

F00568

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-05-03-09

Registry No. F00568

LOCALITY

State Washington

General Locality Central Puget Sound

Sublocality Elliot Bay West Anchorage

.....
2009
.....

CHIEF OF PARTY

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

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DATE

U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION HYDROGRAPHIC TITLE SHEET		REGISTRY No F00568
INSTRUCTIONS — 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: RA-05-03-09
State <u>Washington</u>		
General Locality <u>Central Puget Sound</u>		
Sub-Locality <u>Elliot Bay West Anchorage</u>		
Scale <u>1:5,000</u>		Date of Survey <u>April 13 to April 15, 2009</u>
Instructions dated <u>3/10/2009</u>		Project No. <u>OPR-N395-RA-09</u>
Vessel <u>RA4 (2801), RA5 (2802), RA6 (2804)</u>		
Chief of party <u>CAPT Donald W. Haines, NOAA</u>		
Surveyed by <u>RAINIER Personnel</u>		
Soundings by <u>Reson SeaBat 7125, Klein 3000 SSS</u>		
SAR by <u>Albert Foster</u>		Compilation by <u>Keith H. Toepfer</u>
Soundings compiled in <u>Feet</u>		
REMARKS: <u>All times are UTC. UTM Zone #10</u>		
<u>The purpose of this survey is to provide contemporary surveys to update National Ocean Service (NOS)</u>		
<u>nautical charts. All separates are filed with the hydrographic data. Revisions and end notes in red were</u>		
<u>generated during office processing. Page numbering may be interrupted or non sequential.</u>		
<u>All pertinent records for this survey, including the Descriptive Report, are archived at the</u>		
<u>National Geophysical Data Center (NGDC) and can be retrieved via http://www.ngdc.noaa.gov/.</u>		

Descriptive Report to Accompany Hydrographic Survey F00568

Project OPR-N395-RA-09
Central Puget Sound, Washington
Elliot Bay West Anchorage
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 10, 2009 and all other applicable direction¹, with the exception of deviations noted in this report. The survey area is located at the southern end of Elliot Bay, covering general anchorage area from the entrance to the West Duwamish Waterway to Alki Point. This survey corresponds to sheet “C” in the sheet layout provided with the Project Instructions. OPR-N395-RA-09 responds to a request from the President of Puget Sound Pilots. Over the last several years, large container ships would occasionally foul their anchors on unknown obstructions within the anchorage area. The purpose of this survey was to detect any features in the anchorage area that could cause the anchoring problems.

Object detection multibeam echosounder (MBES) and 100 percent side scan sonar (SSS) coverage were achieved in the survey area. The survey limits for F00568 were altered after consultation with HSD Operations Branch and Pacific Hydrographic Branch (see emails “Updated_Sheet_Limits” in appendix V). The shallowest areas of the survey were modified due to adequacy of prior surveys and the intent of the survey to find obstructions in areas where vessels anchor.

Total mileage acquired by each vessel and system is reference in Table 1.

Data Acquisition Type	Hull Number with Mileage (nm)						Total
	1101	1103	2801	2802	2803	2804	
MBES (mainscheme)	-	-	12.16	3.30	-	-	15.46
SSS (mainscheme)	-	-	-	9.62	-	-	9.62
Crosslines	-	-	-	-	-	1.07	1.07
Total Area Surveyed (sq. nm)	-	-	-	-	-	-	1.09

Table 1. Statistics for survey F00568

Data acquisition was conducted from April 13 to April 15, 2009 (DN 103 to 105).

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 the dates of data acquisition.

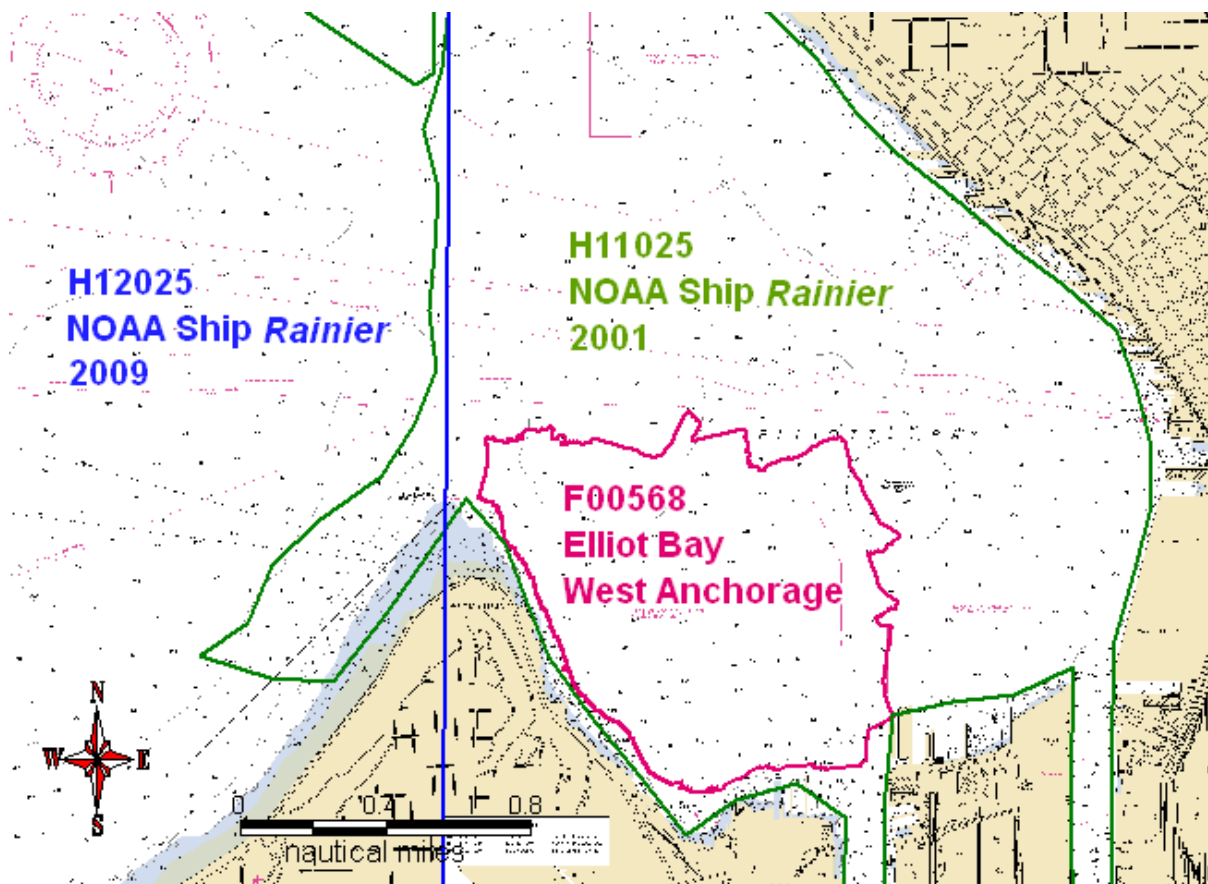


Figure 1. F00568 Survey Limits (Chart 18450).

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), 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
2801	RA-4	29	3.5	Reson 7125 Multibeam Echosounder
2802	RA-5	29	3.5	Reson 7125 Multibeam Echosounder Klein 3000 Side Scan Sonar
2804	RA-6	29	3.5	Reson 7125 Multibeam Echosounder

Table 2. Data acquisition vessels and systems for F00568.

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

Multibeam vessel navigation and attitude data were measured and recorded using Applanix POS/MV 320 systems, version 4.

