East Marrowstone Island Eelgrass Survey

July 1-2, 2006

by

James G. Norris

Submitted To:

CH2M Hill, Inc.
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PO Box 91500
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July 21, 2006

Marine Resources Consultants

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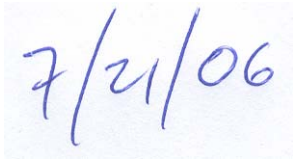

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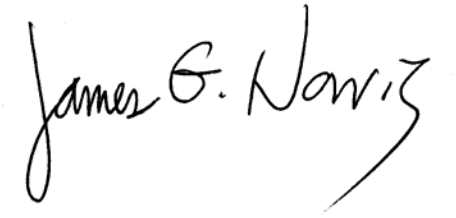

Signature (James G. Norris)

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Introduction

The Jefferson County Public Utility District (PUD) is investigating options for creating a public water system for Marrowstone Island. One option is to build a desalination plant on the island. The PUD hired CH2M Hill, Inc. to conduct a feasibility study for building such a plant. One requirement for the plant is a seawater intake and outfall location with strong currents. The entire eastern shoreline of the island meets this requirement. Piping for the seawater intake and outfall will pass through the environmentally sensitive intertidal region. Of particular concern are possible eelgrass beds (*Zostera marina*), for which the Washington State Department of Fish and Wildlife has a "no net loss" policy. CH2M Hill contracted with Marine Resources Consultants to conduct an eelgrass survey along the eastern shore of Marrowstone Island. The purpose of the survey was to map eelgrass beds in enough detail to evaluate potential locations for the intake and outfall pipes. This survey was not designed to meet the requirements for any permitting process.

Methods

Personnel

We conducted the survey on July 1 and 2, 2006. Table 1 lists the personnel on board the vessel during the survey.

Table 1. Personnel list.

Date	Name	Position
July 1, 2006	Frank Converse	Skipper
	Jim Norris	Chief scientist
	Randy Whitman	CH2M Hill staff
July 2, 2006	Frank Converse	Skipper
	Jim Norris	Chief scientist
	Randy Whitman	CH2M Hill staff

Site Description

The site was defined to be that portion of the Marrowstone Island shoreline lying south of Marrowstone Point, north of Kinney Point, and offshore to a depth of -30 ft Mean Lower Low Water (MLLW). This region contains 12 "fringe" sites defined by the Washington State Department of Natural Resources (DNR) Submerged Vegetation Monitoring Project (SVMP) (Berry et al. 2003; Dowty 2005; Dowty et al. 2005). A fringe site is a 1000 m section of shoreline as measured along the -20 ft isobath.

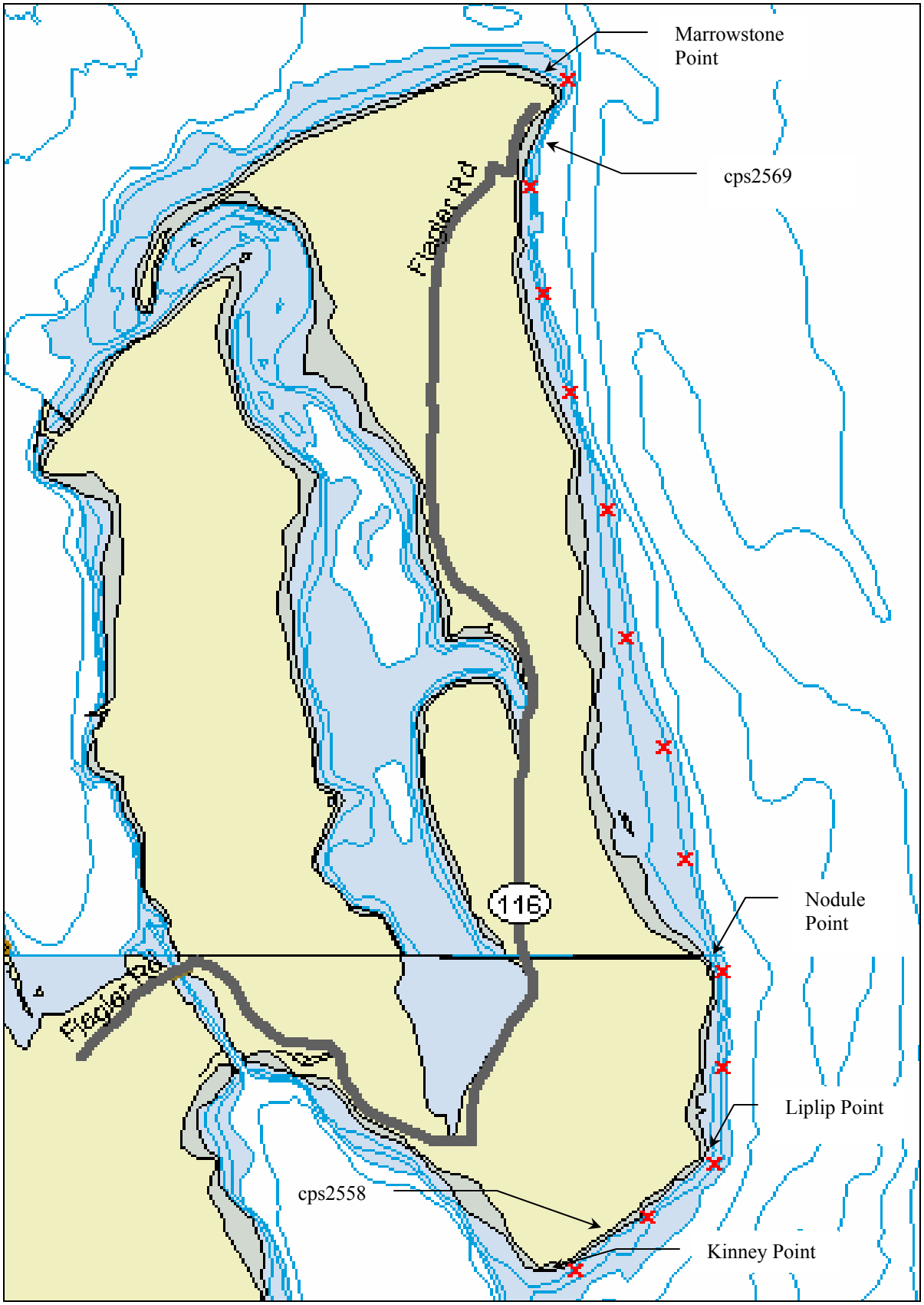

Figure 1. Map of study area showing boundaries of the DNR SVMP fringe sites (red x's).

Sampling Plan

Our sampling plan consisted of three stages: (1) ground-truthing; (2) reconnaissance survey; and (3) site-specific underwater videographic surveys. In Stage 1 we conducted two transects using both underwater videography and the BioSonics echosounder (see Methods section for echosounder description) to ground-truth our identification of eelgrass on echogram.

