

The Impacts of Climate Change on Chappaquiddick

Key findings from the 2020 Zoom Speaker Series sponsored by the Chappy Island Association and the Chappy Community Center



Including a checklist and resource guide to help us all
“**Live ChappySmart!**”

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This booklet marks the beginning of a Chappy-wide communications campaign to drive home the importance of being proactive in addressing climate change mitigation and adaptation, and to encourage volunteering for the Community Emergency Response Team (CERT) to ensure our safety in the event of a major weather occurrence.

Let's All Live Chappy Smart!

Dear Residents of Chappaquiddick Island:

It is time that we face the reality that Chappy is a 'sitting duck' for the impacts of climate change. This Booklet, prepared by the CIA Environmental Committee, is for the purpose of creating awareness of the risks to our highly vulnerable island and help guide us toward a sustainable future—how we can **Live Chappy Smart!**

We have all seen rising sea-levels, coastal erosion from higher tides and stronger storms, more ferry shutdowns, deteriorating salt marshes, rising temperatures and extensive droughts, endangerment of wildlife species, highly toxic creatures invading our grasses, spreading of invasive plant species, negative effects of warmer water on sea-life, and infusion of salt and nitrogen in our drinking water. The best we, as humans, can hope for is the mitigation of the world's temperature rise so it does not exceed 2-degrees Celsius above pre-industrial times. Climate change will almost certainly increase between now and the time the temperature rise levels off—especially given that it continues to increase at an alarming rate. Whatever happens, scientists say, the results of climate change will never go away—at least not until the next ice age. We can only strive to reach a point when it will not get worse.

Many factors will impact mitigation of climate change—including politics, energy sources, and personal lifestyle. We, as Chappy residents, are fortunate to have the capacity to make positive contributions to each of these factors, albeit within the limits of our small piece of the world. The hope of the CIA Environment Committee is that the attached Guidelines and Resources that evolved from the lessons learned during our four Zoom Sessions with scientists and experts will demonstrate to each of you that you have a critical role to play toward the preservation of our special place.

Together, we can make a difference. We must all strive to **Live Chappy Smart!**

Sincerely,

The CIA Environmental Committee

“It is time that we face the reality that Chappy is a 'sitting duck' for the impact of climate change.”

THE CIA ENVIRONMENTAL COMMITTEE

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The Chappaquiddick Island Association (CIA) works to promote the welfare and to operate in the best interests of the Island of Chappaquiddick and of those who make it their permanent or seasonal home. We aim to preserve the beauty and charm of the island, and to maintain its ecological and environmental character.

Two years ago the CIA Environmental Committee was formed with the goal to clarify the effects of climate change on Chappy and identify the pending risks. CIA Board Member and Chair of the Committee, Pete Taft, brought together 15 energetic and committed members, many of whom have impressive qualifications in environmental fields. The Committee was given a mandate to gather information and develop methods of sharing its knowledge with our community.

Since its inception, the Committee has tackled a broad range of issues that focus on preserving the well-being of our unique island. With leading environmental experts, the Committee was able to identify the highest priority issues and communicate them to our community through four successful “Zoom” sessions. What we have learned from these sessions, orchestrated by Bruce Fowle and presented (with technical help from the CCC) in the late summer and fall of 2020, is in this Booklet in the form of Abstracts along with Guidelines For Preserving Chappy In Our Changing Climate and Resources: Where To Find Information Relating to the Guidelines. The Booklet is available both on-line at <https://chappaquiddickislandassociation.org/> and in print.

The Booklet marks the beginning of a Chappy-wide communications campaign (Live ChappySmart!) to drive home the importance of being proactive in addressing climate change mitigation and adaptation, and to encourage volunteering for the Community Emergency Response Team (CERT) to ensure our safety in the event of a major weather occurrence. We welcome your support and strongly encourage you all to participate in these essential activities.

The Board of the Chappaquiddick Island Association

How to Live Chappy Smart!

REDUCING CARBON FOOTPRINT

1. Support Edgartown's commitment—100% renewable energy by 2040—50% by 2030.
2. Install solar panels at your home—utilize current tax rebates.
3. Use all-electric heating/air-conditioning/hotwater heater heat-pump systems.
4. Insulate your home—minimize infiltration.
5. Use only LED lighting—consider motion detector switches.
6. Bike and/or use public transportation.
7. Make your next car or boat all electric or hybrid.

ADAPTING TO SEA LEVEL RISE

1. Proactively support Edgartown's efforts to adapt the ferry.
2. Coordinate addressing beach and bluff erosion with your neighbors and the Martha's Vineyard Commission.
3. On bluffs, stop all forms of above/below grade irrigation—it softens them.
4. Help marshlands migrate to low-lying areas.
5. Stop building in wetland and floodplain areas—if you must build, build resiliently, sustainably and use only permeable paving.
6. Familiarize yourself with the flood maps and vulnerability projections for your home.
7. Prepare to retreat or relocate if you are vulnerable.

ADAPTING TO TEMPERATURE RISE

1. During droughts, take precautions to prevent forest fires.
2. Prepare for increasing high-humidity/heat days — staying in conditioned space will be a necessity.
3. Maintain forest cover for shade.

UTILIZING LOCAL FOOD SOURCES

1. Grow your own vegetables and/or use local farming and community supported agriculture—"CSA".
2. Do regenerative agriculture at home—mulch, cover, and diversify crops.
3. Use cover crops in home gardens—avoid synthetic fertilizers.
4. Compost for yourself or deliver to Slip Away Farm.



How to Live Chappy Smart!

MAINTAINING THE ECOLOGY

1. Control ticks—reduce rodents—wear protective clothing.
2. Save birds—make your windows bird-friendly— focus exterior lighting down.
3. Use only native species for gardens and grasslands with natural fertilizers.
4. Use only non-toxic cleaners, soaps and sprays.
5. Help marshlands and coastal embayments thrive — upgrade your septic system with a denitrifying field.
6. Stop using single-use plastics—re-use or recycle all containers.

SAVING THE AQUIFER

1. Minimize the use of freshwater—use only low -flow fixtures and shower heads.
2. Reduce lawn areas and/or eliminate watering.
3. Test your water regularly for salt water intrusion—report results to the committee.
4. Support funding to re-establish freshwater monitoring wells to measure aquifer “mining.”
5. Upgrade your septic system to a “layer cake” denitrifying field.

PREPARING FOR EMERGENCIES

1. Prepare to shelter in place—purchase an emergency kit with food and supplies for up to five days—Chappy fire house only accommodates 25 people with food for three days.
2. Don't leave Chappy unless you have enough time to get to the other side of the Bourne Bridge—there will be no place of refuge on the Vineyard or the Cape.
3. Join the volunteer Chappy Community Emergency Response Team (CERT) currently in formation.
4. Add battery back up to your solar panel system.
5. Remember to use 911 for all emergencies.