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 1.07 nautical miles, comprising 6.92% of main-scheme MBES hydrography. The main-scheme bathymetry was manually compared to the XL nadir beams in CARIS subset mode and generally agreed within 0.15 meters.¹

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%). An IHO layer was created in Caris HIPS & SIPS and the Uncertainty of all finalized grids, except for the sheet’s 4 m grid, fall below the IHO levels as described in the NOS Specifications and Deliverables.² In depths greater than 75 m on the 4 m grid there are several areas where the uncertainty exceeds IHO standards.

B.2.c. Junctions

The following contemporary survey junction with F00568 (See Figure 1):

Registry #	Scale	Date	Junction side
H11025	1:20,000	2001	Northeast

Sounding data from H11025 were downloaded from the National Geophysical Data Center (NGDC) website for junction comparison. F00568 sounding data were visually compared to the junction sounding data in MapInfo. Agreement between H11025 and F00568 was generally very good along the shorelines and areas less than 80 meters, with the exception of the vicinity of the West Waterway in the southeastern corner of the sheet. It is suspected that this area near the West Waterway is deepening over time. In the deep water in the northwestern portion of the sheet, F00568 soundings were deeper than those in H11025, but generally agreed within one meter.³

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 FactorsTrue-Heave DN 104

POS data was not recorded during acquisition of DN 104's bathymetric data. Because there was no swell present in Elliot Bay and the heave bandwidth filter was set appropriately in the POS MV, the quality of the data was not affected. No offset is seen in the mainscheme BASE surface created when the density holiday lines that were collected that day are added.⁴

B.2.f. Object Detection and Coverage Assessment

One holiday larger than 3 nodes across is located in the northwest corner of the sheet at a depth of 116 m. The 4 node holiday's corresponding multibeam backscatter data as well as the 100% side scan data were examined and no navigationally significant items were found; additionally, the least depths were represented.⁵

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 F00568 conform to those detailed in the *OPR-N395-RA-09 DAPR*.

B.4. Data Processing

Data processing procedures for survey F00568 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 F00568 are listed in Table 3.

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

Table 3: Survey Specific Caris TPU Parameters

Many BASE surfaces were used in processing F00568. Final BASE surface resolutions and depth ranges were set according to table 3 below, with field sheets smaller than 25×10^6 nodes. 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 2, 3, and 4.

Depth Range (m)	Resolution (m)
0-23	0.5
20-40	1
37-80	2
75-160	4
150-350	8

Table 4. Depth range and surface resolutions for F00568

One 100% coverage mosaic was created from the Side Scan Sonar data. This mosaic was created at 1m resolution and named "F00568_SSS100".

Soundings and contours 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.

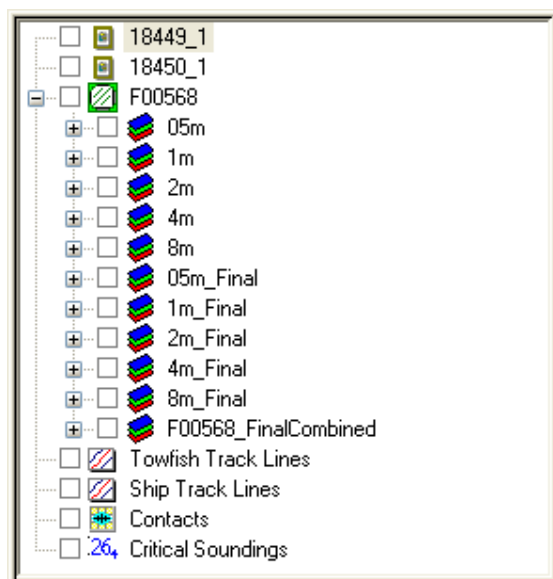


Figure 2. Field sheets and BASE surfaces submitted with F00568.



Figure 3. F00568 Field Sheet Layout (excluding SSS).

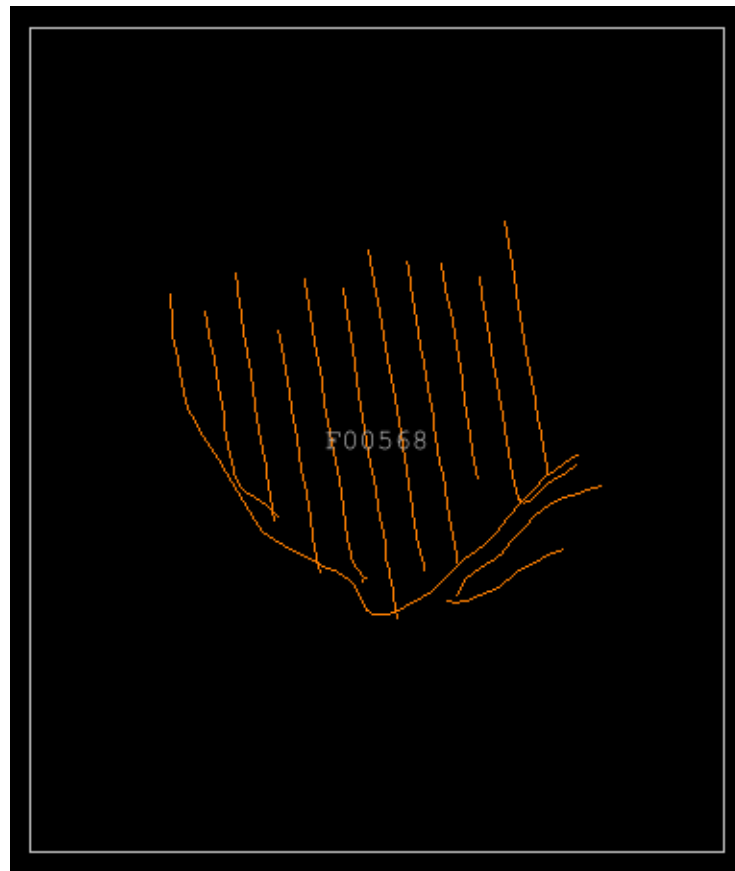


Figure 4. F00568 SSS Field Sheet Layout.

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 4.

Location	Frequency	Operator	Distance	Priority
Robinson Point	323 kHz	USCG	14.3 nm	Primary
Whidbey Island	315 kHz	USCG	59.6 nm	Secondary

Table 5. Differential Corrector Sources for F00568.

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 station at Seattle, WA (944-7130), Tacoma, WA (944-6484), and Port Townsend, WA (944-4900) served as control for datum determination and as the primary source for water level reducers for survey F00568.

No tertiary gauges were required.

All data were reduced to MLLW using final approved water levels from stations Seattle, WA (944-7130), Tacoma, WA (944-6484), and Port Townsend, WA (944-4900) using the tide files 9447130.tid, 9446484.tid, 9444900.tid, 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 F00568 was submitted to CO-OPS on April 22, 2009 and the Final Tide Note was received on May 15, 2009.⁶ This documentation is included in Appendix IV.

D. RESULTS AND RECOMMENDATIONS

D.1. Chart Comparison

D.1.a. Survey Agreement with Chart

Survey F000568 was compared with the following charts:

Chart	Scale	Edition and Date	Local Notice to Mariners Applied Through
18449	1:25,000	18 th Ed, Oct 2003	05/30/2009
18450	1:10,000	18 th Ed; Feb 2004	05/30/2009

Table 6. Charts compared with F00568

Chart 18450

Depths from survey F00568 generally agreed with the chart. The survey soundings that did not agree with charted depths were found in the deepest area in the western half of the survey and at the immediate mouth of the West Waterway. Of these discrepancies, all of survey soundings were found to be deeper than charted, and generally within 3 ft (see Figure 5 below). The western half of the survey area has consistently deeper soundings than charted and is likely deepening over time.⁷ The largest difference in depths in this region is 5 ft. Additionally, the survey sounding in approximate position 47° 35' 38" N, 122 ° 21' 50" W was also significantly deeper than charted, with a disparity of 9 ft.

