FINAL REPORT

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TIER 1 2024 MAPPING OF SUBMERGED AQUATIC VEGETATION IN LONG ISLAND SOUND AND THE PECONIC ESTUARY

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EXECUTIVE SUMMARY

Eelgrass (*Zostera marina L)* and widgeon grass (*Ruppia maritima)* are common species of submerged, rooted vascular plants found in the shallow (<5m) subtidal areas of the Peconic Estuary, NY and Long Island Sound (LIS). Eelgrass is a species of critical concern for the Peconic Estuary Partnership (www.peconicestuary.org) and is a central theme of their resilient Habitats and Wildlife mission. In Long Island Sound, eelgrass is also a species of critical concern for the Long Island Sound Study (www.longislandsoundstudy.net/) and is a central theme of the Thriving Habitats and Abundant Wildlife portion of the Comprehensive Conservation Management Plan (CCMP).

Tier 1 level mapping and monitoring of submerged aquatic vegetation (SAV) is appropriate for region-wide analysis and is the smallest scale of the three-tiered monitoring system (Neckles et al., 2012). Tier 1 level mapping involves the use of an ortho-photography basemap specifically acquired for the photo interpretation (by eye) of shallow subtidal habitats. In addition, extensive field surveys are conducted using an underwater video camera that help during the photo interpretation process.

In July 2024, aerial imagery was acquired following protocols established by the National Oceanic and Atmospheric Administration Office of Coastal Zone Management. New York State's Department of Environmental Conservation and the US Geological Survey's National Geospatial Technical Operation Center contracted the ortho-photography project. Extensive field work was then conducted in late summer 2024 to collect and record underwater video data for locating the existence of eelgrass beds and determining the aerial extent. Underwater video recordings of eelgrass beds help during the photo interpretation process and validate the final SAV polygons.

After the basemap imagery was acquired, a field team took a draft of the aerial imagery out in the field. The draft imagery was used to aid in determining locations to collect underwater video. Thus, the field data was collected during the same year that the basemap imagery was acquired. Underwater video was collected by boat using a tethered digital video camera connected to an on-board console with a GPS receiver (+/- 3m accuracy), a text overlay system (for lat/long and date information), video monitor, and digital video recorder. Underwater video surveys were conducted in September and October 2024. After the field season, underwater videos were converted to a GIS point file by extracting latitude, longitude, and benthic habitat. The video point file data was then overlayed on the final ortho-photography product.

Eelgrass and widgeon grass polygons were delineated in ArcGIS by photo interpretation of the digital ortho-photography basemap and using underwater video data. In addition, NOAA Nautical Charts were also used to interpret and delineate eelgrass polygons. Areas noted on the NOAA charts as rocky, and where rocks are visible in the ortho-photography, were mapped as 'eelgrass and boulders' meaning boulders are common in the map unit and inter-mixes with eelgrass. Eelgrass cover within each polygon was between 5-100%. A user versus producer error matrix was then created using the underwater video data (~7000 points). The 2024 SAV polygons had overall mapping accuracy of 84%.

The total acreage for eelgrass in LIS for 2024 was **2,041.4 acres (826.1 Ha)**. The largest bed of eelgrass was 179 acres west of Groton-Long Point, CT. A change analysis between the 2017 and 2024 Tier 1 eelgrass datasets from LIS indicated an overall net increase in eelgrass habitat of **473.3 acres (191.5 Ha).** The westernmost bed that was delineated was in a restoration project site at Duck Island, south of the town of Clinton, CT. This also corresponds to the westernmost extent of the ortho-photography and the study area.

The total acreage of SAV in the Peconic estuary for 2024 was **800.6 acres (324 Ha),** with eelgrass making up a large portion of this acreage (98% or 785.8 acres).

