Port Townsend Waterfront Eelgrass Survey
September 5 & 8, 2014

Jefferson MRC

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by

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Submitted To:

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September 12, 2014

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Date **Signature (Ian Fraser)**

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Introduction

The Jefferson County Marine Resources Committee (JCMRC) requested a videographic survey of eelgrass (*Zostera marina*) resources along a portion of the City of Port Townsend waterfront in Port Townsend Bay. The purpose of the survey was to gather pre-project baseline data for submitting state, federal and local permit applications for a Voluntary No-anchor Zone south of the ferry dock. The survey will also be used to compare pre- and post-restoration data collected in the future. A secondary purpose of the survey was to gather post-project data for the established VNZ north of the ferry dock to help evaluate long-term effects of the VNZ efforts.

The area in which this survey was conducted corresponds to a similar survey from 2007. By comparing changes between 2007 and 2014 both within and outside of the current VNZ, it may be possible to compare changes in eelgrass under conditions approximating both treatment and control.

Methods

Personnel

We conducted the survey on September 5 and 8, 2014. Table 1 lists the personnel on board the vessel during the survey.

Table 1. Personnel list.

Date	Name	Position
Sept. 5, 2014	Ryan Charrier	Skipper
	Ian Fraser	Chief scientist
Sept. 8, 2014	Ryan Charrier	Skipper
	Ian Fraser	Chief scientist

Site Description

The study area was defined as the areas from the WA State Ferries dock to the Port of Port Townsend Boat Haven jetty, and from the WA State Ferries dock to the Point Hudson Marina. This general description corresponds to the Washington State Department of Natural Resources (DNR) Submerged Vegetation Monitoring Project (SVMP) (Berry et al. 2003; Dowty 2005; Dowty et al. 2005) 1000m (as measured along the -20ft isobaths) "fringe site" units of CPS2598, CPS2597 and CPS2596. In order to maintain consistency with SVMP protocols, the boundaries of the study site as described by JCRMC were slightly expanded to encompass the entirety of these units.