The greatest discrepancy between the charted depths and the survey soundings was observed over the charted wreck at the southern edge of the survey. A 28 ft shoal bias was seen on the chart, where complete multibeam coverage placed the wreck deeper (Figure 6).⁸

Object detection multibeam coverage was achieved over the 28 ft obstruction at the southeastern corner of the sheet near the West Waterway. The obstruction was present in the data; position and depth should be updated as per digital data.⁹

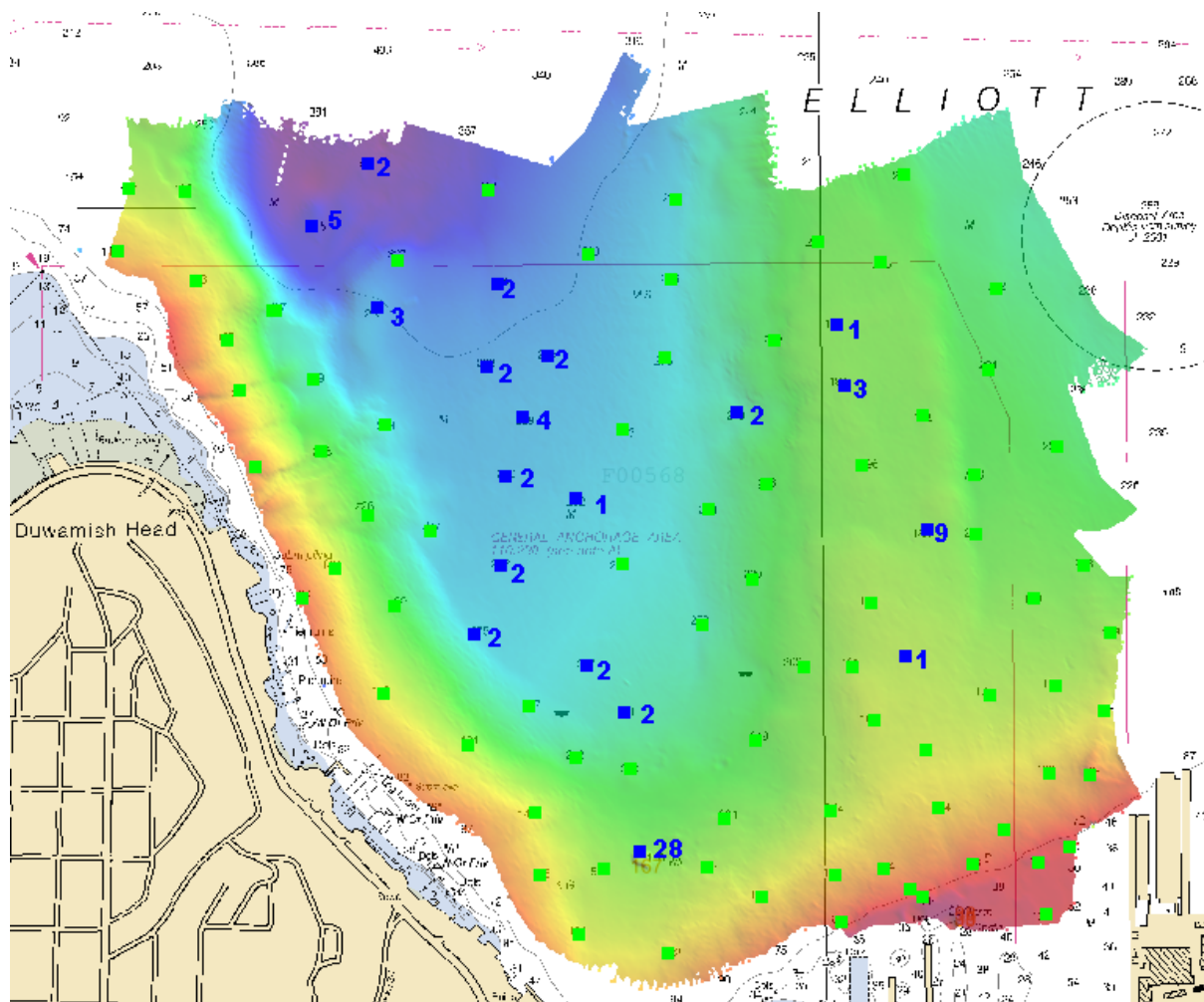


Figure 5. Survey soundings compared with charted depths, with a transparent 4 m resolution DTM overlaid on chart 18450. Green squares represent agreement between survey soundings and charted depths. Blue numbers represent survey soundings that were deeper than charted depths. The associated blue number is the difference, in feet, between the two values. No survey soundings were discovered to be shallower than charted depths.

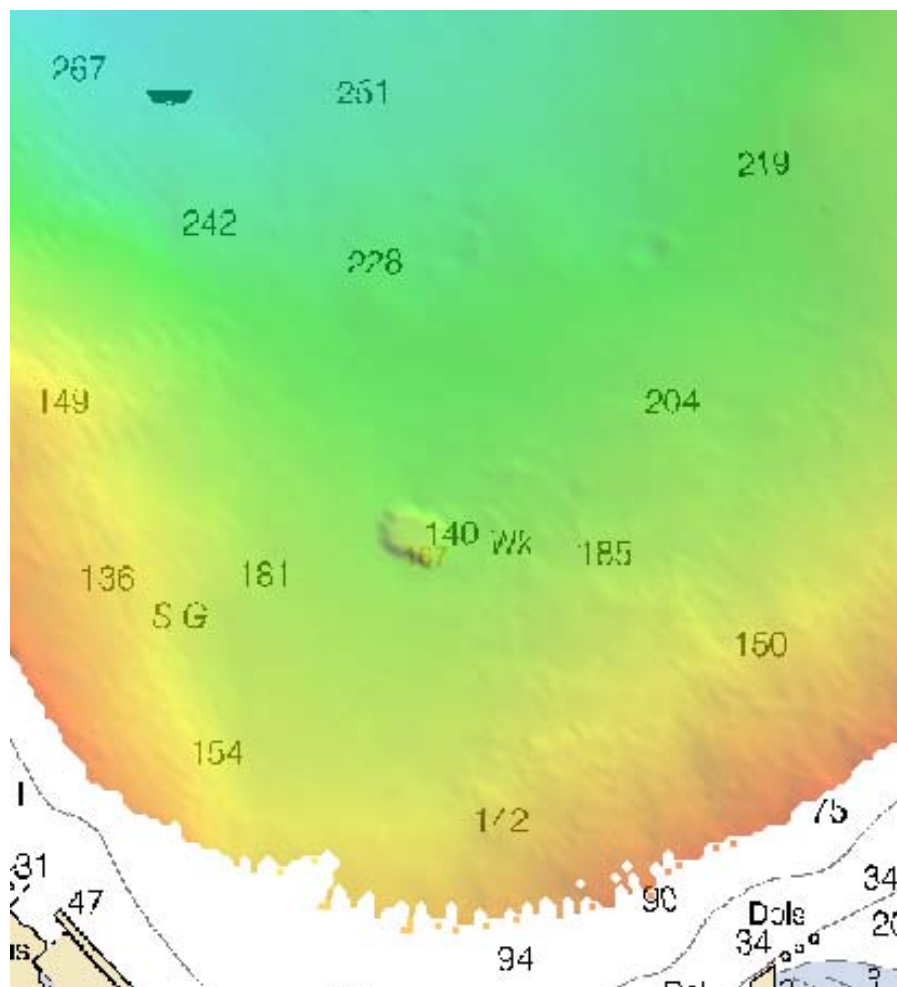


Figure 6. Survey soundings from F00568 over the charted wreck are significantly deeper than the depths from chart 18450, as shown in Caris HIPS/SIPS. The shoalest survey sounding from the wreck was designated at 167 ft.

