AGENDA

Monday

November 7, 2016

TOWN OF EASTHAM
AGENDA
BOARD OF SELECTMEN
Monday, November 7, 2016
5:00 p.m.

Location: Earle Mountain Room

I **SELECTMEN/PUBLIC INFORMATION**

II. **APPOINTMENT**

A. Discussion/Presentation

5:05 p.m. Update on Orleans Meeting About Dredging Town Cove – Shana Brogan, Conservation Agent, and Paul Lagg town Planner

5:15 p.m. Cable TV License Advisory Committee – Consider Establishment to Assist in Negotiating New Contract – Sheila Vanderhoef

III. **ADMINISTRATIVE MATTERS**

A. Action Needed

1. Discussion/Adoption of Conservation Restrictions for Town-owned parcels
2. Appointment Affordable Housing Trust – Carol Martin
3. Review Revised Draft of MOU for Purcell Property Housing Proposal
4. Transient Vendors (various)
5. Consider Committee Appointments, Human Services Advisory, Search Committee, Council on Aging
6. Sign Aquaculture License Approved by Board on May 16, 2016 - Gayle Ashton

IV. **TOWN ADMINISTRATOR'S REPORT**

Library Grand Opening: November 15, 10:00 A.M.
Municipal Water Connections Celebration: November 17, Town Hall from 4:30-7 P.M.

V. **OTHER BUSINESS**

VI. **EXECUTIVE SESSION**: To discuss collective bargaining strategy, and strategy with respect to potential litigation regarding the Library and litigation regarding landfill pollution and the Chairman declares, an open meeting may have a detrimental effect on the bargaining or litigating position of the public body.

Upcoming Meetings

November 9, 2016	*3:00p.m.*	*Timothy Smith Room*	*Work Session*
November 21, 2016	*5:00 p.m.*	*Timothy Smith Room*	*Regular Meeting*

The listing of matters includes those reasonably anticipated by the Chair, which may be discussed at the meeting. Not all items listed may in fact be discussed and other items not listed may be brought up for discussion to the extent permitted by law.

This meeting will be video recorded and broadcast over Local Access Channel 18 and through the Town website www.eastham-ma.gov

II.A. 5:05 pm

Sheila Vanderhoef

From: Beth Gurney <bgurney@whgrp.com>
Sent: Tuesday, October 11, 2016 3:49 PM
To: John Kelly; Tom Daley; Nathan Sears; John Jannell; Judith Scanlon; George Meservey; Sheila Vanderhoef; Mike O'Connor; Paul Lagg; Kathy Tevyaw; Nita Tallent; Sofia Fox; Stephen Smith; Todd Walker; Phil Howarth
Cc: 'Leslie Fields'
Subject: Nauset Harbor Dredging Project

Hello Everyone,

The Town of Orleans is interested in conducting a dredging project in Nauset Harbor for the purposes of improving navigability. A study was completed by Woods Hole Group in February 2016 looking at the environmental, engineering, regulatory, and financial feasibility of a dredging project in the Harbor (http://www.town.orleans.ma.us/sites/orleansma/files/file/file/nauset_estuary_report_final.pdf).

Based on results of this study the Town is looking to further refine the dredge channel layout/design, and to coordinate with project stakeholders as well as local, state, and federal regulatory agencies. The Town is in the process of scheduling a working group meeting with local stakeholders sometime between Oct. 17 and Nov. 4 to further discuss the project. This meeting is the first in a series of working sessions and public meetings, and is intended for a targeted group of stakeholders with knowledge of the system and potential municipal involvement in the project.

You are receiving this email because you are being invited to the upcoming working group meeting, which will be held at Orleans Town Hall. To identify the best meeting date and time when most invitees are available, we will be sending each of you a separate Doodle Poll invitation via email. If you are unfamiliar with the Doodle Poll process, please let us know and we will assist you.

If you cannot attend but would like to send someone else in your place, please let us know who they are and send us their email address.

Again, please keep your eye out for the Doodle Poll invitation, and let us know if you have any questions at this time.

Thank you.

Beth (Hays) Gurney
Environmental Permitting Specialist, Woods Hole Group, Inc.
Address - 81 Technology Park Drive, East Falmouth, MA 02536
Direct: (508) 495-6240; Fax: (508) 540-1001; www.woodsholegroup.com
My email address changed to bgurney@whgrp.com on August 5, 2016.
Please make note of this change for future correspondence.

81 Technology Park Dr., East Falmouth, MA 02536
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Main Telephone: (508) 540-8080
FAX: (508) 540-1001
e-mail:lfields@whgrp.com
www.woodsholegroup.com

MEMORANDUM

Date: November 2, 2016

To: Attendees of Oct. 26, 2016 1st Stakeholders Meeting for Nauset Estuary Dredging Project

From: Leslie Fields

Re: Meeting Minutes from 1st Stakeholders Meeting

Attendees

John Kelly, Tom Daley, Nate Sears, George Meservey, John Jannell, Alan McClennen – Town of Orleans
Paul Lagg and Shana Brogan – Town of Eastham
Nita Tallent – Cape Cod National Seashore
Carolyn Kennedy – Orleans Marine and Freshwater Quality Task Force
Judith Scanlon – Orleans Shellfish and Waterways Improvement Advisory Committee
Charles Harris – Eastham Water Quality Advisory Panel
Gordon Smith – Orleans Water Quality Advisory Panel
Stephen Smith – Commercial Fisherman
Fred Fulcher – Commercial Fisherman
David Reed – Commercial Fisherman
Phil Howarth – Goose Hummock Shop
Rick Francolini – Orleans Resident
Tim Counihan
Leslie Fields, Adam Finkle, Beth (Hays) Gurney – Woods Hole Group

See attached Meeting Participant List for additional contact information.

Introduction:

John Kelly, Orleans Town Administrator provided introductory statements.

- *Nauset Estuary Dredging Feasibility Assessment* completed by Woods Hole Group in January 2016.
- Phase II of the project is now beginning. ~$350k has been approved by the Town of Orleans for Phase II for stakeholder coordination, additional data collection, design, and permitting.
- Town is interested in getting the stakeholders to help prioritize areas to be dredged; help revise scope.
- In addition to invited representatives, a few volunteers and community members were present from both the Town of Eastham and Town of Orleans.

Leslie Fields, Woods Hole Group led the remainder of the meeting.

Meeting Objectives:

a) **Stakeholder Education (describe background and previous work)**

- 2016 Feasibility Assessment evaluated a conceptual dredge plan – 4 mile long channel from Town Cove to inlet and a 4,500 ft long channel to Priscilla Landing; 100 ft wide channel dredged to -5 ft MLLW; total dredge volume of 80,600 cubic yards based on 2015 survey.
- Project purpose is navigation and public safety; not improved water quality/fisheries.
- Feasibility Assessment focused on the follow project aspects:
    1. ***environmental feasibility*** – study found no adverse impacts to red tide, submerged aquatic vegetation, or water levels; ran hydrodynamic model to compare existing conditions with conceptual dredge plan; found that winter dredging would not have an impact on red tide cysts; further study is needed to quantify potential impacts to shellfish, wetlands, shorebirds, and revised hydrodynamic model still needed.
    2. ***engineering feasibility*** – study found lifetime estimates of 1-3 years for channel behind the barrier and higher lifetimes with infrequent maintenance dredging in the back bay channels; combination of hydraulic and mechanical methods likely required to complete entire project; beneficial reuse at Nauset Beach or Nauset Spit is preferred method of disposal.
    3. ***regulatory requirements*** - study found full suite of permits will be needed for this project (MEPA EIR, CCC DRI, Orleans and Eastham NOI, DEP Chapter 91 and WQ, CZM Consistency, and UACE Individual Permit); additional data collection and analyses needed to support permit applications; ideal situation would be for Towns of Orleans and Eastham to file as co applicants.
    4. ***economic feasibility*** – study estimated an additional $300-$350 needed for data collection and permitting; construction estimates on the order of $1.5-1.7M depending on channel design, placement sites, and construction methods.

b) **Define/Refine Scope of Project (channel location, width, depth, problem areas)**

- Comments were sought from users of the estuary on conceptual dredge plan.
- Is the channel of an acceptable width/depth?
- Are the extents of the channel appropriate?
- How important is it to dredge channel area behind the barrier beach given the dynamic nature of this part of the estuary?
- Is the spur channel to Priscilla Road landing an important component of the project?

Public Commentary:

- Shoaled areas are shown well by 2015 bathy survey conducted for Feasibility Assessment; there are about 7 areas where shoaling is a problem and these are shown by the yellow areas with red stars on the Woods Hole Group Feasibility Report figure.
- Hopkins Island leading into Town Cove has shoaled in and is now only ~25' wide- inhibiting water quality and navigation.
- Might want to consider 50' x 5' maximum width through Hopkins Island section to preserve shellfish beds on either side of the existing navigation channel.
- In some areas, 100' width x 5' depth would not be necessary ex. behind Hopkins Island.
- Head of the Cove to Stony Island should be 50' width x 5' depth.
- Focus of the dredging should be on the channel from ~750' south of inlet to Hopkins Island. Navigation is feasible from the inlet to a point ~750' south of the mouth of Nauset inlet.
- Little concern over improving entry/exit through inlet. Navigation through inlet has always been controlled by the timing of low water.
- It was suggested that the channel to Pricilla Landing could be a lower priority; however, if Orleans moves forward with dredging in Mill Pond, the spur to Pricilla would be important.
- The Feasibility Study indicated that a dredged channel to Pricilla Landing might facilitate a breach of the barrier at Nauset Heights like in the 1930s, although the more likely breach location is just north of Tern Island. Consideration should be given to a narrower spur channel to Pricilla Landing, and potentially a shorter channel to minimize potential for breach at Nauset Heights.
- Do not need to dredge east of Tern Island.
- Orleans 2016 Fall Town Meeting voted to explore dredging and dam removal south of Pricilla Landing to Mill Pond. Water quality issues in Mill Pond have been raised and the Town is looking for ways to improve conditions for shell fishermen; this is a priority for the Town.
- Getting more water to leave Nauset Harbor so the low tides are lower is important to the commercial fisherman. There is a water quality issue on the clam flats and they feel the dredging will improve the flushing and therefore the water quality.

c) **Gage Support of Local Stakeholders (municipalities, fisherman, CCNS, etc.)**

- Since the Town of Orleans initiated the Feasibility Study, they are now interested in rolling the project out to the local stakeholders to gage their support.

Public Commentary:

- Historic record has Town or Orleans and Town of Eastham splitting channel. (Orleans maintains cans, Eastham maintains nuns, etc.).
- Need to understand where the line is that separates the Towns, and which Towns we are in at any given area.
- Town of Eastham should share resources/management plan with Town of Orleans.
    - Precedent for ACOE maintenance dredging along East Coast of USA.
    - Ideally, Orleans and Eastham are co-applicants on permit applications.
    - What can Woods Hole Group do to facilitate this discussion?
- Town of Eastham has concerns over septic leachate and nitrogen inputs from properties along Route 6 – Nauset Marsh interface. Salt Pond is not flushing.
- State pushing Eastham to fix Salt Pond in order to meet TMDLs.
- All stakeholders must recognize the differences that exist between Town of Orleans and Town of Eastham budgets/economies.
- Need collaboration between Town officials and Town of Eastham fishermen.
- Town of Eastham fishermen should build consensus with Board of Selectmen and become advocates for the project.
- CCNS to confirm they would allow sand from dredging to rebuild the dune at Nauset Beach.

d) **Identify additional key stakeholders**

- Town of Eastham Board of Selectmen
- Town of Eastham Town Manager
- Town of Eastham Harbor Master / Natural Resources Department
- Town of Eastham fishermen
- Cape Cod National Seashore Advisory Commission

General Questions:

- In 2-3 years, once permit is in hand, dynamics of the system may change. How do we address this?

  Response: The project design and permits will address the system as it is now. The goal would be to build in enough flexibility in the permits to allow the use of dredging zones (rather than a set channel location) that allow dredging to follow the deepest part of the channel where ever that may be at the time of dredging. Flexibility would also be needed to pick and choose which sections of the channel to dredge, give the greatest need. For example, if there is a breach in the barrier that forms a new inlet to the south with safe passage to the Ocean, there would be no need to dredge the portion of the channel behind the current barrier beach.

- Do we attempt to permit ≥ 100' x 5' channel width and then dial back scope? Plan and permit for the worst-case scenario and then revise scope once permit is in hand?

  Response: The best approach is to identify the extent and size of channel needed for safe navigation and then try to permit that.

- The project should prioritize beneficial reuse of dredged material, since it is a valuable commodity. The Town might want to consider placing material dredged from the Town Cove area (which is the most expense part of the project) on private properties around the Cove, where the owners have expressed an interest in receiving sand.

  Response: This was investigated during the Feasibility Assessment and there aren't many sites around Town Cove that could hold the quantities of sediment we are looking to dredge. Permitting would be more difficult if we start to add many more placement sites, and there would potentially be the need to grant public access easements on private properties.

- Currently, there is scour on the back side of barrier beach. Will increasing velocity through the channel result in additional sediment being added to the system?

  Response: This is a possibility and Woods Hole Group still needs to run sediment transport models to evaluate this.

- The fishing fleet has been mooring south of the inlet behind the barrier beach for the last 4 years, rather than traveling into the town landings. This needs to be communicated during the permitting process. The need to support continued/improved maritime uses of the harbor, as has been the history in this area for many years, needs to be a driver for this project.

  Response: Woods Hole Group will need to gather information on past and present uses of the harbor from the folks who are using it. Information on number of boats, changes over time, numbers of fishermen displaced over time, etc. must be gathered and used to tell the story of why this project is so important.

- Town of Orleans may want to consider investing in Ellicutt-370 Dredge (similar to Town of Edgartown). Uses same booster and pump as Barnstable County Dredge. Could be used for Pleasant Bay, Nauset Estuary, Rock Harbor. Is Barnstable County already purchasing second dredge?

  Response: This may make sense, but should only be considered once the permits are issued. The permitting applications would not need to reference a specific dredge, rather the dredge methodology (hydraulic vs. mechanical). So, once the permits are issued, it would be possible to use a local dredge for the work rather than the Barnstable County Dredge, if that is the direction the Town wants to go.

- Will dredging strengthen, weaken, or not affect the beach?

  Response: This needs to be investigated further.

Next Steps:

- Publication of October 26, 2016 Meeting Minutes;
- Introductory presentation to Town of Eastham Board of Selectmen (~ Nov. 2016);
- Introductory presentation to CCNS (~ Nov 2016);
- Collaboration with Town Officials and fishermen from Orleans and Eastham;
- Woods Hole Group design revisions;
- Get Woods Hole Group any additional stakeholders and their contact information, for next meeting;
- Additional, expanded stakeholder meeting to include Town of Orleans and Town of Eastham officials before December 24, 2016.

WOODS HOLE GROUP | 30 YEARS

WOODS HOLE GROUP
MEETING PARTICIPANT LIST

PROJECT NAME/TOWN: Nauset Estuary Dredging Project, Orleans
DATE: 10-26-16 **CONTACT NAME:** Leslie Fields & Beth Gurney

NAME:	COMPANY:	EMAIL:	PHONE
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Fred Fulcher	Com. Fisherman		508-255-5640
David Reed	Com. fisherman		508 221-4937
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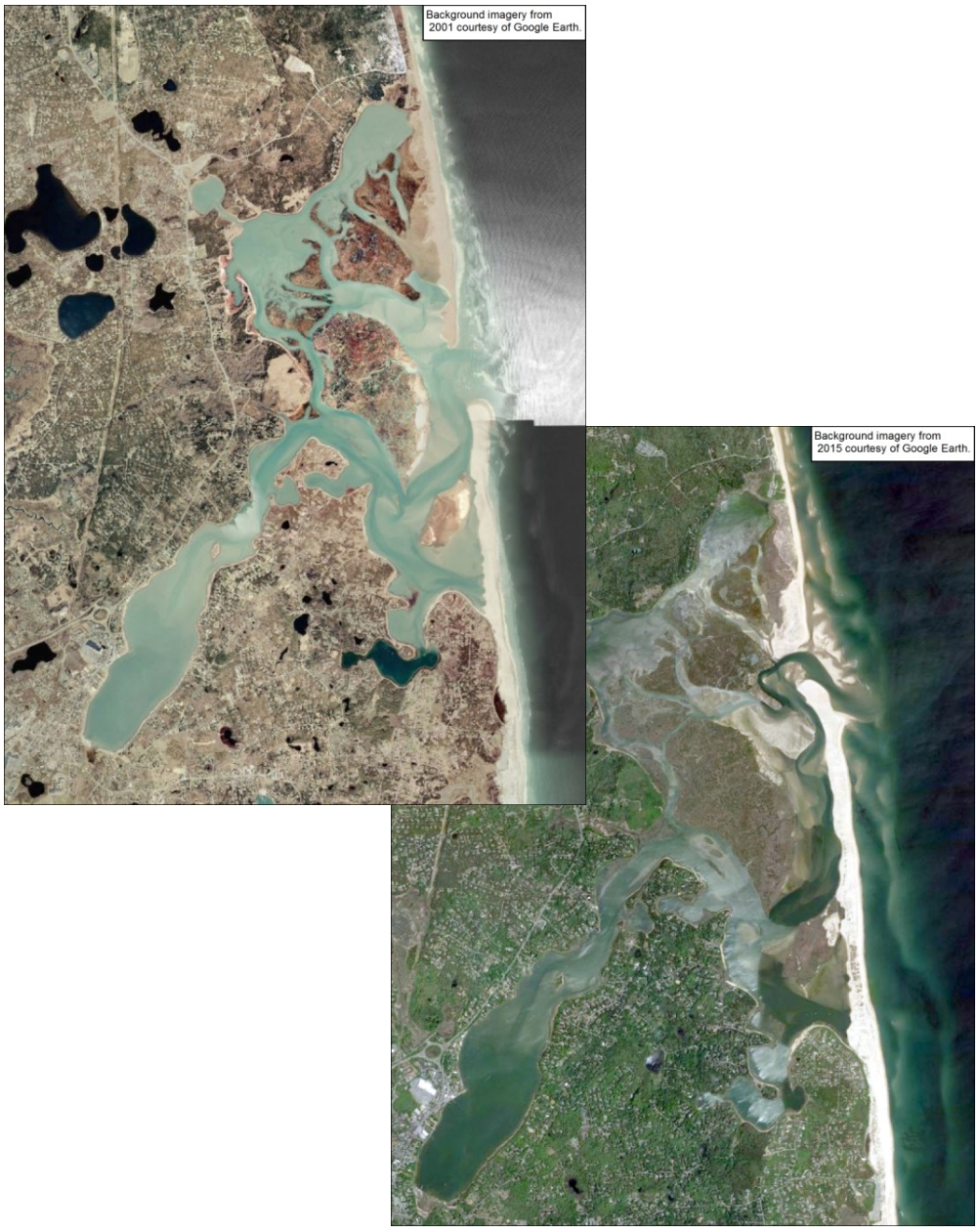
George Meservey	Orleans, Planning Director	gmeservey@town.orleans.ma.us	508-240-3700 x335

Nauset Estuary Dredging Feasibility Assessment



Prepared For:
Office of the Town Administrator
Town of Orleans
19 School Road
Orleans, MA 02653-3699

Prepared By:
Woods Hole Group &
Anderson Consulting Associates

February 2016

Nauset Estuary Dredging Feasibility Assessment

February 2016

Prepared for:
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Table of Contents

List of Figures

List of Tables

1.0 INTRODUCTION

This report describes a study conducted for the Town of Orleans into the feasibility of developing a dredging program for improved navigation in Nauset Estuary. Significant shoaling has resulted in major changes to the channel and mooring areas, and navigation is typically restricted to several hours on either side of high tide. Commercial fishing boats have been forced to moor in deeper areas of the channel immediately behind the barrier beach, and offload their catch and crew to nearby landings via skiff. This is a less efficient alternative to prior practices, which afforded the fleet the opportunity to moor directly offshore Snow Shore, Priscilla and Goose Hummock landings. These difficulties with navigation and the concerns over public safety prompted the Town of Orleans to commission this study to evaluate a potential dredging program for the estuary.

The Town's conceptual dredge plan focused on portions of Nauset Estuary that provide boat access to the public landings and commercial boating facilities (Figure 1). This includes the main channel starting at the inlet to the Atlantic Ocean and continuing approximately 4.2 miles to Town Cove. The Town Cove area supports public facilities at Goose Hummock, Cove Road, and Asa's Landing, as well as private facilities at Orleans Yacht Club, Nauset Marine, and the Goose Hummock Shop. Areas of the estuary southeast of the main channel providing access to Snow Shore and Priscilla Road Landings were included in the plan. These areas of the estuary are located in the Towns of Orleans and Eastham and a portion of the study area is also located in the Cape Cod National Seashore (Figure 1).

The feasibility of a dredging program will depend on a host of factors including environmental impacts, project lifetime, costs and schedule for permitting, and costs for project construction. The purpose of this study is to develop the necessary information to reliably address these factors. Once this information is known, the Town will be in a position to make an informed decision as to the overall feasibility of the project.

This study takes advantage of existing information and studies, and also leverages the valuable experience of Town officials and other local stakeholders. New data collected as part of this study add to an improved understanding of the Nauset Estuary system, particularly as related to the engineering, environmental, financial, and practical aspects of a dredge program. Section 2.0 provides information on the existing physical and ecological environment in the estuary that influence the dredge and disposal plan formulation described in Section 3.0. The primary factors that determine project feasibility are included in Section 4.0, and recommendations for consideration by the Town if the project is pursued are described in Section 5.0.

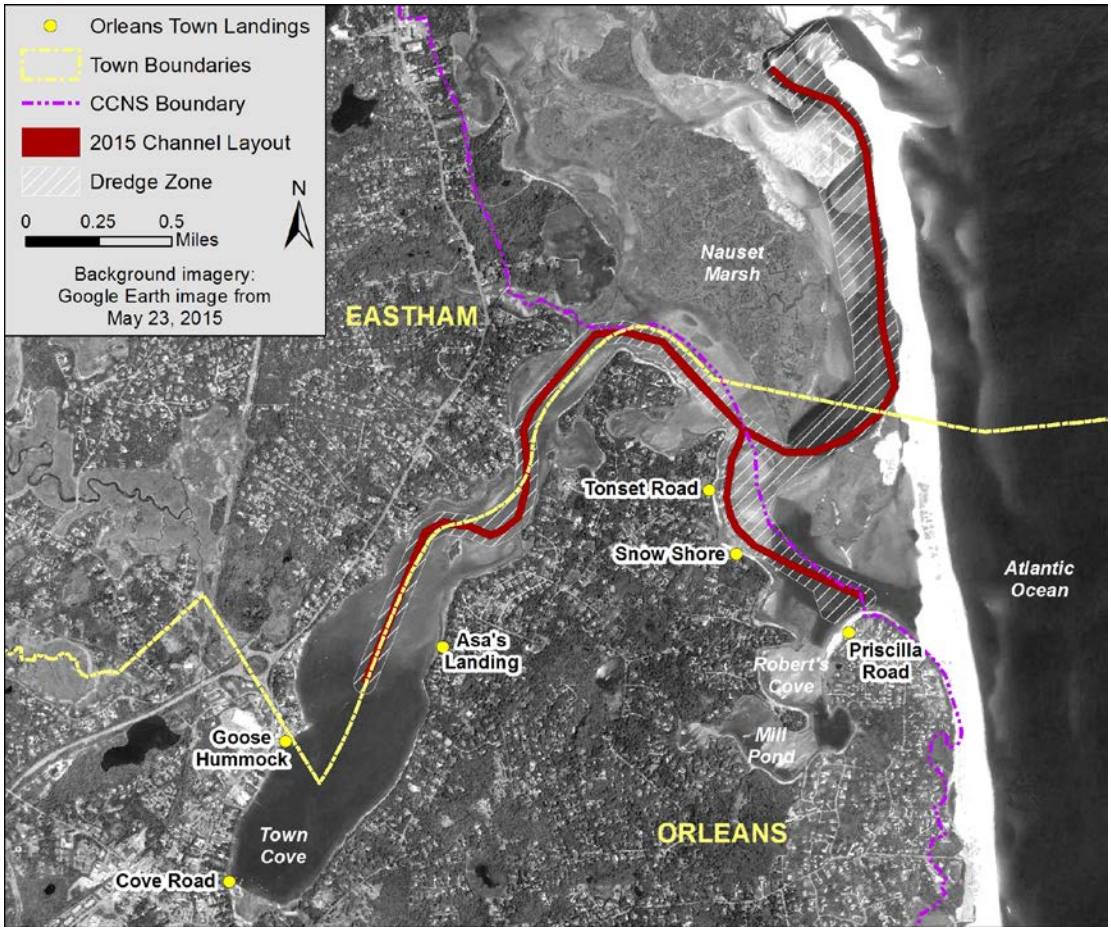

Figure 1. Nauset Estuary showing layout of conceptual dredge plan.

2.0 EXISTING ENVIRONMENT

An understanding of the existing environment in Nauset Estuary is critical to evaluating the feasibility of a dredging program. Data describing the quantity and type of sediment that will need to be dredged given current bathymetric and shoal conditions will control placement alternatives, construction methods, and also construction costs. A fundamental understanding of the changes in geomorphology of the barrier beach and Nauset Estuary inlet and the hydrodynamics of the system will provide valuable insight into areas of the channel that tend to shoal the fastest and will require frequent maintenance dredging. Information on ecological factors such as red tide cysts, shellfish, eelgrass, and other sensitive resources will help to identify potential environmental constraints on a dredging program.

For the purposes of this study the existing conditions of Nauset Estuary were documented through review of available information and limited collection and analysis of new data. The existing physical and ecological conditions of the estuary are described in the following report sections. Data sources are included and where new data were collected, the field and data analysis methods are described.

2.1 GEOMORPHOLOGY

This history of geomorphologic changes at Nauset Inlet was studied by Aubrey and Speer (1984) and more recently by Woods Hole Group (2006). Historical charts dating back to 1779 and aerial photography from 1938 and 1946, show the inlet to be located just north of Nauset Heights at the southeastern edge of the estuary. During the approximate 170-yr period that the inlet was located in the vicinity of Nauset Heights, spit formation extending to the north from the lower beach was non-existent (Figure 2). Although Aubrey and Speer (1984) agree that aperiodic coverage of historical maps may have undersampled previous episodes of inlet migration, they suggest that the persistence of a southern location suggests a historically stable inlet configuration at Nauset Heights.

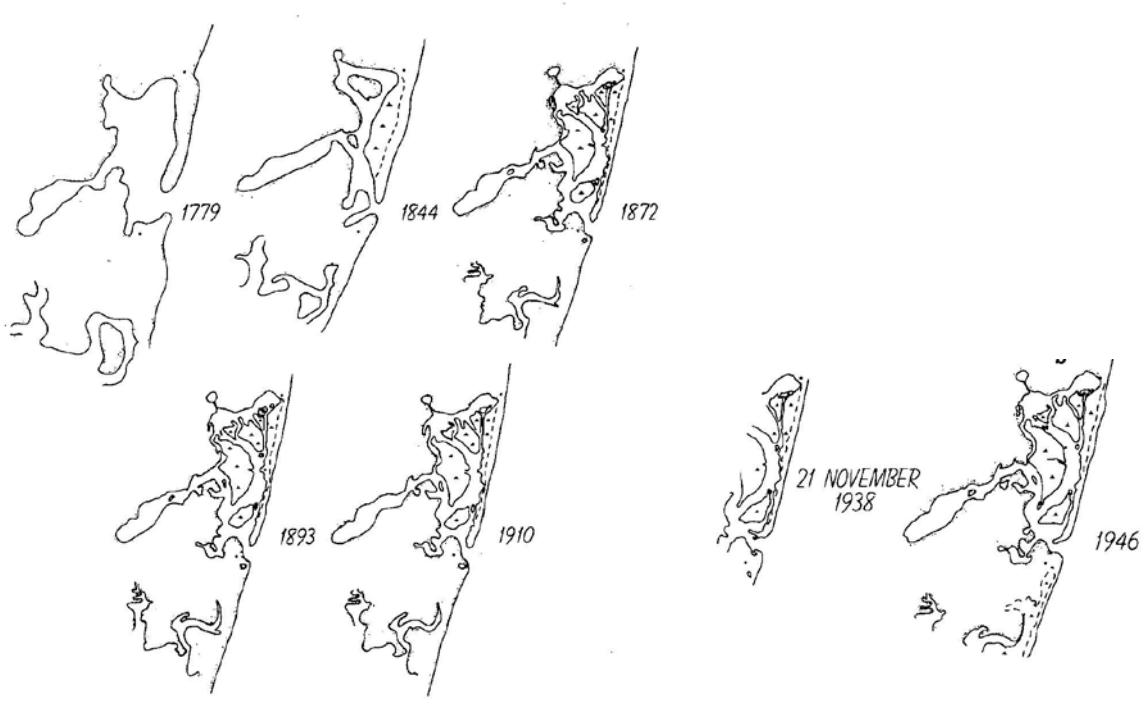

Figure 2. Representative charts and historical aerials from 1779 to 1946 showing stability of the Nauset Estuary inlet at Nauset Heights (Aubrey and Speer, 1984).

Inlet activity at Nauset Harbor has been distinctly more active during the last 70 years. Starting in the 1950s, the inlet experienced two distinct cycles of northward migration. During the first phase between 1950 and 1957, the length of the northern spit extending from Coast Guard Beach remained relatively stable, while the southern spit extending from Nauset Heights continually grew northward. A series of storms in the late 1950s and early 1960s re-established the inlet to its southernmost position immediately adjacent to Nauset Heights. The second cycle began in 1965 and lasted approximately 25 years until 1990. This period of northerly inlet migration was characterized by substantial

erosion of the north spit along with northward growth and extension of the south spit (Figure 3). The distance of northerly inlet migration during this period was about 1.3 miles.

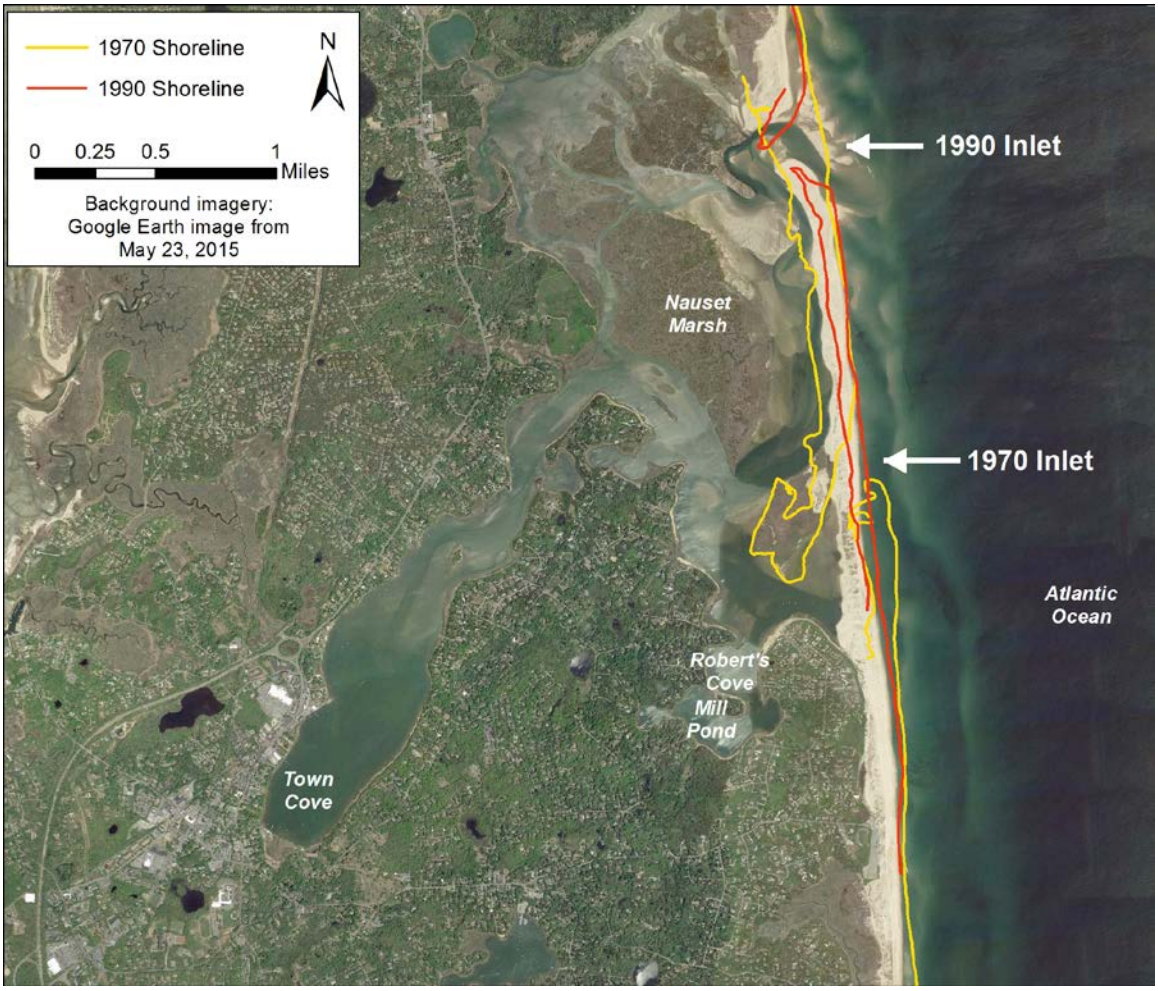

Figure 3. Northerly migration of Nauset Estuary inlet between 1970 and 1990.

Storm activity in the early 1990s caused a breach in the barrier beach near the north end of Tern Island. The system supported two inlets for a period of 2 to 4 years with a northern inlet in the vicinity of the 1990 opening, and a southern inlet at the location of the breach. Sometime after 1996 the northern inlet closed and the system began another cycle of northerly inlet migration. Between 1996 and 2015 the inlet migrated nearly 1.0 mile to the north, back to the location of the 1990 inlet (Figure 4). This represents the most northerly position of the inlet since the early record keeping in 1779.

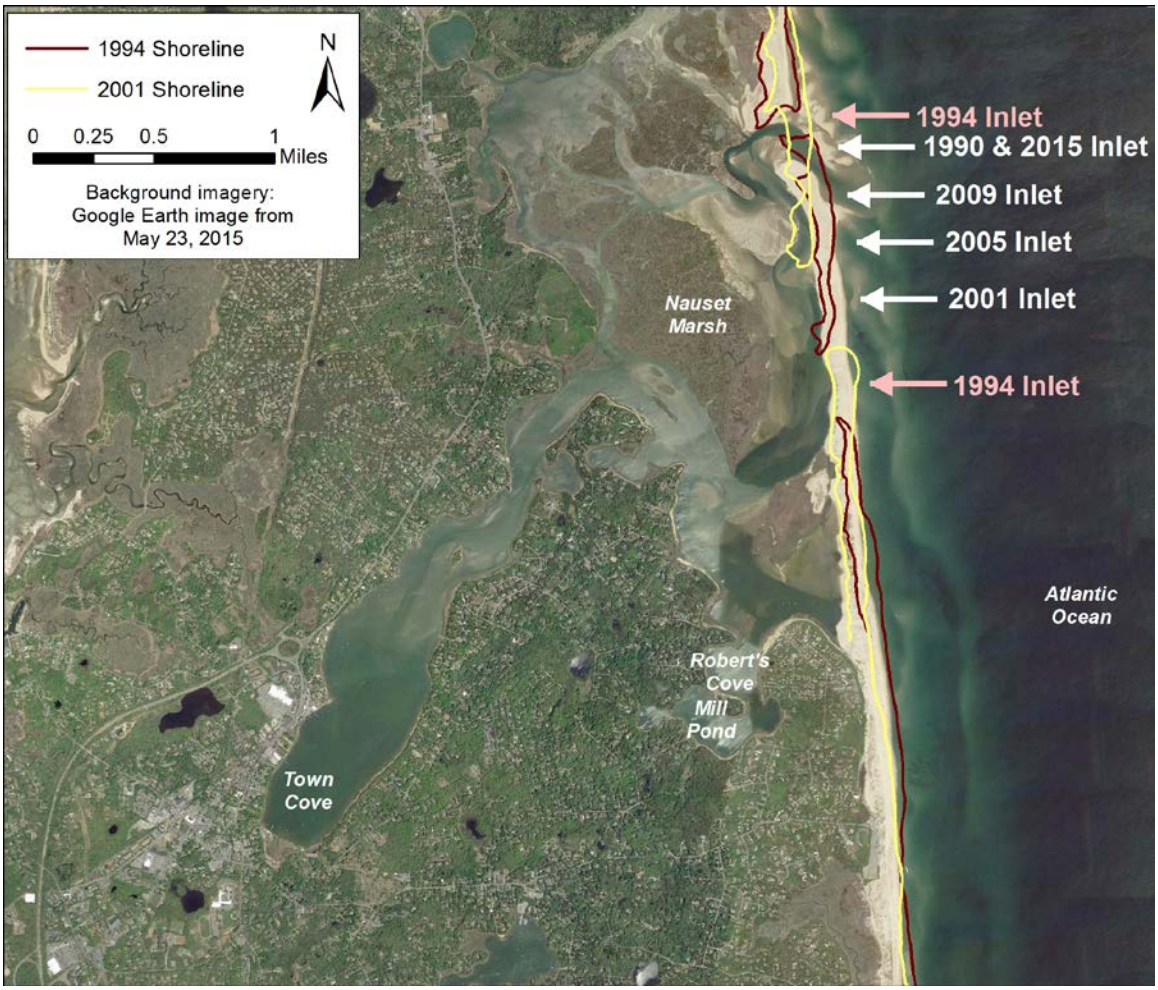

Figure 4. Nauset Estuary Inlet migration between 1990 and 2015.

These cycles of northerly inlet migration, punctuated by breaching to the south, have an influence on the location of the main channel in Nauset Estuary behind the barrier beach. As the spit lengthens to the north pushing the inlet further north, the channel becomes elongated and the hydraulic efficiency of the channel is reduced. Incoming tidal currents bring sediment from the ocean side to form flood shoals and overwash processes during storms deposit sediment in the channel along the west side of the barrier beach. These shoaling processes further reduce the efficiency of the channel. Eventually storms cause the formation of a new breach further to the south where the channel has a more direct link to the ocean. Historical breach locations just north of Tern Island are largely related to the location and orientation of the main channel which directs ebb currents towards the back side of the barrier beach. With enough hydraulic head between the estuary and the ocean, scouring on the west side of the barrier can result in the formation of a new breach from the estuary side. The scouring can also cause a thinning of the barrier beach just north of Tern Island, which weakens the barrier and increases the potential for overwash and breaching from the ocean side.

Historical data indicate that the Nauset Estuary channel between Tern Island and the current inlet location is highly dynamic and strongly influenced by the continuing geomorphologic evolution of the inlet and barrier beach. The data also suggest that a breach in the vicinity of Tern Island is likely to occur in the future. In fact, a washover just north of Tern Island was reported at high tide on February 9, 2016. Whether this develops into a full breach this winter is uncertain. What is clear however, is that a new inlet near Tern Island would allow the Town to temporarily abandon the northern section of channel behind the current barrier beach, in lieu of the more direct channel through the new inlet.

Longshore sediment transport rates and directions along the Eastham/Orleans ocean facing coastline have been studied by Zeigler (1954, 1960), US Army Corps of Engineers (1969) and by Geise (1988). The studies report a net southerly littoral drift with rates ranging between 230,000 and 250,000 cubic meters per year. Sediment is derived from erosion of coastal banks further to the north. The history of northerly inlet migration at Nauset Estuary, in a direction opposite the dominant longshore sediment transport, is contrary to patterns of migration at most other natural inlets. Aubrey and Speer (1984) analyzed historical charts, aerial photos, and storm histories from the area to develop a conceptual model that explains the inlet migration patterns.

The main channel in Nauset Estuary that runs along the west side of the barrier beach is the most dynamic part of the system and is subject to shoaling from inlet processes, barrier formation, and storm generated overwash. However, channel areas further inside the estuary are subject to shoaling as well. A qualitative assessment of channel shoaling was conducted using historical aerial photos from 1972 to the present. Areas of major shoaling were identified on the photos, digitized within a geographic information system (GIS), and then compared over time. This process is influenced by the stage of the tide at the time the photography was collected as well as the ability of the photo interpreter to utilize a consistent proxy for shoaling from one set of photography to the next. Despite these inaccuracies the method provides a reasonable first approximation of areas within the estuary that are prone to shoaling.

Results of the historical shoaling analysis are compared with shoal areas identified from a recent bathymetric survey conducted in November 2015 (Figure 5). The data show significant variability in channel shoaling immediately west of the barrier beach, caused by inlet and barrier migration and storm overwash processes. Patterns of channel shoaling are also evident further inside the estuary where the geometry changes from a narrow constricted channel to a wider configuration. This is consistent with typical flow dynamics where sediment moving with the higher velocity currents in the narrower channels, drops out of suspension when the channels widen and the current velocities decrease. In general the historical shoal locations correspond with current patterns of shoaling from the November 2015 survey, and also with problem areas identified by the Town of Orleans.

