

H12024

NOAA FORM 76-35A

U.S. DEPARTMENT OF COMMERCE  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION  
NATIONAL OCEAN SERVICE

## DESCRIPTIVE REPORT

*Type of Survey* ..... HYDROGRAPHIC

*Field No.* ..... RA-05-02-09

*Registry No.* ..... H12024

### LOCALITY

*State* ..... Washington

*General Locality* ..... Central Puget Sound

*Sublocality* ..... Approaches to Port Madison and Shilshole Bay

.....  
**2009**  
.....

### CHIEF OF PARTY

..... Captain Donald W. Haines, NOAA

### LIBRARY & ARCHIVES

**DATE** .....

U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION		REGISTRY No  <b>H12024</b>
<b>HYDROGRAPHIC TITLE SHEET</b>		
<b>INSTRUCTIONS</b> – The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office.		FIELD No: <b>RA-05-02-09</b>
State <u>Washington</u>		
General Locality <u>Central Puget Sound</u>		
Sub-Locality <u>Approaches to Port Madison and Shilshole Bay</u>		
Scale <u>1:5,000</u> Date of Survey <u>April 8, 2009 - April 22, 2009</u>		
Instructions dated <u>3/10/2009</u> Project No. <u>OPR-N395-RA-09</u>		
Vessel(s) <u>RA1 (1101), RA2 (1103), RA4 (2801), RA5 (2802), RA3 (2803), RA6 (1015)</u>		
Chief of party <u>Captain Donald W. Haines, NOAA</u>		
Surveyed by <u>RAINIER Personnel</u>		
Soundings by <u>Reson SeaBat 7125, Tilted Reson SeaBat 8125, Knudsen 320M</u>		
SAR by <u>Andrew Clos</u> Compilation by <u>Katie Reser</u>		
Soundings compiled in <u>Feet</u>		
REMARKS: <u>All times are UTC. UTM Zone 10N.</u>		
<u>The purpose of this survey is to provide contemporary surveys to update</u>		
<u>National Ocean Service (NOS) nautical charts.</u>		
<u>All separates are filed with the hydrographic data.</u>		
<u>Revisions and end notes in red were generated during office processing.</u>		
<u>Page numbering may be interrupted or non sequential.</u>		

**Descriptive Report to Accompany Hydrographic Survey H12024**

Project OPR-N395-RA-09  
 Central Puget Sound, Washington  
 Approaches to Port Madison and Shilshole Bay  
 Scale 1:5,000  
 April 2009  
**NOAA Ship *Rainier* (s221)**  
 Chief of Party: Captain Donald W. Haines, NOAA

**A. AREA SURVEYED**

This hydrographic survey was completed as specified by Hydrographic Survey Project Instructions OPR-N395-RA-09 dated March 2009 and all other applicable direction<sup>1</sup>, with the exception of deviations noted in this report. The survey area is the Approaches to Port Madison and Shilshole Bay, Washington, and corresponds to sheet “A” in the sheet layout provided with the Project Instructions. OPR-N395-RA-09 responds to a request from the Puget Sound Pilots Association.

Complete multibeam echosounder (MBES) coverage was achieved in the survey area in waters 8 meters and deeper. In depths less than 8 meters additional MBES coverage was acquired to identify least depths over significant features or shoals, as appropriate for this survey. Additional multibeam coverage was achieved in water depths between 8 m and 4 m that meet or exceed the project instruction requirements. Total mileage acquired by each vessel and system is reference in Table 1.

Data Acquisition Type	Hull Number with Mileage (nm)						Total
	1101	1103	2803	2801	2802	2804	
VBES (main scheme)	-	9.5	-	-	-	-	9.5
MBES (main scheme)	13.5	-	70.8	34.4	24.2	97.7	236.6
SSS (main scheme)	-	-	-	-	-	-	-
PDBS (Testing)	-	-	-	-	-	-	-
Crosslines	-	-	14.0	-	-	7.6	21.5
Developments	-	-	-	-	-	-	-
Shoreline	-	-	-	-	-	-	-
Bottom Samples	-	-	-	-	-	-	-
Total Number of Items Investigated	-	-	-	-	-	-	0
Total Area Surveyed (sq. nm)	-	-	-	-	-	-	18.1

**Table 1: Statistics for survey H12024**

Limited Shoreline Verification was performed for the survey area seaward of the Navigable Area Limit Line (NALL) for H12024, as per section 3.5.5 of the Field Procedures Manual April, 2009 (FPM). Shoreline features were given S-57 attribution and included for submission in Notebook .hob files.

1. NOS Hydrographic Surveys Specifications and Deliverables (April 2009), OCS Field Procedures Manual for Hydrographic Surveying (April 2009), and all Hydrographic Surveys Technical Directives issued through April 2009.

The area inside the breakwater of Shilshole Marina was not fully addressed. Limited multibeam coverage was acquired along the breakwater and major pier faces, but complete multibeam coverage and shoreline verification was not obtained due to time and maneuverability constraints within the marina.

Data acquisition was conducted from April 8 to April 22, 2009 (DN 098 to 112).

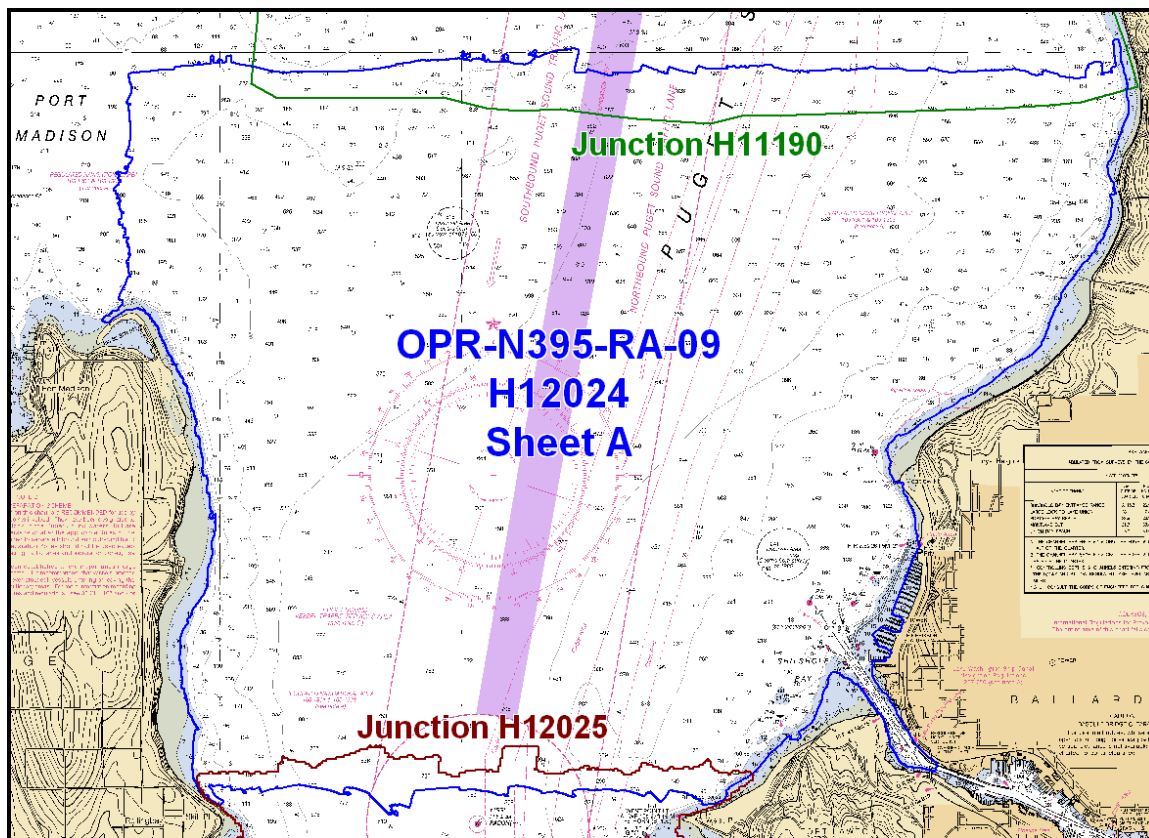


Figure 1: H12024 Survey Outline and Junctions overlaid on Chart 18447

## B. DATA ACQUISITION AND PROCESSING

A complete description of data acquisition and processing systems, survey vessels, quality control procedures and data processing methods can be found in the *OPR-N395-RA-09 Data Acquisition and Processing Report (DAPR)*<sup>1</sup>, submitted under separate cover. Items specific to this survey, and any deviations from the DAPR are discussed in the following sections.