Chart 18449

A charting discrepancy was noted between charts 18449 and 18450 during the chart comparison process. The depth in approximate position 47° 35' 45" N, 122° 22' 29" W is charted as 289 ft on chart 18450 and 298 ft on chart 18449. The survey sounding in this area is 293 ft. Both charts should be updated with the current survey as per the digital data.¹⁰

The Hydrographer recommends that survey soundings supersede all prior survey and charted depths in the common area.¹¹

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

No AWOIS items were located within the survey limits of F00568.¹²

D.1.c. Other Features

No additional charted items were investigated and no other features were located on survey F00568.¹³

D.1.d Dangers to Navigation

No dangers to navigation (DTONs) were found in survey F00568.¹⁴

D.2. Additional Results**D.2.a. Shoreline Verification**

Shoreline verification was not performed for survey F00568.¹⁵

D.2.b. Prior Survey Comparison

Prior survey comparison was not performed.

D.2.c. Aids to Navigation

There are no Aids to Navigation within the limits of F00568.¹⁶

D.2.d. Overhead Features

There are no overhead features within the limits of survey F00568.¹⁷

D.2.e. Submarine Cables and Pipelines

There are no submarine cables or pipelines charted within the limits of F00568, and none were detected by the survey.¹⁸

D.2.f. Ferry Routes

There are no ferry routes charted within the limits of survey F00568. Although no ferries were observed to be operating within the survey limits, several major Washington State Ferry routes are found within a close proximity to the northern extents of the survey. Routes that depart from Pier 52 run to Bainbridge Island and Bremerton operate nearly around the clock. The King County Water Taxi also operates between downtown Pier 55 and the Seacrest Park dock in West Seattle from April 5th through October 30th. Other various local ferries and sightseeing vessels also operate in the area on a seasonal basis.

D.2.g. Bottom Samples

Bottom samples were not performed in survey F00568.¹⁹

D.2.h. Other Findings

One (1) significant contact was found in the side scan data: the charted wreck at the southern edge of the survey as remarked on above in section D.1.a. No other significant contacts were noted. As such, no additional side scan contact list has been submitted with this survey. In order to meet the project instructions, a thorough search was conducted for hazards to anchoring. For more information on these hazards, please refer to Appendix V, side scan memorandum.²⁰

E. APPROVAL

As Chief of Party, Field operations for hydrographic survey F00568 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	8/24/2009	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
2009.07.21 12:46:04 -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:



Christine L. Schultz
2009.07.21 09:56:40 -08'00'

Christine L. Schultz
Ensign, NOAA

Chief Survey Technician:



James B Jacobson
I have reviewed this document
2009.07.21 02:20:35 Z

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

Field Operations Officer:



Brent Pounds
I have reviewed this document
2009.07.20 18:30:20 -08'00'

Lieutenant Brent Pounds, NOAA
Field Operations Officer

Revisions and Corrections Compiled During Office Processing and Certification

¹ Concur.

² Concur.

³ Concur.

⁴ Concur.

⁵ Concur.

⁶ See attached Tide Note dated May 15, 2009.

⁷ Concur. Chart depths as depicted in the HCell.

⁸ Chart wreck (AWOIS 52501 located at 47-35-16.11N, 122-22-17.410W) as depicted in the HCell and recommend updating the AWOIS database.

⁹ Concur. Chart obstruction (AWOIS 52571 located at 47-35-12.97N, 122-21-47.34W) as depicted in the HCell and recommend updating the AWOIS database.

¹⁰ Concur.

¹¹ Concur.

¹² Do not concur. There are three AWOIS items are located within the limits of F00568, however, none were assigned for investigation. Two of the three items were addressed by this survey and are included in the HCell (see endnotes 8 and 9). The third item (AWOIS 52574 located at 47-35-21.707N, 122-22-40.685W) was not addressed, but is included in the HCell to be retained.

¹³ Concur with clarification. A small portion of a charted disposal area was covered by the survey. Given that the area was not fully covered, it is recommended that it be retained as charted.

¹⁴ Concur.

¹⁵ Concur with clarification. Although shoreline verification was not performed, two charted features were updated and two new features were found. See attached feature report.

¹⁶ Concur.

¹⁷ Concur.

¹⁸ Concur.

¹⁹ Charted bottom samples were imported from the ENC to be retained.

²⁰ See attached side scan memorandum.

²¹ Concur.

F00568 Survey Feature Report

Registry Number: F00568
State: Washington
Locality: Central Puget Sound
Sub-locality: Elliot Bay West Anchorage
Project Number: OPR-N395-RA-09
Survey Date: 04/13/2009

Charts Affected

Number	Edition	Date	Scale (RNC)	RNC Correction(s)*
18450	18th	02/01/2004	1:10,000 (18450_1)	USCG LNM: 09/09/2008 (09/16/2008) NGA NTM: 08/09/1997 (09/20/2008)
18449	18th	10/01/2003	1:25,000 (18449_1)	[L]NTM: ?
18474	8th	10/01/2003	1:40,000 (18474_1)	[L]NTM: ?
18445	32nd	08/01/2007	1:80,000 (18445_1) 1:40,000 (18445_6)	[L]NTM: ?
18441	46th	12/01/2007	1:80,000 (18441_1)	[L]NTM: ?
18448	34th	07/01/2006	1:80,000 (18448_1)	[L]NTM: ?
18440	29th	09/01/2007	1:150,000 (18440_1)	[L]NTM: ?
18003	20th	11/01/2006	1:736,560 (18003_1)	[L]NTM: ?
18007	33rd	02/01/2009	1:1,200,000 (18007_1)	[L]NTM: ?
501	12th	11/01/2002	1:3,500,000 (501_1)	[L]NTM: ?
530	32nd	06/01/2007	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

No.	Feature Type	Survey Depth	Survey Latitude	Survey Longitude	AWOIS Item
1.1	Obstruction	10.19 m	47° 35' 12.4" N	122° 21' 46.2" W	---
1.2	Wreck	51.12 m	47° 35' 16.1" N	122° 22' 17.4" W	---
2.1	Obstruction	14.52 m	47° 35' 14.8" N	122° 21' 39.1" W	---
2.2	Shoal	13.19 m	47° 35' 16.2" N	122° 21' 41.3" W	---

1 - Charted Features

1.1) Profile/Beam - 695/349 from f00568_phb / 2801_reson7125_hf_512 / 2009-103 / 000_1902

Survey Summary

Survey Position: 47° 35' 12.4" N, 122° 21' 46.2" W
Least Depth: 10.19 m (= 33.42 ft = 5.569 fm = 5 fm 3.42 ft)
TPU ($\pm 1.96\sigma$): THU (TPEh) ± 1.962 m ; TVU (TPEv) ± 0.125 m
Timestamp: 2009-103.19:03:42.055 (04/13/2009)
Survey Line: f00568_phb / 2801_reson7125_hf_512 / 2009-103 / 000_1902
Profile/Beam: 695/349
Charts Affected: 18450_1, 18449_1, 18445_6, 18474_1, 18441_1, 18445_1, 18448_1, 18440_1, 18003_1, 18007_1, 501_1, 530_1, 50_1

Remarks:

Charted obstn.

