TOWN OF FALMOUTH
SELECT BOARD
AGENDA
MONDAY, JULY 25, 2022 – 5:30 P.M.
SELECT BOARD MEETING ROOM
TOWN HALL
59 TOWN HALL SQUARE, FALMOUTH, MA 02540

The Select Board may discuss and vote appropriate action on any item listed on this Agenda unless a different disposition is noted. At the discretion of the Chair, agenda items may be taken out of order.

5:30 p.m. OPEN SESSION

5:30 p.m. EXECUTIVE SESSION

1. M.G.L. c.30A s.21(a)(2) - To discuss strategy with respect to contract negotiation with non-union personnel (Julian M. Suso, Town Manager) and M.G.L. c.30A s.21(a)(3) - To discuss strategy with respect to potential litigation (Julian M. Suso, Town Manager)

7:00 p.m. OPEN SESSION

1. Call to Order
2. Pledge of Allegiance
3. Proclamation – Eagle Scout Nicholas Cenzalli, Jr. of Boy Scout Troop 40
4. Recognition
5. Announcements
    a. Anniversary of the ADA Act - July 26
    b. Woods Hole Diversity Advisory Committee - Ambrose Jearld, Jr. Lecture July 27, 1:00 pm via Zoom
6. Public Comment

7:15 p.m. TOWN MANAGER'S PRELIMINARY REPORT

7:25 p.m. COMMITTEE INTERVIEWS

Interview, vote and appoint committee members:

1. Zoning Board of Appeals – Susanne Murphy, Marc Finneran
2. Cape Light Compact – Matthew Patrick, Scott Mueller

7:30 p.m. PUBLIC HEARINGS

1. Wetlands/Dock – Stephen Proia – Application for Special Permit for permission to rebuild the existing licensed dock in the waters of Eel Pond located at 31 Edgewater Drive West, East Falmouth

7:45 p.m. BUSINESS

1. Report – Recreation Committee **(15 minutes)**
2. Multi Hazard Mitigation Plan Update – Woods Hole Group, Leslie Fields **(20 minutes)**
3. Report – Cape Cod Commission – Robert Mascali **(15 minutes)**
4. Fire Station Staffing **(30 minutes)**
5. Announce November 2022 Annual Town Meeting schedule **(5 minutes)**

9:10 p.m. CONSENT AGENDA

1. Licenses
    a. Approve application for a Change of Management Agreement of a Wine and Malt Package Store License – OSJL Spirits, LLC d/b/a Ocean State Job Lot located at 50 Teaticket Highway

b. Approve application for two Special One-Day Wine and Malt Liquor Licenses – Quissett Yacht Club – H12 Championship Reception & Dinner – 70 Quissett Harbor Road – Friday, 7/29/22 and Saturday, 7/30/22

c. Approve application for a Special One-Day Wine and Malt Liquor License – Woods Hole Historical Museum – Oyster Talk and Tasting – 579 Woods Hole Road – Friday, 8/26/22

2. Administrative Orders
   a. Authorize approval of grant agreement with Barnstable County for receipt of American Rescue Plan Act (ARPA) grant funds for Wastewater Treatment Facility Improvements

   b. Retroactively approve application for the 2022 Edward Byrne Memorial Justice Assistance Grant funds in the amount of $10,516 for Bosch Crash Computer Reader (CDR) for use by Police Department in crash reconstruction investigations

   c. Approve Warrant for the Tuesday, September 6, 2022 State Primary

   d. Vote to accept donation from Teaticket Civic Association in the amount of $600.00 to the Veterans Department Donation Account

3. Review and Vote to Approve Minutes of Meetings
   a. Public Session – June 6, 2022; June 13, 2022; June 21, 2022; July 11, 2022
   b. Executive Session – July 11, 2022 #1 and #2

9:20 p.m. TOWN MANAGER'S SUPPLEMENTAL REPORT

9:25 p.m. SELECT BOARD REPORTS

9:35 p.m. DISCUSSION OF FUTURE AGENDA ITEMS

9:45 p.m. ADJOURN

Nancy R. Taylor, Chair
Select Board

OPEN SESSION

REGULAR MEETING

3. Proclamation

    a. Eagle Scout Nicholas Cenzalli, Jr. of Boy Scout Troop 40

Boy Scout Troop 40

Lynn A Briggs
Troop Secretary
26 Comanche Drive
Falmouth, MA 02540

phone: (774) 836-8188
e-mail: lynnbdream2@gmail.com

BOY SCOUTS OF AMERICA

July 12, 2022

Nancy R. Taylor, Chair
Falmouth Select Board
59 Town Hall Square
Falmouth, MA 02540

Dear Ms. Taylor,

Nicholas Cenzalli, Jr. of Boy Scout Troop 40 of Falmouth, Massachusetts, sponsored by Saint Barnabas Episcopal Church, has progressed through the ranks of scouting, and has achieved the rank of Eagle Scout. Nicholas is a good citizen and a credit to his community and nation.

Here is a statement from Nicholas about his Eagle Project and what scouting has done for him:

"For my Eagle Scout project, I built 3 benches and placed them along the handicapped accessible Coonamessett Greenway Heritage Trail off of John Parker Road in Falmouth, MA. I also built and installed 3 bird houses in the old cranberry bogs to allow for more small birds to inhabit the area.

Scouting has taught me a couple of ideals that will stay with me for years to come, which are how to be a leader and how to manage and commit my time to important projects. Being a part of Scouting was and is an important part of my life and it has taught me so much about life and how to present myself in it."

Please consider presenting a commendation from the town recognizing this fine individual, to be read at his Eagle Court of Honor Sunday, August 7, 2022 @ 2:00 pm at the Cape Cod Curling Club, 33 Highfield Drive, Falmouth, MA 02540. He wishes to extend an invitation to attend the ceremony to you as well as your colleagues, Onjale' Scott Price, Samuel H. Patterson, Douglas C. Brown, and Edwin (Scott) P. Zylinski II.

Thank you,

Lynn A Briggs, Troop 40, Boy Scouts of America

PROCLAMATION

WHEREAS: Nicholas Cenzalli, Jr. of Boy Scout Troop 40 has successfully completed qualifications for the rank of Eagle Scout, a rigorous and demanding process that teaches patience, perseverance and teamwork, and requires strong goal setting; and

WHEREAS: Nicholas Cenzalli, Jr. met these challenges with aplomb and shall be recognized as an outstanding representative of his family, his troop and his community; and

WHEREAS: The Boy Scouts of America, long acknowledged for building fine citizens, calls for Special Court of Honor to award its highest symbol of achievement to those who complete this rank; and

WHEREAS: Nicholas Cenzalli, Jr. is now an Eagle Scout with all its rank and privilege;

NOW, THEREFORE, We, Nancy R. Taylor, Onjalé Scott Price, Samuel H. Patterson, Douglas C. Brown and Scott Zylinski as Select Board of the Town of Falmouth, do hereby declare and PROCLAIM

NICHOLAS CENZALLI, JR. AS EAGLE SCOUT

IN WITNESS WHEREOF, we have hereunto set our hand and caused the Great Seal of the Town of Falmouth to be affixed on this **25th day of July, 2022**.

Nancy R. Taylor, Chair

Douglas C. Brown

Onjalé Scott Price, Vice Chair

Scott Zylinski

SELECT BOARD

Samuel H. Patterson

OPEN SESSION

REGULAR MEETING

5. Announcements

   a. Anniversary of the ADA Act – July 26

OPEN SESSION

REGULAR MEETING

5. Announcements

   b. Woods Hole Diversity Advisory Committee – Ambrose Jearld, Jr. Lecture July 27, 1:00 p.m. via Zoom

   Information available at:

   https://www.woodsholediversity.org/events/ambrose-jearld-jr-lecture/

TOWN MANAGER'S PRELIMINARY REPORT

July 25, 2022

TOWN OF FALMOUTH
Office of the Town Manager & Select Board
59 Town Hall Square, Falmouth, Massachusetts 02540

TO: **Select Board**

FROM: **Peter Johnson-Staub, Acting Town Manager** PJS

SUBJECT: **Preliminary Report for July 25, 2022**

DATE: **July 22, 2022**

AGENDA TOPICS – PRELIMINARY REPORT:

Committee Interviews:

1. Zoning Board of Appeals – there are two candidates and three open positions (two full members and one associate member). Susanne Murphy is seeking reappointment. She was appointed on 6/13/2022 to fill a vacant seat and the term for that seat expired two weeks later.
2. Cape Light Compact – Scott Mueller was the only applicant for this position in June and he was appointed as the sole Town representative at that time. Upon learning that the incumbent, Matt Patrick, wished to continue to represent the Town on the Cape Light Compact, Mr. Mueller wrote to the Board suggesting he be appointed as an alternate so Mr. Patrick can be appointed as the primary representative. Mr. Mueller's letter is in your packet.

Public Hearings:

1. The application to rebuild an existing dock at 31 Edgewater Drive West has been approved by the Conservation Commission. Town staff have not identified any concerns with respect to shellfish or navigation.

Business:

1. Report – Recreation Committee:

This is the Recreation Committee's annual meeting with the Select Board. No Board action is requested.

2. Multi-Hazard Mitigation Plan Update:

This report outlines plans for addressing hazards such as floods, hurricanes, winter storms, etc. The plan identifies mitigation measures the Town can take to reduce risk to human life and property damage. In addition to serving as a planning tool, updating this plan is required to maintain eligibility for grant funding from FEMA following a natural disaster. An updated plan is also required so that Falmouth property owners can continue to qualify for property insurance discounts through the Community Rating System. The Town retained the Woods Hole Group to work with Town staff to prepare this update. Jennifer Lincoln has been the staff lead for this work but is unable to join us due to a prior commitment. Leslie Fields of the Woods Hole Group is the project manager for this engagement and will give a presentation.

The draft plan has been posted to the Town website. Public comment can be sent to lfields@woodsholegroup.com until August 1st. The plan will then be submitted to FEMA (Federal Emergency

Management Agency) and MEMA (Massachusetts Emergency Management Agency) for approval and finally come back to the Select Board for adoption of the plan.

3. Report - Cape Cod Commission:

This is the annual meeting with the Town's appointed representative to the Cape Cod Commission. As you know, the Cape Cod Commission is the regional land use planning, economic development and regulatory agency for Barnstable County. The Commission is funded through a direct property tax and governed by a board of 19 commissioners. The Executive Director, Kristy Senatori, reports to the Commissioners. There is a flyer in your packet describing some highlights of the Commission's recent activity.

4. Fire Staffing Discussion:

I will have a presentation that reviews the Select Board's fire station staffing goals, describes the current status of fire station staffing and identifies potential actions to achieve future staffing goals.

5. Town Meeting Schedule:

The fall Town Meeting will be held on November 14, 2022. Per the Town Code §49-3, the Board must announce the date for closing the warrant. Consistent with recent practice, we draft a schedule that includes the date the warrant closes and a number of other key dates in the process for preparing for Town Meeting.

Consent Agenda:

All the Licenses and Administrative Orders on the Consent Agenda have been reviewed by staff and I recommend approval.

COMMITTEE APPOINTMENTS

Interview, vote and appoint committee members

1. Zoning Board of Appeals – Susanne Murphy, Marc Finneran

July 25, 2022

7/25/22

Zoning Board of Appeals (7-member committee: 5 full, 2 associate) (5-year terms)

Three vacancies:

- 1 full member with a term until 6/30/27
- 1 full member with a term until 6/30/25 (Scott Zylinski's)
- 1 associate member with a term until 6/30/26 (D. Scott Peterson's)

Two applicants:

- Susanne Murphy (Current member. Appointed to Ed Van Kuren's unexpired term to 6/30/22)
- Marc Finneran

RECEIVED
JUN 24 2022
SELECTMEN'S OFFICE

TOWN OF FALMOUTH

BOARD, COMMITTEE OR COMMISSION
APPLICATION FORM

If you are interested in serving the Town of Falmouth in any capacity, please fill out this form and mail it to the Select Board, Falmouth Town Hall, 59 Town Hall Square, Falmouth, MA 02540. Information received will be available to all Town Boards and Officials, although the filling out of this form does not assure appointment. If selected for an interview, you may wish to submit a resume or additional information. This form and a listing of all boards and committees can be found on the Falmouth website: www.falmouthma.gov.

Name: Susanne Murphy

Address: 10 Old Homestead Rd Village: Falmouth ZIP: 02540

Mailing Address: Same Village: ZIP:

Telephone: [redacted] Email: [redacted]

How long have you been a Resident ✓ (date: 2020) / Taxpayer ✓ (date: 2004)

Amount of time you are available to give: as much as needed

Town Committee, Board or Commission you are interested in serving on:

1. Zoning Board of Appeals
2.
3.

Seeking: Permanent Position ☑ Alternate Position ☐

Have you attended any meetings of the committee for which you are applying? yes

Relevant affiliation and work and personal experiences

I am on the board now

Town offices held in Falmouth or elsewhere and dates of years served:

Zoning 1 week

Briefly describe the particular skills you feel you will add to the committee or board:

Zoning Board of Appeals Walpole mass 24 years
Planning Board Walpole mass 3 years
Rec Comm Walpole mass 25 years
Town Meeting Member Walpole mass 30+ yrs

You may attach a resume to this application.

List three (3) references:

	Name	Title	Phone
1.	Bob Jarvis	self employ	[redacted]
2.	Jim McDonnell	Self employ	[redacted]
3.	Jim Johnson	T.M. Walpole	[redacted]

I hereby certify that I have been provided a summary of Massachusetts General Law 268A, the Conflict of Interest of Law, I have read the material provided, and to the best of my understanding have no potential or actual conflict of interest.

I have received a copy of the Select Board's Appointment Policy and read the material provided.

June 24, 2022
DATE

APPLICANT'S SIGNATURE

In the event the applicant cannot sign this statement, you should provide an explanation of the reason (s) why if you still wish consideration for appointment.

RECEIVED
JUN 23 2022
SELECTMEN'S OFFICE

TOWN OF FALMOUTH

BOARD, COMMITTEE OR COMMISSION
APPLICATION FORM

If you are interested in serving the Town of Falmouth in any capacity, please fill out this form and mail it to the Select Board, Falmouth Town Hall, 59 Town Hall Square, Falmouth, MA 02540. Information received will be available to all Town Boards and Officials, although the filling out of this form does not assure appointment. If selected for an interview, you may wish to submit a resume or additional information. This form and a listing of all boards and committees can be found on the Falmouth website: www.falmouthma.gov.

Name: Marc Finnegan

Address: 98 Grand Ave Village: Fal. Hts. ZIP: 02540

Mailing Address: Same Village: ZIP:

Telephone: [redacted] Email: [redacted]

How long have you been a Resident 40yrs (date: 82) / Taxpayer Same (date:)

Amount of time you are available to give: all needed

Town Committee, Board or Commission you are interested in serving on:

1. Z.B.A.
2.
3.

Seeking: Permanent Position ☒ Alternate Position ☐

Have you attended any meetings of the committee for which you are applying? Yes

Relevant affiliation and work and personal experiences College Educated in Civil engineering, much construction experience. Successfully Petitioned to Ammend a Zoning By-law. I Believe myself To be a Fair Advocate and Arbitor. Qualities Necessary For the Position.

Town offices held in Falmouth or elsewhere and dates of years served:

Town Manager Screening Committee (2011)

Town Meeting member. Solid Waste Advisory com. Sandwich RD Fire Station Location and Building Committees

Briefly describe the particular skills you feel you will add to the committee or board:

I Believe my Background as well as my Town experience and my obvious interest and knowledge of anything Falmouth makes me a well Rounded Candidate.

You may attach a resume to this application.

List three (3) references:

	Name	Title	Phone
1.	Matt McNamara	Former Chair ZBA	[redacted]
2.	Meg. E. Braga	Former Selectperson	[redacted]
3.	Robert Dugan	Former ZBA	[redacted]

I hereby certify that I have been provided a summary of Massachusetts General Law 268A, the Conflict of Interest of Law, I have read the material provided, and to the best of my understanding have no potential or actual conflict of interest.

I have received a copy of the Select Board's Appointment Policy and read the material provided.

6-22-22
DATE

APPLICANT'S SIGNATURE

In the event the applicant cannot sign this statement, you should provide an explanation of the reason (s) why if you still wish consideration for appointment.

COMMITTEE APPOINTMENTS

Interview, vote and appoint committee members

2. Cape Light Compact – Matthew Patrick, Scott Mueller

Cape Light Compact (1 town representative, 1 alternate) (3-year term)

2 vacancies:

- 1 Falmouth representative with a term ending 6/30/24
- 1 Falmouth alternate representative with a term ending 6/30/24

2 applicants:

- Matthew Patrick (current representative requesting reappointment)
- Scott Mueller (requesting to be appointed to alternate representative)

Falmouth Select Board
59 Town Hall Square
Falmouth, MA 02540

June 13, 2022

Re: Falmouth Representative - Cape Light Compact

Dear Select Board Members:

At its meeting on Monday June 6, 2022 the Select Board voted to appoint me as the Town's representative on the Advisory Board for the Cape Light Compact as well as to the Town's Energy Committee. I very much appreciate the Board's support and look forward to working with the Board and interested citizens on the various energy issues affecting Falmouth. Since that meeting, however, I have learned that Falmouth's current representative to the Cape Light Compact, Matt Patrick, desires to continue in that role but due to extenuating circumstances and some miscommunications, did not submit a timely application. I have discussed the matter with Mr. Patrick, and we agree that we could both make a significant contribution to the Town in working with the Cape Light Compact.

Accordingly, in light of Mr. Patrick's experience in currently representing the Town on the Cape Light Compact Advisory Board, and his desire to continue to do so, I am respectfully requesting that the Board re-appoint Mr. Patrick to that position, rather than myself, and appoint me to the position of alternate representative to the Cape Light Compact Advisory Board which I understand is currently vacant.

Please let me know if you have any questions or need anything additional from Mr. Patrick or myself.

Respectfully submitted.

Scott J Mueller
87 Loop Road
Falmouth, MA 02540

Cc: Peter Johnson-Staub, Acting Town Manager
Diane Davidson, Office Manager
Matt Patrick

PUBLIC HEARINGS

1. Wetlands/Dock – Stephen Proia – Application for Special Permit for permission to rebuild the existing licensed dock in the waters of Eel Pond located at 31 Edgewater Drive West, East Falmouth

TOWN OF FALMOUTH

Office of the Town Manager & Select Board

59 Town Hall Square, Falmouth, Massachusetts 02540
Telephone (508) 495-7320
Fax (508) 457-2573

PUBLIC HEARING NOTICE

The Falmouth Select Board will hold a public hearing under Section 240-14.8 (Wetlands Regulations) of the Zoning Bylaws of the Town of Falmouth on Monday, July 25, 2022 at 7:30 p.m. in the Select Board Meeting Room, Falmouth Town Hall, 59 Town Hall Square on the application of Stephen Proia for permission to rebuild the existing licensed dock located at 317 Edgewater Drive West, East Falmouth, MA. Area affected is Eel Pond. Interested parties may review the file on this hearing at the Office of the Select Board.

Per Order of the
Select Board

Publication dates: Friday, July 8, 2022 and Friday, July 15, 2022; Falmouth Enterprise.

PUBLIC HEARING NOTICE

The Falmouth Select Board will hold a public hearing under Section 240-14.8 (Wetlands Regulations) of the Zoning Bylaws of the Town of Falmouth on Monday, July 25, 2022 at 7:30 p.m. in the Select Board Meeting Room, Falmouth Town Hall, 59 Town Hall Square on the application of Stephen Proia for permission to rebuild the existing licensed dock located at 317 Edgewater Drive West, East Falmouth, MA. Area affected is Eel Pond. Interested parties may review the file on this hearing at the Office of the Select Board.

Per Order of the
Select Board

July 8, 15, 2022

317 EDGEWATER DR WEST

CERTIFIED

Bruce Cabral
Assistant Assessor
Town of Falmouth, MA
July 5, 2022

331 EDGEWATER DR WEST — 41 06 000 062
LUC: 101
331 EDGEWATER LLC
144 WINTER ST
WRENTHAM. MA 02093

292 EDGEWATER DR WEST — 41 06 000 190
LUC: 101
ALLIA ANTONIO L
ALLIA COURTNEY D
13 PLYMPTON ST
WALTHAM. MA 02451

3 PINE ROCK RD — 41 06 000 174
LUC: 132
DAWSON BRYCE A
9 PINE ROCK RD
E FALMOUTH. MA 02536-7236

0 EDGEWATER DR WEST — 41 06 000 067B
LUC: 132
DAWSON CAMERON
33 QUIMBY LN
E FALMOUTH. MA 02536

9 PINE ROCK RD — 41 06 000 175
LUC: 101
DAWSON FRANCOISE A
9 PINE ROCK RD
E FALMOUTH. MA 02536-7236

330 EDGEWATER DR WEST — 41 06 000 145
LUC: 101
DICECCO JAMES B
DICECCO RHONDA
330 EDGEWATER DR W
EAST FALMOUTH. MA 02536-7298

322 EDGEWATER DR WEST — 41 06 000 158
LUC: 101
DICECCO JAMES B
DICECCO RHONDA
322 EDGEWATER DR WEST
E FALMOUTH. MA 02536

0 PINE ROCK RD — 41 06 000 189
LUC: 130
DILEO TRUSTEE DOMENICK D
DOMENICK-GILDA DILEO TRUST
13 VOSE RD
C/O ANTHONY J DILEO
WESTFORD. MA 01886-3729

15 FAIRFIELD DR — 41 06 000 161
LUC: 101
DOLLOFF MARK
DOLLOFF TERESA MARQUES
15 FAIRFIELD DR
E FALMOUTH. MA 02536

295 EDGEWATER DR WEST — 41 06 000 069
LUC: 101
HEALEY JAMES P
HEALEY JANICE E
5606 SW 9TH AVE
CAPE CORAL. FL 33914

15 PINE ROCK RD — 41 06 000 176
LUC: 101
LAVIN THOMAS
15 PINE ROCK RD
EAST FALMOUTH. MA 02536

14 PINE ROCK RD — 41 06 000 187
LUC: 101
LEWIS LYNN M
27 MAPLE PARK
NEWTON. MA 02459-2210

11 FAIRFIELD DR — 41 06 000 160
LUC: 101
MACDONALD JOHN K
MACDONALD CYNTHIA A
11 FAIRFIELD DR
EAST FALMOUTH. MA 02536

10 PINE ROCK RD — 41 06 000 188
LUC: 101
MARBLE LAURIE A
10 PINE ROCK RD
EAST FALMOUTH. MA 02536-7237

310 EDGEWATER DR WEST — 41 06 000 173
LUC: 101
MOLLOY BONITA
MOLLOY BARRY JOSEPH
310 EDGEWATER DR WEST
EAST FALMOUTH. MA 02536

10 AMPHIBIAN RD — 41 06 000 157
LUC: 101
MURRAY MICHAEL
PSC 558
BOX 4354
FPO AP 963754300. 88888

336 EDGEWATER DR WEST — 41 06 000 144
LUC: 101
NEALON TRUSTEE M KATHLEEN
ROGERS EDGEWATER RLTY TRUST
336 EDGWATER DR WEST
EAST FALMOUTH. MA 02536

14 AMPHIBIAN RD — 41 06 000 156
LUC: 101
NOE MARGUERITE JULIE
KURDEKA TRUSTEE JOANNE E
20 BROOKDALE RD
STOUGHTON. MA 02072-3309

317 EDGEWATER DR WEST — 41 06 065A 000
LUC: 101
PROIA STEPHEN
SHAW PROIA KELLEY
1106 WINNSBORO CT
ALLEN. TX 75013

13 AMPHIBIAN RD — 41 06 000 146
LUC: 101
SANTAMARIA TRUSTEE JOSEPH J
MONAHAN TRUSTEE CAROLYN W
213 HOBART HILL RD
HEBRON. NH 03241

318 EDGEWATER DR WEST — 41 06 000 159
LUC: 101
STAMOS TR HELEN
HELEN STAMOS TRUST
9404 KINGSTON DR
BRADENTON. FL 34210

12 FAIRFIELD DR — 41 06 000 171
LUC: 101
STOLGITIS JILL
489 CZESKI RD
HARDWICK. MA 01037

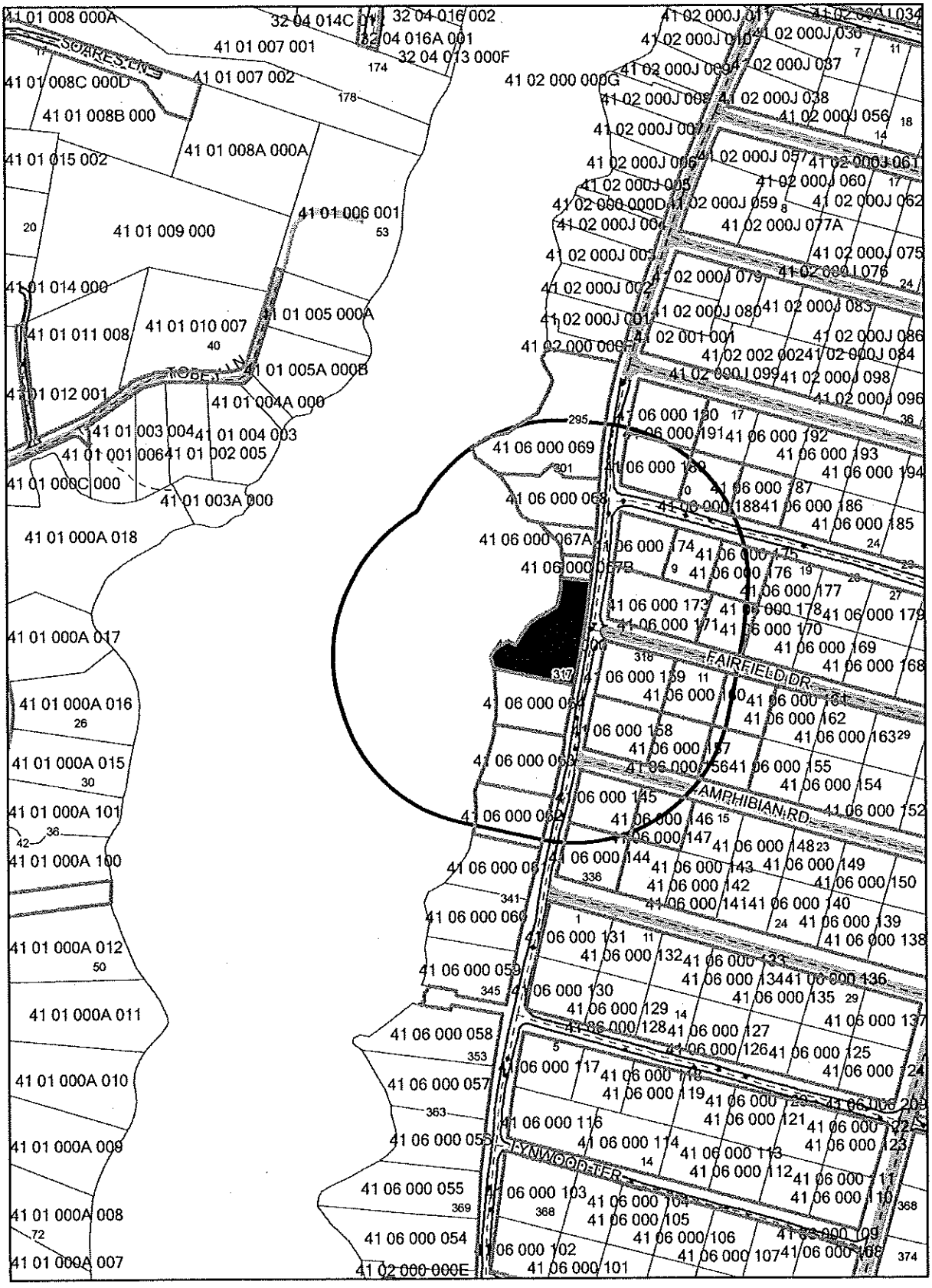
321 EDGEWATER DR WEST — 41 06 000 064
LUC: 101
SYLVESTER TRUSTEE STANLEY J
LAURO TRUSTEE HELENA C
126 WILLARD CIR
WESTWOOD . MA 02090

327 EDGEWATER DR WEST — 41 06 000 063
LUC: 101
TADROS TRUSTEE MAHER N
TADROS TRUSTEE MADELEINE KHALIL
327 EDGEWATER DR WEST
EAST FALMOUTH. MA 02536

0 EDGEWATER DR WEST — 41 06 000 067A
LUC: 132
TROIANI LEDA
74 MAIN ST
WALTHAM. MA 02453-6637

301 EDGEWATER DR WEST — 41 06 000 068
LUC: 109
TROIANI LEDA
74 MAIN ST
WALTHAM. MA 02453-6637

317 EDGEWATER DR WEST



APPLICATION FOR PERMIT TO FILL, DREDGE OR OTHERWISE ALTER WETLANDS

Filing under Section 240-77 (Wetland Regulations) of the Falmouth Zoning By Law

DOCK RECONSTRUCTION

317 EDGEWATER DRIVE WEST

EAST FALMOUTH, MASSACHUSETTS

Prepared for:

Stephen Proia

Prepared by:

Falmouth Engineering, Inc.
17 Academy Lane, Suite 200
Falmouth, MA
02540

TABLE OF CONTENTS

TOWN OF FALMOUTH
BOARD OF SELECTMEN

APPLICATION FOR PERMIT TO DREDGE, FILL OR OTHER ALTER WETLANDS
(As required under Section 240-77 (Wetland Regulations) of the Zoning Bylaw)

To the Board of Selectmen
Falmouth, MA

Date: June 15, 2022

The undersigned hereby applies to the Board of Selectmen as required by Section 240-77 of the Zoning Bylaws, for a permit to alter, as indicated below, the following described premises:

OWNER: Stephen Proia 1106 Winnsboro Ct. Allen, TX 75013
(full name) (address)

AGENT: Falmouth Engineering, Inc. 17 Academy Ln. Ste. 200 Falmouth, MA 02540
(full name) (address)

APPLICANT: Stephen Proia 1106 Winnsboro Ct. Allen, TX 75013
(full name) (address)

1. Location of Property: Map 41 Section 06 Parcel 065A Lot 000

Street Name and House Number 317 Edgewater Drive West East Falmouth, MA 02536

2. Body of water, marsh or stream affected: Eel Pond

3. Description of property and project site: Fully developed residential lot
developed residential area in East Falmouth containing single family dwelling & existing dock.

a. Dimensions, Acreage of total parcel: 18,700 S.F.

b. Length of water marsh frontage: 240'

c. Dimensions of area to be dredged: N/A Depth N/A

d. Dimensions of area to be filled: N/A

e. Volume of dredging spoil to be moved: N/A

APPLICATION FOR PERMIT TO DREDGE, FILL OR OTHERWISE ALTER WETLANDS
(As required under Section 240-77 (Wetland Regulations) of the Zoning Bylaw)

Disposition of Spoil: N/A

f. Describe proposed riprap or bulkheading, if any: N/A

g. Other (docks, piers and etc.) Proposed Dock Re-construction

h. Method (equipment to be used) for proposed work: Barge supported crane

4. Purose of proposed work: Non-commercial docking & access to navigable waters.

5. Zoning which governs area: RC

6. Date of application for permit to dredge or fill from the Commonwealth of Mass. N/A Army Engineers N/A

7. Has a permit ever been approved or refused for this location by State, Federal or Local Authority? Order of Conditions 25-4740

8. Remarks

9. Project Summary for legal notice:

The applicant proposes to rebuild the existing licensed dock.

Owner: Stephen Proia
1106 Winnsboro Ct.
Allen, TX 75013
(Name & Address)
TEL #:

Agent: Falmouth Engineering, Inc.
17 Academy Ln. Ste. 200
Falmouth, MA 02540
(Name & Address)
TEL #: 508.495.1225

Applicant: Same as owner

(Name & Address)
TEL #:

DO NOT WRITE BELOW THIS SPACE, FOR SELECMEN'S OFFICE USE ONLY

ATTACHMENT A

PROJECT NARRATIVE

ATTACHMENT A - PROJECT NARRATIVE

1.0 Introduction and Project Overview

Falmouth Engineering Inc. has filed this Notice of Intent (NOI) application on behalf of Stephen Proia, the applicant, and owner of the property at 317 Edgewater Drive West. The applicant proposes to rebuild the existing licensed dock.

The application has been jointly filed pursuant to the Massachusetts Wetlands Protection Act (MWPA, M.G.L. Chapter 131, Section 40) and its implementing regulations (310 CMR 10.00) and the Falmouth Wetlands Protection Bylaw (Chapter 235 of the Code of Falmouth) and the Falmouth Wetland Regulations (FWR 10.00).

2.0 Existing Conditions

The project site is located in East Falmouth along the eastern shore of Eel Pond (refer to Project Location Map). The property contains a dwelling and typical appurtenances.

The existing dock consists of a pipe and post supported walkway section, ramp and float. The float measures 10' x 16' and is supported by pipes. The walkway is supported by timber posts. The system remains in the water year-round.

2.1 Regulated Resource Areas

The property is bounded to the west by Eel Pond. The wetland resources within jurisdiction include Land Under the Ocean, Land Containing Shellfish, Salt Marsh and Land Subject to Coastal Storm Flowage.

Estimated Habitat and Protected Species

Information published by the Massachusetts Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program indicates that the proposed dock reconstruction is not located within Estimated Habitat of Rare Wetlands Habitat and Priority Habitat.

3.0 Proposed Project

The project involves the reconstruction of the including removal of the posts and pipes. The reconstructed dock will be supported by 6" x 6" posts outside the tidal zone, and nine 10" diameter timber piles within the tidal zone. The piles will be driven, not jetted. The entire dock system is intended to remain in water year-round. The dock will be fitted with a bubbler system to mitigate against pile ice uplift and dock damage.

The existing dock system is substandard and susceptible to damage from storms. The reconstructed dock will be more resilient to storms. The existing dock walkway surface is constructed of solid planks that prevent sunlight penetration. The existing dock walkway is lower than the minimum allowed by current standards. The existing dock does not provide sufficient space beneath the walkway for public access. The reconfigured walkway will be both elevated for public access and allow for sunlight penetration through the use of Thru-flow decking.

4.0 Anticipated Impacts to Resource Areas

The reconstructed dock will be constructed in the same area and alignment as the existing licensed pier. Only short-term temporary impacts are anticipated by the installation of the new pilings.

Overall impacts will be reduced by elevating the walkway section to allow for sunlight penetration and public access.

5.0 Compliance with Applicable Performance Standards

The Massachusetts Wetland Protection Act regulations provide for the construction of water-dependant structures within wetland resource areas provided that the design and construction of the structure is in accordance with the best available measures so as to minimize adverse effects (310 CMR 10.27(6)). The Massachusetts Department of Environmental Protection, Bureau of Resource Protection, Wetlands and Waterways Program has published specific design standards for small pile supported docks and piers (DEP, 2003), which are specifically intended to minimize adverse impacts resulting from the installation and maintenance of such structures. The reconstructed dock meets or exceeds each of these design standards.

Other design requirements for docks and piers are found under the Falmouth Wetland Regulations at FWR 10.16 (1) (d) (1-10) (Design Specifications and Performance Standards for Docks and Piers in Recreational Harbors) and at FWR 10.16 (1) (h)(1-7) (General Requirements and Prohibitions all Docks and Piers). Other relevant performance standards are addressed at FWR 10.34 (5) (Land Containing Shellfish).

The reconstructed dock satisfies each of the locally established performance standards as summarized below or is identified as not meeting the standard.

5.1 Design Specifications and Performance Standards for Docks and Piers in Recreational Harbors (Falmouth Wetland Regulations 10.16 (1) (d) (1-10))

1. *Docks shall not exceed one hundred feet in length beyond mean high tide, or one hundred feet in length beyond the landward edge of salt marsh, or otherwise prohibit or unreasonably impede legitimate passage along a*

beach or through navigation over the waters for recreational or aquaculture purposes;

The existing dock and the proposed dock reconstruction extend 61 feet from Mean High Water. Therefore, this provision of the regulations is met.

The reconstructed dock will allow for public access by providing clearance beneath the structure. This provision of the regulations is met.

2. *To keep disturbance of the bottom minimal at all times during both construction and use, the water depth at the end of the dock shall be a minimum of three feet at the time of mean low water;*

The water depth at the end of the existing dock is less than 3 feet. The length of the dock is not allowed to change, therefore, the water depth will remain the same.

3. *The area of the terminal "L" or "T" shape in a fixed dock, or the float, or combination thereof, shall not exceed one hundred square feet;*

The existing float measures 10' x 16'. This float will continue to be used.

4. *The design and construction shall not interfere with recreational intertidal access;*

The existing dock interferes with recreational intertidal access. The reconstructed dock will enhance intertidal access, therefore improve existing conditions.

5. *No portion of the dock or pier may be closer than ten feet from the property boundary or extended property boundary line into the intertidal and tidal zones;*

The proposed dock reconstruction will be in excess of 10' from property lines at the closest location.

6. *Floating docks shall be fixed by piers using a hoop roller or other approved design fastening system;*

The reconfigured float will be fixed by hoop rollers.

7. *An area where the float(s), if any, will be stored shall be designated on the plan;*

The float is proposed to remain in the wat year-round. A bubbler system will be employed.

9. *Except for floating portions of a dock, the decking surface shall not reduce normal ambient light, i.e. sunlight, by more than 50 percent over salt marsh and bordering vegetated wetland;*

The existing dock walkway is constructed of timber planks in areas crossing over salt marsh. The reconstructed dock will improve conditions by providing Thru-Flow decking. Through Flow decking allows for 50 percent sunlight penetration.

10. *The maximum horizontal footcandle level as measured directly below each complete lighting unit shall not exceed 0.2 footcandles.*

Reconstructed dock will comply with this standard.

5.2 General Requirements and Prohibitions all Docks and Piers (Falmouth Wetland Regulations 10.16 (1) (h) (1-4))

1. *No reconfigured dock or pier or extension of an existing dock or pier may be constructed in any portion of FEMA designated velocity zone (V-Zone) unless the applicant demonstrates that there will be a public benefit from the project. The commission shall weigh the potential likelihood damage and harm that any such dock or pier would cause during a storm event with the public benefit demonstrated by the applicant in determining whether the project should be allowed.*

Although the existing dock is within a FEMA designated velocity zone, it pre-dates the prohibition. The reconstructed dock will be supported by stronger piles to replace posts and pipes. This will result in the reconstructed dock being more resilient to storms.

2. *No dock or pier shall be allowed if, within 35 feet of the area designated by the applicant as the mooring field, there are significant quantities of shellfish as defined by FWR 10.34(3) and the area has been historically used for shellfishing, or has the potential for shellfishing, and the sediment provides a viable shellfish habitat (emphasis added).*

Since the proposed project is the replacement of an existing float system with a reconfigured float system of the same size and in the same location, no formal shellfish survey or accompanying report was proposed.

No CCA-treated materials may be used to construct a dock or pier.

No CCA-treated materials will be used in the construction of the pier. Therefore, the proposed pier complies with this performance standard.

3. *For singular ownership docks, any floating section of a dock or pier shall have a minimum water depth of three feet under all portions of the floating section of the dock or pier including times of extreme low water. This depth shall be measured as the shortest distance from any portion of the bottom of the floating section to the seabed.*

The water depth at the landward end of the existing dock is currently less than 3 feet. The proposed dock reconstruction can not be lengthened due to velocity zone restrictions. The water depth will remain the same.

5.3 Performance Standards for Land Containing Shellfish (FWR 10.34 (6-8))

1. *Any project on land containing shellfish shall not adversely affect any portion of such land or marine fisheries by a change in the productivity of such land caused by:*

a. Alteration of water circulation;

The re-constructed dock will have negligible impact on water circulation. The pile spacing will be increased with reconstructed dock system and the number of piles will be reduced.

b. Alterations in relief elevation;

No alterations in relief elevation are proposed.

c. The compacting of sediments by vehicular traffic;

No compacting of sediments by vehicular traffic is proposed.

d. Alterations in the distribution of sediment grain size;

No alterations in the distribution of sediment grain size are proposed or anticipated.

e. Alterations in natural drainage from adjacent lands;

No changes in natural drainage patterns are proposed.

f. Changes in water quality, including but not limited to, other than natural fluctuations in the levels of salinity, dissolved oxygen, nutrients, temperature, or turbidity, or the addition of pollutants.

The reconstructed dock has been designed to avoid and potential changes in water quality through the use of non-CCA timber.

2. *Notwithstanding FWR 10.34(6), projects approved by DMF that are specifically intended to increase the productivity of land containing shellfish may be permitted.*

The proposed project is not specifically intended to increase the productivity of land containing shellfish, and therefore this performance standard does not apply.

3. *Notwithstanding FWR 10.34(6) and 10.34(7), no project may be permitted which will have any adverse effect on habitat of rare species.*

Information published by the Massachusetts Division of Fisheries and Wildlife, Natural Heritage and Endangered Species indicates that the proposed pier construction is not located within Estimated Habitat of Rare Wetlands Habitat and Priority Habitat.

6.0 Summary

The existing wetland resources, potential project impacts, and proposed mitigation measures associated with this pier construction project have been fully documented in the Notice of Intent. The project should be reviewed favorably in consideration of the following:

- The existing dock consisting of a ramp, walkway and floats will be improved by replacement with a reconstructed more resilient dock.
- Pile spacing will be increased.
- The walkway will be elevated to conform to DMF policy. The existing dock does not conform to DMF policy.
- The walkway will be elevated to provide for public access. The existing dock does not provide proper elevation for public access.
- Piles will be driven from a barge operating in Eel Pond during times of higher tides in such a manner that contact with the substrate will be avoided as much as possible.

In light of these considerations, the Falmouth Select Board is urged to approve the proposed reconstruction and improvements to the existing dock system.

ATTACHMENT B

ORDER OF CONDITIONS 25-4740

Bk 35161 Pg295 #28441
06-02-2022 @ 08:02a

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 5 – Order of Conditions

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:
25-4740
MassDEP File #

eDEP Transaction #

Falmouth
City/Town

A. General Information

Please note: this form has been modified with added space to accommodate the Registry of Deeds Requirements

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

1. From: Falmouth
Conservation Commission

2. This issuance is for (check one): a. ☒ Order of Conditions b. ☐ Amended Order of Conditions

3. To: Applicant:

Stephen
a. First Name

Proia
b. Last Name

c. Organization

1106 Winnsboro Court
d. Mailing Address

Allen
e. City/Town

TX
f. State

75013
g. Zip Code

4. Property Owner (if different from applicant):

a. First Name

b. Last Name

c. Organization

d. Mailing Address

e. City/Town

f. State

g. Zip Code

5. Project Location:

317 Edgewater Dr West
a. Street Address

Falmouth
b. City/Town

41 06
c. Assessors Map/Plat Number

065A 000
d. Parcel/Lot Number

Latitude and Longitude, if known: d m s
d. Latitude

d m s
e. Longitude

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

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A. General Information (cont.)

6. Property recorded at the Registry of Deeds for (attach additional information if more than one parcel):

Barnstable
a. County

b. Certificate Number (if registered land)

30498
c. Book

119
d. Page

7. Dates: 03/23/2022 a. Date Notice of Intent Filed; 4/27/2022 b. Date Public Hearing Closed; 5/26/2022 c. Date of Issuance

8. Final Approved Plans and Other Documents (attach additional plan or document references as needed):

Site Plan - Proposed Dock Reconstruction
a. Plan Title

Falmouth Engineering, Inc
b. Prepared By

Michael J Borselli, PE & Gary S Labrie, PLS

~~4/20/2022~~ 4/19/22
d. Final Revision Date

1"=20'
e. Scale

f. Additional Plan or Document Title

g. Date

B. Findings

1. Findings pursuant to the Massachusetts Wetlands Protection Act:

Following the review of the above-referenced Notice of Intent and based on the information provided in this application and presented at the public hearing, this Commission finds that the areas in which work is proposed is significant to the following interests of the Wetlands Protection Act (the Act). Check all that apply:

a. ☐ Public Water Supply b. ☐ Land Containing Shellfish c. ☐ Prevention of Pollution

d. ☐ Private Water Supply e. ☐ Fisheries f. ☐ Protection of Wildlife Habitat

g. ☐ Groundwater Supply h. ☐ Storm Damage Prevention i. ☐ Flood Control

2. This Commission hereby finds the project, as proposed, is: (check one of the following boxes)

Approved subject to:

a. ☒ the following conditions which are necessary in accordance with the performance standards set forth in the wetlands regulations. This Commission orders that all work shall be performed in accordance with the Notice of Intent referenced above, the following General Conditions, and any other special conditions attached to this Order. To the extent that the following conditions modify or differ from the plans, specifications, or other proposals submitted with the Notice of Intent, these conditions shall control.

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B. Findings (cont.)

