Hazard Mitigation Plan
For Seven Towns in Dukes County
2015

Draft February, 2015

Prepared by:
The Martha's Vineyard Commission
In conjunction with the emergency managers and planning teams of the seven Dukes County towns

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ACKNOWLEDGEMENTS

This plan was prepared with the input and guidance of a Hazard Mitigation Planning Teams representing the seven towns in Dukes County. Those representative planning teams were led by:

Aquinnah	Gary Robinson
Chilmark	Tim Carroll
Edgartown	Peter Shemeth
Gosnold	Seth Garfield
Oak Bluffs	Peter Martell, Jim Klingensmith, John Rose
Tisbury	Chris Cini
West Tisbury	John Christiansen

This report was prepared by staff of the Martha's Vineyard Commission:

Jo-Ann Taylor, Coastal Planner…….Project Manager, Principal Author
Caitlin Michniewitz, Intern
Chris Seidel, GIS Coordinator……..Maps
Curtis Schroeder, Administrator…….Administration

Cover photo of storm surge by United States Geological Survey

EXECUTIVE SUMMARY

Development of a Hazard Mitigation Plan is important in order to prepare a community for the natural hazards that every community faces sooner or later. By being adequately prepared, the community has a chance to cut its losses, in terms of both safety and hardship. An approved Pre-Disaster Mitigation Plan brings the community eligibility for funding for implementation of the mitigation measures included in the plan.

The Hazard Mitigation Plan for the seven Dukes County towns was prepared by planning teams consisting of emergency managers and other stakeholders representing the seven towns. The towns include Aquinnah, Chilmark, Edgartown, Oak Bluffs, Tisbury and West Tisbury on Martha's Vineyard; and the Town of Gosnold, encompassing all of the Elizabeth Islands. Staff from the Martha's Vineyard Commission coordinated the planning and produced the report and maps. Funding was provided by The Massachusetts Emergency Management Agency (MEMA) in cooperation with the Department of Homeland Security – Federal Emergency Management Agency.

Martha's Vineyard and the Elizabeth Islands are no strangers to natural hazards, particularly flood hazards. Hurricanes strike rarely, but with extensive damage done in a few short hours. Nor'easters strike more frequently, last longer, and are responsible overall for more damage and shoreline erosion and modification. Dam failure is a potential flood threat in the Town of West Tisbury alone. Heavy rainfall events have become prevalent and are expected to continue so. Drought is a potential threat to all the communities, particularly to those with public water supplies. Wildfire is a potential natural hazard, particularly where development meets forest land (the wildland-urban interface).

Vulnerability is determined by the threat of a natural hazard striking a particular location, and what level of intensity may be expected. As of March 31, 2014, 114 claims have been filed under the National Flood Insurance Program (NFIP), totaling $1,603,746.70. Of that total, 17 properties have been responsible for 41 of those claims (36%) and for 64% of the total damages in dollars. Critical facilities were identified, with many of those found to be vulnerable to flood damage. Most of the properties found vulnerable to flooding are critical water-dependent facilities such as ferry terminals.

Vulnerability to wildfire is determined by proximity of development to forested lands, and fuel type. Much of Martha's Vineyard is potentially vulnerable, and there is no wildfire management plan outside of the State Forest.

Planning to protect the towns includes shore protection strategies such as beach nourishment, drought mitigation in the form of improved water supply infrastructure, and an outreach campaign to better prepare homeowners and homeowners' associations with wildfire defense strategies.

Section 1. Introduction

Purpose:

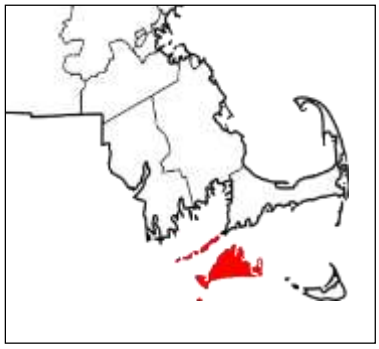
A Hazard Mitigation Plan examines the hazards likely to impact the community, assesses the vulnerabilities associated with those hazards, and makes recommendations on ways to mitigate the negative effects of typical hazards.

The actions recommended in the plan should translate into savings; fewer lives lost, less property destroyed, and minimal disruption to essential services. An additional impetus for planning is that communities with approved Hazard Mitigation Plans are eligible for federal funding for the implementation measures named in the plan.

In order to prepare a Hazard Mitigation Plan, hazards and critical facilities are identified, vulnerability assessed, and actions recommended mitigating the vulnerability. The first Hazard Mitigation Plan was approved in May, 2008. This is an update to that plan.

Section 2. Community Profile

The seven towns of Dukes County consist of islands off the southeast coast of Massachusetts. All of the islands owe their origin to glacial activity, with resultant hilly, morainal areas of boulders, gravel, sand and clay, drained by a very few streams. The remainder of the land mass consists of outwash plains spreading out from the morainal areas. The outwash plains are flat or gently sloping lands made of highly porous sand and gravel. A number of great ponds are found where the outwash plains meet the sea, most fronted by barrier beaches. Travel to and between the islands and the mainland is entirely by boat or plane.



locus

Seven towns comprise Dukes County, including Martha's Vineyard and the Elizabeth Islands, lying several miles west across the waters of Vineyard Sound. Although the islands are perhaps best known as recreational destinations, there is also significant island life year 'round. The year 'round residents tend to be independent but with strong community interest and response in need. Most of the population inhabits the largest island, Martha's Vineyard. The Vineyard's year-round population of 17,000 swells to more than 79,000 on a summer day, when the Vineyard becomes a destination for summer residents, vacationers, and relentless multitudes of visitors.

DRAFT Estimated Average Summer Population – (2010 Census)

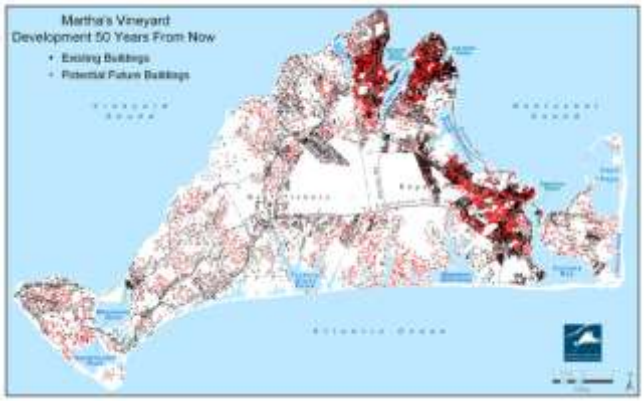
	Aquinnah	Chilmark	Edgartown	Oak Bluffs	Tisbury	West Tisbury	Total
Year-round	311	866	4,067	4,527	3,949	2,740	**16,460**
Guests of Year - round	102	281	1,265	1,415	1,262	848	**5,173**
Seasonal / Vacationers	1,708	5,762	16,342	11,243	6,144	4,803	**46,002**
Transients							
lodging rooms	18	106	1,114	786	396	56	**2,476**
on boats			408	504	600		**1,512**
camping					432		**432**
Day Trippers			500	3,000	2,500		**6,000**
Cruise Passengers				1,000			**1,000**
Total	**2,139**	**7,015**	**23,696**	**22,475**	**15,283**	**8,447**	**79,055**

- *Year-round population as reported by 2010 US Census.*
- *Guests of Year-round residents estimated as an average of 0.70 person for each of the 7,329 year-round households*
- *Seasonal Residents / Vacationers include second-home owners and renters who visit for a week or more. They are estimated as an average of 4.77 people for each of the 9,644 seasonal housing units, based on the results of a survey carried out by the Oak Bluffs Planning Board. It is estimated that about two-thirds of these are seasonal residents.*
- *Transients stay on-island for less than a week. Estimations assume two people per room and 100% occupancy for July and August in the Island's 1238 lodging rooms, hotels, inns and B&Bs. The Edgartown, Oak Bluffs and Tisbury Harbor Masters estimated 3 or 4 people per boat and occupancy rates between 80% and 100% for the 468 boats that can be accommodated on slips and moorings in these three harbors. Camping is based on an average of 3 people per tent and 80% summer occupancy for the Island's 180 campsites in the MV Family Campground.*
- *Day Trippers arrive and leave the Vineyard on the same day. Estimates assume two-thirds of the peak passenger ferry ridership of 10,000 on peak summer days are day-trippers and the others stay for a longer period. Allocation among towns is based upon port of entry.*
- *Cruise Passengers are day trippers. Assumes one cruise ship with a capacity of 1,000 people in harbor on a peak day; in 2010, most cruise ships came in the spring and fall. Allocation among towns is based upon port of entry.*
- *Methodology by Christine Flynn.*

Source: MVC, 2013

On Martha's Vineyard, covering 87 square miles, the three "down-island" towns of Tisbury, Oak Bluffs and Edgartown are more densely inhabited and include village centers with modest commercial activities, much of which is focused on the waterfront of each. The "up-island" towns of West Tisbury, Chilmark and Aquinnah are comparatively rural and sparsely populated.
The Martha's Vineyard Commission has identified how many houses are presently on the Vineyard and projected how many houses would be built on the Vineyard in the next forty-five years, if current zoning is maintained and past rates of construction continue.

Present development on Martha's Vineyard



Projected development on Martha's Vineyard

The table below corresponds to the two maps above, showing the numbers represented by the above graphics.

Projection of Future Development				
	Houses Today	*Projected New Houses in 45 Years*	*Projection in 45 Years*	*Projected Increase*
Aquinnah	*503*	*450*	*946*	*89%*
Chilmark	*1,609*	*750*	*2,054*	*47%*
Edgartown	*5,233*	*2,944*	*7,561*	*56%*
Oak Bluffs	*4,378*	*1,342*	*5,159*	*31%*
Tisbury	*3,091*	*1,400*	*4,201*	*45%*
West Tisbury	*2,219*	*1,150*	*3,248*	*52%*
	17,033	*8,036*	*23,169*	*47%*
Note: It does not account for limits on potential development on some properties from conservation restrictions or agricultural restrictions. Nor does it account for possible additional development on properties with comprehensive permits or zoning changes.				

Section 3. Plan Development

Staff from the Martha's Vineyard Commission began working with the Vineyard towns and Gosnold even before the project was really underway. MVC staff prepared and submitted an application for a highly competitive planning grant, and all the Boards of Selectmen endorsed the grant application. Funding for the update project was awarded by FEMA (through MEMA) in April, 2012.

The first step was to assemble planning teams. Representatives from each town were invited by e-mail to participate. The seven towns reflect the independent spirit of the residents and are generally reluctant to form planning unions, although quick to respond cooperatively in emergency situations. Never the less, each of the seven towns agreed to join in this effort and sent representatives from the Selectmen's offices, Emergency Management, Fire Departments, Police Departments, EMTs, Planning Boards, IT Departments, Highway Departments, and Energy Committees. Conservation groups, the Wamponaog Tribe of Gay Head (Aquinnah), and the press, were invited through e-mail and the MVC website. The kickoff meeting for the update took place in June, 2012. Available materials were reviewed, and a brief presentation was made.

- The Town of Chilmark was represented by Selectman Bill Rossi and by Tim Carroll, Executive Secretary and Emergency Manager.
- The Town of Edgartown was represented by Peter G. Shemeth, Fire Chief and Emergency Manager; Stuart Fuller, Highway Superintendent; and Adam Darack, Information Technology Coordinator.
- The Town of Oak Bluffs was represented by Selectman Walter Vail and by Peter Martell, Emergency Manager.
- The Town of Tisbury was represented by Melinda Loberg, EMT; and Chris Fried, Energy Committee.
- The Town of West Tisbury was represented by Simone DeSorcey, Planning Board Assistant.
- The Wampanoag Tribe of Gay Head (Aquinnah) was represented by Gary Coates, Jr., Natural Resources.
- Conservation groups were well-represented:
    - Vineyard Conservation Society was represented by James Pritchard and Jeremy Houser.
    - Tisbury Waterways, Inc. (TWI) was represented by Melinda Loberg.
    - M.V. Water Alliance was represented by Marnie Stanton.
    - M.V. Land Bank was represented by Bill Veno, Trails Planner.
- The County of Dukes County was represented by Commissioner Melinda Loberg and Chuck Cotnoir, Emergency Management.
- The press was represented by Sara Brown, Vineyard Gazette.

- Regional decision-makers included the M.V. Land Bank (Bill Veno, staff) and The Martha's Vineyard Commission, represented by Commissioner Tim Carroll and by a number of staff members:
    - Jo-Ann Taylor, Coastal Planner
    - Mark London, Executive Director
    - Chris Seidel, GIS Coordinator
    - Sheri Caseau, Water Resources Planner
    - Paul Foley, DRI Coordinator
    - Bill Veno, Senior Planner.

Following the kickoff group meeting, MVC staff communicated one-on-one with town representatives while working on identification of hazards and critical facilities, primarily using MassGIS data. MVC staff followed that process with analysis to assess vulnerabilities.

Once the data had been digested and analyzed, it was time for the towns to review the findings and begin to update mitigation strategies. Assessments (as they became available) and draft actions were published for each town on the MVC website between August and January for public review. The town groups met between August, 2013 and February 2014; were presented a unique Powerpoint presentation for that town for review of the vulnerability assessments and actions. Those meetings were open to the public and widely publicized through e-mail invitations to emergency personnel, town boards and other local and regional decision-makers, to conservation groups, and to the Tribe; and advertised on the MVC website www.mvcommission.org and the widely-distributed Extended Schedule. The Emergency Managers on Martha's Vineyard meet as a group routinely, and that group was enlisted to review the updated vulnerability assessments and to recommend Island-wide strategies.

Vulnerability assessments were presented to the general public, along with the slide show *Visualizing Sea Level Rise Around Martha's Vineyard*, at the Living Local Festival in October. This exposition brings together a wide variety of vendors, conservation groups and others to display various aspects of sustainable living. Attendance includes thousands of local residents and visitors.

Following the extensive public review of the vulnerability assessments and strategies, Martha's Vineyard Commission staff assembled the draft text, including the town planning teams' and All-Island Emergency Managers' consensus choices on strategies. The general public was presented with the draft plan at 2 evening meetings, March 6, 2014 and March 13. Both meetings were publicized on the MVC website www.mvcommission.org, on the widely-distributed MVC Extended Schedule, and in the calendar sections of the local newspapers. The March 6 presentation was part of a meeting that was later televised on the local government cable channel. Minutes are posted on the MVC website. Comments were favorable, particularly for the Sea Level Rise

visualization. Commenters found the information in the draft report significant and helpful. There were no comments that resulted in changes to the draft.

MVC staff continued to work with the towns one-on-one on town actions, which were included in the draft plan that went into distribution in March. The entire draft plan was available on the MVC website in March. Also in March, a press release reported in the M.V. Times announced availability of the draft plan for comment. None was received.

The draft plan began the non-local review process when submitted to MEMA representatives on March 19. While under MEMA and FEMA review, the draft plan was presented to the Boards of Selectmen for their perusal to develop familarity, with the understanding that some revision was likely to arise from the MEMA and FEMA review to come. Following MEMA and FEMA approval, the Boards of Selectmen will be asked for their formal approval of the final plan as approved by FEMA and MEMA.

MVC staff and the planning teams responded to MEMA comments and consultation on the March 19 draft and August 2014 revised draft and submitted a final draft on January 16, 2015.

MEETINGS AND PUBLIC SESSIONS

DATE	MEETING OR CONTACT
7/12/11	MVC staff met with All-Island Emergency Managers about the planned update
10/18/11	MVC staff met with Aquinnah Board of Selectmen for endorsement of grant application
10/18/11	MVC staff met with Chilmark Board of Selectmen for endorsement of grant application
10/25/11	MVC staff met with Oak Bluffs Board of Selectmen for endorsement of grant application
10/26/11	MVC staff met with West Tisbury Board of Selectmen for endorsement of grant application
10/31/11	MVC staff met with Edgartown Board of Selectmen for endorsement of grant application
11/1/11	MVC staff met with Tisbury Board of Selectmen for endorsement of grant application
6/13/12	Planning update kickoff meet'n'greet session
6/14/12	MVC staff, All-Island emergency managers
4/1/13	Town session Chilmark
7/13/13	Town and public sessions to review FEMA draft maps (2)
8/15/13	Town session Oak Bluffs
9/12/13	Town session Oak Bluffs
9/26/13	Town session Oak Bluffs
10/5/13	Display and one-on-one with crowd at Living Local Festival
10/10/13	Town session Oak Bluffs, consensus
1/22/14	Tisbury town session (postponed due to snow)
1/31/14	Chilmark town session to review assessment and actions, consensus achieved
2/3/14	Edgartown town session and consensus assessment and actions
2/6/14	Aquinnah town session and consensus of assessment and actions
2/7/13	West Tisbury town session and consensus of assessment and actions

2/12/14	Tisbury town session and consensus on assessment and actions
3/6/14	Plan update presented to the public at Martha's Vineyard Commission
3/13/14	Plan update presented to All-Island Emergency Managers, who endorsed the plan's actions
3/19/14	Draft plan submitted to MEMA and made available on MVC website

Section 4. Hazard Identification, Assessment, and Vulnerability

(Note: the vulnerabilities associated with each of these hazards are addressed town-by-town in the next section.)

FEMA defines a natural hazard as "an event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss"[1].

Wind and Flood-Related Hazards:

The flood-related hazards historically and potentially impacting Dukes County include hurricanes, nor'easters, coastal erosion and shoreline change, heavy rainstorms and thunderstorms, and dam breaches. The wind-related hazards include hurricanes, nor'easters, winter storms and tornadoes.

Coastal Storms (Nor'easters):

Nor'easters are low pressure centers with sustained winds of 10-40 mph and gusts up to 70 mph circulating in a counter-clockwise faction in our hemisphere (just as hurricanes do). The storms are typically large in lateral extent, with a radius as much as 1,000 miles, and travel up the east coast with a speed of about 25 mph. Nor'easters are frequent visitors to our shores, striking at least once or twice in any year. Although these storms don't have the punch of hurricanes, they last longer, typically 3 days, as often the storms will stall over New England, bringing significant damage and peril. There is often little warning to prepare for these storms, in comparison with the ample warnings that typically precede impending hurricanes. Because of greater frequency and duration, nor'easters have been responsible for more overall damage than hurricanes here. A number of Nor'easters are particularly well-remembered for their damage to our area, including the 1898 gale "The Portland Storm", the Blizzard of '78, the October '91 storm "The Perfect Storm", and the Blizzard of 2013 "Nemo". Also, the Patriot's Day storm of 2007 is remembered for breaching Norton Point Barrier Beach.

Significant modification of the coastline may take place during these storms, as evidenced by the breach that occurred at Norton Point Beach during the April 2007 storm, and by at least one other breach during a January 1886 storm. Some such breaches occur during hurricanes, but the ingredients are just as likely to be present during a nor'easter, with water piling up on the bay side of the barrier beach with enough hydraulic head to create an opening.

The duration is important in determining the damage wrought by these storms. Significant coastal erosion may take place if high tides and wave action continue for several days, as in the following photos taken at Sylvia State Beach on December 19 and 20, 1995.

[1] FEMA, First Edition 1997, *Multi-Hazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy*

Sylvia State Beach, December 19, 1995

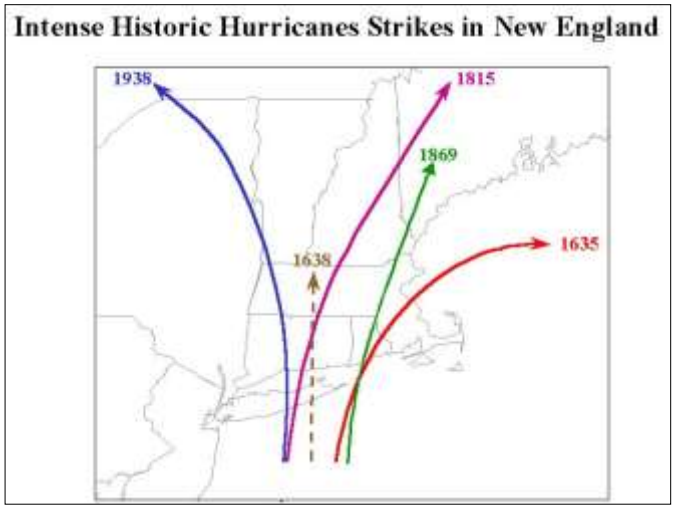
Sylvia State Beach, December 20, 1995

Nor'easters most often strike in winter, and excessive snowfall may accumulate, although that is usually not an issue in our community. The Blizzard of '13, "Nemo", was an exception, involving both heavy snow and high winds and waters. Icing can be a very real danger to vessels and their crews, and has historically been responsible for significant loss of life, particularly in the heyday of coastal shipping, with a number of reports of sailors frozen in the rigging.

Henry Norton wrote this account of the 1898 Nor'easter, also known as the Portland Storm "The most disastrous storm ever known on the island commenced on Saturday night November 28, 1898, and before daybreak of the 29th one of the worst northeast snow blizzards was raging. Vineyard Haven harbor was for many ships a port of refuge from the storm. The next morning found over fifty in a wrecked condition. The number of lives lost were few in comparison with the number of ships destroyed, because of the bravery of Isaac C. Norton, Alvin H. Cleveland, Frank Golart, Stanley Fisher and F. Horton Johnson. Cleveland and Golart, with Norton as captain, dared the wind and sea in a dory. They first went out to the schooner Hamilton, which was ashore near the breakwater, rescuing five sailors. The boat was unable to make the western shore so they went across the harbor, landing near the Standard Oil tanks. The half-frozen sailors were taken to Chadwick's blacksmith shop where they were revived sufficiently to be conveyed to the Marine Hospital. A schooner was ashore near the old Norris wharf at Eastville. The people on land could see the men in the rigging. The dory was launched again, with Fisher, Johnson and Cleveland as crew, Norton in command. This time the dory was towed far to the windward of the schooner and let go by a tug. They managed to get to the Thurlow and save five men, one having frozen in the rigging. These sailors were taken to homes at Eastville where they received the best of care. By this time the storm was at its height, and against the judgment and protest of all, Norton, Cleveland and Golart went out the third time and rescued five more sailors, thereby showing the daring and bravery for which their forefathers were noted when they came to this cold and inhospitable climate and made their homes."[2]

[2] *The History of Martha's Vineyard,* 1923, Henry Franklin (H.F.) Norton

Hurricanes and Tropical Storms (Tropical Cyclones):



Intense Historic Hurricane Strikes[3]

Hurricanes and tropical storms are formidable storms, a number of which have visited the islands making up Dukes County. Hurricanes are powerful storms with winds of 74 – 200 MPH circulating counter-clockwise about a relatively calm eye. Tropical storms are the same (often literally the same storm varying in intensity) with wind speeds 39-73 MPH. North Atlantic hurricanes and tropical storms typically form in the Caribbean or off the coast of Africa and will continue to grow and strengthen as long as they are over water of at least 79 degrees surface temperature, drifting toward our East Coast on the Trade Winds until being steered to the north by the prevailing offshore winds. So, the storms which don't enter the Gulf of Mexico are turned up the East Coast, and the storms which reach the vicinity of Dukes County are frequently moving north at substantial speeds, which may add significant forward speed to the wind speed within the system. The forward speed of the 1938 (Great New England) hurricane is believed to have been in excess of 50 MPH. The most damage is likely on the right shoulder of the storm, eastward of the eye, where the forward speed adds to the wind speed. The speed with which the hurricanes move through our area increases the intensity, causing further damage, but also moves the storms quickly through and thus reduces the impacts when compared to the damage caused by a long-term pounding. Our area will typically be impacted with hurricane-force winds for about 6-12 hours.

Sandy trackline (Wikipedia)

In 2012, Hurricane Sandy formed in the Western Caribbean and reached Category 3 sustained winds of 115 mph before making landfall on the New Jersey coast as an extra-tropical cyclone. Many hurricanes tracking up the Atlantic coast tend to veer off into the ocean, but Sandy was diverted into the coast by conditions in the Jet Stream. Sandy's high winds and high water caused significant damage on Martha's Vineyard and the Elizabeth Islands even though landfall occurred several states away. The proximity of catastrophic damage was a humbling experience for Vineyarders, even as local damage was assessed.

[3] http://www.geo.brown.edu/georesearch/esh/QE/Research/CoastStd/NEHurric.htm

The strength of a hurricane is rated by its wind speed, according to the Saffir/Simpson Scale:

Scale No. (Category)	Winds (mph)	Potential Damage
1	74-95	Minimal
2	96-110	Moderate
3	111-130	Extensive
4	131-155	Extreme
5	>155	Catastrophic

21st century[4]

"So far in the 21st century four tropical cyclones have made landfall in New England. The first was Tropical Storm Hermine in 2004 which affected southeastern Massachusetts with minimal damage. In 2006 Tropical Storm Beryl struck Nantucket, again with minimal damage. Tropical Storm Barry in 2007 made landfall as a remnant extratropical storm which caused heavy rainfall and flooding. In 2009 Tropical storm Danny made landfall in New England as an extratropical storm. Hurricane Irene weakened to a tropical storm before striking Connecticut. It caused significant damage in New England, especially in Connecticut and Vermont. Hurricane Sandy did not make landfall in New England, but never-the-less caused severe local damage.

Storm	Category Peak intensity	Intensity at landfall	Season	Date of landfall
Tropical Storm Hermine	Tropical Storm	Tropical Storm	2004	August 31, 2004
Tropical Storm Beryl	Tropical Storm	Tropical Storm	2006	July 21, 2006
Tropical Storm Barry	Tropical Storm	Extr. Storm	2007	June 4, 2007
Tropical Storm Danny	Tropical Storm	Extr. Storm	2009	August 29, 2009
Hurricane Irene	Category 3	Tropical Storm	2011	August 28, 2011"

Also, Hurricane Sandy, landfalling several hundred miles away, produced flooding from 10/27/12 – 11/8/12, such that a federal disaster declaration was made, including Dukes County[5]

[4] http://en.wikipedia.org/wiki/List_of_New_England_hurricanes

[5] *Commonwealth of Massachusetts State Hazard Mitigation Plan,* 2013, Prepared by The Massachusetts Emergency Management Agency (MEMA) and the Department of Conservation and Recreation (DCR)

HURRICANES IN SOUTHERN NEW ENGLAND (TWENTIETH CENTURY)[6]

NAME	DATE	INTENSITY
Unnamed	7/21/1916	CAT 1
Unnamed	9/21/1938	CAT 3
Unnamed	9/14-15/1944	CAT 3
Carol	8/31/1954	CAT 3
Edna	9/11/1954	CAT 3
Diane	8/18-20/1955	TS
Donna	9/12/1960	CAT 2
Belle	8/9-10/1976	CAT 1
Gloria	9/27/1985	CAT 2
Bob	8/19/1991	CAT 2
Bertha	7/12-13/1996	TS
Floyd	9/18/1999	TS

Records are available for the most recent hurricanes and tropical storms. Note that our area has not been visited by a category 3 storm since 1954. Significant development has occurred since that time, creating greater potential for safety and property risks.

In addition to the records, there's anecdotal information (stories) that bring our collective memory back a few more years. Trap fisherman Captain Norman G. Benson told this tale of the intensity of the 1938 hurricane at Lambert's Cove, undoubtedly referring to storm surge "Right at that moment, I see another big sea comin' in, much higher even than the first one. It was so big I never seen anythin' like it. I dropped the boat an' quick as I could I ran up a high bank just behind where I'd been standing. Even so, I got soaked by the wave, but I was high enough so it didn't knock me down. That sea took the boat I'd been hauling an' the bath house an' all the other boats, too. It tipped 'em up and raised 'em way up in the air an' crunched 'em all to pieces, an' when the wave went out, away they went, bath house an' boats an' all. And down along the whole Cove it was like that. It took six houses an' all the boats that had been there every single one of them. Next day, Franklin an' I walked the beach, an' we never found a trace — not even a trace o' them — not a stick!"[7]

To remember the earliest storms, we have only the stories, in stark contrast to the meticulous documentation of modern storms. In 1891, Sidney Perley wrote about damage from the "Gale" of 1815 (In the 19th century, the term "hurricane" was used interchangeably with "tornado", and "Gale" referred to what we call a Hurricane.)"…caused more damage than any other since the settlement of the country….just how many lives were lost, many of them being those of husbands and fathers, and how much

[6] Vallee, D. *A Centennial Review of Major Landfalling Tropical Cyclones in Southern New England* (Available at www.erh.noaa.gov/er/box/tropical_cyclones.htm)

[7] *Saltwater in My Veins,* 1972, Tales by Captain Norman G. Benson Trap Fisherman of Martha's Vineyard as told to William L. Peltz 1972

property was destroyed cannot be ascertained. Neither can anyone know how many fond hopes were forever blasted, how many changes in life and its plans were caused, nor the pain of body and heart that followed." He wrote of the intensity of the wind "The gale swept away buildings of all sizes and varieties from churches to sheds, unroofed an exceedingly great number of others, and damaged many thousand more to a greater or less extent. On the roofs of some of the structures shingles were stripped off in rows from the eaves to the ridge-poles. In some places the air seemed to be full of shingles and fragments of timbers and boards, forced hither and thither by the blasts"… and of the tremendous numbers of trees felled "Probably New England never knew another season of such building activity as prevailed in 1817 and 1818, the logs having been sawed in the winter of 1815-16, and the lumber seasoned during the following summer"…and of the vessels lost "At New Bedford, all the vessels in the port, except two, were driven ashore, and several of them beaten to pieces. One ship was left on a wharf, and another one on one of the islands. All the warehouses on the lower wharves were swept off, many houses being injured, and four men and women perished."

The most damaging and dangerous flood impacts by far are caused by storm surge. Storm surge waters come up very suddenly with the landfalling storm, with enough force to remove structures from their foundations and with enough surprise to endanger those unfortunate enough to be trapped by the quickly rising waters. In 1900, in what has come to be known as the "Galveston Hurricane", the entire island city of Galveston, Texas was submerged by storm surge, taking about 8,000 lives. More recently, thousands of lives were taken by Hurricane Katrina in 2005. Closer to home, but farther back in our history, a powerful hurricane in 1635 brought storm surge measured at 20 feet in Boston. The new colonists who survived to rebuild must have harbored second thoughts about settling here. The perseverance of the settlements, with such calamity so soon after arrival, says a lot about the courage and determination of the settlers. Storm surge from the 1938 hurricane, known as the "Great New England Hurricane", was about 9 feet in open areas and more like 15 feet in Narragansett Bay and Buzzards Bay, where the funnel-shaped topography compounded the surge with a sloshing affect.

In this USGS photo of storm surge, the damaging power of this type of flood is readily apparent.

Hurricanes have been responsible for significant coastal modification as well. It was during the "Gale" of September, 1815 that the location of the inlet to Lagoon Pond shifted from near Ferry

Boat Island (named for the old crossing), at the other end of the barrier beach, to its present position at the drawbridge (Although known as the "Gale" of 1815, this storm was a hurricane. Writers of the day used the term "gale" for what we call a hurricane and "hurricane" interchangeably with "tornado"). Norton Point Beach, most recently breached by the April 2007 Nor'easter, has been repeatedly breached by hurricanes, in 1938 and 1954, and in 1991 (a minor breach that healed itself within several days).

Vulnerability to Coastal flooding from storms (hurricanes and Nor'easters):

According to the Massachusetts DCR Flood Hazard Management Program, the following National Flood Insurance Program policies are in effect and claims have been made for properties in Dukes County. Note that the costs for the NFIP are borne partially by the property owners and partially by the U.S. taxpayers.

POLICY STATISTICS AS OF MARCH 31, 2014

Community Name	Policies In-force	Insurance In-force whole $ (whole dollars)	Written premium in force (annual)
Aquinnah	11	3,003,200	17,765
Edgartown	496	139,274,500	551,582
Gosnold	7	2,070,400	7,704
Oak Bluffs	230	68,893,000	338,592
Tisbury	150	44,459,400	255,867
West Tisbury	32	10,996,700	23,713
Totals:	926	$268,797,200	$1,195,223

Note: Chilmark does not participate in the NFIP and has 0 policies and claims.

LOSS STATISTICS AS OF MARCH 31, 2014

Community Name	Total Losses	Total Payments	Repeat Claims Properties	Repeat Claims Claims	Repeat Claims Total Paid
Aquinnah	2	13,462.39	1	2	13,462.39
Edgartown	35	630,922.19	4	10	301,823.68
Gosnold	1	2,214.00	0	0	0
Oak Bluffs	60	769,722.98	9	23	559,418.42
Tisbury	24	257,608.95	3	6	148,302.98
Totals	114	$1,603,746.03	17	41	$1,023,007.47

It is interesting to note that, as of March 13, 2014, 17 properties have been responsible for 41 of 114 claims (36%) and for 64% of the dollar value of the claims, all for private residences and one business. In one case, five claims were filed for a single business property, totaling $257,803.72.

A summary follows of the critical facilities that are located within flood hazard areas. Note that there are two different flood hazard representations, both on the maps and in the statistical summary to follow.

The 100-year and 500-year storm areas are those that would be covered by still flood waters, probably most relevant to a nor'easter type of storm. There is no indication of the impacts of storm surge in the event of a landfalling hurricane. Those flood hazard areas are shown on the FIRM maps (Flood Insurance Rate Maps) and are used to price flood insurance policies and by others such as mortgage lenders to determine risk. The maps have recently been updated to utilize better topography through the recently-available LIDAR data for our area. The updated flood elevation data reflect recent Sea Level Rise as well.

- The SLOSH (Sea, Lake and Overland Surges from Hurricanes) maps were made by modeling storm surge, which is often the most destructive part of a hurricane and the first quick hit that would impact critical resources and imperil citizens very early and quickly in the event of a hurricane landfall in the area. Elevation at a particular location is only part of the storm surge vulnerability. Topography is very important in determining risk. Low-lying areas with long, gently slopes are likely to be impacted by the funneling effect of the storm surge, almost like a tidal wave. This is readily apparent upon examination of the maps. An excerpt here shows the funneling effect of storm surge on the coves of Tisbury Great Pond, with the blue indicating inundation. The SLOSH hazard areas are noted by hurricane category (1,2,3,4). These maps (see appendix) are models only, for planning purposes. The only true and accurate map of storm surge is made after the hurricane has come and gone.

Excerpt of SLOSH map

In the statistical summaries to follow by town, vulnerabilities are examined with respect to both floodplain (100, 500-year storms, Nor'easters) and storm surge (hurricanes). Vulnerabilities of critical facilities were determined for both types of flooding, for all the towns. In addition, statistics were developed regarding numbers of buildings vulnerable to storm surge, for all towns, and assessed values for those residences on Martha's Vineyard (assessment data was not available in digital form for Gosnold).

Vulnerable critical facilities were identified by town. It is important to note that most of the flood-vulnerable facilities are water-dependent critical infrastructure such as ferry terminals.
The tables *SLOSH zone statistics* sum up the numbers of properties and the numbers of homes within SLOSH zones (that is, may be subject to storm surge during a landfalling hurricane), and further sums the assessed values of residences within the SLOSH zones.

Coastal Erosion and Shoreline Change:

Although the more dramatic incidents of shoreline modification occur as results of violent storms, most erosion happens very quietly as the result of day-to-day coastal processes. Banks erode every day in response to wave action, rain runoff and inappropriate development. The unconsolidated sediments that make up a coastal beach are much more mobile, and beaches are features that change with each tide. Wave runup sets the sand in motion, and currents pick up the suspended sand and move it laterally along the beach in a process called longshore transport. Beach sand moves offshore for the winter as well, when more intense wave action pulls the sand away from the beach into offshore bars, only to return with the more gentle waves of summer, to rebuild the beach. Erosion is most often not a life-threatening condition, but the economic impacts are significant in a community that relies on its harbors for almost all its transportation needs and where the prosperity of the inhabitants is linked very closely to the summer vacation industry. Above, the red line marks the former extent of popular Pay Beach in Oak Bluffs.

Coastal structures play an important role in the impacts of erosion. A number of important breakwaters and jetties have been constructed in the community, particularly in connection with navigation and harbor protection. Maintenance and improvement of these structures is critical to the infrastructure of the islands.

Vulnerability to Coastal Erosion and Shoreline Change:

Due to sea level rise and general subsidence of the land, most of the shoreline of Dukes County is erosional. Parts of Martha's Vineyard, in particular, are eroding faster than others. The north shore, including the north sides of Aquinnah, Chilmark, West Tisbury, and most of Tisbury and Oak Bluffs, is relatively stable, with headlands and bluffs of morainal sediments, losing a foot or so each year. The sandy south shore, however, experiences much more loss and movement of the unconsolidated sandy outwash plain sediments. Longshore transport takes sand from the Aquinnah and Chilmark bluffs and moves it along the coast to Muskeget Channel. Erosion rates on the south side range from a foot or so per year at the Gay Head cliffs to more than 10 feet per

year at the Edgartown end. Some spots are more dynamic than others, apart from the overall outcome of the play between accretion (building up) and erosion (losing ground). Wasque Point on Chappaquiddick is a good example, with interaction in a breach-and-heal cycle at Norton Point barrier beach.

This shoreline in Edgartown loses about 10-12 feet every year.

Although the south shore is more dynamic and loses more, it is really the more developed north shore harbors and beaches that are more vulnerable to damaging erosion, particularly where inlets have been stabilized by jetties that interfere with the longshore transport of sand, and must therefore be properly constructed and maintained. Much of the older infrastructure was built by the U.S. Army Corps of Engineers or the Commonwealth, and has not been properly maintained, or in some cases was never completed. An example is the stone dike on Canapitsit Beach, Cuttyhunk, Town of Gosnold, where the USACOE is returning some 40 years later with plans to complete this important project to protect the navigational channel into Cuttyhunk Harbor. In some cases, the older structures were not built with the best configuration to get the job done. Examples are the Oak Bluffs Harbor jetties (right), where reconfiguration of the dogleg on the northeast jetty would greatly improve the protection in the event of a storm, and Lake Tashmoo inlet (right), where reconfiguration of the southernmost jetty could greatly improve storm protection afforded the boats sheltered there.

Shoreline change in the area of Lake Tashmoo showing shorelines from 1955, 1978 and 1994 and 1978 (CZM data), right

Dam Failures:

Hadlock Pond Dam, in Fort Ann, New York, failed in 2005. Similar in scale to our local sites, the pond was enlarged by the dam to 220 acres.

There were no casualties, but lots of property damage.

Damage from Hadlock Pond Dam failure, Fort Ann, NY

Although much of the terrain is well-drained outwash plain sediments, and streams are few, there are some dams in Dukes County, at least in West Tisbury and Chilmark, remnants of our early use of hydrologic power (for the colonists' mills).

