H11542

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. N/A

Registry No. H11542

LOCALITY

State Alaska

General Locality Vicinity of Chirikof Island

Sublocality North Shore of Chirikof Island

2006

CHIEF OF PARTY
Darren Stephenson, Tenix LADS, Inc.

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DATE

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

HYDROGRAPHIC TITLE SHEET

REGISTRY No

H11542

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:

N/A

State Alaska

General Locality Vicinity of Chirikof Island

Sub-Locality North Shore of Chirikof Island

Scale 1:10,000 **Date of Survey** 6/20/06 - 09/04/06

Instructions dated 2/8/2006 **Project No.** OPR-P133-KRL-06

Vessel Tenix LADS Aircraft, call sign VH-LCL

Chief of party D.J. Stephenson

Surveyed by S.R. Ramsay, J.G. Guilford, M.S. Hawkins, W.T. Newsham, M.H. Blackbourn, J.K. Young, et all

Soundings by Laser Airborne Depth Sounder

SAR by Toshi Wozumi Compilation by Peter Holmberg

Soundings compiled in Fathoms

REMARKS: All times are UTC. UTM Zone 5

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/.

DESCRIPTIVE REPORT TO ACCOMPANY

HYDROGRAPHIC SURVEY H11542

SCALE 1:10,000, SURVEYED IN 2006

TENIX LADS AIRCRAFT, VH-LCL

TENIX LADS, INC. (TLI)

MARK SINCLAIR, HYDROGRAPHER

PROJECT

Project Number: OPR-P133-KRL-06
Original: DG 133C-03-CQ-0011
Date of Instructions: February 8, 2006
Task Order: T0009

Date of Supplemental Instructions:

- No supplemental correspondence occurred during this survey.[1]

Registry Number: H11542
Sheet: B

A. AREA SURVEYED

Survey operations covered four registered sheets over the OPR-P133-KRL-06 project area, Vicinity of Chirikof Island, AK (see Figure 1 and Figure 2).

A total of 2529 lineal nautical miles were illuminated in the process of flying 199 main scheme survey lines. An additional 1444 lineal nautical miles were illuminated flying 102 crosslines / investigations. The total seabed area surveyed across the project area, from the 0m curve to lidar extinction depth, was 30 square nautical miles (see Appendix III for further information).

The first survey flight was conducted in the Vicinity of Chirikof Island, AK project area on June 20, 2006. A total of 22 sorties were flown in the project area, with the final 2 flights occurring on September 04, 2006. The specific dates of data acquisition, hours flown and time on task were as follows:

Date	Sortie #	Hours Flown	Time on Task
20-June-06	6	5:28	3:36
21-June-06	7	6:26	4:01
23-June-06	8	6:20	4:05
24-June-06	9	6:20	4:41
28-June-06	11	2:02	0
2-July-06	12	2:28	0:56
2-July-06	13	4:50	3:46
4-July-06	14	1:50	0
12-July-06	15	4:16	1:30
14-July-06	17	5:22	3:19
15-July-06	18	4:30	2:22
16-July-06	19	4:51	3:03
26-July-06	20	4:34	2:29
27-July-06	21	6:17	4:42
28-July-06	22	1:46	0
6-August-06	23	4:41	2:27
7-August-06	24	6:00	4:25
12-August-06	26	5:53	4:16
15-August-06	27	5:28	2:59
19-August-06	30	2:04	0
27-August-06	31	4:00	2:20
4-September-06	32	5:37	3:08

Table 1: Specific Dates of Data Acquisition

Environmental factors such as water clarity, tide, wind strength and direction, daylight hours, cloud base height and clouds over high terrain influenced the area and duration of data acquisition on a daily basis. See Section B.2.3 for further details.

This Descriptive Report describes Sheet B, which covers North Shore of Chirikof Island (see Figure 2).

The sheet limits are as follows for Sheet B:

H11542 (B)	Latitude (N)	Longitude (W)
SW corner	55° 53' 43.48"	155° 42' 35.46"
NW corner	55° 58' 17.27"	155° 42' 54.59"
NE corner	55° 58' 36.82"	155° 27' 23.49"
SE corner	55° 54' 02.97"	155° 27' 06.17"