Final Approved Water Levels have been applied to this survey. See Section C. for additional information.

### B.1. Equipment and Vessels

Data for this survey were acquired by the following vessels:

Hull Number	Name	Length (ft)	Draft (ft)	Acquisition Type
1101	RA-1	29	2	Reson 8125 Multibeam Echosounder
1103	RA-2	29	2	Knudsen 320M Vertical Beam Echosounder Detached Positions
2803	RA-3	29	3.5	Reson 7125 Multibeam Echosounder
2801	RA-4	29	3.5	Reson 7125 Multibeam Echosounder
2802	RA-5	29	3.5	Reson 7125 Multibeam Echosounder
2804	RA-6	29	3.5	Reson 7125 Multibeam Echosounder

**Table 2. Data acquisition vessels and systems for H12024.**

Sound speed profiles were measured in accordance with the Specifications and Deliverables using SEACAT 19+ profilers.

Multibeam vessel navigation and attitude data were measured and recorded using Applanix POS/MV 320 systems, versions 4. Vertical beam echosounder navigation and attitude data were measured using a TSS MAHRS system.

A complete description of survey vessels, hardware, and software systems is included in the *OPR-N395-RA-09 DAPR*.

No unusual vessel configurations were used for data acquisition.

## **B.2. Quality Control**

### **B.2.a. Crosslines**

Multibeam Echosounder (MBES) crosslines totaled 21.55 nautical miles, comprising 9.10% of main scheme MBES hydrography. The mainscheme bathymetry was manually compared to the XL nadir beams in Caris subset mode and generally agreed with no discernable offset.<sup>2</sup> However the cross line 904\_2103 run by 2803 (RA-3) on April 16, 2009 (DN 106) showed differences from main scheme lines of up to 0.5-meters in water depths greater than 200 meters. These offsets appear to be the result of tidal correctors, which are discussed in further detail in section B.2.e.

A statistical Quality Control Report has been conducted on representative data acquired with each system used on this survey. Results of these tests are included in the updated 2009 *Rainier* Hydrographic System Readiness Review package submitted with this survey.

### **B.2.b. Final Uncertainty**

Uncertainty values of submitted, finalized grids are calculated in Caris using the “Greater of the Two” of total propagated uncertainty and standard deviation (scaled to 95%). The Uncertainty of all finalized grids fall below the IHO levels as described in the NOS Specifications and Deliverables. This was checked by creating an “IHO-ness” attribute layer under each of the finalized base surfaces in Caris HIPS.

**B.2.c. Junctions**

Survey H12024 junctions with survey H12025, which is Sheet B of the same project, and survey H11190.<sup>3</sup> The sheet limits and area of overlap can be seen in Figure 1.

<b>Junction Survey</b>	<b>Survey Scale</b>	<b>Date of Survey</b>	<b>Survey Location</b>
H11190	1:10,000	2002	North
H12025	1:5,000	2009	South

**Table 3: Junction Surveys**

No data for H11190 were provided for junction comparison and therefore no junction comparison was completed between H12024 and H11190.

Survey H12025 was completed concurrently with survey H12024 during project OPR-N395-RA-09. H12024 finalized combined 8 meter BASE surfaces were compared to the finalized combined 8 meter junction surface in Caris HIPS. Agreement was good with slight discernable offsets in the common area.<sup>4</sup> Differences are less than 1 meter, with most being less than 0.3 meters, in the area of overlap with soundings from H12024 generally shoaler than those from H12025. Only isolated occurrences of offsets up to 1.0-meter were evident and all occurred in water depths greater than 100 meters. Offsets appear to be the result of tidal corrector errors and that are noted throughout the data from H12024 and discussed in greater detail in section B.2.e.

**B.2.d. Quality Control Checks**

MBES quality control checks were conducted as discussed in the quality control section B of the DAPR.

**B.2.e. Data Quality Factors**

Data from H12024 exhibited vertical offsets throughout the survey area, which were attributed to tide modeling error.<sup>5</sup> Data from 2803 (RA-3) on April 16, 2009 (DN 106) had varying vertical offset from surrounding data with a maximum offset of 0.5-meters being evident in approximately 30-meters water depth, as shown in Figure 2. Data from 2804 (RA-6) exhibited similar varying offsets on April 11, 2009 (DN 101) with a maximum offset of approximately 0.2-meters evident in roughly 30-meters water depth, as shown in Figure 3. The varying nature of the offset leads to the conclusion that the vertical offset is largely due to tide error. Data from both 2803 (RA-3) and 2804 (RA-6) on these days show vertical offset between data acquired at different times of the day. Specifically, the greatest offset is evident in 2803 (RA-3) data between roughly 15:49 to 16:50 UTC with data from later in the day correlating with surrounding data better. Similarly, the greatest offsets in 2804 (RA-6) data are evident prior to 17:00 UTC with data from later in the day correlating with surrounding data better.

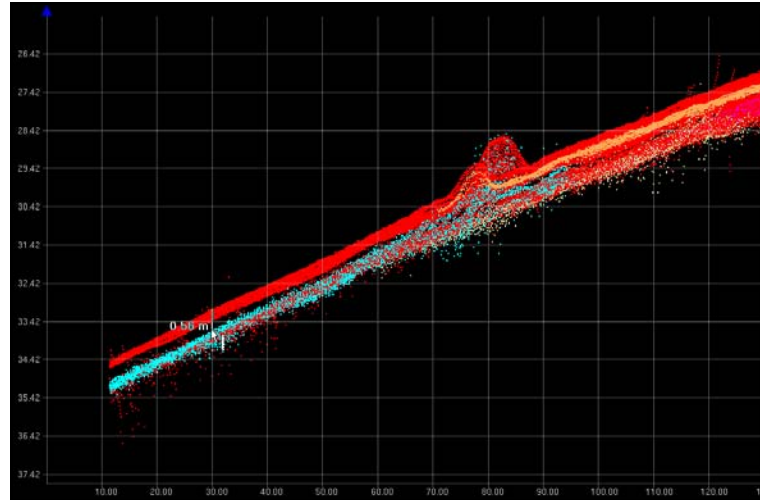


Figure 2: 0.55-meter offset of 2803 data South of Shilshole

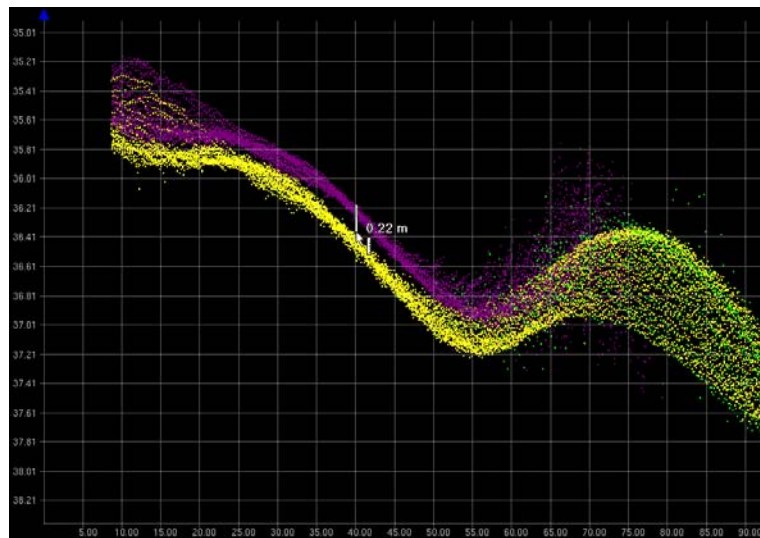


Figure 3: 0.2-meter offset of 2843 data North of Bainbridge Island

### B.2.f. Object Detection and Coverage Assessment

For holidays larger than 3 nodes across, the corresponding multibeam backscatter side scan was examined and no navigationally significant items were found; additionally, the least depths were represented.<sup>6</sup> Such holidays have been noted in the data in the following positions; 7 approximate 6 node holidays at 47° 41.00' N 122° 24.60' W, 4 approximate 6 node holidays at 47° 40.70' N 122° 24.90' W, 1 approximate 5 node holiday and three 2 node holidays at 47° 40.50' N 122° 25.10' W, and 1 approximate 5 node holiday at 47° 40.13' N 122° 25.72' W.