Vulnerability to Dam Failures:

The Office of Dam Safety rates dams in accordance with what kind of damage could be done by failure:

Significant Hazard: Dams located where failure or misoperation may cause loss of life and damage home(s), industrial or commercial facilities, and secondary highway(s) or railroad(s) or cause interruption of service of relatively important facilities.
Low Hazard: Dams located where failure or misoperation may cause minimal property damage to others. Loss of life is not expected.

- There are 12 dams in West Tisbury; 11 are rated low to moderate risk and 1 is rated significant risk (Mill Pond Dam). Failure or misoperation of the Mill Pond Dam presents a risk to the adjacent Edgartown-West Tisbury Road.
- There are also 4 dams in Chilmark; all are rated low to moderate risk.

Heavy Rainstorms and Thunderstorms:

Heavy rain generates stormwater runoff that has significant potential for localized flooding and for erosion of beaches and other waterfront areas where the collection system outlets, particularly for systems which discharge directly to a water body with no treatment. The thunderstorms which are common in our area in the spring and summer may bring flash flooding and also damaging winds and lightning. According to the National Weather Service, a thunderstorm is severe if it

produces hail at least one inch in diameter, brings winds of 58 mph or greater, or produces a tornado[8].

Vulnerability to Heavy Rainstorms and Thunderstorms:

MEMA has recorded a number of severe hailstorms and thunderstorms with wind in our area between 1973 and 2013. All occurred in spring or summer, with the exception of one thunderstorm which occurred in January, 1999 at Martha's Vineyard Airport (a critical facility). Hailstorms were recorded in Tisbury in 1997 and in Oak Bluffs in 2000. Thunderstorms were recorded in Tisbury, Oak Bluffs, Edgartown and West Tisbury. Climate change has begun and will continue to bring about a change in precipitation patterns that includes more short-term droughts punctuated by heavy downpours. This is quite a change from the gentle summer rains that Vineyarders are used to. According to the International Panel on Climate Change[9], "Extreme precipitation events over most of the mid-latitude land masses and over wet tropical regions will very likely become more intense and more frequent by the end of this century, as global mean surface temperature increases".

Tornadoes, Waterspouts and Downbursts:

Tornadoes and waterspouts form when thunderstorms develop a spinning circulation that gets tipped upright. According to the State Hazard Mitigation Plan[10], the most destructive tornado ever to strike New England was the Worcester tornado of 1953. With wind speeds of 200 to 260 mph, the F5 tornado took 94 lives and holds the rank of 20th deadliest tornado in the United States.

Tornado damage is measured by the Enhanced Fujita scale. The Enhanced F-Scale and Enhanced F-Scale Damage Indicators are illustrated following:

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[8] National Weather Service, 2013

[9] *Approved Summary for Policymakers,* 2013, Contribution of Working Group 1 to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

[10] *Commonwealth of Massachusetts State Hazard Mitigation Plan,* 2013, Prepared by The Massachusetts Emergency Management Agency (MEMA) and the Department of Conservation and Recreation (DCR)

THE ENHANCED F-SCALE						
Fujita Scale			Derived		Operational EF Scale	
F Number	Fastest ¼ mile (mph)	3-second gust (mph)	EF Number	3-second gust (mph)	EF Number	3-second gusts (mph)
0	40-72	45-78	0	65-85	0	65-85
1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over -200

ENHANCED FUJITA SCALE DAMAGE INDICATORS			
No.	Damage Indicator	No.	Damage Indicator
1	Small barns, frames outbuildings	15	School – 1-story elementary (interior or exterior halls)
2	One or two-family residences	16	School – junior or senior high school
3	Single-wide mobile home	17	Low-rise (1-4 story) building
4	Double-wide mobile home	18	Mid-rise (5-20) building
5	Apt, Condo, townhouse (3 stories or less)	19	High-rise (over 20 stories
6	Motel	20	Institutional bldg. (hospital, govt. or university)
7	Masonry Apt. or motel	21	Metal building system
8	Small retail building (fast food)	22	Service station canopy
9	Small professional (Doctor office, Bank)	23	Warehouse (tilt-up walls or heavy timber)
10	Strip Mall	24	Transmission line tower
11	Large shopping mall	25	Free-standing tower
12	Large, isolated (big box) retail building	26	Free standing pole (light, flag, luminary)
13	Automobile showroom	27	Tree – hardwood
14	Automobile service building	28	Tree – softwood

Waterspouts are tornadoes that form over water, and are rare in our area. Harmless water devils are sometimes seen in our waters on hot days, similar to dust devils on land. More capable of damage, downbursts (including microbursts and macrobursts) are localized columns of sinking air, with wind speeds up to 75 mph.

Vulnerability to Tornadoes:

Tornadoes are found all over the world, but not with the intensity and destruction known in the United States. Fortunately, this American icon tends to spare our part of the world, and Dukes County is at low risk for tornadoes. There is, however, record of a single tornado that struck in the Katama plains area of Edgartown in 1951.

Winter-related Hazards:

Snow Events:

Winter storms in our area may be accompanied by rain or by snow, depending on the temperature. If the system stalls, snow may accumulate to troubling depths. A blizzard is a winter storm with sustained or frequent wind gusts to 35 mph or more, accompanied by falling or blowing snow reducing visibility to or below a quarter-mile. These conditions must be the predominant condition over a 3-hour period.

Vulnerability to Snow Events:

Snow events are rarely an issue for the islands. The winters of 2011-12 and 2013-4, however, were exceptionally snowy, and there was at least one heavy snowstorm early in 2015. According to the 2013 State Hazard Mitigation Plan, there are 13 State-owned buildings with a replacement cost of $8,112,024, and a replacement cost value for general building stock loss potential due to a winter storm event of $3,037,454,000. Although there are sometimes narrow bands of heavier snow even within the relatively small area of Martha's Vineyard and Gosnold, the overall vulnerability to snowfall is the same for the entire area.

Ice:

Ice storms are defined by liquid rain falling and freezing on contact with cold objects, creating ice build-ups of 1/4th inch or more that can cause severe damage. Ice storms could cause significant interruption of services such as electricity. Harbor ice can restrict ferry service by blocking the navigational channel, impacting delivery of vital goods and services such as food and fuel. That is a rare occurrence.

Vulnerability to Ice:

Because of the open configuration of Vineyard Haven Harbor, icing severe enough to restrict ferry service is rare. Icing may also be a factor in Edgartown Harbor, where the Chappaquiddick Ferry runs year 'round between Chappaquiddick and Edgartown proper, as the only means of travel, particularly since the April 2007 breach of Norton Point Barrier Beach.

Fire-related Hazards:

Drought:

Drought conditions exist when an area experiences an extended period of deficient water supply. The fire hazards associated with drought are closely associated with the time of year. Drought conditions in spring, when trees have not leafed out, may be particular cause for concern for wildfires.

Vulnerability to Drought:

Vulnerability to drought is not a localized issue that can be pinpointed to a specific place or time. Unlike the more ephemeral natural hazards that quickly strike and leave, drought takes some time to establish itself and some time to depart. Drought levels intensify from normal conditions through the range of drought advisory, drought watch, drought warning and drought emergency. According to the Massachusetts Department of Conservation and Recreation[11], the most recent local drought has ended. *A Drought Advisory for two of the state's drought regions, the Southeast Region and the Cape and Islands Region, had been in effect from October 1 through November 30, 2014. As of December 1, 2014, the Drought Advisory is no longer in effect, and conditions have returned to normal.*

In 2003, the Martha's Vineyard Commission produced *Martha's Vineyard Source Water Protection Project*, which assessed the needs for protection of the three major public water supplies on Martha's Vineyard, in part to be better prepared for emergencies like drought. The report recommended redundancy for the Oak Bluffs and Tisbury water supplies, to be prepared for emergencies, particularly establishing permission and infrastructure to cross the State Forest and possibly to drill wells there. The report recommended similar improvements for Edgartown, and also to add to the overall supply and infrastructure, which was not estimated to be adequate to meet the projected demand. In addition, the report recommended that plans be considered to bring public water supply to parts of Edgartown that are presently served by wells, and for the Town of West Tisbury to consider initiating its first public water supply service (The entire town is presently served by private wells). In order to meet existing demand and unable to use one well because of high iron content, Edgartown has reported pumping all available wells 17-24 hours per day in the summer, with no redundancy available in case of emergency, which condition is expected to continue[12], leaving Edgartown particularly vulnerable to emergencies like drought.

Wildfires:

We are less familiar with wildfires as a hazard, maybe thinking that they are more likely to occur in the vast western wildernesses of our nation. Wildfires have happened closer to home. In 1957, a fire burned 18,000 acres from Carver to Plymouth, burning all the way to the sea, which is the only reason that it stopped. In the first 6 hours, 12,500 acres burned at the rate of 53 acres/minute. For scale, the Martha's Vineyard State Forest is about 5,200 acres (Imagine an

[11] http://www.mass.gov/eea/agencies/dcr/water-res-protection/water-data-tracking/drought-status.html

[12] *Superintendent Fred Dumont, Edgartown Water Department,* 2007, personal communication

area more than twice the size of the State Forest burning in 6 hours). On Martha's Vineyard, between 1867 and 1929, there were 16 fires greater than 1,000 acres, including the largest (known) 12,000 acres in 1916, which burned from West Tisbury to Farm Neck, Ocean Heights and Edgartown. Since then, fires have generally been smaller. The last big fire was in 1965, 1,200 acres from Great Plains to Katama.

This type of natural disaster would strike quickly and with potential for great loss of life and property.

Vulnerability to Wildfire:

According to the *Commonwealth of Massachusetts State Hazard Mitigation Plan*[13], Massachusetts' forests are potential fuels for wildfires…."Particular areas at risk include the Southeastern area of Plymouth County, Cape Cod, and the Islands, where forested areas pose wildland fire and urban interface fire hazards. Sandy soils, which dry out quickly, increase the wildfire risk in this area". The table which follows, *Major fires of Martha's Vineyard, 1855-1999,* lists the major fires that have occurred on Martha's Vineyard, and their locations.

Major fires of Martha's Vineyard, 1855-1999[14]

Year	Date	Size (ac)	Location
1855	4/7	large	Willis Plain
1864	4/27	4,000	near Lagoon (south central Martha's Vineyard)
1875	7/2	7-10,000	Quompacha Bottom
1883	8/12		Vineyard Haven town fire
1885	4/4	small	Gay Head-Chilmark boundary
1886	5/3	1,000	near Vineyard Haven
1889	3/25	4,000	Quampeche Bottom
1892	4/9	5-8,000	near Middletown
1894	June	large	location unknown
1900	4/27	5,000	Scrubby Neck toward Edgartown
1903	5/18		Inisfail Hotel
1909	7/23	10,000	on Plains
1914	12/25	1,200	western Great Plains to Katama (south eastern Martha's Vineyard)
1916	5/19	12,000	West Tisbury to Farm Neck, Ocean Heights, and Edgartown
1920	8/6		large Vineyard Haven fire
1926	5/14	6,400	West Tisbury toward Ocean Heights
1927	4/30	6,400	from Dr. Fisher Road to Edgartown
1927	5/24	6,400	from Dr. Fisher Road towards Edgartown
1928	4/28	small	Indian Hill Road
1929	4/6	2,500	Watcha to Tiah's Cove, Waldron's Bottom, to Oyster Pond
1929	5/4	2,560	Waldron's Bottom
1929	7/3	small	Tashmoo/Herring Creek

[13] *Commonwealth of Massachusetts State Hazard Mitigation Plan,* 2013, Prepared by The Massachusetts Emergency Management Agency (MEMA) and the Department of Conservation and Recreation (DCR)

[14] *The Modern and Historic Fire Regimes of Central Martha's Vineyard, Massachusetts*, 2002, A Thesis Presented by Adam Mouw

1930	5/10	200	West Chop
1930	5/17	5,000	between Edgartown and Oak Bluffs
1930	6/7	1,000	north to northeast through State Forest
1932			two fires in State Forest
1935	3/30	4,000	Edgartown Great Pond to Katama
1936			8 fires, none in State Forest
1937			Chappaquiddick
1939	4/1	4,000	Quampacha Bottom on Dr. Fisher Road to Vineyard Haven Road
1940	5/18	1,000	State Forest near Edgartown - Vineyard Haven Road
1942	5/27	350	Job's Neck Pond to Jayne's Cove
1942		1,200	near Edgartown Great Pond
1944		240	in State Forest
1946	4/20	5,120	Head of Tisbury Great Pond towards Edgartown/Oak Bluffs
1948	9/4	300	south & west towards Clevelandtown/Edgartown Airport
1951			10 fires on the Island
1954	4/10	1,000	between Bames Road, Wing Road and Edgartown-Vineyard Haven Road
1954	5/30	2,500	Tiah's Cove, West Tisbury to Edgartown
1954	7/17	100	Chappaquiddick near four comers
1957	4/20	35	near state highway at Deep Bottom
1957	5/4	100	North of Chilmark cemetery, toward Chilmark Pond
1958	6/14		east and north from State Forest
1959	4/25	25	between Old Courthouse Road and state Highway
1959	5/9	500	West Tisbury Road near Deep Bottom
1960	4/23	25	Katama
1963	10/26	300	Quampache Bottom to West Tisbury Road
1965	12/19	1,200	Great Plains to Katama
1971	5/15	20	Oklahoma, Tisbury
1975	4/26	50	Northeast from Edgartown dump
1976	1/1	85	Edgartown: Herring Creek Road to Katama Airfield
1987	8/1	20	Oak Bluffs behind Crosslands Nursery
1987	July	~8	State Forest
1999	July	-16	State Forest, along Edgartown-West Tisbury Rd.

Geologic-related Hazards:

Earthquakes:

There have been earthquakes recorded and remembered here. Sidney Perley wrote about the earthquake in1638, the strongest of the seventeenth century, which shook the new settlements and probably the settlers too, particularly following so closely on the heels of the very intense hurricane of 1635

"The shaking of the earth increased to such a violent extent that people could not stand erect without supporting themselves by taking hold of posts or pilings and other fixtures. Not only the mainland, but the islands in the ocean were shaken violently, and the vessels that rode in the harbors and those sailing along the coast were acted upon as if a series of tidal waves had passed under them…Earthquakes are always fearful and impressive, but the people of the time when this one occurred must have had many doubts and fears in their minds. They were not only

superstitious, but this was a new and unknown world, which but a few years before was pictured with the most awful terrors."[15]

There has not been a major earthquake since. Quakes have been felt here as barely noticeable; similar to a large truck passing. An example is the New Brunswick earthquake of 1982, with a magnitude of 5.9 and lasting 30 seconds. It was felt on the islands as a mild rumble, as it was all over the coast of the Northeast U.S. and Canada.

Earthquakes occur when a sudden release of energy in the Earth's crust creates seismic waves. The potential for damage is greatest closest to the epicenter and with a great magnitude of quake. The magnitude and the location of the epicenter are measured using seismometers. The magnitude is measured using the Richter scale, with the greatest in historic times measuring slightly over 9. There is no limit to the possible magnitude. Distance from the epicenter is an important factor in damage; distance being significant both laterally and in depth. Shallow earthquakes tend to cause more damage, for instance.

Vulnerability to Earthquakes:

Fortunately, Dukes County is at low risk for damaging earthquakes. Earthquakes may be felt at times, but our location is far from the fault zones where the more damaging quakes are produced. In addition, there is no exposed bedrock to shake. The islands are made up entirely of soft sediments.

Landslides:

Landslides occur when unstable areas slip, due to environmental factors such as rainfall or freeze/thaw action. This hazard is most problematic in developed areas where homes, businesses or roadways may be at risk.

Vulnerability to Landslides:

Minor landslides have occurred in the high sea cliffs of Aquinnah and Chilmark. This is most often due to freeze/thaw action, runoff, or undermining of the cliff by erosion. Fortunately, this type of hazard does not threaten developed parts of the planning area, and it is unlikely that these landslides would pose a safety hazard.

Sea Level Rise:

[15] *Historic Storms of New England* , 1891, Sidney Perley

Sea level fluctuates in response to natural processes such as glaciation and plate tectonics, and in response to man-made influences on the atmosphere. Sea level is rising in our area, with the result that erosion is increasing, and that development and infrastructure in flood-prone areas is more and more at risk.

Vulnerability to Sea Level Rise:

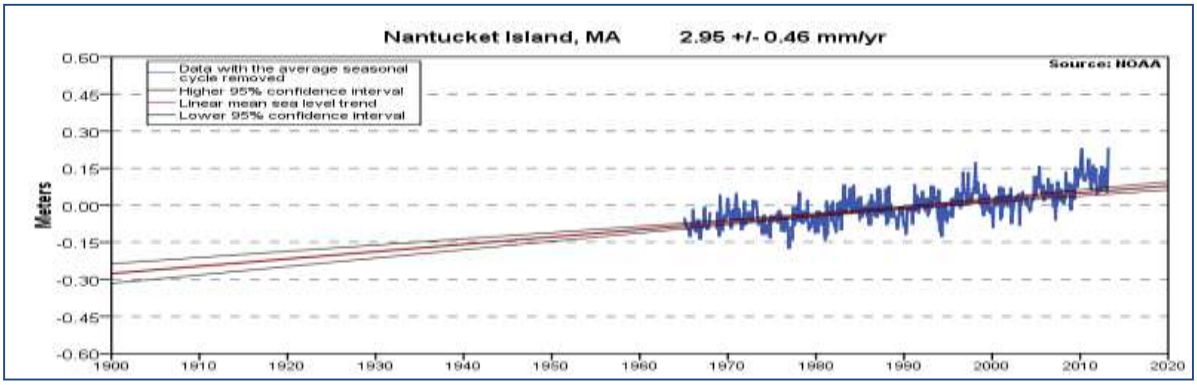
For Martha's Vineyard and Gosnold, sea level has been rising since the retreat of continental glaciation some 12,000 years ago. In relatively recent time, sea level rise has accelerated in response to world-wide climate change. Stakeholders and decision-makers want cut and dry answers to the questions "How much?" and "When"? Unfortunately, the science of projection is inprecise. Reports and future projections seem to bring worse and worse news as the atmosphere continues to degrade.

The Record: The Intergovernmental Panel on Climate Change has met and reported on the status of climate change since 1990. I.P.C.C. reports are widely accepted and viewed as conservative. The panel's projections were included in the 2007 plan. According to the 2013 Working Group I report of the I.P.C.C., the situation continues to decline. Eustatic (world-wide) sea level rose 1.7 millimeters per year between 1901 and 2010, 2.0 mm per year between 1971 and 2010, and 3.2 (2.8 to 3.6) mm per year between 1993 and 2010. The most recent measure of 3.2 mm per year, is equivalent to .126 inches per year[16] (about one foot in 100 years).

Locally, NOAA has tracked sea level since 1932 at Woods Hole and since 1965 at Nantucket. According to the data, sea level has risen 2.8 millimeters per year at Woods Hole between 1932 and 2012 and 3.94 mm per year at Nantucket between 1965 and 2012. The Woods Hole trend of 2.8 mm per year is 65% more than the world-wide rate of 1.7 mm per year for a similar time period. The Nantucket trend of 3.52 mm per year is 76% more than the world-wide measure of 2.0 mm for a similar time period. There should be no surprise that sea level rise in our part of the world is greater than world-wide. This is due to local subsidence, compared to emergence of other areas of the world.

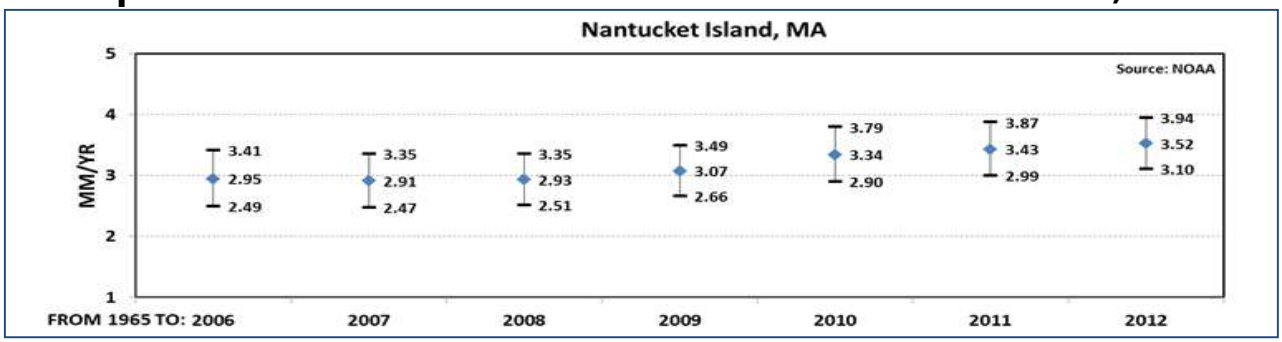
[16] *Approved Summary for Policymakers,* 2013, Contribution of Working Group 1 to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

Mean Sea Level Trend - 8449130 Nantucket Island, Massachusetts[17]



As more data are collected at water level stations, the linear mean sea level trends can be recalculated each year. The figure compares linear mean sea level trends and 95% confidence intervals calculated from the beginning of the station record to recent years (2006-2011). The values do not indicate the trend in each year, but the trend of the entire data period up to that year.

Updated Mean Sea Level Trends - 8449130 Nantucket Island, MA



Projection: As for future projections, the IPCC ventures as follows: "…Warming of the climate system is unequivocal, and since the 1950's, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased", so that we may expect eustatic (world-wide) sea level rise in the next 87 years in the range of 10.2 – 21.7 inches (lowest scenario) to 20.5 – 38.6 inches (highest scenario), with a rate during 2081-2100 of .3 to .6 inches per year [compared to the 2007 projection of 7-15 inches (for a temperature increase of 1.8 degrees C) to 10-23 inches (for a temperature increase of 4 degrees C), in the next century].[18]

[17] http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=8449130

[18] *Approved Summary for Policymakers,* 2013, Contribution of Working Group 1 to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

Some other scientists anticipate more sea level rise than indicated by IPCC. Rahmstorf et al[19], acknowledge that the IPCC reports have been accurate as far as air temperature, but suggest that the rise in water temperature, which is what drives sea level rise (thermal expansion), has consistently exceeded the IPCC projections. They suggest that the IPCC projections for the future are similarly understated. Vermeer and Rahmstorf[20] suggest sea level rise ranging from 75 to 190 cm (2.5 to 6.2 feet) for the period 1990 – 2100.

For planning purposes, it appears prudent to use the Rahmstorf projection. It also appears prudent to use the high emission scenario, because there has been no indication of emissions or energy consumption slowing down or even of the rate of acceleration slowing down world-wide. There isn't yet enough certainty about the likelihood of the various polar cap melting scenarios or their impacts to include a numeric estimate, although that is something that is certain to impact shorelines to some extent, possibly even catastrophically. There is also concern for possible additional sea level rise in our area due to climate-induced changes expected in the nearby Gulf Stream. The projections used here are meant as likely scenarios for use in mapping projections, not as enduring statements of fact. The projections provide a basis for predicting and illustrating the geographic extent of impacts. This should enable the towns and other stakeholders to include this longer-term component in planning for infrastructure investments. Adding at least 4.4 inches/100 years to the Rahmstorf projections to account for local subsidence, the projections for this plan are **18.2 inches by 2050 and 59.4 inches by 2100**. Note that increased acceleration of temperature increase is expected to cause sea level to rise about three times as much in the latter part of this century as in the first part.

The Martha's Vineyard Commission staff prepared a visualization of impacts of sea level rise, which was widely presented and distributed. The visualization appears on the following pages.

[19] Rahmstorf et al, 2012, *Comparing climate projections to observations up to 2011* http://iopscience.iop.org/1748-9326/7/4/044035/article

[20] Vermeer and Rahmstorf, 2009, *Global sea level linked to global temperature* *http://www.pnas.org/content/106/51/21527*

Visualizing Sea Level Rise
Around Martha's Vineyard

Images prepared by Caitlin Michniewicz, MVC intern 2013

The 2013 update to the Pre-Disaster Mitigation Plan for Dukes County projects about a 1.5′ rise in sea level by 2050 for the region and a 5′ rise in Sea Level by 2100. The following images are of locations around Martha's Vineyard with predictions of what this type of change in sea level could look like. The images are used to show high tide level estimates.

Some projections show sea level rise added to typical flooding situations around the Vineyard. Those remind us that BOTH flooding and sea level rise will continue.

Some images represent water-dependent facilities such as ferry transfer bridges and boat launches. Planning for them will need to address the continued need to access land from the water (and vice versa).

Some images represent vulnerable infrastructure in the form of roads. Some difficult decisions lie ahead for the future disposition of these vulnerable roads.

NOAA's CANVIS program (available for free download) was used to produce the projected images.

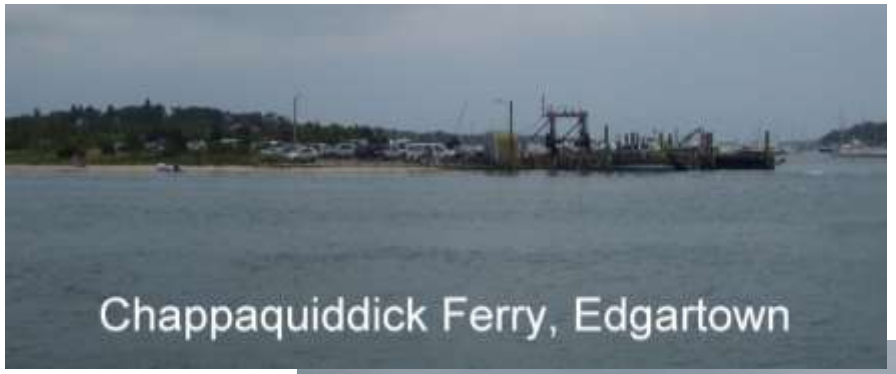
The images are available in slide show format through the following link:

http://youtu.be/hFHzgQzd4_c

Water-dependent facilities are vulnerable to storms as well as to sea level rise, and need to maintain access to rising waters.

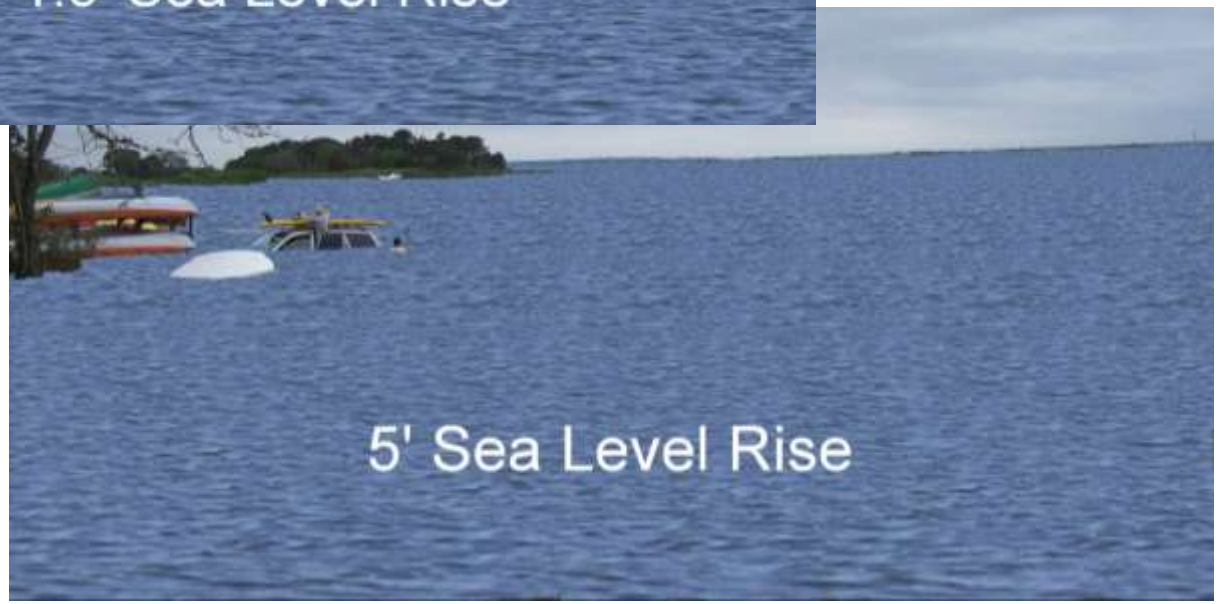
This road is the only access to Chilmark and Aquinnah and has been impacted by storm surge in past hurricanes. Rising waters will only add to the vulnerability to storm damage.

This town beach is only sandy at low tide. The Town of Chilmark is wisely exploring long-range options.



The Chappaquiddick ferry will need continued access to the rising waters. The Chappy side is particularly vulnerable to rising sea level because of its flat terrain.

This popular boat beach is vulnerable due to its flat terrain. Options such as retreat would involve considerable long-range planning.



Typical flooding on Edgartown's waterfront

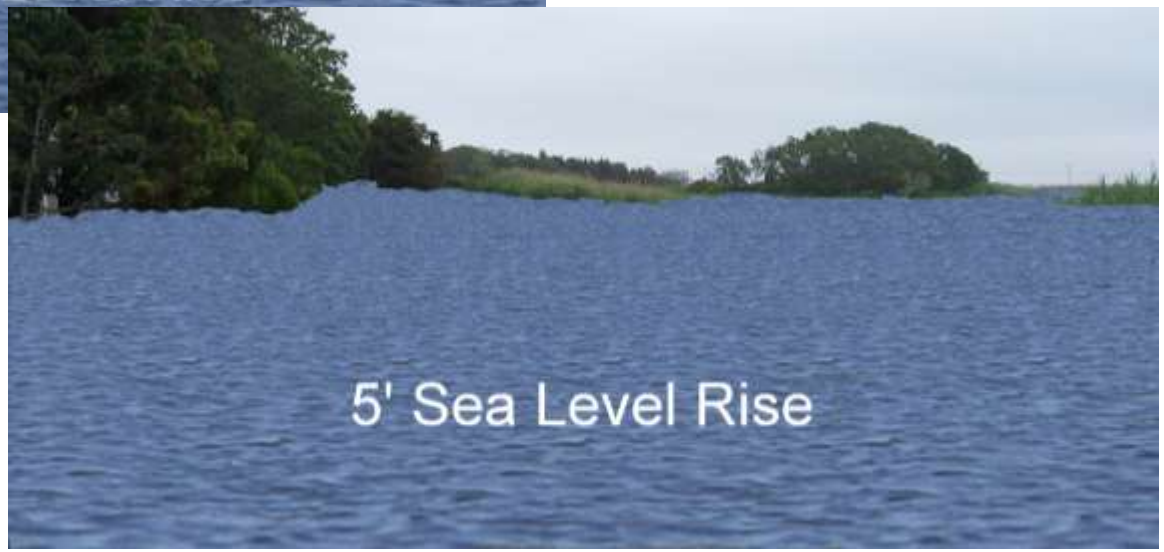
Edgartown's waterfront is the most vulnerable to sea level rise. Most of the infrastructure dates back to the whaling days, and flooding is a routine thing.

Sea View Avenue should remain high and dry for some time. Sand supply for the adjacent beaches is and will remain an issue.

Oak Bluffs Harbor is surrounded by bulkhead and is less vulnerable to sea level rise than to storm damage.

Long range planning is needed for many of the most vulnerable roads.

This road borders a saltmarsh. Decisions about the road will have to include consideration for landward retreat of the marsh.



Steamship Authority terminal -
This water-dependent facility provides the only year 'round passenger and freight passage.

Typical storm flooding in this major intersection may cause drivers hesitation; nothing like the deterrence that is to come.

STOP
1.5' Sea Level Rise

STOP
Five Corners, Vineyard Haven

STOP
5' Sea Level Rise

This boat service facility straddles Beach Road. Sea level rise will add significantly to typical storm flooding.

Section 5. Vulnerability Assessments by Town

The maps illustrate the geographic extent of vulnerability. In some cases, only excerpts are show here. The full sized maps are in the cd pocket and are available on-line. Seeing the full extent is important for planning purposes.

The matrices of vulnerability highlight statistics on vulnerable persons and property. Property is identified both by numbers of buildings and by value. Persons are identified by population (2010 census) as well as by seasonal projection. Projections estimate vulnerability at buildout.

Vulnerability is represented for wildfire (wildland urban interface), flood (Nor'easter), storm (hurricane) and for sea level rise.

Vulnerability assessments were prepared and presented for each town, including the following assumptions:

Year Round Numbers from 2010 Census							
	Aquinnah	Chilmark	Gosnold	Edgartown	Oak Bluffs	Tisbury	West Tisbury
Number of Year Round Housing Units	145	401		1807	2021	1803	1212
Year Round Population Count	311	866		4067	4527	3949	2740
Avg Year-round per House Unit	2.14	2.16		2.25	2.24	2.19	2.26
Draft Estimate of Residential Seasonal Population based on 2010 Census							
Number of Seasonal Housing Units	358	1208		3426	2357	1288	1007
Guest population of Year-rounders	102	281		1265	1415	1262	848
Seasonal Resident Population Count	1708	5762		16342	11243	6144	4803
Draft Estimate of Total In-Season Population Count							
Total # Housing Units	503	1609		5233	4378	3091	2219
Total Population Count	2120	6909		21674	17185	11355	8392
Avg In-season per House Unit	4.22	4.29		4.14	3.93	3.67	3.78

Critical Facilities: Updated in 2013 by the MVC.

Building Structures: MassGIS released in 2013 based on 2011 aerial photos.

Assessor's Data: Cartographic Associates released in 2012. Is Level III compliant.

Future Building Analysis: Initial buildout performed by the MVC in 2007 based on 2007 parcel boundaries, then current zoning regulations, and building locations as of 2005. These buildout numbers were used in the 2007 PDM document. The future numbers in the 2007 PDM document were adjusted given the 2013 count of existing buildings per land use category. For example, if the 2007 PDM reported 15 existing residential buildings and the future number of buildings reported was 10 then, if in 2013, the existing number of residential buildings is 20, the future number was reduced by 5 (10-5) and the 2013 future number of buildings is reported as 5.

Process to identify affected structures and critical facilities: The polygons representing building structures were converted to points - plotted at the center of each structure's polygon. The structure points were spatially joined to the parcel polygons and the respective polygon Loc_ID (unique identifier) was attributed to the point. Identified through spatial analysis with the hazard

data, the affected structures greater than 400sq ft and critical facilities, were joined, in an Access database based on Loc_ID, to the assessor's information. The assessor's data for building value and number of buildings were tallied for the respective parcel uses (i.e. residential, commercial, etc.).

Given the organization of the data, it is impossible to know the exact building record that a structure on a particular parcel links to in the assessor's database. If there is only one structure on a parcel, then there's no issue. However, for parcels where there are many structures or many units (i.e. condo building), completing this join from structure to assessor's data is less straight forward. For example, in some cases there may have only been two structures on a parcel that intersected a hazard but once joined to the assessor's parcel info all the building info for that parcel was included in the tally of financial impact. On the flip side, for condo structures, where there's only one physical structure, all condo units within the structure are included in the financial impact. At this time, there is no perfect solution to this data linking issue. The financial impact numbers should be regarded as being on the high end. The only adjustments made to compensate for this linking issue were performed for Gosnold since the many-to-many data relationship was so egregious (e.g. one structure on this parcel links to 45 building records in the assessor's database).

Vulnerability to Future Natural Hazards:

Based on the identification and profile of the natural hazards that have occurred throughout the region over time, a vulnerability matrix has been developed. The following criteria, adapted from the Massachusetts Hazard Mitigation Plan developed by MEMA, were used for frequency characterization:

- Very Low Frequency: events that occur less frequently than once in 1,000 years (less than 0.1% per year)
- Low Frequency: events that occur from once in 100 years to once in 1,000 years (0.1 to 1% per year)
- Medium Frequency: events that occur from once in 10 years to once in 100 years (1% to 10% per year)
- High Frequency: events that occur more frequently than once in 10 years (greater than 10% per year)

The criteria used for severity characterization, based on past hazard events, include the following:

- Minor: Limited and scattered property damage; no damage to public infrastructure (roads, bridges, parks, etc.); contained geographic area (i.e., one or two towns); essential services (utilities, hospital, schools) not interrupted; no injuries or fatalities
- Serious: Scattered major property damage; some minor infrastructure damage; wider geographic area (several towns); essential services are briefly interrupted; some injuries and/or fatalities
- Extensive: Consistent major property damage; major damage to public infrastructure (taking up to several days for repair); essential services are interrupted from several hours to several days; many injuries and fatalities
- Catastrophic: Property and public infrastructure destroyed; essential services stopped; hundreds of injuries and fatalities

A vulnerability matrix was prepared for each community, using numeric points (one point for each step of higher frequency or impact) and the resulting scores were averaged for the following table of vulnerability for the overall area (Dukes County):

OVERALL VULNERABILITY FOR DUKES COUNTY TOWNS

Natural Hazard	Frequency of Occurrence	Location	Impacts	Hazard Index
	(very low, low, medium, high)	(local or small, medium, multiple towns or large)	(minor, serious, extensive, catastrophic)	(rank by combining how much impact & how frequently this affects the community - average for all planning areas)(one point for each step of higher frequency or impact)
Flood-Related Hazards				
Riverine	very low	n/a	n/a	0
Coastal	medium	large	serious	8
Erosion	high	large	serious	7.4
Dam Failures	very low	local	serious	1
Severe Rainstorms	medium	large	serious	8
Winter Storms (snow)	low	local	minor	4
Coastal Storms/Nor'easters	high	medium	serious	9.4
Hurricanes	medium	large	extensive	9
Wind-Related Hazards				
Hurricanes	medium	large	extensive	9.1
Coastal Storms	high	large	serious	9.1
Winter Storms (snow)	low	local	serious	5
Downspouts	very low	local	serious	3
Tornadoes	very low	local	serious	4.1
Fire-Related Hazards				
Drought	medium	medium	serious	6
Wildfires	low	local	serious	6
Geologic Hazards				
Earthquakes	very low	n/a	n/a	0
Landslides	very low	local	minor	3.6
Sink Holes	very low	n/a	n/a	0
Other Hazards				
Ice	very low	local	serious	3.4
Sea Level Rise	high	large	serious	6.6

VULNERABILITY ASSESSMENTS FOR AQUINNAH

The Town of Aquinnah is the smallest town in the planning area, both in terms of area (5.4 square miles of land area) and of year 'round population (311 as of the 2010 census). Aquinnah (formerly known as Gay Head) is also the least commercially developed and has no town center. The sparse population is scattered across the rugged topography of this morainal land, with a density of 57.6 persons per square mile.

The maps illustrate the geographic extent of vulnerability. In some cases, only excerpts are show here. The full sized maps are in the cd pocket and are available on-line. Seeing the full extent is important for planning purposes.

