

W00166-W00169

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.

Registry No. **W00166-W00169**

LOCALITY

State **Washington**

General Locality **Puget Sound**

Sublocality **Hood Canal and Dabob Bay**

.....
2002
.....

CHIEF OF PARTY
.....
Maxim F. Van Norden

LIBRARY & ARCHIVES

DATE

HYDROGRAPHIC TITLE SHEET

W00166-

W00169

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.

State Washington

General Locality Puget Sound

Sublocality Hood Canal and Dabob Bay

Scale 1:10,000

Date of Survey 6/22/2002 - 9/9/2002

Instructions Dated _____

Project No. _____

Vessel USNS John McDonnell (T-AGS 51)

Chief of Party Maxim F. Van Norden

Surveyed by U.S. Naval Hydrographic Office

Soundings taken by echo sounder, hand lead, pole Simrad EM 1002, EM 3000

Graphic record scaled by Fleet Survey Team

Graphic record checked by Fleet Survey Team

Evaluation by M Andring, T Faulkes Automated plot by N/A

Verification by Physical Scientist: M Andring, T Faulkes Cartographer: R. Shipley

Soundings in meters at MLLW

REMARKS: Revisions and annotations appearing as endnotes were generated during office processing.

As a result, page numbers may be out of order or non-sequential.

All depths listed in this report are referenced to mean lower low water unless otherwise noted.

UTM Zone 10



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
OFFICE OF COAST SURVEY
Pacific Hydrographic Branch
Seattle, Washington 98115-6349

May 29, 2009

MEMORANDUM TO: Captain John E. Lowell, NOAA
Chief, Marine Chart Division

THROUGH: Jeffrey Ferguson
Chief, Hydrographic Surveys Division

FROM: Captain David O. Neander, NOAA
Chief, Pacific Hydrographic Branch

SUBJECT: Approval Memorandum for W00166-W00169
Hood Canal, Washington

The Pacific Hydrographic Branch has completed an evaluation and chart application of Outside Source Data from the Naval Oceanographic Office (W00166 – W00169). These surveys were conducted at the request of the Naval Undersea Warfare Center (NUWC) at Keyport, Washington in support of the National UUV (Unmanned Underwater Vehicle) and Evaluation Center (NUTEC). The primary mission was to collect multibeam and side scan sonar imagery. Side scan data was not submitted for evaluation.

I have reviewed the data, reports and compilation to the chart. Lack of full resolution data and incomplete documentation on survey methods, applied correctors, vessel configurations and data processing procedures does not allow for a comprehensive Quality Assurance Review. Thus, data has only been used to chart soundings and depth curves representing general bathymetric trends and to update charted shoal depths. Data from W00166 - W00169 were not used to supersede shoaler charted soundings and features.

Within the 2008 NOAA Hydrographic Survey Priorities (NHSP), portions of Hood Canal which coincide with surveys W00166 – W00169 are listed as “Priority 3” and “Priority 4” areas. Except where noted in the Evaluation and Quality Assurance Memorandum and Chart Application Memorandum, surveys W00166 – W00169 provided adequate depth information. However, given the lack of quality control and associated documentation, it cannot be stated definitely that object detection criteria were met and that accurate least depths on all new and charted features were obtained. Additional fieldwork including side-scan and/or multibeam surveys of AWOIS items, approaches to harbors and potential anchorage areas is recommended as resources allow in order to complete bottom search and object detection requirements. It is recommended that the area encompassing surveys W00166-W00169 remain classified as “Priority 3” and “Priority 4” areas.

As full bottom coverage and object detection requirements could not be verified, the survey area should be classified as Category of Zone of Confidence (CATZOC) “B” if used to update ENC survey area classification (Seafloor Coverage: Full seafloor coverage not achieved; uncharted features, hazardous to surface navigation are not expected but may exist. Typical Survey Characteristics: Controlled, systematic survey to standard accuracy.).

cc: Chief, HSD Operations Branch N/CS31





UNITED STATES DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

NATIONAL OCEAN SERVICE OFFICE OF COAST SURVEY

Pacific Hydrographic Branch Seattle, Washington

98115-6349

January 6, 2009

MEMORANDUM TO: Captain David Neander, NOAA
Chief, Pacific Hydrographic Branch

FROM: Matt Andring and Tyanne Faulkes
Hydrographic Survey Interns

SUBJECT: Review of Outside Source Data Surveys W00166-W00169
U.S. Naval Oceanographic Office (NAVOCEANO)
Puget Sound, Hood Canal and Dabob Bay

I have reviewed outside source hydrographic surveys W00166 to W00169 with regard to data integrity and completeness of the data submission package, survey field procedures, data processing and quality assurance methods, and overall data accuracy and data quality. Surveys W00166 to W00169 comply with specifications and requirements set forth in the NOS Hydrographic Surveys Specifications and Deliverables Manual, with the following exceptions:

- Data were supplied to PHB in gridded ASCII .xyz and Fledermaus formats, which cannot be opened in Caris HIPS and SIPS. Data were reviewed in Fledermaus and Mapinfo. Full resolution data, as defined in HSSDM 8.5.3, were not supplied.
- Final approved water levels were not applied to the data. Data were corrected using predicted water levels.

Special attention should be given to the following:

- Refer to the Hydrographic Survey Outside Source Data Quality Assurance Checklist for specific charting recommendations.
- Bottom Samples are included in Excel files located in Appendix 6 of the Documentation folder.
- One DTON was found during office processing. See checklist and DTON report for details.

Final Recommendations:

- The data should be used to chart soundings and depth curves representing general bathymetric trends, and new shoals and features that are not currently depicted on NOAA charts 18440, 18441, 18445, 18458, and 18476.
- The data should not be used to supersede near shore features such as wrecks, rocks, obstructions, foul areas or coral reefs.
- The charted shoreline should be retained as charted.

Reviewed and approved: _____

PS Kurt Brown, NOAA
Acting Hydrographic Team Leader, PHB



UNITED STATES DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

NATIONAL OCEAN SERVICE OFFICE OF COAST SURVEY

Pacific Hydrographic Branch Seattle, Washington

98115-6349

May 28, 2009

MEMORANDUM TO: Captain Dave O. Neander
Chief, Pacific Hydrographic Branch

FROM: Rick Shipley
Cartographer, Pacific Hydrographic Branch

SUBJECT: Application of Outside Source Data Surveys
W00166-W00169
U.S. Naval Oceanographic Office
USNS John McDonnell (T-AGS 51)

I concur with all recommendations by the reviewers Matt Andring and Tyanne Faulkes except where noted in their reports.

Summary of compilation:

- soundings, curves and features applied
- no rocks, shoals were superseded
- shoreline was retained as charted
- bottom characteristics were retained
- recommend aids to navigation be updated with the latest information
- no additional Dangers to Navigation were found during compilation

It is recommended that OSD surveys W00166-W00169 supersede charted information within the common area and applied to charts 18458, 18476, and 18477.

Record of Application to Charts is attached.

Review and Approved _____
Gary Nelson, Cartographer Team Leader
Pacific Hydrographic Branch



Title:

HYDROGRAPHIC SURVEY OUTSIDE SOURCE DATA QUALITY ASSURANCE CHECKLIST

Page #:

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Registry No: _____

State: _____

General Locality: _____

Sub Locality: _____

Dates of Survey: _____

OSD Supplier: _____

OSD Project No: _____

Reviewer: _____

Review Date: _____

I. DATA INVENTORY

A. Reports

| Report Type | Format | Document Title | Date |
|--|--------|----------------|------|
| Descriptive Report or equivalent | | | |
| Data Acquisition and Processing Report or equivalent | | | |
| Horizontal and Vertical Control Report or equivalent | | | |
| System Certification Report or Equivalent | | | |
| Other | | | |

B. Data

| Data Type | Format | Description (Raw, Processed) |
|-----------------------------|--------|------------------------------|
| Smooth Sheet Sounding Plots | | |
| XYZ ASCII Files | | |
| Multibeam | | |
| Side Scan Sonar | | |
| LIDAR | | |
| Single Beam | | |



Title:

HYDROGRAPHIC SURVEY OUTSIDE SOURCE DATA QUALITY ASSURANCE CHECKLIST

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II. DATA ACQUISITION AND PROCESSING