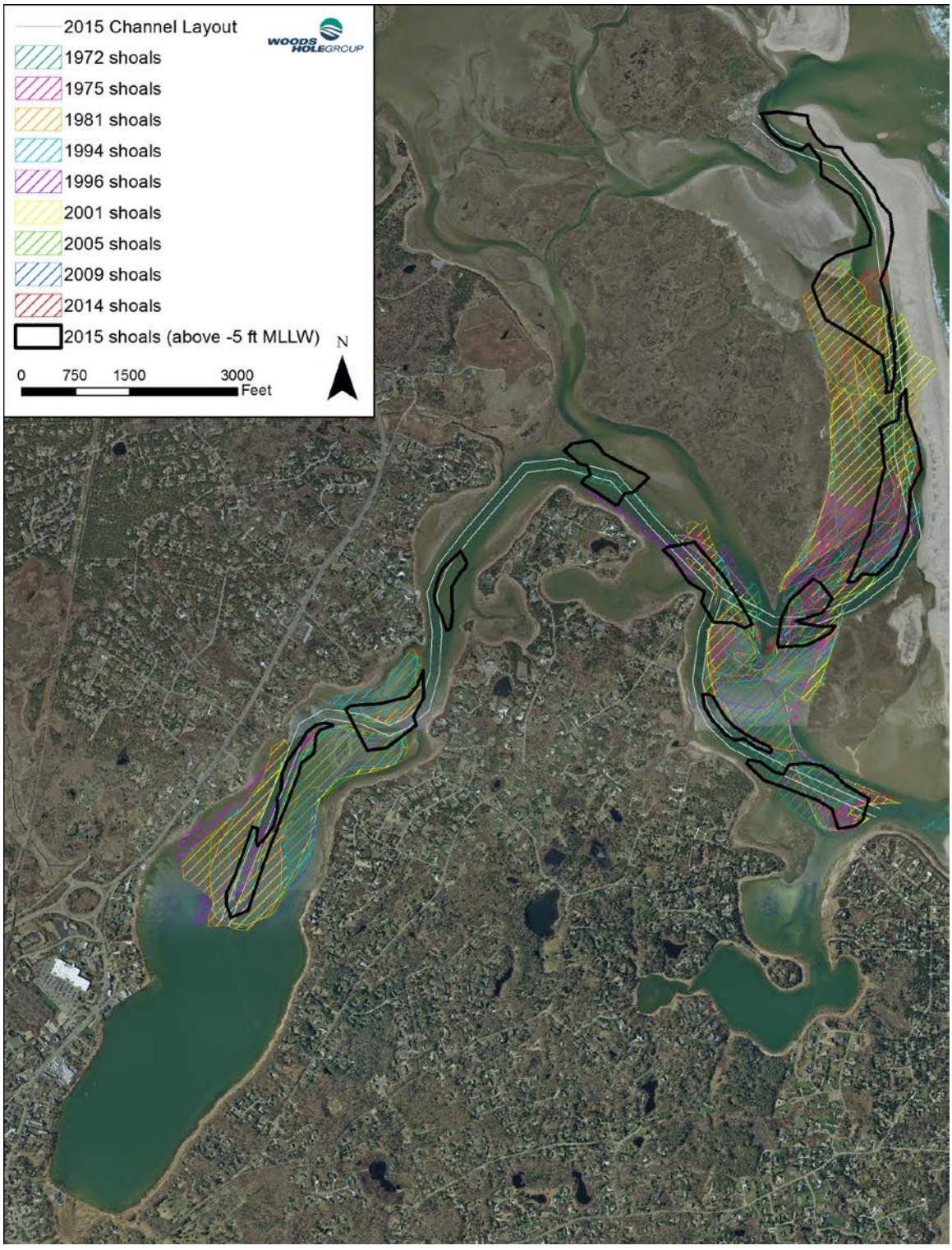

Figure 5. Patterns of historical shoaling in the Nauset Estuary channels compared with current shoal locations surveyed in November 2015.

2.2 BATHYMETRY

The current water depths and shoal locations in the Nauset Harbor estuary were documented via a bathymetric survey conducted on November 23 and 25, 2015. The purpose of the survey was to document existing conditions and to provide information needed to plan a dredge channel layout and compute dredge volumes.

The bathymetric survey was performed by a two-person survey crew including an ACSM/THSOA certified hydrographer. The crew was equipped with a Novatel RTK Global Positioning System with 20Hz update rate and an Innerspace Model "455" survey grade digital depth sounder with a narrow beach 200 kHz transducer and 20 depth/sec update rate. The Model 455 depth sounder incorporated transducer draft corrections, calibration for speed of sound through water and gain control. Calibration was accomplished by performing "bar checks" at the beginning and end of the survey day. Water level was continuously monitored during the survey using a VP electronic tide data recorder. As back-up the water levels were also monitored via the RTK GPS system. The recorded tidal data were used to correct the depth soundings to the NAVD88 vertical datum.

Since the bathymetric survey was collected to aid in channel design for navigation purposes, corrections from NAVD88 to the mean lower low water (MLLW) tidal datum were needed to compare with controlling water depths needed for safe navigation. Typically tidal datum corrections are derived from analyses of long-term tide gage data collected at nearby locations. However, in the case of Nauset Estuary, the closest long-term tide gage stations are in Boston Harbor and Chatham Harbor (Fish Pier), and these locations are not representative of tidal nonlinearities in the estuary. A 29-day tide gage deployment at various locations in the estuary in support of the Massachusetts Estuaries Program (MEP) during the fall of 2001 was identified as the best source of water level data for developing tidal datum corrections (Howes et al., 2012). The data show that MLLW in Nauset Harbor and Town Cove is approximately equal to zero NGVD29 (Figure 6). NOAA's VertCon program was used to determine that NGVD29 is 0.9 ft lower than NAVD88, and therefore a correction of 0.9 ft was used to convert the NAVD88 bathymetry to MLLW (ex. -5.0 ft NAVD88 depth equals -4.1 ft MLLW depth).

A color shaded map of the November 2015 bathymetric survey, with depths referenced to MLLW, is shown in Figure 7. Depths in the main channel range from -32.5 to 0.7 feet (MLLW). The shallowest areas of the channel are west of the barrier beach. A number of isolated shoals with depths less than -5.0 MLLW are located along the channel. These shoal locations correspond closely with the locations of historical shoaling shown in Figure 5.

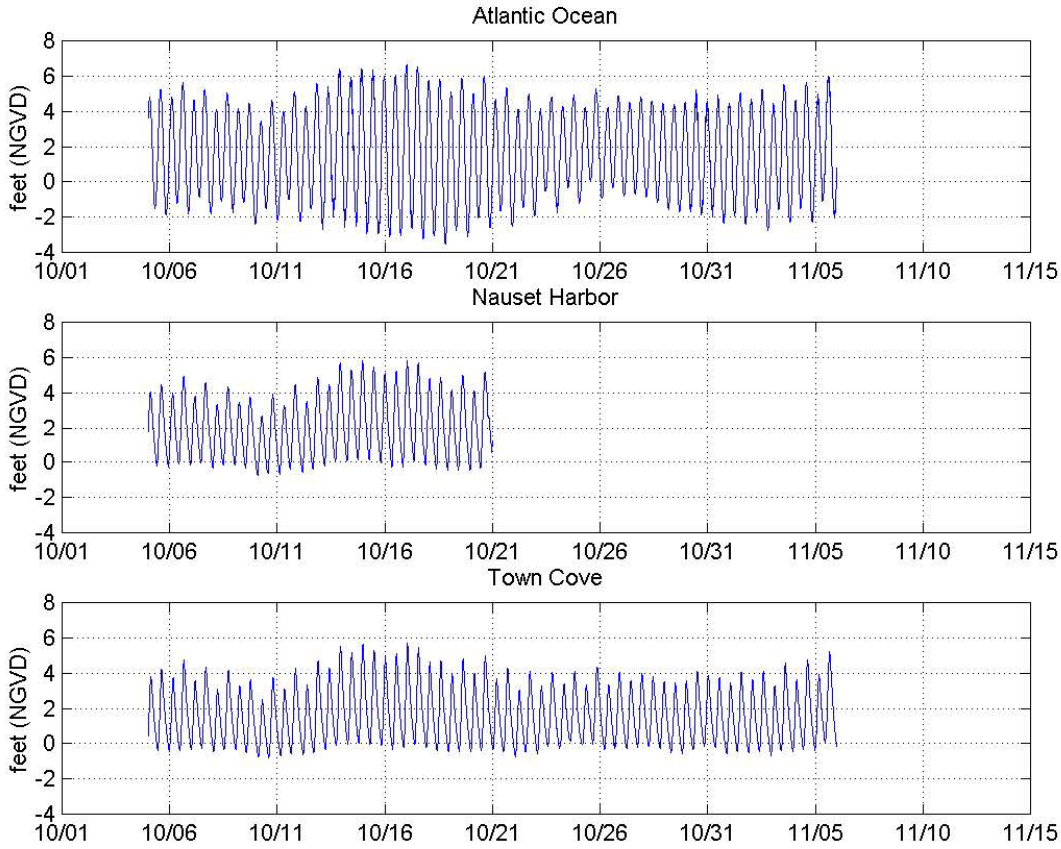

Figure 6. Water level measurements collected Nauset Estuary in support of the MEP in 2001 used to develop a tidal datum correction between NAVD88 and MLLW (Howes et al., 2012).

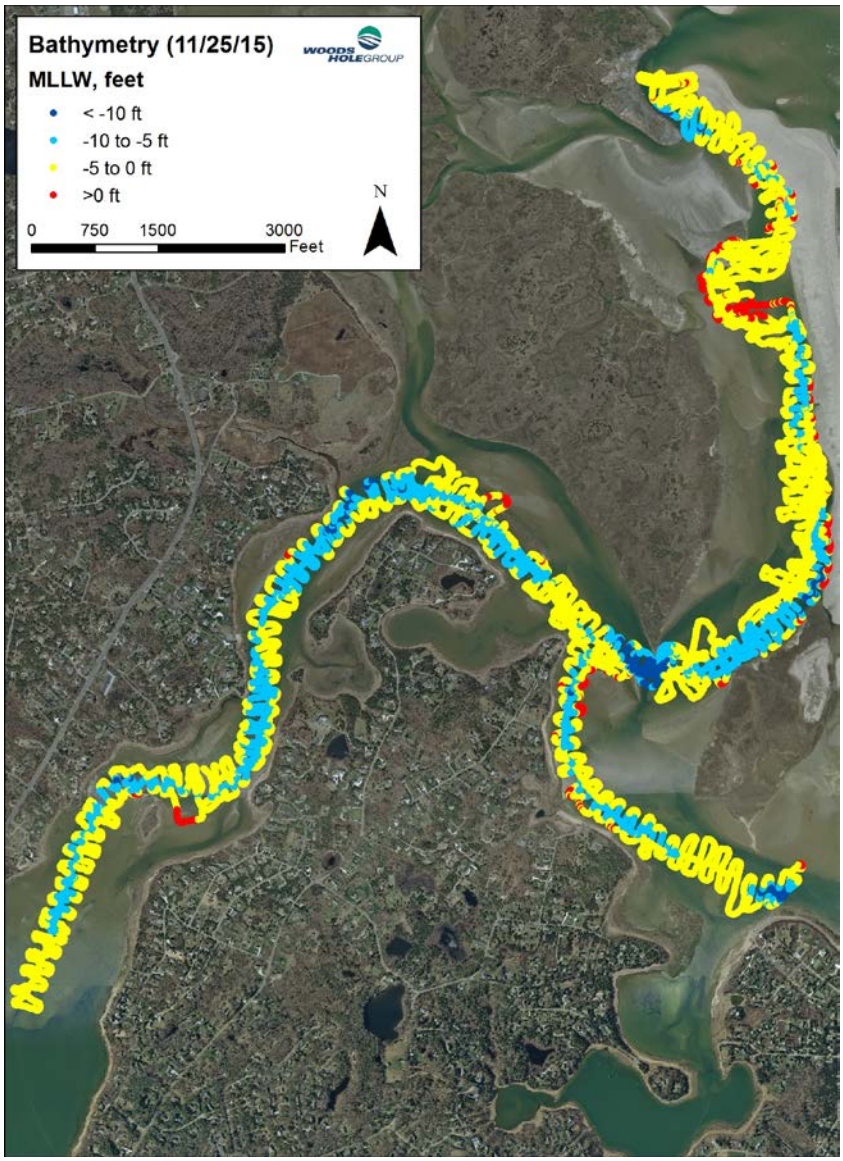

Figure 7. Color shaded map showing water depths referenced to MLLW from the November 2015 bathymetric survey.

2.3 HYDRODYNAMICS

A hydrodynamic model previously developed for Nauset Estuary was used to assess the current hydrodynamic conditions, as well as potential changes that may result from a dredging program. The Finite Volume Coastal Ocean Model (FVCOM) (Chen et al. 2003) used an unstructured grid with node spacing ranging from a minimum of less than 10 m in the estuary to 4 km on the open boundary (Fig. 8). High-resolution bathymetry was used for the model from LiDAR-derived topographic maps of Cape Cod National Seashore from the U.S. Geological Survey (USGS) (Brock et al. 2007). Bathymetry in subtidal regions too deep for LiDAR penetration was based on previous acoustic surveys and observations by investigators from the USGS (Cross et al. 2006) and Woods Hole Oceanographic Institution (WHOI) (Aubrey et al. 1997). The model was previously

evaluated against observations of water level, salinity, temperature, and velocity from moored sensors at multiple locations around the estuary (Ralston et al. 2015).

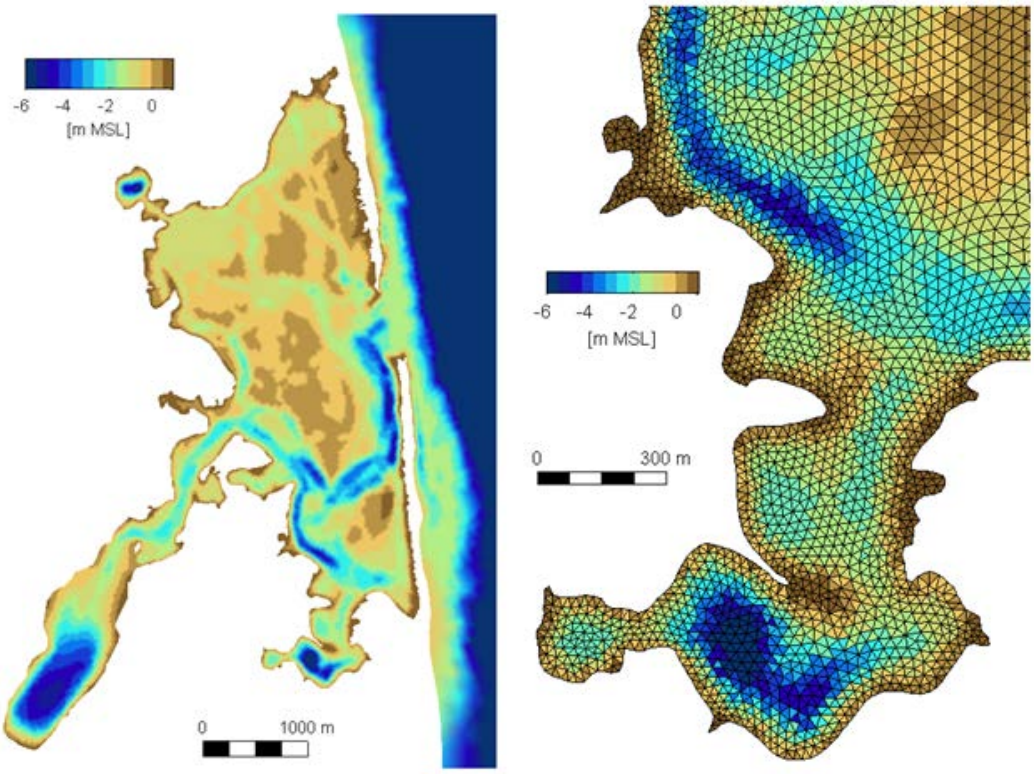

Figure 8. Model bathymetry, with a zoom on the unstructured grid configuration in the vicinity of Mill Pond. Model open boundaries (not shown) extend north, south, and offshore from the inlet approximately 15 miles in each direction.

For the current study the model grid bathymetry was updated based on data collected during the November 2015 bathymetric survey in the vicinity of the planned dredging program. Note that the 2015 configuration of the south spit is approximately 660 ft north of the previous model grid based on the inlet position in 2007. For this study no attempt was made to change the model grid to reflect the more northerly inlet location because the model was being used in a diagnostic sense to evaluate relative changes in flow patterns between the no dredge/dredge condition. Modeling shows that Nauset Estuary is a flood dominated inlet, meaning that peak incoming flood currents are stronger than peak outgoing ebb currents. Flood dominated systems tend to be sediment sinks, as more material is transported in during the flood tide than can be exported on the ebb tide.

2.4 SEDIMENTS

Sediment characteristics and distributions throughout Nauset Estuary were evaluated as part of this study to determine the quality of sediment required for dredging and to evaluate the feasibility of different placement alternatives. Two phases of sampling were conducted to help characterize the site and maximize use of available resources. The sampling methods and results are described in the following report section.

Initial confirmatory grab sampling was conducted within the planned dredge area to validate sediment characteristics documented by previous studies. The purpose of the confirmatory sampling was to gather information to identify targeted areas for subsequent vibracore sampling, with specific emphasis on identifying boundaries between sandy and fine-grained sediments. Confirmatory sediment grabs were collected at sixteen (16) sites on November 30, 2015. A Van Veen grab sampler was used to collect samples from the upper 6-12 inches of the sea floor. Sediment characterizations were conducted by a trained sedimentologist based on visual and textural observations. Results of the qualitative assessment shown in Figure 9 indicate that sediments in the main channel were mostly sand and silty sand. Samples from Town Cove and the southeast oriented channel leading to Priscilla Road Landing contained finer-grained materials characterized as sandy silt. While the confirmatory samples provided a qualitative measure of sediment characteristics at the near surface, core samples were subsequently collected to identify sediments at depth that would be more representative of the entire volume of material potentially removed via dredging.

Results of the confirmatory sediment sampling and the bathymetric survey were used to develop a plan for sediment coring at six (6) locations to quantify material that would need to be dredged from the primary shoal areas. The coring was conducted on December 10, 2015 using a shallow draft pontoon boat specially equipped with an A-frame, winch, anchoring spuds, and a vibracore unit. The coring was conducted to an approximate depth of -6.0 ft MLLW determined based on water depth, tide elevation and time of coring. The cores ranged in length from 2.7 to 6.6 ft depending on water depth at each site. Sample locations were recorded using a RTK GPS. The cores were collected in clear polycarbonate liners and transported to the Woods Hole Group office where they were split, photographed, described, and sub-sampled. The sub-samples were shipped to GeoTesting Express, Inc. in Acton, MA for grain size analyses. Results of the laboratory analyses show the sediments to be sand or silty sand (Figure 9). The only samples containing higher percentages of silt were in Town Cove and near Priscilla Road Landing where the upper 0.2 to 0.6 ft of sediment contained in excess of 30% silts and clays. The core log descriptions and photographs are provided in Appendix A and the laboratory grain size testing results are provided in Appendix B.

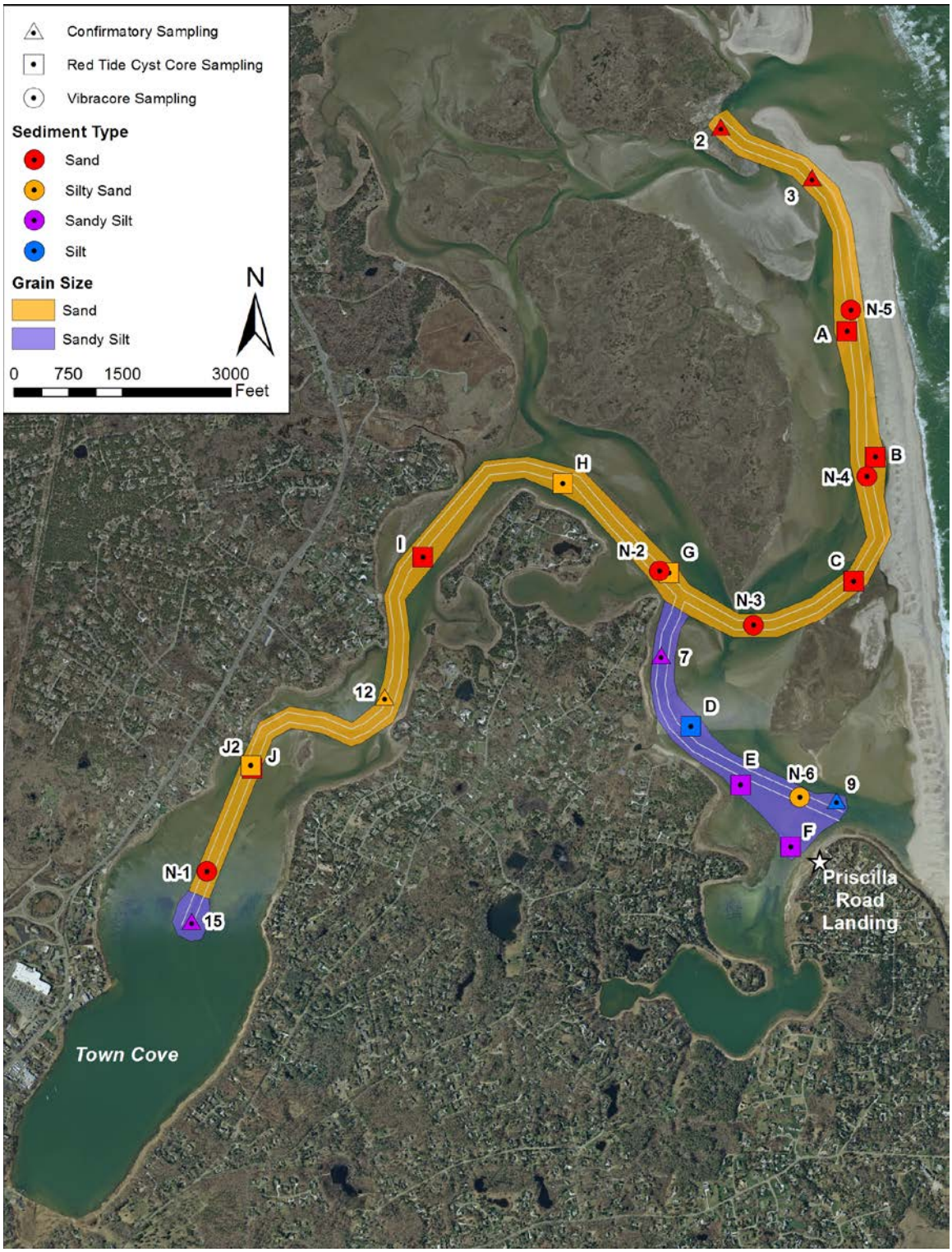

Figure 9. **Sample locations and sediment characteristics from 2015 based on a combination of qualitative assessment and laboratory analyses for grain size.**

2.5 ECOLOGICAL RESOURCES

SAV Resources

An eelgrass survey was performed as the same time as the confirmatory sediment sampling on November 30, 2015 (Figure 10). A video camera mounted atop the Van Veen sediment sampler was used to survey the bottom. Eelgrass surveys were conducted via passive drifting transects at approximately one foot above the seafloor. Due to decreased sunlight towards the end of the day, camera exposure caused a "washing out" effect of the image. However this did not significantly affect the ability to interpret the imagery. An example of the estuary bottom observed during the video surveys is presented in Figure 11.

Eelgrass video transects were analyzed for eelgrass presence or absence. Despite limitations in video quality, the presence of eelgrass was not observed at any of the sixteen site locations. This finding supports previous mapping efforts that have reported there was no eel grass in the study area.

An analysis of historical eelgrass data for Nauset Harbor was conducted by the Massachusetts Estuaries Project (MEP) (Howes et al. 2012). This analysis incorporated mapping done by the MassDEP Eelgrass Mapping Project, as well as aerial photographs from 1951 used to reconstruct the eelgrass distribution prior to substantial development in the Nauset Estuary watershed. At the time of the study, MassDEP's most recent year of eelgrass mapping was 2001. The 1951 data from the aerial photograph analysis were only anecdotally validated, while the 2001 map was field validated. The goal of the MEP analysis was to determine the stability of the eelgrass community in Nauset Estuary over time. Howes et al. (2012) found that by 2001, eelgrass had nearly disappeared from the Nauset Estuary, with most of the remaining eelgrass patches located just north of Tonset Road (Figure 12). The loss was found to be consistent with the level of high nitrogen concentrations in the water and the tidal flows within the system. Nutrient enrichment is known to cause a loss of eelgrass habitat in tidally restricted basins, such as Town Cove. Such areas also tend to be the main discharge points for watershed nitrogen inputs, which further exacerbate the problem. That high nitrogen levels and reduced tidal flushing have contributed to the loss of eelgrass is further supported by the fact that the only location observed to have eelgrass in 2001 was adjacent Tonset Road where these impacts are mitigated by high tidal exchange (Howes et al. 2012).

It should be noted that subsequent sampling in Nauset Estuary by MassDEP in 2012 did not observe the presence of eelgrass. This is supported by the field surveys conducted in 2015 as part of this study, which also found no evidence of eelgrass beds.

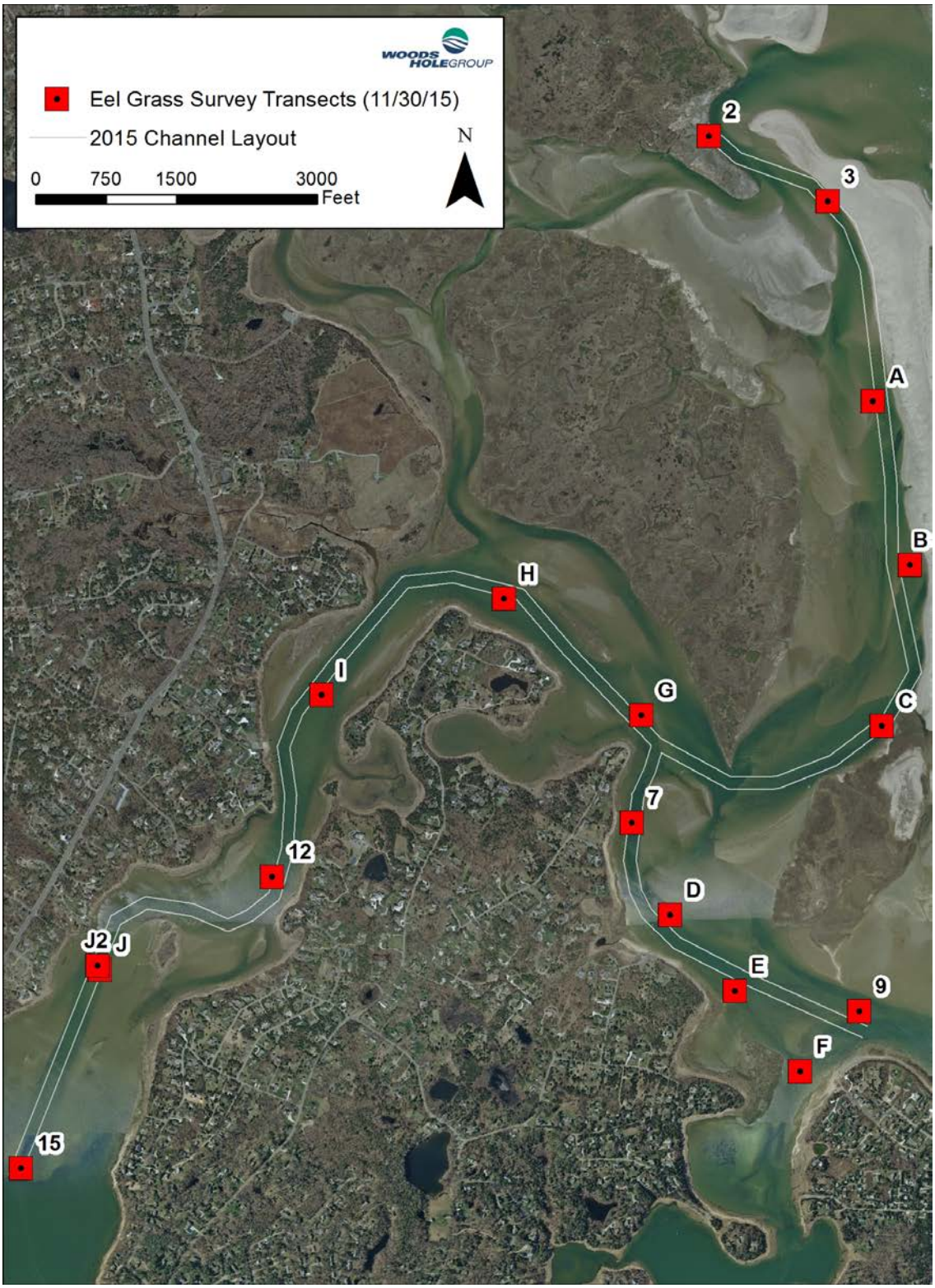

Figure 10. Eelgrass survey transect locations evaluated in November 2015.

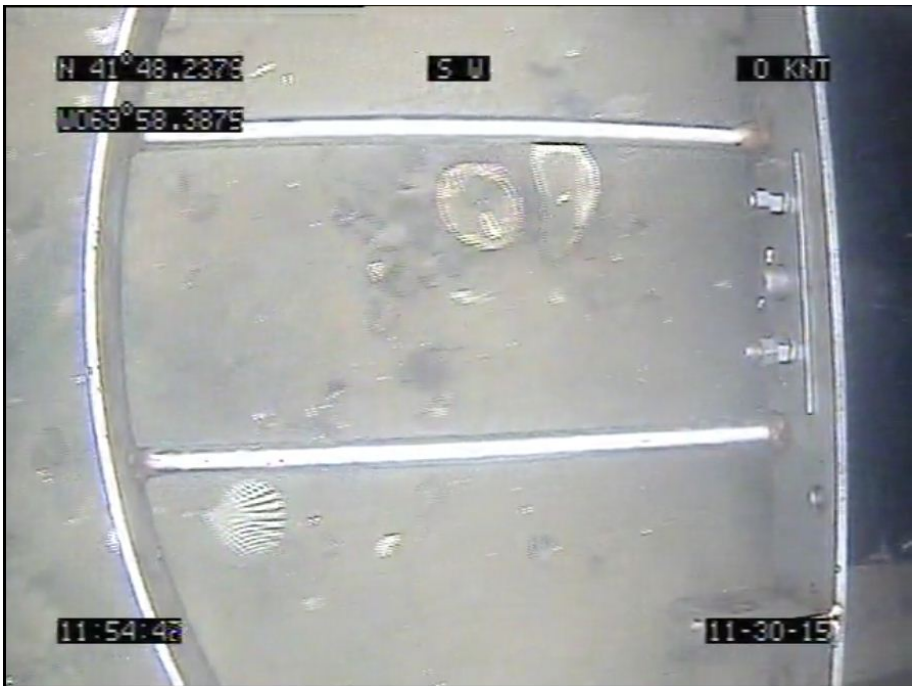

Figure 11. Example image from the November 2015 eelgrass video survey. Bottom cover was mostly sand with shell fragments.

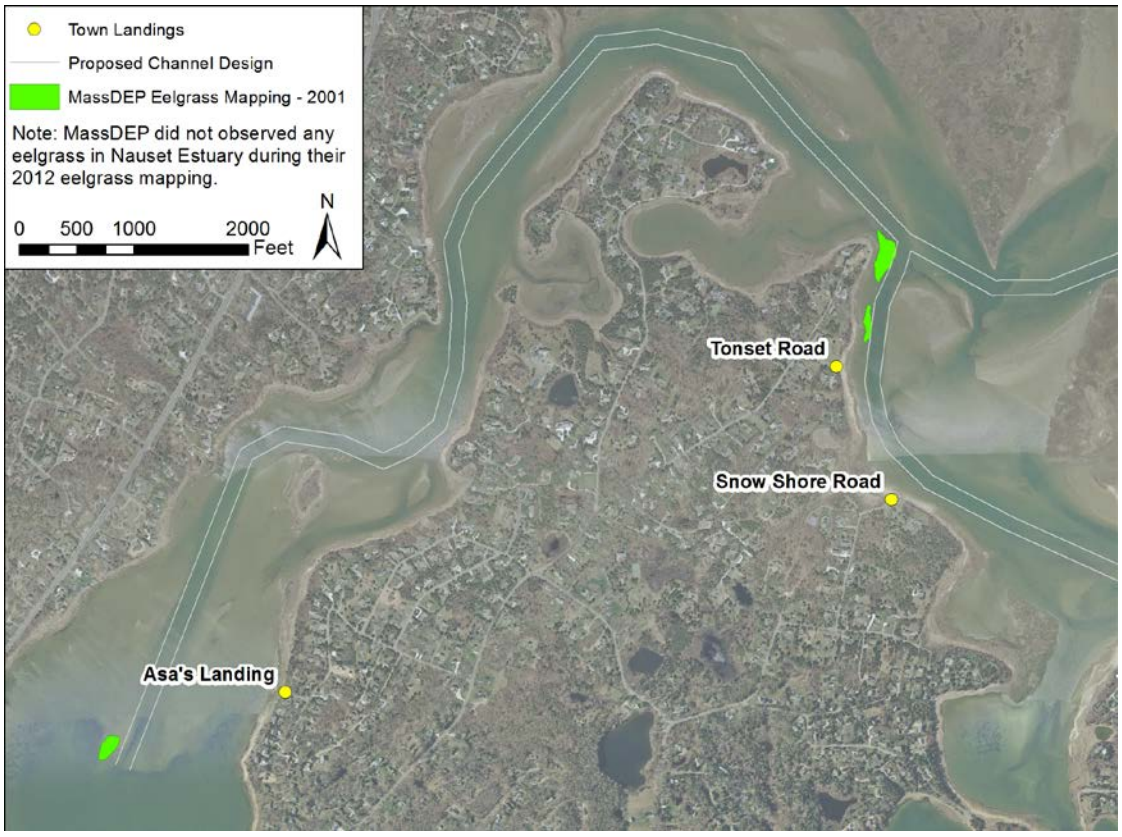

Figure 12. Historical eelgrass mapping results from MassDEP's Eelgrass Mapping Project.

Shellfish Resources

The Massachusetts Division of Marine Fisheries (DMF) has produced a map outlining areas that are believed to be suitable for specific types of shellfish, such as blue mussel, quahog, and soft-shelled clam. These areas are delineated based on the expertise of the DMF staff, in conjunction with input from local shellfish constables, commercial fishermen, and information contained in maps and studies of shellfish in Massachusetts. These areas include places where shellfish have been observed since the 1970s, and have a habitat that is suitable to support that particular type of shellfish, but there may not be any shellfish present at this time. Therefore, these shellfish suitability maps represent *potential* habitat areas. A map of the DMF shellfish suitability areas in Nauset Estuary is shown in Figure 13.

Although no field surveys were done as part of this preliminary assessment, shellfish constables from both the Town of Orleans and the Town of Eastham were interviewed to identify current locations of important shellfish populations. In Orleans, there are high densities of quahogs along the eastern shoreline of Town Cove, north to the area of Hopkins Island. There is also a set of blue mussels that establishes around the channel near Hopkins Island each year; however, the population has not been able to survive the winter during the last few years, either getting scoured by ice or predated by eiders, but has regularly recolonized the area each year. Most recently this blue mussel set was observed on the Eastham side of the channel.

Shellfish constables from both towns noted a high density of shellfish in some of the shoals that have developed. In Orleans, there have been significant quahog, soft-shell clam, and razor clam populations recently in the sandy shoals near Priscilla Road and Snow Shore Landings. While in Eastham, soft-shell clam and surf clam have been observed in the tidal flats near Nauset Inlet. In general, both shellfish constables noted no significant populations of shellfish within the majority of the historic navigation channel.

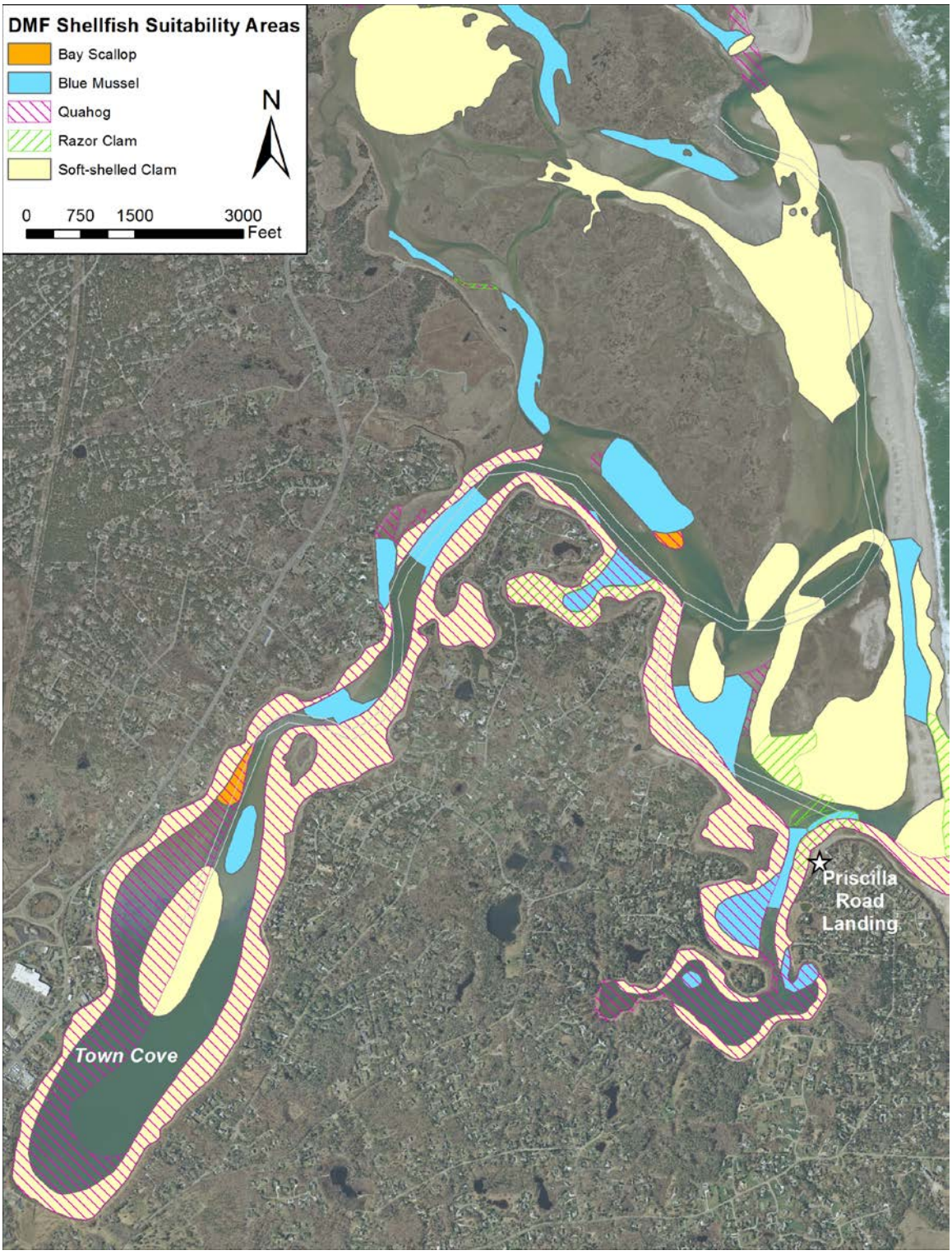

Figure 13. Mass DMF shellfish suitability map for Nauset estuary.

Endangered Species

The Estimated and Priority Habitats of rare species mapped by the Natural Heritage and Endangered Species Program (NHESP) represent the geographic extent of state-listed rare species in Massachusetts based on observations documented within the NHESP database. Estimated Habitats are a subset of the Priority Habitats, which do not include areas delineated for rare plants or wildlife with strictly upland habitat requirements. The Estimated and Priority Habitats within and around Nauset Estuary are presented in Figure 14. When a project falls within Priority Habitat and does not meet a Massachusetts Endangered Species Act (MESA) filing exemption (321 CMR 10.14), it is necessary to file directly with the NHESP pursuant to MESA. For projects within Estimated Habitats that require a Notice of Intent (NOI), a copy of the NOI must also be sent to NHESP.

While specific species driving the habitat designations shown in Figure 14 are not currently known because a MESA information request has not been submitted, other reports produced by NHESP provide some indication of which species might be present. Although, the Natural Heritage BioMap2 program serves only as a conservation tool, without any regulatory significance, and does not supplant the Estimated and Priority Habitats which do have regulatory significance, it does combine decades of documented rare species data, and can provide useful insight into species of concern that might be found in a particular area. For example, the entire ocean-side shoreline of the outer cape is identified as important nesting and foraging habitat for Piping Plovers and Least Terns, as well as an important staging area for Common and Roseate Terns (NHESP 2012). Additionally, the BioMap2 report indicates that American sea-blite is a species of concern along the eastern shore of Town Cove.

Figure 14. Natural Heritage and Endangered Species Program Estimated and Priority Habitats in Nauset Estuary.

2.6 RED TIDE

Background and past studies

Harmful algal blooms (HABs, commonly called "red tides") are a serious economic and public health problem throughout the world. In the U.S., the most serious and widespread manifestation is paralytic shellfish poisoning (PSP), a syndrome caused by human ingestion of shellfish that accumulate toxins from dinoflagellates, predominantly in the genus *Alexandrium*.

In many parts of the world, PSP is a recurrent and serious problem associated with blooms of toxic dinoflagellates in the genus *Alexandrium*. The potent neurotoxins produced by these organisms are accumulated by filter-feeding shellfish and other grazers and are passed on to humans and other animals at higher trophic levels, leading to illness, incapacitation, and even death. *Alexandrium* species cause toxicity in many different hydrographic and climatic regimes, from temperate to tropical. One reason for growth success across such a variety of habitats is that many species have a cyst stage in their life histories. This allows the organism to remain dormant in bottom sediments through temperature extremes (e.g., winter), with seasonal germination inoculating vegetative cells into the water column only during intervals where temperature and light are suitable for growth (Anderson et al., 2012). Population development is thus possible in more locations than would otherwise be the case if year-round persistence in the water column were the only means for survival.

There are two types of *Alexandrium* blooms in the New England region, both caused by the species *A. fundyense* (hereafter referred to simply as *Alexandrium*). One occurs along the open coast of the Gulf of Maine from the Bay of Fundy to Massachusetts and outer Cape Cod, and on rare occasions, this distribution stretches to the islands of Nantucket and Martha's Vineyard and occasionally, to Rhode Island (i.e., Anderson et al., 2005a; Anderson et al., 2005b; Borkman et al. 2014). Blooms in the coastal region of the Gulf of Maine can stretch over hundreds of miles and last for several months.

The second type of *Alexandrium* bloom in the region is much smaller in scale and is representative of the blooms that occur in the Nauset Estuary system. *Alexandrium* blooms occur, but those episodes are sporadic and highly independent of each other or of the large-scale coastal blooms described above. Instead, isolated and localized blooms occur in those areas, with very tight linkage in time and space to cyst populations in bottom sediments of the areas where toxicity occurs. These locations can be viewed as self-seeding "point sources", in that *Alexandrium* populations originate within the embayments or estuaries, with no input of cells from coastal waters, and they deposit cysts after those blooms, to "seed" future blooms. These "localized" or "point source" blooms have been well studied by D. M. Anderson and colleagues (e.g., Anderson et al. 1983; Anderson and Stolzenbach 1985; Crespo et al. 2011; Ralston et al. 2013, 2015; Brosnahan et al. 2014).

The distribution of the *Alexandrium* blooms within Nauset Estuary is not uniform. It has been well established that the hot spots of toxicity occur at the three distal end points of the system - namely Salt Pond, Town Cove, and Mill Pond (collectively termed salt

ponds hereafter). Although the central marsh does occasionally show dangerous levels of toxicity, the highest and earliest levels are always recorded within these salt ponds, with the toxicity in the central marsh delivered there from the localized blooms. In all cases, the salt ponds have deeper central portions (kettle holes), with water exchange with the central marsh limited by shallow, restricted inlet channels. Figure 15 shows the distribution of cysts in Nauset Estuary in 2008, 2009, and 2011. Figure 16 shows a time series of *Alexandrium* cell abundance between March and May 2009. Clearly, there is a strong linkage between the location of the cyst accumulations and the origins of the Nauset blooms, with cells first appearing in Mill Pond, then Town Cove and Salt Pond, with low abundances observed in the central marsh, and no connectivity between the three salt ponds.