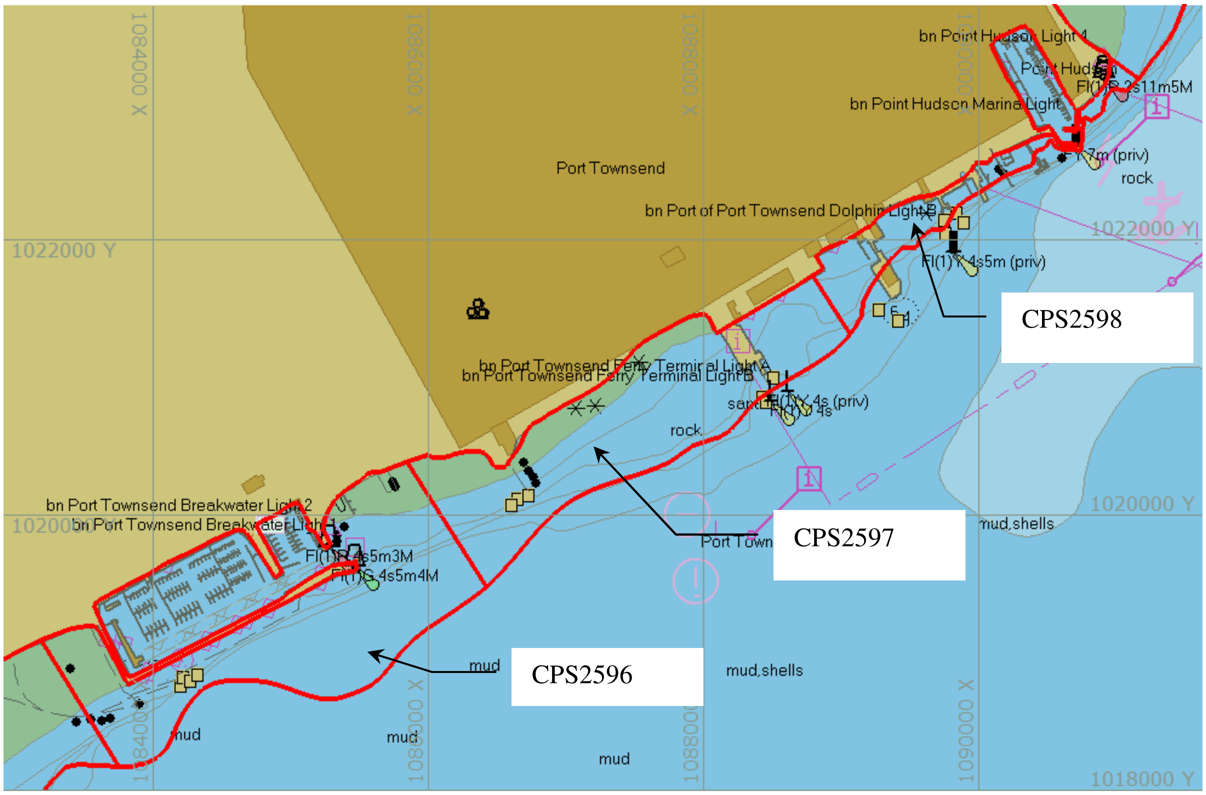

Figure 1. Map of study area showing boundaries of the DNR SVMP fringe sites (in red).

Sampling Plan

DNR SVMP methods for generating statistical estimates of eelgrass parameters require the use of randomly placed transects within each fringe site. Because the boundaries of the SVMP sites do not exactly match up with the delineation of areas of interest for this JCRMC project, we selected transects from the union of all of the above areas. In order to compromise between statistical randomness and even coverage, we selected three sets of 18 systematically spaced transects. Each of the three transect sets were spaced every 495 feet, and started at a random distance between 0 and 495 feet from the southeast end along a line drawn from approximately (48º 6.243'N, 122º 46.737'W) and (48º 7.036'N, 122º 44.899'W).

Because these transects were selected from the wider area, they can be applied to analyses for any subset of the study area not dependent on the transect placement itself.

As with SVMP protocols, all transects were conducted in a straight line approximately perpendicular to the bathymetry gradient, from a point inshore of the shallowest eelgrass out to a depth of approximately -30 ft MLLW, or assuredly beyond the maximum eelgrass depth at that location.

In addition to these transects, we selected two additional sets of systematic random transects with the sub-area between Indian Point and the Port of Port Townsend Boat Haven in order to generate statistical estimates of eelgrass parameters comparable to previous studies conducted over this same area in the 1990s and early 2000s by Marine Resources Consultants and the Port Townsend Marine Science Center.

Nodule

Finally, several meandering and zig-zag transects were conducted in order to further define the extents of various eelgrass beds, and to spot check consistency with eelgrass locations from the 2007 JCMRC eelgrass survey.

