Southern Maine Planning and Development Commission:
Examining the Feasibility of Purchasing and Operating Hydraulic Dredging Equipment in Southern Maine

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EXECUTIVE SUMMARY

- Given the scope of the initial dredge purchase feasibility study, it appears that there is sufficient need for dredging and a sufficient quantity of sandy material within the 10 Federal navigation channels in southern Maine to continue evaluating a regional dredge purchase.
- The Preliminary Data Collection Survey revealed that 3 municipalities in the SMPDC region are experiencing acute hazards to navigation and public safety within their respective Federal navigation channels. An additional 5 municipalities in the SMPDC region are working to schedule or have scheduled ACOE maintenance dredging.
- The Preliminary Data Collection Survey revealed that a significant number of moorings, commercial fishing vessels, charter boat operations, and recreational boats are dependent on safe and navigable waterways in the SMPDC region.
- A review of historic dredging events in the SMPDC region revealed that the 10 Federal navigation channels have been dredged a total of 120 times since 1949, generating nearly 3.5 million c.y. of material.
- Since the year 2000 the Barnstable County Dredge, which was used as a model for this feasibility study, has pumped 1,497,101 c.y. of sandy, beach compatible material. An average of 93,569 c.y. annually.
- The Barnstable County Dredge Program has consistently dredged sandy, beach compatible material at 38-68% below the market rate.
- The purchase of dredging equipment using capital grant funding allowed Barnstable County to quickly establish a reserve fund, allowing repairs to be made and new dredging equipment to be purchased in 2017.
- A hydraulic cutter suction pump dredge, similar to the equipment used in Barnstable County, optimizes the cost of pumping sandy, muddy, and fine-grained material, but does not allow gravel or cobble to be pumped efficiently.
- Muddy and fine-grained materials that are not suitable for beach nourishment require specialized dewatering equipment and disposal methods.
- It should be noted that the Barnstable County Dredge has completed projects that have fine-grained sediment but they receive a lower priority based on the difficulty of setting up dewatering locations.
- Based on the Barnstable County model, it would cost approximately $3.25 million dollars to purchase similar hydraulic dredging and ancillary equipment for use in southern Maine.
- Based on the Barnstable County model, it would cost approximately $700k annually to staff, fuel, insure, and maintain dredging operations in southern Maine.

- If regional dredging equipment were purchased using a capital grant, the lowest-cost scenario identified in this study, a minimum dredge rate of $10 - $12 per c.y. would be needed to cover annual expenses. This rate is based on an estimated production rate of approximately 60,000 c.y. of sandy material dredged annually and does not include additional costs associated with dewatering and disposing of muddy and/or fine-grained material.
- Increasing the minimum dredge rate by $2 - $4 per c.y. would allow for the establishment of a reserve fund to:
    - Pay down any loans or debts incurred during the procurement period;
    - Prepare for the repair and/or replacement of aging equipment.
- Calculations in this report used a composite of total sandy material (%) for volume and economic estimates. This was a simple approach using available data. A mixed source (say, sand and mud) cannot be dredged and sorted so that some of it goes on a beach and some goes elsewhere. Mixed sediments might incur additional costs for dewatering, trucking, and upland disposal or, alternatively, placement on a barge and towed to an offshore disposal site. The cost estimate using a percentage approach may be an underestimate of the cost per cubic yard because not all projects would be pumping and shaping sand onto a beach with the equipment described.

1.0 INTRODUCTION

The Need for Dredging in Southern Maine:

Maine's southern coastline is dominated by miles of sandy beaches and harbors, which serve as the economic backbone of the region by drawing in vital tourism dollars and supporting a mix of marine-related industry and commercial fishing. In 2015, an estimated 12 million visitors came to Maine's beaches and spent $1.61 billion. Many local businesses are dependent on the seasonal influx of visitors and tourism dollars. Without well-maintained harbors and healthy beaches, commercial and recreational boat traffic cannot navigate waterways and tourists may choose to spend their money elsewhere, impacting not only the region, but the State as a whole with lost critical revenue and business.

Numerous harbors and rivers in the region require routine maintenance dredging to ensure they are navigable by maritime commercial interests, fishermen, and recreational boaters. High demand, lack of funds, and limited availability of dredging equipment have caused significant delays, often of years, to many of these much-needed dredging efforts. Furthermore, many of the region's beaches are vulnerable to loss of sand from increases in sea level, increased frequency and intensity storm events, and seasonal erosion and would benefit from periodic nourishment with sandy sediment dredged from local navigation channels. The Protecting Maine's Beaches for the Future: 2017 Update recognizes the need for up to 10,000,000 cubic yards (c.y.) of beach nourishment over the next 20 years, but as with the maintenance of local harbors and rivers, these potential nourishment projects are substantially hindered by a lack of dredging resources.

There are 64 existing Federal navigation projects in Maine in varying degrees of permitting and readiness, a number of these projects are awaiting Federal funds to support dredging activities by the Army Corps of Engineers (ACOE). In York County and the Town of Scarborough, these projects include the Saco River, Wood Island Harbor, Cape Porpoise Harbor, the Kennebunk River, Wells Harbor, Josias River (Perkins Cove), York Harbor, Pepperell Cove, the Piscataqua River (Maine Shore), and the Scarborough River (Pine Point Harbor), respectively.

Many of these harbors and rivers, although permitted and authorized, have been waiting for Federal appropriation to support dredging activities. For example, York Harbor, which was last dredged in 1996 by ACOE contractors, is fully permitted by the ACOE for dredging 40,000 to 50,000 c.y. of material; however, the Town of York waited from the fall of 2015 until spring of 2018 for ACOE dredging funds to be appropriated. Delays such as these highlight the need to investigate alternative means, to supplement Federal action, for undertaking critical dredging activities in the southern Maine region.

Grant Opportunity:

Based on the significant dredging needs of southern Maine coastal communities and lack of available Federal dredging resources to adequately address those needs, Southern Maine Planning and Development Commission (SMPDC) partnered with the Woods Hole Group and the coastal communities of Biddeford; Kittery; Kennebunk; Kennebunkport; Ogunquit; Old Orchard Beach; Saco; Scarborough; York; and Wells to pursue grant funding to conduct a methodical assessment of the feasibility of purchasing and operating a regional dredge.

The Shore and Harbor Planning Grants Program (SHPG), administered by the Maine Coastal Program (MCP), housed within the Maine Department of Marine Resources, offered a fitting opportunity to support the investigation of a regional dredging program. The SHPG provides funding to promote sound waterfront planning, harbor management, and balanced development of shore and harbor areas to improve marine infrastructure and assure access to the shore. The competitive grant program, which is funded by monies provided to MCP by the National Oceanic and Atmospheric Administration (NOAA), provides up to $30,000 for municipal and regional projects in coastal Maine.

The Question:

The central question this project aims to address is whether or not a regionally owned, operated, and managed hydraulic dredge could be a cost effective and efficient means of meeting southern Maine's dredging needs. Using the Barnstable County, Massachusetts Regional Dredge Program as a model, project partners examined southern Maine's historical dredging activities and anticipated future dredging needs to conduct a feasibility analysis, including a financial cost/benefit study, to determine whether the purchase of a hydraulic dredge on a regional scale can provide an efficient and environmentally sustainable method of dredging waterbodies and nourishing local beaches, where appropriate.

Project partners conducted significant outreach to coastal municipalities, regulatory bodies, scientists and others to collect and compile local data and historical information on dredging in the region. Operational and financial data of a regional dredge operation were developed based on the experience of the Barnstable County Dredge Program as well as financial models to determine appropriate cost and benefit factors. Using these data, an initial assessment of the capital outlay that will be required to obtain the dredge and how quickly that investment might be recovered was developed. A return on investment curve, including initial investment costs, annual operating costs, and maintenance and repair costs, was also developed to inform project findings and recommendations.

Summary of Tasks Assigned to Woods Hole Group:

Woods Hole Group, an international environmental services and products organization headquartered in Bourne, Massachusetts, was contracted by the Southern Maine Planning and Development Commission to investigate the feasibility of owning and operating a regional dredge in southern Maine. Working across a collaborative network of local and regional partners, Woods Hole Group completed the following 7 Tasks, which are described in more detail in Chapters 2-7:

Task 1. Meetings and Project Coordination

This task included an on-site kickoff meeting with the Sothern Maine Planning & Development Commission (SMPDC), municipal partners, State officials, and representatives from the Woods Hole Group. The meeting was held at the SMPDC office in Saco, Maine on September 26, 2017. In addition to the kick-off meeting, a representative from the Woods Hole Group attended the Maine Dredging Team Meeting held on October 18, 2017 in Portland, ME to introduce the project to regional authorities and stakeholders.

Task 2. Maine Dredging and Disposal Data Collection

Woods Hole Group worked with representatives from the SMPDC to develop a Preliminary Data Collection Survey designed to generate a baseline dataset for each municipal partner. The Survey included questions regarding historic quantities dredged, dredging location, dredged sediment types, and disposal locations. The Survey was standardized to help ensure that the data received was be similar in nature. Once responses were received, the data was compiled. The Woods Hole Group also reached out to State and Federal agencies including the Maine Geological Survey and the United States Army Corps of Engineers New England District Office to supplement these data. These data were used to develop a record of historic dredging events in southern Maine and to estimate the quantities that a municipal dredge might be expected to dredge in a given year.

Task 3. Develop Operational and Financial Data from the Barnstable County Dredge

The Woods Hole Group facilitated on-site meetings with representatives from the SMPDC, the Town of Chatham, Massachusetts, and the Barnstable County Dredging Team on January 24, 2018 to discuss the Barnstable County Dredge Program. Woods Hole Group and members of the SMPDC were also present for the Barnstable County Dredge Advisory Board Meeting held on January 25, 2018. Following the on-site meetings, Woods Hole Group developed a comprehensive list of dredging and ancillary equipment costs required to operate a municipal dredging program. The Woods Hole Group also researched the model Barnstable County used to recoup their initial costs and fund day-to-day operations.

Task 4. Develop Operational Costs Forecast for the SMPDC

The data obtained in Task 3 was compiled and used to determine the most efficient equipment necessary to fulfill southern Maine's regional dredging needs. Task 4 also considered and incorporated all ancillary costs associated with a dredge, including labor costs, mobilization/demobilization costs, and fuel costs into the operational costs forecast.

Task 5. Feasibility Assessment

The data obtained in Tasks 1 through 4 was used to develop an initial cost assessment to determine the capital outlay that would be required to obtain the dredge and all ancillary equipment and assess how quickly the initial investment could be recovered.

Task 6. Final Report

A final report was generated to document the data obtained in Tasks 1 through 5, outline the assumptions that were made in generating these data, and provide recommendations to the SMPDC and municipal partners.

Task 7. Project Management

This final task provided time for the Woods Hole Group project team to communicate with the SMPDC and the project stake holders, helping to keep the project team up-to-date on project deliverables and to complete administrative tasks not included in the previous tasks.

2.0 MUNICIPAL OUTREACH CAMPAIGN

The Woods Hole Group and representatives from the Southern Maine Planning and Development Commission (SMPDC) identified 11 municipalities within the SMPDC region, each with a vested interest in maintaining safe and navigable waterways and productive coastal resource areas. The 11 municipalities included Scarborough, Cape Elizabeth, Old Orchard Beach, Saco, Biddeford, Kennebunkport, Kennebunk, Wells, Ogunquit, York, and Kittery. A total of 10 Federal navigation projects, maintained by the United States Army Corps of Engineers, were located within or bordering the municipalities identified in this study. The 10 waterbodies identified as Federal navigation projects include the Scarborough River – Pine Point Harbor, the Saco River, Wood Island Harbor, the Kennebunk River, Wells Harbor, Josias River – Perkins Cove, York Harbor, Pepperell Cove, and the Piscataqua River (Maine Shore), respectively. A summary of the municipalities and associated Federal navigation projects is provided in Table 1. Figure 1 provides a locus map of all municipalities and navigation channels in the study region.

Table 1. Municipalities and associated Federal navigation projects within the SMPDC region, York and southern Cumberland County, Maine.

Municipality	Federal Navigation Project
Scarborough; Cape Elizabeth	Scarborough River – Pine Point Harbor
Saco; Biddeford	Saco River
Saco; Biddeford	Wood Island Harbor
Kennebunkport	Cape Porpoise Harbor
Kennebunk	Kennebunk River
Wells	Wells Harbor
Ogunquit	Josias River – Perkins Cove
York	York Harbor
York; Kittery	Pepperell Cove
Kittery	Piscataqua River (Maine Shore)

On September 26, 2017, a project kick-off meeting was held at the SMPDC headquarters in Saco, Maine. Of the 11 municipalities invited to attend, Scarborough, Kennebunk, Kennebunkport, Wells, and Saco were in attendance. State officials from the Maine Department of Transportation and the Maine Geological Survey were also present. The meeting provided the project partners with an opportunity to present a series of Tasks that would be allocated to the Woods Hole Group over the coming year, discuss historic and current dredging practices in the State of Maine, and discuss the need for a municipal outreach campaign to develop a baseline dataset of channel

characteristics, historic dredging practices, and future dredging needs. State officials emphasized the importance of Federal navigation channels to commerce and recreation, the complicated nature of dredging private channels, turning basins, and marinas outside Federal channels, inconsistencies between permitted and actual dredged volumes, and the recent political pressure advocating for safe and navigable waterways, which has drawn the attention of State and Congressional leaders. Kick-off meeting minutes are provided in Appendix A.

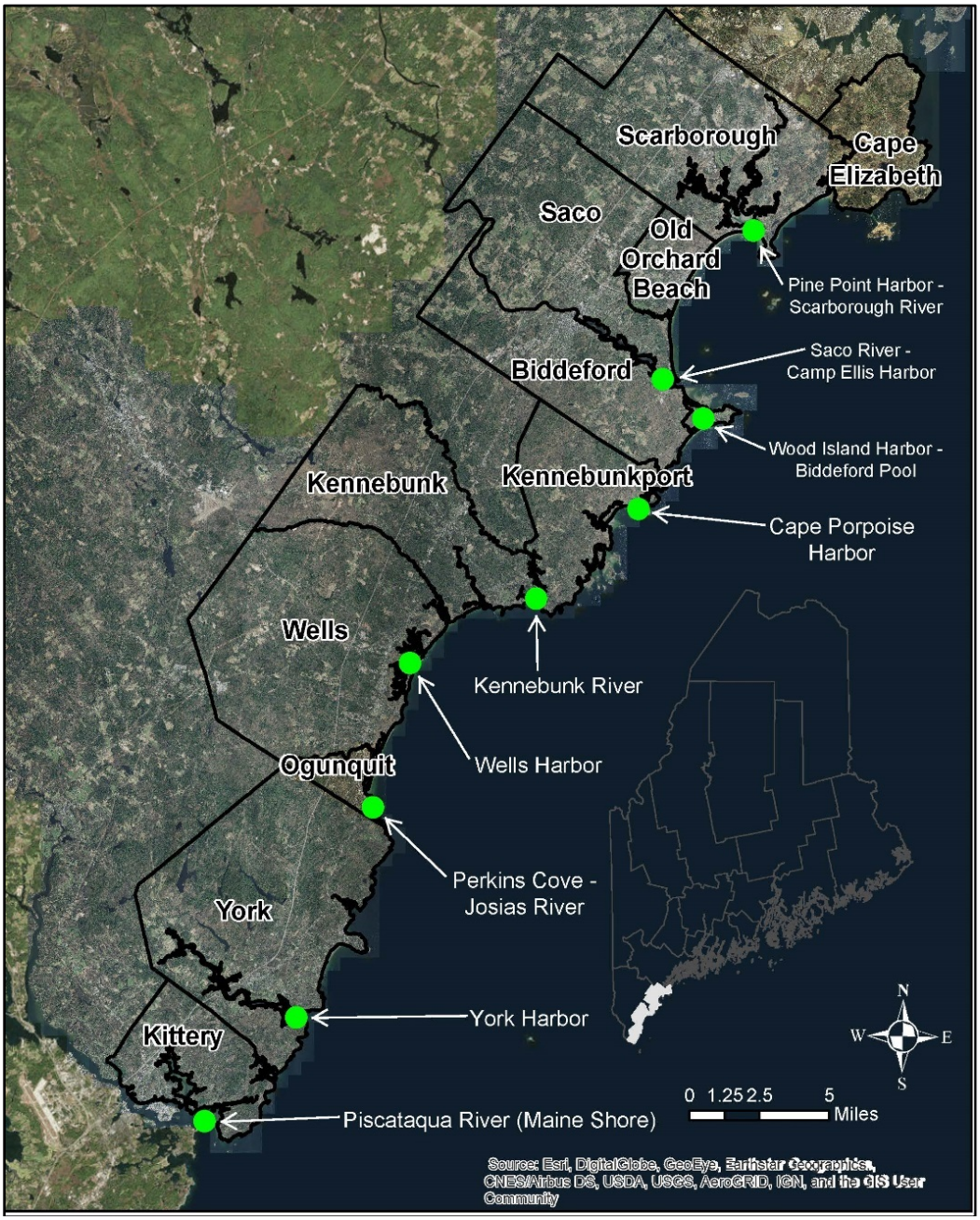

Figure 1. Locus map of municipalities located in the study area.

Following the meeting, Woods Hole Group worked with representatives from the SMPDC and municipal officials to develop a Preliminary Data Collection Survey designed to generate a baseline dataset for each municipality. The Survey included questions regarding the location of the navigation channel, historic dredging practices, funding sources, quantities dredged, and disposal location, dredged sediment types, average period of time between dredging events, and questions regarding dredge channel features and usage. The Survey was standardized to help ensure that the data received from each municipality would be similar in nature and was distributed the week of November 12, 2017. Once responses were received, the data was compiled and archived. Appendix B provides a copy of the Preliminary Data Collection Survey.

With the help of the SMPDC, Woods Hole Group distributed the Preliminary Data Collection Survey to the 11 municipalities. A total of 7 responses were received (Scarborough, Saco, Kennebunkport, Kennebunk, Wells, Ogunquit, and Kittery). All responses were prepared by municipal Harbormasters, except for the City of Saco, whose response was prepared by the Director of the Department of Public Works. Survey responses from participating municipalities are summarized below. A matrix, containing all survey responses is included in Appendix C.

Town of Scarborough

The Scarborough River contains an internal Federal navigation channel and was last dredged in 2015 using a Federal funding source. Mr. Ian Anderson, Harbormaster, indicated that historic dredging activities have kept the channel safe and navigable, but that additional dredging will be required within the River over the next 2 years. Although the Scarborough River has not yet been added to the ACOE dredge schedule, the pre-dredge survey has been completed and the project has been added to the ACOE list for consideration. Once scheduled, it is expected that the dredging will once again be completed using a Federal funding source. According to the Harbormaster, the depth required for safe passage within the navigation channel is -8.0 feet Mean Lower Low Water (MLLW), which will require the removal of both sandy and muddy sediments from the waterway. Historically, dredged material was barged and dumped offshore, or pumped to nearby beaches for beneficial reuse.

The Town of Scarborough reported the presence of a public mooring field adjacent to the Federal navigation channel with an estimated 50 to 60 public moorings that require periodic dredging. The Harbormaster estimated that 25 to 30 commercial fishing vessels and an additional 15 charter boats utilize the channel when in-season. In addition to commercial fishing operations, the Scarborough River also represents a valuable resource to recreational boaters, with an estimated 40 to 50 recreational vessels regularly operating within the navigation channel. Recreational and commercial vessels utilizing the Scarborough River average 25 to 30 feet in length, with an average draft of 4 to 5 feet. The harbormaster estimated that the channel could safely accommodate boats to 50 feet in length overall (LOA). The location of the Federally maintained navigation channel in the Scarborough River – Pine Point Harbor is shown in Figure 2.

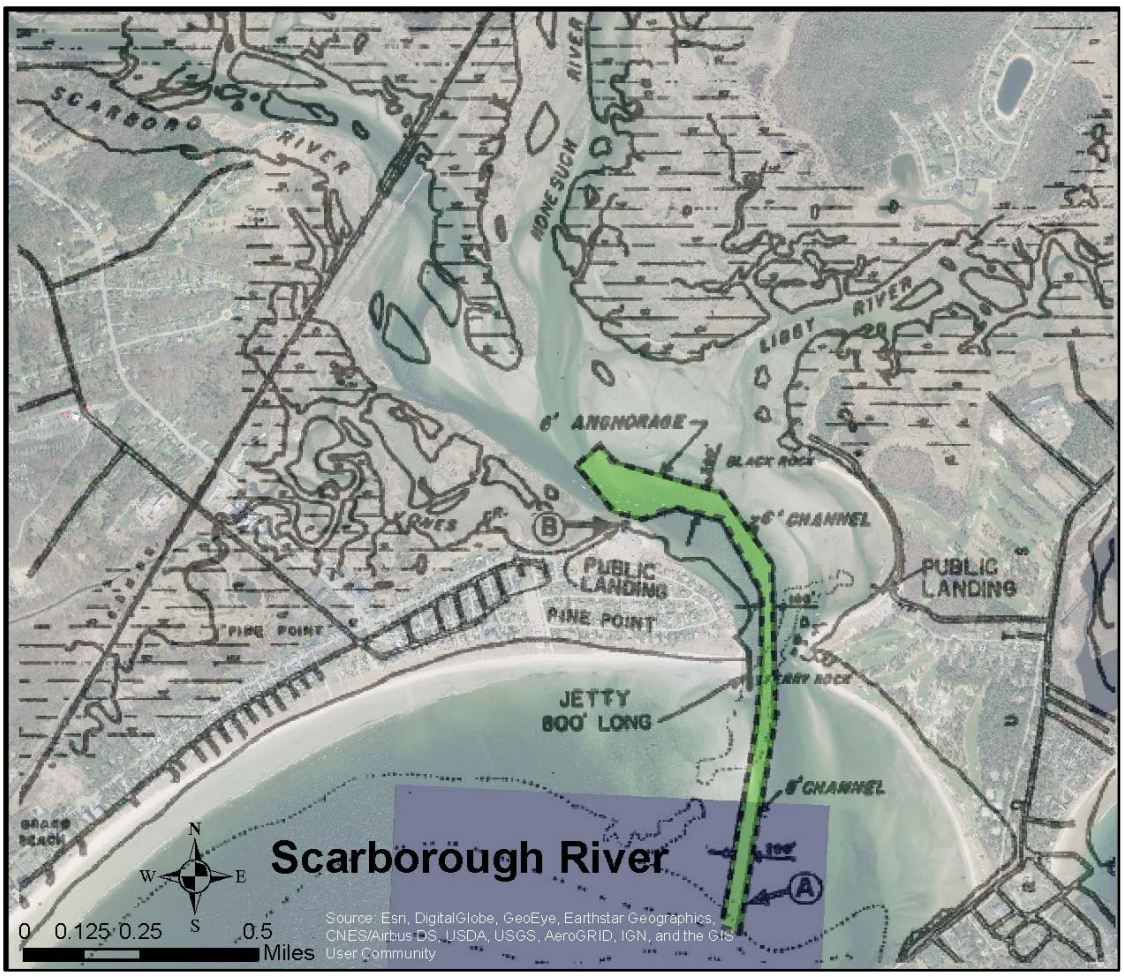

Figure 2. Location of the Federal navigation channel in the Scarborough River – Pine Point Harbor, Scarborough, Maine. Historic channel map lifted from 1994 ACOE Dredged Material Management Study.

City of Saco

The Saco River, with its internal Federally-managed channel was identified as the primary navigation channel within the City. Mr. Patrick Fox, Director of the Department of Public Works, also noted the presence of economically important private anchorages adjacent to the primary navigation channel which require periodic dredging. The last ACOE dredging event in the Saco River took place in the 1990's and was completed using Federal funding. According to City officials, the period of time since the last ACOE dredging event has not keep the channel safe and navigable for commercial and recreational boat traffic. Given the deterioration of conditions within the channel, a new Federally-funded maintenance dredging project commenced during the winter of 2017-2018. However, the project could not be completed in its entirety due to buried obstructions encountered near the head of tide and turning basin. Mr. Fox reported that the depth required for safe passage is -8.0 feet MLLW and that the sediment type is primarily sand. Historically, the dredged material was either disposed of in-river or beneficially reused as beach nourishment.

The City of Saco identified the presence of a turning basin adjacent to the existing navigation channel, as well as public and private mooring fields that require dredging. Four private marinas and a public marina provide safe harbor to over 200 commercial and recreational vessels, access to 3 boat ramps, and access to a public pier. Figure 3 shows the location of the Federally maintained navigation channel in the Saco River.

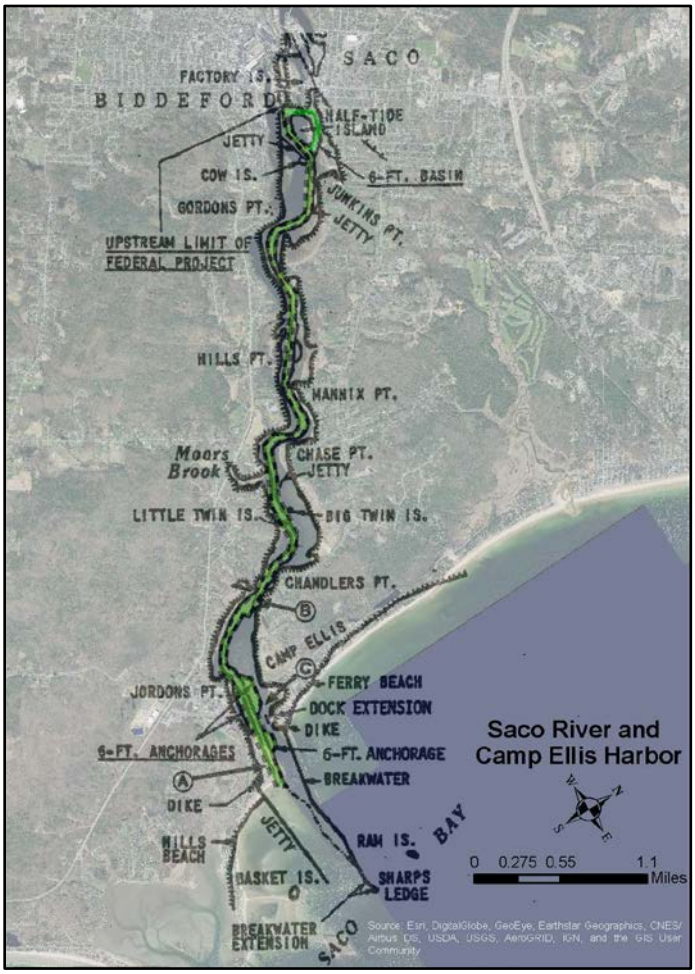

Figure 3. Location of the Federal navigation channel in the Saco River, Saco, Maine. Historic channel map lifted from 1994 ACOE Dredged Material Management Study.

Town of Kennebunkport

The Town of Kennebunkport identified the interior Federal navigation channel into Cape Porpoise Harbor as the Town's primary navigation channel. The channel was last dredged in 1974 – 1975 by the ACOE using a Federal funding source. Given the period of time since the last dredging event, Mr. Lee McCurdy, Harbormaster, reports that the channel is no longer safe and navigable to boat traffic. As a result, the channel is scheduled to be dredged by the ACOE in 2018, again using a Federal funding source. Mr. McCurdy reported that the depth required for safe passage

into and out of Cape Porpoise Harbor is -6.0 feet MLLW, that the channel bottom is primarily mud. Offshore disposal was identified as the historic and preferred method of disposal.

