H12110

NOAA FORM 76-35A

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

DESCRIPTIVE REPORT

Type of Survey Hydrographic Survey

Field No.

Registry No. H12110

LOCALITY

State California

General Locality Gulf of the Farallones

Sublocality 10 NM Southwest of Golden Gate

2009

CHIEF OF PARTY

David D. Briggs, Fugro Pelagros, Inc.

LIBRARY & ARCHIVES

DATE

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

HYDROGRAPHIC TITLE SHEET

REGISTRY No

H12110

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 **California**

General Locality **Gulf of the Farallones**

Sub-Locality **10 NM Southwest of Golden Gate**

Scale **1:10,000** Date of Survey **7/02/09 - 08/03/09**

Instructions dated **12/15/2008** Project No. **OPR-L430-KR-09**

Vessel **Pacific Star**

Chief of party **David D. Briggs**

Surveyed by **REYNOLDS, MOYLES, FARLEY, ROKYTA, LYDON, LOPEZ, BARROW, TIXIER, et al**

Soundings by **Reson SeaBat 7125**

SAR by **Adam Argento** Compilation by **Peter Holmberg**

Soundings compiled in **Feet**

REMARKS: **All times are UTC. UTM Zone 10**

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. Revisions and end notes in red were generated during office processing. Page numbering may be interrupted or non sequential.

All pertinent records for this survey, including the Descriptive Report, are archived at the National Geophysical Data Center (NGDC) and can be retrieved via http://www.ngdc.noaa.gov/.

A. AREA SURVEYED

H12110 (Sheet B) is located 10 NM Southwest of Golden Gate. It is bound by the coordinates listed in **Table 1** and shown in **Figure 1.**

Hydrographic data collection began on July 2, 2009 and ended on August 3, 2009.

Table 1 – Sheet Bounds

Point	Latitude (North)	Longitude (West)
1	37-39-22	122-43-45
2	37-42-54	122-36-02
3	37-34-44	122-30-24
4	37-31-16	122-38-07