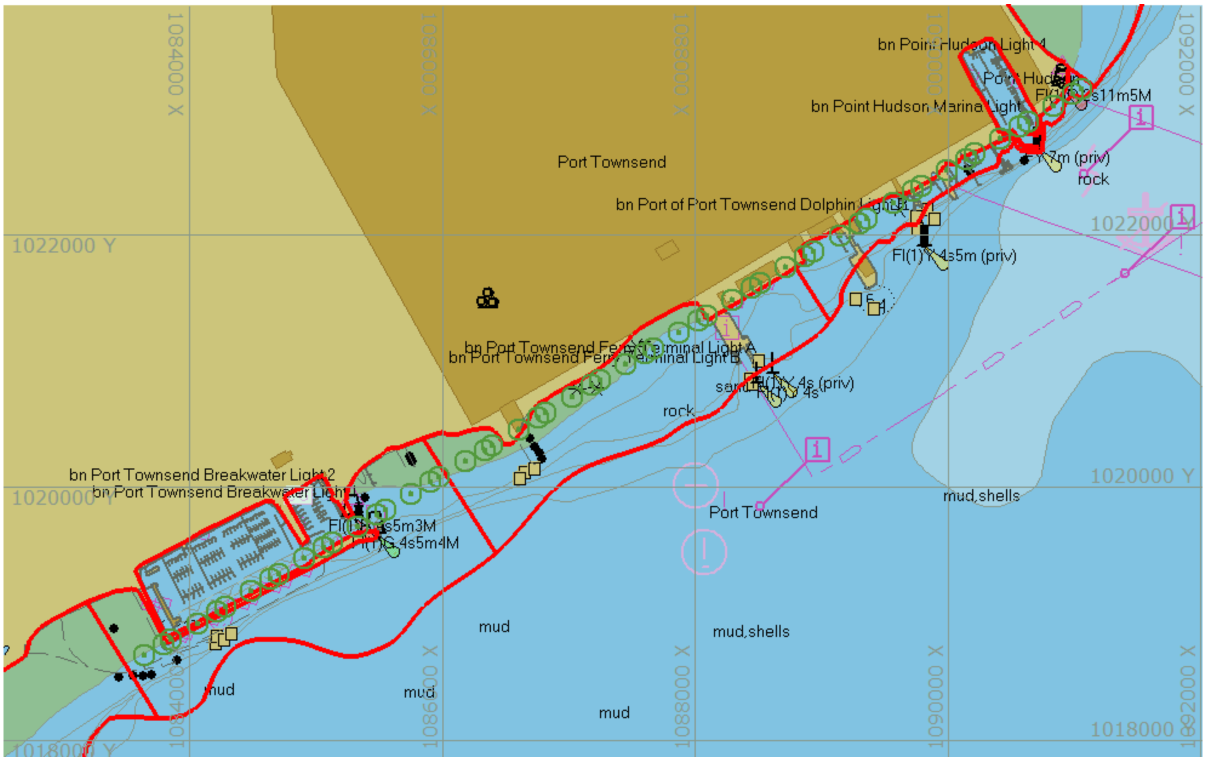

Figure 2. Map of study area showing the three randomly selected sets of 18 systematically placed transects (green circles).

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 WGS84 datum. A laptop computer running Hypack 2012 hydrographic survey software stored time, position and GPS quality data from the DGPS, 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 South, US Survey Feet NAD83 HPGN). All data were updated at 1 s intervals. Table 3 lists all the equipment used during this survey.

Figure 3. The *R/V Brendan D II*.

Table 2. Equipment used onboard the *R/V Brendan D II* during the survey.

Item	Manufacturer/Model
Differential GPS	Trimble AgGPS 124 (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 2012
Video Overlay Controller	Intuitive Circuits TimeFrame
DVD Recorder	Sony VRD-MC6
Digital VideoTape Recorder	Sony GV-D800 Digital8 Video Cassette Recorder
DV Hard Drive Recorder	DataVideo DN-500

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, a DVD-R disk, and to a portable hard drive in .dv format.

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 are combined into larger files and processed through EcoSAV software (part of the BioSonics system). The output is a single text file with time, depth, and position data. These data are 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 2012 program), at times it 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 ignore 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 Hypack 2012 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 orange 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 on the fly to best identify any eelgrass bed.

Field Sampling Procedures

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 skipper 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. We maintained field notes for each transect (Appendix A).

Meandering and zig-zag transects were conducted in a similar manner, though with different geographical and directional references.

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 apply 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 use 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 compute 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 (NOAA) on their web site (http://www.co-ops.nos.noaa.gov/data_res.html).

This process can be applied at any time once the NOAA observed tide heights are published (usually once per month).

Discussion

Initial impressions are of remarkable consistency between the 2007 and 2014 surveys. Over much of the study area there appears to be a possible increase in eelgrass near the shallow edge of the beds, except for perhaps the area between the ferry terminal and Union Wharf. In the area between the ferry terminal and Union Wharf, there appears to be a possible overall loss in eelgrass, particularly on the small off-shore hillocks. These impressions should be checked against the post-processed video from both 2007 and 2014.