Denied because:

b. ☐ the proposed work cannot be conditioned to meet the performance standards set forth in the wetland regulations. Therefore, work on this project may not go forward unless and until a new Notice of Intent is submitted which provides measures which are adequate to protect the interests of the Act, and a final Order of Conditions is issued. **A description of the performance standards which the proposed work cannot meet is attached to this Order.**

c. ☐ the information submitted by the applicant is not sufficient to describe the site, the work, or the effect of the work on the interests identified in the Wetlands Protection Act. Therefore, work on this project may not go forward unless and until a revised Notice of Intent is submitted which provides sufficient information and includes measures which are adequate to protect the Act's interests, and a final Order of Conditions is issued. **A description of the specific information which is lacking and why it is necessary is attached to this Order as per 310 CMR 10.05(6)(c).**

3. ☐ Buffer Zone Impacts: Shortest distance between limit of project disturbance and the wetland resource area specified in 310 CMR 10.02(1)(a) _____ a. linear feet

Inland Resource Area Impacts: Check all that apply below. (For Approvals Only)

Resource Area	Proposed Alteration	Permitted Alteration	Proposed Replacement	Permitted Replacement
4. ☐ Bank	a. linear feet	b. linear feet	c. linear feet	d. linear feet
5. ☐ Bordering Vegetated Wetland	a. square feet	b. square feet	c. square feet	d. square feet
6. ☐ Land Under Waterbodies and Waterways	a. square feet	b. square feet	c. square feet	d. square feet
	e. c/y dredged	f. c/y dredged		
7. ☐ Bordering Land Subject to Flooding	a. square feet	b. square feet	c. square feet	d. square feet
Cubic Feet Flood Storage	e. cubic feet	f. cubic feet	g. cubic feet	h. cubic feet
8. ☐ Isolated Land Subject to Flooding	a. square feet	b. square feet		
Cubic Feet Flood Storage	c. cubic feet	d. cubic feet	e. cubic feet	f. cubic feet
9. ☐ Riverfront Area	a. total sq. feet	b. total sq. feet		
Sq ft within 100 ft	c. square feet	d. square feet	e. square feet	f. square feet
Sq ft between 100-200 ft	g. square feet	h. square feet	i. square feet	j. square feet

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B. Findings (cont.)

Coastal Resource Area Impacts: Check all that apply below. (For Approvals Only)

	Proposed Alteration	Permitted Alteration	Proposed Replacement	Permitted Replacement
10. ☐ Designated Port Areas	Indicate size under Land Under the Ocean, below			
11. ☒ Land Under the Ocean	360 +/- a. square feet	b. square feet		
	c. c/y dredged	d. c/y dredged		
12. ☐ Barrier Beaches	Indicate size under Coastal Beaches and/or Coastal Dunes below			
13. ☐ Coastal Beaches	a. square feet	b. square feet	c. cu yd nourishment	d. cu yd nourishment
14. ☐ Coastal Dunes	a. square feet	b. square feet	c. cu yd nourishment	d. cu yd nourishment
15. ☐ Coastal Banks	a. linear feet	b. linear feet		
16. ☐ Rocky Intertidal Shores	a. square feet	b. square feet		
17. ☒ Salt Marshes	50 +/- a. square feet	b. square feet	c. square feet	d. square feet
18. ☐ Land Under Salt Ponds	a. square feet	b. square feet		
	c. c/y dredged	d. c/y dredged		
19. ☒ Land Containing Shellfish	360 +/- a. square feet	b. square feet	c. square feet	d. square feet
20. ☐ Fish Runs	Indicate size under Coastal Banks, Inland Bank, Land Under the Ocean, and/or inland Land Under Waterbodies and Waterways, above			
	a. c/y dredged	b. c/y dredged		
21. ☒ Land Subject to Coastal Storm Flowage	500 +/- a. square feet	b. square feet		
22. ☐ Riverfront Area	a. total sq. feet	b. total sq. feet		
Sq ft within 100 ft	c. square feet	d. square feet	e. square feet	f. square feet
Sq ft between 100-200 ft	g. square feet	h. square feet	i. square feet	j. square feet

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B. Findings (cont.)

* #23. If the project is for the purpose of restoring or enhancing a wetland resource area in addition to the square footage that has been entered in Section B.5.c (BVW) or B.17.c (Salt Marsh) above, please enter the additional amount here.

23. ☐ Restoration/Enhancement *:

a. square feet of BVW | b. square feet of salt marsh

24. ☐ Stream Crossing(s):

a. number of new stream crossings | b. number of replacement stream crossings

C. General Conditions Under Massachusetts Wetlands Protection Act

The following conditions are only applicable to Approved projects.

1. Failure to comply with all conditions stated herein, and with all related statutes and other regulatory measures, shall be deemed cause to revoke or modify this Order.
2. The Order does not grant any property rights or any exclusive privileges; it does not authorize any injury to private property or invasion of private rights.
3. This Order does not relieve the permittee or any other person of the necessity of complying with all other applicable federal, state, or local statutes, ordinances, bylaws, or regulations.
4. The work authorized hereunder shall be completed within three years from the date of this Order unless either of the following apply:
   a. The work is a maintenance dredging project as provided for in the Act; or
   b. The time for completion has been extended to a specified date more than three years, but less than five years, from the date of issuance. If this Order is intended to be valid for more than three years, the extension date and the special circumstances warranting the extended time period are set forth as a special condition in this Order.
   c. If the work is for a Test Project, this Order of Conditions shall be valid for no more than one year.
5. This Order may be extended by the issuing authority for one or more periods of up to three years each upon application to the issuing authority at least 30 days prior to the expiration date of the Order. An Order of Conditions for a Test Project may be extended for one additional year only upon written application by the applicant, subject to the provisions of 310 CMR 10.05(11)(f).
6. If this Order constitutes an Amended Order of Conditions, this Amended Order of Conditions does not extend the issuance date of the original Final Order of Conditions and the Order will expire on _____ unless extended in writing by the Department.
7. Any fill used in connection with this project shall be clean fill. Any fill shall contain no trash, refuse, rubbish, or debris, including but not limited to lumber, bricks, plaster, wire, lath, paper, cardboard, pipe, tires, ashes, refrigerators, motor vehicles, or parts of any of the foregoing.

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C. General Conditions Under Massachusetts Wetlands Protection Act

8. This Order is not final until all administrative appeal periods from this Order have elapsed, or if such an appeal has been taken, until all proceedings before the Department have been completed.

9. No work shall be undertaken until the Order has become final and then has been recorded in the Registry of Deeds or the Land Court for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, the Final Order shall also be noted in the Registry's Grantor Index under the name of the owner of the land upon which the proposed work is to be done. In the case of the registered land, the Final Order shall also be noted on the Land Court Certificate of Title of the owner of the land upon which the proposed work is done. The recording information shall be submitted to the Conservation Commission on the form at the end of this Order, which form must be stamped by the Registry of Deeds, prior to the commencement of work.

10. A sign shall be displayed at the site not less then two square feet or more than three square feet in size bearing the words,

    "Massachusetts Department of Environmental Protection" [or, "MassDEP"]

    "File Number 25-4740 "

11. Where the Department of Environmental Protection is requested to issue a Superseding Order, the Conservation Commission shall be a party to all agency proceedings and hearings before MassDEP.

12. Upon completion of the work described herein, the applicant shall submit a Request for Certificate of Compliance (WPA Form 8A) to the Conservation Commission.

13. The work shall conform to the plans and special conditions referenced in this order.

14. Any change to the plans identified in Condition #13 above shall require the applicant to inquire of the Conservation Commission in writing whether the change is significant enough to require the filing of a new Notice of Intent.

15. The Agent or members of the Conservation Commission and the Department of Environmental Protection shall have the right to enter and inspect the area subject to this Order at reasonable hours to evaluate compliance with the conditions stated in this Order, and may require the submittal of any data deemed necessary by the Conservation Commission or Department for that evaluation.

16. This Order of Conditions shall apply to any successor in interest or successor in control of the property subject to this Order and to any contractor or other person performing work conditioned by this Order.

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C. General Conditions Under Massachusetts Wetlands Protection Act (cont.)

17. Prior to the start of work, and if the project involves work adjacent to a Bordering Vegetated Wetland, the boundary of the wetland in the vicinity of the proposed work area shall be marked by wooden stakes or flagging. Once in place, the wetland boundary markers shall be maintained until a Certificate of Compliance has been issued by the Conservation Commission.

18. All sedimentation barriers shall be maintained in good repair until all disturbed areas have been fully stabilized with vegetation or other means. At no time shall sediments be deposited in a wetland or water body. During construction, the applicant or his/her designee shall inspect the erosion controls on a daily basis and shall remove accumulated sediments as needed. The applicant shall immediately control any erosion problems that occur at the site and shall also immediately notify the Conservation Commission, which reserves the right to require additional erosion and/or damage prevention controls it may deem necessary. Sedimentation barriers shall serve as the limit of work unless another limit of work line has been approved by this Order.

19. The work associated with this Order (the "Project")
    (1) ☐ is subject to the Massachusetts Stormwater Standards
    (2) ☒ is NOT subject to the Massachusetts Stormwater Standards

    If the work is subject to the Stormwater Standards, then the project is subject to the following conditions:

    a) All work, including site preparation, land disturbance, construction and redevelopment, shall be implemented in accordance with the construction period pollution prevention and erosion and sedimentation control plan and, if applicable, the Stormwater Pollution Prevention Plan required by the National Pollution Discharge Elimination System Construction General Permit as required by Stormwater Condition 8. Construction period erosion, sedimentation and pollution control measures and best management practices (BMPs) shall remain in place until the site is fully stabilized.

    b) No stormwater runoff may be discharged to the post-construction stormwater BMPs unless and until a Registered Professional Engineer provides a Certification that:
    i. all construction period BMPs have been removed or will be removed by a date certain specified in the Certification. For any construction period BMPs intended to be converted to post construction operation for stormwater attenuation, recharge, and/or treatment, the conversion is allowed by the MassDEP Stormwater Handbook BMP specifications and that the BMP has been properly cleaned or prepared for post construction operation, including removal of all construction period sediment trapped in inlet and outlet control structures;
    ii. as-built final construction BMP plans are included, signed and stamped by a Registered Professional Engineer, certifying the site is fully stabilized;
    iii. any illicit discharges to the stormwater management system have been removed, as per the requirements of Stormwater Standard 10;

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C. General Conditions Under Massachusetts Wetlands Protection Act (cont.)

iv. all post-construction stormwater BMPs are installed in accordance with the plans (including all planting plans) approved by the issuing authority, and have been inspected to ensure that they are not damaged and that they are in proper working condition;

v. any vegetation associated with post-construction BMPs is suitably established to withstand erosion.

c) The landowner is responsible for BMP maintenance until the issuing authority is notified that another party has legally assumed responsibility for BMP maintenance. Prior to requesting a Certificate of Compliance, or Partial Certificate of Compliance, the responsible party (defined in General Condition 18(e)) shall execute and submit to the issuing authority an Operation and Maintenance Compliance Statement ("O&M Statement) for the Stormwater BMPs identifying the party responsible for implementing the stormwater BMP Operation and Maintenance Plan ("O&M Plan") and certifying the following:

i.) the O&M Plan is complete and will be implemented upon receipt of the Certificate of Compliance, and

ii.) the future responsible parties shall be notified in writing of their ongoing legal responsibility to operate and maintain the stormwater management BMPs and implement the Stormwater Pollution Prevention Plan.

d) Post-construction pollution prevention and source control shall be implemented in accordance with the long-term pollution prevention plan section of the approved Stormwater Report and, if applicable, the Stormwater Pollution Prevention Plan required by the National Pollution Discharge Elimination System Multi-Sector General Permit.

e) Unless and until another party accepts responsibility, the landowner, or owner of any drainage easement, assumes responsibility for maintaining each BMP. To overcome this presumption, the landowner of the property must submit to the issuing authority a legally binding agreement of record, acceptable to the issuing authority, evidencing that another entity has accepted responsibility for maintaining the BMP, and that the proposed responsible party shall be treated as a permittee for purposes of implementing the requirements of Conditions 18(f) through 18(k) with respect to that BMP. Any failure of the proposed responsible party to implement the requirements of Conditions 18(f) through 18(k) with respect to that BMP shall be a violation of the Order of Conditions or Certificate of Compliance. In the case of stormwater BMPs that are serving more than one lot, the legally binding agreement shall also identify the lots that will be serviced by the stormwater BMPs. A plan and easement deed that grants the responsible party access to perform the required operation and maintenance must be submitted along with the legally binding agreement.

f) The responsible party shall operate and maintain all stormwater BMPs in accordance with the design plans, the O&M Plan, and the requirements of the Massachusetts Stormwater Handbook.

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C. General Conditions Under Massachusetts Wetlands Protection Act (cont.)

g) The responsible party shall:
1. Maintain an operation and maintenance log for the last three (3) consecutive calendar years of inspections, repairs, maintenance and/or replacement of the stormwater management system or any part thereof, and disposal (for disposal the log shall indicate the type of material and the disposal location);
2. Make the maintenance log available to MassDEP and the Conservation Commission ("Commission") upon request; and
3. Allow members and agents of the MassDEP and the Commission to enter and inspect the site to evaluate and ensure that the responsible party is in compliance with the requirements for each BMP established in the O&M Plan approved by the issuing authority.

h) All sediment or other contaminants removed from stormwater BMPs shall be disposed of in accordance with all applicable federal, state, and local laws and regulations.

i) Illicit discharges to the stormwater management system as defined in 310 CMR 10.04 are prohibited.

j) The stormwater management system approved in the Order of Conditions shall not be changed without the prior written approval of the issuing authority.

k) Areas designated as qualifying pervious areas for the purpose of the Low Impact Site Design Credit (as defined in the MassDEP Stormwater Handbook, Volume 3, Chapter 1, Low Impact Development Site Design Credits) shall not be altered without the prior written approval of the issuing authority.

l) Access for maintenance, repair, and/or replacement of BMPs shall not be withheld. Any fencing constructed around stormwater BMPs shall include access gates and shall be at least six inches above grade to allow for wildlife passage.

Special Conditions (if you need more space for additional conditions, please attach a text document):

20. For Test Projects subject to 310 CMR 10.05(11), the applicant shall also implement the monitoring plan and the restoration plan submitted with the Notice of Intent. If the conservation commission or Department determines that the Test Project threatens the public health, safety or the environment, the applicant shall implement the removal plan submitted with the Notice of Intent or modify the project as directed by the conservation commission or the Department.

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D. Findings Under Municipal Wetlands Bylaw or Ordinance

1. Is a municipal wetlands bylaw or ordinance applicable? ☒ Yes ☐ No

2. The Falmouth Conservation Commission hereby finds (check one that applies):

   a. ☐ that the proposed work cannot be conditioned to meet the standards set forth in a municipal ordinance or bylaw, specifically:

   _____ _____
   1. Municipal Ordinance or Bylaw 2. Citation

   Therefore, work on this project may not go forward unless and until a revised Notice of Intent is submitted which provides measures which are adequate to meet these standards, and a final Order of Conditions is issued.

   b. ☒ that the following additional conditions are necessary to comply with a municipal ordinance or bylaw:

   _____ 10.00
   1. Municipal Ordinance or Bylaw 2. Citation

3. The Commission orders that all work shall be performed in accordance with the following conditions and with the Notice of Intent referenced above. To the extent that the following conditions modify or differ from the plans, specifications, or other proposals submitted with the Notice of Intent, the conditions shall control.
   The special conditions relating to municipal ordinance or bylaw are as follows (if you need more space for additional conditions, attach a text document):

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 5 – Order of Conditions

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:
25-4740
MassDEP File #

eDEP Transaction #

Falmouth
City/Town

E. Signatures

This Order is valid for three years, unless otherwise specified as a special condition pursuant to General Conditions #4, from the date of issuance.

5/26/2022
1. Date of Issuance

Please indicate the number of members who will sign this form.
This Order must be signed by a majority of the Conservation Commission.

4
2. Number of Signers

The Order must be mailed by certified mail (return receipt requested) or hand delivered to the applicant. A copy also must be mailed or hand delivered at the same time to the appropriate Department of Environmental Protection Regional Office, if not filing electronically, and the property owner, if different from applicant.

Signature	Printed Name
Jennifer Lincoln	Jennifer Lincoln, Conservation Administrator
Jennifer Lincoln	Jamie Mathews, Chair
Jennifer Lincoln	Kevin O'Brien
Jennifer Lincoln	Elizabeth Gladfelter
Jennifer Lincoln	Peter Walsh

☒ by hand delivery on
5-26-22 Erica Buselli
Date
Falmouth Engineering, Inc.

☐ by certified mail, return receipt requested, on
Date ~~# 7010 2780 0000 0046 4919~~

For Signature Authorization see
Doc: 1,393,706
BARNSTABLE LAND COURT REGISTRY

Falmouth Conservation Commission

59 TOWN HALL SQUARE, FALMOUTH, MASSACHUSETTS 02540
(508) 495-7445

Name: Stephen Proia
Address: 317 Edgewater Dr West, Falmouth
DEP #: 25-4740

FINDINGS:

1. The applicant proposes to reconstruct the existing pier, ramp and float, license #14510 in accordance with Division of Marine Fisheries guidelines and recommendations.

2. Resource areas onsite and within 100 feet of the proposed project include Land Under Salt Pond, Land Under Ocean, Salt Marsh, Coastal Bank, Land Subject to Coastal Storm Flowage (LSCSF), Land Containing Shellfish, and Resource Area Buffer.

STANDARD CONDITIONS

1. Permission is granted to Stephen Proia, to reconstruct and maintain a pier, ramp and float at 317 Edgewater Drive West, Falmouth, MA according to the plans by Falmouth Engineering, Inc., dated March 21, 2022 and revised April 19, 2022 and subject to the following Standard and Special Conditions.

2. This Order is issued pursuant to Mass. General Laws, Chapter 131, sec. 40, the Wetlands Protection Act and Chapter 235 of the Code of Falmouth the Wetlands Bylaw. The Wetlands By-law is more stringent than the Wetlands Protection Act as permitted by that Act. The Conservation Commission reserves the right to impose additional or other conditions to protect the Interests of the Massachusetts Wetlands Protection Act and Falmouth Wetlands Bylaw.

3. All work shall be done according to the plan of reference noted in paragraph 1. Any proposed changes will require that the applicant first obtain all necessary permits and approvals from the Conservation Commission. Any changes undertaken without obtaining approval from the Commission are not permitted and subject to an Enforcement Order. Violations of the Wetlands Protection Act are subject to a maximum fine of $25,000.00 per day.

4. The determinations of the Falmouth Conservation Commission are made solely to determine issues arising under the Massachusetts Wetlands Protection Act and the Town of Falmouth Wetlands By-Law, and are therefore concerned exclusively with the question whether any proposed activity will have an adverse effect on the wetlands resource interests listed in the applicable statutes, regulations, by-laws and rules. Nothing contained in this determination is intended in any way to grant to any person any title, easement or other interest in lands, public or private, and the Falmouth Conservation Commission is without legal authority to make any grant of title, easement or other property interest, or to make any determination of property interests. See Tindley v. D.E.Q.E. 10 Mass. App. Ct. 623 (1980).

5. By the acceptance and recording of this Order, the applicant hereby grants the commission and its duly authorized agents the right to enter onto the land governed by this Order to examine the project and ensure Compliance. Such visits shall be made in a reasonable manner.

6. Any work taking place prior to all administrative and legal appeal periods expiring or during the pendency of any such appeal is at the risk of the applicant and/or owner of the property. At the risk of means that should an administrative agency or court find this order and permit were granted in error all work may have to be restored to its original condition (at the time work was instituted) at the expense of the applicant and/or owner.

7. Issuance of this Order of Conditions does not relieve the applicant from obtaining all other necessary municipal, county, state or federal permits, permission or other approvals required.

8. The Conservation Commission reserves the right to impose additional or other conditions to protect the Interests of the Massachusetts Wetlands Protection Act and Falmouth Wetlands Bylaw.

9. Prior to any work commencing:

    a. Proof of recording of this Order of Conditions including the plan of reference at the Barnstable County Registry of Deeds must be received by the Conservation Commission.
    b. At least 10 days advance **written** notification shall be provided to the Conservation Commission.
    c. The Town of Falmouth Conservation Commission Pier Maintenance or Construction Form for Marine Contractors (which ever applies) must be completed and returned to the Conservation Commission.
    d. Copies of any other permits and licenses including building permit, special permit, variances, and Chapter 91 license shall be submitted to Conservation Commission.
    e. The DEP File Number shall be posted on a sign on the street side of the lot and maintained in a visible condition throughout the project. A copy of this Order of Conditions is to be posted onsite, to be maintained in a visible location and condition throughout the project. Copies of this Order of Conditions are also to be provided to all outside contractors, to be kept onsite during work at all times.
    f. Photographs shall be taken within 20 feet parallel to both sides of the dock alignment of any areas crossing freshwater wetlands or salt marsh. Post construction photographs shall be taken and submitted to the Conservation Commission. Any areas of wetland that have been damaged or destroyed shall be restored immediately to the satisfaction of the Conservation Commission.

10. Unless otherwise specified, all Conditions cited herein will apply to any and all Amendments to this Order of Conditions.

11. The applicant shall use all means to effectively prevent erosion into the wetland or other

Resource Area and to encourage the growth of protective vegetation on ground draining into the wetlands or other Resource Areas.

12. All cuttings and debris from permitted clearing of the lot prior to construction shall be removed offsite immediately. No debris can be stored, even temporarily, in a resource area or within 100 feet of any resource area.

13. All fill or excavated material not required to backfill and grade to the approved plan of reference shall be immediately removed offsite or to an appropriate upland location more than 100 feet from any resource area.

14. No creosote-treated wood or CCA treated wood may be used. The use of non-toxic materials is mandatory and shall be certified in writing by a professional engineer.

15. Equipment, vehicles or other objects are **not** allowed to be placed or stored on any wetland or resource area at any time.

16. Any additional work, not identified at the time this permit was granted, within the Limit of Work , in a resource area or within 100 feet of any resource area will require that the applicant first obtain all necessary permits from the Conservation Commission before proceeding with such work.

17. All work shall be done by hand or from a barge-supported crane during high tide.

18. Any barge used for this project must float at all times.

19. Piles shall be driven, not jetted.

20. All decking surfaces crossing Salt Marsh shall be constructed per design criteria per application.

21. All seasonal floats shall be stored in a predetermined upland location per application and the plan of reference.

22. All construction debris shall be removed off-site to an approved upland disposal site.

23. All disturbed areas are to be re-vegetated using either native plant species (or drought-tolerant fescues on 8-10 inches of loam). Re-vegetation is to be done immediately following completion of construction.

24. The street number and address and the DEP number of the dock approved by this Order shall be affixed to the seaward face (end) of the dock using three inch (3") digits of bright contrasting color. This number shall be maintained in clear visible condition throughout the lifetime of the dock.

25. Water lines and attached hoses shall have nozzles attached.

26. Boats shall only be tied up in those areas designated as the mooring field on the plan of reference.

27. Boats at the dock shall not be allowed to leak oil or other pollutants into the water, nor shall oil or fuel be stored on the dock or pier.

28. Motorboats shall not be run in gear while tied to the dock, since prop wash disturbs shellfish beds, stirs up sediment and causes bank erosion.

29. No Certificate of Compliance will be issued until the entire project, including landscaping, is completed and the site is permanently stabilized with vegetation.

30. Photographic evidence of winter storage location of floats or seasonal dock parts on uplands shall be presented to the Conservation Commission within one year of completion of structure.

31. This Order of Conditions will not be fully complied with unless and until a duly executed Certificate of Compliance is recorded or registered, as appropriate, in Barnstable Registry of Deeds. A request for a Certificate of Compliance must be accompanied by and "Existing Conditions" plan and Engineers written certification of compliance certifying the dock or pier has been constructed and completed in accordance with the conditions contained herein and notes any deviation from the approved plans.

32. If this dock and pier is operated in such a fashion as to cause actual damage to resource areas, including prop dredging, you may be ordered, at your expense, to remove a portion or the entire dock and pier. You have a right to hearing prior to any such order being issued.

33. The dock must be properly maintained in a safe and functioning manner. Docks and piers are coastal structures requiring continual maintenance or else lend themselves to causing significant damage to property at the time of storms. If not properly maintained docks and piers pose a significant danger to public safety. Docks and piers not properly maintained, which in the opinion the Commission have a potential of being destroyed in a storm, may be ordered removed at the owner's expense. You have a right to hearing prior to any such order being issued.

SPECIAL CONDITIONS:

1. All floats and piers if designed to be in continual use shall have adequate bubblers protecting piles during winter months.

VOTE AUTHORIZING SIGNATURES OF COMMISSIONERS

In accordance with the unanimous vote of the Falmouth Conservation Commission, Jennifer

L. Lincoln, Conservation Administrator is authorized to sign on behalf of each individual Commissioner as reflected in the recorded Land Court Document: 1,393,706 dated 04-03-2020 9:24 Barnstable Land Court Registry

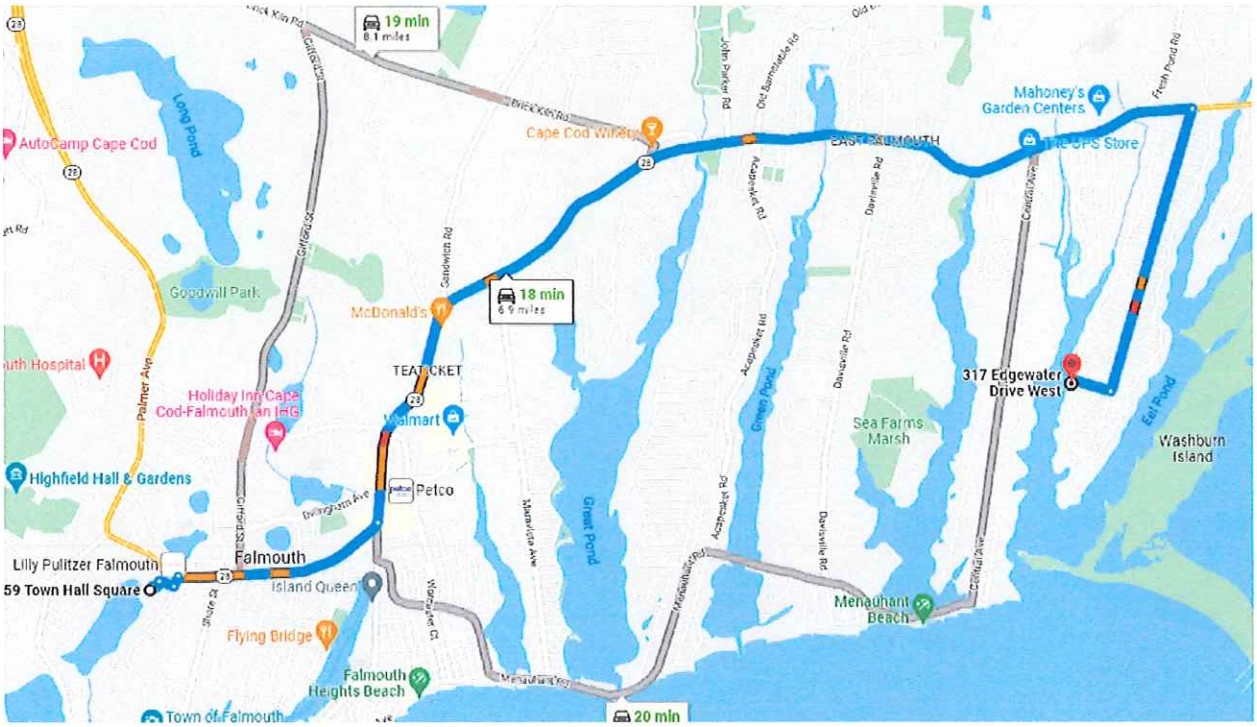
ATTACHMENT C

DRIVING DIRECTIONS TO SITE

Driving Directions to Site

317 Edgewater Drive West East Falmouth

From Town Hall, turn right onto Main Street and continue to Route 28 for about 5.3 miles. Turn right onto Seacoast Shores Blvd. and continue for 1.2 miles. Turn right onto Fairfield Dr. Follow to the end and turn left onto Edgewater Drive West. Number 317 Edgewater Drive West is on your right.



ATTACHMENT D

HARBORMASTER COMMENTS

Mike Borselli

From: Gregg Fraser <gregg.fraser@falmouthma.gov>
Sent: Monday, March 14, 2022 10:22 AM
To: Mike Borselli
Cc: Falmouth Conservation Commission
Subject: RE: Proposed Dock reconstruction - 317 Edgewater Drive West

Hi Mike,

I have no objection to this proposal given there is no increase in the proposed dock footprint.

Thanks,
Gregg

From: Mike Borselli <mike@falmouthengineering.com>
Sent: Saturday, March 12, 2022 2:55 PM
To: Gregg Fraser <gregg.fraser@falmouthma.gov>
Subject: FW: Proposed Dock reconstruction - 317 Edgewater Drive West

Hi Greg,

I hope all is well.

Did you get a chance to review the dock proposal below?

Please get back to me at your earliest convenience.

Thank you.

Michael J. Borselli, P.E.
President
Falmouth Engineering, Inc.
17 Academy Lane, Suite 200
Falmouth, MA 02540
508.495.1225
www.falmouthengineering.com

From: Mike Borselli
Sent: Friday, March 4, 2022 3:30 PM
To: 'Gregg Fraser' <gregg.fraser@falmouthma.gov>
Cc: Jennifer Lincoln <jennifer.lincoln@falmouthma.gov>
Subject: Proposed Dock reconstruction - 317 Edgewater Drive West

Hi Greg,

Attached is a plan showing a proposed dock reconstruction at the above referenced property. In addition, I attach an aerial photo with the existing dock highlighted in red.

The applicant is proposing to reconstruct the existing dock to make it more resilient. He proposes to replace galvanized pipes with timber piles as well as elevate the dock for public access and to meet DMF standards. The dock will be in the same alignment and will not increase in length.

As you know, we are required to submit the plan to you for review and comment and include your comments in our Notice of Intent application.

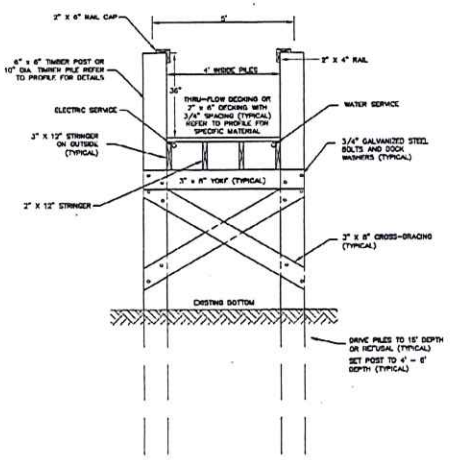
Please review the attached plan and aerial photo and comment at your earliest convenience.

Thank you.

Michael J. Borselli, P.E.
President
Falmouth Engineering, Inc.
17 Academy Lane, Suite 200
Falmouth, MA 02540
508.495.1225
www.falmouthengineering.com

ATTACHMENT E

PLAN OF PROPOSED DOCK RECONSTRUCTION



TYPICAL PIER CROSS-SECTION

SCALE: 1/2" = 1' - 0"

LEGEND

- EXISTING 2' CONTOUR
- EXISTING 10' CONTOUR
- +10.5 EXISTING SPOT GRADE
- +12.0 PROPOSED SPOT ELEVATION
- EXISTING UTILITY POLE
- EXISTING TREE

CONSTRUCTION NOTES:

1. ALL WOOD MATERIALS SHALL BE CUT IN THE UPLAND.
2. ALL WOOD MATERIALS SHALL BE NON CCA TREATED.
3. PILES SHALL BE DRIVEN, NOT JETTED, TO A MINIMUM DEPTH OF 15' OR REFUSAL.
4. FASTENING OF WOOD MATERIALS SHALL BE BY 3/4" BOLTS, NUTS AND DOCK WASHERS, HURRICANE CLIPS OR THRU BOLTS FOR STRINGER CONNECTION TO YOKES OR AS INDICATED ON THE PLANS.
5. ALL DOCK LIGHTING SHALL NOT EXCEED 0.2 FOOTCANDLE (Fc).

PIER PROFILE

SCALE: 1/4" = 1' - 0"

GENERAL NOTES:

1. ASSESSOR'S INFORMATION: 41 06 065A 000
2. FLOOD ZONES: AC12 & VC14 (FEMA MAP 25001C0733J)
3. ZONING DISTRICT: RC
4. WIND EXPOSURE CATEGORY: C
5. LOT COVERAGE BY:
   A. STRUCTURES: 2,165 S.F./18,700 S.F. = 11.6% < 20%
   B. STRUCTURES/PARKING/PAVING: 2,813 S.F./18,700 S.F. = 15.0% < 40%
6. WIND BORNE DEBRIS REGION: HIGH
7. STREET ADDRESS: EDGEWATER DRIVE WEST
8. HOUSE NUMBER: 317
9. TOPOGRAPHIC INFORMATION COMPILED FROM AN ON THE GROUND SURVEY
10. ELEVATIONS SHOWN ARE BASED ON NORTH AMERICAN VERTICAL DATUM 1988.
11. ELEVATIONS IN PARENTHESIS ARE REFERENCED TO MEAN LOW WATER.

SCALE: 1 INCH = 20 FEET

DATE	REVISION
4/19/22	ADD COASTAL BANK, STAIR NOTE, FLOAT STOPS, REVISE WALKWAY HEIGHT.

SITE PLAN – PROPOSED DOCK RECONSTRUCTION

FOR #317 EDGEWATER DRIVE WEST

PREPARED FOR

STEPHEN PROIA

IN

FALMOUTH MA

PLAN DATE: MARCH 21, 2022 PLAN SCALE: 1" = 20'

CIVIL ENGINEERING
WASTEWATER DESIGN
TITLE 5 PLOT PLANS
LAND USE PLANNING
FALMOUTH ENGINEERING
WETLANDS PERMITTING
COASTAL ENGINEERING
PIERS AND DOCKS
COMMERCIAL/RESIDENTIAL
Serving Cape Cod and Southeastern Massachusetts
17 ACADEMY LANE, SUITE 200 – FALMOUTH, MA – 02540 – 508.495.1225

PROJECT NUMBER: 21059 | CAD FILE NAME: 21059SP | DRAWN BY: L.M./M.B. | SHEET 1 OF 1

BUSINESS

1. Report – Recreation Committee (15 minutes)

Recreation Committee Report

Recreation Department Website Statement

"The Falmouth Recreation Department has adopted a philosophy for all of its programs emphasizing a safe and healthy environment that provides sportsmanship, respect, responsibility, and teamwork while always increasing positive self-esteem. We feel through this philosophy winning and losing will not be as important as learning and fun for all."

Recreation Dept. Staff

Joe Olenick, Director
Assistant Director – Vacant
Lindsey Demers, Senior Office Asst.
Adam Souweine, Program Director
Tracy Trotto, Program Director
Program Director - Vacant
Office Assistant – out work injury

Recreation Committee Members

Order of Members by Years of Service

Sandy Cuny, Vice Chair
Patricia Morano
Robert Brown, Chair
Michael Heylin
Scott Ghelfi
Richard Boles
Thomas Zine

Meetings

Falmouth Recreation Committee meets on the Second Wednesday of the Month at 7:00 PM at the Gus Canty Community Center 790 Main Street, Falmouth, MA 02540

Meetings are in Person. The Committee met via Zoom successfully and transition to in person per Town policy and Committee comfort.

Zoom meetings-maintained Quorums and allowed public and government contributors to come to the meetings conveniently.

Quorums for Meeting are rarely a problem. The Committee holds special meetings when necessary and requested by Director Joe Olenick.

Our Select Board liaison is Vice Chair, Onjalé Scott Price.

Recreation Committee Mission

A Recreation Committee of seven (7) members shall be appointed. The Recreation Committee shall be responsible for recommending policies to the Select Board regarding comprehensive year-round, indoor-outdoor recreation policies and programs. Such policies and programs shall be designed to meet the recreational needs of children, youth, adults and the elderly.

Recreation Dept. is More than Sports!

Towns people know the Recreation Department hosts and manages a plenty of youth and adult sports activities. What may not be known is the Recreation Dept. hosts science, arts, crafts, Boy Scouts, Girl Scout (cookies), community service, magic shows, small animal show, goofy fun and adult events too. There is a very popular teen center for our children to socialize, play games and enjoy life.

There is the annual highly popular "Princess Ball" Father\Guardian Daughter Dance and the Mother\ Son Guardian Dance.

There is the annual highly attended "After Prom" event which transforms the Recreation Dept. to the chosen senior theme atmosphere which is highly cherished in Town.

On Friday Afternoons during the school year after dismissal, the Recreation Dept. becomes the most popular square feet for safe fun in Falmouth for middle school students and teenagers. The building logs in 65 to over a 100 children on school day Fridays. Full Staffing is a must these days.

Recreation Staff and Salary Issues

In the last six years, staff turnover of our Program Directors increased since the former Town Manager discontinued the Assistant Director position and the associated salary. Recreation staff no longer had a career path to advance their position with the Town. Soon after the position was known not to be filled, two Program Directors found better jobs. One became a Recreation Director in another Town. Since then, three more additional Program Directors resigned. Two of the three went to other Cape Cod Town Recreation programs for better salary, career advancement and educational opportunities than Falmouth can offer. The other employee went to higher paying job in a restaurant. The majority of the program directors have part time jobs to make ends meet due to salary is not enough for affordable housing.

The Recreation Committee strongly recommends higher salary for all Recreation staff full time, part time and summer camp employees to hire to keep the Department open and safe place to come, work and keep our children, adults and elders active, socializing and safe.

Staffing Issues equals Reduced Hours

Website and Facebook Notice.

6-28-2022

Gus Canty Community Center Notice

Due to temporary staffing vacancy, the Gus Canty Community Center will be closed on Monday evenings from July 11, 2022 through September 5th. We hope to be open Monday nights again starting on September 12, 2022 subject to available staff. We regret having to reduce hours of operation on a temporary basis and look forward to restoring these hours as soon as we have sufficient staff to do so. Thank you for understanding.

Recreation Department Building Issues

Recreation Committee requests the Town to professionally inspect the building and budget the deferred maintenance problems and renovation is needed in the high use bathrooms and an accessibility evaluation.

The Roof still has unending issues of rainwater causing floor damage which needs a resolution. The funded Gymnasium floor upgrade before inflation is on hold due to roof rain damage.

Recreation Committee has sent a letter to DPW and Town Manager regarding the issues earlier in the year.

Finally, the building needs new furniture in office and teen center.

Anniversary of the ADA Act - July 26

Falmouth has made some slow accessibility progress at Upper Trotting Park Fields.

Recreation Committee is grateful with accessible parking spaces at field level by Falmouth Department of Public Works. (DPW).

(Photo 7/6/2022)

Field and Restroom Accessibility is a lawful Right

Upper Trotting Park has the accessible Parking now and need accessible paths.

Persons stay away from events where there is no accessibilities or bathrooms.

Persons suffer when their rightful accessibility is not in place.

Accommodations are need at Trotting Park such as golf cart to shuttle the persons unable to walk or walk well to fields 1, 2 and 3.

CODE OF MASSACHUSETTS REGULATIONS

(ACCESS)

Massachusetts Architectural Access Board

521 CMR: ARCHITECTURAL ACCESS BOARD 521 CMR 19.00: RECREATIONAL FACILITIES 19.1 GENERAL

In pertinent part …**All areas open to and used by the public**, including but not limited to locker rooms, shower facilities, saunas, steam rooms, suntanning rooms, weight rooms, aerobics and dance rooms, tennis, racquet and squash courts **and spectator areas in recreation facilities shall be accessible.**

30.1.2 Portable Toilets: For single user portable toilets clustered at a single location, at least 5% but **not less than one accessible toilet unit shall be installed at each cluster**. Accessible units shall be identified by the International Symbol of Accessibility. Portable units at construction sites used exclusively by construction personnel are not required to be accessible.

30.2 LOCATION

Accessible toilet rooms shall be on an accessible route. Where unisex toilet room(s) are provided, they shall be located in the same area as other toilet rooms.

2017 Athletic Field Master Plan

Funded by the Community Preservation

SECTION 7.0 – OVERALL CONCLUSIONS

The Master Plan is the first step in identifying inventory constraints, community needs and a planning program to help the Town of Falmouth better meet the recreational needs of the community. Gale determined the level of use for each athletic facility in the Town and formulated a planning program based on these use levels. Based on these assessments and the meetings with members of the Recreation Department, this report finds that the field demands placed on the Town have resulted in a deficit **of three (3) multipurpose rectangular artificial turf fields or a deficit of nine (9) natural grass fields** as determined in Section 5.0.

Gale concluded that many of the existing athletic fields have deficiencies in similar areas, which include little to no rest periods essential to turf growth and establishment, field areas devoid of turf (a potential safety hazard), a lack of site amenities, and a **lack of ADA accessibility**. The existing fields are significantly over-used, resulting in poor turf conditions and an unrealistic level of maintenance.

Gale's Master Plan provides a planning program that will guide the Town of Falmouth in its goal to provide adequate and safe athletic fields to its community. Additionally, Gale provided a customizable maintenance program for the Town to determine a maintenance schedule that aligns with their staffing levels and budget.

Recreation Dept. Artificial Turf Field Needed

In 2020, the Recreation Committee was hoping for approval of a third turf field on Sandwich Road - George Gaspa Sports Complex. This has changed due to new Fire Station.

The sustainable cost solution for overuse fields and our recommendation are a full-size Artificial Turf Field be installed at Upper Trotting Park, along with a half of Turf Field at the Sandwich Road fields. Upper Trotting Park fields cannot withstand the annual uses for the fields to remain playable and safe. The Sandwich Road field cannot sustain the overuse to make up the for the overuses at Upper Trotting Park. The care and maintenance can be outsourced. Rules can be implemented to ensure the Soccer – Lacrosse Sandwich Road fields are not double-booked causing congestion.

Upper Trotting Park – Pickle Ball Courts?

The Recreation Committee unanimously voted to form a subcommittee to investigate new sites for long-term solution to place Pickle Ball Courts where noise would not be an issue. The recommendation to Select Board is at Upper Trotting Park fields adjacent to the skateboard park and fields.

Upper Trotting Park –Rehabilitate Old Skate Park

The Upper Trotting Park new skate park adjacent to the old park is a huge success with our children and adults. There is no plans to demolish the old park because it is still heavily used.

The Recreation Committee recommends the Old Skate Park be resurfaced due to high use for safe fun for children and adult use.

SBLI Playground at George Gaspa Complex

SBLI playground moved from Recreation Department site for Senior Center was to be installed at George Gaspa Complex. If not feasible any longer, new structures from any balance left over from the Senior Center budget should build a playground at this site. The Committee has been complaining about this issue since the SBLI playground ouster.

George Gaspa Sports Complex -Sunday 12:00 PM Field Use Rule

Recreation Dept. Director Joe Olenick has applied to the Planning Board to "modify a previous site plan review decision to eliminate a portion of condition number 3 stating Sunday activity shall not commence before 12:00 PM on either field."

The Recreation Committee recommends the Select Board support this decision and advocate for youth sports on this field Sunday mornings.

We do not have enough accessible fields to accommodate Falmouth Youth Flag Football's 172 children on Sunday because Fall Road Races are scheduling Special Events on Saturdays and Sundays at Central Park Fields in Falmouth Heights interfering with youth sports. Without this accommodation from the Planning Board, the Fall Road Race must go back to their old routes and times in order to stop interfering with youth sports.

Falmouth Youth Flag Football supports using the Sandwich Road Fields on Sunday especially due to their equipment storage shed is in on the parcel, central location and allow Fall Road Races to maximize their programs.

Community Preservation funding Outdoor Active Recreation

In the Works!

Shivericks Pond Recreation Trail

Fuller Field Infrastructure, Accessibility and Safety project – near full completion.

Lower Trotting Park – John Neill Little League Field complex Infrastructure, Accessibility and Safety Rehabilitation.

Nye Park - Basketball and Tennis\Pickle Ball Court Rehabilitation. The Committee is grateful for the **America Rescue Plan Act** (ARPA) funds allocated by the Town to meet the Community Preservation shortfall to build new sports courts. ARPA funds the town allocated in the amount of $110,000.00 to cover costs due to inflation.

Bell Tower Field – Tennis Court restoration and accessibility project.

The State of our Fields and DPW

We are not allotted enough time in this presentation to report on all the needs of our Recreations fields. We shall write a separate report with recommendations to the Select Board.

The Recreation Committee recognizes the good work of the Department of Public Works (DPW) workers and leaders. Just as we recommended to the Select Board to increase salaries to Recreation Department employees, we recommend the same for our DPW employees. Without them and a full staff our overall infrastructure will suffer, deteriorate and fail.