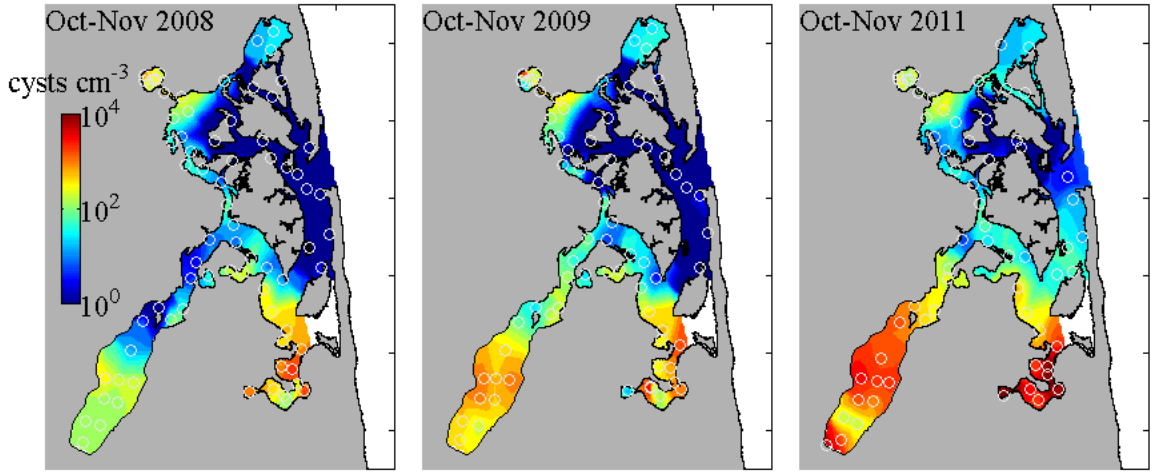

Figure 15. Contour maps of Nauset Estuary mean *A. fundyense* cyst concentrations (cysts/cm^3) in: (left) 2008, (center) 2009, and (right) 2011. Gray circles indicate sample sites (From Ralston et al., 2015).

There are two reasons why these three locations are persistent hot spots for *Alexandrium* and toxicity. The first is that they are accumulation zones for the cysts of *Alexandrium* because of their bathymetry and hydrography. As flood tide-dominated systems, Salt Pond, Mill Pond, and Town Cove accumulate fine sediments year after year, and cysts behave like that fine sediment fraction. Cysts that are formed within the central marsh tend to be disbursed with other fine sedimentary material, much of which ultimately accumulates in kettle holes like the salt ponds and the areas that have silted in near their inlets. The bulk of the *Alexandrium* cysts formed within Nauset Estuary are thus retained within the salt ponds.

The second mechanism that leads to the hotspots results from a combination of the bathymetry and configuration of the salt ponds and the behavior of *Alexandrium*. *Alexandrium* swims vertically in the water column, seeking the appropriate amount of sunlight for photosynthesis in surface waters, while also swimming downward to access nutrients that are often found in deeper waters. This is termed diel vertical migration. *Alexandrium*, however, does not swim to the very surface of the water, but instead finds

suitable sunlight 1.5 - 2.5 meters deep (Anderson and Stolzenbach 1985). This means that the top of the vertical ambit of *Alexandrium* tends to be below the depth of the shallow inlet channel. Thus the water that leaves the salt ponds on ebb tides contains few cells compared to those retained within the ponds. The population is thus retained within the ponds, dividing and accumulating, and reaching dangerous levels of toxicity. For example, Salt Pond has had closures due to toxin levels above quarantine action limits in 23 of the past 26 years. Similar numbers hold for Mill Pond and Town Cove.

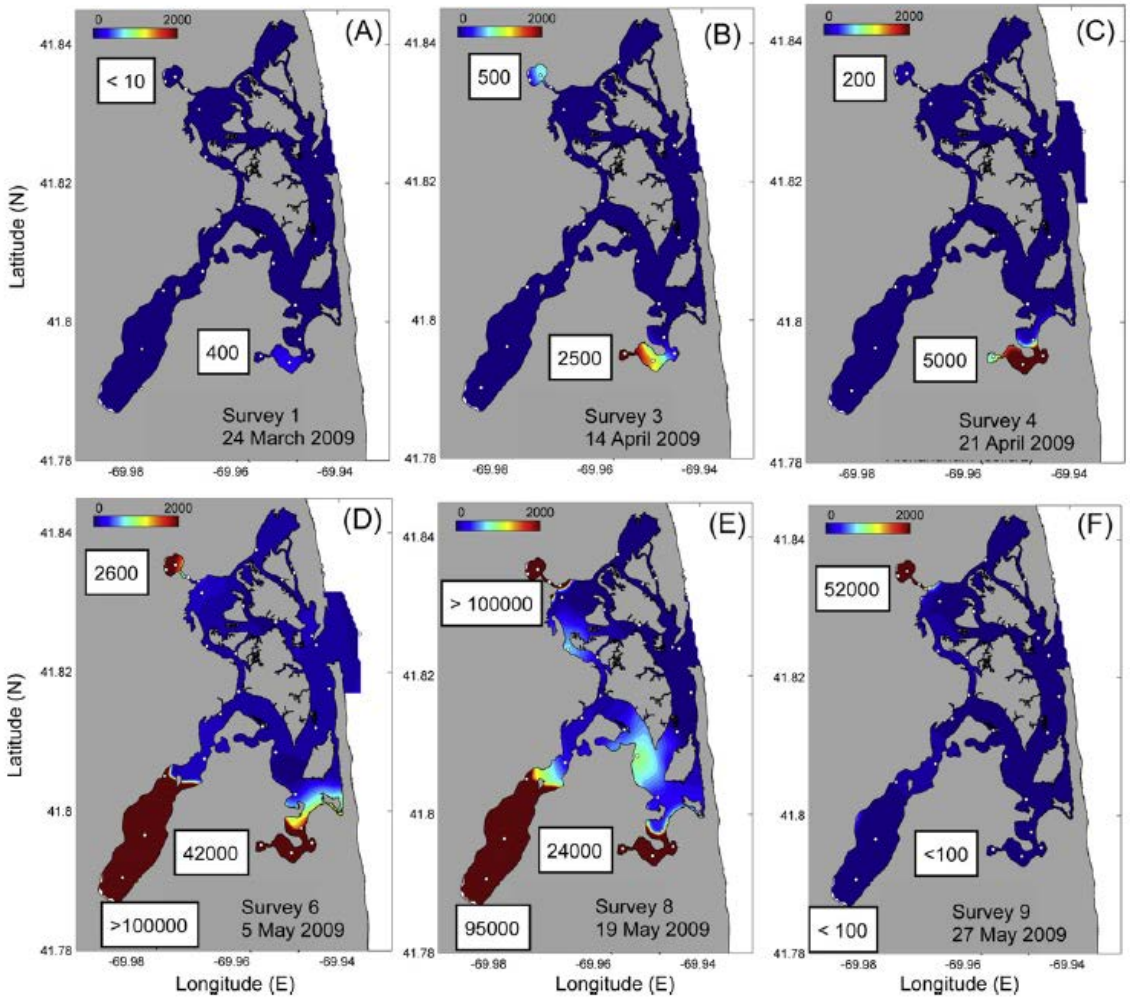

Figure 16. Distribution of Nauset Estuary *A. fundyense* cells (cells L^{-1}) between March 24 and May 27, 2009. Maximum number of cells for Mill Pond, Town Cove and Salt Pond indicated in the white squares. White dots indicate sample sites (From Crespo et al., 2011).

Another important feature of the *Alexandrium* bloom dynamics is that the cysts in bottom sediments do not just sit at the surface of those sediments. Bioturbation (i.e. mixing by worms and other bottom-dwelling animals) as well as physical mixing from storms and

currents can bury the cysts. It is common to find more cysts a few centimeters below the surface than there are at the surface, as shown in a core profile taken in Roberts Cove, immediately adjacent to Mill Pond (Figure 17). However, dinoflagellate cysts require oxygen for germination (Anderson et al. 1987), and typically oxygen is only found in the top centimeter or less of bottom sediments. This means that cysts that are buried below that layer typically do not germinate and participate in the bloom formation in the spring. Instead, they remain dormant and either eventually die, or are mixed to the sediment surface or the water column by storms, bioturbation, or other disturbances. There are reports that *Alexandrium* cysts can live in anoxic sediments for decades (Keafer et al. 1992); there are even reports of successful cyst germination that were over 100 years old (Ribeiro et al. 2011). Clearly, activities that might resuspend deep cyst deposits (i.e., dredging) have the potential to introduce cysts that otherwise would not have germinated, into conditions that would be favorable for germination.

One important conclusion from Figure 17 and from many other cyst profiles in sediment cores is that in Nauset Estuary, *Alexandrium* cysts are quite low in abundance below 10 cm (D. M. Anderson, unpub. data). For this reason, the cyst abundance in the top 0-10 cm layer is most important when considering the impacts of dredging operations.

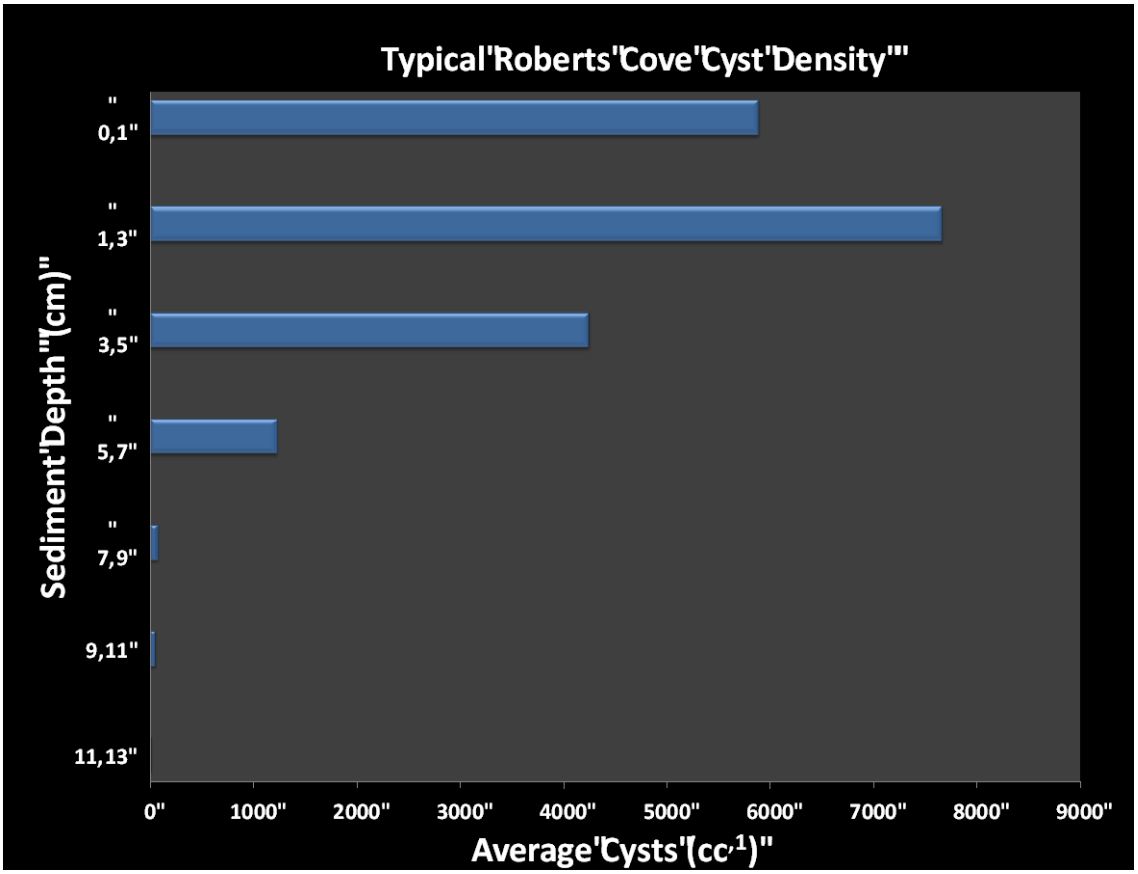

Figure 17. Vertical profile of *Alexandrium* cyst abundance (cysts/cm^3) from Roberts Cove in the Nauset Estuary.

It is also important to recognize other factors that regulate the timing and extent of *Alexandrium* cyst germination. Foremost among these is seasonality in germination that is internally controlled by a "clock" mechanism. The timing or phasing of this "endogenous clock" is in turn regulated by temperature. It is a complicated process that is still under active investigation, but for the purpose of this discussion, suffice it to say that most newly formed cysts that are deposited in the summer or fall from *Alexandrium* blooms typically cannot germinate during the early winter because of a combination of maturation processes and clock regulation. Germination is typically possible beginning in January or early February, but the rate of that germination is controlled by ambient temperatures. In very cold winters, germination is delayed until waters reach 4-6 ^{o}C. At those temperatures, the cysts can germinate, but the *Alexandrium* vegetative cells that are produced grow very slowly, if at all, again because of non-optimal temperatures. An indication of the growth potential of *A. fundyense* from Roberts Cove is described in a study by Watras et al. (1982). In general, a temperature range for survival and growth between 5.5 and 24 ^{o}C was observed. There was no growth at 5.5 ^{o}C, but the cells did not die. At 8.5 ^{o}C, the rate ranged from 0.08 to 0.2/day depending on salinity. The maximum growth rate was 0.44/day, at 22.5 ^{o}C. A broad optimum for growth occurred between 13 and 22.5 ^{o}C.

Interestingly, *Alexandrium* cells also do not germinate or grow when it becomes too warm (Anderson 1998). Typical summer temperatures of 23-28 ^{o}C are inhibitory in this regard.

Some useful information is presented in Figure 18, which shows multiple blooms of *Alexandrium* in Roberts Cove from 2009 to 2015, as well as the bottom temperature, and the rate of cyst germination at ambient temperatures. Bloom initiation tends to vary interannually, with the earliest cells seen in February, but more often, March. Peak motile cell concentrations occur in April and May, and the blooms terminate in late May and early June. Anomalous years like 2012 (yellow curve in Figure 18) show a shifted bloom dynamic, but otherwise the same general shape.

The middle panel of Figure 18 shows the germination success of cysts at ambient temperatures. This would be analogous to the situation if sediments containing cysts were resuspended or dumped into the oxygenated surface waters during a dredging operation. The pattern indicates that germination does occur in the fall and early winter, but is generally near zero in January and February, increasing thereafter. Note that the lack of germination in the mid- and late-summer months (June – September) is due to newly deposited cysts being immature at the time of the incubation. Cysts that were mature but buried in anoxic sediment layers would be expected to germinate at those times.

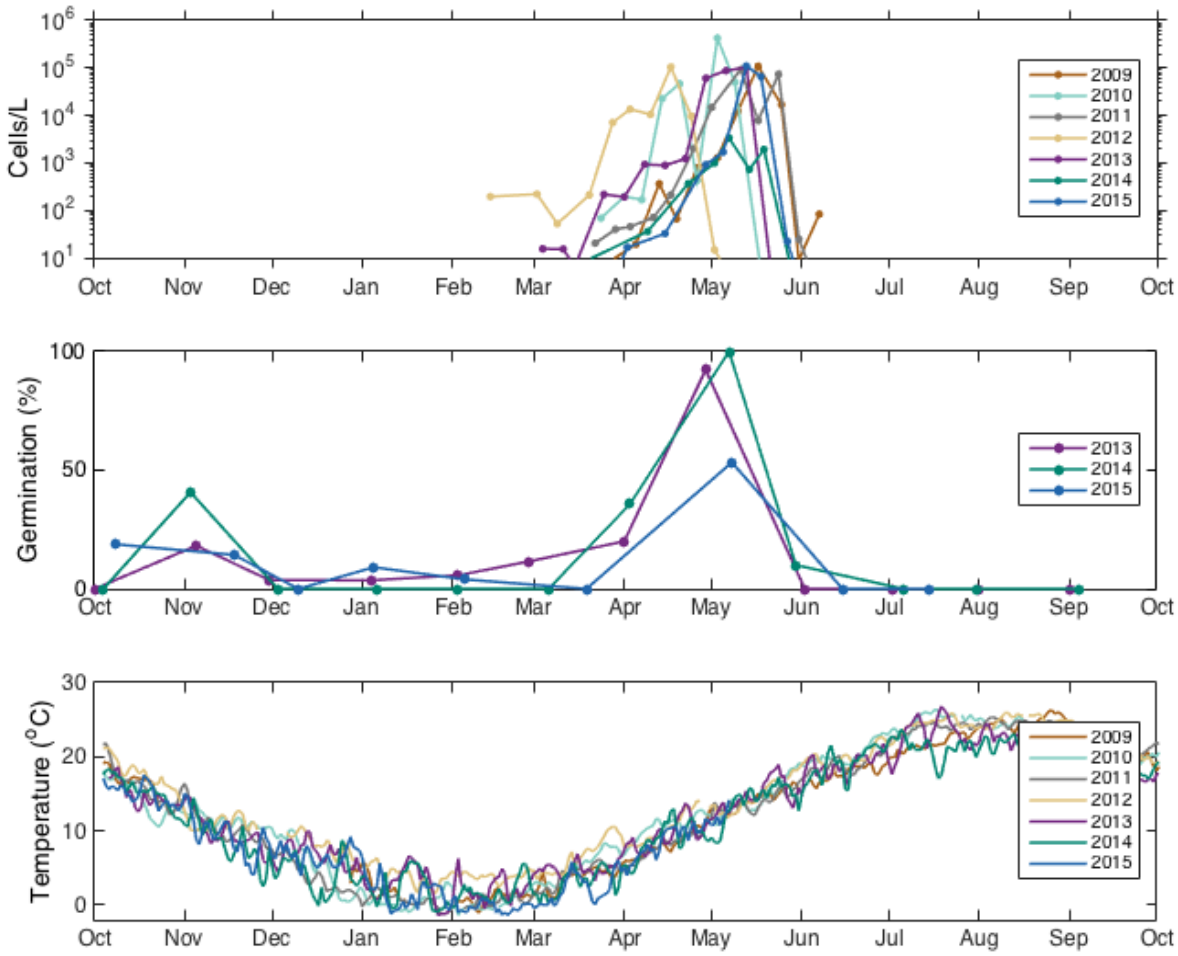

Figure 18. ***Alexandrium*** **motile cell and cyst dynamics from Roberts Cove in Nauset Estuary. Top panel:** ***A. fundyense*** **cell abundance by month. Middle panel: Cyst germination success in surface sediment samples collected and incubated at the ambient water temperature. Bottom panel: temperature (^{o}C). (From A. Fischer, unpub. data).**

2015 red tide cyst assessment

To evaluate current red tide conditions in Nauset Estuary sediment cores were collected at 10 sites on December 10, 2015 for analysis of red tide cysts (Figure 19). The sample locations were planned to coincide with previous red tide cyst analyses conducted by others. A push-core sampling device equipped with a 2 5/8 inch inner diameter clear polycarbonate barrel was used to collect the cores. To ensure sufficient retrieval depth, the cores were pushed to a penetration depth of 1.5 feet. A piston assembly inside the core barrel was used to create suction, thereby preventing excessive compaction during core barrel penetration, and loss of sediment from the bottom of the barrel during recovery. This method provided an undisturbed sediment core of at least 10 cm in length. Upon collection, the cores were packed in ice and stored at 4 ^{o}C in the dark for a maximum of 36 hours prior to processing using standard techniques (Anderson et al., 1982, 2005a).

In brief, the cores were extruded such that the 0-1 cm sediment layer was carefully retained, and the 1–10 cm layer was collected into a plastic basin and completely homogenized by hand. From each layer, a well-mixed 5 cm^3 wet volume sediment subsample was taken and resuspended to 25 mL with filtered seawater. A 10 mL subsample of the 25 ml sediment slurry was sonified using a Branson Sonifier 250 affixed with a 1.25 cm disruptor horn at a constant 40-W output for 1 min, and sieved to yield a clean, 20–80µm size fraction (Anderson et al., 2005).

Alexandrium fundyense cysts were counted in a 1-ml Sedgewick Rafter slide according to standard methods for cyst identification and enumeration (Anderson et al., 2003) using primulin to stain the cysts (Yamaguchi et al., 1995). For this, 10 mL of processed sediment was preserved by the addition of 0.75 mL, 100% ACS grade formalin and returned to 4 ^oC for at least 60 min. This sample was then centrifuged for 10 min at 3000xg, the overlying water aspirated, and the sediment pellet was resuspended in 10 ml ACS grade methanol and stored at 4 ^oC for at least 48 h. The sample was centrifuged and aspirated as before, and resuspended in 10 mL Milli-Q water. Following centrifugation and aspiration, 2 mL of primuline stain (2 mg mL^{-1}) was added. The sample was incubated in the dark at 4 ^oC on a rotating mixer, centrifuged and aspirated, and washed with 10 mL Milli-Q water, centrifuged and aspirated again, and the stained sediment pellet was brought up to 3 to 14 mL with Milli-Q water depending on the volume of the stained sediment pellet. A one mL subsample was enumerated using a Zeiss Imager microscope at 100X total magnification under blue light epifluorescence (Chroma filter set 19002, Chroma Corp, Bellows Falls, VT).

Table 1 shows the results of the sediment coring and cyst analysis, and Figure 19 shows the location of the samples and the distribution of cyst abundance. Cyst concentrations ranged from 0 (central marsh sites) to values as high as 2,446 cysts/cm^3 in the top cm of sediment. The latter site was near Mill Pond and Roberts Cove. Other high values were also in the areas closest to the mouths of the salt ponds. Concentrations in the 1-10 cm fraction were generally much lower than the surface counts at each station, except at station F near Roberts Cove, where 2,941 cysts/cm^3 was measured. Note that these values represent the average cyst abundance over that 9 cm layer.

These 2015 cyst samples were collected and analyzed to allow comparisons between the limited number of samples collected now, and those collected in more extensive, marsh-wide system surveys in 2008, 2009 (Crespo et al., 2011) and 2011 (Ralston et al. 2015). Figure 20 compares cyst abundance at sampling sites from 2008, 2009, 2011, and 2015. It is immediately apparent that the general distribution of *Alexandrium* cysts in the area to be dredged has not changed over these years, and it is also clear that cyst abundance has a similar range to that measured in other years. This is an important observation, and the main justification for taking the samples, as it demonstrates that cyst abundance and distribution within the estuary are generally similar among years. Since the dredging program, if found feasible by the Town, will likely be several years from now, there is confidence that these measurements, and those in the recent past, are a realistic representation of the situation at the time the dredging may eventually occur.

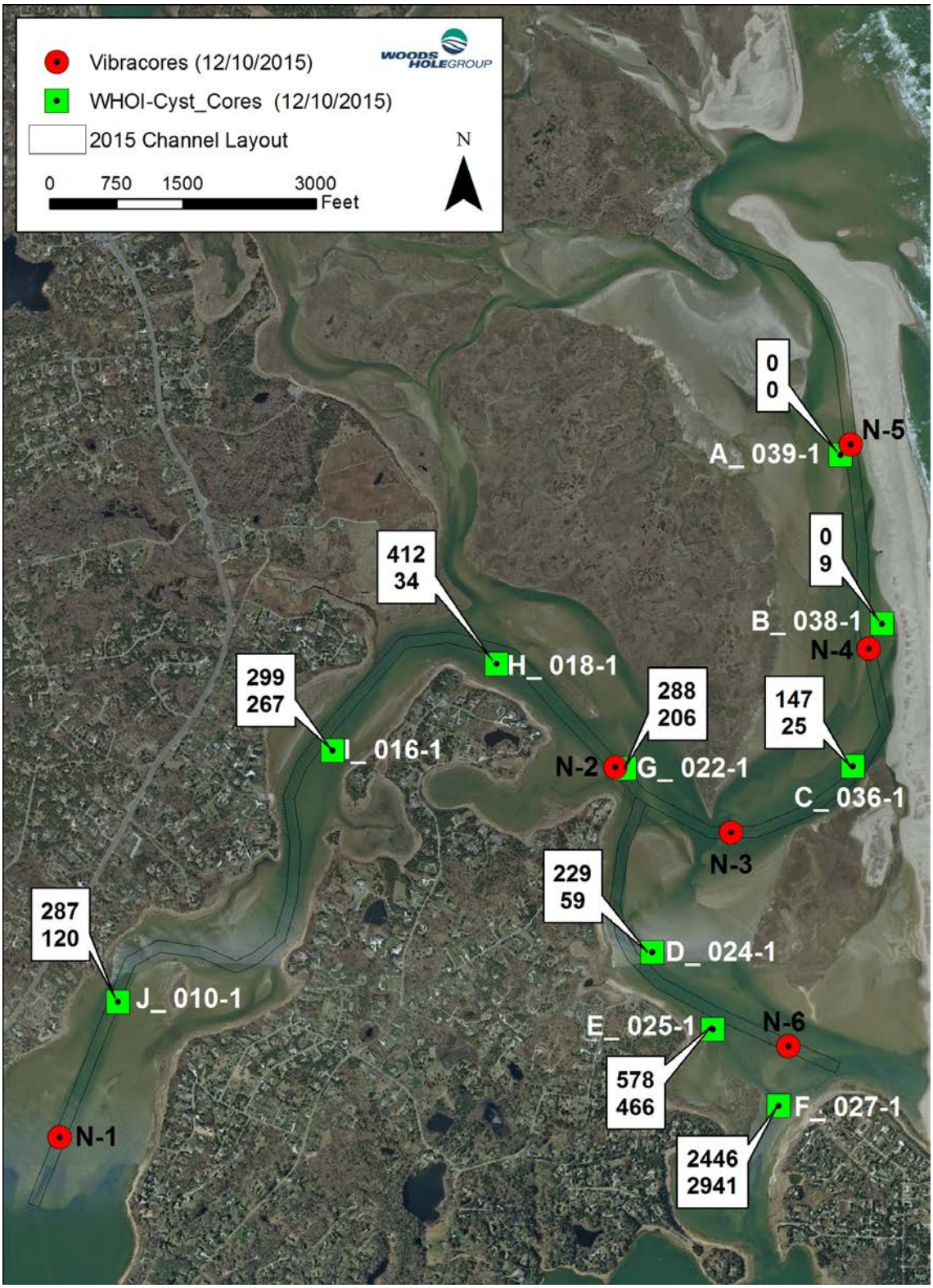

Figure 19. **Map showing cyst coring locations and cyst counts. White boxes near each station show the *Alexandrium* cyst abundances (cysts/cm^3) in the top cm (top line) and 1-10 cm layer (bottom line).**

Table 1. Summary of 2015 red tide cyst sampling and analysis.

Core ID	Latitude	Longitude	Core Recovery (ft)	Collection Date & Time	0-1 cm *Alexandrium* cysts/cm^3	1-10 cm *Alexandrium* cysts/cm^3	Sediment Type (visual)
A_ 039-1	41°49.256	69°56.544	1	12/10/15 11:30	0	0	Sandy
B_ 038-1	41°48.876	69°56.504	0.4	12/10/15 11:05	0	9	Course sand
C_ 036-1	41°48.657	69°56.556	1.2	12/10/15 12:22	147	25	Light sand to dark black
D_ 024-1	41°48.32	69°57.059	0.8	12/10/15 12:51	229	59	Dark silt
E_ 025-1	41°48.175	69°56.911	1	12/10/15 13:04	578	466	Mud
F_ 027-1	41°48.031	69°56.756	0.9	12/10/15 13:40	2446	2941	Light sandy silt
G_ 022-1	41°48.668	69°57.143	1.2	12/10/15 10:21	288	206	Sandy silt
H_ 018-1	41°48.86	69°57.437	0.8	12/10/15 14:07	412	34	Dark silt
I_ 016-1	41°48.709	69°57.841	0.8	12/10/15 14:22	299	267	Sandy silt
J_ 010-1	41°48.247	69°58.384	0.9	12/10/15 14:40	287	120	Sandy silt

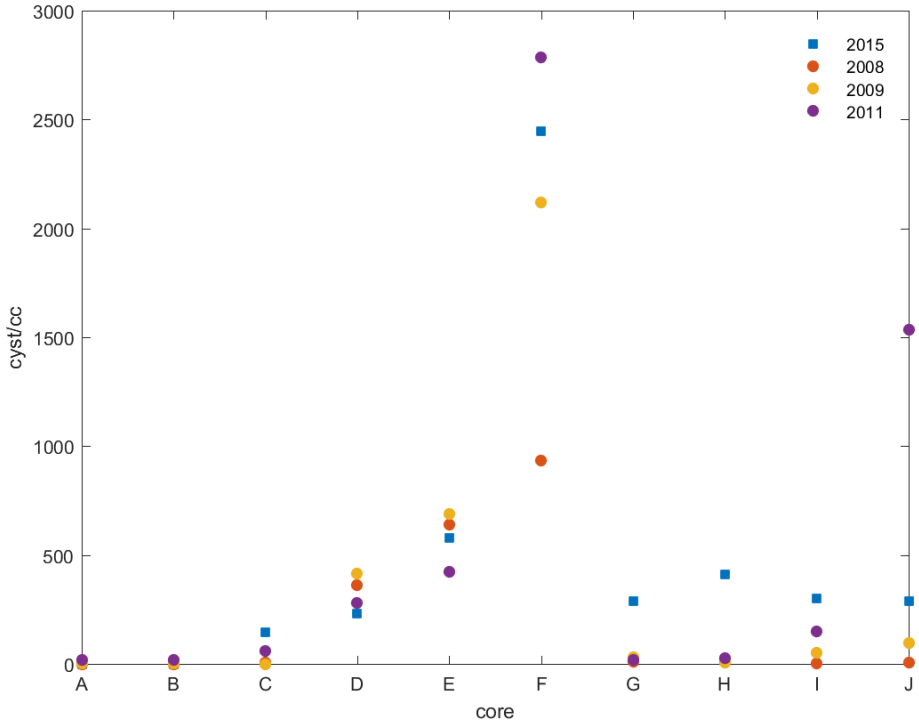

Figure 20. Comparison of cyst abundance at the 2015 core locations with data from previous cyst surveys in 2008, 2009, and 2011.

Red tide cysts in dredged sediments

Observed sediment cyst concentrations and information on the Town's conceptual dredging plan were used to estimate the abundance of red tide cysts in the dredge sediment. The FVCOM model grid bathymetry was used as the basis for the calculations. Cyst concentrations observed at the sample locations were interpolated to the model grid using an inverse-distance weighting approach. The near-surface (0-1 cm) cyst concentrations were used for the spatial distribution. To augment the 10 stations sampled in November 2015, additional near-surface samples (0-1 cm) from the most recent cyst survey of the full estuary during Nov 2011 were utilized (Figure 15). The approach is reasonable given the strong similarities in spatial distributions of cyst abundance across the multiple years of surveys, including those from November 2015 (Figure 20).

The total volume of dredged sediment was calculated by comparing the model grid for the 2015 bathymetry with the grid representing the dredged channel. The amount of material to be removed during the dredging was calculated to be about 73,000 cubic yards, similar to the volume calculated from the bathymetric surveys. The cysts associated with the dredged material were assumed to decrease linearly from the near-surface abundance mapped to the model grid to 0 cysts at 10 cm depth, and equal to 0 in any material below 10 cm. Cyst abundances typically decrease rapidly in the bed over depths of about 10 cm (Figure 17).

Assuming that the cyst concentrations decrease linearly from the surface concentration to 0 at 10 cm depth, and that there are no cysts below 10 cm, the total number of cysts to be removed during dredging was calculated to be 2.2×10^{12}. Dividing that by the dredge volume, an average of concentration in the dredged material of 40 cysts/$cm^3$was determined.

2.7 PAST DREDGING ACTIVITIES

Information on past dredging activities in Nauset Estuary was obtained from the Massachusetts Department of Environmental Protection (DEP) and the Division of Conservation and Recreation (DCR). A total of four (4) permits were identified with issue dates between 1924 and 1974 Table 2 provides a summary of the relevant permit information and Figure 21 shows the locations of the specific activities.

Table 2. Historical permits for Nauset Estuary dredging and associated placement.

Permittee	Permitted Activities	Permit/License No.	Issue Date
Mass DPW/ Waterways	Dredging at 3 sites with placement at 4 in-harbor sites	Contract No. 97	May 24, 1924
Town of Orleans	Maintain bulkhead, piers, dredged & fill	License No. 6256	Aug. 1, 1974
Goose Hummock Shop	Maintain bulkhead, piers, dredge & fill	License No. 5853	Dec. 22, 1971
Esther & Melville Richardson	Dredge & fill	License No. 4844	Jul. 28, 1964

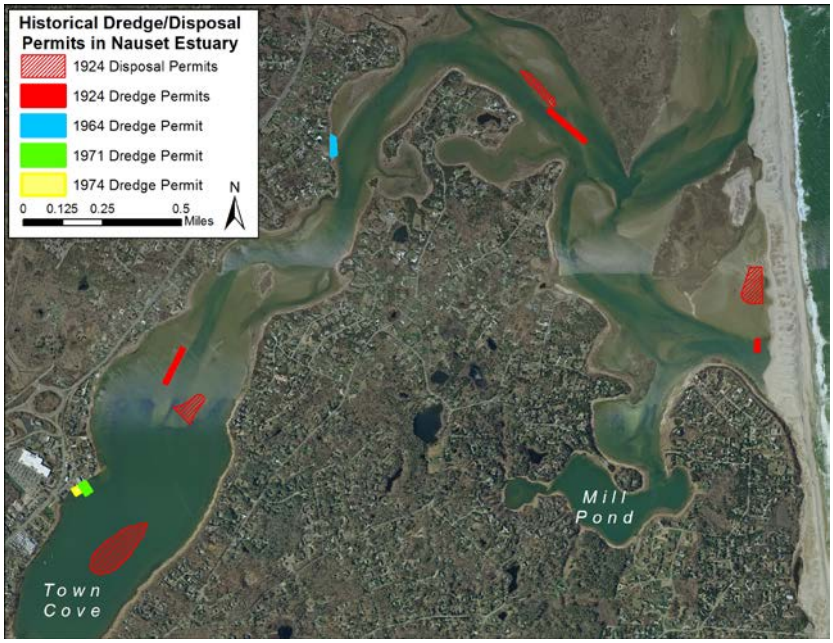

Figure 21. Historical dredging and disposal activities in Nauset Estuary.

3.0 DREDGE AND DISPOSAL PLAN FORMULATION

3.1 TOWN DREDGE CONCEPTUAL PLAN

The Town of Orleans is investigating the feasibility of a dredging program in Nauset Estuary that would improve navigation and public safety. Current shoaling in the channel makes access to the Town landings difficult and dangerous during certain tides. The conceptual channel layout, seen in Figure 1, would facilitate safe passage for navigation not only through the inlet and behind the barrier beach, but also to the key Town landings, such as Priscilla Road, Snow Shore Road, Tonset Road, Asa's Landing, Goose Hummock, and Cove Road, as well as other locations in Town Cove.

To accommodate local boating needs, the Town is investigating a channel design that is 100 feet wide at the base, with 1V:3H side slopes extending an additional 15 feet on each side. The main stem of the dredge channel would extend just over 4 miles from Nauset inlet to Town Cove. A secondary channel, approximately 4,500 feet long would extend south from the main channel towards Robert's Cove, to provide access to Tonset Road, Snow Shore Road and Priscilla Road Landings. The channel would be dredged to a depth of -5 ft at MLLW.

3.2 DREDGE ZONE LAYOUT

The conceptual layout takes advantage of the existing channel and will require significant sediment removal in only a few locations. Figure 5 shows the existing shoals, according to the 2015 bathymetric survey. The major shoal locations are near the inlet and behind the barrier beach, at the first bend in the channel to the south of Nauset Marsh, and towards the upstream end of the channel in Town Cove. However, due to the dynamic nature of the shifting inlet and the resulting change in currents, the exact locations of these shoals changes from year to year. Consequently, the specific areas that need to be dredged today may be different than the areas that need to be dredged a year from now. Given the current bathymetry an estimated total of 80,600 cubic yards of material would need to be removed from the channel to meet the conceptual design described in Section 3.1 (Figure 22). This includes approximately 68,000 cubic yards from the main channel and approximately 12,600 cubic yards from the southern channel.

Due to the dynamic nature of the estuary, the Town is considering an adaptive management approach that would permit a larger dredge zone, rather than a specific channel. This zone is wider than the specific channel layout, and allows flexibility in the future for choosing the optimum dredge route along the deepest part of the natural channel to minimize the volume of dredge material. As part of this feasibility study, a potential dredge zone was developed for Nauset Estuary based on historical variations in the natural channel (Figure 22). At minimum the dredge zone is 300 feet wide near the entrance to Town Cove, and increases to nearly 1,500 feet wide near the inlet. In total, the dredge zone covers approximately 390 acres. However, despite the much larger size of this zone, any particular dredge project would be limited to a 100-foot wide channel within that zone. The total area of dredging in the main channel would not exceed 66 acres and the total area in the channel leading to Priscilla Road Landing would not exceed 13.2 acres. This adaptive management approach would allow the Town to select

a slightly different path for the dredged channel in order to capitalize on the existing channel thalweg, and to minimize costs by removing as little sediment as required.

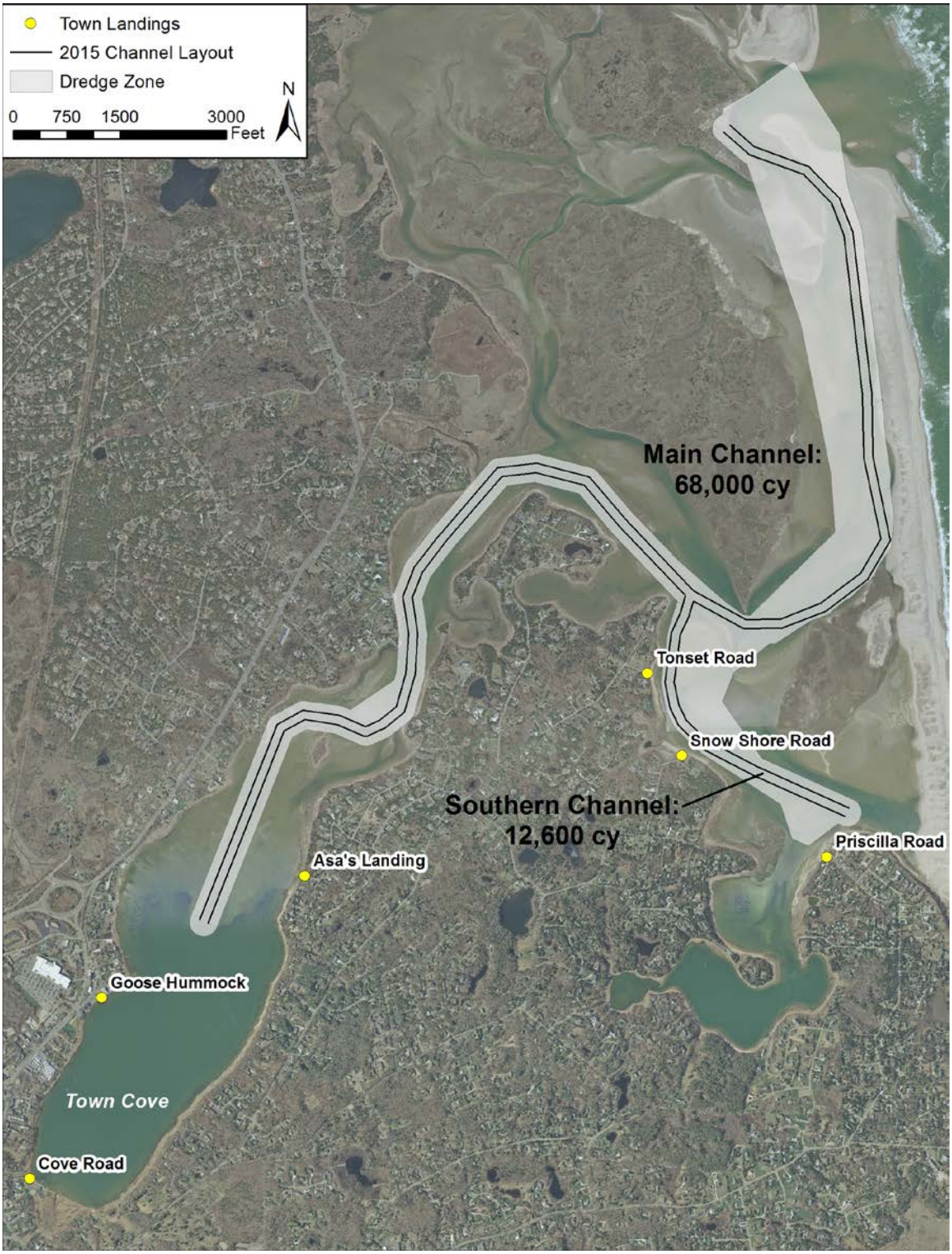

Figure 22. Extent of dredge zone and 2015 channel layout.

3.3 POTENTIAL ALTERNATIVES FOR PLACEMENT

As with all dredge projects, one of the major factors in determining a project's feasibility is where to place the dredged material. Where material can be placed is driven by a number of factors, including distance from the dredging site, characteristics of the sediment being dredged, natural resources, such as eelgrass, shellfish, and salt marsh, feasibility/need to dewater the material, and ownership/size of the potential disposal site(s).

These factors were used as a guide to evaluate the range of possible placement alternatives for the Nauset Estuary dredge program. Unfortunately, the dense residential development, the paucity of shorefront public-owned parcels, and the close proximity to the Cape Cod National Seashore (CCNS) limited the available options for placement. Five potential placement sites/alternatives were identified; however, two of the alternatives are considered experimental due to the need to collect additional information regarding impacts, suitability, and regulatory review. Descriptions of the placement options are provided in the following section.

Dune restoration at Nauset Beach

Use of Nauset Beach as a dredged material placement site would be optimal for the Town, since the beach is currently experiencing significant erosion and the resilience of the site could be enhanced through dune restoration. In fact, in a study recently completed for the Town by Woods Hole Group (2016), a plan of phased retreat for Nauset Beach that included dune enhancement was recommended to protect valuable resources and extend the lifetime of the public beach. Beneficial reuse of sediment dredged from Nauset Estuary for dune enhancement at the public beach would result in a significant cost savings for the Town as the plan of phased retreat for Nauset Beach is implemented.