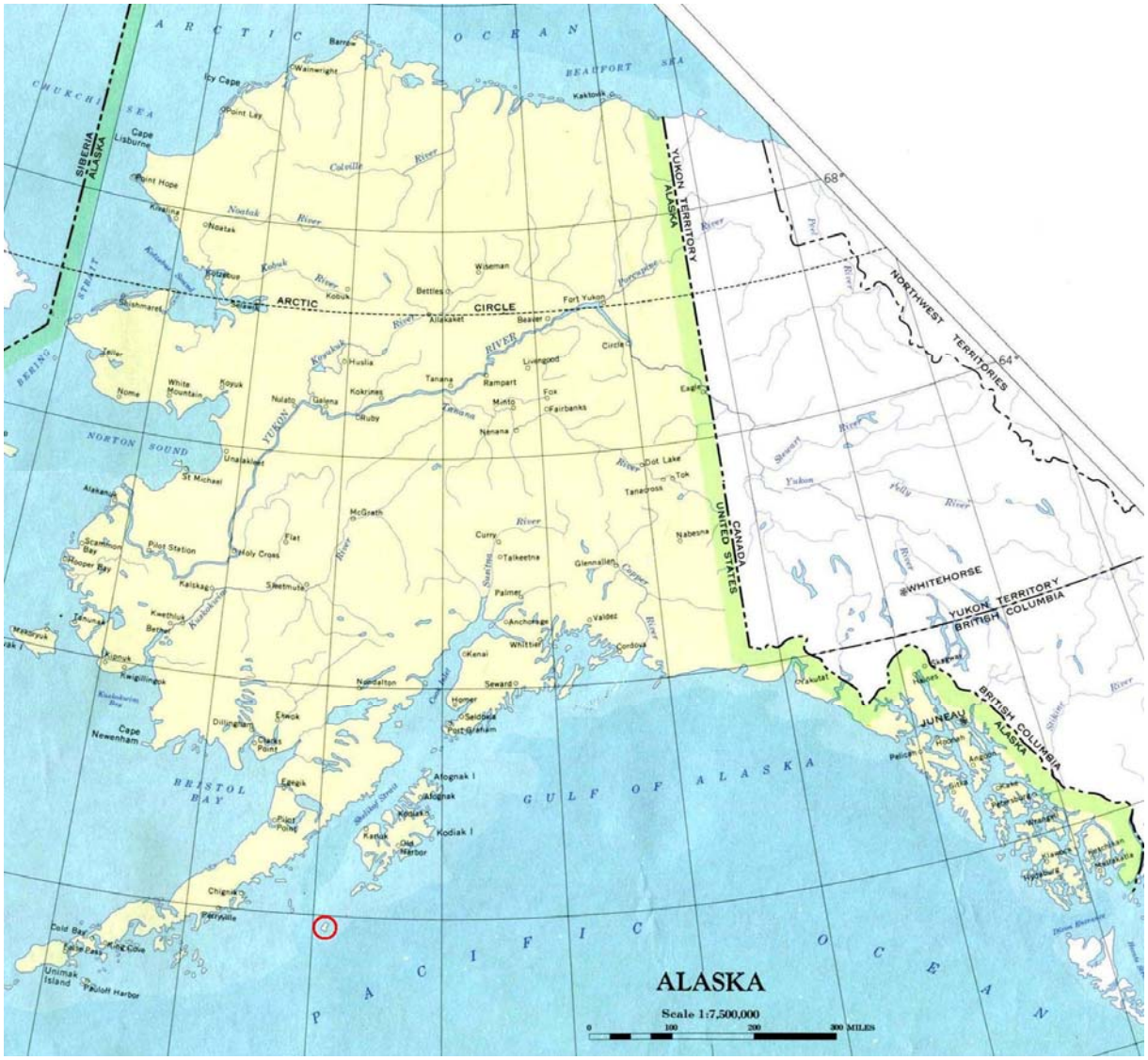

Figure 1 – General Locality of OPR-P133-KRL-06

Statement of Work
February 8, 2006

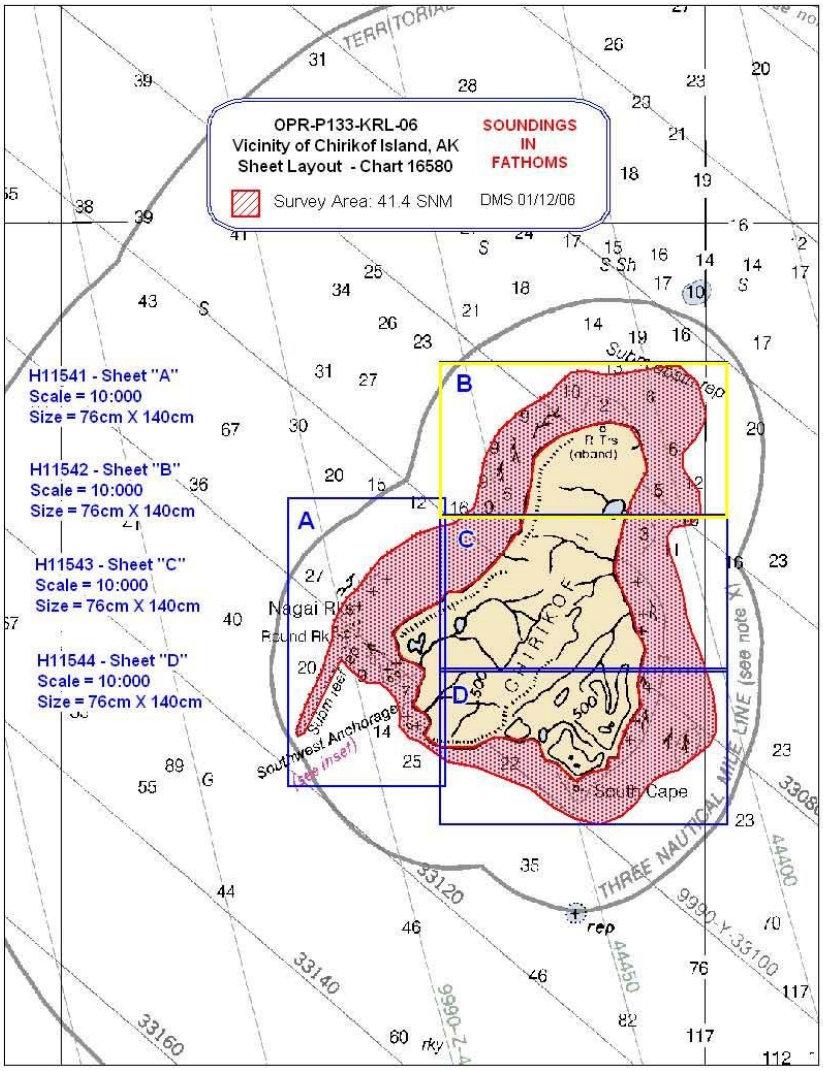

Figure 2 – Sub-Locality of H11542

B. DATA ACQUISITION AND PROCESSING

Refer to the Data Acquisition and Processing Report for a detailed description of the equipment, processing, and quality control procedures used during LADS surveys. A general description and items specific to this survey are discussed in the following sections.

B.1 EQUIPMENT

Data collection was conducted using the LADS Mk II Airborne System (AS), data processing using the LADS Mk II Ground System (GS), and data visualization, quality control and final products using CARIS HIPS and SIPS 6.1.1 and CARIS BASE Editor 2.1.

B.1.1 Airborne System

The LADS Mk II AS platform consists of a De Havilland Dash 8-200 Series aircraft, which has a transit speed of 250kts at altitudes of up to 25,000ft, and an endurance of up to eight hours. Survey operations are conducted from heights between 1,200 and 2,200ft, at ground speeds of between 140 and 210kts. The aircraft is fitted with an Nd: YAG laser, which is eye safe in accordance with ANSI Z136.1-2000, American National Standard for Safe Use of Lasers. The laser operates at 900 Hertz from a stabilized platform to provide a number of different spot spacings across the seabed.

Green laser pulses are scanned beneath the aircraft in a rectilinear pattern. The pulses are reflected from the land, sea surface, within the water column and from the seabed. The height of the aircraft is determined by the infrared laser return, which is supplemented by the inertial height from the Attitude and Heading Reference System (AHRS) and a Global Positioning System (GPS) receiver. Real-time positioning is obtained by an Ashtech GG24 GPS receiver providing autonomous GPS, or is combined with WADGPS (Fugro Omnistar), to provide a differentially corrected position, when coverage is available. Ashtech Z12 GPS receivers are also provided as part of the AS and GS to log data on the aircraft and at a locally established GPS base station.

A prototype Digital Imagery Capture system has been installed to provide georeferenced imagery. This prototype system comprises a laptop computer with ImpreX VCE-PRO 2.5 Analog Video Capture card and captures from the LADS Downward-Looking Analog Camera in JPEG format at 752x582 resolution. The digital images are then time-stamped with LADS AS time for the future georeferencing. At the end of the sortie, the digital images are transferred to the LADS GS and the reference files are calculated for each image. The georeferencing and subsequent mosaicing of the images is performed using GDAL Linux-based software.

B.1.2 Ground System

The LADS Mk II GS ‘Gandalf’ was used to conduct data processing in the field. Gandalf consists of a portable Compaq Alpha ES40 Series 3 processor server with 1GB EEC RAM, 764GB disk space, digital linear tape (DLT) drives and magazines, a digital audio tape (DAT) drive, a CD-ROM drive, and is networked to up to 12 Compaq 1.5GHz PCs and a HP 800ps Design Jet Plotter, printers and QC workstations. The GS supports survey planning, data

processing, quality control and data export. The GS also includes a KGPS base station, which provides independent post-processed position and height data.

Quality control checks and editing of the data were conducted on GS 'Katrina', at the TLI office in Biloxi, MS, upon completion of the data collection phase of the survey.

B.2 QUALITY CONTROL

B.2.1 Quality Control Checks

The internal relative consistency of the survey data was checked with crossline depth comparisons, depth benchmark comparisons along the East coast of Chirikof Island, dynamic position checks, and by observing position confidence quality factors on the GS. System integrity was checked, in an absolute sense, with the local GPS base station site confirmation, the static position check and navigational position checks.

B.2.1.1 Crosslines

No specific crosslines were planned due to the high number of investigation / additional coverage lines flown perpendicular to main scheme survey runs. Due to the complex nature of the seabed and extent of kelp areas, only 7 runs were selected for depth comparison. These 7 lines exhibited good water clarity and generally low gradient slopes, enabling meaningful statistics to be calculated. Below are the overall depth comparison results for the 121 crossline comparisons. A complete summary is presented in the Separates Report.

Total Number of Comparisons	Mean Depth Difference (m)	Mean Standard Deviation (m)
347556	-0.03 +/- 0.13	0.16 +/- 0.04

B.2.1.2 Depth Benchmarks

Five gridded depth benchmark areas were created from bathymetry collected over survey run 220.0.1, which was flown on June, 20, 2006. Comparisons between the gridded benchmark areas and benchmark runs flown at the commencement of each sortie were used to check the relative depth accuracy of the LADS Mk II system for the H11542 survey. Center coordinates for the benchmark areas are as follows:

East Coast of Chirikof Island Benchmarks

		UTM (N) Zone 5	
Benchmark Name	**Depth**	**Easting**	**Northing**
BM 1	5m	340 211	6 198 119
BM 2	8m	340 219	6 199 055
BM 3	13.5m	340 172	6 195 403
BM 4	19m	340 236	6 200 415
BM 5	23m	340 254	6 202 245

The flown benchmark runs were reduced to MLLW using Chirikof final tides and compared against the gridded benchmark surface in the GS. Statistics are generated which include the number of points compared, the mean depth difference (MDD) and the standard deviation (SD) between the data sets.

A summary of the average of the MDD and SD for all depth benchmark area comparisons is presented below. Refer to the Separates Report for detailed results of the depth benchmark comparison results.

GS ID	BM Name	Depth	Number of Comparisons	MDD	SD
1	BM 1	5m	27652	0.18 +/- 0.26	0.2 +/- 0.05
2	BM 2	8m	44499	-0.03 +/- 0.19	0.15 +/- 0.03
3	BM 3	13.5m	38675	0.02 +/- 0.15	0.17 +/- 0.02
4	BM 4	19m	23561	-0.02 +/- 0.17	0.19 +/- 0.04
5	BM 5	23m	24021	0.12 +/- 0.17	0.20 +/- 0.03

The depth benchmark comparison results and the crossline comparisons results are within expected tolerances and show that the LADS Mk II depth performance was within specifications throughout the survey period.[2]

B.2.1.3 Positioning Checks

Two independent positioning systems were used during the survey. Real-time positions were determined by autonomous GPS. Post-processed KGPS positions were determined relative to a local GPS base station that was established by JOA on top of the Tenix office located at 220 Center Street, Kodiak. The post-processed KGPS positions were applied to each sounding during processing and the KGPS height was used in the topographic datum filter.

