State of Vermont – Hazard Mitigation Grant Application Review Form

Name of Reviewer: _____ Project Name (Town/Type): _____

Requested funding amount (75% - federal share): $_____ Date of Review: _____

Threshold Criteria

- Does the project simply address, without an increase in the level of protection, the deferred or future maintenance, rehabilitation, restoration or replacement of existing structures, facilities or infrastructure? (*Not fundable if YES*)
- Does the proposal conform to No Adverse Impact Standards in the State Flood Hazard Area & River Corridor Rule and the State Stream Alteration Rule, where relevant? (*Not fundable if NO*)
- Does the community have a Local Hazard Mitigation Plan in place, or a commitment to generate one? (*Not fundable if NO*)
- Does the community have a Local Emergency Operations Plan in place? (*Not fundable if NO*)
- Is the community in good standing* with the National Flood Insurance Program? (*Not fundable if NO*)

_____

**Good standing* means that the community does not have unresolved NFIP compliance and enforcement issues documented in the FEMA Community Information System. If a community has documented compliance issues, but has made reasonable commitments and progress toward resolution, the committee may still consider the application for funding.

Topic		Question - Yes +5, No +0 (unless otherwise noted)		Point Value*	
				P	R
I	Effectiveness	1	Is the project supported by technical information demonstrating feasibility?		
		2	Will the project be effective at achieving the project objective?		
		3	Is the requested funding sufficient?		
		4	Is the project designed with climate change in mind (e.g. to withstand anticipated future events)?		
		5	What mitigation approach is most applicable to this project? (choose only one) • Reduce Vulnerability/Harden (+5) • Avoidance/Move (+15)	---	
II	Impact	6	Does the project address a site with multiple past damages related to it?	---	
		7	Is the mitigation action a community priority that will result in a significant increase in safety or reduction in risk to a high cost/critical/high impact problem?		
		8	Will the project increase available river corridor/floodplain acreage/storage? (up to +5)	---	
		9	Will the project enhance natural habitat? (Yes +5, Neutral +0, Degrade -5)	---	
		10	Will the project protect important cultural historic features? (Yes +5, Neutral +0, Degrade -5)	---	
III	Proactivity	11	Is the project identified in the local mitigation plan?	---	
		12	Has the community: (Both +10, One +5) • Limited new encroachments in Flood Hazard Areas? • Limited new encroachments in River Corridors?		
		13	Has the community taken previous mitigation actions to remedy, study or alleviate the problem?	---	
IV	Unique Circumstances	14	Does the project have a BCR $\geq$ 3.0? (+5)	---	
		15	Does the project have special qualities in terms of importance to the community, a compelling narrative, or other circumstance that is not reflected in other questions? (up to +5)		
		16	Does the project create significant benefits above the minimum (e.g. highly visible example, meets other state/community priorities in addition to mitigation, community involvement in the Community Rating System, etc.)? (up to +10)		
			TOTAL		

* The "**P**" column is used when scoring planning (7%) and 5% initiative projects. The maximum score is **50**.
* The "**R**" column is used when scoring regular projects. The maximum score is **100**.

Vermont's Hazard Mitigation Grant Program Applications (HMGP) Summary - 2011-2018

Financial Summary by Disaster (DLM 6/19/18)

DR-1995: April-May 2011

	TOTAL	Buyouts	Infrastructure	Planning	5% Initiative	Adv. Asst.
Lock-In Amt	$1,779,618	--	--	$124,573	$88,981	--
App Total (75%)	$1,050,630	$975,393		$75,237		
Approved	$1,050,630	$975,393		$75,237		
Pending	$0	$0				
Total Remaining	$728,988	--	--	$49,336	$88,981	--

DR-4001: May 26, 2011

	TOTAL	Buyouts	Infrastructure	Planning	5% Initiative	Adv. Asst.
Lock-In Amt	$1,528,508	--	--	$106,996	$76,425	--
App Total (75%)	$1,075,792	$1,075,792				
Approved	$1,075,792	$1,075,792				
Pending	$0	$0				
Total Remaining	$452,716	--	--	$106,996	$76,425	--

DR-4022 (Due 8/31/14): August 28-29, 2011

	TOTAL	Buyouts	Infrastructure	Planning	5% Initiative	Adv. Asst.
Lock-In Amt	$34,350,163	--	--	$2,404,511	$1,717,508	--
App Total (75%)	$37,092,496	$17,654,808	$14,281,875	$2,304,679	$2,464,680	$386,456
Approved	$27,340,551	$14,020,713	$9,684,609	$2,304,679	$1,233,050	$97,500
Pending	$4,748,938	$0	$4,597,265	$0	$151,673	
Denied	$2,890,790	$1,835,053	$542,089		$224,693	$288,956
Withdrawn	$5,635,842	$1,799,042	$1,907,181	$1,074,354	$855,265	
Total Remaining	$5,784,299	--	--	$99,833	-$747,171	--

DR-4043: May 20, 2011

	TOTAL	Buyouts	Infrastructure	Planning	5% Initiative	Adv. Asst.
Lock-In Amt	$148,553	--	--	$10,399	$7,428	--
App Total (75%)	$116,063	$116,063				
Approved	$116,063	$116,063				
Pending	$0	$0				
Total Remaining	$32,490	--	--	$10,399	$7,428	--

Project Summary by Disaster

DR-1995

Status	Buyout	Infrastructure	Planning	5% Initiative	Adv. Asst.
Approved	5	0	2	0	0
Pending	0	0	0	0	0

Buyouts: 5 approved applications (9 properties)

DR-4001

Status	Buyout	Infrastructure	Planning	5% Initiative	Adv. Asst.
Approved	5	0	0	0	0
Pending	0	0	0	0	0

Buyouts: 5 approved applications (9 properties)

DR-4022

Status	Buyout	Infrastructure	Planning	5% Initiative	Adv. Asst.
Approved	52	65	9	6	1
Pending	0	7	0	2	0

Buyouts: 52 approved (106 properties)
Infrastructure: 65 approved - 31 drainage, 8 elevations, 14 generators, 1 road relocation, 1 demolition (4 buildings), 9 floodproof/mitigation; 7 pending - 3 elevation, 1 generator, 3 flooproof/mitigation
5% projects: 6 approved - 3 normal projects, 3 buyouts (5 homes); 2 pending
Planning: 9 approved applications (131 towns & SHMP)

DR-4043

Status	Buyout	Infrastructure	Planning	5% Initiative	Adv. Asst.
Approved	1	0	0	0	0
Pending	0	0	0	0	0

Buyouts: 1 approved application (1 property) *originially covered 2 properties, but due to a significant cost overrun, one property was moved to DR4207.

DR-4066: May 29, 2012						
	TOTAL	Buyouts	Infrastructure	Planning	5% Initiative	Adv. Asst.
Lock-In Amt	$122,498	--	--	$8,575	$6,125	--
App Total (75%)	$114,082	$114,082				
Approved	$114,082	$114,082				
Pending	$0	$0				
Total Remaining	$8,416	--	--	$8,575	$6,125	--

DR-4066					
Status	Buyout	Infrastructure	Planning	5% Initiative	Adv. Asst.
Approved	1	0	0	0	0
Pending	0	0	0	0	0

Buyouts: 1 approved application (1 property)

DR-4120 (Due 8/12/14): May 22-26, 2013						
	TOTAL	Buyouts	Infrastructure	Planning	5% Initiative	Adv. Asst.
Lock-In Amt	$275,121	--	--	$19,258	$13,756	--
App Total (75%)	$250,995	$107,580	$127,050	$16,365		
Approved	$250,995	$107,580	$127,050	$16,365		
Pending	$0		$0	$0		
Total Remaining	$24,126	--	--	$2,893	$13,756	--

DR-4120					
Status	Buyout	Infrastructure	Planning	5% Initiative	Adv. Asst.
Approved	1	1	2	0	0
Pending	0	0	0	0	0

Buyouts: 1 approved application (1 property)
Infrastructuren: 1 approved elevation
Planning: 2 approved projects

DR-4140 (Due 10/31/14): June-July, 2013						
	TOTAL	Buyouts	Infrastructure	Planning	5% Initiative	Adv. Asst.
Lock-In Amt	$809,763	--	--	$56,683	$40,488	--
App Total (75%)	$781,204		$680,749	$60,705	$39,750	
Approved	$46,995			$46,995		
Pending	$0		$0	$0		
Denied	$39,750				$39,750	
Withdrawn	$694,459		$680,749	$13,710		
Total Remaining	$762,768	--	--	-$4,022	$738	--

DR-4140					
Status	Buyout	Infrastructure	Planning	5% Initiative	Adv. Asst.
Approved	0	0	4	0	0
Pending	0	4	1	1	0

Infrastructure: 4 withdrawals - 3 elevations 1 drainage
Planning: 4 approved projects, 1 withdrawal
5% Initiative: 1 denied project

DR-4163 (Due 3/14/15): December 20-26, 2013						
	TOTAL	Buyouts	Infrastructure	Planning	5% Initiative	Adv. Asst.
Lock-In Amt	$949,379	--	--	$66,457	$47,469	--
App Total (75%)	$814,168	$443,993	$251,806	$51,031	$67,339	
Approved	$228,406	$145,875		$51,031	$31,500	
Pending	$549,923	$298,118	$251,806	$0	$0	
Denied	$35,839				$35,839	
Withdrawn	$78,743					$78,743
Total Remaining	$249,793	--	--	$15,426	-$19,870	--

DR-4163					
Status	Buyout	Infrastructure	Planning	5% Initiative	Adv. Asst.
Approved	1	1	4	1	0
Pending	2	2	0	0	0

Buyouts: 1 approved application (1 buyout), 2 pending applications (2 properties)
Infrastructure: 1 approved generator, 2 pending elevations
Planning: 4 approved plans

DR-4178 (Due 6/11/15): April 15-18, 2014						
	TOTAL	Buyouts	Infrastructure	Planning	5% Initiative	Adv. Asst.
Lock-In Amt	$251,914	--	--	$17,634	$12,596	--
App Total (75%)	$225,971		$225,971			
Approved	$225,971		$225,971			
Pending	$0		$0			
Total Remaining	$25,943	--	--	--	--	--

DR-4178					
Status	Buyout	Infrastructure	Planning	5% Initiative	Adv. Asst.
Approved	0	2	0	0	0
Pending	0	0	0	0	0

Infrastructure: 1 approved drainage project, 1 approved generator

DR-4207 (Due 11/6/15): December 12, 2014						
	TOTAL	Buyouts	Infrastructure	Planning	5% Initiative	Adv. Asst.
Lock-In Amt	$584,065	--	--	$40,885	$29,203	--
App Total (75%)	$660,988	$566,642	$4,346			$90,000
Approved	$570,988	$566,642	$4,346			
Pending	$0	$0	$0			
Withdrawn	$90,000					$90,000
Total Remaining	$13,077	--	--	--	--	--

DR-4207					
Status	Buyout	Infrastructure	Planning	5% Initiative	Adv. Asst.
Approved	5	1	0	0	0
Pending	0	0	0	0	0

Buyouts: 5 approved applications (5 properties)
Infrastructure: 1 approved generator

DR-4232 (Due 4/8/15): June 9, 2016						
	TOTAL	Buyouts	Infrastructure	Planning	5% Initiative	Adv. Asst.
Lock-In Amt	$226,896	--	--	$15,883	$11,345	--
App Total (75%)	$185,305	$181,005		$4,300		
Approved	$185,305	$181,005		$4,300		
Pending	$0	$0				
Total Remaining	$41,591	--	--	$11,583	--	--

DR-4232					
Status	Buyout	Infrastructure	Planning	5% Initiative	Adv. Asst.
Approved	2	0	1	0	0
Pending	0	0	0	0	0

Buyouts: 2 applications awarded (2 properties)
Planning: 1 approved plan

DR-4330 (Due 8/15/18): July 1, 2017						
	TOTAL	Buyouts	Infrastructure	Planning	5% Initiative	Adv. Asst.
Lock-In Amt (6 mo.)	$13,773,468	--	--	$964,143	$688,673	--
App Total (75%)	$0			$0		
Approved	$0			$0		
Pending	$0	$0				
Total Remaining	$13,773,468	--	--	$964,143	--	--

DR-4330					
Status	Buyout	Infrastructure	Planning	5% Initiative	Adv. Asst.
Approved	0	0	0	0	0
Pending	0	0	0	0	0

HMGP Summary: DR-1995 (April-May 2011) through DR-4232 (June 2016)

Financial Summary by Disaster (DLM 6/19/18)						
	TOTAL	Buyouts	Infrastructure	Planning	5% Initiative	Adv. Asst.
Lock-In Amt (6 mo.)	$41,026,478	--	--	$2,871,854	$2,051,324	--
App Total (75%)	$42,367,695	$21,235,357	$15,571,796	$2,512,317	$2,571,769	$476,456
Approved	$31,205,778	$17,303,145	$10,041,976	$2,498,607	$1,264,550	$97,500
Pending	$5,298,861	$298,118	$4,849,071	--	$151,673	--
Total Remaining	$8,124,206	--	--	$301,018	-$573,589	--

Project Summary by Disaster					
Status	Buyout	Infrastructure	Planning	5% Initiative	Adv. Asst.
Approved	73	69	22	7	1
Pending	2	9	0	2	0

Buyouts: 73 approved applications (135 properties), 2 pending applications (2 properties)
Infrastructure: 69 approved - 32 drainage, 9 elevations, 17 generators, 1 road relocation, 1 demolition (4 buildings), 9 floodproof/mitigation; 9 pending - 5 elevation, 1 generator, 3 flooproof/mitigation
Planning: 22 approved applications (142 towns & SHMP)
5% Initiative: 7 approved - 2 projects, 2 plans, 3 buyouts (5 homes), 1 warning siren; 2 pending projects

State of Vermont
Agency of Administration
Office of the Secretary
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Jeb Spaulding, Secretary

January 29, 2014

Dear Vermont Municipal Official,

I am writing you to let you know of an important change regarding State promised assistance after a major flood or other natural disaster. This change is intended to encourage communities across Vermont to take action to improve their community's resilience to future flood impacts, which will save taxpayer money over time.

Following the recovery from Tropical Storm Irene, the State of Vermont modified its standard for managing the State's Emergency Relief and Assistance Fund (ERAF). The new standard, which will be effective for any disaster after October 23, 2014, is structured to encourage municipalities to take four basic steps to prepare their communities *before the next disaster:*

1. Have proactive flood hazard regulations;
2. Adopt up-to-date (2014-2016) local Transportation Codes and Standards;
3. Establish an up-to-date Local Emergency Operations Plan; and,
4. Develop and adopt a Local Hazard Mitigation Plan.

After a federally-declared disaster, federal public assistance funds from FEMA can reimburse 75% of eligible community losses associated with damage to public infrastructure. Typical community losses eligible for public assistance funds include costs to repair or replace transportation infrastructure, debris removal, and emergency protective measures. **Communities that have taken the four basic steps will receive an additional 12.5% state contribution to cover the damage.**

Communities that have not taken these steps will still receive state aid, but at a reduced amount. Those communities will receive a state contribution rate of 7.5%.

In addition, communities can secure state contribution of 17.5% by completing the four basic steps and by taking an additional step to protect themselves from flood damages. Please refer to the ***ERAF Frequently Asked Questions Enclosure*** for more information.

Please contact your regional planning commission or development agency, the Vermont Agency of Transportation District staff, or the Vermont League of Cities and Towns if you need additional assistance.

Thank you for attention to this important issue.

Sincerely,

Jeb Spaulding
Secretary of Administration

Enclosure: hand-out (with links) about the new ERAF criteria which will take effect on Oct. 23, 2014

VERMONT

Emergency Relief and Assistance Fund (ERAF)

For more information and live links direct your browser to:
tinyurl.com/**eraf2014**

ERAF provides State funding to match Federal Public Assistance after federally-declared disasters. Eligible public costs are reimbursed by federal taxpayers at 75%. For disasters after October 23, 2014, the State of Vermont will contribute an additional 7.5% toward the costs. For communities that take specific steps to reduce flood damage the State will contribute 12.5% or 17.5% of the total cost.

What is needed?

12.5% - eligible communities have adopted four mitigation measures:

1. National Flood Insurance Program (participate or have applied);

2. Town Road and Bridge Standards (annually certify adopted standards that meet or exceed the standards in the current: 2014-2016 *VTrans Orange Book: Handbook for Local Officials);*

3. Local Emergency Operations Plan
(Adopt annually after town meeting and submit before May 1);

4. Local Hazard Mitigation Plan
(The Local Hazard Mitigation Plan requirement can be satisfied if the draft plan has been submitted to FEMA Region 1 for review).

17.5% - eligible communities also:

5. Protect River Corridors from new encroachment; or, protect their flood hazard areas from new encroachments and participate in the FEMA Community Rating System.

After a declared disaster the damage to public infrastructure including roads and culverts may approach a million dollars. Here is how the cost of damage will be carried by federal, state, and municipal taxpayers:

	7.5% ERAF Rate	**12.5% ERAF Rate**	**17.5% ERAF Rate**
Federal Share	$750,000	$750,000	$750,000
State Share	$75,000	$125,000	$175,000
Municipal Share	**$175,000**	**$125,000**	**$75,000**
100% of $1,000,000	$1,000,000	$1,000,000	$1,000,000

What does my community need to do?

Visit tinyurl.com/**eraf2014** to find out what your community has already done.

How do we update our bylaws to protect River Corridors and participate in the National Flood Insurance Program?

Contact the VT DEC Floodplain Manager for your region and your planner at the Regional Commission.

How do we update and certify our Town Road and Bridge standards?

The current 2014 - 2016 VTrans Orange Book is online. The Select Board adopts and certifies the standards. Contact VTrans District Staff or your planner at the Regional Commission for help and more information.

How do we adopt an approved Local Hazard Mitigation Plan?

Support for your Local Hazard Mitigation Plan is available through the Regional Commission and other consulting planners.

How do we update our Local Emergency Operations Plan?

The Local Emergency Operations Plan (LEOP) needs to be updated after Town Meeting and submitted before May 1. Contact your Regional Commission for help and more information.

Who administers ERAF?

The Department of Emergency Management and Homeland Security (DEMHS) manages Public Assistance funds and tracks the eligibility of individual municipalities for State matching funds.

Who can I call or e-mail directly for help and more information?

Milly Archer, VLCT Municipal Assistance Center, (802) 229-9111, marcher@vlct.org

For more information read:
Flood Damage Mitigation Incentives for Municipalities under the New ERAF Rule, A summary of ERAF from the November, 2012, *VLCT News*. www.vlct.org

ANR Subgrant - Project Readiness Workbooks Summary

Under the ANR-HMGP grant, 11 Regional Planning Commissions completed Project Readiness Workbooks for two municipalities in each region. After a training session was held in April 2016, Project Readiness Workbook template and instructions (see appendix) were provided to all RPCs. All workbooks have been converted to pdf and combined into one document – found in the appendix.

Projects from this effort have not been spatially connected to the Statewide River Corridor, given they are site specific locations and the corridor is at the reach scale. Project maps and location information (lat/long) are provided for each project within the Project Worksheet. Additionally, as part of work the Regional Planning Commissions are doing for the Tactical Basin Planning efforts, many of the projects are also being incorporated into the State Tactical Basin Planning and Project Tracking Database http://anrintra.vt.gov/DEC/WDP/Tracking/ProjectSearch2.aspx , where projects are reviewed in context to all natural resources, water quality benefits, and flood resiliency benefits. Projects from the database are spatially tracked as part of that effort and can be reviewed with the River Corridor layer.

While reviewing and compiling all the workbooks, the following highlights should be noted. WRC included informative text, photos and maps all which could be useful in grant applications. SWCRPC included an introduction page to each workbook which does a nice job summarizing the contents. LCPC has used the workbooks to help in grant processes in both towns.

The following are thoughts from some of the Regional Planning Commissions regarding the process, suggested changes and the workbook usefulness for municipalities. Please note not all RPC's provided comments.

From Central Vermont Regional Planning Commission:
Both the Towns of Plainfield and Waterbury were very appreciative to have a document to work from that can easily refer them to the appropriate grant program for their high priority projects outlined in the worksheet. Some of the questions seemed redundant for them and may not be necessary to relist for every project. For instance, basin planner, and VTrans coordinator.

Plainfield and Waterbury are very aware of what projects qualify for hazard mitigation funding. They both have been hit by large floods including Irene and the May 2011 flood and have been through the process of applying for Hazard Mitigation funding. The worksheet will help CVRPC direct the towns for priority projects that they have outlined for hazard mitigation funding.

The towns seemed to want more than just those projects that had a hazard mitigation component. It would be nice for them to have a similar type of worksheet that helped them organize all their projects and types of funding they should go for: flood, water quality, stormwater, transportation, etc. This of course is out of scope of the hazard mitigation goal for this project but was an idea that came out of it. There are many programs/assessments that

already prioritize and a useful planning tool for towns would be something that they could use collectively so they can prioritize what grant they would go for in a given year.

From Two Rivers Ottauquechee Planning Commission:
Some background thoughts, FEMA Hazard Mitigation plans have a project list (usually just a list), while Basin Plans have a project list that links to the DEC ARK https://anrweb.vt.gov/DEC/IWIS/ARK/ProjectSearch.aspx which basically includes digital versions of project packets. River Corridor Plans produce project packets as a deliverable, so Project Readiness Workbooks are project packets for HMGP plans.

It might be better if all projects were tracked by reach through the ARK. Even if they are VTrans, Better Roads, Grants in Aid, HMGP, ERP etc. The VTrans projects don't need a lot of info because they are FHWA ER and just a heads up, but the others should be more detailed. Maybe the ARK could export project info like a project readiness workbook. You could require all project packets generated by various DEC grants to look more like readiness workbooks and then recorded in the ARK.

For HMGP funding, the project readiness workbooks could be as close to the current HMGP or ERP format grant application as possible. Can we still apply for ERP grants in case we have no disasters for a while (no HMGP funds)? It would be useful to rank the projects for HMGP/ERP respectively.

From Chittenden County Regional Planning Commission:
As indicated in the instructions, the first step is to read through the towns All Hazard Mitigation Plan to identify problem areas. The issue with this is that many AHMP identify more general or broad problems than site specific, making it hard to select specific problem areas.

The workbooks are useful one-stop shops but unless RPC staff have the time and resources to continue to work with towns on project development, refinement, grant writing and implementation, these projects may not get off the ground.

From Southern Windsor County Regional Planning Commission:
The Project Readiness Workbook for West Windsor was well received, and the Hazard Mitigation Committee has included it as an appendix in their recent Hazard Mitigation Plan. Three of the projects were identified as specific action items for the HMP which were recently reviewed by the RPC and Select Board.

VTrans Subgrant: PROCESS OVERVIEW AND TIMELINE

- October 2015-December 2015
  - Consultant procurement and project kick-off
- 2016
  - Data collection and development of the on-line transportation resilience planning tool (TRPT). Refinements were made to the TRPT throughout the project.
  - Developed methods to quantify the vulnerability of road embankments, culverts and bridges to damage from floods, applied and validated the methods in three pilot watersheds
  - Developed transportation criticality and risk assessment methods, applied and validated the methods in three pilot watersheds.
- 2017
  - Developed methods to identify mitigation options based on the factors driving the flood vulnerability and the criticality of specific locations.
  - Conducted two stakeholder meetings in each of the three pilot watersheds to review the vulnerability and criticality assessment, and then to review how the TRPT can be used to identify mitigation options.
  - Developed flood vulnerability and resilience metrics for road embankments, culverts and bridges that can be applied statewide for use in the VTrans project selection and project prioritization process.
- 2018
  - Preparing case study summaries for each pilot watershed to demonstrate how the TRPT can be applied to inform hazard mitigation planning
  - Preparing a user guide that includes specific instructions on the methods.
  - Will conduct a workshop to demonstrate how to apply the TRPT and the statewide flood resilience results.

STAKEHOLDERS INVOLVED

Steering Committee: The steering committee provided input at major milestones throughout the project. Membership included VTrans staff from Policy & Planning, Structures, Asset Management, Highway Safety & Design, Operations, Environmental and GIS; Agency of Natural Resources; Vermont Emergency Management; Agency of Commerce and Community Development; Vermont Center for Geographic Information; Regional Planning Commission and the University of Vermont.

Task Teams: Smaller task teams of subject matter experts guided the details for the following specific tasks: Data and On-Line Resilience Tool; Flood Vulnerability Assessment; Transportation Criticality and Risk Analysis; and Mitigation Identification.

Watershed Stakeholder Meetings: Watershed stakeholder groups included municipal officials and staff, watershed groups, regional planning commission staff and VTrans and ANR staff that work in the watersheds. Two rounds of stakeholder meetings were conducted in each of the three pilot watersheds. The first round provided an overview of the project and presented the results of the preliminary vulnerability and criticality results. Feedback from stakeholders was used to refine the methods. The

second round of stakeholder meetings presented the on-line Transportation Resilience Planning Tool and case studies to demonstrate how it can be applied.

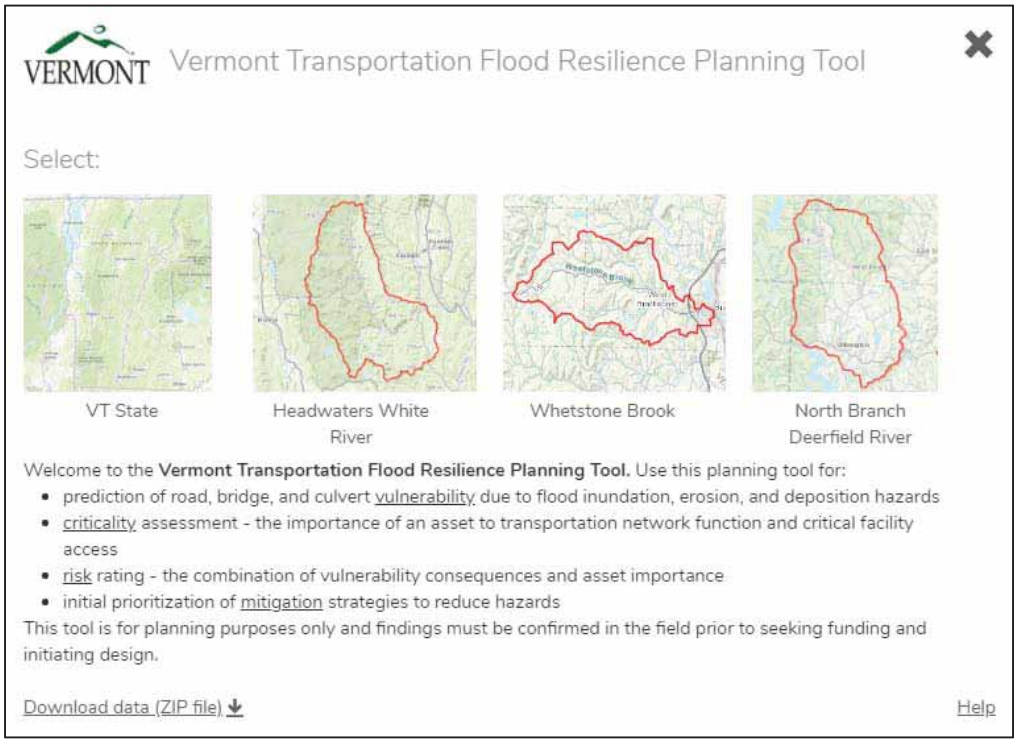
Training: A training workshop will be provided at the completion of the project to train planners, engineers and field staff on how to use the TRPT. Training on the TRPT will also be incorporated in the on-going Rivers and Roads training series provided jointly by the Vermont Agencies of Transportation and Natural Resources.

DELIVERABLES

The major deliverables are the on-line Transportation Resilience Planning Tool (TRPT); the methods that are used by the TRPT to assess flood vulnerability, estimate transportation criticality and risk, and identify mitigation options; and the methods and results of a statewide flood vulnerability assessment for road segments, bridges and culverts on state and municipal highways.

Transportation Flood Resilience Planning Tool: The Transportation Flood Resilience Planning Tool (TRPT) is a web-based application that identifies bridges, culverts and road embankments that are vulnerable to damage from floods; estimates risk based on the vulnerability and criticality of roadway segments; and identifies potential mitigation measures based on the factors driving the vulnerability. The TRPT was developed and tested in three pilot watersheds and is ready to be applied throughout Vermont to inform project scoping, capital programming and hazard mitigation planning at the state, regional and local levels. The TRPT web application is complete and ready to accept data in more watersheds (Figure 1). Documentation is under development and will provide the details on how to upload new vulnerability and criticality data to the TRPT.

Figure 1: Transportation Flood Resilience Planning Tool Front Page



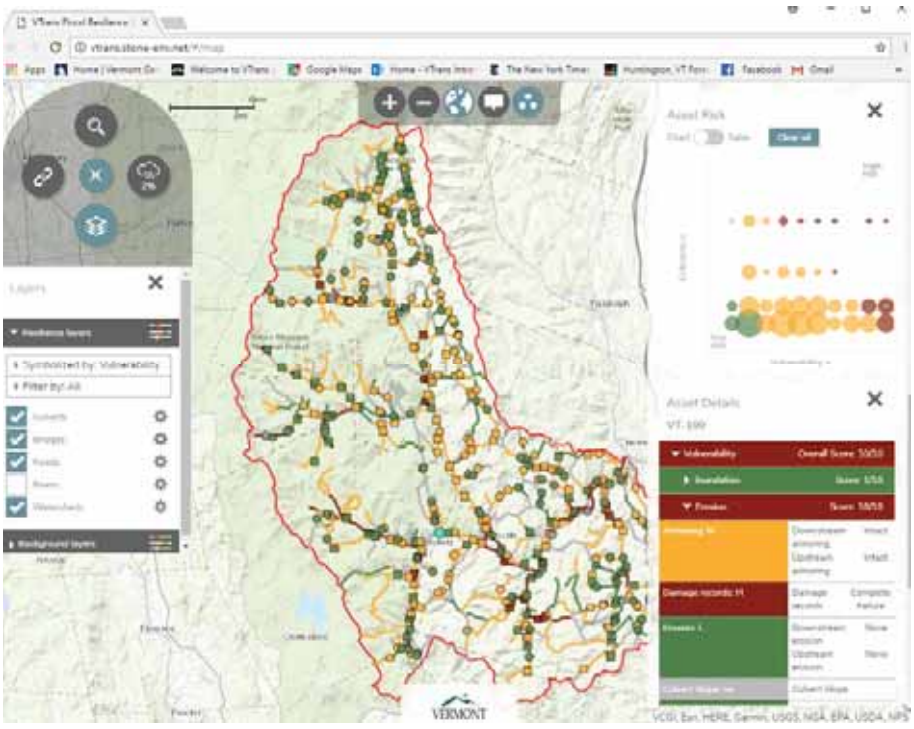
Flood Vulnerability Analysis Method: A GIS level method was developed that identifies road embankments, culverts and bridges that are vulnerable to damage resulting from inundation, erosion and deposition for 10-year, 50-year and 100-year storm events. The vulnerability score relates to the extent of damages likely and their impact on capacity and travel (Figure 2).

