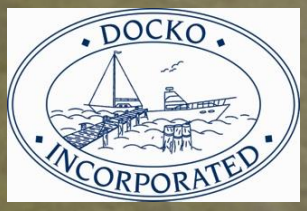
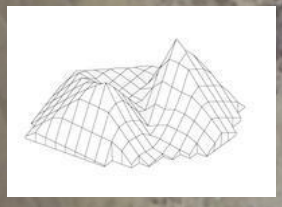
# A COMPREHENSIVE STUDY OF ESSEX HARBOR AND THATCHBED ISLAND ESSEX, CONNECTICUT

## FOR THE PURPOSE OF AN UPDATED HARBOR MANAGEMENT PLAN.

For: Essex Harbor Commission

By: Docko, Inc. and associates



## PREFACE

The purpose of this project was to document and characterize the waters within the jurisdictional boundaries of the Essex Harbor management commission. There are five major waterway elements to be studied:

- North Cove
- The Connecticut River mooring field
- Middle Cove access way
- South Cove Access way
- The waters around Thatchbed Island in general

***Thatchbed Island was to be categorized as well including:***

- Physical topography
- Tidal wetlands and submerged vegetation characterization
- Erosion profiling
- Photographic documentation
- Property ownership

This project was to be conducted over a period of months where tidal effects, climatic influences, vegetation growth on and in immediate proximity to Thatchbed Island. Pertinent features and characteristics of the river and its usage for recreational and commercial boating were to be observed and documented. All of this information was to be collected for the purpose of determining the most appropriate characterization of Thatchbed Island and preparing at least a basic plan and inventory of the physical features of the island. It was intended that future erosion, accretion and variations in vegetation could be studied and compared to the current conditions.

The project was intended to provide adequate information to draw pertinent conclusions about the adequacy of existing navigation ways in the waters of the Town and the need for future channel or travel way dredging projects and adequate characterization of tidal flow conditions in the mooring field to determine its adequacy and the adequacy of current mooring design standards.

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**Vegetation of Thatchbed Island**

Prepared by: New England Environmental Services
Marlborough, CT 06447

Date: June & September 2018

## Introduction

Between June 11, 2018 and September 14, 2018, Richard Snarski of New England Environmental services conducted a vegetation survey of Thatchbed Island.

Mr. Snarski conducted this study to assist Docko, Inc. in a comprehensive study of Thatchbed Island and key areas of Essex Harbor. The purpose of this survey was to identify habitat types and species utilizing Thatchbed Island.

This report presents the findings in the form of a plan view map of the studied area, along with a discussion of the findings.

## Discussion

It is clear from the attached exhibits and the photographic evidence gathered that Thatchbed Island is a diversified, almost non-regionalized, vegetated island populated with tidal wetlands plants of various sizes and types as listed on the attached pages.

Preliminary study considerations were based on NDDB Assessment Number 201701481 dated April 17, 2017 issued with respect to a project proposing to use Thatchbed Island for the placement of dredged materials in hopes of creating a beneficial use as marsh conditions. A determination request was submitted to the Connecticut DEEP Natural Data Diversity Base and attached is the determination that was received in this regard.

Studies of the total vegetation on Thatchbed Island were conducted during two different periods in June and September 2018 so that full observation coverage of the various species could be assured. The attached exhibit shows the location of State Listed species on the island. Otherwise, contrary to the intuition of the study participants, the tidal vegetation was intermixed and not segregated into distinct regions dominated by one or two species. The diversity of total vegetation on the island made it difficult to draw conclusions about dominance by some species and threats to other species. Reviewing the topographic features of the island revealed a relatively uniform and minimal gradient with spot elevations close to the elevation of high tide makes the entire island susceptible to wave wash over (Figure 1), which would tend to allow the majority of the surface exposed to relatively the same inundation of fresh and diluted saline waters and would tend to support observations of regionally similar and intermixed tidal vegetation.

*Figure 1: Debris line over Thatchbed Island*

*Figure 2: Debris line*

It has been surmised that the vegetation growth on Thatchbed Island is healthy and diversified and that current conditions are expected to remain for the foreseeable future with one exception. The east shore of Thatchbed Island is subject to almost continuous wave action and boat wakes generated by traffic transitioning in the Connecticut River. It is acknowledged that there are speed limits for boating traffic in the river, however, as documented in some of the aerial photographs (figure 2-7) there is a long and insidious trail of wake induced waves following each boat transitioning the river. These wakes are not angled to the direction of travel they are basically perpendicular to the line of travel of the boat and stretch for hundreds of yards behind even a boat traveling at minimal speed.

These small wake induced waves, generated by any moving boat traffic have the ability to continually wear and tear at the silty, very fine sandy sediments which comprise the shoreline of Thatchbed Island yielding this easterly face of the island, subject to continuous erosion.

*Figure 3: Boat wake hitting the easterly side of Thatchbed Island*

*Figure 4: Aerial view of boat wakes hitting easterly side of Thatchbed Island*


*Figure 5: Wind generated wakes*

*Figure 6: Wind generated wakes*


*Figure 7. Boat and wind generated wakes*

A brief conversation was held with Mr. Roger Wolf of the Connecticut DEEP to compare notes of recent and long-term observations about vegetation on Thatchbed Island and to discuss historic spraying practices on Thatchbed Island circa 2005. Mr. Wolf indicated that glyphosate, name brand "Rodeo", was probably sprayed on the stand of phragmites being in broader beds on the island. There is no clear record of the extent of growth of phragmites on Thatchbed Island at the time and no pre-project mapping is available to be analyzed at this time. Innovative Mosquito Management, LLC, out of Madison Connecticut was contracted by the State to conduct this work. Their records of the work are being solicited.

Recollections of project Team Members indicate that the phragmites was fragmented to an extent, not continuous across the broad surface area of Thatchbed Island but in patches, more or less. Phragmites observed during the mapping survey by Mr. Richard Snarski during the summer of 2018 indicated approximately 20 to 30% coverage of the island by phragmites patches. These patches tended to be broad-based over the island, not necessarily associated with ground elevation, stability or soil conditions that were consolidated or rocky or irrespective of soil texture's or percentages, soil types or degree of consolidation or firmness.

In any case, it is difficult to imagine that the patches of phragmites observed during 2018, even if eradicated, would lead to a significant change in the erosion susceptibility of Thatchbed Island or the reduction in the perimeter as documented on the mapping contained in this report. This opinion was shared by both Richard Snarski and Roger Wolf who collaborated after Mr. Snarski's four separate ventures to Thatchbed Island for the purposes of observing, mapping and documenting existing establish species.

If the phragmites patches are treated with the herbicide and allowed to stand without cutting the dead phragmites stems, it would take two years for the dead stems to naturally lay down and clear the way for the native vegetation to become established. The phragmite stems will be replaced predominately with Cattail which is the second most abundant plant species of the island. There are, of course, other plant species that will also take over in the absence of the phragmites coverage. Two plants which have deep root systems and would be a part of this vegetation reestablishment would be Tussock Sedge and Switchgrass. Both of these species have deep roots systems and would tend to hold the soils of Thatchbed Island even with the absence of phragmites or perhaps better than the phragmites.

One of the characteristics of Thatchbed Island, which make predictions of growth areas and viable species difficult, is the surface. Conditions of the soil composition and stability vary to a surprising extent across the island. The soils were rocky or actually had visible exposed areas of rock. In other cases, they were loosely consolidated such that the soils would not even support human weight. Soil bearing capacity two feet apart could change from supporting foot pressure to sinking in a foot or two into the sediments. In other cases, frequently close by, they were firm enough to walk on without significant deformation. Areas of vegetation were variable in these different soil conditions and the variations were visibly unpredictable and sporadic. (Figure 8.)

*Figure 8: Typical soils on Thatchbed Island*

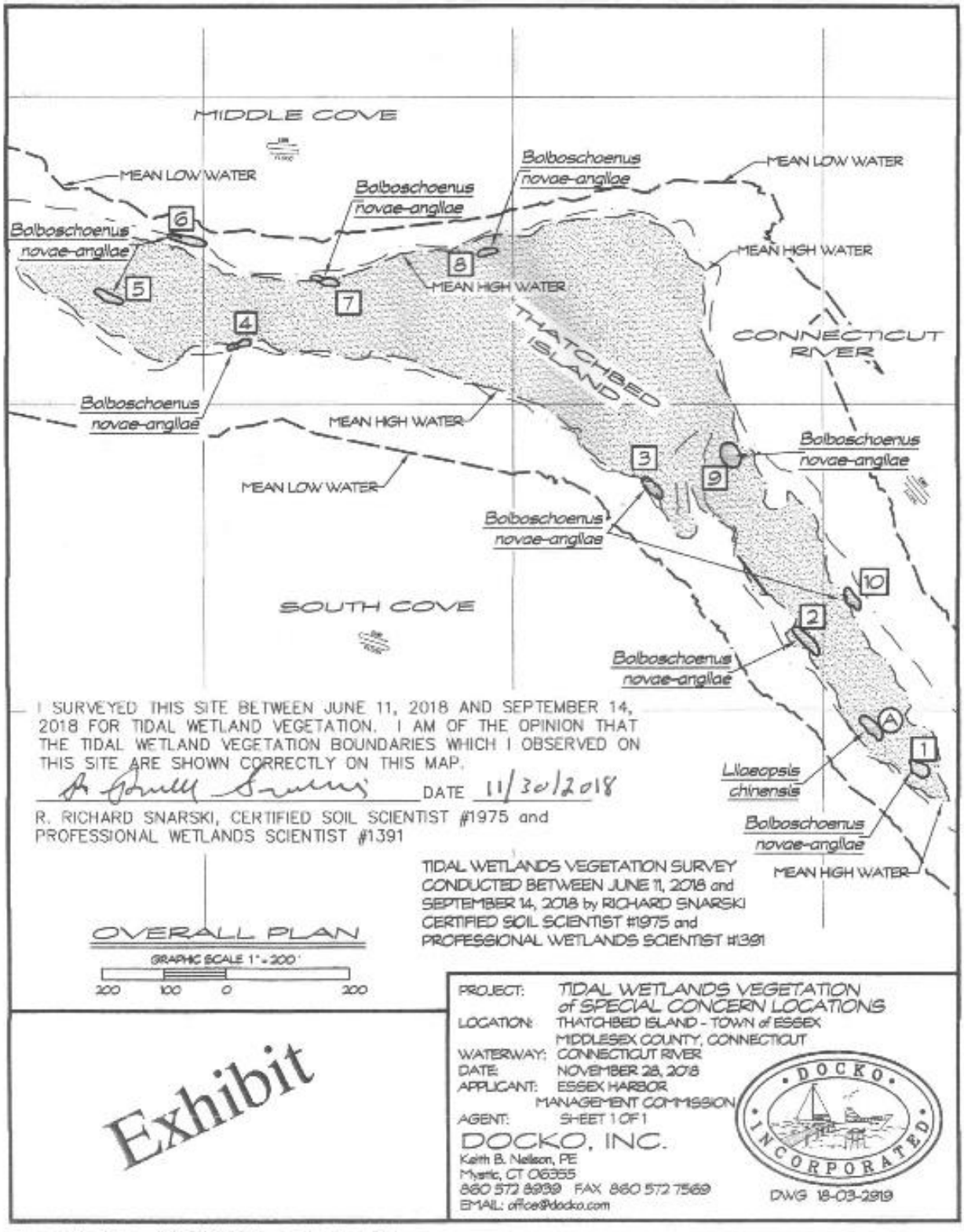
*Figure 9. Mud flats on northern shoreline*

*Figure 10. Island bank exposed at low tide*

*Figure 11. Mud flats exposed at low tide, north-western corner of island*

The State-listed species found in the NDDB Assessment Number 201701431 included Arrowleaf, Eaton beggars-tick and Salt Marsh Bulrush. The Salt Marsh Bulrushes were found in ten locations growing along the edge of the island. The Salt Marsh Bulrush was flagged in the field with stakes and flagging and annotated onto the site map. A second State-listed plant species, Lilaeopsis, occurred in one location which was which is also mapped on the site plan. Salt Marsh Bulrush and Lilaeopsis are both listed species of special concern by the Connecticut DEEP and any management plan for Thatched Island protection should make special mention of the State-listed plant species.

There are few tree size species on the island as listed in the appendix. There are several exotic invasive plants but the dominant woody plant species being False Indigo. False Indigo occurs scattered throughout the island and of course phragmites Australia's the Common Reed. Any management plan for vegetation on Thatchbed Island should include an eradication plan which should include the spraying of phragmites for a three-year period, repeated at 10-year intervals.


MIDDLE COVE
MEAN LOW WATER
Balboschoenus novae-angliae
MEAN HIGH WATER
THATCHBED ISLAND
CONNECTICUT RIVER
SOUTH COVE
Llaeopsis chinensis
I SURVEYED THIS SITE BETWEEN JUNE 11, 2018 AND SEPTEMBER 14, 2018 FOR TIDAL WETLAND VEGETATION. I AM OF THE OPINION THAT THE TIDAL WETLAND VEGETATION BOUNDARIES WHICH I OBSERVED ON THIS SITE ARE SHOWN CORRECTLY ON THIS MAP.
DATE 11/30/2018
R. RICHARD SNARSKI, CERTIFIED SOIL SCIENTIST #1975 and PROFESSIONAL WETLANDS SCIENTIST #1391
TIDAL WETLANDS VEGETATION SURVEY CONDUCTED BETWEEN JUNE 11, 2018 and SEPTEMBER 14, 2018 by RICHARD SNARSKI CERTIFIED SOIL SCIENTIST #1975 and PROFESSIONAL WETLANDS SCIENTIST #1391
OVERALL PLAN
GRAPHIC SCALE 1" = 200'
200 100 0 200
Exhibit
PROJECT: TIDAL WETLANDS VEGETATION of SPECIAL CONCERN LOCATIONS
LOCATION: THATCHBED ISLAND - TOWN of ESSEX MIDDLESEX COUNTY, CONNECTICUT
WATERWAY: CONNECTICUT RIVER
DATE: NOVEMBER 28, 2018
APPLICANT: ESSEX HARBOR MANAGEMENT COMMISSION
AGENT: SHEET 1 OF 1
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DWG 18-03-2919

**Hydrography and Topography of Essex Harbor and Thatchbed Island**

Prepared by: Hydro Data, Inc.

P.O. Box 485

Southbury, CT 06488

Date: May 2018

## Introduction

In May, 2018, Hydro Data, Inc. performed hydrographic and topographic surveys in Essex Harbor, Essex, Connecticut. Hydrographic surveys of the water surrounding Thatchbed Island, as well as North Cove, Middle Cove, South Cove and their navigation channels were performed on 1 May 2018 and 17 May 2018. A topographic survey of Thatchbed Island was performed on 21 May 2018.

Hydro Data Inc. performed these surveys to assist Docko, Inc. in a comprehensive study of Thatchbed Island and key areas of Essex Harbor. The purpose of this survey was to obtain elevation measurements of Thatchbed Island and water depth measurements of North Cove, Middle Cove, South Cove and along the east side of Thatchbed Island to create contoured plan-view drawings of the survey areas.

This report describes the data collection techniques as well as presents the findings in the form of plan view maps of the survey areas. A set of full sized drawings are presented separately.

## Methodology

Hydrographic Survey: A standard single beam hydrographic survey was performed with a field crew including an ACSM/THSOA certified Hydrographer. The crew was equipped with a small survey vessel, a Novatel RTK GPS, and Innerspace Model "455" digital depth sounder and Vespos hydrographic software package.

Precise water depths were collected using the Innerspace Model "455" depth sounder which has a 200kHz transducer and has an accuracy of +/- 0.1 foot. The Model "455" depth sounder incorporates transducer draft correction, calibration for speed of sound through water and gain control. Calibration was accomplished by performing "bar checks" at the beginning and end of the survey.

Data logging and vessel control along survey transects was accomplished by using a computer loaded with "VESPOS" hydrographic software. VESPOS allowed the collection of vessel position in Lat/Lon and state plane coordinate systems, water depth, time, transect number and data quality information. Position data with an accuracy of +/- 0.1 foot was collected with a Novatel RTK GPS system with an update rate of 20 points per second and was recorded digitally onboard the vessel-based computer.

Topographic Survey: A Matrice 100 developers drone was used in conjunction with RTK GPS land control to map Thatchbed Island. A series of parallel transects were flown over the island with a survey grade camera and lens capturing images at predetermined intervals. Approximately 300 photographs were taken during the drone flight. 180 of those photographs were selected and computer processed to generate a geo-referenced 3D surface mesh and an orthomosaic image of Thatchbed Island.

**Site Conditions**

Weather: Weather during all three surveys was fair, with no wind.

Site: The survey sites are located in Essex Harbor of the Connecticut River in Essex, Connecticut. The areas of interest are Thatchbed Island and the area along its eastern shore, Middle and South Coves and their entrance channels, and North Cove and its navigation channel (Figure 12. and Figure 13.)

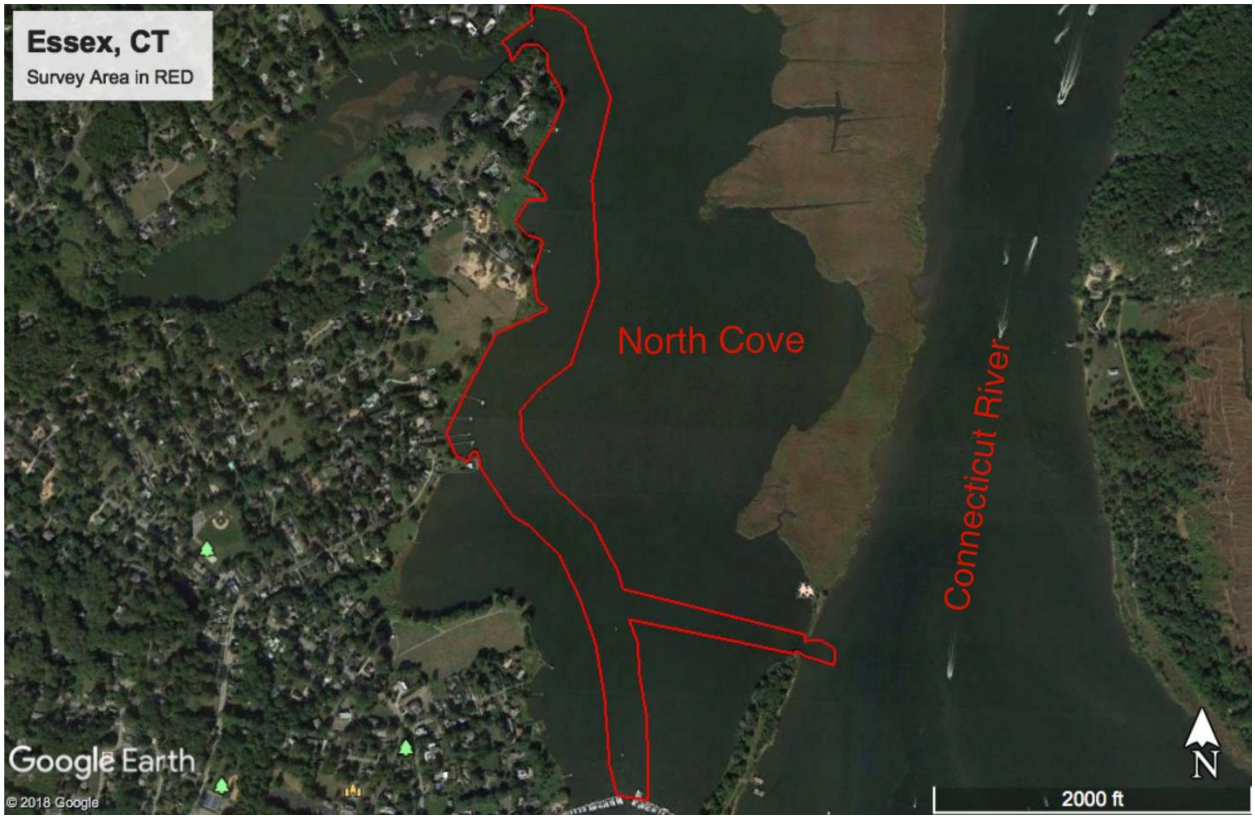



*Figure 12: Survey Areas; North Cove, Essex Harbor, Connecticut River, Essex, CT*


*Figure 13: Survey Areas; Thatchbed Island and Middle & South Coves, Essex Harbor, Connecticut River, Essex, CT*

**Processing:**

Hydrographic Survey: Data were processed using VesPosEdit and Bentley Microstation software. Depth sounder and ship position were collected during field operations using the VesPos hydrographic software package. During post-processing depth sounder data were corrected for tidal variations. Tide data were collected using RTK GPS and referenced to the Mean Low Water (MLW) Datum. The final data set was then used to generate elevation contours in Bentley Microstation

Topographic Survey: Drone survey data was processed by computer software to produce both a geo-referenced orthomosaic image (photograph) of the island and a 3D point cloud (easting, northing elevation or xyz file) of the island. The orthomosaic image was geo-referenced using land-based control points set by a registered land surveyor. The xyz data was used to generate 1-foot contours of Thatchbed Island.

The drone survey data set was combined with the hydrographic survey data to create a complete contour map of Thatchbed Island and the surrounding water.

**Data Presentation:**

Full-sized hydrographic and topographic drawings are submitted separately from this report. Thumbnails are shown below, and B-sized drawings are found in the appendix of this report.

