STATE OF CONNECTICUT
DEPARTMENT OF ENVIRONMENTAL PROTECTION
79 Elm Street, Hartford, CT 06106-5127

Gina McCarthy, Commissioner

# NATURAL HAZARDS MITIGATION PLAN

## *For 2007 – 2010*

Photograph taken by DEP staff, September 19, 1999 at the Jenson's Trailer Park, Still River, Danbury CT.

Prepared by:
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Inland Water Resources Division
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With Assistance From:
FEMA and
The Connecticut Department of Emergency Management and Homeland Security

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# EXECUTIVE SUMMARY

Connecticut's Standard Natural Hazards Mitigation Plan (NHMP) has been updated in response to the requirements of the Disaster Mitigation Act of 2000 (DMA 2000), and FEMA's November 2006 *Multi-Hazard Mitigation Planning Guidance*. The Connecticut Department of Environmental Protection (DEP) prepared the 2007 Plan Update with assistance by the Connecticut Department of Emergency Management and Homeland Security (DEMHS). An external review group, consisting of members from the Connecticut Interagency Hazard Mitigation Committee (CIHMC), reviewed the Plan. Funding for this Plan was provided through the FFY 2007 CAP-SSSE Cooperative Agreement. The areas of focus for the updated 2007 Plan include:

- Update the existing Plan to the standards contained within Section 322 of DMA 2000 for a standard state mitigation plan;
- Identify those areas affected by the October 2005 flood event;
- Incorporate FEMA's newest grant programs into the Plan; and
- Incorporate the new Connecticut Floodplain Management Act (CFMA) into the Plan;
- Incorporation of a discussion on potential impacts due to climate change with regards to natural hazard mitigation;
- Inclusion of potential dam failures as an additional natural hazard; and
- Reassessment of the goals and objectives presented in the 2004 Plan.

The main premise of natural hazards mitigation is the prevention of loss of life, the reduction of damages associated with natural disasters, and the restoration of public services after each disaster. As a means to achieving effective hazard mitigation, states and local communities need to use the planning process and develop effective plans. Connecticut's efforts in updating its 2007 NHMP include:

- An assessment of all natural hazards that affect Connecticut including the frequencies, magnitudes, and distribution of these hazards;
- A risk assessment of Connecticut's vulnerability to natural hazards as addressed through potential loss of life and surveys of critical facilities in areas subject to these hazards;
- The integration of climate impact as it relates to the assessment and analysis of natural hazards that could potentially affect the State;
- An outline of Connecticut's governmental organization before, during, and after a natural disaster. The outline presents the roles of each major state agency or DEP division in planning and responding to these hazards; and
- A summary of the most successful projects undertaken within the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance Program (FMA), and the Pre-Disaster Mitigation Program (PDM) to serve as examples for other communities.

Connecticut is a relatively small state with a strong home rule tradition. There are 169 municipalities in 8 counties in Connecticut. County government is very limited in its authority and capacity. The individual

municipalities function in much the same way as counties do in states with strong county government and limited local authority. The State of Connecticut, in cooperation with several regional planning organizations, is working towards having all its municipalities covered by a local natural hazard mitigation plan. These plans are required prior to the receipt of any available FEMA grant funds. To date, the planning effort has achieved a rate of 75% of Connecticut's communities adopting or soon to adopt and be covered by a local hazard mitigation plan.

A review of FEMA approved local hazard mitigation plans indicate that natural hazard concerns are very similar throughout many geographic areas of Connecticut. From highest level of threat to lowest, the following is a list of natural hazards that almost all local plans focused upon:

- Flooding
- High wind events (includes hurricanes, severe thunderstorms, tornadoes, etc.)
- Winter storms/events (includes ices storms, ice jams, nor'easters, etc.)
- Drought
- Forest fires
- Earthquakes
- Tsunamis

This plan update has provided Connecticut with an opportunity to build more effective interagency communication between its may agencies who affect natural hazard planning and mitigation, and to identify enhancements in current hazard mitigation planning that will help move the State to a better defined place in hazard mitigation planning. In addition, this update provided an opportunity to explore climate impact and its relation to natural hazards mitigation planning as a whole. This analysis of climate impact on hazard mitigation planning has recently become an important focus for CTDEP and will remain a primary focus in future plan updates.

Connecticut's climate is changing. Over the next 50 - 100 years, we can expect significant climate change impacts on Connecticut's coastal communities, forests, fisheries, agriculture, human health, and natural disasters. These impacts include increased annual temperatures, rising sea level, increased sea surface temperatures, more intense storms, and changes in precipitation patterns. Climate change will impact the occurrence and intensity of natural disasters, leading to additional hazards and significant economic losses. For example, the frequency of heavy rainfall events is increasing across the Northeast and scientists expect extreme precipitation to continue to increase due to climate change. The Northeast suffered an estimated $130 million in property damage from several intense storms in the fall of 2005 and spring 2006. Connecticut's coast has almost $405 billion of insured coastal exposure. The 6th highest insured state in the country. Coastal homes, roads, and infrastructure are at increased risk as sea level rises and storms become more intense. Scientists, insurers, investors, planners, designers, and policy makers must respond to the significant consequences of climate impacts on human health, coastal infrastructure, ecosystems, agriculture, and the economy.

Recognizing the global, regional, and local implications of climate change, Connecticut and New England have shown great leadership in addressing mitigation through the reduction of greenhouse gases. In 2001, the New England Governors/Eastern Canadian Premiers signed a regional Climate Change Action Plan and committed to reduce greenhouse gas emissions in the region to 1990 levels by 2010, 10% below that by 2020, and 75-85% by 2050. In 2004, the Connecticut General Assembly adopted these regional goals for Connecticut and the Connecticut Climate Change Action Plan (CCAP) was completed and submitted to the Connecticut legislature in 2005

The State of Connecticut is committed to reducing future damage from natural disasters through mitigation. The mission of Connecticut's Natural Hazards Mitigation Program and this associated Plan is to mitigate the effects of natural hazards by minimizing loss of life and property damage. Chapter 5 of this plan lays out the State's existing goals and objectives that relate to hazard mitigation. The State of Connecticut has developed these goals and their associated strategies potential activities based upon the following:

1. Hazard vulnerability and risk assessments contained in this plan;
2. Evaluation of current state and federal regulations; and
3. State and federal funding sources available to conduct natural hazard mitigation measures in Connecticut.

It is anticipated that by working towards achieving the goals set out in this Plan, effective natural hazards mitigation measures will be implemented to protect all residents of the State, and will promote the responsible natural hazard mitigation throughout Connecticut both on a state and local level.

The implementation of effective hazard mitigation requires on-going planning and dedicated persistence both on a state and local level to maintain what has been done in the past and to improve upon past efforts to strive for implementing the most protection possible from natural hazards.

The related strategies and activities presented in this Plan provide a guide to assist the State in working towards achieving these goals that will be implemented or initiated during the time period encompassing this NHMP Update. The goals themselves are achievable, yet they require adequate resources such as financial and staff resources to achieve significant results. The State of Connecticut believes in the importance of natural hazards mitigation planning and implementation of hazard mitigation activities both on a state and local level in order to reduce/eliminate lives lost and property damaged suffered by natural hazards.

# ABBREVIATIONS USED IN THIS PLAN

| Acronym | Definition |
|---|---|
| ALERT | Connecticut Automated Flood Warning System |
| ASWP | Alternative State Warning Point |
| ATMS | Advanced Traffic Management System |
| BFE | Base Flood Elevation |
| BOCA | Building Officials and Code Administration |
| C.G.S. | Connecticut General Statute |
| CAP | Community Assistance Program |
| CAV | Community Assistance Visit |
| CCMA | Connecticut Coastal Management Act |
| CEO | Council of Elected Officials |
| CFMA | Connecticut Floodplain Management Act |
| CFR | Code of Federal Register |
| CIHMC | Connecticut Interagency Hazard Mitigation Committee |
| CMAG | Connecticut Mitigation Assistance Grant |
| COG | Council of Governments |
| COLLECT | Connecticut On-Line Law Enforcement Telecommunications |
| CRREL | U.S. Army Cold Regions Research & Engineering Laboratory |
| CRVFCC | Connecticut River Valley Flood Control Compact |
| CSO | Coastal State Organization |
| CT PHERP | Connecticut Public Health Emergency Response Plan |
| DEMHS | Connecticut Department of Emergency Management and Homeland Security |
| DEP | Connecticut Department of Environmental Protection |
| DMA 2000 | Disaster Mitigation Act |
| DOE | Connecticut Department of Education |
| DOH | Connecticut Department of Housing |
| DOT | Connecticut Department of Transportation |
| DPH | Connecticut Department of Public Health |
| EAS | Emergency Alert System |
| EMPG | Emergency Management Performance Grant Program |
| EOC | State Emergency Operations Center |
| EWP | Emergency Watershed Protection |
| FECB | Flood and Erosion Control Board |
| FEMA | Federal Emergency Management Agency |
| FHMO | FEMA Natural Hazard Mitigation Officer |
| FIRM | Flood Insurance Rate Map |
| FMA | Flood Mitigation Assistance |
| FMP | Flood Management Program |
| FPMS | Floodplain Management Studies |
| GIS | Geographic Information System |
| GPS | Global Positioning System |
| HMGP | Hazard Mitigation Grant Program |
| HMGRC | Hazard Mitigation Grant Review Committee |
| IA | Individual Assistance |
| IBC | 2003 International Building Code |
| IHMST | Interagency Hazard Mitigation Survey Team |

| | |
|---|---|
| IOOS | Integrated Ocean Observing System |
| IPCC | United Nations Intergovernmental Panel on Climate Change |
| IRC | 2003 International Residential Code |
| IWRD | Inland Water Resources Division |
| LISICOS | Long Island Sound Integrated Coastal Observing System |
| MACOORA | Mid-Atlantic Coastal Ocean Observing Regional Association |
| MHFMMM | Multi-Hazard Flood Map Modernization Management Program |
| MIP | Management Information Portal |
| MOU | Memorandum of Understanding |
| NAWAS | National Warning System |
| NECIA | Northeast Climate Impacts Assessment group |
| NFIA | National Flood Insurance Act |
| NFIP | National Flood Insurance Program |
| NFIRS | National Fire Incident Reporting System |
| NGVD | National Geodetic Vertical Datum of 1929 |
| NHMP | Natural Hazards Mitigation Plan |
| NOAA | National Oceanic & Atmospheric Administration |
| NRCS | National Resources Conservation Service |
| NU | Northeast Utilities |
| NWRAH | NOAA Weather Radio All Hazards |
| OCP | Office of Civil Preparedness |
| OEM | Office of Emergency Management, now CTDEMHS |
| OIM | Connecticut DEP's Office of Information Management |
| OLISP | Office of Long Island Sound Program |
| OPM | Connecticut Office of Policy and Management |
| OSBI | Connecticut Office of the State Building Inspector |
| PA | Public Assistance |
| PDM | Pre-Disaster Mitigation Program |
| PSWP | Primary State Warning Point |
| REP | Radiological Emergency Preparedness Program |
| RFC | Repetitive Flood Claims Grant Program |
| RPA | Regional Planning Agencies |
| RPO | Regional Planning Organization |
| SBA | Small Business Administration |
| SCEL | Stream Channel Encroachment Line |
| SHMO | State Hazard Mitigation Officer |
| SHSGP | State Homeland Security Grant Program |
| SIMS | Site Information Management System |
| SLR | Sea level rise |
| SLOSH | Sea, Lake and Overland Surges from Hurricanes |
| SPOC | Single Point of Contact |
| TRVFCC | Thames River Valley Flood Control Compact |
| USACE | U.S. Army Corps of Engineers |
| USDA | U.S. Department of Agriculture |
| USDHS | U.S. Department of Homeland Security |
| USGS | U.S. Geological Survey |

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Appendix B – Natural Hazards Maps Of Critical Facilities For Every Connecticut Municipality (Copies Available Upon Request Only)

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Appendix D - List of High Hazard Dams in Connecticut (Copies Available Upon Request Only)

Appendix E - Past FEMA Grant Program Funding and Natural Hazard Mitigation Projects Completed

# Appendix A –

# Hurricane and Earthquake Simulation Results (HAZUS Reports)

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# Natural Hazards Maps Of Critical Facilities For Every Connecticut Municipality

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# Appendix D –

# List of High Hazard Dams in Connecticut

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# Appendix E –

# Past FEMA Grant Program Funding and Natural Hazard Mitigation Projects Completed

# CHAPTER 1

## INTRODUCTION

## 1.0 INTRODUCTION

Connecticut's Standard Natural Hazards Mitigation Plan (NHMP) has been updated in response to the requirements of the Disaster Mitigation Act of 2000 (DMA 2000), and FEMA's November 2006 *Multi-Hazard Mitigation Planning Guidance*. The Connecticut Department of Environmental Protection (DEP) prepared this 2007 Plan Update with assistance by the Connecticut Department of Emergency Management and Homeland Security (DEMHS). An external review group, consisting of members from the Connecticut Interagency Hazard Mitigation Committee (CIHMC), reviewed the Plan. Funding for this Plan was provided through the FFY 2007 CAP-SSSE Cooperative Agreement. The areas of focus for the updated 2007 Plan are:

- Update the existing Plan to the standards contained within Section 322 of DMA 2000 for a standard state mitigation plan;
- Identify those areas affected by the October 2005 flood event;
- Incorporate FEMA's newest grant programs into the Plan; and
- Incorporate the new Connecticut Floodplain Management Act (CFMA) into the Plan;
- Incorporation of a discussion on potential impacts due to climate change with regards to natural hazard mitigation;
- Inclusion of potential dam failures as an additional natural hazard; and
- Reassessment of the goals and objectives presented in the 2004 Plan.

## 1.1 PURPOSE

This standard State NHMP has been prepared to fulfill the requirements of DMA 2000, and to minimize the effects of long and short term inland and coastal flooding, high winds, tornadoes and other natural and man-made hazards and to reduce the need for federal assistance.

## 1.2 SCOPE

This plan addresses hazards mitigation implementation for the entire State, and is structured in accordance with post-disaster planning requirements as stated in Section 322 for a standard state plan.

## 1.3 FEDERAL AUTHORITIES

The State of Connecticut is in compliance with FEMA Regulations - 44 Code of Federal Register (CFR), Part 206, Subpart N (P.L. 100-107, the Robert T. Stafford Disaster Relief and Emergency Assistance Act dated 1994.), the Disaster Mitigation Act of 2000, Section 322, and other related Federal authorities including:

- FEMA regulations - 44 CFR, Part 13, Uniform Administrative Requirements of Grants and Cooperative Agreements to State and Local Governments.
- FEMA regulations - 44 CFR, Part 14.
- Executive Order 12612, Federalism.
- Executive Order 11990, Protection of Wetlands.
- Executive Order 11988, Floodplain Management.
- 44 CFR, Part 201.4 (c) (7) § 13.11 (c) and § 13.11 (d).

The State of Connecticut will continue to comply with all applicable Federal statutes and regulations during periods for which it receives grant funding, in compliance with 44 CFR 13.11(c), and will amend it plan whenever necessary to reflect changes in the State or Federal laws and statutes as required in 44 CFR 13.11(d).

## 1.4 STATE AUTHORITIES

DEP has been granted authority under Connecticut General Statutes (C.G.S.) Title 28, Chapter 517, C.G.S., Title 4, Chapter 24, Section 4-28a Management of State Agencies, State Properties and, Advisory Commissions to perform its regulatory duties.

## 1.5 SECTIONS OF THE STATE NHMP

The main premise of natural hazards mitigation is the prevention of loss of life, the reduction of damages associated with natural disasters, and the restoration of public services after each disaster. As a means to achieving effective hazards mitigation, states and local communities need to use the planning process and develop effective plans. Connecticut's efforts in updating its 2007 NHMP include:

1. An assessment of all natural hazards that affect Connecticut including the frequencies, magnitudes, and distribution of these hazards;
2. A risk assessment of Connecticut's vulnerability to natural hazards as addressed through potential loss of life and surveys of critical facilities in areas subject to these hazards;
3. An outline of Connecticut's governmental organization before, during, and after a natural disaster. The outline presents the roles of each major state agency or DEP division in planning and responding to these hazards;
4. An overview of the legal framework and legislative history of hazards mitigation in Connecticut; and
5. A discussion of the State's natural hazard mitigation goals, objectives and proposed activities required to achieve said goals and objectives. In addition, a discussion of the updated criteria utilized by DEP in its project review and selection process is presented.

## 1.6 THE PLANNING PROCESS

### 1.6.1 History

Connecticut's first formal Natural Hazards Mitigation Plan (Section 406 Plan) was adopted on August 17, 1983 as a result of a major flooding event and disaster declaration (FEMA-661-DP) that occurred on June 6, 1982. The 406 Plan was prepared by the DEP in cooperation with the Natural Resources Conservation Service (NRCS, then called the Soil Conservation Service), U.S. Army Corps of Engineers (USACE), Connecticut Department of Transportation (DOT), U.S. Environmental Protection Agency (USEPA), National Weather Service (NWS), Connecticut Department of Economic Development (DED), the Connecticut Department of Emergency Management and Homeland Security (DEMHS, then called the Connecticut Office of Civil Preparedness) and the Federal Emergency Management Agency (FEMA).

Local municipalities also participated in the planning process including the towns of Wallingford, Waterford, Guilford, Orange, Woodbury and Essex, and the cities of Milford, Waterbury, Shelton, Danbury, Ansonia and New Haven.

Several major recommendations of the first plan included updating local and state emergency operations plans, establishing an automated flood warning system, the expanding the Dam Safety

Section of the DEP, setting new standards for road and bridge culvert design, and pursuing several legislative initiatives that enhanced Connecticut's ability to regulate its floodplains.

The 406 Plan was updated in 1985 in response to a smaller flooding event that also resulted in a Federal disaster declaration.

The next major disaster to require an update to the plan occurred on July 10, 1989 (FEMA 837-DR-CT) as a powerful tornado caused extensive damage and two deaths in western Connecticut. Pursuant to the newly adopted Stafford Act (44 CFR Section 409) Connecticut convened an Interagency Hazards Mitigation Survey Team (IHMST) that prepared the 15-day report in August 1989. The IHMST members consisted of DEP, NWS, NRCS, and FEMA.

The updated Connecticut 406 Plan (re-numbered to a 409 Plan) was completed in 1990 and contained several major recommendations including the expansion of the automated flood warning system, the installation of National Oceanic and Atmospheric Administration (NOAA) weather radios in schools, police and fire departments and state parks, and continued development of the floodplain management program in Connecticut.

The 409 Plan was updated in 1992 as a result of Hurricane Bob (FEMA-916-DR-CT) that struck Connecticut and New England on August 19, 1991. Hurricane Bob caused severe coastal flooding in southeast Massachusetts and significant tree damage in Connecticut. FEMA organized a Regional Interagency Hazards Mitigation Team (IHMT) meeting at New Seabury, MA, on September 24 – 26, 1991 to write a regional IHMT report in response to the hurricane.

The regional IHMT report focused on 5 major recommendations: 1) gaining lead time and managing disaster response; 2) protecting key infrastructure during disasters; 3) reducing damage to boats and harbors; 4) building smarter; and, 5) managing vulnerable resources more effectively. Connecticut integrated several recommendations of the regional IHMT report including: a further expansion of the automated flood warning system, of which its primary intent was providing increased lead-time for responders; and, a memorandum of understanding with the NWS which formalized the relaying of watches and warnings in Connecticut. Other recommendations included acquiring of land for recreational purposes, increasing information and education.

Connecticut updated the 409 Plan in 1993 as a result of Winter Storm Beth (FEMA-972-DR-CT), which occurred on December 10 – 13, 1992. Connecticut convened the IHMT and prepared the 15-day report on December 24, 1992.

The next Federally declared natural disaster to strike Connecticut occurred on September 15, 1999 when Tropical Storm Floyd caused severe riverine flooding (FEMA-1302-DR-CT) in Danbury, Connecticut.

The IHMT report for Tropical Storm Floyd was completed on September 30, 1999 and contained several recommendations including: updating the Flood Insurance Rate Maps (FIRM) for Danbury; ensuring that insurance agents recommend flood insurance for persons living within the 100-year floodplain; and, installing an automated flood warning system along the Still River in Danbury.

### 1.6.2 Creation of the State Hazards Mitigation Grant Review Committee (HMGRC)

In response to the tornado and the subsequent Federal disaster declaration of July 1989, the State of Connecticut formed the Hazards Mitigation Grant Review Committee (HMGRC). The purpose and

goal of the HMGRC was to oversee the new post-disaster Hazards Mitigation Grant Program (HMGP) that became law with the passage of the Stafford Act in 1988.

The HMGRC consisted of representatives of the DEP, NWS, Connecticut Department of Education (DOE), Connecticut Office of Emergency Management (OEM, currently CTDEMHS), Connecticut Office of Policy and Management (OPM), NRCS, Small Business Administration (SBA), and FEMA.

The HMGRC met quarterly beginning in August, 1989 to select and approve hazards mitigation applications for submission to FEMA. The HMGRC also assisted in the drafting of the 409 Plan update. HMGRC member agencies were each given a draft copy of the plan and asked to review those sections of the plan that involved their agency. Since 1989, the composition of the HMGRC has expanded to include the representation of additional state agencies. The DOT and the Connecticut Department of the Military joined the HMGRC in the late 1990's. A private group, the Hartford Financial Services Group (Hartford Group) also joined the HMGRC to give private companies representation on the Committee.

During the 1990's the HMGRC met quarterly after each disaster and met annually in non-disaster years to review hazards mitigation project applications. The HMGRC began reviewing and approving applications for the newly developed Flood Mitigation Assistance (FMA) grant program in 1998.

### 1.6.3 Formation of the Connecticut Interagency Hazards Mitigation Committee

The HMGRC was renamed to the Connecticut Interagency Hazards Mitigation Committee (CIHMC) in 1998. The CIHMC meets annually to review and rank FMA and Pre-Disaster Mitigation (PDM) Grant applications and vote to forward approved projects to FEMA for funding consideration. The CIHMC has also been integral in providing input and updating this Natural Hazards Mitigation Plan update

## 1.7 UPDATING THE STANDARD SECTION 322 PLAN

### 1.7.1 History of the Original NHMP

Connecticut began work to update the 409 Plan to the new Disaster Mitigation Act of 2000, Section 322 requirements in 2001.

The first step in the review process was the distribution of the older 409 Plan to the members of the CIHMC. In 2002, the members of the CIHMC included the DEP, NWS, DOE, DEMHS, OPM, NRCS, DOT, State Military Department, and the Hartford Financial Services Group met to discuss and redraft the Plan. Each member agency reviewed their role and responsibility in the Plan and provided updated information as to their agencies' programs relating to hazards mitigation. In addition, the Hartford Group also reviewed the plan and made recommendations as to the Plan's overall integration with the private sector.

The CIHMC recommended that several new sections be added to the Plan to meet the new planning requirements. These sections included:

1. Mapping of public and private critical facilities. (Task completed, a copy of the natural hazard maps with local municipal and private critical facilities can be found in Appendix B);

2. Inventorying high hazards dams and conversion of the State's dam safety database from paper hard copies to a digital database. (Task completed, a copy of the inventory of high hazards dams can be found in Appendix D);
3. Integrating local risk assessments from FEMA approved local Natural Hazards Mitigation Plans into the NHMP;
4. Creating a cost avoidance section that shows actual damages prevented by Connecticut's mitigation actions;
5. Reviewing the grant approval and management procedures in Connecticut. (Review currently being performed); and
6. Integrating Connecticut's flood management regulations (i.e. non-intensive use of the floodplain) into the NHMP. (Beginning in 2004 DEP began to evaluate the types of potential mitigation projects it has received to promote more non-intensive floodplain use projects.).

Funding for required NHMP activities was received from FEMA in 2002 for three plan related projects:

1. Development of the Plan itself (e.g., editing, printing, distribution etc.);
2. Mapping of Critical Facilities; and
3. Creation of an electronic inventory of High Hazards Dams within the State.

Work on the NHMP began in 2002 by DEP full-time staff with the assistance of seasonal staff. The first draft of the Plan was completed in September 2003 and CIHMC members provided input during the planning process. A copy of the critical facilities maps was distributed to FEMA for review and comments.

The members of the CIHMC provided information for the plan, and as a result, several sections were updated to reflect the updated information. Chapter 3 of this Plan provides an encapsulated overview of the supportive roles of many state agencies and/ DEP Divisions in hazards mitigation. The State Administrative Plan currently provides a more in-depth description of the roles of state agencies and local communities.

### 1.7.2 Planning Process for the 2007 NHMP Update

The NHMP update planning process began in January 2007. The planning process consisted of the development of a planning team and an external plan review group. The planning team - which consisted of a Program Specialist from DEMHS, and from DEP: an Environmental Analyst, State NFIP Coordinator, and the Supervising Civil Engineer of the Flood Management Section - was responsible for drafting the Plan update, providing support for the various related planning tasks, and providing guidance for the Plan's focus. The team met every 2 weeks during the planning time period of February through June. During these meetings the team reviewed the existing plan on a per chapter basis, discussed various data issues related to the plan and the current planning process, and made recommended changes to the plan. These changes along with updated information from various state or federal agencies and DEP divisions were incorporated into this plan update. Individual team members provided feedback on changes and revisions to the existing plan. The planning team was asked various questions during the planning process for this plan update. Examples of questions the members were asked and provided input for include:

- What has changed within the State in term of natural hazards or mitigation of natural hazards?
- Is the current data provided within the existing plan and utilized to develop the existing plan still viable for planning purposes for this planning period?
- Are the stated goals and objectives stated in the existing plan still relative to achieving the State's mission for natural hazards mitigation?
- Is the data that was gathered during the past three years appropriate? Should different data be gathered or more data be gathered in the next three years.
- What new data exists that can be beneficial to the plan update and can be incorporated into said plan update?
- What resources are currently available to perform the necessary planning activities required to generate the information needed for the plan update?
- What resources will be available in during the next three years to perform planning activities and data analysis required by the updated plan?
- How successful was the State in implementing hazard mitigation projects in the past three years?
- Has the flood of October 05 changed the State's thoughts or responses regarding hazard mitigation?

The external plan review group consisted of participating members of the CIHMC (please see previous sections for a description of agencies represented). This external plan review group was convened in May 2007 and provided input and comments to the plan and the planning process as it related to each members individual's agency.

In addition, coordinated efforts were employed with various divisions within DEP and other state and federal agencies that are currently not part of the CIHMC throughout the planning process to obtain input and updated information for the NHMP. All divisions and agencies listed in this plan (see Chapter 3) were contacted and sent pertinent chapters of this plan for review, comment and revision. A 100% response was received from all the divisions/agencies presented in this plan. This allowed for the most accurate information to be utilized and presented in this plan with regard to various presented programs related to hazard mitigation. The following is a list of agencies/divisions that were contacted in a coordinated effort to update pertinent data and information for the NHMP update:

State Agencies:

- Office of Policy & Management
- Department of Emergency Management & Homeland Security
- State Bldg. Insp. Office
- Department of Transportation
- Department of Public Works
- Department of Public Health
- DEP Divisions:
  - OLISP
  - Solid Waste
  - Forestry
  - Air Quality – Climate Impact Group
  - Office of Information Management
  - Inland Water Resources Division:
    - Elizabeth Napier (IWRD – State Drought Plan)
    - Dam Safety
    - Engineering Analysis and Engineering Services Sections (SCEL program and Flood Management Certification program)

Federal Agencies/Outside Entities:

- National Resources and Conservation Services
- US Army Corp of Engineers
- National Weather Service
- Northeast Utilities

Information from local risk analyses, was also incorporated into the plan and the planning process where such information was readily accessible in a usable format.

The planning process for this update worked well given the limited timeframe provided by FEMA due to its late distribution of the plan update guidance document. CT DEP received guidance for the plan updating process from FEMA in late January 2007. This late distribution of the planning guidance to the State allowed for a very limited time period to perform the primary planning activities necessary for the plan update. It would be beneficial for future plan updates to receive the necessary and vital planning guidance much earlier in the process to allow for adequate time in performing all planning activities and incorporating all additional FEMA instituted requirements into the state plan within the existing 3-year plan implementation, evaluation and update time period.

However, this plan update did benefit greatly from the increased communication and planning efforts between CTDEP and CTDEMHS that resulted as an outcome of the implemented planning process. This open line of communication and planning effort helped to form the basis of this plan and direct attention towards the needs of the next plan update. It is intended that the communication efforts formed for this plan update will continue into the future for work in the area of hazard mitigation efforts and will expand to include other state agency stakeholders.

### 1.7.3 Future Development of a Hazards Mitigation External Planning Group (HMEPG)

It is the intent of DEP to expand the participation of the external plan review group for future plan updates to include additional stakeholders involved in hazards mitigation. This will be done by soliciting participation from outside groups such as regional planning organizations, planners from various state agencies, continued participation of CIHMC members, Native American tribes, and other representative organizations affected by hazards mitigation. DEP has begun the initial steps on this activity by gathering potential contacts to participate in the group.

Correspondence of both the planning team and the external plan review group and various contributors to the Plan included the use of electronic communications to allow for all participants to be kept up-to-date on NHMP plan activities.

In addition, meetings were held on an as-needed basis for the external plan review group to discuss the plan in process and issues that pertain to natural hazards mitigation planning.

It is the hope that the on-going efforts for the further development of both the planning team and the HMEPG will provide for an improved comprehensive look at hazards mitigation, develop working partnerships between various stakeholders, and increase the amount of hazards mitigation efforts implemented with the State of Connecticut.

### 1.7.4 Future Plan Updates

The State Hazards Mitigation Officer (SHMO) is responsible for ensuring that the NHMP is updated every three years. He/she will work with the members of the planning team and the external plan review group to update the plan.

The status of all state and local implementation measures will be updated every three years. Each implementation measure will be assessed for four elements:

1. Did the measure receive federal or state funding as a project application in the past three years?

2. Was the measure successfully completed?

3. What was the total cost of potential damages the project prevented from occurring in the event that a repeat storm event occurred in the project area? Did the project mitigate the damage it was expected to prevent? and,

4. Did the measure or project foster further cooperation between state and local agencies?

Based on the information collected from an assessment of the above four elements for a measure, DEP will reevaluate the evaluation criteria used to select proposed measures. The criteria may be adjusted, amended, or refined along with the strategies and goals of the Plan to reflect a refinement of the overall state mitigation strategy.

If a presidential disaster declaration leads to the updating of the Plan, data from the storm event will be used to update the vulnerability and risk assessments of the State and affected local plans. The capability assessment will be reviewed and updated. Agency responsibilities will be reviewed and any new legislation or agency reorganizations will be integrated into the Plan. The updated Plan will then be adopted and transmitted to FEMA.

## 1.8 LOCAL PLANNING COORDINATION

In response to the planning requirements of the Disaster Mitigation Act of 2000 (DMA 2000) and the PDM grant program, the State of Connecticut undertook a local planning effort to ensure that local and regional natural hazards mitigation plans would be initiated.

Connecticut began assisting communities in the drafting of local Natural Hazards Mitigation Plans in 1997 utilizing FMA planning grant funds. The town of Westport was the first community to complete a local natural hazards mitigation plan in 1998. Due to limited FMA funding for planning activities, only one community each year may be targeted to develop a plan under this grant program.

DEP realized that the development of one community plan per year would not be an effective approach if the continued goal is to have a plan for every Connecticut community. DEP's current approach is to work with Regional Planning Organizations (RPOs) to prepare regional natural hazards mitigation plans. DEP will also continue to work with an individual community if requested.

When PDM planning funds are made available by the federal government, the State solicits grant applications from both RPOs and municipalities. The applications are evaluated and ranked by the CIHMC. A list of physical hazard mitigation projects and planning activities funded throughout the years under various FEMA

grant programs can be seen Appendix E. On the following page is a list of planning projects excerpted from this list.

Table 1-1: List of Planning Grants Awarded From FFY 97-07 to Connecticut Communities

| *FEDERAL FISCAL YEAR* / *PROGRAM* | DESCRIPTION | STATUS | FUNDING | |
|---|---|---|---|---|
| | | | FEDERAL | LOCAL |
| ***FFY 00*** | | | | |
| ***FMA*** | Drafting of a regional Hazard Mitigation Plan by CREPA | Completed | $19,900 | $4,975 |
| | **Totals for FFY 00** | | **$19,900** | **$4,975** |
| ***FFY 01*** | | | | |
| ***FMA*** | Preparation of the third phase of the Regional Hazard Mitigation Plan by CREPA. | Completed | $19,400 | $4,850 |
| ***HMGP*** | Draft a mitigation plan in cooperation with CT River Estuary RPA | Completed | $20,000 | $9,000 |
| | **Totals for FFY 01** | | **$39,400** | **$13,850** |
| ***FFY 02*** | | | | |
| ***FMA*** | Prepare a Regional Hazard Mitigation Plan | Completed | $19,600 | $6,533 |
| ***PDM*** | Prepare a Regional Hazard Mitigation Plan by SECCOG | Completed | $76,133 | $25,378 |
| | Prepare a Regional Hazard Mitigation Plan by SWRPA | Completed | $37,462 | $12,487 |
| | Prepare a Regional Hazard Mitigation Plan by NECCOG | Completed | $17,791 | $5,930 |
| | **Totals for FFY 02** | | **$150,986** | **$50,329** |
| ***FFY 03*** | | | | |
| ***FMA*** | Prepare a Regional Hazard Mitigation Plan | Completed | $20,000 | $6,668 |
| ***PDM*** | Prepare a Regional Hazard Mitigation Plan by the CCRPA | Completed | $50,878 | $17,007 |
| | Prepare a Regional Hazard Mitigation Plan by the COGCNV | Completed | $51,677 | $17,226 |
| | Prepare a Regional Hazard Mitigation Plan by the GBRPA | Completed | $70,845 | $23,615 |
| | Prepare a Regional Hazard Mitigation Plan by the WRCOG | Completed | $70,000 | $23,333 |
| | Prepare a Regional Hazard Mitigation Plan by CRERPA | Completed | $33,636 | $10,471 |
| | **Totals for FFY 03** | | **$297,036** | **$98,319** |
| ***FFY 04*** | | | | |
| ***PDM*** | Prepare a Regional Hazard Mitigation Plan by the COGCNV | Ongoing | $101,050 | $33,690 |
| | Prepare a Regional Hazard Mitigation Plan by the NWCCOG | Ongoing | $40,857 | $13,619 |

Table 1-1: List of Planning Grants Awarded From FFY 97-07 to Connecticut Communities Continued

| *FEDERAL FISCAL YEAR* / *PROGRAM* | DESCRIPTION | STATUS | FUNDING FEDERAL | FUNDING LOCAL |
|---|---|---|---|---|
| | Prepare a Regional Hazard Mitigation Plan by the CRCOG | Ongoing | $322,500 | $107,500 |
| | Prepare a Regional Hazard Mitigation Plan by the City of New Haven | Completed | $7,505 | $2,502 |
| | **Totals for FFY 04** | | **$471,912** | **$157,311** |
| ***FFY 05*** | | | | |
| ***FMA*** | Update existing Hazard Mitigation Plan, City of Milford | Ongoing | $8,247 | $2,749 |
| | Prepare a Hazard Mitigation Plan, Town of Hamden | Declined | $0 | $0 |
| | **Totals for FFY 05** | | **$8,247** | **$2,749** |
| ***FFY06*** | | | | |
| ***PDM*** | Prepare a Regional Hazard Mitigation Plan by the COGCNV | Ongoing | $95,000 | $31,667 |
| | ***Totals for FFY 06*** | | **$95,000** | **$31,667** |
| ***FFY07*** | | | | |
| ***PDM*** | Prepare a Regional Hazard Mitigation Plan by Midstate RPO | Ongoing | $137,564.60 | $45,856 |
| | **Totals for FFY 07** | | **$137,564.60** | **$45,856** |
| | **Grand Totals FFY 1997-2006** | | **$1,220,045** | **$405,056** |

The DEP and DEMHS provide technical assistance and contract management services to sub-applicants for planning efforts and projects. Technical assistance includes meeting with local officials and RPOs to help guide them through the planning process, provide available planning guides and tools to assist them in developing a plan, and reviewing and providing feedback on draft plans submitted for FEMA approval.

Due to resource constraints, it is not currently feasible to consider local plans. The DEP reviews and analyzes all multi-jurisdictional plans or regional plans when they are submitted to us and forwarded to FEMA. The DEP plays an active role in the coordination of these reviews. We are knowledgeable in the contents of each plan and through our review, make certain that all multi-jurisdictional plans are consistent with the State Natural Hazards Mitigation Plan. The DEP provides comments to the community or RPO to ensure the plan is complete and covers all FEMA requirements. DEP also provides technical assistance to town and RPO staff to guide them in their plan development.

The DEP will look at actions common to all plans and will use that data to target our resources for outreach, technical assistance and grant offerings. We will develop a system to capture this data into a spreadsheet format that will be provided in the next state plan update. In addition, the DEP will formalize our review process. We will develop a checklist and write qualitative comments as they pertain to the mission of the DEP and the State Natural Hazard Mitigation Plan.

Once the initial state review is completed the DEP will forward the plan to FEMA for the initial review. If the plan meets all of the requirements in order to receive conditional approval, FEMA will send the RPO or the community a Conditional Letter of Approval. If the plan needs significant revision, FEMA will forward comments of revision to the plan to the DEP. The DEP will then send the RPO and community a letter with both FEMA and the State's comments and will provide additional technical assistance to the community as they revise their plan. Once the revisions are made to the plan, the RPO or community will resubmit their draft plan to the DEP. The DEP then will forward the final draft plan to FEMA for Conditional Approval. FEMA will then send a letter of Conditional Approval to the RPO or the community. At this point, the community will hold a public meeting and formally adopt the mitigation plan, afterwhich will send applicable documentation of plan adoption to DEP. Adoption documents may be discussed with FEMA on a case-by-case basis. The DEP will then forward the adoption documentation to FEMA who will review and then issue a letter of approval to the community with a CC to the RPO and DEP. The DEP will look at actions common to all plans and will use that data to target our resources for outreach, technical assistance and grant offerings. We will develop a system to capture this data into a spreadsheet format that will be provided in the next state plan update. In addition, the DEP will formalize our review process. We will develop a checklist and write qualitative comments as they pertain to the mission of the DEP and the State Natural Hazard Mitigation Plan.

Once the initial state review is completed the DEP will forward the plan to FEMA for the initial review. If the plan meets all of the requirements in order to receive conditional approval, FEMA will send the RPO or the community a Conditional Letter of Approval. If the plan needs significant revision, FEMA will forward comments of revision to the plan to the DEP. At The DEP will then send the RPO and community a letter with both FEMA and the State's comments and will provide additional technical assistance to the community as they revise their plan. Once the revisions are made to the plan, the RPO or community will resubmit their draft plan to the DEP. The DEP then will forward the final draft plan to FEMA for Conditional Approval. FEMA will then send a letter of Conditional Approval to the RPO or the community. At this point, the community will hold a public meeting and formally adopt the mitigation plan, after which it will send applicable documentation of plan adoption to DEP. Adoption documents may be discussed with FEMA on a case-by-case basis. The DEP will then forward the adoption documentation to FEMA who will review and then issue a letter of approval to the community with a CC to the RPO and DEP.

RPOs and municipalities have drafted plans for approximately three-quarters (75%) of Connecticut's municipalities:

- Capital Region Council of Governments (CRCOG)
- Central Connecticut Regional Planning Agency (CCRPA)
- Connecticut River Estuary Regional Planning Agency (CRERPA)
- Council of Governments of the Central Naugatuck Valley (COGCNV)
- Greater Bridgeport Regional Planning Agency (GBRPA)
- Northeastern Connecticut Council of Governments (NECCOG)
- Northwestern Connecticut Council of Governments (NWCCOG)
- Litchfield Hills Council of Elected Officials (LHCEO)
- South Western Regional Planning Agency (SWRPA)
- Southeastern Connecticut Council of Governments (SCCOG)
- Windham Regional Council of Governments (WINCOG)
- City of New Haven, Town of Milford, and the Town of East Haven

Through the RPOs, a total of 126 local natural hazards mitigation plans will be adopted or in draft form by October 1, 2007. Below in Table 1.2 is a list of communities which currently have a FEMA approved local natural hazard mitigation plan. Several other communities not listed are either currently in the approval

process for their plan or have recently begun the planning process either on their own or through a coordinated effort through one of the RPOs listed above.

**Table 1-2: FEMA-Approved Hazard Mitigation Plans for Local Communities in Connecticut**

| Municipality/ Native American Tribe | Date of Plan Approval | County | RPO |
|---|---|---|---|
| Ashford | February 16, 2007 | Windham | WINCOG |
| Barkhamsted | February 27, 2007 | Litchfield | LHCEO |
| Bozrah | July 19, 2005 | New London | SCCOG |
| Bridgeport | January 29, 2007 | Fairfield | GBRPA |
| Chaplin | February 16, 2007 | Windham | WINCOG |
| Chester | September 7, 2007 | Middlesex | CRERPA |
| Colchester | July 19, 2005 | New London | SCCOG |
| Colebrook | February 27, 2007 | Litchfield | LHCEO |
| Columbia | February 16, 2007 | Tolland | WINCOG |
| Coventry | February 16, 2007 | Tolland | WINCOG |
| Darien | July 18, 2005 | Fairfield | SWRPA |
| Deep River | August 13, 2007 | Middlesex | CRERPA |
| East Haven | January 4, 2005 | New Haven | Town |
| East Lyme | July 19, 2005 | New London | SCCOG |
| Fairfield | January 29, 2007 | Fairfield | GBRPA |
| Franklin | July 19, 2005 | New London | SCCOG |
| Greenwich | July 18, 2005 | Fairfield | SWRPA |
| Griswold | July 19, 2005 | New London | SCCOG |
| Goshen | February 27, 2007 | Litchfield | LHCEO |
| Groton, City | July 19, 2005 | New London | SCCOG |
| Groton, Town | July 19, 2005 | New London | SCCOG |
| Hampton | February 16, 2007 | Windham | WINCOG |
| Hartland | February 27, 2007 | Hartford | LHCEO |
| Harwinton | February 27, 2007 | Litchfield | LHCEO |
| Lebanon | February 16, 2007 | New London | WINCOG |
| Ledyard | July 19, 2005 | New London | SCCOG |
| Lisbon | July 19, 2005 | New London | SCCOG |
| Litchfield | February 27, 2007 | Litchfield | LHCEO |

**Table 1-2: FEMA-Approved Hazard Mitigation Plans for Local Communities in Connecticut Continued**

| Municipality/ Native American Tribe | Date of Plan Approval | County | RPO |
|---|---|---|---|
| Lyme | January 18, 2007 | New London | CRERPA |
| Mansfield | February 16, 2007 | Tolland | WINCOG |
| Milford | August 13, 2007 | New Haven | City |
| Montville | July 19, 2005 | New London | SCCOG |
| Morris | February 27, 2007 | Litchfield | LHCEO |
| New Canaan | July 18, 2005 | Fairfield | SWRPA |
| New Hartford | February 27, 2007 | Litchfield | LHCEO |
| New Haven | October 24, 2005 | New Haven | Town |
| New London | July 19, 2005 | New London | SCCOG |
| Norfolk | February 27, 2007 | Litchfield | LHCEO |
| Norwalk | July 18, 2005 | Fairfield | SWRPA |
| Norwich | July 19, 2005 | New London | SCCOG |
| North Stonington | July 19, 2005 | New London | SCCOG |
| Old Lyme | January 18, 2007 | New London | CRERPA |
| Old Saybrook | August 21, 2007 | Middlesex | CRERPA |
| Oxford | April 6, 2007 | New Haven | COGCNV |
| Preston | July 19, 2005 | New London | SCCOG |
| Salem | July 19, 2005 | New London | SCCOG |
| Scotland | February 16, 2007 | Windham | WINCOG |
| Sprague | July 19, 2005 | New London | SCCOG |
| Stamford | July 18, 2005 | Fairfield | SWRPA |
| Stonington, Borough | July 19, 2005 | New London | SCCOG |
| Stonington, Town | July 19, 2005 | New London | SCCOG |
| Torrington | February 27, 2007 | Litchfield | LHCEO |
| Voluntown | July 19, 2005 | New London | SCCOG |
| Waterford | July 19, 2005 | New London | SCCOG |
| Watertown | April 6, 2007 | Litchfield | COGCNV |
| Weston | July 18, 2005 | Fairfield | SWRPA |
| Westport | July 18, 2005 | Fairfield | SWRPA |
| Wilton | July 18, 2005 | Fairfield | SWRPA |
| Winchester (Winsted) | February 27, 2007 | Litchfield | LHCEO |
| Woodbury | April 6, 2007 | Litchfield | COGCNV |
| Mashantucket Pequot | July 19, 2005 | New London | SCCOG |
| Mohegan Tribe | July 19, 2005 | New London | SCCOG |

It is the responsibility of the local community to update its local natural hazards mitigation plan every 5 years. The community may chose to update the plan itself or in coordination with its affiliated RPO. Risk assessments from the local plans will be used to enhance Connecticut's risk assessment, where applicable, and to develop mitigation measures that will in-turn be evaluated using the goals and strategies listed in Chapter 5.

## 1.9 COORDINATION WITH BUSINESS AND INDUSTRY GROUPS

Throughout the planning process at the state and local level, Connecticut continues to work with public, private, and quasi-public entities to promote mitigation. Past successful examples of mitigation partnerships include:

- In 1998-99 the town of Westport and the city of East Haven partnered with Home Depot Inc. to provide training workshops and low cost materials for coastal homeowners to mitigate their homes against flooding and wind damage.
- The city of Milford participated with the Savings Bank of Milford to provide low interest loans for people to elevate their homes along the coast. This loan program was timed to coincide with a large-scale home elevation project being coordinated with the U.S. Army Corps of Engineers from 2001-2003.
- The city of Norwich worked with Shop Rite Inc. and the NRCS to design a dike to protect a group of flood-prone businesses (including a grocery store) in the Yantic Flats area of Norwich.

