

## Acknowledgements

The City of Cranston commends the efforts of its Hazard Mitigation Committee in completing this important plan. The effort is sure to result in the protection of life and property and special thanks are extended to Committee members: - Peter Lapolla – Planning Director, Cranston Department of Planning and National Flood Insurance Program Coordinator; James Gumbley – Chief, Cranston Fire Department, Cranston Emergency Management Officer and Hazard Mitigation Committee Chair; John Schaffran - Major, Cranston Police Department; Walter Skorupski –City Surveyor for the Cranston Department of Public Works; Lawrence DiBoni - Director, Cranston Department of Economic Development; Stanley Pikul – Director of Building Inspections and Ellary Wims Gamache – Regional Planner, Rhode Island Emergency Management Agency.

In addition the City also recognizes the contribution of the Cranston Tax Assessors Office, Planning Department, School Department, Recreation Department, Historic District Commission, Engineering Division, Harbormaster and Housing Authority; the United States Department of Agriculture Natural Resource Conservation Service; the American Red Cross; Narragansett Electric; Veolia Water; the Providence Water Supply Board; Cox Communications; and Verizon Telecommunications for assisting with the compilation of facilities inventories and in reviewing proposed mitigation actions.

Lastly, the City of Cranston would also like to thank the Rhode Island Emergency Management Agency as well the Federal Emergency Management Agency's Region I Office for their guidance in completing this effort. In particular the City would like to thank staff from FEMA's Joint Field Office for their guidance in completing the 2010 update to the Hazard Mitigation Plan.

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## Executive Summary

This Hazard Mitigation Plan is a product of the Cranston Hazard Mitigation Committee. It has been approved by the Cranston City Council, the Rhode Island Emergency Management Agency, and the Federal Emergency Management Agency in accordance with the Disaster Mitigation Act of 2000.

Its overview of past natural hazard occurrences verifies that the area is vulnerable to diverse events including blizzards, floods and even tornados. The discussion puts the likelihood of these events into historical perspective and recognizes that although the probability of thunderstorm, high wind and lightning events may be higher; the intensity and potential impacts from less likely events such as hurricanes and earthquakes can be far greater.

The risk assessment portion of the plan confirms that the City has much to loose from these events. Total vulnerabilities are conservatively estimated at \$1,570,802,700 in property damages with potential risks to each of the City's 81,686 residents. More specifically, the four highest ranking risks identified include flood prone drainage systems (\$ 558,428,000 estimated property damage with an at risk population of 7,726, potential dam failures, and damage to adult care and sewerage treatment facilities. Those classified as medium risks include the, high density residential developments, electrical substations and critical municipal response facilities. Those facilities classified as lower risks include the State concerns at the Pastore Center, Western Cranston Water District, Tennessee Gas Pipeline, recreational facilities, schools, marinas and private mooring facilities and historical resources.

To address these risks the 2005 HMP put forth a clear mission, a distinct set of goals and 23 specific mitigation actions. As part of this update, the CHMC reviewed each mitigation action with regards to activities completed to date and with regards to if the mitigation actions identified in the 2005 HMP should be carried forward into the 2010 HMP. The City's hazard mitigation mission is to protect and enhance the quality of life, property and resources by identifying areas at risk and implementing appropriate mitigation actions. The specific goals include upgrading infrastructure, protecting property, integrating planning and management approaches, strengthening regulatory control, improving response effectiveness and raising awareness of hazard mitigation benefits and procedures. Each of the subsequent mitigation actions for achieving these goals summarizes specific problems and possible solutions, details the primary tasks to be undertaken, identifies an appropriate lead and anticipates funding concerns.

The implementation element brings the plan full circle. It provides a schedule of when each of the mitigation actions identified in the 2010 HMP are anticipated to be undertaken as well as a specific program for ensuring the plan is revisited, evaluated and kept up to date.

In reviewing the 2005 HMP, the CHMC found that

- 7 of 23 mitigation actions have been completed: Stillhouse Cove Erosion Controls, Tennessee Gas Clear Zone, Update the City's Flooding Ordinance, Flood Hazards Training Workshops, Subdivision Enforcement, Storm Preparedness Plan and Hazard Mitigation Coordinator.
- 3 of the 23 mitigation actions have been partially completed or are underway: Pocasset River Flood Improvements, WCWD Service Loops and NFIP Community Rating System.
- One new mitigation action has been added. Given the City's experience with the March, 2010 flood event, the CHMC has recognized the need for the City to develop and implement a Long Term Community Recovery Plan.
- One mitigation action [Comprehensive Plan – Hazard Mitigation] should not be carried forward.

In addition, seven actions are scheduled to be initiated in the short-term (2005-2006), nine over the mid-term (2007-2008) and three over the long-term (2009). Within this framework the plan itself is scheduled to be evaluated annually with revision and update as necessary.

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## Introduction

The City of Cranston is located at the head of Narragansett Bay on its western shore directly south of the Capital City of Providence and north of the City of Warwick (see map 1). In 2008 U.S. Census American Community Survey set the city's population at 81,686 a figure which ranks it as the third largest in the state behind the Cities of Warwick and Providence respectively. The City's 39 square miles of area are primarily drained by the Pocasset River which itself is composed of two primary sub-basins.

The development pattern of the City is distinctive in that it is densely developed in an urban fashion in the east and gradually transitions to a suburban nature and ultimately to a rural state as one heads west. Land use within the city is approximately 34% residential, 8% industrial, 4% commercial, 6% agricultural, 4 % recreational, 11 % transportation, 20% forested or vacant, with the remaining 13% classified as other uses. Between 1990 and 2008, the City's residential development grew at an average rate of 0.36% per year. Between 1990 and 2008, a total of 1960 new housing units were constructed for an average rate of 109 units per year.

### 1.1 Natural Hazard Mitigation and its Benefits

Natural hazard mitigation planning is advance action taken to identify specific areas that are vulnerable to natural hazards within a city, and seeks to permanently reduce or eliminate the long-term risk to human life and property. It coordinates available resources and identifies community policies, actions, and tools for implementation that will reduce risk and the potential for future losses citywide. The process of natural hazard mitigation planning sets clear goals, identifies appropriate actions, and produces an effective mitigation strategy that can be updated and revised to keep the plan current.

States and communities across the country are slowly, but increasingly, realizing that simply responding to natural disasters, without addressing ways to minimize their potential effect, is no longer an adequate role for government. Striving to prevent unnecessary damage from natural disasters through proactive planning that characterizes the hazard, assesses the community's vulnerability, and designs appropriate land-use policies and building code requirements is a more effective and fiscally sound approach to achieving public safety goals related to natural hazards.<sup>1</sup>

In the past, federal legislation has provided funding for disaster relief, recovery, and some hazard mitigation planning. The Disaster Mitigation Act of 2000 (DMA 2000) is the latest federal legislation to improve this planning process. It reinforces the importance of natural hazard mitigation planning and establishes a pre-disaster hazard mitigation program and new requirements for the national post-disaster Hazard Mitigation Grant Program (HMGP). Section 322 of the Act specifically addresses mitigation planning at the state and municipal levels of government. It identifies new requirements that allow HMGP funds to be used for planning activities. As a result of this Act, states and communities must now have an approved natural hazard mitigation plan in place prior to receiving post-disaster HMGP funds.<sup>2</sup> In the event of a natural disaster; municipalities that do not have an approved natural hazard mitigation plan will not be eligible to receive post-disaster HMGP funding.

The City of Cranston also recognizes the important benefits associated with natural hazard mitigation, its interaction with municipal land use and infrastructure planning, and the need for a comprehensive planning approach, which accommodates these interdependencies. The City's current comprehensive plan addresses land use, housing, economic development, natural resources, services and facilities, open space and recreation, but does not address hazard mitigation. Therefore, the first benefit related to the integration of natural hazard mitigation is that it will ensure a coordinated planning approach into the future and ensure that risk reduction remains a critical element of municipal planning.

A second benefit of natural hazard mitigation allows for a careful selection of risk reduction actions through an enhanced collaborative network of stakeholders whose interests might be affected by hazard losses. Working side by side with this broad range of stakeholders can forge partnerships that pool skills, expertise, and experience to achieve a common goal. Proceeding in this manner will help the City ensure that the most appropriate and equitable mitigation projects are undertaken.<sup>3</sup>

A third benefit of natural hazard mitigation would be endorsing a proactive planning approach focused on sustainability, whereby the City of Cranston could minimize the social and economic hardships that have resulted from the occurrence of previous natural disasters. These social and economic hardships include: the loss of life, destruction of property, interruption of jobs, damage to businesses, and the loss of historically significant structures and facilities. This proactive planning approach would look for ways to combine policies, programs, and design solutions to bring about multiple objectives and seek to address and integrate social and environmental concerns. Linking sustainability and loss reduction to other goals can provide a framework within the state and local governments that will bring the comprehensive planning process full circle.<sup>4</sup>

Lastly, the participation in a hazard mitigation planning process will establish funding priorities. The formal adoption and implementation of this plan will allow the City of Cranston and its residents to become more involved in several programs offered by the Federal Emergency Management Agency (FEMA) including: the Community Rating System Program (CRS); the Pre-Disaster Flood Mitigation Assistance Program (FMA); and the Hazard Mitigation Grant Program (HMGP). Money spent today on preventative measures can significantly reduce the cost of post-disaster cleanup tomorrow.

## 1.2 Cranston Hazard Mitigation Committee

This Hazard Mitigation Plan **[HMP]** is a product of the Cranston Hazard Mitigation Committee **[CHMC]**. Committee members included: James Gumbley - Chief, Cranston Fire Department and Director of Cranston Emergency Management Agency, John Schaffran - Major, Cranston Police Department, Walter Skorupski - City Surveyor for the Cranston Department of Public Works, Lawrence DiBoni - Director, Cranston Department of Economic Development, Peter Lapolla - Planning Director, Cranston Department of Planning and National Flood Insurance Program Coordinator, Stanley Pikul - Director of Building Inspections and Ellary Wims Gamache - Regional Planner, Rhode Island Emergency Management Agency.

In addition the CHMC benefited from contributions of the Cranston Tax Assessors Office, Planning Department, School Department, Recreation Department, Historic District Commission, Engineering Division, Harbormaster and Housing Authority; the United States Department of Agriculture Natural Resource Conservation Service; the American Red Cross; Narragansett Electric; Veolia Water; the Providence Water Supply Board; Cox Communications; and Verizon as well as from the Rhode Island Emergency Management Agency and the Federal Emergency Management Agency. These entities were not only instrumental in inventorying pertinent facilities and in identifying risks but also in reviewing proposed mitigation actions and implementation plans.

## 1.3 The Planning Process

This update of the 2005 HMP is the result of a seven step process. It was initiated on May 7, 2010 with the establishment of the CHMC by the City Director of Administration and the dedication of technical support staff from the City's Planning Department. Step two included the first meeting of the CHMC on May 13, 2010 which focused on the scoping of the process that would be used in prepare the 2010 update to the 2005 HMP. The resulting process is summarized below for convenience and detailed procedural methodologies are presented within the plan's respective chapters. [See Chapter Seven for a more detailed description of both the planning and the public participation process by which the 2010 update of the HMP was completed.]

Step three began with the CHMC reviewing the hazards of concerns identified in the 2005 HMP, documenting their historical occurrences and reassessing the likelihood of future events as set forth in the plan. Follow-up meetings of the CHMC were held to finalize its review which is presented in Chapter Two.

Step four involved the review of the assessment of risk identified in the 2005 HMP and which was undertaken through three meetings of the CHMC designed to identify those elements of concern within the City. The CHMC reviewed and updated detailed facility inventories, mapped the concerns, generated fiscal and population impact analyses, determined the level of risk and produced a draft risk assessment matrix. An additional CHMC meeting was then held to review the concerns raised and to finalize the outputs of chapters three and four.

Step five entailed the CHMC reviewing and adjusting the 2005 HMP hazard mitigation mission statement, specific mitigation goals and individual mitigation actions. As above, a CHMC brainstorming session was used to provide a starting point for the CHMC's efforts. Follow-up meetings of the CHMC were then held to review the drafts and finalize the content of Chapters Four and Five.

Step six focused on the prioritization of the mitigation actions and the development of the implementation, evaluation and revision schedule. This prioritization was completed through a number of meetings of the CHMC where the schedules adopted in the 2005 HMP were reviewed and updated for the 2010 HMP (see Chapter Six).

Step seven furthered the public input and review process with the submittal of complete first drafts to the Rhode Island and Federal Emergency Management Agencies and presentation to the City Planning Commission and the general public for review and comment. The CHMC then held their last meeting, finalized the plan and completed the municipal adoption process as documented in Chapter seven.

Through the planning process, the CHMC was assisted by staff from FEMA's Joint Field Office. The CHMC wishes to acknowledge their help and it believes that their guidance and assistance greatly improved this document.



## Natural Hazards

This history of natural hazard events verifies that the area is vulnerable to diverse events including blizzards, floods and even tornados. The discussion puts the likelihood of these events into historical perspective and recognizes that although the probability of thunderstorm, high wind and lightning events may be higher; the intensity and potential impacts from less likely events such as hurricanes and earthquakes can be far greater.

The primary sources of data researched to identify occurrences of natural hazard events in Cranston were the United States Geological Survey (USGS) Earthquake Hazards Program (<http://neic.usgs.gov>), the National Climatic Data Center within the National Oceanic Atmospheric Administration (NCDC-NOAA) (<http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms>), the 1998 Journal-Bulletin: Rhode Island Almanac, and the Taunton, MA, National Weather Service Forecast Office. The parameters and description of particular events are limited to the availability of information contained in the aforementioned sources. Data relating to the NFIP was provided by Ellary Wims Gamache – Regional Planner, Rhode Island Emergency Management Agency (RIEMA).

### 2.1 Hazards of Concern

#### 2.1.1. Earthquakes

The USGS estimates that there is a 40 to 60 percent chance of experiencing an earthquake of magnitude 6.0 or greater on the Richter Scale in the central or eastern United States within the next 30 years. Buildings that are most at risk from earthquakes are the old masonry buildings and large structures such as those along Elmwood Avenue, the Atlantic Tubing Factory, and Cranston Stebbins Stadium.

Although earthquakes are not considered to be a major problem in the Northeast United States, they are more prevalent than one might expect. Table 1 presents historical seismic activity for Rhode Island. It highlights the earthquake epicenter, the Richter magnitude at the epicenter, and the Mercalli Intensity Level. Richter magnitudes are technical quantitatively based calculations that measure the amplitude of the largest seismic wave recorded. Richter magnitudes are based on a logarithmic scale and are commonly scaled from 1 to 8. The higher the magnitude on the Richter Scale, the more severe the earthquake. Mercalli intensity levels are based on qualitative criteria that use the observations of the people who have experienced the earthquake to estimate the intensity level. The Mercalli scale ranges from I to XII. The higher the intensity level on the scale, the closer the person is to the epicenter.<sup>5</sup>

The CHMC has reviewed this section and has determined that the hazards identified in the 2005 HMP have not changed and that the 2010 HMP update needs to document seismic events that have occurred since 2005.

#### 2.1.2. Flooding

Flooding occurs in Cranston because of high storm surges along the coast and excessive runoff from the Pawtuxet River Watershed, which covers an area of 80.9 sq. miles. The excessive runoff is a result of heavy rainfall or in combination with snowmelt. Two flood control structures that lie outside of the City of Cranston are the Flat River Reservoir, in Coventry, and the Scituate Reservoir and Pawtuxet River Dam, in Scituate. In addition, according to the Rhode Island Department of Environmental Management Dam Safety Program, there are a total of 23 dams within the City. The Cranston Print Works Dam is a privately owned dam and classified as a one of the 16 high hazard dams within the State. In addition, the Curran Upper and Lower Dams are 2 of 41 dams within the State that are classified as significant hazard dams.

The flood of week of March 28, 2010, is considered the flood of record for the main channel of the Pawtuxet River since the construction of the Scituate Reservoir. The flooding that occurred originated from a series of rain events that culminated with a 6 to 9 inches of rainfall over the Pawtuxet River Basin on March 29, 2010. Peak discharge within Pawtuxet was approximately 10,400 cubic feet per second (cfs) and flood evaluations reached 11.79 feet above the 9 foot flood stage (20.79 feet).<sup>6</sup> While stream gauge data are not currently available for the Pocasset River and Meshanticut Brook, the March, the 2010 flooding event was also the record flood event for both bodies. The March, 2010 flooding affected

properties along Meshanticut Brook, along the Pocasset River (especially at Fetcher Avenue and south of Reservoir Avenue in the flood plain near Blackmore Pond) and along the Pawtuxet River main stem (especially in the Perkins Avenue neighborhood). During this flood event, the Natick Avenue, Elmwood Avenue and Warwick Avenue bridges were all impacted resulting in their closure.

**Table 1: Seismic Activity in Rhode Island**

Date	Epicenter	Epicenter Magnitude	Mercalli Intensity Level
02/28/25	St. Lawrence River Region	7	Intensity level V shock effects were felt on Block Island. Intensity level IV effects were felt in Charlestown. The total area affected by this earthquake was over 5,000,000 sq. km.
11/01/35	Quebec, Canada	6.25	Intensity level IV shock effects were felt on Block Island and at Providence and Woonsocket. The total area affected by this earthquake was about 2,500,000 sq. km.
10/16/63	Massachusetts Coast	4.5	Intensity level V shock effects felt at Chepachet. Other places in the Northern Rhode Island felt shock effects with less intensity.
06/14/73	Western Maine	5.2	Intensity level IV shock effects were felt at Charlestown. Intensity level I - III shock effects were felt at Bristol, East Providence, Harmony, and Providence. This earthquake was felt over an area of 250,000 sq. km.
03/11/76	Near Newport, RI	3.5	Intensity level VI shock effects felt throughout Southern New England. This earthquake has the distinction of being the largest earthquake to originate in Rhode Island.
04/20/02	Plattsburgh, NY	5.2	Intensity level II to III shock effects felt throughout Rhode Island.
03/11/08	Central Connecticut	2.9	No data reported for Rhode Island

Source: [http://neic.usgs.gov/neis/states/rhode\\_island/rhode\\_island\\_history.html](http://neic.usgs.gov/neis/states/rhode_island/rhode_island_history.html)

Flood prone areas on Furnace Hill Brook include the area between the State Route 37 (westbound exit ramp) to Interstate Route 95 and Natick Avenue, and the area immediately downstream of the Phenix Avenue Bridge and downstream of the Pippin Orchard Road Bridge.<sup>6</sup>

Lastly, the City does participate in the NFIP, as do all the communities in Rhode Island. There are currently 562 National Flood Insurance Policies [505 residential policies and 56 non-residential policies] held by Cranston property owners. These 562 policies produce total annual premiums of \$654,392 and the value of property covered is \$130,373,100. A total of 8 of the 562 policies are within V Zones; a V Zone refers to the velocity zone, where waves greater than 2.9 ft. are feasible during a 100-year flood. A total of 366 of the 562 policies are within A Zones; A Zones are other areas within the 100-year flood zone with less than 2.9 ft. waves. Since 1978, there have been a total of 472 claims filed for issues related to flooding with total claims paid of \$8,572,758. Based on the March, 2010 flooding event, of the 562 policies held by Cranston property owners, 33 of these properties are classified as repetitive loss with 22 properties located within an A-Zone, 1 within a V-Zone and 9 within B, C or X Zones. A repetitive loss property is defined as a property that has experienced two or more insurance claims of at least \$1,000 due to natural hazards over a period of ten years.<sup>7</sup> Given the short period of time that has elapsed since the March, 2010 event, an address list of the most recent repetitive loss properties has not been generated. Given this, the Risk Assessment Map plots the eighteen repetitive loss properties identified prior to March, 2010. The Map will be update as more data on the 2010 flood event becomes available. Lastly, it is important to note that the City of Cranston has 73 Letters of Map Amendments (LOMA) on file, which is the highest within any Rhode Island municipality. The breakdown of the flood sources for these amendments are the following: Meshanticut Brook (41), Pocasset River (12), Randall Pond (17), Pawtuxet River (1) Furnace Brook (1) and Providence River (1) Pond (1). Table 2 highlights the most recent flooding events that have affected the City of Cranston.

The CHMC has reviewed this section and has determined that the hazards identified in the 2005 HMP Plan still pose a significant threat to the both the residents and property in Cranston and that the 2010 HMP update needs to document flood events that occurred since 2005. The CHMC further finds that hazards from flooding may increase over time as global warming will contribute to an increase in both the intensity and frequency of storm events.

**Table 2: Recent Flooding Events in Cranston**

Date	Type	Comments
04/01/93	Flash Flood	Pawtuxet River was reported flooding onto Woodbury Road, Marine Avenue, and Wellington Avenue.
04/02/93	Flash Flood	The Pawtuxet River flooded again along Woodbury Road.
01/24/98	Flood	In Cranston, the Pocasset River overflowed its banks, flooding a local road with 2' of water between 7:00 am and 9:00 am.
03/10/98	Flood	In Cranston, 3.60" of rain fell. Urban street flooding was quite serious. Many roads had to be closed due to flooding for periods varying from a few hours up to 12 to 24 hrs.
06/14/98	Flood	After 6" to 8" of rainfall, the Pawtuxet River was above flood stage from June 12th through the 14th.
07/01/98	Flood	In Cranston, the Pawtuxet River did not reach flood stage until 10:15 am on July 1st, crested at 9'40" at 8 pm on the 1st, and then fell below flood stage at 10 am on July 2nd.
09/16/99	Flood	Torrential rainfall from Tropical Storm Floyd caused the Pawtuxet River to rise out of its banks in Warwick and Cranston. The Pawtuxet went into flood at 11:32 pm on the 16th, and crested at 9'4" at 5:15 am on the 17th, just over its 9' flood stage. It returned to its banks at 2:45 pm on the 17th. Winds were recorded at 57.6mph.
04/22/00	Flood	Widespread urban flooding occurred in Cranston and West Warwick after 2" to 3" of rainfall. It was reported that some roadways were covered by 10" to 12" of water. The Pawtuxet River in Cranston experienced a minor flood, with a crest of 9'4" at 4:15 pm (flood stage is 9').
03/22/01	Flood	In Cranston the Pawtuxet River crested at 11'36" at 6:15 pm on the 22nd (flood stage is 9'). Property damage for Providence County was estimated at \$3,000,000.
03/30/01	Flood	In Cranston, after 3" to 4" of rainfall, the Pawtuxet River crested at 11'86" at 7:15 pm on the 31st (flood stage is 9'). Flooding was limited to several roads in low-lying areas near the river on April 1st.
05/15/05	Flash Flood	An approaching cold front interacted with a very humid air mass, which was in place across Southern New England, producing locally heavy downpours that caused flash flooding across Rhode Island during the late morning and early afternoon hours of 15 September 2005. A widespread two to five inches of rain fell from this flood event; and most of the rain fell within a three hour period. Most of the flooding occurred across Providence and Kent counties. More specifically, three feet of water was reported on Pontiac Avenue in Cranston, which stranded cars on this flooded roadway. Also, three feet of water was reported on Killingly Street in Providence; and cars parked in the Coventry High School parking lot had water up to their doors. No known injuries directly resulted from this flash flood event.
0/10/06	Flood	Pawtuxet River A late season coastal storm brought heavy rain to Rhode Island, which resulted in widespread flooding in Providence County as well as near Narragansett Bay. Storm total rainfall averaged 2 to 4 inches. In the city of Providence, flooding closed Valley Street at Atwells Avenue. The Pawtuxet River at Cranston went into moderate flood, and crested at 12.57 feet at 415 pm EDT on June 8. Flood stage is 9 feet.
10/28/06	Flood	Widespread urban flooding was reported in greater Providence. The Pawtuxet River at Cranston went into minor flood, cresting at 9.5 feet which was just over its flood stage of 9 feet. Low pressure intensified as it tracked from the mid Atlantic states to New England. This system brought damaging winds to much of central and southern Rhode Island, where trained spotters and amateur radio operators reported many downed trees and power lines. About 10,200 customers were left without power throughout the state, as reported by the media. Rainfall totals of 2 to 4 inches produced significant urban flooding from greater Providence to South Kingstown. Several roads were closed. In Providence, the rain collapsed the third-floor ceiling of an apartment building displacing 14 people. The heavy rainfall also resulted in minor flooding on the Pawtuxet River. At Cranston, the river crested at 9.5 feet, which was just over its flood stage of 9 feet. Significant coastal flooding also occurred as a result of the storm.
11/24/06	Flood	Minor flooding occurred along the Pawtuxet River at Cranston, after nearly 4 inches of rain in an 18-hour period. The river crested just below 10 feet during the morning of the 24th. Flood stage is 9 feet. No flood damage was reported. ODE Low pressure tracking well southeast of Nantucket brought strong northeast winds to portions of Rhode Island as well as heavy rain to much of the state. Sustained winds around 30 mph brought down a telephone pole in Warwick, at the corner of Ocean Street and Shore Avenue. Rainfall averaged between 2 and 4 inches which resulted in localized urban and poor drainage flooding. Minor flooding occurred along the Pawtuxet River in Cranston. The river crested just below 10 feet, which was just over its flood stage of 9 feet. No damage was reported.
04/15/07	Flood	Moderate flooding occurred along the Pawtuxet River. At Cranston, the river crested at 12.4 feet at 1 pm on the 17th (flood stage is 9 feet). Flooding was reported in several neighborhoods near the river in Cranston. An unusually strong and slow moving coastal storm for mid April tracked to western Long Island Sound on April 16th before weakening slowly and drifting offshore. This storm brought a variety of impacts, including damaging winds in excess of 60 mph, widespread river and stream flooding, and significant coastal flooding through several high tide cycles. East to northeast winds gusted as high as 60 mph. The highest gusts reported were 62 mph in

04/15/07 Cont.	Flood	Middletown, 61 mph at T.F. Green Airport in Warwick, and 60 mph in downtown Providence. There were widespread reports of downed trees, large branches, and power lines, especially in southern Rhode Island and as far inland as Providence. Rainfall totals of 3 to 5 inches, combined with wet antecedent conditions, resulted in widespread river and stream flooding, as well as significant flooding of urban areas. Minor to moderate flooding affected the Blackstone and Pawtuxet Rivers. The highest rainfall total reported was 5.00 inches in Little Compton. Many small streams throughout Rhode Island also rose out of their banks and flooded nearby areas, including roadways. Minor to moderate coastal flooding occurred along the coastline of Rhode Island through several high tide cycles, due to the combination of strong onshore winds, high seas, and astronomically high tides. Along the South Coast, the worst coastal flooding occurred with the morning high tide on the 16th, where flood waters and debris closed several shore roads. Large boulders that washed ashore had to be removed with snow plows, according to media reports.
02/13/08	Flood	Route 114 near Greenville Road was flooded in Cranston. Also, Natick and Wilbur Avenues and Fletcher Streets were impassable due to flooding and the Meshanicut Valley construction site was washed out. The Natick Avenue bridge was closed to all traffic because of severe erosion caused by the heavy rain. In addition, Route 116 near the reservoir was flooded with 18 inches of water flowing over the road. In Johnston, severe erosion on the sides of the Plainfield Pike was reported with 12 inches of water flooding portions of the road. A low pressure system developed off the Mid-Atlantic coast and moved up the east coast southeast of Nantucket producing snow, rain, and ice across Southern New England. Widespread two to four inch rainfall amounts resulted in small stream and poor drainage flooding as well as some minor river flooding. In addition, there was some minor wind damage from strong northeast winds, especially along the coast.
2/12/08	Flood	Route 10 and Wellington Road in Cranston were flooded. The Woonasquatucket River at Centerdale overflowed its banks flooding Atwells Avenue in Providence. Benjamin Road in North Providence was closed due to flooding. While a major ice storm affected Massachusetts and Southern New Hampshire, three to five inches of rain fell in Rhode Island resulting in small stream and some street flooding.
08/95/09	Flood	Several streets in Cranston were flooded with water halfway up car tires (about 6 inches). A cold front moved across Southern New England into an unstable atmosphere, resulting in showers and thunderstorms forming along the front. Some of these storms became severe producing strong, damaging winds and frequent lightning strikes. A group of nine people sought shelter under a tree at a sports field. Lightning struck the ground or a fence nearby and the nine felt a shock from the strike. Only minor injuries were sustained.
03/29/10	Flood	Six to nine inches of rain fell across Providence County, resulting in rises on both the Blackstone River at Woonsocket and the Pawtuxet River at Cranston. The Blackstone rose to moderate flood and the Pawtuxet rose to nearly 21 feet, surpassing the previous flood of record set only two weeks prior of nearly 15 feet. Numerous streets and basements were flooded across all of Providence County, including Cranston, North Smithfield, Johnston, Scituate, East Providence, North Providence, Providence, Pawtucket, and Cumberland. Roughly 120 homes were evacuated in the Valley View neighborhood in Cranston. A four building condo complex on Fordson Avenue was also evacuated. About 300 people total were evacuated from their homes in Cranston. Tenants from lower level units of an apartment building on Exchange Court in Pawtuxet were asked to evacuate due to flooding. A car on Valley Street in Providence was stuck in flood waters, leaving the driver stranded. Two homes on Tuxedo Street in Providence were looted while their owners were kept away for safety reasons. The Cranston wastewater treatment plant failed during the flooding, untreated sewage into the Pocasset River at a rate of 8 million gallons per day. In Johnston, the Pocasset Bridge on Route 14 (Plainfield Street) that spans the Pocasset River was closed after it started to show four large cracks. Several items that had floated down the river were caught under the bridge, blocking the water flow. City Hall experienced some flooding as well, prompting employees to shut down the computer system. A low pressure system sat just south of Long Island for two days, bringing heavy rain to much of Southern New England during that time. A persistent southerly low level jet brought very moist air into the area, which resulted in high rainfall rates. A coastal front along the I-95 corridor enhanced rainfall in that area. This event followed a heavy rainfall and record flooding event in mid-March as well as a second lesser rain event about a week prior. Rivers across much of Massachusetts and Rhode Island were still high from those events and warm temperatures in northern Vermont and New Hampshire resulted in a period of snowmelt that resulted in rises on both the main stem Connecticut and Merrimack Rivers. All of these factors led to a second record rainfall and flooding event. Two day rainfall totals across Southern New England ranged from an inch to ten inches. Though concentrated in Rhode Island and southeastern Massachusetts, all of Southern New England was affected by the flooding. In hardest hit Rhode Island, two day rainfall totals ranged from five to ten inches. Providence, set record monthly precipitation totals during the month of March. Providence also set the record for the wettest month ever in the period of record. Both the Pawtuxet River in Rhode Island set flood of record. River and areal flooding resulted in millions of dollars of damage across Rhode Island, with numerous homes, businesses, and people affected. A portion of Interstate 95, the main highway through Rhode Island, was closed for two days after the Pawtuxet River inundated the highway with

03/29/10 Cont.	Flood	up to three feet of water. Amtrak service through the state was suspended for several days because portions of the tracks were under up to two feet of water in several locations across the state. Passengers were rerouted through Springfield, Massachusetts. Though all 39 cities and towns in Rhode Island were affected, the most damage was seen in Warwick, West Warwick, Coventry, and Cranston, where the Pawtuxet and Pocasset Rivers flow through. Four dams in Rhode Island were breached and many others were overtopped and close to breaching, which resulted in the inspection of 42 dams throughout the state. Officials estimated that more than 500 people were evacuated from their homes because of rising water or the threat of rising water. More than 500 Rhode Island National Guardsmen were activated during the flooding, filling sandbags, directing traffic, and aiding in evacuations. Six National Grid substations were flooded and four were close to flooded, disrupting electrical service in Westerly and Warwick. Half a dozen sewage treatment plants through the state were overwhelmed or compromised by the flooding, leading to raw sewage being discharged into area rivers and bays. The Governor's office estimated that tens of thousands of properties were impacted by the flooding and about 4,000 workers were affected when the businesses they worked in were closed during and after the flooding. Numerous schools and many businesses, as well as the state government were closed for at least a day because of the flooding. President Obama issued a federal disaster declaration for the entire state of Rhode Island and residents received an automatic extension for filing their state and federal income taxes. The disaster declaration encompassed both the mid-March storm and this storm
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Source: <http://www4.ncdc.noaa.gov/cgi-win/wwwcgl.dll?wwwevent-storms>.