CONTENTS

1. PROJECT SYNOPSIS

Zostera. marina L. (common name eelgrass) and *Ruppia maritima* (common name widgeon grass) are common species of submerged aquatic vegetation (SAV) found in shallow subtidal (<10m water depth) environments of Long Island Sound (LIS) and the Peconic Estuary (PEC). Of the two species, eelgrass is more common and much more widely studied. Eelgrass is a perennial flowering plant that propagates mainly via rhizomes (roots) that grow horizontally and sprout new blades and shoots to form dense hummocky patches (1m^2) and continuous meadows (beds), some of which can be many hectares in size. These habitats are critically important in estuarine ecosystems by providing nursery areas for commercially and recreationally important fisheries, storing nutrients and carbon, filtering particulates from the water column, and supporting the development of subaqueous soils (Dennison et al. 1993; Hughes et al., 2009; Bradley and Stolt, 2006). In addition, eelgrass meadows play a key role in mitigating changes to the climate, as they function as sinks for carbon storage (blue carbon), holding as much carbon as temperate forest ecosystems (Rohr et al., 2018).

Eelgrass can be sensitive to environmental changes such as eutrophication and therefore, its presence or absence is regarded as a biological indicator of a well-functioning estuarine ecosystem (Hughes et al., 2009). Because of its importance as a habitat and an ecological indicator, eelgrass is protected under the EPAs Clean Water Act and thus is considered a target species within the LIS Comprehensive Conservation and Management Plan (CCMP) (LISS, 2015). In addition, 'eelgrass extent' is recognized as part of the major theme of "Thriving Habitats and Abundant Wildlife" within the CCMP (LISS, 2015).

Mapping the distribution and extent of eelgrass is a critical first step in understanding, managing, and protecting shallow-subtidal estuarine habitats (Stolt et al., 2011). GIS data provide essential baseline information for government agencies, municipalities, and the scientific community. Neckles et al. (2012) proposed a 3-tiered hierarchal strategy for mapping and monitoring SAV in estuaries of the northeastern U.S. The smallest scale of these tiers (Tier 1) utilizes true-color aerial photography whereby photo signatures of eelgrass patches or meadows are interpreted by eye and delineated using ortho-photography (aerial photographs with the distortion removed) as a base map.

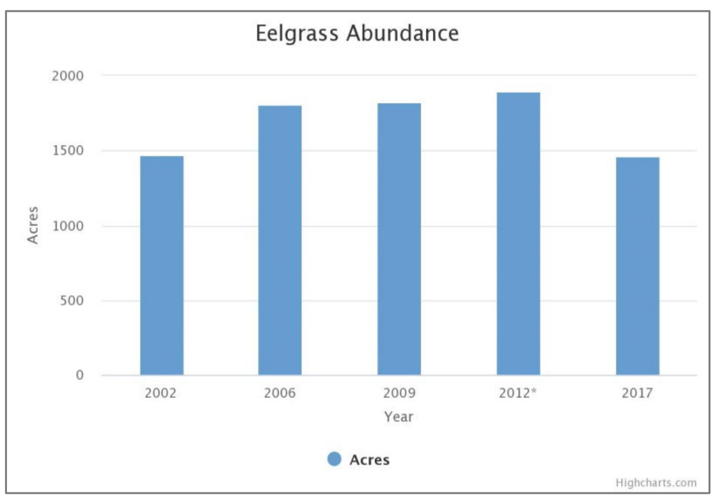


Figure 1. The results of Tier 1 eelgrass mapping efforts for LIS from 2002 to 2017 (from https:\\longislandsoundstudy.net)

Tier 1 mapping projects have successfully mapped the aerial extent of eelgrass for over 25 years in Rhode Island, Massachusetts, and the Chesapeake. In the Chesapeake for example, Tier 1 SAV surveys are done on a yearly basis (Orth et al., 2019). Within LIS, eelgrass has been mapped five times beginning in 2002 (Figure 1) with the last survey conducted in 2017 (Bradley and Paton, 2018). The last Tier 1 comprehensive survey for eelgrass extent in the PEC was done in 2014 (Pickerell and Schott, 2016).

This project continues the Tier 1 mapping efforts in LIS and the PEC with the goal of developing a GIS database identifying the locations of eelgrass and quantifying its aerial extent (acres, hectares) for 2024. Additionally, a change analysis between 2017 and 2024 LIS Sound Tier 1 map products was conducted.