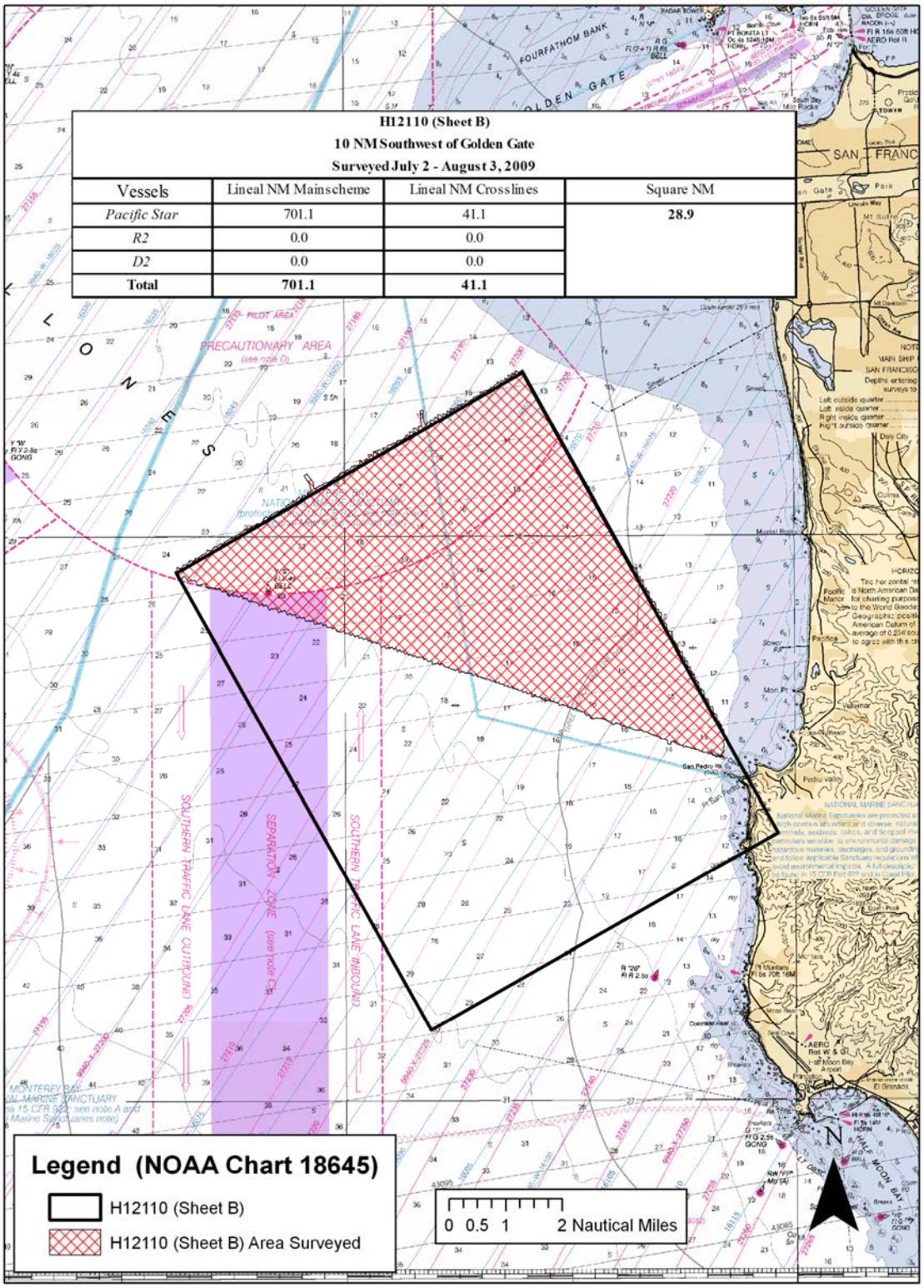

Figure 1 H12110 Area Surveyed

B. DATA ACQUISITION AND PROCESSING

Refer to the OPR-L430-KR-09 Data Acquisition and Processing Report for a detailed description of all equipment, survey vessels, processing procedures, and quality control features. Items specific to this survey and any deviations from the Data Acquisition and Processing Report are discussed in the following sections.

B.1 Equipment & Vessels

The F/V Pacific Star acquired all sounding data for H12110.

F/V Pacific Star, 162 feet in length with a draft of 16 feet, was equipped with a hull mounted Reson SeaBat 7125 dual-frequency multibeam echosounder system for the OPR-L430-KR-09 survey. All 7125 multibeam data files were logged in the S7K format using WinFrog Multibeam v 3.08.44.04. The vessel was equipped with two AML sound velocity and pressure sensors (SV&P), and a Brooks Ocean Moving Vessel Profiler (MVP), for sound velocity profiles. Vessel attitude and position were measured using an Applanix Position and Orientation System for Marine Vessels (POS MV) 320 V4.

Refer to OPR-L430-KR-09 Data Acquisition and Processing Report for a complete listing of equipment and vessel descriptions.

B.2 Quality Control

Crosslines

Crosslines were planned and well distributed throughout the survey to ensure adequate quality control. Total crossline length surveyed was 41.1 nautical miles or 5.9 percent of the total main scheme line length. Each crossline was compared to the 2m CUBE BASE surface, using the CARIS HIPS QC report routine with all beams passing at the 95 percent confidence level or better.[1] Results are located in Separate IV.

Note: The QC reports were generated based on the given accuracy specification of:

$$\pm\sqrt{a^2 + (b * d)^2}$$

Where, a=0.5 and b=0.013, d=depth

Uncertainty Values

The majority of H12110 had uncertainty values of 0.31 m to 0.38 m, which met project specifications **(Figure 2)**.[2]

As seen in the uncertainty surface graphic, uncertainty values are generally lowest near the sonar nadir beams and increase toward the outside of each swath. This is expected and primarily a result of sound velocity error and higher bottom detection uncertainty.

Areas of higher uncertainty include sound velocity error and static draft busts. Other areas of higher uncertainty include irregular bottom topography and rock outcrops.[3]

Oscillations found in the along-track and across-track uncertainty values are a result of vessel pitch and roll and are more pronounced during times of heavy weather.[4]

