University of Massachusetts System Office

UMass System Office Hazard Mitigation Plan

DRAFT

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System Office

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1. INTRODUCTION

The University of Massachusetts (UMass or University) has developed this Multi-Campus Hazard Mitigation Plan for four of its campuses including the University of Massachusetts Boston (UMass Boston), the University of Massachusetts Dartmouth (UMass Dartmouth), the University of Massachusetts Lowell (UMass Lowell) and the University System Office. The purpose of this Hazard Mitigation Plan is to:

1) Assist the University in identifying and reducing its risk from natural and human-caused hazards,
2) Identify actions that can be taken to prevent damage to property and loss of life, and
3) Prioritize funding for mitigation efforts.

This project was funded by a grant allocated by the Massachusetts Emergency Management Agency (MEMA) and Massachusetts Department of Conservation and Recreation (DCR) and funded by the Federal Emergency Management Agency (FEMA).

This Multi-Campus Hazard Mitigation Plan was intended to build upon existing hazard mitigation planning efforts that have been completed on each of the campuses and at the system level. This plan brings together and expands upon previous efforts to form a comprehensive, system-wide approach to hazard mitigation planning.

Major activities involved in the development of this plan consisted of hazard identification and rankings, hazard event profiles, hazard vulnerability assessments and loss estimates, development of hazard mitigation goals and objectives, and formulation of hazard mitigation projects. Each step in this process involved extensive stakeholder engagement both on and off the campuses. Campus representatives were selected from various departments and populations on campus to include a wide cross section of campus participation. Over 100 stakeholders have been engaged in this hazard mitigation planning process.

1.1 PLAN DESCRIPTION

Across the United States, natural and human-caused disasters have led to a multitude of hazards that have included increasing levels of deaths, injuries, property damage, and interruption of educational, research, business and government services. The time, money, and efforts to recover from these disasters exhaust resources, diverting attention from important educational and research programs. With several Commonwealth of Massachusetts gubernatorial and presidential disaster declarations in recent history, UMass recognized the impact of disasters on its community and concluded that proactive efforts needed to be taken to reduce the impact of natural and human-caused hazards.

Hazard mitigation is defined by FEMA as “any action taken to eliminate or reduce the long-term risk to human life and property from natural and technological hazards.” Hazard mitigation is crucial to UMass because of the exposure to many types of hazards and natural disaster events, in particular severe storms and flooding that could impact the core mission of providing high quality education in a safe and secure environment. UMass understands the need for improved information for decision-making in mitigation planning. Recognizing that the impact and effects of most disaster events can be lessened by mitigation planning and preventative measures, the development of this plan was undertaken to identify cost effective mitigation measures, including reduction or avoidance that can be taken to reduce or eliminate the long-term risk to human life and property from natural and human-caused hazards.

As part of this project UMass has developed a methodology to systematically evaluate the nature and extent of vulnerability to the effects of natural and human-caused hazards, and identified corresponding actions that can be taken to minimize future vulnerability to those hazards.

This Multi-Campus Hazard Mitigation Plan was developed in compliance with Disaster Mitigation Act of 2000. By developing this plan, UMass has benefited in several ways by:

- Ensuring a common hazard mitigation planning approach and process amongst all campuses;
- Allowing for economics of scale by leveraging campus capabilities and sharing of costs and resources;
- Enabling a coordinated approach to mitigation of hazards that affect multiple campuses; and
- Improving capital improvement planning amongst all campuses.

Throughout all these benefits, UMass has also experienced intangible benefits by bringing together its diverse stakeholders to engage in this process. Many of the stakeholders involved are those that may not typically work together on a routine or operational basis. The synergies and alignment realized as part of this planning process will no doubt expand beyond hazard mitigation planning to other longer term strategic plans and initiatives.

1.2 PLAN AUTHORITY AND PURPOSE

The decision to embark on a multi-campus hazard mitigation planning effort was made via a multi-campus collaborative effort led by the University's Emergency Planning and Business Continuity Manager. Approval was obtained from senior management from each campus so that UMass could move forward with a comprehensive, system-wide approach. While this Multi-Campus Hazard Mitigation Plan includes only four of the six UMass campuses, the other campuses are also in the process of developing their own individual hazard mitigation plans.

Senior officials from each campus have been actively involved in the hazard mitigation planning process and have served on the campus Hazard Mitigation Planning Committees. These representatives have attended all of the on-campus stakeholder group meetings. Briefings throughout the process have also been regularly provided to the UMass Board of Trustees and other management teams.

In order to support UMass's commitment to a comprehensive, system-wide approach to hazard mitigation planning, the decision was made to incorporate both natural and human hazards as part of this plan. UMass felt this decision was important to both look at the full range of potential hazards that could impact its campuses as well as to optimize the planning effort since the process to assess both human and natural hazards is similar. While the approach to assess the natural hazards addressed in this Plan directly follows FEMA guidance, UMass customized its approach to evaluating human hazards and in some cases, went beyond or in a more focused direction from the FEMA guidance for incorporating human hazards into a mitigation plan.

The purpose of the Multi-Campus Hazard Mitigation Plan is to assist the University in reducing risk. The plan will also help guide and coordinate mitigation activities for the entire UMass

System and on each campus. Planning for mitigation activities provides the University with a number of benefits:

- Reduced vulnerability to future hazard events, specifically reduced loss of life, property, essential services, critical facilities and economic hardship;
- Reduced short-term and long-term recovery and reconstruction costs;
- Quicker resumption of University operations, including education, research and business systems;
- Increased cooperation and communication within UMass campuses and local community partners through the planning process; and
- Increased potential for state and federal funding for mitigation and recovery projects.

The UMass Multi-Campus Hazard Mitigation Plan project approach is directly aligned with the 2010 Massachusetts State Hazard Mitigation Plan, with the mission of the plan being to reduce the UMass loss of life, property, infrastructure and culture resources from disasters, and to assist UMass in achieving its purpose of education, research and public service by enhancing disaster safety, resistance and resilience.

The project was funded by FEMA and MEMA through its Hazard Mitigation Grant Program (HMGP). The HMGP is a federal program administered at the state level through MEMA. Both parties are required to review and approve the plan after adoption by UMass in order to achieve the requirements of the program. The HGMP grant application was submitted by UMass on March 1, 2011 to MEMA and DCR.

Approval of the grant application was received from MEMA on ________. The significance of this grant award is twofold. Once the Hazard Mitigation Plans are developed for each of the campuses, they will help identify cost effective mitigation measures, including reduction or avoidance that can be taken to reduce or eliminate the long-term risk to life and property from hazards. In addition, it will allow the University to be eligible to receive certain types of non-emergency disaster assistance, including state and federal funding for mitigation and recovery projects. To be eligible to receive future funding, projects need to be pre-identified in the hazard mitigation plan, thus making it critical for the campuses to have participation from a variety of campus stakeholders in the hazard mitigation planning team.

To support this important planning initiative UMass decided to seek a consulting partner via a competitive bid process. UMass issued a Request for Proposals (RFPs) to develop Hazard Mitigation Plans for each of the campuses. The RFP associated with this plan was dated February 28, 2012 and bundled UMass Boston, UMass Dartmouth, UMass Lowell and the System Office. Woodard & Curran was issued a contract dated July 27, 2012 after the completion of respondent interviews, selection, and refinement of the scope of work and contractual issues. Woodard & Curran's role was to support UMass in meeting the requirements of the grant and to facilitate the planning process to ultimately receive approval from the grant administrators.

1.3 UNIVERSITY OF MASSACHUSETTS SYSTEM DESCRIPTION

As a state supported higher education institution, UMass is an important educational/research institution and employer of the Commonwealth of Massachusetts (Commonwealth). UMass is transforming students' lives, shaping the future of our Commonwealth and addressing key state needs. The nearly 12,600 annual graduates enrich the Commonwealth, its industries, and society. The nearly 66,000 students educated each year are predominantly drawn from the region and often remain after graduation.

The UMass campuses are noted for their diverse students and faculty and for their affordability in comparison with other institutions of higher education. Award-winning faculty members provide undergraduate and graduate students with research opportunities in a multitude of disciplines, with University scholars participating in $597 million in funded research in fiscal year 2012. More than 242,000 UMass alumni live in Massachusetts, forming the foundation of the state's workforce and contributing enormously to our knowledge-based economy.

1.4 MULTI-JURISDICTIONAL APPROACH

This Multi-Campus Hazard Mitigation Plan is organized in sections with the main document pertaining to all campuses participating in this plan and campus specific 'Annexes' that detail specific risk, hazards, goals and mitigation projects that apply to that campus. **Table 1-1** shows the major components of the Multi-Campus Hazard Mitigation Plan.

Table 1-1: Multi-Campus Hazard Mitigation Plan Organization

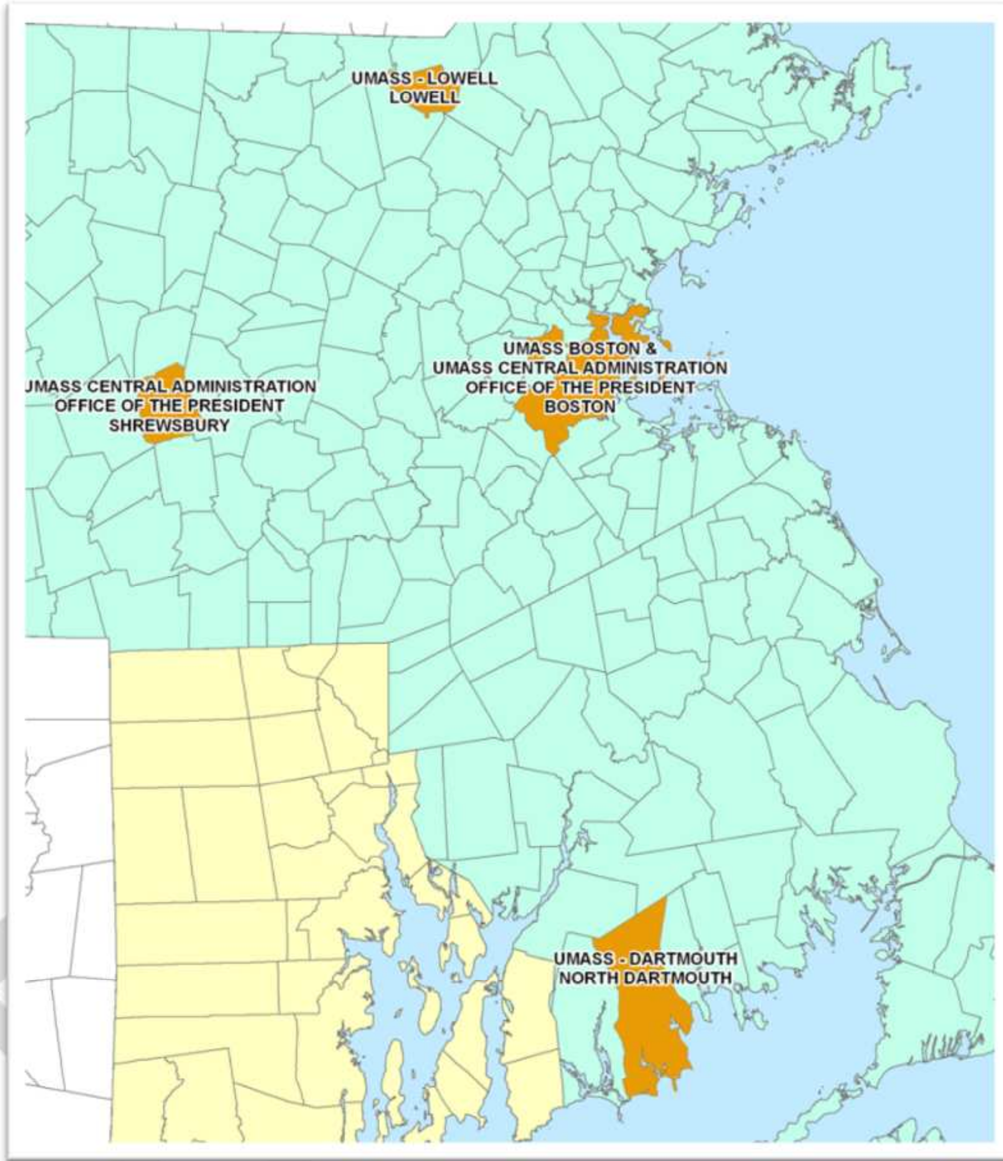
Document	Section	Application
Hazard Mitigation Plan Overview		All campuses
Campus-Specific Annex A	Annex A	UMass Boston
Campus-Specific Annex B	Annex B	UMass Dartmouth
Campus-Specific Annex C	Annex C	UMass Lowell
Campus-Specific Annex D	Annex D	UMass System Office

Each campus specific hazard mitigation plan consists of the main plan overview document combined with a campus specific Annex plan. For example, the UMass Boston Hazard Mitigation Plan includes only the Hazard Mitigation Plan Overview and Annex A. Appendices are provided in each Annex that provide information associated with campus specific documents and meetings.

1.5 CAMPUS DESCRIPTIONS

All of the UMass campuses are involved in the system-wide hazard mitigation planning effort. Four of the six campuses are covered by this plan including UMass Boston, UMass Lowell, UMass Dartmouth and the UMass System Office in both Shrewsbury and Boston (see **Figure 1**). The brief profiles that follow describe each participating campus.

Figure 1: UMass Campus Locations



UMass Boston
100 Morrissey Boulevard
Boston, MA 02125
Suffolk County

The 175-acre Boston campus, which is located three miles from downtown Boston on a harbor peninsula, is home to the John F. Kennedy Presidential Library and the Massachusetts State Archives and Commonwealth Museum. The Boston campus is the only educational institution in the Northeast to share its campus with a presidential library. The students and faculty have access to the John F. Kennedy Library, as well as to the State Archives building, which houses valuable Massachusetts state government records. The Boston campus has a diverse student body, consisting of over 15,000 undergraduate and graduate students. The colleges and graduate schools are staffed by approximately 2,500 faculty, professional and classified employees. The UMass Boston campus is currently going through significant and transformative change as part of implementing its campus master plan. This effort, which will continue through the next several years, will add state of the art facilities and dormitories and redesign the traffic patterns and infrastructure layout on the campus. UMass Boston has also purchased the former Boston Expo Property that is located in close vicinity to the campus and intends to utilize this space in the future.

Photo: *UMass Boston Campus*

UMass Dartmouth
285 Old Westport Road
North Dartmouth, MA 02747
Bristol County

The main campus is located on 710 acres in North Dartmouth and is approximately 55 miles south of Boston and 35 miles east of Providence, Rhode Island. Other Dartmouth campus sites include the School for Marine Science and Technology on the waterfront in New Bedford, the Star Store Center for the Arts in New Bedford, the Advanced Technology and Manufacturing Center in Fall River, a state-of-the-art technology facility for small business incubation, and Professional and Continuing Education Centers located in New Bedford, Fall River and Fairhaven. The Dartmouth campus had approximately 7,580 undergraduate and approximately 1,645 graduate students enrolled in the as of the fall of 2011. and approximately 1,500 faculty, professional and classified employees.

Photo: *UMass Dartmouth Campus*

UMass Lowell
883 Broadway Street
Lowell, MA 01854
Middlesex County

Located in the historic industrial City of Lowell, approximately 30 miles northwest of Boston, the campus spans more than 125 acres along the Merrimack River on three campus clusters – North, South and East. The Lowell campus had a student enrollment of over 16,000 that consists of undergraduate, graduate and continuing studies student and approximately 1,300 faculty and staff. UMass Lowell is one of the largest employers in the northeast region of Massachusetts.

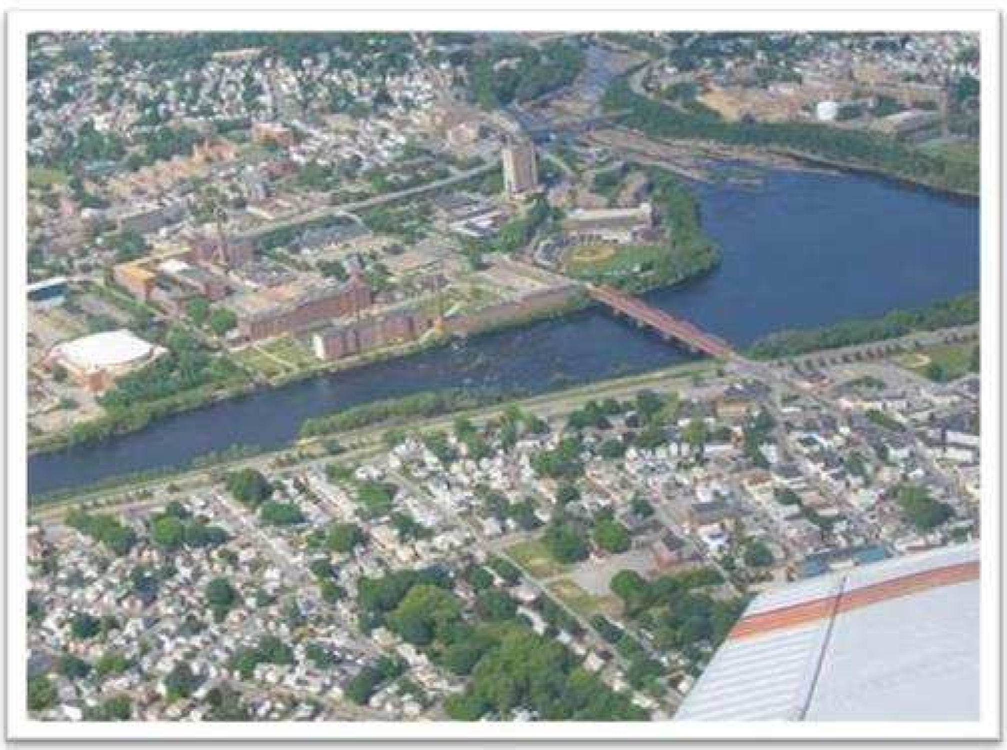


Photo: *UMass Lowell Campus*

UMass System Office
333 South Street
Shrewsbury, MA 01545
Worcester County

225 Franklin Street
Boston, MA 02110
Suffolk County

The UMass System Office maintains two locations in the Commonwealth of Massachusetts with a professional staff of approximately 400 employees.

Photo: *UMass System Office – Shrewsbury, MA*

Shrewsbury Office: The UMass System Office located in Shrewsbury houses the Collaborative Services Facility which was created in 2003 for the purpose of consolidating a number of departments with the UMass System Office and other UMass campuses in an effort to both reduce costs and better serve the University system. The UMass System Office is responsible for managing the shared services for the University in an environment of collaborative governance in which the campuses, as the consumers of the services, are deeply involved in decision making and direction setting. Shared services have been deployed in key support functions such as: information technology, financial administration, auditing and legal services.

Also headquartered in Shrewsbury is UMass Online. UMass Online, the online learning consortium of the University of Massachusetts, provides the highest quality education offered by the UMass system in a flexible, online format enabling students, professionals, and lifelong learners to take courses anywhere, anytime. UMass Online enables the University to provide greater access to its educational programs and to increase revenues that can be used to support all the campuses.

Boston Office: The UMass System Office located in Boston houses the executive office of the President of UMass as well as many members of his executive leadership team. The Boston Office also houses the UMass Club, which is a club established for alumni, faculty, staff and friends of the university that brings these individuals together to foster a culture of academic, business, and social exchange of information.

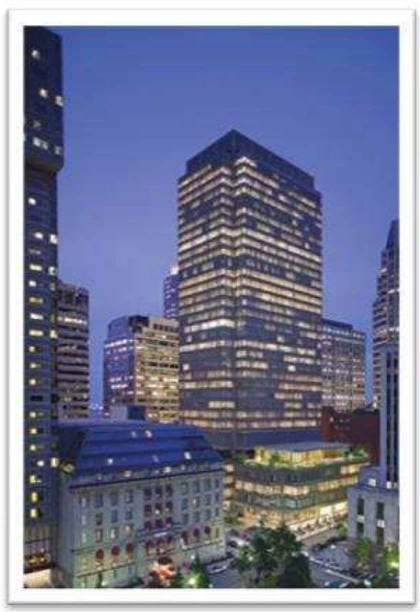


Photo: *UMass System Office, Boston, MA*

2. PLANNING PROCESS

The planning process involved three key elements consisting of, (1) Stakeholder engagement, (2) Project management and (3) resource management. Important initial stakeholder engagement activities consisted of the development of an overall project planning team and key points of contact on each campus that were supported by a larger campus specific team. Stakeholder engagement also involved outreach beyond the campus to other external community stakeholders. Project management activities consisted of developing and overseeing a process and schedule consistent with requirements of the grant and expectations of MEMA and FEMA. Resource management involved assembling and building upon previous related projects, plans and initiatives involving hazard mitigation planning or related efforts.

2.1 PLANNING TEAM

The UMass Multi-Campus Hazard Mitigation Planning effort was led by Jeffrey Hescock, Emergency Planning and Business Continuity Manager, University of Massachusetts System Office. UMass decided to solicit support in this effort and collaborated with Woodard & Curran in the development of its plan. Mary House from Woodard & Curran managed the planning activities and MaryKristin Ivanovich, also from Woodard & Curran, supervised the technical aspects of the planning efforts.

Due to the multi-campus nature of the project, it was decided early on in the process that is was important to have a point of contact at each campus to support campus specific efforts. In some cases this role belonged to a single person, while in other cases this role was shared. The primary points of contact at each campus, along with the University Hazard Mitigation Plan project manager and representatives from Woodard & Curran formed the Hazard Mitigation Planning Steering Committee. **Table 2-1** outlines the Steering Committee membership.

Table 2-1: Hazard Mitigation Plan Steering Committee

Name	Title	Campus
Jeffrey Hescock	Emergency Planning and Business Continuity Manager	University of Massachusetts System Office
Anne Marie McLaughlin	Emergency Management & Business Continuity Coordinator	University of Massachusetts Boston
Michael LaGrassa	Assistant Vice Chancellor for Administrative Services	University of Massachusetts Dartmouth
Emil Fioravanti	Chief of Police	University of Massachusetts Dartmouth
Richard Lemoine	Director, Environmental & Emergency Management	University of Massachusetts Lowell
William Desrosiers	Emergency Preparedness Manager	University of Massachusetts Lowell
Mary House	Project Manager	Woodard & Curran
MaryKristin Ivanovich	Technical Lead	Woodard & Curran

The role of the Hazard Mitigation Plan Steering Committee consisted of the following:

- Coordinate efforts across the campuses to maintain consistency in the process while also customizing the approach to the specific needs and goals of the campus,
- Develop and oversee a campus specific Hazard Mitigation Planning Committee,
- Coordinate all on campus activities related to the completion of the Hazard Mitigation Plan,
- Participate in public meetings,
- Provide regular briefings on the project status to senior campus officials,
- Facilitate the adoption of the Hazard Mitigation Plan, and
- Maintain the Hazard Mitigation Plan as necessary.

In order to support the efforts of Hazard Mitigation Planning Steering Committee and to ensure the appropriate participation at the campus level, a Hazard Mitigation Planning Committee was formed at each campus. The Hazard Mitigation Planning Committee was led by the campus member(s) on the Hazard Mitigation Plan Steering Committee. The Hazard Mitigation Planning Committee was made up of a cross section of campus representatives and included senior members of the campus management in a variety of areas. The role and expectations of the Hazard Mitigation Planning Committee on each campus was as follows:

- Participate in at least six meetings/workshops over the course of the two-year project,
- Supply information associated with past hazard mitigation planning or related efforts,
- Help identify applicable hazards and review the hazard ranking and assessment,
- Evaluate goals and objectives for mitigation activities,
- Support the development of potential projects that would help campus demonstrate progress in meeting goals and objectives,
- Support internal and external outreach activities,
- Review and provide comments on the multi-hazard mitigation plan and campus specific annex, and
- Support the implementation of the plan when an event occurs and be actively involved in continuous improvements

Figure 2 presents the overall structure of the Hazard Mitigation Planning Steering Committee and the campus Hazard Mitigation Planning Committees.

Figure 2: Project Team Organization and Reporting Structure

The leadership demonstrated by the University Project Manager and Hazard Mitigation Planning Steering Committee was essential to the successful completion of this plan. Participation from the campus Hazard Mitigation Planning Committees were constant and consistent which contributed to continuity of the overall process.

2.2 SCHEDULE AND TIMEFRAME OF PLAN RELATED EVENTS

The preparation of the UMass Multi-Campus Hazard Mitigation Plan occurred between July 2012 and December 2013. At the initiation of the project, a project workplan was developed documenting the major deadlines to meet the requirements of the grant. The workplan is presented in **Appendix A.**

Table 2-2 illustrates the project schedule and timeframe of plan related events:

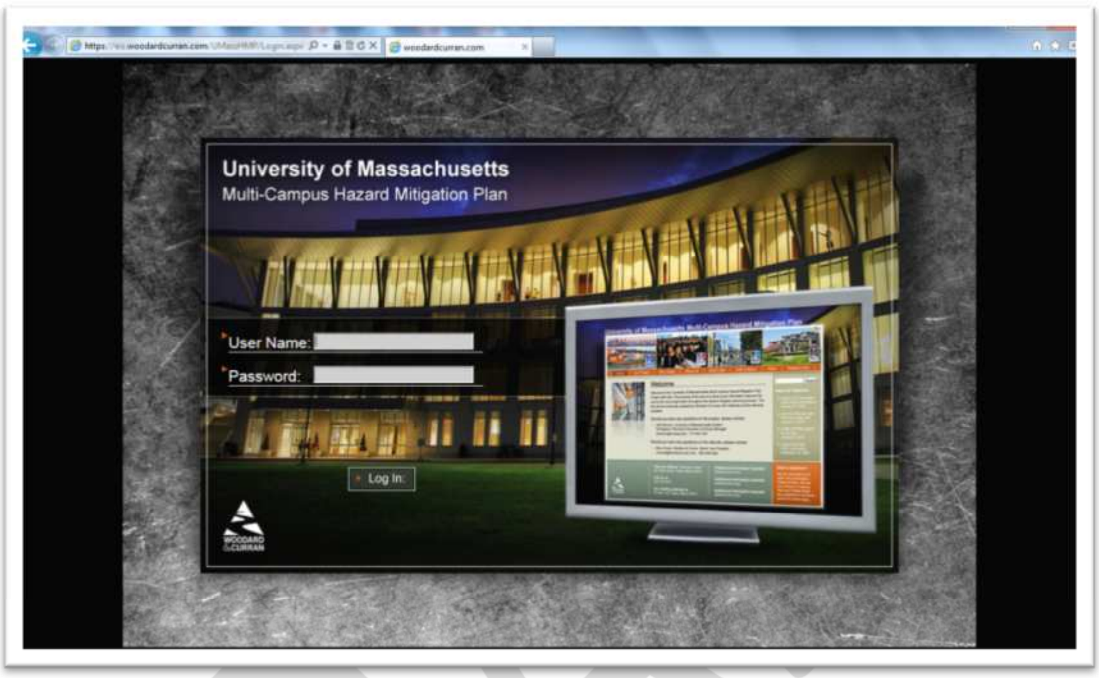
Table 2-2: Project Schedule and Timeframe of Plan Events

Date	Event
September 6, 2012	Project Kick-Off Meeting with University Project Manager
October 1, 2012	Steering Committee Meeting #1 - Kick-Off Meeting with Hazard Mitigation Steering Committee (via conference call)
October 2012	Meetings with Campus Points of Contact to Develop Campus Hazard Mitigation Planning Committees (via conference call)
November 2012	Steering Committee Meeting #2 - Stakeholder Meeting #1 - Campus Kick-Off Meetings
January 18, 2013	Steering Committee Meeting #3 - Project Steering Committee Meeting (via conference call)
January 28, 2013	UMass Boston Meeting to Brief Campus Administration
February 5, 2013	Steering Committee Meeting #4 - Project Steering Committee Meeting (via conference call)
February, March, April 2013	Stakeholder Meeting #2 - Campus Hazard Identification and Risk Assessment Meetings including Interviews with on and off Campus Stakeholders
March 14, 2013	Meeting with University Project Manager and MEMA
March 27, 2013	Steering Committee Meeting #5 - Project Steering Committee Meeting (via conference call)
May 2, 2013	Steering Committee Meeting #6 - Project Steering Committee Meeting (via conference call)
June 2013	Stakeholder Meeting #3 - Campus Hazard Mitigation Goals, Hazard Profiles, Loss Estimates and Projects Meetings including Interviews with on Campus Stakeholders
June 2013	Public Meeting #1 - First Campus Public Participation Meetings
October 2013	Stakeholder Meeting #4 - Meetings to Present Draft Hazard Mitigation Plan to Campuses
October 2013	Public Meeting #2 - Second Campus Public Participation Meetings

In order to monitor progress toward accomplishing each of the milestones outlined above, monthly progress reports were authored outlining the actions completed in the current month, actions to be completed in the next month, and progress toward overall project goals and deadlines. The progress reports are presented in **Appendix B.**

A secure project website accessible only to campus representatives was developed in order to support the Hazard Mitigation Planning Steering Committee and to manage the information presented at stakeholder meetings. The initial log in screen for the website is shown in Error! eference source not found.**.** Upon completion of each stakeholder meeting information such as the meeting agenda, attendees sign in sheet, and meeting materials were uploaded to the web site. The layout of the website is shown in **Figure 3.**

Figure 3: Opening Log in Page for Stakeholder Website and Initial Website View



Detailed information associated with the major stakeholder meetings outlined in Table **2-2** are presented in the Appendices to the campus-specific Annex Sections.

2.3 PUBLIC PARTICIPATION

UMass incorporated Hazard Mitigation Planning as a strategy to bring stakeholders to the planning table by fostering partnerships among local departments, between agencies, and between communities and recognizes the importance of hazard mitigation in supporting the values shared by UMass and the community at large. UMass took the initiative to reach out to and engage the public to the extent practicable during the preparation of this plan. Section 2.2 details the schedule and timeframe for the project and where the opportunities were for the public to attend meetings and provide feedback. In addition, UMass utilized various forms of education and outreach in the community that could also be implemented to communicate information about mitigation activities and hazard-related information. Methods included:

- ☐ Posting the draft plan on UMass web sites,
- ☐ Utilizing local media to advertise public meetings,
- ☐ Targeted outreach via e-mail blasts and University specific communications to advertise public meetings,
- ☐ One on one interviews with off-campus stakeholders, and
- ☐ Regular phone check ins with MEMA representatives.

Figure 4: Hazard Mitigation Plan Website

During the development of the Multi-Campus Hazard Mitigation Plan, UMass conducted the following outreach activities:

- ☐ Developed a core group of key on-campus stakeholders (Hazard Mitigation Planning Steering Committee) to participate in the development of the plan,
- ☐ Identified and sought out key on-campus stakeholders and conducted on one interviews,
- ☐ Identified and sought out key off-campus stakeholders and conducted on one interviews,
- ☐ Conducted two public participation meetings on each campus,
- ☐ Prepared posters regarding the project that were utilized during the public meetings,
- ☐ Created a special email address where the public could submit their comments, questions and concerns (need to develop email for public to submit comments on draft report), and
- ☐ Issued press releases to local news outlets (both online and print).

Select information associated with the above referenced outreach activities completed on each campus is provided in the Annex Appendices.

2.4 EXISTING DATA AND REPORTS UTILIZED FOR THE PLAN

The goal behind this hazard mitigation planning effort was to build upon and enhance previous hazard mitigation planning and related activities conducted at both the campus and system level. These efforts encompassed vulnerability and security assessments, emergency management documents and other related documents, policies, procedures and protocols. At the start of the project, a document request was issued to each campus to gather previous related documents. The document request is provided in **Appendix C.** The campuses all provided extensive important that was assembled and reviewed prior to any of the on-campus meetings. The information received will be presented in each of the campus Annex plans.

3. HAZARD IDENTIFICATION AND RISK ASSESSMENT

3.1 INTRODUCTION & BACKGROUND

The risk assessment process that was conducted for this planning effort focused on utilizing relevant data, anecdotal information and historical records to allow each UMass campus the opportunity to clearly identify natural and human hazards that have and may impact them and then prioritize specific mitigation actions that can potentially reduce losses from future natural hazard events. The four basic components of the risk assessment include:

- ✓ **Identify Hazards –** determine which hazards pose a threat to the subject area,
- ✓ **Profile Hazard Events –** collect data about specific hazards and prepare relevant maps to the extent possible,
- ✓ **Inventory Assets –** prepare an inventory that associates a value to structures/key assets in identified hazard areas, and
- ✓ **Estimate Losses –** predicting if possible, the extent of damage to structures/key assets in the identified hazard areas.

The risk assessment is a critical step that provides the foundation for the rest of the hazard mitigation planning process. The risk assessment process focused the attention of the Hazard Mitigation Planning Committee on the areas most in need of mitigation planning and actions by evaluating which populations and assets are most vulnerable to hazards and to what extent injuries and damages may occur. Since the UMass campuses are growing and changing, consideration was also given to the future development and growth of each campus to determine what additional hazard impacts those efforts may be subjected to in the future. A more detailed description of how the risk assessment process was completed is in **Table 3-1.**

Table 3-1: Risk Assessment Process

Risk Assessment Steps	Detailed Description
Step 1: Identify Hazards	• Identifying hazards includes considering each hazard that has or may affect a campus and then pare down the list to the hazards that are most likely to have an impact in the future (not limited only to ones that have affected the campuses recently). Hazard events may include flooding, fire, extreme wind events, winter storms, active shooter, terrorism as well as others. • Hazards were identified that have impacted or could impact each campus including but not limited to: natural disasters (flood, storm surge, winter storm, etc.), fire, hazardous material event (on- or off-campus), health-related event (communicable disease, foodborne illness, etc.), utility/facilities failure (loss of power, gas leak, loss of heat, etc.), IT/MIS disturbance (server loss, security breech, etc.) and campus security events (bomb threat, active shooter, civil disturbance, etc.). Hazards were prioritized/ranked based on

Risk Assessment Steps	Detailed Description
	likelihood of occurrence and severity of impact to life, personal injury, property damage, and/or economic impact.
Step 2: Profile Hazard Events	• Once hazards were identified, the next step was to answer the question – *how bad can it get?* Hazards have unique characteristics that define what they are and the damage they cause. • Existing FEMA, MEMA, NOAA, NCDC and other data sources were utilized and information from local/regional/state hazard mitigation plans, historical anecdotes, and descriptions of past emergency incidents were reviewed and synthesized to help determine an accurate profile for each hazard event. Working base maps were developed specific to each applicable UMass campus regarding the hazard profiles.
Step 3: Inventory Assets	• The purpose of inventorying assets was to determine what structures/key assets have been or could be affected by the previously identified hazards. • The project team worked together to identify the critical assets on each campus including buildings, infrastructure, essential facilities, lifeline utility systems, vulnerable populations and areas with special considerations (historic, cultural, natural resource areas, etc.). Information was gathered during interviews/meetings regarding the number of structures, value of structures, size of buildings, replacement value, contents value, function/operational use or value, displacement cost per day, occupancy or capacity and people affected. Current development efforts and future development plans were considered as well.
Step 4: Estimate Losses	• Estimating losses provides a general sense of how the campus assets could be affected by hazard events. The extent of loss can vary depending on age of the asset, construction, construction materials, contents, displacement cost, operational use and overall value. Loss calculations estimate potential exposure of the assets, population, operations and infrastructure to hazard events. • The project team estimated the possible extent of damages and the potential monetary impact from each hazard identified using the FEMA guidance document *"Understanding Your Risks – Identifying Hazards and Estimating Losses*" (FEMA 386-2). Information obtained during the previous three risk assessment steps was utilized. The project team did consider the use of HAZUS for this task, but determined that at the campus level, the methodology in 386-2 provided better results. The methodology for estimating losses was used to the extent possible for floods and earthquakes and for all other hazards a qualitative analysis approach was implemented.

3.2 NATURAL HAZARD IDENTIFICATION

For the purposes of this Multi-Campus Hazard Mitigation Plan, the term hazard is defined as an extreme natural or human event that poses a risk to people, infrastructure, operations or resources. Identifying hazards includes detailing geographically where an event has occurred historically, where it is likely to occur in the future, and how substantial the event may be. The natural hazards that have been identified and included in this section received their initial consideration from FEMA Guidance documentation. The hazards were then filtered by utilizing current and historical data points from various sources including but not limited to NOAA, the US Census, regional and local Hazard Mitigation Plans and regional and local specialty plans. Finally, each campus analyzed the findings of each natural hazard and cross referenced the information with anecdotal data points and then developed a final list of natural hazards that have and may continue to impact each of their individual locations.

Since 1953, there have been 47 Major Presidential Disaster Declarations (see **Table 3-2**) that have impacted Massachusetts. Of those declarations, 12 have impacted Bristol County, 28 have impacted Suffolk County, 30 have impacted Middlesex County and 23 have impacted Worcester County.

Table 3-2: Massachusetts Major and Emergency Disaster Declarations 1953 – Present

			Counties Impacted				
Disaster No.	Date Declared	Incident Description	Bristol	Suffolk	Middlesex	Worcester	UMass Campuses Which May Have Been Impacted
4110	4/19/2013	Severe Winter Storm, Snowstorm, Flooding	X	X	X	X	Dartmouth, Boston, Lowell, UMass System Office
3362	4/17/2013	Massachusetts Explosions	X	X	X		Dartmouth, Boston, Lowell
4097	12/19/2012	Hurricane Sandy (Major Disaster)	X	X			Dartmouth, Boston
3350	10/28/2012	Hurricane Sandy (Emergency Declaration)	X		X	X	Dartmouth, Boston, Lowell, UMass System Office
4051	1/6/2012	Severe Storm And Snowstorm			X	X	Lowell, Presidents Office
3343	11/1/2011	Severe Storm		X	X	X	Lowell, Presidents Office
4028	9/3/2011	Tropical Storm Irene	X				Dartmouth
3330	8/26/2011	Hurricane Irene	X	X	X	X	Dartmouth, Lowell, Boston, UMass System Office
1994	6/15/2011	Severe Storms and Tornadoes				X	UMass System Office
1959	3/7/2011	Severe Winter Storm and Snowstorm		X	X		Lowell, Boston
3315	9/2/2010	Hurricane Earl	X	X	X	X	Dartmouth, Lowell, Boston, UMass System Office
3312	5/3/2010	Water Main Break		X	X		Lowell, Boston
1895	3/29/2010	Severe Storm and Flooding	X	X	X	X	Dartmouth, Lowell, Boston, UMass System Office
1813	1/5/2009	Severe Winter Storm and Flooding			X	X	Lowell, UMass System Office
3296	12/13/2008	Severe Winter Storm	X	X	X	X	Dartmouth, Lowell, Boston, UMass System Office
1701	5/16/2007	Severe Storms and Inland and Coastal Flooding					N/A
1642	5/25/2006	Severe Storms and Flooding		X	X		Lowell, Boston
1614	11/10/2005	Severe Storms and Flooding	X		X	X	Dartmouth, Lowell, UMass

			Counties Impacted				
Disaster No.	**Date Declared**	**Incident Description**	**Bristol**	**Suffolk**	**Middlesex**	**Worcester**	**UMass Campuses Which May Have Been Impacted**
							System Office
3264	10/19/2005	Severe Storms and Flooding	X				Dartmouth
3252	9/13/2005	Hurricane Katrina Evacuation	X	X	X	X	Dartmouth, Lowell, Boston, UMass System Office
3201	2/17/2005	Snow	X	X	X	X	Dartmouth, Lowell, Boston, UMass System Office
1512	4/21/2004	Flooding		X	X	X	Lowell, Boston, UMass System Office
3191	1/15/2004	Snow	X	X	X	X	Dartmouth, Lowell, Boston, UMass System Office
3175	3/11/2003	Snowstorm	X	X	X	X	Dartmouth, Lowell, Boston, UMass System Office
1364	4/10/2001	Severe Storms & Flooding	X	X	X	X	Dartmouth, Lowell, Boston, UMass System Office
3165	3/28/2001	Snowstorm					Lowell, UMass System Office
3153	12/6/1999	Fire			X	X	UMass System Office
1224	6/23/1998	Heavy Rain And Flooding	X	X	X	X	Dartmouth, Lowell, Boston, UMass System Office
1142	10/25/1996	Severe Storms/Flooding		X	X		Lowell, Boston
3119	10/23/1996	Extreme Weather/Flooding		X	X		Lowell, Boston
1090	1/24/1996	Blizzard	X		X		Dartmouth, Lowell, Boston, UMass System Office
2116	9/12/1995	Russell Fire					N/A
3103	3/16/1993	Blizzards, High Winds and Record Snowfall	X	X	X	X	Dartmouth, Boston, Lowell, UMass System Office
975	12/21/1992	Winter Coastal Storm		X	X	X	Lowell, Boston, UMass System Office
920	11/4/1991	Severe Coastal Storm		X			Boston
914	8/26/1991	Hurricane Bob	X	X	X	X	Dartmouth, Lowell, Boston,

			Counties Impacted				
Disaster No.	Date Declared	Incident Description	Bristol	Suffolk	Middlesex	Worcester	UMass Campuses Which May Have Been Impacted
							UMass System Office
790	4/18/1987	Severe Storms, Flooding			X	X	Lowell, UMass System Office
751	10/28/1985	Hurricane Gloria	X	X	X	X	Dartmouth, Lowell, Boston, UMass System Office
650	12/3/1981	Urban Fire					
546	2/10/1978	Coastal Storms, Flood, Ice, Snow	X	X			Dartmouth, Boston
3059	2/7/1978	Blizzards and Snowstorms		X			Boston
405	10/16/1973	Fire (City of Chelsea)					Boston
357	9/28/1972	Toxic Algae in Coastal Waters					N/A
325	3/6/1972	Severe Storms, Flooding		X			Boston
43	8/20/1955	Hurricane, Floods					N/A
22	9/2/1954	Hurricane					N/A
7	6/11/1953	Tornado					N/A

Each natural hazard in this section is profiled while the vulnerability for each campus is assessed and discussed in the individual campus annexes of this report. Each profile includes a description of the hazard, its location, severity and extent of the hazard, and impact of the hazard on life, property and operations.

The Commonwealth of Massachusetts State Hazard Mitigation Plan 2010 identified natural hazards that have and may impact the state by grouping them into categories which included flood related hazards, coastal related hazards, atmospheric related and winter related hazards, other natural hazards, geologic hazards and non-natural hazards. For the purposes of this plan, the project team took into consideration the grouped natural hazards and cross referenced them with any regional or local plans and then evaluated the final list of natural hazards on an individual basis. Each campus has a different list of natural hazards that could be of concern. **Table 3-3** details the natural hazards and which campus evaluated each one specifically.

Table 3-3: Natural Hazard Identification by Campus

	UMass Boston	UMass Lowell	UMass Dartmouth Campus	UMass Dartmouth SMAST*	UMass System Office
Coastal Erosion	X				
Coastal Storm	X		X	X	X
Earthquake	X	X	X	X	X
Hurricane	X	X	X	X	X
Tornado	X	X	X		X
Flood	X	X	X	X	X
Drought	X	X	X		X
Winter Storm	X	X	X		X
Thunderstorm/Lightning	X	X	X		X
Hailstorm	X	X	X		X
Wildfire			X		
Extreme Heat	X	X	X		X
Tsunami	X				
Wind Storm	X	X	X		X
Ice Storm	X	X			X
Dam Failure		X	X		
Urban Fire		X			X

** UMass Dartmouth SMAST building was called out specifically during the natural hazard identification process due to its location in New Bedford which directly abuts the ocean.*

Table 3-4 provides details regarding each natural hazard that may impact at least one of the four UMass campuses, how susceptibility was determined and why.

Table 3-4: Natural Hazards Impacting UMass Campuses

	Hazard Description	Campus That Could Be Impacted	How Susceptibility Was Determined	Susceptibility Factors
Coastal Erosion	Coastal erosion is the wearing away of land and the removal of beach or dune sediments by wave action, tidal currents, wave currents, or drainage.	• UMass Boston	• State of Massachusetts (2010) and City of Boston (2008) Hazard Mitigation Plans • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Anecdotal information from UMass Boston	• Boston has an expansive coastline (10 miles along Boston Harbor) and a number of islands. Much of the shoreline is located in the velocity zone (V zone). UMass Boston is a waterfront campus, portions of which are in the V Zone. Boston's waterfront areas are subject to repeated wave action and winds. These natural processes not only destabilize coastal structures, but also lead to shoreline change. • The state plan notes that regardless of the season, coastal storms typically cause erosion. With the anticipated change in climate an increase in intensity and frequency of storms is expected. This will, in turn, increase the likelihood of severe erosion episodes along the coast of Massachusetts. • The state plan notes that highest rates of erosion and the longer expanses of eroding shoreline within a community are generally located along high-wave energy, open-ocean shores. • UMass Boston is currently working on a shoreline stabilization project along the Harbor Walk to mitigate past erosion issues; portions of campus are in a V zone and susceptible to destabilized coastal structures and shoreline change.

	Hazard Description	Campus That Could Be Impacted	How Susceptibility Was Determined	Susceptibility Factors
Coastal Storm or Nor'easter	A nor'easter is a macro-scale storm along the East Coast of the United States and Atlantic Canada that gets its name from the direction the wind is coming from. The storm has characteristics similar to that of a hurricane and can cause severe coastal flooding, erosion, winds and blizzard conditions.	• UMass Boston • UMass Dartmouth • UMass Lowell • UMass System Office	• Massachusetts Hazard Mitigation Plan (2010) • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Anecdotal information from UMass Boston • Anecdotal information from UMass Dartmouth	• Nor'easters are discussed in the state plan as a common cause of flooding and snowstorms, particularly in the coastal part of the state. • The state plan notes that Nor'easters are a common winter occurrence in New England and repeatedly result in flooding, various degrees of wave and erosion damage to structures, and erosion of natural resources, such as beaches, dunes and coastal bluffs. The erosion of coastal features commonly results in greater potential for damage to shoreline development from future storms. • The state plan notes that Nor'easters have an average frequency of 1 or 2 per year with a storm surge equal to or greater than 2.0 feet. The duration of high surge and winds in a nor'easter duration can be from 12 hours to 3 days. • UMass Boston – previous wind damage and leaking buildings due to wind driven rain; Bayside Expo property vulnerable to storms from northeast; concern over potential isolation of the campus. • UMass Dartmouth – a major concern for SMAST building that has seen $37k in damage to the roof in the past during storm events.
Dam Failure	A "dam" is an artificial barrier that has the ability to impound water, wastewater, or any liquid material for the purpose of storage	• UMass Lowell	• Massachusetts Hazard Mitigation Plan (2010) • NMCOG DRAFT Hazard Mitigation Plan (2012) • Merrimack River Watershed Report	• The state plan notes that Worcester County has the highest number of dams in the entire United States (425 dams). • UMass Lowell is adjacent to the Merrimack River and the nearby Pawtucket Dam which was built in 1847. There is a modified Ice Harbor fishway at

	Hazard Description	Campus That Could Be Impacted	How Susceptibility Was Determined	Susceptibility Factors
	or control of water. In general, a dam serves to retain water. Dam failure can be defined as a catastrophic type of failure characterized by the sudden, rapid, and uncontrolled release of impounded water or the likelihood of such an uncontrolled release. Dam failure can also result from other natural events like hurricanes and earthquakes.		• Anecdotal information from UMass Lowell	the Pawtucket Dam which is functional during high flow periods. • NMCOG Plan notes that Lowell is home to a high hazard dam (failure will likely cause loss of life and serious damage to home(s), industrial or commercial facilities, important public utilities, main highway(s) or railroad(s) – Lowell Reservoir Dam). • CMRPC Plan notes that the region it encompasses (System Office is in Shrewsbury which is in this region) is at a low risk for flood threats from dam failure. • UMass Lowell – there are 3 dams along the Merrimack River and if they failed, it would likely impact the campus even though much of it is elevated.
Drought	**Drought** is an extended period of months or years when a region notes a deficiency in its water supply that is either surficial or underground.	• UMass Boston • UMass Dartmouth • UMass Lowell • UMass System Office	• Massachusetts Hazard Mitigation Plan (2010) • Review of FEMA's Multi-Hazard Identification and Risk Assessment • NOAA NCDC North American Drought Monitor Map and data	• According to the NCDC North American drought monitor, Massachusetts is not currently (as of January 2013) suffering from any type of drought condition (unlike much of the rest of the country). • Drought was ranked in the State Hazard Mitigation Plan as having a low frequency of occurrence, with minor to serious severity, and having a widespread statewide impact. • MA has a Drought Management Task Force who prepared a Drought Management Plan that notes western Massachusetts may be more vulnerable than eastern Massachusetts to severe drought conditions. • Massachusetts has experienced multi-year

	Hazard Description	Campus That Could Be Impacted	How Susceptibility Was Determined	Susceptibility Factors
				drought periods and the most severe drought on record in the northeastern United States was during 1961-1969.
Earthquake	An earthquake (also known as a quake, tremor or temblor) is the result of a release of energy in the Earth's crust that creates seismic waves. Earthquakes have the potential to impact hundreds of thousands of miles causing property damage, loss of life and a general disruption to economic functions of an area.	• UMass Boston • UMass Dartmouth • UMass Lowell • UMass System Office	• Massachusetts Hazard Mitigation Plan (2010) • Campus Emergency Management Assessment Report – University of Massachusetts, Boston Campus (February 2009) • Central Massachusetts Region Wide Pre-Disaster Mitigation Plan (2012) • Anecdotal information from UMass Boston • Anecdotal information from UMass Lowell • Anecdotal information from UMass Dartmouth • Anecdotal information from UMass System Office	• The state plan discusses earthquakes and the fact that they have been detected all over New England. • The state plan notes that northeastern Massachusetts, especially along the coastline from the northern portion of Plymouth County through the Boston Metropolitan area to the New Hampshire border, has greater vulnerability to potential earthquake activity than the rest of the state. • The CEMAR plan indicates that based on an evaluation using AIR Corporations' Cat Station, the probability of UMass Boston experiencing an earthquake producing shaking which could equal or exceed VII on the Modified Mercalli Intensity Scale is .67% in 30 years. Impacts could be heavy damage in structurally compromised buildings. • CMRPC plan notes that earthquakes are extremely rare in the central Massachusetts region and when they do occur, they are small. Considered to be a low threat in the region. • UMass Boston – cancelled classes in 2011 after a small earthquake was felt. Concern over catwalk system. • UMass Lowell – concern over lack of maintenance on failing bridges, they are minimally repaired and many not load limited – an earthquake could cause campus access issues if these were

	Hazard Description	Campus That Could Be Impacted	How Susceptibility Was Determined	Susceptibility Factors
				impacted. • UMass Dartmouth – campus is on an earthquake fault and concrete buildings present a potential vulnerability. • UMass System Office – Very minor earthquake movement has been felt in the past.
Extreme Heat or Heatwave	Heat waves are long periods of abnormally high temperatures (usually ten degrees or more above the average) that are typically accompanied by high levels of humidity for an extended period of time.	• UMass Boston • UMass Dartmouth • UMass Lowell • UMass System Office	• Massachusetts Hazard Mitigation Plan (2010) • Anecdotal information from UMass Boston • Anecdotal information from UMass Lowell • Anecdotal information from UMass Dartmouth • Anecdotal information from	• The state plan notes that temperature extremes can occur throughout the entire state. The coastal areas have lower daily averages than the inland parts of the state, but do not carry the same extreme temperature records. Areas that are more prone to heat include inland urban areas. • UMass Boston, UMass Lowell and UMass Dartmouth have concerns over ventilation impacts and loss to chemicals and sensitive research and animal populations.
Flood	Flooding can be defined as a rising and overflowing of a body of water onto normally dry land. Flood related hazards most likely to affect Massachusetts are inland/riverine, dam failure, ice jams and snow melt.	• UMass Boston • UMass Dartmouth • UMass Lowell • UMass System Office	• State Hazard Mitigation Plan (2010) • NMCOG DRAFT Hazard Mitigation Plan (2012) • Central Massachusetts Region Wide Pre-Disaster Mitigation Plan (2012) • Campus Emergency Management Assessment Report – University of Massachusetts, Boston Campus (February 2009) • Anecdotal information from UMass Boston	• The state plan notes that flooding is the most common hazard to affect New England. • NMCOGs plan references NCDC data that 53 flood events were reported in Middlesex County between 1950 and 2010. • NMCOG plan notes that Merrimack River rose 8 feet above flood stage in 2006 and caused widespread damage. (This flood prompted the City of Lowell to install a modern flood control gate). Total damage cost approximately $25 million to infrastructure in Lowell alone. UMass Lowell Inn and Conference Center has been impacted by flooding. • NMCOG plan notes that Lowell has several

	Hazard Description	Campus That Could Be Impacted	How Susceptibility Was Determined	Susceptibility Factors
			• Anecdotal information from UMass Lowell • Anecdotal information from UMass Dartmouth	repetitive loss structures in the community. • Periodic flooding in Lowell has caused extensive property damage in some locations. Lowell's floodplains have been built upon and have exacerbated flooding problems, as wetlands that provide valuable flood storage have been filled to allow for development. • Flooding in Lowell is a problem along the Merrimack River near the water Treatment Plant. • CEMAR for UMass Boston noted that during heavy rain storms, portions of the outer campus roadway become flooded and incoming utility feeds may be disrupted due to water infiltration. No direct impact to campus buildings is anticipated. • "Preparing for the Rising Tide" report notes that the actual UMass Boston campus itself is not vulnerable to surface flooding. Any new campus buildings will not be vulnerable to surface flooding from a coastal storm (they are being built at 5 feet above current 100-year flood elevation). • "Preparing for the Rising Tide" report notes that major UMass Boston campus flood vulnerabilities are at the campus entrances (Morrissey Boulevard and Mount Vernon Street) and the Bayside Expo property. Flooding of the Bayside Expo property already occurs during regular rain events. • CMRPC plan notes that central Massachusetts is at moderate risk for flood threats which may result in serious or extensive damage.

	Hazard Description	Campus That Could Be Impacted	How Susceptibility Was Determined	Susceptibility Factors
				• UMass Boston – Parking lot at Bayside Expo property routinely floods; other vulnerable areas are at campus entrances on Morrissey Boulevard and Mount Vernon Street and cause traffic backups that can impact campus accessibility. • UMass Lowell – in 2007, flooding shut down campus for a week; boathouse on Pawtucket Boulevard flooded. • UMass Dartmouth – areas near parking area and emergency roadway/electrical easements tend to flood frequently (near Pinedale); poor drainage on site can flood basements. • UMass Dartmouth – SMAST building outside protection zone provided by New Bedford flood control system and lies within inundation zone.
Hailstorm	Any thunderstorm which produces hail that reaches the ground is known as a hailstorm.	• UMass Boston • UMass Dartmouth • UMass Lowell • UMass System Office	• Massachusetts Hazard Mitigation Plan (2010)	• Communities in Massachusetts are susceptible to hail that may typically be present during a thunderstorm event.
Hurricane	A storm with a violent wind that may have a force of 12 on the Beaufort scale (equal to or exceeding 64 knots or 74 mph). Hurricanes often cause damage due to winds and heavy precipitation. In coastal areas, storm surge, waves and tidal flooding	• UMass Boston • UMass Dartmouth • UMass Lowell • UMass System Office	• Massachusetts Hazard Mitigation Plan (2010) • NMCOG DRAFT Hazard Mitigation Plan (2012) • Review of NOAA historical tropical cyclone tracks • Central Massachusetts Region Wide Pre-Disaster Mitigation Plan (2012) • Campus Emergency Management Assessment	• Hurricanes are discussed in the state hazard mitigation plan which notes that the entire state of Massachusetts is susceptible to hurricanes with coastal areas be susceptible to both wind damage and storm surge damage. • NOAA's historical tropical cyclone tracks show the paths that tropical storms/hurricanes have taken through the Commonwealth. • The state plan notes that between 1851 and 2004, approximately 32 tropical storms; five Category 1 hurricanes, two Category 2 hurricanes and three

	Hazard Description	Campus That Could Be Impacted	How Susceptibility Was Determined	Susceptibility Factors
	typically can cause additional destruction.		Report – University of Massachusetts, Boston Campus (February 2009) • UMass Dartmouth Website – Press Release dated October 2012 • Anecdotal information from UMass Boston • Anecdotal information from UMass Dartmouth • Anecdotal information from UMass System Office	Category 3 hurricanes have made landfall. To date, the Commonwealth has not experienced a Category 4 or 5 hurricane. • The state plan notes that based on past hurricane and tropical storm landfalls, the frequency of tropical systems to hit the Massachusetts coastline is an average of once out of every six years. • NMCOG plan notes that heavy rains associated with hurricanes probably present the highest recurrent risk in the Northern Middlesex region and high winds are also a risk. • CMRPC Plan (System Office is locate in Shrewsbury which is in this region) notes that the region is at medium risk for hurricane threats, and may experience serious impacts such as wind, vegetative debris, flooding, stormwater flooding, and rain. • CEMAR for UMass Boston notes the campus is exposed to high winds and wave action from Boston Harbor. Past winds have produced moderate roof damage and a storm surge of 15-20 feet may be possible. • UMass Dartmouth closed campus on October 29, 2012 due to the potential for widespread flooding and power outages from Hurricane Sandy. • UMass Boston – has had wind damage and leaking buildings due to wind driven rain during hurricanes. • UMass System Office – the network has gone down in the past due to a hurricane event. During

	Hazard Description	Campus That Could Be Impacted	How Susceptibility Was Determined	Susceptibility Factors
				Hurricane Irene, the two means that connect all campuses through the IT infrastructure went down.
Ice Storm	A type of winter storm that is characterized by freezing rain. Freezing rain from these storms can cover everything with a thick, heavy glaze which causes secondary impacts such as downed trees and power lines.	• UMass Boston • UMass Dartmouth • UMass Lowell UMass System Office	• Anecdotal information from UMass Lowell	• The state plan notes that ice storms can arise in any part of the state, however they most frequently occur in the higher elevations of Western and Central Massachusetts. From 1971 to 2009 there have been about 40 ice storm events which impacted at least one or more counties in the Commonwealth. • UMass Lowell – freezing rain resulted in loss of power to North Campus for 3 days.
Severe Winter Storm	A winter storm is an event in which the varieties of precipitation are formed that only occur at low temperatures, such as snow or sleet, or a rainstorm where ground temperatures are low enough to allow ice to form. Substantial amounts of snow are typical. Downed trees, utilities, property damage and injuries to human life are common.	• UMass Boston • UMass Dartmouth • UMass Lowell • UMass System Office	• Massachusetts Hazard Mitigation Plan (2010) • Campus Emergency Management Assessment Report – University of Massachusetts, Boston Campus (February 2009) • Central Massachusetts Region Wide Pre-Disaster Mitigation Plan (2012) • Anecdotal information from UMass Lowell • Anecdotal information from UMass Dartmouth	• The state plan notes that although the entire state may be considered at risk, higher snow accumulations appear to be prevalent at higher elevations in Western and Central Massachusetts, and along the coast where snowfall can be enhanced by additional ocean moisture. • The CEMAR for UMass Boston evaluated natural hazards including winter storms. Potential consequences included snow loading that may lead to roof damage/collapse and winds that may cause roof damage and related water infiltration to upper floors of buildings. In addition, there may be an inability of students, faculty and staff to evacuate the campus due to limited egress routes and a large commuter population. Traffic congestion could lead to the need for overnight sheltering for limited individuals.

	Hazard Description	Campus That Could Be Impacted	How Susceptibility Was Determined	Susceptibility Factors
				• CMRPC plan notes that winter storms and related hazards (power outages, flooding) have a high frequency in the region though impacts are generally minor. • UMass Lowell – winter storm cut out power on north campus for 2 days. • UMass Dartmouth – have experienced power outages on campus due to winter storms in the past.
Thunderstorm & Lightning	A storm with thunder and lightning and typically also heavy rain or hail. Lightning is a discharge of electrical energy that can cause damage when it impacts objects or humans in the environment.	• UMass Boston • UMass Dartmouth • UMass Lowell • UMass System Office	• Massachusetts Hazard Mitigation Plan (2010) • Central Massachusetts Region Wide Pre-Disaster Mitigation Plan (2012) • Anecdotal information from UMass Lowell	• Thunderstorms are discussed in the state plan which notes that the entire state is susceptible. It notes that one of the more damaging storms was in 1998 and impacted Suffolk, Worcester, Bristol and Middlesex County among others. • CMRPC plan notes that the central Massachusetts region frequently experiences thunderstorm and lightening events, although they typically have resulted in minor damage. • UMass Lowell – thunderstorms have blown out mother boards in the past and fire alarm panels (minor damage caused).
Tornado	A tornado is a violently rotating column of air that is in contact with both the surface of the earth and a cumulonimbus cloud or, in rare cases, the base of a cumulus cloud. Most tornadoes have wind speeds less than	• UMass Boston • UMass Dartmouth • UMass Lowell\ • UMass System Office	• Massachusetts Hazard Mitigation Plan (2010) • NMCOG DRAFT Hazard Mitigation Plan (2012) • MVPC DRAFT Hazard Mitigation Plan • Central Massachusetts Region Wide Pre-Disaster Mitigation Plan (2012) • City of Boston (2008)	• The state plan notes that a tornado may occur anywhere in Massachusetts with the right atmospheric conditions. • The state plan and several of the regional/city plans acknowledge that Massachusetts has a definite vulnerability to tornadoes, with an average annual occurrence of 2.6 tornadoes per year since 1951. • According to the NCDC, between 1991 – 2010, Massachusetts has averaged one tornado per

	Hazard Description	Campus That Could Be Impacted	How Susceptibility Was Determined	Susceptibility Factors
	110 miles per hour, are about 250 feet across, and travel a few miles before dissipating. They are often generated by thunderstorms.		Hazard Mitigation Plan • Tornado History Project (online) • Campus Emergency Management Assessment Report – University of Massachusetts, Boston Campus (February 2009) • Lowell Sun Newspaper Article, June 2011 • Anecdotal information from UMass System Office	year. • Tornadoes are ranked as a medium threat in terms of frequency, with the potential for causing serious or extensive damage in the State Hazard Mitigation Plan. • The State Hazard Mitigation Plan noted that the area at greatest risk for a tornado touchdown runs from central to northeastern Massachusetts and includes the Northern Middlesex Region (UMass Lowell). • Between 1951 – 2011, Suffolk County has recorded 0 tornados, Bristol County has recorded 9, Middlesex County has recorded 17 and Worcester County has recorded 39. • CEMAR noted that a tornado event is unlikely to strike UMass Boston. However, if there was a direct hit, there could be substantial damage to campus buildings and expose staff and students to flying debris. • In Worcester County, a number of F1 tornadoes have occurred over the years. There have been 4 F3 tornados (or higher). Tornadoes are not common in the central Massachusetts region and they are considered to be a minor threat. • A tornado watch was issued for Middlesex County in June 2011. • UMass System Office – tornadoes have occurred in Worcester/Shrewsbury area in the past.
Tsunami	A series of water waves caused by the displacement of a large	• UMass Boston	• Massachusetts Hazard Mitigation Plan (2010) • City of Boston Hazard	• The state plan indicates that all of the coastal areas of Massachusetts are exposed to the threat of tsunamis. It is unknown what the probability is

	Hazard Description	Campus That Could Be Impacted	How Susceptibility Was Determined	Susceptibility Factors
	volume of a body of water, typically an ocean or a large lake. Earthquakes, volcanic eruptions and other underwater explosions all have the potential to generate a tsunami. Unlike a typical wave which crashes at the shore, a tsunami's key characteristic is the wall of water that it brings which has the potential to cause devastating damage in coastal areas located immediately along the shore.		Mitigation Plan 2008	of a damaging tsunami along the MA coast. • The state plan refers to the fact that history suggests that there is some tsunami hazard to Massachusetts, both from a strong, local offshore earthquake and from a major earthquake across the Atlantic Ocean. • City of Boston HMGP noted that the UMass Boston campus's coastal location and because it is at the intersection of two faults makes tsunami though unlikely, possible.
Urban Fire	**Urban Fire:** An uncontrolled fire in an urban area affecting residential or commercial properties.	• UMass Boston (urban fire) • UMass Lowell (urban fire)	• Massachusetts Hazard Mitigation Plan (2010) • NMCOG DRAFT Hazard Mitigation Plan (2012) • Anecdotal information from UMass Boston • Anecdotal information from UMass Lowell • Anecdotal information from UMass Dartmouth • Anecdotal information from	• The state Hazard Mitigation Plan notes that there are a number of areas of the state vulnerable to urban fires, particularly those areas where there are larger concentrations of wood frame construction homes or businesses which are more likely to experience large destructive fire. In addition, many former mill communities exist in Massachusetts, which have abandoned or vacant mills and warehouses such as Lowell. • The City of Lowell has a number of abandoned buildings that add to the risk of urban wildfires.

	Hazard Description	Campus That Could Be Impacted	How Susceptibility Was Determined	Susceptibility Factors
			System Office	• UMass Boston – fire in Healy and lack of sprinkler system is a concern. • UMass Lowell – Perry Hall fire caused $500k in damage to the research building. • General concern over unsprinklered buildings on all campuses.
Windstorm	A storm with high winds or violent gusts but little or no rain. Extreme winds can cause a threat to human life, property and infrastructure due to downed trees, power lines and flying objects/debris.	• UMass Boston • UMass Dartmouth • UMass Lowell • UMass System Office	• Massachusetts Hazard Mitigation Plan (2010) • Anecdotal information from UMass Boston • Anecdotal information from UMass Dartmouth	• The state plan notes that Massachusetts is susceptible to high wind from several types of weather events: before and after frontal systems, hurricanes and tropical storms, severe thunderstorms, Tornados, and Nor'easters. • The state plan also notes that the entire Commonwealth is vulnerable to high winds that can cause a wide range of damage, with the coast typically seeing the most damage impacts. • UMass Boston – there has been damage to roofs at Healy Library and Wheatly in the past. • UMass Dartmouth – the SMAST building has experienced wind damage.

3.2.1 Natural Hazards Not Profiled

Throughout the hazard identification process, it became evident that there were a number of natural hazards that were not relevant to any of the UMass campuses and though initially considered, were not profiled. **Table 3-5** indicates what these hazards were and why they were not included in this evaluation.

Table 3-5: Natural Hazards Not Profiled

	Hazard Description	How Susceptibility Was Determined	Susceptibility Factors
Landslide	The sliding down of a mass of earth or rock from a mountain or cliff. When a slope is greater than 10 degrees and/or vegetative cover is low and soil water is high, a slide is more likely.	• Review of Massachusetts State Hazard Mitigation Plan	• The plan notes that based on the US data set for landslides, areas along the Connecticut River in western Massachusetts and the greater Boston area have the highest risk to landslide. Due to the locations of the campuses, it was determined that the likelihood of one being impacted was minimal so evaluation of this hazard was not prioritized.
Avalanche	A rapid fall or slide of a large mass of snow down a mountainside.	• Review of Massachusetts State Hazard Mitigation Plan	• Avalanches are not included in the MA State Hazard Mitigation Plan
Volcano	A mountain that opens downward to a reservoir of molten rock below the surface of the earth. Volcanoes erupt when pressure from gases and the molten rock beneath becomes strong enough to cause an explosion.	• Review of Massachusetts State Hazard Mitigation Plan	• No volcanoes are located within the vicinity of the UMass campuses.
Ice Jam	Formation of ice over a body of water that limits the flow of the water due to freezing. Ice jam flooding occurs when warm temperatures and heavy rain cause the snow to melt rapidly, causing frozen rivers or lakes to overflow. The ice that is formed on top of the body of water breaks into small pieces of varying sizes.	• Review of Massachusetts State Hazard Mitigation Plan	• Ice jams are discussed in the State Plan as mostly occurring in the western part of the state. • Within the Northern Middlesex region, ice jams have been recorded on the Merrimack River in Lowell and on the Nashua River in the Town of Pepperell. The major hazard associated with an ice jam is flooding. Evaluation of this hazard was not prioritized.

3.3 HUMAN HAZARD IDENTIFICATION

Human hazard identification for each campus focused on hazards that are reasonably viable and have occurred in the past, or may have occurred at other college or university campuses. Information available through local, state and federal agencies and databases associated with the Clery Act was used to identify the 29 human hazards listed below. The assessment process focused on conducting research and interviewing stakeholders such as safety and facilities personnel to learn about their perceptions regarding the highest campus vulnerabilities and their likelihood.

Table 3-6: Human Hazards Identification by Campus

	UMass Boston	UMass Lowell	UMass Dartmouth	UMass System Office
Weapons of Mass Destruction	X			X
Civil Disturbance	X	X	X	X
SCADA Failure	X			
HazMat Release	X	X	X	X
Chemical		X		
Biological		X		
Radiological		X		
Bomb Threat	X	X	X	X
Vandalism	X		X	X
Methane	X			
Proximity to Flight Path	X			
Arson	X	X	X	X
Assault		X		
Theft		X	X	
Fraud		X		X
Violent Criminal Incident	X	X	X	X
Robbery/Burglary	X		X	X
Pandemic	X	X	X	X
Explosion	X		X	
IT Compromises		X	X	
Cyberattack/Cyberterrorism	X	X	X	X
Theft		X		
Human Error		X		
Proximity to Gas Tank at Commercial Point	X			
Armed Attack/Active Shooter	X	X	X	X
Industrial Accident (Fixed/Transport) - Construction	X			
Failure of Building Materials / Building Deterioration	X			
Critical Infrastructure Failure	X		X	X
Terrorism		X	X	

Table 3-7 provides details regarding each human hazard that may impact at least one of the four UMass campuses, how susceptibility was determined and why.

Table 3-7: Human Hazards Impacting UMass Campuses

	Hazard Description	Campuses That Evaluated the Hazard	How Susceptibility Was Determined	Susceptibility Factors
Weapons of Mass Destruction	A weapon of mass destruction is a weapon that can kill and cause significant loss of life, damage to property and to the environment and can be categorized as biological, chemical, radiological or nuclear.	• UMass Boston • UMass System Office	• Anecdotal information from each campus	• No specific incidents were noted but there is a general concern.
Civil Disturbance	A protest or demonstration against some type of political or socioeconomic issue.	• UMass Boston • UMass Lowell • UMass Dartmouth • UMass System Office	• Anecdotal information from each campus	• Drinking after sports events and related civil disturbances is a concern on some of the campuses.
SCADA Failure	Supervisory control and data acquisition (SCADA) systems are industrial control systems that monitor industrial processes via computer and internet technologies. A failure would be the result of some type of interruption to the system.	• UMass Boston	• Anecdotal information from campus	• A few SCADA systems are in place on campus - BMS Johnson Controls
HazMat Release	A hazardous material is any materials that can result in a threat to human	• UMass Boston • UMass Lowell • UMass Dartmouth	• Anecdotal information from each campus	• Accidental spills have occurred on the campuses as part of routine operations and research/laboratory work. Most are minor in nature.

	Hazard Description	Campuses That Evaluated the Hazard	How Susceptibility Was Determined	Susceptibility Factors
	life or property in any quantity. Release of these materials could be accidental or intentional and involve varying degrees of damage depending upon the properties of the material itself, the quantity of material and use of the material.	• UMass System Office		• Potential hazard related to receipt and delivery of chemicals. • Concern over potential diesel oil spill at Columbia point that could result in DEP required shut down of salt water pump house that could impact chillers on UMass Boston campus. • Concern over students potentially working with chemicals using unacceptable practices. General concern over failure to promptly evacuate buildings. Outsourced materials coming on and off campus where in some cases researchers can self-purchase chemicals and keep them for long periods of time; extent of chemical inventories and MSDSs on campuses can vary • Shrewsbury stores chemicals used at UMass Medical School which could potentially impact the other part of the building. • Shrewsbury – June 2012 there was a Tier 1 hazardous materials spill at Tangenx which is approximately 1 mile from the System Office.
Chemical	See HazMat release description.	• UMass Lowell	• Anecdotal information from campus	• Potential for incidents associated with student experiments that are not properly executed.
Biological	See HazMat release description.	• UMass Lowell	• Anecdotal information from campus	• No specific incidents were noted.
Radiological	See HazMat release	• UMass Lowell	• Anecdotal	• UMass Lowell – nuclear reactor is located in

	Hazard Description	Campuses That Evaluated the Hazard	How Susceptibility Was Determined	Susceptibility Factors
	description.		information from campus	campus and there has never been an incident. The university follows very strict NRC requirements. • UMass Lowell - Railroad on south campus (runs behind Mahoney and Coburn) between where a new parking garage is being built and a new dormitory (500 beds) in the future. Concern over what the railroad hauls, and their ability to sit idle for 24-72 hours. Rail line is also in a flood hazard/spillway area that flooded during 2006 - 2007 storms.
Bomb Threat	A bomb threat is a threat to detonate an explosive device provided in a verbal or written form with the intent of causing property damage or physical harm.	• UMass Boston • UMass Lowell • UMass Dartmouth • UMass System Office	• Anecdotal information from each campus	• Campuses have had bomb threats in the past and this is a general concern.
Vandalism	Vandalism is the intentional destruction of property that belongs to another person or the University.	• UMass Boston • UMass Dartmouth • UMass System Office	• Anecdotal information from each campus • Clery Report Statistics • Town of Shrewsbury Data	• General concern of open nature of buildings throughout the campuses. Minor acts of vandalism have occurred on the campuses in the past.
Methane	The major component of natural gas which is present where the fuel is used.	• UMass Boston	• Anecdotal information from campus	• DCAM currently looking at monitoring systems in campus buildings to evaluate if the methane monitoring systems in all buildings are functioning at optimum capacity. There have been detections

	Hazard Description	Campuses That Evaluated the Hazard	How Susceptibility Was Determined	Susceptibility Factors
				of methane in past at low levels. All new buildings will have methane detection systems.
Proximity to Flight Path	UMass Boston is located in close proximity to Logan International Airport in Boston, Massachusetts.	• UMass Boston	• Anecdotal information from campus	• This hazard was considered in the 2009 Marsh report and concern over impacts from airborne flights in distress was noted.
Arson	Arson is the act of intentionally setting fire to property with the goal of causing damage.	• UMass Boston • UMass Lowell • UMass Dartmouth • UMass System Office	• Anecdotal information from each campus • Town of Shrewsbury Data • Clery Report Statistics	• All campuses are susceptible to arson. There have only been minor incidents in the past.
Assault	Assault is an intention physical act of harm or threat of harm against a person.	• UMass Lowell	• Anecdotal information from campus • Clery Report Statistics	• General concern about the potential for assault on all campuses.
General Theft	Theft is a criminal act involving the taking of property without the owner's consent.	• UMass Lowell	• Anecdotal information from campus	• Acts of theft have occurred on all campuses. Most have been associated with personal and campus property.
Fraud	Fraud is a wrong or unlawful act of deception performed to result in personal gain which is often financial in nature.	• UMass Lowell	• Anecdotal information from campus	• Potential impacts discussed as an issue of general concern.
Violent Criminal	According to the Federal	• UMass Boston	• Anecdotal	• Discussed as an issue of general concern.

	Hazard Description	Campuses That Evaluated the Hazard	How Susceptibility Was Determined	Susceptibility Factors
Incident	Bureau of Investigation a violent crime is composed of four offenses: murder and nonnegligent manslaughter, forcible rape, robbery, and aggravated assault.	• UMass Lowell • UMass Dartmouth • UMass System Office	information from each campus • Clery Report Statistics	
Robbery/Burglary	Robbery is an act of violence or threat of violence associated with theft, or taking of property without the owner's consent. Burglary is illegal entry into a building for the purposes of committing an offence.	• UMass Boston • UMass Dartmouth • UMass System Office •	• Anecdotal information from each campus • Clery Report Statistics • Town of Shrewsbury Data	• General concern on all campuses.
Pandemic	A pandemic health issue is the spread of an infectious disease across large populations.	• UMass Boston • UMass Lowell • UMass Dartmouth • UMass System Office	• Anecdotal information from each campus	• General concern regarding the issue. •
Explosion	An explosion is an extreme release of energy which usually results in the generation of high temperatures and gas generation.	• UMass Boston • UMass Dartmouth	• Anecdotal information from each campus	• General concern over the possibility of explosion associated with chemical uses, laboratory research and experiments, fuel handling/power plant operations, and aged equipment.
IT Compromises	Either a virus that has impacted a computer or system or a situation where	• UMass Lowell • UMass Dartmouth	• Anecdotal information from each campus	• General concern over potential IT compromises.