### 2.1.3. Hail Storms

One of the less life-threatening yet very damaging natural hazard events is hail. Large hail can dent automobiles, break windows, and destroy roofs. Even small hail can do considerable damage when accompanied by strong winds. Tables 3 highlights hail storm events that have affected the City of Cranston over the past 15 years.

The CHMC has reviewed this section and has determined that the hazards identified in the 2005 HMP have not changed and that the 2010 HMP update needs to document hail storm events that occurred since 2005.

**Table 3: Recent Hail Storm Events in Cranston**

Date	Magnitude	Comments
06/20/95	1.75"	No damage was reported.
06/22/97	0.75"	The hail was produced from a line of severe thunderstorms that moved southeastward across Rhode Island at 3:45 pm. Approximately, 18,000 Narragansett Electric customers statewide reported power outages. In Cranston, the Deputy Fire Chief, "rushed from fire to fire like never before." Winds were recorded at 65mph.
05/31/98	0.75"	The hail produced was from a severe thunderstorm that moved across Northern Rhode Island at 10:03 pm. Winds were recorded at 57.6mph. No damage was reported.
07/23/02	0.75"	Severe thunderstorms downed trees in Coventry, Providence, and Scituate. Dime sized hail was produced in Cranston at 3:50 pm. Winds were recorded at 57.6mph. There was a total of approximately \$5,000 in damage.
07/23/08	10.75"	Ping pong to golf ball size hail fell in Cranston. A frontal system moved through southern New England with the warm front moving through first and increasing low level moisture. Then the cold front moved through providing a lifting mechanism for showers and thunderstorms to develop. High levels of moisture contributed to heavy downpours that resulted in flash flooding in Rhode Island and portions of Massachusetts. All of this coupled with strong wind shear (turning of the winds with height) over southeast Massachusetts and Rhode Island provided the perfect environment for a tornado to form. This particular tornado began as a waterspout over Narragansett Bay and traveled east-northeast reaching land over the southern portion of Warren, Rhode Island. The tornado continued for 4.2 miles into Swansea, Massachusetts over a mostly continuous track. Most of the damage sustained was to trees which fell on power lines and houses. This tornado was rated by a National Weather Service damage survey team as an EF1 on the Enhanced Fujita Scale.

Source: <http://www4.ncdc.noaa.gov/cgi-win/wwwcgl.dll?wwwevent-storms>

Note: NCDC only reports hail data from 01/01/1950 to 09/30/2003.

#### **2.1.4. Hurricanes**

Hurricanes that strike the Eastern United States originate in the tropical and subtropical North Atlantic Ocean, the Caribbean Sea, and the Gulf of Mexico. The Atlantic hurricane season spans a six-month period [June 1st through November 30th]. A hurricane is a tropical cyclone with winds that exceed 74 mph. The center of the hurricane spiral marks the "eye" of the storm. The weather conditions within the eye are characterized as generally cloud, precipitation, and wind free and the barometric pressure is the lowest at the very center of the eye. Immediately surrounding the eye are the strongest winds of the storm. The greatest potential for loss of life during a hurricane is from the storm surge, which is the elevated water pushed toward the coast by the force of the winds spiraling around the storm.

Hurricanes are categorized according to the strength of their winds using the Saffir-Simpson Hurricane Scale. A Category 1 storm has the lowest wind speeds, while a Category 5 hurricane has the strongest. Relatively speaking, a lower category storms can sometimes inflict greater damage than higher category storms based on where they strike and the particular hazards they create.<sup>8</sup> Hurricanes are considered the greatest natural hazard threat within Rhode Island. RIEMA annually asks the State's 39 communities to rank natural hazards indicating the level of seriousness of each natural hazard to their municipality. Hurricanes consistently rank the highest within the State.<sup>9</sup>

The two hurricanes that resulted in the largest loss of life in the State were "The Great New England Hurricane of 1938" and "Hurricane Carol". "The Great New England Hurricane" occurred on September 21st, 1938, and is considered the worst disaster in Rhode Island history. It resulted in the deaths of 262 persons and caused damage estimated at \$100,000,000. The eye of this hurricane tracked to the west of Rhode Island and hit at high tide. During the storm, two storm surges almost 30' high destroyed most of the beach homes along the South Shore. In downtown Providence, the surge flooded the area to a depth of more than 13'9" above the mean high-water mark. As a result, persons drowned trying to escape automobiles submerged in the streets and from buildings where the first floors were flooded to the ceiling.<sup>10</sup> In Cranston, an abnormally high tide of 15'7" in Narragansett Bay near the mouth of the Pawtuxet River; this tide was 10'2" above the crest of the Pawtuxet and as a result of dam topping, extensive flooding occurred in the lower portions of the Pawtuxet River Watershed.<sup>11</sup>

Throughout Rhode Island, the American Red Cross (ARC) spent \$433,485 for the rehabilitation of 3,074 families. A total of 19,695 families suffered property loss; 797 permanent homes were destroyed; 1,169 summer homes were washed away; 899 boats destroyed and 888 damaged, 177 barns and 1,800 other buildings of various types were destroyed.<sup>12</sup>

On August 31, 1954, "Hurricane Carol" hit Rhode Island, in the same manner as "The Great New England Hurricane of 1938". As a result, downtown Providence was flooded when the water reached 13' above mean high-water level.<sup>13</sup> In Cranston, Hurricane Carol created an abnormally high tide of 14'7" in Narragansett Bay, near the mouth of the Pawtuxet River. The overtopping of the Pawtuxet Dam resulted in flooding 12'5", upstream of the dam.<sup>14</sup> Damage to yacht clubs, marinas and pleasure craft was in the millions with the stretch of shoreline from Fields Point to Pawtuxet Neck the hardest hit. Of the 150 craft moored in this area, 75 were sunk and 26 were damaged.<sup>15</sup>

In Cranston, Ocean Avenue and Narragansett Boulevard, in the vicinity of Stillhouse Cove, serve as an arterial evacuation route. In the event of a natural hazard, this evacuation route faces a serious threat to coastal erosion. However, there are two primary threatened neighborhood areas along the coastal flood plain that depend upon this arterial evacuation route. The first area threatened comprises the Edgewood neighborhood. In this area, the roadways east of Narragansett Boulevard are at risk. Specifically these roadways include: Norwood Avenue, Arnold Avenue, Shaw Avenue, Marion Avenue, and Bluff Avenue. The second area threatened comprises the properties in and around Pawtuxet Village. The primary concern here is the threat that Pawtuxet Neck could become separated from the mainland due to the potential flooding of Ocean Avenue and Sheldon Street. Also noteworthy are several smaller roadways on which development extends to the edge of Pawtuxet Cove such as George Street, Aborn Street, Bridge Street, and Springwood Street. Table 4 highlights the most destructive hurricane events that have affected Rhode Island.

The CHMC has reviewed this section and has determined that the hazards identified in the 2005 HMP Plan still pose a significant threat to the both the residents and property in Cranston and that there has been no change in data since 2005. The CHMC further finds that hazards from flooding may increase over time as global warming will contribute to sea level rise and an increase in both the intensity and frequency of storm events.

**Table 4: Hurricane Events in Rhode Island**

Date	Name	CAT	Tracking of Eye	Sustained Winds (mph)	Wind Gust (mph)	Property Damage (\$ million)	Deaths
09/21/38	N/A	3	New Haven, CT	100	125	100	262
09/14/44	N/A	3	Narragansett & Warwick, RI	82	100	2	0
8/31/54	Carol	3	Old Saybrook, CT	90	105-115	90	19
09/11/54	Edna	3	Cape Cod, MA	75-95	110	0.1	0
08/19/55	Diane	Tropical Storm	South of Block Island, RI	45	N/A	170	1
09/12/60	Donna	2	New Haven, CT	58	81	2.4	0
09/27/85	Gloria	1	New Haven, CT	81	120	19.8	1
10/19/91	Bob	2	Newport, RI	75-100	100	115	0

Source: Providence Journal-Bulletin, 1998; Journal-Bulletin Rhode Island Almanac 112th ed. (Providence, RI: Providence Journal Company, 1999) 255-256; David R.

Valle and Michael R. Don, Southern New England Tropical Storms and Hurricanes: A Ninety-seven Year Summary 1900-1996 including several Early American

Hurricanes. (Taurton, MA: National Weather Service Forecast Office, 1996).

### 2.1.5. Lightning

Lightning is caused by the attraction between positive and negative charges in the atmosphere, resulting in the buildup and discharge of electrical energy. Most thunderstorms produce lightning and are dangerous. High winds, rainfall, and a darkening cloud cover are the warning signs for possible cloud-to-ground lightning strikes. Lightning is one of the most underrated severe weather hazards, yet ranks as the second-leading weather killer in the United States. According to NOAA's National Weather Service, lightning is more prolific than hurricanes or tornadoes and kills an average of 73 people and injures 300 per year. While many lightning casualties happen at the beginning of an approaching storm, more than 50 percent of lightning deaths occur after the thunderstorm has passed. Lightning often strikes as far as 10 miles away from any rainfall. You are in danger from lightning if you can hear thunder. If you can hear thunder, lightning is close enough that it could strike your location at any moment.<sup>16</sup> Table 5 highlights recent lightning strikes that have affected the City of Cranston.

The CHMC has reviewed this section and has determined that the hazards identified in the 2005 HPM have not changed and that there has been no change in data since 2005.

**Table 5: Recent Lightning Events in Cranston**

Date	Number of Injuries	Property Damage	Location	Comments
05/01/94	0	\$5,000	Cranston	A bolt of lightning struck and heavily damaged a single-family house. Lightning struck the side of the house, traveled through the attic, and blew a hole in the peak of the roof. The electrical system was knocked out and pieces of vinyl siding were blown off and embedded in a neighbor's house.
08/05/94	0	\$5,000	Cranston	Lightning started a fire in a single family house and destroyed a barn.
04/03/02	1	\$0	Cranston	Lightning from an isolated thunderstorm moving across Rhode Island struck a woman as she waited at a bus stop.
08/02/02	0	\$8,000	Cranston	Lightning from the same storms struck a communications tower and several utility poles.

Source: <http://www4.nce.noaa.gov/cgi-bin/wc/gcld/www/event-storms>.

Note: NCEC only reports hail data from 01/01/1950 to 07/31/2003.

### 2.1.6. Severe Winter Storms

Historically, severe winter storms for Rhode Island have resulted in the closing of schools/businesses, power outages, fallen trees/wires, disruption of transportation systems, and damage to commercial and residential property. The winter of 1978 is considered one of the worst winters on record for the State. On January 13, 1978 an ice storm hit the State. Heavy ice cover was most severe in Cranston and Warwick. Statewide the storm destroyed thousands of trees and left nearly 120,000 people without power and heat in some circumstances. A little more than three weeks later, on February 6, 1978, the State was pounded by what became known as the "Blizzard of 78". In Warwick, the official measure of snowfall at T.F. Green Airport was 28.6". Snow accumulations ranged from 10" on Block Island to 56" in northern areas. Because the heavy snowfall arrived during rush hour, nearly 30,000 vehicles were left stranded. The State was immobilized for almost a week and the President declared Rhode Island a disaster area. During that week 400 army and navy personnel aided local crews to clear streets and highways. The statewide estimated losses from the blizzard were near \$110 million and there were 21 storm-related deaths.<sup>19</sup> Table 6 highlights severe winter storm events that have affected Rhode Island.

The CHMC has reviewed this section and has determined that the hazards identified in the 2005 HMP have not changed and that the 2010 HMP update needs to document winter storms that occurred since 2005.

**Table 6: Recent Severe Winter Storm Events**

Date	Precipitation	Damage	Comments
01/07/94	Heavy snow and ice	\$555,000	Storm ended on 01/08/94. Snow accumulation ranged from 6" to 10".
01/07/96	Heavy snow "Blizzard of 96"	N/A	Storm ended on 01/08/96. Snow accumulation ranged from 12" to 24". The heavy snowfall disrupted transportation systems, closed schools, stores and businesses. In addition, several roof collapses were reported throughout the State.
03/31/97	Heavy wet snow "Blizzard of 97"	\$700,000	Storm ended on 04/01/97. Wind gusts recorded across the State ranged from 30mph to 71mph. Snow accumulation recorded in Cranston was 24". Damages were mostly due to snow removal and power restoration. Highway travel was near impossible with over 1,000 tree limbs down, and left 55,000 customers left without power.
03/05/01	Heavy snow	\$10 Million	Storm ended on 03/07/01. Across the State, snow accumulation ranged from 6" to 16" and wind gusts were reported to be 47mph to 53mph. Tens of thousands of electric customers left powerless, schools and businesses closed for 3 days in some areas.
03/09/01	Heavy snow	\$500,000	Storm ended on 03/10/01. Snow accumulation ranged from 6" to 8" accumulation.
12/25/02	Heavy snow	\$10,000	Storm ended on 12/26/02. Snow accumulations ranged from 4" to 7" and 40mph wind gusts were recorded at T.F. Green Airport.
2/17/03	Winter Storm	N/A	A major winter storm impacted southern New England with heavy snow and strong winds as it tracked southeast of Nantucket. Snowfall totals of one to two feet were widely observed throughout Rhode Island. No significant damage was reported due to the storm, primarily since the snow was fluffy and light with temperatures in the teens and 20s. Impact on travel was minimal, since the storm affected the region on Presidents Day and most schools were closed that week. However, there were numerous reports of minor accidents as a result of slippery roads. No injuries were reported. Officially, the storm total at T.F. Green State Airport in Warwick was 15.0 inches. Of that total, 14.7 inches fell on February 17th, which set a record for the date. The previous record snowfall was 4.1 inches set in 1974. Other snowfall totals, as reported by trained spotters, included 23 inches in Burrillville; 22 inches in Cumberland; 21 inches in Cranston; 20 inches in Woonsocket; 19 inches in South Kingstown; 17 inches in North Foster, West Warwick, Johnston, and downtown Providence; 16 inches in Middletown; 15 inches in Coventry and North Kingstown; and 14 inches in Portsmouth.
03/06/03	Heavy snow	\$290,000	Snow accumulation recorded in Cranston was 8". Dozens of minor accidents were reported.



12/05/03	Winter Storm	N/A	A major winter storm brought heavy snow and strong winds to southern New England, dumping 1 to 2 feet of snow over a large area as it tracked slowly off the coast. In Rhode Island, snowfall amounts averaged between 10 and 20 inches, and had a major disruption on transportation due to the combination of poor visibility and snow covered roads. Dozens of minor accidents were reported. Two deaths were indirectly attributed to the storm. One man was killed when the inner tube he was riding in, towed behind a truck, hit a utility pole. Another man was killed when he was hit by a train while crossing the tracks on a snowmobile in Exeter. Officially, the snowfall total at T.F. Green State Airport in Warwick was 17.0 inches. Other snowfall totals, as reported by trained spotters, included 21 inches in North Foster; 19 inches in Johnston; 18 inches in downtown Providence and West Warwick; 16 inches in Cranston and North Kingstown; 15 inches in South Kingstown and Barrington; 14 inches in Woonsocket; 12 inches in Exeter and Westerly; and 8 inches in Hope Valley.
07/18/06	Statewide	50	Severe thunderstorms moved through Rhode Island at night, in advance of a cold front pushing through southern New England. Thunderstorm winds brought down trees and large limbs in Scituate, Johnston, Cranston, Warwick, Barrington, Middletown, North Kingstown, and Portsmouth. Damage was more widespread in greater Providence, where nearly two dozen large trees were downed around Roger Williams Park and about one hundred others were either split or splintered by strong winds. In Cranston, a large maple tree fell onto a car and another large tree destroyed a garage. An amateur radio operator in Johnston also reported golf ball sized hail as the storms moved through. Lightning from the storms caused considerable damage in the city of Providence. Lightning struck the State House, causing some marble tiles to fall from the roof. A major fire was ignited on a tanker at the port of Providence on Narragansett Bay, when it was struck by lightning. No one was injured in either case. An estimated 37,000 customers lost power during the storms.
06/28/07	Statewide	56	Very strong thunderstorms wind gusts. Very hot and humid conditions prevailed across Southern New England on the 28th of June. This in combination with an approaching cold front aided in the development of thunderstorms during the late afternoon and early evening hours. Many of the storms produced wind damage and hail across Rhode Island.
08/13/07	Cranston	50	Large tree branches down on Laurehurst Road. Isolated severe thunderstorms developed in association with a weakly unstable air mass on the 13th.

Source: <http://www4.ncdc.noaa.gov/cgi-bin/wncgdl?view=ent-storms>

Note: NCDC only reports hail data from 01/01/1950 to 09/30/2003.

### 2.1.7. Tornados

A tornado is a violent windstorm with a twisting, funnel-shaped cloud. They are often spawned by thunderstorms or hurricanes. Tornadoes are produced when cool air overrides a layer of warm air, forcing the warm air to rise rapidly. The damage from a tornado is a result of the high wind velocity and wind-blown debris. Tornado season is generally March through August, although tornadoes can occur at any time of year. Over 80 percent of all tornadoes strike between noon and midnight.<sup>20</sup> During an average year, about 1,000 tornadoes are reported across the United States, resulting in 80 deaths and over 1,500 injuries. The most violent tornadoes are capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be in excess of one mile wide and 50 miles long.<sup>19</sup>

Tornadoes are categorized according to the damage they produce using the Fujita Scale (F-scale). An F0 tornado causes the least amount of damage, while an F5 tornado causes the most amount of damage. Relatively speaking, the size of a tornado is not necessarily an indication of its intensity. On August, 7th, 1986, a rare outbreak of seven tornadoes occurred in New England. One such tornado, rated F2 on the Fujita Scale, carved its way through Cranston, RI, and Providence, RI, causing twenty injuries and \$2,500,000 in damages. Table 7 highlights tornado events that have affected Providence County, Rhode Island.

The CHMC has reviewed this section and has determined that the hazards identified in the 2005 HMP have not changed and that the 2010 HMP update needs to document tornado events that occurred since 2005.

**Table 7: Recent Tornado Events in Providence County Rhode Island**

Date	Type	Magnitude	Injuries	Damage	Location
08/26/85	Tornado	F1	0	\$0	Providence County
08/07/86	Tornado	F1	0	\$250,000	Providence County
08/07/86	Tornado	F2	20	\$2,500,000	Cranston
08/08/86	Tornado	F1	0	\$250,000	Providence County
09/23/89	Tornado	F0	3	\$250,000	Providence County
07/23/08	Tornado	F1	9	\$45,000	Bristol County

Source: <http://www.fradcrnaag.org/wh/wwg/afw/evnt-storms> Note: NOAA only reports data from 1950 to 09/30/2003.

### 2.1.8. Thunder and Wind Storms

A thunderstorm is formed from a combination of moisture, rapidly rising warm air and a force capable of lifting air, such as the meeting of a warm and cold front, a sea breeze, or a mountain. Most thunderstorms contain lightning. Thunderstorms can occur singly, in clusters, or in lines. Therefore, it is possible for several thunderstorms to affect one location in the course of a few hours. Thunderstorms usually bring heavy rains (which can cause flash floods), strong winds, hail, lightning, and tornadoes.<sup>20</sup> Table 8 highlights some thunderstorm and high wind events that have affected Rhode Island.

The CHMC has reviewed this section and has determined that the hazards identified in the 2005 Plan have not changed and that the 2010 HMP update needs to document thunderstorm and high wind events that occurred after 2005.

**Table 8: Recent Thunder and Wind Storms in Rhode Island**

Date	Location	Winds (mph)	Comments
01/07/95	Cranston	58	No damage was reported.
07/13/96	Statewide	74	Tropical Storm Bertha brought a period of high winds, heavy rain, and minor coastal flooding to Rhode Island. Almost 32,000 electric customers were without power because of falling trees and tree limbs. Approximately 2" to 5.5" of rain fell across the State, resulting in urban street flooding in Coventry, Warwick, and Cranston. At 2:30 pm winds were recorded at 70mph in Cranston.
03/09/98	Statewide	40 to 55	Statewide, damage was reported at \$50,000. Urban street flooding was serious in many parts of the State. Cranston reported 3.60" of rainfall.
01/03/99	Statewide	51 to 73	In a period of less than 12 hours, Cranston recorded 2.56" of rainfall.
01/15/99	Cranston	55	More than 2" of rainfall, combined with rapid snowmelt, resulted in considerable urban street flooding. In Cranston, Oaklawn Avenue flooded and several cars were submerged.
01/18/99	Cranston	55 to 60	Strong winds downed power lines in Cranston resulting in scattered power outages.
02/03/99	Statewide	47 to 65	Cranston reported 2.56" of rainfall.
03/22/99	Statewide	49 to 64	Almost 7,000 electric customers in East Providence, Providence, and Cranston reported scattered power outages because strong winds downed tree limbs and power lines.
10/14/99	Statewide	50	Approximately 7,300 electric customers, primarily located in Cranston and Johnston, lost power when a tree fell on a main line leading from a substation.
07/23/02	Statewide	50	Severe thunderstorms downed trees in Coventry, Providence, and Scituate and produced dime sized hail in Cranston.
07/19/05	Statewide	52	Scattered strong to severe thunderstorms moved across Rhode Island during the early evening hours of 19 July. The hardest hit areas were in Providence and Newport counties. The police station in Smithfield measured a wind gust of 52 mph during the height of the thunderstorms. Trees were knocked down from these winds. A bolt of lightning set a transformer on fire. Another bolt of lightning hit a house, starting an attic fire, which caused structural damage to the house. In Jamestown, a bolt of lightning knocked out the main power supply to the town. No injuries directly resulted from these thunderstorms.

07/18/06	Statewide	50	Severe thunderstorms moved through Rhode Island at night, in advance of a cold front pushing through southern New England. Thunderstorm winds brought down trees and large limbs in Scituate, Johnston, Cranston, Warwick, Barrington, Middletown, North Kingstown, and Portsmouth. Damage was more widespread in greater Providence, where nearly two dozen large trees were downed around Roger Williams Park and about one hundred others were either split or splintered by strong winds. In Cranston, a large maple tree fell onto a car and another large tree destroyed a garage. An amateur radio operator in Johnston also reported golf ball sized hail as the storms moved through. Lightning from the storms caused considerable damage in the city of Providence. Lightning struck the State House, causing some marble tiles to fall from the roof. A major fire was ignited on a tanker at the port of Providence on Narragansett Bay, when it was struck by lightning. No one was injured in either case. An estimated 37,000 customers lost power during the storms.
06/28/07	Statewide	56	Very strong thunderstorms wind gusts. Very hot and humid conditions prevailed across Southern New England on the 28th of June. This in combination with an approaching cold front aided in the development of thunderstorms during the late afternoon and early evening hours. Many of the storms produced wind damage and hail across Rhode Island.
08/13/07	Cranston	50	Large tree branches down on Laurehurst Road. Isolated severe thunderstorms developed in association with a weakly unstable air mass on the 13th.

Source: <http://www4.ncdc.noaa.gov/cgi-win/wwwcgi.dll?wwwevent-storms>

Note: NCDC only reports hail data from 01/01/1950 to 09/30/2003.

### 2.1.9. Coastal Erosion

Coastal erosion refers to the wearing away of upland areas as a result of water action. It can be a slow process that occurs over time or a dramatic event fueled by high winds or elevated sea levels. The city of Cranston is relatively protected from this hazard by its location in the low energy environment of the upper bay and due to the fact that 90% of its shoreline has been hardened; but it is not immune. Unfortunately historic rates of coastal erosion are unavailable for the city. An inventory of other events that might have contributed to this process could include however those documented in tables 4 (hurricanes), 6 (severe winter storms) and 8 (thunderstorms/high wind events) above.

The CHMC has reviewed this section and has determined that the hazards identified in the 2005 Plan have not changed and that the 2010 HMP. However, the CHMC further finds that hazards from coast erosion may increase over time as global warming with contribute to sea level rise.

### 2.1.10. Wildfire

As noted earlier the City of Cranston is approximately 20% forested or vacant and as such it is possible that wildfires could present a risk. Although the Cranston Fire Department does respond to a small number of brush fires on an annual basis, the Department confirmed that significant wildfires have not occurred in recent memory due to the adequacy of fire response and protection in the less developed portions of the City.

The CHMC has reviewed this section and has determined that the hazards identified in the 2005 Plan have not changed.

## 2.2 Likelihood of Future Events

In developing a mitigation plan it is also important to gauge the future likelihood of natural hazard occurrences. To do this an index was calculated by dividing the number of years of available data by the number of events that occurred for each type of event. The resulting figures were then classified as having high medium or low probabilities using the natural breaks presented (see Table 9). This methodology functioned well except for the instance of coastal erosion which has since been classified as having a low probability due to the nature of the coastline and the limited historic data available.

**Table 9: Likelihood of Future Events**

<b>Hazard</b>	<b>Index Value</b>	<b>Probability</b>
Thunderstorms High Wind	1	High
Flooding	0.9	High
Severe Winter Storms	0.7	High
Hail Storms	3.0	Medium
Lightning	4.0	Medium
Tornados	4.2	Medium
Hurricanes	9.0	Low
Earthquake	14.2	Low
Wildfire	24	Low
Coastal Erosion	-	-

## Risk Assessment

This chapter presents the natural hazard risk assessment performed for the City by the CHMC. The purpose of the assessment is to identify those facilities and population at risk from natural hazards, to overview the particular concerns, to gauge the potential level of impact on people and property, and to assess the level of risk posed within the City.

The Assessment has six primary components that culminate in the Risk Assessment Matrix (3.7). The primary components include a: Facilities Inventory (section 3.1), Hazard Mitigation Mapping (section 3.2), Fiscal Impact Analysis (section 3.3), Population Impact Analysis (section 3.4), Level of Risk Determination (section 3.5) and Vulnerability of Future Structures (section 3.6).

### 3.1 Facilities Inventory

The first step in the assessment process was to review and update the inventory of facilities of special concern to the City created for the 2005 HMP. The extensive inventorying process ultimately addressed at least twenty-four separate topical areas and involved almost all departments of city government as well as staff from contributing entities such as the Providence Water Supply Board (PWSB) and American Red Cross (ARC).

Individual inventories were created for the fire stations, police station, city hall, emergency response headquarters, public works garage, American Red Cross Shelters, RIEMA evacuation routes, FEMA flood zones, city schools, bridges, culverts, high density residential buildings, care facilities and hospitals, child day care facilities, dams, public drinking water facilities, sewage treatment facilities, natural gas distribution facilities, electrical substations, marinas and mooring facilities, state response and correctional facilities, historic resources, repetitive loss properties and recreational facilities. These inventories can either be found depicted on the map presented in section 3.2, in the Risk Assessment Matrix presented in section 3.7 or in the plan's appendices.

### 3.2 Hazard Mitigation Mapping

With the facility inventories updated for the 2010 HMP, the CHMC recognized the need to map the resulting information. The City's GIS data base, including parcel data, orthophotography and FEMA flood zone information, were utilized to complete this task. The use of this system not only allowed the CHMC to estimate potential fiscal and population impacts for individual parcels (see sections 3.3. and 3.4. for results) but also allowed them to analyze spatial relations between variables.