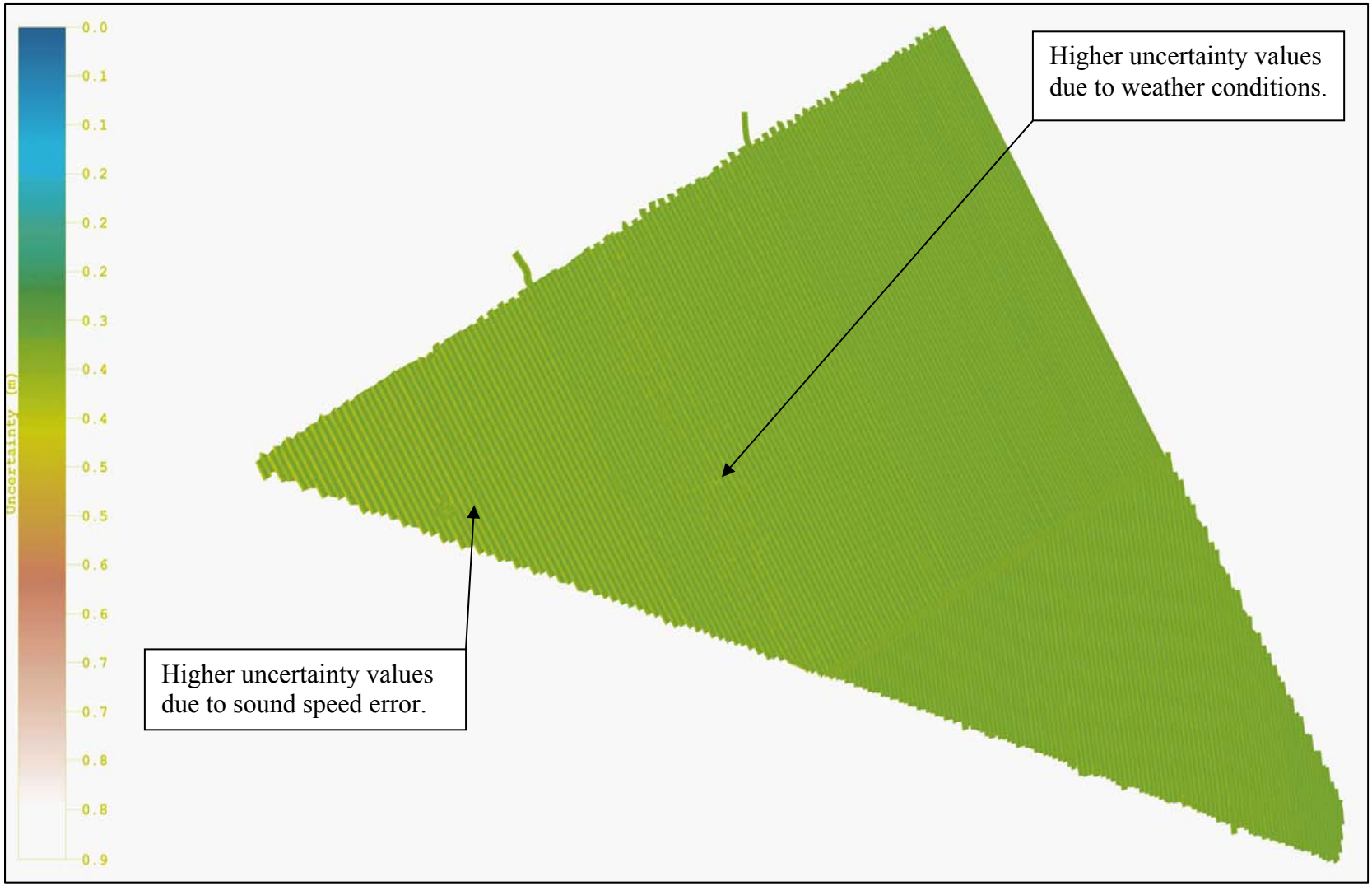

Figure 2 Uncertainty DTM

Survey Junctions

H12110 (Sheet B) junctions[5] with:
See (**Figure 3**).

Registry #	Date	Junction Side
H12109	2009	North
H12112	2009	Northeast
H12113	2009	East

The surveys agree along their common borders. The agreement was noted in the field by comparing the CUBE BASE surfaces during subset cleaning. This conformity is also apparent in the final combined BASE surfaces.[6]

