H12994

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Service

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H12994

LOCALITY

State(s):	Washington
General Locality:	Northwest Washington
Sub-locality:	Vicinity of Hansville

2018

CHIEF OF PARTY
CDR Marc Moser, NOAA

LIBRARY & ARCHIVES

Date:

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

REGISTRY NUMBER:

HYDROGRAPHIC TITLE SHEET

H12994

INSTRUCTIONS: The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office.

State(s):	**Washington**
General Locality:	**Northwest Washington**
Sub-Locality:	**Vicinity of Hansville**
Scale:	**10000**
Dates of Survey:	**10/05/2018 to 10/06/2018**
Instructions Dated:	**09/06/2018**
Project Number:	**OPR-N305-FA-18**
Field Unit:	**NOAA Ship *Fairweather***
Chief of Party:	**CDR Marc Moser, NOAA**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	**Multibeam Echo Sounder Backscatter**
Verification by:	**Pacific Hydrographic Branch**
Soundings Acquired in:	**meters at Mean Lower Low Water**

Remarks:

The purpose of this survey is to provide contemporary surveys to update National Ocean Service (NOS) nautical charts. All separates are filed with the hydrographic data. Any revisions to the Descriptive Report (DR) generated during office processing are shown in bold red italic text. The processing branch maintains the DR as a field unit product, therefore, all information and recommendations within the body of the DR are considered preliminary unless otherwise noted. The final disposition of surveyed features is represented in the OCS nautical chart update products. All pertinent records for this survey, including the DR, are archived at the National Centers for Environmental Information (NCEI) and can be retrieved via http://www.ncei.noaa.gov/.

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Descriptive Report to Accompany Survey H12994

Project: OPR-N305-FA-18

Locality: Northwest Washington

Sublocality: Vicinity of Hansville

Scale: 1:10000

October 2018 - October 2018

NOAA Ship *Fairweather*

Chief of Party: CDR Marc Moser, NOAA

A. Area Surveyed

The survey area is located in Northwest Washington within the sub locality of the Vicinity of Hansville.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
47° 56' 54.33" N 122° 36' 8.86" W	47° 52' 35.53" N 122° 27' 27.92" W

Table 1: Survey Limits

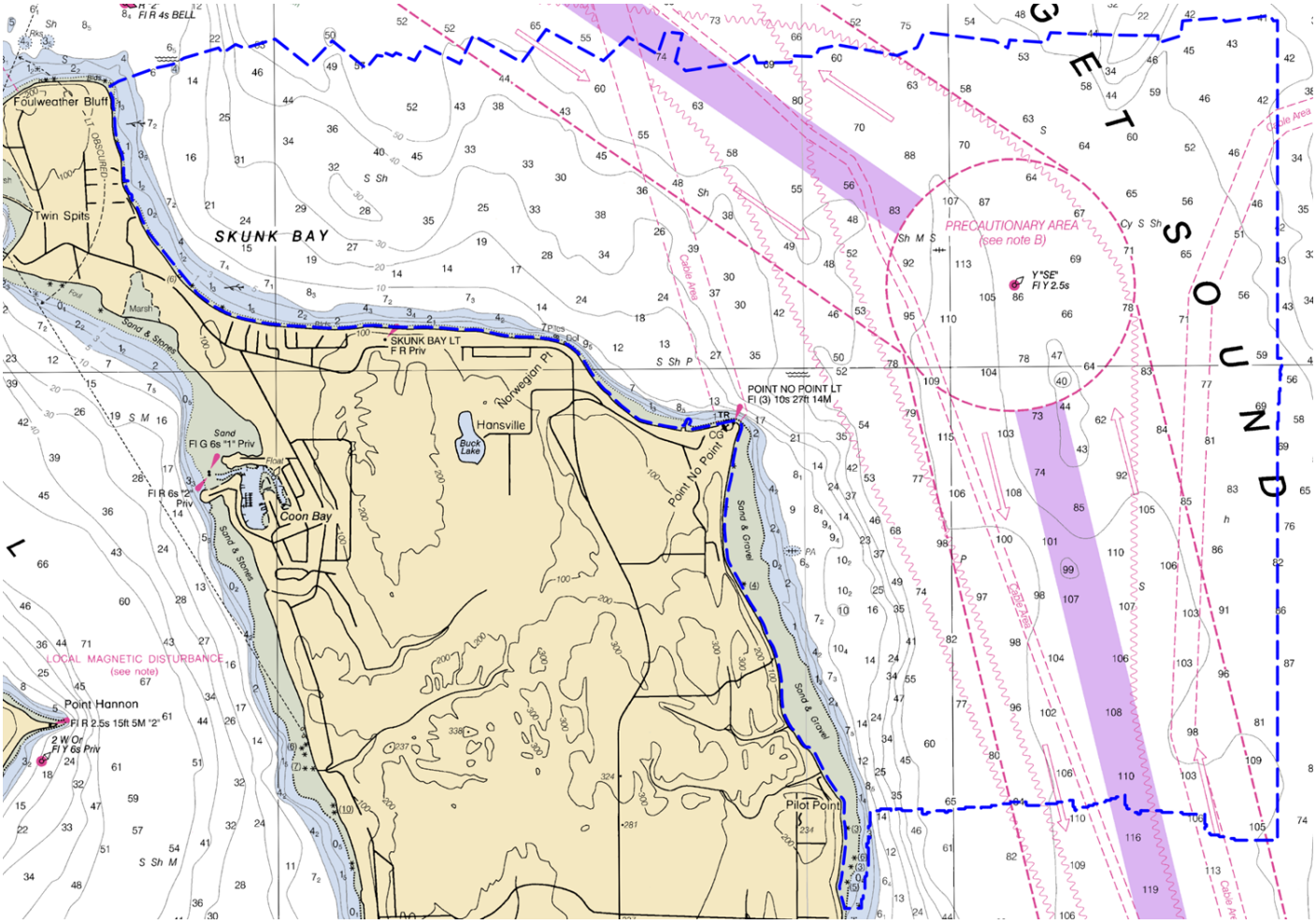


Figure 1: H12994 sheet limits (in blue) overlaid onto Chart 18473

Data were acquired to the survey limits in accordance with the requirements in the Project Instructions and the April 2018 NOS Hydrographic Surveys Specifications and Deliverables (HSSD), as shown in Figure 1. In all areas where the 3.5 meter depth contour or the sheet limits were not met, the Navigable Area Limit Line (NALL) was defined as the inshore limit of bathymetry due to the risks of maneuvering the survey vessel in close proximity to the steep and rocky shoreline. An example of such an area is shown in Figure 2.

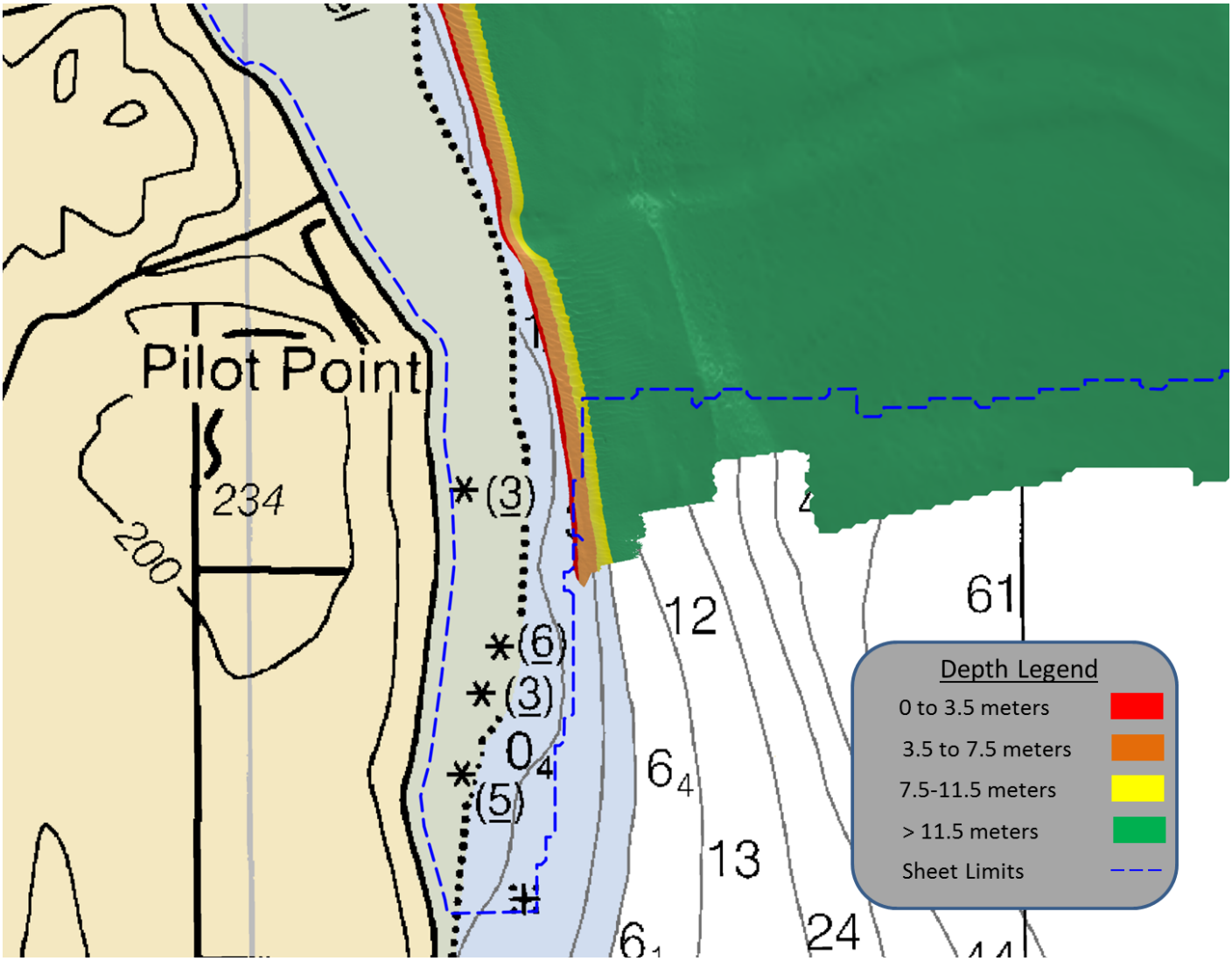


Figure 2: H12994 NALL defined by rocks and 3.5 meter depth contour.

A.2 Survey Purpose

The primary purpose of this project is to provide contemporary surveys for updating National Ocean Service nautical charts and products in an area critical to the nation's economy. The new bathymetric data will enhance the safety of cargo and tanker traffic transiting to and from the ports of Seattle and Tacoma; it will also support military traffic transiting to and from Bangor Naval Submarine Base, commercial/tribal fishing and recreational boating. Survey data from this project is intended to supersede all prior survey data in the common area.

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

Data acquired in H12994 meet multibeam echo sounder (MBES) coverage requirements for complete coverage, as required by the HSSD. This includes crosslines (see Section B.2.1), NOAA allowable uncertainty (see Section B.2.10), and density requirements (see Section B.2.11).

A.4 Survey Coverage

The following table lists the coverage requirements for this survey as assigned in the project instructions:

Water Depth	Coverage Required
All waters in survey area	Complete Coverage with complete MBES backscatter

Table 2: Survey Coverage

The entirety of H12994 was acquired with complete coverage MBES, meeting the requirements listed above and in the HSSD. See Figure 3 for an overview of coverage.

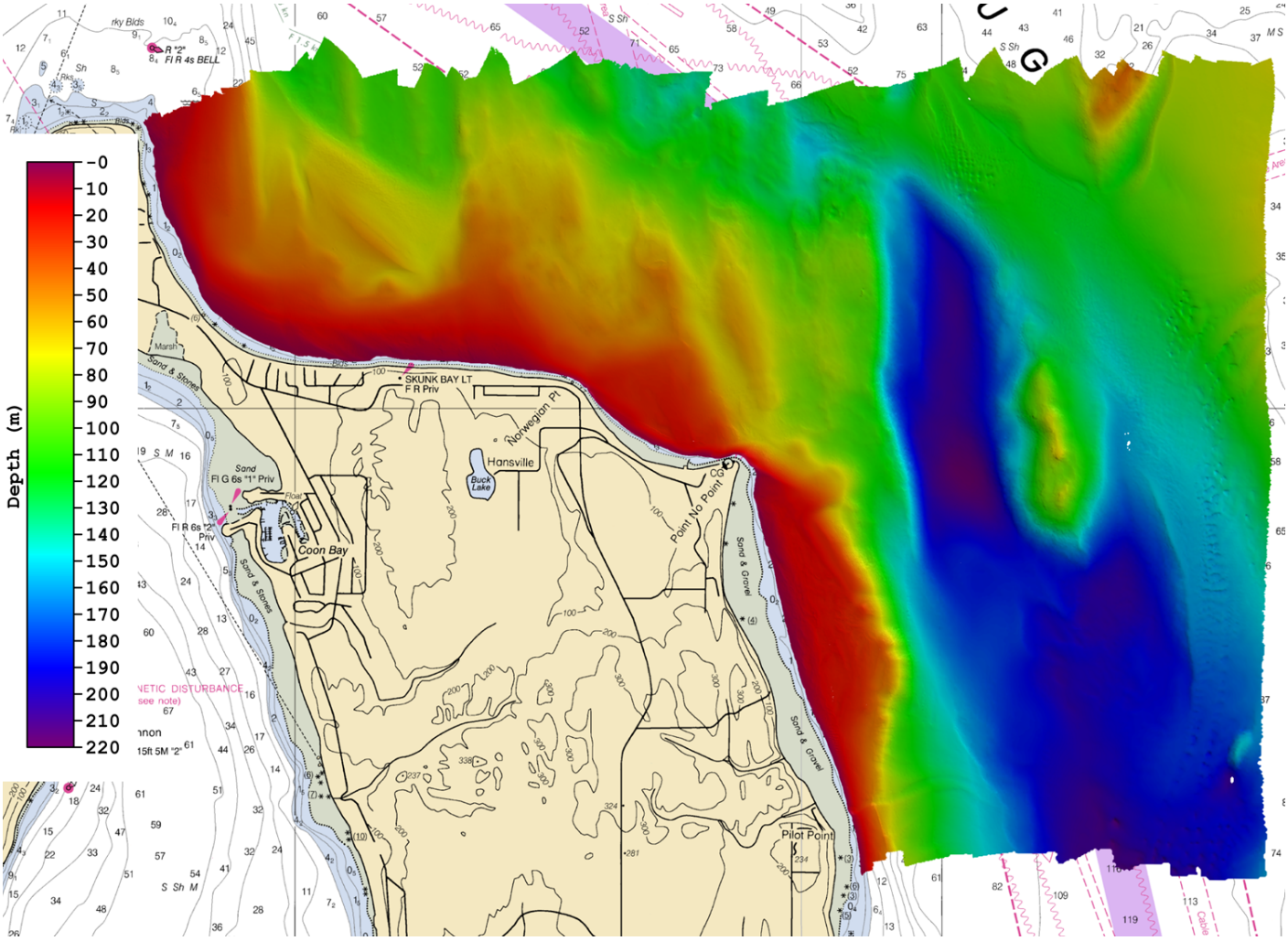


Figure 3: H12994 survey coverage overlaid on to Chart 18473

A.5 Survey Statistics

The following table lists the mainscheme and crossline acquisition mileage for this survey:

	HULL ID	*2805*	*2806*	*2807*	*2808*	*Total*
LNM	SBES Mainscheme	0	0	0	0	0
	MBES Mainscheme	12.76	28.51	76.96	34.27	152.5
	Lidar Mainscheme	0	0	0	0	0
	SSS Mainscheme	0	0	0	0	0
	SBES/SSS Mainscheme	0	0	0	0	0
	MBES/SSS Mainscheme	0	0	0	0	0
	SBES/MBES Crosslines	6.67	0	0	0	6.67
	Lidar Crosslines	0	0	0	0	0
Number of Bottom Samples						4
Number Maritime Boundary Points Investigated						0
Number of DPs						0
Number of Items Investigated by Dive Ops						0
Total SNM						14.97

Table 3: Hydrographic Survey Statistics

The following table lists the specific dates of data acquisition for this survey:

Survey Dates	Day of the Year
10/05/2018	278
10/06/2018	279

Table 4: Dates of Hydrography

B. Data Acquisition and Processing

B.1 Equipment and Vessels

Refer to the OPR-N305-FA-18 Data Acquisition and Processing Report (DAPR) for a complete description of data acquisition and processing systems, survey vessels, quality control procedures and data processing methods. Additional information to supplement sounding and survey data, and any deviations from the DAPR are discussed in the following sections.

B.1.1 Vessels

The following vessels were used for data acquisition during this survey:

Hull ID	***2805***	***2806***	***2807***	***2808***
LOA	8.6 meters	8.6 meters	8.6 meters	8.6 meters
Draft	1.1 meters	1.1 meters	1.1 meters	1.1 meters

Table 5: Vessels Used

B.1.2 Equipment

The following major systems were used for data acquisition during this survey:

Manufacturer	**Model**	**Type**
Kongsberg Maritime	EM 2040	MBES
Sea-Bird Scientific	SBE 19plus V2	Conductivity, Temperature, and Depth Sensor
Teledyne RESON	SVP 71	Sound Speed System
Applanix	POS MV 320 v5	Positioning and Attitude System

Table 6: Major Systems Used

The equipment was installed on the survey platforms as follows: all MBES survey vessels are equipped with POS MV v5 systems for positioning and attitude. All launches utilize Kongsberg EM 2040 MBES, Teledyne RESON SVP 71 surface sound speed sensors, and Sea-Bird Scientific 19plus CTD casts.

B.2 Quality Control

B.2.1 Crosslines

Multibeam/single beam echo sounder/side scan sonar crosslines acquired for this survey totaled 4.37% of mainscheme acquisition.

Crosslines were collected, processed and compared in accordance with Section 5.2.4.2 of the HSSD. To evaluate crosslines, a surface generated via data strictly from mainscheme lines, and a surface generated via data strictly from crosslines were created. From these two surfaces, a difference surface (mainscheme - crosslines = difference surface) was generated (Figure 4), and is submitted in the Separates II Digital Data folder. Statistics show the mean difference between the depths derived from mainscheme data and crossline data was 0.02 meters and 95% of nodes falling within +/-0.51 meters (Figure 5). For the respective depths, the difference surface was compared to the allowable NOAA uncertainty standards. In total, 99.5% of the depth differences between H12994 mainscheme and crossline data were within allowable NOAA uncertainties.

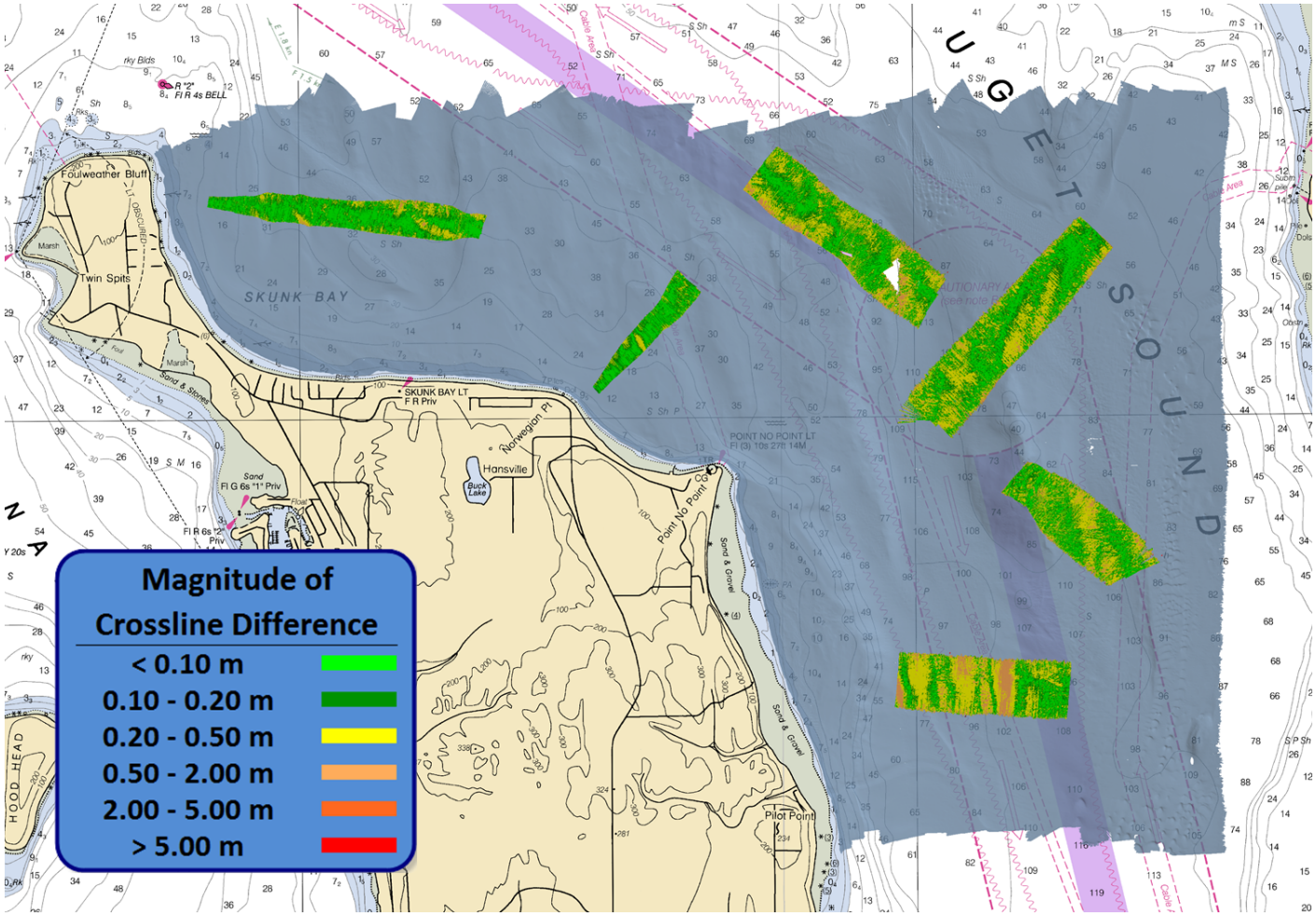
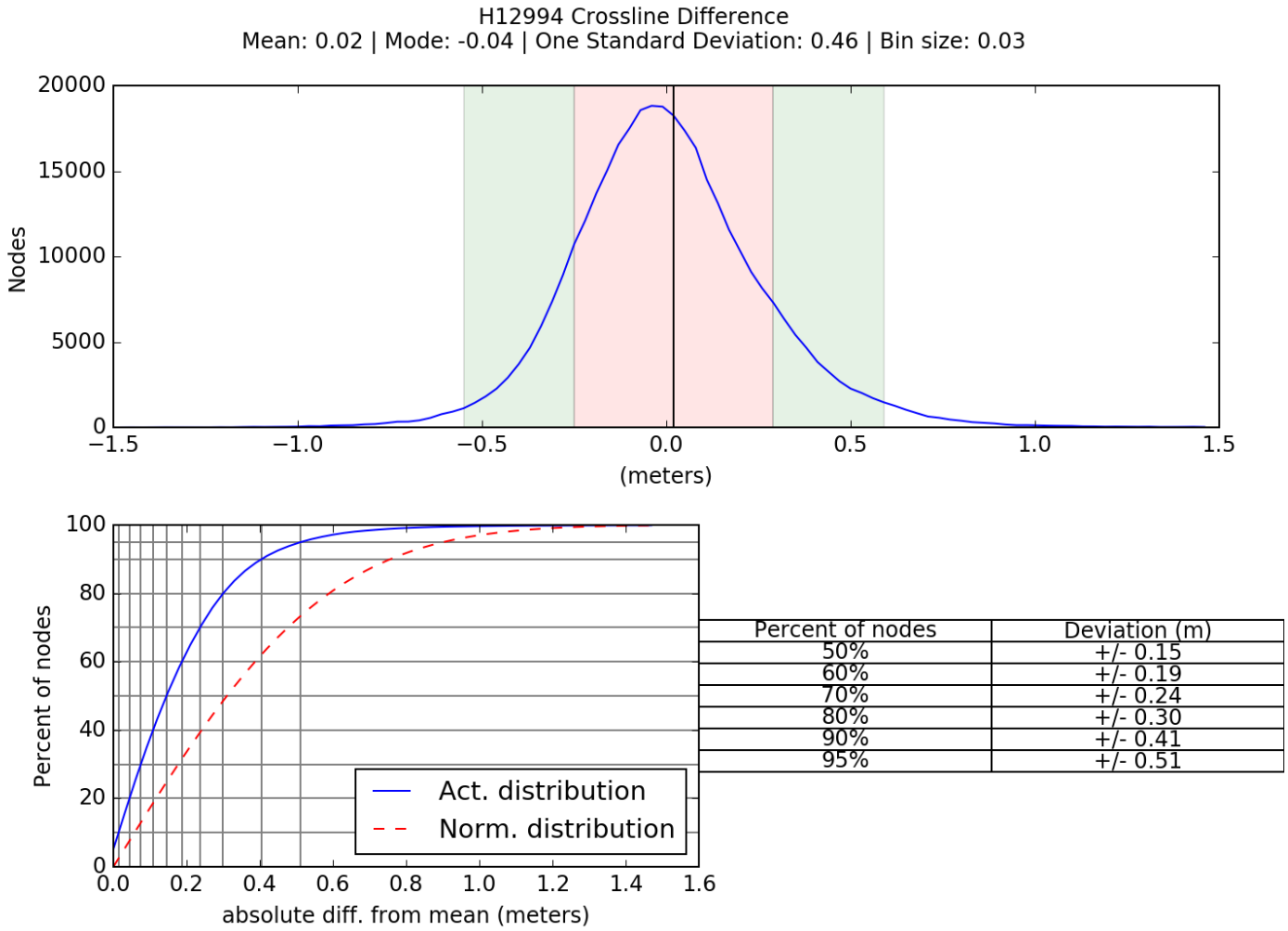


Figure 4: Overview of H12994 crosslines



Percent of nodes	Deviation (m)
50%	+/- 0.15
60%	+/- 0.19
70%	+/- 0.24
80%	+/- 0.30
90%	+/- 0.41
95%	+/- 0.51

Figure 5: H12994 crossline comparison statistics

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Method	Measured	Zoning
ERS via VDATUM	0.136 meters	0 meters

Table 7: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Surface
280x	2 meters/second	N/A meters/second	0.5 meters/second

Table 8: Survey Specific Sound Speed TPU Values.

In addition to the usual a priori estimates of uncertainty provided via device models for vessel motion and VDATUM, real-time and post-processed uncertainty sources were also incorporated into the depth estimates of survey H12994. Real-time uncertainties were provided via EM 2040 MBES data and Applanix Delayed Heave RMS. Following post-processing of the realtime vessel motion, recomputed uncertainties of vessel roll, pitch and navigation were applied in CARIS HIPS and SIPS via a Smoothed Best Estimate of Trajectory (SBET) RMS file generated in Applanix POSPac.

B.2.3 Junctions

H12994 junctions with two surveys from prior projects, H12420 and H12564, as shown in Figure 6. These areas of overlap between surveys were reviewed within CARIS HIPS and SIPS by surface differencing (at equal resolutions) to assess surface agreement. The junctions with H12994 are generally in agreement with each other, however the junction with survey H12564 exceeded the NOAA allowable uncertainty in the areas of overlap. For all junctions with H12994, a negative difference indicates H12994 was shoaler, and a positive difference indicates H12994 was deeper.