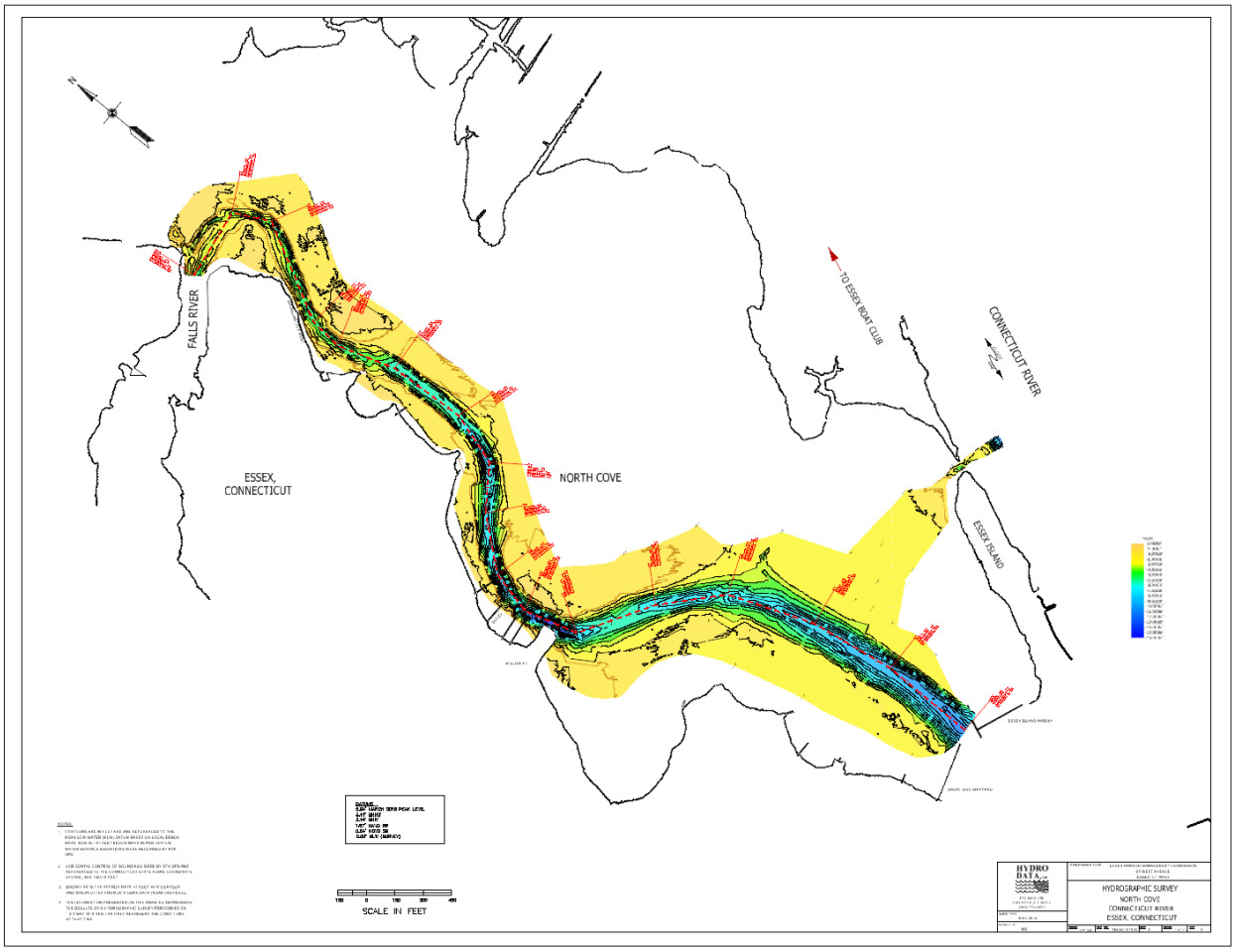



*Figure 14: Thumbnail; Plan view hydrographic map of North Cove, Essex Harbor. For higher resolution, see full-sized drawings attached separately.*

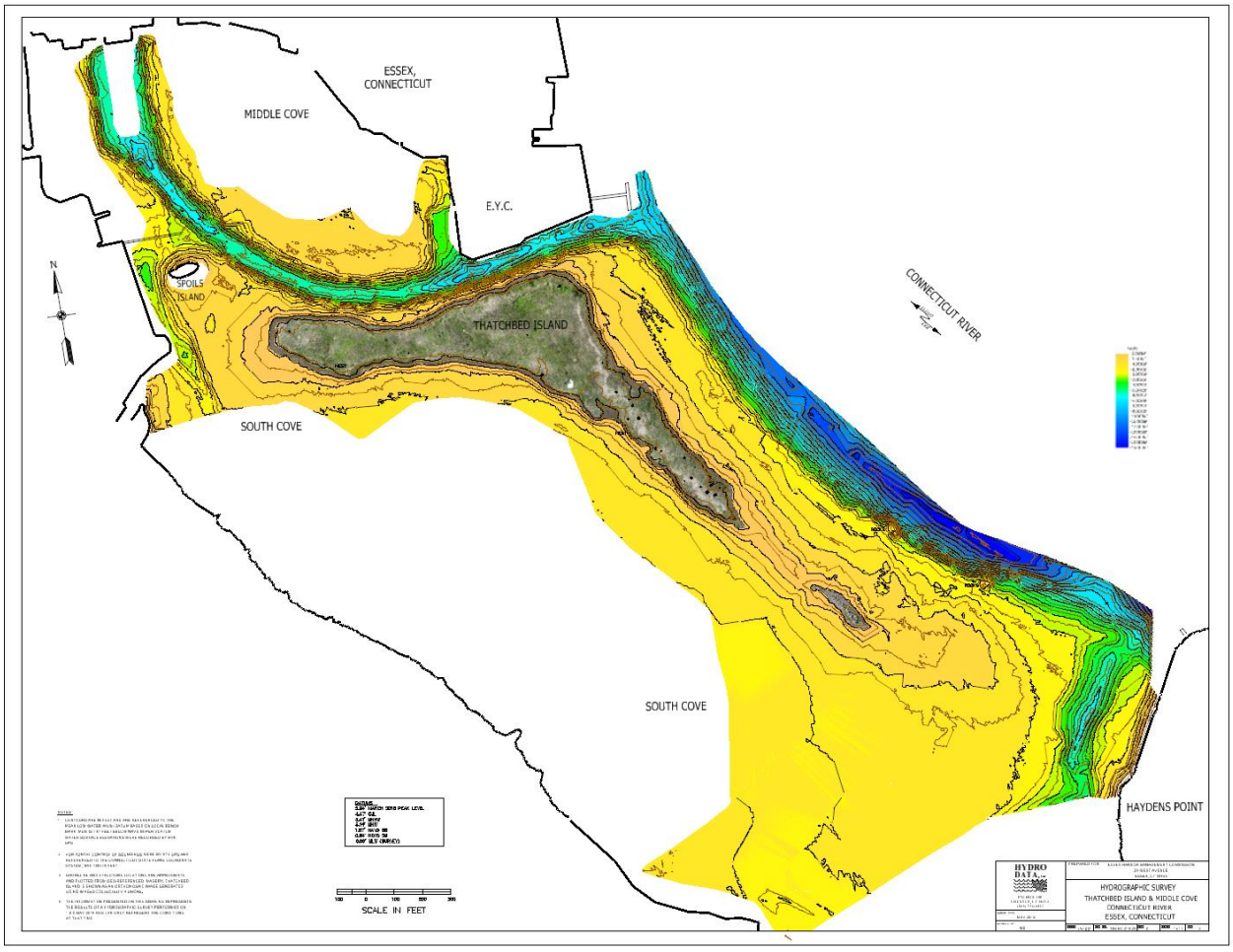



*Figure 15: Thumbnail; Plan view hydrographic map of water surrounding Thatchbed Island, Essex, CT. For higher resolution, see full-sized drawings attached separately.*

Cross-sections of Thatchbed Island and the surrounding water were generated using data collected during this survey. National Oceanic and Atmospheric Administration (NOAA) LiDAR data from 2004, 20014, and 2016 are overlaid in the presented profiles for historical comparison. Two sample cross sections are shown below (Figure 18. And 19.), the locations of which are highlighted in Figure 17. The full set of cross-sectional profiles are found on the full-sized drawings submitted separately.

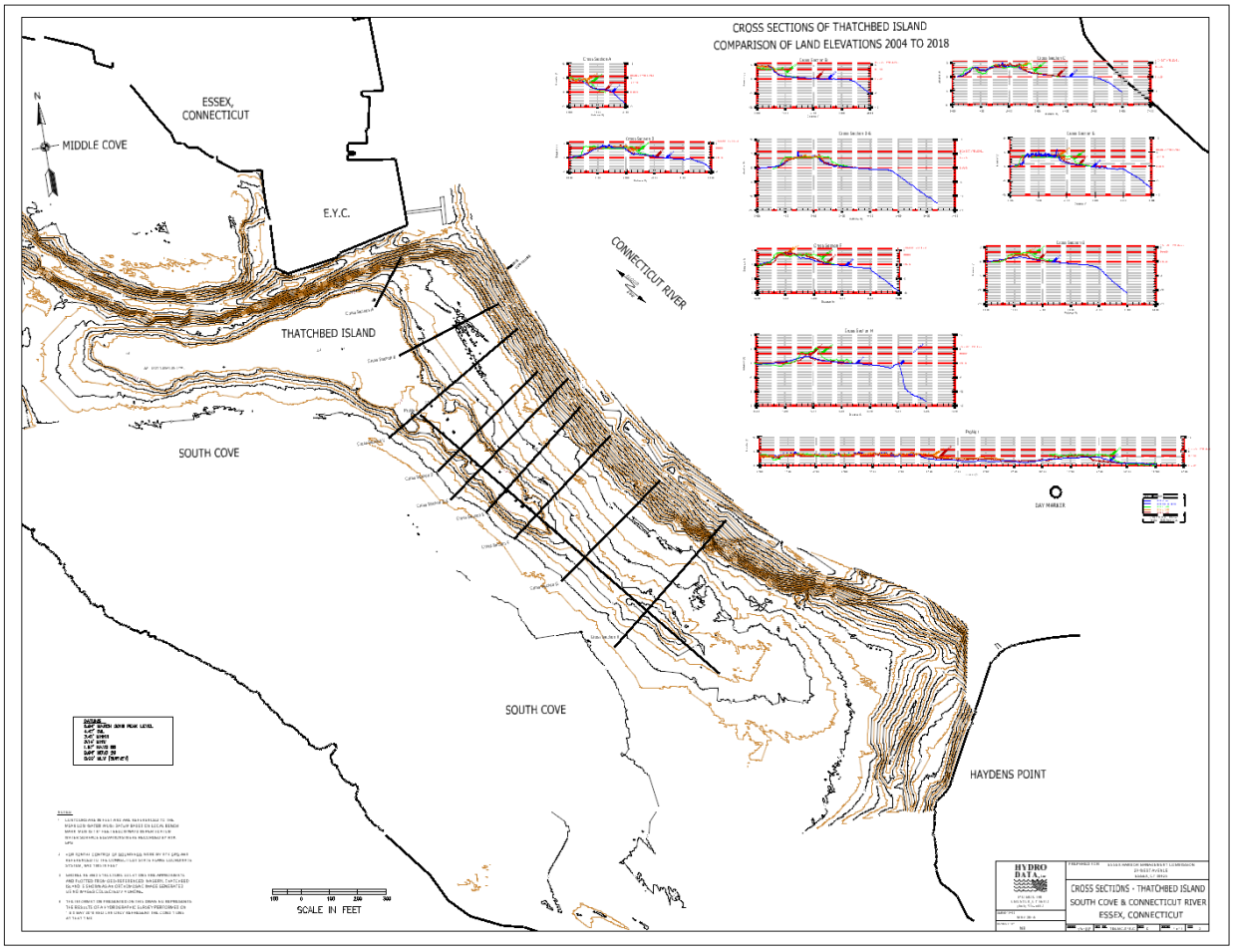



*Figure 16: Thumbnail; Cross section profiles. For higher resolution, see full-sized drawings attached separately.*

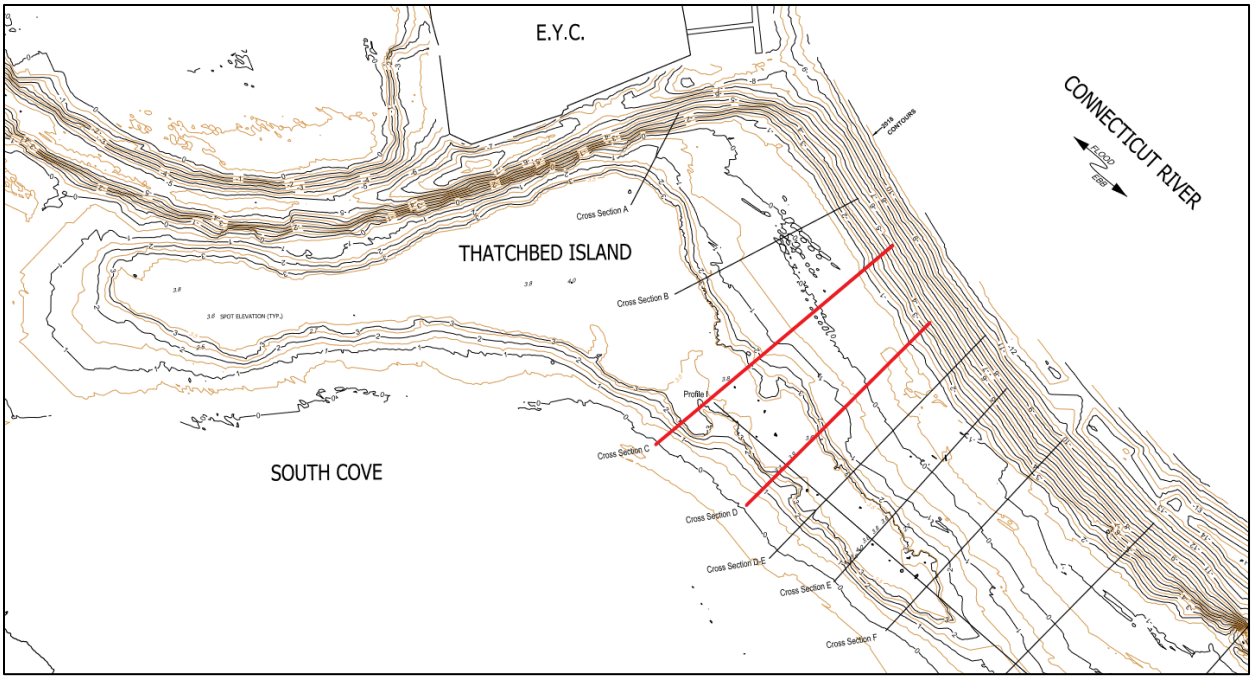



*Figure 17: Cross sections C & D locations highlighted in red, shown in the following figures.*

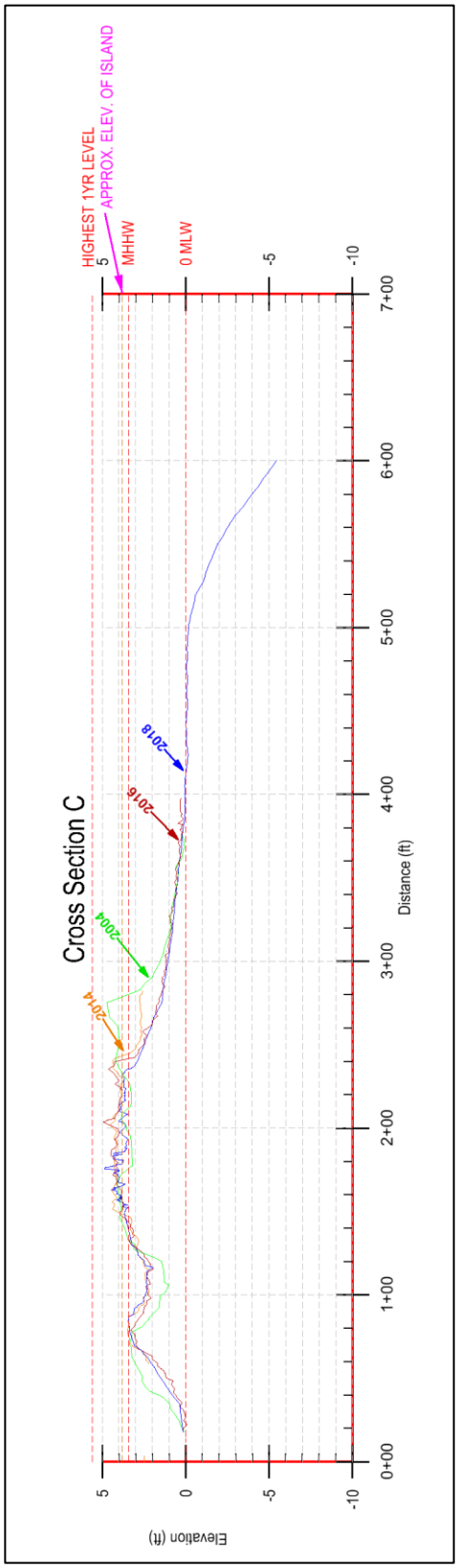



*Figure 18: Cross-sectional elevation profile*

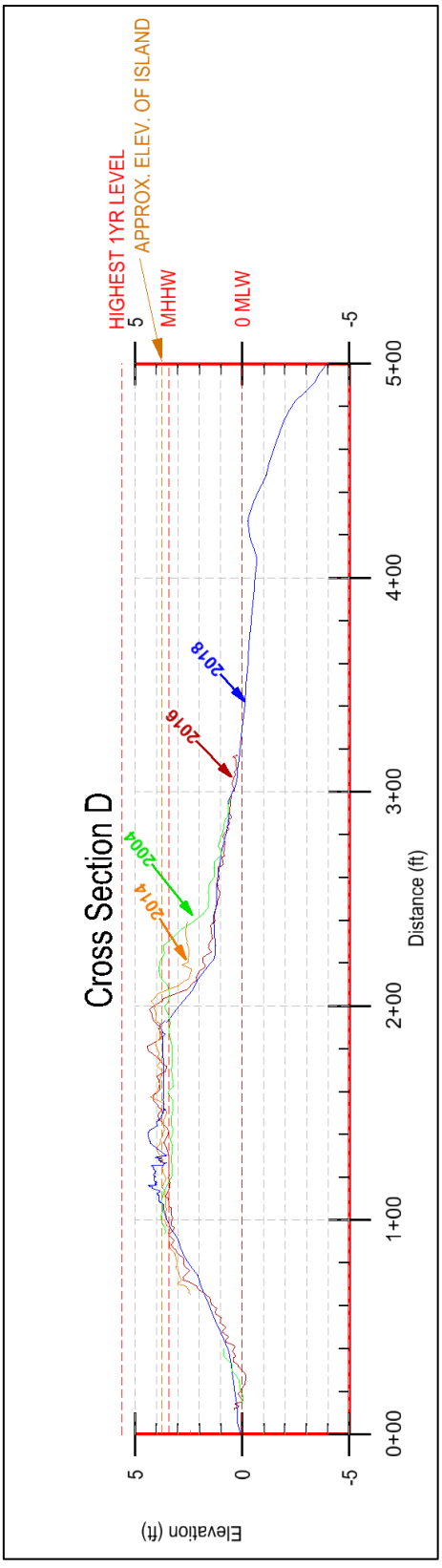



*Figure 19: Cross-sectional elevation profile*

**Tidal Currents of the Connecticut River in the Vicinity of Thatchbed Island**

Prepared by: Hydro Data, Inc.

P.O. Box 485

Southbury, CT 06488

Date: July 2018

## Introduction

On July 11, 2018, measurements of tidal currents were collected in the Connecticut River east of Thatchbed Island in Essex Harbor, Essex Connecticut (Figure 20). Hydro Data Inc. performed this survey to assist efforts in analyzing currents in the vicinity of Thatchbed Island, which is located on the western side of the river and separates South Cove from the main channel of the Connecticut River.


*Figure 20: Survey Area; Connecticut River, Essex, CT*

The measurements were collected using an Acoustic Doppler Current Profiler (ADCP) mounted aboard a survey vessel. The boat navigated a pre-defined set of six main transect lines crossing the river and two to three transects running perpendicular to the previously mentioned six transects, with the ADCP collecting current profiles continuously. This pattern was repeated five times to ensure measurements over the entire tidal cycle. Two data sets were collected during flood tide, one high slack and two data sets were collected during ebb tide. The results of the data collection effort are high-resolution observations of the spatial and temporal variations in tidal current patterns throughout the survey area.

This report describes the data collection techniques as well as presents the observations in graphical format. Color contour plots showing cross-sections of the six main transects are presented here as well as with plan view drawings showing water column averages of current speed and direction.

Full sized drawings showing plan and cross-sectional views of velocity data are presented as five E-sized PDF files.

**Methodology**

Equipment and Operations:

Measurements were obtained with a broadband 1200 kHz Acoustic Doppler Current Profiler (ADCP) manufactured by RD Instruments (RDI) of San Diego, CA. The ADCP was rigidly mounted to the starboard side of the survey vessel, a workboat owned by Hydro Data, of Chester, CT. The ADCP was oriented downward into the water column, with the sensors of the unit located 12 inches below the water surface. This mounting technique assured no flow disturbance due to vessel wake.

The ADCP measures currents using acoustic pulses emitted individually from four angled (20 degrees from vertical) transducers in the instrument. The instrument listens to the backscattered echoes from discrete depth layers in the water column. The returned echoes, reflected from ambient sound scatters (plankton, debris, sediment, etc.), are compared to the original emitted pulse in the frequency domain. The change in frequency (Doppler shift) between the emitted versus the reflected pulse is directly proportional to the speed of the water parallel to the individual beam. For example, an echo of lower frequency indicates water moving away from the transducer while an echo of higher frequency indicates water moving toward the transducer. By combining the Doppler velocity components for at least three of the four directional beams, the current velocities can be transformed using the unit's internal compass readings to an orthogonal earth coordinate system in terms of east, north, and vertical components of current velocity.

Vertical resolution is gained using a technique called 'range-gating'. Returning pulses are divided into discrete 'bins' based on discrete time intervals following the emission of the original pulse. With knowledge of the speed of sound, the discrete time intervals reflect the range (or depth) of each discrete bin from the transducer face. For this project a 1-foot bin setting was used.

The collection of accurate current data with an ADCP requires the removal of the speed of the transducer (mounted to the vessel) from the estimates of current velocity. This is performed by 'bottom tracking' or using the Doppler shift to measure simultaneously the velocity of the transducer relative to

the river bottom. Bottom tracking allows the ADCP to record absolute versus relative velocities beneath the transducer. The accuracy of the current measurements can be compromised by random errors (or noise) inherent to this technique, however, improvements in the accuracy of each measurement are achieved by averaging several individual pulses together. These averaged results are termed 'ensembles'; the more pings used in the average, the lower the standard deviation of the random error.

Position information was collected by navigation software package running on a PC, linked to an RTK GPS. The position data were read from the device in WGS-84 coordinate system and transformed on-the-fly to NAD 1983 Connecticut State Plane coordinates. Position updates were available every 1 second. Clock synchronization between the GPS and ADCP laptop computers allowed each ADCP ensemble to be assigned an accurate GPS position during post-processing.

The areas immediately adjacent to Thatchbed Island where water depths were too shallow for the vessel mounted ADCP to collect data, two bottom-mounted ADCP units were installed. One along the east side of the island mid-way between the northern and southern ends of the island. The other approximately 30 feet south of the southern tip of the island (Figure 21.) These units recorded average velocity from the bottom mounted sensor up the water surface. This data was incorporated into the vessel mounted data sets and presentations.

**Survey Techniques**

Current measurements were collected by the ADCP as the vessel navigated repeatedly along a series of six (6) pre-defined transect lines running from east to west across the river and two to three transect running south to north in the survey area (Figure 21.). The line-cycles were repeated five times throughout the survey day. The first cycle was begun at 0730 hours (Eastern Daylight Time, EDT) and the final cycle was completed at 1410 hours (EDT). Two data sets were collected during flood tide, the second of which was collected during maximum flood current. Three data sets were collected during the outgoing (ebb) tide. The first was shortly after high tide when the currents were slack, with the following two data sets collected during ebb tide (Figure 22.)


*Figure 21: Survey Transects*

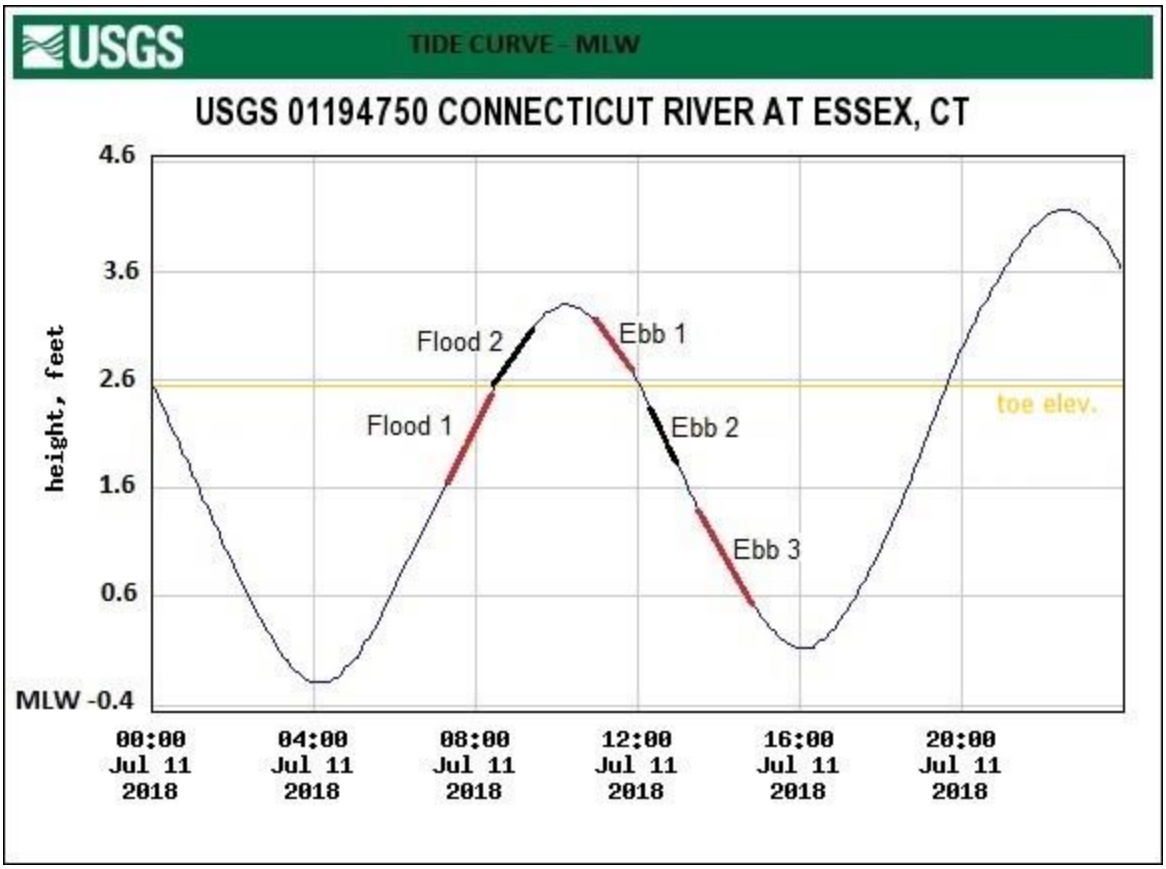



*Figure 22: Survey line-cycle timing relative to tide curve for July 11, 2018. Note: Thatchbed Island toe of vegetation cut-bank approximate elevation 2.5 ft. MLW.*

**Data Processing Techniques**

Data were processed using WinRiver software, VesPosEdit software and Bentley Microstation software.

