

Vinalhaven Sea Level Rise 2020 Report

Prepared by the Vinalhaven
Sea Level Rise (SLR) Committee

Introduction

In 2016, the Vinalhaven Select Board appointed a seven-member committee to begin exploring the impacts of sea level rise on the island. The mission of the Vinalhaven Sea Level Rise (SLR) Committee is two-fold:

1. To understand and assess threats posed by sea level rise, storm surge, and other flooding events, and
2. To educate and inform the Select Board and the community about resiliency actions

After four years of navigating sea level rise at the local level, the SLR Committee has come to believe...

- Focusing on long-term planning is essential.
- Resilience measures need to be incorporated into all aspects of planning.
- Climate change mitigation and adaptation are far less costly than inaction.
- The climate is rapidly changing; current day projections need to be updated as often as new data emerges.
- Climate change is uncharted territory; we must think and act boldly, creatively, and collectively.

The purpose of this report is to share what the Vinalhaven SLR Committee has learned from numerous island-specific studies; organizations, networks, groups, and other communities; as well as from a variety of resources, including conferences, listserves, journals, websites, and apps. Included are recommendations for action and what needs to be done ongoing to help build a resilient Vinalhaven in the face of our ever-changing environment.



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Background

Vinalhaven Sea Level Rise

Sea level rise is only one of many impacts of global climate change, but at this time, it is the primary concern to the island. Two key drivers of sea level rise are the melting of freshwater land-ice (primarily glaciers and ice sheets) and “thermal expansion”, or the expansion of ocean volume as sea surface temperature rises. Both of these phenomena have increased dramatically in recent decades, and are projected to continue as atmospheric temperature continues to rise.

Vinalhaven has already seen evidence of rising seas at many locations on the island. Currently, we have been subjected to more frequent nuisance flooding, high tides that more frequently challenge the capability of the ferry pen, and evidence of higher tidal inundation in many parts of the island. This will get worse.

The Island Institute’s *Sea Level Rise and Coastal Flooding (2019)* paper notes the warning that “The predicted impacts (of sea level rise) on homes, businesses, and critical infrastructure—including working waterfronts—could structurally change the communities and economies along our coast”.

Vinalhaven’s Sea Level Rise (SLR) Committee is dedicated to working with the Town Select Board and the community to understand the extent and magnitude of our vulnerability to sea level rise and associated flooding, and to identify tools of resilience planning. Since 2016, the committee has been

1. Assessing Vinalhaven’s vulnerability to increased flooding, and
2. Pursuing resources and strategies to prepare us for what is to come.

What To Expect and What We Should Be Prepared For: The Extent of Sea Level Rise in the Next 30 years

The most recent Relative Sea Level (RSL) rise scenarios issued by NOAA for the Bar Harbor tide gauge, which serves as the proxy for Vinalhaven as it is the closest gauge to the island, are shown in the graph and chart below. It should be noted that along the Gulf of Maine, as well as other regions of the Northeast Atlantic, “RSL rise is projected to be greater than the global average for almost all future Global Mean Sea level rise scenarios.”(Sweet et. al. 2017).

NOAA et. al 2017 Relative SL Change Scenarios: Bar Harbor

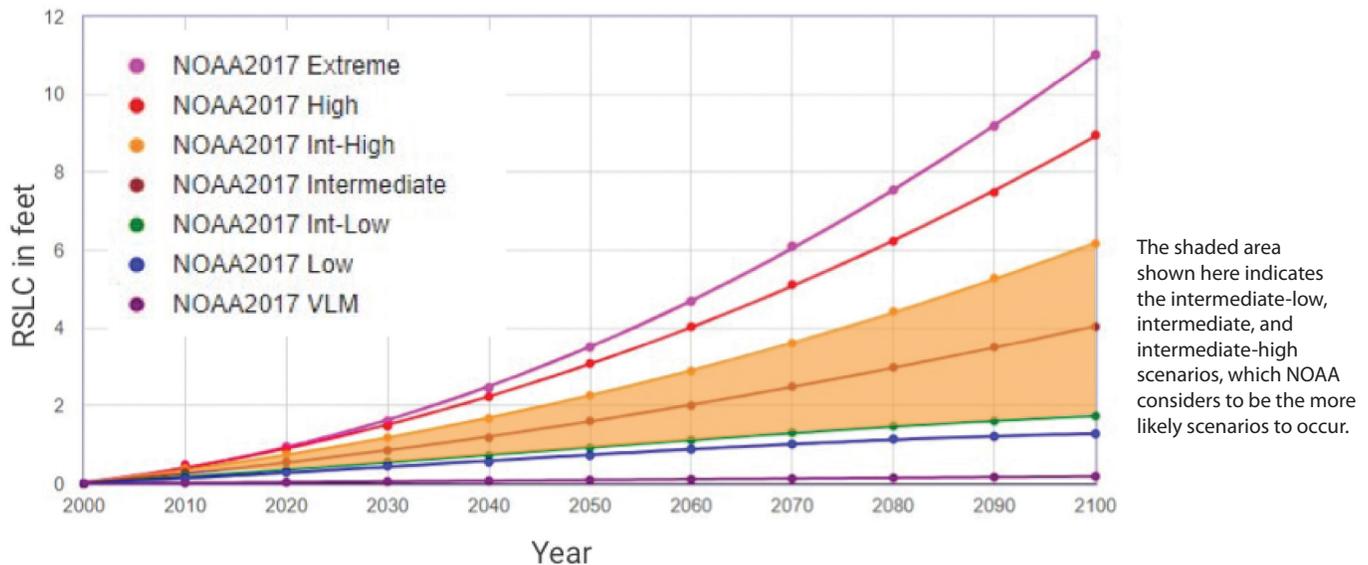


Figure 1: NOAA et. al 2017 Relative Sea Level Change Scenarios based on the Bar Harbor tide gauge.