In addition, since the late 1980's the DEP, in cooperation with the NRCS, has assisted over 600 businesses and homeowners to reduce flood damages through the flood audit program. Flood audits provide the building owners with preventative as well as emergency actions that can be taken before flooding strikes to prevent or reduce flood damage.

The State of Connecticut will continue outreach efforts to local businesses in hazards prone areas to promote mitigation activities. In 2005 Connecticut passed the Connecticut Floodplain Management Act (CFMA). Upon full implementation, this Act will provide limited funding for outreach and planning in the area of hazards mitigation and floodplain protection.

# CHAPTER 2

## NATURAL HAZARDS IDENTIFICATION AND EVALUATION

## 2.0 GENERAL DESCRIPTION OF CONNECTICUT AND ITS NATURAL HAZARDS

According to the 2000 US Census, the State of Connecticut has a population of 3,405,565 people. It is projected that this number will increase to 3,635,414 in 2015, and to 3,688,630 in 2030[1]. Connecticut has 169 municipalities within 8 counties covering 5,543.33 square miles (see Table 2-1). The geography of Connecticut contains a wide variety of landscapes. From the shores of Long Island Sound in southern Connecticut, the land gently slopes upward to rolling hills across the southern half of the State. More rugged terrain covers the northwestern and northeastern areas of Connecticut with forested hills and mountains climbing to elevations of over 2,000 feet. The Connecticut River Valley cuts through the center of the State, and several deep river valleys cut through the eastern and western sections of the State. All of these rivers generally flow from north to south and into Long Island Sound.

There are approximately 8,400 miles of rivers and streams, 6,000 lakes and ponds, 4,300 dams, and 253 miles of shoreline in Connecticut. Connecticut's shoreline and riverine areas were heavily developed for commercial, residential, and industrial uses during the past 200 years, since these areas are relatively flat, highly desirable for construction purposes, and have the ability to provide an ample supply of hydropower, a major power source of early 19th Century industrialization,

The climate of Connecticut is moderate with annual rainfall averaging between 44 - 52 inches, and snowfall averaging between 30 inches at the coast of Long Island Sound up to 100 inches in the northwest hills. Temperatures range from highs in the 80's and 90's during the summer months, down to lows in the teens and single digits during the winter months. Transcontinental storms (low pressure systems), and storms that form near the Gulf of Mexico and along the East Coast deliver most of the annual rain and snowfall to the State. Heavy short-duration rains are also caused by thunderstorm activity in all but the winter season. Occasional hurricanes, which typically occur between June 1st and December 1st, deliver heavy rains of longer duration.

On an average, every ten years, a hurricane strikes Connecticut causing moderate to heavy damage. The extent and location of the damage varies greatly depending on the track, intensity and duration of the hurricane. The Connecticut hurricanes of the 1930's, 40's and 50's were markedly more severe than the hurricanes that occurred between the 1960's and the 1990's.

On an average Connecticut is subjected to severe flooding every 5 years. Flooding events in Connecticut are comprised of three types: coastal, riverine, and urban (see section 2.2 for a definition of each type). Tornadoes also occur on average of once every ten years in Connecticut. The last major tornado to affect Connecticut occurred on July 10, 1989 in western Connecticut.

Severe winter storms, which result in over a foot of snowfall combined with either major coastal flooding or ice storms, have occurred at least seven times since 1973. Fatalities during winter storms are often the result of drowning along the coast and may be preventable. Transportation gridlocks of up to 8 hours or more can occur during heavy snowstorms.

Urban flooding has become more prevalent in recent years as urban and suburban areas continue to grow and become too large for older, under-designed drainage systems. Urban flooding strikes most cities on an annual basis and is most often caused by slow moving heavy or severe thunderstorms.

[1] According to US Census Bureau, *Interim Projections of the Total Population for the United States and States*: *April 1, 2000 to July 1, 2030.* Internet release date: 4/21/05.

Less frequent in Connecticut are damaging droughts, forest fires and earthquakes. Large-scale forest fires are rare in Connecticut. Fires are typically small underbrush and ground fires that rarely damage large numbers of buildings.

Climate change will very likely have an increasingly significant impact on natural disasters in Connecticut. The State and municipalities must consider scientists' projections of climate impacts on sea level, precipitation, storm intensity, flooding, drought, and other natural disasters as we plan for the future.

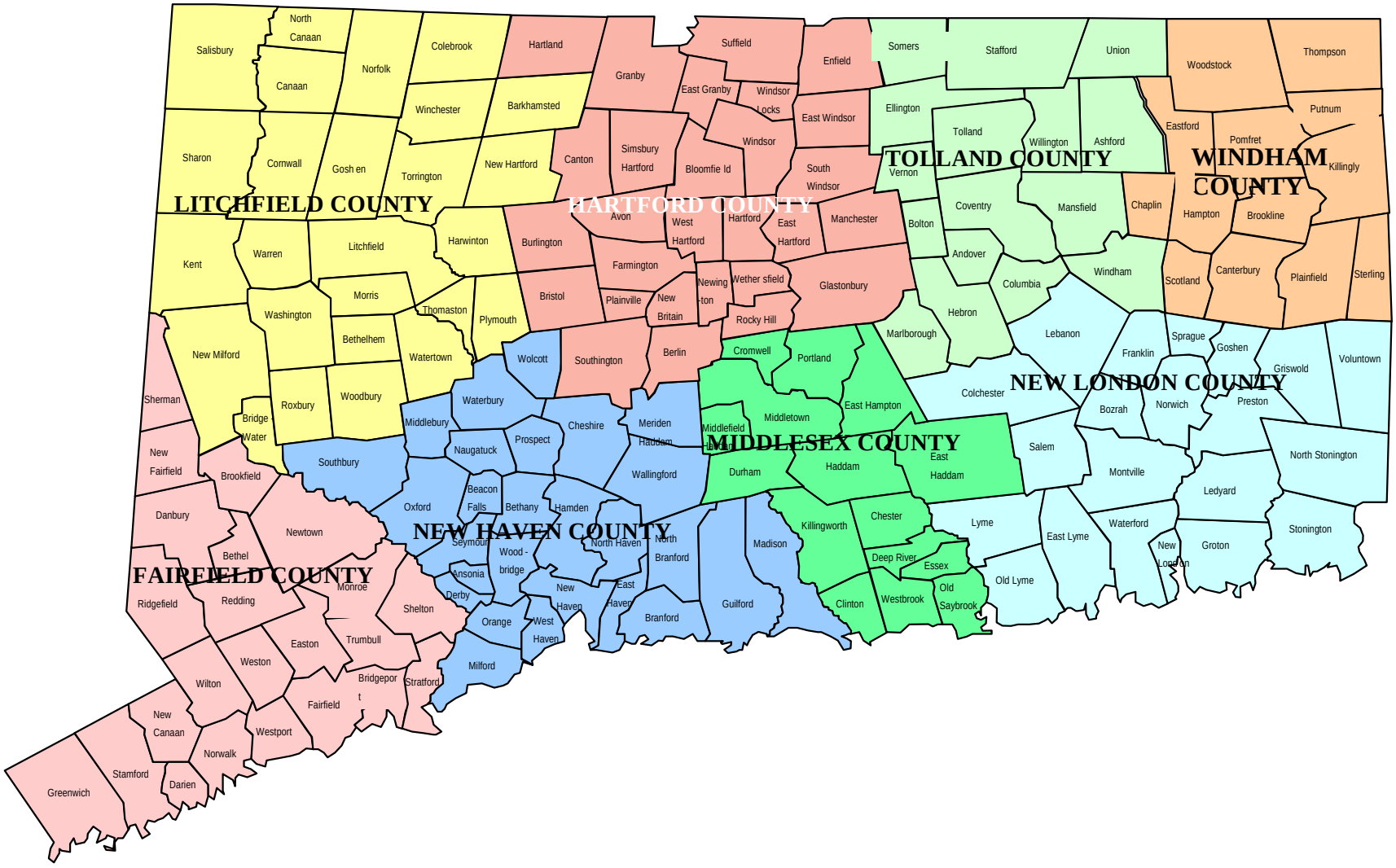
**Table 2-1: Census Data For The State Of Connecticut**

| Geographic Area | Population | Housing Units | Area In Square Miles | | | Density Per Square Mile Of Land Area | |
|---|---|---|---|---|---|---|---|
| | | | Total Area | Water Area | Land Area | Population | Housing Units |
| COUNTY | | | | | | | |
| Fairfield | 882,567 | 339,466 | 836.96 | 211.15 | 625.80 | 1,410.3 | 542.4 |
| Hartford | 857,183 | 353,022 | 750.57 | 15.13 | 735.44 | 1,165.5 | 480.0 |
| Litchfield | 182,193 | 79,267 | 944.57 | 24.65 | 919.92 | 198.1 | 86.2 |
| Middlesex | 155,071 | 67,285 | 439.07 | 69.81 | 369.26 | 419.9 | 182.2 |
| New Haven | 824,008 | 340,732 | 862.02 | 256.38 | 605.64 | 1,360.6 | 562.6 |
| New London | 259,088 | 110,674 | 771.66 | 105.75 | 665.91 | 389.1 | 166.2 |
| Tolland | 136,364 | 51,570 | 417.01 | 6.94 | 410.07 | 332.5 | 125.8 |
| Windham | 109,091 | 43,959 | 521.47 | 8.71 | 512.75 | 212.8 | 85.7 |
| State of Connecticut Totals: | 3,405,565 | 1,385,975 | 5,543.33 | 698.53 | 4,844.80 | 702.9 | 286.1 |

(X) Not applicable

Source: U.S. Census Bureau, Census 2000 Summary File 1

FIGURE 2-1: MUNICIPAL AND COUNTY BOUNDARIES IN CONNECTICUT



## 2.1 CONNECTICUT'S HISTORY OF AND FUTURE RISK FOR NATURAL DISASTERS

This chapter examines the types of natural hazards that impact Connecticut, their history and Connecticut's future vulnerability to each type of natural disaster. A summary of Connecticut's most recent presidential declared disaster, the October 2005 Flood Event, is included.

The National Oceanic and Atmospheric Administration (NOAA) has recorded an estimated 2,092 severe weather events for the State of Connecticut during the time period of 1950-March 2007.[2] Table 2.1 provides the total number of severe weather events recorded for each county. The events recorded by NOAA include such events as droughts, floods, hailstorms, severe lighting Precipitation, snow & ice storms, and extreme temperatures. Records on Hurricanes were not available in this database, therefore they are not reflective in Table 2.1's figures.

**Table 2-2: Weather Event Breakdown Per County**

| | Fairfield | Hartford | Litchfield | Middlesex | New Haven | New London | Tolland | Windham |
|---|---|---|---|---|---|---|---|---|
| **Event Type** | | | | | | | | |
| Blizzard | 3 | 1 | 1 | 2 | 3 | 2 | 1 | 1 |
| Coastal Flood | 11 | | | 1 | 8 | 1 | | |
| Coastal Storm | 3 | | | 2 | 3 | 3 | | |
| Drought | 3 | | 2 | 3 | 3 | 3 | | |
| Excessive Heat | 4 | 8 | 3 | 4 | 4 | 3 | | |
| Extreme Cold/Windchill | 4 | 7 | 4 | 4 | 4 | 4 | 2 | 2 |
| Flash Flood | 29 | 9 | 17 | 6 | 18 | 16 | 2 | 1 |
| Flood | 12 | 60 | 58 | 14 | 29 | 18 | 1 | 4 |
| Freeze/Frost | | | 10 | | | | | |
| Freezing Rain | | 5 | 3 | | | | 5 | 5 |
| Funnel Cloud | 2 | 2 | | 1 | 1 | | | |
| Glaze | 1 | | | 1 | 1 | 1 | | |
| Hail | 37 | 77 | 69 | 16 | 25 | 28 | 28 | 21 |
| Heavy Rain | 24 | 22 | 3 | 21 | 26 | 20 | 15 | 12 |
| Heavy Snow | 33 | 32 | 19 | 27 | 29 | 28 | 36 | 34 |
| High Wind | 26 | 24 | 30 | 15 | 24 | 21 | 14 | 17 |
| Ice Storm | 4 | 4 | | 2 | 3 | 1 | 4 | 2 |
| Lighting | 19 | 19 | 6 | 7 | 21 | 15 | 3 | 3 |
| Mixed Precipitation | 2 | | 1 | | 1 | | | |
| Record Warmth | | 11 | 2 | | | | | |
| Rip Currents | | | | | 1 | | | |
| Smoke | | | 1 | | | | | |
| Strong Wind | 1 | 22 | 2 | | 1 | 2 | 17 | 18 |
| Thunderstorm / Winds | 154 | 144 | 151 | 35 | 116 | 56 | 59 | 54 |
| Tornado (total) | 11 | 14 | 22 | 8 | 13 | 2 | 9 | 3 |
| Urban/Small Stream Flooding | 9 | 1 | | 5 | 7 | 6 | | |

[2] Source of data: NOAA's website and online database located at www4.ncdc.noaa.gov/. Data obtained from website in September 2007.

**Table 2-2: Weather Event Breakdown Per County**

| | Fairfield | Hartford | Litchfield | Middlesex | New Haven | New London | Tolland | Windham |
|---|---|---|---|---|---|---|---|---|
| **Event Type** | | | | | | | | |
| Winter Storm | 13 | 15 | 40 | 9 | 14 | 6 | 13 | 13 |
| Winter Weather | | 1 | 1 | 1 | 1 | 1 | | |
| Total Number of Severe Weather Events | 405 | 478 | 445 | 184 | 356 | 237 | 209 | 190 |

Note: Total Actual number of events listed for the State of Connecticut as a whole is 2,092 events. Many events listed within this breakdown affect multiple Counties, thus are counted in each affected county.

Table 2.2, shown below, provides a detailed breakdown of the total number of tornadoes recorded by NOAA within their severe weather database for each county and the State of Connecticut itself. As one can see from Table 2.2, the 3 counties with the highest level of tornado occurance are: Litchfield, Hartford, and New Haven. More analysis is required to determine why these counties have such higher rates of tornado occurances and degree of event. It is intended that this review will be undertaken over the next three years and be prepared for the next plan update in 2010.

**Table 2-3: Detail Breakdown Per County and State for Tornado Events from 1950 through March 2007**

| | Fairfield | Hartford | Litchfield | Middlesex | New Haven | New London | Tolland | Windham | Statewide |
|---|---|---|---|---|---|---|---|---|---|
| Tornado Category | | | | | | | | | |
| F0 | 2 | 3 | 2 | 2 | 4 | | 1 | | 14 |
| F1 | 7 | 5 | 11 | 4 | 3 | 2 | 4 | 3 | 39 |
| F2 | 2 | 4 | 9 | 1 | 3 | | 3 | | 22 |
| F3 | | 1 | | 1 | 2 | | 1 | | 5 |
| F4 | | 1 | | | 1 | | | | 2 |
| F5 | | | | | | | | | 0 |
| Total Number of Tornadoes Per County: | 11 | 14 | 22 | 8 | 13 | 2 | 9 | 3 | 82 |

The following subsections present a description of each type of natural hazard the State may expect to experience. Connecticut's Office of Policy Management has responsibility for the development of a State Conservation and Development Plan. This plan is updated every five years. The next update is expected in 2010/2011 (year of publication). It is DEP's intent to integrate data and analyses within the Connecticut Conservation and Development Plan into this Natural Hazards Mitigation Plan (NHMP). Work on integrating this information will commence with the next NHMP update, and will be performed to the extent that available resources allow. This data and analysis integration will help to relate hazard data with land development changes within the last decade, at a minimum, and show spatially where development exists in relation to spatial portrayal of various natural hazards and associated risk areas.

### 2.1.1 Hurricanes

The Atlantic hurricane season begins on June 1st and ends on December 1st each year. A hurricane is a warm-core (having warmer air at its center) tropical cyclone. Hurricanes that affect Connecticut

normally form in the tropical Atlantic, Caribbean, or Gulf of Mexico, typically between 15 - 30 degrees north latitude.

#### 2.1.1.1 Hurricane History

The most intense hurricane to strike Connecticut occurred on September 21, 1938. Flooding, 130 MPH hurricane force winds, and a coastal storm surge up to 12 feet high combined to cause the greatest disaster (in terms of lives lost) in the State's history. The hurricane tracked northward up the Connecticut River Valley with the greatest devastation occurring along the coast and east of the center of the hurricane. Shoreline railroad and highway traffic were inoperative for 3 weeks. Along the eastern seaboard the storm killed 600 people (125 in Connecticut) and injured another 1,700. It destroyed over 9,000 structures, damaged more than 90,000, and resulted in extensive agricultural losses. The damages in southern New England were estimated to be $306 million (1938 dollars), and the damages in Connecticut were estimated to be $53 million (1938 dollars).

Another severe hurricane affected Connecticut on September 14 - 15, 1944. As in 1938, damage was sustained in almost every section of Connecticut. In the 1944 Hurricane however, injuries and storm damage were lower than in 1938 due to the additional warning time of the storm's approach and the fact that fewer structures were located in vulnerable areas due to the lack of rebuilding after the 1938 Hurricane. Even with the additional warning time, 7 people were killed, and damages totaled $3 - 5 million (1944 dollars).

The next hurricane to strike Connecticut occurred on August 31, 1954. Hurricane Carol (naming of hurricanes began in 1950) tracked across the southeastern corner of the State. Three counties were declared disaster areas. Damages in the remainder of the State were relatively minor. Although Connecticut suffered no fatalities, property damage exceeded $53 million (1954 dollars).

In 1955 torrential rains fell from August 12 - 19, as the result of Hurricanes Connie and Diane. Flood damage was extreme with countless road/bridge washouts, loss of drinking water, destruction of power lines and loss of communication networks.

Fourteen out of 39 towns affected by the flooding in 1955 were declared health hazards. Seventy people were killed and 4,700 were injured. The State was declared a disaster area. Two months later, on October 15 - 17, heavy rains again brought flooding to the State. Although the entire state was affected, 28 towns in the southwestern part of the state were the hardest hit. Over 4,200 families were evacuated because of the flooding and 23 people died. The two flooding events in 1955 totaled an estimated 350 million (1955 dollars) in damages.

During the 1960's Connecticut was indirectly affected by several tropical storms and hurricanes. Connecticut was hit by Hurricane Belle, a Category I hurricane, in 1976. Belle caused 5 fatalities and some minor shoreline damage.

On September 27, 1985, Hurricane Gloria struck Connecticut, felling thousands of trees and causing minor structural damage. Gloria, a category II hurricane when it made landfall in the Westport area, did not cause flooding due to relatively light rain accompanying the storm. Debris cleanup and restoration of power were the major factors that lead to a disaster declaration for this "dry" hurricane.

On August 19, 1991 Hurricane Bob struck Rhode Island. Bob was a Category III hurricane that formed in the Bahamas and moved up the eastern seaboard. Bob made landfall as a strong Category II hurricane in Newport, R.I. at 2:00 PM, on August 19th. Bob moved quickly through Rhode Island and Massachusetts. Tree damage in Connecticut was very light in western areas and light to moderate in eastern and central areas of the State. Flooding was also minor due to the fast forward speed of Bob and the short duration of the heavy rainfall. On October 30, 1991, a rare late season Hurricane Grace combined with a large non-tropical low-pressure system east of Maine to produce what has become known as the Perfect Storm. Damage in Connecticut was light due to the protective effect of Long Island. However, moderate to heavy damage resulting from 30 – 50 foot seas occurred along the exposed coastlines from New Jersey to Maine. Another factor that made this storm damaging was its 6-day duration.

On September 15, 1999, Connecticut was affected by the remnants of Tropical Storm Floyd. Damage from Floyd was greatest in the Danbury area of western Connecticut.

#### 2.1.1.2 Tropical Storm Floyd

On September 8, 1999, Tropical Storm Floyd formed in the Atlantic Ocean 950 miles southeast of the Virgin Islands. Floyd intensified to hurricane status on September 10th, and moved in a generally west-northwest direction towards the United States southeast coastline. A deep trough formed along the east coast and Floyd moved rapidly up the eastern seaboard and struck Connecticut as a tropical storm (maximum sustained winds of 60 MPH) on September 16th at 9:00 PM. Floyd moved through central Connecticut with a forward speed of 30 MPH. Floyd rapidly weakened as it moved through New England and moved out to sea east of Maine on September 17th.

The greatest damage caused by Tropical Storm Floyd in Connecticut resulted from extraordinary rainfall in western and central Connecticut. Total rainfall from September 15 – 16 ranged from approximately 3 inches in southeastern Connecticut up to 11.13 inches in Danbury. Rainfall amounts on average ranged from 4 – 8 inches across most of the State.

Flood damage from Floyd was greatest in Danbury, along the Still River and it's tributaries. The Still River consists of a 71.3 square mile watershed that flows through the communities of Danbury and Brookfield before flowing into the Housatonic River. Over 300 homes, two car dealerships, an elderly apartment complex, a trailer park and several roads and a bridge were damaged in Danbury. The rainfall return frequencies in the Danbury area are above the 100-year storm event according to the National Weather Service (NWS) Technical Paper #40, dated 1961. Flood elevation analysis indicates that the flooding along a large portion of the Still River in Danbury had a level above the 100-year flood levels published by FEMA. President Clinton signed a disaster declaration for both Public Assistance (PA) and Individual Assistance (IA). See map on page 5-3 showing presidential declared disaster counties.

In Southington, the flood damage was not as great. Approximately 25 – 30 homes and businesses were flooded. Rainfall return frequencies in Southington were on the order of a 250-year event. Water elevations in the Quinnipiac River basin (169.6 square miles) indicated a return frequency of 10 years based on the Federal Emergency Management Agency (FEMA) Flood Insurance Study for Southington. In general, river flow return frequencies were not as great as the rainfall event due to drought conditions and full vegetation.

**Figure 2-2: THE SAFFIR-SIMPSON HURRICANE SCALE**

The Saffir-Simpson Hurricane Scale is a 1-5 rating system based on the hurricane's intensity at a given time. This scale is used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall. Wind speed is the determining factor in the scale, as storm surge values are highly dependent on the slope of the continental shelf in the landfall region. Note that all winds are using the U.S. 1-minute average.

**Category One Hurricane:**

Winds 74-95 mph (64-82 kt or 119-153 kph). Storm surge generally 4-5 ft above normal. No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Some damage to poorly constructed signs. Also, some coastal road flooding and minor pier damage. Hurricanes Allison of 1995 and Danny of 1997 were Category One hurricanes at peak intensity.

**Category Two Hurricane:**

Winds 96-110 mph (83-95 kt or 154-177 kph). Storm surge generally 6-8 feet above normal. Some roofing material, door, and window damage of buildings. Considerable damage to shrubbery and trees with some trees blown down. Considerable damage to mobile homes, poorly constructed signs, and piers. Coastal and low-lying escape routes flood 2-4 hours before arrival of the hurricane's center. Small craft in unprotected anchorages break moorings. Hurricane Bonnie of 1998 was a Category Two hurricane when it hit the North Carolina coast, and Hurricane Georges of 1998 was a Category Two Hurricane when it hit the Florida Keys and the Mississippi Gulf Coast.

**Category Three Hurricane:**

Winds 111-130 mph (96-113 kt or 178-209 kph). Storm surge generally 9-12 ft above normal. Some structural damage to small residences and utility buildings with a minor amount of curtainwall failures. Damage to shrubbery and trees with foliage blown off trees and large trees blown down. Mobile homes and poorly constructed signs are destroyed. Low-lying escape routes are cut by rising water 3-5 hours before arrival of the hurricane's center. Flooding near the coast destroys smaller structures with larger structures damaged by battering of floating debris. Terrain continuously lower than 5 ft above mean sea level may be flooded inland 8 miles (13 km) or more. Evacuation of low-lying residences within several blocks of the shoreline may be required. Hurricanes Roxanne of 1995 and Fran of 1996 were Category Three hurricanes at landfall on the Yucatan Peninsula of Mexico and in North Carolina, respectively.

**Category Four Hurricane:**

Winds 131-155 mph (114-135 kt or 210-249 kph). Storm surge generally 13-18 ft above normal. More extensive curtainwall failures with some complete roof structure failures on small residences. Shrubs, trees, and all signs are blown down. Complete destruction of mobile homes. Extensive damage to doors and windows. Low-lying escape routes may be cut by rising water 3-5 hours before arrival of the hurricane's center. Major damage to lower floors of structures near the shore. Terrain lower than 10 ft above sea level may be flooded requiring massive evacuation of residential areas as far inland as 6 miles (10 km). Hurricane Luis of 1995 was a Category Four hurricane while moving over the Leeward Islands. Hurricanes Felix and Opal of 1995 also reached Category Four status at peak intensity.

**Category Five Hurricane:**

Winds greater than 155 mph (135 kt or 249 kph). Storm surge generally greater than 18 ft above normal. Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. All shrubs, trees, and signs blown down. Complete destruction of mobile homes. Severe and extensive window and door damage. Low-lying escape routes are cut by rising water 3-5 hours before arrival of the hurricane center. Major damage to lower floors of all structures located less than 15 ft above sea level and within 500 yards of the shoreline. Massive evacuation of residential areas on low ground within 5-10 miles (8-16 km) of the shoreline may be required. Hurricane Mitch of 1998 was a Category Five hurricane at peak intensity over the western Caribbean. Hurricane Gilbert of 1988 was a Category Five hurricane at peak intensity and is the strongest Atlantic tropical cyclone of record. Hurricane Katrina in 2005 was a Category Five hurricane before it came on shore in the Gulf Coast states.

Since 1982 the State of Connecticut has undertaken several mitigation measures, which reduced the damage caused by Tropical Storm Floyd. The installation of an Automated Flood Warning system in 1986, and its subsequent expansions in 1992, 1996, and 1998, to include the State's most flood prone rivers proved invaluable during the Tropical Storm Floyd flood event. The system was also expanded to Danbury and East Haven after Floyd. The Automated Flood Warning System was instrumental in avoiding flood damage, thirty homeowners and businesses in Southington were warned by telephone to expect flooding along the Quinnipiac River.

The State of Connecticut has also undertaken several structural mitigation projects including home elevations to prevent tidal flooding from hurricanes and winter storms, and the removal of 13 homes from the floodplain of the Yantic River in Norwich in 1995. DEP has also repaired over 60 high hazards state-owned dams since 1982. Other projects directly related to damage reduction during Floyd included the creation of a state-of-the-art weather warning dissemination system using email updates. The weather dissemination system sent updates in less than 5 minutes to all 169 municipalities in Connecticut. A post-disaster survey conducted by the NRCS indicated that it's own flood control projects in Connecticut prevented 25.2 million dollars (2004) in flood damages. NRCS projects that prevented the most damage included the North and South Branches of the Park River in Hartford ($16.7 million), the Blackberry River ($4.6 million), and the Norwalk River dams ($2.4 million).

As of January 2001 the total of Public Assistance (PA) damages from Tropical Storm Floyd was 2.2 million dollars (see Table 2-1). As shown in Table 2-2 several hundred homes in the municipalities of Danbury, Plainville, Bristol and Southington were flooded as a result of heavy rains from Floyd. A large percentage of the flooding occurred outside the 100-year floodplain.

***Table 2-4 Infrastructure Damage***

| ***DAMAGE CATEGORY*** | ***AMOUNT $*** |
|---|---|
| ***A - Debris Removal*** | $ 492,880 |
| ***B - Protective Measures*** | $ 254,829 |
| ***C - Roads & Bridges*** | $ 786,773 |
| ***D - Water Control Facilities*** | $ 68,093 |
| ***E - Public Buildings*** | $ 98,900 |
| ***F - Public Utilities*** | $ 163,647 |
| ***G - Recreational or Other*** | $ 320,124 |
| ***Grand Total*** | **$2,185,246** |

***Table 2-5***

| ***Damage to Buildings*** | ***No.*** |
|---|---|
| ***Destroyed*** | 16 |
| ***Major*** | 82 |
| ***Minor*** | 285 |
| ***Affected*** | 35 |
| ***Total*** | **418** |

Between 1992 and 1999, (Floyd occurred in 1999), many significant advances in technology have been implemented. The use of the email system, coupled with near real-time weather data collection at both the DEP and OEM, enabled both agencies to receive and transmit weather and emergency response data. This had not been possible previously.

#### 2.1.1.3 Potential Future Hurricane Risk

Hurricanes have the greatest destructive potential of all natural disasters in Connecticut. A moderate Category II hurricane can be expected to make landfall in Connecticut once every ten years. Based on the past frequency and intensity of hurricanes in the twentieth century, at least one major hurricane of Category III or IV may occur before 2040. Although winter storms cause more frequent coastal flooding and more annual damage, a single major hurricane (Category III or greater) can cause 3 - 10 times that amount of damage.

### 2.1.2 Winter Storms (Nor'easters)

A major winter storm, regionally known as a Nor'easter, is typically an intense low-pressure system that forms either in the Carolinas or just off the mid-Atlantic coastline between November 1st and April 1st. These storms normally move in a northeastward direction to a position around 70 degrees north latitude, 40 degrees west longitude or about 80 miles south of Cape Cod. The Nor'easter derives its name from the strong northeast winds that are characteristic during the storm.

#### 2.1.2.1 History of Nor'easters

During the past 25 years there have been six major Nor'easters in Connecticut. These major winter storms can be as intense as a Category II hurricane, both in their low central pressure and the flooding they cause. These storms have claimed nearly a dozen lives since 1979, and injured dozens of people while causing millions of dollars in damages. Deadly winter storms have struck Connecticut in 1979, 1983, 1988, 1992, 1996 and 2003.

During the 1990s two major storms hit Connecticut. The first and most intense was the December 10-13 Nor'easter of 1992. Three people were killed as a result of the storm and 26 homes were destroyed. Tides in Long Island Sound were stacked up by the continued strong east/northeast winds reaching 55 mph. This "stacking" of water resulted in the third highest tide (10.16 Feet NGVD as measured at Bridgeport, CT) ever recorded in Long Island Sound and caused over 4.3 million dollars (1992) in damages to over six thousand homes. Inland areas received up to 4 feet of snow in northeastern Connecticut. The heavy wet snow snapped tree limbs and power lines cutting power to 50,000 homes.

The next major storm to strike Connecticut occurred on January 8-9, 1996. Winter Storm Ginger brought up to 27 inches of snow to Connecticut and forced the State to shutdown for 24 hours. In terms of overall snowfall (outside Connecticut) this was the largest winter storm on the U.S. East Coast since 1888.

Most recent winter storms include:

- December 5-7, 2003, when heavy snowfall (highs as much as 20 inches in Windham County, 19 inches in Hartford County, and 18 inches in Fairfield, New London, and Tolland Counties) occurred. This event received a Presidential Emergency Declaration;
- January 22-23, 2005 Blizzard, which received a Presidential Emergency Declaration; and,

- February 11-12, 2006 Nor'easter Record Snowfall, which received a Presidential Emergency Declaration.

### 2.1.2.2 April 2007 Nor'easter

#### 2.1.2.2.1 Summary Background on Storm Events

A powerful tropical low-pressure system formed in the Atlantic Ocean off the Carolinas on Sunday, April 15, 2007 and moved slowly northward towards New England.

In anticipation of this storm developing, the National Weather Service (NWS) had previously issued flood watches on Saturday, April 14, for all of Connecticut, and coastal flood warnings for coastal western Connecticut for Sunday, April 15th, and Monday, April 16th. High wind warnings were also posted for southeastern coastal Connecticut for Sunday afternoon and evening.

Rain began Sunday morning, April 15, and intensified throughout the day and the early morning hours of April 16, particularly in southwestern Connecticut, which received up to eight inches of rain. By Sunday night, the entire state was under flood warnings.

Highest tides occurred between 8:30 and 10:30 p.m. on Sunday, April 15, resulting in some moderate coastal flooding along the western reaches of the Connecticut shoreline. Winds began increasing steadily from Sunday afternoon through early Monday morning, particularly along the shore and inland in eastern Connecticut, where gusts reached 60 miles per hour and downed numerous trees and power lines. In the northwestern part of the state, heavy frozen precipitation accumulated on roads during the day on Sunday before changing over to rain.

By early Monday morning, April 16, floodwaters, as well as downed trees and wires, had caused dozens of state highway closures and hundreds of local road closures. Amtrak Rail service was interrupted on the Danbury line, and there were numerous flight delays at Bradley International Airport. Over 44,000 customers were without power on Monday, April 16th.

Most rivers were receding slowly by April 17th. The only river still rising by April 17th was the Connecticut River at Hartford and Middletown. The Connecticut River at Hartford crested at 21.9 feet (5.9 feet above flood stage) at 2 a.m. Wednesday morning, flooding fields and some low lying roads. The Connecticut River at Middletown crested at 15.9 feet (7.9 feet above flood stage – major flooding) at 2 p.m. Wednesday afternoon. Flooding of several roads and some structures occurred in the Middletown area. Flooding continued on the Connecticut River at Middletown through Friday, April 27, 2007.

The storm resulted in major river flooding in central and western Connecticut. Some rivers recorded return frequencies of 20 – 50 years, according to USGS. The Rippowam River in Stamford recorded an all-time record flood event with hundreds

of structures flooded. According to the NWS River Forecast Office, the Farmington River experienced its second worst flood of record at Unionville.

#### 2.1.2.2.2 Government Response Operations

##### 2.1.2.2.2.1 State Government

Governor M. Jodi Rell directed implementation of the State Emergency Operations Plan and activated the State Emergency Operations Center (EOC) in Hartford on April 15, 2007. The State EOC was staffed by the Governor's Office, DEMHS, DPS, DOT, DEP, the Connecticut National Guard, the American Red Cross, and Connecticut Light and Power through 12:00 AM on Tuesday, April 17, 2007. Thereafter, the DEMHS continued to monitor flooding from the EOC and receive local situation reports through Friday, April 20, 2007.

State officials conducted emergency operations associated with maintaining state roadways, and also supported local response operations by coordinating the delivery of services and equipment to local officials including bridge and dam inspectors, sandbags, pumps, barriers, and evacuation vehicles and drivers. DOT established a temporary bus service to transport passengers unable to use the Danbury Branch line of the Amtrak rail service, which was lost for a day due to track washouts in three locations. On April 16, the Governor conducted a statewide conference call with municipal officials to discuss storm impacts, continuing threats and other response issues.

##### 2.1.2.2.2.2 Local Government

Local officials opened local emergency operations centers, conducted evacuations and rescues, opened shelters in at least 5 municipalities, monitored and inspected dams and bridges, barricaded unsafe roads, detoured traffic, pumped basements, and towed vehicles swamped by flood waters.

In Stamford, 85 senior citizens were evacuated from the Pilgrim Towers, and 25 residents of a group home for the handicapped were evacuated due to utility outages but were able to return when power was restored. Other evacuations occurred in Westport, Greenwich, Danbury, Southbury, New Milford, Woodbury, and Bristol.

Local authorities declared a State of Emergency in Torrington and Goshen.

Many municipalities allowed residents to place storm debris curbside for municipal pick-up.

#### 2.1.2.2.3 Impacts

##### 2.1.2.2.3.1 FEMA-Eligible Public Sector Impacts

The joint Federal/State Preliminary Damage Assessment (PDA) identified $11,978,231in FEMA-eligible public sector costs and damages resulting from this event. This exceeds FEMA's statewide eligibility indicator of $4,154,789 for Public Assistance in Connecticut by 188% (based on $1.22 per capita and the state census population of 3,405,565). Estimated requirements for FEMA Public Assistance are found in Enclosure A.

Public Sector impacts in the counties of Fairfield and Litchfield currently exceed the FEMA county eligibility indictor of $3.05 per capita. Per capita impacts in Litchfield County are an extremely high $23.28. In Fairfield County, impacts are $6.27 per capita and would be higher if preliminary damage assessments were not cancelled in Danbury, Brookfield and Ridgefield when the county per capita indicator was met.

Per capita impacts in the counties of New Haven and Hartford are $1.58 and $0.87 respectively but are expected to continue to rise as additional reports are received from potentially eligible applicants including municipalities and quasi-governmental agencies.

Several municipalities were particularly hard hit in terms of per capita impacts, including Norfolk ($1,175.30), Torrington ($43), Goshen ($30), Litchfield ($27.49) Harwinton ($18.48) and New Milford ($13.59) in Litchfield County, as well as Weston ($80.72), Greenwich ($40.48), and Stamford ($13.34) in Fairfield County. In New Haven County, the highest per capita impacts are in Bethany ($26.98) and Wolcott ($21.59).

Bridges were washed out in Torrington and Weston, causing a potential increase in response times for emergency service vehicles covering sections of those municipalities. In New Haven and Bridgeport, many parks sustained damage; use of these facilities may be limited until repairs are performed. Erosion along road shoulders in many municipalities required immediate repairs to prevent further erosion and loss of paved surfaces. Many municipalities had to defer capital projects and schedule these repairs of flood damage.

Overall, damages to state facilities were not particularly severe. However, the National Guard reported $40,500 in damage to Air National Guard facilities in Orange; the DEP reported $327,591 to DEP facilities statewide; the Department of Public Safety reported $313,894 in damages to a firing range in Simsbury, and the DPW reported $199,298 in storm-related damages to other buildings statewide. The DOT reported $100,000 in damages to non-FEMA eligible bridges in Bristol and Wallingford (both in New Haven County) and undetermined overtime costs statewide for barricading and other emergency work. In addition, the DOT reports $7,500 in costs related to washouts along the Danbury Branch Line of the Amtrak rail.

#### 2.1.2.2.3.2 Residential Impacts

Over 2,500 residential units statewide were impacted to a degree by flooding. It is estimated that over 200 people were forced to evacuate their residences during these floods. Evacuees have since returned to their homes. There are no shelters open at this time.

Flooding occurred as a result of rivers overflowing their banks; storm drainage systems that were overwhelmed or had become blocked by debris; surface runoff into basements; and groundwater that entered basements and could not be pumped out quickly by sump pumps either due to power failures experienced by over 44,000 customers or because of the overwhelming volume of rain. In addition some communities and neighborhoods experienced sanitary sewer backups.

The joint Federal/State Preliminary Damage Assessment (PDA) has identified 2,406 residential units that are primarily owner-occupied, single family homes damaged by flooding. Overall residential damages were estimated at $23,764,550 in the municipalities surveyed by damage assessment teams. It is estimated that there are more homes that have been affected in other municipalities not surveyed during the PDA, since damage assessment team efforts were concentrated on the most severely impacted municipalities.

Of the more than 2,406 impacted residential units identified by the PDA, no units were destroyed, 92 had major damage, 274 had minor damage and 2,040 others were affected to a lesser degree in accordance with damage criteria used by FEMA.

The following table is a compilation of residential damages by county as determined by FEMA:

**Table 2-6: Residential Damages**

| COUNTY | Municipalities In Counties Surveyed by PDA | Destroyed | Major Damage | Minor Damage | Affected | Total Residential Units Impacted |
|---|---|---|---|---|---|---|
| Fairfield | 13 of 23 | 0 | 48 | 170 | 1,415 | 1,633 |
| Hartford | 3 of 29 | 0 | 7 | 41 | 215 | 263 |
| Litchfield | 3 of 26 | 0 | 2 | 10 | 41 | 53 |
| Middlesex | 3 of 15 | 0 | 3 | 7 | 1 | 11 |
| New Haven | 9 of 27 | 0 | 32 | 46 | 368 | 446 |
| **TOTALS** | **31 of 120** | **0** | **92** | **274** | **2,040** | **2,406** |

A high percentage of the residences sustaining major damage were low-income households (36 of 92, or 39%). Further, a considerable percentage of the residences with minor damage were low-income households (54 of 274, or 20%).

Only 19 of the 92 residential units with major damage (19%) and 54 of 274 units with minor damage (25%) had flood insurance. In situations where groundwater caused basement flooding, flood insurance did not apply.

Primary concerns related to residential units at the time were:

- Unreported below-grade living spaces, particularly below-grade apartment units in urban areas that may have been flooded and rendered uninhabitable;
- Furnaces and electrical systems damaged by flooded basements that presented health and safety hazards.
- Removal of all materials that remained wet for 48 hours or more, including carpeting and sheetrock, particularly in finished basements;
- Residential wells requiring flushing and disinfecting due to flood waters that bridged septic fields and wellheads.
- Extensive soil erosion problems and driveway washouts associated with residential structures.

As of the drafting of this Plan Update, DEMHS continued to receive numerous calls from residents, primarily from Fairfield and New Haven counties, about the availability of government assistance to help recover from this event.

The American Red Cross assisted 74 families and operated 11 shelters in 11 communities. A total of 93 persons stayed in Red Cross shelters.

#### 2.1.2.2.3.3 Business Impacts

The joint Federal/State preliminary damage assessment (PDA) identified 179 businesses damaged by flooding, including 19 with major damage and 160 with minor damage, in accordance with criteria used by the Small Business Administration (SBA). The SBA estimated physical damage to businesses at $7,451,000. Over one-half (i.e. 103) of the businesses that sustained either major or minor damage are located in Fairfield County.

As with residential units, it is estimated that more businesses that were affected in other municipalities not surveyed during the PDA, since damage assessment team efforts were concentrated on the most severely impacted municipalities.

The table below is a breakdown of SBA estimates of business damage by county:

**Table 2-7: Business Damages**

| COUNTY | # Businesses With Major Damage | Estimated Cost of Damage | # Businesses With Minor Damage | Estimated Cost of Damage |
|---|---|---|---|---|
| Fairfield | 5 | $958,000 | 98 | $1,953,000 |
| Hartford | 4 | $479,000 | 17 | $190,000 |
| Litchfield | 0 | $0 | 9 | $168,000 |
| Middlesex | 7 | 598,000 | 13 | $265,000 |
| New Haven | 2 | $55,0002 | 22 | $680,000 |
| New London | 1 | $2,100,000 | 1 | $5,000 |
| **TOTALS** | **19** | **4,190,000** | **160** | **3,261,000** |

### 2.1.2.3 Meteorology of Winter Storms in Connecticut

Although Connecticut is a small state (less than 100 miles long and 60 miles wide), it has a very diverse winter climate. Average winter snowfall in central Connecticut is around 50 inches, however, snowfall at the coast is closer to 30 inches, and snowfall in the hills is close to 100 inches. This wide variation is the result of three factors:

1. The warmer waters in Long Island Sound and south of Long Island moderate the winter air mass and this mild air is drawn into coastal areas during winter storms. The mild air changes snow over to rain at the start of the storms and significantly reduces the total amount of snowfall;
2. The elevation of the northern hills combined with their distance from the coast results in colder temperatures, must less rain mixing in and greater snowfalls. In addition, the waters south of Long Island contribute moisture that is drawn into the storms and falls as snow in the hills. The effect of moisture being drawn into the storm can also lead to very intense heavy snowfalls with blinding conditions; and
3. In certain ideal conditions, as low pressure systems move off the mid-Atlantic or the Carolina coast they will undergo explosive development. This development can occur in as little as 6 hours, and manifests itself as a sharp drop in central pressure in the area surrounding the storm. This sudden drop in pressure is the result of a large mass of air being lifted and expanded into the atmosphere. The sudden expansion causes the air to cool dynamically. This sudden cooling can change a borderline rain/snow event over to all snow very quickly.

The combination of these factors cannot always be predicted with precision by computer models in advance of a storm. Meteorologists and other experts must often ground-truth the computer models during the event and adjust the forecasts accordingly.

### 2.1.2.4 Heavy Snowstorms in Urban Centers

During the early winter of 1988, several large snowstorms affected Connecticut at the height of traffic congestion in late afternoon. Traffic was at a standstill for up to 6 hours in some cases. As a result, the city of Hartford, in cooperation with several of the largest corporations in the city, prepared a snow traffic plan. When heavy snow is anticipated for an afternoon rush hour, each corporation will send a certain number of employees home early to relieve congestion. This plan significantly reduced congestion in similar storm events later that winter.

On February 5th, 2001, a major snowstorm hit Connecticut at noon with very heavy snow. Up to 25 inches of heavy wet snow fell in a 10 hour period causing major traffic jams as agencies and businesses shut down at noon. Traffic jams lasted up to 12 hours in some areas.

### 2.1.2.5 Potential Future Risk of Major Winter Storms

Due to their more frequent occurrence winter storms cause more annual flood damage along Connecticut's coastline than hurricanes. The high frequency of major winter storms occurring on average once every 5 years means that they will be a continued threat to both the coast and inland areas from flooding and heavy snowfall.

### 2.1.3 Ice Storms

Ice storms occur when warm air overrides cold air (32° F or colder) at the surface during a winter storm. The warmer air typically above 1,000 feet changes the precipitation to rain. However, the rain freezes on contact when it reaches the ground because the surfaces are below freezing. Ice storms occur every year in Connecticut. However major ice storms are rare because they require three factors: 1) temperatures well below freezing (28°F or colder); 2) cold temperatures for an extended duration (over 12 hours); and 3) greater than 1/2 inch of rain. The warmer waters of Long Island Sound and the waters south of Long Island mitigate these factors.

#### 2.1.3.1 History of Ice Storms

Connecticut's most severe ice storm occurred on December 18, 1973. Ice storm Felix resulted in two deaths and caused widespread power outages, which lasted several days. In January 1998, Connecticut narrowly missed the worst ice storm ever recorded in New England. A slow moving low-pressure system pushed into cold air over northern New England on January 7, 1998. Freezing rain developed and continued for 4 days. This was widely considered to be a once in a thousand year event.

In November of 2002 an ice storm occurred primarily in Litchfield and western Hartford Counties. The storm resulted in 2.5 million dollars in public sector damages for removal of debris and protective measures. A presidential disaster declaration was denied for this event.

#### 2.1.3.2 Potential Future Risk of Ice Storms

An ice storm of the magnitude of the 1998 northern New England storm is not considered possible in southern New England due to the close proximity of the warmer waters of Long Island Sound and the Atlantic Ocean. However, repeats of the 1973 ice storm are certainly possible. As ice storms can occur throughout the state, it is difficult to focus on any one area of the state as being more prone to ice storms than another. It is evident that since ice storms intersect with the general population at power lines and roadway tree belts areas with overland power lines and an abundance of trees are most vulnerable to the affects of ice storms.