In Stage 2 we conducted 12 zig-zag transects (one in each of the 12 DNR SVMP fringe sites) using only the BioSonics echosounder and visual observations from the vessel (in shallow water) to identify eelgrass. The advantage of this method over underwater videography is that we were able to survey significantly more shoreline in a given time. The limitations are: (1) less intensive sampling (i.e., greater distance between observations); and (2) we used only the BioSonics echogram to identify eelgrass. However, if we felt uncertain about our interpretation of an echogram, we dropped the underwater video camera for validation.

For Stage 3 CH2M Hill staff selected several locations to be surveyed in detail with underwater videography. The exact location of each transect was determined by the onboard staff scientist. All but on of these transects were oriented perpendicular to the shoreline. The lone exception was oriented perpendicular to the pier at Fort Flagler and thus ran parallel to the shoreline. Table 2 lists these sites and the number of transects conducted.

Table 2. Sites selected for high intensity underwater videographic surveying.

Date	Site	Transects
7/1/06	South Marrowstone	4
	Disney Road	1
	Hoyt Road	4
	Jansen Road	1
7/2/06	Fort Flagler	12
	Pier	5
	North Scwartz Road	19
	South Scwartz Road	6
	Total Transects	52

Survey Equipment and Methods

Vessel

We conducted sampling aboard the 36-ft *R/V Brendan D II* (Fig. 3). We acquired position data using a sub-meter differential global positioning system (DGPS) with the antenna located at the tip of the A-frame used to deploy the camera towfish. Differential corrections were received from the United States Coast Guard public DGPS network using the NAD 83 datum. A laptop computer running Hypack Max hydrographic survey software stored position data, depth data from one echosounder (Garmin), and user-supplied transect information onto its hard drive. Position data were stored in both latitude/longitude and State Plane coordinates (Washington North, US Survey Feet). All data were updated at 1 s intervals. Table 3 lists all the equipment used during this survey.

Figure 2. The *R/V Brendan D II*.

Table 3. Survey equipment used onboard the *R/V Brendan D II* during the East Marrowstone Island Eelgrass Survey.

Item	Manufacturer/Model
Differential GPS	Trimble AgGPS 132 (sub-meter accuracy)
Depth Sounders	BioSonics DE4000 system (including Dell laptop computer with Submerged Aquatic Vegetation software) Garmin FishFinder 250
Underwater Cameras (2)	SplashCam Deep Blue Pro Color (Ocean Systems, Inc.)
Lasers	Deep Sea Power & Light
Navigation Software	Hypack Max
Video Overlay Controller	Intuitive Circuits TimeFrame
DVD Recorder	Sony RDR-GX7
Digital VideoTape Recorder	Sony DVR-TRV310 Digital8 Camcorder

Video Data

We obtained underwater video images using an underwater camera mounted in a down-looking orientation on a heavy towfish. Two parallel red lasers mounted 10 cm apart created two red dots in the video images as a scaling reference. We mounted a second forward looking underwater camera on the towfish to give the winch operator a better view of the seabed. We deployed the towfish directly off the stern of the vessel using the A-frame and winch. Video monitors located in both the pilothouse and the work deck assisted the helmsman and winch operator control the speed and vertical position of the towfish. The weight of the towfish kept the camera positioned directly beneath the DGPS antenna, thus ensuring that the position data accurately reflected the geographic location of the camera. A video overlay controller integrated DGPS data (date, time) and user supplied transect information (transect number and site code) into the video signal. We stored video images directly onto a Sony Digital8 videotape and onto a DVD-R disk.

Depth Data

Our primary depth sounder was a BioSonics DE4000 system. The advantage of this system is its ability to accurately measure distance between the transducer and the seabed, even when the seabed is covered with dense vegetation (e.g., eelgrass and/or macroalgae). Other depth sounders often measure distance only to the top of the vegetation canopy. The BioSonics system does not produce depth readings in real time. Instead, it records on a laptop computer all of the returning raw signals in separate files for individual transects. During

post-processing, individual transect files were combined into larger files and processed through EcoSAV software (part of the BioSonics system). The output was a single text file with time, depth, and position data. These data were then merged with the tide correction data (see sub-section below) to give corrected depths.

Our backup depth sounder was a Garmin FishFinder 250. Although this echosounder provided real-time estimates of depth (which were recorded by the Hypack Max program), it often estimated depth only to the top of the vegetation canopy rather than to the seabed.

For both echosounders, we mounted the portable transducers on poles attached to the starboard (Garmin) and port (BioSonics) corners of the transom. Since the DGPS antenna was mounted along the centerline of the vessel, each transducer was offset 1.5 m from the DGPS antenna. During analysis, we ignored this slight offset and assumed that depth readings from both depth sounders were taken at the location of the DGPS antenna.

Real-time Eelgrass Identification

A custom hand-held toggle switch (or "clicker") and an "add-on" to the Mypack Max program allowed us to display and record eelgrass positions in real time. The vessel's track was displayed in the navigation window as either a thin black line (clicker "off") or a thick green line (clicker "on"). In the stored database, the clicker field was stored as either a 0 (clicker "off") or 1 (clicker "on). The ability to display track lines and eelgrass positions in real time allowed us to adjust the sampling plan for the site specific surveys to best identify any eelgrass bed.

Field Sampling Procedures

For the reconnaissance zig-zag transects, the vessel started at the north end of a DNR SVMP fringe site and proceeded offshore on a heading approximately 45 degrees from the shoreline until eelgrass was no longer expected or detected, and then the vessel turned approximately 90 degrees and headed back toward the shoreline. When the vessel reached the shoreline it turned 90 degrees and proceeded offshore again. This process was repeated until reaching the end of the site. Throughout the transect, the chief scientist monitored the BioSonics echogram while the CH2M Hill staff scientist watched for eelgrass from the work deck. If either scientist observed eelgrass, the clicker was set to the "on" position. In some cases we could see eelgrass between the vessel and the shoreline, but could not maneuver the vessel over the eelgrass due to the shallow depths. In these cases we set the clicker to the "on" position to indicate eelgrass presence along this section of shoreline.

For underwater video transects, the skipper backed the vessel close to the shoreline or pier and the winch operator (chief scientist) lowered the camera to just above the seabed. Visual references were noted and all video recorders and data loggers were started. As the vessel moved along the transect the winch operator raised and lowered the camera towfish to follow the seabed contour. The field of view changed with the height above the bottom. The vessel speed was held as constant as possible (about 1 m/sec). During the transect, the CH2M Hill staff scientist monitored the video images and set the clicker to the "on" position whenever eelgrass was observed. At the end of the transect, we stopped the recorders, retrieved the camera towfish, and moved the vessel to the next sampling position. On one occasion we used a small fluke anchor to collect eelgrass specimens for positive identification. We maintained field notes for each transect (Appendix A).

Underwater Video Data Post-Processing

Data stored on the laptop computer were downloaded and organized into spreadsheet files including blank columns for "video code" and "eelgrass code." We reviewed videotapes in the laboratory to assign video codes (0 = cannot view the seabed; 1 = seabed in view) and eelgrass codes (0 = absent; 1 = present) to each position record.