In the area near the southeast end of the Port of Port Townsend Boat Haven, where the remains of the old train trestle was completely removed between the 2007 and 2014 surveys, eelgrass has apparently increased. This increase appears to have occurred not just in the area directly under the footprint of the old trestle, but in the immediately surrounding area as well.

It may also be of interest to note that the character of the sediment in the area between Indian Point and the ferry terminal is notably different than most of that found throughout the study area in the potential eelgrass depths. While most of the site is characterized primarily by sand, in the area between Indian Point and the ferry terminal, there are many large patches of much more coarse sediments, rocks and boulders. This corresponds to a greater prevalence of kelpy brown algaes and comparatively fewer patches of eelgrass.

Finally, we would like to note that even at the height of the Wooden Boat Festival, few boats chose to anchor within the VNZ. The least popular area for anchoring appeared to be the area between the ferry terminal and the entrance to the boat haven. In all areas very few boats chose to anchor within the depths supporting eelgrass through the study site.

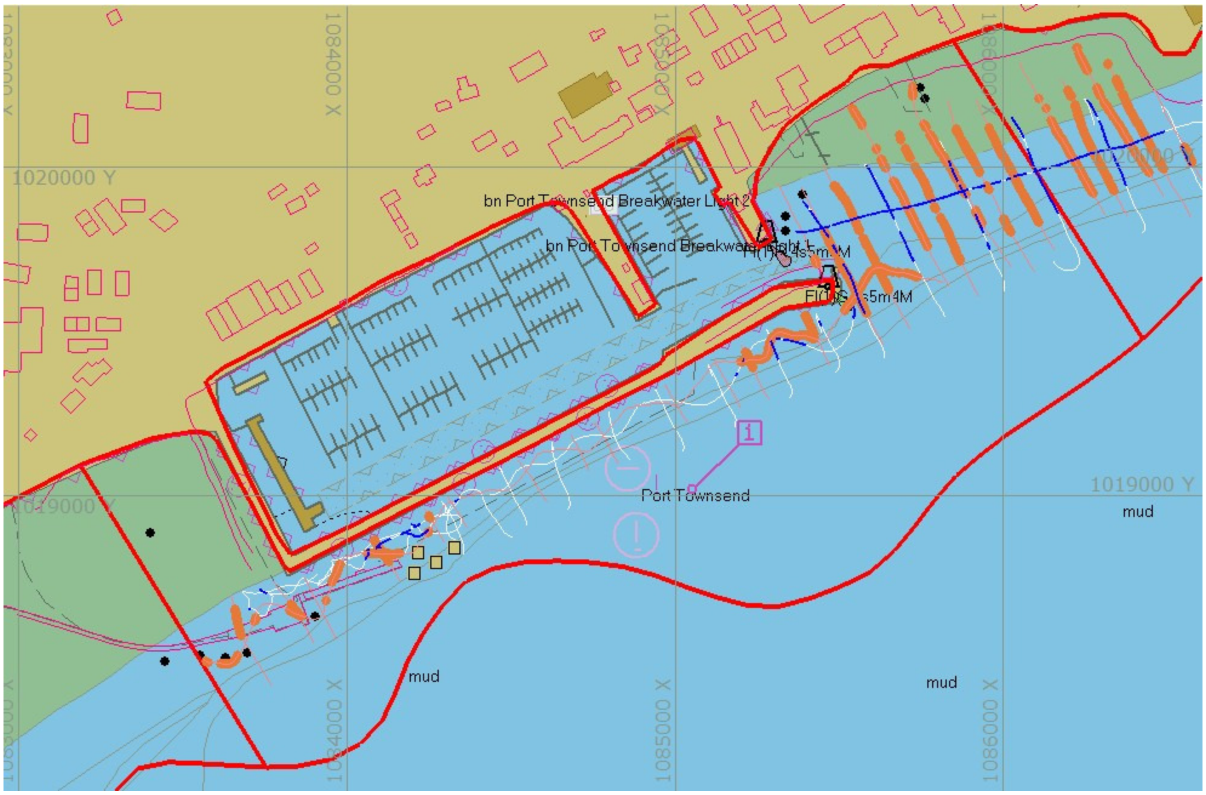

Figure 4. Field map showing transects conducted and associated real-time eelgrass observations in 2007 (white/blue) and 2014 (thin/thick orange) for fringe site CPS2596 near the Port of Port Townsend Boat Haven.