CHANGING YOUR LIFESTYLE

1. **Live ChappySmart!**

See Resources for related information.

For ready access to links, go to www.chappaquiddickislandassociation.org



Live Chappy Smart!

Resources for Further Study, Action

WHAT'S HAPPENING ON MARTHA'S VINEYARD AND AROUND THE WORLD

Island Climate Action Network (ICAN) <https://www.islandclimateaction.org> has consolidated and coordinated all MV efforts to date and sends out regular newsletters and updates. Their "Resources" covers all known studies and reports for the Island's climate change efforts.

Vineyard Conservation Society (VCS) <http://www.vineyardconservation.org/a>. Check out Liz Durkee's 15 articles from the Vineyard Gazette about how climate change will impact our lives and communities.

For a comprehensive view of what's happening in Edgartown and a resource guide to all studies relating to the Vineyard, <https://www.mvcommission.org/sites/default/files/docs/Edgartown%20Climate%20Change%20Context%202020%20FINAL.pdf>

The International Panel for Climate Change (IPCC) is the premiere resource for the earth's current condition: <https://www.ipcc.ch/>

For a book on the ecology of the Vineyard, *The Meeting of Land and Sea: Nature and the Future of Martha's Vineyard*, By David R. Foster.

2021 EPA report: <https://www.epa.gov/climate-indicators/atlantic-coast>. Available at Amazon.

CARBON FOOTPRINT

The Vineyard Sustainable Energy Committee (VSEC) proposed a resolution for 100% renewable energy on the Island by 2040. This was ratified by Edgartown at the town meeting 22 May 2021. <https://vineyardgazette.com/news/2021/05/27/local-efforts-lead-way-combating-climate-change>

Cape Light Compact (<https://www.capelightcompact.org/>) does free energy audits for homes and advises on upgrades of heating/cooling and photo-voltaic systems, for which there are various rebates.

Vineyard Wind <https://www.vineyardwind.com/> and the U.S. Bureau of Offshore Energy Management (BOEM) received approval for this by the Biden administration in May, 2021.



Resources for Further Study, Action (continued)

SEA LEVEL RISE

For the Vulnerability Assessment and Adaptation Study for the Chappy ferry (in progress),

[EdgartownMVP_Vulnerability_20201119_T](#)

[EdgartownCCVA_Task2Pt2Memo.pdf](#)

MV Commission's Climate Action Task Force (CATF) <https://www.mvcommission.org/climate-change> is addressing adaptation and emergency response. They are working with the consultants Woods Hole Group (WHG) <http://www.woodsholegroup.com/>.

The National Oceanic and Atmospheric Administration (NOAA) <https://www.noaa.gov/categories/climate-change> is a resource for updates on sea-level rise and changing climate conditions. For other sources, <https://www.usgs.gov/centers/whcmssc>, <https://www.woodwellclimate.org>, and <https://www.whoi.edu>.

For the vulnerability of your property for hurricanes, flood, tsunamis and the like, go to the interactive map <https://dukescountygis.maps.arcgis.com/home/webmap/viewer.html?webmap=2bd85c79e738499e892ab97224b63253>

For erosion issues, <https://vineyardgazette.com/news/2021/02/04/erosion> and <https://scholarworks.umass.edu/cgi/viewcontent.cgi?article=1266&context=theses>, and Cornelia Dean's book *Against The Tide, The Battle For America's Beaches* —available at Amazon.

For coastal landscaping, <https://www.mass.gov/service-details/stormsmart-coasts-coastal-landscaping-in-massachusetts>

For Mass Coastal Protection Act, <https://www.mass.gov/regulations/310-CMR-1000-wetlands-protection-act-regulations>

For resilient home design, <http://www.resilientalliance.org/> and <https://www.enterprisecommunity.org/solutions-and-innovation/disaster-recovery-and-rebuilding/keepsafe>

TEMPERATURE RISE

For a recent article on the severity of high Temperature/humidity days, <https://www.nytimes.com/2021/03/08/climate/climate-change-heat-tropics.html>



Resources for Further Study, Action (continued)

For drought preparedness and water conservation, <https://www.redcross.org> or <https://www.drought.gov>

FOOD

For local farming and CSA, <https://www.slipawayfarm.com>

For advice on home gardens and landscaping, <https://sustainabilityx.co/15-sustainable-gardening-ideas-b22be80dfc7f>

ECOLOGY

To protect against tick borne illnesses: 1) eliminating debris and leaf litter in your yard to reduce the number ticks on your property; 2) wearing tick protective clothing and insect spray on exposed skin whenever outdoors, and; 3) checking for ticks routinely when returning inside to detect them before they imbed. See: <https://www.dukescounty.org/mv-tick-program> and <https://www.mass.gov/info-details/tick-borne-disease-prevention>

For bird-friendly glass, go to the guidebook, <http://www.abcbirds.org>. For exterior lighting, see <http://www.darksky.org>.

For the impact of nitrogen on marshlands, <https://www.woodwellclimate.org/tide-project-reveals-not-all-nitrogen-is-equal/>

For local recycling, <http://www.mvrefusedistrict.com/recycling.html> and <https://www.mvtimes.com/2021/05/19/climate-solutions-plastics-recycling-can-better/>

For eco-friendly cleaning products, <https://www.goodhousekeeping.com/home/cleaning/g35665355/eco-friendly-cleaning-products/>

For eco-friendly landscaping, <https://greenscapes.org/wp-content/uploads/2019/09/Greenscapes-Guide-2019.pdf>

AQUIFER

For general info, <https://www.usgs.gov/special-topic/water-science-school/science/groundwater-decline-and-depletion> and <https://www.savebuzzardsbay.org/news/new-nitrogen-reducing-septic-systems-help-protect-clean-water-in-westport/>

For a diagram of saltwater intrusion, <https://www.epa.gov/arc-x/climate-adaptation-and-saltwater-intrusion>



Resources for Further Study, Action (continued)

For water testing, get a sterilized contain from the Edgartown Dept. of Health in the Town Hall, follow the guidelines and return the filled container to the same department. They do the rest. Fees are per: <https://wampanoagtribe-nsn.gov/water-testing>

For denitrifying septic systems, <https://www.savebuzzardsbay.org/wp-content/uploads/2017/07/West-Falmouth-Nitrogen-Reducing-Septic-System-Demonstration-Project-May-2017-status-report.pdf>

EMERGENCY PREPAREDNESS

Duke's County CodeRED alert system is critical for getting emergency notificatiions. Register at <https://www.dukescounty.org/public-safety/pages/codered-emergency-notification-system>

Community Emergency Response Team (CERT) is a volunteer program established by the Department of Homeland Security, <https://www.ready.gov/cert> or <https://www.fema.gov/community-emergency-response-teams>. Chappy's is in formation and looking for volunteers.