	Hazard Description	Campuses That Evaluated the Hazard	How Susceptibility Was Determined	Susceptibility Factors
	someone or something has accessed a computer or system without permission.			
Cyberattack or Cyberterrorism	Cyberterrorism is a deliberate attack against computer systems and networks to cause large-scale disruptions and other harmful impacts.	• UMass Boston • UMass Lowell • UMass Dartmouth • UMass System Office	• Anecdotal information from each campus	• General concern that this happens frequently - could be the "next big thing" on campuses. •
IT Theft	Theft is a criminal act involving the taking of property without the owner's consent.	• UMass Lowell • UMass Dartmouth	• Anecdotal information from each campus	• General concern over theft on campus. There have been a number of IT related thefts on the campuses.
Human Error	The potential primary cause or contributing factor to a disaster or accident where staff, faculty, students or visitors are involved.	• UMass Lowell	• Anecdotal information from campus	• General concern over a disaster or accident occurring due to human error.
Proximity to Gas Tank at Commercial Point	UMass Boston is located in close proximity to the Gas Tank at Commercial Point.	• UMass Boston	• Anecdotal information from campus	• General concern over any type of incident involving this gas tank causing a secondary impact to the UMass Boston campus, which was considered in the 2009 Marsh Report.
Armed Attack/Active Shooter	An active shooter is defined by the U.S. Department of Homeland Security as an individual actively engaged in killing or attempting to kill people in a confined and	• UMass Boston • UMass Lowell • UMass Dartmouth • UMass System Office	• Anecdotal information from each campus	• General concern over armed attacks/active shooter situations. • UMass Boston – Conducted an active shooter recently and also participated in Urban Shield Boston. • UMass Lowell – currently the campus is conducting training. There is a weapon registration requirement

	Hazard Description	Campuses That Evaluated the Hazard	How Susceptibility Was Determined	Susceptibility Factors
	populated area; in most cases, active shooters use firearm[s] and there is no pattern or method to their selection of victims.			on campus. • UMass Dartmouth - Recently conducted a full scale exercise sponsored by FEMA. •
Industrial Accident (Fixed/Transport) - Construction	These are disasters caused by industrial companies, either by accident, negligence or incompetence. They are a form of industrial accident where great damage, injury or loss of life are caused.	• UMass Boston	• Anecdotal information from campus	• General concern over hazardous materials transportation or construction accidents.
Failure of Building Materials / Building Deterioration	The loss of building integrity over time due to age, materials, a specific incident or a combination.	• UMass Boston	• Anecdotal information from campus	• General concern over aged infrastructure. Improvements are ongoing through campus construction projects.
Critical Infrastructure Failure	The malfunction of assets that are critical to the functioning of the University including loss of power or communication.	• UMass Boston • UMass Dartmouth • UMass System Office	• Anecdotal information from each campus	• General concern over critical infrastructure failure and power losses. Impacts can result from direct on campus events or external events. •
Terrorism	The FBI defines terrorism as "the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof in furtherance of	• UMass Lowell • UMass Dartmouth	• Anecdotal information from each campus	• General concern over terrorism events.

	Hazard Description	Campuses That Evaluated the Hazard	How Susceptibility Was Determined	Susceptibility Factors
	political or social objectives."			

3.4 HAZARD RANKINGS

For each UMass Campus, after the natural and human hazards were identified and vetted, each hazard was ranked qualitatively on a scale of 0 (very low) to 5 (high) in the categories of frequency, severity, duration and intensity. A value was included for each category for every hazard that was profiled which gave all of them an individual score. The hazards were then weighted regarding the probability (40% which included rankings of frequency, duration and intensity) that the hazard would impact the campus and the consequences (60% which included rankings of severity) that would be realized by each individual campus.[1]

Probability

Frequency + Duration + Intensity/3 = Probability

Consequence

Severity

Total

*Probability *.4 + Consequence * .6 = Total*

Hazard rankings were assigned based on the overall probability and consequence total. Each campus received an overall low, medium or high for each identified hazard which varied slightly by campus. **Table 3-8** below summarizes the range that each campus used for the natural hazard rankings.

Table 3-8: Natural Hazard Numerical Ranking Ranges

	Low	Medium	High	Severe
UMass Boston	1.0-2.0	2.0-3.0	3.0-4.0	4.0+
UMass Lowell	1.0-2.25	2.25-3.0	3.0-4.0	4.0+
UMass Dartmouth	1.0-2.0	2.0-3.0	3.0-4.0	4.0+
UMass System Office	1.0-2.0	2.0-3.0	3.0-4.0	4.0+

A hazard ranking worksheet was prepared which illustrates all of the calculations and formulas that were utilized to rank the natural and human hazards. Each campus prepared their own ranking worksheet and **Table 3-9** below provides a summary of the results. The rankings are discussed in more detail in the individual Annex sections of this plan.

Ranking result categories are:

- Low (L)
- Medium (M)

[1] Some campuses chose to rank natural and/or human hazard probability at 50% and consequence at 50%.

- High (H)
- Severe (S)
- n/a – the campus chose not to evaluate that hazard

Table 3-9: Summary of Natural Hazard Ranking Results by Campus

	Ranking				
	UMass Boston	UMass Lowell	UMass Dartmouth Campus	UMass Dartmouth SMAST	UMass System Office
Coastal Erosion	M	n/a	n/a	n/a	n/a
Coastal Storm	H	n/a	M	H	L
Earthquake	M	M	M	M	M
Hurricane	S	H	S	S	S
Tornado	M	H	M	M	M
Flood	H	M	M	H	L
Drought	L	M	L	L	L
Winter Storm	H	H	M	M	H
Thunderstorm/Lightning	M	L	M	M	L
Hailstorm	L	L	L	L	L
Wildfire	n/a	n/a	L	L	n/a
Extreme Heat	L	M	M	M	L
Tsunami	M	n/a	n/a	n/a	n/a
Windstorm	H	L	M	M	M
Ice Storm	M	H	n/a	n/a	M
Dam Failure	n/a	M	L	L	n/a
Urban Fire	H	S	n/a	n/a	L

Human hazard rankings were based on the overall probability and consequence total. Each campus received an overall low, medium or high for each identified human hazard which varied slightly by campus (see **Table 3-10**).

Table 3-10: Human Hazard Numerical Ranking Ranges

	Low	Medium	High	Severe
UMass Boston	1.0-2.0	2.0-3.0	3.0-3.5	3.5+
UMass Lowell	1.0-2.0	2.0-2.5	2.5-3.25	3.25+
UMass Dartmouth	1.0-2.0	2.0-3.0	3.0-4.0	4.0+
UMass System Office	1.0-2.0	2.0-3.0	3.0-4.0	4.0+

A hazard ranking worksheet was prepared which illustrates all of the calculations and formulas that were utilized to rank the human hazards. Each campus prepared their own ranking worksheet and **Table 3-11** provides a summary of the results. The rankings are discussed in more detail in the individual Annex sections of this plan.

Ranking result categories are:

- Low (L)
- Medium (M)
- High (H)
- Severe (S)
- n/a – the campus chose not to evaluate that hazard

Table 3-11: Summary of Human Hazard Ranking Results by Campus

	UMass Boston	UMass Lowell	UMass Dartmouth	UMass System Office
Weapons of Mass Destruction	L	n/a	n/a	L
Civil Disturbance	L	M	L	L
SCADA Failure	L	n/a	n/a	n/a
HazMat Release	L	S	M	L
Chemical	n/a	S	n/a	n/a
Biological	n/a	H	n/a	n/a
Radiological	n/a	M	n/a	n/a
Bomb Threat	L	M	L	L
Vandalism	L	n/a	M	L
Methane	M	n/a	n/a	n/a
Proximity to Flight Path	M	n/a	n/a	n/a
Arson	M	L	H	L
Assault	n/a	M	n/a	n/a
Theft	n/a	M	n/a	n/a
Fraud	n/a	L	n/a	L
Violent Criminal Incident	M	M	H	M
Robbery/Burglary	M	n/a	M	L
Pandemic	M	H	M	M
Explosion	M	n/a	H	n/a
IT Compromises	n/a	S	M	n/a
Cyberattack/Cyberterrorism	M	M	H	S
Theft	n/a	M	M	n/a
Human Error	n/a	L	n/a	n/a
Proximity to Gas Tank at Commercial Point	M	n/a	n/a	n/a
Armed Attack/Active Shooter	H	H	M	L
Industrial Accident (Fixed/Transport) - Construction	H	n/a	n/a	n/a
Failure of Building Materials / Building Deterioration	H	n/a	n/a	n/a
Critical Infrastructure Failure	n/a	n/a	S	S
Terrorism	S	M	L	n/a

3.5 ASSET INVENTORY

Assets that were assessed during the mitigation planning process focused on facilities/buildings, equipment, and special collections/research and the role they play on each individual campus. While the campuses all have an extensive list of assets, not all buildings/facilities and other assets are critical to University operations. In order to differentiate the more critical buildings on campus from the less critical buildings/structures, each building/structure was ranked on a scale of one to five, with one being the most critical (essential) and five being the least critical (non-essential). The rankings were taken into consideration when mitigation goals and prioritization for mitigation actions were set.

Table 3-12 outlines the methodology that was used to assign rankings to the list of assets that was developed for each campus.

Table 3-12: Asset Ranking Methodology

Criticality Ranking	Ranking Criteria
Level 5	Buildings critical to campus operations and likely to shelter students/faculty: • Residence Halls • Dining Halls/Food Service • Athletic Complexes that may provide shelter • Laboratories and animal research facilities • Critical Infrastructure (including IT)
Level 4	Buildings that are less critical but serve a support function: • Records/document locations • Archives • Libraries/museums • Non-critical but important infrastructure
Level 3	Buildings that are administrative, academic or multi-use.
Level 2	Buildings used for recreational purposes such as Campus Centers or gymnasiums
Level 1	Buildings that are non-essential such as maintenance buildings, storage sheds, etc.

Each campus Annex plan includes a detailed table of assets that were evaluated during the mitigation planning process.

3.6 NON-HAZARD SPECIFIC RISK ASSESSMENT & ESTIMATING LOSSES

The purpose of assessing risks and estimating losses is to determine how the campus assets may be affected by various hazard events. Information gathered in previous steps of the process was used to help estimate losses from hazard events to people, buildings, operations and other assets. Some campus assets are more vulnerable than others due to age, location or some other factor. After assets were inventoried, additional information such as insured building value, building replacement value, insured contents value, occupancy limitations, date constructed and square feet and operational use was collected. The information was utilized to conduct loss estimates for assets according to the methodology outlined in FEMA *“Understanding Your Risks – Identifying Hazards and Estimating Losses”* (FEMA 386-2). The FEMA methodology was applied for a non-hazard specific situation and where applicable for a flood hazard and earthquake hazard. All other hazards followed a qualitative methodology which is discussed in each Annex plan. Each UMass campus evaluated building vulnerability based on a loss of function and total damage calculation using the FEMA methodology.

A **loss of function** calculation was prepared for each campus that included using the following information:

- List of existing buildings
- Date construction completed
- Gross square feet
- Assigned building criticality value (see **Table 3-12**)
- Factored square footage
- Building/total campus square footage
- Per day loss of function cost
- Estimated hazard specific loss of function days
- Loss of function cost per hazard

The calculations that were needed for the loss of function analysis are as follows:

factored square footage

*gross square feet * building criticality value = factored square footage*

building/total campus square footage

factored square footage/total gross square feet = building/total campus square footage

per day loss of function cost

resulting square footage factor/daily operating budget of the college (derived from 2013 operating budget) = per day loss of function cost

estimated hazard specific loss of function days

a minimum of 7 days was assumed

loss of function cost per hazard

per day loss of function cost/estimated hazard loss of function days = loss of function cost per hazard

Once a **loss of function** cost was determined, the project team was able to prepare a vulnerability assessment for buildings on each of the UMass campuses. The **vulnerability assessment** utilized the following information:

- List of existing buildings
- Insurable replacement value
- Insurable contents value
- Loss of function cost

The calculation utilizing the information above provided a total damage dollar value.

total damage

insurable replacement value + insurable contents value + loss of function cost = total damage

Based on the total damage dollar value, each building was given a building vulnerability ranking of high, medium or low that was then transferred onto a vulnerability map that was prepared for each campus. The details for each campus can be found in the Annex sections of this document.

3.7 NATURAL HAZARD PROFILES

3.7.1 Coastal Storm

Coastal Storms/Nor'Easters are common occurrences in the eastern United States and Massachusetts. They are capable of causing substantial damage to coastal (and at times, inland) areas due to strong winds (can be hurricane force), storm surge and substantial rainfall or snow amounts. A storm is specifically a Nor'Easter when the wind blows in from the northeast and pushes the storm up the east coast of the United States. Due to the slow movement of these weather events, storm surge can be in excess of 2 feet above normal high tide and impact the coastline over multiple high tide cycles making coastal erosion and flooding a common secondary effect of these storm events. These types of storms can occur anytime of the year, but are more common in the winter months.

3.7.1.1 Location of Coastal Storms

Massachusetts falls within the designated area known as the North Atlantic Coast which is generally considered to be the coastal area from Long Island, NY to northern Maine. The North Atlantic Coast is most vulnerable to nor'easters, tropical storms and reduced strength hurricanes because the flooding, erosion and wind damage can be substantial to physical property and natural surroundings. One or two nor'easters typically impact the Massachusetts coastline per year between October and April and causes shoreline erosion, flooding and property damage.

3.7.1.2 Severity and Extent of Coastal Storms

Coastal storm events can have a range of impacts on communities located along the shoreline. Heavy sustained winds and rainfall coupled with a high tide and wind driven storm surge can cause more of an impact than just a regular storm event. Contributing to the severity of coastal storms is climate change and sea level rise which increase the volume of water in the ocean from melting ice sheets and glaciers. According to a report by the Coastal Zone Management (CZM) office *"Preparing for the Storm"* during the past 100 years, the relative sea level has risen nearly 10 inches. The Intergovernmental Panel on Climate Change (IPCC) has predicted that sea level rise and the risks that is poses to the built environment and shorelines will continue to accelerate over the next 100 years as well.

3.7.1.3 Impact of Coastal Storms on Life, Property and Operations

In Massachusetts, coastal storms are regular events that cover large geographic areas. Coastal and adjacent low lying areas are most often inundated by seawater and one area of concern is coastal flooding due to storm surge during these events. High winds, erosion, heavy surf and heavy rain can all impact life, property and operations. Depending on the length and strength of the storm, death or serious injury, property damage and operations of local government and businesses can all occur. A common secondary impact of a coastal storm is short and long term electrical power outages.

3.7.2 Coastal Erosion

Coastal Erosion is often associated with some type of Coastal Storm/Nor'Easter or Hurricane. In general, it is the wearing away of land that may result in the removal of beaches, dunes or other shoreline vegetation by substantial wave action, tidal currents or drainage. Coastal erosion may result in long term sediment, rock and sand loss or the redistribution of these features. In severe cases, the shoreline can be temporarily displaced landward and cause damage to personal property. Shoreline structures are a method of mitigation but while they may protect some structures and assets, they can also cause more damage in other areas as a result.

3.7.2.1 Location of Coastal Erosion

According to the Woods Hole Oceanographic Institute, nearly 75% of the US ocean shoreline is eroding. In Massachusetts, approximately 68% has experienced or exhibits susceptibility to long term erosion impacts. In Massachusetts, the Coastal Zone Management (CZM) office has created a StormSmart Coasts program that is implementing a shoreline change project. The only campus directly impacted by Coastal Erosion is UMass Boston as well as the SMAST building in New Bedford associated with UMass Dartmouth.

According to a report associated with the Massachusetts Coastal Infrastructure Inventory and Assessment Project (July 2009), UMass Boston has several hard structures in place to help prevent coastal erosion.

- UMass Boston Campus - Revetment constructed from placed armor stone 2'x2' that appears to be in good condition. Granite post fences are at the top of the slope.

- UMass Boston Campus - Vertical granite block wall with stone size of 2'x4' in good condition that includes a granite fence along the top.
- Bayside Expo Property – Armor stone revetment 2'x2' and 2'x4' blocks that separate revetment from a path.

At UMass Boston, a shoreline stabilization project is currently underway to address 800 linear feet of the HarborWalk to prevent further coastal erosion of the shoreline. The project will stabilize the existing edge, eliminate the continued loss of debris and enhance public access, accessibility to the waterfront and connections between the campus and the waterfront.

3.7.2.2 Severity and Extent of Coastal Erosion

The Massachusetts shoreline is eroding and has been over a long period of time at a rate of approximately .56 feet per year.[2] A study of shoreline change in Massachusetts by the USGS survey, Woods Hole Oceanographic Institution Sea Grant Program, and Cape Cod Cooperative Extension reveals that approximately 68 percent, or 513 miles, of Massachusetts' ocean-facing shore exhibits a long-term erosion trend, 30 percent, or 226 miles, shows long-term accretion, and two percent, or 15 miles, shows no net change.

3.7.2.3 Impact of Coastal Erosion on Life, Property and Operations

Coastal erosion has and can substantially impact coastal areas of Massachusetts as well as the UMass Boston campus and SMAST building associated with UMass Dartmouth. Generally, the shoreline of a community is an active area where nature and the built environment frequently interact. Coastal storms generate heavy rain and sustained winds and wave action that are forceful and impactful to the shoreline. Secondary impacts of these storms such as flooding, erosion and storm surge further complicate the lasting effects. Coastal erosion in general does not necessarily have an immediate impact on life, property or operations. The impacts of this hazard are a result of repeated occurrences over time of coastal storms that can result in property loss or severe consequences that often require hard infrastructure solutions to protect the built environment. However, coastal erosion and shoreline change can cause significant economic loss due to destruction of buildings, roads, infrastructure, natural resources and habitat areas either through one storm event or repetitive storm events over time.

3.7.3 Earthquake

Earthquakes are the result of a release of energy (which can be observed by shifting and fracturing of rock materials beneath the surface) in the Earth's crust that creates seismic activity. Seismic activity is defined by the frequency, type and size of earthquakes that occur. Earthquakes are measured in by the Richter magnitude scale which assigns a value number to each earthquake event as a form of measuring the energy released.

[2] Woods Hole Oceanographic Institute, "Shoreline Change and the Importance of Coastal Erosion," [http://www.whoi.edu/seagrant/page.do?pid=51817&tid=282&cid=88713], May 2013

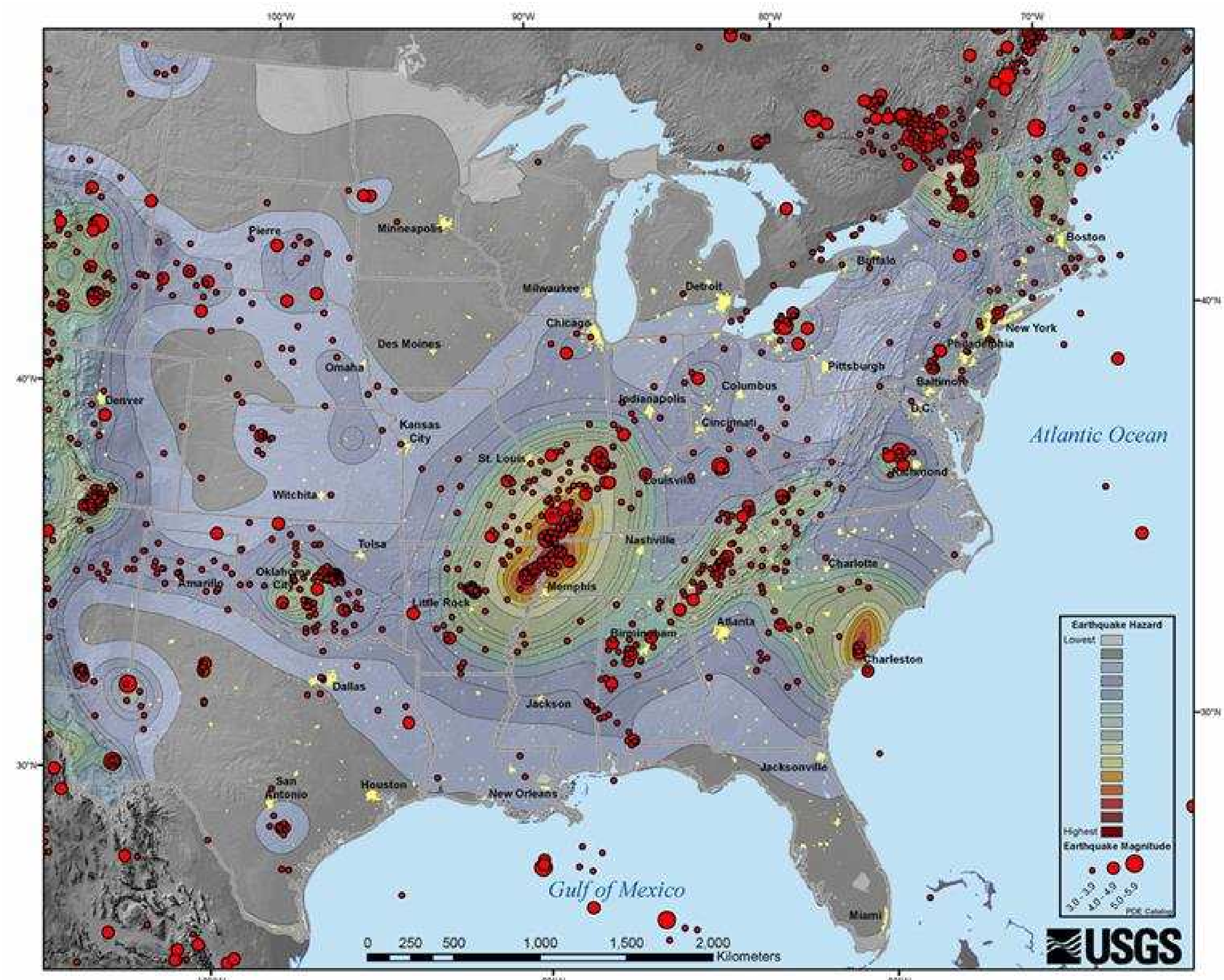
Unfortunately, earthquakes can be large in magnitude, impact thousands of square miles and cause billions of dollars in damage to property.

Earthquakes have been detected all over New England and northeastern Massachusetts, especially along the Massachusetts coastline from the northern portion of Plymouth County through the Boston Metropolitan area to the New Hampshire border, has greater vulnerability to potential earthquake activity than the rest of the state.

3.7.3.1 Location of Earthquakes

Earthquakes are possible in Massachusetts, including Boston where UMass Boston is located. The USGS map (prepared by the Earthquake hazard program) in **Figure 5** below indicates where Earthquake hazard areas are in the central and eastern portion of the country and where specific events have occurred in the past. The earthquake hazard possibility is on the lower end of the spectrum in Massachusetts compared to other areas.

Figure 5: USGS Earthquake Hazard Map

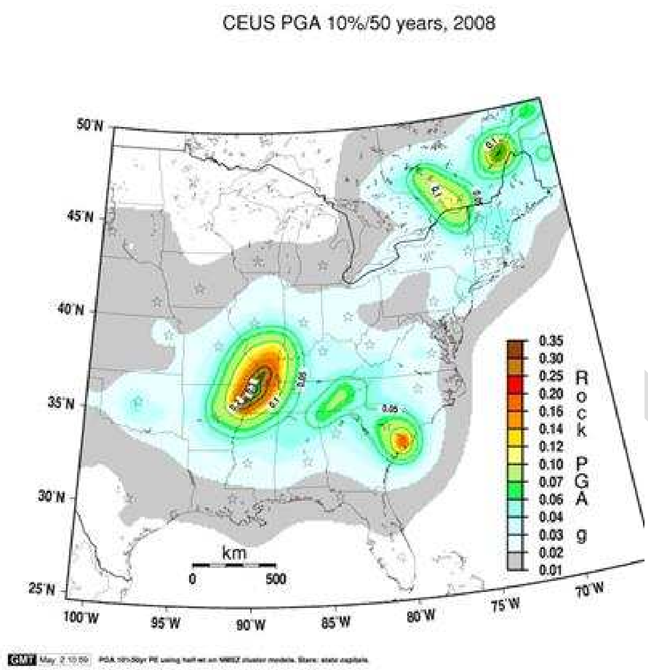


The State of Massachusetts Hazard Mitigation Plan notes that the New England epicenters do not follow major mapped faults of the region, nor are they confined to specific geologic structures or terrain. In addition, past earthquakes in New England have not aligned along fault lines that are known or mapped by geologists. Due to the wide ranging occurrences of earthquakes in New England, it is suspected that a strong event could occur anywhere in the region.

3.7.3.2 Severity and Extent of Earthquakes

Earthquake impacts are measured by how much energy releases from the epicenter of the event and how far any given location is from the epicenter. Severity can be expressed for an earthquake by comparing the acceleration of the event to normal acceleration due to gravity. Peak ground acceleration (PGA) is how the strength of the ground movements can be measured and is expressed as a percent of the established rate of acceleration due to gravity. Magnitude (measure of total energy released) and intensity (measure of earthquake effects at a specific place) are the terms used to commonly describe severity of an earthquake.

Figure 6: USGS Peak Ground Acceleration Map



A common method used to describe the severity of an earthquake is the Modified Mercalli Intensity (MMI) Scale (**see Table 3-13**). The Modified Mercalli Intensity Scale has preceded the Richter Scale (used until 1970) to measure the size of earthquakes in terms of how much energy is released. The scale identifies 12 increasing levels of intensity which are designated by a Roman numeral.

Table 3-13: Modified Mercalli Intensity Scale – Earthquake Intensity

MMI Scale Number	Typical Earthquake Impacts
I	Not felt except by a very few under especially favorable conditions.
II	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes, windows broken.

MMI Scale Number	Typical Earthquake Impacts
	Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Earthquakes are also often referred to on a magnitude scale, which is noted in **Table 3-14.**

Table 3-14: Earthquake Magnitude Scale

Magnitude	Earthquake Effects	Estimated Number Each Year
2.5 or less	Usually not felt, but can be recorded by seismograph.	900,000
2.5 to 5.4	Often felt, but only causes minor damage.	30,000
5.5 to 6.0	Slight damage to buildings and other structures.	500
6.1 to 6.9	May cause a lot of damage in very populated areas.	100
7.0 to 7.9	Major earthquake. Serious damage.	20
8.0 or greater	Great earthquake. Can totally destroy communities near the epicenter.	One every 5 to 10 years

3.7.3.3 Impact of Earthquakes on Life, Property and Operations

The impacts from an earthquake, depending on its magnitude and intensity can vary widely from no change to devastating losses. The main effect of an earthquake is ground shaking that can cause severe damage to buildings, utilities and other structures (bridges, roads, etc.). Other impacts may include:

- Landslide or avalanche due to slope instability,
- Fire due to damaged electrical or gas infrastructure,
- Rupture of water supply tanks, pipelines or aqueducts,
- Hazardous material spills,
- Soil liquefaction due to water saturated ground material,

- Tsunami which can be the result of large earthquakes (they are usually not seen unless the earthquake is a 7.5 or higher),
- Flood which is often a secondary impact of an earthquake, and
- Human injury and loss of life.

During the initial planning process, each UMass Campus identified a list of assets to evaluate which included buildings and associated characteristics. To determine what would be impacted by an earthquake event, the methodology outlined in the FEMA 386-2 guidance document was used to specifically determine how an earthquake may impact assets on each UMass campus. Maps were prepared to provide a visual illustration of vulnerabilities on each campus and are included in the Annex Plans.

Estimating losses to structure and contents due to an earthquake on each campus utilized the following information:

- Year constructed
- Insurable replacement value
- PGA zone
- Building damage ratio (FEMA 386-2)
- Loss of function days (FEMA 386-2)

Several calculations were made utilizing this information.

Content Damage Ratio

building damage ratio/2 = content damage ratio

Estimated Contents Damage Sustained

*insurable replacement value*contents damage ratio = estimated contents damage sustained*

Table 3-15, Table 3-16, Table 3-17 and **Table 3-18** detail the calculations that were made for an earthquake event and indicate what assets may be impacted at UMass Boston, Lowell, Dartmouth and the UMass System Office.

Table 3-15: UMass Boston Campus Buildings - Estimated Loss to Structure & Contents Due to Earthquake

Existing Buildings	Year Constructed	Insurable Replacement Value	PGA Zone	Building Damage Ratio (%)	Estimated Building Damage Sustained ($)	Contents Damage Ratio (%)	Estimated Contents Damage Sustained ($)	Loss of Function (Days)
Campus Center	2004	$123,199,871	0.05	0.0%	$0.0	0.00%	$0.00	0
Calf Pasture Pumping Station	1883	Unknown	0.05	0.2%	Unknown	0.10%	Unknown	1
Phillis Wheatley Hall	1973	$92,382,713	0.05	0.1%	$92,382.71	0.05%	$46,191.36	0
Salt Water Pump House	1974	$727,371	0.05	0.1%	$727.37	0.05%	$363.69	0
McCormack Hall	1975	$97,035,922	0.05	0.0%	$0.0	0.00%	$0.00	0
Science Center	1974	$102,512,053	0.05	0.1%	$102,512.05	0.05%	$51,256.03	0
Utility Plant	1974	$6,621,302	0.05	0.1%	$6,621.30	0.05%	$3,310.65	0
Healey Library	1978	$108,128,176	0.05	0.0%	$0.0	0.00%	$0.00	0
Quinn Administration	1973	$31,620,278	0.05	0.1%	$31,620.28	0.05%	$15,810.14	0
Clark Athletic Center	1979	$38,821,751	0.05	0.0%	$0.0	0.00%	$0.00	0
Service & Supply	1972	$24,060,563	0.05	0.1%	$24,060.56	0.05%	$12,030.28	0
UMass Bayside Expo Center	1968**	$41,250,000	0.05	0.2%	$82,500.0	0.10%	$41,250.00	1

Note: Utilized FEMA 386-2. loss estimation tables by category did not include an educational institution, so for the purposes of this analysis, we utilized the Professional Office category. Once the category was selected, we utilized a PGA value of .05 to select the appropriate building damage ratio % and loss of function days.

Table 3-16: UMass Lowell Campus Buildings - Estimated Loss to Structure & Contents Due to Earthquake

Existing Buildings	Year Constructed	Campus	Insurable Replacement Value	PGA Zone	Building Damage Ratio (%)	Estimated Building Damage Sustained ($)	Contents Damage Ratio (%)	Estimated Contents Damage Sustained ($)	Loss of Function (Days)
49 EAST MEADOW LANE	1971	Other	$8,106,555	0.05	10.0%	$810,655.5	5.00%	$405,328	1
61 EAST MEADOW LANE	1971	Other	$8,106,555	0.05	10.0%	$810,655.5	5.00%	$405,328	1
INN AND CONFERENCE CENTER	1984	East	$90,755,994	0.05	0.0%	$0.00	0.00%	$0	0
ETIC	2012	North	$80,000,000	0.05	0.0%	$0.00	0.00%	$0	0
UNIVERSITY CROSSING - BUILDINGS 1&2	2014	East	Unknown	0.05	Unknown	Unknown	Unknown	Unknown	0
UNIVERSITY CROSSING - BUILDING 6	2014	East	Unknown	0.05	Unknown	Unknown	Unknown	Unknown	0
UNIVERSITY SUITES RESIDENTIAL HALL	2013	East	Unknown	0.05	Unknown	Unknown	Unknown	Unknown	0
SOUTH CAMPUS GARAGE	2013	South	Unknown	0.05	Unknown	Unknown	Unknown	Unknown	0
BOURGEOIS HALL	1960	East	$21,783,841	0.05	Unknown	Unknown	Unknown	Unknown	0
CONCORDIA HALL	1966	South	$16,996,145	0.05	0.1%	$16,996.15	0.05%	$8,498	1
DONAHUE HALL	1989	East	$32,373,608	0.05	10.0%	$3,237,360.8	5.00%	$1,618,680	1
EAMES HALL	1949	North	$11,122,132	0.05	0.0%	$0.00	0	$0	0
FOX HALL	1973	East	$84,000,155	0.05	10.0%	$8,400,015.5	0.05	$4,200,008	1
LEITCH HALL	1960	East	$21,783,841	0.05	10.0%	$2,178,384.10	0.05	$1,089,192	1
SHEEHY HALL	1989	South	$25,179,471	0.05	0.0%	$0.0	0	$0	1
BELLEGARDE BOATHOUSE	1984	Other	$1,131,641	0.05	10.0%	$113,164.10	0.05	$56,582	0
COSTELLO ATHLETIC CENTER	1967	North	$28,303,020	0.05	10.0%	$2,830,302.0	0.05	$1,415,151	0
ALLEN HOUSE	1954	South	$2,902,224	0.05	0.0%	$0.00	0	$0	1
CUMNOCK HALL	1954	North	$12,188,627	0.05	0.0%	$0.0	0	$0	1
MAHONEY HALL	1960	South	$17,905,740	0.05	0.0%	$0.00	0	$0	1
LYDON LIBRARY	1969	North	$15,543,199	0.05	0.0%	$0.0	0	$0	1
ALUMNI HALL	1950	North	$5,255,260	0.05	0.0%	$0.00	0	$0	1
SOUTHWICK HALL	2002	North	$21,897,677	0.05	0.0%	$0.0	0	$0	1
COBURN HALL	1994	South	$17,539,893	0.05	10.0%	$1,753,989.30	0.05	$876,995	0
DUGAN HALL	1962	South	$19,227,156	0.05	0.0%	$0.0	0	$0	0
SOUTH CAMPUS DINING HALL	1972	South	$10,491,048	0.05	10.0%	$1,049,104.80	0.05	$524,552	1
FALMOUTH HALL	2007	North	$16,251,075	0.05	10.0%	$1,625,107.5	0.05	$812,554	1
KITSON HALL	2002	North	$18,059,032	0.05	0.0%	$0.00	0	$0	0
PASTEUR HALL	2038	North	$17,289,791	0.05	0.0%	$0.0	0	$0	0
SOUTH POWER PLANT	1966	South	$3,977,642	0.05	10.0%	$397,764.20	0.05	$198,882	1
PINANSKI HALL	1968	North	$27,900,383	0.05	10.0%	$2,790,038.3	0.05	$1,395,019	1
NORTH POWER PLANT	2010	North	$6,249,440	0.05	10.0%	$624,944.00	0.05	$312,472	1
BALL HALL	1958	North	$34,816,826	0.05	0.0%	$0.0	0	$0	0
DURGIN HALL	1976	South	$27,387,795	0.05	10.0%	$2,738,779.50	0.05	$1,369,390	1
OLSEN HALL	1974	North	$48,236,947	0.05	0.0%	$0.0	0	$0	0
CAMPUS RECREATION CENTER	2001	East	$24,003,129	0.05	0.0%	$0.00	0	$0	1
WEED HALL	1972	South	$26,247,564	0.05	10.0%	$2,624,756.4	0.05	$1,312,378	0
O'LEARY LIBRARY	1974	South	$36,412,791	0.05	0.0%	$0.00	0	$0	1
EAST PARKING GARAGE	2007	East	$50,430,750	0.05	0.0%	$0.0	0	$0	1
150 WILDER STREET	1905	South	$0	0.05	10.0%	$0.00	0.05	$0	0
HEALTH & SOCIAL SCIENCES BUILDING	2013	South	$40,000,000	0.05	10.0%	$4,000,000.0	0.05	$2,000,000	0
820 BROADWAY	1890	South	$0	0.05	0.0%	$0.00	0	$0	0
NORTH CAMPUS PARKING GARAGE	2012	North	$0	0.05	10.0%	$0.0	0.05	$0	1
GROUNDS MAINTENANCE GARAGE	1966	North	$1,079,491	0.05	0.0%	$0.00	0	$0	0
MCGAUVRAN STUDENT UNION	1974	South	$13,445,324	0.05	Unknown	Unknown	Unknown	Unknown	Unknown
PERRY HALL	1950	North	$17,252,232	0.05	10.0%	$1,725,223.20	0.05	$862,612	1
OLNEY HALL	1974	North	$87,551,256	0.05	0.0%	$0.00	0	$0	1
WANNALANCIT MILLS	1962	East	$42,332,584	0.05	10.0%	$4,233,258.40	0.05	$2,116,629	1
AMES TEXTILE	1968	East	$2,994,434	0.05	0.0%	$0.00	0	$0	1
TSONGAS CENTER	1997	East	$28,840,000	0.05	0.0%	$0.00	0	$0	1

Note: Utilized FEMA 386-2. loss estimation tables by category did not include an educational institution, so for the purposes of this analysis, we utilized the Professional Office

Table 3-17: UMass Dartmouth Campus Buildings - Estimated Loss to Structure & Contents Due to Earthquake

Existing Buildings	Year Constructed	Insurable Replacement Value	PGA Zone	Building Damage Ratio (%)	Estimated Building Damage Sustained ($)	Contents Damage Ratio (%)	Estimated Contents Damage Sustained ($)	Loss of Function (Days)
CHESTNUT HALL	1973	$19,283,450	0.05	20.0%	$3,856,690.00	10.00%	$1,928,345	0
ELMWOOD HALL	1976	$20,096,431	0.05	10.0%	$2,009,643.10	5.00%	$1,004,822	0
ROBERTS HALL	1972	$17,417,109	0.05	20.0%	$3,483,421.80	10.00%	$1,741,711	0
CENTER FOR VISUAL AND PERFORMING ART	1978	$34,061,504	0.05	10.0%	$3,406,150.40	5.00%	$1,703,075	0
CHASE ROAD CENTER	1955	$1,943,286	0.05	20.0%	$388,657.20	10.00%	$194,329	0
FOSTER ADMINISTRATION	1970	$15,174,285	0.05	10.0%	$1,517,428.50	5.00%	$758,714	0
LIBERAL ARTS	1966	$41,286,673	0.05	10.0%	$4,128,667.30	5.00%	$2,064,334	0
MACLEAN CAMPUS CENTER	1972	$21,698,067	0.05	10.0%	$2,169,806.70	5.00%	$1,084,903	0
MAIN AUDITORIUM	1971	$15,528,454	0.05	10.0%	$1,552,845.40	5.00%	$776,423	0
PUBLIC SAFETY/STEAM PLANT	1970	$2,968,025		10.0%	$296,802.50	5.00%	$148,401	0
SCIENCE AND ENGINEERING	1969	$63,650,288		10.0%	$6,365,028.80	5.00%	$3,182,514	0
TEXTILE	1969	$15,826,558		10.0%	$1,582,655.80	5.00%	$791,328	0
TRIPP ATHLETIC CENTER	1971	$23,951,346		10.0%	$2,395,134.60	5.00%	$1,197,567	0
VIOLETTE RESEARCH	1969	$14,406,222		10.0%	$1,440,622.20	5.00%	$720,311	0

Note: Utilized FEMA 386-2. loss estimation tables by category did not include an educational institution, so for the purposes of this analysis, we utilized the Professional Office category. Once the category was selected, we utilized a PGA value of .05 to select the appropriate building damage ratio % and loss of function days.

Table 3-18: UMass System Office Buildings - Estimated Loss to Structure & Contents Due to Earthquake

Existing Buildings	Year Constructed	Insurable Replacement Value	PGA Zone	Building Damage Ratio (%)	Estimated Building Damage Sustained ($)	Contents Damage Ratio (%)	Estimated Contents Damage Sustained ($)	Loss of Function (Days)
333 South Street	1986	$27,236,231	0.05	10.0%	$2,723,623.10	5.00%	$1,361,811.55	1
225 Franklin Street - 33rd Flood	Unknown	Unknown	0.05	0.2%	Unknown	0.10%	Unknown	Unknown

Note: Utilized FEMA 386-2. loss estimation tables by category did not include an educational institution, so for the purposes of this analysis, we utilized the Professional Office category. Once the category was selected, we utilized a PGA value of .05 to select the appropriate building damage ratio % and loss of function days.

3.7.4 Flood

A flood is when there is a high flow or inundation of water that submerges land which is normally dry and causes or threatens damage. The most frequently flooded type of area is land adjacent to a water body and in a defined floodplain. Flooding can either be coastal, riverine or shallow flooding (associated with ponding or urban drainage). Flooding situations can develop slowly or very quickly in a situation known as a flash flood. Floods can be dangerous because the flow of water can be rapid and either impact a neighborhood, community or the larger watershed area.

Varying types of floods can exist including[3]:

- ☐ **Coastal Flood:** Flooding of coastal areas due to the vertical rise above normal water level caused by strong, persistent onshore wind, high astronomical tide, and/or low atmospheric pressure, resulting in damage, erosion, flooding, fatalities, or injuries. Coastal areas are defined as those portions of coastal land zones (coastal county/parish) adjacent to the waters and bays of the oceans. Farther inland, flood events are defined as Flash Flood or Flood. Terrain (elevation) features determine how far inland the coastal flooding extends.
- ☐ **Flash Flood:** Rapid and extreme flow of high water into a normally dry area, or a rapid water level rise in a stream or creek above a predetermined flood level, beginning within six hours of the causative event (e.g., intense rainfall, dam failure, ice jam-related), on a widespread or localized basis. Ongoing flooding can intensify to flash flooding in cases where intense rainfall results in a rapid surge of rising flood waters. Flash floods do not exist for two or three consecutive days.
- ☐ **Riverine Flooding:** Generally means the flooding of rivers and streams over their pre-defined banks. In coastal regions, the riverine floodplain is generally a flat area along a larger river or in low-lying coastal areas. The volume that is manageable depends on the watershed, and climate and land use characteristics.
- ☐ **Urban Flooding:** In densely developed areas, heavy rains/precipitation can produce flooding when groundwater levels are high and there is insufficient drainage infrastructure in place.

Other terminology frequently used to describe flood conditions includes:

- ☐ **Base Flood (100 Year Flood) –** Flood that has a 1% chance of being equaled or exceeded in any given year. A 100 Year flood can occur more than once in a short period of time. The term measures the size of the flood, not frequency of occurrence.

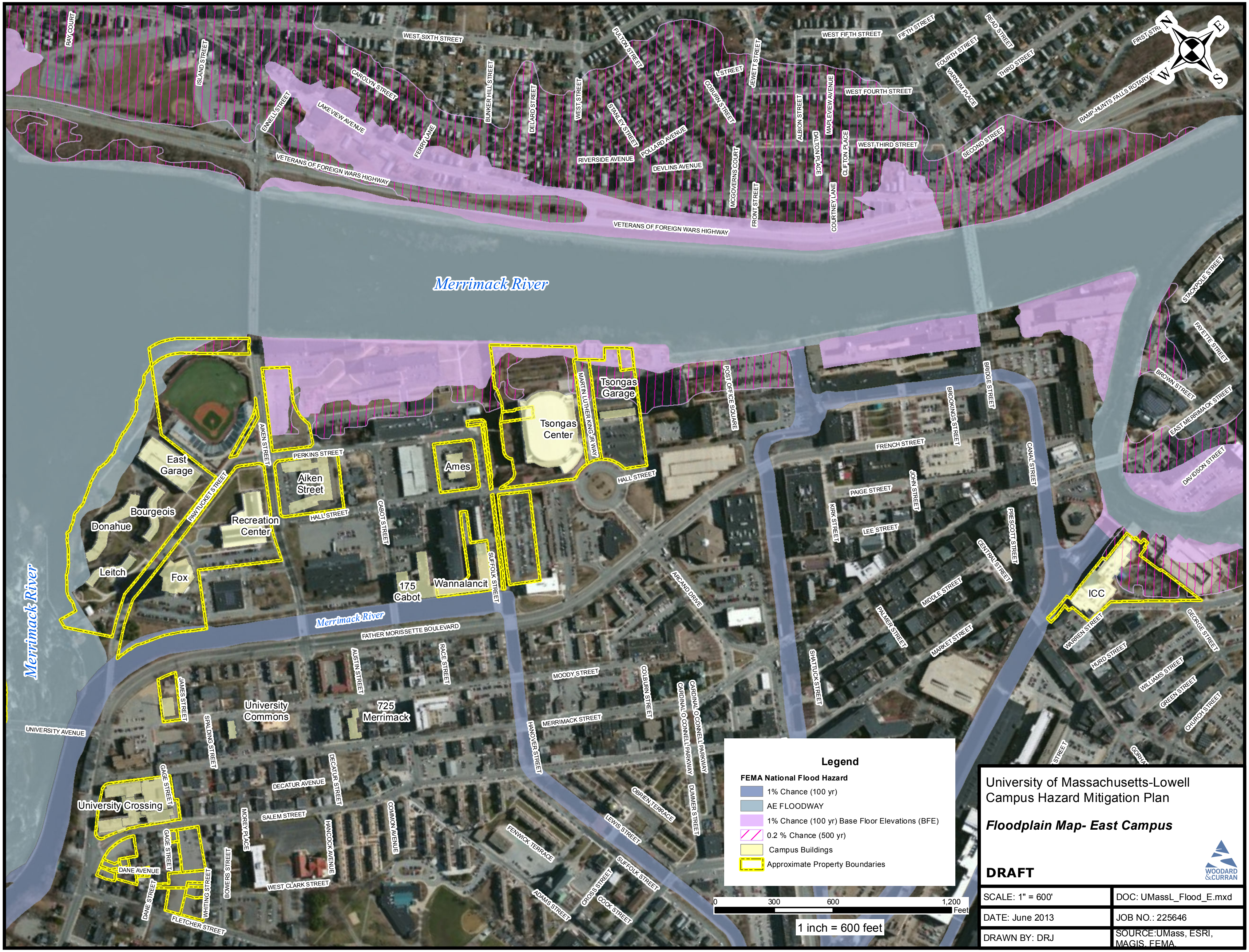
[3] National Weather Service Instruction 10-1605 (August 17, 2007), Operations and Services Performance, NWSPD 10-16 Storm Data Preparation document (http://www.nws.noaa.gov/directives)

- ☐ **500 Year Flood –** Flood that has a .2% chance of being equaled or exceeded in any given year. The 500-Year flood is an infrequent event and can occur between once in eight years to once in fifty years. The term does not mean a flood occurs once in 500 years.

3.7.4.1 Location of Flood Hazard

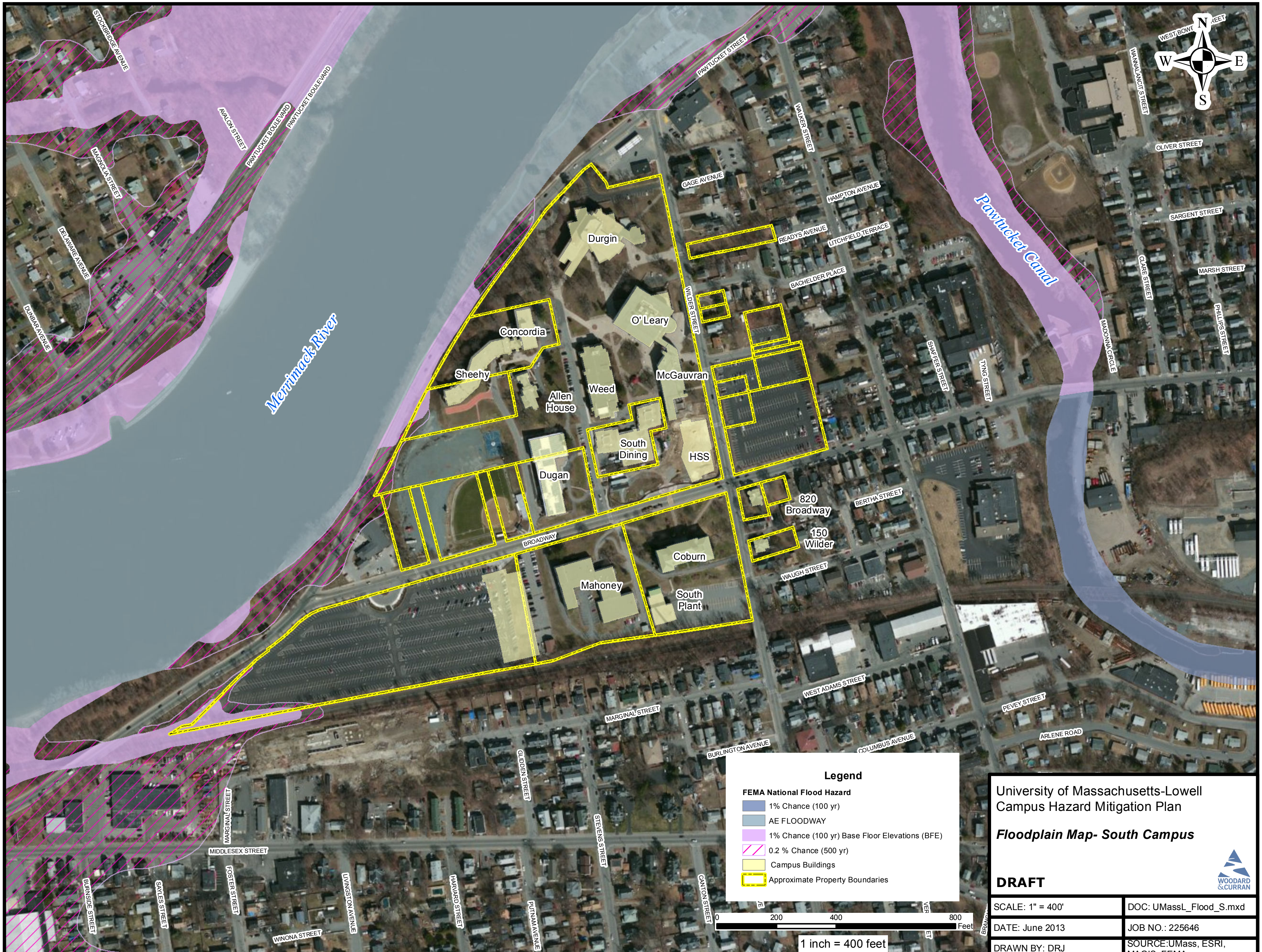
Included on the following pages are Floodplain Maps of the UMass campuses that were evaluated during this planning effort. In Massachusetts, flooding is a regular occurrence and often occurs due to other weather events such as a coast storm, nor'easter, heavy rain, hurricane or winter storm. According to the State Hazard Mitigation Plan (2010), flooding affects the majority of communities in the Commonwealth. Communities along the coast are exposed to coastal flooding.

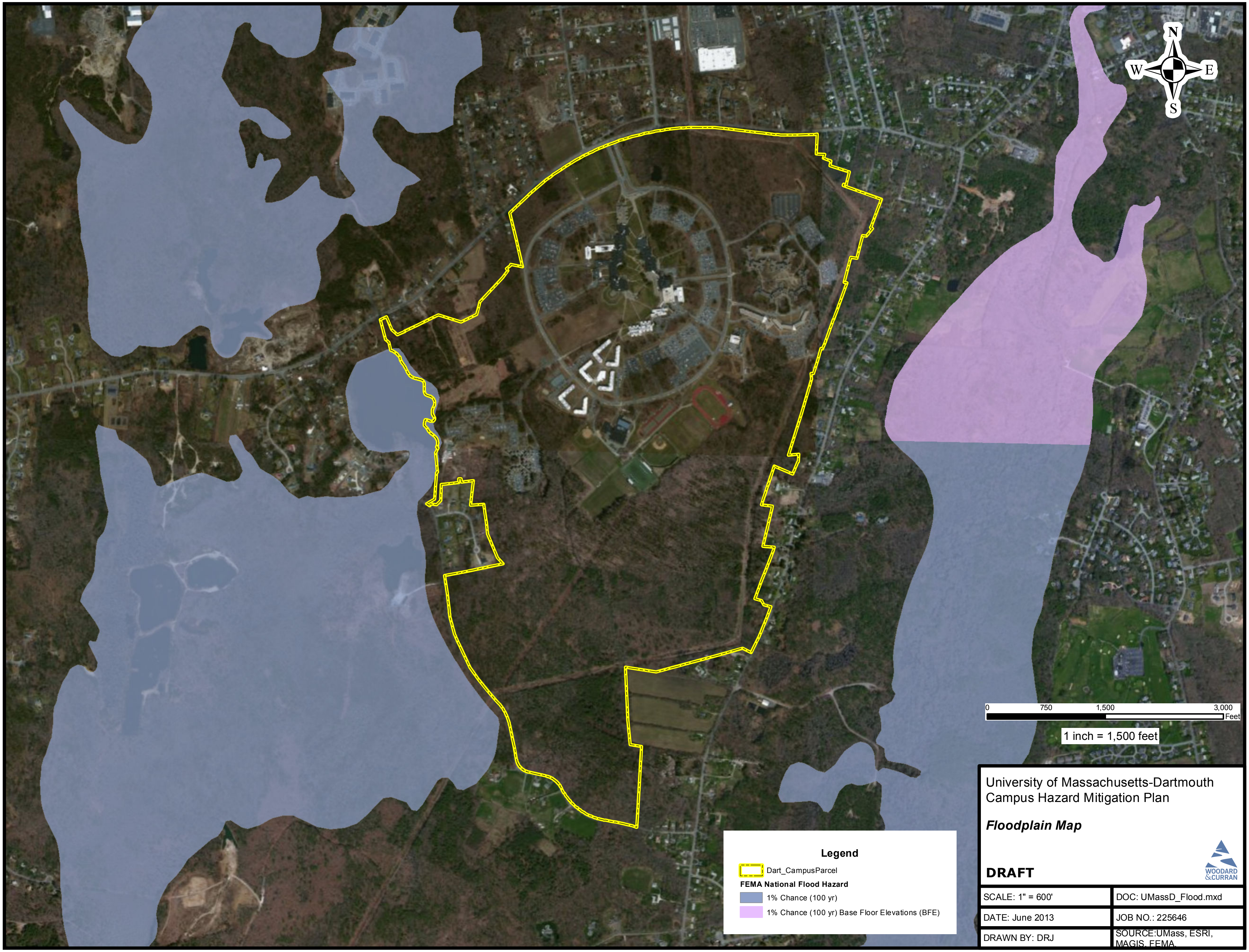

Bayside Exposition
Bayside Expo Lot
Mt. Vernon Street
Morrissey Boulevard
Southeast Expressway Routes (1)&(93)
JFK Library
Parking Lot A
Parking Lot D
Parking Lot C
Parking Lot B
University Drive
Massachusetts Archives
Clark Athletic Center
Beacons Lot
Bus Stop
Quinn
Science Center
Campus Center
Adminstrative Building
Healey Library
Integrated Sciences Complex
McCormack Hall
Wheatly Hall
South Lot
University Drive
Dorchester Bay
Boston Harbor
Legend
Approximate Property Boundaries
FEMA National Flood Hazard
AE 100 yr BFE
AO 100 yr BFE 1-3 Sheeting
VE BFE w/Waves
0.2 % Chance (500 yr)
0 400 800 1,600 Feet
1 inch = 800 feet
University of Massachusetts-Boston
Campus Hazard Mitigation Plan
Flood Plain Map
FIGURE #
WOODARD & CURRAN
SCALE: 1" = 800'
DOC: UMassB_Flood.mxd
DATE: June 2013
JOB NO.: 225646
DRAWN BY: DRJ
SOURCE: ESRI,MAGIS,FEMA.
N E S W



Merrimack River
Merrimack River
Merrimack River
East Garage
Bourgeois
Donahue
Leitch
Fox
Recreation Center
Aiken Street
Ames
Tsongas Garage
Tsongas Center
175 Cabot
Wannalancit
ICC
University Commons
725 Merrimack
University Crossing
Legend
FEMA National Flood Hazard
1% Chance (100 yr)
AE FLOODWAY
1% Chance (100 yr) Base Floor Elevations (BFE)
0.2 % Chance (500 yr)
Campus Buildings
Approximate Property Boundaries
0 300 600 1,200 Feet
1 inch = 600 feet
University of Massachusetts-Lowell
Campus Hazard Mitigation Plan
Floodplain Map- East Campus
DRAFT
WOODARD &CURRAN
SCALE: 1" = 600'
DOC: UMassL_Flood_E.mxd
DATE: June 2013
JOB NO.: 225646
DRAWN BY: DRJ
SOURCE:UMass, ESRI, MAGIS, FEMA.

N
W
E
S
FOURTH AVENUE
MARTIN STREET
SPARKS STREET
EMERY AVENUE
BODWELL AVENUE
ENDICOTT STREET
WHITE STREET
GERSHOM AVENUE
PHEBE AVENUE
DRACUT STREET
SARAH AVENUE
WOODCOCK STREET
GARDNER AVENUE
RIVERSIDE STREET
PLYMOUTH STREET
MOUNT HOPE STREET
UNIVERSITY AVENUE
STANDISH STREET
VETERANS OF FOREIGN WARS HIGHWAY
PAWTUCKET STREET
North Garage
Olney
Costello
Grounds Garage
Olsen
Pinanski
Ball
Engineering
North Power Plant
Cumnock
Kitson Hall
Kitson
Falmouth
Southwick
Pasteur
Eames
Alumni
Lydon
ETIC
Merrimack River
Donahue
Leitch
Fox
University
Legend
FEMA National Flood Hazard
1% Chance (100 yr)
AE FLOODWAY
1% Chance (100 yr) Base Floor Elevations (BFE)
0.2 % Chance (500 yr)
Approximate Property Boundaries
0
150
300
600
Feet
1 inch = 300 feet
University of Massachusetts-Lowell
Campus Hazard Mitigation Plan
Floodplain Map- North Campus
DRAFT
WOODARD & CURRAN
SCALE: 1" = 300'
DOC: UMassL_Flood_N.mxd
DATE: June 2013
JOB NO.: 225646
DRAWN BY: DRJ
SOURCE:UMass, ESRI, MAGIS, FEMA.


N
S
E
W
Merrimack River
Pawtucket Canal
Durgin
O' Leary
Concordia
Sheehy
Allen
House
Weed
McGauvran
South
Dining
HSS
Dugan
820
Broadway
150
Wilder
Coburn
Mahoney
South
Plant
BROADWAY
STOCKBRIDGE AVENUE
AVALON STREET
PAWTUCKET BOULEVARD
PAWTUCKET BOULEVARD
MAGNOLIA STREET
DELAWARE AVENUE
DUNBAR AVENUE
PAWTUCKET STREET
GAGE AVENUE
WALKER STREET
HAMPTON AVENUE
READYS AVENUE
LITCHFIELD TERRACE
BACHELDER PLACE
WILDER STREET
SHAFFER STREET
TYNG STREET
MADONNA CIRCLE
WEST BOWERS STREET
WANNALANCIT STREET
OLIVER STREET
SARGENT STREET
MARSH STREET
CLARE STREET
PHILLIPS STREET
BERTHA STREET
WAUGH STREET
WEST ADAMS STREET
MARGINAL STREET
PEVEY STREET
ARLENE ROAD
COLUMBUS AVENUE
BURLINGTON AVENUE
GLIDDEN STREET
STEVENS STREET
MARGINAL STREET
MIDDLESEX STREET
BURNSIDE STREET
SAYLES STREET
FOSTER STREET
WINONA STREET
LIVINGSTON AVENUE
HARVARD STREET
PUTNAM AVENUE
CANTON STREET
Legend
FEMA National Flood Hazard
1% Chance (100 yr)
AE FLOODWAY
1% Chance (100 yr) Base Floor Elevations (BFE)
0.2 % Chance (500 yr)
Campus Buildings
Approximate Property Boundaries
0
200
400
800
Feet
1 inch = 400 feet
University of Massachusetts-Lowell
Campus Hazard Mitigation Plan
Floodplain Map- South Campus
DRAFT
WOODARD
&CURRAN
SCALE: 1" = 400'
DOC: UMassL_Flood_S.mxd
DATE: June 2013
JOB NO.: 225646
DRAWN BY: DRJ
SOURCE:UMass, ESRI, MAGIS, FEMA


N
W
E
S
0
750
1,500
3,000
Feet
1 inch = 1,500 feet
Legend
Dart_CampusParcel
FEMA National Flood Hazard
1% Chance (100 yr)
1% Chance (100 yr) Base Floor Elevations (BFE)
University of Massachusetts-Dartmouth
Campus Hazard Mitigation Plan
Floodplain Map
DRAFT
WOODARD & CURRAN
SCALE: 1" = 600'
DOC: UMassD_Flood.mxd
DATE: June 2013
JOB NO.: 225646
DRAWN BY: DRJ
SOURCE:UMass, ESRI, MAGIS, FEMA

MAP SCALE 1" = 500'

250 0 500 1000 FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0639E

FIRM
FLOOD INSURANCE RATE MAP
WORCESTER COUNTY, MASSACHUSETTS
(ALL JURISDICTIONS)

PANEL 639 OF 1075

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GRAFTON, TOWN OF	250306	0639	E
SHREWSBURY, TOWN OF	250332	0639	E

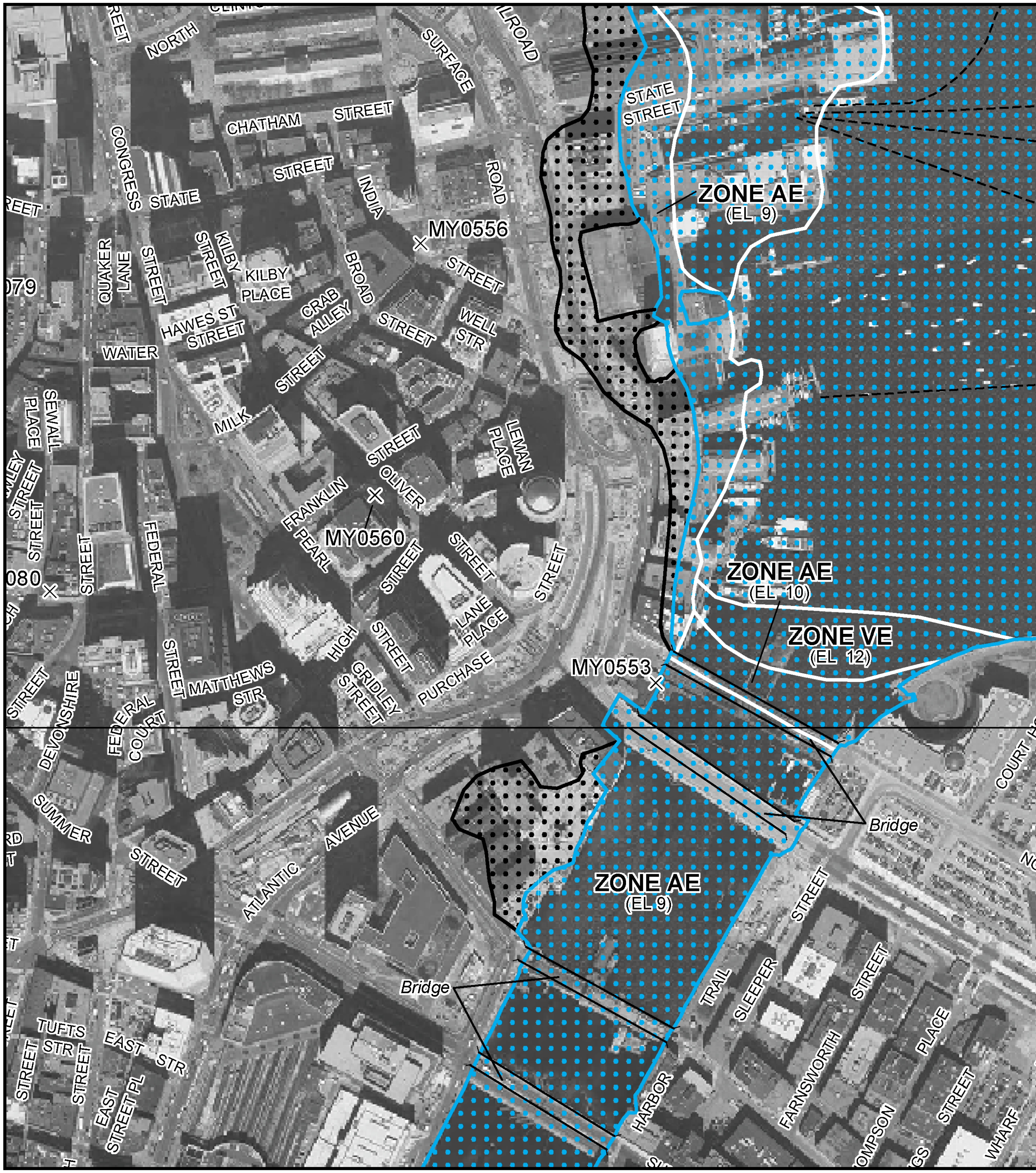
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

U.S. DEPARTMENT OF HOMELAND SECURITY

MAP NUMBER 25027C0639E

EFFECTIVE DATE JULY 4, 2011

Federal Emergency Management Agency



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METE

NFIP

PANEL 0081G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

SUFFOLK COUNTY, MASSACHUSETTS

(ALL JURISDICTIONS)

PANEL 81 OF 151

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BOSTON, CITY OF	250286	0081	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

U.S. DEPARTMENT OF HOMELAND SECURITY

MAP NUMBER
25025C0081G

EFFECTIVE DATE
SEPTEMBER 25, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Several campus buildings (see **Table 3-19**) are located at least partially in the FEMA mapped 100-year floodplain.

Table 3-19: Campus Buildings in FEMA 100 Year Floodplain

Building	Campus
Campus Center (partial)	UMass Boston
Salt Water Pump House (partial)	UMass Boston
UMass Bayside Expo Center	UMass Boston
Inn & Conference Center	UMass Lowell
North Campus Parking Garage (partial)	UMass Lowell
SMAST Building (located in New Bedford)	UMass Dartmouth

The National Flood Insurance Program (NFIP) tracks information regarding the number of flood insurance policies in force, the dollar value of insurance in force, total losses and total payments. While NFIP does not track this information specifically for college campuses, data for the communities in which the UMass campuses reside was available and is summarized in **Table 3-20**.

Table 3-20: National Flood Insurance Program for UMass Campus Communities

	# Policies in Force	Insurance In Force	Total Losses	Total Payments
Boston	1,048	$245,893,300	261	$1,028,242
Lowell	1,266	$241,029,100	240	$4,762,077
Dartmouth	597	$144,636,200	140	$865,001
Shrewsbury	64	$17,279,300	15	$30,238

The NFIP does not track repetitive loss occurrences for specific college or university campuses; however they do track this information by communities that participate in the program. For the purposes of this plan, information was obtained directly from the NFIP for the cities of Boston and Lowell and Dartmouth to provide a frame of reference. Data for Shrewsbury was not available (see **Table 3-21**).

Table 3-21: National Flood Insurance Program Repetitive Loss Occurrences for UMass Campus Communities

Category	Boston	Lowell	Dartmouth
Repetitive Loss Buildings	21	24	5
Repetitive Loss Buildings Insured	9	22	5
Repetitive Loss Total	53	55	14
Repetitive Losses Insured	23	48	14
Losses Total	$598,988.97	$584,907.11	$184,104.84
Losses Insured	$263,251.50	$546,133.01	$184,104.84
Buildings With 4 Losses Total	3	2	1
Buildings With 4 Losses Insured	2	1	1

Category	Boston	Lowell	Dartmouth
Post FIRM A-V Total	0	7	0
Building Payments Paid	$546,946.14	$579,661.68	$160,713.55
Contents Payments Paid	$429,953.20	$5,245.43	$23,391.29
Total Payments Paid	$976,449.34	$584,907.11	$184,104.84
Average Payment	$17,130.69	$10,634.67	$13,150.35
Total Losses	57	55	14

3.7.4.2 Severity and Extent of Flood Hazard

The communities where the UMass campuses are located experience various types of flooding. UMass Boston is a coastal campus and influenced substantially by coastal storms and other hazards while UMass Lowell is adjacent to the Merrimack River. UMass Dartmouth (including the SMAST building in New Bedford) and the System Office (Shrewsbury and Boston) would more likely experience secondary flooding impacts due to infrastructure or building failures. Flooding extents to each campus that have varying probabilities of occurrences can be seen on the floodplain maps presented previously.

3.7.4.3 Impact of Flood Hazard on Life, Property and Operations

Flooding occurrences can cause substantial negative impacts on life, property and operations in a community or university setting, particularly if proper insurance mechanisms are not in place. Cleaning up assets and infrastructure, housing or relocating faculty and staff and displacement costs can be expensive and extensive. Flooding can also modify the natural environment – particularly in coastal communities. The two buildings associated with the UMass System Office in Boston and Shrewsbury were not in a FEMA identified floodplain, so an analysis regarding what would be impacted by a flood event was not conducted.

During the initial planning process, each UMass campus identified a list of assets to evaluate which included buildings and associated information about them. To determine what would be impacted by a flood hazard event methodology outlined in the FEMA 386-2 guidance was utilized to document to specifically determine how flooding may specifically impact assets on each UMass campus. In addition, maps were prepared to provide a visual illustration of the findings.

- **Number of Structures –** Information collected included gross square feet, the actual number of a particular building on campus, the number of buildings in a flood hazard area, and the percent of a building in a hazard area. (Note: Buildings were not grouped into categories for this analysis (i.e. academic, residential, etc.) and were reviewed on an individual basis.
- **Value of Structures –** Information collected to determine the value of structures included insurable replacement value, an estimate of the percent of the building in the hazard area and the total dollar value in a hazard area (*estimated percent of building in hazard area x insurable replacement value).*

- **Number of People –** Information collected regarding number of people for the occupancy of each building evaluated stemmed from numbers provided by UMass Boston staff or the International Building Code Used which was used to calculate number of people on campus per building in accordance with IBC building type categories for the UMass Bayside Expo Center building, the Inn and Conference Center in Lowell and the SMAST building in New Bedford associated with UMass Dartmouth.

Table 3-22, Table 3-23 and **Table 3-24** detail the calculations that were made and indicate what may be impacted by a flood hazard event at UMass Boston, Lowell and Dartmouth.

Table 3-22: UMass Boston - What Will Be Impacted By Flood Hazard Event?

		Number of Structures			Value of Structures			Number of People		
	Gross Square Feet	# on Campus	# in Hazard Area	% in Hazard Area	$ on Campus	$ in Hazard Area	% in Hazard Area	# on Campus	# in Hazard Area	% in Hazard Area
Campus Center	**330,000**	**1**	**1**	**10%**	**$123,199,871**	**$12,319,987**	**10%**	**2,000**	**200**	**10%**
Calf Pasture Pumping Station	N/A	1	0	0%	$0	0	0	0	0	0%
Phillis Wheatley Hall	268,551	1	0	0%	$92,382,713	0	0	2,600	0	0%
Salt Water Pump House	**4,314**	**1**	**1**	**20%**	**$727,371**	**$145,474**	**20%**	**14**	**0**	**0%**
McCormack Hall	266,060	1	0	0%	$97,035,922	0	0	2,000	0	0%
Science Center	297,952	1	0	0%	$102,512,053	0	0	1,000	0	0%
Utility Plant	27,886	1	0	0%	$6,621,302	0	0	93	0	0%
Healey Library	337,446	1	0	0%	$108,128,176	0	0	1,500	0	0%
Quinn Administration	96,897	1	0	0%	$31,620,278	0	0	400	0	0%
Clark Athletic Center	126,427	1	0	0%	$38,821,751	0	0	5,600	0	0%
Service & Supply	74,295	1	0	0%	$24,060,563	0	0	100	0	0%
UMass Bayside Expo Center	**275,000**	**1**	**1**	**100%**	**$41,250,000**	**$41,250,000**	**100%**	**39,286**	**39,286**	**100%**

Source: International Building Code Used to Calculate # of People on Campus Per Building in Accordance with IBC Building Type Categories for the UMass Bayside Expo Center Building. All other capacity #s were provided by UMass Boston.

Table 3-23: UMass Lowell – What Will Be Impacted by Flood Hazard Event?

		Number of Structures			Value of Structures			Number of People		
	Gross Square Feet	# on Campus	# in Hazard Area	% in Hazard Area	$ on Campus	$ in Hazard Area	% in Hazard Area	# on Campus	# in Hazard Area	% in Hazard Area
INN AND CONFERENCE CENTER	192,778	1	1	100%	$90,755,994	$90,755,994	100	3,500	3,500	100%
NORTH CAMPUS PARKING GARAGE	185,263	1	1	40%	$16,000,000	$6,400,000	40	N/A	N/A	N/A

Table 3-24: UMass Dartmouth – What Will Be Impacted By Flood Hazard Event?

		Number of Structures			Value of Structures			Number of People		
	Gross Square Feet	# on Campus	# in Hazard Area	% in Hazard Area	$ on Campus	$ in Hazard Area	% in Hazard Area	# on Campus	# in Hazard Area	% in Hazard Area
SCH. OF MARINE SCIENCE & TECHNOLOGY	35,027	**1**	**1**	**35%**	$12,035,577	**$1,203,558**	**35%**	**640**	**64**	**35%**

Relative to the UMass Boston campus, the *"Preparing for the Rising Tide"* report notes that the UMass Boston campus is not vulnerable to surface flooding and any new campus buildings will not be vulnerable to surface flooding from a coastal storm because they are being built at 5 feet above current 100-year flood elevation.

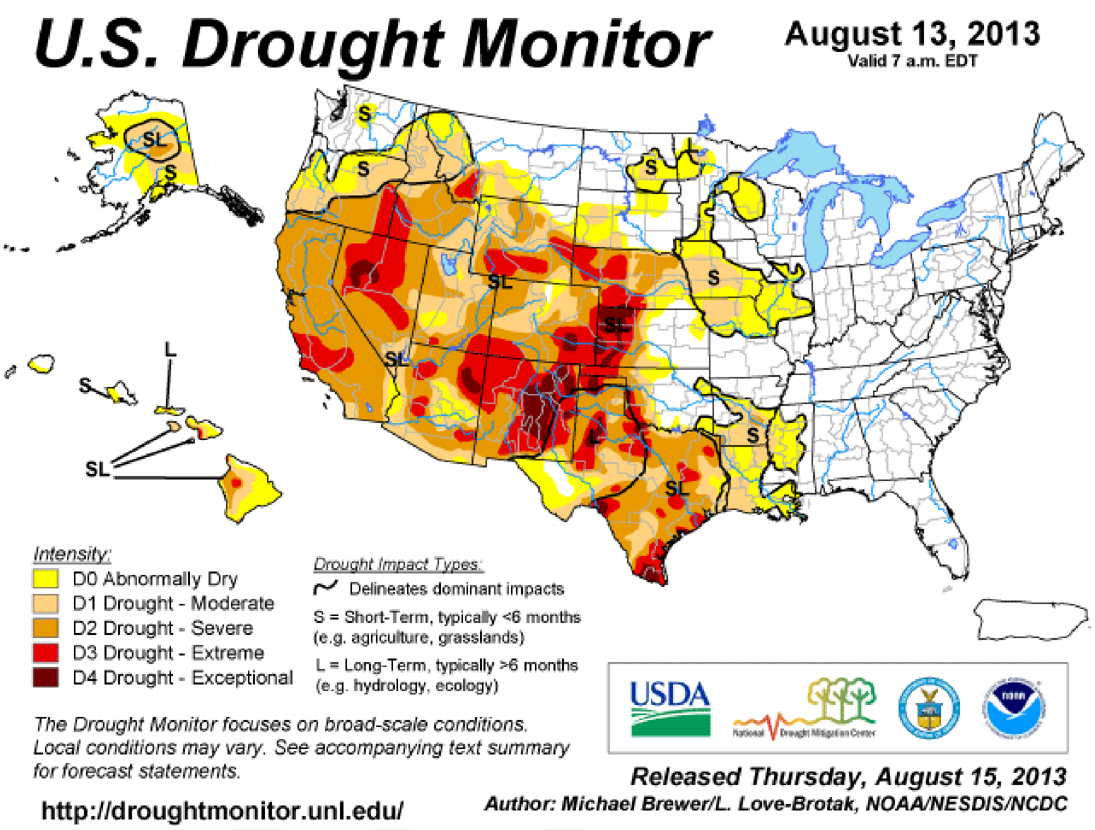
3.7.5 Drought

Drought occurs when there is an insufficient amount of moisture that has adverse impacts on people, animals or vegetation over a geographic area. Drought can occur over a prolonged period of time where the lack of precipitation directly impacts the hydrologic balance of the environment. Examples of impact include water supply shortages, dry soils which may result in crop failure and changed fish and wildlife behavior including death. Other weather characteristics like consistently high temperatures and low humidity can exacerbate the problem. Results of prolonged drought periods can also have a disastrous economic impact on communities and regions who rely upon water for agriculture and tourism type activities.