In the area just north of Meadow Point in approximate position 47° 41.9' N 122° 24.4' W there are a group of holidays, the largest of which is roughly 20 meters by 35 meters. A holiday line was run over these holidays, but the line had bad navigation and was rejected, however the line showed no features in the holiday areas.<sup>7</sup>

**B.2.g. Unusual Conditions**

No unusual conditions were encountered during the survey that affected the expected accuracy and quality of survey data.

**B.3. Corrections to Echo soundings**

Data reduction procedures for survey H12024 conform to those detailed in the *OPR-N395-RA-09 DAPR*.

**B.4. Data Processing**

Data processing procedures for survey H12024 conform to those detailed in the DAPR. Data were processed initially using Caris HIPS & SIPS v6.1, Service Pack 2, and Hotfix 7. During the course of survey processing computer systems processing and finalizing data for submission were updated to Caris HIPS & SIPS v6.1, Service Pack 2, and Hotfix 8. Additional processing details regarding Total Propagated Uncertainty (TPU/TPE) and CUBE Surfaces and Parameters utilized, along with any the deviations from the processing procedures outlined in the DAPR are discussed below.

**TPU VALUES:**

The survey specific parameters used to compute Caris TPU for H12024 are listed in Table 4.

<b>Tide values:</b>	Measured	0.01 m	Zoning	0.0 m
<b>Sound Speed Values:</b>	Measured	0.50 m/s	Surface	As per DAPR

**Table 4: Survey Specific Caris TPU Parameters**

Many BASE surfaces were used in processing H12024. Final BASE surface resolutions and depth ranges were set according to Table 5 below, with field sheets smaller than  $25 \times 10^6$  nodes as shown in Figures 4 and 5. CUBE surfaces were processed with a parameter set corresponding to each resolution as per HTD 2009-2. The CUBE parameter XML file is included with the data deliverables. The submission Field Sheet and BASE Surface structure are shown in figures 9, 10, and 11.

<b>Depth Range (m)</b>	<b>Resolution (m)</b>
0-23	1
20-52	2
46-115	4
103-350	8

**Table 5: Depth range and surface resolutions for H12024**

In areas where multibeam data was acquired on charted cultural features (pilings, piers, etc) that were above MLLW, all data were rejected on the feature itself to more accurately represent the seafloor below these features.



Soundings were generated in Caris HIPS from the final combined BASE surface for field unit review purposes. They are included for reference only and are not intended as a deliverable.

Data collected by launches 1101 (RA-1) and 2804 (RA-6) on April 9, 2009 (DN 099) showed a one second timing error after attitude and navigation data from the processed SBET file was applied. To correct for this timing error the HVF files for these vessels were modified to reflect the one second timing offset for only April 9 (DN 099) and the lines were remerged. No explanation for this timing offset has been determined and it has not been seen in subsequent acquisition.

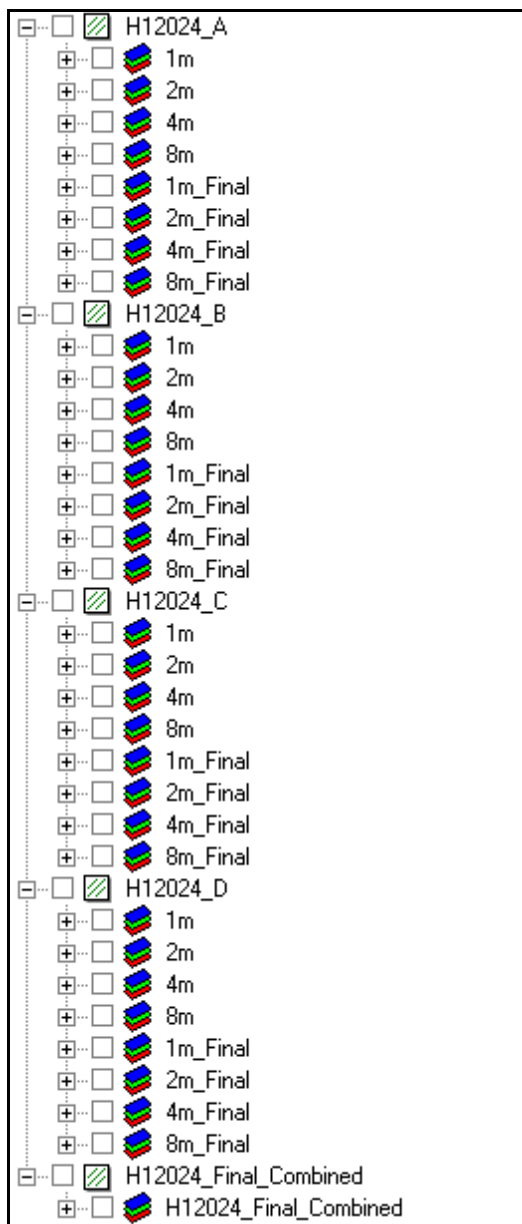


Figure 4: Field sheets and BASE surfaces submitted with H12024.

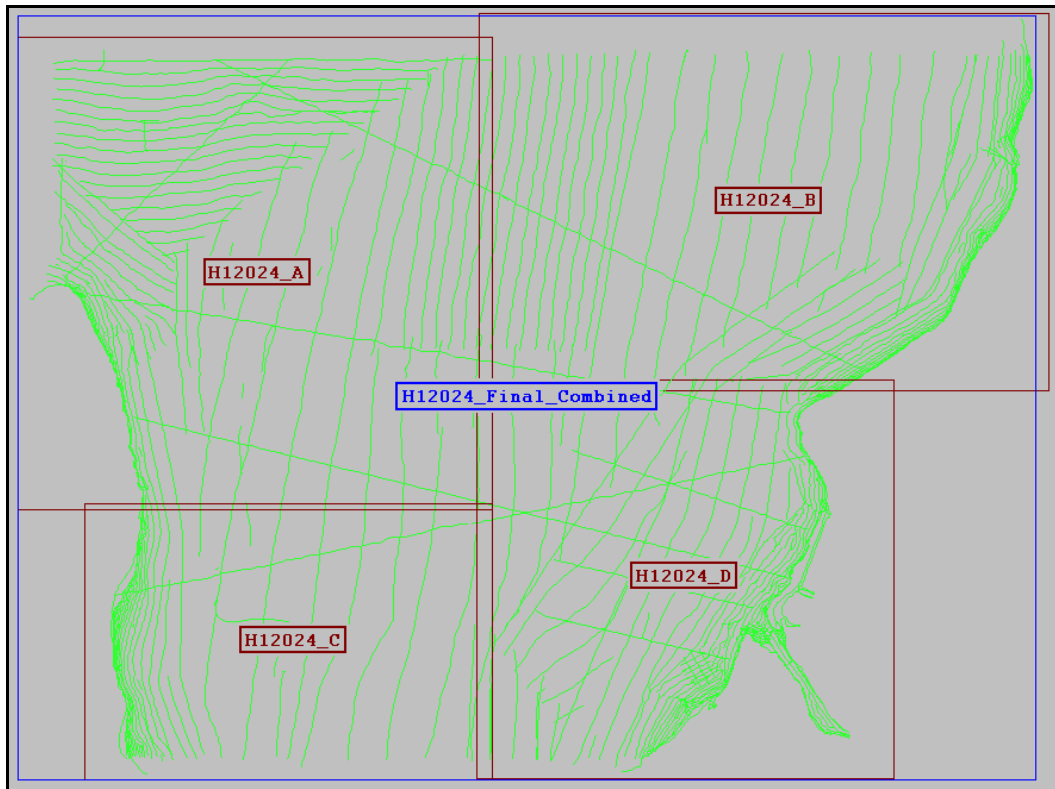


Figure 5: H12024 Field Sheet Layout (excluding VBES).