<u>Partnerships</u>

During this project, several partnerships were successfully leveraged to implement and complete this work. First, the Long Island Sound Study (LISS) provided financial assistance as well as project logistical support including leading and planning team meetings as well as arranging field work schedules. The United States Fish and Wildlife Service Southern New England Coastal Program provided administration and boat support. The Peconic Estuary Partnership (PEP), along with NYSDEC and USGS, oversaw and implemented the aerial photography acquisition and ortho-photography product contract. Finally, Stony Brook University conducted field surveys for the PEC.

<u>Results</u>

In the PEC, **800.6 acres (324 Ha) of SAV** were mapped in 2024 using photo interpretation techniques and underwater field surveys. One hundred twelve (112) individual polygons were delineated, with the largest bed (132.8 acres; 53.7 Ha) occurring off Shelter Island in Coecles Harbor. The minimum mapping unit was 0.01 acre (55 m^2), however 75% of the polygons mapped were larger than 0.25 acres (0.10 Ha). A large majority of the aerial extent of SAV was eelgrass (98% or 785.8 acres). Almost 15 acres of widgeon grass were mapped with the largest bed (7.4 acres; 3.0 Ha) occurring at Cedar Beach Point in Southold, NY. Of the 112 polygons mapped, 28 were field visited in 2024 representing 60% of the total acreage mapped in the Peconic estuary.

In LIS, **2,041.4 acres (826.1 Ha) of eelgrass** were mapped. Two hundred sixty-one (261) individual polygons were delineated, with the largest bed (179 acres; 72.4 Ha) occurring in Groton-Long Point, CT. The minimum mapping unit was 0.01 acre (55 m^2), however 80% of the polygons mapped were larger than 0.25 acres (0.10 Ha). Of the 261 polygons mapped, 113 were field visited in 2024, representing 85% of the total acreage mapped in LIS. The westernmost bed that was delineated was in a restoration project site at Duck Island, south of the town of Clinton, CT. This also corresponds to the westernmost extent of the ortho-photography and the study area. The extent of eelgrass west of the Connecticut river is believed to be minimal, but this observation needs further investigation.

<u>Change Analysis</u>

In PEC, the previous mapping effort was done eleven years ago (2014) and the basemap imagery was not immediately available. Thus, no change analysis was conducted. In LIS, a change analysis was conducted for Tier 1 mapping surveys done in 2017 and 2024. In 2017, 1,464.2 acres (592.5 Ha) of eelgrass were mapped in LIS. The change analysis was a two-step process. First, to account for mapping variability when determining the actual amount of increase or decrease in aerial extent of eelgrass, the 2017 polygons and the 2024 polygons were intersected in ArcGIS. The result is a new polygon layer that contains all polygons from both years. Second, each polygon in the output layer was individually inspected and classified into one of four classes of habitat change:

1) **No change**. The polygon was mapped as eelgrass in both years.

2) **Gain**. The polygon was mapped as eelgrass in 2024 but not in 2017. Upon closer inspection of the underlying imagery and underwater video data, the polygon was determined to be gain of eelgrass between the two years.

3) **Loss**. The polygon was mapped as eelgrass in 2017 but not in 2024. Upon closer inspection of the underlying imagery and underwater video data, it was determined to be loss of eelgrass between the two years.

4) **Mapping Variability**. The benthic habitat in underlying imagery (either 2017 or 2024) is not visible due to solar glint or turbidity; therefore, no interpretation of change can be made. Also included in this category are slight differences during the digitizing process between the two years.

Table 1. The results of the change analysis between the 2017 Tier 1 mapping survey and 2024.