Thank You

BUSINESS

2. Multi Hazard Mitigation Plan Update – Woods Hole Group, Leslie Fields (20 minutes)

DRAFT
Falmouth Multi-Hazard Mitigation Plan

July 2022

Prepared for:
Town of Falmouth
59 Town Hall Square
Falmouth, MA 02540

Prepared by:
Woods Hole Group
A CLS Company
107 Waterhouse Road
Bourne, MA 02532 USA
(508) 540-8080

Table of Contents

Acronym List

APCC	Association for Preservation of Cape Cod
BFE	Base Flood Elevation
CCC	Cape Cod Commission
CEC	Coastal Erosion Commission
CZM	Coastal Zone Management
CERT	Community Emergency Response Team
CFR	Code of Federal Regulations
CPA	Community Preservation Act
DCR	Department of Conservation and Recreation
EEA	Executive Office of Energy and Environmental Affairs
EF-Scale	Enhanced Fujita Scale
EOC	Emergency Operations Center
FEMA	Federal Emergency Management Agency
FHBM	Flood Hazard Boundary Map
FIRM	Flood Insurance Rate Map
LiMWA	Limit of Moderate Wave Action
LEPC	Local Emergency Planning Committee
LPT	Local Planning Team
MassCZM	Massachusetts Office of Coastal Zone Management
MassDOT	Massachusetts Department of Transportation
MC-FRM	Massachusetts Coast Flood Risk Model
MEMA	Massachusetts Emergency Management Agency
MHMP	Multi-Hazard Mitigation Plan
MIPAG	Massachusetts Invasive Plant Advisory Group
MORIS	Massachusetts Ocean Resource Information System
MRC	Medical Reserve Corps
MSL	Mean Sea Level
MVP	Municipal Vulnerability Preparedness
NCDC	National Climatic Data Center
NESIS	Northeast Snowfall Impact Scale
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
SFHA	Special Flood Hazard Areas
SHMCAP	State Hazard Mitigation and Climate Adaptation Plan
SHMO	State Hazard Mitigation Officer
SLOSH	Sea, Lake and Overland Surge from Hurricanes
SLR	Sea-Level Rise
SRL	Severe Repetitive Loss
TSI	Trophic State Index
USACE	US Army Corps of Engineers
USGS	US Geological Survey

Virtually every type of weather has been and will be experienced within a coastal Massachusetts town. From freezing temperatures and blizzard conditions in the winter to heat and humidity in the summer, Falmouth must plan for the worst. The old adage of "if you don't like the weather, wait a minute" certainly applies.

In addition to potentially severe weather, Falmouth's unique coastal geography and its position between Buzzards Bay and the Vineyard Sound exposes the Town to potential wave energy and storm surges capable of causing coastal erosion, flooding, and property damage to multiple sections of Town. In total, Falmouth has over 68 miles of marine shoreline.

Natural hazards of all kinds can result in injury, loss of life, and damage to buildings and infrastructure, which can have significant adverse impacts on the Town's economic, social, and environmental resources. Through the development and implementation of this Multi-Hazard Mitigation Plan, the Town of Falmouth is proactively trying to prepare for and mitigate potential impacts from the various natural hazards.

1.1 PURPOSE OF PLAN

To facilitate review of this plan against FEMA's *Local Mitigation Review Guide*, when the text addresses an element of the *Guide*, it is identified in a colored bullet in the margin.

The Federal Emergency Management Agency (FEMA) defines hazard mitigation as "any sustained action taken to reduce or eliminate the long-term risk to human life and property from (natural) hazards", such as floods, hurricanes, winter storms, tornadoes, earthquakes, etc. Hazard mitigation may include both structural measures, such as flood control structures, and nonstructural measures, such as regulations and bylaws, to prevent flooding. Local planning and mitigation efforts allow communities to reduce or eliminate the loss of life and property damage resulting from natural hazards. The Town of Falmouth produced this updated Multi-Hazard Mitigation Plan for the entire Town with the goal of providing sustained actions to reduce or eliminate risk to human life and property damage from a natural hazard event. Objectives of this plan are as follows:

- Describe the planning process;
- Identify and update relevant background information about the Town, including geography, climate, land use, and infrastructure;
- Identify natural hazard risks and areas in town most likely to be impacted;
- Complete a risk assessment to profile hazard events, inventory assets, and estimate potential losses;
- Identify existing disaster mitigation measures already in place;
- Develop proposed mitigation measures and a mitigation strategy based on the risk assessment; and
- Design a mechanism to keep the plan updated to reflect current conditions and establish a schedule for monitoring and evaluating the plan.

What is a Hazard Mitigation Plan?

Natural hazard mitigation planning is the process of reducing or eliminating the loss of life and property damage resulting from natural hazards such as floods, earthquakes, and hurricanes through long-term strategies, including planning, policy changes, programs, projects, and other activities.

Preparation and updating of this Multi-Hazard Mitigation Plan (MHMP) before a major disaster occurs will help the community prevent property damage and loss of life associated with natural hazards, save money by instituting mitigation measures to protect against natural hazards, allow funding through FEMA for pre-disaster remediation, and expedite disaster recovery. The Plan will also help to reduce or eliminate repetitive flood losses.

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1.2 THE PLANNING PROCESS

Public participation is a central component of this planning process, providing critical information about the local occurrence of hazards while also serving as a means to build a base of support for hazard mitigation activities. Additionally, the most successful mitigation plans are developed after participation by a wide range of stakeholders who play a role in identifying and

implementing mitigation actions. During the update of this MHMP, the planning process included the following:

- An opportunity for the public to attend two informational presentations
- An opportunity for the public to comment on the plan during draft stages and prior to final approval;
- An opportunity for local and regional agencies and organizations, neighboring communities and private industries to be involved in the planning process; and
- A review and incorporation of existing plans, studies, reports, and data.

A1.b

This MHMP is an update of the previous plan, developed by the Town of Falmouth in 2017. It was developed through substantial input from the Local Planning Team (LPT), which consisted of various Town officials who were able to provide critical local knowledge about the community to facilitate the development of an updated MHMP that reflects changes in the Town since 2017.

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A1.d

The LPT was formed by the Conservation Administrator, and included the Town Manager, Assistant Town Manager, Assistant Town Planner, GIS Coordinator, Public Works Department, Town Engineer, Police Chief, Police Captain, Fire Chief, Harbormaster, and several Administrative Assistants. For a full list of LPT members and their departmental affiliations, see Appendix B. The LPT met for 1 kick-off meeting and 5 working meetings during the Plan development process; agendas for each are provided in Appendix B. The 2022 MHMP was funded through a Town Meeting Article for funding of improved coastal resiliency. In addition to the LPT input, public participation in the hazard mitigation planning process is also important, both for plan development and for implementation of the plan. Residents, business owners, and other community members are an excellent source for information on the historic and potential impacts of natural hazard events and particular vulnerabilities the community may face from these hazards. Their participation in this planning process also builds understanding about the hazard mitigation process and potentially creates support for future mitigation actions. Public presentations were held on March 24, 2022 at the Local Emergency Planning Committee (LEPC) meeting and on July 25, 2022 at a Board of Selectmen meeting. These presentations were advertised on the Town of Falmouth website and via LEPC social media posts. Both meetings were held in-person; the Board of Selectmen meeting was also available for live viewing on Falmouth Community TV. Video recordings of the meetings are available on the FCTV web site for residents to view when they are able.

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Copies of the announcements for the public presentations, as well as a master list of LPT members, are provided in Appendix B. These materials provide a foundation for understanding the planning process and major decisions made along the way and can help provide crucial background information the next time the LPT meets to review and update the MHMP.

The following steps were taken during the planning process:

1) Develop an LPT responsible for updating this Plan;
2) Define the potential natural hazards that could affect Falmouth;
3) Determine hazard locations and critical infrastructure potentially affected;

4) Conduct a vulnerability assessment of buildings and infrastructure;
5) Outline existing hazard mitigation measures and progress on the 2017 Plan's actions;
6) Determine gaps in hazard mitigation preparedness;
7) Define proposed hazard mitigation measures to fill these gaps; and
8) Evaluate the feasibility of and prioritize mitigation measures.

The above steps will allow implementation of proposed mitigation measures with a goal of reducing damage and improving public safety during a natural disaster. To solicit public comment, the draft Plan was posted on the Town of Falmouth's website and directions for how to submit questions or comments was provided. A screenshot documenting the website posting is provided in Appendix B. The draft Plan was also presented at the July 25, 2022 Board of Selectmen meeting to gather additional public input. Comments received during the meeting are included in Appendix B. Advertising for the public hearing included posting an announcement on the Town website and in the local paper, copies of which are included in Appendix B. The draft plan was posted on the website for 2 weeks prior to finalization. Comments and responses are provided in the comment response document in Appendix B.

A2.a A2.b

The draft Plan was also sent to Town Planners in Bourne, Sandwich, and Mashpee, as well as the Cape Cod Commission (CCC) for review and comment. A copy of the email sent to these neighboring towns and regional planning body soliciting their feedback on the Plan is also provided in Appendix B.

A4.a A4.b

During the preparation of this Plan, several existing studies and documents related to Falmouth and the surrounding area were reviewed. Preparation of this Plan borrowed from the following plans and documents where appropriate:

- Massachusetts State Hazard Mitigation and Climate Adaptation Plan (2018);
- Barnstable County Hazard Mitigation Plan (2010);
- Cape Cod Emergency Traffic Plan (2008);
- Falmouth Capital Improvement Plan (2021);
- Falmouth 5-Year Strategic Plan (2017-2021);
- Falmouth Community Preservation Plan (2020);
- Falmouth Comprehensive Emergency Management Plan (2020);
- Falmouth Climate Change Vulnerability Assessment and Adaptation Planning (2020);
- Municipal Vulnerability Preparedness (MVP) Workshop Summary of Findings (2018);
- Coastal Resiliency Planning for the Surf Drive Area (2020);
- Report on Coastal Resiliency Falmouth Massachusetts (2021);
- Falmouth Local Comprehensive Plan (2016);
- Falmouth Open Space and Recreation Plan (2014);
- Falmouth Historic Preservation Plan (2014); and
- Local bylaws and regulations.

The 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) was developed through a collaborative process that involved numerous state agencies, a large cross-section of stakeholders, members of the public, working groups, and a consulting team. This was the SHMCAP's eighth revision from its initial preparation in 1986, but this version is unique in that it is the first-of-its-kind statewide plan that fully integrates a traditional hazard mitigation plan with a climate change adaptation plan.

In 2010, the Cape Cod Commission drafted a Multi-Hazard Mitigation Plan for Barnstable County. The Commission worked with all 15 communities, including Falmouth, to assess hazards, evaluate vulnerable areas, and recommend planning and infrastructure improvements. Although this 2010 Barnstable County Plan was never approved by FEMA, it does provide a great deal of background information about local hazards and assessing vulnerability.

The 2018 Cape Cod Emergency Traffic Plan was developed by federal, state, and local agencies to manage traffic operations during hazardous weather that results in an exodus from areas of Cape Cod. The document defines procedures, details the concept of operations, and assigns responsibilities for implementation.

The 2021 Falmouth Capital Improvement Plan is a ten-year planning schedule identifying capital projects and equipment purchases for the Town as well as project goals and performance measurements.

The Falmouth 5-Year Strategic Plan for Fiscal 2017-2021 was developed in July of 2016 by the Falmouth Board of Selectmen. The plan establishes policy objectives for the Departments, Boards, Committees and Commission of the Town. The Board voted to affirm five Strategic Priority areas which include producing a long-term strategic vision plan, financial and economic stability and community development, coastal resources, resource conservation and management water and wastewater management, and health and public safety.

The Falmouth Community Preservation Plan was created in 2020 to outline community preservation goals, which include acquisition and preservation of open space and land for recreational use, creating and preserving community housing, and protecting historical buildings and landscapes. In addition, the document also details requirements given in the Community Preservation Act (CPA) Massachusetts Law (Chapter 44B) and guidelines for project submission.

The Falmouth Comprehensive Emergency Management Plan from 2020 provides a framework for effective preparedness, mitigation, response, and recovery to preserve public welfare and safety. The plan lists responsibilities of each department in an emergency scenario, the most likely threats and hazards facing the Town, and protocols for regional and state communication during and after a disaster.

The Falmouth Climate Change Vulnerability Assessment and Adaptation Plan prepared in 2020 utilized results from modeling of coastal inundation and wetland migration to assess the vulnerability of critical public assets to flooding, both now and through the year 2070. Adaptation

strategies were developed for municipal infrastructure and natural resources. Regional strategies and recommendations for policy and regulation changes were also made.

The Municipal Vulnerability Preparedness (MVP) Workshop Summary of Findings document (workshop conducted in March of 2018) provides an overview of the MVP workshop process including participation of attendees, top hazards identified, vulnerable areas of the town discussed, and natural hazard planning. In addition, participants developed recommendations to improve community resilience within small discussion groups.

The 2020 Coastal Resiliency Planning Study for Surf Drive utilized MVP grant funding to complete a detailed coastal resiliency planning study for the Surf Drive area, identified in an earlier study as one of the most vulnerable areas of Town. The study utilized a conceptual phased management approach to improve coastal resiliency by identifying key time frames and sea level thresholds for action. Resilience actions were grouped into the following themes, natural resources, connection, protection, and managed retreat.

The Report on Coastal Resiliency Falmouth Massachusetts was prepared in 2021 by the Coastal Resiliency Action Committee. The purpose of the report is to prepare action plans to help the town better understand and address the risks and hazards to coastal infrastructure and coastal properties that may be caused by coastal erosion, storms, and sea level rise. The report contains data and recommendations for near-, mid- and long-term actions to improve resiliency to coastal hazards within the Town of Falmouth.

The Falmouth Local Comprehensive Plan was prepared by the Local planning Committee as a tool to communicate community goals to Town boards, departments, committees, commissions, and other interested parties. The document outlines goals and policies on eight elements from Land Use to Coastal Resiliency and was last updated by the Planning Board in 2016.

The Falmouth Open Space and Recreation Plan provides a guide as to how to maintain and expand resources available for the public's enjoyment. Updates to the Plan in 2014 included increasing open and recreational spaces as well as the amount of green infrastructure within the community.

The Falmouth Historic Preservation Plan outlines recommendations to implement historic preservation with the Town. In 2014, the two Chairmen of Falmouth's Historical Commission and Historic District Commission with support of the Town's Planning Department the Cape Cod Commission, and various stakeholders for the Town, determined actions that should be taken to support historic preservation in Falmouth over the next three to ten years.

A2

Various town departments and boards have implemented and updated bylaws and regulations as necessary to control development and ensure safe construction methods that adhere to current best management practices. The Falmouth Planning Board, Conservation Commission, and Building Department are the primary town agencies responsible for regulating development in the town. More specifically, these boards regulate development through the Zoning Bylaw and

the Falmouth Wetlands Protection Bylaw. Feedback to these boards was ensured through the participation of their Town staff liaisons (i.e., Town Planner, Conservation Administrator, etc.) on the LPT.

Technical information from the plans, regulations, and bylaws described above was incorporated into this Falmouth Multi-Hazard Mitigation Plan in a number of ways, including by:

1) Guiding the planning process;
2) Helping develop mitigation actions;
3) Providing recent data on various hazards and their impacts; and
4) Ensuring that mitigation actions in this plan were consistent with current state and local activities and plans.

1.3 PLAN DESCRIPTION

A1.d

FEMA developed a "Local Mitigation Review Guide" (Guide) to ensure Local Hazard Mitigation Plans meet the requirements of the Stafford Act and Title 44 Code of Federal Regulations (CFR) 201.6. This Guide was used as a tool in developing this Plan. For ease of assessment, when the text addresses an element of the Guide, it is identified in a colored bullet in the margin.

1.4 PREVIOUS FEDERAL/STATE DISASTERS

The Town of Falmouth has experienced 5 natural hazards that triggered federal or state disaster declarations since 2010 (FEMA 2021a). These are listed in Table 1-1 below. The vast majority of these events involved flooding. Only one of these events has occurred since the previous Falmouth MHMP in 2017, which was a Severe Winter Storm Disaster from March 2-3, 2018.

Table 1-1. Disaster Declarations for the Town of Falmouth Since 2011.

Disaster Name	Type of Assistance	Declared Areas
Tropical Storm Irene (August 27-29, 2011)	FEMA Public Assistance and Hazard Mitigation Grant Program	Counties of Plymouth, Barnstable, Berkshire, Bristol, Dukes, Franklin, Hampden, Hampshire, & Norfolk
Hurricane Sandy (Oct 27 – Nov 8, 2012)	FEMA Public Assistance and Hazard Mitigation Grant Program	Counties of Plymouth, Barnstable, Bristol, Dukes, Nantucket, & Suffolk
Severe Winter Storm (February 8-10, 2013)	FEMA Public Assistance and Hazard Mitigation Grant Program	All 14 MA Counties
Severe Winter Storm (January 26-28, 2015)	FEMA Public Assistance and Hazard Mitigation Grant Program	Counties of Plymouth, Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Suffolk & Worcester
Severe Winter Storm (March 2-3, 2018)	FEMA Public & Individual Assistance	Counties of Plymouth, Barnstable, Bristol, Nantucket, Norfolk & Essex

1.5 CLIMATE CHANGE

Although this plan is focused on specific natural hazards (e.g., flooding, hurricanes, wind, extreme precipitation, etc.), it is important to consider how each of these hazards will be affected by climate change in the future, and how, in some cases, the effects of climate change are already being felt. Climate change is already intensifying natural hazards, resulting in changes to precipitation patterns, sea level rise, increased temperatures, and more extreme weather. Climate change will continue to alter these natural hazards, in most cases increasing their severity, duration, or frequency. In the face of climate change, it is critical for the Town to build long-term resilience by leveraging historical risk data, integrating data on project future climate conditions, and developing and implementing actions that will reduce the Town's overall risk.

One of the first steps in hazard mitigation planning is to identify and define the Town's assets. Without a detailed and accurate understanding of the infrastructural, societal, and environmental resources present within the Town, it is impossible to develop a plan to protect them. The goal of this chapter is to provide a local profile, detailing the community's assets, the Town's geography and climate, an overview of the Town's environmental resources, the Town's land use and demographic patterns, the locations of major infrastructure and critical facilities, and historical locations throughout Town.

Although all community assets may be affected by natural hazards at times, some assets and infrastructure are more vulnerable because of their physical characteristics, location, or socioeconomic uses. This asset inventory will help support the vulnerability analysis conducted in Chapter 4, which will identify specific vulnerable assets within the Town of Falmouth.

2.1 OVERVIEW

The Town of Falmouth is a coastal community located in Barnstable County, Massachusetts. It was incorporated in 1686. As of the 2020 census, the population of Falmouth was 32,517. This number increases during the summer months with seasonal residents and visitors. The Town has a traditional New England government structure with a five-member Select Board, a Town Manager, and Town Meeting attended by elected members from each voting precinct. Among the basic services provided to the residents are public safety, schools, water, sewer, garbage collection, recreational facilities, and public libraries. Falmouth operates its own Wastewater Treatment Plant, which provides sewage treatment services to approximately 11% of the Town's developed properties. Fire protection is provided exclusively by the Falmouth Fire Department, led by a Fire Chief.

The Town maintains a website at: https://www.falmouthma.gov/

2.2 GEOGRAPHY

Falmouth is located in Cape Cod, Massachusetts and is bordered by Buzzards Bay and the Vineyard Sound. Both shorelines experience a dynamic environment, resulting in erosion. Marsh systems are present throughout the Town, including Little and Great Sippewissett Marsh along the Buzzards Bay shoreline. The shoreline along the Vineyard Sound includes a number of salt ponds. With numerous estuaries and coves, waterways are one of the Town's greatest assets, which not only spurred early maritime industries, but provides multiple coastal outlets and harbors protecting commercial and recreational boaters and beaches to draw summer vacationers.

Falmouth is approximately 54 square miles in area. The Town is located approximately 3 miles northeast of Martha's Vineyard and 77 miles southeast of Boston. Falmouth is bordered by Bourne and Sandwich to the North and Mashpee to the east.

2.3 CLIMATE

Falmouth averages 49 inches of precipitation per year. Average temperatures range from highs in the 70's (Fahrenheit) during the summer months to lows in the low 20's during winter months. Falmouth's location along Buzzards Bay and the Vineyard Sound generally keeps temperatures cooler in the summer and warmer in the winter relative to other nearby inland communities at the same latitude.

2.4 NATURAL ENVIRONMENT

Falmouth's natural environment and natural resources are important to the Town's identity and quality of life. In fact, one of the most important factors in why people move to and visit Falmouth is its natural environment and coastal features. The Town has a varied landscape, with large stretches of open space, forested land, and upland, as well as coastal salt marshes, sandy beaches, and protected harbors. These natural resources support the economy through tourism and recreation, in addition to a variety of other ecosystem services, such as clean air and water.

The natural environment also increases resiliency and reduces hazard impacts, through flood attenuation as wetland areas absorb flood waters, through stormwater management as rainwater drains through the soil, and through erosion control as vegetation secures soil along coastal banks and dunes. Salt marshes are an important first line of defense against storms and provide invaluable ecosystem services to the Town. However, the long-term health of salt marshes is threatened by sea level rise. Without suitable landward areas (e.g., of an appropriate slope and elevation, undeveloped, etc.) for salt marshes to migrate into, there will likely be an overall reduction in total salt marsh area over time. The Town supports efforts to promote or enhance the health of existing salt marshes and recognizes the long-term challenge of sea level rise's impact on salt marsh habitat.

2.5 LAND USE

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During the colonial period, Falmouth relied upon agricultural and maritime industries to support the local economy. Early industries including raising sheep and farming. Like many coastal Massachusetts towns, Falmouth also relied on marine industries such as commercial fishing, the coastal trade, whaling, salt production, and building ships. By the late 1800s, the Town was also farming cranberries and strawberries for local markets including in Boston. Today, the Town of Falmouth still depends on maritime industries, as well as summer tourism as the many beaches provide recreational opportunities.

Figure 2-1 and Table 2-1 depict the 2021 assessor's parcel dataset categorized by land use. The largest category by area is residential (single family) for a total of 35% of Falmouth's total area. The next largest categories by area are open space, public services, vacant, residential (multi-family), and recreation making up 20%, 19%, 12%, 4%, and 4% of Falmouth's area, respectively. This categorization reflects the classifications used in the 2017 Falmouth Multi Hazard Mitigation Plan. There has not been any major development or land use changes since the 2017 Multi Hazard Mitigation Plan that impacts risk level or vulnerability to hazards. In addition, there is no planned development in Falmouth that would affect the Town's vulnerability.

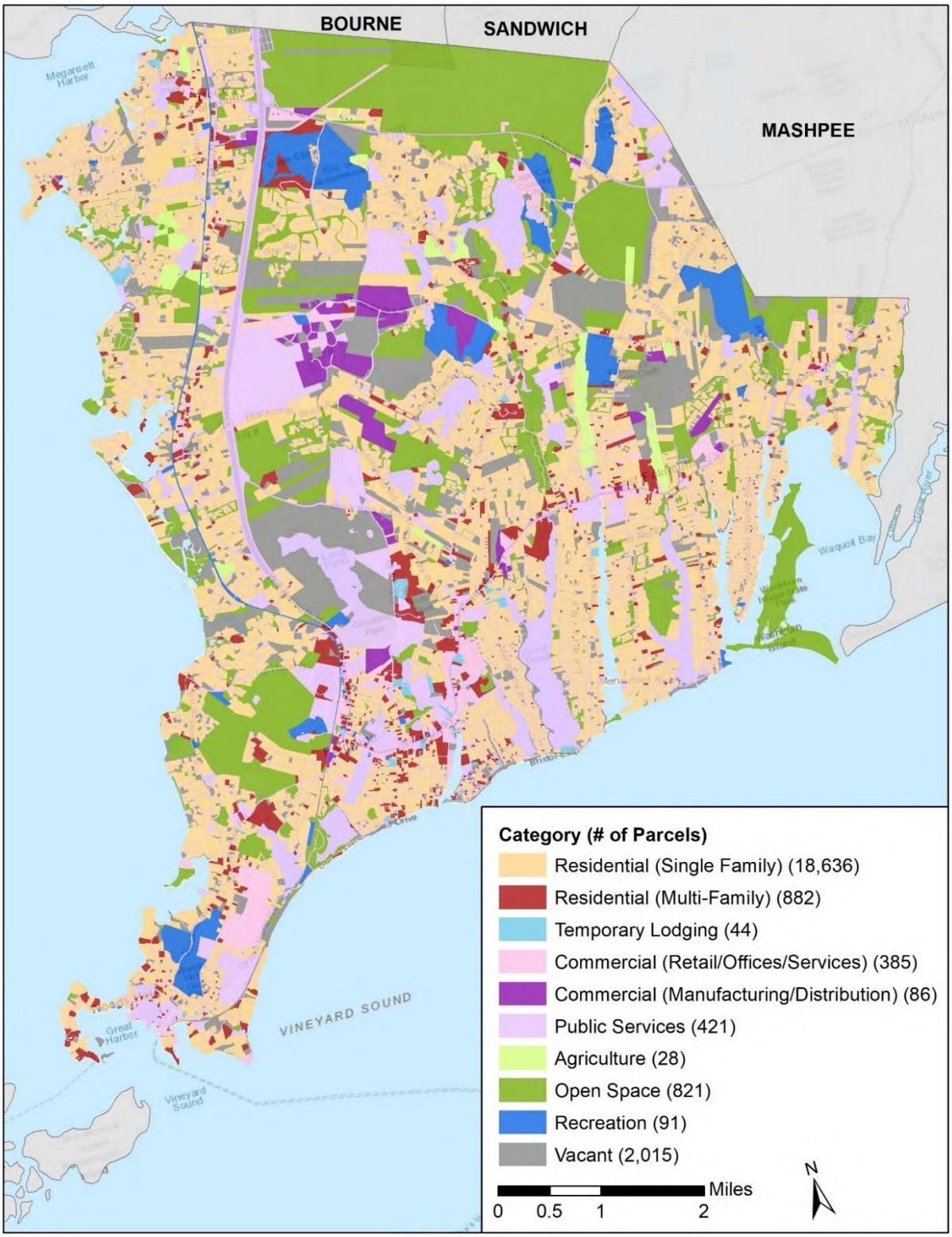

Figure 2-1. Town of Falmouth land use categories (2021).

Table 2-1. Number of Parcels in Each Land Use Classification.

Land Use Type	Number of Parcels
Residential (Single Family)	18,636
Residential (Multi-Family)	882
Temporary Lodging	44
Commercial (Retail/Offices/Services)	385
Commercial (Manufacturing/Distribution)	86
Public Services	421
Agriculture	28
Open Space	821
Recreation	91
Vacant	2,015

2.6 TRANSPORTATION

The Town of Falmouth includes several major transportation corridors including Route 28 and Route 151. The Woods Hole, Martha's Vineyard, and Nantucket Steamship Authority is also located in Woods Hole, Falmouth and provides daily service to the islands. Falmouth contains a private airfield, while the nearest regional airport is located in Hyannis and the nearest international airport being Boston Logan Airport. Bus services are provided by Cape Cod Regional Transit Authority, Peter Pan, and Plymouth Brockton bus companies.

2.7 CRITICAL FACILITIES

Critical facilities are those that are essential to the health and welfare of the Town and those that are especially important for response and recovery following hazard events. Critical facilities include buildings and infrastructure such as emergency operations centers, critical municipal buildings, water and wastewater facilities, schools, churches, marinas, etc. The LPT developed a list of critical facilities, which is provided in Appendix C. The critical facilities in Falmouth are shown in Figure 2-2; the numbers correspond to the list in Appendix C. A portion of these critical facilities are located within high hazard areas, such as floodplains. However, due to the importance of these facilities, special care must be taken to ensure continued operation even during disaster events.

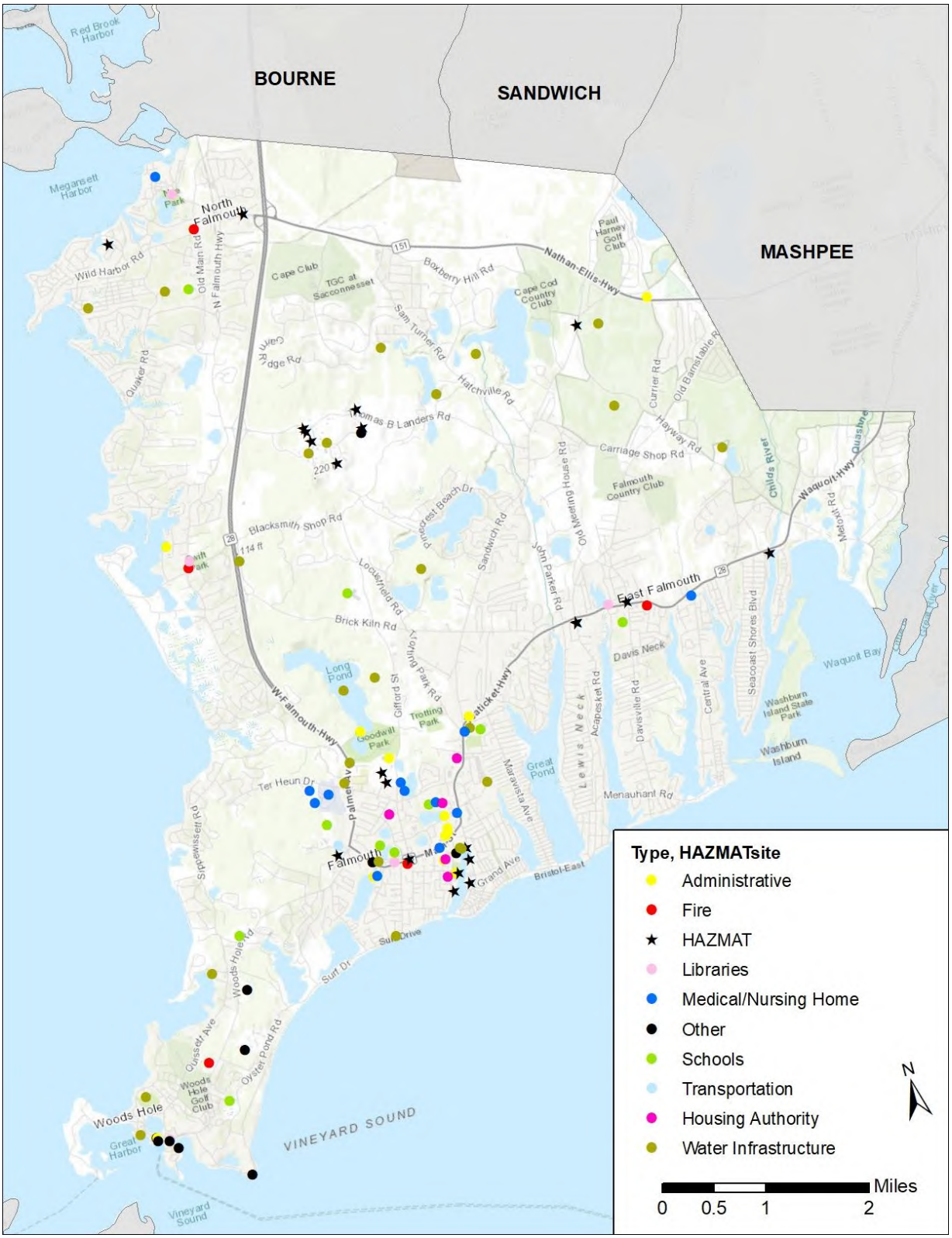

Figure 2-2. Falmouth critical facilities map.

2.8 HISTORICAL PROPERTIES

The Town of Falmouth has many areas and landmarks of historical significance, including seven historic districts, four of which are on the National Register of Historic Places. Falmouth also has ten additional historic sites listed on the National Register. Historic districts and sites are described below.

1) **Falmouth Village Green –** Listed on the National Register of Historic Places, Falmouth Village Green has been the Town center since 1756 and includes late Colonial and Federal period architecture.
2) **North Falmouth Village -** Listed on the National Register of Historic Places, North Falmouth Village was primarily developed over the 19th century to support maritime activities on Buzzards Bay.
3) **Waquoit -** Listed on the National Register of Historic Places, Waquoit Village is located at the head of Waquoit Bay and includes primarily residential properties.
4) **West Falmouth Village -** Listed on the National Register of Historic Places, West Falmouth Village is located south of Bourne Farm and was settled in 1673. Historic buildings located within West Falmouth include the Quaker Meeting House, Quaker Carriage Sheds, and the Emerson House.
5) **Woods Hole –** Woods Hole village is located at the extreme southwest corner of Cape Cod, near Martha's Vineyard. This village is home to several premier scientific institutions including Woods Hole Oceanographic Institute, the Marine Biological Laboratory, the Woodwell Climate Research Center, NOAA Northeast Fisheries Science Center, USGS Coastal and Marine Science Center, and the Sea Education Association.
6) **Davisville –** Davisville is located along the Vineyard Sound shoreline of Falmouth, between Green Pond and Bourne's Pond. The area contains marinas, beaches, and residential developments.
7) **Quissett –** Historic Quissett is located north of Woods Hole and contains Quissett Harbor and several marine based facilities such as the Quissett Yacht Club as well as residential development.
8) **Central Fire Station –** Located at 399 Main Street, the two-story brick fire station was built in 1929, renovated in 2021, and is still operational today.
9) **Crowell-Bourne Farm –** This property includes 49 acres of fields and woods as well as a historic farmhouse built in 1775.
10) **Elnathan Nye House –** Built in 1735 and located at 33 Old Main Road in North Falmouth, this structure was built by Elnathan Nye, a prominent citizen of Falmouth.
11) **Falmouth Pumping Station –** The pumping station complex was built in 1898 in the Queen Anne style and was designed by Ernest Boyden.
12) **Josiah Tobey House –** This structure was built in 1854 in the Greek Revival style for Josiah Tobey.

13) **Lawrence Academy –** Located to 20 Academy Lane, this structure was historically used as a school building. Also built in the Greek Revival style, the building serves as a private academy before being used for veteran's organizations, and currently as the Falmouth Chamber of Commerce.
14) **Nobska Light –** This lighthouse is located near the intersection of Buzzards Bay and the Vineyard Sound within Woods Hole. The lighthouse was originally built in 1826.
15) **Poor House and Methodist Cemetery –** Located on 744 Main Street, this structure was built in 1809 and served the mentally ill and poor until 1963. Adjacent to the building is a cemetery where residents were buried. After 1963, the building was used by the Historical Commission and by the Falmouth Artists Guild but is presently vacant.
16) **Teaticket School –** This school building was built in 1927 in the Colonial Revival style. After 1967, the building has served as the Administration Building for Falmouth Public Schools.
17) **Woods Hole School –** Located at 24 School Street in Woods Hole, this structure was built in 1870. Currently, the building houses the Children's School of Science in the summer and the Woods Hole Daycare Cooperative in the winter.

B4.a

2.9 REPETITIVE LOSS PROPERTIES

Repetitive Loss Properties are those for which two or more losses of at least $1,000 each have been paid under the National Flood Insurance Program (NFIP) within any ten-year period since 1978. In 2017 FEMA reported a total of 26 residential properties in Falmouth with repetitive losses. Data current to 2022 was not released by FEMA in time for preparation of this plan update.

Falmouth is vulnerable to a wide range of natural hazards that can threaten the people, economy, infrastructure, and natural resources of the Town. As suggested under FEMA planning guidance, the Town of Falmouth reviewed the full range of natural hazards identified in the most recent Massachusetts State Hazard Mitigation and Climate Adaptation Plan (2018), which included:

1) Inland Flooding
2) Coastal Flooding
3) Coastal Erosion
4) Hurricanes and Tropical Storms
5) Severe Winter Storms (snow, blizzards, ice storms, Nor'easters)
6) Wildfire
7) Tornadoes
8) Drought
9) Average/Extreme Temperature
10) Earthquake
11) Invasive Species
12) Other Severe Weather (heavy precipitation, high wind, thunder/lightning)
13) Landslide
14) Tsunami

In addition to the hazards above, the Town of Falmouth also included Dam/Culvert Failure and Freshwater Quality as additional hazards. This chapter provides a description of each hazard, the location(s) within Falmouth that are impacted by each hazard, previous occurrences of each hazard, the possible magnitude of each hazard, the probability of each hazard occurring in a given year, and some of the impacts that can happen in the event that hazard occurs.

B1.a

FEMA defines a hazard as an act or phenomenon that has the potential to produce harm or other undesirable consequences to a person or thing. All natural disasters pose hazards to property, loss of human life, and have the ability to limit access to power, communication services, water, wastewater collection/treatment, and transportation. Downed trees and limbs also limit emergency access and complicate cleanup efforts. Through the development of this Plan, Falmouth is taking steps to protect its infrastructure from natural disasters as much as possible, such that essential utilities and services continue when most needed. Hazards associated with natural disasters typically encountered in Falmouth include coastal flooding, winter weather, and other sever weather. Natural disasters occurring less frequently, such as tornadoes, earthquakes, or landslides, pose less frequent but unique challenges.

The 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan identifies 14 natural hazards that could have an impact on communities in the Commonwealth of Massachusetts. These hazards are:

1) Inland Flooding
2) Coastal Flooding
3) Coastal Erosion
4) Hurricanes and Tropical Storms
5) Severe Winter Storms
6) Wildfire
7) Tornadoes
8) Drought
9) Average/Extreme Temperature
10) Earthquake
11) Invasive Species
12) Other Severe Weather
13) Landslide
14) Tsunami

B1.b

As suggested under FEMA planning guidance (FEMA, 2011), the Town of Falmouth reviewed the full range of natural hazards identified in the 2018 Massachusetts State Hazard Mitigation and Climate Adaptation Plan. Also, given some particularly problematic culverts and issues with the water quality of inlands ponds, the Town also evaluated dam/culvert failure and water quality. The full list of hazards addressed in this plan is provided in the call out box below. In addition to the 2018 State Plan, other resources consulted during the drafting of this plan included news articles and other media sources, as well as local knowledge from LPT members. All resources are referenced in the text of each hazard profile.

Hazards Addressed in Detail in the Falmouth Multi-Hazard Mitigation Plan

1. **Flooding (Coastal & Inland)**
2. **Coastal Erosion**
3. **Hurricane/Tropical Storm**
4. **Severe Winter Storm**
5. **Wildfire**
6. **Tornado**
7. **Drought**
8. **Average/Extreme Temperature**
9. **Earthquake**
10. **Invasive Species**
11. **Other Severe Weather**
12. **Landslide**
13. **Tsunami**
14. **Dam/Culvert Failure**
15. **Freshwater Quality**

3.1 FLOODING (COASTAL & INLAND)

Overview

Flooding was identified as one of the top hazards in Falmouth according to the LPT and the MVP Workshop. Flooding can be caused by hurricanes, nor'easters, severe rainstorms, and thunderstorms. Sea-level rise also has the potential to exacerbate these flooding issues in the future.

The Town of Falmouth is subject to two kinds of flooding: coastal flooding where wind, tides, waves, and storm surge lead to flooding low lying coastal areas, and inland flooding where heavy precipitation overwhelms the capacity of natural and structured drainage systems to convey water away from roads and other areas of concern, causing it to overflow the system. Although the Town of Falmouth experiences the majority of its flooding from coastal storm events, these two types of flooding are often related as inland flooding is prevented from draining by wind and tide driven coastal water. Both types of flooding can be caused by major storms, such as nor'easters and hurricanes. Nor'easters can occur at any time of the year, but they are most common in winter. Hurricanes are most common in the summer and early fall. Due to Falmouth's geographic position along Buzzards Bay and the Vineyard Sound, the Town is somewhat protected from significant flooding impacts due to nor'easters but is extremely vulnerable to the high storm surges that would result if a hurricane were to track directly towards the Town. Despite some geographical protection from nor'easters, these storms tend to cover a larger area than hurricanes and tend to last longer, resulting in storm conditions coinciding with at least one high tide – a combination that results in the most severe flooding. Large rainstorms or snowfalls can also lead to inland flooding. See later sections for more specific details on those natural hazards.

Many of the Town's ponds and waterways remain tidally influenced despite being located somewhat inland, meaning inland flooding is closely tied to coastal flooding conditions. Much of this type of flooding is contained within existing wetland areas, reinforcing the need to protect and maintain these areas as a mitigation measure. High tides and coastal flooding can prevent water from draining out of the streams and stormwater conveyance systems. This can result in flooding that occurs well away from coastal areas.

Flooding due to storm run-off that overwhelms the carrying capacity of storm water infrastructure can be exacerbated by poor design or poor maintenance. Flooding from blocked drainage occurs in flat or depressional areas where runoff or rain collects but cannot drain out. Drainage systems are made up of ditches, storm drains, retention ponds, and other infrastructure designed to transport storm water away from roadways and parking lots, to receiving streams, bays, and/or the ocean. Large storms can overwhelm these systems and blocked or clogged drainage ditches and culverts can inhibit the flow of water, resulting in back-ups and ponding. Water will remain in an area until it infiltrates into the soil, evaporates, the blockage is cleared, or the water is actively pumped out.

Coastal flooding results from storm surge, which occurs when water is pushed onshore during powerful storms, such as hurricanes and nor'easters, and can raise the water level by several feet (Figure 3-1). Storm surges are easily capable of inundating low-lying areas, and waves associated with coastal storms can be highly destructive as they move inland, battering buildings, structures, and infrastructure in their path. However, the magnitude of flooding is strongly influenced by the tides; storm surge that occurs during a high tide will inundate a larger area than if the same surge occurs at low tide. A storm surge coinciding with a high tide event can devastate coastal features such as piers, floats, docks, and boats.

Figure 3-1. Storm surge during Winter Storm Riley from March 2nd to 4th, 2018.

Hazard Location

B1.c
B2.a

Figure 3-2 shows the Effective 2021 FEMA Flood Insurance Rate Map (FIRM) for Falmouth. These areas represent the risk of flooding from a 100-year storm. This map depicts the areas of Falmouth in AE, AO, and VE zones and within the 0.2% flood area (an area expected to be inundated during a 500-year storm event). The different FEMA flood zones are defined as follows:

- AE Zones, also within the 100-year flood limits, are defined with BFEs that reflect the combined influence of stillwater flood elevations and wave effects less than 3 feet.
- AO Zones, representing coastal hazard areas that are mapped with flood depths instead of base flood elevations. Depths are mapped from 1 to 3 feet, in whole-foot increments.

These areas are generally located in areas of sheet flow and runoff from coastal flooding where a BFE cannot be established.

- VE Zones, also known as the coastal high hazard areas, are defined by the 1% annual chance flood limits and wave effects 3 feet or greater. The hazard zone is mapped with base flood elevations (BFEs) that reflect the combined influence of stillwater flood elevations, primary frontal dunes, and wave effects 3 feet or greater.

Recent post-storm field visits and laboratory tests throughout coastal flood hazard areas in the U.S. have consistently confirmed that wave heights as low as 1.5 feet can cause significant damage to structures that are constructed without considering coastal hazards. To address this, FEMA has added a line of the FIRMs called the Limit of Moderate Wave Action (LiMWA). The LiMWA marks the inland limit of the Coastal A Zone, which is the part of the coastal Special Flood Hazard Area where wave heights can be between 1.5 and 3.0 feet during the base flood event. This area is subject to flood hazards associated with floating debris and high-velocity flow associated with waves and debris that can erode and scour building foundations and, in extreme cases, cause foundation failure. The LiMWA is shown in Figure 3-2. FEMA, MEMA, and Massachusetts Coastal Zone Management (CZM) recommend building to V Zone standards in the Coastal A Zone, but currently the regulations do not require it.

Localized flooding as a result of blocked or undersized drainage infrastructure occurs in specific areas of town such as at the culvert at Maravista Avenue near the entrance to the Falmouth Mall, and at the intersection of Main Street and Falmouth Heights Road, which floods even during minor events.

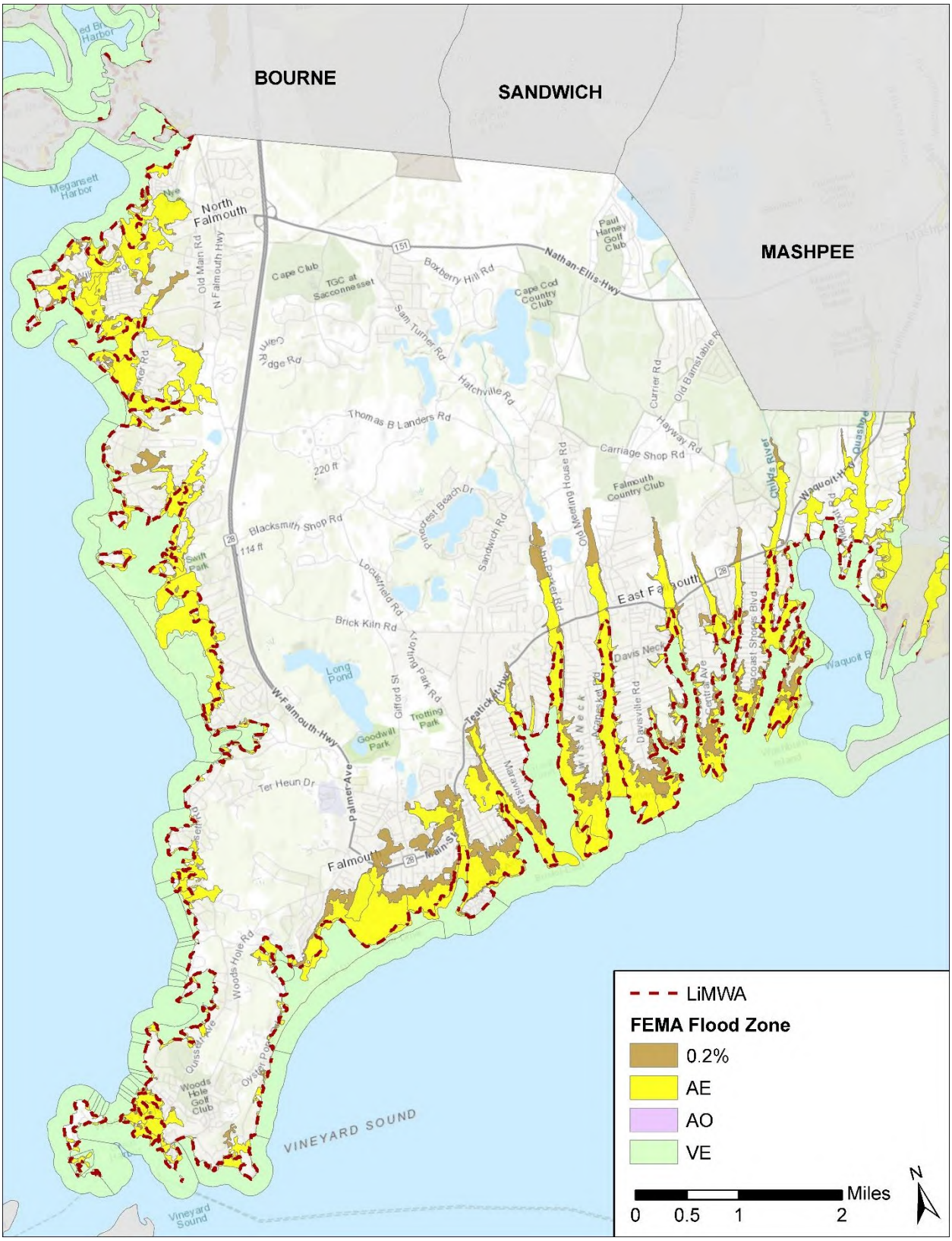

Figure 3-2. FEMA Special Flood Hazard Areas in Falmouth (Effective 2021).