Figure 2: Vulnerability Levels and Scoring

Vulnerability Score	Failure Mode	Influence	Distance	Vulnerability Type
1, 2, 3	Partial Closure	Single lane closure, reduced capacity with some allowable travel, <24 hours	<0.25 miles	Inundation
4, 5	Full Closure	Multi-lane closure, detour required, 24 hours to several days	0.25 – 1 mile	Inundation, Erosion, or Deposition
6, 7, 8	Temporary Operational Failure	Partial destruction of facility. Several days to a 1 week for recovery.	0.25 – 1 mile	Inundation, Erosion, or Deposition
9, 10	Complete Failure	Complete destruction of facility. 1 week to months for recovery.	Varies	Erosion or Deposition

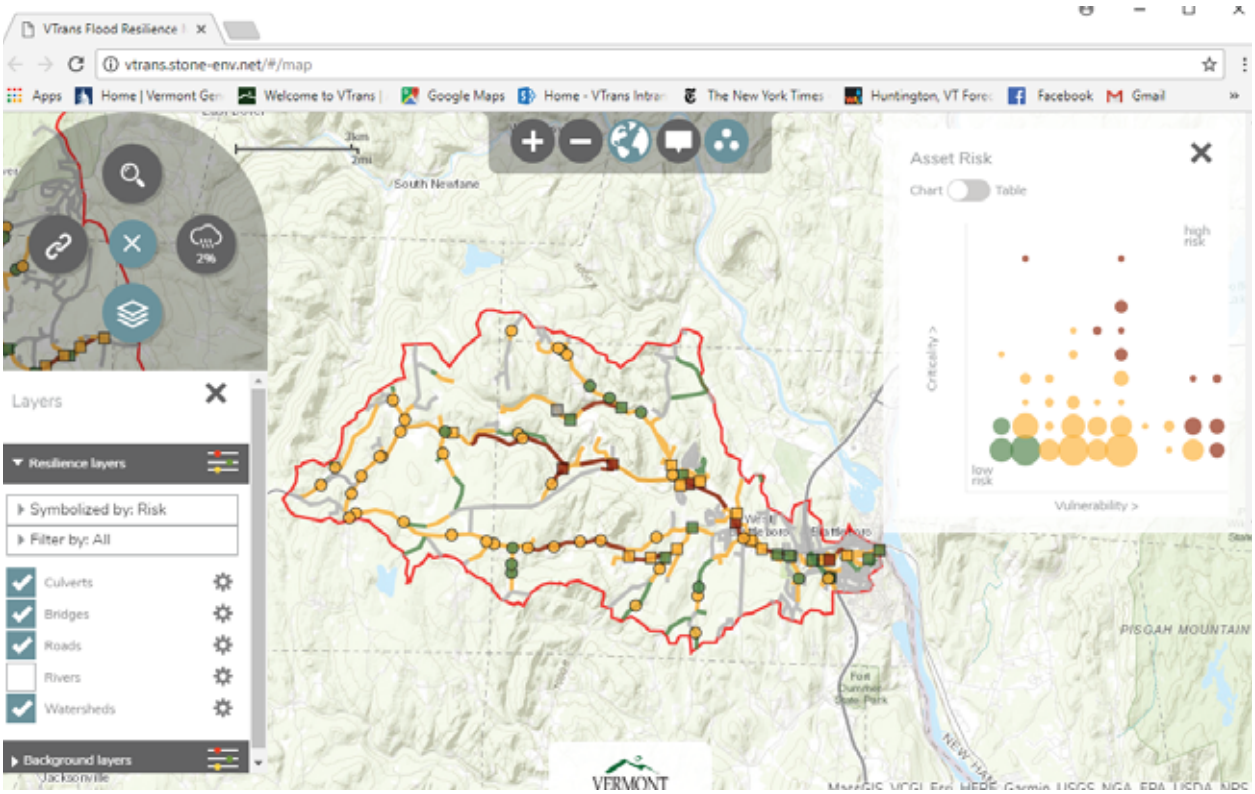
The vulnerability score is calculated based on past damages; geomorphic characteristics of the river; physical characteristics of the road embankment, culvert or bridge; relative location and extent within the floodplain and river corridor; and landscape scale features such as valley slope and confinement. These factors are determined for specific road embankments, culverts and bridges using spatial and other data analysis methods. The variable scores were fine-tuned following stakeholder meetings held in each pilot watershed to reflect local knowledge of vulnerability and criticality. The consultant team conducted field visits to verify the final vulnerability results and found that only 5% of locations required adjustments. Figure 3 shows the vulnerability analysis for the Upper White River Watershed.

Figure 3: TRPT Risk Assessment in Upper White River Watershed



Transportation System Criticality and Risk Assessment Method: A ten-point scale was developed to assign criticality to road segments within a watershed. The criticality score is based on a "network criticality index" estimated using the Vermont statewide travel demand model, a "critical closeness accessibility" index that measures proximity to emergency services, and an override that allows watershed stakeholders to identify important road segments that were not identified through modeling. VTrans has an on-going cooperative agreement with the University of Vermont Transportation Research Center to maintain and support the statewide travel demand model. The UVM TRC will be modifying the statewide model to make the criticality assessment available for all watersheds in the state. For the purposes of the transportation resilience planning tool, risk for each road embankment, culvert and bridge is calculated as the average of the vulnerability and criticality score. Figure 4 shows the risk analysis for the Whetstone Brook Watershed.

Figure 4: Risk Analysis for the Whetstone Brook Watershed



Mitigation Identification and Screening Method: A decision tree and screening methodology was developed to identify mitigation options. Mitigation options are selected for specific road embankments, culverts and bridges based on the causes of the vulnerability and network criticality. The TRPT provides multiple options for each location that can inform hazard mitigation and capital planning. It provides a starting point for project scoping when a more detailed alternatives analysis would be undertaken.

Statewide Road, Bridge and Culvert Flood Vulnerability Assessment and Project Prioritization: The detailed flood vulnerability analysis work in the three pilot watersheds allowed for the identification of key indicators that could be applied statewide using data that are available across the state. Results are shown in Figure 5 for road segments and Figure 6 for bridges and culverts. The vulnerability results will

be combined with a statewide transportation network criticality analysis as the basis for the resilience criterion of the Vermont Agency of Transportation's project selection and prioritization process update. Including flood resilience as a criterion in the annual prioritization of transportation projects will help direct funds available through the VT Agency of Transportation capital program to projects that will help reduce flood and other hazards that could disrupt the transportation system. The statewide assessment will can also be used to inform hazard mitigation at the local and regional levels when the more detailed watershed analyses are not available and will also be considered in the VTrans corridor planning process.

Figure 5: Statewide Flood Vulnerability Assessment for Road Embankments

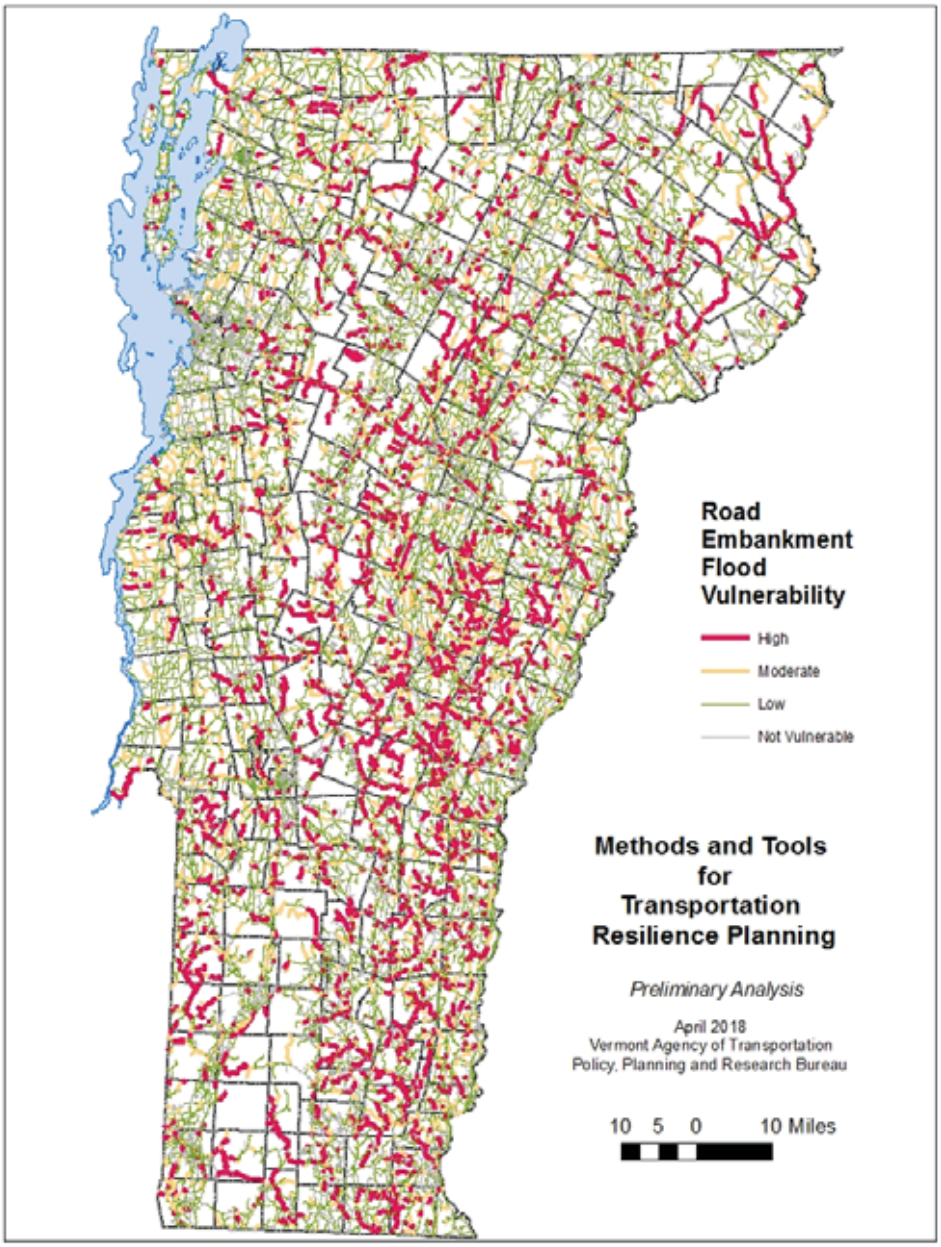
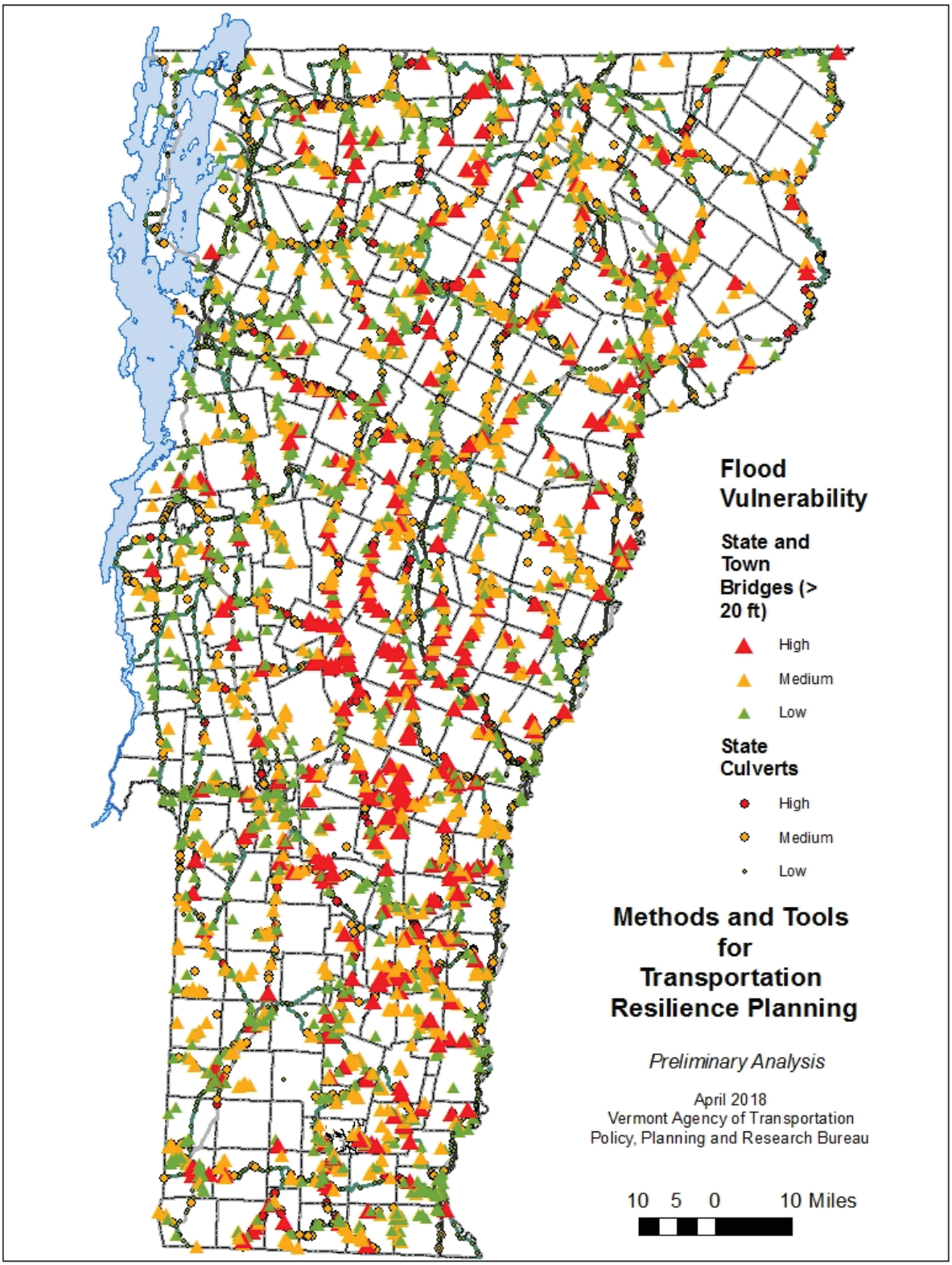


Figure 6: Statewide Flood Vulnerability Assessment for Culverts and Bridges



Building Prioritization: *Methodology*

This document is part of a larger study that assesses *all* state owned and leased properties, identifies those properties that fall within special flood hazard areas, prioritizes these buildings for further mitigation analysis and preliminary engineering. For the purposes of this study, special flood hazard areas refer to those structures that fall within (1) FEMA 100-year flood areas, (2) FEMA 500-year flood areas, and (3) identified fluvial erosion risk hazard areas.

Using GIS analysis and a variety of other data sources, all buildings have been mapped and their exposure to special flood hazard risks has been determined. From this master list, buildings that are currently in the process of major engineering that already have flood hazard mitigation engineering have been removed from this prioritization process to avoid redundant engineering costs. A master list *including* these buildings will be provided as a deliverable with this study.

This document outlines the procedure used to establish criteria and priority for all state of Vermont buildings, owned and leased, that are located within Special Flood Hazard Areas across the state, as well as, the process used to create a prioritization matrix, to establish the actual criteria ratings for each building using a collaborative process across impacted Agencies and Departments, and finally establish prioritized list of buildings that can be used for further engineering planning.

Data sources and descriptions are listed for all data used in during the process.

Initial Identification of buildings falling within Flood Hazard Areas

Using GIS analysis, already described in "Flood Hazard GIS Procedures", all of the State owned, and leased buildings were assessed to identify those structures that fall within the Special Flood Hazard areas listed above. Of the 1705 total buildings, 112 falls within the FEMA 100-year, FEMA 500-year, and Fluvial Erosion Hazard Areas.

As an earlier part of this study, GIS analysis provides a list of buildings and the Agencies/Departments that own them. It also includes data that identifies which buildings wall within each of the above special flood hazard areas, as well as the projected level of flood water inundation that can be expected during and event. The following is a list of the Agencies and Departments that individually owned and/or leased buildings for State use:

- The Agency of Administration
  - Buildings & General Services
- The Vermont Agency of Transportation
- The Vermont Agency of Natural Resources
  - Forest, Parks, and Recreation
  - Fish & Wildlife
- The Vermont Agency of Commerce & Community Development
  - Historic Preservation
- The Vermont National Guard

With the exception of Buildings & General Services, most Agency building owners dedicate use of their facilities to their own Agency and departmental work. However, Buildings & General Services (BGS) is unique in that it manages properties that are used by many agencies and departments that do not have the resources to own and maintain their own structures. BGS acts as a kind of non-profit landlord to these departments. They pay for space on a cost per square foot basis. In any given BGS building, there may be many Departments from many different Agencies occupying different spaces on the same (or different) floors in the same building. Detailed occupancy information is maintained by the BGS CAD Section staff using CAD layouts showing exactly what space is occupied by any given tenant group. This is important from a prioritization perspective because any one (or all) of these groups may be of critical importance based upon any criteria that are ultimately established. This occupancy data is documented in an annual BGS publication titled "The Space Book - State Owned, Leased, Land Holdings, Tower Leases, Rest Areas". For the purposes of this study, the departmental occupancy in buildings that are subject to this study were taken from the 2017 release of this document. Merging this data with those buildings known to be within Special Flood Hazard Areas identified what departments needed to be included in developing prioritization criteria for flood hazard mitigation engineering.

A prioritization committee was created whose membership represented each of these impacted groups. Representatives sent by each Agency/Department included: The Agency of Human Services (Guy Norwood), The Agency of Natural Resources (Brenda Berry), Historic Preservation (Tracy Martin & David Schutz), The Department of Public Safety (Stephanie A. Smith), The Vermont Agency of Transportation (Brad McAvoy), Buildings & General Services (Richard Kehne, Joe Aja, Mike Kuhn, David Schutz), The Agency of Agriculture (Diane Bothfeld) and the Vermont Nation Guard (John Patry). Their tasks were two-fold: First, the committee met mutually decide upon the criteria upon which the prioritization would be based. The criteria established at this meeting are as follows - Functions Critical to:

- Emergency Operations
- Government Function
- Public Safety
- Public Health
- Public Service
- Economic Activity
- Cultural Resource

At the meeting and in subsequent e-mail conversations, it was established that each criterion would be given a point scale rating on a per building basis as flows:

- 0 = non-critical infrastructure: *(interruption of service not significant during any given flood event and thru the recovery process)*
- 1 = low importance as critical infrastructure: *(interruption of immediate and longer-term service poses only minor inconvenience across the usership of this service)*

- 2 = medium importance as critical infrastructure: *(Interruption of service in service poses minor impacts during a flood event but significantly impacts service during a recovery period)*
- 3 = high importance as critical infrastructure: *(Interruption in service has a significant impact during a flood event and during the recovery period.*
- 4 = Indispensably critical to emergency response and operations: *(These are functions critical to response and government function and can not be interrupted without major impact during an event and/or during the recovery period)*

Other items considered as criteria but ultimately rejected include: (1) FEMA 100 & 500-year flood inundation in any given building, and (2) building replacement value. These were rejected as base criteria, but it was decided that these could be used as tie-breakers in the event of matching or very close scoring.

At the meeting, definitions for each Criterion were established as follows:

- Emergency Operations
    - Description: *Groups or services critical to emergency response communications and/or logistics during and after a flood event.*
    - Includes: *Communications, logistical support during a flood event and through the life of the response and clean-up; equipment storage, food and other personal supplies and dispersion, emergency shelters, transportation etc.*
- State Government Operations
    - Description: *infrastructure/groups critical to keeping state government functioning on a daily basis. Examples include: AOT District Garages,*
    - Includes: *Transportation operational facilities, financial services, communications, IT services, etc.*
- Public Safety
    - Description: *Services impacting Public Safety*
    - Includes: *communications, response logistics, material and or supply storage/deployment, Critical equipment storage, transportation, etc.*
- Public Health
    - Description: *Groups or services intended to preserve public health and welfare.*
    - Includes: *clinics, medical supplies, treatment facilities, logistical support communications, etc.*
- Public Service
    - Description: *Services to the public at-large which cannot be interrupted,*
    - Includes: *Financial/economic support services, counseling, family support services, child support services, services supporting at-risk populations.*
- Cultural Resource
    - Description: *Services and structures deemed to be of historic or cultural value.*
    - Includes: *Historic properties, cultural heritage sites, museums and/or storage of artifacts.*

Criterion established but *not* used in initial prioritization, but which can be used as tie breakers or when scores are very close, the descriptions are as follows:

- Vulnerability of Structure during a FEMA 100year and/or 500year flood event
    - Description: Indicates whether or not this property is in the flood plain and what level of water inundation can be expected in a 100-year and or 500-year flood event.
    - Includes: 0 points for "no flood", 1 point for flooding up to 1 foot, 2 points for flooding above 1' up to 4' of flooding, 3 points for flooding above 4 'up to 6', and 4 points for inundation greater than 6' Vulnerability to Fluvial Erosion
- Vulnerability of Structure to Fluvial Erosion
    - Description: Risk that structure is in a fluvial erosion hazard area.
    - Includes: ***0-*** *points if not in a fluvial Erosion hazard area;* ***4-*** *points if located in an identifies fluvial erosion hazard area.*
- Cost of Building Replacement
    - Description: *Cost impact of building replacement*
    - Includes: ***0-points*** *= $0 - $100,000 (non-critical);* ***1-point*** *= $100,000 - $250,000 (low impact);* ***2-points****= $250,000 - $500,000 (moderate impact);* ***3-points*** *= $500,000 - $1,000,000 (high impact);* ***4-points*** *= greater than $1,000,000 (critical impact)*

After the establishment of the Criteria and their definitions were established, the Project Manager compiled these criteria into a prioritization matrix and spreadsheet. This was sent around to each of the committee members with instructions to individually prioritize the buildings under their specific ownership and/or control. In the case of the cultural resource criteria, Historic Preservation and the Curator of the Capitol ranked most of the buildings, regardless of ownership. Within BGS controlled buildings, which generally house multiple groups representing many different agencies and departments, the Project Manager reached out to many specific tenant groups to identify the criticality of their operations within a given building. In any building with multiple tenants, the criteria rating is based upon the *highest rating* among all the tenant groups in the building. *(Note: Within the priority spreadsheet developed for this study, the actual scoring is color coded to identify the source of the prioritization numbers.)*

Prior to actually analyzing and sorting the compiled dated, the Project Manager worked with each of the Agency/Department groups to remove buildings from the list which were clearly not priorities (such as lean-to's and cabins). Buildings that fell within special flood hazard areas, for which we already have engineering projects in process that involve flood hazard mitigation engineering, were also excluded. Examples of these are buildings in the Waterbury Complex. Though not included in the actual prioritization, these buildings will be shown and identified in an accompanying master spreadsheet listing all State owned and leased buildings, along with an explanation of why they were excluded. The Worksheet is called "Master List with Deletions" and resides as an Excel worksheet within the Excel prioritization Workbook named: 2018_4_25_Flood Hazard_List_Final_2a

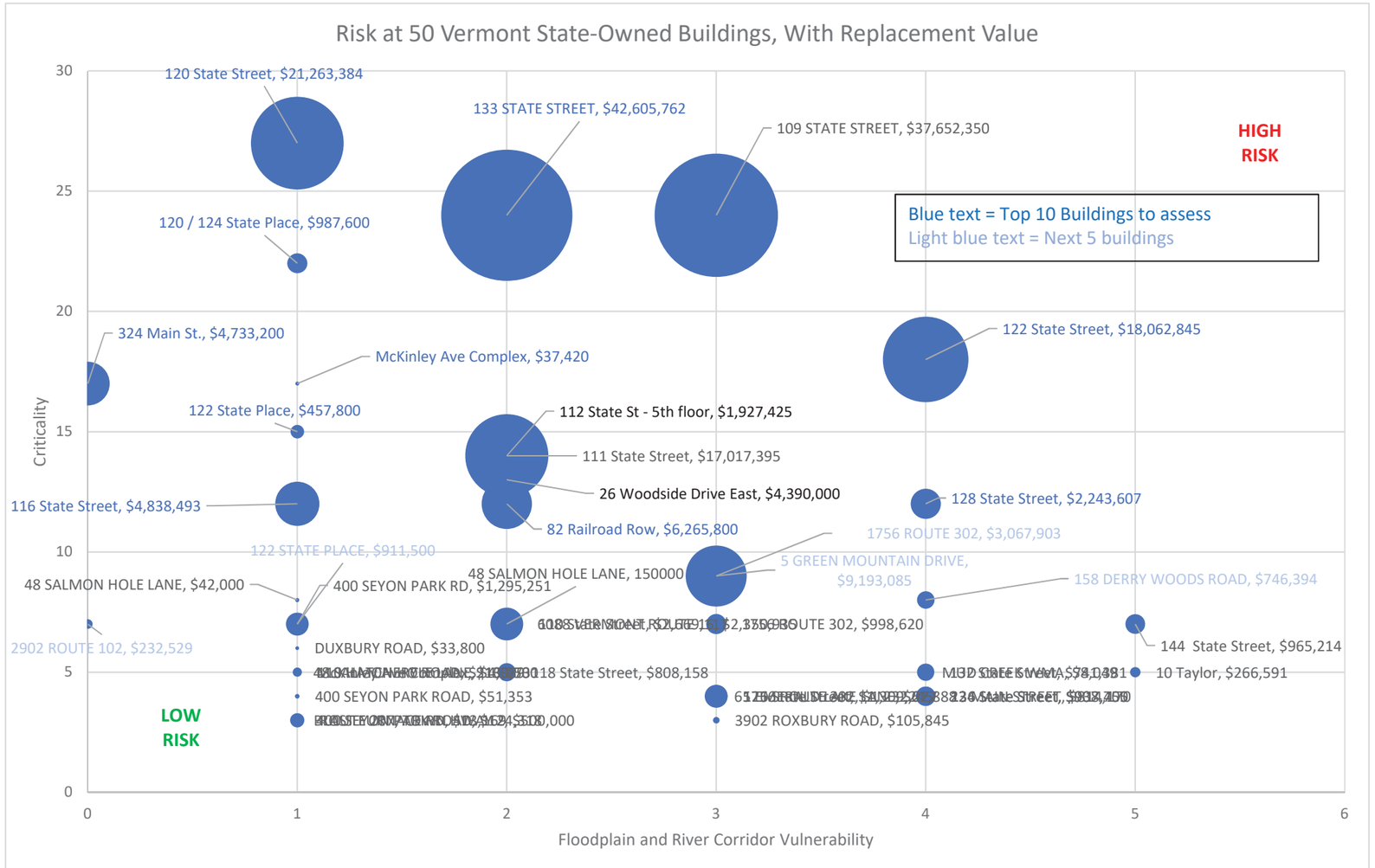
The final priority document to be used for mitigation engineering is also included in this Excel workbook and is named: "Final Priority Mstr List". Within this list, the point scores for each building under each of the specific criteria are summed up as a building total and then sorted from highest to lowest point score: The highest number being the highest priority for mitigation and proceeding in descending order. In the cases where scores are equal, the vulnerability to flood water category rating and then the building replacement value can be used to establish priority.

The group discussed the possibility of applying a weighting structure to different criterion that would give more weight to certain items, but in the end, it was decided to weight all evenly and let the number scores for each drive the priority number. The resulting list includes 112 buildings, all of which fall within 100-year, 500-year, and/or fluvial erosion hazard areas. It is this list that provides the order of priority for mitigation engineering scoping and construction as funds become available.

List of committee members and primary participants involved with the building prioritization process:

- Richard Kehne, BGS
- Stephanie A. Smith, VEM
- Lauren Oates, VEM
- Brenda Berry, ANR
- Steve Gomez, ANR-Fish &W
- Frank Spaulding, ANR-FPR
- Brad McAvoy, VTrans
- Alec Portalupi, VTrans
- Diane Bothfeld, Agriculture
- Tracy Martin, Historic Preservation
- David Schutz, Curator of the Capitol
- John Patry, National Guard

BGS Subgrant Project - Priority Building Assessment



TOP 15 list (Updated from Rick's emails 5/25/2018)

1	120 State Street (6020)*
2	133 State Street (6025)*
3	120/124 State Place, Rutland (6308)
4	122 State Street (6021)*
5	McKinley Avenue Complex, Rutland (6310)
6	324 Main Street, Bennington (6082)
7	122 State Place, Rutland (6309)
8	128 State Street (6023)*
9	82 Railroad Row, White River Junction (6420)
10	116 State Street (6019)* [moved up]
11	5 Green Mountain Drive (1030)*
12	1756 Route 302, Berlin (9004)
13	158 Derry Woods Road, Londonderry (9224)
14	122 State Place (District Garage), Rutland (9322)
15	2902 ROUTE 102, Bloomfield (9931)
EC only	109 State Street (6014)
EC only	111 State Street (6016)

NOTES

109 and 111 State Street already have flood mitigation in progress.
Central Heat Plant at 122 State Street likely to be floodproofed since new.
May want to add 144 State Street (Green Mountain Care Board) as vulnerable with moderate value.
May want to add 122 State Place (District Garage) while in area.

NOTES FROM RICK ON 5/21/2018

We won't need to evaluate 109/111 State Street project as flood mitigation and cost complete. However, add EC for these structures.
Woodside is off of the table as this facility is going to be torn down over the next few years and new structures will be built.
Skip 144 State street as this building is slated to be replaced in the near future.
Skipping 112 State Street as this building already has flood gates in it that are about to be repaired.