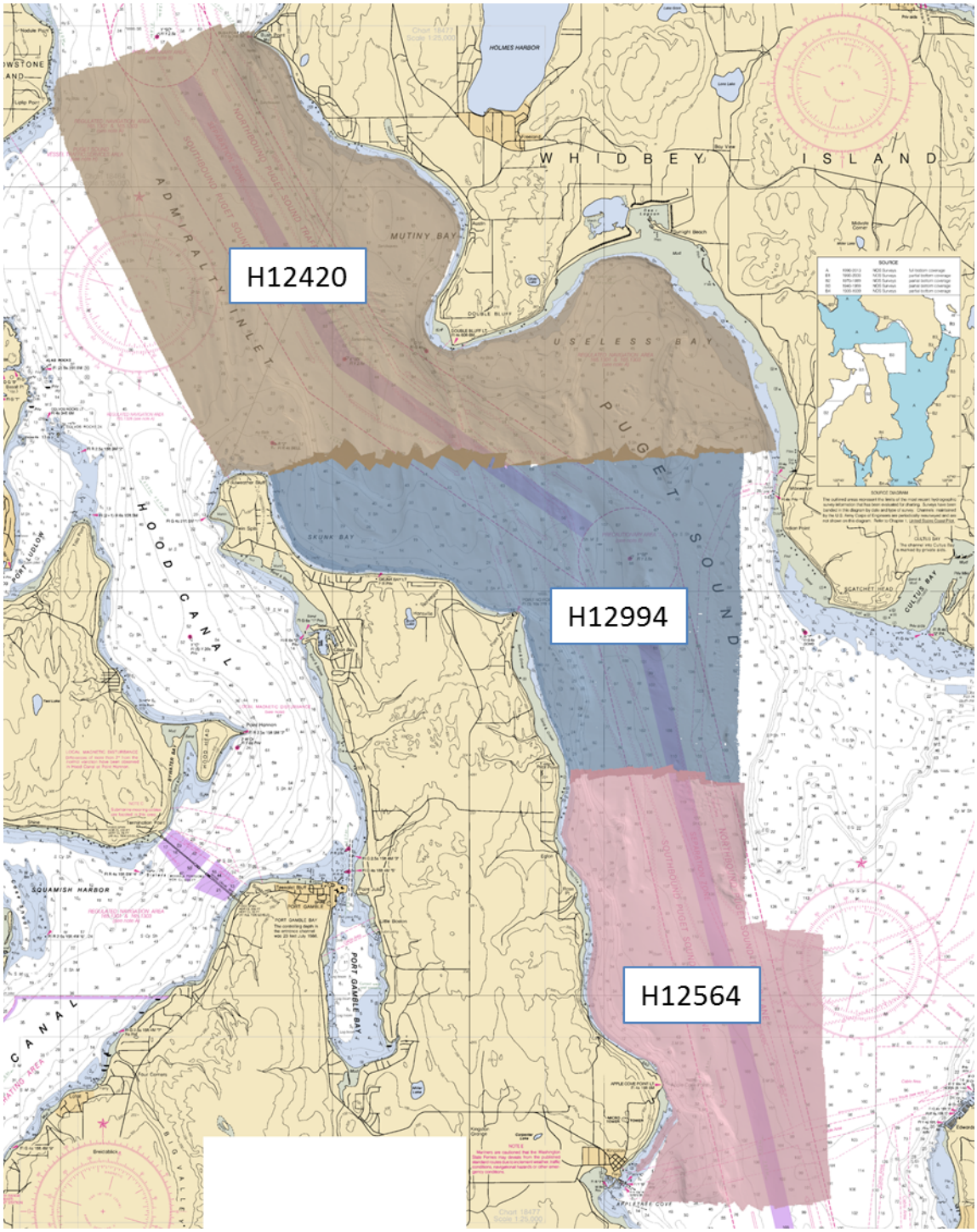


Figure 6: H12994 junction overview

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H12420	1:10000	2012	NOAA Ship FAIRWEATHER	N
H12564	1:10000	2013	NOAA Ship FAIRWEATHER	S

Table 9: Junctioning Surveys

H12420

Surface differencing in CARIS HIPS and SIPS was used to assess junction agreement between the surface generated from H12994 data and the surface generated from H12420 data (Figure 7). The statistical analysis of the difference surface shows a mean of 0.35 meters with 95% of all nodes having a maximum deviation of +/- 0.81 meters, as seen in Figure 8. It was found that 99.5+% of nodes are within the NOAA allowable uncertainty.

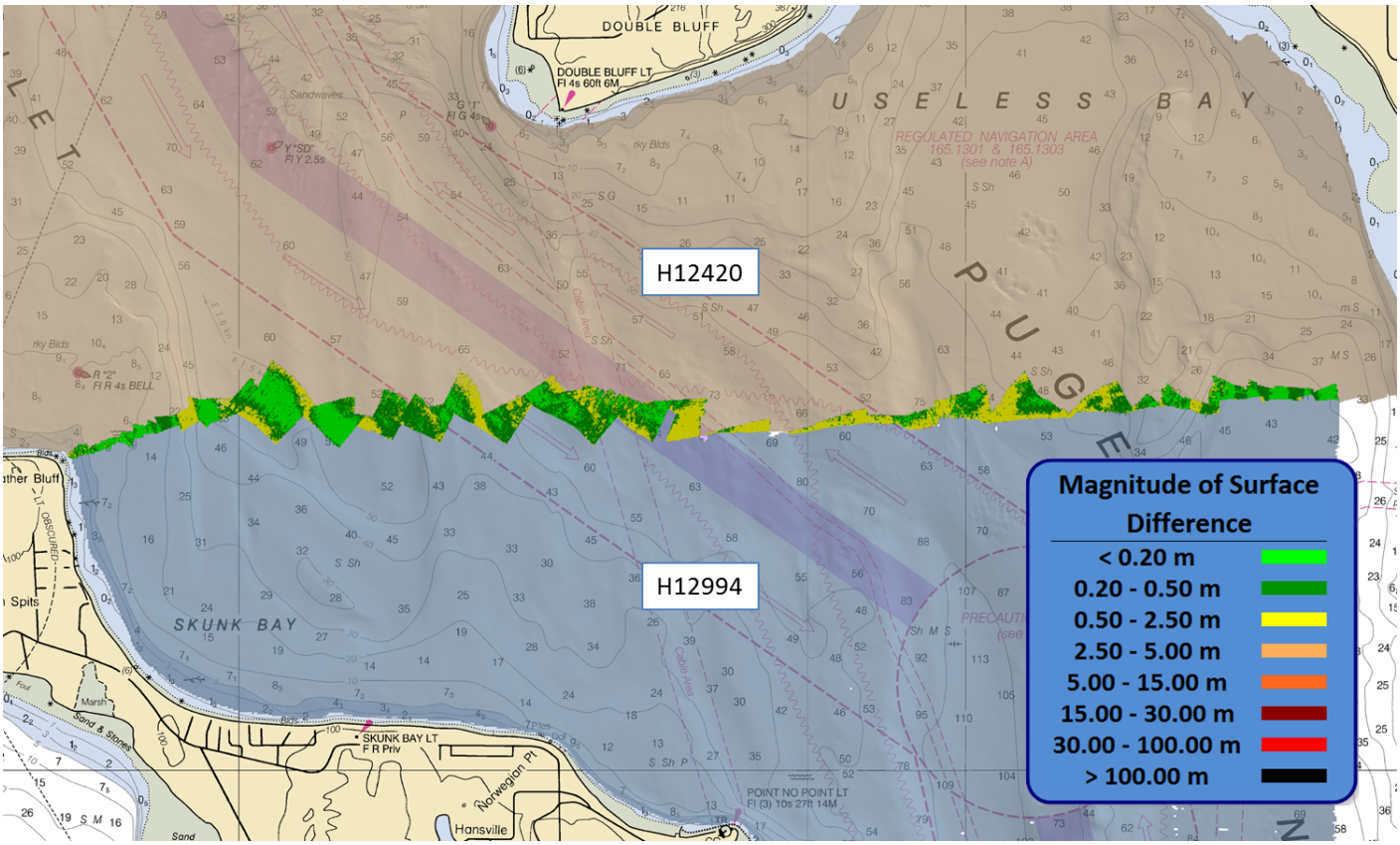
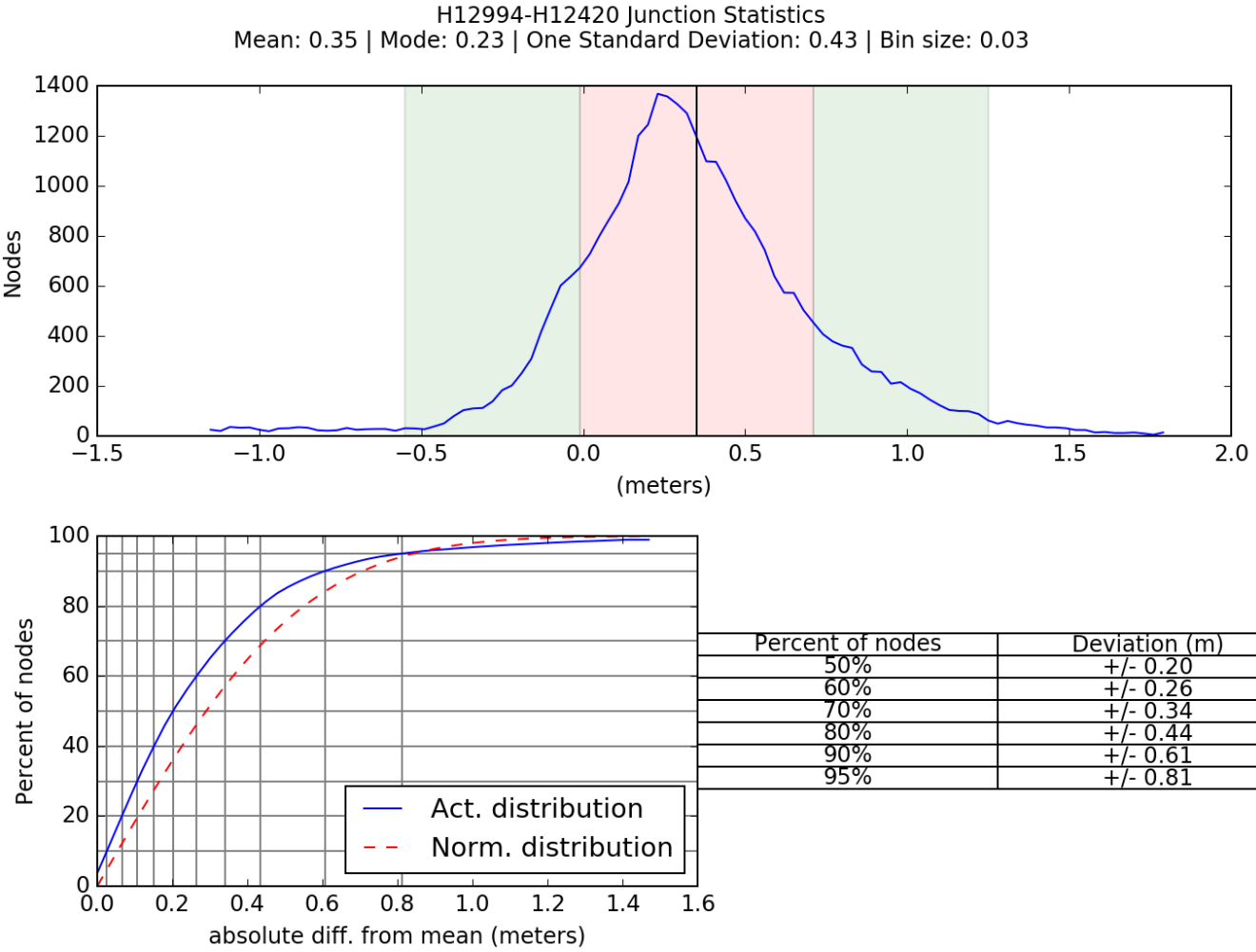


Figure 7: Difference surface between H12994 (blue) and junctioning survey H12420 (brown)



Percent of nodes	Deviation (m)
50%	+/- 0.20
60%	+/- 0.26
70%	+/- 0.34
80%	+/- 0.44
90%	+/- 0.61
95%	+/- 0.81

Figure 8: Difference surface statistics between H12994 and H12420

H12564

Surface differencing in CARIS HIPS and SIPS was used to assess junction agreement between the surface generated from H12994 data and the surface generated from H12564 data (Figure 9). The statistical analysis of the difference surface shows a mean of -0.14 meters with 95% of all nodes having a maximum deviation of +/- 1.67 meters, as seen in Figure 10. It was found that 90% of nodes are within the NOAA allowable uncertainty, falling short of the 95% required by the HSSD. Further inspection by the hydrographer revealed that the largest differences exhibited are in rocky areas where the geological structure of the seafloor is dynamic, and are likely due to differing hypotheses being chosen for corresponding nodes in each surface across the junction, rather than systematic biases in the data (Figure 11).

