Emergency Management Planning Working Group charged with developing a university pandemic flu response plan. The group includes students, faculty, administrators, and staff. To date, this group has participated in conferences, workshops, open forums, and other events related to pandemic planning. Individuals within the group representing different areas of university function—such as academic continuity and human resources—have conducted “functional analysis” to identify critical functions of their area and determine what the impact on those functions would be in a pandemic. They have also met with officials at all levels within the university, and created partnerships with outside entities such as Fletcher Allen Health Center and the Vermont Department of Health.

The goal of the working group is to create a supplement to the university’s Emergency Response and Recovery Plan that describes the university’s planned response to a flu epidemic.

With the development of the H1N1 pandemic in the spring of 2009, University officials have prepared for an outbreak of H1N1 flu on campus during the 2009-2010 academic year. University officials are monitoring the situation and have conducted additional training to prepare for a pandemic. The University is also stocking supplies, such as masks, and is providing disposable thermometers to students. The recommendations of the Emergency Management Planning Working Group were based on the assumption of an avian flu pandemic, and University officials have had to adapt their planning based on the realities of the H1N1 pandemic.

5.2.4 Hazardous Materials Planning

Updated laboratory chemical inventories for emergency response are located on a website. Burlington Fire Department, UVM Police, UVM Environmental Safety Facility, and UVM Emergency Operations Group have password access to this site. A current inventory of hazardous materials at the Environmental Safety Facility (ESF) is also kept on a website.

Updated inventories of oil storage vessels are kept in the UVM Spill Prevention Control and Countermeasures (SPCC) plan and the UVM Underground Storage Tank inventory. These inventories are available at the UVM Physical Plant offices and at the UVM Environmental Safety Facility.

UVM has developed a plan for responding to hazardous materials incidents within campus laboratories. This plan has been coordinated and communicated with Burlington Fire Department, UVM Police Services, UVM Environmental Safety, and UVM Office of Emergency Management and Emergency Operations Group.

UVM has a written contingency plan for incidents at its hazardous waste storage facility (ESF). This plan is a part of the ESF hazardous waste operating permit. Copies of the contingency plan are located at UVM ESF, UVM Risk Management, UVM Police Services, UVM Rescue, Burlington Fire Department, South Burlington Fire Department, Fletcher Allen Medical Center, Chittenden County LEPC, and the university’s spill response contractors.

The university has a written SPCC plan for preventing and responding to spills of oil on the campus. This plan is located at the UVM Physical Plant Office and ESF.

5.2.5 Other Hazard Mitigation Actions

Table 5-1 below summarizes other actions and plans that pertain to hazard mitigation at the University of Vermont.

Table 5-1 Existing actions that support hazard mitigation, University of Vermont

Type of Existing Protection	Description /Details/Comments	Issues, or Concerns
Emergency Response		
Police Services	Department of Police Services maintains cooperative agreements with Burlington Police Department, Winooski Police Department, South Burlington Police Department, Vermont State Police, and Chittenden County Sheriff’s Office.	
Dispatch Services	Police Services operates e-911 call center.	
Police Services Personnel	22 Officers, 6 non-commissioned Service Officers, 3 admin, 5 dispatch	
Fire Services	Relies on Burlington Fire Department, UVM has a Fire Marshal.	
EMS Services	UVM Rescue	
EMS Personnel	Roughly 30 student volunteers.	
EMS Mutual Aid Agreements	various through VT EMS District #3	
Emergency Management	Office of Emergency Management	
Emergency Management Personnel	One full time staff member and 32 part time members belonging to the Emergency Operations Group	
Emergency Management Mutual Aid Agreements	National Intercollegiate Mutual Aid Agreement (IAEM)	