The output data files from field data collection and post-processing procedures consists of a 3D array of data 'packets' containing the time of the profile, the position and the measured water temperature (measured by the ADCP's internal temperature sensor) followed by consecutive rows and columns of the velocity profile data. Each row of profile data corresponds to one bin, or depth layer, with succeeding columns representing east and north components of velocity, error velocity, speed, direction, echo amplitudes (for 4 beams), and correlation magnitudes (for 4 beams). This data set was used to generate both plan view and cross-sectional presentation images.

Cross-sectional views showing surface to bottom current speeds are presented for each transect. In addition, a mean value of each east and north component of velocity is calculated for each vertical profile. These component mean values are then used to determine the mean velocity and mean direction of water current. These values are presented on plan view maps showing velocity as plotted text and direction as 'sticks' or lines.

## Site and Weather Conditions

During the duration of the ADCP measurements, conditions along the river were favorable for the survey. Weather conditions were fair. Wave and wind conditions in the harbor were calm all day with a light north-northeast breeze. Vessel traffic through Essex Harbor was light and never interrupted the course of the survey. Small boat wakes were only observed in the navigation channel as most of the boats passing through the harbor were very small.

## Data Presentation

Due to the size and number of figures per data set, all figures are presented in the appendix of this report.

All figures presented in Appendix C and D were rendered using WinRiverII software from raw data collected via the Workhorse Sentinel ADCP. Both use the aforementioned bottom-tracking feature, so the distances shown in the figures is relative to sensor location rather than GPS coordinates. Appendix C shows average current velocity perpendicular to the transect from surface to bottom. Appendix D shows ship track (relative ship position) with current 'sticks' showing average velocity magnitude and direction. In both Appendix C and D, the figures are in a west-east orientation, i.e. Thatchbed Island on left, main river channel on the right.

Appendix E contains images of plan view maps for each data set. These images show ship tracks with mean current velocity and directional sticks in a map-type format with geographical features outlined and elevation contours around Thatchbed Island from a previously conducted hydrographical survey. For detailed referencing, see full E-sized drawings attached with this report. The appendixed thumbnails are featured in this report to only complement the other figures.

## Discussion

The water surrounding Thatchbed Island in Essex Harbor experiences tidal currents from the Connecticut River. While the velocity and direction of the tidal current varies, the most significant flow is concentrated in the main channel of the river (Figure 23.) This section of the river is approximately 1500 feet off the eastern shore of Thatchbed Island separated by a mooring field. In the shallow areas surrounding Thatchbed Island (<1 foot) current velocities decreased significantly and the direction of the current flow never directly impacts the island. Flow between South Cove and the main river channel is by way of the channels to the north and south of the island (Figure 23.) The entire South Cove and the subtidal flats around Thatchbed Island showed no significant water velocities resultant of tidal currents.

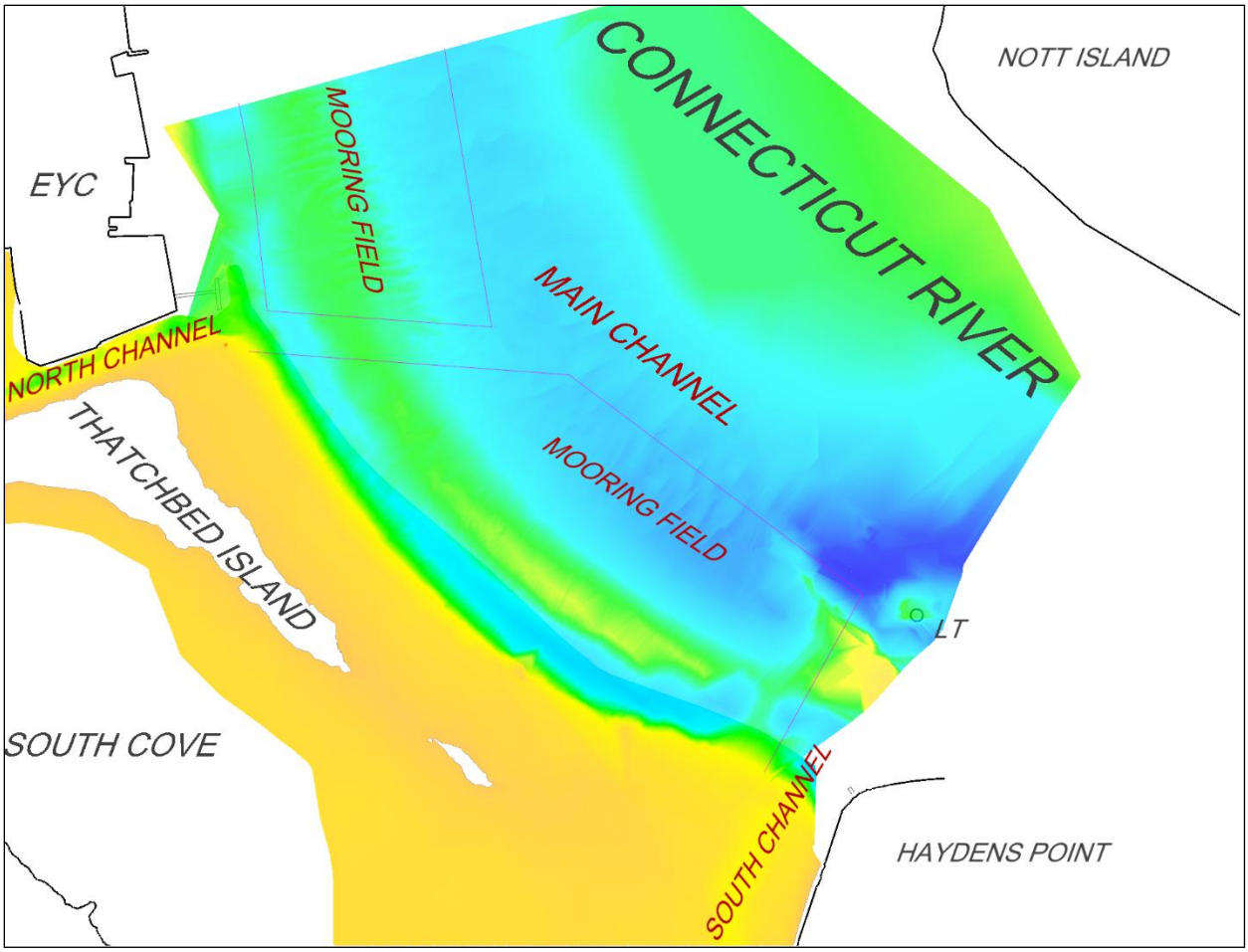



*Figure 23: Main channel location, Connecticut River, north & south channels to South Cove. Color contours rendered from surveyed depths; see E-sized drawings for full detail.*

Approximately 400 feet east of Thatchbed Island lies a submerged bar on the river bottom, running parallel to the shoreline, approximately -5 feet MLW at its crest. This shoal separates Thatchbed Island and the Middle and South Coves from the main river channel where the most significant tidal current velocities occur.

The elevation of Thatchbed Islands shoreline is approximately 2.5 feet MLW at the toe of the vegetation cut bank. This means that any of the observed tidal current couldn't affect the island directly while the tide is below 2.5 feet MLW. All of the velocities observed in the Flood 1, Ebb 2 and Ebb 3 occur below this water surface elevation.

Flood tide data sets show maximum current velocities of 3.42 feet per second, with the highest velocities concentrated on the eastern half of the river channel (Appendix C Flood Cycle 2). During the flood cycle we observed an inward flow of water to the South Cove just to the north of Haydens point (Appendix E, Flood Cycle 2). Flow direction in the main channel was directly up river, while off the eastern shore of Thatchbed Island it trended outward (east) and upward (north) away from the island.

Ebb tide data sets show a slight shift in the areas of high current velocity concentration. The areas of high current velocity were observed to be more widely distributed across the width of the river (Appendix C, Ebb Cycle 2, Ebb Cycle 3) but still bound on the west by the aforementioned shoal feature during maximum ebb currents (Ebb Cycle 3). Maximum observed velocity of 3.46 ft/s is similar to flood tide maximum, and mean current velocity is slightly greater than observed during flood tide (1.81 ft/s versus 1.47 ft/s) which is to be expected considering that river flow and ebb tide currents are combined in the same (downstream) direction. The ebb tide also brings more directional disruption to current flow near Thatchbed Island. While the bulk of the flow is down river in the main channel, we observed an outflow from the channel between the north shore of Thatchbed Island and Essex Yacht Club. The flow off the eastern shore of the island is generally easterly but is much more variable than observed during the flood tide.

Tidal currents surging up and down river coupled with the discharge flow of the Connecticut River create dynamic flow in the Essex Harbor area in both flow direction and velocity. Thatchbed Island and the Middle and South Coves were not significantly impacted by these tidal currents as observed in this survey. During times of higher water levels, such as the spring freshets, and taking into consideration projected sea level rise, there may be a more considerable impact on these areas.

**Tides in Essex Harbor**

Prepared by: Hydro Data, Inc.

P.O. Box 485

Southbury, CT 06488

**Introduction:**

All data and figures in this section were selected from United States Geological Survey (USGS) Site 01194750, a collection site located on the western edge of Essex Village, on the Connecticut River (Figure 24.) This station has tide gage, temperature, salinity, conductance and turbidity data back to 2010. Of particular interest to this study are the tide gage data.

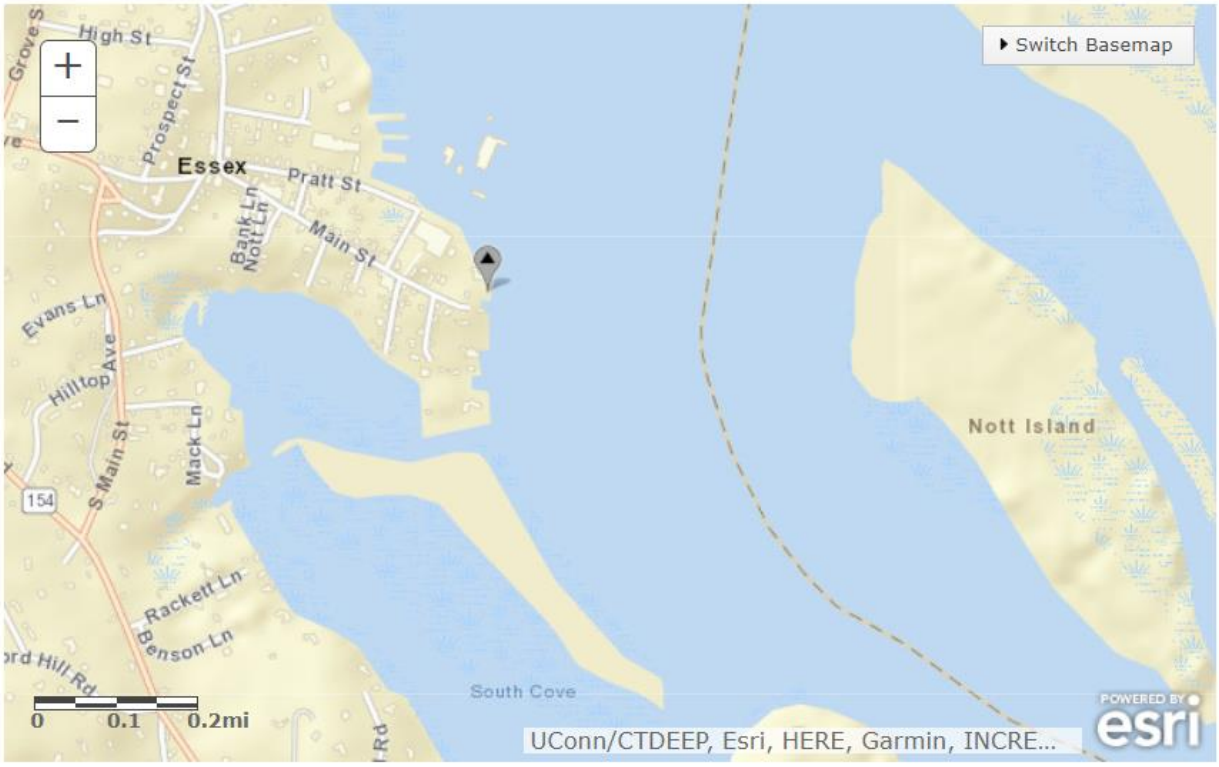



*Figure 24: USGS collection station in Essex Harbor, Essex, CT*

**Data Presentation:**

The following charts show accumulated tide gage data at the USGS Collection Site 01194750 in Essex, CT over 10 year, 1 year, and one month time periods.

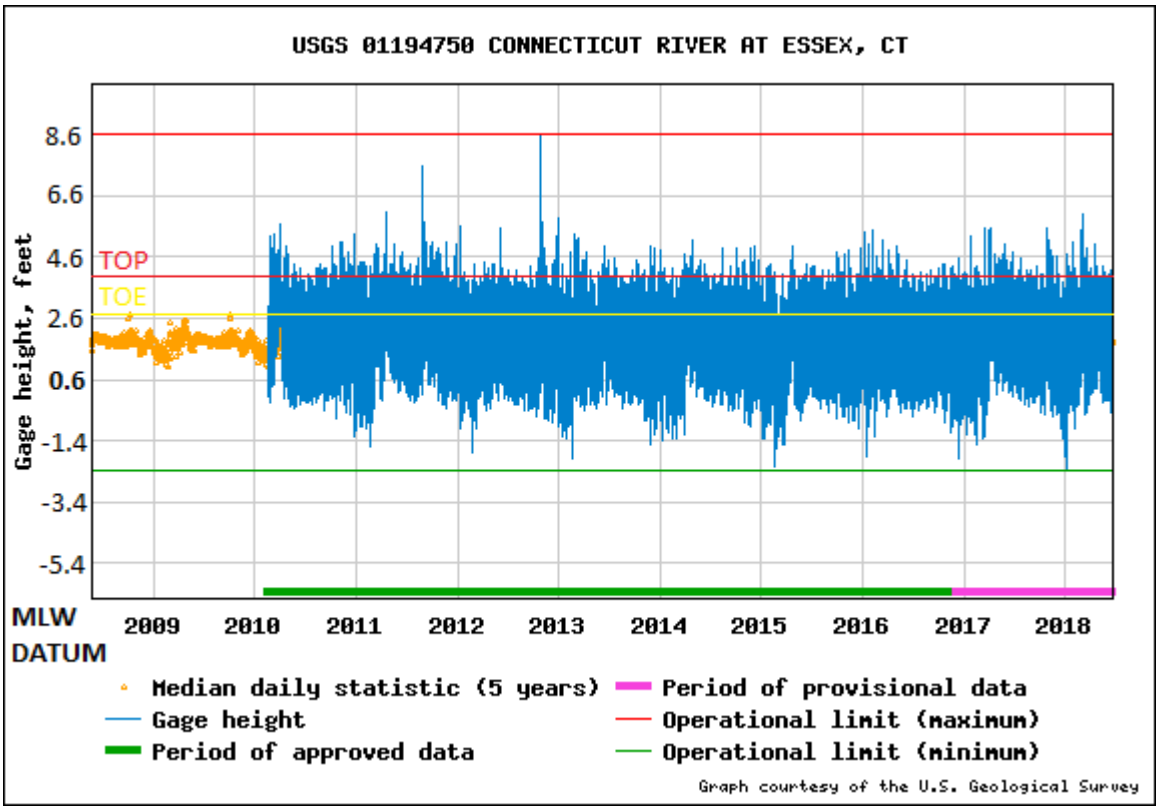



*Figure 25: Tide Gage data for 10 year period. Note: This collection station was installed in 2010 and prior data is from median daily statistics, as indicated.*

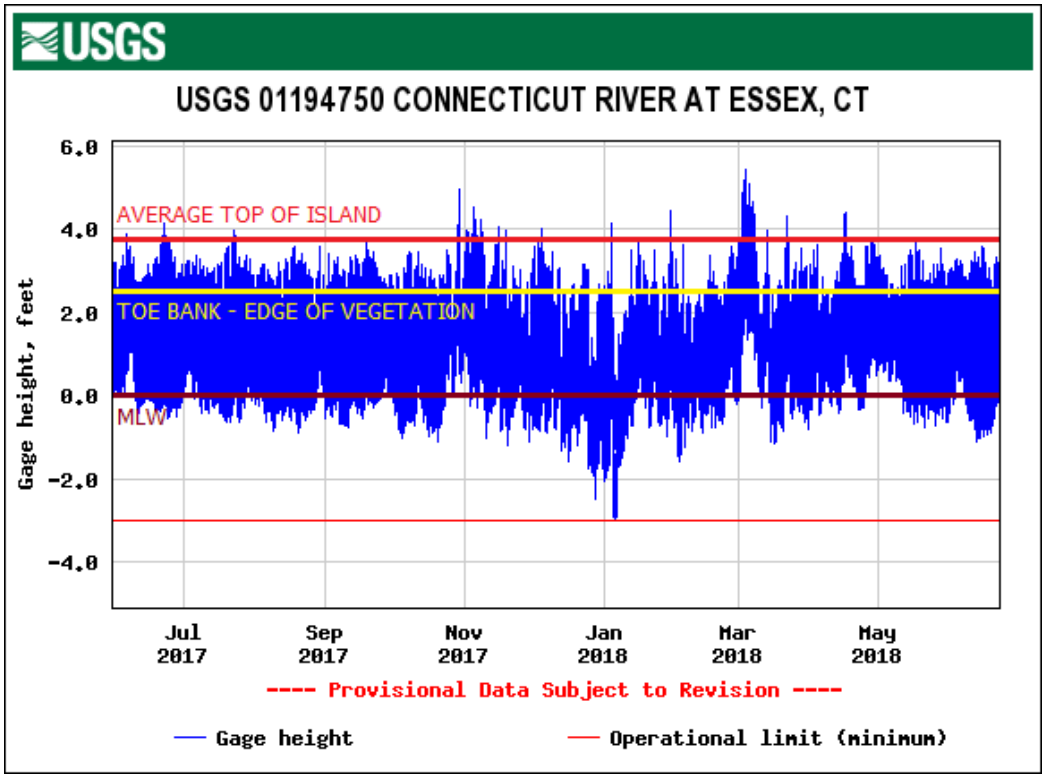



*Figure 26: Tide Gage data for 1 year period.*

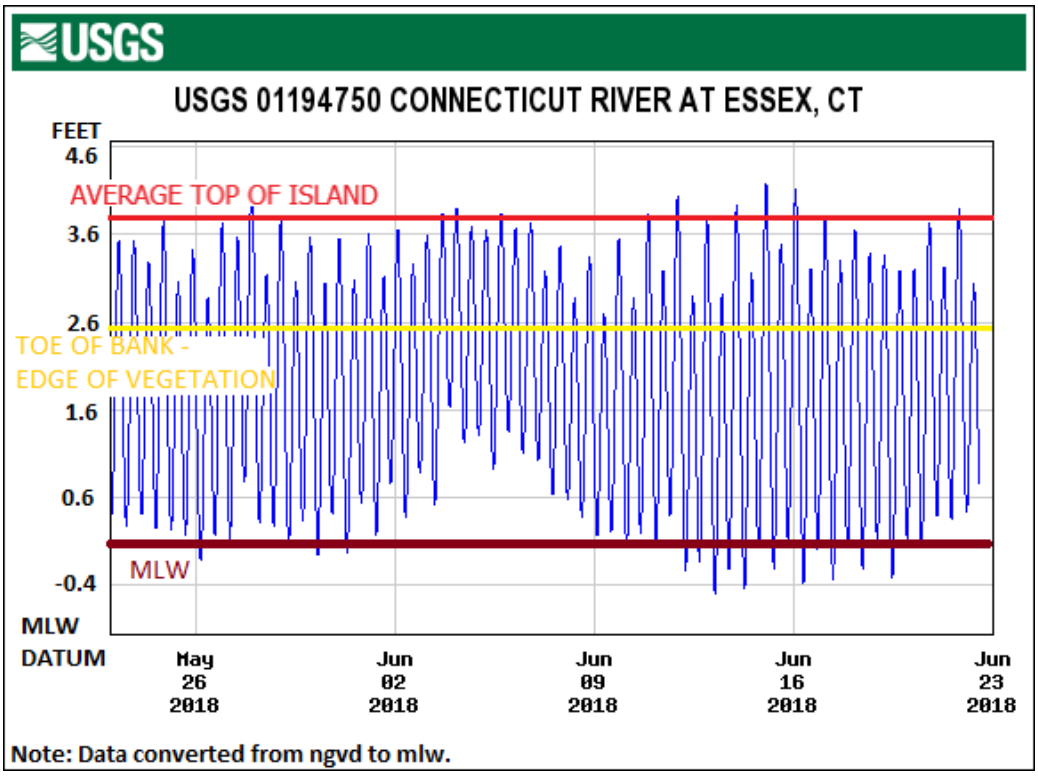



*Figure 27. Tide Gage data for 1 month period. Image shows high tide events that covered the island.*

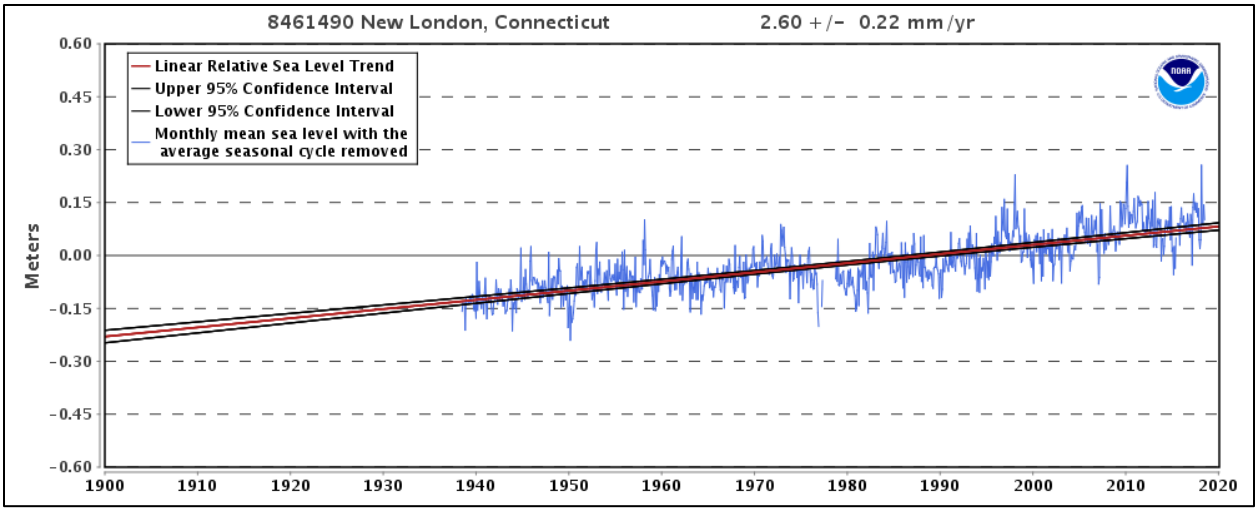



*Figure 28. Mean Sea Level Rise in nearby New London, CT. The trend is 2.6 millimeters/year with a 95% confidence interval of +/- 0.22 mm/yr based on monthly mean sea level data from 1938 to 2017.*


*Figure 29. Shoreline, high tide*


*Figure 30. Shoreline, near high tide*


*Figure 31. Shoreline, near high tide*


*Figure 32. Shoreline, high tide*


*Figure 33. Shoreline, high tide*


*Figure 34. Island south of main island, high tide*

**Discussion:**

The average elevation of Thatchbed Island, Essex, CT is 3.8 feet above Mean Low Water (MLW). This elevation and how it compares to historical high-water levels can help us know more about the erosion of Thatchbed Island. This in a time of particular importance, considering rising sea level trends, when high tides could surpass the islands elevation with increasing frequency.