Tide Heights

We used the BioSonics echosounder to gather bathymetry data. Raw depths collected from the echosounder measure the distance between the seabed and the transducer. We applied three factors to correct these depths to the MLLW vertical datum:

- transducer offset (i.e., distance between the transducer and the water surface);
- predicted tidal height (i.e., predicted distance between the surface and MLLW);
- tide prediction error (i.e., predicted tidal height minus the observed tidal height at a reference station).

Corrected depth equals depth below the transducer plus the transducer offset minus the predicted tidal height plus the tide prediction error. We measured the transducer offsets directly each day. We used the predicted tide heights from the computer program Tides and Currents Pro 3.0; Nobletec Corporation) for the Port Townsend station (station ID 1049; 47 36.20 N; 122 20.20 W). We computed tide prediction errors by comparing the computer program predicted tide heights for the Port Townsend station with actual observed tide heights published by the National Oceanic and Atmospheric Administration on their web site (http://www.co-ops.nos.noaa.gov/data_res.html).

Data Analysis

We merged all data (using time as the common field) into two database files (tab delimited text files) and screened each file for gross errors. We imported position data for vessel track lines and eelgrass observations into AutoCAD and used these data, along with our field notes, to draw polygons around regions where we felt eelgrass was located. Drawing the polygons was a subjective process, and other scientists might draw them differently. We stored AutoCAD files in "dxf" format and imported them into Hypack to create the final illustrations. The resulting maps do not imply that eelgrass formed a continuous bed within each polygon. In some cases the eelgrass beds were quite sparse, and the polygons symbolize the area within which eelgrass plants are located.

Results and Discussion

Fig. 3 shows the transects conducted during all three phases of the survey, and Fig. 4 shows the eelgrass polygons. In general, there is a fringing bed of eelgrass along the entire shoreline, except for the area just south of Marrowstone Point, the immediate vicinity of Nodule Point, and the southern area between Liplip Point and Kinney Point. The largest and most dense bed is located on the broad flat just north of Nodule Point. The remaining beds are, at times, very sparse, as shown in the detail maps (Figs. 5 through 10).

The eelgrass around the Pier also is quite sparse. There appears to be a buried pipe running along the north edge of the Pier. It is covered with a mound of rock that made it too

shallow for us to get the boat over for a good look with the camera. However, it appears that new pipes could be placed along the north edge of the Pier without disturbing any eelgrass.

At the southern portion of the North Scwartz Road site we used a small fluke anchor to collect eelgrass specimens for positive identification. On video these plants appeared to have very narrow leaves, a distinguishing characteristic of surfgrass (*Phyllospaddix* sp). We identified these specimens as generative *Z. marina* plants.

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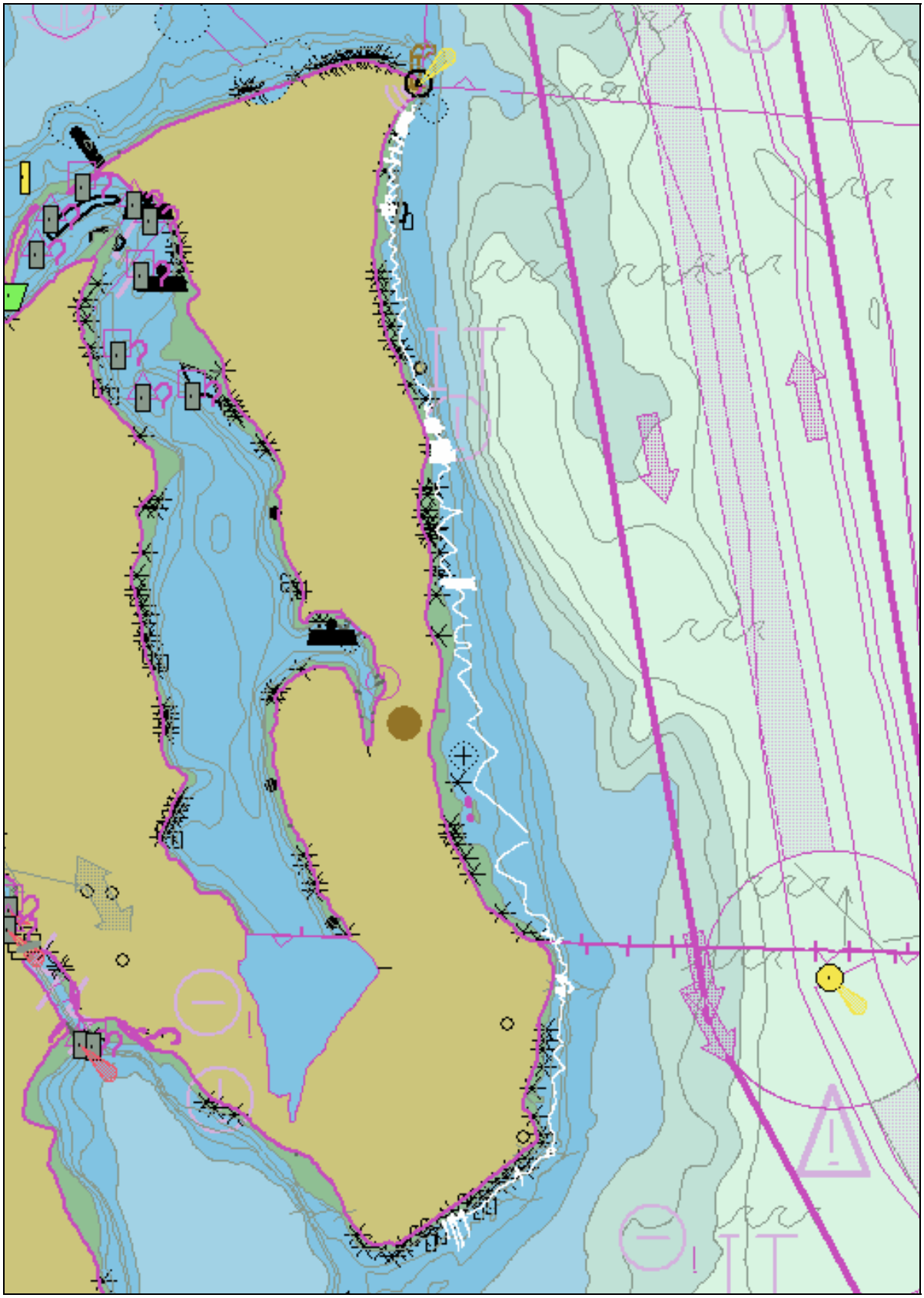

Figure 3. All transects (white lines) conducted during the east Marrowstone Island eelgrass survey on July 1 and 2, 2006.