For emergency kits, go to <https://www.ready.gov/kit>. The CERT will be making recommendations specifically for Chappy.



See Zoom Abstracts for lessons learned specifically relating to Chappy.



The sea is rising. How will it affect Chappy? Here's the hard data and informed opinion.

SESSION I

Sea Level Rise and Coastal Flooding and Its Impacts on Chappy

PARTICIPANTS

Rob Thieler, *US Geological Survey, Woods Hole Coastal and Marine Science Center*

Liz Durkee, *Conservation Agent for Oak Bluffs*

Thieler: Impacts of Sea Level Rise

Where we're going looks nothing like where we've been

Sea level rise (SLR) is one of the most certain impacts of climate change (CC). Recent projections suggest that SLR will rise between 1 and 8.2 ft by 2100—more than likely in between these extremes. (*Current FEMA maps of Chappy show potential flooding as high as 10' to 17'*). Coastal issues today will likely get worse, increasing in extent and magnitude. Effective adaptation will require changing approaches to coastal management.

- How much and how fast SLR will occur depends on future emission pathways, and the behavior of large ice sheets. Loss of West Antarctic ice sheet could cause 25% more SLR.
- *Effects* include bluff erosion, over wash, island breaching, species impacts, ecosystem changes, infrastructure failures, water quality reduction, urban inundation, threshold crossing.
- *Better science* needed to prepare us for CC, especially in coastal areas, “science” meaning better understanding of processes and better situation awareness. We’re entering a period of uncertainty and scientists will make predictions that will and will not happen. Leadership must accept and prepare for an extended period of uncertainty and the reality that CC adaptation infrastructure takes a very long time to build. “Being uncertain is okay. But it’s not an excuse for not taking action.”

Sea-level Rise Projections

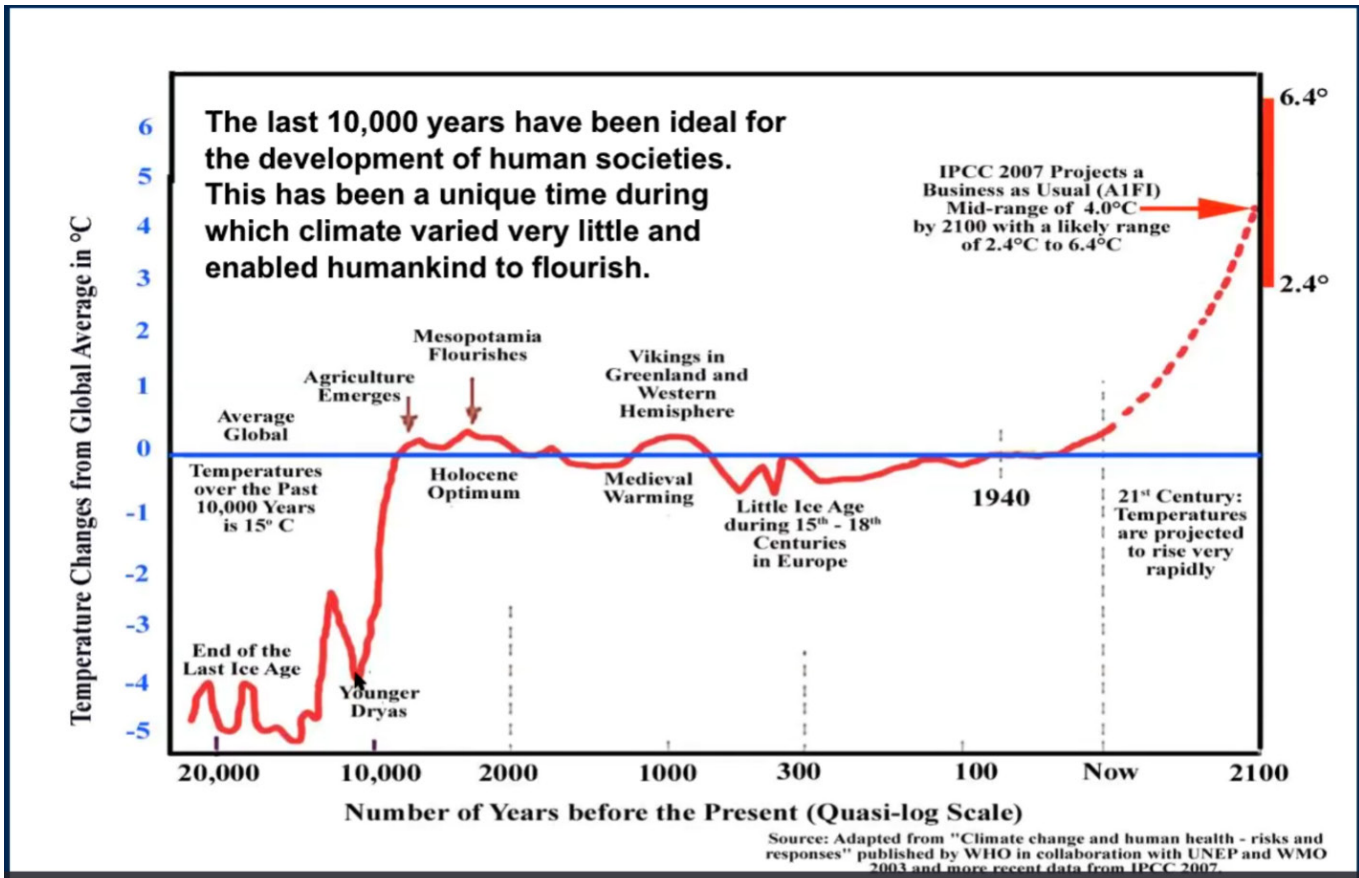
NOAA Global Mean Sea Level (GMSL) Scenarios for 2100

RCP 2.6
RCP 4.5
RCP 6.0
RCP 8.5

Rob Thieles

(Sweet et al., 2017)