## C. VERTICAL AND HORIZONTAL CONTROL

Project OPR-N395-RA-09 did not require static GPS observations or other horizontal control work, and all tide corrections were generated from CO-OPS maintained tide stations. Thus, no Horizontal and Vertical Control Report will be submitted.

### C.1. Horizontal Control

The horizontal datum for this project is the North American Datum of 1983 (NAD83). Differential GPS (DGPS) was the sole method of positioning. The differential corrector beacons utilized for this survey are given in Table 6.

Sheet H12024 was selected as the survey in support of the ellipsoidal referenced survey (ERS) testing. In conjunction with this project a GPS base station was established at the NOAA Sand Point facility by HSTP personnel. This data is not part of the submission package, but will be used by HSD and HSTP to analyze ERS results in comparison to traditionally tidally corrected survey data.

Applanix POSPac software was used to produce a smoothed best estimate of trajectory (SBET) file that contained GPS altitudes based on the NAD83 ellipsoid. The SBET was created using a SmartBase generated by POSPac using surrounding Continually Operated Reference Stations (CORS). The SEAT site (47° 39.24' N 122° 18.57' W) was used as the control and primary station and all coordinates were adjusted to NAD83 from ITRF00. The

SBET navigation and attitudes were loaded to all lines in Caris HIPS, note that GPS tides were not applied to the data nor were vertical correctors loaded.

Location	Frequency	Operator	Priority
Robinson Point	323 kHz	USCG	Primary
Whidbey Island	302 kHz	USCG	Secondary

**Table 6: Differential Corrector Sources for H12024.**

## C.2. Vertical Control

The vertical datum for this project is Mean Lower-Low Water (MLLW). The operating National Water Level Observation Network (NWLON) primary tide stations at Seattle, WA (944-7130) and Tacoma, WA (944-6484) served as control for datum determination and as the primary source for water level reducers for survey H12024.

No tertiary gauges were required.

As per the Project Instructions, all data were reduced to MLLW using the final approved water levels from the stations at Seattle, WA (944-7130), Port Townsend, WA (944-4900), and Tacoma, WA (944-6484) by applying tide file 9447130.txt, 9444900.txt, and 9446484.txt and final time and height correctors using the Tidal Constituent And Residual Interpolator (TCARI) corrector file N395RA2009.tc. **It will not be necessary for the Pacific Hydrographic Branch to reapply the final approved water levels (smooth tides) to the survey data during final processing.**

The request for Final Approved Water Levels for H12024 was submitted to CO-OPS on April 27, 2009 in accordance with the Field Procedures Manual (FPM), dated April, 2009. The Final Tide Note was received on May 15, 2009. This documentation is included in Appendix IV.<sup>8</sup>

## D. RESULTS AND RECOMMENDATIONS

### D.1. Chart Comparison

#### D.1.a. Survey Agreement with Chart

Chart comparison procedures were followed as outlined in section 4.5 of the FPM and section 8.1.3-D.1 of the HSSDM, utilizing Caris HIPS.

Survey H12024 was compared with the following charts:

Chart	Scale	Edition and Date	Local Notice to Mariners Applied Through
18446	1:25,000	17 <sup>th</sup> Ed.; September 2005	05/01/2009
18447	1:10,000	29 <sup>th</sup> Ed.; May 2008	11/05/2005

**Table 7: Charts compared with H12024**

**Chart 18446**

Depths from survey H12024 generally agreed with charted depths to within 10-feet and no significant discrepancies were noted with charted soundings. Most differences of greater than 5-feet were found in waters deeper than 300-feet and are thus not navigationally significant.<sup>9</sup>

The charted 54 foot shoal in position 47° 43.88' N 122° 29.46' W was not seen. Complete multibeam coverage was acquired in this area with an average apparent depth of 80 feet. The hydrographer recommends removing this feature from the chart.<sup>10</sup>

The MLLW line at the northern end of Bainbridge Island appears to have eroded and multibeam coverage was acquired over much of the charted low water shoreline depicted. The zero meter contour in the Notebook Final Feature File was adjusted to reflect the observed MLLW line and coincide with the multibeam data. The resulting MLLW line is 40 meters further in shore than the charted MLLW line. The hydrographer recommends the surveyed MLLW line supersede the charted MLLW line.<sup>11</sup>

There is a charted Disposal Area in position 47° 43.00' N 122° 28.00' W with survey depths from 1987 and 1980. No evidence of significant shoaling is evident in this area and multibeam data generally agree with charted depths. The hydrographer recommends that survey soundings supersede charted depths in this area and that the notation be updated appropriately.<sup>12</sup>

Multibeam data indicates the 600 foot depth contour has shifted approximately 150 meters further off shore than the charted 600 foot depth curve north of Meadow Point. All other depths contours appear to correlate well with charted depth curves. The hydrographer recommends that survey contours supersede charted depth curves in all areas.<sup>13</sup>

Tabulated depths for the Shilshole Entrance Channel correlated well with survey soundings. No soundings shoaler than controlling depths were noted. The hydrographer recommends retaining controlling depths in table on chart 18446.<sup>14</sup>

No evidence of the position approximate wreck in position 47° 41.32' N 122° 26.05' W was visible in the multibeam data. The hydrographer recommends removing this wreck from the chart.<sup>15</sup> All other charted wrecks were located and updated positions and depths are included in the Notebook Final Feature File.<sup>16</sup>

The hydrographer recommends that survey soundings supersede all prior survey and charted depths in the common area.<sup>17</sup>

**Chart 18447**

Depths from survey H12024 generally agreed with charted depths to within 10-feet and no significant discrepancies were noted with charted soundings. Most differences of greater than 5-feet were found in waters deeper than 200-feet and are thus not navigationally significant.<sup>18</sup> A shoal area at the entrance to Shilshole Entrance Channel in position 47° 40.97' N 122° 24.96' W is not denoted on chart 18447. The shoal has an approximate depth of 65-feet and is positioned between two 86-foot soundings, as seen in Figure 6.<sup>19</sup>

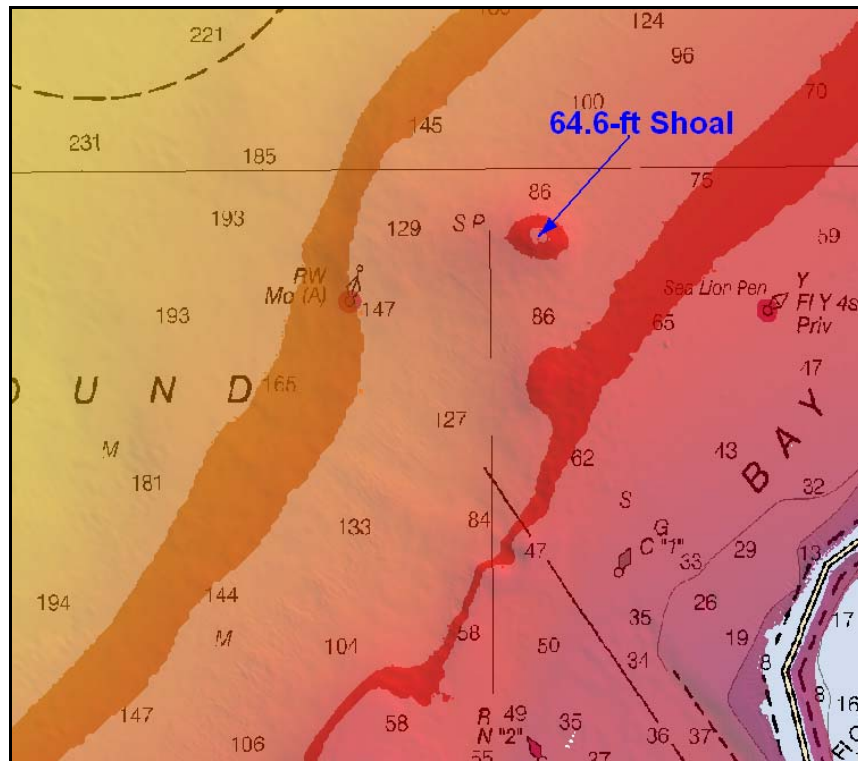


Figure 6. Uncharted shoal on Chart 18447.

