H12542

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H12542

LOCALITY

State(s):	Alaska
General Locality:	Cook Inlet, AK
Sub-locality:	Knik Arm to Fire Island

2013

CHIEF OF PARTY
Andrew Orthmann

LIBRARY & ARCHIVES

Date:

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

REGISTRY NUMBER:

HYDROGRAPHIC TITLE SHEET

H12542

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

State(s):	**Alaska**
General Locality:	**Cook Inlet, AK**
Sub-Locality:	**Knik Arm to Fire Island**
Scale:	**10000**
Dates of Survey:	**06/15/2013 to 07/11/2013**
Instructions Dated:	**04/30/2013**
Project Number:	**OPR-P385-KR-13**
Field Unit:	**TerraSond Limited**
Chief of Party:	**Andrew Orthmann**
Soundings by:	**Singlebeam Echo Sounder**
Imagery by:	**n / a**
Verification by:	**Pacific Hydrographic Branch**
Soundings Acquired in:	**meters at Mean Lower Low Water**

Remarks:

The purpose of this survey is to provide contemporary surveys to update National Ocean Service (NOS) nautical charts. All separates are filed with the hydrographic data. Notes in red were generated during office processing. The processing branch concurs with all information and recommendations in the DR unless otherwise noted. Page numbering may be interrupted or non-sequential. All pertinent records for this survey, including the HYPERLINK "http://www.ngdc.noaa.gov/" Descriptive Report, are archived at the National Geophysical Data Center (NGDC) and can be retrieved via http://www.ngdc.noaa.gov/.

Table of Contents

List of Tables

List of Figures

Descriptive Report to Accompany Survey H12542

Project: OPR-P385-KR-13

Locality: Cook Inlet, AK

Sublocality: Knik Arm to Fire Island

Scale: 1:10000

June 2013 - July 2013

TerraSond Limited

Chief of Party: Andrew Orthmann

A. Area Surveyed

A navigable area survey (H12542) was conducted from Knik Arm to Fire Island, Alaska, in accordance with the NOAA, National Ocean Service, Statement of Work (SOW), OPR-P385-KR-13, dated April 24th, 2013 and Hydrographic Survey Project Instructions dated April 30th 2013. Hydrographic survey data collection began June 15th, 2013 and ended July 11th, 2013, while tide data collection to support the hydrographic operations began June 7th, 2013 and ended August 6th, 2013.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
61° 20" 8.04' N 150° 17" 58.92' W	61° 10" 4.01' N 149° 45" 29.88' W

Table 1: Survey Limits

Single beam operations were conducted in accordance with the project work instructions, which specified 40 m set-line spacing to the survey limits or 4 meter contour, whichever came first. Note that since the 4 m contour was not explicitly described in the project instructions -- this was clarified prior to project commencement with the NOAA COTR on March 19th, 2013 (see Appendix II: Supplemental Survey Records and Correspondence).

The survey limits were achieved in general. The 4 m contour was rarely reached prior to reaching the project limits. In two isolated cases neither the 4 m contour nor the project limits could be fully reached: On the north side of the Port of Anchorage (61-14-49 N, 149-53-07 W) active construction and ship activity prevented survey prevented survey to the project limits. Likewise, it was not possible to achieve the 4 m

contour in the vicinity due to pilings and steep dock face in the vicinity of Port MacKenzie (61-16-07 N, 149-54-53 W). In these cases the survey vessel collected data as close as safely possible.

Supplemental correspondence is appended to this report.

A.2 Survey Purpose

The purpose of this project is to provide an updated survey for northern Cook Inlet. It addresses approximately 18 square nautical miles (SQNM) of area identified as “re-survey” in the 2012 NOAA Hydrographic Survey Priorities (NHSP) document.

Cook Inlet has some of the largest tidal ranges and strongest tidal currents in North America. In the project area, the diurnal tidal range is nearly 9 meters and tidal currents of up to 6 knots are common. The area frequently becomes congested with sea ice in the colder winter months (generally November through March), but strong currents and tidal changes prevent the ice from forming a solid pack.

The Port of Anchorage, which is centrally located on the south side of the survey area, is a critical link between the lower-48 states and Alaska, providing an estimated 90% of the merchandise cargo to 80% of Alaska's populated areas. The Port of Anchorage also provides essential fuel supplies to the south central region of the state and serves as the entry point for additional goods and cargo distributed to rural Alaskan communities.