GLOBAL AND REGIONAL SEA LEVEL RISE SCENARIOS FOR THE UNITED STATES

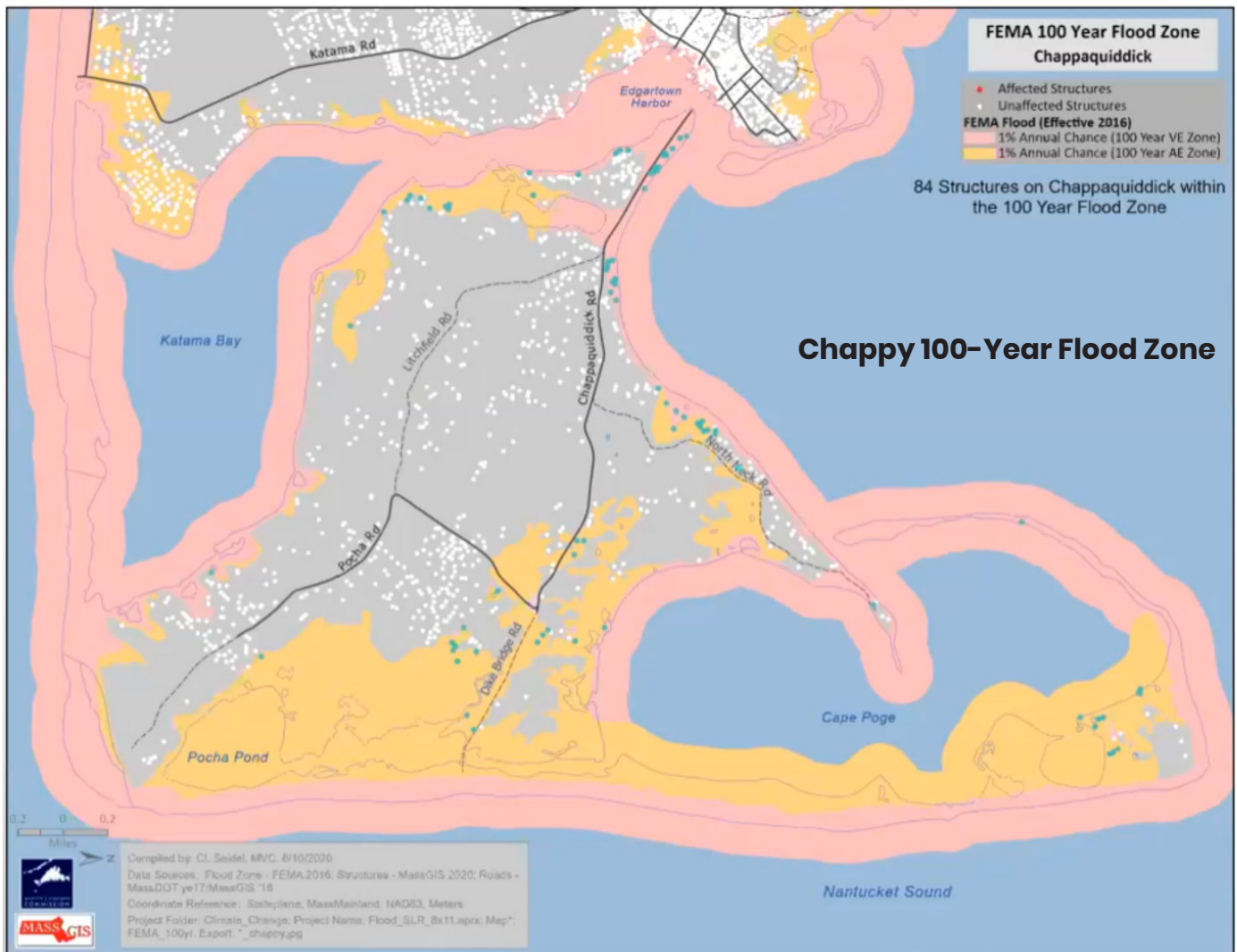


Durkee: SLR Impacts on Chappy

Now is the time to get funds from the State and feds to address SLR. There is lots of competition and cities will likely elbow in later. Grab them while you can.

- Make sure the community is involved in the *grant process*. Applications are getting complicated and there are finite and decreasing dollars at the federal level. Critical that the town of Edgartown makes the ferry a priority in its vulnerability study and the Chappy residents are proactive in that process and ensure that it proceeds to a more detailed level of analysis.
- Apart from the ferry and its access roads, Chappy's *challenges* tend to be mostly natural landscapes—unlike Oak Bluffs with infrastructural issues. Nature-based solutions are best. Need to include CC in all planning while prioritizing issues and sites. Chappy should participate in MV Commission's CC master plan process. Managed "retreat" is a necessity—such as the Squibnocket causeway and Gay Head lighthouse relocation.

- There are 84 structures within the 100-year Chappy flood map area. We must not allow new buildings in floodplains. If you currently live in a FZ, there are remedies—landscaping, moving utilities, etc. Perhaps houses can be raised. Oak Bluffs required planting in flood zone properties to protect against erosion and to enhance water absorption.
- Salt marshes are seriously endangered by SLR. Recommends more study of salt marshes. Coastal ponds are getting warmer and more acidic. MV shellfish group is pro-active in addressing this.



- *Beach erosion* has a wide variability of predicted rates of change. There is a USGS projection on its website. Some beaches might look good for a while, given the movement of sand, but can rapidly deteriorate. Marshes can also look great until they suddenly collapse.
- *Saltwater intrusion* in wells is a problem on Chappy. MA Municipal Vulnerability Program (MVP) is addressing that and the MV Commission is developing an island-wide adaptation plan - currently in phase 2. The Trustees have a similar grant.
- Oak Bluffs commissioned a SLR expert from Holland who recommended: 1) channeling the water where you want it to go; 2) connecting people to the solution; 3) improving economic value of the sites; 4) favoring natural remedies and; 5) thinking long-term.

Takeaways

Future SLR and coastal erosion is a given. Major changes are taking place, driven by human activity and changing climate that will have uncertain impact. “Informed preparation” is key.

We must develop flexible options, holistically examine potential impacts, think about timelines, review risk tolerances, establish protocols, identify the areas we know are going to flood—all with no real certainty of the gravity of what might happen.



What if we have to evacuate or shelter in place? Four experts weigh in.

SESSION II

Emergency Preparedness

PRESENTERS

Alex Schaeffer, Edgartown Fire Chief and Emergency Response Manager

Noli Taylor, Aquinnah Community Emergency Response Team

RESPONDERS

James Hagerty, Edgartown Administrator

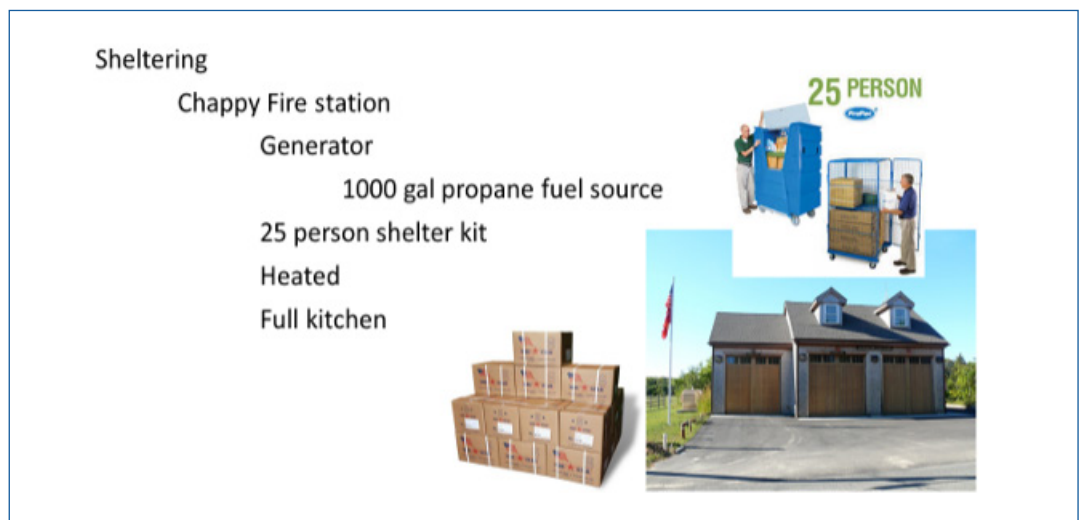
Peter Wells, Chappy Ferry Operator

Schaeffer: Edgartown

Edgartown has a lot of emergency response systems in place and continues to improve the preparedness on Chappy, much of which is awaiting funding.