State of Vermont Owned/Leased buildings by Priority - July 2018

Owner	Town	Address	Occupancy	Total Score	Critical to Emergency Operations	Critical to State Gov't Operations	Critical to Public Safety	Critical to Public Health	Critical to Public Service	Critical to Emonomic Activity	Critical to Cultural Resources	Vulnerability	FEMA 100-yr	FEMA 500-yr	Fluvial Erosion Area	Replacement Value	Flood Height on Structure 100-yr	Flood Height on Structure 500-yr	FEMA Flood Profile?	In Floodway?	Comments
BGS	Montpelier	120 State Street	Digital Services, BGS - Maintenance, DHR, VTHR, Motor Vehicles	**27**	4	4	4	3	4	4	4	3	NO	YES	NO	$21,263,384.14	-0.6	0.6	y	n	
BGS	Montpelier	109 State Street	Pavillion, ADS, BGS, Purchasing & Contracts, Finance, Libraries, Secretary of Administration, Attorney General,Executive Office (Gov),Treasurer, Court admin, Historical Society	**24**	4	4	4	1	4	4	3	2	YES	YES	NO	$37,652,349.99	3.1	4.8	y	n	Flood hazard Scoping for this building has already been completed as part of upcoming rennovation project
BGS	Montpelier	133 State Street	ADS, BGS, Department of Taxes, DPS (radio room)	**24**	4	4	4	2	3	3	4	4	YES	YES	NO	$42,605,761.98	1	2.7	y	n	
DPS	Rutland	120 / 124 State Place	Public Safety	**22**	4	4	4	3	2	3	2	1	NO	NO	YES	$987,600.00	-6.4	-5	y	n	
BGS	Montpelier	122 State Street	BGS Maintenance, Central Heat Plant	**18**	4	4	0	0	4	4	2	2	YES	YES	YES	$18,062,845.36	3.4	4.6	y	y	recently rebuilt and had dry mitigation engineering was built into the structure. However, we arehaving an updated Flood Elevation Certificate ofr this building.
DPS	Rutland	McKinley Ave Complex	Public Safety Radio Shop	**17**	4	3	4	3	3	0	0	1	NO	NO	YES	$37,420.14	-5.4	-4	y	n	
BGS	Bennington	324 Main Street	VDH (Health), FPR, BGS - L.O. 378 - CCV, BGS - L.O. 383 - AIDS Task Force, BGS - Maintenance, BGS - Vacant	**17**	3	4	1	3	3	0	3	1	YES	YES	NO	$4,733,200.00	-7.6	-6	y	n	
DPS	Rutland	122 State Place	Public Safety	**15**	3	3	3	3	3	0	0	1	NO	NO	YES	$457,800.00	-6.4	-5	y	n	
BGS	Montpelier	111 State Street	BGS, Libraries, Court Admin, Family Court, Justices, Supreme Court	**14**	0	3	3	0	3	1	4	0	YES	YES	NO	$17,017,395.38	1	2.8	y	n	Flood hazard Scoping for this building has already been completed as part of upcoming rennovation project
BGS	Montpelier	128 State Street	Secretary of State	**12**	3	3	1	0	3	2	0	1	YES	YES	YES	$2,243,607.30	3	4.6	y	n	
BGS	White River Jct	82 Railroad Row	BGS - Maintenance, District Court, Sheriff	**12**	3	2	3	0	3	0	1	4	YES	YES	YES	$6,265,800.00	-4.8	1	y	n	
BGS	Montpelier	116 State Street	Agriculture, Food, and Markets	**12**	2	0	2	2	0	2	4	2	YES	YES	NO	$4,838,493.24	-1.1	0.4	y	n	

BGS	Montpelier	5 Green Mountain Drive	Dept of Labor	**9**	0	0	0	0	4	3	2	1	YES	YES	YES	$9,193,085.40	0.6	2	y	n	
AOT	Berlin	1756 Route 302	AOT Central Garage	**9**	3	3	2	0	1	0	0	2	YES	YES	YES	$3,067,903.30	1.9	3.5	y	n	
AOT	Londonderry	158 Derry Woods Road	AOT Londonderry Garage	**8**	3	2	3	0	0	0	0	3	YES	YES	NO	$746,394.02	4	8.8	y	n	
AOT	Rutland City	122 State Place	AOT Rutland District Garage	**7**	3	3	1	0	0	0	0	4	NO	NO	YES	$911,500.00	-8.4	-7	y	n	Critical infrastructure observed to be at-risk during site vist to DPS faciltiy. The building becomes isolated by flooding during severe floor events.
AOT	Bloodfield	2902 Route 102	AOT Bloomfield Garage	**7**	2	3	2	0	0	0	0	3	YES	YES	NO	$232,529.28	-54.5		y	n	

BUILDING ASSESSMENT FORM

Building Address & Description: 5 Green Mountain Drive, Montpelier, VT (BGS ID #01030)

Local Contact: Tom Tomasi & Richard Kehne, VT Buildings & General Services

Assessment Team: Tom Bursey (FFF), Cameron Burrows (FFF), Roy Schiff (MMI), Brian Cote (MMI)
Jason Dolmetsch (MSK), Sean Cohen (MSK), Lauren Weston (MMI)

Exterior Photos:

Figure 1: West Façade looking East (photo credit: Freeman French Freeman)

Special Flood Hazard Area and Vermont River Corridor:

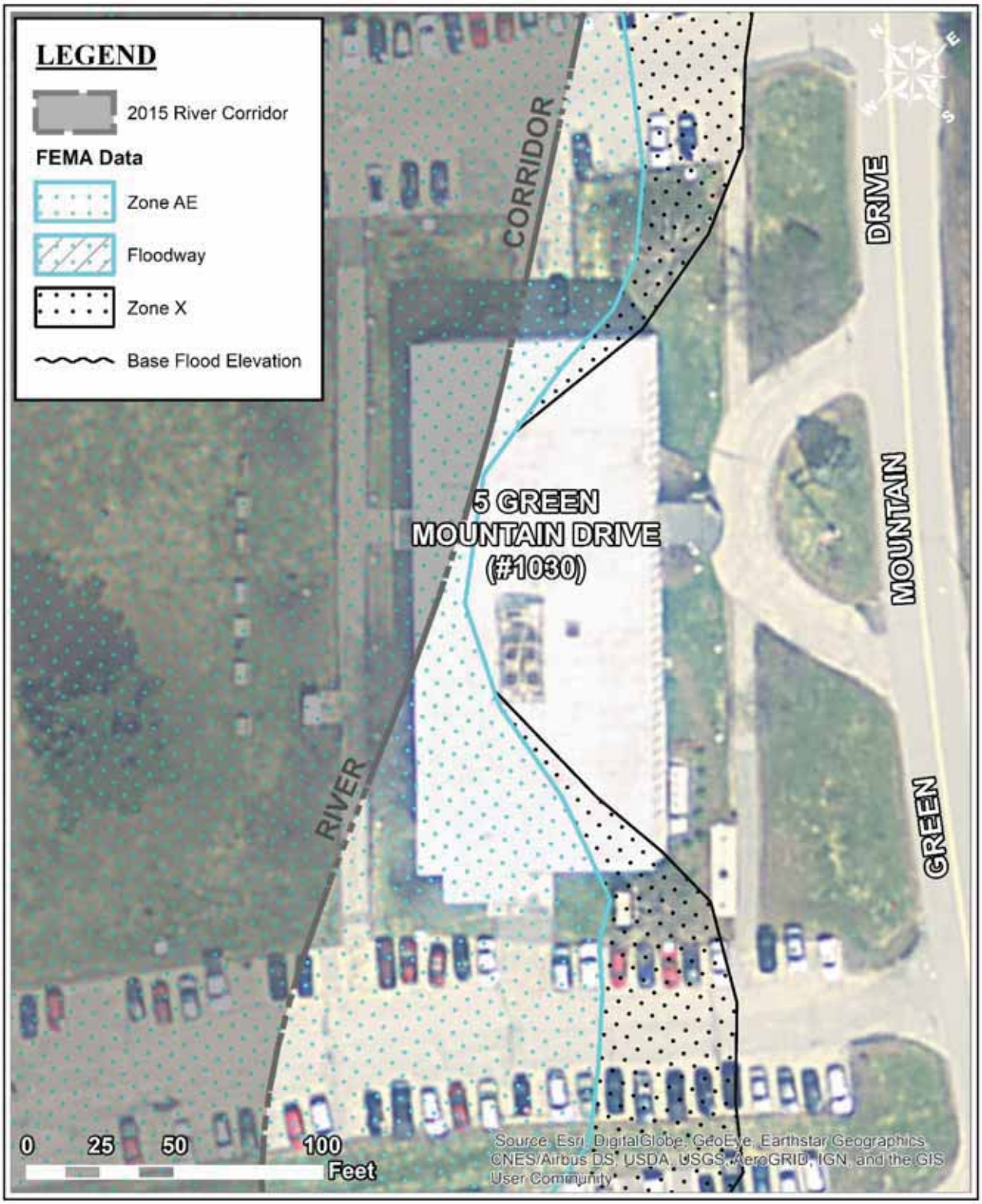


Figure 2: Flood Hazard Map (1in = 50 ft)

Plan View with Lowest Points of Entry:

Figure 3: Lowest Point of Entry (1in = 50 ft, elevations reference NAVD 88 vertical datum)

Floor Plan:

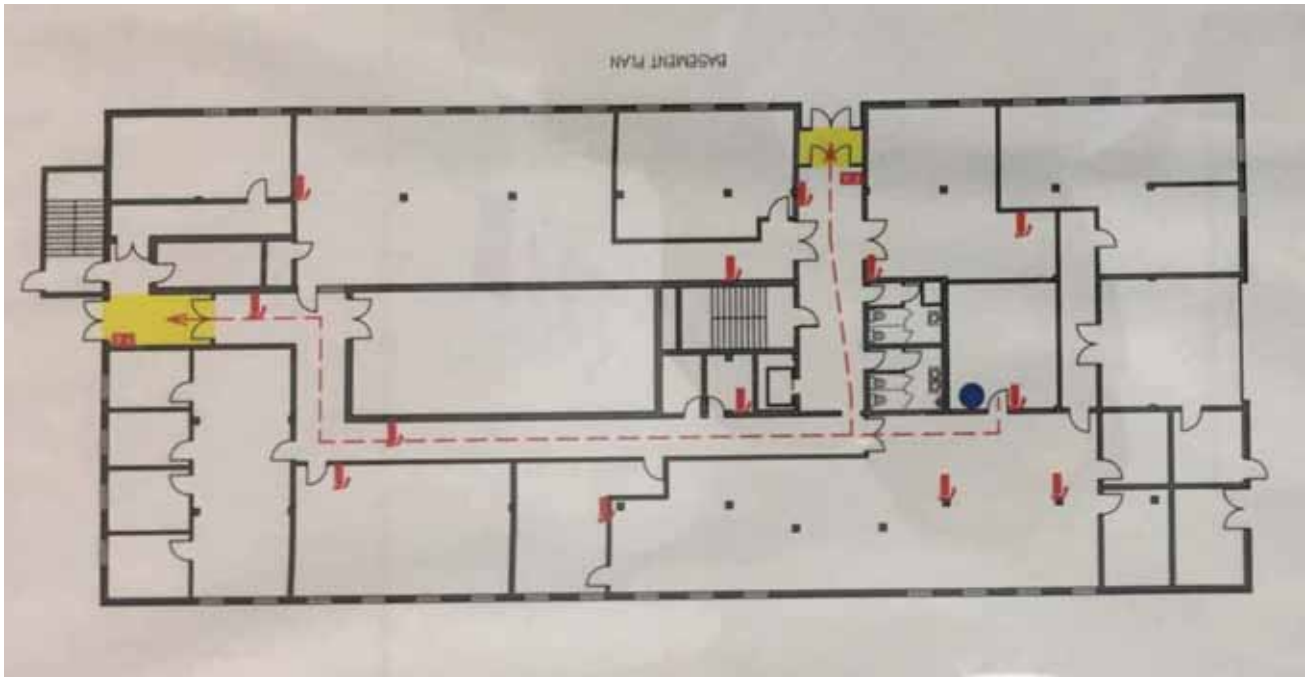


Figure 4: Basement (walk-out) floor plan from building-posted egress map (N.T.S.)

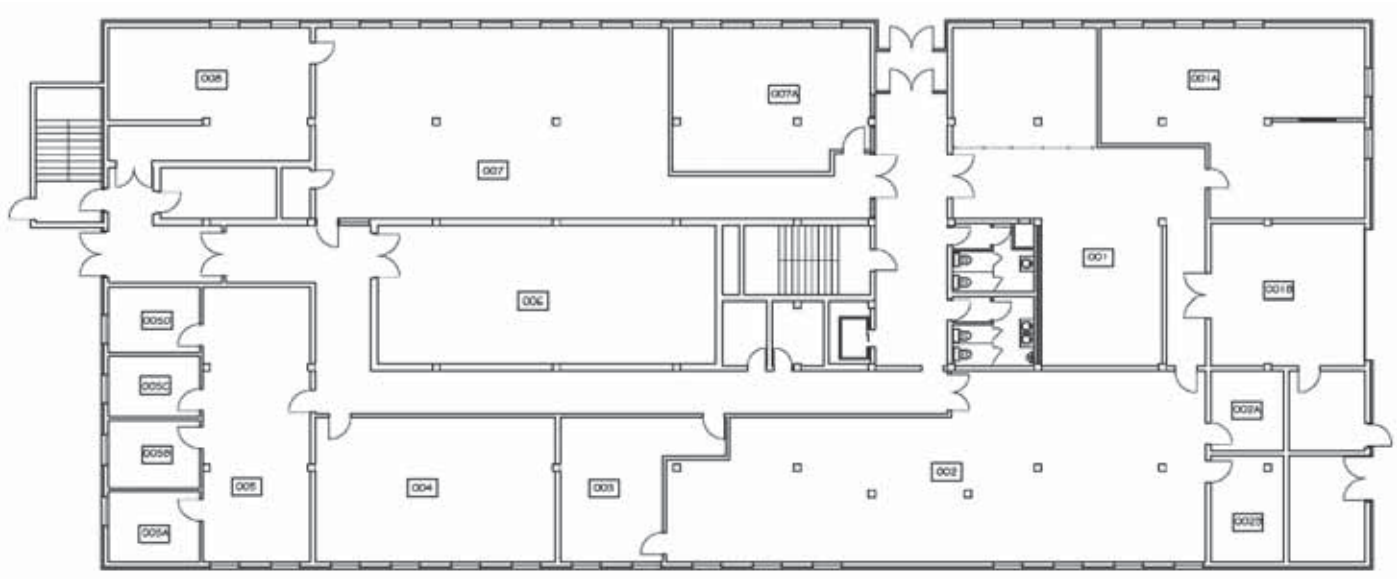


Figure 5: Basement floor plan from June 2008 Floor Plan drawings, Sheet A-1 (N.T.S.)

Photo Documentation:

Figure 6: Basement exit door west

Figure 7: Elevator machine room equip

Figure 8: Elevator

Figure 9: EMR equipment

Figure 10: Liebert network power units

Figure 11: Emergency Generator Tank Monitor

Figure 12: Basement electrical and mechanical equipment.

Figure 13 & 14: Mechanical rooms

Figure 15: Pad mounted Generator (SE corner)

Figure 16: Building West Elevation

Figure 17: Openings in south façade

Figure 18: Vents and openings in west façade

FLOOD HAZARD MITIGATION ASSESSMENT & ANALYSIS FOR STATE-OWNED BUILDINGS

BUILDING ASSESSMENT FORM

Building Information:

ADDRESS:	5 Green Mountain Drive, Montpelier
BUILDING ID:	01030
OWNER:	VT Buildings & General Services
OCCUPYING AGENCIES/DEPARTMENTS:	Department of Labor
REPLACEMENT VALUE (2017):	$9,193,085
SQUARE FOOTAGE:	26,752 sq. ft.
NO. OF FLOORS:	2
GROSS FLOOR AREA:	26,752 sq. ft. (two levels above grade excluding basement)
BASEMENT AREA:	13,376 sq. ft.
COST PER SQUARE FOOT:	$343.64 / sq. ft. (Replacement value / gross floor area) (without basement)

FOUNDATION:

Concrete Footing, Concrete Slab, Concrete Walls

FLOOR STRUCTURE:

Basement – Reinforced Concrete Slab on Ground

Upper Floors – Reinforced Concrete on Metal Deck

EXTERIOR WALLS:

Brick on masonry, Native Stone on Masonry

GENERAL CONTENTS/USAGE:

Basement – primarily used for building systems such as mechanical, electrical, plumbing, fire protection, Tel-com, and elevator machine room, along with restrooms, office space, and storage of supplies.

BASEMENT FLOOR AREA:	13,376 sq. ft.
NO OF FLOORS:	2 (two levels above grade excluding basement)
GROSS BUILDING AREA:	26,752 sq. ft.

Risk Overview

FEMA Zone:	Zone AE and Zone X
100-year Flood Elevation:	522.8 ft NAVD 88
500-year Flood Elevation:	524.2 ft NAVD 88
River Corridor:	Yes, northwest portion of the building
Ground Surface Elevation:	521.59 ft NAVD 88 (lowest grade adjacent to building)
Lowest Point of Entry:	522.29 ft NAVD 88 (threshold at walk-out overhead door)
Basement:	Yes – top of bottom floor = 522.32 ft NAVD 88 (basement)
	Top of next highest floor = 534.1 ft NAVD 88 (1st Floor)
Historic Building:	Yes

Description of Space Below Flood Levels: Lowest floor susceptible to flooding (basement) consists of building systems such as mechanicals, electrical panels, plumbing, fire protection systems, Tel-com panels, and elevator controls, along with restrooms, office space, and space generally used for storage of supplies. Also exterior mounted emergency generator and chiller equipment.

Risk Narrative:

Flood Vulnerability:

The building is located within the left floodplain (looking downstream) of the Winooski River. Approximately half of the building is located within the Zone AE Special Flood Hazard Area (SFHA) as depicted on FEMA Flood Insurance Rate Map (FIRM) Panel No. 0264E dated March 19, 2013, therefore an Elevation Certificate has been prepared. Based on the data provided on the Elevation Certificate, the lowest floor (basement) would be flooded during the 100-year and 500-year flood, however the upper floors (1st floor and 2nd floor) would not be flooded. During the 100-year flood, the depth of water would be approximately 0.5 feet above the basement floor, and the depth above the basement floor would be approximately 1.9 feet during the 500-year flood.

The items damaged during a flood include the majority of the building systems such as mechanical and electrical systems, plumbing and fire protection systems, Tel-com systems, and elevator controls. Damage also includes all porous finishes (wood, wainscoting, sheetrock, carpeting, etc.). All exterior and interior non-porous surfaces below flood levels would require clean up. All items stored at or below the flood levels would be damaged and potentially lost as well. Exterior mounted equipment including an emergency generator and chiller equipment located to the southeast of the building appears to be located outside of the FEMA Hazard Areas, although may be susceptible to flood damage. Additional information regarding potential flood damages is provided with the Recommendations.

Erosion Vulnerability:

The left boundary of the Vermont River Corridor (looking downstream) passes through the northwest corner of the building. Note that the river corridor includes both a meander belt (formerly called the fluvial erosion hazard zone) plus a 50-foot buffer. The corridor boundary is located approximately 400 feet from the top of river bank. The land between the building and river bank consists primarily of a parking lot, access drives, and green space. Given the setting in relation to the river corridor and the characteristics of flooding on the Winooski River, risk of damage due to erosion at this building would be considered medium to low.

Future Vulnerability:

Current trends in weather indicate that flooding in the region is becoming more frequent and more severe. State of Vermont flood mitigation standards require designs to meet a protection level of 1-foot above the 500-year flood. Future improvements at this location should meet or exceed that minimum standard.

Summary and Recommendation:

It is our understanding that the basement will be approximately 0.5 feet below water during a 100-year flood and approximately 1.9 feet below water during a 500-year flood. The majority of building Mechanical / Electrical / Plumbing / Fire Protection / Tel-com / and elevator machine room fixed equipment are located within the basement level. Exterior mounted equipment including an emergency generator and some chiller equipment on the south side of the building appears to be mounted above the 500-year level on stands (pending verification from Elevation Certificate survey). Typical flood waters bring strong currents and debris that may increase the potential to damage or destroy all exterior mounted equipment.

Mitigation Options:

If left as is and allowed to flood, the repair cost for the basement level can be estimated at $3,519,112.94.

It is recommended that the State investigate relocating the fire alarm, security, electrical, and Tel-com panels to spaces on upper levels to minimize renovation costs after a flood. Relocation of other heavier equipment and mechanicals such as boilers and hot water heater could take up too much valuable program space. To relocated select building utility systems, an estimated allowance of S180,000 can be assumed.

Alternatively, dry flood proofing the perimeter openings at the basement level to a point above the 500-year flood could be an option because the flood waters do not exceed 3.0’ and the “basement” is essentially a floor on grade with level walk-out ability. To add flood shields to the basement level openings, as well as emergency power and pumping systems, an estimated allowance of $2,338,964 can be assumed.

Another option would be to demolish the existing building then rebuilt in place at a higher elevation and / or protected from flooding. The cost to demolish the building and rebuild at the existing location can be estimated as $9,193,085.

The final option would be to design and construct a new building with the same square foot area at a new location that is not subject to flooding or erosion hazards. The estimated cost to design and construct a new building of the same area can be estimated at $12,410,664.

Summary of Mitigation Strategies:

A. Leave as-is and allow to flood: $3,519,113
B. Allow to flood and relocate selected systems to upper floors above the 500-year floodplain: $180,000
C. Dry flood proof perimeter building wall openings to a point above the 500 year flood plain, ensure available emergency power, and continually pump floodwater that breaches the flood proofing to minimize damage potential for existing building systems and allow systems reuse with minimal repair once floodwaters recede: $2,338,964
D. Demolish and replace building in existing location: 9,193,085
E. Design and construct new building of same square foot area in new location: $12,410,664

Mitigation Recommendations for Risk Reduction:

Flood-proofing Method	Effective?	Cost ($US)
Wet Flood-proofing:	Allow to flood and repair.	$3,519,113
Elevate Utilities:	Recommended in advance of flood for certain utilities, larger utilities recommend leave as-is because equipment is large and space is limited.	$180,000
Dry Flood-proofing:	Could be considered as an option.	$2,338,964
Building Relocation:	Optional, however not recommended.	
Elevate Building:	Optional, however not recommended.	
Sealing of Openings:	Could be part of dry flood proofing measures.	
Other Modifications:	Make note of contents and their ability to contaminate flood waters.	
TOTAL COST	**Potential project cost for mitigation**	**$ 6,038,077**

Benefit – Cost Summary:

Total Project Benefits	**$ 9,193,085**	**Replacement Value**
Total Project Cost	**$ 6,038,077**	**Potential Mitigation Cost**
Benefit – Cost Ratio	**1.52**	**Replacement Value / Mitigation Cost**

BUILDING ASSESSMENT FORM

Building Address & Description: 82 Railroad Row, White River Junction, VT (BGS ID #06420)

Local Contact: Shawn Brown and Mike Kuban, VT Buildings & General Services

Assessment Team: Cameron Burrows (FFF), Brian Cote (MMI)

Exterior Photos:

Figure 1: Front entrance looking east (photo credit: Freeman French Freeman)

Special Flood Hazard Area and Vermont River Corridor:

Figure 2: Flood Hazard Map (1in = 50 ft)

Plan View with Lowest Points of Entry:

Figure 3: Lowest Point of Entry (1in = 50 ft, elevations reference NAVD 88 vertical datum)

Floor Plan:

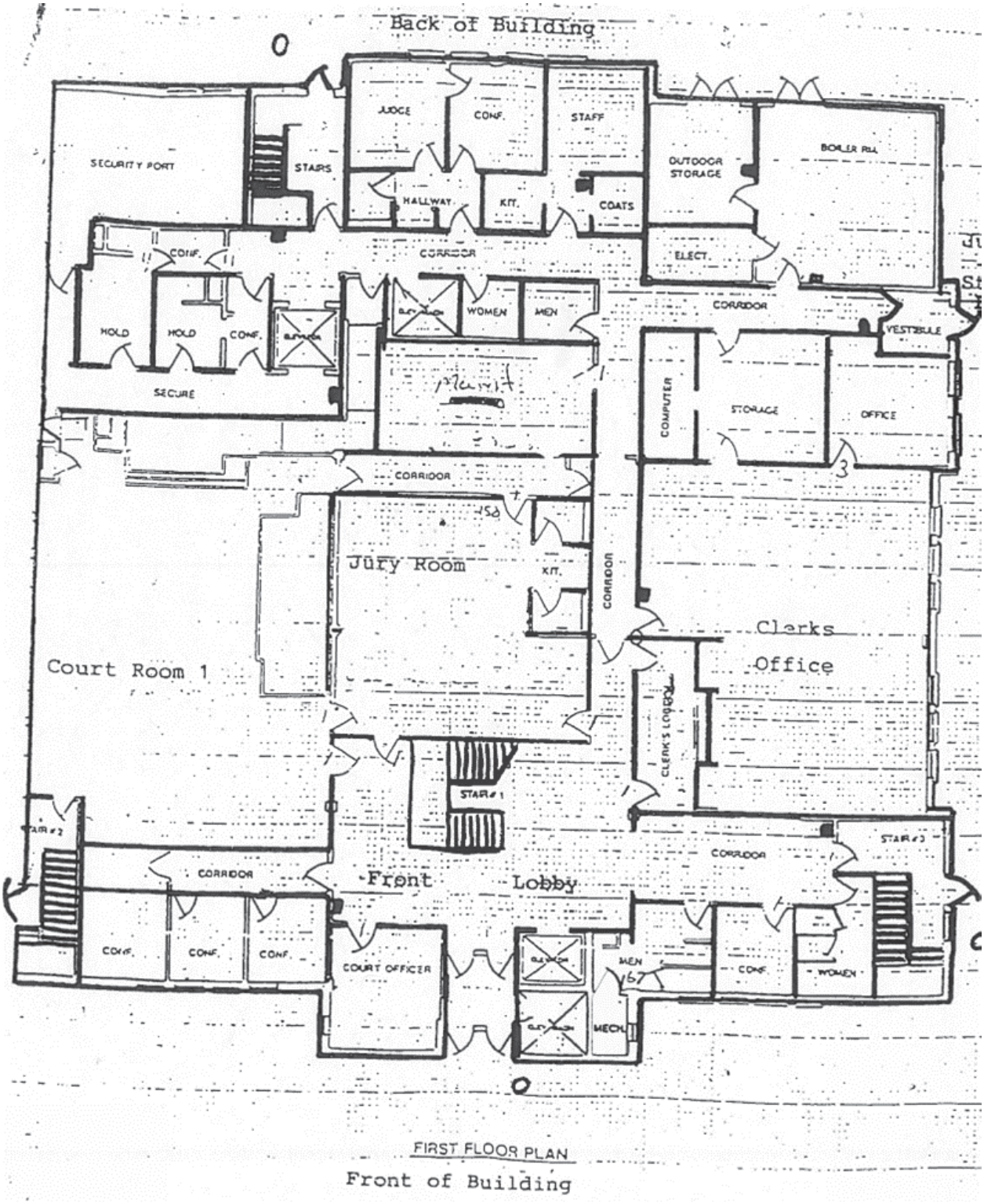


Figure 4: Building Floor Plan provided by BGS (N.T.S.).

Photo Documentation:

Figure 5: Exterior pad mount transformer.

Figure 6: Exterior Storage Shed.

Figure 7: Vent pipe (underground fuel tank?).

Figure 8: Exterior doors.

Figure 9: Exterior doors/ windows/ vents.

Figure 10 & 11: At-grade access panels on site, contents unknown.

Figure 12: Unsealed exterior wall penetration(s).

Figure 13: Woodwork

Figure 14 & 15: Fixed Furnishings

Figure 16: Emergency Generator

Figure 17: Entry Stair and Metal Detector.

Figure 18: Custodial room.

Figure 19: Compressor.

Figure 20: Elevator equipment.

Figure 21: Network Server Room

Figure 22: Conference Room Finishes

Figure 23: Control Panels

Figure 24: Open office space.

FLOOD HAZARD MITIGATION ASSESSMENT & ANALYSIS FOR STATE-OWNED BUILDINGS

BUILDING ASSESSMENT FORM

Building Information:

ADDRESS:	82 Railroad Row
BUILDING ID:	06420
OWNER:	VT Buildings & General Services
OCCUPYING AGENCIES/DEPARTMENTS:	District Court House
REPLACEMENT VALUE (2017):	$6,265,800
SQUARE FOOTAGE:	24,720 sq. ft.
NO. OF FLOORS:	2
GROSS FLOOR AREA:	24,720 sq. ft.
BASEMENT AREA:	N/A (Slab on Grade)
COST PER SQUARE FOOT:	$253.47 / sq. ft. (Replacement value / gross floor area) (without basement)

FOUNDATION:

Concrete Footing, Concrete Slab, Concrete Walls

FLOOR STRUCTURE:

First Floor – Concrete Slab on Compacted Fill

Second Floor – 3.5-inch Concrete on Metal Deck and Steel Joists

EXTERIOR WALLS:

Brick on masonry

GENERAL CONTENTS/USAGE:

Primary use on first floor includes entrance area with security office, clerks office, jury rooms, court room, holding areas, restrooms, and office space. Also includes building systems such as mechanicals, electric panels (including an emergency generator), plumbing, fire protection, Tel-com and I.T. equipment, and elevator controls. Exterior equipment includes pad mounted transformer.

BASEMENT FLOOR AREA:	0 sq. ft.
NO OF FLOORS:	2
GROSS BUILDING AREA:	24,720 sq. ft.

BUILDING ASSESSMENT FORM

Risk Overview

FEMA Zone:	Zone AE and Zone X
100-year Flood Elevation:	354.2 ft NAVD 88
500-year Flood Elevation:	360.0 ft NAVD 88
River Corridor:	Yes, nearly all the building except southwest corner
Ground Surface Elevation:	358.59 ft NAVD 88 (lowest grade adjacent to building)
Lowest Point of Entry:	359.32 ft NAVD 88 (threshold at walk-out overhead door)
Basement:	No
	Top of lowest floor = 359.32 ft NAVD 88 (1st Floor)
Historic Building:	No

Description of Space Below Flood Levels: Lowest floor susceptible to flooding (first floor) consists of building systems such as mechanicals, electrical panels, plumbing, fire protection systems, Tel-com panels, I.T. equipment, and elevator controls. Also includes court rooms, jury rooms, office space, holding areas, entry area with security check point, and restrooms.