Previous Occurrences & Extent

B1.c B2.a,c

Below is a list of major flooding events that have occurred in Falmouth from between 2017 and January 2022, from NOAA's NCEI Storm Events Database (NOAA, 2022), which lists a number of specific flooding incidents for Falmouth:

> July 7, 2017: A low pressure system south of new England brought heavy down poor of 1 to 5inches and thunderstorms. In Falmouth, Main Street and Palmer Avenue were closed due to impassable conditions. Approximately 3.75 inches of rain was reported in East Falmouth.
>
> October 27, 2018: A low pressure system originating in the Gulf of Mexico traveled north to Central and Eastern Massachusetts resulting minor coastal flooding. In Falmouth, Surf Drive near Oyster Pond was closed due to impassable coastal flooding.
>
> October 29, 2018: Localized flooding and waterspouts developed off the southern coast of Massachusetts and one waterspout briefly moved onshore in Woods Hole Village within the Town of Falmouth.
>
> November 12, 2021: A strong southerly wind flow out ahead of an advancing cold front produced strong to damaging wind gusts and some heavy rain that caused street and basement flooding. In Falmouth, extensive flooding occurred on Gifford Street.
>
> January 17, 2022: A strong low pressure system brought damaging winds along the south coast of Barnstable County with moderate coastal flooding. In Falmouth, coastal flooding was reported on Menauhant Road and Surf Drive near Oyster Pond Road.

The extent of flooding in the future, however, will impact a larger area of Falmouth. Sea-level rise refers to the increase in mean sea level over time. Global mean sea level (MSL) has been rising since the end of the last ice age approximately 11,000 years ago. Recently, sea-level rise (SLR) rates have accelerated, with unprecedented rates along the northeastern U.S. since the late 19th century (Kemp et al., 2011). Global sea-level rise is driven by several factors, including thermal expansion of ocean water and freshwater inputs from melting glaciers. Because sea level sets a baseline for storm surge, sea-level rise will exacerbate already existing coastal flood issues. As local sea level rises, it allows coastal storm surge to extend farther inland. With the higher sea levels predicted in 2030, 2050 and 2070, areas much farther inland will be at risk of being flooded. Although sea-level rise plays a substantial role, local flooding also depends on tides, natural and artificial barriers, and the contours of the land along the coast (Figure 3-3).

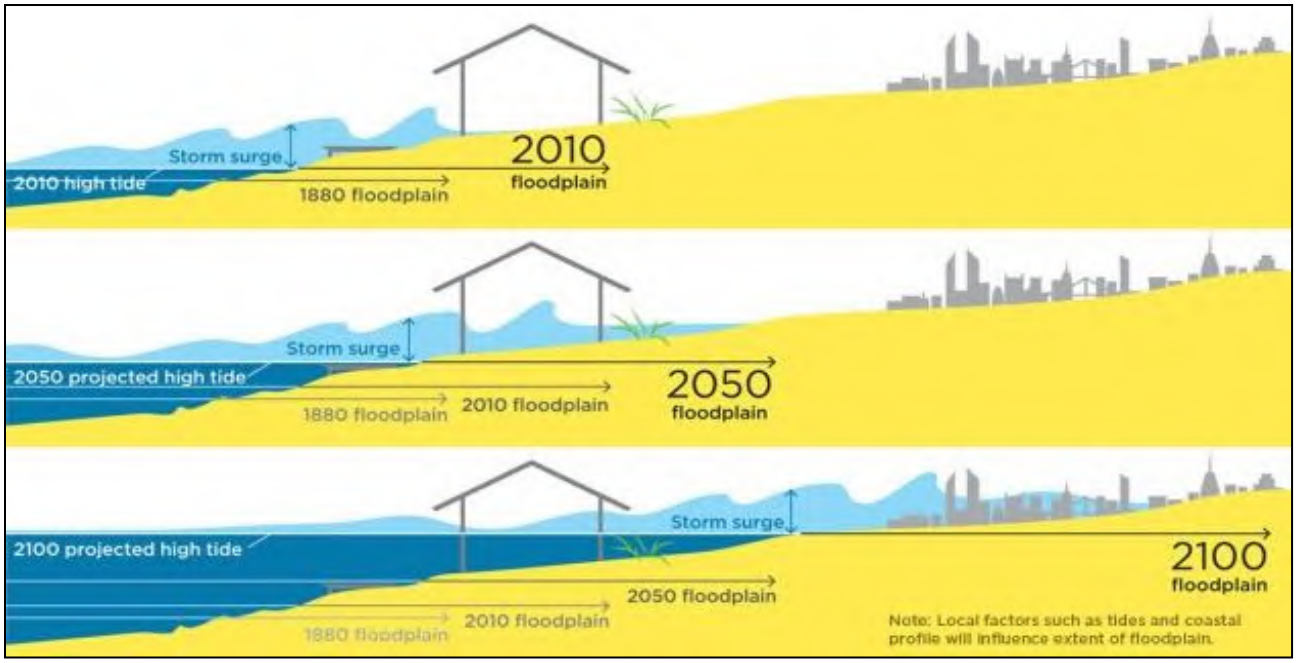

Figure 3-3. Sea-level rise magnifies the risks of storm surge and high tides (UCS, 2015).

The National Oceanic and Atmospheric Administration's (NOAA) Center for Operational Oceanographic Products and Services maintains a series of tide gages along the coast of Massachusetts. Records from NOAA's Woods Hole tide gage (station ID 8447930), indicate that our relative sea level has risen at a rate of 2.98 mm (+/- 0.17 mm) annually based on the monthly mean sea level between 1932 and 2021, resulting in a change of 0.98 feet (11.76 inches) in 100 years (Figure 3-4).

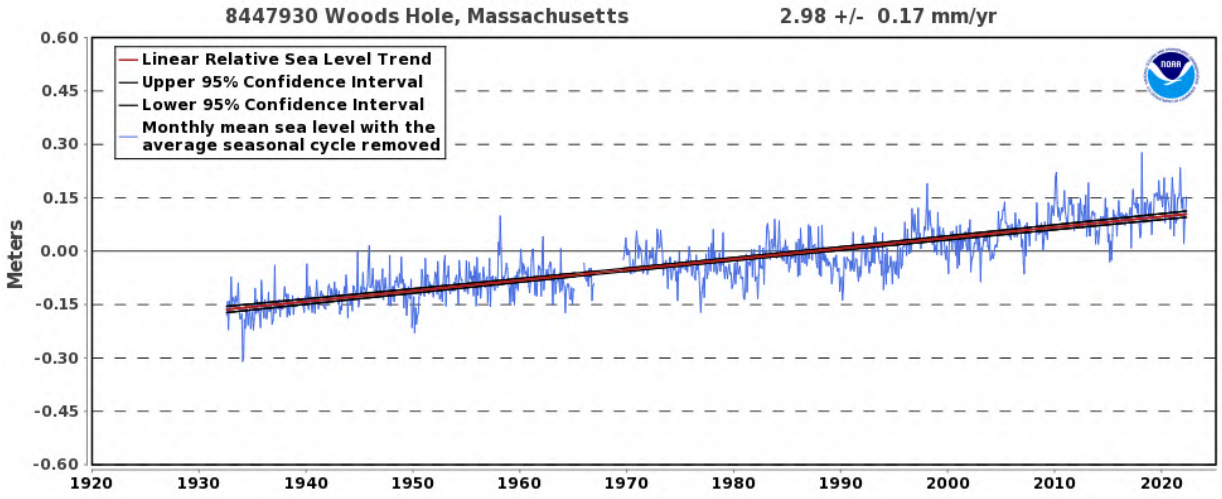

Figure 3-4. Sea-level rise trend from Woods Hole, Massachusetts (NOAA, 2022a).

Although the historical sea-level rise trend presented in Figure 3-4 is linear, this is not expected to continue. Global sea-level rise projections range from an additional 4.3 ft (under an intermediate sea level rise scenario) to 10.5 ft (under an extreme sea level rise scenario) by 2100.

The probability of inundation in present day, as well as in future out years, along the entire Massachusetts coastline has been calculated through the Massachusetts Coast Flood Risk Model (MC-FRM), which was developed for the Massachusetts Department of Transportation (MassDOT) (Bosma et al., 2019). The MC-FRM incorporates a full suite of processes that affect coastal water levels, including tides, waves, winds, storm surge, sea level rise, and wave set-up at a fine enough resolution to identify site-specific locations that may require adaptation alternatives. The MC-FRM provides fine-resolution data and is also superior to a more rudimentary "bathtub" approach, since the latter does not account for critical physical processes that occur during a storm event, including waves and winds, nor can it determine the limited volume of water that may be able to enter certain areas, particularly those with narrow entry points.

The data in Table 3-1 summarize the expected relative mean sea level elevations (relative to NAVD88) for various out-years under various sea-level rise scenarios. MassDOT chose to utilize the high sea level rise values as inputs to the MC-FRM; these values also correspond with the Massachusetts EEA recommendations for assessing sea-level rise (EEA, 2018). Note that the values in Table 3-1 are *elevations* of the projected mean sea level at various times relative to a vertical datum of NAVD88, not the *magnitude of change* in elevation. For comparison, the baseline (i.e., year 2000) mean sea level elevation, is -0.30 feet (NAVD88).

Table 3-1. Relative Mean Sea Level (feet, NAVD88).

	2030	2050	2070	2100
Intermediate	0.7	1.4	2.3	4.0
Intermediate-High	0.8	1.7	2.9	5.0
High	1.2	2.5	4.3	7.8
Extreme	1.4	3.1	5.4	10.2

Probabilistic flood risk maps for 2030, 2050, and 2070 are presented in Figures 3-5 through 3-7. The color-coded results represent the percent chance of flooding in any given year due to the combined impact of sea-level rise and storm surge. For example, areas shaded light purple have a 5-10% chance of flooding. In other words, these areas will flood in a 10 to 20-year storm event. Similarly, areas shaded in yellow have a 0.2-0.5% chance of flooding (i.e., will flood in a 200 to 500-year storm event).

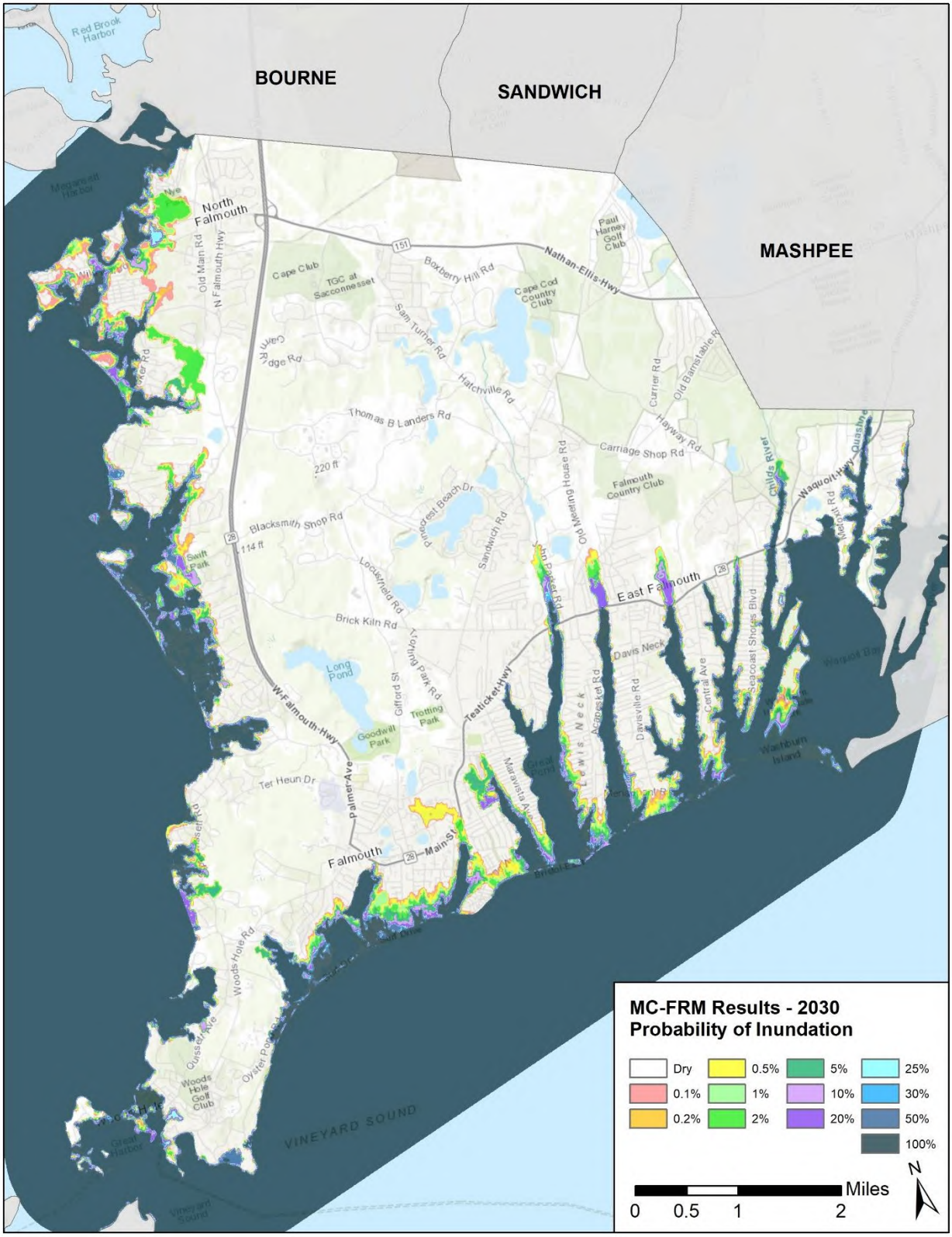

Figure 3-5. Probability of inundation in 2030 given assuming a high sea-level rise scenario (data from MC-FRM).

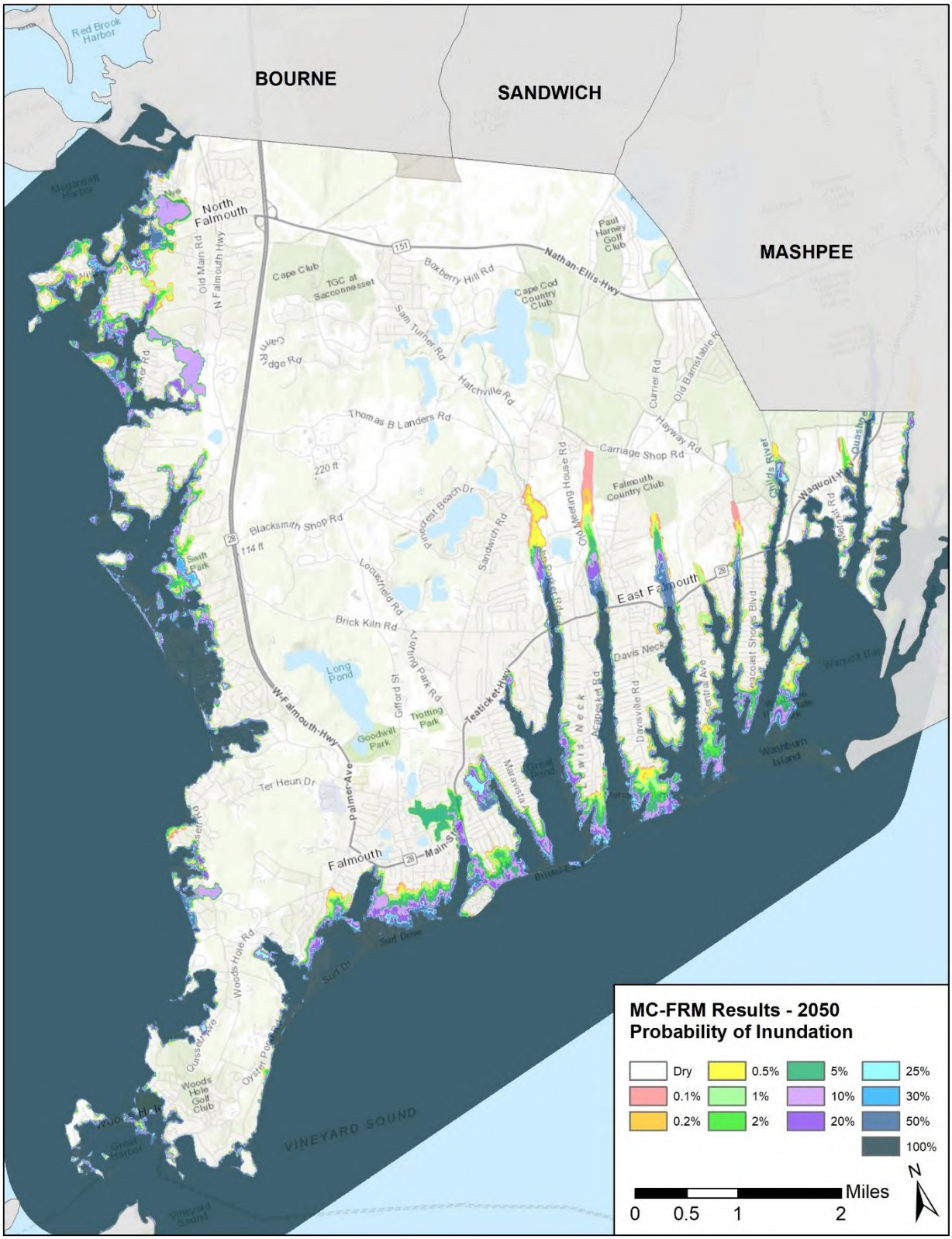

Figure 3-6. Probability of inundation in 2050 given assuming a high sea-level rise scenario (data from MC-FRM).

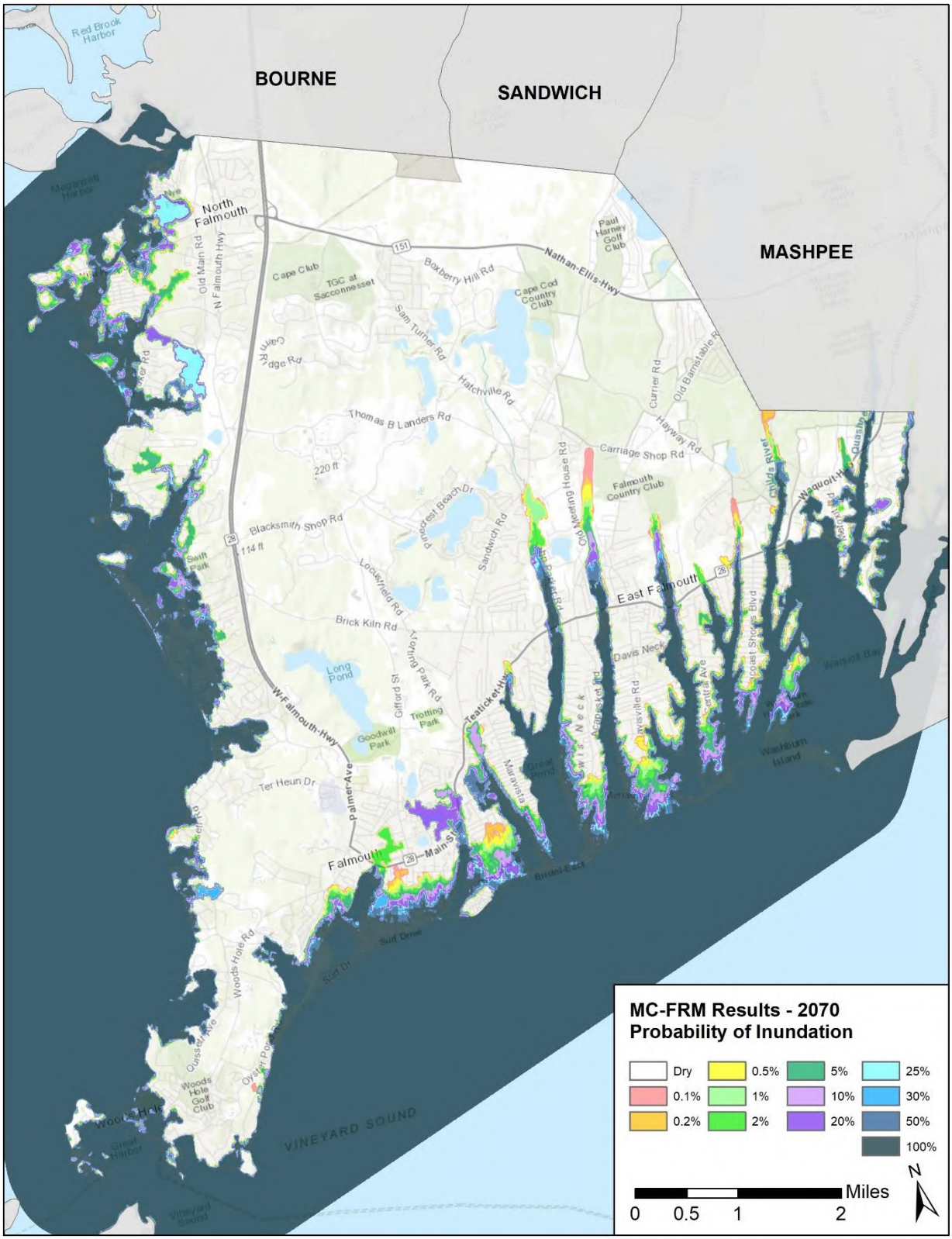

Figure 3-7. Probability of inundation in 2070 given assuming a high sea-level rise scenario (data from MC-FRM).

B2.b

Probability

Based on the frequency of past flooding occurrences described above, it is highly likely (near 100% probability in the next year) that flooding of some type will occur in Falmouth. However, climate change is projected to increase the frequency and intensity of severe weather events that can lead to major flooding events, such as heavy precipitation events, thunderstorms, or hurricanes. Considering projections of increased storm intensity as well as sea level rise, it is likely that in the future Falmouth will experience more severe and/or more frequent flooding.

B3.a

Impact

Below is a list of possible impacts for a flooding event in Falmouth:

- **People**: People can be knocked down or washed off their feet while walking in floodwaters. Injury or death can result from people being trapped in their vehicles during a flood event. People can be displaced from their homes due to post-flood safety and health hazards. Also, intrusion of water into households can lead to health and respiratory issues caused by the development of mold and mildew.
- **Emergency Response**: Flooded roadways can inhibit response access and emergency evacuation.
- **Infrastructure**: Flooding causes debris and sediment deposits on Town infrastructure and roads. Storm surges and associated waves can damage utility poles, roadways, water mains, sewer pipes and other Town infrastructure. Potential loss of potable drinking water in flooded areas due to the need to shut valves to protect the Town's drinking water supply.
- **Buildings**: Moving water associated with floods can damage buildings and other structures. Building foundations on or near the beach can be undermined by the velocity of floodwaters. Debris carried by flood waters can act as battering rams and damage buildings. Buildings can float off their foundations if not anchored properly. Basements can flood or can collapse due to external water pressure.
- **Economy**: Communication and infrastructure systems damaged during floods can disrupt economic activities and close businesses. Roadway disruptions due to flooding can reduce customer base. There can be economic losses associated with reduced value on coastal properties damaged by flooding.
- **Natural Systems**: Floods can deposit sediment and debris onto parks, beaches, marshes, and estuaries.
- **Transportation**: Floods can wash out bridges and culverts. Debris lodged in culverts can inhibit flow, causing additional flooding on the upstream side. There can be major disruptions to transit services.

3.2 COASTAL EROSION

Overview

Coastal shorelines—especially beaches, dunes, and banks—change constantly in response to winds, waves, tides, and other factors including seasonal variations, sea level rise and human alterations to the shoreline system. Every day, winds, waves, and currents move sand, pebbles and other materials along the shore or out to sea. This dynamic and continuous process of erosion, sediment transport, and accretion shapes the coastal shoreline. Shorelines change seasonally, tending to accrete gradually during the summer months when sediments are deposited by relatively low energy waves, and erode dramatically during the winter when sediments are moved offshore by high energy storm waves and currents, such as those generated by nor'easters.

B1.c
B2.a

Hazard Location

The Massachusetts Office of CZM has documented the rate of change of all ocean-facing shorelines of Massachusetts through their Shoreline Change Project (Thieler et al., 2013). Shorelines were delineated and evaluated to demonstrate trends from the mid-1800s to 2009. These data were then incorporated into MORIS, the Massachusetts Ocean Resource Information System (now referred to as MassMapper), to provide better access to the shoreline change data and to allow the public to view the data using the online tool.

Figure 3-8 displays the long-term shoreline change data in Falmouth from CZM's Shoreline Change Project. Long-term data ranges from 1895 to 2013 in Falmouth. Rates shown in Figure 3-8 are in feet per year, where negative values indicate erosion and positive values indicate accretion. Areas of more significant long-term erosion along the western shoreline include Chappaquoit Beach and Black Beach, north of Woodneck Beach, south of Gunning Point, and east of Gansett Point. Along the western shoreline of Falmouth, areas experiencing moderate to severe erosion include around Falmouth Heights, Fay Beach, and Surf Drive, near the Falmouth Yacht Club, and then most significantly from Little Pond to Washburn Island. There are very few accretional trends in the long term, limited to the northeast corner of Chappaquoit Point, sporadic locations along the southern shoreline, and at the eastern end of Washburn Island.

The more recent rates of shoreline change, between 1978 and 2013, are shown in Figure 3-9. Overall, short-term erosion rates indicate that the majority of the Falmouth shoreline is relatively stable. However, these rates may reflect more recent, proactive shoreline management efforts such as beach nourishment or other shoreline stabilization projects. Compared to the long-term erosion rates, in the short term, erosion has decreased in severity almost everywhere, with the exception of east of Gansett Point, western Menauhant Beach, and Washburn Island. In contrast to the long-term rates, short-term erosion rates do not indicate any areas are accreting substantially.

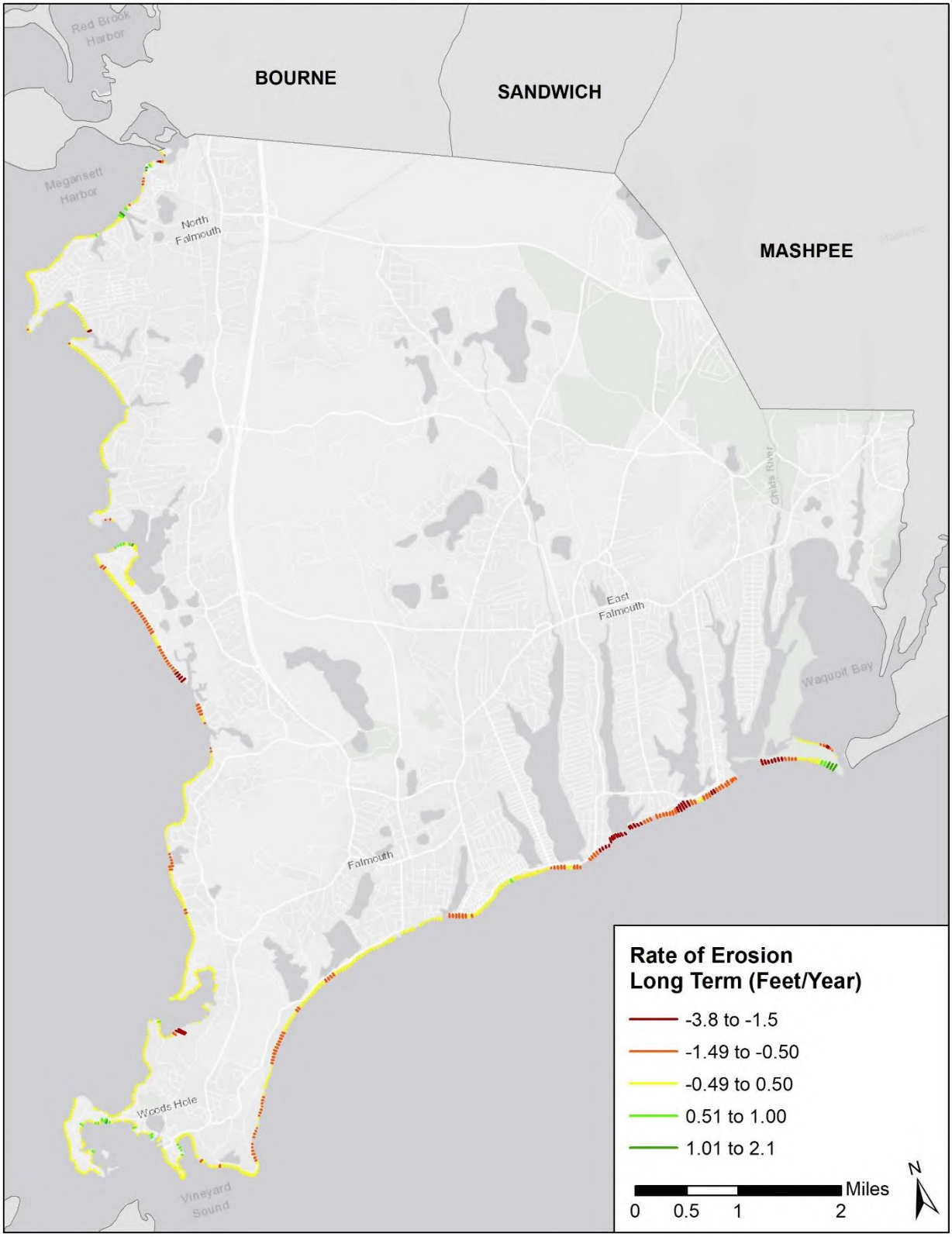

Figure 3-8. Long-term (1895 to 2013) rates of shoreline change (feet/year).

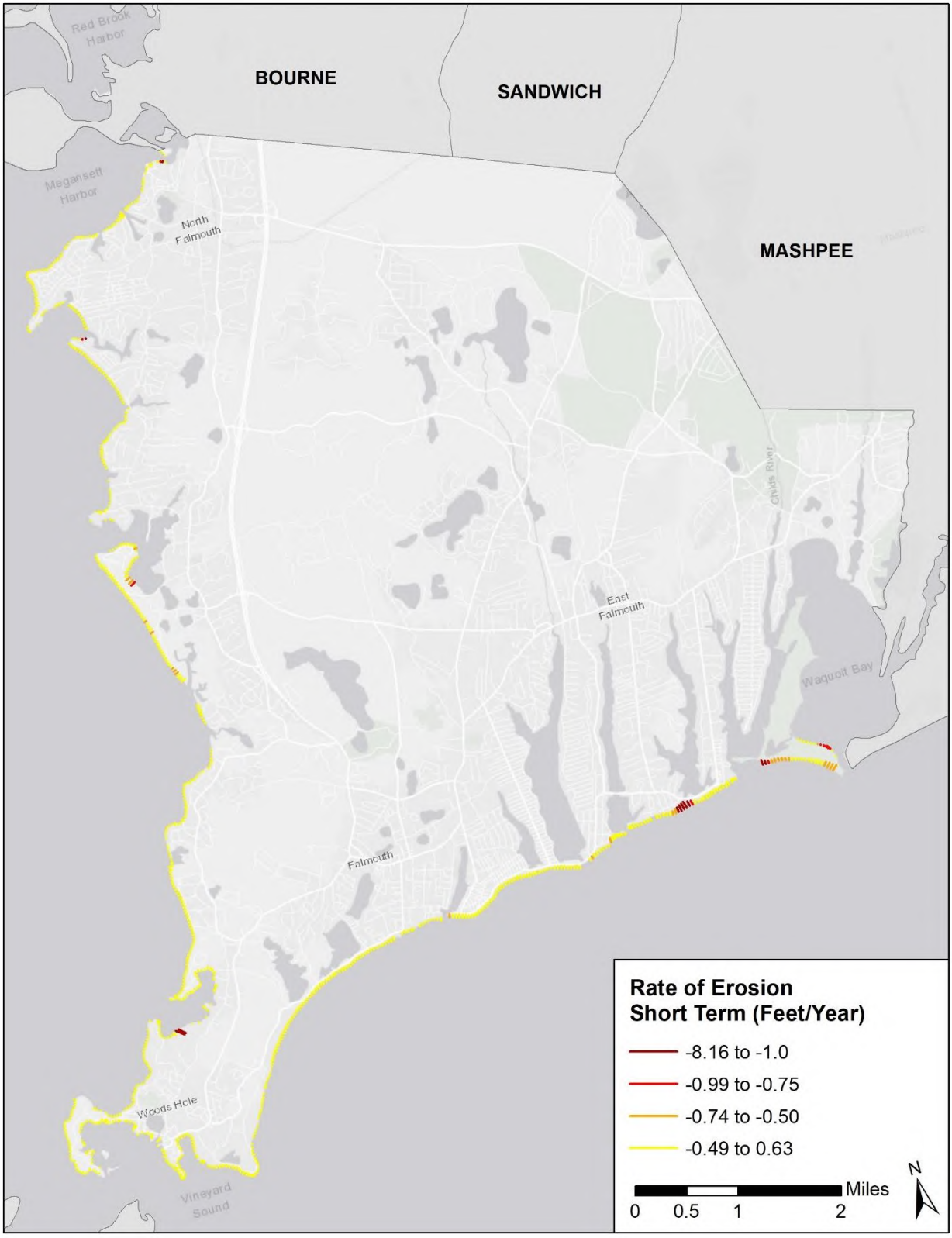

Figure 3-9. Short term (1978 to 2013) rates of shoreline change (feet/year).

The Report of the Massachusetts Coastal Erosion Commission tabulated the average shoreline change rate, in feet/year, for all coastal communities (CEC, 2015). The Coastal Erosion Commission (CEC) calculated both short- and long-term average rates of change: the average short-term rate of change for the entire Falmouth shoreline is -0.5 ft/yr, indicating erosion. The average long-term rate of change is -0.3 ft/yr, also indicating erosion. Average short- and long-term rates of change were also calculated for just the Nantucket Sound portion of shoreline (-1.1 ft/yr and -0.7 ft/yr, respectively) and for just the Buzzards Bay portion of shoreline (-0.3 ft/yr and -0.1 ft/yr, respectively). These results are consistent with the data from CZM's Shoreline Change Project.

B1.c
B2.a,c

Previous Occurrences & Extent

As shown in Figures 3-8 and 3-9, moderate to severe coastal erosion has occurred in Falmouth. Most notably, of the barrier beaches along the eastern shoreline of the Town separating salt ponds from the Nantucket Sound.

Figure 3-10. Severe weather events, such as a storm on October 17, 2019, can cause erosion.

B2.b

Probability

Based on the coastal erosion rates documented in the Massachusetts CZM Shoreline Change Project, it is highly likely (near 100% probability in the next year) that coastal erosion will occur in Falmouth; although the magnitude of these events may vary. As sea level rises and storms become more severe and frequent as a result of climate change, coastal and marine areas in Falmouth will likely experience increased rates of erosion.

B3.a

Impact

Below is a list of possible impacts that could result from coastal erosion:

- **People**: Public safety is jeopardized when buildings and structures collapse.
- **Emergency Response**: Erosion can collapse or damage roadways, which would impede emergency vehicles.
- **Infrastructure**: Erosion can expose septic systems, as well as break sewer pipes and water mains. Accreting sand can block outfall pipes, causing drainage issues and exacerbating flooding.
- **Buildings**: Erosion can undermine the foundations of buildings, making them more susceptible to settlement, lateral movement, or overturning. Debris from buildings that are damaged due to coastal erosion can be swept out to sea. Seawalls and other hard structures installed to reduce the effect of coastal erosion in one location can cause sediment losses at a downdrift area, affecting additional properties.
- **Economy**: Coastal erosion can adversely impact businesses by damaging a business's building. Relocation costs would be an additional economic burden to anyone forced to move to avoid coastal erosion impacts.
- **Natural Systems**: If engineered structures are used to stabilize shorelines, the natural process of erosion is altered, changing the amount of sediment available and the erosion rates at adjacent areas. The Town's natural ecosystem attractions (i.e. beaches, dunes, salt marshes, and estuaries) would also be threatened as sand sources that supply and sustain them are eliminated.
- **Transportation**: Roadways can become damaged through erosion.

3.3 HURRICANES & TROPICAL STORMS

Overview

A tropical cyclone is a rotating, organized system of clouds and thunderstorms that originates over tropical or subtropical waters. The hurricane season for the Atlantic Ocean extends from June 1st to November 30th, with the peak from mid-August to late October. However, deadly hurricanes can occur anytime during the hurricane season. Tropical cyclones are classified as follows (NHC, 2016a), depending on their intensity:

- **Tropical Depression**: A tropical cyclone with maximum sustained winds of 38 mph (33 knots) or less.
- **Tropical Storm**: A tropical cyclone with maximum sustained winds of 39 to 73 mph (34 to 63 knots).
- **Hurricane**: A tropical cyclone with maximum sustained winds of 74 mph (64 knots) or higher. In the western North Pacific, hurricanes are called typhoons; similar storms in the Indian Ocean and South Pacific Ocean are called cyclones.
- **Major Hurricane**: A tropical cyclone with maximum sustained winds of 111 mph (96 knots) or higher, corresponding to a Category 3, 4 or 5 on the Saffir-Simpson Hurricane Wind Scale.

Hurricanes are typically fast-moving storms (typically lasting 6 to 12 hours) with high winds in excess of 74 miles per hour and torrential rains averaging 6 to 8 inches, but possibly dropping as much as 15 to 20 inches of rainfall during a single event.

Hazard Location

The entire Town of Falmouth is vulnerable to hurricanes and tropical storms. Coastal areas are extremely susceptible to damage due to a combination of wind and storm surge. However, even inland areas can be affected by the flooding, strong winds and heavy rains associated with these events. Storm surge occurs when water is pushed towards shore by storm generated winds. Storm surge combines with the water elevation, which can substantially increase water levels. In addition, wind generated waves are superimposed on the storm surge. This rise in water level can cause severe flooding in coastal areas, especially when a storm surge coincides with a high tide. Figure 3-11 depicts the components of storm surge.

The US Army Corps of Engineers (USACE) New England Division, in cooperation with FEMA, prepared Sea, Lake and Overland Surge from Hurricanes (SLOSH) inundation maps. SLOSH maps show the extent of potential flooding from worst-case combinations of hurricane direction, forward speed, landfall point, and high astronomical tide. However, the model considers only storm surge height and does not consider the effects of waves. When selecting model parameters, the USACE considered the highest wind speed for each category, the highest surge level, and the worst-case forward motion of the storm to develop a “worst case” scenario. The resulting inundation areas are grouped in Category 1, Category 2, Category 3, and Category 4. Figure 3-12 shows the SLOSH results for Falmouth.

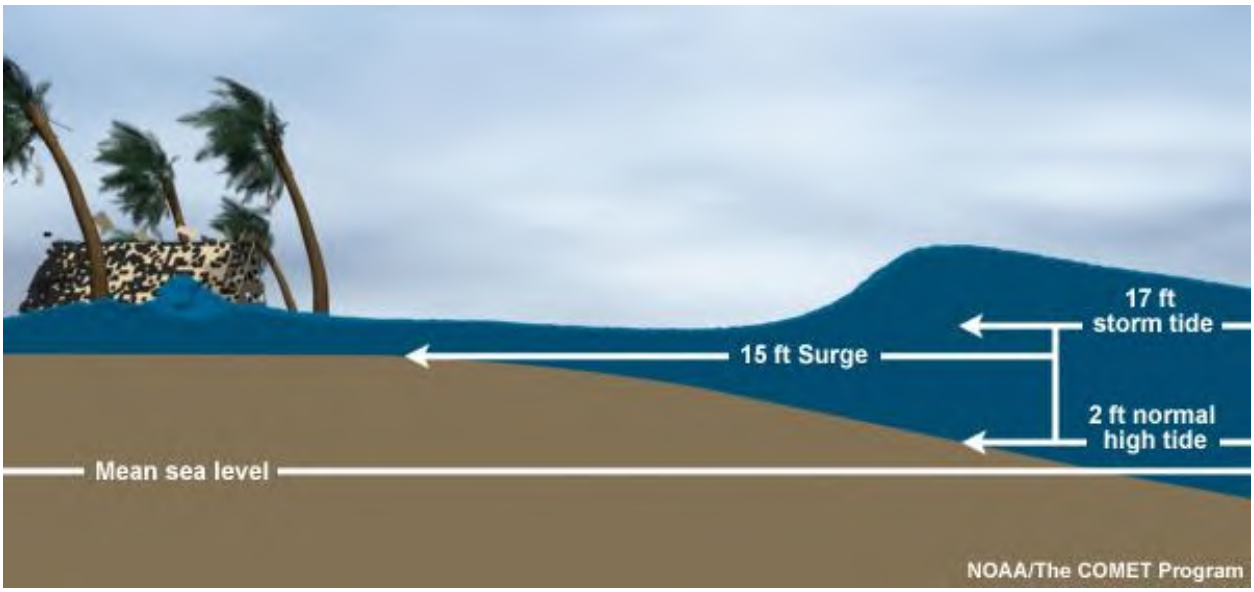

Figure 3-11. Schematic image of a storm surge and storm tide affecting a shoreline (NHC, 2016c).

Previous Occurrences & Extent

A hurricane has not made landfall in Massachusetts for almost 30 years (Hurricane Bob in 1991), and it has been more than 60 years since a major hurricane (Category 3 or higher) has occurred. The most treacherous storm in in the last 50 years was Hurricane Bob, which caused severe storm surge and flooding. In a future storm of similar magnitude, a forced evacuation of the Town would be met with automobile congestion and difficulty for some residents in getting out of harm's way, particularly in neighborhoods with a single point of entry and exit.

Smaller tropical storms and depressions have affected the area, generally inflicting minor damage, such as downed tree limbs, power outages, and limited damage to boating-related infrastructure (Figure 3-13). Table 3-2 provides a summary of historic hurricanes that have impacted Massachusetts. However, due to the large diameter of many hurricanes and tropical storms, and the far-reaching effects of storm surge, even storms that don't make landfall in New England can have significant hazard impacts on Massachusetts, and on Falmouth. To illustrate the frequency of these storms, Figure 3-14 shows all hurricanes and tropical storms that have passed within 100 miles of Falmouth between 1972 and 2022. Note that although major hurricanes (Category 1, Category 2, etc.) occur approximately once every ten or twenty years in Massachusetts (Table 3-2), tropical storms and tropical depressions (represented by the green and blue lines in Figure 3-14) are relatively common, occurring every few years.