- 911 is now the *only number* you should call to reach a local dispatcher for fire or police. Do *not* call the ferry—it will only delay the process. ~3% of Dukes County 911 calls now come from Chappy. Fire Alarm calls will automatically dispatch Ambulance, Police, Chappy Tanker—and, as needed, “mutual aid” that may come from other towns that can provide 4wd emergency vehicles to access remote locations. EFD a vehicle capable of reaching Cape Poge with 300 gallons of water. EFD received 361 calls in the past nine months—6% were from Chappy.
- Emergency *sheltering capacity* at the Chappy Fire Station is at 25 people, including water and food for a limited number of days. Schaeffer does not consider the Community Center an option. More important that residents prepare for sheltering in place with emergency kits and food and water for 5 days.

- *Emergency Preparation Planning* is funded mostly by MEMA, plus a 5% match covered by DCFCA, MVLB, Sheriff’s Meadow, Trustees, CDR. This includes: creating “Wildfire Adaptive Communities;” in-ground water sources (we now have 2 with 2 being added); a “standalone” communication system that currently leverages Katama silo, Chappy’s tower, and Edgartown water tower; and running drills to prepare for extreme high-tide scenarios. CDR will do home visits to explain what you can do to lower risk.



Taylor: Aquinnah

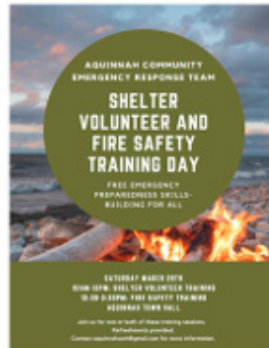
There are many similarities between Chappy and Aquinnah – small islands separated from the mainland.

The “Aquinnah Community Emergency Response Team” (CERT) started with a community meeting: fire chief, police chief, emergency planner, and community members that included dinner. The CERT program is a standardized system established by the US government that is available on the web: www.community.fema.gov/cert

- The program *educates volunteers* about disaster preparedness for the hazards that may impact their area and trains them in basic disaster response skills, such as fire safety, light search and rescue, team organization, and disaster medical operations.

- *Sheltering* focuses on scenarios where residents are cut off from mainland. Wampanoag Community Center has been certified (after much work and coordination) as an overnight shelter. The Town Hall can serve as a daytime, warming shelter. That required a modest effort to put together what was needed.
- *Radios* have been distributed to “neighborhood captains” in coordination with fire and police personnel – and this is being expanded. A microgrid is being developed to ensure electricity continuity during emergencies.
- Aquinnah has taken it on as a *community effort* to expand this function since in all towns the “emergency planner” position is a part-time job. aquinnahcert@gmail.com is used to request info and reach out for training.

Trainings and education



Wells: The Status of the Ferry

- In the event you find yourself in an emergency, use 911—yes, it works on Chappy! Please don’t call the ferry.
- MVP (Municipal Vulnerability Program) is in *progress*—intended to address things such as egress during extreme high tides. Our ferry is listed among the most vulnerable elements in Edgartown.

Hagerty: How Much Can the Town Do?

- Planning can and should be something to make you *believe in your future*, as opposed to being afraid of it.
- The town doesn't not have the *resources* to cover all the expenses necessary to deal with these climate change issues. The process of acquiring grants from the State and other sources will take time and must be done strategically.

Takeaways:

We must be proactive in establishing and signing up volunteers for a CERT.

It is critical that we actively support the Town's efforts for emergency preparedness to secure our safety.



Strategic retreat. Beach armor. Property vulnerability. The facts around our shrinking coastline.

SESSION III

Coastal Erosion and Accessibility

PRESENTERS

Richard Murray, Deputy Director and VP for Research, Woods Hole Oceanographic Institute, and a long-time Chappaquiddicker and Cape Pogueur

Cornelia Dean, Journalist and Author of *Against the Tide: The Battle for America's Beaches*, and a long-time Chappaquiddicker

Joseph Famely, Senior Scientist, Woods Hole Research Group

RESPONDERS

Jane Varkonda, Edgartown Conservation Agent

Peter Wells, Chappy Ferry Operator and long-time Chappaquiddicker

Murray: Impacts of Global Temperature Rise

Rick cited not just his professional experience as a scientist but also his experience on the select board of Scituate, MA, where multiple properties have repeatedly absorbed federal funds for rebuilding after flooding in coastal storms. He offered these major thoughts:

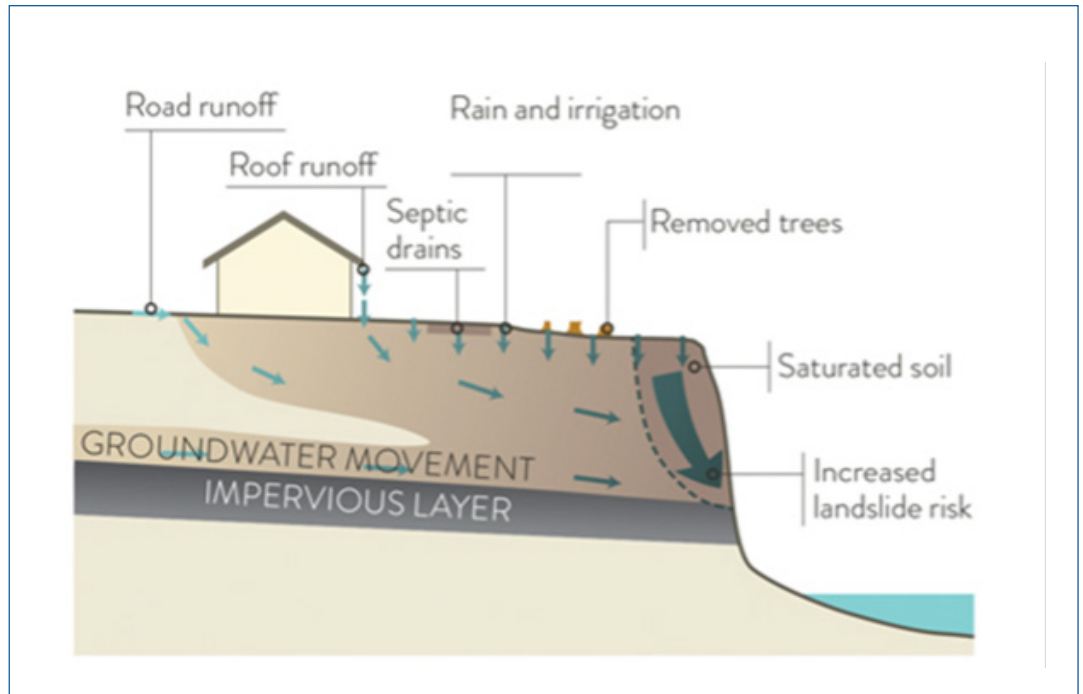
- As a result, it will not be possible to maintain all our coastal infrastructure. Instead, he said, we must “*retreat strategically*.” He noted that, historically, this is what we used to do when buildings or other infrastructure were threatened by coastal flooding. He said, “what we need to do is what we used to do”— i.e., get threatened infrastructure away from rising water.
- We can accomplish this task, but only if we reconcile ourselves to making a series of hard decisions “at all levels.” He added, “it is up to us to make the *hard decisions* because we control our fate.”
- We need to change the “*social architecture*” of insurance, tax breaks and other incentives that reward unwise decisions about coastal infrastructure.