Risk Narrative:

Flood Vulnerability:

The building is located within the right floodplain (looking downstream) of the White River. The northern half of the building is located within the Zone AE Special Flood Hazard Area (SFHA) as depicted on FEMA Flood Insurance Rate Map (FIRM) Panel No. 0389E dated September 28, 2007. The southern half of the building is located within the Zone X SFHA. Since the building is located within the SFHA's, an Elevation Certificate has been prepared. Based on the data provided on the Elevation Certificate, the lowest floor (1st floor) would be flooded during the 500-year flood, however not during the 100-year or Base Flood. The first floor elevation is approximately 5.1 feet above the Base Flood Elevation (BFE). During the 500-year flood, the depth of water would be approximately 0.7 feet above the first floor.

The items damaged during a flood include the majority of the building systems such as mechanical and electrical systems, plumbing and fire protection systems, Tel-com systems, I.T. equipment, and elevator controls. Damage also includes all porous finishes (wood, wainscoting, sheetrock, carpeting, etc.), as well as detailed woodwork and fixed furnishings. All exterior and interior non-porous surfaces below flood levels would require clean up. All items stored at or below the flood levels would be damaged and potentially lost as well. Exterior mounted equipment such as the transformer located to the southeast of the building may be susceptible to flood damage. Additional information regarding potential flood damages is provided with the Recommendations.

Erosion Vulnerability:

The right boundary of the Vermont River Corridor (looking downstream) passes through the southwest corner of the building making almost the entire building located within the corridor. Note that the river corridor includes both a meander belt (formerly called the fluvial erosion hazard zone) plus a 50-foot buffer. The corridor boundary is located approximately 170 feet from the top of river bank, while the northern most corner of the building is located only about 45 feet from the top of river bank. The land between the building and river bank includes an access drive and a small amount of landscaped green space. There was some evidence of erosion observed along the river bank, although the majority seemed to be a result of stormwater runoff flowing down the bank. The river bank is heavily vegetated with brush and large mature trees. Note that the confluence between the White River and Connecticut River is approximately 1,000 feet downstream of the building.

Although the building is located in close proximity to the top of river bank and within the river corridor, the White River in this location is not known to move dramatically during flooding, however the risk of damage due to erosion at this building would still be considered moderate to high.

Future Vulnerability:

Current trends in weather indicate that flooding in the region is becoming more frequent and more severe. State of Vermont flood mitigation standards require designs to meet a protection level of 1-foot above the 500-year flood. Future improvements at this location should meet or exceed that minimum standard.

Summary and Recommendation:

It is our understanding that the first floor slab on grade will be approximately 0.7 feet below water during a 500-year flood. The majority of building Mechanical / Electrical (including an emergency generator) / Plumbing / Fire Protection / Tel-com / I.T. Equipment and elevator controls are located on the first floor. Exterior equipment includes a pad mounted transformer. Other site items include grade level access panels to underground vaults (requires verification), and a freestanding storage shed.

Based on the information gathered during the building assessment, we recommend the following:

A. Leave as-is and allow first floor to flood for a post-flood renovation cost of $3,320,874.
B. Consider dry flood proofing at the perimeter building wall openings (doors, windows, vents) with flood shields to a point above the 500-year floodplain plus 1-foot. Ensure available emergency power, and continually pump any miscellaneous water which breaches the flood proofing to minimize the potential for damage to existing building systems in order to allow system reuse with minimal or no repair once floodwaters recede. It is our opinion that adding dry flood proofing shields for 10 openings at the ground floor perimeter within 1' of the finish floor could add between $150,000 and $250,000 to the above estimate.

Mitigation Recommendations for Risk Reduction:

Flood-proofing Method	Effective?	Cost ($US)
Wet Flood-proofing:	Allow to flood and repair.	$3,320,874
Elevate Utilities:	Following Flood (if recommended at the time)	
Dry Flood-proofing:	Up to the 500-year flood plus 1-foot	$250,000
Building Relocation:	Not recommended.	
Elevate Building:	Not feasible.	
Sealing of Openings:	Would be part of dry flood proofing measures.	
Other Modifications:	Make note of contents and their ability to contaminate flood waters.	
TOTAL COST	**Potential project cost for mitigation**	**$ 3,570,874**

Benefit – Cost Summary:

Total Project Benefits	**$ 6,265,800**	**Replacement Value**
Total Project Cost	**$ 3,570,874**	**Potential Mitigation Cost**
Benefit – Cost Ratio	**1.75**	**Replacement Value / Mitigation Cost**

BUILDING ASSESSMENT FORM

Building Address & Description: 101 State Place, Rutland, VT (BGS ID #06307)

Local Contact: Steven Lahue and Rob Gallipo, VT Buildings & General Services

Assessment Team: Jason Dolmetsch (MSK), Sean Cohen (MSK), Roy Schiff (MMI)

Exterior Photos

Figure 1: Front Entrance looking Southwest (photo credit: MSK Engineering, Inc.)

Special Flood Hazard Area and Vermont River Corridor:

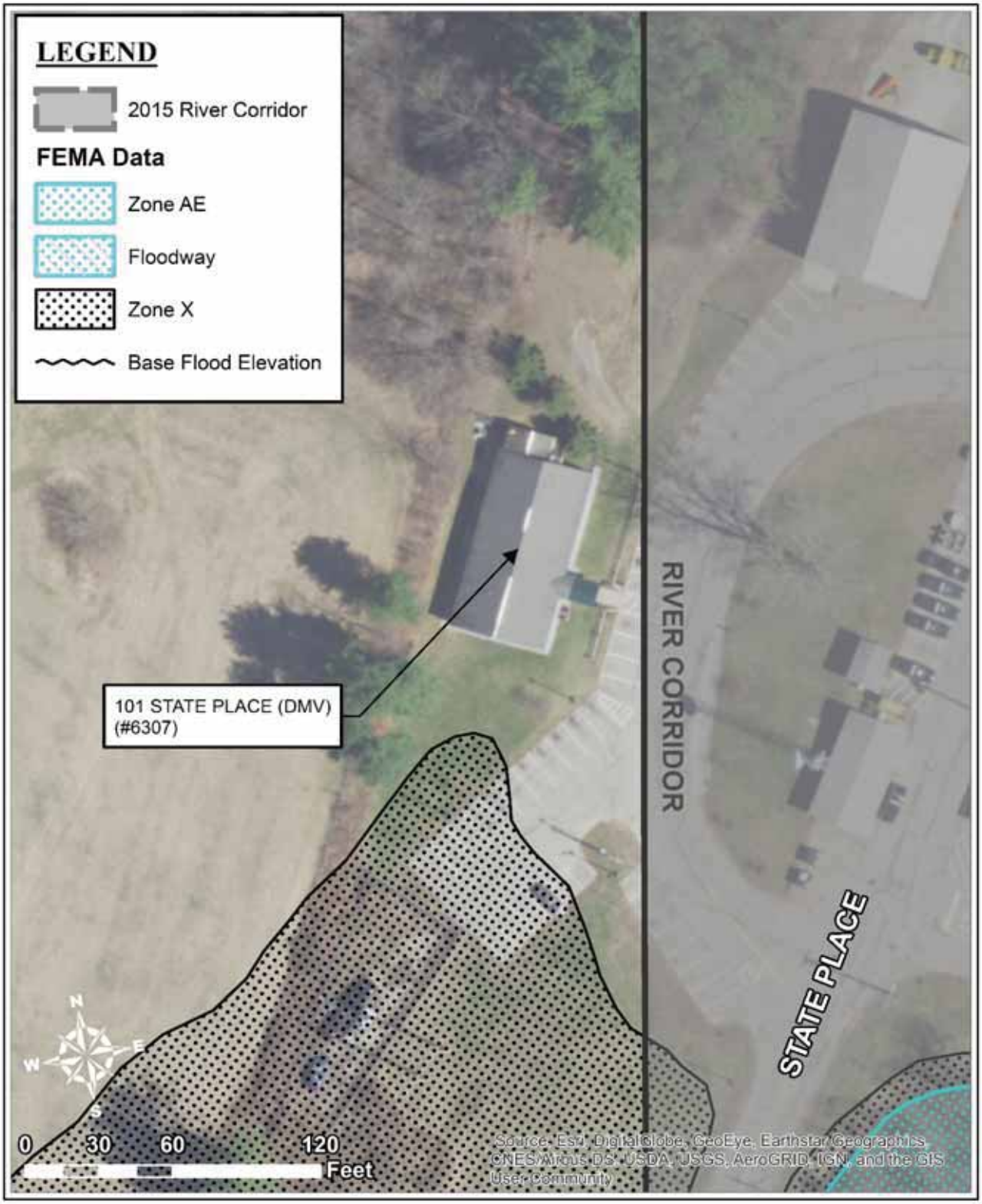


Figure 2: Flood Hazard Map (1in = 60 ft)

Plan View with Lowest Points of Entry:

Figure 3: Lowest Point of Entry (1in = 60 ft, elevations reference NAVD 88 vertical datum)

Floor Plan:

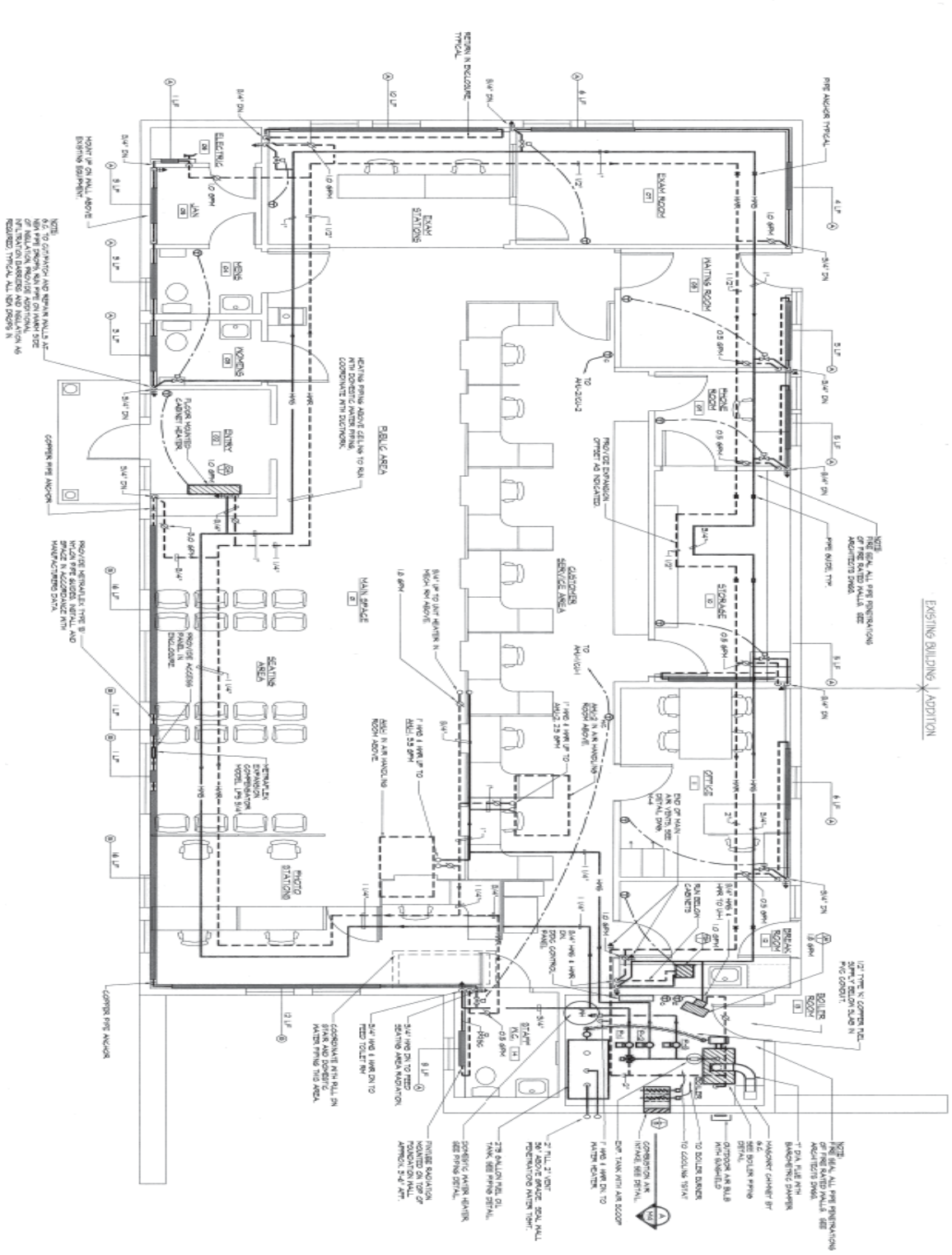


Figure 4: First Floor Plan View (not to scale)

Photo Documentation:

Figure 5: Boiler in Mechanical Room (Source: MSK)

Figure 6: Exterior A/C Units (Source: MSK)

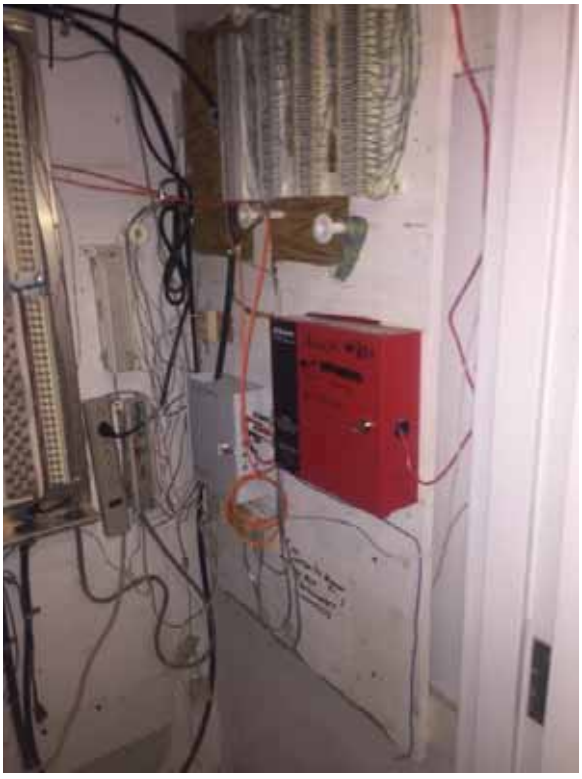


Figure 7: Telcom / Security Panels (Source: MSK)

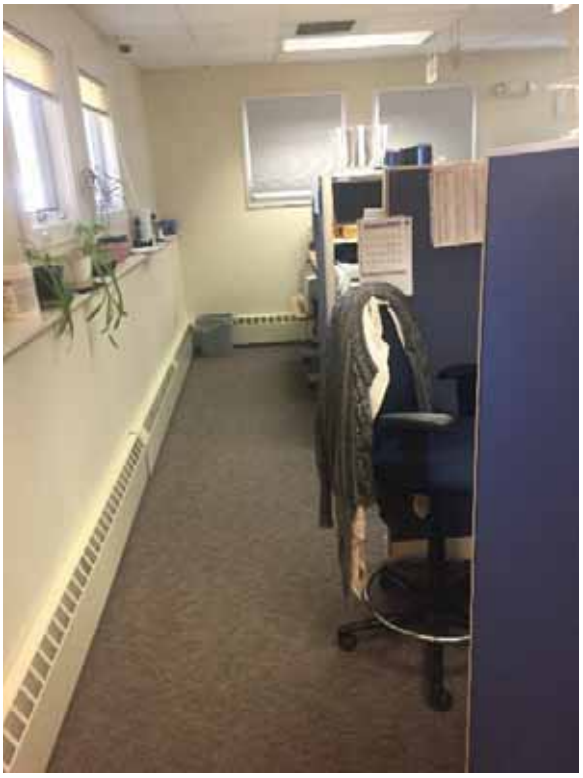


Figure 8: Office Space (Source: MSK)

Figure 9: Break Room (Source: MSK)

Figure 10: Office supplies and equipment (Source: MSK)

FLOOD HAZARD MITIGATION ASSESSMENT & ANALYSIS FOR STATE-OWNED BUILDINGS

BUILDING ASSESSMENT FORM

Building Information:

ADDRESS:	101 State Place, Rutland, VT
BUILDING ID:	06307
OWNER:	VT Buildings & General Services
OCCUPYING AGENCIES/DEPARTMENTS:	Department of Motor Vehicles
REPLACEMENT VALUE (2017):	$506,300
SQUARE FOOTAGE:	3,002 sq. ft.
NO. OF FLOORS:	1
GROSS FLOOR AREA:	3,002 sq. ft.
BASEMENT AREA:	n/a
COST PER SQUARE FOOT:	$168.65 / sq. ft. (Replacement Value / Gross Floor Area)

FOUNDATION:

Concrete Footing, Concrete Slab

FLOOR STRUCTURE:

First Floor – Concrete Slab on Ground over Compacted Base

Second Floor – Wood Plank and Plywood on Wood Beam Framing

EXTERIOR WALLS:

Wood Siding

GENERAL CONTENTS/USAGE:

Building used primarily for regional office space and DMV service center for customers. First floor includes building mechanicals such as boiler and water heater, plumbing, electrical and Telcom panels, and security system. A/C units located outside at the northwest corner of the building.

1ST FLOOR AREA:	3,002 sq. ft.
NO OF FLOORS:	1
GROSS BUILDING AREA:	3,002 sq. ft.

BUILDING ASSESSMENT FORM

Risk Overview

FEMA Zone:	n/a (outside of FEMA Special Flood Hazard Areas, see Risk Narrative)
100-year Flood Elevation:	605.5 ft NAVD 88
500-year Flood Elevation:	607.2 ft NAVD 88
River Corridor:	No, approximately 20 feet away
Ground Surface Elevation:	608.2 ft NAVD 88 (lowest grade adjacent to building)
Lowest Point of Entry:	609.36 ft NAVD 88 (threshold)
Basement:	No
Historic Building:	No

Description of Space Below Flood Levels: As indicated by the elevation data provided above, there are no spaces in the building that are below flood levels. However, during Tropic Storm Irene in August 2011, a portion of the building's first floor was inundated. The first floor contains office space and all building mechanicals including the boiler, water heater, electrical and Telcom panels, and building security system.

Risk Narrative:

Flood Vulnerability:

The building is located outside of the FEMA Floodway, Zone AE, and Zone X Special Flood Hazard Area (SFHA) as depicted on the FEMA Flood Insurance Rate Map (FIRM) Panel No. 0238D dated August 28, 2008. The FEMA FIRM indicates that flooding primary occurs opposite of the building after overtopping U.S. Route 7 and inundating low lying areas to the east. However, during Tropical Storm Irene in August 2011, this building was inundated by flood waters. For this reason, an Elevation Certificate has been prepared.

The data collected as part of the Elevation Certificate indicates that the first floor of the building and lowest grade adjacent to the building are above the published FEMA 100-year or Base Flood Elevation (BFE) and the 500-year Flood Elevation by at least a foot (see Figure 3).

If the building was to flood again, the items that could potentially sustain damaged include all mechanical systems such as the boiler, water heater, plumbing, electrical and Telcom panels, and building security systems. In addition, all porous finishes (wood, wainscoting, sheetrock, carpeting, etc.) would sustain damage if flooding occurs. All exterior and interior non-porous surfaces would also require clean up. All items stored near or on the first floor elevation could potentially be damaged depending on the amount of flood inundation. Additional information regarding potential flood damages is provided with the Recommendations.

Erosion Vulnerability:

The building is located outside of the Vermont River Corridor. Note that the river corridor includes both a meander belt (formerly called the fluvial erosion hazard zone) plus a 50-foot buffer. The northeast corner of the building is located approximately 20 feet from the right edge of the corridor (looking downstream). The top of river bank is located an additional 400 feet away from the building. There are several buildings, parking areas, and access drives located between the DMV building and the top of river bank. Given the setting in relation to East Creek, risk of damage due to erosion at this building would be considered medium to low.

Future Vulnerability:

Current trends in weather indicate that flooding in the region is becoming more frequent and more severe. State of Vermont flood mitigation standards require designs to meet a protection level of 1-foot above the 500-year flood. Future improvements at this location should meet or exceed that minimum standard.

Summary and Recommendation:

Based on the recent history of flood inundation at this building, it is our opinion that dry flood proofing of the building could be a consideration as an added level of protection. It is our opinion that adding dry flood proofing shields for openings at the ground floor perimeter within 1-foot of the finished floor could cost between $150,000 and $250,000. In addition, it is recommended to investigate elevating electrical, Telcom, fire alarm, and security systems or relocating them to upper floors or attic space to minimize renovation costs after a flood. An allowance of approximately $50,000 should be anticipated for utility relocation. All electronic equipment such as desktop computers and servers should be raised off the floor to prevent potential damage in the event of a flood.

Mitigation Recommendations for Risk Reduction:

Flood-proofing Method	Effective?	Cost ($US)
Wet Flood-proofing:	Not recommended	
Elevate Utilities:	Recommended in advanced to a flood event for certain utilities and building functions	$50,000
Dry Flood-proofing:	Could be considered as an option	$250,000
Building Relocation:	Not recommended	
Elevate Building:	Not Recommended	
Sealing of Openings:	Not necessary	
Other Modifications:	Make note of contents and their ability to contaminate flood waters.	
TOTAL COST	**Potential project cost for mitigation**	**$ 300,000**

Benefit – Cost Summary:

Total Project Benefits	**$ 506,300**	**Replacement Value**
Total Project Cost	**$ 300,000**	**Potential Mitigation Cost**
Benefit – Cost Ratio	**1.69**	**Replacement Value / Mitigation Cost**

BUILDING ASSESSMENT FORM

Building Address & Description: 116 State Street, Montpelier, VT (BGS ID #06019)

Local Contact: David Latoundji & Richard Kehne, VT Buildings & General Services

Assessment Team: Tom Bursey (FFF), Brian Cote (MMI), Jason Dolmetsch (MSK), Lauren Weston (MMI)

Exterior Photos:

Figure 1: Front Entrance looking South (photo credit: Freeman French Freeman)

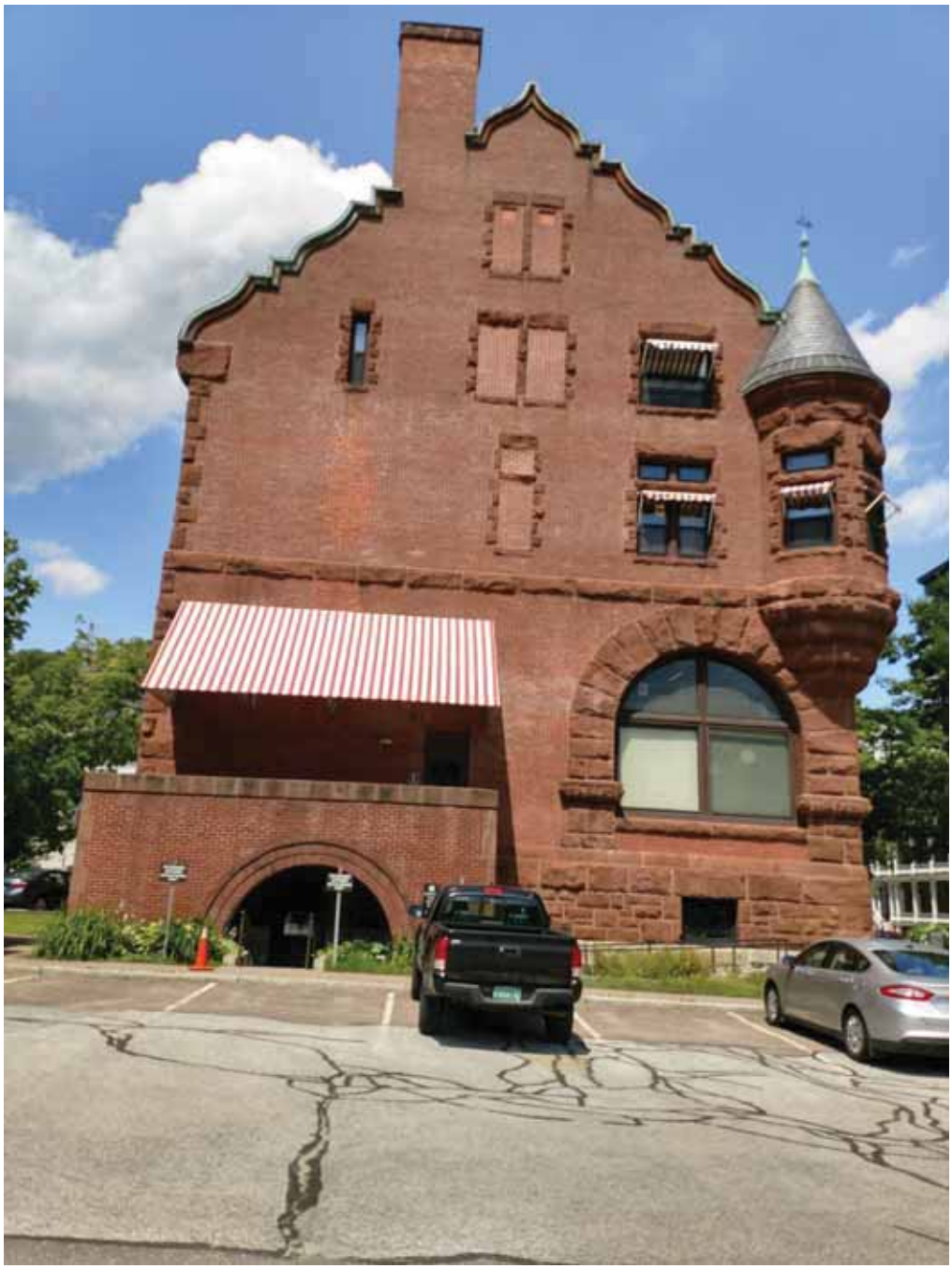


Figure 2: Rear Entrance looking North (photo credit: Grenier Engineering, PC)

Special Flood Hazard Area and Vermont River Corridor:

Figure 3: Flood Hazard Map (1in = 30 ft)

Plan View with Lowest Points of Entry:

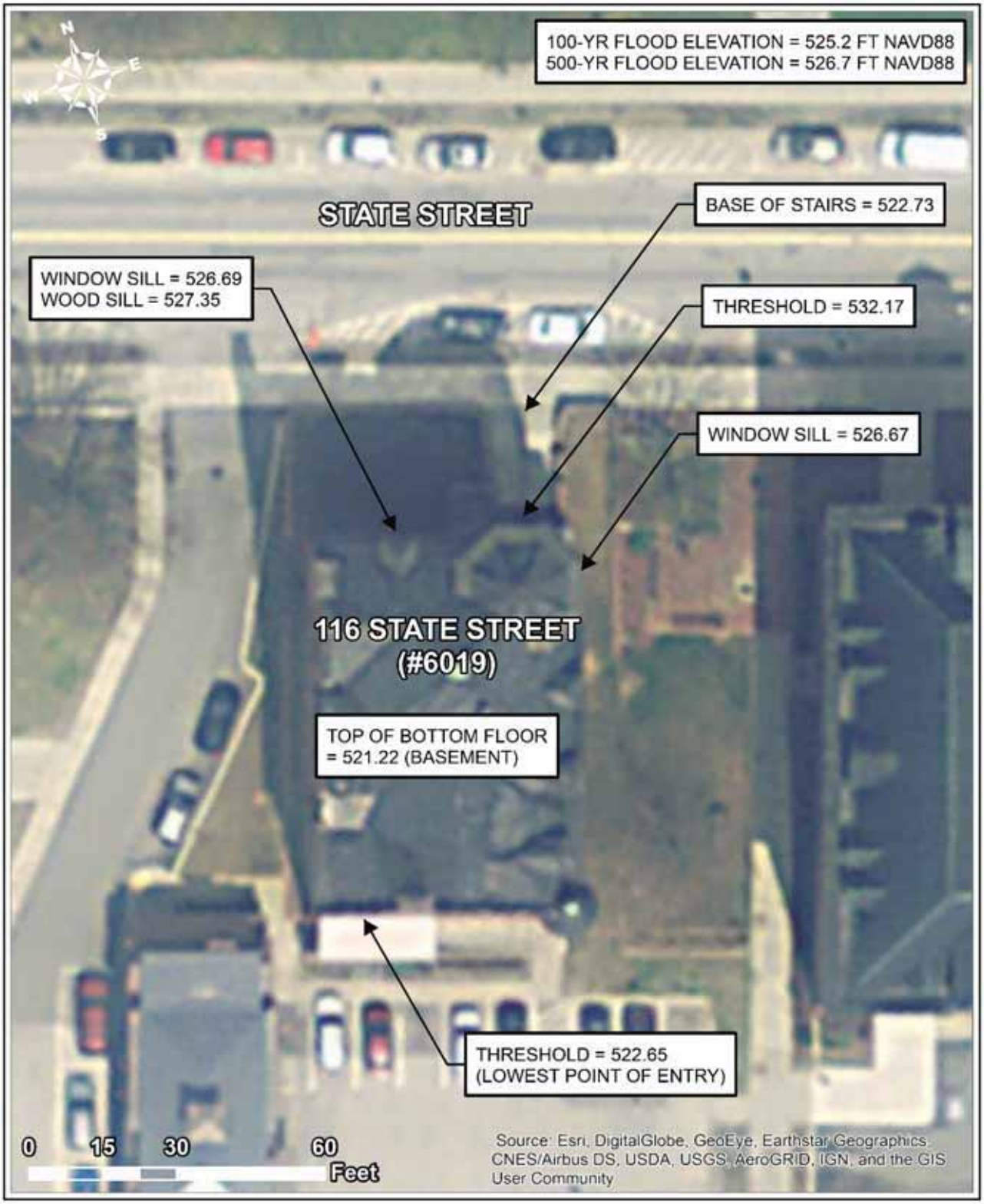


Figure 4: Lowest Point of Entry (1in = 30 ft, elevations reference NAVD 88 vertical datum)

Floor Plan:

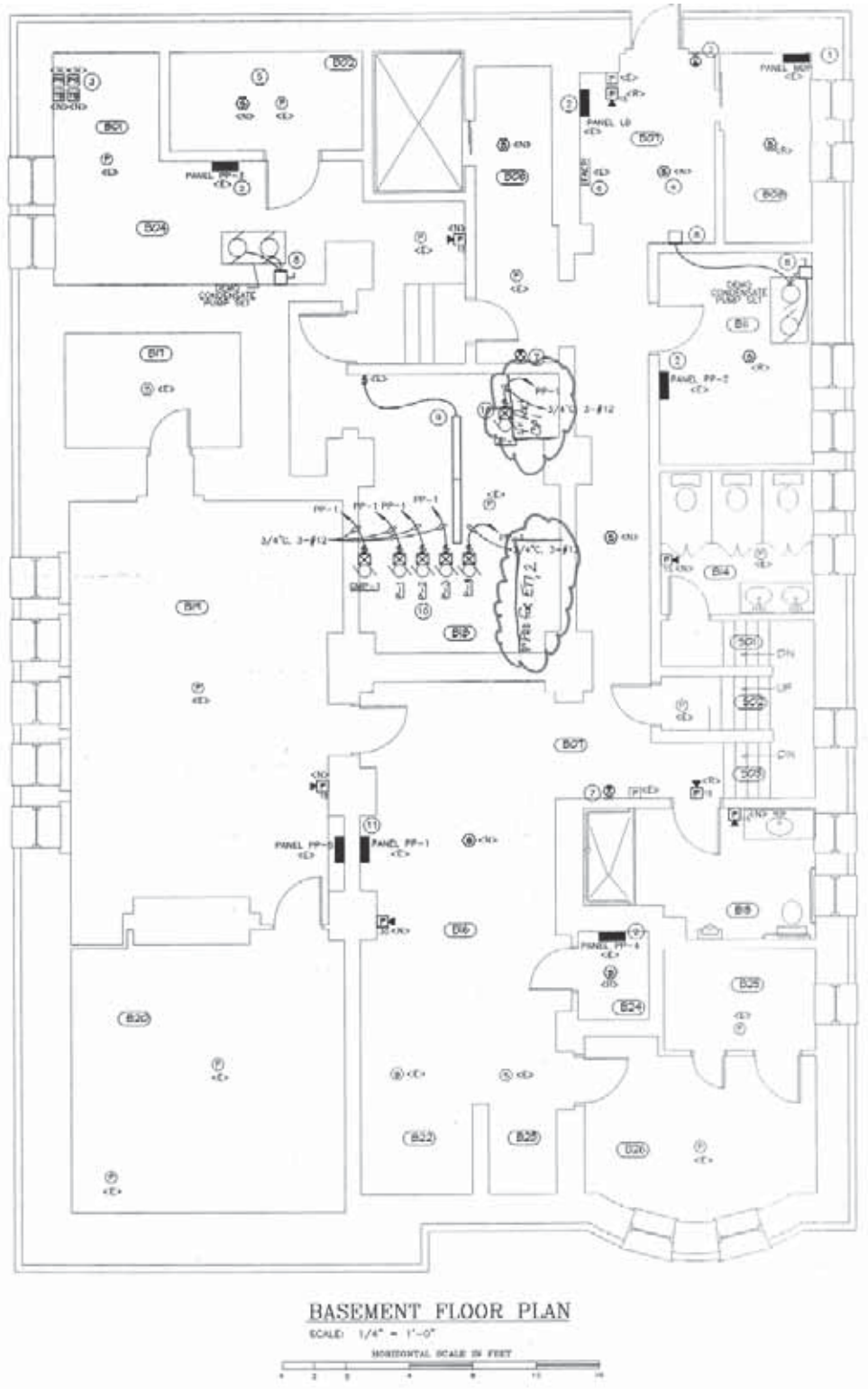


Figure 5: Plan from September 2004 Mechanical Systems Improvements; Plan E1 (N.T.S.)