Status	**Acres (+/-)**
Gain	**765.2**
Loss	291.9
Unchanged between 2017 and 2024 (mapped eelgrass in both years)	1090.3
Mapping Variability	219.8 (9.3%)
Total Assessed for Change Analysis	2367.2
Net Change	**+473.3**

It was not feasible to assess every polygon in the output of the intersection between 2017 and 2024. Therefore, the attribute table was sorted from largest to smallest in terms of area. Every polygon larger than 0.25 acres (1000 m^2) was individually inspected for change status. In total, 2367.2 acres (958 Ha) or 585 polygons representing 98% of the total acreage were inspected (Table 1). The results of the change analysis indicate that LIS had net overall increase of eelgrass of **473.3 acres (191.5 Ha)** between 2017 and 2024. In addition, areas of eelgrass loss between the two years totaled **291.9 acres (118.1 Ha).**

2. TASKS COMPLETED

Task 1: *QAPP Development (SAV mapping process only), submission, and approval to NEIWPCC and EPA*

- QAPP signed on June 15, 2023

Task 2: *Quarterly Report(s)*

- Because of project delays, significantly more quarterly reports were submitted than were anticipated in the task-based payment schedule

Task 3: *Serve as POC for USGS aerial photography contract and attend project kickoff meetings*

- Kickoff meeting with the photogrammetry vendor NV5 was on March 30, 2023. The flights for 2023 were postponed until 2024 due to poor air quality from Canadian wildfires. In 2024, the project area was flown over three days: June 25, June 28, and July 26. We worked closely with USGS and NV5 to monitor the weather as the acquisition windows approached.

Task 4: *Review pilot areas of draft aerial photography product*

- Task completed during the independent QA/QC process.

Task 5: *Along with project partners develop ground-truthing logistics and methods for PEC and LIS*

- We held several meetings with project partners at Stony Brook University to discuss and review field work logistics and protocols. PEC field work (following LIS protocols) was completed on October 16, 2024.

Task 6: *Quarterly Reports*

- See Task 2 above

Task 7: *Define high priority mapping sites and photo interpretation*

- An interactive web map, whose URL is provided below was developed to define high priority field mapping sites (yellow polygons): https://edc.maps.arcgis.com/home/item.html?id=0f4b773195ac4aae96eb340d4e1c55e1

Task 8: *Interpret, delineate, and classify eelgrass (SAV); develop first draft of photo-interpreted polygons*

- Initial polygons of SAV were interpreted and completed after delivery of the draft ortho-imagery in September 2024.

Task 9: *Along with project partners, ground-truth high priority mapping sites using GPS and underwater video camera **(LIS ONLY)***

- Underwater video camera field surveys for LIS were conducted by boat on: August 30, September 5, September 10, September 11, September 13, September 16, September 17, September 30, and October 3, 2024

Task 10: *Quarterly Reports*

- See Task 2 above

Task 11: *Public distribution and management of ortho-imagery product – create and publish image service of mosaic dataset in ArcGIS*

- Public distribution and management of the ortho-imagery products was completed using Esri ArcGIS Online (AGOL) and ArcGIS Pro internet publishing technology. A tiled map service providing detail down to a scale of 1:564 (over 2 million tile caches) was created and hosted using the URI-EDC AGOL for Organization platform. Direct links for the imagery are provided in Section 5 (Deliverables).

Task 12: *Development of GIS database of eelgrass (SAV) polygons and field mapping survey points.*

- Final development of the GIS database of SAV polygons and field mapping survey points was completed during the fall of 2024 and February of 2025.

Task 13: *Analysis and management of underwater video files*

- Over 300 video files were analyzed and processes from the PEC and LIS to create a database of over 8,000 points of benthic habitat. For more information, see Methods section below and Section 5 (Deliverables).