Dean: Beach and Bluff Erosion

Beaches are inherently *impermanent landscapes* that change shape even on ordinary days and can erode dramatically in response to storms and sea level rise. If this erosion threatens buildings or other infrastructure, we experience it as a problem, but these changes are often necessary if the beach is to maintain itself as it responds to sea level rise by moving inland, to higher ground.

- Interfering with this erosion—with *coastal armor* like seawalls, by trapping sand with groins, fences or other structures, or by other methods -- may improve things in one spot, but almost always this improvement means another spot is robbed of sand it would otherwise receive. Absent continual sand pumping, putting coastal armor on an eroding beach will almost inevitably result in the drowning of that beach.
- Therefore, when we consider these kinds of *coastal intervention*, we must weigh the value of the infrastructure we seek to protect against the value of what will be lost—the beach.
- Any sources of freshwater penetrating the soil of a bluff will cause it to soften and erode.





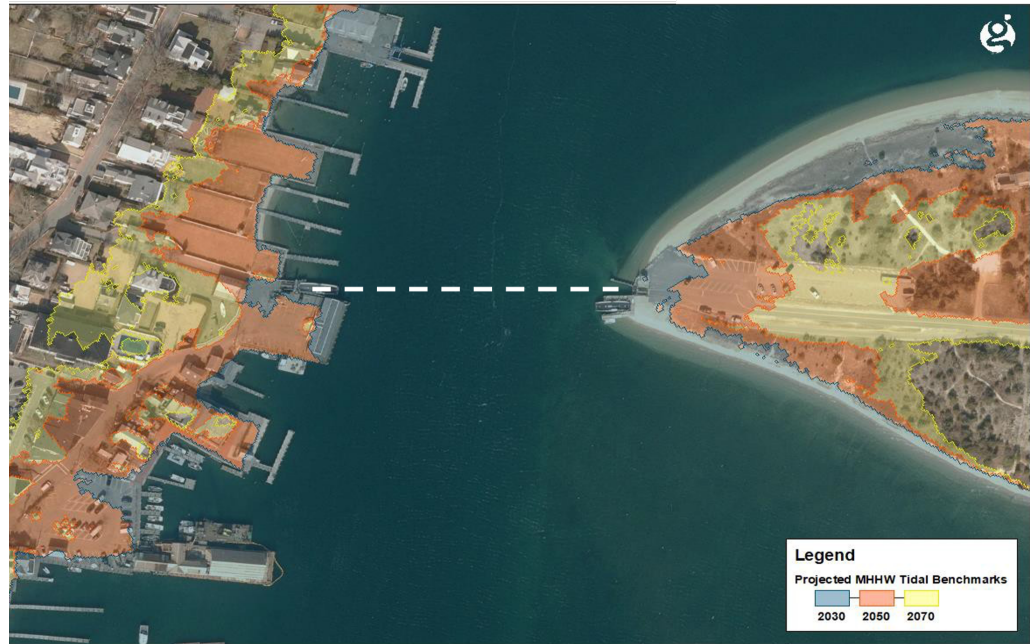
Famely: Ferry Study

Edgartown’s MVP Vulnerability Assessment Study undertaken by the WHG indicates a high vulnerability to flooding from storms and sea level rise. Decisions we as a society have made in the past have left us with “some hard choices.”

- The assessment aims to determine the *vulnerability of particular infrastructure to inundation*, and the consequences for the town if a particular bit of infrastructure is taken out of operation, temporarily or permanently. Where there is high vulnerability plus high consequences there is high risk. That is, these are high priority situations.
- The *most vulnerable assets* are concentrated in and around the downtown waterfront area, including the Chappy Ferry, various municipal parking lots in the downtown area, and Harbormaster facilities. These vulnerable facilities include the critical connection to Chappaquiddick Island and infrastructure that supports revenue generation for the Town (parking lots in the commercial district and public piers/docks).

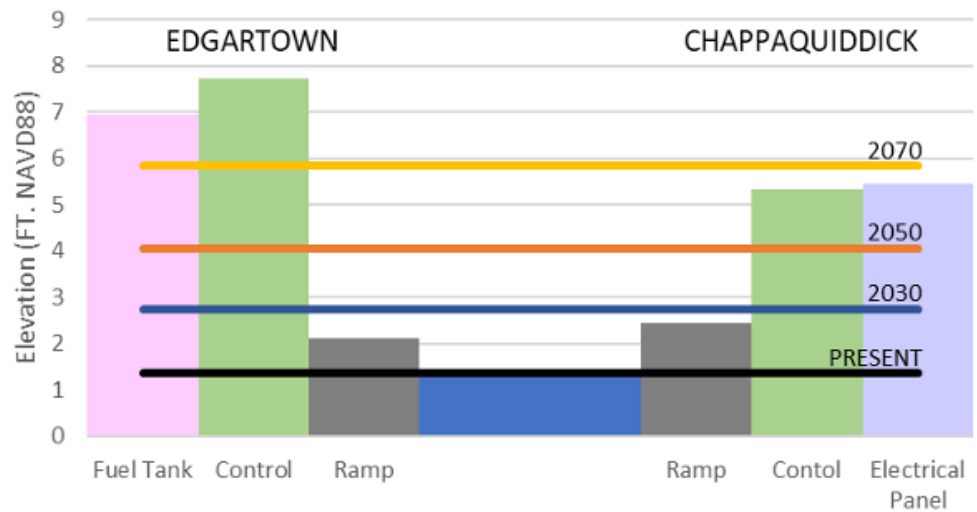
MHHW Projections for Edgartown Harbor

	Present	2030	2050	2070
MLLW	-1.3	0.1	1.4	3.2
MLW	-1.1	0.3	1.6	3.4
MTL	0.0	1.4	2.7	4.5
MHW	1.1	2.4	3.7	5.5
MHHW	1.4	2.7	4.0	5.8



