

BASELINE DATA INVENTORY | MEMORANDUM



TO: Chebeague Island Climate Action Team
FROM: Julia Maine, FB Environmental Associates; Maya Shyevitch, Chebeague Island Resilience Corps Fellow
SUBJECT: [Baseline Data Inventory for Chebeague Island Targeted Climate Vulnerability Assessment](#)
DATE: June 5, 2024
CC: Forrest Bell, FB Environmental Associates; Carol White, Chebeague Island Board of Selectmen

EXECUTIVE SUMMARY

Maya Shyevitch, the Town of Chebeague Island's Resilience Corps Fellow, completed the following Baseline Data Inventory with support from FB Environmental Associates (FBE). The Inventory provides a summary of relevant studies, reports, and datasets to establish a baseline of existing conditions, resilience actions, and climate change impacts on Chebeague Island. The Baseline Data Inventory is part of a larger Targeted Vulnerability Assessment currently being completed by FBE and the Fellow. The Inventory is one of three initiatives funded by a Community Resilience Partnership Grant from the Maine Governor's Office of Policy Innovation and the Future. (The grant has also funded a Groundwater Sustainability Study and Greenhouse Gas Inventory.) This memo aims to guide the Chebeague Climate Action Team (CCAT) and the Town with a comprehensive summary of the island's existing conditions and an identification of current data gaps, establishing a common reference for the Targeted Vulnerability Assessment. The Targeted Vulnerability Assessment will help the Town identify climate vulnerabilities related to island's marine resources and marine related activities so that the Town can make informed decisions about improving the community's resilience to climate change.

The Fellow worked with FBE to create a database of relevant documents pertaining to this project. The Fellow compiled the documents in a Google Sheet along with brief summaries and metadata such as year published, focus area, and source organization or author. The Fellow then synthesized information from these documents into the following sections:

- Flooding: Sea Level Rise & Storm Surge
- Public Wharves
- Groundwater Resources
- Wildfire Risk
- Marine Resources
- Coastal Erosion
- Land Use
- Town Sustainability Initiatives

The Baseline Data Inventory can be accessed using the following link and is attached as an addendum to this memo: https://docs.google.com/spreadsheets/d/10q_XEXyStAuApTD1c3Y6lmR22iVw9DHpcdYzQjCp_gA/edit?usp=drive_link

KEY TAKEAWAYS

- Coastal communities like Chebeague face significant threats from increased flooding, storm surges, and infrastructure damage. The Stone Wharf is the town's primary transportation hub and is one of the most vulnerable public infrastructure assets on Chebeague with regards to sea level rise.
- Chebeague Island is a sole source aquifer and all the drinking water originates on the island. Consequently, the sustainability of the island's water supply is a key concern. Water quality concerns on Chebeague Island, including bacterial contamination, saltwater intrusion, and PFAS contamination, highlight the importance of

ongoing monitoring, community education, and land use controls to safeguard drinking water sources. Thus far, saltwater intrusion has been identified at Deer Point, Division Point, Rose's Point, and Central Landing.

- Changes in the marine environment around Chebeague Island, including warming water temperature, loss of eelgrass and the shellfish fishery, algal blooms, invasive species, and pollution runoff, require adaptation and proactive management to safeguard ecosystem health and biodiversity.
- Challenges related to managing town waters and bottom include limited jurisdiction, competing uses and potential conflicts among multiple uses and activities.
- Accelerated coastal erosion due to increased wave action, storms, and sea level rise have and will continue to impact the shore, both natural and built environments, emphasizing the need for ongoing assessment and management. Erosion on Chebeague is particularly evident on the island's Coastal Barrier Resources System (CBRS) areas known as Indian Point, Sandy Point and Rose's Point.
- Shorefront stabilization measures on Chebeague should be evaluated in the context of critical need and long-term impacts, especially in the dynamic environments of the CBRS areas.
- Land use ordinances inherited from the Town of Cumberland do not adequately address Chebeague's specific needs. The Town of Chebeague's first Comprehensive Plan, completed in 2011, is no longer current and much has changed in the last decade. An updated Comprehensive Plan and revised ordinances that incorporate climate change will help to support a sustainable and resilient future for the island.

DATA GAPS

- Assessment of culvert suitability for major precipitation events.
- Marsh migration study.
- Revised floodplain and shoreland zoning ordinance that incorporate climate resilience.
- Updated shoreland zoning maps.
- Data to mitigate conflicting uses in the Town waters, including data on current marine activities and resources.
- An understanding of aquifer sustainability and protection.

FLOODING: SEA LEVEL RISE & STORM SURGE

Warming waters and melting ice sheets are leading to unprecedented sea level rise in Maine. The Maine Climate Council's *Maine Won't Wait 2020 Climate Action Plan* outlines the State's commitment to manage for 1.5 feet of sea level rise by 2050 relative to sea levels in 2000 and 3.9 feet of sea level rise by 2100. As stated in the Southern Maine Planning and Development Commission's *2023 Regional Climate Impacts Report*, sea levels have already risen 7.5 inches in Casco Bay since 1912. The combination of climate change-induced sea level rise and global warming will increase the frequency and intensity of storms and storm surges, exacerbating the impacts of coastal storms and resulting in significant infrastructure damage. The *2016 Town of Chebeague Island Sea Level Rise Vulnerability Assessment*, completed for the Town of Chebeague by the Greater Portland Council of Governments, notes the following threats associated with sea level rise and storm surge on Chebeague:

- More frequent and severe flooding.
- Flood insurance being required for more properties and at a higher cost.
- Public facilities and infrastructure are becoming more susceptible to flooding.
- Disruptions to the transportation network, including the ferries.
- Reductions in suitable land for development.

Updated Flood Insurance Rate Maps (FIRM), prepared by the Federal Emergency Management Agency (FEMA), became effective in June 2024 and outline what properties are in regulated flood zones. The updated maps can be viewed on the Town’s website: <https://www.townofchebeagueisland.org/index.asp?SEC=2752D94D-91BA-4558-801D-4B971F632929>

In the *Maine Won’t Wait 2020 Climate Action Plan*, the State committed to updating regulations, laws, and practices by 2024 to enhance community resilience to flooding and other climate impacts. According to the Cumberland Emergency Management Agency’s *2022 Cumberland County Hazard Mitigation Plan*, the highest prevalence hazards in the County and State are as follows:

- Severe winter weather
- Severe summer weather
- Flooding
- Hurricane
- Erosion/Coastal Flooding
- Disease Outbreak

In recent years Chebeague has experienced severe erosion and coastal flooding from storms. The damage to public roads and infrastructure from historic storms in December 2023 and January 2024 was estimated to be several million dollars. The *Cumberland County Hazard Mitigation Plan* identifies ferry access, shoreline erosion, and inundation of the post office and Chebeague Island Boat Yard (CIBY) as the highest priority community risks on Chebeague. The *Maine Won’t Wait 2020 Climate Action Plan* notes that \$1 invested in pre-disaster risk reduction results in \$6 of avoided disaster damages according to the National Institute of Building Sciences. Increasing the resilience of at-risk buildings and infrastructure could save money for the Town and property owners over the long term.

Chebeague’s infrastructure is less vulnerable to flooding from sea level rise and storm surges compared to many coastal communities in Maine. The U.S. Department of Homeland Security’s *2016 Resiliency Assessment Casco Bay* lists the fact that critical infrastructure is vulnerable to climate change impacts as one of three key findings of the 2014 Casco Bay Regional Resiliency Assessment Program (RRAP). (Anecdotally, the 2014 Casco Bay RRAP was the first in the history of the program to focus on climate change adaptation planning.) The *2016 Town of Chebeague Island Sea Level Rise Vulnerability Assessment* describes a variety of inundation scenarios on Chebeague. Even under the condition of the Highest Annual Tide (HAT) combined with 1 meter (3.3 ft) of sea level rise, there are relatively few risks to public infrastructure on the island. The report asserts that no public buildings are at risk of inundation and most at-risk roads are low use or private. The Stone Wharf is the most vulnerable public infrastructure asset on Chebeague with regards to sea level rise, and the Town’s *2011 Town of Chebeague Island Comprehensive Plan* (henceforth referred to as the *2011 Comprehensive Plan*), states that it is already “inadequate for all the uses it serves.” The pier deck is 1-2 feet above the current HAT, meaning that Chebeaguers can expect the structure to be regularly inundated during high tide when sea levels rise approximately 2 feet. The Wharf is already often partially or fully inundated by storm surges and astronomical high tides. When the island experienced record-breaking tide levels of 14.4 feet¹ during the January 2024 storms, the Wharf was completely underwater, shown in Figure 1. In the worst-case scenario of HAT coinciding with a Category-2 hurricane event, projections indicate that the Wharf and Wharf Road would be inundated up to 600 feet inland from the parking lot, shown in Figure 2.