A. System Calibrations and/or Certifications

_____ A sensor offset and alignment survey was conducted to NOAA HSSDM requirements

_____ Offset values provided

_____ Patch tests were conducted for shallow-water multibeam systems

_____ Alignment bias and latency values provided

_____ Draft measurements were conducted

_____ Static Draft _____ Dynamic Draft _____ Loading

_____ Draft values were provided

_____ Sensors were calibrated in accordance with manufacturer requirements and NOAA specifications

_____ Calibration reports were provided.

B. Sound Velocity Corrections

_____ Sound velocity sampling regimen is in accordance with NOAA HSSDM requirements

_____ Sound velocity profiles were supplied

_____ All profiles appear valid

C. Water Levels

_____ Water level measuring equipment and methods are consistent with NOAA equipment and methods and are capable of meeting specifications

Equipment / method used: _____

_____ Tide corrector files were supplied

_____ All tide correctors appear valid

_____ Water level correctors applied to sounding data

_____ Verified _____ Observed _____ Predicted _____ NOAA Zoning _____ Other zoning

_____ Water level error estimate provided by CO-OPS

Water level / zoning error estimate: _____



Title:

HYDROGRAPHIC SURVEY OUTSIDE SOURCE DATA QUALITY ASSURANCE CHECKLIST

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E. Survey Methodology

_____ The surveyor has conducted adequate quality control of horizontal positioning data

_____ DTM, BASE surface, and/or mosaics indicate that seafloor coverage requirements (per NOAA HSSDM) were met and no significant coverage holidays exist.

_____ All least depths over shoals, wrecks, rocks, obstructions, and other features have been determined

_____ The Hydrographer has conducted the required quantity of cross lines, or acquired sufficient redundant data, in accordance with the HSSDM, to assess internal data consistency.

F. Data Processing and Quality Control

_____ An adequate description of data processing and quality control methods is provided in documentation.

Processing software used: _____

_____ Data processing methodology is robust enough and adequate to provide a dataset suitable for charting.

_____ Data have been reviewed and are cleaned appropriately with no noise, fliers, or systematic errors noted.

_____ Crossline agreement or redundant data overlap has been visually inspected by the hydrographer

_____ Disagreements have been noted

_____ A Chart comparison was conducted by the hydrographer

_____ Disagreements have been noted.



Title:

HYDROGRAPHIC SURVEY OUTSIDE SOURCE DATA QUALITY ASSURANCE CHECKLIST

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III. DATA QUALITY AND RESULTS

A. Internal Data Consistency

- _____ Full resolution data was provided in order to gauge the adequacy of cleaning and/or processing of the data.
- _____ A review of the data reveals no positioning errors exceeding NOAA specifications
- _____ Crossline agreement or redundant data overlap shows no disagreements exceeding NOAA HSSDM tolerances.
- _____ Anomalous data (fliers, noise, etc) were apparent in the BASE surface, DTM, and/or selected sounding set.
- _____ Are there any tide errors exceeding NOAA HSSDM requirements observable in the data
- _____ Are there any observable SV errors exceeding NOAA HSSDM accuracy standards.
- _____ All shoals are valid (no fliers) and the proper least depth has been retained.
- _____ Where multiple systems, platforms, and/or sensors were used, junctioning or overlapping data agree within NOAA HSSDM tolerance between platforms.
- _____ Any statistical assessment of the data (e.g. BASE standard deviation, QC reports, etc) indicate that data agree within NOAA HSSDM tolerances.

B. Error Budget Analysis

- _____ An error budget analysis was provided by the surveyor
 - _____ The error budget analysis indicates that data are capable of meeting NOAA HSSDM standards
 - _____ The evaluator concurs with the provided error budget analysis
- _____ The evaluator has conducted an error budget analysis
 - _____ The error budget analysis indicates that data are capable of meeting NOAA HSSDM standards

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

- _____ AWOIS Items are located within the limits of the survey.
 - _____ AWOIS Items can be sufficiently confirmed or disproved using data from this survey (Attach AWOIS pages to the certification memorandum.).



Title:

HYDROGRAPHIC SURVEY OUTSIDE SOURCE DATA QUALITY ASSURANCE CHECKLIST

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E. Dangers to Navigation

- _____ Dangers to Navigation (DTONs) were selected and submitted by the surveyor / data provider
- _____ DTONs have been verified by the office evaluator.
- _____ Additional DTONs were noted during office evaluation and submitted

F. Aids to Navigation

- _____ Aids to Navigation (ATONs) were positioned during this survey
- _____ New ATONS were positioned during this survey
- _____ Survey positions match charted positions
- _____ The surveyor / data provider issued DTONs or notified the USCG for any ATON discrepancies
- _____ ATON discrepancies were noted during office evaluation and submitted as DTONs.

G. Shoreline and Bottom Samples

- _____ The shoreline (MHW and/or MLLW lines) were included as part of this survey
- _____ Surveyed shoreline matches charted shoreline
- _____ Surveyed shoreline compares with NGS/RSD source data
- _____ Surveyed shoreline should be used to revise nautical charts
- _____ Shoreline features were positioned during this survey
- _____ Surveyed features match charted shoreline
- _____ Surveyed features compares with NGS/RSD source data
- _____ Surveyed features should be used to revise nautical charts
- _____ Bottom samples were acquired during this survey
- _____ Bottom sample spacing was in accordance with NOAA HSSDM requirements
- _____ Bottom samples should be used to update NOAA charts



Pacific Hydrographic Branch

Document #:

PHB-QA-03

Rev.:

1

Title:

**HYDROGRAPHIC SURVEY OUTSIDE SOURCE DATA QUALITY ASSURANCE
CHECKLIST**

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IV. COMMENTS

DTON Report for Survey W00168

Registry Number: W00168
State: Washington
Locality: Puget Sound
Sub-locality: Dabob Bay
Project Number: OSD-PHB-06
Survey Date: 06/20/2002

Charts Affected

| Number | Edition | Date | Scale (RNC) | RNC Correction(s)* |
|--------|---------|------------|-----------------------|---|
| 18458 | 16th | 07/01/2006 | 1:25,000 (18458_1) | [L]NTM: ? |
| 18476 | 5th | 02/01/2004 | 1:40,000 (18476_2) | USCG LNM: 06/03/2008 (06/03/2008) CHS NTM: None (05/30/2008) NGA NTM: 09/20/2003 (06/07/2008) |
| 18445 | 32nd | 08/01/2007 | 1:80,000 (18445_14) | [L]NTM: ? |
| 18441 | 46th | 12/01/2007 | 1:80,000 (18441_1) | [L]NTM: ? |
| 18440 | 29th | 10/01/2007 | 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 | 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 | Rock | 7.10 m | 47° 43' 26.0" N | 122° 52' 31.0" W | --- |

1 - Danger To Navigation

1.1) GP No. - 1 from W00168_dtons.xls**DANGER TO NAVIGATION****Survey Summary**

Survey Position: 47° 43' 26.0" N, 122° 52' 31.0" W
Least Depth: 7.10 m (= 23.29 ft = 3.882 fm = 3 fm 5.29 ft)
TPU ($\pm 1.96\sigma$): THU (TPEh) [None] ; TVU (TPEv) [None]
Timestamp: 2002-171.09:32:47.000 (06/20/2002)
GP Dataset: W00168_dtons.xls
GP No.: 1
Charts Affected: 18458_1, 18476_2, 18441_1, 18445_14, 18440_1, 18003_1, 18007_1, 501_1, 530_1, 50_1

Remarks:

A 7.1 meter (4 fathom) sounding on a submerged rock was found during office processing of NAVY Outside Source Data Survey W00168. This is a 2002 multibeam survey. The sounding was verified in Fledermaus. No CARIS data was submitted with this survey.

Feature Correlation

| Address | Feature | Range | Azimuth | Status |
|------------------|---------|-------|---------|---------|
| W00168_dtons.xls | 1 | 0.00 | 000.0 | Primary |

Hydrographer Recommendations

Chart 4 fathom submerged rock at position of feature.