- The situation is *complicated*. It can be difficult to predict the effects of wave run-up or storm surges, for example, as well as the effects of inundation behind sea walls or the like.
- At the *Chappy ferry*, flooding that once occurred possibly once a year seems now to occur far more often—even monthly. In the coming decades, much of the Chappy ferry infrastructure will have to be altered/replaced. Ramp and highway access is already an issue.
- There are several approaches to *protecting infrastructure* against inundation. These are: avoid (establish “no build areas”); accommodate (by, for example, elevating structures); protect (with coastal armor like seawalls); and retreat (relocate the infrastructure).
- When asked about *sand piling up* where it is not wanted, for example in spots in the harbor. Rick noted that in theory this sand could be moved to places where it is needed, but that regulations can restrict approach or even make it impossible. These regulations need to be looked at, he said.

Nuisance (MHHW) Flooding Chappy Ferry Assets



Varkonda

The town is *working with the committee* in supporting Vulnerability Assessment Study it is also looking into options to maintain the Town’s recreational beaches as well as options for retreat.

Wells

Some ferry equipment/infrastructure is already being elevated but noted that “the *ferry cannot operate safely in high water.*” He said that when he advises people that driving through salt water to reach the ferry ramp will damage their cars, they almost always ignore the advice.

Notes:

- The MVP Edgartown Vulnerability Assessment Study was originally planned to be completed by the end of 2020. Subsequent to the presentation, the ferry was selected as one of the three priority areas for detailed analysis. However, the study has been delayed and, as of 4/7/21, is has not been completed.
- To assess the interactive map showing the vulnerability of your property, go to this link:

<https://dukescountygis.maps.arcgis.com/home/webmap/viewer.html?webmap=2bd-85c79e738499e982ab97224b63253>

Takeaways:

We must be forthright in planning to relocate our infrastructure (“retreat”).

We must reach a consensus and establish guidelines to mitigate beach and bluff erosion in a manner that will allow nature to take its course.

We must be proactive in assuring that the ferry is treated by the town as a top priority and in seeking funds to take the study to the next stage.



There's more at stake than just rising sea water. Our land is being affected too.

SESSION IV

Global Warming: How Will It Impact the Land and How Can We Mitigate It?

PARTICIPANTS

Christopher Schwalm, Senior Scientist, Woodwell Institute

Chris Neill, Senior Scientist, Woodwell Institute

Jonathan Phinney, Oceanographer, U.S. Fish and Wildlife

Alton Stone, Environmental Engineer, Alton Engineering

Lily Walter, Owner, Slip Away Farm

Schwalm: Impacts of Global Warming Related to Temperature Rise

Extended *periods of drought* that previously occurred once in every 100 years will progress to once in every 5 years if the temperature of the earth is allowed to increase by 3 degrees C above the preindustrial age. Concurrently, the number of days will increase when the wet-bulb temperature (humidity) will exceed what is tolerable for humans to exist in unconditioned space.

- With an all-out global effort to reduce carbon emissions, there is a chance that we can hold the *temperature* to a maximum increase of 2 degrees C. This might reduce the likelihood of a major drought in our area to once in 50 years or so. Every effort must be made to reduce our carbon footprints and minimize CO₂ in the atmosphere.

Warming is a choice variable

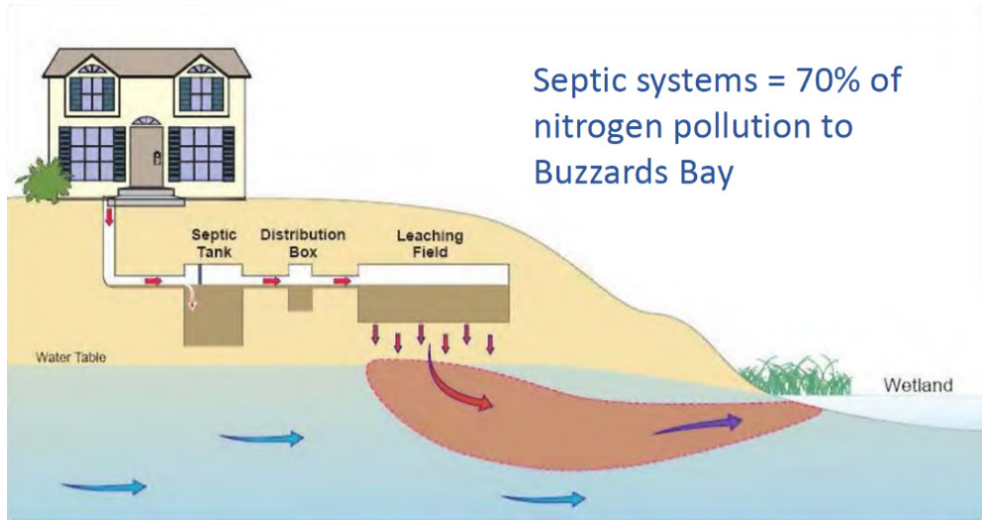
Scenario	Warming			
	1.5°C	2.0°C	2.5°C	3.0°C
Sustainability (Taking the Green Road) (SSP1)	2024	2055	!	!
Middle of the road (SSP2)	2025	2043	2063	2086
Regional rivalry (A Rocky Road) (SSP3)	2025	2039	2052	2065
Fossil-Fueled Development (Taking the Highway) (SSP5)	2023	2036	2047	2056
“Business-as-usual” (RCP8.5)	2025	2039	2051	2062

Neill: Ecosystems and Biodiversity

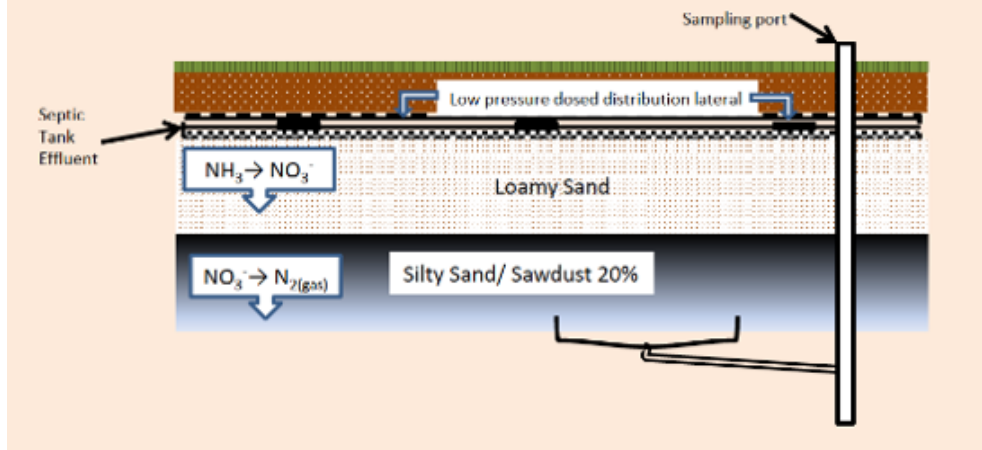
Aerial photos of the shore in Falmouth MA when compared to Chappaquiddick demonstrated the negative *impacts of trying to manipulate nature* by controlling the movement of sand with seawalls, jetties, riprap and the like. We should not make the same mistake.