¹ The Hohonu tide gauge located at Chandlers Wharf recorded a water level of 14.4 feet at 12:00 noon on January 13,th 2024. <https://dashboard.hohonu.io/map-page/hohonu-180/ChebeagueIsland,Maine>



Figure 1. Inundated Stone Wharf on January 13, 2024. Photo: Bill Danielson

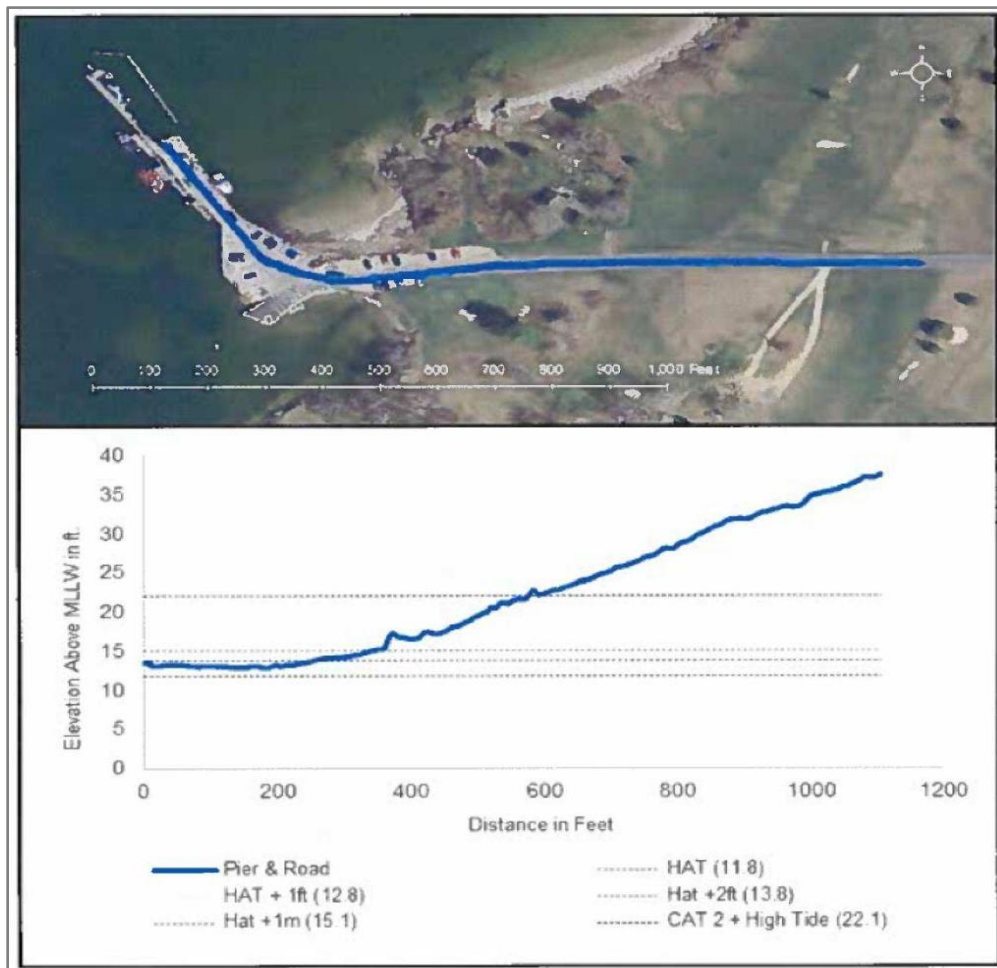


Figure 2. Stone Wharf & Stone Wharf Road Elevation Profile. Town of Chebeague Island Sea Level Rise Vulnerability Assessment, 2016

Several Town of Chebeague ordinances address concerns related to flooding and sea level rise. The Town of Chebeague's revised *2024 Floodplain Ordinance* based on FEMA's 2024 revised maps and flood insurance study includes information about the floodplain development permit application process and floodplain development standards in compliance with the National Flood Insurance Act of 1968. The Town's *Shoreland Zoning Ordinance*, last updated in 2023, includes definitions of the shoreland area overlay district, permitted land uses, and regulations for various sectors in shoreland areas. The ordinance stipulates that all uses should be located on soils that can be established and maintained without adverse environmental impacts and that no activity can impair water quality.

PUBLIC WHARVES

In addition to serving as the primary access point to the mainland, the Stone Wharf is also important working waterfront infrastructure. Many of the island's fishermen moor their boats off the Stone Wharf and it is used for loading and unloading fishing gear throughout the year. Water taxis and recreational boaters also use the temporary ties-ups frequently throughout the summer months. Residents and visitors access the mainland either using their own private boats or the Chebeague Island Transportation Company (CTC) ferry, which is berthed at the Wharf. The CTC ferry is also the island's emergency service vessel for the Fire and Rescue Department. There is also a public barge ramp that is accessible at high tide.

For about a decade, the Town has been exploring different options to address problems related to the Stone Wharf, including rebuilding the structure or moving the ferry landing to Sunset Landing. In 2019, after multiple studies, the Town voted not to move to Sunset and to instead focus efforts on upgrading the existing pier. According to the *2022 Chebeague Island Stone Wharf Evaluation* by Wright-Pierce, the pier is currently physically stable. The evaluation recommended that improvements focus on accessibility, safety, and traffic flow. To this effect it would be beneficial to widen the pier, increase the elevation of the pier surface, and improve its foundation supports. The estimated cost for this project is on the order of \$15.7 to \$18 million. The Town is currently evaluating options for the Stone Wharf, including more cost-effective solutions. In 2023, the Army Corps of Engineers Town completed dredging of the existing navigation channel and turning basin to improve safety and efficiency on the Wharf. The U.S. Army Corps of Engineers' *2021 Navigation Improvement Project--Environmental Assessment and Finding of No Significant Impact* asserted that the project would not have lasting or non-localized impacts to human, animal, or habitat well-being and that a 'no action' approach would negatively impact the operations of the ferry and fishing vessels.

Chandlers Wharf is the second ferry landing located on the island. Casco Bay Lines (CBL), the ferry service located out of Portland, uses this wharf as their landing site. CBL is not used as frequently by residents for transport to the mainland but is the primary transport for freight. Fisherman also utilize the mooring field off Chandlers and use the Wharf for staging gear. The pier structure is maintained by the Maine Department of Transportation (DOT), and as of the writing of the *2011 Comprehensive Plan*, it was working well for the CBL ferry, fishermen, and recreational boaters. The floats which can be accessed from the pier are owned and maintained by the Town. The main issue cited in the *2011 Comprehensive Plan* with regards to Chandlers is that the area does not have enough parking and is not organized efficiently for the large amount of traffic associated with the ferry in the summer. The Plan proposed that the Town could use the school bus in the summer for transport between a satellite lot and Chandlers, or for a continuous loop ride with stops at a satellite lot and both wharfs. That recommendation has not been implemented to date.

CCAT installed a Hohonu tide gauge at Chandlers Wharf in 2023 with funds from an Island Institute ShoreUp Grant. The gauge delivers real-time tide measurements to the Hohonu website, establishing a Chebeague-specific tide baseline for day-to-day use and future comparisons. CCAT plans to install an informational panel at the Wharf providing information about the tide gauge. The panel is currently in draft form.

In addition to the Stone Wharf, Bennetts Cove has been used for barging activity for decades, but recent increases in use and storm impacts as well as input from the Maine Department of Environmental Protection have required the Town to evaluate activities at this site. The beach is mapped as a frontal dune system, prohibiting the construction of a permanent structure.

GROUNDWATER RESOURCES

Chebeague has conducted five groundwater studies to date, in 1988, 1992, 2001, 2006, and 2024. A report on the results of the 2024 study is forthcoming. These studies have focused on the island's groundwater availability and water quality. Water quality degradation on Chebeague has been a concern since at least the first study over 35 years ago. Though not officially designated as such, Chebeague is reliant on a sole source aquifer, meaning that all wells draw from the island aquifer and, if contaminated, it would pose a significant public health risk. In the *Town of Cumberland 1988 Community Groundwater Study* completed by Caswell, Eichler and Hill for the Town of Cumberland, the primary concerns were bacterial contamination, road salts, fertilizers, pesticides, and herbicides. Bacterial contamination from septic systems was deemed the greatest risk. The Chebeague Long Range Planning Committee's *2002 Chebeague Island Long Range Plan* additionally lists junk cars, household waste disposal, and improper petroleum use and storage as threats to the island's groundwater.

The 1992, 2001, and 2006 studies found a high prevalence of Total Coliform in groundwater samples on the island's West End. E. Coli was found in about 5% to 10% of the wells sampled in 2001 and 2006, a potential indicator that the aquifer had been impacted by septic system waste. Bacterial contamination is usually the worst in late summer when recharge rates are low and withdrawal is at its maximum. Nitrate was added to the sampling program in 2006 to assess the impact of contamination from septic systems on the groundwater quality. Elevated nitrate levels were observed in a small percentage of wells. While nitrates showed a strong correlation with Total Coliform in 2001, in 2006 elevated nitrates did not show a strong correlation to bacterial contamination. In 2024, only a few wells tested positive for E. Coli. Owners of those properties were notified, and remediation steps and retesting was conducted.

Sea level rise can also impact groundwater quality. In coastal areas and islands, the freshwater aquifer floats on top of the denser saltwater below. The boundary between fresh and saline water is called the saltwater interface, illustrated in Figure 3. Higher sea levels will cause the saltwater interface to migrate inland, exacerbating the risk of saltwater intrusion in drinking water. Chebeague's reliance on a sole source aquifer increases the island's vulnerability to saltwater intrusion because there are no additional groundwater sources available if the aquifer becomes contaminated.