### 2.1.4 Flooding

#### 2.1.4.1 River Flooding

Since there is no distinct flood season in Connecticut, major riverine flooding can and has occurred in every month of the year. However, the spring snowmelt, and late summer/early autumn hurricanes and tropical storms are periods when riverine flooding is more likely.

On October 7, 2005, a low-pressure system (the remnants of Hurricane Tammy) moved slowly up the eastern seaboard along a stalled frontal boundary. A wide ban of heavy rainfall developed along the U.S. East Coast stretching from South Carolina to Northern New England. Heavy rainfall associated with Tropical Storm Tammy and a surface low that

formed south of Tammy moved into Connecticut at 7:00 PM on Friday evening on October 7th. Rainfall continued heavy at times for the next 36 hours and ended on Sunday morning, October 9th around 3:00 AM. Rainfall totals during the first part of this storm ranged from 4 inches in southeastern Connecticut up to 12 inches in the northwestern hill. Flooding from this first rainfall event was minor across most areas with flood frequencies of less than 5-years in most areas. Flooding was minor during the October 7-9 event due to very dry antecedent soil and river conditions prior to the storm. This first event set the stage for the second event, leaving saturated soils and river basins at ½ to ¾ bank full conditions.

Light to moderate rainfall continued across Connecticut during the next 4 days. On Friday October 14th a surface low pressure system formed suddenly along a frontal boundary south of Long Island and moved northeastward into southern New England. A wide area of very heavy rainfall developed Friday evening that overspread all of southern New England. Rain began falling at a rate of nearly an inch an hour at 9 PM in western Connecticut and continued for 2 to 3 hours resulting in 2-4 inches of rainfall. The heavy rain moved east and intensified with rainfall rates exceeding an inch an hour in central and northeastern Connecticut adding 6-8 inches of rain within a 7-hour period between Friday night and Saturday morning. Combined with the previous week's rainfall, this heavy rainfall resulted in a very rare (100 year) flooding event.

The two rainfall events totaled 9-16 inches across the state causing major flooding of several sub-regional river basins in Hartford and Tolland counties and moderate flooding across the rest of Connecticut. According to Bradley International Airport measurements, this was the wettest October on record since 1905.

A total of 14 dams completely failed or partially failed. Another 30 dams were damaged throughout Connecticut. Several bridges failed and several dozen roads were washed out or undermined. The total damages to state, municipal and non-profit properties was estimated at $6.1 million, damages to businesses were estimated at $6.9 million, and damages to private residences were estimated at $29.6 million.

#### 2.1.4.2 Flood History

The winter of 1935/36 was cold and snowy and the usual January thaw of most winters did not occur. The "Great Connecticut River Flood" of March 1936 was the result of a combination of melting snow and moderately heavy rains over a 13-day period. The rainfall occurred in two peaks. The first peak occurred on March 11 – 12. This peak was the result of an apparent tropical system in the Gulf of Mexico that moved up the Appalachian Mountains and merged with a low-pressure system over western Quebec, Canada. On March 17 – 18 a strong low-pressure system moved up the interior East Coast from Virginia to Connecticut and brought heavy rainfall to the entire region. Rainfall amounts of 6 – 8 inches occurred in Connecticut. Combined with melting snow a total of 10 – 30 inches of water flowed into rivers across the entire Northeast from Ohio to Maine and south to Virginia.

Three major rivers were affected in Connecticut, the Connecticut, Housatonic and Thames Rivers. Each of these rivers reached all-time highs. The Connecticut River rose 8.6 feet higher than had been historically observed in the 300-year known history of the river.

The floodwaters left some 10,000 Connecticut families homeless, contaminated drinking water supplies, brought the threat of typhoid and resulted in curfews in the flood-ravaged

communities. Across the northeastern U.S. 150 – 200 people were killed, and approximately 100 million dollars in damage was caused in New England alone. In Connecticut, the flood left several dead and $20 million (1936 dollars) in property damage.

From June 4 - 7, 1982 heavy rains fell over most of Connecticut totaling 3 - 16 inches during the 48-hour storm. The hardest hit area was south-central Connecticut where flood frequencies up to the 1,000-year flood event occurred, according to the U.S.G.S. This precipitation occurred after a week of prolonged rainfall that had already saturated the ground. Dam failures in the hardest hit area around the mouth of the Connecticut River occurred in the towns of Chester, Haddam, Deep River, and Essex. A total of 30 dams failed or were partially breached during the storm.

Damages from the 1982 storm totaled $270 million (1982 dollars). Thirty-seven homes were destroyed and 1,500 suffered damage. About 200 commercial and industrial businesses suffered damage (including 4 privately owned sewage treatment plants). Eighteen state bridges and 25 municipal bridges also sustained severe damage. Eleven people were killed during or after the storm. The NRCS, in cooperation with DEP, performed emergency watershed protection on 14 rivers and streams in Connecticut following the floods. This storm led to the installation of an automated flood warning system in the State of Connecticut in 1986.

Connecticut was struck again by flooding from May 28 - June 2, 1984. Rainfall amounts reported by the NWS Northeast River Forecast Center (NERFC) ranged from 5.90 inches in Bridgeport up to 9.94" in Weston. Due to the wide coverage area of the rainfall across most of New England, flooding occurred on all three of Connecticut's large rivers.

Flood recurrence intervals ranged from 25 - 75 years in these river basins. Damages to public and private structures and facilities totaled $38 million (1984 dollars). The Department of Housing reported that 177 homes suffered major damage and 715 homes suffered minor damage. Temporary housing was required for 700 families.

Although the 1984 flooding event had a 50-year return frequency on the Connecticut River, damage from the storm was greatly mitigated due to large-scale flood control projects in Hartford and East Hartford. The establishment of Stream Channel Encroachment Lines (SCEL) in the 1960's also helped prevent development in the Connecticut River floodplain.

On June 5 - 6, 1992, a small but intense low pressure system moved northward from the North Carolina coast up the East Coast. A stationary front across Long Island blocked the northward movement of the storm and most of its moisture was wrung out over south central Connecticut. As much as 7-10 inches of rain fell in an 18-hour period, killing one person and causing approximately $10 million (1992 dollars) in flood damages. The Small Business Administration (SBA) declared a flood disaster for this event and provided $612,500 in low interest loans to businesses affected by the storm.

#### 2.1.4.3 Urban Flooding

Severe urban flooding can occur when thunderstorms with intense rainfall develop or stall over an urban center. These are typically summer thunderstorms that can drop 4 - 8 inches of rain over a small area in a matter of hours. Although not as costly in terms of damage or lives lost, urban street flooding is becoming more common in Connecticut because of increased

development. On August 11 - 12, 2000 the town of Stratford and the city of Bridgeport suffered severe urban flooding resulting from a thunderstorm that dropped as much as 7 inches of rainfall over a heavily urbanized area in less than 4 hours. This rainfall was the result of a wet micro-burst from intense slow-moving thunderstorms. A wet micro-burst is an intense downdraft out of the bottom of a thunderstorm that carries a large amount of water. Sixty businesses, 471 homes, and 3 high schools were flooded with as much as 6 feet of water. Damages totaled $5.9 million (2000) dollars, and the SBA declared a disaster, providing low interest loans. Flooding from this storm event exceeded the 500-year recurrence interval along Tanner's Brook in Stratford.

#### 2.1.4.4 Potential Future Risk of River Flooding

Major flooding of Connecticut's small rivers and loss of several lives can be expected once every 5 - 10 years during the 21st Century. Major flooding of the larger rivers (Housatonic, Connecticut, Farmington) with some loss of life and several hundred million dollars in damage can be expected once every 30 years on average. Since the passage of flood regulations in 1968, and the creation of FEMA in 1978, flood vulnerability in Connecticut has continued to increase but at a slower rate than it would have in the absence of regulation.

#### 2.1.4.5 Potential Future Risk of Urban Flooding

The urban flood risk will continue to increase steadily over the next several decades because many factors that affect urban flooding cannot be mitigated. These include large-scale urbanization combined with older, undersized drainage systems that are so extensive that the cost to upgrade them is prohibitive as part of post-disaster mitigation. Urbanization will continue to create more impervious areas that channel increased runoff into under-sized catch basins, causing flooding of low lying areas within municipalities and along small urban brooks. Automated warning systems cannot effectively warn against the very rapid onset of urban flooding that occurs within 1 hour of the start of heavy rainfall.

### 2.1.5 Ice Jams

An ice jam is an accumulation of ice in a river that restricts water flow and may cause backwater that floods low-lying areas upstream from the jam. Areas below the ice jam can also be affected when the jam releases, sending water and ice downstream. Ice jam damages can affect homes, buildings, roads, bridges and the environment (e.g., through erosion, sedimentation, bank scour, tree scarring, etc.)

According to the Special Report 94-7 Ice Jam Data Collection, by the US Army Cold Regions Research and Engineering Laboratory (CRREL) (March 1994), ice jams can be generally grouped into three categories: freeze-up jams, breakup jams, or a combination of both. Each has different ice jam characteristics and associated mitigation and control.

The following description of the types of ice jams, and mitigation and control techniques has been taken all or in part from Pamphlet No. 1110-1-11, Engineering and Design Ice Jam Flooding: Causes And Possible Solutions, US Army Corps of Engineers, November 1994. Freeze-up jams are

composed primarily of frazil[3] ice (often described as slush ice), with some fragmented ice included, and occur during early winter to midwinter. The floating frazil may slow or stop due to a change in water slope from steep to mild because it reaches an obstruction to movement such as a sheet ice cover, or because some other hydraulic occurrence slows the movement of the frazil. Jams are formed when floating frazil ice stops moving downstream, forms an "arch" across the river channel, and begins to accumulate. Freeze-up jams are characterized by low air and water temperatures, fairly steady water and ice discharges, and a consolidated top layer.

Breakup jams occur during periods of thaw, generally in late winter and early spring, and are composed primarily of fragmented ice formed by the breakup of an ice cover or freeze-up jam. The ice cover breakup is usually associated with a rapid increase in runoff and corresponding river discharge due to a significant rainfall event or snowmelt. Late season breakup is often accelerated by increased air temperatures and solar radiation.

The broken, fragmented ice pieces move downstream until they encounter a strong intact downstream ice cover or other surface obstruction to flow (such as a dam or bridge), or other adverse hydraulic conditions such as a significant reduction in water surface slope. Once they reach such a jam initiation point, the fragmented ice pieces stop moving, begin to accumulate, and form a jam. The ultimate size of the jam (i.e., its length and thickness) and the severity of the resulting flooding depend on the flow conditions, the available ice supply from upstream reaches of the river, and the strength and size of the ice pieces.

Midwinter thaw periods marked by flow increases may cause a minor breakup jam. The river flow subsides to normal winter level and the jammed ice drops with the water level as cold weather begins. The jam may become grounded as well as consolidated or frozen in place. During normal spring breakup, this location is likely to be the site of a severe jam. Combination jams involve both freeze-up and breakup jams. Causes of all ice jams include river geometries, weather characteristics, and floodplain land-use practices such as bridge obstructions or dams.

Ice jam mitigation techniques include both structural and non-structural measures. Some are permanent while others can be deployed under emergency conditions when a jam has formed and flooding is occurring. Ice jam mitigation measures are described in Pamphlet No. 1110-1-11.

The CRREL maintains a database of ice jam history, which draws largely from USGS river gauge information. This database includes 132 records of jams in Connecticut dating back to 1902. The database indicates that Connecticut experiences both freeze-up and breakup type events. Other sources of information include historical accounts, newspapers, personal interviews and CRREL files. However these sources of data while providing important narrative information about ice events and related damage often lacks quantitative information of the type found in USGS sources.

[3] Frazil ice consists of small particles of ice formed in highly turbulent, super-cooled water, such as river riffles, during cold, clear winter nights when the heat loss from the water to the atmosphere is very high. As the frazil particles are transported downstream, they join together to form flocs that eventually rise to the surface where they form frazil pans or floes. Frazil ice is often described as *slush ice* because of its appearance. Pamphlet No. 1110-1-11, Engineering and Design Ice Jam Flooding: Causes And Possible Solutions, US Army Corps of Engineers (November 1994) Page 3-1.

### 2.1.5.1 Recent History of Ice Jams in Connecticut

**Salmon River, East Haddam (Leesville)**[4]

Ice jam related flooding has historically been a problem along the lower reach of the Salmon River in the Leesville area of East Haddam. Damaging ice jam occurred most recently in 2000 resulting in local road closure.

A similar event in 1994 was the result of a break-up of thick river ice in response to a sudden increase in discharge by snowmelt and rainfall. The ice jam formed about a half mile downstream of the Route 151 Bridge and progressed back to about 500 feet downstream of the dam. This jam caused water levels in the river to rise even more, flooding several homes and Powerhouse Road.

Another ice jam event occurred in February 1982 when ice flowed over the dam and jammed at the Route 151 Bridge. Many residents in the area believe the lowering of the dam and removal of its control gates has resulted in increased ice jam activity in the area below the dam. Historical evidence supports this presumption as similar winter jams occurred in January 1910 and 1940 when structural damage to the dam allowed ice to flow out of the impoundment. In each of these earlier cases the dam was repaired shortly after the damage occurred.

Based on available records for the Salmon River, it appears that severe ice jams events similar to 1982 and 1994 are likely to occur when ice thickness exceeds 9 inches and average daily discharge increases by 1,400 cubic feet per second (cfs) or more during a single day. Seasonal breakup events based on discharge and temperature records are related to one-day increases in stage, in excess of 1.5 times the ice thickness.[5] Also, tides (tidally influenced back water from the Connecticut River) appear to influence the ice jams location and the ice jams form both above and downstream of the Route 151 Bridge.

**Shetucket River, Sprague (Baltic)**[6]

The village of Baltic, is a section of Sprague located along the Shetucket River about 9 miles upstream from the Thames River confluence. The total drainage area at Baltic is 460 square miles. There are two hydroelectric dams that affect river discharge. The Scotland Dam is located about 4 miles upstream and the Occum Dam is located about 2.2-miles downstream from the Main Street Bridge (Route 97).

Since 1956, the town has experienced several ice jams during mid to late winter, usually in January and February. Prior to 1956, no ice-related flooding was recorded in the village, probably because Baltic Dam, which breached in 1955, controlled the ice upstream of the populated area of the village.

These break-up jams form when solid ice cover on the Shetucket River breaks up and moves downstream. It appears as though most of the ice that causes the problems in Baltic comes

[4] Section 22 Planning Assistance To States Program, Salmon River Ice Jam Investigation, US Army Corps of Engineers (December 1995).
[5] Reconnaissance Report, Shetucket River, Sprague (Baltic), Connecticut, Local Ice Jam Flood Protection, US Army Corps of Engineers (May 1995).
[6] See Footnote #4.

from a 2-mile river reach between the Scotland Dam upstream on the Shetucket River and the village. The slope of the river through this reach is very flat and the channel meanders, causing ice floes to lose momentum and slow down. In addition, the backwater of Occum Dam, located about two miles downstream of the village, causes thick and stable flows. As a result the ice jams tend to remain intact until sufficient pressure is built up behind them to dislodge the jam and move it downstream.

In the mid-1950's, the town requested assistance from the U.S. Army Corps of Engineers (USACE) for non-ice related flooding. As a result an earthen flood control berm was built along the low-lying residential area. This berm has a top elevation of about 77.5 feet NGVD, and a top width of about 8 feet. Although the berm does not tie into high ground, it does provide protection against an approximate 10-year flood event.

**Table 2-8: Rivers Susceptible to an Ice Jam**

| No. | Rivers Name | Location |
|---|---|---|
| **1** | Shetucket River | Baltic |
| **2** | Salmon River | East Haddam |
| **3** | Pomperaug River | Southbury |
| **4** | Yantic River | Norwich |
| **5** | Moosup River | Plainfield |
| **6** | Quanduck River | Sterling |
| **7** | Blackledge River | Marlborough |
| **8** | Willimantic River | Mansfield |
| **9** | Limekilm Brook | Bethel |
| **10** | Shepaug River | Roxbury |
| **11** | Blackberry River | North Canaan |
| **12** | Connecticut River | Hartford |

On January 29, 1994, an ice jam occurred on the Shetucket River downstream of the Route 97 Bridge in Baltic. The ice jam, about three-fourths of a mile in length, was grounded in numerous locations. Although the average ice thickness was 18 to 20 inches, the jam appeared to be about 8 feet thick in several locations. Floodwaters behind the jam overtopped the flood control berm and inundated 31 houses and 4 commercial businesses. One house was severely damaged when the ice broke through the masonry block foundation wall. Eventually, a channel opened under the ice to allow some discharge to pass the jam and the flood area drained, but the jam remained in place.

This severe ice jam flood prompted a post-disaster reconnaissance study by the USACE, who estimated that the ice jam of 1994 resulted in flood damages of $526,000 for 31 residential properties and 4 commercial properties. In addition, it was estimated that the flood stages experienced during the January 1994 flood could occur as a result of ice affected flow approximately once in 12 years. The principal ice jam flood problem is located adjacent to Route 97. It extends a distance of about 2,200 linear feet from a drainage culvert under Route 97 that drains a low area south of the state highway to an area upstream of the Blanchette Field at River Drive. It is estimated that there are 84 structures in the 500-year flood plain, 77 of which are residential structures, 4 are commercial structures and 3 are public buildings.

#### 2.1.5.2 Potential Future Ice Jam Risk

Although limited data exists regarding historic damages associated with ice jams, the twelve well-documented ice jams since 1961indicate that typical damages include road closures, bridge damages, evacuation, residential and commercial damage. Rivers in Connecticut susceptible to ice jam formation based on historic events are listed in Table 2-3. These rivers do not show any geographic or regional similarities. It should be noted that there is a greater knowledge of the series of events that can lead to ice jams, and with this knowledge Connecticut DEP and DEMHS are better prepared to proactively warn downstream residents in the event that ice is moving and has the potential to form an ice jam.

### 2.1.6 Forest Fires

The state-wide system of programs and policies regarding the control of forest fires had its beginning almost 100 years ago. In 1905 the legislature established a formal system of locally appointed forest fire wardens who were supervised by a state forest fire warden.

At that point in history, Connecticut was largely rural. However, farms were gradually being abandoned as farmers and their families found better wages and easier living in the cities. These farms began to revert to a natural state - first to brush land and then to forest. Forest fires started and burned undetected for days. Once a fire was discovered, the efforts of the few, poorly-staffed, ill-equipped, rural volunteer fire companies were usually only effective in protecting houses and barns from approaching forest fires. Rural roads were largely gravel or dirt, and often deep ruts blocked fire-fighters and their equipment from effectively managing a forest fire. Fire-fighting equipment was rudimentary, with very little equipment designed specifically for forest fire suppression.

The statutory foundations for today's forest fire control programs and policies were enacted by the legislature between 1905 and 1927. The death of great numbers of American chestnut trees from 1910 through 1925, due to the Chestnut Blight, led to an increase in the intensity of forest fires during that period. Created during this time was the State Forest Fire Warden system, an establishment of a network of fire lookout towers, the institution of a system regulating open burning, and the establishment of forest fire patrols.

In 1949, the unusually severe fire weather of the mid- to late-1940's (1947 in particular) led the legislature to approve Connecticut's membership in a new, regional mutual aid organization for forest fire protection - the Northeastern Interstate Forest Fire Protection Compact.

The forests of Connecticut today are dramatically different from the Connecticut of 1905, or 1927, or the 1940's. The forests contain an increased amount of older growth large trees, and are more extensive in landmass. The forests have reclaimed more than 500,000 acres of what was once farmland 90 years ago. But perhaps the most significant change that has occurred is what is now found in forested areas – residential development. Increasingly, residents of Connecticut's are returning to live in or near forested areas due to the areas' attractive natural qualities. Once rural communities such as Newtown, Wallingford, and Burlington can now be classified as suburban areas, even though they retain much of their tree cover. The interface between humans and the forest is increasing yearly as sprawl extends further and further out from Connecticut's traditional urban cores.

The technology of forest fire fighting and the capabilities of fire fighting equipment have changed dramatically over the years. Advances in gear, equipment, training and technology have progressed.

For instance the use of radio and cell phone communication has greatly improved fire fighting command capabilities, and the use of equipment such as air attack by helicopter water drops was unheard of in the 1940's. These incremental changes to Connecticut's forests and demographics over the past 50, 70, and 90 years have significantly changed the face of wild fire control. In September 1995 The Findings and Recommendations of the Select Committee on Forest Fire Control was published. This report analyzed the statewide system of forest fire control and made various recommendations, many of which have been implemented.

#### 2.1.6.1 Recent Forest Fire Experience in Connecticut

The Forestry Division of the DEP maintains statistical records concerning forest fire occurrences in the State. Reporting of forest fires is based upon the National Fire Incident Reporting System (NFIRS). This system came on line in 1997 and is administered through the State Fire Marshal's Office. This system has greatly improved the accuracy of reported data concerning forest fires (cause, size, etc.)

In Connecticut, approximately 600 acres per year are burned by wildfires (1994 through 2003).[7] This annually represents less than three one hundredths of a percent of the total forested acreage in Connecticut. Connecticut wild fire experience indicates that fires are small and detected early. During the last ten years only one wildfire occurred of slightly greater than 300 acres. The vast majority of wildfires are less than 10 acres in size. Arson is the number one known cause of forest fires. Almost one-half of all wildfires are intentionally set.

During the past ten years, the worst wildfire year in terms of both number of fires and total acreage burned occurred during 1999, which was the fourth hottest year of the past 100 years. Over 345 separate fires burned 1,733 acres. The annual acreage of forested areas damaged through wildfires has been declining dramatically over the past generation. Statistics indicate that while Connecticut has an increasing urban/wildfire interface, there is not a large resultant wildfire problem.

#### 2.1.6.2 Potential Future Forest Fire Risk

Connecticut traditionally experiences high forest fire danger in the spring from mid-March through May. DEP's Division of Forestry continually monitors the danger of forest fire to help protect Connecticut's 1.8 million acres of forestland. Throughout the spring forest fire season, daily advisories on forest fire danger levels are sent to DEP state park forest field staff, municipalities, fire departments and the media. Forest fire danger levels are classified as low, moderate, high, very high or extreme. In an average year approximately 600 acres of Connecticut's forests are scorched by forest fires.

The DEP Forestry Division is now utilizing precipitation and soil moisture data provided through the Connecticut Automated Flood Warning System to compile forest fire probability forecasts during the spring fire season. This allows the Division to watch only the driest areas and has resulted in a reduction of both costs (measured in the thousands of dollars) and risk.

As development pressures increase within Connecticut, the interface between humans and the forests increase. The urban sprawl has started to intersect with the forested areas in

[7] Statistics on Connecticut forest fires compiled from USDA Forest Service Annual Wildfire Summary Reports for 2003 through 1994.

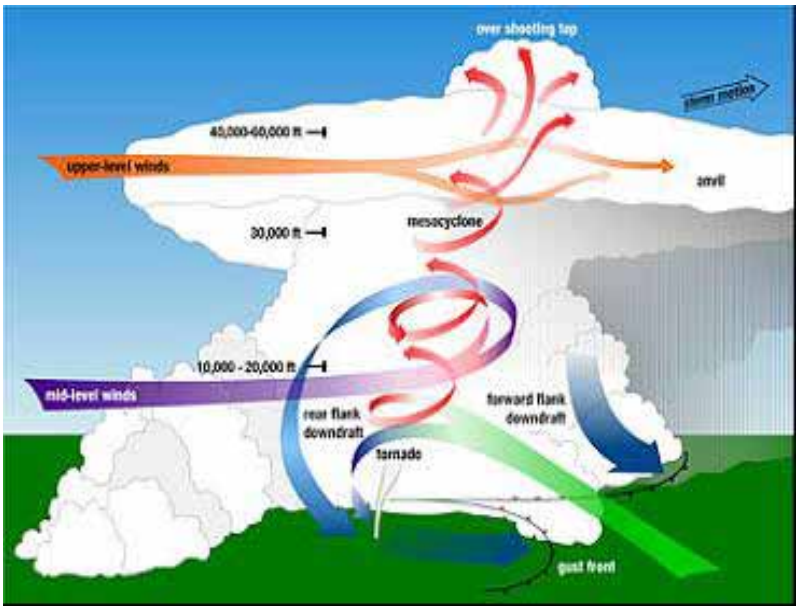
Connecticut. For environmental and aesthetic reasons, we are noticing that home builders are leaving much of the natural setting in place. This means that mature trees and mature forests are much closer to new homes than they have been in the past. This leaves these new homes susceptible to threats from forest fires. Although most of Connecticut's forest fire dangers are in rural areas, sub-urban areas are also susceptible to the threat of forest fire.

## 2.1.7 Tornadoes

### 2.1.7.1 History of Tornadoes

The National Oceanic and Atmospheric Administration (NOAA) defines a tornado as, "a violently rotating column of air extending from a thunderstorm to the ground." There are three main sizes of tornadoes: weak, strong , and violent. Weak tornadoes account for approximately 69% of all tornadoes and have associated winds of less than 110 mph. Strong tornadoes account for approximately 29% of all tornadoes and have associated winds of 110-205 mph. Violent tornadoes are rare but extremely destructive. They account for 2% of all tornadoes and have winds of 205 or greater mph[8]. Figure 2-3 provides a visual presentation of windflow and physical breakdown of a tornado.

Figure 2-3 Visual Diagram of a Tornado




Connecticut experienced 81 tornado incidents in the period from 1950-2003. These incidents have occurred throughout all of Connecticut in the months from April through October. These tornadoes have caused $590 million in damage, claimed at least 7 lives and injured 700 people. Connecticut averages approximately three tornadoes every two years.

[8] Data source: NOAA, A Preparedness Guide; February 1995.

The deadliest tornado on record to strike Connecticut occurred August 9, 1878 in central Connecticut. Although damage along its two-mile path was limited, it left 34 people dead and over 100 injured. Another deadly tornado occurred in Connecticut on May 24, 1962, in which one person was killed and 45 injured. The 1962 tornado destroyed 70 structures and heavily damaged 175 others along its 12-mile path. Total damages exceeded 5 million (2004 dollars). On October 3, 1979, a tornado ripped a path through Windsor and Windsor Locks, killing 2 people, and injuring 10 others. It destroyed 12 homes, left another 40 uninhabitable and caused an estimated $214 million (1979 dollars) in damages. As a result of this tornado, two towns were declared Federal disaster areas.

The most recent deadly tornado in Connecticut occurred on July 10, 1989. The tornado cut a path through western Connecticut, from Salisbury to New Haven in less than 1 hour. Two people were killed and 67 homes were destroyed. Damages totaled $125 million (1989 dollars), and a Presidential Disaster Declaration was issued (FEMA-837-DR-CT).

#### 2.1.7.2 Potential Future Tornado Risk

The pattern of occurrence and locations for tornadoes in Connecticut is expected to remain unchanged in the 21st Century. The highest risk for tornadoes is expected in New Haven and Hartford Counties. The second area of moderate to high risk is in Fairfield and New Haven Counties. The Counties of Middlesex, Tolland and Windham have a moderate risk and the County of New London can expect a low risk.

### 2.1.8 Drought

Droughts have occurred periodically in Connecticut, most recently during 1964-1968, 1981, 1987, 1988 and 2002. Droughts can vary widely in duration, severity, and local impact. They can have widespread social and economic significance that require the response of numerous parties.

While the agricultural drought of 1957 was the most disastrous to the State's agricultural interests it was also a severe meteorological drought for small reservoirs in the State. Other meteorological droughts of June 1929 through July 1932 and the mid-60's were also very serious. Connecticut experienced its drought of record during the 1960's with rainfall deficits reaching their highest levels in the spring of 1965. This 1965 drought severely restricted the ability of a number of water utilities throughout Connecticut to continue to provide unlimited service to their customers.

#### 2.1.8.1 Precipitation and Physiography[9]

Connecticut enjoys relatively abundant precipitation, which ranges from approximately 40 inches median annual along the coastal zone to a median-annual precipitation of over 53 inches in the western uplands. The distribution of precipitation in both space and time is strongly influenced by physiography.[10] The distribution of precipitation in Connecticut may

[9] Hunter, Bruce W. and Meade, Daniel B. Precipitation in Connecticut 1951 – 1980. Natural Resources Center, Connecticut Department of Environmental Protection, DEP Bulletin No. 6 (1983).
[10] Hunter, Bruce W. and Meade, Daniel B. Precipitation in Connecticut 1951 – 1980. Natural Resources Center, Connecticut Department of Environmental Protection, DEP Bulletin No. 6 (1983).

be roughly divided into four major physiographic zones.[11] A coastal zone, extending two to ten miles inland from Long Island Sound is characterized by low elevation, low relief hills, and numerous small bays, inlets, and tidal marshes.

The central lowlands zone extends north to south through central Connecticut from Massachusetts to the coast and ranges up to 20 miles in width. This lowland includes parts of three major river valleys; the Connecticut, the Farmington, and the Quinnipiac.

Topography is generally flat with the exception of narrow north-south ridges that rise abruptly to elevations as much as 700 feet above the lowlands.

The eastern and western uplands are characterized by hills and valleys. Elevations in eastern Connecticut range from 250 feet to over 1,000 feet above sea level. The uplands of western Connecticut range in elevation from 250 feet to over 2,000 feet above sea level, and the area is characterized by considerable and abrupt topographic change.

#### 2.1.8.2 Drought Categories

Donald A. Wilhite, director of the National Drought Mitigation Center, and Michael H. Glantz of the National Center for Atmospheric Research categorized the definitions of drought in terms of four basic approaches to measuring drought: meteorological, agricultural, hydrological, and socioeconomic. The first three approaches deal with ways to measure drought as a physical phenomenon. The last deals with drought in terms of supply and demand, tracking the effects of water shortfall as it ripples through socioeconomic systems. Each of the four basic categories of drought are discussed below (taken generally from the National Drought Mitigation Center web site except where otherwise noted.)

*Meteorological drought* is usually an expression of precipitation's departure from normal over some period of time. These definitions are usually region-specific, and presumably based on a thorough understanding of regional climatology. Meteorological measurements are the first indicators of drought. In Connecticut basic measures of meteorological drought include precipitation deficits and the Palmer drought severity index.

*Agricultural drought* occurs when there isn't enough soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought happens after meteorological drought but before hydrological drought. Agriculture is usually the first economic sector to be affected by drought. The key to agricultural drought is not only its severity but also its timing. In Connecticut, agricultural droughts tend to be most serious when the plants are forming or filling their seeds, generally in mid-summer (*Drought, Forests and Agriculture in Connecticut*, Dr, David Miller, UCONN, 2002).

One of the most significant historic agricultural droughts in Connecticut occurred during 1957. It was a short intense period of precipitation deficit that corresponded with the growing season. "Precipitation from May 3 to October 3 ranged from 7 to 8 inches in the extreme

[11] Hunter, Bruce W. and Meade, Daniel B. Precipitation in Connecticut 1951 – 1980. Natural Resources Center, Connecticut Department of Environmental Protection, DEP Bulletin No. 6 (1983).

northeast to 14 to 16 inches in southern hilly areas away from the immediate coast. Statewide precipitation during the period averaged 55 percent of normal."[12]

*Hydrological drought* refers to deficiencies in surface and ground water supplies. It is measured as streamflow and as lake, reservoir, and groundwater levels. There is a time lag between lack of rain and less water in streams, rivers, lakes, and reservoirs, so hydrological measurements are not the earliest indicators of drought. When precipitation is reduced or deficient over an extended period of time, this shortage will be reflected in declining surface and subsurface water levels.

*Socioeconomic drought* refers to the situation when water shortages begin to effect people and their lives. It associates economic good with the elements of meteorological, agricultural, and hydrological drought. For instance when a hydrological drought becomes so severe as to result in use restriction or prohibition against non-essential uses, some businesses may be adversely affected. Some economic goods such as hydropower are dependent upon the weather and resultant stream flow. Due to variations in climate, some years have high supplies of water, but other years the supply is very low. A socioeconomic drought takes place when the supply of an economic good cannot meet the demand for that production, and the cause of this shortfall is weather related (water supply).

Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors. For example, a precipitation deficiency may result in a rapid depletion of soil moisture that is almost immediately discernible to agriculturalists, but the impact of this deficiency on reservoir levels may not affect hydroelectric power production, drinking water supply availability or recreational uses for many months.

#### 2.1.8.2.1 Hydrological Drought and Land Use

Although climate is a primary contributor to hydrological drought, other factors such as changes in land use (e.g., deforestation), land degradation, and the construction of dams all affect the hydrological characteristics of the basin. Since regions are interconnected by hydrologic systems, the impact of meteorological drought may extend well beyond the borders of the precipitation-deficient area. For example, the Southwest Regional Pipeline interconnects most of the major public water supply systems in Fairfield County, Connecticut. This promotes supply sharing, and system redundancies and results in mitigating the effect of a hydrological drought on any one system. However, since the entire Fairfield county coastline area is dependent upon large reservoirs located further inland, meteorological drought inland may severely affect the sources of supply resulting in the need for drought restrictions in the coastal service areas even if these areas are not experiencing meteorological drought. Land use change is another one of the ways human actions alter the frequency of water

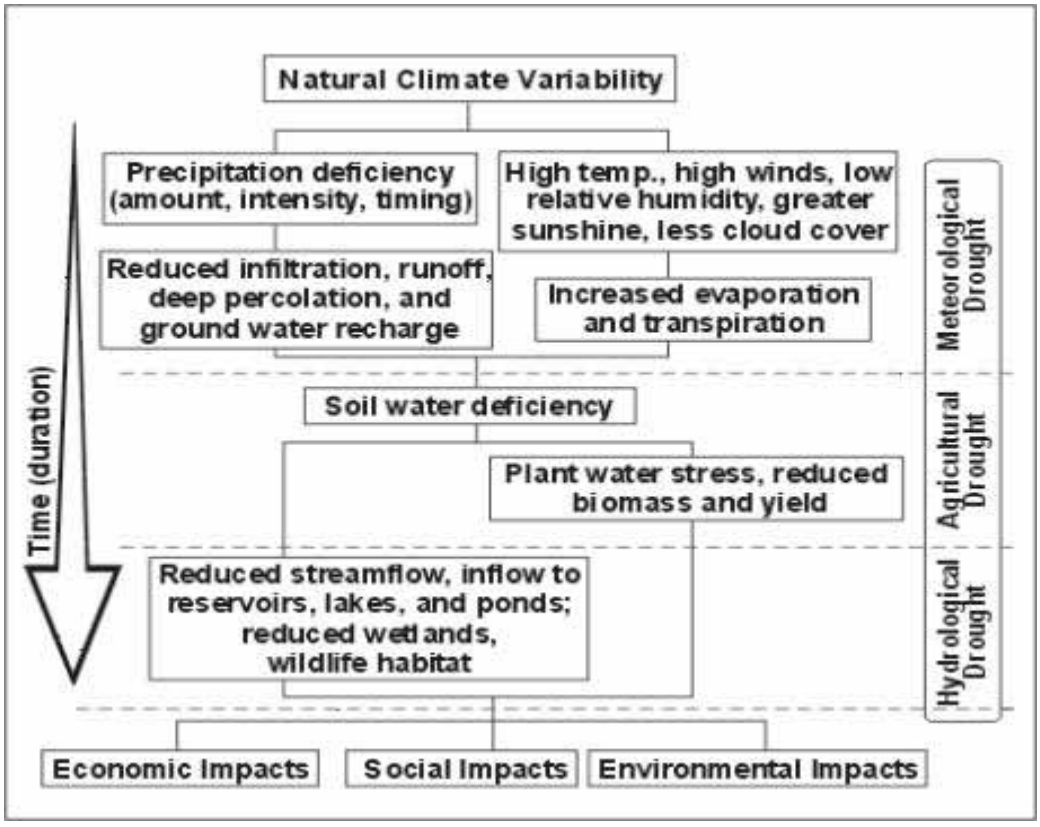
[12] Brumbach, Joseph J. The Climate of Connecticut. State Geological and Natural History Survey of Connecticut, Bulletin Number 99, (1965). P.109

shortage even when no change in the frequency of meteorological drought has been observed. For instance as the degree of imperviousness increases due to development, recharge of groundwater is lessened and low-flows in streams which depend upon this groundwater infiltration are reduced.

#### 2.1.8.2.2 Sequence of and Potential Risk of Drought Impacts

The sequence of impacts associated with meteorological, agricultural, and hydrological drought further emphasizes their differences. When drought begins, the agricultural sector is usually the first to be affected because of its heavy dependence on stored soil water. Soil water can be rapidly depleted during extended dry periods. If precipitation deficiencies continue, then people dependent on other sources of water will begin to feel the effects of the shortage.

**Figure 2-4: Sequence of Drought Impacts**




Those who rely on surface water (i.e., reservoirs and lakes) and subsurface water (i.e., ground water), for example, are usually the last to be affected. A short-term drought that persists for 3 to 6 months may have little impact on these sectors, depending on the characteristics of the hydrologic system and water use requirements.

When precipitation returns to normal and meteorological drought conditions have abated, the sequence is repeated for the recovery of surface and subsurface water supplies. Soil water reserves are replenished first, followed by streamflow, reservoirs and lakes, and ground water. Drought impacts may diminish rapidly in the agricultural sector because of its reliance on soil water, but linger for months or even years in other sectors dependent on stored surface or subsurface supplies. Ground water users, often the last to be affected by drought during its onset, may be last to experience a return to normal water levels. The length of the recovery period is a function of the intensity of the drought, its duration, and the quantity of precipitation received as the episode terminates.

### 2.1.9 Dam Failures

Dam failures have been concern for many years throughout the United States and Connecticut has had a number of significant dams fail in the past seventy plus years. There are a number of causes for dam failure, but the most common reasons for a dam failing is overtopping. Overtopping occurs when a dam's spillway capacity is exceeded and portions of dam which are not designed to convey flow, begin to pass water, and erode away and ultimately fail. Some other modes/causes of failure are design flaws, foundation failure, internal soil erosion, inadequate maintenance, or misoperation

While dam failures that occur during flood events compound an already tenuous situation by adding additional water to streams that are already flooded are considered problematic, it is the dam failures that occur on dry days that are the most dangerous. These "dry day" dam failures typically occur without warning and consequently the unaware downstream property owners are more vulnerable to being caught in such dry day failures then failures during flood events.

Connecticut has experienced many dam failures, mainly resulting from flood events. Exact numbers of dam failures caused by Connecticut's floods of 1938 and 1955 are not available, but anecdotal information leads CTDEP to believe that many more dams were damaged during those storm events than in the 1982 or 2005 events.

A breached or failed dam can be devastating to a community. One of the worst dam failures in Connecticut occurred in 1963, when Spaulding Pond Dam in Norwich failed, causing 6 deaths and over 6 million dollars of damage (1963 dollars). In 1961, Crystal Lake dam in Middletown burst injuring 3 persons and severely damaging 11 homes.

On the weekend of June 5-6, 1982, Connecticut suffered one of its worst floods since 1955. Throughout the State, 17 dams failed and another 31 dams were seriously damaged, due to a rainfall event that produced up to 18 inches of rain and resulted in damages totaling $70 million dollars. Tragically, 11 flood-related deaths were recorded, although none were directly related to dam failure.

**Major Downstream Damage - Bushy Hill Dam Break, 1982**

In October 2005, Connecticut experienced moderate to major flooding statewide. Major flooding occurred in several river basins in Hartford and Tolland counties and widespread moderate flooding across the rest of Connecticut. Flood flow frequencies exceeded a 100-year event in parts of north-central and northeastern Connecticut. DEP is aware of 14 dams which completely failed or partially failed in Hartford and Tolland counties. Another 30 dams were damaged throughout Connecticut. Several bridges failed and several dozen roads were washed out or undermined. Thousands of homes suffered flooded basements and evacuations were conducted in dozens of towns due to severe flooding. As a result of the flooding which resulted in an estimated $42 million in damages, with more than 5,200 homes and 355 businesses affected., President Bush declared Litchfield, New London, Tolland and Windham Counties Disaster Areas.

*Regulated Dams by Hazard Class*

| Dam Hazard Classification | Number of Dams | Percentage |
|---|---|---|
| C - High Hazard | 239 | 8% |
| B - Significant Hazard | 264 | 9% |
| BB - Moderate Hazard | 692 | 23% |
| A - Low Hazard | 1800 | 60% |
| TOTAL Regulated Dams | 2995 | 100% |

The potential for dam failure in Connecticut is significant given that Connecticut has approximately 3,000 dams that come under the jurisdiction of the Commissioner of Environmental Protection. These dams fall into four potential hazard classes: there are 239 "High" hazard potential dams (dams whose failure would cause loss of life or major damage to structures, highways, etc.); 264

"Significant" hazard potential dams (dams where failure might possibly cause loss of life or minor damage to structures, highways, etc.); 692 "Moderate" hazard potential dams (dams whose failure would damage unoccupied storage structures or damage low volume roadways); and 1800 "Low hazard potential dams (dams whose failure would damage agricultural land or unimproved roadways). For the reference of the reader, a list of the 239 High hazard dams in Connecticut is attached as Appendix D.

#### 2.1.9.1 Potential Risk and Impact of Dam Failures

There is no particular season or geographic location that is more susceptible to dam failures than another in Connecticut. However, we have started to monitor climate change predictions as they effect the numbers of and severity of heavy rain events in Connecticut.

### 2.1.10 Earthquakes

Earthquakes are caused by the shifting of sections of the Earth' s crust along faults. There are many more inactive faults than active ones. Most of the faults in Connecticut were created millions of years ago. Connecticut is considered to be a moderate seismic risk as defined by the FEMA. However, the term, "moderate" relates to the fact that earthquakes in the State have a relatively long reoccurrence interval and not that the earthquake magnitudes or impact on the population is necessarily moderate. According to the Northeast States Emergency Consortium there have been a total of 137-recorded earthquakes in Connecticut from 1568 – 1989.

The magnitude of an earthquake is a measure of the amount of energy released. Each earthquake has a unique magnitude assigned to it. This is based on the amplitude of seismic waves measured at a number of seismograph sites, after being corrected for distance from the earthquake. Magnitude estimates often change by up to 0.2 units, as additional data are included in the estimate.

**Table 2-9: Richter Earthquake Magnitude Scale**

| Magnitude | Description |
|---|---|
| M = 1 to 3 | Recorded on local seismographs, but generally not felt. |
| M = 3 to 4 | Often felt, no damage. |
| M = 5 | Felt widely, slight damage near epicenter. |
| M = 6 | Damage to poorly constructed buildings and other structures within 10's km. |
| M = 7 | *"Major"* earthquake, causes serious damage up to ~100 km (recent Taiwan, Turkey, Kobe, Japan, and California earthquakes). |
| M = 8 | *"Great"* earthquake, great destruction, loss of life over several 100 km (1906 San Francisco). |
| M = 9 | *"Rare"* great earthquake, major damage over a large region over 1000 km (Chile 1960, Alaska 1964.) |
| M = 10 | Very rare in the world. Complete destruction. |

The Richter scale is logarithmic, that is an increase of 1 magnitude unit represents a factor of ten times in amplitude. The seismic waves of a magnitude 6 earthquake are 10 times greater in amplitude than

those of a magnitude 5 earthquake. However, in terms of energy release, a magnitude 6 earthquake is about 31 times greater than a magnitude 5.

The intensity of an earthquake varies greatly from site to site depending on the distance from the earthquake epicenter, ground conditions, and other factors.

#### 2.1.10.1 Earthquake History in Connecticut

A significant earthquake occurred in Newbury, Massachusetts in 1727, and was felt from Maine to Delaware. According to the USGS the most severe earthquake to occur in CT happened on May 16, 1791[13]. This earthquake consisted of 2 heavy shocks in short succession, with 30 aftershocks reported within a short period of time following the 2 main shocks. Damage to homes, stonewalls and the opening of fissures near Moodus River Falls was recorded.

The next strongest earthquake to occur in Connecticut was located near Hartford and happened on 11/14,1925[14]. No significant or substantial damaged was recorded for this event.

More recently there have been several earthquakes within states neighboring Connecticut. During 1982, there was an earthquake that occurred near Albany, NY, and one that same year in Moodus, CT. Earthquakes near Moodus rarely exceed one mile in depth. However, buildings constructed in Connecticut were not required to be tolerant any minimum level of seismic activity prior to 1975. This may result in potentially large levels of structural damage for buildings built prior to 1975 in the event of a future earthquake occurring in Connecticut. Connecticut updated its building codes again in 1992 to include the new Building Officials and Code Administration (BOCA) codes for seismic activity.

#### 2.1.10.2 Potential Risk of an Earthquake in Connecticut

In viewing the seismic hazards map prepared by USGS, it was noted that southwestern Connecticut and the area around Moodus Connecticut had the risk of more intense earthquakes than the remainder of Connecticut. The area around Moodus is not commercially developed and has very few if any structures over 4 stories, it will not be as prone to heavy damage during an earthquake of the frequency and magnitude expected in Connecticut. However, the area around Southwestern Connecticut, especially the City of Stamford has a large commercial district. This commercial district is comprised of many multi-story buildings and as such would be more susceptible to earthquake damage than other areas in Connecticut.

### 2.1.11 Tidal Wave (Tsunami) History

Tidal waves along the East Coast are rare events and are caused by two types of natural events, offshore earthquakes causing submarine landslides and backwash from intense hurricanes or severe thunderstorms.

[13] See history of earthquakes in CT, by USGS, website: http://earthquake.usgs.gov/regional/state/connectictu/history.php, date info downloaded from website for this report was 5/30/07.
[14] See footnote 11.

The last documented case of a tidal wave along the Atlantic coast induced by an earthquake occurred in Nova Scotia, Canada in 1929. An offshore earthquake triggered a massive underwater landslide in the Grand Banks offshore, which produced a tidal wave that killed 28 people in Nova Scotia.

There were two hurricane-induced tidal waves in New Jersey during the 20th Century. These were not storm surges caused by the land-falling hurricanes, but were the result of wind-driven water being forced offshore by strong northwest winds. When the winds suddenly slackened off, the water rushed back into the coast resulting in waves 25 - 50 feet high. This happened in 1938 and again in 1944. Five people were killed in the 1944 wave.

The landmass of Long Island provides protection to most of the Connecticut coastline from tidal waves and hurricane-induced waves of the type that have struck New Jersey.