Cape Porpoise Harbor does not contain a turning basin, though it does contain a public mooring field that requires dredging. The Harbor supports 50 commercial fisherman and at least thirty 30 recreational vessels with an average LOA between 25 and 30 feet and an average draft of 4 feet. The Harbormaster reported that the channel can accommodate a maximum vessel length of 49 to 50 feet LOA. The location of the Federally maintained navigation channel in Cape Porpoise Harbor is shown in Figure 4.

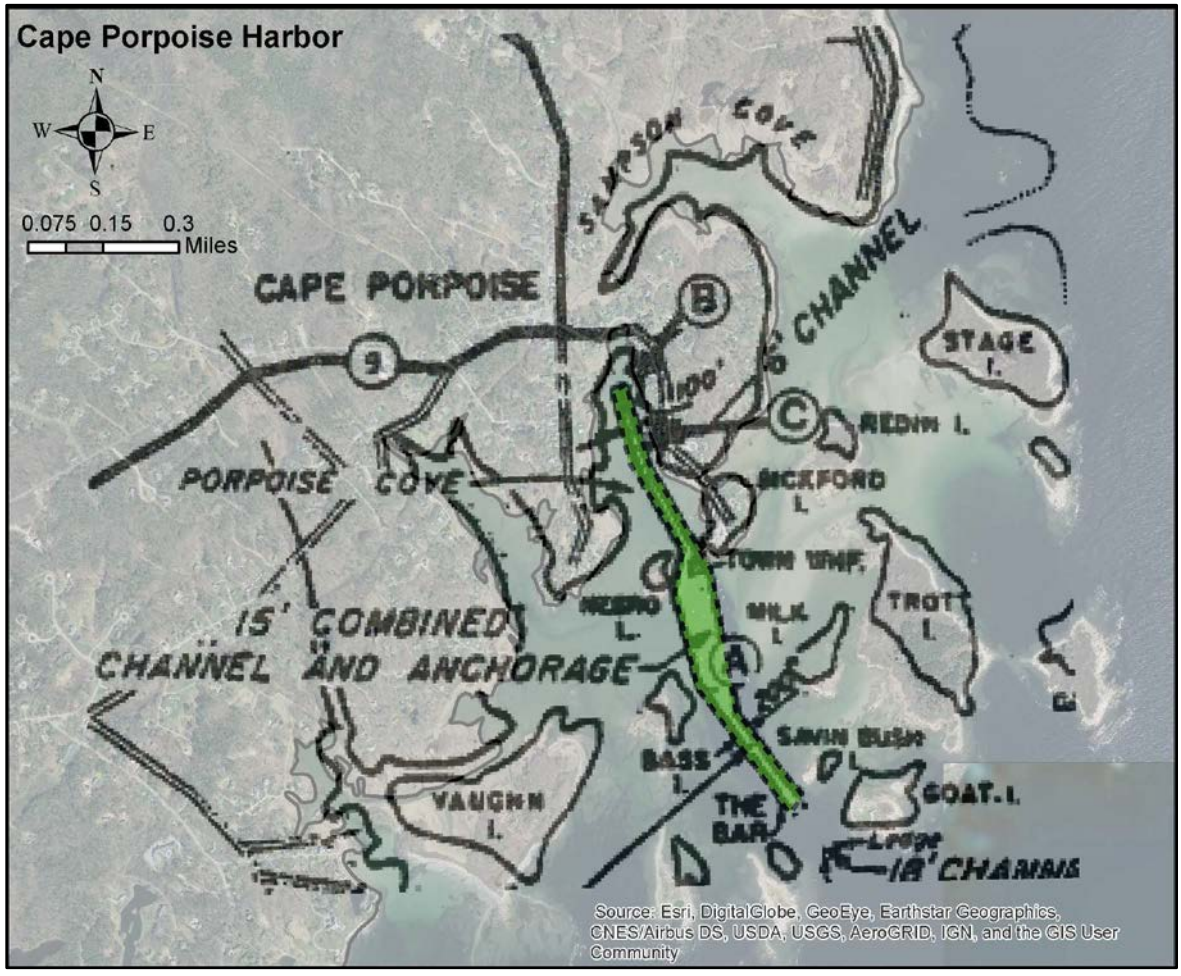

Figure 4. Location of the Federal navigation channel, Cape Porpoise Harbor, Kennebunkport, Maine. Historic channel map lifted from 1994 ACOE Dredged Material Management Study.

Town of Kennebunk

Mr. James Black, Harbormaster, identified the interior channel of the Kennebunk River as the primary navigation channel within the Town of Kennebunk. Historically, the entire length of the channel was managed by the ACOE, though now a section of channel from the Arundel Yacht Club to Lanigan Bridge has been de-authorized by the ACOE and has become the responsibility of the Town. As a result, previous dredging events have utilized a combination of Federal and municipal funding. The last dredging event took place in 1998 and according to the Harbormaster, has kept the channel safe and navigable to commercial and recreational boat traffic.

At the beginning of 2018, The Town of Kennebunk was preparing to start the ACOE process of scheduling a maintenance dredging event. It is expected that any maintenance dredging will be funded using a combination of Federal and municipal sources. The Harbormaster reports that the depth for safe passage within the navigation channel is -6.0 feet MLLW and that the channel contains both mud and silt, with some sand present at the entrance to Government Wharf. Historic dredged materials were either beneficially reused as beach nourishment or barged for offshore disposal.

The Kennebunk River does not contain a dedicated turning basin, though it does contain a public mooring field that requires periodic dredging. The public mooring field contains a total of 68 moorings. Additional boat storage and dockage area available at private marinas located along the River, which are dredged and maintained at a private cost. The Kennebunk River supports 12 to 18 commercial vessels and an additional 4 to 12 charter boat operations. Two-hundred-fifty to 300 recreational craft regularly utilize the waterway. The Harbormaster reports that the commercial and recreational vessels have an average LOA of approximately 30 feet and an average draft of three 3 feet. The Harbormaster reports that the navigation channel can accommodate very large vessels to 145 feet at mean high water. The location of the Federally maintained navigation channel in the Kennebunk River is shown in Figure 5.

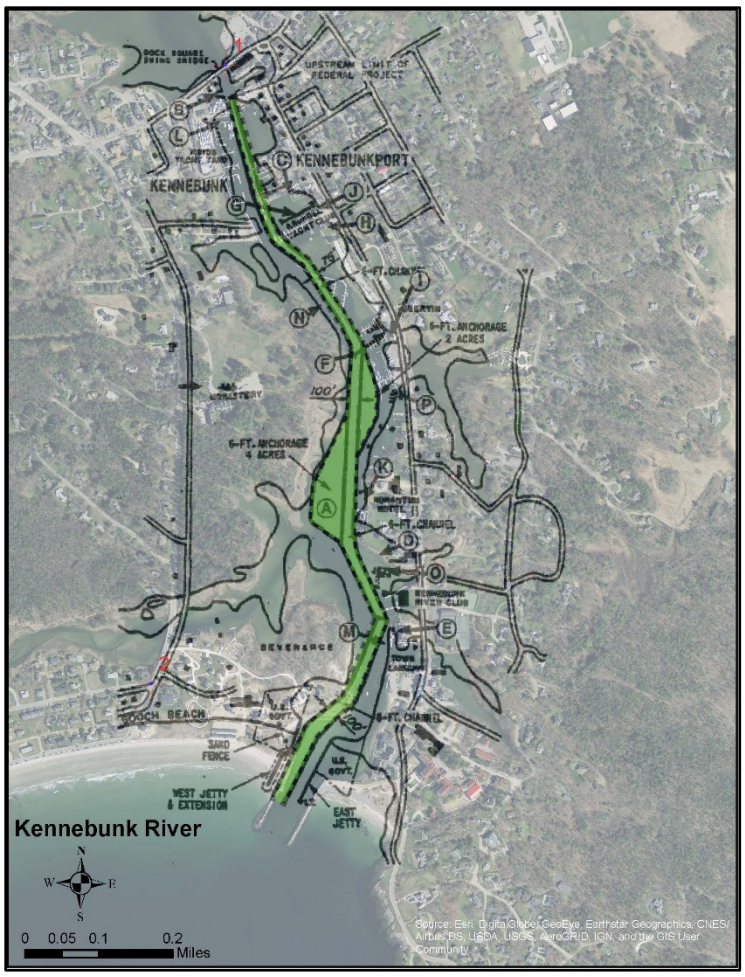

Figure 5. Location of the Federal navigation channel in the Kennebunk River, Kennebunk, Maine. Historic channel map lifted from 1994 ACOE Dredged Material Management Study.

Town of Wells

The Town of Wells identified Wells Harbor and the internal and external channels of the Webhannet River as the primary navigation channels located within the Town. Mr. Chris Mayo, Harbormaster, reported that the primary navigation channels are Federally managed, while sub-channels and sub-basins are maintained by municipal and private entities. Historic dredging of the primary navigation channel has been completed using a combination of Federal and municipal funding. The Harbormaster reported significant shoaling has occurred since the last Federal navigation project was completed in 2014. Dredging is now required annually to maintain a safe and navigable channel. To combat extensive shoaling, the most recent dredging project commenced in June 2018 using a Federal funding source. The depth for safe passage within the channel is reported to be -6.0 feet MLLW. The sandy sediments within and adjacent to the navigation channel have historically been beneficially reused as beach nourishment.

Wells Harbor contains a public mooring field with tackle for 150 vessels. The public mooring field and adjacent public marina, with 88 slips and 62 moorings, also require frequent dredging. Wells Harbor contains no dedicated turning basin. The Harbormaster reports that Wells Harbor supports a commercial fishing fleet of 25 vessels and 15 charter boats with an additional 150 recreational vessels regularly utilizing the navigation channel. The average LOA of commercial and recreational vessels operating out of Wells Harbor is 28 feet, with an average draft of 3 feet. Wells Harbor, and the associated internal and external navigation channels can accommodate vessels up to 38 feet LOA. The location of the Federally maintained navigation channel in the Town of Wells is shown in Figure 6.

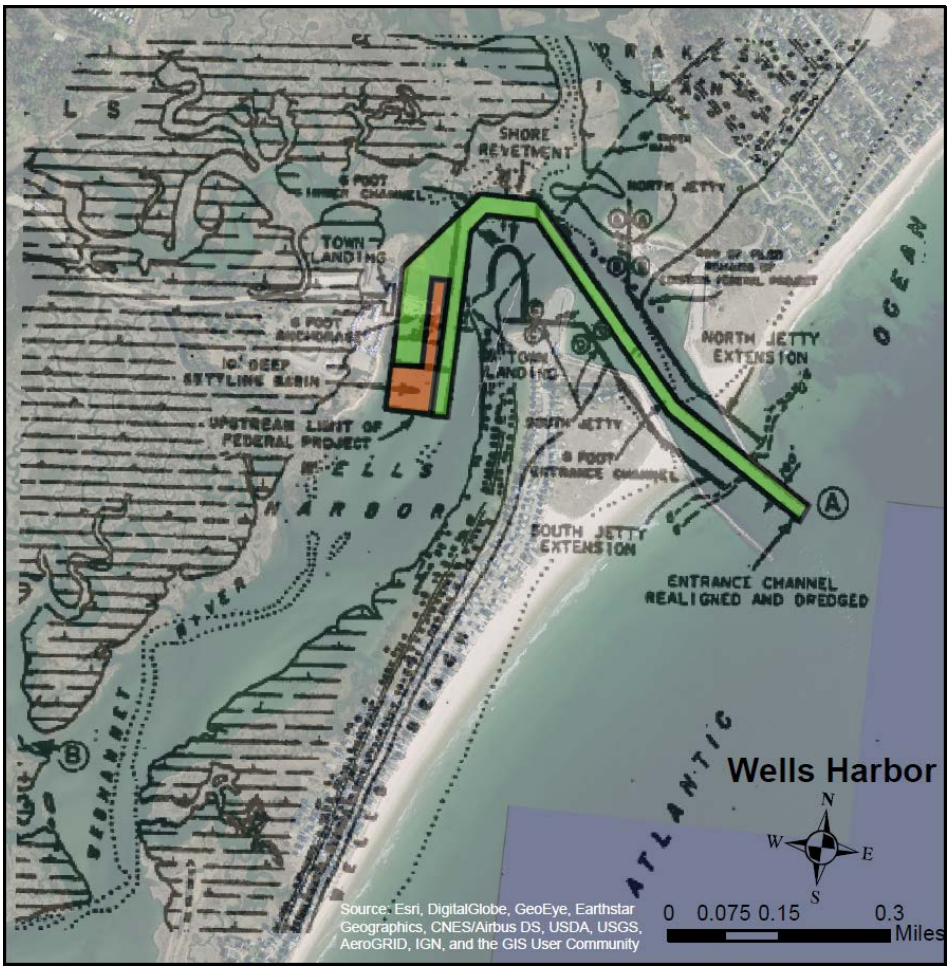

Figure 6. Location of the Federal navigation channel (green) and central flood delta conservation easement (orange) Wells Harbor, Wells, Maine. Historic channel map lifted from 1994 ACOE Dredged Material Management Study.

Town of Ogunquit

Mr. Fred Mayo, Ogunquit Harbormaster, reported that the primary navigation channel in Town is the Josias River, which contains an internal Federally managed channel. The channel was last dredged in 1994, using a Federal funding source. The Harbormaster reports that historic dredging

projects have kept the primary channel safe and navigable to boat traffic. The channel is not scheduled to be dredged, though Federal funding would drive any future maintenance dredging. The depth required for safe passage within Josias River is -6.0 feet MLLW, the primary sediment type within the channel is mud, and dredged materials have historically been barged for offshore disposal.

Josias River contains no dedicated turning basin, although the river does contain a public mooring field for 74 vessels as well as a public marina, which require periodic dredging. The Harbormaster reports that 26 commercial fishing boats and 8 charter boats operate out of Josias River. On busy days, an additional 40 recreational craft regularly utilize the navigation channel. The average LOA of boats operating within Josias River is 32 feet, with an average draft of 3 feet. Josias River can support vessels up to 42 feet LOA. The location of the Federally maintained navigation channel in Josias River – Perkins Cove is shown in Figure 7.

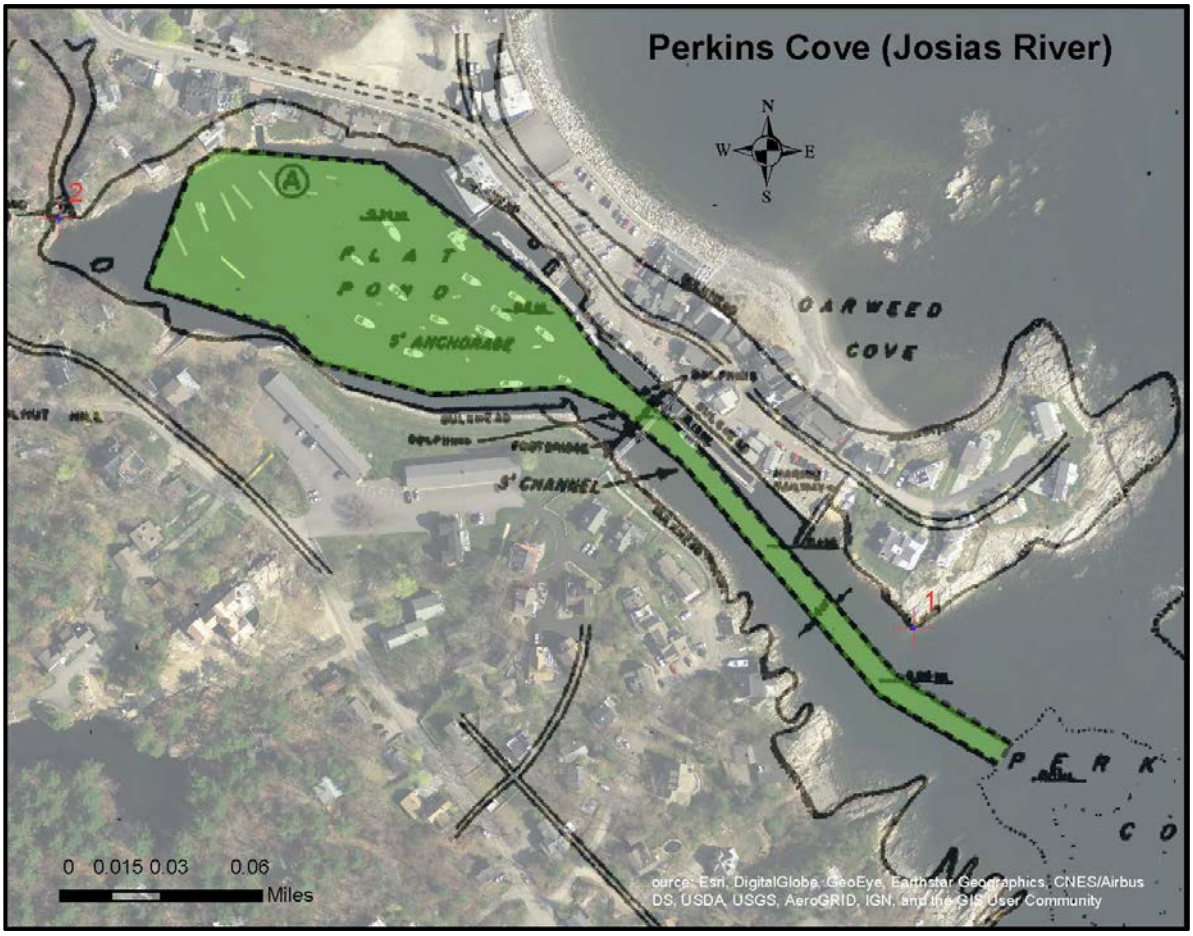

Figure 7. Location of the Federal navigation channel, Josias River – Perkins Cove, Ogunquit, Maine. Historic channel map lifted from 1994 ACOE Dredged Material Management Study.

Town of Kittery

The Town of Kittery provided a brief response to the survey, identifying Pepperrell Cove as the primary internal navigation channel within the Town. Harbormaster Scott Alessi reports that Pepperrell Cove has not been regularly dredged and is not scheduled to be dredged. Alessi reports that the depth required for safe passage into and out of the cove is approximately -12.0 MLLW feet and that the bottom sediments are primarily mud.

Pepperrell Cove contains both a private mooring field and a public marina. The Harbormaster reports that neither the mooring field, nor the marina require regular dredging. The Cove is home to 39 commercial fishing vessels and 6 charter boats. Up to 200 recreational vessels regularly utilize the Cove and the navigation channel for safe passage. The average length of vessels operating out of Pepperrell Cove is reported to be 30 feet with an average draft of 5 feet.

Additional Imagery

The location of the remaining Federal navigation channels in Biddeford (Wood Island Harbor), York (York Harbor), and Kittery (Piscataqua River – Maine Shore and Pepperrell Cove) are illustrated in Figures 8, 9, and 10, respectively. All updated imagery of Federal navigation channels in the southern Maine region historic channel maps and layouts lifted from the 1994 Army Corps Dredged Material Management Study for Maine-New Hampshire.

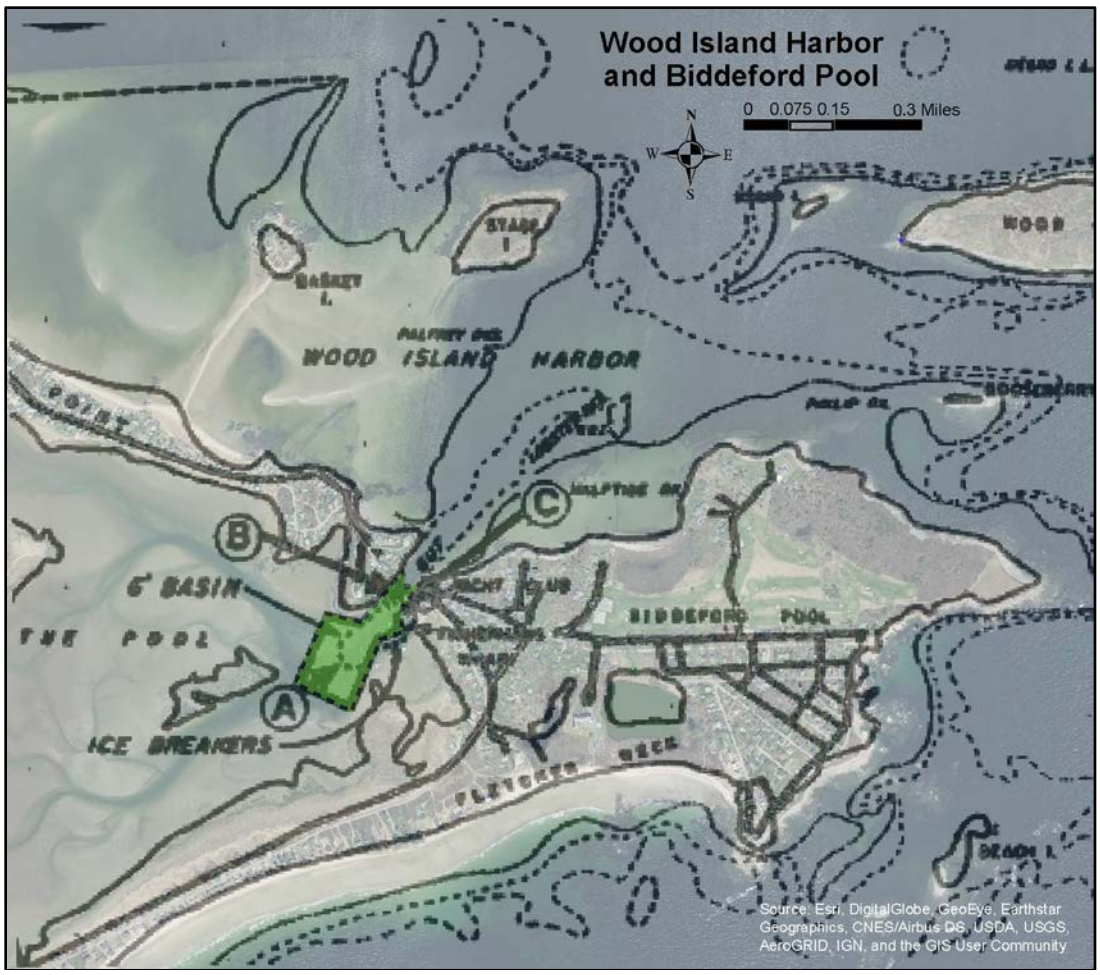

Figure 8. **Location of the Federal navigation channel, Wood Island Harbor, Biddeford, Maine. Historic channel map lifted from 1994 ACOE Dredged Material Management Study.**

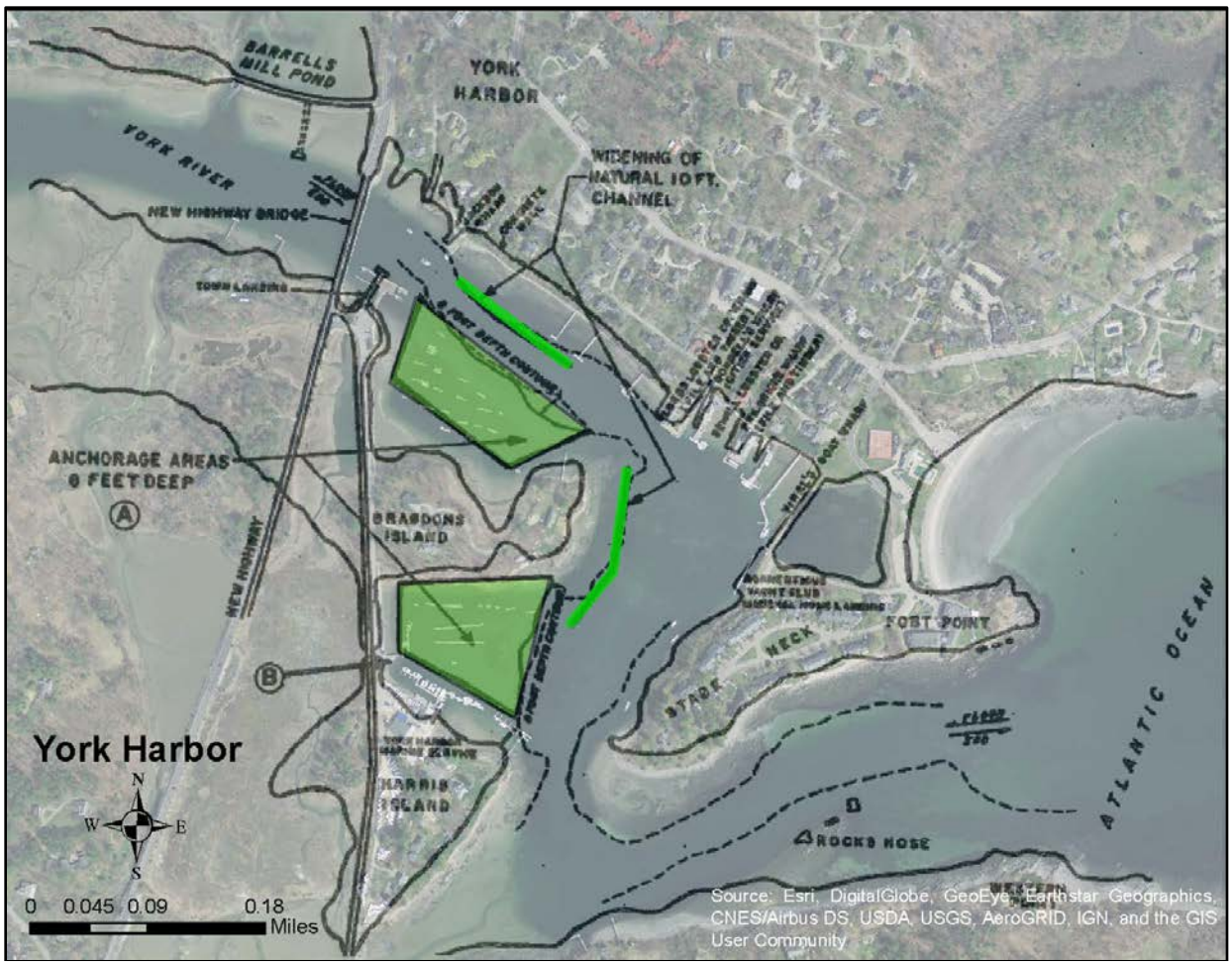

Figure 9. Location of the Federal navigation channel, York Harbor, York, Maine. Historic channel map lifted from 1994 ACOE Dredged Material Management Study.