There is a charted Disposal Area in position  $47^{\circ} 41.19' \text{ N } 122^{\circ} 25.33' \text{ W}$  with survey depths from 1985. No evidence of significant shoaling is evident in this area and multibeam data generally agree with charted depths. The hydrographer recommends that survey soundings supersede charted depths in this area and the notation be updated appropriately.<sup>20</sup>

Tabulated depths for the Shilshole Entrance Channel correlated well with survey soundings. No soundings shoaler than controlling depths were noted. The hydrographer recommends retaining controlling depths in tabulation on chart 18447.<sup>21</sup>

No evidence of the position approximate wreck in position  $47^{\circ} 41.32' \text{ N } 122^{\circ} 26.05' \text{ W}$  was visible in the multibeam data. The hydrographer recommends removing this wreck from the chart.<sup>22</sup>

The charted wreck in position  $47^{\circ} 40.37' \text{ N } 122^{\circ} 25.32' \text{ W}$  extends beyond the wreck danger circle, as shown in Figure 7. The hydrographer recommends making this wreck an area feature on this large scale chart.<sup>23</sup>

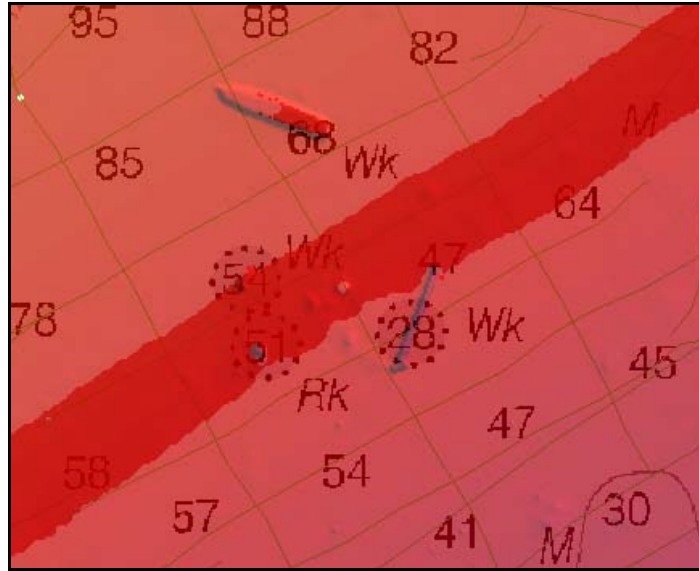


Figure 7. Wreck Extending outside of Danger Circle on Chart 18447.

The hydrographer recommends that survey soundings supersede all prior survey and charted depths in the common area.<sup>24</sup>

#### **D.1.b. Automated Wreck and Obstruction Information System (AWOIS) Items**

No AWOIS items were located within the survey limits of H12024.<sup>25</sup>

#### **D.1.c. Other Investigated Features**

##### Additional Items

Included in the H12024 Caris Notebook session in the H12024\_Final\_Feature\_File.hob file are two possible wrecks and a modification to the pier structure at the Shilshole Bay Marina. These features are discussed in greater detail below.

One potential wreck is located in approximately 125 meters of water in position 47° 40.57' N 122° 26.42' W. This obstruction measures approximately 50-meters in length, 12-meters in width, and stands roughly 4-meters off the surrounding sea floor.<sup>26</sup>

The second potential wreck is in approximately 20 meters of water in position 47° 42.29' N 122° 30.27' W. This obstruction measures approximately 5-meters in length, 2.3-meters in width, and stands roughly 2-meters off the surrounding sea floor.<sup>27</sup>

While complete shoreline verification was not complete in the Shilshole Marina, the pier at the South entrance was noted to be out of position from the charted location. The existing pier was rejected and moved to the H12024\_Disprovals.hob file and the new pier location digitized from supplied Remote Sensing Division (RSD) photogrammetry, as shown in Figure 7.<sup>28</sup>





Figure 7. H12024 Pier Reposition.

#### D.1.d. Dangers to Navigation

One Danger to Navigation (DTON) was found within the survey limits of H12024 and reported to the Marine Chart Division via email on June 8, 2009.<sup>29</sup> The original DTON submission package is included in Appendix I.<sup>30</sup>

### D.2. Additional Results

#### D.2.a. Shoreline Verification

##### Shoreline Source

Limited shoreline verification was accomplished using the composite source file (CSF) provided with the project instructions. The CSF has been created using the latest ENC's, most recent aerial photogrammetry, and prior hydrographic surveys. Prior survey features within the CSF are for reference. This composite source was printed on paper "boat sheets" and displayed in Caris Notebook and/or Hypack for field verification.

##### Shoreline Verification

Limited shoreline verification was conducted near predicted low water in accordance with the Specifications and Deliverables and FPM sections 6.1 and 6.2. Detached positions (DPs) acquired during shoreline verification were recorded and s-57 attributed in Caris Notebook. These indicate revisions to features and features not found in the provided CSF. In addition, annotations describing shoreline were recorded on the hard copy plots of the CSF as described above.

All shoreline data are submitted in Caris Notebook .hob files. The session H12024\_NTBK contains the following:

<b>HOB File</b>	<b>Purpose and Contents</b>
H12024_Comp_Source.hob	Original Source Data as provided for project OPR-N395-RA-09 and filtered to the limits of survey H12024
H12024_Reference.hob	Survey outline and limit lines, and AWOIS item Positions and radii.
H12024_Final_Feature_File.hob	Composite source data modified by the field to best represent the shoreline at survey scale. This includes the addition of new features and modification of source features. This file retains all features neither verified nor disproved by this survey
H12024_Disprovals.hob	Composite source items that were deleted or modified in position or geographic type.

**Table 8. List and Description of Notebook HOB files.**

### Recommendations

The Hydrographer recommends that the shoreline as depicted in the Notebook .HOB files supersede and complement shoreline information compiled on the composite source file and charts as described above.<sup>31</sup>

### **D.2.b. Prior Survey Comparison**

Prior survey comparison was not performed.

### **D.2.c. Aids to Navigation**

There were sixteen (16) aids to navigation (ATONs) located within the sheet limits of H12024. All aids to navigation (ATONs) were found to be correctly charted and serve their intended purpose.<sup>32</sup> These include the Shilshole Bay Entrance Range Lights and Daymarks, which appear to serve their intended purpose.

### **D.2.d. Overhead Features**

There is one (1) overhead feature within the survey limits of H12024. The BNRR Railroad bascule bridge, which spans the Shilshole Entrance Channel just before the entrance to the Hiram M. Chittenden Locks in approximate position 47° 40.00' N 122° 24.13' W, is charted at 43-ft of vertical clearance at MHW in the closed position and 155-feet of vertical clearance at MHW due to overhead cables in the open position. These clearances were not independently verified.<sup>33</sup>

### **D.2.e. Submarine Cables and Pipelines**

Survey H12024 includes several charted cable and pipeline areas. No visible indication of pipelines was evident in the MBES data in the pipeline area on chart 18447 immediately to



the West of the Ship Canal Railroad Bridge in approximate position 47° 40.0' N 122° 24.2' W. No visible indication of pipelines were evident in the MBES data in the pipeline areas on chart 18446 to the North of Meadow Point in approximate position 47° 42.1' N 122° 24.0' W. No visible indication of cables was evident in the MBES data in the cable areas running from the northern sheet limits to the southern sheet limits on the eastern side of the Vessel Traffic Separation lanes on chart 18447. The Hydrographer recommends retaining the cable and pipe areas as charted.<sup>34</sup> All charted pipelines, with the exception of those noted above, on charts 18446 and 18447 were noted in the MBES data and agree well with charted positions, with the exception of the charted pipe in approximate location 47° 40.2' N 122° 25.5' W which is located approximately 50-meters to the southwest of the charted location.<sup>35</sup> This new location for the charted sewer pipeline has been included in the H12024\_Final\_Feature\_File in the Caris Notebook session, as shown in Figure 8.