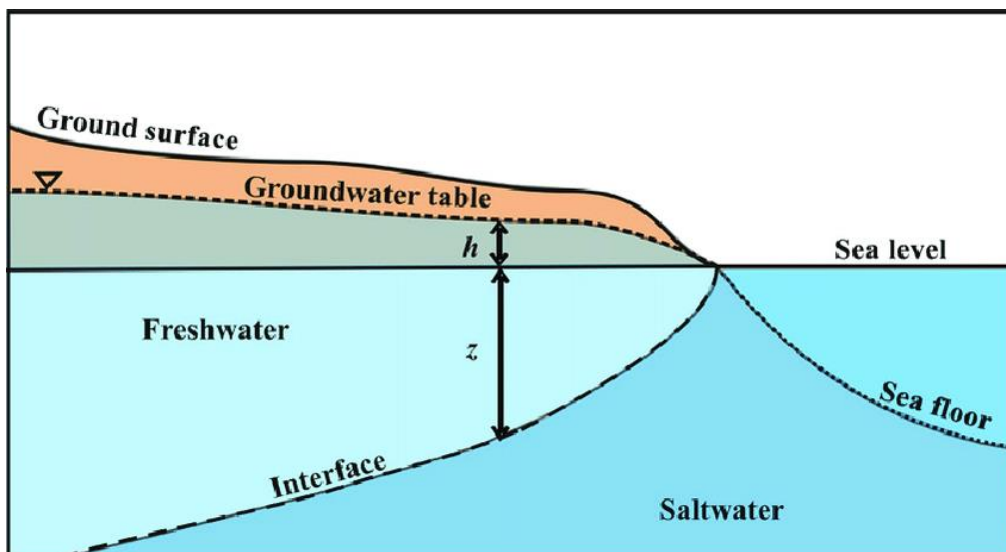


Figure 3. Saltwater Interface Diagram. *Management of Coastal Groundwater Resources. Vengadesan & Lakshmanan, 2018.*

While saltwater intrusion was mentioned as a risk in 1988, salinity testing began as part of the *1992 Chebeague Island Groundwater Study* conducted by Sevee & Maher Engineers. The study identified saltwater intrusion as an issue on Division Point. Subsequent studies have additionally found evidence of saltwater intrusion at Deer Point, Rose's Point, and Central Landing. The *2024 Chebeague Island Groundwater Sustainability Study* will provide a comprehensive update on saltwater intrusion on Chebeague. Currently, there is no evidence that the number of wells impacted by saltwater intrusion has increased since it was first detected.

Nearly all groundwater wells on Chebeague are private. The *2006 Groundwater Study* estimated that there are approximately 400 private wells on the island. The only two public water supplies are at the Chebeague Island School and the Chebeague Recreation Center. Per- and Polyfluoroalkyl Substances (PFAS), 'forever chemicals' which are released from a wide variety of products, were found in both of the island's public water supplies during the 2024 study. There has not been large-scale testing for PFAS in private wells. The extent of PFAS contamination in private wells is unknown, primarily because there is funding available to test public wells, but not private wells. The Friends of Casco Bay and Bigelow Laboratory are conducting PFAS sampling of water sediment samples from Casco Bay. According to their 2024 article *PFAS Sampling Results in Casco Bay*, preliminary results indicate that although PFAS were found at all 18 sites sampled, concentrations were below the State interim drinking water standard of 20 parts per thousand for the sum of six compounds. The Environmental Protection Agency (EPA) recently finalized new legally enforceable levels, called Maximum Contaminant Levels (MCLs), for six common PFAS in drinking water. There is currently no safety standard for PFAS in marine waters. The next phase of the Casco Bay PFAS sampling study will focus on identifying the contributions of PFAS from specific sources and how PFAS are accumulating in the near-shore environment in Casco Bay.

Potential water quality contamination caused by runoff from the Town's capped landfill has also been monitored. The results of this monitoring are discussed in the *2022 Biennial Water Quality Monitoring Report* completed by Sevee & Maher Engineers. The landfill was capped during the fall of 1994, and long-term, post-closure monitoring commenced in August 1995. The wetlands east of the landfill likely receive the bulk of the runoff. The report provided an update on the continuously sampled site determined by the *2000 Post-Closure Monitoring Plan* (PCMP), located to the northwest of the landfill between the Kuntz residence and the landfill. The water quality of the site's shallow overburden groundwater system has been monitored regularly but with decreasing frequency since 2000. In 2022, parameter concentrations were consistent with those measured during the 2020 monitoring event. Based on these results, the Town may further reduce the frequency of landfill water quality monitoring in the area.

The Town's *2022 Solid Waste Ordinance* does not address the impacts of waste disposal on the island's ecology or drinking water, but it does establish requirements for solid waste disposal on Chebeague, including how often the Town must provide safe hazardous waste disposal options. These solid waste disposal practices help to protect the quality of the drinking water supply.

Through surveys conducted as part of the groundwater studies, some Chebeague residents noted elevated levels of iron and manganese in their water supply. Iron and manganese are two naturally occurring constituents in water. At elevated concentrations they can make water smell or taste unpleasant, yet they pose no health risks except at extreme concentrations. Contaminants that do pose health risks in drinking water are held to Primary Drinking Water Standards by the EPA. The EPA has also established guidelines for Secondary Drinking Water Standards for other water supply parameters which may lead to unpleasant tastes, odors, or appearances, but not health risks. None of the Chebeague groundwater studies assess Secondary Drinking Water Standards.

Recommendations discussed in the above reports to protect drinking water quality on the island include:

- Community education on proper septic system maintenance.
- Community education on proper hazardous waste disposal and accessible safe disposal options on the island.

- Limiting the use of road salts to the extent possible without jeopardizing public safety.
- Avoiding overdrawing wells by limiting housing density in areas at risk of saltwater intrusion.

WILDFIRE RISK

Though wildfire risk in Maine is low compared to other parts of the country, devastating wildfires are still possible. Many homes in the State are in the Wildland-Urban Interface (WUI), the zone where unoccupied land and human development meet. The 2008 Maine Forest Service and Town of Chebeague report, *Wildland-Urban Interface Communities at Risk: Hazard Assessment & Mitigation Strategies*, (henceforth referred to as the *Risk Hazard Assessment*) states that the entirety of Chebeague is in the WUI. Chebeague is in the high-risk category for structural fire risk. The main risks on the island are as follows:

- A lack of defensible space: Homes on Chebeague typically have less than 30 feet of space between the structure and wildland vegetation, meaning that fires can spread to structures quickly and firefighters may have difficulties with accessing structures. This is the greatest fire hazard on Chebeague.
- Inadequate road access: The lack of road signage and house numbers combined with the prevalence of dead-end roads without sufficient turn-around space pose a significant fire risk. Regulations for house numbers on Chebeague, including rules about visibility and display, are included in the Town's *2015 Street Naming and Numbering Ordinance*.
- Combustible building materials: Many homes on the island have combustible siding. Unenclosed decks can also be a fire hazard when dry debris collect underneath or on top.
- Water availability and response time: Hydrants, ponds, and the pool are water resources for most of the island, but Deer Point, the East End, and the roads along the Back Shore have limited water access for firefighting.
- Flammable vegetation types: Conifers are far more flammable than deciduous trees. Most homes on Chebeague are surrounded by a combination of the two types, making them moderate risk in the vegetation risk category.

Towns are responsible for paying a certain amount in fire suppression costs, based on the State's valuation of the town, before State monetary assistance begins. In a catastrophic fire, the *Risk Hazard Assessment* estimates that Chebeague could incur up to \$290,112 in fire suppression costs. Preventative measures recommended for community members include:

- Increase defensible space around structures and utilities.
- Clear vegetation from gutters, overhanging roofs, and decks.
- Build with non-combustible materials and enclose decks.
- Move propane away from structures.
- Create a personal fire plan, known to all occupants of the residence.

Preventative measures recommended for the Town, as described in the *2011 Comprehensive Plan* as well as the *Risk Hazard Assessment*, include:

- Provide wildland fire training for volunteer firefighters.
- Increase the number and utility of hydrants on the island.
- Improve roads for use in an emergency with rules regarding width, turnaround space, and multiple access points for residences.
- Provide educational programs on fire risk in Maine, including a community event such as a Fuel Clean Up Day.

- Incorporate firewise building principles into building codes.

As part of the Targeted Vulnerability Assessment, CCAT plans to meet with the Maine Forest Service to discuss updating the 2008 *Risk Hazard Assessment*, as well as funding opportunities and next steps for implementing fire risk reduction measures.

MARINE RESOURCES

The impacts of climate change are already affecting Casco Bay's marine environment. One feature of a healthy ecosystem in Casco Bay is abundant, stable seagrass beds, most of which are dominated by eelgrass. The *2021 State of Casco Bay* report by the Casco Bay Estuary Partnership reports that eelgrass abundance increased from 2013 to 2018 and showed stable and recovering beds around Chebeague, which are largest on the west side of the island. However, the *2023 Casco Bay Seagrass Mapping Aerial Photography Survey Coordination & GIS Mapping Cape Elizabeth to Phippsburg* by the Maine Department of Environmental Protection (Maine DEP) reports that in 2022, high resolution mapping of seagrass in Casco Bay showed the lowest acreage out of all recorded years since 2001 along with reduced density of seagrass beds. Total seagrass acreage was less than half of what it was in 2018. The Maine DEP hypothesized that the decline in seagrass habitat was likely due to filamentous algae observed during earlier field sampling efforts. Additional threats to seagrass habitat include:

- Shading from nutrients in the water column, algal blooms, or structures.
- Disease
- Invasive species such as the green crab, *Carcinus maenas*, which can damage seagrass beds, and *Cribrilina mutabilis*, an introduced species found primarily on eelgrass blades. The Maine Outdoor Heritage Fund's *2020 Invasive Species in Casco Bay: Discovery, Distribution and Biological assessment* identified *C. mutabilis* on Chebeague near the Stone Wharf.
- Human marine activity such as boating, anchoring, dredging, and bottom-dragging fishing gear.
- Pollution from runoff and excess nutrients.
- Direct climate change impacts including rising temperatures, ocean acidification, and extreme weather events.

Harmful Algal Blooms (HABs) are the result of rapid algal growth in aquatic environments. HABs can harm marine animals, negatively impact water quality, and contaminate marine human food sources, leading to human illnesses and poisoning. In Maine, HABs are increasing in frequency, intensity, duration, and geographic extent. Carol White, a Chebeague resident, has been monitoring HABs at the Chebeague Island Boat Yard since 2015 as part of the Department of Marine Resources (DMR) Volunteer Phytoplankton Monitoring Program. Carol White and Julia Maine's *Harmful Algal Blooms in Maine* presentation in 2020 showed how biotoxins in Casco Bay have increased in recent years. As of the writing of the *2011 Comprehensive Plan*, HABs were present in Chebeague's most productive clam flats in late summer. Water quality monitoring, early detection systems for HABs, and limits on nutrient inputs to water bodies can reduce the risk of HABs and related issues in Maine.