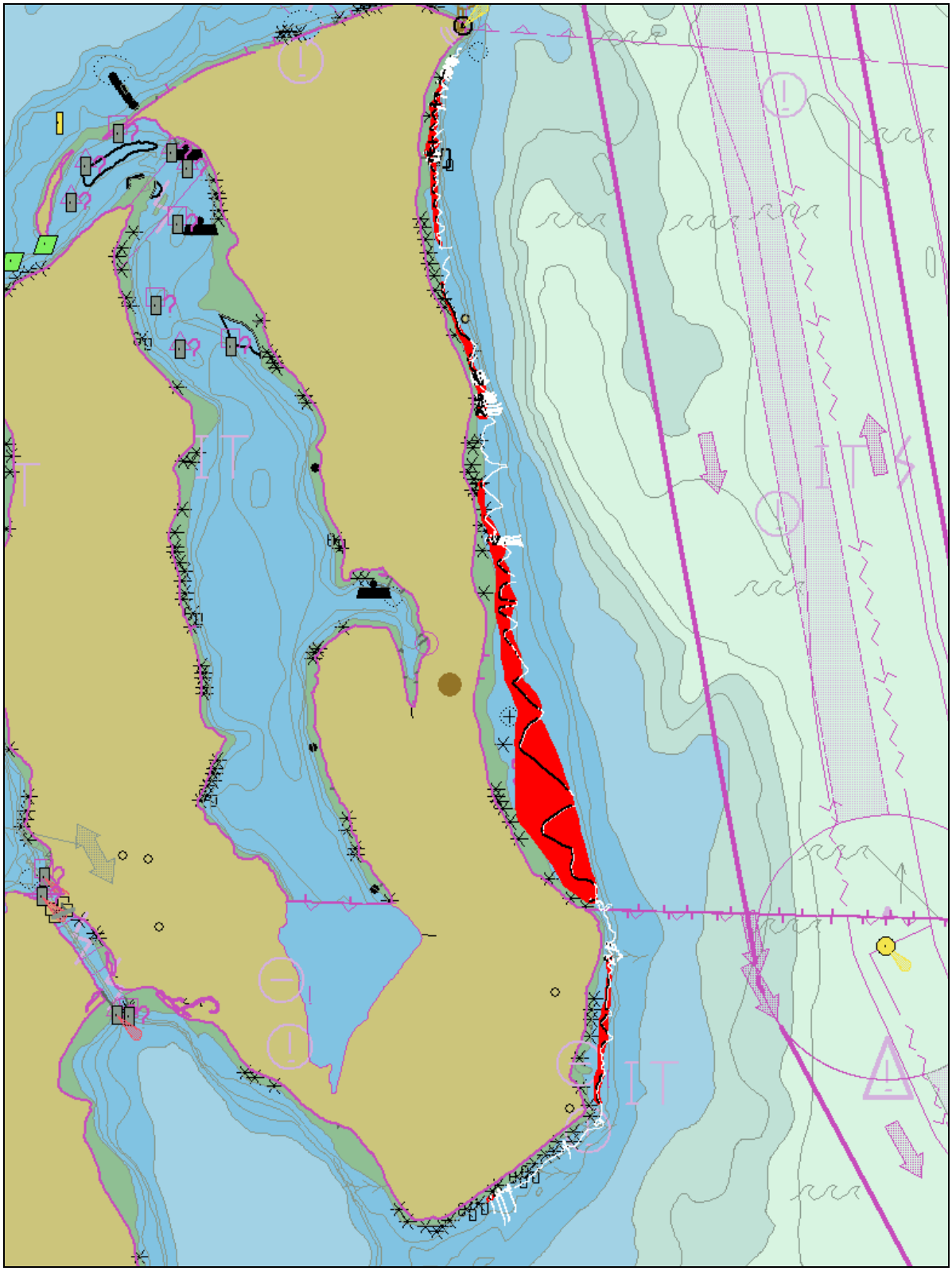

Figure 4. East Marrowstone Island eelgrass bed polygons (shown in red) observed during the July 1 and 2, 2006 survey.

Note: Survey transects are shown in white and eelgrass observations along transects are shown in black.

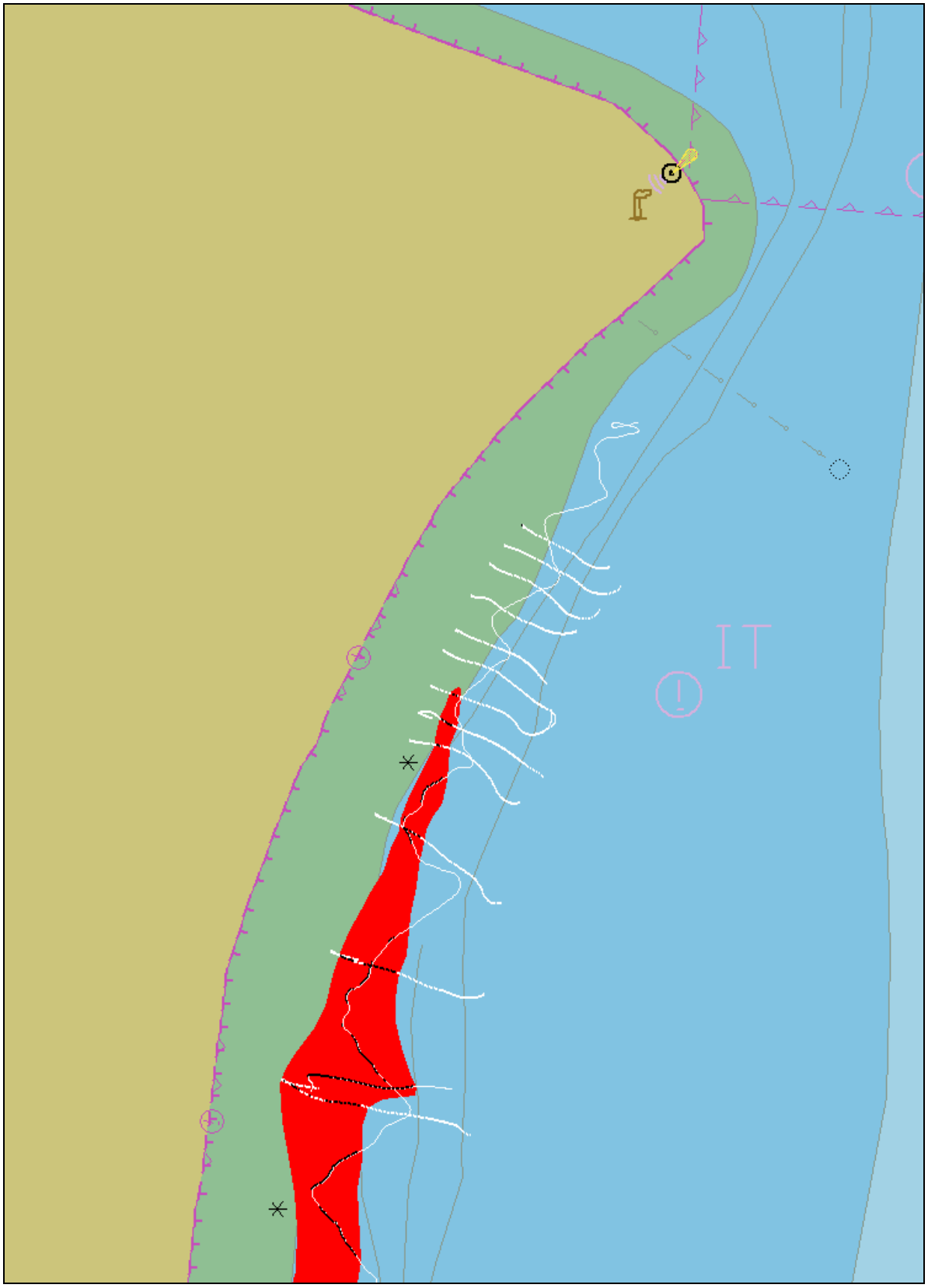

Figure 5. Detail map of eelgrass bed (shown in red) at the Fort Flagler site.