Vinalhaven
Scenarios for BAR HARBOR
NOAA2017 VLM: 0.00187 feet/yr
All values are expressed in feet

Year	NOAA2017 VLM	NOAA2017 Low	NOAA2017 Int-Low	NOAA2017 Intermediate	NOAA2017 Int-High	NOAA2017 High	NOAA2017 Extreme
2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2010	0.02	0.13	0.20	0.30	0.39	0.46	0.49
2020	0.04	0.30	0.36	0.56	0.75	0.89	0.95
2030	0.06	0.46	0.56	0.85	1.18	1.48	1.61
2040	0.07	0.56	0.72	1.18	1.67	2.23	2.46
2050	0.09	0.72	0.92	1.61	2.26	3.08	3.51
2060	0.11	0.89	1.12	2.00	2.89	4.04	4.69
2070	0.13	1.02	1.31	2.49	3.61	5.12	6.10
2080	0.15	1.15	1.48	2.99	4.43	6.23	7.55
2090	0.17	1.21	1.61	3.51	5.28	7.48	9.19
2100	0.19	1.28	1.74	4.04	6.17	8.96	11.02

Table 1: NOAA et. al 2017 Vinalhaven Sea Level Change Scenarios based on the Bar Harbor tide gauge.

In sharing this data with the SLR Committee, Jamie Carter, Remote Sensing Analyst for NOAA, suggested that “the intermediate-low, intermediate, and intermediate-high scenarios (above) are considered to be the more likely scenarios based on the confidence we have in the underlying climate models, but as always, it’s good to bracket the uncertainty in order to address the low probability, high consequence scenarios” (Carter 2019).

Scientists at the Maine Geological Survey (MGS) also use the NOAA data and scenarios shown above, but in their SLR projections also factor in the tidal peculiarities of the coast of Maine, by using the Highest Astronomical Tide (HAT)¹ in projecting sea level rise scenarios for Maine.

¹ Highest Astronomical Tide (HAT) is defined as the elevation of the highest predicted astronomical tide expected to occur at a specific tide station over the National Tidal Datum Epoch (NTDE). The present NTDE is 1983 through 2001. (tidesandcurrents.noaa.gov)

HOW HIGH? BY WHEN?

Considering the sea level rise recommendations suggested by both Jamie Carter (NOAA) and Peter Slovinsky (MGS) for the next 30 years, the Vinalhaven SLR Committee recommends, for purposes of planning, sea level rise in ranges of:

.5-1 foot by 2030

1-2.5+ feet by 2050

Please note that these recommended ranges are consistent with the Island Institute Waypoints study (2019), the Vulnerability Assessment and Resilience Planning Vinalhaven Ferry Terminal report submitted to the BOS by Wood Environment and Infrastructure Solutions in Dec. 2019, and the Vulnerability Study for Downtown conducted by Ransom Consulting Engineering and Scientists in 2017-2018.

Given the recommendation by Jamie Carter that keeping the “low probability but high consequence scenarios” in mind, we should not dismiss the possibility that our projections may be under (or over) estimated, and re-adjust as NOAA projections are updated, every 4-5 years.

Visualizing Sea Level Rise

At the request of the SLR Committee, Knox County EMA has provided the Town with large-scale maps of both Downtown and Carvers Harbor and island-wide, overlaid with sea level rise scenarios that range from 1.2’ to 10.9’ of sea level rise above the HAT (6.48 ft NAVD88)², enabling us to visualize the scope of the areas that are likely to be covered with water at these levels.

These maps were generated using the Maine Geological Survey SLR/SS Scenarios Viewer, which incorporates both the latest SLR projections from NOAA (Sweet et al., 2017) and the HAT, and maps the low to extreme sea level rise scenarios out to the year 2100. Users of these maps should understand that they illustrate flood inundation to a certain elevation but not at any particular time intervals.

² The current HAT for Vinalhaven is 6.48 feet NAVD (Maine Geological Survey Highest Astronomical Tide Line Viewer). This is the base level to which sea level scenarios are added to produce the flood inundation levels portrayed in these maps.

Figure 2: Vinalhaven Sea Level Rise Inundation Maps: Island-wide



Vinalhaven Sea Level Rise Inundation Maps depicting the island (left to right) under present day HAT, HAT+1.2 feet, and HAT+1.6 feet.

Images below (left to right) show the island under HAT+3.9 feet of sea level rise, HAT+6.1 feet, and HAT+10.9 feet.

These maps were generated using the Maine Geological Survey SLR/SS Scenarios Viewer, which incorporates both the latest SLR projections from NOAA (Sweet et al., 2017) and the HAT, and maps the low to extreme sea level rise scenarios out to the year 2100. Users of these maps should understand that they illustrate flood inundation to a certain elevation but not at any particular time intervals.