The Town has designated parts of the island as Resource Protection areas to preserve the ecological wellbeing of the island. Current Resource Protection areas, as of the *2011 Comprehensive Plan*, are: Indian Point, part of the beach and wetlands at Chandler's Cove Beach, Sandy Point, the entire shoreline of Johnson Cove, and the wetland and beach at Rose's Point. The Plan recommends adding the beaches and freshwater wetlands at Springettes and Bennett's Cove. The Town can designate coastal access areas, scenic areas, and areas with archaeological remains as Resource Protection areas as well. Resource Protection areas from 2007 are shown in green in Figure 4.

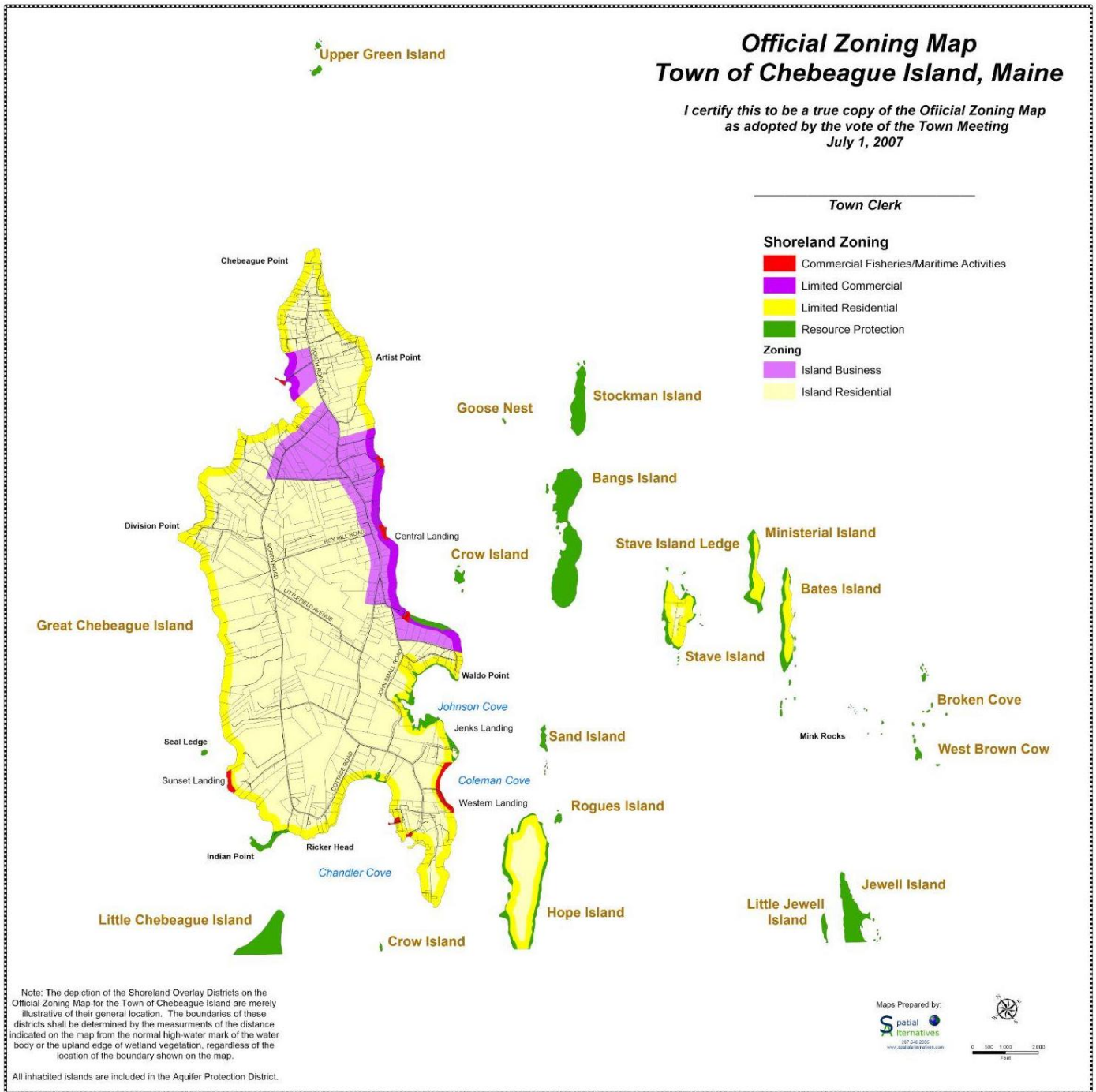


Figure 4. Town of Chebeague Zoning Map as of July 1, 2007. Town of Chebeague Island.

Several regional studies provided additional information about Chebeague’s marine resources. The *2020 Assessment of Benthic Species Assemblages and Their Relation to Environmental Conditions in Casco Bay* by the Maine Coastal Program found that benthic assemblages in the Bay were associated with sediment characteristics and that this relationship explained most of the qualitative differences among sample locations. However, of the four sample sites, the closest to Chebeague was off the coast of Falmouth. The *1995 Identification of Important Habitats in the Lower Casco Bay Watershed* by the U.S. Fish and Wildlife Service used aggregated habitat suitability scores for a variety of species to determine sensitivity zones around habitats and impact zones around human development. The report shows sensitivity

zones for various species on Chebeague, but the scale of the maps makes them difficult to interpret and the data is likely outdated.

The sections below summarize information about Chebeague’s marine resources compiled in the *2011 Comprehensive Plan* and related recommendations.

CLEAN WATERS

Friends of Casco Bay’s (FOCB) *Twelve-Year Water Quality Data Analysis: 1993 – 2004 Report* states that Casco Bay water quality is generally good and that the water quality around Chebeague improved over the study period. Volunteers for the FOCB Citizens Water Quality Monitoring program contributed to the analysis with shore-based measurements at Johnson Cove, the Stone Wharf, and Little Chebeague.

To increase aquifer protection, the *2011 Comprehensive Plan* recommended that the Town have the aquifer officially designated as sole source, adopt an aquifer protection ordinance, disallow commercial groundwater extraction, and educate the community on aquifer sustainability. The Plan underlined the importance of maintaining natural drainage patterns to recharge the island’s aquifer while minimizing runoff to the Bay. To this effect, the Plan recommended more drainage easements and fire ponds along with implementing best practices for roadwork to reduce sediment runoff. Since the Plan was completed, the Town has adopted an Aquifer Protection Ordinance (Section 300 of Zoning Ordinances), which restricts activities related to waste disposal, road salt, petroleum storage, agriculture, and mining in Aquifer Protection areas. These activities have the potential to contaminate the aquifer and gravel extraction can impact aquifer recharge areas. The Town also operates a boat pump-out barge to reduce pollution in the Bay.

WATERFRONT & OUTLYING ISLANDS

Historically, shore and water access was informally organized and did not always align with the mainland sense of private property. Recently, it has become more important to define and protect public access to water as the ownership of shorefront properties is changing. In the 2010s, the Town accepted several “paper streets” to formally create legal access to certain points along the shore. This process is described in the Town’s *2023 Shoreland Zoning Ordinance*. Paper streets exist in the Division Point, Merriam Point, Nubble View, Pleasant View, and Sunset Landing areas.²

The Town of Chebeague Island consists of 17 islands, but only two, Great Chebeague and Hope Island, are inhabited year-round. Hope Island is privately owned, and all Town facilities are located on Great Chebeague. Three other privately owned islands, Stave, Bates and Ministerial, have had limited development in recent years, but the most significant development has occurred on Hope Island.

The shorelands on Chebeague’s outlying islands are not part of the Town’s working waterfront. The *2011 Comprehensive Plan* states that the Town aims to keep the outlying islands as undeveloped as possible by working with the Chebeague & Cumberland Land Trust, the Island Trail Association, the State, and other landowners. The outlying islands are nesting places and migration stopping places for a wide variety of birds, threatened in recent years by the introduction of raccoons.

² https://www.townofchebeagueisland.org/index.asp?SEC=B05F3185-B010-4EC4-92D7-7607807F86CD&DE=FF994185-7BB2-4FD2-8DF8-B66F8B1CFD37&Type=B_BASIC

TOWN WATERS & BOTTOM

State jurisdiction of marine waters extends from the low-tide line to three nautical miles offshore, encompassing the entire coast of Maine. Approximately 80% of the Town of Chebeague is marine waters, which are owned and managed by the State. The Town has jurisdiction of the intertidal areas, including the island's softshell clam flat resources. The Town's *2016 Shellfish Conservation Ordinance* established a shellfish conservation program for the Town's coastal waters, including rules for licensing and harvest limits. As of the *2011 Comprehensive Plan*, there were 400 registered boats on Chebeague and approximately 350 moorings.

There is competition for bottom space for lobstering, compounded by State leases of the bottom for pipelines, cables, and, more recently, aquaculture. In 2004, a proposal to build a liquefied natural gas terminal on Hope Island was retracted in part due to push back from the Chebeague community. If the proposal had gone through, it could have impacted fishing due to loss of bottom, damage to traps and interruptions to fishing when tankers were in the area. Currently, conflicting marine activities include lobstering, pogy fishing, scalloping, ferry and barge transit, water taxis, recreational activities, and the possibility of a wind power cable.