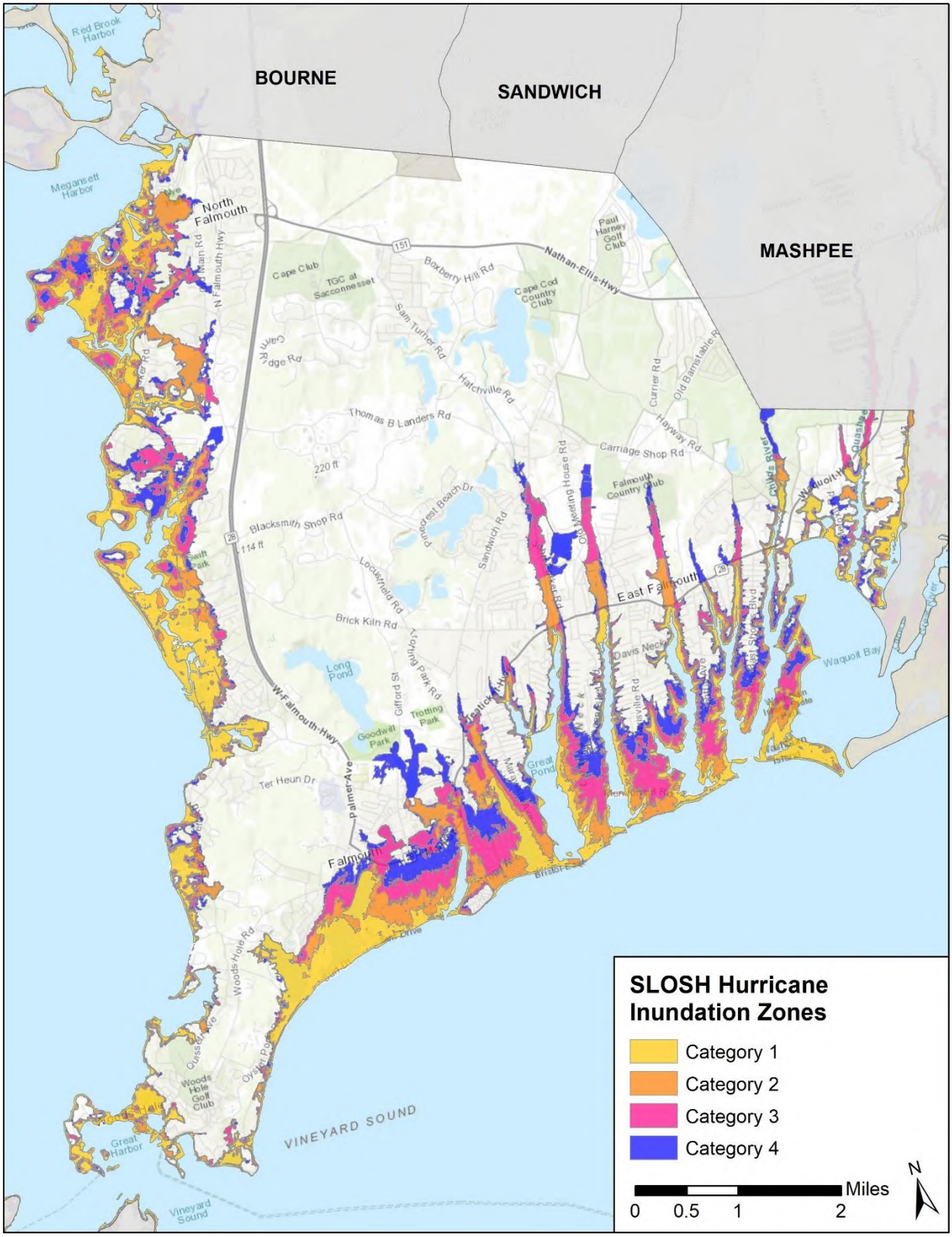

Figure 3-12. SLOSH Categories for Falmouth. Note: The SLOSH model considers only storm surge height and does not consider the added effects of wave height.

Figure 3-13. Large waves overtopping the seawall along Menauhant Road during Tropical Storm Henri on August 22, 2021.

Table 3-2. Massachusetts Hurricanes Since 1938.

Date	Name	Intensity (in MA)
August 19, 1991	Hurricane Bob	Category 2
September 27, 1985	Hurricane Gloria	Category 1
September 12, 1960	Hurricane Donna	Category 2
September 11, 1954	Hurricane Edna	Category 1
August 31, 1954	Hurricane Carol	Category 3
September 15, 1944	Great Atlantic Hurricane	Category 3
September 21, 1938	Great New England Hurricane	Category 3

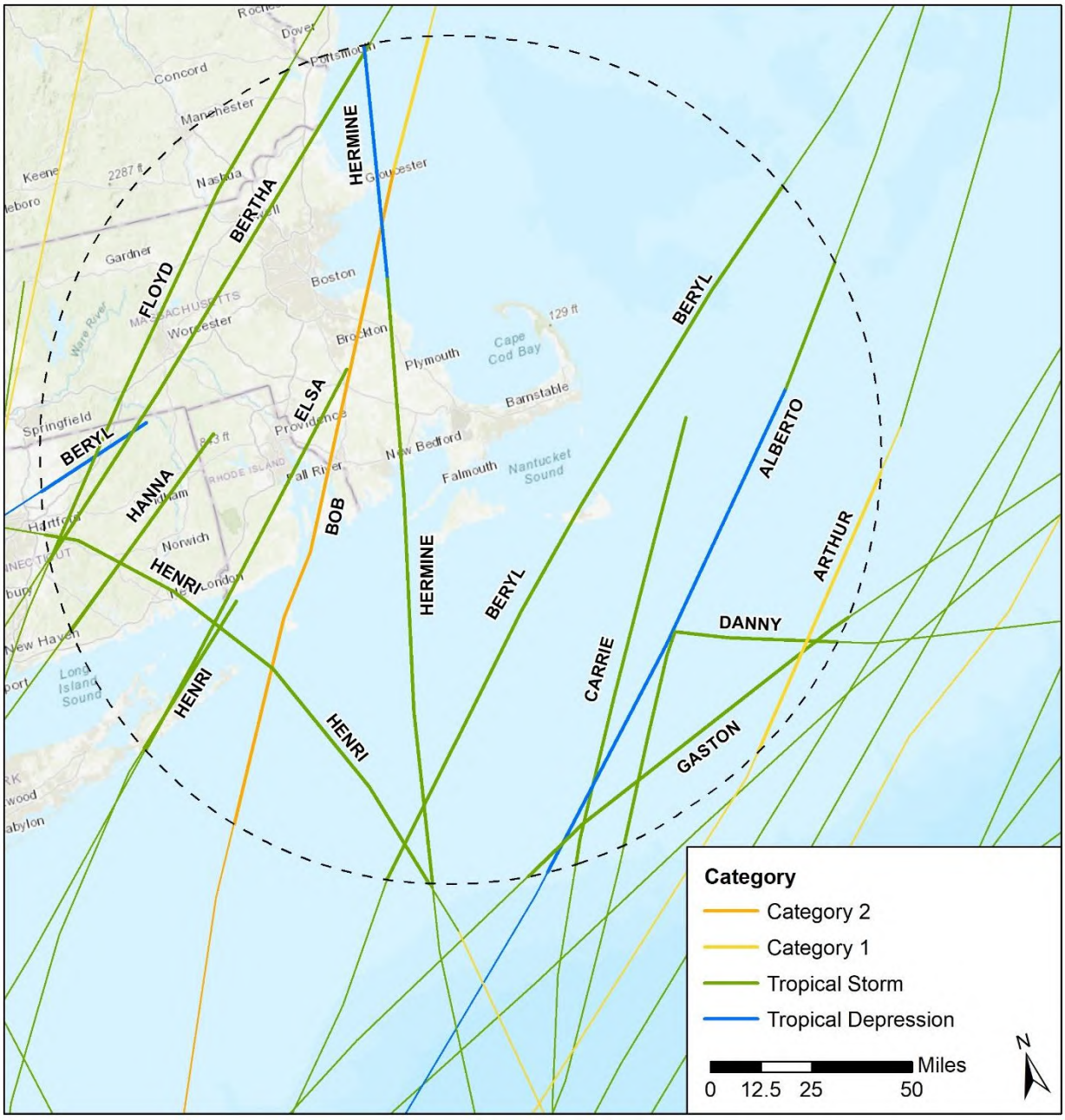

Figure 3-14. Hurricane and tropical storm tracks in the within 100 miles of Falmouth between 1951 and 2021 (NOAA, 2020b).

The Saffir-Simpson Hurricane Wind Scale is often used to classify tropical cyclones. The Saffir-Simpson Scale, described in Table 3-3, outlines a rating system from 1 to 5 based on the hurricane's sustained wind speed. This scale is then used to estimate potential property damage. Hurricanes classified as a Category 3 or higher are considered major hurricanes due to their potential for devastating or catastrophic damage and loss of life.

Table 3-3. Saffir-Simpson Hurricane Wind Scale (NHC, 2016b).

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
1	75-95 mph 64-82 kt 119-153 km/h	**Very dangerous winds will produce some damage:** Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110 mph 83-95 kt 154-177 km/h	**Extremely dangerous winds will cause extensive damage:** Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3 (major)	111-129 mph 96-112 kt 178-208 km/h	**Devastating damage will occur:** Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4 (major)	130-156 mph 113-136 kt 209-251 km/h	**Catastrophic damage will occur:** Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5 (major)	157 mph or higher 137 kt or higher 252 km/h or higher	**Catastrophic damage will occur:** A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

B2.b

Probability

Based on the hurricane and tropical storm frequency documented in this section, it is likely (between 10 and 100% probability) that a hurricane or tropical storm will impact Falmouth in the next year. In the future, higher category storms are predicted to increase as a result of climate change, meaning Falmouth may experience more of the severe weather associated with hurricanes and tropical storms.

B3.a

Impact

Below is a list of possible impacts that could result from a hurricane or tropical storm:

- **People**: Public safety is jeopardized when buildings and structures collapse, downed trees land on buildings or cars, or emergency response is blocked by flooded roadways. Danger of downed live electrical wires.
- **Emergency Response**: Heavy rains and flooding associated with hurricanes and tropical storms, as well as downed trees and branches caused by the high winds, can reduce the response time of emergency vehicles, or block access entirely.
- **Infrastructure**: High winds, heavy rains and coastal storm surge can cause widespread power outages, limit access to other utilities such as drinking water and communications, and limit transportation. A significant hurricane could also damage wellfields and wells, disrupting drinking water supply.
- **Buildings**: High coastal winds and storm surge can cause substantial damage to homes and businesses and devastate coastal infrastructure such as marinas.
- **Economy**: Hurricanes and/or tropical storms can adversely impact businesses if a business's building is damaged by the storm, or if utilities or road access are affected.
- **Natural Systems**: The high winds and heavy precipitation often associated with hurricanes and tropical storms can cause damage to the environment including uprooting vegetation, potentially harming the Town's natural ecosystems.
- **Transportation**: Roadways can become impassible due to flooding and/or downed trees.

3.4 SEVERE WINTER WEATHER (SNOW/BLIZZARD/ICE STORM/NOR'EASTER)

Overview

Snowstorms and blizzards are common events in New England. These storms are often high duration events with significant winds and heavy snowfall. The majority of blizzards and ice storms in the region cause more inconvenience than they do serious property damage, injuries, or deaths. Sleet and ice storms result when temperatures are appropriate for precipitation to fall as frozen or mostly frozen raindrops, or liquid rain that freezes upon contact with structures and objects on the ground. Travel is often limited and disruptions to power and other utility delivery are a high potential. Coastal flooding can occur during these events, especially with westerly winds. However, periodically, a storm will occur that is a true disaster, and necessitates intense large-scale emergency response. On average Falmouth receives 27 inches of snow per year.

In addition to many of the same hazards posed by other natural disasters, winter storms have the added hazard associated with cold weather for prolonged periods of time. Unlike disasters occurring during the summer months such as hurricanes, power outages may result in extended periods of no heat. Prolonged contact with low temperatures can cause pipes to freeze and burst, damaging homes and businesses. Winter storms pose additional health problems with the added strain of exposure to freezing temperatures, especially for the elderly.

A nor'easter is a particular kind of cyclonic winter storm that moves along the east coast of North America, from south to north; once these storms reach New England, they often intensify. It is called a nor'easter because the winds associated with the storm blow from a northeasterly direction. Sustained wind speeds of 20 to 40 mph are common during a nor'easter, with gusting often reaching 50 to 60 mph. In some cases, the wind speed may actually meet or exceed hurricane force. The storm radius of a nor'easter can be as much as 1,000 miles, and the storm is often accompanied with heavy rain and/or snow, depending on temperature. Most nor'easters bring both storm surge and high winds to the coast of Massachusetts, making the coastline particularly vulnerable to erosion and flooding.

B1.c
B2.a

Hazard Location

The entire Town of Falmouth is at risk from severe winter weather. The Northeast Regional Climate Center has compiled 30-year annual snow totals in New England and the eastern United States. Based on this data, between 1981 and 2010, the Falmouth area averaged 20 to 40 inches of snowfall annually between 1981 and 2010 (Figure 3-15). Barnstable County has had 8 FEMA Winter Storm Declared Disasters between 1953 and 2017 (Figure 3-16).

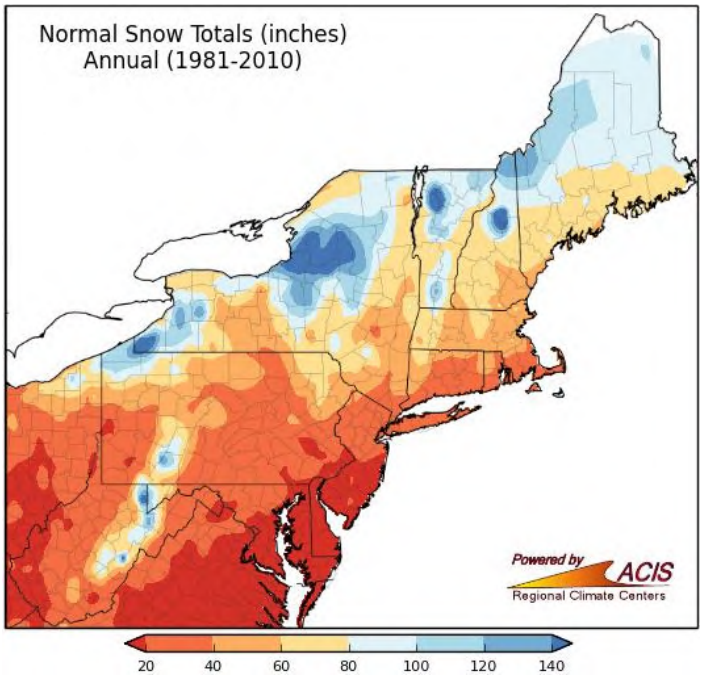

Figure 3-15. Annual average snow totals for New England between 1981 and 2010.

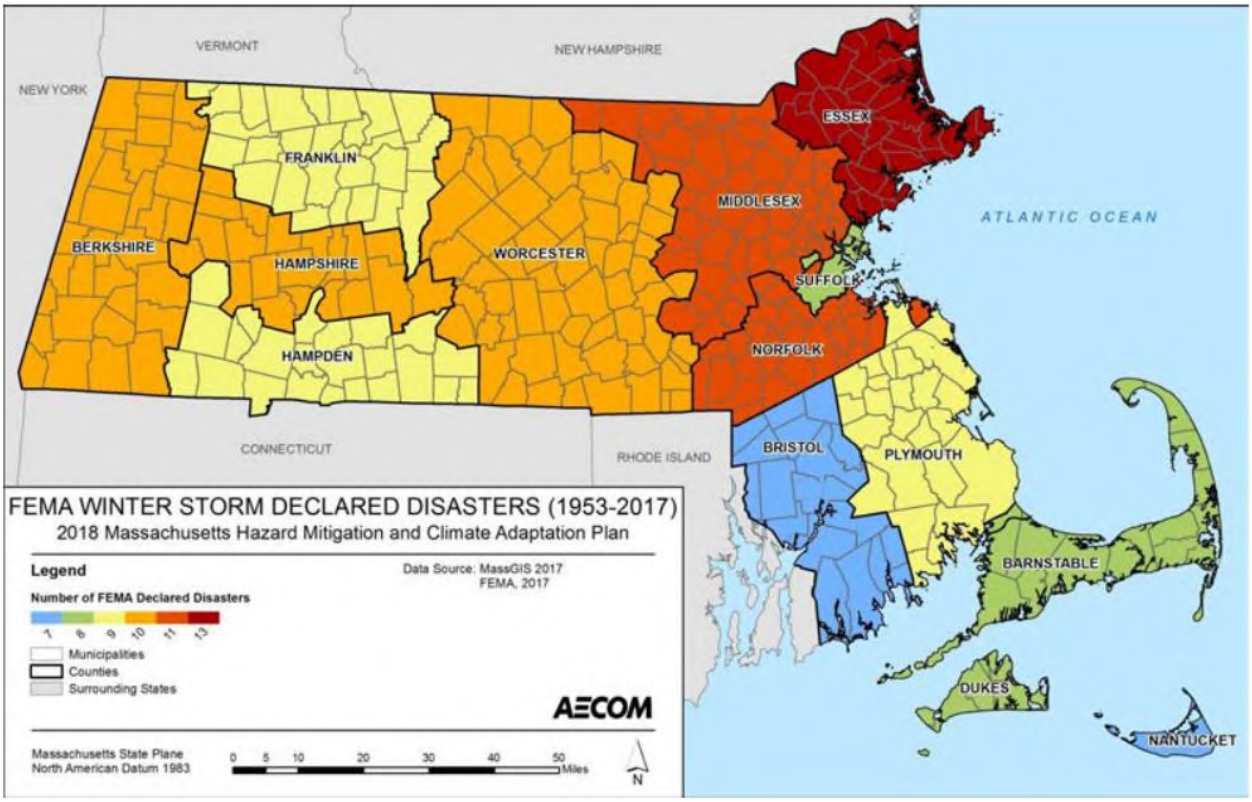

Figure 3-16. FEMA winter storm-related disasters by county (1953-2017) (from 2018 State Hazard Plan).

B1.c
B2.a,c

Previous Occurrences & Extent

Winter storms occur quite frequently, but due to preparation by the Town and its residents, typically amount to no more than a minor inconvenience. School delays and slow travel occur but crippling winter storms are a rarity. However, they do occur. The most severe winter storm to ever hit New England was the Blizzard of 1888, which occurred in March of that year. Snow accumulations reached 30 to 50 inches where precipitation was entirely snow. Boston received a mix of snow and rain creating up to nine inches of slush. The Blizzard of 1978 resulted in 24 to 38 inches of snow across New England, immobilizing the infrastructure and blocking major highways, and causing thousands of motorists to abandon their cars on the road. Two weeks were required to remove the snow. The Blizzard of 1978 resulted in a federal disaster declaration for many counties in Massachusetts. More recent blizzards and snowstorms occurred in March 1993, February 1996, March 2001, January 2005, February 2013 (Winter Storm Nemo) and January 2015 (Winter Storm Juno).

Winter Storm Juno, in January 2015 was a powerful nor'easter that impacted the northeast. A state of Emergency was declared in Massachusetts and travel bans were issued in preparation for the storm. The storm produced winds that gusted to 75 mph, a rain/snow mix that resulted in 15 to 18 inches of snowfall, coastal flooding that caused erosion in many areas across the state, and multi-day loss of electricity for many properties. This nor'easter resulted in a federal disaster declaration for many counties in Massachusetts, including Barnstable County. Table 3-4 below provides a list of major winter storms in New England from 2013 to 2022.

The Northeast Snowfall Impact Scale (NESIS) was developed by the National Weather Service to characterize and rank high-impact Northeast snowstorms. A "High-impact" snowstorm is one that produces large areas of 10-inch snowfall accumulations or greater. The NESIS has five categories: Notable, Significant, Major, Crippling, and Extreme (Table 3-5). This index differs from other meteorological indices, however, because it uses population information in additional to meteorological measurements; the NESIS gives a ranking to the societal impacts of a storm. NESIS values are a function of the area affected by the snowstorm, the amount of snow, and the number of people living in the path of the storm. The largest NESIS values result from storms producing heavy snowfall over large areas that include metropolitan centers. These values are then converted into one of the five NESIS categories (NOAA, 2019b).

Figure 3-17. Winter storm Skylar from March 13-15, 2018. This was the third major Nor'easter in 11 days, resulting in widespread power outages across Cape Cod.

Table 3-4. Major Winter Storms in New England (2013 to 2022).

Date	NESIS	Cat	Description
Feb 7-10, 2013	4.35	3	Major
Mar 4-9, 2013	3.05	2	Significant
Dec 13-16, 2013	2.95	2	Significant
Dec 30, 2013 - Jan 3, 2014	3.31	2	Significant
Jan 20-24, 2014	1.26	1	Notable
Jan 29-Feb 4, 2014	4.08	3	Major
Feb 11-14, 2014	5.28	3	Major
Nov 26-28, 2014	1.56	1	Notable
Dec 9-14, 2014	1.49	1	Notable
Jan 25-28, 2015	2.62	2	Significant
Jan 29-Feb 3, 2015	5.42	3	Major
Feb 8-10, 2015	1.32	1	Notable
Jan 22-24, 2016	7.66	4	Crippling
Mar 12-15, 2017	5.03	3	Major
Jan 3-5, 2018	1.71	1	Notable
Mar 2-8, 2018	3.45	2	Significant
Mar 11-15, 2018	3.16	2	Significant
Mar 20-22, 2018	1.63	1	Notable
Dec 14-18, 2020	3.21	2	Significant
Jan 30-Feb 3, 2021	4.93	3	Major
Jan 30- Feb 3, 2022	4.93	3	Major

Table 3-5. NOAA's Northeast Snowfall Impact Scale (NESIS).

Category	NESIS Value	Description
1	1 – 2.499	Notable
2	2.5 – 3.99	Significant
3	4 – 5.99	Major
4	6 – 9.99	Crippling
5	10+	Extreme

B2.b

Probability

Based on the snow frequency of occurrence recorded from past events, it is likely (between 10 and 100% probability in the next year) that snow will occur in Falmouth. Climate change is predicted to increase moisture within the air, leading to an increase in the intensity and severity of winter storms in places that experience cold winter temperatures. Therefore, future storms that impact Falmouth may result in heavier snowfall.

B3.a

Impact

Below is a list of possible impacts that could result from severe winter weather:

- **People**: Walking and driving can become extremely dangerous due to icy roads and sidewalks, snow accumulation, and low visibility. Poor driving conditions often require people to shelter in place, and loss of utility function can result in dangerous conditions during extreme cold temperatures associated with snow events. Injury is also possible from slipping on ice, overexertion from shoveling, and frostbite.
- **Emergency Response**: Snow, icy roads, and trees felled by storm conditions can reduce emergency vehicle response time.
- **Infrastructure**: Culverts and roads can be washed out during a heavy flow after a snowmelt. Ice and heavy snowfall can impact and cut off utilities, such as heating, power, and communication services, for several hours or days. Water pipes can burst due to extreme cold temperatures. Utility outages can result from nor'easters.
- **Buildings**: Buildings and roofs can experience structural failure as a result of heavy snow loads.
- **Economy**: Poor driving conditions and closed roads prohibit businesses from opening and people from going to work. Heavy snowfalls result in increased cost to the Town for plowing, snow removal, and treatment of roads. Utility outages and damaged buildings can result in loss of business function.
- **Natural Systems**: Snow and ice accumulation can negatively impact vegetation and natural habitat. Trees and tree limbs can be knocked down by the weight of accumulated snow, by high winds, or both. Beaches, coastlines, and inlets can be reshaped by waves and storm surge associated with nor'easters.
- **Transportation**: Roadways can become extremely dangerous due to icy conditions, snow accumulation, and low visibility. Public transportation is also occasionally shutdown as a result of heavy snowfall.

3.5 WILDFIRE

Overview

Fire events can be broken into two major categories: urban fires and wildfires. Urban fires are the result of buildings and structures catching fire, with the potential for the fire to spread to neighboring properties. These events have a higher chance of spreading more rapidly in areas where residential and commercial buildings are clustered closely together. Urban fires tend to occur more frequently than wildfires, and often result from everyday activities such as cooking, smoking, or appliance malfunction.

A wildfire is an unplanned, unwanted fire burning in a natural area, such as a forest, scrubland, or grassy area. Wildfires and forest fires are naturally occurring events, and part of a normal, healthy ecosystem. Naturally occurring fires help keep forest floors free of excessive debris buildup, thin crowded trees, encourage growth of new vegetation, and recycle nutrients into the soil. Forest fires may occur at any time of year, however typically during hot, dry summer months, or during windy conditions during the spring and fall. Natural ignition most frequently occurs as the result of a lightning strike.

In Massachusetts, wildfires are typically caused by lightning or human activity (i.e. discarded cigarettes, unattended camp fires, downed power lines, etc.). The Bureau of Fire Control estimates that nearly 98% of fires in Massachusetts are started by human carelessness.

B1.c
B2.a

Hazard Location

Wildfire has played a role in shaping the northeast landscape for thousands of years. As a result, there are an abundance of fire-adapted ecosystems in the region. Falmouth's forests are primarily composed of pitch pine and oak, which are considered by the State fire officials to be high risk for wildfires. Figure 3-18 illustrates where the most heavily forested areas are within Falmouth, and therefore the areas with the highest risk of wildfire. Within Falmouth, densely forested areas are primarily located within the central part of town and are generally lowest along the waterfront, where residential and commercial development is highest.

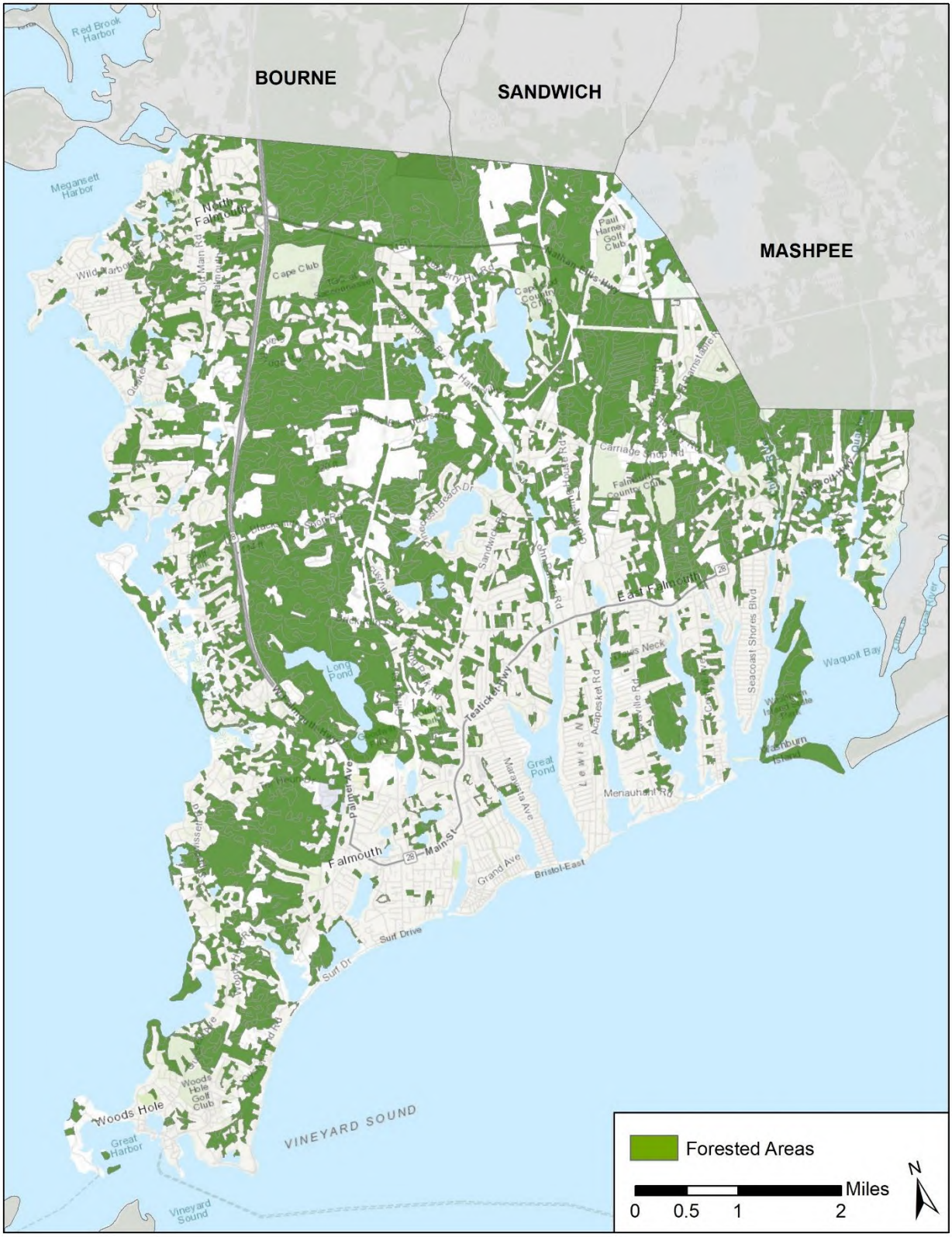

Figure 3-18. Heavily forested areas within the Town of Falmouth.

B1.c
B2.a,c

Previous Occurrences & Extent

Forest fires vary in size, however thanks to modern detection and firefighting equipment methods, fires are typically kept to a reasonably small area. The Bureau of Fire Control estimates that the average fire 100 years ago consumed approximately 34 acres, while today the average fire burns only 1.2 acres. However, large fires have occurred nearby in the past, such as the 1957 fire in Myles Standish State Forest which burned over 18,000 acres, stopping only when it reached the ocean. Fortunately, most fires are quickly identified and suppressed, or extinguish themselves naturally due to wet weather conditions. The majority of wildfires occur in the spring, before "green-up", or in late summer, following periods of drought.

Smaller fires are more common and are generally addressed quickly by the Falmouth Fire Department. Between 2018 and 2021, the Falmouth Fire Department responded to 60 wildfire incidents. Figure 3-19 below illustrates the number of fires that occurred within each year from 2018 to 2021.

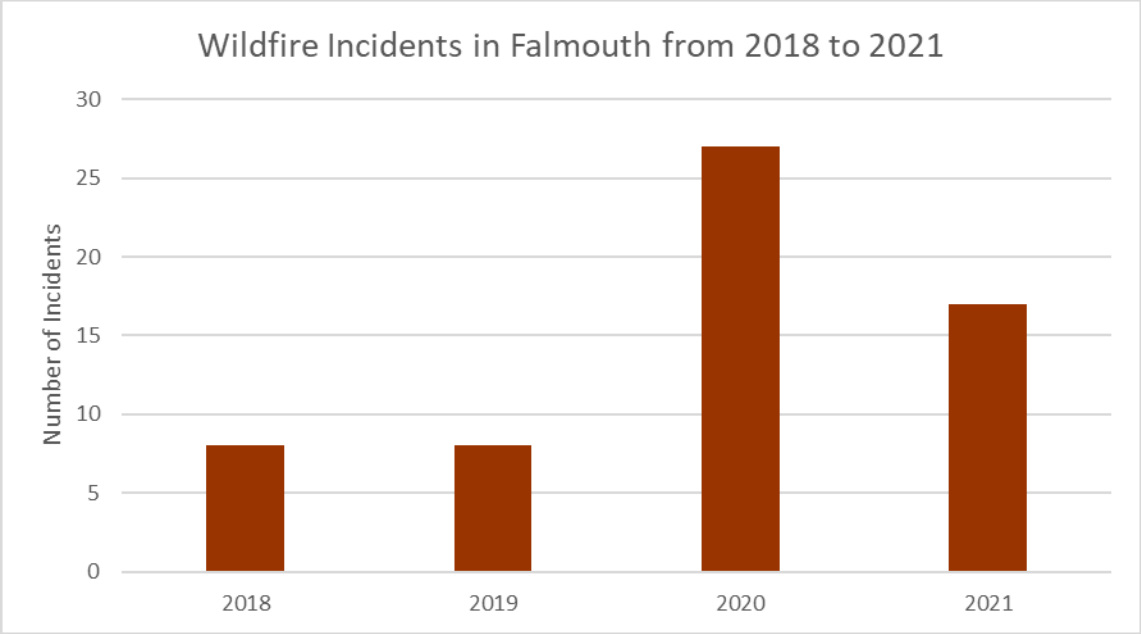

Figure 3-19. Number of wildfire incidents in Falmouth from 2018 to 2021.

Figure 3-20. Brush fire in Falmouth on March 12, 2020 off Brick Kiln Road. No injuries were reported but a total of 9 acres were burned.

Once a fire starts, location of the fire and the type of fuel consumed determines how severe the fire will be. There are four types of wildfires (Table 3-6). These fire types range from ground fires, which tend to travel relatively slowly and are easier to control, to canopy fires, in which flames can jump from tree to tree through the canopy relatively quickly. These are the most difficult to control and extinguish.

Table 3-6. Wildfire Types.

Type	Location	Typical Fuel
Ground	At or below ground surface	Underground roots, buried leaves or other organic matter
Surface	Ground surface	Surface leaves, grass, low lying vegetation, underbrush
Ladder	Between the surface and canopy	Underbrush, downed logs, vines and small trees
Canopy	In the tree canopy	Tall trees, vines and branches

B2.b

Probability

B3.a

The Town of Falmouth is somewhat susceptible to wildfires due to the availability of fuel, impacts from offshore winds, and increasing development within wooded areas. Therefore, it is possible (1 – 10% probability in the next year) that a wildfire will occur in Falmouth. Increasing temperatures caused by climate change leads to dryer soil within forests and a higher flamability of vegetation. In addition, snow may melt earlier, meaning wooded areas will experince drier conditions for a longer period of time. All of these factors contribute to a higher risk of wildfire within the Town of Falmouth in the future as a result of cliamte change.

Impact

Below is a list of possible impacts that could result from wildfire:

- **People**: Death or injury can result if people are trapped by urban or wildfires. Smoke inhalation can cause health issues.
- **Infrastructure**: Utility services may be disrupted; a large fire in the wellfield could negatively impact the wellfield itself, while a large enough fire could adversely impact well water quality. Roads may become impassible, and transportation may be disrupted.
- **Buildings**: Buildings and structures can be damaged or destroyed, either by the fire directly, or through ignition from flying sparks and embers.
- **Economy**: Indirect economic losses can result from lost tourism due to a major fire. Disrupted utilities may halt businesses and other economic activities.
- **Natural Systems**: Extensive areas of forests and other natural areas can be burned. Wildfires can strip slopes of vegetation, increasing the potential for runoff and erosion.

3.6 TORNADO

Overview

Tornadoes are a vortex of rapidly rotating air moving along the ground. Tornadoes typically occur during the spring, summer and fall months, usually during the afternoon. Tornadoes may occur in unusually severe thunderstorms, bringing hazards such as very high wind speeds (typically anywhere from 100 to 300 miles per hour) along a localized area, localized heavy rainfall and flooding, frequent lightning, and damaging hail.

Tornadoes may be anywhere from less than 250 feet to over two miles in diameter. Typically, tornadoes dissipate after no more than a couple miles on the ground; however they have been known to stay on the ground for dozens of miles, causing substantial damage along the way. Although not common in the northeast, tornadoes have occurred in every state of the U.S. In Massachusetts, tornadoes occur most frequently in and around Worcester County, however they may occur wherever conditions are right. According to NOAA, Barnstable County is located in an area of very low probability of occurrence, with less than one tornado expected to occur every five years.

B1.c
B2.a

Hazard Location

NOAA's National Weather Service maintains a database of tornado information in the United States (updated through February 2021). The data include information on date, start and end location, number of injuries and fatalities, and categories of property loss values from each storm. There have been 184 tornadoes documented in Massachusetts from 1951 to 2021 (Figure 3-21). From 1951 to 2022, only three (3) tornadoes have impacted Falmouth and were relatively minor with a scale from EF0 to F1 (Table 3-7).

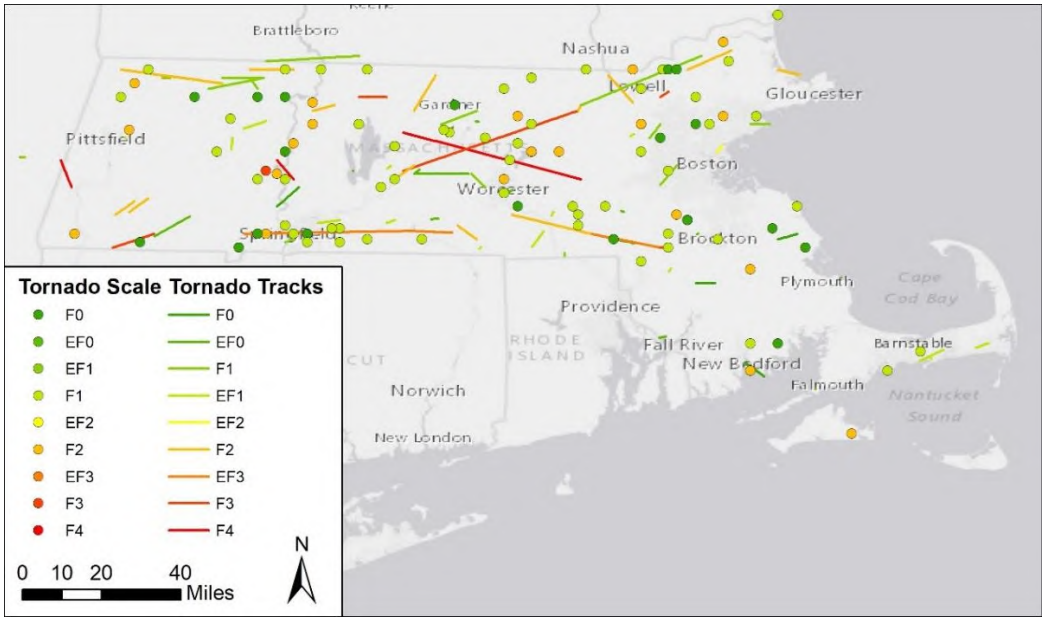

Figure 3-21. Massachusetts tornadoes between 1951 and 2021 (refer to Tables 3-8 and 3-9 for F and EF Scale descriptions).

Table 3-7. Barnstable County Tornadoes Between 1951 and 2022.

Date	Scale	Town	Death/Injury	Length/Width
9/2/2021	EF0	Dennis	0/0	0.1 mi / 15 yds
7/23/2019	EF1	Harwich	0/0	2.77 mi / 250 yds
7/23/2019	EF1	West Yarmouth	0/0	0.25 mi / 50 yds
7/23/2019	EF1	Hyannis Port	0/0	5.52 mi / 250 yds
10/29/2018	EF0	Woods Hole	0/0	0.1 mi / 10 yds
8/22/1977	F1	Barnstable Co.	0/2	0.1 mi / 10 yds
8/9/1968	F1	Barnstable Co.	0/0	0.1 mi / 33 yds

B1.c
B2.a,c

Previous Occurrences & Extent

Although only three tornadoes have impacted Falmouth since 1951, as noted above, five tornadoes have occurred within Barnstable County during the same time period. Table 3-7 documents the characteristics of these tornadoes; this table documents the F-scale (see description of the Fujita Tornado Damage Scale below) or EF-scale (see description of the Enhanced Fujita Scale below), number of injuries and fatalities, and the size of each tornado, as measured by the length and width of its track. Table 3-8 describes the Fujita Tornado Damage Scale developed by Dr. T. Theodore Fujita for winds, including tornadoes, which relates the degree of damage to the intensity of the wind, as well as the number of injuries and fatalities, and the value of any property loss associated with the event.

Recently, the National Weather Service has switched to using a revised rating system for tornadoes. The Enhanced Fujita Scale (EF-Scale) became operational in February 2007 and is similarly used to assign a tornado's rating based on estimated wind speeds and related damage. The EF-Scale was revised from the original Fujita Scale to better reflect the results of tornado damage surveys to align wind speeds more closely with associated storm damage. The new scale has to do with how most structures are currently designed. A summary of the EF-Scale ratings is provided in Table 3-9.

B2.b

Probability

Considering relatively small scale tornadoes do occur throughout Massachusetts on a regular basis, and have directly impacted the Town, it is possible (between 1 and 10% probability in the next year) that a tornado will occur in Falmouth. The effect of climate change on tornados is less clear than in the case of other hazards. Climate change is predicted to increase moisture within the air, an essential ingredient for tornadoes, however, another essential ingredient, wind shear, may decrease. As a result, the exact effect of climate change on tornadoes is still being determined.

Table 3-8. Fujita Tornado Damage Scale.

Scale	Wind Estimate (mph)	Typical Damage
F0	< 73	Light damage: some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged
F1	73-112	Moderate damage: peels surface off roads; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113-157	Considerable damage: roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground
F3	158-206	Severe damage: roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207-260	Devastating damage: well-constructed houses level; structures with weak foundations moved; cars thrown; large missiles generated.
F5	261-318	Incredible damage: strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters; trees debarked; incredible phenomena will occur.

Table 3-9. Enhanced Fujita (EF) Scale.

Scale	3 Second Wind Gust (mph)
EF0	65-85
EF1	86-110
EF2	111-135
EF3	136-165
EF4	166-200
EF5	Over 200

B3.a

Impact

Below is a list of possible impacts that could result from tornadoes:

- **People**: Airborne debris can cause injury or death. Hazardous driving conditions can result from blocked roadways. Tornadoes can cause water contamination, which can affect drinking water quality and human health.
- **Infrastructure**: Tornadoes can damage power lines, other utility infrastructure, and roads. Downed power lines can also cause electrical hazards.
- **Buildings**: Tornadoes that pass through highly developed areas can cause significant property damage, blowing off roofs, and in severe cases, leveling houses.
- **Economy**: Tornadoes can destroy farms and agricultural fields.
- **Natural Systems**: High winds associated with a tornado can break branches and snap or uproot trees. Wildlife can be killed or injured.

3.7 DROUGHT

Overview

Drought is an extended period of time where a region experiences a notable reduction in available water supply typically caused by a lack of precipitation. Drought can affect either surface water or groundwater sources. Though most droughts in Massachusetts last only a matter of months, it is possible for drought conditions to extend over a period of years due to reduced rainfall and snowfall accumulations contributing to lower groundwater and surface water levels.

B1.c B2.a

Hazard Location

The entire Town of Falmouth is equally vulnerable to drought.

B1.c B2.a,c

Previous Occurrences & Extent

Significant periods of drought have occurred in Barnstable County, and Falmouth specifically, in the past. The Massachusetts Department of Conservation and Recreation (DCR) compiles monthly water conditions reports, summarizing the rainfall and its departure from average conditions for each of the 6 regions in the state (Cape Cod and Islands, Central, Connecticut River, Northeast, Southeast, and Western). Data for Cape Cod from a recent eleven (11) month period (DCR, 2021) is summarized in Table 3-10.

Table 3-10. Summary of the Southeast Region Rainfall from DCR Hydrologic Conditions Reports (2020).

Month-Year	Total Rainfall (inches)	Departure from normal (inches)
Jan 2020	2.63	-1.31
Feb 2020	3.80	-0.19
Mar 2020	3.56	-1.09
Apr 2020	6.29	+2.14
May 2020	2.04	-1.62
Jun 2020	1.49	-1.86
Jul 2020	0.80	-2.25
Aug 2020	1.29	-2.17
Sep 2020	1.38	-2.45
Oct 2020	4.67	+0.22
Nov 2020	2.41	-1.52
Total	30.36	-12.10

Based on the total rainfall from the eleven (11) months in Table 3-10, which is 12.1 inches below the average, Falmouth is currently experiencing a drought and droughts are likely to occur again in the future.

There are five levels of drought that have been developed to characterize the severity of the event:

1. Normal
2. Mild Drought (formerly Advisory prior to 2019)
3. Significant Drought (formerly Watch prior to 2019)
4. Critical Drought (formerly Warning prior to 2019)
5. Emergency Drought

These levels are based on the regional conditions and are designed to provide information about the current status of water resources. A Mild Drought calls for a heightened level of vigilance and increased data collection as conditions begin to deviate from normal. During a Significant Drought, increased assessment would continue, in addition to proactive public education about water conservation. Water restrictions might become necessary during the watch or warning stage, depending on the capacity and condition of each water supply system. A Critical Drought designation is issued during a severe situation and the possibility of a drought emergency may be issued. Finally, a Drought Emergency often requires mandatory water restrictions and/or the use of emergency water supplies (EEA, 2019). These categories and their associated characteristics are summarized in Table 3-11.

Based on the categories outlined in Table 3-11, the Massachusetts Executive Office of Energy and Environmental Affairs has compiled information about past drought declarations at a regional level. Drought declarations from 2016 to 2022 for Cape Cod are detailed in Table 3-12. Most recently, there was a drought from April 1, 2021 to August 31, 2021 with a severity level of Mild (Table 3-12).

Table 3-11. Drought Indices from the Massachusetts Drought Management Plan (EEA 2019).

Drought Level	Precipitation	Groundwater	Streamflow	Reservoir
Normal (0)	1 month below normal	2 consecutive months below normal	1 month below normal	Reservoir levels at or near normal for time of year
Mild (1) (*formerly Advisory*)	2 month cumulative total below 65% of normal	3 consecutive months below normal	At least 2 out of 3 consecutive months below normal	Small index reservoirs below normal
Significant (2) (*formerly Watch*)	1 of the following: 3 month cum. <65%; **or** 6 month cum. <70%; **or** 12 month cum. <70%	4-5 consecutive months below normal	At least 4 out of 5 consecutive months below normal	Medium index reservoirs below normal
Critical (3) (*formerly Warning*)	1 of the following: 3 month cum. <65% and 6 month cum <65%; **or** 6 month cum. <65% and 12 month cum. <65%; **or** 3 month cum. <65% and 12 month cum. <65%	6-7 consecutive months below normal	At least 6 out of 7 consecutive months below normal	Large index reservoirs below normal
Emergency (4)	Same Warning **and** previous month was Warning or Emergency	>8 months below normal	>7 months below normal	Continuation of previous month's conditions

Table 3-12. Drought Dates and Levels from Massachusetts DCR for the Cape Cod Region Between 2016 and 2022.