Position checks were conducted prior to, during, and following data collection as follows:

a. Local GPS Base Station Site Confirmation. A 24-hour certification of the local GPS base station established was conducted on June 17-18, 2006. The results reveal that the local GPS base station is free from site specific problems such as multipath and obstructions. Details are provided in the Horizontal and Vertical Control Report and scatter plots in the Separates Report.

b. Static Position Check. Prior to commencing data collection, the coordinates of the aircraft GPS antenna were determined relative to three marks, which were surveyed by JOA on the tarmac at the Kodiak Airport. Data was logged by each LADS Mk II positioning system while the aircraft was static, enabling the positions to be checked against the known GPS antenna point. The absolute accuracy of the post-processed KGPS solution during the static position check was 0.069m (95% confidence). The results and details of the static position check are enclosed in the Horizontal and Vertical Control Report and Separates Report.

c. Dynamic Position Check. During each sortie, GPS data was logged on the aircraft and at the local GPS base station. This provided a check between the real-time and post-processed GPS positions. The mean difference between the real-time and post-processed positions was 2.417m, with an average SD of 0.344m. Details are provided in the Horizontal and Vertical Control Report.

d. Navigation Position Check. Navigation checks were also conducted over a rust-covered connex (surveyed in by JOA – See Appendix III, Horizontal & Vertical Control Report). This enabled the known position of the structure to be checked against the downward-looking video. This provided a gross error check of position. The mean error in Eastings was 2.73m +/- 2.97m and –1.89m +/- 3.79m in the Northings. Further details are provided in the Separates Report.

e. Position Confidence. The position quality was also monitored on the GS by checking a post-processed position confidence (C3), which is determined from the AS platform error, GPS error, and residual errors between the actual GPS positions and aircraft position, as determined from the line of best fit. No position anomalies were detected.

The position checks were within the expected tolerances and demonstrated that the positioning systems were functioning correctly throughout the survey period.[3]

B.2.2 Uncertainty Values

For this survey area, global horizontal and vertical uncertainties have been assigned based on the defined horizontal and vertical error budget, as stated in the Horizontal and Vertical Control Report. The assigned horizontal uncertainty is 3.37m and the assigned vertical uncertainty is 0.50m.

However, when the calculated grid node SD is greater than the assigned vertical uncertainty, the SD is used as the uncertainty value. This has occurred in areas of high relief, which is common throughout the survey area. In some cases the SD may exceed IHO Order-1 limits. This could be attributed to the seabed gradient and a 3m grid resolution being used.[4]

B.2.3 Environmental Factors

B.2.3.1 Sea Conditions - Sea State, Waves, Swell, White Water

The sea state ranged from 1 to 4 on the Beaufort Wind Scale throughout the survey period, but was generally between states 1 and 2 on the western side of Chirikof Island. The areas to the south and east of Chirikof Island were exposed to the weather and sea states to 4 were observed. Where areas of white water were experienced, reflies and additional lines were flown during calmer conditions.

Calm seas were experienced on occasions in the sheltered areas. Under such calm conditions the sea became glassy, which degraded the sea surface model, and resulted in gaps at nadir, where the sea surface returns were completely saturated and seabed returns attenuated.

Long period swell was not significant during the survey. However, an allowance has been made in the assessment of vertical accuracy.

B.2.3.2 Water Clarity

The water clarity in the survey area varied significantly during the period of data collection, and this required careful management to achieve the best possible seabed coverage across the project area. Water clarity varied from extremely poor to good. No secchi observations were taken due to the remoteness of the survey area to the main base of operations in Kodiak.

B.2.3.3 Kelp

Kelp is one of the factors that increases the complexity of a particular survey area. It is one of the reasons why 200% coverage is recommended in Alaskan waters. Kelp reduces laser penetration and the resultant seabed coverage achieved by lidar. Kelp also increases the amount of data processing that is required and the amount of boatwork that is recommended, as described in Section D.2.1. Large areas of kelp exist throughout the survey area.

Kelp areas can be recognized in the data by the following indicators:

- Mid-water column returns are of low amplitude.
- Waveforms have poorly defined leading edges.
- Returns from the seabed are highly attenuated.
- Soundings in shallow water are very sparse.
- Soundings do not correlate with overlapping data from adjacent lines.

Kelp areas appear as data gaps in the BASE surface. In such areas of partial bottom coverage, kelp area polygons (WEDKLP) have been defined in the S-57 feature file at the boundaries of data gaps attributed to kelp. Where kelp is present, but seabed coverage was still achieved, kelp point objects (WEDKLP) have been defined in the S-57 feature file (US511542.000).[5]

Rocks detected by the system in kelp areas may be difficult to discriminate as rock or kelp returns. When it is uncertain if the return is from rock or kelp, a decision whether the feature has 'least depth found' (LDF) by lidar is provided in Section D.1.6. If it is determined that the LDF on a significant feature has not been achieved by lidar, due to the presence of kelp, the item will appear as a feature for examination in the chart comparison file (H11542Chartcomp.hob).[6]

B.2.3.4 Sediment Transport

Sediment transport was prevalent in the north of the survey area. Strong currents north of Chirikof Island resulted in significant movement of the sandy bottom. Several fields of sand waves are clearly visible in the BASE surface. The dynamic nature of these sand wave fields can be observed in the data by significant change of depth from one sortie to the next, which has resulted in some "striping" in the data where adjacent survey lines were flown on different days. Where sand waves are present, sand wave polygons (SNDWAV) have been defined in the S-57 feature file.[7]

B.2.3.5 Topography

The LADS Mk II system can measure topographic heights up to 50m elevation, subject to the depth / topographic logging window selected. For this survey, a 20m topographic height logging window was selected. As a result, the coastline was surveyed and elevations up to 20m were measured.[8]

B.2.3.6 High Ground

In areas of high ground, survey lines were flown at 2200ft. The remainder of the survey area was flown at 1200ft.

B.2.3.7 Wind

Survey operations were conducted in wind strengths of up to 30kts during the survey. In general, the wind strength during sorties was between 5 and 15kts. In certain areas, wind strengths above 20kts generated turbulence that made data collection difficult.

B.2.3.8 Cloud

Low cloud was experienced during the survey and on occasion caused the cancellation or termination of sorties. Poor weather was monitored using, and decisions on the flying program were based on marine and aviation weather forecasts, real-time satellite imagery and 'over the phone' weather reports from personnel stationed at the Alitak cannery on SW Kodiak Island.

B.2.4 Data Coverage and Object Detection

B.2.4.1 Nature of the Seabed

The nature of the seabed is quite complex. The area contains numerous rocks and shoals, often surrounded by thick areas of kelp. Typically, kelp grows from the MLLW line to 15-20m water depth. It is often visible on, or just below the sea surface, in the downward-looking video record. Most gaps in lidar data coverage, in less than 20m depth, are directly attributed to the presence of kelp.

B.2.4.2 Data Coverage

The survey area was illuminated at 4x4m laser spot spacing, resulting in a 192m swath width. Mainlines of sounding were spaced at 80m, which provided the required 200% coverage.

The gain levels automatically set by the AS accommodate for changes in the sea surface, water column and seabed conditions. In some areas, after long overland passages, low gain levels were initialized when passing back over the water. Where this has been identified in the data, these lines were reflown from the opposite direction to improve the coverage.

The raw laser waveform returns from the areas that were covered with kelp are considerably attenuated. In order to detect the seabed in such areas, the threshold in the GS was lowered to detect pulses with low signal-to-noise ratios (SNR). This often enabled the seabed depth to be extracted from the waveform, but also resulted in increased false bottom detects, which in turn increased data validation times.

The variable water clarity throughout the survey period resulted in maximum lidar extinction depths of 30m for the project, but typically full seabed coverage to 15-20m depth was achieved for H11542.

B.2.4.3 Object Detection

At the sea surface the footprint of the laser beam is approximately 2.5m in diameter. As the beam passes through the water column, it slowly diverges due to scattering. It should be noted that at 4x4m laser spot spacing, there is a gap of 1.0 to 1.5m between the illuminated area of adjacent soundings at the sea surface. There is a possibility that small objects in shallow water along the coastline may fall between consecutive 4x4m soundings, and not be detected.[9] A description of the Bottom Object Detection (BOD) algorithm used in data processing is presented in the Data Acquisition and Processing Report.

B.3 CORRECTIONS TO SOUNDINGS

Refer to the Data Acquisition and Processing Report for a description of corrections to soundings. There were no deviations from the corrections described therein.

B.4 DATA PROCESSING

B.4.1 Data Management

The database is identified as follows:

Database Name	General Locality	Sub-Locality	Sheet
06_4chirikof	Vicinity of Chirikof Island	North Shore of Chirikof Island	B

A detailed table of survey line identifiers is presented in the Data Acquisition and Processing Report.

B.4.2 Data Processing Sites

The data acquired during survey flights was processed at the operating site in Kodiak following each sortie. Final validation, checking, approving, reports and products were conducted at the office in Biloxi, MS. The quality control of the data was done using CARIS software and was conducted in the Biloxi, MS office.

B.4.3 CARIS BASE Surface

One BASE surface covers the entire survey area. The Shoal layer of the BASE surface should be used as the official hydrographic record of the survey. A grid resolution of 3m was used for the BASE surface. Grid resolution does not change relative to depth, as the laser pulse footprint stays relatively constant regardless of depth, and the laser spot spacing is constant irrespective of aircraft altitude. The 3m grid provides the largest amount of detail that can be supported by the lidar density.[10]

B.4.4 Gap and Feature Tagging

During data processing on the GS, the operators have the ability to assign S-57 and user-defined tags to gaps and features in the data. This enables accurate delineation and attribution of unsurveyed polygons for the S-57 feature file (US511542.000).