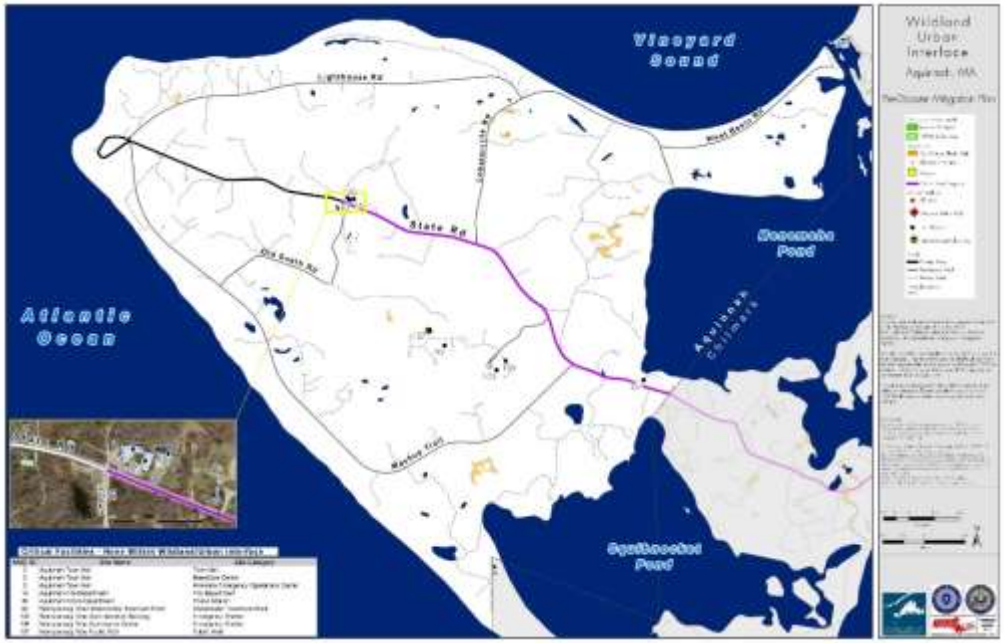
The matrices of vulnerability highlight the persons and property. Property is identified both by numbers of buildings and by value. Persons are identified by population (2010 census) as well as by seasonal projection. Projections estimate vulnerability at buildout.

Vulnerability is represented for wildfire (wildland urban interface), flood (Nor'easter), storm (hurricane) and for sea level rise.

AQUINNAH WILDFIRE VULNERABLITY

Aquinnah is known for its wild landscape, but most of the terrain is made up of moors rather than forests. There are some fuel-rich areas of pitch pine and scrub oak. Otherwise, forest fire is not a major issue for Aquinnah.

Contiguous Woodlands are shown in green; darker green represents area >=50 acres; lighter green shows
1000ft Buffer Area. Pitch Pine or Shrub Oak vegetation is shown in tan.



Wildland-Urban Interface Vulnerability for Aquinnah (Wildfire Vulnerability)

Developed Land					Undevel. Land			
Use	# People (other)	# People (July-Aug)	# Buildings	Approx. Value	# People (other)	# People (July-Aug)	# Buildings	Approx. Value

	2.14 per building	4.22 per building			2.14 per building	4.22 per building		
Residential	6	13	3	$694,803	32	63	15	$3,474,015
Commercial								
Industrial								
Municipal, Public, Non-profit							2	$463,202

FLOOD VULNERABILITY FOR AQUINNAH (NOR'EASTER – TYPE STORM)

2013 PRELIMINARY F.I.R.M. MAP

Darker orange represents the 100-year VE zone (wave heights > 3'). Lighter orange represents the 100-year AE zone (wave heights < 3'). Yellow shows the 500-year flood zone.

FLOOD VULNERABILITY FOR AQUINNAH (NOR'EASTER – TYPE STORM)

Developed Land

Flood Zone Category	Use	# People (other)	# People (July-Aug)	# Buildings	Approximate Value
		2.14 per building	4.22 per building		
100 Year	Residential	39	76	18	$3,509,000
	Commercial			0	
	Industrial			0	
	Exempt (Municipal, Public, Non-profit)			0	
Velocity Zone (also 100yr)	Residential	28	55	13	$2,361,700
	Commercial			2	$12,200
	Industrial			0	
	Exempt (Municipal, Public, Non-profit)			0	
500 Year	Residential	0	0	0	
	Commercial			0	
	Industrial			0	
	Exempt (Municipal, Public, Non-profit)			0	

FLOOD VULNERABILITY FOR AQUINNAH (NOR'EASTER – TYPE STORM)
Developable Land

Flood Zone Category	Use	# People (other)	# People (July-Aug)	# Buildings	Approximate Value
		2.14 per building	4.22 per building		
100 Year	Residential	94	186	44	$8,577,556
	Commercial			0	
	Industrial			0	
	Exempt (Municipal, Public, Non-profit)				
Velocity Zone (also 100yr)	Residential	45	89	21	$3,815,054
	Commercial			0	
	Industrial			0	
	Exempt (Municipal, Public, Non-profit)			0	
500 Year	Residential	43	84	20	$3,898,889
	Commercial			0	
	Industrial			0	
	Exempt (Municipal, Public, Non-profit)			0	

STORM SURGE VULNERABILITY FOR AQUINNAH (HURRICANE) S.L.O.S.H. MAP

The colors in the Storm Surge legend grade in Hurricane intensity from Category 1 (dark purple) lighter and lighter to Category 4 (palest color).

AQUINNAH HURRICANE INUNDATION VULNERABILITY (SLOSH) STORM SURGE
Based on preliminary data Released by the USACOE New England District in March 2013 Developed Land

SLOSH cat.	Use	# People (other)	# People (July-Aug)	# Buildings	Approx. Value
		2.14 per building	4.22 per building		
1	Residential	0	0	0	
	Commercial			2	$12,200
	Industrial			0	
	Municipal, Public, Non-profit			0	
2	Residential	43	84	20	$3,759,600
	Commercial			0	
	Industrial			0	
	Municipal, Public, Non-profit			0	
3	Residential	32	63	15	$3,456,700
	Commercial			0	
	Industrial			0	
	Municipal, Public, Non-profit			0	
4	Residential	17	34	8	$1,886,600
	Commercial			0	
	Industrial			0	
	Municipal, Public, Non-profit			0	

AQUINNAH HURRICANE INUNDATION VULNERABILITY (SLOSH) STORM SURGE
Based on preliminary data Released by the USACOE New England District in March 2013 Developable Land

SLOSH cat.	Use	# People (other)	# People (July-Aug)	# Buildings	Approx. Value
		2.14 per building	4.22 per building		
1	Residential	36	84	17	$3,314,048
	Commercial			0	
	Industrial			0	
	Municipal, Public, Non-profit			0	
2	Residential	32	63	30	$5,639,400
	Commercial			0	
	Industrial			0	
	Municipal, Public, Non-profit			0	
3	Residential	36	72	17	$3,917,593
	Commercial			0	
	Industrial			0	
	Municipal, Public, Non-profit			0	
4	Residential	47	93	22	$5,188,150
	Commercial			0	
	Industrial			0	
	Municipal, Public, Non-profit			0	

AQUINNAH SEA LEVEL RISE VULNERABILITY
SLR Scenarios: 1.5 ft (mid-century) and 5 ft (end of this century)

Light blue shows the mid-century projection of 1.5' above MHHW; dark blue shows the end-of-the-century projection of 5'.

AQUINNAH SEA LEVEL RISE VULNERABILITY
SLR Scenarios: 1.5 ft (mid-century) and 5 ft (end of this century)

Rise Level	Use	# People (other)	# People (July-Aug)	# Buildings	Approximate Value
		2.14 per building	4.22 per building		
<= 1.5ft Rise	Residential	0	0	0	$0
	Commercial			0	$0
	Industrial			0	$0
	Exempt (Municipal, Public, Non-profit)			0	$0
>1.5ft and <= 5ft Rise	Residential	2	4	1	$42,700
	Commercial			2	$12,200
	Industrial			0	$0
	Exempt (Municipal, Public, Non-profit)			0	$0

COASTAL EROSION AND SHORELINE CHANGE

Pre-1978 homes near bluffs are difficult for the towns to regulate (grandfathered under the Wetlands Protection Act). There are 15 in Aquinnah.

AQUINNAH VULNERABILITY OF CRITICAL FACILITIES

Flood	**NONE**

Hurricane Inundation	**NONE**

Sea Level Rise	**NONE**

Wildland-Urban Interface	**NONE**

BRIDGES	**Town**	**Hazard***
Hariph's Bridge	**Chilmark**	**AE 100 year flood zone & SLOSH Category 1**

AQUINNAH VULNERABILITY OF CRITICAL FACILITIES - ROADS

ROADS	Town	Hazard	Length Intersected (ft)	Total Length of Road (ft)
South Road/State Rd	Chilmark	Wildfire Buffer Area	8,368	40,870
		Pitch Pine/Shrub Oak	4,560	
		AE 100 year flood zone	451	
		SLOSH Category 1	50	
		SLOSH Category 2	231	
		SLOSH Category 3	1,632	
		SLOSH Category 4	4,981	
State Road (Chi./Aq. Town line to Aquinnah Police Station)	Aquinnah	AE 100 year flood zone	51	10,328
State Road (Chi./WT town line to Edg-WT Rd)	West Tisbury	AE 100 year flood zone	96	2,212
		SLOSH Category 2	8	
		SLOSH Category 3	186	
		SLOSH Category 4	60	

Future Vulnerability for the Town of Aquinnah

Natural Hazard	Frequency of Occurrence	Location	Impacts	Hazard Index
	(very low, low, medium, high)	(local or small, medium, multiple towns or large)	(minor, serious, extensive, catastrophic)	(combine impact & frequency)(one point for each step of frequency or impact)
Flood-Related Hazards				
Riverine	very low	n/a	n/a	0
Coastal	medium	large	serious	8
Erosion	high	local	minor	6
Dam Failures	n/a	n/a	n/a	0
Severe Rainstorms	medium	large	serious	8
Winter Storms	low	local	minor	4
Coastal Storms/Nor'easters	medium	medium	extensive	9
Hurricanes	high	large	extensive	10
Wind-Related Hazards				
Hurricanes	medium	large	extensive	9
Coastal Storms	high	large	serious	9
Winter Storms	low	local	serious	5
Downspouts	very low	local	serious	3
Tornadoes	very low	local	serious	4
Fire-Related Hazards				
Drought	low	local	minor	4
Wildfires	very low	local	minor	3
Geologic Hazards				
Earthquakes	very low	n/a	n/a	0
Landslides	medium	local	minor	5
Sink Holes	very low	n/a	n/a	0
Other Hazards				
Ice	very low	local	serious	3
Sea Level Rise	high	local	minor	6

VULNERABILITY ASSESSMENTS FOR CHILMARK

The Town of Chilmark includes a year 'round population of 866 (2010 census) on a land area of 19.1 square miles, for a density of 45.3 persons per square mile. With 3-acre zoning, development has spread over the hilly morainal land, and property values are quite high, in 2005 the highest average property value in the Commonwealth, with most of that cost based on the land value rather than the buildings. One exception is the closely-quartered fishing village of Menemsha, which includes a number of water-dependent facilities for the resident fishing fleet and visiting recreational craft in summer, and shore facilities such as fuel and restrooms.

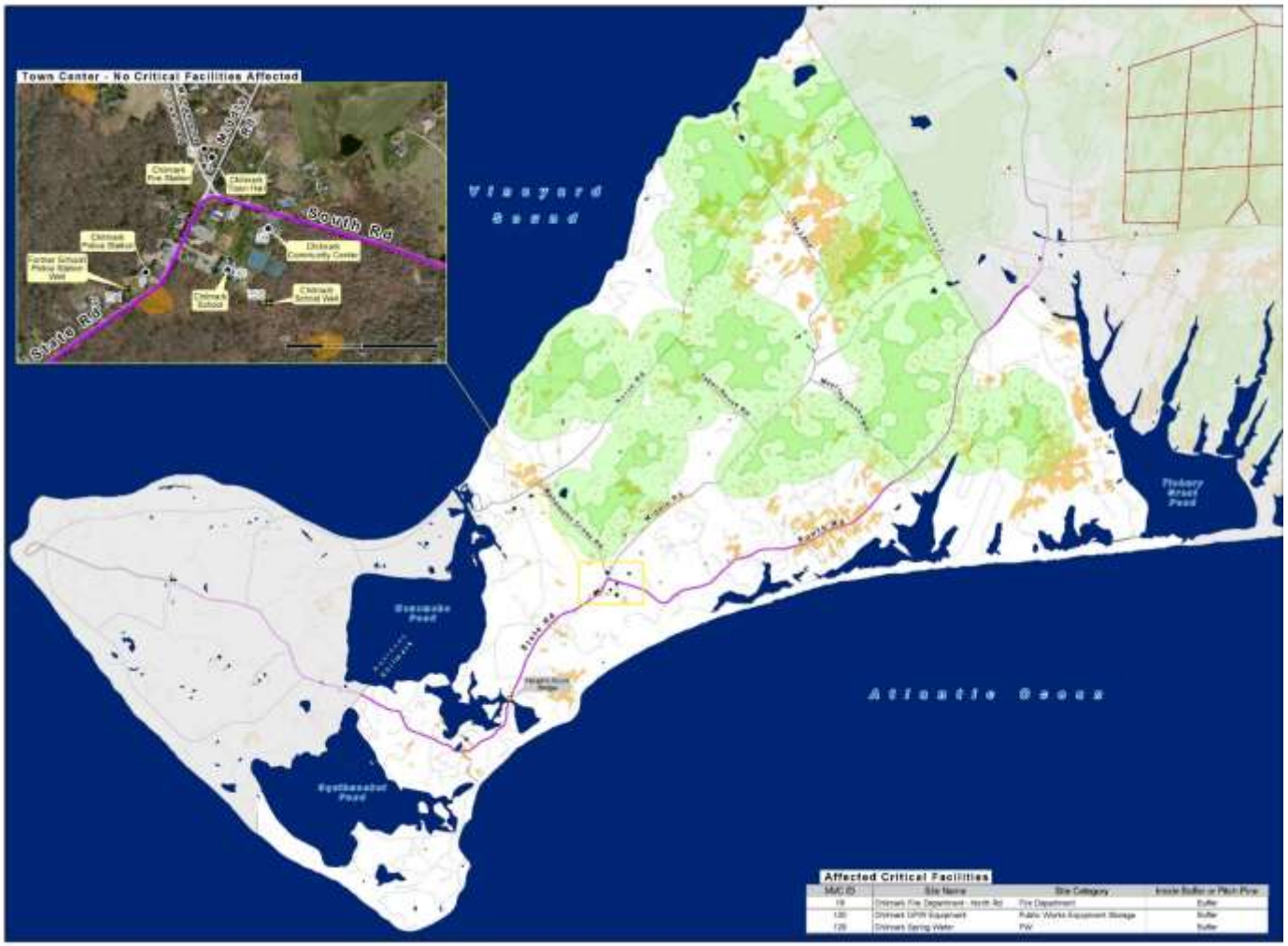
The maps illustrate the geographic extent of vulnerability. In some cases, only excerpts are show here. The full sized maps are in the cd pocket and are available on-line. Seeing the full extent is important for planning purposes.

The matrices of vulnerability highlight the persons and property. Property is identified both by numbers of buildings and by value. Persons are identified by population (2010 census) as well as by seasonal projection. Projections estimate vulnerability at buildout.

Vulnerability is represented for wildfire (wildland urban interface), flood (Nor'easter), storm (hurricane) and for sea level rise.

Sea level rise impacts are illustrated at several sites around town.

CHILMARK WILDFIRE VULNERABILITY (WILDLAND URBAN INTERFACE)



Contiguous Woodlands are shown in green; darker green represents area >=50 acres; lighter green shows 1000ft Buffer Area. Pitch Pine or Shrub Oak vegetation is shown in tan.

CHILMARK WILDFIRE VULNERABILITY (WILDLAND URBAN INTERFACE)

Developed Land					Undevel. Land			
Use	# People (other)	# People (July-Aug)	# Buildings	Approx. Value	# People (other)	# People (July-Aug)	# Buildings	Approx. Value

	2.16 per building	4.29 per building			2.16 per building	4.29 per building		
Residential	1162	2308	538	$266,761,900	1419	2819	657	$325,766,856
Commercial			2	$2,537,000			6	$7,611,000
Municipal, Public, Non-profit			3	$197,500			13	$855,833

CHILMARK FLOOD VULNERABILITY (2013 PRELIMINARY FIRM MAP)

Darker orange represents the 100-year VE zone (wave heights > 3'). Lighter orange represents the 100-year AE zone (wave heights < 3'). Yellow shows the 500-year flood zone.

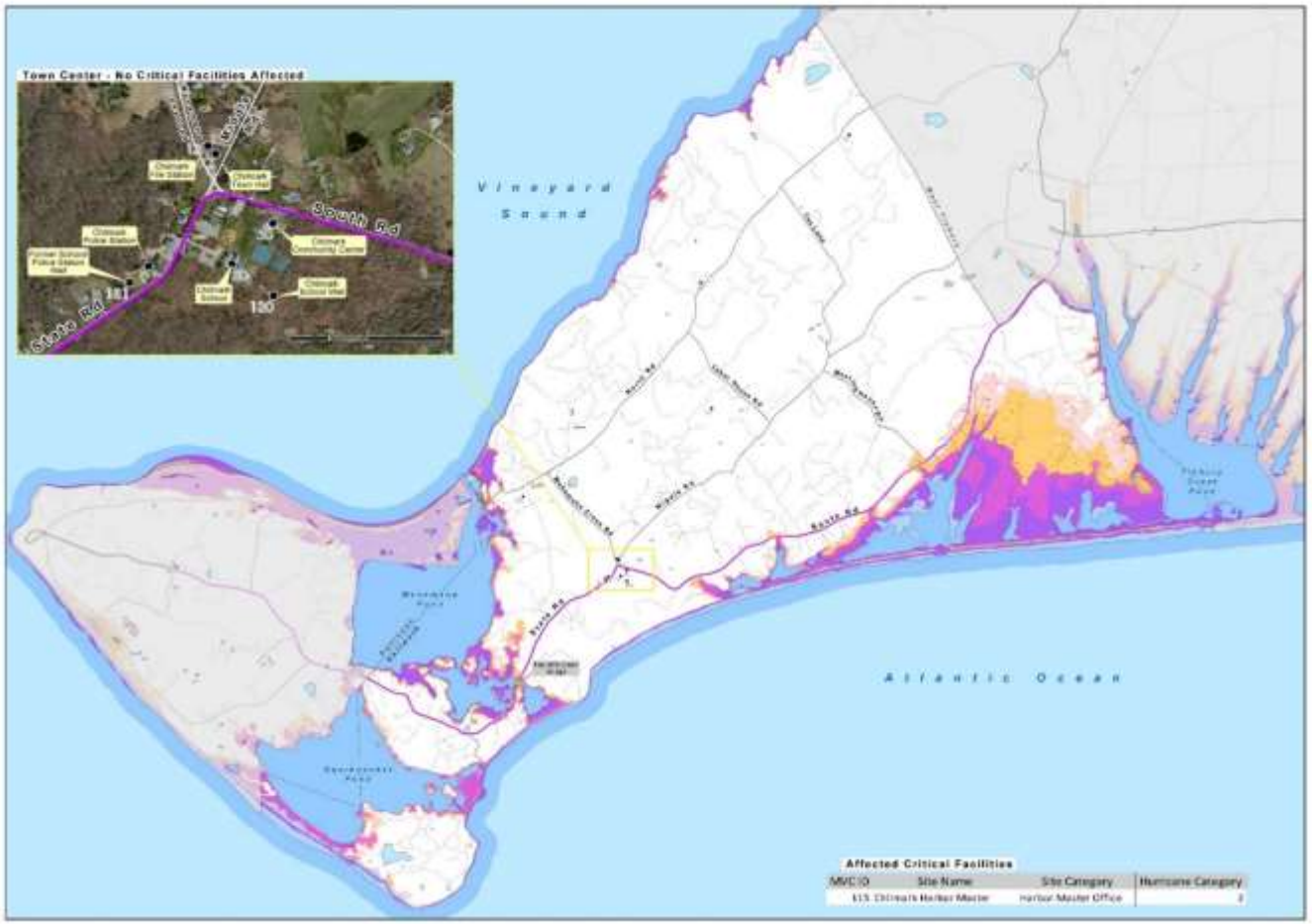
CHILMARK FLOOD VULNERABILITY
Based on Preliminary Flood Data Released in June 2013
Developed Land

Flood Zone Category	Use	# People (other)	# People (July-Aug)	# Buildings	Approximate Value
		2.16 per building	4.29 per building		
100 Year	Residential	110	219	51	$16,156,400
	Commercial			5	$1,302,400
	Exempt (Municipal, Public, Non-profit)			0	
Velocity Zone (also 100yr)	Residential	11	21	5	$5,784,800
	Commercial			3	$356,500
	Exempt (Municipal, Public, Non-profit)			2	$70,300
500 Year	Residential	0	0	0	
	Commercial			0	
	Industrial			0	
	Exempt (Municipal, Public, Non-profit)			0	

CHILMARK FLOOD VULNERABILITY
Based on Preliminary Flood Data Released in June 2013
Developable Land

Flood Zone Category	Use	# People (other)	# People (July-Aug)	# Buildings	Approximate Value
		2.16 per building	4.29 per building		
100 Year	Residential	82	163	38	$12,038,102
	Commercial			2	$520,960
	Exempt (Municipal, Public, Non-profit)			0	
Velocity Zone (also 100yr)	Residential	0	0	0	
	Commercial			0	
	Exempt (Municipal, Public, Non-profit)			0	
500 Year	Residential	32	78	15	$4,751,882
	Commercial			0	
	Exempt (Municipal, Public, Non-profit)			2	

CHILMARK HURRICANE INUNDATION VULNERABILITY (SLOSH)
Based on preliminary data Released by the USACOE New England District in March 2013



STORM SURGE

The colors in the Storm Surge legend grade in Hurricane intensity from Category 1 (dark purple) lighter and lighter to Category 4 (palest color).

CHILMARK HURRICANE INUNDATION VULNERABILITY (SLOSH)
Based on preliminary data Released by the USACOE New England District in March 2013
DEVELOPED LAND

SLOSH cat.	Use	# People (other)	# People (July-Aug)	# Buildings	Approx. Value
		2.16 per building	4.29 per building		
1	Residential	17	34	8	$3,563,000
	Commercial			0	
	Municipal, Public, Non-profit			0	
2	Residential	82	163	38	$13,584,100
	Commercial			7	$1,423,100
	Municipal, Public, Non-profit			2	$70,300
3	Residential	121	240	56	$21,785,900
	Commercial			4	$974,400
	Municipal, Public, Non-profit			2	$606,100
4	Residential	140	279	65	$39,997,400
	Commercial			1	$359,600
	Municipal, Public, Non-profit			1	$198,300

CHILMARK HURRICANE INUNDATION VULNERABILITY (SLOSH)
Based on preliminary data Released by the USACOE New England District in March 2013
DEVELOPABLE LAND

SLOSH cat.	Use	# People (other)	# People (July-Aug)	# Buildings	Approx. Value
		2.16 per building	4.29 per building		
1	Residential	54	107	25	$11,134,375
	Commercial			0	
	Municipal, Public, Non-profit			5	
2	Residential	69	137	32	$11,439,242
	Commercial			0	
	Municipal, Public, Non-profit			1	$35,150
3	Residential	76	150	35	$13,616,188
	Commercial			0	
	Municipal, Public, Non-profit			13	$3,939,650
4	Residential	86	172	40	$24,613,785
	Commercial			0	
	Municipal, Public, Non-profit			6	

CHILMARK SEA LEVEL RISE VULNERABILITY
SLR Scenarios: 1.5 ft (mid-century) and 5 ft (end of this century)

MVOD	SITE NAME	CATEGORY
4	Chilmark Town Hall	Primary Emergency Operations Center
4	Chilmark Town Hall	Town Hall
8	Chilmark Police Station	MassCare Center
9	Chilmark Police Station	Alternate Emergency Operations Center
9	Chilmark Police Station	Police Station
17	Chilmark Fire Department	Fire Department
18	Chilmark Fire Department - North Rd	Fire Department
30	Chilmark Elementary	School
50	Chilmark Community Center	MassCare Center
104	Menemsha Well	Public Well
115	Chilmark Harbor Master	Harbor Master Office
120	Chilmark DPW Equipment	Public Works Equipment Storage
129	Chilmark Spring Water	PW
130	Chilmark School Well	PW
131	Menemsha School Well	PW

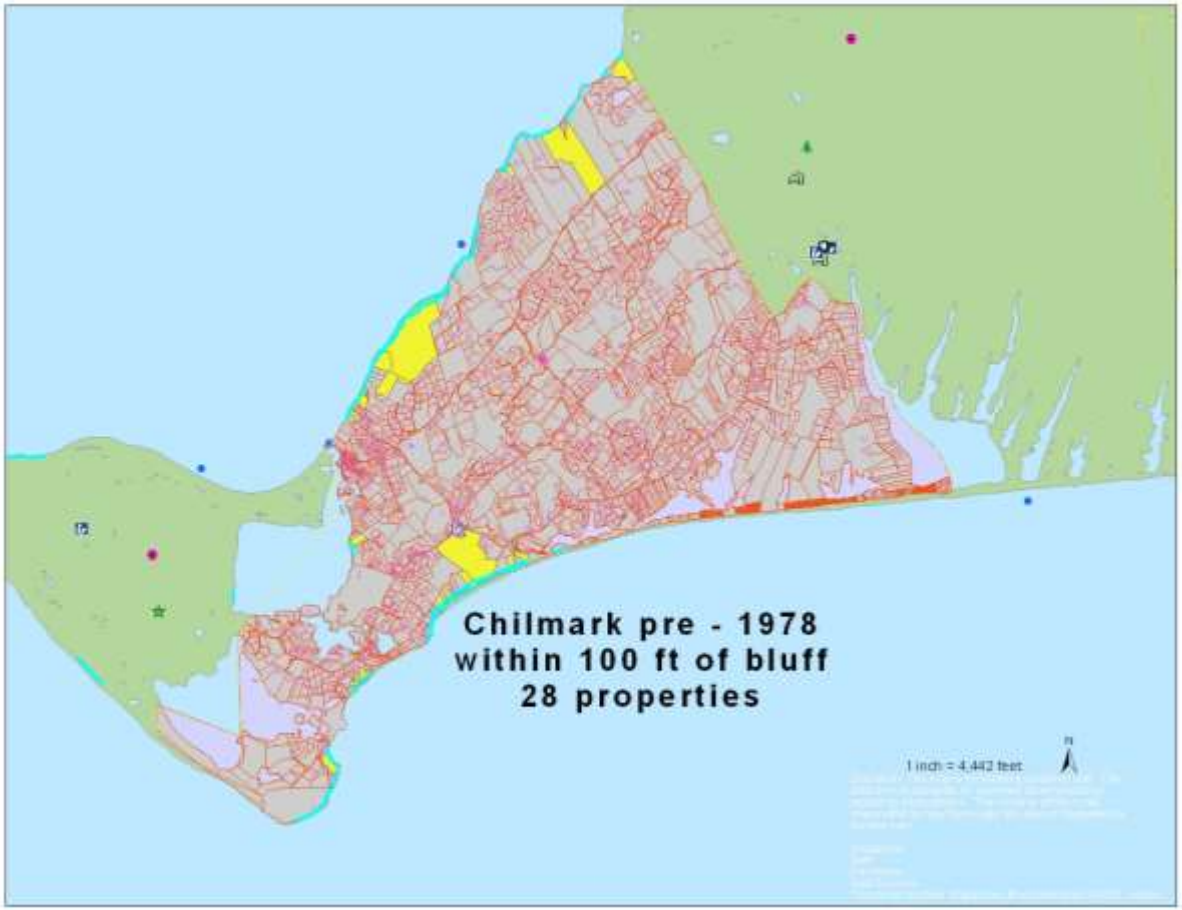
Light blue shows the mid-century projection of 1.5' above MHHW; dark blue shows the end-of-the-century projection of 5'.

CHILMARK SEA LEVEL RISE VULNERABILITY
SLR Scenarios: 1.5 ft (mid century) and 5 ft (end of this century)

Rise Level	Use	# People (other)	# People (July-Aug)	# Buildings	Approximate Value
		2.16 per building	4.29 per building		
<= 1.5ft Rise	Residential	0	0	0	
<= 1.5ft Rise	Commercial			0	
<= 1.5ft Rise	Exempt (Municipal, Public, Non-profit)			0	
>1.5ft and <= 5ft Rise	Residential	17	34	8	$2,879,900
>1.5ft and <= 5ft Rise	Commercial			1	$192,900
>1.5ft and <= 5ft Rise	Exempt (Municipal, Public, Non-profit)			0	

COASTAL EROSION AND SHORELINE CHANGE

Pre-1978 homes near bluffs are difficult for the towns to regulate (grandfathered under the Wetlands Protection Act). There are 28 in Chilmark (marked in yellow).



CHILMARK VULNERABILITY OF CRITICAL FACILITIES

Flood	Flood Zone Category	Critical Facility Category	# Buildings	Approximate Value
	Velocity Zone (also 100yr)	Chilmark Harbor Master	1	$3,000

Hurricane Inundation	SLOSH Category	Critical Facility Category	# Buildings	Approximate Value
	2	Chilmark Harbor Master	1	$3,000

Sea Level Rise	NONE

Wildland-Urban Interface		Critical Facility Category	# Buildings	Approximate Value
	In buffer area	Chilmark DPW Equipment	1	$3,100
	In buffer area	CHILMARK FIRE DEPARTMENT	1	$104,900
	In buffer area	Chilmark Spring Water	1	$37,200

CHILMARK VULNERABILITY OF CRITICAL FACILITIES – ROADS

ROADS	Town	Hazard	Length Intersected (ft)	Total Length of Road (ft)
South Road/State Rd	Chilmark	Wildfire Buffer Area	8,368	40,870
		Pitch Pine/Shrub Oak	4,560	
		AE 100 year flood zone	451	
		SLOSH Category 1	50	
		SLOSH Category 2	231	
		SLOSH Category 3	1,632	
		SLOSH Category 4	4,981	
State Road (Chi./Aq. Town line to Aquinnah Police Station)	Aquinnah	AE 100 year flood zone	51	10,328
State Road (Chi./WT town line to Edg-WT Rd)	West Tisbury	AE 100 year flood zone	96	2,212
		SLOSH Category 2	8	
		SLOSH Category 3	186	
		SLOSH Category 4	60	

BRIDGES	Town	Hazard*
Hariph's Bridge	Chilmark	AE 100 year flood zone & SLOSH Category 1

Town of Chilmark Future Vulnerability

Natural Hazard	Frequency of Occurrence	Location	Impacts	Hazard Index
	(very low, low, medium, high)	(local or small, medium, multiple towns or large)	(minor, serious, extensive, catastrophic)	(combine impacts and frequency)(1 point for each step of frequency or impact)
Flood-Related Hazards				
Riverine	very low	n/a	n/a	0
Coastal	medium	large	serious	8
Erosion	high	local	minor	6
Dam Failures	very low	local	minor	3
Severe Rainstorms	medium	large	serious	8
Winter Storms	low	local	minor	4
Coastal Storms/Nor'easters	high	medium	extensive	10
Hurricanes	medium	medium	extensive	9
Wind-Related Hazards				
Hurricanes	medium	large	extensive	10
Coastal Storms	high	large	serious	9
Winter Storms	low	local	serious	5
Downspouts	very low	local	minor	3
Tornadoes	very low	local	serious	4
Fire-Related Hazards				
Drought	low	local	minor	4
Wildfires	low	local	minor	4
Geologic Hazards				
Earthquakes	very low	n/a	n/a	0
Landslides	medium	local	minor	5
Sink Holes	very low	n/a	n/a	0
Other Hazards				
Ice	very low	local	serious	3
Sea Level Rise	high	local	minor	6

VULNERABILITY ASSESSMENTS FOR EDGARTOWN

Edgartown is the largest in land area of the towns in the County, with 27 square miles of land area and a year 'round population of 4,067 (2010 census) and a density of 150.7 persons per square mile.

Much of Edgartown's land area is very low and flat, made of unconsolidated outwash plain sediments that are susceptible to erosion. The south side of Edgartown experiences erosion at rates of 10-12 feet per year, and the low-lying plains with periglacial valleys are also highly susceptible to storm surge, with considerable risk to developed areas. Part of Edgartown lies on the nearby Island of Chappaquiddick, accessible by ferry year 'round, with associated transfer facilities to load vehicles. There have been times when Chappaquiddick has been accessible by 4-wheel drive vehicle across the barrier beach which sometimes connects Chappaquiddick to Edgartown proper, but an April 2007 storm breached the barrier, and the barrier is expected to remain open for at least 10-15 years in the future, during which time, ferry and boat travel are the only links to Chappaquiddick. Part of Edgartown is also in a direct line for wave action from Nor'easter storms, with potential for significant beach erosion and coastline modification.

Much of the town is serviced by municipal water, and the infrastructure is such that there is not enough redundancy to protect the service from unfortunate events such as drought.

The maps illustrate the geographic extent of vulnerability. In some cases, only excerpts are show here. The full sized maps are in the cd pocket and are available on-line. Seeing the full extent is important for planning purposes.

The matrices of vulnerability highlight the persons and property. Property is identified both by numbers of buildings and by value. Persons are identified by population (2010 census) as well as by seasonal projection. Projections estimate vulnerability at buildout.

Vulnerability is represented for wildfire (wildland urban interface), flood (Nor'easter), storm (hurricane) and for sea level rise.

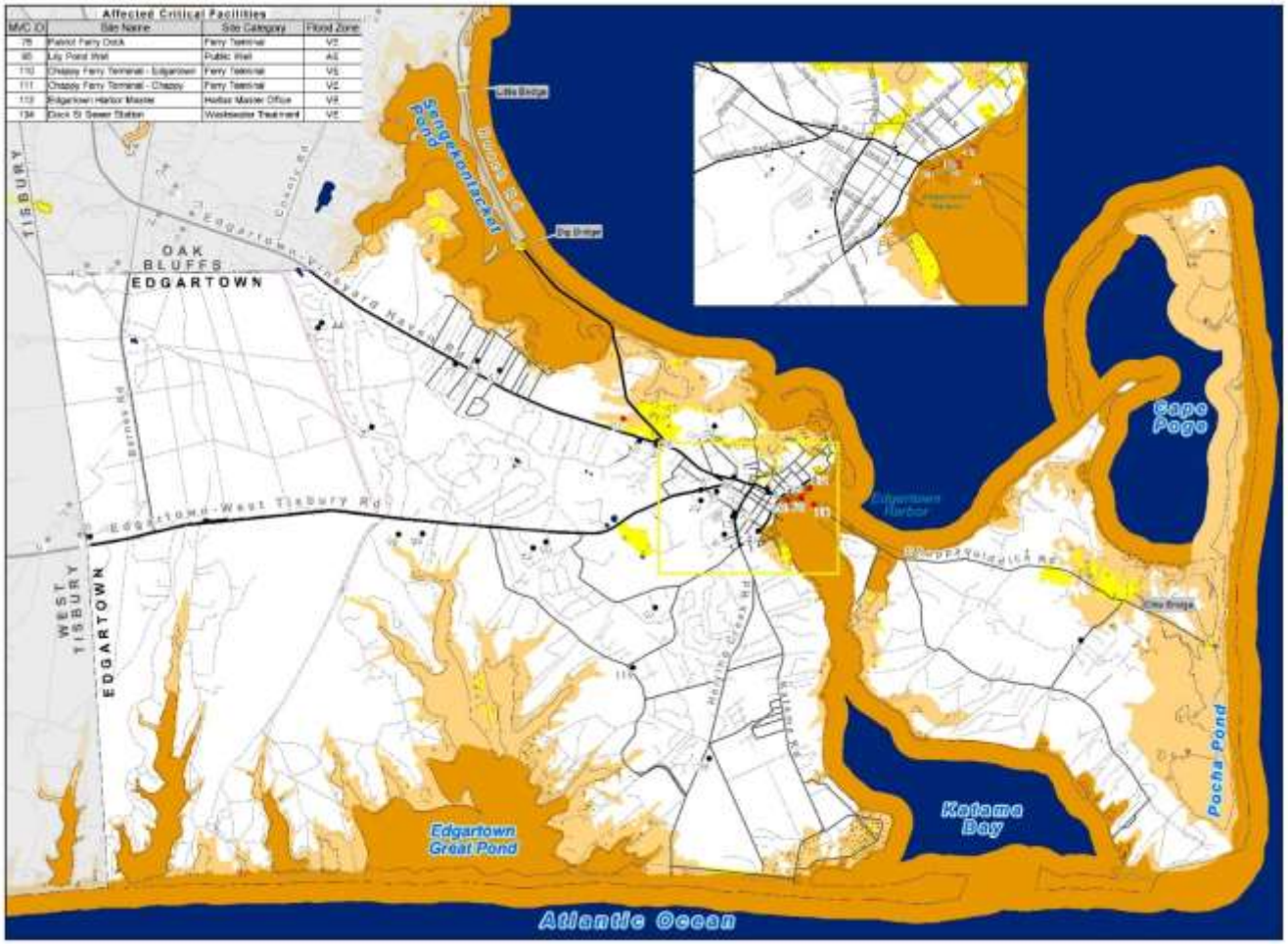
EDGARTOWN WILDFIRE VULNERABILITY

Contiguous Woodlands are shown in green; darker green represents area >=50 acres; lighter green shows 1000ft Buffer Area. Pitch Pine or Shrub Oak vegetation is shown in tan.

Edgartown Wildfire Vulnerability

Developed Land					Undevel. Land			
Use	# People (other)	# People (July-Aug)	# Buildings	Approx. Value	# People (other)	# People (July-Aug)	# Buildings	Approx. Value
	2.25 per building	4.14 per building			2.25 per building	4.14 per building		
Residential	2869	5279	1275	$566,972,200	3670	6752	1631	$725,279,732
Commercial			33	$22,361,800			26	$17,618,388
Industrial			0	$0			14	$0
Municipal, Public, Non-profit			12	$17,175,100			133	$190,357,358

EDGARTOWN FLOOD VULNERABILITY (2013 FIRM MAP)



Nor'Easter- type storm flooding

Darker orange represents the 100-year VE zone (wave heights > 3'). Lighter orange represents the 100-year AE zone (wave heights < 3'). Yellow shows the 500-year flood zone.