The most efficient method to use this site would be to contract with the Barnstable County dredge and hydraulically pump the sediment from the estuary directly to Nauset Beach. Because the beach is approximately one mile to the closest part of the estuary, it would be necessary to incorporate use of a booster pump to transport the material. The maximum pump distance for the County dredge with a booster pump is 11,000 ft. This distance would allow portions of Nauset estuary to be hydraulically dredged and the material directly pumped to Nauset Beach, but the ends of the dredge project near the inlet and towards Town Cove would still be too far (Figure 23). Dredge volume estimates from this section of the channel that could be pumped to Nauset Beach are approximately 45,100 cubic yards (channel area 1 in left panel of Figure 23).

It is estimated that Nauset Beach could hold approximately 80,000 cubic yards, and would likely be available for reuse as a placement site within 5 to 10 years if the estuary required maintenance dredging. A preliminary compatibility assessment indicates that the Nauset Estuary sediments have a median grain size between 0.2 and 0.6 mm (fine to coarse sand) and would therefore be suitable for use as dune enhancement at Nauset Beach.

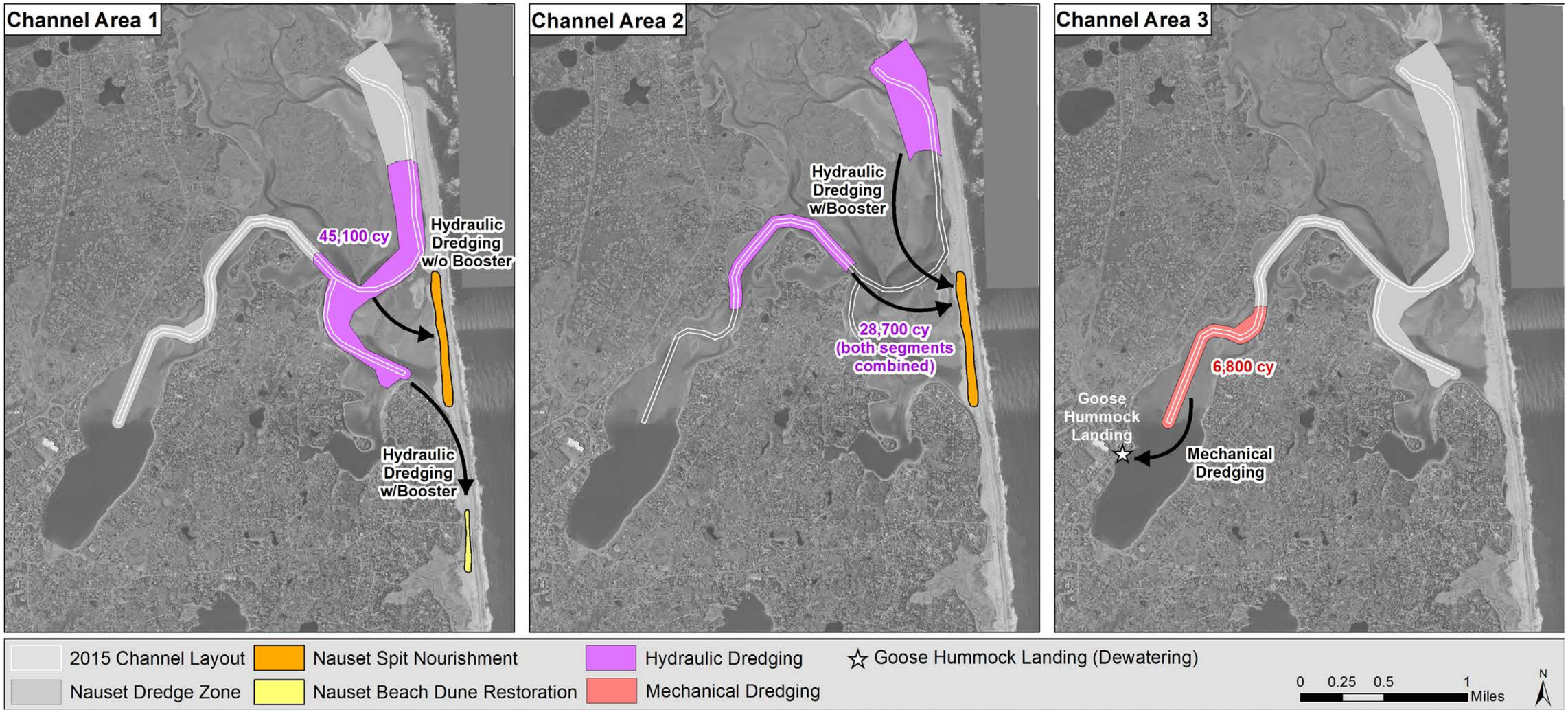

Figure 23. Dredging and placement options for Nauset Estuary.

Dune enhancement along Nauset Spit

The Town-owned portion of Nauset Spit could also be used as a placement site, and could accommodate material acquired through hydraulic dredging. Because of its proximity to the estuary, a good portion of the channel could actually be dredged and the material transported to Nauset Spit without a booster. The left panel of Figure 23 shows approximately 45,100 cubic yards from channel area 1 could be placed on Nauset Spit without the use of a booster pump. With the notable exception of the last mile of channel leading to Town Cove, the remaining portions of the channel would be within reach of Nauset Spit using a hydraulic cutterhead dredge equipped with a booster pump. Approximately 28,700 cubic yards of sand from channel area 2 could be used to enhance Nauset Spit if a booster pump is utilized (channel area 2 in center panel of Figure 23).

Capacity of this site is estimated at more than 100,000 cubic yards, and the site would likely be available for reuse as a placement site within 5 to 10 years. As with the Nauset Beach site, the dredged sediments would be compatible with existing material at Nauset Spit.

Upland/coastal beneficial reuse

There is also the option to beneficially reuse the dredged material at an upland site, or at a site farther away than a hydraulic dredge can pump the material. This option would likely require mechanical dredging with temporary storage, dewatering, and trucking of the dredged material. However, because there is very little upland open space around the estuary, options for dewatering locations are limited. This method is less efficient than hydraulic dredging and would only be recommended for the furthest upstream portion of the channel leading to Town Cove, where even hydraulic methods with the Barnstable County dredge are not feasible. This section of the channel currently requires dredging of approximately 6,800 cubic yards (channel area 3 in right panel of Figure 23).

One potential shorefront staging area in Town Cove is Goose Hummock Landing (Figure 23). In this scenario the material would be mechanically dredged and transported via small barge to Goose Hummock Landing. The sediment would be partially or totally dewatered in the barge (depending on the grain size), and then off loaded at the public bulkhead where it would be temporarily stored for further dewatering (if necessary) and then trucked to a pre-selected beneficial reuse site.

Subaqueous placement

An interesting option that might be considered is to spread sandy dredge material over the surface of the salt ponds, thereby burying the *Alexandrium* cysts that are present in these areas. Calculations performed as part of this study suggest that the dredged sediments will contain very few *Alexandrium* cysts (see Section 4.2 below). If a layer only a few cm thick were dispersed in this manner, and if this were done in the late winter, just before the time when the cysts begin germinating, the inoculum for that year's bloom could be substantially reduced. Not only will sediments quickly become anoxic below

the sand layer, inhibiting germination, but the sand grains would make it very difficult for any germinated cells to successfully swim to the overlying water column.

This placement alternative would accommodate only a small fraction of the dredged material and should be considered experimental at this point. Further discussion with the stakeholders and regulatory officials would be required to evaluate the methods, sites, and potential benefits.

Marsh restoration

A second interesting option for beneficial reuse of dredged material would be to place the sediment in a thin layer over portions of the salt marsh to allow the marsh to keep pace with rising sea levels. This too should be considered experimental, since further data would be needed investigate response of the Nauset Estuary marshes to sea-level rise to see if the alternative is warranted. Additional discussions with the CCNS would be required since the large marsh areas in the estuary are owned by the National Park Service (NPS). The enacting legislation for the CCNS appears to prohibit this type of activity on the salt marsh; however, similar projects under consideration elsewhere may help to demonstrate important benefits of this approach that may allow its use.

4.0 PROJECT FEASIBILITY

The feasibility of establishing a dredging program in Nauset Estuary is described in the following sections in terms of potential environmental impacts, engineering constraints, regulatory requirements, and construction costs.

4.1 ENVIRONMENTAL FEASIBILITY

A dredging program in Nauset Estuary has the potential to have both positive and negative impacts. If the Town decides to pursue the project further it will be necessary to conduct more in-depth environmental impact analyses than were achievable with resources available for this study. However, data and tools developed for this project were used to the extent possible to evaluate potential impacts of the project.

Impacts on hydrodynamics

The FVCOM model described on Section 2.3 was used to evaluate potential changes to the estuary hydrodynamics caused by the dredge plan. The model grid was updated to reflect the 100 ft wide channel dredged to a depth of -5 ft MLLW (Figure 24). To allow comparison with previously validated model results, the model simulations were forced with conditions corresponding to a previous observational period in April 2011.

One of the more notable differences between model simulations with the current 2015 bathymetry and the proposed dredged channel was an increase in tidal amplitude. As the channel has shoaled in recent years and the inlet location has migrated to the north, the channel has become shallower and longer, and therefore more frictional. The added bottom friction causes a reduction in the amplitude of the tide propagating into the estuary from the ocean. Measured water level data from moorings deployed in Town Cove at various times since spring 2009 demonstrate that the tidal amplitude has been

decreasing as the channel has lengthened and the friction increased (Figure 25). The data show a 20% decrease in tidal amplitude over the 5 year period of observation. A similar decrease in water level was observed in measurements from Salt Pond.

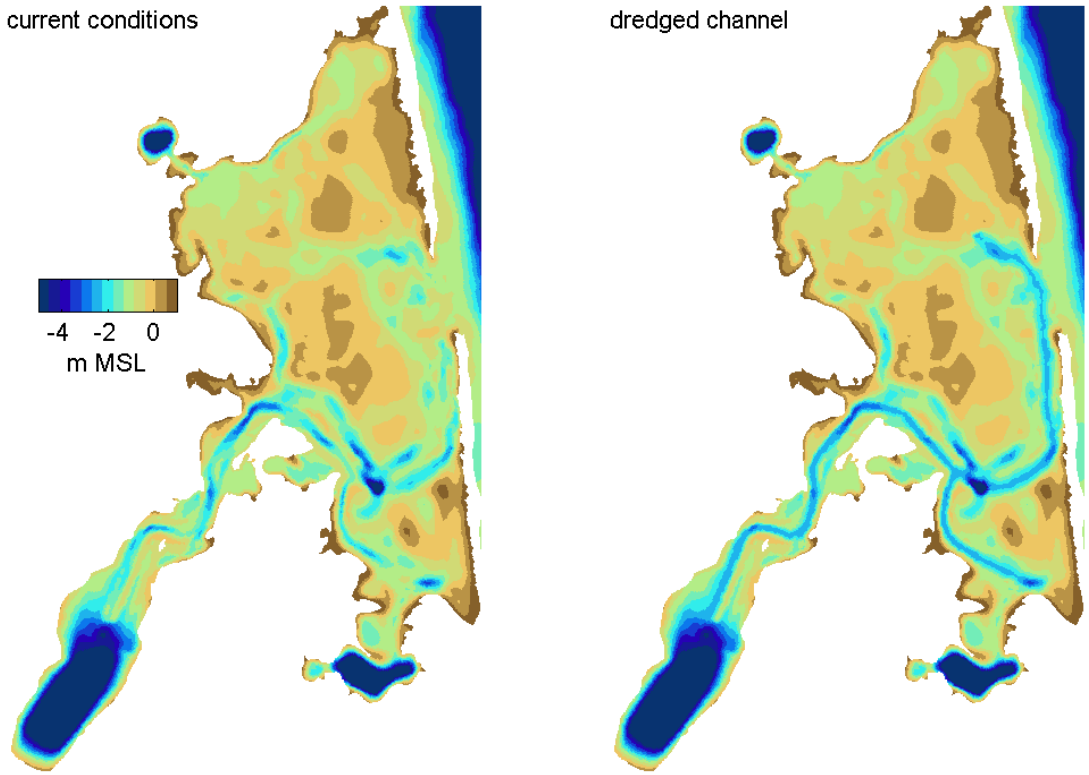

Figure 24. Model bathymetry based on (left) 2015 bathymetric soundings, and (right) channel dredged to -5 feet MLLW.

Model simulations are generally consistent with the observed trends. For example, simulations with the current 2015 bathymetry have a lower tidal amplitude in Town Cove (and the other ponds) than the previous model simulations based on bathymetry surveys through 2009 (Figure 25). In the model, the effect of dredging is to make the tidal flow less frictional, increasing conveyance into the ponds and increasing the tidal amplitude. Therefore, expected effects of the dredging are to restore tidal amplitude to values similar to the model results using the older bathymetry and the observations from 2009-2011.

In the model, tidal velocities and bottom stresses increase modestly in the vicinity of the proposed dredging (Figure 26). The changes in bottom stress, which are important for determining sediment transport, are due both to the increase in water depth and the increase in tidal amplitude. The estuary remains strongly flood dominant, continuing to favor sediment import and accretion. Bed stresses with the proposed dredging are greater in the current configuration only in a few locations, which likely correspond with regions that are currently depositional. In general, the dredging project is not expected to result in increased shoreline erosion within the estuary as the system is expected to return to conditions that existed previously. Longer term, shifts in tidal amplitude, bottom stress,

and sediment transport depend as much on inlet position and dynamics as on the channel depth.

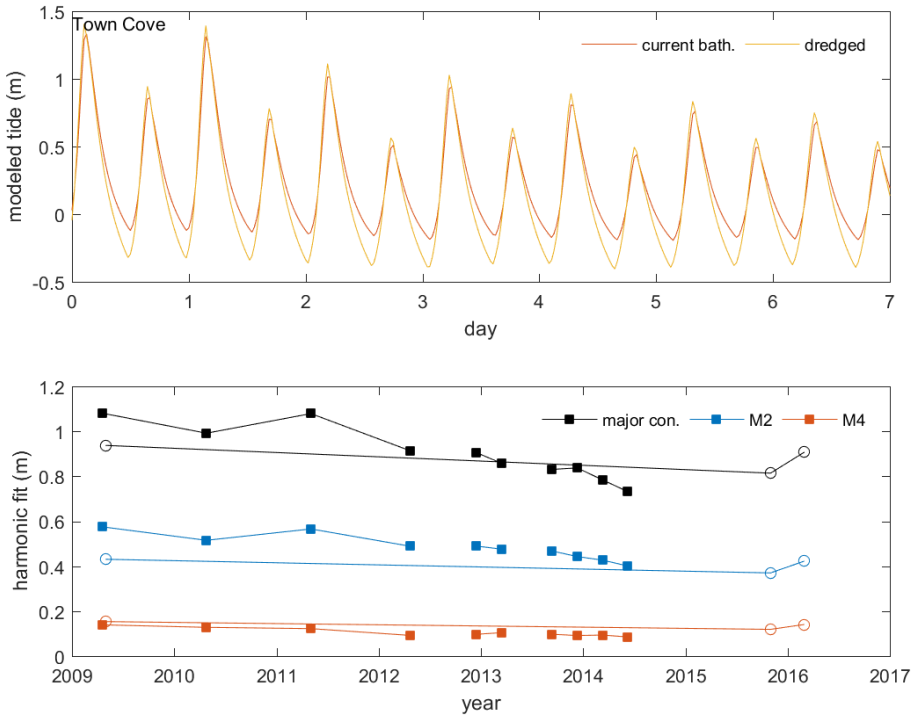

Figure 25. Modeled and observed tidal amplitudes in Town Cove. (top) Modeled water level using 2015 bathymetry vs. the dredge configuration. (bottom) Tidal harmonics based on observations (filled squares) and model results (open circles). Model results are based on simulations using bathymetry from 2009, 2015, and the dredged channel.

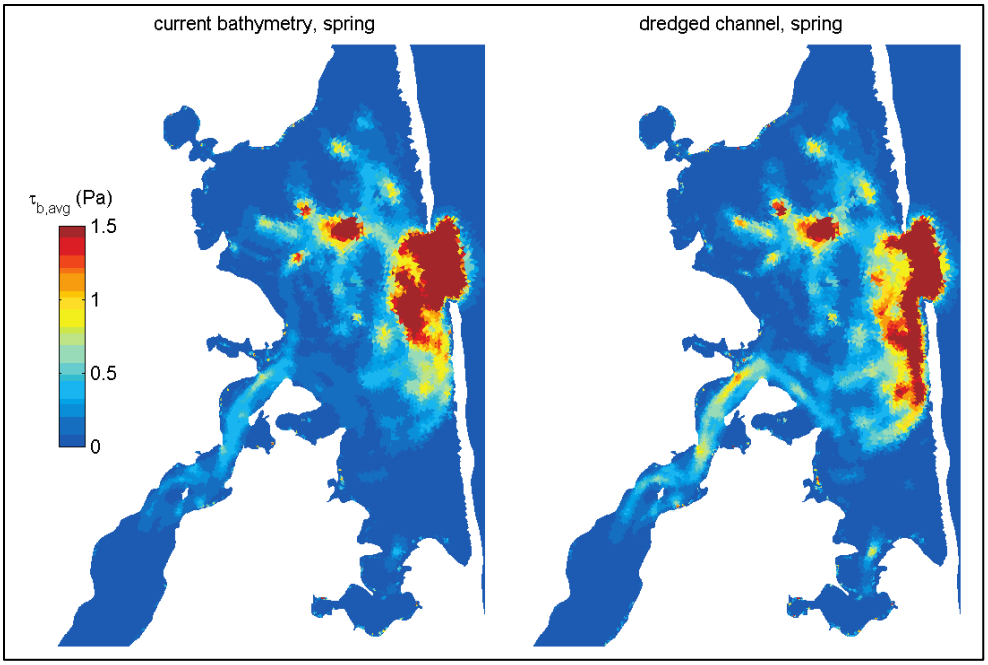

Figure 26. Modeled bottom stresses (average over 2 days) for the current bathymetry (left) and bathymetry with the proposed channel (right).

Impacts on distribution of red tide cysts

There are several ways that the dredging might alter the dynamics and distributions of *Alexandrium* blooms within Nauset Estuary. One is that the mechanical or hydraulic dredging operations will resuspend sediments that contain *Alexandrium* cysts, redistributing those cysts within the marsh, and, depending on the timing of the dredging, provide conditions that are suitable for germination. The latter concern can be eliminated by dredging between December and February when the cysts are generally incapable of germination.

The redistribution of cysts in also not a major concern based on the following reasoning. The estuary is strongly flood dominant and retentive, so resuspended sediment and cysts will likely deposit within the estuary, either on the marsh platform or in regions of lower velocity like shoals at the channel edges or in the salt ponds. It is, however, not possible to estimate the total number of cysts that will be resuspended during dredging, as this will not be constant across the marsh due to variable cyst abundances and sediment types in the areas to be dredged. Previous coring data have shown that cysts are most concentrated in the top few cm of the bed, and that concentrations decrease rapidly within about 10 cm from the surface. The dredging depth would generally be much deeper than 10 cm, and thus the cysts in the surface layer will be mixed and diluted with the deeper bed material. The calculation described in Section 2.6 estimated an average of 40 cyst/ cm^3 in the dredged material, and it is reasonable to assume that the sediment and cysts released to the environment during dredging will have a similar average concentration. Resuspension experiments in test plots in Roberts Cove found that cysts settled at rates similar to silt-sized sediment (Anderson and Ralston, unpublished data), so the cysts and silt can be expected to be transported in the estuary similarly. Silt is most commonly

found in the lower energy regions of the system, including the salt ponds and shallow side embayments, and in these regions the background cyst concentrations range from several hundred to several thousand cysts/cm^3. The addition of newly remobilized material with an average concentration of around 40 cyst/cm^3 would not increase the cyst abundance at the bed surface in these depositional areas, nor would it be expected to increase the magnitude of *Alexandrium* blooms.

Alternatively, the total number of cysts in the dredge material is estimated to be 2.2 x 10^{12}. Using a similar approach, the total number of cysts in the estuary in the top 1 cm of the bed is estimated to be 6.6 x 10^{13}, and the total number in the top 10 cm of the bed as 3.3 x 10^{14}. Estimating that the loss rate of resuspended material during dredging operations to be 1% (Palermo, et al., 2008), the total number of cysts released during dredging would represent an addition of about 0.03% to the cysts in the surface layer. Again, this would not be expected to increase the magnitude of *Alexandrium* blooms.

The changes in tidal amplitude in the estuary associated with dredging that were calculated by the model may have impacts on red tide cysts that are difficult to quantify. An increase in tidal range could enhance flushing of the salt ponds, potentially reducing the accumulation rates of *Alexandrium* cells in the ponds and bloom intensity (Ralston et al. 2015). Larger tides may also increase bed stresses in the system, remobilizing and redistributing fine sediment and associated cysts. This could increase the population of cysts that are available to germinate, although as with the sediment released during dredging operations, the expectation is that the fine sediment and cysts would accumulate in regions that already have high cyst concentrations. An important point in assessing potential effects of a change in tidal amplitude is that the model predicts a return to tidal conditions similar to that of several years ago rather than a significant increase over the historical range. As the Nauset inlet has migrated north and the entrance channel both extended and shoaled, the estuary has become more frictional, accounting for the decrease in tidal range. The proposed dredging would reverse some of that decrease, but the tidal regime and any effects on the harmful algal bloom would be similar to conditions from a few years ago.

Red tide impacts associated with the various placement alternatives shown in Figure 23 present no major concerns or negative impacts. For the dune enhancement alternatives, most cysts in the sand will be buried in the dune, such that few, if any, will be washed back into the water. As the sand dries out, the cysts will desiccate and die. With the upland/coastal beneficial reuse alternative the primary concern with respect to *Alexandrium* cysts is that during the dewatering process, cysts might be carried into Town Cove with the water that drains from the sediment pile. But, sand and silt act as filters when piled in the holding area, so most cysts will be strained from the water as it drains through the tortuous path of the sand, silt, and clay particles. With the marsh restoration option, the dredged sediment and associated *Alexandrium* cysts will be trapped by the *Spartina* and other marsh grasses. The cysts will thus be placed in an environment where they are likely either to die, due to repeated cycles of inundation and drying with the tides, or to be buried into anoxic sublayers of sediment, where they will remain dormant until they die. The subaqueous placement alternative has considerable promise to be effective and

environmentally benign, but it should be pursued as a pilot research study first to demonstrate the principle of using sand deposition to suppress cyst germination.

Impacts requiring further study

Given that FVCOM shows changes in tidal amplitude with the dredging project, it is likely that the project would also result in changes to tidal flushing and water quality. However, these impacts are not expected to result in significant harm since the system will be returning to conditions that existed previously. If the Town proceeds with the project it will be important to quantify these potential impacts. In terms of sediment transport and shoreline erosion, the dredging is not expected to result in significant differences. However, one area that requires further examination is the southern channel leading to Priscilla Road Landing. While the FVCOM model does not indicate significant changes to hydrodynamics in this area caused by dredging, the potential for an increased risk of breaching at the historical 1930's location near Nauset Heights should be evaluated further. If adverse impacts are noted, it may be possible to evaluate different dredging scenarios (narrower, shallower) that would reduce the potential for a breach in this location. If the Town proceeds with the project, it will also be necessary to evaluate potential impacts to existing resources such as shellfish, wetlands, shorebirds, etc. through more detailed surveys.

4.2 ENGINEERING FEASIBILITY

The engineering feasibility of the project was evaluated by looking at two primary aspects of the project. The first was the ability to maintain a dredged channel to the desired width and depth without frequent maintenance dredging. The second included an evaluation of viable construction methods given the dredge channel layout and available placement options. Although determining specific time frames for the former is difficult, based on preliminary hydrodynamic modeling and long-term knowledge of the geomorphology of Nauset Inlet and Nauset Estuary, rough projections of the lifetime of the dredged channel can be made. Because of the dynamic nature of the inlet and barrier beach, the portion of the channel immediately behind the barrier beach and near the inlet would likely require maintenance dredging every 1 to 3 years to maintain the channel design. In the event that a new breach forms to the south near Tern Island, the channel area behind the barrier beach would be abandoned, and maintenance dredging would only be required in the channel leading to the breach. Post-dredge shoaling rates in the interior channels are difficult to predict without a detailed sediment transport model; however, it is likely that these areas would receive small volumes of sedimentation and would require infrequent maintenance dredging.

The second engineering consideration involves which construction methods are viable given the channel layout, available placement options, and equipment limitations. Because there are technical limitations to how far dredged material can be hydraulically pumped, the limits on appropriate placement sites were assumed to the 4,000 and 11,000 ft from the dredge locations. These two distances coincide with the Barnstable County Dredge capabilities to pump dredge material without and with a booster pump. Because Nauset Beach is approximately one mile south of Nauset Estuary, material can only be hydraulically pumped there with a booster pump attached to

the pipe (Figure 23). Alternatively, Nauset Spit is much closer to the proposed dredge areas, and could be used as a placement site for material pumped from within 4,000 feet using a hydraulic dredge, even without a booster. By adding a booster pump, material from much of the proposed dredge area could be pumped to this location.

Finally, due to the length of the dredging project, areas of the channel in the vicinity of Town Cove are more than 11,000 feet from either beach/dune disposal site. As such, the distance limitations of the County Dredge, even with an attached booster pump, rule out the possibility of utilizing a hydraulic dredge to remove the material from this portion of the channel (Figure 23, right panel). Instead, the material will need to be mechanically dredged, and barged to a shorefront location for offloading and trucking to an approved site. Water depths in the estuary would not allow for a fully loaded barge to be towed to the eastern side of the system so the material could be used on Nauset Spit. Instead, the likely destination for any mechanically dredged material, regardless of grain size, from the Town Cove portion of the channel would be Goose Hummock Landing. There, it could be offloaded at the existing bulkhead, dewatered in the parking lot if necessary, and then trucked to Nauset Beach for dune enhancement or some other approved location.

4.3 REGULATORY FEASIBILITY

Any dredging project in Massachusetts requires certain permits and certificates. Based on the 2015 channel layout, which includes removal of approximately 80,600 cubic yards of sediment from over 79 acres, regulatory review will be required by the Massachusetts Environmental Protection Act (MEPA) and the Cape Cod Commission in the form of an Environmental Impact Report (EIR) and District of Regional Impact (DRI). The current plan exceeds the regulatory threshold for the EIR, which is alteration of ten or more acres of a wetland (11.03(3)(a)1a). It may be possible to file an Expanded Environmental Notification Form (ENF) with MEPA requesting a waiver from the requirements of an EIR. This would reduce permitting costs and timing, but at this point it is unclear if MEPA would accept this request. It may also be possible to scale the project back so the EIR threshold is not triggered, but this would require a significant reduction in project scope which may not meet the objectives of improving navigation and public safety.

Since the channel layout includes sections in both the Town of Orleans and the Town of Eastham, a separate Notice of Intent will need to be filed with each town's Conservation Commission. In addition, other standard permits for dredge projects, such as a Massachusetts DEP Water Quality Certification, Chapter 91 Permit, Coastal Zone Consistency, and a USACE Individual Permit will also be required.

Although certain activities are prohibited or more strictly regulated within the Cape Cod National Seashore (CCNS), this dredge plan would not require additional federal permitting because of its location within the CCNS. However, close communication with the CCNS will be important if the project proceeds. Placement options on Town owned land, shown in Figure 23 in Section 3, also do not trigger the need for permitting with the CCNS.

Table 3 summarizes the list of permits that would be required to implement the dredge plan. The table details the type of application, agency responsible for issuing each

permit, the duration of the permits, and the estimated cost associated with preparing and applying for each permit. Combined, the cost for all permits necessary for this project is estimated to be approximately $141,000. If the requirement for an EIR/DRI can be waived the cost for permitting could be reduced to approximately $75,400. Although an exact time line for applying for and receiving all the permits is not possible to develop at this time, it is likely to take between 2 and 3 years.

This feasibility study collected a limited amount of data, to help evaluate the feasibility of the project, but more detailed data will be required for actual permitting. Based on past experience from similar projects, a list of additional data needed to support the permit applications has been developed and is summarized along with associated costs in Table 4. To complete all the additional data collection would cost approximately $195,900 and would take approximately 1 year to complete.

Combined the cost of permitting and additional data collection would range between $271,300 and $336,900 depending on whether or not an EIR/DRI review is required.

Table 3. Required permits for the Nauset Estuary dredge project.

Application	Agency	Permit Duration	Cost
Expanded Environmental Notification Form	MEPA	Not Applicable	$17,400
Environmental Impact Report/ Development of Regional Impact Joint Filing	MEPA/ Cape Cod Commission	Not Applicable	$65,600
Notice of Intent	Orleans Conservation Commission	3-Years, possibly up to 10-Years	$15,000
Notice of Intent	Eastham Conservation Commission	3-Years, possibly up to 10-Years	$15,000
401 Water Quality Certification	MADEP Wetlands & Waterways	5-Years	$8,000
Chapter 91 Waterways Permit	MADEP/ Waterways	10-Years	$8,000
MCZM Federal Consistency Determination	MA Coastal Zone Management	Not Applicable	$5,000
MA Individual Permit	Army Corps of Engineers	10-Years	$7,000

Table 4. Data collection activities and estimated costs to support permit applications.

Data Collection Activity	Estimated Cost
Resource area surveys (wetlands, shellfish, eelgrass, shorebirds)	$23,000
Beach and dune topographic surveys	$7,800
Bathymetric surveys (Pre- and Post-Dredge)	$18,400
Placement site Monitoring	$9,100
Vibracoring and beach sampling for grain size	$42,500
Refined hydrodynamic modeling	$77,700
Engineering design and plans	$17,400
Total	**$195,900**

4.4 CONSTRUCTION COSTS

Construction costs are contingent on a number of factors, including mobilization costs, dredging costs, disposal costs (in the case of mechanical dredge), and whether or not a booster is utilized (in the case of hydraulic dredging). Mobilization costs to get the County Dredge to Nauset Estuary are approximately $25,000 per dredge event. The cost for actual dredging, however, depends on whether a booster pump is utilized. Without a booster pump, dredging costs $9 per cubic yard. With a booster pump, dredging costs $13 per cubic yard. There are no specific disposal costs associated with hydraulic dredging because the material is pumped to the placement site as it is being dredged, although some land-based, mechanical equipment such as bobcats and bulldozers may be required to spread and grade the material, which would add additional costs to this method.

Mechanical dredging is more costly. The mobilization cost for a mechanical dredge is approximately $150,000. The cost of actual dredging is $43 per cubic yard. Unlike hydraulic dredging, the mechanical dredging would also incur a rehandling and trucking fee of approximately $43 per cubic yard. If the material was not reused beneficially, and taken to a landfill for use as daily cover there would also be a tipping fee of about $37 per cubic yard.

Given the volumes of sediment present in different areas of the channel layout (Figure 22), and the limitations of what dredge method and placement site can be utilized for each of the areas (Figure 23), the cost of dredging each channel area has been calculated (Table 5). Assuming that the entire 80,600 cubic yards of material is dredged from all three channel areas in Nauset Estuary, the costs would range between $1.5 and $1.7 million. If sediment dredged from channel areas 1 and 3 (Figure 23) is used beneficially for dune restoration at Nauset Beach, it could save the Town between $900,000 and $1,200,000, which is the estimated cost for purchasing and spreading sand to restore the dune (Woods Hole Group, 2016).

Table 5. Estimated construction costs for dredging Nauset Estuary.

Dredge Method	Channel Area 1[1]	Channel Area 2[1]	Channel Area 3
Hydraulic w/o Booster	$430,900		
Hydraulic w/ Booster	$611,300	$398,100	
Mechanical			$734,800

1: Includes $25,000 mobilization/demobilization fee

4.5 SUMMARY OF FEASIBILITY FACTORS

Sections 4.1 to 4.4 describe the various feasibility considerations for the Nauset Estuary dredging project. These considerations encompass environmental, engineering, regulatory, and financial concerns involved with this project. To better facilitate an understanding of all these project components, the major findings from each feasibility category are summarized below in Table 6. The Town can use this summary, as well as the detailed information presented in this report, to determine the overall feasibility of this project, based on their needs, available funding, and required time frames.

Table 6. Summary of project feasibility.

Feasibility Category	Summary
Environmental	• No adverse impacts are expected due to dredging in areas with red tide cysts provided the work is done between December and February. • Potential impacts to shellfish and water quality will require further study to be determined. • Because no eelgrass is present in Nauset Estuary, no impacts are expected to this resource.
Engineering	• Combination of hydraulic and mechanical dredging • Placement can be through nearby beneficial reuse and offsite upland transport • Lifetime estimates for the dredged areas range from a low of 1 to 3 years immediately behind the barrier beach to higher lifetimes with infrequent maintenance dredging elsewhere.
Regulatory Constraints	• The total cost to complete all necessary additional data collection and prepare and submit all required permits is estimated to be $336,900. • It will take approximately 1 year to complete all additional necessary data collection, and an additional 2 to 3 years to apply for and acquire all permits necessary to commence work
Construction Costs	• Construction cost for the entire project range from $1.5 to $1.7 million. • Beneficial reuse of the dredged sand could offset the costs of dune enhancement and phased retreat at Nauset Beach by approximately $900,000 to $1,200,000.

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APPENDIX A. CORE LOG DESCRIPTIONS

Sediment Core Descriptions

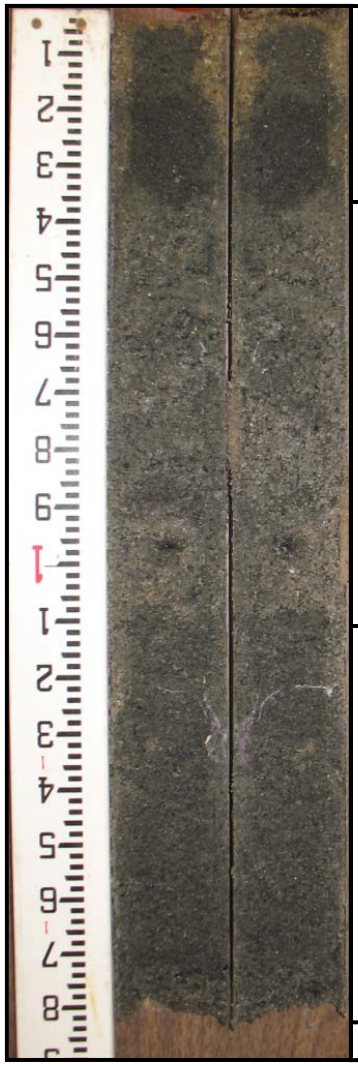
N-1

0.0-0.2’	Black sandy silt. Well sorted.
0.2-1.2’	Fine sand. Moderately-well to well-sorted. Color modeled brown to gray.
1.2-2.7’	Medium to fine sand. Moderately well-sorted. Gray.
2.7-2.9’	Fine sand. Moderately to well sorted.

N-2

0.0-0.4’	Medium to fine sand. Silty clay clast. Slipper snail shell on surface. Variable color. Modeled brown to black.
0.4-0.86’	Fine sand. Occasional shell fragments. Well-sorted. Color is gray/light gray.
↓ 0.86-0.88’	↓ Silt. Gray to dark gray. Crushed shell hash on top layer then silt.
0.88-1.08’	Fine to medium sand. Light brown to gray color. Moderately well sorted
1.08-1.16’	Sandy silt. Gray to dark gray. Well sorted.
1.16-2.78’	Sand. Grain-size coarsens with depth. Medium grained with occasional pockets of coarser sand. Organic material at 2.32’. Crushed shell hash at 2.6-2.62’. Silt content at 2.06-2.22’. Light gray to gray color.

N-3

	0.0-0.36’	Medium to fine sand. Moderately sorted. Dark gray to dark olive gray.
	0.36-1.1’	Sand. Poorly sorted. Fine to coarse sand. Small percentage gravel. Small to coarse gravel size. Organic content includes charcoal, woody debris and shell hash. Color variable light brown to gray.
	1.1-1.86’	Medium to fine sand. Moderately sorted. Gray to dark gray.

N-4

0.0-1.2’	Sand. Poorly sorted. Medium grained matrix with gravel. Light brown color.
1.2-1.6’	Top predominately quartz. Slightly coarser grained. Minerology is different. High content of darker sand grains.
1.6-1.98’	Gray to dark gray. Moderately well sorted.
1.98-2.2’	Well sorted. Fine sand. Very dark gray. Shell fragments. Occasional large gravel.
2.2-2.56’	Bimodal sand. Dark gray.
2.56-3.3’	Medium to coarse grained with gravel. Salt and pepper color. Predominately quartz. Medium to poorly sorted.

N-5

0.0-1.26’	Medium grained sand. Moderately sorted. Shell fragments. Low percentage gravel. Brown to light browns.
1.26-2.84’	Well sorted medium sand. Color variable light gray to dark gray.
2.84-3.52’	Well sorted medium sand. Color variable light gray to dark gray.
3.52-4.56’	Moderately sorted. Medium grained sand matrix. Occasional gravel. Color gray to dark gray.
4.56-4.84’	Poorly sorted sand with low percentage silt and gravel. High percentage organic material with shell hash. Gravel > 1 cm well rounded. Black color.

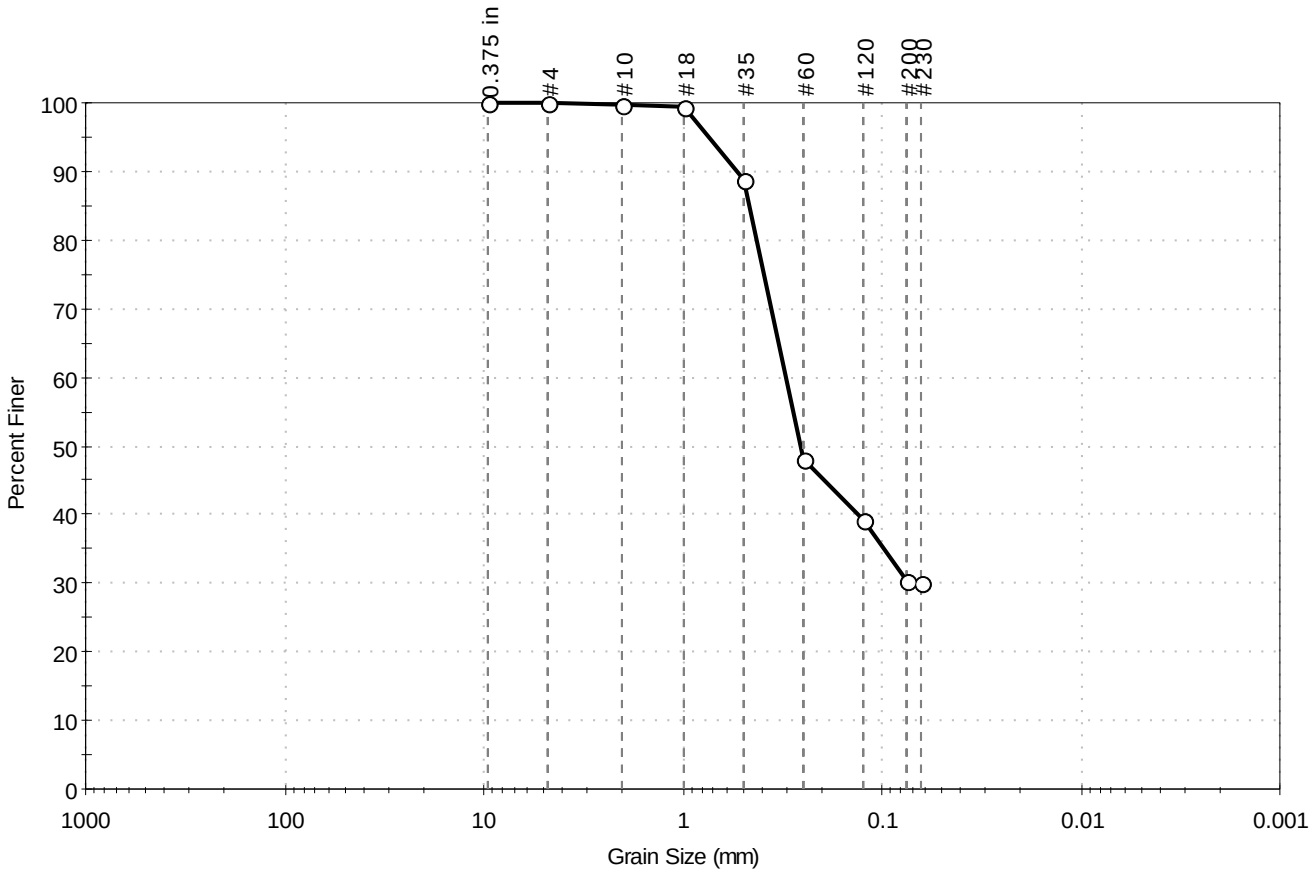
N-6

	0.0-0.2’	Fine to medium sand with gravel. Light brown.
	0.2-0.9’	Uniform texture. Fine sand and silt content. Bottom on transition zone on an angle. Sand content increases with depth. Dark olive gray to black.
	0.9-1.3’	Moderate medium grained sand. Low percentage gravel fragments. Color light grayish to brown.
	1.3-2.6’	Fine to medium grained sand. Well rounded gravel. Gray to dark gray. Well sorted.
	2.6-3.24’	Medium grained. Slightly coarser than above. Moderately sorted. Gray.