Note: Survey transects are shown in white and eelgrass observations along transects are shown in black.

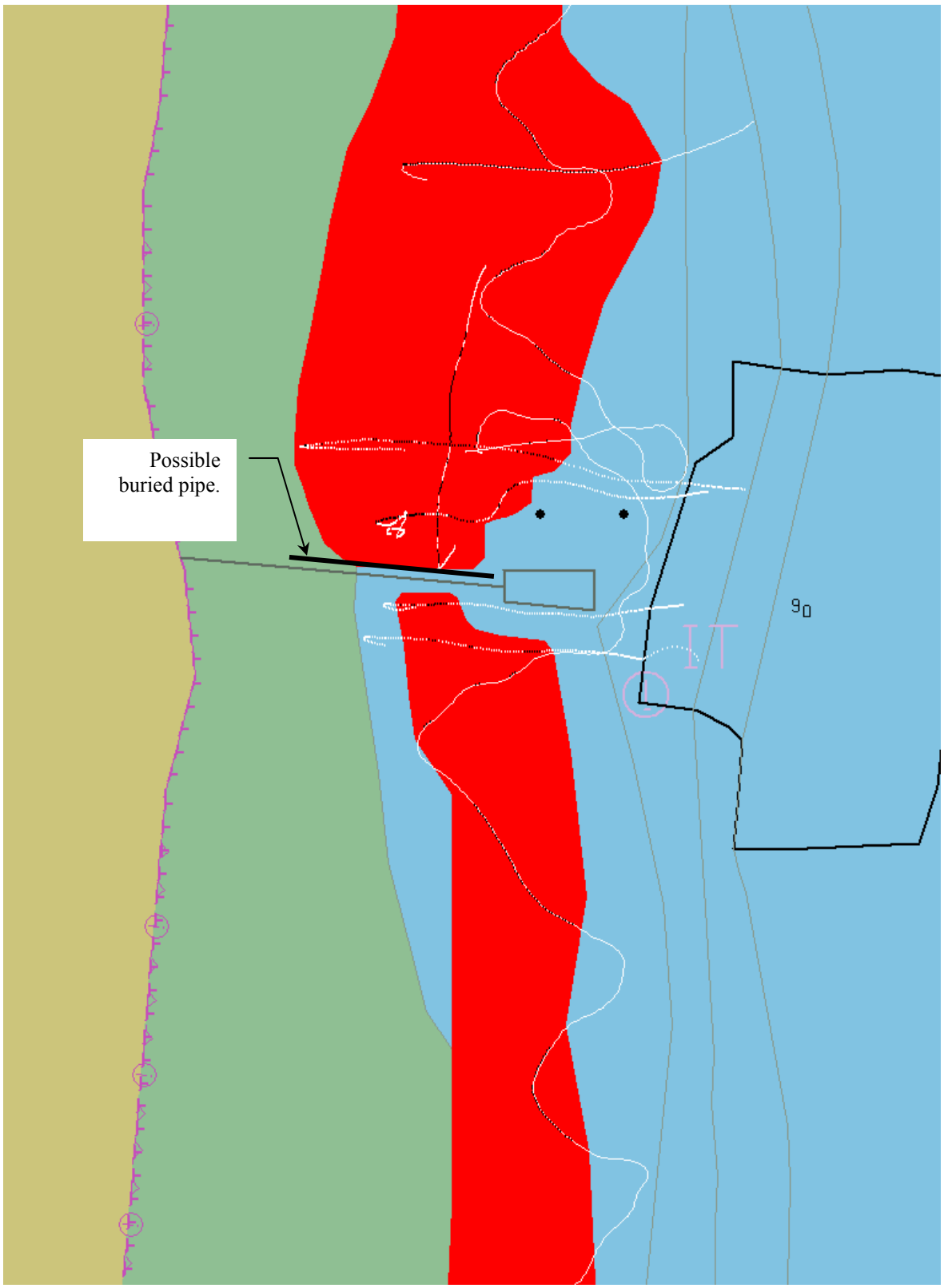

Figure 6. Detail map of eelgrass beds (shown in red) at the Pier site.

Note: Survey transects are shown in white and eelgrass observations along transects are shown in black.