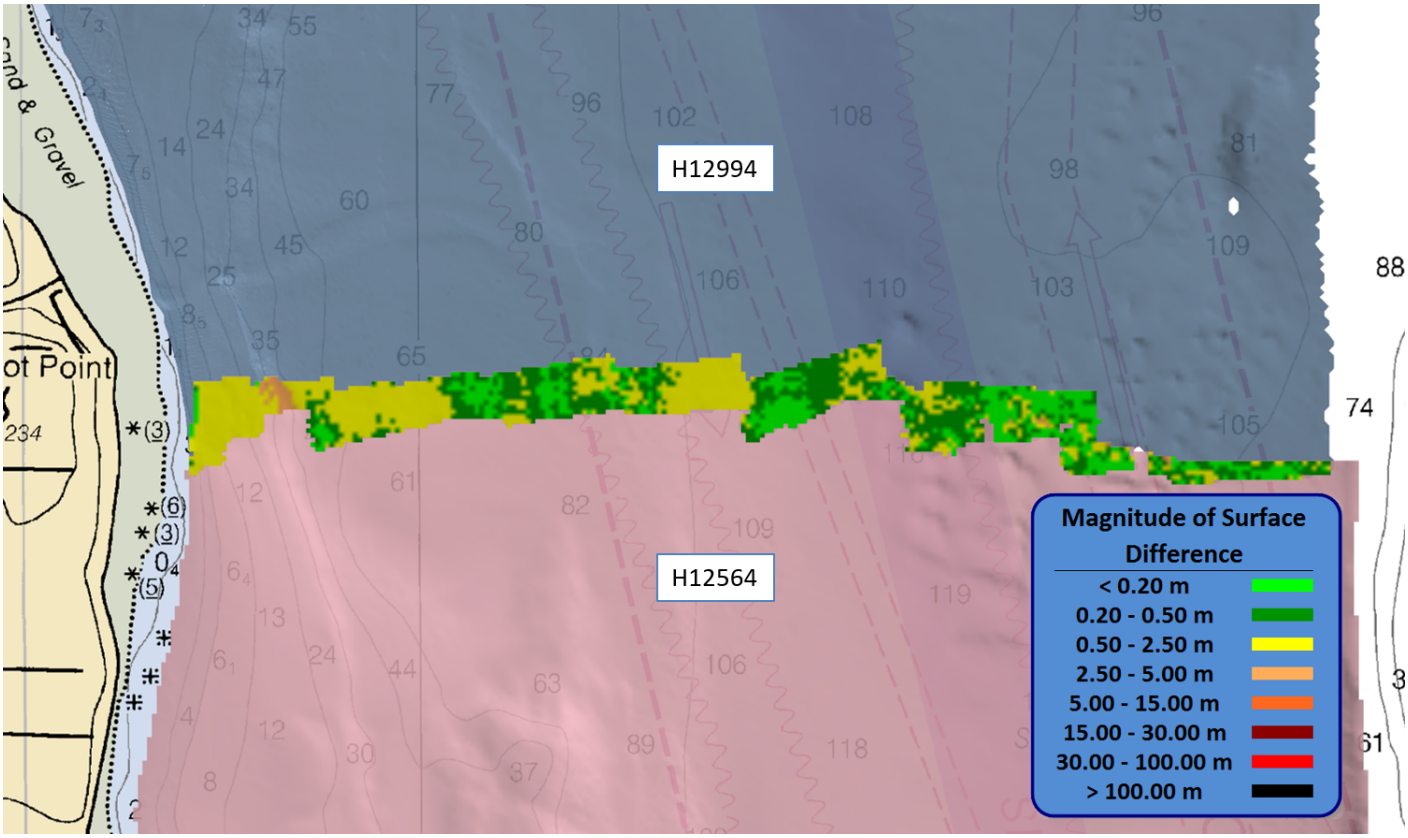
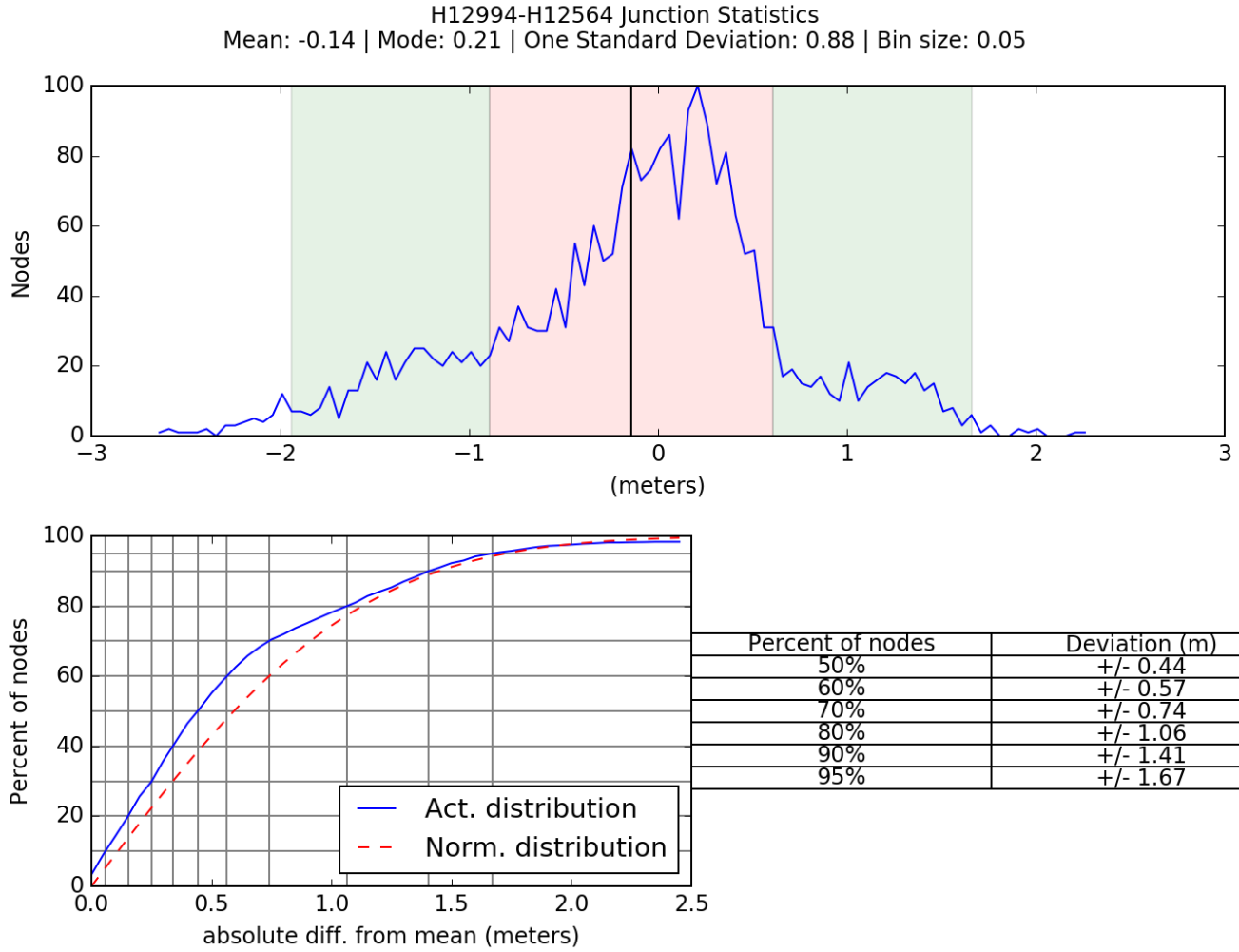


Figure 9: Difference surface between H12994 (blue) and H12564 (pink)



Percent of nodes	Deviation (m)
50%	+/- 0.44
60%	+/- 0.57
70%	+/- 0.74
80%	+/- 1.06
90%	+/- 1.41
95%	+/- 1.67

Figure 10: Difference surface statistics between H12994 and H12564

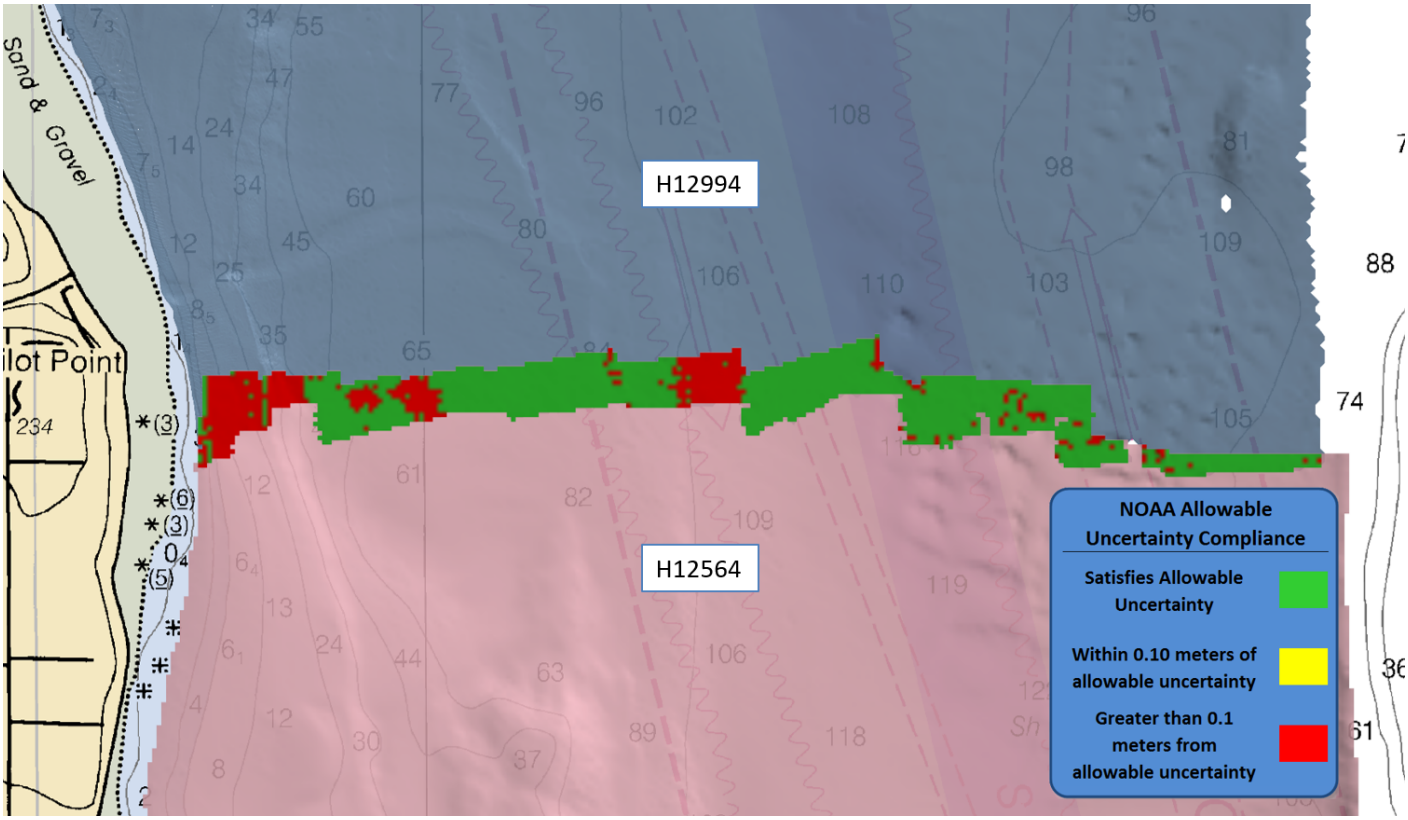


Figure 11: Difference surface compliance with regard to NOAA allowable uncertainty between H12994 (blue) and junctioning survey H12564 (pink)

B.2.4 Sonar QC Checks

Sonar system quality control checks were conducted as detailed in the quality control section of the DAPR.

B.2.5 Equipment Effectiveness

There were no conditions or deficiencies that affected equipment operational effectiveness.

B.2.6 Factors Affecting Soundings

There were no other factors that affected corrections to soundings.

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: Casts were conducted at a minimum of one every four hours during launch acquisition. Casts were conducted more frequently in areas where the influx of freshwater had an effect of the speed of sound in the water column, or in areas where there was a change in surface sound speed greater than two meters per second. All sound speed methods were used as detailed in the DAPR.

B.2.8 Coverage Equipment and Methods

All equipment and survey methods were used as detailed in the DAPR.

B.2.9 Holidays

H12994 data were reviewed in CARIS HIPS and SIPS for holidays in accordance with Section 5.2.2.3 of the HSSD. No holidays which meet the definition described in the HSSD for complete coverage were identified via the Pydro QC Tools Holiday Finder tool. This tool automatically scans the surface for holidays as defined in the HSSD and was run in conjunction with a visual inspection of the surface by the hydrographer.

B.2.10 NOAA Allowable Uncertainty

The surface was analyzed using the Pydro QC Tools Grid QA feature to determine compliance with specifications. Overall, 99.5+% of nodes within the surface meet NOAA Allowable Uncertainty specifications for H12994. For a graphical representation of uncertainty requirements, see Figure 12 below.

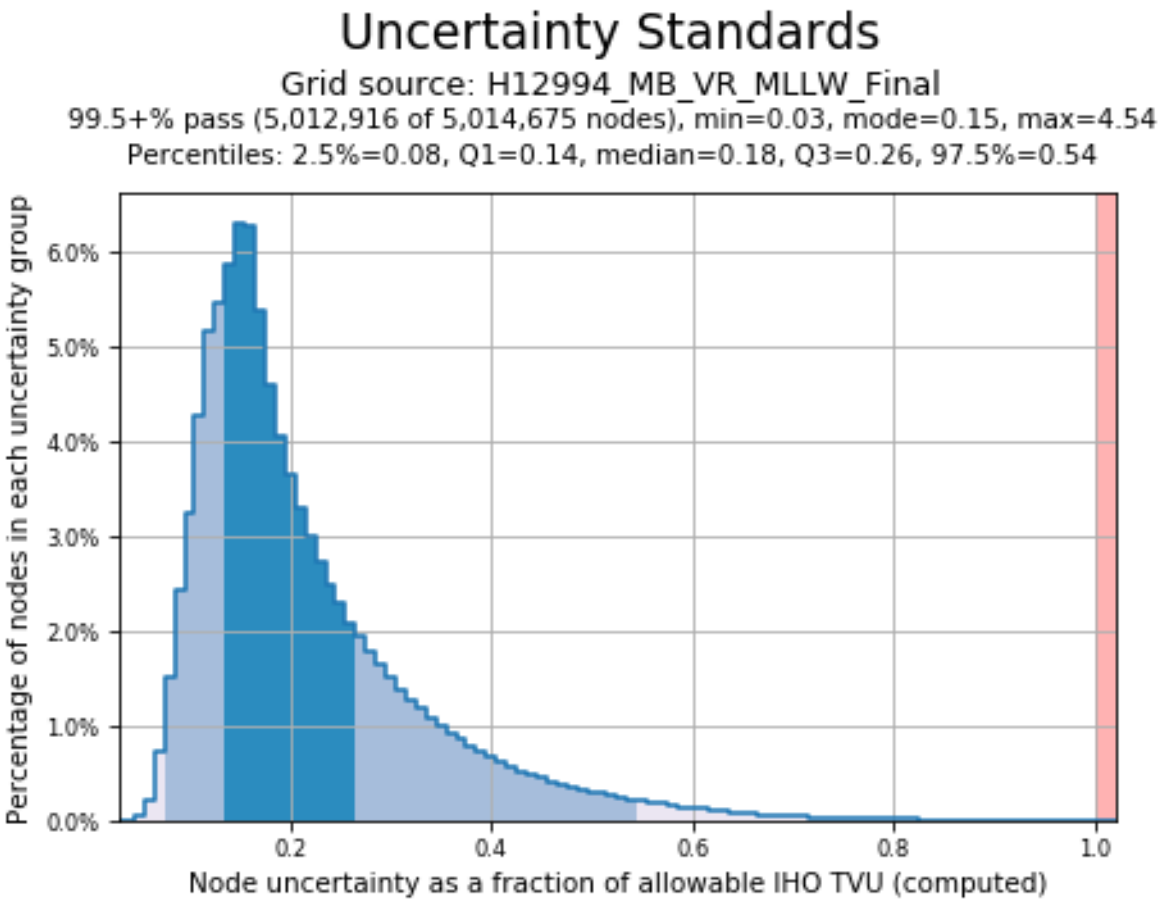


Figure 12: H12994 compliance with uncertainty standards

B.2.11 Density

The surface was analyzed using the Pydro QC Tools Grid QA feature to determine compliance with specifications. Density requirements for H12994 were achieved with at least 99.5% of surface nodes containing five or more soundings as required by HSSD Section 5.2.2.3. For a graphical representation of density requirements, see Figure 13 below.