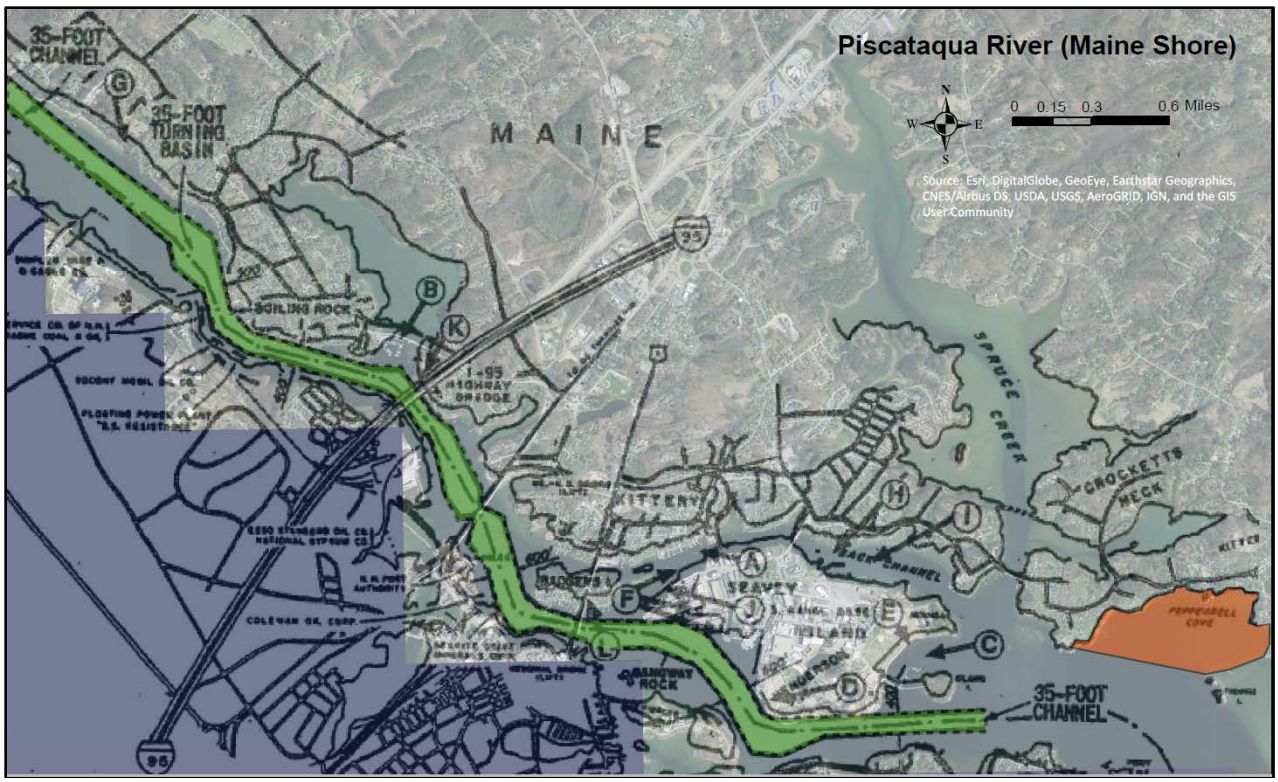

Figure 10. **Location of the Federal navigation channel in the Piscataqua River – Maine Shore (green) and Pepperrell Cove (orange), Kittery, Maine. Historic channel map lifted from 1994 ACOE Dredged Material Management Study.**

Preliminary Data Collection Results

Each of the 7 Federally maintained channels identified in the Preliminary Data Collection Survey have been dredged historically. Of the 7 municipalities responding to the survey, 3 reported that the most recent dredging events have not kept their respective navigation channels safe and navigable to boat traffic. Five of the 7 communities that participated in the Survey reported that they are in various stages of the ACOE Federal maintenance dredging process. All municipalities that anticipated the need for future maintenance dredging expected the majority of funding to come from a Federal source.

Reported hazards to navigation and public safety:

- City of Saco (last dredged 1992; ACOE maintenance underway 2018)
- Town of Kennebunkport (last dredged 1976)
- Town of Wells (last completed project 2014; maintenance project underway June 2018)

2018 ACOE maintenance dredging status:

- Town of Kennebunk (Beginning ACOE maintenance dredging process)
- Town of Scarborough (ACOE survey complete, awaiting ACOE scheduling)
- Town of Kennebunkport; Town of Wells (ACOE scheduling complete)
- City of Saco (ACOE maintenance project underway, completion 2018 – 2019)

Each of the 7 municipalities also reported on the general sediment characteristics and historic disposal practices within their respective waterways (Table 2). Historic disposal practices were generally dictated by sediment type: sandy and some silty materials were beneficially reused for beach nourishment (with some offshore and in-river disposal), while the majority of muddy and fine-grained materials were barged to offshore disposal sites.

Table 2. Reported sediment type and historic disposal practice within 7 Federal navigation channels in southern Maine.

Municipality	Scarborough, Saco, Wells	Kennebunk	Kennebunkport, Ogunquit, Kittery
Sediment Type	Sand, Muddy Sand	Sand, Mud, Silt	Mud
Disposal Practice	Beach Nourishment*; In-River; Offshore**	Beach Nourishment	Offshore

***Beach nourishment – refers to the placement of dredged material on the existing beach profile. In some cases, beach nourishment may extend below mean low water onto the submerged beach profile.**
****Offshore – refers to the disposal of dredged material within an approved offshore site (Cape Arundel Disposal Site (CADS), or similar).**

All municipalities surveyed reported busy commercial and recreational mooring fields and/or marinas accessed via the primary navigation channel. Six out of the 7 municipalities provided supplementary data on typical usage (Table 3). A total of 352 individual moorings requiring at least some maintenance dredging were reported in Scarborough, Kennebunk, Wells, and Ogunquit. Two public marinas in The City of Saco and Town of Wells, support an additional 288 boat slips, 3 boat ramps, and a public pier. At least 188 commercial fishing vessels and 56 charter fishing boats operate out of the 6 waterways, with Kennebunkport representing the largest fleet of approximately 50 boats. In addition to commercial and charter fishing boats, it was estimated that 770 recreational vessels regularly utilize the 6 waterways. The responding municipalities reported an average LOA of 30 feet and an average draft of just over 3.5 feet of vessels operating within their waterways.

Table 3. Moorings, commercial, and recreational use of public waterways in southern Maine.

	Moorings	Commercial Vessels	Charter Boats	Recreational Vessels
Scarborough	60	30	15	50
Kennebunkport	N/A	50	N/A	30
Kennebunk	68	18	12	300
Wells	150	25	15	150
Ogunquit	74	26	8	40
Kittery	N/A	39	6	200
Total	**352**	**188**	**56**	**770**

The Preliminary Data Collection Survey focused exclusively on commercial and recreational usage reliant on municipal resources, turning basins, mooring fields, marinas, etc. The Feasibility Study acknowledges the countless private entities, mooring fields, marinas, docks, piers, restaurants, etc. operating independently along each waterway, though it was beyond the scope of this preliminary study to gauge the impact of a navigable channel on their daily operations.

The Preliminary Data Collection Survey indicated that dredging is a near constant requirement in southern Maine, as evidenced by the 5 municipalities within the SMPDC region actively working to schedule, or actively engaged in maintenance dredging operations with the ACOE and the 3 municipalities reporting hazards to public safety and navigation within their respective channels. Chapter 3 quantifies historic dredging events in southern Maine, will be used to help forecast the quantities that a municipal dredge might be expected to dredge in a given year.

3.0 HISTORIC DREDGING AND DISPOSAL DATA COLLECTION

Historic Dredging Events in SMPDC Coastal Communities

To generate a database of historic dredging events in southern Maine, the Woods Hole Group called on a broad network of State and Federal Agency contacts, including representatives from the Maine Geological Survey and the United States Army Corps of Engineers New England District Office to provide historic dredge quantity data and forecasts of future dredging needs in Maine. To support these data requests, Woods Hole Group Coastal Scientists reviewed historic reports and analyzed public data sets to generate a comprehensive chronology of dredging events, both public and private from 1949 – 2018. These datasets included:

- The United States Army Corps of Engineers Dredged Material Management Study for Coastal Maine and New Hampshire (1994)
- The United States Army Corps of Engineers United States Waterway Database (2018)
- The United States Army Corps of Engineers Ocean Dredged Material Disposal Site Database (2018)

The historic data was used to identify project proponents, type of dredging event (initial improvement, improvement, maintenance), volume of material dredged (in cubic yards (c.y.)), dredged channel depth, characteristics of the material dredged, and protocol for the disposal of dredged material. Each of the sources were cross-referenced to ensure replicate events were only counted once. When available, actual volumes of dredged material were used in place of ACOE estimated quantities to be dredged. A summary of historic dredging events for each of the Federal navigation channels in southern Maine can be found in the following sections. Despite a comprehensive review of the available data, gaps still remained in many fields. Data gaps are symbolized by a (-) in the following Tables.

Town of Scarborough – Scarborough River, Pine Point Harbor

The Scarborough River and Pine Point Harbor have been dredged a total of 9 times, all by public (municipal and Federal) entities, since the initial improvement project was implemented by the Town of Scarborough in 1955. Following the initial improvement projects in 1955 and 1956, a series of regular maintenance projects were implemented by the ACOE from 1956 – 1975, to maintain a channel depth of -6.0 feet MLLW. After the 1973 and 1975 ACOE maintenance projects, which generated nearly 198,000 c.y. of dredged material, no maintenance dredging events occurred over the following two decades. Army Corps of Engineers maintenance dredging resumed in 1996, when 95,000 c.y. of material were removed from the channel, and again in 2013 when an additional 16,078 c.y. were dredged. From 1955 – 1996, approximately 650,000 c.y. of dredged material were dredged and disposed of in both intertidal and offshore sites. The most recent dredging event, completed in 2015, represents only the second event since 1955 when dredged material was beneficially reused as beach nourishment. Table 4 summarizes historic dredging events in the Scarborough River and Pine Point Harbor.

Table 4. Chronology of historic dredging events in the Scarborough River, Pine Point Harbor, Scarborough, Maine.

Year	Proponent	Type	Volume (c.y.)	Depth (ft; MLLW)	Material	Disposal
1955	Town of Scarborough	Initial Improvement	-	-	-	Intertidal
1956	ACOE	Improvement-Mod.	128,099	-6.0	-	Intertidal
1962	ACOE	Maintenance	150,000	-6.0	-	Offshore
1965	ACOE	Maintenance	32,577	-6.0	-	Offshore
1969	ACOE	Maintenance	47,000	-6.0	-	Offshore
1973	ACOE	Maintenance	188,800	-6.0	-	Offshore
1975	ACOE	Maintenance	9,090	-6.0	-	Offshore
1996	ACOE (Sub*)	Maintenance	95,000	-	-	Offshore
2013	ACOE (Sub*)	Maintenance	16,078	-	-	Beach
2015	ACOE	Maintenance	116,325	-	-	Beach
		Total	**782,969**			

*Subcontracted

Saco River – Camp Ellis Harbor

A total of 7 public and 2 private dredging events in the Saco River – Camp Ellis Harbor were implemented between 1965 – 1992 to maintain the navigation channel to a depth of -6.0 feet MLLW. The 9 total dredging events do not include the active ACOE project that is underway and scheduled for completion during the winter of 2018 – 2019. The initial improvement project undertaken by the ACOE in 1969 dredged a total of 160,484 c.y. of material from the Federal navigation channel and was followed by regular maintenance events up until 1992. Since the last ACOE dredging event in 1992, no public maintenance dredging projects have occurred on the Saco River, until the most recent maintenance project commenced during the winter of 2017 – 2018. Unlike the Scarborough River, where the vast majority of dredged material was disposed of in the nearshore and offshore environment, the majority of material dredged from the Saco River, (383,719 c.y. in total), has been used for nourishment on nearby beaches. A summary of dredging events in the Saco River – Camp Ellis Harbor is provided in Table 5.

Table 5. Chronology of historic dredging events in the Saco River – Camp Ellis Harbor, Saco, Maine.

Year	Proponent	Type	Volume (c.y.)	Depth (ft; MLLW)	Material	Disposal
1965	Fred J. Pipinias	Maintenance	37,000	-7.0	-	Upland
1969	ACOE	-	87,354	-8.0	-	Beach
1969	ACOE	-	73,130	-6.0	-	Beach
1970	ACOE	-	-	-10.0	-	Beach
1973	Fred J. Pipinias	Initial Improvement	37,000	-7.0	-	Nearshore
1978	City of Saco	Initial Improvement	50,000	-6.0	Sand	Beach
1978	ACOE	-	80,000	-8.0	Sand	Beach
1982	ACOE	-	7,300	-6.0	-	Beach
1992	ACOE (Sub*)	-	85,935	-8.0	-	Beach
2018	ACOE (In Progress)	-	-	-	-	In-River
		Total	**457,719**			

*Subcontracted

Wood Island Harbor – Biddeford Pool

Just beyond the mouth of the Saco River, Wood Island Harbor – Biddeford Pool has been dredged 3 times by the ACOE since 1956 and an additional 6 times, on a significantly smaller scale, by private entities, including the Biddeford Pool Yacht Club, to maintain a minimum -5.0-foot MLLW channel. The 133,026 c.y. of material dredged by the ACOE in 1956, 1988, and 1992, along with the 5,940 c.y. dredged privately between 1956 – 1988 consisted of variable sand, gravel, and cobble, with the majority of disposal occurring offshore. There are no records of dredge events occurring within Wood Island Harbor – Biddeford Pool after the last ACOE dredging event in 1992. Table 6 summarizes dredging events in Wood Island Harbor – Biddeford Pool.

Table 6. Chronology of historic dredging events in Wood Island Harbor – Biddeford Pool, Biddeford, Maine.

Year	Proponent	Type	Volume (c.y.)	Depth (ft; MLLW)	Material	Disposal
1956	ACOE	Improvement-Mod.	74,781	-6.0	-	Offshore
1956	Biddeford Pool YC	Initial Improvement	3,540	-6.0	-	Upland
1971	Biddeford Pool YC	Maintenance	375	-5.0	Clay	Upland
1976	Biddeford Pool YC	Maintenance	400	-5.0	-	Upland
1979	John G. Oddy	Initial Improvement	500	-8.0	Clay, Gravel, Sand	Upland
1988	ACOE	Maintenance	45,900	-6.0	Sand	Offshore
1988	Biddeford Pool YC	Maintenance	1,125	-7.0	Sand	Offshore
1992	ACOE	Improvement-Mod.	12,345	-10.0	-	Offshore
		Total	**138,966**			

Cape Porpoise Harbor

Historically, 2 large-scale ACOE dredging events kept Cape Porpoise Harbor safe and navigable to boat traffic. The first ACOE improvement dredging project occurred in 1950 and resulted in the removal of 74,802 c.y. of silty material, disposed of offshore. The initial improvement dredging project was followed by a second maintenance dredging event in 1976, when an additional 132,100 c.y. of material were dredged from the channel and barged offshore to the Cape Arundel Disposal Site. A series of small-scale private dredging events supplement the ACOE dredging activity. There are no public records of dredging within Cape Porpoise Harbor since the last private dredging event was completed in 1976. A record of dredging events in Cape Porpoise Harbor is summarized in Table 7.

Table 7. Chronology of historic dredging events in Cape Porpoise Harbor, Kennebunkport, Maine.

Year	Proponent	Type	Volume (c.y.)	Depth (ft; MLLW)	Material	Disposal
1950	ACOE	Improvement-Mod.	74,802	-6.0	Silt	Offshore
1950	Alma W. Kittredge; Fred A.; Prentice & Russel	Initial Improvement	-	-5.0	-	-
1950	Arnold, Margurite Whitehouse	Initial Improvement	-	-5.0	-	-
1976	ACOE	Maintenance	132,100	-15.0	-	CADS*
1976	George Lush	Maintenance	500	-5.0	Clay	CADS*
1976	Hale Whitehouse	Maintenance	120	-6.0	-	CADS*
		Total	**207,402**			

*Cape Arundel Offshore Disposal Site

Kennebunk River

The Kennebunk River contained the most substantial dredge record of any waterbody within the SMPDC region. A total of 48 dredging events have been recorded from 1949 – 2016. While the vast majority of dredging events (39 in total) have been private, a series of 8 ACOE dredging events and an additional 2 municipal dredging events have maintained the Federal navigation channel. The first ACOE dredging event took place in 1949 and resulted in the removal of 37,767 c.y. of silt and clay to an offshore disposal site. A second ACOE improvement dredging project took place in 1964, resulting in the removal of 120,074 c.y. of rock and sand from the system. Army Corps of Engineers Maintenance dredging events followed in 1968 (15,000 c.y.), 1979 (18,000 c.y.), 1984 (20,500 c.y.), 2004 (7,760 c.y.), 2005 (66,400 c.y.), and 2014 (26,090 over 2 separate events). These Federal projects were supplemented by an additional 2 dredging events undertaken by the Town of Kennebunkport.

The additional 38 private dredging events have been completed by local marinas, yacht clubs, boatyards, and private homeowners. Private dredging events, though numerous, have been significantly smaller than any single Federal dredging event. The largest private dredging event was undertaken in 1971 by the Arundel Yacht Club and resulted in the removal of 15,000 c.y. of material, though the majority of private events have not exceeded 5,000 c.y. Historic dredging projects have been designed to maintain a minimum -6.0-foot MLLW navigation channel, and the majority of dredged material (both public and private) has been disposed of offshore at the Cape Arundel Disposal Site, with some upland disposal prior to 1984. The dredged material has been a mix of sand, silt, rock, and clay, depending on the location of the dredging event within the river. In total, from 1949 – 2016, 442,796 c.y. of material have been dredged from the Kennebunk River. Table 8 summarizes dredging events in the Kennebunk River from 1949 – 2016.

Table 8. Chronology of historic dredging events in the Kennebunk River, Kennebunk, Maine.

Year	Proponent	Type	Volume (c.y.)	Depth (ft; MLLW)	Material	Disposal
1949	ACOE	Maintenance	37,776	-	Clay, Silt	Offshore
1959	George Timson	Maintenance	-	-6.0	Rock	Upland
1960	Antoine Guertin	Initial Improvement	-	-6.0	-	Upland
1962	C.D., A.G. Agnew	Maintenance	-	-3.0	-	Upland
1964	ACOE	Improvement-Mod.	120,074	-8.0	Rock, Sand	Intertidal
1965	Antoine Guertin	Maintenance	-	-6.0	-	-
1965	Kennebunk River Club	Maintenance	-	-4.0	-	-
1968	ACOE	Maintenance	15,000	-8.0	Rock	CADS*
1968	Ocean Industries, Inc.	Maintenance	6,500	-6.0	-	Upland

Year	Proponent	Type	Volume (c.y.)	Depth (ft; MLLW)	Material	Disposal
1968	Chick's Marina, Inc.	Maintenance	4,069	-4.0	Sand, Silt	CADS*
1971	Arundel YC	Initial Improvement	12,000	-7.0	Clay, Sand, Silt	Upland
1975	Arundel YC	Maintenance	6,300	-7.0	-	Upland
1976	Kennebunk Harbor	Maintenance	200	-	-	CADS*
1979	ACOE	Maintenance	18,000	-8.0	Sand, Silt	CADS*
1980	Maine Marine Corp	Maintenance	6,000	-	-	Upland
1980	Town of Kennebunkport	Initial Improvement	-	-1.6	Rock, Silt	Upland
1983	Paul, Jacqueline Fiudicia	Initial Improvement	7,076	-6.0	Silt	Upland
1984	ACOE	Maintenance	20,500	-8.0	Sand, Silt	CADS*
1985	Paul, Jacqueline Fiudicia	Maintenance	2,100	-	-	CADS*
1985	Rinaldi Realty LP	Improvement-Mod.	2,500	-6.0	Sand, Silt	CADS*
1985	Anthony, Paul Gelardi	Improvement-Mod.	1,900	-6.0	Sand, Silt	CADS*
1985	Nonantum Hotel	Maintenance	1,422	-6.0	Clay, Silt	CADS*
1985	Kennebunk River Club	Maintenance	9,100	-6.0	Sand, Silt	CADS*
1986	Chick's Marina, Inc.	Maintenance	5,400	-	-	CADS*
1986	Arundel YC	Maintenance	3,000	-6.0	Sand, Silt	CADS*
1987	Arundel YC	Maintenance	3,000	-	-	CADS*
1987	Ried's Boatyard	Maintenance	2,200	-6.0	Sand, Silt	CADS*
1991	Arnold Katz	Maintenance	3,200	-6.0	Gravel, Sand, Silt	CADS*
1992	Rinaldi Realty LP	Maintenance	400	-6.0	Clay, Sand, Silt	CADS*
1994	Rinaldi Realty LP	Maintenance	700	-	-	CADS*
1998	Arundel YC	Maintenance	4,100	-	-	CADS*
1998	Rinaldi Realty Ltd	Maintenance	100	-	-	CADS*
2004	ACOE	-	7,760	-	-	
2005	ACOE	Maintenance	66,400	-	-	CADS*
2005	Wharf Cottages & Marina	Maintenance	1,500	-	-	CADS*
2006	Arundel YC	Maintenance	2,200	-	-	CADS*
2006	Kennebunkport Marina	Maintenance	6,600	-	-	CADS*
2006	Nonantum Resort	Maintenance	2,400	-	-	CADS*

Year	Proponent	Type	Volume (c.y.)	Depth (ft; MLLW)	Material	Disposal
2006	Yachtsman Lodge & Marina	Maintenance	10,400	-	-	CADS*
2009	Chick's Marina	Maintenance	6,100	-	-	CADS*
2009	Kennebunk River Club	Maintenance	8,200	-	-	CADS*
2009	John Rinaldi	Maintenance	500	-	-	CADS*
2014	ACOE	-	18,155	-	-	
2014	ACOE	-	7,935	-	-	
2016	Arundel YC	Maintenance	3,200	-	-	CADS*
2016	Kennebunkport Marina	Maintenance	3,032	-	-	CADS*
2016	Town of Kennebunkport	Improvement-Mod.	1,100	-	-	CADS*
2016	Yachtsman Lodge & Marina	Maintenance	4,697	-	-	CADS*
		Total	**442,796**			

*Cape Arundel Offshore Disposal Site

Wells Harbor

The first improvement-modification dredging project in Wells Harbor took place in 1962 when the ACOE dredged 249,000 c.y. of material from the Federal navigation channel. Improvement-modification and maintenance dredging events completed by the ACOE followed in 1964, 1967, 1970, 1974, 1990, and 1991, resulting in the removal of 285,889 c.y. of material from the system. The ACOE continued to conduct regular maintenance in Wells Harbor throughout the early 2000's, dredging 179,900 c.y. of material in the year 2000, 9,745 c.y. in 2002, and 9,990 c.y. in 2004. Maintenance dredging resumed in 2012, with subsequent projects in 2013 and 2014. In total, 867,522 c.y. of material, (primarily beach compatible sand) have been dredged from Wells Harbor since 1962. Maintenance dredging commenced again in June of 2018, with the ACOE forecasting the need for future maintenance dredging every three years. Dredging events in Wells Harbor are summarized in Table 9.

Table 9. Chronology of dredging events in Wells Harbor, Wells, Maine.

Year	Proponent	Type	Volume (c.y.)	Depth (ft; MLLW)	Material	Disposal
1962	ACOE	Improvement-Mod.	249,000	-	-	Offshore
1962	Russel E. Darling	Initial Improvement	622	-8.0	-	Upland
1962	Town of Wells	Initial Improvement	-	-4.0	-	-
1964	ACOE	Improvement-Mod.	24,300	-	-	Offshore
1967	ACOE	Improvement-Mod.	190,000	-10.0	-	Upland
1970	ACOE	Maintenance	38,674	-8.0	-	Upland
1974	ACOE	Maintenance	13,300	-8.0	-	Nearshore
1990	ACOE	Maintenance	14,615	-10.0	Sand	Beach
1991	ACOE	Maintenance	5,000	-10.0	Sand	Beach
2000	ACOE (Sub*)	Maintenance	179,900	-	-	-
2002	ACOE	Maintenance	9,745	-	-	-
2004	ACOE	Maintenance	9,990	-	-	-
2012	ACOE	Maintenance	20,405	-	-	-
2013	ACOE (Sub*)	Maintenance	99,351	-	-	-
2014	ACOE	Maintenance	12,620	-	-	-
2018	ACOE	Maintenance	-	-	-	-
		Total	**867,522**			

*Subcontracted

Perkins Cove – Josias River

Perkins Cove and the Josias River, Ogunquit, Maine have a long history of initial improvement, improvement modification, and maintenance dredging dating back to 1951. The initial improvement project, implemented by the ACOE in 1951, dredged 15,780 c.y. of gravel, sand, silt, and clay from the navigation channel. This initial improvement project was followed by an ACOE improvement modification project in 1959, and subsequent maintenance projects in 1967 and 1976, which maintained the channel to -5.0 feet MLLW. There was a 17-year gap in maintenance from 1976 – 1993, when a new initial improvement project was implemented by the ACOE, resulting in the removal of 16,100 c.y. of material to the offshore Cape Arundel Disposal Site. Despite regular dredging over a 40-year period from 1951 – 1993, which resulted in the removal of 68,084 c.y. of material from the navigation channel, no new dredging projects have been implemented by the ACOE in Perkins Cove – Josias River since 1993. A history of dredging events in Perkins Cove – Josias River is summarized in Table 10.

Table 10. Chronology of historic dredging events in Perkins Cove – Josias River, Ogunquit, Maine.

Year	Proponent	Type	Volume (c.y.)	Depth (ft; MLLW)	Material	Disposal
1951	ACOE	Initial Improvement	15,780	-5.0	Clay, Gravel, Sand, Silt	Offshore
1959	ACOE	Improvement-Mod.	29,844	-5.0	Rock	Offshore
1967	ACOE	Maintenance	5,500	-5.0	-	Beach
1976	ACOE	Maintenance	860	-5.0	Sand	Upland
1993	ACOE	Initial Improvement	16,100	-	-	CADS*
		Total	**68,084**			

*Cape Arundel Offshore Disposal Site

York Harbor

York Harbor also has a rich history of ACOE improvement and maintenance dredging projects. The first ACOE maintenance dredging project was completed in in 1950 and resulted in the removal of 6,628 c.y. of sand and clay from the navigation channel. The maintenance project in 1950 was followed by a larger-scale improvement modification project implemented by the ACOE in 1961, which removed an additional 200,419 c.y. of material from York Harbor. Maintenance dredging was completed by the ACOE in 1975 and 1996, with a supplementary municipal project completed by the Town of York in 1962. The 6 historic dredging projects completed in York Harbor maintained a deeper (-10-foot MLLW) navigation channel. Disposal of dredged materials varied and included offshore, upland, and in intertidal zones. Since the last maintenance dredging event was completed by the ACOE in 1996, there has only been one additional record of dredging within York Harbor (winter 2017-2018). A summary of dredging events in York Harbor is provided in Table 11.

Table 11. Chronology of historic dredging events in York Harbor, York, Maine.