3.7.5.1 Location of Drought

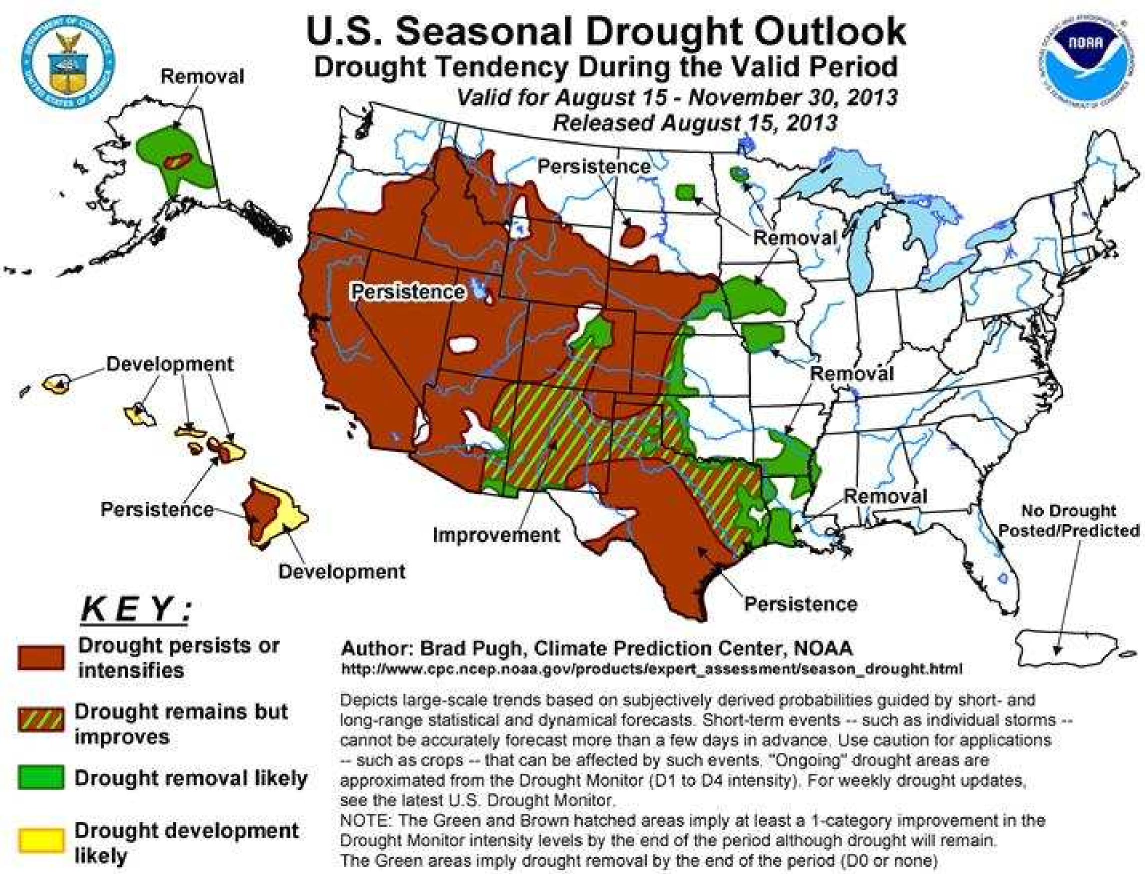
Massachusetts is often considered to be a "water-rich" state and regions throughout the state generally receive between 40 and 50 inches of precipitation on an annual basis. Massachusetts is not immune from experiencing drought conditions and they most often occur when there has been a dry winter. As of August 2013, Massachusetts is not experiencing drought conditions (see **Figure 12** below).

Figure 12: Palmer Drought Index



NOAA also produces a seasonal drought outlook which depicts large, long term trends for the United States (see **Figure 13**).

Figure 13: U.S. Seasonal Drought Outlook – August 2013



3.7.5.2 Severity and Extent of Drought

According to the Massachusetts Drought Management Plan, a number of drought indices are available to assess the various impacts of dry conditions. The state uses a multi-index system that takes advantage of several of these indices to determine the severity of a given drought or extended period of dry conditions.

3.7.5.3 Drought Indices[4]

- **Palmer Drought Index –** an index that reflects soil moisture and weather conditions; available from the National Weather Service or National Climate Data Center.

[4] Massachusetts Drought Management Plan, 2001

- **Crop Moisture Index –** an index that reflects short-term soil moisture conditions as used for agriculture; available from the National Climate Data Center.

- **Fire Danger –** the fire danger level reflects how favorable conditions are for brush fires. Data factored into the index include weather conditions and available fuel. This is a short-term index, which can change daily. The duration of the index will be used to determine relative drought levels.

- **Precipitation –** a comparison of measured precipitation amounts to 30-year averages. Cumulative amounts for 3, 6 and 12-month periods are factored into the drought determination. This data is available from the DEM, Office of Water Resources.

- **Groundwater levels –** a drought level determination is based on the number of consecutive months ground-water levels are below normal (lowest 25% of period of record). Ground-water conditions maps showing areas of above normal, normal and below normal are provided monthly by the USGS.

- **Streamflows –** a drought level determination is based on the number of consecutive months streamflow levels are below normal (lowest 25% of period of record). Streamflow conditions maps showing areas of above normal, normal and below normal are provided monthly by the USGS.

- **Reservoirs –** a drought level determination will be based on the level of small, medium and large index reservoirs across the state. The reservoir level relative to normal conditions will be considered. DEM and Office of Water Resources, as part of its monthly conditions report, will maintain a list of index water supply reservoirs and their percent full.

Table 3-25 defined the drought indices for Massachusetts according to the 2001 Drought Management Plan.

Table 3-25: Drought Indices (Massachusetts Drought Management Plan, 2001)

Drought Level	PDI	CMI*	Fire*	Precipitation	Groundwater	Streamflow	Reservoir
Normal	-1.0 to –1.99	0.0 to -1.0 slightly dry	Low	1 month below normal	2 consecutive months below normal**	1 month below normal**	Reservoir levels at or near normal for the time of year
Advisory	-2.0 to -2.99	-1.0 to –1.9 abnormally dry	Moderate	2 month cumulative below 65% of normal	3 consecutive months below normal**	At least 2 out of 3 consecutive months below normal**	Small index Reservoirs below normal
Watch	-3.0 to 3.99	-2.0 to –2.9 excessively dry	High	1 of the following criteria met: 3 month cumulative. < 65% **or** 6 month cumulative < 70% **or** 12 month cumulative < 70%	4-5 consecutive months below normal**	At least 4 out of 5 consecutive months below normal**	Medium index Reservoirs below normal
Warning	-4.0 and below	< -2.9 severely dry	V. High	1 of the following criteria met: 3 month cumulative < 65% **and** 6 month cumulative <65% **Or** 6 month cumulative <65% **and** 12 month cumulative <65% **Or** 3 month cumulative <65% **and** 12 month cumulative <65%	6-7 consecutive months below normal**	At least 6 out of 7 consecutive months below normal**	Large index reservoirs below normal
Emergency	-4.0 and below	<-2.9 severely dry	Extreme	Same criteria as Warning **And** Previous month was Warning or Emergency	>8 months below normal	>7 months below normal	Continuation of previous month's conditions

3.7.5.4 Impact of Drought on Life, Property and Operations

Drought can substantially impact varying sectors like agriculture, wildfire and recreation, energy, municipal and fish and wildlife. Decreasing flow of streams and rivers due to lack of precipitation can secondarily impact drinking water supplies, wildlife and recreational activities. It can also impact other users such as power generation and water and wastewater utilities. In a campus setting, drought conditions would impact landscaping, laboratory functions, food service and drinking water for students and faculty.

3.7.6 Winter Storm

Winter storms typically consist of varying forms of precipitation including snow, sleet, freezing rain or a mix of these wintry conditions. Blizzards are the most dangerous and severe type of winter storm and are characterized by strong, sustained winds of at least 35 mph that last for a prolonged period of time – typically 3 hours or more. An ice storm is another form of winter storm that is defined as an event which results in the accumulation of at least .25-inch of ice on exposed surfaces and they occur when moisture falls and freezes immediately upon impact on trees, powerlines, roads, structures and other surfaces. These types of storms can down trees, cause lengthy, widespread power outages, damage property and even cause fatalities.

3.7.6.1 Location of Winter Storm Hazard

The entire State of Massachusetts is at risk for winter storm events. According to the State Hazard Mitigation Plan, higher snow accumulations are more common at higher elevations in Central and Western parts of the state and along the coast where snowfall can be fueled by additional ocean moisture.

3.7.6.2 Severity and Extent of Winter Storm Hazard

Winter storms can include snow storms with strong winds (often referred to as blizzards), extreme cold spells that can cause rivers to freeze resulting in ice jams that can lead to flooding, ice storms that produce heavy accumulations of ice, and heavy snow storms that result in above average snow accumulations. A nor'easter includes a cyclonic storm that moves along the east coast that most often includes snow accumulations over nine inches, gale force winds, and storm surge that can cause severe flooding near the coastline.

NOAA's National Climatic Data Center (NCDC) has recently implemented the Regional Snowfall Index (RSI) to categorize significant snowstorms that impact the eastern two thirds of the United States. RSI includes a regional index for the northeast that includes Massachusetts and replaced with the Northeast Snowfall Impact Scale (NESIS) to account for snowfall accumulations, population data, and area affected (see **Figure 14**). The index is similar to the Fujita scale for tornadoes or the Saffir-Simpson scale for hurricanes.

Figure 14: NCDC Regional Snowfall Index (RSI)

Category	RSI Value	Description
1	1–3	Notable
2	3–6	Significant
3	6–10	Major
4	10–18	Crippling
5	18.0+	Extreme

3.7.6.3 Impact of Winter Storm Hazard on Life, Property and Operations

Winter Storms can result in fatalities that are most often not directly related to the storm itself. Fatalities due to traffic accidents on icy roads, heart attacks from excessive shoveling, and hypothermia from prolonged exposure to the cold are typical. Risks related to snow and ice are most often associated with automobile accidents followed by individuals caught outside in the storm. Fatalities due to cold exposure are most often associated with infants and the elderly that are most susceptible.

Impacts to property and operations are usually temporary and include snow removal. However, heavy snow can lead to significant snow removal costs, infrastructure damages (such as weight of snow on roofs), and loss of business that can financially impact communities. Other potential impacts include knocked down trees, power lines, and utility poles. Freezing temperatures can result in downed trees, power lines, utility poles, ice jams that can cause flooding, and building pipe bursts due to poor insulation or lack of heat.

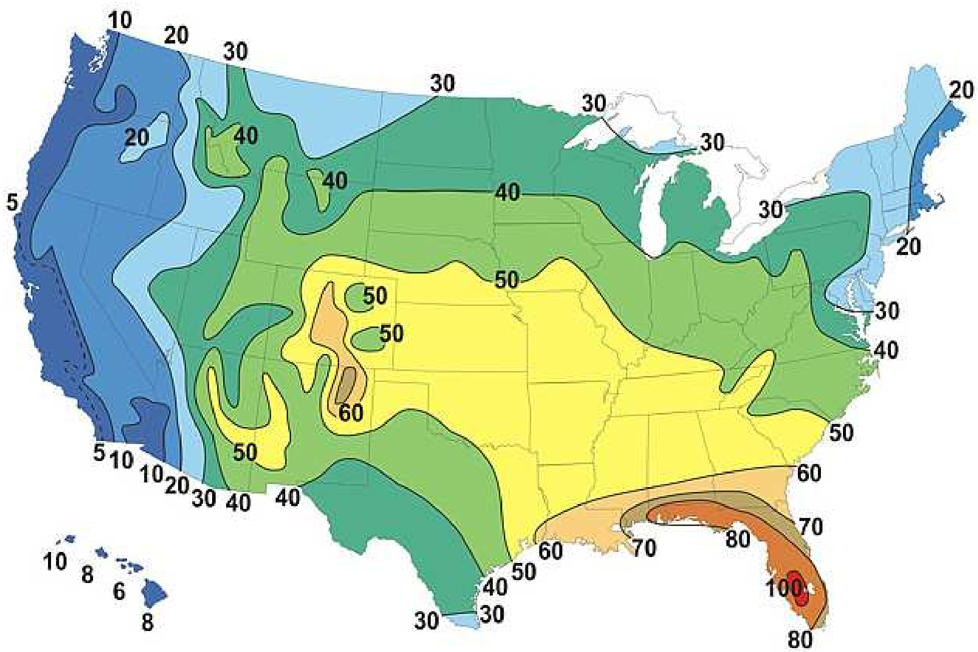
3.7.7 Thunderstorm/Lightning

According to NOAA, a thunderstorm is *"a local storm produced by a cumulonimbus cloud and accompanied by lightning and thunder."* Lightning is defined as *"a visible electrical discharge produced by a thunderstorm. The discharge may occur within or between clouds, between the cloud and air, between a cloud and the ground or between the ground and a cloud."* Compared to a hurricane or winter storm, thunderstorms impact smaller geographic areas and generally last a smaller period of time. Approximately 10% of the 100,000 thunderstorms that occur annually are classified as severe. Thunderstorms need moisture, unstable air and lift to form in the atmosphere.

3.7.8 Location of Thunderstorm/Lightning Hazard

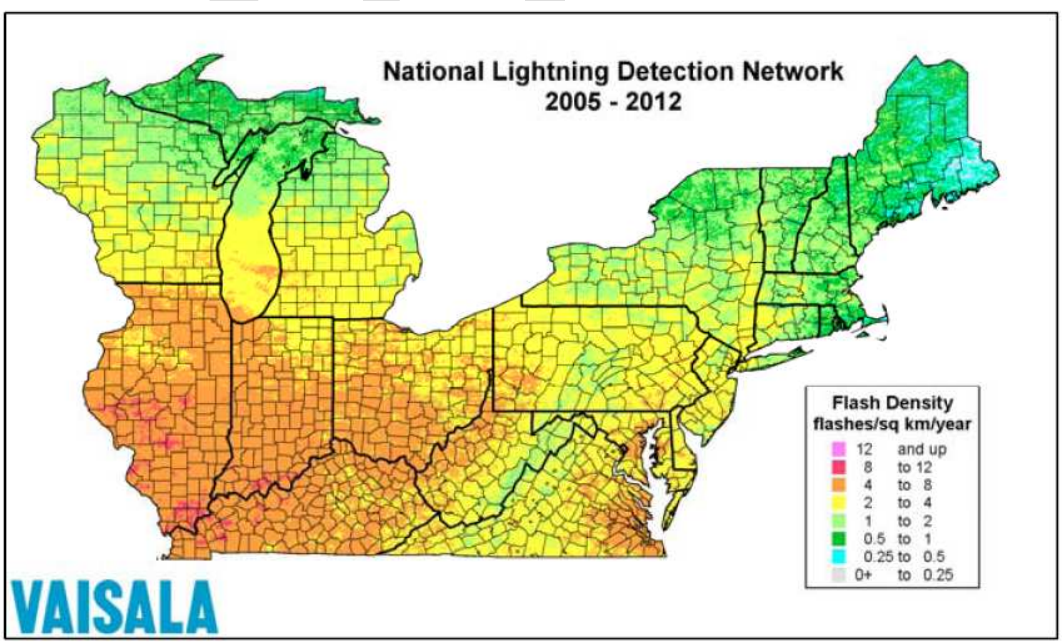
Thunderstorms and lightning can occur in any part of Massachusetts. Figure 11 shows the average number of thunderstorm days in the United States. Massachusetts is divided into two shaded areas where the eastern half of the state averages approximately 20 thunderstorm days while the western half averages approximately 30 thunderstorm days. **Figure 15** shows cloud-to-ground flash density (lightning) from 2005 to 2012 in the northeast states. For Massachusetts, less thunderstorm and lightning frequency are observed than in other parts of the United States.

Figure 15: Average Number of Thunder Storm Days in the U.S (NOAA)



According to data compiled by Vaisala, during a 7 year study period, they observed that lightning occurs less frequently over New England. When they do occur, the storms are less frequent and less intense.

Figure 16: Cloud to Ground Lightning Incidence in the U.S. (Vaisala)



3.7.8.1 Severity and Extent of Thunderstorm/Lightning Hazard

Most thunderstorms and lightning occur during June, July, and August. NOAA uses wind speed and hail size to define severe thunderstorms. A thunderstorm with (1) wind gusts of 57.5 mph faster or (2) hail that is one inch or greater in diameter is defined as a severe thunderstorm. Non-severe thunderstorms include those with heavy rainfall that can cause flash flooding and those that produce lightning.

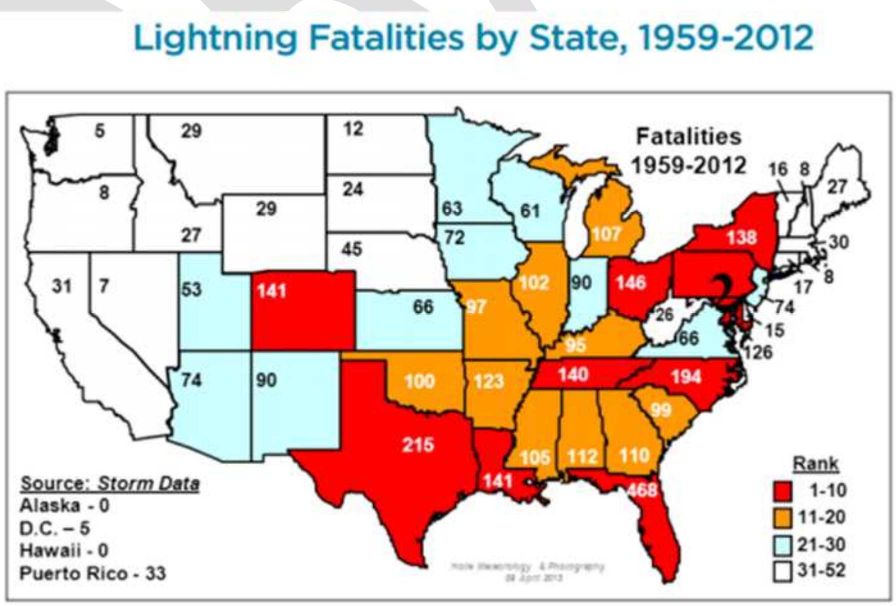
NOAA issues a severe thunderstorm watch if conditions are favorable for the development of a severe thunderstorm. A warning is issued if a storm spotter or radar data indicates a severe thunderstorm is occurring. Severe thunderstorms also have the potential to produce tornadoes that may warrant tornado watches and warnings.

3.7.8.2 Impact of Thunderstorm/Lightning Hazard on Life, Property and Operations

The largest hazard associated with thunderstorms is wind damage that can have impacts on human life and outside structures. Thunderstorm can cause other hazards such as hail, winds, tornadoes, or flash floods discussed in other hazard profile sections.

One hazard specifically associated with thunderstorms is lightning. Fatalities, although rare, can occur from lightning. In the United States, 99 percent of fatalities have occurred outside of a large substantial building or fully-enclosed metal-topped vehicle. For all of the United States, approximately 34 people were killed by lightning per year from 2003 to 2012 or 349 total fatalities where Massachusetts accounted for four of those incidents. As another form of comparison, **Figure 17** shows that 30 fatalities have occurred in Massachusetts from 1959 to 2012.

Figure 17: Lightning Fatalities by State, 1959-2012



3.7.9 Hailstorm

A hailstorm is considered to be associated with hail when irregular pellets or balls of ice more than 5mm in size are present. Hail is formed when an updraft in a thunderstorm carries rain into parts of the atmosphere where the temperature is below freezing. Any thunderstorm that produces hail that reaches the ground is known as a hailstorm.

3.7.9.1 Location of Hail Hazard

Hail can occur anywhere in Massachusetts and is typically part of a larger storm system such as severe thunderstorms and tornado events.

3.7.9.2 Severity and Extent of Hail Hazard

Table 3-26 below illustrates common descriptive terms to describe hail and what size diameter is associated with that description.

Table 3-26: Hail Descriptions and Diameter Sizes

Description	Diameter (inches)
Pea	0.25
Marble or Mothball	0.50
Penny or Dime	0.75
Nickel	0.88
Quarter	1.00
Half Dollar	1.25
Walnut or Ping Pong Ball	1.50
Golfball	1.75
Hen's Egg	2.00
Tennis Ball	2.50
Baseball	2.75
Tea Cup	3.00
Grapefruit	4.00
Softball	4.5

The presence of large hail indicates very strong updrafts and downdrafts within a thunderstorm, which can also be a possible indicator for tornado activity. The National Weather Service classifies a thunderstorm as severe is if the storm produces hail greater or equal to 0.75 inch in diameter. When hail does occur, it typically lasts for several minutes.

3.7.9.3 Impact of Hazard on Life, Property and Operations

According to NOAA, hail causes $1 billion in damage to crops and property each year in the United States. Agriculture is most affected due to crop damage, even from small size hail. Damage to vehicles, roofs, and landscaping are also common. The impact of hail on public safety is usually minimal unless large diameter hail occurs.

3.7.10 Urban Fire

An urban fire is an uncontrolled fire in an urban area affecting residential or commercial properties, which due to the dense nature of some areas, age of buildings and construction material of the buildings can spread quickly.

3.7.10.1 Location of Urban Fire Hazard

A fire could occur anywhere on any of the UMass campuses. The campus that is at greatest risk for this type of event is UMass Lowell due to the densely developed area where the campus is located and its proximity to older, historic buildings that may be constructed with materials such as wood.

3.7.10.2 Severity and Extent of Urban Fire Hazard

The UMass Lowell campus had the most concern about Urban Fire and according to the UMass Lowell 2011 Annual Fire Safety Report, the campus reports:

- The number of fires and the cause of each fire.
- The number of injuries and deaths related to a fire.
- The value of property damage caused by a fire.
- The number of regular mandatory, supervised fire drills; policies or rules on portable electrical appliances; procedures for evacuation; policies or rules regarding fire safety education and training programs provided to students, faculty and staff; and plans for future improvements in fire safety.
- Descriptions of fire protection equipment (fire alarms/sprinklers) in each on-campus housing unit.

Fires are often referred to as one-alarm, two-alarm, three-alarm or higher which are categories of fires that indicate the level of response or action that is needed by local authorities. The more alarms that are designated indicates the more resources that are being used for a specific incident.

3.7.10.3 Impact of Urban Fire Hazard on Life, Property and Operations

Impacts to life, property and operations due to a fire incident can be major. To mitigate potential impacts, UMass Lowell has specific fire policies in place that include:

- Health and safety inspections (safe and healthy living conditions, inventory status, room entry),
- Safety, health and well-being (safe conditions, personal safety, windows and roofs, fire safety, candles, incense and potpourri, appliances)
- Guest policy information
- Fire protection information (fire drills, smoke alarms, fire alarm systems, emergency exit systems)

According to FEMA, "*Each year college and university students, on- and off-campus, experience hundreds of fire-related emergencies nationwide. There are several specific causes for fires on college campuses, including cooking, intentionally set fires, overloaded power strips and open flame. Overall, most college-related fires are due to a general lack of knowledge about fire safety and prevention.*"

3.7.11 Extreme Heat

Extreme heat conditions vary throughout the United States. In general, an extreme heat event is recognized when temperatures are ten degrees or more above the average high temperature for a region for an extended period of time. The extended heat event may cause negative impacts to human health.

3.7.11.1 Location of Extreme Heat Hazard

3.7.11.2 Severity and Extent of Extreme Heat Hazard

During 2012, the US Department of Agriculture declared a federal drought disaster in 26 states which was the largest, single drought disaster declaration ever made by USDA. By November 2012, approximately 80% of the United States was designated a drought disaster-affected area.

3.7.11.3 Impact of Extreme Heat Hazard on Life, Property and Operations

Impacts to human life can be evaluated in accordance with the NOAA National Weather Service Heat Index (see **Figure 18**). The varying levels of humidity and temperature can create either cautionary, extreme cautionary, dangerous or extremely dangerous conditions.

Figure 18: NOAA National Weather Service: Heat Index

Health effects

NOAA national weather service: heat index

	temperature (°F)															
Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

- Caution
- Extreme Caution
- Danger
- Extreme Danger

3.7.12 Tsunami

A tsunami occurrence is typically characterized by a series of waves that are generated by an undersea disturbance such as an earthquake. According to NOAA, the speed of a tsunami can range from 500 miles per hour to 20-30 miles per hour in shallower coastline conditions. A tsunami is different from a regular ocean wave because it is associated with a current that travels from the water surface down to the ocean floor. As tsunami waves approach shore, they slow down and cause a "wave pile-up" which causes wave heights to increase along with a continuously flowing "wall of water" which can cause devastating damage in coastal areas.

Tsunamis are rare, but not unprecedented in the Atlantic Ocean. In order for a tsunami to cause major damage, there needs to be an earthquake of a magnitude of at least 7 which is rare on the East Coast and the earthquake also has to occur in the ocean. According to the FEMA, there have been no Presidential Disaster Declarations made for tsunamis in Massachusetts since 1954.

3.7.12.1 Location of Tsunami Hazard

The largest source region for tsunamis is the Pacific Ocean with approximately 70 percent of all world occurrences. Within the continental United States, the most vulnerable states are those located near the Pacific Ocean. Although tsunamis on the East Coast of the United States are rare, with about seven percent of all tsunami occurrences in the Atlantic Ocean and Caribbean, the threat still exists. The primary source of tsunamis for the East Coast is from landslides that occur along the continental slope in the Atlantic Ocean. Depending on the proximity of the slide, a tsunami could reach the coastline within one to four hours[5]. Another source is due to weather conditions and referred to as a meteotsunami.

3.7.12.2 Severity and Extent of Tsunami Hazard

A tsunami is classified according to its intensity; often characterized by one of the following types:

- **Microtsunami –** tsunami with a small amplitude that must be observed with instruments but is not observed visually.
- **Local tsunami –** tsunami with destructive effects confined to the coast, usually caused from a nearby source less than 200 km (124 miles) away. Tsunami is usually generated by a small earthquake or landslide.
- **Regional tsunami –** tsunami capable of destruction in a geographic region, generally within 1,000 km (621 miles) of its source.
- **Pacific-wide tsunami –** tsunami capable of widespread destruction in an immediate region or across the Pacific Ocean.

Most destructive tsunamis are classified as local or regional and caused by earthquakes. For the United States, NOAA monitors sea height with a network of buoys and tide gauges to identify the height of a tsunami wave and when it will come onshore. This information is used by the

[5] "East Coast Tsunami Threats" Presentation, National Weather Service, http://www.tsunami.noaa.gov/education.html

National Weather Service to issue watches and warnings for locations along the coast and potential impacts inland.

3.7.12.3 Impact of Tsunami Hazard on Life, Property and Operations

Tsunamis can have varying impacts on life, property, and local infrastructure. Approximately 255,000 fatalities and 50,000 injuries have been caused by tsunamis from 1900 to 2009, with 98 percent attributed to the 2004 Indian Ocean tsunami[6]. The primary cause of deaths is drowning. Other impacts can include minor damage to boats and docks along the coast to complete destruction of buildings, infrastructure, and land erosion with significant, long-term social and economic impacts.

3.7.13 Wind Storm

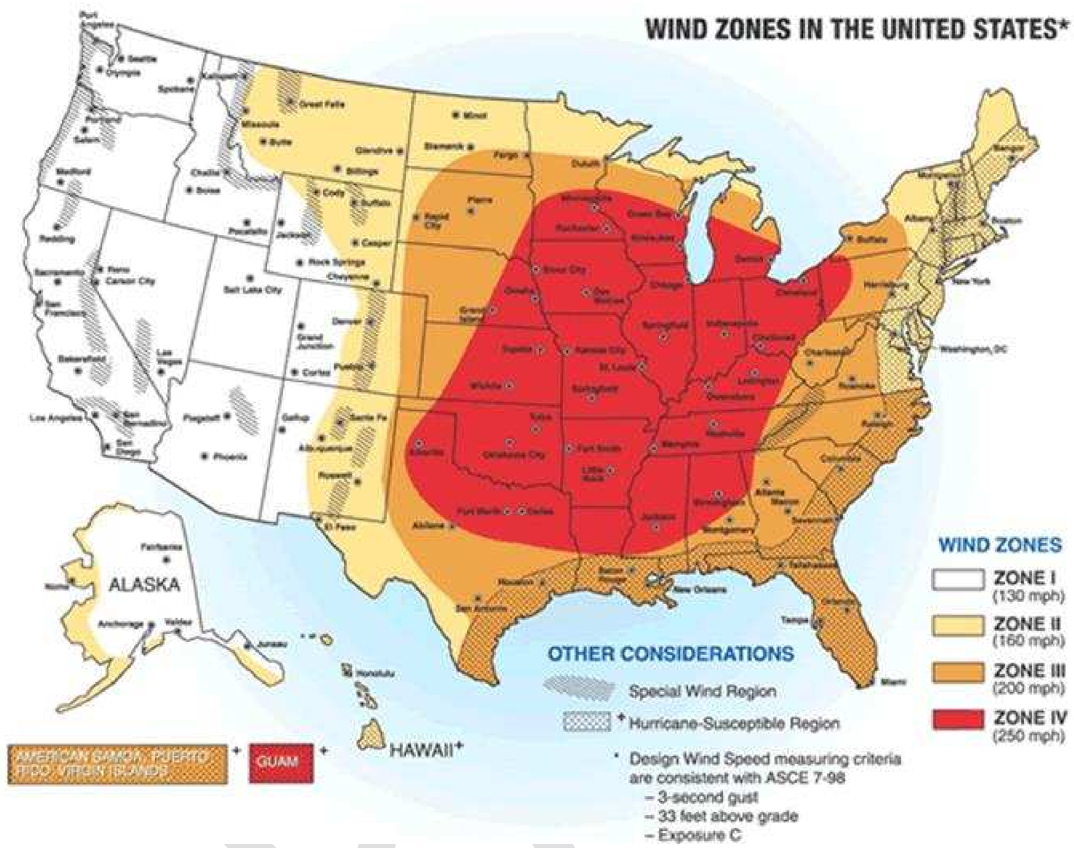
In general, wind is the horizontal motion of the air past a given point. Wind is in constant motion and windstorms can occur suddenly and without warning. Differences in air pressure is how a wind event begins and pressure that is higher at one place versus another sets up a force that pushes from the high toward the low pressure. Wind is used to describe the prevailing direction from which the air is blowing with the speed given usually in miles per hour or knots. Extreme wind events are most often associated with a larger meteorological event such as a winter storm, hurricane, tornado, nor'easter or severe thunderstorm. In the absence of any accompanying characteristics of these other events, the event would be considered a windstorm.

3.7.14 Extreme Wind Events

FEMA maintains a Winds Zone map (see **Figure 19**) that indicates various areas of the United States and their susceptibility to wind speeds in addition to highlighting Special Wind and Hurricane-Susceptible regions. Massachusetts is located in a Zone II which means it is susceptible to winds of up to 160mph and it is also located in a hurricane susceptible region.

[6] Public Library of Science (PLOS), "The Human Impact of Tsunamis: a Historical Review of Events 1900-2009 and Systemic Literature Review", April 16, 2013.

Figure 19: Wind Zones in the United States



3.7.14.1 Hurricane

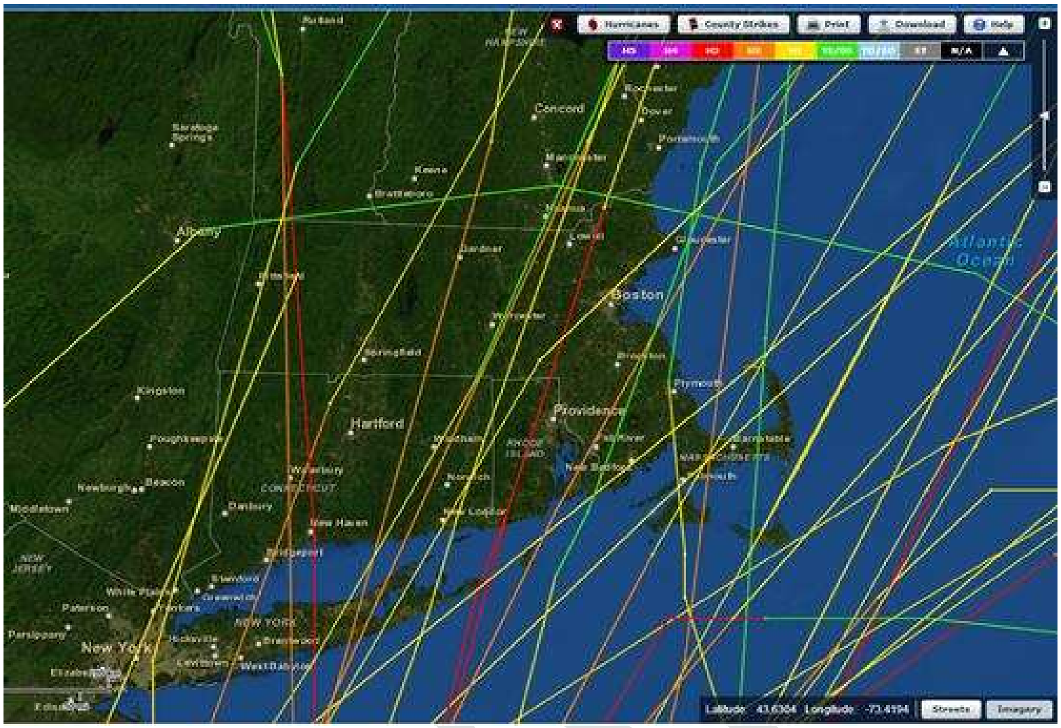
Hurricanes are characterized by a constant speed of 74 miles per hour or more, wind that blows in a large spiral motion around a rotating "eye" (calm center of the storm) and an expansive reach that can extend for hundreds of miles. Powerful in nature, hurricanes can be short in duration or last for several days impacting numerous states, counties and towns along the coastline. The aftermath of a hurricane frequently causes additional damage due to lasting high winds, storm surge and flooding. Storms that have wind speeds associated with them between 39mph and 73 mph are classified as tropical storms.

Between 1851-2010, there have been 10 direct hurricane hits to the Massachusetts coastline. The only other New England state to have as many direct hits was Connecticut. A "direct hit" means that the core of strong winds and/or storm surge was experienced.

3.7.14.1.1 Location of Hurricanes

Massachusetts and the four UMass campuses evaluated during this planning effort are susceptible to hurricane events. **Figure 20** shows the historical hurricane tracks that have impacted Massachusetts through 2011 (does not include tropical storms).

Figure 20: Historical Hurricane Tracks 1861 – 2011 (NOAA)



The State Hazard Mitigation plan notes that coastal areas are more susceptible to damage due to high winds and tidal surge (UMass Boston). Inland areas, particularly those in floodplains are at risk for flooding due to the heavy rain and wind associated with hurricane events.

3.7.14.1.2 Severity and Extent of Hurricanes

For reference and tracking purposes, hurricanes are categorized by class in accordance with the Saffir-Simpson Hurricane Wind Scale (SSHWS) summarized in **Table 3-27**. The SSHWS uses a 1-minute sustained wind speed at a height of 33 feet over open water as the sole parameter to categorize storm damage potential.[7] A storm with organized circulation and sustained winds below a Category 1 Hurricane threshold (winds range from 39 to 73 mph) is categorized as a tropical storm.

Table 3-27: Saffir-Simpson Hurricane Wind Scale (SSHWS)

Category	Wind Speed	Storm Surge (feet above normal sea level)	Expected Damage
1	74-95 mph	4-5 feet	**Minimal:** Damage is done primarily to shrubbery and trees, unanchored mobile homes are damaged, some signs are damaged, damage to structures is minimal or none.

[7] FEMA Coastal Construction Manual, 2011

Category	Wind Speed	Storm Surge (feet above normal sea level)	Expected Damage
2	96-110 mph	6-8 feet	**Moderate:** Some trees are toppled, some roof coverings are damaged, and mobile homes may have major damage.
3	111-130 mph	9-12 feet	**Extensive:** Large trees are toppled, some structural roof damage occurs, mobile homes are destroyed, structural damage to small homes and utility buildings is possible.
4	131-155 mph	13-18 feet	**Extreme:** Extensive damage is done to roofs, windows and doors; roof systems on small buildings completely fail; some curtain walls fail.
5	> 155 mph	> 18 feet	**Catastrophic:** Roof damage is considerable and widespread, window and door damage is severe, there are extensive glass failures, and entire buildings could fall.

It is important to note that lower category storms, including tropical storms, can inflict greater damage than higher category storms depending on where and when the storm strikes. Tropical storms have been known to produce significant damage and loss of life, mainly due to flooding.

NOAA through the National Weather Service's Hurricane Center issues hurricane watches and warnings, forecasts hurricane track and wind field information, and offers locally specific chances of experiencing tropical storm, strong tropical storms, and hurricane force winds out to five days. Effective 2013, NOAA has broadened the definition of hurricane and tropical storm watches and warnings to allow watches and warnings to be issued after a tropical cyclone (hurricane) becomes post-tropical. During the post-tropical stage, storms can pose a significant threat to life and property, as observed with Hurricane Sandy.

3.7.14.1.3 Impact of Hurricanes on Life, Property and Operations

The main hazards associated with hurricanes include storm surge, high winds, heavy rain, flooding, and potential tornadoes. Hurricanes can have significant impacts on human health due to storm intensity. Drowning in a storm surge is the leading cause of hurricane death. In an average 3-year period, approximately five hurricanes strike the United States coastline, killing approximately 50 to 100 people anywhere from Texas to Maine. Of these, two are typically major hurricanes classified as a Category 3 or greater. **Table 3-28** lists the 10 deadliest hurricanes recorded in the United States from 1980 to 2011. This table does not include the 117 fatalities associated with Hurricane Sandy that occurred in 2012[8].

[8] Source: CDC, http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6220a1.htm

Table 3-28: 10 Deadliest Hurricanes Recorded in the United States

Top 10 Deadliest Hurricanes from 1980-2011

Hurricane	*Persons*
Katrina (2005)	1833
Rita (2005)	119
Ike (2008)	112
Hugo (1989)	86
Floyd (1999)	77
Juan (1985)	63
Andrew (1992)	61
Ivan (2004)	57
Isabel (2003)	55
Gustav (2008)	53

Source: Lott et al., 2012.

The greatest impacts from hurricanes to property and infrastructure includes wind and water damage: flooding, utility failure, building damage, shoreline erosion, natural resource damage; interruptions with emergency, fire, and police services, and economic loss due to business property damage and loss of inventory. A hurricane can have devastating effects on a large area if directly in the path of a hurricane causing long term affects to the local economy and environment.

3.7.14.1.4 Occurrences of Hurricanes

Since 1954, there have been 6 Major Disaster Declarations in the State of Massachusetts due to a hurricane or tropical storm (see **Table 3-29**).

Table 3-29: Massachusetts Hurricane Major Disaster Declarations (1954 – Present)

Hurricane Name	Disaster No.	Incident Period	Date Disaster Declared	Notes
Hurricane Sandy	4097	10/27/2012 – 11/08/2012	12/19/2012	Second costliest hurricane in U.S. history. Impacted 24 states with severe damage in New York and New Jersey.
Tropical Storm Irene	4028	8/27/2011 – 8/29/2011	9/23/2011	Impacted much of east coast and is ranked as 6th costliest hurricane in United States history.
Hurricane Bob	914	8/19/1991	8/26/1991	60% southern MA and RI residents lost

				power and the storm surge in Buzzards Bay was 10-15 feet.
Hurricane Gloria	751	9/27/1985	10/28/1985	Dramatic coastal impact including beach erosion and many flooding issues caused and over 2 million without power.
Hurricane Diane	43	8/20/1955	8/20/1955	Was a Tropical Storm when it reached New England, had heavy rain of 10" – 20", setting flood records for the time.
Hurricane	22	9/2/1954	9/2/1954	There was heavy storm surge to Narragansett Bay and New Bedford Harbor, water up to 12 feet in downtown Providence, and massive power loss.
Source: FEMA Major Disaster Declarations 1954 – Present, State of Massachusetts Hazard Mitigation Plan 2010				

Some of the more notable hurricane events include:

- **Hurricane Sandy (2012) –** In the fall of 2012, Hurricane Sandy had a major impact on the New York and New Jersey coastline. The storm broke an all-time record for storm surge height in New York harbor, caused over 100 fatalities, and has reached a cost of over $79 billion for federal aid to cover damages, recovery and mitigation measures. In Massachusetts, Sandy knocked out power to over 200,000 customers, disrupted travel and closed schools. Downed trees, power lines and flooding were also present during and after the storm.
- **Hurricane Bob (1991) –** This was a costly hurricane at approximately $1.5 billion and left extensive damage throughout New England. The loss of life and most of the damage occurred as a result of high winds and rough seas. There were six confirmed tornadoes during its passage.
- **Hurricane Gloria (1985) –** A storm that hit Long Island, NY and New Jersey that caused minor storm surge, erosion damage and substantial wind damage.
- **Long Island Express Hurricane (1938) –** This storm moved up the east coast from New York through New England and caused widespread storm surge and wind damage to buildings. It is used today as a benchmark for predicting worst-case scenario damage in the region.

Direct hurricane hits impacting the New England states are presented in **Table 3-30**.

Table 3-30: Direct Hurricane Hits Between 1851 – 2009

	Saffir-Simpson Hurricane Wind Scale Category					
Area	**1**	**2**	**3**	**4**	**5**	**All**
Connecticut	4	3	3	0	0	10
Rhode Island	3	2	4	0	0	9
New Hampshire	1	1	0	0	0	0
Maine	5	1	0	0	0	6

Massachusetts	**5**	**2**	**3**	**0**	**0**	**10**
Source: FEMA Coastal Construction Manual, 2001 (Blake, 2005 & Jarrell 2001, NOAA)						

3.7.14.1.5 Probability of a Future Hurricane Occurrence

Massachusetts' close proximity to the coast line gives it greater exposure to the risk of future hurricanes. A major hurricane, though infrequent, could strike any of the communities where the UMass campuses are located. Based on NOAA's Adapting to Climate Change Guide[9], the power and frequency of Atlantic Ocean hurricanes has increased in recent decades and the intensity of Atlantic hurricanes is likely to increase over the extended long term.

Within the short term, NOAA makes predictions on a yearly basis at the start of hurricane season to forecast the number of Atlantic Ocean based hurricanes. For 2013, NOAA is forecasting an active or extremely active season with a 70 percent likelihood of 13 to 20 named storms, of which 7 to 11 could become hurricanes. These ranges are above the seasonal average of 12 named storms, 6 hurricanes, and 3 major hurricanes.

3.7.14.2 Tornado

Tornadoes are most commonly associated with a violently rotating visible funnel cloud that is a rotating air column which has contact with the ground. Typically, a loud roaring noise, compared to the sound of a freight train, is associated with a tornado. Speeds of a tornado can range from 40mph to 300mph and are measured on what is known as the Fujita scale. Generation of a tornado can be associated with thunderstorm activity where cool, dry air meets warm, humid air. Damage from a tornado can vary widely and be minimal to completely catastrophic. On a local level, a tornado is the most destructive of all atmospheric conditions. In Massachusetts, tornadoes are not a common occurrence.

3.7.14.2.1 Location of Tornadoes

Based on the wind zone map provided earlier in the Extreme Wind Events section, Massachusetts is located in wind zone II that can include winds up to 160 mph that may be associated with tornadoes. Tornadoes can occur in any region of Massachusetts. In southern New England, there are typically 1 to 3 tornadoes per year that occur mostly in the late afternoon/early evening.

3.7.14.2.2 Severity and Extent of Tornadoes

Tornadoes are rated using the commonly known Enhanced Fujita (EF) Scale (see **Figure 21**) which provides a rating of the wind speed from the tornado event to a category from EF0 to EF5. The degree of damage helps to define the rating of an individual storm. The Fujita scale has been updated and in use since 2007.

[9] Source: NOAA's Adapting to Climate Change: A Planning Guide for State Coastal Managers (2010)

Figure 21: Fujita Scale

EF Scale Rating	3-Second Gust Speed (mph)	Type of Damage
EF0	65–85	Light damage
EF1	86–110	Moderate damage
EF2	111–135	Considerable damage
EF3	136–165	Severe damage
EF4	166–200	Devastating damage
EF5	>200	Incredible damage

3.7.14.2.3 Impact of Tornadoes on Life, Property and Operations

Tornadoes can have significant impacts on human health, property, and campus infrastructure. The most prevalent impact is excessive winds and wind damage. Injuries and fatalities most often result from flying debris. Other injuries and fatalities are associated with building damage and collapses, being trapped inside cars or trailers, or being outside without cover. After a tornado has passed, there are additional health hazards associated with downed power lines, damaged buildings that may be unsafe to exit or enter, and the inability to obtain emergency care.

Property and operational impacts include damage to residential and commercial buildings, trees and vegetation, and exposed infrastructure that can be completely destroyed by a tornado. Damaged bridges and infrastructure may be weakened for use resulting in delays for individuals to move within the community to receive basic services. Although tornadoes are confined to certain areas, the impacts on communities affected can be devastating with damage and destruction.

3.7.15 Ice Storm

Ice storms are a type of winter storm that consists of freezing rain and can create ice build ups which when they occur, can cause substantial damage. Ice storm warnings are issued by the National Weather Service when there is more than ¼ inch of ice accumulation anticipated.

3.7.15.1 Location of Ice Storm Hazard

An ice storm can occur in any part of Massachusetts, but they are most frequent in higher elevations of Western and Central parts of the state.

3.7.15.2 Severity and Extent of Ice Storm Hazard

An ice storm may occur as part of a winter storm and cause some of the same impacts such as temporary utility loss (power outages), treacherous traveling due to poor road condition, business/school cancellations and in some cases direct human impacts such as frostbite or freezing due to over exposure.

According to the Weather Channel, the following categories may describe varying degrees of an ice storm:

- Nuisance
  - Less than ¼ inch of ice
  - Windshields are coated
  - Bridges may be slippery
  - Light ice on trees
- Disruptive
  - ¼ to ½ inch of ice
  - Tree limbs may be sagging due to ice weight
  - Most roads are icy
  - Power outages
- Crippling
  - ½ inch or more of ice
  - Widespread tree and powerline damage
  - Roads impassable or dangerous

The severity of the effects of an ice storm increases as the amount and rate of precipitation increases. In addition, storms with a low forward velocity are in an area for a longer duration and become more severe in their affects. Storms that are in full force during the morning or evening rush hours tend to have their affects magnified because more people are out on the roadways and directly exposed.

3.7.15.3 Impact of Ice Storms on Life, Property and Operations

Ice storms may have similar impacts to winter storms on life, property and operations and can result in fatalities that may be directly related to the storm itself. Fatalities due to traffic accidents on icy roads are typical. Risks related to ice are most often associated with automobile accidents followed by individuals caught outside in the storm.

Impacts to property and operations are usually temporary and include ice buildup removal. However, ice storms can lead to significant infrastructure damages, and loss of business that can financially impact communities. Other potential impacts include knocked down trees, power lines, and utility poles. Freezing temperatures can result in downed trees, power lines, utility poles, ice jams that can cause flooding, and building pipe bursts due to poor insulation or lack of heat.

3.8 HUMAN HAZARD PROFILES

While 29 human hazards were initially considered and ranked by the UMass campuses, the 18 that have been profiled in this section were discussed in the most detail.

3.8.1 Cyberattacks/Cyberterrorism

Cyberterrorism is a deliberate attack against computer systems and networks to cause large-scale disruptions and other harmful impacts. Cyberterrorism is completed via the internet and is often deployed via computer viruses as a form of terrorism. It can also be the intentional use of this media to cause harm for personal or political gain. Cyberattacks can be performed by ‘hacking’ into computer and network systems by an anonymous person or party. Due to the heavy use of technology on university campuses, the opportunity for cyberattacks and cyberterrorism is a constant. At the UMass campuses, these events can occur on a daily basis with the campus population typically being unaware and unimpacted. The volumes of sensitive information stored on a university campus are abundant and includes student records, grades, personnel files and academic course information and research. Having this information secure and not susceptible to cyberattacks is important for the reputation of the UMass campuses and for the protection of institutional knowledge and unique research.

3.8.2 Arson

Arson is the act of intentionally setting fire to property with the goal of causing damage. The UMass campuses have experienced arson incidents by students in the past, mostly in the dormitory setting and on a very small scale. Often these incidents are triggered by the desire to impact campus operations and have resulted in short term building evacuations caused by the triggering of fire alarms. While many buildings across the campuses are sprinklered, others are not which puts them at greater risk from an arson event. While these arson events are typically only intended to see what might happen or gauge a reaction, the potential impacts of an arson event to university property could be significant resulting in costly property damage or even loss of life.

3.8.3 Assault

Assault is an intention physical act of harm or threat of harm against a person. Assaults can take many forms involving illegal or impermissible touching of another. Assaults can be associated with other crimes, such as theft, or can be sexual in nature. Assaults have occurred on UMass campuses typically within the student population. These events have been infrequent in nature, but have resulted in harm to university students involved.

3.8.4 Fraud

Fraud is a wrong or unlawful act of deception performed to result in personal gain which is often financial in nature. Fraud can involve the falsification of documents or projection of untruthful information. Fraudulent acts have been performed in rare cases by UMass employees and students, but often on a small scale. However, due to the large operating budgets of the UMass campuses, a fraudulent event performed by an employee with access to sensitive financial information or accounts could be significant.

3.8.5 Theft

Theft is a criminal act involving the taking of property without the owner’s consent. The owner could be a person, such as a fellow student or University employee, or the University itself. Acts of theft have occurred on University property and have involved personal property, University property, and University information. Most of these events have also been on a small scale and have involved student and University property such as bicycles, computers and other personal property. Many of these instances have involved technology such as cell phones and other electronic devices.

3.8.6 Robbery/Burglary

Robbery is an act of violence or threat of violence associated with theft, or taking of property without the owner's consent. Often robberies involve the threat of physical harm to a person and may be associated with the use of a weapon. Burglary is the intent of entering a building without the consent of the owner in order to commit a crime (which may include theft). The entry into the building can be completed forcibly or via an open access point. These acts have occurred on UMass campuses, however they are rare and have not resulted in personal injuries.

3.8.7 Vandalism

Vandalism is the intentional destruction of property that belongs to another person or the University. Acts of vandalism have occurred on UMass campuses but on a small scale with minimal damages. These acts have been associated with major campus or national sporting events and have not been extremely malicious in nature. They typically have been performed by a student or groups of students and may be triggered by the overconsumption of alcohol. Often these events are more focused on getting attention and not mass destruction of property.

3.8.8 Civil Disturbance

A civil disturbance is a protest or demonstration against some type of political or socioeconomic issue. The severity of these actions can vary from silent protests or verbal demonstrations to full scale riots resulting in damages to property or persons. University students across the country have participated in these types of events for years as the academic setting is a place where students learn about important issues, form opinions, and many of which want to cause change. UMass campuses include several large public venues, such as athletic complexes and halls, that can be a target for these types of events.

A civil disturbance can impact the lives of those not involved to varying degrees. An active protest can impact one's ability to work or even access a place of work. A civil disturbance on a University campus could result in the disruption of operations to a building or portions of campus and result in the deployment of campus and community resources to protect innocent bystanders and break up the event if necessary. These types of events have occurred on the UMass campuses, but have not been large scale or resulted in significant harm to persons or properties. The duration of these events has also been short and isolated.

3.8.9 Violent Criminal Incident

According to the Federal Bureau of Investigation a violent crime is composed of four offenses: murder and nonnegligent manslaughter, forcible rape, robbery, and aggravated assault. Violent crimes are offenses which involve force or threat of force (FBI web site, www.fbi.gov). Robbery and aggregated assault have been discussed previously. Certainly these crimes are severe and can results in extreme physical harm or death. Depending on the nature of these crimes on a University campus, they can become widely publicized and result in damage to the University's reputation.

3.8.10 Bomb Threat

A bomb threat is a threat to detonate an explosive device provided in a verbal or written form with the intent of causing property damage or physical harm. On a University campus these threats can involve significant evasive procedures, such as campus wide notifications, building evacuations and criminal investigations. These threats are often associated with psychopathic behaviors or can be performed as a prank to disrupt campus operations. Bomb threats have occurred on the UMass campuses, but most have not resulted in the identification or detonation of actual explosive devices. There have also been discoveries of the potential construction of explosive devices on the campuses, but these also have not resulted in actual detonation.

3.8.11 Explosion

An explosion is an extreme release of energy which usually results in the generation of high temperatures and gas generation. Explosions can be caused by bombs as discussed above or via other means specifically associated with a campus setting such as the improper use and handling of chemicals or other dangerous substances. Most recently, UMass campuses did experience impacts resulting from the 2013 Boston Marathon bombing which will be discussed in the campus Annexes. Due to the heavy research component of many of the UMass campuses, explosions associated with chemical uses have occurred in the past resulting in injury and even death. Safety protocols and procedures and training are provided on all campuses to try to minimize these events.

3.8.12 Terrorism

The FBI defines terrorism as "the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof in furtherance of political or social objectives" (www.fbi.gov). The FBI further classifies terrorism as either domestic or international, depending on the origin, base, and objectives of the terrorist organization. Terrorism can be either domestic or international. Acts of terrorism can take several forms including bombings, weapons of mass destruction (chemical, biological, radiological, or nuclear); and cyberterrorism as discussed previously.

Terrorists often try to create fear to generate publicity for their causes. They tend to act in public venues, areas of high populations, or other places that may attract large-scale attention. The UMass campuses consist of several areas which could fall into these categories and could be viewed as potential terrorist targets. From a broader perspective, its campuses reside in major communities which may in and of themselves be potential terrorist targets. There are also many sensitive areas of research that may be targets, such as animal, technological and medical research and institutional knowledge and assets located in campus Archives. Acts of terrorism can cause large scale destruction to property, extensive loss of human life, business continuity and operational impacts, and shortages or inaccessibility to essential resources. There may be little or no warning of a terrorist event, making a planned response and the opportunity to take precautionary measures impossible. Post-event response can take weeks, months or years depending on the nature of the event.

There have been no direct terrorist events on the UMass campuses, however impacts from the 2013 Boston Marathon bombings were experienced and will be discussed in the campus Annexes.

3.8.13 Active Shooter

An **active shooter** is defined by the U.S. Department of Homeland Security as an individual actively engaged in killing or attempting to kill people in a confined and populated area; in most cases, active shooters use firearm[s] and there is no pattern or method to their selection of victims. Due to the large populations encompassed by the UMass campuses and events that have taken place on other college and university campuses across the country, an active shooter scenario presents a substantial threat taken seriously by UMass. The direct impacts of an active shooter situation could be serious injury or death on a large scale. UMass actively completes active shooter training and has run active shooter preparedness drills in the past. No active shooter incidents have taken place on UMass campuses.

3.8.14 Weapons of Mass Destruction

A weapon of mass destruction is a weapon that can kill and cause significant loss of life, damage to property and to the environment. Weapons of mass destruction can be categorized as biological, chemical, radiological or nuclear. Damage resulting from the use of weapons of mass destruction can be large scale, and cause massive impacts that could be on a global scale. An event of this type could result in the need for full campus evacuation or large scale and/or long term sheltering in place. While each of these presents its own challenges, performing evacuation of many of the UMass campuses are located in urban environments which add to the complexity. The use of these weapons tends to be associated with psychological and other mental issues. To date there have been no incidents of the use of weapons of mass destruction on UMass campuses.

3.8.15 Hazardous Materials Incident

A hazardous material is any materials that can result in a threat to human life or property in any quantity. Hazardous materials can be solids, liquids or gasses and can include materials that have explosive, flammable, combustible, toxic, infectious, and radioactive properties. Release of these materials could be accidental or intentional and involve varying degrees of damage depending upon the properties of the material itself, the quantity of material and use of the material. At the UMass campuses these materials are used for research, course/laboratory work, cleaning, and fuel and to support other operational functions. Hazardous materials can be delivered to the campuses in large quantities involving additional transportation hazards. The proper handling of these materials by trained professionals is critical to the safe use, transportation, and disposal of these materials.

Hazardous materials incidents have a more regular frequency than many of the other human caused events on UMass campuses due to the widespread use of these materials in operations, laboratory work and research. Typically these events are associated with laboratory experiments, research or minor spills of hazards materials used in operations. While the majority of these incidents on UMass campuses have been accidental, there has been intentional misuse of materials on the campuses. UMass campuses are well prepared to deal with small scale spills and have partners in place to support larger scale issues. The damages resulting from these incidents on the UMass campuses have generally been small and consist of minor injuries, such as burns, and minor, short term operational disruptions.

3.8.16 Pandemic Health Issue

A pandemic health issue is the spread of an infectious disease across large populations. This could be any infectious disease but in recent times has been most associated with influenza. This type of event on a University campus is of particular concern do to large populations living in close proximity, such as in dormitories, and frequent human interaction in confined classroom, research, or activity settings. To date there have been no pandemic health issues that have occurred on UMass campuses. Infectious disease outbreaks have been effectively controlled by proper sanitation and quarantine.

3.8.17 SCADA Failure

Supervisory control and data acquisition (SCADA) systems are industrial control systems that monitor industrial processes via computer and internet technologies. These systems are typically centralized and remotely monitor and control large scale systems through the use of digital control systems (DCS) and programmable logic controllers (PLC). Large quantities of data can are collected and must therefore we managed in a secure manner. Industrial processes that are monitored by these systems consist of water and wastewater distribution systems, power generation, electrical transmission, and building specific energy consumption, heating, ventilation, and air conditioning. Historically there have been no widespread data failures on UMass campuses that have significantly disturbed extended continuity of operations.

3.8.18 Critical Infrastructure Failure

Critical infrastructure failure is a serious consideration for UMass campuses as they strive to minimize any extended impacts to operations. Loss of power or communications is one of the most damaging events that can occur on a University campus as it can result in the need to close the campus and either shelter in place or evacuate. The financial implications in terms of loss of building operations and the inability to continue classes can be significant. Also impacts to sensitive, irreplaceable research that requires refrigeration, cooling and heating, such as particular experiments or animal research are huge. Impacts to critical infrastructure can be caused by a variety of events, many of which are natural such as heavy snow storms that bring down power lines, accidental such as failure from aged infrastructure, or intentional such as terrorism attacks. Some of these have been discussed as associated with other hazards. Infrastructure impacts have also been experienced by UMass campuses related to major construction projects which have proliferated on some of the large UMass campuses.

4. GOALS AND OBJECTIVES

The UMass campuses used the identification, profiling and vulnerability assessment of natural and human hazards that have or may impact them in the future to establish planning goals and objectives that provide the basis for the development of the proposed hazard mitigation projects. The establishment of goals and objectives was based upon a clear understanding of the hazards that have a potential to impact the University community, what the risks associated with each hazard are and where vulnerabilities exist, as well as the University's commitment to reducing future vulnerability and mitigating risks where possible.

According to the FEMA guidance documentation, a goal serves as a general guideline that explains what a community would like to achieve and an objective defines a specific strategy or implementation step that will help reach a specific goal. A mitigation action is a specific task that UMass can tie back to its goals and objectives and measure what has been achieved.

4.1 MITIGATION GOALS

The UMass Hazard Mitigation Plan Goals are long-term statements of what the participating campuses hope to achieve over time through implementation of the Plan. The five goals consider the existing resources and capabilities of the University, and strive to reduce vulnerabilities or mitigate hazards and their risks. All the goals will be evaluated for future updates in the Plan. The following goals were developed for the Multi-Campus Hazard Mitigation Plan:

GOAL 1

- Protect existing and future assets from known hazards by implementing mitigation projects to minimize potential losses and ensure public health and safety.

    - The focus of this goal is to protect property and prevent injuries that could result from natural hazards such as storms, flooding, coastal erosion, earthquake and fires. This goal focuses on impacts to vulnerable property and structures and human safety.

GOAL 2

- Maintain a continuity of campus business operations during and after a hazard event.

    - The focus of this goal is intended to address hazards that could cause a prolonged interruption to normal campus functionality such as a power outage or other loss of utilities. This goal focuses on protection of critical facilities and infrastructure and enhancement of communication and education amongst the campus community.

GOAL 3

- Create and maintain a safe, secure environment for the campus population before, during and after a hazard event.

    - The focus of this goal is intended to protect students, faculty, staff and visitors from potential impacts from a hazard before, during, and after an event. This goal emphasizes the importance of community outreach, communication and scenario planning in protecting lives, safety and property.

GOAL 4

- Communicate natural and human hazard information to the campus community and improve education and outreach efforts regarding their potential impact.
    - The focus of this goal involves ongoing education and outreach to the campus community, surrounding neighborhoods, and other stakeholder groups.

GOAL 5

- Proactively protect existing and future campus assets from known hazards by incorporating mitigation activities into capital improvement and infrastructure planning.
    - The focus of this goal is intended to involve hazard mitigation planning into aspects of campus development, redevelopment, upgrades and retrofits. This goal focuses on evaluating hazards and addressing vulnerabilities from human and natural hazards as a regular part of the construction planning process.

Each goal is intended to reduce hazard vulnerabilities discussed in Section 3 and summarized in **Table 3-4** (natural hazards) and **Table 3-7** (human hazards). The primary natural hazard of concern across all campuses was hurricanes. Depending on the campus location (coastal, inland, etc.), other natural hazards receiving a high ranking included coastal storms (except for the System Office), flooding (Boston and Dartmouth only), and winter storms (except Dartmouth). Hazard ranking results varied more widely from campus to campus for human hazards, which is largely attributable to differences in campus populations, past events, surrounding community, and ease of access to the campus. Vulnerabilities to both the natural and human hazards include campus structures and property, operations, students, faculty, staff and visitors.

The goals and objectives developed for this plan took into consideration the hazard identification and ranking exercise that was detailed in **Section 3**. Any hazard event that can impact or interfere with the University's continuity of operations and ability to carry out its mission of educating students was considered to be of a primary concern. Loss of power, which can occur on its own due to an equipment failure or as a secondary impact of other natural hazards such as hurricanes, winter storms or heavy wind events, was identified universally across all campuses as a major vulnerability. Consideration was also given to human hazards where would be a concern regarding personal safety. Other goals and objectives were developed around the importance of continuing to engage and educate the public about natural and human hazards, their impact, how to be prepared and how residents can continue to participate in the discussion in the future.

Objectives designed to meet these goals are campus-specific and included in the individual plan annexes. These objectives are intended to outline a specific strategy or approach to help each campus identify and implement mitigation projects. Objectives are not intended to be mutually exclusive and may apply to one or more goals. For example, objectives under the goal for protecting human life and safety from disasters can also help avoid the loss of property from flood hazards.

5. MITIGATION ACTIVITIES & ACTION PLAN

The UMass Campuses have developed mitigation activities and an action plan to give each specific campus the ability to prepare for and manage any future natural or human hazard event while keeping property, operations and the life of staff, faculty and students in the forefront of any planning activity.

The objectives and proposed mitigation activities comply with several relevant criteria that include Social, Technical, Administrative, Political, Legal, Economic and Environmental standards (referred to as STAPLEE criteria, see below).

5.1 MITIGATION ACTIVITIES & ACTION PLAN

A Mitigation Action Plan for each of the four participating campuses is included in the campus-specific annexes at the end of this Plan. Action items were identified based on the goals and objectives prepared during the planning process, past occurrences, considerations for future development and the University's commitment to work closely with on-campus and community stakeholders to ensure public safety. Most of the action items focus on mitigating flooding, coastal storm, coastal erosion and hurricane impacts. Other projects include building retrofits, health and safety program development and public outreach.

5.2 MITIGATION PROJECT PRIORITIZATION

The identified projects and mitigation activities have been evaluated and ranked by utilizing the FEMA STAPLEE criteria. The STAPLEE criteria focuses on ensuring that projects and activities are socially acceptable to the community, technically feasible, protective of or beneficial to the environment and are backed by legal authority and consistent with current laws, consider economic benefits and costs and include environmental considerations. The information that is included for each project addresses this criteria. Current campus and community needs were also considered which means the project or activity must be acceptable to decision makers, University/campus representatives, stakeholders and the public. The goals and objectives proposed in this Plan are intended to fulfill at a minimum the following STAPLEE criteria:

Table 5-1: STAPLEE Criteria

STAPLEE CRITERIA	
Social	Improve the quality of life and reduce campus/ neighborhood impacts. • Include public support and involvement. • Consider effects on selected segments of the population. • Compatible with present and future community. • Consider cultural impacts on the community.
Technical	Develop technically feasible mitigation efforts. • Effective in reduction of long-term losses, impacts and risks. • Effective in minimizing secondary losses. • Effective in solving the problem and not only the symptoms.

STAPLEE CRITERIA	
<u>A</u>dministrative	Provide resources and staffing to implement proposed actions. • Jurisdiction and capability necessary to implement an action. • Ability to accomplish activities in a timely manner. • Ability to maintain and manage the mitigation measure.
<u>P</u>olitical	Acceptable to and supported by community politicians. • Have full support of the University Administration. • Involve political leaders in the planning process. • Support and involvement of stakeholders. • Public support and involvement.
<u>L</u>egal	Legal authority to undertake an action. • Meet all applicable regulatory requirements. • Define the roles of University (system and campus level), local, State and Federal governments. • Provide a legal basis for mitigation actions. • Assure laws, regulations, ordinances, and resolutions are in place. • Identify liabilities for an action or lack of an action. • Consider needs for legal counsel.
<u>E</u>conomic	Develop affordable and cost effective mitigation efforts. • Obtain budget and funding for an action. • Economic costs and benefits of a mitigation action. • Burden to the tax base or local economy.
<u>E</u>nvironmental	Improve environmental quality. • Identify and evaluate environmental impacts. • Compliance with all environmental laws and regulations. • Benefit the environment from a mitigation action.

Implementation of projects and mitigation activities were prioritized by a qualitative ranking of high, medium or low. STAPLEE criteria was applied to the extent possible to all of the projects and mitigation activities that have been identified in the campus Annex plans and priorities were evaluated on need, cost-effectiveness, number of hazards addressed, number of objectives met and funding eligibility.

The University utilized a qualitative assessment (high, medium, low) for prioritizing projects and mitigation activities for this plan.

- **High Priority** – Denotes a project or mitigation activity that meets multiple plan objectives, addresses multiple hazards, has benefits that outweigh potential costs, has funding secured or is able to be funded through the university budget and may be eligible for grant funding. Projects of high priority have the potential to be completed within the next 5 years.

- **Medium Priority –** Denotes a project or mitigation activity that meets some goals and objectives, addresses some hazards, has benefits that outweigh potential costs, funding is not in place but could be through university allocation or grant funding.
- **Low Priority –** Denotes a project that meets at least one goal/objective, addresses at least on hazard, costs may outweigh the benefits, funding has not been secured and grant eligibility is unclear and the timeframe for completion is probably long term.

Plan implementation will focus on the projects and mitigation activities that have the highest level priority associated with them. Over time and as the plan is implemented, priorities may change due to new funding sources or information or future hazard events. During the annual review of this document, the Hazard Mitigation Planning Steering Committee, with assistance from each campus' Planning Committee, will review the list of projects and mitigation activities to make sure that the prioritization ranking for each one is still the most appropriate.

5.3 POTENTIAL FUNDING SOURCES

As noted in the Massachusetts Hazard Mitigation Plan, there may be various funding sources available for the UMass Campuses to potentially pursue as they consider implementing various action items from this planning effort. The table below details various federal, state and local agencies and programs that may be available.

Table 5-2: Potential Funding Sources

Agency	Program	Description	More Information
FEDERAL			
National Science Foundation (NSF), Directorate for Engineering, Division of Civil and Mechanical Systems, Hazard Reduction Program	Hazard Reduction Program	Funding for research and related educational activities on hazards.	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13358
NSF -Directorate for Social, Behavioral Economic Science, Division of Social Behavioral and Economic Research Decision, Risk, and Management	Decision, Risk, and Management Science Program	Funding for research and related educational and activities on risk, perception, communication, and management (primarily, technological hazards).	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5423
Department of Commerce (DOC), Economic Development Administration	Disaster Mitigation Planning and Technical Assistance	Technical and planning assistance grants for capacity building and mitigation project activities focusing on creating disaster resistant jobs and workplaces.	http://www.eda.gov/disasterrecovery.htm
US Department of Agriculture (USDA) - National Resources Conservation (NRCS) Watersheds and Wetlands Division	Watershed Surveys and Planning	Surveys and Planning Studies for appraising water and related resources, and service formulating alternative plans for conservation use and development. Grants and advisory/counseling services to assist with planning and implementation improvement.	http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/landscape/wsp/?cid=stelprdb1042175
FEMA	National Flood Insurance Program	Formula grants to States to assist FEMA communities to comply with NFIP floodplain management requirements (Community Assistance Program).	http://www.fema.gov/national-flood-insurance-program
FEMA; DOI-USGS USGS	National Earthquake Hazards Reduction	Training, planning and technical Program assistance under grants to States or local jurisdictions.	http://www.fema.gov/national-earthquake-hazards-reduction-program
DOD-USACE	Beneficial Uses of	Direct assistance for projects that protect, restore, and create aquatic and ecologically related habitats, including wetlands,	http://water.epa.gov/type/oceb/oceandumping/dre

Agency	Program	Description	More Information
	Dredged Materials	in connection with dredging an authorized Federal navigation project.	dgedmaterial/beneficial_use.cfm
USDA-NRCS	Emergency Watershed Protection (EWP)	Provides technical and financial assistance Program for relief from imminent hazards in small watersheds, and to reduce vulnerability of life and property in small watershed areas damaged by severe natural hazard events.	http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp/
DOD - USACE	Section 205 of 1948 Flood Control Act	Resources for small flood damage reduction projects.	http://www.nww.usace.army.mil/Portals/28/docs/assistanceprograms/sec205.pdf
Department of the Interior/National Park Service	Federal Land Transfer / Federal Land to Parks Program	Identifies federal real property available for open space transfer to states and local governments for development of parks and recreation.	http://www.nps.gov/ncrc/programs/flp/index.htm
USDOT FHWA	Bridge Replacement and Rehabilitation	Funding for eligible bridges on any public road.	http://www.fhwa.dot.gov/bridge/hbrrp.cfm
USDOT FHWA	Recreational Trails	Funding for trails used by motorized and nonmotorized recreational vehicles	https://www.fhwa.dot.gov/environment/recreational_trails/
US Department of Education	Emergency Management for Higher Education ***(this program was last funded in 2010)***	The Emergency Management for Higher Education (EMHE) grant program supports institutions of higher education (IHE) projects designed to develop, or review and improve, and fully integrate campus-based all-hazards emergency management planning efforts.	http://www2.ed.gov/programs/emergencyhighed/funding.html
US Economic Development Administration (EDA)	Disaster Relief Opportunity – Economic Adjustment Assistance	The EAA program provides recipients with flexible tools to develop and implement regionally based long term economic development strategies in response to major Federally declared disasters. The EAA program provides a wide range of technical, disaster recovery, economic recovery planning, and public works assistance. It responds adaptively to pressing economic recovery issues and is well-suited to help	http://www.grants.gov/search-grants.html?eligibilities%3D06%7CPublic%20and%20State%20controlled%20institutions%20of%20higher%20education

Agency	Program	Description	More Information
		address challenges faced by regions affected by natural disasters.	
STATE			
FEMA, MEMA	Hazard Mitigation Grant Program	Allows for the completion of post-disaster mitigation projects that will reduce and/or eliminate losses due to natural hazards. Private non-profit entities are eligible to apply.	http://www.mass.gov/eopss/agencies/mema/hazard-mitigation/grants/hazard-mitigation-grant-program-hmgp.html
OTHER			
UMass Campus/System	Various	• Annual Operating Budgets • Staff Time • UMass System Bond Financing • UMass Building Authority • DCAM	

6. PLAN IMPLEMENTATION, MAINTENANCE & ADOPTION

The implementation of the Hazard Mitigation Plan will be overseen by Jeffrey Hescock the Emergency Planning and Business Continuity Manager at the University of Massachusetts. Mr. Hescock will be responsible for engaging the Hazard Mitigation Planning Steering Committee on a regular basis to discuss how various action items might be implemented and to ensure that they are prioritized in the highest order of importance. The meetings will be documented and summarized including the status of any mitigation project actions, risk assessments or needed plan revisions.

6.1 PLAN MAINTENANCE & REVISION

On an annual basis, Mr. Hescock and the Hazard Mitigation Planning Steering Committee will review the Hazard Mitigation Plan or upon the occurrence of a substantial natural or human hazard event at a scheduled "annual plan review meeting." Together, the group will specifically evaluate the progress of the plan and document any mitigation activities that have taken place. The public will be informed about the annual review of the plan by a news announcement that will be posted to the homepage of each individual campus website as well as the website for the System Office. Informing the public about the annual review of the plan will provide an opportunity to obtain comments. Contact information will be provided regarding where input can be sent. The Hazard Mitigation Planning Steering Committee will conduct targeted phone calls with local officials in the communities where campuses are located to obtain their feedback. After the annual review meeting, UMass will issue a progress report and post it on the individual campus websites.

UMass recognizes the importance of continued public outreach and public participation in this planning effort. Once the plan is finalized, a link will be posted to the campus websites, a press release will be issued by each individual campus and the effort may be discussed at various meetings during the year where Mr. Hescock and the Hazard Mitigation Planning Steering Committee can promote the plan and continue to make the public aware and encourage participation. A hard copy of the plan will be made available at each participating campus.

6.2 REVISING THE PLAN

UMass is planning to review and update the Multi-Campus Hazard Mitigation Plan every five years. In January 2019, Mr. Hescock will reconvene the Hazard Mitigation Planning Steering Committee and set forth a schedule for reviewing the plan, updating any development changes that have occurred on the campuses, including a discussion on new/changed regulatory requirements, a discussion of recent hazard events, a re-evaluation of the hazard ranking, updating any loss estimates, discussions of new studies and technologies, revisiting potential projects and discussing projects that have been completed. The team will review any State or Federal changes made to guidance, funding, policies, or plans and will also utilize any updated Census Data that is available and would be relevant. The findings of this research and analysis will be compiled into an updated plan and submitted to MEMA and FEMA for review. The team will review existing goals and objectives and update them along with newer action items as needed.

6.3 INTEGRATION INTO OTHER PLANNING MECHANISMS

The UMass campuses have a number of existing plans, guidance tools and emergency preparedness documents that were reviewed as a part of this planning effort and are detailed in the Annex sections. To the extent possible, requirements, actions or principles of these documents have been integrated into the Multi-Campus Hazard Mitigation Plan. Future mitigation planning can be integrated into those documents or subsequent future efforts by making it a regular topic/agenda item that is discussed. The Hazard Mitigation Planning Steering Committee will serve as the points of contact to be assigned to advocate for Hazard Mitigation on each campus where specific activities may involve:

- Integrate the Hazard Mitigation Plan goals and objectives into any new, amended or updated guidance/planning/policy/future development document to the extent possible,
- Formalize and publicize a recognition of hazard mitigation planning and mitigation activities as a part of university and local community emergency management plans, efforts and operations (where there is a partnered effort),
- Address sea level rise, climate change and hazard mitigation planning specifically in any future versions of campus master plans, emergency preparedness documents, capital improvement planning or other annual planning efforts,
- Seek out opportunities to participate in other local Hazard Mitigation planning efforts, projects or initiatives to share local knowledge and also learn about other activities on other campuses or occurring in the region,
- Further integrate mitigation planning into the university budget cycle by actively and regularly seeking alternative funding sources that have been highlighted in this plan.

6.4 UMASS CAMPUS ANNEX PLANS

The final product for each UMass campus has been prepared as two separate documents which includes the upfront Multi-Campus Hazard Mitigation Plan and then a campus specific Annex Plan and associated appendices. The campus Annex Plans detail specific risk, hazards, goals and mitigation projects and implementation steps that pertain specifically to UMass Boston, UMass Lowell, UMass Dartmouth and/or the UMass System Office. For example, the UMass Boston Hazard Mitigation Plan includes only the Hazard Mitigation Plan Overview and Annex A. Appendices are provided in each Annex that provide information associated with campus specific documents and meetings.

This concludes the overall Multi-Campus Hazard Mitigation Plan and readers should now reference the individual campus specific Annex Plans for more information.

APPENDIX A: WORK PLAN

COMMITMENT & INTEGRITY
DRIVE RESULTS

35 New England Business Ctr.
Suite 180
Andover, Massachusetts 01810
www.woodardcurran.com

T 866.702.6371
T 978.557.8150
F 978.557.7948

WOODARD &CURRAN

MEMORANDUM

TO: Jeff Hescock
FROM: Mary House
DATE: October 1, 2012
RE: Project Work Plan, Multi-Campus Hazard Mitigation Plan

This document is intended to serve as the project work plan for the above referenced project. The purpose of the work plan is to clearly and concisely outline the project objectives, roles and responsibilities, communications, deliverables and overall management activities associated with the project. This plan is intended to be a dynamic document and will be updated as needed to reflect new project information.

Project Objectives

- To develop a FEMA and MEMA approved multi-campus hazard mitigation plan for UMass Lowell, UMass Dartmouth, UMass Boston and the President's and Systems Office. The plan will incorporate both human and natural hazards and consist of an overall plan and individual appendices specific to each campus. Obtaining approval will ensure the campuses meet the requirements of their funding and are eligible for future funding.
- To engage the campus communities and outside entities in the development of the plan to both educate, solicit ideas, assemble resources, and obtain buy-in.