Flood Vulnerability
Based on Preliminary Flood Data Released in June 2013
Developed Land

Flood Zone Category	Use	# People (other)	# People (July-Aug)	# Buildings	Approximate Value
		2.25 per building	4.14 per building		
100 Year	Residential	601	1105	267	$195,286,600
100 Year	Commercial			0	$0
100 Year	Industrial			0	$0
100 Year	Exempt (Municipal, Public, Non-profit)			0	$0
Velocity Zone (also 100yr)	Residential	92	170	41	$30,545,000
Velocity Zone (also 100yr)	Commercial			19	$23,319,700
Velocity Zone (also 100yr)	Industrial			0	$0
Velocity Zone (also 100yr)	Exempt (Municipal, Public, Non-profit)			3	$1,132,800
500 Year	Residential	198	364	88	$74,076,700
500 Year	Commercial			12	$3,317,100
500 Year	Industrial			0	$0
500 Year	Exempt (Municipal, Public, Non-profit)			0	$0

Edgartown Flood Vulnerability
Based on Preliminary Flood Data Released in June 2013
Developable Land

Flood Zone Category	Use	# People (other)	# People (July-Aug)	# Buildings	Approximate Value
		2.25 per bldg	4.14 per bldg		
100 Year	Residential	205	377	91	$66,558,354
100 Year	Commercial			37	$27,062,188
100 Year	Industrial			0	$0
100 Year	Exempt (Municipal, Public, Non-profit)	14	25	6	$4,388,463
Velocity Zone (also 100yr)	Residential			64	$47,680,000
Velocity Zone (also 100yr)	Commercial			2	$2,454,705
Velocity Zone (also 100yr)	Industrial			0	$0
Velocity Zone (also 100yr)	Exempt (Municipal, Public, Non-profit)			12	$4,531,200
500 Year	Residential	176	556	78	$65,658,893
500 Year	Commercial			54	$14,926,950
500 Year	Industrial			0	$0
500 Year	Exempt (Municipal, Public, Non-profit)			26	$9,817,600

EDGARTOWN STORM SURGE VULNERABILITY
HURRICANE INUNDATION

The colors in the Storm Surge legend grade in Hurricane intensity from Category 1 (dark purple) lighter and lighter to Category 4 (palest color).

Edgartown Hurricane Inundation Vulnerability (SLOSH)
Based on preliminary data Released by the USACOE New England District in March 2013
Developed Land

SLOSH cat.	Use	# People (other)	# People (July-Aug)	# Buildings	Approx. Value
		2.25 per building	4.14 per building		
1	Residential	95	174	42	$32,877,400
	Commercial			13	$19,552,000
	Industrial			0	$0
	Municipal, Public, Non-profit			2	$368,100
2	Residential	468	861	208	$154,264,300
	Commercial			7	$11,682,800
	Industrial			0	$0
	Municipal, Public, Non-profit			1	$764,700
3	Residential	790	1453	351	$261,434,400
	Commercial			95	$28,716,000
	Industrial			0	$0
	Municipal, Public, Non-profit			2	$1,034,400
4	Residential	826	1519	367	$262,753,400
	Commercial			142	$61,110,300
	Industrial			0	$0
	Municipal, Public, Non-profit			7	$11,276,300

Edgartown Hurricane Inundation Vulnerability (SLOSH)
Based on preliminary data Released by the USACOE New England District in March 2013
Potential Development

SLOSH cat.	Use	# People (other)	# People (July-Aug)	# Buildings	Approx. Value
		2.25 per building	4.14 per building		
1	Residential	682	1254	303	$237,186,957
	Commercial			26	$39,104,000
	Industrial			0	$0
	Municipal, Public, Non-profit			14	$2,576,700
2	Residential	286	526	127	$94,190,222
	Commercial			0	$0
	Industrial			0	$0
	Municipal, Public, Non-profit			4	$3,058,800
3	Residential	200	368	89	$66,289,634
	Commercial			0	$0
	Industrial			0	$0
	Municipal, Public, Non-profit			6	$3,103,200
4	Residential	263	484	117	$83,766,070
	Commercial			0	$0
	Industrial			0	$0
	Municipal, Public, Non-profit			15	$24,163,500

EDGARTOWN SEA LEVEL RISE VULNERABILITY
1.5' by mid-century and 5' by the end of the century

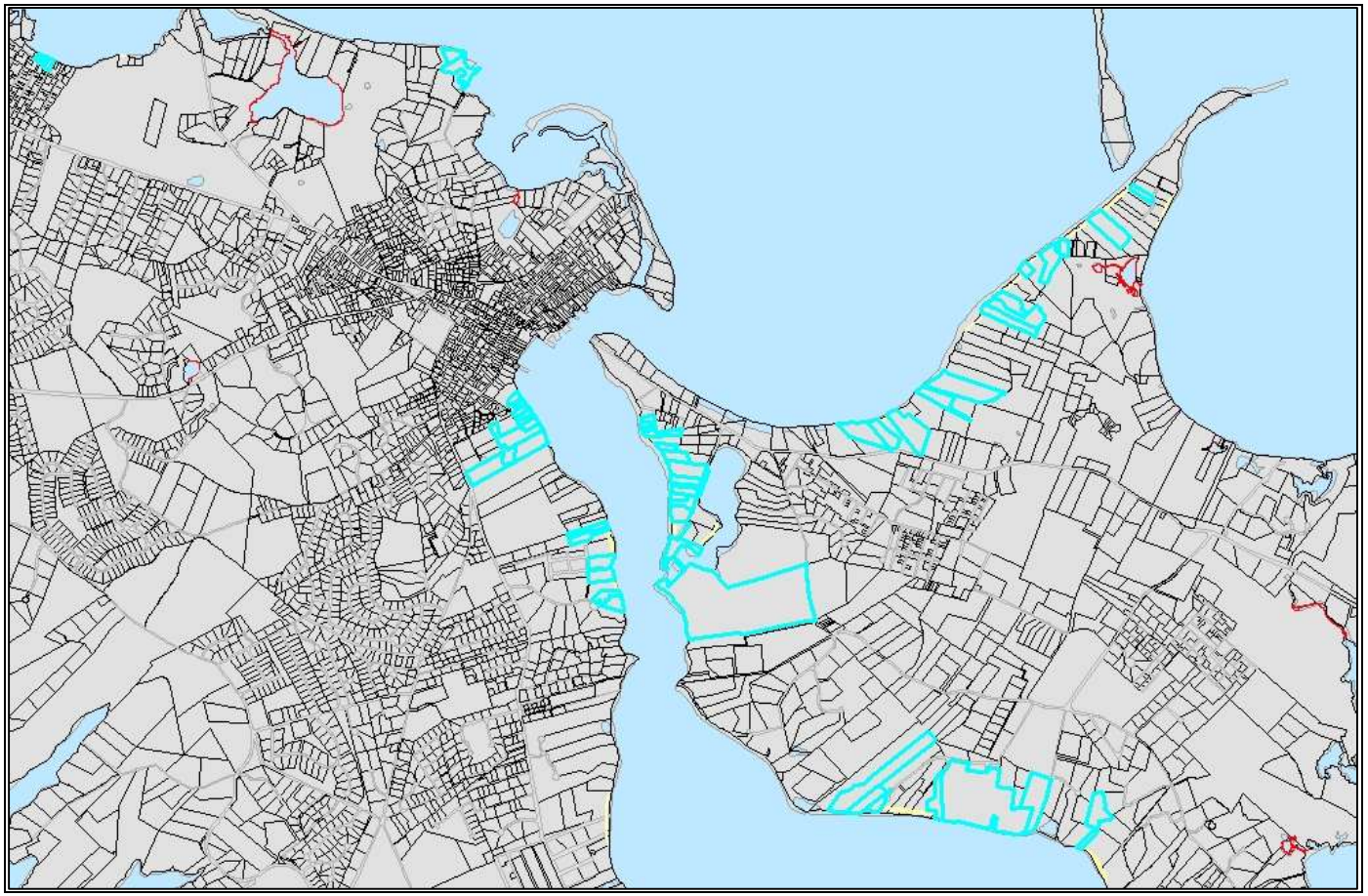
Light blue shows the mid-century projection of 1.5' above MHHW; dark blue shows the end-of-the-century projection of 5'.

Sea Level Rise Vulnerability
SLR Scenarios: 1.5 ft and 5 ft
with MHHW adjustment (1 ft. ave. offset from NAVD Datum)
Developed Land

Rise Level	Use	# People (other)	# People (July-Aug)	# Buildings	Approximate Value
		2.25 per building	4.14 per building		
<= 1.5ft Rise	Residential	5	8	2	$1,324,500
	Commercial			1	$129,500
	Industrial			0	$0
	Exempt (Municipal, Public, Non-profit)			0	$0
>1.5ft and <= 5ft Rise	Residential	122	224	54	$42,183,600
	Commercial			15	$19,713,900
	Industrial			0	$0
	Exempt (Municipal, Public, Non-profit)			3	$1,132,800

COASTAL EROSION AND SHORELINE CHANGE

Pre-1978 homes near bluffs are difficult for the towns to regulate (grandfathered under the Wetlands Protection Act). There are 55 in Edgartown.



EDGARTOWN VULNERABILITY OF CRITICAL FACILITIES

Flood	Flood Zone Category	Critical Facility Category	# Buildings	Approximate Value
	Velocity Zone (also 100yr)	Ferry Terminal (3 of them - no buildings)	0	$1,001,000
	100 Year (AE Zone)	Lily Pond Well	1	Not Applicable
	Velocity Zone (also 100yr)	Harbor Master Office	1	$149,600
	Velocity Zone (also 100yr)	Dock St Sewer Station	1	$53,600

Hurricane Inundation	SLOSH Category	Critical Facility Category	# Buildings	Approximate Value
	1	Ferry Terminal (3 of them - no buildings)	0	$1,001,000
	1	Harbor Master Office	1	$149,600
	1	Dock St Sewer Station	1	$53,600
	2	Lily Pond Well	1	Not Applicable
	4	S. Water & Dunham Rd Sewer	1	$797,800
	4	Medical Facility Walk-in Clinic	6	$1,681,300
	4	Edgartown Police Dept.	1	$4,322,600

EDGARTOWN VULNERABILITY OF CRITICAL FACILITIES

Sea Level Rise	Sea Level Category	Critical Facility Category	# Buildings	Approximate Value
	>1.5 and <=5.0ft	Dock St Sewer Station	1	$53,600
	>1.5 and <=5.0ft	Harbor Master Office	1	$149,600
	>1.5 and <=5.0ft	Lily Pond Well	1	Not Applicable

Wildland-Urban Interface		Critical Facility Category	# Buildings	Approximate Value
	inside Pitch Pine	LONG HILL	1	$802,800
	inside Pitch Pine	QUENOMICA WELL	1	$870,800
	inside forest buffer	Fire Department	1	$5,340,900
	inside forest buffer	Day Care Facility	1	$269,100
	inside forest buffer	Town DPW Barn	1	$1,806,900
	inside forest buffer	Dukes County Police Headquarters	1	$780,200
	inside forest buffer	Public Wells	2	$1,741,600

EDGARTOWN VULNERABILITY OF CRITICAL FACILITIES

Bridges	Town	Hazard*
Little Bridge	Oak Bluffs	VE 100 year flood zone & SLOSH
Big Bridge	OB/Edgartown	VE 100 year flood zone & SLOSH
Dike Bridge	Edgartown	AE 100 year flood zone & SLOSH

TRANSMISSION LINES	Town	Hazard	Length Intersected (ft)	Total Length of Transmission Line (ft)
Unknown Name	West Tisbury	Wildfire Buffer Area	500	2,009
		Forest Land Use	1530	
		Pitch Pine Woodland	1275	
New Bedford Gas & Edison Light	Edgartown	Wildfire Buffer Area	9770	10,748
		Forest Land Use	1050	
Oak Bluffs Water Company	Oak Bluffs	Pitch Pine Woodland	1100	3,099

FUTURE VULNERABILITY FOR EDGARTOWN

Natural Hazard	Frequency of Occurrence	Location	Impacts	Hazard Index
	(very low, low, medium, high)	(local or small, medium, multiple towns or large)	(minor, serious, extensive, catastrophic)	(combine impacts and frequency)(1 point for each step of frequency or impact)
Flood-Related Hazards				
Riverine	very low	n/a	n/a	0
Coastal	medium	large	serious	8
Erosion	high	large	serious	9
Dam Failures	very low	local	serious	0
Severe Rainstorms	medium	large	serious	8
Winter Storms	low	local	minor	4
Coastal Storms/Nor'easters	high	medium	extensive	10
Hurricanes	medium	large	catastrophic	10
Wind-Related Hazards				
Hurricanes	medium	large	extensive	9
Coastal Storms	high	large	serious	9
Winter Storms	low	local	serious	5
Downspouts	very low	local	serious	3
Tornadoes	low	local	serious	5
Fire-Related Hazards				
Drought	medium	medium	serious	8
Wildfires	high	large	extensive	10
Geologic Hazards				
Earthquakes	very low	n/a	n/a	0
Landslides	very low	local	minor	3
Sink Holes	very low	n/a	n/a	0
Other Hazards				
Ice	very low	local	serious	3
Sea Level Rise	high	medium	serious	8

VULNERABILITY ASSESSMENTS FOR GOSNOLD

The Town of Gosnold includes the entire Elizabeth Island chain. They are named Nonamesset, Uncatena, Weepecket, Naushon, Pasque, Nashawena, Penikese and Cuttyhunk. According to the 2010 census, Gosnold had a year-round population of 52 on an area of 13 square miles of dry land, with a density of 4 persons per square mile. Settlement is centered, however, on the outermost island of Cuttyhunk, where most of the population resides. Ferry service for passengers and freight (no cars) is provided year 'round from New Bedford and in summer from Menemesha. Protection and functionality of harbor facilities are essential for the well-being of the residents.

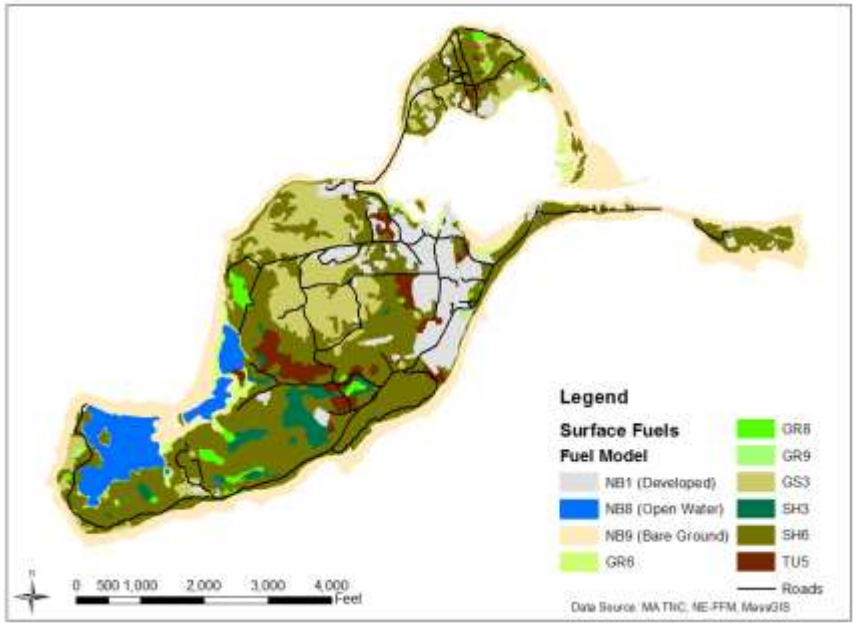
The maps illustrate the geographic extent of vulnerability. In some cases, only excerpts are show here. The full sized maps are in the cd pocket and are available on-line. Seeing the full extent is important for planning purposes.

The matrices of vulnerability highlight the persons and property. Property is identified both by numbers of buildings and by value. Persons are identified by population (2010 census) as well as by seasonal projection. Projections estimate vulnerability at buildout.

Vulnerability is represented for wildfire (wildland urban interface), flood (Nor'easter), storm (hurricane) and for sea level rise.

GOSNOLD WILDFIRE VULNERABILITY

Contiguous Woodlands are shown in green; darker green represents area >=50 acres; lighter green shows 1000ft Buffer Area. Pitch Pine or Shrub Oak vegetation is shown in tan.

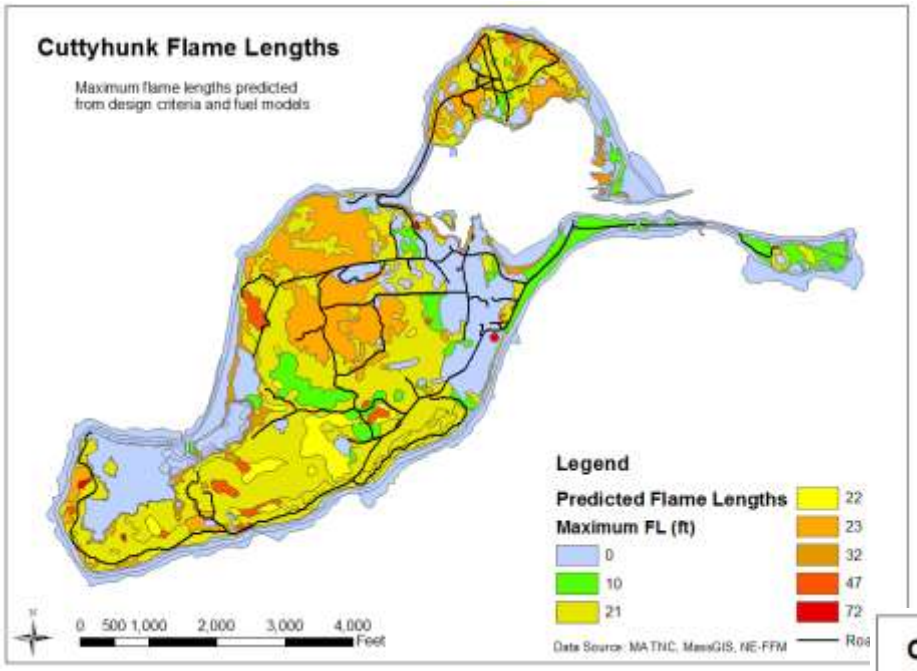


The Cuttyhunk Community Wildfire Protection Plan, 2013, included data and analysis in planning wildfire management for Cuttyhunk Island, the population center of the Town of Gosnold (including the Elizabeth Islands). Surface fuels were mapped according to TNC classification. Flame lengths and rate of spread were then modeled.

Surface Fuels for Cuttyhunk (left)

Fuel models by TNC vegetation class (below).

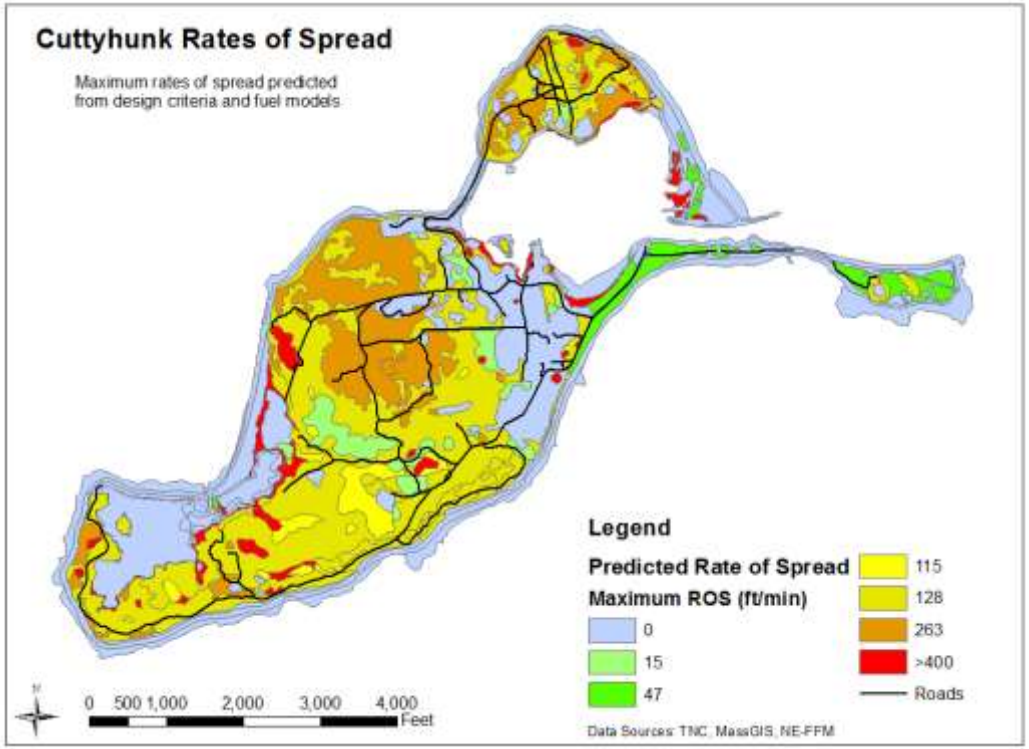
Fuel Model	TNC Classification	Location
GR6 – Moderate load grass	Salt Marsh	Westend Pond and Cuttyhunk Pond edges
GR8 – High load, very coarse grass	Shallow Marsh	Phragmites stands scattered across island
GR9 – Very high load grass	Deep Marsh	Phragmites stands scattered across island
GS3 – Moderate load grass-shrub	Sandplain/Panicum Grassland	Concentrated in the northwest end of the island
SH3 – Moderate load shrub	Shrub Swamps	Southern end of island around area of airstrip
SH6 – Low load shrub	Maritime/Coastal Shrubland	Majority of island
TU5 – Very high load timber-shrub	Successional Maritime Forest	Isolated stands of trees in center of island



from *Cuttyhunk Community Wildfire Protection Plan*, 2013

Cuttyhunk Flame Lengths (left)

Cuttyhunk Rates of Spread (below)



GOSNOLD Wildfire Vulnerability

Developed Land					Undevel. Land			
Use	# People (other)	# People (July-Aug)	# Buildings	Approx. Value	# People (other)	# People (July-Aug)	# Buildings	Approx. Value

	1.92 per building	? per building			1.92 per building	? per building		
Residential	7.68		4	$1,077,716			0	
Commercial								
Industrial			1	$24,500			0	
Municipal, Public, Non-profit								

GOSNOLD FLOOD VULNERABILITY (2013 FIRM MAP)

Nor'Easter- type storm flooding

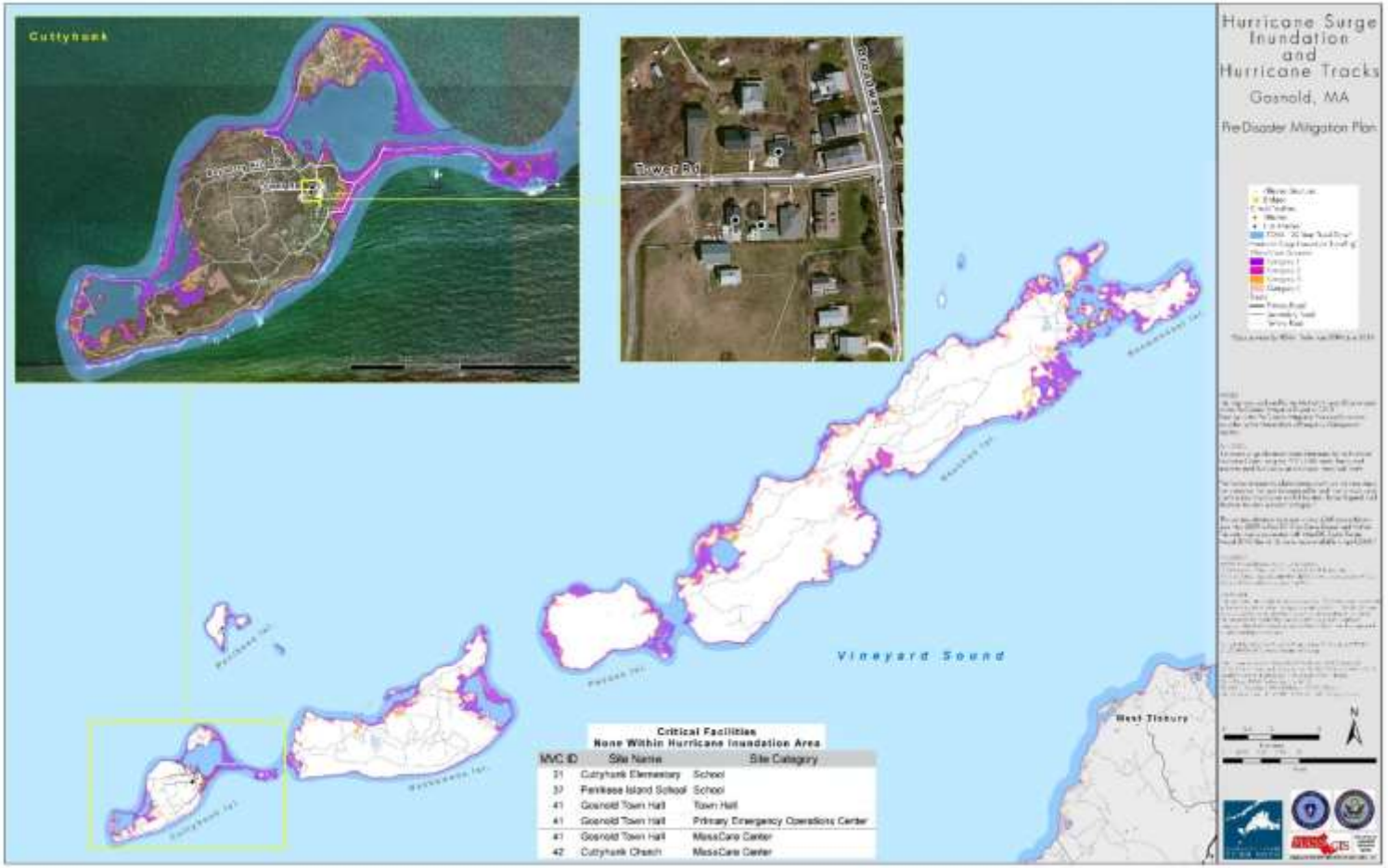
Darker orange represents the 100-year VE zone (wave heights > 3'). Lighter orange represents the 100-year AE zone (wave heights < 3'). Yellow shows the 500-year flood zone.

Flood Vulnerability
Based on Preliminary Flood Data Released in June 2013
Developed Land (only)

Flood Zone Category	Use	# People (other)	# People (July-Aug)	# Buildings	Approximate Value
		1.92 per building	? per building		
100 Year	Residential	72.96		38	$10,238,302
100 Year	Commercial			0	$0
100 Year	Industrial			1	$24,500
100 Year	Exempt (Municipal, Public, Non-profit)			0	$0
Velocity Zone (also 100yr)	Residential	3.84		2	$538,858
Velocity Zone (also 100yr)	Commercial			0	$0
Velocity Zone (also 100yr)	Industrial			1	$24,500
Velocity Zone (also 100yr)	Exempt (Municipal, Public, Non-profit)			2	$294,600
500 Year	Residential	0		0	$0
500 Year	Commercial			0	$0
500 Year	Industrial			0	$0
500 Year	Exempt (Municipal, Public, Non-profit)			0	$0

GOSNOLD STORM SURGE VULNERABILITY
HURRICANE INUNDATION

The colors in the Storm Surge legend grade in Hurricane intensity from Category 1 (dark purple) lighter and lighter to Category 4 (palest color).



GOSNOLD Hurricane Inundation Vulnerability (SLOSH)
Based on preliminary data Released by the USACOE New England District in March 2013
Developed Land (only)

SLOSH cat.	Use	# People (other)	# People (July-Aug)	# Buildings	Approx. Value
		1.92 per building	? per building		
1	Residential	15.36		8	$2,155,432
1	Commercial			0	$0
1	Industrial			1	$24,500
1	Municipal, Public, Non-profit			1	$46,500
2	Residential	40.32		21	$5,658,009
2	Commercial			0	$0
2	Industrial			1	$24,500
2	Municipal, Public, Non-profit			0	$0
3	Residential	21.12		11	$2,963,719
3	Commercial			0	$0
3	Industrial			1	$24,500
3	Municipal, Public, Non-profit			1	$248,100
4	Residential	23.04		12	
4	Commercial			0	$0
4	Industrial			1	$24,500
4	Municipal, Public, Non-profit			1	$59,100

GOSNOLD SEA LEVEL RISE VULNERABILITY
1.5’ by mid-century and 5’ by the end of the century

Light blue shows the mid-century projection of 1.5’ above MHHW; dark blue shows the end-of-the-century projection of 5’.

Sea Level Rise Vulnerability
SLR Scenarios: 1.5 ft and 5 ft
with MHHW adjustment (1 ft. ave. offset from NAVD Datum)
Developed Land

Rise Level	Use	# People (other)	# People (July-Aug)	# Buildings	Approximate Value
		1.92 per building	**? per building**		
<= 1.5ft Rise	**Residential**	**5.76**		**3**	**$808,287**
<= 1.5ft Rise	**Commercial**			**0**	**$0**
<= 1.5ft Rise	**Industrial**			**0**	**$0**
<= 1.5ft Rise	**Exempt (Municipal, Public, Non-profit)**			**2**	**$93,000**
>1.5ft and <= 5ft Rise	**Residential**	**17.28**		**9**	**$1,802,324**
>1.5ft and <= 5ft Rise	**Commercial**			**0**	**$0**
>1.5ft and <= 5ft Rise	**Industrial**			**0**	**$0**
>1.5ft and <= 5ft Rise	**Exempt (Municipal, Public, Non-profit)**			**2**	**$485,000**

GOSNOLD VULNERABILITY OF CRITICAL FACILITIES

Bridges	Hazard*
Bridge 1	**AE 100 year flood zone & SLOSH**
Bridge 2	**AE 100 year flood zone & SLOSH Cat. 1 & Sea Level Rise>1.5 ft and < 5 ft.**
Bridge 3	**AE 100 year flood zone & SLOSH Cat. 1 & Sea Level Rise<1.5 ft**
Bridge 4	**AE 100 year flood zone & SLOSH Cat. 1 & Sea Level Rise<1.5 ft**

*all coastal bridges would most likely be affected by Hurricanes. However due to the delineation of the SLOSH data, knowing which category the bridge is in cannot be determined. Similar situation with bridges and sea level rise. The data processing in most areas masked out the elevation around the bridge as being water. Hence, elevation of the bridge is unable to be determined from the 2010 LiDAR data.

FUTURE VULNERABILITY FOR GOSNOLD

Town of Gosnold				
Natural Hazard	**Frequency of Occurrence**	**Location**	**Impacts**	**Hazard Index**
	(very low, low, medium, high)	(local or small, medium, multiple towns or large)	(minor, serious, extensive, catastrophic)	(combine impacts and frequency)(1 point for each step of frequency or impact)
Flood-Related Hazards				
Riverine	very low	n/a	n/a	0
Coastal	medium	large	serious	8
Erosion	high	large	minor	8
Dam Failures	n/a	n/a	n/a	0
Severe Rainstorms	medium	large	serious	8
Winter Storms	low	local	minor	4
Coastal Storms/Nor'easters	high	medium	extensive	9
Hurricanes	medium	large	extensive	9
Wind-Related Hazards				
Hurricanes	medium	large	extensive	9
Coastal Storms	high	large	serious	9
Winter Storms	low	local	serious	5
Downspouts	very low	local	serious	3
Tornadoes	very low	local	serious	4
Fire-Related Hazards				
Drought	medium	local	minor	5
Wildfires	low	local	minor	4
Geologic Hazards				
Earthquakes	very low	n/a	n/a	0
Landslides	very low	local	minor	3
Sink Holes	very low	n/a	n/a	0
Other Hazards				
Ice	very low	local	serious	3
Sea Level Rise	high	local	minor	6

VULNERABILITY ASSESSMENTS FOR OAK BLUFFS

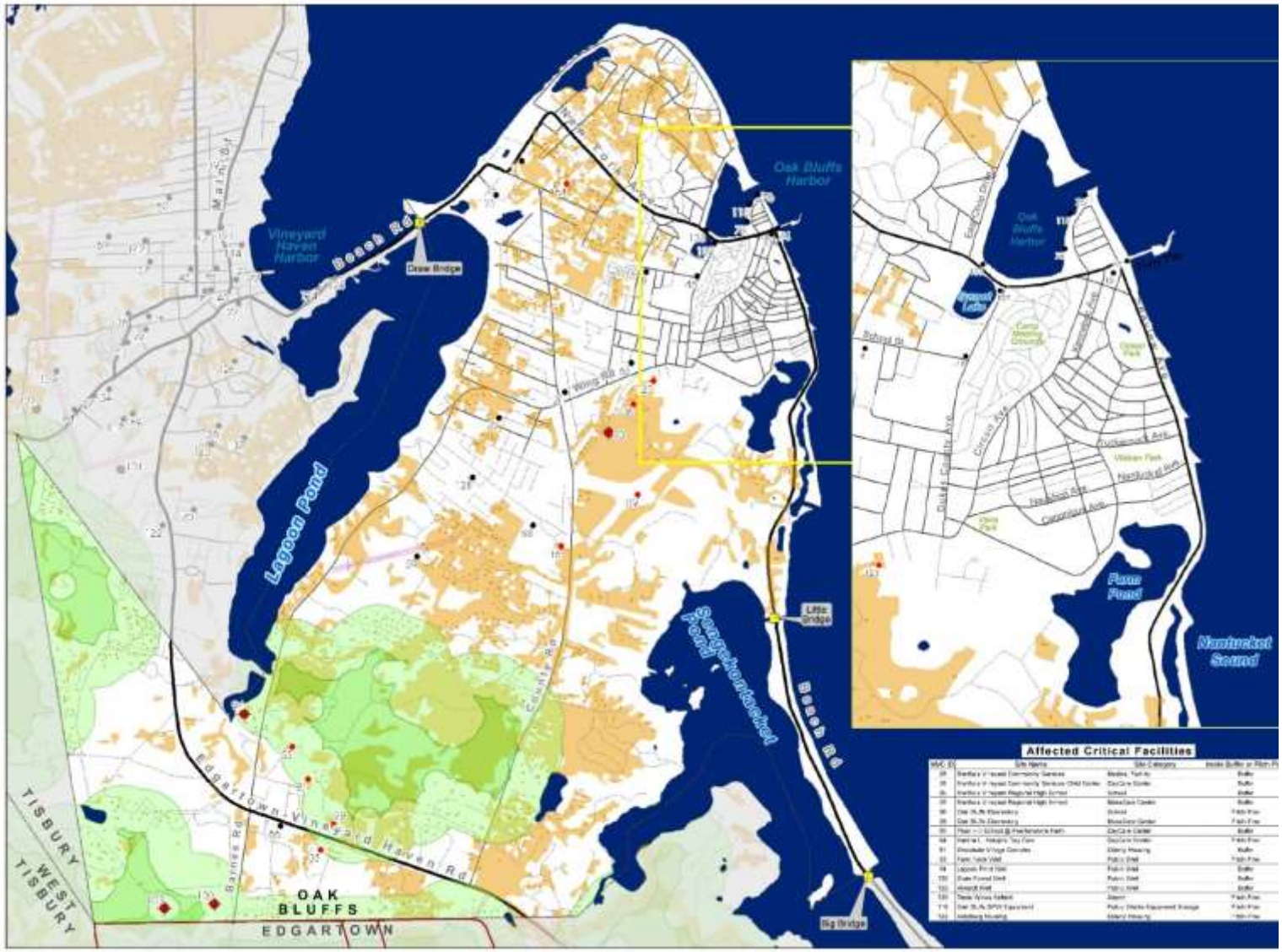
The Town of Oak Bluffs holds a year ‘round population of 4,527 (2010 census) on an area of 7.4 square miles of dry land, with a density of 611.8 persons per square mile. In summer, population increases dramatically, including day passengers from ferries and cruise ships. On any summer day, there might be an estimated 22,452 people in the town. In summer, a number of ferries ply the waters, carrying passengers and freight to and from Oak Bluffs, including one terminal for cars and trucks. In summer, the compact harbor is most often filled with boats on moorings and docks. In winter, much of Oak Bluffs, including the East Chop bluff, the harbor and east-facing beaches are all exposed directly to wave action generated by Nor’easter storms, and subject to significant shoreline and bluff

The maps illustrate the geographic extent of vulnerability. In some cases, only excerpts are show here. The full sized maps are in the cd pocket and are available on-line. Seeing the full extent is important for planning purposes.

The matrices of vulnerability highlight the persons and property. Property is identified both by numbers of buildings and by value. Persons are identified by population (2010 census) as well as by seasonal projection. Projections estimate vulnerability at buildout.

Vulnerability is represented for wildfire (wildland urban interface), flood (Nor’easter), storm (hurricane) and for sea level rise.

OAK BLUFFS WILDFIRE VULNERABILITY

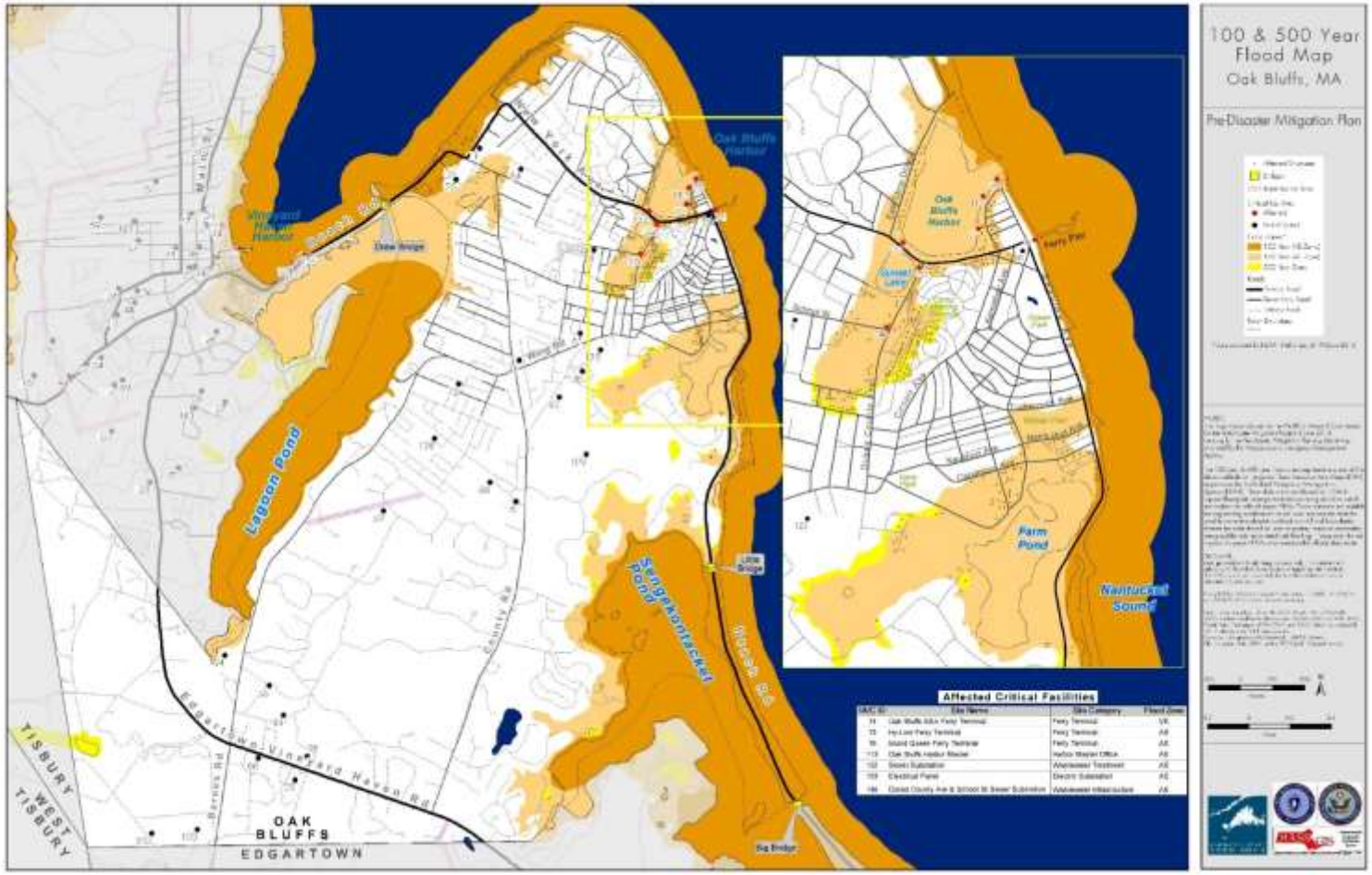


Contiguous Woodlands are shown in green; darker green represents area >=50 acres; lighter green shows 1000ft Buffer Area. Pitch Pine or Shrub Oak vegetation is shown in tan.