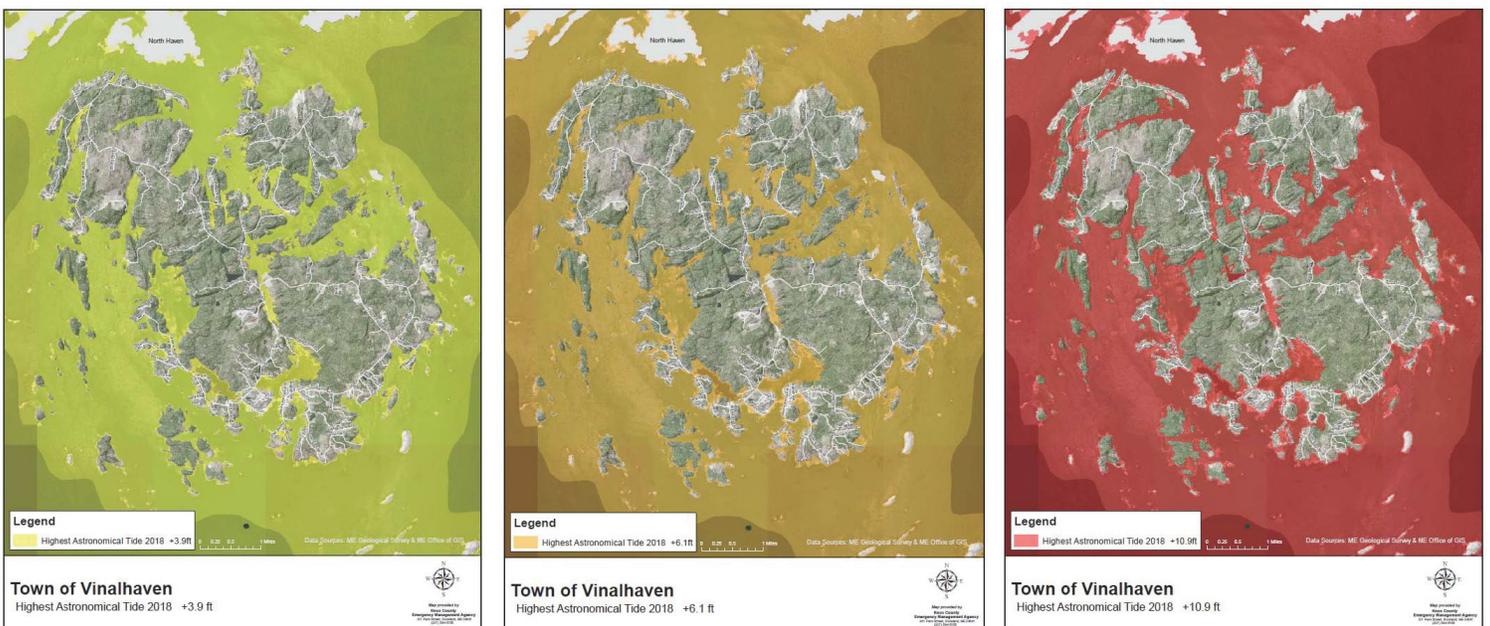
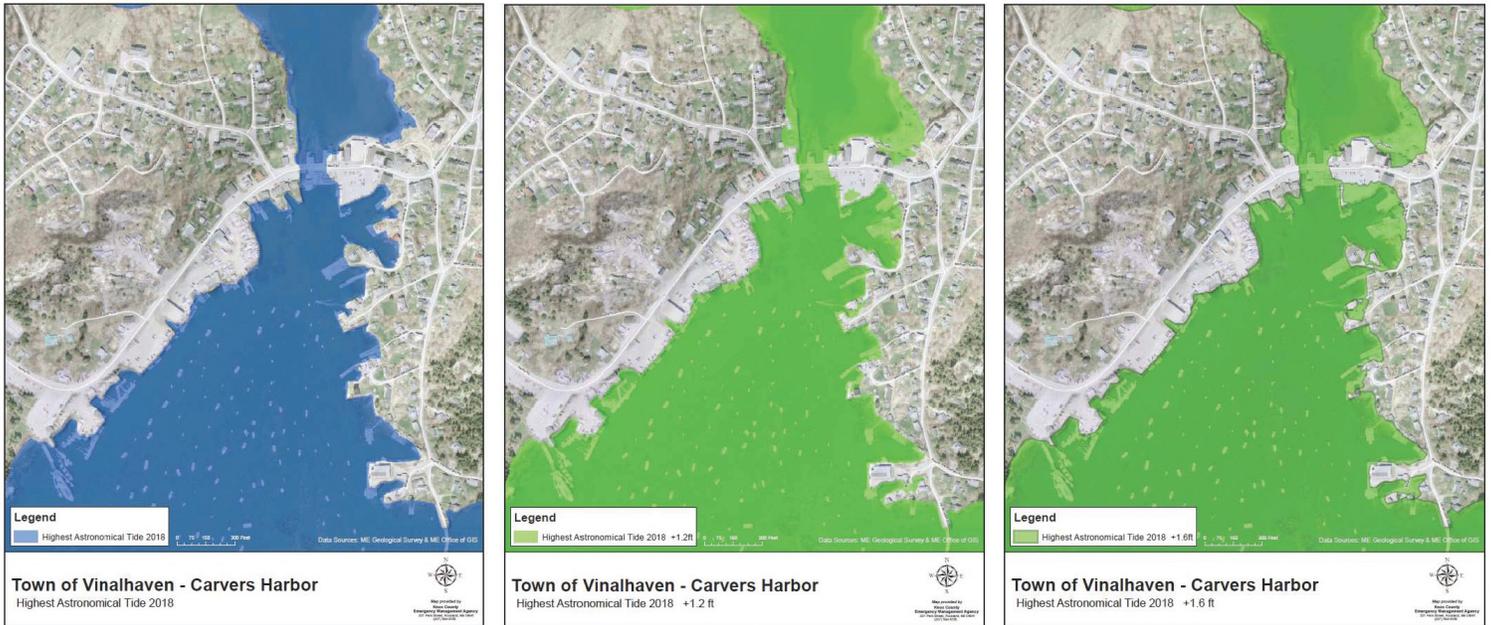


Figure 2: Vinalhaven Sea Level Rise and Storm Surge Inundation Maps (Island-wide) prepared by Leticia vanVuuren, Knox County EMA.

Figure 3: Vinalhaven Sea Level Rise Inundation Maps: Downtown and Carvers Harbor



Vinalhaven Sea Level Rise Inundation Maps depicting the Downtown and Carvers Harbor (left to right) under present day HAT, HAT+1.2 feet, and HAT+1.6 feet.

Images below (left to right) show Downtown and Carvers Harbor under HAT+3.9 feet of sea level rise, HAT+6.1 feet, and HAT+10.9 feet.

These maps were generated using the Maine Geological Survey SLR/SS Scenarios Viewer, which incorporates both the latest SLR projections from NOAA (Sweet et al., 2017) and the HAT, and maps the low to extreme sea level rise scenarios out to the year 2100. Users of these maps should understand that they illustrate flood inundation to a certain elevation but not at any particular time intervals.