Roles and Responsibilities

UMass System
- Jeff Hescock – University Project Manager
- Emil Fioravanti (UMass Dartmouth), Bill Desrosiers (UMass Lowell), A. McLaughlin (UMass Boston), and Rich Lemoine (UMass Lowell) – Project Executive Committee

Woodard & Curran
- Mary House – Project Manager
- MaryKristin Ivanovich – Technical Lead
- Seth Garrison, Alan Benevides, Joanna Wallace, Mary McCran, Brian McGrath, Dave Pollock, Rich Grassie (Prism Security) – Core Project Team and Area Experts

Communications

Project Wide

- Post all relevant project documentation on the project web site after approval from University Project Manager
- Monthly written progress reports to University Project Manager
- Routine status update calls with University Project Manager
- Utilize ftp sites or remote meetings if necessary

Campus Specific

- Coordinate campus specific activities with each campus representative with periodic updates to the University Project Manager

Outreach to FEMA and MEMA

- Develop a plan for proactive engagement with University Project Manager

Project Schedule

- See proposal

Project Deliverables

- See Scope of Work

Project Budget

- See Scope of Work

Quality Assurance and Quality Control

- All draft and final deliverables technically reviewed
- Use of separate technical advisory team
- University review as well as other appropriate stakeholders

Sustainability

- Incorporate waste and carbon reduction principals into deliverable review and production
- Work electronically to the fullest extent possible to reduce paper
- Maximize in person meetings involving travel

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ATTACHMENT A – STATEMENT OF WORK

SECTION 1 – PROJECT OVERVIEW

The purpose of this project is to develop a FEMA approved Multi-Campus Hazard Mitigation Plan for four of the University of Massachusetts' campuses. The four campuses included in this project are UMass Boston, UMass Dartmouth, UMass Lowell and the UMass Central Administration Office/President's Office. The Multi-Campus Hazard Mitigation Plan will address both natural and human hazards and be designed to fulfill federal, state, local and University hazard planning requirements.

This statement of work provides the details of the tasks, milestones and overall project schedule. Additional project details are provided in Woodard & Curran's April 11, 2012 response to RFP #UP12-DJ-0203.

SECTION 2 – PERIOD OF PERFORMANCE

The period of performance for this project extends from July 27, 2012 through November 30, 2014.

SECTION 3 – SCOPE OF SERVICES

The following presents the specific tasks included in the scope of services as well as the schedule and milestones, if applicable, associated with each task.

Project Planning

- Kick-off meeting with University Project Manager to identify project stakeholders (internal and external to UMass) and review methodology, scope, schedule, budget and communications
- Develop project workplan to include a project charter and communications plan
- Develop project schedule in Microsoft Project
- Develop a web-based project IT platform design to be hosted by Woodard & Curran

Deliverables – Project workplan and project schedule
Functioning IT platform

Schedule – Summer 2012

Milestone #1 – completion of above listed subtasks

Project Management (On-going)

- Monthly written progress reports, including updated schedule
- Routine information upload to the IT platform
- Monthly progress calls with University project manager

Schedule – ongoing for project duration

Data Request and Project Review

- Develop a written request for existing information from campuses related to previous hazard mitigation planning associated activities
- Review information received from each campus

  Deliverables – Information request memorandum

  Schedule – Summer/fall 2012

  Milestone #2 – Completion of above listed subtasks

Campus Kick-Off Meetings

- Conduct project kick-off meetings at each campus
  - Present the project workplan, schedule, and IT platform
  - Review general project methodology
  - Initiate preliminary discussion on hazard identification and risk assessment

  Deliverables – Power Point presentation (or other comparable method) highlighting project objectives, methodology, campus engagement, deliverables, and schedule.

  Schedule – Fall 2012

  Milestone #3 – Completion of above listed subtasks

Hazard Identification and Risk Assessment

- Develop hazard methodology and evaluation matrix and outline in a memorandum
- Identify, analyze and rank hazards
- 1-2 day site visit and workshop at each campus to gather data through interviews and group discussions
- Hazard identification and ranking workshop at each campus

  Deliverables – Hazard methodology and evaluation matrix memorandum
  Hazard identification memorandum by campus
  Hazard ranking memorandum by campus
  Minutes from hazard identification and ranking workshop at each campus

  Schedule – Fall 2012/Winter 2013

  Milestone #4 & #5 – Completion of above listed subtasks for first two campuses (milestone #4); completion of above listed subtasks for the second two campuses (milestone #5)

Hazard Mitigation Planning

- Develop mitigation goals
- Develop mitigation plan for top hazards at each campus

- Mitigation planning workshop at each campus

  Deliverables – Minutes from mitigation planning workshop at each campus

  Schedule – Winter/Spring 2013

  Milestone #6 & #7 - Completion of above listed subtasks for first two campuses (milestone #6); completion of above listed subtasks for the second two campuses (milestone #7)

<u>Draft Multi-Campus Hazard Mitigation Plan</u>

- Develop overall plan framework and table of contents
- Develop overall UMass System sections of the plan
- Develop individual campus appendices

  Deliverables – Hazard mitigation plan table of contents
  Electronic Draft of UMass System sections of the plan
  Electronic Draft of individual campus appendices

  Schedule – Spring/Summer 2013

  Milestone #8, #9, & #10 – Completion of plan framework and UMass System sections of the plan (milestone #8), completion of campus sections for first two campuses (milestone #9), completion of campus sections for second two campuses (milestone #10)

<u>Facilitated Review of Draft Plan</u>

- Presentation of the Plan at each campus

  Deliverables – Power Point presentation (or other comparable method) highlighting the plan contents

  Schedule – Summer/Fall 2013

  Milestone #11 – Completion of above listed subtasks

<u>Finalize and Submit Multi-Campus Hazard Mitigation Plan</u>

- Incorporate comments into overall UMass System sections
- Incorporate comments into individual campus appendices
- Finalize the plan
- Complete the local mitigation plan review tool

  Deliverables – Electronic revised version of the plan in red-line strike out or other comparable tracking methodology, if appropriate
  Electronic version of finalized plan to be submitted to State

  Schedule – Fall 2013/Winter 2014

Milestone #12 – Completion of above listed subtasks

<u>Submit Plan to the State and Incorporate Comments</u>

- Submit final electronic plan to the State for review and comment
- Incorporate comments from the State when provided, if necessary

Deliverables – Electronic revised version of the plan in red-line strike out or other comparable tracking methodology, if appropriate, incorporating comments from the State

Schedule – Winter/Spring 2014

Milestone #13 – Completion of above listed subtasks

<u>Submit Plan to FEMA and Incorporate Comments</u>

- Submit final electronic plan to FEMA for review and comment
- Incorporate comments from FEMA when provided, if necessary
- Obtain FEMA approval

Deliverables – Electronic revised version of the plan in red-line strike out or other comparable tracking methodology, if appropriate, incorporating comments from FEMA
Ten hard copies and one electronic copy of the approved plan to UMass

Schedule – Spring/Summer 2014

Milestone #14 – Completion of above listed subtasks

<u>Final Presentations of Approved Plan</u>

- Final Presentation of Approved Plan at each campus

Deliverables – Power Point presentation (or other comparable method) highlighting the plan contents

Schedule – Fall 2014

Milestone #15 – Completion of above listed subtasks

SECTION 4 – TOTAL COMPENSATION

The project will be completed for a fixed fee of $342,500. Payments will be based on installments pursuant to the milestones identified in Section 3. Milestones will be achieved by providing the acceptable deliverables outlined under the applicable task. The following table identifies the milestone installments.

Activity	Milestone Number	Fee
Project Planning	1	$22,000
Data Request and Project Review	2	$22,000
Campus Kick-Off Meetings	3	$11,500
Hazard Identification and Risk Assessment	4 5	$43,000 $43,000
Hazard Mitigation Planning	6 7	$17,000 $17,000
Draft Multi-Campus Hazard Mitigation Plan	8 9 10	$30,000 $30,000 $30,000
Facilitated Review of Draft Plan	11	$9,000
Finalize and Submit Multi-Campus Hazard Mitigation Plan	12	$34,000
Submit Plan to the State and Incorporate Comments	13	$9,000
Submit Plan to FEMA and Incorporate Comments	14	$9,000
Final Presentations of Approved Plan	15	$16,000
TOTAL		**$342,500**

SECTION 5 – PROJECT TEAM

Woodard & Curran's core project team consists of the following:

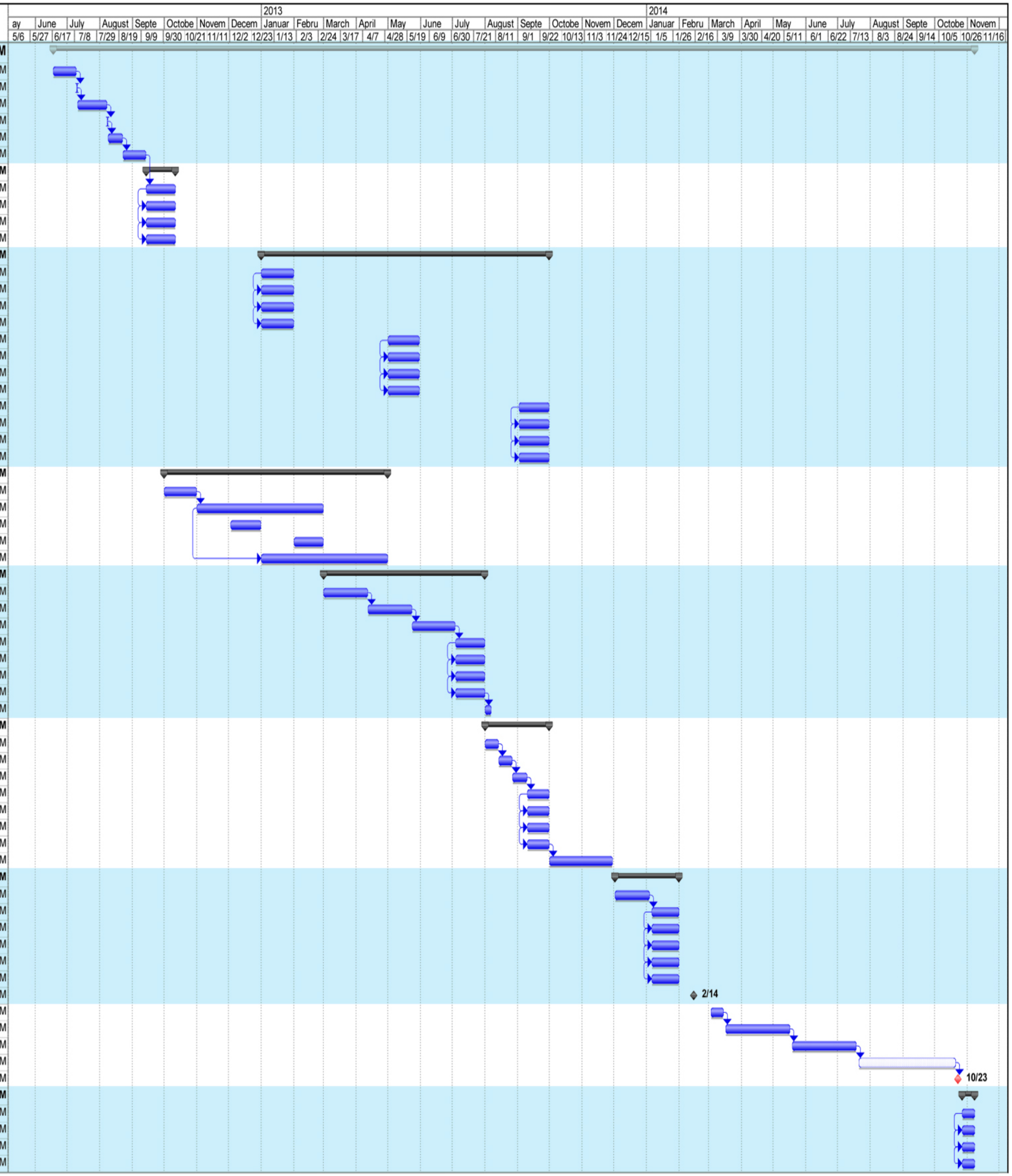
- Mary House, Project Manager
- MaryKristin Ivanovich, Technical Lead
- Seth Garrison
- Alan Benevides, PE
- Mary McCrann, AICP
- David Pollock
- Rich Grassie (PRISM Security)

Other supporting team members consist of the following:

- Adam Steinman, Esq.
- Dan Garson, ACIP
- Sheldon Smith
- Ted Chapin
- Mark Pereira, PE
- David White, PE
- Brian McGrath, CHMM
- Joanna Wallace, CIH
- Michele Shepard, CIH
- Frank Pisciotta, SCS (PRISM Security)

Additional team members may be included should additional resources or areas of expertise be required.

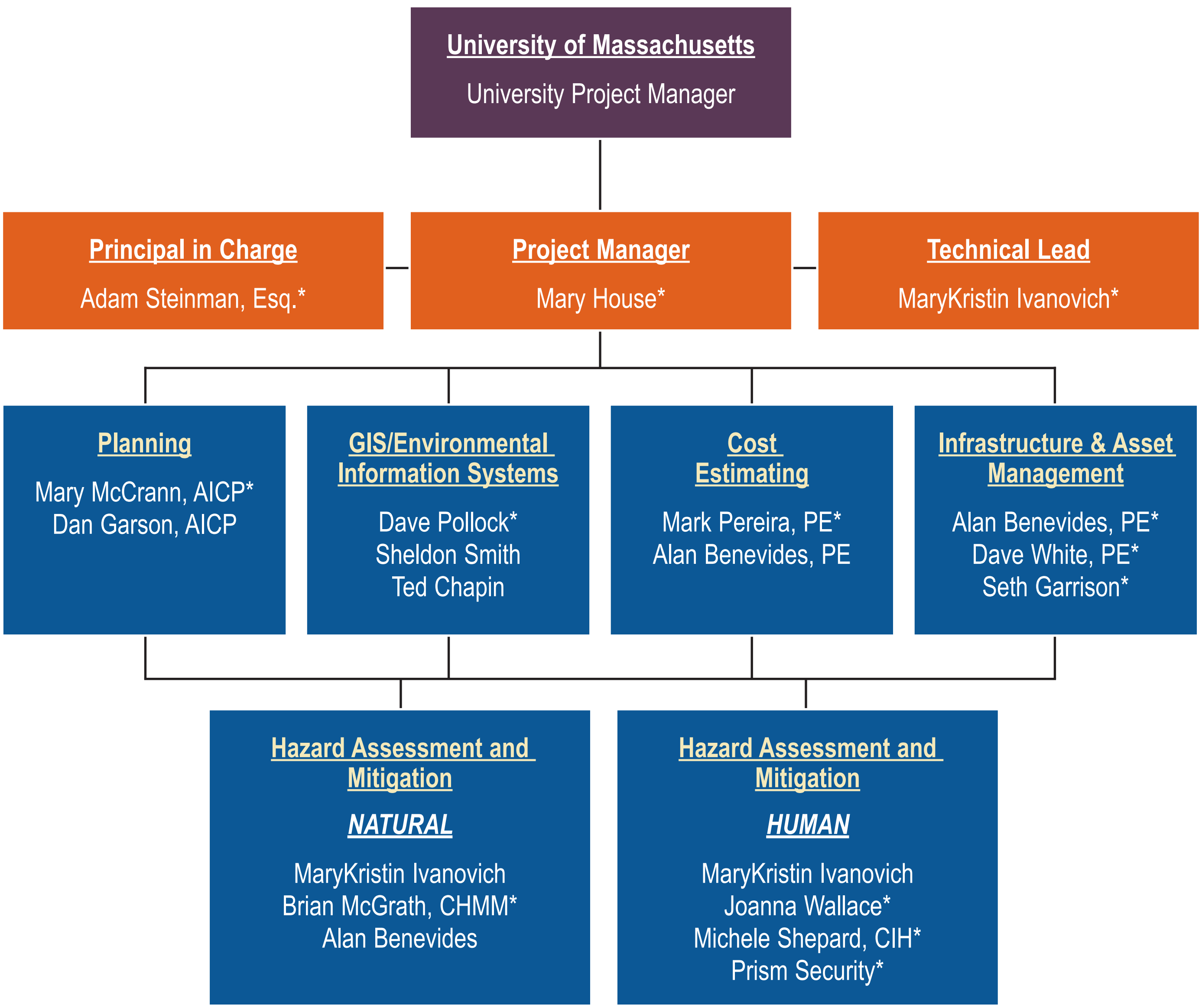
ID	Task Name	Start
0	**Proposal Project Schedule**	**Mon 6/18/12 8:00 AM**
1	Project Kick-Off Meeting with University Project Manager	Mon 6/18/12 8:00 AM
2	Develop Steering Committee	Tue 7/10/12 8:00 AM
3	Develop and Approve Project Charter	Wed 7/11/12 8:00 AM
4	Develop and Approve Commuications Plan	Wed 8/8/12 8:00 AM
5	Develop Project Detailed Project Schedule	Thu 8/9/12 8:00 AM
6	Develop Project IT Platform	Thu 8/23/12 8:00 AM
7	**Series of Project Kick-Off Meetings at Each of the Campuses**	**Fri 9/14/12 8:00 AM**
8	Boston Campus	Fri 9/14/12 8:00 AM
9	Dartmouth Campus	Fri 9/14/12 8:00 AM
10	Lowell Campus	Fri 9/14/12 8:00 AM
11	Central Administration/President's Office/System Office	Fri 9/14/12 8:00 AM
12	**Campus Workshops (at least three at each)**	**Tue 1/1/13 8:00 AM**
13	Boston Campus	Tue 1/1/13 8:00 AM
14	Dartmouth Campus	Tue 1/1/13 8:00 AM
15	Lowell Campus	Tue 1/1/13 8:00 AM
16	Central Administration/President's Office/System Office	Tue 1/1/13 8:00 AM
17	Boston Campus	Wed 5/1/13 8:00 AM
18	Dartmouth Campus	Wed 5/1/13 8:00 AM
19	Lowell Campus	Wed 5/1/13 8:00 AM
20	Central Administration/President's Office/System Office	Wed 5/1/13 8:00 AM
21	Boston Campus	Mon 9/2/13 8:00 AM
22	Dartmouth Campus	Mon 9/2/13 8:00 AM
23	Lowell Campus	Mon 9/2/13 8:00 AM
24	Central Administration/President's Office/System Office	Mon 9/2/13 8:00 AM
25	**Hazard Identification and Risk Assessment**	**Mon 10/1/12 8:00 AM**
26	Develop Hazard Methodology	Mon 10/1/12 8:00 AM
27	Idnentify, Analyze and Rank Hazards	Thu 11/1/12 8:00 AM
28	Campus Visit 1	Mon 12/3/12 8:00 AM
29	Campus Visit 2	Fri 2/1/13 8:00 AM
30	Hazard Mitigation Planning	Tue 1/1/13 8:00 AM
31	**Write Draft Multi-Campus Mitigation Plan**	**Fri 3/1/13 8:00 AM**
32	Overall Plan Framework	Fri 3/1/13 8:00 AM
33	Overall UMass System Section	Fri 4/12/13 8:00 AM
34	Campus Specific Appendices	Fri 5/24/13 8:00 AM
35	Boston Campus	Thu 7/4/13 8:00 AM
36	Dartmouth Campus	Thu 7/4/13 8:00 AM
37	Lowell Campus	Thu 7/4/13 8:00 AM
38	Central Administration/President's Office/System Office	Thu 7/4/13 8:00 AM
39	Complete the Local Mitigation Plan Review Tool	Thu 8/1/13 8:00 AM
40	**Facilitated Reviews**	**Thu 8/1/13 8:00 AM**
41	Overall Plan Framework	Thu 8/1/13 8:00 AM
42	Overall UMass System Section	Wed 8/14/13 8:00 AM
43	Campus Specific Appendices	Tue 8/27/13 8:00 AM
44	Boston Campus	Tue 9/10/13 8:00 AM
45	Dartmouth Campus	Tue 9/10/13 8:00 AM
46	Lowell Campus	Tue 9/10/13 8:00 AM
47	Central Administration/President's Office/System Office	Tue 9/10/13 8:00 AM
48	UMass Review and Final Approval	Tue 10/1/13 8:00 AM
49	**Incorporate Comments into Plan and Finalize**	**Mon 12/2/13 8:00 AM**
50	Revisions to Overall UMass System Section	Mon 12/2/13 8:00 AM
51	Revisions to Campus Specific Appendices	Mon 1/6/14 8:00 AM
52	Boston Campus	Mon 1/6/14 8:00 AM
53	Dartmouth Campus	Mon 1/6/14 8:00 AM
54	Lowell Campus	Mon 1/6/14 8:00 AM
55	Central Administration/President's Office/System Office	Mon 1/6/14 8:00 AM
56	Submit Draft Multi-Campus Mitigation Plan to the State	Fri 2/14/14 8:00 AM
57	Incorporate Comments from the State	Mon 3/3/14 8:00 AM
58	Submit FEMA Review	Mon 3/17/14 8:00 AM
59	Submit Multi-Campus Mitigation Plan to FEMA	Mon 5/19/14 8:00 AM
60	Float	Mon 7/21/14 8:00 AM
61	Receive FEMA Approval of Plan	Thu 10/23/14 8:00 AM
62	**Final Presentation of Approved Plan**	**Mon 10/27/14 8:00 AM**
63	Boston Campus	Mon 10/27/14 8:00 AM
64	Dartmouth Campus	Mon 10/27/14 8:00 AM
65	Lowell Campus	Mon 10/27/14 8:00 AM
66	Central Administration/President's Office/System Office	Mon 10/27/14 8:00 AM



Project Team

Woodard & Curran has assembled a talented project team upon which to execute this critically important project. The team encompasses all of the skills and experience necessary to successfully execute this project. The core project team will be able to draw upon the depth of resources available at Woodard & Curran when needed. A project organization chart identifying the core project team and some of the additional resources available is provided below:

ORGANIZATIONAL CHART



** Core team member - resumes included in following section.*
Detailed descriptions of the anticipated role to be played by each team member and a summary of the skills he or she brings to this role outlined in the following table:

APPENDIX B: PROGRESS REPORTS

COMMITMENT & INTEGRITY
DRIVE RESULTS

35 New England Business Ctr.
Suite 180
Andover, Massachusetts 01810
www.woodardcurran.com

T 866.702.6371
T 978.557.8150
F 978.557.7948

MEMORANDUM

TO: Jeff Hescock
FROM: Mary House
DATE: November 19, 2012
RE: September / October 2012 Monthly Progress Report

WOODARD & CURRAN

REPORTING PERIOD: September & October 2012

ACTIONS COMPLETED DURING REPORTING PERIOD

Summary of Actions Completed:

- Participated in September 6, 2012 project planning meeting with Jeff Hescock (at UMass System Office);
- Developed document request and issued to the project Steering Committee;
- Facilitated and participated in October 1, 2012 kick-off meeting with project Steering Committee (conference call);
- Facilitated and participated in October 5, 2012 meeting with UMass Boston to develop their campus specific Hazard Mitigation Planning Team (conference call);
- Facilitated and participated in October 9, 2012 meeting with the System office to develop their campus specific Hazard Mitigation Planning Team (conference call);
- Facilitated and participated in October 9, 2012 meeting with UMass Lowell to develop their campus specific Hazard Mitigation Planning Team (conference call);
- Facilitated and participated in October 15, 2012 meeting with UMass Dartmouth to develop their campus specific Hazard Mitigation Planning Team (conference call);
- Developed meeting minutes for the project kick-off meeting and meetings with each campus to develop its campus specific Hazard Mitigation Planning Team;
- Developed project web site and uploaded existing documents;
- Reviewed documents received from the System Office and UMass Boston in response to the data request;
- Worked with the project Steering Committee to schedule kick-off meetings at each campus with the Hazard Mitigation Planning Teams in November (a meeting date has yet to be set at UMass Dartmouth); and
- Prepared for Project Kick-off meetings scheduled at each campus with their respective Hazard Mitigation Planning Teams. Developed meeting agenda, memorandum of understanding for campus participants, and kick-off meeting Power Point presentation.

Deliverables Completed & Submitted:

- Document request memorandum;
- Meeting minutes for the kick-off meeting with the Steering Committee and meetings with each campus to develop the campus specific Hazard Mitigation Planning Teams;
- Project web site; and

- Agenda and Memorandum of Understanding for campus specific project kick-off meetings.

CURRENT PERCENT COMPLETE

Percent Complete:

- The project planning task is 100% complete; and
- The data request & project review task is 30% complete.

Activity	Milestone Number / Percent Complete	Budget	Billing
Project Planning	1 – 100%	$22,000	Invoice to be Issued in November, 2012
Data Request and Project Review	2 – 100%	$22,000	Invoice to be Issued in November, 2012
Campus Kick-Off Meetings	3 – 0%	$11,500	-
Hazard Identification and Risk Assessment	4 – 0% 5 – 0%	$43,000 $43,000	- -
Hazard Mitigation Planning	6 – 0% 7 – 0%	$17,000 $17,000	- -
Draft Multi-Campus Hazard Mitigation Plan	8 – 0% 9 – 0% 10 – 0%	$30,000 $30,000 $30,000	- - -
Facilitated Review of Draft Plan	11 – 0%	$9,000	-
Finalize and Submit Multi-Campus Hazard Mitigation Plan	12 – 0%	$34,000	-
Submit Plan to the State and Incorporate Comments	13 – 0%	$9,000	-
Submit Plan to FEMA and Incorporate Comments	14 – 0%	$9,000	-
Final Presentations of Approved Plan	15 – 0%	$16,000	-
TOTAL		**$342,500**	

Issues Encountered and Required Actions

- We are still awaiting information from the data request from UMass Lowell and UMass Dartmouth. The need for information will be further emphasized at the upcoming campus kick-off meetings to be conducted in November.
- We have yet to identify a date for the UMass Dartmouth campus kick-off meeting with the campus specific Hazard Mitigation Planning Team.

PROPOSED MODIFICATIONS TO WORK PLANS OR SCHEDULE

- There are no proposed modifications to the work plans or schedule this month.

PLANNED WORK FOR THE UPCOMING MONTH

Woodard & Curran Planned Work:

- Finalize the materials for the campus kick-off meetings with the Hazard Mitigation Planning Teams;
- Conduct and participate in campus kick-off meetings at each campus with the Hazard Mitigation Planning Teams;
- Develop meeting minutes for all campus-kick off meetings;
- Review additional campus documents as they become available;
- Work with Jeff to develop a strategy to outreach to FEMA; and
- Issue invoice for 100% complete of the project planning task ($22,000) and data request and project review task ($22,00) (Total = $44,000).

Planned Work

- UMass campuses to continue to provide information in response to the data request; and
- Work with Woodard & Curran to identify a date for and coordinate the campus kick-off meeting with the Hazard Mitigation Planning Teams.

Approval of the September / October 2012 Progress Report:

For UMass:	**For Woodard & Curran:**
Jeff Hescock, Emergency Planning & Business Continuity Manager	Mary B. House, Project Manager
11/19/12, Date	November, 19, 2012

COMMITMENT & INTEGRITY
DRIVE RESULTS

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F 978.557.7948

MEMORANDUM

TO: Jeff Hescock
FROM: Mary House
DATE: December 7, 2012
RE: November 2012 Monthly Progress Report

REPORTING PERIOD: November 2012

ACTIONS COMPLETED DURING REPORTING PERIOD

Summary of Actions Completed:

- Reviewed documents received from UMass Lowell in response to the data request;
- Prepared for Project Kick-off meetings scheduled at each campus with their respective Hazard Mitigation Planning Teams. Developed sign in sheets, Power Point presentations and handouts.
- Facilitated and participated in Project Kick-off and Orientation meeting at the UMass System office with the campus Hazard Mitigation Planning Team on November 7, 2012.
- Facilitated and participated in Project Kick-off and Orientation meeting at UMass Lowell with the campus Hazard Mitigation Planning Team on November 8, 2012.
- Facilitated and participated in Project Kick-off and Orientation meeting at UMass Boston with the campus Hazard Mitigation Planning Team on November 13, 2012.
- Facilitated and participated in Project Kick-off and Orientation meeting at UMass Dartmouth with the campus Hazard Mitigation Planning Team on November 28, 2012.
- Uploaded Kick-off meeting documentation (agendas, Power Point presentations, and sign in sheets) to the project web site.
- Began initial planning associated with hazard mitigation identification.

Deliverables Completed & Submitted:

- October 2012 progress report.
- Power Point presentations for the campus Kick-off meetings.

CURRENT PERCENT COMPLETE

Percent Complete:

- The project planning, data request and project review, and campus kick-off meeting tasks are 100% complete.

Activity	Milestone Number / Percent Complete	Budget	Billing
Project Planning	1 – 100%	$22,000	Invoice issued in November 2012
Data Request and Project Review	2 – 100%	$22,000	Invoice issued in November 2012
Campus Kick-Off Meetings	3 – 100%	$11,500	Invoice issued in December 2012
Hazard Identification and Risk Assessment	4 – 0% 5 – 0%	$43,000 $43,000	- -
Hazard Mitigation Planning	6 – 0% 7 – 0%	$17,000 $17,000	- -
Draft Multi-Campus Hazard Mitigation Plan	8 – 0% 9 – 0% 10 – 0%	$30,000 $30,000 $30,000	- - -
Facilitated Review of Draft Plan	11 – 0%	$9,000	-
Finalize and Submit Multi-Campus Hazard Mitigation Plan	12 – 0%	$34,000	-
Submit Plan to the State and Incorporate Comments	13 – 0%	$9,000	-
Submit Plan to FEMA and Incorporate Comments	14 – 0%	$9,000	-
Final Presentations of Approved Plan	15 – 0%	$16,000	-
TOTAL		**$342,500**	

Invoice to Date:	$55,500
Remaining Project Budget	$287,000
Total	**$342,500**

Issues Encountered and Required Actions

- We are still awaiting information from the data request from UMass Dartmouth. The need for information will be further emphasized by Jeff Hescock via email to the Project Steering Committee.

PROPOSED MODIFICATIONS TO WORK PLANS OR SCHEDULE

- There are no proposed modifications to the work plans or schedule this month.

PLANNED WORK FOR THE UPCOMING MONTH

Woodard & Curran Planned Work:

- We are still awaiting information from the data request from UMass Dartmouth. The need for information will be further emphasized by Jeff Hescock via email to the Project Steering Committee.
- Develop meeting minutes for the campus kick-off meetings.

- Begin planning for the next round of campus hazard mitigation identification meetings to be held in mid to late January and early February.
- Develop a hazard methodology and evaluation matrix to be distribution prior to the next round of campus meetings.
- Begin to gather and process campus GIS data.
- Conduct research on hazards that have occurred in the past in campus regions.
- Review additional campus documents as they become available.
- Work with Jeff to develop a strategy to outreach to FEMA.

Planned Work

- UMass campuses to continue to provide information in response to the data request.
- Work with Woodard & Curran to identify a date for the next round of campus meetings with the Hazard Mitigation Planning Teams.

Approval of November 2012 Progress Report:

For UMass:

Jeff Hescock, Emergency Planning & Business Continuity Manager
December 10, 2012

For Woodard & Curran:

Mary B. House

Mary House, Project Manager
December 7, 2012

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F 978.557.7948

MEMORANDUM

TO: Jeff Hescock
FROM: Mary House
DATE: January 17, 2013
RE: December 2012 Monthly Progress Report

REPORTING PERIOD: December 2012

ACTIONS COMPLETED DURING REPORTING PERIOD

Summary of Actions Completed:

- Continued review of documents received from campuses in response to the data request;
- Began initial planning associated with hazard mitigation identification. Began drafting a memorandum on the risk assessment process;
- Participated in discussions regarding the approach to the next round of campus engagement;
- Initiated outreach to campuses for GIS and infrastructure data;
- Began to review campus GIS data received from UMass Dartmouth and gathered State GIS data.

Deliverables Completed & Submitted:

- November 2012 progress report.

CURRENT PERCENT COMPLETE

Percent Complete:

- The project planning, data request and project review, and campus kick-off meeting tasks are 100% complete.

Activity	Milestone Number / Percent Complete	Budget	Billing
Project Planning	1 – 100%	$22,000	Invoice issued in November 2012
Data Request and Project Review	2 – 100%	$22,000	Invoice issued in November 2012
Campus Kick-Off Meetings	3 – 100%	$11,500	Invoice issued in December 2012
Hazard Identification and Risk Assessment	4 – 10% 5 – 0%	$43,000 $43,000	- -
Hazard Mitigation Planning	6 – 0% 7 – 0%	$17,000 $17,000	- -
Draft Multi-Campus Hazard Mitigation Plan	8 – 0% 9 – 0% 10 – 0%	$30,000 $30,000 $30,000	- - -

Activity	Milestone Number / Percent Complete	Budget	Billing
Facilitated Review of Draft Plan	11 – 0%	$9,000	-
Finalize and Submit Multi-Campus Hazard Mitigation Plan	12 – 0%	$34,000	-
Submit Plan to the State and Incorporate Comments	13 – 0%	$9,000	-
Submit Plan to FEMA and Incorporate Comments	14 – 0%	$9,000	-
Final Presentations of Approved Plan	15 – 0%	$16,000	-
TOTAL		**$342,500**	

Invoice to Date:	$55,500
Remaining Project Budget	$287,000
Total	**$342,500**

Issues Encountered and Required Actions:

- We are actively in discussions regarding the approach to the next round of campus engagement. In these discussions we are evaluating the amount of time required from the campus stakeholders and the pros and cons of conference call discussions and group stakeholder meetings.

PROPOSED MODIFICATIONS TO WORK PLANS OR SCHEDULE

- We are tentatively planning on moving the next round of campus engagement from January to February. The campuses felt that meetings in January were spaced too closely to the last meetings held in November.

PLANNED WORK FOR THE UPCOMING MONTH

Woodard & Curran Planned Work:

- Continue to gather GIS data from each campus to assemble basemaps and infrastructure.
- Begin initial research into hazard occurrences in the campus areas and identify and review local planning efforts.
- Participate in a planning conference call with the Project Steering Committee.
- Develop meeting minutes for the campus kick-off meetings.
- Plan for the next round of campus hazard mitigation identification meetings to be held in February.
- Develop a hazard methodology and evaluation matrix to be distribution prior to the next round of campus meetings.
- Review additional campus documents as they become available.
- Work with Jeff to develop a strategy to outreach to MEMA/FEMA.

Planned Work

- UMass campuses to continue to provide information in response to the data request.
- Work with Woodard & Curran to identify a date for the next round of campus meetings with the Hazard Mitigation Planning Teams.

Approval of December 2012 Progress Report:

For UMass:

Jeff Hescock, Emergency Planning & Business Continuity Manager
January 17, 2013

For Woodard & Curran:

Mary B. House

Mary House, Project Manager
January 17, 2013

COMMITMENT & INTEGRITY
DRIVE RESULTS

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MEMORANDUM

TO: Jeff Hescock
FROM: Mary House
DATE: March 1, 2013
RE: January 2013 Monthly Progress Report

WOODARD &CURRAN

REPORTING PERIOD: January 2013

ACTIONS COMPLETED DURING REPORTING PERIOD

Summary of Actions Completed:

- Continued review of documents received from campuses in response to the data request;
- Began initial planning associated with hazard mitigation identification. Drafted a memorandum on the risk assessment process;
- Participated in discussions regarding the approach to the next round of campus engagement;
- Initiated outreach to campuses for GIS and infrastructure data;
- Began to review campus GIS data received from UMass Dartmouth and UMass Lowell and gathered State GIS data.
- Attended January 18, 2013 Project Steering Committee call.
- Had conference calls on January 24, 2013 with Bill Desrosiers and June Eberhardt to plan for on campus meetings at UMass Lowell and UMass Dartmouth respectively.
- Attended a January 28, 2013 meeting at UMass Boston with Ellen O'Connor, Anne-Marie McLaughlin and Jeff Hescock.
- Had conference call on January 29, 2013 with Anne-Marie to plan for on campus meetings.

Deliverables Completed & Submitted:

- December 2012 progress report.
- Memorandum to the Steering Committee on the risk assessment process.
- Meeting minutes for the campus kick off meetings (UMass Boston still in review).

CURRENT PERCENT COMPLETE

Percent Complete:

- The project planning, data request and project review, and campus kick-off meeting tasks are 100% complete. Planning continues on the hazard identification and risk assessment in preparation for campus visits initiating in February.

WOODARD &CURRAN

Activity	Milestone Number / Percent Complete	Budget	Billing
Project Planning	1 – 100%	$22,000	Invoice issued in November 2012
Data Request and Project Review	2 – 100%	$22,000	Invoice issued in November 2012
Campus Kick-Off Meetings	3 – 100%	$11,500	Invoice issued in December 2012
Hazard Identification and Risk Assessment	4 – 20% 5 – 0%	$43,000 $43,000	- -
Hazard Mitigation Planning	6 – 0% 7 – 0%	$17,000 $17,000	- -
Draft Multi-Campus Hazard Mitigation Plan	8 – 0% 9 – 0% 10 – 0%	$30,000 $30,000 $30,000	- - -
Facilitated Review of Draft Plan	11 – 0%	$9,000	-
Finalize and Submit Multi-Campus Hazard Mitigation Plan	12 – 0%	$34,000	-
Submit Plan to the State and Incorporate Comments	13 – 0%	$9,000	-
Submit Plan to FEMA and Incorporate Comments	14 – 0%	$9,000	-
Final Presentations of Approved Plan	15 – 0%	$16,000	-
TOTAL		**$342,500**	

Invoiced to Date:	$55,500
Remaining Project Budget	$287,000
Total	**$342,500**

Issues Encountered and Required Actions:

- After brainstorming several approaches, the Steering Committee decided the next round of campus engagement would be in person and consist of a day and a half at UMass Boston, UMass Dartmouth and UMass Lowell. The approach for the System Office is yet to be determined.

PROPOSED MODIFICATIONS TO WORK PLANS OR SCHEDULE

- We have moved the next round of campus engagement from January to February/March. The campuses felt that meetings in January were spaced too closely to the last meetings held in November.

PLANNED WORK FOR THE UPCOMING MONTH

Woodard & Curran Planned Work:

- Continue to gather GIS data from each campus to assemble basemaps and infrastructure.
- Continue research into hazard occurrences in the campus areas and identify and review local planning efforts.
- Develop a hazard methodology and evaluation matrix to be distributed prior to the next round of campus meetings.
- Conduct campus hazard mitigation identification meetings at UMass Lowell and UMass Dartmouth.
- Review additional campus documents as they become available.
- Work with Jeff to develop a strategy to outreach to MEMA/FEMA.

Planned Work for Campuses:

- UMass campuses to continue to provide information in response to the data request.
- Work with Woodard & Curran to identify a date and schedule for the next round of campus meetings with the Hazard Mitigation Planning Teams and coordinate associated meeting logistics.

Approval of January 2013 Progress Report:

For UMass:	**For Woodard & Curran:**
	Mary E. House
Jeff Hescock, Emergency Planning & Business Continuity Manager March 6, 2013	Mary House, Project Manager March 1, 2013

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WOODARD
&CURRAN

MEMORANDUM

TO: Jeff Hescock
FROM: Mary House
DATE: March 1, 2013
RE: February 2013 Monthly Progress Report

REPORTING PERIOD: February 2013

ACTIONS COMPLETED DURING REPORTING PERIOD

Summary of Actions Completed:

- Continued review of documents received from campuses in response to the data request;
- Conducted campus and community research of associated hazard mitigation activities;
- Continued outreach to campuses for GIS and infrastructure data;
- Developed a hazard methodology and evaluation matrix and reviewed with the Project Steering Committee on February 5, 2013;
- Prepared for and conducted hazard assessment interviews at UMass Lowell on February 11, 2013. Assembled initial hazard list, rankings and summary presentation. Presented findings to the UMass Lowell Hazard Mitigation Planning Committee on February 15, 2013; and
- Prepared for and conducted hazard assessment interviews at UMass Dartmouth on February 25, 2013. Assembled initial hazard list, rankings and summary presentation. Presented finding to the UMass Dartmouth Hazard Mitigation Planning Committee on February 26, 2013.

Deliverables Completed & Submitted:

- January 2013 progress report.
- Memorandum to the Steering Committee on the hazard methodology and evaluation matrix.
- Hazard list, rankings, and summary presentation for UMass Lowell and UMass Dartmouth.

CURRENT PERCENT COMPLETE

Percent Complete:

- The project planning, data request and project review, and campus kick-off meeting tasks are 100% complete. The hazard identification and risk assessment has been completed for UMass Lowell and UMass Dartmouth. Hazard identification and risk assessment for UMass Boston and the System Office will be completed in March.

Activity	Milestone Number / Percent Complete	Budget	Billing
Project Planning	1 – 100%	$22,000	Invoice issued in November 2012 / Paid
Data Request and Project Review	2 – 100%	$22,000	Invoice issued in November 2012 / Paid
Campus Kick-Off Meetings	3 – 100%	$11,500	Invoice issued in December 2012 / Paid
Hazard Identification and Risk Assessment	4 – 100% 5 – 20%	$43,000 $43,000	Invoice issued in March 2013 -
Hazard Mitigation Planning	6 – 0% 7 – 0%	$17,000 $17,000	- -
Draft Multi-Campus Hazard Mitigation Plan	8 – 0% 9 – 0% 10 – 0%	$30,000 $30,000 $30,000	- - -
Facilitated Review of Draft Plan	11 – 0%	$9,000	-
Finalize and Submit Multi-Campus Hazard Mitigation Plan	12 – 0%	$34,000	-
Submit Plan to the State and Incorporate Comments	13 – 0%	$9,000	-
Submit Plan to FEMA and Incorporate Comments	14 – 0%	$9,000	-
Final Presentations of Approved Plan	15 – 0%	$16,000	-
TOTAL		**$342,500**	

Invoiced to Date:	$98,500
Paid to Date:	$55,500
Remaining Project Budget	$244,000
Total	**$342,500**

Issues Encountered and Required Actions:

- While the Steering Committee had previously agreed to conduct the hazard assessment interviews and findings workshops consecutively, this was not practically feasible at UMass Lowell to due scheduling conflicts.

PROPOSED MODIFICATIONS TO WORK PLANS OR SCHEDULE

- While we had originally hoped to complete all campus hazard assessment meetings in February, UMass Boston and the System Office were delayed until March.

PLANNED WORK FOR THE UPCOMING MONTH

Woodard & Curran Planned Work:

- Continue to gather GIS data from each campus to assemble basemaps and infrastructure.
- Conduct campus hazard assessment meetings at UMass Boston and the System Office
- Review additional campus documents as they become available.
- Work with Jeff to develop a strategy to outreach to MEMA/FEMA.

Planned Work for Campuses:

- UMass campuses to continue to provide information in response to the data request.
- Work with Woodard & Curran to identify a date and schedule for the next round of campus meetings with the UMass Boston and System Office Hazard Mitigation Planning Teams and coordinate associated meeting logistics.

Approval of February 2013 Progress Report:

For UMass:

Jeff Hescock, Emergency Planning & Business Continuity Manager
March 6, 2013

For Woodard & Curran:

Mary B. House

Mary House, Project Manager
March 1, 2013

MEMORANDUM

TO: Jeff Hescock
FROM: Mary House
DATE: April 4, 2013
RE: March 2013 Monthly Progress Report

WOODARD
&CURRAN

REPORTING PERIOD: March 2013

ACTIONS COMPLETED DURING REPORTING PERIOD

Summary of Actions Completed:

- Continued review of documents received from campuses in response to the data request;
- Conducted campus and community research of associated hazard mitigation activities;
- Prepared for and conducted hazard assessment interviews at UMass Boston on March 4, 2013. Assembled initial hazard list, rankings and summary presentation. Presented findings to the UMass Boston Hazard Mitigation Planning Committee on March 11, 2013;
- Participated in March 14, 2013 conference call with Marybeth Groff (Massachusetts Emergency Management Agency (MEMA) and Jeff Hescock to discuss our progress to date and solicit input from MEMA regarding our approach, next steps, and report organization. MEMA was very supportive of the efforts to date and the overall approach and offered continued support. MEMA directed us to review and consider a report organization similar to a multi-jurisdictional plan. MEMA requires two public workshops before the completion of the plan, which they would like to attend. They also felt the project was far enough along that UMass should consider applying for mitigation project funding when it becomes available.
- Prepared for and conducted hazard assessment interviews (via conference call) with the UMass System Office on March 22, 2013.
- Participated in a call with the Hazard Mitigation Plan Steering Committee to discuss the hazard mitigation/risk assessment progress and plan for next steps. The hazard identification and ranking spreadsheets had been circulated to the respective campus Hazard Mitigation Planning Teams at UMass Lowell, UMass Dartmouth and UMass Boston. No comments were received, therefore we will move forward with the rankings developed during the hazard ranking workshops. We discussed the next round of campus engagement to be completed in the month of June and would include the development of mitigation goals, the identification of assets that could potentially be impacted by hazards and mitigation projects to address those potential impacts, and completion of the first public workshop.

Deliverables Completed & Submitted:

- February 2013 progress report.
- Hazard list, rankings, and summary presentation for UMass Boston.

WOODARD & CURRAN

CURRENT PERCENT COMPLETE

Percent Complete:

- The project planning, data request and project review, campus kick-off meeting, and hazard identification and risk assessment tasks are 90% complete.

Activity	Milestone Number / Percent Complete	Budget	Billing
Project Planning	1 – 100%	$22,000	Invoice issued in November 2012
Data Request and Project Review	2 – 100%	$22,000	Invoice issued in November 2012
Campus Kick-Off Meetings	3 – 100%	$11,500	Invoice issued in December 2012
Hazard Identification and Risk Assessment	4 – 100%	$43,000	Invoice issued in March 2013
	5 – 90%	$43,000	-
Hazard Mitigation Planning	6 – 0%	$17,000	-
	7 – 0%	$17,000	-
Draft Multi-Campus Hazard Mitigation Plan	8 – 0%	$30,000	-
	9 – 0%	$30,000	-
	10 – 0%	$30,000	-
Facilitated Review of Draft Plan	11 – 0%	$9,000	-
Finalize and Submit Multi-Campus Hazard Mitigation Plan	12 – 0%	$34,000	-
Submit Plan to the State and Incorporate Comments	13 – 0%	$9,000	-
Submit Plan to FEMA and Incorporate Comments	14 – 0%	$9,000	-
Final Presentations of Approved Plan	15 – 0%	$16,000	-
TOTAL		**$342,500**	

Invoiced to Date:	$98,500
Remaining Project Budget	$244,000
Total	**$342,500**

Issues Encountered and Required Actions:

- While the Steering Committee had previously agreed to conduct the hazard assessment interviews and findings workshops consecutively, this was not practically feasible at UMass Lowell and UMass Boston to due scheduling conflicts and stakeholder preferences.

PROPOSED MODIFICATIONS TO WORK PLANS OR SCHEDULE

- While we had originally hoped to complete all campus hazard assessment meetings in February, UMass Boston and the System Office were delayed until March.

PLANNED WORK FOR THE UPCOMING MONTH

Woodard & Curran Planned Work:

- Complete the hazard identification and ranking for the UMass System Office.
- Develop a table of contents for the Multi-Campus Hazard Mitigation Plan.
- Begin to develop campus specific mapping to illustrate the potential impacts of the highest ranked hazards.
- Begin initial planning for the June campus meetings.
- Review additional campus documents as they become available.

Planned Work for Campuses:

- UMass campuses to continue to provide information in response to the data request as it becomes available.
- Work with Woodard & Curran to begin to identify dates for the next round of campus meetings and public workshop in June.

Approval of March 2013 Progress Report:

For UMass:	**For Woodard & Curran:**
	Mary 3. House
Jeff Hescock, Emergency Planning & Business Continuity Manager April 5, 2013	Mary House, Project Manager April 4, 2013

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MEMORANDUM

TO: Jeff Hescock
FROM: Mary House
DATE: May 20, 2013
RE: April 2013 Monthly Progress Report

REPORTING PERIOD: April 2013

ACTIONS COMPLETED DURING REPORTING PERIOD

Summary of Actions Completed:

- Completed the hazard identification and risk assessment for the UMass System Office.
- Began the hazard event profiling of campus hazards. The effort involves mapping, building rankings, loss estimates, goal setting, and identification of campus mitigation projects. This effort will be our primary focus for the next couple of months.
- Coordinated scheduling of UMass Boston campus meeting and public workshop for June 12, 2013.
- Participated in an April 26, 2013 call with Jeff Hescock to continue to discuss the approach to the next round of campus engagement.

Deliverables Completed & Submitted:

- March 2013 progress report.
- Hazard list, rankings, and summary presentation for UMass System Office.

CURRENT PERCENT COMPLETE

Percent Complete:

- The project planning, data request and project review, campus kick-off meeting, and hazard identification and risk assessment tasks are 100% complete.

Activity	Milestone Number / Percent Complete	Budget	Billing
Project Planning	1 – 100%	$22,000	Invoice issued in November 2012
Data Request and Project Review	2 – 100%	$22,000	Invoice issued in November 2012
Campus Kick-Off Meetings	3 – 100%	$11,500	Invoice issued in December 2012
Hazard Identification and Risk Assessment	4 – 100%	$43,000	Invoice issued in March 2013
	5 – 100%	$43,000	Invoice to be issued in May 2013

Hazard Mitigation Planning	6 – 10% 7 – 0%	$17,000 $17,000	- -
Draft Multi-Campus Hazard Mitigation Plan	8 – 10% 9 – 0% 10 – 0%	$30,000 $30,000 $30,000	- - -
Facilitated Review of Draft Plan	11 – 0%	$9,000	-
Finalize and Submit Multi-Campus Hazard Mitigation Plan	12 – 0%	$34,000	-
Submit Plan to the State and Incorporate Comments	13 – 0%	$9,000	-
Submit Plan to FEMA and Incorporate Comments	14 – 0%	$9,000	-
Final Presentations of Approved Plan	15 – 0%	$16,000	-
TOTAL		**$342,500**	

Invoiced to Date:	$141,500
Remaining Project Budget	$201,000
Total	**$342,500**

Issues Encountered and Required Actions:

- None.

PROPOSED MODIFICATIONS TO WORK PLANS OR SCHEDULE

- While we had originally planned to complete the next round of campus engagement and first public meeting in May, due to graduation and other campus conflicts these meetings are now targeted for June.

PLANNED WORK FOR THE UPCOMING MONTH

Woodard & Curran Planned Work:

- Develop a table of contents for the Multi-Campus Hazard Mitigation Plan.
- Begin to develop campus specific mapping to illustrate the potential impacts of the highest ranked hazards.
- Continue the hazard event profiling for each campus and prepare for the June campus and public meetings.
- Schedule the June campus meetings for UMass Dartmouth, UMass Lowell and the UMass System Office.

Planned Work for Campuses:

- UMass campuses to provide information as needed for the hazard event profiling.
- Work with Woodard & Curran to begin to identify dates for the next round of campus meetings and public workshop in June.

Approval of April 2013 Progress Report:

For UMass:

Jeff Hescock, Emergency Planning & Business Continuity Manager
May 20, 2013

For Woodard & Curran:

Mary E. House

Mary House, Project Manager
May 20, 2013

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MEMORANDUM

TO: Jeff Hescock
FROM: Mary House
DATE: June 25, 2013
RE: May 2013 Monthly Progress Report

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REPORTING PERIOD: May 2013

ACTIONS COMPLETED DURING REPORTING PERIOD

Summary of Actions Completed:

- Developed building ranking memorandum.
- Completed the hazard event profiling, building rankings, loss estimates, goal setting, and identification of campus mitigation projects for UMass Boston. Developed Power Point presentation, posters and handout for the first public workshop at UMass Boston.
- Developed draft Power Point presentations for the UMass Lowell, UMass Dartmouth and UMass System Office public meetings.
- Coordinated scheduling of UMass Lowell, System Office and UMass Dartmouth, campus meetings and public workshops for June 17th, June 25th and June 26th respectively.
- Participated in a May 2, 2013 call with the Hazard Mitigation Steering Committee to continue to discuss the approach to the next round of campus engagement.

Deliverables Completed & Submitted:

- April 2013 progress report.

CURRENT PERCENT COMPLETE

Percent Complete:

- The project planning, data request and project review, campus kick-off meeting, and hazard identification and risk assessment tasks are 100% complete.

Activity	Milestone Number / Percent Complete	Budget	Billing
Project Planning	1 – 100%	$22,000	Invoice issued in November 2012
Data Request and Project Review	2 – 100%	$22,000	Invoice issued in November 2012
Campus Kick-Off Meetings	3 – 100%	$11,500	Invoice issued in December 2012
Hazard Identification and Risk Assessment	4 – 100%	$43,000	Invoice issued in March 2013
	5 – 100%	$43,000	Invoice issued in May

WOODARD & CURRAN

			2013
Hazard Mitigation Planning	6 – 25% 7 – 0%	$17,000 $17,000	- -
Draft Multi-Campus Hazard Mitigation Plan	8 – 10% 9 – 0% 10 – 0%	$30,000 $30,000 $30,000	- - -
Facilitated Review of Draft Plan	11 – 0%	$9,000	-
Finalize and Submit Multi-Campus Hazard Mitigation Plan	12 – 0%	$34,000	-
Submit Plan to the State and Incorporate Comments	13 – 0%	$9,000	-
Submit Plan to FEMA and Incorporate Comments	14 – 0%	$9,000	-
Final Presentations of Approved Plan	15 – 0%	$16,000	-
TOTAL		**$342,500**	

Invoiced to Date:	$141,500
Remaining Project Budget	$201,000
Total	**$342,500**

Issues Encountered and Required Actions:

- None.

PROPOSED MODIFICATIONS TO WORK PLANS OR SCHEDULE

- While we had originally planned to complete the next round of campus engagement and first public meeting in May, due to graduation and other campus conflicts these meetings are scheduled for June.

PLANNED WORK FOR THE UPCOMING MONTH

Woodard & Curran Planned Work:

- Develop a table of contents for the Multi-Campus Hazard Mitigation Plan and initiate writing the hazard mitigation plan background sections.
- Develop campus specific mapping to illustrate the potential impacts of the highest ranked hazards.
- Complete the hazard event profiling and lost estimates for each campus. Identify hazard mitigation goals, objectives and mitigation projects for each campus.
- Prepare for the June campus and public meetings.
- Participate in the June campus and public meetings.

Planned Work for Campuses:

- UMass campuses to provide information as needed for the hazard event profiling, loss estimates, building rankings, and mitigation projects.

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Approval of Mary 2013 Progress Report:

For UMass:

Jeff Hescock, Emergency Planning & Business Continuity Manager
June 25, 2013

For Woodard & Curran:

Mary House, Project Manager
June 18, 2013

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WOODARD &CURRAN

MEMORANDUM

TO: Jeff Hescock
FROM: Mary House
DATE: July 22, 2013
RE: June 2013 Monthly Progress Report

REPORTING PERIOD: June 2013

ACTIONS COMPLETED DURING REPORTING PERIOD

Summary of Actions Completed:

- Completed the hazard event profiling, building rankings, loss estimates, goal setting, and identification of campus mitigation projects for UMass Dartmouth, UMass Lowell and the UMass System Office. Developed posters and handout for the first public workshop at UMass Dartmouth, UMass Lowell and the UMass System Office.
- Facilitated the UMass Boston stakeholder meeting to review goals, hazard event profiling, building rankings, loss estimates and hazard mitigation projects at UMass Boston on June 12, 2013. Also completed interviews with UMass Boston Facilities, EH&S, Emergency Management and IT representatives.
- Participated in first public workshop at UMass Boston on June 12, 2013.
- Facilitated the UMass Lowell stakeholder meeting to review goals, hazard event profiling, building rankings, loss estimates and hazard mitigation projects at UMass Lowell on June 17, 2013. Also completed interviews with UMass Lowell EH&S, Facilities, Emergency Management and IT representatives.
- Participated in first public workshop at UMass Lowell on June 17, 2013.
- Facilitated the UMass System Office stakeholder meeting to review goals, hazard event profiling, building rankings, loss estimates and hazard mitigation projects at the UMass System Office on June 25, 2013. Also completed interviews with Emergency Management representative.
- Participated in first public workshop at the UMass System Office on June 25, 2013.
- Facilitated the UMass Dartmouth stakeholder meeting to review goals, hazard event profiling, building rankings, loss estimates and hazard mitigation projects at UMass Dartmouth on June 26, 2013. Also completed interviews with UMass Dartmouth EH&S, Facilities, Emergency Management and IT representatives.
- Participated in first public workshop at UMass Dartmouth on June 26, 2013.

Deliverables Completed & Submitted:

- May 2013 progress report.
- Public workshop Power Point presentations, posters and handouts for UMass Boston, UMass Lowell, UMass Dartmouth and the UMass System Office.
- Stakeholder meeting Power Point presentations for hazard event profiling, building rankings, loss estimates, goal setting, and identification of campus mitigation projects for UMass Boston, UMass Lowell, UMass Dartmouth and the UMass System Office.

CURRENT PERCENT COMPLETE

Percent Complete:

- The project planning, data request and project review, campus kick-off meeting, hazard identification and risk assessment and hazard mitigation planning tasks are 100% complete.

Activity	Milestone Number / Percent Complete	Budget	Billing
Project Planning	1 – 100%	$22,000	Invoice issued in November 2012
Data Request and Project Review	2 – 100%	$22,000	Invoice issued in November 2012
Campus Kick-Off Meetings	3 – 100%	$11,500	Invoice issued in December 2012
Hazard Identification and Risk Assessment	4 – 100% 5 – 100%	$43,000 $43,000	Invoice issued in March 2013 Invoice issued in May 2013
Hazard Mitigation Planning	6 – 100% 7 – 100%	$17,000 $17,000	Invoice issued in July 2013 Invoice issued in July 2013
Draft Multi-Campus Hazard Mitigation Plan	8 – 10% 9 – 0% 10 – 0%	$30,000 $30,000 $30,000	- - -
Facilitated Review of Draft Plan	11 – 0%	$9,000	-
Finalize and Submit Multi-Campus Hazard Mitigation Plan	12 – 0%	$34,000	-
Submit Plan to the State and Incorporate Comments	13 – 0%	$9,000	-
Submit Plan to FEMA and Incorporate Comments	14 – 0%	$9,000	-
Final Presentations of Approved Plan	15 – 0%	$16,000	-
TOTAL		**$342,500**	

Invoiced to Date:	$175,500
Remaining Project Budget	$167,000
Total	**$342,500**

Issues Encountered and Required Actions:

- None.

PROPOSED MODIFICATIONS TO WORK PLANS OR SCHEDULE

- While we had originally planned to complete the above referenced round of campus engagement and first public meetings in May, due to graduation and other campus conflicts these meetings were completed in June.

PLANNED WORK FOR THE UPCOMING MONTH

Woodard & Curran Planned Work:

- Refine hazard mitigation goals and projects based on discussions and interviews during the June meetings. Reissue hazard mitigation goals and projects to the campuses for final review.
- Identify any remaining campus data gaps necessary to be filled for the hazard mitigation plan draft and issue data request to the campuses.
- Develop a table of contents for the Multi-Campus Hazard Mitigation Plan and initiate writing the hazard mitigation plan background sections.
- Develop refined project schedule through to completion of the draft plan.

Planned Work for Campuses:

- UMass campuses to review revised hazard mitigation goals and projects.
- UMass campuses to provide information as needed to address final data gaps.

Approval of June 2013 Progress Report:

For UMass:

Jeff Hescock, Emergency Planning & Business Continuity Manager

7/23/13

For Woodard & Curran:

Mary B. House

Mary House, Project Manager
July 23, 2013

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MEMORANDUM

TO: Jeff Hescock
FROM: Mary House
DATE: August 8, 2013
RE: July 2013 Monthly Progress Report

REPORTING PERIOD: July 2013

ACTIONS COMPLETED DURING REPORTING PERIOD

Summary of Actions Completed:

- Revised goals, objectives, and mitigation projects for UMass Boston, UMass Lowell, UMass Dartmouth and the System Office based on feedback received from the June 2013 on-campus meetings.
- Identified remaining campus data gaps necessary to be filled for the hazard mitigation plan draft.
- Continued to draft Hazard Mitigation Plan background sections.

Deliverables Completed & Submitted:

- June 2013 progress report.

CURRENT PERCENT COMPLETE

Percent Complete:

- The project planning, data request and project review, campus kick-off meeting, hazard identification and risk assessment and hazard mitigation planning tasks are 100% complete.

Activity	Milestone Number / Percent Complete	Budget	Billing
Project Planning	1 – 100%	$22,000	Invoice issued in November 2012
Data Request and Project Review	2 – 100%	$22,000	Invoice issued in November 2012
Campus Kick-Off Meetings	3 – 100%	$11,500	Invoice issued in December 2012
Hazard Identification and Risk Assessment	4 – 100% 5 – 100%	$43,000 $43,000	Invoice issued in March 2013 Invoice issued in May 2013
Hazard Mitigation Planning	6 – 100% 7 – 100%	$17,000 $17,000	Invoice issued in July 2013 Invoice issued in July 2013
Draft Multi-Campus Hazard Mitigation Plan	8 – 25% 9 – 0% 10 – 0%	$30,000 $30,000 $30,000	- - -

Facilitated Review of Draft Plan	11 – 0%	$9,000	-
Finalize and Submit Multi-Campus Hazard Mitigation Plan	12 – 0%	$34,000	-
Submit Plan to the State and Incorporate Comments	13 – 0%	$9,000	-
Submit Plan to FEMA and Incorporate Comments	14 – 0%	$9,000	-
Final Presentations of Approved Plan	15 – 0%	$16,000	-
TOTAL		**$342,500**	

Invoiced to Date:	$175,500
Remaining Project Budget	$167,000
Total	**$342,500**

Issues Encountered and Required Actions:

- None.

PROPOSED MODIFICATIONS TO WORK PLANS OR SCHEDULE

- While we had originally planned to complete the above referenced round of campus engagement and first public meetings in May, due to graduation and other campus conflicts these meetings were completed in June.

PLANNED WORK FOR THE UPCOMING MONTH

Woodard & Curran Planned Work:

- Issue revised goals, objectives and mitigation projects for all campuses based on feedback received during the June 2013 on campus meetings and interviews.
- Issue a data request to the campuses to fill any remaining data gaps needed for the draft plan.
- Develop refined project schedule through to completion of the draft plan.

Planned Work for Campuses:

- UMass campuses to review revised hazard mitigation goals, objectives, building criticality rankings and projects.
- UMass campuses to provide information as needed to address final data gaps.

Approval of July 2013 Progress Report:

For UMass:

Jeff Hescock, Emergency Planning & Business Continuity Manager
August 8, 2013

For Woodard & Curran:

Mary B. House

Mary House, Project Manager
August 8, 2013

APPENDIX C: DOCUMENT REQUEST

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MEMORANDUM

TO: Jeff Hescock (University Project Manager), Emil Fioravanti (UMass Dartmouth), Bill Desrosiers (UMass Lowell), A. McLaughlin (UMass Boston), and Rich Lemoine (UMass Lowell)
FROM: Mary House and MaryKristin Ivanovich
DATE: October 1, 2012
RE: Multi-Campus Hazard Mitigation Plan Document Request

The documents requested below will provide Woodard & Curran with preliminary data and information on existing resources that will help us draft the Multi-Campus Hazard Mitigation Plan. Please review this list and provide as many of these documents (if applicable and/or available) prior to the campus kick-off meetings. We realize some of the information requested may be more effectively gathered during an on-campus visit (e.g., maps, drawings). In that case, please make a notation and have those materials readily available for review during the first scheduled site visit.

- Please provide complete copies of the following plans and procedures for your campus:
  - Emergency Operations Plans
  - Vulnerability or Risk Assessments
  - Emergency or Disaster Response Plans
  - Hazardous Waste Contingency Plans
  - Oil or Chemical Spill Response Plans
  - Stormwater Management Plans
  - Business Continuity or Continuity of Operations Plans
  - Public Health Emergency Response Plans
  - Fire Safety Plans
  - Evacuation Plans
  - Communications Plans
  - Campus Master Plans or Capital Improvement Plans

- Please provide campus map(s) showing building names, location of nearest water bodies, residences, sensitive areas (wetlands, wildlife, etc…).

- Please provide copies of Standard Operating Procedures (SOPs) or policies for responding to oil spills, chemical spills, civil disturbances (bomb threats, terrorist threats), fire, and natural disasters, if such policies exist and are not included in other emergency plans.

- Please list the types of permits held by facility, permit number (NPDES, wastewater, air, hazardous waste, etc.).

Name of Permit	Permit Number

- Please provide the names of utility suppliers (gas, fuel, water, electricity, etc.).
- Please provide a chemical inventory or a list of hazardous substances stored in bulk quantities (i.e. 55 gallons or more) at the facility.
- Please provide copies of the most recent Tier 2 filings and/or Toxic Release Inventory Reports.

University of Massachusetts System Office

UMass System Office Hazard Mitigation Plan

DRAFT

Prepared for:
University of Massachusetts
System Office

Prepared by:
Woodard & Curran
40 Shattuck Road | Suite 110
Andover, MA 01810

December 2013

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APPENDICES

EXECUTIVE SUMMARY

In 2012, the University of Massachusetts (UMass) campuses of UMass Boston, UMass Dartmouth, UMass Lowell and the UMass System Office began an effort to develop a Multi-Campus Hazard Mitigation Plan that would fulfill federal, state and local hazard mitigation planning requirements. The purpose of the Multi-Campus Hazard Mitigation Plan is to promote the safety of students, faculty, staff and visitors, by minimizing the impact of hazards on the University campuses' physical assets and operations, and by reducing or avoiding long-term vulnerabilities from identified hazards. The campuses chose to evaluate and plan for both natural and human hazards. The UMass System Office Annex Plan is one component of this larger planning effort and was written specifically for the UMass System Office. Funding for this project was provided by the Massachusetts Emergency Management Agency (MEMA) Hazard Mitigation Grant Program through a 75% grant and 25% campus match. UMass System Office contributions to the effort were made through in-kind labor contributions of staff members.

The UMass System Office will utilize this document moving forward as guidance in reducing its current and future risk from natural and human hazards by having resources, risk reduction strategies, responsible entities and historical information located in one place. The UMass System Office has been impacted by natural and human hazards in the past and through the development of this plan, focused on evaluating these impacts, engaging the public to understand their concerns and their understanding of mitigation planning.

Public Participation

The UMass System Office established a planning process for this project that included reaching out to local, state and federal stakeholders as well as UMass System Office representatives and key stakeholders from the community. The effort was coordinated by Jeffrey Hescock, Emergency Planning & Business Continuity Manager and hired consultant, Woodard & Curran. The core planning team included UMass System Office representatives who were involved in various aspects of the project and data collection activities and outside stakeholders were also involved. The core planning team met on a regular basis and was responsible for the following activities:

- Providing relevant information, plans, documents and data that was utilized during the preparation of the plan,
- Identifying natural and human hazards and assessing their past and potential future impact,
- Reviewing and evaluating the hazard ranking and assessment,
- Evaluating goals and objectives for mitigation activities,
- Developing potential projects that would help the UMass System Office demonstrate progress in meeting goals and objectives,
- Participating as engagement stakeholders and supporting public meeting events,
- Reviewing and commenting on the plan drafts, and
- Revising, adopting and maintaining the Multi-Campus Hazard Mitigation Plan and UMass System Office Annex Plan.

For the purposes of this Hazard Mitigation plan, identifying natural and human hazards included detailing geographically (if applicable) where an event has occurred historically, where is likely to occur in the future, and how substantial the event may be. Research was conducted using relevant documentation such as FEMA guidance documentation, local and state hazard mitigation plans and UMass System Office strategic planning documents. The hazards were then filtered by utilizing current and historical data points from various sources including but not limited to FEMA, NOAA, NCDC, USGS and the US Census. Finally, the UMass System Office analyzed the findings of each natural and human hazard and cross referenced the information with anecdotal data points to develop a final list of hazards that have and will continue to impact the UMass System Office, as listed in **Table ES-1.**

ES-Table 1: Natural & Human Hazards Impacting UMass System Office

Natural Hazards	Human Hazards
Coastal Storm	Weapons of Mass Destruction
Flood	Civil Disturbance
Drought	Fraud
Earthquake	HazMat Release
Extreme Heat	Bomb Threat
Hailstorm	Vandalism
Hurricane	Arson
Tornado	Violent Criminal Incident
Winter Storm	Robbery/Burglary
Thunderstorm/Lightning	Pandemic
Ice Storm	Explosion
Urban Fire	Cyberattack/Cyberterrorism
Wind Storm	Armed Attack/Active Shooter
	Critical Infrastructure Failure

Each hazard has been thoroughly profiled and discussed within the Hazard Mitigation Plan and the UMass System Office Annex Plan.

Vulnerability & Impact Assessment

The purpose of assessing risks, determining vulnerability and estimating losses is to determine how the UMass System Office assets may be affected by various hazard events. The UMass System Office considered their location and associated assets and then evaluated their vulnerability based on a loss of function and total damage calculation using the FEMA methodology as detailed in the Hazard Mitigation Plan. The specific calculations were then used to identify if impacted, which buildings may sustain the most damage to structures and contents, where applicable.

Goals & Objectives

The UMass System Office used the identification, profiling and vulnerability assessment of natural and human hazards that have or may impact them in the future to establish planning goals and objectives that provide the basis for the development of the proposed hazard mitigation projects. The establishment of goals and objectives was based upon a clear understanding of the hazards that have a potential to impact the UMass System Office community, what the risks associated with each hazard are and where vulnerabilities exist, as well as the University's commitment to reducing future vulnerability and mitigating risks where possible. Five main goals were developed, they include:

1) Protect existing and future assets from known hazards by implementing mitigation projects to minimize potential losses and ensure public health and safety.
2) Maintain a continuity of UMass System Office business operations during and after a hazard event.
3) Create and maintain a safe, secure environment for the UMass System Office population before, during and after a hazard event.
4) Communicate natural and human hazard information to the UMass System Office community and improve education and outreach efforts regarding their potential impact.
5) Proactively protect existing and future UMass System Office assets from known hazards by incorporating mitigation activities into capital improvement and infrastructure planning.

Mitigation Activities & Action Plan

Based on the vulnerability and impact assessment and goal setting phase, the UMass System Office used this information to develop projects and mitigation activities. Most of the action items were focused on mitigating winter storms, windstorms and hurricane impacts. The action items proposed meet the FEMA STAPLEE criteria and are generally socially acceptable to the community, technically feasible, protective of or beneficial to the environment and are backed by legal authority and consistent with current laws, consider economic benefits and costs and include environmental considerations. Each project was given a qualitative high, medium or low ranking based on these criteria.

Plan Implementation, Maintenance & Adoption

The implementation of the Hazard Mitigation Plan at the UMass System Office will be overseen by Jeffrey Hescock, Emergency Planning & Business Continuity Manager. Regular plan maintenance and revision activities have been considered and detailed in this document. Key to its success will be how well this plan is integrated into other UMass planning mechanisms that either directly or indirectly relate to the Hazard Mitigation Plan.

1. INTRODUCTION

The University of Massachusetts (UMass or University) is undertaking a system-wide effort to develop hazard mitigation plans for all of its campuses. This Annex D plan coupled with the introductory sections of the Hazard Mitigation Plan represents the Hazard Mitigation Plan for the University of Massachusetts System Office (UMass System Office). The purpose of this plan is to assist the UMass System Office in the identification of natural and human hazards that could impact its offices and personnel, and reduce the risk associated from applicable hazards through the development of specific hazard mitigation actions. The plan also identifies and discusses funding mechanisms to support the implementation of the mitigation actions.

1.1 UMASS SYSTEM OFFICE OVERVIEW

UMass is a public university system composed of five campuses and the System Office. The System Office maintains two locations in the Commonwealth of Massachusetts. One location is at 333 South Street in Shrewsbury, Massachusetts in Worcester County and the other is at 225 Franklin Street in Boston, Massachusetts in Suffolk County. The UMass System Office has two major components: The President's Office and Central Administrative Services. The President's Office provides overall leadership to the entire University and its five campuses. Central Administrative Services are responsible for the shared management and fiscal services of the University, which are centrally organized through the President's Office. The UMass System Office employs a professional staff of approximately 400 employees.

The UMass System Office located in Shrewsbury houses the Collaborative Services Facility which was created in 2003 to consolidate a number of departments within the University's System Office and other UMass campuses in an effort to both reduce costs and better serve the University system. The UMass System Office manages the shared services for the University in a collaborative environment where all of the campuses are deeply involved in decision making and direction setting. Shared services have been set-up in key support functions including, but not limited to: information technology, financial administration, auditing, and legal services.

UMass Online is also headquartered in Shrewsbury. UMass Online is the online learning consortium of the University of Massachusetts, providing the highest quality education offered by the University of Massachusetts system in a flexible, online format enabling students, professionals, and lifelong learners to take a course anywhere, anytime. UMass Online enables the University to provide greater access to its educational programs and to increase revenues that can be used to support all of the campuses.

The UMass System Office located in Boston, Massachusetts houses the executive office of the President of UMass as well as many members of his executive leadership team. The Boston Office also houses the UMass Club, which is a club established for alumni, faculty, staff, and friends of the University that brings these individuals together to foster a culture of academic, business, and social exchange information.

1.1.1 Town of Shrewsbury

The Town of Shrewsbury is a suburb of both Worcester and Boston and is bordered on the north by Boylston, Grafton on the south, Worcester and Lake Quinsigamond to the west, and Northborough/Westborough to the east, and West Boylston on the northwest. The population of Shrewsbury is over 35,000 people. The community is traversed by the Massachusetts State Highway Route 9 (Boston Worcester Turnpike) and Route 20 (Hartford Turnpike) and U.S. Interstate 290 goes through the northern portion of Shrewsbury.

The climate in Shrewsbury is typically cold and snowy in the winter with an average annual snowfall of 33 inches and warm in the summer with moderate amounts of rainfall. **Table 1-1** presents typical climate data for the Town of System Office.

Table 1-1: Climate Data for Shrewsbury 1981 – 2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Average High (°F)	31	35	43	55	66	74	79	77	70	58	48	36
Average Low (°F)	17	20	27	37	47	56	62	60	53	42	33	23
Average Precipitation (inches)	3.49	3.36	4.21	4.11	4.19	4.19	4.23	3.71	3.93	4.68	4.28	3.82
Source: *weather.com Climate Data for Shrewsbury, MA (1995 – 2012)*												

1.1.2 City of Boston

The City of Boston is located in Suffolk County in southeastern Massachusetts and according to the 2010 US Census, has a population of approximately 617,594. The city plays a major role in a larger metropolitan area known as Greater Boston which is home to nearly 4.5 million people and known as a commuting region for hundreds of thousands of people in Massachusetts and nearby areas of New England.

Figure 1: Boston, MA Location Map

Boston is home to a large number of colleges and universities and is recognized as an area of innovation. Over two thirds of Boston's land area did not exist when it was originally founded. Over time, gravel and fill has been brought into Boston to create the area commonly known as Back Bay as well as other parts of the city.

The greater Boston area typically experiences cold, snowy winters and generally warm, humid, rainy summers but due to its location adjacent to the ocean, can be influenced by coastal weather patterns directly. Nor'easters, snowfall events and thunderstorms are common. The City of Boston's climate data for the last three decades is shown in **Table 1-2**.

Table 1-2: Climate Data for Boston 1981 - 2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Average High (°F)	35.8	38.7	45.4	55.6	66.0	75.9	81.4	79.6	72.4	61.4	51.5	41.2
Average Low (°F)	22.2	24.7	31.1	40.6	49.9	59.5	65.4	64.6	57.4	46.5	38.0	28.2
Average Rainfall (inches)	3.36	3.25	4.32	3.74	3.48	3.68	3.43	3.29	3.44	3.94	3.99	3.78
Average Snowfall (inches)	14.0	11.3	7.8	1.9	0	0	0	0	0	0	1.3	8.8
Source: *NOAA Climate Data for Boston, Logan Airport (1981 – 2010)*												

1.1.3 Location & Environment

The UMass System Office in Shrewsbury is rented space in a building at 333 South Street. The building also houses a portion of UMass Medical School and two businesses: Seagate, a leader in hard disk drives and storage solutions, and Advanced MicroSensors Corporation, a manufacturer of magnetic sensors and thin film fabrication for micro components. The UMass System Office in Boston is located on the 33rd floor of the building at 225 Franklin Street. A list of the buildings occupied by the UMass System Office can be found in **Table 1-3.**

Table 1-3: UMass System Office Building Information

Name of Building	Date Construction Completed	Gross Square Feet	Building Function
333 South Street	1986	548,850	Office Space
225 Franklin Street - 33rd Floor	Unknown	25,000	Office Space

1.1.4 University Emergency Management and Continuity

The UMass System Office Emergency Management and Continuity Department is responsible for developing an Emergency Management and Continuity Program for the UMass System Office and assisting each campus in meeting their priorities in maintaining a system-wide emergency management and continuity program.