#### 2.1.11.1 Potential Risk of a Tidal Wave in Connecticut

By the nature of these waves being ocean born, only the communities immediately along the Connecticut coastline would be affected. However, the potential of tidal waves in Connecticut are of such a small probability that no effort has been given to determining populations and infrastructure at risk.

## 2.2 CONNECTICUT'S VULNERABILITY TO NATURAL HAZARDS

Since flooding is the principal cause of loss of life and property damage in Connecticut, it is given the greatest emphasis in Natural Hazards Mitigation Planning efforts. Most of the natural disasters that have affected Connecticut in the past 100 years have involved flooding which could be caused either directly or indirectly by heavy rainfall or due to other factors such as rapid snowmelt or high winds stacking up water along the coast. This section outlines Connecticut's vulnerability to these hazards as well as ice storms, tornados, forest fires, geomagnetic storms, hurricanes, tsunamis and earthquakes in terms of property damage potential, loss of utilities and loss of lifeDiscussion of other indicators of state vulnerability and the impact of no action are included within this section of the Plan. In addition to the information discussed in this section, natural hazard mitigation planners need to take into account the most current scientific information and projections on how global climate change will impact natural hazards in Connecticut over the coming decades.

It is the intent of DEP to research and analyze available data for Connecticut to work towards attaining a bettered defined probability for each natural hazard that the State may potentially experience in addition to developing a better understanding of the vulnerability for the State and each individual county for said hazards. This will be done through planning efforts supported by FEMA grants and possible other grant/funding sources that may become available to the State. Due to existing resource constraints, the advancement of research and planning activities for future updates of this plan will rely on such supporting funding efforts.

### 2.2.1 Future Hurricane Vulnerability

#### 2.2.1.1. Hydrology of Long Island Sound

Since the end of the last ice age, Long Island Sound has sheltered most of the Connecticut coastline from large sea waves produced by hurricanes, winter storms and tidal waves.

However, the shape and directional orientation of Long Island Sound creates other flooding hazards unique to the Connecticut coast.

During storm events in which there is a strong easterly or northeasterly component to the wind that lasts more than one tide cycle, water piles up in the Sound and is unable to appreciably flow out due to the pressure of the wind. Coastal flooding, particularly in the western end of the Sound, is the result. Although the threshold for significant flooding is approximate, the following criteria are used to determine if flooding will occur:

1) Winds of greater than 30 mph lasting more than 12 hours;
2) Wind direction in a range from the northeast (45 degrees) to the east southeast (120 degrees); and
3) Astronomical high tides.

The combination of these three factors can lead to moderate to major flooding in Long Island Sound. The last event to combine all three factors occurred in December 1992.

Other factors that may lead to increased vulnerability to coastal flood events resulting from hurricanes are:

- A generally acknowledged rise in temperatures may increase the risk from powerful hurricanes because the warmer air will lead to warmer ocean water, which in-turns provides more energy for the development of powerful hurricanes.
- An overall increase in the coastal population of approximately 33% between 1950 and 2000 places more people and structures. This is especially true for east coastal New Haven County and all of coastal Middlesex County. These are highly developed vulnerable areas subject to a direct strike from hurricanes.

The inland effects of future hurricanes will also be significant for several reasons. Although Connecticut adopted the latest BOCA building codes in the early 90's, these changes affect only new construction or renovations. Most of the existing housing stock in Connecticut was built before 1990 and is unaffected by the code changes. In general building codes have been revised following each major disaster in Connecticut during the 20$^{th}$ Century.

Because much of the existing housing stock predates the code improvements, it is highly susceptible to roof and window damage from high winds. Also, a large number of homes (over an estimated 32,000) in Connecticut are within the 100-year floodplain. The expense of mitigating these vulnerabilities all at once would be extreme and cost-prohibitive, older homes will continue to be damaged. It is expected that most will be removed from the housing stock over the next 100 years due in part to substantial damage and changes in demands from housing markets regarding the style, type and size of housing units desired.

By 2030 Connecticut's population is projected to increase by 8.3% (according to the U.S. Census Bureau's middle series estimate) to 3,688,630. All areas of growth and development expand the State's vulnerability to natural hazards such as hurricanes.

An increasingly major impact of hurricanes is on public and private communications. As our State becomes more dependent on the Internet and mobile communications (cellular, paging, and email) for commerce, the disruptions caused by power outages and damaged communications lines will increase. In addition, many people now rely heavily on these communications networks to conduct their lives. A major hurricane has the potential of

causing complete disruption of power and communications for up to 3 weeks rendering many cell phones, pagers, computers and the Internet inoperative. Workplace productivity greatly depends on computers and the Internet and would be severely affected. Personal communications and many emergency communications systems now rely on cell phones and these systems would also be severely affected, although the exact impact cannot be calculated empirically. This remains a significant but quantitatively unknown risk in Connecticut.

In addition, stronger regulations and hazards mitigation targeted at coastal and riverine floodplains should help to lower the vulnerability to flooding (only in floodplain areas) relative to the vulnerability to high winds (all exposed areas) during the next 50 years.

### 2.2.2 Future Vulnerability To Major Winter Storms

Connecticut is increasingly vulnerable to the effects of major winter storms due to our increasing population and our heavy dependence on our aging transportation infrastructure. It is anticipated that severe transportation gridlock during winter storms will continue to occur at times in the future. The State is especially vulnerable to two types of winter storm: 1) rapid onset of heavy snow over urban areas and 2) icing of roadways as a result of lighter snow events that lead to freezing of water on roadways.

The roadway effects of either type of winter storms can be mitigated by the use of staggered timed releases from work, and pre-storm closing of schools. However the costs associated with transportation disruptions and the loss of work and school time will continue to increase.

### 2.2.3 Future Vulnerability To Ice Storms

The vulnerability to ice storm damage is not easily mitigated. More research on this topic is necessary to develop an effective control plan to help reduce the effects from such an event.

### 2.2.4 Future Vulnerability To Ice Jams

Connecticut remains vulnerable to ice jams in areas where ice jams have traditionally occurred in the State. In addition, as older mill dams are breached or removed, attention must be given to the effects of these actions on ice conditions.

DEP intends to investigate potential grant funds for technical assistance from CRREL in performing an ice jam summary and analysis for Connecticut similar to one performed for the State of New Hampshire. In addition, when DEP becomes aware of an ice jam (regardless of whether or not it causes damages), DEP intends to file report forms to CRREL for the centralized national database.

The USACE, in conjunction with DEP, has recently constructed a structure on the Salmon River to prevent or minimize ice jams in the most vulnerable locations on that river. The structure consisted of 9 large piers located in the river and many boulders situated in a way to force an ice jam to form at a less vulnerable location. A small ice jam was realized soon after the construction was complete and it was the conclusion of CRREL that additional construction work is needed to allow the structure to be fully functional.

### 2.2.5 Future Vulnerability To Forest Fires

As the existing forests continue to change in age, structure and species composition and become more fragmented, wildfire danger will continue to be an issue. The problem of the urban/forest interface is also present, although not to the degree that it exists in western states. The urban/forest interface (homes and buildings constructed in and on the borders of forests) is muted somewhat in Connecticut by factors such as declining backyard debris burning, and less uncontrolled or unsupervised interaction with forests and the natural environment as a whole. Other factors which lessen the urban/forest interface problem in Connecticut are: fuel-loading levels which are significantly less than other parts of the country; weather patterns producing median annual precipitation of greater than 42 inches which is well distributed throughout the year; and a landscaping preference which emphasizes large expanses of lawn around buildings.

The prevention emphasis in local fire departments has historically been on fire in the home, with forest fire addressed peripherally. There is a spread of woodland/suburban interface as the population of the State moves from the traditional urban cores out to former farmland and the suburban sprawl continues. However, while the interface of humans with forested areas is increasing, the actual risks appear relatively low in Connecticut as:

1. The wildfire/forest fire prone areas are becoming fragmented;
2. The annual incident of forest fires is very low; and
3. The problematic interface areas (such as zoning regulations which may permit driveways too narrow for fire trucks) are site-specific.

Local fire departments in a home rule state such as Connecticut focus their efforts during interface fires on residential and commercial structure protection.

Moderating any vulnerability to forest fire in Connecticut is DEP's fire fighting capability. Personnel from the state parks and the Forestry Division form the backbone of the State fire fighting staff. The Division of Forestry also maintains a 70-person fire-fighting crew for possible assignment to assist the U.S. Forest Service in the suppression of large forest fires anywhere in the nation. This Connecticut Interstate Fire Crew is utilized instate as well, and is available for mutual aid to states in the Northeast.

### 2.2.6 Future Vulnerability To Tornadoes

The frequency of tornadoes in Connecticut will continue to range from most occurrences in the western and northwestern area of Connecticut, down to least occurrences in southeastern, Connecticut.

Although the frequency of occurrences may be greater in western Connecticut, vulnerability may not be greatest in that part of the state because of the relatively low population density there. When the frequency of occurrences and the population density are combined, the highest vulnerability to damage exists in Hartford and New Haven Counties.

The lowest vulnerability to tornado damage will likely continue to be along the southeast coast. Although this area is very densely populated, the frequency of tornado activity is low with only one confirmed tornado during the past thirty years in New London County.

Although tornadoes pose a real threat to public safety, their occurrence is not considered frequent enough in Connecticut to justify construction of tornado shelters.

### 2.2.7 Future Vulnerability To Drought

Despite the relative abundance of water resources in Connecticut, there is not always enough water to meet needs in certain areas, particularly during drought. All areas of Connecticut are vulnerable to various categories of drought.

There are two major factors contributing to drought vulnerability in Connecticut:

1. Seasonal variation in water availability - Both streamflow and ground water levels vary seasonally, and typically are highest during the spring and lowest during the late summer and early fall. Streamflow and groundwater levels are a function of recent climatic conditions. Most water users have limited ability to vary water needs in response to meteorological or agricultural droughts; and
2. Growth and shifting demand – Demographic changes in Connecticut have resulted in changes in how much water is needed and where it is needed. While population projections prepared by the Office of Policy and Management (draft version 91.2, prepared for public water supply planning purposes) indicate that statewide population growth over the next forty years is not likely to be significant, people continue to leave the cities and move to suburban and rural areas, thereby creating new or additional demand for public drinking water in areas traditionally served by private residential wells. This results in increased vulnerability to a hydrologic drought condition.

The effects of hydrologic drought can be mitigated through the development of interconnections and supply sharing between and amongst public water supply purveyors. The Southwest Regional Pipeline extends from Bridgeport to Greenwich and interconnects a number of municipal and private investor owned water systems. The ability to share water results in ground water dependent water systems being able to use reservoir storage from others during short-term meteorological droughts.

### 2.2.7 Future Vulnerability to Dam Failures

There are over 3,500 dams in the State of Connecticut, which because of their size and location pose a hazard to downstream properties. These dams are all regulated by the DEP under Connecticut General Statutes 22a-401 through 22a-411 inclusive. A failure of most of these dams would not be catastrophic, but about 500 of these dams pose a possible or even a probable threat to human lives upon failure. Dam overtopping is the major cause of dam failures in Connecticut. As dam overtopping is caused by excessive rainfall, it is appropriate to relate the future vulnerability of dams directly with the potential for increased rainfall in CT.

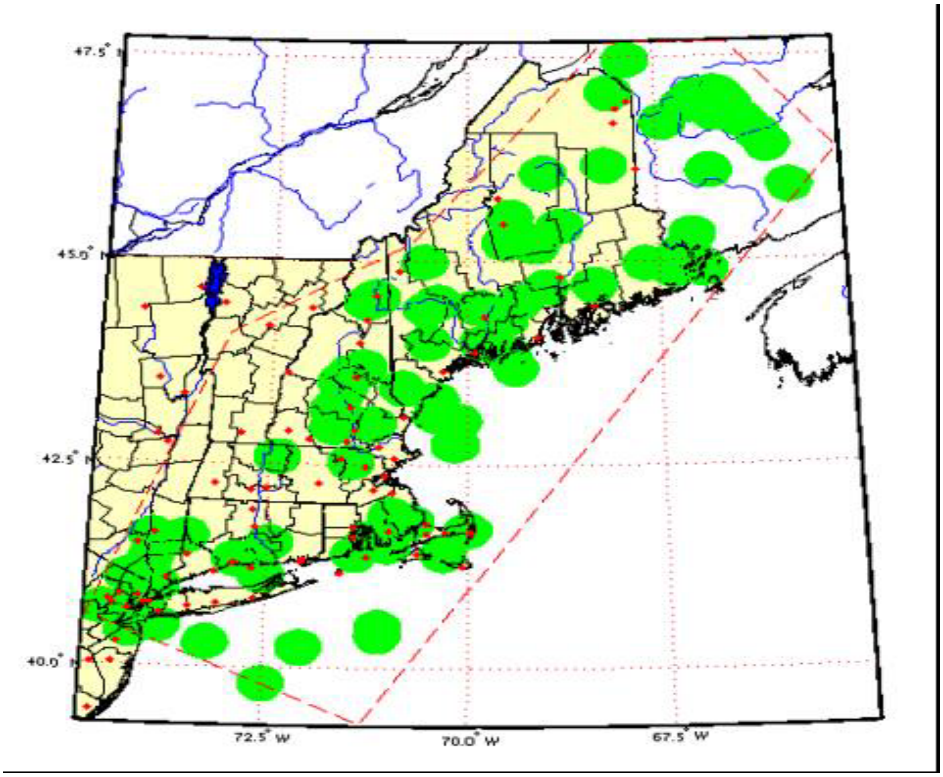
Dams regulated by DEP are designed to pass at least the 100-year rainfall event with one foot of freeboard (a factor of safety against overtopping). The most critical and hazardous dams are required to meet a spillway design standard much higher than passing of the 100-year rainfall event. Although not all of the dams under DEP jurisdiction have been shown to be able to withstand the 100-year rainfall event, most of the dams meet this standard due to original design requirements or recent spillway upgrades. For the most part if smaller rainfall events, i.e.10-year and 25-year events occur more frequently there will be little impact on the ability of Connecticut dams to operate safely.

As more and more state owned and privately owned dams get repaired, the amount of dams that will not meet the state minimum requirements for spillway design diminishes. However, the average age of all dams in Connecticut increases and we should remain vigilant.

### 2.2.9 Future Vulnerability To Earthquakes And Tsunamis

According to Boston College's Weston observatory's New England Seismic Network research, there is a 66% chance that an earthquake of a 2.7 magnitude or greater would occur in one of the green circle areas located on Figure 2-4.[15]

**Figure 2-5: Spatial Earthquake Probabilities**[16]




According to Kafka (2004)[17], earthquake hazards maps generally show that in most parts of New England, there is about a 1chance in 10 that, in any given 50-year period of time, earthquake vibrations that are potentially damaging will strike." Thus although it is very difficult to predict the probable occurrence of a future earthquake in New England, Connecticut will continue to remain vulnerable to such an event in the future.

Due to its geographic location and the protection provided to Connecticut's coastline by Long Island Sound, the chances of a tsunami affecting Connecticut directly are extremely low.

[15] Source for info and Figure 2-4 from Boston College New England Earthquake Probability website: http://www.bc.edu/research/westonobservatory/northeast/eqprobability/, information downloaded from site on 5/30/07.
[16] See footnote #12 for source.
[17] Kafka, Ph.D., Alan L., Why Does the Earth Quake in New England: The Science of Unexpected Earthquakes, revised 1/3/04, Boston College webpage: http://www2.bc.edu/~kafka/Why_Quakes/why_quakes.html.

## 2.2.10 Other Indicators Of State Vulnerability To Flooding

### 2.2.10.1 Location of Flood Prone Lands

While the DEP has no precise measure of the total acreage of land within the State's flood prone areas, FEMA Flood Insurance Rate Maps are a good indication of flood zones located within a particular community.

### 2.2.10.2 Connecticut Coastal Vulnerability Assessment – 1983

In December 1983 the CTDEP published a Study of Coastal Vulnerability to Flooding. This study was a pre-cursor to modern Natural Hazards Mitigation Plans. The intent of the study was to provide the State and its coastal communities with a better understanding of flood hazards and recommended hazards mitigation measure to pursue to decrease vulnerability of hazards in this area. The study looked at the total number of structures located in coastal hazards zones, reviewed local zoning regulations, numbers of uninsured properties, and gathered information on flood awareness.

### 2.2.10.3 Western Connecticut Coastal Study

A study for Long Island Sound from Westport to East Haven was conducted by the USACE in 1990. Major recommendations of the study included:

1. Raising of structures in coastal high hazards zones above the 100-year wave elevation at selected sites;
2. Modifying of town constructed protection works; and
3. Improving forecasting, warning and evacuation plans.

The USACE performed a similar study of eastern Long Island Sound in 1993. If future predictions of sea level rise and the greenhouse effect prove accurate, vulnerability along Connecticut's coastline will increase at a faster rate than current coastal development suggests.

### 2.2.10.4 USACE – SLOSH (Sea, Lake and Overland Surges from Hurricanes) Study

The SLOSH computer program is a numerical computer model, developed by the NWS, for the USACE, and designed to forecast the rise in water level caused by the wind and pressure forces of a hurricane. This rise in the water surface, which accompanies a hurricane, is referred to as the storm surge. The SLOSH model computes the storm surge over water and along the coastline and extends the computations inland over the coastal flood plain. The results of the model can be utilized along with topographic information to determine hurricane flood inundation zones.

The SLOSH model calculates three inundation zones. The three zones correspond to Hurricane Categories I & II, III, and IV respectively on the Saffir/Simpson scale.

In April 2004 FEMA, USACE, NOAA, and OEM (currently CTDEMHS) completed the Connecticut Hurricane Evacuation Study Technical Data Report with an Evacuation Map Atlas and an Inundation Map Atlas (utilizing the NWS' SLOSH model). This study is a decision-making tool which provides information on the extent and severity of potential flooding from hurricanes, the associated vulnerable population, capacity of shelters, estimated sheltering requirements, and evacuation time. In 2006, DEMHS updated information on public shelters, medical and institutional facilities, and mobile home parks in the 25 municipalities and produced updated Evacuation and inundation Maps. The State and its municipalities use the study and maps to plan for a possible evacuation. Tables 2-6 and 2-7 show the numbers of people living in zones I-II and III-IV within Connecticut's 25 coastal municipalities. The study recommends the uniform use of a clearance time of 7 hours plus a dissemination time of 2 hours, resulting in an evacuation time of 9 hours.

Connecticut now has a coastal population of over 1 million people, and most of this coastal population would need to be evacuated in a major hurricane.

For inland flooding areas, FEMA's NFIP has mapped all major riverine floodplains within Connecticut. These inland riverine study areas include:

- Housatonic River Basin (Corps of Engineers) – 624 structures (exclusive of Naugatuck River Basin); and
- South Central Connecticut Coastal Basin (Corps of Engineers) 1340 (excluding municipalities directly abutting coastline).

Approximately three-fourths of these structures are within the 100-year floodplain, and the remaining structures are within the 500-year floodplain. The following Table lists flood data that includes flood policy numbers and flood loss data. This information helps to show Connecticut's ongoing vulnerability to flooding. This data was provided by FEMA through the NFIP.

**Table 2-10: NFIP Data for Connecticut Counties as of 1/31/07**

| County | Total Premium | Total Policies | Total Coverage (in $thousands) | Total Flood Losses | Total Amount PD in Flood Looses - Historical |
|---|---|---|---|---|---|
| Fairfield | $12,241,806 | 13,636 | $3,025,938 | 5,388 | $49,489,748 |
| Hartford | $1,937,234 | 2,868 | $537,811 | 1,234 | $7,014,961 |
| Litchfield | $811,181 | 1,114 | $205,483 | 290 | $2,132,492 |
| Middlesex | $2,490,720 | 2,937 | $612,259 | 1,050 | $6,192,038 |
| New Haven | $7,083,290 | 9,431 | $1,714,333 | 5,129 | $39,070,168 |
| New London | $3,327,105 | 3,933 | $834,750 | 953 | $3,422,034 |
| Tolland | $205,415 | 273 | $55,807 | 131 | $1,269,600 |
| Windham | $184,527 | 220 | $43,918 | 52 | $473,761 |
| **Total for the State** | **$28,281,278** | **34,412** | **$7,030,299** | **14,227** | **$109,064,802** |

### 2.2.10.5 Sea Level Rise

Experts at the National Oceanic and Atmospheric Administration (NOAA) have estimated, through several studies and papers, that sea level may rise by approximately 35 cm (14 inches) by the year 2050.[18] The body of research in this area continues to expend and projections have been developed by the International Panel on Climate Change(IPCC 4th Assessment) and the Union of Concerned Scientists in the JULY 2007 REPORT ON NORTHEAST CLIMATE IMPACTS ASSESSMENT . Additional information can be found at http://www.northeastclimateimpacts.org/ and http://ipcc-wg1.ucar.edu/wg1/wg1-report.html.] In Connecticut there is no data on the slope of the coastal floodplain that is detailed enough to determine what affect this will have. Thus, these data need to be compiled to gain an accurate picture of the affect of sea level rise.

What we do know is that any rise in sea level may lead to a corresponding rise in the actual base flood elevation; however, the rise is expected to be slow. FEMA mapping may need to be updated periodically to reflect the change in sea level. For example, a 1-foot rise in sea level may make the actual 100-year flood elevation coincide with the existing 500-year flood elevation as depicted on the NFIP maps. Thus lands prone to coastal flooding will be subject to more frequent flooding events than currently predicted.

[18] Douglas, Bruce C. - 1995 Global sea level change: Determination and interpretation; NOAA, National Oceanographic Data Center, Washington, D.C., US National Report to IUGG, 1991-1994, Rev. GeopHys. Vol 33 Suppl., © 1995 American Geophysical Union

## Table 2-11: Coastal Connecticut Total Population Change 1970 - 2000

| | Year 1970 | Year 2000 | Total Population Change | Total Population Change |
|---|---|---|---|---|
| **Fairfield County** | | | | |
| Bridgeport | 156,542 | 139,529 | -17,013 | -10.87% |
| Darien | 20,336 | 19,607 | -729 | -3.58% |
| Fairfield | 56,487 | 57,340 | 853 | 1.51% |
| Greenwich | 59,755 | 61,101 | 1,346 | 2.25% |
| Norwalk | 79,288 | 82,951 | 3,663 | 4.62% |
| Stamford | 108,798 | 117,083 | 8,285 | 7.62% |
| Stratford | 49,775 | 49,976 | 201 | 0.40% |
| Westport | 27,318 | 25,749 | -1,569 | -5.74% |
| Non-Coastal Communities | 234,515 | 329,231 | 94,716 | 40.39% |
| Total Population Fairfield County | 792,814 | 882,567 | 89,753 | 11.32% |
| **New Haven County** | | | | |
| Branford | 20,444 | 28,683 | 8,239 | 40.30% |
| East Haven | 25,120 | 28,189 | 3,069 | 12.22% |
| Guilford | 12,033 | 21,398 | 9,365 | 77.83% |
| Madison | 9,768 | 17,858 | 8,090 | 82.82% |
| Milford | 50,858 | 52,305 | 1,447 | 2.85% |
| New Haven | 22,194 | 23,035 | 841 | 3.79% |
| West Haven | 52,851 | 52,360 | -491 | -0.93% |
| Non-Coastal Communities | 551,680 | 600,180 | 48,500 | 8.79% |
| Total Population for New Haven County | 744,948 | 824,008 | 79,060 | 10.61% |
| **Middlesex County** | | | | |
| Clinton | 10,267 | 13,094 | 2,827 | 27.53% |
| Old Saybrook | 8,468 | 10,367 | 1,899 | 22.43% |
| Westbrook | 3,820 | 6,292 | 2,472 | 64.71% |
| Non-Coastal Communities | 92,463 | 125,318 | 32,855 | 35.53% |
| Total Population for Middlesex County | 115,018 | 155,071 | 40,053 | 34.82% |
| **New London County** | | | | |
| East Lyme | 11,399 | 18,118 | 6,719 | 58.94% |
| Groton | 38,244 | 39,907 | 1,663 | 4.35% |
| New London | 31,630 | 25,671 | -5,959 | -18.84% |
| Old Lyme | 4,964 | 7,406 | 2,442 | 49.19% |
| Stonington | 15,940 | 17,906 | 1,966 | 12.33% |
| Waterford | 17,227 | 19,152 | 1,925 | 11.17% |
| Non-Coastal Communities | 111,250 | 130,928 | 19,678 | 17.69% |
| Total Population for New London County | 230,654 | 259,088 | 28,434 | 12.33% |
| | | | | |
| **Total CT Coastal Communities Population Change 1970 To 2000** | 893,526 | 935,077 | 41,551 | 4.65% |

## TABLE 2-12: VULNERABLE COASTAL POPULATION[19] CATEGORY I & II HURRICANES & SEVERE WINTER STORMS

| Coastal Community | Permanent Population | Seasonal Population | Mobile Home Population | Permanent Population living in Evacuation Zones | Seasonal Population living in Evacuation Zones | Total Vulnerable Population |
|---|---|---|---|---|---|---|
| Greenwich | 61,101 | 618 | 11 | 6,702 | 52 | 6,765 |
| Stamford | 117,083 | 380 | 33 | 4,323 | 11 | 4,367 |
| Darien | 19,607 | 129 | 11 | 3,426 | 54 | 3,491 |
| Norwalk | 82,951 | 223 | 96 | 6,513 | 21 | 6,630 |
| Westport | 25,749 | 496 | 179 | 3,723 | 95 | 3,997 |
| Fairfield | 57,340 | 612 | 11 | 8,652 | 236 | 8,899 |
| Bridgeport | 139,529 | 167 | 30 | 14,583 | 30 | 14,643 |
| Stratford | 49,976 | 323 | 20 | 11,028 | 273 | 11,321 |
| Milford | 52,305 | 880 | 461 | 16,548 | 418 | 17,427 |
| West Haven | 52,360 | 58 | 97 | 7,957 | 19 | 8,073 |
| New Haven | 123,626 | 265 | 19 | 9,826 | 29 | 9,874 |
| East Haven | 28,189 | 162 | 11 | 10,503 | 141 | 10,655 |
| Branford | 28,683 | 966 | 686 | 10,445 | 655 | 11,786 |
| Guilford | 21,398 | 852 | 54 | 5,292 | 507 | 5,853 |
| Madison | 17,858 | 1,799 | 12 | 3,251 | 864 | 4,127 |
| Clinton | 13,094 | 1,220 | 595 | 3,783 | 789 | 5,167 |
| Westbrook | 6,292 | 1,617 | 361 | 2,899 | 1,059 | 4,319 |
| Old Saybrook | 10,367 | 2,160 | 11 | 6,849 | 1,791 | 8,651 |
| Old Lyme | 7,406 | 2,616 | 11 | 2,401 | 1,280 | 3,692 |
| East Lyme | 18,118 | 2,811 | 11 | 2,621 | 922 | 3,554 |
| Waterford | 19,152 | 374 | 171 | 3,204 | 129 | 3,504 |
| New London | 25,671 | 262 | 18 | 2,348 | 18 | 2,384 |
| Groton City | 10,100 | 74 | 0 | 498 | 11 | 509 |
| Groton Town | 40,000 | 1,359 | 1,764 | 2,606 | 483 | 4,853 |
| Stonington | 17,906 | 1,016 | 466 | 4,985 | 561 | 6,012 |
| **TOTALS** | **1,045,861** | **21,439** | **5,139** | **154,966** | **10,448** | **170,553** |

[19] The population data in tables 4 and 5 is based on 2000 Block Census Data for Connecticut. The original 1988 data was updated to 2000 using the newer population data from the Connecticut Register and Manual and was linearly extrapolated across all categories to 2000.

## TABLE 2-13: VULNERABLE COASTAL POPULATION CATEGORY III & IV HURRICANES[20]

| Coastal Community | Permanent Population | Seasonal Population | Mobile Home Population | Permanent Population living in Evacuation Zones | Seasonal Population living in Evacuation Zones | Total Vulnerable Population |
|---|---|---|---|---|---|---|
| Greenwich | 61,101 | 618 | 11 | 12,933 | 94 | 13,038 |
| Stamford | 117,083 | 380 | 33 | 4,984 | 11 | 5,028 |
| Darien | 19,607 | 129 | 11 | 4,018 | 65 | 4,094 |
| Norwalk | 82,951 | 223 | 96 | 12,844 | 53 | 12,993 |
| Westport | 25,749 | 496 | 179 | 6,245 | 152 | 6,576 |
| Fairfield | 57,340 | 612 | 11 | 15,006 | 354 | 15,371 |
| Bridgeport | 139,529 | 167 | 30 | 42,864 | 108 | 43,002 |
| Stratford | 49,976 | 323 | 20 | 15,480 | 283 | 15,783 |
| Milford | 52,305 | 880 | 461 | 25,669 | 629 | 26,759 |
| West Haven | 52,360 | 58 | 97 | 17,969 | 29 | 18,095 |
| New Haven | 123,626 | 265 | 19 | 27,108 | 57 | 27,184 |
| East Haven | 28,189 | 162 | 11 | 14,589 | 162 | 14,762 |
| Branford | 28,683 | 966 | 686 | 17,251 | 925 | 18,862 |
| Guilford | 21,398 | 852 | 54 | 7,244 | 647 | 7,945 |
| Madison | 17,858 | 1,799 | 12 | 5,164 | 1,269 | 6,445 |
| Clinton | 13,094 | 1,220 | 595 | 5,362 | 1,004 | 6,961 |
| Westbrook | 6,292 | 1,617 | 361 | 3,337 | 1,232 | 4,930 |
| Old Saybrook | 10,367 | 2,160 | 11 | 8,239 | 2,215 | 10,465 |
| Old Lyme | 7,406 | 2,616 | 11 | 2,865 | 1,789 | 4,665 |
| East Lyme | 18,118 | 2,811 | 11 | 6,779 | 2,031 | 8,821 |
| Waterford | 19,152 | 374 | 171 | 4,518 | 160 | 4,849 |
| New London | 25,671 | 262 | 18 | 4,362 | 72 | 4,452 |
| Groton City | 10,100 | 74 | 0 | 4,408 | 31 | 4,439 |
| Groton Town | 40,000 | 1,359 | 1,764 | 6,695 | 763 | 9,222 |
| Stonington | 17,906 | 1,016 | 466 | 6,096 | 657 | 7,219 |
| **TOTALS** | **1,045,861** | **21,439** | **5,139** | **282,029** | **14,792** | **301,960** |

[20] The population data in tables 4 and 5 is based on 2000 Block Census Data for Connecticut. The original 1988 data was updated to 2000 using the newer population data from the Connecticut Register and Manual and was linearly extrapolated across all categories to 2000.

## 2.3 POTENTIAL IMPACTS FROM CLIMATE CHANGE AND SEA LEVEL RISE

An important factor that needs to be considered in addition to all the stated factors in order to effectively analyze Connecticut's risk and potential vulnerability to various natural hazards is the issue of climate change, both on a global and localized basis.

### 2.3.1 The Global Perspective – A Brief Summary

#### 2.3.1.1 Overview

Connecticut's climate is changing. Over the next 50 - 100 years, we can expect significant climate change impacts on Connecticut's coastal communities, forests, fisheries, agriculture, human health, and natural disasters. These impacts include increased annual temperatures, rising sea level, increased sea surface temperatures, more intense storms, and changes in precipitation patterns. Climate change will impact the occurrence and intensity of natural disasters, leading to additional hazards and significant economic losses. For example, the frequency of heavy rainfall events is increasing across the Northeast and scientists expect extreme precipitation to continue to increase due to climate change.[21] The Northeast suffered an estimated $130 million in property damage from several intense storms in the fall of 2005 and spring 2006. Connecticut's coast has almost $405 billion of insured coastal exposure. [22], The 6th highest state in the country. Coastal homes, roads, and infrastructure are at increased risk as sea level rises and storms become more intense. Scientists, insurers, investors, planners, designers, and policy makers must respond to the significant consequences of climate impacts on human health, coastal infrastructure, ecosystems, agriculture, and the economy.

Recognizing the global, regional, and local implications of climate change, Connecticut and New England have shown great leadership in addressing mitigation through the reduction of greenhouse gases. In 2001, the New England Governors/Eastern Canadian Premiers signed a regional Climate Change Action Plan and committed to reduce greenhouse gas emissions in the region to 1990 levels by 2010, 10% below that by 2020, and 75-85% by 2050. In 2004, the Connecticut General Assembly adopted these regional goals for Connecticut and the Connecticut Climate Change Action Plan (CCAP) was completed and submitted to the Connecticut legislature in 2005. A copy of the plan and information on other actions Connecticut is taking to address climate change can be found athttp://www.ct.gov/dep/cwp/view.asp?a=2684&q=322070&depNav_GID=1619.

Even with policies in place to reduce greenhouse gas emissions, the emissions of the past decades will continue to cause changes to Connecticut's climate for decades to come. According to a 2006 Report by the Union of Concerned Scientists entitled Climate Change in the Northeast: A Report of the Northeast Climate Impacts Assessment, climate change is already influencing natural disasters in our region and increasing impacts in the coming decades will pose additional challenges to the management of natural hazards. Scientists project the following climate change impacts in the US Northeast over the next 100 years. The ranges are based on the choices we make today. The numbers at the low end of the range

[21] Climate Change in the US Northeast. October 2006.Union of Concerned Scientists.
[22] Source: Insurance Information Institute, 2004

reflect a low- emissions scenario, which would entail a shift to less fossil-fuel intensive industries. The numbers at the high end of the range reflect a high-emissions, business as usual, scenario.

- Annual temperature increases from 3.5 – 12.5 degrees F. Annual temperatures across the Northeast US have already increased more than 1.5 degrees F since 1970.
- Sea surface temperatures that are 5 – 8 degrees F higher than today. Off the Northeast coasts, sea surface temperatures have increased 1 degree F in the past 100 years.
- Rise in sea levels from 4 and 33 inches. This is a conservative projection that does not take into account the more rapid melting of major polar ice sheets.
- More frequent and severe heavy rainfall events, including a more than 10 percent increase in the number of annual extreme rainfall events, with 20 percent more rain falling during 5-day heavy precipitation events.
- A 20-30 percent increase in winter precipitation, with more winter precipitation falling as rain as temperatures rise.
- Drier summers and falls, with extended periods of low streamflow.[23]

It is critical for natural hazard mitigation planners to assess future impacts utilizing the most current scientific information and projections on how global climate change will impact natural hazards in Connecticut over the coming decades. We need to take steps now to assist our municipalities in building climate resilient communities for the future. We look forward to partnering with FEMA in this important endeavor and view mitigation of future hazards as a critical effort to support Connecticut's local economies. We look forward to FEMA's support for funding future planning efforts and for providing valuable input and guidance as we develop our climate adaptations framework here in Connecticut.[24]

#### 2.3.1.2 Proposed Planning and Research Activities Planned by DEP's Office of Long Island Sound Programs (OLISP)

In order to gain more accurate insight into the issue of sea level rise and its direct impacts for the State of Connecticut, OLISP has undertaken a number of research and planning activities in the recent past to improve the coastal components of hazard planning. These activities included:

The Coastal Hazards section of the Connecticut Coastal Management Assessment and Strategy for 2006 to 2011 identifies the development of a coastal hazard plan to address current and future coastal hazards.
OLISP has been acquiring data to support coastal hazard planning such as the acquisition 1880 T-sheets and extraction of historic shoreline. OLISP staff has taken CSC training and used LiDAR data to gain experience in developing digital elevation models and visualization techniques. CT DEP and FEMA have recently agreed to acquire high resolution LiDAR data for coastal Connecticut that can provide high-resolution elevation data needed to create accurate inundation scenarios.

OLISP is partnering with the Marine Sciences Program of the University of Connecticut (UCONN) in the development of the Long Island Sound Integrated Ocean & Coastal Observing System (LISICOS; http://lisicos.uconn.edu/). OLISP will be assisting Marine

[23] Climate Change in the US Northeast. October 2006.Union of Concerned Scientists
[24].

Sciences in the working with coastal managers to identify ocean-observing priorities that will likely recommend a series of priorities aimed at Coastal Hazards.

OLISP assisted the Mid-Atlantic Coastal Ocean Observation Regional Association (MACOORA) and the Coastal States Organization (CSO) in hosting an Ocean Observing workshop in November 2006 for coastal managers. The emphasis was on inundation, and the results will start to identify a strategy for developing the inundation component of ocean observing systems. OLISP is involved in participating in several regional ocean governance and ocean observing organizations. At present, these organizations are in loosely defined organizational stages; however they are designed with the intent to combine regional environmental management, scientific, and political skills to leverage Federal and State funds to plan for and respond to hazards, particularly coastal hazards.

A larger scale effort involves participation in the NOAA Coastal Services Center Coastal Management Fellowship. The program provides a unique opportunity for OLISP to make significant advances in the development of a coastal hazard plan that will provide critical information and data to coastal managers and the public at large. Beginning in the Fall of 2007 and continuing until the Fall of 2009, The Fellow will assess the science, policy, data, and technology in the area of coastal hazards to create a framework for an overarching strategy for coastal hazard planning. Specifically, the major objectives identified to support this goal are to:

- Thoroughly research and analyze existing information on coastal hazards, statutory authorities and plan strategies and synthesize the findings in a report;
- Identify gaps in data or information (e.g., mean high water, modeling the response of LIS to sea level rise,) and make specific recommendations to address these gaps;
- Create a web-based data portal about coastal hazards containing visualization tools such as browser-based maps providing general access to hazard layers;
- Conduct outreach and education (workshops, presentations, etc,) regarding coastal hazards at the state and municipal levels; and
- Develop a strategy to integrate ocean observing technology with hazards data and needs and if feasible to compile web based modeling/visualization tools to be available on the portal by 2009.

Partners identified that will participate in the Coastal Fellowship project in association with DEP are the University of Connecticut Marine Sciences Program, the U.S. Geological Survey Connecticut Water Science Center, and the DEMHS.

Pending a successful grant award from the NOAA Coastal Services Center Funding Opportunity "FY2007 Regional Integrated Ocean Observing System Development" OLISP, along with USGS will be supporting the development of a Coastal Inundation Decision Support Information System (CIDSIS). Several departments within the University of Connecticut (Marine Sciences, Geography, Natural Resource Management & Engineering) have proposed to create a cost-effective and dynamic CIDSIS for the shores of Long Island Sound. The system will provide environmental and hazard mitigation planners and emergency responders with accurate and timely information to enhance community resilience to natural hazards. The system will also benefit the residents and businesses of the Long Island Sound region through the enhancement of safety and local emergency responses during severe storms (i.e., hurricanes, nor'easters).

The project will consist of creating a web-based GIS compatible tool that utilizes the Integrated Ocean Observing System (IOOS) infrastructure, numerical models, and new high-resolution coastal topography data to create inundation predictions that can be accessed by State and municipal officials. The CIDSIS will allow environmental information to be displayed with other geospatial infrastructure information to evaluate the impact of storms on their citizens and infrastructure. The goal of the project is to develop and make available the predictive capability for the extent of inundation and flooding resulting from major winter storms and hurricanes. The capability will be central to the rational assessment of risk to humans, infrastructure and the environment, the development of evacuation and restoration plans, and the design of effective coastal development regulations.

The project will link academic, government, and private sector capabilities to create a cost-effective CIDSIS that maximizes the IOOS infrastructure. Work on this project will be performed in close collaboration with the Middle Atlantic Coastal Ocean Observing Regional Association (MACOORA) and the North East Regional Association (NERA). The use of this system and the information it can provide will be used in future updates of the State's NHMP.

The data and information that the efforts expended by OLISP over the next 3 years will greatly enhance state and local hazard mitigation efforts and planning activities for coastal areas of the State. However the identification of non-coastal jurisdictions' vulnerability to hazard events and potential damage and loss occurrences will need to be further developed. It is the intent of DEP to research and analyze available data for Connecticut to work towards attaining a bettered defined probability for each natural hazard that the State may potentially experience in addition to developing a better understanding of the vulnerability for the State and each individual county for said hazards. This will be done through planning efforts supported by FEMA grants and possible other grant/funding sources that may become available to the State. Due to existing resource constraints, the advancement of research and planning activities for future updates of this plan will rely on such supporting funding efforts.

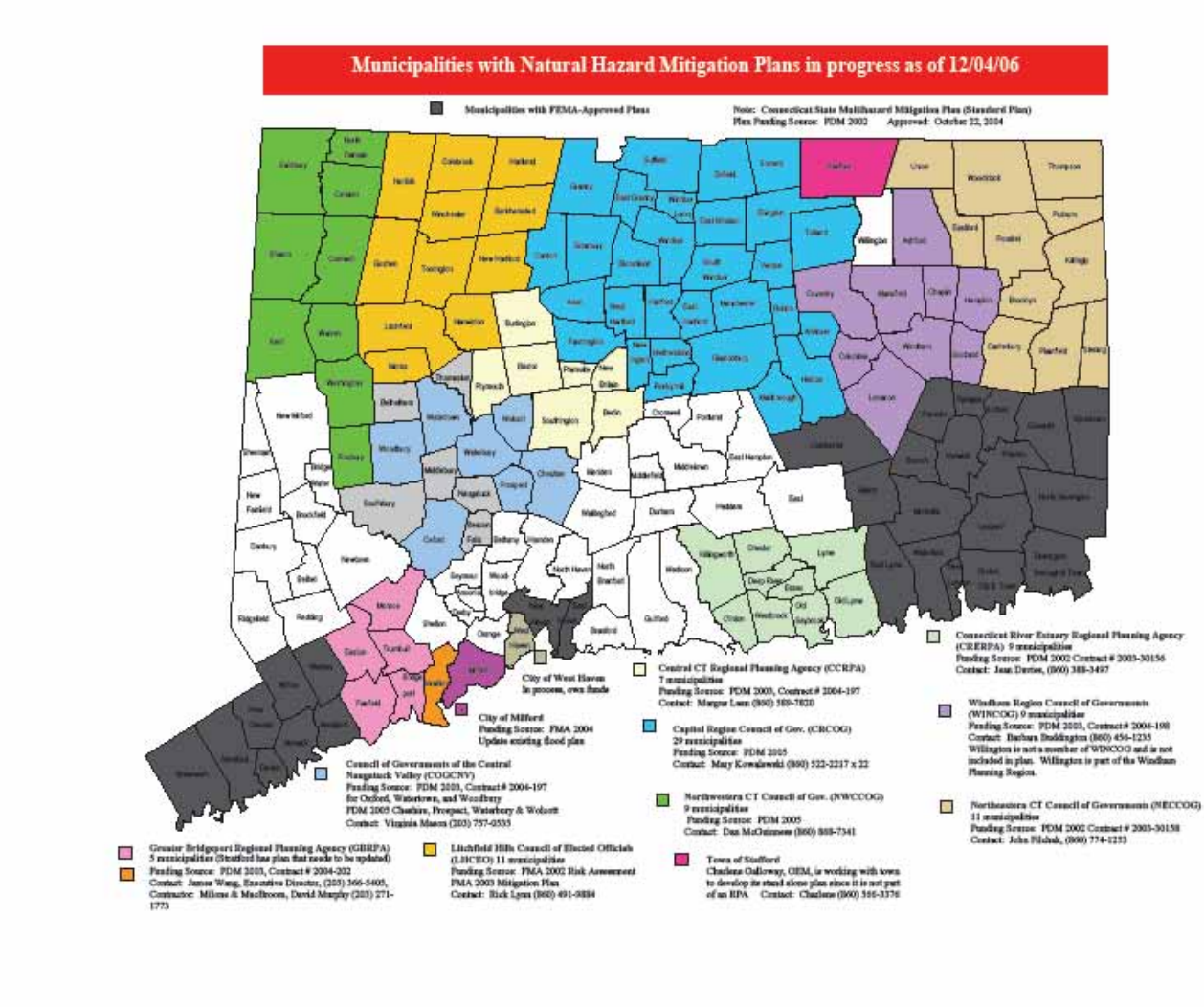
## 2.4 LOCAL AND REGIONAL RISK ASSESSMENTS

Connecticut is a relatively small state with a strong home rule tradition. There are 169 municipalities in 8 counties in Connecticut. County government is very limited in its authority and capacity. The individual municipalities function in much the same way as counties do in states with strong county government and limited local authority. Regional Planning Organizations (RPOs) in Connecticut provide county-level or inter-county planning services (see section 1.8 for more details). As part of the statewide planning strategy to meet the planning requirements for hazard mitigation plans contained in DMA 2000, the DEP has invested in the regional planning agencies. The RPOs submit the majority of local and multi-jurisdictional natural hazard mitigation plans. However in some cases, the community will complete a hazard mitigation plan without technical assistance from the RPO or the DEP.

Due to resource constraints, it is not currently feasible to consider local plans. The DEP reviews and analyzes all multi-jurisdictional plans or regional plans when they are submitted to us and forwarded to FEMA. The DEP plays an active role in the coordination of these reviews. We are knowledgeable in the contents of each plan and through our review, make certain that all multi-jurisdictional plans are consistent with the State Natural Hazards Mitigation Plan. The DEP provides comments to the community or RPO to ensure the plan is complete and covers all FEMA requirements. DEP also provides technical assistance to town and RPO staff to guide them in their plan development.

Regional risk assessments have been completed in Connecticut from continuing efforts in local natural hazards mitigation planning by RPOs and municipalities. Figure 2-5 below shows a map of communities with approved and pending local natural hazards mitigation plans.

**Figure 2-6 Municipal Natural Hazards Mitigation Plan Progress**




A review by Flood Management staff of available FEMA approved local natural hazards mitigation plans indicate that natural hazards concerns are very similar throughout many geographic areas of Connecticut. From highest level of threat to lowest, the following is a list of natural hazards that almost all local plans focused upon:

- Flooding
- High wind events (includes hurricanes, severe thunderstorms, tornadoes, etc.)
- Winter storms/events (includes ices storms, ice jams, nor'easters, etc.)
- Drought
- Forest fires
- Earthquakes
- Tsunamis

In general basically all counties in Connecticut will either experience a direct event from the types of hazards stated above or the indirect impacts these hazards will generate. The 2 unique hazards – earthquakes and tsunamis, will be experienced by specific counties and communities. As stated earlier in this Chapter under the subsection for earthquake hazard, Hartford and Fairfield Counties are primarily susceptible to potential earthquakes due to the fault system located in the northeast. The coastal communities in the counties of Fairfield, New Haven, New London, and Middlesex would potentially be at the higher risk than inland communities in the State for experiencing the impacts from a natural hazard such as a tsumani (through a rare event along this geographic area of the North Atlantic coastline).