Feature Correlation

Address	Feature	Range	Azimuth	Status
f00568_phb/2801_reson7125_hf_512/2009-103/000_1902	695/349	0.00	000.0	Primary
f00568_phb/2801_reson7125_hf_512/2009-103/000_1912	71/486	4.07	182.6	Secondary
f00568_phb/2801_reson7125_hf_512/2009-103/000_1905	824/19	11.53	185.7	Secondary (grouped)

Hydrographer Recommendations

Update obstn based on the depth, position, and S-57 attribution specified in this report.

Cartographically-Rounded Depth (Affected Charts):

33ft (18450_1, 18449_1)

5 ½fm (18441_1, 18448_1, 18440_1, 18003_1, 18007_1, 530_1)

5fm 3ft (18445_6, 18474_1, 18445_1)

10.2m (501_1, 50_1)

S-57 Data

Geo object 1: Obstruction (OBSTRN)

Attributes: SORDAT - 20090415

SORIND - US,US,nsurf,F00568

TECSOU - 3:found by multi-beam

VALSOU - 10.185 m

VERDAT - 5:Mean low water

WATLEV - 3:always under water/submerged

Office Notes

Concur.

1.2) Profile/Beam - 791/22 from f00568_phb / 2801_reson7125_lf_256 / 2009-103 / 000_1805

Survey Summary

Survey Position: 47° 35' 16.1" N, 122° 22' 17.4" W
Least Depth: 51.12 m (= 167.72 ft = 27.954 fm = 27 fm 5.72 ft)
TPU ($\pm 1.96\sigma$): THU (TPEh) ± 2.084 m ; TVU (TPEv) ± 0.441 m
Timestamp: 2009-103.18:08:27.201 (04/13/2009)
Survey Line: f00568_phb / 2801_reson7125_lf_256 / 2009-103 / 000_1805
Profile/Beam: 791/22
Charts Affected: 18450_1, 18449_1, 18445_6, 18474_1, 18441_1, 18445_1, 18448_1, 18440_1, 18003_1, 18007_1, 501_1, 530_1, 50_1

Remarks:

charted wreck

Feature Correlation

Address	Feature	Range	Azimuth	Status
f00568_phb/2801_reson7125_lf_256/2009-103/000_1805	791/22	0.00	000.0	Primary

Hydrographer Recommendations

Chart wreck based on the depth, position, and S-57 attribution specified in this report.

Cartographically-Rounded Depth (Affected Charts):

167ft (18450_1, 18449_1)
 28fm (18441_1, 18448_1, 18440_1, 18003_1, 18007_1, 530_1)
 28fm (18445_6, 18474_1, 18445_1)
 51m (501_1, 50_1)

S-57 Data

Geo object 1: Wreck (WRECKS)
Attributes: CATWRK - 1:non-dangerous wreck
 SORDAT - 20090415
 SORIND - US,US,nsurf,F00568

TECSOU - 3:found by multi-beam

VALSOU - 51.122 m

VERDAT - 12:Mean lower low water

WATLEV - 3:always under water/submerged

Office Notes

Concur.

2 - New Features

2.1) Profile/Beam - 794/428 from f00568_phb / 2801_reson7125_hf_512 / 2009-103 / 000_1907

Survey Summary

Survey Position: 47° 35' 14.8" N, 122° 21' 39.1" W
Least Depth: 14.52 m (= 47.62 ft = 7.937 fm = 7 fm 5.62 ft)
TPU ($\pm 1.96\sigma$): THU (TPEh) ± 1.968 m ; TVU (TPEv) ± 0.147 m
Timestamp: 2009-103.19:09:19.649 (04/13/2009)
Survey Line: f00568_phb / 2801_reson7125_hf_512 / 2009-103 / 000_1907
Profile/Beam: 794/428
Charts Affected: 18450_1, 18449_1, 18445_6, 18474_1, 18441_1, 18445_1, 18448_1, 18440_1, 18003_1, 18007_1, 501_1, 530_1, 50_1

Remarks:

Uncharted obstn

Feature Correlation

Address	Feature	Range	Azimuth	Status
f00568_phb/2801_reson7125_hf_512/2009-103/000_1907	794/428	0.00	000.0	Primary

Hydrographer Recommendations

Chart this Obstn based on the depth, position, and S-57 attribution specified in this report.

Cartographically-Rounded Depth (Affected Charts):

47ft (18450_1, 18449_1)
 7 $\frac{3}{4}$ fm (18441_1, 18448_1, 18440_1, 18003_1, 18007_1, 530_1)
 7fm 5ft (18445_6, 18474_1, 18445_1)
 14.5m (501_1, 50_1)

S-57 Data

Geo object 1: Obstruction (OBSTRN)
Attributes: SORDAT - 20090415
 SORIND - US,US,nsurf,F00568
 TECSOU - 3:found by multi-beam

VALSOU - 14.516 m

WATLEV - 3:always under water/submerged

Office Notes

Do not concur. The depth is not outstanding compared to the surrounding depths and therefore does not appear to be an obstruction. Chart depths as depicted in the HCell.

2.2) Profile/Beam - 281/88 from f00568_phb / 2801_reson7125_hf_512 / 2009-103 / 000_1910

Survey Summary

Survey Position: 47° 35' 16.2" N, 122° 21' 41.3" W
Least Depth: 13.19 m (= 43.27 ft = 7.211 fm = 7 fm 1.27 ft)
TPU ($\pm 1.96\sigma$): THU (TPEh) ± 1.966 m ; TVU (TPEv) ± 0.140 m
Timestamp: 2009-103.19:10:58.834 (04/13/2009)
Survey Line: f00568_phb / 2801_reson7125_hf_512 / 2009-103 / 000_1910
Profile/Beam: 281/88
Charts Affected: 18450_1, 18449_1, 18445_6, 18474_1, 18441_1, 18445_1, 18448_1, 18440_1, 18003_1, 18007_1, 501_1, 530_1, 50_1

Remarks:

Uncharted obstn.

Feature Correlation

Address	Feature	Range	Azimuth	Status
f00568_phb/2801_reson7125_hf_512/2009-103/000_1910	281/88	0.00	000.0	Primary

Hydrographer Recommendations

Chart this Obstn based on the depth, position, and S-57 attribution specified in this report.

Cartographically-Rounded Depth (Affected Charts):

43ft (18450_1, 18449_1)
 7 ¼fm (18441_1, 18448_1, 18440_1, 18003_1, 18007_1, 530_1)
 7fm 1ft (18445_6, 18474_1, 18445_1)
 13.2m (501_1, 50_1)

S-57 Data

[None]

Office Notes

Concur.

NOAA Ship *Rainier*

Side Scan Analysis of Elliott Bay Western Anchorage, F00568

In response to a request from the Puget Sound Pilots Association, the NOAA Ship *Rainier* conducted side scan operations in the W. Anchorage of Elliott Bay on April 14, 2009. The intent of this survey was to attempt to identify and locate features that might foul ships' anchors. See figure 1.