The University System has critical operations that must be performed, or rapidly and efficiently resumed in an emergency to support the safety and protection of employees, students, operations, research, education and facilities. Continuity planning at UMass is designed to address disruptions including:

- Denial or loss of access to a facility;

- Service interruption due to a reduced workforce; and
- Service interruption due to equipment or systems failure.

1.1.4.1 Risk Council

The Risk Council is a multidisciplinary, system-wide council representing each of the five UMass campuses and the UMass System Office. Departments and offices represented in the Disaster Resiliency Council include, but are not limited to:

- Academic Affairs, Student Affairs, and International Relations
- Accountability and Planning
- Administrative Services
- Chief Information Officer
- Contracts and Compliance
- Emergency Management and Continuity Planning
- Environmental Health and Safety
- Financial Services
- Insurance Analyst
- Police
- Risk Management and Insurance
- Strategic Communications

The Risk Council's mission is to foster communication, coordination, and collaboration among the campuses to assist in the prioritization of emergency management and business continuity activities across the UMass System and in identifying resource requests benefitting the University system.

1.1.5 Community Outreach

The UMass System Office engages with the Commonwealth and its communities and businesses through economic development, business and government partnerships and international relations initiatives.

The Office of Economic Development in the UMass President's Office works with major firms in Massachusetts and serves as a University-wide contact for addressing the workforce needs of major Commonwealth firms. In addition, the Office of Economic Development assisted in the development and supports system-wide workforce initiatives, including the Commonwealth Information Technology Initiatives, promoting creative reform of information curriculum of information technology.

Other economic initiatives include the *Mass*Benchmarks journal, which is published by the UMass Donahue Institute for Economic and Public Policy Research (Donahue Institute) in partnership with the Federal Reserve Bank of Boston. The *Mass*Benchmarks journal provides information on the performance of and prospects for the Massachusetts economy. In addition, between 1998 and 2008, the President's Office published a semi-annual newsletter for economic development called "In Brief."

The Donahue Institute is also involved in consulting and custom management services to meet the changing needs of government agencies. The Donahue Institute partners with clients and key stakeholders to customize services to meet the government agencies needs in the areas of strategic planning and goal setting, executive coaching, training plan development, organizational interventions, restructuring and redeployment initiatives, and implementing change and improvements.

The Office of Academic Affairs, Student Affairs and International Relations in the UMass President's Office works to form partnerships to create opportunities to expand the University's global outreach. The Office of Academic Affairs, Student Affairs and International Relations serves as a point of contact for external agencies and organizations including, state and federal higher education agencies, private foundations, and corporate stakeholders.

2. PLANNING PROCESS

The planning process for the UMass System Office Hazard Mitigation Plan was one of the most important components of the project. This section describes the planning process and stakeholders that were involved in this effort. The planning process included stakeholder engagement that was completed through a variety of means, involving both internal and external participation. Opportunities for involvement consisted of stakeholder meetings, interviews, focus groups, public meetings and informal opportunities to provide feedback made available throughout the process. The stakeholders involved included a wide cross section of UMass System Office representation from the offices in Shrewsbury and Boston.

2.1 PLANNING TEAM

The UMass System Office planning team efforts associated with this project were coordinated by Jeffrey Hescock, Emergency Planning & Business Continuity Manager. Mr. Hescock is the UMass System Office representative on the Hazard Mitigation Planning Steering Committee and the primary point of contact at the UMass System Office for this Hazard Mitigation Plan.

The first step in the process was to establish a specific Hazard Mitigation Planning Team at the UMass System Office to support Mr. Hescock, provide input into the hazard assessments and overall plan, and represent a broad cross section of UMass System Office representatives. It was determined that the core essential System Office stakeholders to be involved in the plan consisted of representation from Emergency Planning and Business Continuity, Computing and Information Technology Services, University Information Technology Services, Human Resources, Administration & Finance, Administrative Services and the Controller's Office. The UMass System Office Hazard Mitigation Planning Team is presented in **Table 2-1**.

Table 2-1: UMass Systems Office Hazard Mitigation Planning Team

Person	Title
Matthew Gorzkowicz	Assistant Vice President for Accountability and Planning
Jeff Hescock	Emergency Planning & Business Continuity Manager
Kim Howard	Associate University Director of Human Resources
Ellen Kanter	Associate Chief Information Officer (CIO) of Enterprise Application Services, University Information Technology Services (UITS) - Application Services
Philip Marquis	Assistant Vice President for Central Administrative Services and Associate Treasurer, Treasurer's Office
Sarah Mongeau	University Controller, Controller's Office
Joe Skrzek	Financial Analyst for Capital Programs, Treasurer's Office
Bill Smith	Senior Manager of Client Technology Services, University Information Technology Services (UITS) - Client Technology Services, Operations & Systems Administration
Carol Walsh	Communication Specialist, University Information Technology Services (UITS) - Change Management and Communication

Person	Title
Christine Wilda	Senior Vice President for Administration & Finance, Treasurer, President's Office
Larry Wilson	Lead Security Specialist, University Information Technology Services (UITS) - Info Security

These representatives were involved in important aspects of the project and during data collection activities; however other representatives as well as outside stakeholders were also involved. **Table 2-2** presents an overview of all of the stakeholders engaged in the UMass System Office Hazard Mitigation Plan. Each of the opportunities for stakeholder engagement will be discussed in **Section 2.3**.

Table 2-2: Stakeholders Engaged in UMass System Office Hazard Mitigation Plan

Person	Title	Entity	Attended Oct. 1, 2012 Steering Committee Kick-Off Meeting	Attended Nov. 7, 2012 System Office Kick-Off Meeting	Attended March 22, 2013 Interviews	Attended June 25, 2013 System Office Hazard Mitigation Goals, Hazard Profiles, Loss Estimates and Projects Meeting	Attended June 25, 2012 Focus Groups	Attended June 25, 2013 Public Meeting #1	Attended December. xx, 2013 Presentation of Draft Plan Meeting	Attended December. xx, 2013 Public Meeting #2
Jennifer Allen	Administrative Assistant, UMass Building Authority	Massachusetts Building Authority			X	X				
Tim Blondin	Senior Manager, Network Services	UMass System			X					
Brian Dawson	Customer Service Manager, University Information Technology Services (UITS) - Change Management, Training & Communications	UMass System			X	X				
Richard Grasse	President	PRISM Security		X	X					
Matt Gorzkowicz	Assistant Vice President of	UMass System				X				

Person	Title	Entity	Attended Oct. 1, 2012 Steering Committee Kick-Off Meeting	Attended Nov. 7, 2012 System Office Kick-Off Meeting	Attended March 22, 2013 Interviews	Attended June 25, 2013 System Office Hazard Mitigation Goals, Hazard Profiles, Loss Estimates and Projects Meeting	Attended June 25, 2012 Focus Groups	Attended June 25, 2013 Public Meeting #1	Attended December. xx, 2013 Presentation of Draft Plan Meeting	Attended December. xx, 2013 Public Meeting #2
	Accountability and Planning				X					
Marybeth Groff	State Hazard Mitigation Planner	Mass Emergency Management Agency (MEMA)	X					X		
Jeffrey Hescock	Emergency Planning & Business Continuity Manager	UMass System	X	X	X	X	X	X	X	X
Mary House	Project Manager	Woodard & Curran	X	X	X	X	X	X	X	X
Kim Howard	Associate University Director of Human Resources, Human Resource Department	UMass System	X	X	X	X				
MaryKristin Ivanovich	Technical Lead	Woodard & Curran	X							
Ellen Kanter	Associate Chief Information Officer (CIO) of Enterprise Application Services, University Information Technology Services (UITS) - Application Services	UMass System		X	X					
Julie Kenny	Procard Manager, University Information	UMass System			X	X				

Person	Title	Entity	Attended Oct. 1, 2012 Steering Committee Kick-Off Meeting	Attended Nov. 7, 2012 System Office Kick-Off Meeting	Attended March 22, 2013 Interviews	Attended June 25, 2013 System Office Hazard Mitigation Goals, Hazard Profiles, Loss Estimates and Projects Meeting	Attended June 25, 2012 Focus Groups	Attended June 25, 2013 Public Meeting #1	Attended December. xx, 2013 Presentation of Draft Plan Meeting	Attended December. xx, 2013 Public Meeting #2
	Technology Services (UITS) - EO									
Philip Marquis	Assistant Vice President for Central Administrative Services and Associate Treasurer, Treasurer's Office	UMass System		X	X					
Patrick Masson	Chief Technology Officer	UMass System			X					
Kim Medeiros	Business and Office Manager, President's Office	UMass System			X	X				
Sarah Mongeau	University Controller, Controller's Office	UMass System		X	X	X				
Keith Moran	Associate Chief Technology Officer (CTO), University Information Technology Services (UITS) - Software Administration & Architecture Services	UMass System				X		X		
Andrew Russell	Director of Risk Management and Insurance	UMass System			X	X				
Joe Skrzek	Financial Analyst for Capital Programs, Treasurer's Office	UMass System		X						
Bill Smith	Senior Manager of Client Technology	UMass System		X						

Person	Title	Entity	Attended Oct. 1, 2012 Steering Committee Kick-Off Meeting	Attended Nov. 7, 2012 System Office Kick-Off Meeting	Attended March 22, 2013 Interviews	Attended June 25, 2013 System Office Hazard Mitigation Goals, Hazard Profiles, Loss Estimates and Projects Meeting	Attended June 25, 2012 Focus Groups	Attended June 25, 2013 Public Meeting #1	Attended December. xx, 2013 Presentation of Draft Plan Meeting	Attended December. xx, 2013 Public Meeting #2
	Services, University Information Technology Services (UITS) - Client Technology Services, Operations & Systems Administration				X					
Amy Thompson	Operations Manager of Collaborative Services Facility	UMass System			X	X				
Carol Walsh	Communication Specialist, University Information Technology Services (UITS) - Change Management and Communication	UMass System		X	X	X				
Christine Wilda	Senior Vice President for Administration & Finance, Treasurer, President's Office	UMass System		X	X					
Larry Wilson	Lead Security Specialist, University Information Technology Services (UITS) - Info Security	UMass System		X						

Person	Title	Entity	Attended Oct. 1, 2012 Steering Committee Kick-Off Meeting	Attended Nov. 7, 2012 System Office Kick-Off Meeting	Attended March 22, 2013 Interviews	Attended June 25, 2013 System Office Hazard Mitigation Goals, Hazard Profiles, Loss Estimates and Projects Meeting	Attended June 25, 2012 Focus Groups	Attended June 25, 2013 Public Meeting #1	Attended December. xx, 2013 Presentation of Draft Plan Meeting	Attended December. xx, 2013 Public Meeting #2
Fran Zannoni	Associate Director for Human Resource Systems, Human Resources Department	UMass System			X	X				

2.2 EXISTING DATA AND REPORTS UTILIZED FOR THE PLAN

At the start of the project a data request was issued to the UMass System Office for existing documentation related to hazard and vulnerability risk assessments, emergency preparedness efforts, and System Office assets. The following presents a list of the information received and additional data sources that were utilized during the planning process.

- University of Massachusetts FY12-FY16 Five Year Capital Plan Update
- University of Massachusetts Business Continuity and Planning Guidelines
- University of Massachusetts Business Continuity and Planning Policy
- Multi-Hazard Mitigation Plan – Boston Annex, 2008
- City of Boston Natural Hazard Mitigation Plan – 2013
- Commonwealth of Massachusetts – State Hazard Mitigation Plan, 2010
- CMRPC Pre-Disaster Mitigation Plan, 2012

Appendix A includes a bibliography of the documents that were provided by the UMass System Office. **Section 6.4** provides a detailed capability assessment that includes information regarding data and reports that were utilized during the planning effort.

2.3 STAKEHOLDER ENGAGEMENT

Several opportunities were provided for stakeholder engagement that included the above referenced response to data request, stakeholder meetings, interviews, focus groups and public meetings. Each opportunity for stakeholder engagement and those involved are documented below.

2.3.1 UMass System Office Kick-Off Meeting

On November 7, 2012 a kick off meeting was held at the UMass System Office in Shrewsbury to initiate stakeholder engagement activities. The representatives in attendance are listed in **Table 2-2**. The meeting agenda, sign-in sheet and Power Point presentation are provided in **Appendix B**. The topics reviewed during this meeting are presented below in **Table 2-3.**

Table 2-3: Topics Reviewed During UMass System Office Kick-Off Meeting

Topic	Details
Project overview	Reviewed the goals of the project, background of the grant funding, and benefits to be achieved by the University System.
Hazard Mitigation Planning	Introduced the concept of hazard mitigation planning including the planning phases, types of hazards to be included and recent hazard events that impacted UMass campuses.
Approval Process and Requirements	Reviewed the requirements and expectations of FEMA/MEMA in order to achieve plan approval. Topics included the importance for documentation, stakeholder engagement, and focus on the importance of the process. FEMA's evaluation criteria were provided as a handout.
Components of Hazard Mitigation Planning	Reviewed the planning process, hazard identification and risk assessment, mitigation strategy, and plan review, evaluation, and implementation. FEMA's hazard identification worksheet was provided as a handout.
Team Roles and Responsibilities	Roles and responsibilities consisted of participation in meetings, providing relevant documentation, identification and assessment of hazards, support outreach activities, review and comment on the draft Plan and support Plan implementation.
Project Schedule	The project schedule was reviewed with interim and final deadlines. Approval by MEMA/FEMA is necessary by October 2014 to meet the obligations of the grant.
Project Website	Gave an overview of the project web site including login process and future content to be included.

The UMass System Office kick-off meeting provided a solid foundation for stakeholders regarding the project objectives and how they could work together as a team. The meeting outlined the expectations and process to be followed regarding how to prepare and complete this Plan.

2.3.2 Stakeholder Interviews

On March 22, 2013 stakeholder interviews were completed to discuss hazards that have or could impact the System Office, potential vulnerabilities to those hazards and assets that could be impacted. The interviews were completed via conference call in groups and lasted up to one hour in duration. Four interview timeslots were made available and each stakeholder invited could participate in the call that worked best with each person's schedule. Interviews were conducted by Woodard & Curran and our teaming partner, Prism Security, who supported the human hazard risk assessment efforts. The interview matrix is provided in **Appendix B.**

Table 2-4: UMass Systems Office Stakeholder Interview Matrix

	Department/Person
March 22, 2013	
9:00 - 10:00	• Jeff Hescock (Emergency Planning & Business Continuity Manager); • Brian Dawson (Customer Services Manager, UITS); • Amy Thomson (Operations Manager of Collaborative Services Facility), • Andrew Russell (Director of Risk Management & Insurance), • Patrick Masson (Chief Technology Officer)
10:30 – 11:30	• Jeff Hescock (Emergency Planning & Business Continuity Manager), • Phillip Marquis (Assistant Vice President for Central Administrative Service's and Associate Treasurer), • Julie Kenny (Procard Manager, UITS), • Fran Zannoni (Associate Director For Human Resource Systems), • Carol Walsh (Communication Specialist, UITS), • Jennifer Allen (Administrative Assistant, UMBA), • Kim Medeiros (Business and Office Manager, President's Office)
1:00 - 2:00	• Jeff Hescock (Emergency Planning & Business Continuity Manager), • Kim Howard (Associate University Director of Human Resources), • Christine Wilda (Senior Vice President for Administration & Finance), • Bill Smith (Senior Manager of Client Technology Services), • Tim Blondin (Senior Manager Network Services)
2:30 - 3:30	• Jeff Hescock (Emergency Planning & Business Continuity Manager) • Matt Gorzkowicz (Assistant Vice President of Accountability and Planning) • Sarah Mongeau (University Controller) • Ellen Kanter (Associate Chief Information Officer of Enterprise Application Services)

Interviews were conducted in an open format by two interviewers. An interview questionnaire (**Appendix C**) was prepared and distributed in advance, however this was intended only to give the interviewees a flavor for the types of topics to be addressed as opposed to a list of questions that would be strictly adhered to during the interview. The approach was instead to have the interviews focus on the areas in which he/she had the most experience and information to share and not to be restrictive in the discussion. As a result of the interviews, a series of themes were identified as outlined in **Table 2-5.**

Table 2-5: UMass System Office Interview Topics & Themes

Topic	Themes
Operations	Majority of system administration functions are located at the System Office. Hazards impacting the System Office could result in impacts to other

	campuses.
	Important IT systems and information is housed in the System Office.
Utilities/System Office Assets	Loss of power and utility failure (specifically fiber optic lines) is of the highest concern.
	Ability to access the data center during long term hazard events.
	Potential for roof collapse from a large snow event at the Shrewsbury location.
Utilities/System Office Assets System Office Setting and Surrounding Areas	Dependency on area lines for fiber optic cables and power poles.
System Office Setting and Surrounding Areas, Safety & Security	General safety of staff at the System Office.
	Susceptibility of System Office to cyberattacks.
	Lack of redundancy of information systems and means to capture institutional knowledge.
Safety & Security, System Office Population	Open nature of the buildings.
	Desire for increased key card access.

All of these themes were important considerations that factored into the hazard identification and risk assessment process. Aside from these common themes, interviewees gave perspectives on hazards that had or could impact the UMass System Office and previous damages or impacts that had been experienced from hazard events. A brief summary of the specific previous hazard events mentioned by interviewees includes:

- Minor movement from an earthquake has been felt in the past,
- Tornadoes have impacted the surrounding area in the past, but no direct impacts to the UMass System Office,
- Power outages have been experienced from winter storm events, and
- The IT infrastructure backbone was impacted by Hurricane Irene; there have also been impacts from high winds and other mini-hurricane like events.

The list is not meant to be all inclusive of past events experienced on System Office and only represents events mentioned during the interviews. More specific information provided is presented in **Section 3**.

2.3.3 Hazard Identification and Risk Assessment Meeting

On April 12, 2013 a hazard identification and risk assessment meeting was held at the UMass System Office in Shrewsbury to initiate the hazard identification and risk assessment process. The representatives in attendance are listed inError! Reference source not found. The meeting agenda, sign in sheet and Power Point presentation are provided in **Appendix D**. The topics reviewed during this meeting are presented in **Table 2-6.**

Table 2-6: Topics Reviewed During Hazard Identification and Risk Assessment Meeting

Topic	Details
Overview of Hazard Mitigation Planning Process and Meeting Goal	A brief overview of the hazard mitigation planning process was provided as a review for meeting attendees. The meeting goal was to reach consensus on a ranked list of natural and human hazards that could impact the UMass System Office.
Overview of Potential Hazards	Specific considerations associated with hazard events were presented to the stakeholders and included summaries of previous studies, ongoing planning, and hazard mapping. Abbreviated hazard event profiles were presented.
Summary of Interview discussions	Common themes shared by interviewees and specific hazard events mentioned were reviewed. Considerations resulting from the interviews were discussed as well as initial mitigation projects identified to address potential hazards.
Hazard Ranking Methodology	The hazard ranking methodology was reviewed with the stakeholders and consisted of ranking the categories of frequency, severity, duration and intensity with a 0 to 5 scale. The categories were grouped into probability and consequence factors that could be weighted.
Group Workshop Hazard Ranking	The stakeholder group reviewed the list of natural and human hazards identified and ranked each category using the 0 to 5 scale. The weighting of probability and consequence were assigned to reach a total rank for each hazard. Based on the numerical value of the ranking, each hazard was further categorized in groups of severe, high, medium and low.

Upon completion of the meeting, the System Office stakeholders were provided with the finalized list of ranked hazards to reflect upon and make further modifications as necessary.

2.3.4 Hazard Mitigation Goals, Hazard Profiles, Loss Estimates, and Projects Meeting

On June 25, 2012 a hazard mitigation goal, hazard profile, loss estimate and project meeting was conducted at the UMass System Office in Shrewsbury. The representatives in attendance are listed in **Table 2-2**. The meeting agenda, sign in sheet and Power Point presentation are provided in **Appendix E.** The topics reviewed during this meeting are presented in **Table 2-7.**

Table 2-7: Topics Reviewed During Hazard Mitigation Goals, Hazard Profiles, Loss Estimates and Projects Meeting

Topic	Details
Hazard Mitigation Goals and Objectives	The hazard mitigation goals, objectives and projects developed for the UMass System Office were presented to the stakeholder group for initial review and comment. Goals and objectives were tied to specific hazard events and mitigation projects were identified to address hazards.
Hazard Event	Detailed hazard event profiles were presented for natural hazards and the

Topic	Details
Profiles	hazard rankings previously identified were reviewed against those profiles to determine if any modifications to the rankings were necessary. In a few cases, modifications to the rankings were made.
Building Ratings	The methodology to assign building critically values was reviewed with the stakeholder group as well as the initial assignment of building critically values.
Loss Estimates	The methodology for developing loss estimates was reviewed and findings associated with both specific hazards and non-hazard specific events were presented. A quantitative assessment was completed for non-hazard specific loss of function, floods and earthquakes. Qualitative assessments were completed for other hazard events.
Hazard Mitigation Projects	Specific hazard mitigation projects identified to address the various hazards that could impact the UMass System Office were presented in relation to the specific hazard addressed and plan goals and objectives.
Public Workshop	Stakeholders were briefed on the format and logistics associated with the first public workshop. All stakeholders were invited to participate. Public announcements were issued.

After the meeting, revised goals, objectives, and hazard mitigation projects were provided to the stakeholder group for further review and comment.

2.3.5 UMass System Office Mitigation Projects Focus Groups

In order to develop the most comprehensive list of viable hazard mitigation projects, small focus groups were completed with Emergency Management & Business Continuity, and Computing and Information Technology Services to complete a more in-depth review of the existing list of hazard mitigation projects. These focus groups were also completed on June 25, 2013 and were attended by representatives outlined in Error! Reference source not found.. As a result of these focus groups, additional mitigation projects were identified and insights were provided as to the highest priority from each group’s perspective. Some of the projects discussed in each focus group are listed below:

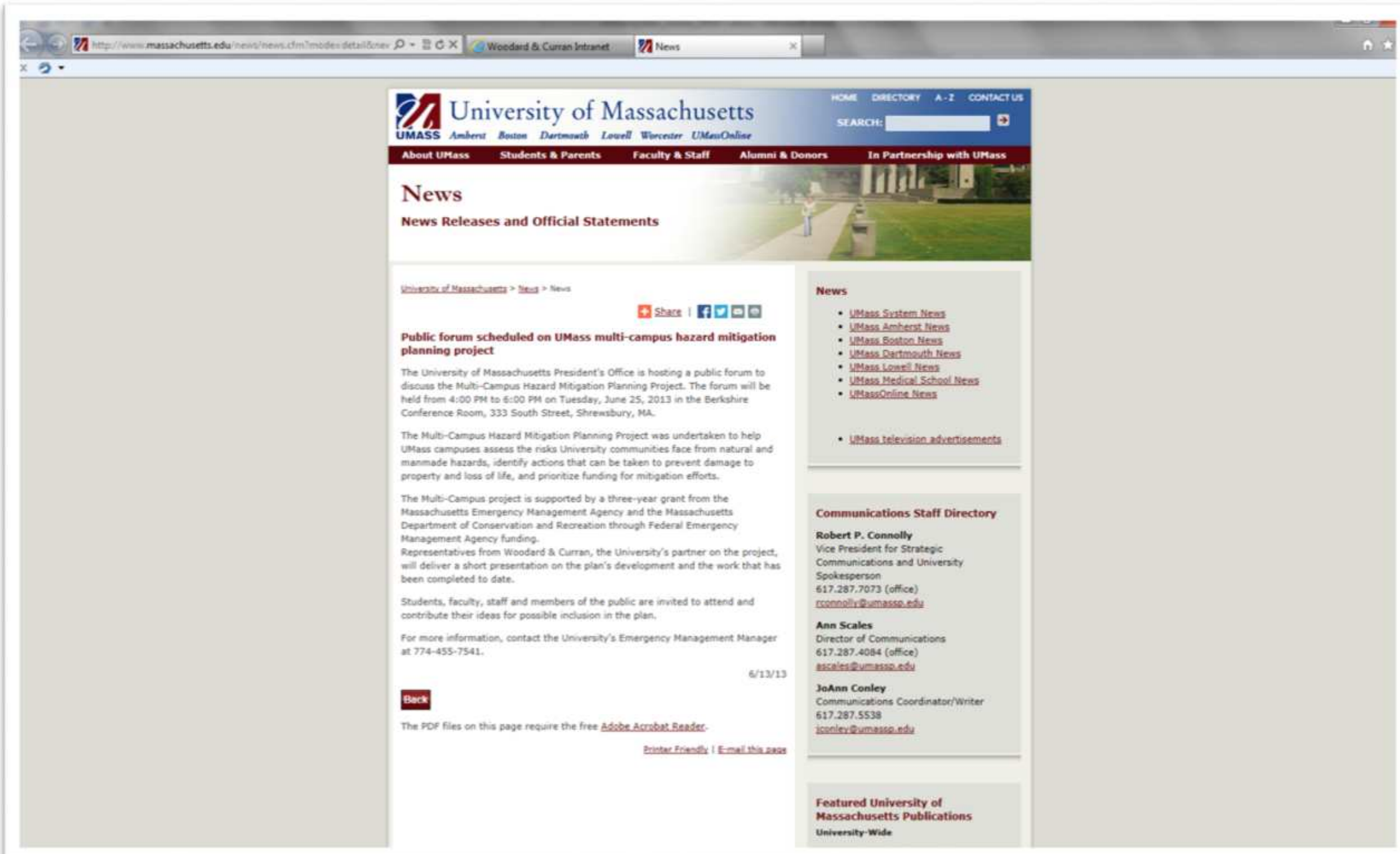
- Redesigning the Information Technology “backbone” to address connectivity issues,
- Relocating the IT infrastructure to Amherst, a lower hazard prone area, and
- Increase building security presence and employee identification system.

A full list of mitigation projects that have been identified is presented in **Section 6**.

2.3.6 Public Meeting No. 1

On June 25, 2012 the first public meeting regarding this hazard mitigation planning process was held on the UMass System Office. The means for advertising consisted of posting the meeting notice on the University of Massachusetts website (see **Figure 2**).

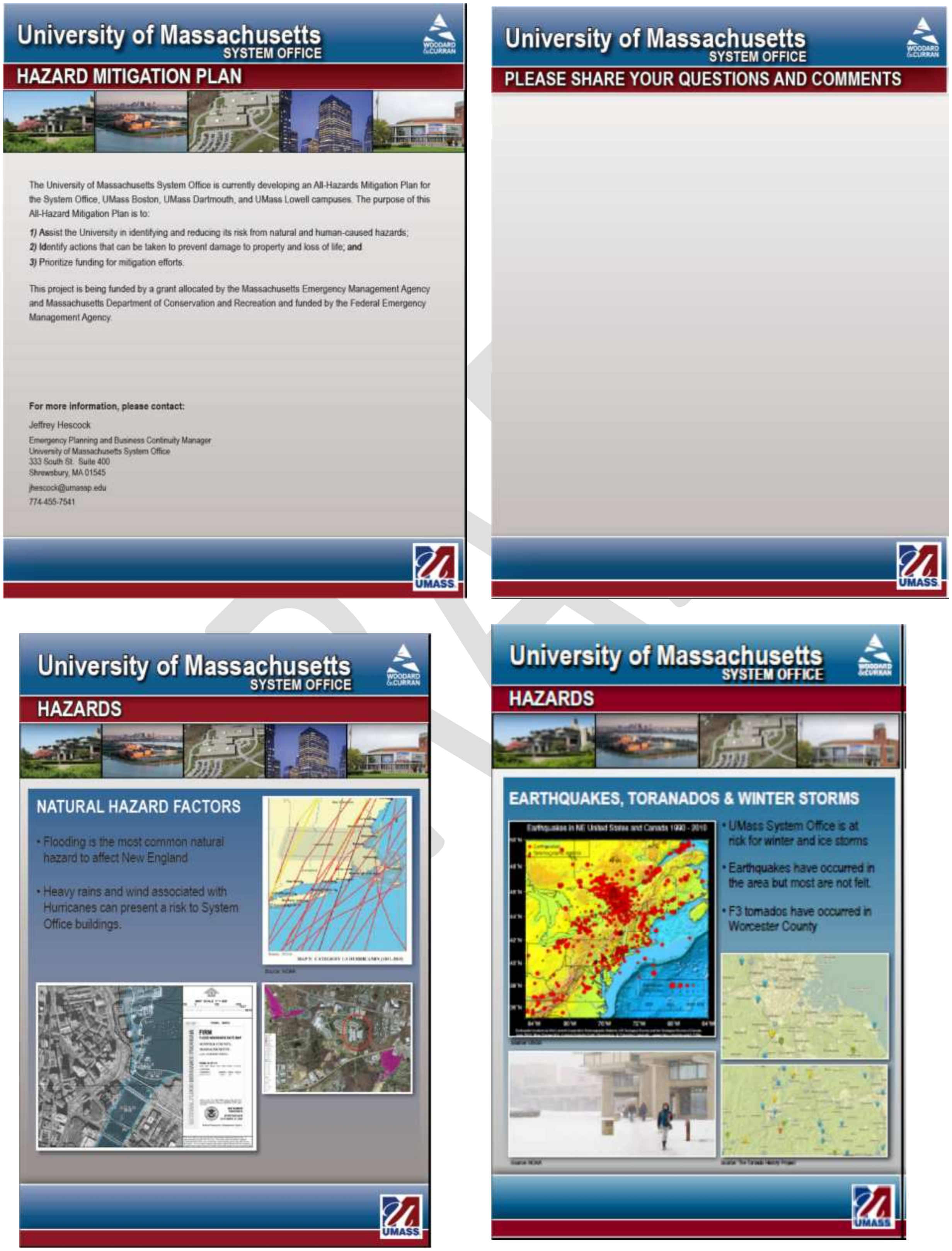
Figure 2: Public Meeting No. 1 Advertising



The format of the public meeting was designed to be casual and informative and conducive to receiving input. The room was set up in stations where the public could learn about or provide input into the planning process which included:

- **Hazard Mitigation Power Point presentation:** An automated Power Point presentation focused on the hazard mitigation planning process was continually displayed with a new slide projected every 20-30 seconds.
- **Hazard Posters:** Posters focused on some of the top hazards to potentially impact the UMass System Office were set up for viewing purposes. One poster focused specifically on flooding, while the second poster focused on other types of common hazards such as hurricanes, tornados and winter storms (**Figure 3**).
- **Handout:** A handout was presented that listed the main goals of the project and who at UMass System Office to contact for further information (**Figure 3).**
- **Comments:** Throughout the room blank handouts with space to write comments, questions or thoughts were provided (**Figure 3**).

Figure 3: Hazard Posters Used During Public Participation Process



The public meeting was attended by several campus representatives, system office representatives, Woodard & Curran representatives and a MEMA representative. While the planning process was discussed among the various attendees, no specific comments were provided that were not already captured in previous interviews, stakeholder meetings or focus groups. Public meeting materials are provided in **Appendix F.**

2.3.7 Presentation of Draft Hazard Mitigation Plan Facilitated Review Meeting

On December 19, 2013, a meeting was held at the UMass System Office to present the written draft plan to the UMass System stakeholders. The representatives in attendance are listed in **Table 2-2**. The meeting agenda, sign in sheet and Power Point presentation are provided in **Appendix G.**

The written draft was issued prior to the meeting such that all stakeholders would have an opportunity to review the draft prior to the meeting. During the meeting a facilitated review of the draft was provided highlighting key areas to focus upon. Feedback on the draft was solicited and recorded for incorporation into the final version of the Plan.

The comments received are presented in **Table x-x**

Table x-x Comments Received from Facilitated Stakeholder Meeting

2.3.8 Public Meeting No. 2

On _____ the second public meeting presenting the draft Hazard Mitigation Plan was held at the UMass System Office in Shrewsbury. The meeting was advertised using a variety of venues with support from the UMass System Office communications representatives. The means for advertising consisted of:

- Listing on area web sites

The format of the public meeting was designed to be casual and informative and conducive to receive input. The room was set up in the following stations where the public could learn about or provide input into the Plan:

- Hazard Mitigation Power Point presentation: An automated Power Point presentation focused on the major components of the Hazard Mitigation Plan was continually displayed with a new slide projected every 20-30 seconds.
- Hazard Posters: Posters focused on some of the top hazards to potentially impact the System Office were set up for viewing purposes. One poster focused specifically on flooding, while the second poster focused on other types of common hazards such as winter storms.
- Hard Copy DRAFT Hazard Mitigation Plan: Several hard copies of the full draft hazard mitigation plan were available for review.
- Comments: Throughout the room blank handouts with space to write any comments, questions or thoughts were provided.

The comments received are presented in **Table x-x.**

Table x-x Comments Received from Public Workshop

Public meeting materials are provided in **Appendix H.**

3. HAZARD PROFILES & RISK ASSESSMENT

For the purposes of this Hazard Mitigation Plan, the term hazard is defined as an extreme natural or human event that poses a risk to people, infrastructure, operations or resources. Identifying hazards includes detailing geographically where an event has occurred historically, where it is likely to occur in the future, and how substantial the event may be. Natural hazards received their initial identification and consideration from FEMA guidance documentation and were then filtered by utilizing both current and historical data from various sources. The human hazard identification for each campus focused on hazards that are reasonably viable and have occurred in the past, or may have occurred at other college or university campuses.

3.1 NATURAL HAZARDS IMPACTING THE UMASS SYSTEM OFFICE

The natural hazards that have been identified and included in this section received their initial consideration from FEMA Guidance documentation. The hazards were then filtered by utilizing current and historical data points from various sources including but not limited to NOAA, US Census and local and state Hazard Mitigation Plans. The findings of each natural hazard were analyzed and the information was cross referenced with anecdotal data points. A list of natural hazards that have and may continue to impact the UMass System Office was developed. Of the natural hazards that have been considered for this planning effort, the UMass System Office was found to be susceptible to thirteen of them (**Table 3-1**). A qualitative or quantitative analysis for each hazard was conducted which is detailed in the sections that follow.

Table 3-1: Quantitative/Qualitative UMass System Office Natural Hazard Risk Ranking

Natural Hazard	System Office Susceptible?	Quantitative/Qualitative
Earthquake	Yes	Quantitative and Qualitative
Hurricane	Yes	Qualitative
Tornado	Yes	Qualitative
Flood	Yes	Quantitative and Qualitative
Drought	Yes	Qualitative
Winter Storm	Yes	Qualitative
Thunderstorm/Lightning	Yes	Qualitative
Hailstorm	Yes	Qualitative
Urban Fire	Yes	Quantitative & Qualitative
Extreme Heat	Yes	Qualitative
Windstorm	Yes	Qualitative
Ice Storm	Yes	Qualitative
Coastal Storm	No	Not Applicable
Ice Jam	No	Not Applicable
Dam Failures	No	Not Applicable
Avalanche	No	Not Applicable
Volcano	No	Not Applicable
Landslide	No	Not Applicable
Wildfire	No	Not Applicable

As a result of interviews and a follow up group meeting, in February 2013, the UMass System Office Hazard Mitigation Planning Team ranked the natural hazards that have or may impact the UMass System Office in the future according to a Hazard Ranking of Low, Medium, High or Severe. Each of these natural hazards is discussed in more detail in the following sections. A qualitative ranking (on a scale of 0 to 5) in the categories of frequency, severity, duration and intensity was conducted after the hazards were identified and vetted. For the UMass System Office, the hazards were then weighted regarding the probability (40% which included rankings of frequency, duration and intensity) that the hazard could impact the UMass System Office and the consequences (60% which included rankings of severity) that would be realized by the UMass System Office

In general, hazards with a low estimated frequency, duration, severity and intensity are expected to have minimal to no impact on the System Office. Hazards with a high frequency, duration, severity and intensity were given a higher mitigation priority. Higher rankings may be more likely to occur on a regular basis or within the next five years and could result in substantial impacts to the UMass System Office with regard to economic damage, loss of function and operations of the UMass System Office and human injury. **Table 3-2** provides a summary of the rankings which are also discussed in more detail in each specific hazard section.

Table 3-2: UMass System Office Natural Hazard Risk Ranking Summary

Natural Hazard	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability F,D,I (40%)	Consequence S (60%)	Total	Ranking L,M,H,S
Drought	1	1	1	1	1.00	1.00	1.00	L
Hailstorm	1	1	1	1	1.00	1.00	1.00	L
Extreme Heat /Cold	2	2	1	1	1.67	1.00	1.27	L
Thunderstorm /Lightning	2	1	2	2	1.67	2.00	1.87	L
Tornado	1	1	3	3	1.67	3.00	2.47	M
Earthquake	1	1	3	2	1.33	3.00	2.33	M
Ice Storm	1	2	3	3	2.00	3.00	2.60	M
Windstorm	4	2	2	2	2.67	2.00	2.27	M
Flood	1	1	1	1	1.00	1.00	1.00	L
Winter Storm	4	3	3	3	3.33	3.00	3.13	H
Coastal Storm (primarily Boston)	1	2	2	2	1.67	2.00	1.87	L
Urban Fire	1	2	2	2	1.67	2.00	1.87	L
Hurricane	3	4	5	4	3.67	5.00	4.47	S

3.1.1 Drought

3.1.1.1 Occurrences of a Drought Hazard

According to FEMA, there has never been a Presidential Disaster Declaration made for a drought in the State of Massachusetts. At the UMass System Office, there are no records of a drought impacting the System Office. For eastern Massachusetts in general, specific details from the NCDC Storm Events Database were available regarding two drought occurrences between 2000 and 2013.

- **April/May 2012 –** The U.S. Drought Monitor declared a severe drought across the eastern half of Massachusetts, Rhode Island and a portion of Connecticut from April 12 – May 15, 2012. Precipitation had been half of the normal amount between January 2012 and April 2012 and rivers and streams were running at low levels during the spring run-off season. One major impact of this meteorological drought was an increase in fire danger.
- **Winter 2001/2002 –** The Northeast experienced record warmth during the December 2001 through February 2002 winter season which coincided with below normal precipitation and led to widespread drought conditions throughout New England.

3.1.1.2 Probability of Future Occurrence of a Drought Hazard

While drought is noted in the State Hazard Mitigation Plan as having a widespread statewide impact, it was ranked as having a low frequency of occurrence. The most severe drought on record in Massachusetts occurred between 1961 – 1969. The eastern portion of Massachusetts has experienced 2 drought scenarios of note in the past ten years, or an average of .18 drought events per year. Past drought occurrences can be an indicator of the probability of future drought events, both long and short term.

3.1.1.3 Vulnerability to Drought Hazard

Boston Location

The UMass System Office location at Franklin Street in Boston receives its water supply from the Massachusetts Water Resources (MWRA) Quabbin Reservoir which the City of Boston is connected to and is located 65 miles to the west. As of May 1, 2013, the Quabbin Reservoir was at 91.7% of its 412 billion gallon maximum capacity to serve 47 communities in the Metro Boston area. Monitoring drought conditions for the state of Massachusetts is important to the UMass System Office location in Boston not only directly, but indirectly as a result of where their water source is actually located. **Table 3-3** summarizes drought information reviewed for the geographic areas (local, regional, state) that are associated with overall drought conditions and the UMass System Office location at Franklin Street in Boston.

Shrewsbury Location

The UMass System Office location on South Street in Shrewsbury receives its water supply from the town source which is a series of gravel packed wells located in the northwest quadrant of the community. According to the Central Massachusetts Regional Planning Commission (CMRPC), the region has no record of a drought-related declaration, though certain parts of Massachusetts do experience drought conditions at times. Frequency of occurrence is low, and should a drought event occur, impacts would vary throughout the region.

Table 3-3: Drought Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• State of Massachusetts (2010) Hazard Mitigation Plan • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Anecdotal Information from UMass System Office • NOAA NCDC North American Drought Monitor Map and data	• According to the NCDC North American drought monitor, Massachusetts is not currently (as of January 2013) suffering from any type of drought condition. • Drought was ranked in the State Hazard Mitigation Plan as having a low frequency of occurrence, with minor to serious severity, and having a widespread statewide impact. • Massachusetts has a Drought Management Task Force who prepared a Drought Management Plan that notes western Massachusetts may be more vulnerable than eastern Massachusetts to severe drought conditions. • Massachusetts has experienced multi-year drought periods and the most severe drought on record in the northeastern U.S. was during 1961-69. • There is no record of a drought event in the central Massachusetts region where the UMass System Office is located on South Street in Shrewsbury.

3.1.1.4 Risk Assessment Methodology, Limitations and Results

After careful consideration of the data available for a drought hazard event and its impact to the UMass System Office locations, the risk assessment for this natural hazard has been developed as a qualitative analysis. The UMass System Office prepared a qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of a drought utilizing a low, medium, high and severe ranking system. The ranking given for the UMass System Office was based on background research, knowledge of its locations and past occurrences and is presented in **Table 3-4**.

Table 3-4: Risk Assessment – Drought Hazard

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Ranking L,M,H,S
Drought	1	1	1	1	1.00	1.00	1.00	L

After reviewing the initial ranking of **low** and conducting further research, specific consideration was given to how an event could impact staff and any visiting students/faculty, existing buildings, future buildings, operations and critical infrastructure (see **Table 3-5**).

Table 3-5: Qualitative Risk Assessment – Drought Hazard

	Drought Hazard - Qualitative Ranking
Risk Ranking	Low
Students, Faculty & Staff	Low
Existing Buildings	Low
Future Buildings	Low
Operations	Low
Critical Infrastructure	Low

As a result of considering these additional factors, the overall ranking remained **low**.

3.1.1.5 Future Development Considerations

The UMass System Office will consider drought hazard scenario planning during discussions about the future of endeavors of the offices. Measures should be in place to position both locations favorably should a drought scenario occur that would impact the water supply to the UMass System Office and/or the ability of the UMass System Office to conduct day to day activities. The following considerations will be incorporated into future planning activities.

- Adequate fire suppression ability for emergency response activities at each UMass System Office location,
- Possibility of capturing and reusing water at the UMass System Office location for a variety of purposes,
- Development of emergency procedures, or a clear understanding of City of Boston and Town of Shrewsbury emergency procedures for back up or interim water supply options and connections should there be disruption of service to the City of Boston or area served by the Quabbin Reservoir and/or water service in Shrewsbury.

3.1.2 Hailstorm

3.1.2.1 Occurrences of a Hailstorm Hazard

According to FEMA, there has not been a Presidential Disaster Declaration made for hailstorm in the State of Massachusetts. At the UMass System Office, there are no records of a hailstorm impacting the buildings. The NCDC tracks storm events and the information in **Table 3-6** was available for Suffolk County regarding hail occurrences. **Table 3-7** details hail event information for the Town of Shrewsbury.

Table 3-6: Hail Event Data for Suffolk County 2000 - 2012

Location	Date	Size	Death	Injury	Property Damage
REVERE	7/18/2012	1.25 in.	0	0	0.00K
REVERE	7/18/2012	0.75 in.	0	0	0.00K
DORCHESTER	6/8/2012	0.75 in.	0	0	0.00K
CHARLESTOWN	8/19/2011	0.75 in.	0	0	0.00K
BOSTON	8/19/2011	1.00 in.	0	0	0.00K
DORCHESTER	6/5/2010	0.75 in.	0	0	0.00K

Location	Date	Size	Death	Injury	Property Damage
DORCHESTER	5/8/2010	1.00 in.	0	0	0.00K
DORCHESTER	8/10/2008	0.88 in.	0	0	0.00K
DORCHESTER	6/23/2006	1.00 in.	0	0	0.00K
BOSTON	7/2/2004	0.75 in.	0	0	0.00K
BRIGHTON	7/18/2000	1.00 in.	0	0	0.00k
Source: NCDC Storm Events Database http://www.ncdc.noaa.gov/stormevents/					

Table 3-7: Hail Event Data for Town of Shrewsbury 2000 - 2012

Location	Date	Size	Death	Injury	Property Damage
SHREWSBURY	5/26/2010	1.00 in.	0	0	0.00K
SHREWSBURY	5/24/2009	1.75 in.	0	0	15.00K
SHREWSBURY	8/22/2003	0.75 in.	0	0	0.00K
Source: NCDC Storm Events Database http://www.ncdc.noaa.gov/stormevents/					

Significant hail events that result in death, injury, or property damage have not occurred in Suffolk County or the Town of Shrewsbury from January 1, 2000 through February 28, 2013. Specific details from the more substantial hail events noted in **Table 3-7** include the following:

- **July 18, 2012 –** Severe weather brought large hail and flash flooding throughout southern New England. Hail 1.25 inches in diameter was reported in Revere.
- **August 19, 2011 –** Severe thunderstorms produced large hail and damaging winds. Hail 1.00 inch in diameter was reported in Boston.
- **May 26, 2010 –** Showers and thunderstorms resulted in hail (1.0 inch in diameter) in Shrewsbury. Showers and thunderstorms produced significant wind damage throughout much of the Connecticut River Valley in Massachusetts.
- **May 24, 2009 –** Severe thunderstorms produced golf size hail (1.75 inch in diameter) in Shrewsbury that dented cars.
- **July 2, 2004 –** Severe weather brought large hail, downed trees, and power lines throughout eastern Massachusetts. Hail 0.75 inches in diameter was reported in Boston.
- **August 22, 2003 –** Severe thunderstorms produced 0.75 inch hail in Shrewsbury. Downed trees, wires, and large branches were reported throughout much of Worcester County.

3.1.2.2 Probability of Future Occurrence of a Hailstorm Hazard

The probability of a future hail event in the City of Boston or the Town of Shrewsbury that could impact the UMass System Office is likely. Boston and Shrewsbury are in areas of Massachusetts that typically experience several hail events on an annual basis.

3.1.2.3 Vulnerability to Hailstorm Hazard

Although not a frequent occurrence, hail can occur in any location of Massachusetts. The UMass System Office is located in a region that is vulnerable to hail events. The susceptibility criteria considered for a hailstorm are presented in **Table 3-8**.

Table 3-8: UMass System Office Hailstorm Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• State of Massachusetts (2010) and City of Boston (2008) Hazard Mitigation Plans	• Hail is discussed as part of thunderstorm events in the state plan which notes that the entire state is susceptible. It notes that one of the more damaging storms was in 1998 and impacted Suffolk, Worcester, Bristol and Middlesex County among others.

3.1.2.4 Risk Assessment Methodology, Limitations and Results

With careful consideration of the data available for hailstorm hazard event and its potential impact to the UMass System Office, the risk assessment for this natural hazard has been developed as a qualitative analysis. The ranking is provided in **Table 3-9** and was based on past occurrences and potential impacts.

Table 3-9: Risk Assessment – Hailstorm

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Ranking L,M,H,S
Hailstorm	1	1	1	1	1.00	1.00	1.00	L

After reviewing the initial ranking of **low** and conducting further research, specific consideration was given to how an event could impact staff and any visiting students/faculty, existing buildings, future buildings, operations and critical infrastructure and is presented in **Table 3-10.**

Table 3-10: Qualitative Risk Assessment – Hailstorm Hazard

	Hailstorm Hazard - Qualitative Ranking
Risk Ranking	Low
Students, Faculty & Staff	Low
Existing Buildings	Low
Future Buildings	Low
Operations	Low
Critical Infrastructure	Low

As a result of considering these additional factors, the overall ranking remained **low**.

3.1.2.5 Future Development Considerations

The UMass System Office will consider hailstorm hazard scenario planning during future endeavors and continue to implement measures to mitigate the impact of hail occurrences. Preventing a hail event is not plausible, but limiting the effects on the UMass System Office is feasible. Future considerations include the following:

- Coordinate communication and tracking of weather and emergency information with City of Boston and Town of Shrewsbury officials, and
- Coordinate outreach to public with consistent messaging, information, and instructions via public broadcast, websites, email, and social media for watches and warnings issued by the National Weather Service.

3.1.3 Extreme Heat

3.1.3.1 Occurrences of Extreme Heat Hazard

According to the FEMA, there has never been a Presidential Disaster Declaration made for extreme temperatures in the State of Massachusetts. At the UMass System Office locations in Boston and Shrewsbury, there are no records of extreme heat impacting the facilities. For southern New England in general, specific details from the NCDC Storm Events Database were available regarding one excessive heat occurrence between 2000 and 2013.

- **July 6, 2010 –** High humidity and temperatures nearing 100 degrees were reported. Heat index values were in the range of 100 to 106 for most of Southern New England.

Other data sources note the following information about Massachusetts extreme heat events:

- **2012** - In 2012, Massachusetts experienced a total of 27 broken heat records.
- **July 22, 2011 –** Very hot temperatures were experienced in Southern New England. A moist southwest low level flow increased humidity levels such that heat index values rose above 105 degrees for a period of a few hours.

3.1.3.2 Probability of Future Occurrence of an Extreme Heat Hazard

The probability of future extreme heat events occurring in the City of Boston is certain and is possible in the Town of Shrewsbury. According to a report by the Center for Disease Control (CDC), *"Climate Change and Extreme Heat Events,"* the number of hot and extremely hot days for Boston is anticipated to increase exponentially in the next 100 years.

According to the CMRPC regional Hazard Mitigation Plan, the frequency of an extreme heat event occurring in Worcester County is extremely low.

3.1.3.3 Vulnerability to Extreme Heat Hazard

According to the International Council for Local Environmental Initiatives (ICLEI), Boston is one of the top 10 cities in the country that is most susceptible to extreme heat events. Though the UMass System Office location may have the potential benefit of cooling impacts from ocean breezes, vulnerability to extreme heat is expected to continue. A May 2010 report, *"Preparing for Heat Waves in Boston"* referenced the City's dark colored infrastructure and lack of vegetation which creates an urban heat island effect as one reason for its vulnerability to extreme heat events. The Town of Shrewsbury is more suburban in nature but has been impacted by extreme heat in the past. **Table 3-11** indicates the susceptibility criteria used to determine vulnerability to extreme heat.

Table 3-11: UMass System Office Extreme Heat Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• State of Massachusetts (2010) • Tufts University Report -*"Preparing for Heat Waves in Boston"* • The Shrewsbury Lantern	• The state plan notes that temperature extremes can occur throughout the entire state. The coastal areas have lower daily averages than the inland parts of the state, but do not carry the same extreme temperature records. Areas that are more prone to heat include inland urban areas. • All areas of Massachusetts are vulnerable to electricity shortages. Shorter-duration heat waves (2-3 days) may cause demand surges, generator stresses/outages, and transmission problems. A prolonged heat wave may lead to electricity supply problems, rolling blackouts, and health and safety risks if priority users cannot be supplied with power. • The likelihood of heat waves occurring in Boston is increasing. The historical data show that the City of Boston is twice as likely to experience a heat wave today as in 1950 and thus the number of declared heat emergency declarations will certainly increase. • Shrewsbury, MA has opened cooling centers at the Senior Center in the past during extreme heat events (July 2011).

3.1.3.4 Risk Assessment Methodology, Limitations and Results

With careful consideration of the data available for an extreme heat hazard event and its impact to the UMass System Office locations, the risk assessment for this natural hazard has been developed as a qualitative analysis as presented in **Table 3-12.**

Table 3-12: Risk Assessment – Extreme Heat

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Ranking L,M,H,S
Extreme Heat	2	2	1	1	1.67	1.00	1.27	L

After reviewing the initial ranking of **low** and conducting further research, specific consideration was given to how an event could impact staff and any visiting students/faculty, existing buildings, future buildings, operations and critical infrastructure and is presented in **Table 3-13.**

Table 3-13: Qualitative Risk Assessment – Extreme Heat

	Extreme Heat Hazard - Qualitative Ranking
Risk Ranking	Low
Students, Faculty & Staff	Low
Existing Buildings	Medium
Future Buildings	Low
Operations	Low
Critical Infrastructure	Low

As a result of considering these additional factors, the overall ranking remained **low**.

3.1.3.5 Future Development Considerations

The UMass System Office will monitor and participate in any Extreme Heat Programs implemented by the City of Boston to the extent that is possible and appropriate. The System Office location in Shrewsbury will monitor and participate in any programs or help with other identified needs by communicating with local and emergency officials in town.

3.1.4 Thunderstorm/Lightning

3.1.4.1 Occurrences of Thunderstorm/Lightning Hazard

Table 3-14 summarizes lightning occurrences provided by NOAA's National Climatic Data Center (NCDC) for Suffolk County.

Table 3-14: Lightning Event Data for Suffolk County (January 1, 2000 – February 28, 2013)

Location	Date	Death	Injury	Property Damage
DORCHESTER	7/18/2012	0	0	50.00K
BOSTON	7/4/2012	0	2	0.00K
WINTHROP	8/21/2011	0	1	0.00K
(BOS)LOGAN INTL ARPT	8/19/2011	0	0	15.00K
DORCHESTER CENTER	5/7/2011	0	0	250.00K
SOUTH BOSTON	8/5/2010	1	0	0.00K
BOSTON	8/2/2008	0	2	0.00K
GROVE HALL	7/20/2008	0	10	0.00K
BACK BAY ANNEX	6/27/2008	0	0	5.000M
BOSTON LOGAN INTL AR	12/9/2005	0	0	100.00K
SOUTH BOSTON	7/2/2004	0	1	0.00K
WINTHROP	6/27/2002	0	0	100.00K
BOSTON	8/3/2001	0	0	1.500M
REVERE	7/10/2001	1	0	0.00K
MATTAPAN	5/10/2000	0	0	0.00K
Totals:		**2**	**16**	**7.015M**
Source: NCDC Storm Events Database http://www.ncdc.noaa.gov/stormevents/				

Specific details from the more significant events noted in **Table 3-14** that have occurred in the City of Boston include:

- **July 4, 2012** - Hot and humid conditions resulted in diurnal showers and thunderstorms. One of these storms became severe, resulting in some wind damage.
- **August 19, 2011** - Southwest flow kept a cold front over Southern New England for a prolonged period of time. Coupled with an approaching shortwave, this created enough lift, instability, and moisture to produce strong to severe thunderstorms. These storms produced large hail and damaging winds with hail up to quarter size and downed trees.
- **August 5, 2010** - A cold front moved through the area producing thunderstorms and heavy rain across Southern New England. A 50 year old man was struck by lightning while walking in an area known as the Sugar Bowl in South Boston.
- **July 2, 2004** – A substantial storm brought many reports of large hail, downed trees, and power lines throughout much of central and eastern Massachusetts. Lightning from the storms caused two injuries.
- **August 3, 2001** - Thunderstorms with frequent lightning knocked out power to about 50,000 electric customers, primarily in Franklin, Hampshire, and Suffolk Counties. Lightning sparked a fire that destroyed the Boston Tea Party gift shop, resulting in an estimated 1.5 million dollars in damage.

Table 3-15 summarizes lightning occurrences provided by NOAA's National Climatic Data Center (NCDC) for Worcester County.

Table 3-15: Lightning Event Data for Worcester County (March 1, 2006 – February 28, 2013)

Location	Date	Death	Injury	Property Damage
BOYLSTON CENTER	6/22/2012	0	1	0.00K
WORCESTER	6/22/2012	0	0	45.00K
SOUTH WORCESTER	8/16/2010	0	0	10.00K
WORCESTER	7/21/2010	0	0	20.00K
ASHBURNHAM	7/19/2010	0	0	150.00K
WHALOM	7/19/2010	0	0	30.00K
UPTON	7/23/2008	0	0	15.00K
BARRE	6/29/2008	0	0	5.00K
WHALOM	9/8/2007	0	0	10.00K
LEOMINSTER	5/16/2007	0	0	300.00K
ATHOL	7/11/2006	0	0	15.00K
BARRE	6/29/2006	0	0	50.00K
WEST BROOKFIELD	6/1/2006	0	0	15.00K
SPENCER	5/21/2006	0	0	100.00K
CHARLTON	5/21/2006	0	0	75.00K
FITCHBURG	3/13/2006	0	0	50.00K
Source: NCDC Storm Events Database http://www.ncdc.noaa.gov/stormevents/				

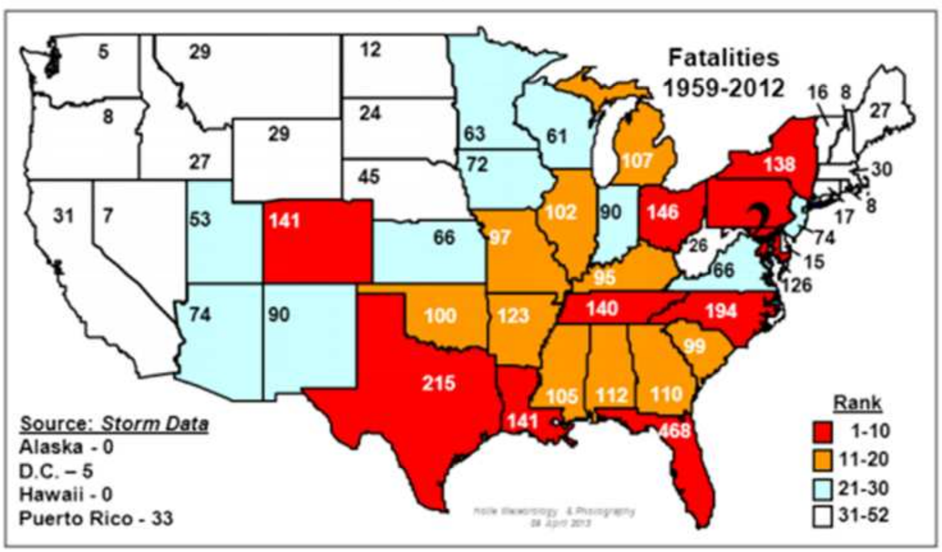
Specific details from the more significant lightning events noted in **Table 3-15** that have occurred in Worcester County include:

- **July 19, 2010 –** Scattered severe thunderstorms produced wind damage and large hail mainly in central Massachusetts. Lightning ignited a building in Ashburnham and a garage in Whalom.
- **May 16, 2007 –** A widespread thunderstorm outbreak resulted in wind damage with downed trees and power lines across Massachusetts. Downed trees were reported in Shrewsbury.
- **June 27, 2002 –** Severe thunderstorms moved through parts of central and northeast Massachusetts resulting in downed trees, power lines, and large branches in areas that included Shrewsbury.

3.1.4.2 Probability of Future Occurrence of a Thunderstorm/Lightning Hazard

The probability of a future lightning occurrence in the City of Boston or the Town of Shrewsbury is likely. Future lightning events will continue to cause minor property damage throughout the City of Boston and Town of Shrewsbury and threaten human life as well. **Figure 4** indicates the number of lightning fatalities by state between 1959 -2012.

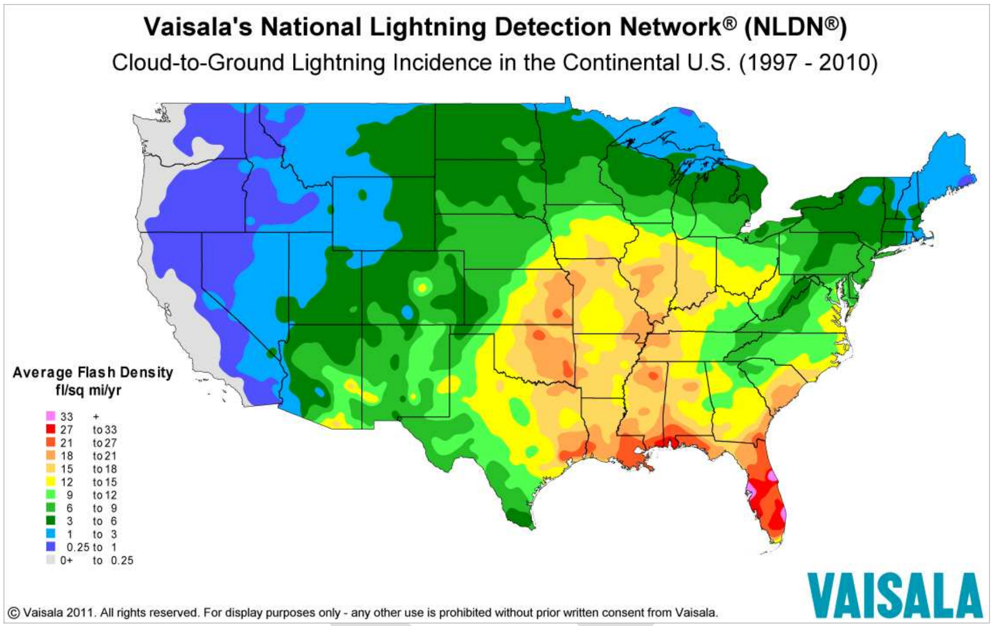
Figure 4: Lightning Fatalities by State, 1959-2012



3.1.4.3 Vulnerability to Thunderstorm/Lightning Hazard

The UMass System Office locations in Boston and Shrewsbury are in a region that is vulnerable to thunderstorm and lightning events, however they are not as susceptible as other areas of the United States. **Figure 5** indicates Vaisala's National Lightning Detection Network display data representing Cloud to Ground Lightning Incidences between 1997 – 2010.

Figure 5: Cloud to Ground Lightning Incidents in the U.S. – Vaisala NLDN



In addition, the UMass System Office vulnerability to thunderstorm and lightning events was also determined by evaluating state and local planning documents as well as gathering anecdotal information from System Office staff. The susceptibility criteria considered for thunderstorm and lightning are presented in **Table 3-16**.

Table 3-16: UMass System Office Thunderstorm & Lightning Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• State of Massachusetts (2010) and City of Boston (2008) Hazard Mitigation Plans • Review of FEMA's Multi-Hazard Identification and Risk Assessment • CMRPC Regional Hazard Mitigation Plan	• Thunderstorms are discussed in the state plan which notes that the entire state is susceptible. It notes that one of the more damaging storms was in 1998 and impacted Suffolk, Worcester, Bristol and Middlesex County among others. • CMRPC plan notes that the central Massachusetts region frequently experiences thunderstorm and lightning events, although they typically have resulted in minor damage.

3.1.4.4 Risk Assessment Methodology, Limitations and Results

After consideration of the data available for a thunderstorm/lightning hazard event and its impact to the UMass System Office locations, the risk assessment for this natural hazard has been developed as a qualitative analysis. A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of a thunderstorm/lightning hazard utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was based on background research, future development plans, knowledge of the UMass System Office locations, infrastructure and past occurrences and is shown in **Table 3-17.**

Table 3-17: Risk Assessment – Thunderstorm/Lightning

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Thunderstorm Lightning	2	1	2	2	1.67	2.00	1.87	L

After reviewing the initial ranking of **low** and conducting further research, specific consideration was given to how an event would impact visiting faculty and students, existing buildings, future buildings, operations and critical infrastructure as presented in **Table 3-18.**

Table 3-18: Qualitative Risk Assessment – Thunderstorm/Lightning Hazard

	Thunderstorm/Lightning - Qualitative Ranking
Risk Ranking	Low
Students, Faculty & Staff	Low
Existing Buildings	Low
Future Buildings	Low
Operations	Low
Critical Infrastructure	Low

As a result of considering these additional factors, the overall ranking remained **low**.

3.1.4.5 Future Development Considerations

The UMass System Office will consider thunderstorm/ lightning hazard scenario planning during future development and redevelopment of the System Office to mitigate the impact of thunderstorm/ lightning occurrences. This includes the following mitigation measures:

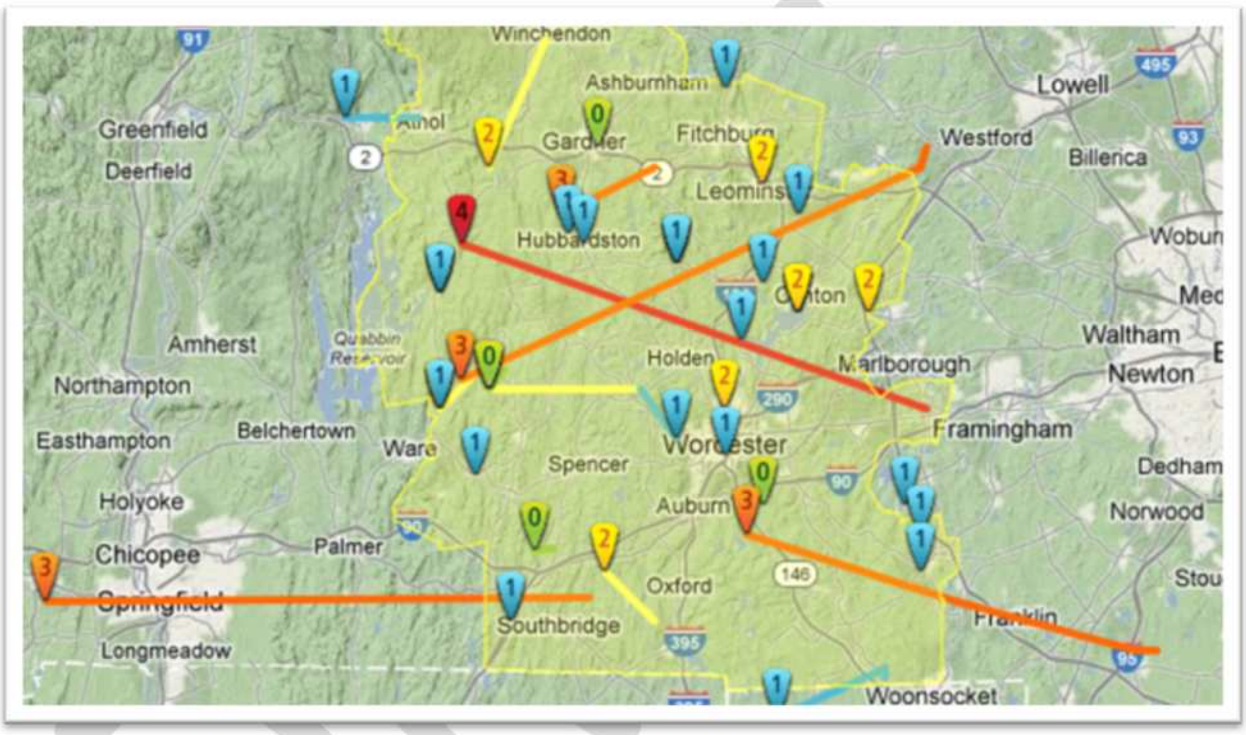
- Coordinate weather and emergency information with City of Boston and Town of Shrewsbury officials.
- Coordinate outreach to public with consistent messaging, information, and instructions via public broadcast, websites, email, and social media for watches and warnings issued by the National Weather Service.
- Coordinate outreach to the UMass System Office stakeholders for the dangers of thunderstorm and lightning.

3.1.5 Tornado

3.1.5.1 Occurrences of a Tornado Hazard

Since 1955, approximately 33 tornadoes have touched down in Worcester County, several of which have impacted the Town of Shrewsbury where the System Office is located (see **Figure 6**). The Tornado hazard was not evaluated for the System Office location in Boston, Suffolk County.

Figure 6: Worcester County Tornadoes 1955 – 2011



Since 1954, there have been 2 Major Disaster Declarations in the State of Massachusetts for Tornadoes (see **Table 3-19**). At least one of these instances impacted Worcester County directly. The State Hazard Mitigation plan indicates that a tornado may occur anywhere in Massachusetts with the right atmospheric conditions.

Table 3-19: Massachusetts Tornado Major Disaster Declarations (1954 – Present)

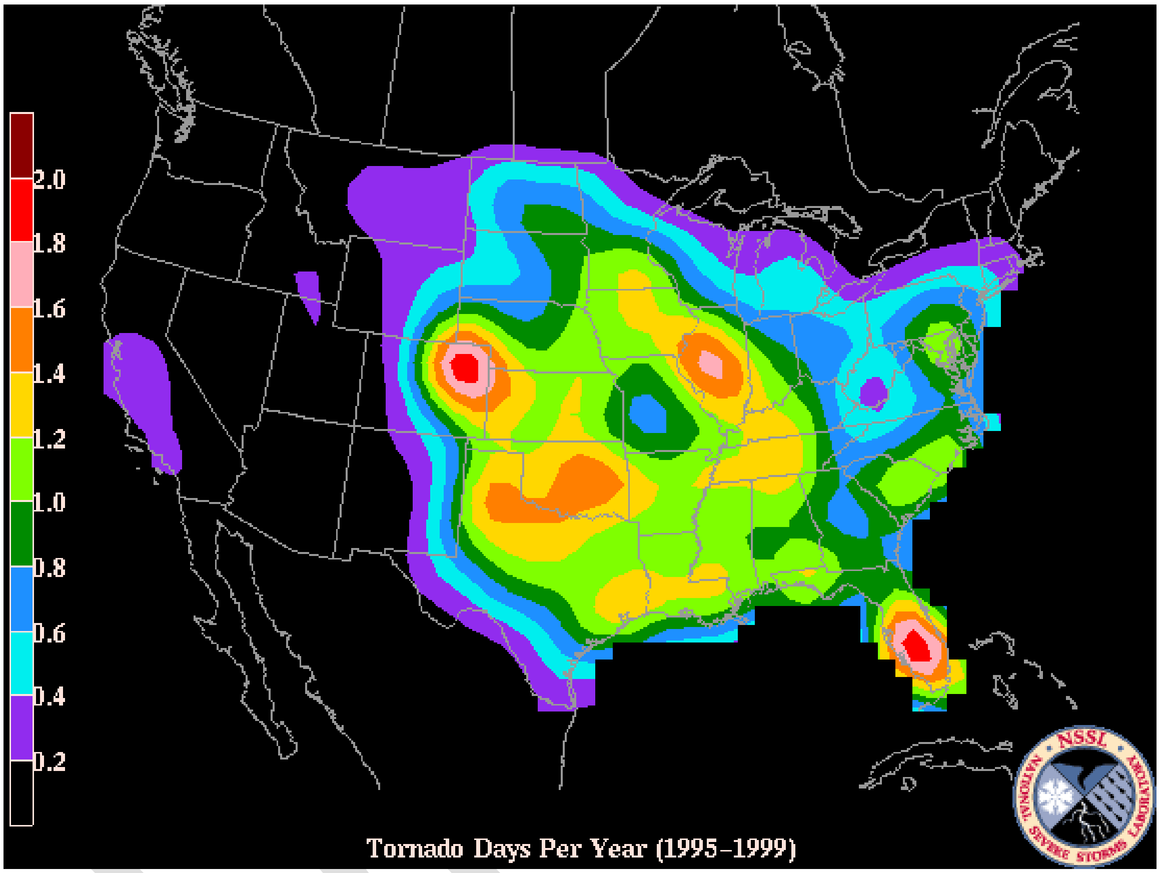
	Disaster No.	Incident Period	Date Disaster Declared	Worcester County a Designated Area?
Severe Storms and Tornadoes	1994	6/1/2011	6/15/2011	Yes
Tornado	7	6/11/1953	6/11/1953	Unknown

Source: FEMA Disaster Declarations 1954 - Present

3.1.5.2 Probability of Future Occurrence of a Tornado Hazard

NOAA's National Severe Storm Laboratory (NSSL) has estimated the likelihood for a tornado on a given day in the United States. **Figure 7** shows that the probability for a tornado in Massachusetts is 0.2 to 0.4 days per year based on tornado data collected from 1995 to 1999.

Figure 7: Tornado Days Per Year in the United States, NOAA's (NSSL)



3.1.5.3 Vulnerability to Tornado Hazard

The Massachusetts State Hazard Mitigation Plan notes that the state has a definite vulnerability towards tornadoes. The greatest risk is from central to northeastern Massachusetts which includes Worcester County. In New England, there averages 6 tornado touch downs per year while Massachusetts averages approximately 2.6 tornado events per year. Tornado susceptibility criteria are outlined in **Table 3-20.**

Table 3-20: UMass System Office Tornado Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• State of Massachusetts (2010) Hazard Mitigation	• The state plan notes that a Tornado may occur anywhere in Massachusetts with the right atmospheric conditions.

How Susceptibility Was Determined	Susceptibility Criteria
Plan • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Anecdotal Information from UMass System Office • Tornado History Project (online) • Hazard Mitigation Plan for the Northern Middlesex Region	• The state plan and several of the regional/city plans acknowledge that Massachusetts has a definite vulnerability to tornadoes, with an average annual occurrence of 2.6 tornadoes per year since 1951. • According to the NCDC, between 1991 – 2010, Massachusetts has averaged one tornado per year. • Tornadoes are ranked as a medium threat in terms of frequency, with the potential for causing serious or extensive damage in the State Hazard Mitigation Plan. • Between 1951 and 2011, there have been 156 tornadoes in Massachusetts which have resulted in 105 fatalities and 1,559 injuries. • Between 1955 – 2011, Worcester County has recorded 33 tornados. • In Worcester County, a number of F1 tornadoes have occurred over the years. There have been 4 F3 tornados (or higher). • In the past, the UMass System Office has sent out PA announcement for awareness. High winds could impact fiber optic/power lines and Tornadoes have occurred in the area in the past.

3.1.5.4 Risk Assessment Methodology, Limitations and Results

After consideration of the data available for a tornado event and its potential impact to the UMass System Office, the risk assessment for this natural hazard has been developed as a qualitative analysis. A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of a tornado hazard utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was based on background research, future development plans, knowledge of the UMass System Office locations, infrastructure and past occurrences and is presented in **Table 3-21.**

Table 3-21: Risk Assessment – Tornado

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Tornado	1	1	3	3	1.67	3.00	2.47	M

After reviewing the initial ranking of **medium** and conducting further research, specific consideration was given to how an event could impact visiting faculty and students, existing buildings, future buildings, operations and critical infrastructure as outlined in **Table 3-22**.

Table 3-22: Qualitative Risk Assessment - Tornado

	Tornado Hazard - Qualitative Ranking
Risk Ranking	Medium
Students, Faculty & Staff	Medium
Existing Buildings	High
Future Buildings	Medium
Operations	Medium
Critical Infrastructure	High

As a result of considering these additional factors, the overall ranking remained **medium**.

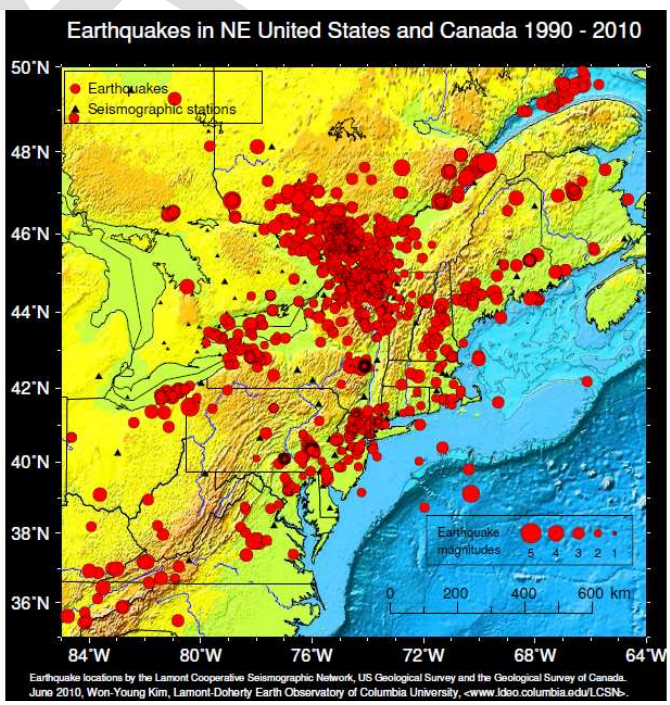
3.1.5.5 Future Development Considerations

The UMass System Office should include tornado hazard scenario planning during their future development and redevelopment efforts and continue to implement measures to mitigate the impact of tornado occurrences. This includes the following mitigation measures:

- Coordinate weather and emergency information with City of Boston and Town of Shrewsbury officials.
- Coordinate outreach to the public with consistent messaging, information, and instructions via public broadcast, websites, email, and social media for watches and warnings issued by the National Weather Service.
- Coordinate outreach to the UMass System Office staff members for tornado guidance and preparation.

3.1.6 Earthquake

3.1.6.1 Occurrences of an Earthquake Hazard



According to FEMA, there has never been a Presidential Disaster Declaration made for an earthquake in the State of Massachusetts. At the UMass System Office, they have felt very minor earthquake movement in the past.

Between 1668 – 2007, Massachusetts has experienced 355 earthquakes of varying magnitudes.[1] According to the State Hazard Mitigation Plan, the last major earthquake to affect Massachusetts was more than 200 years ago in 1755 with an estimated magnitude of about 6.0 to 6.25.

