JAMES POND
Individual System Assessment

Photo Credit:
Martha's Vineyard Commission,
August 2020

Prepared by:

Martha's Vineyard Commission

RJS Development Solutions

Horsley Witten Group

Funding Provided by:

MassDEP

Acknowledgments:

The Martha's Vineyard Commission would like to acknowledge all the contributors to this detailed watershed assessment.

- *James Pond Working Group Members*
- *The Town of West Tisbury*
- *The Martha's Vineyard Shellfish Group*
- *The Buzzard's Bay Coalition and The Woods Hole Group*
- *Chris Murphy for his tireless dedication and contributions as the Chairman of the Up-Island Watershed Management Committee*

February 2023

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RELEASE NOTES

Release of James Pond – Individual System Assessment Report

The Martha's Vineyard Commission, in partnership with MassDEP, Town Officials and the James Pond Up-Island Management Plan Working Group, is developing a framework for up-island watershed management. The primary goal of this effort is to develop and implement water quality mitigation strategies that apply to up-island Ponds. Initial attention will be paid to: James Pond, Chilmark Pond, Menemsha Pond, Squibnocket Pond, and Tisbury Great Pond. The report you are receiving today, the James Pond Individual System Assessment, represents completion of the first of four "acts" that will help us achieve our primary goal, which is to clean our up-island ponds.

This Individual Assessment Report, "Act I", articulates environmental conditions found in James Pond and represents a multi-disciplinary approach to understanding many of the factors that contribute to impaired water quality in the Pond. Based on numerous studies completed in the past, as well as 2021 data and analysis, this report describes the: Watershed, Physical Features, Water Quality, Biological Conditions, Socioeconomic Conditions and Land Conservation.

Although we hope you find the information presented in this report to be comprehensive and informative, it is important to note that ***the purpose of this assessment report is to inform strategic opportunities for restoring and protecting James Pond water quality and surrounding habitats.***

With the completion of Act I, we will move on to the remaining acts. Act II will identify and describe a variety of technologies and biological approaches to mitigating impaired waters and habitats. This will include researching the strengths and weaknesses of each option and quantifying the level of contaminant mitigation expected from technology when applied to specific circumstances.

Act III will focus directly on assessing technologies in terms of potential for mitigating contaminants in James Pond. This phase will focus on analyzing the technologies that are most likely to reduce existing impaired conditions. This will include quantification of potential contaminant reduction methods and their impact relative to specific characteristics/situations found in the Pond.

Up-Island Watershed Management (208 Report)

"Acts"

- **Act I – Individual System Assessment (see links below)**
- **Act II – Water quality mitigation technology and options**
- **Act III – Quantification of most appropriate technology for each unique challenge**
- **Act IV – Implementation strategies**

Act IV, the final act, will result in a management plan (208 Report) that will direct how we clean our up-island ponds. Based on information gathered in Acts I-III the management plan will define implementation

steps that effectively and efficiently reduce excess nutrients in James Pond. Each technology improvement and its process will be articulated alongside a cost/benefit analysis of each option. Additionally, potential funding sources and other requirements, such as permitting, will be illustrated.

In conclusion, please find the links to Act I: The James Pond Individual System Assessment and Annex below. This report was developed by MVC staff, an independent contractor from RJS Development Solutions, and the environmental consulting firm Horsley Witten. The draft was extensively peer reviewed by a variety of experts prior to release.

We look forward to sharing the Acts II-IV with you. If you have questions or comments, please direct them to: **Rachel Sorrentino** or **Sheri Caseau**

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Up-Island Watershed Management Plan (208 Report) Important Links:

James Pond Individual System Assessment Report – prepared for the Up-Island 208 Watershed Management Plan: https://indd.adobe.com/view/3cbe33b3-bbdb-4642-9bb0-37ad06b41c5f

James Pond Individual System Assessment Appendix Document: https://indd.adobe.com/view/126f648f-e9f3-4699-b8d6-13ccdeb928e0

MVC Ponds of the Vineyard Web Page: https://storymaps.arcgis.com/stories/30dc099fffe749178b33b977c1606a8e

Note: all report figures and tables can be found in the appendix to this document. The appendix can also be found online at: https://indd.adobe.com/view/126f648f-e9f3-4699-b8d6-13ccdeb928e0

OVERVIEW

James Pond is a coastal salt pond formed by a barrier beach on the northern coast of Martha's Vineyard. This pond, which has also been known as Pond Royall, Onkakemmy Pond and Eachpoquassit Pond[1] has a restricted tidal inlet to Vineyard Sound[2] and is one of the island's smaller coastal ponds. The entire watershed spans 414 acres, of which approximately 50 acres is surface water (pond) area. The James Pond Watershed is located within the town of West Tisbury[3].

The James Pond watershed has areas of socioeconomic and biological importance, including critical habitat for species of conservation concern. Despite the watershed being mostly forested, the pond suffers from nutrient related impairments likely due to a combination of watershed inputs and limited tidal exchange.

Studies of the James Pond Watershed are limited, and the pond has not been evaluated as part of the Massachusetts Estuaries Project (MEP), therefore there is no established Total Maximum Daily Load (TMDL) for James Pond. In addition to the 2019 and 2020 Martha's Vineyard Commission (MVC) State of the Pond reports, the pond has been studied by the Woods Hole Group in partnership with the Buzzard's Bay Coalition as well as the Land Bank Commission. The Woods Hole Group/ Buzzard's Bay Coalition work was done to support an Inlet Stability Evaluation that was commissioned by James Pond riparian owners in 2021. The Land Bank Commission completed a study in April 2022 for a portion of the land surrounding the pond as part of its James Pond Preservation Management Plan. The existing conditions assessment report presented here consolidates key watershed information input from local experts and information from publicly available sources (e.g., MassGIS, US Census, and town records). This report is organized in four parts to describe physical pond and watershed features, water quality, biological resources, and socioeconomic conditions.

Report Highlights:

- **James Pond currently has fair to moderate water quality. Water quality measures remain relatively consistent for many of the sample stations. While there have been some quality improvements, impairments remain. JMS4 and JMS5 sampling sites are areas of concern.**
- **Water quality indicators suggest that watershed-derived nitrogen impairment will negatively affect critical habitats for eelgrass, other sea grasses and benthic communities.**
- **Limited tidal exchange between Vineyard Sound and the pond, soil conditions, and watershed land use contribute to observed water quality issues in the watershed.**
- **Despite large areas of forested land, population growth and development pressures may inhibit future water quality improvements if appropriate remediation efforts are not pursued.**

Note: all following figures and tables can be found in the appendix to this document. The appendix can also be found online at: https://indd.adobe.com/view/126f648f-e9f3-4699-b8d6-13ccdeb928e0

PHYSICAL FEATURES

The Watershed

The James Pond Watershed is located in the Town of West Tisbury. As a relatively small watershed (when compared to other up-island great pond watersheds), this area does not have any designated sub-watersheds **(Figure 1)**. The 414-acre watershed was delineated by MVC based on hydrology, geology, and topography[4]. The pond's surface area is typically reported to be 50 acres, but ranges between 38 and 55 acres[5].

The northern edge of James Pond is formed by a barrier beach that is influenced by wind and wave action. There are two additional ponds in the watershed, Seth's Pond to the southeast and an un-named freshwater pond to the northwest near Old Herring Creek Road. James Pond is connected to the un-named freshwater pond via "a man-made berm/dike with a concrete culvert that allows water flow between the two water bodies"[6]. In addition to two streams, James Pond receives fresh groundwater flow[7].

Photo Credit: Martha's Vineyard Commission, August 2020

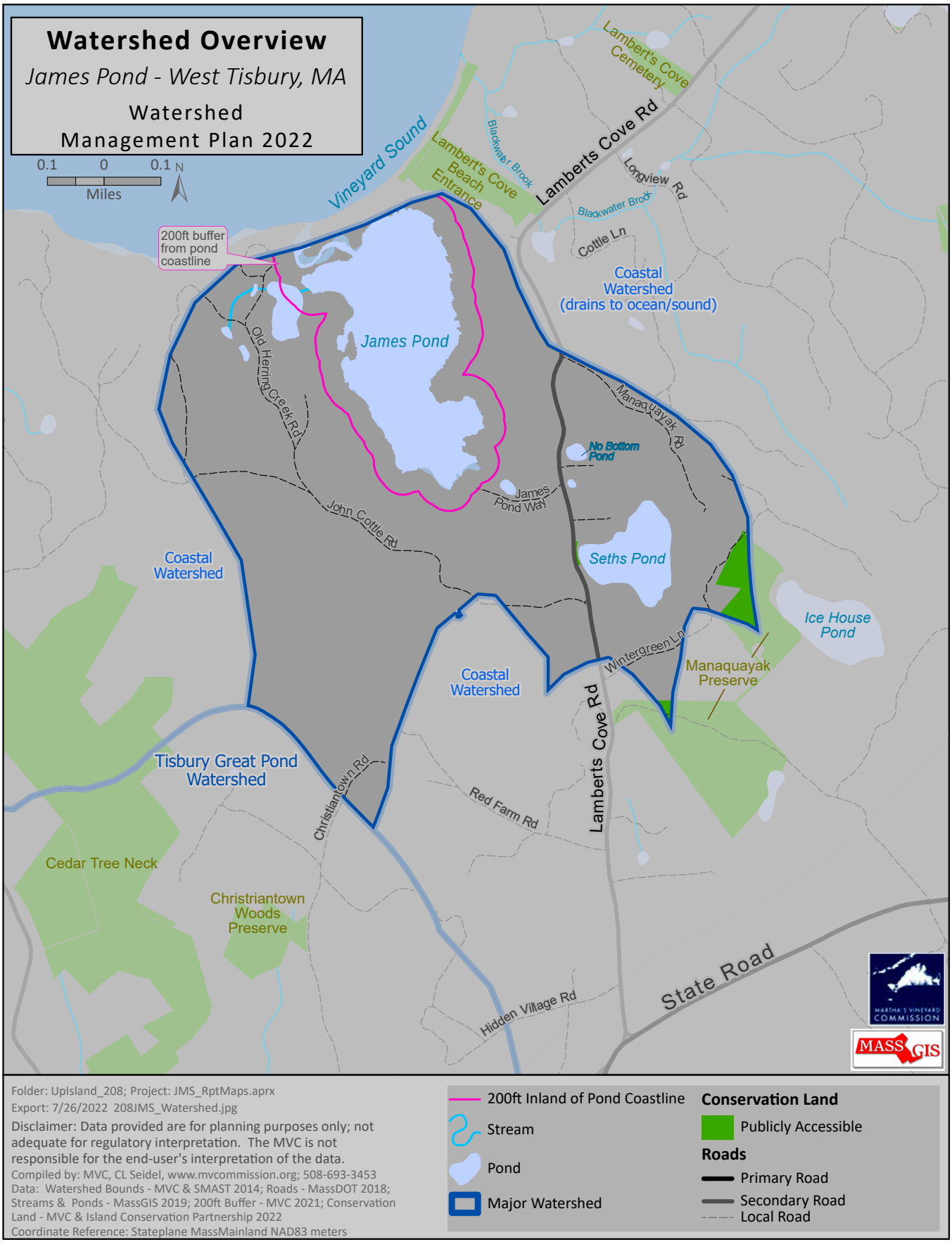


Figure 1. Watershed Boundaries for James Pond (Martha's Vineyard Commission, 2021)

James Pond

Estimating pond size, watershed area, depth, and storage capacity can be challenging given limited data and the varying water flows attributed to barrier beach breaches[8]. Figure 2 shows pond bathymetry based on NOAA Lidar data[9]. According to this data, the pond's mean depth is 3.5 ft with an average tidal range of 0.2 to 0.3 ft. The maximum depth is approximately four feet in the middle of the pond and 1-2 ft along the northern and southern shores. Based on that same analysis, the total volume of James Pond is estimated to be 5,586,997 cubic feet[10]. The shallowness of the system and the dynamics of the barrier beach are likely to influence the ecological and biogeochemical structure of the pond. *Note, additional bathymetry analysis is recommended to further assess the depth of the pond.*

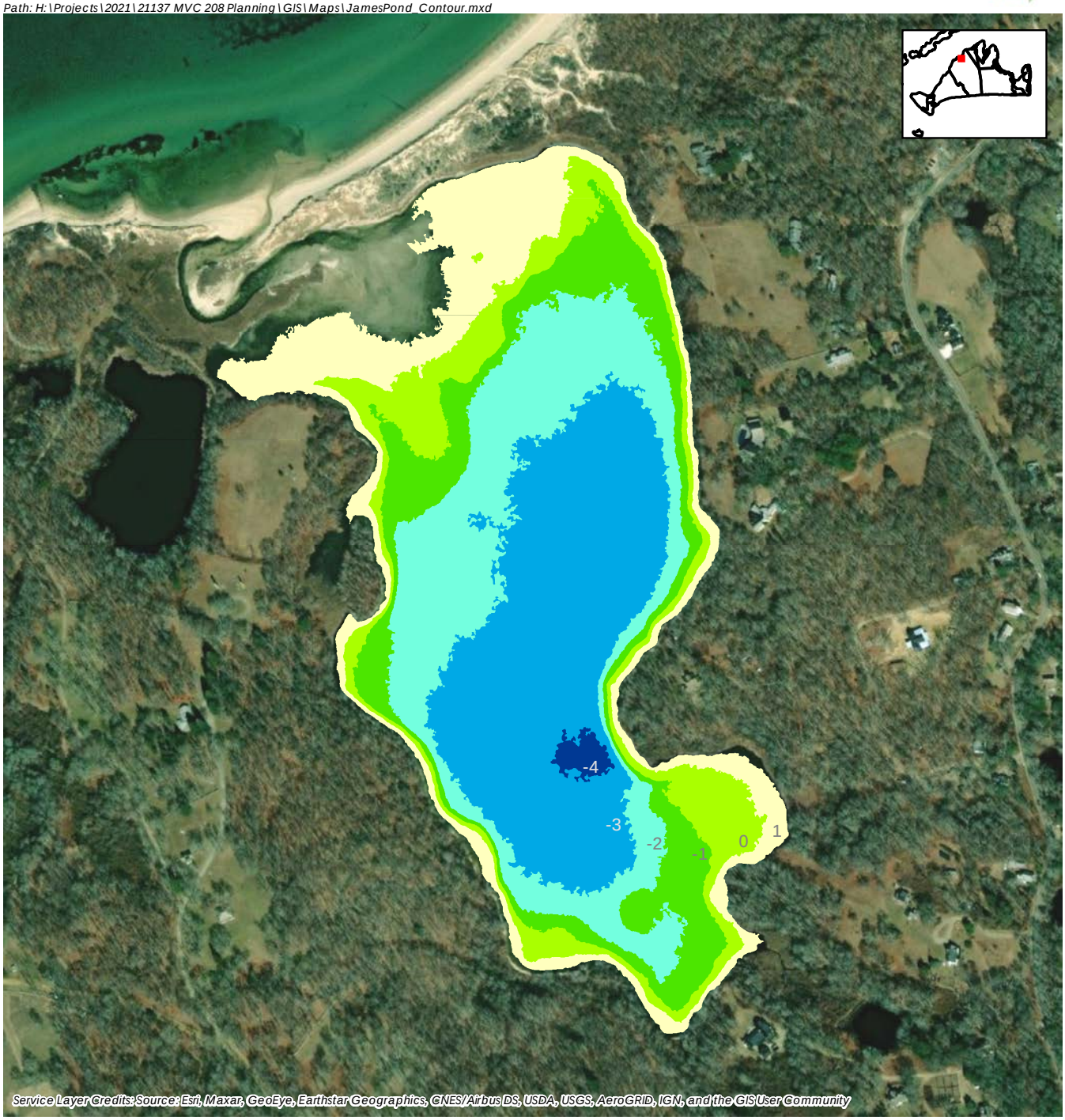
A narrow, tidal channel intermittently connects James Pond to the Vineyard sound. This channel is estimated to be 1,300 ft long[11], this channel opens and closes throughout the year to provide limited tidal exchange. The inlet for this channel is located near Lamberts Cove Beach. This inlet is periodically opened by the West Tisbury Herring Warden in order to support seasonal herring population migration. The Herring Warden is the only individual authorized to open the pond to Vineyard Sound.

When open, the inlet between Vineyard Sound and James Pond typically follows a serpentine path through an area of marshes in the northwest corner of the pond. In addition to intentional breaches, the inlet opens and closes periodically based on wave and wind patterns. James Pond intentional breaches are done on an informal basis relative to other area coastal ponds (e.g., Tisbury Great Pond), consequently there is limited data regarding the timing and duration of breaches[12].

Another physical feature to note is the large flood tidal delta within the pond. Buzzard's Bay Coalition researchers indicated (November 2020) that the size of the delta is nearly 3.0 acres[13]. Given the water surface area of the pond as a whole, the size of the delta could disrupt tidal water flow into and out of the pond.

Despite being mostly in a mostly forested watershed, James Pond suffers from nutrient related impairments likely due to a combination of watershed inputs and irregular tidal exchange with the Atlantic Ocean.

Path: H:\Projects\2021\21137 MVC 208 Planning\GIS\Maps\JamesPond_Contour.mxd



Date: 3/23/2022
Data Sources: ESRI, NOAA, Bureau of Geographic Information (MassGIS)

This map is for informational purposes and may not be suitable for legal, engineering, or surveying purposes.

Elevation (feet)
1
0
-1
-2
-3
-4

N

Feet
0 200 400

Figure 2
James Pond with 1 Foot Contours.

Figure 2. James Pond System Water Depth Map (Horsley Witten, 2022)

Land Cover

Land cover (also known as landscape patterns and conditions) within the watershed is a key component determining estuarine water quality. Undeveloped, forested lands and wetlands provide habitat and water quality benefits. Cultivated lands and impervious cover often contribute polluted runoff to receiving waters and alter natural hydrologic patterns (e.g., less recharge and evapotranspiration and more surface runoff). Information based on MVC's land cover data categories (as of 2016) is presented in the following paragraphs for all areas surrounding the pond[14] (Figure 3).