Type of Existing Protection	Description /Details/Comments	Issues, or Concerns
Other Campus Services		
Facility Maintenance Services	UVM Physical Plant	
Physical Plant personnel	169 Physical Plant personnel, includes administrative positions.	
Environmental Safety Facility Personnel	8 FTE technical personnel in the Environmental Safety Facility some trained to HAZWOPER operations level.	
Emergency Plans		
Emergency Operations Plan (EOP)	Yes, Emergency Operations Plan	
School Evacuation Plan(s)	Early discussions have occurred and a plan is in development for various evacuations.	
HAZMAT Plan	Laboratory hazmat contingency plan < http://www.uvm.edu/safety/lab/prepare-for-emergencies > Hazardous waste facility contingency plan located within permit. (2016). Oil storage response plan located within SPCC plan (2014).	
Shelter, Primary	PFG Athletic Complex or other appropriate facility.	In addition to being a campus shelter, Athletic Facility is listed in the Fletcher Allen Health Care emergency plan as a backup site, and is also a designated Point of Distribution (POD) for the region. University is finalizing agreements with the Red Cross and state for use of the complex in a regional emergency.
Replacement Power, backup generator	40 generators located in various buildings on campus.	Athletic facility, the primary shelter listed above, has limited backup power, an issue of concern to college officials.
College Plans		
College Comprehensive Plan	Strategic Plan, 2009 – 2013, other plans at the level of schools within the university.	

**Champlain College
2017 All-Hazards Mitigation Plan**

Appendix

**to the
2017 City of Burlington
All-Hazards Mitigation Plan**

Prepared by:

**The Chittenden County Regional Planning Commission
the
City of Burlington, Vermont
and
Champlain College**

Adopted October 16, 2017 by the Burlington City Council

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SECTION 1: INTRODUCTION AND PURPOSE

1.1 Purpose and Scope of this Plan

The purpose of this appendix to the Burlington All-Hazards Mitigation Plan is to assist the Champlain College community and the City of Burlington in identifying the specific hazards facing the college and in identifying strategies to begin to reduce the impacts of those hazards. This plan also seeks to better integrate and consolidate efforts of the College with those outlined in the Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan and the Burlington Annex, as well as efforts of quasi-governmental organizations such as Local Emergency Planning Committee, District #1 and the Chittenden County Regional Planning Commission.

1.2 All-Hazards Mitigation Plan Goals

The Chittenden County Multi-Jurisdictional All-Hazards Mitigation Plan sets forth general goals for the county as a whole and its municipalities. Of these goals, the following are relevant to the Champlain College community:

- 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 local plans and the capacity of municipalities and other entities to implement them.
- 5) Encourage municipalities and other entities to formally incorporate elements of their Local All-Hazards Mitigation Plan, particularly their recommended mitigation strategies, into their 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 planning and transportation planning program conducted by the Chittenden County Regional Plan,
- 7) Maintain existing mechanisms or develop additional processes to foster regional cooperation in hazard mitigation, specifically and emergency management planning, generally.

1.3 Champlain College: Demographics and Development Characteristics

Champlain College is a private residential college located in the Hill Section neighborhood of Burlington, Vermont. The college campus has roughly 40 buildings on 22 acres, including a core campus and some college buildings-- many of which are renovated historic houses-- interspersed among residences in the neighborhood. The college has a focus on professional programs, but also provides bachelor's degrees, and has two graduate programs.

Roughly 2,000 students attend Champlain College, about 1,017 of whom live on campus in 23 residential dormitories. The college has approximately 235 faculty/staff employees, including about 97 faculty.

In terms of growth, the college has expanded significantly in recent years, building new residence halls and other facilities. Due to its location in a primarily residential neighborhood, the college's opportunities for continued expansion near the core campus are limited, although the college has a goal of being able to house all students in on-campus housing in the future.