Cartographically-Rounded Depth (Affected Charts):

3 ¾fm (18441_1, 18440_1, 18003_1, 18007_1, 530_1)

3fm 5ft (18458_1, 18476_2, 18445_14)

7.1m (501_1, 50_1)

S-57 Data

Geo object 1: Underwater rock / awash rock (UWTROC)
Attributes: SORDAT - 20020620
 SORIND - US,US,surve,W00168

VALSOU - 7.1 m

WATLEV - 3:always under water/submerged

Feature Images

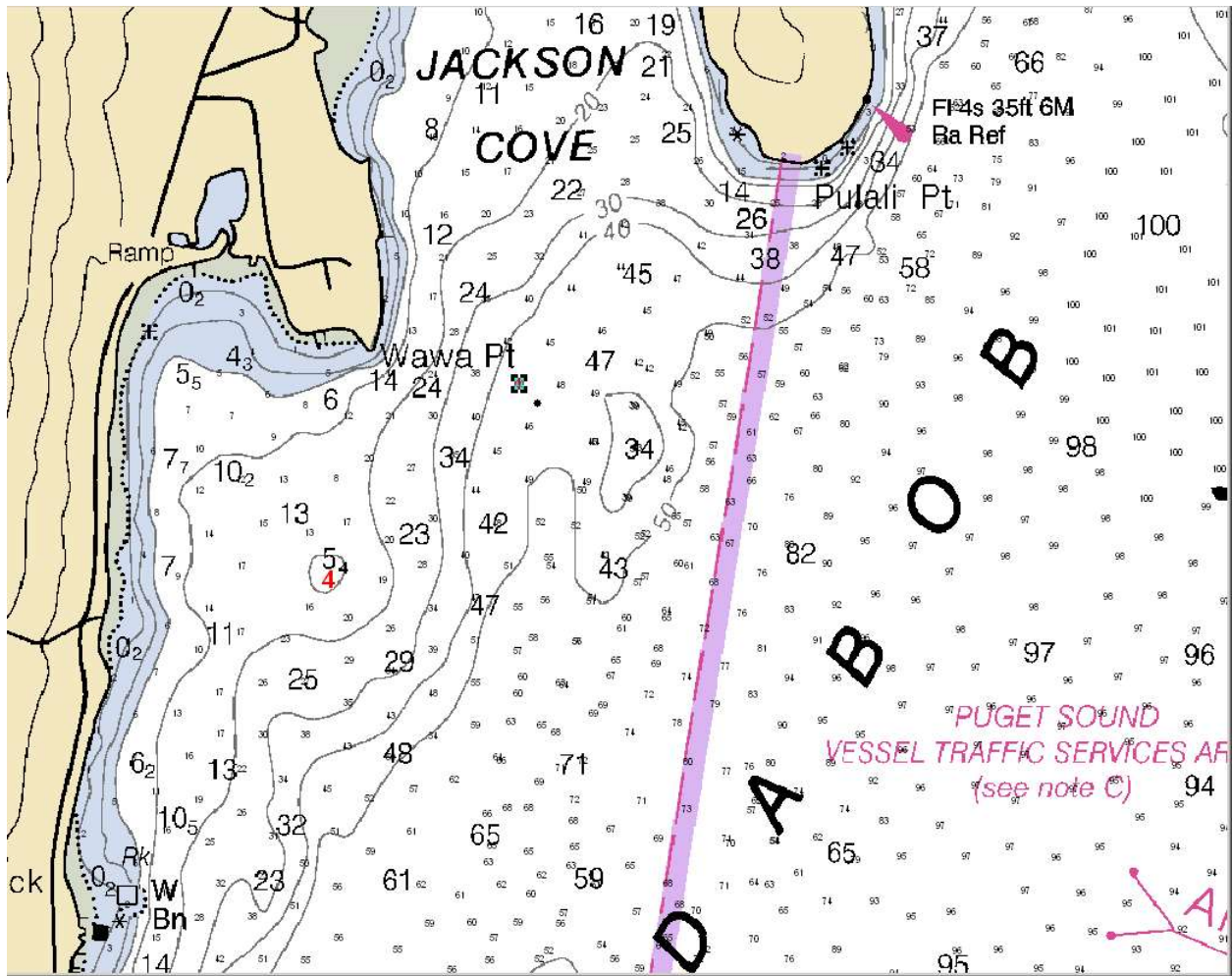


Figure 1.1.1

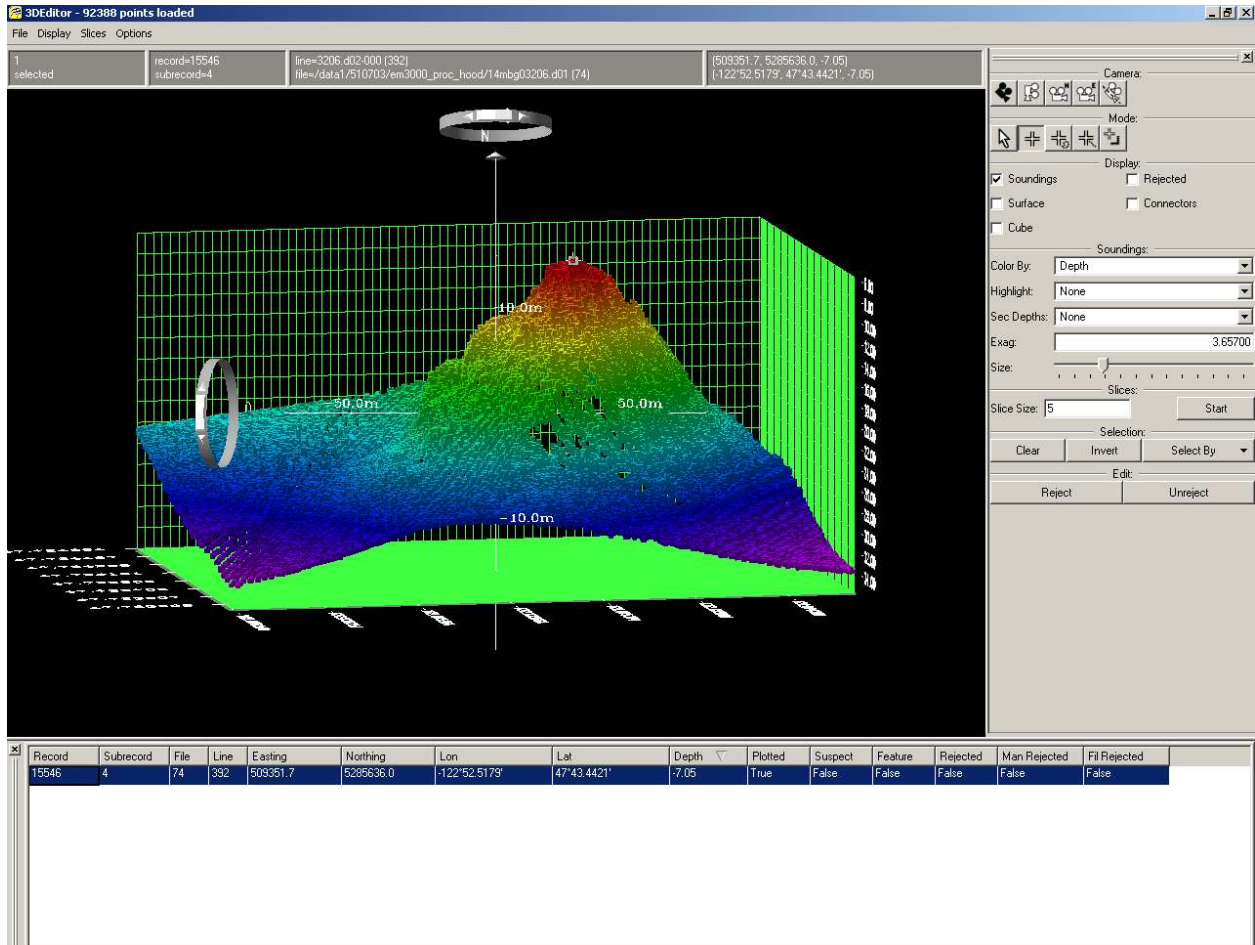


Figure 1.1.2

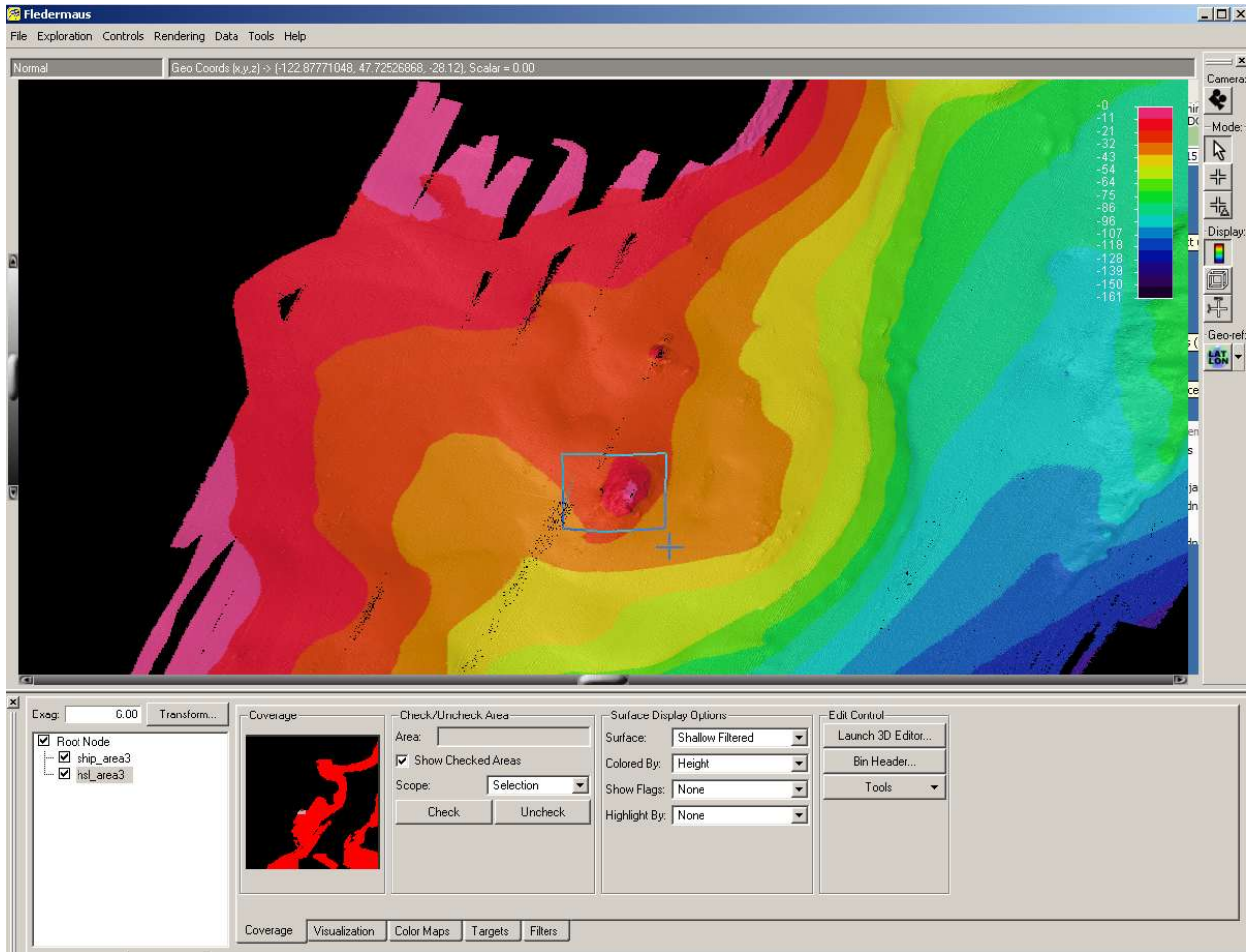


Figure 1.1.3

**Quality Review Summary for, Hood Canal and Dabob Bay,
Washington, U.S.A. (02US13)**

| | |
|--|-----------|
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1.0 Document History:

Initial QA Summary completed on 12 February 2004.
Final QA Summary completed on 25 October 2004.

2.0 Cruise Information:

Vessel: USNS JOHN MCDONNELL (T-AGS 51)
Detachment: NAVOCEANO DET 124
Country: United States of America
Areas: Hood Canal and Dabob Bay
SURVOPs: 510702, 510802, 510902, 510503, 510603, 510703, and 510803
Dates of Survey: 22 June – 22 August 2003
Archive Number: 02US13
Tech Specs: Technical Specifications TS-02-HYD-22 Hydrographic Survey for U.S.A. (CONUS) Hood Canal/Dabob Bay, Washington Area, Revision 15 April 2003.

3.0 Survey Crews:

| SURVOP | Dates | SNR | System Manger |
|---------------|------------------------------|--------------------|----------------------|
| 510702 | 22 June - 14 July 2002 | Giovanni B. Morris | John Brusstar |
| 510802 | 19 July - 12 August 2002 | John Iwachiw | Diane Meadows |
| 510902 | 16 August - 9 September 2002 | John Iwachiw | Diane Meadows |
| 510503 | 13 May – 23 May 2003 | Dave A. Somers | Jeffery C. Stadalis |
| 510603 | 15 June – 20 June 2003 | Dale A. Hare | Gail Smith |
| 510703 | 13 July – 31 July 2003 | John Iwachiw | Stephen Farr |
| 510803 | 10 August – 22 August 03 | John Iwachiw | Stephen Farr |

4.0 General:

NAVOCEANO DET 124, NAVOCEANO representatives at the request of the Naval Undersea Warfare Center (NUWC) conducted survey operations South from N47-53-00 and North of N47-37-49; or from above the Hood Canal Bridge South to Chinom Point, including Dabob Bay. These surveys were in support of the National UUV (Unmanned Underwater Vehicle) and Evaluation Center (NUTEC).

4 smooth sheets were generated for this survey:

| | | |
|---------------------------|----------|-----------|
| Hood Canal Bridge | Sheet 01 | 1: 25,000 |
| Hood Canal & Dabob Bay | Sheet 02 | 1: 25,000 |