APPENDIX B. LABORATORY GRAIN SIZE RESULTS

Client:	Woods Hole Group				
Project:	Orleans Nauset Estuary				
Location:	Nauset Inlet, MA			Project No:	GTX-304172
Boring ID:	2015-0121	Sample Type:	bag	Tested By:	jbr
Sample ID:	N-1	Test Date:	01/04/16	Checked By:	emm
Depth :	0-0.2 ft	Test Id:	359153		
Test Comment:	---				
Visual Description:	Moist, olive silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.1	69.5	30.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	100		
#18	1.00	99		
#35	0.50	89		
#60	0.25	48		
#120	0.12	39		
#200	0.075	30		
#230	0.063	30		

Coefficients

D_{85} = 0.4690 mm D_{30} = N/A

D_{60} = 0.3059 mm D_{15} = N/A

D_{50} = 0.2579 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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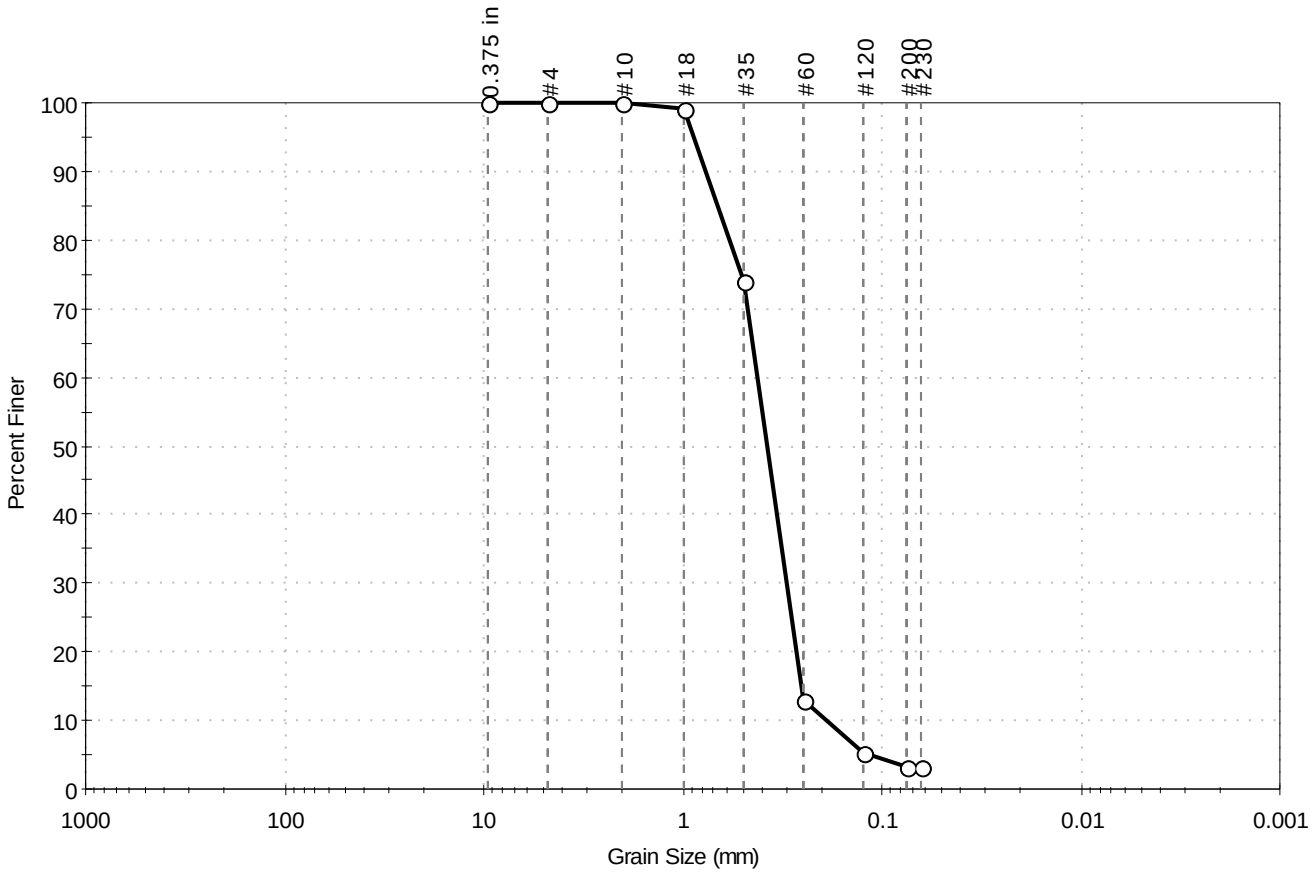
Client:	Woods Hole Group				
Project:	Orleans Nauset Estuary				
Location:	Nauset Inlet, MA			Project No:	GTX-304172
Boring ID:	2015-0121	Sample Type:	bag	Tested By:	jbr
Sample ID:	N-1	Test Date:	01/04/16	Checked By:	emm
Depth :	0.2-2.3 ft	Test Id:	359154		
Test Comment:	---				
Visual Description:	Moist, gray sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	96.8	3.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	100		
#18	1.00	99		
#35	0.50	74		
#60	0.25	13		
#120	0.12	5		
#200	0.075	3.2		
#230	0.063	3		

Coefficients

D_{85} = 0.6765 mm	D_{30} = 0.3031 mm
D_{60} = 0.4262 mm	D_{15} = 0.2556 mm
D_{50} = 0.3804 mm	D_{10} = 0.1901 mm
C_u = 2.242	C_c = 1.134

Classification

ASTM: Poorly graded sand (SP)

AASHTO: Stone Fragments, Gravel and Sand (A-1-b (1))

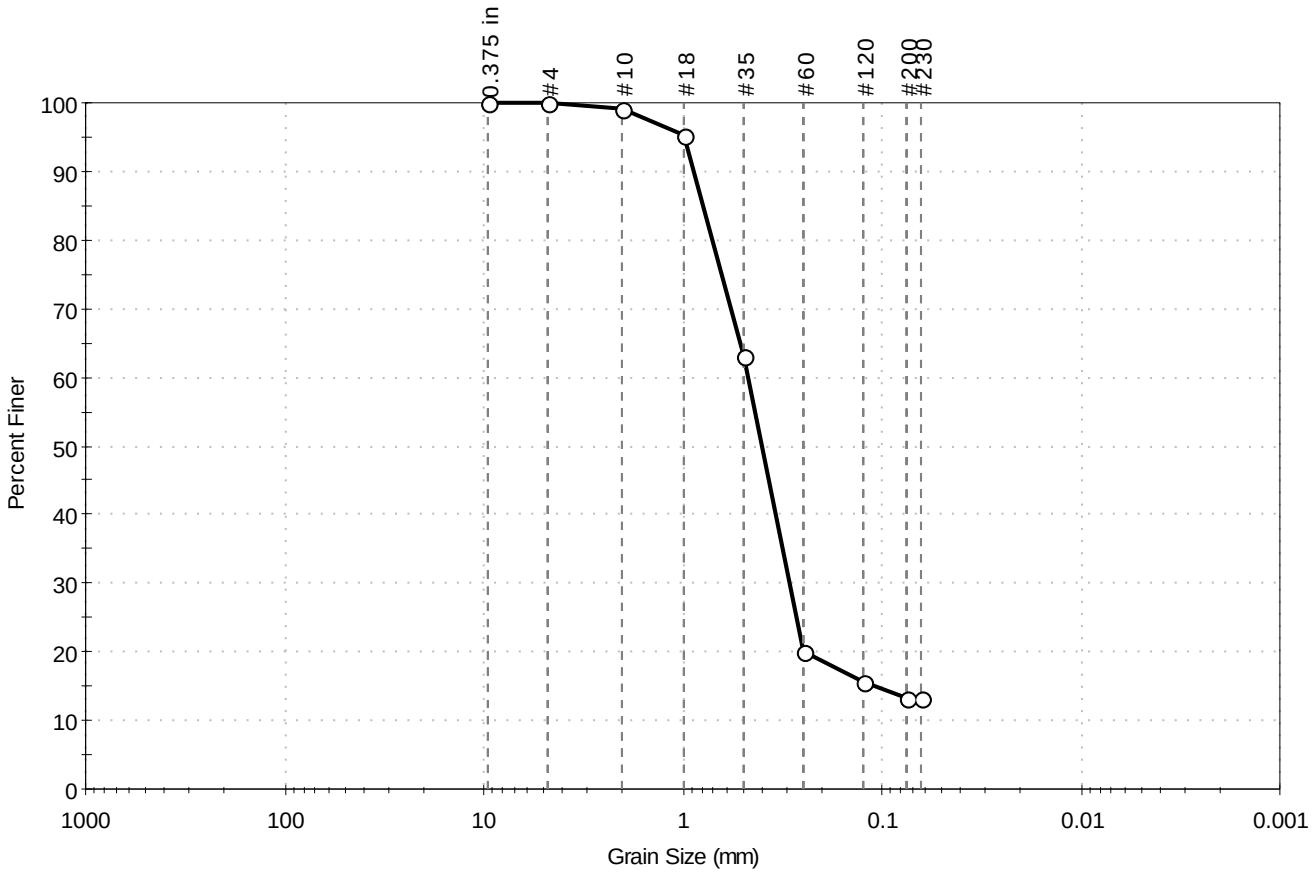
Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Client:	Woods Hole Group				
Project:	Orleans Nauset Estuary				
Location:	Nauset Inlet, MA			Project No:	GTX-304172
Boring ID:	2015-0121	Sample Type:	bag	Tested By:	jbr
Sample ID:	N-2	Test Date:	12/31/15	Checked By:	emm
Depth :	0-2.6 ft	Test Id:	359155		
Test Comment:	---				
Visual Description:	Moist, olive silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	86.7	13.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	99		
#18	1.00	95		
#35	0.50	63		
#60	0.25	20		
#120	0.12	16		
#200	0.075	13		
#230	0.063	13		

Coefficients

D_{85} = 0.8010 mm
D_{30} = 0.2935 mm
D_{60} = 0.4765 mm
D_{15} = 0.1095 mm
D_{50} = 0.4054 mm
D_{10} = N/A
C_u = N/A
C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

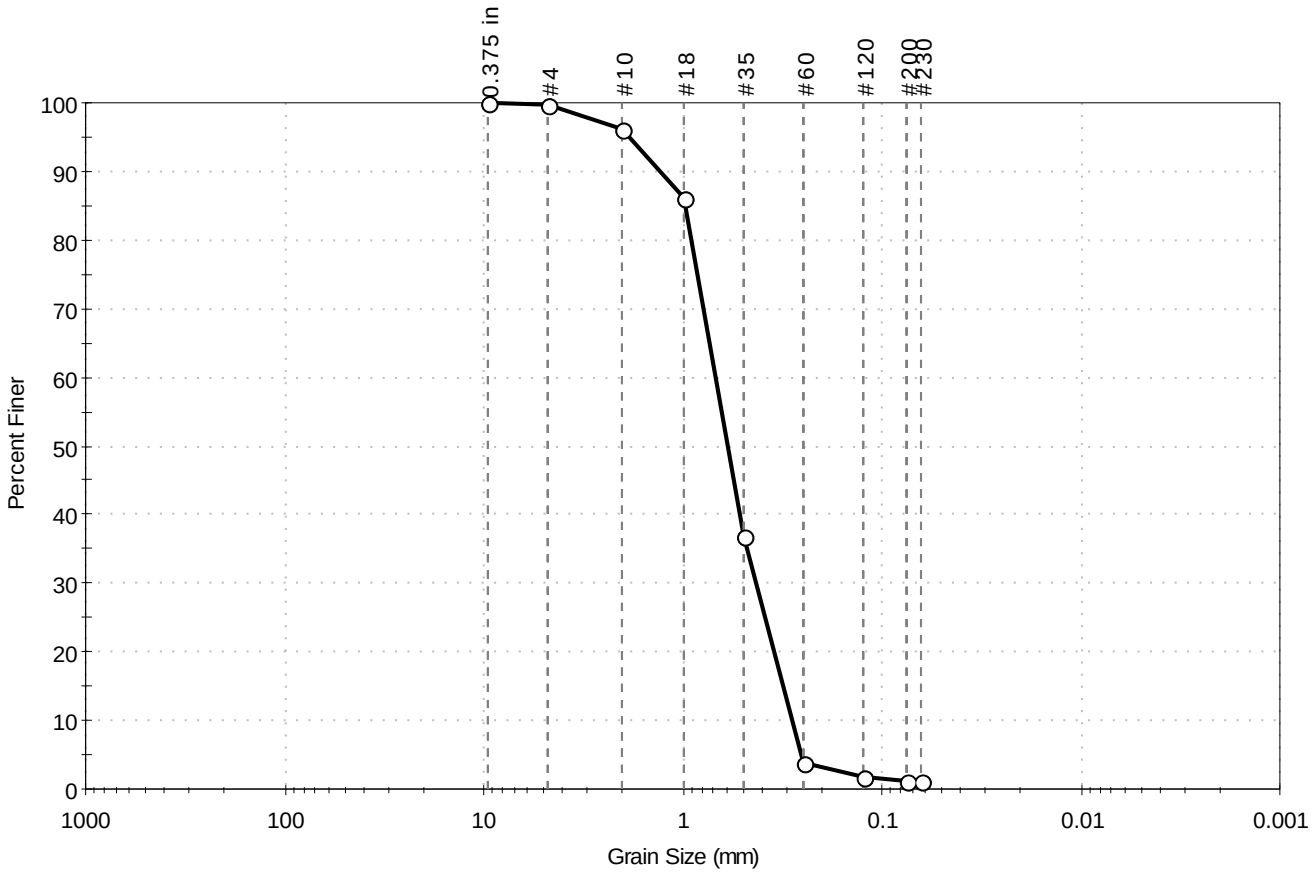
Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Client:	Woods Hole Group				
Project:	Orleans Nauset Estuary				
Location:	Nauset Inlet, MA			Project No:	GTX-304172
Boring ID:	2015-0121	Sample Type:	bag	Tested By:	jbr
Sample ID:	N-3	Test Date:	12/31/15	Checked By:	emm
Depth :	0-1.8 ft	Test Id:	359156		
Test Comment:	---				
Visual Description:	Moist, pale brown sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.4	98.3	1.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	96		
#18	1.00	86		
#35	0.50	37		
#60	0.25	4		
#120	0.12	2		
#200	0.075	1.3		
#230	0.063	1		

Coefficients

D_{85} = 0.9840 mm	D_{30} = 0.4324 mm
D_{60} = 0.6918 mm	D_{15} = 0.3163 mm
D_{50} = 0.6009 mm	D_{10} = 0.2850 mm
C_u = 2.427	C_c = 0.948

Classification

ASTM — Poorly graded sand (SP)

AASHTO — Stone Fragments, Gravel and Sand (A-1-b (1))

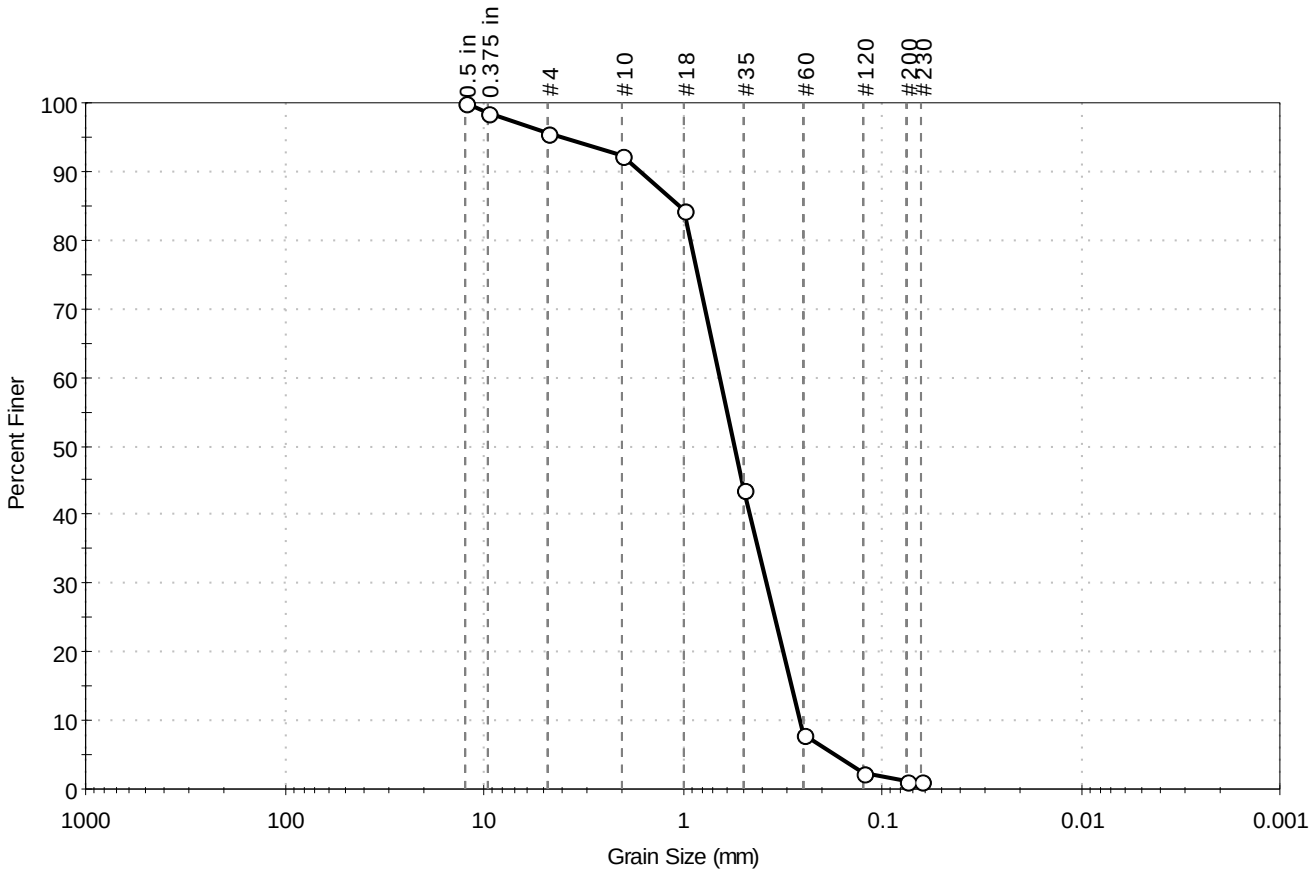
Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Client:	Woods Hole Group				
Project:	Orleans Nauset Estuary				
Location:	Nauset Inlet, MA			Project No:	GTX-304172
Boring ID:	2015-0121	Sample Type:	bag	Tested By:	jbr
Sample ID:	N-4	Test Date:	01/04/16	Checked By:	emm
Depth :	0-3.3 ft	Test Id:	359157		
Test Comment:	---				
Visual Description:	Moist, pale brown sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	4.5	94.2	1.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	99		
#4	4.75	95		
#10	2.00	92		
#18	1.00	84		
#35	0.50	44		
#60	0.25	8		
#120	0.12	2		
#200	0.075	1.3		
#230	0.063	1		

Coefficients

D_{85} = 1.0677 mm	D_{30} = 0.3837 mm
D_{60} = 0.6607 mm	D_{15} = 0.2872 mm
D_{50} = 0.5568 mm	D_{10} = 0.2607 mm
C_u = 2.534	C_c = 0.855

Classification

ASTM: Poorly graded sand (SP)

AASHTO: Stone Fragments, Gravel and Sand (A-1-b (1))

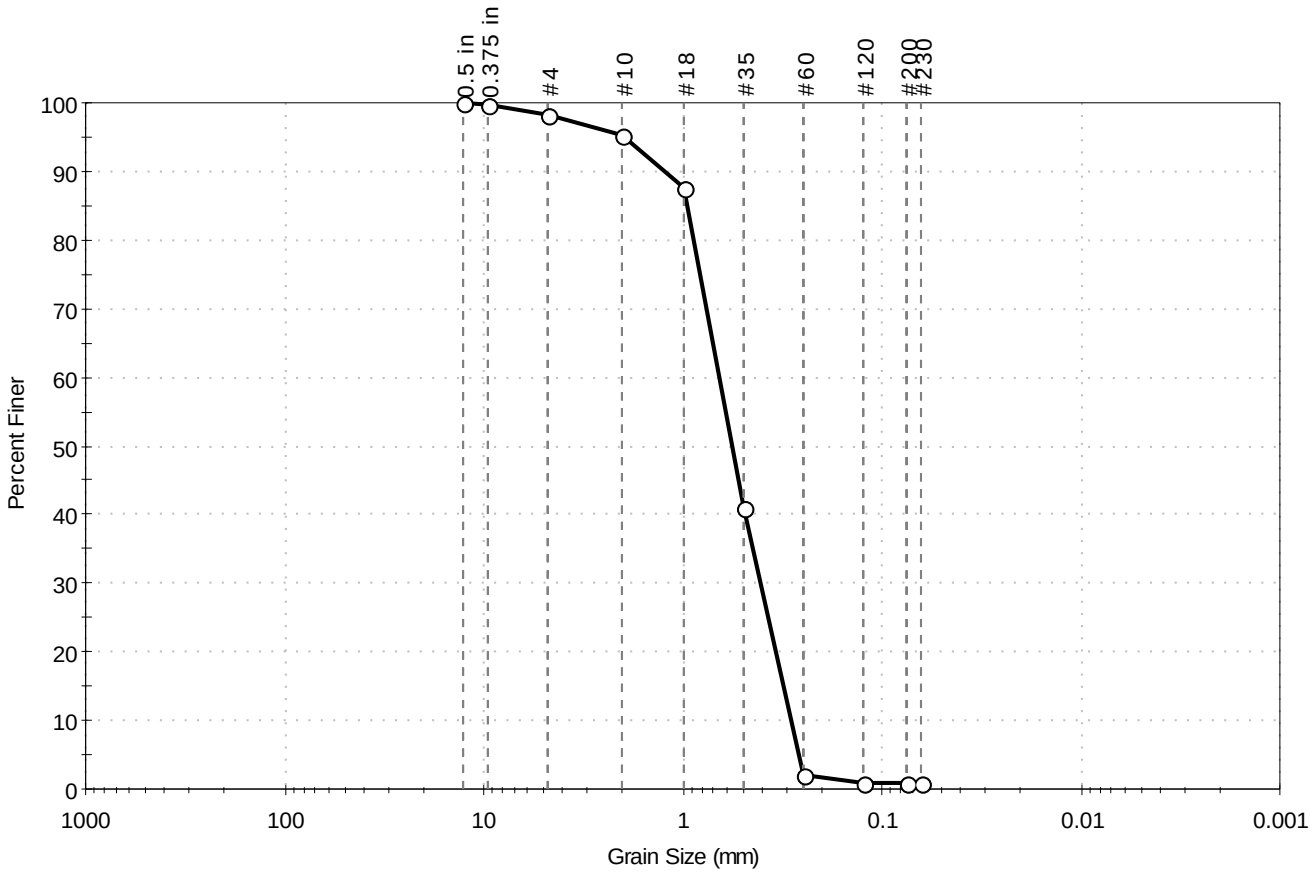
Sample / Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

Client:	Woods Hole Group				
Project:	Orleans Nauset Estuary				
Location:	Nauset Inlet, MA			Project No:	GTX-304172
Boring ID:	2015-0121	Sample Type:	bag	Tested By:	jbr
Sample ID:	N-5	Test Date:	12/31/15	Checked By:	emm
Depth :	0-4.5 ft	Test Id:	359158		
Test Comment:	---				
Visual Description:	Moist, pale brown sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	1.9	97.3	0.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.70	100		
0.375 in	9.50	100		
#4	4.75	98		
#10	2.00	95		
#18	1.00	88		
#35	0.50	41		
#60	0.25	2		
#120	0.12	1		
#200	0.075	0.8		
#230	0.063	1		

Coefficients

D_{85} = 0.9623 mm	D_{30} = 0.4121 mm
D_{60} = 0.6642 mm	D_{15} = 0.3155 mm
D_{50} = 0.5726 mm	D_{10} = 0.2886 mm
C_u = 2.301	C_c = 0.886

Classification

ASTM — Poorly graded sand (SP)

AASHTO — Stone Fragments, Gravel and Sand (A-1-b (1))

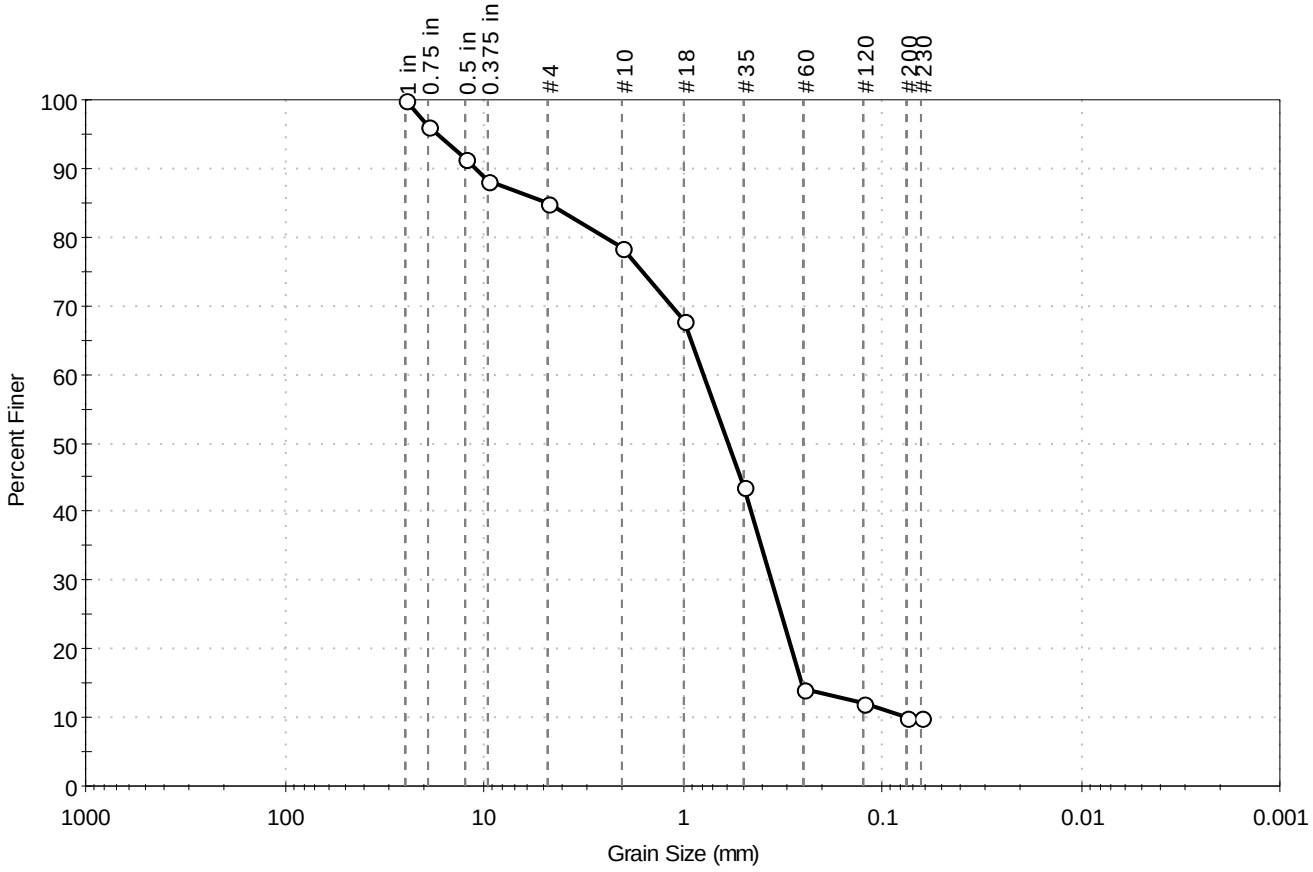
Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Client:	Woods Hole Group				
Project:	Orleans Nauset Estuary				
Location:	Nauset Inlet, MA			Project No:	GTX-304172
Boring ID:	2015-0121	Sample Type:	bag	Tested By:	jbr
Sample ID:	N-5	Test Date:	01/04/16	Checked By:	emm
Depth :	4.56-4.84 ft	Test Id:	359159		
Test Comment:	---				
Visual Description:	Moist, brown sand with silt and gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	15.0	74.9	10.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	96		
0.5 in	12.50	91		
0.375 in	9.50	88		
#4	4.75	85		
#10	2.00	78		
#18	1.00	68		
#35	0.50	44		
#60	0.25	14		
#120	0.12	12		
#200	0.075	10		
#230	0.063	10		

Coefficients

D_{85} = 4.7159 mm
D_{30} = 0.3619 mm
D_{60} = 0.7966 mm
D_{15} = 0.2543 mm
D_{50} = 0.5982 mm
D_{10} = N/A
C_u = N/A
C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

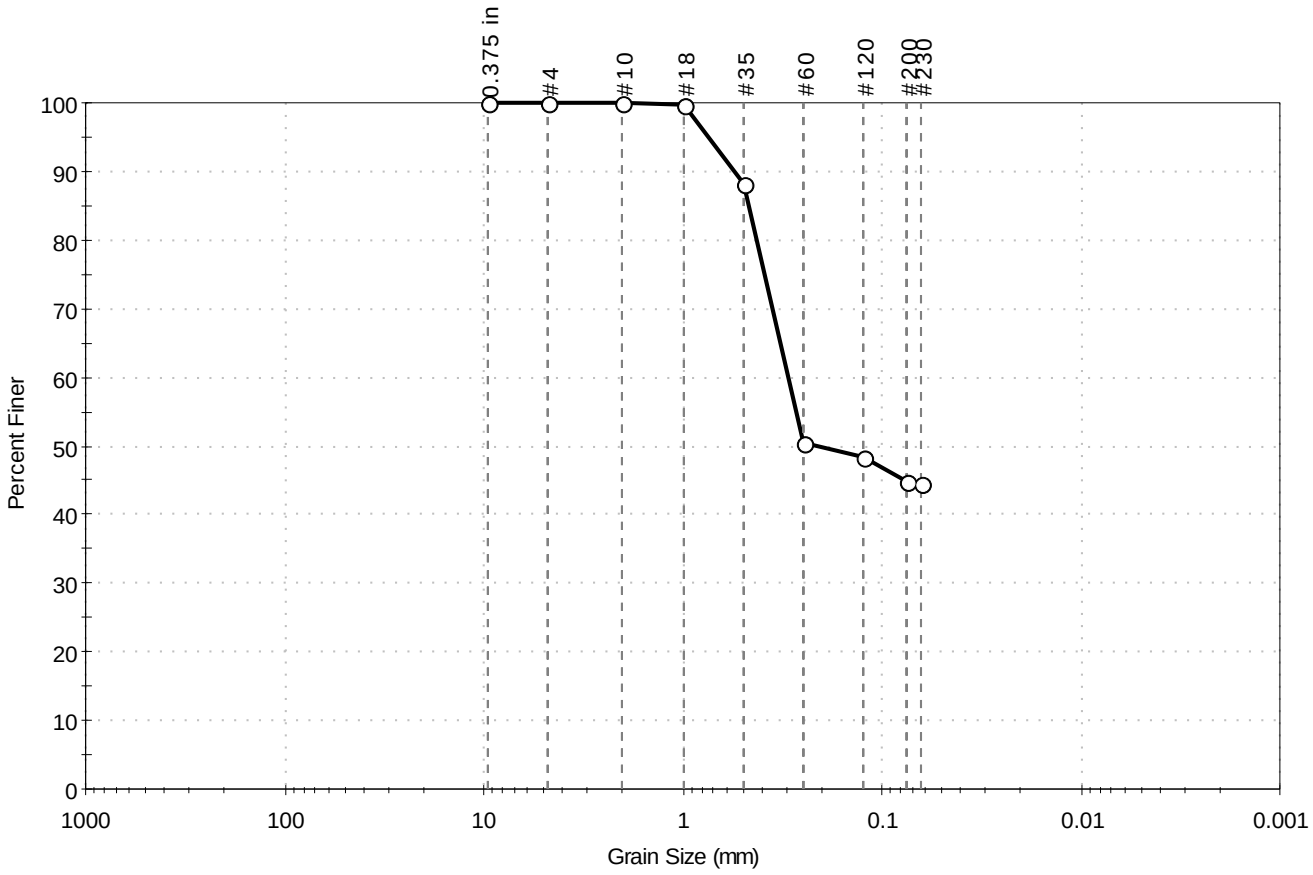
Sample / Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

Client:	Woods Hole Group				
Project:	Orleans Nauset Estuary				
Location:	Nauset Inlet, MA			Project No:	GTX-304172
Boring ID:	2015-0121	Sample Type:	bag	Tested By:	jbr
Sample ID:	N-6	Test Date:	01/04/16	Checked By:	emm
Depth :	0.2-0.6 ft	Test Id:	359161		
Test Comment:	---				
Visual Description:	Moist, olive silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



%Cobble	%Gravel	%Sand	%Silt & Clay Size
---	0.0	55.3	44.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	100		
#18	1.00	100		
#35	0.50	88		
#60	0.25	51		
#120	0.12	48		
#200	0.075	45		
#230	0.063	44		

Coefficients

D_{85} = 0.4722 mm D_{30} = N/A

D_{60} = 0.2978 mm D_{15} = N/A

D_{50} = 0.2097 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

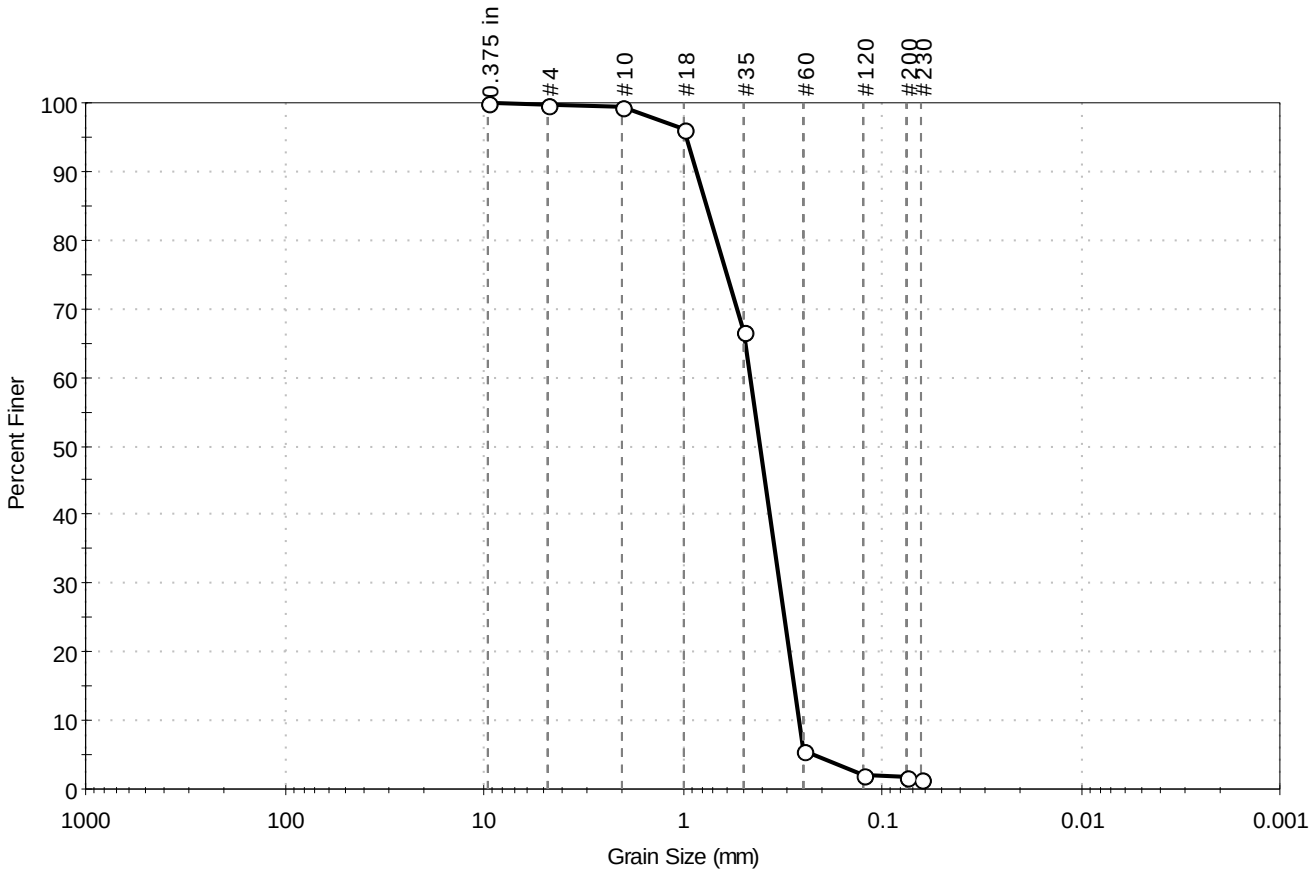
Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Client:	Woods Hole Group				
Project:	Orleans Nauset Estuary				
Location:	Nauset Inlet, MA			Project No:	GTX-304172
Boring ID:	2015-0121	Sample Type:	bag	Tested By:	jbr
Sample ID:	N-6	Test Date:	01/04/16	Checked By:	emm
Depth :	0.9-3.24 ft	Test Id:	359160		
Test Comment:	---				
Visual Description:	Moist, gray sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.2	98.2	1.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	99		
#18	1.00	96		
#35	0.50	67		
#60	0.25	6		
#120	0.12	2		
#200	0.075	1.6		
#230	0.063	2		

Coefficients

D_{85} = 0.7699 mm	D_{30} = 0.3297 mm
D_{60} = 0.4637 mm	D_{15} = 0.2780 mm
D_{50} = 0.4139 mm	D_{10} = 0.2627 mm
C_u = 1.765	C_c = 0.892

Classification

ASTM Poorly graded sand (SP)

AASHTO Stone Fragments, Gravel and Sand (A-1-b (1))

Sample / Test Description

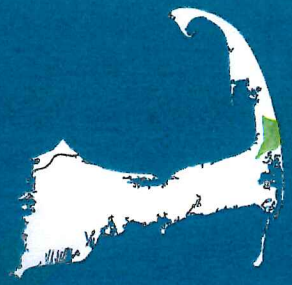
Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

WATERSHED REPORT: LOWER CAPE

Nauset Harbor

ORLEANS & EASTHAM



WATER THREAT LEVEL

HIGH

The Nauset Harbor estuary and embayment system is located in the Towns of Eastham and Orleans. It is comprised primarily of two segments - Town Cove and Nauset Marsh. Sub-systems include Salt Pond, Nauset Bay, Woods Cove, and Mill Pond, which contribute to Nauset Marsh and Nauset Stream, and Rachel Cove, which contribute to Town Cove. The estuary supports a variety of recreational uses including boating, swimming, shell fishing and fin fishing.

The Problem

According to the Massachusetts Estuaries Project (MEP) technical report (available at www.oceanscience.net/estuaries), the nitrogen load from the watershed exceeds the threshold for Nauset Harbor, resulting in impaired water quality. A Total Maximum Daily Load (TMDL) for nitrogen has not yet been established.

- **MEP TECHNICAL REPORT STATUS:** Final
- **TMDL STATUS:** In Progress
- **TOTAL WASTEWATER FLOW:** 180.2 MGY (million gal per year)
  - Treated Wastewater Flow: 4.2 MGY
  - Septic Flow: 176 MGY
- **UNATTENUATED TOTAL NITROGEN LOAD (MEP):** 27,891 Kg/Y (kilograms per year)
- **ATTENUATED TOTAL NITROGEN LOAD (MEP):** 26,080 Kg/Y
- **SOURCES OF CONTROLLABLE NITROGEN (MEP):**

Nauset Marsh
- 83% Septic Systems
- 6% Lawn Fertilizer
- 9% Stormwater from Impervious Surfaces
- 2% Landfill

Town Cove
- 86% Septic Systems
- 5% Lawn Fertilizer
- 8% Stormwater from Impervious Surfaces
- 1% Landfill

Salt Pond
- 72% Septic Systems
- 6% Lawn Fertilizer
- 9% Stormwater from Impervious Surfaces
- 13% Landfill

CONTRIBUTING TOWNS

Percent contributions listed below are the aggregate sub-embayment contributions identified in Appendix 8C of the Cape Cod Section 208 Plan Update (contributions are based on attenuated load where available). See Appendix 8C for detailed town allocations by sub-embayment. A portion of the land area in this watershed is within the boundaries of the Cape Cod National Seashore and any nitrogen load that results from Seashore controlled property is not within control of the towns.

- **ORLEANS:** 53%
- **EASTHAM:** 47%
- **BREWSTER:** <1%

Under existing conditions, the load contributed is so small that reductions are not necessary at this time; however, growth management measures should be taken to ensure

that the contribution does not increase. Contributions will be reevaluated at least every five years, based on updated data.

THE MEP RESTORATION SCENARIO

- **WATERSHED TOTAL NITROGEN REDUCTION TARGET:** 47%
- **WATERSHED SEPTIC REDUCTION TARGET:** 55% (The scenario represents the aggregated sub-embayment percent removal targets from the MEP technical report)

NAUSET HARBOR ESTUARY

- **EMBAYMENT AREA:** 1,513 acres
- **EMBAYMENT VOLUME:** 596 million cubic feet
- **2014 INTEGRATED LIST STATUS:** Category 2
  - Category 2: Attaining some uses; other uses not assessed
  - www.mass.gov/eea/docs/dep/water/resources/07v5/14list2.pdf

NAUSET HARBOR WATERSHED

- **ACRES:** 4,751
- **PARCELS:** 3,276
- **% DEVELOPED RESIDENTIAL PARCELS:** 78%
- **PARCEL DENSITY:** 1.5 acres per parcel (approx.)
- **WASTEWATER TREATMENT FACILITIES:** 1
  - Small commercial facility serving Salt Pond, Eastham area

Freshwater Sources

PONDS

- **IDENTIFIED SURFACE WATERS:** 34
- **NUMBER OF NAMED FRESHWATER PONDS:** 9
- **PONDS WITH PRELIMINARY TROPHIC CHARACTERIZATION:** 9
- **2014 INTEGRATED LIST STATUS:** None listed

The Nauset Harbor watershed shares Baker and Cliff ponds with the Pleasant Bay watershed. The Towns of Eastham and Orleans have benefited from Barnstable County funded ponds assessments through the Cape Cod Commission and the School of Marine Science and Technology (SMAST) at UMASS Dartmouth. Orleans has an active citizens group, the Orleans Ponds Coalition, that provides sampling, education and advocacy. Eastham also has an active Water Quality Advisory Board that coordinates freshwater pond assessment and restoration efforts.

Eastham and Orleans have participated in the Pond and Lake Stewardship (PALS) program that has helped establish baseline water quality. Trophic characterizations are based on most recent Commission staff assessment.

STREAMS

- **SIGNIFICANT FRESHWATER STREAM OUTLETS:** 1

  Nauset Stream:
  - Average Flow: 1,871 cubic meters per day (m3/d)
  - Average Nitrate Concentrations: 0.15 milligrams per liter (mg/L)

Due to the highly permeable soils present in the Nauset Marsh and Town Cove estuaries the majority of freshwater contributions are from groundwater discharge. Nitrate concentrations higher than 0.05 mg/L background concentrations, evident in public supply wells located in pristine areas, provide evidence of the impact of non-point source pollution on the aquifer and receiving coastal water bodies.

DRINKING WATER SOURCES

- **WATER DISTRICTS:** 1
  - Orleans Water Department
- **GRAVEL PACKED WELLS:** 0
- **SMALL VOLUME WELLS:** 40

Orleans provides public water to a small number of Eastham properties. Eastham is primarily served by private wells. A municipal system is in development for a portion of town.