The final output of this exercise is the City of Cranston Natural Hazard Response Facilities and Risk Assessment Map presented below. As the title implies the focus of the map is not to duplicate all of the spatial information generated through the inventorying process but rather to present the location of the identified risks as they relate to the City's response facilities. The mapped elements include parcels within flood zones, parcels with repetitive flood insurance claim, high density residential properties, adult and child care facilities, marinas, dams, electrical substations, bridges, city schools, state concerns, the gas metering station, water main extension location as well as ARC shelters, evacuation routes, fire stations, police station, city hall and the public works garage.

### 3.3 Fiscal Impact Analysis

The City of Cranston Tax Assessor's Database and GIS, and FEMA's 500-year flood plain data were utilized to generate estimates of potential fiscal impacts from natural hazard events. The information utilized from the tax assessor's database and GIS included the improvement values, land usage, and unit counts. The analysis showed that Cranston is comprised of 18,507 acres of land, with 2,721 acres (14.7%) in the flood plain. These 2,721 acres of land are spread throughout eight geographic areas of the City. Six of these geographic areas include properties along and within the following six flood plains: Pocasset River, Pawtuxet River Main Stem, Meshanticut Brook, Furnace Hill Brook, Spectacle Pond, and Spring Lakes. The final two geographic areas are the two neighborhoods of Pawtuxet Village and Edgewood, which are within the coastal flood zone.

Table 10 displays potential damage estimates of property improvement values within the City's 500 year flood plain. Property improvements include structures such as homes and sheds, as well as landscaping and signage. The only limitation noted, using the best available data, is that the tax assessor database does not reflect the current market value of real estate. The table categorizes the improvement values into: residential, commercial/industrial, governmental and mixed use. The table also provides the percentage contribution of the area to the City's total flood plain parcels. This percentage was calculated in order to assist with identifying which areas are at greater risk. According to Table 10, the citywide total potential improvement damages for these flood plain areas are \$555,428,000. As reflected in the table, the areas with the largest percentage of parcels in flood plains are the Pocasset River (44.3%), the Pawtuxet River Main Stem (21.1%), and Furnace Hill and Meshanticut Brooks (24.3%). Coincidentally, these three areas have the highest potential dollar damages for total citywide improvements in flood plains. The table indicates that the Pawtuxet River Main Stem Flood Plain accounts for \$156,955,900 (28.3%) of the total improvements in flood plains; and the Pocasset River Flood Plain accounts for \$188,740,200 (34.0%) of the total improvements in flood plains. The sum of these two figures for total citywide improvements in floodplains is approximately triple the potential dollar damages in total improvements for the Furnace Hill and Meshanticut Brooks Flood Plain, which accounts for \$116,021,600 (20.9%) of the total citywide improvements in flood plains.

Further analysis of the City Tax Assessor's property improvement values, indicated the following facilities to be the most costly to replace in order of expense: state concerns, care facilities, sewerage treatment facilities, high-density residential properties within flood plains, historic resources, critical municipal hazard response facilities, schools within flood plains, Tennessee Gas Metering Station impacted properties, recreational facilities, marinas and private mooring facilities, and electrical facilities.

The state concerns within the City of Cranston relate primarily to the Pastore Center, which houses the State Correctional Complex, Medical Center, and the Rhode Island National Guard and RIEMA Headquarters. These concerns are susceptible to heavy rain, high winds, ice damage, and earthquakes. In the event RIEMA becomes non-operational, the states public response system to natural hazard events would be hindered. The total potential improvement damages for these facilities are \$756,850,400.

Currently, there are 6 public/assisted senior housing facilities, 7 private housing facilities, and 3 private nursing home facilities within the City. The special populations occupying these structures are particularly at-risk to natural hazard events such as high winds, excessive heat, and earthquakes, given the multistory nature of many of these structures. The total potential improvement damages for care facilities are \$66,670,400.

Of the 23 sewerage treatment facilities in Cranston, the Pettaconsett Sewage Treatment Facility and 14 pumping stations fall within the 500-year flood plain (see Appendix A – Critical Municipal Facilities). Flooding at these facilities exposes the potential for sewer backups due to large amounts of water infiltrating the piping system and overwhelming the capacity of the pumping stations. These 14 sewerage treatment facilities account for \$62,227,000 in total potential property improvement damages. Not surprising, the Pettaconsett Sewage Treatment Facility accounts for \$61,826,000 of the aforementioned total potential property improvement damages

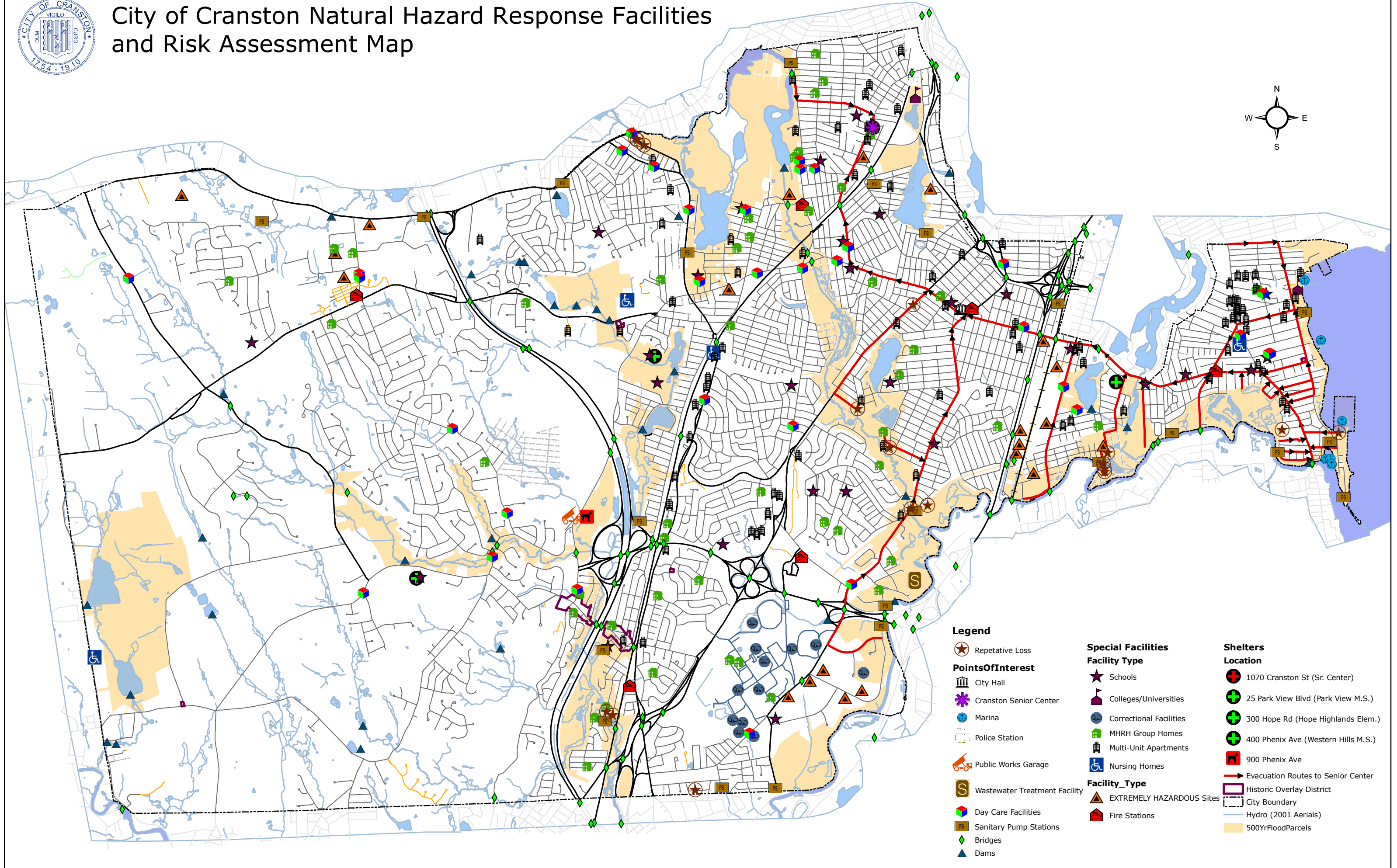
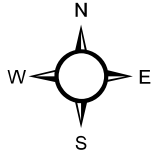
Within Cranston, 16 high-density residential properties serve as alternative housing facilities that contribute to the City's residential housing stock and account for \$66,465,000 in total potential property improvement damages. Fourteen of the high-density residential properties fall within the 500-year flood plain. Not in a flood plain, yet still a concern, is Springfield Apartments because part of the foundation is situated on a rock wall revetment. In the event of an earthquake, this rock wall revetment could become a serious hazard. Springfield Apartments accounts for \$13,789,600 of the aforementioned total potential property improvement damages.

The City has three National Historic Districts and a number of structures on the National Register of Historic Places that could be impacted by natural hazard events (see Appendix D – Inventory of Historic Properties). The total potential improvement damages are \$63, 324,600. The Pawtuxet Village National Historic District is the largest historic district within the City and contains 137 contributing parcels. The estimated potential improvement damages for the Pawtuxet Village National Historic District are





# City of Cranston Natural Hazard Response Facilities and Risk Assessment Map



\$39,646,100. The Oak Lawn Village National and Local Historic District is the second largest historic district within the City and contains 41 contributing parcels. The estimated potential improvement damages for the Oak Lawn Village National and Local Historic District are \$8,563,600. The Furnace Hill Brook National Historical and Archeological District is the smallest historic district within the City and has four contributing parcels. The estimated potential improvement damages for the Furnace Hill Brook National Historic District are \$333,400.

Currently, the City has 12 critical municipal hazard response facilities. These facilities include city hall, the fire department/emergency management headquarters, five additional fire stations, the police department, the public works garage, the Hamilton Building, three ARC approved shelters, and the RIEMA evacuation routes (see Appendix A – Critical Municipal Facilities). However, due to their unique response capacity, only seven of these facilities and the Ocean Avenue – Narragansett Boulevard Evacuation Route had their total potential improvement damage value calculated. The total potential improvement damages were estimated to be \$36,042,100.

Of the 26 public education facilities in Cranston, 3 of these facilities fall within the 500-year flood plain (see Appendix B – School Inventory). Those schools include George J. Peters, Oak Lawn, and the Cranston West Vocational Facility. The total potential improvement damages are \$8,090,400.

The Tennessee Gas Pipeline Gatehouse Metering Station poses an additional concern to the City. The Gatehouse is located at 65 Laten Knight Road and is an above ground processing facility for a major gas transmittal line servicing New England. In the event of an earthquake, because of the presence of natural gas, it is extremely important to keep this facility isolated due to the potential for explosion and threat to life. To estimate the potential dollar damages in the event of a blast originating from the Gatehouse, GIS was utilized to create a 1000' impact zone. Within this zone there would be approximately 31 parcels damaged and the total potential improvement damages could climb as high as \$4,842,400.

Within Cranston, 4 recreational facilities were highlighted as resources of concern and include the CLCF, Budlong Pool, Cranston Stebbins Stadium, and the Cranston Veterans Ice Rink. Currently, the CLCF and Budlong Pool fall within the 500-year flood plain. Cranston Stebbins Stadium and the Cranston Veterans Ice Rink were highlighted because of the possibility of high wind, ice damage, or even an earthquake. The total potential improvement damages to these four structures are \$1,737,500.

The coastline of Cranston, close to three miles in length, is the home of five marinas containing 405 slips. In addition, there are 137 moorings within the City. Excluding vessels, the total potential improvement damages are \$1,366,600.

The area bounded by Plainfield Pike to the north, Town of West Warwick to the south, Interstate 295 to the east, and Seven Mile Road to the west, is commonly referred to as the "Western Cranston Water District" or the WCWD. This district is currently provided with water through one singular distribution main at South Comstock Road running between Fox Ridge and Tomahawk Trail. If that main were to rupture due to an earthquake, approximately one-third of the City would be without water. The total potential improvement damages are \$375,000. This figure was derived from the cost to provide a secondary source for water service by connecting a 1900' gap in service mains.

Lastly, National Grid has a substantial number of general transmission lines running throughout the City and six electrical substations. Although National Grid services these general transmission lines and substations, the total potential improvement damages for the six electrical substations are \$ 58,700. In reviewing this section, the CHMC would note that the \$58,700 identified as the potential for damages represents only the structures on site. The CHMC recognizes that there is substantial value associated with the equipment on site. However, cost estimates are not readily available and will be added into the HMP as they are obtained.

If a natural hazard event were to occur, the improvement damages and the fiscal impacts to the City could be crippling. Approximately 75 percent of the City's revenue is generated from property tax (76 percent from residential and 24 percent from commercial). Should any of the tax base be destroyed by a natural disaster, remaining property owners would carry an increased financial burden with regards to property taxes. Therefore, it is in the best interests of the City of Cranston to take the appropriate provisions necessary to protect both persons and property from natural disasters. In addition, as Cranston's population continues to grow, so does the burden of protecting people and property.<sup>21</sup>



**Table 10: Assessment of Property Improvement Values within Flood Plains**

<b>Pawtuxet Watershed</b>												
			Residential		Commercial		Mixed Use		Governmental		Total	
<i>Floodplain</i>	Parcels	%	Improvements	%	Improvements	%	Improvements	%	Improvements	%	Improvements	%
Pocasset	939	44.3	\$118,833,100	44.5	\$49,220,600	36.9	\$1,748,400	43.8	\$18,938,100	12.5	\$188,740,200	34.0
Pawtuxet	448	21.1	\$34,681,500	13	\$45,991,000	34.5	\$1,336,800	33.5	\$74,946,600	49.5	\$156,955,900	28.3
Spectacle Pond	214	1	\$1,108,700	0.4	\$20,350,200	15.3	\$0.00	0	\$23,800	0.00%	\$21,482,700	3.9
Spring Lake	4	0.2	\$238,000	0.1	\$0.00	0	\$0.00	0	\$250,000	0.2	\$488,000	0.1
Furnace Hill Meshanticut Brooks	515	24.3	\$68,523,600	25.7	\$10,906,900	8.2	\$0.00	0	\$36,591,100	24.2	\$116,021,600	20.9
<b>Subtotal</b>	<b>1927</b>	<b>90.9</b>	<b>\$223,384,900</b>	<b>83.7</b>	<b>\$126,468,700</b>	<b>94.9</b>	<b>\$3,085,200</b>	<b>77.2</b>	<b>\$130,749,600</b>	<b>86.4</b>	<b>\$483,688,400</b>	<b>87.1</b>
<b>Coastal Areas</b>												
			Residential		Commercial		Mixed Use		Governmental		Total	
<i>Floodplain</i>	Parcels	%	Improvements	%	Improvements	%	Improvements	%	Improvements	%	Improvements	%
Edgewood	100	4.7	\$20,466,700	7.7	\$6,461,100	4.8	\$0.00	0	\$20,466,700	13.5	\$24,345,100	4.4
Pawtuxet Village	93	4.4	\$23,054,200	8.6	\$313,700	0.2	\$909,100	22.8	\$68,100	0.1	\$71,739,600	8.5
<b>Subtotal</b>	<b>193</b>	<b>9.1</b>	<b>\$43,520,900</b>	<b>16.3</b>	<b>\$6,774,800</b>	<b>5.1</b>	<b>\$909,100</b>	<b>22.8</b>	<b>\$20,534,800</b>	<b>13.6</b>	<b>\$71,739,600</b>	<b>12.9</b>
<b>Total</b>	<b>2120</b>	<b>100</b>	<b>\$266,905,800</b>	<b>100</b>	<b>\$133,243,500</b>	<b>100</b>	<b>\$3,994,300</b>	<b>100</b>	<b>\$20,534,800</b>	<b>100</b>	<b>\$555,428,000</b>	<b>100</b>

Source: City of Cranston Department of Tax Assessors Database, 2010.

Note: The values contained in the tax assessor's database do not reflect the current market value of real estate.

### 3.4 Population Impact Analysis

In order to estimate the number of City residents impacted by natural hazard events, the number of occupied dwelling units was multiplied by the average household size per occupied dwelling unit (2.54).<sup>22</sup> This approach was utilized throughout this population analysis.

According to Table 11, using the Tax Assessor's Database and the City's GIS, there are total of 3,010 occupied dwelling units within city flood plain areas. Based on this figure, the estimated population within city flood plains is 7,726, which is slightly greater than 9% of the city's population.

In addition, according to Table 11, an estimated 6,070 (87.7%) residents live within the Pawtuxet River flood plain with, 3,789 (49.7%) residents located in the Pocasset River flood plain, 1,447 (19.0%) residents located in the Pawtuxet River Main Stem flood plain and 1,447 (19%) residents located in the Furnace Hill and Meshanticut Brooks flood plain.

Furthermore, based on Table 11, an estimated 1,020 (12.3%) residents live in the City's coastal flood zone flood plain area.

The Providence Water Supply Board holds 3,406 residential accounts in western Cranston that are served by the singular distribution main at South Comstock Road. The at-risk population was estimated to be 8,651, which is slightly more than 10% of the entire Cranston population.

The occurrence of a natural hazard event creates a higher potential for the special populations at the Pastore Center to be rendered vulnerable due to higher security and health concerns. The population at this state institution center was reported at 4,051 in the 2000 US Census.<sup>25</sup>

Currently, there are 1,435 occupied dwelling units within the sixteen high-density residential properties, including the Johnson & Wales dormitories, located in the City. The high-density residential properties at-risk population was estimated to be 3,611. Excluding Springfield Apartments (which is not within a flood plain) the population estimated to be at-risk is 3,096.

The fifteen care facilities in the City have a total capacity of 1,545 residential units. Assuming a one person-per unit occupancy rate, the population at these facilities has been estimated at 1,545.

The three public schools that are within the City flood plain areas are George J. Peters, Oak Lawn, and the Cranston West Vocational Facility. In the event of a natural hazard as many as 2,270 students could be displaced from these schools. [Note the Cranston School Department does not count Cranston West and Cranston West Vocational enrollments separately. Students share classes at both campuses.]

Approximately 31 parcels are located the 1000' impact zone of the Tennessee Gas Pipeline Gatehouse Metering Station with an estimated 79 residents to be considered at-risk.

The final two facilities of concern for which at-risk population estimates were developed for included the sewerage treatment facilities, and the general transmission lines and six electrical substations. These estimates project worst-case scenarios. Therefore, considering that the sewerage treatment facilities serve 22,870 residential units, the appropriate calculation yields 58,090 at-risk residents. With regard to the general transmission lines and the six electrical substation facilities that serve the City of Cranston, the entire 81,686 city population is classified as at-risk.

Lastly, at-risk population estimates could not be developed for historic resources, critical municipal hazard response facilities, recreational facilities, and marinas and private mooring fields. Therefore, the analysis classifies the at-risk population as not available.

**Table 11: Population Living within Flood Plains**

Pawtuxet River			
Flood Plain Area	Occupied Units	Population	%
Pocasset River	1492	3789	49.7
Pawtuxet River	570	1447	19
Furnace Hill Brook & Meshanticut Brooks	570	1447	10
Spectacle Pond	8	20	0.6
Spring Lake	1	3	0.1
<b>Subtotal</b>	<b>2640</b>	<b>6707</b>	<b>87.7</b>
Pawtuxet Village	183	545	6.1
Edgewood	187	475	6.2
<b>Subtotal</b>	<b>370</b>	<b>1020</b>	<b>12.3</b>
<b>City Wide Total</b>	<b>3010</b>	<b>7726</b>	<b>100</b>

Source: City of Cranston GIS and Tax Assessor's Database. 2010.

### 3.5 Level of Risk Determination

Determining the City's level of risk from natural hazards was completed through a combined ranking, of the fiscal and population impacts for each of the 14 resources of concern (see Table 12). These rankings were then divided into high, medium, and low categories using a quantile approach.

The statistical rankings were then analyzed to determine if additional non-numerical factors should be adjusted for. In the end, the classifications for the state concerns, the WCWD, schools, critical municipal response facilities, and historic resources were adjusted.

The state concerns were downgraded from a high classification to a medium, because the administration and management of the Pastore Center falls under the control of the State. The WCWD concern was downgraded from a medium classification to a low, because the historical analysis of earthquake occurrences proved it to have a low probability. Schools concern was downgraded from a medium classification to a low because schools are likely to be closed during a major storm event. Historic concern was downgraded from a medium classification to a low because the low probability that all historic resources would be affect by any one event. Critical municipal hazard response facilities were upgraded from a low classification to a medium, because they are key for coordinating a strong governmental response to a natural hazard event.

**Table 12: Level of Risk Determination**

Risk	Fiscal Impacts		Population Impacts		Combined	Classification	
	Damages	Ranking	Population	Ranking		Initial	Final
Flood Prone Drainage Systems	\$555,428,000	12.5	7,726	10.5	23.0	High	High
Dams	N/A	12.5	N/A	10.5	23.0	High	High
Sewage Treatment Facilities	\$62,227,000	9	58,090	13	22.0	High	High
State Concerns	\$756,850,400	14	4,051	9	23.0	High	Medium
Care Facilities	\$66,670,400	11	1,545	6	18.0	High	High
High Density Residential	\$13,789,600	7	3,096	8	15.0	Medium	Medium
Electrical Facilities	\$58,700	1	81,686	16	17.0	Medium	Medium
Western Cranston Water District	\$375,000	2	8,651	12	14.0	Medium	Low
Schools	\$8,090,400	6	2,270	7	13.0	Medium	Low
Historic Resources	\$63,324,600	10	N/A	2.5	12.5	Medium	Low
Tennessee Gas Pipeline	\$4,842,400	5	79	5	10.0	Low	Low
Critical Municipal Response Facilities	\$36,042,100	8	N/A	2.5	10.5	Low	Medium
Recreational Facilities	\$1,737,500	4	N/A	2.5	6.5	Low	Low
Marias & Private Mooring Facilities	\$1,366,600	3	N/A	2.5	5.5	Low	Low
			Mean	15	High Quartile Range= 23 to 17.2		
			Cut Points	5.8	Medium Quartile Range= 17.1 to 11.3		
			Low Quartile Range= 11.2 to 5.4				

### 3.6 Vulnerability of Future Structures

A preliminary buildout analysis produced by the Cranston Planning Department projects that the potential exists for an additional 2760 residential, 231 commercial, and 84 industrial units to be constructed within the city over the years to come. Whereas all of these may be at risk to hazards such as earthquakes, hail, hurricanes, lightning, tornados, severe winter storms, high wind events and thunderstorms; the possibility does exist for 551 residential, 21 commercial, and 9 industrial units to be developed specifically within flood zones. The CHMC has reviewed the build out analysis and has determined that, given the significant downturn in the economy since 2005, the assumption and conclusions of the buildout analysis remain unchanged.

### 3.7 Risk Assessment Matrix

The matrix (Table 13: Risk Assessment and Identification of Priority Problems in Cranston) represents the culmination of the risk assessment process and is the final product. Its purpose is to gather all the pertinent results in one place for ease of presentation and to serve as a starting point for discussion of specific mitigation actions. It not only lists the specific concerns, but provides detailed location information, summarizes the applicable hazard, problem, mitigation benefits, and the perceived level of risk.

Table 13: Risk Assessment Matrix							
RISK	LOCATION		HAZARD	PROBLEM	BENEFITS	LEVEL OF RISK:	2010 REVIEW
I. Flood Prone Drainage Systems	<div>A. <u>Pocasset River Flood Plain</u><div><div>1. Fletcher Avenue Industrial Park Area - Regularly floods from Plainfield Pike (State Highway), southerly along Fletcher Avenue (State Highway) to approximately Tabor Street including bridge number 8101 (A.P. - 12/1 and 12/2).</div><div>2. Lower Eden Park Neighborhood - Area of concern lies between Reservoir Avenue and Pontiac Avenue northeast of the Pocasset River including Davis Court, Autumn Street, and Fordson Avenue (A.P. 9/1).</div><div>3. Garden City Neighborhood - Area of concern lies primarily along Lawnacre Drive between Reservoir Avenue (State Highway) and Pontiac Avenue (State Highway) on the southerly section of the Pocasset River including bridge numbers 2301, 20101, and 75801 (A.P. - 9/1, 9/2, and 10/2).</div><div>4. Upper Eden Park Neighborhood - Area of concern lies between Reservoir Avenue (State Highway) and Pontiac Avenue (State Highway), northeast of the Pocasset River including Aqueduct Road, Delway Road, Interavale Road, and Longway Road (A.P. 9/2).</div><div>5. Park Avenue Area - Floods in the vicinity of Old Park Avenue including bridge numbers 48001 and 49401 (A.P. - 11/1).</div><div>6. Cranston Print Works Area - Area of concern is bounded by the Pocasset Cemetery to the north, Dyer Avenue to the east, the Dyer Avenue Industrial Park to the south and Southern Street to the west including bridge number 99501 (A.P. - 8/1, 8/2, 8/3, 8/4, and 8/5).</div><div>7. Pontiac Avenue Area – The apartment complex located at 825 Pontiac Avenue (A.P. 9 Lot 149).</div><div>8. Pontiac Avenue Area – The City’s sewer pump station located at 900 Pontiac Avenue (A.P. 5 Lot 1). This pump station process over 75% of the City’s sewerage flows.</div></div><div>B. <u>Meshanticut Brook Flood Plain</u><div><div>1. Meshanticut Area - Primary area of concern is the flooding that occurs on Wilbur Avenue including Burdick Drive, Redfern Drive, Amanda Court, Rodel Street, Clay Street, Warren Avenue, Ellison Street, and Benjamin Avenue, including bridge numbers 42401 and 2401, and culvert number 81901(A.P. – 18/2, 18/3, and 18/4).</div><div>2. Meshanticut Brook Culvert System - This is the largest culvert system in the City of Cranston and is located beneath Interstate 295 and Route 37, and includes culvert numbers 81221, 81401, 81421, 81501, 81601 and 81701 (A.P. - 18/1, 18/2, 18/4, 19/1, and 19/3).</div></div><div>C. <u>Furnace Hill Brook Flood Plain</u> - Natick Avenue floods in the vicinity of Furnace Hill Brook including bridge number 42401, a bridge on Phenix Avenue and a bridge on Hope Hill Terrace, and culvert number 81801 (A.P. - 19/1, 21/2, and 25/3).</div><div>D. <u>Pawtuxet River Flood Plain (Main Stem)</u><div><div>1. Elmwood Area - Floods occur on Wellington Avenue including bridge number 101, specifically in the vicinity where the Amtrak main line bridge crosses over the Pawtuxet River and intersects with Elmwood Avenue (State Highway) (A.P. - 4/2 and 5/3).</div><div>2. Parkview Area - Floods occur at Perkins Avenue including bridge numbers 15001 and 19001, a private footbridge and private abandoned bridge on Mill Street (A.P. - 1, 4/3 and 4/5).</div><div>3. Pontiac Av enue Area – Floods occur at the City’s sewer treatment facility located of off Pontoace Avenue at 140 Pettaconsett Avenue (A.P. 10 Lot 27).</div></div><div>E. <u>Pawtuxet Coastal Flood Zone</u> - Floods occur at Ocean Avenue after the intersection with Commercial Street, and on Narragansett Boulevard in the vicinity of Stillhouse Cove (A.P. - 1 and 2/2).</div><div>F. <u>Spectacle Pond Flood Plain</u> - Floods occur at the end of Lake Street in the vicinity of a small culvert (A.P. - 7/5).</div><div>G. <u>Auburn Area</u> - Garden Street has a drainage issue before intersection at Laurens Street (A.P. - 5/1).</div><div>H. <u>Spring Lakes Flood Plain</u> - Bridge number 99601 carries Seven Mile Road over Clark Brook, and bridge number 84201carries Hill Street in Coventry over the Pawtuxet River to Main Street in Cranston (A.P. - 30/1).</div><div>I. Rhode Island State Roads 2 and 5.</div><div>Source: Bridge and culvert data provided by David DeNuccio, Cranston Engineering Dept., 06/27/2003. (See Appendix C: Inventory of All Bridges and Culverts).</div></div></div></div>		<div>Primary concern is for flooding related to heavy rain and storm surge events. A secondary concern relates to potential earthquake damage to bridges and culverts.</div>	<div>These drainage systems have historically flooded and face a higher potential than other areas in Cranston for future flooding. Flood events of 3 to 4 inches over a 24-hour period have the potential to hinder physical access in and out of these areas, disrupt utility service, cause real property damage, and threaten life.</div> <div>Total potential improvement damages are \$555,428,000 and the total potential population at-risk is 7,727.</div> <div>(See Section 3.3 and 3.4 for more detailed discussion).</div> <div>The estimated potential improvement damages for the Pocasset River are \$188,740,200 and the estimated at-risk population is 3,785.</div> <div>The estimated potential improvement damages for Meshanticut Brook and Furnace Hill Brook are \$116,021,777 and the estimated at-risk population is 1,447.</div> <div>The estimated potential improvement damages for the Pawtuxet River Main Stem are \$156,955,900 and the estimated at-risk population is 1,447.</div> <div>The estimated potential improvement damages for the Coastal Flood Zone are \$116,021,700 and the estimated at-risk population is 1,020.</div> <div>The estimated potential improvement damages for Spectacle Pond are \$21,482,700 and the estimated at-risk population is 20.</div> <div>The estimated potential improvement damages for Spring Lakes are \$488,000 and the estimated at-risk population is 3.</div>	<div>Protection of property, reduction of cleanup and repair costs, and insurance losses. Improved physical access and the protection of life and public safety.</div> <div>The Pocasset River Flood Plain Management Study, conducted by NRCS, produced a 1.07 benefit/cost ratio for the area of Cranston within the Pocasset River Flood Plain. The total estimated benefits (\$15,895,391) reflect reduced flood damages as a result of installing flood prevention measures. The benefits are net of project administration costs and operation and maintenance costs. The total estimated costs (\$14,856,180) represent the installation costs for planned flood control measures</div>	High	<div>This section has been reviewed and updated to reflect current conditions.</div> <div>The CHMC has determined that the Hazard, Benefits &amp; Risk identified in the 2005 Plan are unchanged.</div> <div>The CHMC also determined that there are additional areas of flooding that require study and mitigation. These are: Lake Street, Randall Street at Atwood Avenu, and Cranston Street at Haven Street.</div>
II. Dams	<div>A. ANGELL'S POND</div> <div>B. ARROW LAKE #1</div> <div>C. ARROW LAKE #2</div> <div>D. BELLEFONTE POND</div> <div>E. CLARKE'S POND UPPER</div> <div>F. COLVIN POND</div> <div>G. CRANSTON BRAID MILL POND</div> <div>H. CRANSTON PRINT WORKS POND</div> <div>I. CURRAN LOWER RESERVOIR</div> <div>J. CURRAN UPPER RESERVOIR</div> <div>K. DELFINO'S POND</div> <div>L. FEDOROWICZ FARM POND</div> <div>M. FENNER POND</div> <div>N. FERRY POND</div> <div>O. MARSELLA FARM POND</div> <div>P. MESHANTICUT PARK POND</div> <div>Q. POWERS POND</div> <div>R. R.I. PRINTWORKS POND</div> <div>S. SARGENT'S POND</div> <div>T. SPECTACLE POND</div> <div>U. STONE POND</div> <div>V. WOOD'S MILL POND</div> <div>W. CONFREDA</div> <div>SEE APENDIX -----FOR DESCRIPTION OF THE DAMS.</div>		<div>Flooding related to heavy rain events, and structural damage due to earthquake.</div> <div>Deterioration due to lack of ongoing maintenance</div>	<div>Extreme rain and earthquake events have the potential to cause structural failure resulting in catastrophic flooding.</div> <div>Calculation of potential improvement damages and populations at-risk is impractical for the City at this time.</div>	<div>Structural preservation preventing catastrophic flooding, reducing property loss and protecting public health, safety, and welfare.</div>	High	<div>This section has been reviewed and updated to reflect current conditions.</div> <div>The CHMC has determined that the Hazard, Problem, Benefits &amp; Risk identified in the 2005 Plan are unchanged.</div>