[1] The Northeast States Emergency Consortium, “Earthquakes,” [http://www.nesec.org/hazards/earthquakes.cfm.html#history], May 2013

The epicenter was probably located off the coast of Cape Ann, north of Boston. The area of greatest damage in Massachusetts stretched along the northern coast of the state from Cape Ann to Boston. There have been other damaging earthquakes centered in New England in the past. The 1727 earthquake at Newbury, Massachusetts caused local damage to masonry chimneys and buildings; its magnitude is estimated to have been about 5.6. In 1940 there was a pair of magnitude 5.5 earthquakes centered in the Ossipee Mountains of New Hampshire, and in 1904 there was a magnitude 5.7 earthquake at Eastport, Maine. Both of these earthquakes caused minor damage near their epicenters and were felt throughout Massachusetts. According to a recent newspaper article published by US News[2], in the past year, 12 small earthquakes have occurred off the coast of Boston, which now, could indicate that the City is at risk for tsunami activity in the future. Other earthquake events relevant to the Boston area are listed in **Table 3-23** and include:

Table 3-23: Recent Earthquake Events in Massachusetts

Date	Magnitude	Location
May 15, 2011	2.1	Buzzard's Bay
July 22, 2003	3.6	Offshore
October 25, 1965	5	Nantucket
April 24, 1924	5	Wareham
August 8, 1847	4.2	Brewster
January 2, 1785	5.4	Off Shore
November 18, 1755	6.0	Cape Ann

3.1.6.2 Probability of Future Occurrence of an Earthquake Hazard

According to USGS, known faults and fault lines east of the Rocky Mountains are unreliable guides to the likelihood of earthquakes. However, an earthquake is as likely to occur on an unknown fault as it is on a fault that has been documented and studied, if not more likely. Fault lines east of the Rocky Mountains are unreliable in terms of predicting where earthquakes are likely to occur. Earthquakes are most likely to occur in places or regions that they have been located in during the past.

Boston, MA is located in a region where there is a moderate history of seismic activity and several historic events have occurred at a magnitude of 6.0. Earthquake events can't be predicted and they can occur anytime. The possibility does exist that a future earthquake could occur at a substantial magnitude to cause severe impacts to the UMass System Office locations in Boston and Shrewsbury and the surrounding area.

3.1.6.3 Vulnerability to Earthquake Hazard

According to the State Hazard Mitigation Plan, based on the data provided by Weston Observatory, and on the national earthquake hazards map, it appears that northeastern Massachusetts, especially along the Massachusetts coastline from the northern portion of

[2] Jason Koebler, "Study: Boston, New England at Greatest Tsunami Risk in US," online [http://www.usnews.com/news/articles/2013/04/19/study-boston-new-england-at-greatest-tsunami-risk-in-us], May 2013

Plymouth County through the Boston Metropolitan area to the New Hampshire border, has greater vulnerability to potential earthquake activity than the rest of the state. The City of Boston, due to its dense population and older, more historic structures that are not designed to withstand the impacts of seismic activity. Earthquakes are rare in central Massachusetts where the UMass System Office is located and when they do occur, they are small.

Table 3-24 indicates additional details regarding the UMass System Office's vulnerability to an earthquake hazard.

Table 3-24: UMass System Office Earthquake Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• State of Massachusetts (2010) and City of Boston (2008) Hazard Mitigation Plans • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Anecdotal Information from the UMass System Office • CMRPC Pre-Disaster Hazard Mitigation Plan, 2012	• The state plan discusses earthquakes and the fact that they have been detected all over New England. • The state plan notes that northeastern MA, especially along the MA coastline from the northern portion of Plymouth County through the Boston Metropolitan area to the New Hampshire border, has greater vulnerability to potential earthquake activity than the rest of the state. • CMRPC plan notes that earthquakes are extremely rare in the central Massachusetts region and when they do occur, they are small and considered to be a low threat in the region. • The UMass System Office has experienced very minor earthquake movement in the past. Associated debris could impact ability to access facilities.

3.1.6.4 Loss Estimate

A loss estimate was prepared to further determine how the UMass System Office assets could be affected by an earthquake hazard event.[3] Utilizing the FEMA guidance document *"Understanding Your Risks – Identifying Hazards and Estimating Losses (FEMA 386-2)"* calculations were conducted for Estimated Building Damage Sustained, Contents Damage Ratio, Estimated Contents Damage Sustained and then a Total Damage Sustained was calculated (see **Table 3-25**). The information presented in this table is a rough estimate and should not be used for any other purpose other than this hazard mitigation planning effort.

[3] For the purposes of calculating losses to structures due to earthquakes, FEMA 386-2 guidance documentation was utilized. The loss estimation tables by category did not include an educational institution, so for the purposes of this analysis, Professional Office category was utilized. Once the category was selected, a PGA value of .05 was assigned to select the appropriate building damage ratio % and loss of function days.

There are no historical records available regarding an earthquake's damage to the UMass System Office or its assets. The quantitative assessment for earthquake event is based on if an event damaged 5% of the assets. Damages to human life are not considered in this calculation.

For the purposes of calculating losses to structures due to earthquakes FEMA 386-2 guidance was utilized. The loss estimation tables by category did not include an educational institution, so for the purposes of this analysis, the Professional Office category was utilized. Once the category was selected, a PGA value of .05 was assigned to select the appropriate building damage ratio % and loss of function days. The Building Damage Ratio percentages are based on a FEMA formula for Repair Cost/Replacement Value and the Contents Damage Ratio percentage is one half of the percent structural damage and derived from the FEMA 386-2 guidance document (see **Table 3-25**).

Table 3-25: UMass System Office - Estimated Loss to Structure & Contents Due to Earthquake

Building Location	Year Constructed	Insurable Replacement Value	PGA Zone	Building Damage Ratio (%)	Estimated Building Damage Sustained ($)	Contents Damage Ratio (%)	Estimated Contents Damage Sustained ($)	Loss of Function (Days)	Ranking
333 South Street	1986	$27,236,231	0.05	10.0%	$2,723,623	5.00%	$1,361,811	1	Low
225 Franklin Street - 33rd Floor	Unknown	Unknown	0.05	0.2%	Unknown	0.10%	Unknown	Unknown	Medium

3.1.6.5 Risk Assessment Methodology, Limitations and Results

The UMass System Office prepared a qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of an earthquake utilizing a low, medium, high and severe ranking system. The ranking given for the UMass System Office was based on background research, knowledge of the UMass System Office locations and past occurrences and is presented in **Table 3-26**.

Table 3-26: Risk Assessment – Earthquake Hazard

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Ranking L,M,H,S
Earthquake	1	1	3	2	1.33	3.00	2.33	M

After reviewing the initial ranking of **medium** and conducting further research, specific consideration was given to how an event could impact visiting faculty and students, existing buildings, future buildings, operations and critical infrastructure and is presented in **Table 3-27**.

Table 3-27: Qualitative Risk Assessment - Earthquake

	Earthquake Hazard - Qualitative Ranking
Risk Ranking	Medium
Students, Faculty & Staff	Medium
Existing Buildings	High
Future Buildings	Medium
Operations	Medium
Critical Infrastructure	High

As a result of considering these additional factors, the overall ranking remained **medium**.

3.1.6.6 Future Development Considerations

The UMass System Office will include earthquake hazard scenario planning during discussions about future plans the Shrewsbury and Boston locations. Mitigation measures to lessen the impact of an earthquake occurrence for consideration include:

- Stay familiar with changes to the International Code Council (ICC) building codes which are published every three years. In addition, work with City of Boston officials to stay informed regarding any regulatory changes that could impact the floor occupied on Franklin Street.
- Continue to communicate with the UMass System Office population regarding consistent messaging, information, and instructions via public broadcast, websites, email, and social media for emergency information including safety information, the location of shelters, and additional information.
- Coordinate emergency information with City of Boston and Town of Shrewsbury officials and other UMass System campuses.

3.1.7 Ice Storm

3.1.7.1 Occurrences of an Ice Storm Hazards

Ice storms are events that have occurred in Massachusetts. The most recent substantial event was in December 2008 which caused widespread power outages throughout the area. According to FEMA, there was a Presidential Disaster Declaration made for this event which was categorized as a severe winter storm that had associated ice storm characteristics. Damage from the storm throughout New England was measured in millions of dollars in property damage, lost business and clean-up costs. Between 1971 and 2009, 40 ice storm events have occurred in the Commonwealth of varying degrees.

3.1.7.2 Probability of Future Occurrence of an Ice Storm Hazard

Ice storms have been recorded in New England since 1929. The U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory estimates a 40 – 90 year return period for an event with a uniform ice thickness of between .75 and 1.25 inches. On average, a one-inch ice storm is likely every fifty years.

3.1.7.3 Vulnerability to Ice Storm Hazard

The UMass System Office has experienced ice storm events in recent years. **Table 3-28** indicates susceptibility criteria reviewed as related to the selection of an ice storm as a hazard of concern for the System Office.

Table 3-28: UMass System Office Ice Storm Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• State of Massachusetts (2010) Hazard Mitigation Plans • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Anecdotal Information from UMass System Office	• The state plan notes that between 1971 - 2009, 40 ice storm events have occurred in the Commonwealth of varying degrees. • Ice conditions could impact fiber/power lines or make access to facilities difficult. • The state plan notes that ice storms can arise in any part of the state, however they most frequently occur in the higher elevations of Western and Central Massachusetts. From 1971 to 2009 there have been about 40 ice storm events which impacted at least one or more counties in the Commonwealth.

3.1.7.4 Risk Assessment Methodology, Limitations and Results

After consideration of the data available for an ice storm hazard event and its impact to the UMass System Office, the risk assessment for this natural hazard has been developed as a qualitative analysis. A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of an ice storm hazard utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was based on background research, future development plans, knowledge of the UMass System Office locations, infrastructure and past occurrences and is shown in **Table 3-29.**

Table 3-29: Risk Assessment – Ice Storm

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Ice Storm	1	2	3	3	2.00	3.00	2.60	M

After reviewing the initial ranking of **medium** and conducting further research, specific consideration was given to how an event could impact visiting faculty and students, existing buildings, future buildings, operations and critical infrastructure **(Table 3-30).**

Table 3-30: Qualitative Risk Assessment – Ice Storm Hazard

	Ice Storm Qualitative Ranking
Risk Ranking	Medium
Students, Faculty & Staff	Medium
Existing Buildings	Medium
Future Buildings	Medium
Operations	Medium
Critical Infrastructure	High

As a result of considering these additional factors, the overall ranking remained **medium.**

3.1.7.5 Future Development Considerations

The UMass System Office will continue to give consideration to ice storm events during future development and redevelopment endeavors and continue to mitigate the impact of ice storm occurrences. This includes the following mitigation measures:

- Coordinate weather and emergency information with City of Boston and Town of Shrewsbury officials,
- Coordinate outreach to public with consistent messaging, information, and instructions via public broadcast, websites, email, and social media for watches and warnings issued by the National Weather Service.
- Coordinate outreach to the office staff for ice storm guidance preparation and possible impacts.

3.1.8 Wind Storm

3.1.8.1 Occurrences of an Wind Storm Hazards

Wind Storm events will remain a regular occurrence in the City of Boston and in the Town of Shrewsbury and could impact the UMass System Office locations. The probability of future occurrences is certain. The entire State of Massachusetts is susceptible to both extreme wind events such as hurricanes and tornadoes but also just wind storms that do not have any other associated characteristics other than the movement of air (i.e. no precipitation).

3.1.8.2 Probability of Future Occurrence of an Wind Storm Hazard

The probability of a future occurrence of a wind storm at one or both of the UMass System Office locations is certain due to their locations and susceptibility to other natural hazards that typically have a wind associated characteristic.

3.1.8.3 Vulnerability to Wind Storm Hazard

The UMass System Office has experienced minor windstorm events in recent years. **Table 3-31** indicates susceptibility criteria reviewed as related to the selection of a wind storm as a hazard of concern for the UMass System Office.

Table 3-31: UMass System Office Wind Storm Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• State of Massachusetts (2010) and City of Boston (2008) Hazard Mitigation Plans • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Anecdotal Information from UMass System Office	• The state plan notes that Massachusetts is susceptible to high wind from several types of weather events: before and after frontal systems, hurricanes and tropical storms, severe thunderstorms, Tornados, and Nor'easters. • The state plan also notes that the entire Commonwealth is vulnerable to high winds that can cause a wide range of damage, with the coast typically seeing the most damage impacts. • There have been wind storm impacts in the past – mostly to administrative and operational functions. Policies are in place for personnel to work remotely to prevent travel during inclement weather or power outages.

3.1.8.4 Risk Assessment Methodology, Limitations and Results

After consideration of the data available for a wind storm hazard event and its impact to the UMass System Office, the risk assessment for this natural hazard has been developed as a qualitative analysis. A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of a wind storm hazard utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was based on background research, future development plans, knowledge of the UMass System Office locations, infrastructure and past occurrences and is shown in **Table 3-32.**

Table 3-32: Risk Assessment – Wind Storm

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Wind Storm	4	2	2	2	2.67	2.00	2.27	M

After reviewing the initial ranking of **medium** and conducting further research, specific consideration was given to how an event could impact staff, visiting faculty and staff, existing buildings, future buildings, operations and critical infrastructure **Table 3-33.**

Table 3-33: Qualitative Risk Assessment – Wind Storm Hazard

	Wind Storm Qualitative Ranking
Risk Ranking	Medium
Students, Faculty & Staff	Medium
Existing Buildings	Medium
Future Buildings	Medium
Operations	Medium
Critical Infrastructure	High

As a result of considering these additional factors, the overall ranking remained **medium.**

3.1.8.5 Future Development Considerations

Any future development or expansion plans for either UMass System Office location should take into consideration wind storm events and constructed, updated and implemented with regard to the most up to date building codes and materials to minimize wind damage.

3.1.9 Flood

3.1.9.1 Occurrences of a Flood Hazard

According to the FEMA, there have been 14 Presidential Disaster Declarations made for some type of flooding incident in the State of Massachusetts and a number of those events impacted Suffolk and/or Worcester County (see **Table 3-34**). The UMass System Office locations in Boston and Shrewsbury have not been directly impacted by flooding events in the past.

Table 3-34: Massachusetts Flooding Major Disaster Declarations (1954 – Present)

	Disaster No.	Incident Period	Date Disaster Declared	Suffolk/Worcester County a Designated Area?
Severe Winter Storm, Snowstorm, Flooding	DR-4110	2/8/2013 – 2/9/2013	4/19/2013	Suffolk/Worcester
Severe Storm and Flooding	DR-1895	3/12/2010 – 4/26/2010	3/29/2010	Suffolk/Worcester
Severe Winter Storm and Flooding	DR-1813	12/11/2008 – 12/18/2008	1/5/2009	Worcester
Severe Storms, Inland and Coastal Flooding	DR-1701	4/15/2007 – 4/25/2007	5/16/2007	No
Severe Storms and Flooding	DR-1642	5/12/2006 – 5/23/2006	5/25/2006	Suffolk
Severe Storms and Flooding	DR-1614	10/7/2005 – 10/16/2005	11/10/2005	Worcester
Flooding	DR-1512	4/1/2004 – 4/30/2004	4/24/2004	Suffolk/Worcester
Severe Storms and Flooding	DR-1364	3/5/2001 – 4/16/2001	4/10/2001	Suffolk/Worcester
Heavy Rain and	DR-1224	6/13/1998-	6/23/1998	Suffolk/Worcester

	Disaster No.	Incident Period	Date Disaster Declared	Suffolk/Worcester County a Designated Area?
Flooding		7/6/1998		
Severe Storms and Flooding	DR-1142	10/20/1996-10/25/1996	10/25/1996	Suffolk
Severe Storms and Flooding	DR-790	3/30/1987-4/13/1987	4/18/1987	Worcester
Coastal Storms, Flood, Ice, Snow	DR-546	2/6/1978-2/8/1978	2/10/1978	Suffolk
Severe Storms, Flooding	DR-325	3/6/1972	3/6/1972	Suffolk
Hurricane, Floods	DR-43	8/20/1955	8/20/1955	Unknown

The NCDC tracks storm events and the information in **Table 3-35** was available for Boston and Shrewsbury regarding flood occurrences.

Table 3-35: Select Flood Event Data for Boston & Shrewsbury (Jan 2000 – Feb 2013)

Location (County/City)	Date	Type[1]	Deaths	Injury	Property Damage Estimate
BOSTON	7/10/2010	Flash Flood	0	0	500.00K
BOSTON	7/6/2005	Flash Flood	0	0	30.00K
BOSTON	7/6/2005	Flash Flood	0	0	20.00K
BOSTON	4/22/2000	Flash Flood	0	0	0.00K
SHREWSBURY	8/7/2008	Flash Flood	0	0	100.00K
Source: NCDC Storm Events Database http://www.ncdc.noaa.gov/stormevents/					

Specific details from the more significant coastal, flash, and other flood events noted in **Table 3-35** that have occurred in the Boston area include:

- **October 29, 2012 –** Hurricane Sandy, a hybrid storm with tropical and extra-tropical characteristics brought high winds and coastal flooding to southern New England. In Boston, minor coastal flooding closed the ramp for Morrissey Boulevard off of Interstate 93 and occurred at Columbia Point over the Harborwalk. The Savin Hill beach was washed over the seawall.
- **December 27, 2010 –** Moderate to major coastal flooding affected the eastern Massachusetts coast during early morning high tide. A portion of Morrissey Boulevard near UMass Boston was closed.
- **July 10, 2010 –** Two to four inches of rain fell within an hour's time and produced significant urban flash flooding in and around the city of Boston.
- **March 14, 2010 –** Stacked low pressure system (surface low and upper level low on top of each other) moved southeast of Nantucket, spreading rain across southern New England. This resulted in widespread rainfall totals of three to six inches. Heavy rains resulted in flooding across much of Boston. In eastern Massachusetts, a strong

southeasterly low level jet stream pumped ample moisture into the area, resulting in six to ten inches or rainfall. The Massachusetts governor declared a state of emergency.

- **July 6, 2005** – Showers and thunderstorms resulted in local heavy downpours. In Suffolk County, Storrow Drive, Soldiers' Field Road, and Memorial Drive were closed due to flash flooding.
- **March 5, 2001** – Major winter storm impacted the Bay State with near blizzard conditions, high winds, and coastal flooding.

Specific details from the more significant flash and other flood events noted in **Table 3-35** that have occurred in the Worcester County area include:

- **March 29, 2010** – 3 to 7 inches of rain fell across portions of Worcester County. Several roads and basements flooded in Shrewsbury.
- **March 15, 2010** – Widespread rain totals of 3 to 6 inches fell across southern New England. The Governor of Massachusetts declared a state of emergency and this was followed by a federal disaster declaration for several state counties including Worcester.
- **March 14, 2010 –** Rainfall totals of 3 to 6 inches fell across Worcester County resulting in major flooding in Clinton.
- **August 7, 2008 –** Heavy rain resulted in flash flooding in Shrewsbury where Route 9 from the Worcester/Shrewsbury line to Route 140 was flooded.

3.1.9.2 Probability of Future Occurrence of a Flood Hazard

The State of Massachusetts Hazard Mitigation plan notes that flooding is the most common hazard to affect New England. It is likely that flood events could impact the UMass System Office locations either directly or indirectly.

3.1.9.3 Vulnerability to Flood Hazard

Throughout Massachusetts, there are no areas that are exempt from flooding impacts. What varies is the type of flooding. Flooding is frequently associated with coastal storms and storm surge, rivers and streams but it can also be an issue due to aging, undersized or poorly maintained infrastructure and drainage systems. **Table 3-36** indicates additional details regarding the UMass System Office vulnerability to a flood hazard event.

Table 3-36: Flood Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• State of Massachusetts (2010) and City of Boston (2008) Hazard Mitigation Plans • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Anecdotal Information from UMass System	• The state plan notes that flooding is the most common hazard to affect New England. • CMRPC plan notes that central Massachusetts is at moderate risk for flood threats which may result in serious or extensive damage. • At the UMass System Office in Shrewsbury, the data center is on the ground floor. It has never flooded and critical operations could be brought back online out of the Boston location.

How Susceptibility Was Determined	Susceptibility Criteria
Office • CMRPC Pre-Disaster Hazard Mitigation Plan	

3.1.9.4 Loss Estimate

A loss estimate was prepared to further determine how the UMass System Office's assets would be affected by a flood hazard event. Utilizing the FEMA guidance document *"Understanding Your Risks – Identifying Hazards and Estimating Losses (FEMA 386-2)"* calculations were conducted for Structure Loss, Contents Loss and Structure Use and Function Loss to determine a Total Loss for the Hazard Event. The main criteria for determining which buildings would receive a loss estimate analysis was based on those that are located either fully or partially in a flood hazard zone (see maps that were presented in the Hazard Mitigation Plan). Neither UMass System Office location (Boston or Shrewsbury) are located in a flood hazard zone, so this calculation was not conducted for these buildings.

3.1.9.5 Risk Assessment Methodology, Limitations and Results

After consideration of the data available for a flood event and its impact to the UMass System Office, the risk assessment for this natural hazard has been developed as a qualitative analysis. A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of a flood hazard utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was based on background research, future development plans, knowledge of the UMass System Office locations, infrastructure and past occurrences and is presented in **Table 3-37**.

Table 3-37: Risk Assessment – Flood Hazard

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Flood	1	1	1	1	1.00	1.00	1.00	L

After reviewing the initial ranking of **low** and conducting further research, specific consideration was given to how an event would impact students, faculty and staff, existing buildings, future buildings, operations and critical infrastructure (see **Table 3-38**).

Table 3-38: Qualitative Risk Assessment – Flood Hazard

	Flood - Qualitative Ranking
Risk Ranking	Low
Students, Faculty & Staff	Low

Existing Buildings	Low
Future Buildings	Low
Operations	Low
Critical Infrastructure	Low

As a result of considering these additional factors, the overall ranking remained **low**.

3.1.9.6 Future Development Considerations

Flooding is a minor concern to the UMass System Office. For future planning purposes, the university may want to consider the following:

- Ensure that critical infrastructure/generators/data centers are located in places with minimum susceptibility for flooding impacts,
- Work with City of Boston and Town of Shrewsbury officials on emergency procedures should the ingress/egress routes be dramatically impacted by floodwaters,
- Evaluate green infrastructure techniques that can be implemented to minimize flood occurrences where appropriate,
- Track, evaluate and plan for areas of the university frequently impacted by flooding and consider drainage/engineering solutions that would minimize future occurrences, and
- Evaluate flooding impacts after storm events and plan for recovery and redevelopment once impacts are known.

3.1.10 Winter Storm

3.1.10.1 Occurrences of a Winter Storm Hazard

Since 1954, there have been 6 Major Disaster Declarations in the State of Massachusetts due to some form of winter storm and 3 of those have resulted in Suffolk County receiving a designated area status from FEMA (see **Table 3-39**).

Table 3-39: Massachusetts Winter Storm Major Disaster Declarations (1954-Present)

	Disaster No.	Incident Period	Date Disaster Declared	Suffolk/Worcester County a Designated Area?
Severe Winter Storm, Snowstorm, Flooding	4110	2/8/2013 – 2/9/2013	4/19/2013	Suffolk/Worcester
Severe Storm and Snowstorm	4051	10/29/2011 – 10/30/2011	1/6/2012	Worcester
Severe Winter Storm and Flooding	1813	12/11/2008 – 12/18/2008	1/5/2009	Worcester
Blizzard	1090	1/7/1996 – 1/13/1996	1/24/1996	Suffolk/Worcester
Winter Coastal Storm	975	12/11/1992 – 12/13/1992	12/21/1992	Suffolk/Worcester
Coastal Storm, Flood, Ice, Snow	546	2/6/1978 – 2/8/1978	2/10/1978	Suffolk
Source: FEMA Disaster Declarations 1954 – Present				

The NCDC tracks storm events and the information below was available for Suffolk County regarding winter storm and blizzard occurrences.

Table 3-40: Winter Storm/Blizzard Data for Suffolk County (January 1, 2000 - February 28, 2013)

Location (County)	Date	Type	Death	Injury	Property Damage
SUFFOLK	2/8/2013	Blizzard	0	0	0.00K
SUFFOLK	2/1/2011	Winter Storm	0	0	432.00K
SUFFOLK	1/21/2011	Winter Storm	0	0	0.00K
SUFFOLK	1/12/2011	Winter Storm	0	0	50.00K
SUFFOLK	12/26/2010	Winter Storm	0	0	0.00K
SUFFOLK	3/16/2007	Winter Storm	0	0	0.00K
SUFFOLK	2/14/2007	Winter Storm	0	0	0.00K
SUFFOLK	2/12/2006	Winter Storm	0	0	10.00K
SUFFOLK	12/5/2003	Winter Storm	0	0	0.00K
SUFFOLK	2/17/2003	Winter Storm	0	0	0.00K
SUFFOLK	12/25/2002	Winter Storm	0	0	15.00K
Totals:			**0**	**0**	**507.00K**
Source: NCDC Storm Events Database http://www.ncdc.noaa.gov/stormevents/					

Specific details from the more significant events noted in **Table 3-40** that have impacted the City of Boston include:

- **February 8, 2013 –** A historic winter storm deposited large amounts of snow all over southern New England between February 8-9, 2013. Most locations received 2 to 2.5 feet of snow. The blizzard produced a prolonged period of strong winds and moderate to major coastal flooding. Along the coastline, storm surge reached 3-4 feet.
- **December/February 2011** - A series of significant heavy snow events occurred between December 26, 2010 and February 2, 2011. Snow for the winter season totaled 86.4 inches, most of which fell during this period. Across Massachusetts, numerous roof collapses due to heavy snow load occurred following the February 2nd storm.
- **January 12, 2011** - Fourteen to nineteen inches of snow fell across Suffolk County. Strong winds combined with the heavy snow resulting in numerous trees and limbs downed in Boston and Chelsea.

The NCDC storm event information below was available for Worcester County regarding winter storm and blizzard occurrences.

Table 3-41: Winter Storm/Blizzard Data for Worcester County (January 1, 2000 - February 28, 2013)

Location (County)	Date	Type	Death	Injury	Property Damage
SOUTHERN WORCESTER	2/8/2013	Blizzard	0	0	0.00K
SOUTHERN WORCESTER	2/1/2011	Winter Storm	0	0	552.00K
SOUTHERN WORCESTER	1/21/2011	Winter Storm	0	0	0.00K

SOUTHERN WORCESTER	1/18/2011	Winter Storm	0	0	0.00K
SOUTHERN WORCESTER	1/11/2011	Winter Storm	0	0	0.00K
SOUTHERN WORCESTER	12/26/2010	Winter Storm	0	0	0.00K
SOUTHERN WORCESTER	1/28/2009	Winter Storm	0	0	5.00K
SOUTHERN WORCESTER	1/7/2009	Winter Storm	0	0	0.00K
SOUTHERN WORCESTER	3/16/2007	Winter Storm	0	0	0.00K
SOUTHERN WORCESTER	2/13/2007	Winter Storm	0	0	0.00K
SOUTHERN WORCESTER	2/12/2006	Winter Storm	0	0	10.00K
Source: NCDC Storm Events Database http://www.ncdc.noaa.gov/stormevents/					

Specific details from the more significant events noted in the table above that have impacted the greater Worcester area include:

- **February 1, 2011 –** A total of 9 to 15 inches of snow fell across southern Worcester County on February 1 and 2. Up to one quarter of an inch of ice accumulated on isolated locations. Roof collapses occurred to 16 structures due to the heavy snowfall that totaled 92.6 inches by the end of the snow season. Most of this snow fell between December 26 and February 2.
- **March 6, 2003 –** A total of 5 to 10 inches of snow fell across sections of south central and southeast Massachusetts. Damage included several vehicle accidents. Hundreds of people were also stranded for several hours after authorities shut down a ten mile stretch of I-95 from Attleboro to the Rhode Island border.
- **February 17, 2003 –** A major winter storm impacted southern New England with heavy snow and strong winds. Shrewsbury received 20 inches of snow from February 17-18.

At the UMass System Office, the potential impacts of a winter storm are mostly administrative and operational.

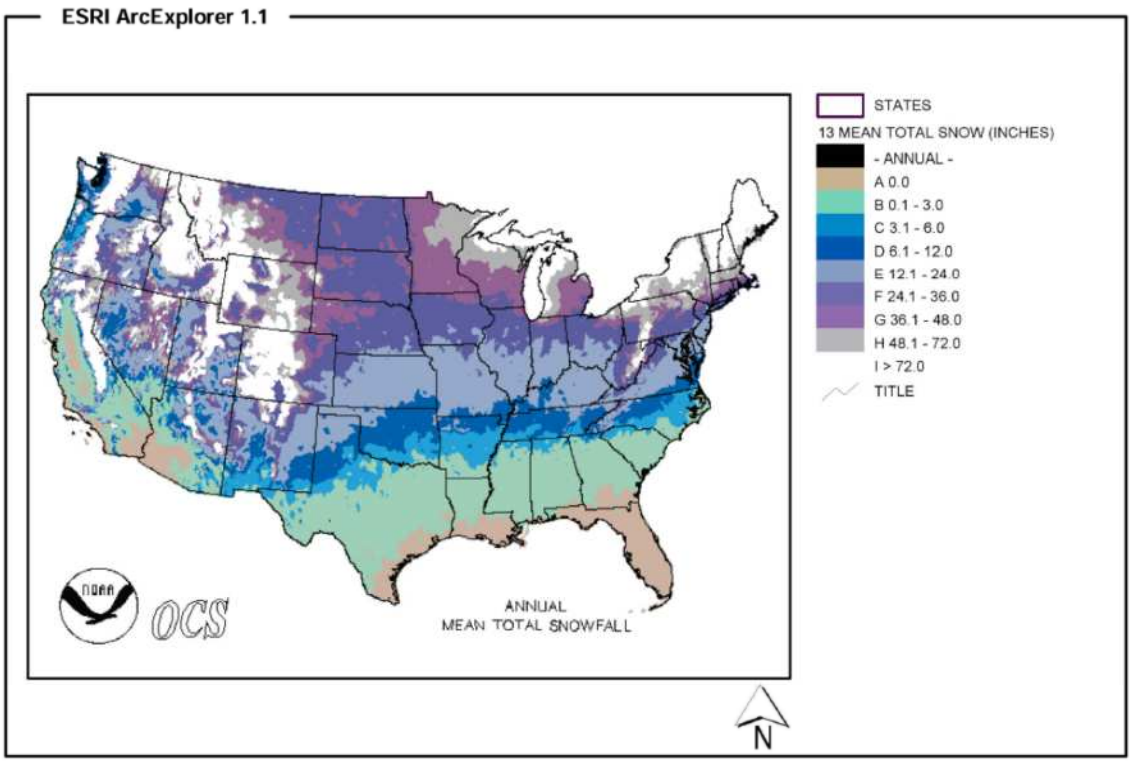
3.1.10.2 Probability of Future Occurrence of a Winter Storm Hazard

The probability of future winter storms impacting the UMass System Office is virtually certain on an annual basis. According to the City of Boston Hazard Mitigation plan update, winter storms are the most common and familiar of the region's hazards that affect large geographic areas.

3.1.10.3 Vulnerability to Winter Storm Hazard

Data gathered by the National Climatic Data Center (NCDC) indicates that Massachusetts has an annual mean total snowfall between 48" and 72." The City of Boston Hazard Mitigation Plan update notes that the average annual snowfall for the northern portion of Boston (including Jamaica Plain Roxbury, Mattapan, north Dorchester, South End, South Boston, Allston/Brighton, Back Bay, Beacon Hill, the Financial District, North End, East Boston, and Charlestown) falls within a range of 38.1 to 48 inches while the southern portion of the city, including Roslindale, West Roxbury, and Hyde Park, are in the range of 48.1 - 72 inches of snow annually (see **Figure 8**).

Figure 8: Annual Mean Total Snowfall



Some of the criteria that was used to determine susceptibility to a winter storm is provided in **Table 3-42**.

Table 3-42: UMass System Office Winter Storm Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• State of Massachusetts (2010) and City of Boston (2008) Hazard Mitigation Plans • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Anecdotal Information from UMass System Office • CMRPC Pre-Disaster Mitigation Plan	• The state plan notes that although the entire state may be considered at risk, higher snow accumulations appear to be prevalent at higher elevations in Western and Central Massachusetts, and along the coast where snowfall can be enhanced by additional ocean moisture. • CMRPC plan notes that winter storms and related hazard (power outages, flooding) have a high frequency in the central Massachusetts region though impacts are generally minor. • Winter storm impacts have been felt in the past and mostly are administrative or operational. Policies are in place for personnel to work remotely to prevent travel during inclement weather. The last power outage caused by a snowstorm was October 31, 2012.

3.1.10.4 Risk Assessment Methodology, Limitations and Results

After consideration of the data available for a winter storm hazard event and its impact to the UMass System Office locations, the risk assessment for this natural hazard has been developed as a qualitative analysis. A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of a winter storm hazard utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was based on background research, future development plans, knowledge of the UMass System Office locations, infrastructure and past occurrences and is shown in **Table 3-43**.

Table 3-43: Risk Assessment – Winter Storm

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Winter Storm	4	3	3	3	3.33	3.00	3.13	H

After reviewing the initial ranking of **high** and conducting further research, specific consideration was given to how an event could impact staff, visiting students and faculty, existing buildings, future buildings, operations and critical infrastructure **Table 3-44**.

Table 3-44: Qualitative Risk Assessment – Winter Storm Hazard

	Winter Storm - Qualitative Ranking
Risk Ranking	High
Students, Faculty & Staff	High
Existing Buildings	Medium
Future Buildings	Medium
Operations	High
Critical Infrastructure	High

As a result of considering these additional factors, the overall ranking remained **high**.

3.1.10.5 Future Development Considerations

The UMass System Office locations will continue to give consideration to winter storm events during future development and redevelopment endeavors and continue to mitigate the impact of winter storm occurrences. This includes the following mitigation measures:

- Coordinate weather and emergency information with City of Boston and Town of Shrewsbury officials.
- Coordinate outreach to public with consistent messaging, information, and instructions via public broadcast, websites, email, and social media for watches and warnings issued by the National Weather Service.
- Coordinate outreach to the UMass System Office population for winter storm guidance preparation.

3.1.11 Coastal Storm

3.1.11.1 Occurrences of a Coastal Storm Hazard

The Coastal Storm hazard was only evaluated for the UMass System Office Boston location due to its proximity to the ocean. According to the FEMA, there have been two Presidential Disaster Declarations made for "coastal storms" in the State of Massachusetts (**Table 3-45**). At the UMass System Office Boston location, there have been varying degrees of impacts from these storms.

Table 3-45: Massachusetts Coastal Storm Major Disaster Declarations (1954 – Present)

	Disaster No.	Incident Period	Date Disaster Declared	Suffolk County a Designated Area?
Severe Storms and Inland and Coastal Flooding	1701	4/15/2007 – 4/25/2007	5/16/2007	No
Coastal Storms, Flood, Ice and Snow	546	2/6/1978 – 2/8/1978	2/10/1978	Yes
Source: FEMA Disaster Declarations 1954 – Present				

The National Climatic Data Center (NCDC) tracks storm events and two events were listed for Suffolk County regarding Coastal Storm/Nor'easter occurrences.

- March 5-7, 1962
- October 28 – November 3, 1991

The New England Blizzard of 1978 and the No-Name or Halloween Storm of 1991 are examples of moderate to severe nor'easters that influenced the coast of Massachusetts. The New England Blizzard brought record-breaking snowfall and hurricane-force winds that caused beach erosion, flooding, and property damage. The Halloween Storm also resulted in erosion and considerable property damage due to heavy surf and lunar-enhanced storm surges along the coast.

3.1.11.2 Probability of Future Occurrence of a Coastal Storm Hazard

Coastal storms are certain to occur in the future and they will continue to impact the City of Boston and the UMass System Office Boston location.

3.1.11.3 Vulnerability to Coastal Storm Hazard

The UMass System Office Boston location is vulnerable to future coastal storm events which are detailed in **Table 3-46**.

Table 3-46: Coastal Storm Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• State of Massachusetts (2010) and City of Boston (2008) Hazard Mitigation Plans • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Anecdotal Information from UMass System Office	• Coastal Storms are discussed in the state plan as a common cause of flooding and snowstorms, particularly in the coastal part of the state. • The state plan notes that Coastal Storms/Nor'easters are a common winter occurrence in New England and repeatedly result in flooding, various degrees of wave and erosion damage to structures, and erosion of natural resources, such as beaches, dunes and coastal bluffs. The erosion of coastal features commonly results in greater potential for damage to shoreline development from future storms. • The state plan notes that Coastal Storms/Nor'easters have an average frequency of 1 or 2 per year with a storm surge equal to or greater than 2.0 feet. The duration of high surge and winds in a nor'easter can be from 12 hours to 3 days. • General concern over wind damage, power outages or leaking buildings due to wind driven rain during coastal storms.

3.1.11.4 Risk Assessment Methodology, Limitations and Results

After consideration of the data available for a Coastal Storm/Nor'Easter event and its impact to the UMass System Office Boston location, the risk assessment for this natural hazard has been developed as a qualitative analysis. A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of a coastal storm/Nor'easter hazard utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office Boston location was based on background research, future development plans, knowledge of the UMass System Office location, infrastructure and past occurrences and is presented in **Table 3-47**.

Table 3-47: Risk Assessment – Coastal Storm/Nor'Easter Hazard

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Coastal Storm or Nor'Easter	1	2	2	2	1.67	2.00	1.87	L

After reviewing the initial ranking of **low** and conducting further research, specific consideration was given to how an event could impact staff, visiting faculty and staff, existing buildings, future buildings, operations and critical infrastructure.

Table 3-48: Qualitative Risk Assessment – Coastal Storm/Nor'Easter Hazard

	Coastal Storm/Nor'Easter - Qualitative Ranking
Risk Ranking	Low
Students, Faculty & Staff	Low
Existing Buildings	Low
Future Buildings	Low
Operations	Low
Critical Infrastructure	Low

As a result of considering these additional factors, the overall ranking remained **low.**

3.1.11.5 Future Development Considerations

Coastal storms are of mild concern to the UMass System Office location. During future planning, the following items will be considered:

- Evaluate coastal storm impacts after storm events and plan for recovery and redevelopment once existing conditions are known.
- Ensure that there are multiple ingress/egress routes available for faculty, staff and students that can be utilized during a coastal storm.

3.1.12 Urban Fire

3.1.12.1 Occurrences of an Urban Fire Hazard

Neither UMass System Office location has had any notable fires in recent years. **Table 3-49** indicates susceptibility criteria related to selecting Urban Fire as a hazard of concern for the office locations.

Table 3-49: UMass System Office Urban Fire Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• State of Massachusetts (2010) and City of Boston (2008) Hazard Mitigation Plans • Review of FEMA's Multi-Hazard Identification and Risk Assessment • Anecdotal Information from UMass System Office	• The state Hazard Mitigation Plan notes that there are a number of areas of the state vulnerable to urban fires, particularly those areas where there are larger concentrations of wood frame construction homes or businesses which are more likely to experience large destructive fire. • The UMass System Office location in Boston makes it more susceptible (due to the density of the area) than the Shrewsbury location to impacts from a fire.

3.1.12.2 Probability of Future Occurrence of an Urban Fire Hazard

The probability of a future occurrence of an urban fire at the UMass System Office locations is possible. The Boston location makes it more susceptible than the Shrewsbury location which is not as densely developed.

3.1.12.3 Vulnerability to Urban Fire Hazard

According to City of Boston records, in 1975, there were 417 major fires and in 2012, there were 40 throughout the City. While better building codes and automatic sprinkler systems are regularly utilized, the UMass System Office locations are still vulnerable to fire.

3.1.12.4 Risk Assessment Methodology, Limitations and Results

After consideration of the data available for an urban fire hazard event and its potential impact to the UMass System Office, the risk assessment for this natural hazard has been developed as a qualitative analysis. A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of an urban fire hazard utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was based on background research, future development plans, knowledge of the UMass System Office locations, infrastructure and past occurrences and is shown in **Table 3-50.**

Table 3-50: Risk Assessment – Urban Fire

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Urban Fire	1	2	2	2	1.67	2.00	1.87	**L**

After reviewing the initial ranking of **low** and conducting further research, specific consideration was given to how an event would impact staff, visiting students and faculty existing buildings, future buildings, operations and critical infrastructure **(Table 3-51).**

Table 3-51: Qualitative Risk Assessment – Urban Fire Hazard

	Urban Fire Qualitative Ranking
Risk Ranking	Low
Students, Faculty & Staff	Low
Existing Buildings	Low
Future Buildings	Low
Operations	Low
Critical Infrastructure	Low

As a result of considering these additional factors, the overall ranking remained **low.**

3.1.12.5 Future Development Considerations

Future development at the UMass System Office locations should be constructed, updated and redeveloped with regard to the most up to date building and fire codes.

3.1.13 Hurricane

3.1.13.1 Occurrences of a Hurricane Hazard

Since 1954, there have been 6 Major Disaster Declarations in the State of Massachusetts due to a hurricane or tropical storm and 4 of those have resulted in Suffolk County receiving a designated area status from FEMA (see **Table 3-52**).

Table 3-52: Massachusetts Hurricane Major Disaster Declarations (1954 – Present)

	Disaster No.	Incident Period	Date Disaster Declared	Suffolk/Worcester County a Designated Area?	Notes
Hurricane Sandy	4097	10/27/2012 – 11/08/2012	12/19/2012	Suffolk	Second costliest hurricane in U.S. history. Impacted 24 states with severe damage in New York and New Jersey.
Tropical Storm Irene	4028	8/27/2011 – 8/29/2011	9/23/2011	No	Impacted most of east coast and is ranked as 6th costliest hurricane in United States history.
Hurricane Bob	914	8/19/1991	8/26/1991	Suffolk/Worcester	60% southern MA and RI residents lost power and the storm surge in Buzzards Bay was 10-15 feet.
Hurricane Gloria	751	9/27/1985	10/28/1985	Suffolk/Worcester	Dramatic coastal impact including beach erosion

	Disaster No.	Incident Period	Date Disaster Declared	Suffolk/Worcester County a Designated Area?	Notes
					and many flooding issues caused and over 2 million without power.
Hurricane Diane	43	8/20/1955	8/20/1955	Unknown	Was a Tropical Storm when it reached New England, had heavy rain of 10" – 20", setting flood records for the time.
Hurricane	22	9/2/1954	9/2/1954	Unknown	There was heavy storm surge to Narragansett Bay and New Bedford Harbor, water up to 12 feet in downtown Providence, and massive power loss.
Source: FEMA Major Disaster Declarations 1954 – Present, State of Massachusetts Hazard Mitigation Plan 2010					

Some of the more notable hurricane events include:

- **Hurricane Sandy (2012) –** In the fall of 2012, Hurricane Sandy had a major impact on the New York and New Jersey coastline. The storm broke an all-time record for storm surge height in New York harbor, caused over 100 fatalities, and has reached a cost of over $79 billion for federal aid to cover damages, recovery and mitigation measures. In Massachusetts, Sandy knocked out power to over 200,000 customers, disrupted travel and closed schools. Downed trees, power lines and flooding were also present during and after the storm.
- **Hurricane Bob (1991)** – Made landfall in Rhode Island on Block Island and left extensive damage throughout New England totaling over $1 billion.
- **Hurricane Gloria (1985) –** A storm that hit Long Island, NY and New Jersey that caused minor storm surge, erosion damage and substantial wind damage.
- **Long Island Express Hurricane (1938) –** This storm moved up the east coast from New York through New England and caused widespread storm surge and wind damage to buildings. It is used today as a benchmark for predicting worst-case scenario damage in the region.

Table 3-53 details how many hurricanes have directly hit each New England state between 1951 – 2009.

Table 3-53: Direct Hurricane Hits Between 1851 - 2009

	Saffir-Simpson Hurricane Wind Scale Category					
Area	**1**	**2**	**3**	**4**	**5**	**All**
Connecticut	4	3	3	0	0	10
Rhode Island	3	2	4	0	0	9
New Hampshire	1	1	0	0	0	0
Maine	5	1	0	0	0	6
Massachusetts	**5**	**2**	**3**	**0**	**0**	**10**
Source: FEMA Coastal Construction Manual, 2001 (Blake, 2005 & Jarrell 2001, NOAA)						

3.1.13.2 Probability of Future Occurrence of a Hurricane Hazard

Based on NOAA's Adapting to Climate Change Guide[4], the power and frequency of Atlantic Ocean hurricanes has increased in recent decades and the intensity of Atlantic hurricanes is likely to increase over the extended long term. Within the short term, NOAA makes predictions on a yearly basis at the start of hurricane season to forecast the number of Atlantic Ocean based hurricanes. For 2013, NOAA is forecasting an active or extremely active season with a 70 percent likelihood of 13 to 20 named storms, of which 7 to 11 could become hurricanes. These ranges are above the seasonal average of 12 named storms, 6 hurricanes, and 3 major hurricanes. According to the State Hazard Mitigation Plan, based on past hurricane landfalls and the frequency of tropical systems to hit Massachusetts is once out of every six years on average.

3.1.13.3 Vulnerability to Hurricane Hazard

According to the State of Massachusetts Hazard Mitigation Plan, Massachusetts is susceptible to hurricanes (and tropical storms). Impacts to the Commonwealth in addition to a direct hit can include effects from tropical remnants such as heavy rain, localized flooding and storm surge. In Worcester County, heavy rains associated with hurricanes (and flooding events that occur as a result) present the greatest risk to the area. **Table 3-54** details the susceptibility of the UMass System Office locations to hurricanes.

Table 3-54: UMass System Office Hurricane Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• State of Massachusetts (2010) Hazard Mitigation Plan • Review of FEMA's Multi-Hazard Identification and Risk Assessment	• Hurricanes are discussed in the state hazard mitigation plan which notes that the entire state of MA is susceptible to hurricanes with coastal areas being susceptible to both wind damage and storm surge damage. • NOAA's historical tropical cyclone tracks show the paths that tropical storms/hurricanes have taken through the Commonwealth.

[4] Source: NOAA's Adapting to Climate Change: A Planning Guide for State Coastal Managers (2010)

How Susceptibility Was Determined	Susceptibility Criteria
• Review of NOAA historical tropical cyclone tracks • Anecdotal Information from UMass System Office • CMRPC Pre-Disaster Hazard Mitigation Plan	• The state plan notes that between 1851 and 2004, approximately 32 tropical storms; five Category 1 hurricanes, two Category 2 hurricanes and three Category 3 hurricanes have made landfall. To date, the Commonwealth has not experienced a Category 4 or 5 hurricane. • The state plan notes that based on past hurricane and tropical storm landfalls, the frequency of tropical systems to hit the Massachusetts coastline is an average of once out of every six years. • CMRPC Plan notes that the Central Mass region is at medium risk for Hurricane threats, and may experience serious impacts due to wind, vegetative debris, flooding, stormwater flooding and rain. • In the past, the UMass System Office network has gone down due to a hurricane event. During Hurricane Irene, the two means that connect the System Office through the IT infrastructure backbone both went down (this is the only time both fiber strands from the major carrier have experienced a double failure. Windows have leaked in the past at Franklin Street location during storm events.

3.1.13.4 Risk Assessment Methodology, Limitations and Results

After consideration of the data available for a hurricane event and its impact to the UMass System Office locations, the risk assessment for this natural hazard has been developed as a qualitative analysis. A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of a hurricane hazard utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office locations was based on background research, future development plans, knowledge of the campus, infrastructure and past occurrences and is presented in **Table 3-55**.

Table 3-55: Risk Assessment – Hurricane

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 50%	Consequence (S) 50%	Total	Risk Ranking L,M,H,S
Hurricane	3	4	5	4	3.67	5.00	4.47	S

After reviewing the initial ranking of **severe** and conducting further research, specific consideration was given to how an event could impact staff, visiting faculty and students, existing buildings, future buildings, operations and critical infrastructure (**Table 3-56**).

Table 3-56: Qualitative Risk Assessment - Hurricane

	Hurricane Hazard - Qualitative Ranking
Risk Ranking	Severe
Students, Faculty & Staff	Severe
Existing Buildings	High
Future Buildings	Medium
Operations	Severe
Critical Infrastructure	Severe

As a result of considering these additional factors, the overall ranking remained **severe**.

3.1.13.5 Future Development Considerations

The UMass System Office will give consideration to hurricane hazards during future planning efforts. Additional considerations include:

- Implement building code requirements in building rehabilitations or new construction that relate to FEMA policies and guidelines that may be included in City of Boston and Town of Shrewsbury regulations.
- Coordinate weather and emergency information with City of Boston and Town of Shrewsbury officials.
- Coordinate outreach to public with consistent messaging, information, and instructions via public broadcast, websites, email, and social media for watches and warnings issued by the National Weather Service, hurricane evacuation routes, and guidance for hurricane preparation.
- Develop a shelter in place plan for the UMass System Office location populations.

3.2 HUMAN HAZARDS IMPACTING THE UMASS SYSTEM OFFICE

The assessment process for human hazards takes on a different aspect than natural hazards due to the inherent unpredictability of these events. Although natural hazard events are also unpredictable, they are related to weather patterns and seasonal changes and often correspond to specific times of the year. Human hazards tend to be related to human behaviors that can be difficult to predict and can be either accidental or intentional in nature.

The human hazards that have been identified and included in this section received their initial consideration from FEMA Guidance documentation, but were then expanded and customized to meet the UMass System Office's intent to have an inclusive assessment of the human hazards that could impact the UMass System Office locations. While there are some anecdotal data points regarding human hazard occurrences, much of the assessment was based on what could happen and how it could impact the UMass System Office population, facilities and operations. Each of the human hazards was analyzed and a final list of human hazards was developed that could impact the UMass System Office. Each of the human hazards the UMass System Office is potentially susceptible to that were considered by the stakeholders is listed in **Table 3-57** and further discussed in the specific human hazard assessment sections.

Table 3-57: Human Hazard Qualitative Risk Ranking Summary

	UMass System Shrewsbury, MA Worcester County	UMass System Boston, MA Suffolk County	Qualitative Hazard Risk Ranking
Weapons of Mass Destruction	X	X	Low
Fraud	X	X	Low
Civil Disturbance	X	X	Low
HazMat Release	X	X	Low
Bomb Threat	X	X	Low
Vandalism	X	X	Low
Arson	X	X	Low
Violent Criminal Incident	X	X	Medium
Robbery / Burglary	X	X	Low
Pandemic	X	X	Medium
Explosion	X	X	Low
Cyberattack / Cyberterrorism	X	X	Severe
Armed Attack / Active Shooter	X	X	Low
Critical Infrastructure Failure	X	X	Severe

3.2.1 Weapons of Mass Destruction

Weapons of mass destruction could be utilized by anyone at any time and can cause death and significant loss of life, damage to property and to the environment. While the use of these weapons at the UMass System Office is not highly likely to occur, the potential damage resulting from an event involving weapons of mass destruction at one or more of the UMass System Office locations could be devastating and threaten the entire function of the UMass System Office and surrounding areas. An event of this type could result in the need for office evacuation or long term sheltering in place. To date there have been no incidents of the use of weapons of mass destruction at any UMass System Office location.

A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of weapons of mass destruction utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was low (see **Table 3-58**) based on the unlikelihood of this type of event.

Table 3-58: Risk Assessment – Weapons of Mass Destruction

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Weapons of Mass Destruction	0	1	1	1	0.67	1.00	0.83	L

3.2.2 Fraud

Due to the large operating budget of the UMass System, fraud is a concern. The UMass System has guidelines in place that provide reporting procedures, responsibilities and investigation responsibilities around suspected fraudulent financial activities. In addition, The UMass System has an ethics and fraud hotline available for reporting suspected fraudulent activities. With the large operating budget, a fraudulent event performed by an employee with access to sensitive financial information or accounts could be significant.

A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of a fraud event utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was **low** due to no past occurrences and relatively low concern over potential impacts to the victims of these incidents (see **Table 3-59).**

Table 3-59: Risk Assessment – Fraud

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Fraud	1	1	2	1	1.00	2.00	1.50	L

3.2.3 Civil Disturbance

University students across the country have participated in civil disturbance events associated with a variety of political or socioeconomic issues. The damages resulting from these events if they were to occur at the UMass System Office locations could vary from small scale damages to property or persons to larger scale impacts. Disruptions to operations could occur if buildings are inaccessible or workers feel threatened to access certain areas. These events could also cause a deployment of public safety resources to ensure a safe environment. The UMass System has Guidelines for Responses to Demonstrations for all campuses.

There have been small scale civil disturbance events experienced on the UMass System Office locations but these have been short in duration and have not resulted in significant impacts. Attempts are made at the UMass System Office locations to control access to the building. The susceptibility criteria considered in the risk assessment associate with a civil disturbance is presented in **Table 3-60**.

Table 3-60: Civil Disturbance Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• Anecdotal Information	Civil disturbances have occurred at UMass System Office locations in the past.

A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of a civil disturbance utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was **low** due to the minimal impacts experienced from these types of events in the past (see **Table 3-61**).

Table 3-61: Assessment – Civil Disturbances

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Civil Disturbances	1	1	2	1	1.00	2.00	1.50	**L**

3.2.4 HazMat Release

While there are no laboratories or chemicals used or stored by the UMass System Office, the building used by the UMass System Office at the Shrewsbury location is owned by the UMass Medical School (UMMS), which occupies the other half of the building and stores and uses chemicals. UMMS's use of chemicals could potentially impact the part of the building occupied by the UMass System Office, but the impacts are anticipated to be low and unlikely. In June 2012, there was a Tier 1 hazardous materials spill at a company approximately one mile from the UMass System Office in Shrewsbury, which minimally impacted the UMass System Office. The susceptibility criteria considered in the risk assessment associated with a hazardous materials incident is presented in **Table 3-62.**

Table 3-62: Hazardous Materials Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• Anecdotal Information	• The UMass Medical School stores and uses chemicals in a building occupied by the UMass System Office. • Hazardous waste spills from the surrounding community have potential to impact UMass System Office locations.

A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of a hazardous materials event utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was **low** due to the potential impacts that could be experienced from these types of events (see **Table 3-63**).

Table 3-63: Risk Assessment – Hazardous Materials

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Hazardous Materials Incident	0	1	1	1	0.67	1.00	0.83	L

3.2.5 Bomb Threat

According to the FEMA, there has been one Presidential Disaster Declaration made for a bombing event in the State of Massachusetts as shown in **Table 3-64**.

Table 3-64: Massachusetts Bombing Related Major Disaster Declarations

	Disaster No.	Incident Period	Date Disaster Declared	Worcester County a Designated Area?	Suffolk County a Designated Area?
Boston Marathon Bombing	EM 3662	4/15/13	4/17/13	No	Yes
Source: FEMA Disaster Declarations 1954 – Present					

On April 15, 2013 during the Boston Marathon two bombs were intentionally detonated near the finish line for the race on Boylston Street in Boston. A total of five deaths and 280 injuries resulted from the bombings. Impacts of a bomb threat may include temporary building evacuations, human injury or death or disruptions to UMass System Office operations. The susceptibility factors that were incorporated into the bomb threat risk assessment are provided in **Table 3-65**.

Table 3-65: Bomb Threat Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• Anecdotal information	• There have been bomb threats at the UMass System Office in the past.

A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of weapons of bomb threats utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was **low** (see **Table 3-66**).

Table 3-66: Risk Assessment – Bomb Threat

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Bomb Threat	0	1	2	2	1.00	2.00	1.5	**L**

3.2.6 Vandalism

Acts of vandalism at the UMass System Office have the potential to occur, due to the open nature of the buildings. Acts of vandalism have the potential to cause destruction of personal property and UMass System Office assets. For acts of vandalism, the Shrewsbury location would rely on the local police department as primary responder to the incident, while the Franklin Street location would rely on Boston Campus Police for primary response. While acts of vandalism are a nuisance, they are unlikely to disrupt UMass System Office operations or threaten the safety of the UMass System population. The susceptibility criteria factoring into the risk assessment are provided in **Table 3-67**.

Table 3-67: Vandalism Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• Anecdotal information	• Many contractors have access to the building. • There are frequent visitors and guests.

A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of vandalism utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was **low** (see **Table 3-68**) given the low frequency and relatively minor impact resulting from these types of events.

Table 3-68: Risk Assessment – Vandalism

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Vandalism	1	1	2	1	1.00	2.00	1.5	L

3.2.7 Arson

The UMass System Office locations have the potential to experience arson attempts, but have not experienced arson incidents to the degree experienced by the UMass campuses with high student populations and student residence halls. Impacts from arson events could include a complete loss of a building, destruction to UMass System Office operations, injuries and even loss of life. Some of the susceptibility factors contributing to the risk assessment are provided in **Table 3-69.**

Table 3-69: Arson Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• Anecdotal information	• Arson offences have occurred on UMass campuses in the past. • Arson incidents have occurred in the Town of Shrewsbury.

A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of an arson event utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was **low** (see **Table 3-70**).

Table 3-70: Risk Assessment – Arson

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Arson	1	2	2	2	1.67	2.00	1.83	L

3.2.8 Violent Criminal Incident

Violent criminal incidents include murder and non-negligent manslaughter, forcible rape, and aggravated assault. The UMass System Office has experienced violent criminal incidents in the past, some resulting in injury. Crimes of this nature can be extremely severe and can result in extreme physical harm or death to the victim, as well as lingering impacts to the overall sense of security and well-being of the UMass System Office community. The susceptibility criteria factoring into the risk assessment is presented in **Table 3-71**.

Table 3-71: Violent Criminal Incident Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• Anecdotal information	• There have been physical assaults at the UMass System Office. • Threats have been made to UMass System Office employees at work.

A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of a violent criminal incident utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was **medium** due to the past occurrences and potential impacts to the safety and health of the victims of these events (see **Table 3-72**).

Table 3-72: Risk Assessment – Violent Criminal Incident

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Violent Criminal Incident	2	2	3	3	2.33	3.00	2.67	M

3.2.9 Robbery and Burglary

To date, the UMass System Office has not experienced robbery or burglary incidents, but the open access of the buildings may leave the UMass System Office open to cases of theft. Injuries and even death could result from a severe incident of a robbery or burglary gone wrong. The criteria that were considered in the risk assessment for a robbery or burglary incident are provided in **Table 3-73**.

Table 3-73: Robbery Incident Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• Anecdotal information	• The open access of the buildings may leave the UMass System Office open to incidents of robbery or burglary. • There have been reported incidents in the Town of Shrewsbury and in the City of Boston.

A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of a robbery utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was **low** (see **Table 3-74**).

Table 3-74: Risk Assessment – Robbery and Burglary

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Robbery / Burglary	1	1	2	1	1.00	2.00	1.50	L

3.2.10 Pandemic

A pandemic health issue is the worldwide spread of an infectious disease across large populations of human beings. This could be any infectious disease but in recent times has been most associated with influenza. To date there have been no pandemic diseases that have impacted the UMass System Office.

Depending on the nature and severity of the pandemic illness (e.g., flu and other diseases), the impacts from a pandemic health issue could involve quarantine, office closure, and health impacts including death. A severe, widespread event could greatly disrupt UMass System Office operations as UMass System Office administration personnel have unique skill sets and extended absences could impact the office's ability to provide important services to the UMass System. In addition, some UMass System Office personnel travel internationally, potentially increasing the chances of exposure to illness. The susceptibility criteria considered for a pandemic health issue are presented in **Table 3-75**.

Table 3-75: Pandemic Health Issue Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• State of Massachusetts Hazard Mitigation Plan, 2010 • Anecdotal information	• Public health emergencies can occur in any community in the Commonwealth. Depending on the level of contagiousness or method or infectivity, urban environments may be more susceptible for faster spread of certain disease. • Massachusetts was impacted by the H1N1 flu in 2009. • UMass System personnel travel internationally. • UMass System personnel have unique skillsets and other personnel are not necessarily cross-trained to cover in the event of absences.

A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of a pandemic health issue utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was **medium** given the health impacts and viability of this type of event (see **Table 3-76**).

Table 3-76: Risk Assessment – Pandemic Health Issue

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Pandemic Health Issue	1	2	3	3	2.00	3.00	2.50	**M**

3.2.11 Explosion

Explosions can be caused by bombs, as discussed above, or via other means, such as the improper use and handling of chemicals or other dangerous substances. While chemicals are not used or stored by the UMass System Office, the building occupied by the UMass System Office in Shrewsbury is owned by UMMS, which occupies the other half of the building and stores and uses chemicals. UMMS's use of chemicals could potentially impact the part of the building occupied by the UMass System Office. A large scale explosion could result in impacts to UMass System assets, injuries or loss of life. UMass System Office operations could also be impacted and the need for building evacuation could result. Susceptibility criteria that were factored into the risk assessment are presented in **Table 3-77.**

Table 3-77: Explosion Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• Anecdotal information	The UMass Medical School stores and uses chemicals in a building occupied by the UMass System Office in Shrewsbury and if used or stored incorrectly, some of the chemicals have the potential to cause an explosion.

A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of an explosion utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was **low** due to the lack of chemicals directly used and stored by the UMass System Office (see **Table 3-78**).

Table 3-78: Risk Assessment – Explosion

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Explosion	0	1	2	2	1.00	2.00	1.50	L

3.2.12 Cyberattack and Cyberterrorism

Information technology (IT) intrusion and unauthorized access to IT systems is a real threat to the UMass System Office. The UMass System Office has experienced frequent small-scale cyberattacks in the past, but to date there has been no event that has resulted in significant impacts. Over time it is expected that cyber events will continue to be a major concern. A successful cyber event could result in the loss of sensitive information and impact the operations of essential computer systems. Susceptibility factors contributing to the risk assessment for cyberattacks are provided in **Table 3-79**.

Table 3-79: Cyberattack

How Susceptibility Was Determined	Susceptibility Criteria
• Anecdotal Information	• There have been cyber-related events at the UMass System Office.

A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of a cyberattack event utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was **severe** due to the high frequency of these events and potential impacts to operations (see **Table 3-80**).

Table 3-80: Risk Assessment – Cyberattack

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Cyberattack/ Cyberterrorism	5	1	5	4	3.33	5.00	4.17	S

3.2.13 Armed Attack and Active Shooter

The UMass System Office takes the threat of an active shooter or armed attack very seriously. To date there have been no active shooter events at the UMass System Office. While this type of event is unlikely, it has occurred on other college and university campuses, making it worth serious consideration and planning. The direct impacts of an active shooter situation could be serious injury or death on a large scale. Also, the negative press associated with this type of event could greatly impact the reputation of the UMass System. The aftermath of such an incident to the mental health state and feeling of safety to the system population would need to be carefully managed and could require counseling and increased security presence. The susceptibility criteria included in the risk assessment are provided in **Table 3-81**.

Table 3-81: Armed Attack and Active Shooter Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• Anecdotal information	• Large number of building occupants and visitors. • There have been reported incidents in the Town of Shrewsbury.

A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of an active shooter utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was **low** (see **Table 3-82**).

Table 3-82: Risk Assessment – Active Shooter

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Armed Attack/ Active Shooter	0	1	2	2	1.00	2.00	1.50	L

3.2.14 Critical Infrastructure Failure

Infrastructure failure is an extremely serious consideration for the UMass System Office as it strives to minimize any extended impacts to operations. Loss of power or communications is one of the most disruptive events that can occur as it can result in the need to close the office and evacuate. The financial implications in terms of loss of building operations could be significant.

Infrastructure impacts could be caused from a variety of natural events, but also could result from the failure of infrastructure that could be for a variety of reasons. Susceptibility factors contributing to the risk assessment for infrastructure failure are provided in **Table 3-83.**

Table 3-83: Infrastructure Failure Susceptibility

How Susceptibility Was Determined	Susceptibility Criteria
• State Hazard Mitigation Plan, 2010 • Anecdotal information	• Technological emergencies have the potential to occur in every corner of the Commonwealth. Entities with limited technological infrastructure are more vulnerable to experiencing an incident because of the lack of redundant systems. Entities should consider mitigation measures such as emergency generators, buried cable, and preventative pruning to help reduce the risk of this type of emergency. • Electricity problems in neighboring power pools to New England may deplete available electricity reserves, leading to supply problems if conditions in New England deteriorate. Disruptions in the supply of natural gas or petroleum to New England may impact generating capacity in the region. Disruptions to generation plants or key transmission lines due to natural disasters, mechanical failure, or deliberate action may reduce the supply of electricity to the region. • Experienced the only double failure of both fiber optic lines by a major carrier during Hurricane Irene. • Construction activities have impacted the water lines at the UMass System in the past. • IT functions are replicated, but replication locations are not located far from one another.

A qualitative assessment of the frequency, duration, severity, intensity, probability and consequence of infrastructure failure utilizing a low, medium, high and severe ranking system was prepared. The ranking given for the UMass System Office was severe (see **Table 3-84**) due to frequency and potential impacts to system operations.

Table 3-84: Risk Assessment – Infrastructure Failure

	Frequency 0-5	Duration 0-5	Severity 0-5	Intensity 0-5	Probability (F,D,I) 40%	Consequence (S) 60%	Total	Risk Ranking L,M,H,S
Critical Infrastructure Failure	3	2	5	4	3.00	5.00	4.00	S

4. VULNERABILITY & IMPACT ASSESSMENT

The purpose of assessing risks, determining vulnerability and estimating losses is to determine how the UMass System Office locations and their assets may be affected by various hazard events. The UMass System Office evaluated building vulnerability in Shrewsbury and for the floor that is occupied in Boston to the extent possible using the FEMA methodology for loss of function and total damage calculation which was detailed in the Hazard Mitigation Plan. The information included in the following sections provides the specific calculations for the UMass System Office locations.

4.1 ASSET INVENTORY

Table 4-1 summarizes the assets that were evaluated during the mitigation planning process for the UMass System Office. Both of these buildings are rented space and not owned by UMass.

Table 4-1: UMass System Office Assets Evaluated During Mitigation Planning Process

Existing Buildings	Date Construction Completed	Gross Square Feet
333 South Street, Shrewsbury, MA	1986	548,850
225 Franklin Street, 33rd Floor, Boston, MA	Unknown	25,000 (just the floor UMass occupies)

4.1.1 Loss of Function

The methodology for discussing the Loss of Function Calculation can be found in **Section 3.6** of the Hazard Mitigation Plan. Data specific for the UMass System Office is presented in **Table 4-2**. The data in this table and supporting graphic are for a non-hazard specific loss of function cost to the buildings associated with the UMass System Office.

Table 4-2: UMass System Office Loss of Function Cost

	Date Construction	Gross Square Feet	Building Criticality Value	Factored Square Footage	Building/Total System Office Square Footage	Per Day Loss of Function Cost	Estimated Hazard Specific Loss of Function Days	Loss of Function
Existing Buildings								
333 South Street, Shrewsbury, MA	1986	548,850	3	1,646,550	2.869303825	$37,987	7	$265,909
225 Franklin Street, 33rd Floor, Boston, MA	Unknown	25,000)	3	75,000	0.130696175	$1,730.30	7	$12,112

4.1.2 Building Vulnerability Assessment

Using the Loss of Function cost per hazard, a Building Vulnerability Assessment was conducted that included utilizing additional information such as Insurable Replacement Value and Insurable Contents Value for buildings. A Total Damage amount was calculated and then building vulnerability rankings were assigned based on the dollar amount (see **Table 4-3)**.

Table 4-3: UMass System Office Buildings - Vulnerability Assessment

	Insurable Replacement Value	Insurable Contents Value	Loss of Function Per Hazard	Total Damage	Building Vulnerability Ranking
Existing Buildings					
333 South Street, Shrewsbury, MA	$27,236,231	$40,854,347	$278,021	$68,368,599	Medium
225 Franklin Street, 33rd Floor, Boston, MA	Unknown	Unknown	$12,112	Unknown	Unknown
Note: Building Vulnerability Ranking is based on Replacement Value + Insurable Contents Value + Loss of Function Value					

Photo: *UMass System Office Building, 333 South Street, Shrewsbury, MA*

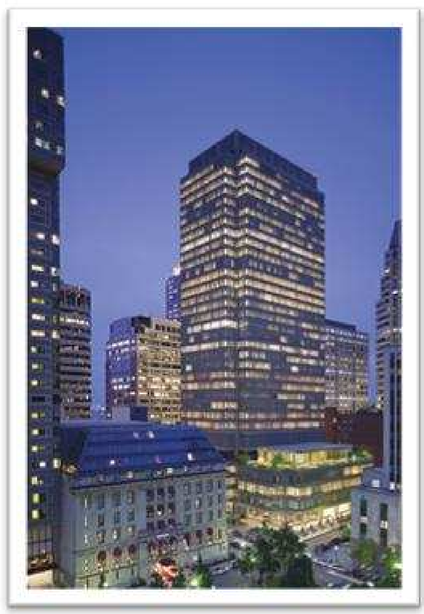


Photo: *UMass System Office Building, 33rd Floor, Boston, MA*

5. GOALS & OBJECTIVES

The UMass System Office used the identification, profiling and vulnerability assessment of natural and human hazards that have or may impact them in the future to establish planning goals and objectives that provide the basis for the development of the proposed hazard mitigation projects. The establishment of goals and objectives was based upon a clear understanding of the hazards that have a potential to impact the University community, what the risks associated with each hazard are and where vulnerabilities exist, as well as the University's commitment to reducing future vulnerability and mitigating risks where possible.

According to the FEMA guidance documentation, a goal serves as a general guideline that explains what a community would like to achieve and an objective defines a specific strategy or implementation step that will help reach a specific goal. A mitigation action is a specific task that the UMass System Office can tie back to its goals and objectives and measure what has been achieved. The goals and objectives identified for the UMass System Office are presented in **Table 5-1**.

Table 5-1: UMass System Office Goals & Objectives

Goal/Objective	Explanation
Goal 1	**Protect existing and future assets from known hazards by implementing mitigation projects to minimize potential losses and ensure public health and safety.**
Objective 1-A	Use appropriate techniques to mitigate against impacts from winter and ice storms.
Objective 1-B	Use appropriate techniques to mitigate against impacts from high wind events such as windstorms, hurricanes, and tornadoes.
Objective 1-C	Use appropriate techniques to mitigate against impacts from earthquakes.
Goal 2	**Maintain a continuity of UMass System Office business operations during and after a hazard event.**
Objective 2-A	Build redundancy in essential systems.
Objective 2-B	Protect critical infrastructure.
Objective 2-C	Evaluate and enhance communication and education during hazard events to increase the understanding of impacts to the UMass System Office.
Objective 2-D	Establish contingency procedures.
Goal 3	**Create and maintain a safe, secure environment for the UMass System Office population before, during and after a hazard event.**
Objective 3-A	Improve safety and security.

Goal/Objective	Explanation
Objective 3-B	Proactively conduct scenario planning activities.
Objective 3-C	Focus on the mental health of the UMass System Office community.
Objective 3-D	Continually develop and maintain emergency response programs.
Objective 3-E	Protect human health.
Goal 4	**Communicate natural and human hazard information to the UMass System Office community and improve education and outreach efforts regarding their potential impact.**
Objective 4-A	Advise the community on health and safety precautions against potential hazards.
Objective 4-B	Work collaboratively with external UMass System Office stakeholders on hazard mitigation.
Objective 4-C	Consider and obtain feedback from the UMass System Office population on hazard planning communications.
Goal 5	**Proactively protect existing and future UMass System Office assets from known hazards by incorporating mitigation activities into capital improvement and infrastructure planning.**
Objective 5-A	Use appropriate measures to ensure new development or redevelopment will not increase hazard threats.

6. MITIGATION ACTIVITIES & ACTION PLAN

6.1 MITIGATION ACTIVITIES & ACTION PLAN

The mitigation actions and projects noted in this section were identified based on the goals and objectives prepared during the planning process, past occurrences and the UMass System Office's commitment to work closely with administration, faculty, staff, students, residents and City/Town officials to ensure public safety. **Table 6-1** summarizes a list of mitigation projects for the UMass System Office.

Table 6-1: UMass System Office Mitigation Projects

Project No.	Hazard Addressed	Description	Objectives Addressed	Estimated Cost
1	Winter storms and ice storms	• Assess Shrewsbury building roof condition and potential for impacts from a large snow event.	1A	$
2	Windstorm, hurricanes, tornadoes	• Upgrade leaking windows at Franklin Street. • Develop a debris management plan.	1B	$ $
3	Earthquake	• Conduct an assessment of critical infrastructure structural integrity.	1C	$
4	All	• Study the emergency generator and backup power redundancies. • Conduct a utility vulnerability assessment. • Review long-term accessibility to the data center in the case of a multi-day event. • Review and develop redundancies for critical administrative functions.	2A	$ $ $ $
5	All	• Ensure that all critical facilities have generators and other portable devices to support critical infrastructure (potentially these devices could be shared among the campuses). • Complete an assessment of the data center and evaluate and address any potential vulnerabilities. • Redesign IT "backbone" to address repetitive loss on connectivity. • Relocate IT infrastructure from Shrewsbury/Boston to Amherst and build network logistics in Amherst to accommodate the relocation.	2B	$ $ $ $

Project No.	Hazard Addressed	Description	Objectives Addressed	Estimated Cost
		• Complete a coordination analysis to determine where it makes sense to have a common set of practices for IT functions. • Develop backup HVAC/air capacity for Boston network closet.		\$ \$
6	All	• Conduct training on business continuity plans.	2C	\$
7	All	• Develop a relocation plan if building or floor needed to be evacuated or if critical functions are impacted.	2D	\$
8	All	• Conduct a System Office wide information security risk assessment. • Implement an employee badge system for Shrewsbury. • Increase building security presence and protocols. • Increase notification protocols for threatening employees. • Conduct an assessment of building lockdown capabilities. • Develop and communicate a central phone number to call to report potential emergency management issues.	3A	\$ \$ \$ \$ \$ \$
9	All	• Conduct System Office evacuation training and drills.	3B	\$
10	All	• Evaluate mental health programs on System Office and create an outreach program.	3C	\$
11	All	• Develop a plan for sheltering in place.	3D	\$
12	Pandemic health issue	• Develop a pandemic health management plan.	3E	\$
13	All	• Develop and implement a hazards public education and outreach program. • Incorporate hazard awareness into the web site and other social media.	4A	\$ \$
14	All	• Implement regular communications with other building occupants and a mechanism to share information related to an event. • Participate in municipal, regional and	4B	\$ \$

Project No.	Hazard Addressed	Description	Objectives Addressed	Estimated Cost
		state hazard mitigation planning efforts. • Work collaboratively with all UMass campuses on hazard mitigation.		$
15	All	• Conduct surveys or other outreach soliciting feedback from the community.	4C	$
16	Windstorm, hurricane, tornadoes, winter storm, ice storm, fire, earthquake	• Complete a hazard assessment on each new project. • Ensure new buildings incorporate structural integrity and protection issues associated with top hazards.	5A	$ $

6.2 MITIGATION PROJECT PRIORITIZATION

The projects and mitigation activities noted in the previous section that have been proposed meet the FEMA STAPLEE criteria. To meet the STAPLEE criteria, projects and activities must be socially acceptable to the community, technically feasible, protective of or beneficial to the environment and are backed by legal authority and consistent with current laws, consider economic benefits and costs and include environmental considerations. **Table 6-2** indicates the project number, responsible party and whether or not the project meets each individual STAPLEE criteria at a high, medium or low level. After taking this information into consideration, each project is given a qualitative high, medium or low ranking.