1.4 Summary of Planning Process

In January 2017 CCRPC staff consulted with College staff via email. Data pertaining directly to Champlain College was identified for this appendix. Additional data regarding the college was gathered at this time. Specific sources, plans, and reports reviewed include:

- Champlain College website (for general information)
- Champlain College Campus Public Safety Website (Safety Protocols and Pandemic Flu Plan)
- *Emergency Response Plan – Champlain College – Updated July 21, 2009*
- *2009 Champlain College Campus Public Safety Annual Security Report*
- *2014 City of Burlington Municipal Development Plan*

A draft was submitted to VDEMH and FEMA on July 27, 2017. On July 26, 2017 FEMA Region One issued a notice that the City of Burlington AHMP was approved pending adoption by the relevant municipal governing body.

The appendix, along with the Burlington Annex and the Multi-Jurisdictional All-Hazards Mitigation Plan, were adopted by the Burlington City Council on October 16, 2017 and subsequently approved by FEMA Region One on November 6, 2017.

SECTION 2: HAZARD IDENTIFICATION

Detailed descriptions of the natural, technological, and societal hazards affecting the municipalities of Chittenden County are contained in the Multi-Jurisdictional All-Hazards mitigation plan. A few of the hazards identified in the Multi-Jurisdictional AHMP are presented in more detail for this appendix. College campuses have unique characteristics not shared by municipalities as a whole, and are thus susceptible to different kinds of hazards.

2.1 Utilities

2.1.1 Telecommunications Failure

As a college campus, Champlain College relies heavily on electronic communications. Students, faculty, and staff all use electronic means for day-to-day communications. Champlain College has a campus alert emergency notification system, which sends alerts through voice and text alerts to all students, faculty and staff. Phone mail, email and Web advisories may also be used. In the event that an emergency closes the campus for a brief or extended period, the College's Educational Continuity Plan relies on web-based instruction. A large-scale telecommunications failure would affect these alert mechanisms and web-based instruction platforms. The College is upgrading their telecommunications system, including hardware and a generator backup system, to prevent or mitigate a telecommunications failure.

2.1.2 Power, Heat or Water Failure

As a preparedness and mitigation measure, Champlain College has been installing redundant systems to address power, heat or water failures.

2.2 Hazardous Substances

Hazardous material release is discussed as a possible hazard in the Multi-Jurisdictional All-Hazards Mitigation Plan. As the campus is densely populated, especially during the daytime hours, a significant hazardous material incident would have the potential to affect a large number of people. According to the Hazmat data obtained from VEM for 2007, Champlain College had no locations storing in excess of 10,000 lbs of fuel. For 2007, Champlain College campus reported storing the following extremely hazardous substances.

Table 2-1 Champlain College, Extremely Hazardous Substances storage sites

Owner / Facility	Type of Substance
CHAMPLAIN COLLEGE	HYDROGEN PEROXIDE
CHAMPLAIN COLLEGE	HYDROQUINONE

Source: Vermont Emergency Management

The College has taken actions across the entire campus to eliminate or minimize the amount and use of hazardous substances. College officials report that cleaning chemicals containing hydrogen peroxide identified in Table 2-1 have a dilute concentration that is well below the threshold concentration for extremely hazardous substances. They also report that hydroquinone is no longer being used by the photo lab. Other mitigation actions have included replacing

ethylene glycol as a coolant in the chiller systems with a non-toxic coolant, and installing electrical pulse filtration in cooling towers to eliminate the use of biocides. Science laboratories stock only kit-sized amounts of chemicals.

Champlain College Campus Public Safety publishes community guidelines for response to hazardous material spills. Among other things, these guidelines state that Material Safety Data Sheets are stored both in the Public Safety office and near any hazardous materials. These data sheets serve as references for spill clean-up and first aid.

2.3 Transportation Incident

Located in an urban residential neighborhood, Champlain College generates substantial pedestrian and bicycle traffic. A Champlain student was struck by an automobile in 2009. The College is a participant in the Safe Streets Initiative, which seeks to increase awareness and enforcement related to pedestrian, bicycle and automobile safety. The Safe Streets Initiative, which is sponsored by the City Police Department and the bike/ped advocacy group Local Motion, has done education and awareness events at the College.