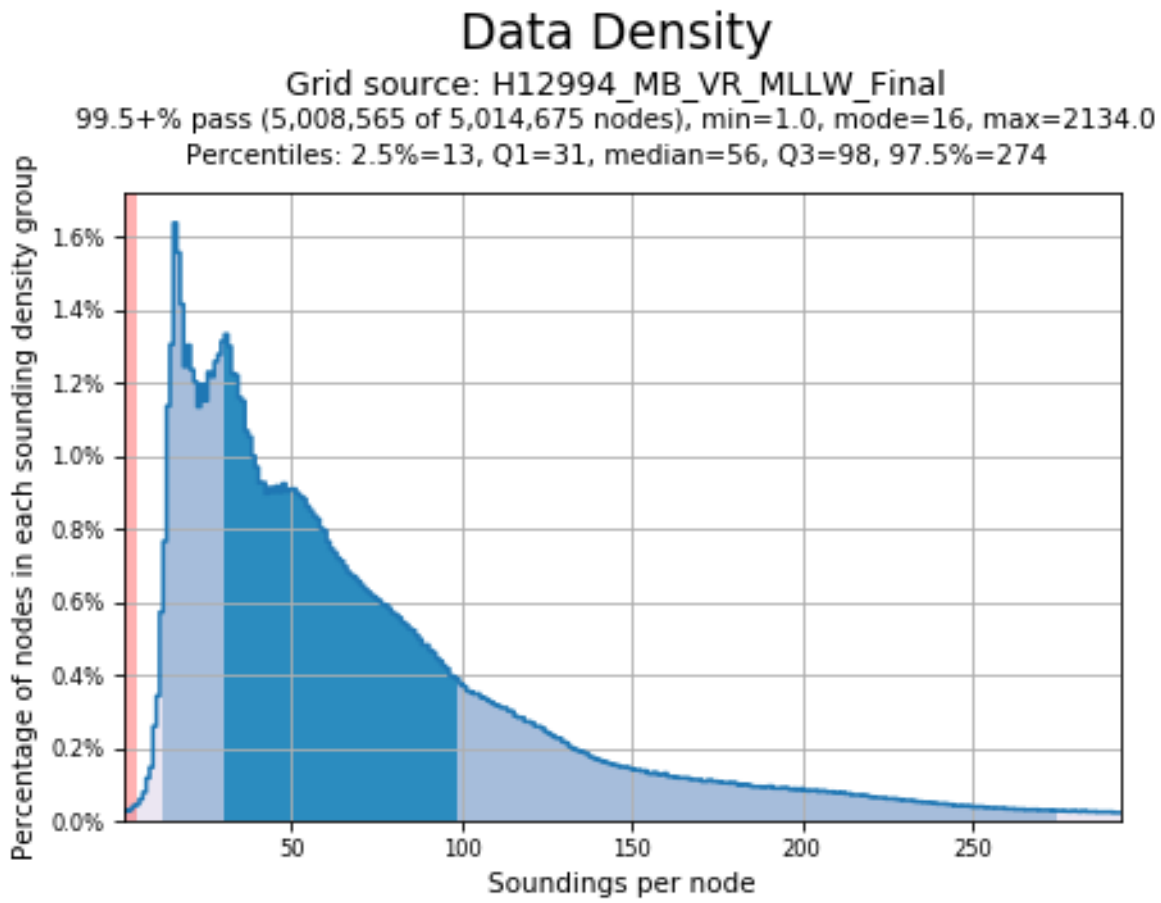


Figure 13: H12994 compliance with density requirements

B.3 Echo Sounding Corrections

B.3.1 Corrections to Echo Soundings

All data reduction procedures conform to those detailed in the DAPR.

B.3.2 Calibrations

All sounding systems were calibrated as detailed in the DAPR.

B.4 Backscatter

Raw Backscatter were stored in the .all file for Kongsberg systems. All backscatter have been processed by the field unit via Fledermaus FMGT 7.8.5. All processed mosaics and .gsf files have been submitted to the Pacific Hydrographic Branch. A relative backscatter calibration was performed by HSTB via a patch test in

order to bring the survey systems on each of the launches into alignment. This allowed for better consistency in the data across the different platforms. See Figure 14 for a table of the calibration values entered into the Processing Settings within FMGT. See Figure 15 for a complete mosaic.

	200				300				400		
	Short CW	Med CW	Long CW	FM (Both)	Short CW	Med CW	Long CW	FM (Both)	Short CW	Med CW	Long CW
2805	2.1	2.25	2.4	2.7	2.1	2.7	3.3	3	3	3.9	4.8
2806	1.8	1.8	1.8	2.4	0.9	1.35	1.8	1.8	3.6	4.65	5.7
2807	-0.3	-0.15	0	0	-1.8	-0.9	0	0.6	3.3	4.2	5.1
2808	0	0.6	1.2	1.6	-2.7	-1.95	-1.2	-2.1	1.8	2.7	3.6

Figure 14: Relative backscatter calibration values

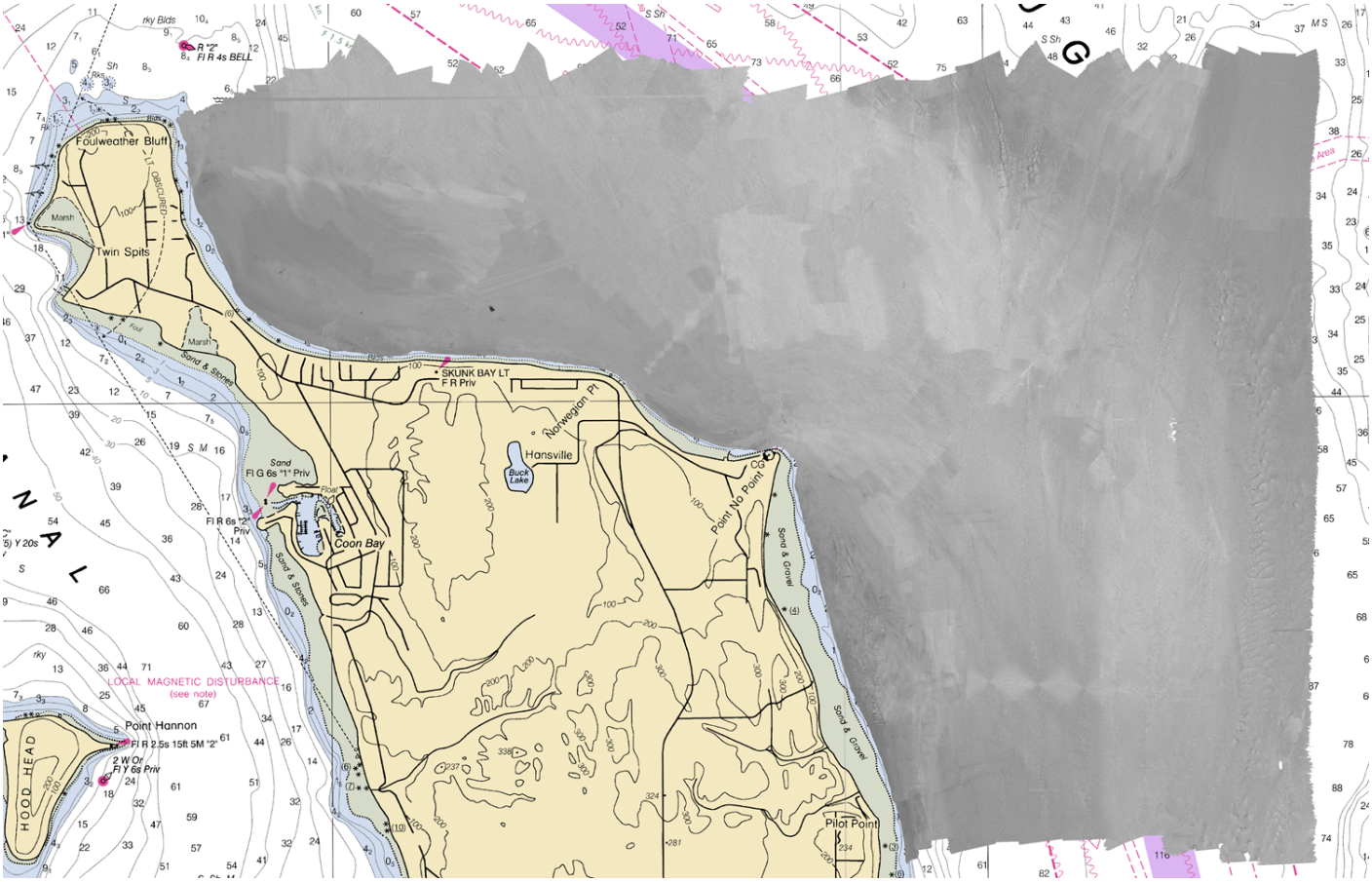


Figure 15: Overview of H12994 backscatter mosaic

B.5 Data Processing

B.5.1 Primary Data Processing Software

The following software program was the primary program used for bathymetric data processing:

Manufacturer	Name	Version
Teledyne CARIS	HIPS and SIPS	10.4.5

Table 10: Primary bathymetric data processing software

The following software program was the primary program used for imagery data processing:

Manufacturer	Name	Version
QPS	Fledermaus FMGT	7.8.5

Table 11: Primary imagery data processing software

The following Feature Object Catalog was used: NOAA Extended Attribute Files version 5.7.

B.5.2 Surfaces

The following surfaces and/or BAGs were submitted to the Processing Branch:

Surface Name	Surface Type	Resolution	Depth Range	Surface Parameter	Purpose
H12994_MB_VR_MLLW	CARIS VR Surface (CUBE)	1-32 meters	1 meters - 218.9 meters	NOAA_VR	Complete MBES
H12994_MB_VR_MLLW_Final	CARIS VR Surface (CUBE)	1-32 meters	1 meters - 218.9 meters	NOAA_VR	Complete MBES

Table 12: Submitted Surfaces

The NOAA CUBE parameters defined in the HSSD were used for the creation of all CUBE surfaces for H12994. The surfaces have been reviewed where noisy data, or "fliers" are incorporated into the gridded solutions causing the surface to be shoaler or deeper than the true sea floor. Where the spurious soundings

cause the gridded surface to vary from the reliably measured seabed by greater than the maximum allowable Total Vertical Uncertainty at that depth, the noisy data have been rejected by the hydrographer and the surface recomputed.

B.5.3 Data Logs

Data acquisition and processing notes are included in the acquisition and processing logs, and additional processing such as final tide and sound speed application are noted in the H12994 Data Log spreadsheet. All data logs are submitted digitally in the Separates I folder.

B.5.4 Designated Soundings

H12994 contains 1 designated sounding in accordance with HSSD Section 5.2.1.2.3. The sounding was selected to represent the least depth of a newly positioned wreck (Figure 16).