OAK BLUFFS Wildfire Vulnerability

Developed Land					Undevel. Land			
Use	# People (other)	# People (July-Aug)	# Buildings	Approx. Value	# People (other)	# People (July-Aug)	# Buildings	Approx. Value
	2.25 per building	4.14 per building			2.25 per building	4.14 per building		
Residential	2869	5279	1275	$566,972,200	3670	6752	1631	$725,279,732
Commercial			33	$22,361,800			26	$17,618,388
Industrial			0	$0			14	$0
Municipal, Public, Non-profit			12	$17,175,100			133	$190,357,358

OAK BLUFFS FLOOD VULNERABILITY (2013 FIRM MAP)



Nor'Easter- type storm flooding

Darker orange represents the 100-year VE zone (wave heights > 3'). Lighter orange represents the 100-year AE zone (wave heights < 3'). Yellow shows the 500-year flood zone.

Flood Vulnerability
Based on Preliminary Flood Data Released in June 2013
Developed Land

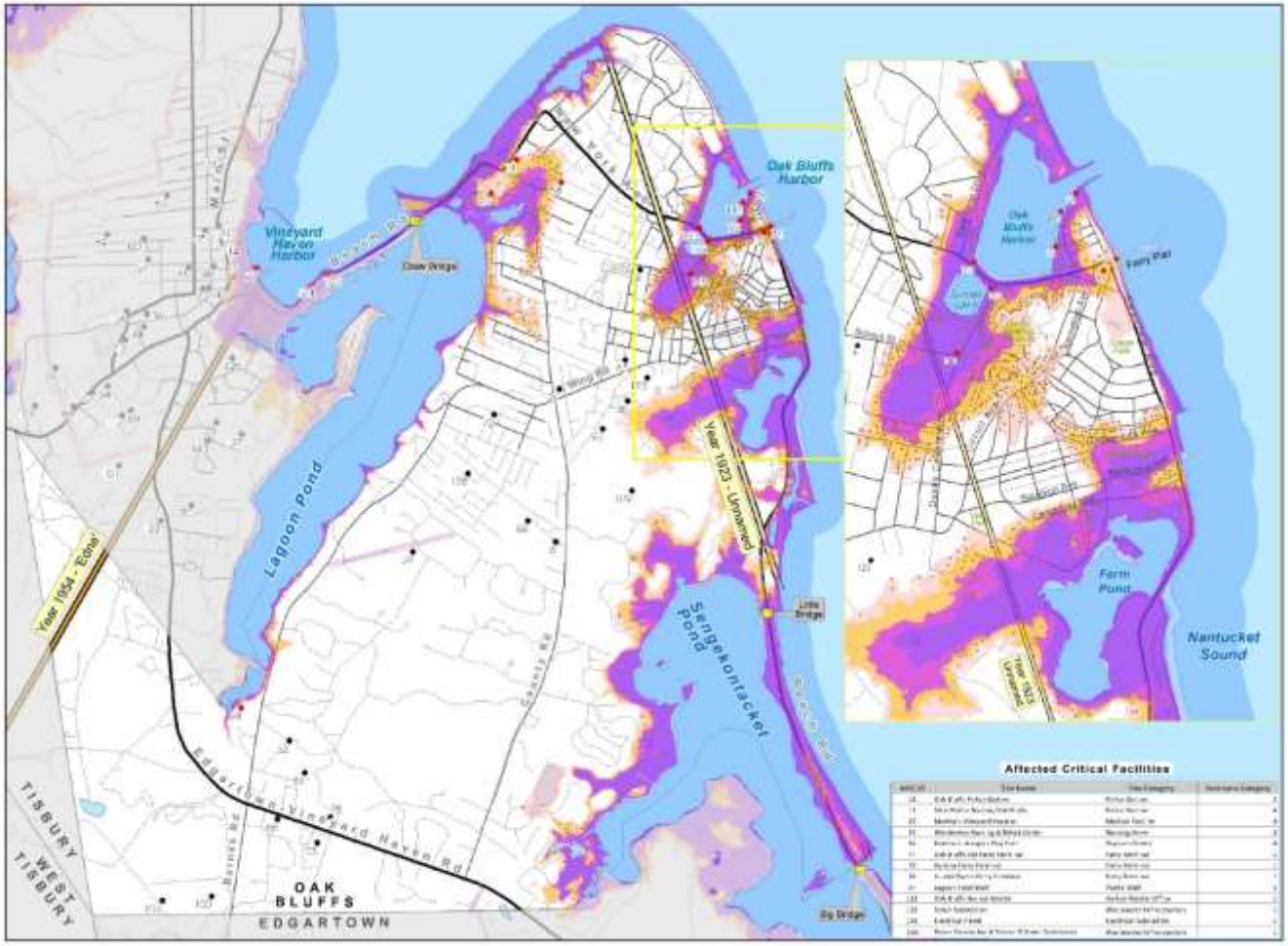
Flood Zone Category	Use	# People (other)	# People (July-Aug)	# Buildings	Approximate Value
		2.25 per building	4.14 per building		
100 Year	Residential	601	1105	267	$195,286,600
100 Year	Commercial			0	$0
100 Year	Industrial			0	$0
100 Year	Exempt (Municipal, Public, Non-profit)			0	$0
Velocity Zone (also 100yr)	Residential	92	170	41	$30,545,000
Velocity Zone (also 100yr)	Commercial			19	$23,319,700
Velocity Zone (also 100yr)	Industrial			0	$0
Velocity Zone (also 100yr)	Exempt (Municipal, Public, Non-profit)			3	$1,132,800
500 Year	Residential	198	364	88	$74,076,700
500 Year	Commercial			12	$3,317,100
500 Year	Industrial			0	$0
500 Year	Exempt (Municipal, Public, Non-profit)			0	$0

OAK BLUFFS Flood Vulnerability
Based on Preliminary Flood Data Released in June 2013
Developable Land

Flood Zone Category	Use	# People (other)	# People (July-Aug)	# Buildings	Approximate Value
		2.25 per bldg	4.14 per bldg		
100 Year	Residential	205	377	91	$66,558,354
100 Year	Commercial			37	$27,062,188
100 Year	Industrial			0	$0
100 Year	Exempt (Municipal, Public, Non-profit)	14	25	6	$4,388,463
Velocity Zone (also 100yr)	Residential			64	$47,680,000
Velocity Zone (also 100yr)	Commercial			2	$2,454,705
Velocity Zone (also 100yr)	Industrial			0	$0
Velocity Zone (also 100yr)	Exempt (Municipal, Public, Non-profit)			12	$4,531,200
500 Year	Residential	176	556	78	$65,658,893
500 Year	Commercial			54	$14,926,950
500 Year	Industrial			0	$0
500 Year	Exempt (Municipal, Public, Non-profit)			26	$9,817,600

OAK BLUFFS STORM SURGE VULNERABILITY
HURRICANE INUNDATION

The colors in the Storm Surge legend grade in Hurricane intensity from Category 1 (dark purple) lighter and lighter to Category 4 (palest color).



OAK BLUFFS Hurricane Inundation Vulnerability (SLOSH)
Based on preliminary data Released by the USACOE New England District in March 2013
Developed Land

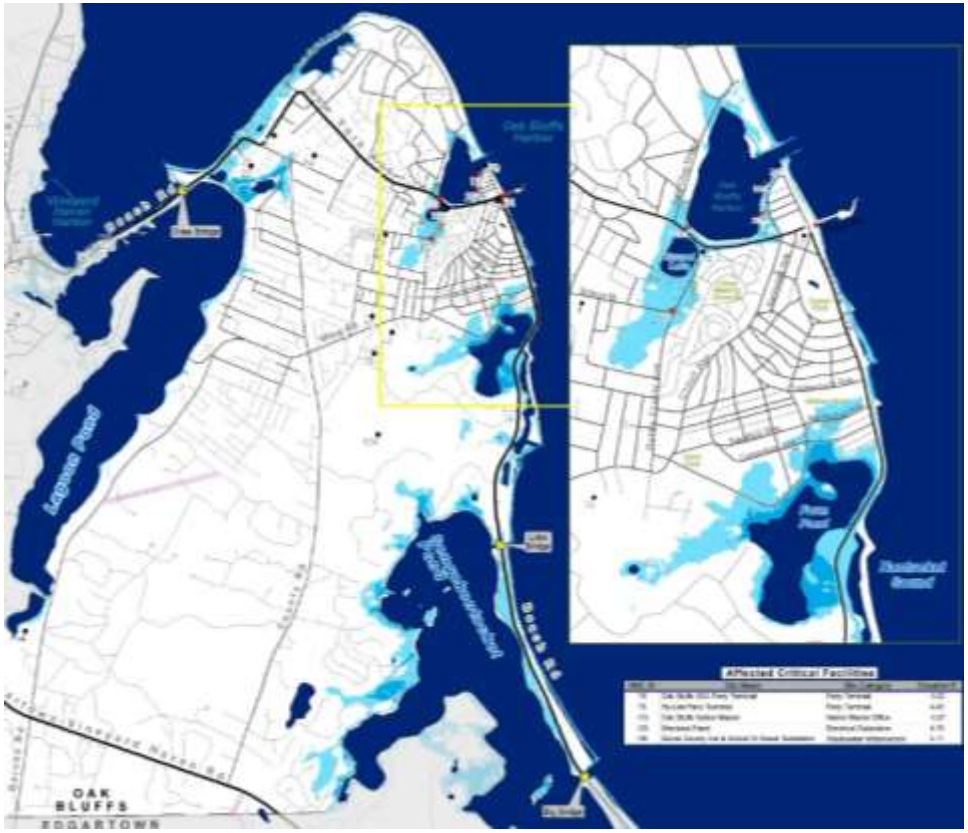
SLOSH cat.	Use	# People (other)	# People (July-Aug)	# Buildings	Approx. Value
		2.25 per building	4.14 per building		
1	Residential	95	174	42	$32,877,400
1	Commercial			13	$19,552,000
1	Industrial			0	$0
1	Municipal, Public, Non-profit			2	$368,100
2	Residential	468	861	208	$154,264,300
2	Commercial			7	$11,682,800
2	Industrial			0	$0
2	Municipal, Public, Non-profit			1	$764,700
3	Residential	790	1453	351	$261,434,400
3	Commercial			95	$28,716,000
3	Industrial			0	$0
3	Municipal, Public, Non-profit			2	$1,034,400
4	Residential	826	1519	367	$262,753,400
4	Commercial			142	$61,110,300
4	Industrial			0	$0
4	Municipal, Public, Non-profit			7	$11,276,300

OAK BLUFFS Hurricane Inundation Vulnerability (SLOSH)
Based on preliminary data Released by the USACOE New England District in March 2013
Potential Development

SLOSH cat.	Use	# People (other)	# People (July-Aug)	# Buildings	Approx. Value
		2.25 per building	4.14 per building		
1	Residential	682	1254	303	$237,186,957
1	Commercial			26	$39,104,000
1	Industrial			0	$0
1	Municipal, Public, Non-profit			14	$2,576,700
2	Residential	286	526	127	$94,190,222
2	Commercial			0	$0
2	Industrial			0	$0
2	Municipal, Public, Non-profit			4	$3,058,800
3	Residential	200	368	89	$66,289,634
3	Commercial			0	$0
3	Industrial			0	$0
3	Municipal, Public, Non-profit			6	$3,103,200
4	Residential	263	484	117	$83,766,070
4	Commercial			0	$0
4	Industrial			0	$0
4	Municipal, Public, Non-profit			15	$24,163,500

OAK BLUFFS SEA LEVEL RISE VULNERABILITY
1.5’ by mid-century and 5’ by the end of the century

Light blue shows the mid-century projection of 1.5’ above MHHW; dark blue shows the end-of-the-century projection of 5’.

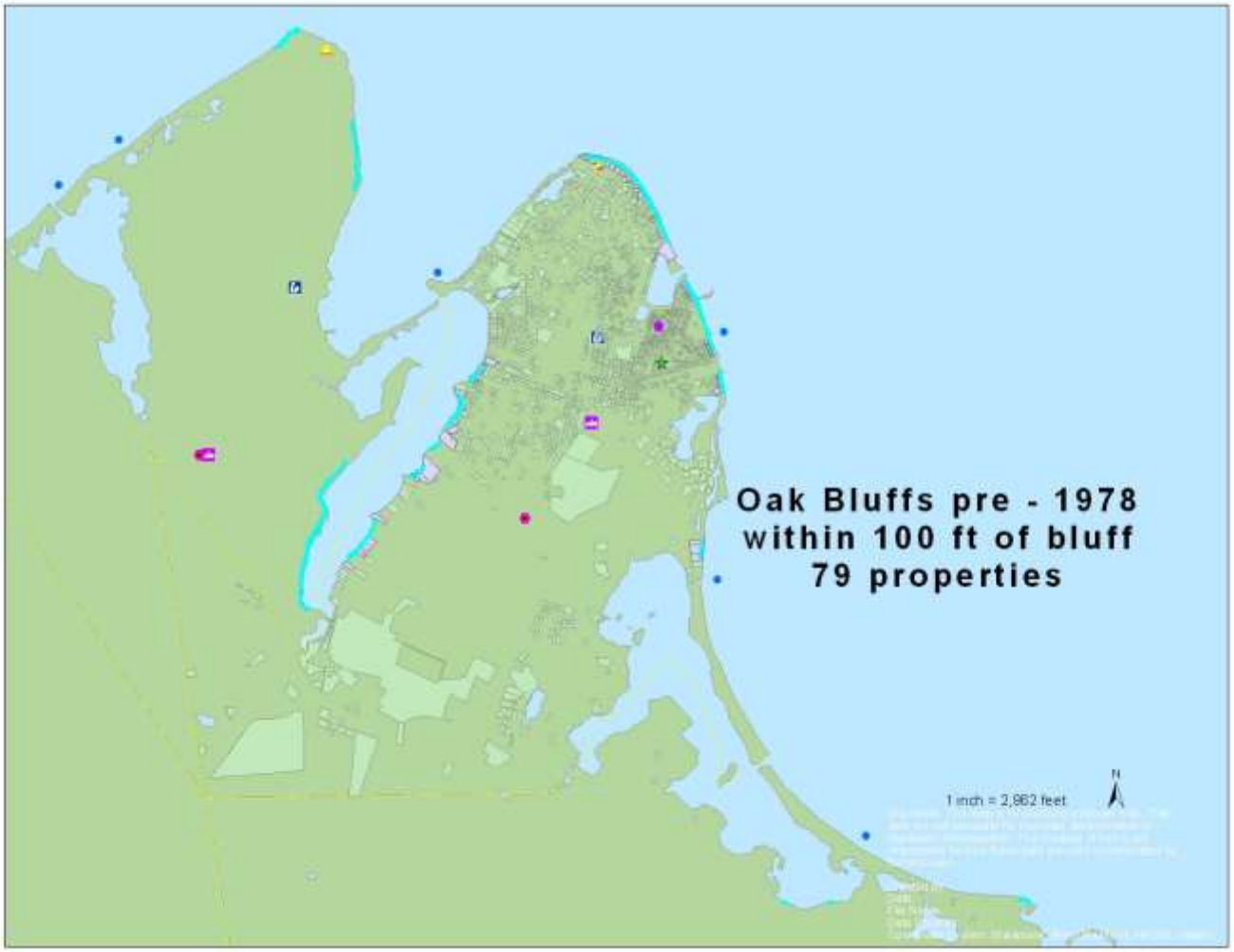


Sea Level Rise Vulnerability
SLR Scenarios: 1.5 ft and 5 ft
with MHHW adjustment (1 ft. ave. offset from NAVD Datum)
Developed Land

Rise Level	Use	# People (other)	# People (July-Aug)	# Buildings	Approximate Value
		2.25 per building	4.14 per building		
<= 1.5ft Rise	Residential	4	8	2	$291,400
<= 1.5ft Rise	Commercial			0	$0
<= 1.5ft Rise	Industrial			0	$0
<= 1.5ft Rise	Exempt (Municipal, Public, Non-profit)			0	$0
>1.5ft and <= 5ft Rise	Residential	206	362	92	$24,582,100
>1.5ft and <= 5ft Rise	Commercial			11	$5,452,100
>1.5ft and <= 5ft Rise	Industrial			0	$0
>1.5ft and <= 5ft Rise	Exempt (Municipal, Public, Non-profit)			3	$547,400

COASTAL EROSION AND SHORELINE CHANGE

Pre-1978 homes near bluffs are difficult for the towns to regulate (grandfathered under the Wetlands Protection Act). There are 79 in OAK BLUFFS.



OAK BLUFFS VULNERABILITY OF CRITICAL FACILITIES

Flood	Flood Zone Category	Critical Facility Category	# Buildings	Approximate Value
	Velocity Zone (also 100yr)	Ferry Terminal (3 of them - no buildings)	0	$1,001,000
	100 Year (AE Zone)	Lily Pond Well	1	Not Applicable
	Velocity Zone (also 100yr)	Harbor Master Office	1	$149,600
	Velocity Zone (also 100yr)	Dock St Sewer Station	1	$53,600

Hurricane Inundation	SLOSH Category	Critical Facility Category	# Buildings	Approximate Value
	1	Ferry Terminal - Steamship	1	$91,700
	1	Ferry Terminal - Island Queen & Hy-Line	0	$193,133
	1	Harbor Master Office	1	$96,567
	1	Sewer Substation	2	$107,200
	1	Electrical Panel	1	unknown
	3	Lagoon Pond Well	1	$90,800
	3	Oak Bluffs Police Station	1	$1,127,200
	4	State Police Station	1	$781,600
	4	Day Care Facility	1	$220,300
	4	MV Hospital & Windemere Nursing Home	2	$28,551,300

OAK BLUFFS VULNERABILITY OF CRITICAL FACILITIES

Sea Level Rise	Sea Level Category	Critical Facility Category	# Buildings	Approximate Value
	>1.5 and <=5.0ft	Ferry Terminal (2 of them)	2	$2,085,000
	>1.5 and <=5.0ft	Electrical Panel	1	unknown
	>1.5 and <=5.0ft	Sewer Substation	2	$107,200

Wildland-Urban Interface		Critical Facility Category	# Buildings	Approximate Value
	inside Pitch Pine	LONG HILL	1	$802,800
	inside Pitch Pine	QUENOMICA WELL	1	$870,800
	inside forest buffer	Fire Department	1	$5,340,900
	inside forest buffer	Day Care Facility	1	$269,100
	inside forest buffer	Town DPW Barn	1	$1,806,900
	inside forest buffer	Dukes County Police Headquarters	1	$780,200
	inside forest buffer	Public Wells	2	$1,741,600

OAK BLUFFS VULNERABILITY OF CRITICAL FACILITIES

Bridges	Town	Hazard*
Little Bridge	**Oak Bluffs**	**VE 100 year flood zone & SLOSH**
Big Bridge	**OB/Edgartown**	**VE 100 year flood zone & SLOSH**
Draw Bridge	**OB/Tisbury**	**AE 100 year flood zone & SLOSH**
Dike Bridge	**Edgartown**	**AE 100 year flood zone & SLOSH**

TRANSMISSION LINES	Town	Hazard	Length Intersected (ft)	Total Length of Transmission Line (ft)
Unknown Name	West Tisbury	Wildfire Buffer Area	500	2,009
		Forest Land Use	1530	
		Pitch Pine Woodland	1275	
New Bedford Gas & Edison Light	Edgartown	Wildfire Buffer Area	9770	10,748
		Forest Land Use	1050	
Oak Bluffs Water Company	Oak Bluffs	Pitch Pine Woodland	1100	3,099

*all coastal bridges would most likely be affected by Hurricanes. However due to the delineation of the SLOSH data, knowing which category the bridge is in cannot be determined. Similar situation with bridges and sea level rise. The data processing in most areas masked out the elevation around the bridge as being water. Hence, elevation of the bridge is unable to be determined from the 2010 LiDAR data.

OAK BLUFFS FUTURE VULNERABILITY

Natural Hazard	Frequency of Occurrence	Location	Impacts	Hazard Index
	(very low, low, medium, high)	(local or small, medium, multiple towns or large)	(minor, serious, extensive, catastrophic)	(combine impacts and frequency)(1 point for each step of frequency or impact)
Flood-Related Hazards				
Riverine	very low	n/a	n/a	0
Coastal	medium	large	serious	8
Erosion	high	large	serious	9
Dam Failures	n/a	n/a	n/a	0
Severe Rainstorms	medium	large	serious	8
Winter Storms	low	local	minor	4
Coastal Storms/Nor'easters	high	medium	extensive	10
Hurricanes	medium	large	extensive	9
Wind-Related Hazards				
Hurricanes	medium	large	extensive	9
Coastal Storms	high	large	serious	9
Winter Storms	low	local	serious	5
Downspouts	very low	local	minor	3
Tornadoes	very low	local	serious	4
Fire-Related Hazards				
Drought	medium	medium	serious	8
Wildfires	medium	medium	serious	8
Geologic Hazards				
Earthquakes	very low	n/a	n/a	0
Landslides	very low	local	minor	3
Sink Holes	very low	n/a	n/a	0
Other Hazards				
Ice	very low	local	serious	3
Sea Level Rise	high	local	minor	6

VULNERABILITY ASSESSMENTS FOR TISBURY

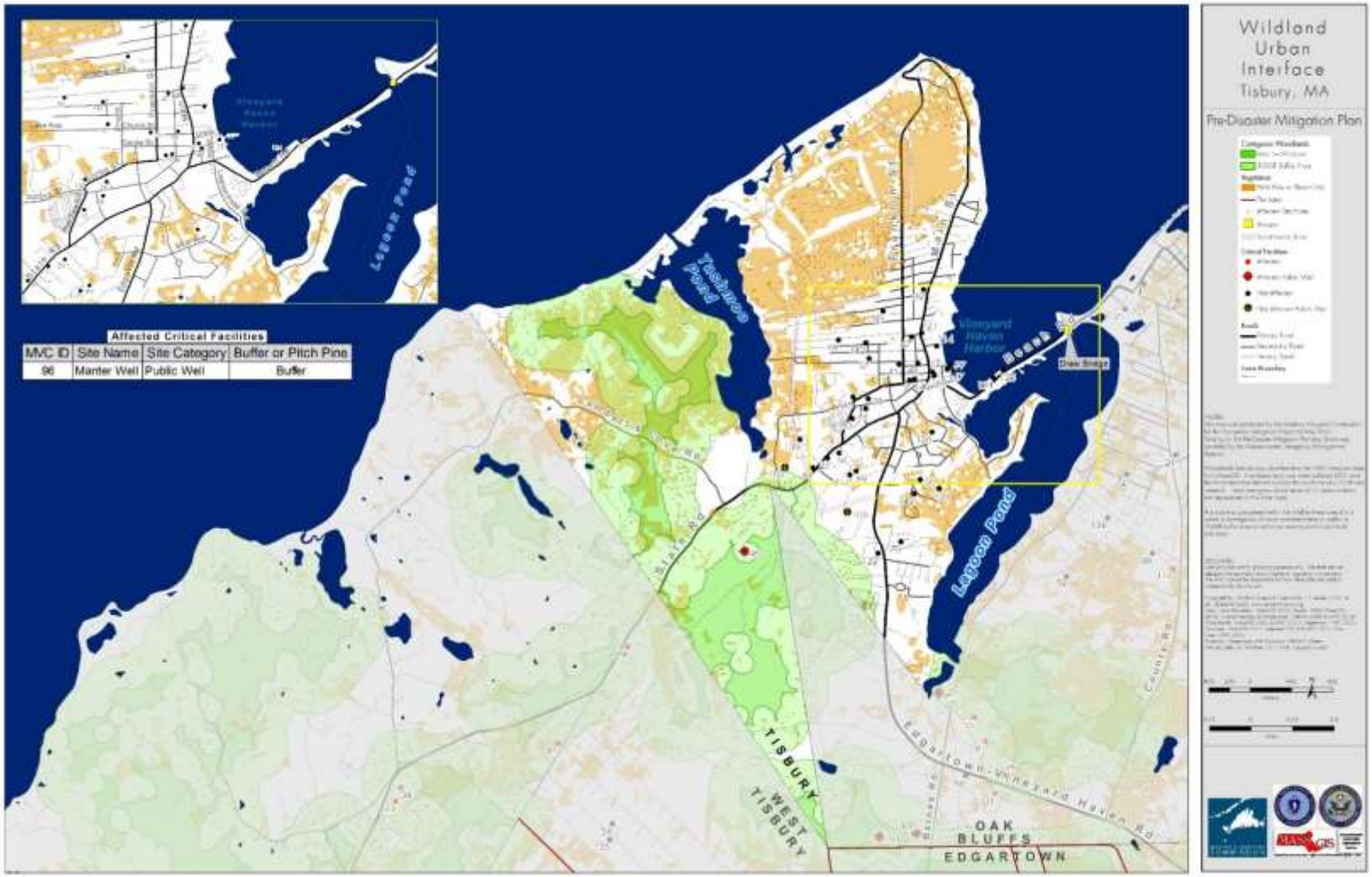
The Town of Tisbury has a year ‘round population of 3,949 (2010 census) on a land area of 6.6 square miles of dry land, with a density of 598.3 persons per square mile. Most of the year ‘round waterfront activity takes place in Tisbury. Vineyard Haven Harbor is open year ‘round for ferry passengers, freight, and vehicles, and the waterfront facilities include boatyards, fuel, etc. The harbor is protected somewhat by the “Chops”, the high bluffs of West Chop and East Chop that form the mouth of the outer harbor, which is otherwise open to Vineyard Sound. Commercial and recreational boats fill the inner harbor all summer, spilling out to the outer harbor (outside the breakwater) and into nearby Lagoon Pond. In summer, recreational boats also berth in Lake Tashmoo, on the northwest side of the town, where there are approximately 600 moorings.

The maps illustrate the geographic extent of vulnerability. In some cases, only excerpts are show here. The full sized maps are in the cd pocket and are available on-line. Seeing the full extent is important for planning purposes.

The matrices of vulnerability highlight the persons and property. Property is identified both by numbers of buildings and by value. Persons are identified by population (2010 census) as well as by seasonal projection. Projections estimate vulnerability at buildout.

Vulnerability is represented for wildfire (wildland urban interface), flood (Nor’easter), storm (hurricane) and for sea level rise.

TISBURY WILDFIRE VULNERABILITY

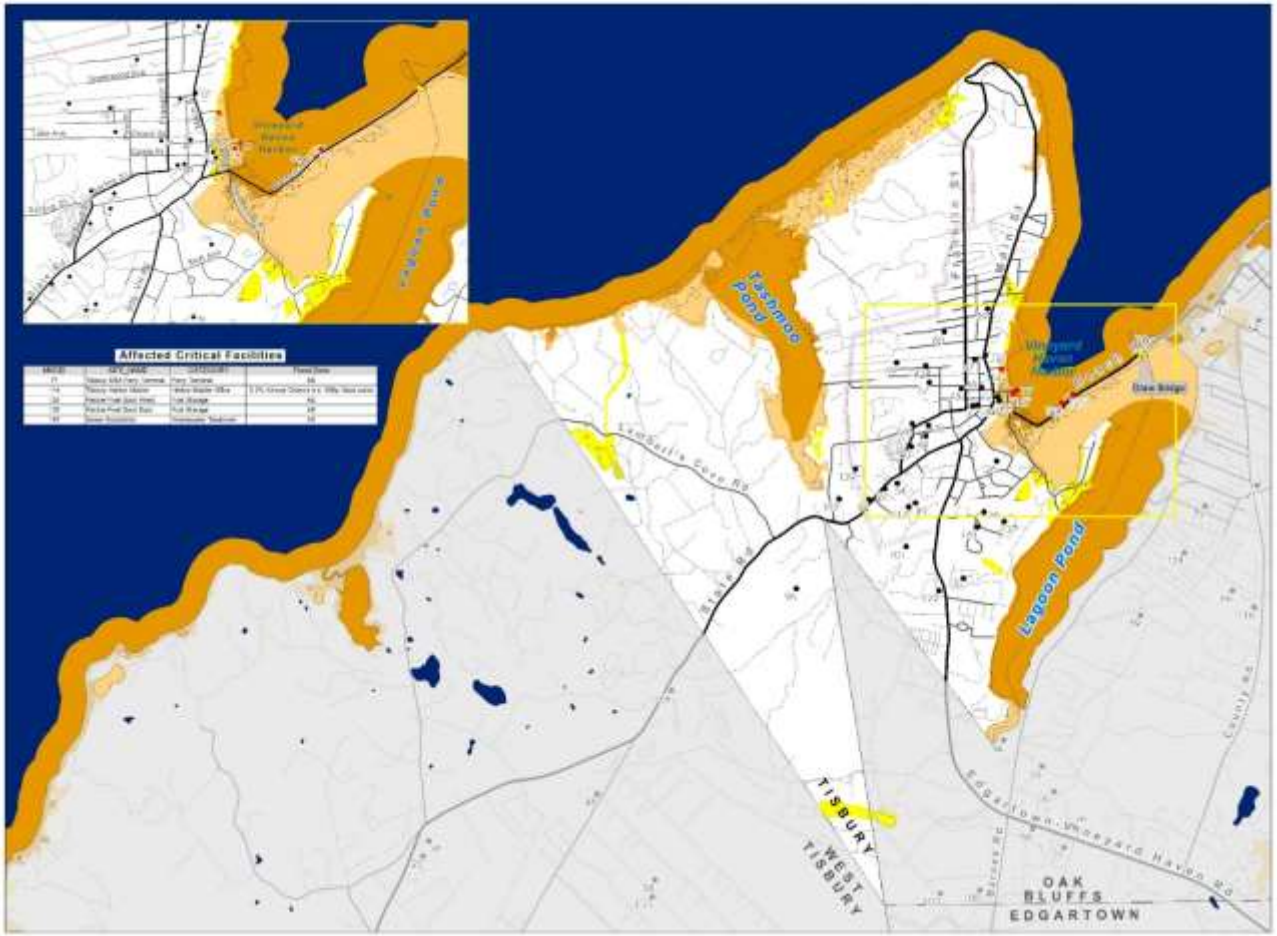


Contiguous Woodlands are shown in green; darker green represents area >=50 acres; lighter green shows 1000ft Buffer Area. Pitch Pine or Shrub Oak vegetation is shown in tan.

TISBURY Wildfire Vulnerability

Developed Land					Undevel. Land			
Use	# People (other)	# People (July-Aug)	# Buildings	Approx. Value	# People (other)	# People (July-Aug)	# Buildings	Approx. Value
	2.19 per building	3.67 per building			2.19 per building	3.67 per building		
Residential	1,286	2,154	587	$246,006,600	1,071	1,795	489	$204,935,651
Comm.			39	$11,439,900			0	$0
Industrial			1	$236,600			10	$2,366,000
Exempt (Municipal, Public, Non-profit)			11	$5,853,600			1	$532,145

TISBURY FLOOD VULNERABILITY (2013 FIRM MAP)



Nor'Easter- type storm flooding

Darker orange represents the 100-year VE zone (wave heights > 3'). Lighter orange represents the 100-year AE zone (wave heights < 3'). Yellow shows the 500-year flood zone.

Tisbury Flood Vulnerability
Based on Preliminary Flood Data Released in June 2013
Developed Land

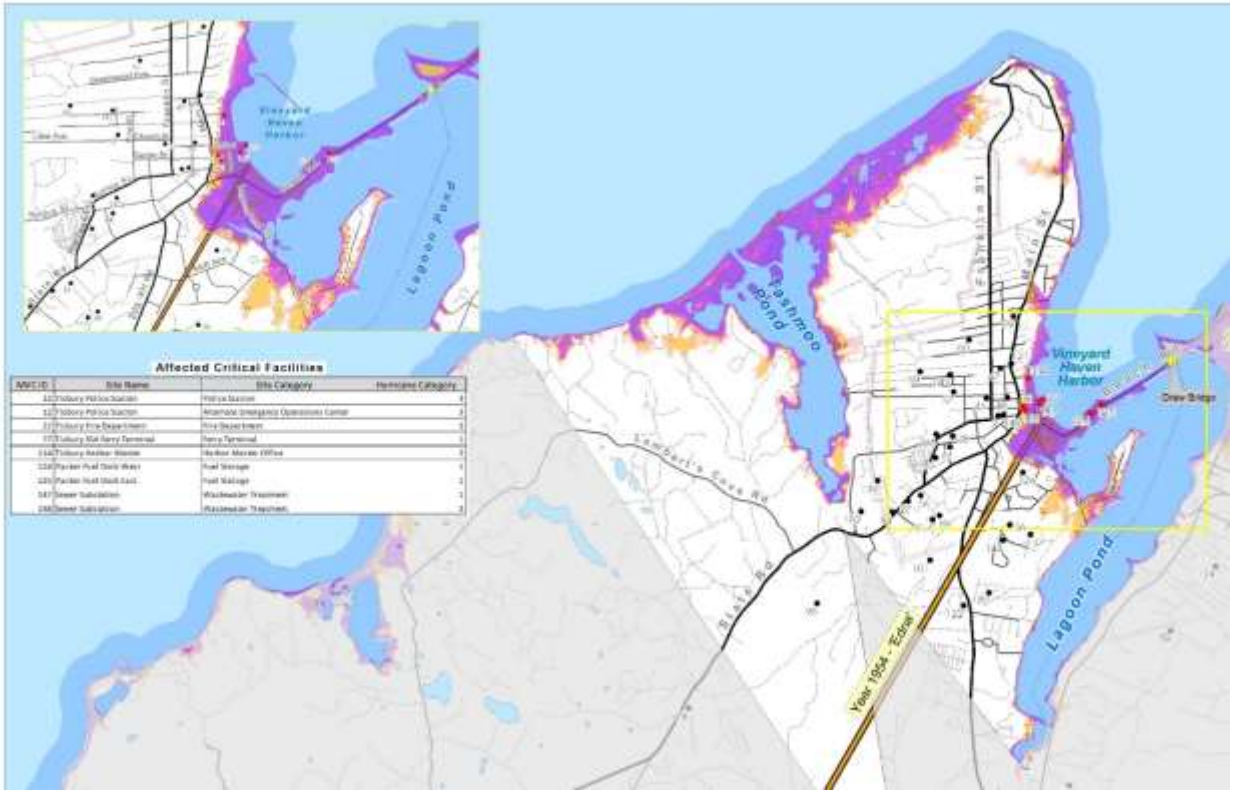
Flood Zone Category	Use	# People (other)	# People (July-Aug)	# Buildings	Approximate Value
		2.19 per building	3.67 per building		
100 Year	Residential	149	250	68	$38,713,100
	Commercial			65	$18,732,000
	Industrial			0	$0
	Exempt (Municipal, Public, Non-profit)			5	$4,194,500
Velocity Zone (also 100yr)	Residential	81	136	37	$15,323,600
	Commercial			89	$15,945,000
	Industrial			0	$0
	Exempt (Municipal, Public, Non-profit)			0	$0
500 Year	Residential	94	158	43	$15,685,300
	Commercial			4	$1,866,700
	Industrial			0	$0
	Exempt (Municipal, Public, Non-profit)			2	$540,500

TISBURY Flood Vulnerability
Based on Preliminary Flood Data Released in June 2013
Developable Land

Flood Zone Category	Use	# People (other)	# People (July-Aug)	# Buildings	Approximate Value
		2.19 per building	3.67 per building		
100 Year	Residential	105	176	48	$27,326,894
	Commercial			0	
	Industrial			0	
	Exempt (Municipal, Public, Non-profit)			6	$5,033,400
Velocity Zone (also 100yr)	Residential	0	0	0	
	Commercial			0	
	Industrial			0	
	Exempt (Municipal, Public, Non-profit)			0	
500 Year	Residential	116	195	53	$19,333,044
	Commercial			6	$2,800,050
	Industrial			0	
	Exempt (Municipal, Public, Non-profit)			5	$1,351,250

TISBURY STORM SURGE VULNERABILITY
HURRICANE INUNDATION

The colors in the Storm Surge legend grade in Hurricane intensity from Category 1 (dark purple) lighter and lighter to Category 4 (palest color).