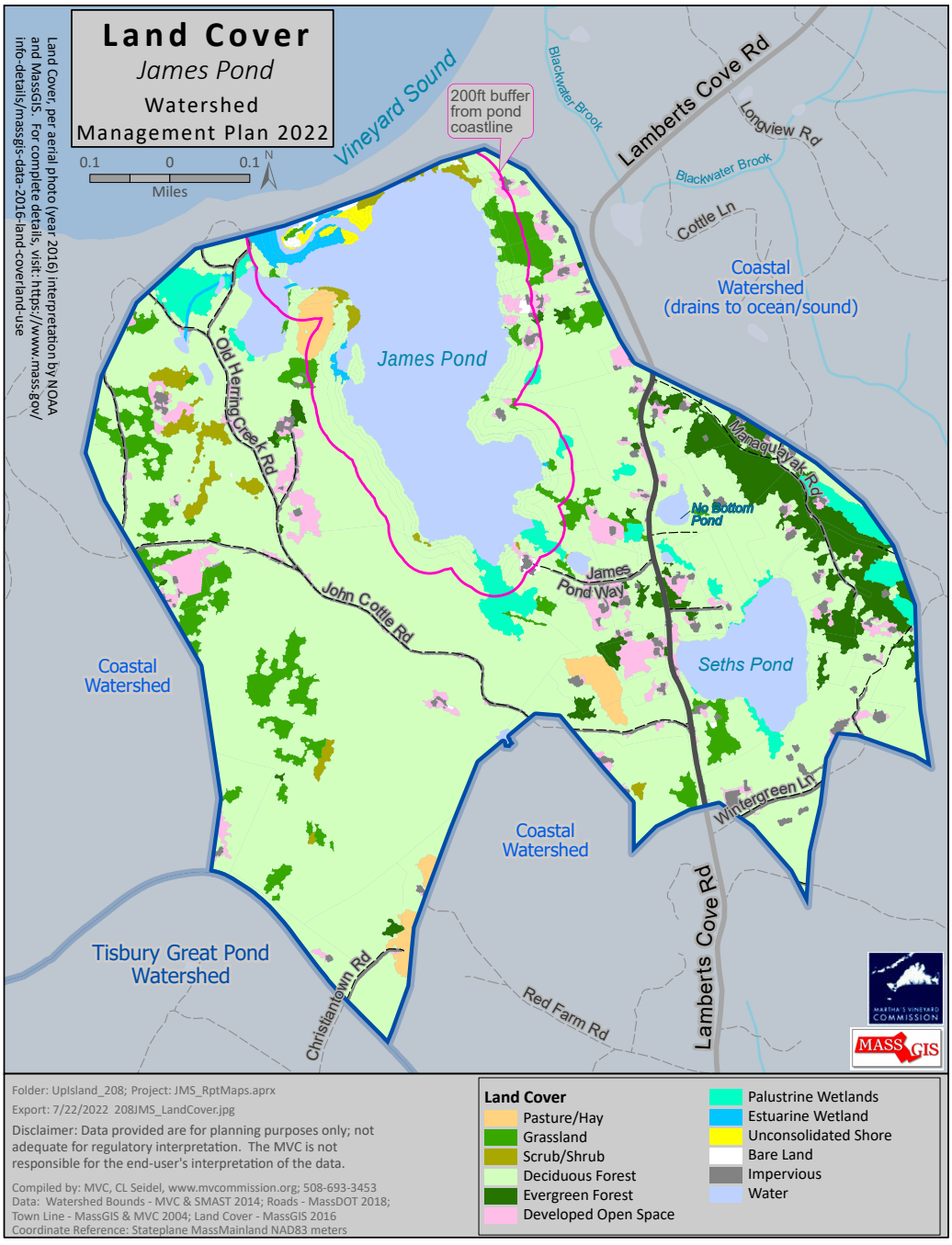


Figure 3. James Pond Land Cover Types

Nearly two-thirds (62%) of the watershed is covered by deciduous forest. The next largest land cover type is water at 16%, followed by grassland (5%), evergreen forest (4%), and developed open space (4%). All other land cover types occupy three percent or less of the watershed (Figure 4)[15].

Two of the more impactful land cover types—pasture/hay and impervious cover—make up 1% (6 acres) and 3% (14 acres) of the watershed, respectively. Pasture/hay, when fertilized or actively grazed by livestock, can negatively influence water quality in the watershed. Pollution from stormwater run-off that falls on impervious surfaces, is also known to negatively influence water quality in surrounding areas. Finally, cultivated area is often associated with negative water quality indicators. However, based on available land cover data, there is no documented cultivated land in the James Pond Watershed.

The presence of pasture/hay land cover (1% of the watershed) can be indicative of animal grazing areas that may contribute pollutants to the watershed (e.g., nitrogen and/or bacteria from animal wastes). Further, legacy nutrients from historical agricultural uses can continue to contribute to water quality issues for decades due to the travel time it takes for pollutants in groundwater to be carried through the watershed. Historic land use information prior to 1971 is not available at this time; however, given land use trends in Martha's Vineyard and the broader New England region, historically, there was likely some type of agriculture present in the James Pond watershed.

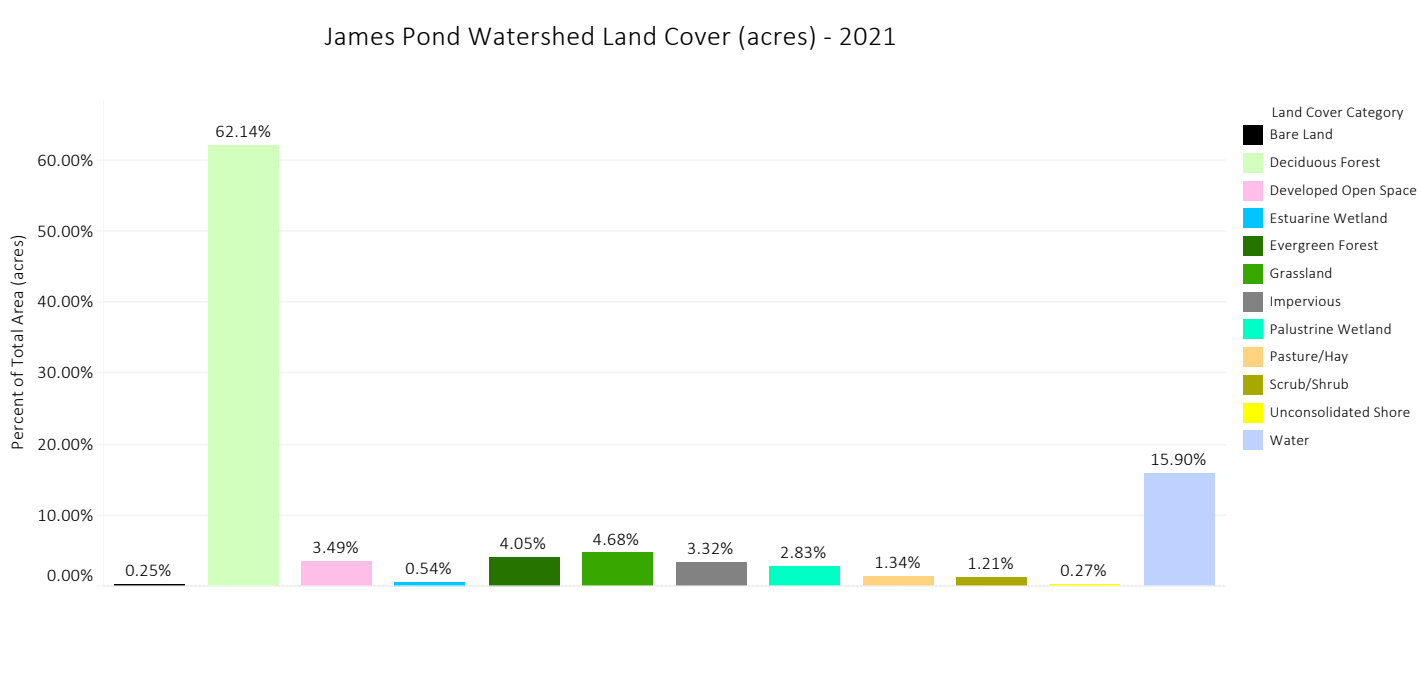


Figure 4. James Pond Land Cover Area (acres)

Impervious land cover in the James Pond watershed represents 3% of the total land cover. Studies have shown that waterbodies may experience adverse water quality impacts when impervious cover levels reach as little as 5% to 10%[16] of the watershed area. Additional management practices for impervious surfaces should be considered as development and/or additional impervious cover levels increase.

Geology and Soils

The James Pond watershed is in the island's north-central moraine[17]. The Natural Resources Conservation Service (NRCS) classifies the predominant watershed soils as Eastchop loamy sand (77%), followed by Chilmark sandy loam (4%). Remaining soil types are each 2% or less[18] (Figure 5).

Overall, 79% of the watershed soils are classified in Hydrologic Soil Group A, which is generally suitable for infiltration (Figure 6). In other words, these soil types are likely to absorb more rainfall than others. Although the characteristics of these soils may reduce stormwater runoff by filtering stormwater (and wastewater), the attributes of these soil types can also increase the potential for pollutants to leach into groundwater, including wastewater from septic systems.

James Pond Watershed Soil Type and Nitrate-Nitrogen Leaching Potential (acres) - 2021

Note: Areas representing less than 1% of the sub-watershed are not labeled.

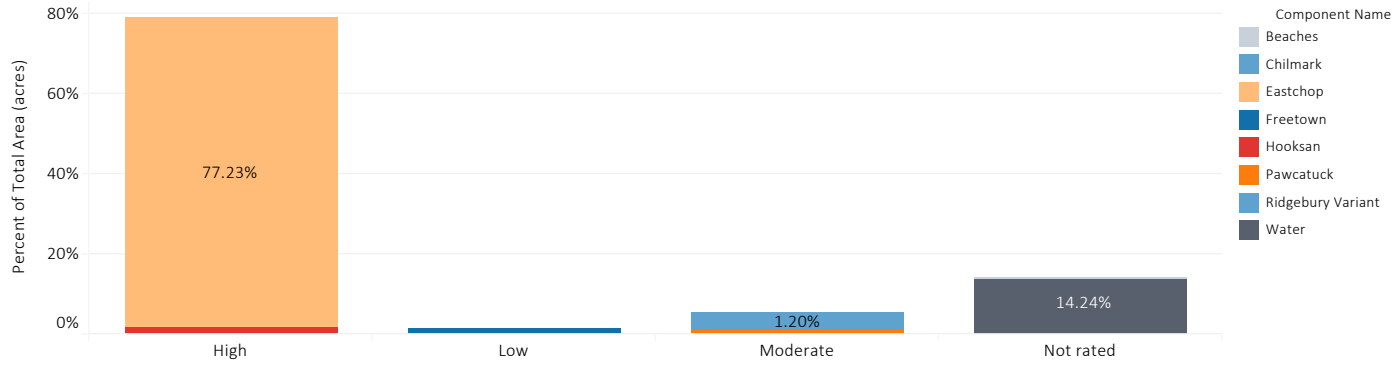


Figure 5. James Pond Natural Resources Conservation Service Soil Types

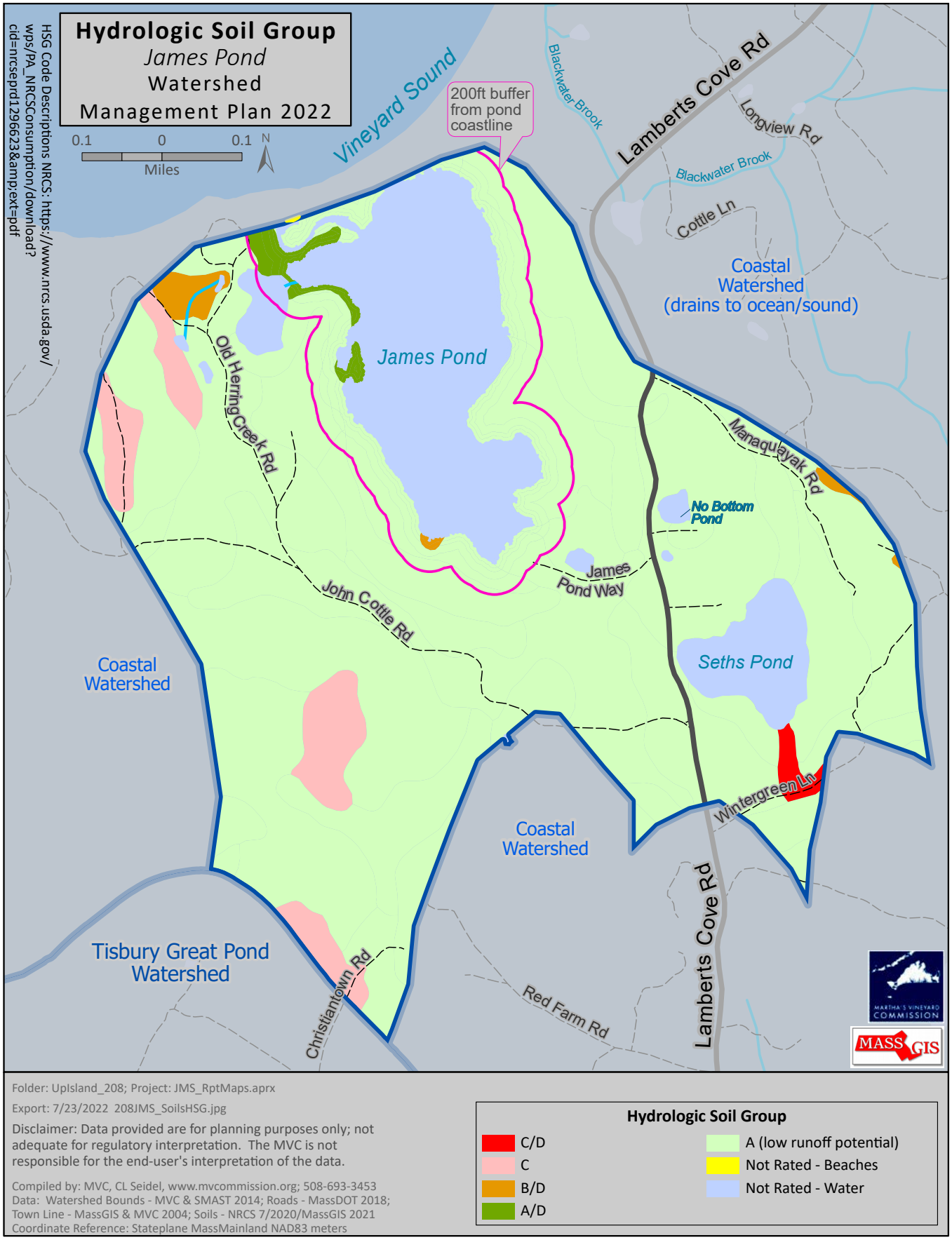


Figure 6. James Pond Hydrologic Soil Groups

Eastchop loamy sand (along with Hooksan soils) has a high potential for nitrate-nitrogen leaching (Figure 6). Soluble nitrate is highly mobile and easily moves through the soil profile, especially after heavy rainfall or with increased irrigation. These conditions demonstrate James Pond's susceptibility to nitrogen pollution and the associated importance of effective designs for onsite wastewater systems.

Figure 7 indicates proportion of soils in terms of high, medium, and low nitrate leaching soil types[19]. As shown in this graphic, 79% of the soil in the James Pond watershed falls into the highest leaching potential category. Moderate and low leaching potential soil types represent less than 7% of soils combined. Un-rated soils are simply those that cannot be categorized according to leaching potential; 14% of the watershed soil is considered "un-rated". Figure 8 shows where all nitrogen leaching soil types are found within the watershed.

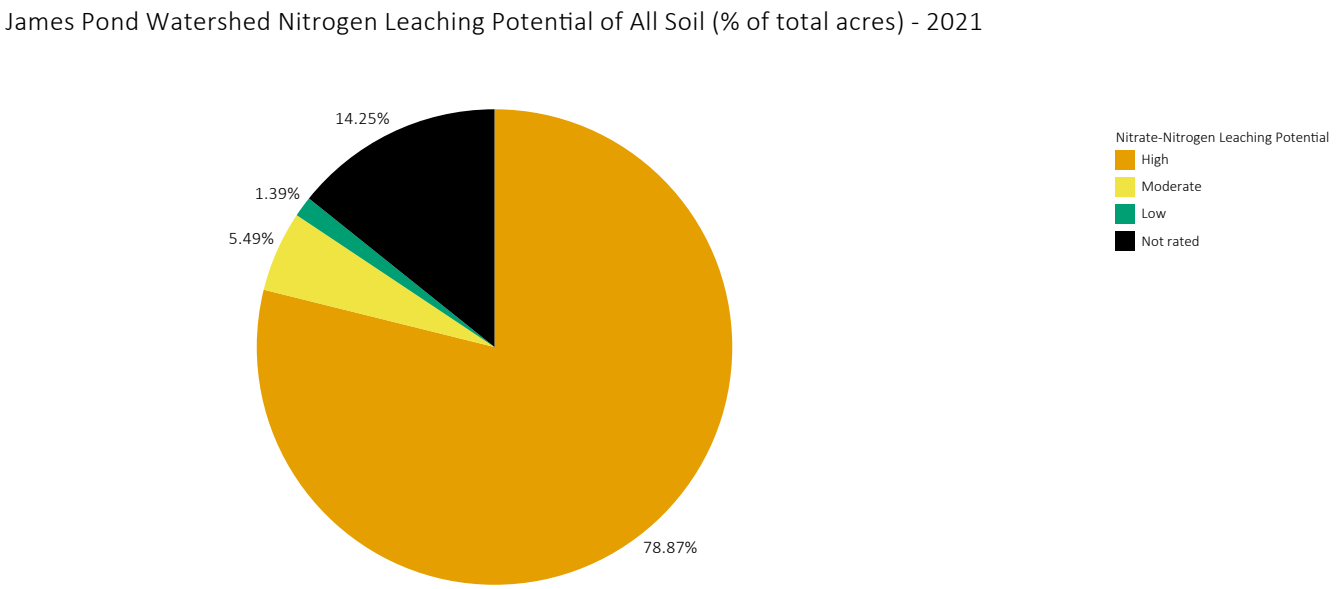


Figure 7. James Watershed Nitrogen Leaching Potential

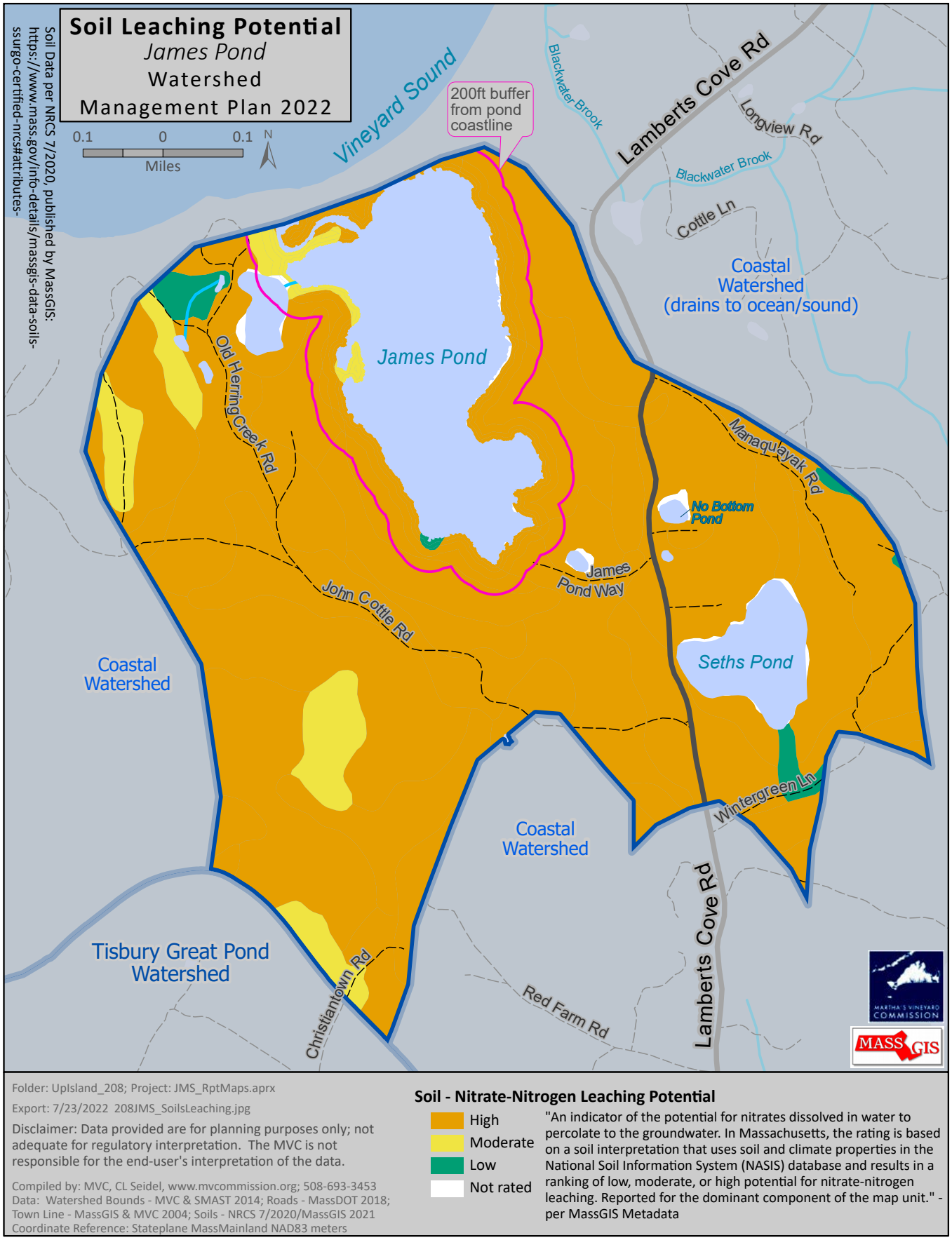


Figure 8. James Pond Soil Leaching Potential

The combination of sandy soils and shallow groundwater tables can increase susceptibility to poor water quality. The depth to groundwater in the area is estimated by the NRCS to be within 1 ft of the surface[20], [21]. However, these estimates are not available for all of the James Pond Watershed and should be used for general planning purposes only. More accurate groundwater elevation data may be found via monitoring wells, onsite soil evaluations, and from local studies and records, if available. Depth to groundwater is important when considering stormwater and onsite wastewater management systems, as there are strict requirements regarding the distance separating groundwater and wastewater management systems.