Degree of Impairment and Areas of Need

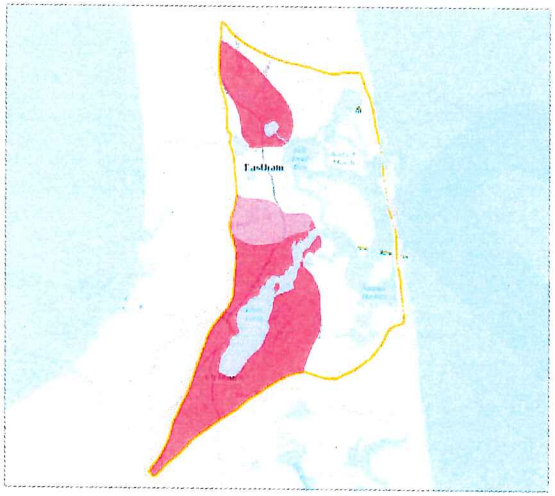
For the purposes of the Section 208 Plan Update areas of need are primarily defined by the amount of nitrogen reduction required as defined by the TMDL and/or MEP technical report. These are listed above as 47% of the total load and 55% of the septic load and, more specifically, as the targeted amount of nitrogen reduction required by subwatershed, as shown in the Subwatersheds with Total Nitrogen Removal Targets figure and Subwatersheds with Septic Nitrogen Removal Targets figure. Subwatershed removals range from 75% for Town Cove (as depicted by the polygon in the lower portion of the Septic

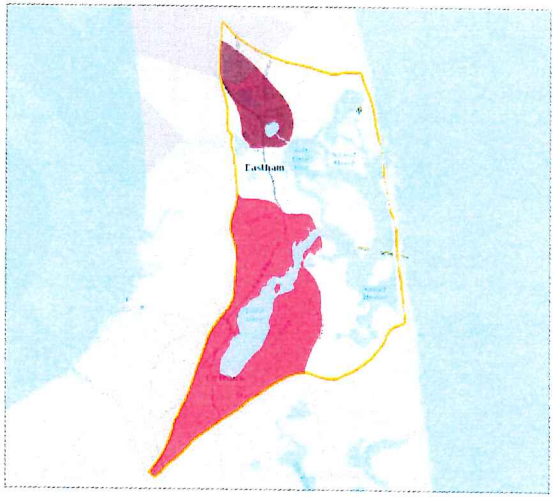
Nitrogen Removal Targets figure) to 100% for Salt Pond (as depicted by the polygon in the upper portion of the Septic Nitrogen Removal Targets figure).

The nitrogen load from the watershed exceeds the threshold for Nauset Harbor, resulting in impaired water quality. The upper head waters are particularly impaired. Although the lower portions of the embayment are healthy, due to the severe conditions of the upper headwaters, the Nauset Harbor system is categorized as significantly impaired. The ecological health of a water body is determined from water quality, extent of eelgrass, assortment of benthic fauna, and dissolved oxygen and ranges from 1-severe degradation, 2-significantly impaired, 3-moderately impaired, 4- healthy habitat conditions.

MEP ECOLOGICAL CHARACTERISTICS AND WATER QUALITY

- **OVERALL ECOLOGIC CONDITION:** Healthy to Significantly Impaired
- **NAUSET MARSH**
- **NAUSET MARSH:** Healthy
- **NAUSET BAY:** Healthy
- **SALT POND BAY:** Significantly Impaired
- **TOWN COVE:** Significantly Impaired
- **SALT POND:** Significantly Impaired
- **WOOD COVE:** Significantly Impaired
- **MILL POND:** Significantly Impaired
- **SENTINEL STATION:**
  - Total Nitrogen Concentration Threshold: 0.45 mg/L
  - Total Nitrogen Concentration Existing: 0.53 mg/L (As reported at the MEP sentinel water-quality monitoring station)





0.1% - 9%
9.1% - 38%
38.1% - 62%
62.1% - 86%
86.1% - 100%

Subwatersheds with Total Watershed Removal Targets

(Left) Benthic and atmospheric loads directly on embayments are not included.

Subwatersheds with Septic Nitrogen Removal Targets

(Right)

Collection & Non-Collection Scenarios

Regional Data

In 2010, the Commission sought to collect regionally consistent data for the purposes of watershed scenario development. Both parcel data and water use data was identified and collected for the entire region. While the scientific basis for planning is the thresholds identified in the MEP technical reports, each report uses data from different years, and in some cases the MEP data used is 10 or more years old. In addition, there are watersheds on Cape Cod without the benefit of an MEP report; therefore, similar data was not available for planning purposes.

The updated regional data set was used to estimate wastewater, stormwater and fertilizer loads, using the same methodologies as the MEP. This approach allows for a reevaluation of existing development, which may have changed in the last 10 years. Parcel data included in the regional database is from 2010-2012 and water use data is from 2008-2011, depending on the water district. This approach allows for regionally consistent watershed scenario development.

Watershed Scenarios

The watershed scenarios that follow outline possibilities for the watershed. A series of non-traditional technologies that might be applicable are included, as well as the amount of flow and approximate number of residential parcels that would need to be collected if a traditional collection system and treatment facility was implemented. Some assumptions were made in determining the approximate flows and parcels for collection, including a treatment factor of 5 parts per million (ppm), disposal occurring inside the watershed, and no natural attenuation, therefore prioritizing parcels with a direct impact on the water body. Site specific determinations of collection areas may result in the need to collect more or less parcels to meet the nutrient reduction target. The scenarios presented are meant to act as a starting point for discussions regarding effective and cost efficient solutions.

In Nauset Harbor, the Towns of Orleans and Eastham have done additional and more detailed planning. Included in the last section of this report is a description of their efforts, along with details of plans developed to date.

NAUSET HARBOR NITROGEN SOURCES	TOTAL NITROGEN LOAD (kg-N/yr)
Wastewater	15,706
Fertilizer	1,334
Stormwater	3,290
Other	1,123
TOTAL	21,454
Total Watershed Load (including atmospheric)	21,454
Total Watershed Threshold	10,333
TOTAL LOAD TO BE REMOVED	11,121

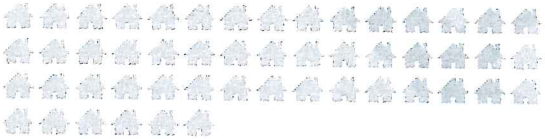
Collection & Non-Collection Scenarios

Non-Collection

- 25 % Nitrogen Reduction - Fertilizer Management
- 25 % Nitrogen Reduction - Stormwater Mitigation
- 3,750 Linear Feet - Permeable Reactive Barrier (PRB)
- 38 Acres - Fertigation - Turf
- 7 Acres - Aquaculture/Oyster Beds
- 2,250 Square Feet - Floating Constructed Wetlands
- 356 Units - Ecotoilets (UD & Compost)
- 2,248 People Per Year - UD School or Public Facility
- 536 Units - I & A Systems
- 303 Units - Enhanced I & A Systems

Collection

DEVELOPED RESIDENTIAL PARCELS IN WATERSHED



RESIDENTIAL EQUIVALENTS NECESSARY TO MEET NITROGEN REDUCTION TARGET VIA COLLECTION

= 50 Residential Parcels

2,631	378,814
Residential Equivalents Necessary to Meet Nitrogen Reduction Target	Flow Collected (gpd)

SCENARIO ASSUMPTIONS: Assumes treatment to 5 parts per million (ppm) nitrogen. Assumes disposal occurs inside the watershed. In this watershed, reduction targets may not be met with disposal inside the watershed. Assumes no natural attenuation; therefore, prioritizing parcels with a direct impact on the water body.

Town of Eastham Local Progress

The Town of Eastham completed a town-wide needs assessment in March 2009. The needs assessment concluded that a new public water supply system to protect public health was an overriding concern.

The spring 2014 Town Meeting approved $45.8 million to fund a scaled back version of the full town-wide water system. The Cape Cod Commission approved this project as a Development of Regional Impact (DRI) in February 2015.

In May 2015 Eastham staff, along with their consultant (GHD), met with Commission staff to discuss the 208 planning process, decision support tools, and scenario development for their watersheds, the beginnings of a shift toward wastewater planning after a necessary focus on securing a clean drinking water supply for residents.

Eastham shares the watershed to the Nauset estuary with the Town of Orleans and is willing to have further discussions about potential opportunities to share the wastewater treatment facility proposed in the approved Orleans Comprehensive Wastewater Management Plan (CWMP). The town has sent a representative to each of the Orleans Water Quality Advisory Panel meetings, as they discussed potential scenarios in 2014 and early 2015. The Town of Eastham is actively pursuing the protection and restoration of its freshwater ponds. The town completed a town-wide assessment and is pursuing in-pond restoration efforts. Alum treatments for Herring Pond and Great Pond are complete and others are under consideration.

In the fall of 2014, Eastham adopted local nitrogen-oriented fertilizer management regulations consistent with the Cape-wide Fertilizer Management District of Critical Planning Concern (DCPC).

Eastham is a member of the Orleans, Brewster and Eastham Ground Water Protection District which, until June 1, 2016, operated the Tri-Town Septage Treatment Facility in Orleans. The member towns voted to decommission and remove the facility, which is expected to take place in 2017.

In addition, Eastham staff are working with the Commission and the Cape Cod National Seashore on a number of other projects to address nitrogen in their watersheds. The Commission is assisting the town to modify a design for stormwater management along Route 6 and to conduct hydrogeologic modeling at a previously identified site for a permeable reactive barrier.

Eastham submitted conceptual watershed scenarios based on discussions with the Commission, use of available decision support tools, and ongoing local water quality planning efforts. Those scenarios are included in this report.

Town of Eastham Watershed Scenario Details

The Eastham approach for nitrogen management for Nauset Harbor Embayment System focuses on the Town Cove and Salt Pond subwatersheds which include:

- Town Cove, including: Town Cove; Mary Chase Gauge; and Nauset Stream
- Salt Pond, including: Salt Pond; Ministers Pond; and Depot Pond

The following management approaches are based on the Draft Technical Memorandum No. 3 for Salt Pond and the Draft Technical Memorandum No. 4 for Town Cove currently under development for the Town of Eastham (References 1 and 2 respectively). These technical memorandums on Eastham's hybrid evaluations for these two subwatersheds are being developed as part of the Town's wastewater planning efforts. As these efforts are currently under development, the findings have not been completed and therefore the Town has not formally accepted any findings. The following information presents the approaches that are currently being considered and evaluated for economic viability. At this time no costs are being presented until the Town has the opportunity to comment on the proposed hybrid approaches and the two above referenced technical memorandums are finalized. Approaches identified below are based on updates to the Town's Interim Needs Assessment Report and Alternatives Screening Analysis report summarized in Technical Memorandums 1 and 2 (References 7 and 8).

In addition, the Town of Eastham has the following regulations in place to manage nitrogen in Town that are considered part of any alternative or hybrid approach:

- Fertilizer Bylaw: the Town of Eastham voted to adopt a Board of Health regulation on the content and application of fertilizer to turf on November 20, 2014 (see Reference 4). This regulation incorporates current Best Management Practices, which are deemed essential in this effort to protect the public health and aid in achieving compliance with the Total Maximum Daily Loads (TMDL) for the Towns water resources prescribed by the Commonwealth of Massachusetts while allowing reasonable use of fertilizers for the enhancement of turf quality.
- Board of Health Regulations: requirements for Nitrogen Reducing Septic Systems in Environmentally Sensitive Areas (see Reference 5). The use of nitrogen-reducing septic systems is required as a condition of any of the following variances in any lot determined to be an environmentally sensitive area:
  - Less than 100 feet separation distance exists between a drinking water supply well and a soil absorption system
  - Soil absorption system is located less than 100 feet from a salt marsh or any marine surface water, or fresh surface water body
  - When the lot is defined an environmentally sensitive area any setback reduction is requested
  - Distance to adjusted high groundwater is less than 5 feet
- Massachusetts Estuaries Project at Nauset Estuary: The Towns of Eastham and Orleans are working together to expand water quality monitoring for Nauset Estuary. Over the next three years, Eastham and Orleans will collect water samples from 15 stations in order to provide current water quality data. The data will be used to recalibrate or update the Massachusetts Estuary Program Model.
- Public Education Newsletter: updates to the Town's wastewater management planning efforts are posted on the Town's website and available at Town Hall (see Reference 6). Another newsletter that is planned to update the public will discuss the hybrid evaluations and watershed reports.

Town of Eastham Watershed Scenario Details Continued

Traditional Approach (Eastham Focus)

The following information is based on the Draft Hybrid Evaluations currently under development for Salt Pond and Town Cove. These evaluations have not been finalized, and therefore the approaches outlined below are subject to change based on the final recommendations and Town decision-making process.

SALT POND

Several "Traditional Approaches" were evaluated and considered several different levels of sewering and recharge, such as:

- Cape Cod Commission "Bookend Evaluation", with wastewater collected and then recharged inside/outside the watershed representing an 81% nitrogen removal.
- Modified traditional "Bookend Evaluation" to address Ministers Pond and representing a 95% nitrogen removal, likely in conjunction with a regional facility within the Town of Orleans, Ma.
- Recharge within the Salt Pond watershed, representing a 100% nitrogen removal. However, for the purpose of this document, recharge within the Salt Pond watershed was considered the most feasible option based on the state of the Town of Orleans planning efforts focused on a reduced wastewater treatment facility footprint and limited recharge capacity.

TOWN COVE

Several "Traditional Approaches" were evaluated and considered several different levels of sewering and recharge, such as:

- Cape Cod Commission "Bookend Evaluation", with wastewater collected and then recharged inside the watershed representing an 81% nitrogen removal.
- Wastewater treatment as part of the Salt Pond approach
- Regional solution of an Eastham collection system with treatment at the Town of Orleans proposed wastewater treatment facility if capacity is available and an agreement between the Towns could be developed.

Any sewering done in the upper reaches of the Town Cove watershed should be evaluated in combination with what is done with the Salt Pond subwatershed.

Refer to References 1 and 2 for additional detail on both Salt Pond and Town Cove traditional approaches.

Non-Traditional Approach (Estuary Focus)

The Cape Cod Commission developed two possible approaches outlined below, however neither approach was specific enough to the Eastham portions of Town Cove or Salt Pond and therefore are not considered further. Non-traditional approaches are included as part of the draft hybrid approaches being developed to manage nitrogen in these specific watersheds as discussed in the Hybrid Approach section below.

APPROACH 1 NON-TRADITIONAL BOOKEND

- 50% fertilizer nitrogen load reduction
- 50% stormwater nitrogen load reduction
- 3.1 miles of Permeable Reactive Barrier
- 10 acres of fertigation
- 5 acres of aquaculture/oyster beds
- 2,500 cubic feet of floating constructed wetlands
- 27 homes with ecotoilets
- Urine diversion toilets to serve 402 people
- 60 residential I/A systems
- 3 residential advanced I/A systems

Town of Eastham Watershed Scenario Details Continued

APPROACH 2 NON-TRADITIONAL BOOKEND

- 25% fertilizer nitrogen load reduction
- 25% stormwater nitrogen load reduction
- 3.1 miles of Permeable Reactive Barrier
- 10 acres of fertigation
- 5 acres of aquaculture/oyster beds
- 3 acres of coastal habitat restoration
- 2,500 cubic feet of floating constructed wetlands
- 67 homes with ecotoilets
- Urine diversion toilets to serve 556 people
- 46 residential I/A systems

Refer to References 1 and 2 for additional detail on both Non-Traditional Bookends

Hybrid Approach (Eastham Focus)

The following information is based on the Draft Hybrid Evaluations currently under development for Salt Pond and Town Cove. These evaluations have not been finalized, and therefore the approaches outlined below are subject to change based on the final recommendations and Town decision making process.

SALT POND

Two hybrid approaches were identified for Salt Pond and are summarized in the following subsections.

SALT POND HYBRID 1

This approach includes the following:

- 2,300 linear feet of PRB located at the Cape Cod National Seashore (CCNS) Salt Pond Visitor Center site
- Shellfish propagation within Salt Pond approximately 10 – 17 acres of shellfish bed required to support 2 to 3.5 million shellfish (oysters or quahogs respectively)
- Fertilizer and stormwater reductions of approximately 20% of the nitrogen load from these sources.
- Upgrade of the CCNS On-site treatment system

SALT POND HYBRID 2

This approach includes the following:

- Construction of a small collection system and treatment facility with recharge within the watershed to service approximately 180 properties.
- 2,300 linear feet of PRB located at the CCNS Salt Pond Visitor Center site
- Shellfish propagation within Salt Pond approximately 1 to 2 acres of shellfish bed required to support between 200,000 and 340,000 shellfish (oysters or quahogs respectively).
- Fertilizer and stormwater reductions of approximately 20% of the nitrogen load from these sources.

TOWN COVE

Four hybrid approaches were identified for Town Cove and are summarized in the following subsections.

TOWN COVE HYBRID 1A

This approach is outlined as follows:

- Shellfish propagation within Town Cove approximately 10 – 17 acres of shellfish bed required to support 2 to 3.5 million shellfish (oysters or quahogs respectively)
- Fertilizer and stormwater reductions of approximately 20% of the nitrogen load from these sources.
- Up to 40 individual I/A systems – likely located adjacent to Town Cove

TOWN COVE HYBRID 1B

This approach is outlined as follows:

- Shellfish propagation within Town Cove approximately 5 – 9 acres of shellfish bed required to support 1 to 1.7 million shellfish (oysters or quahogs respectively)
- Fertilizer and stormwater reductions of approximately 20% of the nitrogen load from these sources.
- Up to 170 individual I/A systems – likely located between Route 6 and Town Cove

Town of Eastham Watershed Scenario Details Continued

TOWN COVE HYBRID 2A

This approach is outlined as follows:

- Wastewater collection system for approximately 200 properties within the Town Cove subwatershed with recharge outside of the watershed but within the Town of Eastham's boundaries or to a regional facility in Orleans.
- Shellfish propagation within Town Cove approximately 1.2 to 2.0 acres of shellfish bed required to support between 240,000 and 400,000 shellfish (oysters or quahogs respectively).
- Fertilizer and stormwater reductions of approximately 20% of the nitrogen load from these sources.

TOWN COVE HYBRID 2B

This approach could include the following:

- Wastewater collection system for approximately all the properties within Mary Chase Gauge and Nauset Stream subwatersheds (approximately 280 properties) with recharge outside of the watershed to an in Eastham option.
- Wastewater collection system for approximately 30 properties in the Nauset Marsh subwatershed (located along Route 6) to offset removal needs from the Town Cove subwatershed.
- Wastewater collection system for approximately 180 properties in the Salt Pond subwatershed (in place of the Salt Pond only hybrid approaches).
- Fertilizer and stormwater reductions of approximately 20% of the nitrogen loads from these sources from Mary Chase Gauge, Nauset Stream, Town Cove and Salt Pond subwatersheds.
- Shellfish propagation within Town Cove approximately 5.4 to 9 acres of shellfish bed required to support between 1.1 to 1.8 million shellfish (oysters or quahogs respectively).

For the hybrid evaluations listed above, nitrogen management approaches may adjust prior to or during implementation through the adaptive management process. Therefore, the distribution of technologies may shift as the Town selects the most appropriate solutions.

Additional detail on hybrid approaches for both Salt Pond and Town Cove will be available upon completion of the draft documents cited as References 1 and 2.

References

1. DRAFT Technical Memorandum No. 3 – Initial Hybrid Approach for Salt Pond (currently under development)
2. DRAFT Technical Memorandum No. 4 – Initial Hybrid Approach for Town Cove (currently under development)
3. Cape Cod Commission, Cape Cod Area Wide Water Quality Management Plan Update, Appendix 5B, Watershed Summary for Boat Meadow River, June 2015.
4. Town of Eastham, Massachusetts Fertilizer Bylaw, Approved 11/2014, http://www.easthamma.gov/Public_Documents/EasthamMA_Health/FertalizerRegulation/
5. Town Eastham Board of Health Regulations, Section I.E. Environmentally Sensitive Area, http://www.easthamma.gov/Public_Documents/EasthamMA_Health/healthinfo/BOHRegulations2014.pdf
6. Public Outreach Newsletter – "Wastewater Management Planning Project – Newsletter" Spring 2016
7. Technical Memorandum No. 1 – Update to Wastewater and Nitrogen Management Needs Assessment; GHD Inc.; February 10, 2015
8. Technical Memorandum No. 2 – Update to Wastewater and Nitrogen Management Alternatives Screening Analysis; GHD Inc.; February 10, 2015

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Town of Orleans Local Progress

The Orleans Comprehensive Wastewater Management Plan (CWMP) was approved by the Massachusetts Environmental Policy Act (MEPA) Unit and the Cape Cod Commission in 2011 and provides a strategy for wastewater management to achieve reductions of its share of nitrogen loading to restore and protect Orleans's coastal embayments. The CWMP also addresses freshwater ponds and areas with septic system problems associated with frequent pumping, intensity of use and mounded systems. It provides modest capacity for expanded residential housing in the commercial district and includes an adaptive management approach for its implementation.

The town received its MEPA certificate on the Final Environmental Impact Review (FEIR) and a Development of Regional Impact (DRI) approval in 2011. The town has since engaged independent consultants to review the use of alternative sewer collection technologies and the Massachusetts Estuaries Project findings about the Nauset Marsh. The town received significant input from the community as the board of selectmen considers its appropriate next steps.

The town appropriated $1.045 million at the spring 2014 Town Meeting for engineering, planning and hydrogeologic studies necessary for the development of septage, wastewater, groundwater and stormwater management plans needed to maintain and protect the water resources of the town by integrating the CWMP with a new Adaptive Management Plan and components of the Cape-wide Section 208 Water Quality Management Plan.

The town established a Water Quality Advisory Panel (WQAP) that included diverse representation and professional facilitation, consistent with the 208 planning process. The WQAP established a consensus plan for moving forward that includes reduction, remediation, and restoration strategies and is expected to achieve a 40% cost savings over the original CWMP. In 2015, Town Meeting appropriated an additional $1 million to further investigate potential disposal sites and locations for innovative remediation and restoration solutions identified in the consensus plan. Those investigations are underway. An additional $691,000 was approved by voters in May 2016 to fund an Amended Water Quality Management Plan and associated Adaptive Management Plan. Development of those plans are in progress.

Orleans is a member of the Orleans, Brewster and Eastham Ground Water Protection District which, until June 1, 2016, operated the Tri-Town Septage Treatment Facility in Orleans. The member towns voted to decommission and remove the facility, which is expected to take place in 2017. In addition, the town is working with neighboring towns through the Pleasant Bay Alliance.

In the fall of 2014, Orleans added phosphorus to its local fertilizer management regulations consistent with the Cape-wide Fertilizer Management District of Critical Planning Concern (DCPC).

Orleans requested that the Commission use the consensus plan scenarios as its watershed report submission.

In June 2016, Orleans received $15,000 from the Commission for implementation of shellfish/aquaculture demonstration project in Lonnie's Pond. Funding was part of $142,149 in local grants made by the Commission in support of 208 Plan implementation.

Town of Orleans Watershed Scenario Details

Nauset Harbor	CREDITS		REDUCTION TECHNOLOGIES			REMEDIATION AND RESTORATION TECHNOLOGIES			REMOVAL
NAME OF TECHNOLOGY	% Nitrogen Reduction	Load Reduction (kg-N/yr)	# Properties / Units	Flow Collected (gpd)	Load Reduction (kg-N/yr)	# Units Proposed	Unit Metric	Load Reduction (kg-N/yr)	Total Scenario Load Reduction (kg-N/yr)
Scenario									5,239
Fertilizer Management	25%	160							
Centralized Sewer			Not Reported	63,781	3,024				
Permeable Reactive Barrier (PRB)						Not Reported		566	
Aquaculture/Oyster Beds						Not Reported		600	
Coastal Habitat Restoration						Not Reported		760	
I & A Systems			Not Reported		129				

Scenario Maps

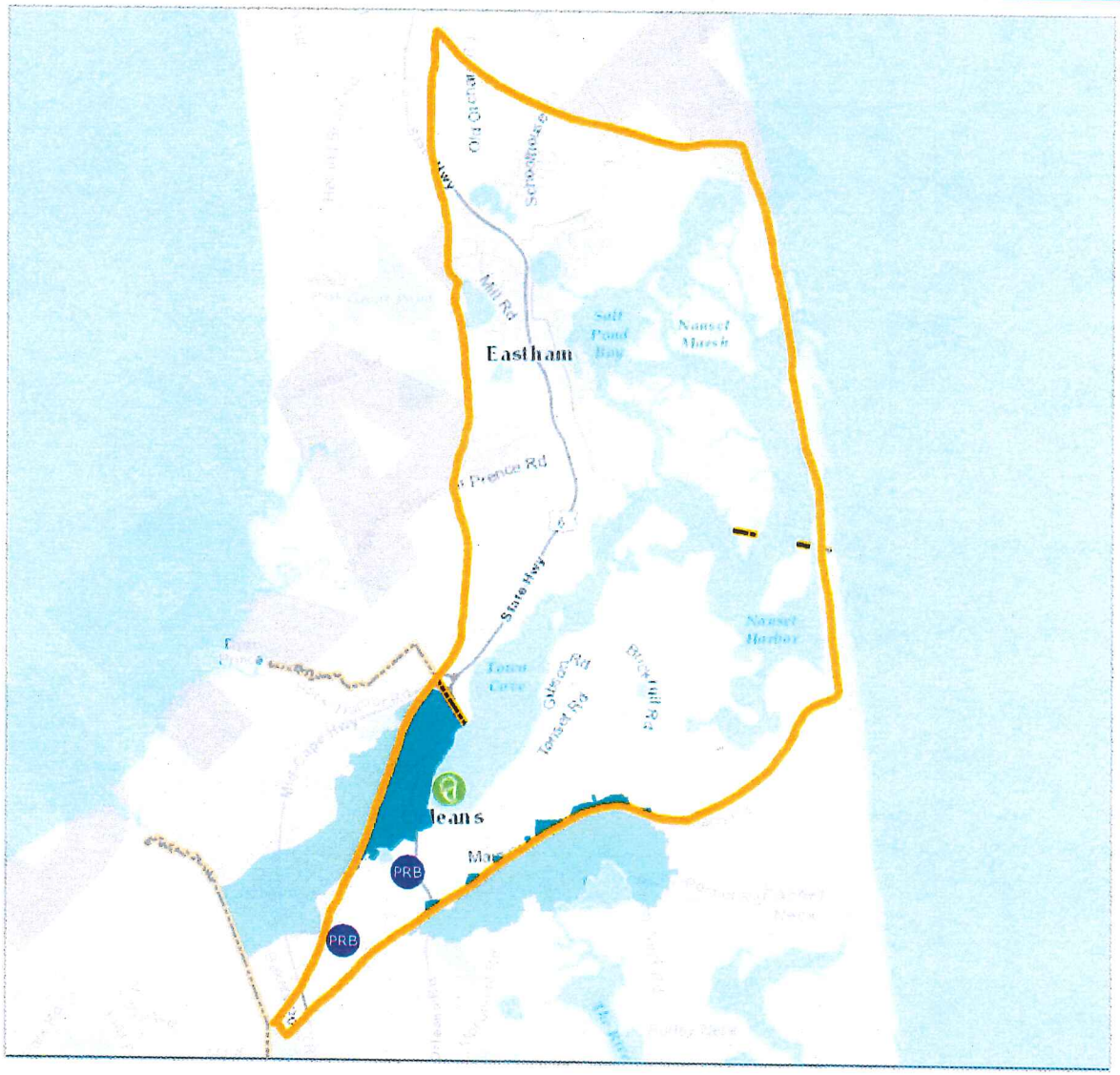
Nauset Harbor Watershed Scenario

ORLEANS

Representative locations of conceptually proposed infrastructure

Legend

- Aquaculture
- Constructed Wetland
- Eco-Toilets
- Fertigation
- Fertilizer Management
- Floating Constructed Wetlands
- I/A Toilet
- Inlet Widening
- Permeable Reactive Barrier
- PhytoRemediation
- PhytoBuffer
- Coastal Restoration
- Stormwater
- Stormwater - Bio Retention
- Stormwater Management
- Widening
- Town Lines
- Embayment Watersheds
- Proposed Sewershed
- Sewered Areas



TOWN OF EASTHAM
2500 Stare Highway, Eastham, MA 02642-2544
All departments 508-240-5900 • *Fax* 508-240-1291
www.eastham-ma.gov

II.A. 5:15 pm

TO: Board of Selectmen
FROM: Jacqui Beebe
RE: Cable Contract
DATE: 11/3/16

We currently have a ten year contract with Comcast to provide cable services in Eastham. The contract will expire in 2020. We have had continuous complaints from residents who live within the boundaries of the Seashore Park, and are unable to receive cable TV/internet services from Comcast. They are requesting that this be addressed in the next contract negotiation.

Sheila would like you to consider appointing a Cable TV License Advisory Committee to begin to work on the various issues and assist in negotiating the new contract.

TOWN OF EASTHAM
2500 Stare Highway, Eastham, MA 02642-2544
All departments 508-240-5900 • *Fax* 508-240-1291
www.eastham-ma.gov

III. A. 1.

TO: Board of Selectmen
FROM: Jacqui Beebe
RE: Conservation Restrictions
DATE: 11/3/16

The discussion/adoption of conservation restrictions for several parcels of town owned property is on the Monday night meeting agenda.

A conservation restriction, formerly known as a conservation easement, is a means authorized by Sections 31-33 of Chapter 184 of the General Laws of the Commonwealth of Massachusetts to limit the use of land in order to protect specified conservation values including the natural, scenic or open condition of the land. Both the Community Preservation Act and the Land Bank regulations require that land that is purchased with funds from the Community Preservation Fund or with Land Bank Funds shall be bound by a permanent deed restriction that meets the requirements of Chapter 184.

The CR's you will be adopting have all been before you in draft form, and were forwarded to the Open Space Committee, the Eastham Conservation Foundation, our Conservation Agent and Town Counsel for review. They are now in final form and ready for your signature.

I did not want to send all the final documents in the packet, but they are available for review on Monday, and there is no urgency if you need to take the time to review them individually next week. This is a legal formality to ensure that the properties are protected in perpetuity.

III. A. 2.

TOWN OF EASTHAM

2500 State Highway, Eastham, MA 02642
All Departments 508-240-5900
www.eastham-ma.gov

Date: November 7, 2016

Memo To: Eastham Board of Selectmen

Memo From: Laurie Gillespie-Lee

Re: **Committee Appointment**

The following and the attached is the information needed to make a committee appointment to the Affordable Housing Trust.

Carol F. Martin

If the Board appoints her, Carol Martin's first term would commence November 7, 2016 and expire June 30, 2017. She seeks to replace James McMakin whose resignation was accepted by the Board at your meeting on September 6, 2016.

III.A.3.

MEMORANDUM OF AGREEMENT
4300 STATE HIGHWAY/CAMPBELL-PURCELL PROPERTY
NOVEMBER 7, 2016

This Agreement ("Agreement") is entered into by and between Pennrose Properties, LLC, ("Pennrose"), a Pennsylvania corporation, with a usual place of business at One Brewery Park, 1301 North 31st Street, Philadelphia, PA 19121 and local place of business at 50 Milk Street, 16th Floor, Boston, MA 02109, and the Town of Eastham, a municipal corporation organized under the laws of the Commonwealth of Massachusetts, with a usual place of business at 2500 State Highway, Eastham, MA ("Town"), acting by and through its duly elected Board of Selectmen ("Board of Selectmen"), regarding the proposed long term lease of a town owned parcel, which is located at 4300 State Highway, Eastham, MA and is shown on Eastham Assessor's Map 8 as Parcels 147 and 147A, consisting of 11.2 acres ("Property"), for the development of said parcel into affordable rental housing and further to be managed by Pennrose Properties, LLC, with Pennrose, and the Town and the Board of Selectmen collectively referred to herein as the "Parties."

WHERE AS, the Town has not yet achieved and seeks to achieve the goal of ten percent affordable housing as defined under the affordable housing statute and regulations, respectively, G.L. c.40B, §§20-23 and 760 CMR 56.00;

WHERE AS, the Town, based upon the 2010 Census, has 2,632 Year Round Housing Units;

WHERE AS, the Town, as of December 5, 2014, has 50 Subsidized Housing Units ("SHI") as inventoried by the Department of Housing and Community Development ("DHCD") or 1.9% affordable housing based upon its total year round housing based upon the 2010 Census;

WHERE AS, the Town owns the Property and it is appropriate for development with affordable housing, having access to municipal water, public transportation (Flex Bus), the Cape Cod Rail Trail bike path, and adjacent commercial retail activities;

WHERE AS, the Town issued a Request for Proposals ("RFP") (Exhibit 1) that sought a developer and manager of the Property for affordable rental housing that would have a mix of units and mixed affordability requirements in relation to Area Median Income ("AMI");

WHERE AS, Pennrose responded to the RFP (Exhibit 2) and proposed to construct 65 rental units at the Property in 18 residential buildings, with 27 one-bedroom units, 31 two-bedroom units and 7 three-bedroom units for a total of 65 units, and with a mix of affordability requirements for the tenant households as stipulated in the RFP and the Project Eligibility Letter (PEL). The development shall also include 3,000 s.f. community and management facility building as contained in the RFP.

WHERE AS, the Town is willing to contribute up to $400,000 toward infrastructure costs ,specifically water service, and, potentially, the development of the internal access way infrastructure to assist with the Project;

WHERE AS, to accomplish the above goals, Pennrose is amenable to constructing, managing and maintaining an affordable rental housing project at the density and affordability limits set forth, including a projected construction start date of December 2017 and occupancy beginning December 2018;

WHERE AS, the Parties agree that cost certification shall occur as required under the DHCD Guidelines for G.L.C. 40B Comprehensive Permits dated May 2013 ("Guidelines"); and

NOW THEREFORE, based upon good and valuable consideration, the receipt of which is hereby acknowledged by the Parties, Pennrose agree as follows:

I. PENNROSE'S UNDERTAKINGS

Pennrose already has sought and obtained Project Eligibility Letter (PEL) (attached here) from the Department of Housing and Community Development (DHCD) and a Comprehensive Permit from the ZBA for a rental project with a maximum of 65 rental units, with a maximum of 110 bedrooms, all of which are affordable at no more than 60% of area median income, per the PEL and as stipulated in the RFP response.

A. The Project shall consist of no more than 65 residential rental units.

B. The 65 residential rental units at the Project shall contain no more than 110 bedrooms, with the following mix of bedrooms:

One Bedroom:	27 units
Two Bedrooms:	31 units
Three Bedrooms:	7 units

C. The mix of affordability for the households occupying the 65 units shall be as follows:

- 90% of the units shall be reserved for households earning at or below 60% of AMI, with at least 10% reserved for households earning 30% of AMI.

D. The affordable units at the Project shall be permanently restricted as affordable, with the affordability mix as described above and shall remain affordable so long as the Project continues to benefit from the Comprehensive Permit because the Project does not conform to zoning requirements. The Town shall have the right to enforce the affordability requirements, including by exercising its right to have the Property revert to the Town and terminate the 99-year lease in the event that the affordability requirements terminate or lapse or are otherwise not in effect.

E. Vehicular Access.

- There shall be two means of egress from the Project parcels. One of which shall be limited to and specifically for emergency vehicle access only, and it shall be gated and locked at all times when not in active use.

- There shall not be any vehicular egress onto State Highway (Route 6). (Except for emergency vehicles if necessary.)

- There shall not be a turnout provided to allow for a dedicated bus stop on the State Highway frontage for the Property.

- The main vehicular access shall be from Brackett Road; and emergency vehicular access from the rear of the Property, via an easement to be obtained by Pennrose. Failure to obtain the easement shall not invalidate this agreement.

F. There shall be a setback of the development from the State Highway to allow for the potential installation of a sidewalk if the town so chooses in the future. There shall be a sidewalk on Brackett Road.

G. Pennrose shall provide screening landscaping, and fencing buffers to prevent light pollution or visual intrusion from abutting properties. Pennrose shall also create effective sound barriers using natural vegetation and/or fencing for an effective year-round visual mitigation for the residents of the Project from adjacent commercial/industrial or residential uses.

H. Pennrose shall locate any dumpster for the Project so that the dumpster shall not be visible from any adjacent residential property and shall not create noise or odor issues for any adjacent residential property or for residents of the Project. All dumpsters shall be in enclosures, and emptied no less than weekly, or as needed to contain all trash within the container. Bulky items if disposed of shall not remain outside of the dumpster for more than 24 hours.

I. The maximum height of any building or structure shall not exceed two stories or a maximum of 35 feet, as measured as required under the Zoning By-law. There shall be no habitable space below the mean finished grade of the ground adjoining any building. There shall be no bedroom or bedrooms above the maximum story of any building.

J. Aggregate parking spaces shall be no less than 101 or 1.5 per unit.

K. The maximum lot coverage (buildings and parking areas and driveways) shall not exceed 55% and pervious pavement shall be used where appropriate and feasible. There shall be maximum building lot coverage of 15%. There shall be a minimum of 25% open space. Recreational areas provided shall count toward the open space requirement.

L. The Project shall be connected to municipal water infrastructure and all water use and fees shall be paid including but not limited to permits and inspection fees. There are no "connection fees"

M. Pennrose shall work with the Town's consulting engineers to size the water main and building connections. All water piping, electric wiring and gas lines (if used) shall be underground. The water main on the Property shall be looped as per a design to be reviewed and approved by the Town's consultant. The Town will assist with the first $400,000 in cost for this infrastructure and, if there are remaining funds, then the remaining funds will be contributed to assist with the cost of the construction of the internal access ways.

N. The Town shall retain a 40-foot wide permanent right and privilege over the leased property for water and sewer main and related accessories, (generally following the road layout). The Town shall be responsible, under the lease for maintenance and snow removal of the road, upon completion of all infrastructure and unit construction. Areas for storage of plowed snow shall be shown on the plan and remain available for that purpose only.

O. There shall be no blasting to support the improvements detailed in this agreement, either on or off the Property.

P. Pennrose shall complete a final 1.5-inch overlay of the entire road surface after all construction is complete. Construction standards for the road shall be those required by the planning board for roads serving over 65 residential units and detailed in the Town of Eastham Subdivision Rules and Regulations.

Q. Pennrose shall maintain one of the 65 units for a live in manager and shall maintain 24 /7 access to management coverage. Pennrose shall provide all tenants, the town emergency services, and the office of the Board of Selectmen with the after hour's telephone number to call for emergencies. This number shall have 24/7 live answering capability and response time. The number shall also be displayed outside the management office /apartment and near each the entrance to each building and in the common areas, including the outdoor recreation areas.

R. All signage, trash receptacles, benches and playground equipment and similar chattel, within the development will be vandal resistant and maintained free of damage and in a safe condition at all times.

S. The 65 units shall be subject to a permanent deed restriction that shall be delivered to the Town, accepted, and recorded before the first building permit is issued. The permanent deed restriction requiring that the 65 units remain rental units shall not be converted to permit ownership of units without the approval of Town Meeting to release the restriction.

T. The leasehold interest in the Property shall be conveyed to Pennrose subject to an express requirement within the lease instrument that all of the units shall be rental units for the full duration of the leasehold and for the duration of any renewal

period thereof and a separate restriction shall be recorded against the Property and bind all future leaseholders.

U. Pennrose shall install a bench on Brackett Road for the Flex Bus, unless otherwise provided, before any occupancy permit is issued for any unit. Further sidewalks or walking paths within or on the exterior of the development shall be ADA compliant particularly with respect to widths and grades and other details of the statute.

V. Pennrose shall provide all of the amenities, for the Project, as detailed in its May 5, 2016 response to the RFP for the Development of the Campbell-Purcell Property, including, but not limited to:

- Public Bus Stop area on Brackett Road;
- 3,000 s.f. community/office management facility;
- Walking Trails;
- Social Area;
- Tot Lot;
- Community Garden Area
- Covered Communal Bike Parking Area;
- Active Leisure Activities;
- Community Barbeque Area.

W. Pennrose shall either provide a washer and dryer in each unit or shall provide for laundry facilities in the community facility to provide for a minimum of two washers and two dryers per 20 residential units, to serve the residents of the Project and shall provide for a sufficient water service to the community facility. The town preference is for washers and dryers in each unit.

X. Pennrose shall provide the following information and satisfy the following design standards during the public hearing before the ZBA:

i. Sight distances at each means of egress for the Project shall be designed in accordance with best engineering practices, using ASHTO specifications, and each shall be established and installed and maintained at all times.

ii. To ensure that all runoff is contained on site, the project area shall include a storm water management system(s). Such system shall be designed at a minimum to ensure that the site is free of flooding and standing water during a calculated 25-year storm event. The Applicant shall provide pre-construction and post-construction drainage calculations, as prepared by a licensed professional engineer and shall prepare and provide and then install a stormwater drainage system that controls runoff in compliance with town of Eastham Subdivision Rules and Regulations.

iii. The Town Planner and the Superintendent of Public Works or designee shall witness the soil testing for the drainage basins.

iv. A lighting plan, that provides safe on site lighting to protect the residents, but which does not create adverse impacts for abutting properties shall be designed and peer reviewed by the ZBA at Pennrose's expense and then installed and maintained by Pennrose or its successors. All external lights at the project shall be shielded so that light is not shed onto abutting properties. Design shall provide minimum necessary candlepower to provide safety and vision.

v. Cameras shall be provided to ensure site access control and enhance the safety of all residents. The Town of Eastham shall review and approve surveillance plans before installation. Minimum camera locations shall be established with assistance of the police department. The primary purpose of the camera system is to curb vandalism, and enhance safety and the information shall be retained for at least 72 hours.

vi. Landscaping plan shall be provided with all plants being installed prior to issuance of the first occupancy permit. Maintenance of the landscaped plantings shall be maintained on a minimum weekly basis during the spring and summer season. Lawn area maintenance including leaf removal is the responsibility of Pennrose and shall be performed as needed.

vii. Pennrose shall provide a management plan that details a schedule of maintenance and inspections of all buildings structures, mechanical systems, and outdoor equipment and amenities. Additionally, the plan will include a schedule for unit maintenance such as painting, and carpet replacements and cleaning of carpet and painting in congregate areas if any.

Y. Pennrose shall pay the reasonable cost of peer review by the ZBA, both for civil engineering review, including review of storm water drainage calculations, and any expert pro forma review allowed under 760 CMR 56; and the peer review fees shall be disclosed and paid for in advance and held and expended under G.L. c.44, §53G. Any peer review contracts will be subject to a "not to exceed" limit, with replenishment to be mutually agreed upon by the parties where reasonable necessary.

Z. The Town does not have sufficient funds to review the Project. Pennrose agreed to provide $10,000 to the Board of Selectmen pursuant to G.L. c. 44, §53A in order for the Town to pay for the Town's initial costs. The Town will make available up to $5,000 to the ZBA, pursuant to G.L. c. 44, §53A, to pay for the services of Town Counsel at the usual hourly rate paid by the Town, or other consultants to the ZBA selected to provide service to the Town on this matter.

AA. Pennrose agrees that it shall not assert to the ZBA or to the Housing Appeals Committee or to any other party that the payment of any of the improvements or costs detailed in this agreement causes or contributes towards causing the Project to be uneconomic under G.L. c.40B or 760 CMR 56.00, et seq., provided that all of the terms of this Agreement are satisfied.