2.4 Crime

The overwhelming majority of crimes reported by Champlain College Campus Public Safety are minor offenses, most commonly drug and liquor law violations. However, as with any community, more serious crimes are a possibility. Mass shootings have occurred in other educational institutions in recent years, although their occurrence is difficult, if not impossible, to predict. The College's Campus Public Safety Office has published on its website guidelines instructing community members how to respond to both an active shooter and any armed, suspicious, or disruptive individual. Campus Public Safety also publishes community guidelines for response to bomb threats.

2.5 Civil Disturbance

Colleges are often vulnerable to civil disturbance. However, Champlain College officials report that while students are active in matters of civil importance, disturbances are uncommon. The College pre-plans for possible events, but civil disturbances have not been an issue.

2.6 Epidemic

Colleges and other residential institutions have challenges not shared by municipalities and governments when it comes to epidemics. At a residential college, large numbers of students live in fairly close quarters, often with shared dining facilities. Over the course of a day, each student is exposed to several different groups of people in classes, campus activities, and leisure activities. Similarly, faculty members may teach several completely different groups of students each day.

As a result of these factors, infectious disease has the potential to spread rapidly through the entire campus community. Mindful of this, officials at most colleges have engaged in pandemic planning in recent years, mostly focused on a flu pandemic. If a disease is circulating in the community, officials at a college must decide whether to send students home or keep them on campus. Evacuating the campus could potentially result in students being sent home to areas where the epidemic is more widespread, while keeping them at school runs the risk of disease sweeping through the campus population. College officials must reconcile the different kinds of risk, and also make plans for continuity of operations should the campus be shut down due to an epidemic.

See section 5.2.2 for information about the College's pandemic flu planning.

SECTION 3: RISK ASSESSMENT

3.1 Mapped Hazard Areas

The Champlain College campus does not fall within either the 100-year floodplain or a designated River Corridor or River Corridor Protection Area.

3.2 Other Information

The Champlain College campus does not contain any non-designated hazard areas.

3.3 Future Events

Champlain College officials have conducted an analysis of risks facing the College, identifying the following hazards as most significant:

- Natural disaster, such as an ice storm;
- Long-term power outage; and
- Widespread illness.

SECTION 4. VULNERABILITY ASSESSMENT

4.1 Critical Facilities

The entire Champlain College campus is identified as a critical facility. Table 4-1 does not contain critical facilities designated as hazardous materials storage sites, as those are listed in Tables 2-1.

Table 4-1 Critical Facilities located at Champlain College

Category	Facility Type	Facility Name
Education	College / University	Champlain College

Source: VCGI

4.2 Estimating Potential Losses

Champlain College officials report that none of the campus is located in a designated hazard area. The College has valued campus structures and equipment for property insurance purposes; the value was not disclosed for this plan. Other potential losses of concern include lost revenue if the College had to be shut down for an extended period.

Champlain College has been proactive in addressing significant identified risks, implementing redundant systems (e.g., electric power, heat and water) and contingency plans (e.g., pandemic flu) to prepare for and mitigate hazards and potential losses.

SECTION 5: MITIGATION STRATEGY

5.1 Existing 2006 City of Burlington Municipal Development Plan Policies Pertaining to Champlain College That Support Hazard Mitigation

5.1.1 Land Use

INSTITUTIONS

Burlington's institutions of higher education and health care play an important role in the city's economy and overall vitality. Not only do they provide nearly 30 percent of all jobs in the city, they serve statewide educational and health care needs, attract new and expanded business to the region, and broaden cultural opportunities within the city.

In order to compete in their respective missions, they must continue to change and grow over time. The Institutions do however pose impacts on adjoining residential neighborhoods. Issues such as noise, parking, traffic, housing costs and neighborhood character continue to be of great concern.