RISK	LOCATION	HAZARD	PROBLEM	BENEFITS	LEVEL OF RISK	2010 REVIEW
III. Care Facilities	<p>A. <u>Public/Assisted Senior Housing</u></p> <ol style="list-style-type: none"> <li>Randall Manor - 175 Mathewson Street - 168 units (A.P. - 8/1 Lot 328).</li> <li>Jennings Building - 125 Harris Avenue 152 units (A.P. - 7/1 Lot 787).</li> <li>Arlington Manor - 50 Birch Street - 151 units (A.P. - 7/1 Lot 787).</li> <li>Knightsville Manor - 85 Briggs Street - 99 units (A.P. - 11/2 Lot 232).</li> <li>Hall Manor - 70 Warwick Avenue - 79 units (A.P. - 2/5 Lot 3962).</li> <li>Budlong Manor - 100 Arthur Street - 71 units (A.P. - 5/2 Lot 2556).</li> </ol> <p>B. <u>Private Housing</u></p> <ol style="list-style-type: none"> <li>Scituate Vista – private/assisted senior housing – 125 Scituate Vista Drive - 233 units (A.P. - 20/2 Lot 2170).</li> <li>Meshanticut Vista – private/assisted senior housing - 225 New London Avenue 99 units (A.P. - 10/3 Lot 666).</li> <li>Park Avenue Apartments – private/assisted housing - 315 Park Avenue - 71 units (A.P. - 3/1 Lot 1011).</li> <li>Victoria Court - private/assisted senior housing - 55 Oaklawn Avenue - 43 units (A.P. - 11/3 Lot 1856).</li> <li>Harris House - private/assisted senior housing - 28 Harris Avenue - 60 units (A.P. - 7/2 Lot 3142).</li> <li>Scandinavian Retirement Home - private/assisted senior housing - 50 Warwick Avenue - 35 units (A.P. - 2/5 Lot 1334)</li> <li>New Life Estates, Inc – private handicapped housing -20 Phenix Avenue – 12 unites (A.P. 11 Lot 4077)</li> </ol> <p>C. <u>Private Nursing Homes</u></p> <ol style="list-style-type: none"> <li>Cedar Crest – private nursing facility - 125 Scituate Avenue - 99 units (A.P. - 37/4 Lot 611).</li> <li>Cra-Mar – private nursing facility -575 Seven Mile Road - 40 units (A.P. - 30/2 Lot 213).</li> <li>Scandanavian Home – private nursing facility - 1811 Broad Street - 30 rooms with 130 beds (A.P. - 2/5 Lot 1335).</li> </ol> <p><i>Source: Sal Saccoccio, Cranston Tax Assessor's Aide Technician; Tony Vecchio, Cranston Deputy Tax Assessor, 06/20/2003; Anthony Conti, Cranston Housing Authority Maintenance Supervisor, 07/08/2003.</i></p>	High winds, excessive heat events, as well as concerns for earthquakes given the multistory nature of many of the structures.	<p>These care facilities play a vital role in housing Cranston's elderly and handicapped populations. The occurrence of a natural hazard event creates a higher potential for these special populations to become vulnerable due to their reduced mobility, thus placing their lives and living quarters in danger.</p> <p>Total potential improvement damages are \$66,670,400 and the total potential population at-risk is 1,545.</p> <p>The estimated potential “Public/Assisted Senior Housing” at-risk population is 720. The estimated potential “Private Housing” at-risk population is 570. The estimated potential “Private Nursing Homes” at-risk population is 269.</p>	Protection of life.	High	<p>This section has been reviewed and updated to reflect current conditions.</p> <p>The CHMC has determined that the Hazard, Problem, Benefits &amp; Risk identified in the 2005 Plan are unchanged.</p>
IV. Critical Municipal Hazard Response Facilities	<p>A. <u>Municipal Offices</u></p> <ol style="list-style-type: none"> <li>Cranston City Hall - 869 Park Avenue (A.P. - 6/2 Lot 240)</li> <li>Cranston Fire Department Headquarters/ Cranston Emergency Management Agency Headquarters - 301 Pontiac Avenue (A.P. - 6/2 Lot 260).</li> <li>Cranston Police Station –5 Garfield Avenue (A.P. - 7 Lot 3873).</li> <li>Cranston Public Works Garage – 929 Phenix Avenue (A.P. - 17/1 Lot 200).</li> <li>Cranston Building Inspection and Engineering Department – 1090 Cranston Street (A.P. 7 Lot 2630).</li> </ol> <p>B. <u>American Red Cross Approved Emergency Shelters</u></p> <ol style="list-style-type: none"> <li>Cranston Senior Services Center – 125-person capacity, 1070 Cranston Street (A.P. - 7/4 Lot 2371).</li> <li>Western Hills Middle School – 250-person capacity, 400 Phenix Avenue (A.P. - 17/2 Lot 1810).</li> <li>Park View Middle School – 378-person capacity, 25 Park View Boulevard (A.P. - 4/4 Lot 1400).</li> <li>Hope Highland Elementary School – 1555 Scituate Avenue (A.P. 34 Lot 8).</li> <li>Cranston Youth Center – 155 Gansett Avenue (A.P. 11 Lot 2984).</li> </ol> <p>C. <u>Ocean Avenue - Narragansett Boulevard Evacuation Route</u></p> <p><i>Source: A.R.C. approved emergency shelter capacities provided by Robert Warren, Chief of the Cranston Fire Department, 05/14/2003. (See Appendix A: Critical Municipal Facilities.)</i></p>	Depended upon for responding to all natural hazard events.	<p>Potential loss of physical access, power supply and critical systems, thus hindering the governmental response to natural hazard events. The Cranston Emergency Management Agency is the command center; Cranston's communication tower and facilities are located at the police station and Cranston's heavy-duty response machinery such as backhoes and loaders are stored at the public works facility.</p> <p>The emergency shelters are critical in protecting the lives of Cranston residents. However, Cranston faces a shortage of space with an anticipated evacuation population of 1640 under a 500-year storm, and a shelter capacity for only 753. In addition, there is a need to upgrade the existing shelters to make them more habitable during emergencies.</p> <p>Ocean Avenue and Narragansett Boulevard, in the vicinity of Stillhouse Cove, are primary evacuation routes for the coastal portions of the City. In the event of hurricanes and high wind hazards, these evacuation routes face a serious threat of failure due to wind and wave induced erosion.</p> <p>Total potential improvement damages are \$36,042,100.</p> <p>Population impacts do not apply here, since the properties of concern are not residential in nature.</p>	Protection of essential public services, records, evacuation routes, and the general livelihood of Cranston residents and their property.	Medium	<p>This section has been reviewed and updated to reflect current conditions.</p> <p>The CHMC has determined that the Hazard, Problem &amp; Benefits identified in the 2005 Plan are unchanged.</p> <p>Risk has been changed to medium.</p>
V. Sewerage Treatment Facilities	<p>A. <u>Pettaconsett Sewage Treatment Facility</u> -Pettaconsett Avenue (A.P. - 10/2 Lot 27)</p> <p>B. <u>Pumping Stations within Flood Plain</u></p> <ol style="list-style-type: none"> <li>Allard Pumping Station – Historically has flooded. 85 Allard Street (A.P. - 18/4 Lot 692).</li> <li>Randall Street Pumping Station – Historically has flooded. 176 Randall Street (A.P. - 12/4 Lot 2825).</li> <li>Seaview Avenue Pumping Station – Pumping station within velocity zone. 85 Seaview Avenue (A.P. - 1 Lot 496).</li> <li>Bay View Avenue Pumping Station – 9 Bay View Avenue (A.P. - 2/3 Lot 2769).</li> <li>Dyer Avenue Pumping Station - 399 Dyer Avenue (A.P. - 8/4 Lot 2691).</li> <li>Hollow Tree Pumping Station – 1771 Pontiac Avenue (A.P. - 15/3 Lot 1577).</li> <li>Howard Pumping Station – 103 Kenney Drive (A.P. - 10/4 Lot 1466).</li> <li>Sheldon Street Pumping Station – 115 Sheldon Street (A.P. - 1 Lot 82).</li> <li>Sherman Avenue Pumping Station – 90 Sherman Avenue (A.P. - 17/3 Lot 1822).</li> <li>Woodbury Road Pumping Station - 110 Woodbury Road (A.P. - 1 Lot 467).</li> <li>Worthington Road Pumping Station – 54 Worthington Road (A.P. - 10/4 Lot 767).</li> <li>Youlden Avenue Pumping Station - 7 Youlden Avenue (A.P. - 4/3 Lot 822).</li> <li>Pontiac Pumping Station – 900 Pontiac Ave (A.P. 5 Lot 1)</li> <li>Mayflower Pump Station – 140 Mayflower Dr. (A.P. 4 Lot 5).</li> </ol> <p><i>Source: Jack McGilhray, Cranston Public Works Aide, 05/06/2003. Historical natural hazard events provided by William Wilbur, Collection Supervisor for Veolia Water, 5/14/2003. (See Appendix A: Critical Municipal Facilities).</i></p>	Flooding resulting from heavy rain events or coastal storm surge.	<p>Flooding at these facilities causes two distinct problems. First, there is the potential for sewer backups due to large amounts of storm water infiltrating the piping system and overwhelming the capacity of pumping stations. Second, there is a potential for sewer backups due to short-circuiting of pumping equipment caused by overland flooding of pumping stations themselves.</p> <p>Total potential improvement damages are \$62,226,000.</p> <p>There are 22,870 residential units connected to the sewer system. This figure multiplied by the 2.54 average household size per occupied dwelling unit, indicates the total potential at-risk population is 58,090 dependents. This figure accounts for 71% of the City population.</p>	Reduced cleanup and repair costs and protection of public welfare through the elimination of a potential health concern.	High	<p>. This section has been reviewed and updated to reflect current conditions.</p> <p>The CHMC has determined that the Hazard, Problem, Benefits &amp; Risk identified in the 2005 Plan are unchanged.</p>

RISK	LOCATION	HAZARD	PROBLEM	BENEFITS	LEVEL OF RISK	2010 REVIEW
VI. High-density Residential Properties within Floodplains	A. <u>Willow Brook Apartments</u> - 825 Pontiac Avenue - 252 units (A.P. - 9/1 Lot 149). B. <u>Riverbend Apartments</u> - 575 Dyer Avenue - 168 units (A.P. - 8/3 Lot 999). C. <u>Johnson and Wales Hospitality Center</u> – 1150 Narragansett Boulevard - 134 units (A.P. - 2/3 Lot 681). D. <u>Pocasset Apartments</u> - 941thru 945 Dyer Avenue -120 units (A.P. - 11/1 Lot 3586). E. <u>Garden Village Apartments</u> - 935 Pontiac Avenue - 95 units (A.P. - 10/2 Lot 4). F. <u>Western Hills Village Apartments</u> - 2 thru 7 Western Hills Lane - 84 units (A.P. - 12/6 Lot 2945). G. <u>Farmington Terrace Apartments</u> - 151 Farmington Avenue - 56 units (A.P. - 8/4 Lot 14). H. <u>Riverview Acres Apartments</u> - 130 Fordson Avenue - 48 units (A.P. - 9/1 Lot 145). I. <u>Rosedale Landings</u> - 1180 Narragansett Boulevard - 34 units (A.P. - 2/3 Lot 1912). J. <u>King Philip Arms Apartments</u> - 2015 Broad Street - 24 units (A.P. - 2/6 Lot 2595). K. <u>Aqueduct Apartments</u> - 292 Aqueduct Road - 17 units (A.P. - 9/2 Lot 2736). L. <u>Harbor Apartments</u> - 1224 Narragansett Boulevard - 11 units (A.P. - 2/3 Lot 2757). M. <u>Bellevue Apartments</u> - 100 Arcadia Avenue - 8 units (A.P. - 4/4 Lot 1230). N. <u>Conetta's Trailer Park</u> - 443 Dyer Avenue - 20 trailers (A.P. - 8/4 Lot 844). O. <u>Johnson and Wales Dormitories</u> - 100 Harborside Boulevard - 148 Student units /576 beds (A.P. 2 Lots 3974, 3935, 3949) P. <u>Springfield Apartments</u> - 100 Elena Street - 216 units (A.P. - 12/3 Lot 2429). <i>Not in a floodplain but part of foundation is situated on a rock wall revetment.</i>  <i>Source: Sal Saccoccio, Cranston Tax Assessor's Aide Technician; and Tony Vecchio, Cranston Deputy Tax Assessor, 06/20/2003</i>	Flooding from heavy rain, as well as concerns for earthquakes given the multistory nature of many of the structures	These alternative housing facilities contribute to Cranston's high residential housing stock. The occurrence of a natural hazard event creates a threat to life and property damage.  Total potential improvement damages are \$66,465,000 and the total potential at-risk population is 3,611.	Protection of life and the preservation of diverse and affordable housing stock.	Medium	This section has been reviewed and updated to reflect current conditions. The CHMC has determined that the Hazard, Problem, Benefits & Risk identified in the 2005 Plan are unchanged.
VII. Marinas and Private Mooring Facilities	A. <u>Edgewood Yacht Club</u> - 1 and 3 Shaw Avenue (A.P. - 2/2 Lots 866, 2852, and 4000). B. <u>Port Edgewood Marina</u> - 1128 Narragansett Boulevard (A.P. - 2/4 Lots 680, 1896, 1966, 2491, 2492, 2865, 3952, 3955, and 3993). C. <u>Pawtuxet Athletic Club</u> – 12 Aborn Street (A.P. - 1 Lots 26 and 27). D. <u>Rhode Island Yacht Club</u> – 1 Ocean Avenue (A.P. - 2/2 Lot 1678, 3793, and 3794). E. <u>Pawtuxet Cove Marina</u> - 8 Aborn Street and 69 Fort Avenue (A.P. - 1 Lots 28, 29, 88, and 91).	Flooding from heavy rain and coastal storm surge; high winds, and earthquake.	These marinas provide residents of Cranston places to go for recreational and leisure activity, as well as the occasional residence. The occurrence of a natural hazard event creates a threat to life and property damage. There currently exist 405 slips and 137 moorings within the City.  Excluding vessels, the total potential improvement damages are \$1,366,600. Estimates of vessel value and the number of live-boards is impractical at this time.	Protection of the lives of individuals who reside in the marinas. Reduced potential for property damage, as well as the provision of commercial and recreational water dependant activities	Low	This section has been reviewed and updated to reflect current conditions. The CHMC has determined that the Hazard, Problem & Benefits identified in the 2005 Plan are unchanged. Risk has been changed to low.
VIII. Electrical Facilities	A. <u>General Transmission Lines</u> B. <u>Substations</u> <ol style="list-style-type: none"> <li>Well Avenue Substation - Well Avenue (A.P. - 5/3 Lot 2538).</li> <li>Huntington Park Substation - Corner of Kenwood Street and Niantic Avenue (A.P. - 7/2 Lot 2581).</li> <li>Knightsville Substation - Corner of Park Avenue and Palmer Street (A.P. - 11/2 Lot 1754).</li> <li>Pontiac Substation - End of Ross Simon Drive (A.P. - 13 Lot 44).</li> <li>West Cranston Substation - Laten Knight Road approximately 500' west of Pippin Orchard Road (A.P. - 28 Lot 47).</li> <li>Elmwood Substation – 510 Wellington Avenue (A.P. – 3/3 Lot 508).</li> </ol> <i>Source: Steve Marin, Narragansett Electric Engineer, 4/29/2003</i>	High winds, ice damage, and earthquake.	High winds and ice damage resulting in falling objects breaking transmission lines and damaging substations.  Excluding the service population of 81,686 the total potential improvement damages for the electrical substations are \$58,700.	Provision of essential utility service, reduction in cleanup and repair costs, and the promotion of public health, safety, and welfare.	Medium	This section has been reviewed and updated to reflect current conditions. The CHMC has determined that the Hazard, Problem, Benefits & Risk identified in the 2005 Plan are unchanged.
IX. Schools within Floodplains	A. <u>Elementary Schools</u> <ol style="list-style-type: none"> <li><u>George J. Peters Elementary</u> - Historically has flooded. (Peters also doubles as a YMCA child daycare facility). 15 Mayberry Street - Grades K – 5 (A.P. - 12/4 Lot 3244).</li> <li><u>Oak Lawn Elementary</u> - 28 Stoneham Street - Grades K - 5 (A.P. - 18/4 Lot 692).</li> </ol> B. <u>Cranston West Vocational Facility</u> - 80 Metropolitan Avenue - Grades 9 - 12 (A.P. - 17/2 Lot 1956).  <u>Source: Historical natural hazard events provided by Joel Zisserson, Cranston School Department Director of Transportation, 07/02/2003 and 07/28/2010. €(See Appendix B: School Inventory and Appendix E: Inventory of Child Daycare Facilities).</u>	Flooding, resulting from a coastal storm surge or heavy rain, high winds, and earthquake.	These school facilities play a vital role in educating Cranston's youth. The occurrence of a natural hazard event creates a higher potential for students to be rendered vulnerable, thus placing their lives in danger. Furthermore, the physical structures themselves are put at-risk for severe property damage.  Total potential improvement damages are \$8,090,400.  The total enrollment for the three facilities is 2,270.	Provision of a safe and secure learning environment, as well as the protection of school infrastructure from property damage.	Low	This section has been reviewed and updated to reflect current conditions. The CHMC has determined that the Hazard, Problem & Benefits identified in the 2005 Plan are unchanged. Risk has been changed to low.

RISK	LOCATION	HAZARD	PROBLEM	BENEFITS	LEVEL OF RISK	
<b>X. State Concerns</b>	<p>A. <u>State Adult Correctional Institution Complex and Medical Center</u> – Pastore Center (A.P. - 13 Lot 39; A.P. - 14 Lots 4, 5, 6, 7, 8, 9, and 10; A.P. - 15-3 Lots 7, 19, 50; A.P. 15-4 Lot 1694).</p> <p>B. <u>Boys and Girls Training School</u> - Pastore Center (A.P. - 14 Lot 15).</p> <p>C. <u>Rhode Island National Guard Headquarters/ Rhode Island Emergency Management Agency (R.I.E.M.A.)</u> - 645 New London Avenue (A.P. - 15/4 Lot 1696).</p> <p>D. <u>State Bridges and Culverts</u> - not in Flood Prone Drainage System section of risk identification matrix.</p> <p><i>(See Appendix C: Inventory of All Bridges and Culverts)</i></p>	Heavy rain, high winds, ice damage, and earthquakes.	<p>The state institutions play a vital role in housing the State's handicapped, juvenile delinquent, and adult criminal facilities. The occurrence of a natural hazard event creates a higher potential for these special populations to be rendered vulnerable due to higher security and health concerns.</p> <p>In addition, the R.I.E.M.A. headquarters faces potential loss of physical access, power supply, loss of critical records and systems, thus hindering public response to natural hazard events.</p> <p>Total potential improvement damages are 756,850,400.</p> <p>According to the 2000 Census, the at-risk population within the State institutions is 4,051.</p>	Protection of life and state property, while maintaining high standards for security and potential health concerns. Reducing utility service interruption, repair, and cleanup, thus continuing the provision of essential public services and record maintenance.	Medium	This section has been reviewed and updated to reflect current conditions. The CHMC has determined that the Hazard, Problem & Benefits identified in the 2005 Plan are unchanged. Risk has been changed to medium.
<b>XI. Western Cranston Water District</b>	<p>A. <u>Public Drinking Water System</u> – The area bounded by Plainfield Pike to the north, Town of West Warwick to the south, Interstate 295 to the east, and Seven Mile Road to the west.</p> <p><i>Source: Marco Schiappa, Cranston Public Works Director, 05/06/2003. (See Appendix A: Critical Municipal Facilities).</i></p>	Earthquake.	<p>Providence Water is currently provided with water through one singular distribution main at South Comstock Road running between Fox Ridge and Tomahawk Trail. If that main were to rupture approximately one-third of the City would be without water. An opportunity exists however to provide a secondary source for water service by connecting a 1900' gap in service mains. The gap currently extends from the corner of Pippin Orchard Road and Scituate Avenue to the site of the Orchard Farms Elementary School on Scituate Avenue.</p> <p>Total potential improvement damages are \$375,000.</p> <p>There are 3,406 accounts for the Public Drinking Water System. This figure multiplied by the 2.54 average household size per occupied dwelling unit, indicates the at-risk population is approximately 8,651 residents.</p>	Creating service redundancy by filling this gap would ensure the provision of public water to a large portion of Cranston in the event of natural hazard induced ruptures in the existing service main.	Low	This section has been reviewed and updated to reflect current conditions. The CHMC has determined that the Hazard, Problem, Benefits & Risk identified in the 2005 Plan are unchanged.
<b>XII. Tennessee Gas Pipeline</b>	<p>A. <u>Gatehouse Metering Station</u> - 65 Laten Knight Road (A.P. - 28 Lot 132).</p>	Wildfires and earthquake.	<p>The Gatehouse is an above ground processing facility for a major gas transmittal line servicing New England. Because of the presence of natural gas it is extremely important to keep this facility isolated due to the potential for explosion and threat to life.</p> <p>Total potential improvement damage to the Gatehouse is \$38,400. In the event of an explosion, within a 1000' radius of the facility there would be 32 units impacted. The total potential improvement damages could climb to \$4,842,400 and approximately 79 residents would be at-risk.</p>	Prevention of large wildfires thereby protecting the lives and property of Cranston residents and costly repairs.	Low	This section has been reviewed and updated to reflect current conditions. The CHMC has determined that the Hazard, Problem, Benefits & Risk identified in the 2005 Plan are unchanged.
<b>XIII. Recreational Facilities</b>	<p>A. <u>CLCF</u> – 970 Pontiac Avenue (A.P. - 10/2 Lot 1471).</p> <p>B. <u>Budlong Pool</u> - 222 Aqueduct Road (A.P. - 9/2 Lot 141).</p> <p>C. <u>Cranston Stadium</u> – 35 Flint Avenue (A.P. - 6/3 Lot 2700). <i>Not in floodplain.</i></p> <p>D. <u>Cranston Veterans Ice Rink</u> – 900 Phenix Avenue (A.P. - 17/1 Lot 1). <i>Not in floodplain.</i></p>	Flooding from heavy rain; high wind, ice damage, and earthquake.	<p>These facilities provide residents of Cranston places to go for recreational and leisure activity. The occurrence of a natural hazard event creates a threat of property damage.</p> <p>Total potential improvement damages are \$1,737,500.</p>	Reducing utility service interruption, repair, and cleanup, thus continuing the provision of recreational and leisure activity.	Low	The CHMC has reviewed and updated this section to reflect current conditions. The CHMC has determined that the Hazard, Problem, Benefits and Level of Risk identified in the 2005 Plan remain unchanged
<b>XIV. Historic Resources</b>	<p>A. <u>National Historic Districts</u></p> <ol style="list-style-type: none"> <li>Pawtuxet Village Historic District (A.P. - 1).</li> <li>Oak Lawn Village Historic District (A.P. -18/2, 18/4, and 21/3) - this is also a Local Historic District.</li> <li>Furnace Hill Brook Historical and Archeological District (A.P. - 21/2 and 21/3).</li> </ol> <p>B. <u>National Register Properties</u></p> <ol style="list-style-type: none"> <li>Rhodes on the Pawtuxet – 60 Rhodes Place (A.P. - 1 Lot 299).</li> <li>Edgewood Yacht Club - 3 Shaw Avenue (A.P. - 2/2 Lots 866, 2852, and 4000).</li> </ol> <p><i>Source: Lynn Furney, Cranston Associate City Planner, 05/07/2003. (See Appendix D: Inventory of Historic Properties)</i></p>	Flooding from heavy rain and coastal storm surge; high winds, ice damage, and earthquake.	<p>These historic resources are most susceptible to property damage, which contribute to Cranston's culture, heritage, and general character.</p> <p>Although historic resources are truly irreplaceable, the total potential improvement damages are \$63,324,600.</p> <p>The estimated potential “Pawtuxet Village Historic District” improvement damages are 39,646,000. The estimated potential “Oak Lawn Village Historic District” improvement damages are \$8,563.600. The estimated potential “Furnace Hill Brook Historical and Archeological District” improvement damages are \$333,400.</p>	Protecting irreplaceable property that contributes to Cranston's culture, heritage, and general character.	Low	This section has been reviewed and updated to reflect current conditions. The CHMC has determined that the Hazard, Problem, Benefits & Risk identified in the 2005 Plan are unchanged.

## Programmatic Capability Assessment

### 4.1 Purpose

This capability assessment examines the existing studies, plans, programs, and policies that have incorporated hazard mitigation and other pro-active tools into the City system. The purpose of the capability assessment is to highlight successes, identify shortcomings, and to lay the groundwork for possible improvement. Cranston recognizes that the inclusion of mitigation initiatives would not only benefit the community by reducing human suffering, damages and the costs of recovery, but would also help build and maintain the sustainability and economic health of the City. Section 4.2 details the City's existing plans, programs, and policies.

### 4.2 Primary Programs

#### **4.2.1. Cranston Comprehensive Plan**

The Cranston Comprehensive Plan was originally adopted in February 1992. In 2010 the City updated its comprehensive plan. The updated plan has been approved by the City Plan Commission and is current on review for approval by the City Council. The proposed plan outlines the goals, policies, issues, and actions that guide the community to fulfilling its vision for future development. It addresses land use, housing, economic development, natural resources, services and facilities, open space and recreation, and circulation, but does not address hazard mitigation. The City recognizes the importance of hazard mitigation, its interaction with municipal land use and infrastructure planning, and the need for a comprehensive planning approach which accommodates these interdependencies.

#### **4.2.2. Cranston Waterfront Storm Preparedness Plan**

The Rhode Island Coastal Resources Management Council (RICRMC) guidelines for Harbor Management Plans require municipalities with approved HMP's to provide waterfront storm preparedness plans. The purpose of these plans is to detail specific measures to be taken in mitigating storm damage, preparing vessels and their structures for storm events, and appropriate response procedures for waterfront boating facilities. On December 17, 2008, the Cranston City Council adopted the City's first Harbor Management Plan and on May 27, 2010 the RICRMC approved said plan had been approved by CRMC. Said plan includes a storm preparedness and hazard mitigation plan for the City's coastal areas.

#### **4.2.3. Subdivision and Land Development Regulations**

The subdivision and land development regulations are one of the City's primary tools for regulating development in the City. The purpose of the regulations are to protect the public health, safety, and welfare of the community by ensuring that development respects the natural limitations of specific locals including those presented by natural hazards.<sup>24</sup> The subdivision and land development process is overseen by the City's seven member Plan Commission, and it is here, where the majority of the coordination between various regulatory siting and design programs actually occurs.

The City and it's Planning Commission are to be commended on the thoroughness of these regulations and more importantly, on their implementation, which has been sensitive to mitigating the impacts from natural hazards through proper regulatory review, siting, and design. Having reviewed the program it should be pointed out however, that mitigation benefits could be furthered by stronger enforcement of the regulation requirements for underground utilities. Although requiring underground utilities for individual new developments may appear to have minimal effects, the cumulative impact over time could reduce potential damages to utility infrastructure and result in significant savings.