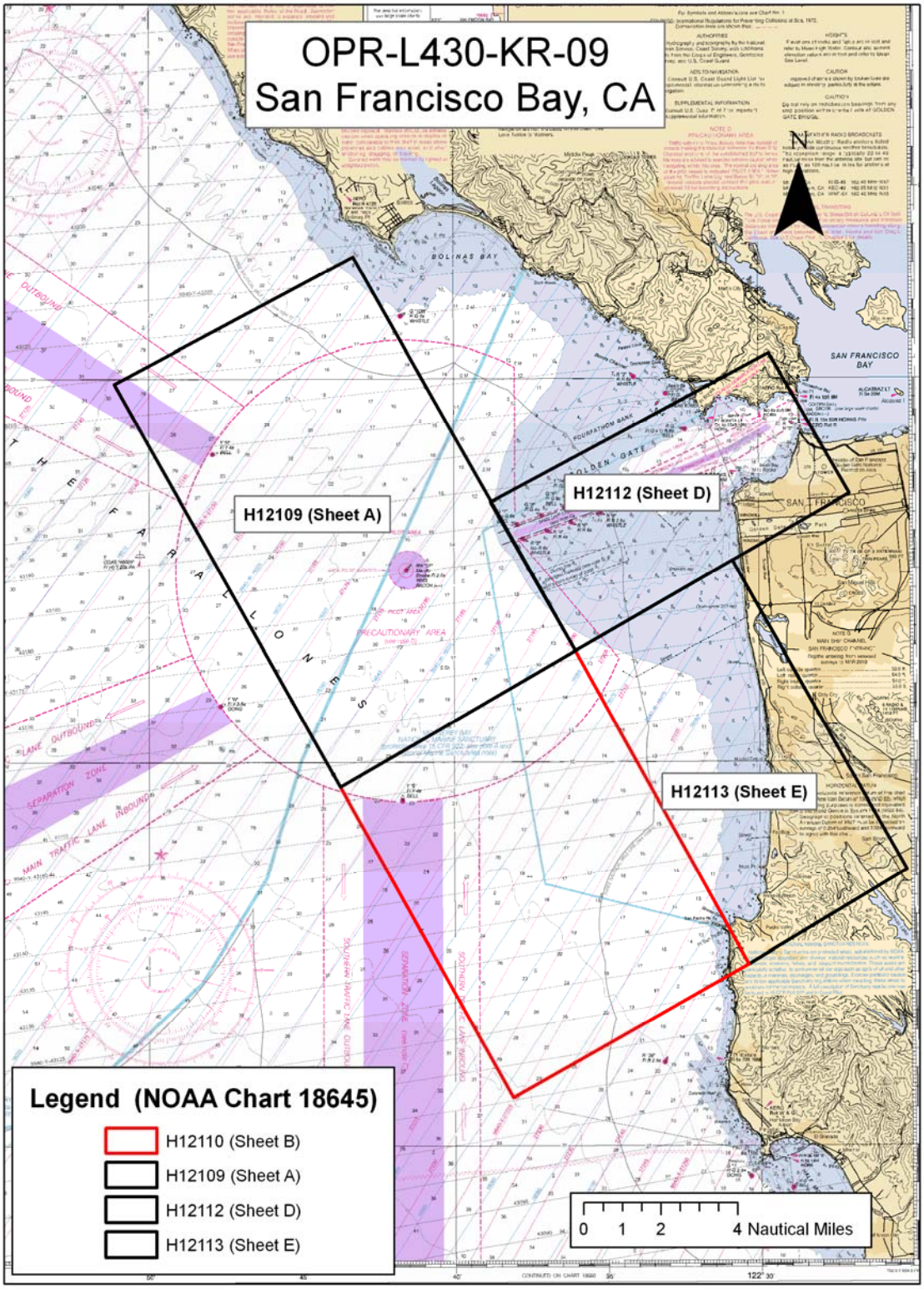

Figure 3 H12110 Survey Junctions

Quality Control Checks

Positioning system confidence checks were conducted on a daily basis using the (POS MV) controller software. The controller software had numerous real-time displays which were monitored throughout the survey to ensure that positional accuracies specified in the NOS Hydrographic Surveys Specifications and Deliverables were achieved. These include, but are not limited to the following: GPS Status, Position Accuracy, Receiver Status (which included HDOP), and Satellite Status. During periods of high HDOP and/or low number of available satellites, survey operations were suspended.

Sonar system confidence checks were performed weekly by comparing post-processed depth information collected by multiple vessels surveying over a common area. In addition, bar checks were performed to maintain a high confidence level. Sound Velocity Probe confidence checks were conducted weekly by producing comparable sound velocity data for all vessels. This was accomplished by having all sound velocity profiling equipment (MVP and SVPs) perform an SVP cast concurrently, with all vessels in close proximity to each other.

Data Quality

In general, the multibeam data quality for H12110 was good.[7] Three notable problems follow:

1. A general downward and/or upward cupping is noticeable in the across-track sounding profiles for certain areas. This is most likely due to a high volume of thermal layering and to strong undercurrents in the water column. To address this problem, full water column sound speed measurements were conducted more frequently. Even though this SVP error is noticeable in the data, it is within required specifications.

The MVP system on the Pacific Star was deployed at an interval of once every two hours, where the system was used to collect as many as five profiles along the course of a single line. Two hours later, another set of profiles was collected, with the result being the creation of a grid of sound velocity profiles. This method kept differences in time and distance to a minimum between the survey data and the applied sound velocity profile.

2. During routine processing, areas were found which contained excessive sound speed error. Although this data was valid and within IHO Order 1, the outer beam data were marked rejected during subset cleaning to allow a stronger hypothesis for near nadir beams in adjacent lines. Data density requirement of 5 pings per node were met prior to subset cleaning, refer to **Figure 4,** and were adhered to during data acquisition. It is apparent in the final surface that after the subset cleaning process, some areas fell outside the data the density requirement, refer to **Figure 5**.

Figure 4 is a snippet of data from H12110 prior to subset cleaning; it is evident from the graphic that no areas, excluding the border region, fell outside the data density requirement.