TISBURY Hurricane Inundation Vulnerability (SLOSH)
Based on preliminary data Released by the USACOE New England District in March 2013
Developed Land

SLOSH cat.	Use	# People (other)	# People (July-Aug)	# Buildings	Approx. Value
		2.19 per building	3.67 per building		
1	Residential	123	206	56	$20,235,000
1	Commercial			124	$27,404,900
1	Industrial			0	$0
1	Municipal, Public, Non-profit			4	$3,597,200
2	Residential	169	283	77	$41,317,700
2	Commercial			32	$7,859,700
2	Industrial			0	$0
2	Municipal, Public, Non-profit			3	$762,700
3	Residential	182	305	83	$37,658,600
3	Commercial			8	$5,727,800
3	Industrial			0	$0
3	Municipal, Public, Non-profit			3	$2,852,900
4	Residential	164	275	75	$40,525,900
4	Commercial			10	$11,227,800
4	Industrial			0	$0
4	Municipal, Public, Non-profit			0	$0

TISBURY Hurricane Inundation Vulnerability (SLOSH)
Based on preliminary data Released by the USACOE New England District in March 2013
Potential Development

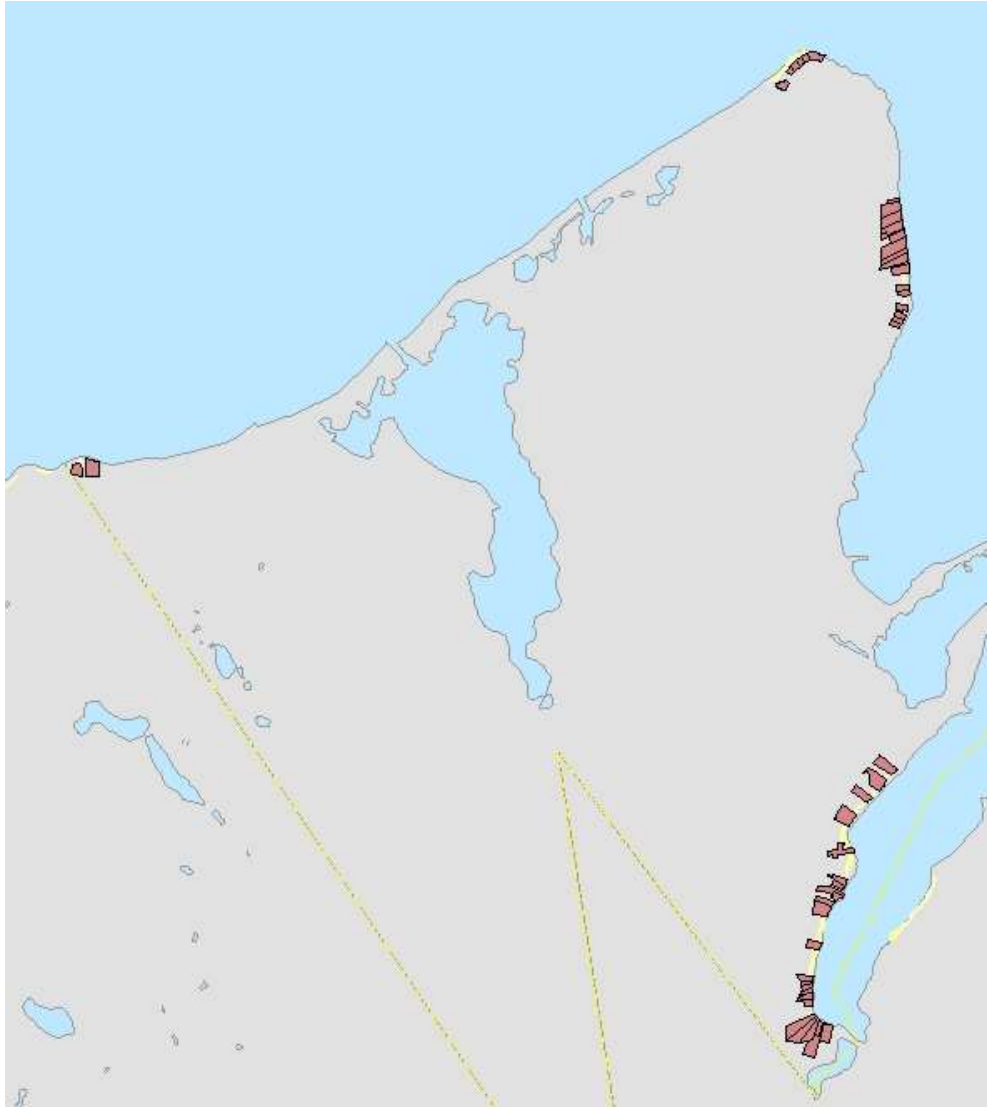
SLOSH cat.	Use	# People (other)	# People (July-Aug)	# Buildings	Approx. Value
		2.19 per blding	3.67 per building		
1	Residential	55	92	25	$9,033,482
1	Commercial			40	$8,840,290
1	Industrial			0	$0
1	Municipal, Public, Non-profit			6	$5,395,800
2	Residential	92	154	42	$22,536,927
2	Commercial			0	$0
2	Industrial			0	$0
2	Municipal, Public, Non-profit			0	$0
3	Residential	11	18	5	$2,268,590
3	Commercial			0	$0
3	Industrial			0	$0
3	Municipal, Public, Non-profit			1	$950,967
4	Residential	61	103	28	$15,129,669
4	Commercial			5	$5,613,900
4	Industrial			0	$0
4	Municipal, Public, Non-profit			0	$0

TISBURY SEA LEVEL RISE VULNERABILITY
1.5’ by mid-century and 5’ by the end of the century

Light blue shows the mid-century projection of 1.5’ above MHHW; dark blue shows the end-of-the-century projection of 5’.

Sea Level Rise Vulnerability
SLR Scenarios: 1.5 ft and 5 ft
with MHHW adjustment (1 ft. ave. offset from NAVD Datum)
Developed Land

Rise Level	Use	# People (other)	# People (July-Aug)	# Buildings	Approximate Value
		2.19 per building	3.67 per building		
<= 1.5ft Rise	Residential	2	4	1	$231,400
<= 1.5ft Rise	Commercial			1	$133,600
<= 1.5ft Rise	Industrial			0	$0
<= 1.5ft Rise	Exempt (Municipal, Public, Non-profit)			0	$0
>1.5ft and <= 5ft Rise	Residential	110	184	50	$18,176,200
>1.5ft and <= 5ft Rise	Commercial			122	$27,603,400
>1.5ft and <= 5ft Rise	Industrial			0	$0
>1.5ft and <= 5ft Rise	Exempt (Municipal, Public, Non-profit)			3	$2,621,700



COASTAL EROSION AND SHORELINE CHANGE

Pre-1978 homes near bluffs are difficult for the towns to regulate (grandfathered under the Wetlands Protection Act). There are 48 in TISBURY.

TISBURY VULNERABILITY OF CRITICAL FACILITIES

Flood	Flood Zone Category	Critical Facility Category	# Buildings	Approximate Value
	100 Year (AE Zone)	Ferry Terminal - Steamship	1	$2,254,500
	100 Year (AE Zone)	Fuel Storage	2	$412,100
	100 Year (AE Zone)	Sewer Substation at SSA	1	$53,600
	500 Year	Harbor Master Office	1	$100,400

Hurricane Inundation	SLOSH Category	Critical Facility Category	# Buildings	Approximate Value
	1	Ferry Terminal - Steamship	1	$2,254,500
	1	Fuel Storage	2	$412,100
	1	Sewer Substation - SSA	1	$53,600
	2	Harbor Master Office	1	$100,400
	3	Sewer Substation at Comfort Station	1	$53,600
	3	Police Station	1	$377,300

Sea Level Rise	Sea Level Category	Critical Facility Category	# Buildings	Approx. Value
	>1.5 and <=5.0ft	Packer Fuel Dock West	1	$58,300
	>1.5 and <=5.0ft	Sewer Substation at SSA	1	$53,600

TISBURY VULNERABILITY OF CRITICAL FACILITIES

Wildland-Urban Interface		Critical Facility Category	# Buildings	Approximate Value
	inside forest buffer	Public Well	1	Not Applicable

Bridges	Town	Hazard*
Draw Bridge	OB/Tisbury	AE 100 year flood zone & SLOSH

TRANSMISSION LINES	Town	Hazard	Length Intersected (ft)	Total Length of Transmission Line (ft)
TISBURY Water Company	TISBURY	Pitch Pine Woodland	1100	3,099

*all coastal bridges would most likely be affected by Hurricanes. However due to the delineation of the SLOSH data, knowing which category the bridge is in can not be determined. Similar situation with bridges and sea level rise. The data processing in most areas masked out the elevation around the bridge as being water. Hence, elevation of the bridge is unable to be determined from the 2010 LiDAR data.

TISBURY FUTURE VULNERABILITY

Natural Hazard	Frequency of Occurrence	Location	Impacts	Hazard Index
	(very low, low, medium, high)	(local or small, medium, multiple towns or large)	(minor, serious, extensive, catastrophic)	(combine impacts and frequency)(1 point for each step of frequency or impact)
Flood-Related Hazards				
Riverine	very low	n/a	n/a	0
Coastal	medium	large	serious	8
Erosion	high	large	serious	9
Dam Failures	n/a	n/a	n/a	0
Severe Rainstorms	medium	large	serious	8
Winter Storms	low	local	minor	4
Coastal Storms/Nor'easters	high	medium	extensive	10
Hurricanes	medium	large	extensive	9
Wind-Related Hazards				
Hurricanes	medium	large	extensive	9
Coastal Storms	high	large	serious	9
Winter Storms	low	local	serious	5
Downspouts	very low	local	minor	3
Tornadoes	very low	local	serious	4
Fire-Related Hazards				
Drought	medium	medium	serious	8
Wildfires	medium	medium	serious	8
Geologic Hazards				
Earthquakes	very low	n/a	n/a	0
Landslides	very low	local	minor	3
Sink Holes	very low	n/a	n/a	0
Other Hazards				
Ice	very low	local	serious	3
Sea Level Rise	high	local	minor	6

VULNERABILITY ASSESSMENTS FOR WEST TISBURY

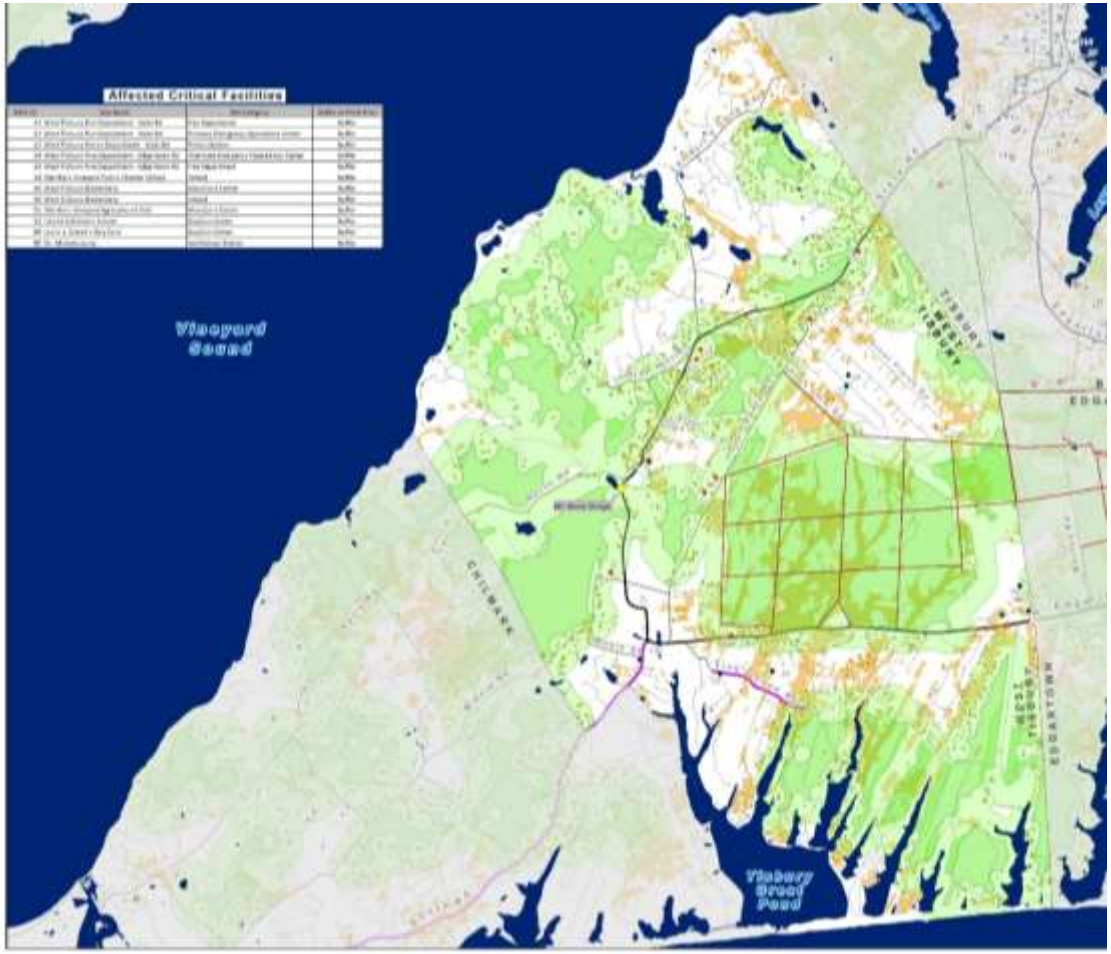
The Town of West Tisbury has a year 'round population of 2,740 (2010 census) on a land area of 25 square miles of dry land, with a density of 109.6 persons per square mile. West Tisbury is the fastest growing town in Dukes County, but still doesn't have municipal water or sewer service. The north side of West Tisbury is hilly, morainal land and the south side is lowland made of unconsolidated outwash plain sediments that are highly susceptible to erosion and disappearing at the rate of about 7 feet per year. The south side is also punctuated by periglacial valleys that are susceptible to storm surge and to sea level rise.

The maps illustrate the geographic extent of vulnerability. In some cases, only excerpts are show here. The full sized maps are in the cd pocket and are available on-line. Seeing the full extent is important for planning purposes.

The matrices of vulnerability highlight the persons and property. Property is identified both by numbers of buildings and by value. Persons are identified by population (2010 census) as well as by seasonal projection. Projections estimate vulnerability at buildout.

Vulnerability is represented for wildfire (wildland urban interface), flood (Nor'easter), storm (hurricane) and for sea level rise.

WEST TISBURY WILDFIRE VULNERABILITY

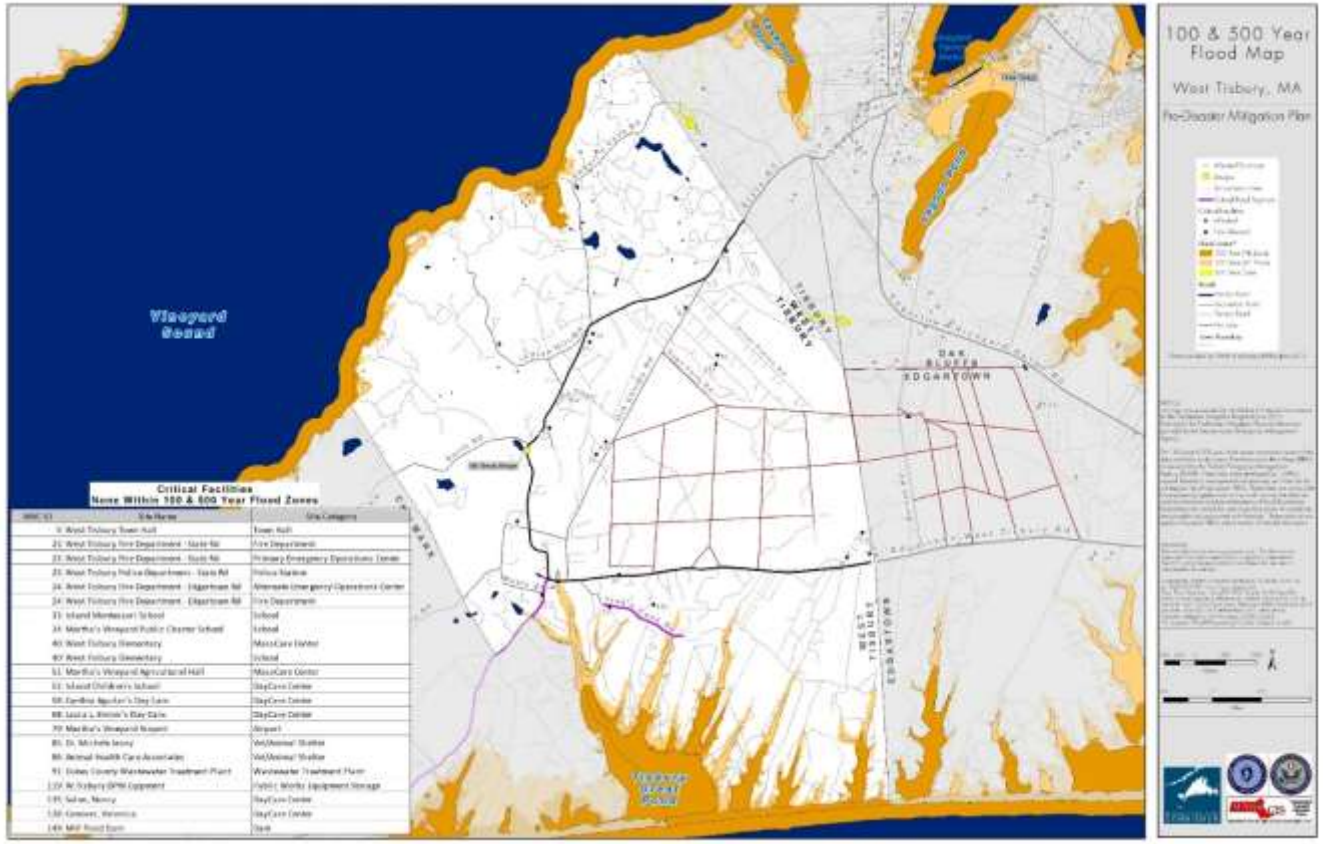


Contiguous Woodlands are shown in green; darker green represents area >=50 acres; lighter green shows 1000ft Buffer Area. Pitch Pine or Shrub Oak vegetation is shown in tan.

WEST TISBURY Wildfire Vulnerability

Developed Land					Undevel. Land			
Use	# People (other)	# People (July-Aug)	# Buildings	Approx. Value	# People (other)	# People (July-Aug)	# Buildings	Approx. Value
	2.26 per building	3.78 per building			2.26 per building	3.78 per building		
Residential	2,034	3,402	900	$346,541,900	1,351	2,260	598	$230,257,840
Commercial			39	$14,989,500			0	$0
Industrial			1	$215,800			1	$0
Municipal, Public, Non-profit			16	$27,652,100			6	$10,369,538

WEST TISBURY FLOOD VULNERABILITY (2013 FIRM MAP)



Nor'Easter- type storm flooding

Darker orange represents the 100-year VE zone (wave heights > 3'). Lighter orange represents the 100-year AE zone (wave heights < 3'). Yellow shows the 500-year flood zone.

Flood Vulnerability
Based on Preliminary Flood Data Released in June 2013
Developed Land

Flood Zone Category	Use	# People (other)	# People (July-Aug)	# Buildings	Approximate Value
		2.26 per building	3.78 per building		
100 Year	Residential	23	38	10	$5,882,300
	Commercial			1	$147,100
	Industrial			0	$0
	Municipal, Public, Non-profit			0	$0
Velocity Zone (also 100yr)	Residential	0	0	0	$0
	Commercial			0	$0
	Industrial			0	$0
	Municipal, Public, Non-profit			0	$0
500 Year	Residential	0	0	0	$0
	Commercial			0	$0
	Industrial			0	$0
	Municipal, Public, Non-profit			0	$0

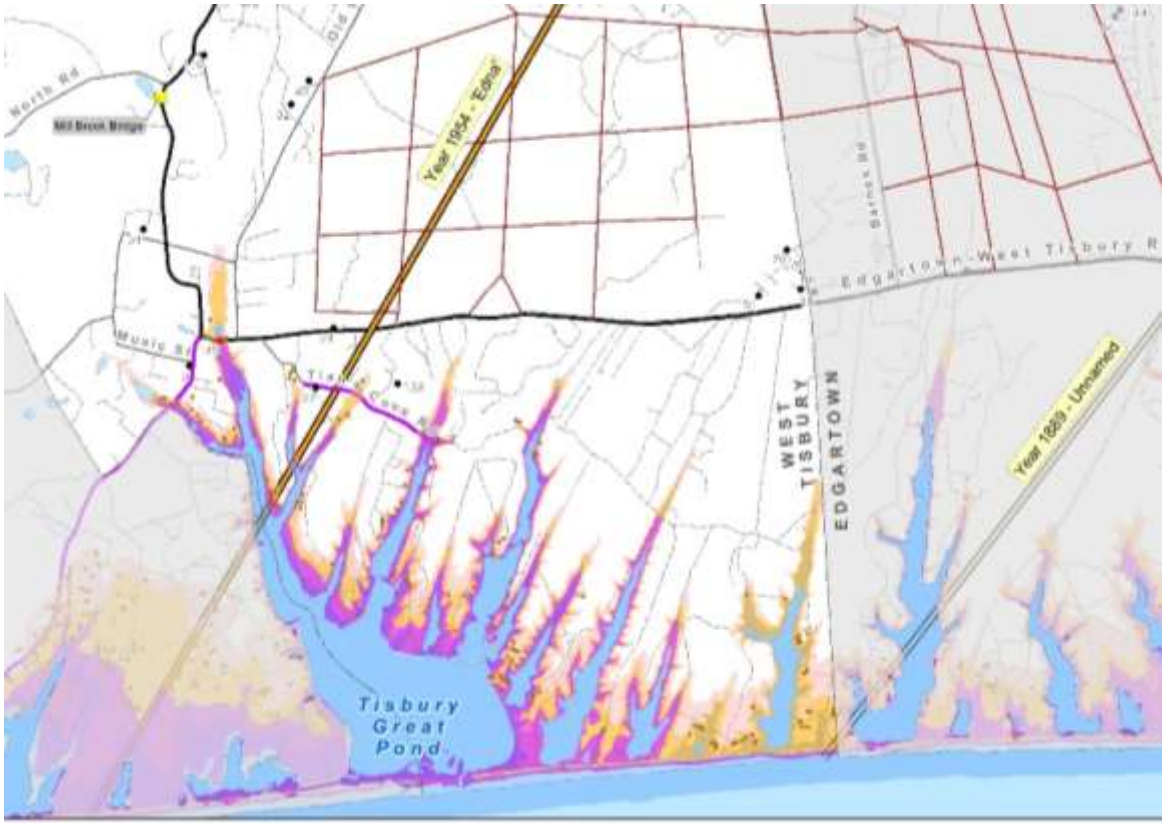
WEST TISBURY Flood Vulnerability
Based on Preliminary Flood Data Released in June 2013
Developable Land

Flood Zone Category	Use	# People (other)	# People (July-Aug)	# Buildings	Approximate Value
500 Year	Exempt (Municipal, Public, Non-profit)			26	$9,817,600
		2.26 per building	3.78 per building		
100 Year	Residential	54	91	24	$14,117,520
	Commercial			0	$0
	Industrial			0	$0
	Municipal, Public, Non-profit			1	$220,833
Velocity Zone (also 100yr)	Residential	43	72	19	$11,176,370
	Commercial			0	$0
	Industrial			0	$0
	Municipal, Public, Non-profit			0	$0
500 Year	Residential	54	91	24	$14,117,520
	Commercial			0	$0
	Industrial			0	$0
	Municipal, Public, Non-profit			0	$0

WEST TISBURY STORM SURGE VULNERABILITY
HURRICANE INUNDATION

The colors in the Storm Surge legend grade in Hurricane intensity from Category 1 (dark purple) lighter and lighter to Category 4 (palest color).

Note that the funnel-shape topography of the geat pond coves intensifies the impacts of storm surge.



WEST TISBURY Hurricane Inundation Vulnerability (SLOSH)
Based on preliminary data Released by the USACOE New England District in March 2013
Developed Land

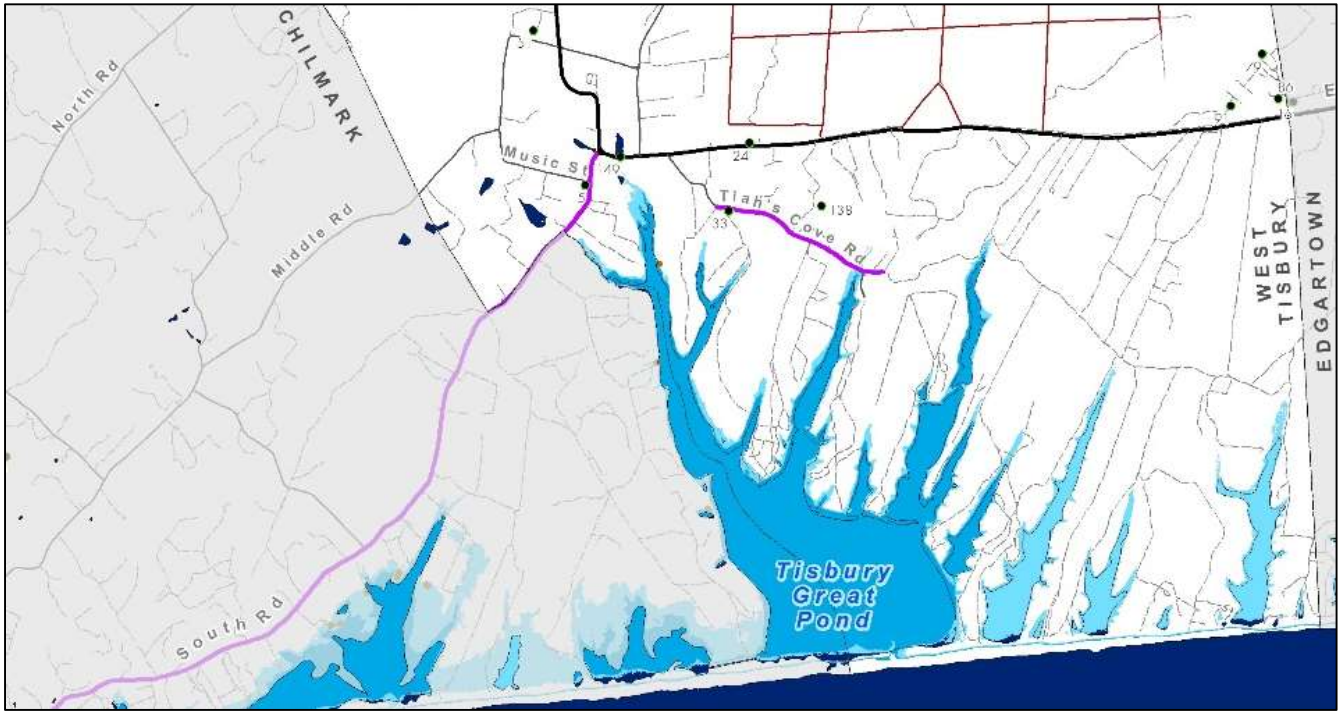
SLOSH cat.	Use	# People (other)	# People (July-Aug)	# Buildings	Approx. Value
		2.26 per building	3.78 per building		
1	Residential	2	4	1	$398,300
	Commercial			0	$0
	Industrial			0	$0
	Municipal, Public, Non-profit			0	$0
2	Residential	25	42	11	$5,469,900
	Commercial			0	$0
	Industrial			0	$0
	Municipal, Public, Non-profit			0	$0
3	Residential	61	102	27	$13,216,800
	Commercial			1	$147,100
	Industrial			0	$0
	Municipal, Public, Non-profit			2	$280,300
4	Residential	66	110	29	$20,917,000
	Commercial			0	$0
	Industrial			0	$0
	Municipal, Public, Non-profit			1	$151,400

WEST TISBURY Hurricane Inundation Vulnerability (SLOSH)
Based on preliminary data Released by the USACOE New England District in March 2013
Potential Development

SLOSH cat.	Use	# People (other)	# People (July-Aug)	# Buildings	Approx. Value
		2.26 per building	3.78 per building		
1	Residential	57	95	25	$9,957,500
	Commercial			0	$0
	Industrial			0	$0
	Municipal, Public, Non-profit			1	$0
2	Residential	79	132	35	$17,404,227
	Commercial			0	$0
	Industrial			0	$0
	Municipal, Public, Non-profit			0	$0
3	Residential	129	215	57	$27,902,133
	Commercial			1	$0
	Industrial			0	$0
	Municipal, Public, Non-profit			0	$0
4	Residential	208	348	92	$66,357,379
	Commercial			1	$0
	Industrial			0	$0
	Municipal, Public, Non-profit			0	$0

WEST TISBURY SEA LEVEL RISE VULNERABILITY
1.5' by mid-century and 5' by the end of the century

Light blue shows the mid-century projection of 1.5' above MHHW; dark blue shows the end-of-the-century projection of 5'.



Sea Level Rise Vulnerability
SLR Scenarios: 1.5 ft and 5 ft
with MHHW adjustment (1 ft. ave. offset from NAVD Datum)
Developed Land

Rise Level	Use	# People (other)	# People (July-Aug)	# Buildings	Approximate Value
		2.26 per building	**3.78 per building**		
<= 1.5ft Rise	**Residential**	**0**	**0**	**0**	**$0**
	Commercial			**0**	**$0**
	Industrial			**0**	**$0**
	Exempt (Municipal, Public, Non-profit)			**0**	**$0**
>1.5ft and <= 5ft Rise	**Residential**	**2**	**4**	**1**	**$398,300**
	Commercial			**0**	**$0**
	Industrial			**0**	**$0**
	Exempt (Municipal, Public, Non-profit)			**0**	**$0**

COASTAL EROSION AND SHORELINE CHANGE

Pre-1978 homes near bluffs are difficult for the towns to regulate (grandfathered under the Wetlands Protection Act). There are 16 in WEST TISBURY.

WEST TISBURY VULNERABILITY OF CRITICAL FACILITIES

Flood	**NONE**

Sea Level Rise	**NONE**

Hurricane Inundation	**NONE**

Wildland-Urban Interface		Critical Facility Category	# Buildings	Approximate Value
	inside forest buffer	Daycare Center	1	$326,600
	inside forest buffer	Fire Stations	2	$1,734,500
	inside forest buffer	MV Ag. Hall (potential backup site)	1	$1,209,300
	inside forest buffer	Schools	3	$11,613,400
	inside forest buffer	Vet/Animal Shelter	1	$225,900

WEST TISBURY VULNERABILITY OF CRITICAL FACILITIES - ROADS

ROADS	Town	Hazard	Length Intersected (ft)	Total Length of Road (ft)
South Road/State Rd	Chilmark	Wildfire Buffer Area	8368	40,870
		Pitch Pine/Shrub Oak	4560	
		AE 100 year flood zone	451	
		SLOSH Category 1	50	
		SLOSH Category 2	231	
		SLOSH Category 3	1632	
		SLOSH Category 4	4981	
State Road (Chi./Aq. Town line to Aquinnah Police Station)	Aquinnah	AE 100 year flood zone	51	10,328
State Road (Chi./WT town line to Edg-WT Rd)	West Tisbury	AE 100 year flood zone	96	2,212
		SLOSH Category 2	8	
		SLOSH Category 3	186	
		SLOSH Category 4	60	
Tiah's Cove Road	West Tisbury	Wildfire Buffer Area	944	4,712
		Pitch Pine/Shrub Oak	1,079	
		AE 100 year flood zone	623	
		SLOSH Category 2	668	
		SLOSH Category 3	474	
		SLOSH Category 4	393	
		Sea Level Rise > 2.5ft & < 6.0ft	118	

West Tisbury Vulnerability of Critical Facilities

BRIDGES	Town	Hazard*
Mill Brook Bridge	West Tisbury	Wildfire Buffer Area

Transmission Lines	Town	Hazard	Length Intersected (ft)	Total Length of Transmission Line (ft)
Unknown Name	West Tisbury	Wildfire Buffer Area	500	2,009
		Forest Land Use	1530	
		Pitch Pine Woodland	1275	

*all coastal bridges would most likely be affected by Hurricanes. However due to the delineation of the SLOSH data, knowing which category the bridge is in cannot be determined. Similar situation with bridges and sea level rise. The data processing in most areas masked out the elevation around the bridge as being water. Hence, elevation of the bridge is unable to be determined from the 2010 LiDAR data.

WEST TISBURY FUTURE VULNERABILITY

Natural Hazard	Frequency of Occurrence	Location	Impacts	Hazard Index
	(very low, low, medium, high)	(local or small, medium, multiple towns or large)	(minor, serious, extensive, catastrophic)	(combine impacts and frequency)(1 point for each step of frequency or impact)
Flood-Related Hazards				
Riverine	very low	n/a	n/a	0
Coastal	medium	large	serious	8
Erosion	high	medium	minor	7
Dam Failures	very low	local	serious	4
Severe Rainstorms	medium	large	serious	8
Winter Storms	low	local	minor	4
Coastal Storms/Nor'easters	high	medium	extensive	9
Hurricanes	medium	medium	serious	7
Wind-Related Hazards				
Hurricanes	medium	large	extensive	9
Coastal Storms	high	large	serious	10
Winter Storms	low	local	serious	5
Downspouts	very low	local	minor	3
Tornadoes	very low	local	serious	4
Fire-Related Hazards				
Drought	medium	medium	minor	6
Wildfires	high	medium	serious	8
Geologic Hazards				
Earthquakes	very low	n/a	n/a	0
Landslides	very low	local	minor	3
Sink Holes	very low	n/a	n/a	0
Other Hazards				
Ice	very low	local	serious	3
Sea Level Rise	high	medium	minor	7

Section 6. Hazard Mitigation

Having performed the data and analysis involved in assessment of vulnerabilities, the next step was to address those vulnerabilities with an action plan. In developing the following action plans, the Hazard Mitigation Planning Teams evaluated the hazard identification and analysis, the vulnerabilities and the existing protections to discover what goals and actions might be adopted to further lessen the impacts of natural hazards.

Flood and Storm

Most Dukes County towns participate in the FEMA flood insurance program (NFIP) and have floodplain zoning by-laws associated with that program. Chilmark is the exception. That town does not participate in the program, doesn't have a floodplain by-law, and property owners are not eligible to purchase flood insurance. It should be noted that the floodplain by-laws required for participation in the insurance program are minimal. The Vineyard towns also have the Coastal District DCPC (District of Critical Planning Concern) and several DCPC's specific to individual ponds, harbors and shores. These DCPC regulations are, in most cases, more restrictive than the FEMA floodplain by-laws.

The Town of Oak Bluffs upgraded its Floodplain Bylaw to a level of protection above and beyond the basics, perhaps a model for the other towns to consider. In 2009, Oak Bluffs became one of eight pilot communities in the Storm Smart Coast Program which is run by Massachusetts Coastal Zone Management (CZM) office. The goal for Oak Bluffs was to revise the bylaw to better protect the property, public health and natural resources within the Floodplain Overlay District. CZM staff provided assistance to a team of Oak Bluffs officials in order to revise the basic floodplain overlay district bylaw in place at that time, to better regulate development and land use. New regulations include stricter rules against new construction, additions and expanding impervious surfaces throughout most of the flood plain district. While regulations are more extensive in this update of the bylaws, guidelines are available on how and when to apply for special permits for unique circumstances in The Rules and Regulations for the Floodplain Overlay Zoning District document. The updated bylaws were passed at Town Meeting in May, 2010, after which the CZM representatives congratulated Oak Bluffs for its progressive work to protect residents, businesses and natural resources.

Wildfire

The 5,700-acre Manuel F. Correllus State Forest was created in 1908 as a refuge for the last remaining population of heath hen, and was managed as heath hen habitat until the last one died in 1932. Since then, management practices have left considerable areas of exotic pines that are dead and dying, providing significant fuel for wildfires.

According to past State Forest Supervisor John Varkonda, the State Forest has an active fire management program. Controlled burns are used. Grazing is used following mowing/brushcutting.

The Town of Gosnold completed its *Cuttyhunk Community Wildfire Protection Plan* in 2013, including an assessment of vulnerability and management recommendations. The Town of Chilmark performed a similar assessment, determining Probability of Ignition. Perhaps this is something for the other towns to consider.

Community (County-wide) Goals:

OVERALL GOAL: To reduce the loss of or damage to life, property, infrastructure, and natural, cultural and economic resources from natural disasters.

- Protect critical public facilities and services from damage due to natural hazards.
- Ensure that critical infrastructure is protected from natural hazards.
- Promote strong natural shore defenses such as coastal beaches and dunes.
- Improve circulation for tidally restricted harbors, ponds and marshes.
- Develop programs and measures that protect residences and other structures from natural hazards.
- Develop mitigation strategies that consider area businesses, including marinas, and protect the economic vitality of the region.
- Protect and preserve irreplaceable cultural resources, particularly for recreation, located in hazard-prone areas.
- Support the communities with information concerning hazard mitigation funding opportunities, and assist the communities in the identification and development of specific mitigation projects.
- Increase each town's capacity for responding to a natural hazard event by promoting the adequate provision of emergency services capabilities.
- Increase awareness and support for natural hazard mitigation among municipalities, private organizations, and area residents through outreach and education.
- Discourage future development in vulnerable areas and encourage restoration of vulnerably-developed properties to more natural and defensible conditions or to open space.
- Reduce vulnerability to drought, by improving water supply infrastructure and by encouraging conservation measures such as low-maintenance landscaping.
- Support greater resiliency by developing and implementing climate change adaptation strategies.

Mitigation Categories: The actions have been organized by project staff, as recommended in the MEMA Community Planning Guide, into categories as follows:

Prevention: Activities including planning, zoning, District of Critical Planning Concern regulations, open space preservation, floodplain and wetland regulations, stormwater management, watershed protection measures and best management practices, erosion control, vegetation management for firewise strategies, and subdivision regulations

Protection: Activities including acquisition, building relocation, building elevation, flood-proofing and retrofitting, and insurance

Public information: Activities including providing informational mailings or workshops, education and technical assistance provided on disaster management and mitigation issues

Structural projects: Including dredging and beach nourishment, dune restoration, construction, maintenance of dams, floodwalls, channel improvements, drainage improvements, detention/retention basins

Emergency services: Including hazard recognition, emergency warning systems, emergency response, protection of critical facilities, and health and safety maintenance

Mitigation: those actions and projects which are in response to the April 2007 storm and Hurricane Sandy in 2012

A number of abbreviations are used here to represent agencies and programs as follows:

MVC	Martha's Vineyard Commission
DCR	Department of Conservation and Recreation
USACOE	United States Army Corps of Engineers
FEMA	Federal Emergency Management Agency
MEMA	Massachusetts Emergency Management Agency
PDM	Pre-Disaster Mitigation
FMA	Flood Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
NFIP	National Flood Insurance Program
WTGHA	Wampanoag Tribe of Gay Head (Aquinnah)

Prioritization of Mitigation Strategies

The actions were categorized by staff of the Martha's Vineyard Commission and evaluated through a consensus-building process within the Hazard Mitigation Planning Teams in order to establish priorities. Considerations used in evaluating priorities included: consistency with the goals in the Hazard Mitigation Plan; whether or not the strategy addresses vulnerable critical facilities or infrastructure; whether or not the strategy is intended to promote reduction in loss of

lives or improved safety, or to reduce impacts to property; whether or not the strategy requires a capital expenditure and if a source has been identified.