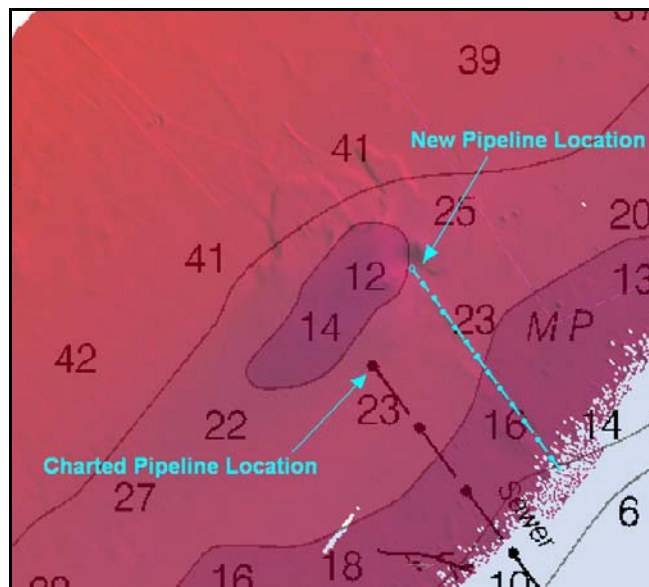


Figure 8. H12024 Pipeline Reposition.

#### D.2.f. Ferry Routes

There are no ferry routes charted within the limits of survey H12024, and none were observed to be operating in the area. The traffic lanes for the Seattle Vessel Traffic System (VTS) do run north and south through roughly the middle of the sheet. These lanes are accurately charted and heavily utilized.<sup>36</sup>

#### D.2.g. Bottom Samples

Bottom samples were not performed in survey H12024.<sup>37</sup>

#### D.2.h. Other Findings

None.

**E. APPROVAL**

As Chief of Party, Field operations for hydrographic survey H12024 were conducted under my direct supervision, with frequent personal checks of progress and adequacy. I have reviewed the attached survey data and reports. The survey data meets or exceeds requirements as set forth in the NOS Hydrographic Surveys and Specifications Deliverables Manual (April 2009 edition), Field Procedures Manual (April 2009 edition), Standing and Project Instructions, and all HSD Technical Directives issued through April 2009. These data are adequate to supersede charted data in their common areas. This survey is complete and no additional work is required. All data and reports are respectfully submitted to N/CS34, Pacific Hydrographic Branch.

Listed below are supplemental reports submitted separately that contain additional information relevant to this survey:

<u>Title</u>	<u>Date Sent</u>	<u>Office</u>
Data Acquisition and Processing Report for OPR-N395-RA-09	7/5/2009	N/CS34
Coast Pilot Report for OPR-N395-RA-09	<i>To be submitted under separate cover</i>	N/CS26

Approved and Forwarded:



Donald W. Haines, CAPT/NOAA  
I am approving this document  
2009.07.01 11:48:46 -08'00'

Captain Donald W. Haines, NOAA  
Commanding Officer

In addition, the following individuals were also responsible for overseeing data acquisition and processing of this survey:

Survey Sheet Manager:



Brent Pounds  
I am the author of this document  
2009.07.01 10:25:41 -07'00'

Lieutenant Brent J. Pounds, NOAA  
Field Operations Officer

Chief Survey Technician:



James B Jacobson  
I have reviewed this document  
2009.07.01 00:04:22 Z

James B. Jacobson  
Chief Survey Technician, NOAA Ship *Rainier*

Field Operations Officer:



I have reviewed this document  
2009.06.30 20:42:15 -08'00'

Lieutenant Charles Yoos, NOAA  
Field Operations Officer

**Revisions and Corrections Compiled During Office Processing and Certification**

<sup>1</sup> Filed with project records.

<sup>2</sup> Concur.

<sup>3</sup> A common junction will be made with H12025 when that survey is compiled. No junction was made with H11190 because the survey has already been applied to the charts.

<sup>4</sup> Concur.

<sup>5</sup> The shoalest data is represented in the combined surface that was used as the basis for compilation. The data is adequate to supersede charted data in the common area despite the tide modeling errors.

<sup>6</sup> Concur.

<sup>7</sup> Concur.

<sup>8</sup> See attached Tide Note dated May 15, 2009.

<sup>9</sup> Concur.

<sup>10</sup> Concur. The shoal has been superseded with a 78 ft sounding in the HCell.

<sup>11</sup> Concur. The new MLLW line is included in the HCell.

<sup>12</sup> Concur.

<sup>13</sup> Concur.

<sup>14</sup> Concur.

<sup>15</sup> Concur. The charted wreck PA has been blue noted to be removed.

<sup>16</sup> The updated wrecks are included in the HCell.

<sup>17</sup> Concur.

<sup>18</sup> Concur.

<sup>19</sup> A 64 ft sounding is included in the HCell.

<sup>20</sup> Concur.

<sup>21</sup> Concur.

<sup>22</sup> Concur. The charted wreck PA has been blue noted to be removed.

<sup>23</sup> Do not concur. The shoalest point of the wreck is represented as a point feature in the HCell. The end of the wreck is represented by a sounding.

<sup>24</sup> Concur.

<sup>25</sup> Do not concur. There are seven AWOIS items located within the limits of H12024, however, no AWOIS items were assigned to be investigated during this survey.

<sup>26</sup> Recommend wreck be added to the AWOIS database.

<sup>27</sup> Recommend wreck be added to the AWOIS database.

<sup>28</sup> Chart pier as depicted in the HCell.

<sup>29</sup> The reported DTON has been applied to the charts and is included in the HCell.

<sup>30</sup> See attached DTON report.

<sup>31</sup> Concur with clarification. The submitted hob files were used in the compilation of HCell H12024. During compilation, some modifications were made to accommodate chart scale. Chart features as depicted in the HCell.

<sup>32</sup> Concur with clarification. Two private lighted mooring buoys have been relocated and the new positions were verified during H12024. The previously charted positions of the two mooring buoys have been blue noted to be removed and the lighted mooring buoys are depicted at the new positions in the HCell. Chart all other ATONs per latest ATONIS information.

<sup>33</sup> Retain railroad bridge as charted.

<sup>34</sup> Concur.

<sup>35</sup> The position of the new pipeline is included in the HCell as a \$LINES linear blue note.

<sup>36</sup> Concur.

<sup>37</sup> All charted bottom samples have been imported from the ENC to be retained.

# H12024 DTON Report

**Registry Number:** H12024  
**State:** Washington  
**Locality:** Central Puget Sound  
**Sub-locality:** Approaches to Port Madison and Shilshole Bay  
**Project Number:** OPR-N395-RA-09  
**Survey Date:** 04/20/2009

## Charts Affected

Number	Edition	Date	Scale (RNC)	RNC Correction(s)*
18447	28th	12/01/2005	1:10,000 (18447_1)	[L]NTM: ?
18446	17th	09/01/2005	1:25,000 (18446_1)	USCG LNM: 04/15/2008 (09/16/2008) CHS NTM: None (08/29/2008) NGA NTM: 02/02/2008 (09/20/2008)
18473	8th	09/01/2005	1:40,000 (18473_1)	[L]NTM: ?
18445	31st	04/01/2006	1:80,000 (18445_1)	[L]NTM: ?
18441	45th	04/01/2006	1:80,000 (18441_1)	[L]NTM: ?
18440	28th	12/01/2005	1:150,000 (18440_1)	[L]NTM: ?
18003	20th	11/01/2006	1:736,560 (18003_1)	[L]NTM: ?
18007	32nd	07/01/2005	1:1,200,000 (18007_1)	[L]NTM: ?
501	12th	11/01/2002	1:3,500,000 (501_1)	[L]NTM: ?
530	31st	06/01/2005	1:4,860,700 (530_1)	[L]NTM: ?
50	6th	06/01/2003	1:10,000,000 (50_1)	[L]NTM: ?