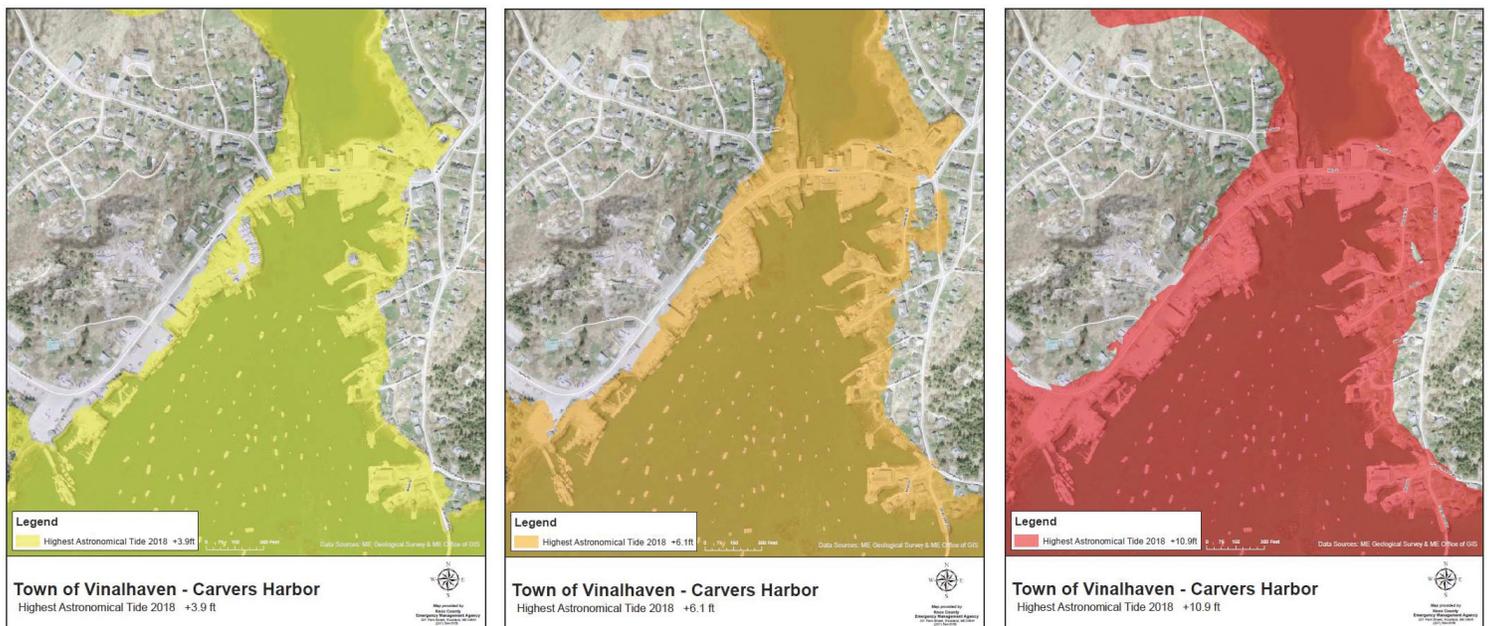


Figure 3: Vinalhaven Sea Level Rise Maps (Downtown and Carvers Harbor) prepared by Leticia vanVuuren, Knox County EMA.

Economic Impacts

The Island Institute and the Vinalhaven Sea Level Rise Committee have compiled data used to generate an online Story Map outlining the economic impacts of failing to address sea level rise. Some of the more significant impacts to the island economy include:

- Sea level rise of 1.6 feet would put almost \$35 million in assessed value at risk, more than 6% of the island's total tax base. If the flooded properties lose 25% of their value, the island's tax base will shrink by 1.5%, Vinalhaven's mill rate will rise by 20 cents per thousand dollars of assessed value, and property taxes for the median priced home (\$294,000) will rise by \$60 annually. If the properties lose 75% of their value, the tax base will shrink by 4.8%, the mill rate will rise by 62 cents per thousand, and taxes for the median-priced home will increase by \$180 annually.
- 40% of Vinalhaven's workforce make a living lobstering or fishing, industries with infrastructure that is especially vulnerable to flooding. With a sea level rise of 1.6 feet, it is likely 30 fish houses would be flooded.
- With 1.6 feet of sea level rise, water would breach more than 30 homes and almost 20 commercial buildings. The flooding of commercial buildings represents almost one-third of business structures on the island and will put more than 100 workers and \$3.5 million of annual wages at risk.

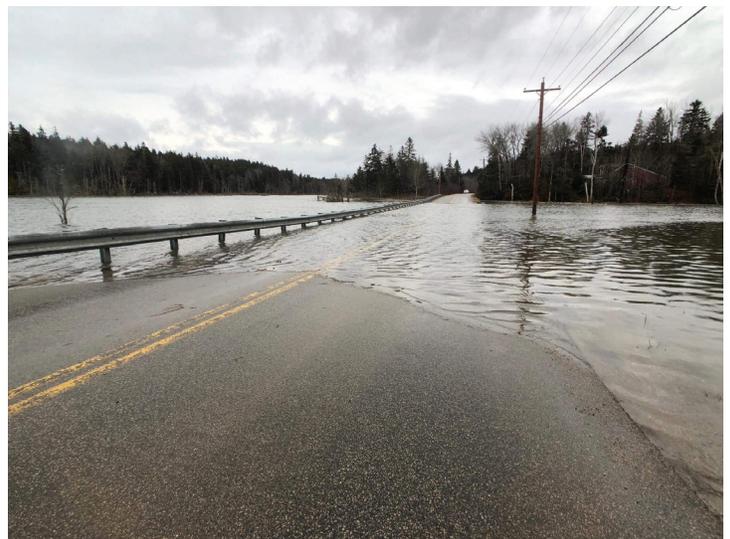


Figure 4: Vinalhaven inundation photos (left) view towards Downtown from Clamshell Alley, February 2019; (right) "The Meadow", North Haven Road, March 2018.

Sources

Background: Vinalhaven Sea Level Rise:

Carter, Jamie. Email regarding Latest Projections for SLR to 2100, January 23, 2019

Island Institute *Sea Level Rise and Coastal Flooding*, 2019

Slovinsky, Peter. Emails regarding MGS SLR viewer and related data.

Sweet et al, 2017. *NOAA Technical Report NOS Co-OPS 083, Global and Regional Sea Level Rise Scenarios for the United States*

Background: Economic Impacts

Arnold, S., Belknap, S., Colby-George, M., Grabill, M., J., Hertz, & E., LeVert. (2019, September). Cost of Sea Level Rise - Vinalhaven. Retrieved February 2020, from <https://islandinstitute.maps.arcgis.com/apps/MapJournal/index.html?appid=7f1cf3b3f8a243bdb9393a87397aacae>

Considerations

FEMA Flood Maps and Flood Insurance

In 2014, the US Federal Emergency Management Agency (FEMA) issued requests for property owners, whose land was located in the floodplain, to review proposed FEMA Flood Map updates and contest any questionable revisions.

At the time, the Town did not contest the proposed maps for municipally-owned properties, but is now determining the feasibility of applying to FEMA for a change in zoning designation on the south side of the downtown area on Carvers Harbor and on the north side on Carvers Pond. The Town is working with Ransom Engineering to assess the likelihood of success in pursuing a “Letter of Map Revision (LOMR)” with FEMA before committing to what is usually a costly process. If pursued and if

successful, the LOMR could potentially change flood zone designations so property owners with mortgages and required flood insurance could see a significant decrease in their premiums.

Both the 2019 Downtown Master Plan and Vinalhaven’s Flood Resilience Checklist Report recommend Vinalhaven consider participating in FEMA’s Community Rating System. While this is a significant investment for communities, mostly in staff time, the long-term economic and safety benefits of reduced insurance premiums and increased flood resilience may be enough to outweigh the upfront investment.

For further reference, see sections 4.5 FEMA Flood Zone Limitations and 6.9 Capital Projects and Actions – Flooding and Stormwater Management of the 2019 Downtown Master Plan.