The practice of towns making plans for larger sections of ocean, also known as marine spatial planning, was just beginning in the U.S. at the time of the Town's *2011 Comprehensive Plan*. The Plan recommended that Chebeague develop a proactive plan for managing its waters and bottom. Such a plan could mitigate or alleviate conflicts from cooccurring marine activities. Although Town jurisdiction in marine waters is limited, the Town can take steps to manage pollution, maintain the natural ecosystems of beaches, salt marshes and mud flats, and protect eelgrass beds. The Targeted Vulnerability Assessment will further this recommendation by mapping conflicting uses and documenting climate impacts on Chebeague's marine resources.

COASTAL EROSION

Coastal areas are inherently dynamic systems, but climate change impacts such as increased wave action, sea level rise, and more frequent and intense storms are accelerating natural erosion processes. Pete Slovinsky from the Maine Geological Survey (MGS) described some of these processes in the document *Description of Sand Transport Processes between Little Chebeague and the Hook*. His evaluation concluded that sand is being removed faster than it can be replaced on the sandbar between Little Chebeague and Indian Point, which is causing erosion of the beach and dunes. Chebeague has several areas that are part of the federally designated Coastal Barrier Resource System (CBRS). The CBRS areas on Chebeague are: Indian Point/the Hook and the sandbar between Chebeague and Little Chebeague, Jenks Landing/Sandy Point, and Rose's Point. These areas are highly dynamic beach and dune systems that have limited development.

Four beaches on Chebeague, including all three CBRS areas, are monitored as part of the Maine Geological Survey's biennial *State of the Beaches Report*: Indian Point, Chandlers, Rose Point, and Sandy Point. As of 2022, there was a mix of positive and negative change across metrics such as dune changes, beach changes, and mean dry beach width at each Chebeague beach. There was more significant erosion of Indian Point at the end of the pilings and of the Sandy Point dunes. Since the report was published, there has been significant erosion, especially at Indian Point from severe storms in December 2023 and January 2024 (Figure 5). GPCOG is working with Chebeague and other Casco Bay islands to track shoreline erosion using drone imagery aerial photography (Figure 6 and Figure 7).



Figure 5. The Hook (Indian Point) during the December 23, 2022 Storm. *Photo: Herb Maine.*



Figure 6. Aerial drone image of the Hook from 2020. *Photo: GPCOG*



Figure 7. Aerial drone image of the Hook from 2023. *Photo: GPCOG*

Recent storms and associated erosion have led to an increase in shorefront stabilization projects on the island. While stabilization can protect at-risk structures in the short term, it is not always an appropriate long-term solution because measures like seawalls and rip-rap cause increased erosion in adjacent areas. State and federal funds, including designated disaster damage funds from FEMA, may not be used to build shorefront stabilization in CBRS areas. However, there are currently no rules limiting the types of stabilization measures private landowners can install in the CBRS.

LAND USE

Decisions about land use, zoning, and development are integral to preserving the Town's character while envisioning its future. The Town's *Growth Management Ordinance* is intended to ensure sustainable growth and development on Chebeague while also accounting for immediate housing needs on the island. The Ordinance limits new Growth Permits to four per year plus two for affordable housing and states that the limit is to be reviewed every three years.

When the Town of Chebeague seceded from the Town of Cumberland, it inherited Cumberland's land use ordinances, but these ordinances are in many cases insufficient for the particularities of island life as laid out in the Town's *2011 Comprehensive Plan*. Physical features such as wetlands and floodplains, as well as federally designated CBRS areas, constrain development on the island. The Cumberland ordinances were also missing aquifer protection regulations. The Town of Chebeague has since adopted an Aquifer Protection Ordinance.

Some aspects of Chebeague's organization that previously happened organically, such as the distinction between more and less rural areas on the island, are now maintained by the Town's land-use ordinances. The *2011 Comprehensive Plan* states that despite development pressures, any new land use ordinances should maintain open space and natural areas. Chebeague residents' heavy reliance on private wells and septic systems means that the Town cannot use municipal infrastructure to influence private development. Instead, if the Town wishes to maintain undeveloped open space it can use the following strategies:

- Encourage residents to use tax incentives such as those in the State Tree Growth and Open Space Programs.
- Create conservation easements.
- Purchase land.
- Institute an open space and recreation impact fee—the Town of Cumberland had one at the time of secession, but it was not carried over to Chebeague.
- Encourage higher housing density in some areas to preserve open space elsewhere.

The Town also needs more precise zoning for land that meets the legal standards for Resource Protection under the Shoreland Zoning Ordinance. Many residents want to see Chebeague's shoreland zoning simplified, but if anything, the *2011 Comprehensive Plan* states that it needs to be more rigorous and compliant with State guidelines.

TOWN SUSTAINABILITY INITIATIVES

In 2017, the Town formed the Tick-Borne Disease (TBD) Committee to research TBDs and TBD mitigation methods on Chebeague. Warmer temperatures and earlier springs brought on by climate change expand the range of tick habitats and lead to earlier annual emergence as well as longer tick seasons. Additionally, changes in climate can affect the distribution and abundance of tick host species such as deer. The *2023 Maine CDC Report to Maine Legislature on Lyme Disease* showed that Lyme disease incidence has increased more rapidly in Maine since 2013 than in the Northeast regionally or the U.S. as a whole. Throughout the study period, Lyme incidence was also higher in Maine compared to the region or country. Lyme was also more prevalent in senior citizens than other age groups. During the Committee's three-year term, they gathered data on tick infestation numbers and infection rates, researched the island deer population the possibility of organized hunts, and provided educational presentations, as described in the Committee's

2018 Chebeague Island Ad-hoc Tick-borne Disease Committee Report. Over 50% of the ticks tested on Chebeague in 2017 and 2018 tested positive for Lyme.

Another sustainability initiative which pre-dates the formation of CCAT in 2023 is the Town's *2011 Property Assessed Clean Energy (PACE) Ordinance*. The ordinance established a program by which qualifying property owners could access funds for energy saving property improvements via the Efficiency Maine Trust.

The Town currently has a Power Purchase Agreement (PPA) contract with ReVision Energy. The solar array on the island was installed in 2017 at the Town Garage. The PPA includes an option for the Town to purchase the solar array in 2025 (Contract Year 7) for \$77,826. However, ReVision has offered the Town the option to buy the system a year early (Contract Year 6) for \$84,160. After reviewing the PPA and five-year analysis in addition to two meetings with ReVision's Director of Development and Chebeague resident Steve Hinchman, CCAT recommend to the Board of Selectmen that the Town wait to purchase the array. While purchasing the array would result in savings for the Town in the long run, the upfront cost, added responsibilities, continued availability of the option to purchase, and the potential for more efficient systems in the future led CCAT to decide that it would be best to wait before investing in purchasing the system. The *2011 Comprehensive Plan* mentions that the Town has considered offshore wind, but that State action would be more likely to install offshore wind power. For now, solar continues to be the Town's most viable renewable option.

CCAT completed a Greenhouse Gas (GHG) Inventory in January 2024. The Inventory provides an accounting of the island's GHG emissions by sector in 2021 as well as information on the efficacy of the solar array in the same year. Community-wide 2021 emissions amounted to 4,247 MT CO₂e (metric tons of carbon dioxide equivalent). While emissions were distributed relatively evenly across sectors, transportation was the greatest source of emissions, accounting for 33% of total emissions.

CCAT's community education and outreach events have provided resources to residents on topics including:

- Causes and impacts of climate change.
- The potential effects of climate change induced sea level rise on drinking water quality.
- Efficiency Maine programs and State rebates.
- CCAT projects such as the 2024 Groundwater Sustainability Study and 2024 GHG Inventory.
- Window Dressers inserts.
- FEMA flood zones on the island.