Year	Begin Date	End Date	Southeast Status
2016	8/1/2016	8/31/2016	Advisory
2016	9/1/2016	10/31/2016	Watch
2016-2017	11/1/2016	4/30/2017	Advisory
2020	6/1/2020	6/30/2020	Mild
2020	7/1/2020	10/31/2020	Significant
2020	11/1/2020	11/30/2020	Mild
2021	4/1/2021	8/31/2021	Mild

B2.b

Probability

Based on the data summarized above about past drought conditions in Falmouth, the probability that a drought will occur in Falmouth in the future is likely (between 10% and 100% probability in the next year). Although climate change is predicted to increase precipitation in the Northeast, such as through snowfall, more frequnt and severe droughts are still predicted to occur as a result of increased temperature and evaporation.

B3.a

Impact

Below is a list of possible impacts that could result from drought:

- **People**: Drought conditions can increase conflicts between water users. Water conservation actions may impact users' activities. Reduction in drinking water supply. Health related issues may arise due to dust inhalation.
- **Infrastructure**: Droughts can result in lower water levels in reservoirs. Drought can cause well water quality, and potentially quantity, to worsen. Drought can cause sanitary issues in the water distribution system, as well as increase water demand. Drought can also result in private residential wells to dry up, increasing requests to be connected to the municipal water supply system.
- **Economy**: Farmers experience financial losses if a drought destroys their crops. Finances may need to be diverted to provide additional irrigation or drill new wells. Businesses that depend on farming may lose business. Food costs may increase.
- **Natural Systems**: Loss of fish habitat such as streams, rivers, and ponds dry up. Lack of food and drinking water for wildlife. Wildlife may be forced to migrate to find adequate resources. Wildfires may become more common.

3.8 EXTREME TEMPERATURE

Overview

There is no defined cut-off for what defines extreme temperatures. Instead, extreme temperatures are considered relative to the usual weather in a region based on long-term climatic averages. According to the Massachusetts State Hazard Mitigation and Climate Adaptation Plan (2018), extreme heat for this region is usually defined as a period of three or more consecutive days with temperatures above 90°F. However, more generally it can be thought of as a prolonged period of excessively hot weather, which is often accompanied by high humidity. Similarly, extreme cold is also relative to normal climatic lows in the region. Temperatures that drop well below normal, especially when accompanied by high winds can produce dangerous wind-chill factors. The wind-chill is the perceived decrease in air temperature felt by the body on exposed skin due to the flow of air.

Since extreme temperatures are defined relative to normal conditions, it is important to know the average temperatures for the region for a particular season. The average low winter temperature (January) for Massachusetts is 22°F, while the average high summer temperature (July) is 81°F.

B1.c B2.a

Hazard Location

The entire Town of Falmouth is equally vulnerable to extreme temperature hazards.

B1.c B2.a,c

Previous Occurrences & Extent

NOAA's National Centers for Environmental Information houses a Storm Events Database (NOAA, 2021), which includes accounts of Cold/Wind Chill, Extreme Cold/Wind Chill, Heat, and Excessive Heat. Querying the data for these types of events for the past 20 years returned three occurrences of extreme temperature:

1) February 14, 2016: An arctic high-pressure system brought strong northwest winds and extremely cold wind chills to southern New England. Wind chills as low as -32°F were reported in Plymouth.
2) July 22, 2011: High temperatures and high humidity levels brought the heat index above 105 for several hours. Heat index values at the Coast Guard Air Station Cape up to 105.
3) Jul 6, 2010: Similar to July of 2011, high temperatures and severe humidity resulted in a heat index of 100 to 102 across Cape Cod.

NOAA's National Weather Service (NWS) has developed a Heat Index (NWS, 2016a), which measures how hot it feels when relative humidity is considered along with the actual air temperature (Figure 3-22). Relative humidity is the amount of atmospheric moisture present relative to the amount that would be present if the air were fully saturated. For example, a 90°F day with 80% humidity would have a heat index of 113°F, and there is a dangerous likelihood of heat disorders with prolonged exposure or strenuous activity. The NWS issues alerts when the Heat Index is expected to exceed 105-110°F (depending on local climate) for at least 2

consecutive days. Wind chill temperature indicates how cold it feels outside, based on the rate of heat loss from exposed skin caused by the combination of wind and cold. Because wind draws heat from the body, reducing skin temperature, as well as internal body temperature, the wind actually makes it feel colder than the absolute temperature would indicate. Frostbite is the result of body tissue (i.e. skin) freezing. The most vulnerable parts of the body are the fingers, toes, ears and nose. The National Weather Service's Wind Chill Temperature Index (NWS, 2016b) provides a useful method for calculating the dangers from extreme cold temperatures and winter winds, and the amount of time exposed skin will take to get frostbite (Figure 3-23). According to the chart in Figure 3-23, if it is 0°F with a 15 mph, the wind chill temperature would be -19°F and it would take exposed skin 30 minutes to get frostbite. The index calculates wind speed at an average height of 5 feet above the ground's surface, the typical height of a person's face, from the measured wind data collected from standard 33-foot high anemometers.

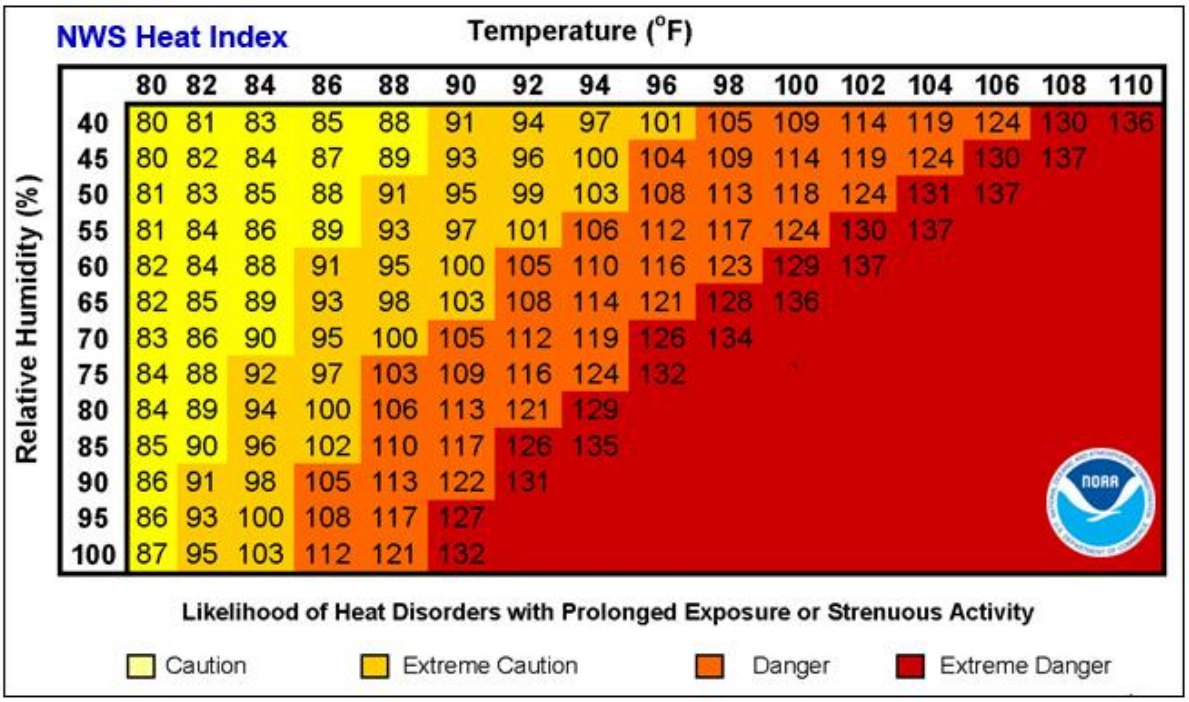

Figure 3-22. NWS's heat index.

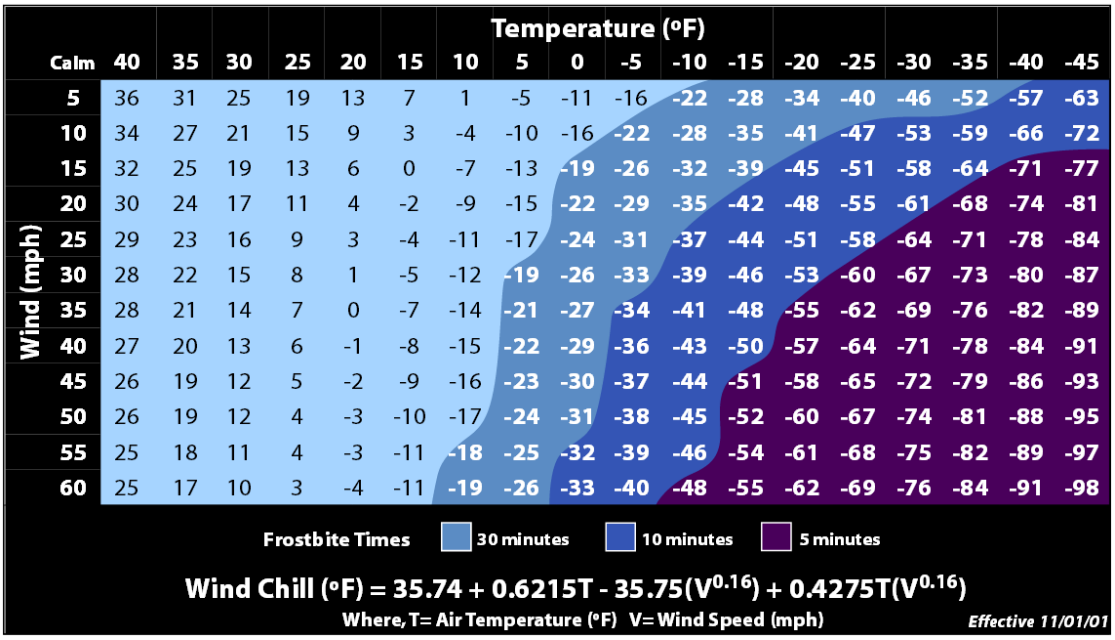

Figure 3-23. NOAA's wind chill chart.

B2.b

Probability

Based on the data summarized above about past extreme temperature conditions in Barnstable County, the probability that extreme temperatures will occur in Falmouth in the future is likely (between 10% and 100% probability in the next year). Overall, Massachusetts has been experincing an increase in temperaure as a result of climate change, meaning extreme summer temperatures are becoming more intense, while winter tempatures are becoming less severe.

B3.a

Impact

Below is a list of possible impacts that could result from extreme hot or cold temperatures:

- **People**: Excessive heat and severe cold poses serious health risks, including death.
- **Emergency Response**: Stress will be placed on the cooling systems of emergency vehicles in extreme heat.
- **Infrastructure**: Highways and roads can be damaged by excessive heat as asphalt softens. Both extreme heat and extreme cold can put significant strain on power utilities, as users' energy needs increase to run air conditioners or heaters. Extreme heat can cause well water quality, and potentially quantity, to worsen. Extreme heat can cause sanitary issues in the water distribution system as the water in tanks and the groundwater heat up, as well as increase water demand.
- **Economy**: Transported refrigerated goods experience a higher degree of spoilage during excessive heat conditions. Agriculture and livestock can be adversely impacted by extreme heat.
- **Natural Systems**: Extreme heat can reduce water levels in natural ponds and reservoirs, as well as increase surface water temperatures to dangerous levels. Both can have an adverse impact on fish and wildlife.

3.9 EARTHQUAKE

Overview

An earthquake is a sudden, intense shaking of the Earth's surface caused by the movement of large portions of the Earth's crust. These movements tend to occur along faults, which are fractures in the Earth's crust along which two plates of crust can move against each other. Earthquakes can occur suddenly at any time, with virtually no warning.

The depth at which an earthquake occurs is called a focal depth. A focal depth of less than 43.5 miles is considered to be a shallow earthquake; the majority of earthquakes fall into this category. Earthquakes originating at focal depths of 43.5 to 186 miles are considered intermediate. However, focal depths of earthquakes can reach depths of more than 435 miles. The epicenter of an earthquake is the location on the Earth's surface directly above the focal point of an earthquake.

New England is located in the middle of the North American tectonic plate; the western edge of this plate is along the west coast where it is pushing up against the Pacific Ocean Plate, and the eastern edge is in the middle of the Atlantic Ocean where it is spreading away from the European and African plates. Because New England is located a considerable distance from either edge of the North American plate, most earthquakes that occur here are due to the cracking of crustal rocks due to compression as the plate is slowly squeezed by the global movement of other plates.

B1.c B2.a

Hazard Location

Due to the configuration of the tectonic plates, the greatest threat from earthquakes in the United States occurs along the fault lines on the west coast. While earthquakes do occur in the eastern United States, they tend to be less frequent and less intense. Figure 3-24 shows earthquakes since the 1970s as reported by US Geological Survey (USGS); this includes 156 earthquakes ranging in magnitude from 0 to 3.8 within 100 miles of the Town of Falmouth.

B1.c B2.a,c

Previous Occurrences & Extent

There has only been one recorded earthquake within Falmouth since 1970. The earthquake occurred in 1981 and had a magnitude of 2.1. There have been an additional 155 occurrences of earthquakes since 1970 within 100 miles of Falmouth. The epicenter locations of these earthquakes are shown in Figure 3-24; the range in magnitude of each event is indicated by color. The Richter magnitude of these 45 events ranged from 0 to 3.8, which as described below, can often be felt, but only cause minor damage.

The Richter Scale (Table 3-13) is frequently used to measure the magnitude of earthquakes. It measures the maximum recorded amplitude of a seismic wave, which quantifies the ground motion and the energy released at the source of an earthquake.

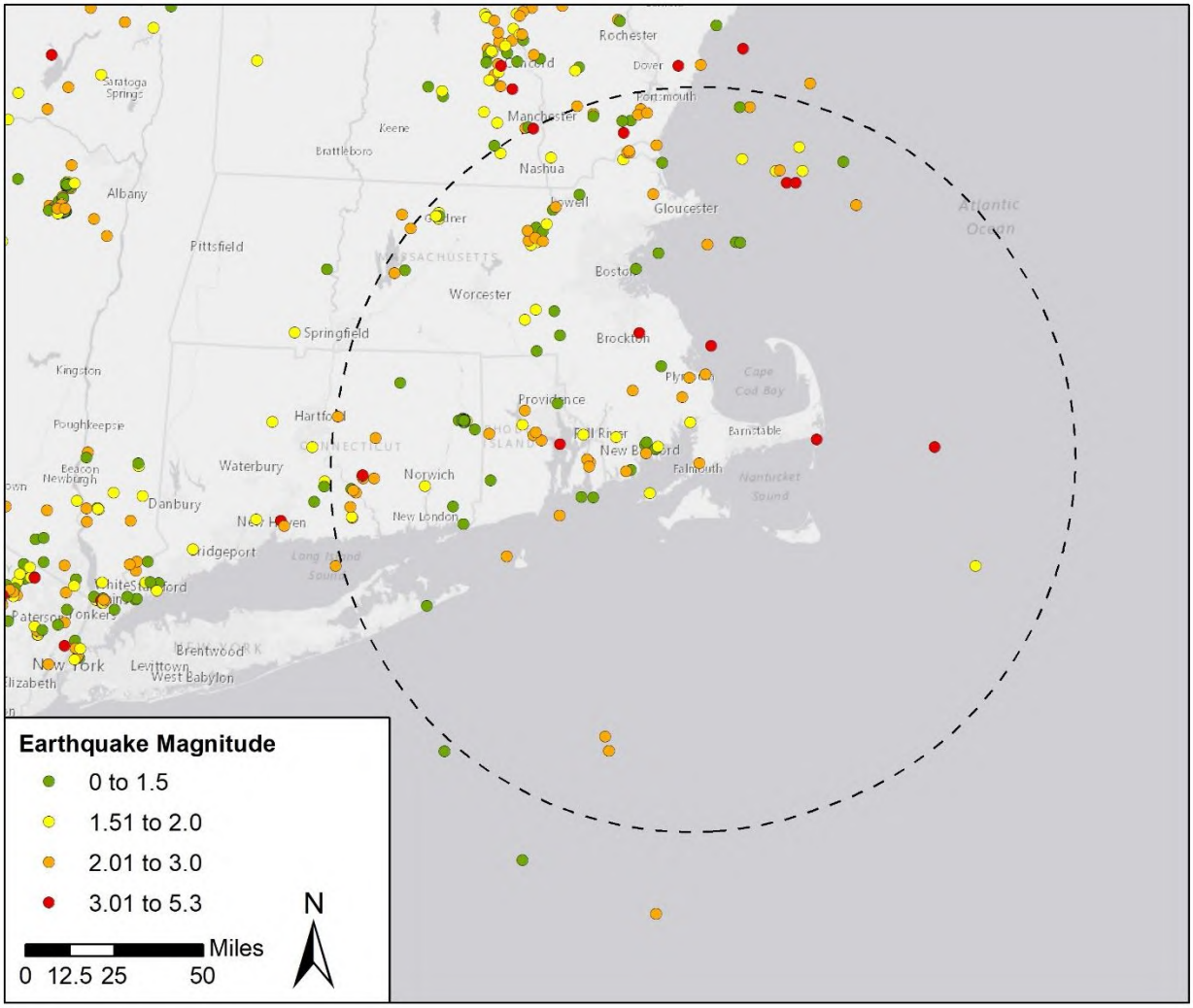

Figure 3-24. Earthquakes that have occurred within 100 miles of Falmouth since 1970.

Table 3-13. Richter Scale.

Richter Magnitude	Earthquake Effects
2.5 or less	Not felt or felt mildly near the epicenter; can be recorded by seismographs
2.5 to 5.4	Often felt, but only causes minor damage
5.5 to 6.0	Slight damage to buildings and other structures
6.1 to 6.9	May cause a lot of damage in very populated areas
7.0 to 7.9	Major earthquake; serious damage
8.0 or greater	Great earthquake; can totally destroy communities near the epicenter

B2.b

Probability

Given that earthquakes have occurred in Massachusetts and in Barnstable County specifically in recent years, it is possible (1-10% probability in the next year) that an earthquake could occur in Falmouth. Any possible effects of climate change on earthquakes are still being determined.

B3.a

Impact

Below is a list of possible impacts that could result from an earthquake:

- **People**: Damage caused to buildings and other structures during an earthquake can lead to injury or loss of life.
- **Emergency Response**: Downed trees and power lines, as well as damaged roads caused by an earthquake can impede emergency vehicles.
- **Infrastructure**: Earthquakes can cause utility poles to fall and live wires to become exposed or to start fires. The shaking caused by an earthquake can also rupture gas lines causing the release of flammable substances and can break or separate sewer collection and water distribution pipes, resulting in loss of service.
- **Economy**: Earthquakes can damage foundations and buildings; most property damage is caused by the failure and collapse of structures during ground shaking. Concrete and masonry structures are brittle and thus more susceptible to damage and collapse.
- **Natural Systems**: Earthquakes can cause landslides and slope failure; this could have hazardous impacts on areas with steep slopes, such as coastal banks.

3.10 INVASIVE SPECIES

Overview

Invasive species are defined as non-native species that cause or are likely to cause harm to ecosystems, economies, and/or public health. Although invasive species can be any type of organism, including marine organisms, insects, and birds, the 2018 Massachusetts State Hazard and Climate Adaptation Plan focuses specifically on invasive terrestrial plants, as these are the most studied and managed type of invasive species. However, other categories of invasive species, such as insects and fungi, can cause significant damage to native flora, increasingly the likelihood for downed trees and limbs during many other natural hazard events.

B1.c B2.a

Hazard Location

Although the entire Town of Falmouth is potentially vulnerable to the introduction and establishment of invasive species, they pose the biggest threat to native or minimally managed ecosystems. In addition, the ability of invasive species to travel far distances (either via natural means or accidental human interference) allows these species to propagate rapidly over large geographic areas.

B1.c B2.a,c

Previous Occurrences & Extent

The Massachusetts Invasive Plant Advisory Group (MIPAG) recognizes 69 plant species as "Invasive", "Likely Invasive", or "Potentially Invasive." In addition, the 2018 State Plan also lists a number of other invasive species, including gypsy moths (*Lymantria dispar*), the Dutch elm disease fungus (*Ophiostoma sp*.), European green crabs (*Carcinus maenus*), and Asian shore crab (*Hemigrapsis sanguineus*).

Within the Town of Falmouth, invasive species are present within the Coonamessett Reservation, Mares Pond, Spectacle Pond Conservation Area, and Sea Farms Conservation Area. The Falmouth Open Space and Recreation Plan (2014) suggests control and/or removal of these species. Similar to most coastal Massachusetts towns, Falmouth struggles to control common reed (*Phragmites australis*) stands, bittersweet (*Solanum dulcamara*), and Japanese knotweed (*Reynoutria japonica*). These species are found in many areas throughout town. The Town has been using DPW staff to control these species. Local not for profit groups like the 300 Committee and the Oyster Pond Environmental Trust have also been working to control invasive species.

B2.b

Probability

There are known invasive species within the Town of Falmouth, so it is 100% likely that invasive species occur in Town. However, the likelihood that a significant negative impact would occur due to the presence of these species is possible, but not as high. In the future, the Town of Falmouth may become more susceptible to additional invasive species as climate change facilitates the spread and establishment of invasive species.

B3.a

Impact

Below is a list of possible impacts that could result from invasive species:

- **People**: Those who rely on natural systems for their livelihood or well-being are more likely to experience negative repercussions from the expansion of invasive species.
- **Economy**: The agricultural sector is vulnerable to increased invasive species associated with increased temperatures. More pest pressure from insects, diseases, and weeds may harm crops and cause farms to increase pesticide use.
- **Natural Systems**: Biodiversity and ecosystem health may be impacted by invasive species. Aquatic invasive species pose a particular threat to water bodies. Impacts of aquatic invasive species include impairment of recreational uses, such as swimming, boating and fishing, degradation of water quality and wildlife habitat, declines in finfish and shellfish habitat, and diminished property values.

3.11 OTHER SEVERE WEATHER (HEAVY PRECIPITATION, HIGH WIND, THUNDER/LIGHTNING)

Overview

Heavy Precipitation: The Massachusetts State Hazard Mitigation and Climate Adaptation Plan notes that the Fourth National Climate Assessment published by the U.S. Global Change Research Program shows that heavy precipitation events have increased in both intensity and frequency over the past century across much of the country, with the largest increases occurring in the Northeast. Annual precipitation in Massachusetts is projected to increase by as much as 7.3 inches by the end of this century. Furthermore, increased precipitation will likely occur during more intense periods of precipitation coupled with more frequent episodic drought, causing more stormwater runoff, and higher surface water levels.

High Wind: Major wind events in coastal Massachusetts are hurricanes and nor'easters. Tornadoes are extremely rare, although they do occur. Waterspouts have been seen in Cape Cod Bay, in the Cape Cod Canal, and in Buzzards Bay. Thunderstorms, especially in the summer months, do occur and can bring localized damage due to wind, especially to summer cottages of poorer construction and old or rotted tree limbs.

Thunder and Lightning: A thunderstorm is a storm that produces lightning and thunder and is usually accompanied by gusty winds, heavy rain, and sometimes hail. The National Weather Service defines a severe thunderstorm as one that produces a tornado, winds of at least 58 mph (50 knots or ~93 km/h), and/or hail at least 1 inch in diameter. Structural wind damage may imply the occurrence of a severe thunderstorm. A thunderstorm wind equal to or greater than 40 mph (35 knots or ~64 km/h) and/or hail of at least ½ inch is defined as approaching severe. Lightning is one of the most dangerous aspects of a thunderstorm, and it can strike up to 10 miles away from the main thunderstorm location; however, because lightning occurs during every thunderstorm, its presence does not indicate a "severe" thunderstorm.

Three basic ingredients required for a thunderstorm to form are moisture, rising unstable air (air that keeps rising when given a nudge), and a lifting mechanism. The sun heats the surface of the earth, which warms the air above it. If this warm surface air is forced to rise—by hills or mountains, or areas where warm/cold or wet/dry air bump together—it will continue to rise as long as it weighs less and stays warmer than the air around it. As the air rises, it transfers heat from the surface of the earth to the upper levels of the atmosphere (the process of convection). The water vapor it contains begins to cool, releasing the heat; and it condenses into a cloud. The cloud eventually grows upward into areas where the temperature is below freezing. Some of the water vapor turns to ice, and some of it turns into water droplets. Both have electrical charges. Ice particles usually have positive charges, and rain droplets usually have negative charges. When the charges build up enough, they are discharged in a bolt of lightning, which causes the sound waves we hear as thunder.

B1.c
B2.a

Hazard Location

Heavy Precipitation: Heavy precipitation can affect all portions of the Town of Falmouth. Based on recent studies, New England has already experienced an increase in heavy precipitation events in the last 50 years. This is due to increased sea surface temperatures in the Atlantic Ocean that cause air moving north over the water to hold more moisture. As a result, when these warm fronts meet cold air systems from the north, an even greater amount of precipitation than normal can be anticipated to fall on Massachusetts. As shown in Figure 3-25, the percent change in the precipitation amount occurring as very heavy precipitation has increased by 38% in the northeast. This data compares a reference period from 1901-1960 with a more recent period: 1986-2016. The threshold used to define a heavy precipitation event is the top 1 percent of all days with precipitation.

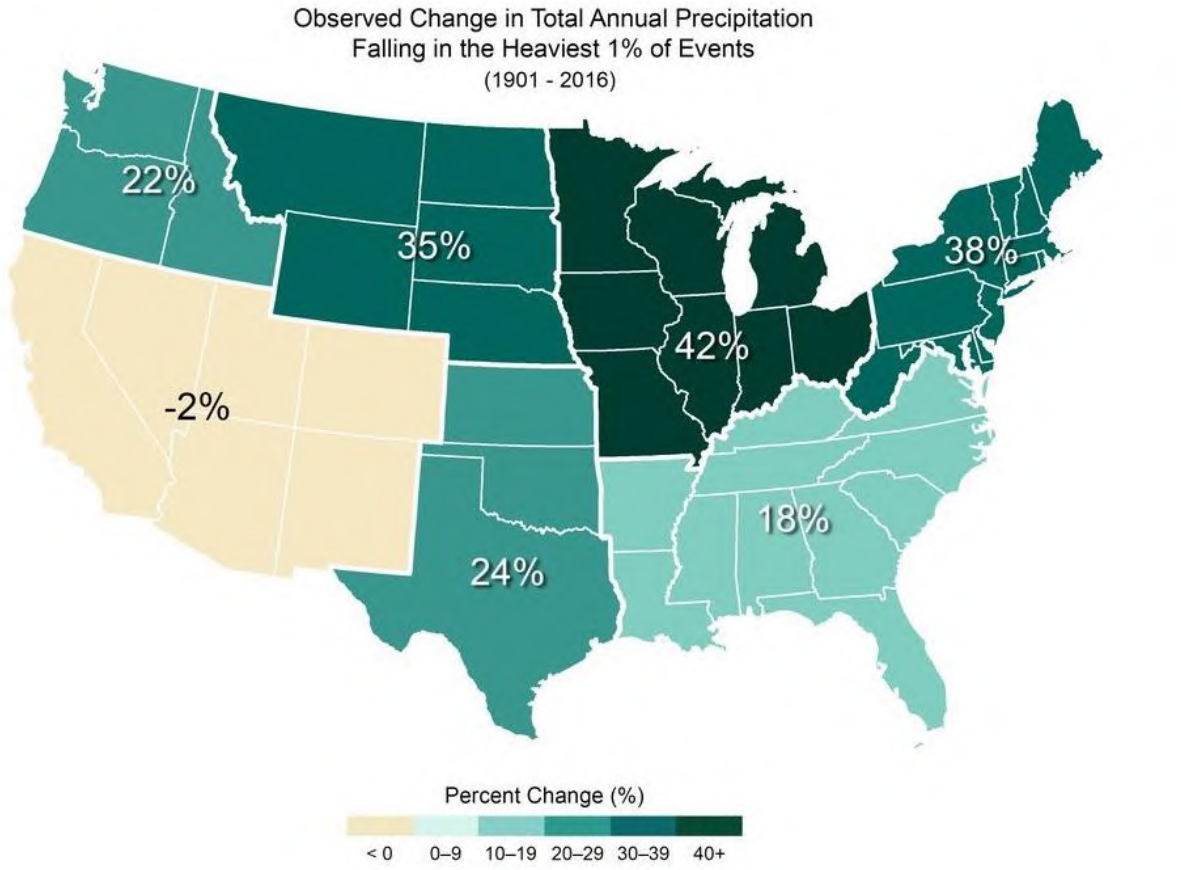

Figure 3-25. Observed changes in heavy precipitation (GlobalChange.gov, 2020).

High Wind: In their effort to research potential sites for wind energy facilities, the Executive Office of Energy and Environmental Affairs (EEA) put considerable effort into measuring wind velocities in Massachusetts. These efforts produced four sets of data, representing mean wind speed at different elevations above the land's surface: 30, 50, 70 and 100 meters. The mean wind speed, in miles per hour, at 30 meters above the land's surface is shown for Falmouth in Figure 3-26.

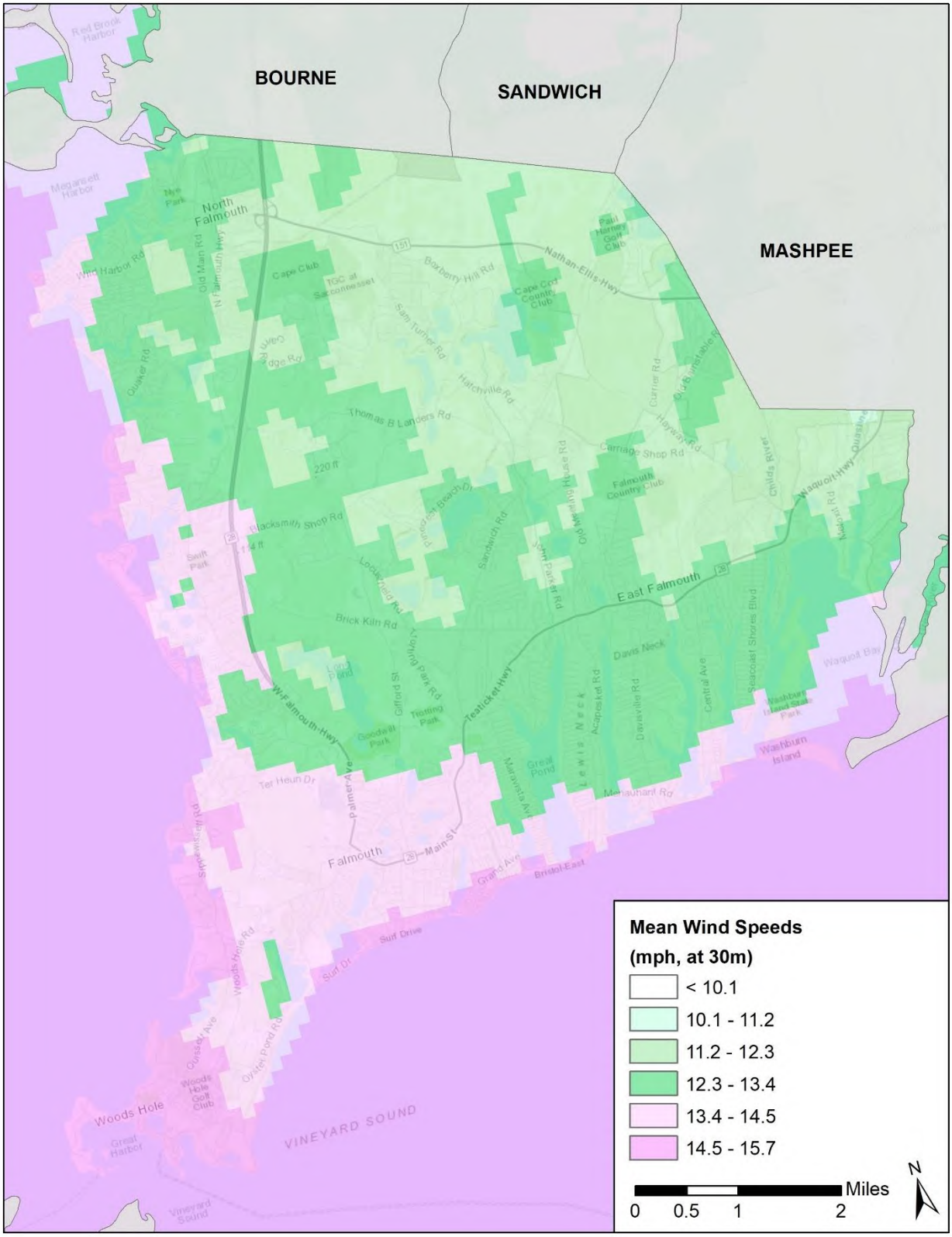

Figure 3-26. Mean wind speed (mph) at 30 meters above the surface.

Thunder and Lightning: The entire Town of Falmouth is at risk from thunderstorms. NOAA has compiled data about the annual number of thunderstorms across the United States. Figure 3-27 shows the annual number of thunderstorms in the northeastern United States. The arrow shows that all of eastern Massachusetts, including Falmouth, falls in the darker blue area, which receives, on average, 10-20 thunderstorms per year.

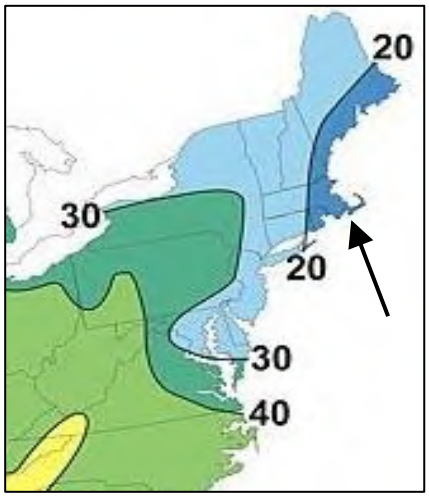

Figure 3-27. Annual number of thunderstorms.

B1.c
B2.a,c

Previous Occurrences & Extent

Heavy Precipitation: Because heavy rain is often associated with other major weather events (e.g., tropical storms, nor'easters, etc.) the list of heavy rain events from the NOAA NCDC Storm Events (NOAA, 2021) does not have many entries from the past 20 years, none of which occurred prior to 2008):

1) March 8, 2008: A low pressure system moved from New York spreading heavy rain and strong winds, which coincided with snowmelt. Coastal areas such as Falmouth also experienced heavy surf.

2) April 11, 2003: A slow moving pressure system tracked over southern New England resulting in 1 to 3 inches of precipitation. No reports of major flooding.

3) March 29, 2003: Rainfall between 2 to 4 inches fell on Cape Cod when a low-pressure system tracked north from the mid-Atlantic. No serious flooding was reported.

4) September 22, 2002: Central and eastern Massachusetts experienced heavy rainfall when a slow-moving cold front passed over the state. The highest precipitation totals were reported on Cape Cod and were as high as 3 inches.

Although not recorded in the NOAA Storm Events Database, the Town also experienced heavy precipitation on February 4, 2022, which combined with snowmelt from a blizzard on January 29, 2022 and resulted in flooding along Surf Drive, Menauhant Road, Millfield Street, and Gardner Road. Given the tendency for heavy precipitation to occur during other weather events, it is likely that the frequency of these events is underestimated by this database. Average precipitation data within Falmouth for 2021 is displayed in Figure 3-28 below.

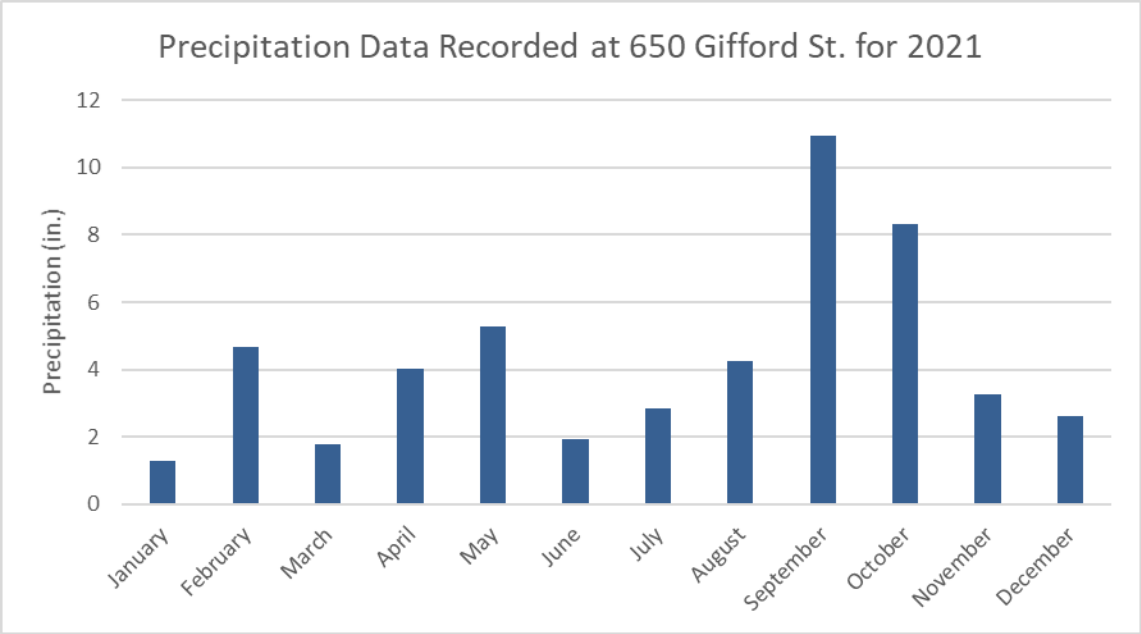

Figure 3-28. Precipitation data from 650 Gifford St. for 2021.

High Wind: A summary of the high wind events from the NOAA NCDC Storm Events database (NOAA, 2021) for the most recent 15 high wind events that included information specific to Falmouth are listed below and indicate high wind events are very common in Falmouth (multiple times per year):

1) October 26-27, 2021: A low pressure nor'easter resulted in wind gusts of 60 to over 90 mph. Over 495,000 people lost power in Massachusetts. Falmouth recorded wind gusts of 79 mph.
2) March 2-3, 2021: An artic cold front moved into new England bringing damaging west-northwest winds. Gusts of 56 mph were reported in Falmouth and a downed tree on North Falmouth Highway was reported.
3) December 25, 2020: A strong frontal system moved north from the southern US over Massachusetts. Wind gusts of 60 mph were recorded in Woods Hole.
4) September 30, 2020: A cold front moved across the northeast region causing damaging winds. Gusts over 50 mph were reported in Falmouth.
5) April 13, 2020: A pressure system originating the great Lakes area caused sustained winds of over 50 mph in Falmouth.
6) April 3, 2020: An intense ocean storm brought wind gusts of up to 55 mph in Falmouth.
7) March 6-7, 2020: A bomb cycle caused winds of 59 mph in Woods Hole and a downed tree at the intersection of John Parker Road and Harris Hill Road.
8) February 27, 2020: A cold front across New England caused strong southwest to west winds of up to 61 mph in Falmouth and downed a tree on Ashumet Road.
9) February 7, 2020: A powerful low-pressure system moved across Massachusetts downing trees on English Street and Davisville Road in Falmouth.

10) October 17, 2019: A coastal storm developed off New Jersey then brought wind gusts of over 65 mph to Falmouth.
11) October 10-11, 2019: An ocean storm combined with a high-pressure system causing high winds. In Falmouth, a large branch was downed on Woods Hole Road by the Golf course and there were downed trees on Brick Kiln Road, Jamie Lane, Katy Hatches Road, Madeline Road, and Maravista Avenue.
12) January 30, 2019: A low pressure system moved across the New England region. The strongest wind gust was recorded in West Falmouth and was 62 mph.
13) November 13, 2018: A low pressure system moved across Massachusetts bringing winds over 50 mph to Falmouth and downed a tree on Union Street.
14) November 3, 2018: A low pressure system originating in New York brough high winds to Cape Cod. In Falmouth, two oak trees were downed on Vidal Avenue.
15) March 2-3, 2018: A low pressure system out of Ohio Valley brough strong winds to new England and East Falmouth experienced wind gust of over 60 mph.

The National Weather Service issues a variety of warnings related to wind hazards. They are:

- High Wind Watch: Issued when the following conditions are possible – sustained winds of 40 mph or higher for one hour or more, or wind gusts of 58 mph for one hour or more.
- High Wind Warning: Issued when the following conditions are occurring or imminent – sustained winds of 40 mph or higher for one hour or more, or wind gusts of 58 mph for one hour or more.
- Hurricane Watch: Issued when a tropical cyclone containing winds of 74 mph or higher poses a possible threat, generally within 48 hours.
- Hurricane Warning: Issued when sustained winds of 74 mph or higher associated with a tropical cyclone are expected in 36 hours or less.
- Wind Advisory: Issued when the following conditions are expected for 3 hours or longer – sustained winds of 31 to 39 mph and/or wind gusts of 46 to 57 mph.
- Extreme Wind Warning: Issued for surface winds of 115 mph or greater associated with non-convective, downslope, derecho (not associated with tornado), or sustained hurricane winds are expected to occur within one hour.
- Small Craft Advisory: Issued when one or all of the following conditions are expected to occur within 36 hours – sustained winds of 18 to 33 knots or frequent gusts (with a duration of 2 hours or more) between 18 to 33 knots or waves of 4 feet or higher.
- Gale Warning: Issued when one or both of the following conditions are expected to occur within 36 hours and is not directly associated with a tropical cyclone – sustained winds of 34 to 47 knots or frequent gusts (with a duration of 2 hours or more) between 34 to 47 knots.
- Storm Warning: Issued when one or both of the following conditions are expected to occur within 36 hours and is not directly associated with a tropical cyclone – sustained winds of 48 to 63 knots or frequent gusts (with a duration of 2 hours or more) between 48 to 63 knots.

- Hurricane Force Wind Warning: Issued when one or both of the following conditions are expected to occur within 36 hours and is not directly associated with a tropical cyclone – sustained winds of 64 knots or greater or frequent gusts (with a duration of 2 hours or more) between 64 knots or greater.

Figure 3-29. Downed wires on Quissett Avenue (left) and downed trees on Jones Road (right) caused by wind gusts of up to 92 miles per hour during Winter Storm Riley from March 2 to 4, 2018.

Thunder and Lightning: The NOAA NCDC Storm Events database lists 18 lightning and/or thunderstorm wind events were reported for Barnstable County within the last 10 years (NOAA, 2021). Only two (2) of the recorded events were specific to Falmouth:

1) August 22, 2020: A short wave trough led to a connective complex that triggered severe thunderstorms in eastern Massachusetts. In North Falmouth, multiple trees were reported down on Quaker Road and on Old Main Road.
2) April 9, 2020: A strong cold front joined with an upper-level disturbance to create thunderstorm winds across southeastern Massachusetts. In East Falmouth, thunderstorms produced wind gusts of up to 60 mph.

There are a variety of types of thunderstorms:

- Single-cell thunderstorms, which are small, brief, weak storms that can develop and then dissipate within an hour. They are typically produced by heating on a summer afternoon. Single-cell storms produce brief, heavy rain and lightning.

- Multi-cell storms form along the leading edge of rain-cooled air. Although individual cells that comprise the multi-cell storm can only last 30-60 minutes, the entire multi-cell storm system can persist for many hours. Multi-cell storms may produce hail, strong winds, brief tornadoes and flooding.

- A squall line is a group of storms arranged in line, often associated with "squalls" of heavy wind and rain. These storms tend to pass quickly and are less likely to produce tornadoes than supercells. A squall line can be hundreds of miles long but tend to only be 10-20 miles wide.

- A supercell is a highly organized, long-lived storm fueled by an updraft that is tilting and rotating. These tilting and rotating updrafts can produce severe tornadoes.

B2.b

Probability

Based on the data presented above, it is highly likely (near 100% probability in the next year) that other severe weather (heavy precipitation, high wind, and thunder/lightning) will occur in Falmouth. As mentioned with prior hazards, climate change is predicted to increase the frequncy and intensity of storms and severe weather events, which includes heavy precipitaiton, high winds, and thunder/lightning storms.

B3.a

Impact

Below is a list of possible impacts that could result from other severe weather:

- **People**: Thunderstorms and high winds can result in power outages, leaving people without heat or other utilities. Lightning may cause injury or death to people who are outdoors during the onset of a thunderstorm if they are unable to seek shelter. Flooding in and around residential structures due to heavy precipitation can result in mold, which can cause serious health concerns, ranging from itching eyes, sneezing and coughing to serious allergic reactions, asthma attacks, and even permanent lung damage.
- **Emergency Response**: Trees and power lines felled by high winds and/or lightning can impede emergency vehicles.
- **Infrastructure**: Lightning and high winds can result in downed power lines. High wind events can generate significant waves which can damage coastal infrastructure and moored/docked vessels. Heavy rains associated with thunderstorms can result in flooded roads and overwhelm drainage systems.
- **Buildings**: Wind and wind-born debris can damage roofs, windows, and other portions of houses and buildings. Heavy rains and flooding can damage properties; the resulting water damage and mold may require removal and replacement of wall boards, insulation, etc. Lightning strikes can start fires, which can threaten buildings and structures.
- **Economy**: Power outages can force businesses to close temporarily.
- **Natural Systems**: Heavy winds can bring down trees and branches.