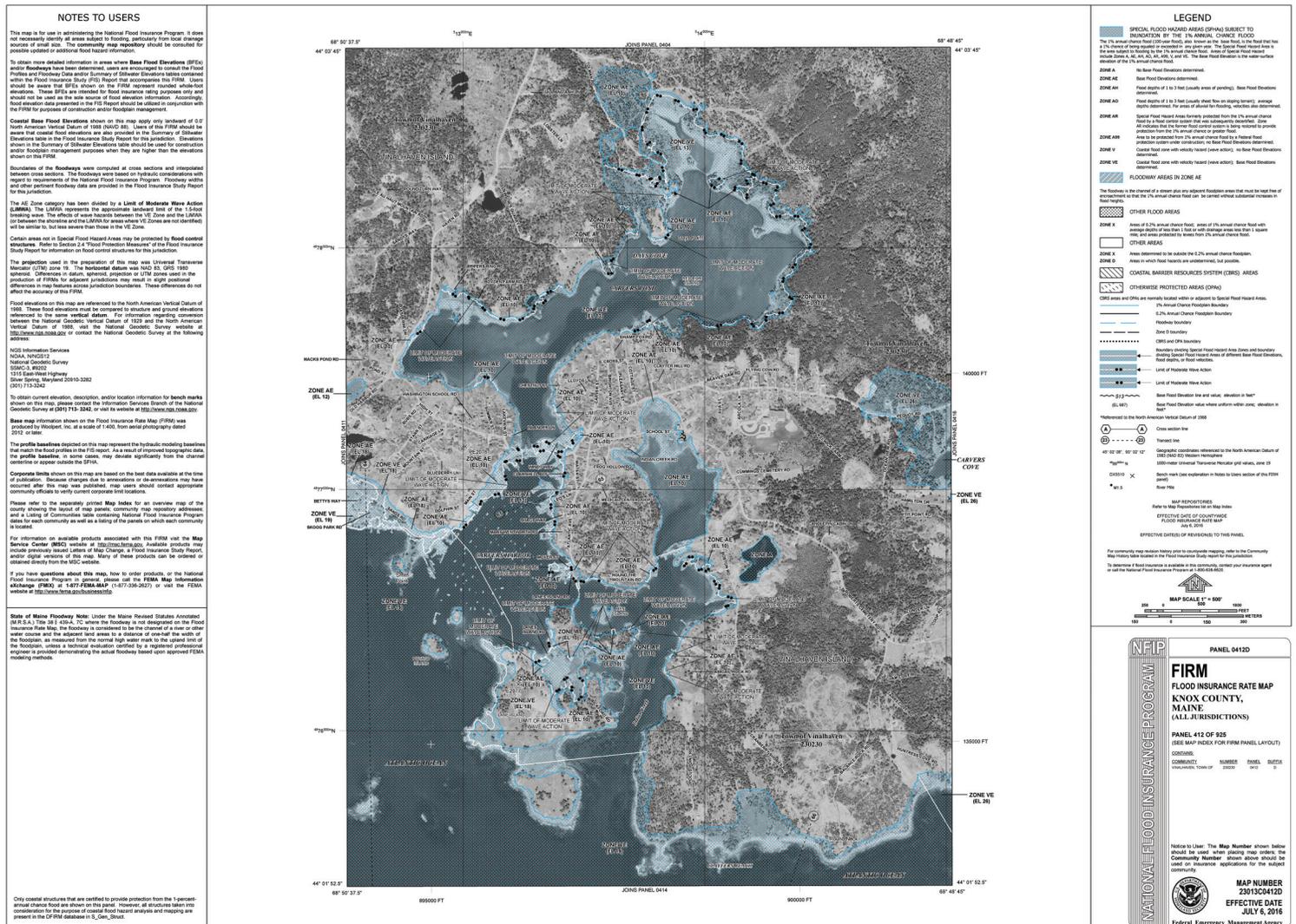


Figure 5: 2016 FEMA Flood Map 23013C0412D showing the Downtown, Carvers Harbor, and surrounding areas.

Infrastructure

The Town manages capital improvements and infrastructure projects using a Capital Improvement Plan (CIP) which includes roads, bridges, buildings, and equipment. The 2019 Downtown Master Plan (DTMP) and the 2019 Wastewater System Climate Adaptation Plan (CAP) are the first Town planning documents that include infrastructure improvement recommendations addressing the impacts of sea level rise.

Table 2: Sea Level Rise Impacts and Considerations for Critical Infrastructure on pages 9 and 10 identifies critical Town and state-owned infrastructure most vulnerable to the impacts of sea level rise within the next 30 years, the typical capital improvement cycle for roads and sidewalks. “Critical infrastructure” is defined as roads, buildings, and bridges essential to public safety and the economy.

Future Infrastructure

Most of the recommended infrastructure improvements in the DTMP and CIP have a lifespan of 20-30 years, so the current projection of a 1-2.5+ ft rise in sea levels by 2050 is a reasonable guideline to use in current planning, at least until NOAA projections are updated (2021-2022). Bridges, on the other hand, should be improved considering SLR projections beyond 30 years. Since projections this far in the future are less certain, careful consideration should be given to comparing intermediate-low, intermediate, and intermediate-high SLR scenarios to the present and future cost-benefit of adapting to each.

As the Town begins discussing capital projects beyond 2050, the SLR Committee recommends determining the cost-benefit of adapting infrastructure to sea level rise vs. relocation to higher ground. Pre-planning for the next capital cycle for Downtown should begin with conducting a cost-benefit analysis for Main Street and Downtown in order to compare the three primary options for addressing the impacts of sea level rise: Accommodation, Adaptation, and Relocation. It is likely this study could be grant-funded by the Island Institute and the Maine Coastal Program.

Natural Resources

Over the next 30 years, the two significant impacts of sea level rise and climate change on Vinalhaven natural resources will likely be

1. Salt water intrusion into wells and drinking water reservoirs—Folly and Round Ponds, and
2. Loss of marine life and habitat caused by warming oceans and ocean acidification

Over a decade ago the Town conducted a study to assess salt water intrusion into wells, and Vinalhaven Land Trust recently explored the topic at their 2019 Annual Meeting. When wells become unusable due to salt water intrusion, properties become less habitable unless alternative water sources are available. The result may be an eventual loss in tax revenue as high-value shoreland properties become less desirable homesites. Additionally, the municipal water supply is at risk of salt water intrusion when flooding occurs as a result of sea level rise and increased precipitation.