\* Correction(s) - *source: last correction applied (last correction reviewed--"cleared date")*

## Features

Feature Type	Survey Depth	Survey Latitude	Survey Longitude
Shoal	2.55 m	47° 40' 21.7" N	122° 24' 29.0" W

## **1 - Danger To Navigation**

## 1.1) Profile/Beam - 3160/210 from h12024 / 1101\_reson8125 / 2009-110 / 000\_1751

### DANGER TO NAVIGATION

#### Survey Summary

**Survey Position:** 47° 40' 21.7" N, 122° 24' 29.0" W  
**Least Depth:** 2.55 m (= 8.36 ft = 1.393 fm = 1 fm 2.36 ft)  
**TPU ( $\pm 1.96\sigma$ ):** THU (TPEh)  $\pm 1.964$  m ; TVU (TPEv)  $\pm 0.152$  m  
**Timestamp:** 2009-110.17:57:08.250 (04/20/2009)  
**Survey Line:** h12024 / 1101\_reson8125 / 2009-110 / 000\_1751  
**Profile/Beam:** 3160/210  
**Charts Affected:** 18447\_1, 18446\_1, 18473\_1, 18441\_1, 18445\_1, 18440\_1, 18003\_1, 18007\_1, 501\_1, 530\_1, 50\_1

#### Remarks:

Shoal Sounding

#### Feature Correlation

Address	Feature	Range	Azimuth	Status
h12024/1101_reson8125/2009-110/000_1751	3160/210	0.00	000.0	Primary

#### Hydrographer Recommendations

[None]

#### Cartographically-Rounded Depth (Affected Charts):

8ft (18447\_1, 18446\_1)

1 ¼fm (18441\_1, 18440\_1, 18003\_1, 18007\_1, 530\_1)

1fm 2ft (18473\_1, 18445\_1)

2.5m (501\_1, 50\_1)

#### S-57 Data

**Geo object 1:** Sounding (SOUNDG)

## Feature Images

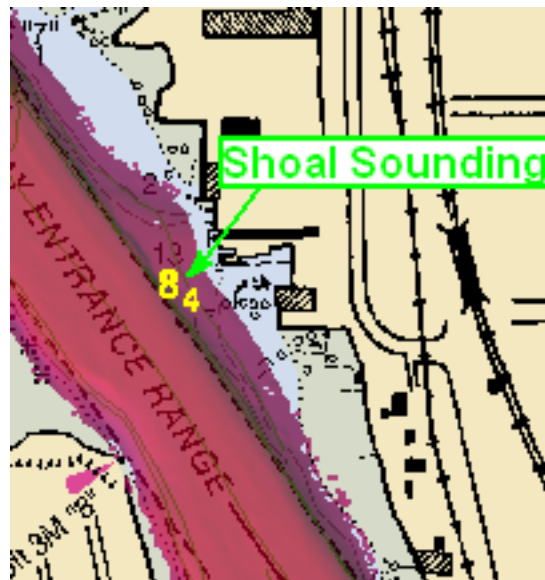


Figure 1.1.1



**UNITED STATES DEPARTMENT OF COMMERCE**  
**National Oceanic and Atmospheric Administration**  
National Ocean Service  
Silver Spring, Maryland 20910

**TIDE NOTE FOR HYDROGRAPHIC SURVEY**

**DATE :** May 15, 2009

**HYDROGRAPHIC BRANCH:** Pacific  
**HYDROGRAPHIC PROJECT:** OPR-N395-RA-2009  
**HYDROGRAPHIC SHEET:** H12024

**LOCALITY:** Approaches to Port Madison and Shilshole Bay, WA  
**TIME PERIOD:** April 8 - 22, 2009

**TIDE STATION USED:** Seattle, WA 944-7130  
Lat. 47° 36.2' N Long. 122° 20.4' W  
**PLANE OF REFERENCE (MEAN LOWER LOW WATER):** 0.000 meters  
**HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE:** 3.199 meters

**TIDE STATION USED:** Port Townsend, WA 944-4900  
Lat. 48° 06.8' N Long. 122° 45.6' W  
**PLANE OF REFERENCE (MEAN LOWER LOW WATER):** 0.000 meters  
**HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE:** 2.389 meters

**TIDE STATION USED:** Tacoma, WA 944-6484  
Lat. 47° 16.0' Long. 122° 24.7'  
**PLANE OF REFERENCE (MEAN LOWER LOW WATER):** 0.000 meters  
**HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE:** 3.336 meters

**REMARKS: RECOMMENDED GRID**

Please use the TCARI grid "N395RA2009.tc" as the final grid for project OPR-N395-RA-2009, H12024, during the time period between April 8 and 22, 2009.

**Refer to attachments for grid information.**

**Note 1:** Provided time series data are tabulated in metric units (meters), relative to MLLW and on Greenwich Mean Time on the 1983-2001 National Tidal Datum Epoch (NTDE).

**Peter J. Stone**

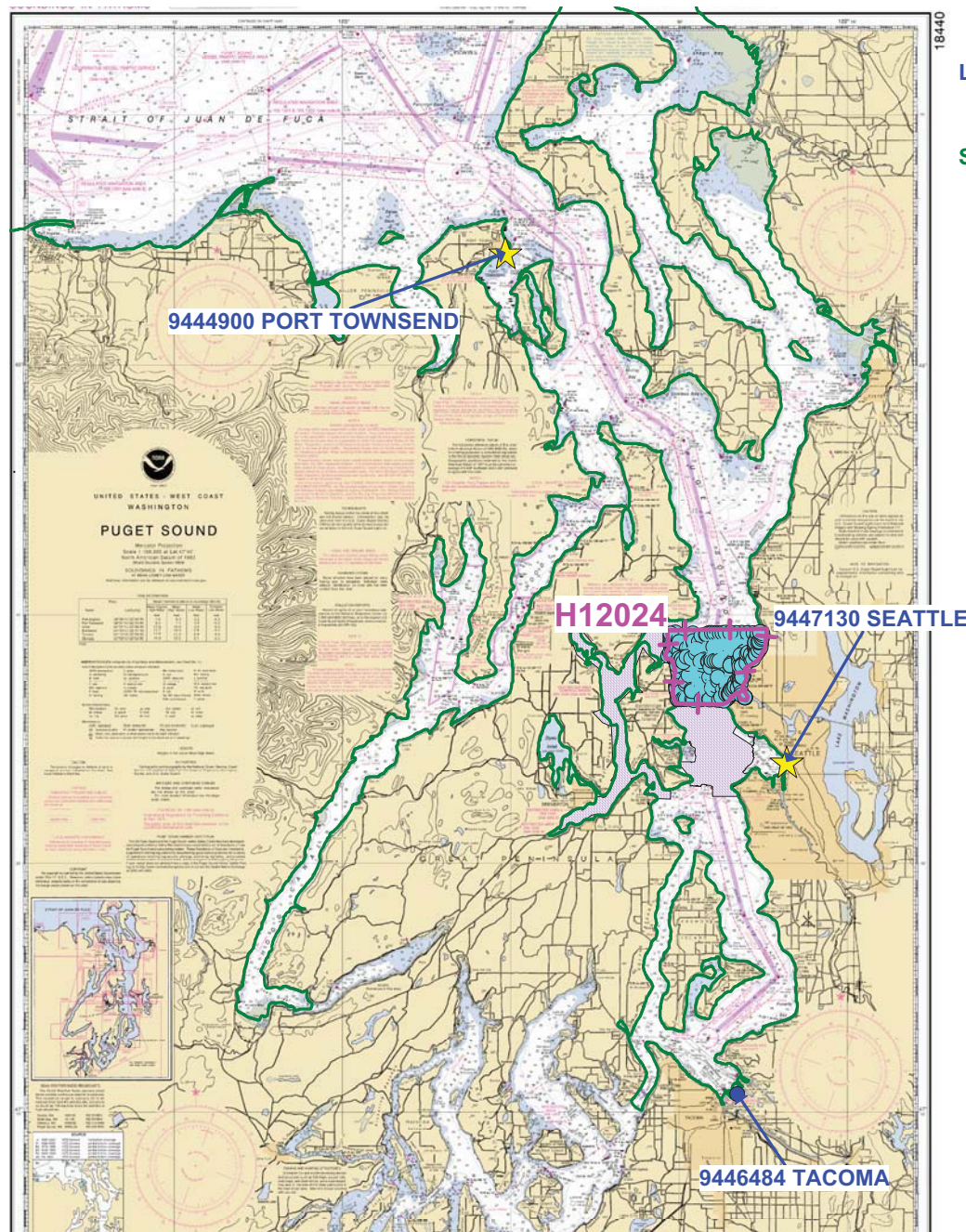
Digitally signed by Peter J. Stone  
DN: cn=Peter J. Stone, o=CO-OPS, ou=NOAA/  
NOS, email=peter.stone@noaa.gov, c=US  
Date: 2009.05.18 14:14:56 -04'00'

CHIEF, OCEANOGRAPHIC DIVISION





**Stations used for TCARI grid N395-RA-2009  
Central Puget Sound, WA**



Labeled Stations (blue) used for  
harmonics and residuals

Shoreline for TCARI grid boundary  
shown in green

**H12024 HCell Report**  
Katie Reser, Physical Scientist  
Pacific Hydrographic Branch

**1. Specifications, Standards and Guidance Used in HCell Compilation**

HCell compilation of survey H12024 used:

Office of Coast Survey HCell Specifications: Draft, Version: 4.0, 17 March, 2010.  
HCell Reference Guide: Version 2.0, 22 February, 2010.