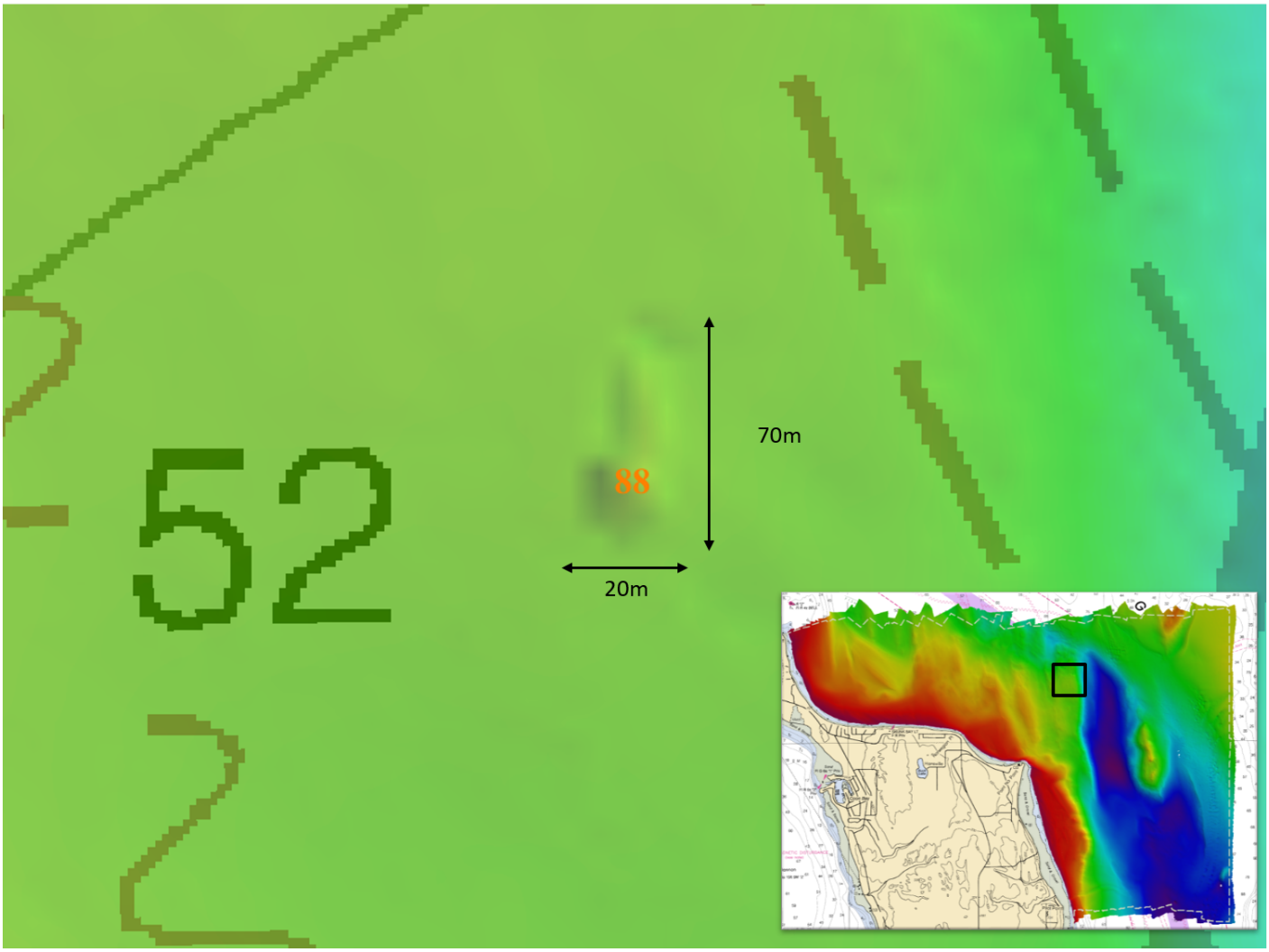


Figure 16: H12994 designated sounding

C. Vertical and Horizontal Control

Per Section 5.1.2.3 of the 2014 Field Procedures Manual, no Horizontal and Vertical Control Report has been generated for H12994.

C.1 Vertical Control

The vertical datum for this project is Mean Lower Low Water.

Traditional Methods Used:

TCARI

File Name	Status
9444900.tid	Final Approved
9447130.tid	Final Approved

Table 13: Water Level Files (.tid)

File Name	Status
H12993_H12994.tc	Final

Table 14: Tide Correctors (.zdf or .tc)

A request for final approved tides was sent to N/OPS1 on 10/12/2018. The final tide note was received on 10/17/2018.

ERS Methods Used:

ERS via VDATUM

Ellipsoid to Chart Datum Separation File:

VDatumShape_xyNAD83-MLLW_geoid12b.csar

ERS methods via a VDATUM separation model were used as the final means of reducing H12994 to MLLW for submission. The final TCARI grid was used to reduce all features to MLLW.

C.2 Horizontal Control

The horizontal datum for this project is North American Datum 1983.

The projection used for this project is Projected UTM 10.

Vessel kinematic data were post-processed using Applanix POSPac processing software and RTX methods as described in the DAPR. Smoothed Best Estimate of Trajectory (SBET) and associated error (RMS) data were applied to all MBES data in CARIS HIPS and SIPS. For further details regarding the processing and quality control checks performed, see the H12994 POSPac Processing Logs spreadsheet in the Separates I folder.

Differential correctors from the US Coast Guard beacon at Whidbey Island (302kHz) was used in real-time for acquisition when not otherwise noted in the acquisition logs, and was the sole method of positioning of bottom samples.

The following DGPS Stations were used for horizontal control:

DGPS Stations
Whidbey Island, WA

Table 15: USCG DGPS Stations

D. Results and Recommendations

D.1 Chart Comparison

A comparison was performed between survey H12994 and ENCs US5WA17M and US5WA19M using CARIS HIPS and SIPS sounding and contour layers derived from the surface generated from H12994 data. The contours and soundings were overlaid on the charts to assess differences between the surveyed soundings and charted depths. An 8 meter grid was generated from the ENC by extracting all soundings from the chart and creating an interpolated TIN surface which could be differenced with the surface generated from H12994 data.

All H12994 data should supersede charted data. In general, surveyed soundings agree with the majority of charted depths. A full discussion of the comparisons follows below.

D.1.1 Electronic Navigational Charts

The following are the largest scale ENCs, which cover the survey area:

ENC	Scale	Edition	Update Application Date	Issue Date	Preliminary?
US5WA17M	1:40000	27	05/29/2018	05/29/2018	NO
US5WA19M	1:25000	20	05/29/2018	10/25/2018	NO

Table 16: Largest Scale ENCs

US5WA17M

Soundings from H12994 are in general agreement with charted depths on ENC US5WA17M and US5WA19M. Most depths agree to 1-3 fathoms with the exception of a few soundings on both charts where differences are observed of up to 6 fathoms, as seen in Figure 17.

To more accurately visualize trends within these differences, a TIN surface was interpolated from the ENC sounding layer. This surface was then differenced with a corresponding surface from H12994 and visualized in Figure 18. In this difference surface red colors indicated H12994 was shoaler than ENCs US5WA17M and US5WA19M, green colors indicate agreement, and blue colors indicated H12994 was deeper than the ENCs. Statistics show the mean difference between the surfaces derived from mainscheme data and the interpolated TIN data was 1.60 meters with 95% of nodes falling within +/- 5.45 meters (Figure 19). The largest differences are in areas where charted soundings are scarce, affecting accuracy of the interpolated TIN surface.

Contours from H12994 are in general agreement with the charted contours on ENC US5WA17M and US5WA19M as seen in Figure 20.

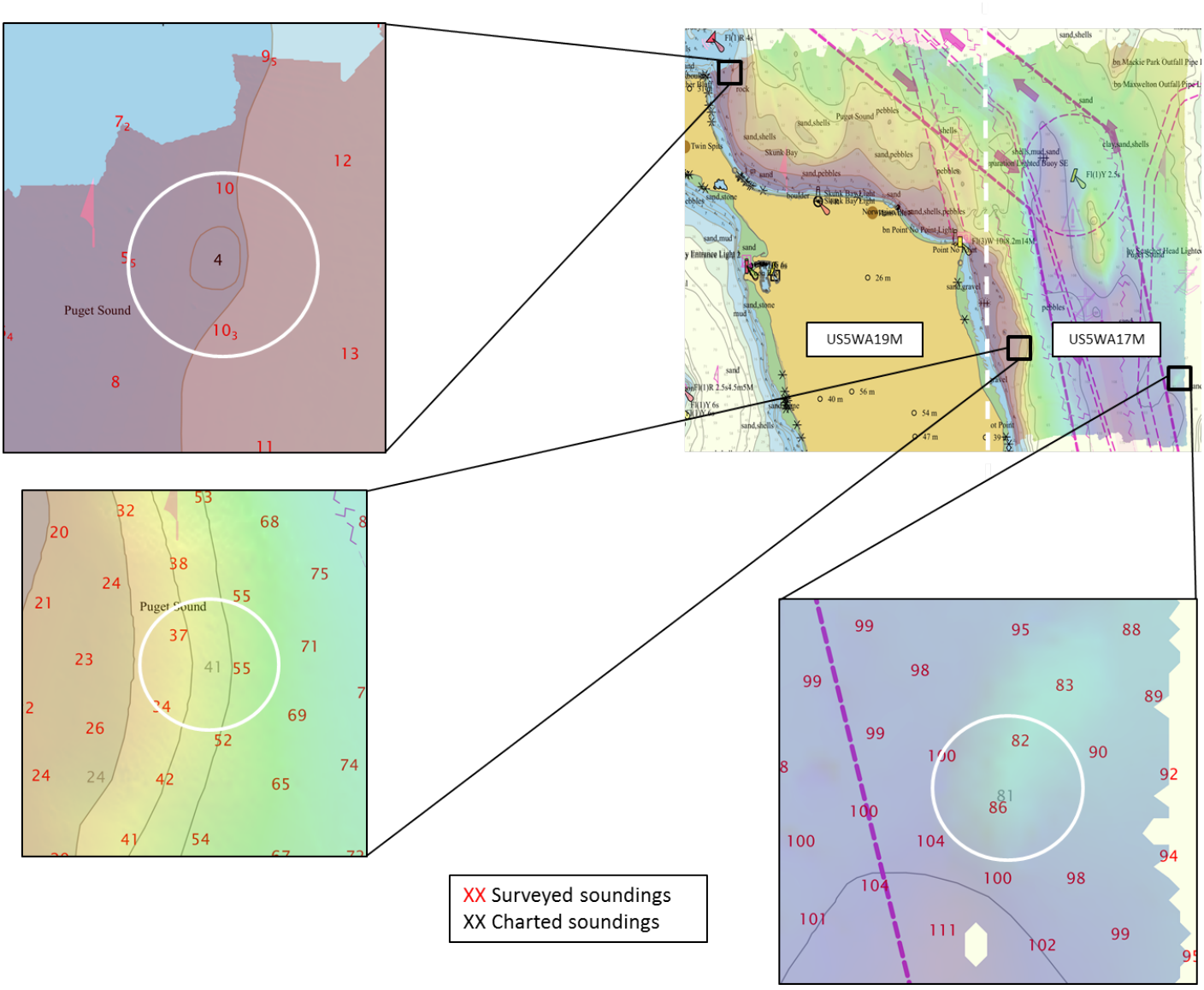


Figure 17: H12994 soundings (in red) as compared to ENC US5WA17M and US5WA19M soundings (in black)

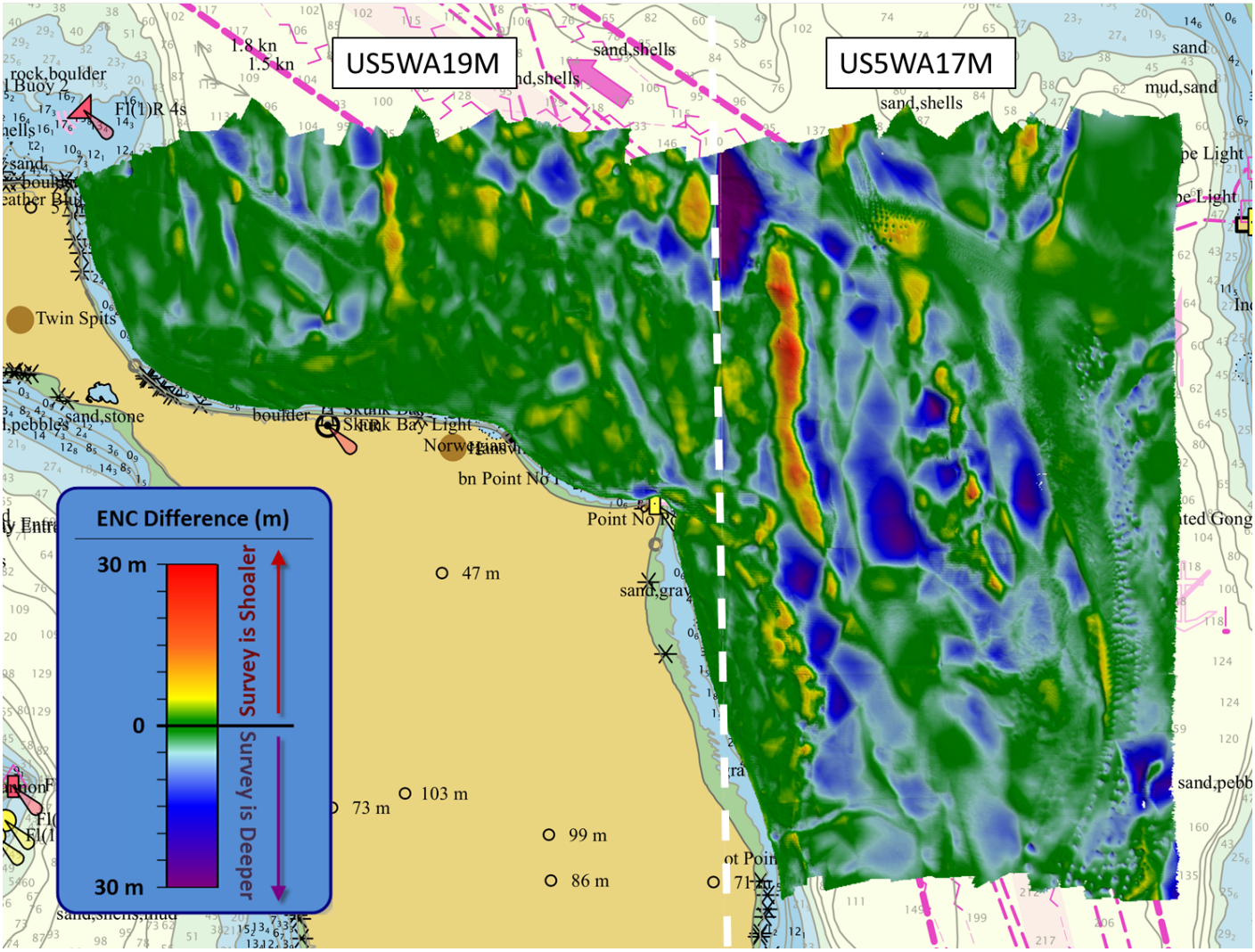
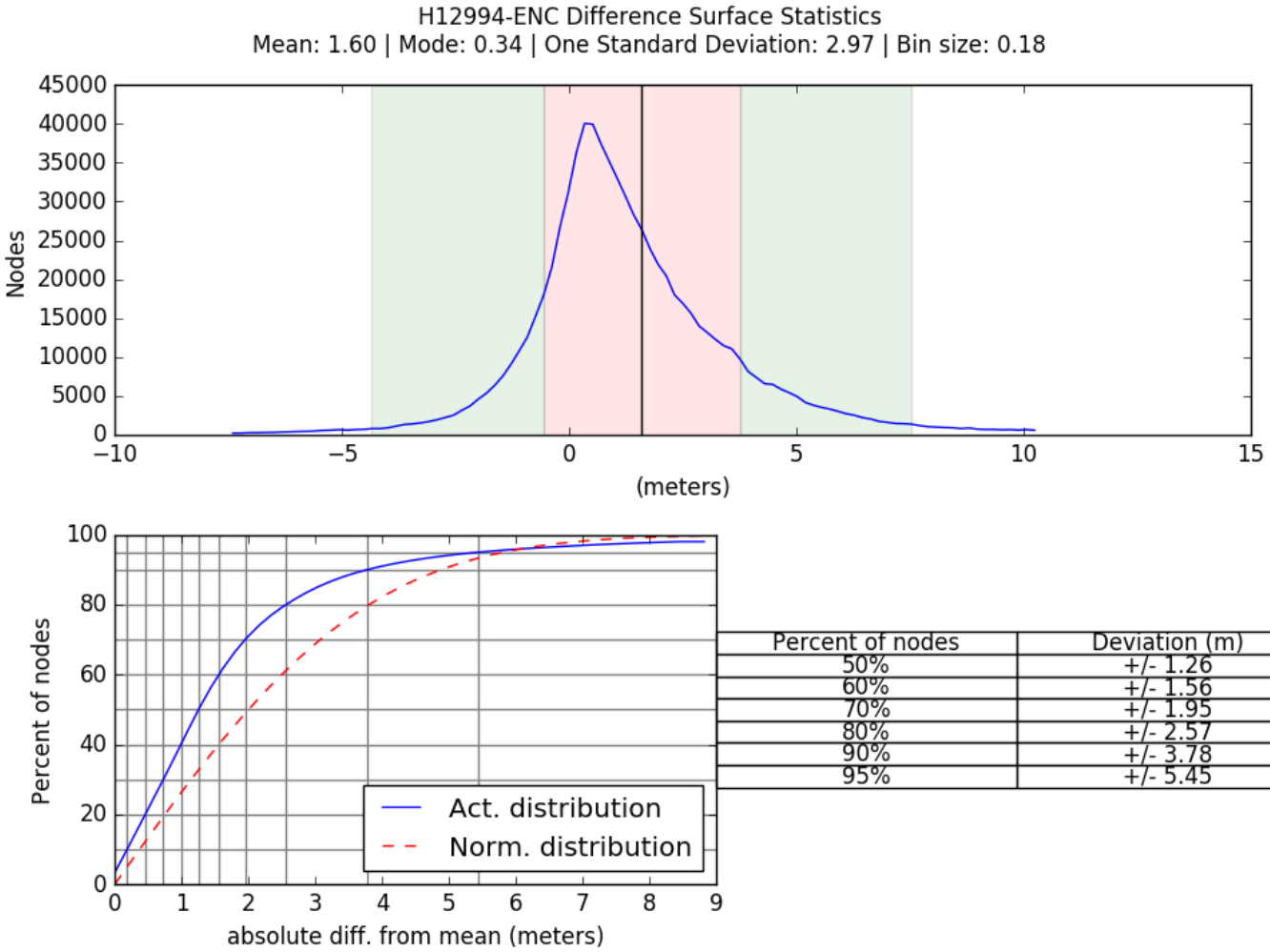