3.12 LANDSLIDE

Overview

Landslides are a form of mass wasting in which there is a mass movement of rock, debris, or earth down a slope under the direct influence of gravity. There are five different types of slope movement that are considered landslides including falls, topples, slides, spreads, and flows. These categories can be further divided up by the type of material composing the landslide including bedrock, debris, or earth. The most common types of landslides are mudflows or mudslides, otherwise known as debris flows. Depending on the severity of the event, landslides can be a threat to human life, buildings, infrastructure, and the natural environment.

Landslides occur when down-slope forces exceed the strength of the earthen material on the slope. Landslides are often the result of a combination of factors increasing down-slope forces and decreasing strength of material. These factors can be brought on by heavy precipitation, snowmelt, stream erosion, earthquakes, and/or human disturbance. Landslides can travel as slow as millimeters per year, or in the case of severe debris flows, as fast as 200 mph, but more commonly 30 to 50 mph. Landslide speed is dependent on steepness of the slope, water composition, and debris volume and type. Generally, landslides are not common in Massachusetts. The coastal and mountainous areas of the west coast, as well as the Appalachian Mountains, Rocky Mountains, Alaska, and Hawaii all have more severe and frequent landslide events.

B1.c
B2.a

Hazard Location

In 2013, the Massachusetts Geologic Survey mapped potential landslide hazards for the entire state of Massachusetts. Maps were specifically produced for use in the upcoming 2018 Massachusetts Statewide Hazard Mitigation Plan and shows where past slope movement has occurred and/or may occur in the future under heavy precipitation events. Figure 3-30 shows the slope stability map for Falmouth. Overall, the topography of Falmouth is relatively flat and stable. Areas with low stability or moderate instability are limited but include around Coonamessett Pond, seaward of Oyster Pond Road, south of Old Silver Beach at the Falmouth Cliffs, south of Research Road, and south of Goodwill Park.

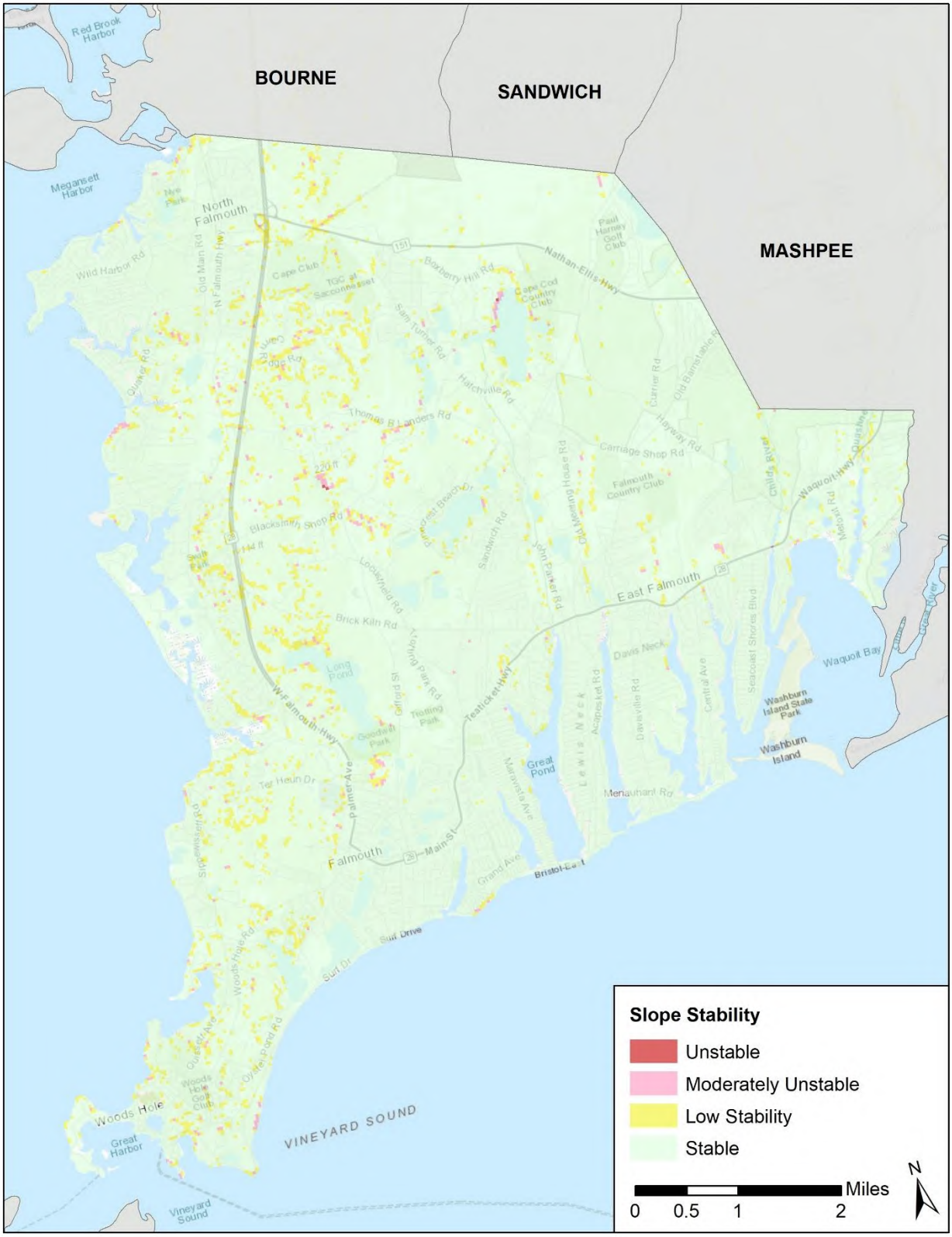

Figure 3-30. Slope stability of Falmouth (Massachusetts Geological Survey, 2013).

B1.c
B2.a,c

Previous Occurrences & Extent

Although there have been no reported landslides within the Town of Falmouth since 1900, there have been seven (7) reported landslides within 100 miles of Falmouth. These events are shown in Figure 3-31 and listed in Table 3-14. The U.S. Geological Survey, in cooperation with NASA, maintains a database of landslides across the U.S. from 1900 through 2019. The database includes landslides from a variety of sources, and thus, each landslide is reported with a confidence in the ground failure event and location. Landslide confidence categories and the number of landslides within 100 miles of Falmouth in each category are listed below:

- High confidence in extent or nature of the landslide (0);
- Confident consequential landslide at this location (1);
- Likely landslide at or near this location (4);
- Probable landslide in the area (2); and
- Possible landslide in the area (0).

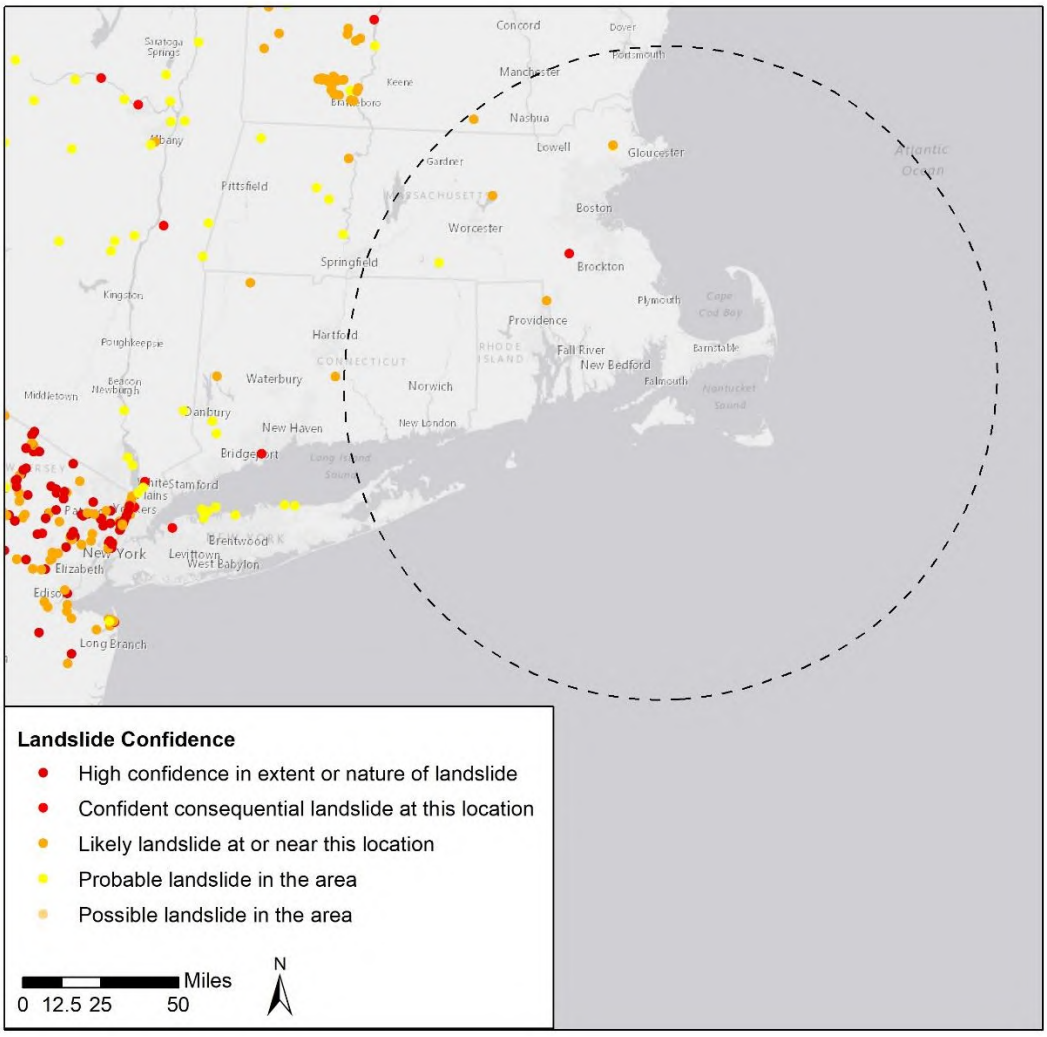

Figure 3-31. Landslides that have occurred within 100 miles of Falmouth from 1900 to 2019 (USGS, 2019).

Table 3-14. Landslide Inventory from 1900 to 2019 Within 100 Miles of Falmouth.

Date	Location	Confidence
12/9/2014	Topsfield, MA	Likely landslide at or near this location
11/4/2014	Attleboro, MA	Likely landslide at or near this location
9/30/2013	Southbridge, MA	Probable landslide in the area
3/31/2010	Greenville, NH	Likely landslide at or near this location
3/15/2010	Walpole, MA	Confident consequential landslide at this location
3/15/2010	Clinton, MA	Likely landslide at or near this location
3/14/2010	Topsfield, MA	Probable landslide in the area

B2.b

Probability

Considering the low occurrence of landslides within the vicinity of the Town of Falmouth, as well as the flat topography and lack of major hills, the likelihood of a landlside occuring within Falmouth is unlikley (less than 1% probability in the next year). Similar to hazards previously discussed, climate change is predicted to increase heavy precipitation events, which may result in destabilization of slopes and a higher frequency of landslides in some areas.

B3.a

Impact

Below is a list of possible impacts that could result from a landslide:

- **People**: Could become trapped or blocked by obstructed roads resulting from displaced sediment, vegetation, tree limbs, etc. In severe cases, landslide events can also lead to injury or death.
- **Infrastructure:** Could be damaged leading to an interruption in utilities such as electricity or water, due to damaged pipes or power lines near landslide.
- **Buildings**: Major landslides could lead to property and/or building damage.
- **Economy**: Businesses could experience economic losses due to obstructed roads prohibiting employees and/or customers from accessing certain areas of Town.
- **Natural Systems**: Landslides can result in the loss of habitat areas and vegetation. Debris and sediment can also accumulate in rivers or streams negatively affecting fish habitat and water quality.

3.13 TSUNAMI

Overview

A tsunami is a series of ocean waves generated by earthquakes, a sudden displacement of the ocean floor, underwater landslides, or volcanic activity. In the deep ocean, a tsunami wave may only be a few inches high. However, as the wave nears shore, tsunamis generate a devastating onshore surge of water. Major tsunamis are produced by large (greater than 7 on the Richter scale), shallow focal depth (<30 km) earthquakes associated with continental plate movement. The waves associated with a tsunami move hundreds of miles per hour in the open ocean and can come ashore with wave heights of 100 feet or more. However, even waves that are 10 to 20 feet high can be extremely destructive.

B1.c B2.a

Hazard Location

Although tsunamis most commonly occur in the Pacific Ocean, where dense oceanic plates slide under lighter continental plates, they can occur in the Atlantic Ocean as well.

B1.c B2.a,c

Previous Occurrences & Extent

Although there are no records of a tsunami occurring in Falmouth, there are three (3) reported tsunamis within 100 miles of Falmouth since the mid-1500s (Figure 3-32), the most recent of which occurred in 1879.

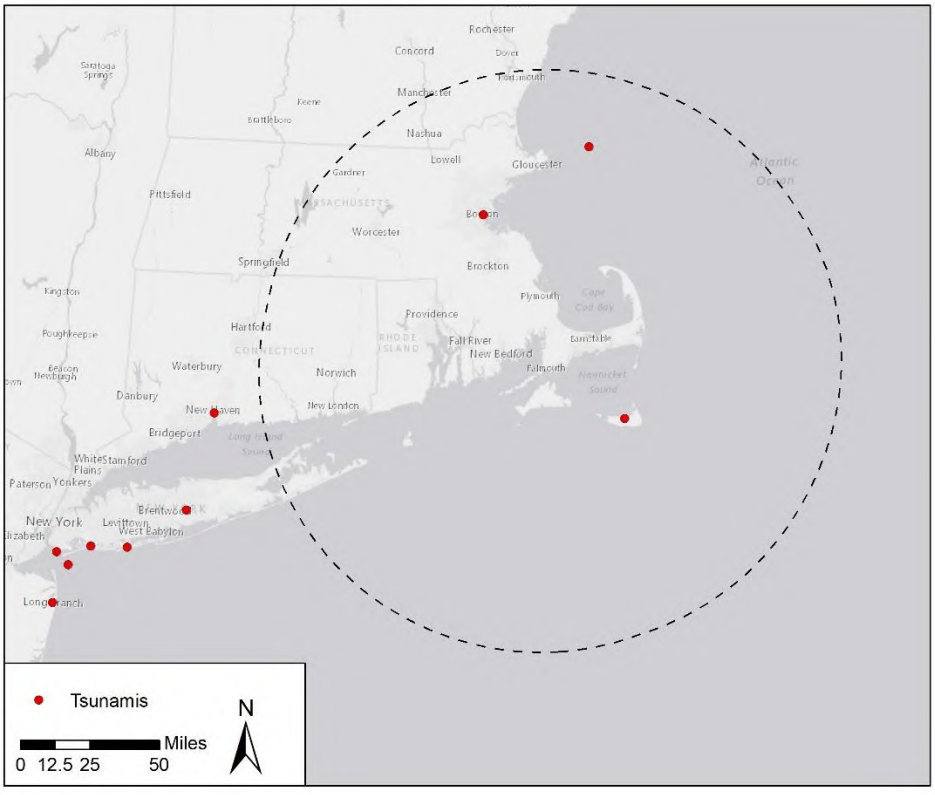

Figure 3-32. Tsunamis that have occurred within 100 miles of Falmouth from the mid 1500s to 2022 (NOAA NCEI, 2021).

B2.b

Probability

There is no record of tsunamis ever occuring in Falmouth, and only three occurrences within 100 miles since the mid-1500s. Therefore, it is unlikely (less than a 1% probability over the next 100 years) that a tsunami will occur in Falmouth. As sea level rises, the extent of inland flooding resulting from a tsunami will likley increase, however, the overall risk to Falmouth will still likley be very low.

B3.a

Impact

Below is a list of possible impacts that could result from a tsunami:

- **People**: The forces of a tsunami wave itself can injure people or lead to death. Floating debris can endanger human lives, and the effects of a tsunami may leave people within food or fuel.
- **Emergency Response:** Flooded roads and deposited debris may block emergency response.
- **Infrastructure:** Tsunami waves and floating debris can damage coastal infrastructure and piers. Ruptured utility pipes and storage containers can release oil and gas, resulting in fire hazards.
- **Buildings**: The force of the tsunami wave can destroy buildings, and floating debris can damage structures. Also, the scouring action of moving water can sweep away buildings.
- **Economy**: Utilities can be damaged and roadways blocked, which can adversely impact economic activities. Coastal systems impacted by tsunamis can also adversely impact the fishing and tourism industries.
- **Natural Systems**: Tsunamis can uproot trees and plants. Land animals can be killed by drowning and marine life can be killed by pollution if toxic chemicals are washed into the ocean.

3.14 DAM AND CULVERT FAILURE

Overview

A dam is any artificial barrier and/or any controlling structure that can or does impound or divert water. There are 2,903 public and privately owned dams in Massachusetts, eight (8) of which are located in Falmouth (Figure 3-33).

Dam failure is any sudden, uncontrolled release of impounded water due to structural deficiencies in a dam. Dams can fail for a variety of reasons, including the dam being overtopped by floods that exceed its capacity, structural failure of the dam construction materials or the foundation supporting the dam, and inadequate maintenance and repair.

The hazards associated with a failing dam can also occur from culverts that act like dams during flooding events. A culvert is a structural opening under a roadway that allows water to pass from one side of the road to the other. They are typically made of concrete, steel or aluminum, and their size is calculated based on the location-specific volume of water expected to pass through that location. The primary function of a culvert is to prevent flooding during normal and extreme weather conditions and to provide proper road drainage. Culverts can fail due to the pipe becoming occluded by debris or improper maintenance, the pipe caving in due to structural deficiencies, or from a buildup of flood waters exceeding the capacity of the culvert. The Town of Falmouth's Municipal Maintenance Department has identified 127 culverts within the Town, 3 of which are in a concerning condition (Figure 3-33).

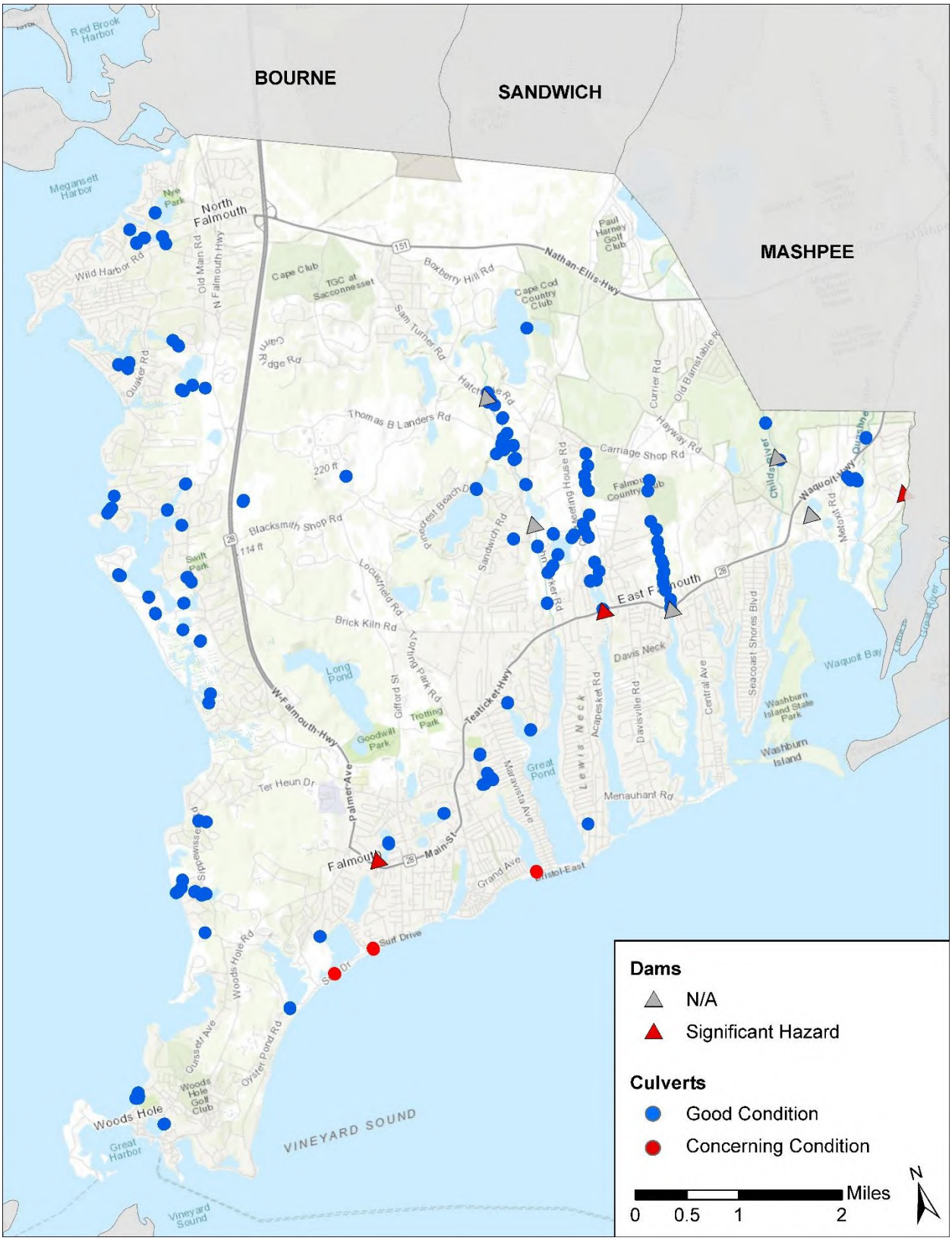

Figure 3-33. Locations of dams and culverts within Falmouth.

B1.c B2.a

Hazard Location

The Massachusetts Office of Dam Safety, within the Department of Conservation and Recreation, maintains a database of all the dams in Massachusetts, classified by their hazard potential. This database divides dams into three categories:

1) High Hazard Potential Dam: A dam location where failure will likely cause loss of life and serious damage to homes, industrial or commercial facilities, important public utilities, main highways or railroads.

2) Significant Hazard Potential Dam: A dam located where failure may cause loss of life and damage to homes, industrial or commercial facilities, secondary highways, or railroads, or cause interruption of use or service of relatively important facilities.

3) Low Hazard Potential Dam: A dam located where failure may cause minimal property damage to other, and loss of life is not expected.

Hazards associated with dam failure are confined to the areas around existing dams. Of the eight (8) dams located in Falmouth, three (3) are classified as a significant hazard by the Office of Dam Safety (Figure 3-33). The remaining dams have not been classified. This is likely because the remaining five (5) are very small dams located on cranberry bogs and are generally not considered to be a hazard in the event of failure. There are no Emergency Action Plans for any of the dams in Falmouth.

B1.c B2.a,c

Previous Occurrences & Extent

There have been no previous occurrences of dam or culvert failure in the Town of Falmouth. However, aging infrastructure, as well as increased storm intensity and rising sea levels associated with climate change, may produce such incidents in the future.

B2.b

Probability

Even though a dam or culvert failure has never occurred in the Town of Falmouth, the probability of it occuring is moderate, especially for those sites recognized as being a significant hazard or a concern (10-100% probability in the next year). The 2018 Massachusetts Hazard Mitigation and Climate Adaptation Plan describes two primary types of dam failure: catastrophic failure, characterized by the sudden, rapid, and uncontrolled release of impounded water, and design failure, which occurs as a result of minor overflow events. Dam overtopping is caused by floods that exceed the capacity of the dam, and it can occur as a result of inadequate spillway design, settlement of the dam crest, blockage of spillways, and other factors. Overtopping accounts for 34 percent of all dam failures in the U.S. More extreme precipitation events could increase the frequency of overtopping events. So, although climate change will not increase the probability of catastrophic failure, it may increase the probability of design failure.

B3.a

Impact

Below is a list of possible impacts that could result from dam or culvert failure:

- **People**: Could become trapped or blocked by flooded roads resulting from overtopped dams or culverts.
- **Infrastructure:** Utilities may be disrupted due to damaged pipes or power lines near the dam or culvert.
- **Buildings**: May be damaged by flooding caused by a failed dam or blocked culvert.
- **Economy**: Businesses could experience economic losses due to flooded or blocked roads prohibiting employees and/or customers from accessing certain areas of Town.
- **Natural Systems**: Dam and culvert failures can result in bank erosion. Debris and other materials can be deposited in natural systems.

3.15 FRESHWATER QUALITY

Overview

Clean freshwater resources, such as ponds and rivers, are essential for a healthy ecosystem. Freshwater ponds provide habitat for a variety of flora and fauna. In addition, ponds on Cape Cod support agricultural activities, such as cranberry bogs, which also have a historical and cultural significance. However, nutrient pollution from poorly maintained septic systems and lawn fertilizers, among other sources, can fuel the growth of algae: tiny plants that can bloom rapidly in a body of water. This process of over-suppling nutrients (i.e., nitrogen and phosphorus) to an aquatic system is called eutrophication. An algal bloom is a rapid increase in the amount of algae. When this occurs, it affects the whole ecosystem. Its impacts range from benign (e.g., providing additional food for herbivorous organisms) to harmful (e.g., blocking sunlight from other photosynthetic organisms, depleting dissolved oxygen levels, or secreting toxins into the water). Poor water quality in rivers that flow downstream to the ocean or in salt ponds can also lead a negative effect on marine water quality.

Since clean drinking water in Falmouth is provided via a sole source aquifer, the Town regulates development density, land use, and wastewater discharges for the protection of freshwater quality. Without continued protection, there is the potential for aquifer contamination from stormwater runoff, non-point source pollution, and nitrification in areas where the groundwater is presented as surface water. Saltwater intrusion may also be a concern in the future as sea levels continue to rise and the potential for contamination increases.

B1.c
B2.a

Hazard Location

There are 38 major freshwater ponds in Falmouth ranging in size from 152 acres (Coonamessett Pond) to 1.7 acres (unnamed pond) (Figure 3-34). Due to the factors causing algal blooms and eutrophication, freshwater ponds are some of the most likely areas to be adversely affected. Falmouth also has two rivers, Coonamessett River and Quashnet River. Eutrophication can also affect nearshore estuaries and shallow bays. Long Pond is a protected surface water reservoir and the major source of drinking water for Falmouth, supplying up to 80% of daily water needs on a summer day. Other sources of drinking water are from the Coonamessett Pond and Crooked Pond wells which draw from groundwater sources.

Figure 3-34. Major freshwater ponds and rivers in Falmouth.

B1.c
B2.a,c

Previous Occurrences & Extent

In order to minimize the risk of illness from water contaminated with bacteria, public beaches have to be tested for E. coli or Enterococci. Towns are then required to report testing results to the Massachusetts state government/Board of Health. Below in Table 3-15 are E. coli testing records for freshwater beaches in Falmouth from 2020. Ponds that did exceed E. coli benchmarks include the Cape Cod Camp Resort pond (Round Pond), Jenkin's Pond, and the Lochstead Association pond.

Table 3-15. E. Coli Testing Data for Falmouth Freshwater Beaches in 2020.

Beach	Testing Frequency	Tests	Single Sample Exceedances	Minimum Exceedance (cfu/1000mL)	Maximum Exceedance (cfu/1000mL)
Ashumet Valley Holly Sands	Weekly	14	0	-	-
Cape Cod Camp Resort	Weekly	15	2	274.4	2239.8
Coonamessett Pond	Weekly	14	0	-	-
Grew's Pond	Weekly	14	0	-	-
Jenkins Pond (Pinecrest)	Weekly	15	1	1046.2	1046.2
Lochstead Association	Weekly	15	1	866.4	866.4
Mares Pond Association	Weekly	14	0	-	-
Sand Pointe Shores: Rock Hollow	Weekly	13	0	-	-
Sand Pointe Shores: White Cap	Weekly	13	0	-	-
Shady Lane Homeowners: Crooked Pond	Weekly	12	0	-	-
Water-by-Estates Association (Flax Pond)	Weekly	14	0	-	-

The Association for the Preservation of Cape Cod (APCC), recently published a State of the Waters Report in 2021 in which freshwater ponds on Cape Cod were graded using the Carlson Trophic State Index (TSI) and cyanobacteria data to form a combined pond grading system. An "acceptable; ongoing protection required" grade was given if CTI grade was acceptable and/ or cyanobacteria was low. An "unacceptable; immediate restoration required" grade was given if the CTI was unacceptable and/or cyanobacteria was high. Within Falmouth, ponds that received an unacceptable grade include Ashumet Pond (partially within Mashpee), Deep Pond, Crooked

Pond, Mares Pond, and Jenkins Pond (red in Figure 3-35). Ponds that received an acceptable grade include Cedar Lake and Fresh Pond (blue in Figure 3-35).

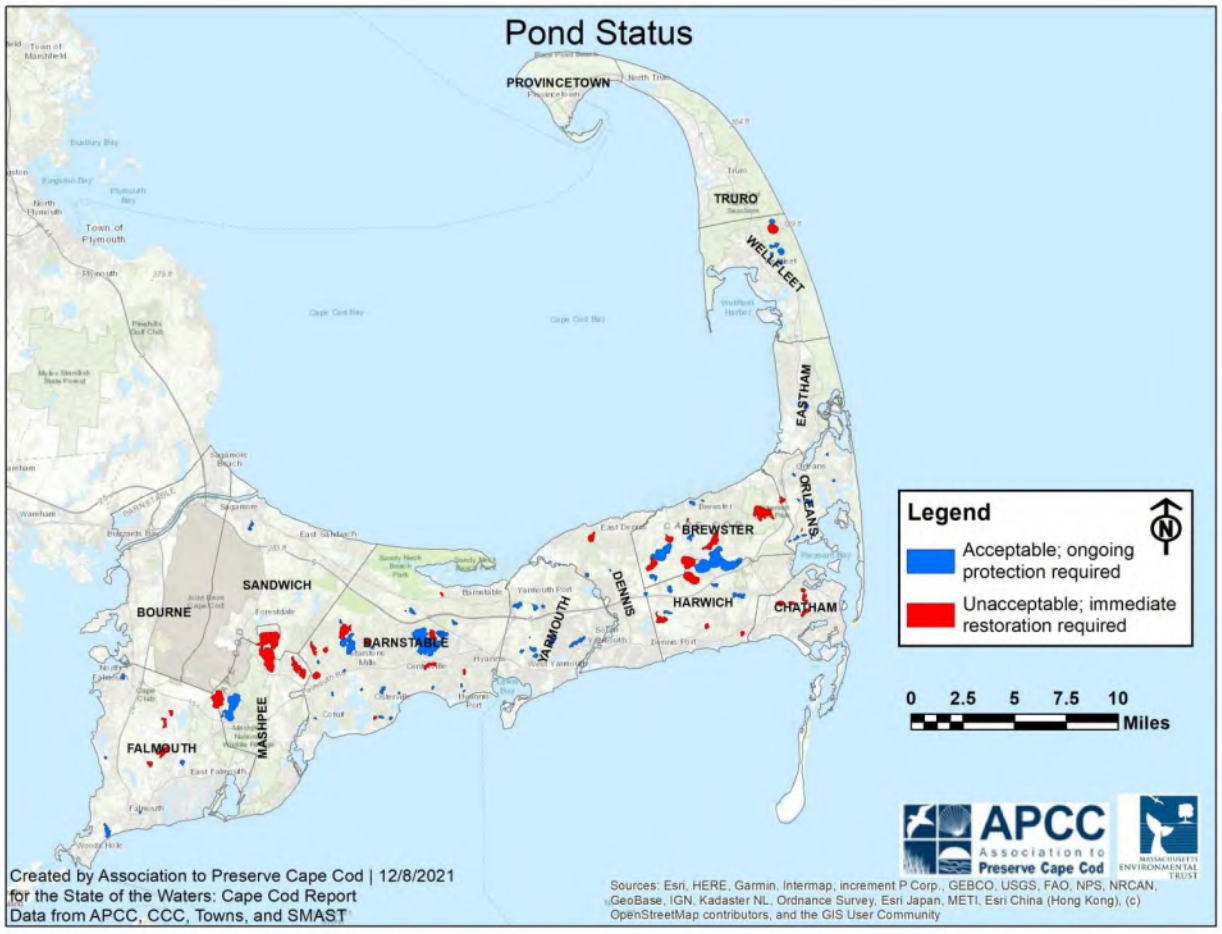

Figure 3-35. Pond Ssatus on Cape Cod (created by the APCC, 2021).

The APCC also evaluated drinking water sources on Cape Cod (Figure 3-36). Within Falmouth, drinking water supply was scored as “excellent”. The Long Pond Reservoir was outfitted with a new state-of-the-art drinking water filtration plant in 2017 and water filtration systems are also active on the Coonamessett Pond and Crooked Pond wellhead sites.

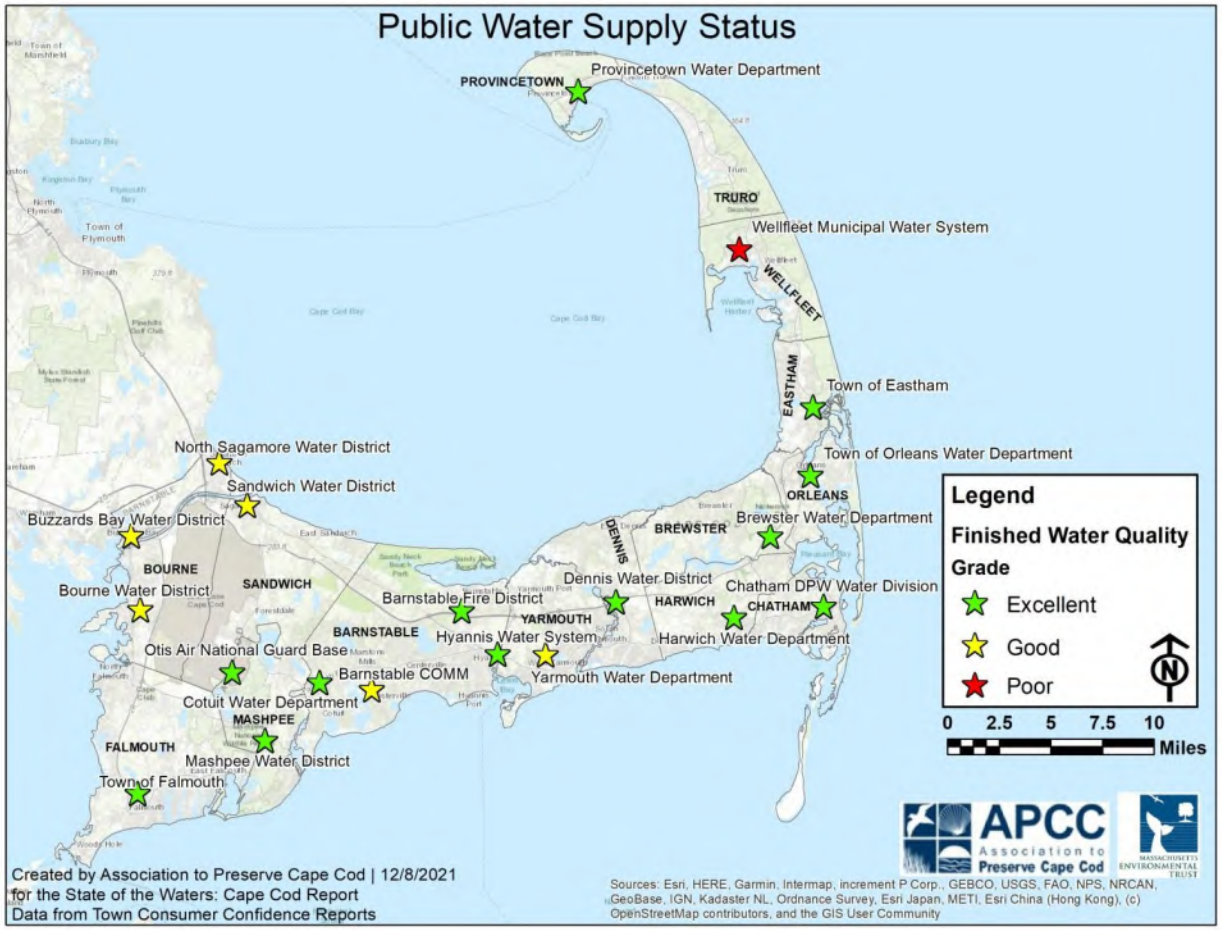

Figure 3-36. Public water supply status on Cape Cod (created by the APCC, 2021).

B2.b

Probability

Based on past records, the likelihood of poor water quality in the Town's freshwater ponds is somewhat likely (1 to 10% probability in the next year).

B3.a

Impact

Below is a list of possible impacts that could result from water quality problems:

- **People**: Serious illness can result if people consume fish contaminated with toxins. Drinking water sources can be impacted if drinking water reservoirs are impacted by algal blooms.
- **Economy**: Businesses relying on freshwater recreation can be negatively impacted by unhealthy levels of bacteria when ponds are closed for swimming.
- **Natural Systems**: Freshwater systems can be severely degraded due to algal blooms: algal blooms can shade out other photosynthetic organisms and oxygen depletion can result in fish kills.

3.16 SUMMARY OF HAZARDS

As suggested by the FEMA planning guidance, the Local Planning Team (LPT) reviewed the full range of natural hazards identified in the 2018 Massachusetts State Hazards and Climate Adaptation Plan and identified natural hazards that could impact Falmouth in the future, or that have impacted the Town in the past (Chapter 3). The 15 individual hazards discussed in Chapter 3 are evaluated below in Table 3-16 based on the likelihood of occurrence, severity, and area. Likelihoods for each hazard, as described in Chapter 3, are scored from 1 (unlikely) to 4 (highly likely). The severity of the hazard was scored on a scale of 1 to 4, with 1 being minor and 4 being catastrophic. Finally, whether the hazard was likely to have isolated impacts, or a town-wide effect was scored as 1 or 2 respectively. For both severity and area, an "X" was used in Table 3-16 to indicate the most likely severity, while a "P" indicates the anticipated severity of a worst-case scenario (i.e., a "potential" scenario). The value associated with the "X", rather than the "P", was used to calculate the estimated cumulative risk from that hazard. These determinations were made using local expertise from LPT members, data from the 2018 Massachusetts State Hazard and Climate Mitigation Plan and other resources.

The LPT selected only a subset of hazards from Table 3-16 to consider during the vulnerability analysis in Chapter 4. This selection was based on:

- Lack of data: If spatial information about the likelihood of a hazard is not available, conducting a site-specific vulnerability assessment is not possible. Examples of this include thunderstorm, tornado, and invasive species.
- Low estimated cumulative risk: If the estimated cumulative risk from a particular hazard is low, fully developing a vulnerability assessment to address it may be un-necessary. An example of this is tsunami.

However, a discussion-based qualitative vulnerability assessment was conducted for high-risk hazards that could not be analyzed quantitatively, such as severe winter weather and other severe weather (heavy precipitation, high wind, thunderstorm). The hazards that were selected for a quantitative or qualitative vulnerability assessment are indicated in Table 3-16 in bold font. Additional detail as to what data was used to evaluate these selected hazards in the vulnerability assessment is provided in Section 4.1. Finally, it is important to acknowledge that the cumulative risk associated with each hazard may change in the future due to climate change (e.g., flooding frequency and extent will likely increase due to sea level rise, there will be an increased likelihood of extreme temperatures, etc.). These factors will be considered in future updates of this plan (i.e., every 5 years) and the cumulative risk score adjusted accordingly.

Table 3-16. Relative Risk of Hazards in Falmouth.

	Likelihood				Severity				Area		Estimated Cumulative Risk†
	Unlikely	Possible	Likely	Highly Likely	Minor	Serious	Extensive	Catastrophic	Isolated	Town Wide	
Score	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	
Severe Winter Weather			X			X		P		X	12
Hurricane & Tropical Storm			X			X		P		X	12
Flooding (Inland & Coastal)				X			X		X		12
Other Severe Weather				X			X	P	X	P	12
Coastal Erosion				X		X	P		X		8
Water Quality		X				X	P			X	8
Extreme Temperature			X		X					X	6
Drought			X		X					X	6
Dam/Culvert Failure			X			X			X		6
Tornado		X				X		P	X		4
Wildfire		X				X	P		X		4
Earthquake		X			X		P			X	4
Invasive Species				X	X				X	P	4
Landslide	X				X	P			X		1
Tsunami	X				X			P	X		1

X indicates the believed value, while P indicates an extreme potential.
*These **bolded** hazards were selected for specific vulnerability analyses in Chapter 4.
† This value is based on the formula Likelihood*Severity*Area. The Likelihood of the hazard is based on a scale of 1 to 4, with 1 being unlikely and 4 being highly likely. The Severity of the hazard was based on a scale from 1 to 4, with 1 being minor and 4 being catastrophic. Area was given a value of 1 for isolated and 2 for town-wide. The "P"s were not incorporated into the Estimated Cumulative Risk value.

Source: Falmouth Enterprise

A risk analysis involves identifying a potential hazard event, determining the likelihood of its occurrence, and evaluating the consequence of it happening. Chapter 2 of the Falmouth Multi-Hazard Mitigation Plan profiled the local assets, natural resources, demographics, infrastructure and critical facilities, to document assets within the Town. Chapter 3 detailed the various natural hazards that have impacted or could impact the Town in the future. Chapter 4 combines the hazard descriptions and asset inventories to conduct an exposure analysis, that quantifies the number, type, and value of properties and critical facilities located in identified hazard areas.

This vulnerability assessment provides a foundation for the rest of the mitigation planning process, which is focused on identifying and prioritizing actions to reduce risks to hazards. In addition to informing the mitigation strategy, the vulnerability assessment also facilitates the establishment of emergency preparedness and response priorities, land use and comprehensive planning, and decision making by elected officials, city and county departments, businesses, and organizations in the community.

4.1 METHODOLOGY

This report includes two separate quantitative vulnerability assessments:

1) Vulnerability assessment of parcels and buildings; and
2) Exposure assessment of critical facilities

To estimate the total number of parcels, as well as both the value of the buildings on the property and the total property value (total property value is the sum of the value of the buildings, other structures, and the land itself within a given parcel), the planning team utilized the most current Assessor's Parcel dataset for the Town of Falmouth (2021). The dataset provides information about parcel size, land use type, assessed value, and building characteristics.

This parcel dataset was first classified into various land use types based on the Massachusetts Property Type Classification Codes according to the Land Use classifications presented in Figure 2-1. The outcome of this classification was presented in Table 2-1 where the number of parcels within each land use category were quantified. Table 4-1 details the parcels Land Use Codes that are encompassed by each land use type used in this report.

Table 4-1. Falmouth Land Use Classifications Based on Property Land Use Codes.

Land Use Type	Land Use Codes
Residential - Single Family	101, 106
Residential - Multi-Family	013, 102, 104, 105, 109, 111, 112, 121, 123, 125, 959, 970, 996
Temporary Lodging	301, 302, 303, 304
Commercial - Retail/Offices/Services	031, 318, 321, 323, 325, 326, 327, 330, 331, 332, 337, 340, 343, 356, 423, 900, 929
Commercial - Manufacturing/Distribution	310, 311, 313, 316, 333, 334, 400, 401, 402, 403, 404, 405, 410
Public Services	140, 341, 342, 349, 350, 352, 354, 355, 384, 388, 424, 431, 433, 903, 906, 914, 931, 934, 935, 941, 943, 951, 952, 955, 956, 957, 960, 961, 962, 985
Agricultural	014, 016, 017, 018, 710, 712, 714, 717, 719
Open Space	201, 210, 383, 385, 601, 720, 9035, 910, 911, 916, 919, 920, 928, 932, 950, 982
Recreation	038, 083, 805, 353, 369, 370, 375, 380, 381, 802, 804, 805, 9036, 905, 924, 954, 958
Vacant	130, 131, 132, 390, 392, 393, 440, 442, 930, 933, 936, 946, 980, 997

To determine each parcel's vulnerability, a GIS analysis was conducted by overlaying extent maps for a subset of the hazards shown in Chapter 3 with the parcel data. Below is a list of the hazard types selected for this vulnerability analysis, and a description of the data used for the evaluation:

1. **Flooding:** FEMA Hazard Maps (effective 2021) (see Figure 3-2).
2. **Sea-Level Rise:** MC-FRM Results produced by Woods Hole Group for MassDOT (see Figures 3-5 through 3-7)
3. **Hurricanes and Tropical Storms:** The extent of storm surge and flooding during a hurricane was estimated using the SLOSH model (Figure 3-12).

Once the parcels affected by each hazard type were identified, the number of parcels in each land use category was totaled, as well as the value of the buildings and total property value associated with each parcel. In this way, the percent of the Town's parcels and the percent of the Town's property value potentially affected by each hazard type was quantified. These parcel totals and property values also represent the potential impact from secondary issues associated with each hazard (e.g., mold, mildew and other water damage impacts associated with flood hazard events). These results are summarized in Tables 4-3 to 4-15. To convert the potential value losses from flooding to potential revenue loss for the Town with respect to property taxes, the current tax rate can be applied to any of the values in Tables 4-3 to 4-15. The Town of Falmouth tax rate for fiscal year 2022 is $8.05 per thousand.