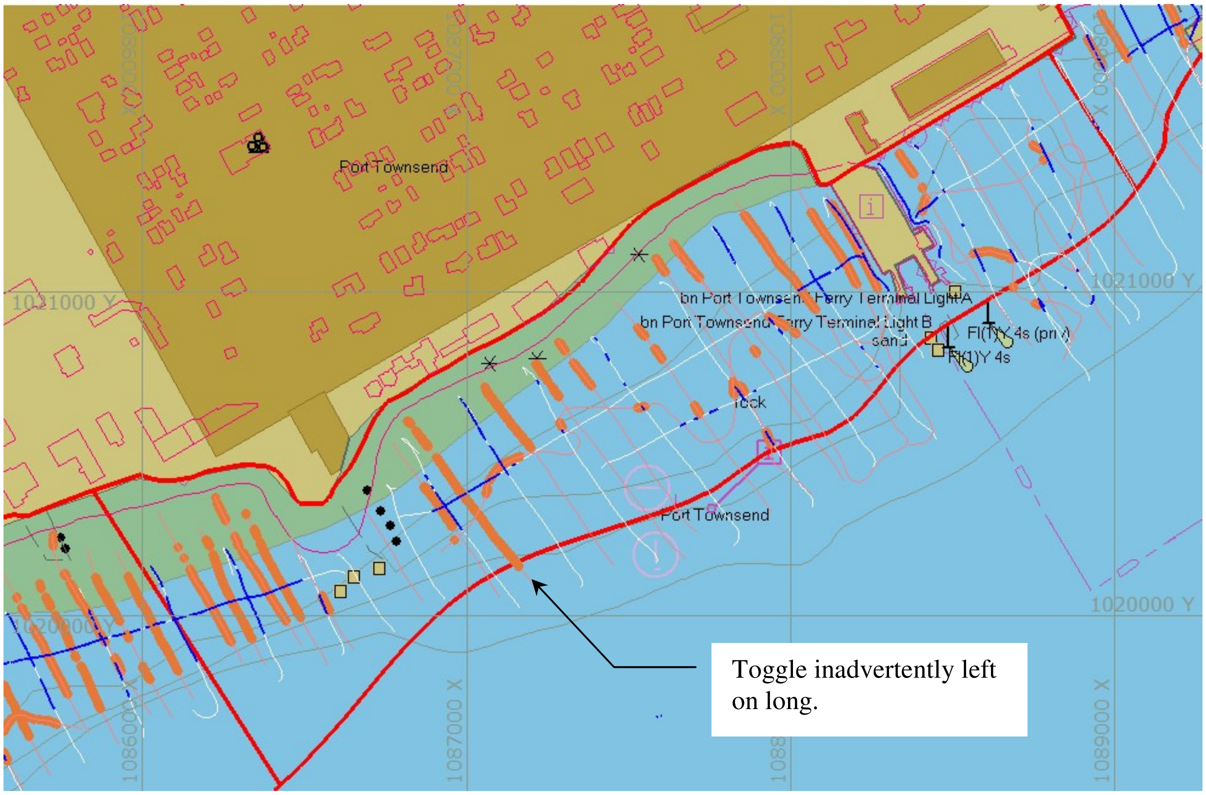

Figure 5. Field map showing transects and associated real-time eelgrass observations conducted in 2007 (white/blue) and 2014 (thin/thick orange) for fringe site CPS2597 near the WA State Ferry terminal.