Summary

James Pond watershed sensitivity to nitrogen enrichment could be attributed to limited tidal exchange and soil conditions. An unstable inlet through the barrier beach prevents regular tidal exchanges between the pond and the Vineyard Sound. And, although much of the watershed is forested, soil conditions could lead to higher nitrate leaching.

Managed breaches will likely play a significant role in maintaining the health of the pond in the future. Therefore, changing coastal conditions, such as sea level rise, are expected to affect these conditions and should be considered when evaluating the frequency and effectiveness of managed breaches going forward.

Photo Credit: Martha's Vineyard Commission, August 2020

WATER QUALITY

James Pond is currently impaired for dissolved oxygen and Total Pigment. Relevant regulatory water quality standards and impairment thresholds are summarized in Table 1. These standards reflect the Massachusetts Surface Water Quality Standards (314 CMR 4.00), which designate uses and water quality criteria to support those uses, per the federal Clean Water Act[22] and the Massachusetts Integrated List of Waters[23].

Water quality samples are collected during the critical summer period by the MVC in James Pond at three locations (Figure 9).

The MVC uses a variety of state and nationally adopted biological and chemical water quality indicators to monitor and assess ecosystem health, habitat suitability, and potential sources of stress including the following: salinity, temperature, nitrogen, dissolved oxygen, chlorophyll-a, total pigment, and water clarity. Phosphorous sampling is not conducted because it was not found to be the limiting nutrient in James Pond, or other similar estuaries in Massachusetts. Chemical analyses are performed at the Coastal Systems Analytical Facility at SMAST-UMass Dartmouth following procedures consistent with the MEP, which are part of numerous monitoring QAPPs approved by MassDEP and USEPA.

Water Quality Parameters	Regulatory Standards	MVC Average (2017-2021)	Standard Sources
Temperature	<85°F/29.4°C (At one time) <80°F/26.7°C (Max daily mean)	Meets Standard Requirements (76.1°F (24.5°C))	Massachusetts Surface Water Quality Standards (314 CMR 4.00)
Dissolved Oxygen	6.0 mg/L	**Range between 3.3 and 10.2mg/L**	Massachusetts Surface Water Quality Standards (314 CMR 4.00)
Total Pigment Gradient	10.0 µg/L	**All sampling sites exceed requirements**	2020 Martha's Vineyard Water Quality Technical Report

Table 1. James Pond Water Quality Standards and Thresholds

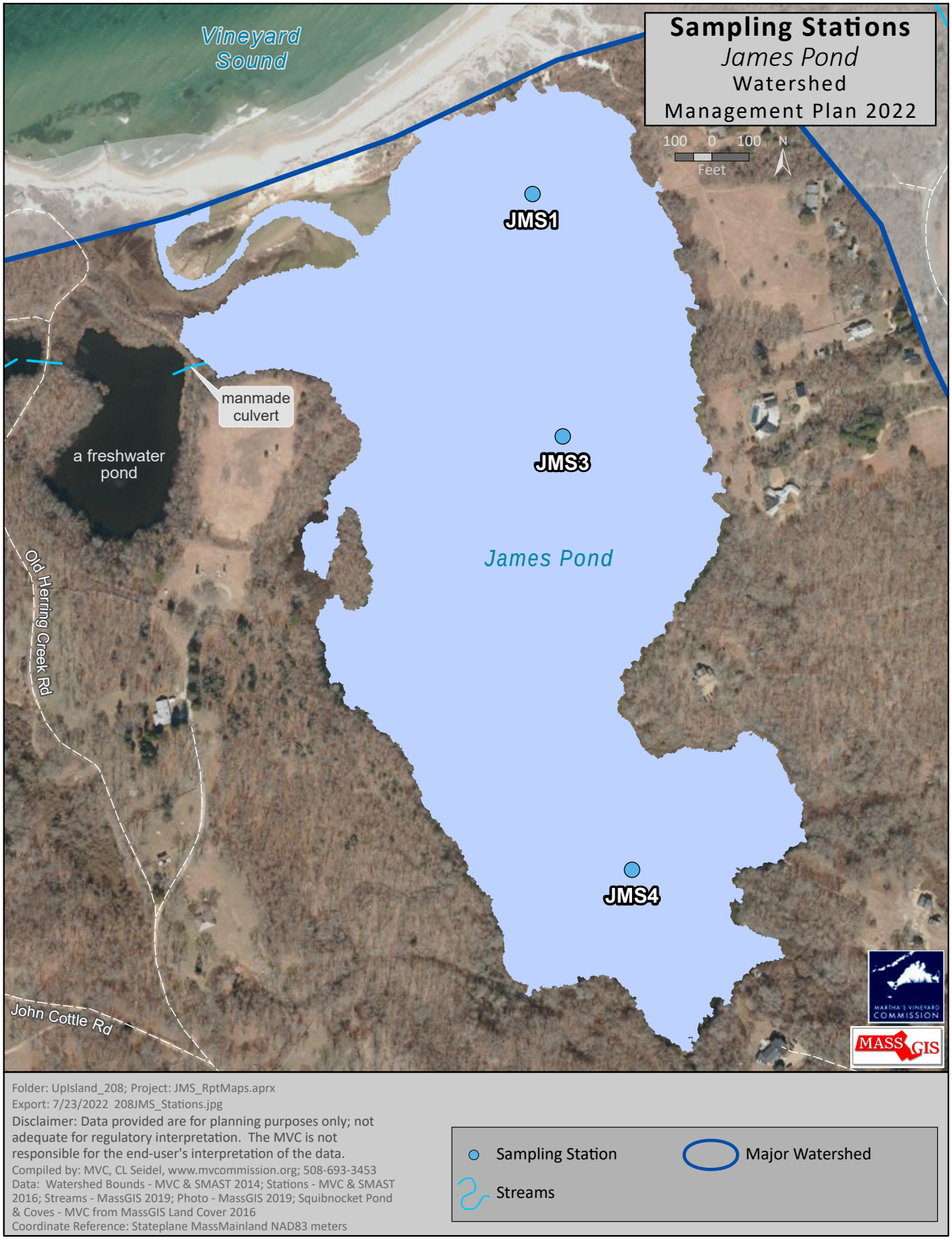


Figure 9. James Pond Water Quality Sampling Stations (2017-2021)

Salinity

Salinity is an important physical characteristic of a waterbody and can indicate habitat quality for aquatic organisms, as well as indicate the extent of tidal influence. As seen in Figure 10, salinity values fluctuated at all sites over the past five years with a low of 11.69 ppt at JMS4 in 2019 and a high of 28.35 pp at JMS3 in 2020[24].

If significant changes in salinity are detected, dramatic impacts on the ecosystem may occur. Accordingly, changes in salinity have important habitat implications for future managements strategies.

Changes in salinity, such as the substantial decrease in salinity observed in 2019, may indicate changing conditions that impact ecosystem health and could be reflective of the impacts of managed breaches. Accordingly, changes in salinity have important habitat implications for future managements strategies including managed breaches.

James Pond Watershed Stations - Salinity (2017-2021)

The BLUE LINE in the upper area of the graph represents average offshore/Atlantic Ocean salinity (ppt). The average salinity In the waters off Martha's Vinyard is 33 (ppt).
The BLACK LINE within the sub-watershed pane indicates the average salinity value over a five year period (2017-2021).

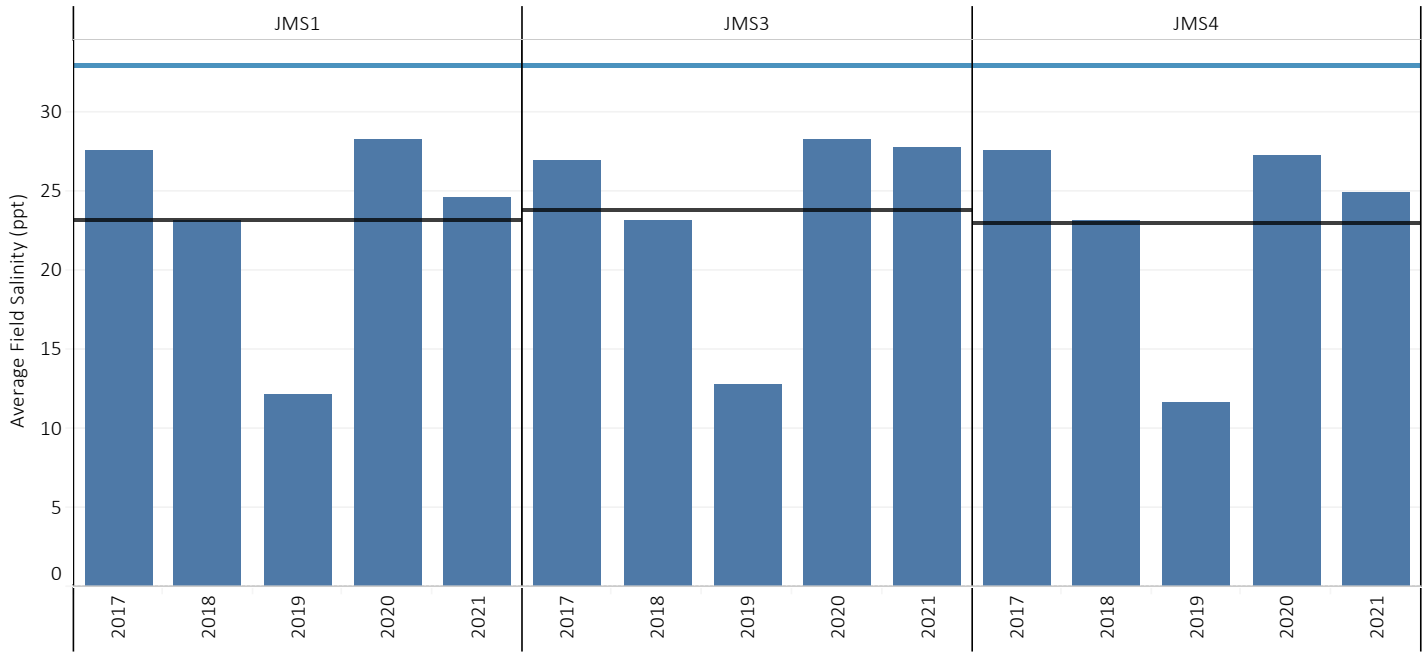


Figure 10. James Pond Salinity Data (2017-2021)

Temperature

Water temperature exerts a strong influence on biological activity and dissolved oxygen levels; there is lower dissolved oxygen solubility at higher temperatures. As required by 314 CMR 4.00, temperature must not exceed 85˚ F (29.4˚ C) at any one time nor a maximum daily mean of 80˚ F (26.7˚ C). As seen in Figure 11, average water temperature at all sites have been below 80 ˚F since 2017 but climate change may pose a threat with increased temperatures.

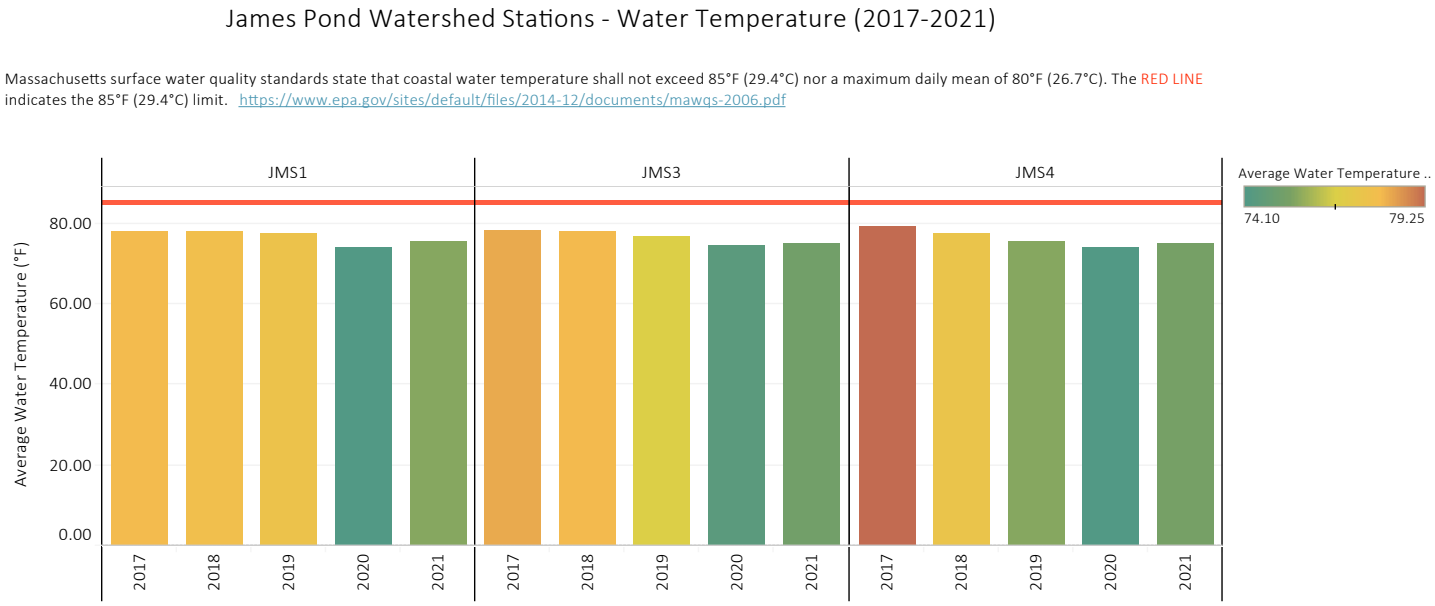


Figure 11. James Pond Temperature Data (2017-2021)

Nitrogen

Nitrogen is often the factor limiting plant, phytoplankton and algae growth in brackish coastal waters and therefore is often the target for management. It is the excess of nitrogen and resulting eutrophication of our estuaries and coastal waters world-wide, which is causing fish kills, loss of eegrass and benthic animal communities and significant habitat declines. In other words, low levels of nitrogen would negatively affect the growth of organisms in brackish water. However, in excess, nitrogen can be harmful to a estuarine water and habitat quality.

Potential sources of nitrogen include wastewater, agriculture, fertilizers, run-off from impervious surfaces and direct atmospheric deposition to the waterbody surface area.

There is no established nitrogen threshold, otherwise known as a Total Maximum Daily Load (TMDL) for James Pond. MEP studies for other coastal ponds on Martha's Vineyard included thresholds of 0.35 (Menemsha Pond), 0.46 and 0.48 (Tisbury Great Pond), or 0.50 (Chilmark and James Ponds) mg/L as the threshold at which the particular pond could still support its benthic community and/or eelgrass.

Table 2 shows average water quality data from 2017-2021. Although the 2017-2021 average values varied across all five years, the total nitrogen (TN) concentrations in the James estuarine system exceeded TMDLs established for similar up-island ponds. Over the

Sampling Station	2017-2021 Average Total Nitrogen Concentration (mg/L)	2021 Observed Total Nitrogen Concentration (mg/L)
JMS1	0.78	0.75
JMS3	0.76	0.75
JMS4	0.75	0.74
Total System	0.78-0.75	0.75-0.74

Table 2. James Pond Total Nitrogen Data Comparison

entire five-year period, total nitrogen concentrations were 0.76 mg/L. A value that is well above the established TMDLs in similar up-island ponds.

As noted, nitrogen concentrations have fluctuated throughout the years, but elevated TN was observed in 2019 at all sites (Figure 12).

Furthermore, nitrogen concentrations were variable in James Pond among all sampling sites during the 2017-2021 time-period. The five-year average among most sampling sites demonstrates that nitrogen concentrations are relatively consistent throughout the entire pond. Moreover, James Pond has consistently had high TN concentrations and could be considered impaired due to nitrogen levels since 2017, which is likely to negatively impact ecosystem health of the overall pond.

Load reductions can potentially be achieved through a variety of strategies: better management of watershed nitrogen sources (wastewater, stormwater, fertilizers), increasing the natural attenuation of nitrogen within the freshwater systems, and/or modifying the tidal exchange[25].