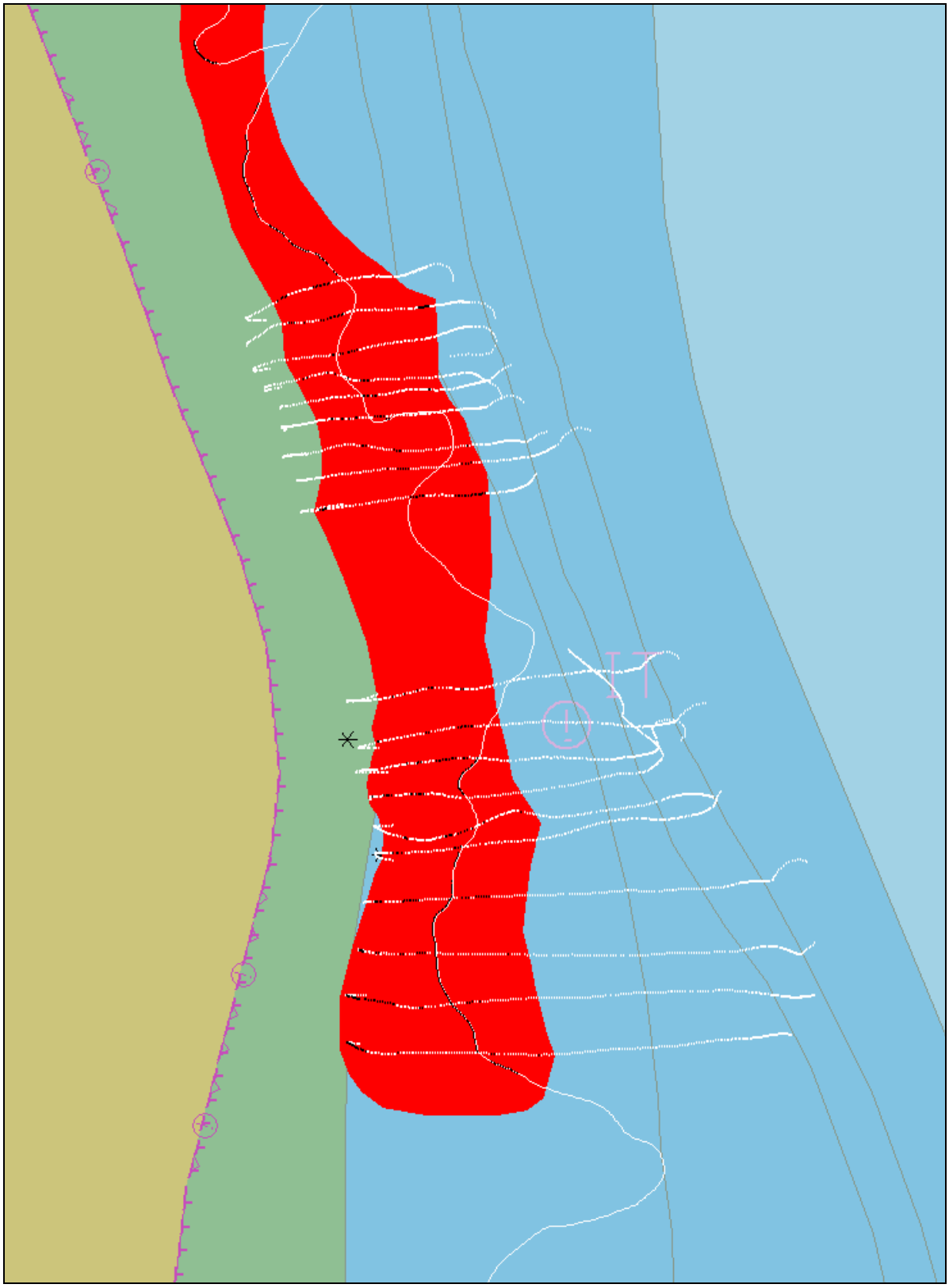

Figure 7. Detail map of eelgrass bed (shown in red) at the North Scwartz Road site.

Note: Survey transects are shown in white and eelgrass observations along transects are shown in black.

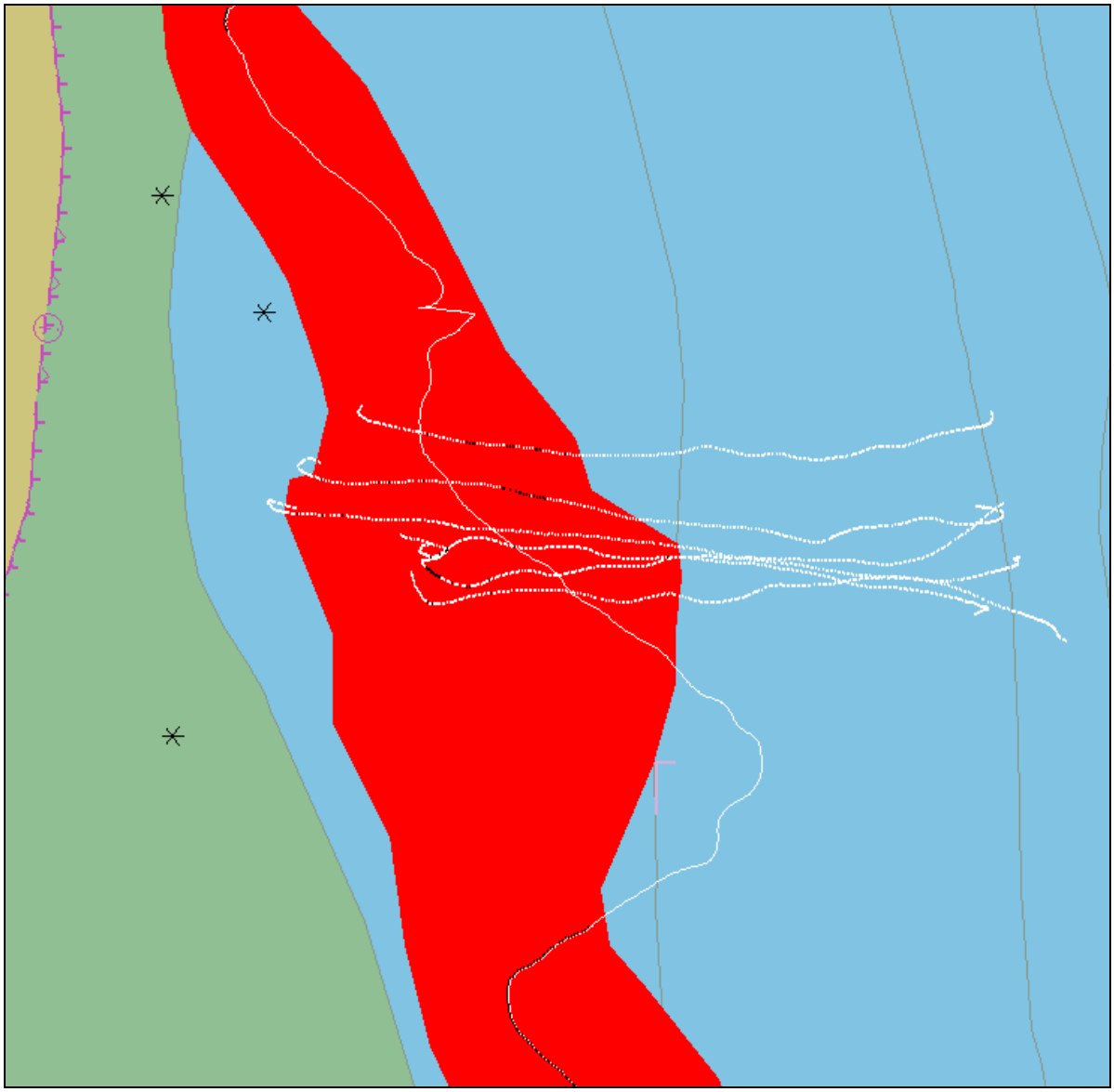

Figure 8. Detail map of eelgrass bed (shown in red) at the South Scwartz Road site.

Note: Survey transects are shown in white and eelgrass observations along transects are shown in black.