Table 6-2: UMass System Office Project Prioritization

Project No.	Project	Responsible Party	Cost Effectiveness of Activity	Socially Acceptable	Technically Feasible	Protect/Benefit Environment	Legal	Economic Benefit	Project Priority
1	Assess Shrewsbury building roof condition and potential for impacts from a large snow event.		High	High	High	Low	Low	Medium	Medium
2	Upgrade leaking windows at Franklin Street.		Medium	High	High	Low	Low	High	High
3	Develop a debris management plan.		Medium	Medium	High	Medium	Medium	Low	Low
4	Conduct an assessment of critical infrastructure structural integrity.		Medium	Medium	High	Low	Low	High	Medium
5	Study the emergency generator and backup power redundancies.	Emergency Management & Business Continuity (EM/BC)	High	High	High	Low	Low	Low	Medium
6	Conduct a utility vulnerability assessment.		High	Medium	High	Low	Low	Medium	Medium
7	Review long-term accessibility to the data center in the case of a multi-day event.	University Information Technology Systems (UITS)	High	High	High	Low	Low	Medium	High
8	Review and develop redundancies for critical administrative functions.	UITS	High	Medium	High	Low	Low	Low	Low

Project No.	Project	Responsible Party	Cost Effectiveness of Activity	Socially Acceptable	Technically Feasible	Protect/Benefit Environment	Legal	Economic Benefit	Project Priority
9	Ensure that all critical facilities have generators and other portable devices to support critical infrastructure (potentially these devices could be shared among the	EM/BC	High	High	High	Low	Low	High	High
10	Complete an assessment of the data center and evaluate and address any potential	UITS	High	High	High	Low	Low	High	High
11	Redesign IT “backbone” to address repetitive loss on connectivity.	UITS	Medium	Medium	Medium	Medium	Medium	Medium	Medium
12	Relocate IT infrastructure from Shrewsbury/Boston to Amherst and build network logistics in Amherst to accommodate	UITS	Medium	Medium	Medium	Medium	Medium	Medium	Medium
13	Complete a coordination analysis to determine where it makes sense to have a common set of practices for IT functions.	UITS	Medium	Medium	Medium	Medium	Medium	Medium	Medium
14	Develop backup HVAC/air capacity for Boston network closet.		Medium	Medium	Medium	Medium	Medium	Medium	Medium
15	Conduct training on business continuity plans.	EM/BC	High	High	High	Low	Low	Medium	Medium
16	Develop a relocation plan if building or floor needed to be evacuated or if critical functions are impacted.	EM/BC	High	High	High	Low	Low	Medium	Medium
17	Conduct a System Office wide information security risk assessment.	UITS	Medium	Medium	Medium	Low	Medium	Medium	Medium

Project No.	Project	Responsible Party	Cost Effectiveness of Activity	Socially Acceptable	Technically Feasible	Protect/Benefit Environment	Legal	Economic Benefit	Project Priority
18	Implement an employee badge system for Shrewsbury.	UITS & EM/BC	Medium	Medium	Medium	Low	Medium	Low	Medium
19	Increase building security presence and protocols.	EM/BC	Medium	Medium	Medium	Low	Medium	Low	Medium
20	Increase notification protocols for threatening employees.	EM/BC	High	High	High	Low	High	Low	High
21	Conduct an assessment of building lockdown capabilities.	EM/BC	High	High	High	Low	High	Low	High
22	Develop and communicate a central phone number to call to report potential emergency management issues.	EM/BC	High	High	High	Low	High	Medium	Medium
23	Conduct System Office evacuation training and drills.	EM/BC	Medium	High	High	Low	Medium	Low	Medium
24	Evaluate mental health programs on System Office and create an outreach program.	Human Resources (HR)	Medium	High	High	Low	Medium	Low	Medium
25	Develop a plan for sheltering in place.	EM/BC	High	High	High	Low	Medium	Low	Medium
26	Develop a pandemic health management plan.	HR	High	High	High	Low	Medium	Low	Medium
27	Develop and implement a hazards public education and outreach program.	EM/BC	High	High	High	Low	Medium	Low	Medium
28	Incorporate hazard awareness into the web site and other social media.	EM/BC	High	High	High	Low	Medium	Low	Medium

Project No.	Project	Responsible Party	Cost Effectiveness of Activity	Socially Acceptable	Technically Feasible	Protect/Benefit Environment	Legal	Economic Benefit	Project Priority
29	Implement regular communications with other building occupants and a mechanism to share information related to an event.	EM/BC	Medium	High	High	Low	Low	Low	Low
30	Participate in municipal, regional and state hazard mitigation planning efforts.	EM/BC	Medium	High	High	Low	Low	Medium	Medium
31	Work collaboratively with all UMass campuses on hazard mitigation.	EM/BC	Medium	High	High	Low	Low	Medium	Medium
32	Conduct surveys or other outreach soliciting feedback from the community.	EM/BC	Medium	Medium	Medium	Low	Low	Low	Low
33	Complete a hazard assessment on each new project.	EM/BC	Medium	Medium	High	Low	Low	Low	Low
34	Ensure new buildings incorporate structural integrity and protection issues associated with top hazards.		Medium	High	High	Low	Low	Low	Medium

6.3 POTENTIAL FUNDING SOURCES

Potential funding sources were listed in the Hazard Mitigation Plan (see **Section 5.3**) and some of them pertain to the UMass System Office. Consideration should be given to pursuing these funding opportunities where appropriate as a way to implement action items.

6.4 CAPABILITIES ASSESSMENT

The UMass System Office has policies, procedures and action plans in place as well as qualified staff available that can be utilized for implementation of this Hazard Mitigation Plan which addresses both natural and human hazards. The capability assessment focuses on identifying where the UMass System Office already has mechanisms and staff in place that can either be used directly or modified to support mitigation activities.

6.4.1 Administrative Capability

The UMass System is governed by a single Board of Trustees which is composed of 19 voting members and 3 non-voting members. The President of the University (office located in Boston) oversees the five campus system. At each campus (UMass Amherst, UMass Boston, UMass Dartmouth, UMass Lowell and UMass Medical School) there is a Chancellor.

The development of the UMass System Office Hazard Mitigation Plan Annex was led by Jeffrey Hescock, Director of University Emergency Management and Business Continuity. The UMass System Office provides leadership and support to the University and its five campuses. It manages through the Management and Fiscal Affairs department and the University Central Administration Services (Information Technology, Auditing, Budget Office, Human Resources, Treasurer's Office and Controllers Office). Within these departments, various levels of staff perform regular job duties as well as special projects when assigned. The UMass System Office can involve any of these offices and staff to provide administrative and technical capabilities to implement hazard mitigation activities.

6.4.2 Plan & Program Capability

The following documents were either reviewed as a part of this mitigation planning process or identified as having relevance to implementation of mitigation activities for the UMass System Office Boston and Shrewsbury locations.

Table 6-3: Plan & Program Capability Assessment

Name of Plan	State, Local, Campus Plan or Program	Relevance to Hazard Mitigation Planning Effort
Multi-Hazard Mitigation Plan – Boston Annex, 2008	Local	Expired local Hazard Mitigation Plan for Boston region that included specific Boston Annex.
City of Boston Natural Hazard Mitigation Plan – 2013	Local	Update to 2008 Hazard Mitigation Plan that discusses natural and some human hazards.

Name of Plan	State, Local, Campus Plan or Program	Relevance to Hazard Mitigation Planning Effort
Commonwealth of Massachusetts – State Hazard Mitigation Plan, 2010	State	Current Hazard Mitigation Plan for Massachusetts that discusses vulnerabilities throughout the state to natural (and some human) hazards and associated mitigation activities.
Fiscal Year 2012 – 2016 Capital Plan Update	UMass System Office	Details the University's capital planning process that focuses on a five-year planning period, but incorporates planning assumptions, needs assessments, and funding projections for the next decade.
CMRPC Pre-Disaster Mitigation Plan, 2012	Regional	Regional Hazard Mitigation Plan for central Massachusetts area which includes the Town of Shrewsbury.

6.4.3 Fiscal Capability

Annually, an operating budget is prepared for the University System and approved by the Board of Trustees. The operating budget presents projected revenue and expenditures for all five campuses as well as the President's Office. The fiscal year of the campuses runs from July 1st to June 30th of the next calendar year.

The UMass System is in the middle of implementing its 2012 – 2016 Five Year Capital Plan update. In general, due to the age of the facilities that make up the UMass System, it is a challenge to maintain and upgrade all of the capital assets including infrastructure, buildings and grounds. According to the Capital Pan, there is no single source of funding that has the capacity to address all of the work that needs to be done, so the University relies on a combination of revenue sources to fund future capital improvement investment. The four main revenue sources are:

- State support either through general obligation bond funds or economic stimulus and supplemental legislative appropriations,
- Financing through the University of Massachusetts Building Authority,
- Financing through the Massachusetts Health and Educational Facilities Authority, and
- Other legally available sources, operating funds and external funding such as private giving and grants.

The Capital Plan also notes that between 2008 – 2010, a number of developments occurred that will continue to help the University and its five campuses as well as the System Office improve and invest in infrastructure. The events that directly and indirectly relate to the UMass System Office include:

- The Commonwealth passed a $2 billion Higher Education Bond Bill that included over $1 billion for University projects,

- The Commonwealth passed a $1 billion Life Sciences Investment Bill that could provide up to $240 million of capital support to the University,
- The UMASS Building Authority borrowed $550 million in October 2009 to initiate projects at all of the University's campuses, and
- The UMASS Building Authority borrowed $547 million in November 2010 to initiate a third round of projects across the University.

The UMass Boston FY12-FY21 Capital Plan details over $1.1 billion in spending over the next ten fiscal years in four major areas (see **Table 6-4**).

Table 6-4: UMass Boston FY12-FY21 Capital Plan Details

Program Type	Amount Allocated	% of Total Funds
Basic Infrastructure/Deferred Maintenance/Compliance Projects	$63,600,000	5.7%
Master Plan Related Projects	$1,019,400,000	89.6%
Substructure Related Projects	$8,300,000	.7%
Teaching/Learning/Research	$44,000,000	4.0%

In general, larger capital projects for the entire UMass System such as buildings and athletic facilities are funded through the UMass Building Authority. DCAM generally may fund smaller projects that tend to be more operational in nature such as building maintenance, energy projects, emergency generators and other energy related/efficiency projects. Depending on the nature of the project, utilizing staff time and assigning specific people may be another way to advance certain mitigation projects.

6.4.4 Regulatory Environment

Additional legal and regulatory policies are in place in the City of Boston and Town of Shrewsbury that pertain to the UMass System Office and have an impact on the implementation of mitigation activities that are listed in **Table 6-5.**

Table 6-5: Legal and Regulatory Policies – City of Boston & Town of Shrewsbury

Regulation/Policy	Purpose
Article 80	Regulates large project review, small project review, planned development area review and institutional master plan review. Hospital or college projects that add more than 20,000 square feet of gross floor area or that involve interior alterations for more than 50,000 square feet of gross floor area require Institutional Master Plan Review according to Article 80. Once an Institutional Master Plan is approved, any project fully described in the plan may be completed (built) by the institution.
Town of Shrewsbury Zoning Bylaw	The UMass System Office is located in the Office/Research Zone. Zoning bylaw regulates use and characteristics of land and buildings in the Town of Shrewsbury.

7. PLAN IMPLEMENTATION, MAINTENANCE & ADOPTION

The implementation of the Hazard Mitigation Plan at the UMass System Office will be overseen by the UMass Emergency Planning and Business Continuity Manager, Jeffrey Hescock. The Emergency Planning and Business Continuity Manager will be responsible for:

- Participating on the Multi-campus Hazard Mitigation Steering Committee;
- Convening the System Office Hazard Mitigation Planning Team on a regular basis to discuss how various action items might be implemented, to ensure mitigation projects are prioritized in the highest order of importance, and to discuss action items that have been completed or are underway, and
- Ongoing stakeholder engagement and participation in other local and regional Hazard Mitigation Planning efforts (e.g. Town of Shrewsbury and City of Boston).

All meetings will be documented and summarized including the status of any mitigation project actions, risk assessments or needed plan revisions.

7.1 PLAN MAINTENANCE & REVISION

Informal Hazard Mitigation Plan monitoring activities will be ongoing on a regular basis. The UMass System Office will formally review the Hazard Mitigation Plan annually, or upon the occurrence of a substantial hazard event at any of the campuses. First, an annual plan review meeting with the Hazard Mitigation Steering Committee will be held by the Emergency Planning and Business Continuity Manager. Following that meeting, the Emergency Planning and Business Continuity Manager will assemble the UMass System Office Hazard Mitigation Planning Team to discuss the outcome of the Hazard Mitigation Steering Committee meeting and any recommended or needed changes to the Plan. Then, the Hazard Mitigation Planning Team will evaluate the progress of the UMass System Office Plan and document any mitigation activities that have taken place at the UMass System office locations since the last review.

In preparation for the annual meetings of the Hazard Mitigation Steering Committee and Hazard Mitigation Planning Team, the Emergency Planning and Business Continuity Manager will prepare a status report to document the campus' progress in implementing the Mitigation Plan. Status reports should describe:

- Projects that have been scoped for FEMA grant applications;
- Projects that have been submitted for FEMA funding programs;
- Grant applications that have been either approved or denied FEMA funding;
- Projects funded internally or by other grant programs;
- Projects that have been initiated or are under construction; and/or
- Completed projects.

The public will be informed about the annual review of the plan by the UMass Communications Office in accordance with the UMass System Office public affairs protocols. The public will be offered the opportunity to provide input and comment through the Emergency Planning and Business Continuity Manager. The public will also have an opportunity to comment on the plan during the 5-year plan update meeting. After the annual review meeting, UMass will issue a progress report and post it on the UMass System Office website.

The UMass System Office recognizes the importance of continued public outreach and public participation in this planning effort. Once the plan is finalized, a link to the Hazard Mitigation Plan and UMass System Office Annex, as well as a link to the complete plan will be posted to the UMass system website (www.massachusetts.edu). A press release will be issued by the Communications Office, and the effort may be discussed at various meetings where the Emergency Planning and Business Continuity Manager and UMass System Office Hazard Mitigation Planning Team members can promote the Plan and continue to make the System Office and neighboring community aware and encourage participation. Hard copies of the plan will be made available at the System Office through the Emergency Planning and Business Continuity Manager.

7.2 REVISING THE PLAN

The UMass System Office will review and update this plan annex every five years in coordination with the review and update of the entire multi-campus plan. Following a meeting of the Hazard Mitigation Planning Steering Committee in January 2019, the Emergency Planning and Business Continuity Manager will convene the UMass System Office Hazard Mitigation Planning Team and set forth a schedule for reviewing the plan. The review and update will include:

- Updating the plan to reflect any changes in development or in the System Office communities;
- A discussion on new/changed regulatory requirements;
- A discussion of recent hazard events;
- A re-evaluation of the hazard ranking and any changes in System Office priorities;
- An update of any loss estimates,
- A discussion of any new studies and technologies;
- Revisiting potential projects; and
- A discussion of projects that have been completed.

The UMass System Office Hazard Mitigation Planning Team will review any State or Federal changes made to System Office plans, funding, and policies, and will also utilize any updated Census Data that is available. The Hazard Mitigation Planning Team will also review existing goals and objectives and update them along with newer action items as needed. The findings of this research and analysis will be compiled into an updated UMass System Office plan annex and included in the Multi-Campus Hazard Mitigation Plan. Ultimately, the entire revised Multi-Campus Hazard Mitigation Plan will be issued to MEMA and FEMA for review.

7.3 INTEGRATION INTO OTHER PLANNING MECHANISMS

The UMass System Office has evaluated a number of local plans that were previously discussed in **Section 6.4.2** that are related either directly or indirectly to this Hazard Mitigation Plan. To the extent possible, requirements, actions or principles of these documents have been integrated into the Hazard Mitigation Plan and the UMass System Office Hazard Mitigation Plan Annex. Mitigation planning can be integrated conversely into those documents by making it a regular topic that is discussed through any new or updated document and during the associated planning effort. The Emergency Planning and Business Continuity Manager will work with other appropriate members of the System Office community to advocate for hazard mitigation. Specific activities may include:

- Integrate the Hazard Mitigation Plan goals and objectives into any new, amended or updated planning/policy document to the extent possible,
- Formalize and publicize a recognition of hazard mitigation planning and mitigation activities as a part of local and joint emergency management plans, efforts and operations,
- Address sea level rise, climate change and hazard mitigation planning in any future versions of the System Office emergency response and disaster recovery plans, etc.,
- Seek out opportunities to participate in other local Hazard Mitigation planning efforts, projects or initiatives to share local knowledge and also learn about other activities occurring in the region,
- Further integrate mitigation planning into the Capital Improvement/Master Planning process by actively and regularly seeking alternative funding sources that have been highlighted in this plan.

7.4 ADOPTION

In order to be approved by MEMA and FEMA, this Plan must be formally adopted by UMass. Documentation that the Hazard Mitigation Plan has been formally adopted by the University and the UMass System Office is provided below.

The UMass Hazard Mitigation Plan and UMass System Office Annex was thoroughly reviewed by the UMass System Office Hazard Mitigation Planning Committee. The System Office Hazard Mitigation Planning Committee formally endorsed the Hazard Mitigation Plan and System Office Annex on ____ and recommended it for adoption by UMass System Office senior campus officials. The System Office Plan was formally adopted by ______ on ______. The UMass System Office issued a press release announcing plan endorsement on ____ and posted the plan on the UMass System Office web site.

7.5 APPROVAL

A copy of the formal approval letter for this Plan is provided in Appendix XX.

[To be included once the Plan has been approved by MEMA and FEMA]

APPENDIX A: CAMPUS KICK OFF MEETING MATERIALS

UMASS MULTI-CAMPUS HAZARD MITIGATION PLAN
CAMPUS KICK-OFF MEETING AGENDA

CENTRAL ADMIN OFFICE / PRESIDENT'S OFFICE

NOVEMBER 7, 2012

I. Introductions of Meeting Attendees

II. Project Overview

   a. Background Information
   b. Goals and Objectives
   c. What this Means for UMass
   d. Roles and Responsibilities
   e. Examples of Hazard Events

III. Requirements of FEMA

   a. Focus on Mitigation Strategy
   b. Importance of the Planning Process
   c. Customize Requirements
   d. Engage the Community
   e. Documentation

IV. Multi-Hazard Mitigation Planning Process

   a. Hazard Identification and Risk Assessment
      i. Description of Hazard
      ii. Previous Occurrences and Probability
      iii. Hazard Vulnerability
      iv. Critical Assets in Hazard Areas
      v. Hazard Impacts
   b. Mitigation Strategy
      i. Description of Mitigation Goals
      ii. Mitigation Actions and Projects

V. Project Implementation

   a. Schedule
   b. Communications
      i. Web Site
      ii. Scheduled Meetings
   c. Plan Review Process

VI. Open Discussion/Questions and Comments

MEETING SIGN-IN SHEET – CAMPUS KICK-OFF MEETING

Project:	UMass – Multi-Campus Hazard Mitigation Plan	**Meeting Date:**	November 7, 2012
Facilitator:	Woodard & Curran	**Campus:**	Central Admin Office/President's Office

Name	Department or Organization	Title	Phone	E-Mail
Carol Walsh	UITS - Change Services	Change Services		cwalsh@umassp.edu
Larry Wilson	UITS - info security			lwilson@umassp.edu
Phil Marquis	Treasurer's Office	AVP & Assoc Treas		pmarquis@umassp.edu
Joe Skrzek	Treasurer's Office	Financial Analyst		jskrzek@umassp.edu
Kim Howard	HR	Assoc. Director		khoward@umassp.edu
Ellen Kanter	UITS	ACIO		ekanter@umassp.edu
Christine Wilda	President's Office	SVP A+F		cwilda@umassp.edu
Jeffrey Hesiock	EM/BCP	EM/BCP mgr.		Jhesiock@umassp.edu
Bill Smith	UITS	Director Tech Services		bsmith@umassp.edu
Sarah Mongeau	~~Pre~~ Controller's Office	Acting Univ Controller		smongeau@umassp.edu
MaryKristin Ivanovich	Woodard & Curran	Technical Lead		mivanovich@woodardcurran.com
Mary Hause	Woodard + Curran	Project Manager		mhause@woodardcurran.com

WOODARD &CURRAN

University of Massachusetts

MULTI-CAMPUS HAZARD MITIGATION PLAN

University of Massachusetts

Multi-Campus Hazard Mitigation Plan

President's/System Office Kick-Off Meeting

November 7, 2012

UMASS UMASS BOSTON UMASS LOWELL UMASS

Introductions

MARY HOUSE

PROJECT MANAGER

MARYKRISTIN IVANOVICH

TECHNICAL LEAD

About Woodard & Curran

- 680 Person engineering, environmental consulting and contract operations firm
- Experience working with UMass stakeholders for over ten years
- Worked at five of the six campuses
- Completed 50 UMass projects in 5 years
- Completed ICPs at two campuses
- FEMA trained staff and have authored hundreds of emergency management plans
- Secured Millions of Dollars in FEMA Funding – City of Salem/Salem State University $3M FEMA grant
- Teamed with Prism Security
- Offices in Dedham, Andover, and Plymouth

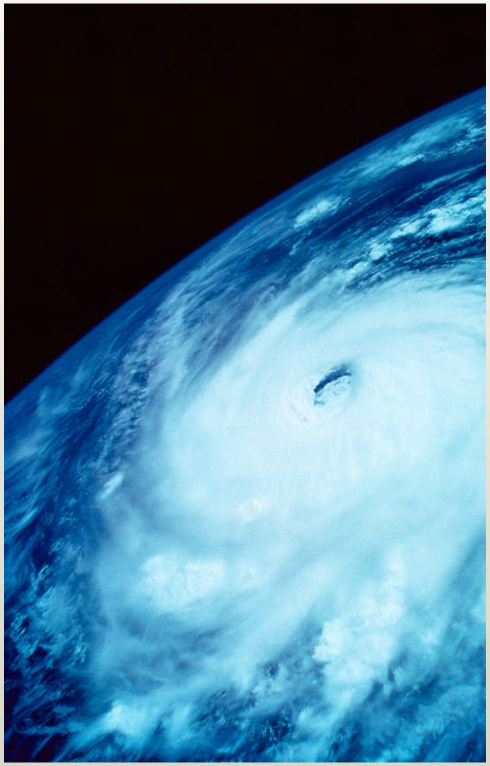
Meeting Agenda

- Project Overview
  - Background and Goals
  - Roles and Responsibilities
- Requirements of FEMA
  - Strategy, process, engagements
  - Documentation
- Multi-Hazard Mitigation Planning Process
  - Hazard identification and risk assessment
  - Mitigation strategy
- Project Implementation
  - Schedule and communications
  - Review process
- Open Discussion/Questions and Comments

Project Overview

Project Background

- The Disaster Mitigation Act was signed by the President in October 2000.
  - Incentive for states and local governments to undertake natural hazard mitigation planning.
  - Promotes sustainability as a strategy for disaster resistance.
  - Encourages state and local governments to work together, and facilitates cooperation between state and local authorities.
  - Results in faster allocation of funding and more effective risk reduction projects.
  - Colleges and Universities can plan in concert with similar planning efforts in their community.



UMASS

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Project Background

- The University of Massachusetts campuses (Boston, Dartmouth, Lowell and System Office) received a grant of $350K from FEMA/MEMA to develop hazard mitigation plans
- Plans will help identify cost effective mitigation measures to reduce or eliminate long-term risk to life and property from hazards
- Allow the University to be eligible to receive non-emergency disaster assistance, including state and federal funding for mitigation and recovery projects
- Projects must be pre-identified in the hazard mitigation plans to receive future funding

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Phases of Emergency Management

- **Mitigation** – long-term reduction of vulnerability
- **Preparedness** – plans and preparations to save lives and property and facilitate response operations
- **Response** – actions taken to provide emergency assistance, save lives and minimize property damage
- **Recovery** – actions taken to return to normal conditions.

Hazard Mitigation Overview

- Hazard mitigation is defined as "any action taken to reduce or eliminate the long-term risk to human life and property from natural [and/or manmade] hazards."
- Hazard mitigation activities may be implemented prior to, during, or after an event; however, it is most effective when based on an inclusive, comprehensive, long-term plan that is developed before a disaster occurs.
- Hazard mitigation is often focused on reducing repetitive loss, as many damaging events tend to occur in the same locations over time (e.g. flooding).

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Benefits of Hazard Mitigation Planning

- Campuses benefit from Mitigation Planning by:
  - Identifying cost effective actions for risk reduction that are agreed upon by stakeholders
  - Focusing resources on the greatest risks and vulnerabilities
  - Building partnerships by involving the campus community, organizations, local government and businesses
  - Increasing education and awareness of hazards and risk
  - Communicating priorities to local, state and federal officials
  - Aligning risk reduction with other University objectives

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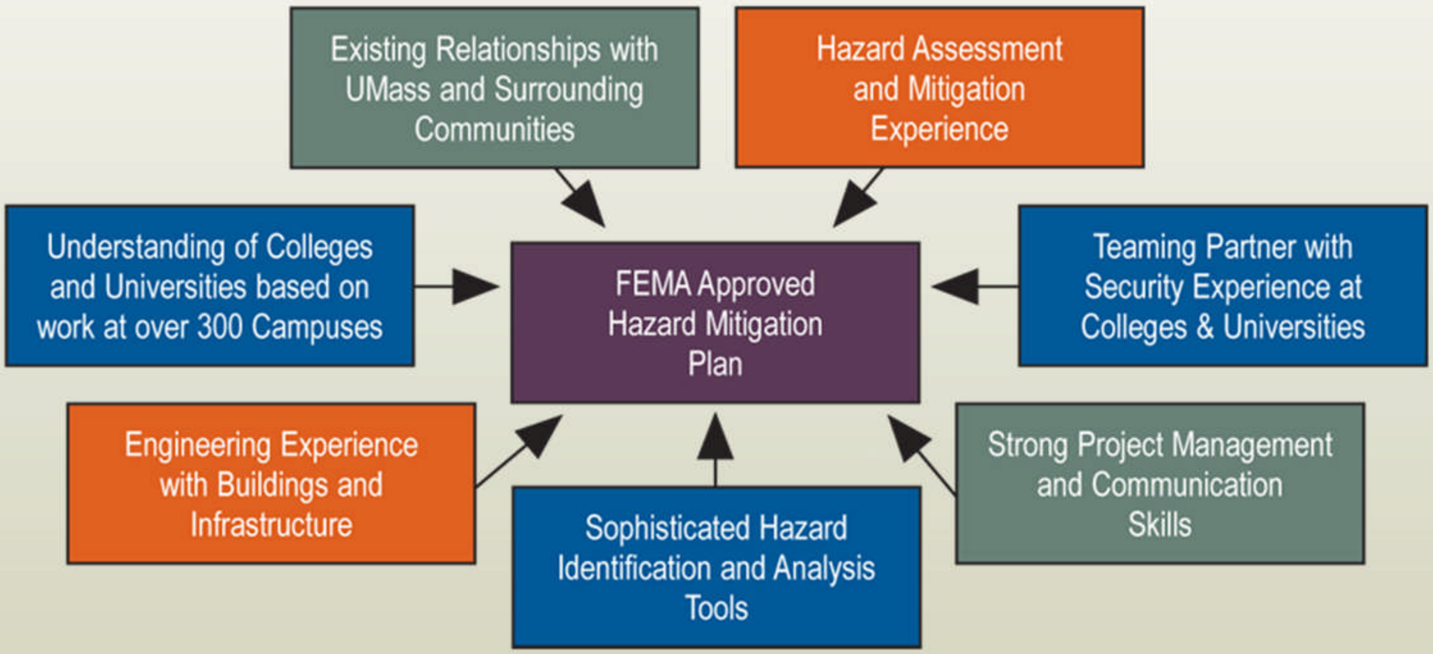
Project Goals

- Fulfill Federal, State, Local and University Hazard Mitigation Planning Requirements
- Promote the Safety of Students, Faculty, Staff and Visitors
- Minimize Hazard Impacts to Physical Assets
  and Operations
- Reduce or Avoid Long-Term Vulnerabilities from Hazards
- University Eligibility for Future Funding

Delivery of a Practical and Implementable Plan



University Project Manager

Jeff Hescock

Project Steering Committee

UMass Boston: Anne-Marie McLaughlin
UMass Dartmouth: Chief Emil Fioravanti & Mike LaGrassa
UMass Lowell: Richard Lemoine & William Desrosiers
Presidents/System Office: Jeff Hescock
Woodard & Curran: Mary House & MaryKristin Ivanovich

UMass Boston

Hazard Mitigation Planning Committee

UMass Dartmouth

Hazard Mitigation Planning Committee

UMass Lowell

Hazard Mitigation Planning Committee

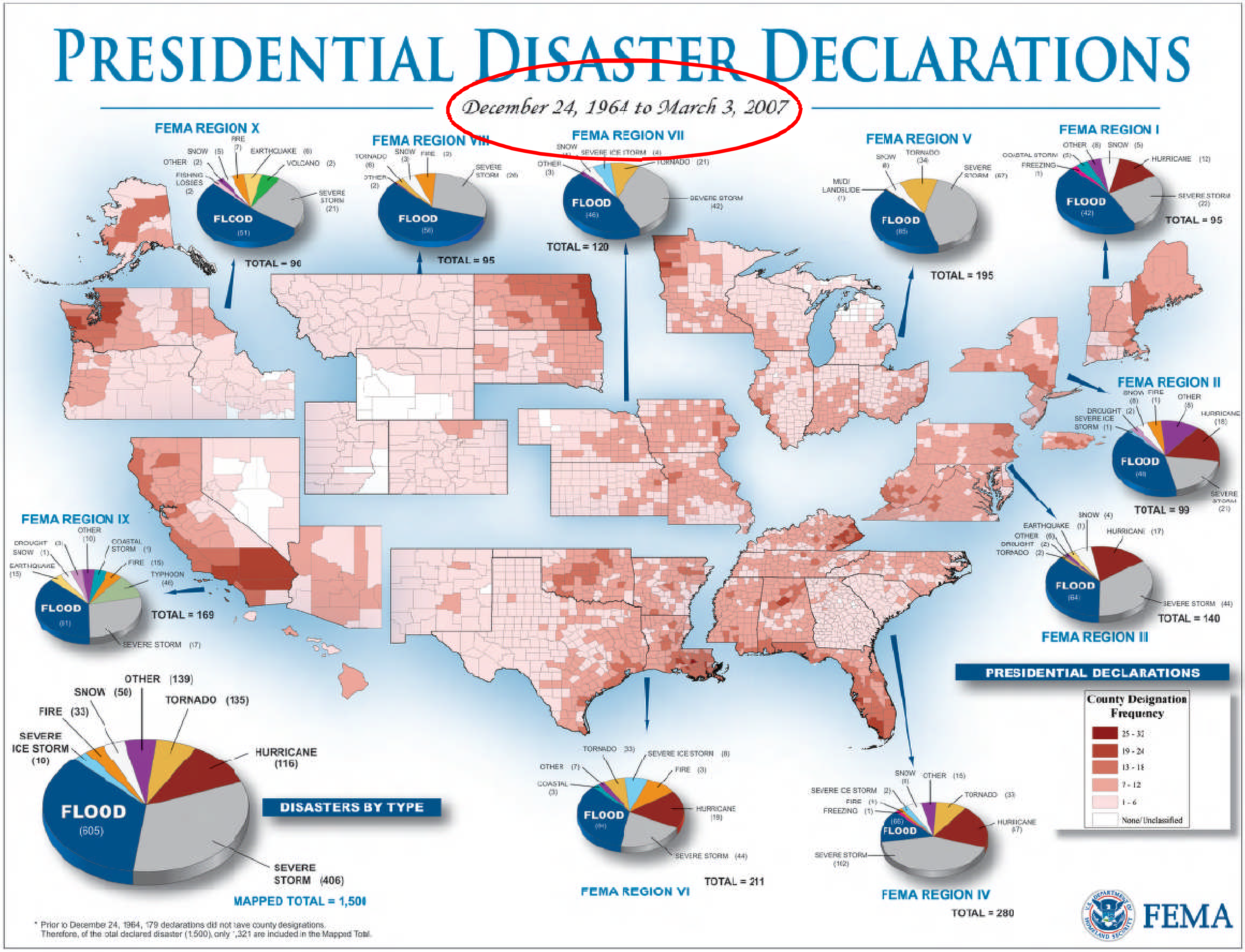
UMass Presidents / System Office

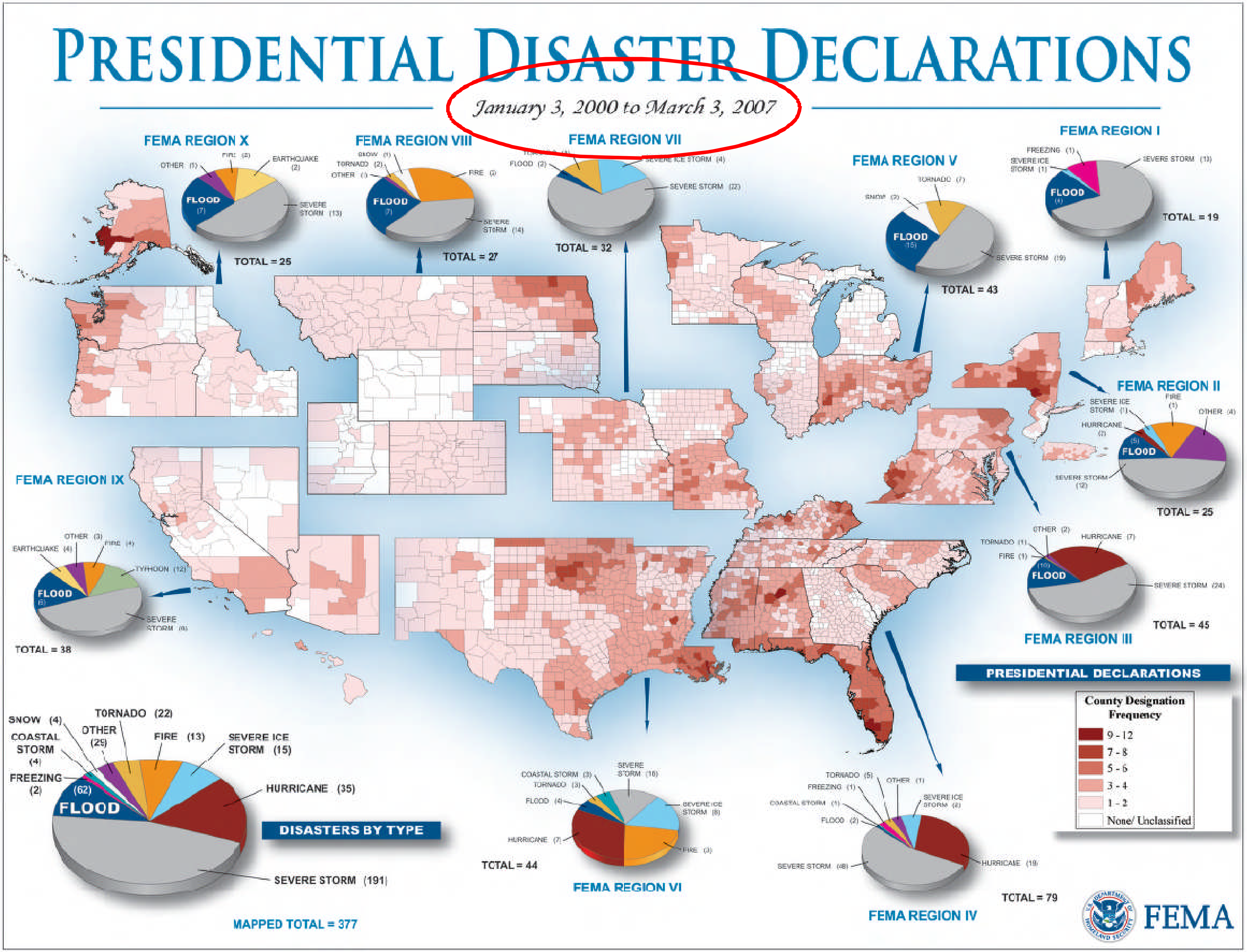
Hazard Mitigation Planning Committee

Project Organizational Structure

Roles and Responsibilities of Hazard Mitigation Planning Team

- Participate in at least six meetings/workshops over the course of the two-year project
- Supply information associated with past hazard mitigation planning or related efforts
- Help identify applicable hazards and develop mitigation actions
- Support internal and external outreach activities
- Review and provide comments on the multi-hazard mitigation plan and campus specific appendix
- Support the implementation of the plan when an event occurs and be actively involved in continuous improvements


PRESIDENTIAL DISASTER DECLARATIONS
December 24, 1964 to March 3, 2007
FEMA REGION X
FLOOD (51)
TOTAL = 96
FEMA REGION VIII
FLOOD (58)
TOTAL = 95
FEMA REGION VII
FLOOD (46)
TOTAL = 120
FEMA REGION V
FLOOD (85)
TOTAL = 195
FEMA REGION I
FLOOD (42)
TOTAL = 95
FEMA REGION II
FLOOD (48)
TOTAL = 99
FEMA REGION III
FLOOD (64)
TOTAL = 140
FEMA REGION IX
FLOOD (61)
TOTAL = 169
FEMA REGION VI
FLOOD
TOTAL = 211
FEMA REGION IV
FLOOD (65)
TOTAL = 280
OTHER (139)
SNOW (50)
TORNADO (135)
FIRE (33)
SEVERE ICE STORM (10)
HURRICANE (116)
FLOOD (605)
SEVERE STORM (406)
DISASTERS BY TYPE
MAPPED TOTAL = 1,500
PRESIDENTIAL DECLARATIONS
County Designation Frequency
None/ Unclassified
FEMA
* Prior to December 24, 1964, 179 declarations did not have county designations.
Therefore, of the total declared disaster (1,500), only 1,321 are included in the Mapped Total.



PRESIDENTIAL DISASTER DECLARATIONS
January 3, 2000 to March 3, 2007
FEMA REGION X
FLOOD (7)
SEVERE STORM (13)
TOTAL = 25
FEMA REGION VIII
FLOOD (7)
TOTAL = 27
FEMA REGION VII
SEVERE STORM (22)
TOTAL = 32
FEMA REGION V
FLOOD (15)
SEVERE STORM (19)
TOTAL = 43
FEMA REGION I
FLOOD (4)
TOTAL = 19
FEMA REGION II
FLOOD (5)
TOTAL = 25
FEMA REGION IX
FLOOD (6)
TOTAL = 38
FEMA REGION III
FLOOD (10)
HURRICANE (7)
SEVERE STORM (24)
TOTAL = 45
PRESIDENTIAL DECLARATIONS
County Designation Frequency
9 - 12
7 - 8
5 - 6
3 - 4
1 - 2
None/ Unclassified
SNOW (4)
TORNADO (22)
COASTAL STORM (4)
OTHER (29)
FIRE (13)
SEVERE ICE STORM (15)
FREEZING (2)
FLOOD (62)
HURRICANE (35)
DISASTERS BY TYPE
SEVERE STORM (191)
MAPPED TOTAL = 377
TOTAL = 44
FEMA REGION VI
TOTAL = 79
FEMA REGION IV
FEMA

Hurricane Katrina – Tulane University

- Late August 2005
- Most serious disruption of American higher education in the nations history
- Second time in history to close, the first being during the American Civil War
- The university closed for four months, as compared to four years during the Civil War
- Nearly 400 students were led in a rare evacuation to Jackson State University
- Faculty, staff and students transferred around the country
- The University Hospital & Clinic lost power during the storm and all were evacuated via helicopters.
- Extensive physical damage
- Flooded 70% of the main campus and the entire health sciences center campus
- Resulted in 13,000 students and 8,000 employees dispersed for five months
- Became the first major U.S. university in the last century to close its doors for a whole semester
- Led to losses in excess of $550M

Severe Windstorm – Syracuse University

- Labor Day 1998
- Severe windstorm in central New York State
- Damaged buildings, trees and utilities
- Server residence halls closed resulting in the relocation of 600 students
- Cost of repairs resulted in more than $4 million dollars

UMASS

Campus Fire – Seton Hall University

- January 19, 2000
- Residence hall destroyed by fire in the middle of the night
- The resident hall did not have a sprinkler system
- Students leapt from windows, crawled out stairways, and a number were rescued by firefighters
- Three students died in the fire
- 12 students were serious injured

SETON HALL UNIVERSITY

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Tornado – University of Maryland

- September 24, 2001
- Several facilities extensively damaged
- Instructional and student services space, along with several temporary Maryland Fire Institute trailers were damaged
- Two students were killed when their car was overturned
- Classes were canceled for one day

UNIVERSITY OF MARYLAND

UMASS

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Open Discussion

Recent Hazards on Campus

UMASS

Requirements of FEMA

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What is FEMA Interested In?

- **Focus on Mitigation Strategy** – Emphasize Actions and Implementation of the Hazard Mitigation Strategy
- **Review for Intent, as well as Compliance** – Does the Plan Meet the Intent of the law and regulation
- **Process is as Important as the Plan Itself** – Planning Process to be Defined by the University
- **This is Your Plan** – Must be Reflective of your University, Stakeholders and Community
- **Foster Relationships** – The relationships are as Important as the Words in the Plan

Documentation is Critically Important

- UMass Labor in Kind
- Meetings
  - Agenda
  - Attendees List
  - Meeting Minutes
- Campus Visits
  - Data Gathered and Data Sources
  - Interview Summaries
- Stakeholder Workshops
  - Agenda
  - Attendees List
  - Workshop Summaries

FEMA Evaluation Criteria (handout)

UMASS

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Hazard Mitigation Planning

Comprehensive Methodology

1. **Planning Process**
   - Community engagement
   - Building upon existing information
2. **Hazard Identification and Risk Assessment**
   - Systematically identifying hazards through the use of GIS and other tools to assess/prioritize risk
3. **Mitigation Strategy**
   - Reach across broad skill sets to identify hazard mitigation goals
   - Draw upon broad campus experience to develop mitigation strategies
4. **Plan Review, Evaluation, and Implementation**
   - Work collaboratively and proactively with regulators

Hazard Mitigation Planning Process

- The UMass planning process will closely follow FEMA's recommended four-stage approach.
- Initial and ongoing community support is critical to the planning process.

Hazard Mitigation Planning Process

- Phase 1 – Organize Resources – identifies the resources available and necessary to complete the process:
  - Assess community support
  - Build the planning team
    - Identify and organize interested members of the community (stakeholders – on and off campus)
    - Identify the necessary technical expertise
  - Establish a steering committee
    - Develop a mission statement
    - Hold a project kick-off meeting
    - Establish a meeting schedule and goals
    - Engage the public

Hazard Mitigation Planning Process

- Phase 2 – Assess risks – identify the hazards that present risks to the campus and the assets that are vulnerable to those hazards.
  - Gather historical information, review existing university plans/reports, communicate with local planning experts, MEMA and FEMA.
  - Determine which hazards present the greatest risk to the campus community
    - Assess vulnerability
    - Create a base map to profile potential hazard events
  - Inventory campus assets
    - Show how hazard events could impact campus (physically and operationally)
    - Estimate losses

Hazard Identification

Worksheet 3 **Identify the Hazards**

Date: *What kinds of natural hazards can affect you?*

1. List the hazards that may occur on campus.

a. Research newspapers and other historical records. (Check campus archives in library.)
b. Review existing university and community plans and reports.
c. Talk to the experts on campus and in your community, state, or region.
d. Gather information on Internet Web sites.

In the hazard list below, put a check mark in the boxes on the left (Column I) beside all hazards that may occur on your campus.

2. Focus on the most prevalent hazards in your community or state, and your campus.

a. Go to hazard Web sites.
b. Locate your campus on the Web site map.
c. Determine whether you are in a high-risk area. Get more localized information if necessary.
d. In the hazard list below, put a check mark in the boxes on the right (Column II) beside all hazards that pose a significant threat to your community and/or campus.

Use this space to record information you find for each of the hazards you will be researching. Attach additional pages as necessary.

	I	II
Avalanche	☐	☐
Coastal Erosion	☐	☐
Coastal Storm	☐	☐
Dam Failure	☐	☐
Drought	☐	☐
Earthquake	☐	☐
Expansive Soils	☐	☐
Extreme Heat	☐	☐
Flood	☐	☐
Hailstorm	☐	☐
Hurricane	☐	☐
Land Subsidence	☐	☐
Landslide	☐	☐
Severe Winter Storm	☐	☐
Tornado	☐	☐
Tsunami	☐	☐
Volcano	☐	☐
Wildfire	☐	☐
Windstorm	☐	☐
*Other*______	☐	☐
*Other*______	☐	☐
*Other*______	☐	☐

Hazard or Event Description *(Type of hazard, date of event, number of injuries, cost and types of damage, etc.)*	***Source of Information***	***Map Available for This Hazard?***	***Scale of Map***

Building a Disaster-Resistant University

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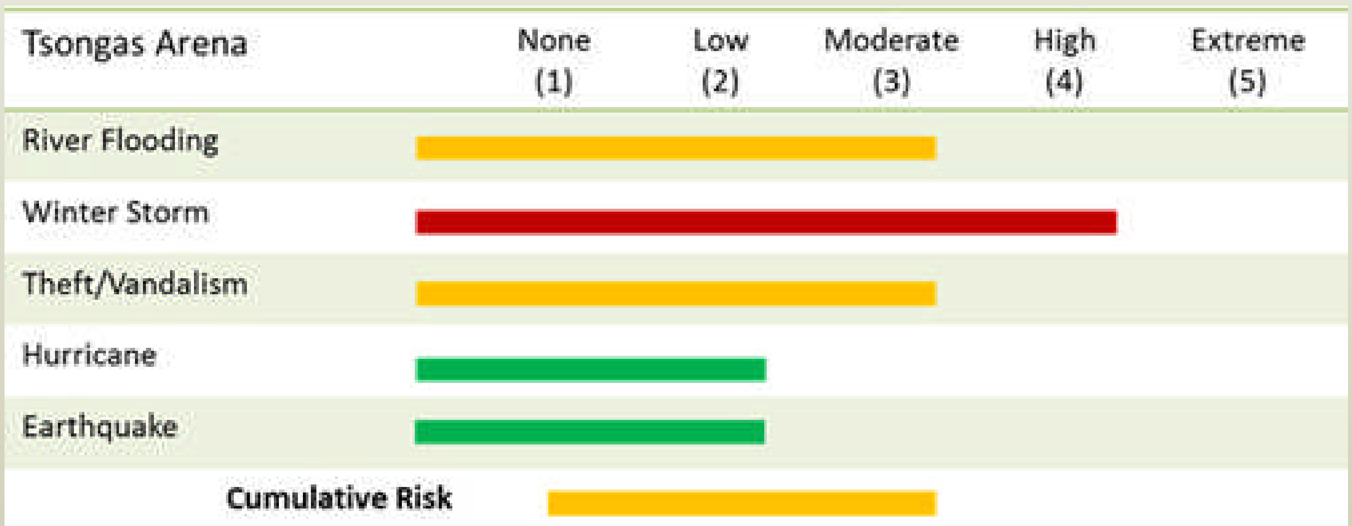
Lowell Campus Facilities & Assets	*Flooding Risk*			*Winter Strom Risk*			*Theft & Vandalism*			*Hurricane*			*Cumulative Risk*		
	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L
Tsongas Area	1	2	3	1	2	3	1	1	1	1	3	4	1	2	4
Lydon Library	1	2	2	1	1	3	1	2	3	1	2	2	1	2	3
Fox Hall	1	2	2	1	2	3	1	1	2	1	2	2	1	1	2
Costello Gym	1	3	4	3	3	5	1	2	4	2	2	5	1	3	5
Riverview Field	1	2	4	1	1	1	1	3	4	1	3	5	1	3	4
University Crossing	1	2	3	1	1	1	1	2	3	1	3	5	1	3	4
Engineering Building	1	2	3	4	4	5	1	1	1	1	1	1	1	2	4
Cushing Field Complex	1	3	5	1	2	3	2	3	4	1	4	4	1	4	4
Power Plant/ Garage	1	3	3	1	1	3	1	1	1	1	1	1	1	1	3
Campus Center	1	2	1	2	3	3	1	1	1	1	1	2	1	1	2
Aiken Street	1	2	1	3	3	5	1	1	1	1	2	3	1	2	3

L= Immediate Term, M = Mid-Term, H = Long Term Relative Risk is rated 1-5 (5 highest) and color coded



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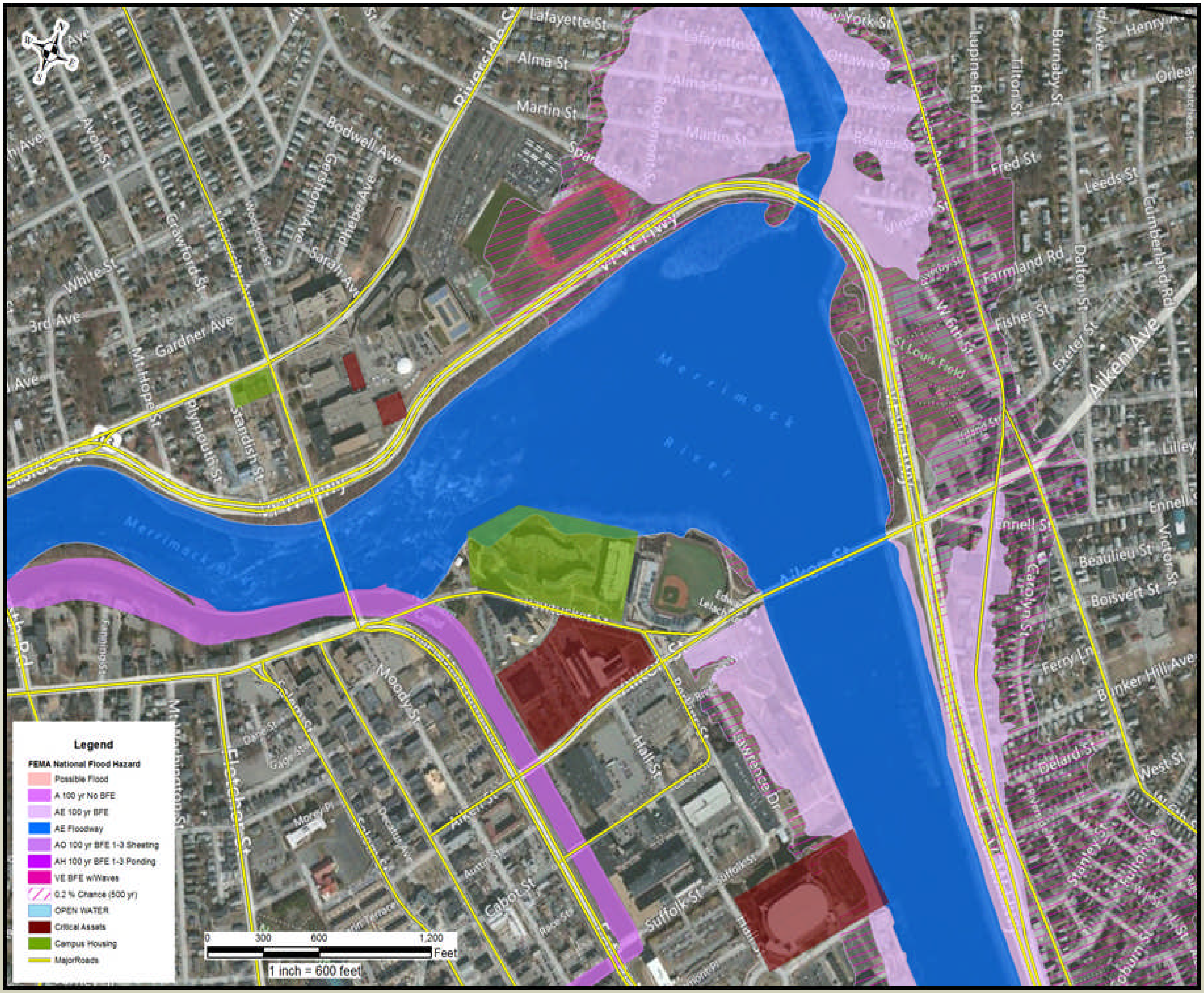
Legend
FEMA National Flood Hazard
Possible Flood
A 100 yr No BFE
AE 100 yr BFE
AE Floodway
AO 100 yr BFE 1-3 Sheeting
AH 100 yr BFE 1-3 Ponding
VE BFE w/Waves
0.2 % Chance (500 yr)
OPEN WATER
Critical Assets
Campus Housing
MajorRoads
0
300
600
1,200
Feet
1 inch = 600 feet
Merrimack River
Lafayette St
Alma St
Martin St
New York St
Bodwell Ave
Riverside St
Aiken Ave
Moody St
Cabot St
Suffolk St
Fred St
Leeds St
Farmland Rd
Fisher St
Ennell St
Beaulieu St
Boisvert St
Ferry Ln
Bunker Hill Ave
Delard St
West St
Gardner Ave
White St
3rd Ave
Avon St
Crawford St
Standish St
Hall St
Lupine Rd
Tilton St
Burnaby St
Dalton St
Exeter St
Carolyn St

Hazard Mitigation Planning Process

- Phase 3 – Develop the mitigation plan – lays out in detail the proposed mitigation actions.
  - Establish priorities
    - Compare university mission with the results of the hazard identification and risk assessment
  - Develop hazard mitigation goals
    - Minimize interruption to campus operations and mission
    - Protect research
  - Determine appropriate mitigation actions
  - Prioritize mitigations actions
  - Prepare an implementation strategy

Hazard Mitigation Plan Contents

- Executive Summary
  - Purpose, Process, Major Recommendations
- Goals and Objectives
- Hazard Identification and Risk Assessment
  - Hazard Background, Asset Inventory, Loss Estimation
- Mitigation Strategy
  - Identification of Mitigation Actions, Prioritization of Actions and Methodology, Timeline
- Implementation and Plan Maintenance
  - Responsibilities, Integration with Other Plans, Schedule

Hazard Mitigation Planning Process

- Phase 4 – Implement the plan and monitor progress
  - Formally adopt the Hazard Mitigation Plan
  - Implement mitigation measures
  - Monitor, evaluate and update the plan as needed
  - Continue to engage stakeholders from the campus and community

Project Implementation

Timeline

- Project Planning - Summer 2012
- Kick off Meetings – Fall 2012
- Hazard Identification and Risk Assessment – Fall 2012/winter 2013
- Campus Workshops
- Submit Draft Plan to UMass – August 2013
- Review and Finalize Plan – Fall 2013 to early 2014
- Submit Draft to State – Feb 2014
- Submit Draft to FEMA – May 2014
- Obtain Approval and Complete Final Presentations – Fall 2014

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Plan Review Process

- Initial review by Steering Committee
- Distribution of initial draft to Campus Hazard Mitigation Planning Committee for review and comment
  - Steering Committee representative to coordinate electronic comments
  - Look at Schedule – facilitated review meeting
- Distribution of second draft to Campus Hazard Mitigation Planning Committee for review and comment
  - Steering Committee representative to coordinate electronic comments
- Final review and approval by Steering Committee
- Submit draft to agency

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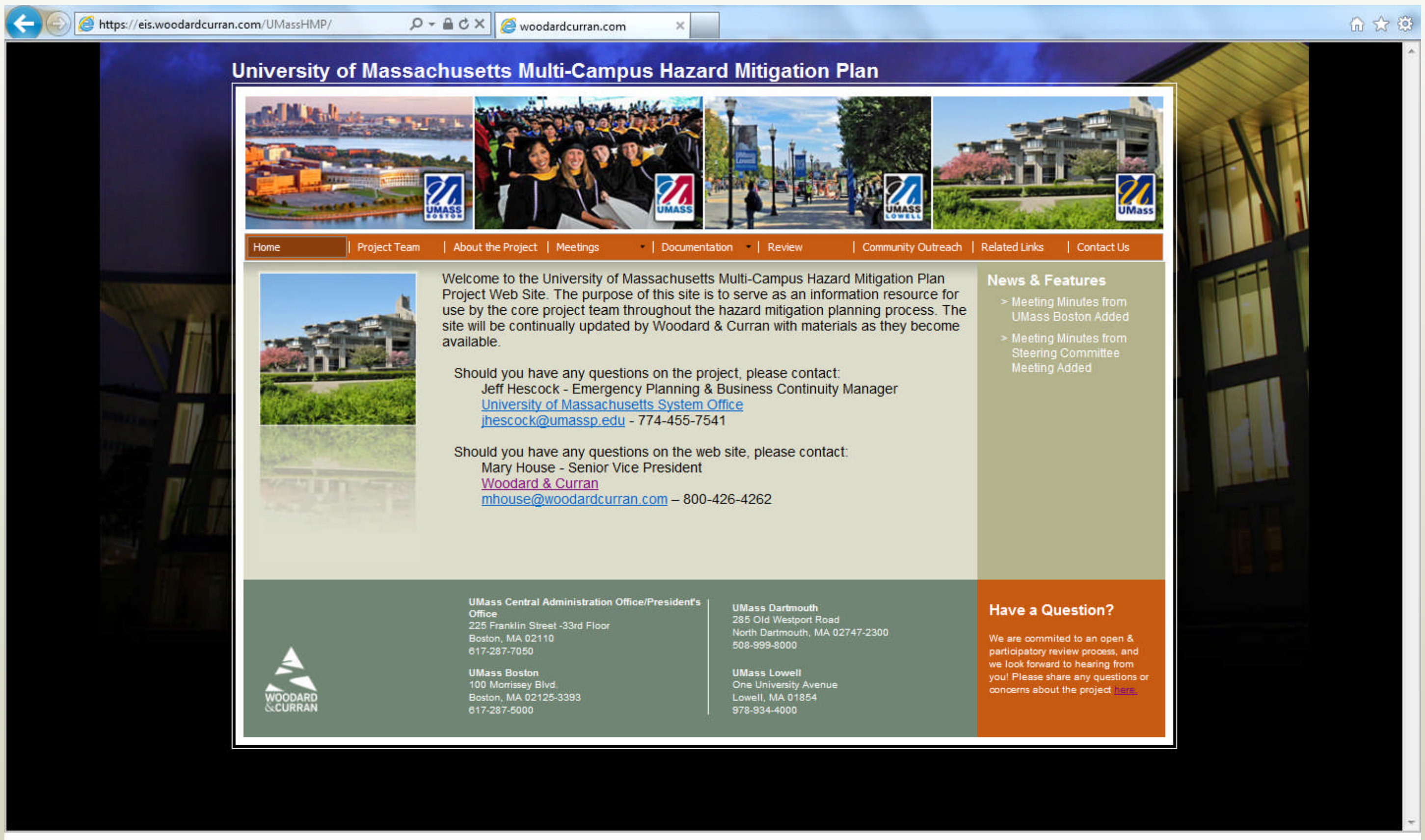
Project Web Site

Project Web Site



Project Web Site Details

- Unlimited access to all users
- For viewing purposes only

- Link: https://eis.woodardcurran.com/UMassHMP
- User Name:
- Password:

Scheduled Meetings

- Hazard Identification and Risk Assessment – January 2013
- Campus Workshops – January, May, September 2013
- Facilitated Review – September 2013
- Meeting to Discuss Comments, if needed – January 2014
- Final Presentations – November 2014

University of Massachusetts

MULTI-CAMPUS HAZARD MITIGATION PLAN

Thank You

Questions?

UMASS
UMASS BOSTON
UMASS LOWELL
UMASS

Sources

- Building a Disaster Resistant University (FEMA, August 2003)
- Getting Started – Building Support for Mitigation Planning (FEMA, September 2002)

APPENDIX B: INTERVIEW QUESTIONNAIRES

40 Shattuck Road
Suite 110
Andover, Massachusetts 01810
www.woodardcurran.com

T 866.702.6371
T 978.557.8150
F 978.557.7948

UMASS MULTI-CAMPUS HAZARD MITIGATION PLAN

Name:

Job Title/Relationship to the University:
Campus Location:

Address:
Phone:
Email:

Date of Interview:
Interviewer Name:

ON-CAMPUS INTERVIEW QUESTIONS

1) What are the natural hazards that occur/impact this campus?

2) Do you know the frequency and magnitude of possible future hazard events?

3) What is your level of concern regarding how susceptible this UMass Campus is to a natural hazard?

   __ No Concern __ Somewhat Concerned __ Very Concerned

   Why, or why not?

4) What hazard do you think are of the highest threats to this UMass Campus? Please circle the most serious threat and just check the other hazards that you think have potential.
   __ Coastal Storm
   __ Coastal Erosion
   __ Hurricane
   __ Tornado
   __ Flood
   __ Drought
   __ Winter Storm
   __ Thunderstorm/Lightning
   __ Hailstorm
   __ Urban or Wildfire
   __ Tsunami
   __ Extreme Heat
   __ Windstorm

5) In your experience, has hazard mitigation been a part of any discussions at this UMass campus during Master Planning or Strategic Planning?

Please elaborate:

6) Has any work been done to make this UMass Campus more resistant to natural hazards?

Please elaborate:

7) What do you think this UMass campus could do to minimize their level of vulnerability to a natural hazard?

8) Using your own institutional knowledge, are you aware of any damages from various hazards that may have occurred to your campus? Can you please provide detail?

9) Are some parts of the campus particularly vulnerable to damages, or is the entire campus?

10) Are some buildings particularly vulnerable to damages? What are the uses and occupancies of the vulnerable buildings?

11) What buildings on campus, in your opinion, are the most critical to protecting the safety of the public and to the continuity of a high functioning campus (where is emergency management, fire/safety, medical facilities, information storage, utilities)?

12) Are your utilities vulnerable to damages? How?

13) What could it cost to repair damages? How long could it take?

14) How will research be impacted?

15) How will students be affected on and off campus?

16) Could the University be closed down for a significant period of time because of possible disaster losses?

MITIGATION ACTIVITIES

Mitigation activities can generally be grouped into several categories including:

- **Public Education and Awareness** (information campaigns about how people can prepare and protect themselves during a natural disaster)
- **Emergency Services** (actions that protect people like emergency alerts, evacuation planning, etc.)
- **Structural Projects** (upgrades that lessen the impact of a hazard such as dams, seawalls, storm sewers, etc.)
- **Natural Resource Protection** (preserve and restore natural habitat areas so that they can function in their natural state during a natural hazard)
- **Protection of Property** (modifying a building/property to protect it from a natural hazard)

Please ask each interviewee:

- How important are each of the above noted Mitigation Activities for your individual campus?

- To what extent has your campus already made strides in any of the above category areas? Please be specific.

Other

Any additional information that you would like to share/have available that would assist the project team during this effort?

COMMITMENT & INTEGRITY
DRIVE RESULTS

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T 866.702.6371
T 978.557.8150
F 978.557.7948

UMASS MULTI-CAMPUS HAZARD MITIGATION PLAN

Name:

Job Title/Relationship to the University:
Campus Location:

Address:
Phone:
Email:

Date of Interview:
Interviewer Name:

ON-CAMPUS INTERVIEW QUESTIONS

1) From your viewpoint, what are the actual and anticipated principal man-made hazards that occur/could occur that could have a significant impact on this campus?

2) Of the following man-made hazards, which hazards do you think are the highest threats to this UMass Campus? Please circle the most serious threat and just check the other hazards that you think have potential to occur.

	Frequency	Magnitude
__ Active Shooter		
__ Bioterrorism		
__ Bomb Threat		
__ Civil Disturbance		
__ Explosion		
__ Violent Criminal Incident		
__ Hostage Situation		
__ Food Shortage		
__ Fuel Shortage		
__ HazMat Incident (on or off campus)		
__ Radiological Incident		
__ Structural Collapse		
__ Terrorism		
__ Transportation Accident		
__ Utility Failure		
__ Cyber Attack/SCADA Attack		

3) Is there any kind of estimation of possible frequency and magnitude of these man-made hazard events? Indicate below or on the previous list in the column provided.

4) What is your level of concern regarding how susceptible this UMass Campus is to specific man-made hazards?

__ No Concern __ Somewhat Concerned __ Very Concerned

Why, or why not?

5) In your experience, has actual or potential hazard mitigation been a part of any discussions at this UMass campus during Master Planning or Strategic Planning?

Please elaborate:

6) Has any work been done either on campus or off campus to make this UMass Campus more resistant or resilient to significant man –made hazards?

Please elaborate:

7) What specific prevention or mitigation strategies do you think this UMass campus could do to minimize your level of vulnerability to man-made hazards?

What strategies have already been implemented?

8) Using your own institutional knowledge, are you aware of any losses or harm that have occurred due to various man-made hazards that may have occurred on your campus? Can you please provide detail?

9) Are some parts or key elements of the campus particularly vulnerable to intentional harms or losses, or is the entire campus?

10) Are some buildings particularly vulnerable to man-made damages? What are the uses and occupancies of the vulnerable buildings?

11) What buildings or areas on campus, in your opinion, are the most critical and potentially vulnerable to protecting the safety and security of the public and to the continuity of a high functioning campus (where is business continuity, emergency management, fire/life safety, medical facilities, information storage, utilities)?

12) Is any part of your critical infrastructure vulnerable to damages in terms of significant losses from any intentional hazards? How?

13) What would be the direct (replacement costs, etc.) and indirect (down time, etc.) impacts of a significant man-made hazard to this campus? How long do you think it would take to return to normal?

14) How will the University's core services and assets be impacted?

15) How will students be affected on and off campus?

16) Could the University be closed down for a significant period of time because of possible man-made disaster losses?

MITIGATION ACTIVITIES

Mitigation activities can generally be grouped into several categories including:

- **Public Education and Awareness** (information campaigns about how people can prepare and protect themselves during a natural disaster or man-made incident)
- **Emergency Services** (actions that protect people like police patrols, emergency communications, emergency notifications & alerts, evacuation planning, crime prevention, etc.)
- **Structural Projects** (upgrades that lessen the impact of a man-made hazards such as blast mitigation, asset compartmentalization, environmental designs (CPTED), etc.)
- **Environmental Protection** (employing natural strategies such as territoriality, access control, surveillance, activity support and maintenance of the built environment to influence human behavior)
- **Protection of Property** (modifying a building/property to protect it from a man-made hazard – site security, perimeter security, entry security, interior security)

Please ask each interviewee:

- How important are each of the above noted Mitigation Activities for your individual campus?

- To what extent has your campus already made strides in any of the above category areas? Please be specific.

Other

Any additional information that you would like to share/have available that would assist the project team during this effort?

APPENDIX C: HAZARD IDENTIFICATION AND RISK ASSESSMENT MEETING MATERIALS

University of Massachusetts

MULTI-CAMPUS HAZARD MITIGATION PLAN

University of Massachusetts

Multi-Campus Hazard Mitigation Plan
Hazard Identification & Risk Assessment

April 26, 2013

COMMITMENT & INTEGRITY DRIVE RESULTS

Meeting Agenda

- Overview of Potential Hazards
- Summary of Interview Discussions
- Hazard Ranking Methodology
- Group Workshop Hazard Ranking
- Open Discussion

COMMITMENT & INTEGRITY DRIVE RESULTS

UMASS

Overview

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COMMITMENT & INTEGRITY DRIVE RESULTS

UMASS

Project Goals

- Fulfill Federal, State, Local and University Hazard Mitigation Planning Requirements
- Promote the Safety of Students, Faculty, Staff and Visitors
- Minimize Hazard Impacts to Physical Assets and Operations
- Reduce or Avoid Long-Term Vulnerabilities from Hazards
- University Eligibility for Future Funding

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COMMITMENT & INTEGRITY DRIVE RESULTS

Hazard Mitigation Planning Process – Step 2

COMMITMENT & INTEGRITY DRIVE RESULTS

Meeting Goal

To reach consensus on a ranked list of hazards (natural and human) that could impact the President's Office (Boston) and Central Administrative Services (Shrewsbury)

COMMITMENT & INTEGRITY DRIVE RESULTS

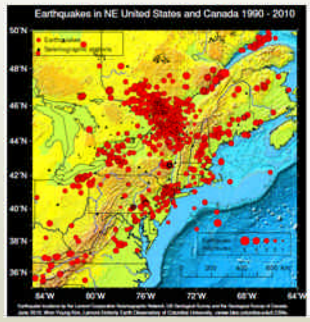
Items to Consider

Items to Consider

- The University's system administration has two major components: The President's Office and Central Administrative Services
  - 333 South Street, Shrewsbury, MA
  - 225 “Franklin Street”, 33rd Floor, Boston, MA
- The President's Office provides overall leadership to the entire University and its five campuses
- Central Administrative Services are responsible for the shared management and fiscal services of the University, which are centrally organized through the President's Office

Earthquakes

- Between 1924-1989 there have been 8 earthquakes in New England with a magnitude of 4.2 or greater.
- 30-40 earthquakes occur annually in New England – most are not felt
- In the Central Mass region, earthquakes are extremely rare and when they do occur, they are small.



Source: USGS, Weston Observatory

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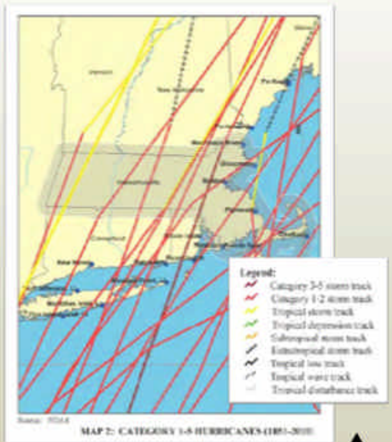
COMMITMENT & INTEGRITY DRIVE RESULTS

Hurricanes

- Massachusetts has been impacted by a number of hurricanes of varying strengths
- The Central Mass region is at medium risk for Hurricane threats, and may experience serious impacts wind, vegetative debris, flooding, stormwater flooding, and rain



Source: NOAA

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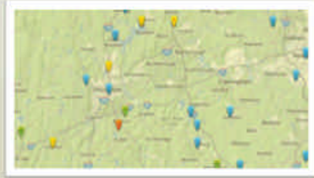
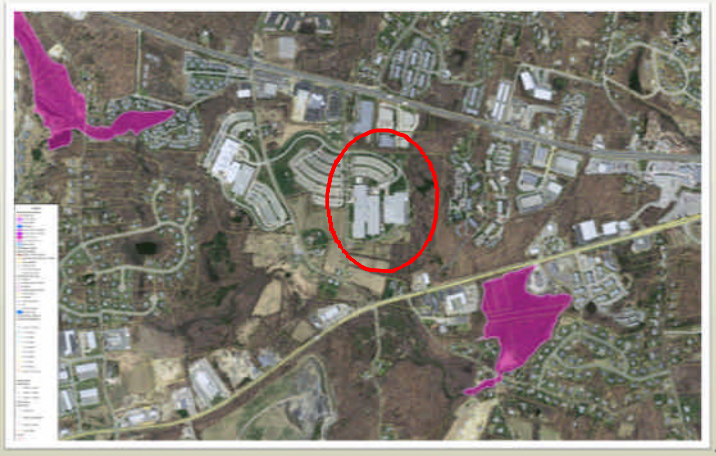
Tornadoes – Suffolk & Worcester Counties

- Average of 6 tornadoes per year touch down in New England
- No tornadoes in Suffolk County since 1951
- In Worcester County, a number of F1 tornadoes have occurred. There have been 4 F3 tornados (or higher)
- State Hazard Mitigation plan indicates that greatest risk in MA for a tornado is from central to northeastern MA



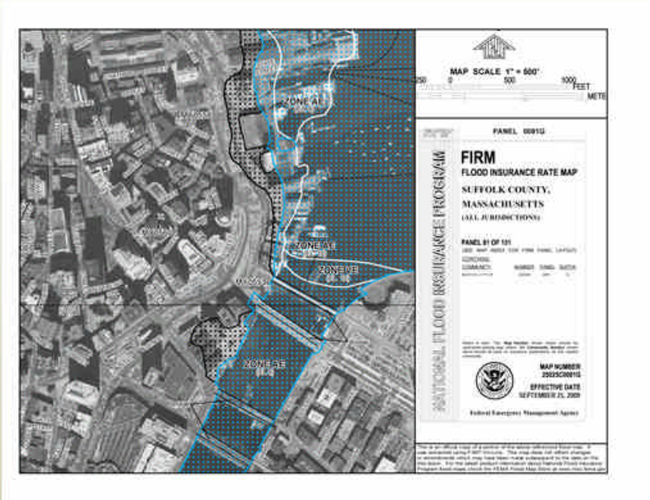
Source: http://www.tornadohistoryproject.com/

System Office Flood Map



COMMITMENT & INTEGRITY DRIVE RESULTS

Boston Office FIRM Map



Other Natural Hazards

- **Winter/Ice Storms**
  - Entire state is at risk
  - From 1971 – 2009 there have been about 40 ice storm events
  - Central Massachusetts, winter storms and related hazards (power outages, flooding) have a high frequency in the region though impacts are generally minor
- **Flooding**
  - Central Massachusetts is at moderate risk for flood threats which may result in serious or extensive damage.

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Hazard Identification

- Drought
- Earthquake
- Extreme Heat
- Flood
- Hailstorm
- Hurricane
- Severe Winter Storm
- Thunder/Lightning
- Tornado
- Windstorm

Sources: State of Massachusetts Hazard Mitigation Plan (2010); City of Boston Hazard Mitigation Plan (2008); CMRPC DRAFT Hazard Mitigation Plan 2012

Summary of Interviews

Common Themes

- Any hazard that might result in a power loss or impact to fiber optic lines is of concern
- Majority of System administrative functions are located here
  - If systems are impacted it could affect all campuses
- "Open" nature of buildings - there is a key card system, but no one challenged when they arrive at the building. Desk in Shrewsbury is more for informational instead of security purposes.

COMMITMENT & INTEGRITY DRIVE RESULTS

Specific Events

- Area has experienced mini-hurricane, tornado and earthquake events in the past
- Seasonal winter storms occur annually
- Civil disturbances and bomb threats have occurred in the past
- Attempts to access the Office's IT infrastructure are common.

COMMITMENT & INTEGRITY DRIVE RESULTS

Considerations

- Dependency on area lines - have fiber optic cables on power poles and lease fiber.
  - Any major weather event could result in multiple fiber disruptions.
- Need to be able to access the data center - while this can be done remotely for a couple of days, long term reduced access from a major weather event could be problematic.
- Potential for roof collapse at the Shrewsbury building with a large snow event.

Possible Mitigation Projects

- Redesigning IT "backbone" to be completed in 2014 to address repetitive loss on connectivity.
- Moving IT infrastructure from Shrewsbury/Boston to Amherst (lower hazard prone area). Need to build network logistics in Amherst to accommodate this move.
- Develop a relocation plan if building or floor needed to be evacuated or critical functions are impacted.

Ranking Methodology

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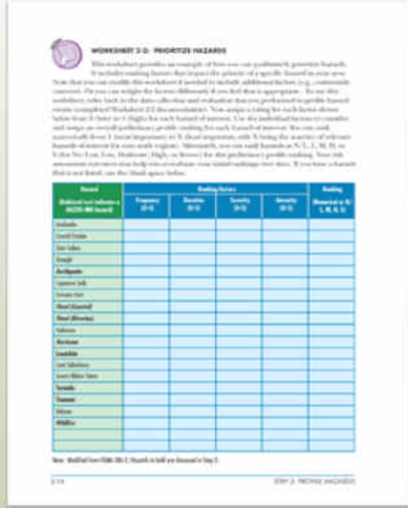
Hazard Ranking Methodology

- The primary objective of the upcoming campus meetings is to identify and prioritize risks
- Hazards will be ranked on a scale of 0 (very low) to 5 (high) in the categories of frequency, severity, duration, and intensity
- Values will be added for each profile item, so that each hazard will ultimately be given a “rank”
- Weighting of probability vs. consequence

COMMITMENT & INTEGRITY DRIVE RESULTS

Hazard Ranking Worksheet



COMMITMENT & INTEGRITY DRIVE RESULTS

Hazard Ranking Workshop (handout)

COMMITMENT & INTEGRITY DRIVE RESULTS

University of Massachusetts

MULTI-CAMPUS HAZARD MITIGATION PLAN

Thank You

Questions?