Photo Documentation:

Figure 6 & 7: Basement Electrical and mechanical

Figure 8 & 9: Basement mechanical and electrical

Figure 10 & 11: Basement mechanical and elevator

Figure 12 & 13: Basement electrical and seating space

Figure 14 & 15: Basement restroom and recessed entry

Figure 16 & 17: Basement shower and restroom

Figure 18: Basement storage space

Figure 19: Basement recessed entry

Figure 20: East façade and openings

Figure 21: South façade and recessed basement entry

FLOOD HAZARD MITIGATION ASSESSMENT & ANALYSIS FOR STATE-OWNED BUILDINGS

BUILDING ASSESSMENT FORM

Building Information:

ADDRESS:	116 State Street, Montpelier
BUILDING ID:	06019
OWNER:	VT Buildings & General Services
OCCUPYING AGENCIES/DEPARTMENTS:	Agriculture, Food and Markets
REPLACEMENT VALUE (2017):	$4,838,493.24
SQUARE FOOTAGE:	18,775 sq. ft.
NO. OF FLOORS:	5
GROSS FLOOR AREA:	18,775 sq. ft.
BASEMENT AREA:	4,592 sq. ft.
COST PER SQUARE FOOT:	$257.71 / sq. ft. (replacement value / gross floor area)

FOUNDATION:

Concrete Footing, Concrete Slab, Concrete Walls

FLOOR STRUCTURE:

Basement – Reinforced Concrete Slab on Ground

First Floor – Elevated Lift Slab

Upper Floors – Wood Plank on Wood Joists

EXTERIOR WALLS:

Concrete Block – Decorative Solid Brick Exterior, Native Stone on Masonry

GENERAL CONTENTS/USAGE:

Basement – Building mechanicals, elevator controls, bathrooms (2), equipment & supply storage

BASEMENT FLOOR AREA:	4,592 sq. ft.
NO OF FLOORS:	5
GROSS BUILDING AREA:	22,738 sq. ft.

BUILDING ASSESSMENT FORM

Risk Overview

FEMA Zone:	Zone AE
100-year Flood Elevation:	525.2 ft NAVD 88
500-year Flood Elevation:	526.7 ft NAVD 88
River Corridor:	No, located approximately 110' away to the south of the building
Ground Surface Elevation:	522.65 ft NAVD 88 (lowest grade adjacent to building)
Lowest Point of Entry:	522.65 ft NAVD 88 (threshold of rear entrance to basement level)
Basement:	Yes – top of bottom floor elevation = 521.22 ft NAVD 88
Historic Building:	Yes

Description of Space Below Flood Levels: Lowest floor (basement) includes mechanical room for the building, elevator control room, two bathrooms, and storage space.

Risk Narrative:

Flood Vulnerability:

The building is located within the right floodplain (looking downstream) of the Winooski River. The entire building is located within the Zone AE Special Flood Hazard Area (SFHA) as depicted on FEMA Flood Insurance Rate Map (FIRM) Panel No. 0264E dated March 19, 2013, therefore an Elevation Certificate has been prepared. Based on the data provided on the Elevation Certificate, the lowest floor (basement) would be flooded during the 100-year and 500-year flood, however the upper floors (1st floor through 4th floor including Mezzanine) would not be flooded. During the 100-year flood, the depth of water would be approximately 4 feet above the basement floor, and the depth above the basement floor would be approximately 5.5 feet during the 500-year flood.

The items damaged during a flood include items such as mechanical systems, insulation surrounding the copper piping, electrical systems, and all porous finishes (wood, wainscoting, sheetrock, carpeting, etc.). All exterior and interior non-porous surfaces below flood levels would require clean up. All items stored at or below the flood levels would be damaged and potentially lost as well. Additional information regarding potential flood damages is provided with the Recommendations.

Erosion Vulnerability:

The building is located outside of the Vermont River Corridor. Note that the river corridor includes both a meander belt (formerly called the fluvial erosion hazard zone) plus a 50-foot buffer. The right edge of the corridor is located approximately 110 feet to the south of the

building, across the rear parking lot and on the opposite side of the railroad tracks. It is an additional 130 feet from the corridor boundary across another parking lot to the top of river bank, which consists of a combination of retaining walls and riprap armoring through this reach. Given the setting in relation to the river corridor and the characteristics of flooding on the Winooski River, risk of damage due to erosion at this building would be considered low.

Future Vulnerability:

Current trends in weather indicate that flooding in the region is becoming more frequent and more severe. State of Vermont flood mitigation standards require designs to meet a protection level of 1-foot above the 500-year flood. Future improvements at this location should meet or exceed that minimum standard.

Recommendation:

It is our opinion that the basement could be remediated back to as-is or better condition for the amount allocated. This includes elevator repair including possible cab replacement, decontaminating and reinsulating all copper piping, replacing all electrical, and replacing all porous finishes (wood, wainscoting, carpeting, etc.) and decontaminating all non-porous surfaces, inside and out (including the marble in the bathrooms, and the red stone and brick on the outside, etc.).

Three items of note but out of the scope of this document:

1) There are two Glycol loops in the boiler room (one snowmelt and the other a heating supply line) that have the potential to contaminate flood water.
2) There are unknown content in the storage room(s) B17, 19 & 20 on the plan that may have the potential of contaminating flood water. Our recommendation would be to remove/ relocate any material from these storage rooms that would potentially cause a hazardous condition if flooding occurs.
3) There are unknown content in other storage rooms within the basement, it is recommended to elevate valuable or irreplaceable items to be stored above the specified flood depths.

Mitigation Recommendations for Risk Reduction:

Flood-proofing Method	Effective?	Cost ($US)
Wet Flood-proofing:	Allow to flood and repair.	$1,418,743.21
Elevate Utilities:	Following a flood event. (if recommended at that time)	
Dry Flood-proofing:	Not recommended due to basement condition	
Building Relocation:	Not Recommended	
Elevate Building:	Not Recommended	
Sealing of Openings:	Not necessary	
Other Modifications:	Make note of contents and their ability to contaminate flood waters.	
TOTAL COST	**Potential project cost for mitigation**	**$ 1,418,743.21**

Benefit – Cost Summary:

Total Project Benefits	**$ 4,838,949**	**Replacement Value**
Total Project Cost	**$ 1,418,743**	**Potential Mitigation Cost**
Benefit – Cost Ratio	**3.41**	**Replacement Value / Mitigation Cost**

BUILDING ASSESSMENT FORM

Building Address & Description: 118 State Street, Montpelier, VT (BGS ID #06030)

Local Contact: David Latoundji & Richard Kehne, VT Buildings & General Services

Assessment Team: Tom Bursey (FFF), Alex Halpern (FFF), Roy Schiff (MMI), Brian Cote (MMI)
Jason Dolmetsch (MSK), Sean Cohen (MSK), Lauren Weston (MMI)

Exterior Photos:

Figure 1: Front Entrance looking South (photo credit: Freeman French Freeman)

Special Flood Hazard Area and Vermont River Corridor:

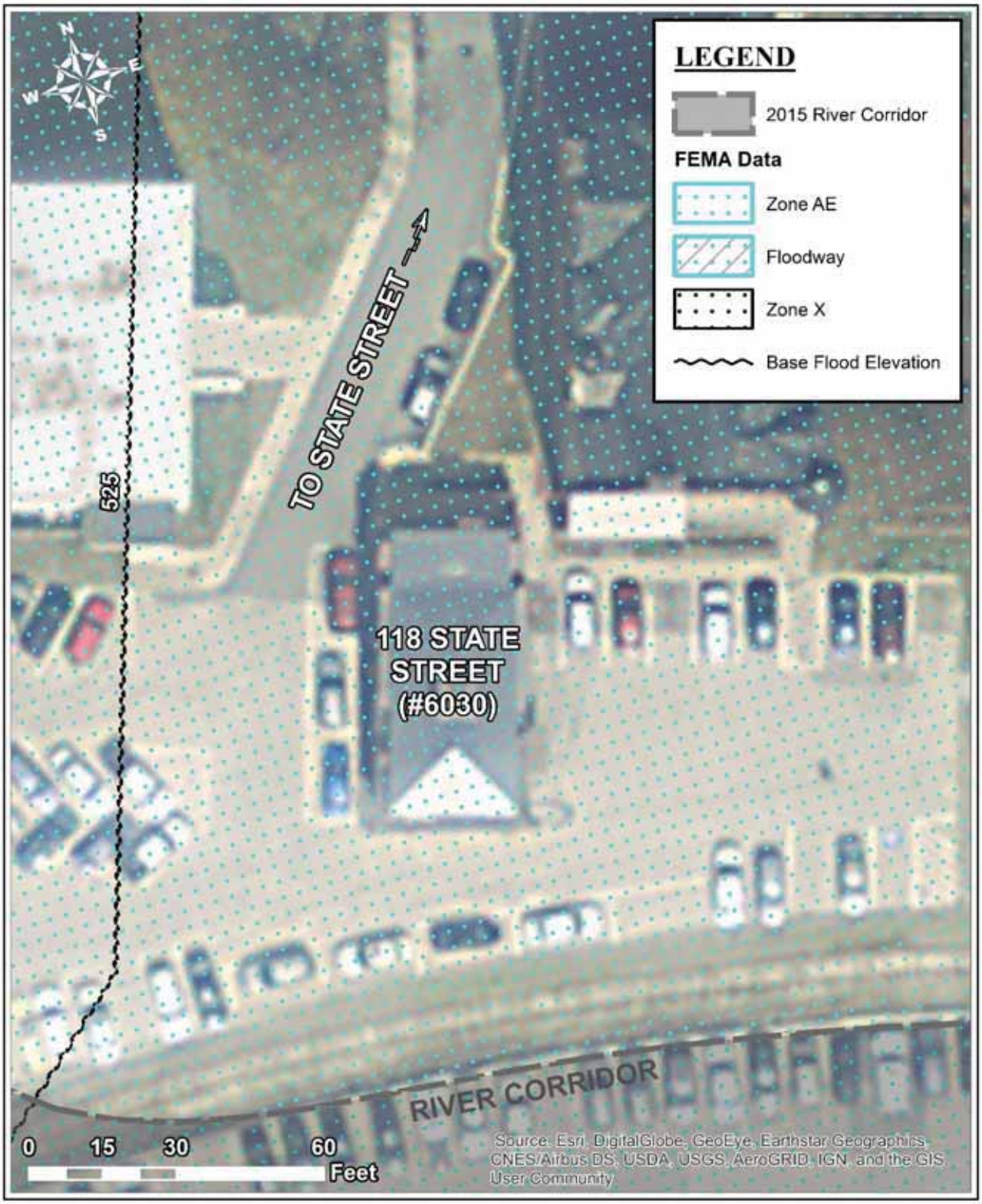


Figure 2: Flood Hazard Map (1in = 30 ft)

Plan View with Lowest Points of Entry:

Figure 3: Lowest Point of Entry (1in = 30 ft, elevations reference NAVD 88 vertical datum)

Floor Plan:

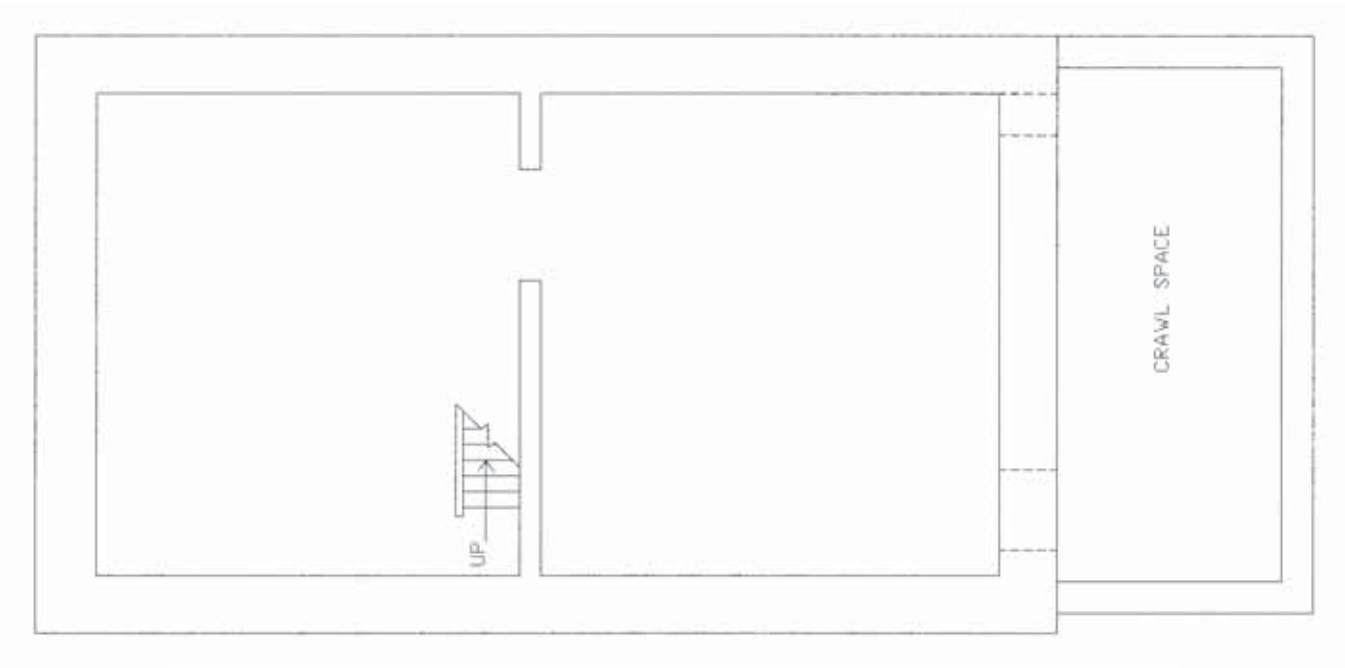


Figure 4: Basement Floor Plan from August 1998 Floor Plan drawings, Sheet A-1 (N.T.S.)

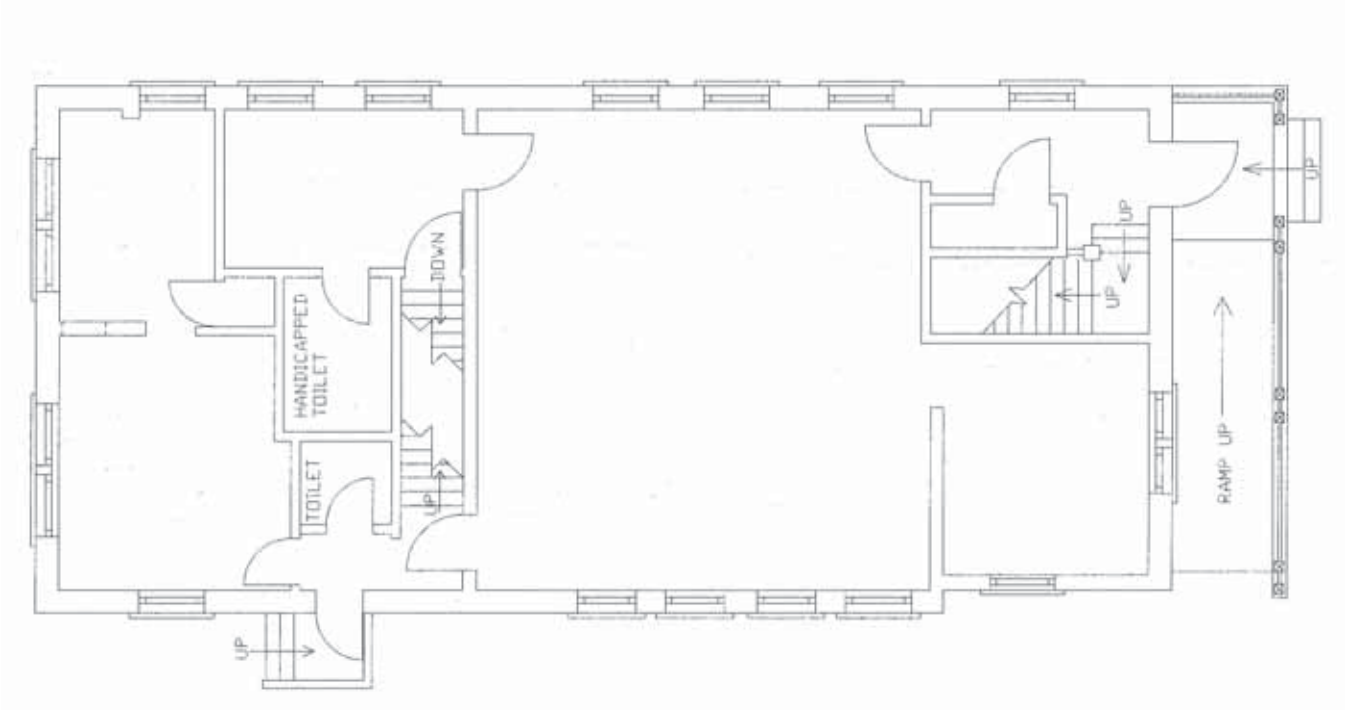


Figure 5: 1st Floor Plan from August 1998 Floor Plan drawings, Sheet A-1 (N.T.S.)

Photo Documentation:

Figure 6: West Elevation

Figure 7: North Elevation

Figure 8: West Elevation

Figure 9: Crawl Space

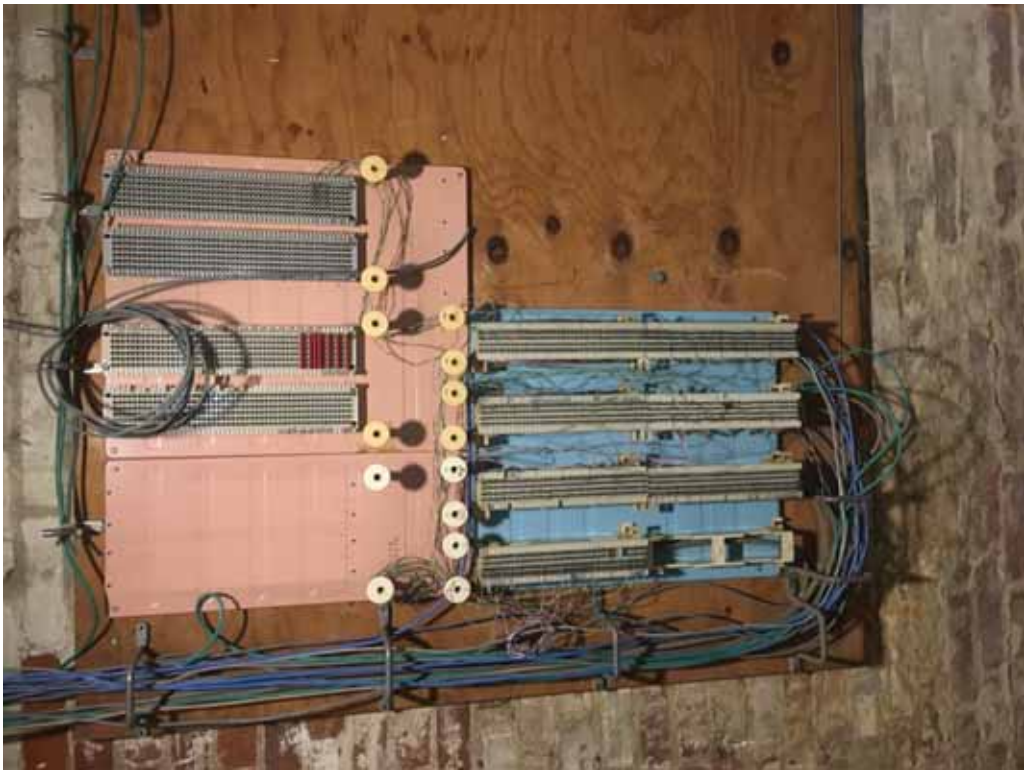


Figure 10: Tele-com panel

Figure 11: Basement Steam

Figure 12: East elevation

Figure 13: IT, Electrical, Security

FLOOD HAZARD MITIGATION ASSESSMENT & ANALYSIS FOR STATE-OWNED BUILDINGS

BUILDING ASSESSMENT FORM

Building Information:

ADDRESS:	118 State Street, Montpelier
BUILDING ID:	06030
OWNER:	VT Buildings & General Services
OCCUPYING AGENCIES/DEPARTMENTS:	Veteran's Affairs
REPLACEMENT VALUE (2017):	$808,158
SQUARE FOOTAGE:	3,360 sq. ft.
NO. OF FLOORS:	2 (2 levels above grade excluding basement)
GROSS FLOOR AREA:	3,360 sq. ft.
BASEMENT AREA:	1,351 sq. ft.
COST PER SQUARE FOOT:	$240.52 / sq. ft. (replacement value / gross floor area)

FOUNDATION:

Raised Wood and Stone

FLOOR STRUCTURE:

Basement –Concrete on Ground

Upper Floors – Wood Plank on Wood Joists

EXTERIOR WALLS:

Brick on Stud, Wood Siding

GENERAL CONTENTS/USAGE:

Basement – Building mechanicals, plumbing, electrical and Tel-com panels, fire protection

Systems, fixed equipment

BASEMENT FLOOR AREA:	1,351 sq. ft.
NO OF FLOORS:	2
GROSS BUILDING AREA:	3,360 sq. ft.

Risk Overview

FEMA Zone:	Zone AE
100-year Flood Elevation:	525.2 ft NAVD 88
500-year Flood Elevation:	526.7 ft NAVD 88
River Corridor:	No, located approximately 50 feet away to the south of the building
Ground Surface Elevation:	524.70 ft NAVD 88 (lowest grade adjacent to building)
Lowest Point of Entry:	527.03 ft NAVD 88 (threshold)
Basement:	Yes – top of bottom floor elevation = 518.62 ft NAVD 88
	Top of next highest floor elevation = 527.03 ft NAVD 88
Historic Building:	Yes

Description of Space Below Flood Levels: Lowest floor susceptible to flooding (basement) consists of building systems such as mechanicals, electrical panels, plumbing, fire protection systems, Tel-com panels, and otherwise generally vacant with only a small number of miscellaneous items stored.

Risk Narrative:

Flood Vulnerability:

The building is located within the right floodplain (looking downstream) of the Winooski River. The entire building is located within the Zone AE Special Flood Hazard Area (SFHA) as depicted on FEMA Flood Insurance Rate Map (FIRM) Panel No. 0264E dated March 19, 2013, therefore an Elevation Certificate has been prepared. Based on the data provided on the Elevation Certificate, the lowest floor (basement) would be flooded during the 100-year and 500-year flood, however the upper floors (1st floor through 4th floor including Mezzanine) would not be flooded. During the 100-year flood, the depth of water would be approximately 6.6 feet above the basement floor, and the depth above the basement floor would be approximately 8.1 feet during the 500-year flood. Note that with an elevation of 527.03 (see Figure 3 above), the 1st floor is more than a foot above the 100-year flood, however is only approximately 0.3 feet above the 500-year flood elevation.

The items damaged during a flood include the majority of the building systems such as mechanical, plumbing, electrical panels, fire protection systems, and Tel-com systems. Damage also includes all porous finishes (wood, wainscoting, sheetrock, carpeting, etc.). All exterior and interior non-porous surfaces below flood levels would require clean up. Additional information regarding potential flood damages is provided with the Recommendations.

Erosion Vulnerability:

The building is located outside of the Vermont River Corridor. Note that the river corridor includes both a meander belt (formerly called the fluvial erosion hazard zone) plus a 50-foot buffer. The right edge of the corridor is located approximately 50 feet to the south of the building, across the rear parking lot and on the opposite side of the railroad tracks. It is an additional 130 feet from the corridor boundary across another parking lot to the top of river bank, which consists of a combination of retaining walls and riprap armoring through this reach. Given the setting in relation to the river corridor and the characteristics of flooding on the Winooski River, risk of damage due to erosion at this building would be considered low.

Future Vulnerability:

Current trends in weather indicate that flooding in the region is becoming more frequent and more severe. State of Vermont flood mitigation standards require designs to meet a protection level of 1-foot above the 500-year flood. Future improvements at this location should meet or exceed that minimum standard.

Summary and Recommendation:

It is our understanding that the basement will flood with the depth of water being 6.6 feet during the 100-year flood and 8.1 feet during the 500-year flood. The first floor elevation will be approximately 1.8 feet above the 100-year flood, however 500-year flood will be within 0.3 feet of the first floor elevation.

The majority of building Mechanical / Electrical / Plumbing / Fire Protection / Tel-com / fixed equipment is located in the basement and will be completely underwater in both the 100-year and 500-year flood conditions.

We recommend the following:

Relocated basement mounted Tel-com, electrical and IT panels to upper levels to prevent flood damage and allow the building to flood. The presence of first floor wood framing and siding along with the presence of a basement makes dry flood proofing an undesirable option for this building.