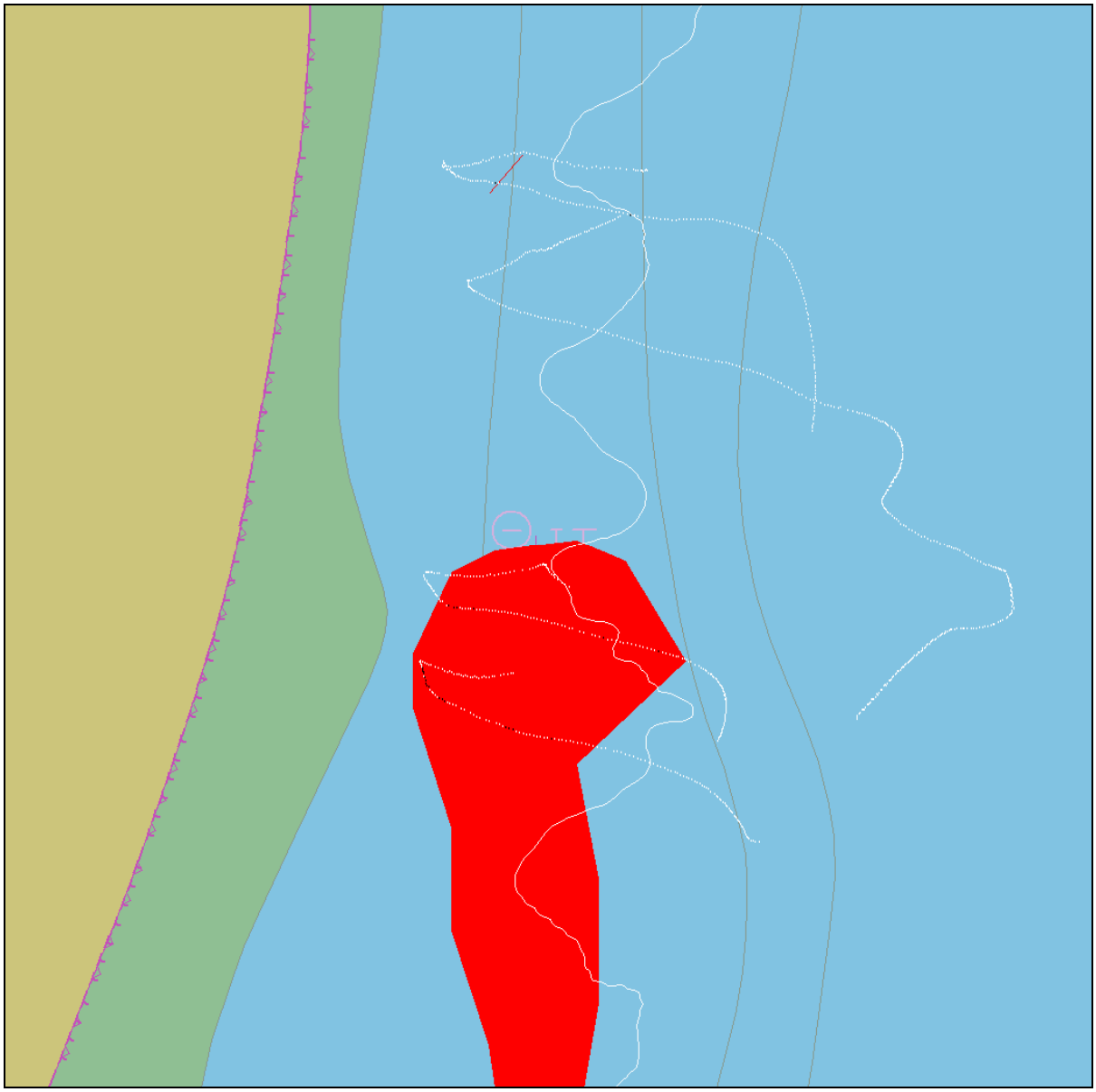

Figure 9. Detail map of eelgrass bed (shown in red) at the Hoyt Road site.

Note: Survey transects are shown in white and eelgrass observations along transects are shown in black.

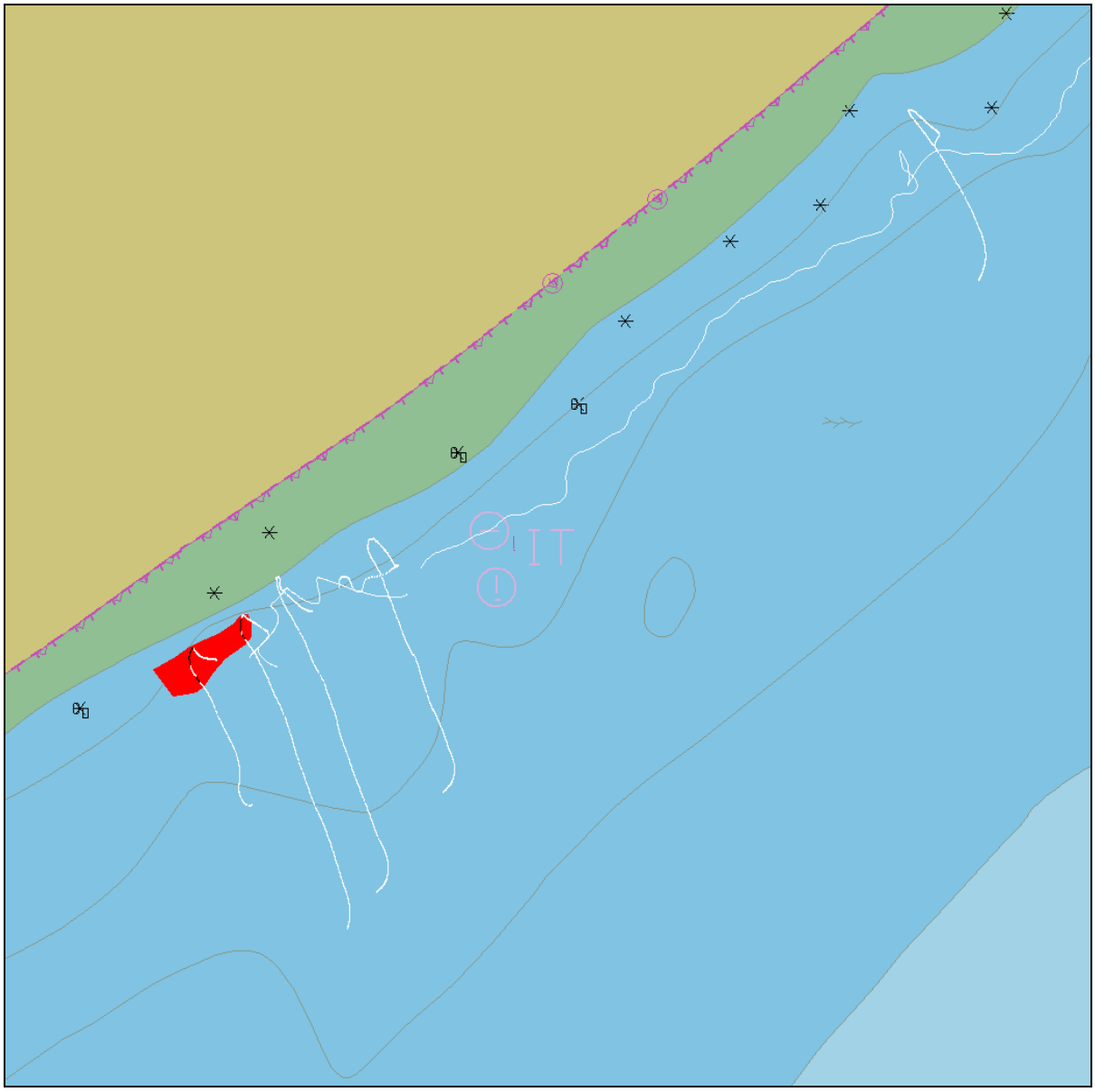

Figure 10. Detail map of eelgrass bed (shown in red) at the South Marrowstone site.

Note: Survey transects are shown in white and eelgrass observations along transects are shown in black.