Task 14: *Quarterly Repor*t

- See Task 2 above

Task 15: *Produce maps of eelgrass (SAV) for LIS and PEC*

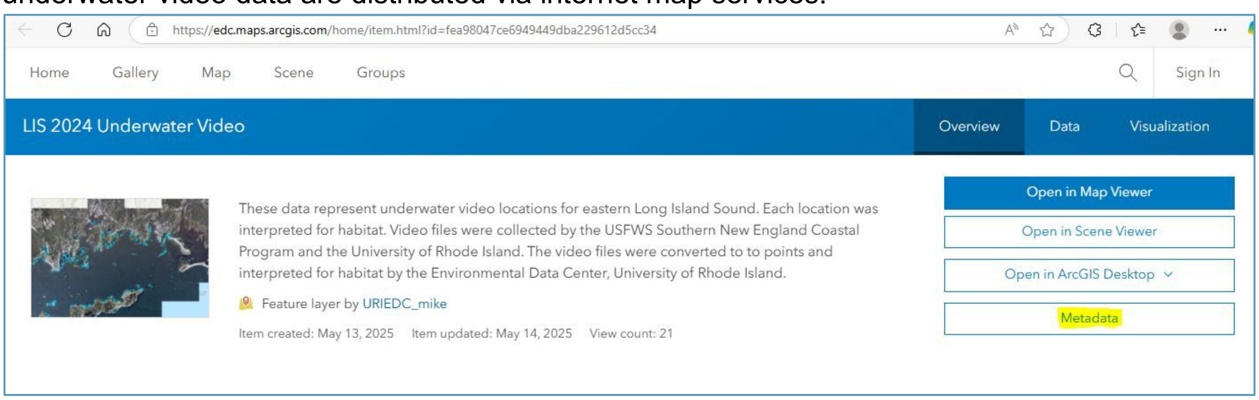
- Several maps of SAV for LIS and PEC were produced over the course of this project. For example, during the field training for Stony Brook University and for presentations listed below for Task 19.

Task 16: *Publish maps of eelgrass (SAV) extent on internet*

- Internet applications for the PEC and LIS were created in ArcGIS Online and can be found in Section 5 (Deliverables) below.

Task 17: *Metadata and mapping data distribution*

- Metadata is included in all AGOL Item Page links and can be viewed by selecting the 'metadata' tab. Additionally, eelgrass and SAV polygons for the PEC and LIS are available for download by clicking on the 'Export Data' button. Ortho-photography and underwater video data are distributed via internet map services.



Task 18: *Using previous studies, conduct trends analysis and write report on findings*

Trends analysis was conducted for LIS eelgrass by comparing data from the most recent Tier 1 mapping survey of eelgrass done in 2017. See Project Synopsis above for more information.

Task 19: *Develop presentations and present findings at regional meetings*

- This task was completed with virtual presentations for the LIS Eelgrass Monitoring Collaborative on December 12, 2023; September 24, 2024; and poster presentation on May 29, 2025. See https://estuarineresearchreserve.center.uconn.edu/lis-eelgrass-collaborative/

Task 20: *Final Report*

- The final report and project deliverables were submitted to NEIWPCC.

3. METHODOLOGY

Aerial Photography Acquisition

Digital four-band (true color and infra-red) aerial photographs were taken by a photogrammetry vendor on June 25th, 28th, and July 26th, 2024. The extent of the area photographed was based on recent (this century) presence of eelgrass in LIS (Tiner et al., 2013). Project partners at PEP aided in determining the area of acquisition for the PEC. The photographs were taken following NOAA's Office of Coastal Management guidelines (Finkbeiner et al., 2001). Based on these guidelines, photographs were taken at a low sun angle, two hours within low tide, when wind and atmospheric haze were minimal, and when water clarity was high. The altitude of the aircraft during photo acquisition was about 20,000 ft (NV5, 2024). The vendor (NV5) was selected by the USGS Geospatial Product and Service Contracts office (https://www.usgs.gov/national-geospatial-technical-operations-center/geospatial-products-and-services-contracts).

Final draft ortho-photography was color balanced, mosaicked, and projected to the Connecticut State Plane meters (NAD83_2011) coordinate system for the LIS study area (NV5, 2024). The PEC study area was projected to New York Long Island State Plane meters (NAD83_2011) (NV5, 2024). It was also reviewed by project team members in November of 2024, and a final QAQC was done by an independent contractor (Dewberry, Inc.).

Accuracy assessments of the ortho-photography product were completed by NV5 using survey grade GNSS receivers on locations of features (e.g. manholes, parking lot lines) that were both visible in the photography and accessible on the ground. Differences between the two were then compared and statistically analyzed. The listed accuracy of the ortho-photography was RMSEx = 0.139 m and RMSEy = 0.386 m for the Peconic imagery and RMSEx 0.102m and RMSEy = 0.109 m for LIS (NV5, 2024). The pixel resolution of the ortho-photography for both study areas was 0.31 m.