| Dabob Bay | Sheet 03 | 1: 25,000 |
| Hood Canal & Chinom Point | Sheet 04 | 1: 25,000 |

5.0 Requirements:

Side scan sonar coverage was required for all water depths in all areas. All areas dangerous to both surface and subsurface navigation, including doubtful soundings, shoals and wrecks, whether discovered during the survey or appearing on existing charts, were to be fully investigated in accordance with HP 6.4.3 "Investigation of Shoals, Seabed Features, and Submerged Hazards," October 1988.

6.0 Side Scan Data Collection:

Klien 5000 and DATASONICS dual frequencies SSS were utilized along with GEODAS Data Acquisition software. The SSS data was processed with the UNISIPS software.

SURVOP 510802: The Unmanned Underwater Vehicle (UUV) Seahores test was implemented. The test area starts from the confluence of Dabob Bay and the Hood Canal around the Toandos Peninsula to PSB Bangor Delta Pier.

SURVOP 510902: Main scheme lines were ran at 75-meter range scale, with alternating azimuths of 225 and 045 degrees. A near bridge corridor approximately 600 meters north and south of the bridge itself was surveyed at 100-meter line spacing with 150-meter range scale to maximize coverage as close to the bridge as possible. The central passage was side scanned at 150-range scale.

SURVOP 510503: SSS was operated in depths to approximately 45meters. Main scheme lines were run at 40 meters line spacing and a range scale of 75 meters were used to ensure nadir coverage. This survey achieved a coverage of 200 percent or better.

SURVOP 510603: SSS was operated using a range scale of 75 meters in the entire area.

SURVOP 510703 and 510803: SSS requirements were modified. The modifications included to complete multibeam portion of the survey and then identify the SSS coverage. 120 percent multibeam coverage was achieved.

DABOB BAY: 100 percent SSS coverage was not achieved due to lack of survey time. The portion of area affected includes the area North of the White Cable Buoy to Tabok Point.

HOOD CANAL BRIDGE: 100 percent or better SSS coverage was achieved.

HOOD CANAL: 100 percent or better SSS coverage was achieved.

7.0 In-House Side Scan Sonar Target Verification:

In-House Side Scan Target verification was completed by comparing existing documentation with plotted smooth sheets.

8.0 Sounding Collection:

510802: Development line spacing was 100 meters. The UUV seahores data was collected at 50 meter lines spacing.