Appendix A

Field Notes—July 1-2, 2006

Date	Site	Track	Time	Comment
7/1/06				Start two test tracks using both video and sounder to make sure eelgrass shows up well on BioSonics echosounder.
	Ground truth	1	1025	Test track. Grass here and looks good on BioSonics.
	Ground truth	2	1033	Narrow grass bed.
				Start recon survey using only the BioSonics echosounder and direct observations to ID eelgrass.
	cps2569	1	1045	Zig-zag track with BioSonics only (no video). From Marrowstone Point to end of site. No grass on north end. Look like one of the prime sites has no grass. Could not get to nearshore edge of grass—not enough water. Grass is in a fairly narrow fringing bed to about -10 to -15 ft.
	cps2568	1	1108	Zig-zag track with BioSonics only (no video). Went over a spot on north side of dock where there was no grass—may be a spot to get a pipe through. Also looks pretty clear on south side of dock (couldn't get too close now due to strong ebb). We could visual eelgrass patches between the boat and shoreline. Draw eelgrass polygon as a continuous bed. Recorded as cps2569 on Hypack.
	cps2567	1	1139	Zig-zag track with BioSonics only (no video). Looks like a possible break at north end of site (marked on Nobletech). Hypack started late—after the mark. We started running as close to shore as possible, given the low tide height (about +2 ft). We could see eelgrass on starboard side of boat, but not on BioSonics. We put the clicker on—so……eelgrass marks on Hypack are correct, even though BioSonics will not show grass. Grass gets thick again around Craven Rock.
	cps2566	1	1205	Zig-zag track with BioSonics only (no video). Quite a bit of bare shoreline at south end. Some understory kelp.
	cps2565	1	1225	Zig-zag track with BioSonics only (no video). Dropped camera a few times (to ground truth)—algae, not grass. Quite a bite of bare space. Then a grass bed at south end.
	cps2564	1	1251	Zig-zag track with BioSonics only (no video). Pretty big grass bed at north end, near #1 option.

Date	Site	Track	Time	Comment
	cps2563	1	1308	Zig-zag track with BioSonics only (no video). Lots of eelgrass here. Recorded as track 8 on Hypack.
	cps2562	1	1325	Zig-zag track with BioSonics only (no video). Still lots of eelgrass, until the south end. South end has bare spot. Check w/camera tomorrow.
	cps2561	1	1345	Zig-zag track with BioSonics only (no video). Starts at north end—Nodule Point. Looks like kelp close to beach, but too rocky and shallow to get in close enough to see. Right at point there are some vacant lots and no grass (apparently) and lots of current here. Middle of site has some dark patches that we can't get close enough to see.
	cps2560	1	1405	Zig-zag track with BioSonics only (no video). Rocky shoreline. Some dark patches close to shore could not be identified.
	cps2559	1	1421	Zig-zag track with BioSonics only (no video). Rocky shoreline. Hit a rock at 1423. Doesn't appear to be any damage. Seems bare of eelgrass, but can't get a close look at this tide stage. Strong current (back-eddy). Backed into beach near mid-track to check veg patch—looks like *Sargassum*, not grass.
	cps2558	1	1439	Zig-zag track with BioSonics only (no video). Start by backing into beach to check veg patch—kelp (*Sargassum*). Promising site—no grass, low bank, undeveloped lot. Stop track here (ie early). Start setting up for high density video transects at hot spots.
				End of recon survey. Now start video tracks at high intensity sites. Start recording these tracks on the same Dig8 tape and DVD as first two Ground Truth tracks.
	South Marrow	1	1510	Eelgrass at start—just outside kelp.
		2	1516	Recorded as Track01 on video recorders. No grass here.
		3	1530	No grass here. Lots of kelp.
		4	1541	Starts between tracks 1 and 2.
	Disney Road	1	1600	No grass. Garmin was turned off by mistake (no real-time depths).
	Hoyt Road	1	1625	No grass. Wind N15. Seas 1-2 ft.
		2	1635	Small grass patch at start.
		3	1639	More grass here.
		4	1644	No grass—but clicker on accidentally at start (before track started).
	Jansen Road	1	1700	Quite a bit of grass here. Can't go further south due to development—more grass to north. Sooo…abandon this site.

Date	Site	Track	Time	Comment
7/2/06				Start second day. Continue intensive video sampling at hot spots. Start with new Dig8 and DVD.
	Fort Flagler	1	0855	Grass here.
		2	0901	North of #1. Grass here.
		3	0906	North of #2. Grass here, but getting less and less.
		4	0910	North of #3. Grass here, but getting less and less.
		5	0915	North of #4. One clump of grass.
		6	0919	North of #5. No grass.
		7	0924	North of #6. No grass.
		8	0928	North of #7. No grass.
		9	0931	North of #8. No grass.
		10	0936	Between #5 and #6. No grass. No DVD.
		11	0942	Between #5 and #10. No grass. DVD is long.
		12	0945	Between #4 and #5.
	Pier	1	0955	South of Pier. One small patch of grass.
		2	1001	Adjacent to south edge of Pier. A few clumps of grass.
		3	1007	North of Pier. Several grass patches.
		4	1016	Close to Pier. Hit bottom on set-up. Looks like a pipe buried in rock. Several clumps of grass.
		5	1025	Starts at north edge of Pier and goes perpendicular to pier (parallel to shoreline).
				All of the above saved in “Marrowstone5” project folder.
				Start Dig8 tape #3.
	North Scwartz Road	1	1052	North end of site. A few grass patches.
		2	1056	South of #1. A few grass patches.
		3	1102	South of #2. A few grass patches.
		4	1106	South of #3. A few grass patches.
		5	1111	South of #4. A few grass patches.
		6	1117	South of #5. A few grass patches.
		7	1122	South of #6. A few grass patches.
		8	1127	South of #7. A few grass patches.
		9	1133	South of #8. A few grass patches.
		10	1141	South of #9. Starts past some houses.
		11	1148	South of #10. A few grass patches.
		12	1154	South of #11. A few grass patches. Caught crab pot buoy line during haul-back.
		13	1201	South of #12. A few grass patches. Caught crab pot buoy line during haul-back.
		14	1210	South of #13. A few grass patches.
		15	1217	South of #14. A few grass patches.
		16	1225	South of #15. Check first eelgrass observations. Randy thinks it might be *Phylospaddix* (surfgrass).

Date	Site	Track	Time	Comment
				Start Dig8 tape #4.
		17	1236	South of #16. Eelgrass getting thicker. Doesn't look like surfgrass to me. We backed close to beach and used small fluke anchor to get a sample. Turns out these nearshore eelgrass shoots are *Z. marina* generative shoots.
		18	1245	South of #17.
		19	1304	Between #13 and #14. Some grass.
				Note to reviewer: Algae nearshore with light brown stem and darker fronds is *Aleria*.
	South Scwartz Road	1	1321	No grass.
		2	1333	Just north of #1. A few grass patches. No DVD.
		3	1343	North of #2. A few grass patches. No DVD.
		4	1352	South of #1. A few clumps of grass. No DVD.
		5	1402	Between #1 and #4. More grass here. No DVD.
		6	1412	Some grass.