In late December 2024, 727 individual ortho-photography tiles (217 gigabytes) covering both study areas (PEC and LIS) were delivered on external hard drives to the University of Rhode Island (URI) Environmental Data Center. The photography was copied to a lab file server and mosaiced in a raster dataset for internet distribution utilizing ArcGIS Pro and ArcGIS Online tiled map service technology. As a result, the ortho-photography could be viewed in ArcGIS Pro (and on the internet) utilizing one data connection.

Photo Interpretation

Shortly after the photography was acquired, draft imagery was sent to project leaders for use during the September and October field season. The draft imagery was used to aid in the identification of underwater video field survey sites. Initial eelgrass delineations and areas to be ground-truthed were identified by eye and digitized on-screen by hand using the draft imagery as a base map. After delivery of the final ortho-photography product in December 2024, final SAV delineations were made using these data as a basemap. In addition, historical data sets of SAV extent (including GPS ground truth points) were also used as supplemental sources to aid in photo interpretation. We also geo-referenced NOAA Nautical charts to aid in delineation of rocky map units and for depth information. Areas that have historically supported eelgrass were targeted first for the photo interpretation of new beds. However, to avoid any bias, digitizing of the 2024 polygons was always done with historical data sets turned off. All digitizing was conducted at around a scale of 1:1500. The percent cover of all polygons delineated is estimated to be between 5-100%. In addition, we delineated polygons where eelgrass inter-mixes with boulders. These areas were identified using the NOAA Nautical Charts in addition to the underwater video and ortho-photography. These polygons have many boulders that co-exist with eelgrass within the polygon boundary.

Field Work and Field Surveys

Underwater video data collection was performed in the field by boat in September and October 2024. Eelgrass photo-signatures from true-color aerial photographs can be highly variable and flight specific, thus field surveys are conducted during the same year the aerial photographs were taken. The presence of eelgrass was determined using a high-definition, digital underwater video camera linked to a GPS and capable of recording video for archive purposes (SeaViewer, Inc.). Not all polygons were ground-truthed in 2024.

The goals of underwater field surveys were to verify photo-signatures of eelgrass, to assess the imagery quality for identification of the deep-water edge of eelgrass beds, and to verify areas of change from the previous mapping effort. Historical eelgrass delineations from 2014 (PEC) and 2017 (LIS) and draft imagery from 2024 were published to ArcGIS Online to enable viewing of these data on a mobile device such a cellular phone. These data were then viewed with location services turned on to aid in navigating to field sites for collection of underwater videos. The deep-water edge of the 2024 imagery was visible at many sites, however GPS and video data were still used to estimate the extent of eelgrass beds in deeper water and to delineate bed edges.

At the end of field day, video files were copied to URI-EDC servers for back up and storage. After the field season, video files from Stony Brook University were downloaded from an internet drive and all other LIS video files centralized. Video files from LIS were analyzed using a custom Python script developed at URI-EDC that created a snapshot of the video at about 7 second intervals. The script then used a character recognition library to output a comma delimited file that included the latitude and longitude coordinates and date from every snapshot. Each snapshot subsequently interpreted and classified into one of five benthic habitat classes: Eelgrass, Low Cover Eelgrass, Mix Algae / Eelgrass, Macro Algae / Rocks, and Sand Shells. To be used in ArcGIS Pro, video files from Stonybrook had to be converted into a point data set manually, which was very time consuming. In addition, the GPS output coordinates for these files was in lat/long decimal minutes, which had to be converted to decimal degrees in a spreadsheet. In total, 300 video files were collected during the field season, and after processing using the Python script or by manual techniques, resulted in over 8,000 data points that were used for this project during the SAV delineation process.

4. QUALITY ASSURANCE TASKS COMPLETED

Task: *Overall Project Review*

As reviewed by the Quality Assurance officer for the project (Bonynge), this project has followed the quality objectives and criteria as listed in the submitted QAPP. All resources and time constraints were met. Project delays due to Canadian wildfires were documented and successfully managed. Data quality assurances were followed (calibration of equipment, data collection during operable weather, GPS data collection using differential correction, and data backups). Project documentation and recording complied with QAPP timelines, except for one quarterly report that was submitted past due. In addition, all data have had metadata written following Federal Geographic Data Committee (FGDC) metadata standards. All steps for data generation and acquisition were followed as outlined in the project QAPP. Project partners reviewed draft SAV delineations and submitted omissions or errors.