SURVOPS 510503, 510603: Development line spacing was 40 meters in shallow water were the SSS was towed, and at variable line spacing in waters over 40 meters to obtain better than 120 percent coverage by EM3000 multibeam sonar on board the HSLs.

SURVOPS 510703, 510803: 200 percent multibeam coverage was achieved.

9.0 Cross Check Lines:

Generally no crosschecks were completed due to either the lack of maneuverability by the main platform or due to the HSL multibeam system limitations because of the greater depths.

510503 and 510603: Crosschecks ten times the nominal 40 meter lines spacing.

10.0 Sounding Verification:

Soundings were verified in the field by comparison of the multibeam values with singlebeam values during data collection which were in agreement. Another sounding verification was completed in house which included the use of the Area Based Editor. Sounding were verified by ingesting the data into the CARIS EDITOR and compared to existing charts. Finally, soundings were reviewed by the Hydrographic Inspection Team.

11.0 Calibration (s):

| SURVOP | System | Platform | Cal.Dates | Position | Max. Port/Starboard Angle | Cal. Depth Range (m) | Sensor Location Forward(x) | Sensor Location Starboard(y) | Sensor Location Downward(z) | Sensor Location Transducer Waterline (m) |
|--------|--------|----------|-----------------|------------------|---------------------------|----------------------|----------------------------|------------------------------|-----------------------------|--|
| 510702 | EM1002 | SHIP | 23-Jun-02 | ? | ?? | ?? | ?? | ?? | ?? | ?? |
| 510702 | EM1002 | SHIP | 9-Jul-04 | ? | ?? | ?? | ?? | ?? | ?? | ?? |
| 510802 | EM1002 | SHIP | 23-25 July 2002 | N47 47, W 122 44 | 55/55 | 41-120 | 0.75 | 2.38 | 5.26 | 0.89 |
| 510902 | EM1002 | SHIP | 26-27 Aug 2002 | ? | ?? | ?? | ?? | ?? | ?? | 1.09 |
| 510703 | EM1002 | SHIP | 14-Jul-03 | N47 40, W 122 47 | 55/55 | 50-120 | 0.75 | 2.38 | 5.26 | 0.82 |
| 510702 | EM3000 | HSL013 | ?? | ?? | ?? | ?? | ?? | ?? | ?? | ?? |
| 510802 | EM3000 | HSL013 | 31-Jul-02 | N47 47, W 122 44 | 60/60 | 41-120 | 2.14 | 1.08 | -1.18 | -0.82 |
| 510503 | EM3000 | HSL013 | 13-May-03 | ? | ? | ? | ? | ? | ? | ? |
| 510703 | EM3000 | HSL013 | 15-Jul-03 | N47 40, W 122 47 | 65/65 | 50-120 | -2.14 | 1.08 | -1.18 | -0.82 |
| 510702 | EM3000 | HSL014 | ?? | ?? | ?? | ?? | ?? | ?? | ?? | ?? |
| 510802 | EM3000 | HSL014 | 25-Jul-02 | N47 47, W 122 44 | 60/60 | 41-120 | -2.14 | 1.13 | -1.17 | -0.79 |
| 510503 | EM3000 | HSL014 | 13-May-03 | ? | ? | ? | ? | ? | ? | ? |
| 510703 | EM3000 | HSL014 | 15-Jul-03 | N47 40, W 122 47 | 65/65 | 41-120 | -2.14 | 1.13 | -1.17 | -0.79 |

Table 1.

| SURVOP | System | Platform | Cal.Dates | Position | Max. Port/Starboard Angle | Cal. Depth Range (m) | Installation Angle Transducer, Roll (deg) | Installation Angle Transducer, Pitch (deg) | Installation Angle Transducer, Heading (deg) |
|--------|--------|----------|-----------------|------------------|---------------------------|----------------------|---|--|--|
| 510702 | EM1002 | SHIP | 23-Jun-02 | ? | ?? | ?? | ?? | ?? | ?? |
| 510702 | EM1002 | SHIP | 9-Jul-04 | ? | ?? | ?? | ?? | ?? | ?? |
| 510802 | EM1002 | SHIP | 23-25 July 2002 | N47 47, W 122 44 | 55/55 | 41-120 | -0.37 | 0 | 0 |
| 510902 | EM1002 | SHIP | 26-27 Aug 2002 | ? | ?? | ?? | ?? | ?? | ?? |
| 510703 | EM1002 | SHIP | 14-Jul-03 | N47 40, W 122 47 | 55/55 | 50-120 | -0.37 | 0 | 0 |
| 510702 | EM3000 | HSL013 | ?? | ?? | ?? | ?? | ?? | ?? | ?? |
| 510802 | EM3000 | HSL013 | 31-Jul-02 | N47 47, W 122 44 | 60/60 | 41-120 | 0 | 2.53 | 0 |
| 510503 | EM3000 | HSL013 | 13-May-03 | ? | ? | ? | ? | ? | ? |
| 510703 | EM3000 | HSL013 | 15-Jul-03 | N47 40, W 122 47 | 65/65 | 50-120 | 0 | 2.53 | 0 |
| 510702 | EM3000 | HSL014 | ?? | ?? | ?? | ?? | ?? | ?? | ?? |
| 510802 | EM3000 | HSL014 | 25-Jul-02 | N47 47, W 122 44 | 60/60 | 41-120 | 0 | 2.53 | 0 |
| 510503 | EM3000 | HSL014 | 13-May-03 | ? | ? | ? | ? | ? | ? |
| 510703 | EM3000 | HSL014 | 15-Jul-03 | N47 40, W 122 47 | 65/65 | 41-120 | 0 | 2.53 | 0 |

Table 2.

| SURVOP | System | Platform | Cal.Dates | Position | Max. Port/Starboard Angle | Cal. Depth Range (m) | Motion Sensor, Roll (deg) | Motion Sensor, Pitch (deg) | Motion Sensor, Heading (deg) | Motion Sensor, Time (s) | Outer Beam (deg) |
|--------|--------|----------|-----------------|------------------|---------------------------|----------------------|---------------------------|----------------------------|------------------------------|-------------------------|------------------|
| 510702 | EM1002 | SHIP | 23-Jun-02 | ? | ?? | ?? | -0.08 | 0 | 0 | 0 | 0.06 |
| 510702 | EM1002 | SHIP | 9-Jul-04 | ? | ?? | ?? | -0.08 | 0 | 0 | 0 | 0.15 |
| 510802 | EM1002 | SHIP | 23-25 July 2002 | N47 47, W 122 44 | 55/55 | 41-120 | -0.08 | 0 | 0 | 0 | 0.63 |
| 510902 | EM1002 | SHIP | 26-27 Aug 2002 | ? | ?? | ?? | ?? | ?? | ?? | ?? | ?? |
| 510703 | EM1002 | SHIP | 14-Jul-03 | N47 40, W 122 47 | 55/55 | 50-120 | -0.09 | 0 | 0 | 0 | 0.27 |
| 510702 | EM3000 | HSL013 | ?? | ?? | ?? | ?? | ?? | ?? | ?? | ?? | ?? |
| 510802 | EM3000 | HSL013 | 31-Jul-02 | N47 47, W 122 44 | 60/60 | 41-120 | 0.36 | 0.3 | 0 | 0 | ?? |
| 510503 | EM3000 | HSL013 | 13-May-03 | ? | ? | ? | 0.26 | 0 | 0 | 0 | ?? |
| 510703 | EM3000 | HSL013 | 15-Jul-03 | N47 40, W 122 47 | 65/65 | 50-120 | 0.26 | 0 | 0 | 0 | ?? |
| 510702 | EM3000 | HSL014 | ?? | ?? | ?? | ?? | ?? | ?? | ?? | ?? | ?? |
| 510802 | EM3000 | HSL014 | 25-Jul-02 | N47 47, W 122 44 | 60/60 | 41-120 | 0.17 | 0 | 0 | 0 | ?? |
| 510503 | EM3000 | HSL014 | 13-May-03 | ? | ? | ? | 0.17 | 0 | 0 | 0 | ?? |
| 510703 | EM3000 | HSL014 | 15-Jul-03 | N47 40, W 122 47 | 65/65 | 41-120 | 0.17 | 0 | 0 | 0 | ?? |

Table 3.