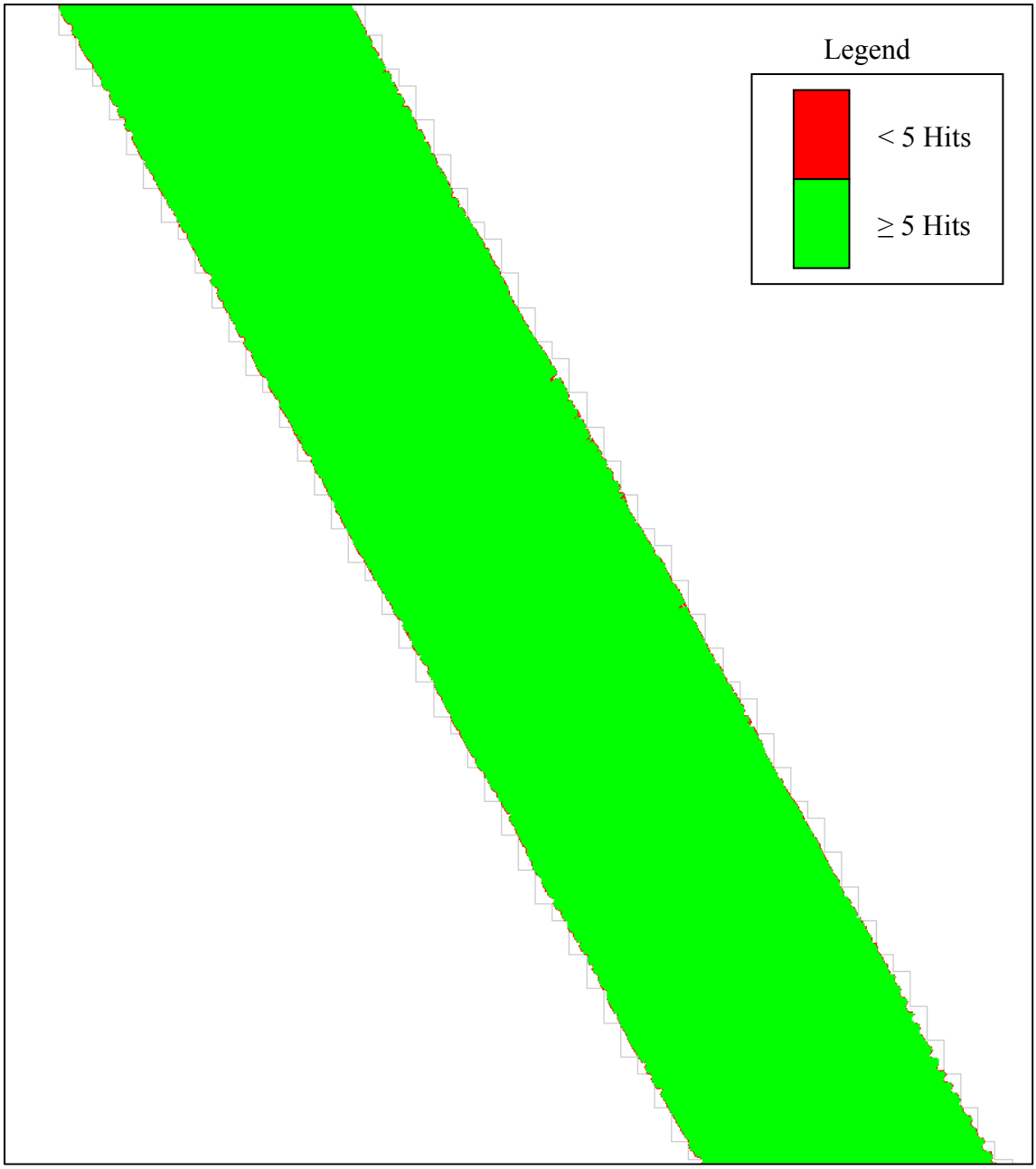

Figure 4 Data prior to Subset Editor cleaning

Figure 5 is the same snippet of data, but displays the data set after the cleaning process outlined above, from the graphic there are numerous grid nodes (in red) that now fall outside of the data density requirement.