ADDENDUM A

Title	Geography	Date	Source	Category	URL or File Location	Brief Summary
Chebeague Island Greenhouse Gas Inventory Report	Chebeague	2024	Chebeague Climate Action Team	CCAT	https://drive.google.com/drive/folders/1TspigEM0kriLuxBiP5jFwlf1VK2DfHeU	Overview of purpose, methods, and results of 2024 Chebeague Greenhouse Gas Inventory for emissions in 2021. 2021 emissions amounted to 4,247 MT CO2e (metric tons of carbon dioxide equivalent). While emissions were distributed relatively evenly across sectors, transportation was the greatest source of emissions, accounting for 33% of total emissions. The Report also provides information on the efficacy of the Town's solar array, carbon sequestration on the island, and recommendations for next steps.
Casco Bay's Vulnerability to Climate Change Factsheet	Casco Bay	2017	Casco Bay Estuary Partnership	Climate Impacts	https://drive.google.com/file/d/1SQ8eY7SrN-arUXgoRLuePS56dtf9g2fT/view?usp=drive_link	Risks to Casco Bay associated with various climate threats. Overview of Casco Bay Plan 2016-2021 goals. Recommendations for climate friendly actions on the personal/ local level.
Ecological Charecterization and Stewardship Recommendations	Great and Little Chebeague	1991	Portland High School Students	Climate Impacts	Physical copy	Overview of history, ecology, geology, soils, hydrology, water quality, plastic deposition, habitats, and biodiversity for Great and Little Chebeague. The document also makes some recommendations for the island's hydrology, soils, wetlands, and intertidal zones. Creating the report clearly provided an excellent learning opportunity for students, however it is less rigorous than the town and state reports on the same topics.
Regional Climate Change Impacts Report	Southern Maine	2023	Southern Maine Planning and Development Commission	Climate Impacts	https://drive.google.com/file/d/13Vf2uvacJGypGgForg4p6OZmMaQJ_8_a/view?usp=drive_link	High level overview of climate threats in Maine and impacts to southern Maine ecosystems and livelihoods. Threats include temperature, changing precipitation, sea level rise, terrestrial and marine ecosystem changes, damage to infrastructure, public health risks, economic loss, stress on public resources, and impacts to outdoor recreation oppritunities.
Scientific Assessment of Climate Change and Its Effects in Maine	State	2020	Maine Climate Council	Climate Impacts	https://drive.google.com/file/d/1QUmSRjQLDz1RX9xq1BKk_3ApWb_xe_Z0/view?usp=drive_link	First of its kind in Maine, component of 2020 MCAP. In-depth scientific summary of climate impacts in Maine, SLR projections, data gaps, and resiliency planning. Broken into sections with seperate 'highlights', appendices, and references which makes the long document easily searchable.
Climate Trends in the Casco Bay Region	Casco Bay	2015	Casco Bay Estuary Partnership	Climate Impacts	https://drive.google.com/file/d/1Rx5V0bwu2c_nblAbD0NvB_il0_zwMKDFI/view?usp=drive_link	Overview of climate trends-- warmer summers, warmer/ shorter winters, warmer waters, increased drought and storm intensity/ frequency, SLR, ocean acidification, general increased variability and uncertainty. There doesn't seem to be any unique information in this document but it is a nice summary.
Maine Won't Wait One Year Progress Report	Maine	2021	Maine Climate Council	Climate Impacts	https://drive.google.com/file/d/1Fe4Qle2U7k_BhlPonJoeX2ECau5gMVmhe/view?usp=drive_link	Broken down in the same way as the original climate plan, brief updates on each topic.
Maine Won't Wait	State	2020	Maine Climate Council	Climate Impacts	https://drive.google.com/file/d/18BS-A585kVGCAXae1Xu47zPvl8m5BEcL/view?usp=drive_link	Overview of current climate conditions, threats, and goals in Maine. The document provides a detailed outline of MCC's eight strategies for acheiving the state's climate goals over the coming decades. Strategy F: Build Healthy and Resilient Communities, describes the state's goals for managing sea level rise and other climactic threats on the municipal/ community level. Other relevant strategies to the state's marine resources include Strategy C: Reduce Carbon Emissions in Energy and Industrial Sectors, Strategy D: Grow Maine's Clean-Energy Economy and Protect Our Natural Resource Industries, Strategy E: Protect Maine's Environment, and Strategy G: Invest in Climate-Ready Infrastructure.
Drone images show dramatically changing landscape on Chebeague Island due to storm erosion	Regional	2023	Maine Public	Coastal Erosion	https://www.mainepublic.org/environment-and-outdoors/2023-08-28/drone-images-show-dramatically-changing-landscape-on-chebeague-island-due-to-storm-erosion	News article on erosion of the hook, including community perspectives.

State of the Beaches Report, Maine Beach Mapping Program, Maine Geological Survey	Maine	2022	Peter Slovinsky and Friends, MGS	Coastal Erosion	https://drive.google.com/file/d/1eTxrmch_oAnWC-cj0vkM_LOGdIIDiG0r/view?usp=drive_link	Biannual update on state beaches. Four beaches are monitored on Chebeague, all within CBRS areas: Indian Point, Chandlers, Rose Point, and Sandy Point. The report provides an overview of SLR and wave history in the region as a whole, followed by figures and text describing dune changes, beach changes, and mean dry beach width for each area. Some statistics like overall trends are not calculated for Chebeague beaches because they were only added to the study in 2020 whereas other beaches have been surveyed since 2007. There is generally a mix of positive and negative change across metrics at each Chebeague beach. Finally, the end of the report contains statewide averages for each metric.
Sand Transportation Process	Chebeague	Unsure	Unsure	Coastal Erosion	https://drive.google.com/file/d/1SQHJXrV6nBQEE8nwIYT2EVs0Y-8ldA92/view?usp=drive_link	Results of analysis of orthophotos showing changes to sandbar between Little Chebeague and Indian Point. Conclusion that sands are being removed faster than they can be replaced leading to the eventual total degradation of the feature.
Groundwater Study-- 1988	Town of Cumberland	1988	Cumberland Planning Board	Groundwater	https://drive.google.com/file/d/1jgO3NAE-iRCqFlnWRAvCJe3yz6YhWAEZ/view?usp=drive_link	The report is about the Town of Cumberland as a whole, not Chebeague specifically, and it is sometimes unclear whether statements in the report are relevant to the entire town or only the mainland. There are however several places where information and recommendations for Chebeague are provided. The document focuses on geological properties of the town. Groundwater contamination from septic systems, road salts, fertilizers, pesticides, and herbicides are discussed. Septic contamination is deemed the biggest risk. Saltwater intrusion (SWI) is mentioned but there is no testing for SWI in this report. The report estimates recharge on Chebeague to be .5-.75 ft/yr or 3.09-4.64 x 108 gallons. Based on an estimate of 120 gallons per bedroom per day, the report states that Chebeague could support 7,050 to 10,600 bedrooms but admits that this estimate is unreliable. The report identifies areas of potential overdevelopment on the island and recommends that all of Chebeague be considered an aquifer recharge zone.
Ground Water Study-- 1992	Chebeague	1992	Sevee & Maher Engineers	Groundwater	Physical copy	Surficial and bedrock geology of the island. Description of methodology to test wells, asses well depths, types, and location, and measure water level/ water level fluctuation (piezometric surface & water table). Also installed three water level gauges on island. Tested 22-29 wells on island for sodium, nitrate-nitrogen, and coliform bacteria. A couple of wells exceeded twice the drinking water standard for sodium and coliform bacteria was present in 6/23 wells sampled for it. Sodium levels are attributed to salt water intrusion which seems to mainly be an issue at Division Point. Coliform bacteria is attributed to septic issues or housing density, and most issues were in the west end near CBF dock. (Chandlers?) Nitrate-nitrogen wasn't an issue in sampled wells/ levels were less than half of drinking water standard. Some residents complained about iron and sulfide but there's no health risk so the study didn't test for this. Study also determined that current groundwater use is sustainable considering how much water is sent back to the aquifer via local wastewater disposal systems. Report also makes some basic recommendations such as maintaining the gauges, maintaining an accurate well database, and only considering community wells at the center of the island to avoid overdraw near the shore.
Ground Water Study-- 2006	Chebeague	2006	Carla Nixon, Carol White, Judy Colby-George, Al Frick	Groundwater	https://docs.google.com/document/d/18m-dE4A4CDPt5543OEkrpxHE1LEtB0N/edit?usp=drive_link&oid=102868383975434982832&rtopof=true&sd=true	Follow up to 2001 groundwater study. Incorporated 3/4 of island wells into GIS database and created educational material to distribute to residents on the proper maintenance of sewage systems. Found 30% positive for total coliform of 51 wells tested and 30% exceeding drinking water standard for chloride of 21 wells tested. Found evidence of SWI at Division, Roses, Deer, and Central Landing (was only found at Division in 2001). This study faced some logistical issues and confounding variables like abnormal amounts of rain.

2022 Biennial WQ Report-- Chebeague Island Landfill	Chebeague	2023 Sevee & Maher Engineers	Groundwater	https://drive.google.com/file/d/1wsZWptLmPpBybo3fmIOUjrJwd9vBpTPU/view?usp=drive_link	This report is based on data through November 2022. It covers groundwater and drinking water quality testing with regards to the landfill which was closed in 1994 with an impermeable cover system, leading to generally stable conditions. The report states that the wetland east of the landfill probably receives the most runoff. There is a map of sampling sites determined in the August 2000 Post-Closure Monitoring Plan (PCMP), which have been monitored regularly but with decreasing frequency since. The sites are currently monitored biennially using sampling techniques laid out in the PCMP. Both groundwater and drinking water are monitored as well as well quality and new wells in the impacted area. Water quality overall is found to be leveling off after an initial decrease. The report recommends that Chebeague continue the biennial testing and limit use of deicing salts, to the extent possible, in and around the CIL facility.
Wildland-Urban Interface Communities at Risk Hazard Assessment & Mitigation Strategies	Chebeague	2008 Town of Chebeague	Hazards	https://drive.google.com/file/d/1Q8ja0dhBSnyjTC0751aVJCduwVHpzcyJ/view?usp=sharing	Methods and results of fire risk study on Chebeague in 2008 surveying 102 structures and 25 vegetation plots. Provides recommendations on next steps on individual, property owner, and town scales. Also provides resources on state and federal funding opportunities.
Cumberland County Hazard Mitigation Plan	County	2022 Cumberland Emergency Management Agency	Hazards	https://drive.google.com/file/d/1JaM4dgCTKL_CvZ-z-j6g_oP2ZGve96Hdx/view?usp=drive_link	Update of 2017 hazard plan. Describes highest frequency hazards in Cumberland County--severe winter weather, severe summer weather, flooding, hurricane, erosion/ coastal flooding, and disease outbreak. Landslides are also included due to the september 2020 incident in Westbrook. Estimates worst-case future losses for each high frequency hazard (excluding landslides) by town. Provides a municipal risk overview by town. (Chebeague section focuses on ferry access, shoreline erosion, and inundation of post office and CIBY.) Provides CCEMA strategy overview for various social and physical vulnerabilities. Table showing ongoing projects on Chebeague (outdated).
Resiliency Assessment Casco Bay	Casco Bay	2016 U.S. Dept Homeland Security	Hazards	https://drive.google.com/file/d/1j2IMtxg9SiYr_wcrYWBCN1Kavmw6Rei4f/view?usp=drive_link	This document describes the Regional Resiliency Assessment Program (RRAP) conducted in the Casco Bay region in fiscal year 2014. This RRAP was the first ever to focus on climate change and regional resiliency. The document provides an overview of risks to the region generally and more specific risks to critical infrastructure. It describes national-level climate change actions aligned with the RRAP and state/ regional policy and planning response. It also identifies three key sources of vulnerability for the region: Institutional barriers and challenges to meeting regulatory requirements are hindering effective adaptation planning, critical infrastructure is vulnerable to climate change impacts, and critical dependencies and interdependencies exist that can compound climate change impacts across multiple infrastructure systems. Lastly there are recommendations for resilience enhancement including the formation of a regional planning body, the Casco Bay Climate Change Coalition. Based on my googling the coalition was never formed.
Casco Bay Sediment Assessment 1991-2011	Casco Bay	2017 Casco Bay Estuary Partnership	Marine Environment/Habitat	https://drive.google.com/file/d/1RMaYA129noEZzjdiQd0EDvWORqtOnZd8/view?usp=drive_link	Latest of three ten-year sediment assessments from CBEP. Found that concentrations of most chemicals in Casco Bay have either decreased or shown little change since the first sampling in 1991. Concentrations of most chemicals in the Bay were also lower than or similar to concentrations elsewhere along the coast of Maine. The highest chemical concentrations were associated with adjacent land use and the physical characteristics of sediment. The paper theorizes about the cause of changing concentrations. For example, declined concentrations of metals is evidence of laws such as the Clean Water Act which limited industrial loading. Chebeague is right on the edge of the inner bay and outer bay regions for this study. The highest concentrations around Chebeague, mapped with IDW, are zinc and selenium, but the report doesn't specify if the concentrations are worrying or not.
Casco Bay Seagrass Mapping Aerial Photography Survey Coordination & GIS Mapping Cape Elizabeth to Phippsburg	Casco Bay	2023 Maine DEP	Marine Environment/Habitat	https://drive.google.com/file/d/17B-0yjXgjEjk6HC9b0qTK2mqk_YXIKvf/view?usp=drive_link	2022 methods and results of high resolution mapping of seagrass in Casco Bay. Found lowest acreage out of all mapping years and reduced density of seagrass beds.