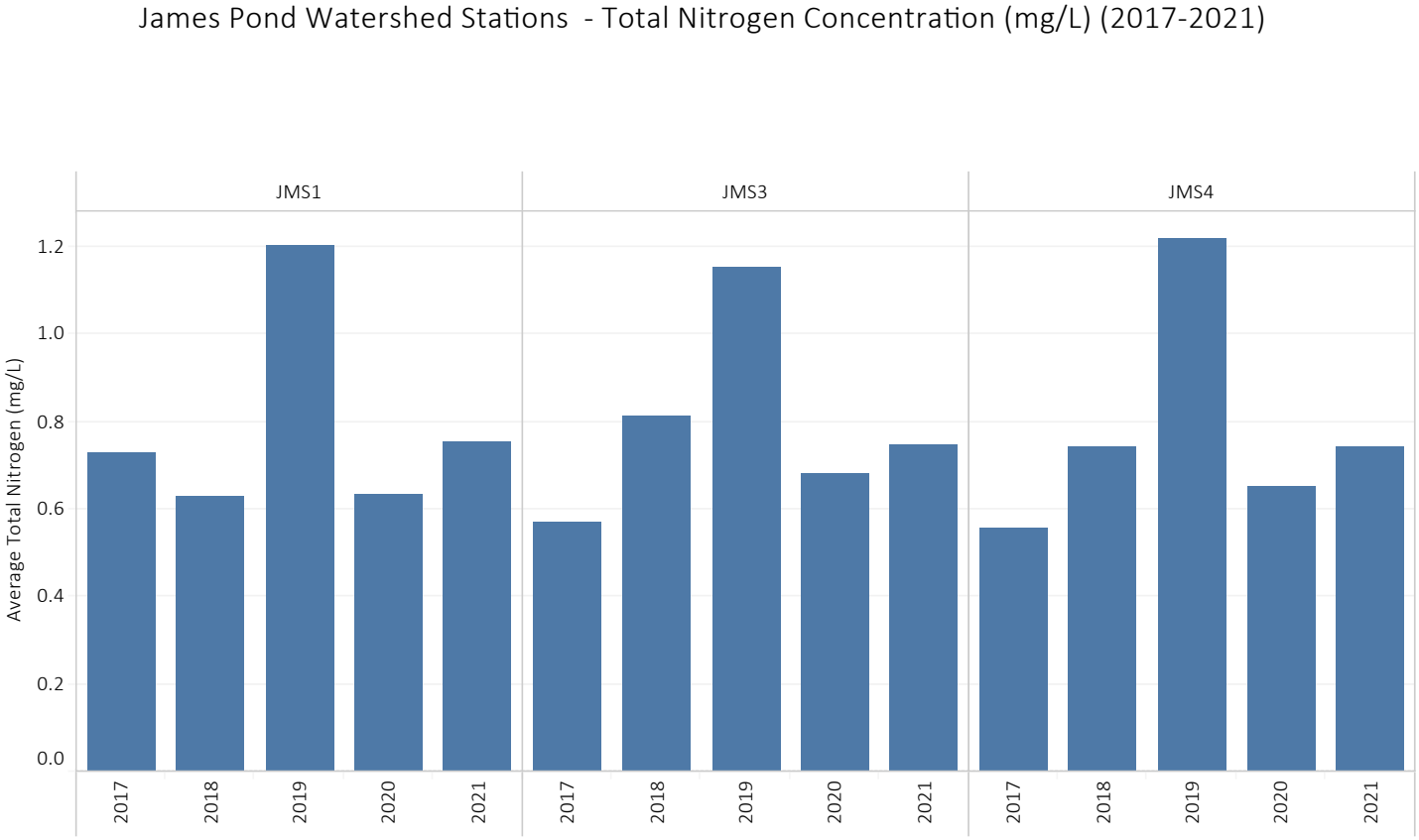


Figure 12. James Pond Total Nitrogen (2017-2021)

Dissolved Oxygen

Dissolved Oxygen (DO) levels are a good indicator of water quality conditions that can affect plant and animal habitat. Habitat quality is determined in large part by the time periods in which water quality is at its worst, even if that is for only brief period of time. When considering DO, low DO concentrations may indicate excessive nutrient (eutrophic) conditions in Massachusetts estuaries. The DO threshold of 6 mg/L represents the amount of DO required for most organisms to thrive. The values indicated below represent DO as it is measured at the bottom of the pond, where the least mobile, and therefore most vulnerable species live.

James Pond is classified as impaired for dissolved oxygen, based on the Massachusetts Surface Water Quality Standards (314 CMR 4.00) established DO threshold of 6 mg/L. Over the course of five years (2017-2020) DO fluctuated above and below 6 mg/L at all sites. Although it is common for DO levels to fluctuate with photosynthesis and respiration of plants throughout the day and night, in areas where the DO stays close to the threshold during the day, one could expect DO to drop below the threshold at night. However, studies in estuaries indicate that periodic declines to 4 mg/L can support moderate to high productivity diverse benthic communities.

The frequency with which DO fell below 6mg/L at all James Pond sites indicates that DO is likely to fall below the recommended stress threshold at night during summer months, especially at JMS1 and JMS4 where the DO was measured above 6mg/L nearly as often as it was below. Consequently, one could expect the benthic communities in these areas to exist in stressful habitat conditions[26](Figure 13).

James Pond Watershed Stations - Dissolved Oxygen (2017-2021)

The RED LINE indicates the threshold dissolved oxygen level, values below this line are associated with stressful conditions in which aquatic species fail to thrive.

*All values represent dissolved oxygen levels taken at the BOTTOM surface of the pond.

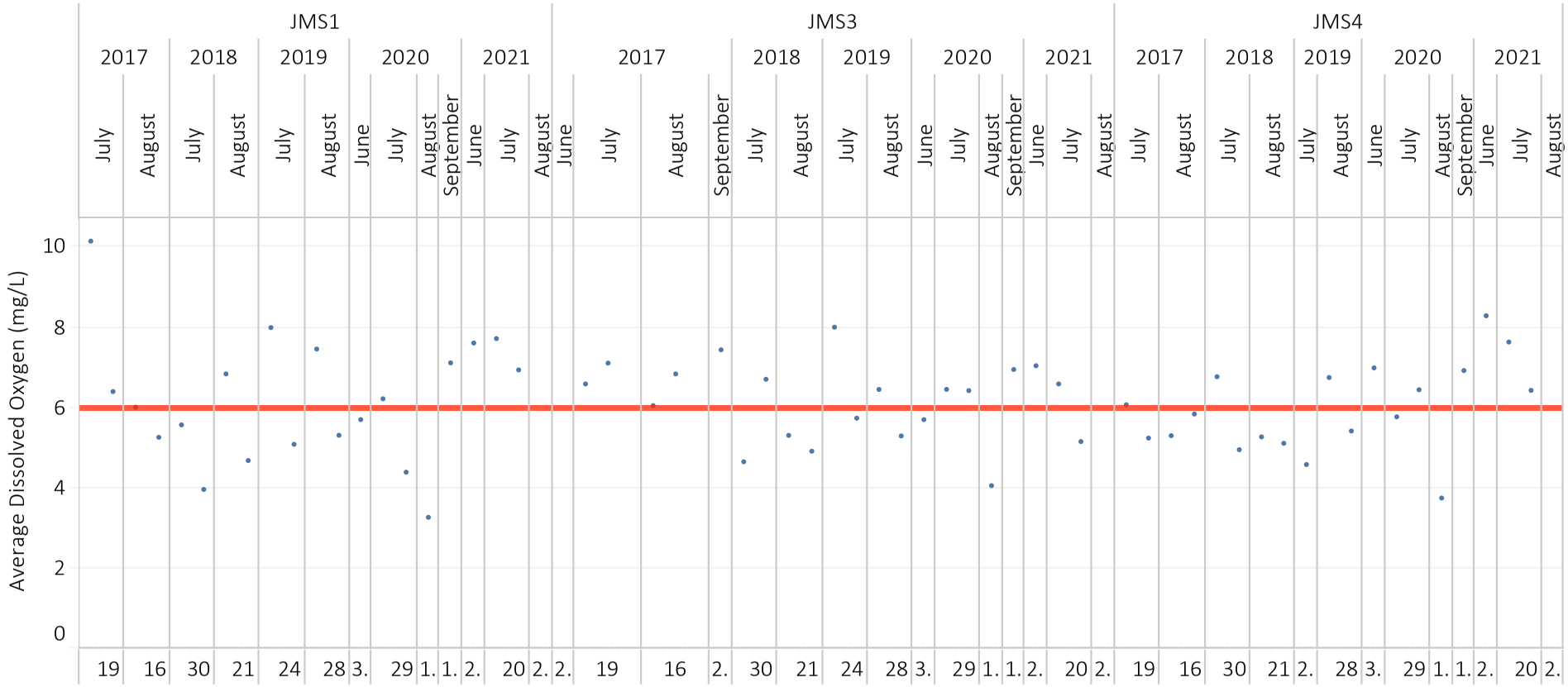


Figure 13. James Pond Dissolved Oxygen (2017-2021)

Chlorophyll-a and Total Pigment

Chlorophyll-a is a water quality indicator used to classify the trophic condition of a waterbody and is reflective of the amount of algae (in this case phytoplankton) present. Chlorophyll-a is the major chlorophyll in green plants and algae and therefore is naturally present in aquatic systems. Excess algae, which is often expressed as elevated Chlorophyll-a values, can be harmful to ecosystems as it indicates high organic matter quantities that could result in low oxygen levels at night or during the aging and decay after death of the algae. waterbody and is reflective of the amount of algae (in this case, phytoplankton) present. Chlorophyll-a concentrations are highest at JMS4 (Figure 14).

Total pigment is a combined measure of Chlorophyll-a and Pheophytin that indicates the amount of microscopic living and expiring plant matter in the water. While this is not a direct measure of phytoplankton biomass, total pigment is a commonly used indicator for assessing biological and habitat health. Note, the extent to which the observed values show conditions in the entire pond is unclear because the frequency of sampling may allow the impact of blooms to be only partially captured before they have settled.

The MVC has been analyzing James Pond water samples annually for total pigment since 2017 (Figure 15). As is true for Chlorophyll-a samples, total pigment samples show variation in total pigment concentrations over the last five years. Despite fluctuations, the average values show total pigment concentrations above the University of Massachusetts at Dartmouth's School for Marine Science and Technology (SMAST) established threshold of impairment of 10.0 µg/L at all sampling locations during the 2017 – 2022 time period[27, 28]. High pigment concentrations combined with high Total Nitrogen levels are a strong indicator of eutrophication.

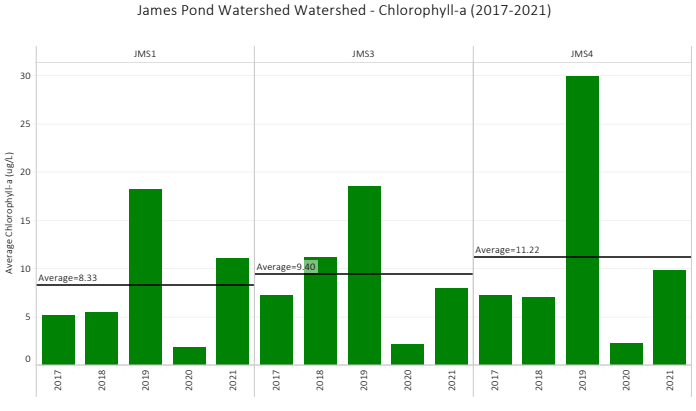


Figure 14. James Pond Chlorophyll-a (2017-2021)

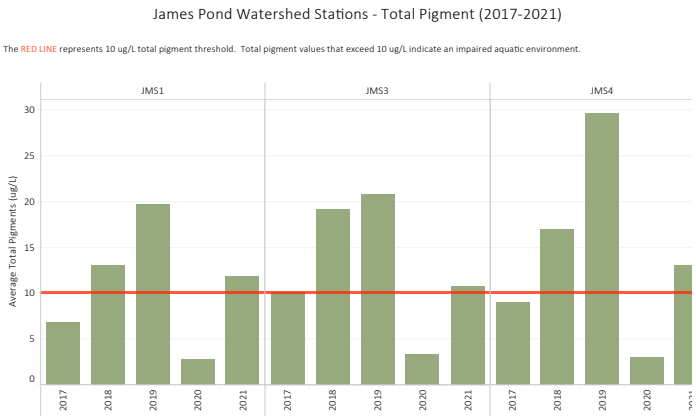


Figure 15. James Pond Total Pigment (2017-2021)

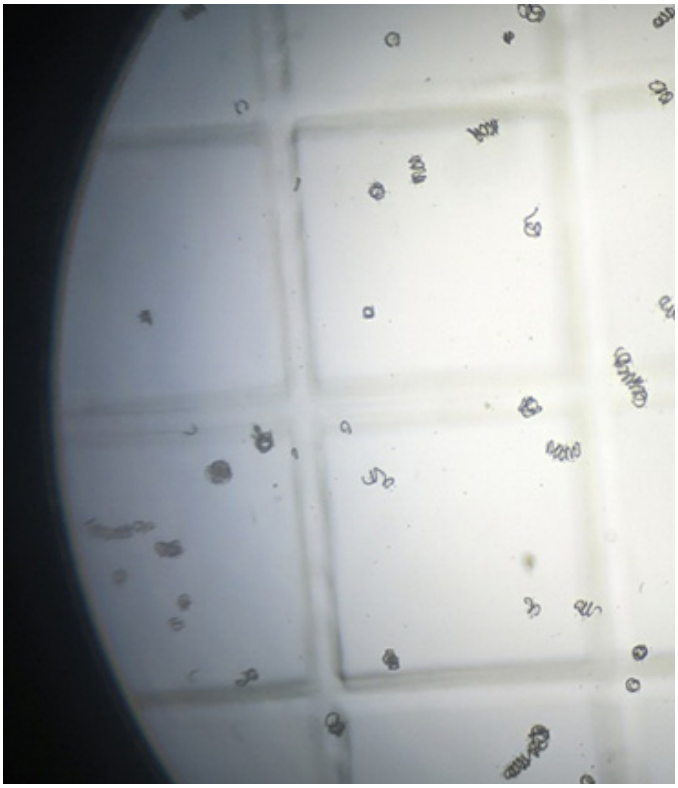
Cyanobacteria

In 2021, the MVC began an island-wide cyanobacteria monitoring project. In the first year of the study, MVC focused on establishing a baseline of cyanobacterial presence and abundance in Island ponds. Cyanobacteria can cause toxic algae blooms, which at certain concentrations can be dangerous to human and animal health.

Bloom-forming cyanobacteria tend to be found grouped together as large colonies and filaments, while picocyanobacteria tend to be found as single cells and sometimes small colonies. Both types of these cyanobacteria (bloom-forming and pico) are known to produce cyanotoxins.

James Pond was regularly sampled from June through September at the JMS3 and JMS5 sample sites. No bloom-forming cyanobacteria (those responsible for visible surface accumulations) were found. Analysis indicated that there were natural background levels of picocyanobacteria and that there was no evidence of exponential growth or change in the population that would cause concern during the testing time period (June-September 2021).

The MVC continues to monitor and research the bloom-forming cyanobacteria, picocyanobacterial populations and associated toxin levels in James Pond. MVC will also work with its partners to analyze eDNA samples of the bacteria in order to identify the cyanobacteria at the species level.



Cyanobacteria Samples: Sheri Caseau, Martha's Vineyard Commission, 2021

Summary

James Pond generally demonstrates fair to moderate water quality. Temperature and salinity are stable and relatively consistent. When compared to TMDLs established for similar ponds in the area, James Pond can be considered impaired for nitrogen. For example, the TMDL established for both Chilmark and James ponds was 0.50 mg/L. Nitrogen levels in James Pond average 0.76 mg/L over the 2017-2022 time period. Furthermore, total pigment values exceed the total pigment threshold of 10.0 µg/L at all three stations.

As noted elsewhere, load reductions could be achieved through a variety of strategies: better management of watershed nitrogen sources (wastewater, stormwater, and fertilizer use), increasing the natural attenuation of nitrogen within the freshwater systems, and/or modifying tidal exchange[29].

Although there is no established TMDL for James Pond, total nitrogen concentrations in the pond exceed TMDLs that exist for similar up-island estuary systems..

Pond and Upland Habitat

James Pond and the surrounding watershed include critical areas for rare and other species of conservation concern. There are areas designated by The MassWildlife's Natural Heritage & Endangered Species Program as Natural Communities, Priority Habitats of Rare Species, Estimated Habitats of Rare Wildlife and State Protected Rare Species[30] (Figure 16).

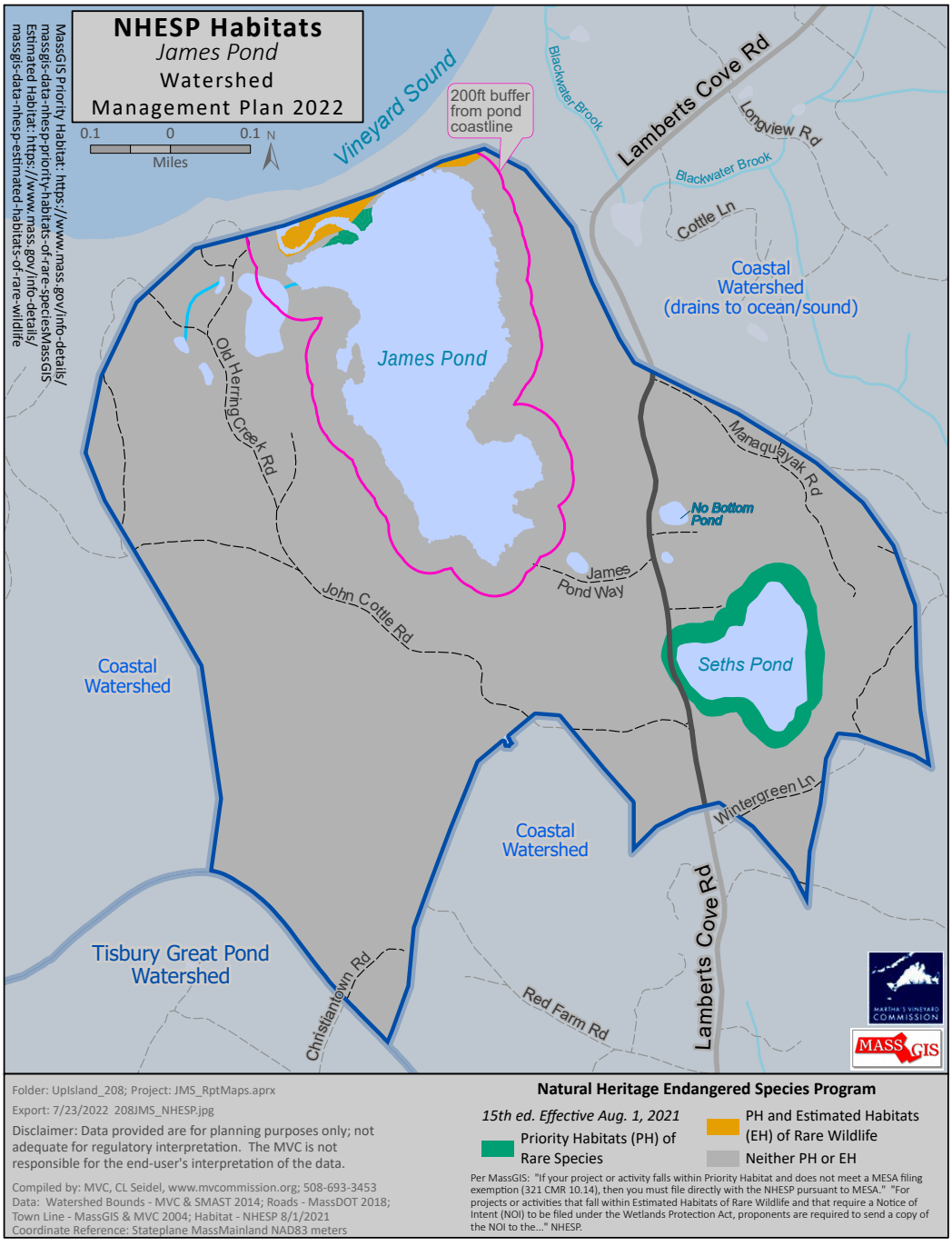


Figure 16. Natural Heritage & Endangered Species Program Map

Core Habitat and Critical Natural Landscapes are mapped under the BioMap2 project (2010) to protect the state's biodiversity and their habitats (Figures 17 and 18). Core Habitats include Aquatic Core and Species of Conservation Concern[31]. The only in-pond areas mapped is the area closest to Vineyard Sound. Critical Natural Landscape include Tern Foraging, Upland Buffer of Aquatic Core, and Landscape Blocks[32]. There is one threatened species, and one special concern species listed in James Pond Watershed in the Core 89 area and there are approximately seven endangered species, 21 threatened species, 27 special concern species listed in the pond and/or upland Core 102 area[33]. The Core 102 area has one critically imperiled community (Sandplain Grassland) and one imperiled natural community (Estuarine Subtidal: Coastal Salt Pond)[34].