A decline in the lobster fishery due to warming waters, acidification, and loss of habitat will have a significant impact on the island economy. Investing in options for diversifying the marine economy, including environmentally beneficial kelp aquaculture, as well as other non-marine-related employment options, is an important strategy for increasing overall resilience.

Table 3: Natural Resource Considerations on page 11 lists natural resources that will be impacted by sea level rise, storm surge and flooding within the next 30+ years. The information represents the SLR Committee’s best thinking.

Table 2: Sea Level Rise Impacts and Considerations for Critical Infrastructure

1. Ferry Bridge and Pen, state-owned		
Current Impacts of Inaction	Potential Impacts of Inaction by 2050,1-2 feet+ scenario	Current and Future Considerations for Action, Based on Studies
Boats are cancelled when tides make the ramp angle too severe for loading and unloading	Likelihood of boat cancellations increase	Review Wood Report for specific information
Cancellations affect the economy, EMS, and quality of life	Frequent cancellations and /or a limited boat schedule will impact the economy, EMS, and quality of life	Alternative scheduling based on lunar phases and tide charts
		Ferry bridge and pen adaptation
Related Studies for Reference: 2020 Vulnerability Assessment and Resilience Planning, Ferry Terminal, Vinalhaven, Maine Penobscot Bay Working Waterfront resilience Analysis (aka “Wood. Report”)		
Island Insititute Story Map: Cost of Sea Level Rise - Vinalhaven		
2019 Downtown Master Plan		
2018 Vulnerability Study for Downtown (aka “Ransom Report”)		
2. Main Street: Drainage System, Downstreet locations, and Carvers Parking Lot		
Current Impacts of Inaction	Potential Impacts of Inaction by 2050,1-2 feet+ scenario	Current and Future Considerations for Action, Based on Studies
Flooding during extreme high tides and extreme rainfall events	Nuisance flooding becomes a regular occurrence with sea level rise, high tides, and increased precipitation due to extreme rainfall events	Refresh the 2007 Stormwater Management Engineering study and design as part of the Downtown Master Plan project
Business is interrupted	Business is interrupted	Coordinate the design and installation of appropriately-sized and located catch basins, collection pipes, culverts, and outfall pipes, with engineering designs and layouts for reconstruction of Main Street roadway and sidewalks.
EMS access is affected	EMS access is affected	Install one-way valves on outfall pipes to prevent backflow
Affects quality of life	Impacts quality of life	Consider cost benefit of adaptation and relocation options for downtown
Water inundation from both north and south sides of Main Street make redirecting water a challenge	Without adaptation or relocation, Main Street may be impassable	
Certain low-lying buildings are affected		
Related Studies for Reference: 2019 Downtown Master Plan, sections 4.5, 6.9		
2018 Vulnerability Study for Downtown (aka “Ransom Report”)		
2007 Stormwater Management Engineering Study		

Table 2: Sea Level Rise Impacts and Considerations for Critical Infrastructure.

Table 2: Sea Level Rise Impacts and Considerations for Critical Infrastructure (continued from page 9)

3. Wastewater Pump Stations, located within the floodplain, as ranked most to least at risk in 2019 Wastewater Climate Adaptation Plan (CAP)		
Current Impacts of Inaction	Potential Impacts of Inaction by 2050, 1-2 feet+ scenario	Current and Future Considerations for Action, Based on Studies
Review 2019 Wastewater CAP for specific information	Review 2019 Wastewater CAP for specific information	Work with Maine Water and Town Sewer Commissioners to seek funding for implementing the 2019 Wastewater CAP recommendations
Related Studies for Reference: 2019 Wastewater System Climate Adaptation Plan (CAP)		
4. Carrying Place Bridge		
Current Impacts of Inaction	Potential Impacts of Inaction by 2050, 1-2 feet+ scenario	Current and Future Considerations for Action, Based on Studies
At HAT, water is 6 feet from underside of bridge	At HAT, water will be 5 to 4 feet from underside of bridge	Elevate bridge 1-2 feet to accommodate 4 foot sea level rise by 2080 (minimum lifespan of the bridge); provides 4 to 3 foot clearance from water to underside of bridge.
Related Studies for Reference: 2020 Woodard & Curran Carrying Place Bridge engineering designs		
5. North Haven Road: The Meadow		
Current Impacts of Inaction	Potential Impacts of Inaction by 2050, 1-2 feet+ scenario	Current and Future Considerations for Action, Based on Studies
Floods regularly during extreme high tides and extreme rainfall events	Additional information is needed.	Additional information is needed.
Travel is delayed		
Business is made less efficient		
EMS access is affected		
Affects quality of life		
6. Other: Old Harbor Road, between The Sands and Old Harbor Pond, Public Safety Building, Granite Island Bridge, Water District Building and Net Factory Property		
Current Impacts of Inaction	Potential Impacts of Inaction by 2050, 1-2 feet+ scenario	Current and Future Considerations for Action, Based on Studies
Additional information is needed.	Additional information is needed.	Additional information is needed.
Some of these locations are being monitored by the SLR committee in order to collect data for assessment		

Table 2: Sea Level Rise Impacts and Considerations for Critical Infrastructure.

Table 3: Natural Resource Considerations

1. Municipal Water Supply: Folly Pond, Round Pond		
Impacts	Considerations	Budget Implications
Additional information is needed	Additional information is needed.	TBD
Salt water intrusion	Partner with Water District to conduct a study to determine impact and mitigation options	
Loss of fresh water supply		
Desalinization or other methods of sourcing freshwater must be found for users of the municipal water supply		
2. Wells Near Shore		
Impacts	Considerations	Budget Implications
Additional information is needed	Additional information is needed.	\$25k+ Possible funding through Coastal Communities Grant
Salt water intrusion	Partner with VLT and MCHT to conduct a well monitoring study to assess impacts and determine options	
Loss of fresh water supply		
Desalinization or other methods of sourcing freshwater must be found for users of the municipal water supply		
Potential property value loss		
3. Coastal Habitat, Beaches, Salt Marshes: Whitmore Pond and State Beach		
Impacts	Considerations	Budget Implications
Additional information is needed	Additional information is needed.	TBD
Beach erosion	Collaborate with Knox EMA to document shoreline change and erosion rates and use findings in planning	
Marsh flooding and inland migration	Partner with MCHT to conduct a Marsh Migration Analysis and consider findings in land use ordinances and zoning	
	Review post-storm recovery plans for standards that ensure the protection of environmentally sensitive areas	

Table 3: Natural Resource Considerations.