**2. Compilation Scale**

Depths and features for HCell H12024 were compiled to the largest scale raster charts shown below:

Chart	Scale	Edition	Edition Date	NTM Date
18447	1:10,000	29 <sup>th</sup>	05/01/2008	08/07/2010
18446	1:25,000	17 <sup>th</sup>	09/01/2005	08/07/2010

The following ENC's were also used during compilation:

Chart	Scale
US5WA12M	1:25,000
US5WA13M	1:10,000

**3. Soundings**

A survey-scale sounding (SOUNDG) feature object layer was built from a 8-meter multibeam combined surface from H12024 in CARIS BASE Editor. A shoal-biased selection was made at 1:4,000 and 1:10,000 survey scale using a Radius Table file with values shown in the table, below.

Shoal Limit (m)	Deep Limit (m)	Radius (mm)
-5	10	3
10	20	4
20	50	4.5
50	500	5

In CARIS BASE Editor soundings were manually selected from the high density sounding layers (SS) and imported into a new layer (CS) created to accommodate chart density depths. Manual selection was used to accomplish a density and distribution that closely represents the seafloor morphology.

#### 4. Depth Contours

Depth contours at the intervals on the largest scale chart are included in the \*\_SS HCell for MCD raster charting division to use for guidance in creating chart contours. The metric and fathom equivalent contour values are shown in the table below.

Chart Contour Intervals in Feet	Metric Equivalent to Chart Feet, Arithmetically Rounded	Metric Equivalent of Chart Feet, with NOAA Rounding Applied	Feet with NOAA Rounding Applied	Feet with NOAA Rounding Removed for Display on H12024_SS.000
0	0.0000	0.2286	0.750	0
6	1.8288	2.0574	6.750	6
12	3.6576	3.8862	12.750	12
18	5.4864	5.715	18.750	18
30	9.144	9.3726	30.750	30
60	18.288	18.5166	60.750	60
300	91.44	91.6686	300.750	300
600	182.88	183.1086	600.750	600

With the exception of zero contours included in the \*\_CS file, contours have not been de-conflicted against shoreline features, soundings and hydrography, as all other features in the \*\_CS file and soundings in the \*\_SS have been. This may result in conflicts between the \*\_SS file contours and HCell features at or near the survey limits. Conflicts with M\_QUAL, COALNE, DEPCNT and SBDARE objects should be expected. HCell features should be honored over \*\_SS.000 file contours in all cases where conflicts are found.

#### 5. Meta Areas

The following Meta object areas are included in HCell H12024:

M\_QUAL  
M\_CSCL

The Meta area objects were constructed on the basis of the limits of the hydrography.

#### 6. Features

Features addressed by the field units are delivered to PHB where they are de-conflicted against the hydrography and the largest scale chart. These features, as well as features to be retained from the chart and features digitized from the Base Surface, are included in the HCell. The geometry of these features may be modified to emulate chart scale per the HCell Reference Guide on compiling features to the chart scale HCell.

## 7. S-57 Objects and Attributes

The \*\_CS HCell contains the following Objects:

\$CSYMB	Blue notes
\$LINES	Linear blue note for placement of new sewer pipeline
DEPCNT	Zero contours
LIGHTS	Lights on private mooring buoys
MORFAC	Private mooring buoys
M_CSCL	Compilation scale meta object
M_QUAL	Data quality meta object
SBDARE	Bottom samples retained from the charts
SLCONS	New pier
SOUNDG	Soundings at the chart scale density
UWTROC	Rocks
WRECKS	Wrecks

The \*\_SS HCell contains the following Objects:

DEPCNT	Generalized contours at chart scale intervals
SOUNDG	Soundings at the survey scale density

## 8. Spatial Framework

### 8.1 Coordinate System

All spatial map and base cell file deliverables are in an LLDG geographic coordinate system, with WGS84 horizontal, MHW vertical, and MLLW (1983-2001 NTDE) sounding datums.

### 8.2 Horizontal and Vertical Units

DUNI, HUNI and PUNI are used to define units for depth, height and horizontal position in the chart units HCell, as shown below.

Chart Unit Base Cell Units:

Depth Units (DUNI):	Feet
Height Units (HUNI):	Feet
Positional Units (PUNI):	Meters

During creation of the HCell in CARIS BASE Editor and CARIS S-57 Composer, all soundings and features are maintained in metric units with as high precision as possible. Depth units for soundings measured with sonar maintain millimeter precision. Depths on rocks above MLLW and heights on islets above MHW are typically measured with range finder, so precision is less. Units and precision are shown below.

BASE Editor and S-57 Composer Units:

Sounding Units:	Meters rounded to the nearest millimeter
Spot Height Units:	Meters rounded to the nearest decimeter

See the HCell Reference Guide for details of conversion from metric to charting units, and application of NOAA rounding.

## **9. Data Processing Notes**

There were no significant deviations from the standards and protocols given in the HCell Specification and HCell Reference Guide.

## **10. QA/QC and ENC Validation Checks**

H12024 was subjected to QA checks in S-57 Composer prior to exporting to the metric HCell base cell (000) file. The millimeter precision metric S-57 HCell was converted to chart units and NOAA rounding applied. dKart Inspector was then used to further check the data set for conformity with the S-58 ver. 2 standard (formerly Appendix B.1 Annex C of the S-57 standard). All tests were run and warnings and errors investigated and corrected unless they are MCD approved as inherent to and acceptable for HCells.

## **11. Products**

### **11.1 HSD, MCD and CGTP Deliverables**

H12024_CS.000	Base Cell File, Chart Units, Soundings and features compiled to 1:10,000 and 1:25,000
H12024_SS.000	Base Cell File, Chart Units, Soundings and Contours compiled to 1:4,000 and 1:10,000
H12024_DR.pdf	Descriptive Report including end notes compiled during office processing and certification, the HCell Report, and supplemental items
H12024_Outline.gml	Survey outline
H12024_Outline.xsd	Survey outline

## 11.2 Software

CARIS HIPS Ver. 6.1	Inspection of Combined BASE Surfaces
CARIS BASE Editor Ver. 2.2	Creation of soundings and bathy-derived features, meta area objects, and blue notes; Survey evaluation and verification; Initial HCell assembly.
CARIS S-57 Composer Ver. 2.0	Final compilation of the HCell, correct geometry and build topology, apply final attributes, export the HCell, and QA.
CARIS GIS 4.4a	Setting the sounding rounding variable for conversion of the metric HCell to NOAA charting units with NOAA rounding.
CARIS HOM Ver. 3.3	Perform conversion of the metric HCell to NOAA charting units with NOAA rounding.
HydroService AS, dKart Inspector Ver. 5.1	Validation of the base cell file.
Northport Systems, Inc., Fugawi Marine ENC Ver.3.1.0.435	Independent inspection of final HCells using a COTS viewer.

## 12. Contacts

Inquiries regarding this HCell content or construction should be directed to:

Katie Reser  
Physical Scientist  
Pacific Hydrographic Branch  
Seattle, WA  
206-526-6864  
[katie.reser@noaa.gov](mailto:katie.reser@noaa.gov)

APPROVAL SHEET  
H12024

The survey evaluation and verification has been conducted according to branch processing procedures and the HCell compiled per the latest OCS HCell Specifications.

The survey and associated records have been inspected with regard to survey coverage, delineation of the depth curves, development of critical depths, S-57 classification and attribution of soundings and features, cartographic characterization, and verification or disproval of charted data within the survey limits. The survey records and digital data comply with OCS requirements except where noted in the Descriptive Report and are adequate to supersede prior surveys and nautical charts in the common area.

I have reviewed the HCell, accompanying data, and reports. This survey and accompanying digital data meet or exceed OCS requirements and standards for products in support of nautical charting except where noted in the Descriptive Report.