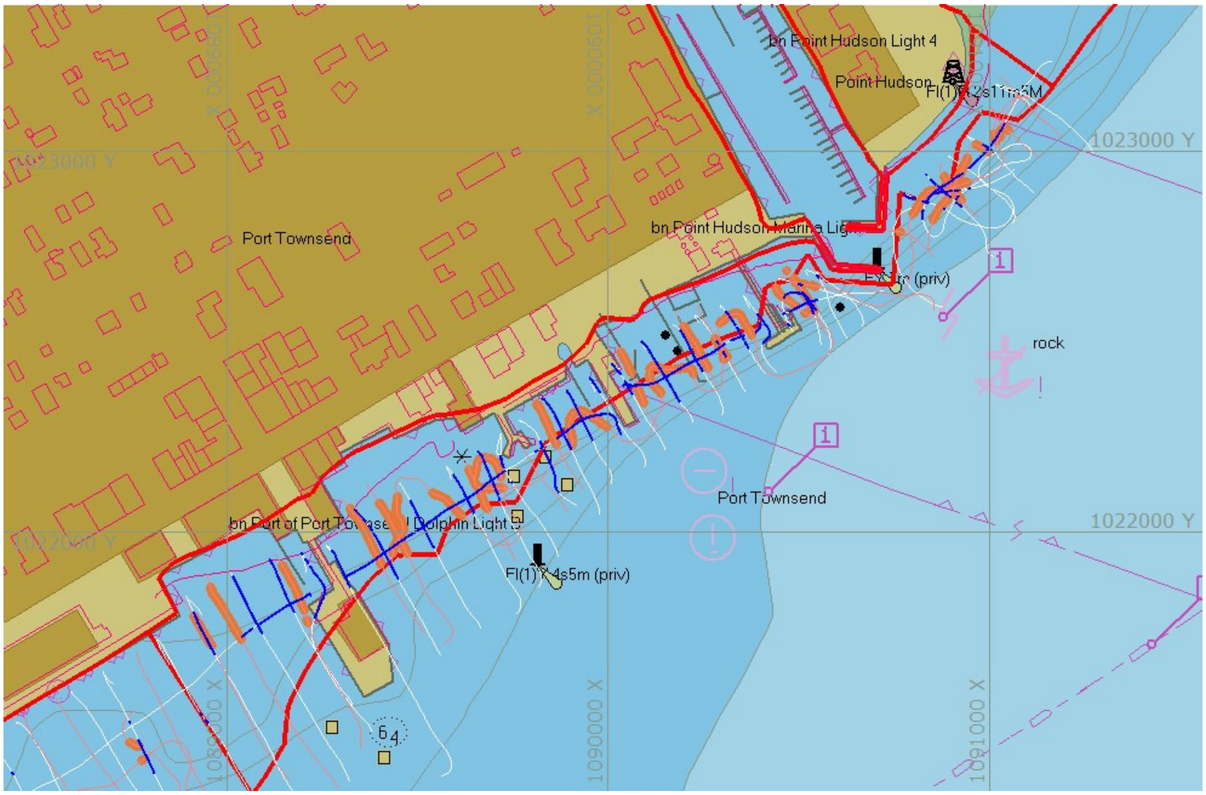

Figure 6. Field map showing transects and associated real-time eelgrass observations conducted in 2007 (white/blue) and 2014 (thin/thick orange) for fringe site CPS2598 near Point Hudson.