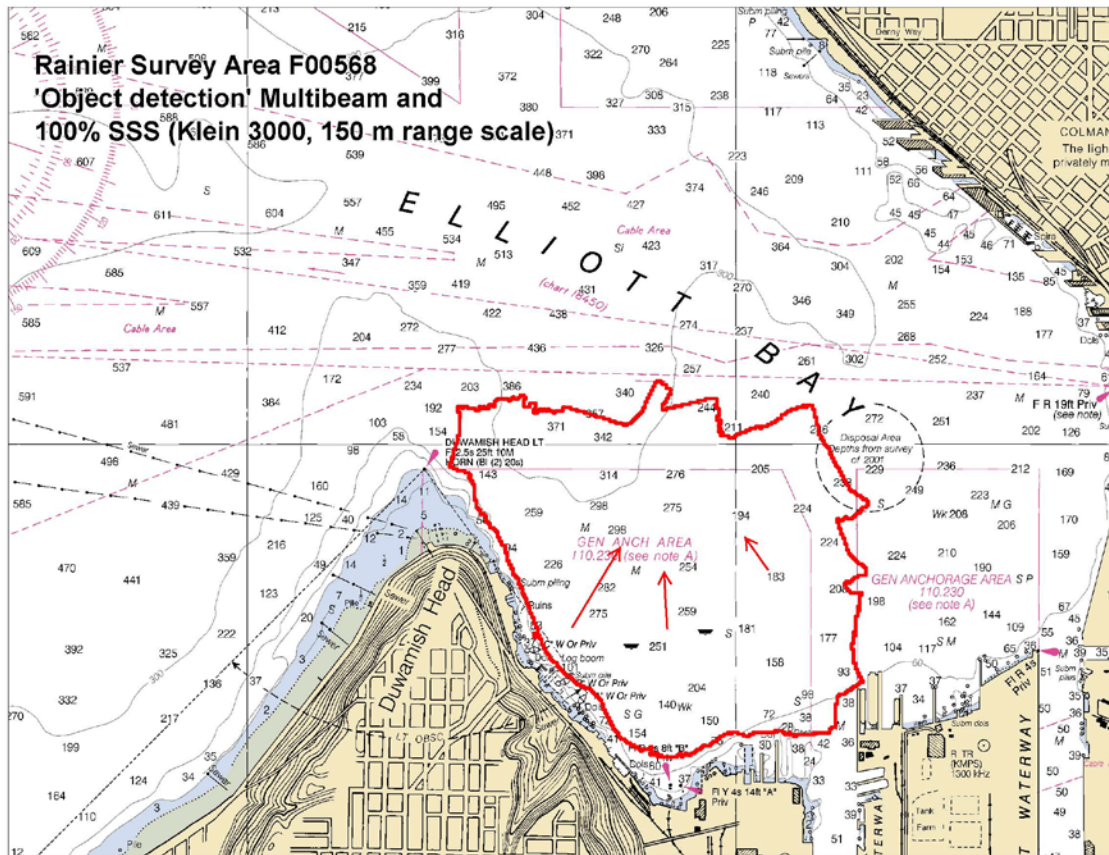


Figure 1: Survey area outlined in Red. Fouled Anchor locations indicated by Red Arrows

Rainier utilized a towed, Klein 3000 side scan configuration from survey launch 2802 (RA-5) in order to place the side scan closer to the seafloor for better resolution. However, due to the depths of the anchorage and the tow capabilities of the configuration, ship's hydrographers were unable to tow the fish much deeper than 30 m below water level, even though the launch operated at as slow a speed as possible. Due to the slope on the southern side of the survey area, a maximum of 130 m cable out was used. With this much cable out, positioning of resulting side scan data are within 10 m accuracy. In the deep waters of this anchorage, this resulted in a towfish height of 30 – 50 m off the seafloor. NOS Specifications require the towfish height to be between 8 and 20% of the side scan range scale. For a search survey like this, typically a 50 or 75 m range scale would be used, resulting in a required towfish height of 4 – 15 m. In an attempt to balance the height requirement (which gives proper geometry) and selecting a

small range scale (which samples objects at a higher rate making detection easier), the hydrographers selected the 150 m range scale. Unfortunately, the resulting data are ambiguous as to contacts that might foul anchors due to the height and long range scale.

Rainier found only one obstruction -- previously charted as a 140 ft Wk in the southern part of the survey area -- that would qualify as a significant contact under NOS specifications. However, as the intent of the survey was to provide information on hazards to anchoring, *Rainier* personnel attempted to select any contacts that might foul an anchor. Many small contacts (less than 1 m proud of the seafloor) were identified in the course of this search. See figure 2 for a typical example of this type of contact.

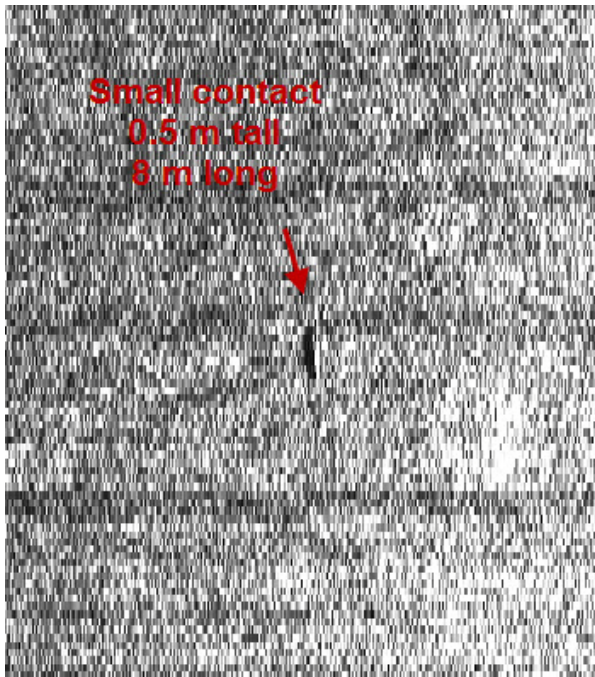


Figure 2: Small contact identified by side scan sonar. Black indicates sonic shadow; white indicates return. The contact shadow indicates the feature has a height of 0.5 m and the contact length is app. 8m.

Contacts like this and smaller are densely scattered throughout the survey area. Because the intent of this survey was to identify obstructions for further investigation or removal, the number and density of these small contacts would not reduce a search area at all and, therefore, were not worthwhile selecting. Additionally, small point contacts like this are unlikely to hang a large ship's anchor significantly.

In addition to the small, point contacts mentioned above, the survey area has many long, linear, drag-type marks, not unusual for an anchorage. See figure 3.