Year	Proponent	Type	Volume (c.y.)	Depth (ft; MLLW)	Material	Disposal
1950	ACOE	Maintenance	6,628	-	Clay, Sand	-
1961	ACOE	Improvement-Mod.	200,419	-10.0	-	Offshore
1962	Town of York	Maintenance	-	-8.0	-	Intertidal
1975	ACOE	Maintenance	25,000	-8.0	-	Upland
1996	ACOE	Maintenance	49,800	-	-	CADS*
2017	ACOE (Sub**)	Maintenance	-	-	-	CADS*
		Total	**281,847**			

*Cape Arundel Offshore Disposal Site
**Subcontracted

Piscataqua River (Maine Shore)

The Piscataqua River (Maine Shore) has historically been maintained by the Department of Navy, The Maine – New Hampshire Bridge Authority, and the ACOE. The first recorded dredging event recorded by the ACOE occurred in 1952 and was implemented by the Department of Navy. A total of 10,000 c.y. of material were dredged to maintain the channel depth at -20.0 feet MLLW. Additional improvement dredging and maintenance dredging events implemented by the Department of Navy followed in 1952 (11,600 c.y.), 1960 (86,000 c.y. over 2 events), 1963 (1,650 c.y.), 1968 (10,000 c.y.), 1974 (300 c.y.), 1978 (108,000 c.y.), and 1993 (1,200 c.y.). A total of 10 historic dredging events undertaken by public entities between 1952 and 1993 maintained a navigation channel to a maximum depth of -35.0 feet MLLW and resulted in the upland, intertidal, and offshore disposal of 238,350 c.y. of mixed rock, gravel, silt, and sand. The ACOE assumed responsibility for maintenance dredging in the early 2000's, with the most recent event occurring in 2012. A summary of historic dredging events in the Piscataqua River (Maine Shore) is illustrated in Table 12.

Table 12. Chronology of historic dredging events in the Piscataqua River (Maine Shore), Kittery, Maine.

Year	Proponent	Type	Volume (c.y.)	Depth (ft; MLLW)	Material	Disposal
1952	Dept. Of Navy	-	10,000	-20.0	-	Intertidal
1952	Dept. Of Navy	Improvement-Mod.	11,600	-20.0	-	Nearshore
1960	Dept. Of Navy	Improvement-Mod.	52,000	-35.0	-	Intertidal
1960	Dept. Of Navy	Maintenance	34,000	-35.0	-	Intertidal
1963	Dept. Of Navy	Maintenance	1,650	-35.0	-	Intertidal
1965	ME-NH Bridge Auth.	Improvement-Mod.	5,000	-12.0	-	Upland
1968	Dept. Of Navy	Maintenance	10,000	-30.0	-	Intertidal
1971	Cianbro Corporation	Maintenance	2,300	-10.0	-	Upland
1973	Jerry's Marina	Initial Improvement	1,500	-4.0	-	Upland
1974	Dept. Of Navy	Maintenance	300	-27.0	Sand, Silt	Upland
1978	Dept. Of Navy	Improvement-Mod.	108,000	-13.0	Rock	Upland
1989	Marc P. DeMontigny	Initial Improvement	800	-10.0	Gravel, Rock, Sand, Silt	CADS*
1993	Dept. Of Navy	Maintenance	1,200	-	Silt	Upland
2000	ACOE (Sub**)	-	7,857	-	-	-
2012	ACOE (Sub**)	-	14,323	-	-	-
		Total	**260,530**			

*Cape Arundel Offshore Disposal Site
**Subcontracted

Pepperrell Cove

No record of Federal or private dredging events were found for Pepperell Cove, located along the Piscataqua River in the Town of Kittery. However, the Kittery Port Authority was recently approached by the ACOE about the opportunity to dredge Pepperrell Cove. The Kittery Port Authority distributed a brief survey to mooring holders in May 2017 to gauge need and interest in the project. Results are forthcoming.

Dredging Events and Quantities

Within the 10 waterbodies included in the study area, a total of 123 dredging events have resulted in a total of 3,507,835 c.y. of material dredged since 1949. The smallest number of c.y. have been dredged from Perkins Cove – Josias River, where a total of 5 dredging events dating back to 1951 resulted in the removal of 68,084 c.y. of material. The waterbody with the greatest number of c.y. dredged was Wells Harbor, where a total of 867,522 c.y. of material were dredged over 16 events dating back to 1962. The waterbody with the greatest number of dredging events (12 public and 36 private) was the Kennebunk River, with a total of 48 dredging events dating back to 1949. The waterbodies with the fewest number of dredging events were Perkins Cove – Josias River with 5 dredging events. Total dredging events and total c.y. dredged per water body are summarized in Table 13 and Figures 11 and 12.

Table 13. Total dredging events and total c.y. dredged from waterbodies in the SMPDC study region.

Waterbody	Total Dredging Events Since 1949	Total Cubic Yards Dredged
Scarborough River - Pine Point Harbor	10	**782,969**
Saco River - Camp Ellis Harbor	9	**457,719**
Wood Island Harbor and Biddeford Pool	8	**138,966**
Cape Porpoise Harbor	6	**207,402**
Kennebunk River	48	**442,796**
Wells Harbor	16	**867,522**
Josias River - Perkins Cove	5	**68,084**
York Harbor	6	**281,847**
Piscataqua River (Maine Shore)	15	**260,530**
Pepperrell Cove	0	**0**
Total	**123**	**3,507,835**

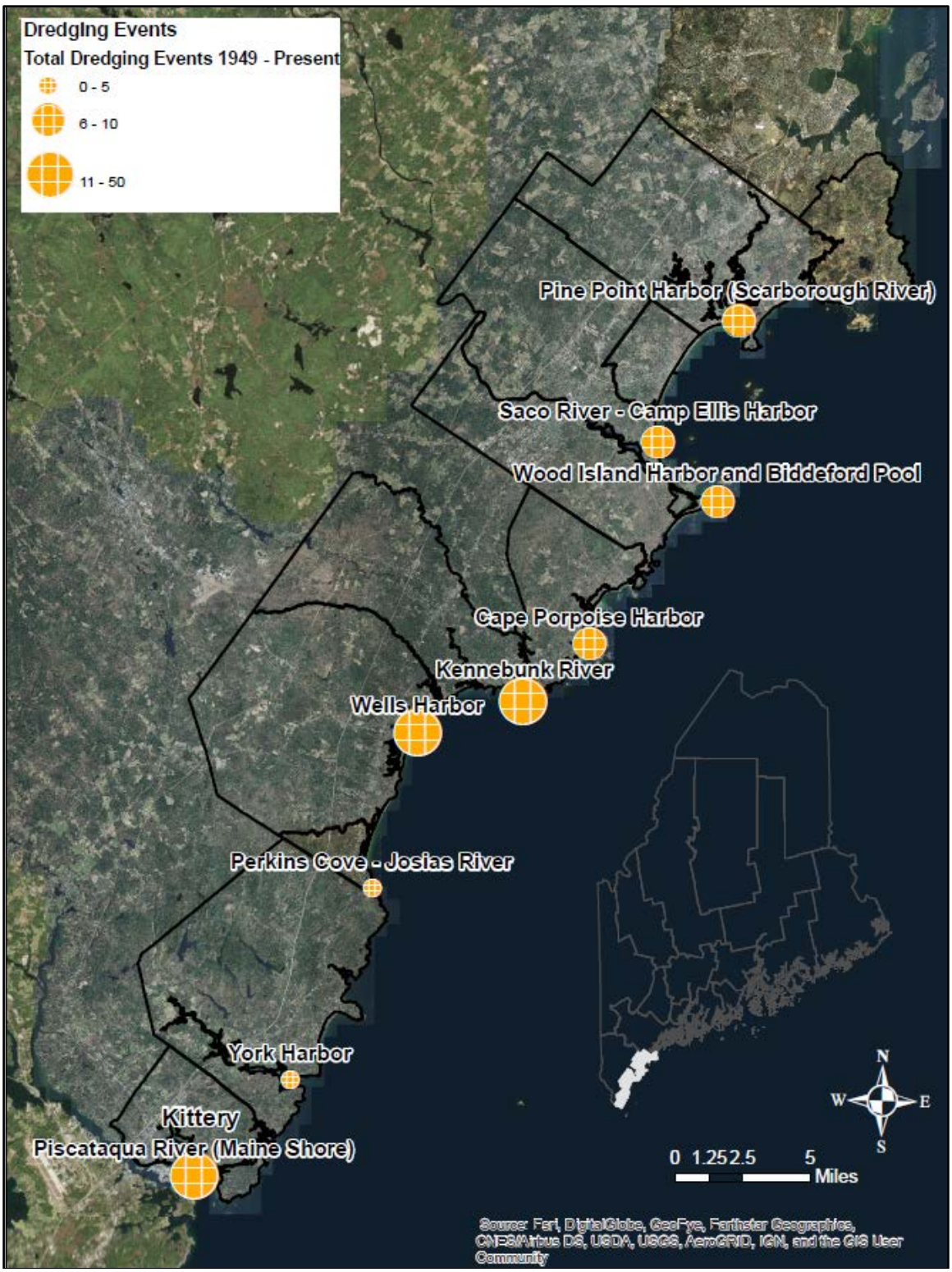

Figure 11. Total Dredging Events in in SMPDC region 1949 – present.

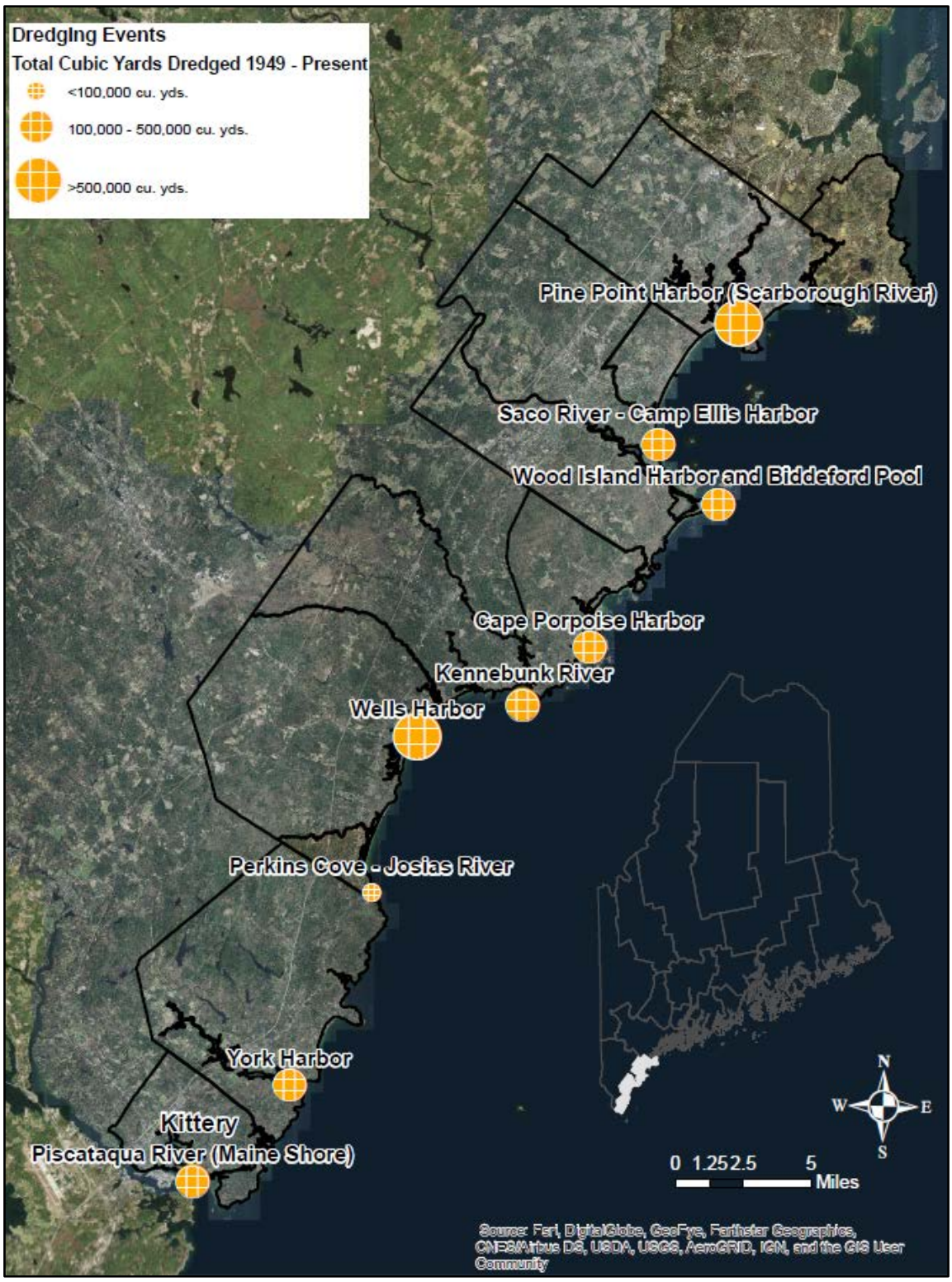

Figure 12. Total Cubic Yards Dredged in SMPDC region 1949 – present.

4.0 BARNSTABLE COUNTY DREDGE CASE STUDY

The Barnstable County Dredge Program, serving all municipalities on Cape Cod, Martha's Vineyard, and Nantucket, was used as a model to help determine the feasibility of purchasing and operating a municipal dredge in southern Maine. Prior to the establishment of the Barnstable County Dredge Program, local municipalities often relied on private dredge contractors to maintain Federal and non-Federal navigation channels, municipal and private mooring fields, and marinas between ACOE dredging projects. Individual municipalities were responsible for funding 25% of the cost of private municipal dredge projects, while the State of Massachusetts was responsible for funding the remaining 75%. Given the high costs associated with private dredging and inherent limitations on State funding, municipal dredging projects in Barnstable County were routinely delayed, if ever completed.

In 1993, a needs assessment and cost-benefit analysis conducted by Barnstable County determined that a County dredging program would benefit local municipalities and be cost-effective to operate. Barnstable County then appealed to the Massachusetts Department of Environmental Management (now Department of Environmental Protection (DEP)), requesting a $1 million-dollar capital grant for the purchase of a dredge and ancillary equipment. A $1 million-dollar capital grant was subsequently awarded to Barnstable County as a replacement for any future State funding of municipal dredging projects on Cape Cod. Over time, the capital grant provided the State with significant cost savings while enhancing the Towns' ability to manage their own waterways. Shortly after the grant was awarded, Barnstable County took delivery of a hydraulic cutter suction (pipeline) dredge, affectionately named the "Codfish" (Figure 13).

Figure 13. Barnstable County Dredge "Cod Fish" at rest in Popponessett Bay, Massachusetts, March 2018.

Barnstable County Dredge Advisory Committee

The Barnstable County Dredge Advisory Committee was established in 1994 to manage the Barnstable County Dredge Program. The Advisory Committee is made up of representatives from all Cape Cod Towns, with the exception of Brewster, which has no navigable waterways, DEP and County officials and is responsible for developing and maintaining an equitable dredge schedule and dredge rate. Each member Town is required to maintain their own environmental permits – with several municipalities opting for consolidated, comprehensive permits covering multiple dredging and disposal locations. This permitting structure gives Towns the flexibility to adaptively manage waterways from year to year. Towns are required to have all permits in-hand prior to scheduling a dredging project with the Barnstable County Dredge Advisory Committee. Please refer to Appendix D for a copy of the Report of the Barnstable County Dredge, which includes a summary of completed dredging projects, quantities dredged, and fiscal status of the dredge in FY 2016.

Consultation with SMPDC

To better understand the operational and financial structure of the Barnstable County Dredge Program, representatives from the SMPDC and Woods Hole Group conducted a series of meetings with municipal and county officials in January 2018. First, the group met with Mr. Theodore Keon, Director of Coastal Resources in the Town of Chatham, MA, who also serves on the Barnstable County Dredge Advisory Committee, to discuss the municipal perspective of the Barnstable County Dredge Program. Next, the group met with Mr. Wayne Jeadtke, the Barnstable County Dredge Superintendent for a tour of the County-owned dredge. The following morning, the group attended the annual planning meeting of the Barnstable County Dredge Advisory Committee. Appendix E includes a summary of each meeting.

Barnstable County-owned Dredge and Ancillary Equipment

With the $1 million-dollar capital grant awarded by the State of Massachusetts Barnstable County purchased the following dredging and ancillary equipment:

- **<u>Hydraulic Cutter Suction (Pipeline) Dredge</u>**

  A hydraulic cutter suction dredge was selected to transport sandy, beach compatible sediments from dredging sites to dewatering sites on nearby beaches. A hydraulic cutter suction dredge uses a rotating cutter head attached to the intake of a suction pipe to break-up and loosen material on the seafloor (Figure 14). The suction pipe vacuums the agitated material, mixed with seawater, into a large centrifugal pump. The centrifugal pump pushes the slurry of seawater and dredged material from the dredging site through a discharge pipe to an adjacent dewatering site. At the dewatering site, dredged material falls out of solution, accumulates, and must be managed by ancillary excavation and / or loading equipment. An effluent of seawater and fine-grained material flows from the dewatering site back into the adjacent waterbody. Clean, beach compatible sand can be used to nourish beaches proximal to the dewatering site or trucked to an approved stockpile for later use.

The Barnstable County Dredge "Cod Fish" can pump coarse-grained, sandy material through up to 4,000 linear feet (l.f.) of discharge pipe at an average of 1,000 c.y. per day. Pumping distances over 4,000 l.f. require the use of a booster pump. Use of the Barnstable County Dredge is limited by the availability of suitable, nearby dewatering sites and the type of material being dredged. Sandy material, suitable for beach nourishment is easily pumped, dewatered, and placed. Muddy material requires a more elaborate dewatering structure to prevent fine-grained material still in solution from flowing back into adjacent waterways. Upland disposal of muddy material may be required if the material is unsuitable for beach nourishment. Significant amounts of gravel and cobble cannot be dredged using a hydraulic cutter suction dredge because of the risk of damage to internal components of the centrifugal pump and cutter head and limitations on pumping distance.

Figure 14. Hydraulic suction dredge cutter head (left) on the County dredge "Cod Fish", January 2018.

- **<u>Primary Push Boat</u>**

The hydraulic cutter suction dredge does not navigate under its own power. The dredge relies on a primary push boat, the M/V "J.W. Doane", which was purchased to mobilize and position the dredge. The primary push boat is fastened to the stern of the dredge and provides the power necessary to move the dredge from project site to project site and position the dredge at the dredging site (Figure 15).

Figure 15. Primary push boat, M/V "J.W. Doane" supporting the County dredge "Cod Fish", January 2018.

- **<u>Support Boat</u>**

A secondary support boat was acquired to mobilize discharge pipe and ancillary dredging equipment. The support boat may also assist the primary push boat in positioning the dredge in heavy current or navigating tightly restricted coastal waterways (Figure 16).

Figure 16. Typical marine support craft. 29 June 2018, https://www.joshuapreston.co.uk/workboats/

- **Support Skiff**

A small support skiff was purchased to mobilize County Dredge personnel from shore to the dredge superstructure and between the dredging site and the adjacent dewatering site (Figure 17).

Figure 17. Typical support skiff. 29 June 2018, http://www.carolinaskiff.com/boats/carolina-skiff/jv-th-series/17-jv-th

- **Discharge Pipe**

Barnstable County purchased several thousand l.f. of HDPE plastic discharge pipe and steel fasteners to transport dredged material from municipal dredging sties to dewatering sites. (Figure 18). The HDPE discharge pipe is connected in 500-1,000 l.f. sections to simplify transport from project site to project site.

Figure 18. Lengths of HPDE discharge pipe and dewatering area, April 2017.

- **Wheeled Front-End Loader**

The County Dredge relies on a wheeled Front-End Loader to manage dredged material at the dewatering site, transport dredged material to adjacent beach nourishment sites, and re-grade dredged material to reflect permitted slopes and elevations (Figure 19).

Figure 19. Typical wheeled front-end loader, March 2018.

- **Booster Pump**

After 8 years in operation, the Barnstable County Dredge Program purchased an auxiliary, skid-mounted booster pump to extend the distance dredged material could be pumped (Figure 20). The purchase of the booster pump cost the County an additional $250,000 in 2002. Additional dredge pipe was also purchased in concert with the booster pump to extend the maximum pumping distance from 4,000 l.f. to 8,000 (l.f.).

Figure 20. Typical skid-mounted hydraulic dredge booster pump. 29 June 2018,
https://www.westerndredge.com/product/10in-cat-booster-pump/

Reserve Fund and Purchase of Replacement Dredging Equipment

The use of a State of Massachusetts capital grant to purchase dredging and ancillary equipment allowed Barnstable County to quickly establish a reserve fund to account for unexpected breakdowns and maintenance and to save for future replacement of dredging equipment. In 2017, 24 years after the establishment of the Barnstable County Dredge Advisory Committee, the County invested $1.8 million-dollars in the construction of a new, larger Ellicott 670 Dragon Cutterhead Dredge. The County expects that the Ellicott 670, named the "Sand-shifter" will be responsible for larger-scale dredging projects, or those requiring pumping distances in excess of 8,000 linear feet (Figure 21). The "Codfish" will continue to operate on smaller scale projects. The County expects to be able to minimize down time, reduce mobilization time, and maximize productivity by simultaneously utilizing both pieces of dredging equipment.

Figure 21. Newly commissioned Ellicott 670 Dragon cutter suction dredge awaits final inspection, Falmouth, Massachusetts, April 2018.

Completed Projects and Cost Savings

The Barnstable County Dredging Program relies on the availability of clean, beach compatible sand to remain financially solvent. With rare exceptions, all dredged material is beneficially reused as nourishment on nearby beaches.

- Since 1994, Barnstable County has dredged nearly 1.8 million c.y. of material from waterways in 16 Towns on the Cape and Islands.
- Dredging projects have been completed at rates 38% to 68% below market average.
- In addition to direct cost savings, the Barnstable County Dredge saves municipalities:

- The significant cost of mobilizing and demobilizing private dredging equipment

- The cost of conducting pre and post-dredge surveys required by the regulatory agencies, an added savings of nearly $6,000 per project. Pre and post-dredge surveys are conducted by the Barnstable County Dredge crew and are an effective means of determining the net volume dredged and subsequently, the net cost of the project to the municipality. Equipment and personnel costs of pre and post-dredge surveys are included in the cost per c.y. as determined by the Barnstable County Dredge Advisory Committee.

- Over a 17-year period from 2000 – 2016, the County completed:
  - An average of 10 projects, annually;
  - Pumped an average of 93,569 c.y. of material annually; and
  - Saved taxpayers an estimated $13,408,653 (based on the State paying 75% of the cost of private municipal dredging projects at market rate).

Barnstable County Dredge Operations from 2000 – 2016 are summarized in Table 14. The fiscal status of the Barnstable County Dredge from 2000 – 2016 is summarized in Table 15.

Table 14. Barnstable County Dredge Operations from FY 2000 – FY 2016.

Year	C.Y. Dredged	Total Projects
2000	123,281	4
2001	113,339	6
2002	75,385	15
2003	84,973	9
2004	N/A	10
2005	52,000	12
2006	94,070	11
2007	82,928	10
2008	60,553	11
2009	91,731	8
2010	104,782	8
2011	170,835	6
2012	102,827	11
2013	72,331	13
2014	106,774	15
2015	102,418	10
2016	58,874	9
Total	**1,497,101 c.y.**	**168 projects**
Average	**93,569 c.y. / annually**	**10 projects / annually**

Table 15. Fiscal Status of the Barnstable County Dredge 2000 – 2016.

Year	Cost per CY	Market Rate per CY	Cost Below Market Rate	Operating Budget	Cost Savings to Taxpayers*	Reserve Fund**
2000	$4.55	$12.00	38%	$468,914	$1,082,529	$125,533
2001	$4.55	$12.00	38%	$588,240	$1,047,051	$272,291
2002	$4.55	$12.00	38%	$444,725	$678,465	$481,736
2003	$4.55	$12.00	38%	$554,780	$764,757	$302,371
2004	$4.55	$12.00	38%	$409,622	N/A	N/A
2005	$5.55	$12.00	46%	$524,703	$468,000	$220,000
2006	$6.45	$14.00	46%	$558,167	$856,037	$295,000
2007	$6.45	$14.00	46%	$631,698	$870,744	$310,698
2008	$6.45	$16.00	40%	$611,094	$726,636	$370,000
2009	$7.00	$16.00	44%	$628,671	$1,100,772	$370,000
2010	$7.00	$16.00	44%	$635,817	$943,038	$520,000
2011	$7.00	$16.00	44%	$660,228	$1,537,515	$310,714
2012	$7.00	$16.00	44%	$798,440	$411,308	$785,373
2013	$11.00	$16.00	68%	$835,284	$867,972	$453,042
2014	$11.00	$16.00	68%	$929,859	$830,701	$346,082
2015	$11.00	$18.00	61%	$737,742	$716,926	$421,082
2016	$11.00	$18.00	61%	$631,289	$506,202	$421,082
		Total	**N/A**	**$10,649,273**	**$13,408,653**	
		Average	**47%**	**$626,428**	**$838,041**	

***Based on the State paying 75% of the market rate of private municipal dredging projects**

****Established to finance the purchase of replacement dredging equipment**

5.0 FORECASTING ANNUAL DREDGE VOLUMES

The Barnstable County Dredge Program relies on the availability of clean, beach compatible material within Federal and municipal navigation channels to maintain a busy production schedule and cost-effective dredging rate. Based on this model, Woods Hole Group developed an estimate of the volume of clean, beach compatible material (sand) that could be dredged from each of the 10 Federal navigation channels in the SMPDC region on an annual basis. To determine the approximate volume of sand that could be dredged annually, total dredged volumes from each waterway from 1949 – present (described in Chapter 3.0) were converted to annual volumes (since the date of the first dredging event). Sediment quality data (grain size, lithology) and historic disposal data from the ACOE and the National Oceanic and Atmospheric Administration (NOAA) were then used to determine the approximate percentage of the annual dredge volume made up of sandy sediments. Sediment quality data used to develop this estimate was drawn from:

- ACOE Sediment Data from Maine and New Hampshire
- NOAA Maine Sediment Grab Data (York Harbor; Wells Harbor)

Within the context of this report, "beach compatible" refers to uncontaminated, sandy material that may closely match the grain size and composition of regional beaches. For example, if a beach comprised of 90 – 95% medium to coarse sand with less than 10% gravel and less than 5% fine-grained material is identified as a possible nourishment site, any dredged material placed at the site should closely match these characteristics. In practice, it is rare for dredged material to exactly match native sand located at a beach nourishment project site, requiring evaluation on a case-by-case basis.

Woods Hole Group utilized a tiered-approach to assign percentages of presumed clean, beach compatible material within each waterway. If clear descriptions of sediment samples and sediment lithology existed in the literature and were indicative of predominantly sandy material, 100% of the annual volume for the respective waterway was counted towards the cumulative annual total. In waterways where less than 100% of the material was sandy, an estimate of the percentage of sandy material was developed based on a composite of all historic sediment samples taken within the waterway and counted towards the cumulative annual total. In waterways where the literature indicated that very little sandy material and high percentages of mud or fines were present, 0% of the annual volume was counted towards the scaled annual volume (Table 16). Appendix F includes a summary of sediment quality data used to estimate quantities of clean, beach compatible material within each waterway.

All Woods Hole Group estimates of sandy material were within 10% of the composite total sandy material within each waterway derived from the ACOE and NOAA sediment quality data (except Cape Porpoise Harbor, which was considered too muddy to be factored into the cumulative total). In the case of the Saco River, which contained no historic sediment quality data, the estimate was based on historic disposal practices (beach nourishment) for material dredged from the site.

Table 16. Estimated annual volume of beach compatible material in southern Maine waterways.