#### **4.2.4. Cranston Flood Hazard District**

In 1984, the Federal Emergency Management Agency (FEMA) completed a scientific engineering report entitled Flood Insurance Study: City of Cranston, Rhode Island with accompanying Flood Insurance Rate Maps (FIRM's). As a result, in accordance with the Code of Federal Regulations Title 44 Chapter 1 Part 9 "The Flood Plain Management and Protection of Wetlands" (44CFR Ch. 1 Part 9), the City of Cranston subsequently adopted its own local flood hazard management ordinance that, in conjunction with the Rhode Island State Building Code, discussed below, provides specific regulations for the building of, or substantial improvement to, structures within Special Flood Hazard Areas. On March 2, 2009, FEMA issued updated FIRM's for the City. In conjunction with the issuance of new FIRM's, the City updated its local flood hazard management ordinance to reflect current regulatory practices and to correct deficiencies in the ordinance as identified in the 2005 Plan.

The provisions of the Cranston Flood Hazard District are implemented by the Planning Department and the Building Inspections Department. Planning's role is to determine if, in fact, a particular proposal will take place within a Flood Hazard Area and Building Inspections determines whether construction techniques and calculations conforms to the specifics of the ordinance.

#### **4.2.5 Rhode Island State Building Code**

All municipalities within the State of Rhode Island share a single building code (RIGL 23-27.3-100 et. Al.). The Code itself was last amended in 2009 and provides comprehensive construction requirements designed to mitigate the impacts from natural hazards, such as high wind events. The Code is enforced by the Cranston Building Inspections Department and provides an additional layer of regulatory control to those discussed above.

#### **4.2.6. Cranston Emergency Operations Plan (EOP)**

The Cranston EOP was last updated In January 2004. Currently, there is currently a draft 2010 EOP that is pending approval by RIEMA and FEMA. Its primary purpose is to plan for the coordination and execution of specific roles, duties and responsibilities of individual municipal emergency response personnel in the event of a disaster or general emergency. Cranston's plan combines mitigation, preparedness, response, and recovery. It is currently up to date and has been approved by RIEMA and FEMA.<sup>25</sup>

#### **4.2.7. Cranston Public Education Program**

The fire chief/emergency management officer does implement public education programs that are geared toward school-age children and residents of the City residing in elderly housing. In fact, the CEMA does circulate a pamphlet entitled "Sheltering in Place Guidelines" throughout the Cranston School Department. In addition, once a month CEMA does produce a series of public education articles that are published in the Cranston Herald. These articles routinely cover topics ranging from fire safety to natural disaster preparation and response. However, this publication has been temporarily discontinued in order to focus on the enforcement of new fire code safety legislation.

#### **4.2.8 Rhode Island State Dam Safety Program**

The City of Cranston participates in the State Dam Safety Program because the Cranston Print Works Dam is classified as one of sixteen high hazard dams within the State. The State Dam Safety Program was created to facilitate the enforcement of the primary dam inspection law (RIGL 46-19, Inspection of Dams and Reservoirs). RIGL 46-19 states that dam owners are responsible for the safe operation, maintenance, repair, and rehabilitation of a dam, which are the essential elements in preventing dam failure; furthermore, dam owners are liable for the consequences of accidents or failures of their dams. According to the Dam Safety and Maintenance Task Force, RIGL 46-19 needs to be updated to address the specifics of a comprehensive dam inspection and permitting program. In addition, the current law does not address the fiscal impacts of dam repairs or removal, and the possible need for state financial assistance to assist dam owners under-take crucial and necessary repairs.<sup>26</sup>

#### **4.2.9. National Flood Insurance Program (NFIP): Community Rating System (CRS)**

The Community Rating System (CRS) is a part of the National Flood Insurance Program (NFIP). The CRS allows participating communities to be rewarded with incentives for doing more than meeting the minimum NFIP requirements to help their property owners prevent or reduce flood losses. These incentives are in the form of flood insurance premium discounts.

Although Cranston does participate in the CRS Program, it is currently ranked in the lowest classification. Steps should be taken by the City to receive credit for what it is already doing, but also to receive credit for the appropriate elements of this plan as they are implemented. There are 10 CRS classes: Class 1 requires the most credit points and gives the greatest premium reductions; Class 10 identifies a community that does not apply for the CRS or does not obtain a minimum number of credit points and receives no discount.<sup>27</sup>

#### **4.2.10. The Pocasset River Flood Plain Study and Management Plan**

*The Pocasset River Flood Plain Study and Management Plan* was initiated with the Natural Resource Conservation Service (NRCS), as a result of a storm event that occurred in August of 1999. Funded through the Federal Small Watershed Program it analyzes existing conditions, models present and future hydrology, provides updated Flood Insurance Rate Maps, analyzes alternative solutions to flooding concerns, proposes recommended strategies, and provides connections for needed implementation funds.<sup>28</sup> Since the 2005 HMP, the NRCS has completed hydrologic studies to a point where public hearing can be held and engineering designs undertaken. However, the need for funding, especially the local match, has caused project to be delayed.

#### **4.2.11. The Meshanticut Brook Flood Plain Management Study: Cranston And Warwick, RI**

*The Meshanticut Brook Flood Plain Management Study* was published in October 1983 and is known as the "Popular Report". This report was produced by the United States Department of Agriculture: Soil Conservation Service (currently known as NRCS); and it identifies problem areas within the flood plain and provides an analysis of potential alternatives and recommended solutions. Five recommendations originate from this study and are as follows<sup>29</sup>:

1. All property owners in the 100-year flood plain should participate in the NFIP.
2. Flood plain property owners, particularly those within the 10-year flood plain, should consider having a qualified engineer evaluate their property for specific nonstructural measures.
3. Both Cranston and Warwick, with the full participation of and coordination with affected property owners, should develop a flood warning plan.
4. Several wetlands, natural areas, and ponds located along Meshanticut Brook upstream of the Furnace Hill Brook confluence provide significant natural storage for floodwater. These areas moderate flood discharges similar to a dam. Without this existing storage, flood damage would be much worse. The City of Cranston should take action to protect these areas from any alteration that would reduce the volume of storage presently available.
5. The City of Cranston should make full use of the existing erosion and sediment control standards and enforcement ordinances to insure that development projects within the City will be adequately controlled.

Since the 2005 HMP, the City has encouraged property owners within the 100-year flood plain to purchase flood insurance and the City has required new development to comply with the City's Erosion Control Ordinance. However, the items 2, 3 and 4 above remain outstanding.

### **4.3 Other Resources**

The other resources included within this capability assessment are located in Appendices F, G, and H. Appendix F highlights existing state federal, as well as other entities that provide technical and financial assistance for mitigation. Appendix G identifies existing federal and state protection systems. Lastly, appendix H details additional financing options not identified in Chapter 5.

## Identification of Mitigation Actions

Whereas the two preceding Chapters identify risks from natural hazards and programmatic shortcomings, this chapter defines a broad mission for the City in mitigating these risks, re-evaluates the series of hazard mitigation goals and 23 specific implementation actions that were identified in the 2005 HMP.

### 5.1 Mission Statement

It is the mission of the City and the CHMC to protect and enhance the quality of life, property and resources by identifying areas at risk from natural hazards and implementing hazard mitigation actions to protect the City's residents; infrastructure; economy and its historical, natural and cultural resources.

### 5.2 Mitigation Goals

To achieve its mission the Cranston Hazard Mitigation Committee established a series of goals that could be used to focus mitigation efforts and provide a framework for discussion of specific actions. These goals include: upgrading infrastructure and protecting property, integrating planning and management approaches, strengthening regulatory control, improving response effectiveness and raising awareness of hazard mitigation benefits and procedures.

Upgrading infrastructure and protecting property refers to improving the structural facilities needed to sustain and protect residential, commercial, and industrial uses and the people who occupy them. Examples include drainage structures, bridges, dams, and municipal facilities such as schools.

Integrating planning and management refers to the incorporation of hazard mitigation principles into the plans, policies, programs and administrative actions of both public and private entities. Examples include development of a debris management plan and participation in the Community Rating System.

Regulatory change refers to improvements to rules or procedures that regulate the location of new development as well as construction techniques. Examples include municipal subdivision regulations; flood hazard overlay districts and building codes.

Preparedness to reduce losses refers to ensuring that needed facilities are in place to assist people during natural hazard events and that the City is ready to respond effectively. Examples include increasing the capacity of American Red Cross approved shelters and development of repetitive loss strategies.

Education and training refers to raising community awareness of how to prepare for and respond to natural hazard events. Examples include flood hazard training workshops for municipal officials, small business disaster outreach programs and public education and preparedness programs.

### 5.3 Identified Actions and Objectives

The following mitigation actions and objectives were developed by the CHMC with review and opportunity for input from each of the prospective project leads. They are organized in accordance with the topical areas of the five mitigation goals discussed above and each summarizes the specific problem and proposed possible solution, details the primary tasks to be undertaken, identifies an appropriate lead and anticipates funding concerns.

#### **5.3.1. Infrastructure Improvement and Property Protection**

##### **A. Implement the NRCS Pocasset River Flood Plain Study and Management Plan**

1. Summary - The Pocasset River Watershed is 20.6 sq. miles or 13,200 acres in size. Three municipalities are located in the watershed: the Town of Johnston, the City of Cranston, and the City of Providence. The City of Cranston comprises approximately 29 percent of the watershed. The Pocasset River has experienced numerous major flood events in the past twenty years. Commercial and residential property in the Fletcher Avenue area of Cranston has been particularly vulnerable to damage from these floods.

The floods also pose a threat to the environment and public health and safety. By most accounts, flooding in the past few years is both more frequent and severe. Previous efforts by local, state, and federal interests have failed to solve this problem.

In October 1999, a senatorial appropriation of \$500,000 was earmarked for the Natural Resources Conservation Service (NRCS) Small Watershed Program budget for FY 2001 to complete a watershed study and plan for the Pocasset River. The City of Cranston will support and seek implementation for the NRCS Pocasset River Watershed Flood Plain Management Plan. The plan addresses the repetitive flooding in the watershed. Under the framework of the Small Watershed Program the project completed the following tasks:

- a. Collected data on river flow rates and flood heights.
- b. Inventoried the natural resources in the flood plain including: wildlife habitat, wetlands, and cultural resources.
- c. Located and surveyed structures at risk to flooding.
- d. Estimated past and potential financial losses.
- e. Identified elements contributing to the increased flooding rates.
- f. Drafted alternatives for mitigating future losses.

NRCS and their field crews surveyed cross sections along the Pocasset River and its tributaries. The data collected built the present and future hydrologic and hydraulic models of the watershed. These models in turn were used to analyze the mitigation alternatives. Following the analysis of the mitigation alternatives, NRCS produced benefit/cost ratios for Cranston, Johnston, and the Pocasset Watershed as a whole. A benefit/cost ratio of 1.07 was produced for Cranston. This ratio, being greater than one, indicates a financially beneficial outcome for Cranston. The benefits depict reduced flood damages as a result of installing flood prevention measures.<sup>30</sup> Below are the draft mitigation action alternatives presented by NRCS in the *Pocasset River Watershed Flood Plain Management Study*.<sup>31</sup>

## 2. Primary Tasks

- a. Perform debris removal throughout the Pocasset River Channel to prevent natural damming and increase the flow rates and volume.
- b. Increase the distance between the abutments for the Rhode Island Department of Transportation (DOT) bridge on Garden City Drive (DOT bridge # 75801) - *State task*.
- c. Flood proof structures in the vicinity of the Garden City Drive flood plain.
- d. Flood proof structures and retrofit Lower Eden Park with two floodwalls to control river flow, or have the City obtain land rights for the potential removal of structures in the Lower Eden Park flood plain. (The first floodwall will encompass Willow Brook Apartments. The second floodwall will encompass the Riverview Acre Apartments and Davis Court.)
- e. Flood proof structures and retrofit Upper Eden Park with a floodwall to control river flow, or have the City obtain land rights for the potential removal of structures in the Upper Eden Park flood plain. (This floodwall will encompass the Forest Hills Nursery located on Reservoir Avenue. This is A.P. - 9/2 Lots 2431 - 2436, 2526, 3089, 3500 and 3513).
- f. Flood proof structures in the vicinity of the Park Avenue bridge (DOT # 48001), or have the City obtain land rights for the potential removal of structures in the vicinity of the Park Avenue bridge (DOT bridge # 48001).
- g. Increase the distance between the abutments of Park Avenue bridge (DOT bridge # 48001) - *State task*.
- h. Flood proof structures in the vicinity of the Dyer Avenue bridge (DOT bridge # 49401).
- i. Increase the distance between the abutments of Dyer Avenue bridge (DOT bridge # 49401) - *State task*.

- j. Flood proof structures and retrofit the Dyer Avenue Industrial Park with a floodwall to control and channel the river flow.
  - k. Flood proof structures and retrofit Fletcher Avenue Industrial Park Area with a floodwall to control and channel the river flow, or have the City obtain land rights for the potential removal of structures in the vicinity of the Fletcher Avenue Industrial Park.
  - l. Flood proof structures in the vicinity of the Plainfield Street flood plain, or have City obtain land rights for the potential removal of structures at Plainfield Street.
  - m. Increase the distance between the abutments of Plainfield Street bridge (DOT bridge # 8101) - *State task*.
3. Project Lead - The NRCS Small Watershed Program has joint sponsorship between the City of Cranston and Town of Johnston to coordinate implementation with regards to securing sufficient funding and ensuring the recommendations are carried out in a timely fashion.
4. Funding Concerns - The total estimated cost to implement the corrective measures within the entire Pocasset Watershed is \$30,653,386. The total estimated cost to implement the corrective measures in Cranston is \$14,856,180. The NRCS Small Watershed Program will provide \$11,611,200 in funding toward the estimated cost for the Cranston area. Specifically, the NRCS Small Watershed Program will provide 100% funding for floodwall costs and 75% funding for flood proofing and home removal. The NRCS Small Watershed Program will not pay for utilities.
- Cranston will be responsible for securing the remaining \$3,088,050.00 in funding. In addition, the City will be responsible for the cost of obtaining land rights, if recommendations acted upon include structure removal. Lastly, the City will be responsible for bridge retrofitting costs if the City maintains bridge; and the State will be responsible for bridge retrofitting costs if the State maintains the bridge.<sup>32</sup>
5. Actions Since 2005 HMP - The NRCS has completed hydrologic analysis of the Pocasset River Basis and has completed preliminary design. The NRCS and the City is currently seeking funds so that NRCS can undertake final engineering design and undertake the flood improvements proposed.

6. Time Frame for Completion - Five years.

## **B. Flooding Improvements [Meshanticut Brook Flooding Improvements]**

1. Summary - The flooding on Wilbur Avenue occurs east of Warren Avenue and west of Oaklawn Avenue and is the primary area of concern within the Meshanticut Brook Flood Plain. Preliminary opinions suggest that the flooding is a result of limited water flow capacity due to an inadequately sized drainage system with little to no land slope. The City of Cranston will study and choose the most cost-effective alternative to replace the current drainage system beneath Wilbur Avenue. The alternative will increase the size of the drainage piping and increase the capacity of flow from the intersection of Wilbur and Oaklawn Avenues to the Meshanticut Brook outfall.
2. Primary Tasks
- a. Secure funding for study and design components.
  - b. Reassess recommendations of the *Meshanticut Brook Flood Plain Management Study* prepared by the Soil Conservation Service (SCS or NRCS - 1983).
  - c. Study the current condition of the drainage system and flooding concern to assess potential residential, commercial and public property cost damages.
  - d. Conduct a cost-benefit analysis for the design alternatives.
  - e. Design the selected replacement drainage systems.
  - f. Develop a method to monitor and maintain new drainage system.
  - g. Secure implementation funding and obtain necessary permits
  - h. Advertise an invitation to bid and award contract.
  - i. Construct, monitor and maintain new drainage system.

3. Project Lead - City of Cranston Public Works Department.
4. Funding Concerns - The Public Works Department must first obtain funding for study and design and then for implementation. The Department currently estimates the study and design costs to be \$35,000.00. The costs for implementation cannot be accurately estimated at this point. However, implementation costs will be identified through the study and design process. The capital improvement planning process, as well as appropriate grant opportunities should be pursued as funding sources for both study and implementation.
5. Actions Since 2005 HMP - No actions have been taking on these proposed activities. In reviewing this action item, the CHMC identified drainage improvements to Wilbur Avenue where it passes under the State's bike path as the primary issue to be addressed. In addition, the CHMC identified other areas with similar flooding issues that should be address in a similar manner. These areas are Lake Street, Randall at Atwood Avenue and Cranston Street at Haven Street.
6. Time Frame for Completion - Five years.

#### **C. Stillhouse Cove Erosion Control Project**

1. Summary - Pawtuxet Neck can become an isolated island in Narragansett Bay under strong hurricane or storm surge conditions. Currently the roads serving as the necks' evacuation route (Ocean Avenue and Narragansett Boulevard) are threatened by coastal erosion. At present, the mean high tide line is within 5' of the roadways. In light of this, the City of Cranston will construct an 800' rock riprap revetment at Stillhouse Cove. The construction of this revetment will protect the Ocean Avenue and Narragansett Boulevard evacuation routes, as well as the underlying utility infrastructure, by eliminating the potential for the roadbed to become a victim of coastal erosion.
2. Primary Tasks
  - a. Replace current stormwater drainage system with two vortech units to properly treat runoff.
  - b. Construct revetment to prevent erosion and re-establish launching facility.
  - c. Restore coastal marsh including accumulation of stormwater sediments.
  - d. Reconstruct existing sidewalk for American Disability Act (ADA) compliance.
  - e. Continue to implement Stillhouse Cove Restoration Project as approved by the Rhode Island Department of Environmental Management (DEM), Coastal Resources Management Council (CRMC), Rhode Island Department of Transportation (DOT) and the United States Army Corp. or Engineers (USACE).
3. Project Lead - City of Cranston Public Works Department.
4. Funding Concerns - Total project cost is estimated at \$650,390.00. Of this the City is currently expected to directly contribute \$320,266.55. The remaining difference will be comprised of a DEM: Nonpoint Pollution Source Abatement Program grant of \$200,271.00, a DOT: Enhancement Program grant of \$88,000.00, a Natural Resource Conservation Services (NRCS): Wildlife Habitat Incentive Program grant of \$34,529.00, and a CRMC grant of \$7,323.45.
5. Actions Since 2005 HMP - This activity was completed in the spring of 2009.

#### **D. Western Cranston Water District Service Loop**

1. Summary - The Western Cranston Water District (WCWD) is roughly bounded by Plainfield Pike on the north, the Town of West Warwick to the south, Interstate 295 to the east, and Seven Mile and Pippin Orchard Roads to the west. Currently the primary concern involves the southerly half of the District, which is serviced by only one distribution main. If that main were to be compromised by earthquake damage, servicing the southern portion of the District would not be possible. Therefore, the Providence Water Supply Board (PWSB) will be encouraged to complete this secondary distribution main, lying approximately between Pippin Orchard Road and Alpine Estates

Drive. Correcting the problem in this fashion will loop the system; thereby allowing a secondary means of service to the southerly portion of the District.

2. Primary Tasks
  - a. Finalize PWSB Capital Improvement Plan for WCWD.
  - b. Revise WCWD needs assessment and impact fee calculation.
  - c. Design 16" distribution main project.
  - d. Have project lead address funding concerns and obtain necessary permitting.
  - e. Advertise an invitation to bid and award contract.
  - f. Construct the most cost-effective 16" distribution main.
3. Project Lead - Providence Water Supply Board (PWSB).
4. Funding Concerns - This project will be funded by the PWSB using monies collected through the Western Cranston Water District Impact Fee Program. Cost is currently estimated at \$375,000.00.
5. Actions Since 2005 HMP – Since the 2005 Plan, the PWSB has completed design activities a. to d. above. PWSP needs to advertise and award a bid and to construct the 16" main.
6. Time Frame for Completion - The PWSB indicates that the project will be completed within one year.

#### **E. Sewage Infiltration and Inflow Analysis**

1. Summary - During a large rainfall event, the City of Cranston sewage pump stations may experience sewer backups due to large amounts of storm water infiltrating the piping system and overwhelming the capacity of the pump stations. This creates a serious potential health concern and liability for the City. To alleviate this concern, Veolia Water, operator of the City's sewage treatment facilities, will conduct an infiltration/inflow analysis that will identify illegal entry points of non-effluence into the City sewer system. Flow tests will be performed to model different intensity storms. If the analysis indicates infiltration/inflow contributing to overwhelming the sewage pump station capacity, the City will pursue a form of recourse. This recourse will detail the consequences associated with allowing the infiltration/inflow to exist and the contrary. Lastly, conclusive evidence should guide Veolia Water regarding their ability to eliminate infiltration/inflow or upgrade the pump stations to accommodate the infiltration/inflow.
2. Primary Tasks
  - a. Identify illegal inflow points of non-effluence within the sewage system.
  - b. Calculate an infiltration volume measure to determine whether infiltration is an issue.
  - c. Determine a form of recourse against individuals or entities regarding illegal inflow into the sewage system.
  - d. Conduct a cost-benefit analysis to identify the ramifications associated with allowing the illegal inflow to exist verses removal.
  - e. Evaluate conclusive evidence to guide decisions related to alternatives that limit the illegal inflow within the sewage system or upgrade the pump stations to accommodate the inflow.
3. Project Lead – Veolia Water and the City of Cranston Public Works Department.
4. Funding Concerns - Primary tasks a. and b. have been initiated and the costs to complete these tasks will be approximately \$808,942.00. The costs to complete primary tasks c. - e. have not been identified as of yet since they are dependent on primary task a. and b. All costs are anticipated to be budgeted costs into the Sewer Enterprise Fund and through appropriate grants.
5. Actions Since 2005 HMP – No action has been taken on this activity.
6. Time Frame for Completion
  - a. Primary tasks a. and b. will be completed by Spring 2012.

- b. Tasks c. - e. are estimated to be completed in approximately three years after tasks a. and b. although this is contingent upon funding.
- c. When tasks a. – e. have been completed Inflow and Infiltration Analysis will need to be conducted on an on going basis.

#### **F. Sewage Pump Station Flood Proofing**

1. Summary - The City of Cranston has an additional concern regarding the potential for sewer backups to occur during a large rainfall event. This concern is focused on the short-circuiting of sewage pumping equipment caused by the overland flooding of the sewage pump stations themselves. The first step to resolve this concern will be to conduct a cost-benefit analysis to address which of the nine pump stations within the flood plain could benefit by being flood proofed. The Allard, Randall Pontiac and Mayflower Pump Stations are of particular concern due to their flood history and the Sea View Pump Station is of concern due to its location within a V-Zone (see Appendix A – Critical Municipal Facilities).
2. Primary Tasks
  - a. Secure funding for study and design components.
  - b. Study the current flooding conditions to assess the potential public property cost damages and the potential for sewage backups.
  - c. Conduct a cost-benefit analysis to determine which of the nine pump stations within the flood plain could most benefit by being flood proofed.
  - d. Design flood proof improvements for selected sewage pump stations.
  - e. Develop a method to monitor and maintain flood proof improvements.
  - f. Secure implementation funding and obtain necessary permits.
  - g. Advertise an invitation to bid and award contract.
  - h. Retrofit selected sewage pump stations with flood proof improvements.
3. Project Lead – Veolia Water and City of Cranston Public Works Department.
4. Funding Concerns - The Public Works Department must first obtain funding for study and design and then for implementation. The Department currently estimates the study and design costs to be \$30,000.00. The costs for implementation cannot be accurately estimated at this point. However, implementation costs will be identified through the study and design process. All costs are anticipated to be budgeted costs into the Sewer Enterprise Fund and through appropriate grants.
5. Actions Since 2005 HMP - Due to the City's recent experience during the March, 2010 flooding event, the CHMC has determined that the pump stations, as well as the City's sewerage treatment facilities should be projected to the 500-year flood event. Upgrades to occur as funds become available.
6. Time Frame for Completion – On-going conditioned on funding.

#### **G. Flood Proof George J. Peters Elementary School**

1. Summary - George J. Peters Elementary School is located within the Pocasset River Flood Plain, and has historically flooded. The school plays a vital role in educating Cranston's youth and also is utilized as a YMCA child daycare facility. The occurrence of a natural hazard event creates a higher potential for recurring and more severe property damage. Flood proofing the school could efficiently minimize these recurring property damage costs and ensure the buildings viability as an educational center.
2. Primary Tasks
  - a. Secure funding for study and design components.
  - b. Estimate impact of proposed Pocasset River Drainage Improvements on expected flood levels at the site.
  - c. Study the current and potential future flooding condition to assess the public property cost damages.
  - d. Assess and identify appropriate structural flood proofing alternatives.



- e. Conduct a cost-benefit analysis that compares the cost of damages with the improvement benefits.
  - f. Design flood proof improvements for George J Peters Elementary School.
  - g. Develop a method to monitor and maintain flood proof improvements.
  - h. Secure implementation funding and obtain necessary permits.
  - i. Advertise an invitation to bid and award contract.
  - j. Retrofit George J. Peters Elementary School with selected improvements.
3. Project Lead - Cranston School Department.
  4. Funding Concerns - The School Department must first obtain funding for study and design and then for implementation. The Department currently estimates the study and design costs to be \$25,000.00. The costs for implementation cannot be accurately estimated at this point. However, implementation costs will be identified through the study and design process. Cost and funding sources to be identified in Primary Task 2e above.
  5. Actions Since 2005 HMP – No action have been taken on these proposed activities. However in reviewing this action item, the CHMC believes that this action item should not be a high priority. The George J. Peters Elementary School shown as being located within the Randall Pond floodplain. However, given both recent and past flood events which did not impact the school, the CHMC would recommend undertaking flood studies to determine if the school can be removed from the floodplain.
  6. Time Frame for Completion – One year after initiation.

#### **H. Coordinated Tree-Trimming Program**

1. Summary - Maintaining electrical service provision during and after natural hazard events is critical in mitigating property damages and protecting life. Electricity is not only essential for lighting, heating and refrigeration but is also relied upon for traffic control, health support, communications and security. Unfortunately many of the electrical transmission lines in the city are jeopardized by the ever increasing number of tree limbs that grow in their midst. During high wind and ice events these limbs often break bringing down transmission lines and electrical service. Increasing the strategic removal of these subject limbs beforehand can go a long way in mitigating the impacts of natural hazard events.
2. Primary Tasks
  - a. Establish a working committee with representation from Cranston Emergency Management, Narragansett Electric, Verizon Telecommunications, and Cox Communications.
  - b. Identify existing tree trimming programs, priorities and available resources.
  - c. Identify priority transmission corridors for trimming.
  - d. Work to better coordinate existing programs in priority areas as a Phase I effort.
  - e. Seek and secure additional funding for Phase II expansion of coordinated program.
  - f. Develop a communication network with the public to assist with maintenance and carry out implementation program.
  - g. Educate the public regarding the need to properly maintain and trim trees on private property that are adjacent to power lines.
  - h. Evaluate program effectiveness and initiate planning process for additional phases if feasible.
3. Project Lead - Cranston Emergency Management Agency (CEMA) in partnership with Narragansett Electric, Verizon Telecommunications, and Cox Communications.
4. Funding Concerns - Phase I coordination costs are minimal and can be covered by stakeholders existing budgets, whereas the focus of Phase II is to identify additional funding grant opportunities for expanding the program. The anticipated costs associated with the Phase II expansion of the program are \$1,137,500.00 for tree trimming, \$200,000.00 for tree removal, and an additional \$36,400.00 for police details.

5. Actions Since 2005 HMP – No action has been taken on this activity. However, the CHMC would note that the electric and telecommunications utilities have an ongoing and highly effective program of tree trimming. The CHMC has determined that in addition to the above activities identified under that action item, the City should enact an ordinance which would prohibit the planting of trees within a utility easement.
6. Time Frame for Completion
  - a. Phase I will be completed one and half year from initiation.
  - b. Phase II will be an ongoing program contingent upon funding.

#### **I. Bridge Retrofitting and Repair**

1. Summary – The City of Cranston recognizes the importance of safe and convenient circulation for residents and commuters traveling about the City. Understanding the extreme likelihood that a natural hazard will occur, all City maintained bridges (see Appendix C) are to be evaluated, regarding their structural integrity and resistance to earthquakes, and retrofitted as needed. All retrofits will be made in accordance to the *RIDOT Standard Specifications for Road and Bridge Construction*.
2. Primary Tasks
  - a. The City of Cranston Public Works Department - Engineering Division must inspect all City maintained bridges to ensure structural integrity and earthquake resistance.
  - b. Identify retrofits needed to bring all City maintained bridges into compliance with *RIDOT Standard Specifications for Road and Bridge Construction*.
  - c. Project construction costs for each individual retrofit.
  - d. Identify total funding available for implementation of bridge retrofits.
  - e. Prioritize desired retrofits given available funding, traffic carried, relation to evacuation routes and alternative circulation options.
  - f. Complete design, funding acquisition and permitting for prioritized retrofits.
  - g. Finalize overall implementation plan and execute.
3. Project Lead - City of Cranston Public Works Department - Engineering Division.
4. Funding Concerns - Bridge inspections have been performed by the Rhode Island Department of Transportation (DOT). Funding needs to be secured through the capital budget or through various grants to hire a consultant to prioritize and design the bridge repairs. The DOT is responsible for providing funding for retrofitting all state maintained bridges.
5. Actions Since 2005 HMP – No action has been taken on this activity. However, the CHMC would note that 3 bridges located within the City have are in the process of being repaired. The RIDOT has begun the process of repairing its bridges on Reservoir Avenue and Pontiac Avenue. These bridges has deteriorate with age and had been weight restrict. The City has begun the process of replacing the Natick Avenue Bridge. This bridge suffered major damage during the March, 2010 flood event. A replacement bridge is currently being design with construction to follow design.
6. Time Frame for Completion – Six months for the State bridges, three and half years for the remainder of this activity.