The main emphasis of the prioritization process is to promote initiatives with the greatest mitigation benefits which support public health and safety. In developing the prioritization procedures, it is not the intent of the Hazard Mitigation Planning Teams to direct that the initiatives be accomplished in their prioritized order. The purpose of the ranking is to indicate the overall importance of the project to local mitigation efforts. The accomplishment of an initiative will usually depend more on the availability of funds, than on how high or low it ranked compared to other initiatives. After a natural disaster event receives a presidential declaration and the Commonwealth of Massachusetts was designated as a result of the disaster; the Dukes County towns will be eligible for Hazard Mitigation Grant Program funding. At that time the Hazard Mitigation Planning Teams will convene to analyze the damage that was sustained. Then in respect to current conditions in the Dukes County towns, changes in policy and overall mitigation needs, the Hazard Mitigation Planning Teams will prioritize a list of projects to be funded for the specific disaster.

The prioritization process developed by the 2014 Hazard Mitigation Planning Teams requires the identification of projects and programs that will protect the health, safety and welfare of the Dukes County towns' citizens. The project initiatives identified by the Hazard Mitigation Planning Teams will be analyzed for benefits and costs (benefit cost review) based on the guidelines set forth by the state and FEMA. The Benefit Cost Ratio will be calculated on projects included in any applications for funding to ensure the projects are cost effective at the time of project application submittal.

Each action is scored individually and is based on four weighted criteria developed by the Hazard Mitigation Planning Teams (below). The process to prioritize the mitigation actions is accomplished during joint meetings between Hazard Mitigation Team members and officials from the respective local agencies.

Listed below are the criteria and weighted values:

Prioritization criteria

1. Does it accomplish one or all of the HMP goals? 5 points for each goal addressed
2. Does it promote the reduction of the loss of lives? Yes = 25 points; no = 0 points
3. Promote reduction in property damage? Yes = 20 points; no = 0 points
4. Funding needs and availability.
    a. No capital needed = 10 points
    b. Potential source for capital expenditure identified = 5 points

Presentation of Mitigation

The goals and actions were presented in PowerPoint format at the public sessions. Those presentations are available on the MVC website http://www.mvcommission.org/ as stand-alone documents. Town-by-town mitigation includes an existing protection matrix and a detailed action plan.

The first Mitigation is the community plan, followed by mitigation for each of the towns.
The Teams chose the term "community" to represent County-wide items, rather than the more ubiquitous "regional", in order to better foster cooperation.

Community (Seven Towns) Mitigation Action Items:

The Community Hazard Mitigation Planning Team developed and prioritized actions and strategies intended to meet the Community Goals.

PROPOSED COMMUNITY MITIGATION ACTIONS FOR ALL OF DUKES COUNTY TOWNS

Category of Action	Description of Action	Implementation Responsibility	Priority	Resources/Funding
Structural, protection	Beach nourishment, dredging and structural reconfiguration of inlets and inlet protections to improve natural defenses and circulation of storm surge waters, in order to minimize storm impacts; vegetation management for dune restoration	DCR, County, towns, USACOE, Mass DOT	40	PDM, HMGP, DCR, Mass DOT towns, County, USACOE
Prevention	Increase capacity in adaptation to climate change, by incorporating 25-year storm calculations rather than 10-year volume into regulations	Towns, MVC, Mass DOT	75	PDM, HMGP, Mass DOT, towns, MVC
Structural	Increase capacity in adaptation to climate change, by incorporating 25-year storm calculations rather than 10-year volume into public and private infrastructure planning	Towns, Mass DOT, private	71	PDM, HMGP, Mass DOT, towns, private
Adaptation	Work with the Joint Transportation Committee to make long-range plans for public roads vulnerable to Sea Level Rise	Towns, Mass DOT, MVC	40	Mass DOT
Prevention	Incorporate PDM plan proposals in other local and regional plans – Island Plan, master plans, transportation plans, open space plans, capital improvement programs, harbor plans; and DRI and MEPA reviews	MVC, Martha's' Vineyard towns, Island Plan Steering Committee, Joint Transportation Committee	60	MVC, Mass DOT
Prevention	Work with federal and state agencies and their contractors to develop improved mapping and estimates of structures located within the 100-year floodplain	MVC, towns, FEMA contractor, MEMA	COMPLETED	FEMA
Protection, emergency services	Flood-proof or relocate selected critical facilities in the floodplain (other than water-dependent uses	Municipalities, Commonwealth	35	FMA, HMGP

Prevention	Review and possibly amend Coastal District and other overlay regulations for hazard mitigation	MVC, Martha's Vineyard towns	60	PDM, HMGP
Structural, protection	Structural and non-structural retrofitting (e.g. storm shutters) of existing public or private structures	Private and public owners	40	FMA, PDM, HMGP
Emergency services	Generators and other retrofits for emergency shelters	Towns	35	PDM, HMGP
Structural	Reduce flood impacts by identifying stormwater systems that have potential to discharge hazardous materials in the event of a storm or flood and installing an emergency shut-off system in each of those systems	Commonwealth and towns	55	Mass DOT, towns, HMGP, PDM
Structural	Reduce flood impacts by identifying and correcting discharges from town and Commonwealth roadways where they cross streams, including: Mill Brook (West Tisbury portion), Tiasquam (West Tisbury portion), Black Brook (Aquinnah and West Tisbury), Smith Brook (Tisbury) and Witch Brook (West Tisbury)	Commonwealth and town DPW's	60	Mass DOT, towns, HMGP, PDM
Prevention	Map stormwater collection areas and discharges	Commonwealth and town DPW's, MVC	40	Mass DOT, MVC, towns
Prevention	Hold informational sessions with the Planning Boards to encourage the incorporation of Low Impact Development Techniques in local subdivision regulations;	MVC, towns	45	
Prevention	In order to reduce the impacts of drought and wildfire, establish an overall management plan for the State Forest, including establishment of specific procedures or Memoranda of Agreement regarding the transfer of land for new public water supplies and for easements to install water supply lines	DCR and State Forest Advisory Committee	65	DCR
Structural, Prevention	In order to reduce the impacts of drought and wildfire, install new public water supplies and water supply lines within the State Forest.	Town Water Departments and District	60	HMGP, PDM
Structural	In order to lessen the impacts of drought and wildfire, establish plans and build infrastructure for water supply needs to alleviate future drought emergencies. The Towns of Tisbury and Oak Bluffs, nearly at buildout, should focus their attention on redundancy plans in response to potential emergencies such as drought.	Town Water Departments and District	60	HMGP, PDM

	The Town of Edgartown has much greater needs for water supply beyond the capacity of the existing Edgartown wells, in addition to needs for redundancy to be prepared for emergencies such as drought			
Structural	In order to lessen the impacts of drought and wildfire, establish plans and build infrastructure for water supply needs to alleviate future drought emergencies. Consider potential need for and options to provide water supply to areas with a development pattern that may not be compatible with continued private well water supplies, which may not be adequate in the event of emergencies such as drought and wildfire; build the necessary infrastructure.	Town Water Departments and District	60	HMGP, PDM
Prevention	Vegetation management to reduce the impacts of wildfire, including but not limited to the cutting, chipping and disposal (by shipment off-Island or by reuse as compost) of excess fuel materials in forest.	DCR, private and public owners	60	DCR, HMGP, PDM
Prevention	Perform outreach to encourage the towns to revise local subdivision and building regulations to require fire-proof roofing materials in areas vulnerable to wildfire; and homeowners' association to include the same in covenants or in renewal of covenants, possibly including review by the Fire Chiefs.	Towns, MVC, private and public owners	65	MVC
Emergency services	Develop a dedicated on-Island fire cache that would allow prescribed fire teams to respond on very short notice and conduct preventive prescribed burns.	DCR	65	HMGP, PDM, DCR
Public information	Employ data-gathering (such as LIDAR), analysis and consensus-building to establish an Island-wide comprehensive plan for adaptations to climate change	MVC	20	HMGP, PDM
Public information	Establish a Dukes County Citizens Academy for the education of Martha's Vineyard residents, both full time and part time, in the areas of family and individual emergency preparation and response to natural and man-made hazards, including but not limited to hurricane preparedness, flood awareness, and wildfire risks.	County	60	County

Emergency services	Establish an MOU with the public service entities of all island towns and the Wampanoag Tribe of Gay Head (Aquinnah) to provide incident support, whereby the Dukes County Emergency Management Agency would provide the services of the vehicles, manpower, and emergency management computer program services etc. that are owned or managed by the Dukes County Emergency Management Agency.	County, towns, WTGHA	60	County

EXISTING PROTECTION MATRIX FOR ALL OF DUKES COUNTY TOWNS

Category of Action	Description of Action	Implementation Responsibility	Timeframe/Priority	Resources/Funding
Prevention	Work with federal and state agencies and their contractors to develop improved mapping and estimates of structures located within the 100-year floodplain	MVC, towns, FEMA contractor, MEMA	COMPLETED	FEMA
Prevention	Encourage Mass DOT and the towns to routinely clean and maintain drainage infrastructure.	Mass DOT, towns	Ongoing	Mass DOT, towns
Public information	Encourage the towns and others to participate in the DCR/Fire Wise Program	DCR, Towns, MVC	Ongoing	DCR
Prevention, public information	Educate public and private landowners and homeowners' associations concerning the importance of techniques for defensible space to reduce the risk of wildfire, such as utilization of low-maintenance native landscaping and removing fuel in forested areas; also consider issues of access to and through the developments for fire-fighting; fund implementation	DCR, MVC	Ongoing	DCR
Emergency services	Continue to support the Martha's Vineyard Medical Reserve Corps in partnership with the Island town Boards of Health, the Martha's Vineyard Hospital, the Wampanoag Tribe of Gay Head (Aquinnah), and the	County, towns, WTGHA	Ongoing	County

	Cape & Islands Health Coalition and to continue to host the offices of the MVMRC			
Emergency services	Continue to work with the Island Boards of Health in their Emergency Dispensing Site and other program planning efforts for Pandemic outbreaks and other infectious disease outbreaks, both natural and man-made.	County, towns, WTGHA	Ongoing	County
Emergency services	Continue to support the Martha's Vineyard Regional Emergency Planning Committee in their effort to foster a more regional approach to emergency and other planning.	County	Ongoing	County
Emergency services	Establish a regional center for emergency information collection, reception and dissemination before, during, and after disasters.	County	Ongoing	County
Emergency services	Continue to expand and publicize the disaster warning system for visitors.		Ongoing	County

AQUINNAH MITIGATION

Matrix of Existing Protection
Prioritization of Actions
Mitigation Matrix

EXISTING PROTECTION MATRIX AQUINNAH

Type of Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Town participation in the National Flood Insurance Program (NFIP)	Provides flood insurance for structures located in flood-prone areas	FEMA flood zones	Effective	None
Floodplain District Zoning Bylaw	Requires Flood Plain Permit for new construction, substantial improvement; addition of increased water, electric or septic systems to conform to rules and regs of Board of Health; alteration of landforms by Special Permit from ZBA; within V-Zone new construction to be located landward of Mean High Water and man-made alteration of sand dunes prohibited	Flood zones AE and VE as shown on Flood Insurance Rate Map dated July 6, 2010	Enforced by zoning official; effective	None
Coastal District DCPC (District of Critical Planning Concern)	Underground utilities; height restrictions; special permit for construction within 200' of wetlands, waterbodies, beaches, dunes or crests of bluffs over 15' high, only fishing-related commercial structure within 100' of those features, for vehicular access wider than 12', or for pre-existing stone wall to be moved, removed or altered	Below 10-foot contour or within 500' of MHW or inland edge of beach or marsh grass, and most of seaward of State Road and Moshup Trail; except named tribal lands	Effective but could use updating Island-wide	Needs updating
Gay Head Cliff Area DCPC	Special permit from Planning Board Plan Review Committee required for any development, includes site plan review; height restriction 18' for a pitched roof and 13' for a flat roof, up to 24' by special permit from PBPRC; no cut/no build zone within 150' of the crest of bluffs and cliffs; no further subdivision within the district	Cliffs and environs landward to Lighthouse Road and Moshup Trail	Effective	None

Moshup Trail DCPC	site plan review for special permit to construct any building, driveway, fence (or stone wall) or private parking area; existing stone walls protected; height restrictions; no clearing of vegetation > 100square feet except by special permit with plan review; site design guidelines are available	lands adjacent to Moshup Trail and publicly visible	Effective	None
Town of Aquinnah DCPC	site plan review for most construction; specific regs for cutting, stone walls, etc	town-wide except named tribal lands	Effective	None
Rate of Development District	building permit limitation to 7 per year	town-wide, except for named tribal lands	Effective	None
Wild and Scenic North Shore DCPC	permitted uses- routine maintenance, uses such as recreational fishing and boating not involving the permanent placement of any new fill or structure; specially permitted uses - permanent placement of any fill or structure for municipal purposes or for purposes of commercial fishing, shellfishing or aquaculture; all other uses prohibited (including private piers)	waters and lands of north shore, lighthouse to lighthouse, extending 100' seaward from MLW	Effective	None
Fire-Wise Outreach	Outreach and response person on Martha's Vineyard 24/5; outreach to groups and available for response	Martha's Vineyard	DCR	This program could use some support in order to reach more of the vulnerable homeowners
Emergency services	Generator for emergency shelter at Aquinnah Town Hall	Town of Aquinnah	Completed	Completed

PRIORITIZATION OF MITIGATION STRATEGIES

Prioritization of Mitigation Strategies

The actions were categorized by staff of the Martha's Vineyard Commission and evaluated through a consensus-building process within the Aquinnah Hazard Mitigation Planning Team in order to establish priorities. Considerations used in evaluating priorities included: consistency with the goals in the Hazard Mitigation Plan; whether or not the strategy addresses vulnerable critical facilities or infrastructure; whether or not the strategy is intended to promote reduction in loss of lives or improved safety, or to reduce impacts to property; whether or not the strategy requires a capital expenditure and if a source has been identified.

The main emphasis of the prioritization process is to promote initiatives with the greatest mitigation benefits which support public health and safety. In developing the prioritization procedures, it is not the intent of the Hazard Mitigation Planning Team to direct that the initiatives be accomplished in their prioritized order. The purpose of the ranking is to indicate the overall importance of the project to local mitigation efforts. The accomplishment of an initiative will usually depend more on the availability of funds, than on how high or low it ranked compared to other initiatives. After a natural disaster event receives a presidential declaration and the Commonwealth of Massachusetts was designated as a result of the disaster; the Dukes County towns will be eligible for Hazard Mitigation Grant Program funding. At that time the Aquinnah Hazard Mitigation Planning Team will convene to analyze the damage that was sustained. Then in respect to current conditions in Aquinnah, changes in policy and overall mitigation needs, the Aquinnah Hazard Mitigation Planning Team will prioritize a list of projects to be funded for the specific disaster.

The prioritization process developed by the 2014 Hazard Mitigation Planning Team requires the identification of projects and programs that will protect the health, safety and welfare of Aquinnah's citizens. The project initiatives identified by the Hazard Mitigation Planning Team will be analyzed for benefits and costs (benefit cost review) based on the guidelines set forth by the state and FEMA. The Benefit Cost Ratio will be calculated on projects included in any applications for funding to ensure the projects are cost effective at the time of project application submittal.

Each action is scored individually and is based on four weighted criteria developed by the Hazard Mitigation Planning Team (below). The process to prioritize the mitigation actions is accomplished during joint meetings between Hazard Mitigation Team members and officials from the respective local agencies.

Listed below are the criteria and weighted values:

Prioritization criteria

1. Does it accomplish one or all of the HMP goals? 5 points for each goal addressed
2. Does it promote the reduction of the loss of lives? Yes = 25 points; no = 0 points
3. Promote reduction in property damage? Yes = 20 points; no = 0 points
4. Funding needs and availability.
    a. No capital needed = 10 points
    b. Potential source for capital expenditure identified = 5 points

PROPOSED MITIGATION ACTIONS
FOR THE TOWN OF AQUINNAH (ALONG WITH ALL THE COMMUNITY ACTIONS)

Category of Action	Description of Action	Implementation Responsibility	Timeframe/Priority	Resources/Funding
Structural, protection	Beach nourishment, dredging and structural reconfiguration of inlets and inlet protections to improve natural defenses and circulation, in order to minimize storm impacts; vegetation management for dune restoration	DCR, County, towns, USACOE, Mass DOT	40	HMGP, PDM, DCR, Mass DOT, towns, County, USACOE
Emergency services	Retrofits for structural stability of emergency shelter at Aquinnah Town Hall	Town of Aquinnah	35	HMGP, PDM
Structural	Reduce flood impacts by identifying and correcting discharges from town and Commonwealth roadways where they cross streams, including but not limited to: Black Brook in Aquinnah (completed) and a culvert on Lobsterville Road, where flooding is a known problem. The road surface at each crossing should be adjusted during repaving to divert as much runoff as possible into roadside vegetation before it reaches the road crossing.	Commonwealth and Town of Aquinnah	Black Brook addressed by PDM funding and the Wampanoag Tribe of Gay Head(Aquinnah) Remaining crossings 60	Mass DOT, towns, HMGP, PDM
Structural, prevention	Install dry hydrants to pump pond water for firefighting. Require for some new (larger) subdivisions. Encourage elsewhere. If there is no pond nearby, install a water source.	Town, private	60	Town, private, HMGP, PDM
Structural, prevention	Increase capacity in adaptation to climate change, by incorporating 25-year storm calculations rather than 10-year volume into regulations and public infrastructure planning	Towns, Mass DOT, private	75	HMGP, PDM, Mass DOT, towns, private
Adaptation	Work with the Joint Transportation Committee to make long-range plans for public roads vulnerable to Sea Level Rise	Towns, Mass DOT	40	Mass DOT

CHILMARK MITIGATION

Matrix of Existing Protection
Prioritization of Actions
Mitigation Matrix

Proposed New Beach & Parking Area Lease

EXISTING PROTECTION MATRIX CHILMARK

Type of Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Coastal District DCPC (District of Critical Planning Concern)	height and construction standards for inland zone, including site plan review; in shore zone, non-residential construction by special permit with site plan review and no residential construction	Below 10-foot contour or within 500' of MHW or inland edge of beach or marsh grass; includes the shore zone, from MLW to 100' inland of the inland edge of beach or marsh grass and 100' inland of the crest of a bluff >15' in height; the rest is the inland zone	Effective but could use updating Island-wide	Needs updating
Stonewall, Nashaquitsa and Menemsha Pond District	special permit required for municipal structures and fill for furthering the commercial fisheries or public access, for dredging activities other than those for navigational channels or to improve circulation for shellfish propagation, and non-municipal piers	Stonewall Pond, Nashaquitsa Pond, and the Chilmark side of Menemsha Pond, inland to MHW	Effective	None
Wild and Scenic North Shore DCPC	permitted uses- routine maintenance, uses such as recreational fishing and boating not involving the permanent placement of any new fill or structure; specially permitted uses - permanent placement of any fill or structure for municipal purposes or for purposes of commercial fishing, shellfishing or aquaculture; all other uses prohibited (including private piers)	waters and lands of north shore, lighthouse to lighthouse, extending 100' seaward from MLW	Effective	None
Squibnocket Pond District	Septic systems set back 500’ from pond, 200’ from other wetland, vertical separation from groundwater 6’; erosion	Squibnocket Pond and adjacent lands	Effective; enforced by Building and Zoning,	Effective

	and sedimentation plan for slope ≥ 8%; new structures set back 200 from crest of bluff > 15′ or inland edge of beach or marsh grasses; restricted uses and site plan review		SPDAC Advisory Committee	
Wildfire Mitigation	Model of Probability of Ignition	town		
Fire-Wise Outreach	Outreach and response person on Martha's Vineyard 24/5; outreach to groups and available for response	Martha's Vineyard	DCR	This program could use some support in order to reach more of the vulnerable homeowners
Prevention	Encourage Mass DOT and the Town to routinely clean and maintain drainage infrastructure	Mass DOT, Town	Ongoing	Mass DOT, Town
prevention	Recommendations in the Probability of Ignition report	Town	Ongoing	HMGP, PDM

Note: Chilmark does not participate in the National Flood Insurance Program.

PRIORITIZATION OF MITIGATION STRATEGIES

The actions were categorized by staff of the Martha's Vineyard Commission and evaluated through a consensus-building process within the Chilmark Hazard Mitigation Planning Team in order to establish priorities. Considerations used in evaluating priorities included: consistency with the goals in the Hazard Mitigation Plan; whether or not the strategy addresses vulnerable critical facilities or infrastructure; whether or not the strategy is intended to promote reduction in loss of lives or improved safety, or to reduce impacts to property; whether or not the strategy requires a capital expenditure and if a source has been identified.

The main emphasis of the prioritization process is to promote initiatives with the greatest mitigation benefits which support public health and safety. In developing the prioritization procedures, it is not the intent of the Hazard Mitigation Planning Team to direct that the initiatives be accomplished in their prioritized order. The purpose of the ranking is to indicate the overall importance of the project to local mitigation efforts. The accomplishment of an initiative will usually depend more on the availability of funds, than on how high or low it ranked compared to other initiatives. After a natural disaster event receives a presidential declaration and the Commonwealth of Massachusetts was designated as a result of the disaster; the Dukes County towns will be eligible for Hazard Mitigation Grant Program funding. At that time the Hazard Mitigation Planning Team will convene to analyze the damage that was sustained. Then in respect to current conditions in Chilmark, changes in policy and overall mitigation needs, the Hazard Mitigation Planning Team will prioritize a list of projects to be funded for the specific disaster.

The prioritization process developed by the 2014 Hazard Mitigation Planning Team requires the identification of projects and programs that will protect the health, safety and welfare of Chilmark's citizens. The project initiatives identified by the Hazard Mitigation Planning Team will be analyzed for benefits and costs (benefit cost review) based on the guidelines set forth by the state and FEMA. The Benefit Cost Ratio will be calculated on projects included in any applications for funding to ensure the projects are cost effective at the time of project application submittal.

Each action is scored individually and is based on four weighted criteria developed by the Hazard Mitigation Planning Team (below). The process to prioritize the mitigation actions is accomplished during joint meetings between Hazard Mitigation Team members and officials from the respective local agencies.

Listed below are the criteria and weighted values:

Prioritization criteria

1. Does it accomplish one or all of the HMP goals? 5 points for each goal addressed

2. Does it promote the reduction of the loss of lives? Yes = 25 points; no = 0 points
3. Promote reduction in property damage? Yes = 20 points; no = 0 points
4. Funding needs and availability.
    a. No capital needed = 10 points
    b. Potential source for capital expenditure identified = 5 points

PROPOSED MITIGATION ACTIONS FOR THE TOWN OF CHILMARK (ALONG WITH ALL THE COMMUNITY ACTIONS)

(Note: Chilmark does NOT participate in the National Flood Insurance Program)

Category of Action	Description of Action	Implementation Responsibility	Timeframe/Priority	Resources/Funding
Structural, protection	Beach nourishment, dredging and structural reconfiguration of inlets and inlet protections to improve natural defenses and circulation, in order to minimize storm impacts (appropriateness to be determined by Board of Selectmen on a case-by-case basis)	DCR, County, towns, USACOE, Mass DOT	40	DCR, Mass DOT, towns, County, USACOE
Structural	Relocation of Squibnocket Beach parking area, renegotiation of lease, removal of revetment	Town, private owners	40	Town, private
Prevention, structural	Establish South Road as a critical facility from town line to town line and prioritize its storm protection and adaptation to rising sea level. Protect and possibly elevate the bridge adjacent to Stonewall.	Towns, Mass DOT	60	Mass DOT
Structural	Rehabilitate Menemsha parking lot drainage.	Town	30	Town
Structural	Rehabilitate South Road stormwater drainage.	Town, private owners, Mass DOT	55	Town, private, Mass DOT

Prevention	Update subdivision regulations to keep drainage from private roads from flowing onto South Road.	town	30	town
Structural, prevention	Increase capacity in adaptation to climate change, by incorporating 25-year storm calculations rather than 10-year volume into regulations and public infrastructure planning	Towns, Mass DOT, private	70	Mass DOT, towns, private
Adaptation	Work with the Joint Transportation Committee to make long-range plans for public roads vulnerable to Sea Level Rise	Towns, Mass DOT	40	Mass DOT
Structural, prevention	Install 8,000 gallon holding tank for Menemsha public water supply	Town, private	65	HMGP, PDM
Structural, prevention	Install dry hydrants to pump pond water for firefighting. Required for some new subdivisions. Encourage elsewhere. If there is no pond nearby, install a water source.	Town, private	65	Town, private, HMGP, PDM
Prevention	Review and possibly amend Coastal District and other overlay regulations for hazard mitigation	MVC, Town	60	Local
Prevention	Map stormwater collection areas and discharges	Commonwealth and Town, MVC	40	Mass DOT, MVC, Town
Structural	Reduce flood impacts by identifying and correcting discharges from town and Commonwealth roadways where they cross streams, including: Mill Brook (Chilmark portion), Tiasquam (Chilmark portion), Fulling Mill Brook, Paint Mill Brook, and Roaring Brook (all in Chilmark), Turtle Brook, 2 unnamed stream crossings in the Great Rock Bight area, and unnamed stream flowing along portion of North Road that extends from the Menemsha Cross Road to Menemsha village. The road surface at each crossing should be adjusted during repaving to divert as much runoff as possible into roadside vegetation before it reaches the road crossing.	Commonwealth DPW and town	50	Mass DOT, Town
Structural	Reduce flood impacts by identifying stormwater systems that have potential to discharge hazardous materials in	Mass DOT, Town	50	Mass DOT, Town

	the event of a storm or flood and installing an emergency shut-off system in each of those systems			
Structural	Reduce damaging volume of direct stormwater discharges to beaches and surface waters by infiltration of those segments of the systems where infiltration is possible back in the watershed, particularly in the vicinity of Menemsha.	Mass DOT, Town	50	Mass DOT, Town
Prevention	Review and possibly revise local subdivision regulations for stormwater management to lessen the impacts of flooding	MVC, Town	50	Town
Prevention	Hold informational sessions with town boards to encourage the incorporation of Low Impact Development Techniques in local subdivision regulations	MVC, Town	45	Town

EDGARTOWN MITIGATION

Matrix of Existing Protection
Prioritization of Mitigation Strategies
Mitigation Matrix

EXISTING PROTECTION MATRIX EDGARTOWN

Type of Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Town participation in the National Flood Insurance Program (NFIP)	Provides flood insurance for structures located in flood-prone areas	FEMA flood zones	Effective	None
Floodplain District Zoning Bylaw	Requires Flood Plain Permit for new construction, substantial improvement; addition of increased water, electric or septic systems to conform to rules and regs of Board of Health; alteration of landforms by Special Permit from ZBA; within V-Zone new construction to be located landward of Mean High Water; within AO zones residential structures elevated	Flood zones as shown on Flood Insurance Rate Map dated July 6, 2010	Enforced by Building Official; effective	None
Coastal District DCPC (District of Critical Planning Concern)	height and construction standards for inland zone, including site plan review; no residential construction in shore zone; underground utilities except by special permit; septic 200' from salt water body; minimum separation 200' between septics; septics at least 5' above groundwater; septics 600' from public water supply and 200' from private well; private well 200' from salt water body; no road > 10' except by special permit	Below 10-foot contour or within 500' of MHW of ocean or pond > 10 acres; includes the shore zone, from MLW to 100' inland of the inland edge of beach or marsh grass and 100' inland of the crest of a bluff >15' in height; the rest is the inland zone; excludes village waterfront	Effective but could use updating Island-wide' administered by building inspector, special permit by planning board with site plan review by site review committee	Needs updating Island-wide
Edgartown Ponds Area DCPC	Restrictions on uses, no dwellings in first 100' and special permit from Planning Board for most uses there including	Lands and waters adjacent to south shore great ponds within 700' of a coastal water body > 10 acres or the ocean, or within 300" streams	Effective; administered by Building Official with special permit by	None

	additions of more than 10% to existing; restrictions on hazardous materials	and wetlands draining into ponds; zones to 100', to 200' and remainder	Planning Board with site plan review	
Cape Poge DCPC	Prohibits subdivision, non-municipal piers, more than one dwelling on a lot, use of turf chemicals; special permit from Planning Board for any development, includes site review	Cape Poge Bay, Poucha Pond and surrounding lands	Effective; administered by Building Official with special permit by Planning Board with a site review committee	None
Surface Water District	Site plan review and special permit from Planning Board for most uses requiring facilities such as piers	All town waters seaward of Mean High Water	Effective; administered by Planning Board	None
Fire Breaks in State Forest	Fire breaks maintained by grazing, brushbreaking, controlled burns	Within Manuel F. Correllus State Forest	DCR	Need continued management
Fire-Wise Outreach	Outreach and response person on Martha's Vineyard 24/5; outreach to groups and available for response	Martha's Vineyard	DCR	This program could use some support in order to reach more of the vulnerable homeowners
Structural	Retrofit Dock Street sewer substation for flood resiliency.	Town	Project funded and in progress	Project funded 75% through HMGP

PRIORITIZATION OF MITIGATION STRATEGIES

The actions were categorized by staff of the Martha's Vineyard Commission and evaluated through a consensus-building process within the Edgartown Hazard Mitigation Planning Team in order to establish priorities. Considerations used in evaluating priorities included: consistency with the goals in the Hazard Mitigation Plan; whether or not the strategy addresses vulnerable critical facilities or infrastructure; whether or not the strategy is intended to promote reduction in loss of lives or improved safety, or to reduce impacts to property; whether or not the strategy requires a capital expenditure and if a source has been identified.

The main emphasis of the prioritization process is to promote initiatives with the greatest mitigation benefits which support public health and safety. In developing the prioritization procedures, it is not the intent of the Hazard Mitigation Planning Team to direct that the initiatives be accomplished in their prioritized order. The purpose of the ranking is to indicate the overall importance of the project to local mitigation efforts. The accomplishment of an initiative will usually depend more on the availability of funds, than on how high or low it ranked compared to other initiatives. After a natural disaster event receives a presidential declaration and the Commonwealth of Massachusetts was designated as a result of the disaster; the Dukes County towns will be eligible for Hazard Mitigation Grant Program funding. At that time the Hazard Mitigation Planning Team will convene to analyze the damage that was sustained. Then in respect to current conditions in Edgartown, changes in policy and overall mitigation needs, the Hazard Mitigation Planning Team will prioritize a list of projects to be funded for the specific disaster.

The prioritization process developed by the 2014 Hazard Mitigation Planning Team requires the identification of projects and programs that will protect the health, safety and welfare of Edgartown's citizens. The project initiatives identified by the Hazard Mitigation Planning Teams will be analyzed for benefits and costs (benefit cost review) based on the guidelines set forth by the state and FEMA. The Benefit Cost Ratio will be calculated on projects included in any applications for funding to ensure the projects are cost effective at the time of project application submittal.

Each action is scored individually and is based on four weighted criteria developed by the Hazard Mitigation Planning Team (below). The process to prioritize the mitigation actions is accomplished during joint meetings between Hazard Mitigation Team members and officials from the respective local agencies.

Listed below are the criteria and weighted values:

Prioritization criteria

1. Does it accomplish one or all of the HMP goals? 5 points for each goal addressed

2. Does it promote the reduction of the loss of lives? Yes = 25 points; no = 0 points
3. Promote reduction in property damage? Yes = 20 points; no = 0 points
4. Funding needs and availability.
    a. No capital needed = 10 points
    b. Potential source for capital expenditure identified = 5 points

PROPOSED MITIGATION ACTIONS FOR THE TOWN OF EDGARTOWN (ALONG WITH ALL THE COMMUNITY ACTIONS)

Category of Action	Description of Action	Implementation Responsibility	Timeframe/Priority	Resources/Funding
Structural, protection	Beach nourishment, dredging and structural reconfiguration of inlets and inlet protections to improve natural defenses and circulation, in order to minimize storm impacts; vegetation management for dune restoration	DCR, County, Town, USACOE, Mass DOT	40	HMGP, PDM, DCR, Mass DOT, Town, County, USACOE
Structural	Retrofit sewer substation at the corner of Dunham Road and South Water Street for flood resiliency.	Town	50	HMGP, PDM, town
Structural, prevention	Increase capacity in adaptation to climate change, by incorporating 25-year storm calculations rather than 10-year volume into regulations and public infrastructure planning	Town, Mass DOT, private	75	HMGP, PDM, Mass DOT, towns, private
Adaptation	Work with the Joint Transportation Committee to make long-range plans for public roads vulnerable to Sea Level Rise	Towns, Mass DOT	40	Mass DOT

Structural, protection, emergency services	Retrofit two ferry landings for Chappaquiddick Ferry: a manual chain hoist for each side to raise or lower the transfer bridges in the event of storm-induced prolonged power outage	Private owner	60	HMGP, FMA
Structural, protection, emergency services	Retrofit Chappaquiddick Ferry facilities on both sides to lessen the impacts of storm damage: replace diesel fuel tank with flood-proof tank, anchor buildings on both sides, elevate electric circuits, emergency generators to power ramps and spotlights short-term	Private owner	60	HMGP, FMA
Structural	Purchase a redundant third boat for the Chappaquiddick Ferry in the event of storm damage, install a storm mooring for it in Caleb's Pond or other secure berth	Private owner	60	HMGP, PDM
Structural, protection	Install dolphins off corners of Chappaquiddick Ferry slips to fend off impact of rough landings due to vastly increased tidal flow following breach of Norton Point barrier beach	Private owner	60	HMGP, FMA
Mitigation, structural	Repair storm damage to Chappaquiddick Ferry slips from increased impact of boats due to vastly increased tidal flow following breach of Norton Point barrier beach	Private owner	60	HMGP, FMA
Structural	Reduce flood impacts by replacing culvert that currently restricts stormwater flow in and out of Trapp's Pond with one adequately sized and designed to lessen flood impacts	Commonwealth and Town	60	Mass DOT, HMGP, PDM
Structural	Reduce damaging volume of direct stormwater discharges to beaches and surface waters by infiltration of those segments of the systems where infiltration is possible back in the watershed	Town, Mass DOT	55	HMGP, PDM
Prevention	In order to reduce the impacts of drought and wildfire, establish an overall management plan for the State Forest, including establishment of specific procedures or Memoranda of Agreement regarding the transfer of land for new public water supplies and for easements to install water supply lines	DCR and State Forest Advisory Committee	65	DCR
Structural	In order to reduce the impacts of drought and wildfire, install new public water supplies and water supply lines within the State Forest	Town Water Department	60	HMGP, PDM

Structural	In order to lessen the impacts of drought and wildfire, establish plans and build infrastructure for water supply needs to alleviate future drought emergencies. The Town of Edgartown has great need for water supply beyond the capacity of the existing Edgartown wells, in addition to needs for redundancy to be prepared for emergencies such as drought	Town Water Department	60	HMGP, PDM
Structural	Consider potential need for and options to provide water supply to areas with a development pattern that may not be compatible with continued private well water supplies, which may not be adequate in the event of emergencies such as drought and wildfire, particularly in the Arbutus Park, Ocean Heights and southern Katama Plains areas; build the necessary infrastructure.	Town Water Department	60	HMGP, PDM

GOSNOLD MITIGATION

Matrix of Existing Protection
Mitigation Strategies Illustrated
Mitigation Matrix
Prioritization of Actions

EXISTING PROTECTION MATRIX GOSNOLD

Type of Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Floodplain District Zoning Bylaw		Flood zones as shown on Flood Insurance Rate Map dated July 6, 2010	Effective	None
Participation in the NFIP flood insurance program		FEMA flood zones	Effective	None

PRIORITIZATION OF MITIGATION STRATEGIES

The actions were categorized by staff of the Martha's Vineyard Commission and evaluated through a consensus-building process within the Gosnold Hazard Mitigation Planning Team in order to establish priorities. Considerations used in evaluating priorities included: consistency with the goals in the Hazard Mitigation Plan; whether or not the strategy addresses vulnerable critical facilities or infrastructure; whether or not the strategy is intended to promote reduction in loss of lives or improved safety, or to reduce impacts to property; whether or not the strategy requires a capital expenditure and if a source has been identified.

The main emphasis of the prioritization process is to promote initiatives with the greatest mitigation benefits which support public health and safety. In developing the prioritization procedures, it is not the intent of the Hazard Mitigation Planning Teams to direct that the initiatives be accomplished in their prioritized order. The purpose of the ranking is to indicate the overall importance of the project to local mitigation efforts. The accomplishment of an initiative will usually depend more on the availability of funds, than on how high or low it ranked compared to other initiatives. After a natural disaster event receives a presidential declaration and the Commonwealth of Massachusetts was designated as a result of the disaster; the Dukes County towns will be eligible for Hazard Mitigation Grant Program funding. At that time the Hazard Mitigation

Planning Team will convene to analyze the damage that was sustained. Then in respect to current conditions in Gosnold, changes in policy and overall mitigation needs, the Hazard Mitigation Planning Team will prioritize a list of projects to be funded for the specific disaster.

The prioritization process developed by the 2014 Hazard Mitigation Planning Team requires the identification of projects and programs that will protect the health, safety and welfare of Gosnold's citizens. The project initiatives identified by the Hazard Mitigation Planning Team will be analyzed for benefits and costs (benefit cost review) based on the guidelines set forth by the state and FEMA. The Benefit Cost Ratio will be calculated on projects included in any applications for funding to ensure the projects are cost effective at the time of project application submittal.

Each action is scored individually and is based on four weighted criteria developed by the Hazard Mitigation Planning Team (below). The process to prioritize the mitigation actions is accomplished during joint meetings between Hazard Mitigation Team members and officials from the respective local agencies.