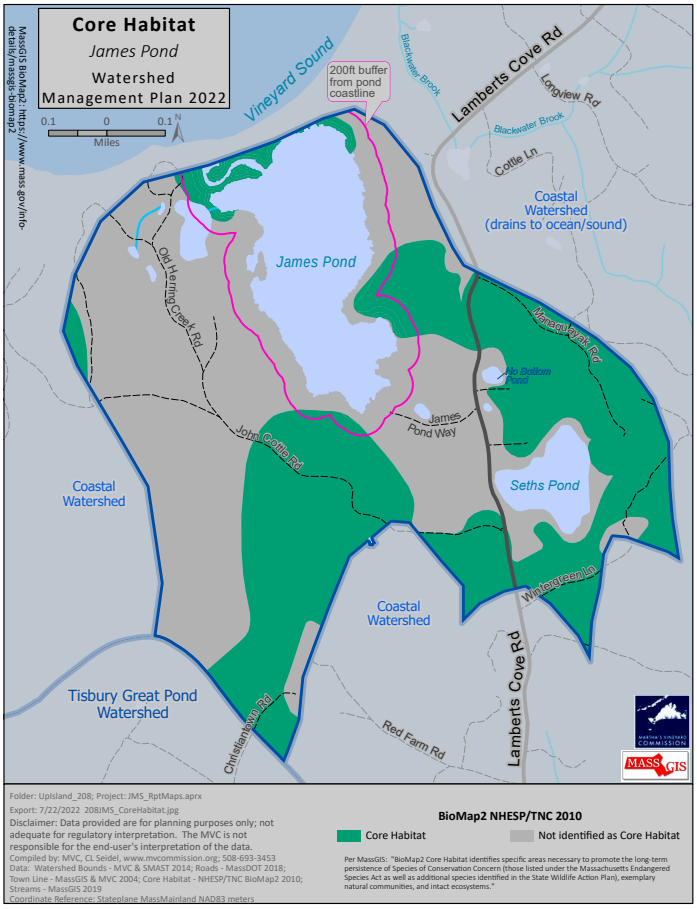


***Figure 17. BioMap2 Core Habitat and Critical Natural Landscapes** (Note Core IDs correspond with elements list)*

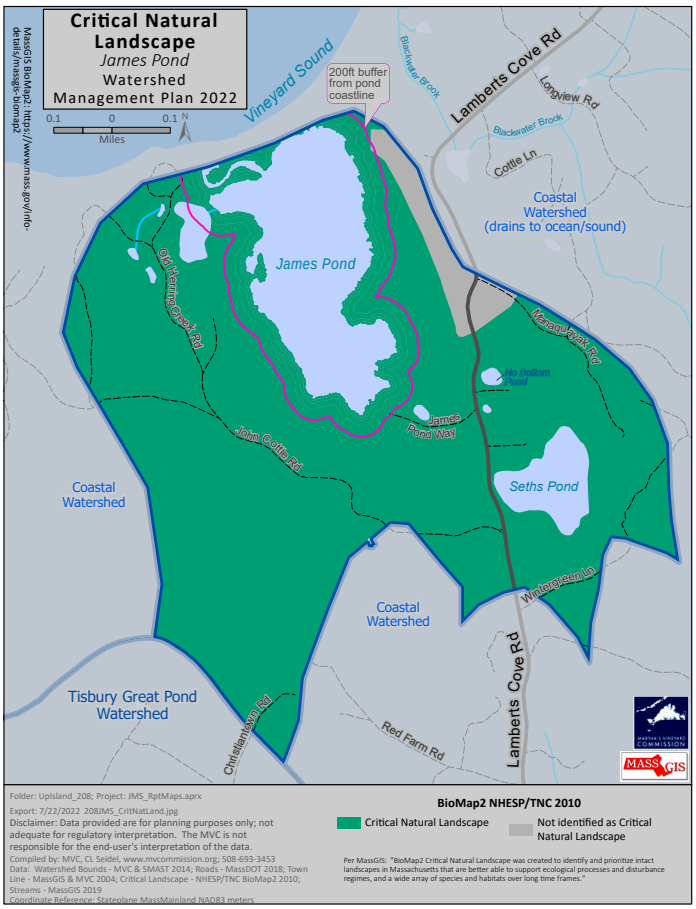
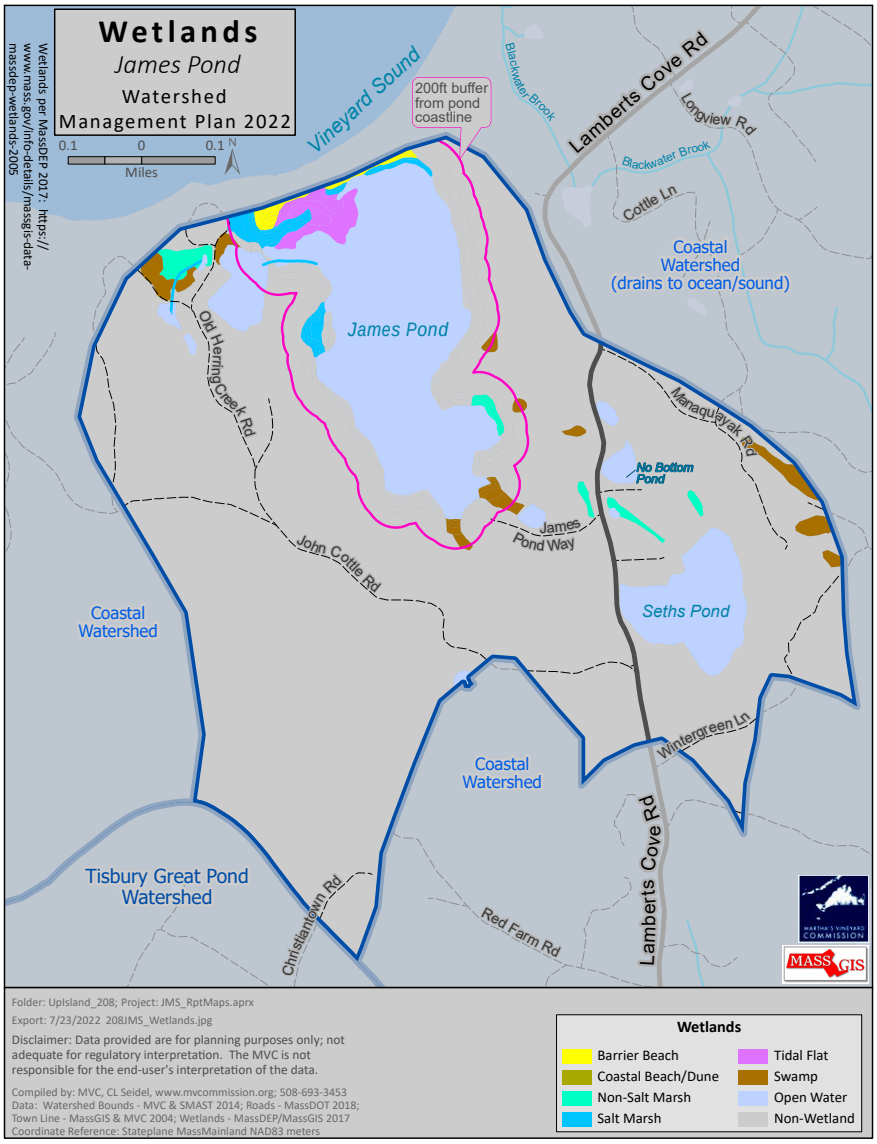


Figure 18. Critical Natural Landscape Map

Until November 2020, there was relatively little conserved open space in the James Pond watershed. The total area represented only 2.7% (11 acres) of the entire watershed. However, in December 2020 the Martha's Vineyard Landbank Commission acquired land that will be conserved in perpetuity[35]. With the additional Landbank conservation area[36], total conserved open space in the James Pond watershed totals 6% (24.9 acres) of the total area.

Despite the recent transaction, the remaining non-conserved land is habitat area at risk of development or other disturbances. Future conservation opportunities may provide permanent protection for key habitat areas. Therefore, protection of additional conservation land is a potential key management strategy for the James Pond watershed.

Wetlands of multiple varieties make up 20% (80 acres) of the entire watershed. Like other protected habitats, wetlands provide valuable habitat benefits to a variety of wildlife species (Figure 19).



Benthic infauna and epifauna surveys

Benthic infauna are organisms that live within the bottom sediments. The presence (or absence) of some types of benthic animals can reflect habitat quality, as well as conditions for other pond residents. There are no documented benthic infauna or epifauna surveys in James Pond. Ampharetids, or "bristle worms" were identified by a researcher in James Pond in 1953[37]. Future management plans may benefit from including a study of the James Pond benthic community.

Finfish surveys

There are no documented finfish surveys for James Pond. The pond is an active spawning area for river and blueback herring. The herring run is an important feature of James Pond, the inlet that allows migration is managed by the West Tisbury Herring Warden[38].

Eelgrass mapping

There is no historic evidence of eelgrass beds in James Pond. According to the MassDEP Eelgrass Viewer, there are no eelgrass beds currently mapped in James Pond[39].

Phytoplankton survey

There are no documented phytoplankton surveys of James Pond. However, other indicator parameters have been used to evaluate phytoplankton biomass. As described previously, several water quality indicators can be used to assess biological and habitat health. For example, chlorophyll-a is a proxy indicator measure for phytoplankton biomass[40]; and total pigment measurements can indicate the amount of live and expired plant matter within a body of water.

Summary

James Pond and the upland watershed provide critical habitat for species of conservation concern. Little to no information exists on the condition of finfish, benthic infauna and epifauna, eelgrass and phytoplankton communities, therefore our understanding of the biological conditions in the pond are limited. Furthermore, although the absence of eelgrass may be indicative of watershed nitrogen impairment, this association cannot be established without documented or anecdotal information. It is recommended that future management monitoring plans include additional information about existing biological conditions in the pond.

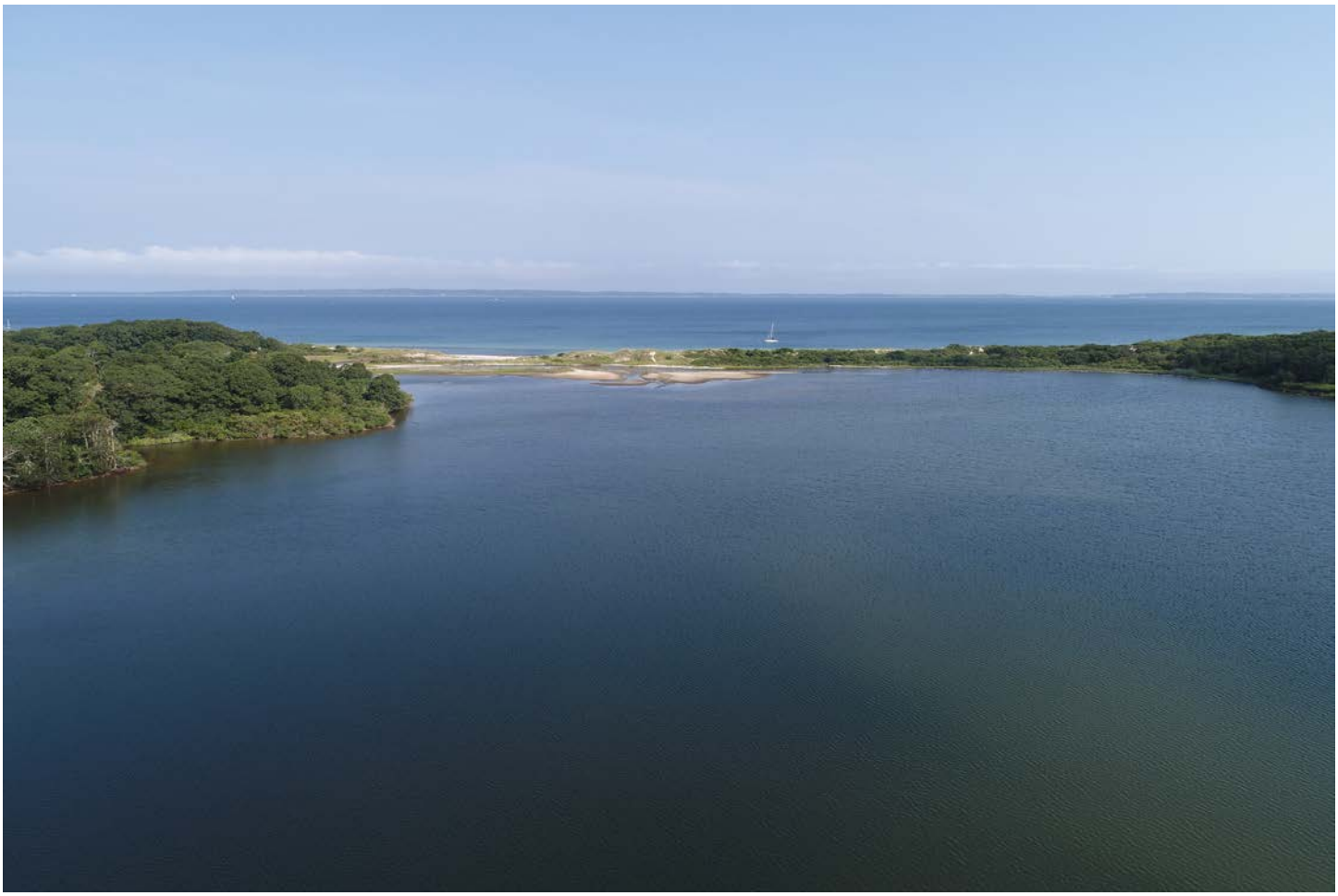


Photo Credit: Martha's Vineyard Commission, August 2020

Population and housing

The town of West Tisbury has experienced a large population increase since the 1950s. As shown in Table 3, the estimated population of West Tisbury has grown from 347 people in 1950 to 3,555 people in 2020. Due to a large seasonal population, the town's population increases by approximately 5,000 additional residents each summer according to 2020 US Census Data[41]. Note, population statistics cited here refer to the entire town and are not limited to the James Pond watershed boundaries.

As is true for many other communities with seasonal populations nearly half (44%) of the parcels in West Tisbury are owned by seasonal residents (Figure 20)[42]. These increased populations, both year-round and seasonal, contribute to water quality stressors, along with the associated nutrient inputs from onsite wastewater systems and changes in land use for previously undeveloped land.

Town	Year-round Population 1950	Year-round Population 2020	Total Population % Increase 1950 - 2020	Peak In-season Population 2020
West Tisbury	347	3,555	925%	8,723

Table 3. James Pond Watershed Population

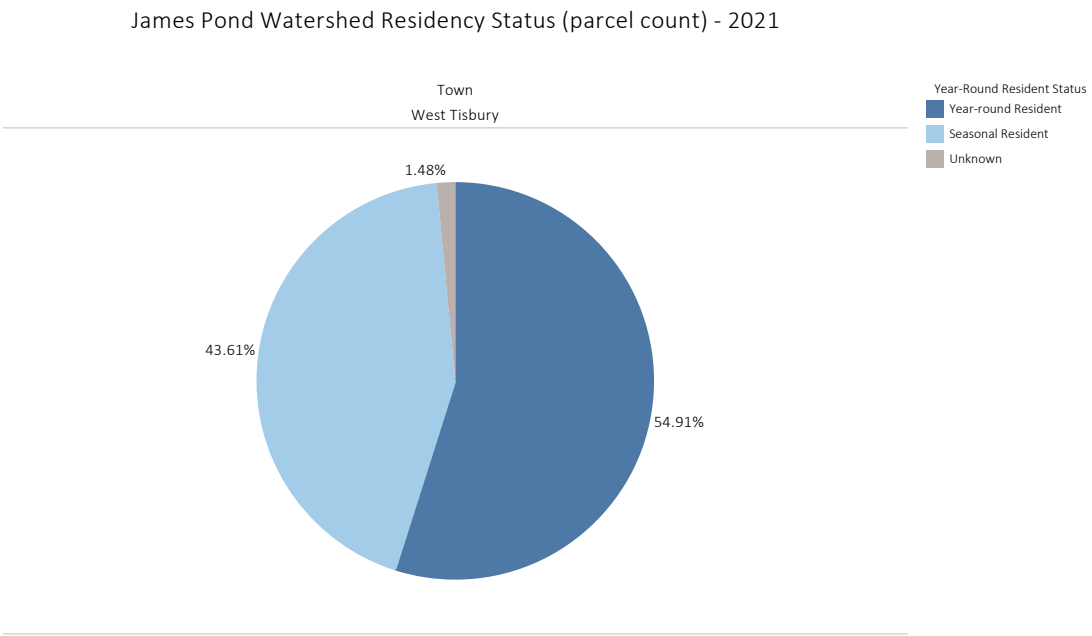


Figure 20. Housing and Residency Status (2021)

Land use and development

As noted previously, "Land Cover" refers to physical features and landscaping patterns/characteristics that exist in a particular area. For example, Land Cover can refer to the type of vegetation that exists in the watershed area (forests, pastures, wetlands etc.). "Land Use" refers to how the land is managed or used. Following this example, forested areas tend not to have large residential or commercial structures, agriculture land references pasture that feed animals, and wetlands, like forests, are unlikely to be used for residential or commercial purposes.