BB. Once the Project receives a comprehensive permit from the ZBA that does not alter the material terms set forth above, Pennrose or its successor shall immediately seek funding from Department of Housing and Community Development DCHD) and other sources.. Building permits for the Project shall be applied for within one year of the issuance of the comprehensive permit taking final effect (i.e., after any appeal by an abutter is resolved), or such other time within 18 months of the Comprehensive Permit becoming final that Pennrose is able to secure funding from the DHCD or other sources . The obligations hereunder shall be enforceable only if a comprehensive permit is granted and takes final effect without altering the terms and conditions of this Agreement. If there are changes to the Project in the future that are not detailed in this MOA, then Pennrose shall return to the Board of Selectmen to seek to amend this MOA.

CC. Construction of the entire Project shall be completed no later than two years from the date that a comprehensive permit is granted and /or funding from DHCD or other sources is secured for the Project, within eighteen months of the Comprehensive Permit taking final effect, The comprehensive permit shall lapse; provided, however, that this deadline may be extended by amending this Agreement in writing by agreement of the Parties, with the understanding that the Board of Selectmen desires to have the affordable housing contained in the Project developed as soon as possible.

DD. Pennrose may seek additional grants from the Town, over and above the $400,000 referenced above, including from the Community Preservation Committee (CPA) or other available fund, for any lawful purpose; however, Pennrose acknowledges that CPA grants are subject to appropriation by the legislative body and are in no way guaranteed or committed at this time.

EE. Pennrose shall cooperate with the Town and in a timely manner, provide the Town Administrator with all relevant information and material to support applications by the Town to DHCD to add the Project's units to the Subsidized Housing Inventory (SHI).

FF. Pennrose shall pay all reasonable household income monitoring fees for required activities under DHCD's Guidelines.

HH. At least 5% of the 65 dwelling units shall be accessible to and usable by persons with disabilities. An additional 2% of the 65 units shall be accessible to individuals with sensory impairments (i.e., hearing or vision impairments) All other units shall satisfy visitability standards including but not limited to interior passage doors with and all ground floor units shall have one zero step entrance .

II. Pennrose shall place a prohibition in each lease for each rental unit that strictly prohibits off road recreational motorized vehicles, including mopeds, any unlicensed and derelict vehicles, or boats larger than 8' feet and on-site boat and vehicle repairs of any type. These restrictions shall be strictly enforced by the management.

JJ. Mailboxes may be located at central locations in accordance with US Post office directions, with vehicular and safe pedestrian access.

KK. There shall be porches or decks for the first floor units.

LL. As much as practical green construction standards shall be followed and water saving devices shall be installed throughout and all appliances shall be energy star rated.

MM. Pennrose agrees that it shall provide as-built plans to the Town for the water infrastructure within 90 days of completion of the infrastructure and shall provide as-built plans within six months of completion of the Project, unless the Project is phased, in which case as-built plans for each Phase shall be provided within six months of completion of each Phase and any plan to phase the project shall be approved in advance by the ZBA.

NN. Pennrose agrees that this agreement shall bind it and its successors in interest and that the Town along with the 99-year lease document may record a Notice of the MOA against the Property and the additional affordable and rental housing restrictions and notices of any renewals.

II. TOWN'S UNDERTAKINGS

1. Pennrose may not apply for waivers of fees by the Board of Selectmen. Pennrose shall not assert that any of its obligations set forth herein render the Project uneconomic under G.L. c.40B or 760 CMR 56 in the event that fees are charged.

2. Upon request by Pennrose, the Town Administrator shall review and respond to any inquiry by Pennrose regarding proposed changes to the Project and shall refer any change she deems substantial to the Board of Selectmen for action under this Agreement for a determination as to whether the proposed change would or would not cause the Selectmen to exercise its rights to cancel this Agreement as provided for hereunder.

III. PARTIES' RIGHT TO CANCELLATION

If the Comprehensive Permit Application issued for the Project (a) does not include the improvements and costs required by this Agreement; (b) increases the number of units or bedrooms other than as agreed to above; (c) decreases the number of affordable units agreed to above; (d) substantially changes the location and/or size and height of the structures, buildings and/or infrastructure as shown on the Plans considered by the Board

of Selectmen, the Board of Selectmen shall have the right for those reasons, in its unfettered discretion, to void this Agreement by providing written notice of the same to Pennrose and DHCD and the leasing of the Property proposed under this MOA to Pennrose shall not take place. Additionally, since Pennrose has a PEL, the Town shall have the right to cancel if Pennrose does not file the comprehensive permit application within 60 days of executing this MOA and the Town's right shall include the right not to proceed with the lease of Property, unless the relevant timeline is mutually agreed by the parties to be extended in writing and signed by the Parties.

IV. MISCELLANEOUS

1. Any breach of this Agreement shall be enforceable by the Parties.

2. Any amendment to this Agreement shall occur only pursuant to a written amendment that is duly authorized by the Parties and then duly executed by the Parties.

3. The Parties acknowledge they had advice of counsel before executing the Agreement.

4. Notice of this Agreement may be recorded by either party when the application for the Comprehensive Permit is submitted, but a discharge shall be provided if the Agreement is cancelled as provided for hereunder; otherwise this Agreement shall bind all of Pennrose's successors in interest.

5. This Agreement may be executed in any number of counterparts, which together shall constitute one instrument. An electronic signature on this Agreement shall have the same effect as an original.

6. All notices and other communications required or permitted to be given under or by reason of this Agreement shall be in writing and may be delivered by electronic mail, facsimile, US mail or overnight mail. Notices, demands, and communications will, unless another address is specified in writing, be sent to the persons and at the addresses indicated below:

For the Board of Selectmen: Ilana M. Quirk, Esq.
KP-Law, P.C.
101 Arch Street
Boston, MA 02110
iquirk@k-plaw.com

With a copy to the Town Administrator and Board of Selectmen Chairman at:
2500 State Highway
Eastham Ma 02642

To: Pennrose: One Brewery Park,
1301 North 31st Street
Philadelphia, PA 19121

With a copy to: Pennrose
50 Milk Street
16th Floor
Boston, MA 02109

Exhibit 1: Eastham RFP

Exhibit 2: Pennrose's May 5, 2016 RFP Response

INTENTIONALLY OMITTED, SIGNATURE PAGE TO FOLLOW.

IN WITNESS, the parties hereunto set their hands and fixed their seals as of _____, 2016.

By: **EASTHAM BOARD OF SELECTMEN***

_____ _____
John F. Knight, Chairman William O'Shea, Vice Chairman

_____ _____
Linda S. Burt, Clerk Elizabeth Gawron, Member

_____
Wallace F. Adams, II

*Pursuant to a vote taken by the Board of Selectmen on _____, 2016.

COMMONWEALTH OF MASSACHUSETTS
Barnstable, SS.
On this ___ day of _____, 2016, before me, the undersigned Notary Public, personally appeared of the Eastham Board of Selectmen, as aforesaid, who proved to me through satisfactory evidence of identification, which was _____, to be the person whose name is signed on the preceding document, and acknowledged to me that s/he signed it voluntarily for its stated purpose on behalf of the Town of Eastham.

_____
(Official Signature and Seal of Notary)

PENNROSE PROPERTIES, LLC
By: _____
, Manager

COMMONWEALTH OF MASSACHUSETTS
, SS.
On this ___ day of_____, 2016, before me, the undersigned Notary Public, personally appeared _____, as Manager of Pennrose Properties, LLC, who proved to me through satisfactory evidence of identification, which was_____, to be the person whose name is signed above, and acknowledged s/he signed it voluntarily for its stated purpose on behalf of Pennrose Properties, LLC.

_____
(Official Signature and Seal of Notary)

567087 v1A7/EAST/0197

TOWN OF EASTHAM
2500 State Highway, Eastham, MA 02642-2544
All departments 508 240-5900 *Fax* 508 240-1291
www.eastham-ma.gov

III. A. 4.

November 7, 2016

To: Board of Selectmen
From: Sheila Vanderhoef, Town Administrator
Re: Transient Vendor Permits

Please find below and attached the Transient Vendor applicants for approval by the Board of Selectmen. In each case, the $20.00 fee has been received.

*Permits are valid as stated, and were approved by Sheila as dated.

Adela M Blanco Roman 255 Quail Cover Lane Eastham, MA 02642 Valid: November 7, 2016 – November 7, 2017	Jennifer Baudanza 119 Misty Meadow Lane #7 North Chatham, MA 02650 Valid: November 19, 2016 – November 19, 2017
Desiree Cole P.O. Box 423 North Eastham, MA 02651 Valid: November 19, 2016 – November 19, 2017	Susan Connor P.O. Box 1902 North Eastham, MA 02651 Valid: November 19, 2016 – November 19, 2017
Art Hartung 220 Lawton Road Eastham, MA 02642 Valid: November 19, 2016 – November 19, 2017	Lori McKenzie 330 Hay Road Eastham, MA 02642 Valid: November 19, 2016 – November 19, 2017
Traci Noone 1454 Long Pond Road Brewster, MA 02631 Valid: November 19, 2016 – November 19, 2017	James Owens P.O. Box 777 Eastham, MA 02642 Valid: November 19, 2016 – November 19, 2017
Gale D. Preston P.O. Box 621 West Chatham, MA 02669 Valid: November 19, 2016 – November 19, 2017	Eliza Travisano 12 Park Street Harwich, MA 02645 Valid: November 19, 2016 – November 19, 2017
Pamela Tomchak 17 Upper County Road South Dennis, MA 02660 Valid: November 19, 2016 – November 19, 2017	Gianna Sinopoli P.O. Box 168 South Orleans, MA 02662 Valid: November 19, 2016 – November 19, 2017
Robin Wignot 45 Dale Avenue South Wellfleet, MA 02663 Valid: November 19, 2016 – November 19, 2017	

III.A.5

TOWN OF EASTHAM

2500 State Highway, Eastham, MA 02642-2544
All departments 508 240-5900 *Fax* 508 240-1291
www.eastham-ma.gov

November 7, 2016

To: Board of Selectmen

From: Sheila Vanderhoef, Town Administrator

Re: Committee Appointments

The following is the information needed to make two committee appointments.

Deborah Albert
The Search Committee recommends the appointment of Deborah Albert to the Board of Council on Aging as a regular member.

If the Board appoints her, her first term would commence November 7, 2016 and expire June 30, 2018. She seeks to replace Theresa McApline, whose term ended 6/30/15.

James Connor
The Search Committee recommends the appointment of James Connor to the Board of Council on Aging as a regular member.

If the Board appoints him, his first term would commence November 7, 2016 and expire June 30, 2018. He seeks to replace Mary Sullivan, whose term ended 6/30/15.

Estella Edmondson
The Search Committee recommends the appointment of Estella Edmondson to the Human Services Advisory Committee as a regular member.

If the Board appoints her, her first term would commence November 7, 2016 and expire June 30, 2019. She seeks to replace Margaret Phillips, whose term ended 6/30/16.

III A. 6.

Town of Eastham

Natural Resources Department
555 Old Orchard Road
Eastham, MA. 02642

508 240-5972
natres@eastham-ma.gov

To: Eastham Board of Selectmen

From: Michael J. O'Connor
Senior Natural Resources Officer

RE: Aquaculture License

Date: November 3, 2016

Gayle Ashton

Site# N71
Nauset Marsh

Ms. Gayle Ashton has satisfied her permitting requirements for her aquaculture site in Nauset Marsh. This site was approved by the Eastham Board of Selectmen at their May 16, 2016 meeting. Ms. Ashton has obtained her permit from the Army Corp of Engineers and the MA Division of Marine Fisheries. It is now OK to issue her the town license and she may move forward with planting shellfish.

Thank you for your attention to this matter.

COMMONWEALTH OF MASSACHUSETTS
TOWN OF EASTHAM

Barnstable, ss. **Site N-71**

THIS IS TO CERTIFY that the Board of Selectmen of the Town of Eastham does hereby issue a NEW LICENSE to **GAYLE ASHTON**, 120 Joshua's Way, Eastham, MA 02642 to plant, grow, dig and take shellfish, and to plant shells for the purpose of catching shellfish seed on a parcel of shore flats in the Nauset Marsh described as follows:

Computed to have an area of one half (1/2) acres, more or less.

This license is granted under Section 57 of Chapter 130 of the General Laws as amended Chapter 692 of the Acts of 1986 and the Town of Eastham Shellfish Aquaculture Regulations, and all acts in addition thereto, and amendments thereof, are incorporated herein and made a part hereof.

This license shall expire one hour after sunset on the first day April, 2019 unless sooner suspended or revoked.

WITNESS the hands of the Selectmen of the Town of Eastham, at Eastham, this 16th Day of May, 2016.

John Knight, Chair

Wallace Adams

William O'Shea, Vice Chair

Elizabeth Gawron

Linda Burt, Clerk

EASTHAM BOARD OF SELECTMEN

INFORMATION

P3 PROJECT PLANNING PROFESSIONALS

ADMINISTRATION
OCT 20 2016
RECEIVED

John F. Knight – Chairman
Eastham Board of Selectmen
2500 State Highway
Eastham, MA 02642

October 17, 2016

Re: Water Project Phase II

Subject: OPM Services,

John,

Eastham offered OPM services to P-3 back in the spring of 2016. We have never received a notice to proceed nor a contract to the agreed upon services. We have committed to four other municipalities during this time and do not have the capacity to monitor the Water Phase II work.

This letter serves as our withdrawal from consideration for these services. We hope this does not cause the Town any delays as it seeks to monitor the massive expenditures on this project.

If there are any questions, please do not hesitate to call

Very truly yours,

Daniel Pallotta – President

cc: Sheila Vandefhoff – Town Administrator

150 Longwater Dr Ste 102
Norwell MA 02061-1618
tel 781.871.3136
www.p-threeinc.com

TOWN OF EASTHAM
REQUEST FOR PROPOSALS FOR ENGINEERING SERVICES/ OWNERS
REPRESENTATIVE MUNICIPAL WATER DESIGN AND INSTALLATION PROJECT

The Town of Eastham is seeking the services of a qualified consultant to serve as the Owners Representative in respect to a 45.8 million dollar horizontal construction project to provide municipal water to approximately 2200 residential and commercial properties in the Town of Eastham. The Town currently has no municipal water service. This is the first construction related to the initiation of such service. The construction for the project is expected to begin as early as March 2015, with the first element being the construction of a water tower to serve the system. The work program for this project is to develop construction plans concurrent with the permitting process. The project's permitting needs include, a Water Management Act Permit, Cape Cod Commission Development of Regional Impact (DRI) Permit, MEPA and several DEP permits and approvals. The engineering firm selected to design and manage the permit process, as defined is Environmental Partners of Quincy/Hyannis/Worcester, principals Mark White and Paul Gabriel. The selected firm will review their work on behalf of the town.

Specifically, the town is seeking the services of an engineering individual or firm with the ability and experience to: 1) perform peer review of the design and construction plans at agreed upon milestones 2) provide value engineering services including cost estimation of alternate design and construction approaches 3) conduct constructability review 4) evaluate long-term operational issues for cost effectiveness and sustainability, and 5) make recommendations and assist in developing and evaluating alternative models of operator options for operation of the finished system. The town intends to have the system privately operated when it comes on line in late 2016.

The successful consultant will have experience in value engineering, water, or waste water system design and construction management. It is desirable that the successful consultants has experience in water or waste water system operation and the ability to develop and evaluate long term operational costs and needs. The Town meeting has approved and funded this project for the initial phase one portion. The term of work will be approximately twenty-four (24) months and is expected to commence in October 2014. Additional portions may be funded and the successful consultant will be considered in this role for subsequent phases of the work.

All interested individuals and firms interested in replying to this RFP, are directed to the town website www.eastham-ma.gov for full submission requirements.

All responses shall be received in writing on or before October 14, 2014, at 2:00 p.m. in a sealed envelope addressed to:

Town of Eastham
Attn: Sheila Vanderhoef,
Chief Procurement Officer
2500 State Highway
Eastham, MA 02642

Late responses will not be considered and will be returned unopened.

TOWN OF EASTHAM
REQUEST FOR PROPOSALS FOR ENGINEERING SERVICES
(OWNERS REPRESENTATIVE)
MUNICIPAL WATER DESIGN AND INSTALLATION PROJECT

I.0 Request for Proposal

The Town of Eastham is seeking the services of a qualified consultant to serve as the Owners Representative in respect to a 45.8 million dollar horizontal construction project to provide municipal water to approximately 2200 residential and commercial properties in the Town of Eastham. The Town currently has no municipal water service.

Specifically, the town is seeking the services of an engineering individual or firm with the ability and experience to: 1) perform peer review of the design and construction plans at agreed upon milestones 2) provide value engineering services including cost estimation of alternate design and construction approaches 3) conduct constructability review 4) evaluate long-term operational issues for cost effectiveness and sustainability, and 5) make recommendations and assist in developing and evaluating alternative models of operator options for operation of the finished system. The town intends to have the system privately operated when it comes on line in late 2016.

2.0 General Requirements

Applicants should submit proposals in two sealed envelopes as follows: (1) an original *non-price* proposal with three (3) copies and (2) an original *price* proposal with two (2) copies, on or before ***Tuesday, October 14, 2014 at 2:00 p.m.***

Chief Procurement Officer
Eastham Town Hall
2500 State Highway
Eastham, MA 02642

At which time and place the RFP will be opened and recorded.

Proposals should be submitted in two separate envelopes and marked as follows:

NON-PRICE PROPOSAL
"MUNICIPAL WATER DESIGN AND INSTALLATION PROJECT OWNERS REPRESENTATIVE"

PRICE PROPOSAL
"MUNICIPAL WATER DESIGN AND INSTALLATION PROJECT OWNERS REPRESENTATIVE"

Proposals received after this time will be deemed non-responsive and will not be accepted. Faxed or e-mailed proposals will be deemed non-responsive and will be rejected. Responses to this Request for Proposals must include all required documents, completed and signed per the instructions and attached forms included in this bid packet.

Applicants are cautioned to allow sufficient time for their proposals to be hand-delivered or received by mail. The Town of Eastham reserves the right to reject all proposals or proposals that are incomplete or deemed non-responsive or that are not in the best interest of the Town.

The Town of Eastham has determined that while engineering activities are not strictly regulated by 30B, this Request for Proposals is issued consistent with the Uniform Procurement Act, M.G.L. c30B. Therefore, the provisions of M.G.L. c30B are incorporated herein by reference.

All submissions shall included a statement of interest outlining the consultants approach, experience of the Firm/Individual and project manager, and experience of any other staff to be utilized. A resume for each team member shall be attached to each response.

Each Firm/Individual responding shall also complete the Non Collusion and Tax Compliance Statements attached here.

The successful Firm(s) will be interviewed and it is expected that the full project team as well as the project manager will attend.

3.0 Project Description

The Town of Eastham is a municipality located on Cape Cod, Massachusetts, with a year-round population of 5,200, with approximately 6,350 parcels, with less than 200 vacant buildable lots remaining. The Town has contracted with an engineering firm Environmental Partners Group, for the past seven years to develop a town wide water system to be installed in phases, as approved by Town Meeting. Recently, Town Meeting (May 2014) approved Phase One of the system which included service to 2200 parcels. **(See Attachment 1)** Phase One also included the construction of two drinking water wells and well housing. One of the wells is located, by easement, on land owned by the Nauset Regional School District. The other is on town owned land on the north end of town. The preliminary plans also provide for the construction of an interconnect through Orleans and Wellfleet. The Board of Selectmen is in discussion on the exact route through both of those towns. The full system will be serviced by three drinking water wells.

The phase one program will be divided into five separate construction contracts to meet stringent timelines, set by the town. **(See Attachment 2).** Each work contract will need to be reviewed and monitored by the Town's representative.

The engineer is proceeding to work with state and regional agencies on all aspects of the necessary permitting and simultaneously moving forward on design. A significant portion of the phase one construction will occur on the state highway, Route 6, which runs the full length of

the town. The engineering firm is actively engaged in permitting activities with Mass DOT. The timeline for construction start is no later than March 2015. Construction of the water tower is expected to begin at that time. **(See Attachment 3 for Complete Implementation Schedule)**

4.0 Tasks

The successful proposal will identify staff capable of carrying out all the duties related to this work, including but not limited to:

1) Peer review of the design and construction plans at agreed upon milestones;

2) Value engineering services including cost estimation of alternate design and construction approaches;

3) Conducting constructability reviews of all roads, buildings, and wells;

4) Evaluating long-term operational issues for cost effectiveness and sustainability;

5) Making recommendations and assisting in developing and evaluating alternative models of system operator options;

6) Coordination meetings and liaison with the owner's, staff as may be identified but particularly, the Health Agent, DPW Superintendent, and Town Administrator; and

7) Other minor tasks that may be identified by the consultant or town in support of the owner's interest.

5.0 Evaluation Criteria

All proposals will be evaluated and ranked in accordance with stated criteria as:

Highly Responsive:	Meeting and exceeding the requirements or criteria.
Responsive:	Meeting the requirements or criteria.
Unresponsive:	Does not meet the requirements or criteria.

Further, all rrespondents shall be available for an interview with all primary team members present (if applicable) to discuss the details of their approach, experience, tasks and background.

Specifically, the criteria for evaluating proposals will include the following:

5.1 Applicant response conforms to all submission requirements, and is complete;

5.2 Each member of Individual/Firm development team has experience in similar work in a specific aspect of the RFP tasks;

5.3 Individual/Firm demonstrates and presents evidence of successful project peer review experience showing capability to communicate and support the owner's best interest while working collaboratively with the projects engineering team;

5.4 Individual/Firm has successful experience securing federal, state, and/or local grants for projects and thereby understands the design and contracting rigors imposed by such regulations;

5.5 Individual/Firm has similar experience in operation of or in developing specifications for, the operation of water systems, within the last ten years;

5.6 Individual/Firm has similar project management, peer evaluation or engineering design experience in municipal water system initiation or expansion within the last ten years in Massachusetts;

5.7 Individual/Firm has similar project management, peer evaluation or engineering design experience in municipal water system initiation or expansion within the last ten years on Cape Cod;

5.8 Individual/Firm has successfully applied for water system related permits such as Water Management Act Permits, MEPA permits for water or other engineering work, or Cape Cod Commission (DRI) based permits;

5.9 Individual/Firm has successfully applied for State Revolving Loan Funds, USDA Funds or other state and federal grants for specific infrastructure projects.

5.10 Individual/Firm is familiar with the personnel at DEP in Solid Waste and Drinking Water Supply at the Southeast Region and/or Boston offices.

Project proposals meeting at least five (5) of the above criteria will be ranked responsive, and reviewed further. Preference will be given to respondents who have knowledge of Cape Cod municipalities specifically Eastham, and the water systems of Orleans and Wellfleet.

6.0 Submission Requirements

All submissions for consideration shall be received at the time and place specified below:

Tuesday October 14, 2014 at 2:00 P.M.
Eastham Town Hall
2500 State Highway,
Eastham MA 02642
Attn: Sheila Vanderhoef, Chief Procurement Officer

With a price and non-price proposal in separate envelopes and so labeled as shown, and with the name of the respondent prominently shown on the envelope.

NON-PRICE PROPOSAL
"MUNICIPAL WATER DESIGN AND INSTALLATION PROJECT OWNERS REPRESENTATIVE"

PRICE PROPOSAL
"MUNICIPAL WATER DESIGN AND INSTALLATION PROJECT OWNERS REPRESENTATIVE"

Additionally, all proposals shall include:

- Letter of interest signed by firm principals
- Resume of all proposed project team members
- Narrative description of approach
- Signed and Completed Certificate of Non-Collusion and Statement of Tax Compliance (**Attachment 4**)

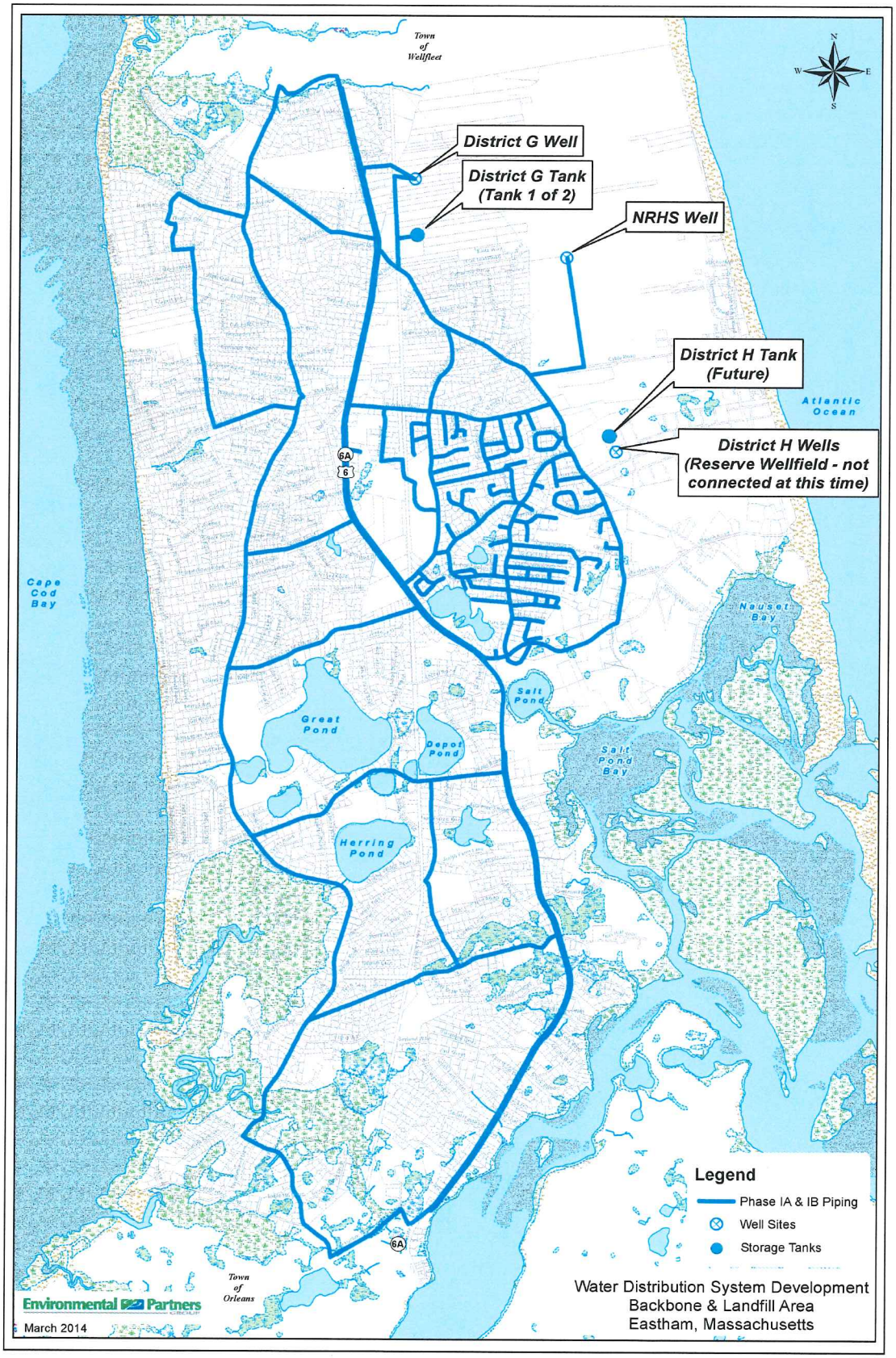
7.0 Questions

All questions shall be in writing **(email preferred)** and addressed to:

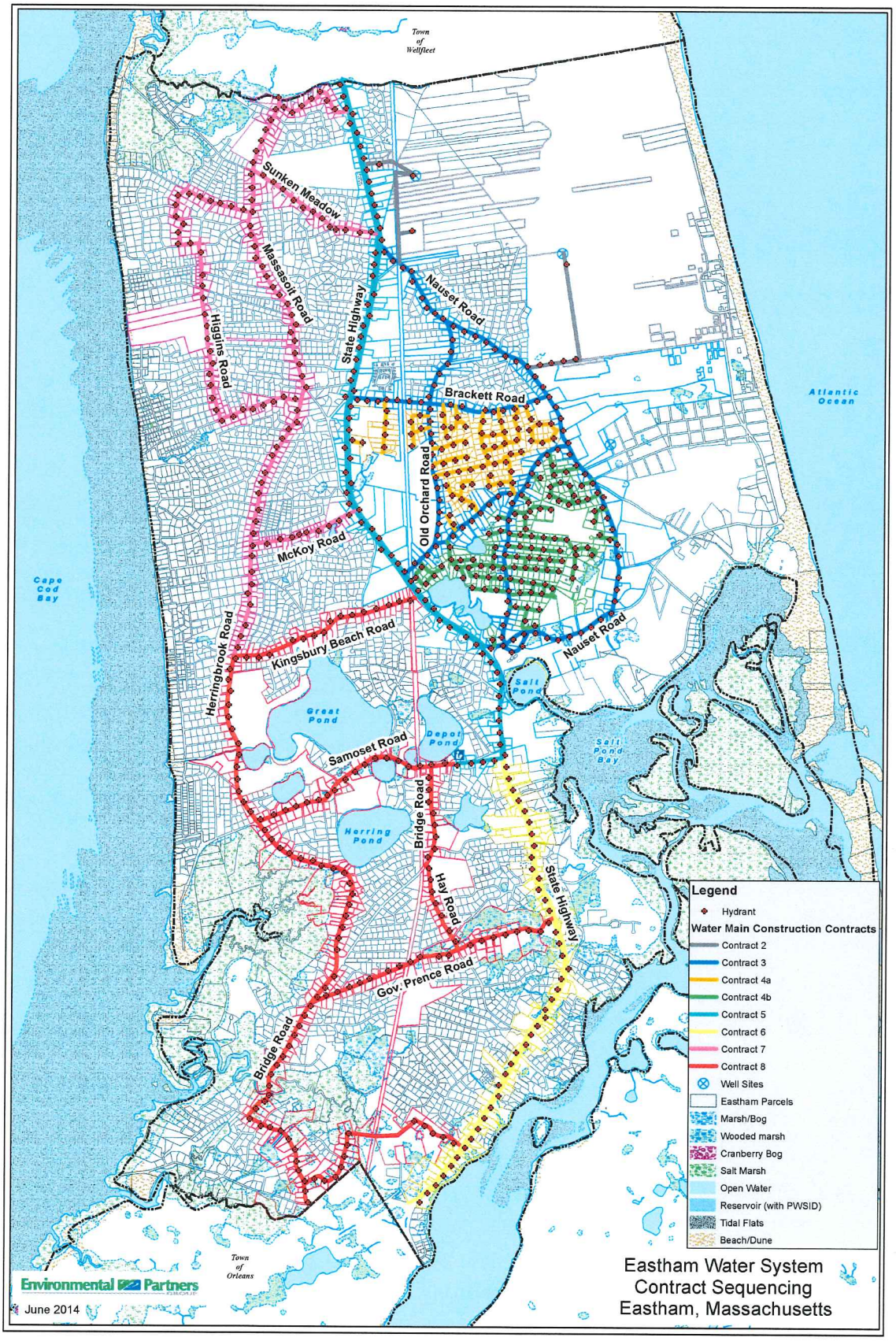
Town of Eastham
Sheila Vanderhoef, Chief Procurement Officer
2500 State Highway,
Eastham, MA 02642
Or (www.admin2@eastham-ma.gov)

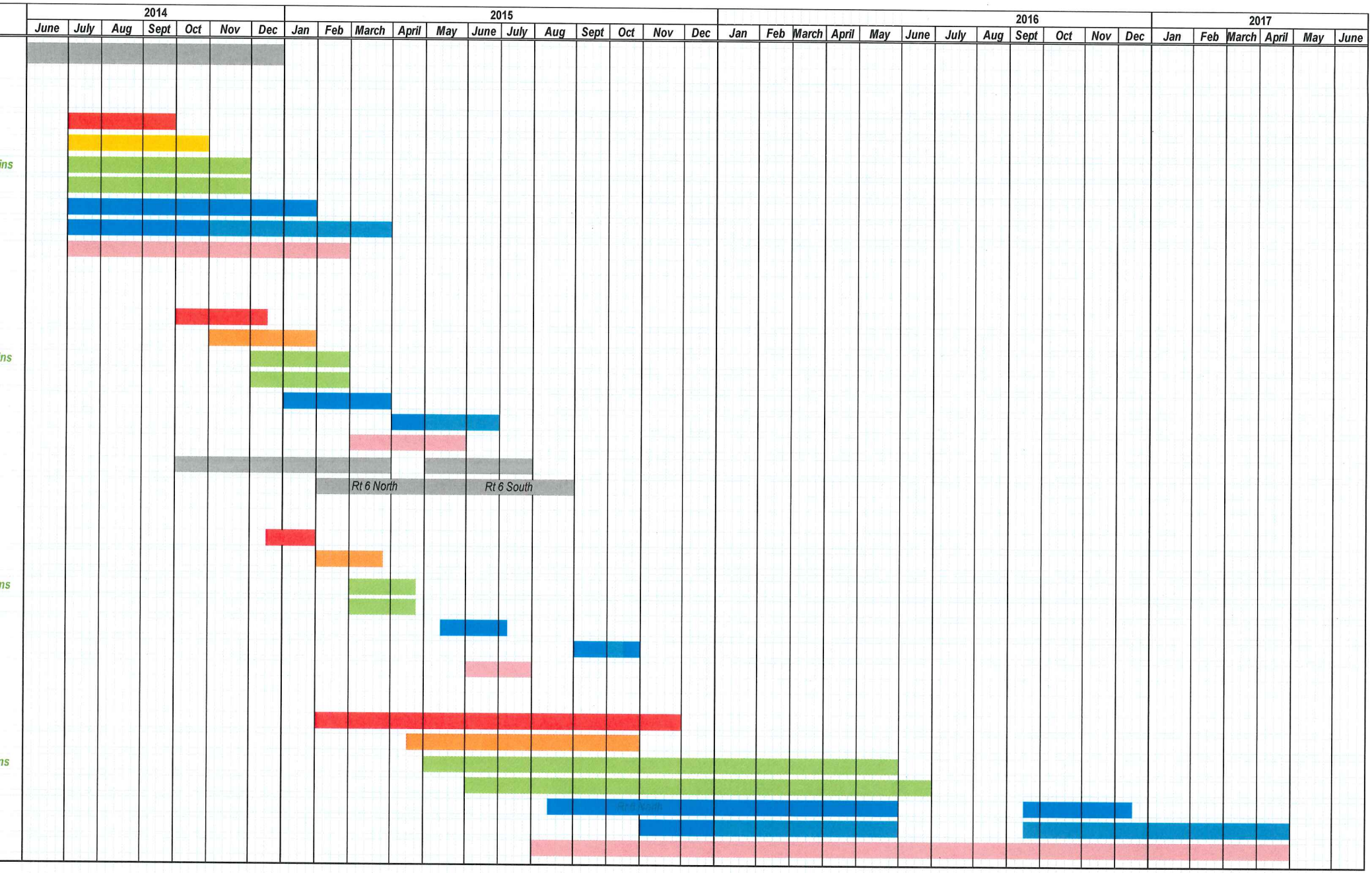
All written question shall be received no later than October 6, and will be answered in by email writing by October 10. Responses will be distributed to all firms that have registered on the Town website under this RFP.

ATTACHMENT 1



ATTACHMENT 2

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Rt 6 South

ATTACHMENT 4
TOWN OF EASTHAM

CERTIFICATE OF NON-COLLUSION

EXHIBIT B

The undersigned certifies under penalties of perjury that this bid or proposal has been made and submitted in good faith and without collusion or fraud with any other person. As used in this certification the word "person" shall mean any natural person, business, partnership, corporation, union, committee, club or other organization, entity or group of individuals.

_____
(Signature of individual signing bid or proposal)

_____
(Name of business)

STATEMENT OF TAX COMPLIANCE

Pursuant to M.G.L. Chapter 62C, Section 49A, I certify under penalties of perjury that I, to my best knowledge and belief, have complied with all laws of the Commonwealth of Massachusetts relating to taxes.

Social Security or Federal
Identification Number _____

Signature of Individual signing proposal

_____

ZONING SUMMARY AND TABLE

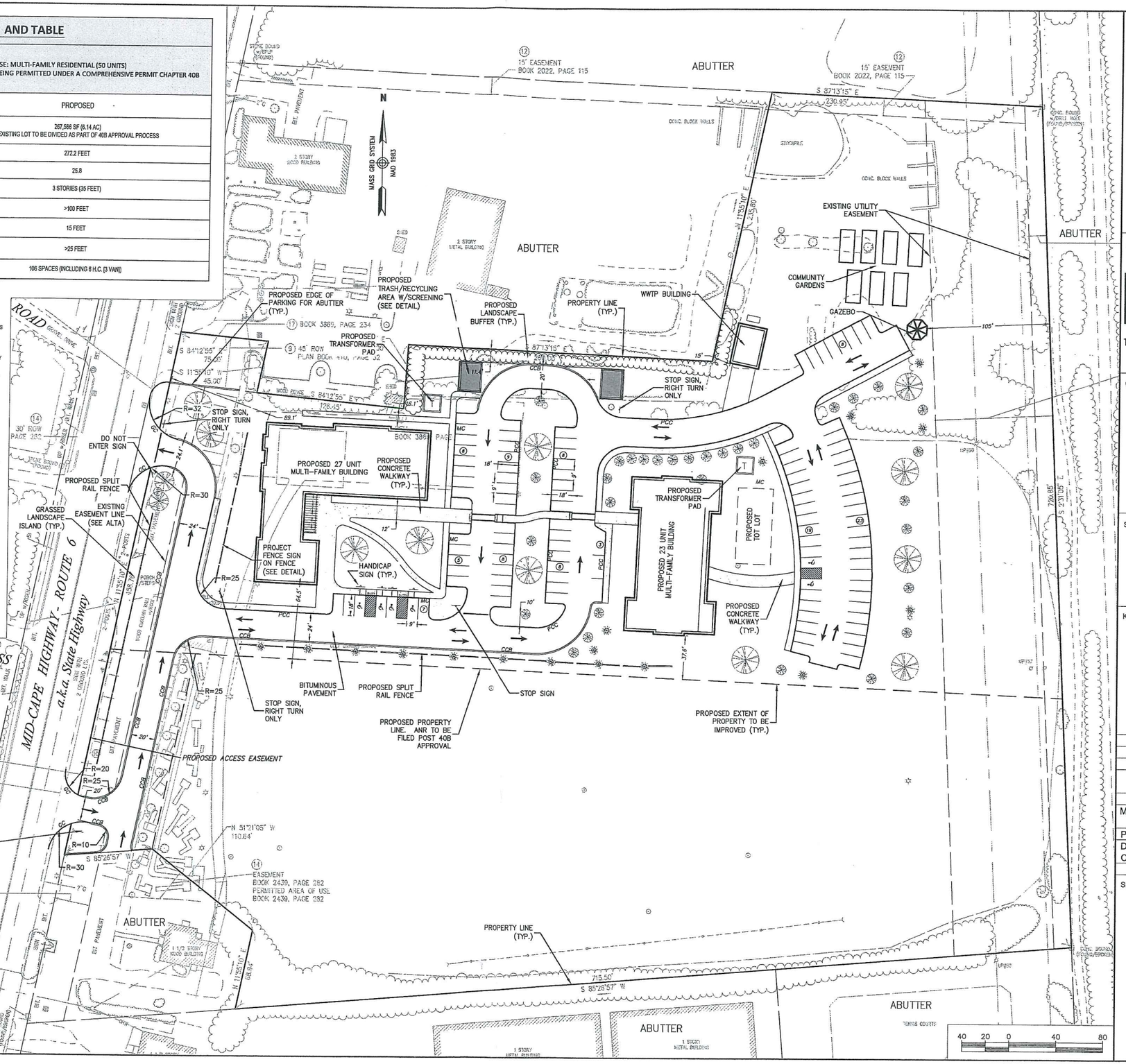
ZONING DISTRICT: DISTRICT E		• PROPOSED USE: MULTI-FAMILY RESIDENTIAL (50 UNITS) • PROJECT IS BEING PERMITTED UNDER A COMPREHENSIVE PERMIT CHAPTER 40B
BULK & DIMENSIONAL REQUIREMENTS	REQUIRED - DISTRICT E	PROPOSED
MINIMUM LOT AREA (SQUARE FEET)	40,000 SQUARE FEET	267,566 SF (6.14 AC) *EXISTING LOT TO BE DIVIDED AS PART OF 40B APPROVAL PROCESS
MINIMUM FRONTAGE	40 FEET	272.2 FEET
SHAPE NUMBER	22	25.8
MAXIMUM BUILDING HEIGHT (FEET)	30 FEET	3 STORIES (35 FEET)
MINIMUM FRONT YARD SETBACK (FEET)	100 FEET	>100 FEET
MINIMUM SIDE YARD (FEET)	25 FEET	15 FEET
MINIMUM REAR YARD (FEET)	25 FEET	>25 FEET
PARKING	–	106 SPACES (INCLUDING 6 H.C. (3 VAN))

LAYOUT NOTES:

1. SEE OTHER SHEETS FOR APPLICABLE NOTES.
2. THE PURPOSE OF THIS PLAN IS FOR PERMITTING ONLY. CONSTRUCTION DRAWINGS AND SPECIFICATIONS TO BE PROVIDED PRIOR TO BUILDING PERMIT APPLICATION.
3. SEE ARCHITECTURAL DRAWINGS FOR ADDITIONAL BUILDING INFORMATION.
4. SURVEY INFORMATION BASED ON A PLAN ENTITLED "EXISTING CONDITIONS PLAN OF LAND" PREPARED BY VHB DATED JANUARY 10, 2013 ISSUED FOR ALTA/ACSM LAND TITLE SURVEY.
5. DESIGN OF RAMPS AT HANDICAP PARKING AND WALKWAYS ALONG ACCESSIBLE ROUTE TO CONFORM TO ADA REQUIREMENTS. CONTRACTOR IS RESPONSIBLE TO ENSURE COMPLIANCE WITH ALL ADA REQUIREMENTS, AS SET FORTH BY THE ADAAG AND THE MASS ARCHITECTURAL ACCESS BOARD. CONTRACTOR IS REQUIRE TO KEEP A COPY OF BOTH THE ADAAG AND THE MASS ARCHITECTURAL ACCESS BOARD REGULATIONS ON SITE AT ALL TIMES, FOR REFERENCE.
6. ALL LINES OR POINTS ARE PERPENDICULAR OR PARALLEL TO LINES FROM WHICH THEY ARE MEASURED UNLESS OTHERWISE NOTED; WRITTEN DIMENSIONS SHALL PREVAIL.
7. THE CONTRACTOR SHALL VERIFY ALL LAYOUT, DIMENSIONS, GRADES, AND INVERTS PRIOR TO CONSTRUCTION; REPORT ANY AND ALL DISCREPANCIES TO THE ENGINEER. ALL DISCREPANCIES SHALL BE RESOLVED IN WRITING PRIOR TO BEGINNING WORK.
8. ALL AREAS DISTURBED BY CONSTRUCTION ACTIVITY NOT DESIGNATED TO RECEIVE OTHER TREATMENT, SHALL BE RAKED, SMOOTHED, FERTILIZED AND SEEDED IN ACCORDANCE WITH PROJECT SPECIFICATIONS, UNLESS OTHERWISE NOTED.
9. ALL NEW WALKS AND SURFACES TO MEET EXISTING WALKS AND SURFACES WITH SMOOTH, CONTINUOUS LINE AND GRADE.
10. THE CONTRACTOR SHALL NOT INSTALL CONCRETE DURING ADVERSE WEATHER CONDITIONS (RAIN, SLEET, ETC.) UNLESS OTHERWISE DIRECTED BY THE ENGINEER.
11. ALL MATERIALS REMOVED FROM THE SITE SHALL BE DISPOSED OF IN ACCORDANCE WITH ALL APPLICABLE LOCAL, STATE & FEDERAL STANDARDS.
12. CONTRACTOR IS RESPONSIBLE FOR CONTRACTING WITH A LICENSED LAND SURVEYOR TO OBTAIN AS-BUILT INFORMATION DURING CONSTRUCTION INCLUDING BUT NOT LIMITED TO SUBSURFACE UTILITIES, DETENTION STONE BASE, TOP OF DETENTION STONE, TOP OF CHAMBER, TOP OF SYSTEM, OTHER SUBSURFACE AND SURFACE IMPROVEMENTS NECESSARY TO FURNISH OWNERS ENGINEER WITH A COMPLETE AS-BUILT UPON COMPLETION OF CONSTRUCTION.
13. CONTRACTOR SHALL NOTIFY ENGINEER 72 HOURS PRIOR TO INSPECTIONS OF SUB BASE, PAVEMENT, UNDERGROUND SYSTEM BASE STONE INSTALLATION AND OTHER ITEMS WHICH MAY BE REQUESTED BY ENGINEER.
14. CONTRACTOR IS RESPONSIBLE FOR SUPPLY OF ALL NECESSARY ITEMS REQUIRED TO FULFILL THE INTENT OF THE DESIGN, WHETHER EXPLICITLY INDICATED HEREIN OR IMPLIED BY THE CONTRACT DOCUMENTS.
15. CONTRACTOR SHALL COMPLY WITH APPLICABLE CONDITIONS OF APPROVALS, INCLUDING BUT NOT LIMITED TO 40B COMPREHENSIVE PERMIT AND BOH APPROVALS.