State of Casco Bay - Eelgrass	Casco Bay	2021 Casco Bay Estuary Partnership	Marine Environment/Habitat	https://www.cascobayestuary.org/strategic-planning/state-of-casco-bay/eelgrass/	Describes eelgrass increase from 2013-2018 mapping. Overview of ecological benefits of eelgrass and risks to eelgrass populations. Includes a map of Chebeague showing stable and recovering beds around Chebeague, particularly on the west side of the island. Does not include 2022 data which may have shown more of a decline.
Juvenile Lobster Monitoring Program - Diane Cowan	Maine	2008 Diane Cowan, Loster Conservancy	Marine Environment/Habitat	https://drive.google.com/file/d/1waMti_8I53LwCcu4J88quL25IVCVV_v/view?usp=drive_link	2007 update on juvenile lobster monitoring program tracking abundance and distribution of lobsters along the Maine coast since 1993. The document provides a summary of the program's major accomplishments and an overview of population trends in each of the 8 zones. It was unclear to me from this report how/ where the zones are defined. There is a monitoring site at Chebeague at Bennetts Cove. Relatively large juveniles made up the bulk of lobsters sampled there according to a figure. At 21 of their 24 monitoring sites, lobster abundance had increased in recent years at the time of this report.
Harmful Algal Blooms Presentation	Maine	2020 Carol White & Julia Maine	Marine Environment/Habitat	https://docs.google.com/presentation/d/1IAhO1vVxrYrsiba2bwXW8W4iLJAuxJF7/edit?usp=drive_link&oid=102868383975434982832&rtpof=true&sd=true	Describes threat of HABs, shows monitoring sites and biotoxin risk areas along Maine coast, shows examples of biotoxin risk communication, provides recommendations on biotoxins for harvesters.
Assessment of Benthic Species Assemblages and Their Relation to Environmental Conditions in Casco Bay	Casco Bay	2020 Thomas J. Trott, Ph.D., Benthic Ecologist, Maine Coastal Mapping Initiative, Maine Coastal Program, Department of Marine Resources	Marine Environment/Habitat	https://drive.google.com/file/d/1z9loSsmnVrUTeHb-598jYLjnM8xOIVxp/view?usp=drive_link	Highly technical overview of methodology and results for benthic species assemblage study. Compares species diversity and abundance between test stations in the inner waters of Casco Bay, theorizes about why they exist. Includes information on habitat quality and environmental conditions at the stations. Very dense report without much context for unfamiliar readers.
Invasive Species in Casco Bay	Casco Bay	2020? Maine Coastal Program	Marine Environment/Habitat	https://drive.google.com/file/d/1NSEumf3ketqAseQc-QmsUIa9I8Oetjtl/view?usp=drive_link	The document outlines the threat of invasive species in Casco Bay and the limits of previous sampling which tended to focus on inland or near shore areas. The study specifically aims to determine the range and prevalence of <i>Cribrilina mutabilis</i> and <i>Grandidierella japonica</i> . <i>C. mutabilis</i> was found at 10/13 sites, including near the Chebeague Golf Club in September 2019. (The highest prevalence month for <i>C. mutabilis</i> overall). <i>G. japonica</i> was more rare and no maps are provided. The report also includes a table comparing the prevalence of different invasives at the Stone Wharf in August and Sept 2019 using different sampling methods.
Friends of Casco Bay Twelve-Year Water Quality Data Analysis: 1993 – 2004 Report	Casco Bay	2005 Friends of Casco Bay and USM	Marine Environment/Habitat	https://drive.google.com/file/d/1mXUDAvsP1LaL7hMhEU0JphyKMmauiHgG/view?usp=drive_link	Samples were taken by volunteers at 80 shore-based stations and by FOCB staff at 11 off-shore profile stations. Three volunteer-sample locations were located on Chebeague, at Johnson Cove, the Stone Wharf, and Little Chebeague. They tested for standard oceanographic parameters of temperature, salinity, pH, Secchi depth, dissolved oxygen, plus ancillary air and water measurements. Chlorophyll and dissolved inorganic nutrient measurements were added in 2001. For the most part, Chebeague specific information in the Report must be gleaned from maps and figures.
Ocean Acidification Update	Maine	2014 Island Institute-- Julia Maine!	Marine Environment/Habitat	https://drive.google.com/file/d/1E3D8npFShRppP3sNDLtwyQY-oVSDQx4J/view?usp=drive_link	Response to local concerns about OA. Information on OA & impacts as well as Maine actions. Points out that GOM is especially susceptible due to cold temps and freshwater input.
Maine Shellfish Handbook	Maine	2021? Maine Department of Marine Resources, Maine Coastal Program, Maine Sea Grant	Marine Environment/Habitat	https://drive.google.com/file/d/1a3rd_-Lu6MMuccGck0UnCVzCrMJhU_VZ/view?usp=drive_link	Outlines effective management systems for bivalve shellfish in Maine on the local and state level. Provides information on shellfish harvesting history and biology, and conservation strategies.
PFAS Sampling Results in Casco Bay	Casco Bay	2024 Friends of Casco Bay	Marine Environment/Habitat	https://www.cascobay.org/pfas-sampling-results-in-casco-bay/	Article providing a brief update on PFAS testing in Casco Bay. The effort is a partnership between FOCB and Bigelow. While low levels of PFAS were found at all sites, all levels were below current state drinking water regulations. The next phase, which will go through 2025, will focus on identifying the contributions of specific sources and how these chemicals are accumulating in the near-shore environment