Waterbody	Total C.Y. Dredged 1949-present	Annual Volume (C.Y.)*	Estimated Percent Sand**	Estimated Annual Volume Sand (C.Y.)
Scarborough River - Pine Point Harbor	782,969	13,499	100	13,499
Saco River - Camp Ellis Harbor	457,719	16,953	100	16,953
Wood Island Harbor - Biddeford Pool	138,966	3,860	85	3,281
Cape Porpoise Harbor	207,402	7,977	0	0
Kennebunk River	442,796	6,609	75	4,957
Wells Harbor	867,522	16,683	100	16,683
Josias River - Perkins Cove	68,084	1,621	50	811
York Harbor	281,847	6,127	70	4,289
Piscataqua River (Maine Shore)	260,530	4,342	50	2,171
Pepperrell Cove	0	0	0	0
Total	**3,507,835**	**77,672**	**-**	**62,644**

***Since first recorded dredging event**
****Scaled, based on available ACOE, NOAA sediment quality data**

Two additional estimates of the annual volume of sandy sediment that could be dredged from southern Maine waterways were also included for consideration and were based on:

- ACOE Dredge Forecast Data from the 1994 Dredged Material Management Study and;
- 2017 ACOE Dredge Forecast Data for select Federal projects in northern Massachusetts, New Hampshire, and southern Maine (including Cape Porpoise Harbor, Kennebunk River, Wells Harbor, Josias River – Perkins Cove and the Piscataqua River (Maine Shore).

Total forecasted quantities from each dataset were scaled to the 25-year period from 2019 – 2044. Total forecasted quantities were used to develop annual dredge volumes for each waterway and were factored against the estimated percent sand within each waterway described in the previous section. Estimated annual volumes of beach compatible material in southern Maine waterways based on the 1994 ACOE forecasted dredge quantities are summarized in Table 17. Table 17 contains several waterbodies where the ACOE determined that "0" c.y. of material would need to be dredged from 2019 – 2044. Estimates were made based on the availability of

dredge forecast data and may not reflect dredging projects that have (or have not) occurred within each waterbody since the report was released in 1994 and may not reflect the current need for dredging.

Estimated annual volumes of beach compatible material in southern Maine waterways based on the 2017 ACOE forecasted dredge quantities are summarized in Table 18. The 2017 ACOE forecasted dredge quantities were developed as the ACOE considered the development of a new long-term disposal site for dredged material. Waterbodies located north of Cape Porpoise Harbor were located outside the ACOE draw area and were assigned a "(-)". Waterbodies located inside the ACOE draw area that did not receive a ACOE forecasted quantity were assigned "0" (c.y.). Estimates were made based on the availability of dredge forecast data and may not reflect dredging projects that have (or have not) occurred within each waterbody and may not reflect the current need for dredging.

Table 17. Estimated annual volume of beach compatible material in southern Maine waterways 2019-2044 based on 1994 ACOE dredge forecast data.

Waterbody	Forecasted Quantity 2019-2044 (C.Y.)	Annual Volume (C.Y.)*	Estimated Percent Sand**	Estimated Annual Volume Sand (C.Y.)
Pine Point Harbor (Scarborough River)	575,000	23,000	100	23,000
Saco River - Camp Ellis Harbor	222,000	8,880	100	8,880
Wood Island Harbor - Biddeford Pool	33,000	1,320	85	1,122
Cape Porpoise Harbor	0	0	0	0
Kennebunk River	100,000	4,000	75	3,000
Wells Harbor	0	0	100	0
Perkins Cove - Josias River	60,000	2,400	50	1,200
York Harbor	60,000	2,400	70	1,680
Piscataqua River (Maine Shore)	0	0	50	0
Pepperrell Cove	0	0	0	0
Total	**1,050,000**	**42,000**	**-**	**38,882**

***Based on 25-year period 2019-2044**

****Scaled, based on available ACOE, NOAA sediment quality data**

Table 18. Estimated annual volume of beach compatible material in southern Maine waterways 2019-2044 based on 2017 ACOE dredge forecast data

Waterbody	Forecasted Quantity 2019-2044 C.Y.	Annual Volume (C.Y.)*	Estimated Percent Sand**	Estimated Annual Volume Sand (C.Y.)
Pine Point Harbor (Scarborough River)	-	-	100	-
Saco River - Camp Ellis Harbor	-	-	100	-
Wood Island Harbor - Biddeford Pool	-	-	85	-
Cape Porpoise Harbor	25,000	1,000	0	0
Kennebunk River	16,300	652	75	489
Wells Harbor	248,000	9,920	100	9,920
Perkins Cove - Josias River	8,500	340	50	170
York Harbor	0	0	70	0
Piscataqua River (Maine Shore)	753,800	30,152	50	15,076
Pepperrell Cove	0	0	0	0
Total	**1,051,600**	**42,064**	**-**	**25,655**

***Based on 25-year period 2019-2044**

****Scaled, based on available ACOE, NOAA sediment quality data**

Estimates of Available Sand

Woods Hole Group

- Based on historic dredging events, The Woods Hole Group estimates that approximately 62,644 c.y. of sandy material could be dredged from the 10 Federal navigation channels in the SMPDC district in southern Maine annually. This estimate is based on a total estimated annual volume of 77,672 c.y. factored against the estimated percentage sand in each of the 10 waterways (based on available ACOE and NOAA sediment quality data), which ranged from 0% in Cape Porpoise Harbor (primarily muddy), to 100% in the Scarborough River – Pine Point Harbor, Saco River – Camp Ellis Harbor, and Wells Harbor.

1994 ACOE Forecast

- The 1994 ACOE forecasted dredge volume data from 2019 – 2044 factored against the estimated percentage sand in each of the 10 waterways, revealed that 38,882 c.y. of sand may be available to be dredged from SMPDC-region waterways on an annual basis.

2017 ACOE Forecast

- The updated 2017 ACOE forecasted dredge volume data for select Massachusetts, New Hampshire, and Maine waterways factored against the estimated percentage sand in each of the 10 waterways revealed that 25,655 c.y. of sand may be available to be dredged from SMPDC-region waterways on an annual basis.

6.0 EVALUATING A SMPDC REGIONAL DREDGE PURCHASE

To remain productive and financially solvent, the Barnstable County Dredge Program relies on the following factors:

- The availability of small-scale, high-frequency regional dredging events;
- The availability of clean, beach compatible material within Federal and municipal navigation channels; and
- The availability of nearby beaches for dewatering and beneficial reuse of dredged material.

Based on the Barnstable County model, the Woods Hole Group investigated the feasibility of purchasing, owning, and operating a similar municipal dredge in southern Maine. The following scenarios for the purchase and operation of a municipal dredge in southern Maine were developed based on the needs expressed by participating communities in the Preliminary Data Collection Survey, the compilation of historic dredging events, available sediment quality data, and estimates of future annual dredge volumes.

Dredge Purchase Analysis

In Barnstable County, direct placement of dredged material on nearby beaches is performed using a hydraulic cutter suction dredge. This type of dredging equipment has proven effective at maintaining the safety and navigability of Barnstable County's many waterways. Based on the availability of sandy sediment within southern Maine's navigable waterways and a desire to beneficially reuse beach compatible dredged material, a hydraulic cutter suction dredge was the primary type of dredging equipment considered for use in southern Maine. In order to effectively operate a municipal dredging program, the following dredging and ancillary equipment costs were considered:

Dredge Superstructure

- Ellicott 670 Dragon Hydraulic Cutter Suction Dredge – to transfer dredged material from dredging site(s) to nearby dewatering site(s).

Ancillary Equipment

- (1) Primary Push Boat – to mobilize dredge to project site and position dredge at dredging site.

- (1) Support Boat – to mobilize and position dredge pipe at project site and aid in positioning dredge at dredging site.

- (1) Support Skiff – to mobilize crew to and from the dredge superstructure and/or dewatering site.

- (1) Skid-Mounted Booster Pump – to increase standard pumping distance of hydraulic cutter suction dredging equipment.

- (11,000 l.f.) Dredge Pipe – to contain dredge slurry and facilitate transport from dredging site to dewatering site.

Land-Based Vehicular Support

- (3) 2500HD Duramax Diesel Pickup Trucks – to mobilize crew and ancillary equipment to project site.

- (2) Heavy-Duty Equipment Trailers – to mobilize ancillary equipment to project site.

- (1) Cat 928 Wheeled Front-End Loader – to position dredge pipe and manage dewatered dredged material at dewatering site.

- Misc. Loader Attachments – including bucket, forks, etc.

The following cost estimate (Table 19) was prepared outlining the cost of purchasing a new Ellicott 670 Dragon Cutter Suction Dredge and all ancillary equipment for use in southern Maine:

Table 19. Cost summary for purchasing hydraulic cutter suction pump dredge and associated ancillary equipment for use in southern Maine.

Initial Dredge Purchase	Projected Cost
Ellicott 670 Dragon Cutter Suction Dredge	**$1,800,000**

Ancillary Equipment	Projected Cost
Primary Push Boat	$250,000
Support Boat (to haul pipe)	$75,000
Support Skiff (to haul personnel)	$20,000
Booster Pump	$350,000
Dredge Pipe (11,000 linear feet (12-14"))	$418,000
Total Ancillary Purchase	**$1,113,000**

Land-Based Vehicular Support	Projected Cost
3x 2500HD Duramax Diesel Pickups	$180,000
2x Heavy-Duty Equipment Trailers	$15,000
CAT 928 Wheeled Loader	$125,000
Loader Attachments	$10,000
Total Support Purchase	**$330,000**

Total Cost Dredging and Ancillary Equipment	$3,243,000

Ancillary Costs

- Personnel
    - (1) Dredge Superintendent – facilitates implementation of municipal dredge projects, manages dredge crew.
    - (1) Dredge Captain – operates primary push boat and ensures safety of dredge crew.
    - (1) Dredge Maintenance Engineer – maintains and repairs hydraulic dredging equipment.
    - (1) Dredge Leverman – operates hydraulic dredging equipment on-board dredge.
    - (2) Dredge Deckhands – assist in all dredging and ancillary tasks.
- Maintenance Costs – to cover typical wear and tear as well as unexpected breakdowns.
- Insurance Costs – Scalable, based on months of operation.
- Diesel Fuel Costs – 150 – 300 gallons / day to fuel dredging operation.

The following cost estimate (Table 20) was prepared outlining the personnel and ancillary costs associated with purchasing and operating a new Ellicott 670 Dragon Cutter Suction Dredge and all ancillary equipment in southern Maine. The Barnstable County Dredge rate table used to estimate salary information for dredge personnel is included in Appendix G.

Table 20. Summary of personnel and ancillary costs associated with purchasing a hydraulic cutter suction pump dredge and associated ancillary equipment for use in southern Maine.

Personnel	Projected Cost
Dredge Superintendent	$100,000
Dredge Captain	$75,000
Dredge Leverman	$65,000
Maintenance Engineer	$65,000
Dredge Deckhand	$50,000
Dredge Deckhand	$50,000
Total Personnel Cost (Annual)	**$405,000**

Ancillary Cost	Projected Cost
Maintenance	$100,000
Insurance	$25,000
Diesel Fuel*	$151,000
Total Ancillary Cost (Annual)	**$276,000**

Total Personnel and Ancillary Costs (Annual)	**$681,000**

***Assuming 168 days of operation at approximately 300 gallons per day at $3.00 per gallon.**

Annual Operating Cost and Payback Scenarios

Based on the previous analysis, the cost of purchasing a hydraulic cutter suction dredge and all ancillary equipment for use in southern Maine would be approximately $3,243,000. The cost of operating the dredge on an annual basis, including all personnel, maintenance, insurance, and fuel costs would be approximately $681,000. The Woods Hole Group considered the following scenarios when developing annual and monthly costs associated with purchasing and operating a dredge in southern Maine:

- Capital Grant Award covering initial dredge purchase
- 0% APR loan paid over 30-years
- 3% APR loan paid over 30-years

Table 21 includes a summary of annual and monthly costs associated with each of these scenarios.

Table 21. Estimated annual and monthly operating expenses of Ellicott 670, inclusive of all personnel and ancillary costs.

Dredge Purchase Scenario	Annual Cost	Monthly Cost
Capital Grant Award	$681,000	$56,750
30-year, 0% interest loan	$789,096	$65,758
30-year, 3% interest loan	$845,076	$70,423

Estimating Dredge Rate

To determine the approximate dredge rate per c.y., the annual operating costs for each of the 3 dredge purchase scenarios were factored against the Woods Hole Group, 1994 ACOE, and 2017 ACOE forecasted annual dredge quantities described in Chapter 6. The lowest cost scenario assumed a Capital Grant Award to purchase the dredge and all ancillary equipment. The only cost would be for annual overhead and personnel, totaling approximately $681,000 annually. Given the Woods Hole Group estimate of approximately 62,644 c.y. of sandy material available to be dredged on an annual basis, it would cost $10.87 per (c.y.) to dredge the material from southern Maine's waterways. If a 30-year, 0% interest loan were secured to finance the purchase of the dredge and all ancillary equipment, the minimum cost per c.y. would increase to ($12.60). The dredge rate per c.y. would increase to just over $13.49 assuming a 30-year, 3% interest loan were secured to finance the dredge purchase (Table 22).

Table 22. Approximate dredge rates per c.y. under various dredge purchase scenarios using Woods Hole Group estimate of available sand. Assumes Ellicott 670 dredge, inclusive of all personnel and ancillary costs.

Dredge Purchase Scenario	Annual Operating Cost	Estimated Annual Volume Sand (C.Y.)	Approximate Dredge Rate (per C.Y.)
Capital Grant Award	$681,000	62,644	$10.87
30-year, 0% interest loan	$789,096	62,644	$12.60
30-year, 3% interest loan	$845,076	62,644	$13.49

The 1994 ACOE dredge forecast assumed 38,882 c.y. of sandy material could be dredged from southern Maine waterways on an annual basis from 2019 – 2044 (Table 23). Under this scenario, the dredge rate would be $17.51 per c.y. assuming a Capital Grant Award, $20.29 per c.y. assuming a 30-year, 0% interest loan, and $21.73 per c.y. assuming a 30-year, 3% interest loan.

Table 23. Approximate dredge rates per c.y. under various dredge purchase scenarios using 1994 ACOE estimate of available sand. Assumes Ellicott 670 dredge, inclusive of all personnel and ancillary costs.

Dredge Purchase Scenario	Annual Operating Cost	Estimated Annual Volume Sand (C.Y.)	Approximate Dredge Rate (per C.Y.)
Capital Grant Award	$681,000	38,882	$17.51
30-year, 0% interest loan	$789,096	38,882	$20.29
30-year, 3% interest loan	$845,076	38,882	$21.73

The 2017 ACOE dredge forecast assumed 25,655 c.y. of material was available to be dredged from southern Maine waterways from 2019 – 2044 (Table 24). Based on this scenario, a Capital Grant award would allow the material to be dredged at $26.54 per (c.y.). The dredge rate would increase to a minimum of $30.76 assuming a 30-year, 0% interest loan, and to $32.94 assuming a 30-year, 3% interest loan.

Table 24. Approximate dredge rates per c.y. under various dredge purchase scenarios using 2017 ACOE estimate of available sand. Assumes Ellicott 670 dredge, inclusive of all personnel and ancillary costs.

Dredge Purchase Scenario	Annual Operating Cost	Estimated Annual Volume Sand (C.Y.)	Approximate Dredge Rate (per C.Y.)
Capital Grant Award	$681,000	25,655	$26.54
30-year, 0% interest loan	$789,096	25,655	$30.76
30-year, 3% interest loan	$845,076	25,655	$32.94

Reserve Fund and Accelerated Repayment

If a regional dredge were procured, it would be essential to establish a reserve fund to deal with unexpected repairs, prepare to replace aging equipment, and pay down any procurement loans. The simplest way for a regional dredge program to increase revenue, establish a reserve, and pay down any debts is to increase the minimum dredge rate per (c.y). If 60,000 c.y. of material can be dredged annually, increasing the minimum dredge rate by $2 per c.y. would allow an additional $120,000 in revenue to be generated annually. Increasing the minimum dredge rate by $4 per c.y. would allow an additional $240,000 in revenue to be generated annually. If half ($60k or $120k, respectively) of the additional revenue generated annually under this scenario were applied directly towards the principal of a 30-year, 0% interest or 30-year, 3% interest loan, the repayment period could be shortened by up to 15 years (Figure 22).

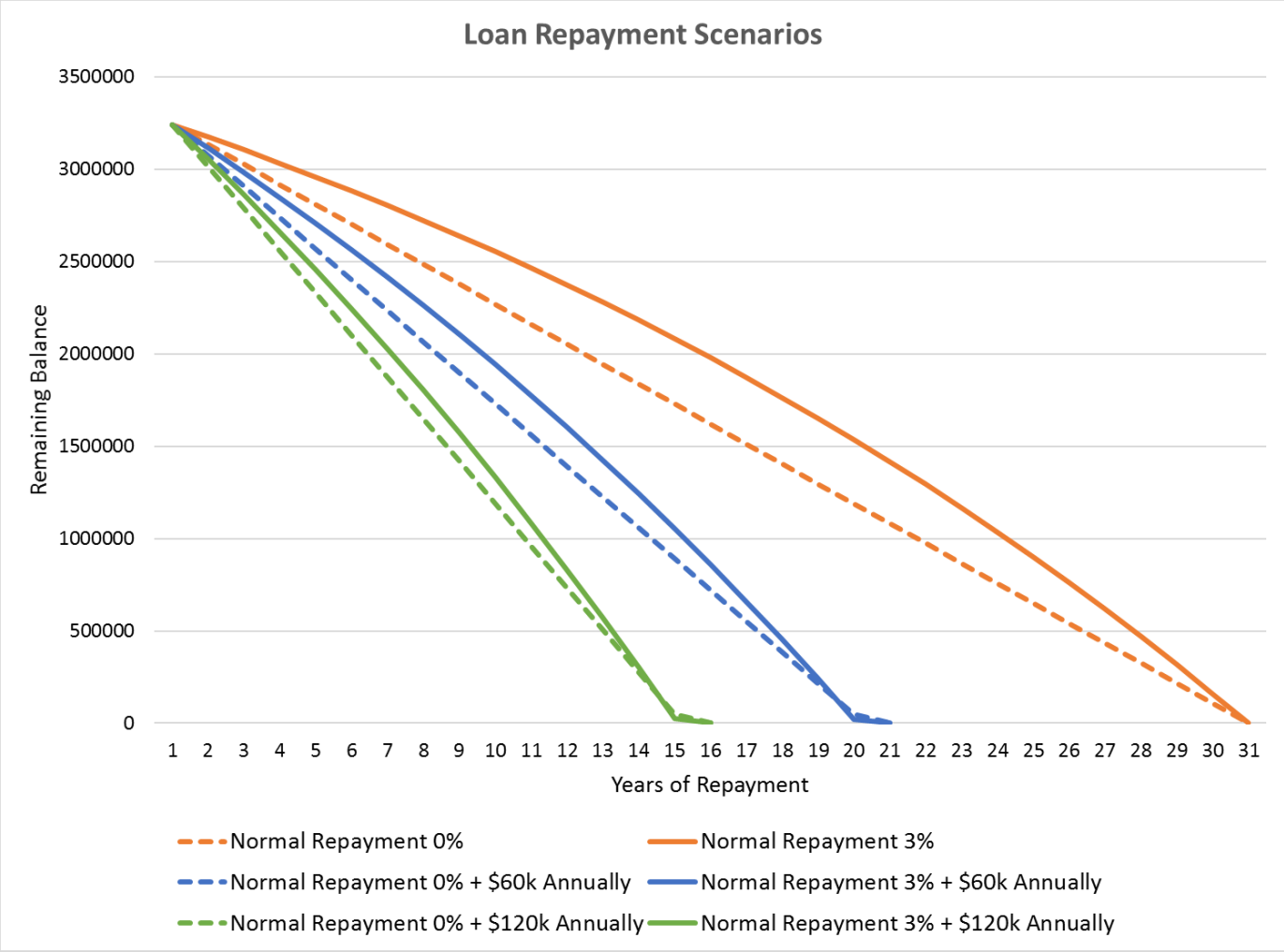

Figure 22. **Normal and accelerated repayment schedules based on an estimated 60,000 c.y. of sandy material dredged annually. Extra $60k or $120k annual payments would be generated by charging $2 - $4 per c.y. above minimum dredge rates.**

7.0 FINDINGS AND RECOMMENDATIONS

Initial Dredge Purchase Feasibility Study Findings

- Given the scope of the initial dredge purchase feasibility study, it appears that there is sufficient need for dredging and a sufficient quantity of sandy material within the 10 Federal navigation channels in southern Maine to continue evaluating a regional dredge purchase.
- The Preliminary Data Collection Survey revealed that 3 municipalities in the SMPDC region are experiencing acute hazards to navigation and public safety within their respective Federal navigation channels. An additional 5 municipalities in the SMPDC region are working to schedule or have scheduled ACOE maintenance dredging.
- The Preliminary Data Collection Survey revealed that a significant number of moorings, commercial fishing vessels, charter boat operations, and recreational boats are dependent on safe and navigable waterways in the SMPDC region.
- A review of historic dredging events in the SMPDC region revealed that the 10 Federal navigation channels have been dredged a total of 120 times since 1949, generating nearly 3.5 million c.y. of material.
- Since the year 2000 the Barnstable County Dredge, which was used as a model for this feasibility study, has pumped 1,497,101 c.y. of sandy, beach compatible material. An average of 93,569 c.y. annually.
- The Barnstable County Dredge Program has consistently dredged sandy, beach compatible material at 38-68% below the market rate.
- The purchase of dredging equipment using capital grant funding allowed Barnstable County to quickly establish a reserve fund, allowing repairs to be made and new dredging equipment to be purchased in 2017.
- A hydraulic cutter suction pump dredge, similar to the equipment used in Barnstable County, optimizes the cost of pumping sandy, muddy, and fine-grained material, but does not allow gravel or cobble to be pumped efficiently.
- Muddy and fine-grained materials that are not suitable for beach nourishment require specialized dewatering equipment and disposal methods.
- It should be noted that the Barnstable County Dredge has completed projects that have fine-grained sediment but they receive a lower priority based on the difficulty of setting up dewatering locations.
- Based on the Barnstable County model, it would cost approximately $3.25 million dollars to purchase similar hydraulic dredging and ancillary equipment for use in southern Maine.
- Based on the Barnstable County model, it would cost approximately $700k annually to staff, fuel, insure, and maintain dredging operations in southern Maine.

- If regional dredging equipment were purchased using a capital grant, the lowest-cost scenario identified in this study, a minimum dredge rate of $10 - $12 per c.y. would be needed to cover annual expenses. This rate is based on an estimated production rate of approximately 60,000 c.y. of sandy material dredged annually and does not include additional costs associated with dewatering and disposing of muddy and/or fine-grained material.
- Increasing the minimum dredge rate by $2 - $4 per c.y. would allow for the establishment of a reserve fund to:
    - Pay down any loans or debts incurred during the procurement period;
    - Prepare for the repair and/or replacement of aging equipment.
- Calculations in this report used a composite of total sandy material (%) for volume and economic estimates. This was a simple approach using available data. A mixed source (sand and mud) cannot be dredged and sorted so that some of it goes on a beach and some goes elsewhere. Mixed sediments might incur additional costs for dewatering, trucking, and upland disposal or, alternatively, placement on a barge and towed to an offshore disposal site. The cost estimate using a percentage approach may be an underestimate of the cost per cubic yard because not all projects would be pumping and shaping sand onto a beach with the equipment described.

Pros and Cons of a Municipal Dredge Purchase in Southern Maine

Purchasing and operating regional dredging equipment presents a significant opportunity for municipalities to take responsibility for the management of their own waterways. However, owning and operating hydraulic dredging equipment is not without risk. Pros and Cons of owning and operating regional dredging equipment are summarized below:

Pros

- Purchasing a dredge reduces uncertainty and prevents scheduled projects from being delayed due to a lack of State, Federal, or private dredging resources.
- Purchasing a dredge allows individual municipalities to exercise a high degree of autonomy in managing waterways and prioritizing projects outside Federal navigation channels.
- Purchasing a dredge allows projects to be implemented at a rate well below the market average, saving taxpayers money in the long-term.
- Purchasing a dredge would allow municipalities, if approved, to beneficially reuse dredged material as beach nourishment, reducing beach management costs while increasing coastal resilience.

- Purchasing and staffing a dredge would provide much needed year-round employment for up to 6 skilled laborers in southern Maine. Year-round responsibilities outside of the dredging season might include maintenance of dredging and ancillary equipment, scheduling, surveying, etc.

Cons

- Purchasing and operating regional dredging equipment is a significant long-term investment.
- Purchasing and operating regional dredging equipment in a cost-effective manner is contingent on identifying, permitting, and dredging a sufficient volume of material annually to cover expenses, debts, and to establish a reserve fund. This level of production would be required annually for the lifetime of the dredging equipment.
- A hydraulic cutter suction pump dredge similar to Barnstable County's Ellicott 670 Dragon would be limited to pumping sandy, muddy, and fine-grained material. Projects with significant amounts of gravel or cobble could not be completed using a hydraulic cutter suction pump dredge.
- Purchasing and operating a regional dredge in southern Maine would expose the owners to liability and risk inherent of the marine construction industry.
- Ensuring equitable access to dredging equipment and equitable scheduling of projects throughout the region may prove challenging.
- Identifying and recruiting a qualified dredge superintendent and skilled laborers with industry experience into a municipal role could prove challenging.

Limitations of this Study

The Barnstable County Dredge was used as a model to assess the feasibility of owning and operating regional dredging equipment in southern Maine. With rare exceptions, the Barnstable County Dredge pumps exclusively sandy, beach compatible material from municipal, state, and Federal waterways on Cape Cod, Martha's Vineyard, and Nantucket and beneficially reuses the material to nourish nearby recreational beaches. The established dredge rate and financials assume that the vast majority of material dredged by the County on an annual basis can be beneficially reused for beach nourishment. A dredge purchase in southern Maine would need to account for significantly more variability in sediment type. The study revealed the presence of mud, silt, sand, gravel, and cobble in many waterways, but focused on an estimate of sandy material to generate the dredge rate. If a hydraulic cutter suction dredge were considered for purchase, limitations associated with pumping and/or dewatering muddy, fine-grained, gravelly, or cobbly material would need to be closely considered.

One of the largest limitations of this dredge purchase feasibility study was the availability of current, detailed information regarding the quality and quantity of sediment that could be

dredged from each site. Estimated dredge quantities were calculated based on available dredge records associated with Federal navigation channels. It is possible that more material could be dredged from private and municipal sites within the study area. However, detailed dredge records from areas outside Federally managed waterways were not readily available and identifying additional, suitable dredge sites was beyond the scope of this study. The analysis also assumed that the quantities of sandy material that were identified could be used for beach nourishment. Although the State of Maine has a significant need for beach nourishment, it is unclear from the available sediment quality data whether the material identified in this study would meet the specific requirements set forth in Maine regarding the beneficial reuse of dredged material.