Listed below are the criteria and weighted values:

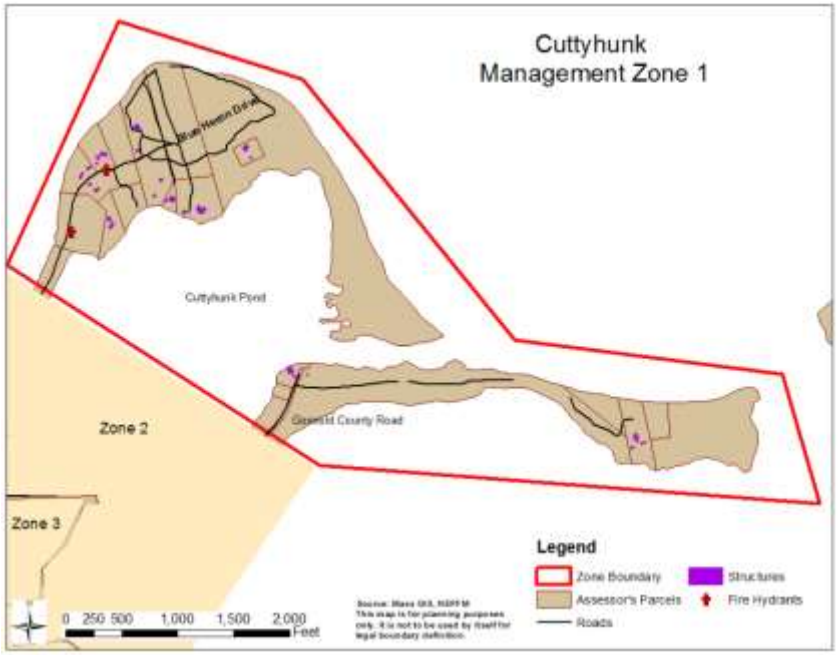
Prioritization criteria

1. Does it accomplish one or all of the HMP goals? 5 points for each goal addressed
2. Does it promote the reduction of the loss of lives? Yes = 25 points; no = 0 points
3. Promote reduction in property damage? Yes = 20 points; no = 0 points
4. Funding needs and availability.
    a. No capital needed = 10 points
    b. Potential source for capital expenditure identified = 5 points

GOSNOLD MITIGATION ACTIONS
Cuttyhunk
Wildfire Mitigation Actions – new
(from Cuttyhunk Community Wildfire Protection Plan, 2013)

Zone 1:

- Firewise treatments on individual properties/structures

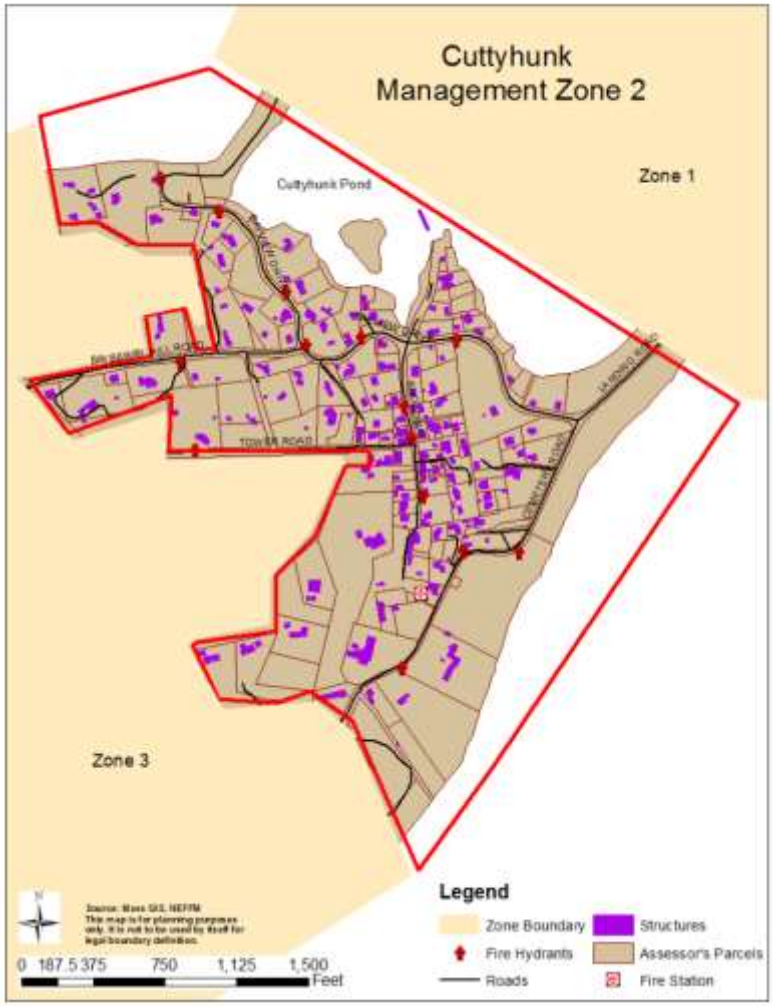


GOSNOLD MITIGATION ACTIONS
Cuttyhunk
Wildfire Mitigation Actions – new
(from Cuttyhunk Community Wildfire Protection Plan, 2013)

Zone 2:

Firewise treatments on individual properties/structures

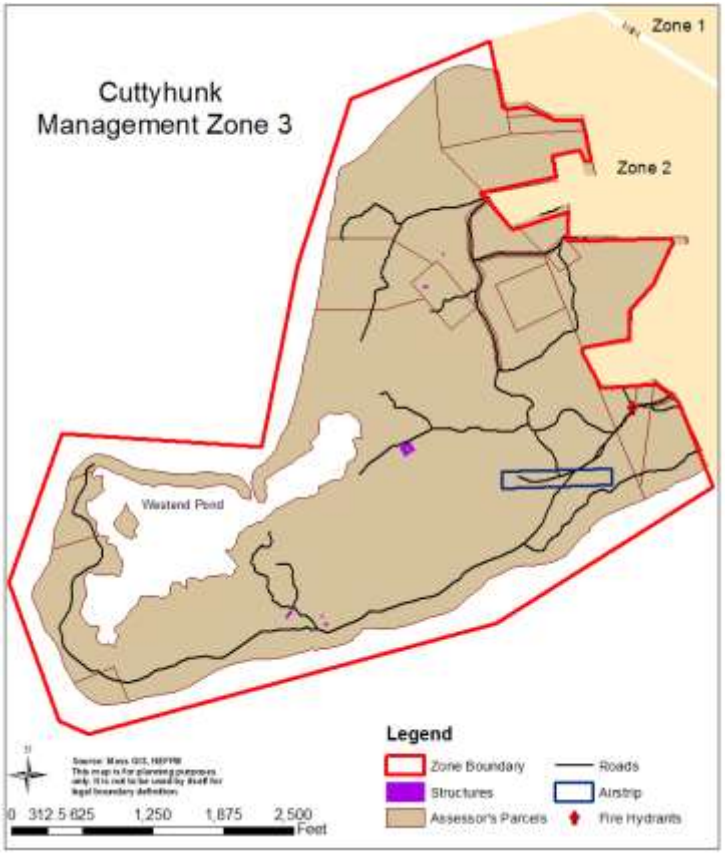
- Mowed firebreak 15’ (for egress) to 80’ (for suppression) wide separating Zone 2 from western end of island
- Possible prescribed burning in certain areas of Zone 2



GOSNOLD MITIGATION ACTIONS
Cuttyhunk
Wildfire Mitigation Actions – new
(from Cuttyhunk Community Wildfire Protection Plan, 2013)

Zone 3:

- Firewise treatments on individual properties/structures
- Prescribed burning in uninhabited areas and along firebreak
- Road clearance/widening to improve access for emergency vehicles



PROPOSED MITIGATION ACTIONS FOR THE TOWN OF GOSNOLD (ALONG WITH ALL THE COMMUNITY ACTIONS)

Category of Action	Description of Action	Implementation Responsibility	Timeframe/Priority	Resources/Funding
Structural, protection	Beach nourishment, dredging and structural reconfiguration of inlets and inlet protections to improve natural defenses and circulation, in order to minimize storm impacts; vegetation management for dune restoration	County, Town, USACOE	40	HMGP, PDM, Town, County, USACOE
Structural, protection	Improve storm damage prevention for entrance to Cuttyhunk Harbor by extending the USACOE riprap by 1,000 ft along the southern/eastern stretch of Canapitsit barrier beach	USACOE	70	USACOE, HMGP, PDM
Structural	Improve access to critical harbor facilities in the event of a storm by dredging around the town-owned marina, probably an area that is 250x150 ft by 1 foot deep	Town	70	HMGP, PDM
Structural, protection	Retrofit/ replace existing Coast Guard dock (now owned by Town) for better access to critical harbor facilities in the event of a storm	Town	70	HMGP, PDM
Structural	Reduce flood impacts by identifying stormwater systems that have potential to discharge hazardous materials in the event of a storm or flood and installing an emergency shut-off system in each of those systems	Town	55	Town, HMGP, FMA
Structural, prevention	Increase capacity in adaptation to climate change, by incorporating 25-year storm calculations rather than 10-year volume into regulations and public infrastructure planning	Town, private	75	HMGP, PDM, town, private
prevention	Implement recommendations in Cuttyhunk Wildfire Protection Plan, 2013	Town, private	70	HMGP, PDM, town, private

OAK BLUFFS MITIGATION

Matrix of Existing Protection
Mitigation Matrix
Prioritization of Mitigation Strategies

EXISTING PROTECTION MATRIX OAK BLUFFS

Type of Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Town participation in the National Flood Insurance Program (NFIP)	Provides flood insurance for structures located in flood-prone areas	FEMA flood zones	Effective	None
Floodplain District Zoning Bylaw	Prohibits any new construction of residential or non-residential structures in zones V, VE or AO. Repair of substantially damaged structures, additions which increase floor area, and any increase of impervious surfaces on residential lots are also all prohibited in these zones, as well as any removal or storage of soil, sand or other mineral substance or use of soil as structural support a structure. Installation of a basement is prohibited from all zones. Special permits may be granted for repair of substantially damaged structures and new construction if located landward of the reach of the mean high tide in V, VE and AO zones. Special Permits may also be granted for new construction, additions and repairs in A and AE zones and increases of impervious surfaces and storage and disposal of soils may be permitted if a registered professional engineer certifies there will be no increase in wave-runup, deflection or channelization of flood waters or increase in velocity of flows. Special permits may be granted in any part of the Floodplain District for	Flood zones as shown on Flood Insurance Rate Map dated July 6, 2010	Enforced by zoning official; effective	Recently updated, protective regulations adopted by Town Meeting May 2010

	restoration and repairing of nationally registered historic places, coastal resource areas, existing septic systems, existing impervious surfaces and foundations. Water dependent structures and beach and dune nourishment also may be allowed by special permit.			
Coastal District DCPC (District of Critical Planning Concern)	height and construction standards for inland zone, including site plan review; no residential construction in shore zone; existing health in shore zone allowed; septic 200′ from salt water body; minimum separation 200′ between septics; septics at least 5′ above groundwater; septics 600′ from public water supply and 200′ from private well; private well 200′ from salt water body; no road > 10′ except by special permit	Below 10-foot contour or within 500' of MHW of ocean or pond > 10 acres and all land within 100′ of streams and wetlands flowing into great ponds; except around West Chop just land below 10′ contour and faces of bluffs >15′; excludes developed area between Highland Dr (East Chop) and Canonicus Ave (near Farm Pond); segments include the shore zone, from MLW to 100' inland of the inland edge of beach or marsh grass and 100' inland of the crest of a bluff >15' in height and within 100′ of streams or wetlands draining into a great pond; the rest is the inland zone	Effective but could use updating Island-wide′ administered by Board of Health, Building Inspector, Special Permit by Planning Board with site plan review by site review committee	Needs updating Island-wide; particularly in Oak Bluffs the boundary for the East Chop bluff doesn′t manage land uses on top of and just landward of the bluff
Sengekontacket Pond DCPC	Water quality monitoring program; density 1 SFR/60,000 sf; growth restricted to 75 dwelling units/3 years with up to 15 more in a year by special permit from zba	Lands and waters adjacent to Sengekontacket Pond	Not Enforced; administered by Board of Health, Building Official with special permit by ZBA	Enforce the regulations, possible expansion to include Edgartown side
Oak Bluffs Harbor DCPC	Site plan review, special setbacks, special permit by zba for a privately-owned marina in B1; in R2 prohibits boat yards and boat services, conversion of SFR to more than 2 families, hotels, rooming houses, semi-detached 2-family dwellings	Oak Bluffs Harbor and adjacent lands, covers B1, R1 and R2 zoning districts	Effective; administered by Building Official with special permit by Zoning Board of Appeals with a site review committee	None
Lagoon Pond DCPC	Density restrictions; pier regulations	Lagoon Pond and inland 1500′	Effective; administered by Board of Health	None

			and Conservation Commission	
Fire-Wise Outreach	Outreach and response person on Martha's Vineyard 24/5; outreach to groups and available for response	Martha's Vineyard	DCR	This program could use some support in order to reach more of the vulnerable homeowners

Prioritization of Mitigation Strategies

The actions were categorized by staff of the Martha's Vineyard Commission and evaluated through a consensus-building process within the Oak Bluffs Hazard Mitigation Planning Team in order to establish priorities. Considerations used in evaluating priorities included: consistency with the goals in the Hazard Mitigation Plan; whether or not the strategy addresses vulnerable critical facilities or infrastructure; whether or not the strategy is intended to promote reduction in loss of lives or improved safety, or to reduce impacts to property; whether or not the strategy requires a capital expenditure and if a source has been identified.

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The prioritization process developed by the 2014 Hazard Mitigation Planning Team requires the identification of projects and programs that will protect the health, safety and welfare of Oak Bluffs' citizens. The project initiatives identified by the Hazard Mitigation Planning Team will be analyzed for benefits and costs (benefit cost review) based on the guidelines set

forth by the state and FEMA. The Benefit Cost Ratio will be calculated on projects included in any applications for funding to ensure the projects are cost effective at the time of project application submittal.

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Listed below are the criteria and weighted values:

Prioritization criteria

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3. Promote reduction in property damage? Yes = 20 points; no = 0 points
4. Funding needs and availability.
    a. No capital needed = 10 points
    b. Potential source for capital expenditure identified = 5 points

PROPOSED MITIGATION ACTIONS
FOR THE TOWN OF OAK BLUFFS
(ALONG WITH ALL THE COMMUNITY ACTIONS)

Category of Action	Description of Action	Implementation Responsibility	Timeframe/Priority	Resources/Funding
Structural, protection, mitigation	Beach nourishment, dredging and structural reconfiguration of inlets and inlet protections to improve natural defenses and storm circulation, to protect infrastructure on shore and recreational/cultural beach facilities, in order to minimize storm impacts: <u>North Bluff Seawall Repair and New Boardwalk</u> Rebuild 730' of seawall, rehabilitate 730' of rip-rap (and construct new boardwalk) to provide enhanced protection from coastal storms and wave wash-over for public infrastructure and private properties. This site is a critical transportation link between the harbor and the Steamship Authority terminal. (Need funding) <u>Beach Nourishment and Groin & Jetty Rehabilitation: Jetty Beach, North Bluff Beach, Pay Beach & Inkwell</u> Comprehensive beach nourishment program along approximately 3,950 linear feet of shoreline along Sea View Ave Extension/Sea View Ave. shoreline. Implementation will provide protection to existing coastal banks, crucial infrastructure and adjacent private properties, and restore/enhance four Town beaches. Existing jetties at entrance to Oak Bluffs Harbor and several timber and stone groins to be maintained/rehabilitated as part of nourishment program to ensure stability of nourished areas. (Need permits & funding)	DCR, County, Town, MassHighway	40	HMGP, DCR, MassHighway, Town, County, PDM

	Protect State Beach, Sea View Avenue & Sengekontacket Pond Dredge Sengekontacket Pond and use dredge material for beach nourishment on State Beach to enhance recreational opportunities and protect against storm surge, erosion and sea level rise. (Need permits for some portions of pond & funding) MA Coastal Infrastructure Inventory and Assessment Reinforce/rebuild seawalls and other coastal structures if structures are failing. (Need engineering, permits & funding if stabilization is needed)			
Structural	Retrofit drainage in the vicinity of Waban Park/Inkwell Beach to prevent further beach erosion by stormwater discharge as occurred during the April 2007 storm	MassHighway	55	HMGP,FMA, PDM
Structural	Reduce damaging volume of direct stormwater discharges to beaches and surface waters by infiltration of those segments of the systems where infiltration is possible back in the watershed	Town, MassHighway	55	HMGP, FMA, PDM
Structural	Replace the culvert that currently restricts stormwater flow in and out of Farm Pond with one adequately sized and designed. Although the proposed 16-foot culvert would slightly increase the flood elevation for surrounding homes, flood waters would be able to recede faster and thus lessen water damage overall.	Commonwealth	60	Town, MA Wetlands Restoration Program
Structural, protection	Reconfiguration of armorment for vulnerable part of East Chop bluff for better storm damage protection, to protect the town-owned road at the top of the bluff	Private owner	15	HMGP, PDM
Prevention	In order to reduce the impacts of drought and wildfire, establish an overall management plan for the State Forest, including establishment of specific procedures or Memoranda of Agreement regarding the transfer of land for new public water supplies and for easements to install water supply lines	DCR and State Forest Advisory Committee	65	DCR

Structural	In order to reduce the impacts of drought and wildfire, install new public water supplies and water supply lines within the State Forest	Town Water District	60	HMGP, PDM
Structural	In order to lessen the impacts of drought and wildfire, establish plans and build infrastructure for water supply needs to alleviate future drought emergencies. The Town of Oak Bluffs, nearly at buildout, should focus its attention on redundancy plans in response to potential emergencies such as drought.	Town Water District	60	HMGP, PDM
New Prevention	Revise the Coastal District regulations to require a restriction on additions to or replacement of pre-1978 buildings that would stipulate that the new development is not "grandfathered" as in the Wetlands Protection Act regarding armorment of a bluff. (Could alternatively fit in the Town Wetlands By-Law)	Town, MVC	60	MVC, PDM
New Prevention	Ask MVC to revise the Coastal District boundary to include the top of East Chop bluff (presently includes only the face of the bluff). Possible expansion to include the developed area from Canonicus to East Chop Drive as well.	Town, MVC	60	MVC
New Structural	In order to prevent storm damage, engineering and construction needed to retrofit 3 vulnerable sewer pump stations: Sunset Lake (relocate controls to operate remotely), Our Market parking lot (elevate control panel and relocate to landward side of bathrooms), elevate or relocate the control panel at the corner of School St./Dukes County Ave.	Town Wastewater Dept.	50	HMGP, PDM
New Structural	In order to lessen the impacts of increased heavy rainstorms, construct/reconstruct stormwater facilities to the 25-year standard rather than 10-year.	Town, Mass DOT	70	HMGP, PDM
New Prevention	In order to lessen the impacts of increased heavy rainstorms, revise stormwater standards to the 25-year standard rather than 10-year.	Town	75	Town
New Prevention	In order to lessen the impacts of sea level rise, prioritize and plan for vulnerable infrastructure for retreat, armorment, or abandonment.	Town	40	Town

	Even without sea level rise, several major roads are in the velocity zone: Beach Road, lower East Chop Drive, portions of Sea View Avenue (by Farm Pond and State Beach Barrier Beach system). The 100 year flood zone covers all but one access road to the hospital (and one access road is in the velocity zone). Develop plan to address flooding/wash-out of coastal roads.			
New prevention	Develop Wetlands Bylaw regulations for Vegetation and update regulations for Land Subject to Coastal Storm Flowage Strengthen Oak Bluffs Wetlands Bylaw to protect against flooding and storm damage.	Town	60	Town
New prevention	Identify sources of beach nourishment material for use as protection against storm surge, erosion and sea level rise. (Need funding to purchase nourishment material if sources are identified)	Town	40	
New prevention	In order to lessen wildfire vulnerability, clear a 100-foot firebreak between the Southern Woodlands and vulnerable residences. (Proposed by Acting Chief Rose)	M. V. Land Bank	65	HMGP, M.V. Land Bank, PDM
Adaptation New	Work with the Joint Transportation Committee to make long-range plans for public roads vulnerable to Sea Level Rise	Towns, Mass DOT	40	Mass DOT

TISBURY MITIGATION

Matrix of Existing Protection
Mitigation Matrix
Prioritization of Mitigation Strategies

EXISTING PROTECTION MATRIX TISBURY

Type of Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Town participation in the National Flood Insurance Program (NFIP)	Provides flood insurance for structures located in flood-prone areas	FEMA flood zones	Effective	None
Floodplain District Zoning Bylaw	Requires Flood Plain Permit for new construction, substantial improvement; addition of increased water, electric or septic systems to conform to rules and regs of Board of Health; alteration of landforms by Special Permit from ZBA; within V-Zone new construction to be located landward of Mean High Water; within AO zones residential structures elevated	Flood zones as shown on Flood Insurance Rate Map dated July 6, 2010	Enforced by Building Official; effective	None
Coastal District DCPC (District of Critical Planning Concern)	height and construction standards for inland zone, including site plan review, may be modified by special permit from ZBA; no residential construction in shore zone; Special Permit by ZBA in shore zone for non-residential structures or for additions to existing residential structures ≤ 500 sf with no increase in plumbing or septic; septic 200' from salt water body; minimum separation 200' between septics; septics at least 5' above groundwater; septics 600' from public water supply and 200' from private well; private well 200' from salt water body; no road > 10' except by special permit	Below 10-foot contour or within 500' of MHW of ocean or pond > 10 acres, includes more lands around Lake Tashmoo and all of West Chop; excludes working waterfront; includes the shore zone, from MLW to 100' inland of the inland edge of beach or marsh grass and 100' inland of the crest of a bluff >15' in height; the rest is the inland zone; excludes village waterfront	Effective but could use updating Island-wide' administered by Board of Health, building inspector, special permit by ZBA	Needs updating Island-wide

Lagoon Pond DCPC	Density restrictions; pier regulations	Lagoon Pond and inland 1500'	Effective; administered by Board of Health and Conservation Commission	None
Cape Poge DCPC	Prohibits subdivision, non-municipal piers, more than one dwelling on a lot, use of turf chemicals; special permit from Planning Board for any development, includes site review	Cape Poge Bay, Poucha Pond and surrounding lands	Effective; administered by Building Official with special permit by Planning Board with a site review committee	None
Surface Water District	Site plan review and special permit from Planning Board for most uses requiring facilities such as piers	All town waters seaward of Mean High Water	Effective; administered by Planning Board	None
Vineyard Haven Harbor DCPC	Harbor Use Permit required for most uses	Vineyard Haven Harbor	Effective; administered by Board of Selectmen	None
Wild and Scenic North Shore DCPC	permitted uses- routine maintenance, uses such as recreational fishing and boating not involving the permanent placement of any new fill or structure; specially permitted uses - permanent placement of any fill or structure for municipal purposes or for purposes of commercial fishing, shellfishing or aquaculture; all other uses prohibited (including private piers)	waters and lands of north shore, lighthouse to lighthouse, extending 100' seaward from MLW	Effective	None
Fire-Wise Outreach	Outreach and response person on Martha's Vineyard 24/5; outreach to groups and available for response	Martha's Vineyard	DCR	This program could use some support in order to reach more of the vulnerable homeowners
Structural, protection, emergency services	Relocation of Fire/Ambulance Departments out of floodplain	Town	completed	
Emergency Services	Land purchase for new Emergency Services facility out of floodplain	Town	completed	
Structural, protection	Hardened utilities – electric lines on Main St, Union St., Beach St., and Water St.	Town	Conduit completed, no utilities in as yet	Town

Emergency services	Generator for Tisbury School, which is the primary shelter in town	Town	completed	
Emergency services	foam trailer for fighting ethanol-based fires	Town	completed	

Prioritization of Mitigation Strategies

The actions were categorized by staff of the Martha's Vineyard Commission and evaluated through a consensus-building process within the Tisbury Hazard Mitigation Planning Team in order to establish priorities. Considerations used in evaluating priorities included: consistency with the goals in the Hazard Mitigation Plan; whether or not the strategy addresses vulnerable critical facilities or infrastructure; whether or not the strategy is intended to promote reduction in loss of lives or improved safety, or to reduce impacts to property; whether or not the strategy requires a capital expenditure and if a source has been identified.

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Listed below are the criteria and weighted values:

Prioritization criteria

1. Does it accomplish one or all of the HMP goals? 5 points for each goal addressed
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3. Promote reduction in property damage? Yes = 20 points; no = 0 points
4. Funding needs and availability.
    a. No capital needed = 10 points
    b. Potential source for capital expenditure identified = 5 points

PROPOSED MITIGATION ACTIONS FOR THE TOWN OF TISBURY (ALONG WITH ALL THE COMMUNITY ACTIONS)

Category of Action	Description of Action	Implementation Responsibility	Timeframe/Priority	Resources/Funding
Structural, protection	Beach nourishment, dredging and structural reconfiguration of inlets and inlet protections to improve natural defenses and circulation, in order to minimize storm impacts, particularly to reconfigure the southern jetty at Lake Tashmoo to provide better protection for the town mooring field and private boatyard in the pond; vegetation management for dune restoration	DCR, County, Town, USACOE, Mass DOT	40	HMGP, PDM, DCR, Mass DOT, Town, County, USACOE
Structural	Dredging in the harbor to provide better access to critical harbor facilities in the event of a storm and for storm damage prevention	Town, USACOE	40	HMGP, PDM
Structural, protection, emergency services	Relocation of Fire/Ambulance Departments out of floodplain	Town	completed	

Emergency Services	Land purchase for new Emergency Services facility out of floodplain	Town	completed	
Structural, protection	Hardened utilities – electric lines on Main St, Union St., Beach St., and Water St.	Town	Conduit completed, no utilities in as yet	Town
Emergency services	Generator for Tisbury School, which is the primary shelter in town	Town	completed	
Emergency services	foam trailer for fighting ethanol-based fires	Town	completed	
Structural	Retrofit main sewer pump station and generator in town parking lot on Water St. for storm resiliency and SLR	Town	50	HMGP, PDM
Structural	Retrofit sewer pump station in SSA lot for resiliency.	SSA	50	SSA, HMGP, PDM
prevention	Develop a prognosis and suitable plan for Beach Road and the adjacent seawall.	Town, Mass DOT	40	Town, Mass DOT
Prevention	Ensure that outdoor storage materials are secured from creating a flood hazard.	Town, private	40	Town, private
Structural	Reduce flood impacts by identifying and correcting discharges from town and Commonwealth roadways where they cross streams, including: Smith Brook in Tisbury. The road surface at each crossing should be adjusted during repaving to divert as much runoff as possible into roadside vegetation before it reaches the road crossing.	Town DPW	60	Town, HMGP, PDM
Structural	Reduce damaging volume of direct stormwater discharges to beaches and surface waters by infiltration of those segments of the systems where infiltration is possible back in the watershed	Town, Mass DOT	60	HMGP, PDM
Prevention	In order to reduce the impacts of drought and wildfire, establish an overall management plan for the State Forest, including establishment of specific procedures or Memoranda of Agreement regarding the transfer of land for new public water supplies and for easements to install water supply lines	DCR and State Forest Advisory Committee	65	DCR

Structural	In order to reduce the impacts of drought and wildfire, install new public water supplies and water supply lines within the State Forest	Town Water Department	60	HMGP, PDM
Structural	In order to lessen the impacts of drought and wildfire, establish plans and build infrastructure for water supply needs to alleviate future drought emergencies. The Town of Tisbury, nearly at buildout, should focus its attention on redundancy plans in response to potential emergencies such as drought or wildfire.	Town Water Department and District	60	HMGP, PDM
Structural	Consider potential need for and options to provide water supply to areas with a development pattern that may not be compatible with continued private well water supplies, which may not be adequate in the event of emergencies such as drought and wildfire; build the necessary infrastructure.	Town Water Department	60	HMGP, PDM
Structural, prevention	Increase capacity in adaptation to climate change, by incorporating 25-year storm calculations rather than 10-year volume into regulations and public infrastructure planning	Towns, Mass DOT, private	75	HMGP, PDM, Mass DOT, towns, private
Adaptation	Work with the Joint Transportation Committee to make long-range plans for public roads vulnerable to Sea Level Rise	Towns, Mass DOT	40	Mass DOT

WEST TISBURY MITIGATION

Matrix of Existing Protection
Mitigation Matrix
Prioritization of Mitigation Strategies

EXISTING PROTECTION MATRIX WEST TISBURY

Type of Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Town participation in the National Flood Insurance Program (NFIP)	Provides flood insurance for structures located in flood-prone areas	FEMA flood zones	Effective	None
Floodplain District Zoning Bylaw	Requires Flood Plain Permit for new construction, substantial improvement; addition of increased water, electric or septic systems to conform to rules and regs of Board of Health; alteration of landforms by Special Permit from ZBA; within V-Zone new construction to be located landward of Mean High Water; within AO zones residential structures elevated	Flood zones as shown on Flood Insurance Rate Map dated July 6, 2010	Enforced by Building Official; effective	None
Coastal District DCPC (District of Critical Planning Concern)	height and construction standards for inland zone, including site plan review; no residential construction in shore zone; underground utilities except by special permit; special permit for road wider than 10′; special permit for alteration of bank or stream; perc test required for subdivision; for new lots average of 300′ between septics or 5 per 1500′ of shoreline; septic 200′ from water body; septics at least 7′ above groundwater if perc faster than 5 min/inch and 5′ if slower than 5 min/inch; septics 600′ from public water supply and 200′ from well; separation well from saltwater body 200′	Below 10-foot contour or within 500' of MHW of ocean or pond or within 100′ streams or wetlands draining into coastal ponds > 10 acres; includes the shore zone, from MLW to 100' inland of the inland edge of beach or marsh grass and 100' inland of the crest of a bluff >15' in height; the rest is the inland zone	Effective but could use updating Island-wide′ administered by Board of Health, Building Inspector, Special Permit by ZBA with site plan review by Plan Review Board	Needs updating Island-wide
Wild and Scenic North Shore DCPC	permitted uses- routine maintenance, uses such as recreational fishing and boating not involving the permanent placement of	waters and lands of north shore, lighthouse to lighthouse, extending 100' seaward from MLW	Effective	None

	any new fill or structure; specially permitted uses - permanent placement of any fill or structure for municipal purposes or for purposes of commercial fishing, shellfishing or aquaculture; all other uses prohibited (including private piers)			
Dr. Fisher Mill DCPC	Special permit for alteration of mill; prohibits destruction or removal of any part of the mill or dam	Within 150′ of Dr. Fisher Mill	Effective; administered by Planning Board	None
Fire Breaks in State Forest	Fire breaks maintained by grazing, brushbreaking, controlled burns	Within Manuel F. Correllus State Forest	DCR	Need continued management; this program could use some support
Fire-Wise Outreach	Outreach and response person on Martha's Vineyard 24/5; outreach to groups and available for response	Martha's Vineyard	DCR	This program could use some support in order to reach more of the vulnerable homeowners
Structural	Work with DCR Office of Dam Safety, dam owners and the Town to ensure that significant hazard dams are inspected according to the prescribed schedule, that up-to-date evacuation plans are in place, and that needed repairs are implemented in a timely fashion.	Town, private owners	Ongoing	Town, private owners
Structural	Work with the DCR Office of Dam Safety and the Town to ensure that DCR records are up-to-date and reflect work accomplished by the Town and private parties to inspect, repair, maintain and renovate dam structures.	Town, private owners, DCR Office of Dam Safety	Ongoing	Town, private owners, DCR Office of Dam Safety

Prioritization of Mitigation Strategies

The actions were categorized by staff of the Martha's Vineyard Commission and evaluated through a consensus-building process within the West Tisbury Hazard Mitigation Planning Team in order to establish priorities. Considerations used in evaluating priorities included: consistency with the goals in the Hazard Mitigation Plan; whether or not the strategy addresses vulnerable critical facilities or infrastructure; whether or not the strategy is intended to promote reduction in loss of lives or improved safety, or to reduce impacts to property; whether or not the strategy requires a capital expenditure and if a source has been identified.

The main emphasis of the prioritization process is to promote initiatives with the greatest mitigation benefits which support public health and safety. In developing the prioritization procedures, it is not the intent of the Hazard Mitigation Planning Team to direct that the initiatives be accomplished in their prioritized order. The purpose of the ranking is to indicate the overall importance of the project to local mitigation efforts. The accomplishment of an initiative will usually depend more on the availability of funds, than on how high or low it ranked compared to other initiatives. After a natural disaster event receives a presidential declaration and the Commonwealth of Massachusetts was designated as a result of the disaster; the Dukes County towns will be eligible for Hazard Mitigation Grant Program funding. At that time the Hazard Mitigation Planning Team will convene to analyze the damage that was sustained. Then in respect to current conditions in the Dukes County towns, changes in policy and overall mitigation needs, the Hazard Mitigation Planning Team will prioritize a list of projects to be funded for the specific disaster.

The prioritization process developed by the 2014 Hazard Mitigation Planning Team requires the identification of projects and programs that will protect the health, safety and welfare of West Tisbury's citizens. The project initiatives identified by the Hazard Mitigation Planning Team will be analyzed for benefits and costs (benefit cost review) based on the guidelines set forth by the state and FEMA. The Benefit Cost Ratio will be calculated on projects included in any applications for funding to ensure the projects are cost effective at the time of project application submittal.

Each action is scored individually and is based on four weighted criteria developed by the Hazard Mitigation Planning Team (below). The process to prioritize the mitigation actions is accomplished during joint meetings between Hazard Mitigation Team members and officials from the respective local agencies.

Listed below are the criteria and weighted values:

Prioritization criteria

1. Does it accomplish one or all of the HMP goals? 5 points for each goal addressed

2. Does it promote the reduction of the loss of lives? Yes = 25 points; no = 0 points
3. Promote reduction in property damage? Yes = 20 points; no = 0 points
4. Funding needs and availability.
    a. No capital needed = 10 points
    b. Potential source for capital expenditure identified = 5 points

PROPOSED MITIGATION ACTIONS FOR THE TOWN OF WEST TISBURY (ALONG WITH ALL THE COMMUNITY ACTIONS)

Category of Action	Description of Action	Implementation Responsibility	Timeframe/Priority	Resources/Funding
Structural	Beach nourishment and dredging to improve natural defenses and circulation, in order to minimize storm impacts; vegetation management for dune restoration	Town	40	HMGP, PDM, Town
Structural	Reduce flood impacts by identifying and correcting discharges from Town and Commonwealth roadways where they cross streams, including: Mill Brook (West Tisbury portion), Tiasquam (West Tisbury portion), Black Brook (West Tisbury), and Witch Brook (West Tisbury). The road surface at each crossing should be adjusted during repaving to divert as much runoff as possible into roadside vegetation before it reaches the road crossing.	Commonwealth and Town	60	Mass DOT, Town, HMGP, PDM
Structural	Consider potential need for and options to provide water supply to areas with a development pattern that may not be compatible with continued private well water supplies, which may not be adequate in the event of emergencies such as drought and wildfire; build the necessary infrastructure.	Town	60	HMGP, PDM

Prevention	In order to reduce the impacts of drought and wildfire, establish an overall management plan for the State Forest	DCR and State Forest Advisory Committee	65	DCR
Structural	Priester's Pond Dam The pond level should be recorded continuously so that water flow and spillway capacity can be measured after every major storm event. An operation and maintenance manual should be developed. The brush on the entire dam should be cut yearly and the condition of the spillway and the masonry wall on the upstream face be determined and repairs made as necessary.	Town	25	Town, HMGP, PDM (annual cost about $2,000)
Structural	Mill Pond Dam The brush on the upstream and downstream faces should be cut yearly and the condition of the spillway planks should be determined and replaced if necessary. (annual cost about $2,000) Areas of potential erosion from road runoff should be protected with asphalt aprons. A simple static and seismic stability analysis of the dam should be done. (cost about $5,000) An operation and maintenance manual should be developed. An emergency action plan for an alternative travel route should be prepared by the West Tisbury Emergency Planning Group. New – Consider options such as dredging.	Town	25	Town, HMGP, PDM (annual cost of recommended analyses and maintenance about $3,000)
Structural	For Looks Pond Dam All saplings, vines and trees located on any part of the dam should be cut and removed from the site, especially near the primary and auxiliary spillways (the roots will rupture or crack the adjacent cement concrete). General or standard Dam Engineering practice calls for a tree-clear area extending 10 feet from the dam. Replace stoplogs within the auxiliary spillway	Private owner	25	HMGP, PDM

Structural, prevention	Increase capacity in adaptation to climate change, by incorporating 25-year storm calculations rather than 10-year volume into regulations and public infrastructure planning	Town, Mass DOT, private	75	HMGP, Mass DOT, town, private
Adaptation	Work with the Joint Transportation Committee to make long-range plans for public roads vulnerable to Sea Level Rise	Towns, Mass DOT	40	Mass DOT
Prevention, structural	Establish South Road as a critical facility from town line to town line and prioritize its storm protection and adaptation to rising sea level. Protect and possibly elevate the bridge adjacent to Stonewall.	Towns, Mass DOT	60	Mass DOT
Prevention	In order to reduce the impacts of drought and wildfire, establish an overall management plan for the State Forest, including establishment of specific procedures or Memoranda of Agreement regarding the transfer of land for new public water supplies and for easements to install water supply lines	DCR and State Forest Advisory Committee	65	DCR
Structural	In order to reduce the impacts of drought and wildfire, install new public water supplies and water supply lines within the State Forest	Town Water Department	60	HMGP, PDM
Structural	Consider potential need for and options to provide water supply to areas with a development pattern that may not be compatible with continued private well water supplies, which may not be adequate in the event of emergencies such as drought and wildfire; build the necessary infrastructure.	Town Water Department	60	HMGP, PDM
Prevention New	Use town regulations to prevent subdivision covenants from restricting homeowners from using fire-wise roofing materials such as asphalt.	town	65	

Section 7. Implementation, Evaluation, Monitoring and Update

The action plan has a community (all seven towns) component as well as outlining actions and projects to be undertaken by the individual towns. Both responsibility and potential funding sources have been noted, and it is understood that availability and securing of funding is very likely to affect the outcome of many of the proposals. Each action or project proposed in the action plan will be implemented by the party or parties noted in the action plan as being responsible. The action plan will be coordinated with other town and community priorities, as well as with mitigation goals of Commonwealth and federal agencies. Such coordination will improve access to technical assistance, provide broader support for implementation and reduce duplication of effort.

Hazard mitigation information from this plan has been shared with the Dukes County Joint Transportation Committee for incorporation in the Regional Transportation Plan for Martha's Vineyard and to help prioritize TIP (Transportation Improvement Program) projects that will lessen the impacts of natural hazards.

Hazard mitigation information from this plan is available to the town governments, who are encouraged to incorporate the findings in their local master plans, open space plans or harbor plans as they may be updated. The plan is available on the Martha's Vineyard Commission website http://www.mvcommission.org/

Because the Martha's Vineyard Commission has been entrusted with development of this plan, the Commission will continue to take responsibility for evaluating, monitoring and updating the plan, using the following procedures:

- The Community Hazard Mitigation Planning Teams will remain functional after adoption of the plan. Meetings of the Planning Teams are open to the public and are advertised on the Commission website, where minutes are posted. Many of the meetings are televised on the local access station MVTV.
- The first evaluation will take place within one year, in the fall of 2015, and will be performed by distributing a survey to the members of the Community Hazard Mitigation Planning Teams, with a face-to-face meeting called as needed in accordance with the comments. The team and project staff will together review the status of actions, projects and funding options, as well as note any new projects that may have become significant. Should the team find it necessary to update the plan; that will be done.
- Following the first year's evaluation, the plan will be evaluated at least every two years, with the next such evaluation to take place in the fall of 2017, and to be formally updated every five years, with the next such formal update to take place in 2020.

- Notwithstanding the scheduled evaluations and updates, the plan will be evaluated in the wake of a disaster, should one occur in Dukes County, and will be updated as needed in response to unexpected changes in conditions that may arise.

SLOSH map from the 2008 plan at the Chappaquiddick Fire Station

Outreach was and remains an important part of the success of the plan. The maps were particularly appreciated by first responders and planners. The maps were presented to the towns on paper and also readily accessible on the MVC website. The 2014 planning materials will be widely distributed as well.