Identification of Important Habitats in the Lower Casco Bay Watershed	Casco Bay	1995 U.S. Fish and Wildlife	Marine Environment/ Habitat	https://drive.google.com/file/d/1oUnEEIBIOd-zeHxYyje-HFMuiindRU1P/view?usp=drive_link	Collaboration with CBEP, they assigned scores to each cell in a raster grid based on habitat suitability for each species and then aggregated scores. The bulk of the report is methodology and habitat information for various species, including data sources, management concerns, and specific mapping methods. All Chebeague specific information must be gleaned from the maps at the end which can be hard to read (they're pretty small) but they show sensitivity zones and important habitats for various species present on/ around the island.
Coastal Waters Rules and Regulations	Chebeague	2019 Town of Chebeague	Public Wharfs	https://drive.google.com/file/d/1uJdGip1oJ0qOeTAwV7aJITnExzVDv0gk/view?usp=drive_link	Rules and regulations for use, i.e. tying vessels to and leaving things on, the town wharfs. Rules and regulations don't apply for the purposes of loading and unloading and are flexible in emergencies and at the discretion of the harbor master.
Chebeague Island Stone Wharf Evaluation	Chebeague	2022 Wright-Pierce Team	Public Wharfs	https://drive.google.com/file/d/1yQ-tsKzdHmDhPnl-qAkBj-aak0tN8m7G/view?usp=drive_link	States that wharf is currently stable but could be improved. Describes a series of possible improvements which would maximize accessibility, safety, and flow. Includes images and renders of current and planned structure.
Navigation Improvement Project-- Environmental Assessment and Finding of No Significant Impact	Chebeague	2021 U.S. Army Corps of Engineers	Public Wharfs	https://drive.google.com/file/d/1-uAqCwdOuNHauOWxSksvJEB_goQzdqwZ/view?usp=drive_link	This document covers the proposed dredging of a new navigation channel and turning basin at the Stone Wharf since the existing channel is not deep enough for safe and efficient landing, with impacts to both the ferry and fishing vessels. It is determined that this action will not have lasting or non-localized impacts to human, animal, or habitat well-being. However, the 'no action' approach would negatively impact the operations of the ferry and fishing vessels. The report provides details on the dredge area and logistics for the project, including the stipulation that work will only take place from October through April to avoid impact to island fishing. Potential alternatives are examined and deemed insufficient. Lastly, there is a brief overview of actions taken to avoid negative externalities during the course of the project.
Sea Level Rise Vulnerability Assessment	Chebeague	2016 Town of Chebeague	Sea Level Rise	https://drive.google.com/file/d/1VR40WXP9MYWrijXPG97XbJD1qMGSPiBcD/view?usp=drive_link	Describes threat of SLR on Chebeague and local SLR trends. Shows impact to vital town built infrastructure (wharfs, roads, culverts, wells) and natural infrastructure (bluffs). Identifies areas where data is missing, such as a marsh migration assessment and a culvert assessment. Provides recommendations for changes to/ strengthening of town shoreland zoning, floodplain regulations, and land use ordinances. The assessment notes the Stone Wharf, Bennett's Cove Road, and Indian Point Road as key municipal structures at risk of degradation. Chandler's Wharf, East Shore Drive, and Jenks Road are other municipal structures at risk, but the risk is considerably lower and, in the case of Jenks Road, the infrastructure is less vital.
Adapting Maine's Coastal Communities to SLR and Storm Surge	Maine Coast/ Casco Bay	Unsure Peter Slovinsky	Sea Level Rise	https://docs.google.com/presentation/d/1vwA1l0x4guY4msp4Y3Hx-aaLONPIQ7-m/edit?usp=drive_link&oid=102868383975434982832&rtfpof=true&sd=true	Describes SLR trends and future projections, describes steps communities have taken to deal with risk and provides additional recommendations. Discusses National Flood Insurance Program Community Rating System (CRS)
Tick-Borne Disease Committee	Chebeague		Tick Borne Disease		Overview of function and purpose of Chebeague Tick-Borne Disease Subcommittee which is tasked with researching risk mitigation and education strategies and reporting to board of selectmen. Est. 2017, 5 members with 3 year term.
Tick Collection, October 2017 Chebeague Island, Maine	Chebeague	2017 TBD Subcommittee	Tick Borne Disease	https://drive.google.com/file/d/1HbFCYYrA72jgZn2MRQixJalZarKzwleG/view?usp=drive_link	Maps showing quantities of ticks collected and ticks collected per hour at various sampling sites on Chebeague. High densities seem to be generally in the north/ northeast areas of the island but the sampling doesn't seem very comprehensive.
Recommendations to the Chebeague Board of Selectmen from The Ad hoc Subcommittee on Tick-Borne Diseases	Chebeague	2018 TBD Subcommittee	Tick Borne Disease	https://drive.google.com/file/d/12dvEiRmN93UD0KYiQ2R0eoKclMqZvdgD/view?usp=drive_link	Subcommittee recommends organized deer hunts coordinated with Inland Fisheries and Wildlife and public TBD awareness programs.

Report to Chebeague Select Board by the ad hoc Subcommittee on Tick Borne Disease 01/17/2018	Chebeague	2018		Tick Borne Disease	https://docs.google.com/document/d/1iP3kjpAJFI-MknW9V_UUlsIq0EuIDF1/edit?usp=drive_link&oid=102868383975434982832&rtpof=true&sd=true	Overview of subcommittee's goals and progress. Subcommittee succeeded in gathering data on tick infestation in numbers and infection rates, researching the deer population + hunts, educating subcommittee members on tick life cycles and IDing, providing educational presentations, and communicating with other islands, elected officials, and organizations.
			TBD Subcommittee			
Chebeague Island Ad-hoc Tick-borne Disease Committee Report	Chebeague	2018		Tick Borne Disease	https://docs.google.com/document/d/12TGCUnofUwtScv2aCx2LU2xv7dJ2Vbov/edit	States that Maine Disease tracking Network lists Chebeague as the town with the third highest rate of Lyme Disease in Cumberland County but that associated data is incorrect. Update on subcommittee partnerships with Maine Medical Center Vector-borne Disease Lab and other Casco Bay islands. States that 26 deer were tagged in 2017.
			TBD Subcommittee			
Chebeague Island Ad-hoc Tick-borne Disease Committee Report	Chebeague	2019		Tick Borne Disease	https://docs.google.com/document/d/12PAasi0UtT3jIW8AwW59zFOUw5-lmvSV_/edit	Provides estimate from Game Warden that the deer herd on the island was between 80 and 100 deer when he visited and that a herd that size could produce about 30 fawns. Reports on system for communication between hunters. States that 57% of the flagged ticks in 2018 were positive for the Lyme bacteria and 20% carried Anaplasmosis.
			TBD Subcommittee			
Tick Flagging at 11 Springettes Road	Chebeague	2023		Tick Borne Disease	https://drive.google.com/file/d/1LCeDcUAFu20ULPihpd6v09iUOYBQZ9/view?usp=drive_link	Tick flagging results and graphs of Lyme incidence. Graphs show that Lyme is more prevalent in Maine than in the U.S. or New England per 100,000 people and more prevalent in senior citizens per 100,000 people than other age groups. In fall of 2017 and 2018 over 50% of deer ticks found on Chebeague tested positive for Lyme.
			TBD Subcommittee			
Lyme and Other Tickborne Illnesses 2022 Annual Report	Maine	2023	Division of Disease Surveillance Maine Center for Disease Control and Prevention Maine Department of Health and Human Services	Tick Borne Disease	https://drive.google.com/file/d/1sgcHPbXoSv0lNfrSVuA_UXY2Ph5sPc0S/view?usp=drive_link	Summary of Lyme cases in Maine counties, Cumberland County had one of the highest case counts. (Makes sense based on population.) Background on Lyme and other TBDs, current research and educational materials.
Comprehensive Plan	Chebeague	2011	Town of Chebeague	Town Plans	https://drive.google.com/file/d/1X5SPFY1H62FVII3uUc9s1W3YnfTXRcm6/view?usp=drive_link	Plan including discussion of drainage patterns, aquifer protection, land use, water quality, forestry, island development constraints, the power of the town to control development, planning for the towns wharfs, waters, and bottom, fire risk, and power. Some sections are definitely outdated/ haven't been updated since 2011. Addresses high water levels and storm risks but doesn't really address sea level rise directly. The Clean Waters section of the report focuses on aquifer recharge and pollutants in drinking water and the marine environment. The Wharfs, Waterfront, and Outlying Island section is primarily about the Stone Wharf's inadequacy, possible plans for Sunset Landing, development on the outlying islands, and the impacts of changes to island cultural norms of water access. The Management of the Town's Waters section describes development options and policies for managing the town's marine resources, water access, and bottom in accordance with the input of various stakeholders and state regulations.
Floodplain Management Ordinance	Chebeague	2007	Town of Chebeague	Town Plans	https://drive.google.com/file/d/1KcGvd43HIRB4BNZZm_f-hLheLp9XloWA/view?usp=drive_link	Floodplain regulations based on 1985 FEMA 'Flood Insurance Study- Town of Cumberland.' Includes information on permit application process and development standards in floodplains.
Growth Management Ordinance	Chebeague	2022	Town of Chebeague	Town Plans	https://drive.google.com/file/d/1LIF5IDAE9CgSDAIYOsGaaXwKW0Z1Wej2/view?usp=drive_link	Ordinance to ensure a sustainable rate of growth and development on Chebeague which also accounts for immediate housing needs on the island. Limits new Growth Permits to four per year plus two for affordable housing. The number of permits will be reviewed every three years to make sure maximum growth rate is still appropriate.
Long Range Plan with Town of Cumberland	Chebeague	2002?	Chebeague Long Range Planning Committee	Town Plans	https://drive.google.com/file/d/1sNx3FCdPxn1QfQnuiOocVLOI0fWhDxX0/view?usp=drive_link	Submission from Chebeague Committee to the Town of Cumberland, with the hopes that the Town will incorporate the long range plan into their comprehensive plan. The document is mainly an overview of the results of other projects with regards to the sections on groundwater (following the 2001 study), wetlands, land use, open space, and fishing. The road maintenance section encourages the town to open a new gravel pit on Chebeague but also warns that aquifer recharge areas must be protected.

Property Assessed Clean Energy Ordinance	Chebeague	2011 Town of Chebeague	Town Plans	https://drive.google.com/file/d/1kKe6A76cOrvFJsm4WZwaHqXrkB6FQPQE/view?usp=drive_link	Ordinance establishing program by which qualifying property owners can access funds for energy saving proerty improvements via the Efficiency Maine Trust.
Shellfish Conservation Ordinance	Chebeague	2016 Town of Chebeague	Town Plans	https://drive.google.com/file/d/1N2Erj84OJLncOiiIbOCi-vZ39dICZGZ/view?usp=drive_link	Establishes shellfish conservation program for the Town's coastal waters, including rules for licensing and harvest limits.
Shoreland Zoning Ordinance	Chebeague	2023 Town of Chebeague	Town Plans	https://drive.google.com/file/d/1waoGxaO3y3naf2rP129lbdNV0Mob5liA/view?usp=drive_link	Ordinance includes definitions of shoreland area overlay districts, permitted land uses, and regulations for various sectors such as housing, public utilities, etc. The ordinance stipulates that all uses should be located on soils that can be established and maintained without adverse environmental impacts and that no activity can impair water quality. The ordinance also covers administrative subjects.
Solid Waste Ordinance	Chebeague	2022 Town of Chebeague Island	Town Plans	https://drive.google.com/file/d/1MwYbVSypmGMXFJp9jZGiBbp4HIFxjT61/view?usp=drive_link	General rules, definitions, and expectations established for solid waste disposal on Chebeague. Does not include information on impacts of waste disposal on the island's ecology or drinking water. Does include rules for how often the Town must provide safe hazerdous waste disposal options.
Street Naming and Numbering Ordinance	Chebeague	2015 Town of Chebeague	Town Plans	https://drive.google.com/file/d/1lqzah1AXjvVbydmsm54GMZehOjOFpX_/view?usp=drive_link	Regulations for house numbers on Chebeague, including rules about visibility and display.