The United States Geological Survey (USGS) collection station at site 01194750 in Essex Harbor, Essex, CT has been in place and continuously collecting data from February 2010 to present. In those 8 years, high water levels have frequently overcome the island (Figure 25). Looking in a little closer, over the course of one month in 2018, highs surpassed the average elevation of the island 10 times.

While the USGS collection station in Essex has not been in service long enough to detect any considerable trend in average water levels, a collection station in nearby New London, Connecticut, which has been in service since 1940 indicates an average rise in sea level at a rate of 2.6 millimeters per year. Over time similar trends could be observed at the site in Essex which would likely translate to more frequent high-water events submerging Thatchbed Island.

High tides that bring water levels above the average island elevation could be increasing erosion on Thatchbed Island as that water drains out with the ebbing tide bringing along with it the material that

makes up the island. It should be noted, however, that Thatchbed Island is completely covered with a variety of salt marsh plant species which are adapted to intertidal environments and these high tide flood events are a normal occurrence for the island, as indicated by figures 25-27. When water levels rise above the average elevation of the island, these plant species and their root mats are in and above the water. See photos of shoreline at high tide and near high tide (Figures 29-34). While this tidal flooding may be perfectly normal for an island such as Thatchbed, rising sea level trends hold the potential to increase the frequency of these flooding events which could affect island erosion.

**Thatchbed Island Historical Data**

Prepared by: Hydro Data, Inc.

P.O. Box 485

Southbury, CT 06488

**Introduction:**

Historical photographs including aerial imagery dating back to 1934 offers a useful way to observe the development of Essex Harbor, Essex, Connecticut and changes on Thatchbed Island over the years.

Aerial images were selected from the University of Connecticut's Connecticut Historical Aerial Photography database from their Map and Geographic Information Center.

**Figures:**


*Figure 35. 1881 illustration depicting Essex Harbor.*

*Figure 36. Aerial Photograph, 1934. Note side casting of dredge spoils adjacent to navigation channel in middle cove.*

*Figure 37. Aerial Photograph, 1951. Photo taken during low tide. Land extends out to two rock piles located at southeast side of Island. Today these rock piles are far from the Thatchbed Island shoreline.*

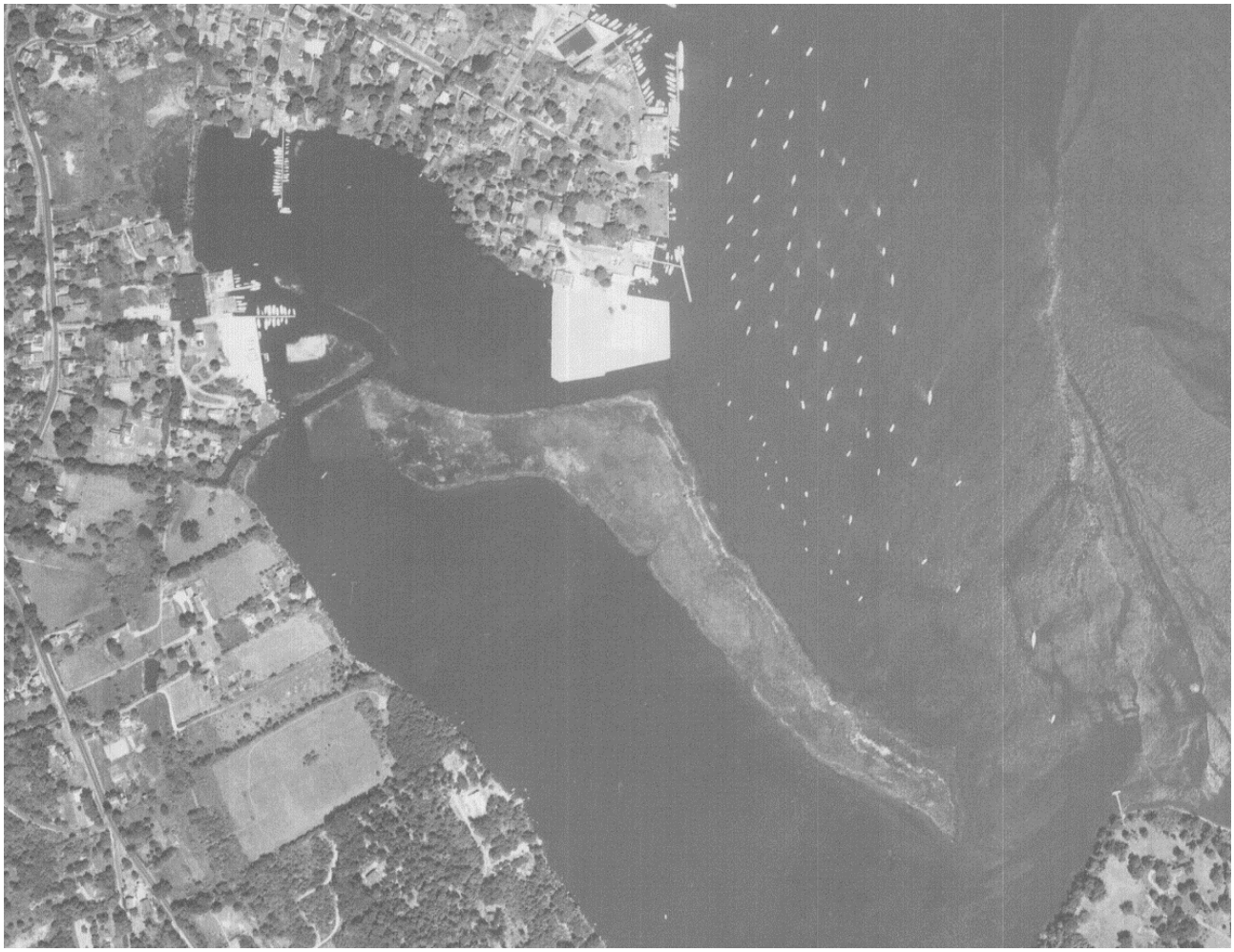


*Figure 38. Aerial Photograph, 1957. Note development of Essex Yacht Club area and marina located at west end of middle cove. Dredging activity around the western end of Thatchbed Island*

*Figure 39. Aerial Photograph, 1965.*

*Figure 40. Aerial Photograph, 1990.*

*Figure 41. Aerial Photograph, 2004. Note: Image shows Island vegetation recently mowed. The southern end of the Island is narrower than seen in 1990 photograph. Erosion rate increases (see graph below).*

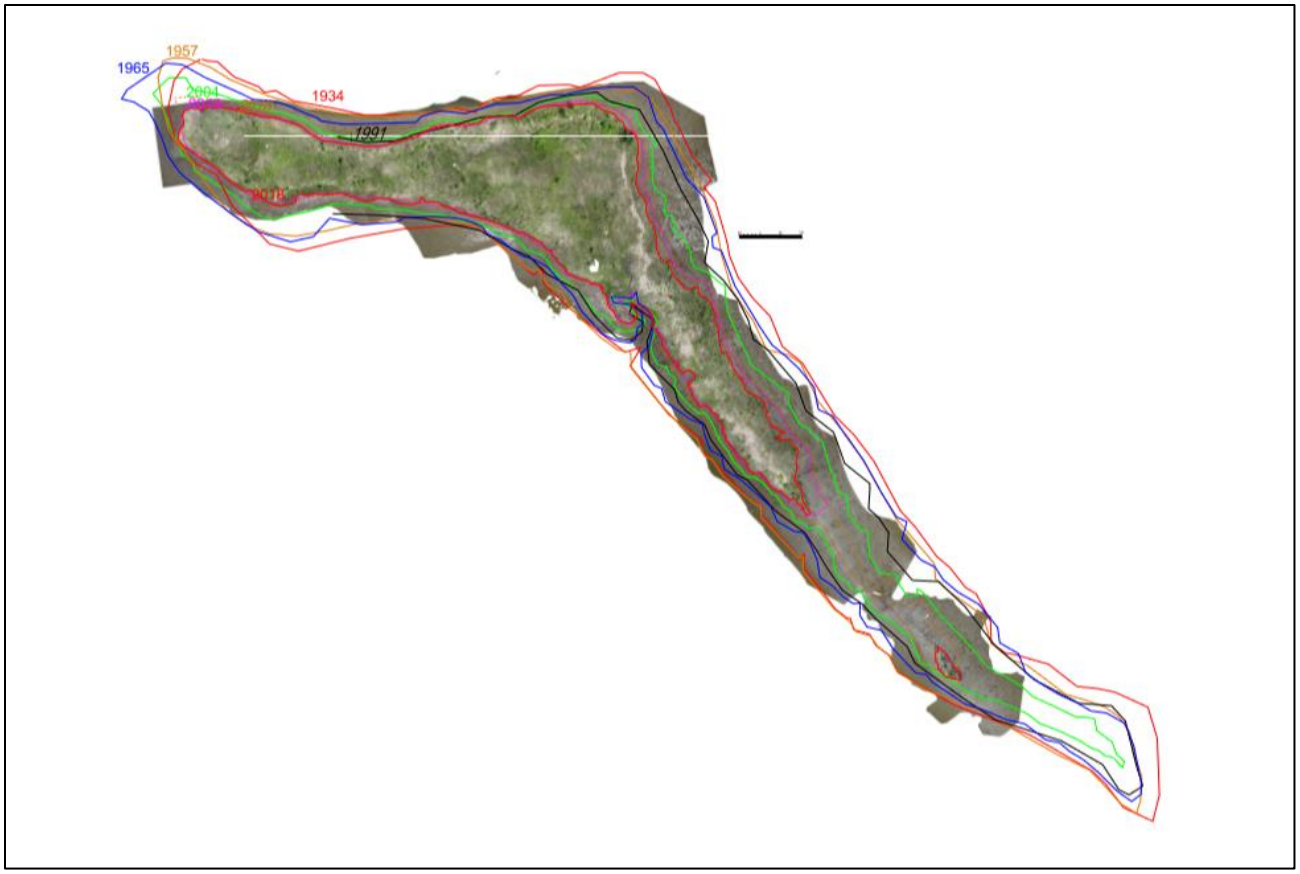



*Figure 42. 2018 aerial image with shoreline traced.*

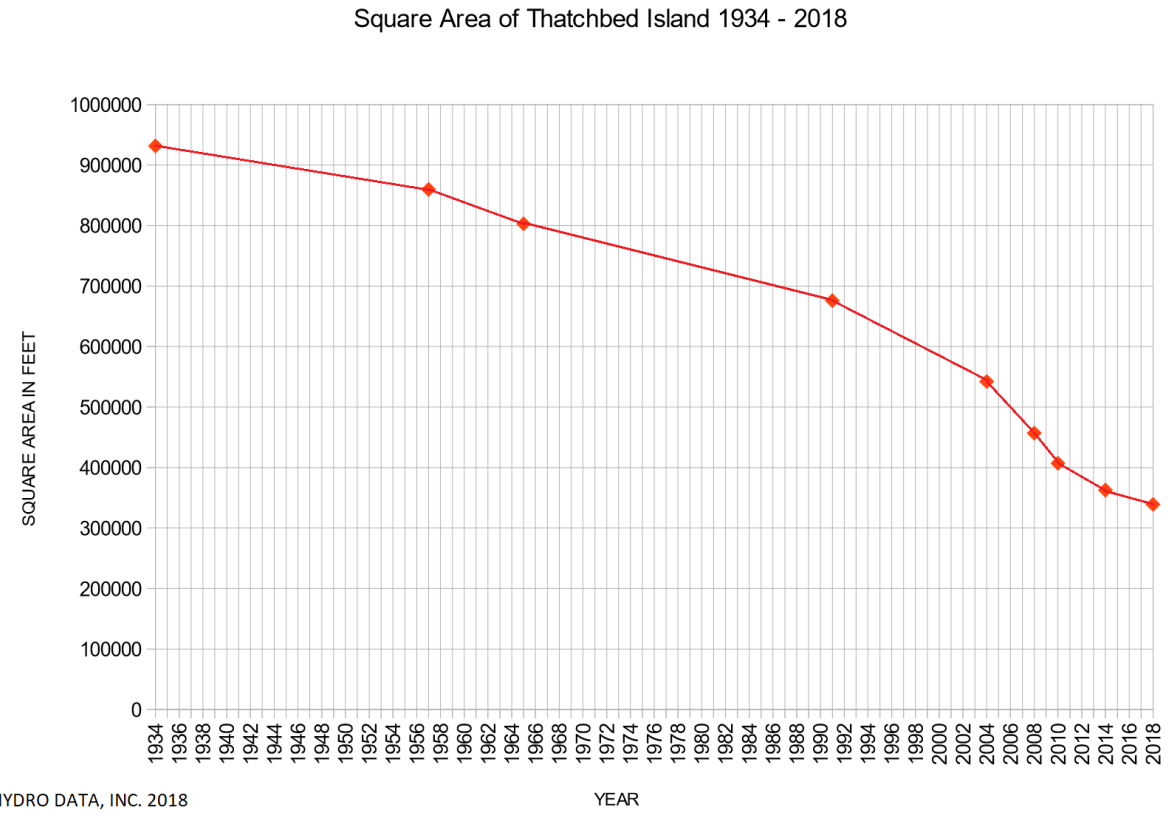



*Figure 43. Graph shows rate of erosion over time.*

## Discussion

The 1934 image is the earliest aerial photograph used in this report to determine square area of Thatchbed Island. The west end of the island to the mainland is marsh with shallow channels. Dredged channels seen northwest of island close to mainland. Side casting of dredge material in this area close to current location of Spoils Island. Areas exposed along north side of channel through middle cove, possible natural feature (side casting undetermined). Essex Island not developed at this time and the Essex mainland is not fully bulkheaded.

The 1951 image shows marsh and tidal mud flats exposed at low tide extending from western end of island to mainland with dredge cuts though this area. Mean low water (MLW) line extends out to the two rock piles in the Connecticut River. Essex Island has been developed and bulkheaded, approximately 75 percent of Essex mainland is bulkheaded, and the property of the current Essex Yacht Club is not yet developed.

The 1957 image displays evidence of a developing Spoils Island. Filling of areas west of Thatchbed Island for new bulkhead and filling of property now owned by Essex Yacht Club located north of Thatchbed Island. The marsh area west of Thatchbed is altered by human activities, indicated by decreased extents of marsh. Mud flat appears to extend out to rock piles. All of Essex mainland along Connecticut River is now bulkheaded up to Essex Island.

In 1965 we see a well-defined Spoils Island, and in 1990 increased bulkhead on the Essex Yacht Club property. Now bulkhead exists from EYC all the way to Essex island. In 2004, all vegetation on the island was mowed.

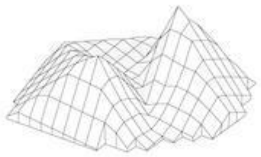
In the 84 years that aerial images of the Essex Harbor are available, the shoreline of Thatchbed Island has receded considerably. Figure 42 shows traced shorelines from the selected historic images overlaid on one image from a 2018 aerial survey. This figure shows major changes in three primary areas: the northwestern tip changes in shape as development occurs in Middle Cove, the receding eastern shoreline, and the reduction of the southern tip. The traced shorelines were used to calculate square area of the island for each year represented and compared in Figure 43. The island has been steadily eroding for as long as we have data. Note the increased rate in area loss after the 2004 mowing event. By 2014 rate of square area loss returns to the norm, possibly due to restored vegetation.

**Property Survey of Thatchbed Island**

Prepared by: Resource Management & Mapping

61 Liberty Street

Chester, CT 06412



Date: June 2018

## Introduction

In June 2018, Fred Guenther of Resource Management & Mapping conducted a property survey of Thatchbed Island in Essex, CT.

Mr. Guenther performed this survey to assist Docko, Inc. in a comprehensive study of Thatchbed Island and key areas of Essex Harbor. The purpose of this survey was to identify property boundaries on Thatchbed Island.

This report presents the findings in the form of a plan view map of the survey area.

## Discussion

The project was set up and research was conducted into known control datum. Random profile lines were surveyed across Thatchbed Island to verify the aerial surveys. The surveying was extended to known ConnDOT geodetic control to anchor the survey into a known datum. Both the control and aerial verifications were successful and the profile line data was issued to HydroData.

Boundary information was researched at the Town of Essex land records and a recent boundary survey was found. The boundary survey was compiled with the new topography and a map (Figure 44) was created showing the property boundary lines against the Mean High Water line determined by topographic survey. Also the Mean High Water line from the existing boundary survey was added for reference. The map was certified as Class D and issued to Docko, Inc and subsequently to the Town of Essex.

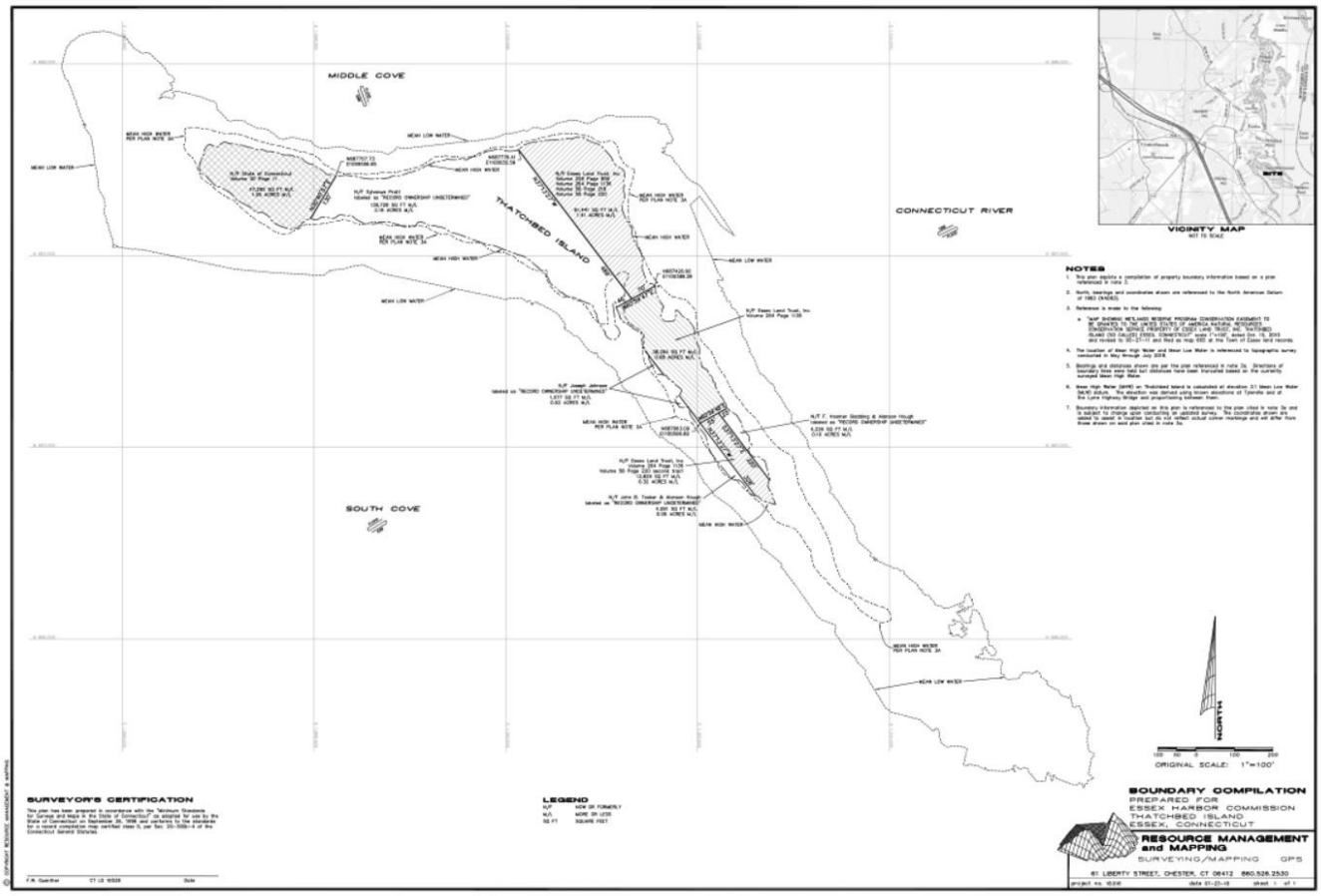



*Figure 44. Property boundary survey. Full size drawing is submitted separately from this report*

# Final Discussion

In summary, multiple surveys were performed in an effort to document and categorize the waters in the Essex Harbor and Thatchbed Island for use by the Essex Harbor management commission. Water depths were collected which can be used to support future engineering or dredging computations. A velocity study was performed and was determined to not be a major factor in the shoreline erosion of Thatchbed Island, but the complete data set can be used for future analysis of the harbor. The topographic survey of Thatchbed Island determined that the surface of the island was at the top of the high water line, which is typical of a tidal marsh. The vegetation study determined that the Island is full of non-regionalized intertidal plants of various species. Finally the property survey was performed to find out what entity owned which part of Thatchbed Island.

Different approaches might be taken to protect Thatchbed Island and to help preserve the vegetation and soil characteristics of this unique geographical feature. The soft island soils, while not unconsolidated, are clearly not capable of supporting significant weight such as massive armor stone structures or even concentrated, linear stone type development such as a seawall or armor stone band through the upper intertidal zone. Combining a load distribution mat with a coarse wave grid material matrix such as a coir or jute mesh would greatly help to stabilize the soil on the easterly face of the island. Such a base of material could help to stabilize the bank enough to allow vegetation to take root.

The river, however, provides a source of protection for Thatchbed Island that while massive and unsightly, does not weigh a lot and naturally attenuates wave energy. Trees come down the river with surprising regularity but particularly in spring and after regional coastal storms. These trees can be fairly easily held in place with piles to help dampen and attenuate wave energy in such a way that would be fairly natural and yet still provide water flow and circulation in the shallow subtidal waters around the east face. It is recommended that the Commission explore the possibilities of capturing and retrieving trees floating down the river and utilizing pile restraints along the east face of the island to hold these trees in place to serve as erosion protection for the island (Figure 45).