Figure 18: Difference surface between H12994 and interpolated TIN surface from ENC US5WA17M and US5WA19M



Percent of nodes	Deviation (m)
50%	+/- 1.26
60%	+/- 1.56
70%	+/- 1.95
80%	+/- 2.57
90%	+/- 3.78
95%	+/- 5.45

Figure 19: Difference surface statistics between H12994 and interpolated TIN surface from ENC US5WA17M and US5WA19M

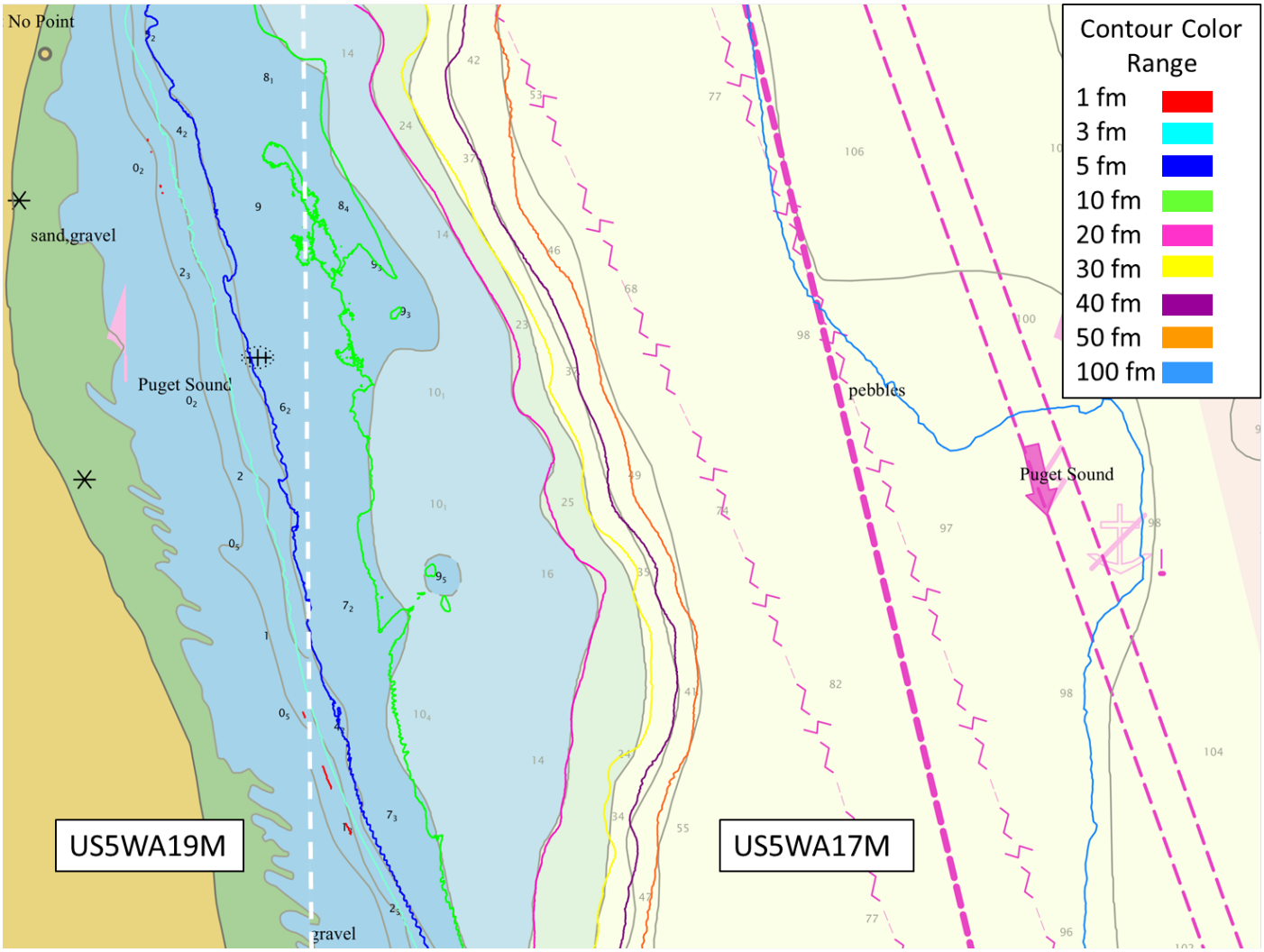


Figure 20: H12994 contours overlaid onto ENC US5WA17M and US5WA19M

US5WA19M

See discussion above.

D.1.2 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.1.3 Charted Features

One charted feature, a position approximate (PA) wreck in the south west portion of H12994, was investigated but not observed in the bathymetry data (Figure 21). The hydrographer recommends the deletion of this feature.

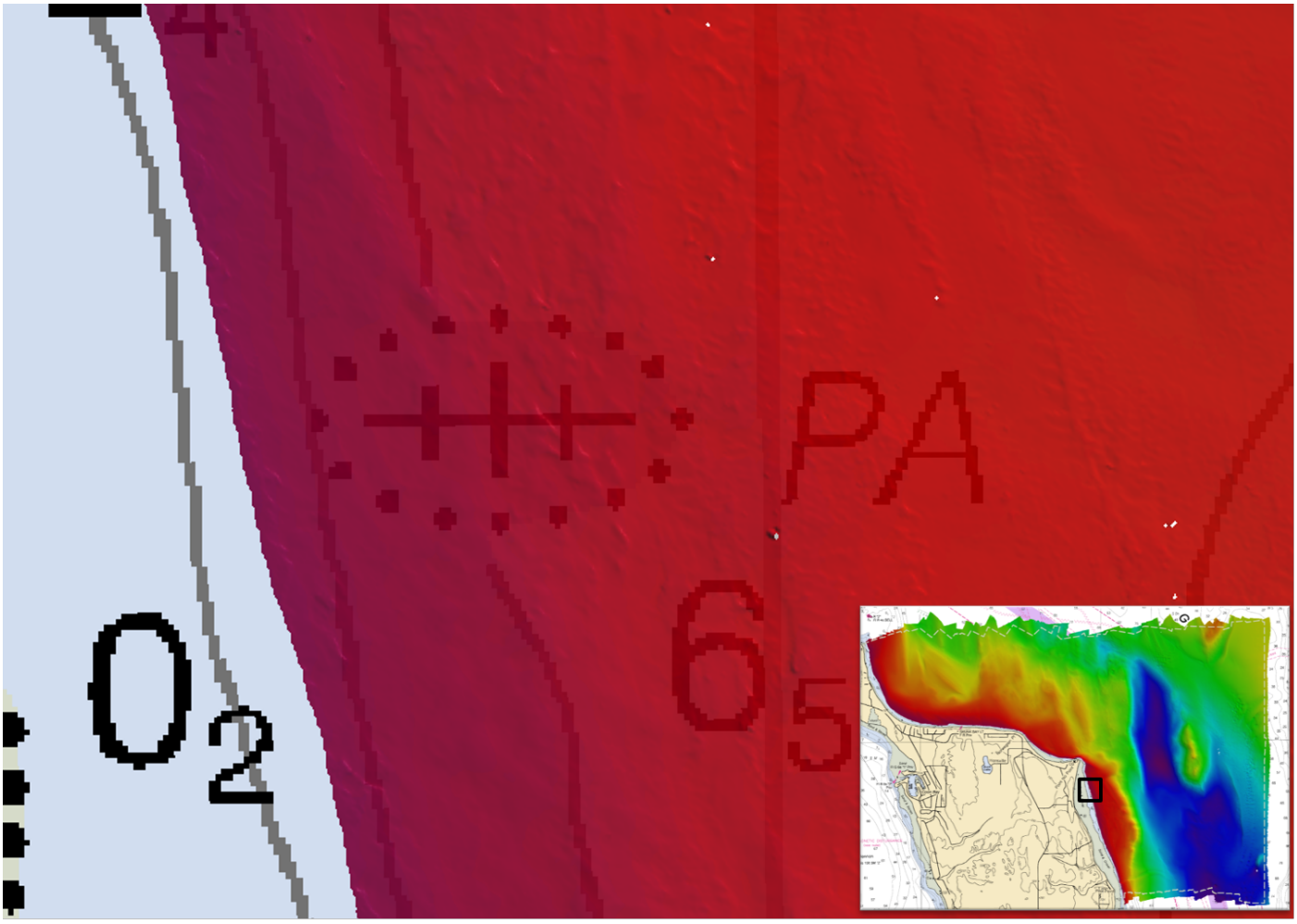


Figure 21: H12994 charted position approximate wreck

D.1.4 Uncharted Features

Survey H12994 has 8 new features that are addressed in the H12994 Final Feature File. Of these features there are 4 new Seabed Areas, 1 new Underwater Rock, 1 new Wreck, 1 new Obstruction Area and 1 new Pipeline.

D.1.5 Shoal and Hazardous Features

No shoals or potentially hazardous features exist for this survey.

D.1.6 Channels

Data were collected within the Puget Sound Traffic Lane. No navigationally significant features or major discrepancies between charted and surveyed soundings were observed.

D.1.7 Bottom Samples

Four bottom samples were acquired in accordance with the Project Instructions for survey H12994. All bottom samples were entered in the H12994 Final Feature File. See Figure 22 for a graphical overview of sample locations.