Opinion of construction costs:

A. If left as is and allowed to flood, in our opinion, the renovation cost to repair damage to the basement could be $300,000.
B. Plus the following allowance to permanently relocate existing fixed equipment ahead a flood event.
   a) Electrical Panels: $25,000
   b) Tel-com Panels: $15,000
   c) I.T. Racks: $15,000
   Total: $55,000

Total estimate A = $300,000

Total estimate B = $55,000

Mitigation Recommendations for Risk Reduction:

Flood-proofing Method	Effective?	Cost ($US)
Wet Flood-proofing:	Allow to flood and repair.	$300,000
Elevate Utilities:	Recommended in advance of flood for specific utilities.	$55,000
Dry Flood-proofing:	Not recommended	
Building Relocation:	Not Recommended	
Elevate Building:	Could be an option, but not recommended	
Sealing of Openings:	Not required	
Other Modifications:	Make note of contents and their ability to contaminate flood waters.	
TOTAL COST	**Potential project cost for mitigation**	**$ 355,000**

Benefit – Cost Summary:

Total Project Benefits	**$ 808,158**	**Replacement Value**
Total Project Cost	**$ 355,000**	**Potential Mitigation Cost**
Benefit – Cost Ratio	**2.28**	**Replacement Value / Mitigation Cost**

BUILDING ASSESSMENT FORM

Building Address & Description: 120 State Street, Montpelier, VT (BGS ID #06020)

Local Contact: David Latoundji & Richard Kehne, VT Buildings & General Services

Assessment Team: Tom Bursey (FFF), Roy Schiff (MMI), Brian Cote (MMI), Lauren Weston (MMI), Cameron Burrows (FFF), Jason Dolmetsch (MSK), Sean Cohen (MSK)

Exterior Photos:

Figure 1: Front Entrance looking South (photo credit: Grenier Engineering, PC)

Exterior Photos:

Figure 2: North Façade (photo credit: Freeman French Freeman)

Special Flood Hazard Area and Vermont River Corridor:

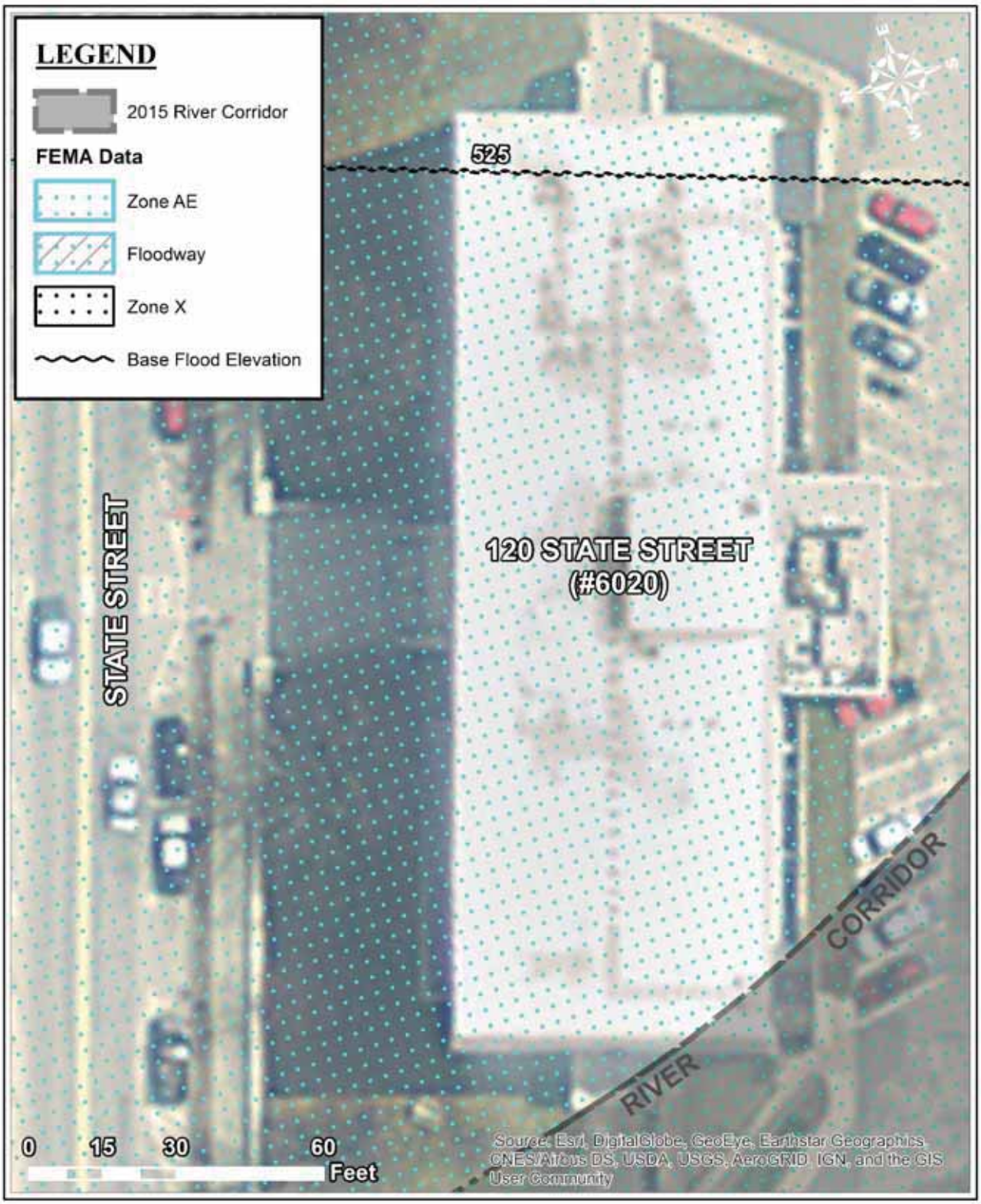


Figure 3: Flood Hazard Map (1in = 30 ft)

Plan View with Lowest Points of Entry:

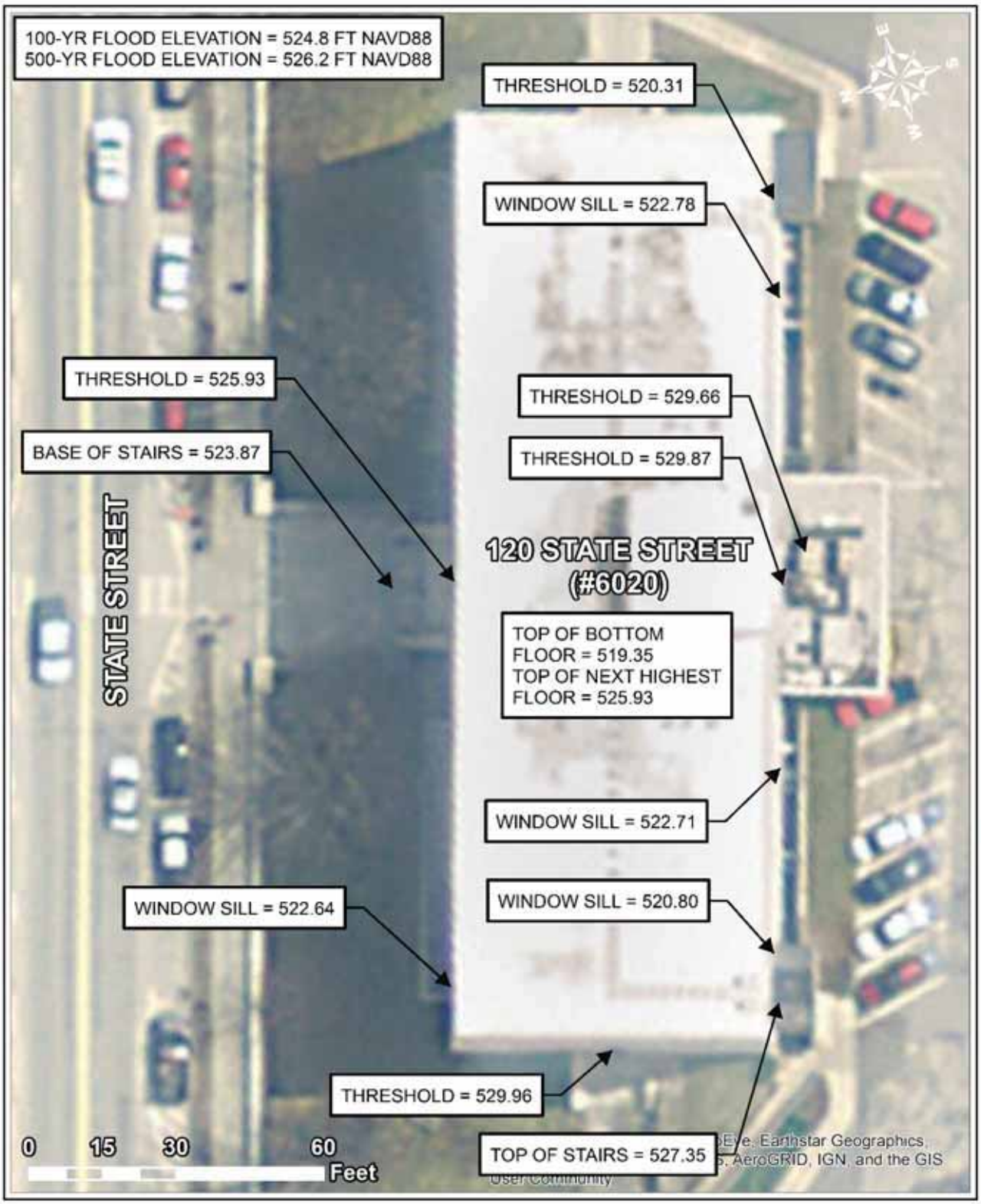


Figure 4: Lowest Point of Entry (1in = 30 ft, elevations reference NAVD 88 vertical datum)

Floor Plan:

Figure 5: Basement Floor Plan (source: VT Buildings & General Services, N.T.S.)

Photo Documentation:

Figure 6: West and south façades

Figure 7: East and south façades

Figure 8 & 9: East areaway

Figure 10: South areaway and loading dock

Figure 11: Exterior drainage structure

Figure 12: Basement electrical equipment

Figure 13: Basement mechanical equipment

Figure 14: Basement electrical equipment

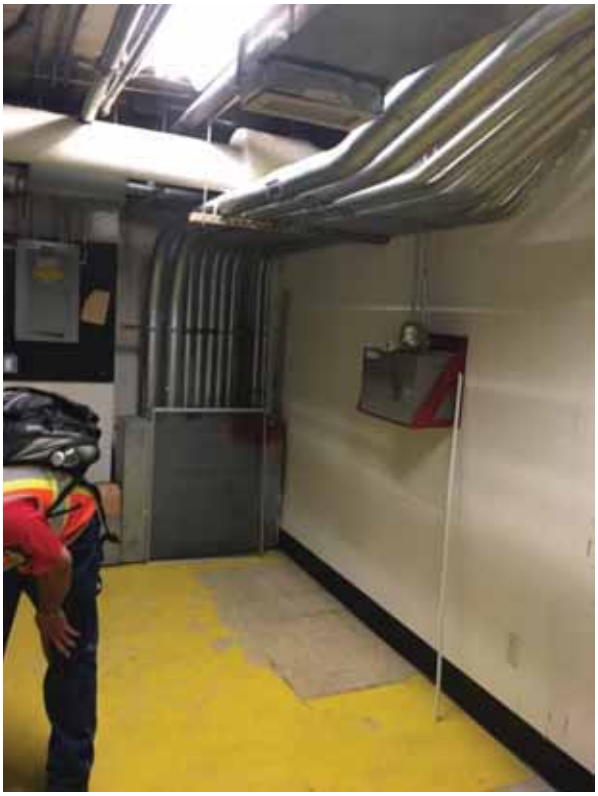


Figure 15: Basement electrical equipment

Figure 16: Basement Tel-com equipment

Figure 17: Basement sprinkler room

Figure 18: Basement mechanical equipment

Figure 19: Basement electrical equipment

Figure 20: Basement floor trench with cover plate

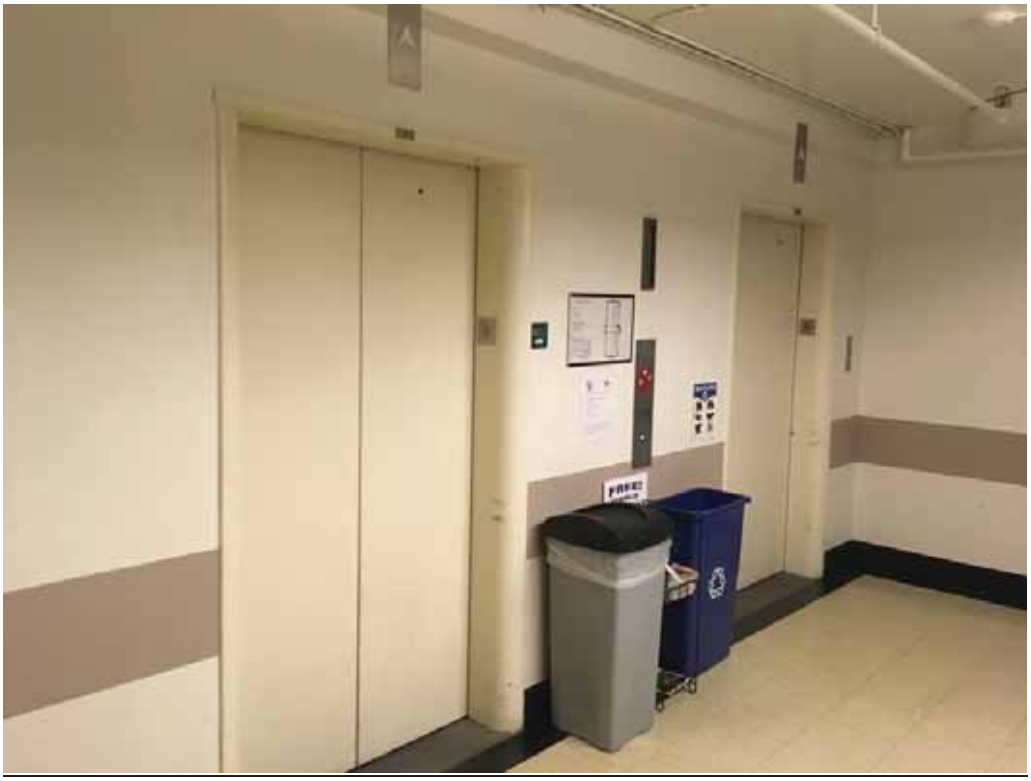


Figure 21: Basement elevators

Figure 22: Basement office space

Figure 23: Basement breakroom space

Figure 24: Basement breakroom space

Figure 25: Basement window into areaway

Figure 26: Areaway with grate cover

FLOOD HAZARD MITIGATION ASSESSMENT & ANALYSIS FOR STATE-OWNED BUILDINGS

BUILDING ASSESSMENT FORM

Building Information:

ADDRESS:	120 State Street, Montpelier
BUILDING ID:	06020
OWNER:	VT Buildings & General Services
OCCUPYING AGENCIES/DEPARTMENTS:	Digital Services, BGS, Maintenance, DHR, VTHR, DMV
REPLACEMENT VALUE (2017):	$21,263,384
SQUARE FOOTAGE:	68,325 sq. ft.
NO. OF FLOORS:	5
GROSS FLOOR AREA:	68,325 sq. ft.
BASEMENT AREA:	12,752 sq. ft.
COST PER SQUARE FOOT:	$311.21 / sq. ft. (Replacement value / gross floor area)

FOUNDATION:

Concrete Footing, Concrete Slab, Concrete Walls

FLOOR STRUCTURE:

Basement – Reinforced Concrete Slab on Ground

Upper Floors – Elevated Lift Slabs

EXTERIOR WALLS:

Brick on Masonry, Native Stone on Masonry

GENERAL CONTENTS/USAGE:

Basement – building systems such as mechanicals, electrical (including emergency generator), plumbing, fire protection, tel-com, and elevator controls. Also includes conference / meeting areas, office space, and equipment / supply storage.

Risk Overview

FEMA Zone:	Zone AE
100-year Flood Elevation:	524.8 ft NAVD 88
500-year Flood Elevation:	526.2 ft NAVD 88
River Corridor:	Yes, crosses southwest corner of the building
Ground Surface Elevation:	520.31 ft NAVD 88 (lowest grade adjacent to building)
Lowest Point of Entry:	522.64 ft NAVD 88 (window sill)
Basement:	Yes – top of bottom floor = 519.35 ft NAVD 88 (basement)
Historic Building:	Yes

Description of Space Below Flood Levels: Lowest floor susceptible to flooding (basement) consists of building mechanicals, electrical panels (including emergency generator), plumbing, fire protection systems, Tel-com panels, and elevator controls, as well as conference rooms, office space, and equipment / supply storage.

Risk Narrative:

Flood Vulnerability:

The building is located within the right floodplain (looking downstream) of the Winooski River. The entire building is located within the Zone AE Special Flood Hazard Area (SFHA) as depicted on FEMA Flood Insurance Rate Map (FIRM) Panel No. 0264E dated March 19, 2013, therefore an Elevation Certificate has been prepared. Based on the data provided on the Elevation Certificate, the lowest floor (basement) would be flooded during the 100-year and 500-year flood, however the upper floors (1st floor through 5th floor) would not be flooded. During the 100-year flood, the depth of water would be approximately 5.5 feet above the basement floor, and the depth above the basement floor would be approximately 6.9 feet during the 500-year flood.

The items damaged during a flood include the majority of the building systems such as mechanical and electrical systems (including emergency generator), plumbing and fire protection systems, Tel-com systems, and elevator controls. Damage also includes all porous finishes (wood, wainscoting, sheetrock, carpeting, etc.). All exterior and interior non-porous surfaces below flood levels would require clean up. All items stored at or below the flood levels would be damaged and potentially lost as well. Additional information regarding potential flood damages is provided with the Recommendations.

Erosion Vulnerability:

The right boundary of the Vermont River Corridor (looking downstream) crosses the southwest corner of the building. Note that the river corridor includes both a meander belt (formerly

called the fluvial erosion hazard zone) plus a 50-foot buffer. The corridor boundary is located approximately 200 feet from the top of river bank, which consists of a combination of retaining walls and riprap armoring through this reach. There are developed lands and infrastructure in the river corridor located between the building and the top of river bank, including the Central Heat Plant, the railroad embankment, access driveways, and parking lots. Given the setting in relation to the river corridor and the characteristics of flooding on the Winooski River, risk of damage due to erosion at this building would be considered medium to low.

Future Vulnerability:

Current trends in weather indicate that flooding in the region is becoming more frequent and more severe. State of Vermont flood mitigation standards require designs to meet a protection level of 1-foot above the 500-year flood. Future improvements at this location should meet or exceed that minimum standard.

Summary and Recommendation:

It is our understanding that the basement floor slab on grade will be approximately 5.5' below water during a 100 year flood condition, and approximately 6.9' below water during a 500 year flood condition. Elevator pits and various floor trenches also extend below the basement floor slab.

The majority of building Mechanical/ Electrical (including an emergency generator) / Plumbing/ Fire Protection/ Tel-com/ and elevator machine room fixed equipment is located in the basement.

Although the first floor is above both the 100-year and 500-year flood elevations, the basement level has two large areaways on the east façade that are below predicted flood elevations and provide ample points of access for floodwaters.

FEMA does not recommend dry flood proofing if spaces are under three or more feet of water, or if there are basement spaces (unless significant structural engineering analysis is prepared and findings implemented).

We recommend the following:

1. Leave as-is and allow basement to flood. This recommendation is made because of the predicted flood depths, presence of a basement, and significant life safety hazards that would be present if dry flood proofing were pursued.
2. Due to the significant amount of Mechanical / Electric / Plumbing (MEP) in the sub-basement, it may be worth considering specialty structural analysis to dry flood proof all openings (doors, windows, vents) at the basement level around the perimeter building wall with flood shields or extended areaway walls to a point above the 100-year and perhaps the 500-year floodplain. If pursued, the intent would be to limit the amount of damage to the MEP equipment. It is critical to note that during a flood event no people would be allowed in the building and the pump system would need to operate autonomously. This is because basements and spaces below the flood level are severe life safety hazards. Accordingly, strict legal protocol would need to be crafted and put in place if such flood protection measures were pursued. Additionally, if this approach were pursed, then it is also recommended that a second emergency generator (adequate to run pumps) is located in a location above the floodplain – either on an upper level

or somewhere on the exterior site. Even with dry flood proofing there will be potential for water to enter the building such that limited renovations will still be necessary after the event. Again, this is only a suggestion for further investigation and not a formal recommendation.

Opinion of construction costs:

A. *If left as-is and allowed to flood, in our opinion, the renovation cost for the basement and mechanical spaces is $7,093,464.90*.
B. *Potential allowances if dry flood proofing of basement level openings were to be pursued could be $4,430,614 as follows:*
    a. *Structural study $45,000*
    b. *Implementation of study reinforcing recommendations: $250,000*
    c. *Secondary emergency generator and pumping system: $300,000*
    d. *Flood proof shields or extended areaway walls: $200,000*
    e. *Post flood renovation costs: $3,635,614*

Total estimate A = $7,093,465

Total estimate B (if deemed feasible) = $4,430,614

Mitigation Recommendations for Risk Reduction:

Flood-proofing Method	Effective?	Cost ($US)
Wet Flood-proofing:	Allow to flood and repair.	$7,093,465
Elevate Utilities:	Recommend leave as-is because existing utility equipment is large, and space is limited.	
Dry Flood-proofing:	Not Recommended due to basement life safety hazards.	$4,430,614
Building Relocation:	Not Feasible	
Elevate Building:	Not Feasible	
Sealing of Openings:	Structural study required	
Other Modifications:	Make note of contents and their ability to contaminate flood waters.	
TOTAL COST	**Potential project cost for mitigation**	**$ 11,524,079**

Benefit – Cost Summary:

Total Project Benefits	**$ 21,263,384**	**Replacement Value**
Total Project Cost	**$ 11,524,079**	**Potential Mitigation Cost**
Benefit – Cost Ratio	**1.85**	**Replacement Value / Mitigation Cost**

BUILDING ASSESSMENT FORM

Building Address & Description: 128 State Street, Montpelier, VT (BGS ID #06023)

Local Contact: David Latoundji & Richard Kehne, VT Buildings & General Services

Assessment Team: Alex Halpern (FFF), Roy Schiff (MMI), Sean Cohen (MSK)
Kristen Darby (Grenier), Cameron Burrows (FFF)

Exterior Photos:

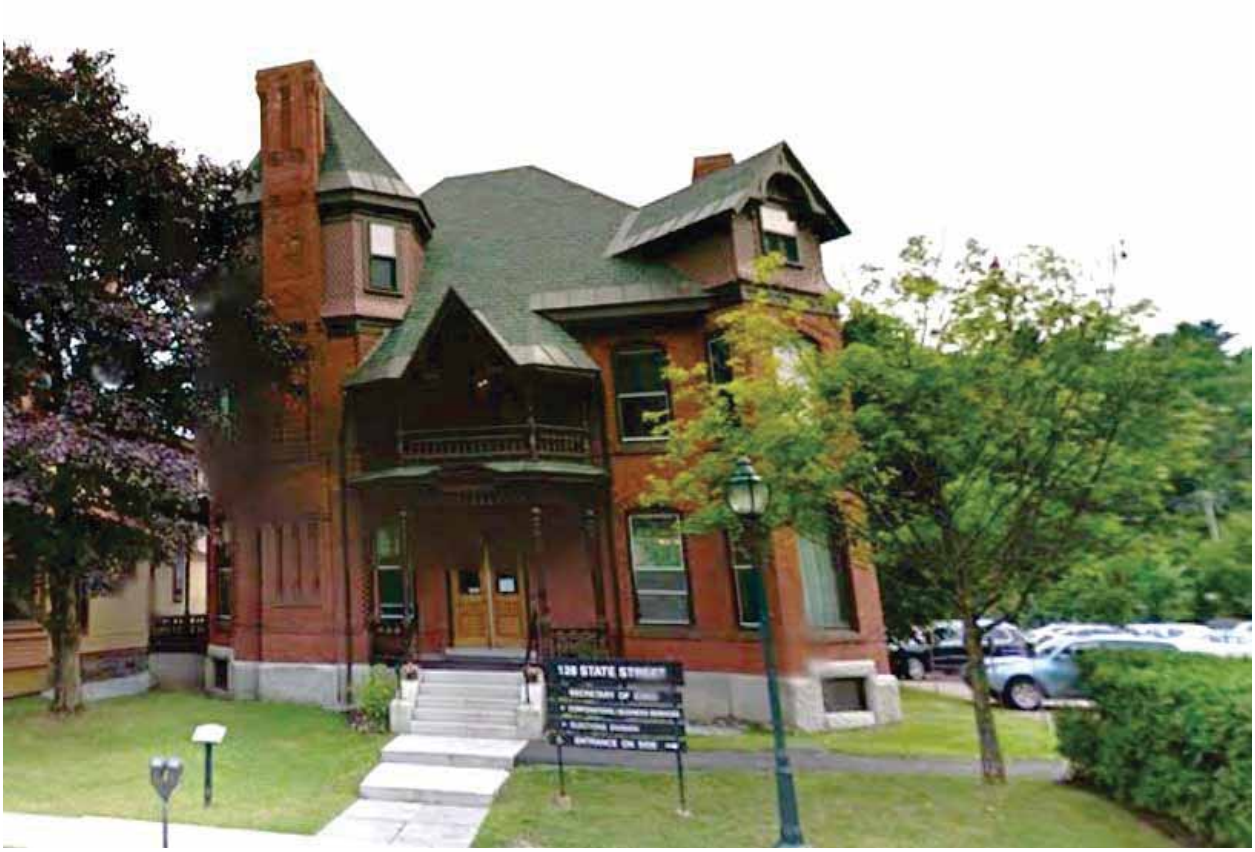


Figure 1: Front Entrance looking South (photo credit: Freeman French Freeman)

Special Flood Hazard Area and Vermont River Corridor:

Figure 2: Flood Hazard Map (1in = 30 ft)

Plan View with Lowest Points of Entry:

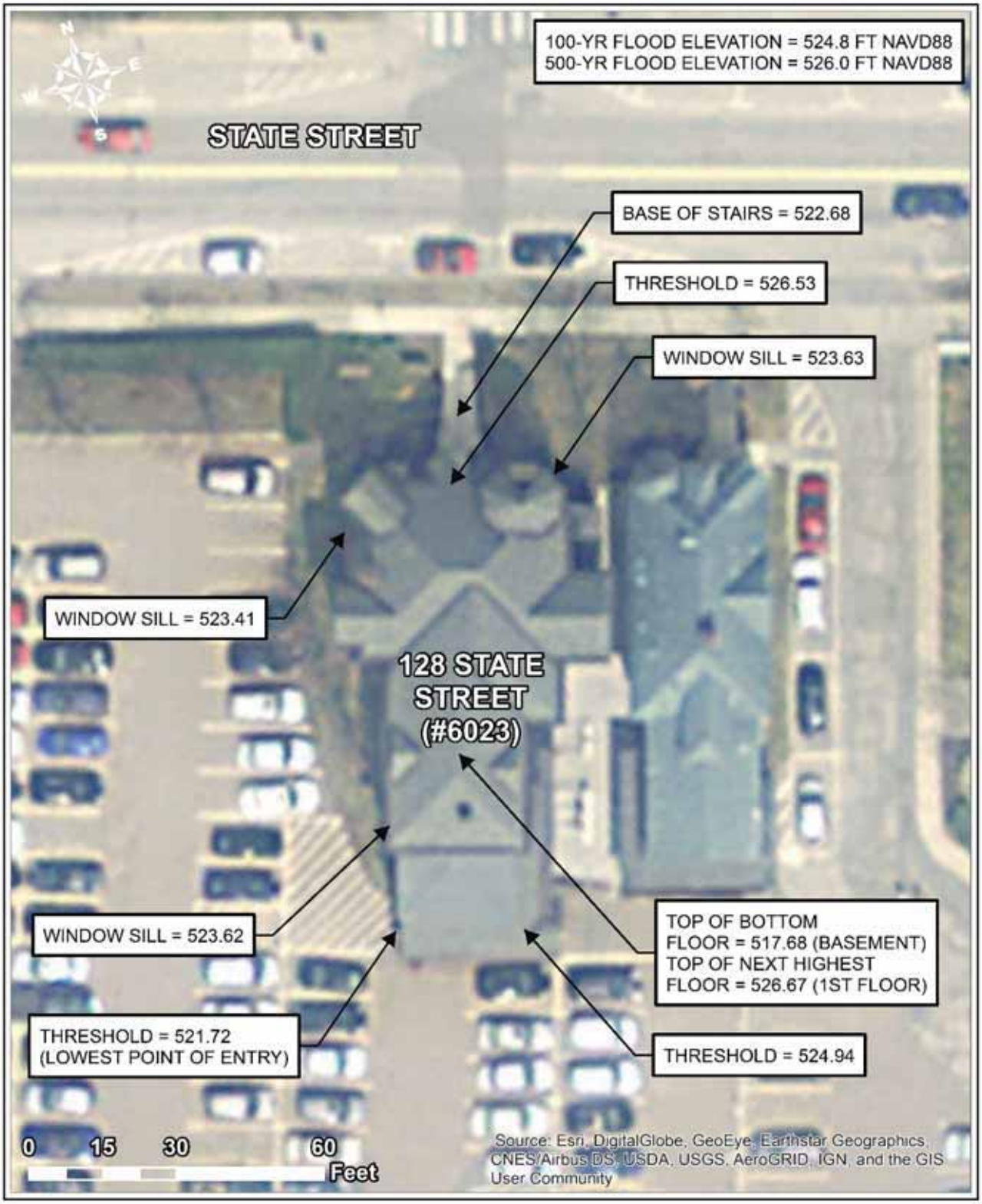


Figure 3: Lowest Point of Entry (1in = 30 ft, elevations reference NAVD 88 vertical datum)

Floor Plan:

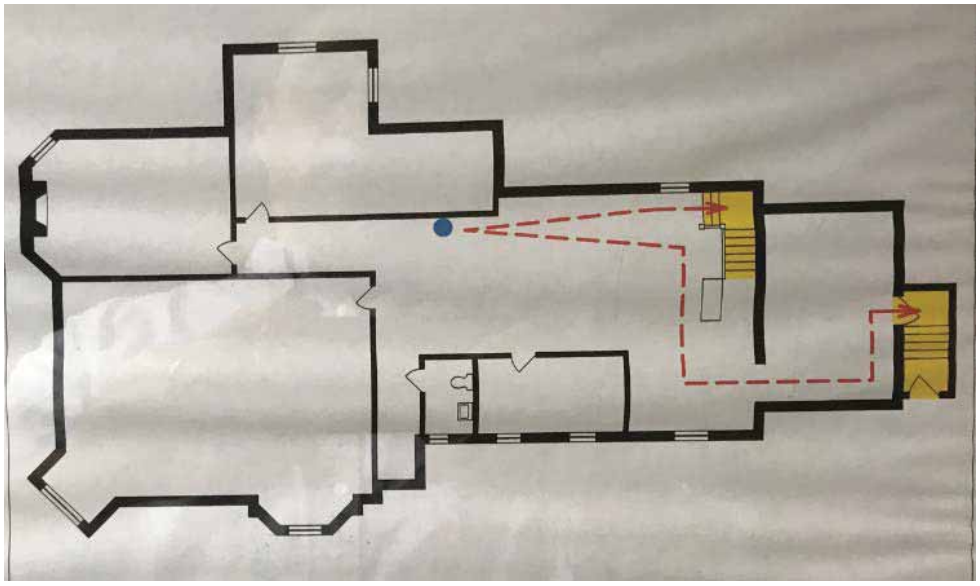


Figure 4: Building mounted egress basement floor plan diagram (N.T.S.)