LEGEND

CCB	CAPE COD BERM
PC	PRECAST CONCRETE CURB
GC	GRANITE CONCRETE
MC	MONOLITHIC CURB
	HANDICAP PARKING SYMBOL
	SIGN (HANDICAP OR TRAFFIC)
	DIRECTIONAL TRAFFIC ARROWS
	BITUMINOUS PAVEMENT
	CONCRETE SIDEWALK



Governor Prence Residences

4790 State Highway
(Route 6)
Eastham, Massachusetts

STRATFORD CAPITAL GROUP

ARCHITECT

E-ICON ARCHITECTURE
101 SUMMER ST BOSTON MA 02110

CONSULTANT

CHA
101 Accord Park Drive
Norwell, MA 02061
Main: (781) 982-5400 · www.chacompanies.com

STAMP

KEY PLAN

MARK	DATE	DESCRIPTION
	10/28/2016	BLDG. LAYOUT REV.
	9/13/2016	
	8/12/2016	

PROJECT NO.: 21101.00
DRAWN BY: DAR
CHECKED BY: KK

SHEET TITLE

LAYOUT PLAN

C-201

ZONING SUMMARY AND TABLE

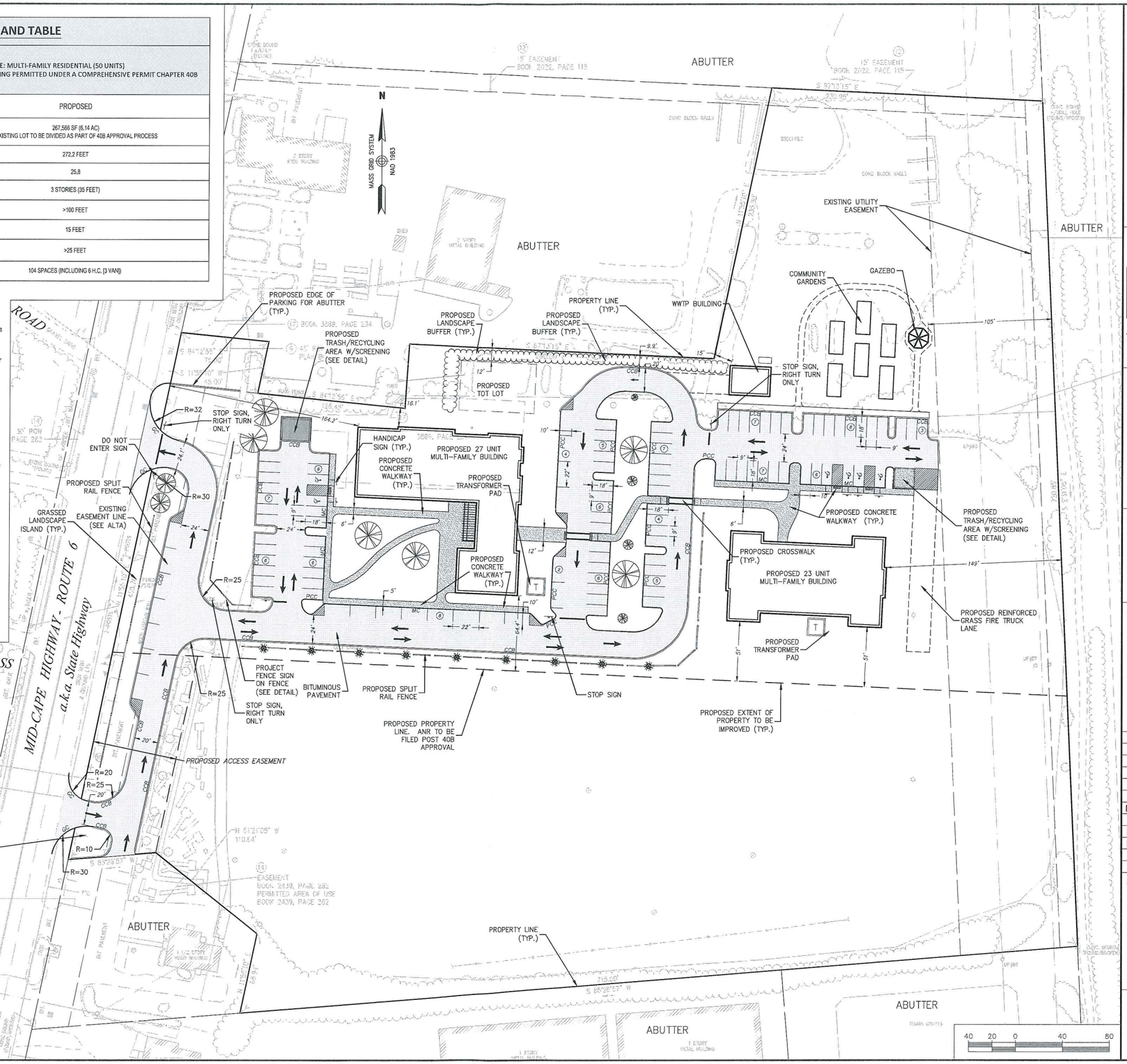
ZONING DISTRICT: DISTRICT E		· PROPOSED USE: MULTI-FAMILY RESIDENTIAL (50 UNITS) · PROJECT IS BEING PERMITTED UNDER A COMPREHENSIVE PERMIT CHAPTER 40B
BULK & DIMENSIONAL REQUIREMENTS	REQUIRED - DISTRICT E	PROPOSED
MINIMUM LOT AREA (SQUARE FEET)	40,000 SQUARE FEET	267,566 SF (6.14 AC) *EXISTING LOT TO BE DIVIDED AS PART OF 40B APPROVAL PROCESS
MINIMUM FRONTAGE	40 FEET	272.2 FEET
SHAPE NUMBER	22	25.8
MAXIMUM BUILDING HEIGHT (FEET)	30 FEET	3 STORIES (35 FEET)
MINIMUM FRONT YARD SETBACK (FEET)	100 FEET	>100 FEET
MINIMUM SIDE YARD (FEET)	25 FEET	15 FEET
MINIMUM REAR YARD (FEET)	25 FEET	>25 FEET
PARKING	-	104 SPACES (INCLUDING 6 H.C. (3 VAN))

LAYOUT NOTES:

1. SEE OTHER SHEETS FOR APPLICABLE NOTES.
2. THE PURPOSE OF THIS PLAN IS FOR PERMITTING ONLY. CONSTRUCTION DRAWINGS AND SPECIFICATIONS TO BE PROVIDED PRIOR TO BUILDING PERMIT APPLICATION.
3. SEE ARCHITECTURAL DRAWINGS FOR ADDITIONAL BUILDING INFORMATION.
4. SURVEY INFORMATION BASED ON A PLAN ENTITLED "EXISTING CONDITIONS PLAN OF LAND" PREPARED BY VHB DATED JANUARY 10, 2013 ISSUED FOR ALTA/ACSM LAND TITLE SURVEY.
5. DESIGN OF RAMPS AT HANDICAP PARKING AND WALKWAYS ALONG ACCESSIBLE ROUTE TO CONFORM TO ADA REQUIREMENTS. CONTRACTOR IS RESPONSIBLE TO ENSURE COMPLIANCE WITH ALL ADA REQUIREMENTS, AS SET FORTH BY THE ADAAG AND THE MASS ARCHITECTURAL ACCESS BOARD. CONTRACTOR IS REQUIRE TO KEEP A COPY OF BOTH THE ADAAG AND THE MASS ARCHITECTURAL ACCESS BOARD REGULATIONS ON SITE AT ALL TIMES, FOR REFERENCE.
6. ALL LINES OR POINTS ARE PERPENDICULAR OR PARALLEL TO LINES FROM WHICH THEY ARE MEASURED UNLESS OTHERWISE NOTED; WRITTEN DIMENSIONS SHALL PREVAIL.
7. THE CONTRACTOR SHALL VERIFY ALL LAYOUT, DIMENSIONS, GRADES, AND INVERTS PRIOR TO CONSTRUCTION; REPORT ANY AND ALL DISCREPANCIES TO THE ENGINEER. ALL DISCREPANCIES SHALL BE RESOLVED IN WRITING PRIOR TO BEGINNING WORK.
8. ALL AREAS DISTURBED BY CONSTRUCTION ACTIVITY NOT DESIGNATED TO RECEIVE OTHER TREATMENT, SHALL BE RAKED, SMOOTHED, FERTILIZED AND SEEDED IN ACCORDANCE WITH PROJECT SPECIFICATIONS, UNLESS OTHERWISE NOTED.
9. ALL NEW WALKS AND SURFACES TO MEET EXISTING WALKS AND SURFACES WITH SMOOTH, CONTINUOUS LINE AND GRADE.
10. THE CONTRACTOR SHALL NOT INSTALL CONCRETE DURING ADVERSE WEATHER CONDITIONS (RAIN, SLEET, ETC.) UNLESS OTHERWISE DIRECTED BY THE ENGINEER.
11. ALL MATERIALS REMOVED FROM THE SITE SHALL BE DISPOSED OF IN ACCORDANCE WITH ALL APPLICABLE LOCAL, STATE & FEDERAL STANDARDS.
12. CONTRACTOR IS RESPONSIBLE FOR CONTRACTING WITH A LICENSED LAND SURVEYOR TO OBTAIN AS-BUILT INFORMATION DURING CONSTRUCTION INCLUDING BUT NOT LIMITED TO SUBSURFACE UTILITIES, DETENTION STONE BASE, TOP OF DETENTION STONE, TOP OF CHAMBER, TOP OF SYSTEM, OTHER SUBSURFACE AND SURFACE IMPROVEMENTS NECESSARY TO FURNISH OWNERS ENGINEER WITH A COMPLETE AS-BUILT UPON COMPLETION OF CONSTRUCTION.
13. CONTRACTOR SHALL NOTIFY ENGINEER 72 HOURS PRIOR TO INSPECTIONS OF SUB BASE, PAVEMENT, UNDERGROUND SYSTEM BASE STONE INSTALLATION AND OTHER ITEMS WHICH MAY BE REQUESTED BY ENGINEER.
14. CONTRACTOR IS RESPONSIBLE FOR SUPPLY OF ALL NECESSARY ITEMS REQUIRED TO FULFILL THE INTENT OF THE DESIGN, WHETHER EXPLICITLY INDICATED HEREIN OR IMPLIED BY THE CONTRACT DOCUMENTS.
15. CONTRACTOR SHALL COMPLY WITH APPLICABLE CONDITIONS OF APPROVALS, INCLUDING BUT NOT LIMITED TO 40B COMPREHENSIVE PERMIT AND BOH APPROVALS.

LEGEND

CCB	CAPE COD BERM
PC	PRECAST CONCRETE CURB
GC	GRANITE CONCRETE
MC	MONOLITHIC CURB
	HANDICAP PARKING SYMBOL
	SIGN (HANDICAP OR TRAFFIC)
	DIRECTIONAL TRAFFIC ARROWS
	BITUMINOUS PAVEMENT
	CONCRETE SIDEWALK



Governor Prence Residences

4790 State Highway
(Route 6)
Eastham, Massachusetts

STRATFORD CAPITAL GROUP

ARCHITECT

E-ICON ARCHITECTURE
101 SUMMER ST BOSTON MA 02110

CONSULTANT

CHA
101 Accord Park Drive
Norwell, MA 02061
Main: (781) 982-5400 • www.chacompanies.com

STAMP

COMMONWEALTH OF MASSACHUSETTS
KELLY KOLLEEN CIVIL No. 39991
REGISTERED PROFESSIONAL ENGINEER
9/13/16

KEY PLAN

MARK	DATE	DESCRIPTION
	9/13/2016	
	8/12/2016	

PROJECT NO.: 21101.00
DRAWN BY: DAR
CHECKED BY: KK

SHEET TITLE

LAYOUT PLAN

C-201

TOWN OF EASTHAM

2500 State Highway, Eastham, MA 02642 - 2544
All departments 508 240-5900 *Fax* 508 240-1291
www.eastham-ma.gov

October 31, 2016

Engineering Excellence Award Committee
American Council of Engineering Companies of Massachusetts
The Engineering Center
One Walnut Street
Boston, MA 02108-3615

Re: Eastham Town-Wide Water System
2017 American Council of Engineering Companies of Massachusetts
Engineering Excellence Award Submission

Dear Members of the Awards Committee,

This letter is in support of the application of Environmental Partners Group submission for our town-wide water project to your Engineering Excellence Award Committee. We believe that the work of the team on this project clearly sets a client /consultant work standard that defines excellence in design and responsiveness to the client.

The Town of Eastham is a small town without any municipal infrastructure for water supply or wastewater disposal. We were introduced to Environmental Partners Group when they responded to our solicitation for engineering services when we were interested in the feasibility of implementing a municipal water system. There were several issues driving our community's interest in such a water system, not least of which was a well-documented trend of our resident's private wells being increasingly impacted by discharges of nitrates and other compounds from nearby onsite wastewater discharges. In addition, we learned that the closed landfill in our Town is also adversely impacting groundwater and private water wells in that area with volatile organic compound. Finally, without a municipal water system Eastham had limited ability to provide fire protection to our residents and businesses.

We needed a firm that could provide us with evaluative and design expertise as we sought to understand the complexities of a new infrastructure, its effect on our community and how we can reasonably manage its cost. Environmental Partners skillfully brought this to us. The Principals and senior staff have remained deeply involved with us, from the early phases of the project through the design, permitting, construction and now the operation of the water system to ensure that we were well prepared for each aspect of the system's implementation, and that all of our community's concerns and questions are answered each step of the way. As this project was being considered by the Board of Selectmen Environmental Partners met frequently with them and our staff to educate them on the project's issues and process, and also participated with us in an extensive educational outreach program that included meetings with taxpayers with numerous Saturday and evening workshop. They assisted us in garnering support from key regulatory agencies, including the Department of Environmental Protection and the Cape Cod Commission. As a result of this effort, the Eastham community ultimately supported the

project in overwhelming fashion and authorized funding of $130 Million for a full town-wide water system that is projected to take approximately eight years to complete. This was the single largest commitment that Town has ever made in its history, and today the first phase of the water system is completed to the point where the system is in operation, we have working fire hydrants and, by mid-November 2016, water is being delivered to properties.

Small towns can hire consultants who minimize the value of their dollars because they are smaller. Environmental Partners have not treated us in any way other than as an important client with an important piece of work to be done. They have been efficient, technically proficient and remarkably responsive at every turn, and have maintained their complete commitment to Eastham every day throughout the project.

Eastham whole heatedly supports this application and sincerely appreciates the opportunity for the Town-wide water system project to be considered as a nominee for this prestigious award. Please feel free to contact me with any questions or if additional information is required.

Yours very truly,

Sheila Vanderhoef

Sheila Vanderhoef
Eastham Town Administrator

cc: Eastham Board of Selectmen
Mark White, Principal, Environmental Partners Group

info

ADMINISTRATION
OCT 26 2016
RECEIVED

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Drinking Water Program

Public Water System Certified Operator Compliance Notice

COCM

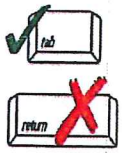
Eastham
City/Town

Eastham Municipal Water System
PWS Name

4086095
PWS ID

A. Certification

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



Roy Maher III
Print Operator's Name

Roy A. Maher III
Operator's Signature

10/19/16
Date

Sheila Vanderhoef, Town Administrator
Print System Owner's Name and Title

Sheila Vanderhoef
System Owner's Signature

10/20/16
Date

B. System Information

PWS must complete the COCM *and* the appropriate "COD" Duty Form for the system. See Instructions.

Eastham Municipal Water System
Public Water System Name

4086095
PWS ID

2500 State Highway Rt. 6
Street Address

Eastham
City/Town

MA
State

02642
Zip Code

508-240-5900
Phone

svanderhoef@eastham-ma.gov
E-mail Address

System Type: ☒ Community ☐ Non-transient Non-community ☐ Transient Non-community

Population in Winter 800 Population in Summer 2400

Distribution Class: ☒ I ☐ II ☐ III ☐ IV ☐ VND ☐ VSS

Treatment: ☒ Yes ☐ No Treatment Class: ☒ I ☐ II ☐ III ☐ IV

If yes, please specify treatment types and purpose of treatment and chemicals used:

Corrosion Control using Potassium Hydroxide. Disinfection using Sodium Hypochlorite.

C. Operator Information

Roy A. Maher III
Print Name

25 Station Street
Street Address

Wareham
City/Town

MA
State

02571
Zip Code

508-864-1570
Phone

RMaher@RHWhite.com
E-mail Address

23650/23819
License #

3D/3T
Grade

☐ OIT or ☒ Full

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Drinking Water Program

Public Water System Certified Operator Compliance Notice

Eastham
City/Town

Eastham Municipal Water System
PWS Name

4086095
PWS ID

D. Operator Information (cont'd)

Will assume responsibility as the [☒ primary / ☐ secondary] operator for

4 hours per day 5 days per week/month

and will be able to respond to an emergency within 60 minutes.

Please list the names and PWS ID #'s of all other systems which you currently operate. (Attach list if necessary.)

Public Water System Name	PWS ID #

Please describe any sanctions the Board has levied on your operator's license in the past 3 years:

E. Typical Duties and Responsibilities

Please choose the "Typical Duties and Responsibilities" (COD) sheet that applies to your system. System owner and operator are to jointly complete the sheet that best describes the system. That sheet becomes part of this notice. The notice is not complete without this duties sheet attached. Duties sheets are provided separately at http://www.mass.gov/dep/water/approvals/dwsforms.htm#opcert.

Check appropriate form: ☐ COD-1 ☐ COD-2 ☐ COD-3 ☐ COD-4
☐ COD-5 ☐ COD-6 ☐ COD-7 ☐ COD-8 ☒ COD-9

F. Other Duties

List other duties to be operator's responsibility:

Monitor SCADA on site and remotely.

List other duties to be the system's responsibility:

COCM

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Drinking Water Program

Public Water System Certified Operator Compliance Notice

Eastham
City/Town

Eastham Municipal Water System
PWS Name

4086095
PWS ID

G. For MassDEP Use Only

SERO
MassDEP Office

CHARLES P. SHURTLEFF
Print Name

EAT IV
Title

Signature

10-21-2016
Date

☒ Approved ☐ Denied

Comments:

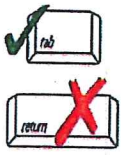
Original gets mailed back to PWS; copy to certified operator; copy to MassDEP-Boston; and copy for MassDEP-Region.

Massachusetts Department of Environmental Protection COD-9
Bureau of Resource Protection – drinking water program

Typical Duties & Responsibilities of a Certified Operator

PWS Type: Small Community
Treatment: Chemical Treatment
Operator Grade Required: VSS and 1T

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



PWS must complete the COCM and the appropriate "COD" Duty Form for the system. See Instructions.

	Operator	Owner	Shared
1. Be responsible for the day-to-day operation and management of the system.	☒	☐	☐
2. Ensure the delivery of safe drinking water at all times by complying with Massachusetts Drinking Water Regulations.	☒	☐	☐
3. Inspect the system daily (source, storage facilities, treatment process, and distribution).	☒	☐	☐
4. Measure and record the chemical dosage daily making dosage adjustments as necessary.	☒	☐	☐
5. Add chemicals when necessary and rotate stand-by pumps monthly.	☒	☐	☐
6. Test, flush, clean and disinfect the water distribution system and storage tanks when necessary.	☒	☐	☐
7. Develop, and maintain for accuracy, a site plan showing the water source, a map of the water distribution system and sample location, disinfection process, and all other appropriate appurtenances.	☒	☐	☐
8. Collect /oversee collection of water samples as specified by MassDEP.	☒	☐	☐
9. Ensure that all samples are delivered to and analyzed by a Massachusetts certified laboratory.	☒	☐	☐
10. Report all results to MassDEP within the time frames specified.	☒	☐	☐
11. Conduct a sanitary survey of the system as specified by MassDEP.	☒	☐	☐
12. Complete and submit to MassDEP the Annual Water Supply Statistical Report and all other required forms in a timely manner.	☒	☐	☐
13. Complete and deliver the annual Consumer Confidence Report.	☐	☐	☒
14. Notify MassDEP of violations and issue public notices as necessary.	☒	☐	☐
15. Review the sample monitoring schedule and locations annually.	☒	☐	☐
16. Protect the water distribution system and storage facilities from corrosion effects.	☐	☐	☒
17. Observe pump motors routinely to detect unusual noises, vibrations, or excessive heat.	☒	☐	☐
18. Inspect, adjust, and clean pump seals, packing glands, and any mechanical seals when necessary.	☒	☐	☐
19. Be present during water system repairs and maintenance and/or oversee the maintenance of the public water system conducted by other individuals such as staff or contractors.	☒	☐	☐
20. Be present within 24 hours of fecal or second Total Coliform positive or other water system failures.	☐	☐	☒
21. Record quantity of water pumped from source monthly.	☒	☐	☐

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – drinking water program

Typical Duties & Responsibilities of a Certified Operator

PWS Type: Small Community
Treatment: Chemical Treatment
Operator Grade Required: VSS and 1T

	Operator	Owner	Shared
22. Develop, implement, and keep up to date a cross connection control program, a preventive maintenance schedule, an operation and maintenance budget plan, an emergency response plan, a safety program plan, and a wellhead protection program plan.	☐	☐	☒
23. Ensure the accuracy of water meters and other flow measuring devices annually or as necessary.	☒	☐	☐
24. Delineate the wellhead protection zone.	☐	☐	☒
25. Identify all potential sources of contamination within the wellhead protection zone.	☒	☐	☐
26. Troubleshoot mechanical equipment, water quality/quantity problems, and take corrective actions as necessary.	☒	☐	☐
27. Keep abreast of changes in the drinking water regulations.	☒	☐	☐
28. Attend training programs and workshops for certification renewal when appropriate.	☒	☐	☐
29. Accompany regulatory agencies during on-site inspections.	☒	☐	☐
30. Troubleshoot to locate the causes of water quality complaints and respond to consumer complaints in a timely fashion.	☒	☐	☐
31. Discuss with consumers their concerns of water quality and quantity.	☒	☐	☐
32. Develop and maintain a complaint log book.	☐	☐	☒
33. Keep accurate records and maintain a filing system for correspondence.	☐	☐	☒
34. Develop, maintain, and keep up to date a public water system standard operational and maintenance manual which contains at a minimum: a) the most recent version of 310 CMR 22.00, Drinking Water Regulations; b) the Department's Guidelines and Policies for Public Water Systems; c) the Standard Monitoring Framework; and d) other pertinent correspondence or documents.	☒	☐	☐
35. Report emergencies to MassDEP and Board of Health (BOH) within specified time frames.	☒	☐	☐
36. Conduct or ensure the annual Emergency Response Program (ERP) training is completed.	☒	☐	☐

Estimated Time: The annual estimated time required to perform all the duties and responsibilities listed above is approximately 180 to 360 hours. Exceptions to the staffing requirements may be allowed by the Department. Contact your regional office for further information.

Contract Services: A public water system may contract for the services of a certified operator to perform all or some of the duties listed above with written approval from MassDEP. A contract certified operator should spend approximately one hour per on-site visit to perform the various duties listed above. This time may vary from system to system as will the frequency of visits depending on the specific needs of each system as identified by the Department. In some cases, the certified operator can supervise the operation without being present on a daily basis provided the certified operator has a person working with the system on a daily basis under his or her supervision.

Roy Maher - Primary Operator List

Class	PropIDLocation	CityStZip	PWSID#
TNC	Atlantic Oaks	Eastham	4086014
TNC	Atlantis	Truro	4300044
COM	Blueberry Estates	Lakeville	4146039
TNC	Box Lunch	Wellfleet	4318075
TNC	Brownies Cabins	S.Wellfleet	4318002
TNC	Camp Bournedale	Plymouth	4239029
TNC	Catch of the Day, LLC	S.Wellfleet	4318070
TNC	Chequessett Village	Wellfleet	4318019
TNC	Chequessett Yacht Club	Wellfleet	4318071
TNC	Corn Hill Condominium Association	Truro	4300027
TNC	Cranberry Cottage Condominium Assoc	Eastham	4086015
COM	Cranberry Knoll	Plympton	4240008
NTNC	Drummer Boy Condominiums	Wellfleet	4318010
TNC	Drummer Cove	Wellfleet	4318074
TNC	Finely JP's	Wellfleet	4318076
TNC	Flying Fish Café	Wellfleet	4318030
COM	Freetown Water	Freetown	4102035
TNC	Gull Pond Beach	Wellfleet	4318113
TNC	Hiawatha Condominium Association	Wellfleet	4318118
TNC	Maguire Landing Beach	Wellfleet	4318112
TNC	Marconi Beach Restaurant	Wellfleet	4318055
COM	Meadow Wood Mobile Home Park	Carver	4052054
TNC	Montano's	N.Truro	4300030
TNC	Nauset Haven	Eastham	4086007
COM	Nemasket Health Care	Middleboro	4182015
TNC	Newcomb Hollow Beach	Wellfleet	4318110
TNC	Oak Grove Cottages	Eastham	4086022
TNC	Ocean Pines Condo	Wellfleet	4318011
TNC	Orleans/Eastham Elks Lodge	N. Eastham	4086049
TNC	Outdoor World MHC Gateway To Cape	Rochester	4250005
TNC	Outer Cape Health Care	Wellfleet	4318103
TNC	Outer Reach Resort	N.Truro	4300023
TNC	Pine Tree Condo	Eastham	4086017

Class	PropIDLocation	CityStZip	PWSID#
NTNC	Rochester Memorial School	Rochester	4250002
TNC	Roseville Condominiums	Truro	4300039
TNC	Salt Air Cottages Condos	North Truro	4300031
TNC	Saltbox Cottage	Wellfleet	4318093
TNC	Sandy Neck Beach	Centerville	4020023
TNC	Sandys Restaurant	Buzzard Bay	4036007
TNC	Sladeville Cottages	Truro	4300035
COM	South Meadow Village	Carver	4052001
COM	Southfield Redevelopment Authority	S. Weymouth	4336007
TNC	South Wellfleet General Store	Wellfleet	4318108
TNC	Springbrook Center	S.Wellfleet	4318038
TNC	Starfish Condominiums	Eastham	4086053
TNC	Starfish Vacation Village	Wellfleet	4318007
NTNC	Stones Throw Condominiums	Truro	4300040
TNC	Wagner at Duck Creek (Sweet Seasons, Inc.)	Wellfleet	4318073
TNC	Truro	Truro	4300041
COM	Twin Coach / Edgeway	Lakeville	4146045
TNC	Van Rensselears	Wellfleet	4318097
TNC	Wellfleet Bay Wildlife	Wellfleet	4318049
TNC	Wellfleet Beachcomber	Wellfleet	4318081
TNC	Wellfleet Cultural and Commerce Center Cond	Wellfleet	4318119
TNC	Wellfleet Lodge	S.Wellfleet	4318092
TNC	Wellfleet Marketplace	Wellfleet	4318109
TNC	Wellfleet Motel	S.Wellfleet	4318035
COM	Wellfleet Municipal	Wellfleet	4318094
NTNC	West Parish of Barnstable	W Barnstable	4020020
NTNC	Whispering Pines	Eastham	4086011
TNC	White Crest Beach	Wellfleet	4318111
TNC	Whitman House	Truro	4300019

Info

Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

Southeast Regional Office • 20 Riverside Drive, Lakeville MA 02347 • 508-946-2700

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Matthew A. Beaton
Secretary

Martin Suuberg
Commissioner

October 19, 2016

Ms. Sheila Vanderhoef, Town Administrator
Town of Eastham
2500 State Road
Eastham, MA 02642

RE: EASTHAM – Public Water Supply
Town of Eastham
PWS ID#: 4086095
BRPWS 20, To Construct Source = or > 70 gpm
Transmittal No.: X264973 & X264975;
and BRPWS 23C, To Construct Facility = or > 200,000 gpm and < 1 MGD
Transmittal No.: X265311 & X265310;
and BRPWS32, Distribution System Modifications
Transmittal No.: X264573 & X265979
Final Inspection

Dear Ms. Vanderhoef:

Attached please find an approval to activate two public water supply wells (NRHS and District G), two treatment facilities (one at each well), the District G storage tank, and the Contract 5 Water Mains, all serving the Town of Eastham, Massachusetts.

The signature on this cover letter indicates formal issuance of the attached document. If you have any questions concerning this document, please contact Jim McLaughlin at (508) 946-2805 or via email at james.m.mclaughlin@state.ma.us.

Sincerely,

Richard J. Rondeau, Chief
Drinking Water Program
Bureau of Water Resources

CERTIFIED MAIL NO. 7014 2120 0003 6904 2191
JM/encl.
Y:\DWP Archive\SERO\Eastham-4086095-System Modifications-2016-10-19

ec: Paul C. Millett, P.E.
Environmental Partners Group, Inc.
1900 Crown Colony Drive, Suite 402
Quincy, MA 02169
pcm@envpartners.com

Sheila Vanderhoef
svanderhoef@eastham-ma.gov

Jacqueline Beebe
jbeebe@eastham-ma.gov

Eastham Board of Health
jcrowley@eastham-ma.gov

Mark White
mnw@envpartners.com

Ryan Trahan, P.E.
rjt@envpartners.com

Russell Tierney, Certified Operator
rtierney@rhwhite.com

Roy Maher, Certified Operator
RMaher@Rhwhite.com

ec: Yvette DePeiza, DEP-DWP
Rebecca Weidman, DEP-WMA
Steve McCurdy, DEP-SRF
Ashraf Gabour, DEP-SRF
Dave Ankener, DEP-SRF
Duane LeVangie, DEP-WMA
Catherine Sarafinas-Hamilton, DEP-DWP
David Johnston, DEP-SERO
All DEP-SERO-DWP

Alexander Strysky, MEPA
Alexander.Strysky@State.MA.US
EEA No. 15273

Jan Sullivan, DPH
Jan.Sullivan@State.MA.US

Eastham Water Department
Eastham, Massachusetts
PWS ID #4086095
Water Supply Wells, Control Buildings, & Piping
BRP WS 20 To Construct Source = or > 70 gpm
Transmittal No. X264973 & X264975
BRP WS 23C To Construct Facility = or > 200,000 gpm and < 1 MGD
Transmittal No. X265311 & X265310
BRP WS 32 Distribution System Modifications
Of PWS Systems Serving > 3,300 People
Transmittal No. X264573 & X265979

The Massachusetts Department of Environmental Protection (the Department) has received a request for the Department's final inspection of the newly constructed municipal public water supply in the Town of Eastham, Massachusetts (the Town). The request was accompanied by certifications, water quality test results, and pressure test results from Environmental Partners Group, Inc. (EPG), acting as consultant for the Town. The certifications were signed and stamped by Mr. Paul C. Millett, Massachusetts Registered Professional Engineer License Number 37250, and Mr. Ryan J. Trahan, Mass. P.E. No. 47241. EPG has hired WhiteWater, Inc. of Charlton, Massachusetts, to provide certified operator oversight of the water system during the start-up phase. Construction of the water system has been funded in part through the Department's State Revolving Fund.

Technical personnel from the Department's Southeast Region Drinking Water Program conducted an inspection of the water works on September 22, 2016. The Department's inspecting engineer found all facilities constructed according to the approved plans and specifications. Monitoring systems have been designed to be in compliance with the Department's Chemical Safety Control Strategy for Critical Chemical Feed Systems. The inspection included successful testing of safety controls and alarm systems at the treatment facilities. EPG provided the Department with the Town's Business Plan, Emergency Response Plan, Operation and Maintenance Manuals, and other materials to review the Town's capacity for operating a Public Water Supply. Facilities inspected include the Nauset Regional High School (NRHS) Well (X264975) and Treatment Facility (X265310), the District G Well (X264973) and Treatment Facility (X265311), and the District G elevated storage tank (X264573). Fire hydrants and well-patched roadways indicated where distribution pipes have been installed under Contract 5, Route 6 North Water Main Construction Project (X265979). The Department has rated both treatment facilities as I-T facilities. The Distribution system will be rated initially at a I-D, and expand to at least a II-D at full-build. Primary and secondary operators with the appropriate licenses are currently operating the system. The Town will directly contract with operators with appropriate licenses when it assumes full responsibility for the water system.

The Department hereby approves the Town of Eastham to activate its water system and commence connecting customers to the water mains. The Town has developed procedures to disconnect private wells from plumbing systems prior to connecting customers to the municipal water system. EPG will gather data into electronic databases as each building inspection and connection is made, including locations of valves and service pipes, along with a material survey. Cross connection

surveys will be performed and documented. WhiteWater has agreed to assist with outreach to small public water suppliers who will need a Department permit to abandon their water supply well for potable purposes.

As water main projects are completed and certified by a Massachusetts Registered Professional Engineer of Record, the Town need not wait for Department permission to activate the mains provided acceptable bacteria test results and pressure results are obtained. Copies of those results must be submitted to the Department along with the Engineer's certification in accordance with the original approval letters. The operators will be responsible for updating sampling schedules as the service population grows to ensure a sufficient number of samples are collected, and that the geographical service area is sufficiently represented in sampling.

The following identification numbers have been assigned to the Eastham Public Water Supply (PWS):

Public Water Supplier (PWS) ID: 4086095

NRHS Well ID: 4086095-01G

NRHS Treatment Plant ID: 4086095-01T

District G Well ID: 4086095-02G

District G Treatment Plant ID: 4086095-02T

Enclosed, please find a water quality sampling schedule outlining required sampling of your system. The three-year sampling schedule cycle ends after December, 2016. You will receive a new schedule in December to cover the years 2017 through 2019. Your sample results will be reviewed after one year of sampling to determine future sampling requirements. The design intent is to eventually discontinue disinfection once construction of the entire distribution system is substantially complete. Please note that you must contact the Department's Southeast Region Drinking Water Program in writing prior to altering treatment. Should the change be approved, your sampling schedule will be revised.

This project has been reviewed pursuant to the Massachusetts Environmental Policy Act (MEPA) as EEA No. 15273. The Secretary of Energy and Environmental Affairs (EEA) issued a certificate on December 24, 2014, on the Single Environmental Impact Report and "determined that it adequately and properly complies with MEPA and its implementing regulations." The Department has additionally issued the Town a Water Management Act (M.G.L. c. 21G; 310 CMR 36.00) permit for its water withdrawals.

This approval pertains only to the water supply aspects of the facility and therefore does not negate the responsibility of the owners or operators to comply with other applicable laws, and/or regulations.

PWS ID **4086095** PWS Name **TOWN OF EASTHAM** Town: **EASTHAM** Class: **COM**

BACTERIA SAMPLING

Apr - Sep: 3 per MONTH Season Start Date: 01/01
Oct - Mar 2 per MONTH Season End Date: 12/31

Refer to your DEP Coliform Sampling Plan for approved coliform sample locations. Systems open before or beyond the start/end dates must collect samples during these extra months.

Loc ID #	SAMPLE LOCATION	MULT/SIN	R/F	D/S	WAIVER Y / N	2014 QTR1	2014 QTR2	2014 QTR3	2014 QTR4	2015 QTR1	2015 QTR2	2015 QTR3	2015 QTR4	2016 QTR1	2016 QTR2	2016 QTR3	2016 QTR4
CHLORINE																	
CL	APPROVED COLIFORM SITES	S	F	D		[1 times per Month]											
GROSS ALPHA PARTICLE ACTIVITY																	
10000	NRHS FINISHED WATER	S	F	D													X
10001	DISTRICT G FINISHED WATER	S	F	D													X
HALOACETIC ACIDS																	
100010	WILD CARE	S	F	D		[Next Sampling due in 2017]											
INORGANICS																	
10000	NRHS FINISHED WATER	S	F	D	A												X
10001	DISTRICT G FINISHED WATER	S	F	D	A												X
NITRATE																	
10000	NRHS FINISHED WATER	S	F	D													X
10001	DISTRICT G FINISHED WATER	S	F	D													X
NITRITE																	
10000	NRHS FINISHED WATER	S	F	D													X
10001	DISTRICT G FINISHED WATER	S	F	D													X
PERCHLORATE																	
10000	NRHS FINISHED WATER	S	F	D	A	[Next Sampling due in 2017]											
10001	DISTRICT G FINISHED WATER	S	F	D	A	[Next Sampling due in 2017]											
RADIUM 226 & RADIUM 228																	
10000	NRHS FINISHED WATER	S	F	D													X
10001	DISTRICT G FINISHED WATER	S	F	D													X
SECONDARY CONTAMINANTS																	
10000	NRHS FINISHED WATER	S	F	D		[DEP recommends annual testing]											
10001	DISTRICT G FINISHED WATER	S	F	D		[DEP recommends annual testing]											
SYNTHETIC ORGANIC COMPOUNDS																	
10000	NRHS FINISHED WATER	S	F	D	A												X
10001	DISTRICT G FINISHED WATER	S	F	D	A												X

R/F = RAW OR FINISHED WATER; D/S = DISTRIBUTION OR SOURCE SAMPLE Waiver: (Y)es, or (N)o MULT/SIN: (MULT)iple sources or a (SIN)gle source

Required Water Quality Sampling Schedule Frequency For **2014** To **2016**

PWS ID **4086095** PWS Name **TOWN OF EASTHAM** Town: **EASTHAM** Class: **COM**

BACTERIA SAMPLING

Apr - Sep: 3 per MONTH
Oct - Mar 2 per MONTH

Season Start Date: 01/01
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Loc ID #	SAMPLE LOCATION	MULT/SIN	R/F	D/S	WAIVER Y / N	2014 QTR1	2014 QTR2	2014 QTR3	2014 QTR4	2015 QTR1	2015 QTR2	2015 QTR3	2015 QTR4	2016 QTR1	2016 QTR2	2016 QTR3	2016 QTR4
TRIHALOMETHANES																	
100010	WILD CARE	S	F	D		[Next Sampling due in 2017]											
VOLATILE ORGANIC COMPOUNDS																	
10000	NRHS FINISHED WATER	S	F	D	A												X
10001	DISTRICT G FINISHED WATER	S	F	D	A												X

R/F = RAW OR FINISHED WATER; D/S = DISTRIBUTION OR SOURCE SAMPLE Waiver: (Y)es, or (N)o MULT/SIN: (MULT)iple sources or a (SIN)gle source

TOWN OF EASTHAM

2500 State Highway, Eastham, MA 02642
All Departments 508-240-5900
www.eastham-ma.gov

October 31, 2016

To: Board of Selectmen

From: Sheila Vanderhoef, Town Administrator

Re: Staff Appointment- Carrie DeAngelo, Patrolman

You are hereby notified of the following staff appointment in accordance with the Town of Eastham Home Rule Charter, **§C4-4-D-Powers of Appointment.**

Consistent with that section, you now have fifteen (15) days following the date on this notice to reject any such appointment.

Staff Appointment

Effective October 31, 2016
Carrie DeAngelo. Patrolman

Thank you.

EASTHAM POLICE DEPARTMENT

2550 State Highway • Eastham, MA 02642
508-255-0551 • Fax: 508-255-5412

EDWARD V. KULHAWIK
Chief of Police

KENNETH J. RODERICK
Deputy Chief

October 31, 2016

To: Sheila Vanderhoef, Town Administrator
Board of Selectmen

From: Edward V. Kulhawik
Police Chief

Would you please appoint the following person to the Police Department for the term indicated below:

Carrie De'Angelo	Police Officer, Harbormaster, Constable	10-31-16 to 06-30-17

approved
10-31-2016
Sheila Vanderhoef

East Ham Town Hall London E6 2RP England Opened 1903 By Passmore Edwards

Courtesy of a visitor from East Ham, England

East Ham Library Built 1903 East Ham Technical Collage (Now East ham Campus) Originally built Mid 1960

Bus info 11/7

TOWN OF EASTHAM

2500 State Highway, Eastham, MA 02642
All Departments 508-240-5900
www.eastham-ma.gov

Date: October 26, 2016

Memo To: Eastham Board of Selectmen

Memo From: Sheila Vanderhoef

Re: Nickerson Gas Station License

At your meeting on October 3, 2016, you voted to proceed with the process to revoke the Nickerson Gas Station License.

Since that time, Bruce MacGregor has advised Chief Kent Farrenkopf that he will be removing the tanks at the Nickerson Gas Station. Therefore, to process to revoke the license is not needed at this time.