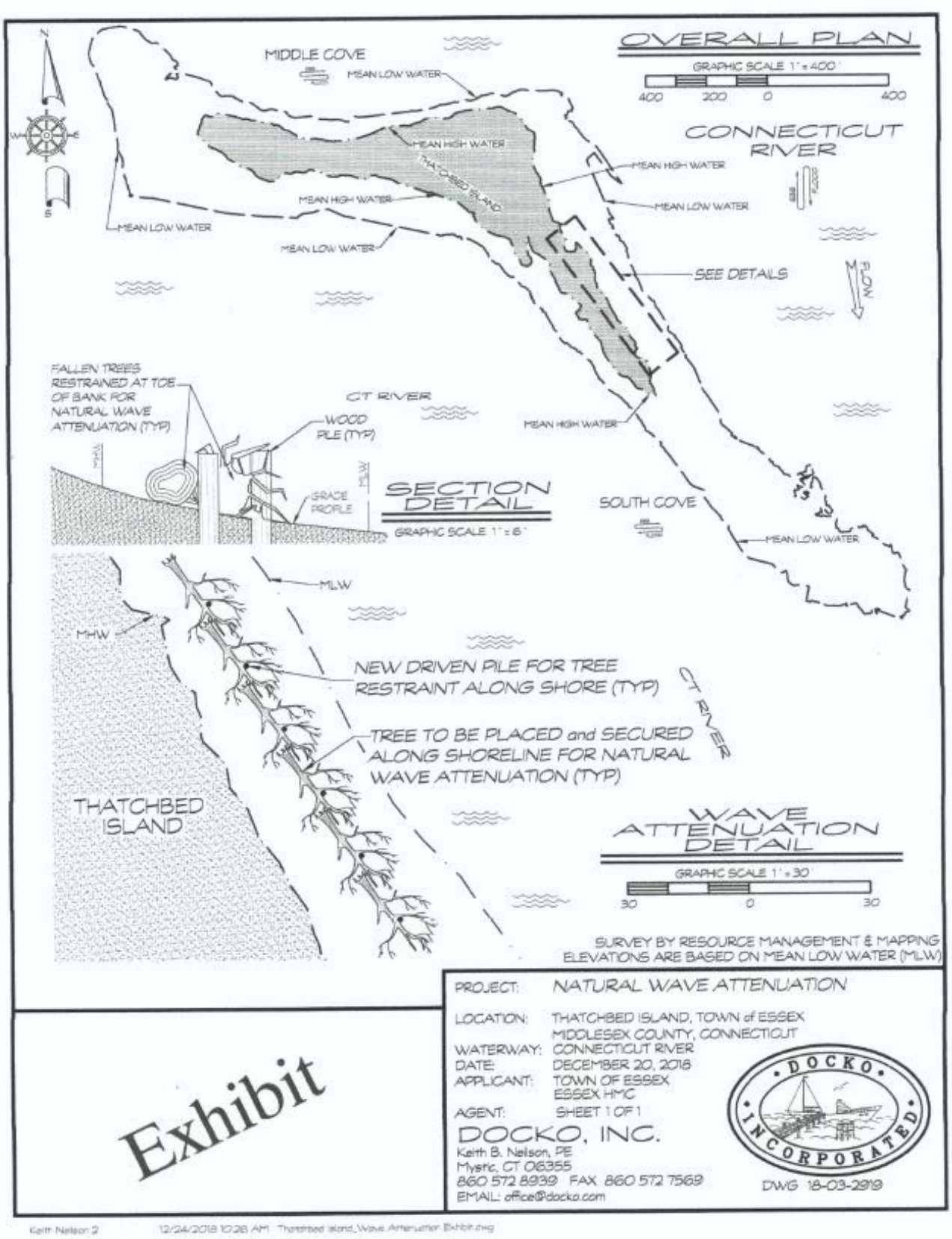
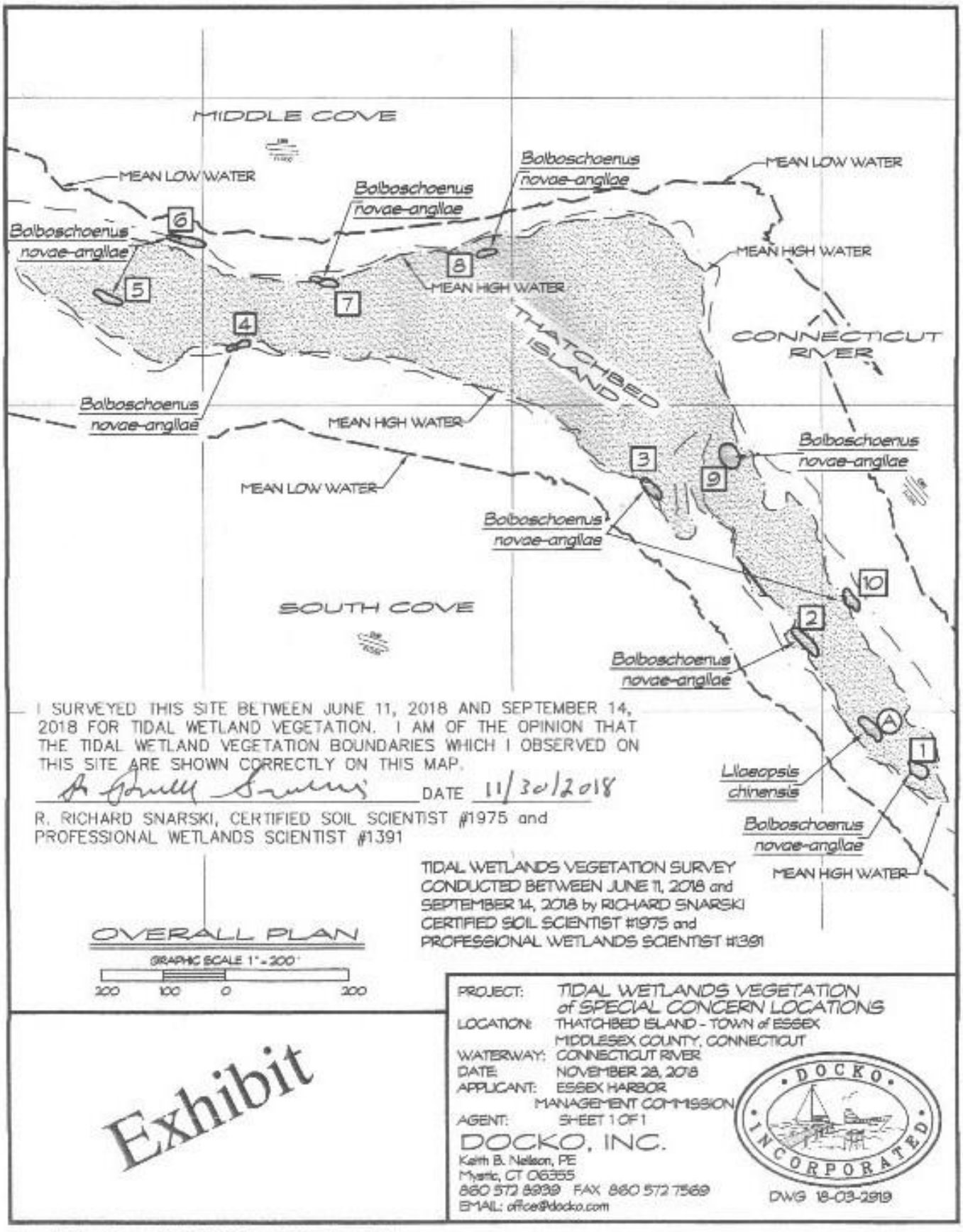
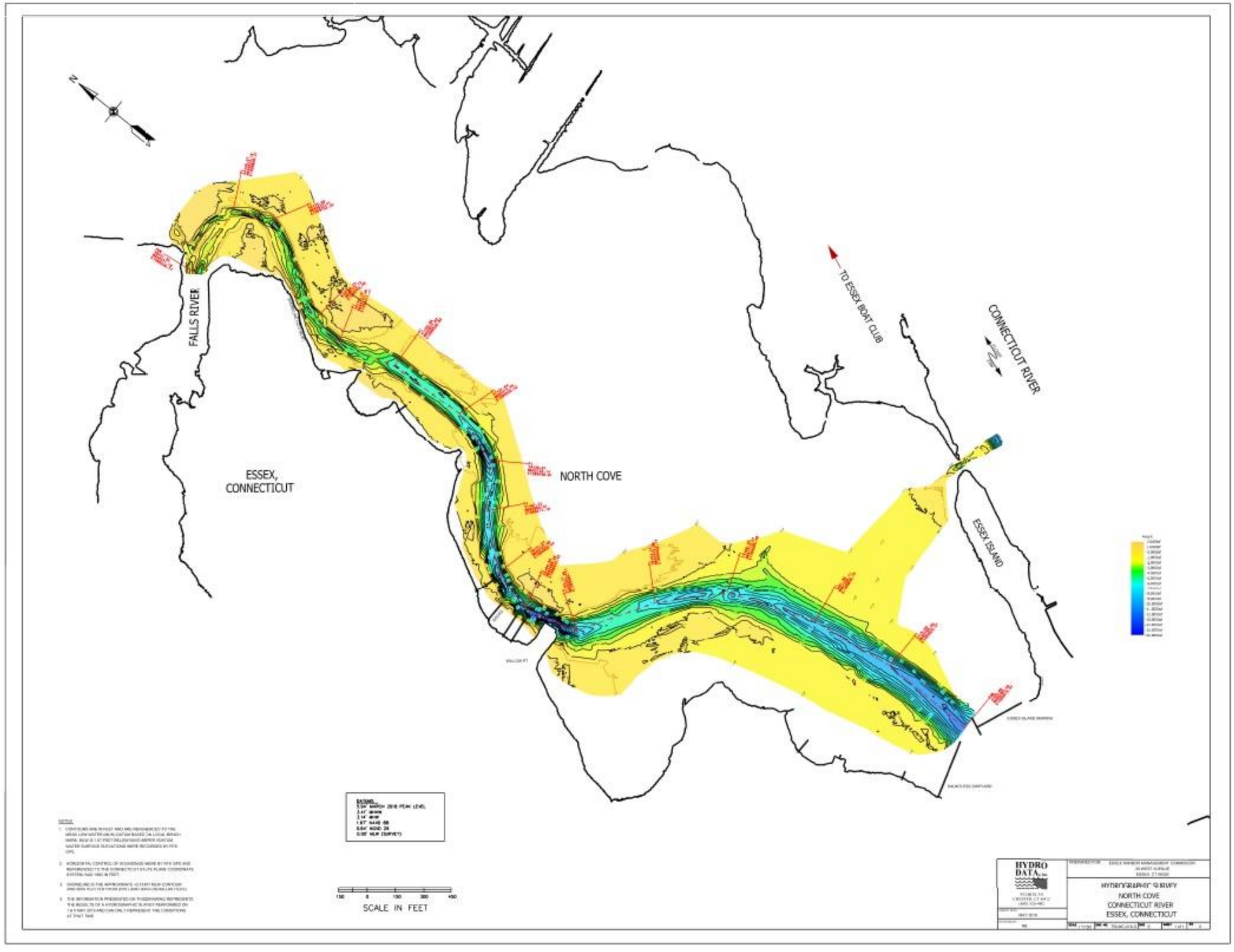


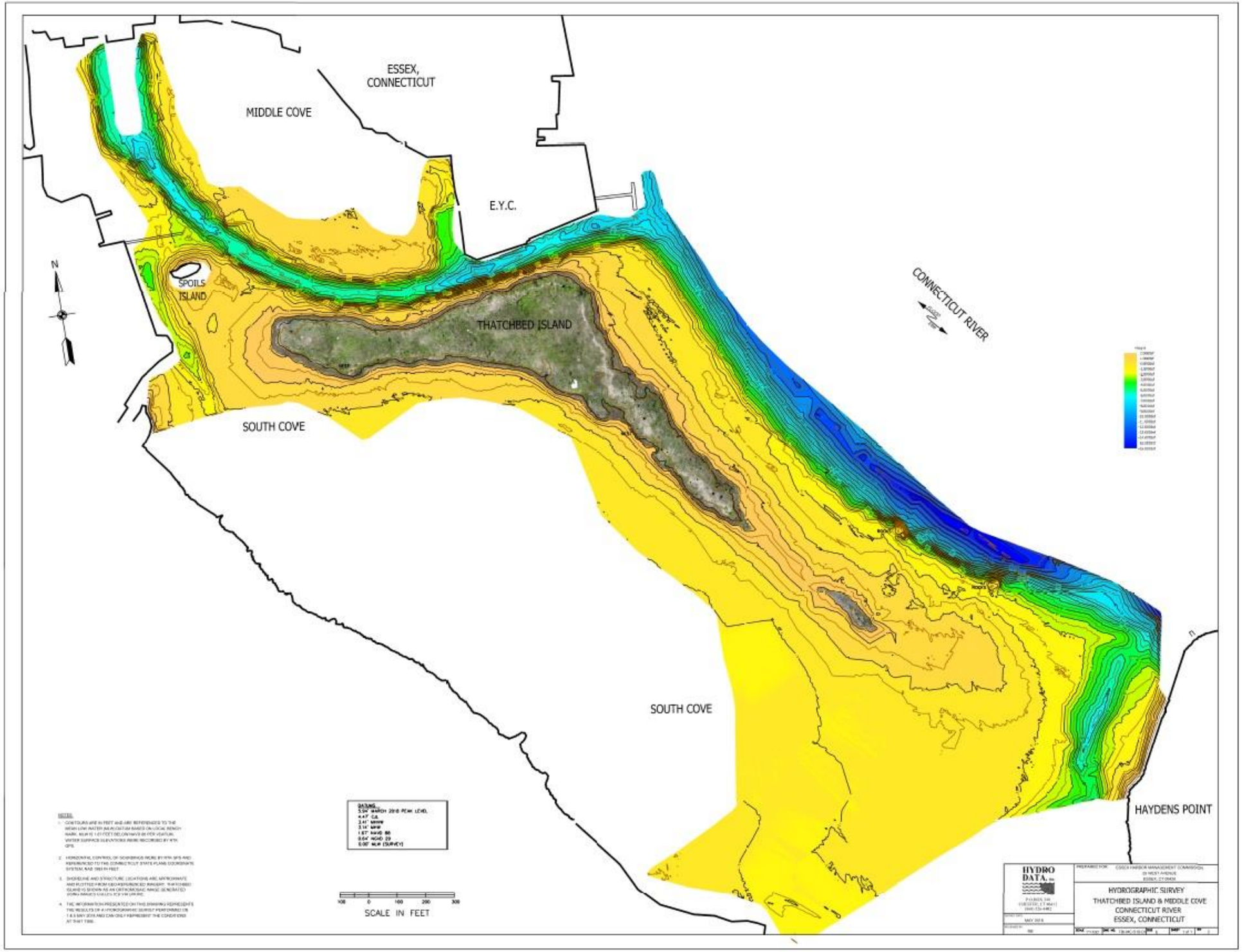

*Figure 45. Natural wave attenuation drawing*

**Appendix A.**
Vegetation survery, Thatchbed Island



Appendix B. Hydrographic survey plan view maps




ESSEX,
CONNECTICUT
MIDDLE COVE
E.Y.C.
SPOILS
ISLAND
THATCHBED ISLAND
CONNECTICUT RIVER
SOUTH COVE
SOUTH COVE
HAYDENS POINT
SCALE IN FEET
HYDRO
DATA, Inc.
HYDROGRAPHIC SURVEY
THATCHBED ISLAND & MIDDLE COVE
CONNECTICUT RIVER
ESSEX, CONNECTICUT

CROSS SECTIONS OF THATCHBED ISLAND
COMPARISON OF LAND ELEVATIONS 2004 TO 2018

N

MIDDLE COVE

ESSEX,
CONNECTICUT

E.Y.C.

THATCHBED ISLAND

CONNECTICUT RIVER

SOUTH COVE

SOUTH COVE

HAYDENS POINT

DAY MARKER

SCALE IN FEET

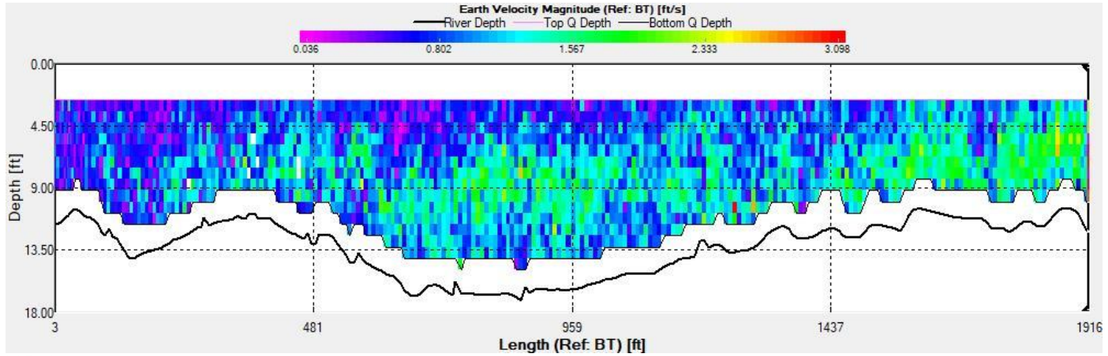
HYDRO DATA, INC.

PREPARED FOR: ESSEX HARBOR MANAGEMENT COMMISSION
29 WEST AVENUE
ESSEX, CT 06426

CROSS SECTIONS - THATCHBED ISLAND
SOUTH COVE & CONNECTICUT RIVER
ESSEX, CONNECTICUT

**Appendix C.**
Cross-sectional velocity profiles for each of 6 transects and 5 line-cycles with west-east orientation

**Flood Cycle 1:**

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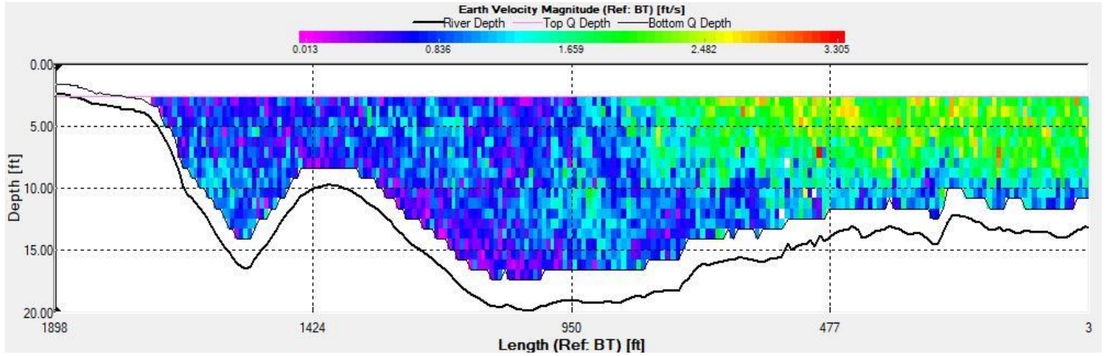
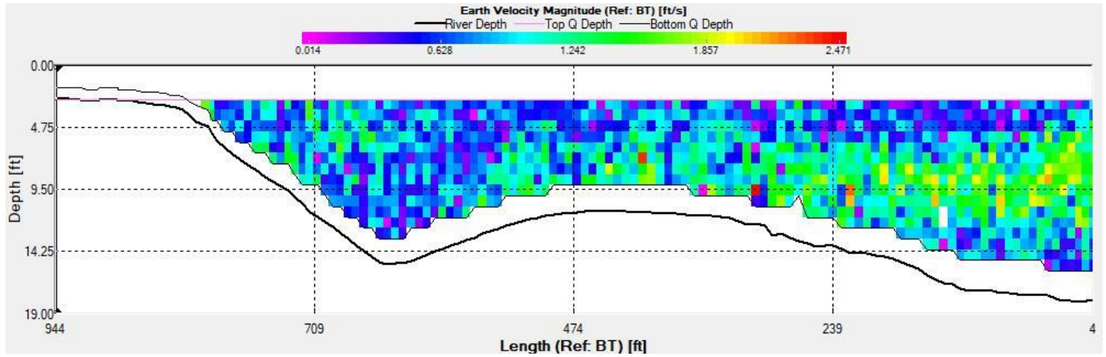



XS-4

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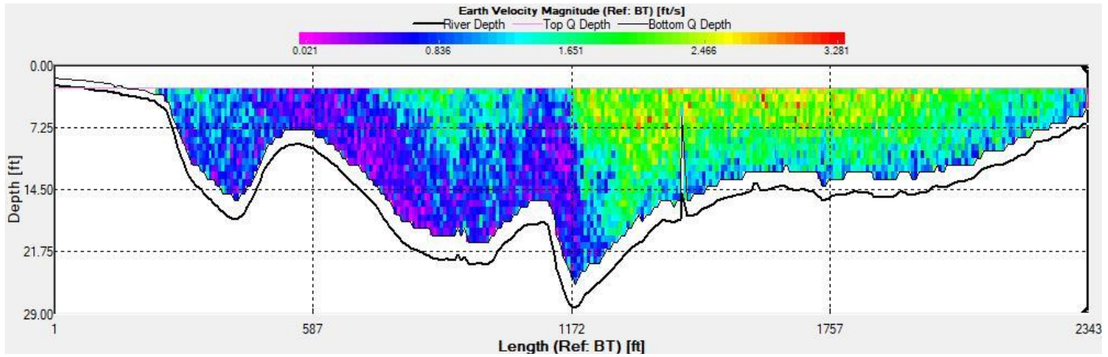


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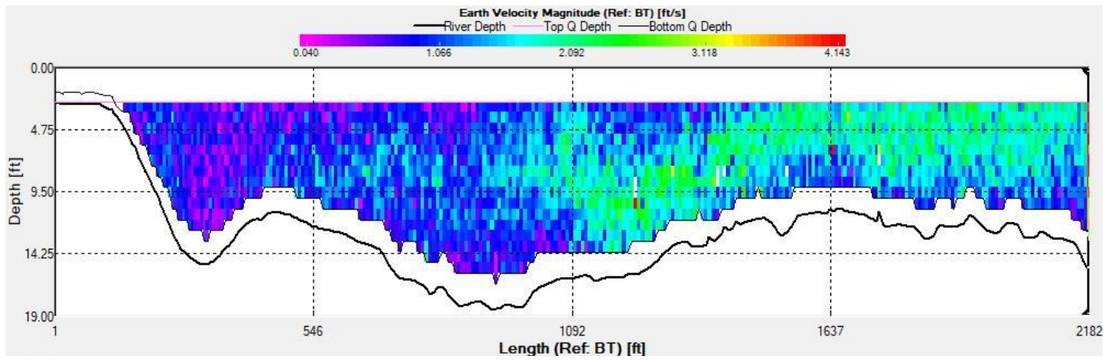
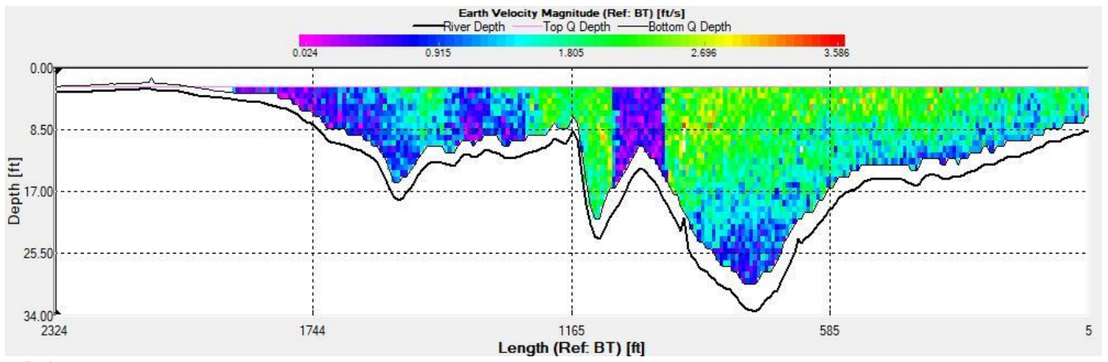



XS-3




XS-6

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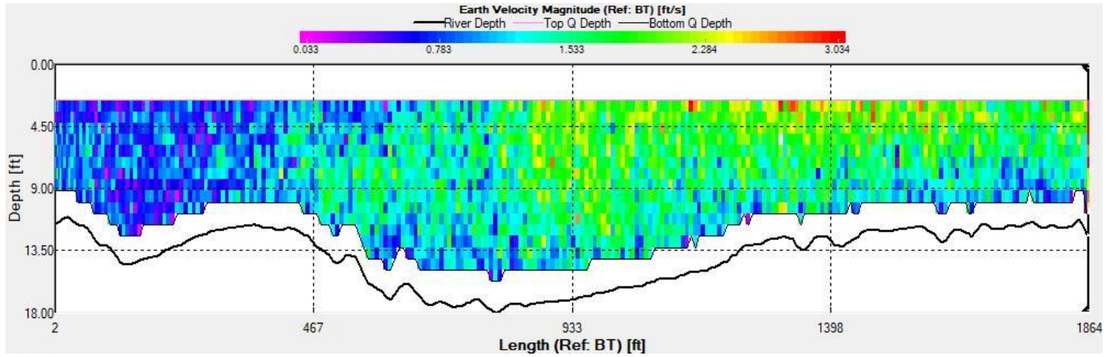


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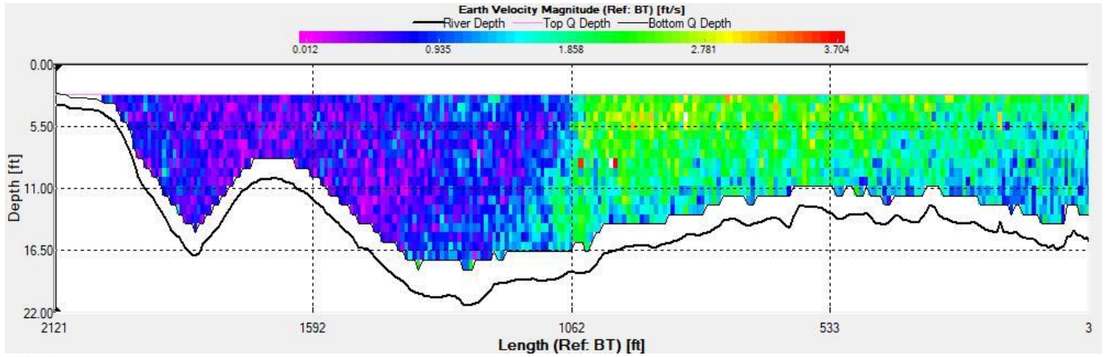