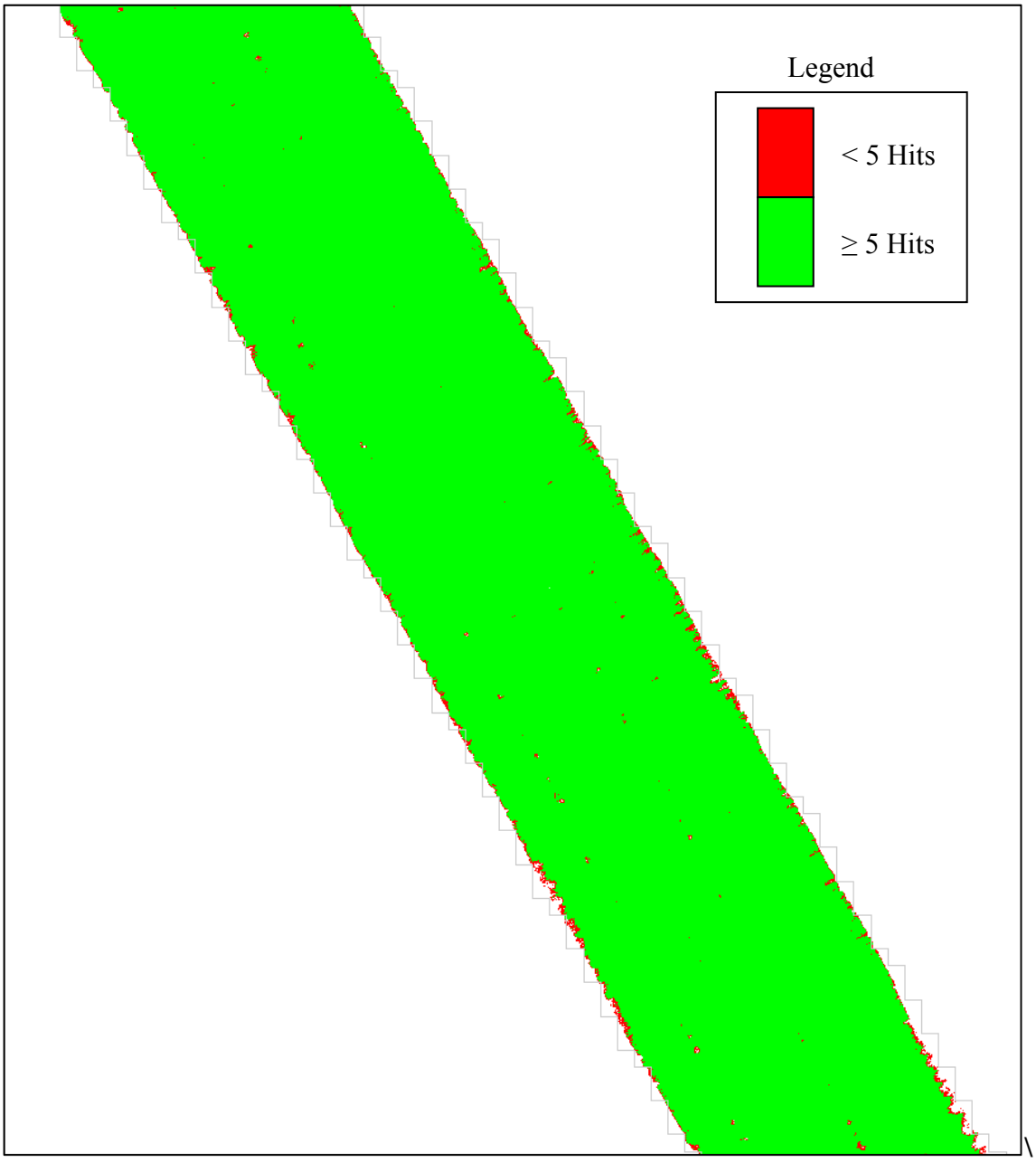

Figure 5 Data after Subset Editor cleaning

Detection requirements were met by minimizing vessel speed when necessary, using sonar range scales appropriate to the water depth to maximize ping rates, and maximizing swath overlap. These variables were adjusted in real-time by the online acquisition crew based on the WinFrog QC and coverage displays. The office-based processing crew provided feedback after preliminary processing and coverage creation in CARIS HIPS, and reported re-runs or in-fills as necessary to the acquisition crew.

3. Several inaccurate waterline measurements were logged on the Pacific Star as a result of significant wave action combined with considerable vessel roll. An effort was made to record waterline values at 12-hour intervals and vessel ballasting was avoided, but significant variance was still found in these values. Waterline values were evaluated using Post Processed Kinematic GPS Altitude and erroneous values were removed from the CARIS Vessel Configuration File. Some lines still exhibit vertical busts of up to 15cm as a result of higher than normal uncertainty in waterline measurements.[8]

Refer to the OPR-L430-KR-09 Data Acquisition and Processing Report for a detailed description of the survey equipment and methodology used over the course of this survey.

B.3 Corrections to Soundings

Refer to the OPR-L430-KR-09 Data Acquisition and Processing Report for a detailed description of all corrections to soundings. No deviations from the report occurred.

B.4 Data Processing

Refer to the OPR-L430-KR-09 Data Acquisition and Processing Report for a detailed description of the processing flow.

In order to provide more accurate project wide TPU values, all full water column sound speed cast measurements were statistically analyzed in MBTools, via the SVP Statistics utility. This utility calculated a mean, variance, and standard deviation at a user specified depth interval. The standard deviation was then used to produce a TPU value of higher accuracy that was vessel and sheet specific.

The calculated Sound Velocity TPU values are as follows for H12110:

Vessel	Measured	Surface
3-Pacific Star	0.500	4.456

The final fieldsheet for H12110 is called "H12110_(Sheet_B)" and it contains two CUBE BASE surfaces and two finalized CUBE BASE surface.[9] The following parameters were used for the finalized surfaces:

0-23 meters: 1 m resolution, name "H12110_1m_Final"
20-52 meters: 2 m resolution, name "H12110_2m_Final"

Note:

- Maximum depth was approximately 46 m; therefore, resolutions coarser than 2m were not computed.

The final S57 file for this project is called "H12110_S57_Features.000". This file contains the object and metadata S57 objects as required in the Specifications and Deliverables.[10]

C. VERTICAL AND HORIZONTAL CONTROL

Refer to the OPR-L430-KR-09 Horizontal and Vertical Control Report for a detailed description of the horizontal and vertical control used on this survey. No deviations from the report occurred. A summary of the project's horizontal and vertical control follows.

C.1 Horizontal Control

The horizontal control datum for this survey was the North American Datum of 1983 (NAD83).

For real-time DGPS corrections, a CSI MBX-3 unit was tuned to the Pigeon Point, CA. USCG DGPS site. The unit output differentially corrected positions at 1 Hz to the (POS MV) 320 V4 where it was integrated with inertial data, and a position for the top-center of the IMU was generated. This position was logged concurrently with the bathymetry from WinFrog and the POS file by WinFrog PosMvLogger. It was later corrected for offsets to the multibeam echosounder (MBES) by CARIS HIPS in processing.

Final positioning, however, was done using post-processed kinematic (PPK) methods. Applanix POSPac software was used in conjunction with the POS files and local base station data to generate a higher accuracy position which was applied in processing, replacing the real-time position records.

See OPR-L430-KR-09 Horizontal and Vertical Control Report for a more detailed description of PPK positioning methods used.