For this survey, the following user-defined tags were used to delineate the seaward extent of gaps in the lidar seabed coverage, typically at a 50m interval:

GK	Bathymetry data gap due to kelp.
GS	Bathymetry / topography data gap due to the secondary exclusion zone (SEZ).

Detailed descriptions of these gaps in seabed coverage are presented in Section B.8 of the Data Acquisition and Processing Report.

The following tags were used in the GS for features that require further examination:

FEK	Feature for examination in kelp, as the least depth has not been determined.
FERA	Feature for examination of a rock awash, as the feature has not been surveyed adequately due to the presence of white water.
FE	Feature for examination, generally in deep water, as the least depth has not been found due to poor water clarity.

The tags associated with features requiring further examination have been compiled in the H11542_INV.hob file, and each have been given certain priority and a suggested examination method for the undertaking of additional boatwork.

In most cases the least depth has deemed not to be found on a feature and it requires further examination by boat to determine the least depth.[11]

B.4.5 Georeferenced Imagery

Digital imagery was captured on each sortie using the prototype system described in Section B.1.1. The images were combined to produce a georeferenced mosaic of the survey area. The imagery was used during product compilation and is also presented as part of the final survey deliverables for this project.

B.4.6 Progress Sketches

Progress sketches were provided to NOAA on a monthly basis. The final progress sketch can be found in Appendix III.

B.4.7 Deliverables Data Formats

Data is provided in the following formats:

- Digital S-57 feature file
- CARIS BASE surface

- CARIS features for investigation and chart comparison files in .hob format
- CARIS compatible data – CAF Format – LADS soundings and waveforms, which can be imported into CARIS HIPS
- CARIS compatible data – HDCS Format – LADS soundings in CARIS HIPS native format
- Tidal data provided in ASCII, .xls and .csv formats
- Digital georeferenced image in .tif / .tfw format

Refer to the Data Acquisition and Processing Report for specific details.

C. VERTICAL AND HORIZONTAL CONTROL

Refer to the Horizontal and Vertical Control Report for a detailed description of the horizontal and vertical control used during this survey. A summary of horizontal and vertical control used for the survey follows.

C.1 VERTICAL CONTROL

The initial vertical control for the survey was based on the Mean Lower Low Water (MLLW) tidal datum from the National Water Level Observation Network (NWLON) station at Sand Point (9459450). Final vertical control for the survey was based on the MLLW tidal datum from the tide station, Chirikof Island SW Anchorage (9458293), established by John Oswald & Associates, LLC (JOA).

The vertical control for the survey was based on the MLLW tidal datum. During field operations tide data for the NWLON station at Sand Point was downloaded from the CO-OPS website and these preliminary tide values were used to reduce depth soundings.

The final tidal levels for Chirikof Island were computed by JOA from observed tide at Chirikof Island SW Anchorage.

Station details are as follows:

		WGS84	
Gauge	**Location**	**Latitude**	**Longitude**
9459450	City Dock - Sand Point, AK	55° 20.2' N	160° 30.1' W
9458293	Chirikof Island - SW Anchorage	55° 48' 54" N	155° 44' 35" W

C.2 ZONING

For the preliminary reduction of soundings, tide zones that cover the extent of the survey area were supplied by NOAA. Each of these tide areas use time and range correctors relative to the Sand Point tide station. These are as follows:

Tide Zone	GS Identifier	Time Corrector	Range Corrector	Reference Station
SWA148	TA1	-18 minutes	x1.21	9459450
SWA149	TA2	-18 minutes	x1.25	9459450
SWA150	TA3	-18 minutes	x1.29	9459450

The final tide zone that covers the extent of the survey area was supplied by JOA. The Tide Station Report, supplied by JOA, detailing the tide zone, can be found in Appendix I of the Horizontal and Vertical Control Report. A .pdf copy is also available in the Tidal Data section of the USB drive. No time or range correctors were applied to the verified tide from

the Chirikof Island SW Anchorage (9458293) tide gauge as one tide zone covered the extent of the survey area.

The derived value for the difference between MLLW and MHW at the Chirikof Island SW Anchorage subordinate tide gauge is 2.40m. From the final zoning, a range factor of 1.00 was applicable for Sheet B, resulting in a MHW value of 2.40m.

C.3 HORIZONTAL CONTROL

Data collection and processing were conducted on the AS and GS in World Geodetic System (WGS84) on Universal Transverse Mercator (Northern Hemisphere) projection UTM (N) in Zone 5, Central Meridian 153° W. This data was post-processed and all soundings are positioned relative to the North American Datum 1983 (NAD83). All units are in meters.

C.3.1 LADS Local GPS Base Station – Kodiak

Real-time positions were determined using an Ashtech GG24 GPS receiver on the aircraft, operating in autonomous GPS mode. A local GPS base station was established by JOA on the roof of the Tenix LADS office building in Kodiak, AK on May 9, 2006, in order to post-process KGPS positions following survey flights.

The derived NAD83 coordinates for the local GPS base station are:

NAD83		**UTM (N) Zone 5**		
Latitude (N)	**Longitude (W)**	**Easting (m)**	**Northing (m)**	**Ellipsoidal Height (m)**
57° 47' 19.2830"	152° 24' 22.1333"	535 308.385	6 405 339.545	28.354

Post-processed KGPS positions were determined offline using data logged at the local GPS base station and on the aircraft. This data was processed with Ashtech PNAV software to calculate both a DGPS and KGPS position solution for the survey flights. The post-processed KGPS positions were imported into the GS and applied to all soundings. This provided increased sounding position accuracy from the real-time autonomous GPS.

D. RESULTS AND RECOMMENDATIONS

The results for the H11542 survey are submitted separately to this Descriptive Report as the S-57 feature file, BASE surface, CARIS .hob files, georeferenced imagery, Chart Comparison Spreadsheet, etc. on the USB hard drive. Refer to Appendix II of the Data Acquisition and Processing Report for a list of all the deliverable files from H11542.

Below is a table listing the S-57 feature objects found in the S-57 feature file (US511542.000):

S-57 Object Class	S-57 Object Acronym	Geometry	Description	Spatial Attribute	Attribute 1	Attribute 2	Attribute 3	Attribute 4	Comments
Coastline[12]	COALNE	L	The high waterline. Where depth equals 0 relative to MHW.	Quality of position (QUAPOS)	Category of Coastline (CATCOA)				The spatial attribute QUAPOS is used when coastline is interpolated from the georeferenced imagery.
Depth Contour[13]	DEPCNT	L	The approximate location of the line of equal depth. Also referred to as a depth curve.		Value of depth contour (VALDCO)				Tenix is only responsible for defining the 0m curve.
Land Area[14]	LNDARE	P	The solid portion of the Earth's surface, as opposed to sea, water.						Used for defining islet point features.
Land Elevation[15]	LNDELV	P	The vertical distance of a point or level measured from a specified vertical datum.		Elevation (ELEVAT)				Used for defining islet heights related to MHW.
Seabed Area[16]	SBDARE	A	An area of the sea where the nature of bottom is homogeneous. The nature of bottom includes the material of which it is composed and its physical characteristics.		Nature of surface (NATSUR)				Used for defining areas where several rocks may be present but coverage is poor generally due to kelp. Using SBDARE helps minimize the number of features that are reported in rocky areas.

S-57 Object Class	S-57 Object Acronym	Geometry	Description	Spatial Attribute	Attribute 1	Attribute 2	Attribute 3	Attribute 4	Comments
Sand Wave Area[17]	SNDWAV	A	A large mobile wave-like sediment feature in shallow water and composed of sand.						Used for identifying areas where the sandy bottom is mobile in the form of sand waves.
Underwater / Awash Rock[18]	UWTROC	P	A concreted mass of stony material or coral which dries, is awash or is below the water surface.		Water level effect (WATLEV)	Quality of sounding measurement (QUASOU)	Technique of sounding measurement (TECSOU)	Value of sounding (VALSOU)	
Weed / Kelp[19]	WEDKLP	P, A	Usually large, blade-shaped or vine-like brown algae.		Category of weed / kelp (CATWED)				Polygon limits defined using the (GK) tags exported from the GS. Kelp point features defined using the (GKP) tags exported from the GS and georeferenced imagery.
Unsurveyed Areas[20]	UNSARE	A	Unsurveyed area.		Information (INFORM)				Used to define gaps in data coverage. INFORM has been identified as SEZ (GS) tags.
Meta Objects									
Coverage[21]	M_COVR	A	A geographical area that describes the coverage and the extent of spatial objects.		Category of coverage (CATCOV)				M_COVR: CATCOV = 1 polygons define the extents of good LIDAR data coverage.
Quality of Data[22]	M_QUAL	A	An area within which a uniform assessment of the quality of the data exists.		Category of zone of confidence in data (CATZOC)				

Table 2: S-57 Attribution for the S-57 feature file (US511542.000)

Recommendations for registry number H11542 are divided into 2 components:

1. Recommended charting action, primarily for MCD.[23]
2. Recommended further boatwork to sufficiently junction with lidar seabed coverage and examine uncertain lidar features.[24]

Recommendations for charting action for registry number H11542 are provided in Sections D.1.1 to D.1.6 below. The Chart Comparison Spreadsheet has historically been one of the sources for the lidar features for examination list. In order to provide just one list of features for examination to field units, the Chart Comparison Spreadsheet has had some minor adjustments for this survey (H11542_ChartComp.xls). All features that appear in the chart comparison, but have not accurately had least depth determined by lidar, appear in the features for examination file. Where the least depth has not been found by lidar, no recommended charting action has been specified. Instead, a vessel-based verification method is suggested. The determination of least depth is at the discretion of the ships conducting junctioning / investigations and their results should be reported for charting action to MCD in due course.