Emergency Management

Rising sea levels and storm surge will lead to the flooding of roadways on a routine basis. Eventually certain areas will be inaccessible altogether as roads remain permanently under water. Lack of access has serious emergency management implications. Currently The Meadow, Clamshell Alley, Main Street, and the ferry ramp are impassable during certain king tide and storm conditions. *How do first responders attend to those in need when access is cut off?*

Additionally, as precipitation levels increase, more and more basements flood during rainfall events. Homeowners contact the Fire Department to address these emergencies on an ever increasing basis. *What are the capacity and budgetary implications for the Public Safety Department as staff and volunteers are called to address flood situations?*

In the fall of 2018, the SLR Committee hosted a Flood Resilience Checklist Workshop to evaluate Vinalhaven's vulnerability to flood hazards and develop recommendations for increasing resilience. Central to the resulting Flood Resilience Checklist Report are recommendations for flood preparedness and response from a public safety perspective. These include the following disaster preparedness considerations:

- Reassessing evacuation routes
- Developing strategies for rerouting and/or elevating roads above flood elevations
- Developing and implementing plans and backup systems for critical infrastructure and facilities to ensure continuation of function of services during and after flood hazard events
- Developing a town-specific hazard mitigation plan
- Completing the National Weather Service's Storm-Ready designation process
- Implementing the use of reverse 911 and IPAWS (for cell phones) call systems to notify residents and visitors of impending storms, flooding events, and other potential disasters
- Offering flood hazard and disaster education and outreach activities tailored for the school-age population and general public

The SLR Committee recommends that emergency management planning incorporate impacts of climate change. To do so without taxing existing staff capacity, the SLR Committee's EMA Work Group, along with support from Knox County EMA, are able to work with Vinalhaven EMA to address the considerations listed above, as well as emerging challenges. In addition, the SLR Committee can seek grant funds as needed to help offset any budget increases from preparedness planning and implementation.

Climate Change and Mitigation

The current mission of the SLR Committee is to focus on only one aspect of climate change—sea level rise. However, it is impossible to effectively address sea level rise without considering all aspects of climate change. Additionally, the SLR Committee's work focuses on impacts only—as if climate change outcomes were a certainty. The Committee's scope does not include how to address root causes of climate change through mitigation strategies.

The SLR Committee recommends the Board consider broadening the scope of the SLR Committee to include all impacts of climate change and to include mitigation. Additionally, the Committee requests the Board consider endorsing and facilitating the organization of an intergenerational Island or Islands Climate Council with representatives from Town committees focused on sustainability, community organizations, community representatives, and members of the business sector. The Council would consider recommendations of the Maine Climate Council, as well as island specific recommendations, and work to address climate action at the local level.

Planning

The SLR Committee recommends sea level rise be considered in all aspects of Town planning and policies, across all committees and departments. For Vinalhaven to remain a strong, resilient community, we must plan for and not simply react to sea level rise impacts. This requires making a wide variety of policy, ordinance, and zoning changes to Town planning documents as suggested in the following table.

Table 4: Considerations for Changes and Additions to Town Planning Documents

Policies	
Town Infrastructure	Develop and adopt a formal policy requiring all municipal projects to consider, and mitigate to the greatest extent practicable, existing and potential future impacts of coastal flooding, storm surge, sea level rise, and coastal erosion/shoreline change. Future impacts should be based upon the project's anticipated useful life cycle and the corresponding sea level risk scenarios identified by the Town's planning horizons.
	Require all municipal facilities and infrastructure located in flood hazard areas to be elevated, floodproofed, or considered for relocation from the flood zone.
	Require any new critical facilities and infrastructure and future development to be located outside of coastal or flood-prone areas.
Private Infrastructure	Consider developing and adopting a local hazard disclosure policy requiring disclosure by real estate agents, private sellers, and/or by municipal officials for properties located in the 100-year floodplain and/or other flood hazard areas (e.g., storm surge, sea level rise, etc.). Share about hazard disclosures information with existing residents and property owners with property at risk from flooding, sea level rise, and storm surge.
	Consider offering incentives, financial or otherwise, (e.g., waiving application or permit fees for new development and construction) for property owners that voluntarily implement flood risk reduction practices on their property (e.g., voluntary elevation of structure above a specified flood level, storm water retention/treatment, etc.).
Ordinances	
Consider modifying and strengthening the Town's floodplain ordinance through some or all of the following measures:	
<ul style="list-style-type: none"> • Adopt higher freeboard requirements for development in areas subject to existing and potential future flood hazards based on projected water depths associated with sea level rise, storm surge, and increased precipitation • Apply the floodplain ordinance to flood hazard areas that extend vertically and/or horizontally beyond those identified as the regulatory 100-year floodplain to account for more intense storm events • Limit or prohibit new development in the regulatory floodplain • Revise and adopt a regulatory floodplain map that includes both the FEMA-designated 100-year floodplain and areas vulnerable to sea level rise • Establish development standards to reduce flood vulnerabilities in areas subject to inundation from sea level rise and storm surge. 	
Establish a sea level rise/storm surge zoning overlay district to encompass areas vulnerable to potential future flooding and develop and adopt accompanying regulations to ensure new and substantially improved structures are elevated above projected flood depths.	
Enhance the Town's existing land use regulations and policies that encourage the use of green infrastructure approaches for stormwater management and consider developing advanced requirements for properties located in areas vulnerable to flooding, storm surge, and sea level rise.	
Comprehensive Plan	
Incorporate sea level rise and other coastal hazards into the Town's Comprehensive Plan.	
Incorporate social, cultural, economic, and environmental resilience into the Town's Comprehensive Plan.	
Floodplain Management	
Consider joining FEMA's Community Rating System.	

Table 4: Considerations for Changes and Additions to Town Planning Documents.

SLR Committee Plan of Work 2020-2021

The SLR Committee's current plan of work was generated from the recommendations of the Resilience Checklist Report. The seven member SLR Committee meets monthly to discuss and collaboratively build upon the work done outside of meeting time by the Committee's four work groups: Outreach and Engagement, Citizen Science and Data Collection, Emergency Management, and Planning. The information below outlines each work group's plan of work for 2020-2021.

Outreach and Engagement Work Group

Objective: To provide information to the Select Board and broader community about SLR, community vulnerabilities, and strategies to build and inspire actions toward greater resilience.