- *Marshlands* need to be protected while preparing for the reality that they are going to move inland to higher elevations as sea-level rises. Efforts should be made now to assure that the future marshland spaces on higher ground are in a natural state and ready for transition.
- Many of our marshlands are deteriorating as a result of *excessive nutrients* (nitrogen) seeping out of our septic systems. This reduces the root systems, thereby weakening the grasses and their ability to withstand weather events and higher tides. Our leaching fields should be upgraded to denitrifying type systems:

Typical System



Denitrifying Septic Field



- *Grasslands* must be retained to stabilize the ecosystem. Lawns should be minimized and replaced with native plantings to provide habitat for birds and other wildlife while reducing water usage.
- *Glass in buildings* kill up to one billion migrating birds a year in North America. Residents should install bird-proof films or screens on their windows, as recommended by the American Birding Conservancy. <https://abcbirds.org/glass-collisions/>

Walter: Agricultural and Gardening Practices to Mitigate Climate Change

Agriculture produces 10% and the food industry contributes 30% of CO₂ in the atmosphere. 75% of the earth's soil has been degraded and most soils have lost 30-75% of original organic carbon to the atmosphere.

- It is important to use *regenerative agriculture* that is achieved through reduced tillage, mulches and ground covers, diversifying planting, cover crops, elimination of synthetic fertilizers.
- *Reduced tillage* keeps soils alive and healthier. Covering soil with plastic sheeting for a week or so is all that is necessary to prepare it for planting. Use mulch and ground cover such as leaves, black plastic, woodchips, grass clippings, and cardboard.
- In *personal gardens*, grow what wants to grow on Chappy: perennial crops like carrots, squash, and cucumber. Tomatoes do not do well. Use cover crops in spring: oats, peas, clover. Summer: buckwheat. Fall: Tillage radish, rye, and vetch.
- *Support* local organic farming and sign up for a GSA system.

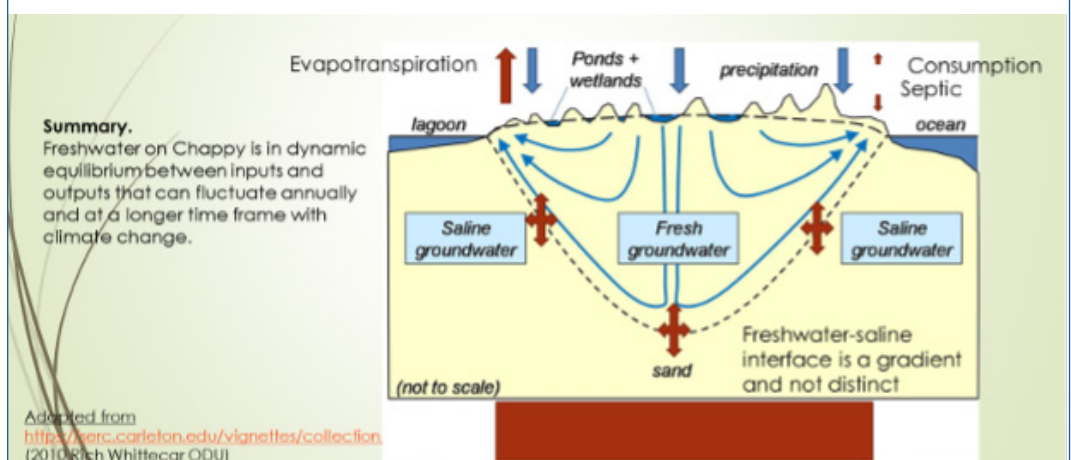


Phinney/Stone: Freshwater Supply

There are 5 water sheds on Chappy that feed its aquifer which is separate from other aquifers on Martha's Vineyard. Thus, we are the sole users. The "lens" is deepest in the middle of the island and is formed by a dynamic equilibrium between supply and demand. Areas closer to the water are more susceptible to saline intrusion from high tides and sea-level rise. Droughts, sea-level rise, septic seepage and over-building are the biggest threats to retaining an adequate supply of freshwater.

- An *aquifer study* done from 1998 through 2009 included 18 monitoring wells (2" plastic pipes to below sea-level) placed in various parts of the Island. Testing indicated that 13 wells exceeded the recommended level for a low-sodium diet and 2 wells had excessive nitrate levels.
- In 1999, estimated *elevations of the aquifer above sea-level* in May ranged from less than 1' to over 3'. Levels in August averaged about 1'. The theoretical aquifer thickness in May ranged from 19' to 128' and the drawdown in August ranged from 19' to 84'.
- While the *mining of the aquifer* in 1999 may have been sustainable, it is doubtful that it will continue to be with more development and water usage and the impacts of climate change.

Model Aquifer through a barrier island (like Chappaquiddick)



18 monitoring wells were drilled across Chappy representing all five island watersheds



Measured aquifer height and theoretical lens thickness over the 1999 summer (dry season)

<u>Location</u>	<u>Piezometric Elevation (ft)</u>		<u>Theoretical Aquifer Lens Thickness (ft)</u>		
	May 1999	August 1999	May 1999	August 1999	Delta
Sampson Hill	3.20*	2.1*	128	84	- 44 (ft)
MW-1, Chappaquiddick Fire Station (School Road)	2.37	1.27	95	51	- 44
MW-3, Edgartown Lot (Enos Lots complex)	1.72	0.78	69	31	- 38
MW-7, Welch hayfield	0.79	0.47	32	19	- 13

* Estimated.

Takeaways

We must do all we can to reduce our carbon footprints to control the rise of the earth's temperature.

We must reduce our nitrogen output into the coastal bays and ocean by upgrading our septic fields to save our marshlands and aquifer.

We must prepare for future marsh migration inland by preserving low-lying areas from development.

We must support local organic farming, utilize GSA, and grow more of our own vegetables using reduced tillage techniques and cover crops.

We must preserve our aquifer by reducing our freshwater usage, upgrading our septic systems and limiting fertilizers and other chemicals that quickly percolate through the sandy soil.