Recommendations for ship junctioning and investigations are provided in Section D.2.1. In order to minimize the historical double handling of reporting uncertain lidar soundings on features, the features for examination are now contained exclusively in the CARIS .hob file (H11542_INV.hob). The features for examination have been prioritized with respect to multibeam junctioning, investigating features in 'coastal' foul areas and within the NALL.

A summary of charting actions and recommended investigations is provided in Section D.2.2.

D.1 CHART COMPARISON

H11542 LADS survey deliverables were compared to:

Raster Chart 16587 1st Edition. Scale 1:135,000. Dated 9/9/06.[25]
*ENC US3AK5KM Edition 7, compiled from Raster Chart 16580. ENC update application date 8/8/08, at scale 1:52,150 and 1:350,000.
The Raster Charts were downloaded from the NOAA Office of Coast Survey – NOAA Raster Navigational Charts download website on June 11, 2008.
(http://chartmaker.ncd.noaa.gov/mcd/raster/download.htm)
The ENC was downloaded from the NOAA Office of Coast Survey – NOAA Electronic Navigational Charts download website on June 11, 2008.
(http://chartmaker.ncd.noaa.gov/mcd/ENC/download.htm)

*Note: US3AK5KM was not used during the chart comparison because of a large datum shift in the ENC.

Recommendations for charting action are described in Sections D.1.4 to D.1.6.

D.1.1 Dangers to Navigation

Danger to Navigation (DTON) reports were submitted to Pacific Hydrographic Branch (PHB) during deliverables compilation. Final DTON recommendations were provided to PHB, as part of the preliminary survey delivery, during July, 2008.[26] A description of each DTON for H11542 is provided below:[27]

- Item number 1 is a 5.2m shoal in kelp, approximately 2700m E of the N tip of Chirikof Island. Kelp is noted in the area.[28]

- Item number 2 is a possible 13.3m Rk in kelp, approximately 6000m E of the N tip of Chirikof Island. This feature requires further investigation by boat to determine the extent and least depth. Kelp is noted in the area.[29]
- Item number 3 is a 13.5m shoal, located in the vicinity of a charted 10fm sounding, approximately 1750m NW of the N tip of Chirikof Island.[30]
- Item number 4 is a 16.6m Rk in kelp, located in the vicinity of a charted 16fm sounding, approximately 6000m NE of the N tip of Chirikof Island.[31]

D.1.2 AWOIS

No AWOIS were assigned to this Task Order.[32]

D.1.3 Aids to Navigation

No Aids to Navigation were detected by Lidar or observed in the digital imagery in the survey area for H11542.[33]

D.1.4 Charted Depths and Features

Registry number H11542 covers part of NOAA chart 16580 and 16587 covering the N portion of Chirikof Island. From the Source Diagrams, the area covered by survey area H11542 was covered by NOS surveys between 1940 and 1969, presumably by singlebeam echosounder. Partial bottom coverage was achieved. The chart in this area was inadequately surveyed, with minimal soundings and only a number of rocks and minimal soundings along the coast portrayed.

The area surveyed is represented by the BASE surface and S-57 feature file in considerably more detail than is currently shown on the chart. The following general recommendations are relevant:

a. Coastline. The charted coastline from Raster Charts 16587 is slightly offset to the S of the surveyed coastline. The surveyed coastline differs from the charted position by a maximum of 175m in some parts of the survey area. The existing ENC appears to be positioned incorrectly, with a significant datum shift portrayed in the coastline. It is recommended that the coastline on the chart be amended to match the LADS surveyed MHW line.[34]

b. Islets. No islets exist for Sheet H11542.[35]

c. Rocks. Many rocks and 2 drying rocks have been surveyed along the coastline and offshore, which are not presently shown on the chart. It is recommended that the chart be amended to match the LADS survey deliverables. Where significant, these rocks are detailed in the Chart Comparison Spreadsheet in Section D.1.6.[36]

D.1.5 Detailed Chart Comparison

In addition to the general recommendations above, some 19 specific differences between the chart and the LADS survey have been identified and are described in Section D.1.6. An expanded version of the spreadsheet is included digitally on the USB hard drive

(H11542_ChartComp.xls). A CARIS .hob file containing just the chart comparison items has also been compiled and is provided as part of survey deliverables (H11542_Chartcomp.hob). The attribution methodology for this file is presented below:

S-57 Object Class	S-57 Object Acronym	Geometry	Description	Attribute 1	Attribute 2	Attribute 3	Attribute 4
Built-up Areas	BUUARE	P	An area containing a concentration of buildings and the supporting road or rail infrastructure.	OBJNAM (used for storing a unique chart comparison ID)	INFORM (used for storing the charting recommendation)	NINFOM (used for storing a reference to a Feature for Investigation if applicable)	PICREP (used for storing a link to GS screen captures)

The chart comparison was conducted by reviewing the chart, the LADS survey deliverables and the georeferenced imagery. For each item identified, screen dumps of the Local Area Display and Raw Waveform Display were extracted from the LADS Mk II GS.

These have been reviewed in order to make the following assessments:

a. Type of Feature

b. Kelp Area

c. Least Depth Found

d. Charting Recommendation

e. Remarks

When the least depth has been adequately surveyed by lidar, the LDF Column is populated with a 'Y' for yes. The charting recommendation for a feature that has an adequately surveyed least depth will be either 'Insert' for a new feature, 'Replace' for an amendment to an existing charted feature or 'Remove' for a disproved charted feature.

When the least depth has NOT been found by lidar (populated with an 'N'), the chart comparison number has been used as the identifier within the S-57 feature file that contains the features for examination. If a chart comparison item had previously been identified as a feature for examination during data processing, a reference is made in the 'Remarks' column to the S-57 feature for examination item. For all chart comparison items that have not had least depth surveyed adequately, a suggested boatwork examination method acronym has been assigned. The description of these is provided in Section D.2.1.4.

Each chart comparison was categorized as follows:

1. New shoal found

2. Charted shoal disproved / not found

The fields in the Chart Comparison Spreadsheet have been developed from experience learned and feedback received from previous lidar surveys in Alaska, witnessing survey operations aboard NOAA ship Rainier, from meetings at PHB and UNH and the 2007 NOAA Field Procedures Workshop. They have been designed for ease of use and to minimize double handling of data and transcription. Continued feedback is welcomed in order to develop these formats to achieve further efficiencies in data handling.[37]

D.1.6 Chart Comparison Spreadsheet

			CHARTED			SURVEYED							
Sequence No	**Shoal No**	**Category**	**Charted Depth (meters)**	**NAD83 Latitude N (DMS)**	**NAD83 Longitude W (DMS)**	**Surveyed Depth (meters)**	**NAD83 Latitude N (DMS)**	**NAD83 Longitude W (DMS)**	**Type of Feature**	**Kelp Area**	**Least Depth Found**	**Charting Recommendation**	**Remarks** **All items covered by 4x4m laser spot spacing at 200% lidar coverage.**
1	B2	1				3.85	55° 54' 35.05"	155° 33' 41.54"	Rk	N	N	BV	Possible small feature on seabed.
2	B3	1				6.41	55° 54' 3.71"	155° 33' 12.31"	Rk	Y	Y	Insert	
3	B4	1				5.20	55° 54' 29.29"	155° 32' 50.01"	Rk	Y	Y	Insert	See Danger to Navigation Report. Item 1.
4	B5	1				8.67	55° 54' 18.5"	155° 32' 2.22"	Rk	Y	Y	Insert	
5	B6	1				11.34	55° 54' 16.18"	155° 31' 29.44"	Rk	Y	N	JV	Possible Rk in kelp. Refer to FEKB65.
6	B7	1				13.28	55° 54' 53.69"	155° 29' 55.14"	Rk	Y	N	JV	Possible Rk in kelp. Refer to FEKB76. See Danger to Navigation Report. Item 2.
7	B8	2	16.4	55° 54' 8.61"	155° 39' 50.47"		55° 54' 8.61"	155° 39' 50.47"	Rky	Y	N	Replace	Shoaler depths surveyed in vicinity. Even shoaler depths likely. Investigate by boat or replace charted sounding with a surveyed depth from the BASE Surface.
8	B9	1				12.02	55° 54' 45.97"	155° 31' 23.32"	Rk	Y	N	BV	Possible small feature on seabed.
9	B10	1				7.84	55° 54' 37.85"	155° 32' 50.68"	Rk	N	N	BV	Possible small feature on seabed.
10	B11	1				4.63	55° 54' 44.08"	155° 33' 32.63"	Rk	N	Y	Insert	
11	B12	1				-1.06	55° 54' 38.5"	155° 34' 17.71"	Drying Rk	N	N	VV	Possible Drying Rk in whitewater. Refer to FEDRB2.
12	B15	1				-0.22	55° 54' 53.6"	155° 36' 6.07"	Rk Awash	N	N	VV	Possible Rk Awash in white water.