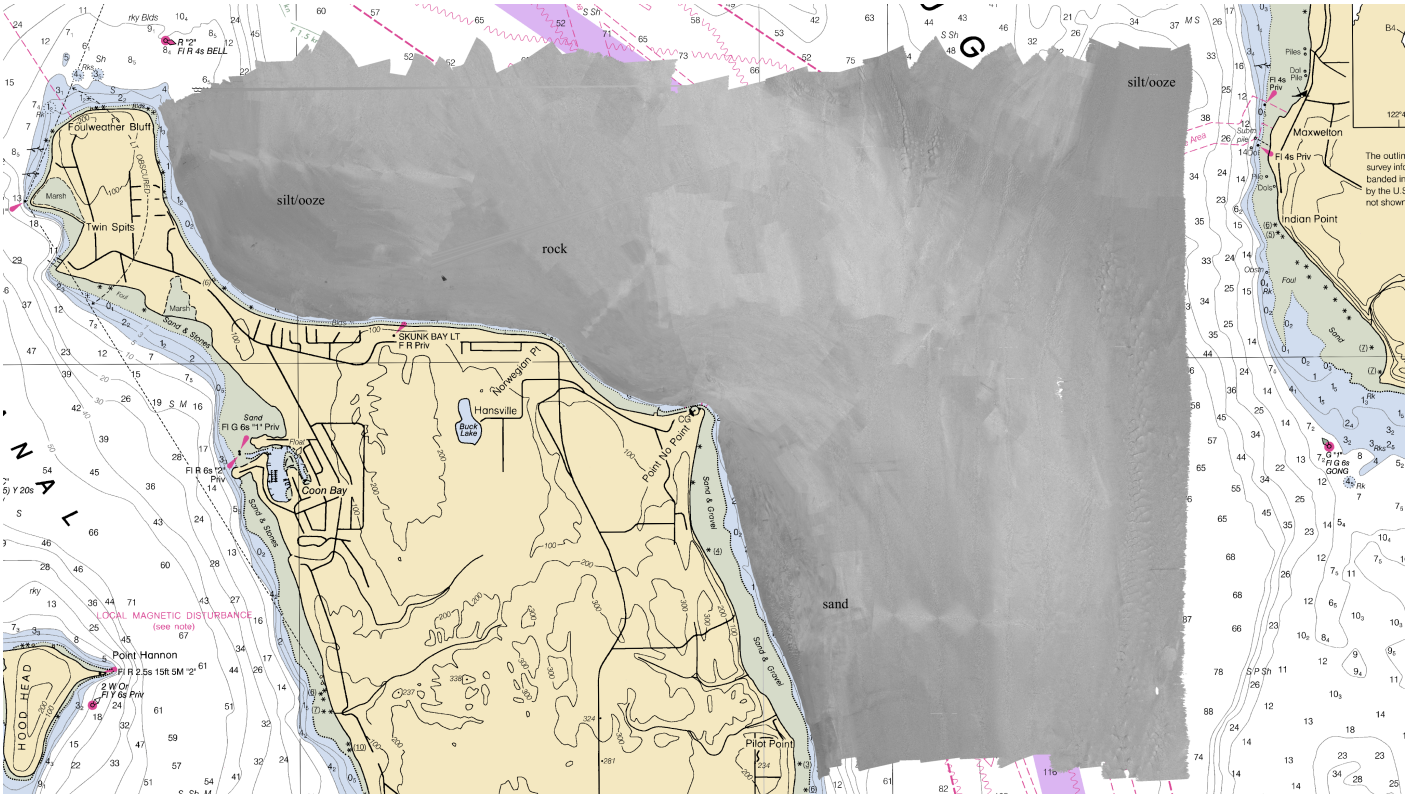


Figure 22: H12994 overview of bottom sample locations

D.2 Additional Results

D.2.1 Shoreline

H12994 survey limits extended to the NALL (see Section A.1) and all features within these limits were addressed and attributed in the H12994 Final Feature File. All features inshore of NALL were attributed in the Final Feature File with the description of "Not Addressed" and remarks of "Retain as charted, not investigated due to being inshore of NALL" as per HSSD Section 7.3.1. Annotations and information collected on boat sheets during field operations are scanned and included in the Separates I Detached Positions folder.

D.2.2 Prior Surveys

No prior survey comparisons exist for this survey.

D.2.3 Aids to Navigation

The Puget Sound Traffic Lane Separation Lighted Buoy and Point No Point Light were on station and observed to be serving their intended purpose.

D.2.4 Overhead Features

No overhead features exist for this survey.

D.2.5 Submarine Features

Charted cable/submarine areas were investigated but not observed in the bathymetry data.

D.2.6 Platforms

No platforms exist for this survey.

D.2.7 Ferry Routes and Terminals

No ferry routes or terminals exist for this survey.

D.2.8 Abnormal Seafloor and/or Environmental Conditions

No abnormal seafloor and/or environmental conditions exist for this survey.

D.2.9 Construction and Dredging

No present or planned construction or dredging exist within the survey limits.

D.2.10 New Survey Recommendation

No new surveys or further investigations are recommended for this area.

D.2.11 Inset Recommendation

No new insets are recommended for this area.

E. Approval Sheet

As Chief of Party, field operations for this hydrographic survey were conducted under my direct supervision, with frequent personal checks of progress and adequacy. I have reviewed the attached survey data and reports.

All field sheets, this Descriptive Report, and all accompanying records and data are approved. All records are forwarded for final review and processing to the Processing Branch.

The survey data meets or exceeds requirements as set forth in the NOS Hydrographic Surveys Specifications and Deliverables, Field Procedures Manual, Letter Instructions, and all HSD Technical Directives. These data are adequate to supersede charted data in their common areas. This survey is complete and no additional work is required with the exception of deficiencies noted in the Descriptive Report.

Approver Name	Approver Title	Approval Date	Signature
CDR Marc Moser, NOAA	Chief of Party	02/22/2019	MOSER.MARC.STANTON.1163193902 Digitally signed by MOSER.MARC.STANTON.1163193902 Date: 2019.02.26 09:17:05 -08'00'
LT Stephen Moulton, NOAA	Field Operations Officer	02/22/2019	MOULTON.STEPHEN.F.1282116835 Digitally signed by MOULTON.STEPHEN.F.1282116835 Date: 2019.02.26 11:13:40 -08'00'
HCST Sam Candio	Chief Survey Technician	02/22/2019	
HAST Megan Shapiro	Sheet Manager	02/15/2019	Megan Shapiro

F. Table of Acronyms

Acronym	Definition
AHB	Atlantic Hydrographic Branch
AST	Assistant Survey Technician
ATON	Aid to Navigation
AWOIS	Automated Wreck and Obstruction Information System
BAG	Bathymetric Attributed Grid
BASE	Bathymetry Associated with Statistical Error
CO	Commanding Officer
CO-OPS	Center for Operational Products and Services
CORS	Continually Operating Reference Staiton
CTD	Conductivity Temperature Depth
CEF	Chart Evaluation File
CSF	Composite Source File
CST	Chief Survey Technician
CUBE	Combined Uncertainty and Bathymetry Estimator
DAPR	Data Acquisition and Processing Report
DGPS	Differential Global Positioning System
DP	Detached Position
DR	Descriptive Report
DTON	Danger to Navigation
ENC	Electronic Navigational Chart
ERS	Ellipsoidal Referenced Survey
ERZT	Ellipsoidally Referenced Zoned Tides
FFF	Final Feature File
FOO	Field Operations Officer
FPM	Field Procedures Manual
GAMS	GPS Azimuth Measurement Subsystem
GC	Geographic Cell
GPS	Global Positioning System
HIPS	Hydrographic Information Processing System
HSD	Hydrographic Surveys Division
HSSD	Hydrographic Survey Specifications and Deliverables

Acronym	Definition
HSTP	Hydrographic Systems Technology Programs
HSX	Hypack Hysweep File Format
HTD	Hydrographic Surveys Technical Directive
HVCR	Horizontal and Vertical Control Report
HVF	HIPS Vessel File
IHO	International Hydrographic Organization
IMU	Inertial Motion Unit
ITRF	International Terrestrial Reference Frame
LNM	Linear Nautical Miles
MBAB	Multibeam Echosounder Acoustic Backscatter
MCD	Marine Chart Division
MHW	Mean High Water
MLLW	Mean Lower Low Water
NAD 83	North American Datum of 1983
NAIP	National Agriculture and Imagery Program
NALL	Navigable Area Limit Line
NM	Notice to Mariners
NMEA	National Marine Electronics Association
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NRT	Navigation Response Team
NSD	Navigation Services Division
OCS	Office of Coast Survey
OMAO	Office of Marine and Aviation Operations (NOAA)
OPS	Operations Branch
MBES	Multibeam Echosounder
NWLON	National Water Level Observation Network
PDBS	Phase Differencing Bathymetric Sonar
PHB	Pacific Hydrographic Branch
POS/MV	Position and Orientation System for Marine Vessels
PPK	Post Processed Kinematic
PPP	Precise Point Positioning
PPS	Pulse per second

Acronym	Definition
PRF	Project Reference File
PS	Physical Scientist
PST	Physical Science Technician
RNC	Raster Navigational Chart
RTK	Real Time Kinematic
SBES	Singlebeam Echosounder
SBET	Smooth Best Estimate and Trajectory
SNM	Square Nautical Miles
SSS	Side Scan Sonar
SSSAB	Side Scan Sonar Acoustic Backscatter
ST	Survey Technician
SVP	Sound Velocity Profiler
TCARI	Tidal Constituent And Residual Interpolation
TPE	Total Propagated Error
TPU	Topside Processing Unit
USACE	United States Army Corps of Engineers
USCG	United Stated Coast Guard
UTM	Universal Transverse Mercator
XO	Executive Officer
ZDA	Global Positiong System timing message
ZDF	Zone Definition File

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

TIDE NOTE FOR HYDROGRAPHIC SURVEY

DATE : October 17, 2018

HYDROGRAPHIC BRANCH: Pacific
HYDROGRAPHIC PROJECT: OPR-N305-FA-18
HYDROGRAPHIC SHEET: H12993 and H12994

LOCALITY: Holmes Harbor to Elger Bay; Vicinity of Hansville, WA
TIME PERIOD: September 27 - October 06, 2018

TIDE STATION USED: 9444900 Port Townsend, WA
Lat. 48° 6.8′ 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: 9447130 Seattle, WA
Lat. 47° 36.1' N Long. 122° 20.3' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 3.199 meters

REMARKS: RECOMMENDED GRID

Please use the TCARI grid "H12993_H12994.tc" as the final grid for project OPR-N305-FA-18, Registry Nos. H12993 & H12994, during the time period September 27 - October 06, 2018.

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).

Note 2: Due to an inaccurate shoreline, survey track lines fall outside of the TCARI grid boundaries in some areas. TCARI will extrapolate the tide corrector to cover these soundings.

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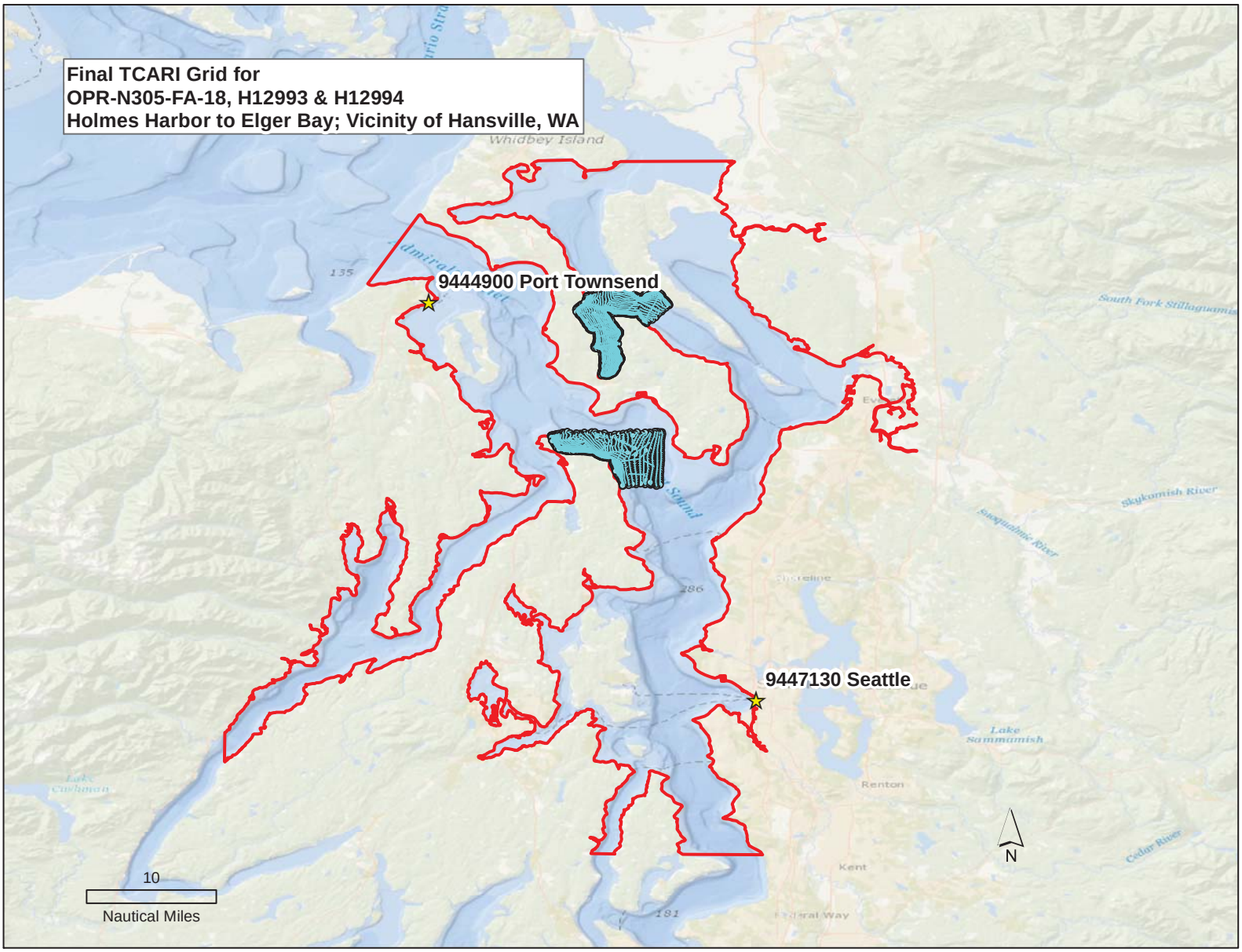
Date: 2018.10.29 12:58:12 -04'00'

CHIEF, PRODUCTS AND SERVICES BRANCH


Final TCARI Grid for
OPR-N305-FA-18, H12993 & H12994
Holmes Harbor to Elger Bay; Vicinity of Hansville, WA
9444900 Port Townsend
9447130 Seattle
Whidbey Island
Renton
Kent
Lake Sammamish
Skykomish River
Snoqualmie River
South Fork Stillaguamish
Lake Cavanaugh
Federal Way
Cedar River
N
10
Nautical Miles

APPROVAL PAGE

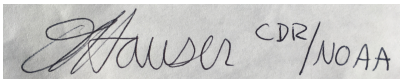
H12994

Data meet or exceed current specifications as certified by the OCS survey acceptance review process. Descriptive Report and survey data except where noted are adequate to supersede prior surveys and nautical charts in the common area.

The following products will be sent to NCEI for archive

- Descriptive Report
- Collection of Bathymetric Attributed Grids (BAGs)
- Backscatter mosaics
- Processed survey data and records
- GeoPDF of survey products

The survey evaluation and verification has been conducted according current OCS Specifications, and the survey has been approved for dissemination and usage of updating NOAA's suite of nautical charts.



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Approved:_____

Commander Olivia Hauser, NOAA
Chief, Pacific Hydrographic Branch