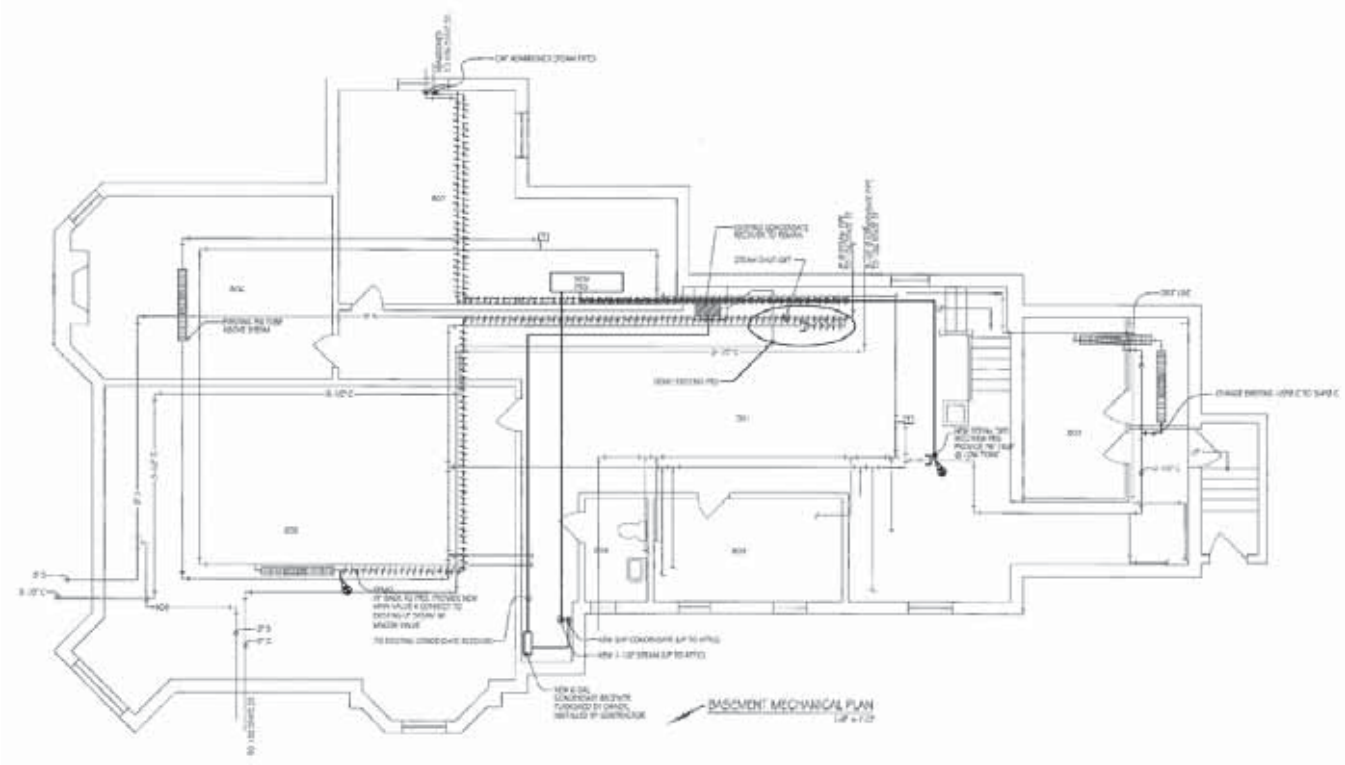


Figure 5: Basement plan from September 2010 Mechanical Renovation plans, Sheet M-1 (N.T.S.)

Photo Documentation:

Figure 6: West elevation

Figure 7: North elevation

Figure 8: East elevation

Figure 9: Partial west elevation

Figure 10: Basement access door

Figure 11: Basement access door open and stairs to basement

Figure 12: Southeast façade

Figure 13: Site mounted split system AC units

Figure 14: South façade

Figure 15: South façade

Figure 16: First floor woodwork (understood to be above predicted flood elevations)

Figure 17: First floor woodwork (understood to be above predicted flood elevations)

Figure 18: First floor woodwork (understood to be above predicted flood elevations)

Figure 19: First floor woodwork (understood to be above predicted flood elevations)

Figure 20: Basement mechanical / hot water heater

Figure 21: Basement fire alarm panel

Figure 22: Basement column and stored supplies

Figure 23: Basement electrical

Figure 24: Basement steam

Figure 25: Basement sprinkler riser

Figure 26: Basement fiber-optic and electrical panel

Figure 27: Basement fiber-optic

Figure 28: Basement sump

Figure 29: Basement restroom

FLOOD HAZARD MITIGATION ASSESSMENT & ANALYSIS FOR STATE-OWNED BUILDINGS

BUILDING ASSESSMENT FORM

Building Information:

ADDRESS:	128 State Street, Montpelier
BUILDING ID:	06023
OWNER:	VT Buildings & General Services
OCCUPYING AGENCIES/DEPARTMENTS:	Secretary of State
REPLACEMENT VALUE (2017):	$2,243,607
SQUARE FOOTAGE:	9,211 sq. ft.
NO. OF FLOORS:	3
GROSS FLOOR AREA:	9,211 sq. ft.
BASEMENT AREA:	3,151 sq. ft.
COST PER SQUARE FOOT:	$243.58 / sq. ft. (Replacement value / gross floor area)

FOUNDATION:

Concrete Footing, Concrete Slab, Concrete Walls

FLOOR STRUCTURE:

Basement – Reinforced Concrete Slab on Ground

Upper Floors – Wood Plank on Wood Joists

EXTERIOR WALLS:

Brick on studs

GENERAL CONTENTS/USAGE:

Basement – primarily used for building systems such as mechanical systems, electrical (including emergency generator), plumbing, fire protection, Tel-com, and elevator controls, along with a restroom and storage of supplies.

Risk Overview

FEMA Zone:	Zone AE
100-year Flood Elevation:	524.8 ft NAVD 88
500-year Flood Elevation:	526.0 ft NAVD 88
River Corridor:	Yes, completely within

Ground Surface Elevation:	522.68 ft NAVD 88 (lowest grade adjacent to building)
Lowest Point of Entry:	521.73 ft NAVD 88 (threshold)
Basement:	Yes – top of bottom floor = 517.68 ft NAVD 88 (basement)
Historic Building:	Yes

Description of Space Below Flood Levels: Lowest floor susceptible to flooding (basement) consists of building systems such as mechanicals, electrical panels (including emergency generator), plumbing, fire protection systems, Tel-com panels, and elevator controls, along with a restroom and space generally used for storage of supplies.

Risk Narrative:

Flood Vulnerability:

The building is located within the right floodplain (looking downstream) of the Winooski River. The entire building is located within the Zone AE Special Flood Hazard Area (SFHA) as depicted on FEMA Flood Insurance Rate Map (FIRM) Panel No. 0264E dated March 19, 2013, therefore an Elevation Certificate has been prepared. Based on the data provided on the Elevation Certificate, the lowest floor (basement) would be flooded during the 100-year and 500-year flood, however the upper floors (1st floor, 2nd floor, and mechanical attic) would not be flooded. During the 100-year flood, the depth of water would be approximately 7.1 feet above the basement floor, and the depth above the basement floor would be approximately 8.3 feet during the 500-year flood. Note that with an elevation of 526.67 (see Figure 3 above), the 1st floor is more than a foot above the 100-year flood, however is only approximately 0.7 feet above the 500-year flood elevation.

The items damaged during a flood include the majority of the building systems such as mechanical and electrical systems (including emergency generator), plumbing and fire protection systems, Tel-com systems, and elevator controls. Damage also includes all porous finishes (wood, wainscoting, sheetrock, carpeting, etc.). All exterior and interior non-porous surfaces below flood levels would require clean up. All items stored at or below the flood levels would be damaged and potentially lost as well. Additional information regarding potential flood damages is provided with the Recommendations.

Erosion Vulnerability:

The right boundary of the Vermont River Corridor (looking downstream) is located to the north of the building along the edge of State Street, therefore the entire building is located within the river corridor. Note that the river corridor includes both a meander belt (formerly called the fluvial erosion hazard zone) plus a 50-foot buffer. The corridor boundary is located approximately 275 feet from the top of river bank, which consists of a combination of retaining walls and riprap armoring through this reach. The land to the south between the building and river bank consists of parking lot and access drives. It should be noted that this area is located within the flood shadow of the railroad embankment and Central Heat Plant facility, which could act to deflect erosive flood flows away from the building. Given the setting in relation to the river corridor and the characteristics of flooding on the Winooski River, risk of damage due to erosion at this building would be considered medium to low.

Future Vulnerability:

Current trends in weather indicate that flooding in the region is becoming more frequent and more severe. State of Vermont flood mitigation standards require designs to meet a protection level of 1-foot above the 500-year flood. Future improvements at this location should meet or exceed that minimum standard.

Summary and Recommendation:

It is our understanding that the basement floor slab will be approximately 7.1 feet below water during a 100-year flood condition, and approximately 8.3 feet below water during a 500-year flood condition. The first floor, which contains significant intricate and ornamental woodwork, is understood to be above the both flood conditions, however is only about 0.7 feet above the predicted 500-year flood elevation.

The majority of building Mechanical/ Electrical (including an emergency generator) / Plumbing/ Fire Protection/ Tel-com/ and elevator machine room fixed equipment is located in the basement will be essentially completely underwater.

The basement windows, vents, and doors which could serve as points of water access. Although the foundation materials are made of materials that could be suitable for dry flood proofing, FEMA does not recommend dry flood proofing of basements due to the associated life safety hazards. Accordingly, dry flood proofing is not recommended.

We recommend the following:

1. Leave as-is and allow basement to flood. This recommendation is made because of the life safety hazards that would be present if dry flood proofing were pursued.
2. Investigate relocating the fire alarm, security, electrical, and telecom panels to spaces on upper levels to minimize renovation costs after a flood. Relocation of other heavier equipment such as steam piping; sprinkler entrance; and hot water heater, could take up too much valuable program space.

Opinion of construction costs:

A. *If left as is and allowed to flood, in our opinion, the renovation cost for the basement and mechanical spaces is $845,839.84.*
B. *Plus the following allowance to permanently relocate existing fixed equipment ahead a flood event.*
    a. *Electrical Panels $75,000*
    b. *Fire Alarm Panels: $50,000*
    c. *Telcom Panels/ Fiber Optic: $25,000*
    d. *Security Panel: 5,000*

Total estimate A = $845,840

Total estimate B = $155,000

Mitigation Recommendations for Risk Reduction:

Flood-proofing Method	Effective?	Cost ($US)
Wet Flood-proofing:	Allow to flood and repair.	$845,840
Elevate Utilities:	Recommended in advance of flood for certain utilities, larger utilities recommend leave as-is because equipment is large and space is limited.	$155,000
Dry Flood-proofing:	Not Recommended due to basement life safety hazards.	
Building Relocation:	Not Feasible	
Elevate Building:	Not Feasible	
Sealing of Openings:	Structural study required	
Other Modifications:	Make note of contents and their ability to contaminate flood waters.	
TOTAL COST	**Potential project cost for mitigation**	**$ 1,000,840**

Benefit – Cost Summary:

Total Project Benefits	**$ 2,243,607**	**Replacement Value**
Total Project Cost	**$ 1,000,840**	**Potential Mitigation Cost**
Benefit – Cost Ratio	**2.24**	**Replacement Value / Mitigation Cost**

BUILDING ASSESSMENT FORM

Building Address & Description: 133 State Street, Montpelier, VT (BGS ID #06025)

Local Contact: David Latoundji & Richard Kehne, VT Buildings & General Services

Assessment Team: Alex Halpern (FFF), Tom Bursey (FFF), Roy Schiff (MMI), Brian Cote (MMI), Jason Dolmetsch (MSK), Sean Cohen (MSK), Lance Triebel (Stewart Const.) Kristen Darby (Grenier), Lauren Weston (MMI)

Exterior Photos:

Figure 1: South and east elevations (photo credit: Freeman French Freeman)

Special Flood Hazard Area and Vermont River Corridor:

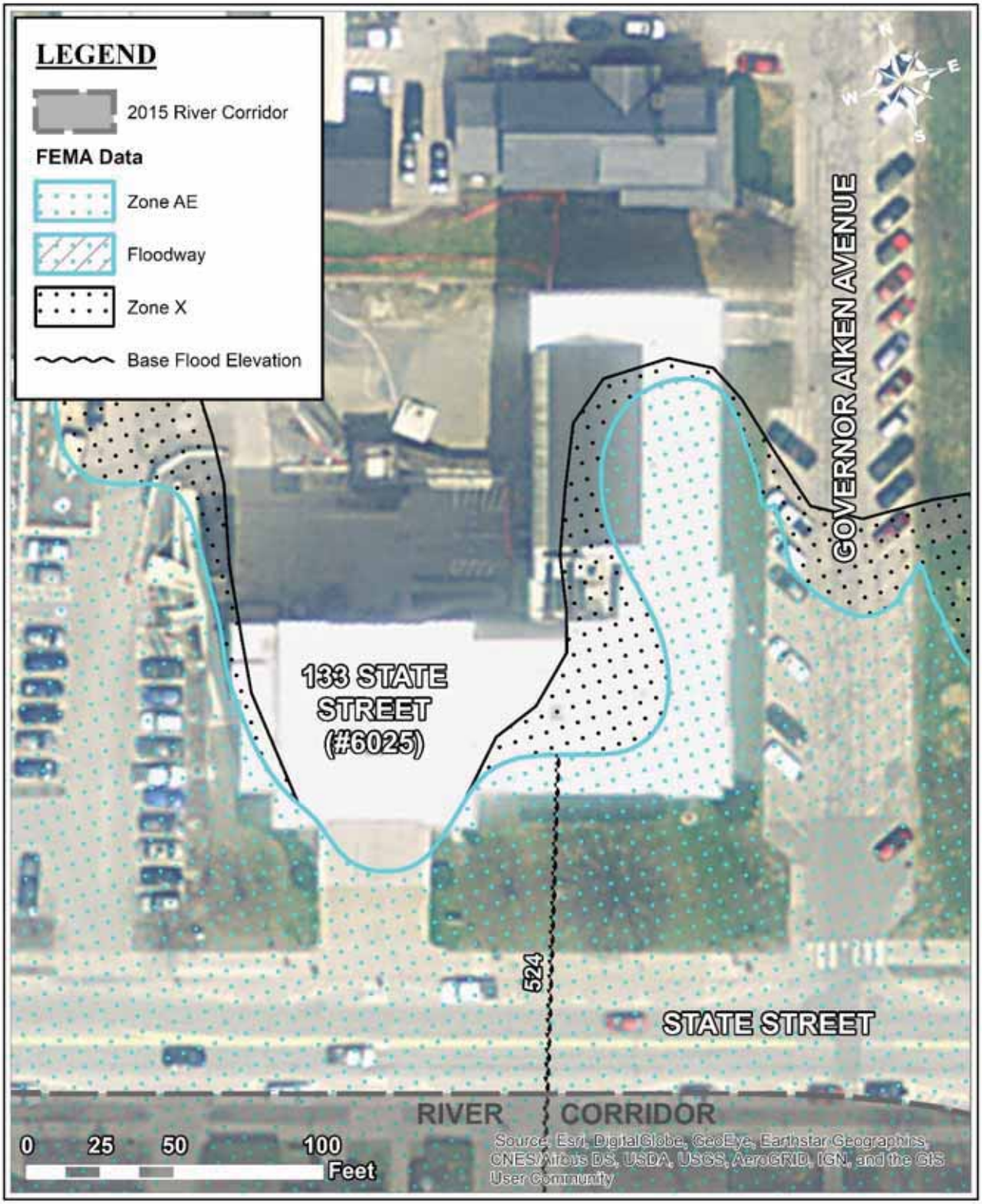


Figure 2: Flood Hazard Map (1in = 50 ft)

Plan View with Lowest Points of Entry:

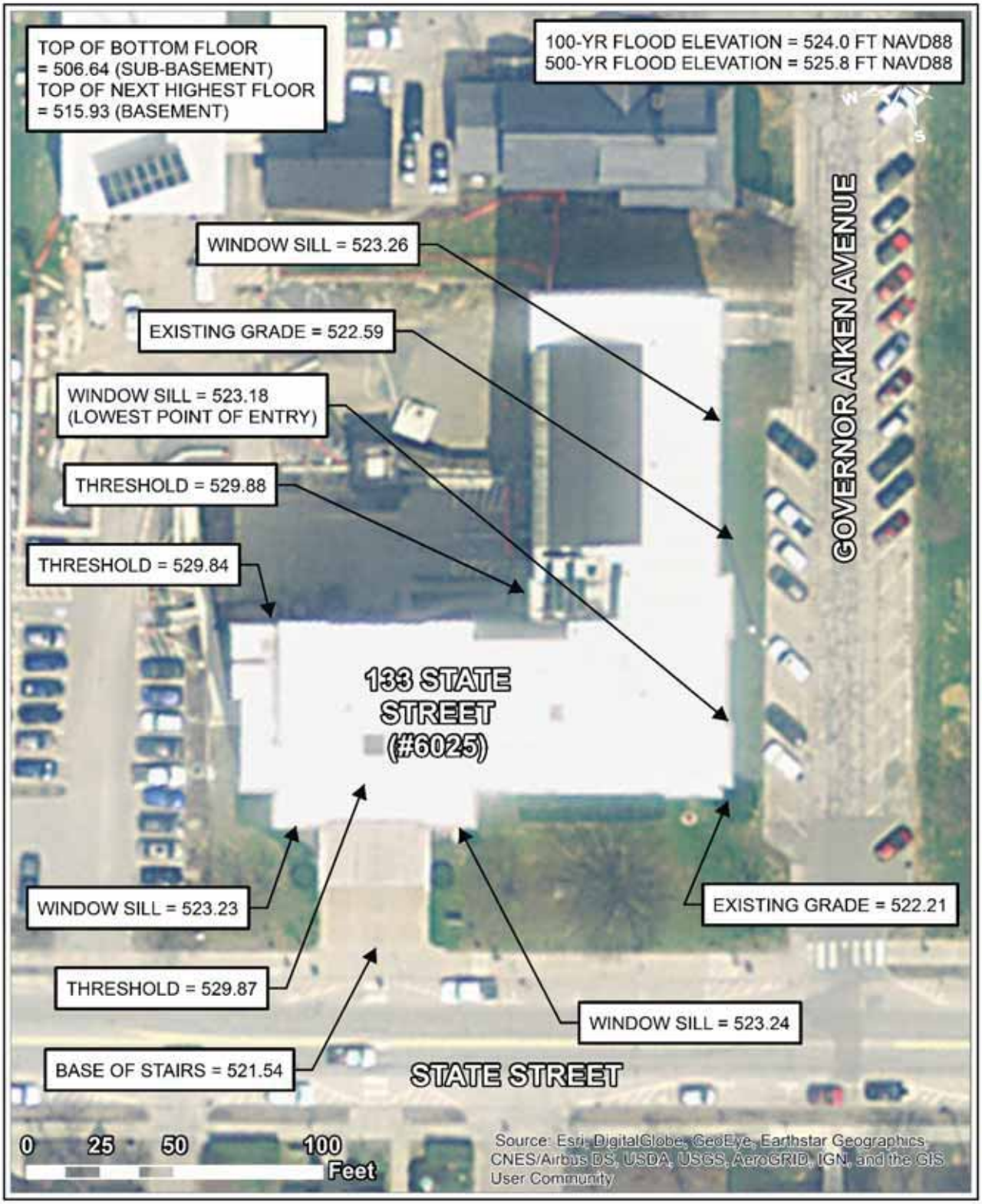


Figure 3: Lowest Point of Entry (1in = 50 ft, elevations reference NAVD 88 vertical datum)

Floor Plan:

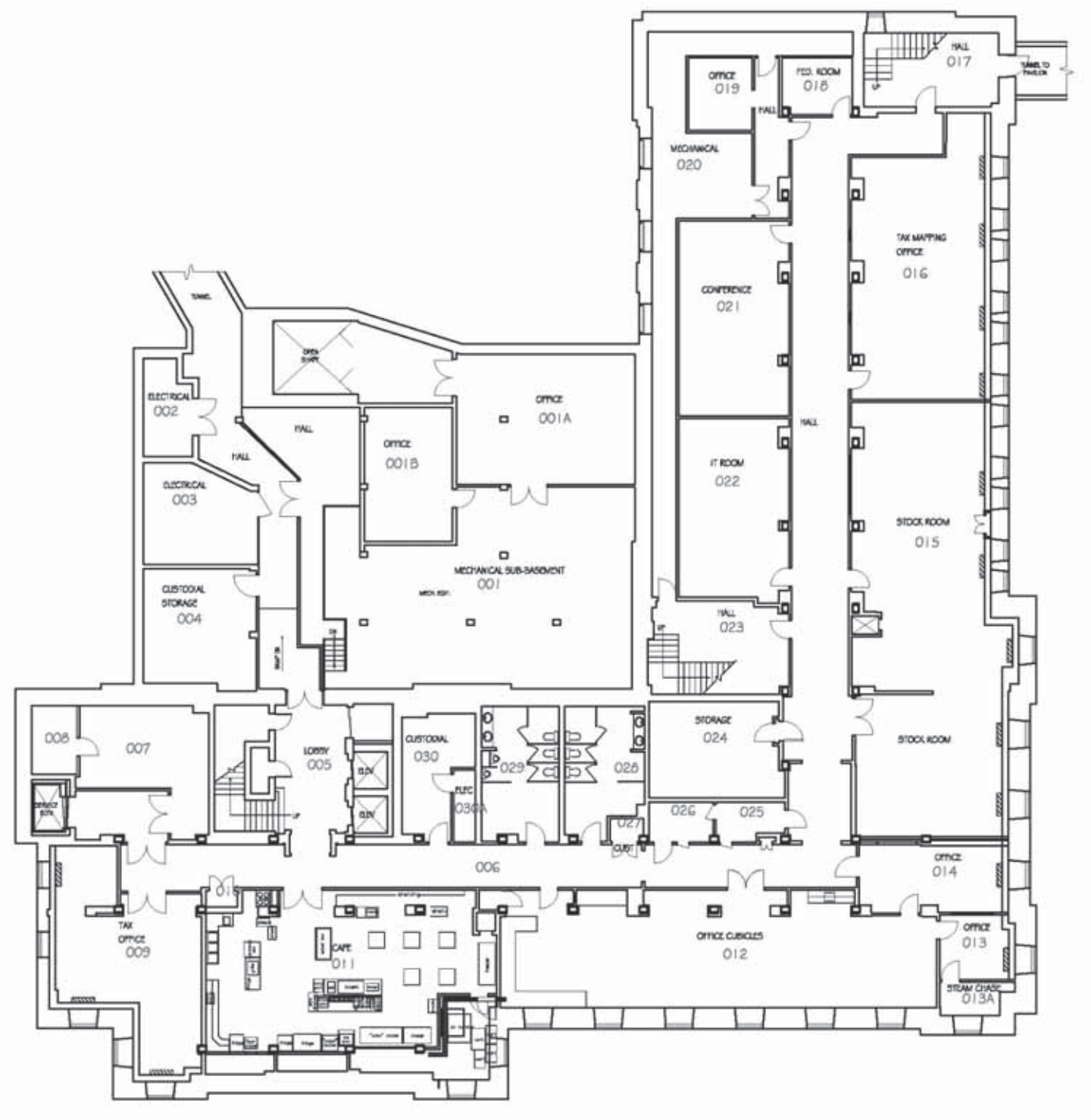


Figure 4: Basement Floor Plan (source: VT Buildings & General Services, N.T.S.)

Photo Documentation:

Figure 5: South façade and main entrance

Figure 6: North façade and rear entrance

Figure 7: Northwest façade

Figure 8: North and west façades

Figure 9: West exterior wall granite base course (appears to be of newer construction)

Figure 10: Basement floor looking towards tunnel and access to sub-basement

Figure 11: Basement level fire safety equipment

Figure 12: Sub-basement floor access grate to lower areaway(s)

Figure 13: Sub-basement emergency generator

Figure 14: Sub-basement steam piping

Figure 15: Sub-basement mechanicals and steam

Figure 16: Sub-basement electrical panels

Figure 17: Sub-basement electrical panels

Figure 18: Sub-basement electrical panels / mechanicals

Figure 19: Sub-basement sump

Figure 20: Sub-basement floor drain

Figure 21: Multiple wall penetrations in sub-basement walls (potential for water infiltration)

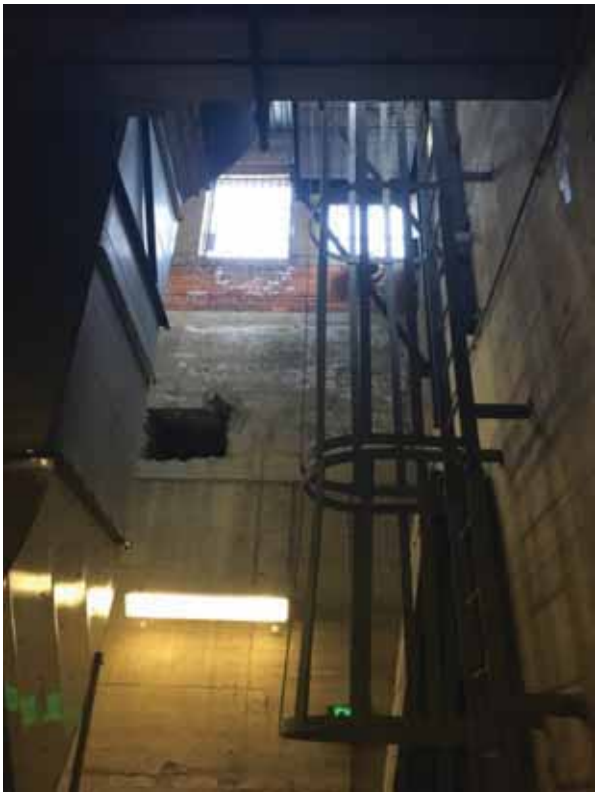


Figure 22: Roofed areaway (former ice storage tower) from sub-basement to rear parking area

Figure 23: Roofed areaway (former ice storage tower) from sub-basement to rear parking area

Figure 24: Roofed areaway (former ice storage tower) at the rear parking area

Figure 25: Basement windows at building perimeter (east façade)

Figure 26: Basement window (typical)

Figure 27: Basement window (typical)

Figure 28: Basement windows (north facade), first floor at top of stairs

Figure 29: Basement kitchen

Figure 30: Basement hallway and access panels

Figure 31: Basement hallway with floor access panels

Figure 32: Basement-level office space adjacent to perimeter basement windows

Figure 33: Basement-level office space and storage adjacent to perimeter basement windows

Figure 34: Basement-level office supply storage adjacent to perimeter basement windows

Figure 35: Basement-level storage racks (FF+E is not included in cost opinions)

Figure 36: Basement-level water electrical panels

Figure 37: Pre-existing basement-level water damage observed in areas

Figure 38: Basement-level tunnel across Statehouse Green

Figure 39: Basement-level passageway

FLOOD HAZARD MITIGATION ASSESSMENT & ANALYSIS FOR STATE-OWNED BUILDINGS

BUILDING ASSESSMENT FORM

Building Information:

ADDRESS:	133 State Street, Montpelier
BUILDING ID:	06025
OWNER:	VT Buildings & General Services
OCCUPYING AGENCIES/DEPARTMENTS:	ADS, BGS, Dept. of Taxes, DPS (Radio Room)
REPLACEMENT VALUE (2017):	$42,605,762
SQUARE FOOTAGE:	81,472 sq. ft.
NO. OF FLOORS:	5+
GROSS FLOOR AREA:	81,472 sq. ft.
BASEMENT AREA:	20,040 sq. ft.
COST PER SQUARE FOOT:	$522.95 / sq. ft. (Replacement value / gross floor area)

FOUNDATION:

Concrete Footing, Concrete Slab, Concrete Walls

FLOOR STRUCTURE:

Basement – Reinforced Concrete Slab on Ground

Upper Floors – Elevated Lift Slabs

EXTERIOR WALLS:

Native Stone on Masonry

GENERAL CONTENTS/USAGE:

Basement – Building mechanicals including emergency generator, office space, conference and meeting rooms, supply storage.

Risk Overview

FEMA Zone:	Zone AE and Zone X
100-year Flood Elevation:	524.0 ft NAVD 88
500-year Flood Elevation:	525.8 ft NAVD 88
River Corridor:	No, located approximately 100' away to the south of the building
Ground Surface Elevation:	522.21 ft NAVD 88 (lowest grade adjacent to building)
Lowest Point of Entry:	523.18 ft NAVD 88 (window sill)
Basement:	Yes – top of bottom floor = 506.64 ft NAVD 88 (sub-basement)
	Top of next highest floor = 515.93 ft NAVD 88 (basement)
Historic Building:	Yes

Description of Space Below Flood Levels: Lowest floor susceptible to flooding (basement) consists of building systems such as mechanicals, electrical panels (including emergency generator), plumbing, fire protection systems, Tel-com panels, and elevator controls, along with conference areas, break rooms, office space, and areas generally used for storage of supplies.

Risk Narrative:

Flood Vulnerability:

The building is located at the edge of the right Winooski River floodplain (looking downstream). The eastern portion and southwestern corner of the building is located within the Zone AE and Zone X Special Flood Hazard Area (SFHA) as depicted on FEMA Flood Insurance Rate Map (FIRM) Panel No. 0264E dated March 19, 2013, therefore an Elevation Certificate has been prepared. Based on the data provided on the Elevation Certificate, the lowest floors, including the sub-basement and basement levels, would be flooded during the 100-year and 500-year flood, however the upper floors (1st floor through 5th floor) would not be flooded. During the 100-year flood, the depth of water would be approximately 17.4 feet above the sub-basement floor and 8.1 feet above the basement floor. The depth of water would be approximately 19.2 feet above the sub-basement floor and 9.9 feet above the basement floor during the 500-year flood.

The items damaged during a flood include all buildings systems such as mechanical and electrical systems (including emergency generator), plumbing and fire protection systems, Tel-com systems, and elevator controls located in the sub-basement. Damage also includes all porous finishes (wood, wainscoting, sheetrock, carpeting, etc.) located in the basement and sub-basement. All exterior and interior non-porous surfaces below flood levels would require clean up. All items stored in the basement at or below the flood levels would be damaged and potentially lost as well. Additional information regarding potential flood damages is provided with the Recommendations.

Erosion Vulnerability:

The building is located outside of the Vermont River Corridor. Note that the river corridor includes both a meander belt (formerly called the fluvial erosion hazard zone) plus a 50-foot buffer. The right boundary of the river corridor (looking downstream) is located approximately 100 feet to the south of the building along the south edge of State Street. The corridor boundary is located approximately 275 feet from the top of river bank, which consists of a combination of retaining walls and riprap armoring through this reach. Therefore, the building is located a total of approximately 375 feet away from the top of river bank. The land between the building and the river bank consists of State Street, several buildings, parking lots, and access driveways. Given the setting in relation to the river corridor and the characteristics of flooding on the Winooski River, risk of damage due to erosion at this building would be considered low.

Future Vulnerability:

Current trends in weather indicate that flooding in the region is becoming more frequent and more severe. State of Vermont flood mitigation standards require designs to meet a protection level of 1-foot above the 500-year flood. Future improvements at this location should meet or exceed that minimum standard.

Summary & Recommendation:

It is our understanding that the basement floor slab on grade will be approximately 8.1 feet below water during a 100-year flood condition, and approximately 9.9 feet below water during a 500-year flood condition. The mechanical room and associated floor vaults will be an additional 10’ to 18’ below water for each of the above flood conditions.