C.2 Vertical Control

All sounding data were initially reduced to mean lower low water (MLLW) using preliminary tidal data for gauges 9414290 & 9415020, from the National Water Level Observation Program accessed through the NOAA tides and currents website (http://tidesandcurrents.noaa.gov/). A cumulative file for the gauges was updated daily by appending the new data. Preliminary tidal zoning provided by NOAA was used in conjunction with the preliminary tide data for initial data processing.

On September 14, 2009, JOA issued verified tidal data and final zoning for H12109, H12110, H12111, H12112, and H12113 of OPR-L430-KR-09. The tidal zoning was modified by JOA, providing a more elaborate zoning scheme from those zones issued in the Statement of Work. Verified tidal data had a light smoothing applied to alleviate high frequency noise.

All sounding data were then re-merged using CARIS HIPS and SIPS tide routine. Verified tidal data from the San Francisco, CA (9414290) and Point Reyes, CA (9415020) tidal stations were used for the final Navigation Base Surfaces and S-57 Feature files. Tidal Stations were owned and operated by NOAA's National Ocean Service through the National Water Level Observation Program.

Table 2 – Tide Gauge

Gauge	Location	Latitude	Longitude
9414290	San Francisco, CA	37° 48.4' N	122° 27.9' W
9415020	Point Reyes, CA	37° 59.7 N	122° 58.6 W

See OPR-L430-KR-09 Horizontal and Vertical Control Report for a more detailed description of final tidal zoning.

D. RESULTS AND RECOMMENDATIONS

D.1 Chart Comparison

H12110 survey was compared with charts shown in **Table 3**.

Table 3 – Chart Comparisons

Chart Number	Type	Scale	Edition	Edition Date
18645	Raster	1:100,000	26	September, 2008
18649	Raster	1:40,000	67	December, 2009
US5CA11M	ENC	n/a	12	March, 2010
US4CA12M	ENC	n/a	11	March, 2010
US3CA14M	ENC	n/a	10	July 2010

Comparison of Soundings

A comparison of soundings was accomplished by overlaying the latest edition of NOAA charts and ENCs onto the final BASE surfaces in CARIS HIPS & SIPS. The general agreement between the charted soundings and H12110 soundings is noted. A more detailed comparison was undertaken for any charted shoals or other dangerous features.

Agreement between the H12110 BASE surface depths and the charted soundings for all applicable ENC and Raster charts was within +/- 1 to 2 fathoms.[11] Since the survey area was ensonified with 100% multibeam coverage, shoaler depths were discovered between the charted soundings. In these areas, when necessary, the sounding was designated to ensure its inclusion in the finalized BASE surface.

The Hydrographer recommends that soundings within the survey limits of H12110 supersede all prior survey and charted depths.[12]

Automated Wreck and Observation Information System (AWOIS)

There were no AWOIS items assigned to H12110.[13]

Charted Features

There were no charted features labeled ED, PD, or PA within the limits of H12110.[14]

Dangers to Navigation

No dangers to navigation were found or reported for this survey.[15]

D.2 Additional Results

Shoreline verification was not a requirement for OPR-L430-KR-09. In addition to providing NOAA with high-density multibeam data for charting purposes, an in depth VDatum analysis was conducted as a joint effort between Fugro Pelagos, Inc. and John Oswald & Associates. The results and findings can be found in the Horizontal & Vertical Control Report for the project.

Bottom Samples

The F/V Pacific Star and launches (R2 and D2) were fitted to obtain bottom samples as specified in the Statement of Work.

Samples were taken with a Van Veen grab sampler and positions were recorded with WinFrog Multibeam v 3.08.44.04. Samples retrieved were analyzed and then encoded with the appropriate S57 attributes. Positions and descriptions of all samples are found in the H12110_S57_Features file.[16]

Aids to Navigation

The following aid to navigation was examined during this survey:

1. Buoy Y "S" FI Y 4s BELL at 37-39-00 N, 122-41-42 W (chart 18645) found to exist and to be serving its intended purpose.[17]

No uncharted aids to navigation were found in the survey area.[18]

E. APPROVAL SHEET

Approval Sheet

For

H12110

Standard field surveying and processing procedures were followed in producing this survey in accordance with the following documents:

OPR-L430-KR-09 Statement of Work
NOS Hydrographic Surveys Specifications and Deliverables, April 2009 Edition
Fugro Pelagos, Inc. Acquisition Procedures (2009-MBES_Acquisition_Procedures_R0);
Fugro Pelagos, Inc. Processing Procedures (2009-MBES_Processing_Procedures_R0)

The data were reviewed daily during acquisition and processing, and the survey is complete and adequate for its intended purpose.

This report has been reviewed and approved. All records are forwarded for final review and processing to the Chief, Pacific Hydrographic Branch.