In this section of the report, we limit our discussion to "Land Use". Changes in land use patterns influences water quality conditions in associated aquatic systems. For example, increased residential areas, impervious surfaces, and cultivated agriculture can contribute to higher nitrogen loading from watersheds to receiving waters.

While historic land use classifications differ from those used in 2021, changes in land use patterns can be seen when comparing 1971, 1985 and 1999 land use using aerial photos. For example, in the James Pond Watershed, conversion of forest land use into residential areas is evident. Of note, the decrease in forest has been roughly proportional to the increases in residential use (Figure 21).

The MVC tracks development over time using year-built data from the towns' assessing records. Figure 22 highlights the growth in the number of buildings since the 1700s. In addition to implications of shifting forest to residential land use, increased building development shifts the focus of onsite wastewater systems from merely disposal to how efficiently these systems process nitrogen.

According to MVC data, just over half (54%) of existing building development occurred between 1900 and 1969. Since 1970, less than 10% of new building development has occurred each decade, with the 1980s as the peak decade for new development during that timeframe[43]. These values indicate that much of the development in the James Pond watershed is relatively old which has important implications for the efficiency and nitrogen passing through older wastewater systems. Furthermore, land availability information presented below suggests that there are likely unrealized development pressures in the watershed, which also has important implications for onsite wastewater systems.

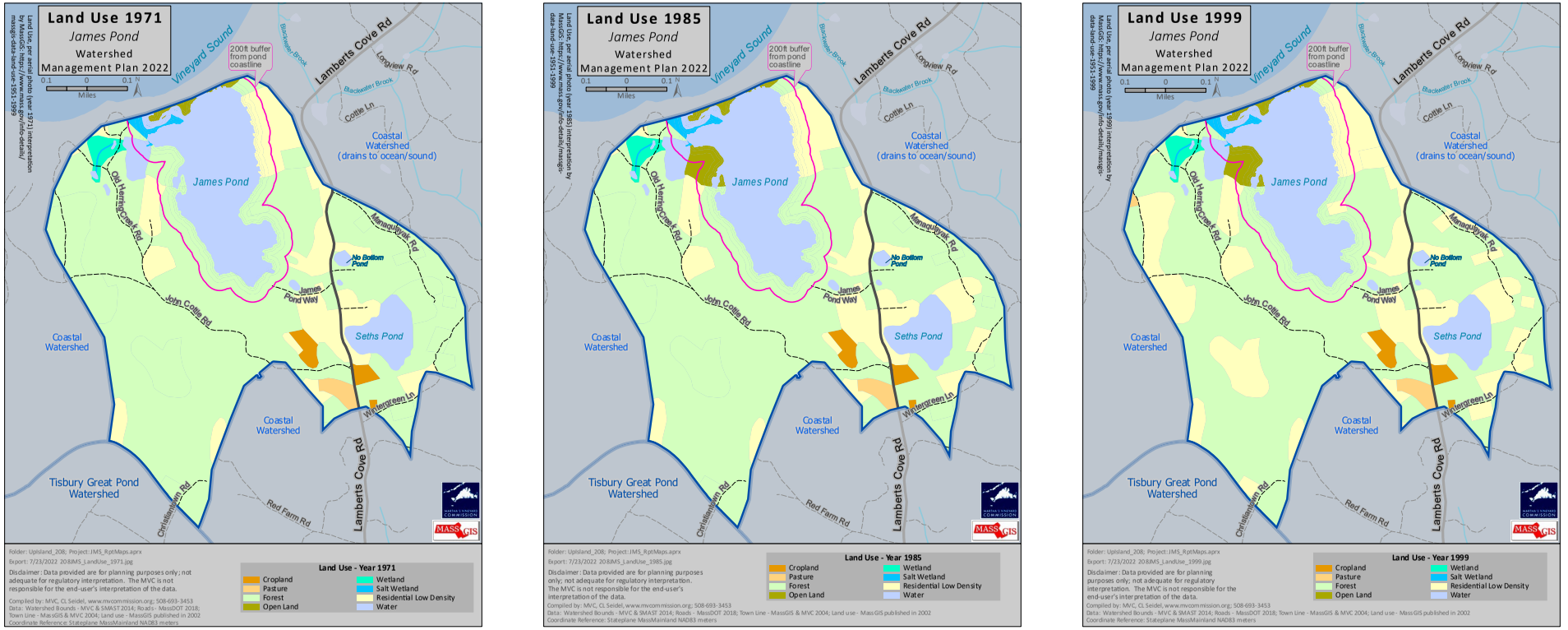
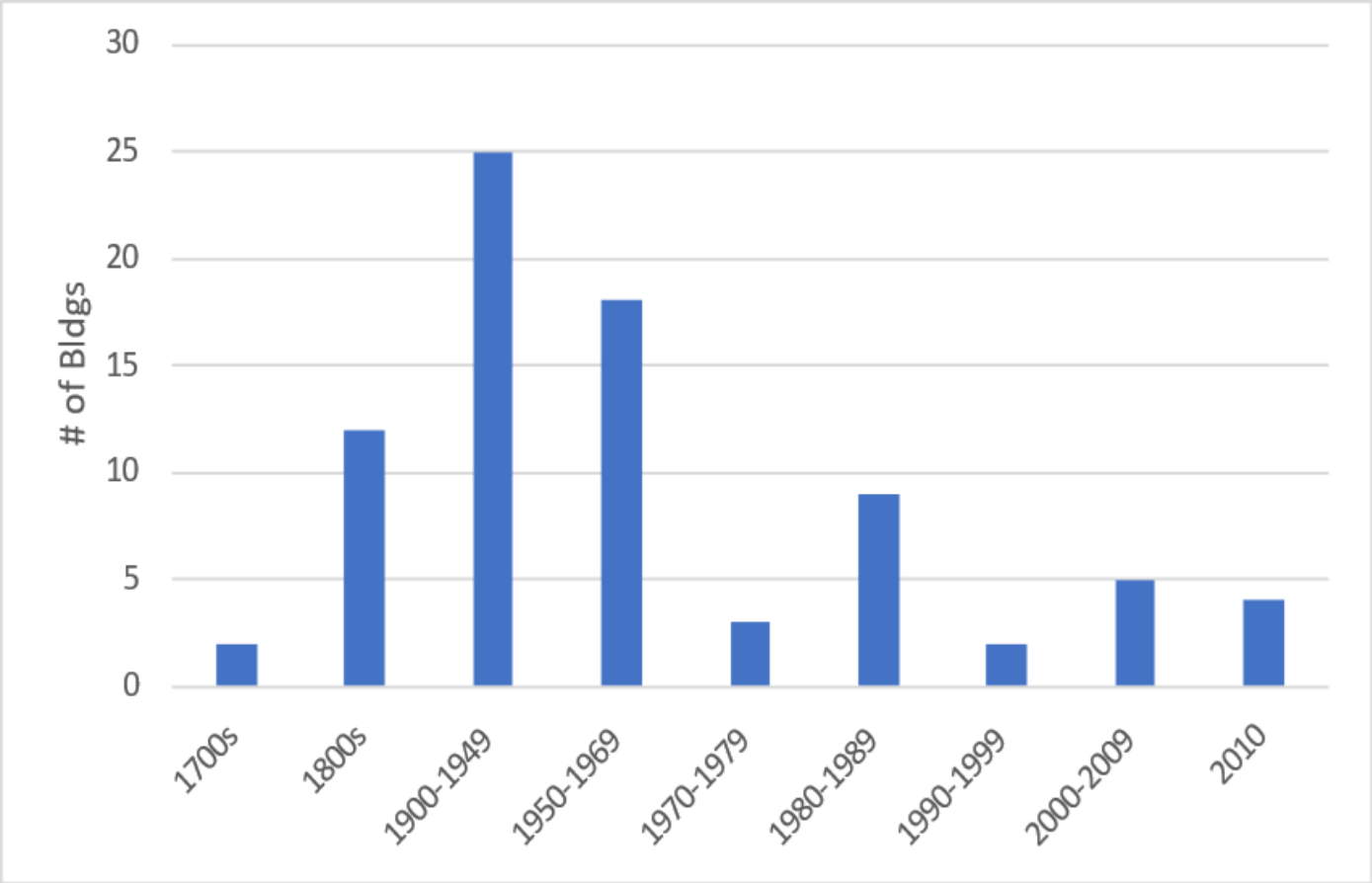


Figure 21. Land Use Map Comparison - 1971, 1985, 1999



Note: Time frames indicated on bar graph do not represent proportionate or equal time periods.

Figure 22. Construction Year of Oldest Building on a Given Parcel In James Pond Watershed

As shown in Figures 23 and 24, based on the use code assigned by the town assessor, just over three quarters of the James Pond watershed is occupied by residential land uses, and 15% is occupied by undeveloped land[44]. However, it is important to note that while a significant portion of land within the James Pond watershed is zoned for residential use, less than half of the land area (38%) has been fully developed. Please see the "Buildout" portion of this report for additional information on the number of actual vs. potential residences in this watershed. Large residential parcels have remained sparsely developed with very few residential structures constructed. Consistent with the land cover data presented earlier, agricultural land use occupies a negligible portion of the watershed.

Addressing older onsite disposal systems likely presents the greatest opportunities for immediate impact.

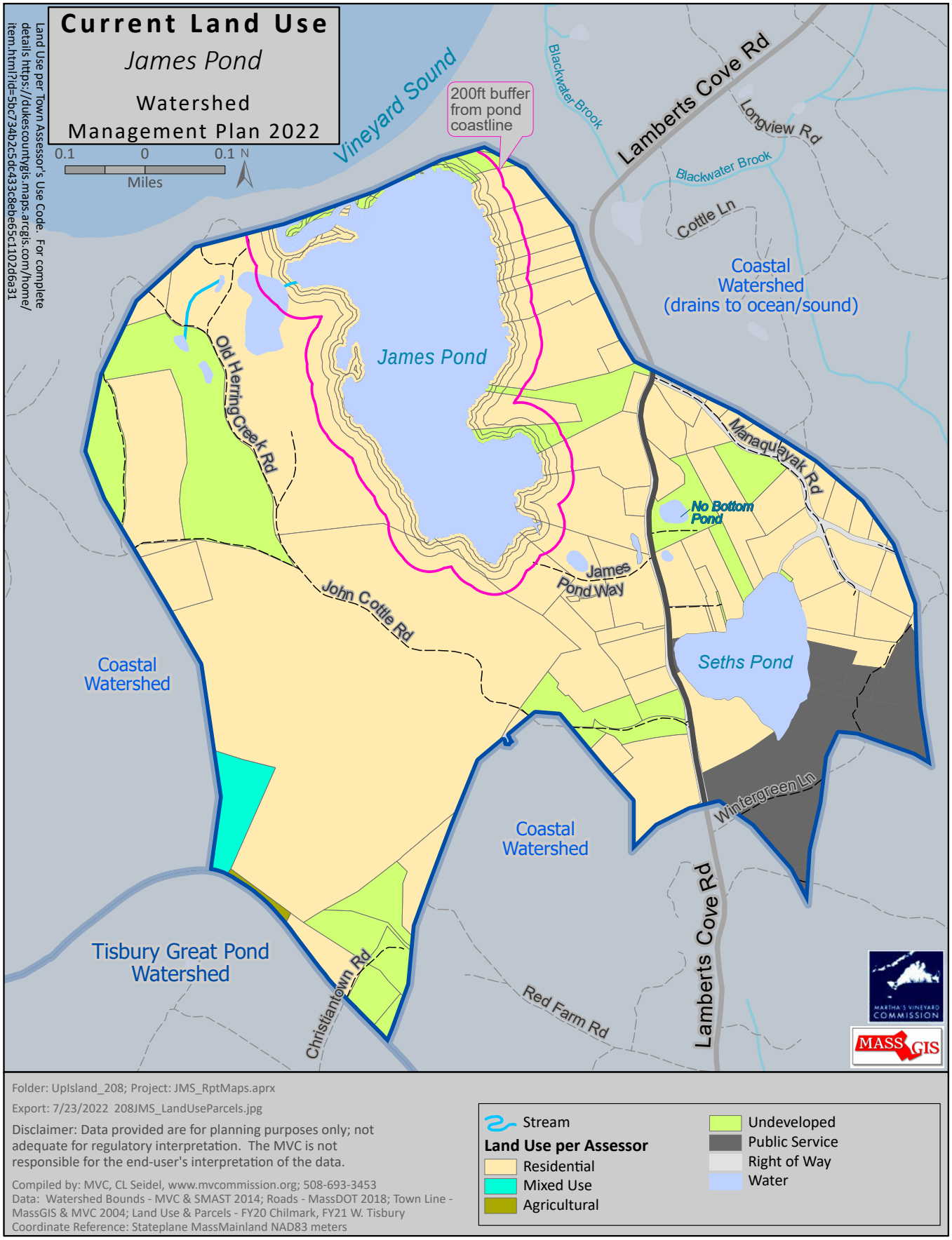


Figure 23. James Pond Watershed Land Use Map (2021)

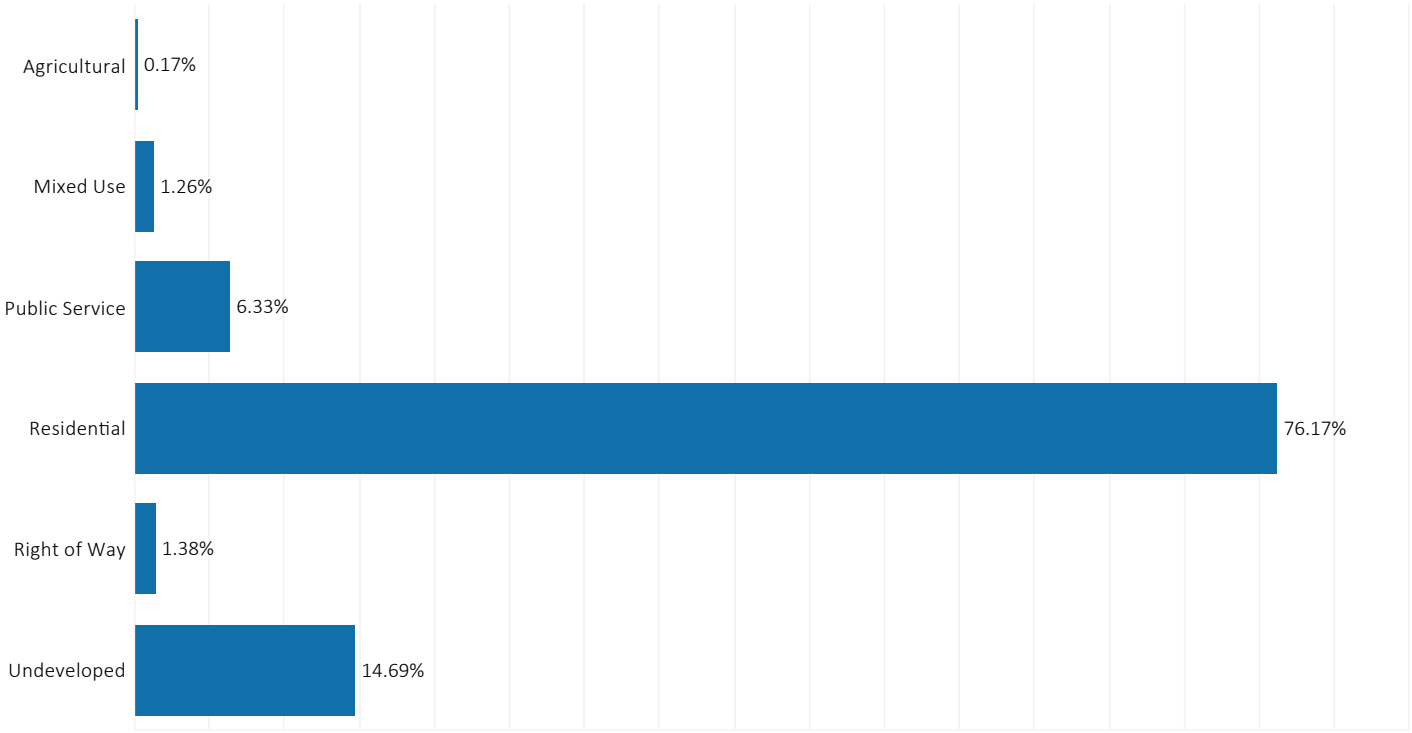


Figure 24. Current (2021) Land Use in James Pond Watershed

Wastewater Management Systems

There are no centralized wastewater treatment facility or decentralized package plants in the James Pond watershed. Onsite wastewater disposal systems (OSDS) are a likely source of nitrogen loading to James Pond. It is estimated there are 34 non-Title V systems built before 1978, 17 Title V septic systems built after 1978, and no innovative alternative systems in the watershed[45]. Almost all of these systems (47) are located greater than 200 feet from the pond's edge, four of the Title V systems and one of the non-Title V systems are estimated to be located within 200 feet of the pond's edge Figure 25. Development within 100 feet of the pond edge is closely monitored and regulated to ensure development does not occur immediately adjacent to the pond[46].

Opportunities to improve wastewater management exist in the James Pond-watershed, especially given the potential age of existing OSDS. While OSDS closest to the pond edge may present the greatest opportunities for immediate impact, given the nitrogen leaching potential of watershed soils, replacement of any low performance OSDS with enhanced nitrogen removal systems would be beneficial.