#### **J. Tennessee Gas Metering Station Clear Zone**

1. Summary - The Tennessee Gas Pipeline Company is the owner of the Gatehouse Metering Station located at 65 Laten Knight Road. This facility is an above-ground processing center for a major gas transmittal line that services New England. Because of the presence of large quantities of natural gas it is extremely important to isolate this facility by maintaining a 150' clear zone around its perimeter. Keeping this zone free and clear of brush, vegetation and other debris will reduce the likelihood of wildfires reaching the metering station and the potential for explosion.

2. Primary Tasks
  - a. Establish lines of communication with appropriate staff at Tennessee Gas.
  - b. Obtain documentation regarding Tennessee Gas's policy and maintenance schedule for the 150' clear zone.
  - c. Analyze Tennessee Gas's policy and maintenance schedule for effectiveness.
  - d. Suggest additional recommended actions for maintenance of the 150' clear zone.
  - e. Monitor Tennessee Gas's activities and ensure maintenance of the 150' clear zone by performing field inspections twice a year.
  - f. Advocate for proactive policies and Tennessee Gas's implementation of additional recommendations.
3. Project Lead - Cranston Emergency Management Agency (CEMA).
4. Funding Concerns - No direct expenses to the City of Cranston are anticipated due to the nature of CEMA's role in this activity.
5. Actions Since 2005 HMP – This action item has been completed.
6. Time Frame for Completion - There is currently ongoing coordination between the City and Tennessee Gas Pipeline Company.

### 5.3.2. **Planning and Management**

#### **A. Debris Management Plan**

1. Summary - Currently, the City does not have a debris management plan. A debris management plan is a critical component to efficient recovery efforts when a disaster strikes. Debris removal is described as the clearance, removal and/or disposal of items such as trees, sand, gravel, building components, wreckage, vehicles and personal property. Having a debris management plan will establish better circulation for people moving back to their properties, allow for the safe passage of emergency vehicles, and increase accessibility to critical infrastructure. The creation and adoption of the debris management plan will consist of two phases. The first phase of the debris management plan will focus on the identification of priority roadways, bridges, dams, and culverts that have a tendency to collect debris and inadvertently contribute to potential road and property flooding. The second phase will concentrate on the scheduled debris clean-up efforts. In addition, it will address the how, who, and where will assist the City in the implementation of clean-up efforts.
2. Primary Tasks
  - a. Prioritize roadways for debris removal.
  - b. Identify the bridges, dams and culverts that are most susceptible to collecting debris.
  - c. Identify waste disposal methods (i.e., dumping, chipping, recycling, etc.).
  - d. Identify and prepare debris storage and reduction sites.
  - e. Obtain appropriate Federal, State and local permits.
  - f. Advertise an invitation to bid and award debris removal contract based on cost and the contractor's debris removal monitoring and staffing plan.
  - g. Implement a public information campaign that instructs the general public on guidelines for dealing with debris.
3. Project Lead - City of Cranston Public Works Department.
4. Funding Concerns - The estimated number of staff hours to complete this task is 200. In light of this, the City of Cranston has estimated the cost for producing this plan to be \$20,000.00. In addition, minimal costs are anticipated to advertise the invitation to bid and public information campaign.

5. Actions Since 2005 HMP – The City had developed a basic strategy for debris removal after a storm event. However, given magnitude and complexity of debris issues encountered during the March, 2010 flood event, the CHMC has identified the need for a detailed debris removal plan. Said plan needs to include guidance on the funding debris removal, debris removal on private properties and the coordination of state and federal resources in the debris removal effort.
6. Time Frame for Completion – Eighteen months.

#### **B. Waterfront Storm Preparedness Plan**

1. Summary – Cranston's waterfront is home to 121 moored vessels, five marinas with dockside accommodations for an additional 354, and numerous private recreational boating facilities or docks. These facilities not only face direct risks from severe coastal storms but also pose risks to the people that often inhabit them; to the environment should they become holed; and to adjacent shore-side improvements and public evacuation and response activities should they wash ashore. Proactive steps can and should be taken to limit these risks however in accordance with the Rhode Island Coastal Resource Management Council's Guidelines for Municipal Harbor Management Plan storm preparedness requirements.
2. Primary Tasks
  - a. Form a steering committee composed of waterfront stakeholders to serve as an informational resource and to help guide the process.
  - b. Assess the risks including identification of the specific concerns, their level of impact, and their anticipated benefits.
  - c. Identify, assess and select appropriate waterfront mitigation, preparedness and recovery strategies.
  - d. Develop an implementation plan for city and state approval.
  - e. Implement both proactive and re-active strategies as directed.
  - f. Review, evaluate and if necessary revise the storm preparedness plan on an annual basis.
3. Project Lead – City of Cranston Harbormaster
4. Funding Concerns – Completion of this action is estimated to cost between \$5,000 and \$10,000.
5. Actions Since 2005 HMP – A Storm Preparedness and Hazard Mitigation Plan is incorporated into the Cranston Harbor Management Plan as adopted by the City Council in December, 2008 and approved by the CRMC in May, 2010.

#### **C. Hazard Mitigation Comprehensive Plan Element**

1. Summary - The City of Cranston recognizes the importance of hazard mitigation, its interaction with municipal land use and infrastructure planning, and the need for a comprehensive planning approach which accommodates these interdependencies. In light of this and the coordinated yet semi-independent process used to develop this hazard mitigation plan, the City should formally integrate this plan as an eighth functional element of its municipal comprehensive plan. The City's current comprehensive plan addresses land use, housing, economic development, natural resources, services and facilities, open space and recreation and the integration of the proposed eighth element will ensure a coordinated approach to hazard mitigation planning into the future.
2. Primary Tasks
  - a. Reformat the final hazard mitigation plan into a layout consistent with the comprehensive plan design.
  - b. Incorporate this "eighth element" into the comprehensive plan review and update process currently being initiated by the City.

- c. Ensure that hazard mitigation is integrated into the re-write of the comprehensive plan as a whole and that an eighth hazard mitigation element is adopted through standard city procedure.
3. Project Lead - City of Cranston Planning Department.
4. Funding Concerns - The State of Rhode Island requires that municipal comprehensive plans be updated every five years. In light of this, the City of Cranston has budgeted \$80,000.00 to undertake the comprehensive plan review and update process, including the incorporation of an eighth hazard mitigation element. In addition, a master's candidate from the University of Rhode Island has been secured to produce the first draft of the hazard mitigation element at no cost to the city and a request for proposal for completion of the larger comprehensive plan update process will be released in late 2004.
5. Actions Since 2005 HMP – A draft of updated Comprehensive Plan as adopted by the City Plan Commission in the spring of 2010 and is currently under review for adoption by the City Council. In reviewing this action item, the CHMC determined not to include the HMP as a formal element of the Comprehensive Plan. Given the regulatory requirements for amending a comprehensive plan, appending the HMP to the Comprehensive Plan would make future amendments to HMP difficult to implement.

#### **D. – National Flood Insurance Program Community Rating System**

1. Summary – The Community Rating System (CRS) is a part of the National Flood Insurance Program (NFIP). The CRS allows participating communities to be rewarded with incentives for doing more than meeting the minimum NFIP requirements to help their property owners prevent or reduce flood losses. Currently, Cranston is rated a Class 10.  
  
Other incentives for communities to participate in CRS include free technical assistance in designing and implementing recommended flood plain management activities. Implementing some CRS activities, such as flood plain management planning, can help a community qualify for certain federal assistance programs. With the benefits of participating in the CRS program far outweighing the costs, the City NFIP Coordinator and other relevant City Administrators should prepare and implement those activities that will deal with Cranston's priority problems.
2. Primary Tasks
  - a. Establish a working relationship between the City of Cranston NFIP Coordinator and the RIEMA CRS officer.
  - b. Obtain a letter from the FEMA Regional Office detailing the level of the community's compliance with the latest NFIP requirements.
  - c. Inventory the City of Cranston for the 18-flood plain management activities credited by the CRS program.
  - d. Prepare application and appropriate documentation that supports the City's intention for implementing the flood plain management activities recognized in the *CRS Coordinator's Manual*.
  - e. Submit application to RIEMA CRS officer, as well as copies to FEMA and the state NFIP Coordinator.
  - f. Upon feedback given from FEMA and the state NFIP Coordinator to the CRS officer, a verification visit may be scheduled if warranted.
  - g. Continue to recertify application each year that it is continuing to implement those activities specified in the first application.
3. Project Lead - City of Cranston National Flood Insurance Program (NFIP) Coordinator.
4. Funding Concerns - The City of Cranston Planning Department has salaried individuals on staff qualified to complete this project. The estimated number of staff hours to complete this task is 400 hours.

5. Actions Since 2005 HMP – Items a. to c. above have been completed.
6. Time Frame for Completion – Items d. to g. six months and on-going after initial application.

#### **E. Hazard Mitigation Coordinator**

1. Summary – The City will minimize the potential effect of natural disasters by planning proactively. However, this ability to plan proactively is hindered because the full DMA 2000 requirements, as well as the implementation and evaluation of the full plan is beyond the capacity of current staff resources. The City simply cannot carry out these tasks without hiring more people.
2. Primary Tasks
  - a. Secure funding to hire an additional planner on staff for the City of Cranston Planning Department that will specialize in natural hazard mitigation and act as a liaison with the Rhode Island Emergency Management Agency (RIEMA).
  - b. Advertise planning position and hire qualified applicant.
3. Project Lead – City of Cranston Planning Department and the Cranston Emergency Management Agency (CEMA)
4. Funding Concerns – The City of Cranston has estimated the cost of an additional planner on staff to be \$50,000.00. In addition, minimal costs are anticipated to advertise planning position.
5. Actions Since 2005 HMP – Given the City's current fiscal constraints, the CHMC determined that the addition of a full time Hazard Mitigating Coordinator is not feasible. However, the City, working through its Fire Department and the RIEMA, has secured funding to hire a part time planner. This planner splits her time between the City and RIEMA.

#### **F. Evaluation, Revision, and Update of the Cranston Hazard Mitigation Plan**

1. Summary - The City will bi-annually evaluate the Cranston Hazard Mitigation Plan, complete annual supplemental revisions, and five-year updates. This process of evaluation, revision, and update will identify additional priority problems as they may occur, and will allow the City to monitor project implementation schedules to bring the planning process full-circle.
2. Primary Tasks
  - a. Administer annual project evaluations that assess project completeness.
  - b. Conduct biannual public meetings that evaluate the progress of the mitigation actions within the HMP.
  - c. Complete annual supplemental revisions of the HMP, which will address additional natural hazard concerns as they arise.
  - d. Update the HMP every five years.
3. Project Lead – City of Cranston Planning Department and the Cranston Emergency Management Agency (CEMA).
4. Funding Concerns – The City of Cranston has estimated the cost for the evaluation, revision, and update of the Cranston Hazard Mitigation Plan to be \$5,000.00 in staff time.
5. Actions Since 2005 HMP – Upon review, the CHMC recommend that it meets annually to update the HMP. The CHMC has prepared this current update as part of its ongoing activities.
6. Time Frame for Completion – This action item is on-going program.

## **G. Long Term Disaster Mitigation Plan**

### **5.3.3. Regulatory Change**

#### **A. Flood Hazard District Update**

1. Summary – The Cranston Flood Hazard District is in non-compliance with the October 1, 2002, Federal Emergency Management Agency (FEMA) update of the Code of Federal Regulations Title 44 Chapter 1 Part 9 “The Flood Plain Management and Protection of Wetlands” (44CFR Ch. 1 Part 9). The current local zoning ordinance does not make reference to Standards for Variance, the NFIP coordinator, or the floodway maps. Therefore, it is necessary to update the local zoning ordinance to be in accordance with 44CFR Ch. 1 Part 9.
2. Primary Tasks
  - a. Study the current City Zoning Ordinance for Flood Hazard Districts (Sec. 30-4.2) and identify inconsistencies and gaps in comparison to 44CFR Ch. 1 Part 9.
  - b. Draft ordinance application.
  - c. Usher revised Flood Hazard Districts (Sec. 30-4.2) through the municipal approval process including review by City Planning Commission.
3. Project Lead - City of Cranston Planning Department
4. Funding Concerns - The Cranston Planning Department has salaried individuals on staff qualified to perform primary tasks a. - c. at no additional costs to the City. In addition, minimal costs are anticipated to advertise the ordinance revision.
5. Actions Since 2005 HMP – This activity was completed in December, 2008 with the adoption of an updated Floodplain Ordinance and updated FIRM's.

#### **B. Underground Utilities Requirement**

1. Summary – The City of Cranston Subdivision Regulations, Section XII - Design and Public Improvement Standards, Subsection H – Utilities, requires mandatory underground utilities in high hazard areas. However, these requirements have been inconsistently enforced. Mandatory underground utilities would insure essential services are being enhanced for the safety and security of City residents and other entities in high hazard areas. Therefore, the City of Cranston Subdivision Regulations should be amended at Section III, Part 2a(5) Master Plan Submittal Requirements for Utilities to require developers to express their intentions regarding utilities in high hazard areas at the first formal planning review stage. After the developers have introduced their intentions, the City of Cranston Public Works Department - Engineering Division can calculate the cost of the performance bond.
2. Primary Tasks
  - a. Draft regulation.
  - b. Hold optional working session with planning commission.
  - c. Send text to Planning Commission for their review.
  - d. Advertise and hold public hearing.
  - e. Planning Commission decision.
3. Project Lead - City of Cranston Planning Department.
4. Funding Concerns – The City of Cranston Public Works Department - Engineering Division has salaried individuals on staff qualified to coordinate the placement of underground utilities with developers. However, the developer must take on the responsibility of securing the performance bond, which includes the cost for the placement of underground utilities. Lastly, minimal costs are anticipated to advertise the public hearing.
5. Actions Since 2005 HMP – This activity was completed. Since the adoption of the 2005 HMP the City Plan Commission has stringently applied the underground utility requirements of its Subdivision and Land Development Regulations.



### **5.3.4. Preparedness to Reduce Losses**

#### **A. American Red Cross Approved Shelter Capacity**

1. Summary - Providing sufficient shelter capacity is a primary means for protecting life and thereby mitigating the impact from natural hazards. The primary problem that the City faces in increasing its capacity is the number of options that exist, and the need to find the most cost efficient solutions that balances the need with the City's ability to provide staffing during natural hazard events. Whereas the City has a population of 81,686 it only has three American Red Cross (ARC) approved emergency shelters. The Cranston Senior Center, Western Hills Middle School, and Park View Middle School have all been designated as ARC approved emergency shelters. According to the ARC, "experience nationwide indicates that up to 25 percent of the evacuated population will seek public shelters in most disasters. The remainder of evacuees usually provide for themselves or stay with friends or relatives."<sup>33</sup> If the "evacuated population" is defined as the City population living within flood plains, this would indicate that 1640 residents would seek emergency shelter. The City's three emergency shelters are capable of providing public shelter for 753 individuals. Therefore, the City currently faces a deficit of 887 spaces for public emergency sheltering.
2. Primary Tasks
  - a. Project cost for hiring of consultant to evaluate concern.
  - b. Secure funding for consultant and services.
  - c. Advertise a request for proposal and award contract to consultant.
  - d. Identify desired additional capacity based on the City's ability to staff.
  - e. Identify City owned structures that could be considered for shelter designation.
  - f. Identify requirements for receiving ARC approval - create a matrix.
  - g. Compare existing conditions of individual structures against ARC requirements to determine needed improvements for ARC designation at each facility.
  - h. Estimate cost of providing needed improvements at each facility.
  - i. Estimate additional shelter capacity to be gained with appropriate retrofits.
  - j. Analyze information above to identify most cost efficient means for increasing shelter capacity to the targeted level identified in primary task 2a.
  - k. Select appropriate projects for implementation based on the above as well as geographic location.
  - l. Develop implementation plans including consideration for project design, funding, permitting, contractor selection, official ARC designation and project leadership.
3. Project Lead – The Cranston Emergency Management Agency (CEMA) and the American Red Cross (ARC).
4. Funding Concerns - The City of Cranston anticipates the cost of hiring a consultant for this project to be \$15,000.00. In addition, minimal costs are anticipated to advertise the request for proposal.
5. Actions Since 2005 HMP – Since 2005, emergency shelter capacity has been increase by the additions of the Hope Highlands School as a certified Red Cross shelter. Other than the addition of Hope Highlands, no additional action has been taken on this activity.
5. Time Frame for Completion – Two and half years from initiation.

#### **B. Repetitive Loss Strategy**

1. Summary - Repetitive loss properties are those properties enrolled in the National Flood Insurance Program (NFIP) that have experienced two or more insurance claims of at least \$1,000 due to natural hazards over a period of ten years. In other words, repetitive loss properties are properties that are regularly impacted by natural hazards and have a higher than average probability of being impacted in the future and thereby represent a priority for mitigation action. According to the Federal Emergency Management Agency (FEMA) there are currently 352 NFIP holders in the City of Cranston, of which there are 10 repetitive loss properties.

The creation of a repetitive loss strategy simply entails the development of a mitigation plan for each property within the City that experiences repetitive losses. The individual parcel-specific plans can range from structural alterations to complete removal and when combined form a strategy for addressing repetitive losses. In this manner, the development of a repetitive loss strategy directly advances the goals of hazard mitigation planning while also bolstering the City's potential participation in the NFIP Community Rating System Program (CRS).

2. Primary Tasks

- a. Obtain repetitive loss data from NFIP.
- b. Map property location and determine if mitigation recommendations have already been generated through other efforts such as the NRCS Pocasset River Watershed Flood Plain Management Plan.
- c. Estimate cost for hiring of consultant to evaluate concern and produce mitigation designs for repetitive loss properties that have none.
- d. Secure funding for consultant and services.
- e. Advertise a request for proposal and award contract to consultant.
- f. Complete study and design phase, produce final repetitive loss strategy, including individual project estimates, funding sources and implementation schedules.
- g. Initiate implementation.

3. Project Lead - City of Cranston National Flood Insurance Program (NFIP) Coordinator.

4. Funding Concerns – Development of the strategy can be completed by the City's NFIP Coordinator. However, the cost to implement the strategy cannot be identified at this time and it is anticipated that a variety of private as well as public grant funds will be needed. In addition, the City of Cranston has estimated the cost of hiring a consultant to evaluate concern and produce mitigation designs for repetitive loss properties that have none to be \$15,000.00. Lastly, minimal costs are anticipated to advertise the request for proposal.

5. Actions Since 2005 HMP – Given the number of repetitive loss properties, the City is required to develop a flood plain management plan or repetitive loss analysis as part of any CRS application. As noted above, the City is in the process of submitting a CRS application to FEMA.

6. Time Frame for Completion – Eighteen months.

### 5.3.5. Education and Training

#### A. **Flood Hazard Districts Training for Municipal Officials**

1. Summary - The purpose of the workshop is to present a greater understanding to municipal officials, employees, boards, and commissions regarding the implications of the amended City Zoning Ordinance for Flood Hazard Districts (Sec. 30-4.2) as indicated in Action III-A. These training workshops will review the amendments made to Sec. 30-4.2, as well as discuss hazard mitigation, particularly flood mitigation, and actions/responsibilities of the City administration during a natural disaster. This action will also support Action IV-B.

2. Primary Tasks

- a. Establish a working committee that includes: the Cranston National Flood Insurance Program (NFIP) Coordinator, the Cranston Emergency Management Agency (CEMA), and the Rhode Island Emergency Management Agency (RIEMA) to conduct necessary trainings on disaster mitigation and preparedness.
- b. Draft an agenda that includes topics of hazard mitigation to be discussed including flood mitigation and actions/responsibilities during a natural disaster.
- c. Secure venue for workshops.
- d. Advertise training sessions that will be deemed necessary for the City Planning Department, Planning Commission, Building Inspections Department and Zoning Board to attend.

3. Project Lead – The Cranston National Flood Insurance Program (NFIP) Coordinator.
4. Funding Concerns - Federal certification funding is available. Minimal costs are anticipated to advertise workshops.
5. Actions Since 2005 HMP – Since 2005, CEMA, RIEMA and FEMA has formed a partnership by which flood hazard training is offered through RIEMA. The workshop offered through RIEMA has minimized, if not altogether eliminated, the need for the City sponsored workshops target to local official.
6. Time Frame for Completion – On-going.

#### **B. Small Business Hazard Mitigation Training and Disaster Outreach Program**

1. Summary - The City of Cranston understands the importance of small businesses to the City's economic vitality. The City also realizes that small businesses face larger challenges recovering from natural disasters. Therefore, the City will create a Small Business Disaster Outreach Program that will educate small business owners about the Small Business Administration (SBA) Pre-Disaster Mitigation Loan Program. The Small Business Disaster Outreach Program will present financial options available to small business owners for implementing mitigation measures to protect business property from damage that may be caused by future disasters. This action will also support Action IV-B.
2. Primary Tasks
  - a. Compile contact information for all businesses located within all identified risk areas of the City (see Table 10) and update annually.
  - b. Identify local contact at the SBA regarding disaster loan programs and establish a working relationship.
  - c. Confirm understanding and availability of programs and procure educational materials.
  - d. Educate small business owners as to the availability of the programs through direct mailings and informational workshops.
3. Project Lead – Cranston Department of Economic Development
4. Funding Concerns - The Department currently estimates the cost for completing the primary tasks to be \$5,000.00.
5. Actions Since 2005 HMP – No action has been taken on this activity.
6. Time Frame for Completion – One year after initiation.

#### **C. Hazard Mitigation Public Preparedness & Education Program**

1. Summary - The City will seek assistance from the Cranston Emergency Management Official (CEMO) and the American Red Cross (ARC) as a phase I effort to develop public education and outreach programs on disaster mitigation and preparedness, and distribute and make material available concerning: evacuation routes, emergency shelters, critical facilities and maps of City risks. In addition, as a phase II effort, the City will seek assistance from the Cranston National Flood Insurance Program (NFIP) Coordinator to provide property owners information regarding properties that are subject to flooding. Discussion topics will include property protection measures appropriate for flood mitigation and basic facts about the NFIP. This action will also support Action IV-B.
2. Primary Tasks
  - a. Establish a working relationship between the Cranston National Flood Insurance Program (NFIP) Coordinator, the Cranston Emergency Management Agency (CEMA), and the American Red Cross (ARC) regarding topics to be discussed with public.

- b. Draft an agenda for the phase I effort that includes topics to be discussed such as: materials concerning: evacuation routes, emergency shelters, critical facilities and maps of City risks.
  - c. Draft an agenda for the phase II effort that includes topics to be discussed such as property protection measures appropriate for the flood mitigation and the basic facts about flood insurance.
  - d. Secure venue for workshops.
  - e. Schedule the trainings along with outreach materials that are to be distributed at least 90% of the target audience.
  - f. Advertise public preparedness education workshops available to the public.
3. Project Lead – The Cranston NFIP Coordinator, the CEMA, and the ARC.
4. Funding Concerns - Federal certification funding is available. Minimal costs are anticipated to advertise the public preparedness workshops.
5. Actions Since 2005 HMP – No action has been taken on this activity.
6. Time Frame for Completion – Two years after initiation.

**Table 14: Review of 2005 HMP Mitigation Actions and Objectives**

Actions From 2005 Plan		Implementation Status			Implementation Notes <i>(e.g. work completed, next steps, no funds, staff limitations, no longer an issue, carry forward to 2010 plan update)</i>
		Complete	Partially Complete	Not Started	
1	Pocasset River Flooding Improvement		X		The NRCS has completed hydrologic analysis of the Pocasset River Basis and has completed preliminary design. The NRCS and the City is currently seeking funds so that NRCS can undertake final engineering design and undertake the flood improvements proposed.
2	Meshanticut Brook Flooding Imp.			X	No actions have been taking on these proposed activities. In reviewing this action item, the CHMC identified drainage improvements to Wilbur Avenue where it passes under the State's bike path as the primary issue to be addressed. In addition, the CHMC identified other areas with similar flooding issues that should be address in a similar manner. These areas are Lake Street, Randall at Atwood Avenue and Cranston Street at Haven Street.
3	Stillhouse Cove Erosion Control	X			This activity was completed in the spring of 2009
4	WCWD Service Loop		X		Since the 2005 Plan, the PWWSB has completed design activities a. to d. above. PWSP needs to advertise and award a bid and to construct the 16" main.
5	Sewage Infiltration & Inflow Analysis			X	The CHMC has determined this mitigation action is still relevant, Initial studies to be completed by Spring 2012 with detailed studies to be completed within three years after initial studies. [Conditioned on funding]. This mitigation will be ongoing as new lines are added.
6	Pump Station Flood Proofing			X	Due to the City's recent experience during the March, 2010 flooding event, the CHMC has determined that the pump stations, as well as the City's sewerage treatment facilities should be projected to the 500-year flood event. Upgrades to occur as funds become available.
7	Flood Proof Peters School			X	No action has been taken on these proposed activities. However in reviewing this action item, the CHMC believes that this action item should not be a high priority. The George J. Peters Elementary School shown as being located within the Randall Pond floodplain. However, given both recent and past flood events which did not impact the school, the CHMC would recommend undertaking flood studies to determine if the school can be removed from the floodplain.

Actions From 2005 Plan		Implementation Status			Implementation Notes <i>(e.g. work completed, next steps, no funds, staff limitations, no longer an issue, carry forward to 2010 plan update)</i>
		Complete	Partially Complete	Not Started	
8	Tree-Trimming Program			X	No action has been taken on this activity. However, the CHMC would note that the electric and telecommunications utilities have an ongoing and highly effective program of tree trimming. The CHMC has determined that in activities identified under that action item are still relevant and need to be completed. In addition, the CHMC has determined that the City should enact an ordinance which would prohibit the planting of trees within a utility easement.
9	Bridge Retrofitting and Repair		X		The CHMC would note that 3 bridges located within the City have are in the process of being repaired. The RIDOT has begun the process of repairing its bridges on Reservoir Avenue and Pontiac Avenue. These bridges have deteriorate with age and had been weight restrict. The City has begun the process of replacing the Natick Avenue Bridge. This bridge suffered major damage during the March, 2010 flood event. A replacement bridge is currently being design with construction to follow design. The CHMC has determined this remaining activities in this mitigation action are still relevant and should be implemented .
10	Tennessee Gas Clear Zone	X			This action item has been competed.
11	Debris Management Plan			X	The City had developed a basic strategy for debris removal after a storm event. However, given magnitude and complexity of debris issues encountered during the March, 2010 flood event, the CHMC has identified the need for a detailed debris removal plan. Said plan needs to include guidance on the funding debris removal, debris removal on private properties and the coordination of state and federal resources in the debris removal effort.
12	Storm Preparedness Plan	X			A Storm Preparedness and Hazard Mitigation Plan is incorporated into the Cranston Harbor Management Plan as adopted by the City Council in December, 2008 and approved by the CRMC in May, 2010.
13	Comp Plan - Hazard Mitigation	N/A			The CHMC determined not to include the HMP as a formal element of the Comprehensive Plan. Given the regulatory requirements for amending a comprehensive plan, appending the HMP to the Comprehensive Plan would make future amendments to HMP difficult to implement.
14	NFIP Community Rating System		X		The City has undertaken the preliminary steps need to apply for participation in the CRS program. It plans to file a full application to participate in the CRS program in Fall, 2010.
15	Hazard Mitigation Coordinator	X			Given the City's current fiscal constraints, the CHMC determined that the addition of a full time Hazard Mitigating Coordinator is not feasible. However, the City, working through its Fire Department and the RIEMA, has secured funding to hire a part time planner. This planner spits her time between the City and RIEMA.

		Implementation Status			Implementation Notes <i>(e.g. work completed, next steps, no funds, staff limitations, no longer an issue, carry forward to 2010 plan update)</i>
Actions From 2005 Plan		Complete	Partially Complete	Not Started	
16	CHMP Evaluation & Update	X			Upon review, the CHMC recommend that it meets annually to update the HMP. The CHMC has prepared this current update as part of its ongoing activities.
17	Flood Hazard District Update	X			This activity was completed in December, 2008 with the adoption of an updated Floodplain Ordinance and updated FIRM's
18	Underground Utilities Requirement	X			Since the adoption of the 2005 HMP the City Plan Commission has stringently applied the underground utility requirements of its Subdivision and Land Development Regulations.
19	ARC Shelter Capacity		X		Since 2005, emergency shelter capacity has been increase by the additions of the Hope Highlands School as a certified Red Cross shelter. Other than the addition of Hope Highlands, no additional action has been taken on this activity. The CHMC has determined that the remaining activities in this mitigation action are still relevant and should be implemented .
20	Repetitive Loss Strategy			X	Given the number of repetitive loss properties, the City is required to develop a flood plain management plan or repetitive loss analysis as part of any CRS application. As noted below, the City is in the process of submitting a CRS application to FEMA.
21	Flood Hazards Training Workshop	X			Since 2005, CEMA, RIEMA and FEMA has formed a partnership by which flood hazard training is offered through RIEMA. The workshop offered through RIEMA has minimized, if not altogether eliminated, the need for the City sponsored workshops target to local official. The City will continue to participate in RIEMA and FEMA sponsored workshops.
22	Small Bus. Outreach Program			X	No action has been taken on this activity. The CHMC has determined that the activities in this mitigation action are still relevant and should be implemented .
23	Public Preparedness Program			X	No action has been taken on this activity. The CHMC has determined that the activities in this mitigation action are still relevant and should be implemented .
24	Long Term Disaster Mitigation Plan			X	Given the City's experience during the March, 2010 flood events, the CHMC has added this activity to its list of mitigation actions. It is clear to the CHMC that said plan needs to be developed to better address damage resulting from flood events.