This state plan is the first Natural Hazard Mitigation Plan where it was a requirement of the State to consider local data. It is intended that the next plan update will include a greater in-depth analysis of available risk data from regional FEMA approved plans. Over the next three years DEP will develop a more defined list of basic data it would like to see included in local risk analysis and hazard mitigation plans and will formalize a process for regional plan review.. The DEP will look at actions common to all plans and will use that data to target our resources for outreach, technical assistance and grant offerings. We will develop a system to capture this data into a spreadsheet format that will be provided in the next state plan update. In addition, the DEP will formalize our review process. We will develop a checklist and write qualitative comments as they pertain to the mission of the DEP and the State Natural Hazard Mitigation Plan.

Once the initial state review is completed the DEP will forward the plan to FEMA for the initial review. If the plan meets all of the requirements in order to receive conditional approval, FEMA will send the RPO or the community a Conditional Letter of Approval. If the plan needs significant revision, FEMA will forward comments of revision to the plan to the DEP. At The DEP will then send the RPO and community a letter with both FEMA and the state's comments and will provide additional technical assistance to the community as they revise their plan. Once the revisions are made to the plan, the RPO or community will resubmit their draft plan to the DEP. The DEP then will forward the final draft plan to FEMA for Conditional Approval. FEMA will then send a letter of Conditional Approval to the RPO or the community. At this point, the community will hold a public meeting and formally adopt the mitigation plan, after which will send applicable documentation of plan adoption to DEP. Adoption documents may be discussed with FEMA on a case-by-case basis. The DEP will then forward the adoption documentation to FEMA who will review and then issue a letter of approval to the community with a CC to the RPO and DEP. This will be an ongoing program task under the State's Community Assistance Program and will be performed to the extent existing resources allow.
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## 2.5 HAZUS MH DISASTER SIMULATIONS

HAZUS Multi-Hazards (MH) is a geographic information system based regional loss estimation model developed by FEMA and the National Institute of Building Sciences. The primary purpose of HAZUS MH is to provide loss estimates for earthquakes, hurricanes and flood hazards.

The DEP in cooperation with the Northeast States Emergency Consortium (NESEC) performed a hurricane and earthquake disaster simulation using the HAZUS MH model. The data used for the simulations was taken solely from the HAZUS MH database provided by FEMA.

If the HAZUS building coordinates were determined to be greater than 200 meters from the apparent location of a facility, the DEP corrected the locations using a hand-held GPS. Corrections were made to the locations of schools, hospitals, police, fire and emergency management facilities and were sent to FEMA for inclusion in the next version of HAZUS MH software.

The region used for the simulation contained the entire State of Connecticut (815 census tracks totaling 4,962.77 square miles). HAZUS MH estimated that a total of 941,000 buildings (residential and non-

residential) are contained within the State with a total replacement value of $222.7 billion. The value of transportation and utility lifeline systems was estimated by HAZUS MH to be $83 billion and $10.3 billion, respectively.

Upon review of the information provided from the existing simulations and a review of existing conditions to date within Connecticut, it was determined that for this Plan Update, the original MH HAZUS simulations and subsequent damage estimations remained adequate for mitigation planning purposes. In subsequent updates, DEP will perform further reviews and update all data as necessary for all performed MH HAZUS simulations. It is DEP's intent that future simulations will be developed for all potential natural hazards that the State may experience, including debris and economic loss estimates. This will be done through planning efforts supported by FEMA grants and possible other grant/funding sources that may become available to the State. Due to existing resource constraints, the advancement of research and planning activities for future updates of this plan will rely on such supporting funding efforts.

The 2004 5.0 earthquake and Category 3 hurricane HAZUS simulations are located in Appendix A. In addition to these simulations Appendix B contains the natural hazards maps for each community including municipal-owned critical facilities. In addition, Appendix C contains the Sea, Lake and Overland Surge from Hurricane (SLOSH) Inundation Maps. Any critical facilities listed within these maps are municipal-owned.

Currently state critical facilities are not included in the HAZUS data for Connecticut. To collect the necessary data needed to incorporate these facilities within HAZUS would be a major undertaking for the State. Connecticut will continue to investigate the feasibility of developing and performing such a planning task in the future. However, this work would be performed through planning efforts supported by FEMA grants and possible other grant/funding sources that may become available to the State. Due to existing resource constraints, the advancement of research and planning for this specific activity will rely heavily on obtaining such support funding.

### 2.5.1 Hurricane Simulation

The hurricane simulation modeled a repeat of the 1938 hurricane on the current infrastructure. The 1938 hurricane represents the most destructive natural disaster in Connecticut's history for which records are available.

Connecticut's estimated distribution of value for its building stock was generated as a result of these simulations. As one can see, three counties – Hartford, Fairfield and New Haven – had the highest estimated building stock values in the State. In addition, 75% of Connecticut's population resides in these 3 counties.

**Table 2-14: Estimated Distribution of Value for Connecticut Building Stock**

| | | | Estimated Value of Structures (Thousands of dollars) | |
|---|---|---|---|---|
| **County** | **Population** | **% of Total State Population** | **Residential** | ***Non-Residential** |
| Hartford | 857,183 | 25.17% | $43,525,294 | $12,364,834 |
| Fairfield | 882,567 | 25.92% | $48,284,671 | $13,579,192 |
| Litchfield | 182,193 | 5.35% | $10,260,849 | $1,991,193 |
| Middlesex | 155,071 | 4.55% | $8,946,226 | $1,844,635 |
| New Haven | 824,008 | 24.20% | $41,253,327 | $9,951,721 |
| New London | 259,088 | 7.61% | $13,940,774 | $2,663,204 |
| Tolland | 136,364 | 4.00% | $6,991,223 | $884,378 |
| Windham | 109,091 | 3.20% | $5,029,223 | $1,148,605 |
| State of Connecticut Totals: | 3,405,565 | | $178,231,587 | $44,427,762 |

*Note: Nonresidential includes commercial, industrial, agricultural, religious, government, and education.

During a re-occurrence of the 1938 hurricane (a strong Category III with 130 mph sustained winds moving north at 60 mph) the model estimates that about 269,000 buildings will be at least moderately damaged. The model also estimated that approximately 23 million tons (46 billion pounds) of debris would be generated by the storm. Of that amount, brick and wood comprises an estimated 21%, reinforced concrete/steel comprises 0.27% with the remainder being tree and green waste debris. The model estimated that it would require 919,000 truckloads (at 25 tons per truckload) to remove the debris potentially generated by the simulated hurricane.

**Table 2-15: HAZUS Debris Summary For The State Of Connecticut**

| County | Brick, Wood and Other (Tons) | % of State Total for Brick, Wood and Other Generated | Reinforced Concrete and Steel (Tons) | % of State Total for Reinforced Concrete and Steel Generated | Tree Debris (Tons) | % of State Total for Tree Debris Generated | Total Debris Generated Per County (Tons) | % of State Total for Debris Generated |
|---|---|---|---|---|---|---|---|---|
| Fairfield | 362,036 | 7.62% | 2,055 | 3.26% | 3,532,747 | 19.46% | 3,896,838 | 16.97% |
| Hartford | 1,273,822 | 26.82% | 14,125 | 22.40% | 3,707,381 | 20.42% | 4,995,328 | 21.75% |
| Litchfield | 59,813 | 1.26% | 352 | 0.56% | 5,785,796 | 31.87% | 5,845,961 | 25.45% |
| Middlesex | 545,201 | 11.48% | 11,186 | 17.74% | 220,369 | 1.21% | 776,756 | 3.38% |
| New Haven | 1,301,055 | 27.40% | 15,536 | 24.63% | 1,741,643 | 9.59% | 3,058,234 | 13.32% |
| New London | 890,595 | 18.75% | 15,776 | 25.02% | *0 | 0.00% | 906,371 | 3.95% |
| Tolland | 206,433 | 4.35% | 2,870 | 4.55% | 1,434,295 | 7.90% | 1,643,598 | 7.16% |
| Windham | 109,987 | 2.32% | 1,165 | 1.85% | 1,733,055 | 9.55% | 1,844,207 | 8.03% |
| State of Connecticut Totals: | 4,748,942 | 20.68% | 63,065 | 0.27% | 18,155,286 | 79.05% | 22,967,293 | |

*Note: Projected tonnage calculated for tree debris in New London County was –2,941,485. This anomaly requires further verification for accuracy.

**Table 2-16: Estimated Economic Losses Per County For A Category III Hurricane**

| | Residential (Thousands of dollars) | | | *Non-residential (Thousands of dollars) | | | | |
|---|---|---|---|---|---|---|---|---|
| County | Building | Contents | Total Loss Estimate for Residential | Building | Content | Inventory | Total Loss Estimate for Non-Residential | Total Estimate of Losses for County |
| Fairfield | $1,603,564 | $404,454 | $2,008,018 | $218,284 | $109,463 | $8,330 | $336,077 | $2,344,094 |
| Hartford | $5,740,693 | $2,138,583 | $7,879,276 | $1,062,457 | $664,545 | $42,827 | $1,769,829 | $9,649,105 |
| Litchfield | $280,067 | $75,267 | $355,333 | $21,334 | $10,672 | $1,270 | $33,277 | $388,610 |
| Middlesex | $2,592,795 | $1,138,168 | $3,730,963 | $339,250 | $247,254 | $17,301 | $603,805 | $4,334,768 |
| New Haven | $6,023,270 | $2,309,821 | $8,333,090 | $866,053 | $571,188 | $37,872 | $1,475,112 | $9,808,202 |
| New London | $4,180,423 | $1,796,986 | $5,977,409 | $487,636 | $330,783 | $15,626 | $834,045 | $6,811,454 |
| Tolland | $1,059,133 | $421,842 | $1,480,975 | $75,675 | $45,315 | $2,751 | $123,740 | $1,604,715 |
| Windham | $479,877 | $171,863 | $651,740 | $69,300 | $44,042 | $4,680 | $118,021 | $769,761 |
| State of Connecticut Totals: | $21,959,822 | $8,456,982 | $30,416,804 | $3,139,988 | $2,023,262 | $130,656 | $5,293,906 | $35,710,710 |

*Note: Non-residential industrial, commercial, and all other.

Total hurricane damages to buildings and infrastructure were estimated by HAZUS to be approximately $36 billion. Damages to governmental buildings were estimated by HAZUS to be

$1.39 billion. Table 2-15 Provides a breakdown of estimated residential and non-residential economic losses per county for a Category III hurricane. Estimated business interruption losses lwere calculated separately and are not part of the total economic losses presented in the table under Non-residential.

Hartford and New Haven counties combined showed the highest potential building and contents losses for all of Connecticut's counties, 53% for building and 52% for contents respectively.

### 2.5.2 Earthquake Simulation

The earthquake simulation modeled a magnitude 5.0 earthquake centered in Moodus, Connecticut. This location was selected based on the historical frequency of minor earthquakes in Connecticut.

During a magnitude 5.0 earthquake centered in Moodus, the HAZUS MH model estimates that about 1,273 buildings will be at least moderately damaged. The model estimated that a potential 64,000 tons of debris would be generated by such an event. This is based upon the models estimation that approximately 90% of the buildings in Connecticut are of wood frame construction.

Since earthquakes often generate fires as a result of broken gas lines, the model also estimates that 24 fires will result from the simulated earthquake in Connecticut. These fires are predicted to cause $5 million in damage and displace 79 people.

Total building and economic losses from the 5.0 earthquake were estimated to be $594 million. Damages to governmental buildings in Connecticut were estimated by HAZUS to be $1.4 million.

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# CHAPTER 3

## CAPABILITY ASSESSMENT

# 3.0 CAPABILITY ASSESSMENT

This chapter describes and evaluates State and local mitigation policies, programs, and capabilities. In particular the role and responsibilities of the various agencies, departments, and offices that participated in the planning process as well as their role in implementation is discussed. In addition information regarding how the State mitigation planning process is integrated with FEMA mitigation programs and initiatives is presented**.** No significant changes have occurred over the last 3 years with regards to this chapter and the State's capabilities analysis for this plan.

## 3.1 GOVERNMENTAL ORGANIZATION IN CONNECTICUT AS IT RELATES TO NATURAL HAZARDS MITIGATION

Within Connecticut, the primary responsibility for the formulation of hazards mitigation actions rests with the CIHMC. Dissemination of flood watches and warnings issued by the NWS rests with DEP under a memorandum of understanding with the NWS. DEMHS also assists in dissemination of flood watches and warnings. Several additional state and federal agencies such as the NRCS, the USACE and FEMA assist in long term planning and construction of damage reduction measures.

### 3.1.1 The Department of Environmental Protection

The DEP is the principal flood management agency in the State. Within the DEP, the Inland Water Resources Division (IWRD) is the lead division for planning and coordinating flood management and post natural disaster mitigation responses. Other assisting DEP divisions are the Office of Information Management, Office of Long Island Sound Programs, and the Forestry Division.

#### 3.1.1.1 Inland Water Resources Division

The Inland Water Resources Division (IWRD) consists of six major sections: Wetlands Management, Enforcement, Environmental Analysis, Dam Safety, Flood Management, and Engineering. The Dam Safety, Flood Management, and Engineering Sections are responsible for various aspects of Natural Hazards Mitigation Planning and floodplain management.

**Dam Safety Section**

The Dam Safety Section regulates the operation and maintenance of all dams in the State, which would endanger life or property through failure. This Section reviews and approves permit applications for dam repair, modification or construction. This section has the statutory authority to enter onto private property to conduct inspections and when inspections lead to a finding that the dam is unsafe, this Section has the authority to order dam owners to make necessary repairs to correct unsafe structures. This can be accomplished by repairing the dam or by removing the dam. If an emergency condition exists which represents a clear and present danger to the public, Dam Safety can order the repair or removal of the structure. Should the dam owner fail to repair or remove the structure, the Department may do so and bill the owner for the costs. Activities undertaken by Dam Safety over the last ten years are presented in Table 3-1 on page.

| *TABLE 3-1 ACTIVITIES CARRIED OUT BY DEP'S DAM SAFETY SECTION* | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Category*** | ***1990*** | ***1991*** | ***1992*** | ***1993*** | ***1994*** | ***1995*** | ***1996*** | ***1997*** | ***1998*** | ***1999*** | ***2000*** | ***2001*** | ***2002*** | ***2003*** | ***2004*** | ***2005*** | ***2006*** | ***Totals 1990 - 2006*** |
| Inspections | 353 | 347 | 259 | 359 | 174 | 179 | 155 | 138 | 141 | 143 | 111 | 102 | 88 | 106 | 150 | 275 | 166 | 3,246 |
| Certificates of Approval For Permitted Repairs | 9 | 14 | 12 | 22 | 10 | 9 | 14 | 8 | 11 | 7 | 8 | 5 | 5 | 2 | 6 | 10 | 10 | 162 |
| Orders for Dam Repairs | 14 | 5 | 22 | 11 | 5 | 2 | 8 | 4 | 5 | 1 | 5 | 2 | 5 | 2 | 0 | 0 | 4 | 95 |
| Requests for Maintenance & Engineering | 65 | 71 | 38 | 16 | 22 | 36 | 17 | 21 | 7 | 8 | 25 | 17 | 8 | 25 | 24 | 35 | 50 | 485 |
| Dam Construction Permit Applications Received | 62 | 39 | 32 | 29 | 22 | 18 | 19 | 16 | 26 | 24 | 13 | 17 | 20 | 15 | 18 | 16 | 17 | 402 |
| Dam Construction Permits Issued | 44 | 40 | 38 | 21 | 21 | 19 | 14 | 15 | 19 | 18 | 15 | 15 | 15 | 17 | 10 | 13 | 20 | 352 |
| | | | | | | | | | | | | | | | | | | |
| **TOTALS** | **547** | **516** | **401** | **458** | **254** | **263** | **227** | **202** | **209** | **201** | **177** | **158** | **141** | **167** | **208** | **349** | **267** | **4,742** |

## Flood Management Section

The Flood Management Section is the state coordinating agency for the National Flood Insurance Program (NFIP). This section conducts municipal NFIP compliance audits, training workshops, and provides assistance for the development of local floodplain ordinances. The Flood Management Section provides general technical assistance to municipalities on flood mapping and floodplain management inquiries. This section also manages the FEMA HMGP, FMA, and PDM grant programs.

## Engineering Analysis and Engineering Services Sections

The Engineering Analysis Section administers the Stream Channel Encroachment Line (SCEL) Program and State Floodplain Management Certification Program. The SCEL Program predates the NFIP and is a state program that regulates the placement of encroachments and obstructions in the floodplain of certain watercourses. The Flood Management Certification Program regulates all state actions in or affecting floodplains including regulating state sponsored changes to storm water drainage. Any state project located in a FEMA-mapped 100-year floodplain (or project that utilizes state funds) must certify to the DEP that certain statutory and regulatory requirements have been met. These requirements always are equal to or exceed NFIP minimum standards (e.g., critical facilities must be elevated above the 500-year floodplain elevation, no increase in "intensity of use" in the floodplain without going to a hearing and demonstrating that the project is "in the public interest" and that the project "will not injure persons or damage property in the area of the project", etc.).

The Engineering Services Section is responsible for the study, design, repair and maintenance of state owned and operated dams and flood control works. This Section coordinates with

municipal flood and erosion control boards (FECB) on flood control and shore erosion projects. The Commissioner of DEP responsible for the coordination of flood control projects within the State and is to be the sole initiator of a flood control project with a federal agency. The Commissioner has designated this section of DEP to coordinate with the NRCS and USACE on feasibility studies and flood control projects. The Engineering Services Section also provides technical assistance to municipalities and other state agencies to help address their flooding issues.

#### 3.1.1.2 Office of Long Island Sound Program

The Office of Long Island Sound Program (OLISP) administers and oversees Connecticut's federally approved coastal management program. The substance of this comprehensive land and water use program is contained primarily within the Connecticut Coastal Management Act (CCMA), Connecticut General Statutes section 22a-90 through 22a-113j), which sets forth specific policies that must be applied to changes in structures and uses within the coastal zone. A summary of these policies is found in the Connecticut Coastal Management Manual (http://www.ct.gov/dep/lib/dep/long_island_sound/coastal_management_manual/manualsection3.pdf).

Among these policies are several regarding actions within coastal hazards areas. Such hazards areas are the coastal flood zones (100-year and less) as defined and mapped by FEMA. The CCMA policies regarding activities within the coastal hazards area require that each proposal be designed to minimize risks to life and property. These policies apply to decisions made by any land or water use agency with regulatory authority (either the local municipality or the DEP) and to state and federal agencies proposing actions within the coastal zone.

The DEP is lawfully a party to any local land use decision made under the authority of the CCMA and has responsibility to provide technical assistance in the review of individual proposals. DEP comments frequently include project modifications to ensure that risks to life and property are, in fact, minimized.

OLISP had acquired and geo-referenced the "Topographic Sheets" (T-Sheets) for the 1880's. The shorelines have been extracted and coded per national conventions. This data can be used for shoreline change analysis. The Coastal Services Center has accepted a proposal by OLISP for a two-year coastal fellow to develop 'visualization tools' related to coastal hazards. This will likely become a website include an interactive Internet map service to allow managers and the public to access information about coastal hazards including map information. OLISP is also partnering with the University of Connecticut Marine Sciences Program, which manages the Long Island Sound Integrated Coastal Observing System (LISICOS) (i.e., an ocean observing system). The priority modification for LISICOS is to provide information related to coastal hazards planning and response (e.g., provide better but real time surge forecasting, development of inundation scenarios associated with sea level rise.).

#### 3.1.1.3 Forestry Division

There are 32 state forests (totaling nearly 150,000 acres) in the Connecticut state forest system managed by the Division of Forestry. These forests provide a variety of recreational experiences, natural diversity (including threatened, endangered and special concern species), the preservation of unique sites (both geologic and archeological), the provision of raw

materials as forest products, and the maintenance of wildlife and fisheries habitats. The Division's professional foresters work to insure that these forests remain healthy and vigorous while meeting the wide range of demands that the public places on these lands.

The Division of Forestry maintains an active forest fire prevention program and a specially trained force of fire fighting personnel to combat forest fires. The division also has crews ready to assist the US Forest Service in controlling large fires across the nation. The Division prepares a daily Forest Fire Danger Report. Division of Forestry programs and activities related to forest fire prevention include:

- Maintaining a fully trained and equipped crew of fire fighters "on call" for assistance both in-state and to the federal government in fighting fires in the other parts of the U.S.;
- Conducting a forest fire prevention program utilizing Smokey the Bear as a focus;
- Coordinating the timely suppression of all forest fires in the state using trained DEP personnel, trained Fire Warden personnel, local fire departments, and the Connecticut National Guard;
- Administering the federally-funded Volunteer Fire Assistance Program, which provides federal funds for equipment and training to fire departments which serve small communities; and
- Participating in the Northeastern Interstate Forest Fire Protection Commission (see CGS Chapter 450) to coordinate mutual aid in fire prevention and supression efforts among the Northeastern State and adjacent Canadian provinces.

The National Weather Service Offices in Albany NY, Upton NY, and Taunton MA issue Fire Weather Watches and Red Flag Warnings for fire danger when the combination of dry fuels and weather conditions support extreme fire behavior.

#### 3.1.1.4 Office of Information Management

DEP's Office of Information Management (OIM) oversees the agency's information management and information technology systems. OIM plans, manages, and coordinates major information management and information technology projects within DEP. In 2006 OIM deployed the first phase of a significant new DEP internal integrated information system, called SIMS (Site Information Management System). In addition, OIM participates in initiatives to monitor, research, and collect information about the State's land surface, earth materials, water resources, and climate.

In order to carry out its functions, OIM is organized into two sections, Information Technology and Administration, with several significant units within each section. The Information Technology Section includes Applications Programming, Database Development, and Geographic Information Systems (GIS). GIS is a key agency technology, used to integrate and analyze a range of environmental and natural resource information of interest to DEP staff and other public and private sector entities. The Administration Section includes Project Management and Planning units. Among the programs located within OIM Administration are the Geological Survey portion of the Connecticut Geological and Natural History Survey, Field Data Collection, DEP Records Center and Records Management, and SIMS Project Management.

### 3.1.2 Department Of Emergency Management and Homeland Security (DEMHS)

Title 28 of the Connecticut General Statutes (CGS.) outlines the roles and responsibilities of the DEMHS. DEMHS is responsible for:

1. Providing a coordinated, integrated program for state-wide emergency management and homeland security;
2. Directing the preparation of a comprehensive plan and program for the civil preparedness of the State;
3. Coordinating with state and local government personnel, agencies, authorities, and the private sector to ensure adequate planning, equipment, training, and exercise activities;
4. Coordinating emergency communications and communication systems of the state and local government personnel, agencies, authorities, the general public, and the private sector; and
5. Distributing and coordinating the distribution of information and security warnings to state and local government personnel, agencies, authorities, and the general public.

The agency assumes many roles for the State including:

1. Maintains the local branch of the National Warning System (NAWAS);
2. Serves as the Alternate State Warning Point (AWSP). The Department of Public Safety serves as the Primary State Warning Point (PSWP).
3. Develops and maintains various types of emergency operations plans for state government;
4. Provides technical planning assistance to communities as requested or as needed;
5. Provides emergency management and homeland security training programs for state and local governments;
6. Conducts emergency operations drills and exercises;
7. Works with the DEP to administer the Hazards Mitigation Programs of the state; and
8. In times of disaster or emergency, alerts key state, federal and local response organizations and acts as a central coordination point for all state agencies at it's Emergency Operations Center (EOC) in Hartford, CT.

### 3.1.3 Department of Transportation (DOT)

In addition to its overall responsibility to provide a safe, efficient and cost-effective transportation system that meets the mobility needs of its users, the Connecticut Department of Transportation (DOT) is responsible for several short- and long-term natural hazards mitigation objectives in Connecticut. The short-term objectives include plowing of roads during winter storms and repairing the public transportation network after natural disasters. DOT's long-term goals include the design of flood and earthquake resistant roads and bridges.

Three of DOT's major short-term mitigation efforts are their Storm Control Center, Advanced Traffic Management System (ATMS), and Scour Watch™ Bridge Monitoring Program.

The DOT Storm Control Center is operational during severe weather events ranging from winter storms to hurricanes. The Storm Control Center coordinates the plowing operations of over 600 crews during winter storms.

The ATMS system is a network of cameras and road sensors that monitor road conditions and traffic flow on Connecticut's Interstate Highways. Using automated road signs, the ATMS system also warns drivers of traffic congestion, accidents or hazardous driving conditions.

The Scour Watch™ program is a computerized monitoring system that alerts DOT personnel if heavy rainfall and rapid river flows may lead to scouring of the footings on which the bridge is supported. DOT is currently calibrating the program with ground-truth data following storms and is working on a formal action plan for use after the calibration is complete.

Some of DOT's long-term mitigation efforts include:

1. Improving the design of roads and bridges above the 100-year floodplain;
2. Seismic resistant bridge retrofit projects and designing new bridges to resist earthquakes;
3. Installing retention ponds in clover leaf highway interchanges to hold excess runoff from roadways during heavy rain events; and
4. Storm evacuation route planning.

### 3.1.4 Department of Public Health (DPH)

The Department of Public Health (DPH) works to protect the health and safety of the people of Connecticut and actively work to prevent disease and promote wellness through education and programs. The DPH is also responsible for ensuring the health and safety of the State's water supply. All water suppliers who either serve 1,000 or more persons, or 250 or more consumers are required by the DPH to prepare water supply plans in accordance with CGS 25-32d Sections 1a – 5. The DPH maintains two plans that relate to emergency response and mitigation, 1) Connecticut Public Health Emergency Response Plan, and 2) Drinking Water Division Emergency Contingency Plan.

**Connecticut Public Health Emergency Response Plan**[1]

The DPH is the lead administrative and planning agency for public health initiatives, including public health emergency preparedness. DPH works with federal, state, regional, and local partners to improve the State's ability to respond to public health emergencies. The Connecticut Public Health Emergency Response Plan (CT PHERP) identifies the appropriate DPH response activities during a public health emergency. This plan supports the public health and medical care component in existing state disaster and emergency plans.[2]

The purpose of the CT PHERP is to support the following four functions of the Connecticut emergency response effort:

1. Maximize the protection of lives and properties;
2. Identify the DPH procedures to implement when responding to a natural, biological, chemical, radiological, nuclear, or explosive emergency that threatens the public health of Connecticut;
3. Contribute to emergency support functions, as appropriate, particularly emergency support function #8 (Health and Medical Services) at the state level to define policies and procedures for DPH and other public health partners in preparation for and in response to a public health emergency; and

[1] Public Health Emergency Operations Plan, Connecticut Department of Public Health 410 Capitol Ave., Hartford, CT Working Draft, August, 2004

[2] Connecticut DEMHS. Natural Disaster Plan. Hartford, CT. January 27, 2006 signed by Governor Rell. Connecticut Mass Casualty Response Concept Plan (draft), Hartford, CT. 2004

4. Enable the State of Connecticut to continue to operate and provide services as normally and effectively as possible in the event of a public health emergency.

**Drinking Water Division Emergency Contingency Plan**[3]

Acting on behalf of the DPH, the Drinking Water Division protects public health through regulatory oversight of public water systems throughout the state. In the course of a day, virtually every Connecticut resident, as well as many others who visit the state, comes into contact with drinking water provided by a public water system. Implicit in this mission statement is providing immediate "emergency" support to water supplies and the public. It is part of the DPH's mission to influence, through regulation and communication, the operation of public water systems so that all necessary precautions to protect and preserve sources and systems of supplies are taken.

### 3.1.5 Office of the State Building Inspector

The lead agency for the adoption and administration of building code provisions for wind and seismic matters is the Office of the State Building Inspector. The 2005 State Building Code was adopted effective December 31, 2005. The 2003 International Residential Code (IRC) portion of this code regulates construction of all detached one- and two-family dwellings and all townhouses up to and including three-stories in height. The 2003 International Building Code (IBC) portion of this code regulates all other construction.

New rules found in the 2003 IRC include*:*

1. Requirement that all residential structures are to have a structural system that provides a complete load path capable of transferring all loads from their point of origin through the load resisting elements to the foundation;
2. Allowance for alternative compliance using Wood Frame Construction Manual or Standard for Cold-Formed Steel Framing;
3. An engineering requirement for non-conventional elements of otherwise conventional construction (but only requires engineering for the non-conventional elements);
4. New wind speeds utilizing three-second gust winds have been adopted consistent with the ASCE-7 requirements. More accurate mapping of the State's wind speeds results in a more appropriate enforcement of the regulations;
5. New design criteria for wind speeds that equal or exceed 110 MPH (the southern 1/3 of Connecticut);
6. Glazed opening protection requirement (or removable fitted wood structural panels with attachment hardware) in wind borne debris regions (municipalities with basic wind speed of 120 MPH.) on southeastern Connecticut;
7. Requirements for engineered design of masonry or concrete foundation walls, for walls subject to hydrostatic pressure from groundwater;
8. Expanded crawl space ventilation information as defined in code (R408.2); 1) additional materials approved to cover openings, 2) code now allows for under-floor space (crawlspace)

[3] Public Health Emergency Operations Plan, Connecticut Department of Public Health, 410 Capitol Ave., Hartford, CT, May 2004

access through perimeter walls (16 x 24 areaway required if below grade) as option to openings through floor as defined in code (R408.3); and

9. Requirements for construction in A and V flood hazards areas, but all construction in floodways must follow the requirements of the IBC.

## 3.2 EVALUATION OF STATE PROGRAMS AND POLICIES

Connecticut has several state statutes, regulations, policies and practices that achieve the goal of hazards mitigation in hazards prone areas. During the past 100 years, flooding has caused more damage and loss of life than any other natural disaster in the State. Most of the State's programs and policies deal either directly (structural mitigation) or indirectly (non-structural methods through enforcement, education and monitoring) with flooding. These state programs focus on preventing damage within the 100-year floodplains of Connecticut's rivers as well as the coastline. These programs are applied to the entire State of Connecticut, due to the fact that Connecticut has floodplain areas in all of its 169 municipalities.

Structural mitigation of flooding in Connecticut has either dealt with the causes of flooding (building dams to reduce the frequency of flooding) or the effects (elevating or moving structures out of the floodplain) of the flooding.

The DEP is the lead agency in the mitigation of flooding in Connecticut. Table 3.2 on pages 3-9 and 3-10 presents the programs that the DEP has undertaken to mitigate flooding. Each program is evaluated as to its effectiveness in achieving the goal of mitigation. The programs are evaluated from un-satisfactory up to excellent. Over the next planning period DEP intends to expand this table to include all state agencies' policies that affect both hazard mitigation and post-disaster operations. The table will include the state agency responsible for implementing the policy, the related hazard the policy pertains to, and the current information fields as presented in Table 3.2. This task will be performed during the next three-year period as State resources permit.

**PROGRAM EVALUATION RATINGS**

**UN-SATISFACTORY:** The program is unable to achieve its goals due to lack of funding, staffing, regulatory authority or local (municipal) interest.

**FAIR:** The program attains only a minimum amount of success in achieving its goals. Funding, local interest and regulatory authority are not sufficient to expand the program.

**GOOD:** The program achieves most of its stated goals, however, still has deficiencies in funding, staffing, regulatory authority or local interest. Funding and local interest are steady.

**VERY GOOD:** The program achieves all of its state goals and has sufficient funding, staffing, regulatory authority and local interest. Staffing levels and local interest are increasing or remaining steady.

**EXCELLENT:** The program excels beyond its stated goals and serves as an excellent example for other programs. Staffing levels and local interest continue to increase.

### 3.2.1 State Hazards Mitigation Programs

#### 3.2.1.1 State Floodplain and Management Act

The Flood Management Act as referenced in the Connecticut General Statutes (CGS) Section 25-68b and 25-68c outline the flood management responsibilities of DEP and lay out the rules and regulations to be used by all state agencies when undertaking actions in the floodplain..

CGS Section 25-68b defines the terms (Floodplain, Base Flood, etc.) used by Section 25-68c. Section 25-68c goes beyond the regulations contained within the NFIP in many aspects and references the NFIP standards as a minimum standard.

The Commissioner of DEP has the following powers and duties under Section 25-68c:

1. To coordinate, monitor and analyze the floodplain management activities of state and local agencies;
2. To coordinate flood control projects within Connecticut and be the sole initiator of a flood control project with a federal agency;
3. To act as the primary contact for federal funds for floodplain management activities sponsored by the State;
4. To regulate actions by state agencies affecting floodplains except conversion by the University of Connecticut of commercial or office structures to an educational structure;
5. To designate a repository for all flood data within the State;
6. To assist municipalities and state agencies in the development of comprehensive floodplain management programs;
7. To determine the number and location of State-owned structures and uses by the State in the floodplain and to identify measures to make such structures and uses less susceptible to flooding including flood-proofing or relocation;
8. To mark or post the floodplains within lands owned, leased or regulated by state agencies in order to delineate past and probable flood heights and to enhance public awareness of flood hazards;
9. To designate the base flood elevation for a critical activity where no such base flood elevation is designated by the NFIP. The Commissioner may add a freeboard factor to any such designation; and
10. To require that any flood control project be designated to provide protection equal to or greater than the base flood.

Section 25-68f mandates that if more than one floodplain designation exists for the same area, the most stringent designation shall be used to fulfill the provisions of sections 25-68b to 25-68h inclusive.

#### 3.2.1.2 Floodplain Management and Mitigation Act

During the 2004 session, the State legislature passed the Floodplain Management and Hazards Mitigation Act. This new legislation covers many different aspects of floodplain management. It requires municipalities to revise their current floodplain zoning regulations or ordinances to include new standards for compensatory storage and equal conveyance of

floodwater. Municipalities are not required to make such revisions until they revise their regulations for another purpose. The DEP has developed model regulation language, which is planned for distribution by late 2007 Connecticut communities.

The legislation requires OPM to incorporate natural hazards into the next revision of the Statewide Plan of Conservation and Development.

The legislation imposes a $10 increase to current land use fees in order to fund a new state hazards mitigation and floodplain management grant program. Municipalities will be able to access these funds to:

- Reduce or eliminate long-term risks to human life, infrastructure and property from natural hazards, including but not limited to flooding, high winds, wildfires; and
- Retain present capacity of designated floodplain areas to store and convey floodwaters.

Regulations and grant requirements are currently being developed by the DEP.

#### 3.2.1.3 Stream Channel Encroachment Lines

The Stream Channel Encroachment Line (SCEL) program regulates obstructions and encroachments riverward of legally established lines. A permit from the DEP is required for any activity riverward of established encroachment lines.

Encroachment lines are generally based on a 100-year flood or the flood of record, whichever is greater. The initial line placement is determined by an engineering firm contracted by the DEP and the proposed lines are then presented at a public hearing in the affected communities. Following the public hearing the DEP Commissioner legally established the lines and maps depicting the lines are filed with the affected communities. The lines encompass significant floodwater conveyance areas, areas of high velocity flows and areas subject to significant depths of flooding.

While the program has been successful in discouraging inappropriate development within the 285 river miles, which have been delineated, the high cost of establishing new lines (between $12,000 - $14,000 per mile in 1997) has reduced the ability of the State to extend lines along other flood prone rivers. Also the strong home rule ethos of municipalities in Connecticut has led many communities to prefer to regulate development in local floodplain through local zoning regulations and participation in the NFIP program.

The majority of the lines were established following the devastating floods of 1955. However, in 1982 an additional 12 miles were established on the highly flood damage prone Yantic River in southeastern Connecticut. More recently, the Norwalk River Basin was re-studied, and revised SCEL maps were established in 1997

Other enabling State Legislation related to flood plain management includes:

- Sections 22a-36 through 22a-45, inclusive – Inland Wetlands and Watercourses Act
- Section 22a-401 through 22a-410, inclusive – Dam Safety
- Section 13a-94 – Construction Over and Adjacent to Streams

- Section 25-84 through 25-98 – Flood & Erosion Control Board Statutes
- Section 22a-318, 22a-321 – NRCS Statutes
- Section 25-74 through 25-76 – Authorization to perform flood and erosion projects under Federal authority
- Section 22a-342 through 22a-350 – Stream Channel Encroachment Line Program Statutes
- Section 22a-365 through 22a-378 – The Connecticut Water Diversion Policy Act

| Table 3-2: State Funded Programs Related to Floodplain Management | | | |
|---|---|---|---|
| **State Funded or Staffed Program in a Hazards Prone Area.** | **Pre or Post[4] Disaster** | **Evaluation of Program's Use in Hazards Mitigation** | **Area's of Concern where Improvement is Necessary** |
| Flood Management Section 25-68 | Pre and Post Disaster | Good | This program needs additional staffing and funding support to fully meet the State's goals of 1 & 6 |
| Dam Safety Section 22a-401 – 22a-410 | Pre and Post Disaster | Fair to Very Good | The program does a very good job of meeting Goal 1, however significant increases in funding and staffing are necessary to meet Goal 6. |
| Flood and Erosion Control Boards Section 25-84 | Pre and Post Disaster | Fair to Good | The program assists municipalities with the repair of dams and construction of flood control projects by utilizing a combination of State and local funding. Current program guidance needs to be updated to include all aspects of the program. |
| National Flood Insurance Program | Pre-Disaster | Fair to Good | The State NFIP targets repetitive loss properties (RLPs), however staff and resources are not sufficient to follow-through on mitigating RLP's. Annual program obligations are being fulfilled with limited staff, however more staff resources are needed to provide training to towns in the filing of grant applications. |
| Stream Channel Encroachment Line Program Section 22a-342 through 22a-350 | Pre-Disaster | Fair | This program is limited to enforcement of the currently established SCEL lines. No funding for new lines is available. |
| Automated Flood Warning "Alert" System. | Pre-Disaster | Fair to Good | Funding for the maintenance of the Alert system is limited. New Flood Alert system should be integrated with USGS real time data. Stand-alone DEP systems should be avoided. Any new Alert Systems cannot be maintained by the State unless additional staffing is provided for maintenance and a source of funding can be obtained for operation and maintenance. |
| Section 22a-318, 22a-321 – NRCS Statutes | Pre and Post Disaster | Good | Coordination between the NRCS and DEP is very good. Funding is limited, and future funding is based partly on damages suffered during flooding disasters. |
| Section 25-74 through 25-76 – Authorization to perform flood and erosion projects under Federal authority. | Pre and Post Disaster | Good | Coordination between the USACE, NRCS and DEP is very good. Funding is limited, and future funding is based partly on damage suffered during flooding disasters. |
| PL 566 Section 205 | Pre and Post Disaster | Good | Funding for PL-566 continues to be limited for flood control projects in Connecticut. |
| Floodplain Management and Mitigation Act | Pre-Disaster | Very Good | The newly adopted CFMA will provide a new source of funding for staffing, planning and implementation of mitigation projects. |
| PDM Planning | Pre-Disaster | Good | Funding is limited and is nationally competitive. Local interest in applying for these grant funds is low in some areas that have not been impacted by a recent disaster. Many regional planning projects have been performed through funding from this grant program. DEP encourages communities with FEMA approved Natural Hazards Mitigation Plans to submit applications through this grant to fund and implement recommended projects presented in their approved plan. |

[4] Pre-Disaster Programs: Programs that receive annual funding before a disaster declaration.
Post-Disaster Programs: Programs that receive funding partly or fully following a disaster.

### 3.2.2 FEDERAL EXECUTIVE ORDERS

The following Federal Executive Orders are mandated on DEP projects that relate to natural hazards mitigation.

- ***Executive Order 11988***- Floodplain Management- This Executive Order requires Federal agencies to evaluate the potential effects of any Federal action, which may affect floodplains, and to eliminate or reduce any negative effects of that action.
- ***PL-566, Section 205*** – This Public Law authorizes the U.S.D.A., NRCS and the USACE to undertake flood and erosion control projects in cooperation with the DEP.
- ***Executive Order 11990*** – Protection of Wetlands

### 3.2.3 DEP Disaster Preparedness Actions

The following actions have been undertaken by DEP' IWRD and other state agencies to improve the State's capability to respond to flood emergencies. These measures were taken as a result of recommendations formulated in the 1983 and 1989 Flood Hazards Mitigation Reports:

- State Sandbag Policy and Procedures (OCP, currently DEMHS 1984)
- Guidance for municipal flood emergency planning issued (1983)
- Operational Guide for the Connecticut Automated Flood Warning System (updated in 2000) prepared, Emergency Operations Guidelines prepared for the Flood Warning System (1987)
- Installations of Advanced Technology NOAA Weather Radios (A.K.A WRSAME) in schools, state parks, and command centers (1992-93)
- Expansion and upgrading of equipment and technology within the Automated Flood Warning System (1992, 2002)
- Installation of telemetry equipment to receive satellite and radar information (1993)
- Establishment of a fax/email weather warning system (1994).

### 3.2.4 Other DEP Programs

#### 3.2.4.1 The Automated Flood Warning System

The original Automated flood warning system was installed in Connecticut by the NRCS in cooperation with DEP in 1985 as a direct result of the June flooding of 1982. The flood warning system has aided the NWS in issuing faster flood watches and warnings, and has aided communities in responding more rapidly to impending flooding situations. In several communities flood audits were prepared by the NRCS. These flood audits identified which structures were in danger at specific water levels as measured by the water level gages in the warning system. The water level gages in the flood warning system are calibrated to closely match local USGS level gages. Either system's gages can be used in conjunction with the audits to mitigate flood damages. The precipitation data the system collects is used by the NWS in real time to augment radar rainfall estimates.

DEP owns and maintains 45 ALERT gages. Each gage can have from 1 to 6 sensors associated with it. The DEP gages have 11 river level sensors, 36 precipitation sensors, and 6 weather group sensors

collecting data. These gages and sensors were purchased over the course of twenty years and are of various makes and models. Component parts and sensors are not necessarily compatible between the individual gages. The flood warning system monitors rainfall and river levels statewide, and transmits the data via VHF radio to a computer base station in Hartford, Connecticut. Radio repeaters are used to relay data to the base station from outside the Hartford area.

The base station is located at 79 Elm Street, in Hartford. Precipitation, river, tide and weather data is received, decoded, and then stored in the base station computer. The base station equipment simultaneously sends the data to the NWS via an Internet connection. The State base station computer has a bank of modems to facilitate remote viewing of the data. Several communities in the State operate their own base station equipment to store and display data from their area. The City of Stamford and the South Central Connecticut Regional Water Company own and operate warning systems that are separate from the State's system.

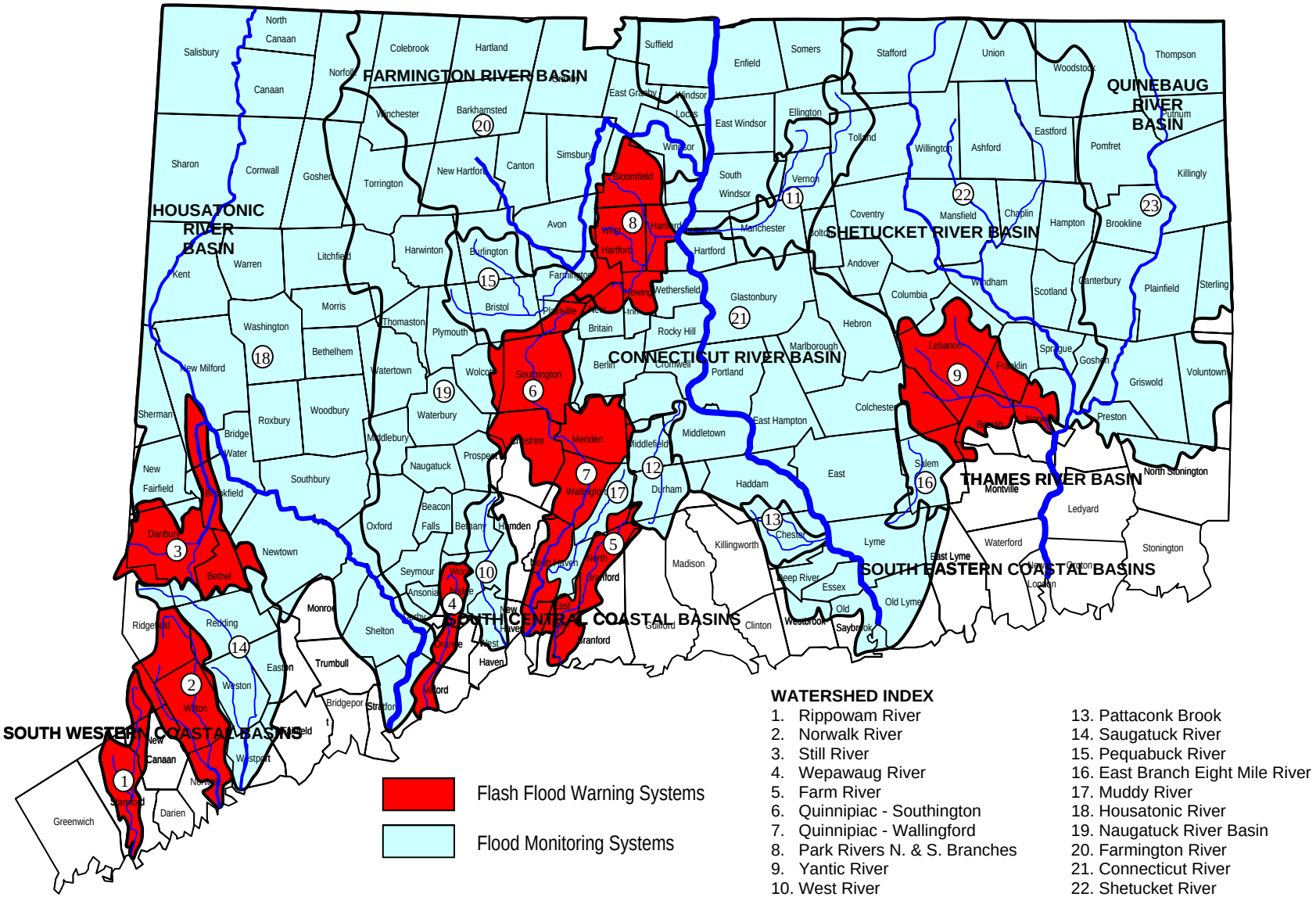
The municipalities use the river level data to help determine what actions to take to safeguard their communities. Currently, only 13 of the State's 169 towns have the flood data available to them in real time. Not all rivers and streams in the State are covered by the ALERT system. River and stream selection was done based on flood potential, availability of funding and municipal interest in being able to monitor the waterway. As a result the current system is a hodge podge of local, state and federal ownership with inconsistent geographical coverage. Local flood warning systems have been installed in Westport, East Haven, Danbury, Southington, Norwich, Wallingford, Hartford, Milford, Ridgefield, Wilton, Redding and Norwalk. Currently, DEP operates and maintains river level monitoring in only five river basins: Quinnipiac, Norwalk, Yantic, Weepawaug and the Still Rivers.