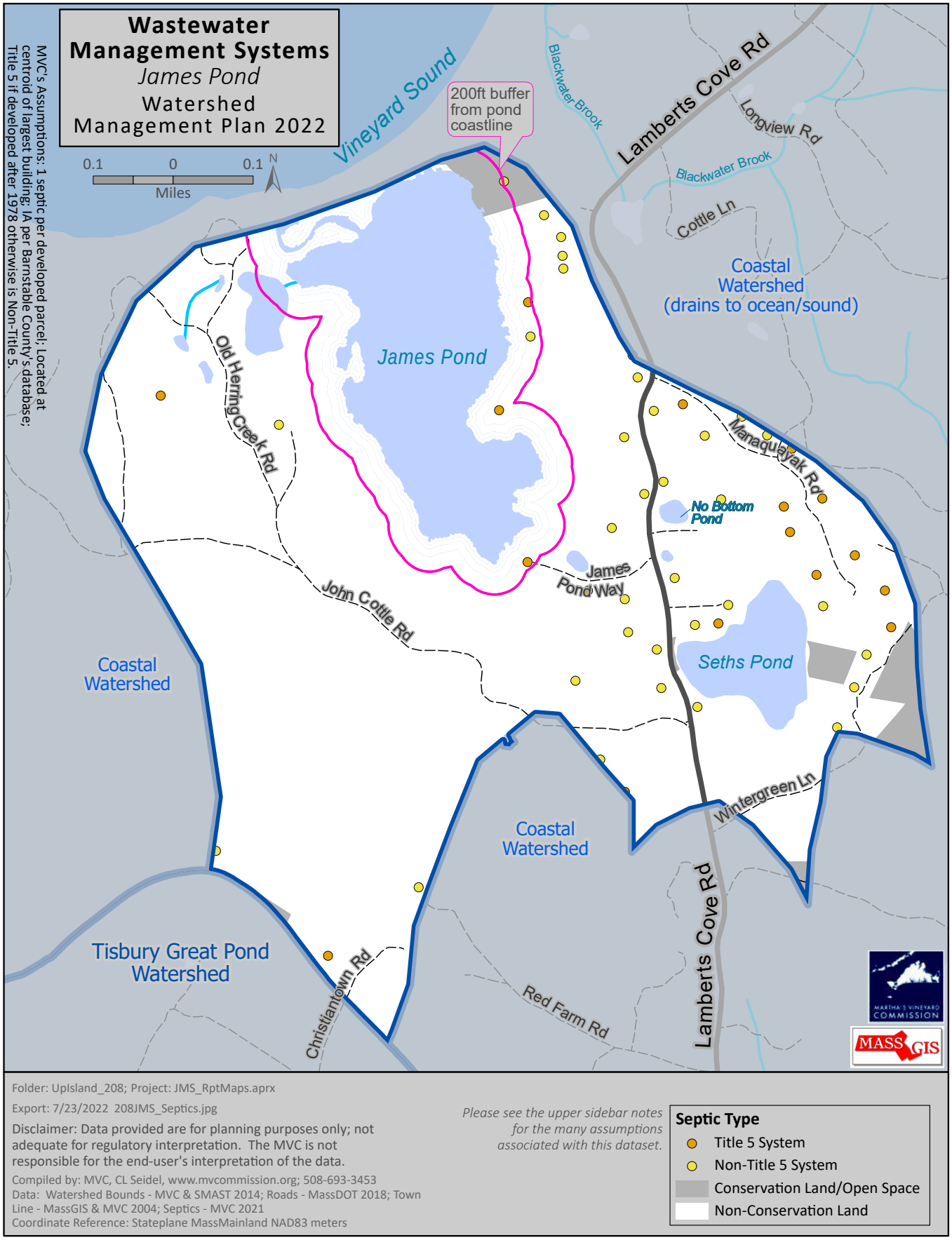


Figure 25. Wastewater Management Systems in James Pond Map

Stormwater Management

There is no inventory of public or private stormwater infrastructure in the watershed at this time; therefore evaluating the effectiveness of stormwater management is difficult. West Tisbury is not considered an "urbanized area" under the 2010 U.S. Census, so the town is not covered under the Massachusetts Municipal Separate Storm Sewer System (MS4) permit but is subject to the Massachusetts Stormwater Standards. West Tisbury cleans and maintains the infrastructure on town roads annually. An additional assessment of existing stormwater management and retrofit potential will be needed to target specific stormwater improvements.

Buildout

Approximately 41% of the watershed is available for development, with another 18% considered potentially available for development[47]. Despite the high numbers of forest land cover in the watershed, approximately 2% of the watershed is currently conserved (Figures 26 and 27). With approximately half of the watershed available or potentially available for development, there are likely unrealized development pressures and potential associated water quality stressors. Land conservation is a possible management strategy to protect some of this developable land.

Current (2021) regulatory guidelines address the density of residential structures within the town of West Tisbury. According to current regulatory

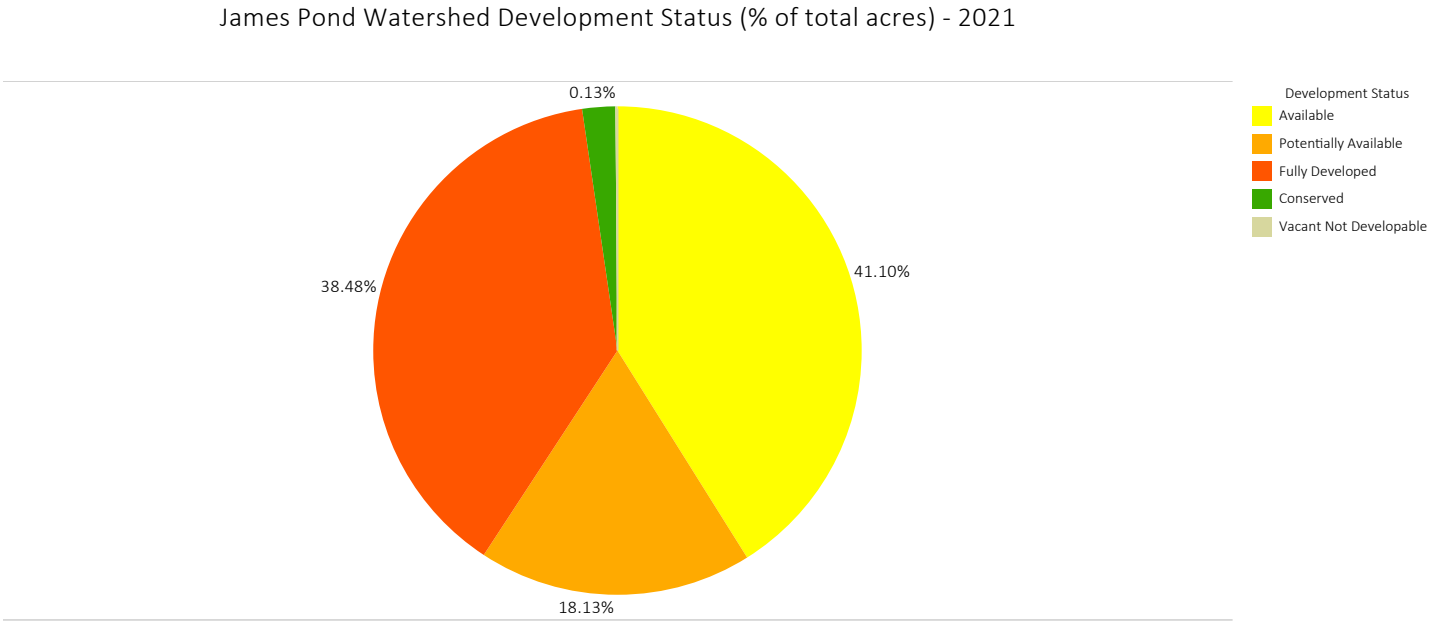


Figure 26. James Pond Watershed Development Status/Land Availability

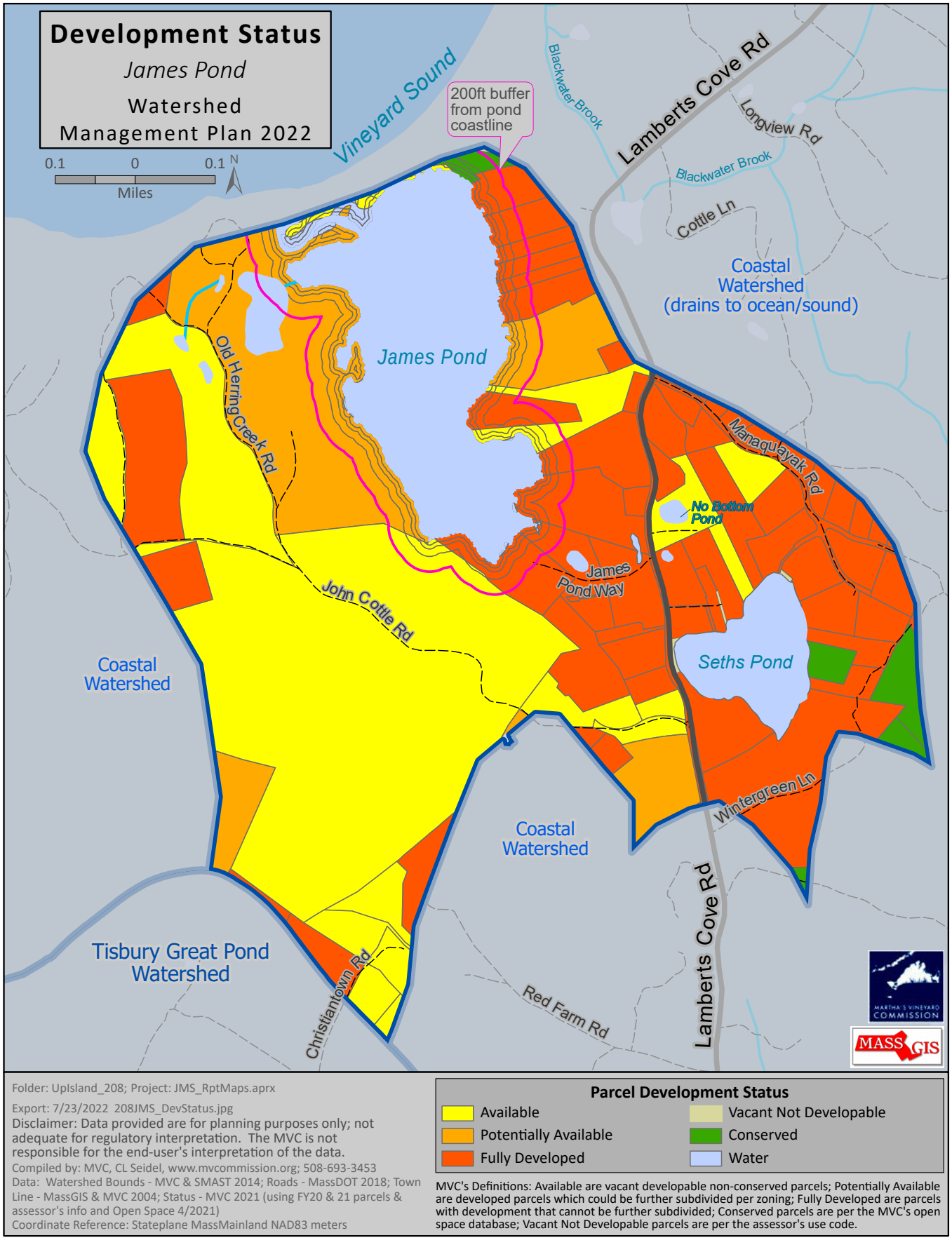


Figure 27. James Pond Development Status Map

guidelines, the maximum number of structures allowable within the James Pond watershed is 143. Of these, 84 (59%) have been built and another 59 could be built in the future (Figure 28)[48].

It is important to note that there are several very large parcels within the watershed on which only one or two residential structures exist. Although this could change in the future, as of 2022, approximately 59% of all potential residences have been built.

All development within the watershed, regardless of proximity to water surface areas, directly impacts water quality in the pond. Development closer to the pond edge has short term impacts, while development on parcels farther away from the pond edge will impact water well into the future as nitrogen makes its way to the pond. One way to illustrate the impact of development proximity as it relates to water quality in the pond is to consider the rate at which groundwater is transported through the watershed and into the pond. A general rule of thumb is that groundwater (and pollutants/nutrients in groundwater) travel approximately four hundred feet per year. Therefore, nutrients in the groundwater of a house built four hundred feet from the pond edge would take one year to reach the pond. The groundwater/nutrient load from a home that was built 2000 feet from the pond edge would begin to enter the pond and impact water quality five years from the date it was built.

When taking proximity to the pond into consideration, there are four (5%) structures within 200 feet of the edge of the pond, with potentially an additional six that could be built in the future. The average building density for the entire James watershed is 0.20 buildings for each acre of land. These values further highlight potential future development pressures in the watershed.

Other Uses

No golf courses or active cranberry bogs are present in the watershed. There are no active landfills in the James Pond watershed.

Livestock

While West Tisbury has longstanding, well established agricultural communities, detailed information is not available about livestock in the James Pond watershed. Based on the land cover and land use data presented earlier that showed minimal areas of agricultural land use and pasture/hay land cover, it can be assumed that there are not large numbers of livestock animals in the watershed. However, there may be improved operational management strategies related to livestock if they are present in specific areas, especially if such areas are proximate to the ponds or streams, with little or no buffer.

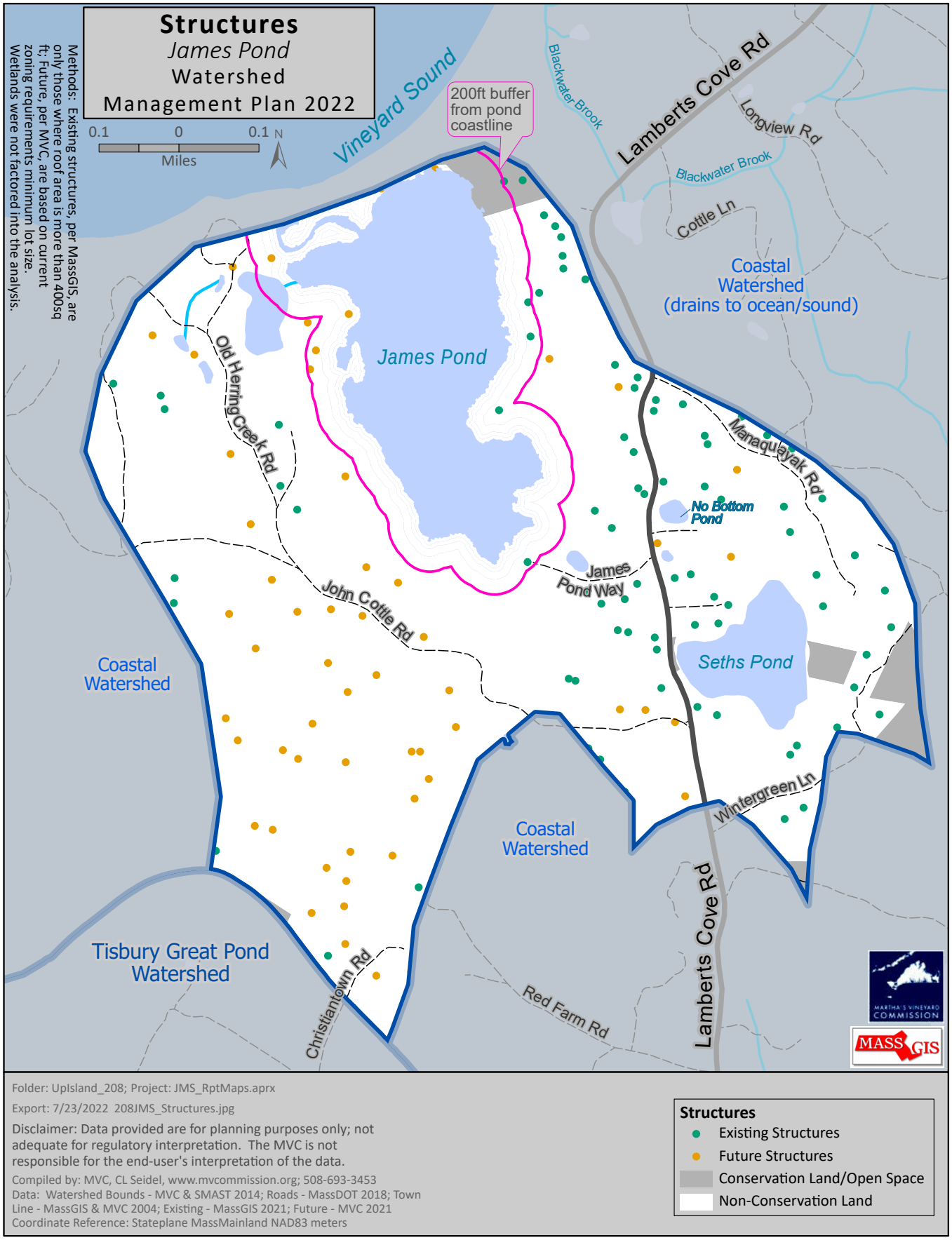


Figure 28. Existing and Potential Structures in James Pond Watershed

LAND CONSERVATION

Land conservation areas protect water quality by lowering future nitrogen loading and by holding and filtering water and associated pollutants before they reach downstream waterbodies. In general, predominantly forested watersheds with limited developed or cultivated land alterations tend to have better water quality due to exceptionally low nutrient output from these areas when compared to developed land. Protecting additional acres of undeveloped land can be an effective management strategy to prevent further degradation of water quality. A map of all conserved open space is found in Figure 29.

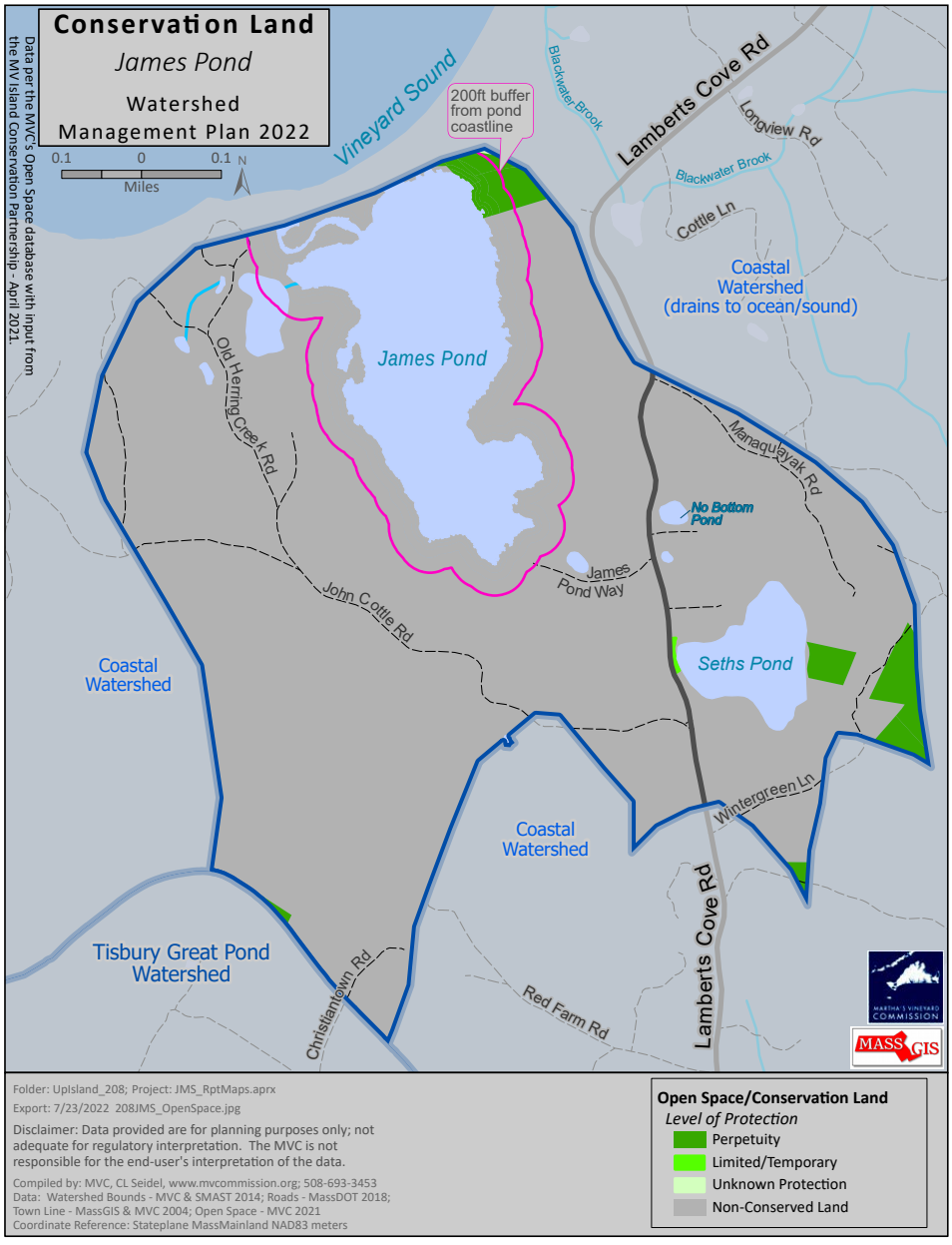


Figure 29. James Pond Watershed Conservation Land Map

As of December 2021, approximately 25 acres (6%) of the James Pond Watershed is categorized as conserved open space. Nearly all (99.9%) of this open space is conserved in perpetuity and therefore excluded from future development through legal restrictions[49].