This feasibility study also assumed that Capital Grant funding and/or financing could be secured to purchase regional dredging equipment and establish a crew of skilled laborers. It was also assumed that a Regional Dredge Management Council could be established to ensure equitable access to dredging services, prioritize projects of greatest need, and develop an annual schedule that would maximize the productivity and efficiency of dredging equipment. The Regional Dredge Management Council would then need to hire a cohesive group of skilled laborers, (deckhands, levermen, engineer, captain) and an experienced superintendent to facilitate the implementation of municipal dredging projects, minimize down-time, and repair any equipment break-downs or failures in a timely manner.

Recommendations and Next Steps

If municipalities in the SMPDC region were to continue evaluating a regional purchase of hydraulic cutter suction dredging equipment, the following recommendations would need to be considered:

- Collect additional sediment quality and geochemical testing data within Federal navigation channels, municipal, and private dredge sites in the SMPDC region to refine forecasted annual dredge quantities.
- Develop a comprehensive list and maps (GIS layers) of all Federal and non-Federal dredge sites in the SMPDC region, identifying all proposed dredge sites within each municipality.
- Once all proposed dredge sites have been identified within each municipality, research permitting requirements for dredging, dewatering, and disposal of dredged material.
- Identify suitable dewatering sites for sandy material that could be beneficially reused for beach nourishment. Any proposed dewatering site would need to be within the maximum pumping distance of any dredging equipment considered for purchase.
- Identify suitable dewatering sites with room to accommodate dewatering equipment for muddy and fine-grained material. Any proposed dewatering site would need to be within the maximum pumping distance of any dredging equipment considered for purchase.
- Identify suitable beach nourishment sites proximal to dredge and dewatering sites.

- If no suitable beach nourishment sites exist proximal to dredge and dewatering sites, identify a suitable upland location to stockpile sandy material for later use.
- Identify suitable disposal sites for muddy, fine-grained material unsuitable for beach nourishment.
- Consider alternatives for dealing with gravel and cobble that cannot be dredged with hydraulic dredging equipment.
- Consider costs for hauling sediment to an offshore disposal site (CADS, or similar).
- Consider costs for dewatering, trucking, and disposing of contaminated sediment at a secure landfill.
- Develop a conceptual design for a regional advisory committee and administrative structure that would ensure equitable access to dredging equipment for all communities in the SMPDC region.
- In addition to a regional advisory committee, consider the need for administrative support staff to manage bookkeeping tasks, dredge records, active contracts, etc.
- Compare the economic benefits of purchasing and operating regional dredging equipment against the cost of hiring a private dredge contractor to complete the work. Rates for hiring a private dredge contractor are site-specific and generally assume a mobilization cost of $150k - $350k per project in addition to dredging rates of $18 – $35 per c.y. assuming that the dredged material can be beneficially reused. Dredging rates do not include the added cost of transporting, placing, and grading dredged material that will be beneficially reused as beach nourishment.

Release of the 2018 ACOE Work Plan

After completing the draft SMPDC Dredge Purchase Feasibility Study, the Woods Hole Group received additional data from *Dredging Today*, a leading publication in the dredging industry, regarding the release of the ACOE's 2018 Work Plan. *Dredging Today* outlined the following projects in the SMPDC region which are slated to receive funding under the F.Y. 2018 Work Plan:

- **Saco River – $4,200,000 -** Funds are being used to award a fully funded base bid contract with options to perform maintenance dredging of about 140,000 cubic yards of material from the 8-foot channel and anchorage with in-river placement and beach nourishment.
- **York Harbor – $2,500,000** - Funds are being used to award a fully funded contract to perform maintenance dredging of about 42,000 cubic yards of material from the 10-foot channel and 8-foot anchorages with placement at the Cape Arundel Disposal Site.
- **Cape Porpoise Harbor – $2,500,000** - Funds will be used for maintenance dredging.

- **Wells Harbor – $400,000** - Funds are being used to perform maintenance dredging of the 8-foot entrance channel using the government dredger Currituck. About 5,000 cubic yards of sandy material would be removed and placed at a near shore site off Wells Beach.

- **Disposal Area Monitoring – $1,050,000 -** Funds are being used to perform annual disposal site monitoring; including condition surveys, sediment sampling and testing, repositioning of disposal site buoys and preparation of several monitoring study reports.

Based on the article in *Dredging Today*, it is unclear how the dredge quantities identified in the F.Y. 2018 Work Plan differ from the previous ACOE dredge forecast estimates. In addition, it is likely that the Work Plan will remain fluid and the availability of funding uncertain through the end of the fiscal year. Lastly, it is worth noting several waterways in southern Maine were not included in the 2018 Work Plan, emphasizing the need to continue exploring a regional dredge purchase to maintain the safety and navigability of all waterways in the SMPDC region.

Review Comments on the Draft Report

The Southern Maine Planning and Development Commission and the Woods Hole Group received and responded to comments from the Maine Geological Survey and the Town of Wells Maine. A formal response to comments in included in Appendix H.

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1.0 Appendix A

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MEMORANDUM

Date: September 26, 2017

To: Paul Schumacher; Lee-Jay Feldman; Lee Weishar

From: Adam Finkle

Re: **SMPDC Kick Off Meeting Minutes**

Attendees: Please see attached sign in sheet.

Meeting Minutes:

I. WELCOME AND INTRODUCTIONS – Paul Schumacher – SMPDC

- Paul Schumacher discussed the need for the project and recent partnership with the Woods Hole Group.
- Individuals in attendance introduced themselves and their role in the dredge planning process and discussed specific needs at the municipal level.

II. DISCUSSION OF PROJECT TASKS

- Adam Finkle of the Woods Hole Group reviewed the Tasks allocated to the Woods Hole Group:
  - A. Task 1. Meetings and Project Coordination
  - B. Task 2. Maine Dredging and Disposal Data Collection
  - C. Task 3. Develop Operational and Financial Data from BCD
  - D. Task 4. Develop Operational Costs Forecast for the SMPDC
  - E. Task 5. Feasibility Assessment
  - F. Task 6. Final Report
  - G. Task 7. Project Management

III. ROUND TABLE DISCUSSION

- Scarborough, Saco, Kennebunk, Kennebunkport, Wells, Ogunquit, and York all expressed considerable interest in the project at the municipal level and the

need to present the project at the next Statewide Dredging Task Force Meeting in October 2017.

- Representatives from Maine DEP advocating for beneficial reuse and beach nourishment discussed the road blocks that they have encountered due to State Law require the treatment and handling of dredge spoils as solid waste.
    A. Historic soil testing revealed elevated arsenic in dredged glacial material.
    B. Elevated arsenic prohibited use of 350,000 cubic yards of sand from Portsmouth Harbor on Maine beached.
    C. Efforts to modify the allowable threshold at the State level were voted down.
    D. Comment period open for review of solid waste rules.
- In developing feasibility study, important to consider Federal navigation channels and the dredging cycle.
- Emphasis on fact that dredged volumes in historic permit applications may not match actual dredged volumes.
    A. Refer to Craig Martin – ACOE Project Manager
- Maine harbors have only recently been dredged following political pressure in Congress – beached boats, hazards to public safety.
- ACOE dredge schedule is driven by commerce, local harbors, marinas, etc. often overlooked.
- Disposal of non-sandy materials will be an issue.
- How to address the project need on a regional level?
- Maine DEP – collaboration will be needed moving forward; understanding regulatory arena will be critical moving beyond initial feasibility study.

Sign In Sheet SMPDC Kick Off Meeting - September 26, 2017			
Name	**Affiliation/Company**	**Telephone Number**	**Email Address**
Lee Wikshaa	Woods Hole Group	508 [redacted] 4956291	LWickshaa@WHGRP.com
Patrick Fox	City of Saco	207-284-6641	pfox@sacomaine.org
Lee Jay Feldman	SMPDC		ljfeldman@smpdc.org
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Joel Downs	Town of Kennebunk	604-1327	jdowns@kennebunkmaine.us
Adam Finkle	Woods Hole Group	315-415-2263	afinkle@whgrp.com
Werner Gilliam	Town of Kennebunkport	967-1604	wgilliam@kennebunkportme.gov
Larissa Crockett	Town of Scarborough	730-4149	lacrockett@ci.scarborough.me.us
Jim Carter	" " Wells	646-5115	
Paul Schumacher	SMPDC	571-7065	pschumacher@smpdc.org
Steve Dickson	MDS	287-7174	stephen.m.dickson@maine.gov
~~Matt Burns~~	~~Me Port Auth.~~		
Jane Carter	Town of Wells	207-361 8894	JCarter@wellstown.org
Matt Burns	Maine DOT	207 592 3221	matthew.j.burns@maine.gov
Regional dredge Mtg → Portland, ME	Town of York, ME	> Points of Contact for follow-up / data collection	
	Town of Ogunquit, ME		
	Town of Kittery, ME		x

Wed Oct. 18th 10-12 maine DEP Portland

2.0 Appendix B

Southern Maine Planning & Development Commission

CZMA Coastal Communities Grant Program
Preliminary Data Collection
Town of Wells, ME

Name:

Position:

Contact Information:

Name of Navigation Channel – (ex. harbor, river, inlet etc.):

Location of Channel – Exterior (outside harbor) v. Interior (inside harbor):

Type of Channel - Federal (managed by Army Corps) v. Private (managed by municipality)?

Historic Dredging: - Has channel been dredged historically (Yes / No)

- Project funding source (Federal / municipal / private)?

- Date last dredging project occurred? _____

Future Dredging: - Have historic projects kept channel safe and navigable at mean low water (Yes / No)?

- If "Yes", for how long before it is needed again?

- Is channel scheduled to be dredged (Yes / No)

- Project funding source (Federal / municipal / private)?

- Date dredging scheduled to occur? _____

- What is the required depth for safe passage at mean low water?

Beneficial Use of Dredged Material:

- What type of sediment does the channel contain (cobble / sand / mud, or variable)? If variable, please explain:

- How will dredged material be used (beach nourishment / offshore disposal / upland disposal / CAD site)? Please explain:

Channel Features and Usage:

Please describe turning areas located in / adjacent to the channel?

Ownership (public / private)?

Please describe mooring fields located in / adjacent to the channel?

Ownership (public / private)?

Number of moorings in harbor affected by dredge? _____

Please describe marinas located in / adjacent to the channel?

Ownership (public / private)?

Please describe typical, peak season boat traffic in / adjacent to the channel?

Number of commercial fishermen affected by dredge? _____

Number of charter boats affected by dredge? _____

Number of recreational craft affected by dredge (daily, peak season) ____

Average length vessel operating in / adjacent to the channel? _____

Average draft vessel operating in / adjacent to the channel? _____

Maximum length vessel allowed in / adjacent to the channel? _____

3.0 Appendix C

Municipality	Scarborough	Saco	Kennebunkport	Kennebunk	Wells	Ogunquit	Kittery
Point of Contact	Ian Anderson - Harbormaster	Patrick Fox - DPW Director	Lee McCurdy - Harbormaster	James Black - Harbormaster	Chris Mayo - Harbormaster	Fred Mayo - Harbormaster	Scott Alessi - Harbormaster
Telephone Number	207-671-2821	207-284-6641	207-967-5040	207-205-0991	207-646-3236	207-646-9326	207-451-0829
Email Address	N/A	pfox@sacomaine.org	lmmccurdy@kennebunkportme.	N/A	cmayo@wellstown.org		kpa@kitteryme.org
Historic and Future Dredging Events							
Name of Channel	Scarborough River	Saco River	Cape Porpoise Harbor	Kennebunk River	Wells Harbor / Webhannet River	Josia's River	Pepperrell Cove
Location of Channel (Inside v. Outside Harbor)	Interior	Interior	Interior	Interior	Interior and Exterior	Interior	Interior
Type of Channel (Federal, Municipal, Private)	Federal	Federal (some private adjacent anchorage)	Federal	Federal, Municipal, Private (Arundel Yacht Club's to Lanigan Bridge have been de-	Federal, Municipal, Private	Federal	Municipal
Has Channel Been Dredged Historically?	Yes	Yes	Yes	Yes	Yes	Yes	No
Project Funding Source?	Federal	Federal	Federal	Federal, Municipal	Federal, Municipal	Federal	Federal
Date of Last Dredging Project?	2015	1990's	1974-1975	1998	2014	1994	N/A
Has Dredging Kept Channel Safe?	Yes	No	No	Yes	No	Yes	N/A
If "Yes" How Long Until Needed Again?	2 Years	10 years	N/A	15 Years. Dredging due, but not ACOE priority yet. Starting ACOE process in 2018.	Yearly	18 Years	N/A
Is Channel Scheduled to be Dredged?	Not Scheduled, but surveyed and added to ACOE list	Yes, in progress	Yes	No, requesting ACOE info January 2018	Yes	No	No
Project Funding Source?	Federal	Federal	Federal	Federal, Municipal	Federal	Federal	N/A
Date Dredging is Scheduled to Occur?	N/A	2017-2018; 2018-2019	2018	N/A	2018	N/A	N/A
Depth Required for Safe Passage?	8 feet	8 feet	6 feet	6 feet	6 feet	6 feet	12 feet
Sediment Type?	Sand, Mud	Sand	Mud	Mud, Silt, Sand at enterence to Gov't Warf	Sand	Mud	Mud
Historic Disposal of Dredged Material?	Beach Nourishment, Offshore Disposal	Upper Half - In-River; Lower Half - Beach Nourishment	Offshore Disposal	Beach Nourishment, Offshore Disposal	Beach Nourishment	Offshore Disposal	N/A
Channel Features and Usage							
Turning Basin?	No	Yes	No	No	No	No	No
Mooring Fields?	Public, Require Dredging	Public, Private, Require Dredging	Public, Require Dredging	Public, Requiree Dredging	Public, Require Dredging	Public, Require Dredging	Private, Does Not Require Dredging
Moorings Requiring Dredging?	50-60	N/A	N/A	68	150	74	N/A
Marinas?	N/A	Public, Private (4), 200+ boats, 3 boat ramps, public pier	N/A	Private, dredged at private cost	Public, 88 slips, 62 moorings, Require Dredging	Public	Public, Does Not Reuqire Dredging
Number of Commercial Fishermen?	25-30	N/A	50	12 to 18	25	26	39
Number of Charter Boats?	15	N/A	0	4 to 12	15	8	6
Number of Recreational Craft?	40-50	N/A	30	250-300	150	40	200
Average LOA?	25-30 feet	N/A	25-30 feet	30 feet	28 feet	32 feet	30 feet
Average Draft?	3-4 feet	N/A	4 feet	3 feet	3 feet	3 feet	5 feet
Maximum Length Allowed?	50 feet	N/A	49-50 feet	No Limit - to 145 feet at MHW	38 feet	42 feet	N/A

4.0 Appendix D

Report of the Barnstable County

DREDGE

THE CODFISH

Barnstable County Dredge
The Codfish

Superior Court House
P.O. Box 427
Barnstable, MA 02630

M/V "J.W. Doane" with dredge "Cod Fish" passing through the Cape Cod Canal.

Wayne Jaedtke, Superintendent
508-375-6634 | jaedtke@barnstablecounty.org

Staff

Stephen Bradbury, Captain
Christopher E. Armstrong, Leverman
Jason Bevis, Deckhand
Jacob LaRoche

INTRODUCTION

In 1993 Barnstable County conducted a needs assessment and cost benefit analysis of operating a municipal dredge program on behalf of the towns. This report documented that a County operated maintenance-dredging program would be both beneficial to the towns and cost effective to operate.

The County and its legislative delegation approached the Massachusetts Department of Environmental Management (DEM) and requested financial assistance in the form of a $1 million capital grant for the purchase of a dredge and ancillary equipment. Prior to this grant, the state was responsible for funding 75% of the cost of municipal dredge projects and the town was responsible for the remaining 25%. However, funding constraints at the state level meant that much of the dredge work was not completed on a timely basis or was never accomplished. As stipulated in the grant Agreement, the provision of a capital grant replaces the state funding for municipal dredge projects here on the Cape.

The Barnstable County Dredge Advisory Committee was established in October of 1994. The Committee has representation from all of the Cape towns, except Brewster, which has no navigable harbors, DEM and County staff. The Advisory Committee is responsible for developing the dredge schedule and recommending the dredge rate each fiscal year.

COMPLETED DREDGE PROJECTS:

To date the County has dredged 1,778,596 cubic yards of material from the waterways in 16 Cape and Island towns over 20 years. Barnstable County dredged these waterways at a rate approximately 65% below the market rate. The cost per cubic yard to dredge this material ranged between $3.33 and $11.00 per cubic yard. The average market rate for dredge services is over $18.00 per cubic yard.

If there were no Barnstable County dredge program, it would have cost the tax payers an additional $506,202 to complete the dredge projects that the County has completed on behalf of the towns on the Cape and Islands in FY 2016. This amount is based on the state paying 75% of the cost of town dredge projects at $18.00 per cubic yard.

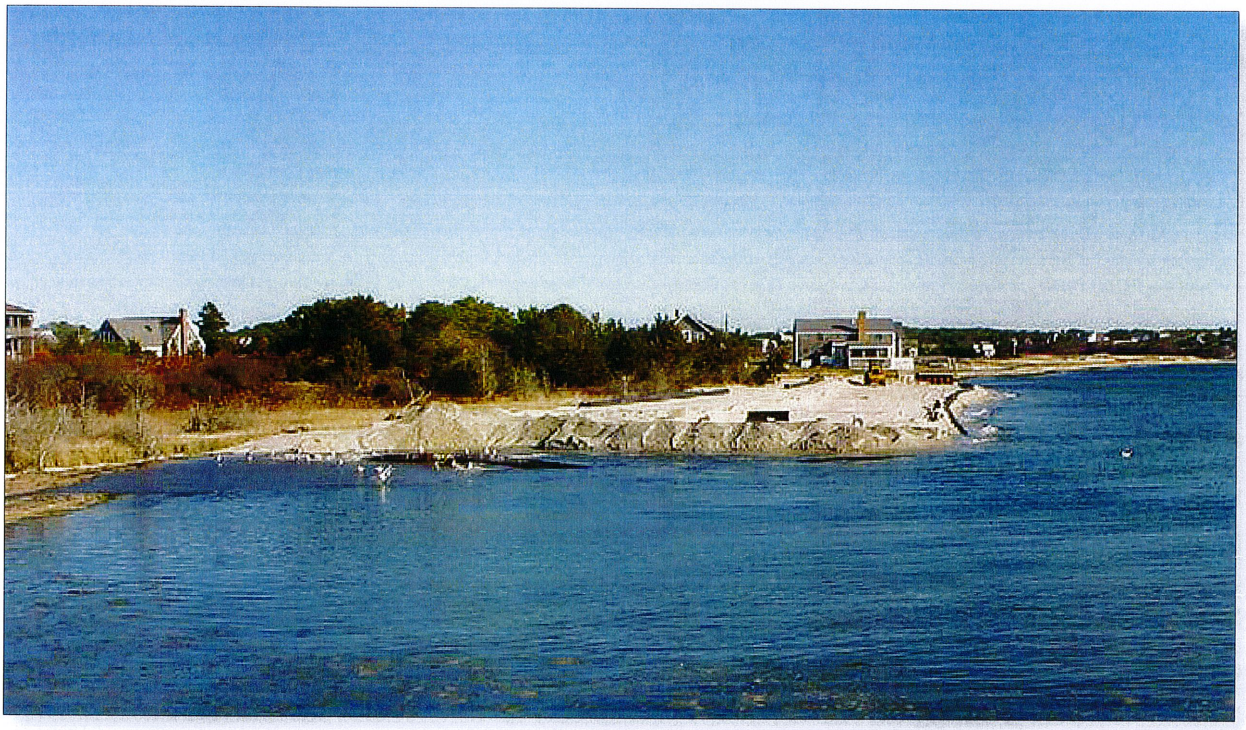
The following projects were completed this fiscal year totaling 58,874 cubic yards of material to nourish the beaches:

- Wychmere Harbor Channel
- Allen Harbor Inlet
- Green Pond Inlet
- Popponesset Cross Bay Channel
- South River Channel
- Barnstable Harbor Approach Channel
- Pamet River Channel
- Popponesset Bay Approach Channel
- Allen Harbor Approach Channel
- Sesuit Harbor Channel

In addition to a reduced rate for dredging services, the County conducts before and after dredge surveys at a savings of approximately $6,000 per project to the towns. These surveys are invaluable records in the event of a major hurricane for submission to the Federal Emergency Management Agency as documentation of storm damage.

FISCAL STATUS

The operating revenue for FY 2016 was $631,289. As of June 30, 2016 the dredge enterprise account has a reserve fund balance of $421,082. The purpose of the reserve fund balance is to establish a fund to replace the dredge.



Chatham's south coast shoreline nourishment with sand dredged from Stage Harbor Channel.

5.0 Appendix E

81 Technology Park Dr., E. Falmouth, MA 02536
Direct Extension: (508) 495-6272
Main Telephone: (508) 540-8080
FAX: (508) 540-1001
e-mail: afinkle@woodsholegroup.com
www.woodsholegroup.com

MEMORANDUM

Date: February 1, 2018

To: Paul Schumacher; Abbie Sherwin; Lee Weishar

From: Adam Finkle

Re: **SMPDC-BCD Trip Report / Meeting Minutes**

Attendees: Paul Schumacher (SMPDC), Abbie Sherwin (SMPDC), Lee Weishar (WHG), Adam Finkle (WHG), Theodore Keon (Town of Chatham), Wayne Jaedtke (Barnstable County), members of the Barnstable County Dredge Advisory Committee

January 24, 2018 – Meeting with Director of Coastal Resources, Town of Chatham, MA

- Mr. Theodore Keon, Director of Coastal resources and Stuart F.X. Smith, Harbormaster both serve on Barnstable County Dredge Advisory Committee
- Chatham has 2 Federally maintained dredge channels – Barnstable County Dredge has supplemented ACOE work since 1998.
- Each Town required to maintain own dredge permits, no scheduling until permits in hand, comprehensive dredge permits including multiple locations for dredging and disposal are highly recommended.
- Dredge Advisory Committee – Schedule and rates discussed and approved, dredge Superintendent coordinates directly with Towns.
- To ensure smooth dredge operation, ensure Superintendent has adequate support staff (including admin / contract admin).
- Prior to Barnstable County Dredge, municipal projects went to bid, Towns paid 25%, State 75% to finance projects.
- Barnstable County Dredge increased autonomy of the Towns and created desirable rate schedule (cheaper than open market).
- Chatham's comprehensive permit contains dredge "zones" allowing channels to be adaptively managed. Dredging targets seasonal shoaling.

- The Barnstable County Dredge can pump 1,000-1,2000 c.y. daily. Projects range from 2,000-20,000 c.y.
- The dredge program relies on small scale, high frequency dredging events to guarantee the dredge remains busy year-to-year.
- A busy dredge keeps competent crew active year-round.
- Functionally, County dredge can only contract with municipalities – exceptions can be made If private entities provide Town with funding.
- In other instances, Town projects can be funded by private entities who are willing to buy dredged sand (disposal on private property).
- When developing comprehensive permit, prioritize disposal locations that benefit coastal processes. Don't sell sand to private entities if disposal location doesn't make sense from a sediment transport perspective.
- Prior to placement of dredged sand using public funding on private beach, "strolling easement" must be granted at State level allowing public foot traffic to pass over private property.
- The Barnstable County Dredge has 2 rates: without a booster pump (<4,000 l.f.) and with a booster pump (>4,000 l.f.). Both rates include mobilization and demobilization, regardless of how many yards are pumped, rate is standard for all Towns.
- New Dredge Purchase: able to pump further without booster, increased capacity (stronger pump), increased efficiency.
- With new dredge, strategy is to stage one dredge while other is operating. With one project complete, crew jumps to staged dredge while completed project site is demobilized and dredge is moved to next site – concurrent operation.
- To maximize efficiency of Dredge Advisory Committee – ask them to take on more responsibility for projects, ensure Superintendent has administrative support needed.
- Successful program need competent Superintendent, leverman, captain, and crew.
- Some projects have occurred for sole purpose of nourishing beaches, though permitting climate makes this type of project difficult.

January 24, 2018 – Meeting with Barnstable County Dredge Superintendent

- $800-900k income is required for the Barnstable County Dredge to "operate in the black".
- $1M capital grant was used for initial dredge + ancillary equipment purchases, no payback required, 3-year probationary period.
- Current within navigation channels is a consideration when sizing equipment.
- CAT-320, 850hp diesel powers newly purchased dredge, carriage spud to maintain stability (40' length up from 26' spud length).
- Don't forget land operations / pipe work component of dredge operations – critical to project success.

January 25, 2018 – Meeting of the Barnstable County Dredge Advisory Committee

- Every Harbormaster/Town believes their harbor or waterway is critical – how to prioritize what is? Timeline? Schedule?
- Dealing with time of year restrictions – birds, winter flounder, horseshoe crabs – each Town can apply for (5) (3)-day waivers to dredge around time of year restrictions.
- New dredge, new fabrication, listing to starboard – boom on board to handle / lift all pump parts during maintenance / repairs.
- Staffing: 2 deckhand positions currently being advertised ($18-$21/hr.)
- Staffing 1 project engineer position currently in development (for pre/post dredge surveys)
- Not just 2 dredge crews operational with new dredge being commissioned, but also 2 loaders, pipe, support, and push boats
- Ellicott Dredge fabrication with different manufacturers pump on board (County's choice).
- Mobilization and demobilization costing options: Percentage rate cost (ex. 10%) of project cost for mobilization / demobilization? Or, increase dredge rate across the board?
- New dredge is scheduled for delivery – start planning to replace "Cod Fish" now. New plan must include sediment mapping and depreciation curve for "Cod Fish" dredge. Working with NOAA or WHOI, may be able to apply for grant funding if portion of project includes resiliency planning.
- Contracts are required for all work over $5,000 – how to deal with weather variability (down time) and quantity variability (less material than expected)?