To assess the vulnerabilities of Falmouth's critical facilities, as discussed in Chapter 2, the planning team first developed a list of the critical facilities and structures. Each location was mapped in GIS (Figure 2-2). The same hazards that were mapped and applied to the parcel vulnerability assessment were again overlaid on the map of critical infrastructure (i.e., flooding, sea-level rise, and hurricanes). If a critical facility was located in a hazard area, that particular facility was considered to be exposed, and therefore vulnerable, to that particular hazard. For the same reasons listed above in the description of the parcel vulnerability analysis, potential impacts from other hazards, such as earthquakes and tsunamis were not quantitatively evaluated for critical facilities. Results from the quantitative vulnerability analysis for critical facilities are summarized in Table 4-2.

4.2 RESULTS

Table 4-2. Critical Facility Vulnerability Assessment.

ID	Name	Category	FEMA Flood Zone	Min Hurricane Category That Will Affect Facility	Storm Surge Inundation Risk 2030	Storm Surge Inundation Risk 2050	Storm Surge Inundation Risk 2070
1	Town Archives	Admin					
2	Falmouth Housing Authority			4			
3	Falmouth School Administration						
4	Town Hall		AE	3	3%	9%	22%
5	Falmouth Harbor Master Building		AE	2	0.2%	2%	9%
6	Mass Highway Dept						
7	Falmouth Police Dept						
8	Falmouth Recreation Department			2		2%	8%
9	Human Services Dept			3	0.1%	1%	4%
10	Falmouth Senior Center						
11	Veterans Service Center		AE	2	0.3%	5%	18%
12	Harbor Master Shack		VE	1	94%	94%	95%
13	Drawbridge Hut		VE	1	99%	100%	100%
14	Department of Public Works	Admin/HAZMAT		4			
15	West Falmouth Fire Station	Fire		4			
16	North Falmouth Fire Station						
17	Emergency Operations Center (Headquarters)						
18	East Falmouth Fire Station						
19	Woods Hole Fire Station						

Table 4-2 (cont.). Critical Facility Vulnerability Assessment.

ID	Name	Category	FEMA Flood Zone	Min Hurricane Category That Will Affect Facility	Storm Surge Inundation Risk 2030	Storm Surge Inundation Risk 2050	Storm Surge Inundation Risk 2070
20	North Marine	HAZMAT	AE	1	56%	74%	80%
21	Accurate Plastics						
22	Associates of Cape Cod						
23	Cape Cod Aggregates						
24	East Marine		AE	1	71%	76%	100%
25	Falmouth Ice Arena						
26	Falmouth Ready Mix			4			
27	Lawrence Ready Mix Concrete						
28	Eversource Station 967						
29	Eversource Station 933						
30	Eversource Station 936						
31	The Fuel Co. Inc 1						
32	The Fuel Co. Inc 2						
33	Verizon 1						
34	Verizon 2						
35	Falmouth Coal Co. / Falmouth Energy						
36	Wynne Fuel Oil Co.						
37	Safe Harbor Fiddler's Cove Marina	HAZMAT/ Wastewater	AE	2	2%	7%	20%
38	Falmouth Marine		AE	1	24%	53%	72%
39	MacDougall's Cape Cod Marine		AE	2	9%	37%	67%
40	Bosun's Marina		AE	1	75%	98%	100%
41	Town Marina Dock		AE	1	96%	96%	97%

Table 4-2 (cont.). Critical Facility Vulnerability Assessment.

ID	Name	Category	FEMA Flood Zone	Min Hurricane Category That Will Affect Facility	Storm Surge Inundation Risk 2030	Storm Surge Inundation Risk 2050	Storm Surge Inundation Risk 2070
42	Falmouth Public Library	Library		4			
43	North Falmouth Public Library						
44	East Falmouth Public Library						
45	West Falmouth Public Library						
46	Woods Hole Library						
47	Coastal Medical Transportation Services LLC	Medical					
48	ConvenientMD Urgent Care			3		2%	7%
49	Cape Cod Healthcare Urgent Care			3			
50	Overlook - Visiting Nurse						
51	Cape Cod Free Clinic & Community Health Center			3	0.1%	1%	4%
52	Atria Woodbriar Park (Assisted Living)	Medical/Nursing					
53	Atria Woodbriar Place (Independent Living)						
54	Heritage At Falmouth						
55	JML Care Center, Inc.						
56	Royal Megansett Nursing and Retirement Home						
57	Royal Falmouth Nursing & Rehabilitation Center						

Table 4-2 (cont.). Critical Facility Vulnerability Assessment.

ID	Name	Category	FEMA Flood Zone	Min Hurricane Category That Will Affect Facility	Storm Surge Inundation Risk 2030	Storm Surge Inundation Risk 2050	Storm Surge Inundation Risk 2070
58	Falmouth Hospital	Medical/HAZMAT					
59	Post Office	Other		3			0.25%
60	Cape & Islands NPR Radio						
61	Woods Hole Community Center		AE	1	84.29%	90.28%	95.03%
62	Falmouth Landfill						
63	Town Fuel Dock/Pier 37			4			
64	Nobska Lighthouse						
65	WHOI 1		VE	1	86.99%	92.95%	93.84%
66	WHOI 2						
67	WHOI 3						
68	Coast Guard Station	Other/HAZMAT	VE	1	72%	79%	100%
69	Falmouth Airpark	Transportation					
70	Falmouth Bus Terminal						
71	Island Queen Ferry Terminal	Transportation/ Wastewater	AE	1	100%	100%	100%
72	Steamship Authority Ferry Terminal	Transportation/HAZMAT	AE	1	61%	75%	87%

Table 4-2 (cont.). Critical Facility Vulnerability Assessment.

ID	Name	Category	FEMA Flood Zone	Min Hurricane Category That Will Affect Facility	Storm Surge Inundation Risk 2030	Storm Surge Inundation Risk 2050	Storm Surge Inundation Risk 2070
73	East Falmouth Elementary School	Schools					
74	Falmouth Academy						
75	Lawrence Jr. High School						
76	Morse Pond Middle School						
77	North Falmouth Elementary School						
78	Teaticket Elementary School			3			0.33%
79	Falmouth High School						
80	Mullen Hall School			3			0.68%
81	Sea Education Association Inc						
82	MBL/WHOI Dorms						
83	Former Water Plant Pumping Station	Water/Wastewater					
84	Long Pond Water Treatment Plant						
85	Town Marine Pumpout Boat		AE	1	97%	98%	99%
86	Coonamessett Well						
87	Ashument Well						
88	Crooked Pond Well						
89	Long Pond Reservoir						

Table 4-2 (cont.). Critical Facility Vulnerability Assessment.

ID	Name	Category	FEMA Flood Zone	Min Hurricane Category That Will Affect Facility	Storm Surge Inundation Risk 2030	Storm Surge Inundation Risk 2050	Storm Surge Inundation Risk 2070
90	Water Tower 1	Water/Wastewater					
91	Hayway Water Tower						
92	Water Tower 2						
93	Water Street Pump Station		AE	2	21%	36%	66%
94	Park Road Pump Station		AE	1	75%	95%	100%
95	Shivericks Pond Pump Station			3			2%
96	Surf Beach Pump Station		VE	1	51%	73%	76%
97	Inner Harbor Pump Station		AE	1	46%	71%	81%
98	Spring Bars Road Pump Station		AE	2	3%	20%	46%
99	Alphonse Street Pump Station			3			1%
100	Silver Beach Avenue Pump Station		AE	1	72%	75%	76%
101	Quissett Harbor Boat Yard		VE	2	50%	53%	58%
102	Service Road Wastewater Treatment Plant	Water/Wastewater/ HAZMAT					
103	Crooked Pond Treatment Plant						
104	NS Treatment Plant			2	0.1%	1%	3%
105	Mares Pond Well						

Table 4-2 (cont.). Critical Facility Vulnerability Assessment.

ID	Name	Category	FEMA Flood Zone	Min Hurricane Category That Will Affect Facility	Storm Surge Inundation Risk 2030	Storm Surge Inundation Risk 2050	Storm Surge Inundation Risk 2070
106	Fresh Pond Well	Water/Wastewater/ HAZMAT					
107	Sewer Pumping Station						
108	Harborview Housing	Vulnerable Populations - Housing Authority		4			
109	Tataket Apartments						
110	Salt Sea Apartments			3			
111	Mayflower Housing						
112	Rose Morin Apartments			3			

In the case a critical facility does not have any flood information listed, it is not vulnerable.

Table 4-3. Parcels and Buildings Vulnerable to Flooding in the AE Zone.

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**Total**	**Total in Hazard**	**% in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**
Residential - Single Family	18,636	3,729	20%	$6,021,861,900	$1,336,314,800	22%	$11,738,149,300	$2,814,629,400	24%
Residential - Multi-Family	882	183	21%	$387,789,450	$68,025,600	18%	$748,562,150	$141,419,300	19%
Temporary Lodging	44	14	32%	$63,805,400	$21,199,800	33%	$125,633,000	$38,759,600	31%
Commercial - Retail/Offices/ Services	385	76	20%	$187,746,795	$48,437,400	26%	$426,350,095	$120,607,800	28%
Commercial - Manufacturing/ Distribution	86	9	10%	$45,925,400	$6,264,600	14%	$110,878,700	$11,969,800	11%
Public Services	421	104	25%	$593,189,700	$165764700	28%	$879,352,300	$243,503,300	28%
Agricultural	28	13	46%	$4,792,200	$1,170,200	24%	$9,017,574	$2,449,643	27%
Open Space	821	151	18%	$1,800,100	$35,500	2%	$221,462,542	$59,921,771	27%
Recreation	91	8	9%	$32,721,400	$1,897,900	6%	$85,932,495	$5,188,200	6%
Vacant	2,015	392	19%	$694,000	$212,900	31%	$406,286,300	$85,040,900	21%
Total	**23,409**	**4,679**	**20%**	**$7,340,326,345**	**$1,649,323,400**	**22%**	**$14,751,624,456**	**$3,523,489,714**	**24%**

Table 4-4. Parcels and Buildings Vulnerable to Flooding in the AO Zone.

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**Total**	**Total in Hazard**	**% in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**
Residential - Single Family	18,636	2	0.01%	$6,021,861,900	$1,034,700	0.02%	$11,738,149,300	$2,280,100	0.02%
Residential - Multi-Family	882	0	0%	$387,789,450	$-	0%	$748,562,150	$-	0%
Temporary Lodging	44	0	0%	$63,805,400	$-	0%	$125,633,000	$-	0%
Commercial - Retail/Offices/ Services	385	0	0%	$187,746,795	$-	0%	$426,350,095	$-	0%
Commercial - Manufacturing/ Distribution	86	0	0%	$45,925,400	$-	0%	$110,878,700	$-	0%
Public Services	421	0	0%	$593,189,700	$-	0%	$879,352,300	$-	0%
Agricultural	28	0	0%	$4,792,200	$-	0%	$9,017,574	$-	0%
Open Space	821	0	0%	$1,800,100	$-	0%	$221,462,542	$-	0%
Recreation	91	0	0%	$32,721,400	$-	0%	$85,932,495	$-	0%
Vacant	2,015	0	0%	$694,000	$-	0%	$406,286,300	$-	0%
Total	**23,409**	**2**	**0.01%**	**$7,340,326,345**	**$1,034,700**	**0.02%**	**$14,751,624,456**	**$2,280,100**	**0.02%**

Table 4-5. Parcels and Buildings Vulnerable to Flooding in the VE Zone.

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**Total**	**Total in Hazard**	**% in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**
Residential - Single Family	18,636	1,307	7%	$6,021,861,900	$798,642,200	13%	$11,738,149,300	$2,387,104,600	20%
Residential - Multi-Family	882	79	9%	$387,789,450	$76,799,100	20%	$748,562,150	$222,533,000	30%
Temporary Lodging	44	7	16%	$63,805,400	$19,686,100	31%	$125,633,000	$43,497,100	35%
Commercial - Retail/Offices/ Services	385	19	5%	$187,746,795	$14,198,800	8%	$426,350,095	$53,769,000	13%
Commercial - Manufacturing/ Distribution	86	2	2%	$45,925,400	$831,900	2%	$110,878,700	$1,960,800	2%
Public Services	421	55	13%	$593,189,700	$33,991,200	6%	$879,352,300	$98,244,500	11%
Agricultural	28	0	0%	$4,792,200	$-	0%	$9,017,574	$-	0%
Open Space	821	228	28%	$1,800,100	$1,420,900	79%	$221,462,542	$61,888,566	28%
Recreation	91	12	13%	$32,721,400	$5,672,400	17%	$85,932,495	$13,488,625	16%
Vacant	2,015	350	17%	$694,000	$-	0%	$406,286,300	$76,095,600	19%
Total	**23,409**	**2,059**	**9%**	**$7,340,326,345**	**$951,242,600**	**13%**	**$14,751,624,456**	**$2,958,581,791**	**20%**

Table 4-6. Parcels and Buildings Vulnerable to a Category 1 Hurricane (SLOSH 1).

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**Total**	**Total in Hazard**	**% in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**
Residential - Single Family	18,636	2,943	16%	$6,021,861,900	$1,411,860,000	23%	$11,738,149,300	$3,748,880,300	32%
Residential - Multi-Family	882	150	17%	$387,789,450	$107,519,400	28%	$748,562,150	$290,897,400	39%
Temporary Lodging	44	11	25%	$63,805,400	$23,888,800	37%	$125,633,000	$52,863,200	42%
Commercial - Retail/Offices/ Services	385	42	11%	$187,746,795	$21,333,100	11%	$426,350,095	$81,828,200	19%
Commercial - Manufacturing/ Distribution	86	6	7%	$45,925,400	$4,242,100	9%	$110,878,700	$8,588,200	8%
Public Services	421	119	28%	$593,189,700	$127,164,900	21%	$879,352,300	$239,175,600	27%
Agricultural	28	4	14%	$4,792,200	$798,000	17%	$9,017,574	$1,413,368	16%
Open Space	821	333	41%	$1,800,100	$1,456,400	81%	$221,462,542	$75,971,328	34%
Recreation	91	17	19%	$32,721,400	$7,570,300	23%	$85,932,495	$18,242,625	21%
Vacant	2,015	590	29%	$694,000	$212,900	31%	$406,286,300	$121,552,700	30%
Total	**23,409**	**4,215**	18%	**$7,340,326,345**	**$1,706,045,900**	23%	**$14,751,624,456**	**$4,639,412,921**	31%

Table 4-7. Parcels and Buildings Vulnerable to a Category 2 Hurricane (SLOSH 2).

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**Total**	**Total in Hazard**	**% in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**
Residential - Single Family	18,636	1,821	10%	$6,021,861,900	$623,909,900	10%	$11,738,149,300	$1,262,655,700	11%
Residential - Multi-Family	882	91	10%	$387,789,450	$30,192,400	8%	$748,562,150	$61,069,900	8%
Temporary Lodging	44	9	20%	$63,805,400	$16,097,100	25%	$125,633,000	$27,990,300	22%
Commercial - Retail/Offices/ Services	385	49	13%	$187,746,795	$43,943,500	23%	$426,350,095	$96,580,900	23%
Commercial - Manufacturing/ Distribution	86	6	7%	$45,925,400	$3,339,800	7%	$110,878,700	$6,231,000	6%
Public Services	421	38	9%	$593,189,700	$87,979,900	15%	$879,352,300	$120,033,700	14%
Agricultural	28	7	25%	$4,792,200	$0	0%	$9,017,574	$127,436	1%
Open Space	821	32	4%	$1,800,100	$0	0%	$221,462,542	$44,831,611	20%
Recreation	91	3	3%	$32,721,400	$0	0%	$85,932,495	$434,200	1%
Vacant	2,015	124	6%	$694,000	$0	0%	$406,286,300	$34,267,900	8%
Total	23,409	2,180	9%	$7,340,326,345	$805,462,600	11%	$14,751,624,456	$1,654,222,647	11%

Table 4-8. Parcels and Buildings Vulnerable to a Category 3 Hurricane (SLOSH 3).

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**Total**	**Total in Hazard**	**% in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**
Residential - Single Family	18,636	2,044	11%	$6,021,861,900	$611,130,000	10%	$11,738,149,300	$1,153,291,000	10%
Residential - Multi-Family	882	96	11%	$387,789,450	$37,572,700	10%	$748,562,150	$64,914,800	9%
Temporary Lodging	44	4	9%	$63,805,400	$4,418,400	7%	$125,633,000	$7,627,800	6%
Commercial - Retail/Offices/ Services	385	60	16%	$187,746,795	$28,652,400	15%	$426,350,095	$56,882,400	13%
Commercial - Manufacturing/ Distribution	86	3	3%	$45,925,400	$998,400	2%	$110,878,700	$2,908,100	3%
Public Services	421	36	9%	$593,189,700	$102,921,800	17%	$879,352,300	$116,121,900	13%
Agricultural	28	3	11%	$4,792,200	$567,900	12%	$9,017,574	$1,350,414	15%
Open Space	821	42	5%	$1,800,100	$0	0%	$221,462,542	$4,164,698	2%
Recreation	91	2	2%	$32,721,400	$394,700	1%	$85,932,495	$773,700	1%
Vacant	2,015	128	6%	$694,000	$71,800	10%	$406,286,300	$27,885,500	7%
Total	**23,409**	**2,418**	10%	**$7,340,326,345**	**$786,728,100**	11%	**$14,751,624,456**	**$1,435,920,312**	10%

Table 4-9. Parcels and Buildings Vulnerable to a Category 4 Hurricane (SLOSH 4).

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**Total**	**Total in Hazard**	**% in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**
Residential - Single Family	18,636	1,618	9%	$6,021,861,900	$461,919,000	8%	$11,738,149,300	$822,342,300	7%
Residential - Multi-Family	882	104	12%	$387,789,450	$56,697,200	15%	$748,562,150	$89,030,600	12%
Temporary Lodging	44	9	20%	$63,805,400	$7,181,500	11%	$125,633,000	$13,380,200	11%
Commercial - Retail/Offices/ Services	385	61	16%	$187,746,795	$33,812,100	18%	$426,350,095	$64,033,700	15%
Commercial - Manufacturing/ Distribution	86	6	7%	$45,925,400	$3,286,400	7%	$110,878,700	$8,297,300	7%
Public Services	421	34	8%	$593,189,700	$16,263,100	3%	$879,352,300	$35,550,400	4%
Agricultural	28	1	4%	$4,792,200	$218,300	5%	$9,017,574	$506,465	6%
Open Space	821	35	4%	$1,800,100	$0	0%	$221,462,542	$2,341,400	1%
Recreation	91	6	7%	$32,721,400	$836,800	3%	$85,932,495	$4,677,927	5%
Vacant	2,015	114	6%	$694,000	$0	0%	$406,286,300	$21,382,400	5%
Total	**23,409**	**1,988**	8%	**$7,340,326,345**	**$580,214,400**	8%	**$14,751,624,456**	**$1,061,542,692**	7%

Table 4-10. Parcels and Buildings Vulnerable to Flooding During a Major Storm Event (1% to less than 20% chance of inundation) in 2030.

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**Total**	**Total in Hazard**	**% in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**
Residential - Single Family	18,636	1,289	7%	$6,021,861,900	$474,076,400	8%	$11,738,149,300	$982,111,100	8%
Residential - Multi-Family	882	60	7%	$387,789,450	$22,604,800	6%	$748,562,150	$45,937,000	6%
Temporary Lodging	44	8	18%	$63,805,400	$10,720,200	17%	$125,633,000	$19,439,700	15%
Commercial - Retail/Offices/ Services	385	34	9%	$187,746,795	$28,791,300	15%	$426,350,095	$60,256,700	14%
Commercial - Manufacturing/ Distribution	86	3	3%	$45,925,400	$986,500	2%	$110,878,700	$2,149,300	2%
Public Services	421	29	7%	$593,189,700	$45,738,700	8%	$879,352,300	$60,130,700	7%
Agricultural	28	8	29%	$4,792,200	$0	0%	$9,017,574	$135,454	2%
Open Space	821	40	5%	$1,800,100	$0	0%	$221,462,542	$44,858,074	20%
Recreation	91	3	3%	$32,721,400	$390,400	1%	$85,932,495	$1,174,200	1%
Vacant	2,015	113	6%	$694,000	$0	0%	$406,286,300	$26,585,000	7%
Total	**23,409**	**1,587**	7%	**$7,340,326,345**	**$583,308,300**	8%	**$14,751,624,456**	**$1,242,777,228**	8%

Table 4-11. Parcels and Buildings Vulnerable to Flooding During a Minor Storm Event (20% or greater chance of inundation) in 2030.

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**Total**	**Total in Hazard**	**% in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**
Residential - Single Family	18,636	2,761	15%	$6,021,861,900	$1,342,012,500	22%	$11,738,149,300	$3,603,322,200	31%
Residential - Multi-Family	882	146	17%	$387,789,450	$103,803,800	27%	$748,562,150	$284,522,900	38%
Temporary Lodging	44	10	23%	$63,805,400	$23,588,900	37%	$125,633,000	$52,098,700	41%
Commercial - Retail/Offices/ Services	385	36	9%	$187,746,795	$19,805,000	11%	$426,350,095	$80,861,100	19%
Commercial - Manufacturing/ Distribution	86	6	7%	$45,925,400	$4,242,100	9%	$110,878,700	$8,588,200	8%
Public Services	421	119	28%	$593,189,700	$93,550,400	16%	$879,352,300	$205,761,000	23%
Agricultural	28	3	11%	$4,792,200	$798,000	17%	$9,017,574	$1,405,350	16%
Open Space	821	326	40%	$1,800,100	$1,456,400	81%	$221,462,542	$75,772,828	34%
Recreation	91	16	18%	$32,721,400	$7,179,900	22%	$85,932,495	$17,294,125	20%
Vacant	2,015	553	27%	$694,000	$212,900	31%	$406,286,300	$116,602,600	29%
Total	**23,409**	**3,976**	17%	**$7,340,326,345**	**$1,596,649,900**	22%	**$14,751,624,456**	**$4,446,229,003**	30%

Table 4-12. Parcels and Buildings Vulnerable to Flooding During a Major Storm Event (1% to less than 20% chance of inundation) in 2050.

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**Total**	**Total in Hazard**	**% in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**
Residential - Single Family	18,636	1,888	10%	$6,021,861,900	$634,141,200	11%	$11,738,149,300	$1,246,874,600	11%
Residential - Multi-Family	882	88	10%	$387,789,450	$30,024,100	8%	$748,562,150	$58,757,000	8%
Temporary Lodging	44	6	14%	$63,805,400	$13,697,100	21%	$125,633,000	$21,446,600	17%
Commercial - Retail/Offices/ Services	385	43	11%	$187,746,795	$25,989,400	14%	$426,350,095	$53,856,600	13%
Commercial - Manufacturing/ Distribution	86	5	6%	$45,925,400	$2,450,900	5%	$110,878,700	$4,853,700	4%
Public Services	421	36	9%	$593,189,700	$56,629,200	10%	$879,352,300	$77,280,000	9%
Agricultural	28	6	21%	$4,792,200	$195,700	4%	$9,017,574	$498,105	6%
Open Space	821	26	3%	$1,800,100	$0	0%	$221,462,542	$43,605,911	20%
Recreation	91	1	1%	$32,721,400	$0	0%	$85,932,495	$38,300	0%
Vacant	2,015	128	6%	$694,000	$0	0%	$406,286,300	$28,537,400	7%
Total	**23,409**	**2,227**	10%	**$7,340,326,345**	**$763,127,600**	10%	**$14,751,624,456**	**$1,535,748,216**	10%

Table 4-13. Parcels and Buildings Vulnerable to Flooding During a Minor Storm Event (20% or greater chance of inundation) in 2050.

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**Total**	**Total in Hazard**	**% in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**
Residential - Single Family	18,636	3,350	18%	$6,021,861,900	$1,559,056,400	26%	$11,738,149,300	$4,067,060,900	35%
Residential - Multi-Family	882	176	20%	$387,789,450	$115,095,800	30%	$748,562,150	$307,419,700	41%
Temporary Lodging	44	15	34%	$63,805,400	$27,188,800	43%	$125,633,000	$60,810,100	48%
Commercial - Retail/Offices/ Services	385	58	15%	$187,746,795	$42,121,500	22%	$426,350,095	$128,135,600	30%
Commercial - Manufacturing/ Distribution	86	8	9%	$45,925,400	$5,540,700	12%	$110,878,700	$10,700,400	10%
Public Services	421	113	27%	$593,189,700	$134,319,800	23%	$879,352,300	$253,305,400	29%
Agricultural	28	6	21%	$4,792,200	$798,000	17%	$9,017,574	$1,484,274	16%
Open Space	821	352	43%	$1,800,100	$1,456,400	81%	$221,462,542	$78,508,928	35%
Recreation	91	18	20%	$32,721,400	$7,570,300	23%	$85,932,495	$18,430,025	21%
Vacant	2,015	607	30%	$694,000	$212,900	31%	$406,286,300	$127,793,900	31%
Total	**23,409**	**4,703**	20%	**$7,340,326,345**	**$1,893,360,600**	26%	**$14,751,624,456**	**$5,053,649,227**	34%

Table 4-14. Parcels and Buildings Vulnerable to Flooding During a Major Storm Event (1% to less than 20% chance of inundation) in 2070.

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**Total**	**Total in Hazard**	**% in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**
Residential - Single Family	18,636	1,893	10%	$6,021,861,900	$604,198,900	10%	$11,738,149,300	$1,152,531,700	10%
Residential - Multi-Family	882	90	10%	$387,789,450	$31,455,900	8%	$748,562,150	$56,727,600	8%
Temporary Lodging	44	3	7%	$63,805,400	$6,576,800	10%	$125,633,000	$10,718,300	9%
Commercial - Retail/Offices/ Services	385	59	15%	$187,746,795	$33,634,700	18%	$426,350,095	$65,150,200	15%
Commercial - Manufacturing/ Distribution	86	2	2%	$45,925,400	$1,451,800	3%	$110,878,700	$2,721,300	2%
Public Services	421	43	10%	$593,189,700	$163,703,500	28%	$879,352,300	$200,313,800	23%
Agricultural	28	4	14%	$4,792,200	$372,200	8%	$9,017,574	$911,059	10%
Open Space	821	24	3%	$1,800,100	$0	0%	$221,462,542	$2,840,237	1%
Recreation	91	2	2%	$32,721,400	$394,700	1%	$85,932,495	$773,700	1%
Vacant	2,015	148	7%	$694,000	$71,800	10%	$406,286,300	$33,299,600	8%
Total	**23,409**	**2,268**	10%	**$7,340,326,345**	**$841,860,300**	11%	**$14,751,624,456**	**$1,525,987,496**	10%

Table 4-15. Parcels and Buildings Vulnerable to Flooding During a Minor Storm Event (20% or greater chance of inundation) in 2070.

	Number of Parcels			Value of Buildings			Value of Total Property		
Land Use	**Total**	**Total in Hazard**	**% in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**	**Total Value**	**Total Value in Hazard**	**% Value in Hazard**
Residential - Single Family	18,636	4,157	22%	$6,021,861,900	$1,831,933,100	30%	$11,738,149,300	$4,620,573,800	39%
Residential - Multi-Family	882	212	24%	$387,789,450	$127,121,600	33%	$748,562,150	$332,204,100	44%
Temporary Lodging	44	18	41%	$63,805,400	$34,309,100	54%	$125,633,000	$71,538,400	57%
Commercial - Retail/Offices/ Services	385	73	19%	$187,746,795	$50,166,300	27%	$426,350,095	$144,383,600	34%
Commercial - Manufacturing/ Distribution	86	11	13%	$45,925,400	$6,539,800	14%	$110,878,700	$12,832,800	12%
Public Services	421	144	34%	$593,189,700	$136,764,700	23%	$879,352,300	$259,211,600	29%
Agricultural	28	10	36%	$4,792,200	$993,700	21%	$9,017,574	$1,980,159	22%
Open Space	821	366	45%	$1,800,100	$1,456,400	81%	$221,462,542	$120,902,802	55%
Recreation	91	19	21%	$32,721,400	$7,570,300	23%	$85,932,495	$18,468,325	21%
Vacant	2,015	673	33%	$694,000	$212,900	31%	$406,286,300	$144,196,700	35%
Total	**23,409**	**5,683**	24%	**$7,340,326,345**	**$2,197,067,900**	30%	**$14,751,624,456**	**$5,726,292,286**	39%

The Local Planning Team (LPT) decided not to quantitatively evaluate the vulnerability from the remaining natural hazards listed in Table 3-16, for the following reasons:

1. **Coastal Erosion**: Although rates of erosion are available from MassCZM, a detailed vulnerability assessment for this hazard was not performed since it is assumed that any waterfront parcel has a risk of erosion.
2. **Severe Winter Weather, Other Severe Weather, Drought, Extreme Temperature, Tornado, Wildfire, Earthquake, Invasive Species, and Tsunami**: Location specific data within Falmouth is not available meaning a detailed vulnerability assessment could not be completed.
3. **Landslide**: This hazard is unlikely to occur (i.e. less than 1% chance), meaning a vulnerability assessment for this hazard would not have a high value to the Town.
4. **Dam and Culvert Failure**: Although the locations of potentially problematic dams are known, location specific data for areas that would be impacted by a failure of any of these structures is not available. Therefore, a detailed vulnerability assessment could not be completed.
5. **Water Quality**: Although the locations of freshwater lakes and ponds are known, a detailed vulnerability assessment for this hazard was not performed since the water quality is expected to fluctuate by season.

However, the impacts from hazards ranked in Table 3-16, including Severe Winter Weather, Hurricane/Tropical Storm, Other Severe Weather, Drought, and Wildfire on critical facilities were qualitatively discussed with the LPT and are summarized below in Table 4-16.

Table 4-16. Results of the Qualitative Vulnerability Assessment of Critical Facilities.

Vulnerability	Applicable Critical Facilities
Severe Winter Weather (roof vulnerable to heavy snowfall, and/or access impacted by heavy snowfall)	Falmouth Housing Authority Harborview Housing Eversource Stations 967, 933, & 936 Falmouth Hospital East Falmouth Elementary School Falmouth Academy Lawrence Jr. High School Morse Pond Middle School North Falmouth Elementary School Teaticket Elementary School Falmouth High School Mullen Hall School Pump Stations (Water Street, Park Road, Shivericks Pond, Surf Drive Beach, Inner Harbor, Spring Bars Road, Alphonse Street, Silver Beach Avenue,

	Treatment Plants (Service Road Wastewater, Crooked Pond, New Silver) Wells (Mares Pond, Fresh Pond)
Hurricane/Tropical Storm/High Wind (waterfront areas vulnerable to high winds and waves)	Town Hall Harbor Master Shack Drawbridge Hut North Marine East Marine Safe Harbor Fiddler's Cove Marina Falmouth Marine MacDougall's Cape Cod Marine Bosun's Marina Town Marina Dock Royal Megansett Nursing & Retirement Home Woods Hole Community Center WHOI 1 Coast Guard Station Island Queen Ferry Terminal Steamship Authority Ferry Terminal Town Marine Pumpout Facility Pump Stations (Water Street, Park Road, Surf Drive Beach, Inner Harbor, Spring Bars Road, Silver Beach Avenue) Quissett Harbor Boat Yard Harborview Housing Salt Sea Apartments
Heavy Precipitation (heavy rains cause localized street flooding)	Falmouth Police Department Falmouth Recreation Department Falmouth Senior Center Veterans Service Center Alphonse Street Pump Station
High Wind (critical facility where downed trees could cause loss of power would impair ability to provide necessary services)	Falmouth Housing Authority Falmouth Harbor Master Building Drawbridge Hut Department of Public Works West Falmouth Fire Station North Falmouth Fire Station Emergency Operations Center (HQ) East Falmouth Fire Station Woods Hole Fire Station Eversource Stations 967, 933, 936 Verizon 1 and 2 Coastal Medical Transportation Services LLC

	ConvenientMD Urgent Care Cape Cod Healthcare Urgent Care Overlook – Visiting Nurse Cape Cod Free Clinic & Community Health Center Atria Woodbriar Park Atria Woodbriar Place Heritage at Falmouth JML Care Center, Inc. Royal Megansett Nursing and Retirement Home Royal Falmouth Nursing & Rehabilitation Center Falmouth Hospital WHOI 1 Coast Guard Station Island Queen Ferry Terminal Steamship Authority Ferry Terminal Schools (East Falmouth, Falmouth Academy, Lawrence Jr. High, Morse Pond, North Falmouth, Teaticket, Falmouth High, Mullen Hall) Long Pond Water Treatment Plan Wells (Coonamessett, Ashument, Crooked Pond) Water Towers (Tower 1, Tower 2, Hayway Tower) Treatment Plants (Service Road, Crooked Pond, New Silver, Mares Pond, Fresh Pond) Housing Authority Facilities (Harborview, Tataket, Salt Sea, Mayflower, Rose Morin)
Lightning	Water Tower 1 Water Tower 2 Hayway Water Tower
Wildfire	Falmouth Hospital Falmouth Academy Coonamessett Well Ashumet Well Crooked Pond Well Long Pond Reservoir Crooked Pond Treatment Plant Mares Pond Well Fresh Pond Well

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4.3 VULNERABLE PROPERTIES AND CRITICAL FACILITIES

Although the tables in Section 4.2 provide a detailed summary of the potential impacts from each type and magnitude of risk analyzed, this section will summarize the main risks identified from this analysis. The discussion below will focus on hazards that have the potential to harm the most properties or cost the most economic damage, critical facilities that are impacted by the most hazards, and vulnerabilities of the highest concern to the Town. This summary was also used to guide the development of mitigation actions.

Tables 4-3 through 4-5 summarize the number of parcels that overlap with a FEMA flood zone. Although individual parcels may overlap with more than one flood zone, because the risk to each parcel was noted as the highest hazard flood type, the values in Tables 4-3 through 4-5 are additive. For example, a single property can contain both a VE and an AE zone but would only be listed in the VE zone risk table. Therefore, by summing the total values from those three tables, the total value of all structures and property at risk from flooding is approximately $6.5 billion. Additionally, because flooding often causes more permanent damage to structures than to the land itself, it is worth noting that the total value of buildings within the SFHA in Falmouth is approximately $2.6 million. Surge inundation (i.e., flooding) from hurricanes would also result in substantial financial impact on properties. For instance, a Category 2 hurricane would impact properties significantly, valuing approximately $1.7 billion, with the structures and buildings on those properties valuing $805 million (Table 4-7). Finally, although based on the mapping criteria alone, it appears that flooding will cause similar damage to hurricanes, this does not account for the Town-wide impacts that hurricanes can produce from heavy rains and high winds; these additional forces would likely make the financial impacts of a Category 2 hurricane much more substantial than would be expected with flooding alone.

Most of the critical facilities likely to be impacted by flooding are sewer pump stations, marinas, and marine based facilities (Table 4-2), located within VE and AE zones. Other critical facilities within both AE and VE flood zones include the Town Hall, Veterans Service Center, Woods Hole Community Center, Drawbridge Hut, WHOI 1, Coast Guard Station, Island Queen Ferry Terminal, and the Steamship Authority Ferry Terminal.

It is also worth acknowledging the breakdown of land use types impacted by these hazards. The inundation projected within the AE and VE flood zones will impact primarily single-family residential properties (3,726 and 1,307 parcels, respectively, out of a total of 18,636 single family residential parcels), which cumulatively represents 27% of the single-family residential land use category. The inundation projected from a Category 2 hurricane will also impact primarily single-family residential properties (1,821 parcels out of a total of 18,636 parcels), which represents 10% of that land use category.

The MC-FRM results (see Section 3.1) were utilized to evaluate how climate change and sea level rise could affect the Town's vulnerability to flooding in the future. For the vulnerability assessment, two categories of vulnerability to flooding were selected: a probability of inundation from 1% to less than 20% (representing larger storm events) and a probability of inundation of

20% or greater (representing smaller, more frequent storm events). These results are based on a high sea level rise projection for 2030 and 2070. In 2030, 1,587 parcels have between a 1% and 20% chance of inundation in a given year of experiencing some level of coastal flooding (Table 4-10), while an additional 3,976 parcels have a 20% chance or greater in any given year (Table 4-11). This means that during a 100-year flood event (i.e., the 1% chance event) in 2030, a total of 5,563 parcels are at risk of coastal inundation. These numbers increase to 2,268 and 5,683 parcels with between a 1% and 20% chance of inundation (Table 4-14) and a greater than 20% chance of inundation (Table 4-15), respectively, in 2070. This means that during a 100-year flood event (i.e., the 1% chance event) in 2070, a total of 7,951 parcels are at risk of coastal inundation.

4.4 VULNERABLE POPULATIONS

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Falmouth has several vulnerable populations, including areas with a high concentration of elderly residents, childcare facilities, healthcare facilities, and environmental justice populations.

Concentrations of Elderly People

Falmouth Housing Authority has five (5) facilities that house many elderly and disadvantaged people. These include Harborview Housing, Tataket Apartments, Salt Sea Apartments, Mayflower Housing and Rose Moring Apartments. In addition, there are six (6) medical nursing facilities in Town that provide independent, assisted, and nursing care services. These include Atria Woodbriar Park, Atria Woodbriar Place, Heritage at Falmouth, JML Care Center, Royal Megansett Nursing and Retirement Home, and Royal Falmouth Nursing and Rehabilitation Center. These locations will need special attention during emergencies or if evacuations become necessary, as residents may need additional help to exit buildings during an emergency. The locations of these communities are shown in Figure 4-1 in green and listed in Table 4-17.

Concentrations of Children

The Town of Falmouth has multiple areas with a high concentration of young children including Sandpiper Nursery School, Falmouth Preschool, Tender Years Preschool, VNA Child Care Center, Friendship Garden Nursery School, Little Milestones, Little Kids, Woods Hole Child Center, Magic Years Nursery School and Day Care, Montessori Academy of Cape Cod, Cape Cod Child Development, and YMCA Cape Cod – North Falmouth Early Learning Center. Falmouth also has concentrations of children at public and private schools including, North Falmouth, Teaticket, East Falmouth, Mullen Hall, Morse Pond, Lawrence, Falmouth High, and Falmouth Academy. During a natural hazard emergency, these locations may need additional assistance evacuating children and coordinating a safe pick-up system for parents. The locations of these facilities are shown in Figure 4-1 in purple and listed in Table 4-17.

Health Care Facilities

Within the Town of Falmouth there are several health care centers including Falmouth Hospital, Coastal Medical Transportation Services, ConvenientMD urgent Care, Cape Cod Healthcare Urgent Care, Overlook – Visiting Nurse, and Cape Cod Free Clinic & Community Health Center. During a natural hazard emergency, these locations may need increased support in order to safely evacuate patients in a variety of conditions. The locations of these facilities are shown in Figure 4-1 in orange and listed in Table 4-17.

Environmental Justice Populations

Falmouth has six (6) areas of environmental justice populations based on income and/or minority status. The populations may need extra assistance during a natural hazard emergency to safely prepare and to evacuate, if necessary. The locations of these facilities are shown in Figure 4-1 and summarized in Table 4-18.

Table 4-17. List of Vulnerable Populations in Falmouth.

#	Name	Address
Concentrations of Elderly People		
1	Atria Woodbriar Park (Assisted Living)	339 Gifford Street
2	Atria Woodbriar Park (Independent Living)	389 Gifford Street
3	Heritage At Falmouth	140 Ter Heun Drive
4	JML Care Center, Inc.	184 Ter Heun Drive
5	Royal Megansett Nursing and Retirement Home	209 County Road
6	Royal Falmouth Nursing and Rehabilitation Center	359 Jones Road
7	Harborview Housing	115 Scranton Avenue
8	Tataket Apartments	138 Teaticket Highway
9	Salt Sea Apartments	211 Scranton Avenue
10	Mayflower Housing	238 Lakeview Avenue
11	Rose Morin Apartments	58 Rose Morin Lane
Concentrations of Children		
12	Little Kids Inc.	381 Front Street
13	YMCA CC North Falmouth Early Learning Center	155 Old Main Road
14	Montessori Academy	81 Chester Street
15	VNA Child Care Center	67 Ter Heun Drive
16	Sandpiper Nursery School	184 Jones Road
17	Falmouth Pre School	704 Main Street
18	Tender Years Pre School	545 Main Street
19	Woods Hole Child Center	93 Harbor Hill Road
20	Little Milestones	805 Teaticket Highway
21	Cape Cod Child Development	439 East Falmouth Highway
22	Magic Years Nursery and Day School	222 Trotting Park Road
23	Friendship Garden Nursery School	460 Locustfield Road
24	East Falmouth Elementary School	33 Davisville Road
25	Falmouth Academy	7 Highfield Drive
26	Lawrence Jr. High School	113 Lakeview Avenue
27	Morse Pond Middle School	323 Jones Road
28	North Falmouth Elementary School	62 Old Main Road
29	Teaticket Elementary School	45 Maravista Avenue
30	Falmouth High School	847 Gifford Street
31	Mullen Hall School	140 Katharine Lee Bates

32	Sea Education Association Inc.	171 Woods Hole Road
33	MBL & WHOI Dorms	Devil's Lane
Health Care Facilities		
34	Falmouth Hospital	15 Mill Street
35	Coastal Medical Transportation Services LLC	668 Main Street
36	Overlook – Visiting Nurse	East Falmouth Highway
37	Cape Cod Free Clinic & Community Health Center	65C Town Hall Square
38	ConvenientMD Urgent Care	40 Davis Straits
39	Cape Cod Healthcare Urgent care	273 Teaticket Highway

Table 4-18. List of Environmental Justice Populations in Falmouth.

Block Group	Census Tract No.	EJ Criteria
2	144.02	Minority
3	149	Income
1	148	Income
3	148	Income
2	146	Minority and Income
3	145	Income

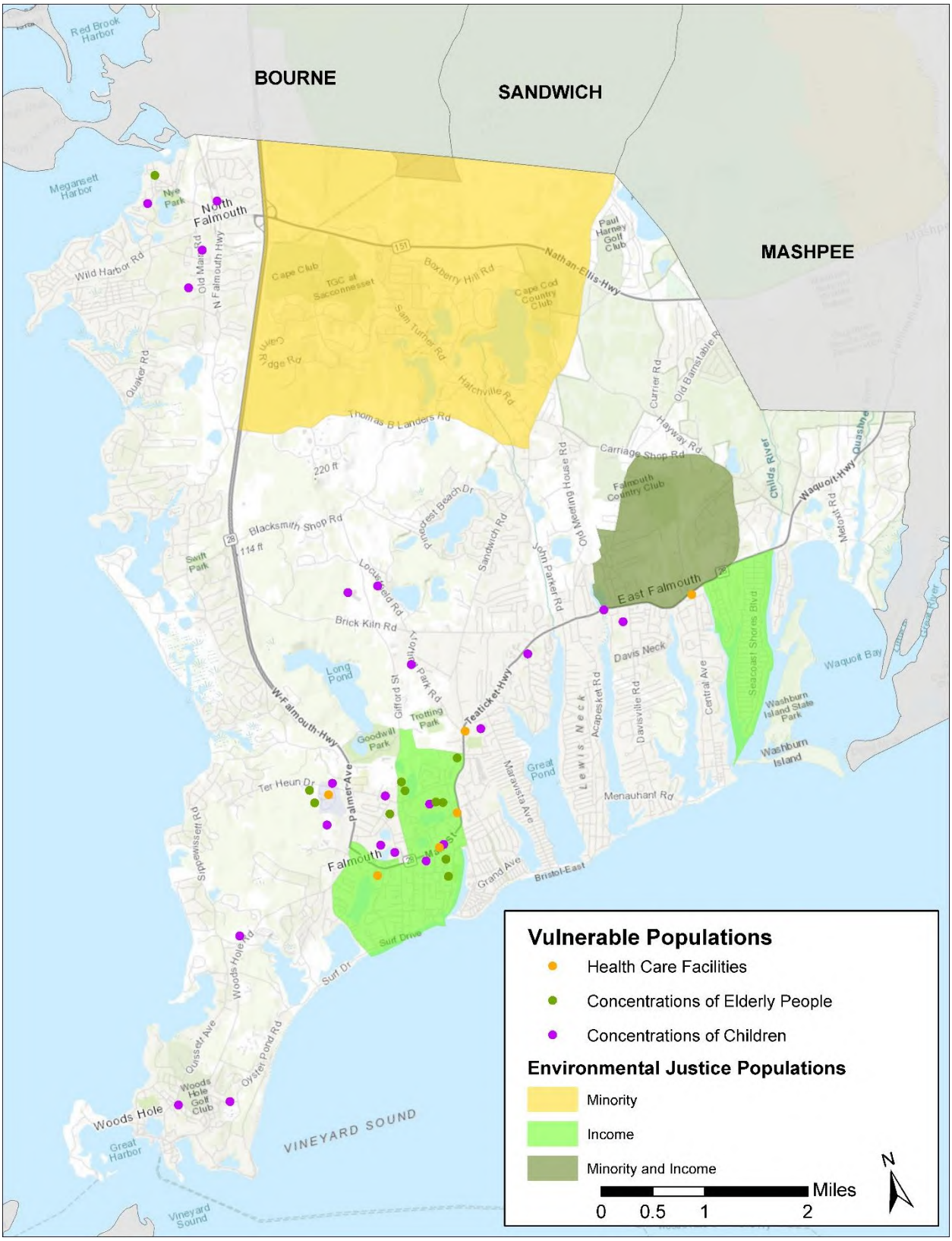

Figure 4-1. Locations of vulnerable populations in Falmouth.