COMMITMENT & INTEGRITY DRIVE RESULTS

APPENDIX D: HAZARD MITIGATION GOALS, HAZARD PROFILES, LOSS ESTIMATES AND PROJECTS PRESENTATION AND MATERIALS

MEETING SIGN-IN SHEET – ALL-HAZARDS MITIGATION PLANNING TEAM MEETING

Project:	UMass System Office – Multi-Campus Hazard Mitigation Plan	**Meeting Date:**	June 25, 2013
Facilitator:	Woodard & Curran	**Campus:**	UMass System Office

Name	Title	Department or Organization	Phone	Email
Keith Moran	ACTO	UITS	508 277 5126	KMoran@umassp.edu
Amy Thompson	Ops Mgr	A&F	774 455 7141	athompson@umassp.edu
Brian Dawson	CS&BR mgr	UITS	774-455-7873	BDawson@Umassp.edu
Carol Walsh	Change Services	U.I.T.S	508 808 8488	CWalsh@umassp.edu
Andrew Russell	Dir. Insurance	Treasury	774-455-7590	arussell@umassp.edu
Fran Zannoni	Assoc. Dir. HR Systems	H.R	774-455-7571	fzannoni@umassp.edu
Sarah Mongeau	Univ Controller	Controller's Office	774-455-7520	smongeau@umassp.edu
Kim Howard	Assoc Dir-HR	HR	774 455 7559	khoward@umassp.edu
Kim Medeiros		EO		
Matt Gorzalski	AVP Planning + accountability	A&F		
Julie Kenny		UITS/EO		
Jen Allen		UMBA		
Jeff Hescock	EM/BC Manager	~~UMass~~ EM	774 455 7541	jhescock@umassp.edu
Mary House	Sr. VP	Woodard + Curran	800-426-4262	mhouse@woodardcurran.com

University of Massachusetts

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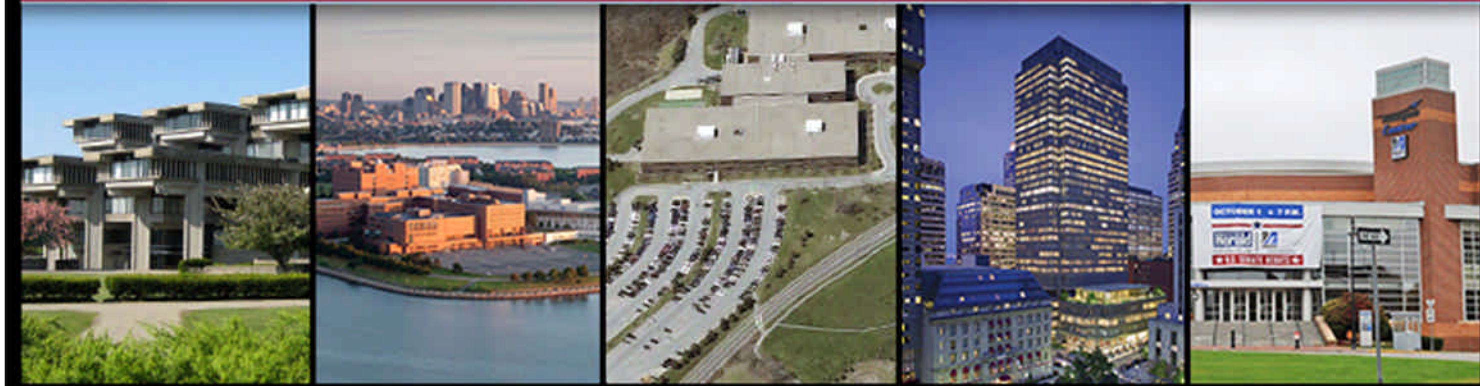
MULTI-CAMPUS HAZARD MITIGATION PLAN



Systems Office Hazard Mitigation Planning Team

Hazard Mitigation Goals, Hazard Profiles, Loss Estimates and Projects

June 25, 2013

UMASS

COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD &CURRAN

Meeting Agenda

- Hazard Mitigation Goals and Objectives
- Hazard Event Profiles
- Building Ratings
- Loss Estimates
- Hazard Mitigation Projects
- Public Workshop
- Open Discussion

What Have We Done Thus Far and What are We Doing Now?

- Previously the project focus has been two fold:
  - (1) Stakeholder engagement
  - (2) Hazard identification & risk assessment
- This phase of the project builds on the previous and includes:
  - (1) Hazard event profiles
  - (2) Asset inventories and building ranking
  - (3) Hazard event loss estimates
  - (4) Goals and objectives
  - (5) Public meeting

Hazard Mitigation Goals & Objectives

Goals & Objectives

Goal 1	Protect existing and future assets from known hazards by implementing mitigation projects to minimize potential losses and ensure public health and safety.
Objective 1A	**Use appropriate techniques to mitigate against impacts from winter and ice storms.**
Hazard Addressed:	Winter storms and ice storms.
Potential Mitigation Projects	• Assess Shrewsbury building roof condition and potential for impacts from a large snow event .
Objective 1B	**Use appropriate techniques to mitigate against impacts from high wind events such as windstorms, hurricanes and tornadoes.**
Hazard Addressed:	Windstorm, hurricanes, tornadoes
Potential Mitigation Projects	• Upgrade leaking windows at Franklin Street. • Develop a system-wide debris management plan .
Objective 1C	**Use appropriate techniques to mitigate against impacts from earthquakes.**
Hazard Addressed:	Earthquake
Potential Mitigation Projects	• Conduct an assessment of critical infrastructure structural integrity

Goals & Objectives

Goal 2	Maintain a continuity of campus business operations during and after a hazard event.
Objective 2A	**Build redundancy in essential systems.**
Hazard Addressed:	All
Potential Mitigation Projects	• Study the emergency generator and backup power redundancies • Conduct a utility vulnerability assessment. • Review long-term accessibility to the data center in the case of a multi-day event. • Review and develop redundancies for critical administrative functions.
Objective 2B	**Protect critical infrastructure.**
Hazard Addressed:	All
Potential Mitigation Projects	• Ensure that all critical facilities have generators and other portable devices to support critical infrastructure (potentially these devices could be shared among the campuses) • Complete an assessment of the data center and evaluate and address any potential vulnerabilities • Develop backup HVAC/air capacity for Boston network closet.

Goals & Objectives

Goal 2	Maintain a continuity of campus business operations during and after a hazard event.
Objective 2C	**Evaluate and enhance communication and education during hazard events to increase the understanding of impacts to campus.**
Hazard Addressed:	All
Potential Mitigation Projects	• Conduct training on business continuity plans
Objective 2D	**Establish contingency procedures.**
Hazard Addressed:	All
Potential Mitigation Projects	• Develop a relocation plan if building or floor needed to be evacuated or if critical functions are impacted.

Goals & Objectives

Goal 3	**Create and maintain a safe, secure environment for the campus population before, during and after a hazard event.**
Objective 3A	**Improve safety and security.**
Hazard Addressed:	All
Potential Mitigation Projects	• Conduct an annual safety and security seminar.
Objective 3B	**Proactively conduct scenario planning activities**
Hazard Addressed:	All
Potential Mitigation Projects	• Conduct annual active shooter training and drills

Goals & Objectives

Goal 3	Create and maintain a safe, secure environment for the campus population before, during and after a hazard event.
Objective 3C	**Focus on the mental health of the campus community.**
Hazard Addressed:	All
Potential Mitigation Projects	• Evaluate mental health programs on campus and create an outreach program
Objective 3D	**Continually develop and maintain emergency response programs.**
Hazard Addressed:	All
Potential Mitigation Projects	• Develop a plan for sheltering in place.
Objective 3E	**Protect human health.**
Hazard Addressed:	Pandemic Health Issue
Potential Mitigation Projects	• Develop a pandemic health management plan

Goals & Objectives

Goal 4	Communicate natural and human hazard information to the campus community and improve education and outreach efforts regarding their potential impact.
Objective 4A	**Advise the community on health and safety precautions against potential hazards.**
Hazard Addressed:	All
Potential Mitigation Projects	• Develop and implement a hazards public education and outreach program • Incorporate hazard awareness into the web site and other social media.
Objective 4B	**Work collaboratively with external campus stakeholders on hazard mitigation.**
Hazard Addressed:	All
Potential Mitigation Projects	• Implement regular communications with other building occupants and a mechanism to share information related to an event. • Participate in municipal, regional and state hazard mitigation planning efforts • Work collaboratively with all UMass campuses on hazard mitigation
Objective 4C	**Consider and obtain feedback from the campus population on hazard planning communications.**
Hazard Addressed:	All
Potential Mitigation Projects	• Conduct surveys or other outreach soliciting feedback from the community

Goals & Objectives

Goal 5	**Proactively protect existing and future campus assets from known hazards by incorporating mitigation activities into capital improvement and infrastructure planning.**
Objective 5A	**Use appropriate measures to ensure new development or redevelopment will not increase hazard threats.**
Hazard Addressed:	Windstorm, hurricane, tornadoes, winter storm, ice storm, fire, earthquake
Potential Mitigation Projects	• Complete a hazard assessment on each new project • Ensure new buildings incorporate structural integrity and protection issues associated with top hazards

Hazard Profiles, Risk Assessment & Loss Estimates

Natural Hazard Identification & Ranking

Natural Hazard	Hazard Ranking for Systems Office*	Suggested Hazard Ranking Modification**
Hurricane	Severe	None
Urban Fire	Low	None
Drought	Low	None
Windstorm	Medium	None
Flood	Low	None
Winter Storm	High	None
Hailstorm	Low	None
Ice Storm	Medium	None
Earthquake	Medium	None
Thunderstorm/Lightning	Low	None
Extreme Heat	Low	None
Tornado	Medium	None

* Rankings as defined by UMass Team; **Non-Hazard Specific Ranking Based on Qualitative/Quantitative Analysis

Human Hazard Identification & Rankings

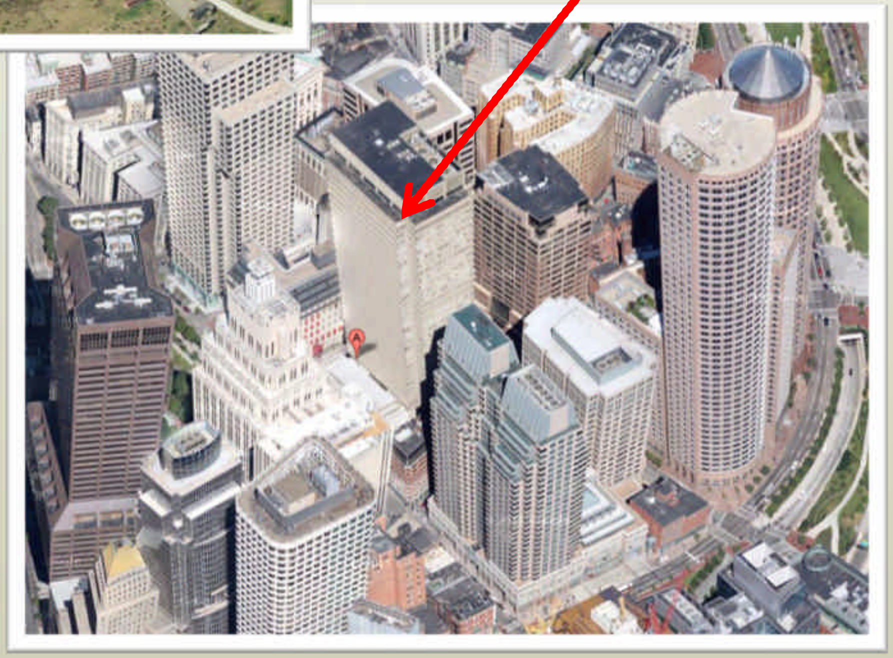
Man-Made Hazard	Hazard Ranking for Systems Office*
Critical Infrastructure Failure	Severe
Weapons of Mass Destruction	Low
Civil Disturbance	Low
HazMat Release	Low
Armed Attack/Active Shooter	Low
Fraud	Low
Bomb Threat	Low
Arson	Low
Violent Criminal Incident	Medium
Robbery/Burglary	Low
Pandemic	Medium
Vandalism	Low
Cyberattack/Cyberterrorism	Severe

* Rankings as defined by UMass Team

Inventory of Assets

Shrewsbury, MA

Boston, MA



Inventory of Assets

- The University's system administration has two major components: The President's Office and Central Administrative Services:
  - 333 South Street, Shrewsbury, MA
  - 225 “Franklin Street”, 33rd Floor, Boston, MA
- The President's Office provides overall leadership to the entire University and its five campuses
- Central Administrative Services are responsible for the shared management and fiscal services of the University, which are centrally organized through the President's Office

Non-Hazard Specific Loss of Function Cost

Table: Loss of Function Cost System Office								
Existing Buildings	Date Construction Completed	Gross Square Feet	Building Criticality Value	Factored Square Footage	Building/Total Campus Square Footage	Per Day Loss of Function Cost	Estimated Hazard Specific Loss of Function Days	Loss of Function Cost Per Hazard
333 South Street	1986	548,850	3	1,646,550	2.869303825	$37,987	7	$265,909
225 Franklin Street - 33rd Floor	Unknown	25,000	3	75,000	0.130696175	$1,730.30	7	$12,112
Note: 333 South Street Information from Shrewsbury Assessors Data; 225 Franklin Street Information from Building Website								

Calculations & Assumptions:

•**Building Gross Square Feet** – Information from Shrewsbury Assessors Data and 225 Franklin Street Website
•**Building Criticality Value** – Buildings given a rank based on May 15, 2013 memorandum defining what characteristics pertain to each number value
•**Factored Square Footage** = Gross Square Feet * Building Criticality Value
•**Building/Total Campus Square Footage** = Factored Square Footage/Total Gross Square Feet
•**Per Day Loss of Function Cost** = Resulting square footage factor/daily operating budget of the college (derived from 2012 operating budget)
•**Estimated Hazard Specific Loss of Function Days** – Assumed to be 7 days for this calculation
•**Loss of Function Cost Per Hazard** - Per Day Loss of Function Cost/Estimated Hazard Loss of Function Days

Non-Hazard Specific Vulnerability Assessment

Table: System Office Buildings - Vulnerability Assessment					
Existing Buildings	Insurable Replacement Value	Insurable Contents Value	Loss of Function Per Hazard	Total Damage	Building Vulnerability Ranking
333 South Street	$27,236,231	$40,854,347	$278,021	$68,368,599	Medium
225 Franklin Street - 33rd Flood	Unknown	Unknown	$12,112	Unknown	Unknown
Note: Building Vulnerability Ranking is based on Replacement Value + Insurable Contents Value + Loss of Function Value					

Calculations & Assumptions:

- **Insurable Replacement Value** – Information from Shrewsbury Assessors Data and not available for 225 Franklin Street
- **Insurable Contents Value** – Insurable Replacement Value*150% (Contents Value as % of Building Replacement Value – FEMA 386-2)
- **Loss of Function Per Hazard** – See previous slide
- **Total Damage** – Insurable Replacement Value + Insurable Contents Value + Loss of Function Per Hazard
- **Building Vulnerability Ranking** – Anything over $50M got a "medium"

Note: This is based on a Loss of Function where the building would be out of use for 7days.

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Wind Hazard Events (Windstorm, Hurricane, Coastal Storm)

Hazard Profile & Risk Assessment
Windstorm

- A storm marked by consistent, high winds with little to no precipitation.
- Massachusetts is located in a Zone II which means it is susceptible to winds of up to 160mph and it is also located in a hurricane susceptible region.
- Massachusetts building regulations and standards require a basic wind speed design factor of 105 mph for the City of Boston.
- High winds could impact power/fiber optic lines.
- The System Office is certain to experience future hurricane/windstorm events

Qualitative Hazard Ranking – MEDIUM

Suggested Ranking Modification - NONE

Hazard Profile
Coastal Storm/Nor'Easter

- Common occurrence in Massachusetts.
- Can cause substantial damage to coastal (and at times, inland) areas due to strong winds (can be hurricane force), storm surge and substantial rainfall or snow amounts.
- Nor'Easter occurs when the wind blows in from the northeast and pushes the storm up the east coast of the United States.
- One or two nor'easters typically impact the Massachusetts coastline per year between October and April.
- There have been two Presidential Disaster Declarations made for "coastal storms" in Massachusetts.
- Potential for high winds and associated power outages at 225 Franklin Street.

Photo: Morrissey Boulevard - John Hamman, November 2011

Qualitative Hazard Ranking – LOW

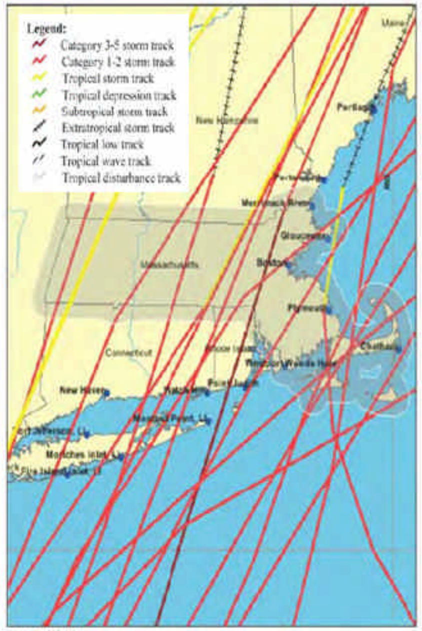
Suggested Ranking Modification - NONE

Hazard Profile
Hurricane

- Characterized by a constant speed of 74 mph or greater, wind blowing in spiral motion around an eye and an expansive reach (can be 100s of miles).
- Hurricanes can be short in duration or last for several days impacting numerous states, counties and towns along the coastline.
- Aftermath of a hurricane frequently causes additional damage due to lasting high winds, storm surge and flooding.
- Hurricanes are categorized by class in accordance with the Saffir-Simpson Hurricane Wind Scale and receive a number of 1-5.

Risk Assessment
Hurricane

- Between 1851-2010, there have been 10 direct hurricane hits to the Massachusetts coastline.
- Since 1954, there have been 6 Major Disaster Declarations in Massachusetts due to a hurricane or tropical storm - 4 have resulted in Suffolk County receiving a “designated area” status from FEMA.
- Network has gone down in the past due to "mini" hurricane event.
- During Hurricane Irene the two means that connect all campuses through the IT infrastructure backbone both went down (this is the only time both fiber strands from the major carrier have experienced a double failure).
- There have been leaking windows at Franklin Street associated with rain events.



Source: NOAA

MAP 2: CATEGORY 1-5 HURRICANES (1851-2010)

Qualitative Hazard Ranking – SEVERE

Suggested Ranking Modification - NONE

Hazard Profile

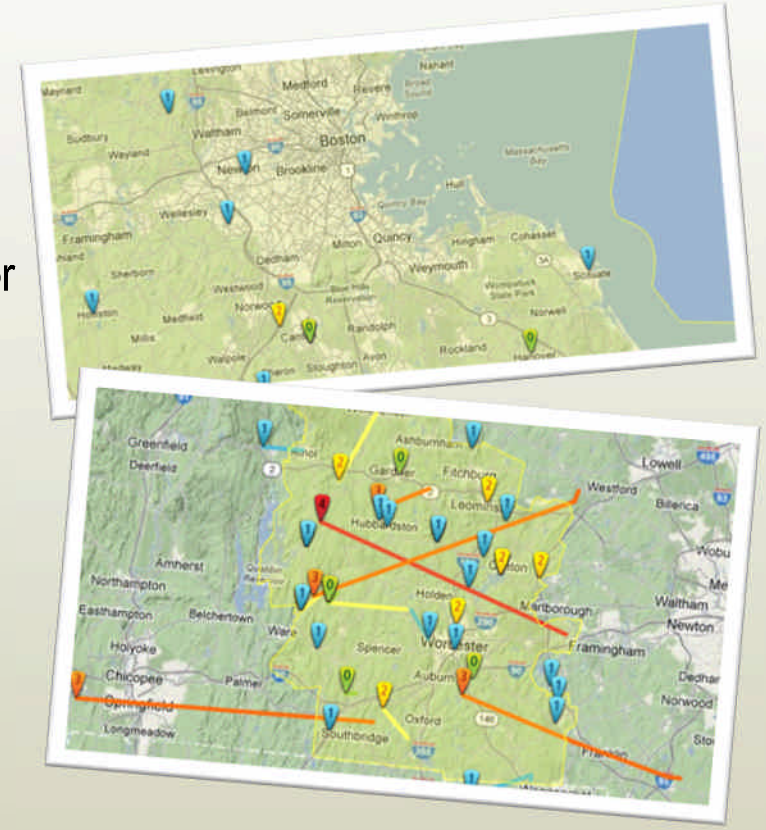
Tornado

- A Tornado may occur anywhere in MA with the right atmospheric conditions.
- Violently rotating visible funnel cloud that is a rotating air column which has contact with the ground.
- Speeds of a tornado can range from 40mph to 300mph and are measured on what is known as the Fujita scale.
- Damage can vary widely and be minimal to completely catastrophic.

EF Scale Rating	3-Second Gust Speed (mph)	Type of Damage
EF0	65–85	Light damage
EF1	86–110	Moderate damage
EF2	111–135	Considerable damage
EF3	136–165	Severe damage
EF4	166–200	Devastating damage
EF5	>200	Incredible damage

Risk Assessment
Tornado

- Massachusetts has a vulnerability to tornadoes, with an average annual occurrence of 2.6 tornadoes per year since 1951.
  - There have been 4 F3 tornadoes or higher in Worcester County.
- State Hazard Mitigation Plan noted that the area at greatest risk for a tornado touchdown runs from central to northeastern Massachusetts.



Qualitative Hazard Ranking – Medium

Suggested Ranking Modification - None

Winter Storm

Hazard Profile – Winter Storm

- Consist of varying forms of precipitation including snow, sleet, freezing rain or a mix of these wintry conditions
- Blizzards are the most dangerous and severe type of winter storm and are characterized by strong, sustained winds of at least 35 mph that last for a prolonged period of time – typically 3 hours or more
- An ice storm is another form of winter storm that is defined as an event which results in the accumulation of at least .25-inch of ice on exposed surfaces
- Since 1954, there have been 6 Major Disaster Declarations in Massachusetts due to some form of winter storm and 3 of those have resulted in Suffolk County receiving a "designated area" status from FEMA
- Have been occurrences of winter storms and impacts have been mostly administrative and operational
- Policies are in place for personnel to work remotely to prevent travel during inclement weather
- Last power outage caused by a snowstorm was Oct. 31, 2012

Qualitative Hazard Ranking – HIGH

Suggested Ranking Modification - NONE

Flood

Hazard Profile - Flood

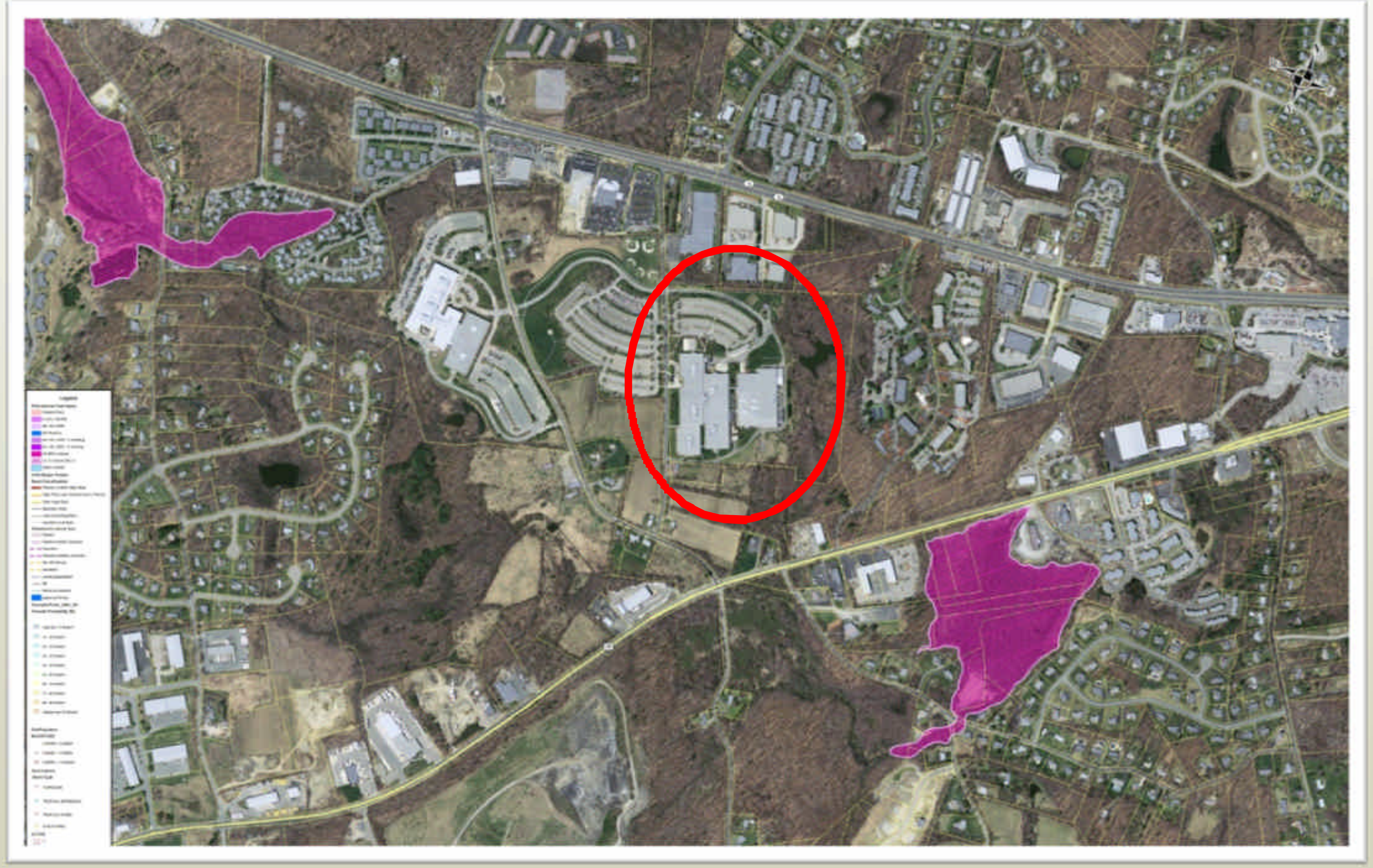
- A flood is when there is a high flow or inundation of water that submerges land which is normally dry and causes or threatens damage
- Flooding is the most common hazard to affect New England and can result from coastal storms/nor'easters, hurricanes, winter storms, thunder/lightning storms and hailstorms
- Neither 333 South Street or 225 Franklin Street are in flood zones
- Data center is on ground floor (behind main building in Shrewsbury). Has never flooded - would take large amount of water to flood. Critical operations could be brought back on-line out of Boston
- Leaking windows at Franklin Street associated with rain events

Qualitative Hazard Ranking – LOW

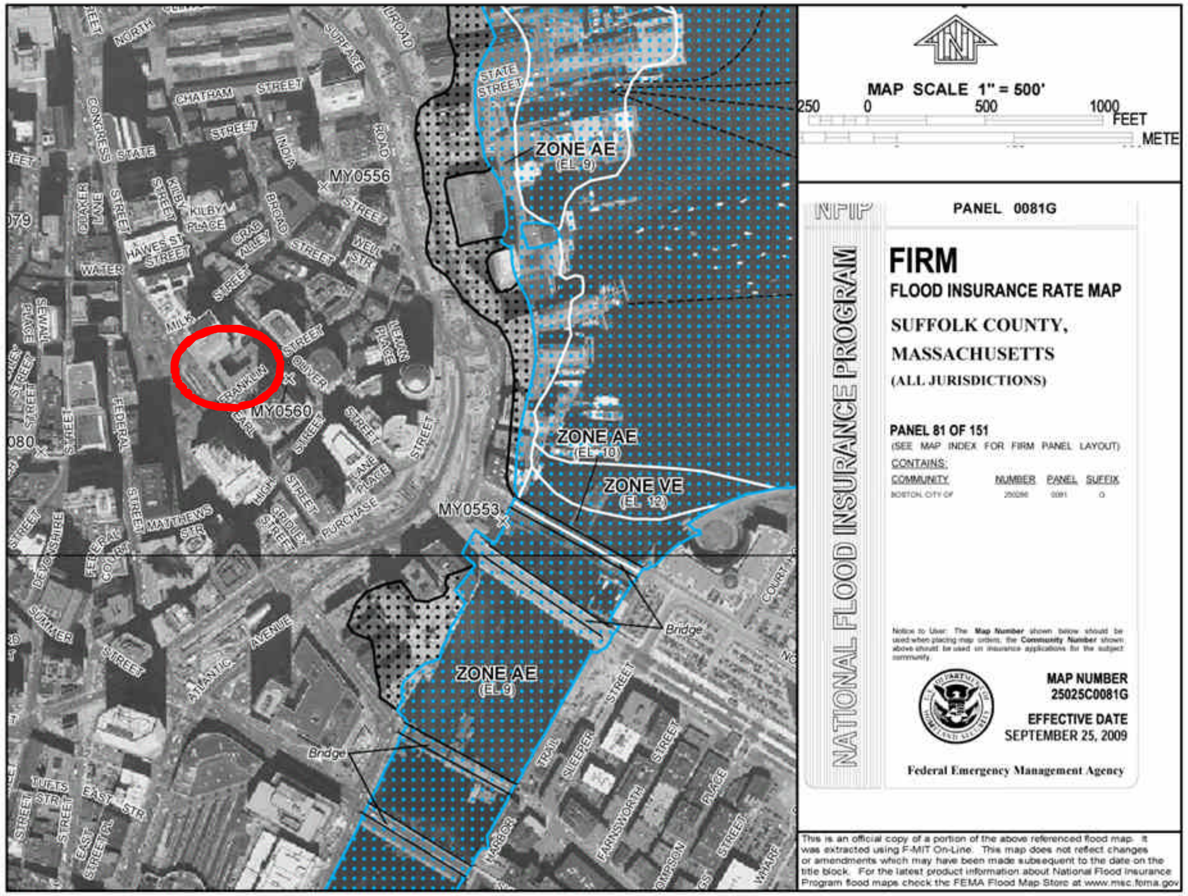
Suggested Ranking Modification - NONE

Flood Hazard

What Will Be Affected by the Hazard?



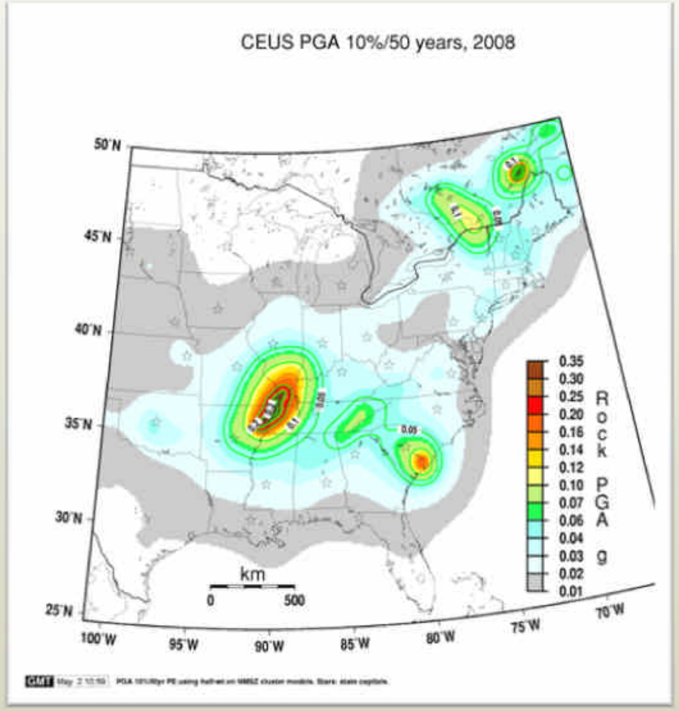
Flood Hazard
What Will Be Affected by the Hazard?



Earthquake

Hazard Profile - Earthquake

- An earthquake is the result of a release of energy (which can be observed by shifting and fracturing of rock materials beneath the surface) in the Earth's crust that creates seismic activity.
- Seismic activity is defined by the frequency, type and size of earthquakes that occur.
- The last major earthquake to affect Massachusetts was more than 200 years ago in 1755 with an estimated magnitude of about 6.0 to 6.25. The epicenter was probably located off the coast of Cape Ann, north of Boston.
- The earthquake hazard possibility is on the lower end of the spectrum in Massachusetts compared to other areas of the country.



Risk Assessment - Earthquake

- The Massachusetts coastline from the northern portion of Plymouth County through the Boston Metropolitan area to the New Hampshire border, has greater vulnerability to potential earthquake activity than the rest of the state.
- There has never been a Presidential Disaster Declaration made for an earthquake in Massachusetts.
- Have had very minor earthquake movement in the past. Associated debris could impact ability to access facilities.

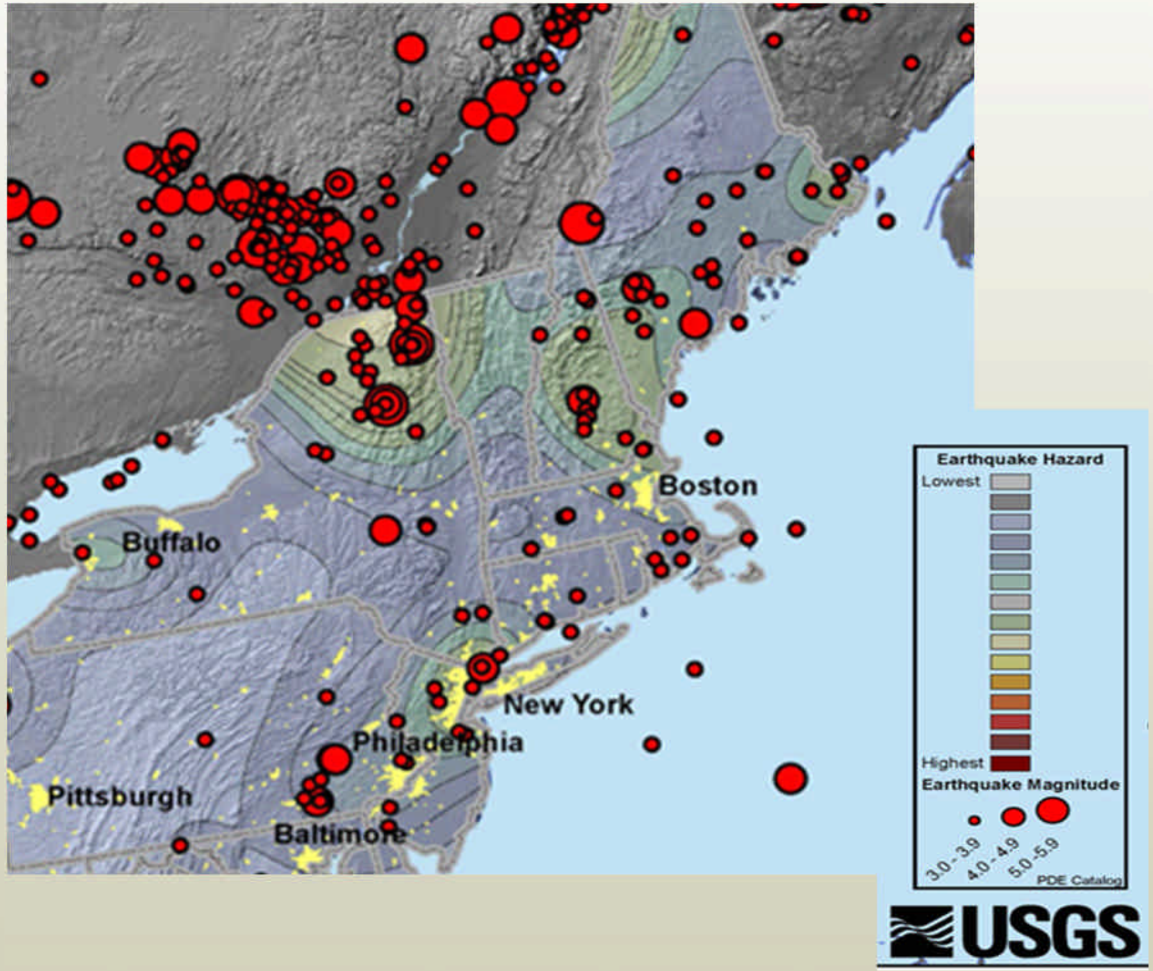
What will be affected by the Hazard Event?				EARTHQUAKE				
Table: UMass Boston Campus Buildings - Estimated Loss to Structure & Contents Due to Earthquake								
Existing Buildings	Year Constructed	Insurable Replacement Value	PGA Zone	Building Damage Ratio (%)	Estimated Building Damage Sustained ($)	Contents Damage Ratio (%)	Estimated Contents Damage Sustained ($)	Loss of Function (Days)
333 South Street	1986	$27,236,231	0.05	10.0%	$2,723,623.10	5.00%	$1,361,811.55	1
225 Franklin Street - 33rd Flood	Unknown	Unknown	0.05	0.2%	Unknown	0.10%	Unknown	Unknown

Note: Utilized FEMA 386-2. loss estimation tables by category did not include an educational institution, so for the purposes of this analysis, we utilized the Professional Office category. Once the category was selected, we utilized a PGA value of .05 to select the appropriate building damage ratio % and loss of function days.

Qualitative Hazard Ranking – MEDIUM

Suggested Ranking Modification - NONE

Earthquake Hazard
What Will Be Affected by the Hazard?



Human Hazards

Hazard Profiles – Receiving Severe and High Rankings

- Critical Infrastructure Failure – Severe
  - Majority of System administrative functions are located in Shrewsbury so if systems are impacted it could affect all campuses.
- Cyberattack/Cyberterrorism - Severe

Note: Rankings that were "high" or "severe" as defined by UMass Team

First Public Workshop

Public Workshops

- Need to have two public workshops to meet FEMA & MEMA requirements
  - First Public Workshop:
    - Later today
    - Focus on the process not the details
    - Open house style format
  - Second Public Workshop:
    - Late summer/early fall
    - Focus on the details and mitigation projects
    - Completed during draft report review

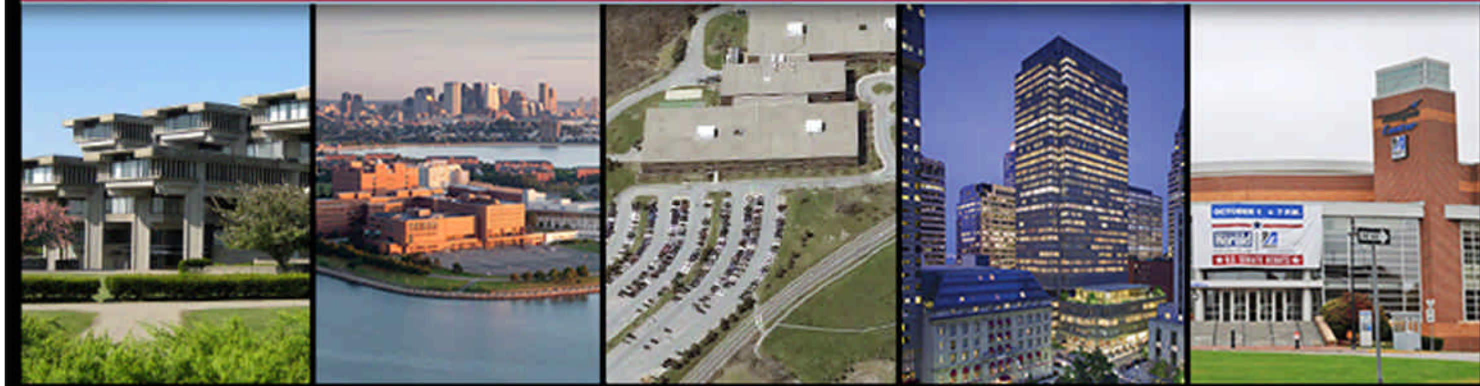
Next Steps

Hazard Mitigation Plan Next Steps

- Make sure all mitigation projects are identified
  - Have one on one meetings with key personnel
- Campus to review hazard event profiles, building rankings and loss estimates
- Finish writing the draft plan
- Present draft plan in late summer/early fall
- Grant applications for current MEMA HMGP funding round due in August 2013 – need to identify project to submit

University of Massachusetts

MULTI-CAMPUS HAZARD MITIGATION PLAN



Thank You

Questions?

APPENDIX E: PUBLIC MEETING NO. 1 – MEETING MATERIALS

Meeting Sign-In Sheet – All-Hazards Mitigation Plan Public Forum

Project:	UMass System Office – Multi-Campus Hazard Mitigation Plan	**Meeting Date:**	June 25, 2013
Facilitator:	Woodard & Curran	**Campus:**	UMass System Office

Name	Address	Phone	Email	Group Represented (*Self or Organization's Name*)
Keith Moran	333 South St Shrewsbury MA	508 277 5126	KMORAN@UMASSP.EDU	UMASS Systems Office
Marybeth Groff	400 Worcester Road Framingham MA 01702	508 820 1435	marybeth.groff@massmail.state.ma.us	MEMA
Mary House	Woodard + Curran	800 424 4242	mhouse@woodardcurran.com	Woodard + Curran
Jeff Hescock	333 So. St Shrewsbury, MA	774 455 7541	Jhescock@umassp.edu	UMSO

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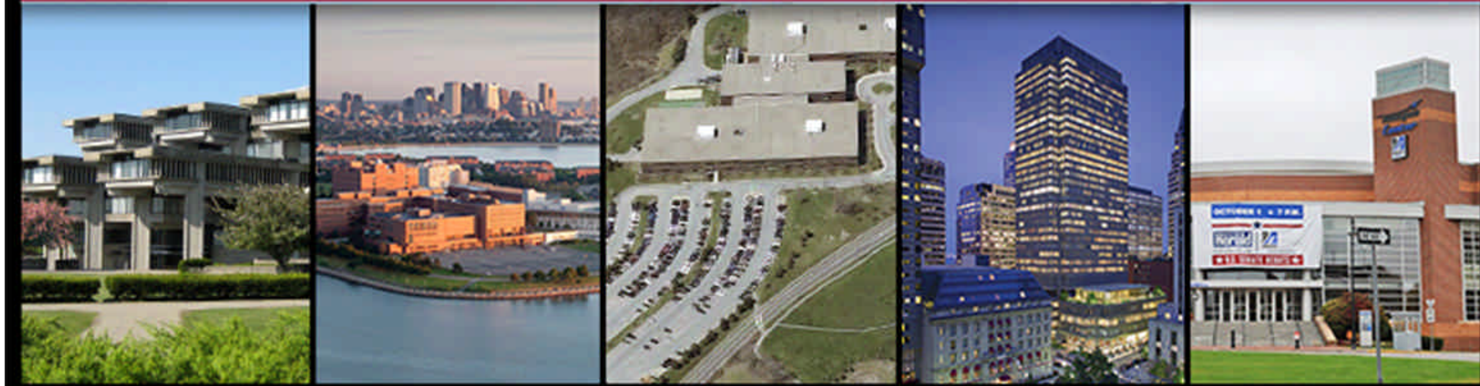
MULTI-CAMPUS HAZARD MITIGATION PLAN



University of Massachusetts

Hazard Mitigation Planning Process

June 25, 2013

COMMITMENT & INTEGRITY DRIVE RESULTS

Public Engagement

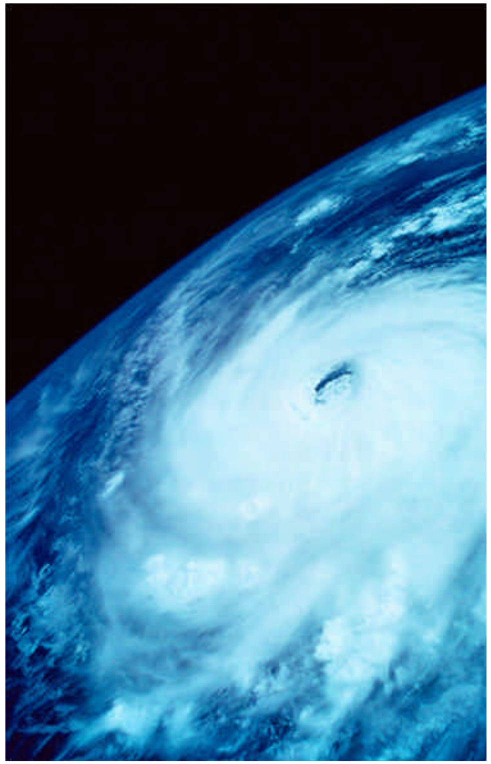
- **Why are We Having this Workshop?**
  - Public Engagement of both on and off campus stakeholders is a critical component of hazard mitigation planning
- **What do We Want from You?**
  - Your questions, thoughts, ideas, suggestions on how to make this the best possible plan to:

    (1) assist the University in identifying and reducing its risk from natural and human-caused hazards; and

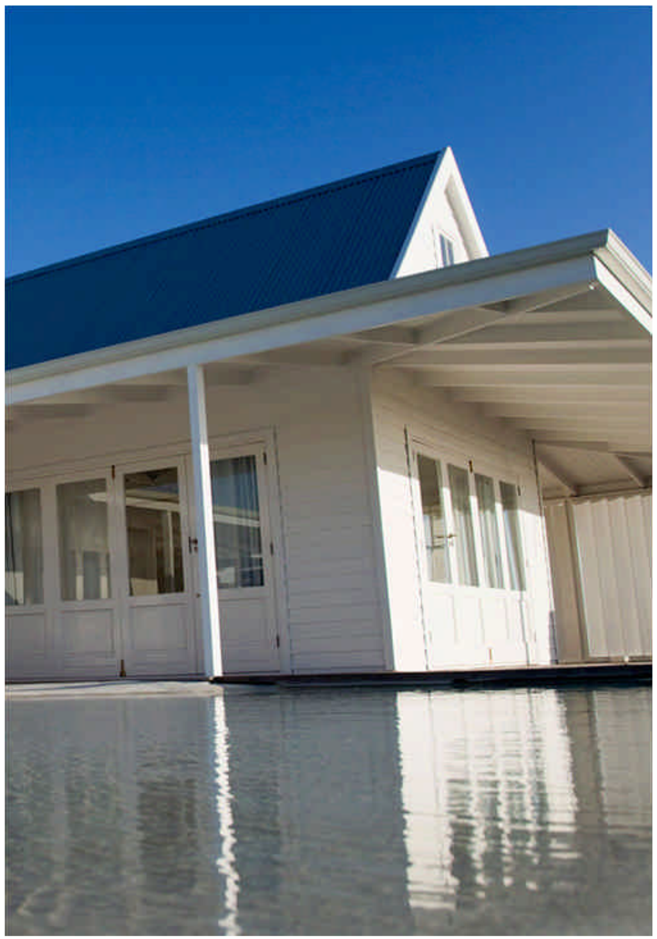
    (2) identify actions that can be taken to prevent damage to property and loss of life

Project Background

- The Disaster Mitigation Act was signed by the President in October 2000.
  - Incentive for states and local governments to undertake natural hazard mitigation planning.
  - Promotes sustainability as a strategy for disaster resistance.
  - Encourages state and local governments to work together, and facilitates cooperation between state and local authorities.
  - Results in faster allocation of funding and more effective risk reduction projects.
  - Colleges and Universities can plan in concert with similar planning efforts in their community.



Project Background



- The University of Massachusetts System Office received a grant from FEMA/MEMA to develop a multi-campus hazard mitigation plan
- Plan will help identify cost effective mitigation measures to reduce or eliminate long-term risk to life and property from hazards
- Allow the University to be eligible to receive non-emergency disaster assistance, including state and federal funding for mitigation and recovery projects
- Projects must be pre-identified in the hazard mitigation plans to receive future funding

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Benefits of Hazard Mitigation Planning

- Campus benefits from Mitigation Planning by:
  - Identifying cost effective actions for risk reduction that are agreed upon by stakeholders
  - Focusing resources on the greatest risks and vulnerabilities
  - Building partnerships by involving the campus community, organizations, local government and businesses
  - Increasing education and awareness of hazards and risk
  - Communicating priorities to local, state and federal officials
  - Aligning risk reduction with other University objectives

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Project Goals

- Fulfill Federal, State, Local and University Hazard Mitigation Planning Requirements
- Promote the Safety of Students, Faculty, Staff and Visitors
- Minimize Hazard Impacts to Physical Assets and Operations
- Reduce or Avoid Long-Term Vulnerabilities from Hazards
- University Eligibility for Future Funding

Hazard Mitigation Overview

- Hazard mitigation is defined as "any action taken to reduce or eliminate the long-term risk to human life and property from natural [and/or manmade] hazards."
- Hazard mitigation activities may be implemented prior to, during, or after an event; however, it is most effective when based on an inclusive, comprehensive, long-term plan that is developed before a disaster occurs.
- Hazard mitigation is often focused on reducing repetitive loss, as many damaging events tend to occur in the same locations over time (e.g. flooding).

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Hazard Mitigation Planning Process

- The UMass planning process closely follows FEMA's recommended four-stage approach.
- Initial and ongoing community support is critical to the planning process.

Phase 1 – Organize Resources

- Identify the resources available and necessary to complete the process:
  - Assess community support
  - Build the planning team
    - Identify and organize interested members of the community (stakeholders – on and off campus)
    - Identify the necessary technical expertise
  - Establish a steering committee
    - Develop a mission statement
    - Hold a project kick-off meeting
    - Establish a meeting schedule and goals
    - Engage the public

Phase 2 – Assess Risk

- Identify the hazards that present risks to the campus and the assets that are vulnerable to those hazards.
  - Gather historical information, review existing university plans/reports, communicate with local planning experts, MEMA and FEMA.
  - Determine which hazards present the greatest risk to the campus community
    - Assess vulnerability
    - Create a base map to profile potential hazard events
  - Inventory campus assets
    - Show how hazard events could impact campus (physically and operationally)
    - Estimate losses

Phase 3 – Develop the Mitigation Plan

- Lay out in detail the proposed mitigation actions:
  - Establish priorities
    - Compare university mission with the results of the hazard identification and risk assessment
  - Develop hazard mitigation goals
    - Minimize interruption to campus operations and mission
    - Protect research
  - Determine appropriate mitigation actions
  - Prioritize mitigations actions
  - Prepare an implementation strategy

Phase 4 – Implement the Plan and Monitor Progress

- Formally adopt the Hazard Mitigation Plan
- Implement mitigation measures
- Monitor, evaluate and update the plan as needed
- Continue to engage stakeholders from the campus and community

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Massachusetts Disaster Declarations Since 2010

Date	Description
4/19/13	Severe winter storm, snowstorm & flooding
4/17/13	Explosions
12/19/12, 10/28/12	Hurricane Sandy
1/6/12	Severe storm & snowstorm
11/1/11	Severe storm
9/3/11	Tropical storm Irene
8/26/11	Hurricane Irene
6/15/11	Severe storms & tornadoes
3/7/11	Severe winter storm & snowstorm
9/2/10	Hurricane Earl
5/3/10	Water main break
3/29/10	Severe storm & flooding

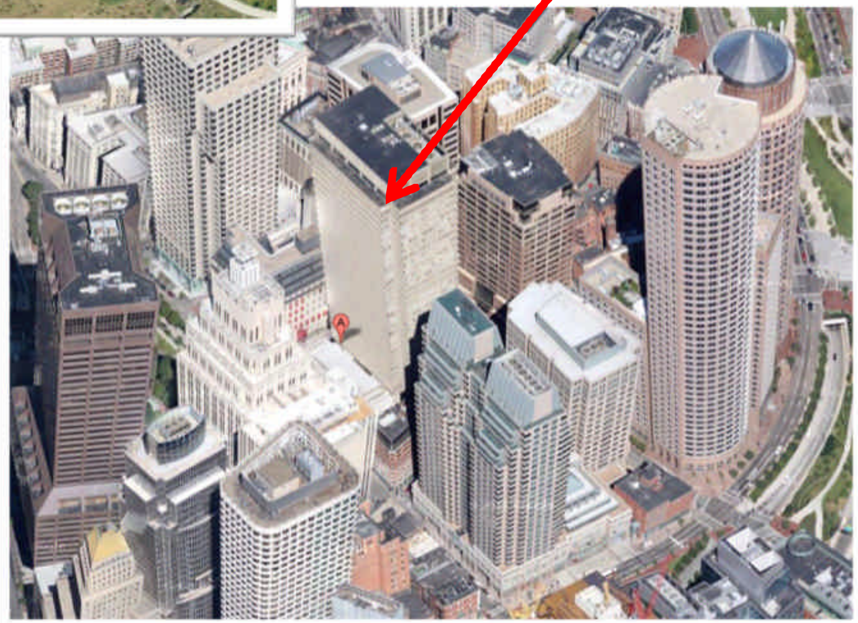
Examples of Types of Hazards (Natural and Human)

- Earthquake
- High winds
- Hurricane
- Fire
- Floods
- Extreme cold/heat
- Winter storm
- Hailstorm
- Lightning
- Tornado
- Terrorism
- Civil Disturbance
- Robbery, vandalism, theft
- Power or IT Interruption
- All hazards – generators, computer backups, additional contingency planning

UMass System Office

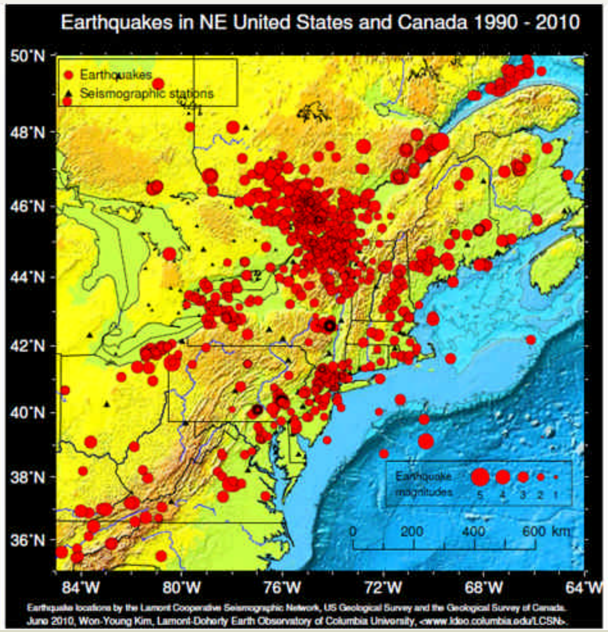
Shrewsbury, MA

Boston, MA



Earthquakes

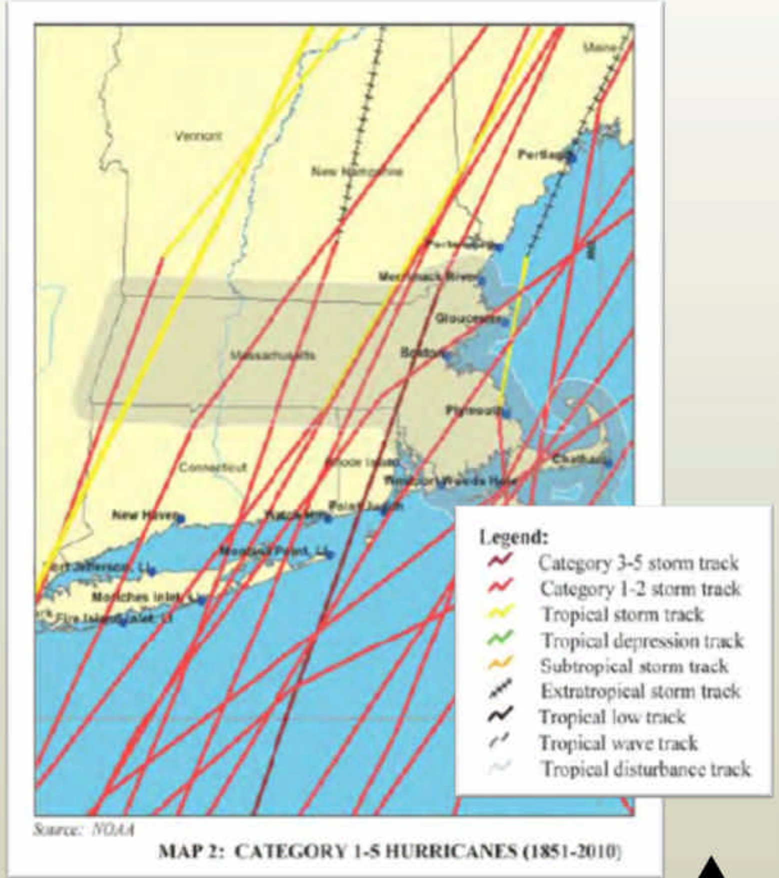
- Between 1924-1989 there have been 8 earthquakes in New England with a magnitude of 4.2 or greater.
- 30-40 earthquakes occur annually in New England – most are not felt
- In the Central Mass region, earthquakes are extremely rare and when they do occur, they are small.



Source: USGS, Weston Observatory

Hurricanes

- Massachusetts has been impacted by a number of hurricanes of varying strengths
- The Central Mass region is at medium risk for Hurricane threats, and may experience impacts such as wind, vegetative debris, flooding, stormwater flooding, and rain

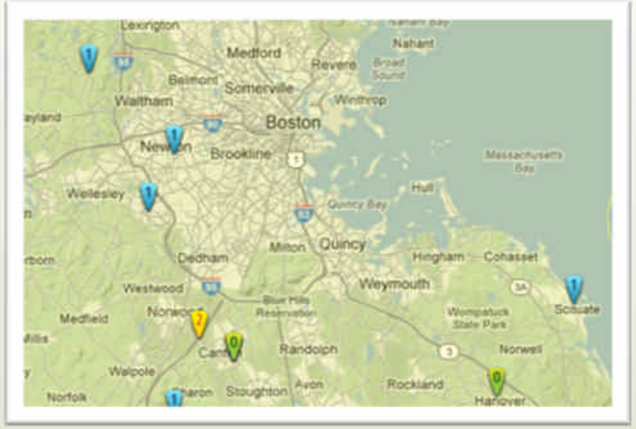


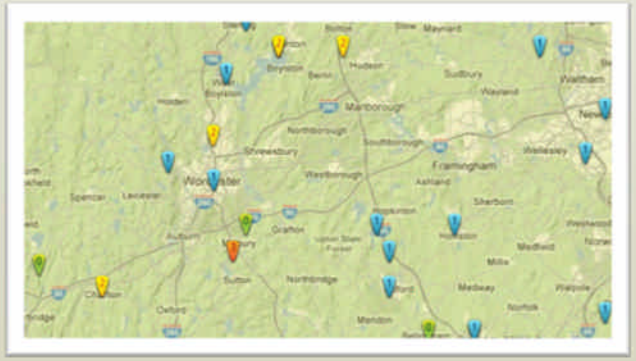
MAP 2: CATEGORY 1-5 HURRICANES (1851-2010)

Source: NOAA

Tornadoes – Suffolk & Worcester Counties

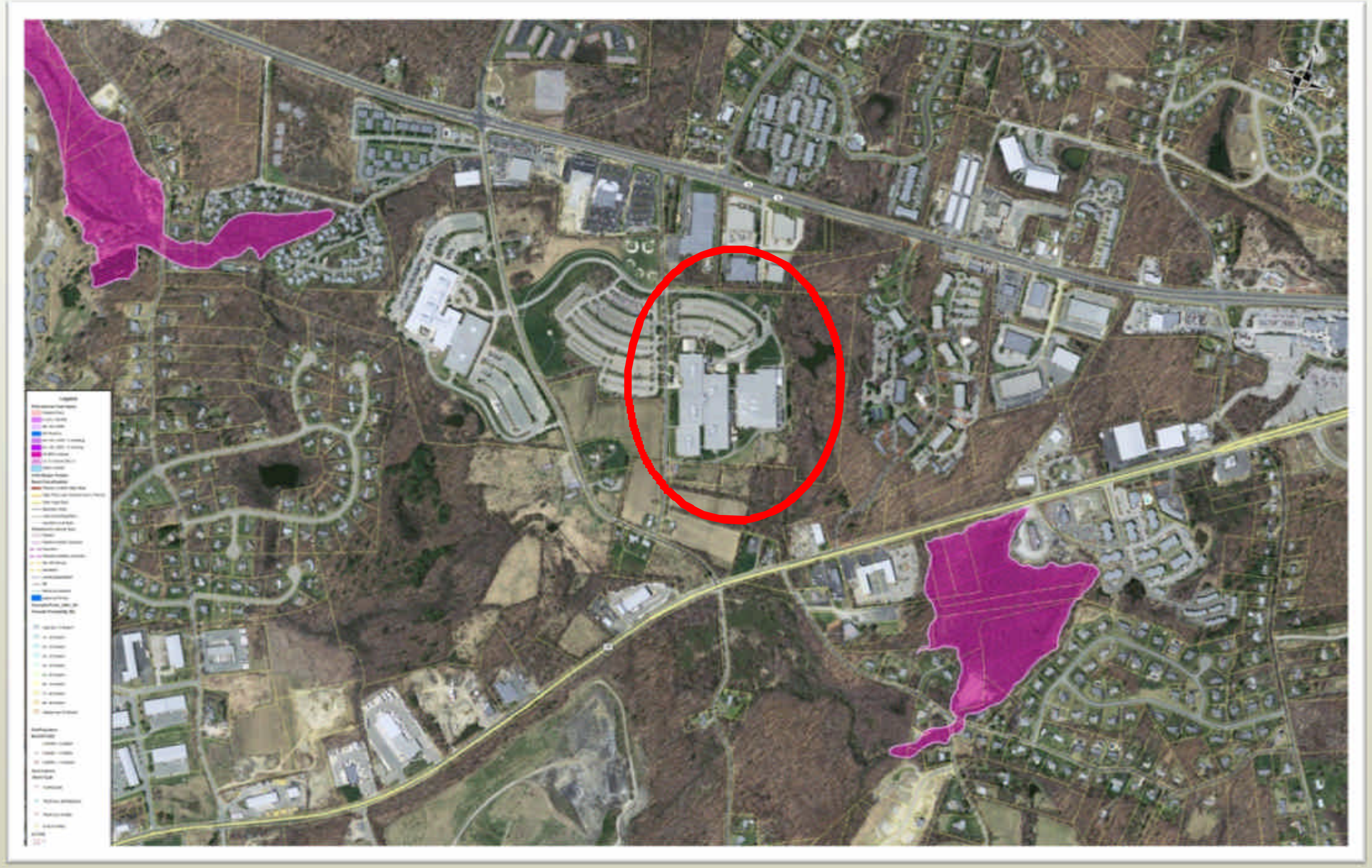
- Average of 6 tornadoes per year touch down in New England
- No tornadoes in Suffolk County since 1951
- In Worcester County, a number of F1 tornadoes have occurred. There have been 4 F3 tornados (or higher)
- State Hazard Mitigation plan indicates that greatest risk in MA for a tornado is from central to northeastern MA



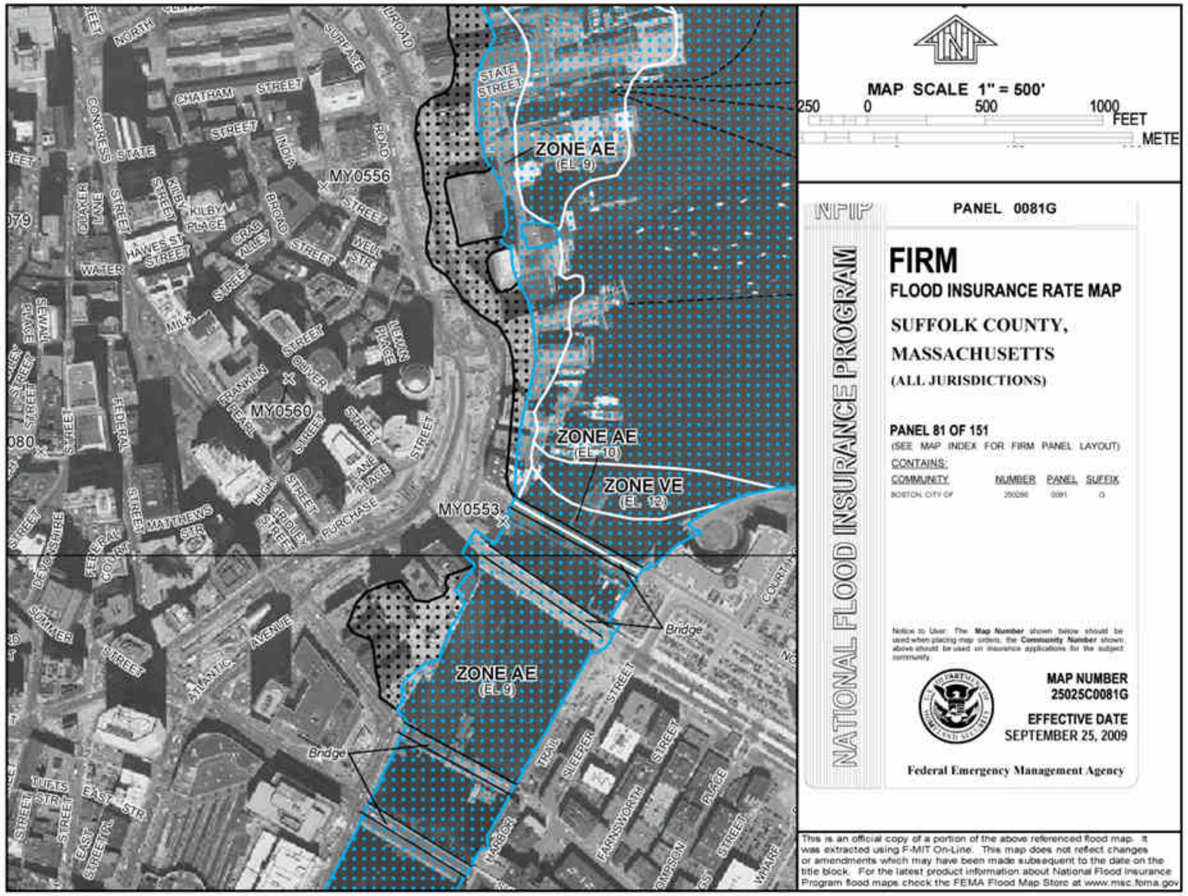


Source: http://www.tornadohistoryproject.com/

System Office Flood Map

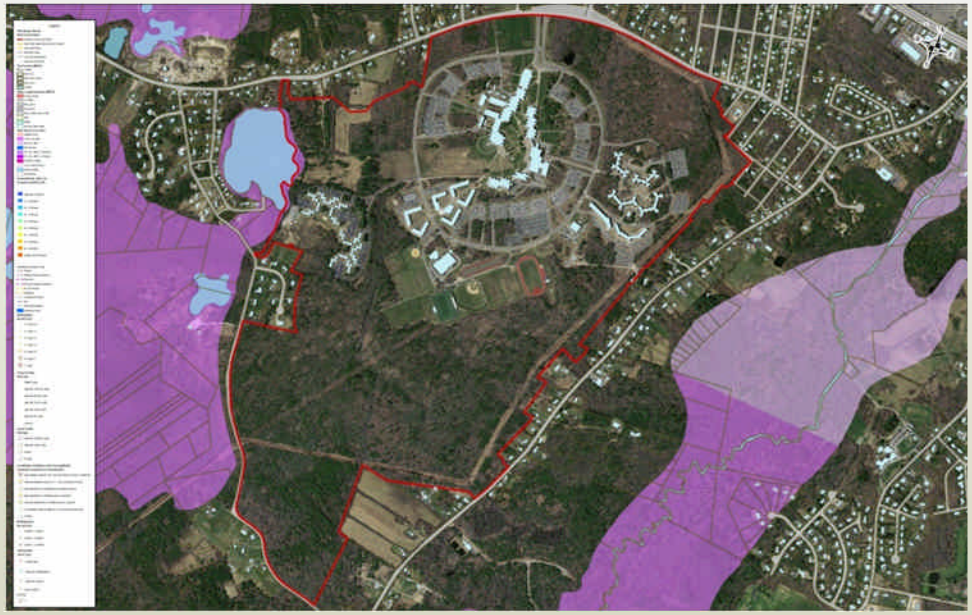


Boston Office FIRM Map



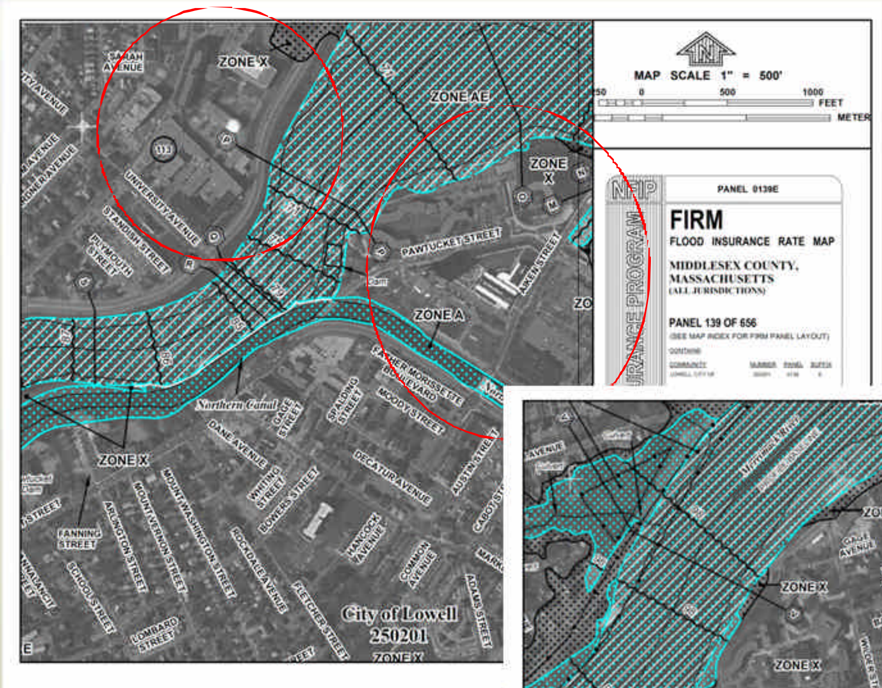
UMass Dartmouth *(Main Campus)* Flood Map

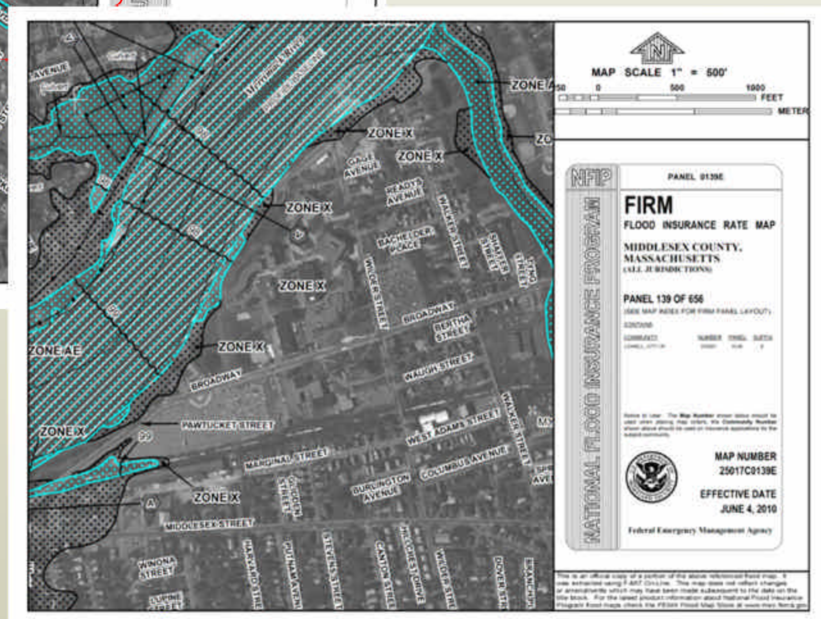
- Town of Dartmouth historically experiences flooding in a number of areas multiple times a year, with flooding limited to a localized area or widespread depending on the cause.
- Southeastern MA particularly vulnerable to storm surge due to Buzzards Bay



Source: State Hazard Mitigation Plan – 2010, Town of Dartmouth Hazard Mitigation Plan - 2013

UMass Lowell Flood Maps

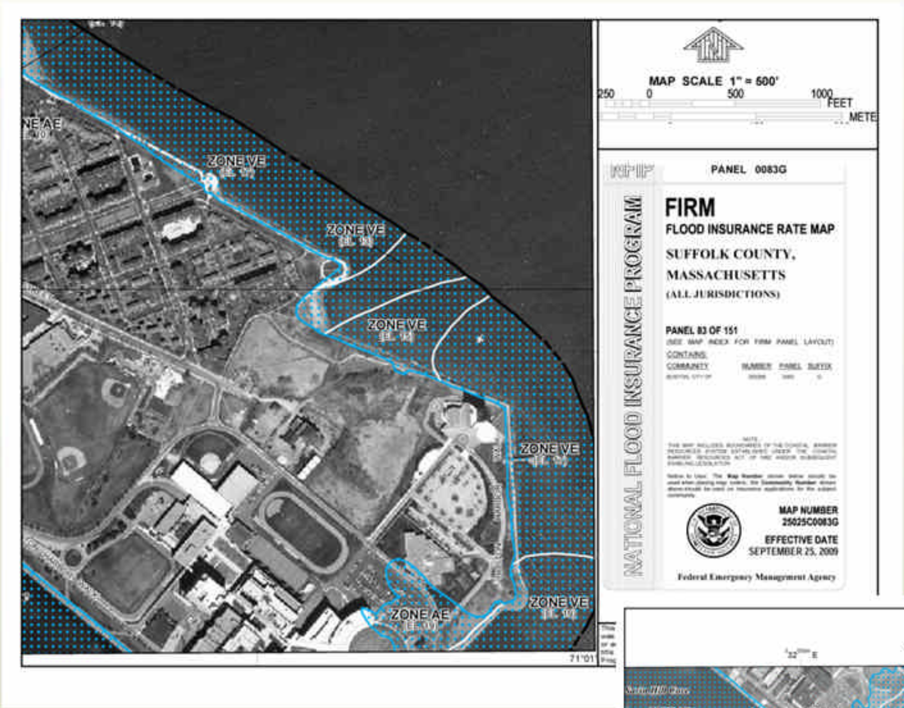


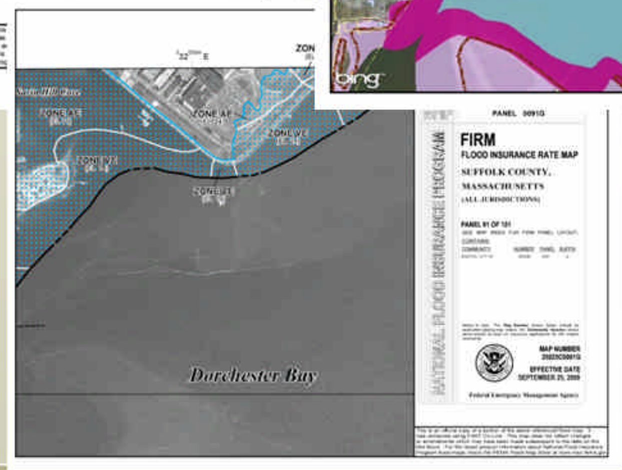


UMass Lowell Flood Zones

- State Hazard Mitigation Plan – “Most common hazard to affect New England”
- 53 flood events reported in Middlesex County between 1950 – 2010 (NCDC data)
- 2006 flood – Merrimack River rose and caused widespread damage, prompting Lowell to install modern flood gate control

UMass Boston – Flood Maps





Other Natural Hazards

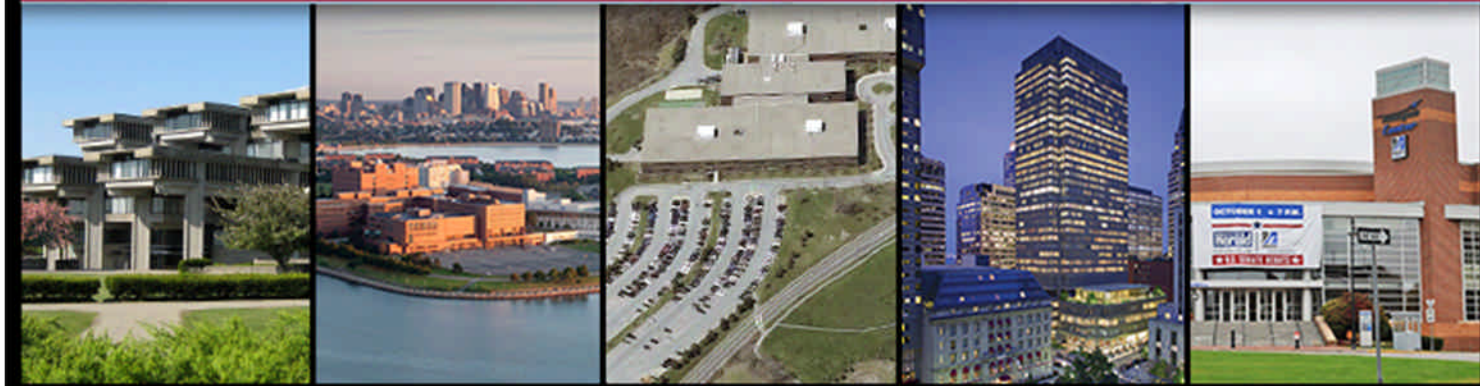
- **Winter/Ice Storms**
  - Entire state is at risk
  - There have been about 40 ice storm events in the last 40 yrs.
  - Central Massachusetts - winter storms and related hazards (power outages, flooding) have a high frequency in the region though impacts are generally minor
- **Flooding**
  - Central Massachusetts is at moderate risk for flood threats

Hazard Mitigation Plan Contents

- Executive Summary
  - Purpose, Process, Major Recommendations
- Goals and Objectives
- Hazard Identification and Risk Assessment
  - Hazard Background, Asset Inventory, Loss Estimation
- Mitigation Strategy
  - Identification of Mitigation Actions, Prioritization of Actions and Methodology, Timeline
- Implementation and Plan Maintenance
  - Responsibilities, Integration with Other Plans, Schedule

University of Massachusetts

MULTI-CAMPUS HAZARD MITIGATION PLAN



Thank You for Attending!

COMMITMENT & INTEGRITY DRIVE RESULTS

APPENDIX F: PUBLIC MEETING NO. 2 – MEETING MATERIALS

APPENDIX G: PLAN APPROVAL LETTER