6.0 Appendix F

Scarborough River

FID	NAI_ID	NAI_DRDG	SAMPLEID	LATITUDE	LONGITUD	SOURCE	REGFILE	SOIL	GRAINMED	GRAINQ1	GRAINQ2	GRAINQ3	GRAVEL	SAND	SILT	CLAY	FINES	LITHOLOGY
195	312	312.6	GE-3	43.53963	-70.3282	ACOE-NED		SAND	0.96	1.7	0.96	0.68	2	97	0	0	0.3	SAND
205	312	312.6	GE-1	43.532	-70.3265	ACOE-NED		SAND	0.23	0.33	0.23	0.17	0	99	0	0	0.6	SAND
206	312	312.6	GE-2	43.53485	-70.3283	ACOE-NED		SAND	0.26	0.4	0.26	0.18	0	99	0	0	0.8	SAND
219	312	312.6	GE-6	43.54697	-70.3353	ACOE-NED		SAND	0.25	0.35	0.25	0.21	0	0	0	0	0.6	SAND
220	312	312.6	GE-4	43.54278	-70.3284	ACOE-NED		SAND	0.5	0.69	0.5	0.4	0	0	0	0	0.7	SAND
221	312	312.6	GE-5	43.54567	-70.3301	ACOE-NED		SAND	0.3	0.5	0.3	0.28	0	0	0	0	0	SAND

Biddeford Pool_Saco

FID	NAI_ID	NAI_DRDG	SAMPLEID	LATITUDE	LONGITUD	SOURCE	REGFILE	SOIL	GRAINMED	GRAINQ1	GRAINQ2	GRAINQ3	GRAVEL	SAND	SILT	CLAY	FINES	LITHOLOGY
113	317	317.2	B	43.445	-70.36	ACOE-NED		SAND	0.33	0.55	0.33	0.23	0	0	100	0	0	SILT
126	316	316.4	100-87-6	43.46133	-70.3807	ACOE-NED		SAND	0.4	9.5	0.4	0.2	36	52.1	0	0	11.9	GRAVELLY SEDIMENT
145	1023	1023.1	C	43.44767	-70.3553	ACOE-NED		SAND	0.13	0.3	0.13	0	2	64	0	0	34	MUDDY SAND
148	1023	1023.1	A	43.44767	-70.3553	ACOE-NED		SAND	0.24	0.6	0.24	0.09	12	66	0	0	22	GRAVELLY SEDIMENT
168	317	317.2	D	43.445	-70.36	ACOE-NED		SAND	0.18	0.24	0.18	0.08	0	75	0	0	25	MUDDY SAND
174	317	317.2	C	43.445	-70.36	ACOE-NED		SAND	0.18	0.24	0.18	0.1	1	79	0	0	20	SAND
175	317	317.2	E	43.445	-70.36	ACOE-NED		SAND	0.17	0.25	0.17	0.1	0	79	0	0	21	SAND
190	317	317.2	F	43.445	-70.36	ACOE-NED		SAND	0.22	0.3	0.22	0.15	0	90	0	0	10	SAND
196	317	317.2	A	43.445	-70.36	ACOE-NED		SAND	0.4	0.5	0.4	0.2	2	97	0	0	1	SAND
199	317	317.2	2	43.445	-70.36	ACOE-NED		SAND	0.37	0.5	0.37	0.2812	2.6	97.1	0	0	0.3	SAND
203	316	316.4	100-87-2	43.46133	-70.3807	ACOE-NED		SAND	0.6	1.3	0.6	0.3	0	98.1	0	0	1.9	SAND
204	316	316.4	100-87-7	43.46133	-70.3807	ACOE-NED		SAND	1.1	1.8	1.1	0.77	0	98.8	0	0	1.2	SAND
209	316	316.4	100-87-3	43.46133	-70.3807	ACOE-NED		SAND	0.41	0.68	0.41	0.3	0	99.1	0	0	0.9	SAND
210	316	316.4	100-87-4	43.46133	-70.3807	ACOE-NED		SAND	0.33	0.51	0.33	0.28	0	99.4	0	0	0.6	SAND
211	316	316.4	100-87-8	43.46133	-70.3807	ACOE-NED		SAND	0.41	0.55	0.41	0.32	0	99.7	0	0	0.3	SAND
215	316	316.4	100-87-1	43.46133	-70.3807	ACOE-NED		SAND	0.9	1.4	0.9	0.67	0	99.9	0	0	0.1	SAND
216	316	316.4	100-87-9	43.46133	-70.3807	ACOE-NED		SAND	0.68	0.9	0.68	0.49	0	99.9	0	0	0.1	SAND
222	316	316.4	100-87-5	43.46133	-70.3807	ACOE-NED		SAND	0.85	1.3	0.85	0.6	0	0	0	0	0.2	SAND
361	317	317.2	4	43.445	-70.36	ACOE-NED		SILT	0.07	0.08	0.07	0.0437	0.8	36.4	54.9	7.9	62.8	SANDY SILT
368	317	317.2	3	43.445	-70.36	ACOE-NED		SILT	0.07	0.09	0.07	0.0484	4.1	40.5	45.5	9.8	55.3	SANDY SILT
379	317	317.2	1	43.445	-70.36	ACOE-NED		SILT	0.07	0.1	0.07	0.0452	0	47.8	40.1	12.1	52.2	SILTY SAND
470	317	317.3	I	43.445	-70.36				0	0	0	0	0	0	0	0	16	SAND
478	317	317.3	H	43.445	-70.36				0	0	0	0	0	0	0	0	2	SAND
479	317	317.3	J	43.445	-70.36				0	0	0	0	0	0	0	0	2	SAND

Cape Porpoise Harbor

FID	NAI_ID	NAI_DRDG	SAMPLEID	LATITUDE	LONGITUD	SOURCE	REGFILE	SOIL	GRAINMED	GRAINQ1	GRAINQ2	GRAINQ3	GRAVEL	SAND	SILT	CLAY	FINES	LITHOLOGY
336	55	55.2	PE-2	43.35667	-70.4298	ACOE-NED		SILT	0	0	0	0	0	18	0	0	82	MUD
338	55	55.2	PE-1	43.35667	-70.4298	ACOE-NED		SILT	0	0	0	0	0	2	0	0	98	MUD
356	55	55.2	PE-4	43.35667	-70.4298	ACOE-NED		SILT	0	0	0	0	0	32	0	0	68	SANDY MUD
357	55	55.2	PE-3	43.35667	-70.4298	ACOE-NED		SILT	0	0	0	0	0	33	0	0	67	SANDY MUD
413	55	55.2	PE-1-2A	43.35667	-70.4298	ACOE-NED		SILT	0	0	0	0	0	0	0	0	0	MUD
414	55	55.2	PE-1-2B	43.35667	-70.4298	ACOE-NED		SILT	0	0	0	0	0	0	0	0	0	MUD
415	55	55.2	PE-2-2A	43.35667	-70.4298	ACOE-NED		SILT	0	0	0	0	0	0	0	0	0	MUD
416	55	55.2	PE-2-2B	43.35667	-70.4298	ACOE-NED		SILT	0	0	0	0	0	0	0	0	0	MUD
417	55	55.2	PE-3-2A	43.35667	-70.4298	ACOE-NED		SILT	0	0	0	0	0	0	0	0	0	MUD
418	55	55.2	PE-3-2B	43.35667	-70.4298	ACOE-NED		SILT	0	0	0	0	0	0	0	0	0	MUD
419	55	55.2	PE-4-2A	43.35667	-70.4298	ACOE-NED		SILT	0	0	0	0	0	0	0	0	0	MUD
420	55	55.2	PE-4-2B	43.35667	-70.4298	ACOE-NED		SILT	0	0	0	0	0	0	0	0	0	MUD

Kennebunk_River

FID	NAI_ID	NAI_DRDG	SAMPLEID	LATITUDE	LONGITUD	SOURCE	REGFILE	SOIL	GRAINMED	GRAINQ1	GRAINQ2	GRAINQ3	GRAVEL	SAND	SILT	CLAY	FINES	LITHOLOGY
130	50	50.5	PE-3-74	43.3562	-70.4752	ACOE-NED		SAND	0.079	0.13	0.079	0.0175	1	54	0	0	45	MUDDY SAND
150	50	50.5	PE-4-74	43.35965	-70.4782	ACOE-NED		SAND	0.18	0.35	0.18	0.048	2	67	0	0	31	MUDDY SAND
181	182	182.1	T3D	43.35983	-70.4773	ACOE-NED	90-10602	SAND	0	0	0	0	0	85	0	0	15	SAND
183	182	182.1	T3S	43.35983	-70.4773	ACOE-NED	90-10602	SAND	0	0	0	0	0	87	0	0	13	SAND
202	50	50.5	PE-2-74	43.3449	-70.4758	ACOE-NED		SAND	0.26	0.33	0.26	0.195	0	98	0	0	1.8	SAND
229	50	50.6	C	43.35192	-70.4757	ACOE-NED		SAND	0.18	0.22	0.18	0.13	0	0	0	0	2	SAND
236	50	50.6	B	43.35478	-70.4749	ACOE-NED		SAND	0.09	0.13	0.09	0.045	0	0	0	0	32	SAND
237	50	50.6	A	43.36004	-70.478	ACOE-NED		SAND	0.095	0.15	0.095	0.04	0	0	0	0	32	SAND
292	50	50.5	PE-2A	43.3449	-70.4758	ACOE-NED		SAND	0	0	0	0	0	0	0	0	0	SAND
293	50	50.5	PE-1A	43.35203	-70.4759	ACOE-NED		SAND	0	0	0	0	0	0	0	0	0	SAND
294	50	50.5	PE-3A	43.3562	-70.4752	ACOE-NED		SAND	0	0	0	0	0	0	0	0	0	SAND
295	50	50.5	PE-4	43.35965	-70.4782	ACOE-NED		SAND	0	0	0	0	0	0	0	0	0	SAND
296	182	182.2	T3D	43.35983	-70.4773			SAND	0	0	0	0	0	0	0	0	0	SAND
297	182	182.2	T3S	43.35983	-70.4773			SAND	0	0	0	0	0	0	0	0	0	SAND
382	50	50.5	PE-1-74	43.35203	-70.4759	ACOE-NED		SILT	0.088	0.15	0.088	0.026	0	59	0	0	41	SILTY SAND
466	182	182.1	YS-2	43.35983	-70.4773	ACOE-NED	90-10602		0	0	0	0	0	0	0	0	11.8	SAND
469	182	182.1	YM 1P1	43.35983	-70.4773	ACOE-NED	90-10602		0	0	0	0	0	0	0	0	14.97	SAND
471	182	182.1	YS-3	43.35983	-70.4773	ACOE-NED	90-10602		0	0	0	0	0	0	0	0	16.4	SAND
473	182	182.1	YM 2PS	43.35983	-70.4773	ACOE-NED	90-10602		0	0	0	0	0	0	0	0	17.33	SAND
476	182	182.1	YS-1	43.35983	-70.4773	ACOE-NED	90-10602		0	0	0	0	0	0	0	0	19.4	SAND
477	182	182.1	YM 1PS	43.35983	-70.4773	ACOE-NED	90-10602		0	0	0	0	0	0	0	0	19.62	SAND
484	182	182.1	YC-1	43.35983	-70.4773	ACOE-NED	90-10602		0	0	0	0	0	0	0	0	21.2	SAND
485	182	182.1	YS-4	43.35983	-70.4773	ACOE-NED	90-10602		0	0	0	0	0	0	0	0	22.8	SAND
492	307	307.1	NAI #1	43.35933	-70.4768	ACOE-NED	1986-003		0	0	0	0	0	0	0	0	33.6	MUDDY SAND
514	39	39.1	NAI #1	43.36083	-70.4782	ACOE-NED	1987-185		0.3	0.08	0.3	0.25	0	0	0	0	74	SANDY MUD

Wells Harbor

FID	NAI_ID	NAI_DRDG	SAMPLEID	LATITUDE	LONGITUD	SOURCE	REGFILE	SOIL	GRAINMED	GRAINQ1	GRAINQ2	GRAINQ3	GRAVEL	SAND	SILT	CLAY	FINES	LITHOLOGY
20	325	325.6	PE-1	43.31633	-70.5527	ACOE-NED		CLAY	0.0495	0.14	0.0495	0.008	0	0	0	0	62.5	SANDY MUD
23	325	325.6	PE-2	43.31633	-70.5527	ACOE-NED		CLAY	0.018	0.13	0.018	0.0087	0	0	0	0	71.5	SANDY MUD
28	325	325.6	PE-3	43.31633	-70.5527	ACOE-NED		CLAY	0.012	0.034	0.012	0.0029	0	0	0	0	87.5	MUD
182	325	325.6	L	43.31633	-70.5527	ACOE-NED		SAND	0.83	2.32	0.83	0.3815	13.7	86.3	0	0	0	GRAVELLY SEDIMENT
200	325	325.6	M	43.31633	-70.5527	ACOE-NED		SAND	0.43	0.63	0.43	0.3051	1.5	97.9	0	0	0.6	SAND
213	325	325.6	N	43.31633	-70.5527	ACOE-NED		SAND	0.26	0.32	0.26	0.2109	0	99.8	0	0	0.2	SAND
217	325	325.5	GE-2	43.32069	-70.5583	ACOE-NED		SAND	0.78	2.9	0.78	0.43	0	0	0	0	0.2	SAND
218	325	325.5	GE-1	43.32089	-70.5625	ACOE-NED		SAND	0.25	0.72	0.25	0.18	0	0	0	0	0.5	SAND
223	325	325.5	GE-4	43.31873	-70.5567	ACOE-NED		SAND	0.37	0.58	0.37	0.3	0	0	0	0	0.4	SAND
225	325	325.5	GE-5	43.31695	-70.5547	ACOE-NED		SAND	0.31	0.37	0.31	0.29	0	0	0	0	0.6	SAND
231	325	325.5	GE-3	43.31774	-70.5629	ACOE-NED		SAND	0.14	0.19	0.14	0.07	0	0	0	0	26.9	SAND

453	325	325.6	34	43.31633	-70.5527	ACOE-NED		0	0	0	0	0	100	0	0	0 SAND
457	325	325.6	38	43.31633	-70.5527	ACOE-NED		0	0	0	0	1.4	98.4	0	0	0.1 SAND
458	325	325.6	37	43.31633	-70.5527	ACOE-NED		0	0	0	0	0.1	99.6	0	0	0.3 SAND
459	325	325.6	35	43.31633	-70.5527	ACOE-NED		0	0	0	0	0.3	99.6	0	0	0.1 SAND
460	325	325.6	36	43.31633	-70.5527	ACOE-NED		0	0	0	0	0	99.8	0	0	0.2 SAND

NOAA_Wells

FID	STATION	RIVER	LATITUDE	LONGITUD	FOLK	GRAVEL	SAND	SILT	CLAY	SILTCLAY	SANDGRAV	MEDIAN	TOC
0	222	Webhanne	43.31362	-70.5653	Silty Sand	0	78.15	21.85	0	21.85	78.15	2.8629	2.05838
1	225	Webhanne	43.3137	-70.5664	Sand	0	96.46	3.48	0.05	3.53	96.46	2.857	1.14493
2	232	Webhanne	43.31258	-70.5699	Silty Sand	0	89.87	5.64	4.49	10.13	89.87	2.9898	999
3	235	Webhanne	43.31187	-70.5671	Sand	0	95.52	4.48	0	4.48	95.52	2.8814	999
4	240	Webhanne	43.31114	-70.5713	Silty Sand	0	87.29	12.71	0	12.71	87.29	2.7763	0.47733
5	242	Webhanne	43.311	-70.5695	Sand	0	96.64	3.36	0	3.36	96.64	1.9989	0.5558
6	249	Webhanne	43.31015	-70.5711	Sand	0	92.07	7.63	0.31	7.94	92.07	1.9804	0.97735
7	251	Webhanne	43.30991	-70.5696	Sand	0.67	98.46	0.87	0	0.87	99.13	1.568	0.50736
8	252	Webhanne	43.31172	-70.57	Sand	0	98.78	1.22	0	1.22	98.78	2.3202	0.11297
9	258	Webhanne	43.31103	-70.5688	Sand	0	99.06	0.94	0	0.94	99.06	1.9077	0.12705
10	262	Webhanne	43.31324	-70.573	Sand	0	94.22	5.58	0.2	5.78	94.22	2.3628	0.23524
11	266	Webhanne	43.31087	-70.573	Sand	0	98.89	1.11	0	1.11	98.89	2.3614	0
12	268	Webhanne	43.31002	-70.5705	Sand	0	98.4	1.6	0	1.6	98.4	2.6146	0.12297
13	272	Webhanne	43.30908	-70.5698	Sand	0	98.32	1.68	0	1.68	98.32	2.7153	0.14954
14	277	Webhanne	43.30828	-70.5707	Silty Sand	0	82.25	17.3	0.45	17.75	82.25	3.1556	0.27992
15	283	Webhanne	43.30558	-70.5756	Gravelly Sa	12.08	86.03	1.89	0	1.89	98.11	1.6516	999
16	288	Webhanne	43.3066	-70.5722	Sand	0	94.71	5.29	0	5.29	94.71	2.4058	0.39551
17	101	Webhanne	43.32913	-70.5615	Silty Sand	0	85.06	14.32	0.62	14.94	85.06	2.9116	0.34836
18	104	Webhanne	43.32785	-70.5644	Sand	0	92.5	7.5	0	7.5	92.5	2.6932	0.27997
19	106	Webhanne	43.32641	-70.5634	Sand	0	99.59	0.14	0.28	0.42	99.59	1.8319	0.10386
20	109	Webhanne	43.32519	-70.5617	Silty Sand	0	88.44	11.25	0.31	11.56	88.44	2.7038	0.40333
21	112	Webhanne	43.32465	-70.559	Silty Sand	4.37	89.95	5.68	0	5.68	94.32	2.497	0.16738
22	115	Webhanne	43.3237	-70.5589	Sand	0	95.41	4.59	0	4.59	95.41	2.7958	0.20693
23	121	Webhanne	43.3226	-70.5609	Sand	1.09	98.09	0.82	0	0.82	99.18	2.1815	0.07699
24	125	Webhanne	43.3206	-70.57	Sand	0	95.63	3.39	0.98	4.37	95.63	2.9041	0.17093
25	127	Webhanne	43.322	-70.5689	Sand	0	100	0	0	0	100	2.5542	0.07922
26	129	Webhanne	43.3217	-70.5666	Sand	0	91.66	8.35	0	8.35	91.66	1.534	0.26729
27	132	Webhanne	43.32202	-70.5648	Sand	0	95.51	4.49	0	4.49	95.51	2.5199	0.24172
28	146	Webhanne	43.32086	-70.559	Sand	0	98.51	1.49	0	1.49	98.51	2.3992	0.83954
29	152	Webhanne	43.31826	-70.556	Sandy Grav	62.27	36.1	1.63	0	1.63	98.37	1.9512	0.19654
30	156	Webhanne	43.32166	-70.5632	Sand	0	98.88	1.12	0	1.12	98.88	2.3451	0.08755
31	158	Webhanne	43.3214	-70.5619	Gravelly Sa	27.98	69.74	2.28	0	2.28	97.72	0.7946	0.16104
32	163	Webhanne	43.32098	-70.5608	Silty Sand	7.13	83.3	9.57	0	9.57	90.43	2.2415	0.18882
33	164	Webhanne	43.32076	-70.5631	Sand	0	94.54	5.46	0	5.46	94.54	2.7235	0.78299
34	166	Webhanne	43.32032	-70.5618	Silty Sand	0	89.67	10.11	0.22	10.33	89.67	2.6001	0
35	171	Webhanne	43.31985	-70.5635	Sand	0	98.7	1.3	0	1.3	98.7	2.4707	0.09273
36	173	Webhanne	43.31953	-70.5619	Silty Sand	0	87.16	12.84	0	12.84	87.16	2.9046	0.36715
37	180	Webhanne	43.3193	-70.564	Sand	0	96.62	3.38	0	3.38	96.62	2.0602	0.0831
38	182	Webhanne	43.3182	-70.5623	Silty Sand	0	88.07	8.53	3.4	11.93	88.07	2.807	0.19996
39	184	Webhanne	43.31786	-70.5616	Silty Sand	0	80.66	15.22	4.12	19.34	80.66	2.68	1.5213
40	192	Webhanne	43.31712	-70.564	Sand	0	94.22	5.78	0	5.78	94.22	2.6699	0.68125
41	201	Webhanne	43.31597	-70.563	Sand	0	97.7	2.3	0	2.3	97.7	2.6458	0.12417
42	209	Webhanne	43.31669	-70.5652	Sand	0	100	0	0	0	100	2.8078	0.15613
43	211	Webhanne	43.31499	-70.5653	Sand	0	98.72	1.28	0	1.28	98.72	2.123	0.07517
44	214	Webhanne	43.31435	-70.564	Sand	0	93.82	6.19	0	6.19	93.82	2.7057	0.15238
45	289	Webhanne	43.30627	-70.5705	Gravelly Sa	7.26	89.12	3.63	0	3.63	96.38	2.4201	0.17725

Perkins Cove Josiahs River

FID	NAI_ID	NAI_DRDG	SAMPLEID	LATITUDE	LONGITUD	SOURCE	REGFILE	SOIL	GRAINMED	GRAINQ1	GRAINQ2	GRAINQ3	GRAVEL	SAND	SILT	CLAY	FINES	LITHOLOGY
133	47	47.4	GE-2	43.23609	-70.5909	ACOE-NED		SAND	1.25	17.5	1.25	0.39	38	57	0	0	5.2	GRAVELLY SEDIMENT
193	47	47.4	PE-1; CORE	43.23555	-70.5899	ACOE-NED		SAND	0.17	0.199	0.17	0.14	2	94	0	0	4.8	SAND
289	47	47.4	PE-1; BOTT	43.23555	-70.5899	ACOE-NED		SAND	0	0	0	0	0	0	0	0	0	SAND
290	47	47.4	PE-1; SURF	43.23555	-70.5899	ACOE-NED		SAND	0	0	0	0	0	0	0	0	0	SAND
291	47	47.4	PE-4; BOTT	43.23661	-70.5933	ACOE-NED		SAND	0	0	0	0	0	0	0	0	0	SAND
327	47	47.4	PE-4; CORE	43.23661	-70.5933	ACOE-NED		SILT	0.028	0.041	0.028	0.0061	0	12	0	0	88.8	MUD
360	47	47.4	PE-3; CORE	43.23673	-70.5924	ACOE-NED		SILT	0.46	0.145	0.46	0.011	2	35	0	0	63.8	SANDY MUD
410	47	47.4	PE-4; SURF	43.23661	-70.5933	ACOE-NED		SILT	0	0	0	0	0	0	0	0	0	MUD
411	47	47.4	PE-3; BOTT	43.23673	-70.5924	ACOE-NED		SILT	0	0	0	0	0	0	0	0	0	MUD
412	47	47.4	PE-3; SURF	43.23673	-70.5924	ACOE-NED		SILT	0	0	0	0	0	0	0	0	0	MUD

York Harbor

FID	NAI_ID	NAI_DRDG	SAMPLEID	LATITUDE	LONGITUD	SOURCE	REGFILE	SOIL	GRAINMED	GRAINQ1	GRAINQ2	GRAINQ3	GRAVEL	SAND	SILT	CLAY	FINES	LITHOLOGY
43	319	319.99	B	43.12617	-70.6405			CLAY	0.07	0.12	0	0.0051	0	0	0	0	0	MUD
274	319	319.99	C	43.126	-70.6397			SAND	0.1	0.13	0	0.0147	0	0	0	0	0	SAND
275	319	319.99	D	43.12667	-70.6392			SAND	0.17	0.23	0	0.1194	0	0	0	0	0	SAND
276	319	319.99	A	43.12683	-70.6402			SAND	0.15	0.2	0	0.1089	0	0	0	0	0	SAND
277	319	319.99	I	43.1275	-70.6377			SAND	0.3	0.38	0	0.2328	0	0	0	0	0	SAND
278	319	319.99	E	43.12883	-70.6395			SAND	0.08	0.12	0	0.0108	0	0	0	0	0	SAND
279	319	319.99	H	43.129	-70.639			SAND	0.22	0.28	0	0.1748	0	0	0	0	0	SAND
280	319	319.99	F	43.12933	-70.6408			SAND	0.08	0.14	0	0.0142	0	0	0	0	0	SAND
281	319	319.99	G	43.12983	-70.6412			SAND	0.12	0.16	0	0.0791	0	0	0	0	0	SAND
282	319	319.99	PE-1A	43.13019	-70.6468			SAND	0.1	0.16	0	0.051	0	0	0	0	0	SAND
283	319	319.3	PE-5A	43.13027	-70.6471			SAND	0.08	0.15	0	0.017	0	0	0	0	0	SAND
284	319	319.99	GE-2	43.1308	-70.6469			SAND	0.18	0.21	0	0.11	0	0	0	0	0	SAND
285	319	319.3	GE-4	43.1308	-70.6454			SAND	0.08	0.18	0.08	0.024	0	0	0	0	0	SAND
286	319	319.3	GE-1	43.13181	-70.6438			SAND	0.3	4	0.3	0.2	0	0	0	0	0	SAND
287	319	319.3	PE-3A1	43.13355	-70.6471			SAND	0.11	0.17	0	0.048	0	0	0	0	0	SAND
288	319	319.99	PE-3	43.13376	-70.6474			SAND	0.16	0.205	0	0.105	0	0	0	0	0	SAND
406	319	319.3	PE-1A	43.13041	-70.6463			SILT	0.096	0.17	0.096	0.021	0	0	0	0	0	MUD
407	319	319.3	PE-2A1	43.13242	-70.646			SILT	0.58	0.12	0	0.0058	0	0	0	0	0	MUD
408	319	319.3	PE-2A2	43.13264	-70.6457			SILT	0.07	0.14	0	0.011	0	0	0	0	0	MUD
409	319	319.3	PE-3A2	43.13373	-70.6473			SILT	0	0	0	0	0	0	0	0	0	MUD

NOAA_York

FID	STATION	RIVER	LATITUDE	LONGITUD	FOLK	GRAVEL	SAND	SILT	CLAY	SILTCLAY	SANDGRAV	MEDIAN	TOC
46	401	York	43.13585	-70.6589	Gravelly Sa	31.42	67.7	0.88	0	0.88	99.12	1.557	0.4444