Approved and forwarded,

David D. Briggs
Lead Hydrographer
Fugro Pelagos, Inc.
September 2, 2010

9/2/2010

X 

David D. Briggs
Lead Hydrographer

Revisions

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[1] Concur.
[2] Concur.
[3] Do not concur, H12110 does not contain any ears with irregular topography or rock outcrops.
[4] Data are adequate for charting.
[5] H12110 was compiled in conjunction with H12109 and H12113. H12110 and H12112 do not share a border.
[6] Concur.
[7] Despite minor imperfections, the survey acceptance review (SAR) finds the data to be adequate for charting.
[8] Regardless of 'busts' data are still adequate for charting.
[9] After completion of the SAR the 2 meter resolution BASE surface H12110_2m_Combined.csar. was provided and used as the basis of compilation.
[10] Some features from the file H12110_S57_Features.000 were used in the compilation of H12110_CS.000.
[11] Concur.
[12] Concur, chart as shown in H12110_CS.000.
[13] Concur.
[14] Concur.
[15] Concur.
[16] Three of the acquired bottom samples were selected for charting as appropriate for chart scale. Chart per H12110_CS.000.
[17] Chart per latest ATONIS publication.
[18] Concur.

H12110 HCell Report

Peter Holmberg, Physical Scientist
Pacific Hydrographic Branch

1.0 Specifications, Standards and Guidance Used in HCell Compilation

HCell compilation of survey H12110 used:

Office of Coast Survey HCell Specifications: Version: 4.0, 2 June, 2010.
HCell Reference Guide: Version 2.0, 2 June, 2010.

2.0 Compilation Scale

Depths and features for HCell H12110 were compiled to the largest scale raster charts shown below:

Chart	Scale	Edition	Edition Date	NTM Date
18645	1:100,000	26th	09/01/2008	03/26/2011
18649	1:40,000	67th	12/01/2009	03/26/2011

The following ENCs were also used during compilation:

Chart	Scale
US4CA11M	1:40,000
US5CA12M	1:100,000

3.0 Soundings

A survey-scale sounding (SOUNDG) feature object layer was built from the 2-meter Combined Surface in CARIS BASE Editor. A shoal-biased selection was made at 1:10,000 and 40,000 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	200	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.

4.0 Depth Contours

There are no depth contours within the survey area on the largest scale chart 18649, though there are 20 fathom contours on chart 18645. The 20 fathom contours are included in the *_SS HCell for MCD raster charting division to use for guidance in creating chart contours. The metric and fathom equivalent contour values are shown in the table below.

Chart Contour Intervals in Fathoms 18645	Metric Equivalent to Chart Fathoms, Arithmetically Rounded	Metric Equivalent of Chart Fathoms, with NOAA Rounding Applied	Fathoms with NOAA Rounding Applied	Fathoms with NOAA Rounding Removed for Display on H12110_SS.000
20	36.576	37.9476	20.75	20

5.0 Meta Areas

The following Meta object areas are included in HCell H12110:

M_QUAL
M_CSCL

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

6.0 Features

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

7.0 Spatial Framework

7.1 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.

7.2 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.

7.3 S-57 Object Classes

The CS HCell contains the following Object Classes:

$CSYMB	Blue Notes (points) —Notes to the MCD chart Compiler
M_CSCL	Portion of HCell compiled at different scale
M_QUAL	Data quality Meta object
SBDARE	Bottom samples
SOUNDG	Soundings at chart scale density

The M_QUAL is adequate for NDB product searches.

The SS HCell contains the following Object Classes:

DEPCNT	Generalized contours at chart scale intervals (See table under section 4.)
SOUNDG	Soundings at the survey scale density (See table under section 3.)

8.0 Data Processing Notes

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

9.0 QA/QC and ENC Validation Checks

H12110 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.

10.0 Products

10.1 HSD, MCD and CGTP Deliverables

H12110_CS.000	Base Cell File, Chart Units, Soundings and features compiled to 1:40,000, and 100,000
H12110 _SS.000	Base Cell File, Chart Units, Soundings and Contours compiled to 1:10,000, and 40,000
H12110 _DR.pdf	Descriptive Report including end notes compiled during office processing and certification, the HCell Report, and supplemental items
H12110 _outline.gml	Survey outline
H12110 _outline.xsd	Survey outline

11.0 Software

CARIS HIPS Ver. 7.0	Inspection of Combined BASE Surfaces
CARIS BASE Editor Ver. 3.1	Creation of soundings and bathy-derived features, creation of the meta area objects, and Blue Notes; Survey evaluation and verification; Initial HCell assembly.
CARIS S-57 Composer Ver. 2.2	Final compilation of the HCell, correct geometry and build topology, apply final attributes, export the HCell, and QA.
CARIS GIS 4.5a	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.

12.0 Contacts

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

Peter Holmberg
Physical Scientist
Pacific Hydrographic Branch
Seattle, WA
206-526-6843
Peter.Holmberg@noaa.gov

APPROVAL SHEET
H12110

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.

Digitally signed by Pete Holmberg
DN: cn=Pete Holmberg, o=NOAA, ou=PHB, email=peter.holmberg@noaa.gov, c=US
Date: 2011.05.20 13:15:27 -07'00'

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

Katie Reser
2011.05.20
13:37:02 -07'00'

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.

Digitally signed by NELSON.GARY.C.1365885318
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=NELSON.GARY.C.1365885318
Date: 2011.05.20 13:55:49 -07'00'