The DEP does not provide full time monitoring of river or rainfall conditions during non-business hours. It is incumbent upon local communities to assess their river conditions and respond to NWS Flood Alerts and Watches. The DEP has only one staff position to operate and maintain the State's portion of the Flood Warning System.

DEP does not have any dedicated funding available for maintenance or operation of the system, although DEMHS has provided some funding for equipment such as replacement batteries. The cost of operation of this system should be carefully reviewed with consideration given to on-going operations and maintenance cost sharing arrangements with the benefiting communities.

Consideration should be given to federal/state/municipal partnerships to assume maintenance of portions of the ALERT system. The system could also be better integrated with weather and roadway information collected by a variety of agencies, including DOT. A strategic plan for selective gaging of Connecticut streams to provide statistically meaningful statewide coverage of both climate change, stream flow conditions including low flow (drought) and high flow (floods), as well as precipitation should be developed. Currently, areas of the state, particularly in the Northeast and Northwest corner, have little to no rain gages and limited stream flow information. The USGS is the national agency charged with providing scientific data to the National Weather Services, NOAA and other federal and state entities. Working with the USGS, many of the DEP Alert sites could be replaced by USGS stations thereby providing enhanced information such as low flow with the scientific data collection standards of USGS. Currently the DEP data is relativistic, whereas USGS collected data meets strict data collection and quality assurance standards whereby statistical frequency analyses can be performed.

**Figure 3-1**
**DEP Flood Warning Systems**




**WATERSHED INDEX**

1. Rippowam River
2. Norwalk River
3. Still River
4. Wepawaug River
5. Farm River
6. Quinnipiac - Southington
7. Quinnipiac - Wallingford
8. Park Rivers N. & S. Branches
9. Yantic River
10. West River
11. Hockanum River
12. Coginchaug River
13. Pattaconk Brook
14. Saugatuck River
15. Pequabuck River
16. East Branch Eight Mile River
17. Muddy River
18. Housatonic River
19. Naugatuck River Basin
20. Farmington River
21. Connecticut River
22. Shetucket River
23. Quinebaug River

**IN DETAIL: THE FLOOD AUDIT PROGRAM**

The flood audit program was developed by the USDA Natural Resource Conservation Service (NRCS) to help reduce flood damage to contents and nonstructural building components for buildings within the 100-year floodplain of selected rivers.

The flood audit provides homeowners and small businesses with information on flood warning levels and the relationship of the flood levels on and in their structures. The audit includes an individual action plan, which will guide owners in reacting quickly and effectively to flood stage reports broadcast over the radio, television, or both. When a flood warning level is actually forecasted for the area, the individual takes the actions listed in the flood audit for the forecasted flood level. Using this information, the individual can move furniture, appliances, etc., out of basements and other low-lying areas, or take whatever action is merited.

Flood audit data may also be entered into the local community's flood warning system computer database to produce the computer display as shown in Figure 3-2. In the upper right hand corner of the display is an elevation graph for each structure in the flood-prone area. The structures are listed in order of height starting with the lowest. Each bar on the graph represents a building. The bottom of the bar is the basement or lowest floor elevation, and the top of each bar is the elevation of the next floor, usually the first floor.

If the next floor is above 12 feet, then the bar extends to the top of the graph, and has no top. The elevation at which water from the river will enter the building through an opening (e.g., such as a door or a basement window) is shown by an arrow pointing to a level on the bar. The names of owners and residents are listed in the same order (by structure height) as in the graph. Under the person's name is a phone number. With the computer display, municipal and state officials can quickly spot the lowest structures in flood-prone areas and notify audited homeowners and small businesses to begin taking actions to reduce flood damages. Audits involve one field day per structure and result in a package of information that property owners maintain and review annually.

When a flooding event is imminent, home owners and businesses take the actions prescribed in the audits, including evacuation when flood heights are at a level that threatens lives and roads are flooded.

### 3.2.4.2 Ensuring Local Compliance to the National Flood Insurance Program (NFIP)

The U.S. Congress established the NFIP on August 1, 1968, with the passage of the National Flood Insurance Act of 1968. The NFIP is a Federal program administered by FEMA enabling property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods.

Participation in the NFIP is based on an agreement between local communities and the Federal government that states if a community will adopt and enforce a floodplain management ordinance to reduce future flood risks to new construction in Special Flood Hazards Areas, the Federal Government will make flood insurance available within the community as a financial protection against flood losses.

The State of Connecticut and all of its communities participate in the NFIP. Connecticut's NFIP coordinator is located within DEP's IWRD.

The following lists a few of the NFIP regulations:

1. All new construction in the floodplain of a river and within coastal floodplain areas must have their lowest floor situated at or above the Base Flood Elevation (BFE);
2. Additions or renovations to existing flood prone buildings that exceed 50% of the buildings market value require that the entire building be elevated and/or otherwise brought into compliance with the NFIP regulations;
3. Any encroachment into the floodplain must not increase the 100-year water elevation more than 1 foot. (It is important to note that many local communities have instituted more stringent policies regarding encroachments into the Floodplain)*;* and
4. Buildings constructed in the V-Zone must have no walls or breakaway walls below the BFE to allow the passage of rapidly moving water under the structure and must have the lowest horizontal structural member elevated above the BFE.

### 3.2.4.3 Map Modernization

In the past, FEMA's NFIP re-mapping efforts have been limited by both technology and funding. In recognition of these limitations, Congress has committed to a Multi-Hazards Flood Map Modernization Management Program (MHFMMM); herein referred to as Map Modernization. Starting in fiscal year 2003 the goal of Map Modernization is to upgrade flood hazards data and mapping to create a more accurate digital product by 2010. Upgrading the maps should improve floodplain management throughout the nation by providing more accurate flood data for use in planning and regulatory decision-making and by providing a product in a digital format that will be easily accessible to multiple users. By 2009, it is expected that digital flood hazards data will be available nationwide. The Map Modernization Program will be phased in over the course of several years with priority given to areas of greatest flood risk as determined by the State and approved by FEMA..

The purpose of this Map Modernization Plan; herein referred to as Business Plan, is to outline the DEP's strategic approach for partnering with FEMA to participate in Map Modernization through DEP's existing Floodplain Management Program (FMP). The Plan describes the

FMP's current roles and responsibilities related to floodplain management, outlines its future role, organizational design, and execution strategy to meet the data and mapping needs of communities within the State of Connecticut.

The FMP currently includes a proactive approach that combines two key elements under one organization: (1) NFIP community compliance, and (2) technical assistance and outreach to communities and agencies. It is envisioned that the compliance element will expand significantly based on map modernization activities due to municipal floodplain management ordinance changes. This linkage of NFIP community status assurance from the existing NFIP Compliance efforts, within the DEP Community Assistance Program (CAP), will compliment and enhance the effectiveness of the expanded FMP. If fully funded by FEMA, program management of the FMMP will be achieved through the expertise of a diverse, skilled project team complemented by external support from an independent state mapping contractor, and other state and federal partners. Program management will be centered on the identification of program goals and clear implementation and tracking of these goals during the program execution. Program management will be further enhanced by a data management system such as the Management Information Portal (MIP) provided by FEMA's National Service Provider.

The Business Plan addresses how Map Modernization will integrate with existing program needs over time, such as coastal erosion mapping, stream flow modeling for varying flow conditions, comprehensive land use planning, and others.

Education and outreach play a vital role in Map Modernization by promoting and building floodplain management capacity throughout the State, which includes training, workshops and presentations for local officials, lenders, insurance agents, land surveyors, engineers, regional planning commissions, and various state agencies and programs.

The success of the FMP and related programs within the DEP is contingent on the receipt of adequate funding over multiple years from our Federal partners. Approximately $1.45 million per year (on average) is required to implement this plan. Of that amount, the FMP anticipates that approximately $480,000 per year may be available from state and partner contributions, which are mostly in-kind, and data matches. Total implementation costs over the 5-year period are estimated to be $8 million. In order to adequately pursue efforts to manage mapping activities and contractors a multiple year commitment from FEMA for funding for staff is essential.

#### 3.2.4.4 Inventory of High Hazards Dams

In 2003, Connecticut received a grant from FEMA to perform an inventory of 227 High Hazards Dams in the State. This inventory updated existing database information. Each dam was also photographed and its location recorded using the Global Positioning System (GPS).

In 2004/2005 construction plans for dams within the State were scanned and recorded in an electronic format. The plans are now readily accessible to IWRD staff on their personal computers.

### 3.2.4.5 Critical Facilities Mapping

In 2003 Connecticut received a grant from FEMA to produce Critical Facilities Maps of each town based on HAZUS 99 data from FEMA. These maps show the locations of critical facilities such as schools, police and fire departments, hospitals, nuclear facilities, and hazardous materials sites. These maps also show hazards information (floodplains, earthquake and wind vulnerability).

In September 2003, Connecticut submitted a first draft of the mapping to FEMA for review. In 2004, Connecticut modified the maps to segregate public and private facilities and updated the database to the new HAZUS MH data as requested by FEMA. A graphical user interface was also created and the maps are planned for dissemination to local towns in the fall of 2004.

Federal, state, and local governments will use these maps to provide improved responses to both natural and man-made disasters by putting critical information into the hands of the first responders.

Currently state critical facilities are not included in the HAZUS data for Connecticut. To collect the necessary data needed to incorporate these facilities within HAZUS would be a major undertaking for the State. Connecticut will continue to investigate the feasibility of developing and performing such a planning task in the future. However, this work would be performed through planning efforts supported by FEMA grants and possible other grant/funding sources that may become available to the State. Due to existing resource constraints, the advancement of research and planning for this specific activity will rely heavily on obtaining such support funding for required resources.

### 3.2.4.6 Debris Management Plan

The CTDEP has prepared the *State of Connecticut Disaster Debris Management Plan, 2007* (the Plan) as a component in the State's overall comprehensive efforts to support and implement improved planning for disaster debris management. This Debris Plan is to be made an Annex to the *State's Natural Disaster Plan, 2006*. The Plan establishes the framework for State agencies and municipalities to facilitate proper management of debris generated by a natural disaster. In addition to the Plan, the State will be establishing pre-need and pre-event contracts to assist the State in disaster debris management preparedness. These contracts will be activated only by the Governor as the result of an emergency declaration and will cover debris removal operations and the monitoring of these operations.

The Plan is based on guidance provided by the FEMA, EPA, USACE and lessons learned from the destructive hurricanes in the gulf coast states in 2004 and 2005. The Plan outlines the CTDEP's processes to consider, approve or disapprove requests for authorizations, variances, and waivers as needed for rapid and environmentally sound waste management, specifically with regard to managing the natural-disaster debris waste stream. In addition, this Plan outlines debris removal and monitoring roles and responsibilities and presents an overview of eligible federal reimbursable costs resulting from debris clean up and monitoring. State government agencies and municipalities will be the primary users of this Plan. Municipalities in particular, will make use of the information for planning pre-positioned contracts with waste haulers, as well as identifying disaster Temporary Debris Storage and Reduction Sites (TDSRS) that may be called into use during disaster recovery operations.

Much of the information will also be useful to the waste management industry as they develop their own in-house plans for participating in a potential disaster recovery scenario.

The *Disaster Debris Management Plan* implemented by Connecticut state agencies and municipalities will be based on recycling and material separation at the point of generation to the extent possible with additional segregation occurring at TDSRS in order to minimize disposal and reduce potential threats to human health and safety. TDSRS will be those sites that have been identified by local and state government, and which have been evaluated and approved by CTDEP for the purposes of collection, volume reduction, and transfer to final permitted disposal and recycling facilities. The CTDEP is responsible for the permitting of these sites. The goal will be to maximize potential processing and recycling options consistent with the *State Solid Waste Management Plan*. This strategy will be of highest priority and public education together with municipal, State, and federal cooperation will be imperative to effectively carry out this mission.

State will be establishing pre-need and pre-event contracts to assist the State in disaster debris management preparedness. The contracts will be activated only by the Governor, as the result of an emergency declaration. These contracts will cover debris removal operations and the monitoring of these operations.

## 3.2.5 DEMHS DISASTER PREPAREDNESS PROGRAMS

### 3.2.5.1 State Homeland Security Grant Program (SHSGP)

DEMHS is in charge of the SHSGP with monies provided by the U.S. Department of Homeland Security (DHS). This program contains several different funding pools including the Emergency Management Performance Grant Program (EMPG), the Buffer Zone Protection Program, the Urban Area Security Initiative, among others. Funds from these programs are used for providing planning and equipment grants to state, regional, and local government agencies. The purchase of interoperable communication systems has been a major activity in ensuring disaster preparedness.

### 3.2.5.2 Radiological Emergency Preparedness (REP) Program

This program is responsible for off-site planning and preparedness for the Millstone Nuclear Power Stations in Waterford, the only nuclear power plant in Connecticut since the decommissioning of the Connecticut Yankee Nuclear Power Plant in Haddam Neck. The REP program develops and maintains radiological plans and procedures, which are regularly evaluated by the Nuclear Regulatory Commission and FEMA. The REP network includes ten emergency planning zone communities, six host communities, numerous key state agencies and utility emergency responders. In addition, the REP program conducts other related activities such as annual conferences for public officials, media briefings, and training of state and local emergency workers.

### 3.2.6 Related State and Federal Plans

The Connecticut NHMP is one of a group of plans in Connecticut dedicated to the mitigation and preservation of the quality of life, state services and the natural environment of Connecticut from the negative affects of natural disasters.

In the preparation of the Natural Hazards Mitigation Plan, the following State plans were consulted:

- The Department of Public Health, Drinking Water Division Emergency Contingency Plan (see section 3.1.4)
- Connecticut Public Health Emergency Response Plan (see section 3.1.4)
- Connecticut Automated Flood Warning System Operational Guide (DEP)
- State Map Modernization Plan (DEP) (see section 3.2.4.3)
- Connecticut Debris Management Plan (DEP) (see section 3.2.4.7)
- Connecticut Drought Plan (WPC) (see section 3.7)
- Connecticut Natural Disaster Plan, January 2006 (DEMHS)
- Connecticut Radiological Emergency Response Plan (DEMHS)
- Connecticut Consequence Management Plan for Deliberately Caused Incidents Involving Chemical Agents, January 2006 (DEMHS)
- Model Town Emergency Operations Plan and Annexes, 2004 (OEM, currently DEMHS)
- Local emergency response plans (Towns/DEMHS)
- Local and Regional Natural Hazards Mitigation Plans from Connecticut communities (DEP)

These plans are a valuable source of information on state actions to reduce the effects of natural disasters.

In the preparation of this NHMP, the following Federal plans were consulted:

- National Response Plan (USDHS)
- National Incident Management System (USDHS)

### 3.2.7 The State Severe Weather Warning System

The NWS Warning System (NAWAS) disseminates warnings to the Connecticut State Warning System that acts as the local branch of the NAWAS. The Connecticut State Warning System consists of four interrelated networks; 1) DEMHS, 2) Connecticut State Police Warning Point, 3) Tolland County Fire Radio, and 4) National Weather Service. The NAWAS disseminates warnings to 20 municipalities in Connecticut via the three warning networks. These 20 municipalities are responsible for conveying warnings or watches to all communities in their regions, thereby attaining 100% coverage of the State.

The 4 in-state networks operate as follows:

*1) DEMHS*

Acts as the Alternate State Warning Point.

DEMHS will alert its own personnel through it's own radio system, or via pagers and cell phones. In cases of extreme emergency the DEMHS may activate the Emergency Alerting System (EAS) to alert the general public directly.

*2) Connecticut State Warning Point*

a. Receives the watch or warning from a NWS office. The NWS offices also issue flood warnings.
b. Disseminates the watch or warning via the Connecticut On-line Law Enforcement Telecommunications (COLLECT) teletype to 96 municipal police and fire departments.
c. Relays the watch or warning to DEP's IWRD, which currently maintains the ALERT Flood Warning System.
d. Sends the warning message via NAWAS to 20 municipal police and fire departments, which are responsible for alerting all towns in their regions.

*3) Tolland County Fire Radio Dispatch*

a. Upon receipt of the watch or warning from the State NAWAS (i.e. State Warning Point or DEMHS) System, the State Fire Control Center at Tolland will transmit the information over the State and Tolland-Windham-New London-Hartford County Fire Radio Systems.
b. County fire control centers will then re-transmit the warning received from the State Fire Radio Systems to individual municipalities.

*4) National Weather Service Northeast River Forecast Center (NERFC) in Taunton, Mass.*

a. Prepares river flood forecasts at river forecast points. The three NWS offices that have warning responsibility for Connecticut disseminate these forecasts.
b. Rainfall and river data from the Connecticut ALERT System are relayed to the NERFC for analysis. The NERFC prepares site-specific forecasts for river basins monitored by the ALERT System. The three additional NWS offices utilize ALERT data to assess urban and stream flood potential.

## 3.3 FEDERAL AGENCIES AND PROGRAMS FOR DISASTER RESPONSE AND RECOVERY

This section describes the roles and programs of the major federal agencies that assist the State and provide funding for natural hazards mitigation.

### 3.3.1 FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

In March 2003 FEMA became a part of the newly established U.S. Department of Homeland Security, under the Emergency Preparedness and Response Directorate.

FEMA sponsors major flood related programs through the Federal Insurance Administration, the National Preparedness Programs Directorate, and the State and Local Programs Directorate. FEMA also provides disaster assistance under Section 404 of the Robert T. Stafford Disaster Assistance and Recovery Act and the Flood Mitigation Assistance Act, Part 78.

#### 3.3.1.1 FEMA Enabling Legislation

State participation in the NFIP, Stafford Act, and related actions are authorized under the Connecticut General Statutes Section 25-68b thru 25-68h and associated regulations. The NFIP is mandated under the Code of Federal Regulations, Title 44 Sections 59 - 80 inclusive.

#### 3.3.1.2 FEMA Disaster Preparedness Programs

**The National Flood Insurance Program (NFIP)**

A major effort of FEMA is the continued implementation of the NFIP. This program seeks to limit flood losses and the significant federal cost related to those losses by requiring communities to properly manage their floodplain development. This is accomplished by:

1. Conducting detailed engineering studies of most watercourses,
2. Delineating floodways and floodway fringes showing flood conveyance and storage areas;
3. Requiring communities to adopt floodplain management regulations;
4. Subsidizing insurance for structures already in flood risk areas;
5. Requiring insurance at actuarial rates for new structures proposed for flood risk areas;
6. Joining the availability of disaster relief programs, federal grants and loans and federally backed mortgages to a community's willingness to participate in the program; and
7. Requiring lending institutions to notify the purchaser or lessee of special flood hazards in advance of the signing of purchase or lease agreements. As of April 2007, all communities in Connecticut participate in the NFIP. All communities within the State of Connecticut are participating in the NFIP.

**Civil Preparedness Activities**

These activities are funded in-part by FEMA, and are described in the DEMHS section 3.2.5.

### 3.3.2 Natural Resources Conservation Service

The United States Department of Agriculture's (USDA) NRCS provides significant technical assistance to the DEP and other state agencies in the planning and implementation of activities, most of which have been conducted under Public Law (PL)-566, the Small Watershed Program Authorization.

#### 3.3.2.1 NRCS Enabling Legislation

NRCS projects are conducted under federal PL-566, and CGS Sections 22a-318 through 324 and provide the framework for state cooperation with the NRCS when utilizing the Watershed Protection and Flood Prevention Act, PL 83-566 Section 6, Statute 666 for planning and implementation of flood damage reduction projects on a watershed basis.

The Emergency Watershed Protection Program (EWP) is administered by the NRCS under Section 216, PL 81-516 and Section 403 of Title IV of the Agricultural Credit Act of 1978, PL 95-334. The EWP program provides the State and local units of government with technical and financial assistance to plan, design and implement measures that repair watershed impairments resulting from natural disasters.

Federal Level Recommendation 3 of "A Unified National Program for Floodplain Management" and Section 6 of PL 83-566 provide the authorization to NRCS for Floodplain Management and Cooperative USDA River Basin studies.

### 3.3.2.2 NRCS Water Resources Programs

The Watershed Protection and Flood Prevention Act, P.A. 83-566, CGS 22a-318 through 22a-323, authorizes the Secretary of Agriculture to "cooperate with states and local agencies in the planning and carrying out of works of improvement for soil conservation and other purposes." It provides for technical and financial assistance by the department through the NRCS to local organizations representing persons living in small watersheds (less than 250,000 acres). The Act provides for a project-type approach to solving land, water, and related resource problems. Flood prevention is an eligible purpose for which NRCS can pay 100% of the costs for planning studies, design and construction of structural solutions. The local sponsoring organization is solely responsible for land rights, operation and maintenance. Often these costs are equal to 1/2 the total costs of the project. For on-site measures such as flood proofing, the costs for implementation are divided 75% federal and 25% non-federal.

Floodplain Management Studies (FPMS) authorized in Section 6 of PL-566 are a means of NRCS assisting state agencies and communities in the development, revision, and implementation of their floodplain management programs..

A FPMS can identify site-specific flood problem areas (or potential problem areas), inventories natural values, incorporates public participation, studies the community's management alternatives, and provides for study follow-up assistance. A FPMS may serve as the source of technical data for the community to implement local floodplain management programs.

Implementation programs such as PL-566, or the Connecticut Flood Management Program are needed to install structural or on-site (such as flood proofing, raising or acquisition) measures. Floodplain studies and additional studies such as Dam Breach Analyses are underway.

### 3.3.2.3 NRCS Disaster Recovery Program

***Emergency Watershed Protection (EWP)*** program's objective is to assist in relieving imminent hazards to life and property from floods and the products of erosion created by natural disasters. Any corrective measure must prevent flooding or soil erosion, and reduce threats to life or property.

Authorized EWP technical and financial assistance may be made available when an emergency exists. Federal funds may bear up to 75% of the construction costs of emergency measures in an exigency situation and 75% in a non-exigency situation. Sponsors are responsible for obtaining any needed land rights. The number of EWP projects initiated after most recent natural hazards events in Connecticut include:

- 37 EWP projects after the June 1982 floods;
- 1 EWP project each after a thunderstorm in June 1989 in Franklin, Connecticut
- 1 EWP project after the July, 1989 tornadoes in western Connecticut;
- 5 EWP projects after Tropical Storm Floyd;
- 1 EWP project after the April 2005 storm in Danbury; and
- 7 EWP projects after the October 2005 storm.

### 3.3.3 UNITED STATES ARMY CORPS OF ENGINEERS (USACE)

The USACE provides significant flood assistance to Connecticut. In their role as an assisting federal agency, the USACE has undertaken several flood and erosion control projects within the State. Tables 3-5 and 3-6 provide damage reduction and suffered estimates based on USACE supported facilities within Connecticut, as well as a listing of authorized flood control projects within the State.

**Table 3-3 USACE Damage Information for Connecticut (based on USACE supported reservoirs and levees in the State)[5]**

| Fiscal Year | Flood Damage Reduction, by State (in thousands of dollars) | Flood Damages Suffered, by State (in thousands of dollars) |
|---|---|---|
| 1996 | $74,414 | $2,092 |
| 1997 | $11,518 | $52 |
| 1998 | $55,971 | $40 |
| 1999 | $27,303 | $1,112 |
| 2000 | $375 | $6,010 |
| 2001 | $37,364 | $237 |
| 2002 | $83 | $0 |
| 2003 | $24,268 | $70 |
| 2004 | $116,333 | $0 |
| 2005 | $53,911 | $25 |
| | 10 Year Average = $40,154 | 10 Year Average = $964 |

[5] Source: Fiscal Year 2005 Annual Report of the Secretary of the Army on Civil Works Acitivites, North Atlantic Division; website – http://www.usace.army.mil/cw/cecwb/annual_reports/fy05_annual_report/index_fy-5.htm.

| Table 3-4: USACE Authorized Flood Control Projects in Connecticut[6] | | | |
|---|---|---|---|
| **Project** | **Construction Cost (Cost to 9/30/05)** | **Total Contributed Funds (includes excluded funds as noted by USACE)** | **Year of Last Full Report** |
| Ansonia-Derby | $18,266,040 | $727,460 | 1977 |
| Connecticut River, Middletown | $262,046 | $93,255 | 1996 |
| Danbury | $13,143,000 | $1,146,828 | 1978 |
| Derby | $7,582,642 | $406,653 | 1977 |
| East Branch Dam | $1,959,836 | $0 | 1973 |
| East Hartford | $2,135,447 | $7,637 | 1951 |
| Farmington River, Simsbury | $500,000 | $267,915 | 1996 |
| Faulkners Island | $3,168,000 | $0 | 2003 |
| Folly Brook, Wethersfield | $220,284 | $0 | 1979 |
| Gulf Street, Milford | $365,000 | $21,000 | 1991 |
| Hall Meadow Brook Dam | $2,572,357 | $0 | 1970 |
| Hartford | $6,929,100 | $2,781,100 | 1960 |
| Housatonic River, Salisbury | $102,800 | $0 | 1982 |
| Mad River Lake | $4,773,020 | $0 | 1973 |
| Mad River, Waterbury (Woodtick Area) | $1,177,905 | $392,635 | 1998 |
| New London Hurricane Barrier | $8,504,919 | $3,948,216 | 1992 |
| Nonewaug River | $222,500 | $0 | 1985 |
| Blackberry River, North Canaan | $73,865 | $0 | 1977 |
| Norwalk | $52,150 | $0 | 1952 |
| Norwich | $1,209,000 | $0 | 1960 |
| Park River, Hartford | $60,176,919 | $259,408 | 1986 |
| Pawcatuck | $644,311 | $214,106 | 1966 |
| Port 5 Facility, Bridgeport | $227,500 | $0 | 1986 |
| Salmon River, Colchester | $247,100 | $0 | 1983 |
| Squantz Pond, New Fairfield | $116,296 | $0 | 1983 |
| Sucker Brook Dam | $2,227,792 | $58,800 | 1976 |
| Torrington, East Branch | $389,237 | $0 | 1963 |
| Torrington, West Branch | $228,237 | $0 | 1963 |
| Waterbury-Watertown | $265,300 | $0 | 1963 |
| West River, New Haven | $3,883,293 | $1,375,128 | 1996 |
| Winsted | $245,500 | $0 | 1954 |

[6] See footnote #4

#### 3.3.3.1 USACE Enabling Legislation

The USACE has worked within Connecticut to develop several floodplain management studies. These studies include ice jam protection on the Salmon River in Haddam and East Haddam, and a feasibility study of flood protection on the West River in West Haven, Connecticut and New Haven, Connecticut.

Connecticut is able to undertake projects with the USACE as authorized under CGS Section 25-76 entitled "Small Flood Control, Tidal and Hurricane Protection and Navigation Projects; and State Cooperation with Federal and Municipal Governments," and through CGS Section 25-95 entitled "Agreements Concerning Navigation and Flood and Erosion Control."

#### 3.3.3.2 Section 205 Program

The USACE, in cooperation with the DEP and the city of Milford, elevated 36 residential structures under the authority of Section 205 of PL-858 in 2002 - 2003. The total cost of the project is estimated at $3.4 million. The city and State contributed 35% of the cost and the USACE covered the remaining 65% of the construction costs. The project was completed in 2003.

#### 3.3.3.3 USACE Disaster Preparedness Programs

The USACE has undertaken several large flood control projects all across New England to reduce flood levels by retaining storm water runoff in upstream impoundments. These projects located in the Connecticut, Housatonic, Naugatuck, and Thames river basins. These structural measures have saved the State millions of dollars in flood damages. The USACE works in cooperation with the DEP by providing technical assistance on flood control and prevention projects, and assistance to the State's flood warning system.

### 3.3.4 National Weather Service (NWS)

NWS offices in Albany, NY, Upton, NY (on Long Island), and Taunton, MA share Forecast and warning operations for Connecticut. See Figure 3-2a for NWS Connecticut county responsibility. Connecticut's nine counties are sub-divided into 13 weather forecast zones to account for topography and climatological variation across the State. See Figure 3-2b for a depiction of Connecticut forecast zones.

Each NWS office maintains sophisticated computer forecasting technology and Doppler radar for continuous weather and radar surveillance of Connecticut. Furthermore, each NWS office enlists the aid of volunteer severe weather observers through Skywarn training across the State. Finally, NWS offices collaborate on forecast and warning services for Connecticut.

Four NOAA Weather Radio All Hazards (NWRAH) transmitters are located in Connecticut. These transmitters are located in Cornwall, Meriden, Hartford, and New London. The Cornwall transmitter was made possible by an allocation of $100,000 from the Connecticut Legislature to install a NWRAH transmitter on Mohawk Mountain in Cornwall, Connecticut. This new transmitter was installed in February 2001 to fill a gap between the three existing NOAA weather radio transmitters in Connecticut. This transmitter serves Litchfield County and (is) controlled by the NWS office in

Albany, New York. In addition, NWRAH transmitters in neighboring states provide forecast and warning information for adjacent Connecticut municipalities. A computer-generated depiction of NWRAH coverage in Connecticut is provided in Figure 3-3. NWRAH is the official voice of the NWS and delivers weather forecasts, watches and warnings 24 hours per day, and as requested by emergency management officials other hazardous awareness information such as Civil Emergency Messages.

As a direct result of the 1989 western Connecticut tornado outbreak, the State purchased 300 advanced technology Specific Area Message Encoder (SAME) radios in 1992 and 1994. These SAME radios allow the NWS to issue watches and warnings to specific counties in Connecticut when severe weather threatens the State.

Figure 3-2: Map of NWS County Warning Forecast Areas in Connecticut.

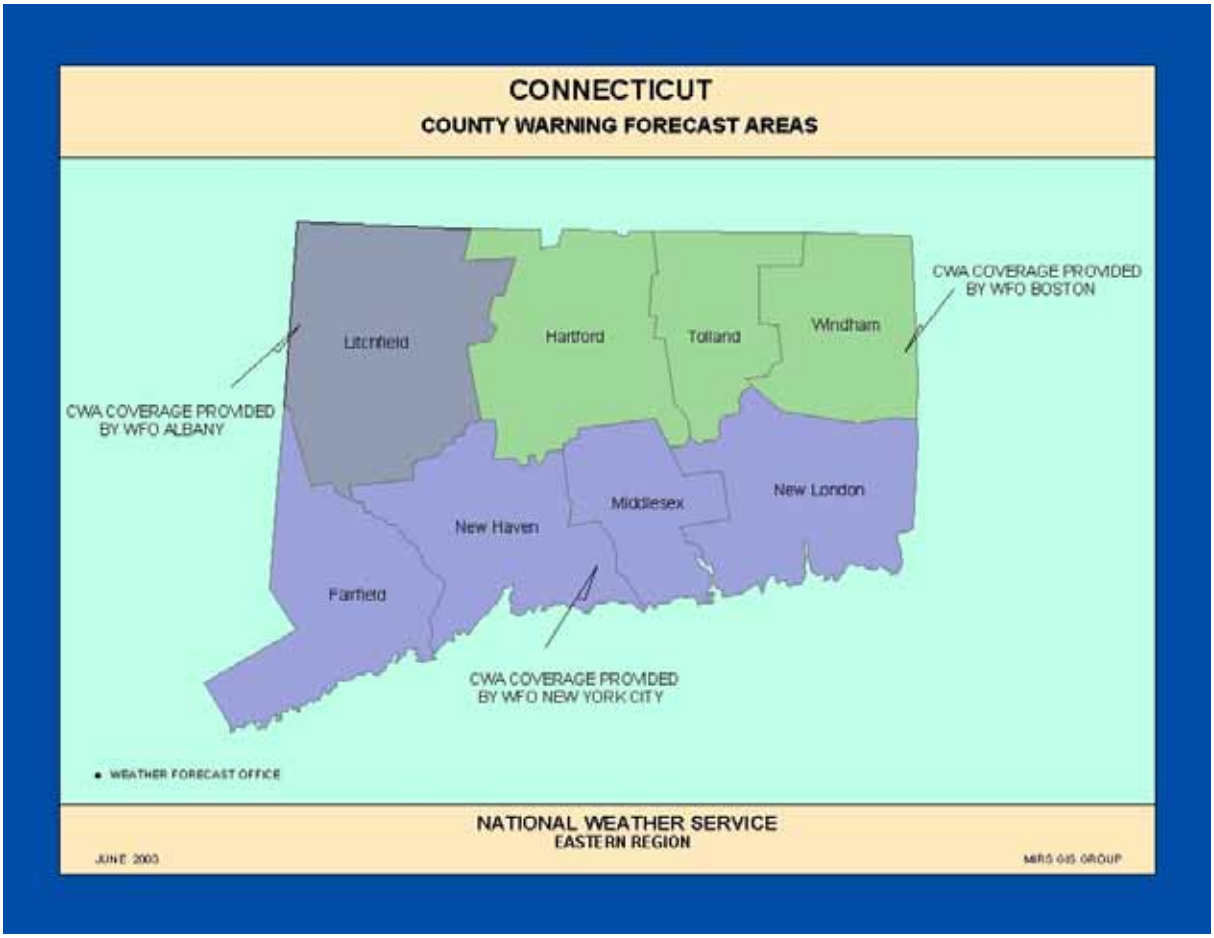


Figure 3-3. Depiction of Connecticut Forecast Zones

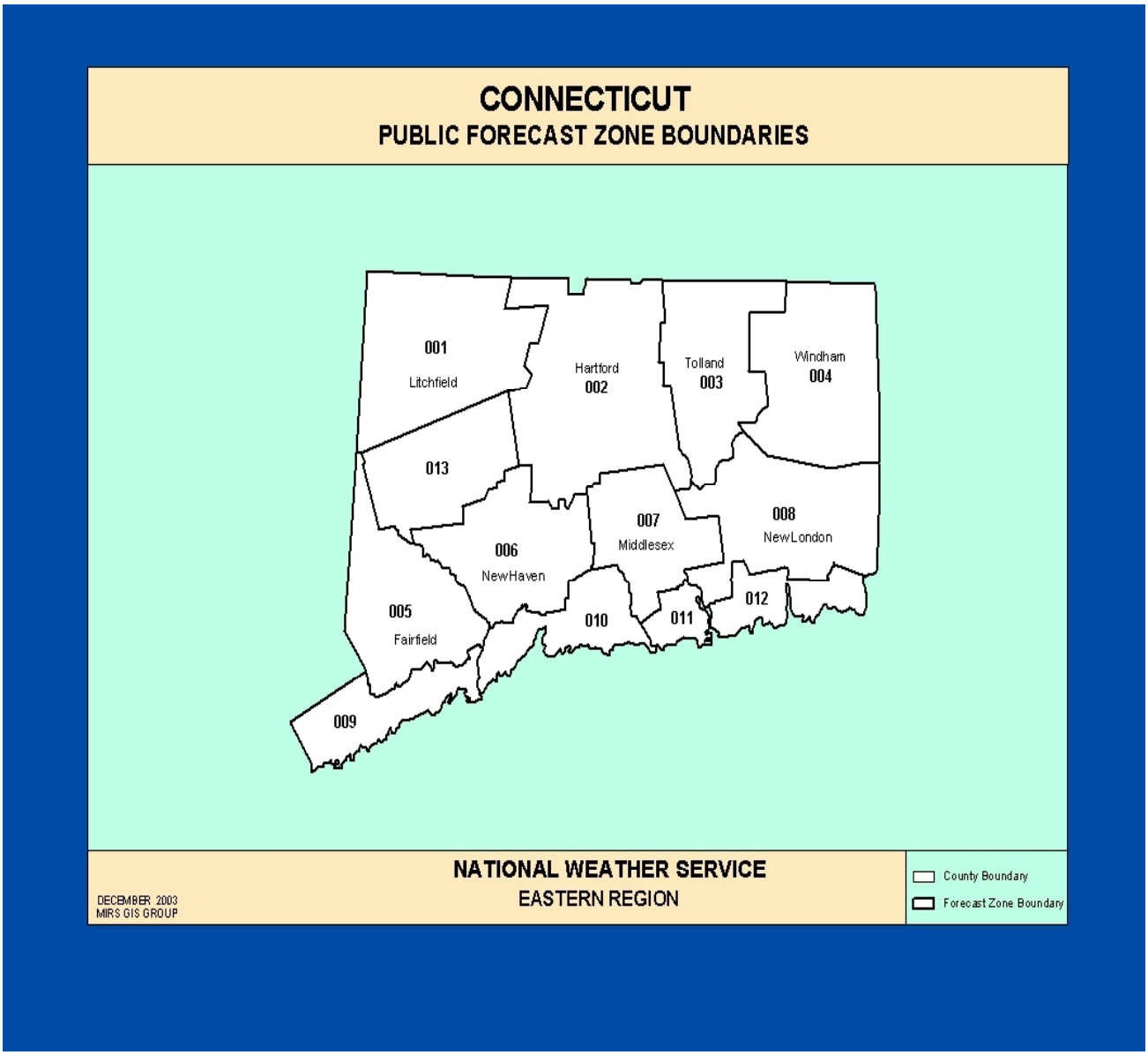
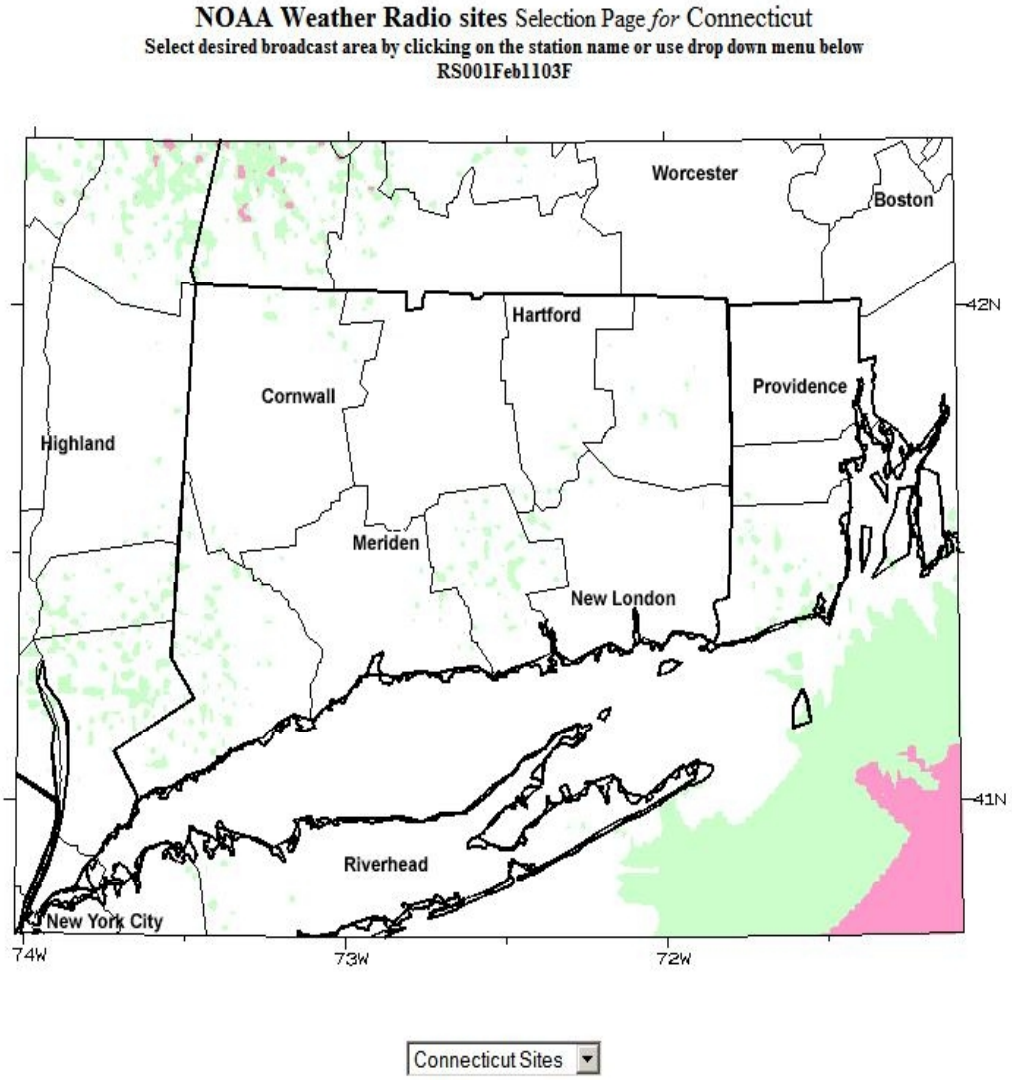


Figure 3-4. Depiction of NWRAH Coverage in Connecticut



## Table 3-5: Warning/Advisory Criteria for Connecticut

The following are National Weather Service criteria for issuing **Warnings** and **Advisories** for various weather events when issued for ***Connecticut***. **Watches** generally are issued with longer lead times when there is a potential of meeting **Warning** criteria.

| TYPE OF ISSUANCE | WHEN ISSUED FOR CONNECTICUT |
|---|---|
| WINTER WEATHER ADVISORY | When the following expected in the next 24 hours:<br>• Any accretion less than .50 inches of freezing rain or freezing drizzle on road surfaces<br>• Blowing/drifting snow occasionally reducing visibility to <= 1/4 mile<br>**Snow or snow and sleet combination:**<br>• 3, 4, or 5 inches averaged over a forecast zone in 12 hours *except 4, 5, or 6 inches in Litchfield County, CT.* |
| SNOW ADVISORY | Same thresholds as for Winter Weather Advisory, but issued when snow is the *only* weather type expected |
| FREEZING RAIN ADVISORY | Same thresholds as for Winter Weather Advisory, but issued when freezing rain is the *only* weather type expected |
| WINTER STORM WARNING | When the following expected in the next 24 hours:<br>• At least 1/2 inch accretion of freezing rain in any zone<br>**Snow or snow and sleet combination:**<br>• 6 inches or more averaged over a forecast zone in 12 hours *except 7 inches or more in 12 hours across Litchfield County*<br>• 8 or more inches averaged over a forecast zone in 24 hours *except 9 or more inches in 24 hours across Litchfield County* |
| HEAVY SNOW WARNING | Same thresholds as for Winter Storm Warning, but issued when snow is the *only* weather type expected |
| ICE STORM WARNING | Same thresholds as for Winter Storm Warning, but issued when freezing rain is the *only* weather type expected |
| BLIZZARD WARNING | At least 3 hours, falling and/or blowing snow frequently reduces visibility to < 1/4 mile **AND** sustained winds or frequent gusts >= 35 mph |
| WIND CHILL ADVISORY | Wind chill index between -15F and -24F for at least 3 hours using the sustained wind |
| WIND CHILL WARNING | Wind chill index<= -25F for at least 3 hours using the sustained wind |
| WIND ADVISORY | Sustained winds 31-39 mph (27-34 kts) for at least 1 hour; **OR** any gusts to 46-57 mph (40-49 kts) |
| HIGH WIND WARNING | Sustained winds 40-73 mph (>= for at least 1 hour; **OR** any gusts >= 58 mph (>= 50 kts) |
| INLAND HURRICANE FORCE WIND WARNING | Sustained winds >= 74 mph |
| HEAT ADVISORY | Heat Index expected to be from 100 to 104 for at least 2 hours |
| HEAT WARNING | Heat Index expected to be 105 or higher for at least 2 hours |

**Table 3-5: Warning/Advisory Criteria for Connecticut Continued**

| TYPE OF ISSUANCE | WHEN ISSUED FOR CONNECTICUT |
|---|---|
| DENSE FOG ADVISORY | Widespread visibility <= 1/4 mile for at least 3 hrs. |
| SMALL CRAFT ADVISORY | Sustained wind 25-33 knots **AND/OR** Seas >= 5 feet within 24 hours |
| GALE WARNING | Sustained wind 34-47 knots within 24 hours from a non-tropical system |
| STORM WARNING | Sustained wind >= 48 knots within 24 hours from a non-tropical system |
| TROPICAL STORM WARNING | Along coast: sustained winds of 39-73 mph (34-63 knots) within 24 hours |
| HURRICANE WARNING | Along coast: sustained winds >= 74 mph (64 knots) within 24 hours; implies dangerous storm surge |
| SPECIAL MARINE WARNING | Brief/sudden occurrence of sustained wind or frequent gusts >= 34 knots, usually associated with thunderstorms; also issued for waterspouts |
| SEVERE THUNDERSTORM WARNING | Thunderstorms with wind gusts >= 58 mph **AND/OR** hail >= 3/4" in diameter |
| TORNADO WARNING | Likelihood of a tornado within the given area based on radar or actual sighting; usually accompanied by conditions indicated above for "Severe Thunderstorm Warning" |
| FLASH FLOOD WARNING | A flood that occurs within a few hours of heavy rainfall, a dam or levee failure, or water released from an ice jam |
| FLOOD WARNING | Expected inundation of a normally dry area near a stream or other watercourse; **OR** unusually severe ponding of water expected |
| RIVER FLOOD WARNING | Expected flooding of main stem rivers (e.g. Connecticut, Farmington, Shetucket, Housatonic) |
| COASTAL FLOOD WARNING | *Widespread* coastal flooding expected within 12 hours; more than just typical overwash |
| RED FLAG WARNING | • Winds sustained or with frequent gusts > 25 mph<br>• Relative Humidity at or below 30% anytime during the day<br>• Rainfall amounts less than 0.25 inches for the previous 5 days (except 3 days in pre-greenup)<br>• Keetch-Byron Drought Index values of 300 or greater** (Summer Only) |

## 3.4 INTERSTATE PROGRAMS

### 3.4.1 Thames and Connecticut River Flood Control Compacts

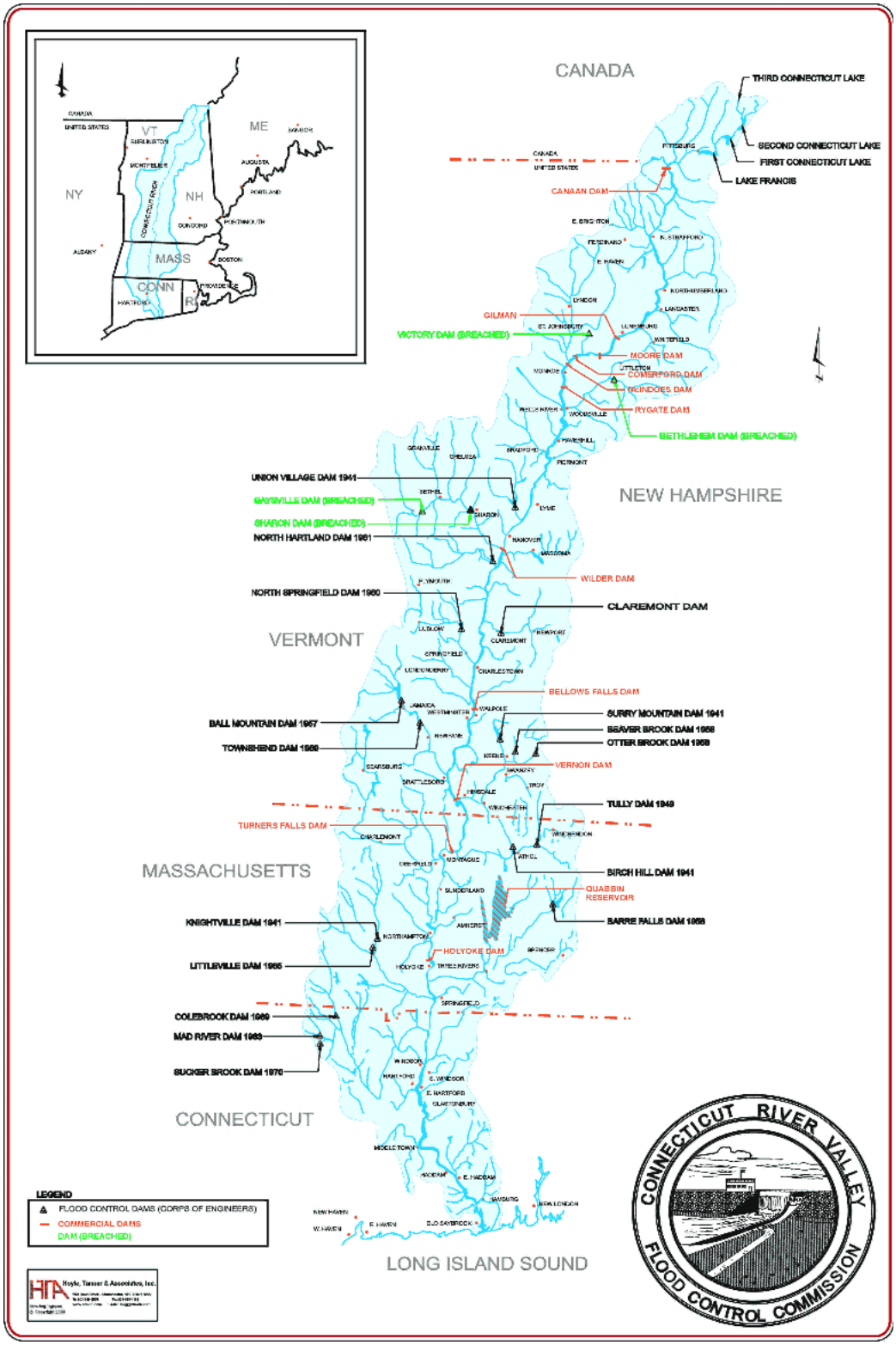
There are two active interstate flood control commissions; the Thames River Valley Flood Control Compact (1957 TRVFCC), and the Connecticut River Valley Flood Control Compact (CRVFCC 1953). These compacts were enacted to provide the authority to create detention reservoirs. The creation of each of the compacts required an act of Congress and legislative authorization from each of the signatory states. The CRVFCC is composed of three representatives each, from Connecticut, Massachusetts, New Hampshire, and Vermont, while the TRVFCC has three representatives from Connecticut and three from Massachusetts.