Despite the small amounts of conservation land in the James Pond Watershed, there are more extensive publicly accessible open space recreation areas located just outside the watershed. These areas present potential opportunities for open space network connectivity. These areas include Lambert's Cove Beach, northeast of the pond watershed and the Manaquayak Preserve, southeast of the pond's watershed, between Seth's Pond and Old House Pond[50]. In 2021, the Martha's Vineyard Land Bank Commission acquired several privately owned properties between Lambert's Cove Beach and James Pond for a future 13.9-acre James Pond Preserve that will include beach and pond frontage. The preserve opening is planned for sometime in 2022[51].

Given the considerable proportion of land that is available or potentially available for development (59%, 210 acres) land conservation is a potential management strategy for this watershed. Future conservation opportunities may provide permanent protection for key habitat areas.

Pond Uses

James Pond and surrounding areas are a valuable recreational, cultural, and economic resource that rely on clean water and a healthy pond. Pond uses include recreational boating, swimming, and fishing. As of July 2022, there are no large mooring areas, marinas, or public access points in the pond. Several homeowners have private access points. Seth's Pond (in the southeast corner of the watershed) is a popular freshwater swimming pond when water quality allows.

Shellfish Areas

The Massachusetts Division of Marine Fisheries (DMF) prohibits shellfish harvesting and propagation in James Pond[52] due to water quality conditions and high bacteria levels. See Figure 30 for a map of areas closed to shellfishing.

Local Regulations

West Tisbury has a Conservation Commission that implements the MA Wetlands Protection Act, a Planning Board that oversees development under its authority, a Board of Health that regulates wastewater systems, and other relevant town bodies that influence pond management and water quality. Conservation Commission authority includes wetland resource areas and

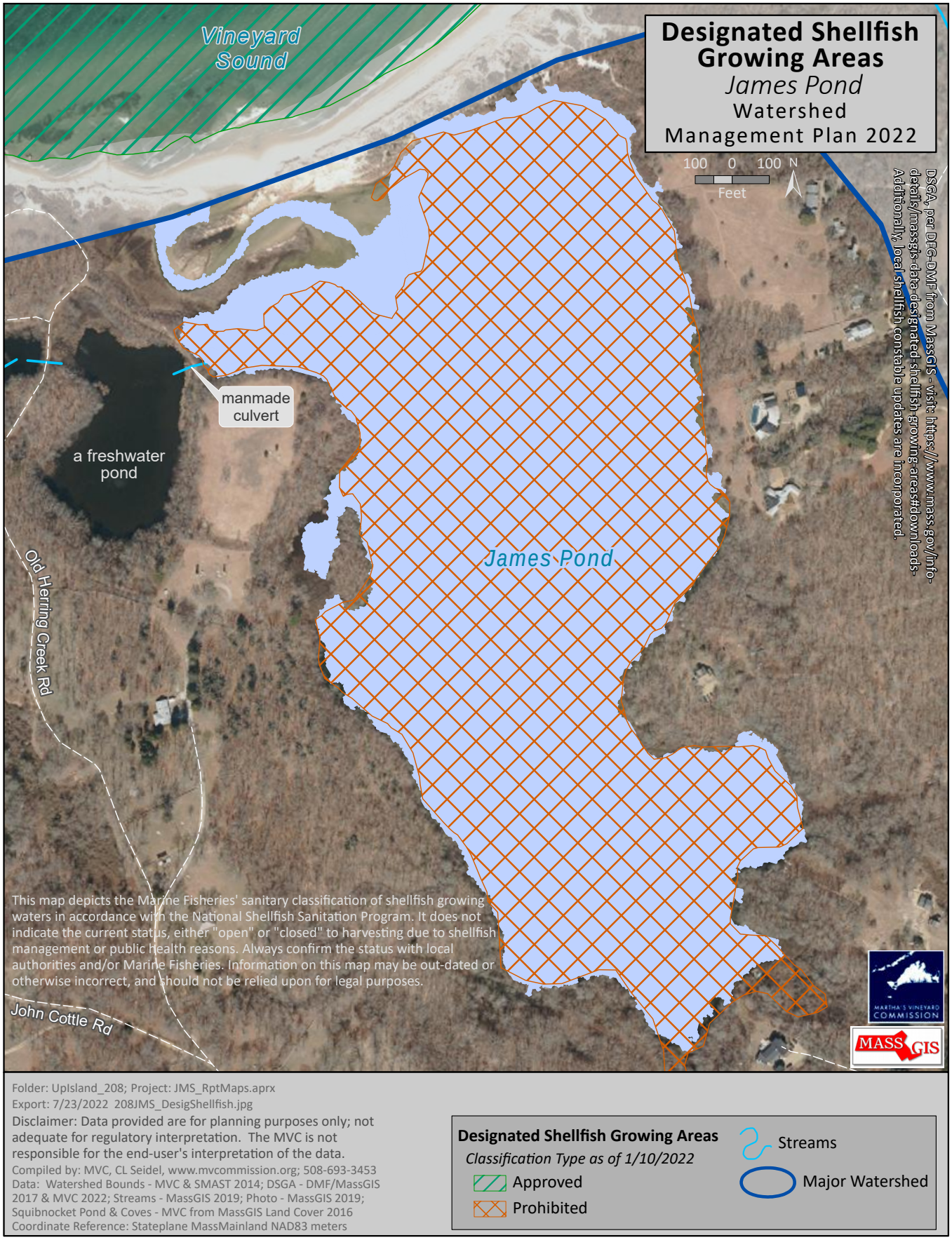


Figure 30. James Pond Designated Shellfish Harvest Area

associated buffer zones, as defined by the Wetlands Protection Act and the town's bylaws and regulations. These regulations shape the form, density, and location of development, with implications for water quality.

All of the James Pond watershed in West Tisbury is zoned as Rural. This zoning district has a minimum lot size of three acres for single family uses and six acres for two-family uses, encouraging low density development[53]. West Tisbury also has a Coastal District Special Overlay District in its Zoning Bylaw that includes areas around James Pond and prohibits most development in the "Shore Zone"[54]. Furthermore, development is restricted in the "Inland Zone"[55]. Some areas that also fall within the watershed are also in the Flood Plain Overlay District[56]. All of these regulations are intended to protect the areas immediately adjacent to the pond.

The West Tisbury Board of Health regulates fertilizer use[57]. Language for this regulation is found in the "The Content and Application of Fertilizer for Turf on Martha's Vineyard" policies. This policy articulates best practices and standards related to timing, concentration, location, and processes for fertilizer application. The policy also addresses nitrogen and other water quality impacts from fertilizer application. Fertilizer can be a source of excess nutrients to waterbodies, so by controlling fertilizer use, West Tisbury contributes to protecting James Pond.

Summary

Above all, James Pond's socioeconomic conditions reflect a watershed that has large areas of forested land, few acres of which are protected from future development. These conditions reflect unrealized development pressures that could threaten water quality. In addition, existing infrastructure, especially aged onsite wastewater treatment, and population growth have the potential to amplify water quality stressors.

ENDNOTES

1. Banks, C.E., (1911). History of Martha's Vineyard, Vols I, II and III. George H. Dean. Boston, MA.

2. Martha's Vineyard Commission, (2022). James Pond. Accessed March 15, 2022 from https://mvcommission.org/james-pond.

3. Data provided by the Martha's Vineyard Commission, March 2022.

4. Martha's Vineyard Commission, (2015). Major Watersheds of Martha's Vineyard Map. Accessed December 27, 2021 from https://www.mvcommission.org/document/major-watersheds-marthas-vineyard-map.

5. Data provided by the Martha's Vineyard Commission, March 2022.

6. Buzzard's Bay Coalition, James Pond Inlet Stability Evaluation Final Report, February 2022.

7. Buzzard's Bay Coalition, James Pond Inlet Stability Evaluation Final Report, February 2022.

8. Martha's Vineyard Commission, (2022).

9. NOAA Lidar (light detection and ranging) data and 1 ft contours, 2016 NOAA NGS Topobathy Lidar: https://www.fisheries.noaa.gov/inport/item/51272; and https://coast.noaa.gov/dataviewer/#/lidar/search/where:ID=8460, analysis completed by Horsley Witten Group, 2022.

10. Bathymetry analysis approximation conducted by Horsley Witten Group, 2022, using publicly available NOAA Lidar (light detection and ranging) data and 1 ft contours.

11. Buzzard's Bay Coalition, James Pond Inlet Stability Evaluatiown Final Report, February 2022.

12. Elvin, A., (2016). Many Hands (and Shovels) Make Wet Work at James Pond. Vineyard Gazette. Accessed March 16, 2022 from https://vineyardgazette.com/news/2016/03/02/many-hands-and-shovels-make-wet-work-james-pond.

13. Buzzard's Bay Coalition, James Pond Inlet Stability Evaluation Final Report, February 2022.

14. These categories are provided for areas delineated within 200 feet of the pond edge and beyond 200 feet from the pond edge.

15. Data provided by the Martha's Vineyard Commission, March 2022.

16. NOAA, (2021). How to Use Land Cover Data as a Water Quality Indicator. Accessed December 27, 2021 from https://coast.noaa.gov/howto/water-quality.html.

17. United States Geological Survey, (2018). Geologic map of Cape Cod and the Islands, superimposed with maximum extent of ice lobes. Accessed March 16, 2022 from https://pubs.usgs.gov/of/2008/1288/html/imagepages/figure2.html.

18. 'Not Rated' is a group of soil types that didn't fit the criteria to be assigned to a different rating category. In the up-island area, the 'not rated' category appears to be soil types of water and beaches. The Up-Island 208 maps show two soil survey interpretations (1. Hydrologic Soil Group; & 2. Nitrate-Nitrogen Index). The respective "[s]oil survey interpretations assign ratings to soil types based on their properties…" These "…interpretations are developed by soil scientists within the state to provide information specific to the state of Massachusetts."

19. "The Nitrate-Nitrogen Leaching Index (NLI) is an indicator of the potential for nitrates dissolved in water to percolate to the groundwater. In Massachusetts, the NLI is based on a soil interpretation that uses soil and climate properties in the National Soil Information System (NASIS) database and results in a ranking of low, moderate, or high potential for Nitrate-Nitrogen leaching." From https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ma/soils/?cid=nrcseprd1371099.

20. Data provided by the Martha's Vineyard Commission, March 2022

21. Soil Data is a subset attribute fields from the MassGIS (11/21) SSURGO Certified 'Top20' Soils data from NRCS Database (6/20). To fully understand these attributes please read the metadata: https://www.mass.gov/info-details/massgis-data-soils-ssurgo-certified-nrcs#attributes-

22. https://www.mass.gov/regulations/314-CMR-4-the-massachusetts-surface-water-quality-standards

23. https://www.mass.gov/lists/integrated-lists-of-waters-related-reports

24. UMass Dartmouth's School for Marine Science & Technology (SMAST), (2017-2021). Data provided by the Martha's Vineyard Commission 2021. Subsequent data summaries compiled by Horsley Witten Group 2021.

25. Commonwealth of Massachusetts, (2019).

26. Martha's Vineyard Commission, (2020). James Pond 2020 M.V.C. Sampling Summary. Accessed December 2021 from https://www.mvcommission.org/sites/default/files/docs/james-pond-2020_55349395%20%281%29.pdf.

27. UMass Dartmouth's School for Marine Science & Technology (SMAST), (2003-2021). Data provided by the Martha's Vineyard Commission 2021. Subsequent data summaries compiled by Horsley Witten Group 2021.

28. Total Pigment threshold is a well established parameter as described by Brian Howes in an email correspondence with Rachel Sorrentino on 9/30/2022

29. Howes et al., (2013).

30. Massachusetts Natural Heritage and Endangered Species Program (NHESP) (https://maps.massgis.digital.mass.gov/MassMapper/MassMapper.html) and Howes et al., (2017).

31. http://maps.massgis.state.ma.us/dfg/biomap2.htm. For definitions of these categories, visit the BioMap2 website.

32. http://maps.massgis.state.ma.us/dfg/biomap2.htm. For definitions of these categories, visit the BioMap2 website.

33. https://www.mass.gov/service-details/biomap2-town-reports. See West Tisbury Report.

34. https://www.mass.gov/service-details/biomap2-town-reports. See West Tisbury Report.

35. https://vineyardgazette.com/news/2021/04/06/land-bank-doubles-property-holdings-lamberts-cove, accessed July 25, 2022.

36. James Pond Preserve Draft Management Plan, available at: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://mvlandbank.com/documents/2022_4_20_JamesPondplan.pdf. Accessed July 25, 2022.

37. Pettibone, (1977). Available at: https://repository.si.edu/bitstream/handle/10088/3404/Pettibone-1977-205.pdf?sequence=1&isAllowed=y.

38. Vineyard Gazette (2016). Available at: https://vineyardgazette.com/news/2016/02/10/james-pond-cut-subject-study-town-state

39. The MassDEP Eelgrass Viewer shows mapping project years from 1195, 2001, 2006/2007, 2010-2013, 2015-2017, and 2019-2022. The viewer is available here: https://mass-eoeea.maps.arcgis.com/apps/webappviewer/index.html?id=07f8d48c714f4f81bec49864ecf252da.

40. Howes et al., (2015).

41. U.S. Census Bureau (2019). American Community Survey (ACS) Five-Year Estimates 2015-2019 and

U.S. Census Bureau (2020). 2020 Census. Data provided by the Martha's Vineyard Commission, 2022.

42. U.S. Census Bureau (2019) and U.S. Census Bureau (2020). Data provided by the Martha's Vineyard Commission, 2022.

43. Town of West Tisbury, (2021), Assessors Databases and MassGIS, (2020), Structures. Data provided by the Martha's Vineyard Commission March 2022. Additional data summaries compiled by Horsley Witten Group, 2022.

44. Town of West Tisbury, (2021) Assessors Databases. Data provided by the Martha's Vineyard Commission March 2022.

45. The Structure roofprints from MassGIS were used to determine which parcels are currently developed. This dataset identifies structures from aerial photographs which are only obtained every so many years. Therefore, structure data may not reflect the 2021 status. The septic numbers represent an approximate count of parcels containing a septic system. It is assumed only one septic per parcel. It is assumed that Non-title V septics are parcels that were initially developed prior to 1978; parcels initially developed in 1978 or later are assumed to have a Title V septic. Parcels with Innovative Alternative systems were identified & geolocated based on info provided by the Barnstable County Innovative/Alternative Septic System Tracking Program. The IA data only included info for Active IA systems in Chilmark & West Tisbury as of June 2nd, 2021. For parcels with multiple buildings, the earliest year built was used to classify Non-Title V vs Title V septic. Therefore, if the parcel's initial building was developed in 1965 but a second structure was built in 2000, then the type of septic assigned to that parcel is Non-Title V (since the Title V regulations went into effect in 1978).

46. Town of West Tisbury, (2021) Assessors Database and MassGIS, (2020), Structures, with support from Barnstable County. Data provided by the Martha's Vineyard Commission, March 2022.

47. Town of West Tisbury, (2021), Assessors Databases and MassGIS, (2020), Structures. Data provided by the Martha's Vineyard Commission, March 2022.

48. Future Buildings: The future building analysis, performed in the Spring of 2021 by the MVC, incorporated the most currently available parcel boundary, structure, zoning data, and open space/ Conservation land available. These data will not reflect the reality of the current moment as there is always a delay between obtaining data, processing, and then dissemination. The future buildout only considers minimum lot size per town zoning. Meaning, if a 9 acre parcel in a 3 acre minimum zoning area has one existing structure, then the model will determine that 2 future buildings could be developed on this parcel. The analysis does not restrict building on wetlands nor does it incorporate Town Board of Health regulations or special housing association or deed restrictions. The model did restrict future development on land that is protected as conservation land (as of April 2021). This methodology results a maximum future buildout.

49. MVC & MV Island Conservation Partnership, (2021). Data provided by the Martha's Vineyard Commission 2022. Additional data summaries compiled by Horsley Witten Group 2022.

50. Martha's Vineyard Land Bank Commission, (2022). Accessed March 16, 2022 from http://www.mvlandbank.com/newfullmap2020.shtml; Sheriffs Meadow Foundation, (2022). Accessed March 16, 2022 from https://sheriffsmeadow.org/lands/.

51. Asimow, N, (2021). Land Bank Doubles North Shore Property Near Lambert's Cove. Vineyard Gazette. Accessed March 16, 2022 from https://vineyardgazette.com/news/2021/04/06/land-bank-doubles-property-holdings-lamberts-cove; Thors, L, (2020). Land Bank Acquires North Shore Land for Public Preserve. MV Times. Accessed March 16, 2022 from https://www.mvtimes.com/2020/12/09/land-bank-acquires-north-shore-land-public-preserve/.

52. MassMapper, see Shellfish Growing Areas layer: https://maps.massgis.digital.mass.gov/MassMapper/MassMapper.html.

53. Martha's Vineyard Commission, (2015). West Tisbury, MA – Zoning. Accessed December 20, 2021 from wti_zn_par_current.pdf (mvcommission.org). https://dukescountygis.maps.arcgis.com/apps/instant/interactivelegend/index.html?appid=efe97a77a8324945a61f3d8c74d95efb

54. "Shore Zone" includes area "from mean low water to one hundred feet inland of the inland edge of any beach or marsh grasses and one hundred feet inland of the crest of any bluff exceeding a height of fifteen feet." CITATION?

55. "Inland Zone" refers to the area "below ten-foot elevation above sea level or within five hundred feet of mean high water of a coastal water body exceeding ten acres in size or the ocean and all land within one hundred feet of streams and wetlands draining into coastal great ponds"

56. Untitled map (arcgis.com) Town of West Tisbury, MA, (2020). Zoning Bylaw. Accessed December 20, 2021 from https://www.westtisbury-ma.gov/sites/g/files/vyhlif4036/f/uploads/zoning_bylaws_as_of_october_2020.pdf.

57. Town of West Tisbury, (2014). Town of West Tisbury Board of Health Regulations. Accessed December 27, 2021 from https://www.westtisbury-ma.gov/sites/g/files/vyhlif4036/f/uploads/bohregs_2014.pdf.