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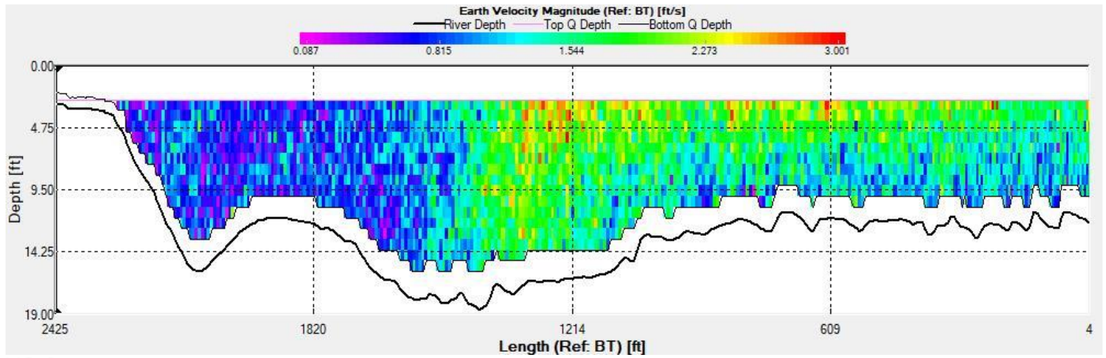


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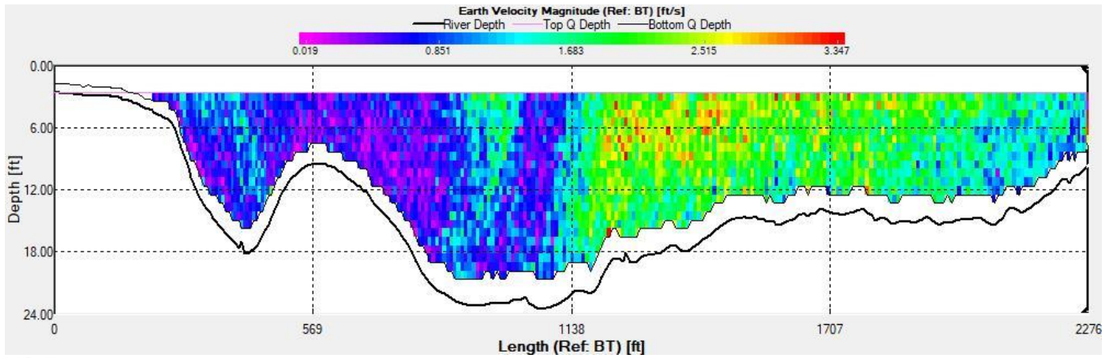


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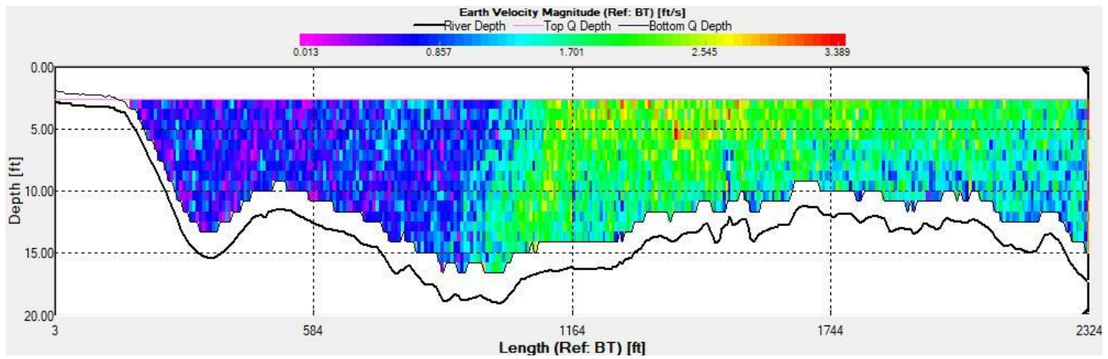


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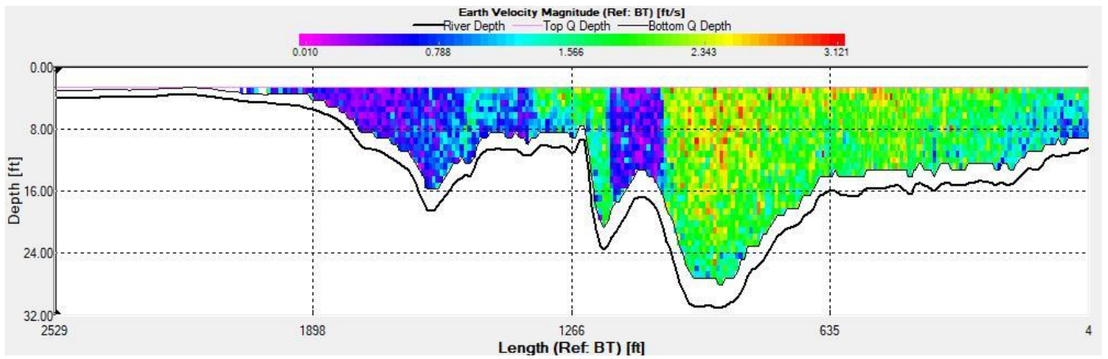


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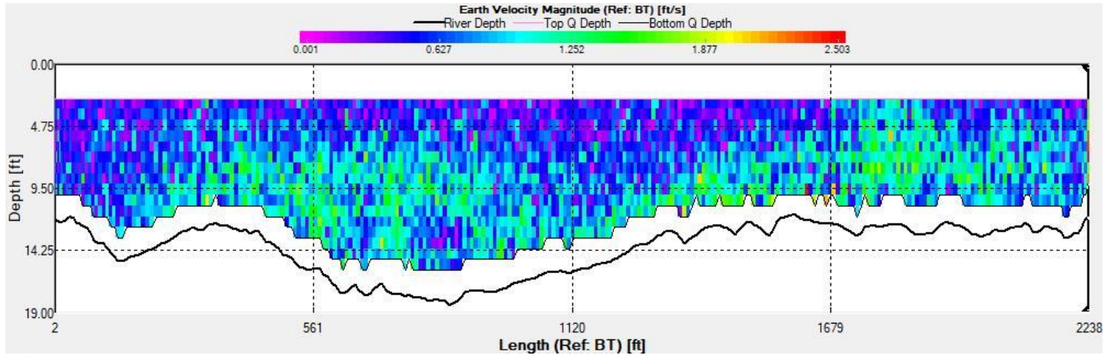


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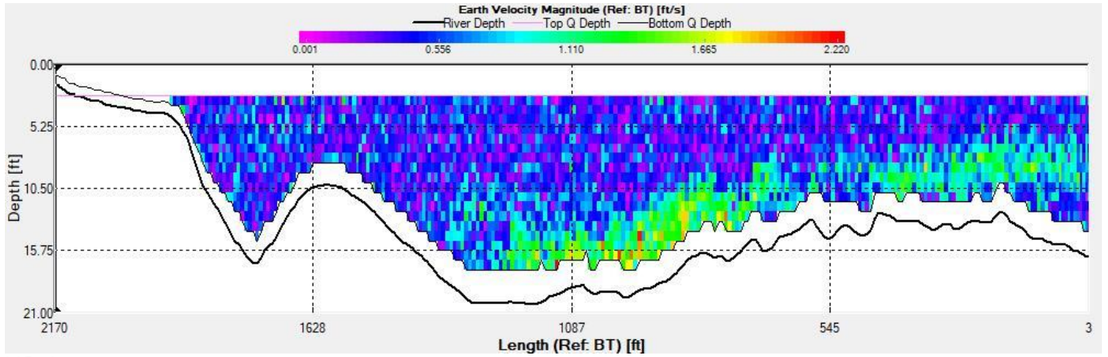


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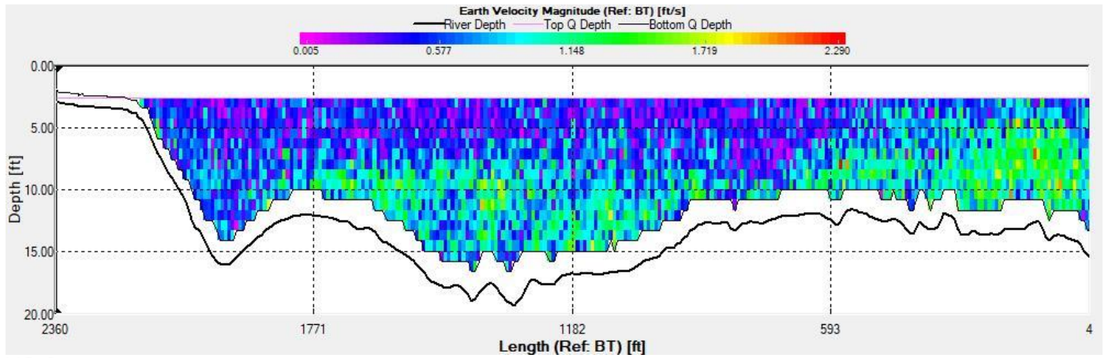


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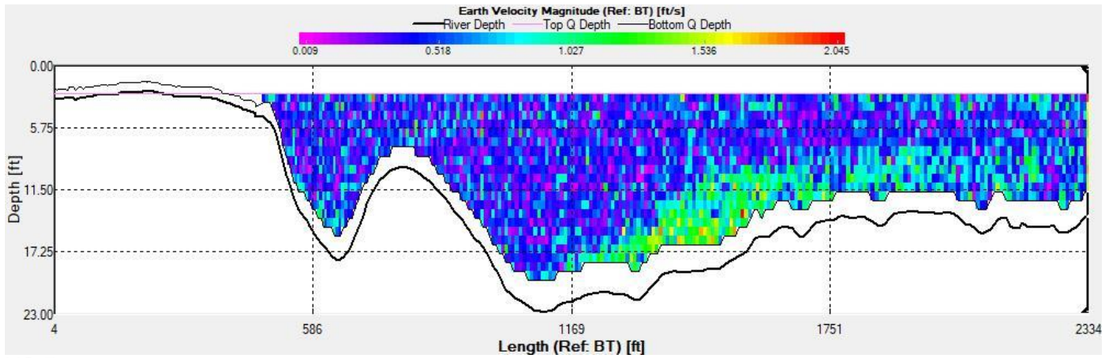


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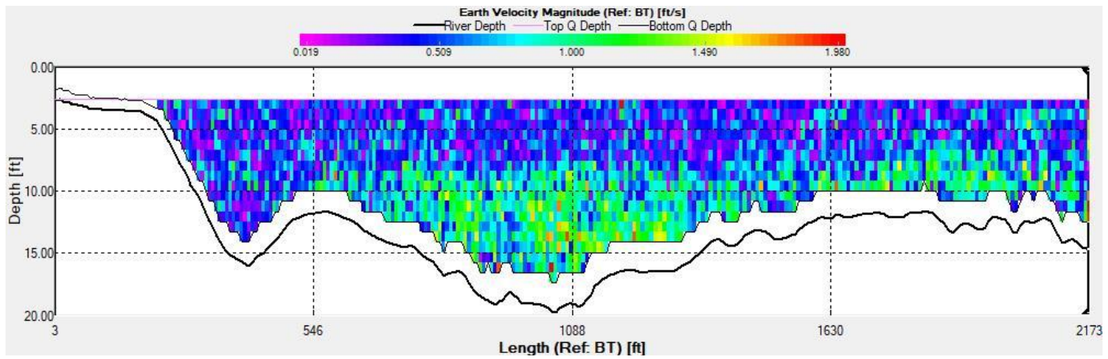


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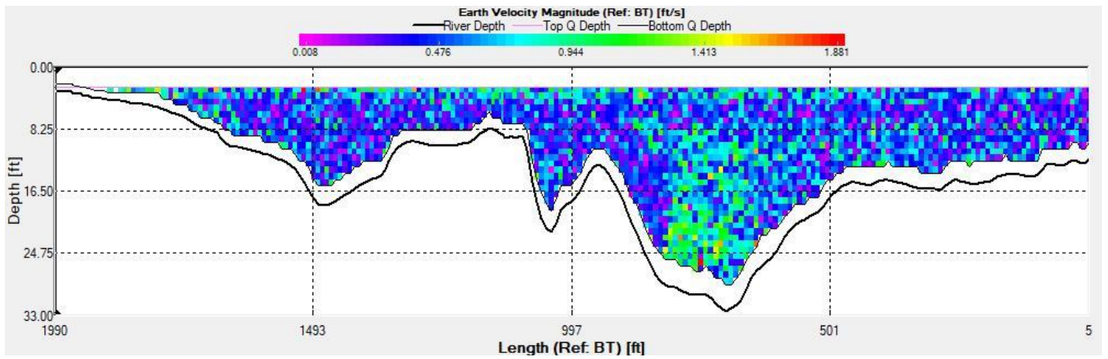


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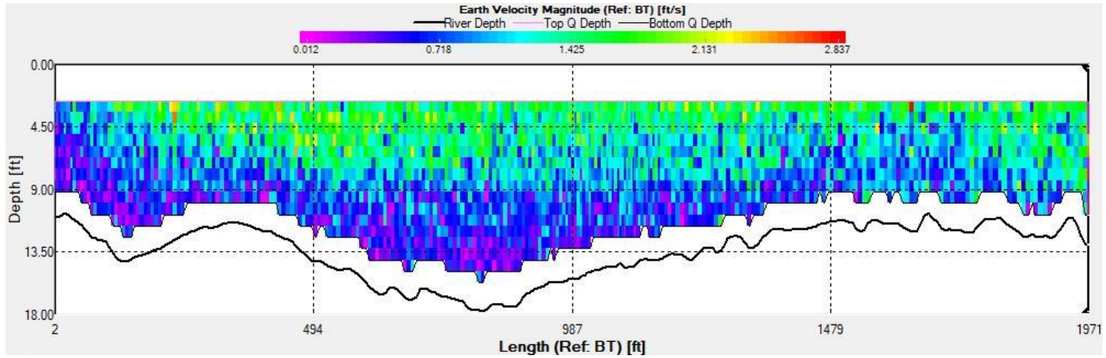


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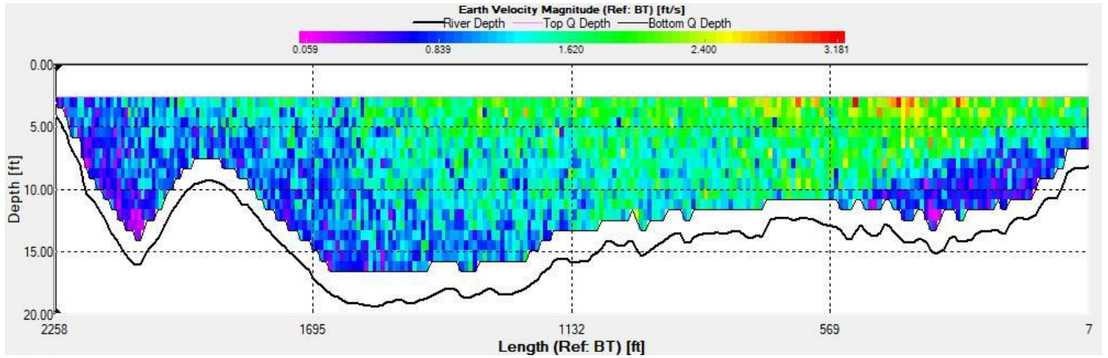


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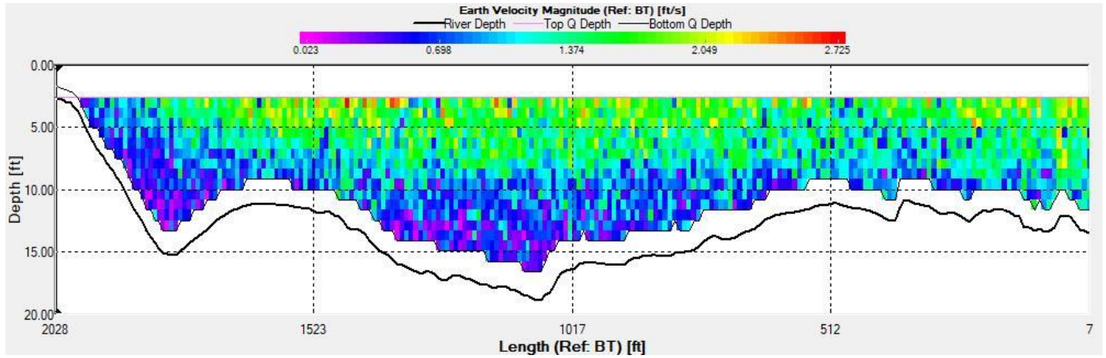


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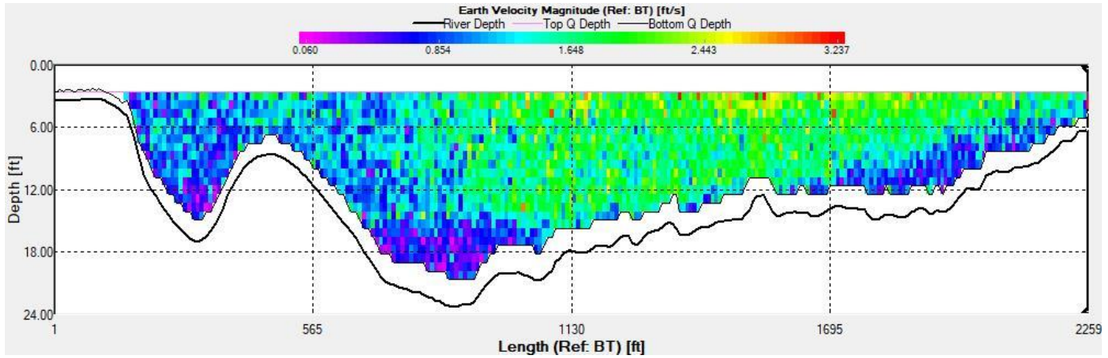


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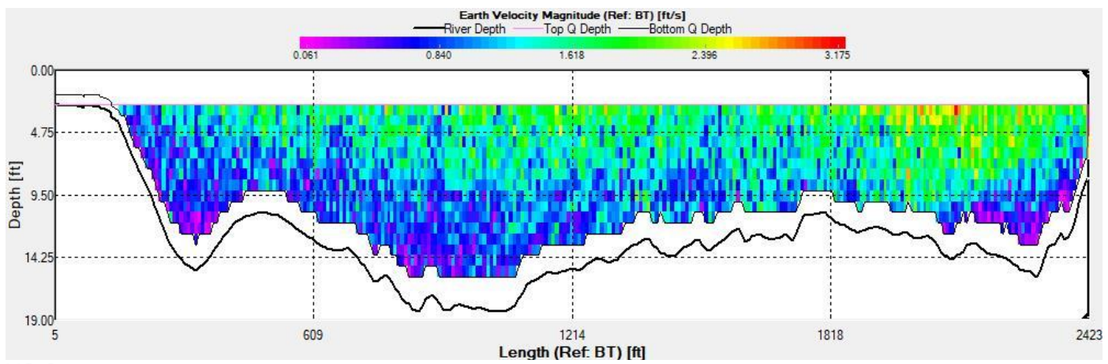
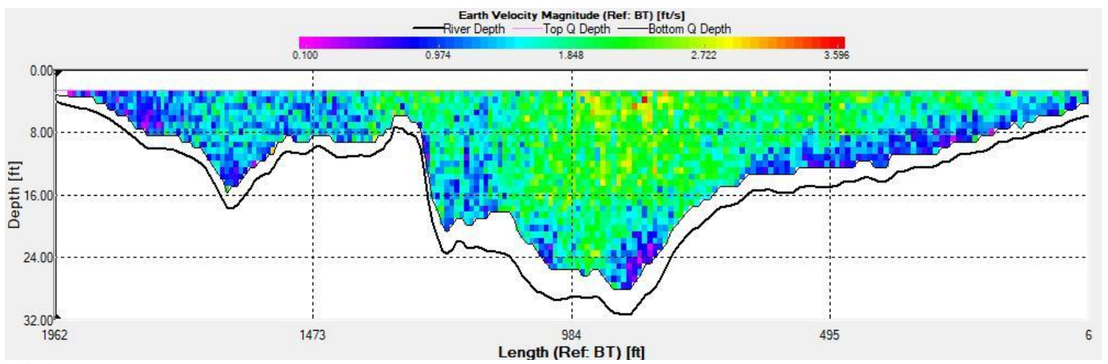
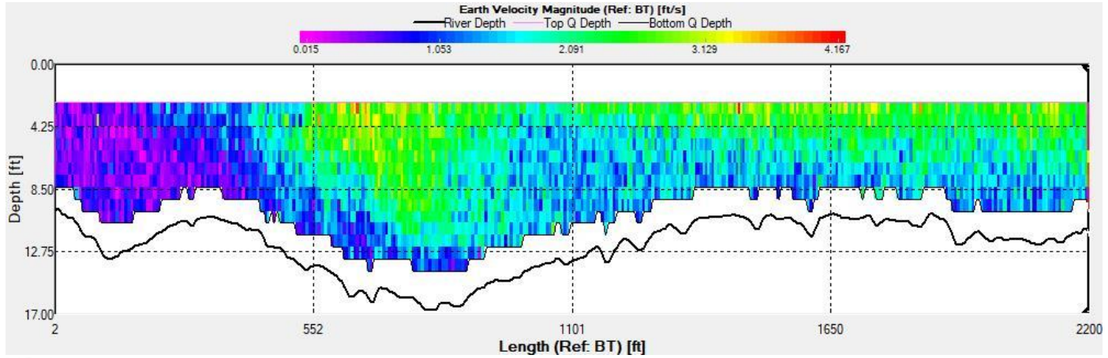