Table(s) 1-3, Summary: The above tables summarizes the calibrations values used for each survey operation (SURVOP). The cells with annotations of ? or ?? are values that are assumed the same as the previous survey values but were not documented in a report as such.

12.0 Smooth Sheet Production:

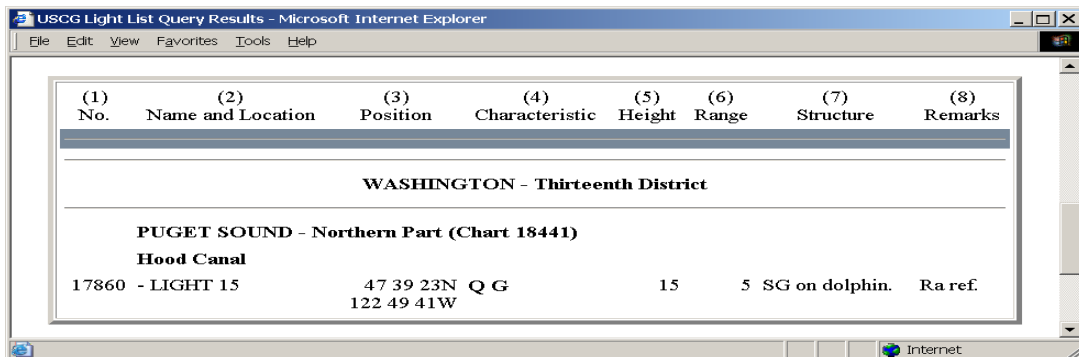
Comments/recommendations:

1. The side-scan contact file contains all of the relevant information needed, assuming that significant contacts which were developed and investigated further will appear on the smooth sheet with the appropriate symbol.

Recommendation is to add side-scan line/file name and image name to the contact spreadsheet, if a thumbnail image exists.

2. The following recommendation for Oak Head Light 15 Symbolization:

- to use " black circle with a small x inside (Carto Code 200)."
- 'Oak Head Light "15" (dol)'.



| (1) No. | (2) Name and Location | (3) Position | (4) Characteristic | (5) Height | (6) Range | (7) Structure | (8) Remarks |
|--|--------------------------|-------------------------|-----------------------|---------------|--------------|------------------|----------------|
| WASHINGTON - Thirteenth District | | | | | | | |
| PUGET SOUND - Northern Part (Chart 18441) | | | | | | | |
| Hood Canal | | | | | | | |
| 17860 | - LIGHT 15 | 47 39 23N 122 49 41W | Q G | 15 | 5 | SG on dolphin. | Ra ref. |

3. Switch to new Caris symbology file(s) (based on Chart 1).

1. This can be a scheduled switch:

- Systems not being used can be done first.
- Then as someone completes a project (and before starting another) their system can be updated.

Follow above process until all systems are updated, but we do not want to drag this out over a long time frame

because some systems are bound to be forgotten and never upgraded.

2. The other option is to just do every system at one time and then face the issues.

4. Color of light flares.

Use all purple, and distinguish the red lights from the green lights by using text of R or G, or make the flares either red or green. Both are correct under IHO, with the first being for standard charts and the second for multi-colored charts.

5. Distribution Statement Changes:

Presently, the Hood Canal data is held under distribution statement "D" as follows:

Distribution Statement D: Distribution limited to DOD and DOD contractors only. Administrative/Operational use (06 February 2004). Other requests must be referred to the Commanding Officer, Naval Oceanographic Office. This information may not be released to a third county/party without prior approval of the Commanding Officer, Naval Oceanographic Office.

Unless, we can change the distribution statement of the Hood Canal project, we will be unable to release the data to NOAA.

Since the Hood Canal project lies entirely shoreward of the sea buoy, (located at the mouth of the Strait of Juan de Fuca), it was recommended to change the distribution statement from "D" to "A", thereby making it available to NOAA. Similar projects with the distribution statements for Keyport (WA), Kings Bay (GA) and Norfolk (VA).

6. All other comments and recommendations were modified to reflect the sheets as they were being processed.

13.0 Extraneous activities affecting the survey:

1. PSB Bangor Navy Base and Dabob Range activities limited survey activities on several occasions. Coordination with both as required to complete specific areas and meet delivery schedules.
2. Admiralty Inlet, Hood Canal, and Dabob Bay areas have a dynamic environment with a diurnal tide ranging upwards of 3 meters at higher high tide. The average delta values range from 1.6 to 4.8, but values exceeding 8.0 have been noted.
3. Strong currents due to tidal effects resulted in running numerous Side Scan Sonar lines to eliminate holidays.
4. The lack of ability to maneuver the ship due to narrow confines of the Hood Canal.
5. Crab pots located in Dabob Bay area.

14.0 Geodetic Control:

Horizontal Datum: World Geodetic System of 1984
 Projection: Transverse Mercator
 Spheroid: World Geodetic System of 1984
 Grid: Universal Transverse Mercator (Zone 10: CM 123 degrees West)
 Vertical Datum: Mean Sea Level
 Sounding Datum: Mean Lower Low Water
 Note: Geodetic Reports do not exist.

15.0 Source of Shorelines:

Controlled Image Base (CIB) dataset with 5 meter resolution. The raster file is a shape (SHP) file.

16.0 Tide Gage Operation:

The following tidal stations are located in the survey area: Port Townsend, WA (9444900) and Seattle, Wa. (9447130). These tide stations are maintained by the National Oceanic and Atmospheric Administration (NOAA).

Predicted tidal data were used during real-time data collection. The zoning information for the Hood Canal and Dabob Bay survey areas were taken from the Seattle tide gauge. These zones included Zones 35, 37-41, and 97-98.

| TIDAL INFORMATION | | | | | | |
|--|--|-----------------|--------|----------------|-------------------|---|
| PLACE | Height referred to datum of soundings (MLLW) | | | | | <i>Tide</i> Characteristics |
| | Mean Higher High Water | Mean High Water | MSL | Mean Low Water | Extreme Low Water | MIXED TIDE, PREVAILING SEMI- DIURNAL |
| | meters | meters | meters | meters | meters | |
| Bangor Wharf N 47° 44' 54" W 122° 43' 36" | 3.4 | 3.1 | 2.00 | 0.9 | -1.5 | |
| Zelatched Point, Dabob Bay N 47° 42' 42" W 122° 49' 18" | 3.5 | 3.2 | 2.04 | 0.9 | -1.5 | |
| Seabeck N 47° 38' 30" W 122° 49' 42" | 3.5 | 3.2 | 2.07 | 0.9 | -1.5 | |
| Quilcene, Dabob Bay N 47° 48' 00" W 122° 51' 30" | 3.5 | 3.2 | 2.05 | 0.9 | -- | |

Table 4.

Table 4, Summary: In-house data compilation used the published bench marks to compute tidal datums and tide correctors: 1. Bangor Wharf (9445133), 2. Zelatched Point, Dabob Bay.(SY5492) 3. Seabeck(9445296), 4. Quilcene, Dabob Bay(9445272). These tidal benchmarks are maintained by NOAA.

17.0 Tides Accuracy:

The estimated error for Sutron observed tides is 0.1m (1 SIGMA), and for predicted tides is 0.2m (1 SIGMA).

18.0 Comparison with Existing Data:

Agreement with existing charts:

Data agreed well. Contours and depths are not considered hazardous to navigation.

Agreement with Prior Surveys

Data collected during SURVOPS 510702, 510802, and 510902 considerable agreed with data obtained during SURVOPS 510503 through 510803. However, disagreements are believed to be the result of using predicted tides. It was recommended to allow observed tides be acquired for the final correction of the sounding data.