Representatives are chosen by their respective governors, and in Connecticut, are appointed for six-year terms. The CRVFCC requires all states to share in the cost of the office located in Massachusetts, and to share in reimbursements of property tax losses to the 21 communities in which the reservoirs are located. The office fees and tax reimbursements are fixed in the Compact according to proportional benefits. Because Connecticut and Massachusetts benefit most from the upstream dams, they pay more. Although tax reimbursement proportions are fixed, while property assessments change, correspondingly yearly payments change.

The costs of building the 16 dams and 16 local protection projects works along the Connecticut River and its tributaries have been principally borne by the Federal government.

Similar to the CRVFCC, the TRVFCC assesses each state for the tax losses associated with the flood control benefits provided by upstream communities. DEP pays for the two flood control commission assessments on behalf of the state through a dedicated budget line item.

**Figure 3-5: Map of Connecticut River Flood Control Facilities**
Source CRVFCC website: www.crvfcc.org/damprojects.htm



### 3.4.2 Connecticut Interagency Hazards Mitigation Committee (CIHMC)

The Connecticut Interagency Hazards Mitigation Committee was formed to discuss and oversee mitigation-related activities and issues within the State. The CIHMC had its MOU signed by the head officials of respective participating state and federal agencies in 2001. The 5 participating state agencies at this time are DEP, DEMHS, DOT, OPM and OSBI. The one participating federal agency is NRCS. In addition, one private sector representative from the Hartford Life Insurance Company sits on the Committee.

### 3.4.3 State Drought Plan

The first *State Drought Preparedness and Response Plan for Connecticut* was adopted on August 4, 2003 by the Water Planning Council (WPC), a group of Commissioners from four (4) state agencies, DEP, DPH, DPUC, and OPM. The plan was initiated due to record low ground water level during the spring of 2002. The plan was prepared by the Interagency Drought Working Group, comprised of staff from the DEP, DPH, DPUC, OPM, Department of Agriculture, and DEHMS with assistance from the U.S. Geological Society.

The plan provides statewide guidance to assess and to minimize the impacts of a drought on Connecticut. The plan is to be used as a flexible non-regulatory guidance document. The State will also be able to mobilize state resources more quickly and efficiently in response efforts. To accomplish these objectives the *State Drought Preparedness and Response Plan for Connecticut*:

1. Defines a process to guide state agencies to address drought-related activities, including monitoring, impact assessment, and the preparedness for successively more severe drought stages;
2. Identifies activities that may be implemented to coordinate drought assessment, response and impact mitigation;
3. Identifies the federal, state, local, and private sector entities that are primarily responsible for managing drought-related activities; and
4. Promotes effective mobilization of public and private resources to manage drought mitigation efforts.

The Drought Plan is currently undergoing a review by the Inter-Agency Drought Committee to assess the need for improving the Plan. The Inter-Agency Drought Committee formed three subcommittees in the fall of 2006 to review suggestions for revisions to the plan to improve the State's response in a drought emergency. The three subcommittees' areas of focus are:

1. Text Changes to the Drought Plan;
2. Evaluation of Drought Measures; and
3. Water Use Restrictions.

The Drought Plan may be revised in the future to incorporate recommendations from the subcommittees.

## 3.5 INTRASTATE REGIONAL PROGRAMS

RPOs and Councils of Government provide land use guidance to municipalities, and assist with drafting of ordinances or zoning regulations.

The Connecticut River Gateway Commission and the Connecticut River Assembly advises municipalities on land use changes along the Connecticut River, and both consider flooding as a major consideration in making their decisions. Created by State statute, the Assembly is concerned with the northern half of the river, while the Gateway Commission reviews proposals for the southern half.

## 3.6 MUNICIPAL PROGRAMS

### 3.6.1 Determining the Effectiveness of Policies, Programs and Capabilities.

The State of Connecticut reviews local flood management programs, local NFIP procedures, mitigation actions and local capabilities through the Community Assistance Program (CAP) of the NFIP. Each year IWRD staff perform 10 – 20 Community Assistance Visits (CAVs). During the CAV, the community's ordinances are reviewed along with any variances, which have been granted in the floodplain. DEP staff meet with the local floodplain coordinators and "drive the floodplain" looking for compliance issues and checking on possible violations. DEP staff then return to the office and prepare a report on the CAV to FEMA. CAVs are targeted for coastal communities once every 5 years due to their increased vulnerability to flooding. Inland communities normally receive a CAV once every 10 years. Plans for potential future projects are also reviewed back at the DEP to determine if they are in compliance with NFIP and State floodplain management regulations. The CAV program has uncovered violations and allowed the DEP to more effectively monitor local municipal flood management regulations. Every municipality in Connecticut is a member of the NFIP and is required to submit to a CAV upon request. This has made the program very effective in assisting municipalities to monitor and prevent floodplain violations.

### 3.6.2 Determining The Effectiveness Of Local Natural Hazards Mitigation Plans.

Connecticut's local planning effort began in 2000. The effectiveness of the local plans will be updated at least every 5 years, however, the success of the measures taken by local communities may have to wait for a return of a significant storm event. Although the DEP currently has no provisions to analyze the effectiveness of local policies, the DEP has reviewed the local plans during their preparation. Through this review, the DEP has observed an evolution of the plans, which having been prepared most recently by consultants, and which are less "cookie cutter" in nature. In the future, the DEP expects that local plans will have stricter requirements. The DEP will evaluate by the quality of the proposed measures that result from the implementation of the adopted plans. Upon revision, the regulatory elements of the plan will also be analyzed as part of all future planning grants in those communities. The DEP will develop a checklist of accomplishments related to the local plans that will be identified in a format approved by FEMA.

### 3.6.3 Land Use Controls

Currently, every municipality within Connecticut has some form of flood zone protection authority authorized within one of several CGS.

Section 7-148 of the Connecticut General Statutes of (CGS) gives municipalities authority to pass ordinances, and many communities have done so under this authority. CGS. Section 8-2 (et. seq.) provides authority for municipal zoning including provisions to use zoning to "secure from flood". A zoning commission administers zoning and its actions in most cities and towns are independent of a municipality's legislative body. Some communities may have both a flood ordinance and flood zoning. Municipalities also have authorities, which allow them to purchase open space (7-13lb), to conduct comprehensive planning (8-18 et. seq.), to regulate inland wetlands (22a-57 et. seq.), to establish and maintain civil preparedness plans (28-7), and to regulate construction of buildings (29-260 et. seq). As discussed in Section 3.1.1.2, coastal municipalities have additional authority and responsibility under the Connecticut Coastal Management Act, including ensuring that development within coastal flood hazards areas are managed to minimize risks to life and property.

Although the State has a 100% participation rate of its municipalities in the NFIP, the real measure of success cannot be determined merely by participation in the program. The minimum regulations required for admission into the NFIP must be adequately understood and enforced at the local level. The Flood Management Section's CAP has enabled DEP to greatly expand its technical and general assistance capabilities to local officials, residents, banks, insurance agents and engineers.

CTDEP has not performed a formal assessment of local capabilities in the past 3 years. CTDEP will perform further research into if this activity has been or continues to be performed by another state agency over the next planning period. In addition, CTDEP will continue to gather information on this subject through its performance of local floodplain ordinance/regulation reviews, as it continues to perform in coordination with its MAP Mod program, and through annual Community Assistance Visits (CAVs) and Community Assistance Contacts (CACs). However, due to current and foreseeable staff constraints over the next three years, the CTDEP does not intend to conduct a more advanced assessment update for natural hazards at any level of government for the next NHMP update.

Available qualitative information and ongoing communications between Inland Water Resource Division programs and local governments indicate that local governments' land use policies and the enforcement of these policies and local regulatory controls have been and continue to be effective with regards to the mitigation of natural hazards at the local level. Many communities have been proactive with regards to managing their local natural resources and in developing local strategies to mitigate and/or plan for post-disaster recovery. The majority of communities located within the state actively work with CTDEP and CTDEMHS to develop and implement local hazard mitigation activities, and enhance and exercise evacuation and post-disaster plans of action

### 3.6.4 Flood and Erosion Control Boards

CGS Sections 25-85 through 25-98, inclusive, enable municipalities to form a municipal Flood and Erosion Control Board (FECB) with the power to plan, layout, acquire, construct, reconstruct, repair, maintain, supervise and manage flood and erosion control systems, flood control projects, and dam repair projects. These boards may also enter upon, take and hold by purchase, condemnation or otherwise, property which it determines necessary for use in connection with flood or erosion control systems; defray the cost of such systems by issuing bonds or other evidence debt, or from general taxation, special assessment or any combination thereof; and assess those properties benefiting from such project according to such rules as the FECB may adopt. The FECB is further empowered to negotiate, cooperate, and enter into agreement with: 1) The United States, 2) the United States and the State of Connecticut or 3) the State of Connecticut in order to satisfy the conditions imposed by the United States or the State of Connecticut in authorizing any system for the improvement of navigation of any harbor or river and for protection of property against damage by floods or by erosion, provided such system shall have been approved by DEP's Commissioner.

These statutes listed above enable a municipality, which has recognized a particular flood or erosion hazards potential and is dedicated to reducing or eliminating the hazards, to work with, and receive assistance from, federal and state agencies. The municipality must make a financial commitment based on federal cost-sharing requirements for a federal project. For a state/local project, the cost-sharing ratio is based on the ownership of the benefited property. The State will provide two-thirds of the project cost if the property protected is municipally owned. When the project benefits private properties, the State will provide one-third and the municipality will provide two-thirds of the project costs.

## 3.7 Northeast Utilities

Northeast Utilities (NU) is the largest power utility company within Connecticut. NU has several short and long-term programs to reduce the impact of natural disasters on the general public. NU's short-term programs include using power restoration crews to restore power after small-scale storms. NU also has agreements with other states and Canada to bring in up to hundreds of additional crews after major disasters to restore power. During the peak summer usage months, NU maintains agreements with large companies to curtail power usage during peak periods to prevent the need for brownouts or rolling blackouts. NU also issues power watches and warnings when necessary to conserve energy.

**Power Watch**

When a power warning is issued, NU asks customers to turn off all unnecessary electrical appliances, air conditioning and lights during the peak hours of 11 a.m. to 4 p.m.

**Power Warning**

When a power warning is issued, NU urges customers to immediately turn off all unnecessary air conditioning, lights and electrical equipment, as significant reduction in power usage is necessary to avoid overload of the electrical system. NU has special information for customers who are dependent on electrically operated life-support equipment.

**Tree Trimming Program**

NU has an annual proactive program of tree trimming across the State. Trees are identified and property owners are notified that their trees that overhang or threaten power lines will be trimmed. Tree trimming saves millions in yearly damage to the power grid.

## 3.8 Activities for Future Updates

It is the intent of DEP to enhance this section of the NHMP in future updates by developing the following items:

- A review of any future agency/division organizational changes and their effect on said agency/divisions efforts relating to hazard mitigation; and
- Overview of local hazard mitigation policy initiatives, where available and a review of their effectiveness.

This work will be performed through planning efforts supported by FEMA grants and possible other grant/funding sources that may become available to the State. Due to existing resource constraints, the advancement of research and planning for these stated activites for future updates of this plan will rely heavily on obtaining such support funding.

# TABLE 3-6 NRCS DAMAGE REDUCTION
# NRCS Public Law 566 Watershed Projects

| Project | Location | Damages Prevented In A Recurring Evaluation Flood in 2007 Dollars* |
|---|---|---|
| Roaring Brook/Walnut St | Farmington | $ 367,000 |
| Furnace Brook/Middle River | Stafford | $ 1,582,000 |
| Blackberry River | Norfolk, North Canaan | $ 7,461,000 |
| North Branch-Park River | Bloomfield, Hartford | $ 8,140,000 |
| South Branch-Park River | Newington, West Hartford Hartford | $12,209,000 |
| Spaulding Pond Brook | Norwich | $ 3,053,000 |
| Farm Brook | Hamden, New Haven | $ 5,223,000 |
| Norwalk River | Ridgefield, Wilton, Redding, Norwalk | $ 4,477,000 |
| Avery Brook | South Windsor | $ 827,000 |
| Neck River | Madison | $ 212,000 |
| Mill-Horse Brook | Plainfield | $ 21,000<br>$ 2,713,000 (when completed) |
| Yantic River | Franklin, Norwich | $ 495,000<br>$17,636,000 (when completed) |
| TOTAL DAMAGE PREVENTED | Present | $44,067,000 |
| | When All Projects Are Completed | $63,900,000 |

* Evaluation Flood is the larger of the 100-Year or Flood of Record

# CHAPTER 4

## NATURAL HAZARDS MITIGATION PROGRAMS

# 4.0 NATURAL HAZARDS MITIGATION PROGRAMS

This chapter describes the Federal and State natural hazards mitigation programs and potential mitigation funding resources. This chapter does not serve as the State Grant Administrative Plan, which was recently revised and developed as a stand-alone state procedures plan. The following descriptions are not intended to dictate state policy or decision-making procedures or outcomes. Any questions on the applicability of this chapter should be directed to the State Hazards Mitigation Officer (SHMO).

Five major natural hazards mitigation programs administered by FEMA are presented in this chapter: 1) Hazards Mitigation Grant Program (HMGP), 2) Flood Mitigation Assistance (FMA), 3) Emergency Management Performance Grant (EMPG), 4) Pre-Disaster Mitigation (PDM), and Repetitive Flood Claims Program (RFC) (See Table 4-1). Each program is similar in its funding formula (75% federal / 25% State or Local); however, each program has different eligibility criteria and timelines for project completion. Each program also requires that all projects be cost-effective (i.e., at least one dollar of benefit must result from each dollar of cost). The Federal law that covers the first program, the HMGP, is the Stafford Act (44 CFR Section 404). Applicants for these grants may include municipalities, state agencies, non-profit groups, and Indian Tribes. In general the potential financial support sources listed in this chapter have not changed from the 2004 Plan. The most pertinent change is the addition of the Repetitive Flood Claims Program. DEP has placed an importance on encouraging communities to apply for project funds under this grant as a way to encourage increased non-intensive use of floodplain areas.

## 4.0.1 Robert T. Stafford Disaster Relief And Emergency Assistance Act

On November 23, 1988, President Reagan signed the Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 USC 5121 et seq.) into law. The Stafford Act provides disaster assistance to states and municipalities after major disasters. A major disaster is defined as a natural disaster that causes damage equal to or greater than $1.00 per capita in a state. Based on current population information, this Act would normally be initiated for Connecticut after a disaster that caused greater than $3.2 million in damages statewide. If several states are affected by the same disaster, the $1.00 per capita standard may be waived.

## 4.0.2 The Hazard Mitigation Grant Program (HMGP)

Section 404 of the Stafford Act created the HMGP, which provides federal grants to states and municipalities for post-disaster natural hazards mitigation. HMGP funding is allocated to a state by the use of a sliding scale calculation. The total grant funding from HMGP cannot exceed 15% (Standard Natural Hazards Mitigation Plan) or 20% (Enhanced Natural Hazards Mitigation Plan) of the total disaster damages for the first $2 billion. After the total aggregate amount of $2 billion in damages the amount of funding for subsequent aggregate damages is decreased according to FEMA's formula. Thus for the next portion of aggregate damages between $2 billion and $10 billion, funding is calculated by 10%, and for the next portion of aggregate damages between $10 billion and $35.333, funding is calculated based on 7.5%.[1] The monies from this federal grant are given to Connecticut and used to support local mitigation projects, which carry a local cost share ratio of 75% federal and 25% local match.

[1] Information derived from FMEA Fact Sheet, *Hazards Mitigation Grant Program*, available at FEMA's website: www.fema.gov.

The HMGP is active only after a presidentially declared disaster. The HMGP grant provides communities with up to 75% of the total cost of projects that reduce or prevent further damage from natural disasters. Projects may include, but are not limited to: acquisition, relocation, elevation or demolition of flood prone structures, construction of small scale flood control projects such as levees and small dams, retrofitting of structures to withstand wind and seismic forces and the drafting of plans that lead directly to the implementation of mitigation measures.

### 4.0.3 Flood Mitigation Assistance (FMA)

In 1994 the United States Congress created a new grant program called Flood Mitigation Assistance (FMA). The purpose of FMA is to assist state and local governments in funding cost-effective actions that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other insurable structures. The long-term goal of FMA is to reduce or eliminate claims under the NFIP through the use of mitigation activities with a specific focus on repetitive loss properties. Repetitive loss properties are those properties that suffer at least 2 claims of more than $1,000 each for flood damage in a 10-year period.

The FMA program provides cost-share grants for three purposes: 1) planning grants (approximately $20,000 annually for Connecticut) to states and communities to assess the flood risk and identify actions to reduce that risk; 2) project grants (approximately $200,000 annually for Connecticut) to execute measures to reduce flood losses; and 3) technical assistance grants (approximately $20,000 annually for Connecticut) that states may use to fund staff salary and program expenses in order to administer the FMA program.. FMA also outlines a process for development and approval of Natural Hazards Mitigation Plans.

### 4.0.4 State Homeland Security Grant Program (SHSGP)

DEMHS is in charge of the SHSGP with monies provided by the U.S. Department of Homeland Security (DHS). This program contains several different funding pools including the Emergency Management Performance Grant Program (EMPG), the Buffer Zone Protection Program, the Urban Area Security Initiative, among others. Funds from these programs are used for providing planning and equipment grants to state, regional, and local government agencies. The purchase of interoperable communication systems has been a major activity in ensuring disaster preparedness.

### 4.0.5 Project Impact (PI) (1997 – 2000)

Project Impact helped communities protect themselves from the devastating effects of natural disasters by taking actions that dramatically reduce disruption and loss.

In 1997, FEMA partnered with seven pilot communities across the country. Project Impact became a nationwide initiative in 1998. Before the program was ended there were nearly 250 Project Impact communities nationwide, as well as more than 2,500 businesses that had joined as Project Impact partners. In Connecticut, the communities of Westport, Milford, East Haven, and Norwich each received Project Impact assistance ranging from $300,000 - $500,000.

To each new community that committed to the partnership, FEMA provided up to $500,000 to conduct natural hazards mitigation efforts that made the community more natural disaster resistant.

Projects included but were not limited to: relocation, elevation or demolition of flood prone structures, construction of small scale flood control projects such as levees and small dams, retrofitting of structures to withstand wind and seismic forces and the drafting of plans that lead directly to mitigation measures. FEMA also offered technical assistance at both the national and regional levels, as well as incorporated other federal agencies and states into the project. FEMA guided these communities through the complete risk assessment process, which allows each community to identify and prioritize those mitigation initiatives that will have the greatest benefits to the community.

### 4.0.6 Pre-Disaster Mitigation Program (PDM)

The disaster experiences of the 1990's demanded that federal, state and local emergency managers reassess their approach to disaster response and recovery. Based on the lessons of the 1990's, it became apparent that the nation needed to shift its approach from a disaster-response driven system to a system based on pre-disaster or ongoing risk analysis so that we could become proactive rather than reactive to hazards events. This acknowledgement caused FEMA to re-evaluate its national strategy, resources and priorities. As a result of this evaluation, a unit for Natural Hazards Mitigation Planning was established in 1998 within FEMA to provide guidance and resources to states and local communities to promote and support the mitigation planning process. FEMA and the State of Connecticut place great value on the planning process as an approach to mitigation that must be promoted and supported in order to build sustainable, disaster resilient communities.

On October 20, 2000, Congress passed the Disaster Mitigation Act of 2000 (DMA 2000) (Public Law 106-390). This was the first major amendment to the Robert T. Stafford Disaster Relief and Emergency Assistance Act since that law was initially passed in 1988. Through DMA 2000, Congress approved the creation of a new mitigation grant program, the Pre-Disaster Mitigation (PDM) program to provide a mitigation funding mechanism that is not dependent on a presidential disaster declaration and could fund both natural hazards mitigation construction projects and natural hazards mitigation planning initiatives. The PDM grant program is administered by FEMA. PDM funding has changed. In the program's initial years, a base allocation of funding was granted to each state and additional funds were provided using a population formula. Recently, FEMA has changed the program to a nationally competitive grant program where projects from all states compete against each other with the best projects receiving funding. Eligible PDM projects include: state and local natural hazards mitigation planning, mitigation projects, and community outreach and education. The PDM grant is a 75% federal 25% local cost-share grant (e.g., cash, in-kind services, etc.).

For fiscal years 2002-2007, a main focus of the PDM program was on the development of local or regional natural hazards mitigation plans to help meet the new local natural hazards mitigation planning requirements of DMA 2000. In Connecticut, communities applying for any FEMA mitigation grants, such as the FMA, to conduct mitigation projects (e.g. home elevations, acquisitions) must have an adopted local natural hazards mitigation plan in place prior to receiving funds. In addition, following a presidentially declared disaster, municipalities will not be able to receive funding under the HMGP without an approved local natural hazards mitigation plan.

### 4.0.7 Repetitive Flood Claims Grant Program (RFC)

Authorization for the Repetitive Flood Claims Grant Program (RFC) is granted under the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004 (P.L. 108-264), which amended the National Flood Insurance Act (NFIA) of 1968 (42 U.S.C. 4001, et al). The RFC program began in FY2006 and provides funding to reduce or eliminate the long-term risk of flood damage to structures

insured under the NFIP that have had one or more claim payments for flood damages. RFC funds may only mitigate structures that are located within a state or community that cannot meet the requirements of the FMA program for either the 25% cost share or capacity to manage the activities. The long-term goal of the RFC is to reduce or eliminate claims under the NFIP through mitigation activities. A municipality does not need a local Natural Hazards Mitigation Plan to apply for the RFC grant, however, a state must have a FEMA-approved state Natural Hazards Mitigation Plan in order to submit an application. Eligible activities include only the acquisition of insured property that have one or more claim payments for flood damage; and the demolition or relocation of insured structures, with conversion of property to deed-restricted open space use. Property owners must have a flood insurance policy on the structure to be mitigated that is current at the time of application and maintained through award. All RFC grants are eligible for up to 100% Federal assistance. RFC grants are awarded nationally without reference to state allocations, quotas, or other formula-based allocations of funds.

With its flood management certification program, DEP encourages the implementation of less intensive floodplain land uses. This also coincides with CT OPM's policy of promoting less intensive uses of floodplain areas. The newly created RFC program is seen as an important funding tool for use by the state and local communities to move towards more open space acquisition and less intensive uses of floodplain areas, while providing important local quality of life benefits by protecting such important resources. DEP intends to promote such less intense uses of floodplain areas where possible, and promote the use of this program to local communities to encourage protection of these floodplain areas, while protecting public health, welfare, and safety.

### 4.0.8 Severe Repetitive Loss Grant Program (SRL)

On October 31, 2007 FEMA issued an inter rule which is expected to become effective on December 3, 2007. This rule establishes a new grant program under the Bunning-Bereuter-Blumenauer Act of 2004 called the Severe Repetitive Loss grant program (SRL). The intention of this new grant program is to," provide mitigation assistance to address properties that have experienced repetitive flood losses and that are insured under the NFIP. The SRL focuses on a subset of all repetitive flood loss properties (Federal Register, Vol. 72, No. 210)." Flood mitigation projects acceptable for funding under this new program include buyouts, elevation, relocation, or floodproofing. It is anticipated that FEMA will issue its final guidance for this program in December 2007.

The State of Connecticut will review the guidance issued by FEMA and assess the minimum resources required to effectively manage this program, in addition to the total benefits in terms of natural hazards mitigation for the State. Once this analysis is complete the State will decide as to its participation status in the new FEMA program and, if necessary, will submit an amendment to this NHMP if required at the appropriate time.

As stated in Section 4.0.7, with its flood management certification program, DEP encourages the implementation of less intensive floodplain land uses. This also coincides with CT OPM's policy of promoting less intensive uses of floodplain areas. The newly created RFC program is seen as an important funding tool for use by the State and local communities to move towards more open space acquisition and less intensive uses of floodplain areas, while providing important local quality of life benefits by protecting such important resources. DEP intends to promote such less intense uses of floodplain areas where possible, and promote the use of this program to local communities to encourage protection of these floodplain areas, while protecting public health, welfare, and safety.

### 4.0.9 Connecticut Floodplain Management and Natural Hazards Mitigation Act of 2004

During 2004, the Connecticut Legislature passed the Connecticut Floodplain Management and Hazards Mitigation Act. The Act mandates state and local compliance with the National Flood Insurance Program (44 CFR, Part 59 et seq.) and requires municipalities to revise their current floodplain zoning regulations or ordinances to include new standards for compensatory storage and equal conveyance of floodwater.

The legislation imposes an additional $10 increase to a current land use fee in order to fund a new state hazards mitigation and floodplain management grant program, and designates the DEP as the administrating department for a new mitigation grant program created by this Act. The new grant program will be known as the Connecticut Mitigation Assistance Grant (CMAG). The CMAG will provide the State the ability to fund up to 90% of the cost for projects that plan for or mitigate the effects of natural disasters including but not limited to floods, wildfires and hurricanes.

These funds can be accessed by municipalities to: 1) Prepare Natural Hazards Mitigation Plans; 2) Prepare applications to participate in the NFIP's Community Rating System (CRS); or 3) complete hazards mitigation projects in accordance with approved Natural Hazards Mitigation Plans. Regulations and grant requirements are currently being developed by the DEP.

At least sixty percent of the funds collected from the sale or transfer of property shall be used to fund natural hazards mitigation activities under this Act. The remaining 40% may be used for staffing and overhead necessary to administer the planning and project grants.

### 4.0.10 Local Mitigation Planning

Of Connecticut's 169 cities and towns, approximately 83 communities either have Natural Hazards Mitigation Plans or are in the process of writing such plans. In an effort to get more plans completed, DEP is working with RPOs, such as Councils of Government (COGs), Councils of Elected Officials (CEOs) and Regional Planning Agencies (RPAs), to complete Natural Hazards Mitigation Plans for their communities. With 2002 PDM funding, four RPOs are developing regional Natural Hazards Mitigation Plans. These RPOs are: the Connecticut River Estuary Regional Planning Agency (CRERPA), covering 8 municipalities; the South Western Regional Planning Agency (SWRPA), covering 9 municipalities; the Southeastern Connecticut Council of Governments (SCCOG) covering 20 municipalities; and the Northeastern Connecticut Council of Governments (NECCOG) covering 11 municipalities.

With 2003 PDM funding, four RPOs are developed regional Natural Hazards Mitigation Plans. These RPOs were: Central Connecticut Regional Planning Agency (CCRPA) covering 7 municipalities; Council of Governments of the Central Naugatuck Valley (COGCNV) covering 3 municipalities; Greater Bridgeport Regional Planning Agency (GBRPA) covering 5 municipalities; and Windham Region Council of Governments (WINCOG) covering 9 municipalities.

With FMA 2002 and 2003 planning funds, the Litchfield Hills Council of Elected Officials (LHCEO) completed a regional plan covering 11 municipalities. The city of Milford is utilizing FMA 2004 planning funds to update its local Natural Hazards Mitigation Plans to meet the new DMA 2000 requirements.

With PDM 2005 funding, three RPOs are developing regional Natural Hazards Mitigation Plans. These RPOs are: Capitol Region Council of Governments (CRCOG) covering 29 municipalities; Northwestern Connecticut Council of Governments (NWCCOG) covering 9 municipalities, and Council of Governments of the Central Naugatuck Valley (COGCNV) covering 4 municipalities.

In Connecticut, local governments are the primary decision-makers for land use. Their authorities include land use, planning, management measures, zoning and other regulatory tools. Development of a natural hazards mitigation plan at the community level is vital if the community is to effectively address natural hazards. Communities cannot prevent disasters from occurring, however, they can lessen the impacts and associated damages from these disasters. An effective plan will improve a community's ability to deal with natural disasters and will document valuable local knowledge on the most efficient and effective ways to reduce losses. Preparing a plan to lessen the impact of a disaster before it happens will provide the following benefits to a community: reduce public and private damage costs; reduce social, emotional, and economic disruption; provide better access to funding sources for natural hazards mitigation projects; and improve their ability to implement post-disaster recovery projects.

### 4.0.11 Grants Administration Overview

Federal mitigation grants are administered by FEMA on the federal level, and by DEP and DEMHS on the state level. The State of Connecticut's CIHMC reviews and approves projects submitted by municipalities for submission under the State's application for FEMA grants programs FMA, PDM, and HMGP. The CIHMC meets annually, but may meet more frequently if necessary, to review and approve potential FEMA grant funded projects.

## 4.1 ENABLING FEDERAL AND STATE REGULATIONS

The State of Connecticut will administer the HMGP, FMA, EMPG, RFC, and PDM under the provisions of the following federal and state regulations:

**a. Federal Laws and Regulations**

- FEMA Law - Title V, The National Flood Insurance Reform Act of 1994, Subtitles D, E, and F
- FMA Regulations - 44 CFR, Part 13, Uniform Administrative Requirements of Grants and Cooperative Agreements to State and local Governments
- FEMA Regulations - 44 CFR, Section 60.3
- The National Flood Insurance Program
- FEMA Regulations - 44 CFR, Part 14
- Executive Order 12612, Federalism
- Executive Order 11990, Protection of Wetlands
- Executive Order 11988, Floodplain Management

**b. State Laws and Regulations**

- Connecticut General Statutes Title 28, Chapter 517, Section 28-9, 28-15a, and 28-15b, Civil Preparedness and Emergency Services

- Federal Aid Connecticut General Statutes, Title 4, Chapter 24, Section 4-28a, Management of State Agencies, State Properties and Funds, Advisory Commission, and Section 25-68b et seq. flood control projects
- Connecticut General Statutes Sections 25-68b to 25-68h inclusive and associated regulations

The distribution of state or federal funding requires full compliance with all regulations. A formal contract is entered into between the applicant and the State to ensure compliance with all applicable regulations.

## 4.2 DELEGATION OF RESPONSIBILITY

FEMA funded mitigation in Connecticut is administered through DEP's IWRD in conjunction with DEMHS. Federal funding for the programs are provided through the smart-link system maintained between FEMA and DEMHS. Transfer invoices will be utilized to channel approved funding through DEP to the eligible projects.

### A. The Connecticut Department of Environmental Protection (DEP)

IWRD administers the HMGP, FMA, RFC, and PDM. The IWRD is located at 79 Elm Street, in Hartford, Connecticut. IWRD staff review project applications received from applicants, and if necessary, pass the applications onto other divisions within DEP or to other state agencies for further review. Upon FEMA approval, the State Hazards Mitigation Officer (SHMO) who resides in the IWRD or his/her designated representative must give final authorization to award the grants to individual projects.

### B. The Connecticut Department of Emergency Management and Homeland Security (DEMHS)

DEP accepts and prepares the applications for submission to FEMA. DEMHS provides technical assistance to the IWRD in reviewing applications concerning communications and disaster warning systems. Once a project has been approved by FEMA, DEP requests a release of funds from DEMHS in the amount equal to 75% of the total project cost. DEP then drafts an agreement with the sub-applicant(s) and process the agreement(s) for approval by the Connecticut Attorney General's Office.

### C. State Office of Policy and Management (OPM)

OPM provides technical support to the DEMHS and IWRD in reviewing project applications. A member of OPM is appointed to the CIHMC.

### D. The Connecticut Department of Education (DOE)

DOE provides technical support to the IWRD and DEMHS in reviewing project applications. A member of the DOE may be appointed to the CIHMC.

### E. Office of the State Building Inspector (OSBI)

OSBI provides technical assistance to the IWRD and DEMHS in reviewing projects concerned with issues of post disaster housing, and building codes. A member of the OSBI may be appointed to the CIHMC.

### F. Department of Housing (DOH)

DOH provides technical assistance to the IWRD and DEMHS in reviewing projects concerned with improving construction practices, and building codes. A member of the DOH may be appointed to the CIHMC.

### G. Department of Transportation (DOT)

DOT provides technical assistance to the IWRD and DEMHS in reviewing projects concerned with implementing roadway construction projects, and other related transportation issues. A member of the DOT is appointed to the CIHMC.

### H. The U.S. Natural Resources Conservation Service (NRCS)

NRCS provides technical and engineering assistance to the IWRD and DEMHS in reviewing projects concerned with soil erosion and flooding. A member of the NRCS is appointed to the CIHMC.

## 4.3 MAJOR COMPONENTS OF FEMA GRANT PROGRAMS

This section discusses the major components of the FEMA funded mitigation programs. This section covers project eligibility, applicant eligibility, notification criteria, application procedures, project funding and management, appeals, and project monitoring.

### 4.3.1. Project Solicitation and Eligibility

The SHMO will solicit eligible projects from local communities and other state agencies on an annual basis via a mass mailing and public notices. The SHMO will also consult the State and local NHMPs, and the hazards mitigation survey team report that is prepared after a disaster, for potential projects. Efforts shall also be made to further inform low-income communities and other potential applicants of the grant programs via a program briefing or public meetings if necessary.

#### 4.3.1.1 Eligible Mitigation Activities

Subtitle E of Title V of the National Flood Insurance Reform Act, establishes the minimum criteria that all projects must meet in order to be eligible for funding consideration by the CIHMC. The following types of projects will be considered by the CIHMC along with other types of related projects:

1. **Demolition or relocation** of any structure located on land that is located in any designated 100-year floodplain, lake, river or other body of water and is certified by the State to be subject to imminent collapse or subsidence as a result of erosion or flooding;
2. **Elevation, relocation, demolition, or floodproofing** of buildings (public or private) located in flood prone areas. The new buildings must meet all building codes;
3. **Mitigation of earthquake hazards** by the State or a community for the retrofit of structures for seismic reinforcement. The properties and/or buildings, which are retrofitted, must meet all current building codes and practices;
4. **Mitigation of high wind hazards** by the State or a community for public use. The buildings, which are retrofitted, must be located in an area subject to hurricane force winds from a Category 2 Hurricane or greater;
5. **Beach nourishment activities** that protect coastal structures from repetitive flood damages; and

6. **Other projects, which mitigate a natural hazards** will be reviewed by the CIHMC to ensure that they substantially reduce or prevent damage from a reasonable natural disaster.

#### 4.3.1.2 Applicant Eligibility

The following entities are eligible to apply for FEMA funded mitigation programs: state and local governments; state agencies; private nonprofit organizations or institutions that own or operate a public nonprofit facility or other public holdings, or are defined as a separate taxing district as defined in Section 206.221 (e) of the Stafford Act, and Connecticut General Statutes Section 7-324 et seq.; and Indian Tribes or tribal organizations.

#### 4.3.1.3 Notification to Potential Applicants

In response to the availability of a grant, the SHMO will coordinate with the FEMA Natural Hazards Mitigation Officer (FHMO) in the preparation of a general announcement of the availability of FEMA funded mitigation programs during a public assistance applicant's briefing or a mass mailing. The announcement will be designed to create an awareness of the program, with further detailed information being available upon request. A joint press release may also be developed and issued by the FHMO and the SHMO.

Under FEMA the SHMO will be the point of contact for applicants to obtain additional details relative to the FEMA funded mitigation programs. The SHMO will also be responsible for determining the scope of the outreach effort through the media. Additional briefings or mailings may be announced by the SHMO to increase further public awareness if necessary.

The SHMO will establish a Single Point of Contact (SPOC) (a.k.a. Applicant's Agent) with each sub-grantee, and will provide technical assistance to the SPOC if necessary throughout the duration of the project. The SPOC may be a local fire or police chief, or town planner, who serves as the local point of contact for the mitigation programs.

### 4.3.2 Application Procedures

#### 4.3.2.1 Submission of Applications

The SHMO will have primary responsibility for ensuring that all applications are properly completed prior to submission to FEMA. Each application must contain the following information:

- **Name of applicant (sub-grantee)** - For local projects unless otherwise stated, this will be the name of the town or municipality where the project is located;
- **Applicant's agent** - Person designated by the applicant as the project coordinator. The agent will prepare the project application and coordinate day-to-day tasks to complete the project;
- **Location of project** - Street address or physical description of project location. GPS coordinates can also be provided along with the address;

- **Description** - Detailed description of project purpose and goals;
- **Cost estimate** - An itemized estimate of costs of the project from start to finish. Construction projects above $50,000 (except for home elevations) will be required to provide a design prepared by a Professional Engineer certified in Connecticut. Applicants need to be sure that all cost estimates for projects must be guaranteed for not less than one year from the date of the original estimate, as no modifications will be made to the amount of the grant once the application is approved by FEMA;
- **Benefit to cost ratio** - A computer model supplied by FEMA will be used to calculate the benefit to cost ratio. For projects that cannot be calculated using the FEMA model, the applicant will be required to prepare a numerical Benefit to Cost (B/C) Ratio. Projects must have a B/C ratio of 1:1 or greater to be eligible for funding;
- **Justification for selection** –Within each state guidance document created for an administered FEMA grant program, DEP has established State application requirements and minimum project criteria that are used by the CIHMC during its review and selection process;
- **Work schedule** - A task list in chronological order showing the number of days required to complete each task within the project. At a minimum, the tasks of designing the project, any necessary inspections and all major construction tasks (i.e. pouring foundation, framing, electrical etc.) must be included in the schedule;
- **Alternatives considered** - List all alternatives (at least 2 alternatives) considered to accomplish the goal of your project. Describe briefly why each of the non-selected alternatives were not chosen and include the cost of each alternative for comparison;
- **Environmental assessment -** Unless a project meets one of the five exclusion criteria listed in the environmental assessment form;
- **Site map -** A standard local street map showing the site of construction if necessary; and
- **Application deadline -** Applicants will be given a deadline to file an application. The application form will be provided to sub-grantees upon request. All completed applications can be mailed to:

**State Hazards Mitigation Officer**
The Department of Environmental Protection
Inland Water Resources Division
79 Elm Street - 3rd Floor
Hartford, CT 06106

#### 4.3.2.2 Application Review Process

In addition to meeting all of the requirements listed in the previous sections, all applications will be reviewed as to eligibility and completeness. Eligible and complete applications will then be passed on to the appropriate state agency for a technical review if necessary (i.e. emergency communications applications will be reviewed by DEMHS to ensure they meet current requirements). The applicant will be notified by mail that the project has been passed on for technical review.

Once a technical review has been completed the projects will be sent to the CIHMC/SHMO for project ranking. Each year the DEP will set the limit for the number of projects to be submitted to FEMA, per FEMA's grant guidelines. DEP will only approve the appropriate number of eligible projects based on current staffing and the Department's ability to carry

projects to completion. Upon CIHMC selection, the application will be forwarded to FEMA via the e-grant system.

#### 4.3.2.3 Technical Assistance

Applicants will be responsible for hiring consultants to prepare design drawings and cost estimates, if necessary, and to provide financial justification for projects during the application phase.

#### 4.3.2.4 Breaking of Ties

If two or more projects are ranked and a tie results, and funding is not available to fully fund all of the tied projects, the SHMO will break the tie by drawing the project names by lot. Once FEMA has approved a project, the project management phase begins.

### 4.3.3 Project Management and Funding

The DEP's IWRD shall serve as the grantee, responsible for grant administration activities, including grant management, project management, and accountability of funds at the state level. Applicants will be notified of their project approval by DEP/IWRD.

Sub-grantees (applicants) who have been approved for projects will be required to attend a detailed briefing to discuss the State's contract procedures and requirements. Municipalities will be expected to co-administer the grants with the State and serve as the point of contact with the homeowners. Projects shall also conform to the following criteria:

1. The total contribution of FEMA mitigation funding under the FEMA funded mitigation programs will not exceed seventy five percent (75%) of the project cost. The project cost shall be based on the original cost estimate of the project as appears in the final application.
2. The total cash contribution by the applicant (sub-grantee) must equal at least 25% of the total project cost. The amount of the grant shall be based on the original cost estimate contained in the application. No increase in the grant shall be allowed.
3. Record keeping and financial system (in conformance with generally accepted accounting practices) based upon the approved application(s) and work schedule of the project(s), will be implemented by the Grantee and sub-grantee for the duration of the project. Progress reports will be submitted to FEMA within 30 days after each quarter (April 30$^{th}$, July 30$^{th}$, October 31$^{st}$, and January 31$^{st}$) after receipt of funding.
4. Any and all work or expenses incurred prior to the written approval of the grant application, and the formal execution of a binding contract between the applicant (sub-grantee) and the State of Connecticut (Grantee) shall be ineligible for funding. A notice to proceed will be sent to the applicant upon approval of the binding agreement.
5. A closeout report will be prepared by the SPOC upon the completion of the project(s) and include a thorough assessment and accounting of all project accomplishments.

#### 4.3.3.1 Contractual Agreements for Approved Projects

Contractual agreements between the applicants (sub-grantee) and the State for release of funds will proceed as follows:

1. When a state agency is an applicant and is named as the sub-grantee, a Memorandum Of Understanding (MOU) will be drafted between the DEP and the sub-grantee. This MOU shall include provisions to guarantee compliance with all state and local floodplain management requirements and any Connecticut Environmental Protection Act (CEPA) approvals that may be necessary. The state agency receiving FEMA mitigation funding will be responsible for securing a 25% cost share of the total project cost. (All contractual obligations and permits required for administering the project rest with the sub-grantee).