XS-3

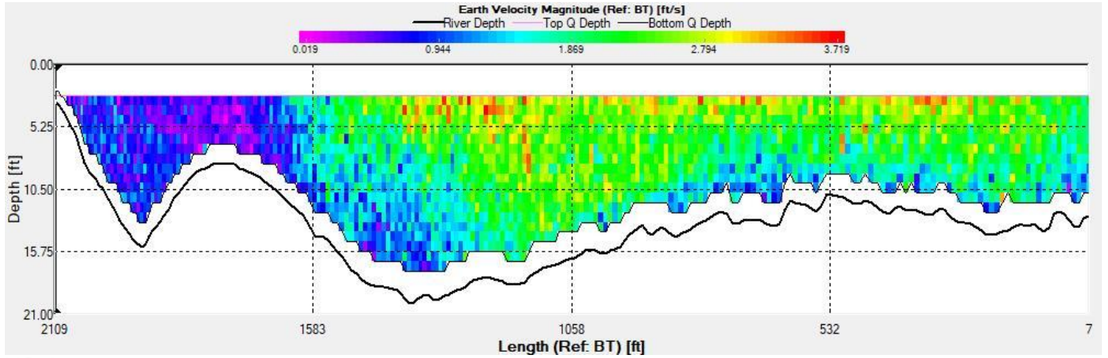



XS-6

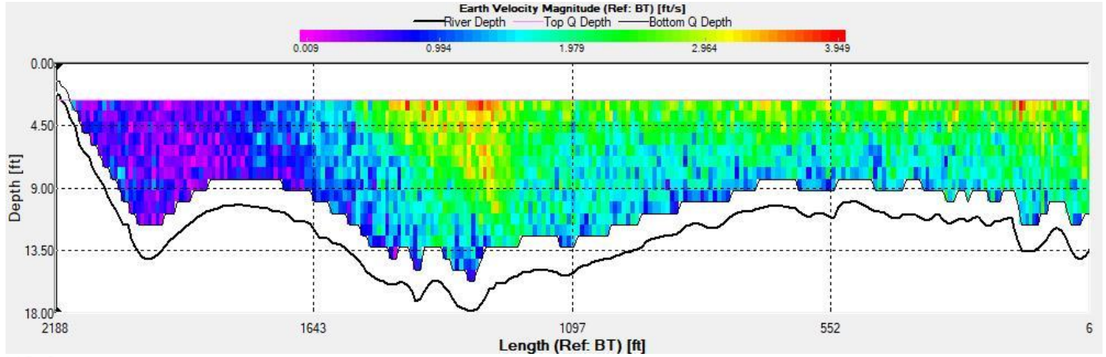
**Ebb Cycle 3:**



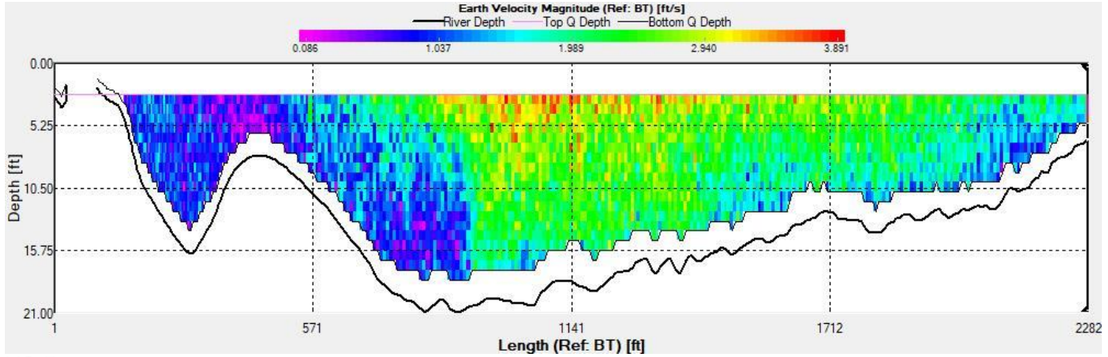

XS-1



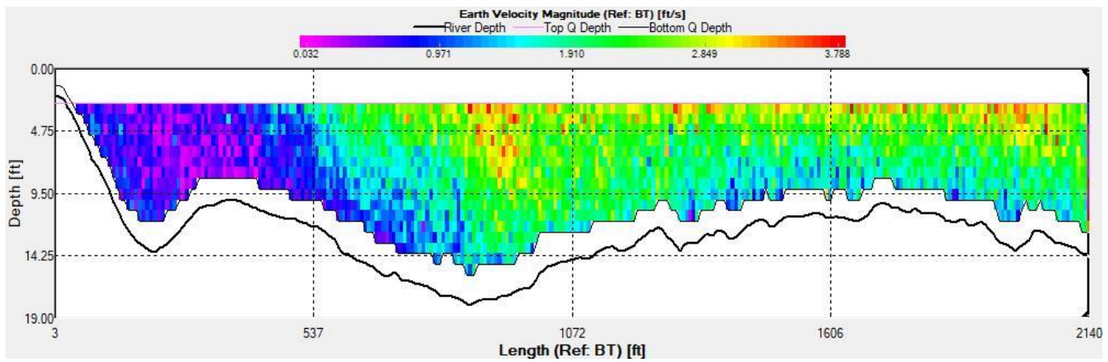

XS-4



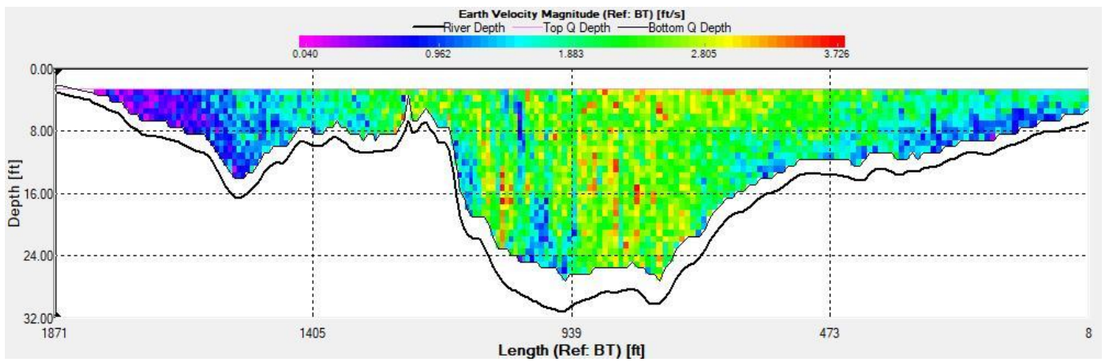

XS-2




XS-5



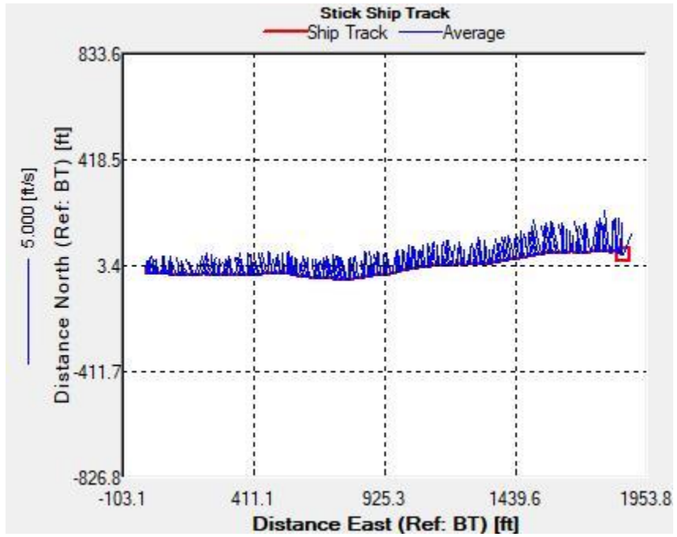

XS-3



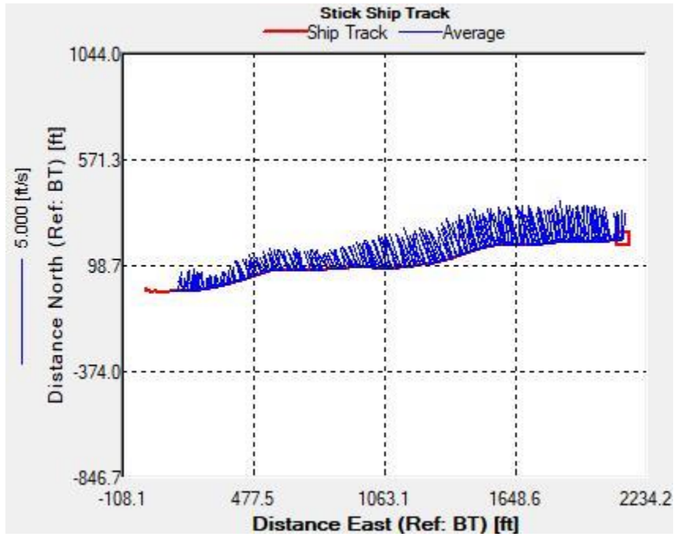

XS-6

**Appendix D.**
Vertically averaged current velocity vectors for each of 6 transects and 5 line-cycles

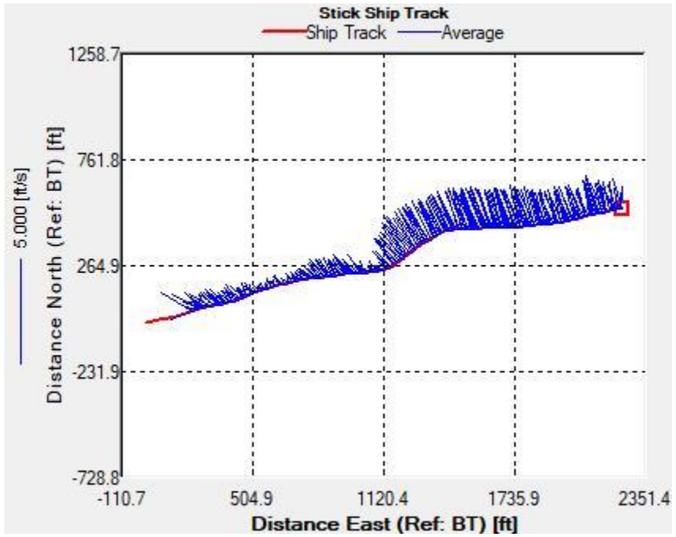
**Flood Cycle 1:**



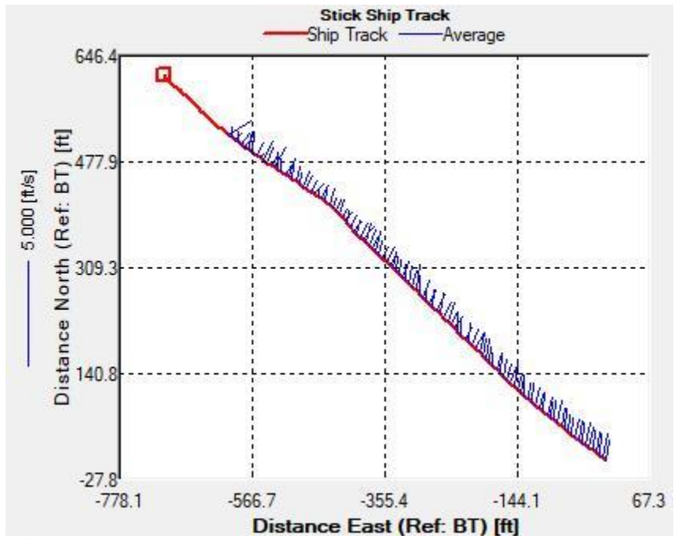

XS-1



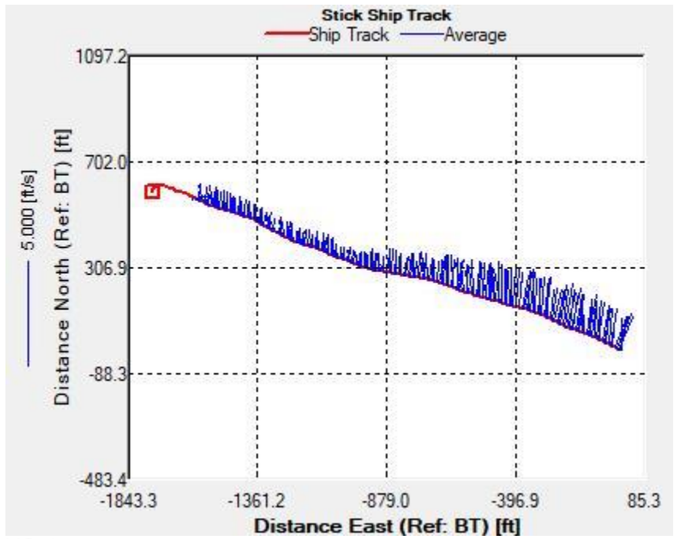

XS-3



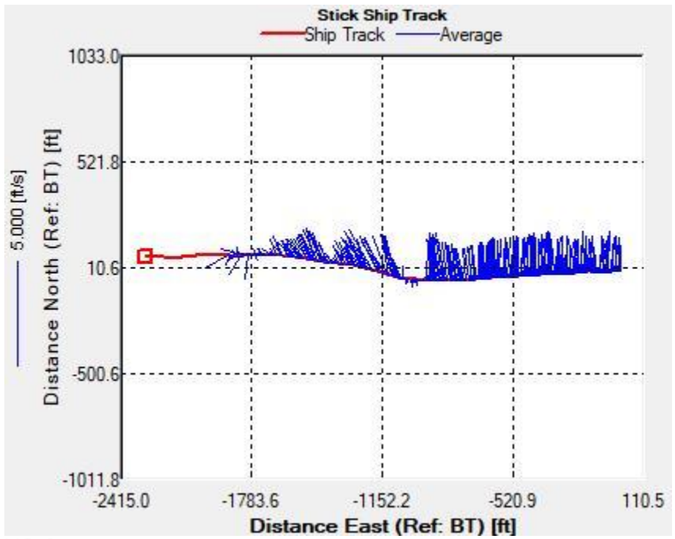

XS-5




XS-2

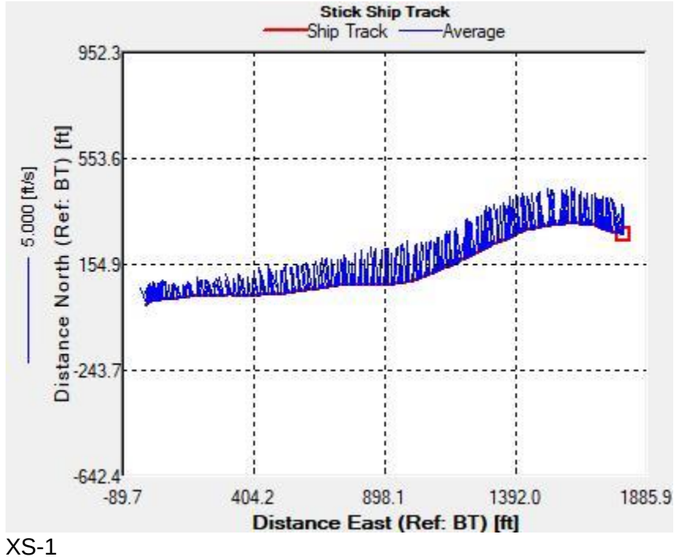



XS-4

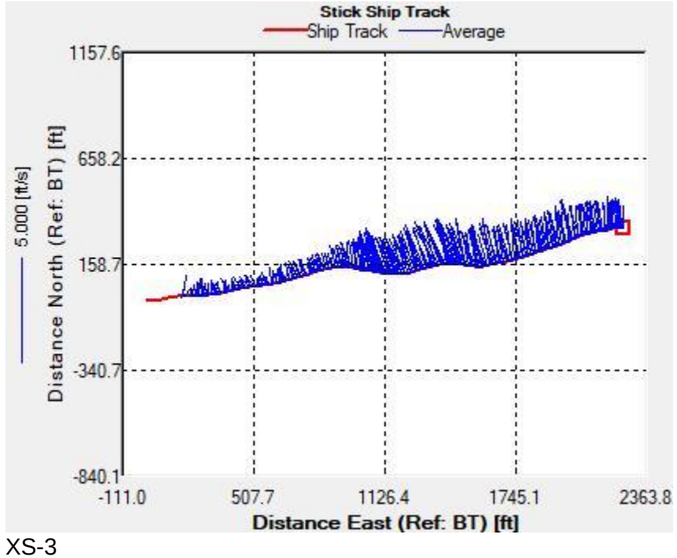



XS-6

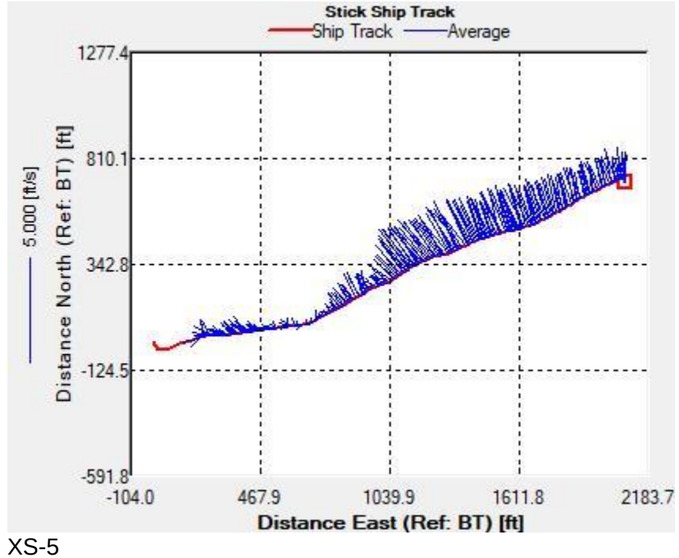
**Flood Cycle 2:**



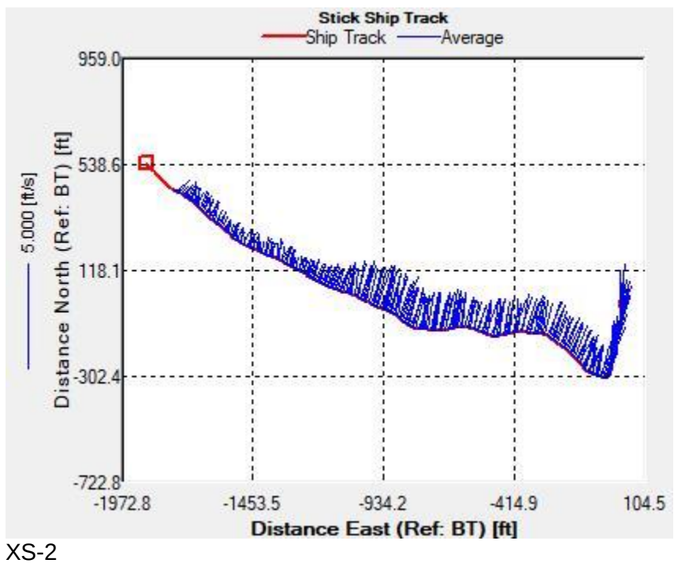

XS-1



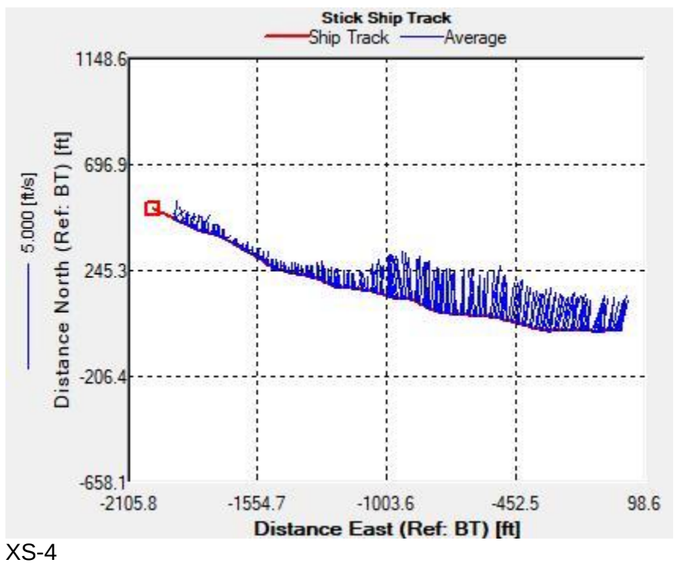

XS-3



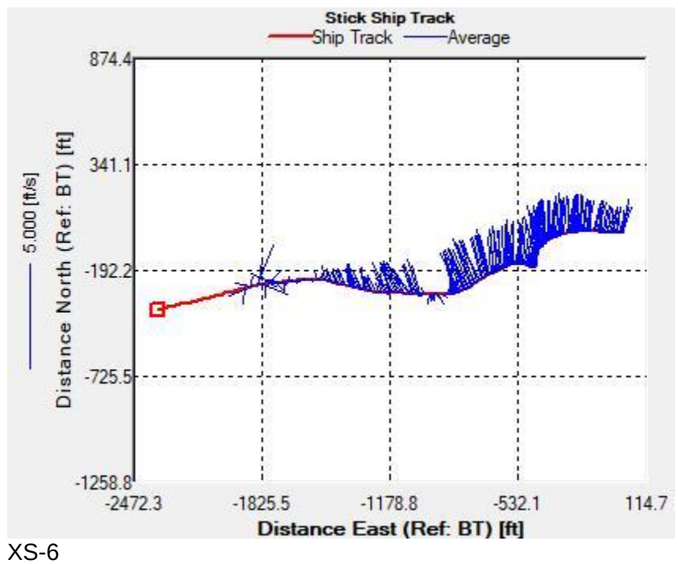

XS-5




XS-2

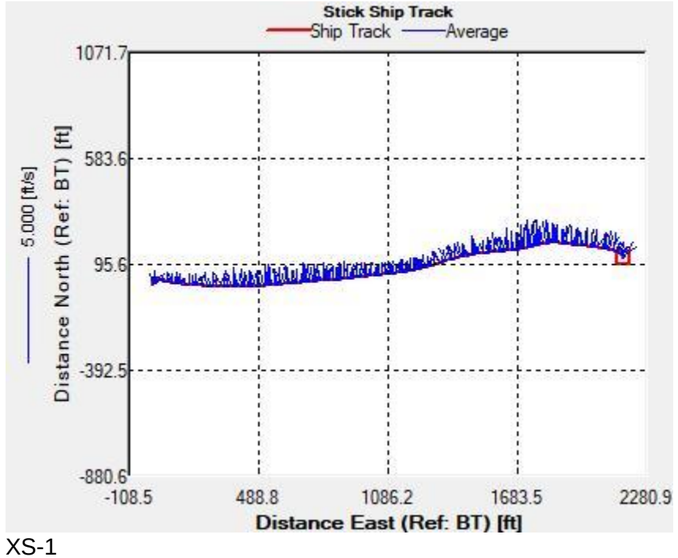



XS-4

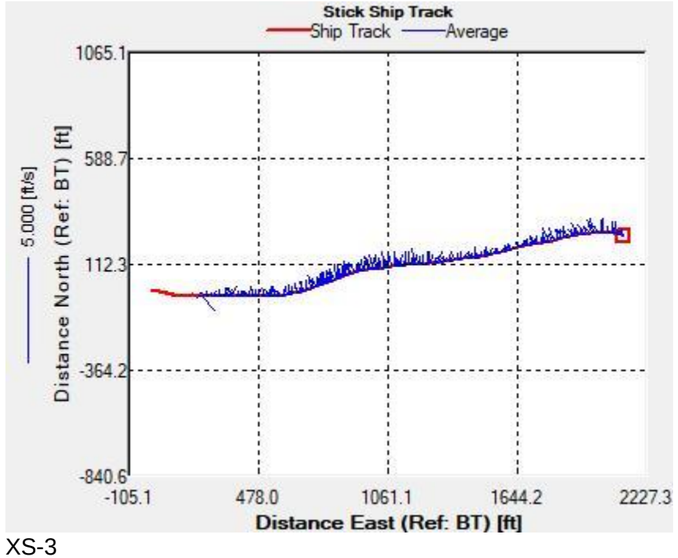



XS-6

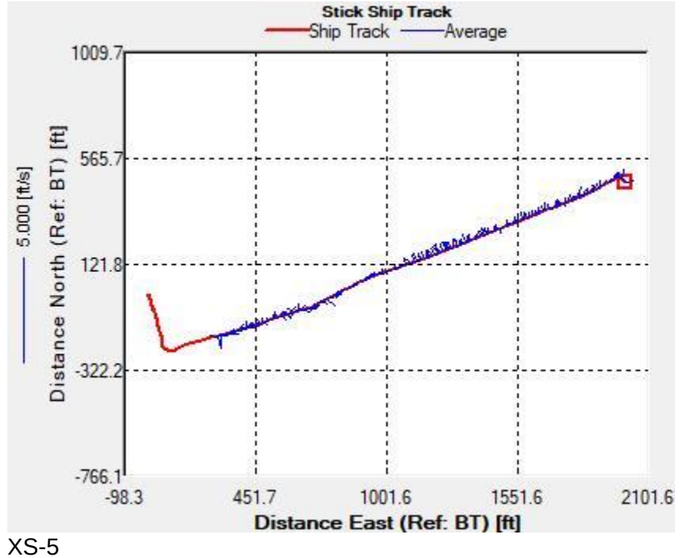
**Ebb Cycle 1:**



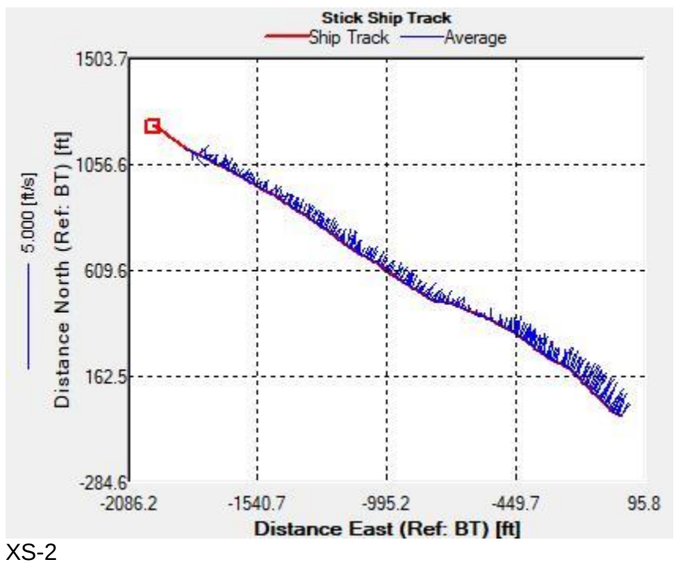