## Implementation Element

### 6.1 Prioritization of Mitigation Actions

Having identified appropriate mitigation actions the Cranston Hazard Mitigation Committee set about prioritizing them for implementation. To accomplish CHMC ranked the actions from 1 to 16 with 1 representing their highest implementation priority and 16 their lowest. Criteria used by members in formulating their rankings included the probability of the hazard, potential fiscal impacts and potential population impacts among others. These individual values were then totaled to produce combined rankings for each action and a prioritized approach to implementation. As above, those actions with the lowest total values were considered high priorities and those with the highest were considered low priorities. The prioritized results of this process are displayed in Table 15.

### 6.2 Implementation Schedule

With the implementation of the mitigation actions prioritized the Cranston Hazard Mitigation Committee developed the following schedule which programs when the actions should be implemented. A five year timeframe is used and the programming is based on the prioritization discussed above as well as the existing work plans of the respective project leads and conditioned on funding availability. Prospective project leads were given an opportunity for input in this process and the city is committed to working with its respective partners to ensure completion of the tasks in accordance with the specified timeframes.

**Table 15: Implementation Schedule**

	Mitigation Actions	2010	2011	2012	2013	2014
High Priority	5.3.1.A. Pocasset River Flooding Improvement					
	5.3.2.G. Long Term Recovery Plan					
	5.3.2.A. Debris Management Plan					
	5.3.1.B. Meshanticut Brook Flooding Imp.					
	5.3.1.F. Pump Station Flood Proofing					
Medium Priority	5.3.1.E. Sewage Infiltration & Inflow Analysis					
	5.3.1.D. WCWD Service Loop					
	5.3.4.A. Increase ARC Shelter Capacity					
	5.3.1.H. Tree-Trimming Program*					
	5.3.1.I. Bridge Retrofitting and Repair					
Medium Priority	5.3.4.B. Repetitive Loss Strategy					
	5.3.2.D. NFIP Community Rating System					



	Mitigation Actions	2010	2011	2012	2013	2014
Low Priority	5.3.2.F CHMP Evaluation & Update*	e	e	e	e	e
	5.3.5.B. Small Bus. Outreach Program					
	5.3.5.C. Public Preparedness Program					
	5.3.1.G. Flood Proof Peters School					
Completed	5.3.1.C. Stillhouse Cove Erosion Control	completed				
	5.3.1.J. Tennessee Gas Clear Zone*	completed				
	5.3.3.A. Update City Flooding Ordinance	completed				
	5.3.5.A. Flood Hazards Training Workshop	completed/on going				
	5.3.3.B. Subdivision Enforcement	completed/on going				
	5.3.2.B. Storm Preparedness Plan	completed				
	5.3.2.E. Hazard Mitigation Coordinator	completed/on going				
	5.3.2.C. Comp Plan - Hazard Mitigation	deleted				

### 6.3 Evaluation and Revision

The Cranston Hazard Mitigation Committee recognizes that an effective planning process does not have a beginning and end but is cyclical and incorporates evaluation and revision as a reoccurring mid point in a continuing process of accomplishment, assessment, and refinement. In recognition of this, the Cranston Hazard Mitigation Committee has committed to an ongoing process that will evaluate and refine this Hazard Mitigation Plan at regularly scheduled intervals.

The Cranston Hazard Mitigation Committee will meet every six months to monitor and encourage implementation of the mitigation actions in accordance with the above schedule. Supplemental revisions to the strategy may also be considered by the Cranston Hazard Mitigation Committee whenever deemed appropriate.

The Cranston Hazard Mitigation Committee will conduct a complete evaluation and plan update every five years. The five year update will start with an evaluation of effectiveness of the current plan with an eye toward documenting mitigated potential losses, re-assess the risks of the City as they exist at that time and propose additional mitigation actions for future implementation.

## Public Input and Adoption Processes

Prior to public release of the 2010 HMP, the HMPC reviewed and updated the 2005 HMP. Said review was undertaken through a series of committee meetings. While these meetings did not rise to the level of public hearings and were not advertised, they were open to the public. Table 16 below provides a summary of the HMPC meeting dates and the activities that they conducted:

**Table 16 Summary of CHMC Activities**

<b>Date</b>	<b>Meeting Summary</b>
5/14/10	Kick of meeting. CHMC set strategy for update and established future meeting dated. The CHMC reviewed and updated "Executive Summary", "Introduction" and "Natural Hazards" [partial].
5/21/10	The CHMC reviewed and updated "Natural Hazards" and "Risk Assessment" [partial]. The CHMC identified areas of the risk assessment for which new data would be required. The CHMC also reviewed a draft of the Risk Assessment Map for corrections and format.
5/28/10	The CHMC reviewed and updated "Risk Assessment" [see above] and "Risk Assessment Matrix" [partial].
6/4/10	The CHMC completed its review and update of the "Risk Assessment Matrix".
6/11/10	The CHMC reviewed and updated "Programmatic Capability Assessment" and "Identification Mitigation Actions" [partial].
6/18/10	The CHMC reviewed and updated "Identification Mitigation Actions". The CHMC also review updated data for "Natural Hazards", "Risk Assessment" and "Risk Assessment Matrix".
7/1/10	The CHMC also review updated data for "Natural Hazards", "Risk Assessment" and "Risk Assessment Matrix". The CHMC undertook a second review of "Identification Mitigation Actions."
7/23/10	The CHMC review draft of 2010 HMP document for accuracy and revisions.
7/30/10	The CHMC review draft of 2010 HMP document for accuracy and revisions. The CHMC also reconfirmed its public participation process.
8/13/10	The CHMC review draft of 2010 HMP document for accuracy and revisions. The CHMC also established priorities and a time schedule for Mitigation Actions.

This hazard mitigation plan benefits from two distinct types of public input strategies that were utilized by the CHMC during the drafting process and prior to its adoption by the City Council.

The first strategy focused on seeking the direct and early involvement of those entities that were specifically identified as being at risk and whose support and cooperation would be needed for implementation of mitigation actions. Those encouraged to participate in this process included National Grid, Veolia Water, the Providence Water Supply Board, Verizon, Cox Communications, the United States Department of Agriculture Natural Resource Conservation Service, and the American Red Cross. At a minimum each of the parties identified above were provided a copy of the draft 2010 update to the HMP and were asked for the review and comments. Their specific roles focused on reviewing the content of the risk assessment matrix to ensure proper classification of problems and estimates of potential impacts; formulation of mitigation actions and sequencing of primary tasks; and identification of feasible implementation methods and schedules. Their comments are incorporated into the final 2010 HMP. In addition, a copy of the 2010 HMP was forwarded to Planning Departments of the abutting communities including Providence, Johnston, Scituate, Coventry, West Warwick and Warwick for review and comments and the departments were contacted on **[dates]**. The comments received from the abutting communities are incorporated into the final 2010 HMP.

In addition, the CHMC invited input from the Cranston Harbormaster, Housing Authority, School Department, Recreation Department, Historic District Commission, Engineering Division, Tax Assessors Office and Planning Department. Review and comment was also sort from the Federal Emergency Management Agency as well as the Rhode Island Emergency Management Agency prior to adoption.

The second public input strategy used in the formulation of this plan was geared toward the general public as opposed to specific stakeholders. The general public was encouraged to become involved through a public participation process. A copy of the draft 2010 HMP was posted to the Planning Department's page on the City of Cranston's web site. On September 7, 2010, the City Plan Commission conducted a public workshop on the HMP. The opportunity for public involvement was provided to the

public through publication in the Cranston Herald, a newspaper of general circulation within the City of Cranston during the week of **[date]**. In addition, the Cranston City Council conducted two public hearings on a City ordinance that adopted the 2010 HMP. The first public hearing was then held on **[date]** before the City's Ordinance Committee and the Cranston City Council subsequently heard and approved what at that point had become a resolution for adoption of the plan at a second advertised public meeting held on **[date]** (see appendix J).

## APPENDIX A

***Critical Municipal Facilities Inventory***

<b>Name</b>	<b>Location</b>	<b>Zip Code</b>	<b>A. P.</b>	<b>Lot</b>
Cranston City Hall	869 Park Avenue	02910	6/2	240
Cranston Fire Department - Auburn/Cranston Emergency Management Headquarters	301 Pontiac Avenue	02910	6/2	260
Cranston Fire Department - Edgewood	131 Park Avenue	02905	2/5	1319
Cranston Fire Department - Knightsville	1384 Cranston Steet	02910	8/2	2642
Cranston Fire Department - Garden City	160 Sockanosset Cross Road	02920	14	12
Cranston Fire Department - Oaklawn	1099 Oaklawn Avenue	02920	18/4	1290
Cranston Fire Department - Comstock	1155 Scituate Avenue	02921	36/3	65
Cranston Police Station*	275 Atwood Avenue	02920	12/4	2700
Cranston Public Works Garage	929 Phenix Avenue	02920	17/1	200
Cranston Senior Services Center - ARC	1070 Cranston Street	02920	7/4	2371
Western Hills Middle School - ARC	400 Phenix Avenue	02920	17/2	1810
Park View Middle School - ARC	25 Park View Boulevard	02910	4/4	1400
Pettaconsett Sewage Treatment Facility*	Pettaconsett Avenue	02920	10/2	27
Allard Pumping Station*	85 Allard Street	02920	18/4	692
Amanda Pumping Station	5 Redfern Drive	02920	18/3	1675
Bay Street Pumping Station*	9 Bay Street	02905	2/3	2769
Burnham Street Pumping Station	77 Burnham Street	02921	7/5	1429
Cranston Commons Pumping Station	36 Starline Way	02921	35	207
Dyer Avenue Pumping Station*	399 Dyer Avenue	02920	8/4	2691
East Street Pumping Station	328 East Street	02920	15/3	1603
Gleason Street Pumping Station	11 Gleason Street	02910	6/4	2124
Hollow Tree Pumping Station*	1771 Pontiac Avenue	02920	15/3	1577
Howard Pumping Station*	103 Kenney Drive	02920	10/4	1466
Mayflower Pumping Station	140 Mayflower Drive	02905	4/5	2605
Plainfield Circle Pumping Station	1580 Plainfield Circle	02920	37/2	In Right of Way (Underground)
Pontiac Avenue Pumping Station	900 Pontiac Avenue	02920	5/4	1
Randall Street Pumping Station (Libera, Fletcher and Cross Country)*	176 Randall Street	02920	12/4	2825
Seaview Avenue Pumping Station*	85 Seaview Avenue	02905	1	496
Sheldon Street Pumping Station*	115 Sheldon Street	02905	1	82
Sherman Avenue Pumping Station*	90 Sherman Avenue	02920	17/3	1822
Wellington Street Pumping Station	245 Station Street	02910	5/3	2562
Welsh/I-295 Pumping Station	1970 Plainfield Pike	02921	36/2	55
Woodbury Road Pumping Station*	110 Woodbury Road	02905	1	467
Worthington Road Pumping Station*	54 Worthington Road	02920	10/4	767
Youlden Street Pumping Station*	7 Youlden Avenue	02910	4/3	822
Alpine Estates Water Booster Station	6 Basil Crossing	02921	35	131
Aqueduct/Scituate Water Booster Station Western Cranston Water Facility	430 Scituate Avenue	02921	20/2	2122
Cranston Commons Water Booster Station	34 Starline Way	02921	35	206
Dean Estates Water Booster Station	50 Melody Lane	02920	16/4	1089
Garden Hills Water Booster Station	90 Rockcrest Street	02920	16/3	761

Sources: Jack McGilvray, Cranston Public Works Aide, 05/06/2003. Robert Warren, Chief of the Cranston Fire Department, 05/14/2003.

Note: \* Within flood plain.

## APPENDIX B

### *School Inventory*

<b>School Name</b>	<b>Address</b>	<b>Zip Code</b>	<b>A. P.</b>	<b>Lot</b>	<b>Grades</b>	<b>Floors</b>	<b>ADA Compliant</b>	<b>Generators</b>
Arlington Elementary	155 Princess Avenue	02920	7/4	3248	K - 5	1	No	No
Chester Barrows Elementary	9 Beachmont Avenue	02905	3/1	1283	K - 5	2	No	No
William R. Dutemple Elementary	32 Garden Street	02920	6/1	142	K - 5	2	No	No
Eden Park Elementary	180 Oakland Avenue	02910	9/3	2847	K - 5	1	No	No
Edgewood Highlands Elementary	160 Pawtuxet Avenue	02905	2/3	3487	K - 5	2	Yes	Yes
Garden City Elementary	70 Plantation Drive	02910	10/1	709	K - 5	1	Yes	No
Gladstone Elementary	50 Gladstone Street	02920	7/4	2357	K - 5	3	No	No
Glen Hills Elementary	50 Glen Hills Drive	02920	16/4	138	K - 5	1	Yes	No
Hope Highlands Elementary	300 Hope Road	02921	24	6	K - 5	2	Yes	No
Horton Elementary	1196 Park Avenue	02910	9/4	1710	K - 5	2	No	No
Norwood Avenue Elementary	205 Norwood Avenue	02905	2/3	834	K - 5	2	No	No
Oak Lawn Elementary*	28 Stoneham Street	02920	18/4	692	K - 5	2	No	No
Orchard Farms Elementary	1555 Scituate Avenue	02921	34	8 & 9	K - 5	1	Yes	Yes
George J. Peters Elementary*	15 Mayberry Street	02920	12/4	3244	K - 5	1	No	No
Edward S. Rhodes Elementary	160 Shaw Avenue	02905	2/2	1674	K - 5	2	No	No
Stadium Elementary	100 Crescent Avenue	02910	7/5	1900	K - 5	1	Yes	No
Stone Hill Elementary	21 Village Avenue	02920	37/2	268	K - 5	1	No	No
Daniel D. Waterman Elementary	722 Pontiac Avenue	02910	5/2	2109	K - 5	2	No	No
Woodridge Elementary	401 Budlong Road	02920	11/6	3151	K - 5	1	Yes	No
Hugh B. Bain Middle School	135 Gansett Avenue	02910	7/5	1160	6 - 8	2	No	No
Park View Middle School	25 Park View Boulevard	02910	4/4	1400	6 - 8	2	No	No
Western Hills Middle School	400 Phenix Avenue	02920	17/2	1810	6 - 8	2	Yes	Yes
Cranston East High	899 Park Avenue	02910	6/2	550	9 - 12	3	No	No
Cranston West High	80 Metropolitan Avenue	02920	17/2	199	9 - 12	2	Yes	Yes (Just Gym)
Cranston West Vocational Facility*	80 Metropolitan Avenue	02920	17/2	1956	9 - 12	2	Yes	Yes
Cranston Charter School	4 Sharpe Drive	02920	13	61	9 - 12	1	Yes	Yes

Source: Joel Zisserson, Cranston School Department Director of Transportation, 07/02/2003 and 07/08/2003.

Note: \* Within flood plain.

## APPENDIX C

***Bridge and Culvert Inventory***

<b>RIDOT Bridge #</b>	<b>Bridge or Culvert</b>	<b>Structure Carried</b>	<b>Utilities</b>	<b>Feature Intersected</b>	<b>A. P.</b>	<b>Ownership</b>	<b>Maintainee</b>
101*	Bridge	Elmwood Avenue	X	Pawtuxet River	4/2	State	State
2301*	Bridge	Reservoir Avenue		Pocasset River	9/2	State	State
2401*	Bridge	Providence Street		Meshanticut Brook	18/3	State	State
2501	Bridge	Providence Street		State Bike Path	18/3	State	State
8101*	Bridge	Plainfield Pike	X	Pocasset River	12/2	State	State
8201*	Bridge	Plainfield Pike	X	Locust Brook	36/1	State	State
15001*	Bridge	Warwick Avenue	X	Pawtuxet River	4/5	State	State
15201	Footbridge	Furnace Hill Road	X	Furnace Hill Brook	19/1	City	City
19001*	Bridge	Broad Street	X	Pawtuxet River	1	State	State
20101*	Bridge	Pontiac Avenue	X	Pocasset River	10/2	State	State
28601	Bridge	Oaklawn Avenue		State Bike Path	11/3	State	State
32801	Bridge	Gansett Avenue		State Bike Path	11/2	City	City
32901	Bridge	Scituate Avenue		Brook	12/6	State	State
33001*	Bridge	Scituate Avenue		Meshanticut Brook	34	State	State
33101	Bridge	Pippin Orchard Road	X	Brook	34	State	State
33201*	Bridge	Pippin Orchard Road	X	Furnace Hill Brook	34	State	State
33301*	Bridge	Pippin Orchard Road	X	Meshanticut Brook	28	State	State
34701	Bridge	Dean Parkway	X	State Bike Path	17/4	City	City
34901*	Bridge	Phenix Avenue	X	Furnace Hill Brook	17/1	State	City
35701	Bridge	Pontiac Avenue		Branch R.R.	13	State	State
41301	Bridge	Phenix Avenue		Furnace Hill Brook	21/2	City	City
42001	Bridge	State Bike Path		Wilbur Avenue	18/4	State	State
42002	Bridge	State Bike Path		Wilbur Avenue	18/4	State	State
42101	Bridge	Reservoir Avenue		Meshanticut Interchange Lane B	15/1	State	State
42102	Bridge	Reservoir Avenue		Meshanticut Interchange Lane B	15/1	State	State
42201	Bridge	Meshanticut Interchange		Oaklawn Avenue	18/3	State	State
42202	Bridge	Meshanticut Interchange		Oaklawn Avenue	18/3	State	State
42301	Bridge	Meshanticut Viaduct		Oaklawn Avenue & Lane C	15/1	State	State
42302	Bridge	Meshanticut Viaduct		Oaklawn Avenue & Lane C	15/1	State	State
42401*	Bridge	New London Avenue - Lane H		Meshanticut Interchange - Lane A	18/3	State	State
43401*	Bridge	Natick Avenue		Furnace Hill Brook	19/1	State	State
45301	Bridge	Route 10 Viaduct		Cranston Street, SR -3 & AMTRAK	7/1	State	State
45302	Bridge	Route 10 Viaduct		Cranston Street, SR -3 & AMTRAK	7/1	State	State
48001*	Bridge	Park Avenue	X	Pocasset River	11/1	State	State
49401*	Bridge	Dyer Avenue Extension	X	Pocasset River	11/1	State	State
	Skeleton						
54101	Valley Bridge	Scituate Avenue		Pedestrian Underpass	12/6	State	State
61601	Bridge	Interstate - 95		Glen Hills Drive	16/4	State	State
61602	Bridge	Interstate - 95		Glen Hills Drive	16/4	State	State
61701	Culvert	Interstate - 95		Three Ponds Brook	13	State	State
62001	Bridge	Cranston Park Ramp E - N		Interstate - 295 S	19/1	State	State
62002	Bridge	Cranston Park Ramp E - N		Interstate - 295 S	19/1	State	State
62101	Bridge	Route 37		Cranston Street	17/3	State	State
62201	Bridge	Route 37		State Bike Path	17/3	State	State
62301	Bridge	Route 37		Oaklawn Avenue	16/1	State	State
62302	Bridge	Route 37		Oaklawn Avenue	16/1	State	State
62401	Bridge	Route 37		New London Avenue	14	State	State
62402	Bridge	Route 37		New London Avenue	14	State	State
62501	Bridge	Route 37		Howard Service Road	14	State	State
62601	Bridge	Route 37		Branch R.R.	10/4	State	State
62701	Bridge	Route 37		Pontiac Avenue	10/4	State	State
62801*	Bridge	Route 37 E		Pawtuxet River (South)	10/4	State	State
62901*	Bridge	Route 37 W		Pawtuxet River (North)	10/4	State	State
66101	Bridge	Interstate - 95		Wellington Avenue	3/3	State	State
66201	Bridge	Interstate - 95 & Ramp CB		Wellington Avenue	3/3	State	State
66301	Bridge	Wellington Avenue and AMTRAK		Interstate - 95	3/3	State	State
66401	Bridge	Route - 10 North Ramp BC		Interstate - 95	3/3	State	State
66402	Bridge	Route - 10 North Ramp BC		Interstate - 95	3/3	State	State

Source: David DeNuccio, Cranston Engineering Dept., 06/27/2003.

Note: \* Within flood plain.

## APPENDIX C (CONTINUED)

**Bridge and Culvert Inventory**

<b>RIDOT Bridge #</b>	<b>Bridge or Culvert</b>	<b>Structure Carried</b>	<b>Utilities</b>	<b>Feature Intersected</b>	<b>A. P.</b>	<b>Ownership</b>	<b>Maintainee</b>
66501	Bridge	Route - 10 Viaduct		Interstate - 95 & AMTRAK	3/3	State	State
66502	Bridge	Route - 10 Viaduct		Interstate - 95 & AMTRAK	3/3	State	State
66601	Bridge	Route - 10 South Ramp DB		Interstate - 95	3/3	State	State
66602	Bridge	Route - 10 South Ramp DB		Interstate - 95	3/3	State	State
66801	Bridge	Pontiac Avenue		Route - 10	6/1	State	State
66802	Bridge	Pontiac Avenue		Route - 10	6/1	State	State
67501	Bridge	Park Avenue East		Route - 10	3/2	State	State
67502	Bridge	Park Avenue East		Route - 10	3/2	State	State
67601	Bridge	Park Avenue		Interstate - 95	3/2	State	State
67602	Bridge	Park Avenue		Interstate - 95	3/2	State	State
67701	Bridge	Laurens Street		Interstate - 95	3/2	State	State
67702	Bridge	Laurens Street		Interstate - 95	3/2	State	State
67801	Bridge	Milford Street		Interstate - 95	5/2	State	State
67802	Bridge	Milford Street		Interstate - 95	5/2	State	State
67901	Bridge	Branch R.R.		Interstate - 95	5/2	State	State
67902	Bridge	Branch R.R.		Interstate - 95	5/3	State	State
68001*	Bridge	Interstate - 95		Pawtuxet River	5/3	State	State
72601	Bridge	Providence Street		Interstate - 295	18/3	State	State
72602	Bridge	Providence Street		Interstate - 295	18/3	State	State
72701*	Bridge	Interstate - 295 N		Wilbur Avenue (Northbound)	18/4	State	State
72721*	Bridge	Interstate - 295 S		Wilbur Avenue (Southbound)	18/2	State	State
72801*	Bridge	Cranston Park East - Route 37		Interstate - 295 N	19/2	State	State
72802*	Bridge	Cranston Park East - Route 37		Interstate - 295 N	19/2	State	State
72821*	Bridge	Cranston Park West - Route 37		Interstate - 295 S	19/2	State	State
72822*	Bridge	Cranston Park West - Route 37		Interstate - 295 S	19/2	State	State
72901	Bridge	Phenix Avenue (Eastbound)		Interstate - 295 N	17/1	State	State
72902	Bridge	Phenix Avenue (Eastbound)		Interstate - 295 N	17/1	State	State
72921	Bridge	Phenix Avenue (Westbound)		Interstate - 295 S	17/1	State	State
72922	Bridge	Phenix Avenue (Westbound)		Interstate - 295 S	17/1	State	State
73001	Bridge	Interstate - 295 N		Water Aquaduct (Northbound)	26/1	State	State
73021	Bridge	Interstate - 295 S		Water Aquaduct (Southbound)	26/1	State	State
73101	Bridge	Interstate - 295		Scituate Avenue	37/3	State	State
73102	Bridge	Interstate - 295		Scituate Avenue	37/3	State	State
73201	Bridge	Interstate - 295 N		Plainfield Pike (Northbound)	36/2	State	State
73202	Bridge	Interstate - 295 N		Plainfield Pike (Northbound)	36/2	State	State
73221	Bridge	Interstate - 295 S		Plainfield Pike (Southbound)	36/2	State	State
73222	Bridge	Interstate - 295 S		Plainfield Pike (Southbound)	36/2	State	State
75801*	Bridge	Garden City Drive		Pocasset River	9/1	State	State
81201	Culvert # 2	Interstate - 295		Meshanticut Brook (Northbound)	18/1	State	State
81221*	Culvert # 2	Interstate - 295 S		Meshanticut Brook (Southbound)	18/1	State	State
81301	Culvert # 3	Interstate - 295		Meshanticut Brook	18/3	State	State
81321	Culvert # 3	Interstate - 295 S		Meshanticut Brook (Southbound)	18/1	State	State
81401*	Culvert # 4	Interstate - 295 N		Meshanticut Brook (Northbound)	18/4	State	State
81421*	Culvert # 4	Interstate - 295 S		Meshanticut Brook (Southbound)	18/2	State	State
81501*	Culvert # 5	Interstate - 295 & Route 37 Ramp		Meshanticut Brook	17/1	State	State
81601*	Culvert # 6	Route 37 Ramp & Interstate 295 S		Meshanticut Brook	19/1	State	State
81701*	Culvert # 7	Interstate - 295 Ramps WS & SW		Meshanticut Brook	19/1	State	State
81801*	Furnace Hill Brook Culvert	Interstate - 295 S & Ramp W - S		Furnace Hill Brook	17/1	State	State
81901*	Culvert	Wilbur Avenue		Meshanticut Brook	18/2	State	State
83101	Bridge	Route 37 Ramp		Cranston Street Ramp	17/3	State	State
84201	Bridge	Hill Street (Coventry)		Pawtuxet River	30/1	State	City
92201	Bridge	Park Avenue		AMTRAK	3/2	State	State
92401	Bridge	AMTRAK		Cranston Street (Providence)	7/1	State	State
93801	Bridge	Providence-Worcester R.R. (track removed)		Cranston Street	7/2	NY, NH & H R.R.	City
99501*	Bridge	Cranston Street		Pocasset River	8/2	State	City
99601*	Bridge	Seven Mile Road		Clark Brook	30/1	State	City
106101*	Bridge	Park Avenue		Elm Lake Brook	4/4	State	State

Source: David DeNuccio, Cranston Engineering Dept., 06/27/2003.

Note: \* Within flood plain.

## APPENDIX C (CONTINUED)

### *Bridge and Culvert Inventory*

<b>Lot</b>	<b>Bridge or Culvert</b>	<b>Structure Carried</b>	<b>Utilities</b>	<b>Feature Intersected</b>	<b>A. P.</b>	<b>Ownership</b>	<b>Maintainee</b>
844*	Bridge	Dyer Avenue		Pocasset River	8/4	Pocasset Cemetery	Private
2985	Bridge	Burnham Avenue		Bike Path	7/4	City	City
2630*	Bridge	Mill Street		Pawtuxet River	4/5	Ciba - Geigy	Private
1102*	Footbridge	Mill Street		Pawtuxet River	4/5	Ciba - Geigy	Private
41	Bridge	Beechwood Drive		Stream	29	Resident	Private
47	Bridge	Beechwood Drive		Stream	29	Resident	Private
2560*	Bridge	Wellington Avenue (Railroad)		Pawtuxet River	5/3	NY, NH & H R.R.	Private
24*	Bridge	Phenix Avenue		Furnace Hill Brook	25/3	City	City
1525*	Bridge	Amanda Court		Bike Path	18/3	City	City
679	Bridge	Natick Avenue		Stream	18/1	City	City

Source: David DeNuccio, Cranston Engineering Dept., 06/27/2003.

Note: \* Within flood plain.



## APPENDIX D

***Historic Properties Inventory***

<i><b>Historic Districts</b></i>	<i><b>Location</b></i>	<i><b>A. P.</b></i>	<i><b>Lot</b></i>
Furnace Hill Brook National Historic and Archaeological District*	Phenix Avenue and Hope Road	21/2 and 21/3	
Lippitt Hill National Historic District	Burlingame and Hope Roads, and Lippitt Avenue	23, 30/3 and 30/4	
Norwood Avenue National Historic District	Norwood Avenue	2/5	
Oak Lawn Village National and Local Historic District*	Wilbur Avenue, from Natick Road to Oaklawn Avenue	8/4 and 18/2	
Pawtuxet Village National Historic District*	Bounded easterly on Narragansett Bay; southerly on the Pawtuxet Cove, Bayside Avenue, and South Fair Street; westerly on South Atlantic Avenue; and northerly on the Pawtuxet River and Ocean Avenue (Cranston and Warwick).	1	
<i><b>National Register Properties</b></i>	<i><b>Location</b></i>	<i><b>A. P.</b></i>	<i><b>Lot</b></i>
Arad Wood House	407 Pontiac Avenue	9/5	125
Arkwright Bridge	Hill Street (Coventry and Cranston)	30/1	
Edgewood Yacht Club*	3 Shaw Avenue	2/2	2852
Governor Sprague Mansion/ William Sprague House	1351 Cranston Street	8/2	201
Joy Homestead/ Job Joy House	156 Scituate Avenue	12/6	3139
Knightsville Meeting House/ Knightsville-Franklin Congregational Church	67 Phenix Avenue	12/4	125
Nathan Westcott House	150 Scituate Avenue	12/6	3109
Niles Westcott House/ Westcote	101 Mountain Laurel Drive	16	825
Potter Remington House	571 Natick Avenue	22/4	117
Rhodes-on-the-Pawtuxet*	60 Rhodes Place	1	299
Sheldon House	458 Scituate Avenue	20/2	2120
Thomas Fenner House	43 Stony Acre Drive	37/2	6

Source: Lynn Furney, Cranston Associate City Planner, 05/07/2003.

Notes: \* Within flood plain.