19.0 Vertical Accuracy:

Draft Correction (Squat and Settlement).

| SURVOP | System | Platform | Sensor Location Transducer Forward(x) | Sensor Location Transducer Starboard(y) | Sensor Location Transducer Downward(z) | Sensor Location Transducer Waterline (m) | Draft Correction (m) |
|--------|--------|----------|---------------------------------------|---|--|--|----------------------|
| 510702 | EM1002 | SHIP | ?? | ?? | ?? | ?? | ?? |
| 510702 | EM1002 | SHIP | ?? | ?? | ?? | ?? | ?? |
| 510802 | EM1002 | SHIP | 0.75 | 2.38 | 5.26 | 0.89 | 6.15 |
| 510902 | EM1002 | SHIP | ?? | ?? | ?? | 1.09 | 6.35 |
| 510703 | EM1002 | SHIP | 0.75 | 2.38 | 5.26 | 0.82 | 6.08 |
| 510702 | EM3000 | HSL013 | ?? | ?? | ?? | ?? | ?? |
| 510802 | EM3000 | HSL013 | 2.14 | 1.08 | -1.18 | -0.82 | -2.00 |
| 510503 | EM3000 | HSL013 | ? | ? | ? | ? | ? |
| 510703 | EM3000 | HSL013 | -2.14 | 1.08 | -1.18 | -0.82 | -2.00 |
| 510702 | EM3000 | HSL014 | ?? | ?? | ?? | ?? | ?? |
| 510802 | EM3000 | HSL014 | -2.14 | 1.13 | -1.17 | -0.79 | -1.96 |
| 510503 | EM3000 | HSL014 | ? | ? | ? | ? | ? |
| 510703 | EM3000 | HSL014 | -2.14 | 1.13 | -1.17 | -0.79 | -1.96 |

Table 5.

Table 5 Summary: The draft correction is the sum of Sensor Location Transducer Downward (z) value from the EM1002 or EM3000 sensor and the value obtained by calculating the waterline value. Aboard the main platform (SHIP) the depth correction values range from 6.08 meters to 6.35 meters. Aboard hydrographic survey launch (HSL013) the value was constant at -2.00 meters. Aboard the hydrographic survey launch (HSL014) the value was constant at -1.96 meters. Again, the cells with the annotations of ? or ?? values are assumed not changed from previous survey values but were not documented as such.

Instrument Error (Bar Checks). Bar checks not conducted or were not required.

Sound Velocity Correction.

Sound velocity profiles were generated to analyze the temperature and salinity gradients to include the entire area and all depth ranges. Soundings are corrected for sound speed variations with an estimated error, based on N3221 study, of 0.02 meters (1 SIGMA).

Heave Corrections.

Soundings were corrected for heave, pitch and roll via the POS/MV system.

Slope.

The effects of slope on these calculations are negligible.

Roll and Pitch.

The effects of roll and pitch are compensated for in the multi-beam data. The POSMV monitors roll, pitch, and heave which corrects the soundings accordingly.

Multi-beam Accuracy.

The sounding data collected during this survey was required to meet IHO Order 1 standards.

IHO depth accuracy

| Depth (m) | ORDER 1 Requirement (m) |
|-----------|-------------------------|
| 1 | 0.500 |
| 5 | 0.504 |
| 10 | 0.517 |
| 20 | 0.564 |
| 25 | 0.596 |
| 30 | 0.634 |
| 40 | 0.721 |
| 50 | 0.820 |
| 75 | 1.096 |
| 100 | 1.393 |
| 200 | 2.648 |

Table 6.

Table 6, Summary: According to Table 6, based on the IHO depth accuracy, for the depth of water in areas between 1 meter to 200 meters the Order 1 error is 0.500m to 2.648m respectively.

| REQUIRED Order 1 Survey: Depth Uncertainty for reduced depths (95% Confidence Level) | | | | | | |
|--|-----------|-----------|---------------|------------------------------|------------------------------|----------------------------------|
| Sheet | Min depth | Max depth | Average Depth | Reduced Depth Accuracy(min) | Reduced Depth Accuracy (max) | Reduced Depth Accuracy (average) |
| | (meters) | (meters) | (meters) | $\sqrt{a^2 + (b \cdot d)^2}$ | $\sqrt{a^2 + (b \cdot d)^2}$ | $\sqrt{a^2 + (b \cdot d)^2}$ |
| 1 | 0 | 128 | 46.41 | 0.5 | 1.73749705 | 0.783586044 |
| 2 | 0 | 168 | 65.28 | 0.5 | 2.240503515 | 0.984982157 |
| 3 | 0 | 187 | 109.328 | 0.5 | 2.481886581 | 1.506649049 |
| 4 | 0 | 180 | 110.774 | 0.5 | 2.392822601 | 1.524394491 |

Table 7.

Table 7, Summary: These values are the required accuracy values with sum of all constant depth errors, a, equal to 0.5 and the sum of all depth dependent error, b, equal to 0.013.

The primary dataset rendered for this survey was generated using the Simrad EM1002 and EM3000 multibeam echosounders. The vertical error parameters have been assessed as realistic by the survey team in the field and the resultant theoretical error budget is tabulated below for 10 meters depth, 50 meters depth and 180 meters depth. The minimum depth of the survey area was 0.0 meter and the maximum depth in the survey area was 188 meters depth.

SOUNDING ERROR BUDGET

- a. Echosounder transmission mark setting (draft)
- b. Variation of draft setting with time
- c. Sound velocity (SV) measurement
- d. Spatial variation in SV
- e. Temporal variation in SV
- f. Application of measured SV (more problematical with older analogue systems)
- g. Depth measurement (system accuracy)
- h. Heave
- i. Squat and Settlement
- j. Roll, pitch, (gyro), seabed slope
- k. Tidal Measurement
- l. Co-tidal corrections
- m. At depth (m)

| EM3000 System | | | | EM1002 System | | | |
|--|-----------|-----------|-----------|------------------------|-----------|-----------|-----------|
| | Depth (m) | Depth (m) | Depth (m) | | Depth (m) | Depth (m) | Depth (m) |
| | 10 | 50 | 180 | | 10 | 50 | 180 |
| Source of Error | | | | Source of Error | | | |
| a | 0.07 | 0.07 | 0.07 | a | 0.1 | 0.1 | 0.1 |
| b | 0.05 | 0.05 | 0.05 | b | 0.05 | 0.05 | 0.05 |
| c(+/- 10m/s (0.0067d)) | 0.067 | 0.335 | 1.206 | c(+/- 10m/s (0.0067d)) | 0.067 | 0.335 | 1.206 |
| d(+/-5m/s (0.0033d)) | 0.033 | 0.165 | 0.594 | d(+/-5m/s (0.0033d)) | 0.033 | 0.165 | 0.594 |
| e(+/-5m/s (0.0033d)) | 0.033 | 0.165 | 0.594 | e(+/-5m/s (0.0033d)) | 0.033 | 0.165 | 0.594 |
| f | 0 | 0 | 0 | f | 0 | 0 | 0 |
| g | 0.05 | 0.05 | 0.05 | g | 0.05 | 0.05 | 0.05 |
| h | 0.1 | 0.1 | 0.1 | h | 0.1 | 0.1 | 0.1 |
| l | 0.005 | 0.005 | 0.005 | l | 0.05 | 0.05 | 0.05 |
| j | 0.02 | 0.02 | 0.02 | j | 0.1 | 0.1 | 0.1 |
| k | 0.1 | 0.1 | 0.1 | k | 0.1 | 0.1 | 0.1 |
| l | 0.05 | 0.05 | 0.05 | l | 0.05 | 0.05 | 0.05 |
| SUM(a2+...l2) | 0.039492 | 0.1995 | 2.192933 | SUM(a2+...l2) | 0.056667 | 0.216675 | 2.210108 |
| (SUM(a2+...l2)1/2) | 0.1987259 | 0.4466542 | 1.4808555 | (SUM(a2+...l2)1/2) | 0.2380483 | 0.4654836 | 1.4866432 |
| IHO Cat 1 Requirement [+/- (a^2 + (b*d)^2)^1/2] | 0.517 | 0.82 | 2.39 | | 0.517 | 0.82 | 2.39 |

Table 8.

Table 8, Summary: The actual reduced depth accuracy (95 %) for the EM3000 and EM1002 multibeam systems are 0.2m @ 10 m, 0.4m @ 50 m and 1.5 m @ 180 m. These values meet requirements for Order 1 standards.