Shoal Categories
1-New Shoal Found
2-Charted Shoal Disproved / Not Found

			CHARTED			SURVEYED							
Sequence No	**Shoal No**	**Category**	**Charted Depth (meters)**	**NAD83 Latitude N (DMS)**	**NAD83 Longitude W (DMS)**	**Surveyed Depth (meters)**	**NAD83 Latitude N (DMS)**	**NAD83 Longitude W (DMS)**	**Type of Feature**	**Kelp Area**	**Least Depth Found**	**Charting Recommendation**	**Remarks** **All items covered by 4x4m laser spot spacing at 200% lidar coverage.**
13	B17	2	16.4	55° 54' 57.79"	155° 38' 24.59"		55° 54' 57.79"	155° 38' 24.59"	Slope	N	Y	Replace	Shoaler depths surveyed in vicinity. Replace charted sounding with a surveyed depth from the BASE Surface.
14	B18	1				13.54	55° 55' 21.32"	155° 36' 56.09"	Rk	N	Y	Insert	See Danger to Navigation Report. Item 3.
15	B19	1				13.85	55° 55' 27.41"	155° 36' 36.43"	Rk	N	Y	Insert	
16	B20	1				10.83	55° 55' 13.31"	155° 35' 53.56"	Rk	Y	Y	Insert	
17	B21	1				12.56	55° 55' 6.82"	155° 34' 52.23"	Rk	N	N	BV	Possible small feature on seabed. Refer to FERB1.
18	B22	2	29.2	55° 57' 8.6"	155° 31' 46.02"	16.57	55° 57' 8.78"	155° 31' 57.47"	Rk	N	Y	Replace	See Danger to Navigation Report. Item 4.
19	B23	2	35	55° 57' 3.63"	155° 33' 46.42"		55° 57' 3.63"	155° 33' 46.42"	Slope	N	Y	Replace	Shoaler depths surveyed in vicinity. Replace charted sounding with a surveyed depth from the BASE Surface.

Table 3: Chart Comparison Spreadsheet

D.2 ADDITIONAL RESULTS

D.2.1 Supplemental Information for Boatwork[38]

For the H11542 survey, the supplemental information for further boatwork was compiled by:

1. Defining the seaward limit of good lidar seabed coverage as a M_COVR, CATCOV=1 polygon.
2. Reviewing the features for investigation compiled during data processing and adding the uncertain soundings identified during the chart comparison to this examination list.
3. Prioritizing all features for investigation with respect to the M_COVR polygon and dangers to safe vessel-based examination.
4. Recommending the vessel-based method of disproving 'suspicious' lidar features or confirming 'real' lidar feature detections and determining least depth.

D.2.1.1 Seaward Limit of Lidar Coverage

The survey area H11542 consists of a large number of kelp covered submerged rocks close to the coast and offshore. Heavy kelp is present throughout the survey area. As a result of the presence of heavy kelp, several areas across the sheet have poor seabed coverage. This is reflected by gaps in the BASE surface rendered as part of the survey deliverables.

In particular, the areas of poor lidar seabed coverage include:

- To the W of the Chirikof Island at position 55° 54' 22" N, 155° 39' 08" W, due to kelp.[39]
- To the N of Chirikof Island, in water deeper than laser extinction depth, at position 55° 56' 26" N, 155° 34' 42" W.[40]

Traditionally, the suggested lidar-ship junctioning polyline was drawn too far to seaward, across areas of sparse, 'noisy' lidar coverage. For this survey, the polyline submitted as an S-57 M_COVR CATCOV=1 polygon is the seaward extent of good lidar coverage. When there is poor lidar coverage due to poor water clarity, the presence of kelp, or expansive white water, the polyline has been drawn just to seaward of the MLLW line. It should be noted that TLI is not providing a recommended junctioning line. The determination of where multibeam survey lines need to be conducted is at the discretion of the PHB and the ships conducting the junctioning.

When planning multibeam junctioning with lidar seabed coverage, the NALL and the following must be taken into consideration:

- Lidar derived MHW line and MLLW line.
- Drying, awash and shallow features detected by lidar.
- Features for examination.
- 'Unsurveyed' polygons due to kelp, poor water clarity and the SEZ.

These are all provided in the S-57 feature file (US511542.000) or the H11542_INV.hob file for H11542.

The areas of good lidar seabed coverage include:

- N of Chirikof Island, at position 55° 55’ 41” N, 155° 35’ 59” W.
- E extent of sheet, at position 55° 54’ 36” N, 155° 32’ 05” W.

The seaward limit of good lidar data coverage has been described by the S-57 feature object M_COVR in the S-57 feature file (US511542.000).

D.2.1.2 Lidar Features Requiring Further Investigation

A list of uncertain lidar soundings was collated during data processing and is presented in a S-57 feature file. For example, some detections on isolated rocks in thick kelp beds were difficult to correctly classify as either rock or kelp.

Tagging in the GS was used to flag features for which the least depth has not been found. Typically this meant that there were less than 3 supporting soundings, within 0.5 – 1.0m of the depth, on the primary and overlapping lines. These tags were exported from the GS and compiled in CARIS BASE Editor. Features for examination have been captured within the H11542_INV.hob as M_NPUB feature objects. Where these features correlate with an item listed in the Chart Comparison Spreadsheet, a reference has been made in the H11542_INV.hob file. The S-57 attribution methodology for lidar features requiring further investigation is presented below:

S-57 Object Class	S-57 Object Acronym	Geometry	Description	Attribute 1	Attribute 2	Attribute 3	Attribute 4
Built-up Areas	BUUARE	P	An area containing a concentration of buildings and the supporting road or rail infrastructure.	OBJNAM (used for storing a unique feature for examination ID)	INFORM (used for storing the method of investigation recommendation)	NINFOM (used for storing a reference to a Chart Comparison if applicable)	PICREP (used for storing a link to GS screen captures)

Refer to Section B.4.4 for the descriptions of the GS tagging philosophy used for all lidar seabed coverage gaps and recommended features for investigation.

In circumstances where least depth has not been found over a significant feature, a recommendation for investigation by boat for 37 uncertain soundings has been made in the CARIS H11542_INV.hob file. All features in the chart comparison that have not had least depth adequately surveyed also appear in this file.

D.2.1.3 Prioritization of Features Requiring Further Investigation

All features for investigation have been assigned a priority, based on location with respect to the limit of 'good' lidar coverage polyline, the coastal foul areas, and the NALL. In addition, they have been attributed with a recommended examination method, as specified in the following section. The priorities are assigned using the following table:

Priority	Location w.r.t. Polyline	Coastal Foul Area / NALL	Examination Method	Remarks
1	Seaward	No	Typically BV or VV / BV for shallow features	MUST be examined prior to multibeam junctioning.
2	Inshore	No NALL Possibly within Foul	Typically BV or VV / BV for shallow features	Investigation at ships discretion. Typically for uncertain shallow features.
3	Inshore / Seaward	NALL Coastal kelp	VV / BV	Investigation at ships discretion. Typically for drying rocks or rocks awash.
4	Seaward	No	JV	Can be safely navigated over during multibeam. Post acquisition comparison required.
5	Inshore / Seaward	Generally No	Typically BV or VV / BV for shallow features	Doubtful sounding. Possibly floating kelp / whale or fish strikes.

Note: All features recommended for investigation are reported as possible hazards when conducting survey work by boat.

Table 4: Prioritization Hierarchy for Features Requiring Further Investigation

D.2.1.4 Recommended Examination Method of Features Requiring Further Investigation

Each feature for investigation has been attributed with a recommended examination method, based on the general depth around the feature, the least depth as detected by lidar and the nature of the feature (kelp, white water etc.). The examination methods are categorized as follows:

Acronym	Examination Method
VV	Visual Verification - may be hazardous to approach even with shallow draft vessel running single beam.
VV / BV	Visual Verification required prior to Bathymetric Verification - potentially shoaler than 3m depth.
BV	Bathymetric Verification, generally greater than 3m depth.
JV	Junctioning Verification, generally greater than 6m depth.