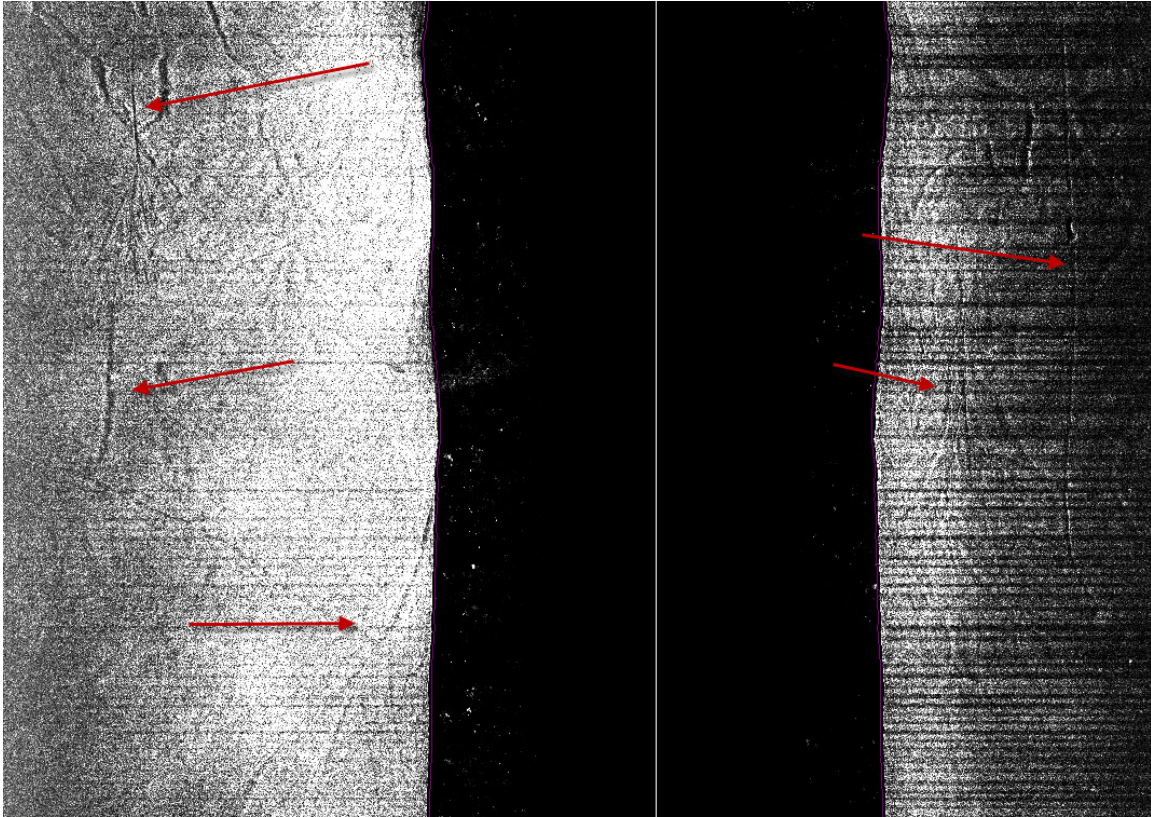


Figure 3: A sampling of drag marks in the survey area F00568. Note that in the image the shadow is closer to nadir on all these marks, indicating that these are depressions in the seafloor.

These marks are typical for where an anchor chain has laid in the mud and then been picked up. Unfortunately, from the data acquired, it is impossible to tell the difference between a drag mark and a chain or cable laying on the bottom. During the survey, a ship was anchored and the side scan was able to pick up the chain from where it entered the water, all the way to the seafloor. From there, it is in a depression that looks exactly like the anchor drag marks. See figure 4. Because the seafloor is comprised of mud, a chain or wire rope will simply sink in the mud and, to the side scan at the range scale used, look like an empty anchor drag mark. For this reason, it is difficult to tell which linear features might have a chain or wire rope that might foul an anchor. As with the point contacts, if all of the linear features were selected, it would be so many that it would not help distinguish any future search.

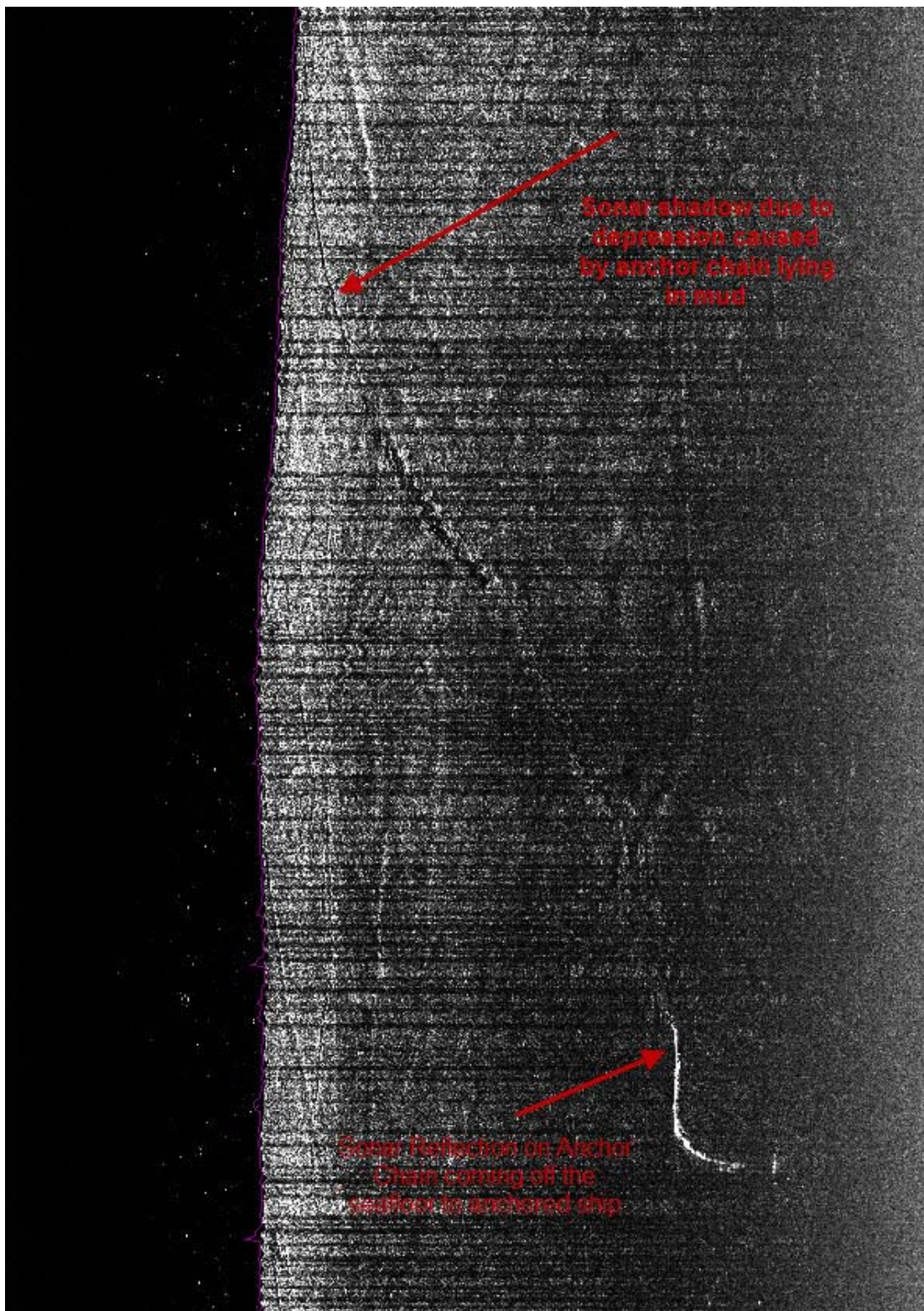


Figure 4: The anchor chain from an anchored ship. Note that once the chain is in the mud, it is indistinguishable from the types of marks in Figure 3.

This survey was unable to detect any items that would be suspicious in fouling ships' anchors. Furthermore, due to the number of features, this survey was unable to focus on a set of particular features for further examination. The hydrographer recommends using a survey methodology that will allow the sensor to be closer to the seafloor for better object detection and resolution. A towfish with a heavy depressor wing would be a possibility but, due to the confines and heavy traffic of the area, it is not advisable to use a survey ship capable of using the wing. Smaller vessels, like 2802 (RA-5) are not capable of deploying the depressor wing. Therefore, the hydrographer recommends using the multibeam bathymetry acquired as part of F00568 to plan Autonomous Underwater Vehicle (AUV) operations in the areas of concern. The AUV would be deep enough to avoid surface traffic and the high density bathymetry should allow safe planning. The AUV would be able to run at the short range scales (25 m or 50 m) much better suited for this type of search. Another option may be the use of a magnetometer to detect ferrous features.



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: F00568

LOCALITY: Elliott Bay West Anchorage, WA
TIME PERIOD: April 13 -15, 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, F00568, during the time period between April 13 and 15, 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).