2. When a municipality, private non-profit organization or tribal organization is named as the sub-grantee, an agreement will be entered into between the State and the sub-grantee. The agreement will ensure that a sub-grantee complies with all state and federal regulations when selecting a contractor and in performance of the contracted work and services. Responsibility for securing all contractual obligations and permits required for administering the project rest with the sub-grantee. Terms of the agreement are as follows:

    a. An Itemized Cost Estimate will be prepared by the applicant defining the work and/or services to be performed under the agreement and the estimated costs. All cost estimates must be guaranteed for a period of not less than one year from the date of the original estimate;
    b. The sub-grantee will designate a person to sign the agreement via a stamped corporate resolution. This person may be the SPOC or any other person deemed qualified by the municipality;
    c. The sub-grantee must adhere to state nondiscriminatory policies pursuant to C.G.S. 4a-60 and 4a-60a, and Executive Order #16;
    d. The sub-grantee is responsible for securing all permits, easements, and land rights prior to performing the project;
    e. The State will reimburse the sub-grantee (municipality, nonprofit organization or tribal organization) for up to 75% of the total project cost in partial payments. The specific reimbursement schedule varies with the type of project performed; and
    f. For planning and non-construction projects, payment will be made on a monthly basis upon receipt and approval of invoices for planning and non-construction projects. Evidence of funding expenditure (i.e. invoices, canceled checks, and billing receipts) must accompany the invoices.

#### 4.3.3.2 Cost Overruns

Grant amounts will be based on the cost estimate contained in the approved application. Any cost overrun will be the sole responsibility of the project applicant. No additional grant funding will be made available.

#### 4.3.3.3 Appeals

Due to the limited timeframe of the FEMA grant application period, an appeal of the CIHMC's denial of a proposed mitigation grant and denial of submission of said application to FEMA is not feasible. However, an applicant, whose proposed mitigation grant application has been denied submission to FEMA under the State grant application by CIHMC may request technical assistance from DEP. DEP encourages applicants who have received a submission denial of their applications to pursue such a meeting to assist the applicant. Knowledge of where and why a proposed application was incomplete and/or lacking of necessary information can help an applicant enhance the proposed application so the proposed project application may compete more effectively for other possible funding opportunities.

## 4.4 CONNECTICUT INTERAGENCY HAZARDS MITIGATION COMMITTEE (CIHMC)

The CIHMC meets as necessary to review project applications and apply (through DEP) to FEMA for the FEMA funded mitigation programs. Although the final responsibility for selection of projects remains with the SHMO, the CIHMC advises the SHMO. The CIHMC consists of the state agencies named in Section 4.2 in cooperation with federal agencies (i.e. NRCS), and private agencies as necessary to evaluate projects. It is the responsibility of the SHMO to reconvene or re-staff the committee as necessary for future grant awards.

The CIHMC ranks potential projects for submission to FEMA. In addition, projects must have a benefit to cost ratio of 1:1 or greater for each project application. Projects must solve the problem being addressed. HMGP, FMA, RFC and PDM funding may not be used as a substitute or a cost share for any other federally funded projects. Sub-grantees may secure funding from other state, and local programs to provide their required 25% cost share for a particular project.

Sub-applicant and state proposed projects are evaluated and selected for funding based on the degree to which they address the following stated criteria put forth in the State's PDM and FMA grant guidance documents, such as how a project will:

- Utilize the best strategy to ensure the success of the project goal
- Allocate sufficient staff and resources for the successful implementation of the proposed mitigation project
- Demonstrate that the proposed mitigation activity reduces the overall risks to the general population and structures
- Result in a long-term solution to a flooding problem with minimal maintenance required
- Provide a benefit to the general population of an area (ex. culvert upgrade, storm damage system upgrade, public education)
- Protect critical facilities
- Leverage Federal/State/tribal/local/private partnerships to enhance the outcome of the proposed activity
- Promote measures that prevent future construction or development in hazard-prone areas
- Promote stormwater management practices according to CGS Section 25-68h
- Are located in a community listed on the Public Investment Community Index with a PIC rank of 1-42 (OPM website)
- Have a multi-objective mitigation purpose
- Are consistent with the State Natural Hazard Mitigation Plan
- Are consistent with Local or Regional Hazard Mitigation Plans

Proposed projects are given a weighted score base on several factors such as the ones stated above. In addition, for federal fiscal year 2008 grant applicants, CIHMC will utilize a weighted evaluation form similar

to the following example to evaluate and select potential projects for funding. Specific evaluation criteria may be modified for a particular grant year in response to FEMA stated requirements as set forth in FEMA grant guidance document for a particular grant and fiscal year.

Figure 4-1: Grant Program Weighted Evaluation Form Example

## CT FY2008 PRE-DISASTER MITIGATION GRANT PROGRAM

## Rating and Evaluation Form

Sub-Applicant name:_____
Project name:_____
Evaluator name:_____

| EVALUATION CRITERIA | Evaluators Score 1-10 | Criteria Weight | Weighted Score |
|---|---|---|---|
| Utilizes the best strategy to ensure the success of the project goal | | 1 | |
| Sufficient staff and resources for implementation of the proposed mitigation project | | 1 | |
| Demonstrates that the proposed mitigation activity reduces the overall risks to the general population and structures | | 1 | |
| Results in a long-term solution to a flooding problem with minimal maintenance required | | 1 | |
| Has a multi-objective purpose | | 1 | |
| Leverages Federal/State/tribal/local/private partnerships to enhance the outcome of the proposed activity | | 1 | |
| Protection of critical facilities | | 1 | |
| Includes outreach activities appropriate to the proposed project | | 1 | |
| Promotes measures that prevent future construction or development in hazard-prone areas | | 1 | |
| Is located in a community listed in the top 15% of 2007 Distressed Community Index as defined by CGS Section 32-9p * | Yes = 5<br>No = 0 | 1 | |
| **TOTAL SCORE** | | | |

(**The top 15% of all municipalities or 25 cities/towns were used for this category. The 25 were then broken down into percentiles of 20, with 20% being the lowest of the Distressed Municipality scores.)*

### 4.5 PROJECT MONITORING

Throughout project's life the SHMO and his/her staff monitor the project against the project scope and costs to make sure that the project is on time and within budget, and to ensure that all contracted work shall coincide with the FEMA performance period for the specific grant received. The SHMO is tasked with coordinating overall staff support necessary to manage the FEMA funded mitigation programs. If needed, the applicant (sub-grantee) must request any time extensions to contracts 6 months prior to the end of the contract (expiration). The State may conduct meetings and follow-up surveys to ensure that all contract work meets

contract requirements, and shall require a progress report from the applicant at the end of each quarter. All work must be completed by the end of the contract period to be eligible for reimbursement. It is required that the applicant (sub-grantee) submit a final report within 30 days of the completion of the project or expiration of the contract whichever comes first.

### 4.5.1 Allowable Project Costs For Construction

The allowable projects costs for construction shall include all costs directly related to the approved construction project. Costs will be reimbursed to the maximum of the approved FEMA grant value.

### 4.5.2 Allowable Planning Costs

The allowable planning costs for planning activities shall include all costs directly related to the approved planning project. Costs will be reimbursed to the maximum of the approved FEMA grant value.

### 4.5.3 General Administration of FEMA Grant Projects

During non-disaster routine administration of the FEMA funded mitigation programs the DEP dedicates up to three persons to the program on a part-time basis.

- **State Natural Hazards Mitigation Officer:** Oversees the HMGP, FMA, RFC, and PDM grant programs. Serves as the signature authority on the highest level (denials, letters to proceed, etc.) mitigation correspondence regarding FEMA funded mitigation programs.
- **Project and Planning Coordinators:** Assist in the day-to-day activities within the HMGP, FMA, RFC, and PDM programs, write reports, coordinate inspections, coordinate with other agencies and serves as the signature authority for routine correspondence.

### 4.5.4 Non-Performance of Projects

Sub-grantees (applicants) who have been approved for funding by the FEMA under the National Flood Insurance Reform Act must complete all contracted work within the performance period set forth by FEMA. Sub-grantees who fail to complete their projects within the performance period will be subject to revocation of any unexpended grant funds. Also, the SHMO may place a 3-year moratorium against further FEMA funding for applicants (homeowners, municipalities, nonprofit organizations or tribal organizations) found to be in non-performance of a project agreement.

As outlined in section 4.3.4 (a) (5) all estimates of cost for work must be guaranteed for a period of not less than one year from the date of the original estimate. Therefore any applicant that declines a grant on the basis of increased costs will be subject to revocation of any unexpended grant funds. Also the SHMO may place a 3-year moratorium against further HMGP, FMA, RFC, and PDM projects with applicants found to be in non-performance of a project.

### 4.5.5 Project Interruption Due to a Disaster Declaration

The SHMO may place on hold the FMA, RFC, and PDM programs in the event that a presidential declared disaster occurs in Connecticut during any phase of the grant. This program freeze will place a on hold all deadlines, work schedules, and inspections being performed by state staff for a period not to exceed 90 days. Notice of this freeze will be sent to all project applicants (sub-grantees) within 10 days of the date of the declaration. In the event of a catastrophic disaster, this freeze may be extended to 180 days. Such program freezes may required project contract extensions between the State and the applicant, and a time extension approval by FEMA.

Projects that are autonomous in nature and do not require state assistance may be continued. However this does not mean that the applicant may forego any required inspections.

## 4.6 PLAN UPDATES

### 4.6.1 Natural Hazards Mitigation Plan

The Plan will be updated every three years. The next planned update is in 2010. If a major natural disaster impacts Connecticut prior to 2010, the plan may be updated to reflect the new mitigation goals resulting from the disaster. Another regular update will then be conducted 3 years after the disaster update.

### 4.6.2 Local Plans

Local plans will be reviewed and updated if necessary every five years by the municipality or the affiliated RPO who has been charged with this task by the municipality. If a major natural disaster occurs within the community, the plan will be reviewed and updated if necessary within 180 days of the date of the disaster declaration. Subsequent plan reviews and updates, if necessary, will then be conducted 5 years after a disaster update.

## 4.7 EFFECTIVENESS OF CONNECTICUT'S NATURAL HAZARDS MITIGATION MEASURES

Since the inception of Connecticut's Natural Hazards Mitigation Program in 1982, Connecticut has spent millions of dollars on mitigation, and has avoided millions of dollars in damages to roads, bridges, dams, commercial and residential buildings.

Three types of mitigation are most commonly used in Connecticut: 1) large scale structural mitigation, 2) small scale structural mitigation, and 3) mitigation planning. This section discusses the measures that have been taken and their effectiveness at preventing future damages.

### 4.7.1 Large-Scale Structural Mitigation Measures

Large-scale structural mitigation in Connecticut involves construction or repairs to flood control dams, levees and flood control systems. This was the preferred method of mitigation following the June Floods of 1982 in which 30 dams failed in Connecticut.

Since 1982 a total of approximately 34 million dollars has been spent on the repair of dozens of dams within Connecticut. The repair or replacement of dams is considered to be a 100% effective means of flood damage prevention within the areas protected by the dams. All dam repairs in Connecticut are designed to pass the 100-year storm without damage to the dam. Although no damage avoidance figures have been calculated for each of the dam repair projects, several large storms have occurred between 1982 and 2005 that produced little or no damage to dams within the State. Between 2005 and 2007, 2 storms produced significant damage to several dams within the State.

### 4.7.2 Small-Scale Structural Mitigation Measures

Following the tornado outbreak of July 10, 1989, Connecticut qualified for funding under the Natural Hazards Mitigation Grant Program Section 404 of the Robert T. Stafford Disaster Relief Act.

Since 1989, Connecticut has completed more than 26 home elevations, and over 31 other Natural Hazards Mitigation projects.

### 4.7.3 Mitigation Planning

The State of Connecticut, in cooperation with several RPOs, is working towards having all its municipalities covered by a local natural hazards mitigation plan. These plans are required prior to the receipt of any available FEMA grant funds. To date, the planning effort has achieved a rate of 75% of Connecticut's communities adopting or soon to adopt and be covered by a local natural hazards mitigation plan.

| ***Table 4-1 - NATURAL HAZARDS MITIGATION PROGRAMS AVAILABLE IN CONNECTICUT*** | | | | |
|---|---|---|---|---|
| ***FEATURE / PROGRAM*** | ***HMGP - HAZARDS MITAGATION GRANT PROGRAM*** | ***FLOOD MITIGATION ASSISTANCE*** | ***REPETITIVE FLOOD CLAIMS GRANT*** | ***PRE-DISASTER MITIGATION*** |
| ***AUTHORIZATION*** | Section 409 of the Stafford Act Only available after a Presidentially Declared Disaster | 44 Code of Federal Regulations Part 78 | Authorized in Section 1323 of the NFI Act of 1968, as amended by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004. | Disaster Mitigation Act of 2000 |
| ***QUALIFYING CRITERIA*** | • Must be a project that mitigates damages from the current disaster or a past disaster within Connecticut.<br>• Can be a recommendation of the current State NHMP, Hazards Mitigation Survey Team Report or CIHMC Report. | • Must be a project that mitigates damages from flooding to insurable repetitive loss structures.<br>• Can be a recommendation of the current State NHMP, Hazards Mitigation Survey Team Report or CIHMC Report. | • .Must be a project that reduces or eliminates the long-term risk of flooding of NFIP insured structures. | • Full range of Natural Disaster Hazards in Connecticut, however, flood mitigation is preferred. |
| ***APPROVALS*** | • State approval based on recommendations from the CIHMC.<br>• Federal approval from the Federal Emergency Management Agency (FEMA) | • State approval based on recommendations from the CIHMC.<br>• Federal approval from the Federal Emergency Management Agency (FEMA) | • State approval based on recommendations from the CIHMC.<br>• Federal approval from the Federal Emergency Management Agency (FEMA) | • State approval based on recommendations from the CIHMC.<br>• Federal approval from the Federal Emergency Management Agency (FEMA) |
| ***NATURE OF WORK*** | • Surveys & feasibility studies that lead directly into projects.<br>• Construction of mitigation measures. Operation and maintenance activities are prohibited. | • Surveys & feasibility studies that lead directly into projects.<br>• Construction of mitigation measures. Operation and maintenance activities are prohibited. | • Acquisition of insured properties that have 1 or more claim payments for flood damages for either demolition or relocation of structure(s), with conversion of property to deed restricted open space uses. | • Surveys & feasibility studies that lead directly into projects.<br>• Construction of mitigation measures. Operation and maintenance activities are prohibited. |
| ***TIME LIMITS*** | • 2 Years for construction<br>• 3 Years for studies | • 2 Years for construction<br>• 3 Years for studies | • 2 Years for acquisition and demolition projects | • 2 Years for construction<br>• 3 Years for studies |
| ***FUNDING LIMITS*** | • 15% of 1st $2 billion of estimated aggregate amounts of disaster assistance; 10% for next portion of amounts between $2 and $10 billion; and 7.5% for the next portion of amounts between $10 and $35.333 billion | • $20,000 for studies<br>• $20,000 for technical assistance<br>• $300,000 for projects | • Up to 100% Federal Assistance for eligible projects, no dollar limits stated for projects | • $500,000 for construction of mitigation projects, public information and studies |
| ***COST SHARING PROVISION*** | • FEMA will fund up to 75% of an eligible and approved project's costs, local match up to 25% of total approved project costs is required. | • FEMA will fund up to 75% of an eligible and approved project's costs, local match up to 25% of total approved project costs is required. | • Projects are eligible for up to 100% federal funding of total approved project costs; community must provide a signed Reduced Capacity Certification form stating that proposed activities cannot be funded under the FMA program. | • FEMA will fund up to 75% of an eligible and approved project's costs, local match up to 25% of total approved project costs is required. |

# CHAPTER 5

## NATURAL HAZARDS MITIGATION GOALS, STRATEGIES, AND ACTIVITIES FOR 2007-2010

# 5.0 CONNECTICUT'S NATURAL HAZARDS MITIGATION GOALS, STRATEGIES AND ACTIVITIES FOR 2007 – 2010

The State of Connecticut remains committed to reducing future damage from natural disasters through mitigation. The mission of Connecticut's Natural Hazards Mitigation Program and this associated Plan is to mitigate the effects of natural hazards by minimizing loss of life and property damage. The State of Connecticut has identified 3 primary goals to focus its hazards mitigation efforts towards to assist in accomplishing its mission. These 3 goals are:

1. Increase implementation of sound floodplain management and natural hazards mitigation principles on a state and local level;
2. Increase implementation of effective natural hazards mitigation projects on a state and local level; and
3. Increase research and planning activities for natural hazards mitigation on a state and local level particularly with regard to climate change and associated adaptation strategies.

The planning team and the CIHMC agreed that the previous goals in the first NHMP were too numerous to effectively concentrate limited resources to obtain. In addition, the previous set of goals fit within the primary hazard mitigation goals stated above.

The State of Connecticut has developed these goals and their associated strategies for potential activities based upon the following:

1. Natural hazards vulnerability and risk assessments contained in this plan;
2. Evaluation of current state and federal regulations; and
3. State and federal funding sources available to conduct natural hazards mitigation measures in Connecticut.

It is anticipated that by working towards achieving the goals set out in this Plan, effective natural hazards mitigation measures will be implemented to protect residents of this state where appropriate, and will promote responsible natural hazards mitigation throughout the State on both a state and local level.

## 5.1 GOAL 1 – IMPLEMENTATION OF SOUND FLOODPLAIN MANAGEMENT AND NATURAL HAZARDS MITIGATION PRINCIPLES ON A STATE AND LOCAL LEVEL

The fundamental basis of this goal is what makes it important to achieve. The implementation of sound floodplain management and natural hazards mitigation principles is primary to protecting the health and welfare of the residents of this State.

### 5.1.1 Strategies and Activities to be Utilized to Achieve Goal 1

There are various strategies that can be utilized to achieve Goal 1. The following strategies and associated activities presented in this Plan will be effective in working towards achieving this goal.

**Strategy 1** - Provide technical guidance to communities regarding local floodplain ordinance enhancement and enforcement. Several activities implemented under this strategy will include:

1. Provide model ordinances and sample higher standards language that communities can adopt into existing floodplain ordinances.
2. Provide local ordinance reviews for communities to provide communities an indication as to where existing ordinances require updates/enhancements to current standards.
3. Increase the performance of community assistance visits (CAVs) each year by 20% to maximize efforts to provide technical guidance and educational materials to communities. This activity is important to promote compliance with FEMA's NFIP floodplain management minimum standards and those additional requirements as stated in local ordinances.

**Strategy 2** – Provide educational opportunities to communities, state agencies, and engineering and land surveyor professionals. Activities implemented under this strategy will include:

1. Develop a series of workshops to take place over the next 3-year period that will include floodplain management 101 (presentation of FEMA floodplain management requirements and the NFIP), overview of elevation certificates, coastal construction standards, effective flood and other natural hazards mitigation measures, floodplain resource protection, and the use of the new FEMA digital FIRMS.
2. Utilize meetings with other state agencies, including pre-permitting conferences, as opportunities to encourage responsible floodplain management and floodplain development activities, and natural hazards mitigation potential in proposed projects.

**Strategy 3** – Develop sound floodplain management policies to address climate change adaptation scenarios. Activities implemented under this strategy will include:

1. Modeling of IPCC climate change data sets to determine floodplain changes associated with potential sea level rise.
2. Based on modeling develop policies to restrict development within inundation areas and relocate or remove critical facilities for increasing risk. Policies should also address disinvesting federal and state mitigation monies in inundation zones.

## 5.2 GOAL 2 – IMPLEMENTATION OF EFFECTIVE NATURAL HAZARDS MITIGATION PROJECTS ON A STATE AND LOCAL LEVEL

In order to have effective natural hazards mitigation, successful mitigation projects need to be initiated on both a state-level for state-owned facilities, and on a local level. Connecticut will continue to encourage local communities to become more proactive in terms of flood management and natural hazards mitigation, by encouraging the implementation of specific mitigation projects appropriate for a community's self-assessed hazards and risks. In addition, DEP encourages other state agencies either involved with floodplain management, natural hazards mitigation/risk reduction, or that maintain critical facilities within a natural hazards area to take actions to perform mitigation projects to reduce their facilities risk.

### 5.2.1 Strategies and Activities to be Utilized to Achieve Goal 2

The following strategies and associated activities presented in this Plan will be effective in working towards achieving this goal.

**Strategy 1** - Provide educational opportunities to communities, state agencies, and engineering and land surveyor professionals. Activities implemented under this strategy will include:

1. Utilize meetings with other state agencies, including pre-permitting conferences, as opportunities to encourage responsible floodplain management and floodplain development activities, and natural hazards mitigation potential in proposed projects.
2. Develop a series of workshops to provide technical advice and training on FEMA minimum grant requirements for proposed project funding requests through PDM, FMA, and the new Repetitive Flood Claim (RFC) program.
3. Develop a communication process including webpage development and reminder notifications of potential grant opportunities to encourage continued project planning tasks by state agencies and communities to develop highly competitive and effective mitigation projects.

**Strategy 2** – Promote the various FEMA, NOAA and other federal agency grant programs to local communities and state agencies as potential funding sources for projects along with other potential state funding sources.

1. Through working with the NHMP external Plan review committee (expanded planning group including the CIHMC) develop a list of potential funding sources available on a state and federal level for Natural Hazards Mitigation Planning activities and projects.
2. Develop a tracking system of submitted FEMA grant project/planning applications, to help analysis the types of projects and the mitigation needs that continue to exist within the State.
3. Through communications with other state agencies and communities with approved FEMA Natural Hazards Mitigation Plans, develop a list of potential mitigation projects that can be maintained and assessed for further development upon availability of funding sources. This will also help assist in future NHMP planning by identifying when areas and facilities of concern exist. DEP will maintain this listed and will provide a copy of the list in the next plan update. However, projects on the list are expected to include:
    - Property acquisition and demolition
    - Home elevations
    - Dry-proofing of commercial buildings and wet-proofing of residential structures
    - Culvert and storm water management projects
    - Relocation/ or protection of critical facilities
    - Forest fire mitigation projects
    - Emergency management hazards mitigation projects
    - Transportation hazards mitigation projects
    - State Building Code educational activities for communities and construction contractors, homeowners
4. Process technical assistance requests from communities and state agencies to FEMA for technical assistance in the area of project development.
5. Develop educational materials on successful natural hazards mitigation projects.

## 5.3 GOAL 3 – INCREASE RESEARCH AND PLANNING ACTIVITIES FOR NATURAL HAZARDS MITIGATION ON A STATE AND LOCAL LEVEL.

Further research and enhanced planning activities are vital in the development of advanced or new/improved natural hazards mitigation measures, stronger understanding of the hazards that affect your community or State, and maximize efficiency and effectiveness of implementing mitigation measures

with limited resources. Planning is the foundation which projects can be developed and studied to determine their feasibility in mitigation loss from a particular natural hazards, by assisting a state or local community as to what hazards affect it, where the most vulnerable areas are located which are affected by a particular hazards, and potentially what can be done to eliminate/reduce the affects from a hazards. In essence it helps a community determine its needs in terms of hazards mitigation. Enhanced planning and research of the rate of climate change and adaptation principals and responses is urgently needed.

Effective planning is much more than just the processes end product – the plan. It involves the development or improvement of communications of different groups, stakeholders, agencies and internal division. It also involves the sharing of knowledge, the incorporation of various perspectives and concerns, the promotion of positive change for a community.

In order for any Natural Hazards Mitigation Plan (state or local) to remain effective and current, the planning process that created it must be continuous in nature, and the plan itself reviewed and updated on a regular basis. Thus DEP believes it is vital for itself and local communities to prepare effective Natural Hazards Mitigation Plans and maintain them in a current status.

### 5.3.1 Strategies and Activities to be Utilized to Achieve Goal 3

**Strategy 1** - Provide educational opportunities for communities and state agencies regarding natural hazards mitigation research and planning activities that may enhance existing Natural Hazards Mitigation Plans, and encourage all communities in Connecticut to develop and adopt FEMA approved Natural Hazards Mitigation Plans. Activities implemented under this strategy will include:

1. Encouraging communities to pursue funding opportunities to develop FEMA approved Natural Hazards Mitigation Plans. The State's sub-objective for this activity is to have at least 95% of the State's population covered under local FEMA approved Natural Hazards Mitigation Plans by 2010.
2. Encouraging communities and state agencies to pursue funding opportunities to develop advanced research and plans in the area of natural hazards mitigation. Planning activities included under this section would be:
    - Planning activities anticipated would include stand alone plans which can assist in enhancing existing Natural Hazards Mitigation Plans (e.g., debris management plans, evacuation and sheltering plans, hazards studies and evaluations (including recommendations) which are not part of existing approved plans);
    - Development of a State Climate Change Science plan to measure the rate of climate change including sea level rise, evapotransporation increase, etc.
    - Climate Change adaptation planning;
    - Transportation Natural Hazards Mitigation Planning activities and research; and
3. Provide planning workshops through FEMA assistance to promote planning and enhanced planning activities that communities can utilize to develop increased comprehensive Natural Hazards Mitigation Plans.
4. Encourage state agencies to perform research and planning activities in the area of natural hazards mitigation for their facilities and operations.
5. Develop educational materials on successful natural hazards mitigation activities.
6. Act as a clearinghouse for FEMA produced educational materials in the area of natural hazards mitigation including flood management and planning; as well as climate change and adaptation approaches.

## 5.4 EVALUATION MEASURES FOR STRATEGIES AND ACTIVTIES PRESENTED FOR GOALS 1, 2 AND 3

Table 5-1 presents an overview of the strategies and associated activities presented in this chapter. In addition, it provides the evaluation methods that will be used to evaluate achievement towards the associated goal, and provides a summary evaluation of past activities performed in Federal Fiscal Years 2004, 2005, and 2006 that helped supported the presented strategies.. A list of past activities pursued for natural hazard mitigation by the State and local communities can be found in appendix E. The activities presented below focus on activities which the State, as a whole, intends to implement consistent with availability of resources.. A list of completed and past proposed projects for hazard mitigation purposes during the time period of 2004-2007 is located in Appendix E.

**Table 5-1: Measures For Evaluating Strategies and Activities Associated With Goals 1, 2 and 3**

| Goal | Strategy | Activity | Activity Prioritization (H=High, M= Medium, L=Low) | Lead Agency | Type of Evaluation | Evaluation Measure | Desired Outcome | Evaluation of Past Activities Which Supported Strategy (FFY04, 05, 06)/Comments |
|---|---|---|---|---|---|---|---|---|
| Increase Implementation of Sound Floodplain Management and Natural Hazards Mitigation Principles on a State and Local Level | Provide technical guidance to communities regarding local floodplain ordinance enhancement and enforcement. | | | | | | | |
| | | Provide model ordinances and sample higher standards language that communities can adopt into existing floodplain ordinances | H | DEP | Qualitative | Collection of feedback received from communities used for future revisions of the Model Ordinances (A and V-Zones) | Development of a comprehensive sample ordinance that incorporates all FEMA's NFIP minimum standards, all state requirements, and higher regulatory language which communities can choose to adopt. | Work on the new model ordinances has been performed during the last NHMP 3-year time period. Finalization of the updated model ordinances is expected in 2007. |

**Table 5-1: Measures For Evaluating Strategies and Activities Associated With Goals 1, 2 and 3 Continued**

| Goal | Strategy | Activity | Activity Prioritization (H=High, M= Medium, L=Low) | Lead Agency | Type of Evaluation | Evaluation Measure | Desired Outcome | Evaluation of Past Activities Which Supported Strategy (FFY04, 05, 06)/Comments |
|---|---|---|---|---|---|---|---|---|
| | | Provide local ordinance reviews for communities to provide communities an indication as to where existing ordinances requirement updates/enhancements to current standards. | L | DEP | Quantitative | Number of local ordinances reviewed; target is the review of all 169 municipalities by 2011 | Updated model ordinances that incorporate all of FEMA's updated NFIP standards and all State requirements. | In conjunction with the Map Modernization Program, it is expected that ordinance reviews will commence for communities in Middlesex County in 2007, and Hartford County in 2008 with additional counties and their associated communities added to the review list in subsequent years. |
| | | Increase the performance of community assistance visits (CAVs) each year by 20% to maximize efforts to provide technical guidance and educational materials to communities. This activity is important to promote compliance with FEMA's NFIP floodplain management minimum standards and those additional requirements as stated in local ordinances. | M | DEP | Quantitative | Number of CAVs performed on an annual basis, and an analysis of on the number performed over a specific time period. | Improved communities between the state's NFIP office and local communities; increased enforcement of local floodplain management ordinances; compliance by local communities with FEMA's NFIP standards; also will provide for educational opportunities for communities | Over the past 3 FFYs, a total of 23 CAVs were performed by State flood management staff. CAVs are normally performed with a community on the following intervals: at least once every five years for a coastal community, and at least one visit every 10 years for an inland (Riverine) community. The past 3 FFY will be used to develop a timeline analysis on the performance of CAVs to assist in analysis increased efforts. |
| | Provide educational opportunities to communities, state agencies, and engineering and land surveyor professionals. | | | | | | | |

**Table 5-1: Measures For Evaluating Strategies and Activities Associated With Goals 1, 2 and 3 Continued**

| Goal | Strategy | Activity | Activity Prioritization (H=High, M= Medium, L=Low) | Lead Agency | Type of Evaluation | Evaluation Measure | Desired Outcome | Evaluation of Past Activities Which Supported Strategy (FFY04, 05, 06)/Comments |
|---|---|---|---|---|---|---|---|---|
| | | Develop a series of workshops to take place over the next 3-year period that will include floodplain management 101 (presentation of FEMA floodplain management requirements and the NFIP), overview of elevation certificates, coastal construction standards, effective flood and other natural hazards mitigation measures, floodplain resource protection, and the use of the new FEMA digital FIRMS. | H | DEP/FEMA | Quantitative and Qualitative | Number of workshops performed; review and compilation of | Provide effective educational opportunities to improve and expand floodplain management activities on a local level and provide the floodplain management tools and information needed by local floodplain administrators | A PDM grants sub-applicant workshop was performed in CT by FEMA for prospective PDM sub-applicants; in addition a series of NFIP floodplain requirements presentations are plan for Spring 2007 for Wetlands Agents as part of an Inland Wetlands training series. |
| | Develop sound floodplain management policies to address climate change adaptation scenarios. | | | | | | | |
| | | Using IPCC climate change data sets model floodplain changes associated with potential sea level rise. | M | DEP-OLISP | Qualitative | | Series of GIS map layer depicting various sea level rise and climate change impacts. Sea level rise inundation maps would be provided to each coastal community. | |
| | | | | | Quantitative | Determine population living in coastal towns at risk to sea level rise. | Provide additional floodplain management tool to municipalities. Encourage relocation of critical state and municipal facilities that are at increasing risk. | |

**Table 5-1: Measures For Evaluating Strategies and Activities Associated With Goals 1, 2 and 3 Continued**

| Goal | Strategy | Activity | Activity Prioritization (H=High, M= Medium, L=Low) | Lead Agency | Type of Evaluation | Evaluation Measure | Desired Outcome | Evaluation of Past Activities Which Supported Strategy (FFY04, 05, 06)/Comments |
|---|---|---|---|---|---|---|---|---|
| | | Based on sea level rise modeling, develop policies to restrict new development and relocate or remove existing hazards within inundation areas with increasing risk. Policies should also address disinvesting federal and state mitigation monies in inundation zones. | M | DEP - OLISP | Qualitative | Development of state Policies that restrict infrastructure investment that promote development in areas at risk to inundation from sea level rise. | State monies are redirected to avoid hardening investments in areas of increasing risk. | |
| | | Utilize meetings with other state agencies, including pre-permitting conferences, as opportunities to encourage responsible floodplain management and floodplain development activities, and natural hazards mitigation potential in proposed projects. | H | DEP | Quantitative and qualitative | Number of meetings, assessment of future actions taken subsequent to meetings | Increased floodplain management and resource protection on a state-level | Strong working relationships have been developed between the flood management program and other Inland Water Resource Division sections/programs |
| Increase Implementation of Effective Natural Hazards Mitigation Projects on a State and Local Level | | | | | | | | |
| | Provide educational opportunities to communities, state agencies, and engineering and land surveyor professionals. | | | | | | | |

**Table 5-1: Measures For Evaluating Strategies and Activities Associated With Goals 1, 2 and 3 Continued**

| Goal | Strategy | Activity | Activity Prioritization (H=High, M= Medium, L=Low) | Lead Agency | Type of Evaluation | Evaluation Measure | Desired Outcome | Evaluation of Past Activities Which Supported Strategy (FFY04, 05, 06)/Comments |
|---|---|---|---|---|---|---|---|---|
| | | Utilize meetings with other state agencies, including pre-permitting conferences, as opportunities to encourage responsible floodplain management and floodplain development activities, and natural hazards mitigation potential in proposed projects. | H | DEP | Quantitative and qualitative | Number of potential projects and funded projects which have been proposed by various state agencies; review of outcomes from meetings | Increased number of proposed projects being developed and number which have received funding | This is an on-going activity performed by flood management staff which will begin to be tracked for analysis |
| | | Develop a series of workshops to provide technical advice and training on FEMA minimum grant requirements for proposed project funding requests through PDM, FMA, and the new Repetitive Flood Claim (RFC) program. | M | DEP/FEMA | Qualitative and quantitative | Number of workshops and number of projects developed for funding requests, and analysis of feedback from attendees to determine if needs were met or if additional training in specific areas is required | Increased number of strongly competitive projects developed and submitted for potential funding | This has been performed in the past on an annual basis by FEMA for prospective grant applicants, improved tracking and analysis is proposed for this activity |
| | | Develop a communication process including webpage development and reminder notifications of potential grant opportunities to encourage continued project planning tasks by state agencies and communities to develop highly competitive and effective mitigation projects. | M | DEP | Qualitative | Actual development of the webpage and progress reports | The development of an information resource for local officials, consultants and the general public can access for floodplain management info. | |

**Table 5-1: Measures For Evaluating Strategies and Activities Associated With Goals 1, 2 and 3 Continued**

| Goal | Strategy | Activity | Activity Prioritization (H=High, M= Medium, L=Low) | Lead Agency | Type of Evaluation | Evaluation Measure | Desired Outcome | Evaluation of Past Activities Which Supported Strategy (FFY04, 05, 06)/Comments |
|---|---|---|---|---|---|---|---|---|
| | Promote the various FEMA grant programs to local communities and state agencies as potential funding sources for projects along with other potential state funding sources. | | | | | | | |
| | | Through working with the NHMP External Plan Review Committee (expanded planning group including the CIHMC) develop a list of potential funding sources available on a state and federal level for natural hazards mitigation planning activities and projects. | M | DEP | Qualitative | Development of a list of potential funding sources which can be distributed | Provide communities and state agencies with a functional list of potential funding sources so that the development of hazards mitigation projects are developed and pursued | |
| | | Develop a tracking system of submitted FEMA grant project/planning applications, to help analysis the types of projects and the mitigation needs that continue to exist within the State. | M | DEP | Quantitative and qualitative | Development of a tracking system | To maintain a list of potentially fundable projects, and maintain information on funded projects regarding estimated costs compared to projected benefits for future analysis of a projects success. | This information can be used in the development of project fact sheets and "success stories" to provide ideas and encourage others to pursue mitigation projects |

**Table 5-1: Measures For Evaluating Strategies and Activities Associated With Goals 1, 2 and 3 Continued**

| Goal | Strategy | Activity | Activity Prioritization (H=High, M= Medium, L=Low) | Lead Agency | Type of Evaluation | Evaluation Measure | Desired Outcome | Evaluation of Past Activities Which Supported Strategy (FFY04, 05, 06)/Comments |
|---|---|---|---|---|---|---|---|---|
| | | Through communications with other state agencies and communities with approved FEMA Natural Hazards Mitigation Plans, develop a list of potential mitigation projects that can be maintained and assessed for further development upon availability of funding sources. This will also help assist in future NHMP planning by identifying when areas and facilities of concern exist. DEP will maintain this listed and will provide a copy of the list in the next Plan Update. | H | DEPDEMHS | Qualitative | Development of projects that could be potentially pursued for floodplain management and mitigation/protection of state-owned facilities; | Potential projects which could be pursued for feasibility and potential funding through federal grants, state monies which may have the potential to eliminate or reduced the risk from specified hazards | |
| | | Process technical assistance requests from communities and state agencies to FEMA for technical assistance in the area of project development. | H | DEMHS | Quantitative | Number of requests received and accommodated | Development and submission by sub-applicants of sound competitive projects for funding through FEMA grant programs | |
| | | Develop educational materials on successful hazards mitigation projects. | M | DEMHS and DEP | Qualitative | Number and nature of fact sheets developed that focus upon successful projects and mitigation measures that were implemented by local communities | To highlight success stories within the State and promote hazards mitigation to other communities. | |
| Increase Research and Planning Activities for Natural Hazards Mitigation on a State and Local Level | | | | | | | | |

**Table 5-1: Measures For Evaluating Strategies and Activities Associated With Goals 1, 2 and 3 Continued**

| Goal | Strategy | Activity | Activity Prioritization (H=High, M= Medium, L=Low) | Lead Agency | Type of Evaluation | Evaluation Measure | Desired Outcome | Evaluation of Past Activities Which Supported Strategy (FFY04, 05, 06)/Comments |
|---|---|---|---|---|---|---|---|---|
| | Provide educational opportunities for communities and state agencies regarding hazards mitigation research and planning activities that may enhancement existing Natural Hazards Mitigation Plans, and encourage all communities in Connecticut to develop and adopt FEMA approved Natural Hazards Mitigation Plans. | | | | | | | |
| | | Encouraging communities to pursue funding opportunities to develop FEMA approved Natural Hazards Mitigation Plans. | M | DEP | Quantitative | Number of hazards mitigation research and planning activities proposed to FEMA for funding | The state's objective for this activity is to have at least 95% of the state's population covered under local FEMA approved NHMPs by 2010. | A secondary goal is to encourage local communities to expand their Natural Hazards Mitigation Plans and enhance their objectives and potential mitigation measures. |
| | | Encouraging communities and state agencies to pursue funding opportunities to develop advanced research and plans in the area of natural hazards mitigation. Planning activities included under this section would be: | M | DEP | Qualitative and quantitative | Number of planning activities proposed and a review of the of projects | Planning activities that will help to further natural hazards mitigation on both a state and local level, and increase communities interested in joining the CRS program | |

**Table 5-1: Measures For Evaluating Strategies and Activities Associated With Goals 1, 2 and 3 Continued**

| Goal | Strategy | Activity | Activity Prioritization (H=High, M= Medium, L=Low) | Lead Agency | Type of Evaluation | Evaluation Measure | Desired Outcome | Evaluation of Past Activities Which Supported Strategy (FFY04, 05, 06)/Comments |
|---|---|---|---|---|---|---|---|---|
| | | Planning activities anticipated would include stand alone plans which can assist in enhancing existing Natural Hazards Mitigation Plans (e.g., debris management plans, evacuation and sheltering plans, hazards studies and evaluations (including recommendations) which are not part of existing approved plans); Development of a State Climate Change Science plan to measure the rate of climate change including sea level rise, evapotransporation increase, etc.; Climate Change adaptation planning; Transportation Natural Hazards Mitigation Planning activities and research; and | | | | | | |

**Table 5-1: Measures For Evaluating Strategies and Activities Associated With Goals 1, 2 and 3 Continued**

| Goal | Strategy | Activity | Activity Prioritization (H=High, M= Medium, L=Low) | Lead Agency | Type of Evaluation | Evaluation Measure | Desired Outcome | Evaluation of Past Activities Which Supported Strategy (FFY04, 05, 06)/Comments |
|---|---|---|---|---|---|---|---|---|
| | | Provide planning workshops through FEMA assistance to promote planning and enhanced planning activities that communities can utilize to develop increased comprehensive Natural Hazards Mitigation Plans. | L | DEP/FEMA | Quantitative and qualitative | Number of workshops and an analysis of attendee feedback | Have communities enhance existing Natural Hazards Mitigation Plan | |
| | | Encourage state agencies to perform research and planning activities in the area of natural hazards mitigation for their facilities and operations. | H | DEP | Quantitative | Number of proposed activities submitted for funding | Increased inter-agency communications and sharing of information, working towards the development of an enhanced Natural Hazards Mitigation Plan | |
| | | Develop educational materials on successful natural hazards mitigation activities. | M | DEP | Quantitative | Number of fact sheets developed based on available performed activities | Encourage an awareness and/or continuous Natural Hazards Mitigation Planning by various state agencies for their facilities/resources and highlight innovative efforts made by various state agencies | |
| | | Investigate the feasibility and scope of developing an inventory of state-owned critical facilities from existing state-owned facility lists. | M | DEP/DEMHS/OPM | Quantitative | Develop a state definition of critical facilities, develop the facility list | This would be beneficial for all state agencies planning needs with regards to development and hazard mitigation. | Ongoing throughout 2007-2010. Proposed project requires additional work in feasibility, resource requirements, proposed support funding sources, and determination as to project lead agency. |

**Table 5-1: Measures For Evaluating Strategies and Activities Associated With Goals 1, 2 and 3 Continued**

| Goal | Strategy | Activity | Activity Prioritization (H=High, M= Medium, L=Low) | Lead Agency | Type of Evaluation | Evaluation Measure | Desired Outcome | Evaluation of Past Activities Which Supported Strategy (FFY04, 05, 06)/Comments |
|---|---|---|---|---|---|---|---|---|
| | | Act as a clearinghouse for FEMA produced educational materials in the area of natural hazards mitigation including flood management and planning; as well as climate change and adaptation approaches. | L | DEP | Quantitative | Number of requests for educational materials and number of publications provided | Provide local communities with an easy access to hazards mitigation materials and knowledge of other sources where information may be obtained | This activity is performed on a continuous basis by flood management staff, it is proposed that a tracking system for requests and materials provided be instituted |

### 5.4.1 Assessment of Proposed Mitigations Activities

As CTDEP developed the priority of the activities listed in Table 5-1, 5 activities were highlighted as having the highest priority.

The factors used for ranking the activities listed in Table 5-1 included:

- Feasibility of implementation (both on a state and local level);
- Potential mitigation gains that could be achieved by the activity; and
- If the proposed activity would assist the State in achieving improved resource effectiveness and data collection, two current areas of constraint that have been noted within the current plan.

CTDEP also considered an activity's potential to assist and enhance local floodplain management programs and activities. Due to the short time period provided by FEMA for this update, a comprehensive and detailed analysis of potential activities was not feasible. Further analysis of individual activities will be performed based on the evaluative factors stated above prior to the implementation of an initiate and all associated activities.

One proposed activity involves the development of partnerships within state government between various state agencies. In implementing this proposed activity, the State would be able to effectively pool its resources for planning, GIS, and data collection and analysis to expand its efforts in natural hazards mitigation planning. This action will help to open new lines of communications between various state agencies and to increase the sharing of state resources and data. It should be noted that activity is long-term in nature and will require co-operative agreements signed by affected agencies.

Two other activities rated as high for this plan involve the promotion of outreach and educational activities to municipalities. This involves such actions as promoting the adoption and implementation of higher floodplain regulatory standards, and supporting training and workshops for various types of natural hazards planning and mitigation. Such educational opportunities will help to increase the knowledge base of local floodplain managers and provide them the tools necessary to maintain an appropriate balance between development and the protection and conservation of local natural resources, while implementing mitigation measures to reduce losses from potential natural hazards which may affect a community.

All of the potential mitigation activities presented in table 5-1 are feasible both technically and politically on a state and local level. Each of the potential activities can be implemented independently of other proposed activities. In addition, each activity will support the development of an increasingly effective and comprehensive NHMP.
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The factors used for ranking the activities listed in Table 5-1 included:

- Feasibility of implementation (both on a state and local level);
- Potential mitigation gains that could be achieved by the activity; and
- If the proposed activity would assist the State in achieving improved resource effectiveness and data collection, two current areas of constraint that have been noted within the current plan.

CTDEP also considered an activity's potential to assist and enhance local floodplain management programs and activities. Due to the short time period provided by FEMA for this update, a comprehensive and detailed analysis of potential activities was not feasible. Further analysis of individual activities will be performed based on the evaluative factors stated above prior to the implementation of an initiate and all associated activities.

One proposed activity involves the development of partnerships within state government between various state agencies. In implementing this proposed activity, the State would be able to effectively pool its resources for planning, GIS, and data collection and analysis to expand its efforts in natural hazards mitigation planning. This action will help to open new lines of communications between various state agencies and to increase the sharing of state resources and data. It should be noted that activity is long-term in nature and will require co-operative agreements signed by affected agencies.

Two other activities rated as high for this plan involve the promotion of outreach and educational activities to municipalities. This involves such actions as promoting the adoption and implementation of higher floodplain regulatory standards, and supporting training and workshops for various types of natural hazards planning and mitigation. Such educational opportunities will help to increase the knowledge base of local floodplain managers and provide them the tools necessary to maintain an appropriate balance between development and the protection and conservation of local natural resources, while implementing mitigation measures to reduce losses from potential natural hazards which may affect a community.

All of the potential mitigation activities presented in table 5-1 are feasible both technically and politically on a state and local level. Each of the potential activities can be implemented independently of other proposed activities. In addition, each activity will support the development of an increasingly effective and comprehensive NHMP.

## 5.5 SUMMARY OF STATED GOALS, STRATEGIES, AND ACTIVITIES

For the time period of 2007 – 2010, the State of Connecticut has chosen to focus its efforts in natural hazards mitigation towards the achievement of 3 goals:

1. Increase implementation of sound floodplain management and natural hazards mitigation principles on a state and local level;
2. Increase implementation of effective hazards mitigation projects on a state and local level; and
3. Increase research and planning activities for natural hazards mitigation on a state and local level especially with regard to climate change And associated adaptation strategies.

The implementation of effective natural hazards mitigation requires on-going planning and dedicated persistence both on a state and local level to maintain what has been done in the past and to improve upon past efforts to strive for implementing the most protection possible from natural hazards.

The related strategies and activities outlined in this Plan provide a guide to assist Connecticut in working towards achieving these goals that will be implemented or initiated during the time period encompassing this Natural Hazards Mitigation Plan update. The goals themselves are achievable, yet they require adequate resources such as financial and staff resources to achieve significant results. The State of

Connecticut believes in the importance of natural hazards mitigation planning and implementation of hazard mitigation activities both on a state and local level in order to reduce/eliminate lives lost and property damaged suffered by natural hazards. The State also believes that climate change and adaptation techniques are an area of continued concern for which new policies and strategies will need to be developed.