The majority of building Mechanical/ Electrical (including an emergency generator) / Plumbing/ Fire Protection/ Tel-com/ and elevator machine room fixed equipment is located in the sub-basement and have the potential to be under approximately 10 feet to 28 feet of water.

Although the first floor is above both flood elevations, the basement level has numerous windows below both the predicted 100-year and 500-year flood elevations that provide ample points of access for floodwaters. A freestanding roofed areaway with masonry walls and roof located in the back parking lot appears to intersect grade just above the predicted 500-year flood elevation (as checked on Google Earth – so spot elevations would need to be confirmed).

FEMA does not recommend dry flood proofing if spaces are under three or more feet of water, or if there are basement spaces (unless significant structural engineering analysis is prepared and findings implemented).

We recommend the following:

1. Leave as-is and allow basement and sub-basement to flood. This recommendation is made because of the extreme water depths and significant life safety hazards that would present if dry flood proofing were pursued.
2. Due to the significant amount Mechanical / Electrical/ Plumbing (MEP) in the sub-basement, it may be worth considering specialty structural analysis to dry flood proof all openings (doors, windows, vents) at the basement level around the perimeter building wall with flood shields to a point above the 100-year and perhaps the 500-year flood plain. If pursued, the intent would be to limit the amount of damage to the MEP equipment. It is critical to note that during a flood event no people would be allowed in the building and the pump system would need to operate autonomously. This is because basements and spaces below the flood level are severe life safety hazards. Accordingly, strict legal protocol would need to be crafted and put in place if such flood protection measures were pursued. Additionally if this approach were pursed, then it is also recommended that a second emergency generator (adequate to run pumps) is located in a location above the flood plain – either on an upper level or somewhere on exterior site. Even with dry flood proofing there will be potential for water to enter the building such that limited renovations will still be necessary after the event. Again, this is only a suggestion for further investigation and not a formal recommendation.

   Opinion of construction costs:

   A. If left as is and allowed to flood, in our opinion, the renovation cost for the basement and mechanical spaces is $16,667,374.09.

   B. Potential allowances if dry flood proofing of basement level openings were to be pursued could be $10,123,792 as follows:

      a. Structural study $65,000
      b. Implementation of study reinforcing recommendations: $750,000
      c. Secondary emergency generator and pumping system: $450,000
      d. Flood proof shields for openings: $320,000
      e. Variables allowance @15%: $223,000
      f. Post flood renovation costs: $8,315,792

Total estimate A = $16,667,374

Total estimate B (if deemed feasible) = $10,123,792

Mitigation Recommendations for Risk Reduction:

Flood-proofing Method	Effective?	Cost ($US)
Wet Flood-proofing:	Allow to flood and repair.	$16,667,374
Elevate Utilities:	Not Recommended	
Dry Flood-proofing:	Not recommended (see recommendations above)	$10,123,792
Building Relocation:	Not feasible	
Elevate Building:	Not feasible	
Sealing of Openings:	See recommendations above	
Other Modifications:	Make note of contents and their ability to contaminate flood water.	
TOTAL COST	**Potential project cost for mitigation**	**$ 26,791,166**

Benefit – Cost Summary:

Total Project Benefits	**$ 42,605,762**	**Replacement Value**
Total Project Cost	**$ 26,791,166**	**Potential Mitigation Cost**
Benefit – Cost Ratio	**1.59**	**Replacement Value / Mitigation Cost**

BUILDING ASSESSMENT FORM

Building Address & Description: 1756 Route 302, Berlin, VT (BGS ID #09004)

Local Contact: Brad McAvoy, VTrans

Assessment Team: Cameron Burrows (FFF), Brian Cote (MMI), Doug Osborne (MMI)

Exterior Photos:

Figure 1: View of Central Garage Building looking northeast (photo credit: Google Maps)

Figure 2: Historic overhead view of Central Garage Building (photo credit: VTrans)

Special Flood Hazard Area and Vermont River Corridor:

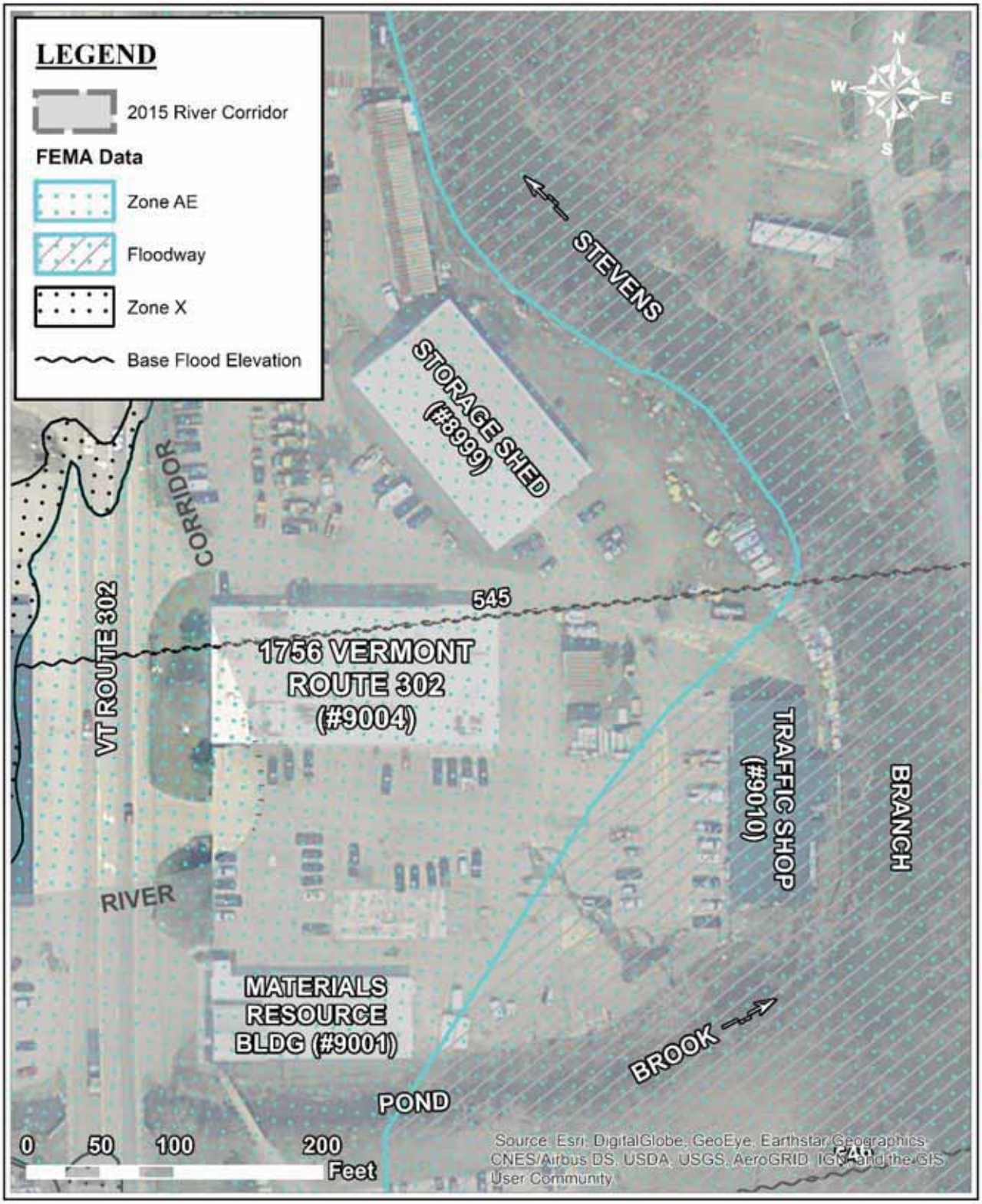


Figure 3: Flood Hazard Map (1in = 100 ft)

Plan View with Lowest Points of Entry:

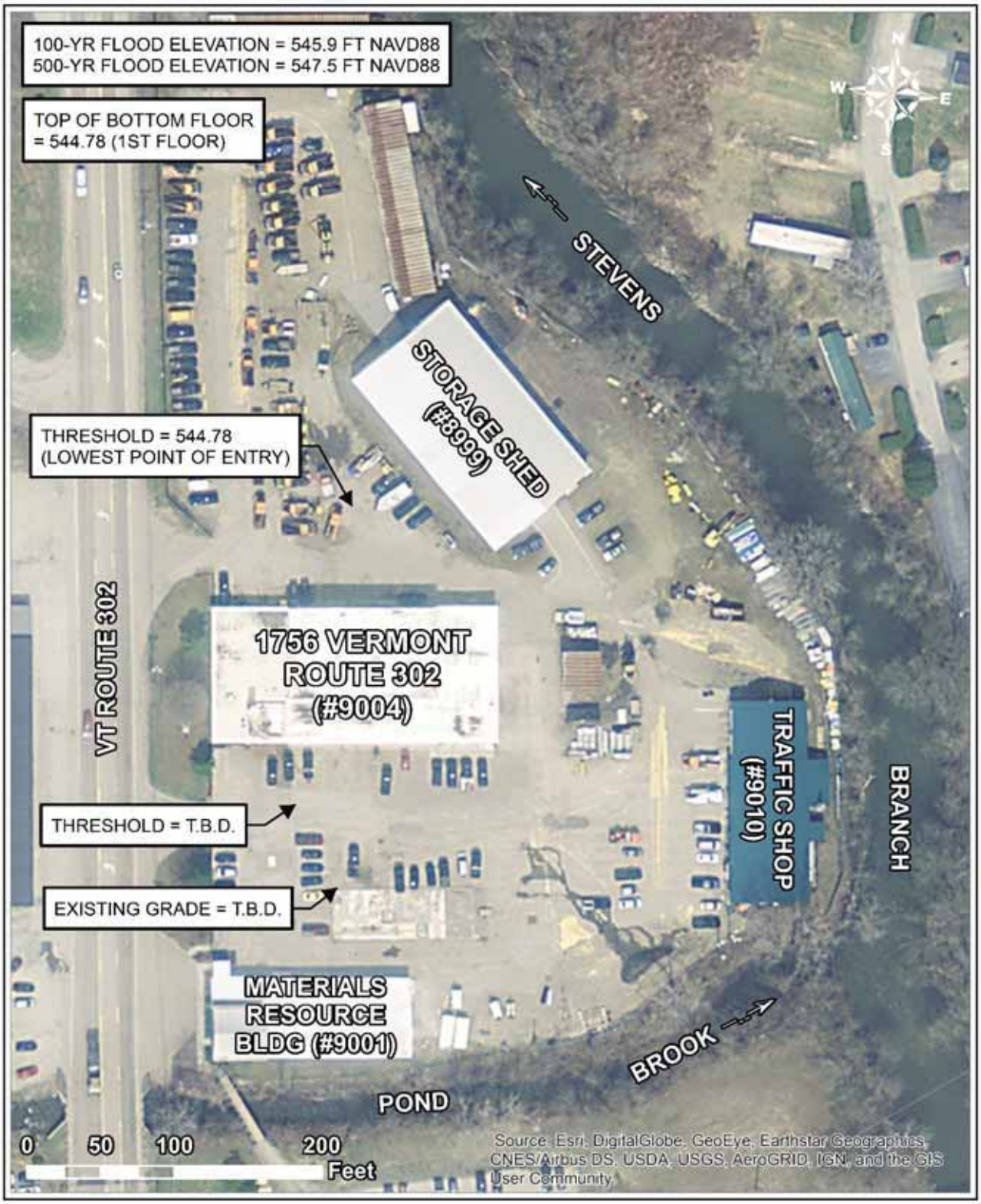


Figure 4: Lowest Point of Entry (1in = 100 ft, elevations reference NAVD 88 vertical datum)

Floor Plan:

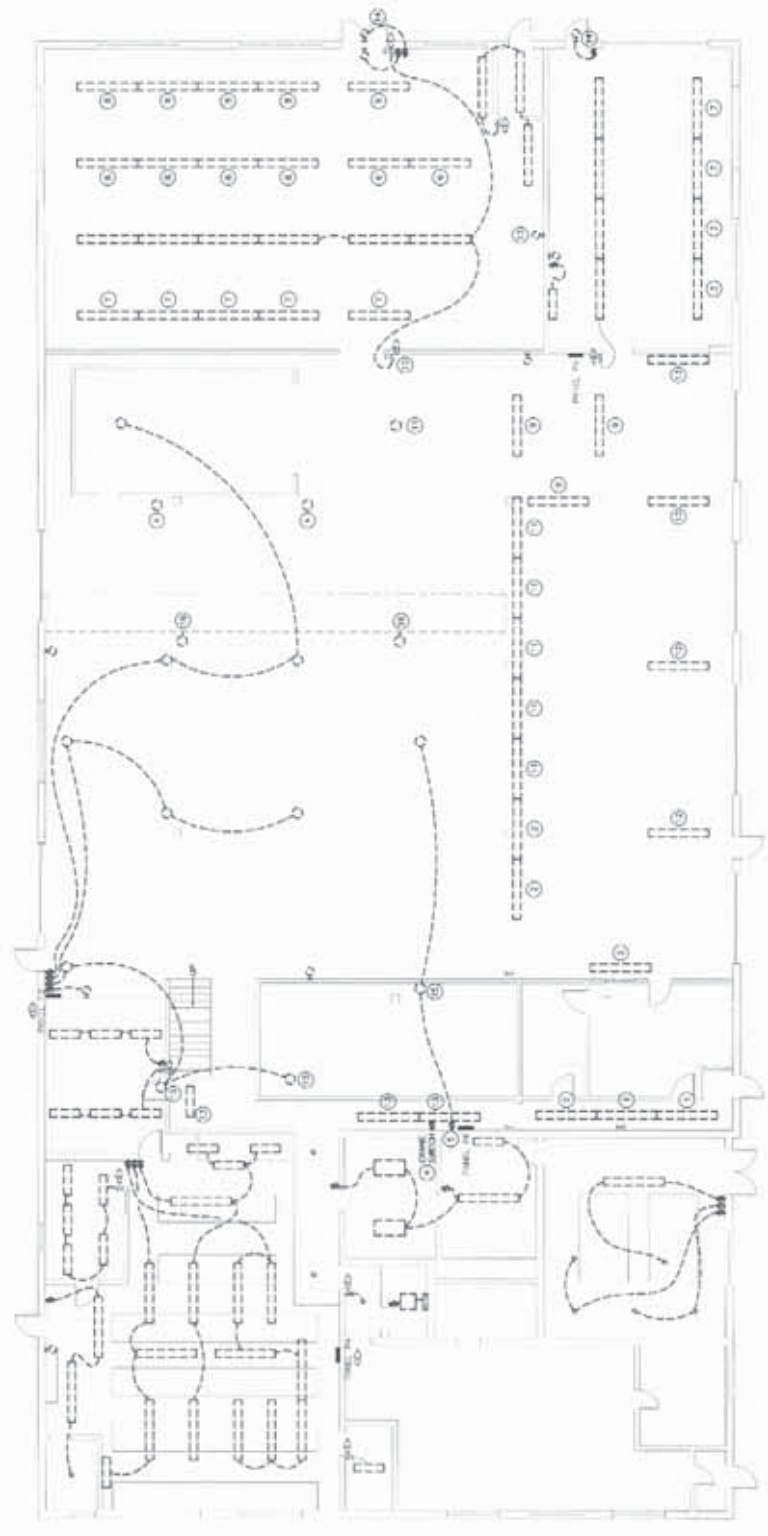


Figure 5: Building Floor Plan from Electrical Demolition Plans dated March, 2006, Sheet E-1, provided by VTrans (N.T.S.).

Photo Documentation:

Entry door

Copier Room

Office Space

Telecom

Telecom

Communications/ Fiber optics

Office space

Floor Drain

Power panels and fixed equipment

Wash station

Fixtures

Emergency Generator

Boiler

Mechanical / Electrical

Mechanical/ Steam

Mechanical

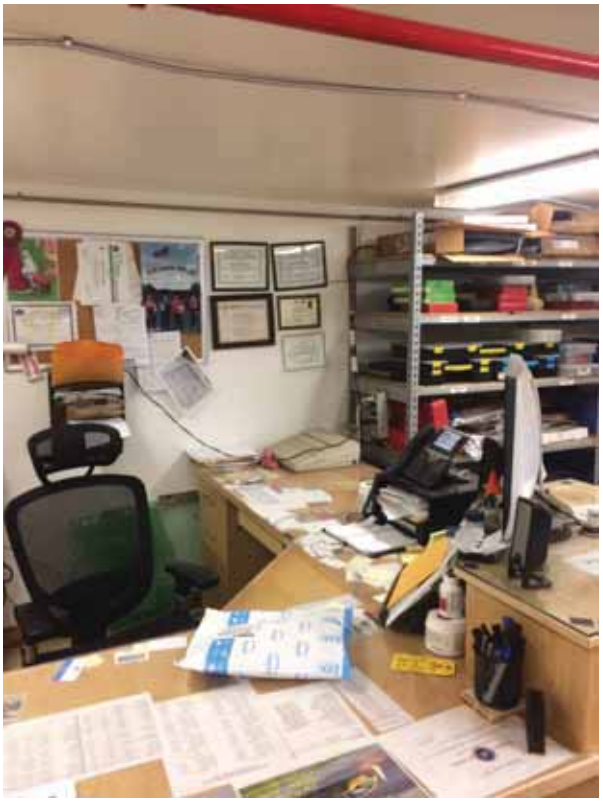
Plumbing assembly

Floor drains and access panel

Contents could be hazardous if not addressed prior to flood event

Building exterior

Parts storage

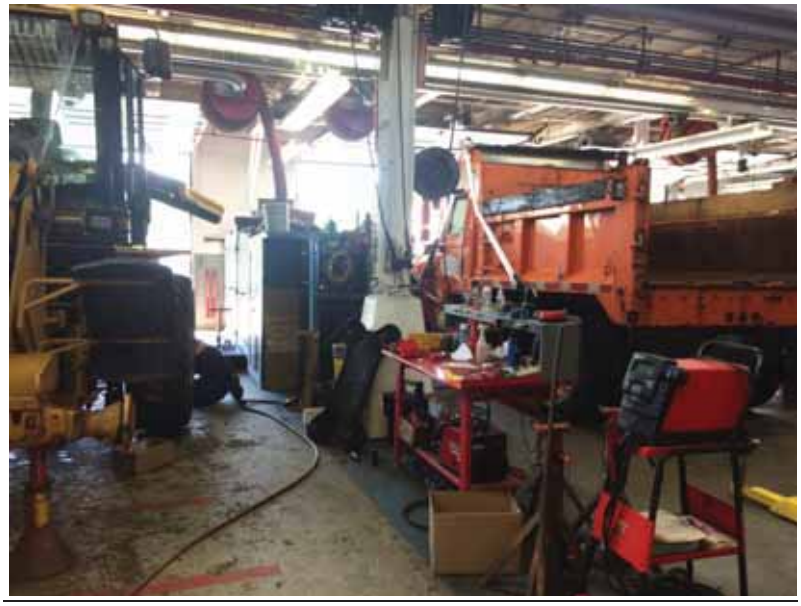


Parts storage and office space

Storage mezzanine

Contents could be hazardous if not addressed prior to flood event

Contents could be hazardous if not addressed prior to flood event



Contents could be hazardous if not addressed prior to flood event

Contents could be hazardous if not addressed prior to flood event

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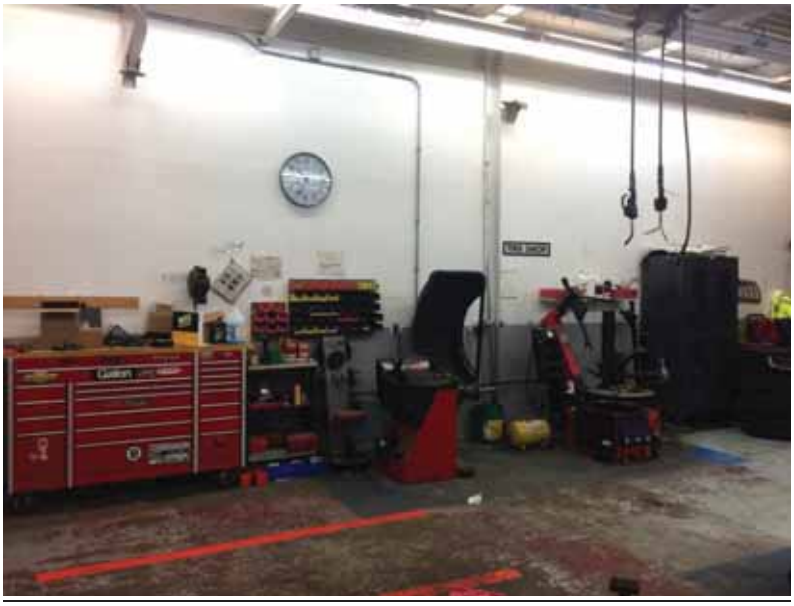
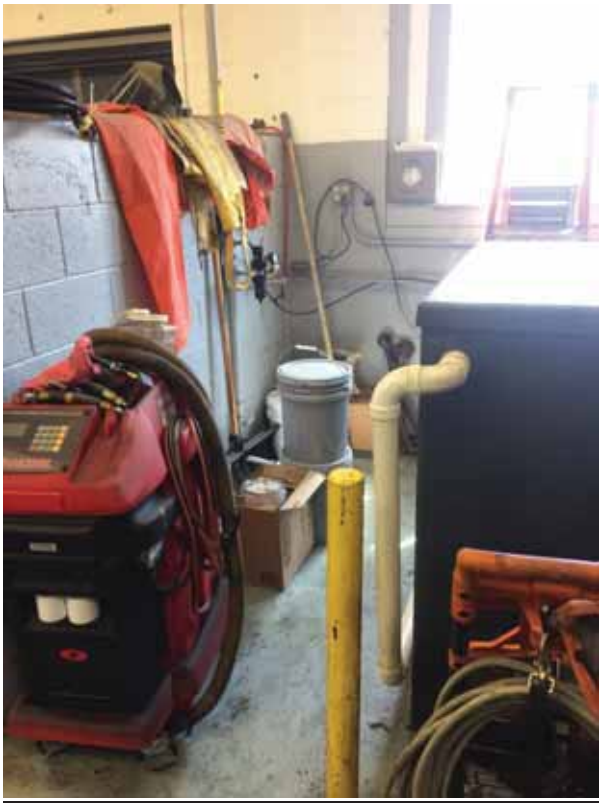


Contents could be hazardous if not addressed prior to flood event

Floor openings

Contents could be hazardous if not addressed prior to flood event



Contents could be hazardous if not addressed prior to flood event

Floor drain and piping

Compressors

Low piping

Utility sink

Contents could be hazardous if not addressed prior to flood event

Building exterior

Building exterior

Floor trench drain

Tools and storage

Contents could be hazardous if not addressed prior to flood event

Door undercut

Building exterior

Building exterior

Building exterior

Building exterior

Building exterior

FLOOD HAZARD MITIGATION ASSESSMENT & ANALYSIS FOR STATE-OWNED BUILDINGS

BUILDING ASSESSMENT FORM

Building Information:

ADDRESS:	1756 Route 302, Berlin, VT
BUILDING ID:	09004
OWNER:	VT Agency of Transportation (VTrans)
OCCUPYING AGENCIES/DEPARTMENTS:	Building H Central Garage
REPLACEMENT VALUE (2017):	$3,67,903
SQUARE FOOTAGE:	17,550 sq. ft.
NO. OF FLOORS:	1
GROSS FLOOR AREA:	17,550 sq. ft.
BASEMENT AREA:	N/A (Slab on Grade)
COST PER SQUARE FOOT:	$174.81 / sq. ft. (Replacement value / gross floor area) (without basement)

FOUNDATION:

Concrete Footing, Concrete Slab, Concrete Walls

FLOOR STRUCTURE:

First Floor – Reinforced Concrete Slab on Grade, Insulation typical

EXTERIOR WALLS:

Concrete Block – Decorative, Solid Brick Exterior, Native Stone on Masonry

GENERAL CONTENTS/USAGE:

Primary use on first floor includes entrance area and office space, restrooms, parts storage, and areas generally used for the repair and maintenance of the VTrans fleet of vehicles, trucks, and heavy equipment. Also includes building systems such as mechanicals, electric panels (including an emergency generator), plumbing, fire protection, Tel-com, and I.T. equipment. Note that building includes numerous mechanics tools and equipment and various stored automotive fluids

BASEMENT FLOOR AREA:	0 sq. ft.
NO OF FLOORS:	1
GROSS BUILDING AREA:	17,550 sq. ft.

Risk Overview

FEMA Zone:	Zone AE
100-year Flood Elevation:	545.9 ft NAVD 88
500-year Flood Elevation:	547.5 ft NAVD 88
River Corridor:	Yes, nearly all the building except southwest corner
Ground Surface Elevation:	544.02 ft NAVD 88 (lowest grade adjacent to building)
Lowest Point of Entry:	544.78 ft NAVD 88 (threshold at walk-out overhead door)
Basement:	No
	Top of lowest floor = 544.78 ft NAVD 88 (1st Floor)
Historic Building:	Yes

Description of Space Below Flood Levels: Lowest floor susceptible to flooding (first floor) consists of building systems such as mechanicals, electrical panels, plumbing, fire protection systems, Tel-com panels, and I.T. equipment. Also includes office space, restrooms, parts storage areas, and areas used for the maintenance and repair of VTrans vehicles, trucks, and heavy equipment.

Risk Narrative:

Flood Vulnerability:

The building is located within the left floodplain (looking downstream) of the Stevens Branch just downstream of the confluence between Stevens Branch and Pond Brook. The entire building is located within the Zone AE Special Flood Hazard Area (SFHA) as depicted on FEMA Flood Insurance Rate Map (FIRM) Panel No. 0431E dated March 19, 2013. It should be noted that the FEMA Floodway boundary is located approximately 80 feet to the east of the building also. Since the building is located within the FEMA SFHA, an Elevation Certificate has been prepared. Based on the data provided on the Elevation Certificate, the lowest floor (1st floor) would be flooded during both the 100-year or Base Flood as well as the 500-year Flood. During the 100-year flood, the depth of water would be approximately 1.1 feet above the first floor, while the depth of water would be approximately 2.7 feet above the first floor during the 500-year flood.

The items damaged during a flood include the majority of the building systems such as mechanical and electrical systems (including an emergency generator), plumbing and fire protection systems, Tel-com systems, and I.T. equipment. In addition, the large amounts of mechanics tools, equipment, and parts used and stored at the facility would potentially be damaged. Damage also includes all porous finishes (wood, wainscoting, sheetrock, carpeting, etc.), as well as fixed furnishings and restroom fixtures. All exterior and interior non-porous surfaces below flood levels would require clean up. All items stored at or below the flood levels would be damaged and potentially lost as well. Automotive fluids such as fuel, oils, and grease

could potentially contaminate flood waters as well. Additional information regarding potential flood damages is provided with the Recommendations.

Erosion Vulnerability:

The left boundary of the Vermont River Corridor (looking downstream) passes through the building with all except a small portion of the southwest corner of the building located within the corridor. Note that the river corridor includes both a meander belt (formerly called the fluvial erosion hazard zone) plus a 50-foot buffer. The corridor boundary is located approximately 325 feet from the top of river bank, which has evidence of erosion and historic armoring. The northeastern most corner of the building is located about 180 feet from the top of river bank. The land between the building and river bank includes parking area, access drives, and other buildings. There was some evidence of erosion observed along the river bank during the site visit, both to the north of the building near the river access point referred to as the boat launch, and also at the confluence of Steven Branch and Pond Brook behind the Traffic Shop buildings (BGS #09010). VTrans staff noted that the area behind the chain link fence along the river bank used to be mowed, however no longer can be due to the bank erosion that has occurred in this area over the years. While on site, we noted that the alignment of the Partridge Farm Road Bridge appears to be directing flow towards the bank behind the Traffic Shop building. Based on the conditions at the site and close proximity to the top of river bank, the risk of damage due to erosion at this building would be considered moderate.

Future Vulnerability:

Current trends in weather indicate that flooding in the region is becoming more frequent and more severe. State of Vermont flood mitigation standards require designs to meet a protection level of 1-foot above the 500-year flood. Future improvements at this location should meet or exceed that minimum standard.

Summary and Recommendation:

It is our understanding that the first floor slab on grade will be approximately 1.1 feet below water during a 100-year flood, and approximately 2.7 feet below water during a 500-year flood. The majority of building Mechanical / Electrical (including an emergency generator) / Plumbing / Fire Protection / Tel-com / and I.T. equipment are located on the first floor.

Based on the information gathered during the building assessment, we recommend the following:

1. Leave as-is and allow first floor to flood for a post-flood renovation cost of $2,438,982.89.
2. Due to the amount of heavy equipment, it may be work considering dry flood proofing at the perimeter building wall openings (doors, windows, vents) with flood shields to a point above the 500-year floodplain. Ensure available emergency power, and continually pump any miscellaneous water which breaches the flood proofing to minimize the potential for damage to existing building systems in order to allow system reuse with minimal or no repair once floodwaters recede. This is only recommended to an elevation at the 500-year because above that the flood waters would be too deep to allow.

Summary of Mitigation Strategies:

A. Leave as-is and allow to flood: $2,438,983
B. Raise existing emergency generator to a minimum of 3.0 feet above the finish floor. Add an allowance of $35,000.
C. It is our opinion that adding dry flood proofing shields for 10 wide openings at the ground floor perimeter to a height of 3.0 feet above the finish floor could add an additional $200,000 to $300,000 to the above estimates.

Total estimate A = $2,438,983

Total estimate B = $35,000

Total estimate C = $300,000

Mitigation Recommendations for Risk Reduction:

Flood-proofing Method	Effective?	Cost ($US)
Wet Flood-proofing:	Allow to flood and repair.	$2,438,983
Elevate Utilities:	Following Flood (if recommended at the time)	$35,000
Dry Flood-proofing:	Up to the 500-year flood plus 1-foot	$300,000
Building Relocation:	Not recommended.	
Elevate Building:	Not feasible.	
Sealing of Openings:	Would be part of dry flood proofing measures.	
Other Modifications:	Make note of contents and their ability to contaminate flood waters.	
TOTAL COST	**Potential project cost for mitigation**	**$ 2,773,983**

Benefit – Cost Summary:

Total Project Benefits	**$ 3,067,903**	**Replacement Value**
Total Project Cost	**$ 2,773,983**	**Potential Mitigation Cost**
Benefit – Cost Ratio	**1.11**	**Replacement Value / Mitigation Cost**