Task: *Accuracy assessment of the SAV Polygons*

Accuracy assessment of the SAV interpretations and delineations were analyzed using a user's versus producer's accuracy matrix (Congalton, 1991). We used 6,675 data points from the underwater video as reference data. During the photo interpretation process, the underwater video points were displayed on the screen, however the benthic habitat class was not symbolized. Thus, these data were not available for the photo-interpreter during digitization. To delineate SAV bed edges, the photo-interpreter had to rely on the ortho-imagery (which was not always visible), the location of the underwater video surveys, and water depths as listed on NOAA Nautical Charts. Errors of omission and commission and overall user's accuracy (84%) can be found in Table 2.

Table 2. A user's versus producer's accuracy matrix for the 2024 Tier 1 surveys. Overall user's accuracy of 84%

		Classified	
		eelgrass	not eelgrass
Reference Data	eelgrass	3234	501
	not eelgrass	3598	2363

TASK: *Field Training of Stony Brook University personnel*

As listed in section A8 of the QAPP, training was provided to Stony Brook University personnel prior to field data collection.

5. DELIVERABLES COMPLETED

Project deliverables include:

1. A GIS database and metadata of eelgrass polygons for 2024 (available for download by clicking on the 'Export Data' button. A free ArcGIS Online account is required).

   Long Island Sound:
   https://edc.maps.arcgis.com/home/item.html?id=af4ad4c7215a46d29b446f0525209be7

Peconic Estuary:
https://edc.maps.arcgis.com/home/item.html?id=79cc606231e74fa595e91993840a34aa

2. Ortho-photography mosaic from the aerial photo acquisition done for this project.

   Long Island Sound:
   https://edc.maps.arcgis.com/home/item.html?id=f8bd7e5ea2ac4bae83ac390530277e25

   Peconic Estuary:
   https://edc.maps.arcgis.com/home/item.html?id=adb2183f1bf9494293d5d84924ee398c

3. GIS database of underwater video collected during field surveys.

   Long Island Sound:
   https://edc.maps.arcgis.com/home/item.html?id=fea98047ce6949449dba229612d5cc34

   Peconic Estuary:
   https://edc.maps.arcgis.com/home/item.html?id=ca6719bcda564cc7b846746847b66902

4. A web map (app) of eelgrass and underwater video data collected during this project.

   Long Island Sound:
   https://edc.maps.arcgis.com/apps/instant/basic/index.html?appid=5913431678c64ac08e389bc973c7fdb3

   Peconic Estuary:
   https://edc.maps.arcgis.com/apps/instant/basic/index.html?appid=9e5beec5fe3d46e9bca72a622601fbaa

5. A final report on all findings. This report.

6. CONCLUSIONS

Both mapping and monitoring SAV are critical first steps for the conservation, management and restoration of these vital habitats. The total acreage for eelgrass in LIS for 2024 was **2,041.4 acres (826.1 Ha)**. In the Peconic, **800.6 acres (324 Ha),** of SAV were mapped. Eelgrass made up a large portion of this acreage (98% or 785.8 acres). When conducted at regular intervals, change analyses are possible with Tier 1 data. A change analysis between the LIS 2017 and 2024 Tier 1 eelgrass datasets indicated an overall net increase in eelgrass habitat of **473.3 acres (191.5 Ha).** Change analyses provide a guideline for the future activities of managers, scientists, and conservation groups.

Tier 1 assessments are used for regional estimations of SAV acreage and aerial extent. These data are essential for the LISS CCMP and the 'Habitats and Wildlife' mission of the PEP. These data are relatively inexpensive to collect and can be done efficiently even over study areas that are several thousand acres in size. Thus, Tier 1 level mapping projects should be undertaken at consistent intervals (every 3 years) to plan for the persistence of this valuable habitat well into the future.

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