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Appendix A

Field Notes—July 1-2, 2006

Date	Track	Time	Comment
			Random systematic tracks
9/5/2014	1	1205	Old train trestle. More grass than expected.
	2	1210	Right @ south end of boat haven. Some ZM. Forgot to advance track # on video
	3	1216	No grass or a few plants near start.
	4	1220	Near end of old trestle. Lots of ZM.
	5	1225	A bit – near the end of trestle dolphins.
	6	1230	No grass.
	7	1235	No grass. Working north on breakwater
	8	1240	No grass.
	9	1242	No grass. Steep off breakwater
	10	1245	No grass.
	11	1250	No grass.
	12	1253	Plentiful grass on downslope consistent with 2007 or increase
	13	1257	As above. Near end of breakwater.
	14	1305	Across mouth of boat haven. Loss of shallow edge grass and increase in deep?
	15	1310	More grass @ shallow edge
	16	1317	Grass patchier—particularly in shallows.
	17	1325	More shallow patches than 2007
	18	1332	Grass less patchy. More shallow patches than 2007. End of CPS2596.
	19	1340	Just south of Indian Point. More shallow patches than 2007.
	20	1348	Similar to 19. Started @ a shallow patch. Maybe some shallower? Couldn't get there.
	21	1355	S. edge of Indian Pt. Consistent with 2007.
	22	1400	Off center of Indian Pt. No grass. More cobble & mixed algae.
	23	1408	N. of Indian Pt. cobble and algae, then grass consistent with 2007
	24	1415	Nearly solid ZM interrupted by brown alg patches. Clicker on long.
	25	1422	Consistent with 2007. Grass ends @ ~-10 ft for unknown reasons.
	26	1430	Consistent with 2007. Grass starts right up in rocks & stops shallower than track 25.

Date	Track	Time	Comment
9/8/14	27	1414	At Point Hudson, just north of marina entrance. No ZM. Plentiful algae.
	28	1420	S. of 27. Some grass. Thin band.
	29	1425	Just N. of entrance. Thicker bed.
	30	1430	At entrance. One clump of ZM.
	31	1437	S. of entrance. No ZM.
	32	1445	Between dolphin & Maritime dock. Solid bed of ZM.
	33	1450	In front of Maritime center launch ramp. Patchy ZM.
	34	1455	Just N. of Pope Park pilings. Solid ZM bed including period obscured by kelp.
	35	1500	Just N. of pope park building dock. Gap about ½ way through the bed.
	36	1505	Off Elevated Park dock. Grass right up to structure. Continuous, but sparse & mixed with brown algaes.
	37	1510	Out old ferry landing. Starts too deep for grass. Lots of debris.
	38	1515	Off Waterman building rock. Grass consistent with 2007. Still piling debris.
	39	1525	Off Nifty 50s. continuous low density ZM.
	40	1530	Off Sirens, against Sea Galley. Denser bed.
	41	1537	S. side of Union Wharf consistent with 2007. Maybe new deep patch.
	42	1545	In front of Waterfront Pizza. Short bed down to -15 ft. Consistent with 2007.
	43	1553	Corner of parking lot. Maybe less ZM than 2007.
	44	1600	Corner of Mercantile building. No ZM.
	45	1610	Center of Mercantile building. No ZM?
	46	1620	South end of Mercantile building. No ZM, even on offshore hillocks.
	47	1627	N. of ferry dock. No grass on previously vegetated offshore hillock area.
	48	1633	S. of ferry dock. Continuous bed along dock.
	49	1640	S. of 48. Similar. Didn't advance track # on vid.
	50	1650	Center of beach. More ZM.
	51	1700	N. of Bayview. Inshore grass & small patch offshore.
	52	1710	N. of bayview. Got a shallower patch than in 2007. Otherwise similar including offshore.
	53	1718	Bayview. Patches of ZM.
	54	1726	Off northernmost condos. Inshore patches only. Started @ rocks & grass.
			Extra random systematic tracks for Indian Point to Boat Haven only.
	55	1740	1st of extra. Got shallowest patch.
	56	1748	OK
	57	1755	3rd. Grass very far inshore. More than 2007. Less @ deep edge?

Date	Track	Time	Comment
	58	1805	4^{th}. Again some very shallow grass missed in 2007.
	59	1810	Last of these. Only grass in channel.
			Meanders to define bed extents.
	60	1820	Meander along breakwater
	61	1840	Meander Indian Pt. to ferry
	62	1900	Meander N. of ferry
	63	1915	Meander north end.