## APPENDIX E

## Child Daycare Facilities Inventory

<i>Name</i>	<i>Address</i>	<i>Zip Code</i>	<i>A.P.</i>	<i>Lot</i>
A Safer Start, Child University	117 Woodbine Street	02910	6	47
All About Kids	490 Atwood Avenue	02920	12	2132
Alpine Preschool	400 Pippin Orchard Road	02921	33	56
Budlong Pre School	10 Budlong Road	02920	11	1862
Candy Cane Preschool	54 Olney Arnold Road	02921	21	58
Candy Cane Two	359 Olney Arnold Road	02920	26	9
Carriage House Day Care	156 Shaw Avenue	02905	2	888
CCAP	160 Pawtuxet Avenue	02905	2	2487
CCAP Child Development Ctr.	155 Gansett Avenue	02920	11	2984
CCAP May Westcott School	848 Atwood Avenue	02920	12	720
Cornorstone School	665 Dyer Avenue	02920	8	2780
Creative Ctr.	717 Atwood Avenue	02920	12	454
Doric Day Nursery	145 Pontiac Avenue	02910	6	3255
Faith Nursery School	499 Hope Road	02921	28	65
First Year Learning Center	1400 Elmwood Avenue	02910	4	2617
Henderson Learning Center	74 Alton Street	02910	4	2627
Jendza Creative Center Preschool	1326 Plainfield Street	02920	12	419
Kids Kingdom	116 Puritan Avenue	02920	8	671
Learning Brooke ECE Center	1170 Pontiac Avenue	02920	10	706
Miss Lee Ann's	180 Oaklawn Avenue	02920	11	3419
Noahs Ark (Community World Chapel Outreach)	1308 Phenix Avenue	02921	21	290
Pumpkin Patch Academy	210 Comstock Parkway	02921	36	14
Pumpkin Patch Early Learning Center	220 Comstock Parkway	02921	36	14
St. Paul School	1789 Broad Street	02905	2	1339
Starbirth Day Care	80 East Street	02920	15	20
St. Mary's After School Care	85 Chester Avenue	02920	8	949
Sunshine Preschool	690 Dyer Avenue	02920	8	2725
The Ginerbread House Pre-School	1458 Park Avenue	02920	11	2971
Western Cranston Learning Ctr.	140 Natick Avenue	02921	19	67
Wonderland Early Learning Ctr.	546 Budlong Road	02920	11	3027
YMCA Schools Out	1224 Park Avenue	02910	11	3553
YMCA Community Youth Center	155 Gansett Avenue	02920	11	2984
YMCA -Eden Park School	180 Oaklawn Avenue	09310	11	3419
YMCA (George J. Peters Elementary School)*	15 Mayberry Street	02920	12	3244
YMCA (Edward S.Rhodes Elementary School)	160 Shaw Avenue	02905	12	1674

Source: Cranston Department of Inspection August, 2010

Notes: \* Within flood plain.

APPENDIX F

DAM INVENTORY

STATE ID	NAT-ID	DAM NAME	LATITUDE	LONGITUDE	RIVER	LENGTH (FT)	HT (FT)	NORM STOR (AC-FT)	MAX STOR (AC-FT)	SURF AREA (AC)	DRN AREA (SQ MI)	Dam Data OWNER	OWNER TYPE	HAZARD
	RI04080	ANGELL'S POND	41.773476	-71.47412114	MESHANTICUT BROOK	200	7	12	15	4	1	CRANSTON, C/O PUBLIC WORKS DEPT.	LOCAL GOV.	LOW
335	RI04076	ARROW LAKE #1	41.784206	-71.49440007	MESHANTICUT BROOK	190						ARROW LAKE INVESTMENT CORP.	PRIVATE	LOW
336	RI04077	ARROW LAKE #2	41.779987	-71.48986817	MESHANTICUT BROOK	150		9	12	3	0	ARROW LAKE INVESTMENT CORP.	PRIVATE	LOW
299	RI04071	BELLEFONTE POND	41.767971	-71.41478728	MASHAPAUG BROOK		6	3	4	1	6	ATLANTIC TUBING & RUBBER CO.*	PRIVATE	LOW
373	RI04087	CLARKE'S POND UPPER	41.736992	-71.54595952	CLARKE BROOK	190	10	3	5	1	0	LABRIE, LOIS	PRIVATE	LOW
338	RI04079	COLVIN POND	41.779564	-71.48432924	MESHANTICUT BROOK	120	8					BOY SCOUTS OF AMERICA, NARRAGANSETT COUNCIL	PRIVATE	LOW
199	RI04070	CRANSTON BRAID MILL POND	41.761261	-71.44380949	POCASSET RIVER		6	3	4	1	20	UNKNOWN	PRIVATE	LOW
172	RI00701	CRANSTON PRINT WORKS POND	41.793465	-71.45970919	POCASSET RIVER	350	14	180	255	25	18	CRANSTON PRINT WORKS CO.	PRIVATE	HIGH
198	RI00703	CURRAN LOWER RESERVOIR	41.741745	-71.54538729	CLARKE BROOK	1100	12	200	250	20	1	RIDEM PARKS & RECREATION	STATE	SIGNIFICANT
166	RI00702	CURRAN UPPER RESERVOIR	41.750549	-71.55107119	CLARKE BROOK	1200	27	390	500	32	1	RIDEM PARKS & RECREATION	STATE	SIGNIFICANT
333	RI04075	DELFINO'S POND	41.788689	-71.5190811	CEDAR SWAMP BROOK - TR	45	6			0	1	RI INDUSTRIAL FACILITIES CORP.	PRIVATE	LOW
505	RI04089	FEDOROWICZ FARM POND	41.749622	-71.53469849	LIPPITT BROOK	650	10	6	9	3	0	CROMPTON REALTY CORP.	PRIVATE	LOW
301	RI04072	FENNER POND	41.76976	-71.41948704	MASHAPAUG BROOK	25	3	36	50	18	1	COLANTONIO, PASQUALE (& REGINA)	PRIVATE	LOW
326	RI04074	FERRY POND	41.788708	-71.47356419	RANDALL BROOK - TR		8	3	5	1		UNKNOWN		LOW
510	RI04090	MARSELLA FARM POND	41.746284	-71.49695586	MESHANTICUT BROOK - TR	430	10	4	5	1	0	MARSELLA, DR. AUGUSTUS F.	PRIVATE	LOW
340	RI04081	MESHANTICUT PARK POND	41.767796	-71.47830202	MESHANTICUT BROOK	90	8	35	50	9	0	RIDEM PARKS & RECREATION	STATE	LOW
342	RI04083	POWERS POND	41.754913	-71.50942232	FURNACE HILL BROOK	50	5	2	2	0		UNKNOWN	PRIVATE	LOW
337	RI04078	R.I. PRINTWORKS POND	41.779945	-71.48696902	MESHANTICUT BROOK	40		0	2	0	0	BOY SCOUTS OF AMERICA, NARRAGANSETT COUNCIL	PRIVATE	LOW
341	RI04082	SARGENT'S POND	41.757084	-71.49806208	FURNACE HILL BROOK	30	5	2	3	0		UNKNOWN	PRIVATE	LOW
173	RI04069	SPECTACLE POND	41.792934	-71.43806453	MASHAPAUG BROOK	200	10	150	230	38	0	BEECROFT REALTY COMPANY	PRIVATE	LOW
320	RI04073	STONE POND	41.790794	-71.48957059	FENNER BROOK	200	8	25	34	8	0	DI NOFRIO, ANTHONY, sold to Dan Greico? (6-04)	PRIVATE	LOW
343	RI04084	WOOD'S MILL POND	41.771282	-71.53322596	FURNACE HILL BROOK	210						SHAW, JAMES A. (& LYNDA)	PRIVATE	LOW

## APPENDIX G

### Technical and Financial Assistance for Mitigation State Resources

**Coastal Resources Center**

University of Rhode Island  
Narragansett Bay Campus  
Narragansett, RI 02882  
(401) 874-6224

**Coastal Resources Management Council**

Stedman Government Center  
4808 Tower Hill Road  
Wakefield, RI 02879  
(401) 222-2476

**Department of Administration/Division of  
Planning**

One Capitol Hill  
Providence, RI 02908  
(401) 222-6478

**Department of Environmental Management**

Division of Parks and Recreation  
2321 Hartford Avenue  
Johnston, RI 02919  
(401) 222-2635

**Rhode Island Banking  
Commission/Associate Director**

233 Richmond Street  
Providence, RI 02903  
(401) 222-2405

**Rhode Island Builders Association**

Terry Lane  
Gloucester, RI 02814  
(401) 568-8006

**Rhode Island Department of Business  
Regulations**

233 Richmond Street  
Providence, RI 02903  
(401) 222-2246

**Rhode Island Emergency Management  
Agency**

645 New London Avenue  
Cranston, RI 02920  
(401) 946-9996

**Public Utilities Commission**

100 Orange Street  
Providence, RI 02903  
(401) 222-3500 Ext. 153

**State Fire Marshal's Office**

272 West Exchange Street  
Providence, RI 02903  
(401) 222-2335

**State of Rhode Island Building Committee  
Office**

Building Commissioner's Office  
One Capitol Hill  
Providence, RI 02903  
(401) 222-3529

## APPENDIX G (CONTINUED)

### Technical and Financial Assistance for Mitigation Federal Resources

**Economic Development Administration**  
143 North Main Street, Suite 209  
Concord, NH 03301  
(603) 225-1624

**Federal Emergency Management Agency  
Mitigation Division**  
Region I Office  
J.W. McCormack POCH, Room 462  
Boston, MA 02109  
(617) 223-9561

**Small Business Administration**  
360 Rainbow Boulevard South, 3<sup>rd</sup> Floor  
Niagara Falls, NY 14303  
(716) 282-4612 or (800) 659-2955

**U.S. Department of Agriculture  
Natural Resources Conservation Service**  
451 West Street  
Amherst, MA 01002  
(413) 253-4362

**U.S. Department of Commerce  
National Weather Service Forecast Office**  
445 Myles Standish Boulevard  
Taunton, MA 02780  
(508) 823-2262

**U.S. Department of Housing and Urban  
Development  
Community Development Block Grants**  
Region I – O'Neill Federal Building  
10 Causeway Street  
Boston, MA 02222  
(617) 565-5354

**U.S. Department of the Interior  
National Park Service**  
Rivers and Trails Conservation Program  
Regional Office  
15 State Street  
Boston, MA 02109  
(617) 223-5203

**U.S. Environmental Protection Agency**  
Region I – JFK Federal Building  
Government Center  
Boston, MA 02203  
(617) 565-3400

**U.S. Fish and Wildlife Service**  
New England Field Office  
22 Bridge Street, Unit #1  
Concord, NH 03301-4986

## APPENDIX G (CONTINUED)

### **Technical and Financial Assistance for Mitigation Other Resources**

#### **The Association of State Flood Plain Managers (ASFPM)**

Professional association with a membership of almost 1,000 state employees that assists communities with the NFIP. ASFPM has developed a series of technical and topical research papers and a series of proceedings from their annual conferences. Many mitigation “success stories” have been documented through these resources and provide a good starting point for planning.

#### **Flood Plain Management Resources Center**

Free library and referral service of the ASFPM for flood plain management publications. Co-located with the Natural Hazards Center at the University of Colorado in Boulder, staff can use keywords to identify useful publications from the more than 900 flood-related documents in the library.

#### **Institute for Business and Home Safety (IBHS) (formerly Insurance Institute for Property Loss Reduction)**

An insurance industry – sponsored, nonprofit organization dedicated to reducing losses – deaths, injuries, and property damage – resulting from natural hazards. IBHS efforts are directed at five specific hazards: flood, windstorm, hail, earthquake, and wildfire. Through its public education efforts and information center, IBHS communicates the results of its research and statistical gathering, as well as mitigation information, to a broad audience.

#### **Volunteer Organizations**

Organizations, such as the American Red Cross, the Salvation Army, Habitat for Humanity, Interfaith, and the Mennonite Disaster Service, are often available to help after disasters. Service organizations, such as the Lions, Elks, and VFW are also available. These organizations have helped others with food, shelter, clothing, money, etc. Habitat for Humanity and the Mennonite Disaster Service provide skilled labor to help rebuild damaged buildings incorporating mitigation or floodproofing concepts. The offices of individual organizations can be contacted directly, or the FEMA Regional Office may be able to assist.

#### **Flood Relief Funds**

After a disaster, local businesses, residents, and out-of-town groups often donate money to local relief funds. They may be managed by the local government, one or more local churches, or an ad hoc committee. No government disaster declaration is needed. Local officials should recommend that the funds be held until an applicant exhausts all sources of public disaster assistance. Doing so allows the funds to be used for mitigation and other projects that cannot be funded elsewhere.

#### **New England States Emergency Consortium (NESEC)**

NESEC conducts public awareness and education programs on natural disaster and emergency management activities throughout New England. Brochures and videotapes are available on such topics as earthquake preparedness, mitigation, and hurricane safety tips. NESEC maintains a WWW home page that is accessible at <http://www.serve.com/NESEC>.

#### **The New England Flood Plain and Stormwater Managers Association (NEFSMA)**

Professional organization for New England flood plain and stormwater managers. Provides workshops, conferences, and a newsletter to membership and interested individuals and companies. Contact: Nicholas Winter, chairman, at (617) 727-0488 or the NEFSMA home page on the Web at <http://www.seacoast.com/~nefsma>.

## APPENDIX H

### **Existing Protection Systems Federal and State**

#### **Coastal Barrier Resource Act**

Administered by the U.S. Fish and Wildlife Service, this program has mapped public and private land identified as undeveloped coastal barrier areas. These areas may be denoted as "Otherwise Protected Areas" if they are owned by public entities. In the coastal barrier areas shown on FEMA's flood insurance rate maps, structures newly built or substantially improved after the date shown on the maps are ineligible for federal insurance. This serves to restrict new development in these areas because the purchase of flood insurance is required to obtain backed mortgages and improvement loans for structures located in special flood hazard areas.

#### **Community Rating System (CRS)**

A voluntary initiative of the NFIP, the CRS was developed to encourage communities to perform activities that exceed the minimum NFIP flood plain management standards. If a community participating in the CRS performs activities that include maintaining records for flood plain development, publicizing the flood hazard, improving flood data, and conducting flood plain management planning, then the flood insurance premiums paid by policy holders in the community will be reduced by 5 to 45 percent. Developing a flood mitigation plan will help communities gain additional credit under the CRS.

#### **Earthquakes and Hurricanes**

A certain amount of funding is allotted to each state per year based on a risk formula for earthquakes. Coastal states are allocated funds based on a risk formula for hurricanes. Each state receiving such funds has the ability to grant project funds to a community. There is not a match requirement on the part of the community, but the funds are limited, and are generally only available once a year. The projects or products proposed for such funding must demonstrate that earthquake or hurricane risk will be reduced or eliminated, and that the proposed project or product is a cost-effective measure (a stringent cost/benefit analysis need not be performed). Information about the amount of funding available per year and the state requirements for eligibility and performance may be obtained from RIEMA at (401) 946-9996.

#### **Economic/Community Development**

There may be programs existing to help floodproof homes using Community Development Block Grant funds. There may be housing assistance programs in the community that can be used following a major flood, achieving both objectives of reducing flood damage and improving the communities housing stock (see Appendix F, Federal Resources, for more information).

#### **Evacuation Plans and Systems**

Your community's emergency operations center should have evacuation plans in place. For communities near a nuclear power plant, evacuation plans are required, and may be also used for flood evacuation. RIEMA may have additional evacuation plan information.

#### **Land Use Restrictions**

There are several federal and state regulations that serve to restrict land use in certain areas that may help reduce flood hazard vulnerability. If your community has open land owned by the state or federal government, examine what restrictions are placed on its development. In addition, the state Wetlands Protection Act regulates the development of all lands identified as significant to the protection of resources identified in the act.

## APPENDIX H (CONTINUED)

### **Existing Protection Systems Federal and State**

#### **Septic Systems**

If there are areas in the community not served by a public sewer system, state septic system regulations influence development and may be a consideration for mitigation alternatives that include rebuilding and elevation of structures. Specific design requirements must be met for any construction in coastal velocity zones or river floodways. Generally, an inspection of a septic system is required if there is a change in use of the structure, an increase in flow, or a failed system. Limited inspections are required if the footprint of the structure is being changed. Upgrades are required by the state if an inspection reveals a failed system. However, local regulations may be more restrictive than state requirements, requiring inspections or upgrades in other cases.

#### **State Barrier Beaches**

Your community may have barrier beaches, as defined by the state's Coastal Resource Management Program. The regulations applying to these areas are enforced by CRMC. These regulations restrict alteration of the beach and/or dunes and the construction of coastal engineering structures. New or substantially reconstructed buildings generally must be elevated to a minimum of 1 foot above base flood elevation. No new commercial development is allowed on barrier beaches. If a structure is damaged more than 50 percent, it cannot be rebuilt.

#### **Warning Systems and Emergency Operations Plans**

Your community may have a flood warning system in place and should have a plan for response to flooding. In addition, RIEMA has offices throughout the state that maintain area-wide plans for flood events.



## APPENDIX I

### **Financing Options**

#### ***Federal Emergency Management Agency***

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

All of Rhode Island's 39 municipalities participate in the NFIP. This program is a direct agreement between the federal government and the local community that flood insurance will be made available to residents in exchange for community compliance with minimum flood plain management regulations. Communities participating in the NFIP must:

- Adopt the flood insurance rate maps as an overlay regulatory district.
- Require that all new construction or substantial improvement to existing structures in the flood hazard area be elevated or (if nonresidential) floodproofed to the identified flood level on the maps.
- Require design techniques to minimize flood damage for structures being built in high hazard areas, such as floodways or velocity zones.

In return for community adoption of these standards, any structure in that community is eligible for protection by flood insurance, which covers property owners from losses due to inundation from surface water of any source. Coverage for land subsidence, sewer backup, and water seepage is also available subject to the conditions outlined in the NFIP standard policy (see Appendix F, Federal Resources, for contacts regarding insurance coverage and purchase). Since homeowners insurance does not cover flooding, a community's participation in the NFIP is vital to protecting property in the flood plain as well as being essential to ensure that federally backed mortgages and loans can be used to finance floodprone property.

##### **Hazard Mitigation Grant Program (HMGP)**

Also known as the 404 Program or HMGP, this program is available only after a federally declared disaster occurs. It represents an additional 15 percent of all the infrastructure and individual assistance funds that are provided to states to repair damages and recover from losses, and is administered by the state in partnership with FEMA. Having a plan or completed mitigation action matrix prior to a disaster event is extremely helpful in meeting the state's deadlines for applications and ensuring the project is eligible and technically feasible. It provides 75/25 matching grants on a competitive basis to state, local, and tribal governments, as well as to certain nonprofit organizations that can be matched by either cash or in-kind services. The grants are specifically directed toward reducing future hazard losses, and can be used for projects protecting property and resources against the damaging effects of floods, earthquakes, wind, and other hazards. Specific activities encouraged under the HMGP include acquiring damaged structures to turn the land over to the community for open space or recreational use, relocating damaged or damage-prone structures out of the hazard area, and retrofitting properties to resist the damaging effects of disasters. Retrofitting can include wet- or dry-floodproofing, elevation of the structure above flood level, elevation of utilities, or proper anchoring of the structure.

For further information contact the state of Rhode Island hazard mitigation officer at (401) 946-9996 or FEMA Region I at (617) 223-9540.

##### **Flood Mitigation Assistance Program (FMA)**

Two programs that have been authorized under the National Flood Insurance Reform Act of 1994 include the Flood Mitigation Assistance (FMA) program and a provision for increased cost of compliance (ICC) coverage. FMA makes grants available on a pre-disaster basis for flood mitigation planning and activities, including acquisition, relocation, and retrofitting of structures. FMA grants for mitigation projects will be available only to those communities with approved hazard mitigation plans.

## APPENDIX I (CONTINUED)

### **Financing Options**

ICC coverage has recently been implemented for all new NFIP policies and renewals and is intended to be “mitigation insurance” to allow homeowners whose structures have been repeatedly or substantially damaged to cover the cost of elevation and design requirements for rebuilding with their flood insurance claim up to a maximum of \$15,000.00. A certain amount of funding is allotted to each state per year based on a risk formula for floods. Each state has the discretion to award funds to communities or to state government agencies. States may use whatever criteria or method they choose to award the funds as long as the applicant and the proposal are eligible. The program may fund up to 75 percent of the cost of the proposed project, with a minimum of 25 percent of the cost coming from the community. A minimum of half the community share must be cash or “hard match.”

Funds can also be granted to communities to help them prepare local flood mitigation plans. The same match requirements apply. Once a community receives a planning grant, however, it is not eligible to receive additional planning grants for another five years. For further information on the FMA program or ICC coverage contact RIEMA at (401) 946-9996.

### ***Natural Resources Conservation Service (NRCS)***

#### **Small Watershed Program and Flood Prevention Program**

The Watershed and Flood Prevention Act, P.L. 83-566, August 4, 1954, (16 USC 1001 – 1008) authorized this program. Prior to fiscal year 1996, small watershed planning activities and the cooperative river basin surveys and investigations authorized by Section 6 of the Act were operated as separate programs. The 1996 appropriations act combined the activities into a single program entitled Watershed Surveys and Planning Program.

The purpose of the Watershed Program, including River Basin operations, is to assist Federal, State, local agencies, local government sponsors, tribal governments, and program participants to protect and restore watersheds from damage caused by erosion, floodwater, and sediment, to conserve and develop water and land resources, and solve natural resource and related economic problems on a watershed basis. The program provides technical and financial assistance to local people or project sponsors, builds partnerships, and requires local and state funding contribution.

Resource concerns addressed by the program include watershed protection, flood prevention, erosion and sediment control, water supply, water quality, opportunities for water conservation, wetland and water storage capacity, agricultural drought problems, rural development, municipal and industrial water needs, upstream flood damages, water needs for fish, wildlife, and forest-based industries, fish and wildlife habitat enhancement, wetland creation and restoration, and public recreation in watersheds of 250,000 or fewer acres. Both technical and financial assistance are available.

#### **Wildlife Habitat Incentives Program**

The Wildlife Habitat Incentives Program (WHIP) is a voluntary program for people who want to develop and improve habitat primarily on private land. Through WHIP USDA’s Natural Resources Conservation Service (NRCS) provides both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat. WHIP agreements between NRCS and the participant generally last from 5 to 10 years from the date the agreement is signed.

### ***National Weather Service (NWS)***

The Taunton, Massachusetts NWS office has developed a partnership with RIEMA. NWS donates staff time and tide gauges to help gain more lead time for evacuation.

For further information contact NWS at (508) 823-2262. <http://www.nws.noaa.gov/>.

## APPENDIX I (CONTINUED)

### **Financing Options**

#### ***American Red Cross (ARC)***

The ARC chapter of Rhode Island has supplied public education materials and volunteered to conduct training programs and hold seminars for the Rhode Island Hazard Mitigation Project.

For further information contact the Rhode Island Chapter of the American Red Cross at (401) 831-7700. <http://www.redcross.org>.

#### ***U.S. Army Corps of Engineers***

Beneficial Uses of Dredged Material – Section 204, Water Resources Development Act of 1992, as amended, authorizes projects for the protection, restoration, and creation of aquatic and ecologically related habitats, including wetlands, in connection with dredging an authorized federal navigation project. Non-federal sponsors are responsible for 25 percent of the project cost and 100percent of the cost of operation, maintenance, replacement and rehabilitation. There is an annual appropriations limit of \$15 million. For projects with an estimated federal cost of less than \$5 million, divisions have approval authority.

1948 Flood Control Act, as amended - Section 205 (Small Flood Damage Reduction Projects) aids in the development and construction of small flood damage reduction projects for eligible non-federal sponsors. The 1960 Flood Control Act, as amended, provides 100 percent funding for technical and planning guidance to state and local governments and federally recognized Native American tribes to help develop and interpret flood and flood plain data, such as flood hazard mapping, and for assessment for structural and non-structural flood damage reduction measures.

Under Flood Control Act of 1946 – Section 14, as amended, projects are eligible for construction only after an analysis demonstrates the engineering and environmental feasibility and economic justification of the improvement. The local sponsor must be a municipality or public agency. Funding may also be available for flood damage reduction measures if the community writes a request letter to the U.S. Army Corps of Engineers. The non-federal cost share is 35 percent of the analysis and implementation, and the initial \$40,000 of the analysis is 100 percent federally funded.

The 1974 Water Resources Development Act, as amended – Section 22 (Planning Assistance to States Program) provides technical assistance for such flood projects as erosion and control. This program uses cost-shared studies with a non-federal sponsor. The non-federal share of the cost is 50 percent and in-kind services are not authorized. The federal limit for each state is \$500,000 annually.

For more information, contact the U.S. Army Corps of Engineers at (978) 318-8087 or (978) 318-8647. <http://www.usace.army.mil>.

#### ***State of Rhode Island***

The capital budget is approved on a 5-year basis and is proposed by the governor. If there is any surplus available in the emergency fund, this could be a possible source of financing for mitigation projects.

#### ***Rhode Island Department of Environmental Management (DEM)***

In the 1980's, four major open space bond issues were approved that resulted in an investment of more than \$100 million for recreational and open space land acquisition. Each application is reviewed by a committee to assure consistency with local plans and habitat values. The state participates in funding either through a matching grant or of a revolving loan. Funds may be available through the DEM Parks and Recreation Division for tree trimming, dune restoration and bulkhead repair. In

## APPENDIX I (CONTINUED)

### **Financing Options**

addition, the state has several funding programs for the acquisition of land or purchase of development rights to protect open spaces. For instance, two Rhode Island municipalities use a real estate transfer tax for land preservation. Rhode Island has incorporated land trusts that work to preserve land and natural resources. Land owners can participate in the Farm, Forest and Open Space Program. Under this program, land may qualify for a reduced property tax assessment if it meets specific criteria as farmland, forest land or open space.

For current funding availability contact the Open Space and Recreational Bond Fund Land Acquisition Program or DEM at (401) 222-2776.

#### **Rhode Island Department of Transportation (DOT)**

The State Planning Council designates which Transportation Improvements Plan enhancement projects the state will pursue. Applications for the Federal Wooden Bridge Replacement Program can be made through DOT. In addition, DOT has a debris management program that goes into effect during a storm event. The new federal transportation bill, TEA-21, is a successor to the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA). There are a few categories within this bill that may have available funding for natural hazard mitigation projects. These include transportation enhancement (categories include storm water remediation, storm water runoff protection, and environmental mitigation) and bridge replacement. The municipality must apply for project funds through DOT. The annual funding averages for Rhode Island are \$156,781.00. There is an average of \$26,749 available under the Bridge Rehabilitation and Replacement category.

For further information contact DOT at (401) 277-2481.

#### **North East States Emergency Consortium (NESEC)**

Since 1998, RIEMA has been given funds for preventative measures and maintenance. Providence and Woonsocket both received \$5,000 grants from NESEC for mitigation activities that were addressed in their local hazard mitigation strategies.

For further information contact at (781) 224-9874.

#### ***Municipal***

Several utility companies have prevention and clean-up programs that require cooperation from municipalities. For instance, companies are usually willing to co-sponsor planting low-growing trees as part of a tree replacement program. Utility companies will provide the bucket truck area lift if the town/city helps dispose of tree trunks.

The Clean Water Finance Agency has financing programs for local government units and water suppliers. The clean water state revolving fund uses monies from the Federal Clean Water Act to support sewer work such as sewer extensions and septic system repair, and to give homeowners of all incomes low-interest loans for septic system repairs. The community wide onsite wastewater management plan is a Clean Water Finance Agency program for failing or sub-standard septic systems, and it identifies areas in municipalities where system failures could cause degradation to water quality. Municipal loans for large infrastructure projects are also available through this program at discounted interest rates.

Appendix J.

**THE CITY OF CRANSTON  
ORDINANCE OF THE CITY COUNCIL**

APPROVING CRANSTON 2010 HAZARD MITIGATION PLAN

*No.*

Passed:

\_\_\_\_\_  
**John E. Lanni, Jr., Council President**

Approved

\_\_\_\_\_  
**Allan W. Fung, Mayor**

*It is ordained by the City Council of the City of Cranston as follows:*

WHEREAS, the City of Cranston is vulnerable to natural hazards including hurricanes, flooding, severe winter storms, thunder storms, high wind events, tornados, lightning, hail storms, coastal erosion and wildfire, and

WHEREAS, total vulnerabilities are conservatively estimated at \$1,570,802,700 in property damages with potential risks to each of the City's 81,686 residents, and

WHEREAS, the Cranston Hazard Mitigation Committee has updated the City's 2005 Hazard Mitigation Plan in accordance with the Federal Disaster Mitigation Act of 2000 that documents specific courses of action that can be taken in advance of natural hazard events to reduce the City's vulnerabilities, a copy of which is appended hereto as Exhibit A and

WHEREAS, adoption of a local Hazard Mitigation Plan will qualify the City to compete for implementation funds from the Federal Emergency Management Agency's Pre-disaster Mitigation Grant PROGRAM,

NOW, THEREFORE, IT IS ORDAINED by the City Council of the City of Cranston that the 2010 Hazard Mitigation Plan updated by the Hazard Mitigation Committee is adopted as the City's policy document which assesses the community's risk to natural hazards and which identifies appropriate mitigation actions for potential implementation.

Positive Endorsement

Negative Endorsement (attach reasons)

\_\_\_\_\_  
Anthony Cipriano, Solicitor

\_\_\_\_\_  
Date

\_\_\_\_\_  
Anthony Cipriano, Solicitor

\_\_\_\_\_  
Date

Sponsored by: Allan W. Fung, Mayor

## End Notes

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- <sup>17</sup> RIEMA, State of Rhode Island and Providence Plantations: Hazard Mitigation Plan - 1993-1994. (Providence, RI: RIEMA Publications, 1994) B-7.
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