20.0 Horizontal Accuracy:

Positions were obtained using data collection systems FUGRO SEASTAR WDGPS along with the TASMANTP(Y) and TSS POS/MV systems. These system accuracies are maintained by periodic testing performed by NAVO personnel. The differential beacon receiver error is recorded as 2.0 meter (2DRMS) positioning error.

| Order 1 Survey: Depth Uncertainty for reduced depths (95% Confidence Level) | | | |
|--|-------------------------------------|-----------------------------------|--|
| Depth (m) | Required Horizontal Accuracy | Actual Horizontal Accuracy | Actual Horizontal Accuracy Field Computations |
| | 5m+5% of Depth (m) | 2m + 5% of Depth (m) | Lever arms and offsets (m) |
| 10.00 | 5.50 | 2.50 | 3.10 |
| 50.00 | 7.50 | 4.50 | 5.60 |
| 125.00 | 11.25 | 8.25 | --- |
| 180.00 | 14.00 | 11.00 | --- |

Table 9.

Table 9, Summary: The required horizontal accuracies were obtained using the IHO Order 1, TABLE 1, "Summary of Minimum Standards for Hydrographic Surveys". From IHO Order 1, TABLE 1, the required horizontal accuracy (95% Confidence Level) were computed to be 5.5m @10m, 7.5m @50m and 14.0 @ 180 m. The actual horizontal accuracy computations are 2.5m @10m, 4.5m @50m and 11.0 @180m. The field computations of the actual values using offsets and lever arms corrections are 3.1 m @ 10m, and 5.6m @ 50m.

21.0 Navigational Features:

Approximately, thirty (30) navigational features were obtained during surveys 510902, 510603 and 510803. The positions were determined using a closest point of approach from two angles aboard an HSL from several directions.

22.0 Wrecks and Obstructions: ¹

| SHEET | ID | Description | Symbol | Latitude | Longitude | Depth (m) |
|-------|----|--|----------|---------------|----------------|-----------|
| 4 | 1 | Wreck, Depth unknown, submerged wreck | DLWKDU | 47-39-09.844N | 122-49-11.559W | ?? |
| 4 | 2 | Rock, Under Water Rock | DLRK | 47-39-31.768N | 122-49-50.319W | 47.00 |
| 4 | 3 | Submerged Rock with neighboring depth of 58 meters. (4492) | DLLD | 47-39-42.109N | 122-50-01.074W | 58.00 |
| 4 | | | DLLD | 47-39-43.330N | 122-50-05.625W | 58.00 |
| 4 | 4 | Obstruction (4462) | DDLD1 | 47-39-28.811N | 122-49-49.190W | 13.50 |
| 4 | 5 | Rock Area, Under Water Rock (4474) | DLRK | 47-39-14.610N | 122-49-03.992W | 27.90 |
| 4 | | Rock Area, Under Water Rock | DLRK | 47-38-58.863N | 122-49-05.844W | 27.90 |
| 4 | | Rock Area, Under Water Rock | DLRK | 47-38-58.863N | 122-49-05.844W | 27.90 |
| 4 | | Rock Area, Under Water Rock | DLRK | 47-39-03.457N | 122-49-17.693W | 27.90 |
| 4 | | Rock Area, Under Water Rock | DLRK | 47-39-07.930N | 122-49-04.554W | 27.90 |
| 4 | | Rock Area, Under Water Rock | DLRK | 47-39-12.258N | 122-49-01.603W | 27.90 |
| 4 | 6 | Wreck- Least depth known, underwater wreck outline (4488) | DLWKDUW | 47-38-40.499N | 122-49-44.553W | 7.50 |
| 4 | 7 | Piles, Drying Piling | DLPL% | 47-38-32.398N | 122-49-42.123W | 5.00 |
| 4 | 8 | Submerged rock with neighboring depth (4482) | CLTSV1 | 47-39-55.037N | 122-49-15.479W | 88.00 |
| 4 | | | DLLD | 47-39-53.999N | 122-49-24.833W | 88.00 |
| 4 | | Rock Area, Submerged Rock With neighboring depth | DLRK | 47-39-53.348N | 122-49-22.558W | 88.00 |
| 4 | 9 | Submerged Stumps, Pilings | DLPLF% | 47-39-50.366N | 122-49-05.965W | 83.00 |
| 3 | 10 | Underwater Rock | DLRK | 47-41-32.333N | 122-50-09.059W | 100.00 |
| 3 | 11 | Underwater Rock | DLRK | 47-41-39.411N | 122-50-03.759W | 67.00 |
| 3 | 12 | Underwater Rock | DLRK | 47-41-39.689N | 122-49-59.920W | 36.00 |
| 3 | 13 | Underwater Rock | DLRK | 47-42-19.111N | 122-49-50.197W | 35.00 |
| 3 | 14 | Underwater Rock | DLRK | 47-42-17.208N | 122-49-50.143W | 31.00 |
| 3 | 15 | Underwater Rock | DLRK | 47-44-14.919N | 122-49-02.825W | 62.00 |
| 3 | 16 | Underwater Rock | DLRK | 47-44-40.503N | 122-48-59.434W | 21.00 |
| 1 | 17 | Rock | CLISCUSF | 47-51-22.472N | 122-40-38.889W | 3.4 |
| 1 | 18 | Rock | CLISCUSF | 47-51-40.658N | 122-38-32.648W | 1 |
| 1 | 19 | Rock | CLISCUSF | 47-51-41.109N | 122-38-24.515W | 11.8 |
| 1 | 20 | Rock | CLISCUSF | 47-50-54.925N | 122-37-06.910W | ashore |
| 1 | 21 | Wreck Depth Unknown | DLWKDU | 47-50-56.303N | 122-37-09.195W | ashore |
| 1 | 22 | Wreck Depth Unknown | DLWKDU | 47-50-58.116N | 122-37-05.154W | ashore |
| 1 | 23 | Rock | CLISCUSF | 47-51-36.648N | 122-35-52.040W | 18.2 |
| 1 | 24 | Rock | CLISCUSF | 47-52-54.203N | 122-34-55.378W | 6.2 |
| 1 | 25 | Rock | CLISCUSF | 47-52-59.019N | 122-34-57.073W | 8.1 |
| 1 | 26 | Rock Awash | DLRA | 47-51-34.146N | 122-38-22.903W | 1.6 |

Table 10.

Table 10, Summary: Several rocks, rock areas, and rock awash were identified. Several piling were located ashore the river banks. One major obstruction under the bridge was determined to be a dangerous rock wash.

23.0 Title Block:

| IHO ORDER 1 SURVEY ACCURACIES | |
|---|------------------------|
| REQUIRED | ACTUAL |
| HORIZONTAL ACCURACY (95%) 5m + 5% of DEPTH | 3.1 @ 10m, 5.6 @ 50m |
| REDUCED DEPTH ACCURACY (95%) 0.50m @ 0m – 1.27m @ 90m | 0.3 @ 10m, 0.4m @ 50 m |
| 100% BOTTOM SEARCH MAY BE REQUIRED | Yes |
| SYSTEM DETECTION CAPABILITY CUBIC FEATURES > 2m | 2.0 m |
| MAXIMUM LINE SPACING 3x AVERAGE DEPTH OR 25m | 100m |
| FIXED AIDS TO NAVIGATION 2m | < 1 m |
| NATURAL COASTLINE 20m | (CIB IMAGERY), 5.0 m |
| MEAN POSITION OF FLOATING AIDS TO NAVIGATION 10m | N/A |
| TOPOGRAPHICAL FEATURES 20m | N/A |

24.0 Summary:

This report is compiled mostly from information contained in the United States- Washington-Hood Canal Report of Survey , *WASH 02us13 ROS.doc*. Very small variations in computations accessed in the field compared to computations completed in-house. No major problems were uncovered during this QA summary.

Revisions compiled during office processing by the cartographer

¹The previous items were not compiled on the smooth sheets. The data will be review in fledermaus and any significant items will be reported as a Danger to Navigation.

APPROVAL SHEET
W00166 – W00169

Evaluated by:

Tyanne Faulkes
Physical Scientist (Hydrographer)
Pacific Hydrographic Branch

Review by:

Kurt Brown
Hydrographic Team Leader

Cartography

The evaluated survey has been inspected with regard to delineation of the depth curves, development of critical depths, cartographic symbolization, and verification or disproval of charted data

Compiled by:

Rick Shipley
Cartographer
Pacific Hydrographic Branch

Reviewed by:

Gary Nelson
Cartographic Team Leader
Pacific Hydrographic Branch

Approval

I have reviewed the data, and reports. Data are suitable for nautical charting except where specifically recommended in this report.

David O. Neander
CAPT., NOAA
Chief, Pacific Hydrographic Branch