XS-1



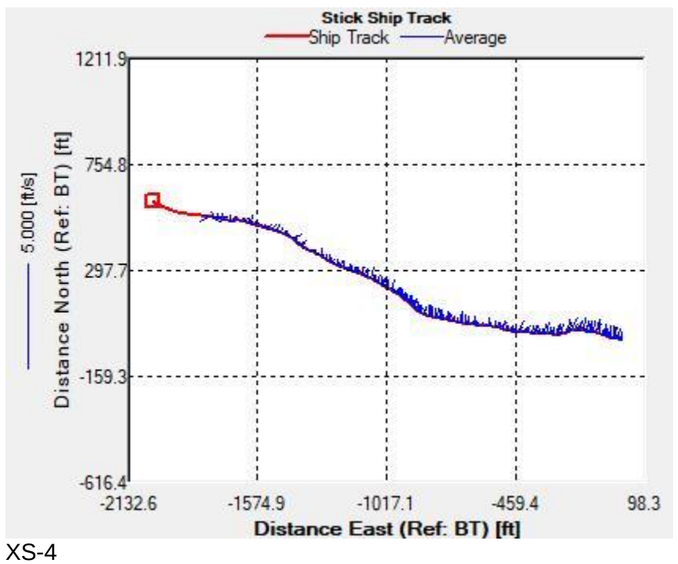

XS-3



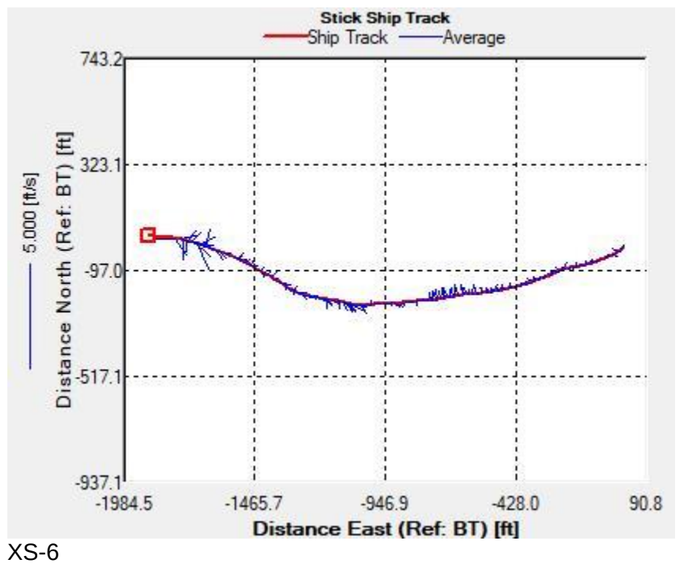

XS-5




XS-2

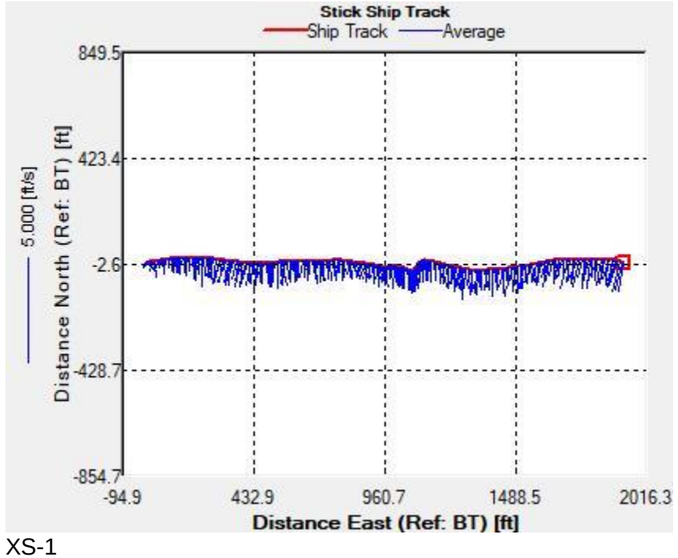



XS-4

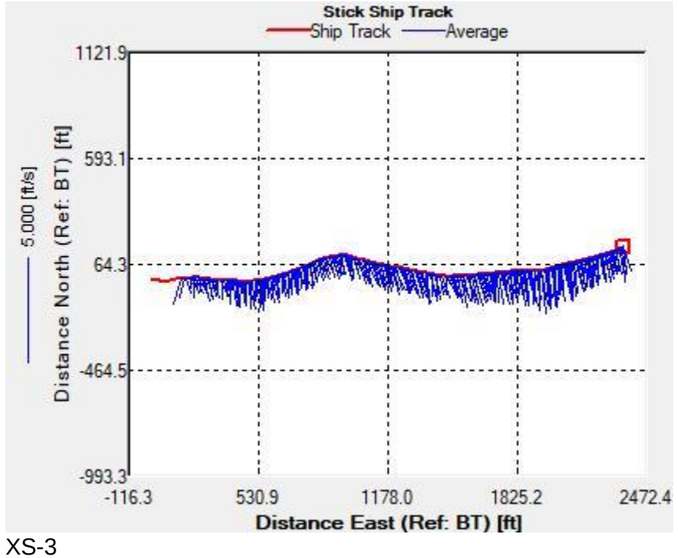



XS-6

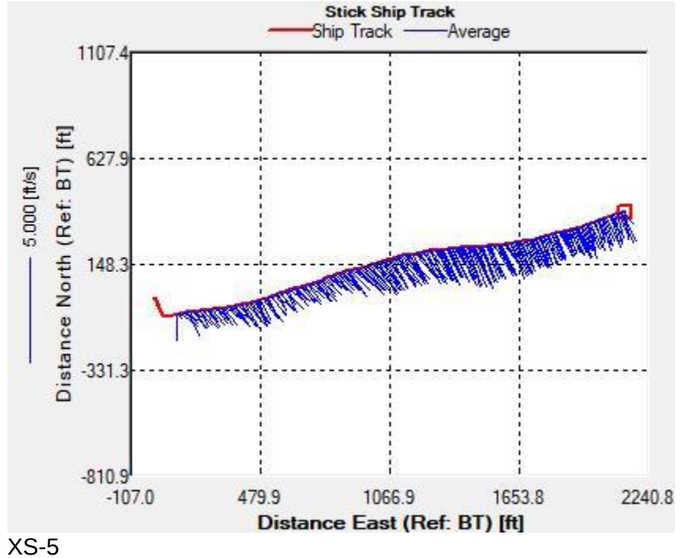
**Ebb Cycle 2:**



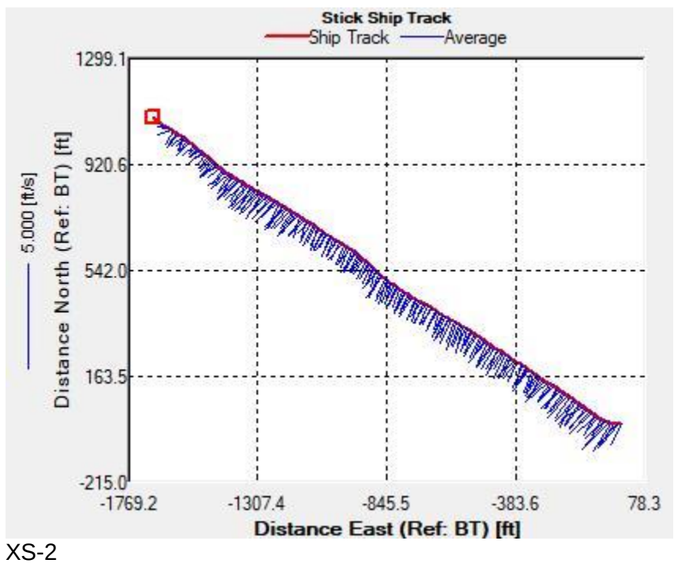

XS-1



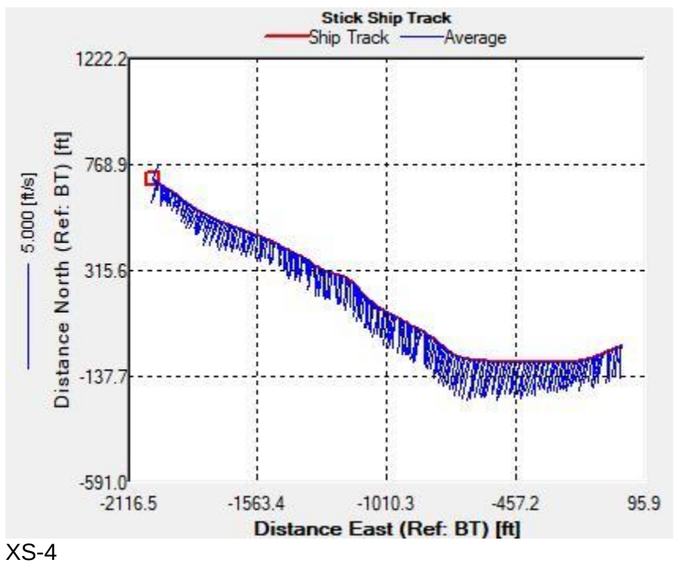

XS-3



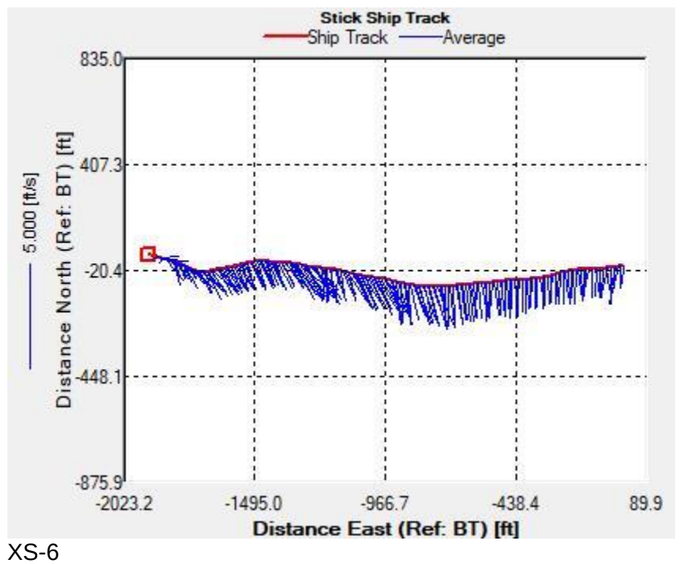

XS-5




XS-2

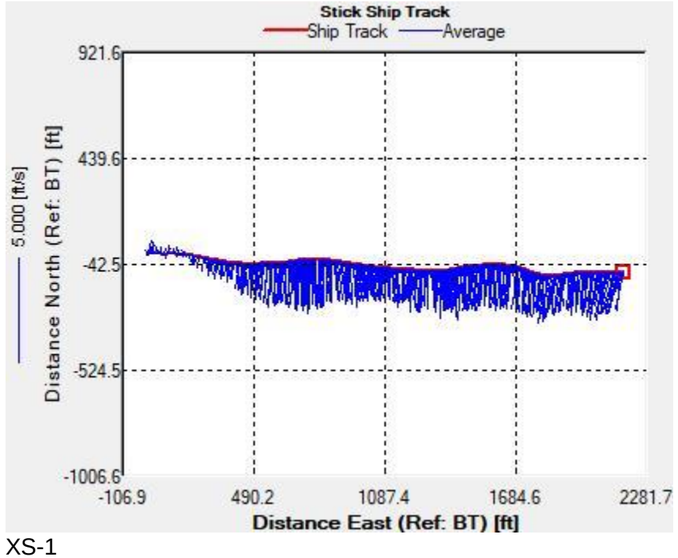



XS-4

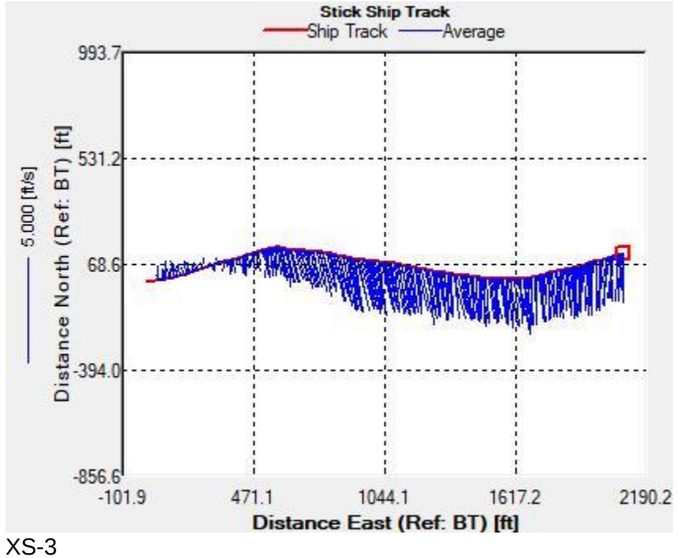



XS-6

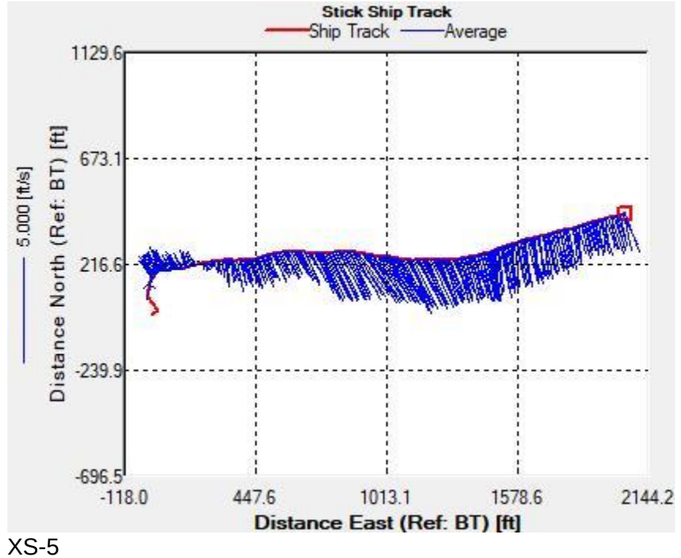
**Ebb Cycle 3:**



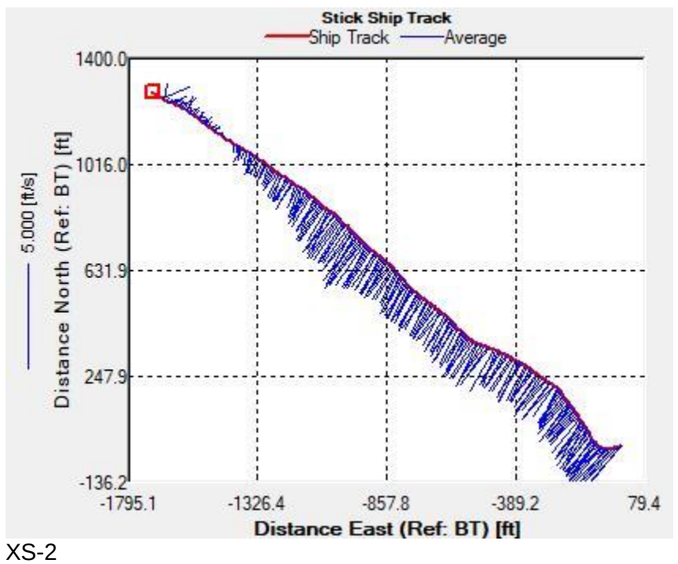

XS-1



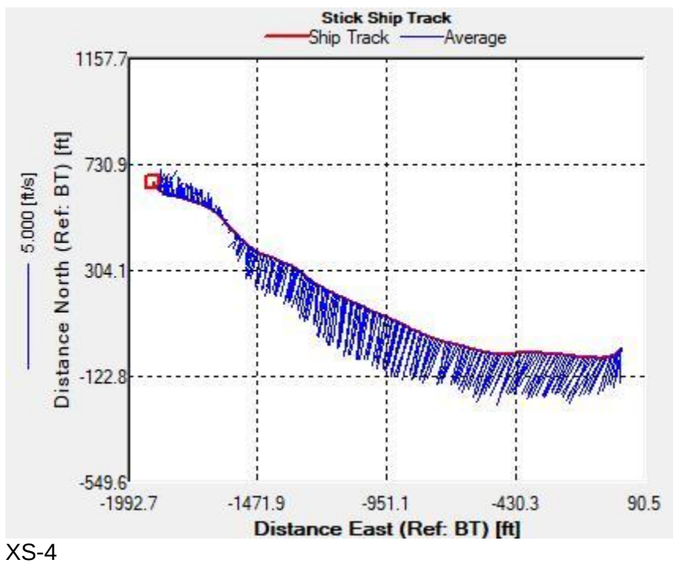

XS-3



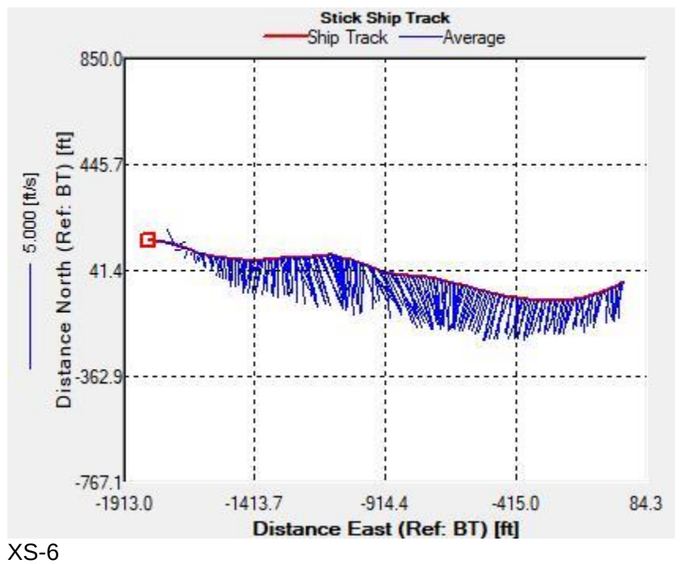

XS-5




XS-2




XS-4

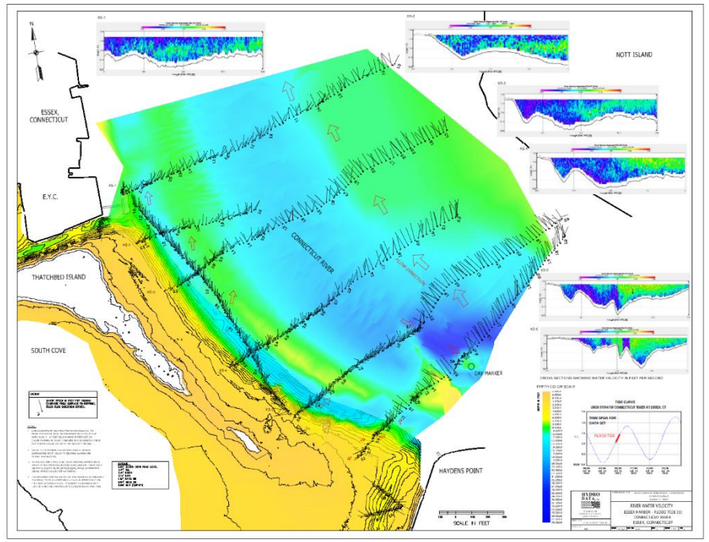



XS-6

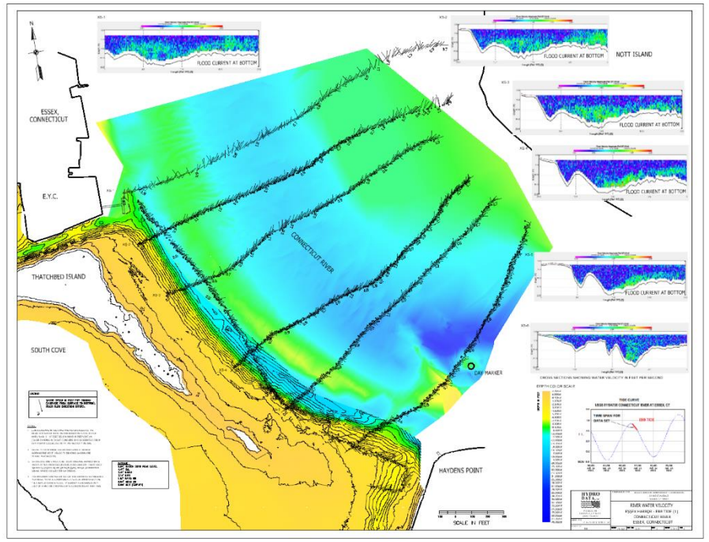
**Appendix E**

Thumbnail of E-sized drawing attached separately

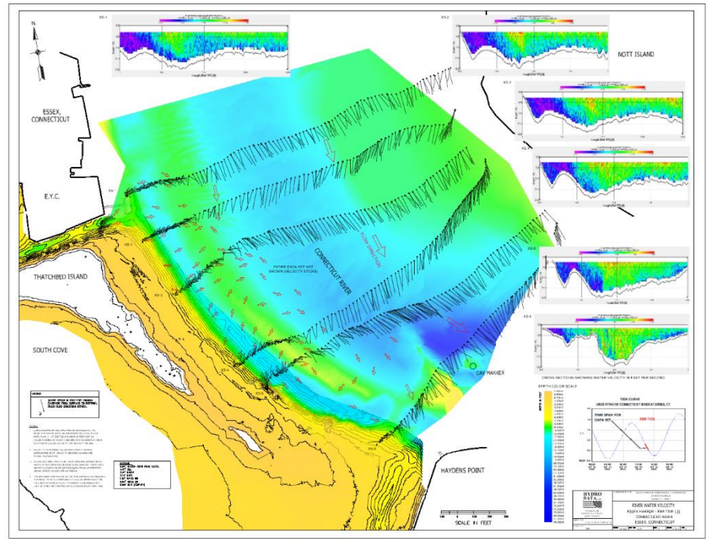
Flood Cycle 1:



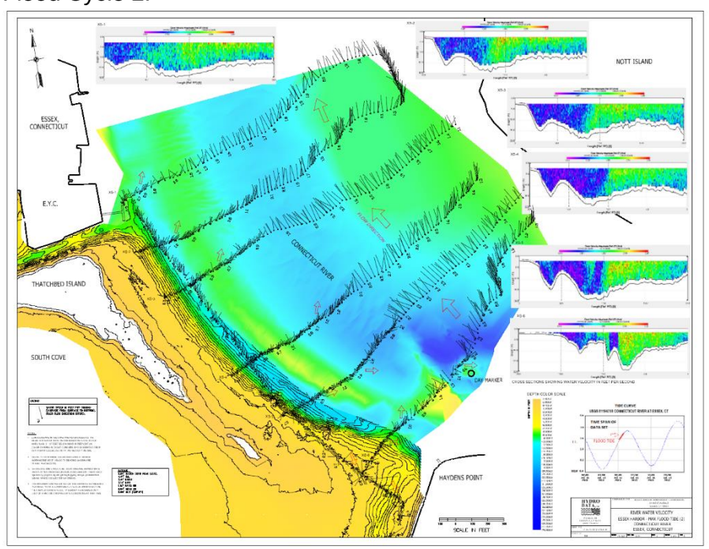

Ebb Cycle 1:



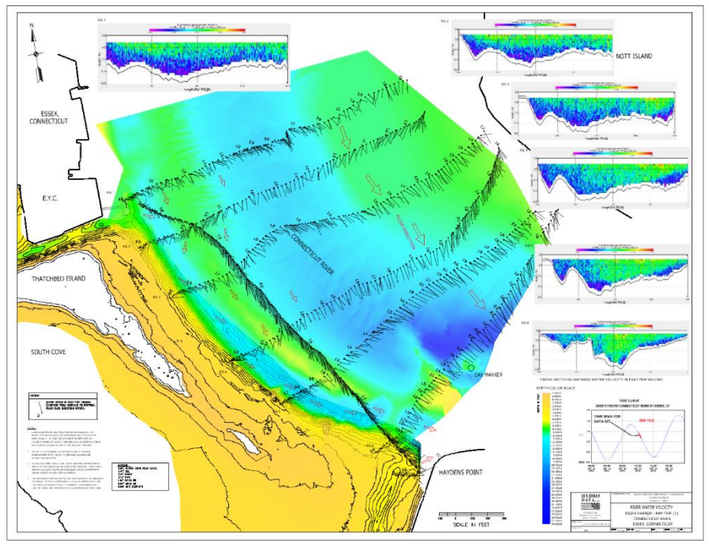

Ebb Cycle 3:




Flood Cycle 2:




Ebb Cycle 2:



Appendix F.  Property Survey, Thatchbed Island