A more urban configuration of each core campus, fixed growth boundaries, more efficient use of existing facilities, and cooperative relationships such as CATMA (Campus Area Transportation Management Association) and partnerships such as UVM's Winooski Falls apartments, will help the Institutions develop without further intrusion into the neighborhoods. In recent years, the City, the institutions and the neighborhoods have worked jointly on the creation of Institutional Core Overlay (ICO) Zones that would concentrate development within their respective core campuses. To date core campuses have been adopted for Champlain College, UVM and Fletcher Allen. A separate ICO for UVM's Redstone Campus has been contemplated to concentrate future housing.

As the Institutions focus future growth within these core campuses, a fresh look should be taken at the current University Campus (UC) zoning district boundaries, and allowed densities outside of the core campuses, to ensure both continue to reinforce safe and healthy neighborhoods with vital and growing institutions.

- Champlain College

Champlain College is a small private college located between the University of Vermont and the downtown. Champlain was established in 1878 as a business college, and operated as a two-year college until 1991 when its first bachelor's degree was offered. A graduate program was added in 2002. Today, Champlain occupies 40 buildings on over 22 acres, and serves approximately 1,800 students. Champlain is currently in the process of developing a new campus master plan. This planning effort will need to address how and where Champlain College will grow in the future if it is to meet its goal of increasing its student base without further intrusion into the surrounding residential neighborhood. Opportunities for consideration may include apartment-style housing in the City Center.

5.2 Existing Champlain College Actions That Support Hazard Mitigation

5.2.1 Excerpts from the 2009 Champlain College Campus Public Safety Annual Report that are Relevant to Hazard Mitigation

5.2.1.1 Campus Public Safety Department

Campus Public Safety Officers are on duty 24 hours a day. They are trained public safety professionals who provide coverage for the campus area. All personnel are trained in First Aid, CPR and are equipped with life-saving AED devices and digitally secure two-way radios as well as Nextel radio telephones that provide secure, instant two-way radio communications.

5.2.1.2 Crime Prevention Efforts

Campus Public Safety has many on-going programs to educate members of the campus community about safety practices. These vary from lectures to one on one contact with students. Programs include:

Safety Presentations: Through-out the year the Director and Asst. Directors of Campus Public Safety visits each dorm to educate residents of various aspects of remaining safe. Topics range from fire safety to sexual assault prevention.

Investigations: All reports of incidents are reviewed initially by the Director of Public Safety and/or supervisors. If a report requires follow up, various supervisors assist in additional investigations and report back to the Director and local agencies as needed. Specific incidents are reviewed weekly at a joint meeting of Residential Life and Campus Public Safety to provide ongoing training and development of new protocols and procedures.

Escorts: One program providing 24 hour a day service is the safety escort program. Campus community members can call public safety and be provided a walking escort between points on campus to include vehicle escorts to the local hospital.

Lighting and Grounds Surveys: CPS officers perform walking tours of the campus area daily to review exterior lighting and to identify safety issues that may arise from either weather conditions (snow & ice) or from poorly lighted and overgrown areas.

Fire & Safety Inspections: Each semester, CPS personnel perform a fire and safety inspection in each dorm room at Champlain College. Fire hazards and safety issues are sought out and rectified. Routine fire and safety inspections are conducted nightly in each dormitory building. The goal is to ensure exterior doors are accessible to authorized persons and that exit signs, life safety equipment, and points of egress are clearly marked and available for use.

5.2.1.3 Residential Hall Security

Every evening CPS officers check carbon monoxide, methane, hydrogen sulfide, and oxygen levels within each residence hall. Boiler temperature and pressures, life safety equipment, and physical security of exterior doors are verified. Non-stop walking and driving patrols of the residence hall areas are conducted and problems are acted upon immediately.

5.2.1.4 Crime Reporting and Emergency Response

The Director of Campus Public Safety maintains an excellent working relationship with the local police. The Director as well as the commander of the police division in which the campus is located, routinely communicate, sharing information regarding criminal activity on and off campus.