Table 5: Recommended Examination Methods for Features Requiring Further Investigation

D.2.1.5 Recommended Junctioning with Unsurveyed Lidar Areas

The ‘unsurveyed’ gaps in lidar seabed coverage are defined as polygons in the S-57 feature file. They were constructed utilizing the export of the operator assigned gap tags covered in Section B.4.4. In the case of ‘unsurveyed’ areas for kelp and SEZ, junctioning is not recommended for the obvious risks to surface vessels.

D.2.1.6 Comparison with prior Surveys

Comparison with prior surveys was not required under this Task Order. See Section D.1 for comparison to the nautical charts.

D.2.2 Summary of Charting Actions and Investigations – H11542

D.2.2.1 Summary of Charting Actions – H11542[41]

Total number of new significant islets recommended for insertion on chart: 0
Total number of new significant drying rocks recommended for insertion on chart: 0
Total number of new significant rocks awash recommended for insertion on chart: 0
Total number of new significant rocks recommended for insertion on chart: 7
Total number of charted features disproved by lidar (Remove): 0
Total number of charted features recommended for amendment by lidar (Replace): 4
Total number of chart comparison items requiring further investigation: 8

Total number of DTONs submitted to PHB during data acquisition: 0
Total number of DTONs submitted to PHB during data processing: 4
Total number of DTONs submitted to PHB for H11542: 4

D.2.2.2 Summary of Lidar Features Requiring Further Investigation – H11542

Total number of Priority 1 investigations identified: 1
Total number of Priority 2 investigations identified: 11
Total number of Priority 3 investigations identified: 5
Total number of Priority 4 investigations identified: 20
Total number of Priority 5 investigations identified: 0

Total number of investigations recommended during data processing: 31
Total number of investigations recommended from georeferenced imagery review: 2
Total number of investigations recommended from chart comparison compilation: 4
Total number of recommended feature investigations: 37

E. APPROVAL SHEET

LETTER OF APPROVAL – OPR-P133-KRL-06

This report and the accompanying LADS survey deliverables are respectfully submitted.

Field operations contributing to the accomplishment of this survey were conducted under my direct supervision with frequent personal checks of progress and adequacy. This report and the accompanying LADS survey deliverables have been closely reviewed and are considered complete and adequate as per the Statement of Work.

Report	Submission Date
Descriptive Report – H11542	September 26, 2008

Mark Sinclair
Hydrographer
Tenix LADS, Incorporated

Date September 26, 2008

Revisions and Recommendations

[1] Concur.
[2] Concur.
[3] Concur.
[4] Despite minor deviations from IHO order 1 accuracy the data are suitable for charting.
[5] During the compilation of H11542_CS.000, point kelp features were placed as appropriate per chart scale and spaced relative to non seasonal objects such as rocks and selected soundings. The kelp features are based on kelp points and areas provided from the delivered S-57 feature file US511542.000.
[6] All of H11542_CS.000 is encoded with a Meta object qualifying the data as un-assessed, heeding caution to mariners in the area.
[7] Area delineated as sand waves was deemed insignificant relative to chart scale due to its thin size and proximity to the MLLW line. Sand waves are not included in H11542_CS.000.
[8] With the exception of off shore islets and rocks, depths above mean high water have been excluded from H11542_CS.000 and H11542_SS.000.
[9] Due to the object detection limitations of Lidar, all charted features in the area are retained within H11542_CS.000. Lidar data is only being used to supplement areas where no prior survey data exists.
[10] The 3 meter resolution BASE surface H11542_3m_Final.csar was used as the basis for compilation of H11542_CS.000 and H11542_SS.000.
[11] Regardless of object detection capabilities among thick kelp and white water, data from H11542 still adds value to 16587 which contains little to no hydrographic data around Chirikof Island.
[12] Coastline objects were not used in the compilation.
[13] Zero depth contours were slightly generalized relative to chart scale and compiled.
[14] No LNDARE objects were submitted with survey H11542.
[15] No LNDELV objects were submitted with survey H11542.
[16] Seabed area objects were directly imported into the HCell and used to depict rocky seabed areas.
[17] Sand waves were not compiled due to scale.
[18] As many rocks were selected for charting as could appropriately fit at chart scale. Height and position relative to navigational significance of rocks were primarily used for selection of rocks to be represented at chart scale.
[19] Point kelp features were placed as appropriate per chart scale and spaced relative to non seasonal objects such as rocks and selected soundings. The kelp features are based on kelp points and areas provided from the survey.
[20] Unsurveyed were not carried forward to the HCell. These areas were very small relative to chart scales and located within intertidal areas that are not relevant to navigation.
[21] The M_COVR is not a required deliverable, therefore it was not compiled to the HCell.
[22] The M_QUAL was modified to reflect post processing survey coverage, particularly removing sections showing coverage over land.
[23] Recommendations intended for MCD in this report should be disregarded as they are superseded by the cartographic compilation from the Pacific Hydrographic Branch (PHB).
[24] Concur with clarification, survey area as time and resources allow.
[25] Compiled to 1st edition 09/01/2006, LNM 03/26/2011.

[25] Compiled to 1st edition 09/01/2006, LNM 03/26/2011.
[26] DTON report is appended to this report.
[27] Due to minor adjustments in data processing at PHB specific positioning and depth values of reported DTONs may not match those listed in the DTON report.
[28] Chart rock at 55-54-29.25N, 155-32-50.05W.
[29] Chart sounding at 55-54-53.70N, 155-29-55.17W
[30] Do not chart sounding, chart soundings selected per H11542_CS.000.
[31] Retain 9 fathom sounding as charted at 55-57-08.78N, 155-31-57.47W.
[32] Concur.
[33] Concur.
[34] Concur, current edition of chart 16587 has already been corrected.
[35] Concur.
[36] Chart rocks per H11542_CS.000.
[37] Do not concur. Chart comparison table D.1.6. should be disregarded by MCD for chart compilation purposes. H11542_CS.000 has been specifically compiled for application to the charts containing an appropriate level of generalization and conservative cartography regarding surveyed features.
[38] Concur with clarification, survey area as time and resources allow.
[39] Chart kelp at this location per H11542_CS.000.
[40] A hole in the M_QUAL object in H11542_CS.000 represents the gap in data coverage.
[41] Chart features per H11542_CS.000.

APPENDIX I – DANGERS TO NAVIGATION

Recommended DTONS Submitted to PHB

I.1.1 Danger to Navigation Report

Hydrographic Survey Registry Number: H11542

State: Alaska

Locality: Vicinity of Chirikof Island

Sub-locality: North Shore of Chirikof Island

Project Number: OPR-P133-KRL-06

Survey Dates: June – September 2006

Depths are in meters and reduced to Mean Lower Low Water using final verified tides. Drying heights are in meters relative to MLLW. Positions are based on the NAD83 horizontal datum. All times and dates are relative to UTC.

Number	Edition	Date	Scale
16587	1st	9/9/06	1:135,000
US3AK5KM*	7th	8/8/08	1:52,150 1:350,000

*Note: US3AK5KM was not used during the chart comparison or DTON evaluation because of a large datum shift in the ENC.

The following items were found during hydrographic survey operations:

No.	Feature	Depth	Latitude (N)	Longitude (W)	Time, Date, Year	Investigate
1	Rk in kelp	5.2	55° 54' 29.29"	155° 32' 50.01"	20:59:15, July 15, 2006	No
2	Rk in kelp	13.3	55° 54' 53.69"	155° 29' 55.14"	16:28:43, July 27, 2006	Yes
3	Shoal	13.5	55° 55' 21.32"	155° 36' 56.09"	00:56:59, June 21, 2006	No
4	Shoal	16.6	55° 57' 08.78"	155° 31' 57.47"	22:08:38, Sept 4, 2006	No

COMMENTS: Final verified tides have been applied from the Chirikof Island tide gauge (9458293). The shoals were found using LIDAR. DTON items 1 though 4 were submitted following data processing from the Biloxi office.

Questions concerning this report should be directed to the Survey Manager, Mr. Scott Ramsay, in the Tenix LADS Inc. office in Biloxi MS. at (228) 594 6800.