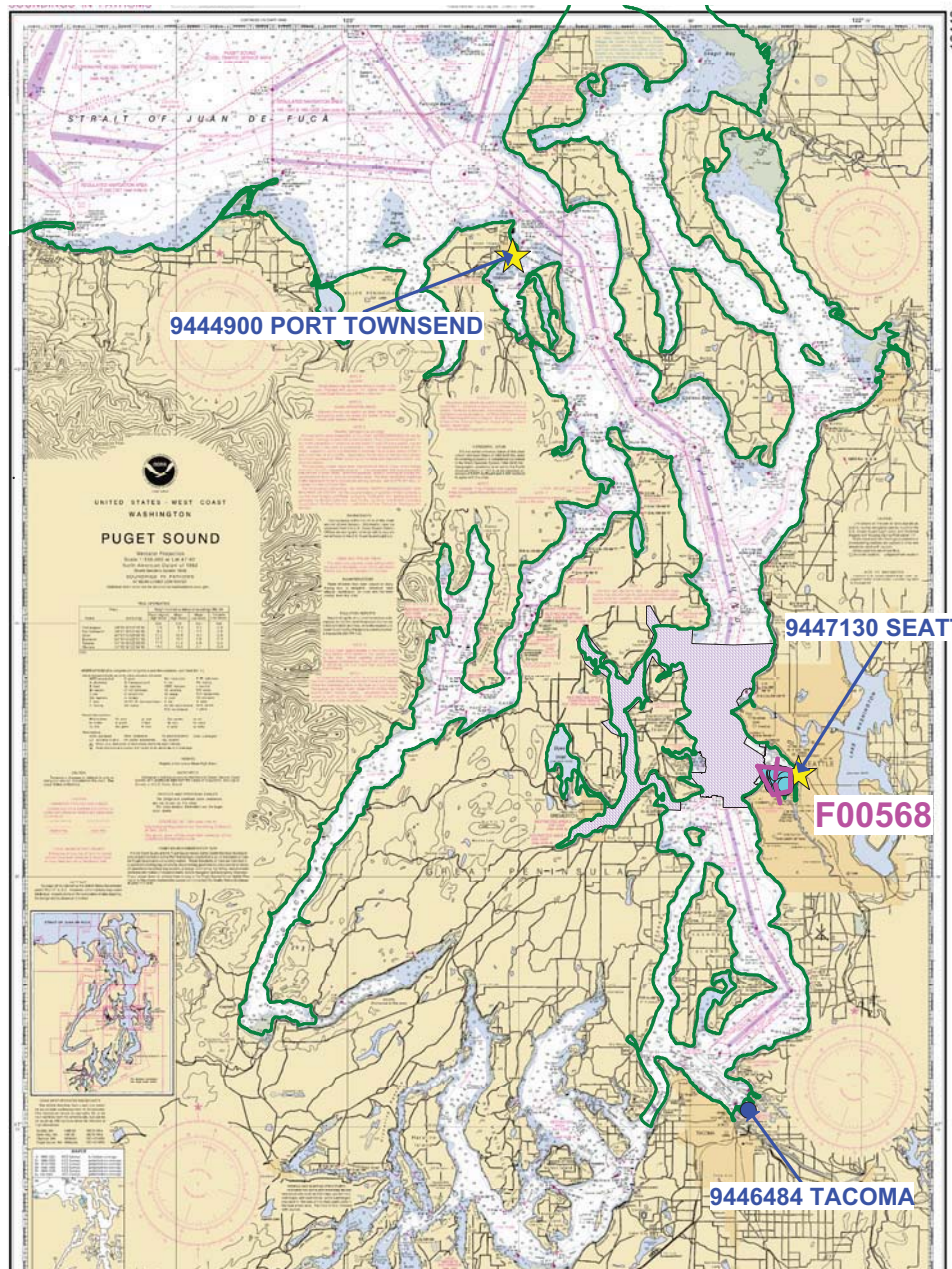
Peter J. Stone

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 14:14:22 -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

F00568 HCell Report
Keith H. Toepfer, Physical Scientist
Pacific Hydrographic Branch

1. Specifications, Standards and Guidance Used in HCell Compilation

HCell compilation of survey F00568 used:

Office of Coast Survey HCell Specifications: Draft, Version: 4.0, 17 March, 2010.
HCell Reference Guide: Version 2.0, 29 July, 2010.

2. Compilation Scale

Depths and features for HCell F00568 were compiled to the largest scale raster chart, shown below:

Chart	Scale	Edition	Edition Date	NTM Date
18450	1:10,000	18th	02/01/2004	08/28/2010

The following ENC was also used during compilation:

Chart	Scale
US5WA15M	1:10,000

3. Soundings

A survey-scale sounding (SOUNDG) feature object layer was built from the 4-meter Combined Surface in CARIS BASE Editor. A shoal-biased selection was made at 1:5,000 survey scale using a Radius Table file with values shown in the table, below.

Shoal Limit (m)	Deep Limit (m)	Radius (mm)
0	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 feet equivalent contour values are shown in the table below.

Chart Contour Intervals in Feet from Chart 18450	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 F00568_SS.000
30	9.144	9.3726	30.75	30
60	18.288	18.5166	60.75	60
300	91.44	91.6686	300.75	300

The shoalest measured depth in the survey area was 28.87 ft, the deepest measured depth was 390.09 ft, and no shoreline features were submitted with the data. Therefore there will be no conflicts between contours and shoreline.

5. Meta Areas

The following Meta object area is included in HCell F00568:

M_QUAL

The Meta area object was constructed on the basis of the limits of the hydrography.

6. Features

No feature file was submitted by the field unit, however, a Pydro Feature Report was submitted listing two (2) charted features and two (2) new features. The two charted features have been updated based on the new survey data and are included in the HCell. The first of the new features reported is not included in the HCell because it was determined that the depth was not outstanding with respect to the surrounding depths and therefore is not an obstruction. The second of the new obstructions is included in the HCell. With the exception of the features noted above, all other features were imported from the ENC.

7. S-57 Objects and Attributes

The *_CS HCell contains the following Objects:

\$CSYMB	Blue notes
M_QUAL	Data quality meta object
OBSTRN	Obstruction point objects imported into the HCell from the ENC
SBDARE	Bottom samples imported into the HCell from the ENC
SOUNDG	Soundings at the chart scale density
WRECKS	Wreck
MORFAC	Mooring buoys (privately owned)

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

F00568 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

F00568_CS.000	Base Cell File, Chart Units, Soundings and features compiled to 1:10,000
F00568_SS.000	Base Cell File, Chart Units, Soundings and Contours compiled to 1:5,000
F00568_DR.pdf	Descriptive Report including end notes compiled during office processing and certification, the HCell Report, and supplemental items
F00568_outline.gml	Survey outline
F00568_outline.xsd	Survey outline

11.2 Software

CARIS HIPS Ver. 7.0, SP1	Inspection of Combined BASE Surfaces
CARIS BASE Editor Ver. 2.3	Creation of soundings and bathy-derived features, creation of the meta area object, and blue notes; Survey evaluation and verification; Initial HCell assembly.
CARIS S-57 Composer Ver. 2.1	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, SP 1	Validation of the base cell file.
Northport Systems, Inc., Fugawi View ENC Ver.1.0.0.3	Independent inspection of final HCells using a COTS viewer.

12. Contacts

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

Keith H. Toepfer
Physical Scientist
Pacific Hydrographic Branch
Seattle, WA
206-526-6877
Keith.Toepfer@noaa.gov.

APPROVAL SHEET
F00568

Initial Approvals:

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 disproof 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.