5.2.1.5 Timely Warning

If circumstances warrant, special printed security alerts and advisories are prepared by the Director of Campus Public Safety and the Residential Life office. They are then distributed to each building on campus by a CPS officer. In addition, these are also sent via e-mail to each member of the campus community, student, staff and faculty member.

If warranted, a special campus alert system (MIR3) located at <https://cu.mir3.com> is available to Champlain students, faculty and staff to warn affiliates about present dangers occurring on or near campus. Affiliates are encouraged to register themselves to receive timely warnings from the MIR3 campus alert system.

5.2.2 Pandemic Planning

Champlain College prepared an extensive pandemic flu plan in response to concerns about possible pandemic avian flu (H5N1). This plan has since been updated in response to the much less virulent swine flu (H1N1) pandemic. College officials have determined that the best response in an epidemic is to evacuate the campus and send students home or to a different, pre-determined evacuation location. Before students are allowed to register for classes, they must submit two different cities/locations to which they could evacuate in the event of an epidemic. If college officials determine that an epidemic is underway, even if it is not yet affecting Vermont or the college, they can call for an immediate evacuation of the campus. According to the college plan, the campus should be almost completely evacuated within six hours of the epidemic declaration. The college plans to notify students of an evacuation using email, text messaging, posters in public locations, local media, and the college website. A few essential personnel would remain on campus. In the event of a long-term closure of the campus, the college has plans for continuity of education, using online classes and other means of remote instruction.

In Spring 2009, the swine flu (H1N1) outbreak was determined to be an pandemic. Because this flu strain is less virulent than the avian flu (H5N1), College officials determined that the school could remain open. Champlain College is actively monitoring the Winter 2009-2010 flu season and has scheduled flu vaccination clinics for the College community. The College reports that it is prepared to completely evacuate within hours of a closure decision. Implementation of the online instruction system called for in the continuity of education plan has been tested. A Human Resources policy was changed related to sick time, to make sure that employees would stay home if they had the flu.

5.2.3 Other Hazard Mitigation Actions

Table 5-1 below summarizes other actions and plans that pertain to hazard mitigation at Champlain College.

Table 5-1 Existing actions that support hazard mitigation, Champlain College

Type of Existing Protection	Description /Details/Comments	Issues, or Concerns
Emergency Response		
Police Services	Campus Public Safety. maintains cooperative agreements with UVM Police Services, Burlington Police Department, and Winooski Police Department.	
Public Safety Personnel	11 officers.	
Fire Services	Relies on City of Burlington Fire Department	
EMS Services	Relies on City of Burlington Fire Department EMS Division	

Type of Existing Protection	Description /Details/Comments	Issues, or Concerns
Other Campus Services		
Facility Maintenance Services	Champlain College Physical Plant	
Physical Plant personnel	11 FTE	
Residential Building Code / Inspection	The City Building Inspector inspects some new projects. Some inspections done by contractors, others by Physical Plant personnel. Boiler inspection 1/yr. Fire marshal and life safety inspection 2/yr. Fire extinguisher inspection 1/mo. Security inspections daily.	

	Boiler inspection daily.	
Building Inspectors	See above	
Emergency Plans		
Emergency Response Plan (ERP)	Yes, updated July 2009. Updated annually.	
School Evacuation Plan(s)	Yes, pandemic flu school evacuation plan.	
HAZMAT Plan	No specific Hazmat plan. Primary College responders assess the situation and determine whether to call City responders.	College has systematically worked to eliminate hazardous materials.
Shelter, Primary	IDX Student Life Center	
Replacement Power, backup generator	Installing diesel backup generator in 2009.	
Shelter, Secondary:	Joyce and Freeman Halls	
Replacement Power backup generator	Installing diesel backup generator in 2009.	
College Plans		
College Comprehensive Plan	2007 Champlain College Master Plan	