DTONS Submitted to MCD

I.1.2 Danger to Navigation Report (Submitted upon completion of data processing)

Dangers to Navigation for Lidar Survey H11542

Registry Number: H11542
State: Alaska
Locality: Chirikof Island
Sub-locality: North Shore of Chirikof Island
Project Number: OPR-P133-KRL-06
Survey Dates: June, 2006 - September, 2006

Charts Affected

Number	Version	Date	Scale
16587	1st Ed.	09/01/2006	1:135000
16580	13th Ed.	01/01/2005	1:350000
16013	30th Ed.	07/01/2006	1:969761
531	23rd Ed.	01/01/2006	1:2100000
500	8th Ed.	06/01/2003	1:3500000
530	31st Ed.	06/01/2005	1:4860700
50	6th Ed.	06/01/2003	1:10000000

Features

No.	Feature Type	Survey Depth	Survey Latitude	Survey Longitude
1.1	GP	5.20 m	55° 54' 29.290" N	155° 32' 50.010" W
1.2	GP	13.30 m	55° 54' 53.690" N	155° 29' 55.140" W
1.3	GP	13.50 m	55° 55' 21.320" N	155° 36' 56.090" W
1.4	GP	16.60 m	55° 57' 08.780" N	155° 31' 57.470" W

Generated by Pydro v7.3 (r2252) on Wed Sep 17 23:28:58 2008 [UTC]

1 - Danger To Navigation

1.1) GP No. - 1 from H11542_dtons.xls

DANGER TO NAVIGATION

Survey Summary

Survey Position:	55° 54' 29.290" N, 155° 32' 50.010" W
Least Depth:	5.20 m
Timestamp:	2006-196.20:59:00.000 (07/15/2006)
GP Dataset:	H11442_dtons.xls
GP No.:	1
Charts Affected:	16587_1, 16580_1, 16013_1, 531_1, 500_1, 530_1, 50_1

Remarks:

This feature was found during Lidar hydrographic survey operation. Depth was reduced to Mean Lower Low Water using verified tides from the Chirikof Island tide gauge (9458293).

Feature Correlation

Address	Feature	Range	Azimuth	Status
H11442_dtons.xls	1	0.00	000.0	Primary

Hydrographer Recommendations

Chart as surveyed.

Cartographically-Rounded Depth (Affected Charts):

2 ¾fm (16587_1, 16580_1, 16013_1, 530_1)

2fm 5ft (531_1)

5.2m (500_1, 50_1)

S-57 Data

Geo object 1:	Sounding (SOUNDG)
Attributes:	QUASOU - 1:depth known
	SORDAT - 20060911
	SORIND - US,US,nsurf,H11542
	TECSOU - 7:found by laser

VERDAT - 12:Mean lower low water

1.2) GP No. - 2 from H11542_dtons.xls

DANGER TO NAVIGATION

Survey Summary

Survey Position:	55° 54' 53.690" N, 155° 29' 55.140" W
Least Depth:	13.30 m
Timestamp:	2006-208.16:28:00.000 (07/27/2006)
GP Dataset:	H11442_dtons.xls
GP No.:	2
Charts Affected:	16587_1, 16580_1, 16013_1, 531_1, 500_1, 530_1, 50_1

Remarks:

This feature was found during Lidar hydrographic survey operation. Depth was reduced to Mean Lower Low Water using verified tides from the Chirikof Island tide gauge (9458293). Further investigation for least depth determination is recommended for this sounding. The QUASOU was set to '3' for doubtful sounding.

Feature Correlation

Address	Feature	Range	Azimuth	Status
H11442_dtons.xls	2	0.00	000.0	Primary

Hydrographer Recommendations

Chart as surveyed.

Cartographically-Rounded Depth (Affected Charts):

7 ¼fm (16587_1, 16580_1, 16013_1, 530_1)

7fm 1ft (531_1)

13.3m (500_1, 50_1)

S-57 Data

Geo object 1:	Sounding (SOUNDG)
Attributes:	QUASOU - 3:doubtful sounding
	SORDAT - 20060911
	SORIND - US,US,nsurf,H11542
	TECSOU - 7:found by laser

VERDAT - 12:Mean lower low water

1.3) GP No. - 3 from H11542_dtons.xls

DANGER TO NAVIGATION

Survey Summary

Survey Position:	55° 55' 21.320" N, 155° 36' 56.090" W
Least Depth:	13.50 m
Timestamp:	2006-172.00:56:00.000 (06/21/2006)
GP Dataset:	H11442_dtons.xls
GP No.:	3
Charts Affected:	16587_1, 16580_1, 16013_1, 531_1, 500_1, 530_1, 50_1

Remarks:

This feature was found during Lidar hydrographic survey operation. Depth was reduced to Mean Lower Low Water using verified tides from the Chirikof Island tide gauge (9458293).

Feature Correlation

Address	Feature	Range	Azimuth	Status
H11442_dtons.xls	3	0.00	000.0	Primary

Hydrographer Recommendations

Chart as surveys.

Cartographically-Rounded Depth (Affected Charts):

7 ¼fm (16587_1, 16580_1, 16013_1, 530_1)

7fm 2ft (531_1)

13.5m (500_1, 50_1)

S-57 Data

Geo object 1:	Sounding (SOUNDG)
Attributes:	QUASOU - 1:depth known
	SORDAT - 20060911
	SORIND - US,US,nsurf,H11542
	TECSOU - 7:found by laser

VERDAT - 12:Mean lower low water

1.4) GP No. - 4 from H11542_dtons.xls

DANGER TO NAVIGATION

Survey Summary

Survey Position:	55° 57' 08.780" N, 155° 31' 57.470" W
Least Depth:	16.60 m
Timestamp:	2006-247.22:08:00.000 (09/04/2006)
GP Dataset:	H11442_dtons.xls
GP No.:	4
Charts Affected:	16587_1, 16580_1, 16013_1, 531_1, 500_1, 530_1, 50_1

Remarks:

This feature was found during Lidar hydrographic survey operation. Depth was reduced to Mean Lower Low Water using verified tides from the Chirikof Island tide gauge (9458293).

Feature Correlation

Address	Feature	Range	Azimuth	Status
H11442_dtons.xls	4	0.00	000.0	Primary

Hydrographer Recommendations

Chart as surveyed.

Cartographically-Rounded Depth (Affected Charts):

9fm (16587_1, 16580_1, 16013_1, 530_1)

9fm 0ft (531_1)

16.6m (500_1, 50_1)

S-57 Data

Geo object 1:	Sounding (SOUNDG)
Attributes:	QUASOU - 1:depth known
	SORDAT - 20060911
	SORIND - US,US,nsurf,H11542
	TECSOU - 7:found by laser

VERDAT - 12:Mean lower low water

H11542 HCell Report

Peter Holmberg, Physical Scientist
Pacific Hydrographic Branch

1.0 Specifications, Standards and Guidance Used in HCell Compilation

HCell compilation of survey H11542 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 H11542 were compiled to the largest scale raster chart shown below:

Chart	Scale	Edition	Edition Date	NTM Date
16587	1:135,000	1st	09/01/2006	03/26/2011

The following ENC was also used during compilation:

Chart	Scale
US4AK5XM	1:135,000

3.0 Soundings

A survey-scale sounding (SOUNDG) feature object layer was built from the 3-meter surface H11542_3m_Final in CARIS BASE Editor. A shoal-biased selection was made at 1:40,000 and survey scales using a Radius Table file with values shown in the table, below.

Shoal Limit (m)	Deep Limit (m)	Radius (mm)
-4.7	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

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

Chart Contour Intervals in Fathoms from Chart 16587	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 H11542_SS.000
0	0.0	0.2286	0.125	0
3	5.4864	5.715	3.125	3
10	18.288	18.517	10.125	10

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

5.0 Meta Areas

The following Meta object area is included in HCell H11542:

M_QUAL

The Meta area object was 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):	Fathoms and 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
DEPCNT	Modified surveyed MLLW
M_QUAL	Data quality Meta object
SBDARE	Rocky seabed areas
SOUNDG	Soundings at chart scale density
* UWTROC	Rock features
WATTUR	Breakers
WEDKLP	Points of kelp

* The M_QUAL is adequate for NDB product searches except for features in these object classes which reside outside the M_QUAL limits.

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

H11542 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

H11542_CS.000	Base Cell File, Chart Units, Soundings and features compiled to 1:135,000.
H11542 _SS.000	Base Cell File, Chart Units, Soundings and Contours compiled to 1:40,000.
H11542 _DR.pdf	Descriptive Report including end notes compiled during office processing and certification, the HCell Report, and supplemental items
H11542 _outline.gml	Survey outline
H11542 _outline.xsd	Survey outline

11.0 Software

CARIS HIPS Ver. 6.1	Inspection of Combined BASE Surfaces
CARIS BASE Editor Ver. 3.0	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 4.4a	Setting the sounding rounding variable for conversion of the metric HCell to NOAA charting units with NOAA rounding.
CARIS HOM Ver. 3.3	Perform conversion of the metric HCell to NOAA charting units with NOAA rounding.
HydroService AS, dKart Inspector Ver. 5.1, SP 1	Validation of the base cell file.
Northport Systems, Inc., Fugawi View ENC Ver.1.0.0.3	Independent inspection of final HCells using a COTS viewer.

12.0 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
H11542

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: 2011.06.27 13:15:37 -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
2011.06.27
13:20:43 -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: 2011.06.27 14:00:42 -07'00'