Goals and Projects

- Update all outreach materials, most importantly the Town website SLR Committee pages
- Generate a Community SLR Fact Sheet
- Host and facilitate an SLR community engagement event
- Provide regular updates to the Select Board and community organizations
- Work with local businesses to share info about SLR/storm vulnerabilities and assist with flood hazard preparation, adaptation, and mitigation actions
- Working with the Citizen Science and Data Collection work group, develop and support citizen scientist engagement and data reporting strategies

Citizen Science and Data Collection Work Group

Objective: To document local knowledge and collect site specific data to support SLR policy initiatives and help prioritize the implementation of SLR adaptation strategies.

Goals and Projects

The SLR committee has identified 13 "vulnerable locations" on the island, based on the current vulnerability

of these locations to flooding during king tides and major storms, and/or their importance to transportation and commerce. These are

1. The Ferry Float
2. Town Parking Lot
3. Clamshell Alley
4. Indian Creek Footbridge
5. The Meadow (North Haven Road)
6. Ballfield Wastewater Pump Station
7. Carrying Place Bridge
8. Net Factory property
9. Granite Island Bridge
10. Causeway to Dyer's Island
11. Lanes Island Bridge
12. Leo's Lane
13. State Beach

Working collaboratively with Knox County EMA, the Citizen Science and Data Collection Work Group is developing a citizen science data collection project using the ArcGIS app Survey 1-2-3. The project will engage citizen scientists in documenting, via picture-post-monitoring, the extent of flooding at a number of these locations during king tides and storms. The data will be collected overtime and used to inform

- Vinalhaven's SLR "story" via an ArcGIS story map linked to the Town website
- Policy at the state and local level
- The prioritization of implementation of SLR adaptation strategies

As part of this project, the Citizen Science and Data Collection Work Group hopes to install signage that identifies flood depths associated with historical flooding events and sea level rise and storm surge in the downtown area to increase local flood risk awareness and eventually earn FEMA Community Rating System credit. In addition, the signage will be used as an engagement tool to educate the community and inspire climate action.

Emergency Management Work Group

Objective: To become a more resilient community by being “hazard-ready.”

Goals and Projects

The SLR Emergency Management Work Group is working with Vinalhaven EMA with support from Knox County EMA to revise the Emergency Operations Plan for the Town of Vinalhaven. This plan covers how the emergency response team will respond to many types of catastrophic emergencies, including localized flooding. It describes when and how to access support resources both on and off the island. The current revision will begin to consider the risks of gradual sea level rise, as well as the response to a VE storm event. Part of the plan is how to alert town residents quickly of impending dangers, and train them in how to protect themselves and their property to the greatest extent possible.

Once the plan has been developed the Emergency Management Work Group will use elements of the plan to help inform flood hazard and disaster education and outreach activities tailored for the school-age population and general public.

Planning Work Group

Objective: To incorporate resilience into Town policies, protocols, and ordinances.

Goals and Projects

Working with Knox County EMA, the Vinalhaven Planning Commission, and MidCoast Economic Development District, the Planning Work Group will help to develop and build understanding of policies, protocols, and ordinances that address the impacts of sea level rise and build community resilience. These include the considerations listed in Table 4: Considerations for Changes and Additions to Town Planning Documents on page 13.

Helpful Resources

Vinalhaven Specific Grant-Funded SLR Studies and Reports

Study/Report Name	Partner, Consultant	Study Date	Description
Vulnerability Study for Downtown	Ransom Consulting Engineers and Scientists	2016-2018	Modeling SLR and storm surge scenarios
Vinalhaven: Turning the Tide	Design and Resilience Team (DART)	2017	Imagining future flood resilience strategies for downtown
Vinalhaven Flood Resilience Checklist	Southern Maine Planning and Development Commission, Knox County EMA, Mid Coast Regional Planning Commission	2018	Assessing flood risk and recommending preparedness strategies
Vulnerability Assessment and Resilience Planning, Vinalhaven Ferry Terminal	Wood Environment & Infrastructure Solutions, Inc.	2020	Assessing vulnerability of SLR and storm surge on Vinalhaven ferry infrastructure

Our Partners

Knox County EMA – knoxcountymaine.gov/ema

Island Institute – islandinstitute.org

Vinalhaven EMA

Vinalhaven Land Trust – vinalhavenlandtrust.org

Tools for Visualizing Impacts of Flooding, Sea Level Rise, and Storm Surge

Flood Factor

Online tool for assessing a property's current and future risk of flooding

<https://www.floodfactor.com/>

FEMA Flood Map Service Center

Interactive online FEMA Flood Map viewer

<https://msc.fema.gov/portal/search?AddressQuery=04863#searchresultsanchor>

Maine Flood Hazard Map

Interactive web map containing flood hazard layers

<https://www.arcgis.com/apps/webappviewer/index.html?id=3c09351397764bd2aa9ba385d2e9efe7>

Maine Geological Survey Sea Level Rise Viewer

Web mapping tool to visualize inundation from several scenarios of sea level rise or storm surge along the Maine coastline on top of the Highest Astronomical Tide

https://www.maine.gov/dacf/mgs/hazards/slr_ss/index.shtml

Nature Conservancy's Coastal Resilience Apps

Visualization platform where ecological, social, and economic information can be viewed alongside sea level rise and storm surge scenarios in specific geographies

<https://coastalresilience.org/tools/apps/>

NOAA's Digital Coast Sea Level Rise Viewer

Web mapping tool to visualize community-level impacts from coastal flooding or sea level rise

<https://coast.noaa.gov/digitalcoast/tools/slr.html>

Citizen Science and Data Collection Apps We Use

Survey 1-2-3 for ArcGIS

The simple formcentric data collection GIS app we use for collecting our Vinalhaven site specific data. An essential tool for all Vinalhaven sea level rise citizen scientists

<https://apps.apple.com/us/app/survey123-for-arcgis/id993015031>

Other Citizen Science, Data Collection, and Climate Change Apps to Explore

Friends of Casco Bay Water Reporter

A volunteer Observing Network app used for reporting conditions in and around Casco Bay, as well as other areas

<https://www.cascobay.org/water-reporter/>

My Coast: Maine

Maine Geological Survey portal for collecting and analyzing pictures and data relating to coastal events. Information collected is used to visualize impacts of coastal hazards and to enhance awareness among decision-makers and stakeholders.

<https://mycoast.org/me>