47	404	York	43.13618	-70.6575	Gravelly Sa	29.19	66.22	1.6	2.99	4.59	95.41	2.0872	0.68091
48	407	York	43.13616	-70.655	Gravelly Sa	26.88	62.31	9.92	0.9	10.82	89.19	2.0398	0.20146
49	410	York	43.13641	-70.6532	Clayey San	1.61	73.84	13.4	11.14	24.54	75.45	1.8469	0.66
50	415	York	43.13576	-70.651	Sandy Grav	66.41	32.46	1.13	0	1.13	98.87	1.9076	0.30046
51	420	York	43.1359	-70.6499	Sandy Grav	72.3	25.07	2.01	0.61	2.62	97.37	1.2755	0.34865
52	425	York	43.13473	-70.6486	Sand	0.85	95.25	1.95	1.95	3.9	96.1	3.0027	0.23505
53	428	York	43.13497	-70.6474	Gravelly Sa	42	49.36	6.46	2.18	8.64	91.36	2.0568	0.3824
54	432	York	43.13428	-70.6464	Gravelly Sa	41.48	57.68	0.84	0	0.84	99.16	1.3568	0.21747
55	438	York	43.1325	-70.6458	Silty Sand	0	53.3	33.46	13.25	46.71	53.3	2.9432	0.25502
56	441	York	43.13381	-70.6452	Sandy Grav	64.02	35.44	0.56	0	0.56	99.46	0.6889	0.18458
57	445	York	43.13282	-70.6438	Gravelly Sa	38.38	61.62	0	0	0	100	1.2192	0.49499
58	449	York	43.13231	-70.6421	Silty Sand	0	81.69	13.2	5.11	18.31	81.69	2.8118	0.42952
59	451	York	43.12686	-70.6471	Gravelly Sa	13.24	69.4	12.91	4.44	17.35	82.64	2.6026	0.24139
60	465	York	43.13101	-70.6452	Silty Sand	0.69	59.07	23.59	16.64	40.23	59.76	2.2216	0.20177
61	473	York	43.13084	-70.6467	Silty Sand	0	49.7	38.29	12.01	50.3	49.7	2.8652	0.46119
62	476	York	43.12985	-70.6439	Sandy Grav	51.5	47.31	1.19	0	1.19	98.81	1.4112	0.50675
63	479	York	43.12847	-70.6448	Sandy Grav	61.87	37.76	0.37	0	0.37	99.63	2.4633	0.27
64	574	York	43.12717	-70.6509	Silty Sand	0	84.8	14.02	1.18	15.2	84.8	3.0342	0.30575
65	577	York	43.12551	-70.6513	Silty Sand	0.76	66.77	27.79	4.68	32.47	67.53	3.0082	0.88681
66	578	York	43.12626	-70.6508	Sand	0	91.37	8.3	0.33	8.63	91.37	3.0491	0.27179
67	582	York	43.1273	-70.6485	Sand	0	90.6	7.75	1.66	9.41	90.6	2.965	0.86921
68	589	York	43.1298	-70.6505	Sandy Silt	6.73	41.29	46.85	5.13	51.98	48.02	3.1069	0.64
69	592	York	43.13336	-70.6523	Sand	0	90.9	9.1	0	9.1	90.9	2.638	0.22493
70	595	York	43.13434	-70.6546	Silty Sand	0	67.99	23.08	8.93	32.01	67.99	3.0196	0.4541
71	598	York	43.1308	-70.6505	Silty Sand	0	55.07	36.92	8	44.92	55.07	3.3083	0.57343
72	803	York	43.13695	-70.6769	Silty Sand	0	73.92	21.19	4.89	26.08	73.92	3.0041	0.77494
73	809	York	43.13595	-70.6754	Silty Sand	0	78.99	13.83	7.18	21.01	78.99	2.9182	0.55158
74	814	York	43.13649	-70.6733	Sand	0	90.87	7.43	1.7	9.13	90.87	3.0954	-2.67151
75	820	York	43.13559	-70.6736	Silty Sand	13.51	57.97	17.2	11.32	28.52	71.48	2.9	0.28681
76	823	York	43.13701	-70.672	Silty Sand	0	81.11	14.9	3.99	18.89	81.11	3.0668	0.41111
77	831	York	43.13662	-70.6711	Silty Sand	4.37	86.44	9.19	0	9.19	90.81	2.6545	0.23797
78	833	York	43.13545	-70.6715	Silty Sand	0	71.92	22.78	5.3	28.08	71.92	3.0649	0.28042
79	835	York	43.13702	-70.6703	Silty Sand	2.84	54.44	35.19	7.53	42.72	57.28	2.963	0.33287
80	843	York	43.13592	-70.6697	Silty Sand	10.6	61.22	19.77	8.42	28.19	71.82	2.7987	0.50037
81	845	York	43.1372	-70.669	Silty Sand	0.69	83.43	14.6	1.28	15.88	84.12	3.0475	0.27102
82	850	York	43.13652	-70.6688	Sand	1.19	96.94	1.87	0	1.87	98.13	2.8134	0.1979
83	852	York	43.13749	-70.6673	Sand	0	93.4	5.39	1.21	6.6	93.4	3.0187	0.18612
84	862	York	43.13651	-70.6676	Silty Sand	0	48.76	31.41	19.82	51.23	48.76	2.8879	0.70772
85	865	York	43.13734	-70.6666	Sand	0	94.16	2.43	3.41	5.84	94.16	2.4566	0.25865
86	871	York	43.13595	-70.666	Sand	0	92.54	6.39	1.07	7.46	92.54	3.0706	0.46456
87	874	York	43.13655	-70.6654	Sand	0	96.09	3.08	0.83	3.91	96.09	2.5862	0.37448
88	883	York	43.13607	-70.6627	Sand	0	94.35	5.65	0	5.65	94.35	3.0402	0.25325
89	888	York	43.13647	-70.6614	Gravelly Sa	10.3	82.72	4.06	2.93	6.99	93.02	2.1352	0.33126

Piscataqua River

FID	NAI_ID	NAI_DRDG	SAMPLEID	LATITUDE	LONGITUD	SOURCE	REGFILE	SOIL	GRAINMED	GRAINQ1	GRAINQ2	GRAINQ3	GRAVEL	SAND	SILT	CLAY	FINES	LITHOLOGY
8	238	238.1	E-10S	43.0845	-70.7433	ACOE-NED	78-390	CLAY	0	0	0	0	11.15	31.43	16.57	40.84	0	GRAVELLY SEDIMENT
42	1001	1001.1	SB-3; MIDD	43.081	-70.7513	ACOE-NED		CLAY	0	0	0	0	0	0	0	0	0	MUD
90	59	59.7	GE-2	43.10605	-70.7937	ACOE-NED		GRAVEL	76.5	90	76.5	23	83	16	0	0	0.6	GRAVEL
91	87	87.1	NAI #2	43.10967	-70.803	ACOE-NED	74-53	GRAVEL	76.5	23	76.5	90	36	16	0	0	1	GRAVELLY SEDIMENT
93	59	59.7	GE-1	43.10526	-70.7924	ACOE-NED		GRAVEL	17	25.5	17	6500	80	19	0	0	0.6	GRAVEL
94	87	87.1	NAI #1	43.10967	-70.803	ACOE-NED	74-53	GRAVEL	17	6.5	17	25.5	80	19	0	0	1	GRAVEL
96	238	238.1	E2S	43.0845	-70.7433	ACOE-NED	78-390	GRAVEL	0	0	0	0	69.21	22.15	7.44	1.2	0	GRAVEL
97	238	238.1	E-11S	43.0845	-70.7433	ACOE-NED	78-390	GRAVEL	0	0	0	0	57.32	27.48	9.94	5.26	0	GRAVEL
99	238	238.1	E-15D	43.0845	-70.7433	ACOE-NED	78-390	GRAVEL	0	0	0	0	49.35	31.18	4.56	14.92	0	GRAVELLY SEDIMENT
100	238	238.1	E-18D	43.0845	-70.7433	ACOE-NED	78-390	GRAVEL	0	0	0	0	51.61	34.04	5.62	8.72	0	GRAVEL
101	59	59.9	A	43.10673	-70.7942	ACOE-NED		GRAVEL	7.3	14.74	7.3	1.508	59	41	0	0	0	GRAVEL
104	59	59.9	B	43.10676	-70.7936	ACOE-NED		GRAVEL	5.11	17.38	5.11	0.7816	51	48.9	0	0	0	GRAVEL
107	59	59.8	GE-4	43.07897	-70.7472	ACOE-NED		GRAVEL	0	0	0	0	0	0	0	0	0	GRAVEL
108	1001	1001.1	SB-3; BOTT	43.081	-70.7513	ACOE-NED		GRAVEL	0	0	0	0	0	0	0	0	0	GRAVEL
109	59	59.8	GE-3	43.08666	-70.762	ACOE-NED		GRAVEL	0	0	0	0	0	0	0	0	0	GRAVEL
110	59	59.8	GE-2	43.11158	-70.8015	ACOE-NED		GRAVEL	0	0	0	0	0	0	0	0	0	GRAVEL
114	238	238.1	E-11D	43.0845	-70.7433	ACOE-NED	78-390	SAND	0	0	0	0	32.33	34.55	24.62	8.5	0	GRAVELLY SEDIMENT
115	59	59.7	GE-5	43.10627	-70.7934	ACOE-NED		SAND	7	16	7	1.15	58	41	0	0	0.7	GRAVEL
116	87	87.1	NAI #5	43.10967	-70.803	ACOE-NED	74-53	SAND	7	1.15	7	16	59	41	0	0	1	GRAVEL
117	238	238.1	E1S	43.0845	-70.7433	ACOE-NED	78-390	SAND	0	0	0	0	34.96	42.77	10.99	4.79	0	GRAVELLY SEDIMENT
118	59	59.8	GE-4-79	43.08407	-70.7582	ACOE-NED		SAND	4.765	15	4.765	0.7	50	47	0	0	2.5	GRAVEL
119	238	238.1	E-16S	43.0845	-70.7433	ACOE-NED	78-390	SAND	0	0	0	0	44.21	47.15	2.73	5.9	0	GRAVELLY SEDIMENT
129	238	238.1	E-16D	43.0845	-70.7433	ACOE-NED	78-390	SAND	0	0	0	0	35.96	53.07	4.04	6.92	0	GRAVELLY SEDIMENT
131	238	238.1	E-12S	43.0845	-70.7433	ACOE-NED	78-390	SAND	0	0	0	0	1.3	55.34	23.73	19.63	0	SILTY SAND
134	238	238.1	E5S	43.0845	-70.7433	ACOE-NED	78-390	SAND	0	0	0	0	1.76	58.69	19.01	20.53	0	CLAYEY SAND
135	238	238.1	E3S	43.0845	-70.7433	ACOE-NED	78-390	SAND	0	0	0	0	31.08	59.15	8.81	0.97	0	GRAVELLY SEDIMENT
138	238	238.1	E-13S	43.0845	-70.7433	ACOE-NED	78-390	SAND	0	0	0	0	32.09	61.05	4.86	2	0	GRAVELLY SEDIMENT
139	238	238.1	E-14D	43.0845	-70.7433	ACOE-NED	78-390	SAND	0	0	0	0	27.89	61.52	2.39	8.2	0	GRAVELLY SEDIMENT
141	238	238.1	E-17D	43.0845	-70.7433	ACOE-NED	78-390	SAND	0	0	0	0	30	62.45	2.88	4.66	0	GRAVELLY SEDIMENT
144	238	238.1	E-14S	43.0845	-70.7433	ACOE-NED	78-390	SAND	0	0	0	0	32.27	63.18	2.45	2.09	0	GRAVELLY SEDIMENT
151	59	59.8	PE-1	43.08541	-70.7583	ACOE-NED		SAND	0.495	2	0.495	0.155	15	68	0	0	16.5	GRAVELLY SEDIMENT
153	238	238.1	E-15S	43.0845	-70.7433	ACOE-NED	78-390	SAND	0	0	0	0	19.31	68.55	5.66	6.49	0	GRAVELLY SEDIMENT
161	59	59.7	GE-3	43.10548	-70.793	ACOE-NED		SAND	1.25	4.1	1.25	0.58	24	74	0	0	1.9	GRAVELLY SEDIMENT
162	87	87.1	NAI #3	43.10967	-70.803	ACOE-NED	74-53	SAND	1.25	0.58	1.25	4.1	24	74	0	0	2	GRAVELLY SEDIMENT
165	59	59.7	GE-4	43.10581	-70.7927	ACOE-NED		SAND	0.47	2.15	0.47	0.37	22	75	0	0	2.9	GRAVELLY SEDIMENT
169	87	87.1	NAI #4	43.10967	-70.803	ACOE-NED	74-53	SAND	0.47	0.32	0.47	2.15	22	75	0	0	3	GRAVELLY SEDIMENT
172	59	59.8	PE-2	43.08452	-70.757	ACOE-NED	35' CHANN	SAND	0.53	1.65	0.53	0.185	8	78	0	0	14	SAND
185	238	238.1	E-13D	43.0845	-70.7433	ACOE-NED	78-390	SAND	0	0	0	0	3	89.17	6	1.84	0	SAND
187	59	59.9	C	43.10592	-70.7928	ACOE-NED		SAND	0.92	1.82	0.92	0.65	10.3	89.6	0	0	0	GRAVELLY SEDIMENT
192	59	59.9	G	43.10644	-70.7931	ACOE-NED		SAND	0.99	1.66	0.99	0.65	6.4	93.5	0	0	0	SAND
194	238	238.1	E-17S	43.0845	-70.7433	ACOE-NED	78-390	SAND	0	0	0	0	3.04	94.3	1.27	1.38	0	SAND
208	59	59.9	D	43.10543	-70.7921	ACOE-NED		SAND	0.53	0.65	0.53	0.42	0.7	99	0	0	0	SAND
212	59	59.9	E	43.1051	-70.7916	ACOE-NED		SAND	0.52	0.63	0.52	0.41	0	99.8	0	0	0	SAND
214	59	59.9	F	43.10461	-70.7908	ACOE-NED		SAND	0.46	0.35	0.46	0.35	0	99.9	0	0	0	SAND
269	1001	1001.1	SB-2; BOTT	43.081	-70.7513	ACOE-NED		SAND	0	0	0	0	0	0	0	0	0	SAND
270	1001	1001.1	SB1; BOTTO	43.081	-70.7513	ACOE-NED		SAND	0	0	0	0	0	0	0	0	0	SAND
271	238	238.1	E-18S	43.0845	-70.7433	ACOE-NED	78-390	SAND	0	0	0	0	0	0	0	0	0	SAND
272	59	59.8	GE-5	43.10644	-70.7935	ACOE-NED		SAND	0.32	0.45	0.32	0.26	0	0	0	0	0	SAND
273	59	59.8	GE-1	43.11824	-70.8118	ACOE-NED		SAND	0	0	0	0	0	0	0	0	0	SAND

328	238	238.1	E-5D	43.0845	-70.7433	ACOE-NED	78-390	SILT	0	0	0	0	0.46	12.98	56.1	30.46	0	CLAYEY SILT
345	238	238.1	E-12D	43.0845	-70.7433	ACOE-NED	78-390	SILT	0	0	0	0	0.07	24.88	38.98	36.07	0	SAND SILT CLAY
403	1001	1001.1	SB-2; TOP	43.081	-70.7513	ACOE-NED		SILT	0	0	0	0	0	0	0	0	0	MUD
404	1001	1001.1	SB-3; TOP	43.081	-70.7513	ACOE-NED		SILT	0	0	0	0	0	0	0	0	0	MUD
405	1001	1001.1	SB1 TOP	43.081	-70.7513	ACOE-NED		SILT	0	0	0	0	0	0	0	0	0	MUD

7.0 Appendix G

FY18 SALARY SCHEDULE - DREDGE - 2% COLA

		MINIMUM	MID-POINT	MAXIMUM	
D-1	ANNUAL	40,034.59	44,021.89	52,201.55	deckhand
	80 HRS	1,539.79	1,693.15	2,007.75	
	DAILY	153.9792	169.3150	200.7752	
	HOURLY	19.2474	21.1644	25.0969	
D-2	ANNUAL	44,665.71	55,515.20	64,955.07	Leverman
	80 HRS	1,717.91	2,135.20	2,498.27	
	DAILY	171.7912	213.5200	249.8272	
	HOURLY	21.4739	26.6900	31.2284	
D-3	ANNUAL	44,665.71	55,515.20	64,955.07	Maintenance Engineer
	80 HRS	1,717.91	2,135.20	2,498.27	
	DAILY	171.7912	213.5200	249.8272	
	HOURLY	21.4739	26.6900	31.2284	
D-4	ANNUAL	48,501.44	60,499.09	71,476.08	Captain
	80 HRS	1,865.44	2,326.89	2,749.08	
	DAILY	186.5440	232.6888	274.9080	
	HOURLY	23.3180	29.0861	34.3635	
D-5	ANNUAL	79,308.18	86,662.10	97,539.10	Superintendent
	DAILY	305.0315	333.3152	375.1504	
	HOURLY	42.3131	46.2354	52.0408	

8.0 Appendix H

Review Comments on the Draft Report

Examining the Feasibility of Purchasing and Operating Hydraulic Dredging Equipment in Southern Maine

Prepared by Woods Hole Group, July 2018

for the Southern Maine Planning and Development Commission

by Stephen M. Dickson, Marine Geologist, Maine Geological Survey, DACF

August 15, 2018

Specific comments are provided within the report at discrete locations. These embedded comments raise both important and minor suggestions. Below are additional comments that are more broadly related to the report. The report is a great compilation of the dredging history, needs, and potential economic aspects for consideration of the ways and means to expedite small harbor dredging projects in Maine.

Economic Projections: Calculations in this report used a composite of total sandy material (%) for volume and economic estimates. This was a simple approach using available data (e.g. Tables 16-18). A mixed source (say sand and mud) cannot be dredged and sorted so that some of it goes on a beach and some goes elsewhere. Mixed sediments might incur additional costs for dewatering, trucking, and upland disposal or, alternatively, placement on a barge and towed to an offshore disposal site. The cost estimate using a percentage approach may be an underestimate of the cost per cubic yard because not all projects would be pumping and shaping sand onto a beach with the equipment described. The report identifies this aspect of the economic projections also (p. 58).

The preceding comment regarding Economic Projections was incorporated into Section 7.0 of the Dredge Purchase Feasibility Assessment under Initial Dredge Purchase Feasibility Study Findings (p. 57-58). The Recommendations and Next Steps listed in Section 7.0 includes important considerations regarding the dewatering and disposal of material not suitable for beach nourishment (mud, cobble, contaminated sediment, etc.) and acknowledges the added costs of dealing with such material. Woods Hole Group freely acknowledges that the report may have underestimated the costs of dredging in some locations, but the Dredge Purchase Feasibility Report used the best available data and addresses this in the suggested Recommendations and Next Steps outlined in Section (7.0).

Sand Only Projects: If the harbors with only 100% sand (Scarborough, Saco, Wells) used this equipment, then using Table 16, the annual need would be (11,494 + 16,953 + 16,683) 45,130 c.y. This annual demand may also be too high because it includes sand volumes from *one-time* past improvement projects and perhaps some upper Saco River sediment that was moved by means other than a pipeline. The optimistic annual operating cost (after a capital grant award; Table 21) is $681,000. The annual cost, by this "sand only" estimate would be $15 per c.y. With a 30-year, 3% interest loan (Table 21), the price rises to $19 per c.y.

If only 100% sand sources were serviced by the dredge, 3 municipalities (Scarborough, Saco, Wells) would incur the capital cost of purchasing and operating the dredging equipment. It is unlikely that the 3 municipalities would have the annual need to support dredging activities for the lifetime of the equipment. As noted above and in Section 7.0 of the Dredge Purchase Feasibility Study, a hydraulic cutter suction pump dredge optimizes the cost of pumping sandy, muddy, and fine-grained material, allowing the dredge to deal with material that is less than 100% sand, so long as mixed disposal methods (in-river, CADS, upland, etc.) are employed. Mixed dewatering and disposal methods would be at an added cost above the average prices per c.y. listed in Section 6.0 of the Dredge Purchase Feasibility Study.

Data Additions: There are some recent dredging projects missing from the tables. Inclusion could change the economics and demand estimates in the report. For example, the 2015 Scarborough project was more than 100,000 c.y.

- Scarborough dredged one more time and placed on the beach in 2015 (Table 4; https://digitalmaine.com/mgs_publications/533/; ACOE Project Manager Matt Walsh)
- Wells Harbor was just dredged in June 2018 (Table 9; ACOE Project Manager Coral Siligato)
- York Harbor was just dredged starting in November 2017 (Table 11)

Data regarding historic (and current) dredging events relied on data publicly available datasets from the United States Army Corps of Engineers, data requests, and outreach to municipal, state, and federal officials. Projects that were active, ongoing, not yet included in publicly available datasets, or not supplied to SMPDC or the Woods Hole Group by the publication date were not included in the draft Dredge Purchase Feasibility Study.

The final draft of the Dredge Purchase Feasibility Study incorporates the 3 additional projects listed above, changing the annual Woods Hole Group estimate of available sand from 60,638 c.y. to 62,664 c.y. and reducing the most cost-effective estimated dredge rate from $11.23 to ($10.87).

Recent Needs: In Section 7, Findings and Recommendations it is noted that since the year 2000 the Barnstable County dredge has moved, on average, 93,569 c.y. of sand. For direct comparison, this report could tally all sand moved in Maine *since 2000* and get an average for (a) 100% sand projects and (b) the sand fraction of mixed sediment projects for a more direct comparison.

Only limited data regarding sediment quality was available through publicly available sources. This limitation was acknowledged in Section 7.0 of the Dredge Purchase Feasibility Study. Therefore, it would not be possible to estimate, with confidence, all sand moved in Maine since the year 2000. The following provides a gross comparison between Barnstable County and southern Maine from the year 2000-present: Total material (mud, sand, cobble, etc.) dredged in southern Maine from the year 2000-present = 636,773 c.y., or 33,514 c.y. annually.

Survey Costs: Dredge area pre- and post-survey bathymetric surveys were mentioned (as a potential cost-savings) but it is unclear if this is budgeted in "ancillary costs" or outside the budget. Clarification would

help, and as mentioned in the document comments, what purpose the surveys serve, who does them, and what type of equipment is used, and how survey equipment costs are covered.

The cost of conducting pre and post-dredge surveys along with all added equipment and personnel is included in the standardized cost per c.y. as determined by the Barnstable County Dredge Advisory Committee. This provides municipalities with an added cost savings of nearly $6,000 per project. Pre and post-dredge surveys are conducted by the Barnstable County Dredge crew are a regulatory requirement and an effective means of determining the net volume dredged and subsequently, the net cost of the project to the municipality. Additional detail regarding this added cost savings has been included in Section 4.0 of the Dredge Purchase Feasibility Study.

Sampling and Testing: There is no mention of sediment sampling and geochemistry costs. This was most likely outside the scope-of-work for WHG, but there could be municipal or regional costs added to those priced in this report for vibracoring to project depths and laboratory analyses of potential contaminants necessary to obtain environmental permits.

A bullet emphasizing the importance of geochemical testing been added to Section 7.0 Recommendations and Next Steps. The State of Maine Department of Transportation Dredging Management Action Plan (2002) referenced in the Dredge Purchase Feasibility Study provides a comprehensive outline of geochemical testing requirements in the State of Maine.

Operational Time: Table 20 estimates fuel consumption for 168 days of operation. This seems like too many days for Maine. There are time-of-year restrictions on some dredging projects and physical limitations during the boating season. If a dredge moves 1,000 c.y. per day then, based on Table 16, there might be 60 days per year of pumping (and others related to mobilization, etc.)

The Barnstable County Dredge has experienced higher-than-normal dredging activity during the 2017-2018 dredging season. The dredge is still fully operational as of September 2018, a result of multiple time-of-year-extensions and emergency exemptions since the dredging season commenced during the fall of 2017. The estimate of 168 days of operation represents 6 days of operation for 7 months out of the year. The Barnstable County Dredge has just surpassed 10 months of near-continuous operation.

Project Funding: Under Section 7, the first bullet point under "Pros" suggests that a lack of funding creates project uncertainty. This is certainly true, even under the current dredging approach and may remain a challenge with a dedicated dredge. Owning a dredge may create an incentive for funding projects, but federal, state, municipal, and private funding may always be difficult to obtain.

It bears repeating that securing funding for municipal dredging is always a challenge, regardless of whether the municipality or broader, regional authority owns and operates their own dredging equipment.

Competition: Part of the economic analysis would benefit from clarifying if ACOE projects could pay for some of the routine maintenance dredging normally paid by Congress. In other words, could this community dredge operation compete with the private sector in a federal bid process? If not, a significant volume of the dredging used in the cost/benefit analysis would need to be removed.

Maintenance dredging of federal navigation channels is based on the "base cost", or the least cost alternative. Generally, the least cost alternative involves the ACOE completing the dredging project using a hopper dredge and disposing of the material offshore. If a project proponent would like to make changes to the project or select an alternative other than the least cost alternative, (this would include utilizing a private or municipally-owned hydraulic cutter suction pump dredge to complete the work and beneficially reusing the material for beach nourishment) any costs incurred above the ACOE least cost alternative would be born by the project proponent(s). In general, the ACOE is willing to fund changes to navigation projects up to the value of the least cost alternative even if a private dredge contractor (or municipal dredging authority) completes the work.

Boom and Bust Cycle: Most of the projects in Maine do not need annual dredging. Could there be some years when there is very little or no dredging to support the annual costs? Some sort of temporal analysis might shed light on cycles of "boom and bust" years for the equipment.

The Barnstable County Dredge also experiences variability in net c.y. dredge from season to season. For instance, the dredge completed a total of 12 projects in 2005, but only dredged a total of 52,000 (c.y.). In 2011, the Barnstable county dredge only completed 6 projects, but dredged a total of 170,835 (c.y.). This degree of variability is fairly common (See Table 14 in the Dredge Purchase Feasibility Study) and illustrates the fact that some years, there are more small-scale projects and some years there are fewer projects, but they are larger in scale. A reserve fund, similar to the one established by the Barnstable County Dredge Advisory Committee has the ability to offset some seasonal variability.

Review Comments on the Draft Report

Examining the Feasibility of Purchasing and Operating Hydraulic Dredging Equipment in Southern Maine

Prepared by Woods Hole Group, July 2018

for the Southern Maine Planning and Development Commission

by Jonathan L. Carter, Town Manager, Wells, Maine, August 9, 2018

The Draft Dredge Report was interesting, but a key feasibility feature that I either missed or not really mentioned was the restrictions on dredging placed on the towns by the Federal and Maine Agencies. These are randomly in a list below:

- Federal Permits
- USF&W / IF&W – Piping Plover Time of Year Restrictions to be on Beach
- Maine DEP – Sand testing – Solid Waste Rules
- Maine DEP Time of Year dredge DMR Fisheries
- Maine Geological Concerns
- Weather conditions
- Beach Ownership

How has these impediments been managed in Barnstable or do they exist for them as they do up in Maine which I doubt.

You raise some great and important points that we should certainly address when SMPDC, Woods Hole Group, and the towns meet to discuss the project findings. While state and federal restrictions and permitting requirements are vital considerations for dredge activities, the scope of this particular project focused on assessing whether or not there is sufficient sediment material (i.e. sand) in the study waterbodies to support the purchase of a regional dredge vessel and ancillary equipment/personnel. That information is only one component of a more comprehensive feasibility assessment, but does provide a critical baseline for understanding if a regional dredge program is practicable for southern Maine based on the amount of sediment available for dredging. It also facilitates next steps for evaluating how other relevant factors, including those you noted, impact the feasibility of a regional purchase.

Section 4 of the draft dredge report briefly discusses how the Barnstable County program has approached permitting (p. 37). Permitting does have a significant cost associated with it and is both financially and time intensive for towns. All of the County's towns are responsible for applying for and maintaining their own permits. Some towns have "umbrella" permits that identify zones, or broad areas, where dredging is allowed and where dredged material can be disposed. The umbrella permit structure allows the towns flexibility in their management of waterways, reflects the dynamic nature of natural sediment movement, and accounts for changing channel locations over time. Although not mentioned in the report, the Barnstable County program has considered pursuing a coordinated regional permit for county-wide dredging activities, but has not proceeded with that option to-date.

The Barnstable program has dredged some privately-owned areas, such as marinas, at no cost to towns when there were impacts to the public waterway. Due to the uniform characteristics (e.g., size, type,

quality) of sediment on the Cape, almost all of the dredged material is used for beach nourishment. In general, the sediment dredged from a waterbody is pumped directly on to an adjacent beach. It is up to the towns where the dredged material gets placed. Towns have sold dredged material to private homeowners for beach nourishment; in those cases, the cost of dredging was covered by the sale of dredged material. Additionally, when any public funds are used to place sediment on privately-owned areas, a "strolling easement" is required on those areas, allowing public rights for walking from the pre-project (sediment placement) high tide line to the post-project low-tide line. That easement isn't in perpetuity, but rather expires once the placed sediment erodes and the area returns to pre-project conditions. This easement system requires surveying, but so far, the Barnstable County program has not worked out who is responsible for paying for the pre and post surveys and monitoring.

Once SMPDC and Woods Hole Group meet with the towns to discuss the report, key findings, and next steps, the draft report will be revised and finalized. Perhaps additional information about the issues you noted can be incorporated in the report at that time or can be addressed in any subsequent efforts that arise from this project. In the meantime, I will be sure to compile all comments, concerns, and questions, including yours, about that draft final report and share them with folks at the meeting.

Abbie Sherwin
Coastal and Land Use Planner
Southern Maine Planning and Development Commission