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

A.4 Survey Coverage

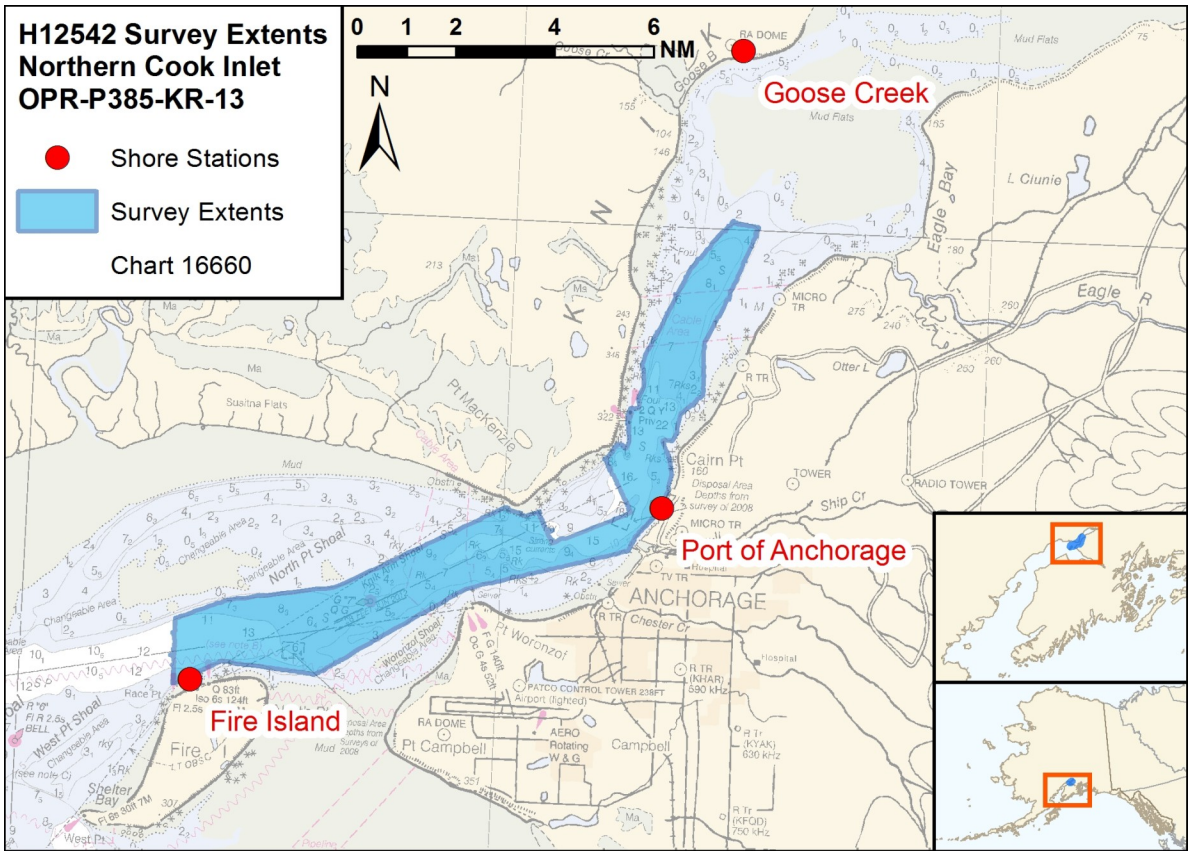

Figure 1: H12542 Survey Extents and overview.

The 40 m line spacing requirement was generally met, however, in isolated cases, lines may vary to slightly over 40 m apart in instances of line driving "wobble" when extreme current or weather made line tracking problematic.

Data is adequate to only supersede charted soundings in the common area. All charted rocks are recommended to be retained.

A.5 Survey Statistics

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

	Vessel	***Luna Sea***	***Total***
LNM	**SBES Mainscheme**	966.8	966.8
	MBES Mainscheme	0	0
	Lidar Mainscheme	0	0
	SSS Mainscheme	0	0
	SBES/MBES Combo Mainscheme	0	0
	SBES/SSS Combo Mainscheme	0	0
	MBES/SSS Combo Mainscheme	0	0
	SBES/MBES Combo Crosslines	77.5	77.5
	Lidar Crosslines	0	0
Number of Bottom Samples			0
Number AWOIS Items Investigated			0
Number Maritime Boundary Points Investigated			0
Number of DPs			0
Number of Items Items Investigated by Dive Ops			0
Total Number of SNM			17.8

Table 2: Hydrographic Survey Statistics

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

Survey Dates	Julian Day Number
06/15/2013	166
06/16/2013	167
06/17/2013	168
06/18/2013	169
06/19/2013	170
06/22/2013	173
06/23/2013	174
06/24/2013	175
06/25/2013	176
06/26/2013	177
06/27/2013	178
06/28/2013	179
06/29/2013	180
06/30/2013	181
07/01/2013	182
07/02/2013	183
07/03/2013	184
07/05/2013	186
07/06/2013	187
07/07/2013	188
07/08/2013	189
07/09/2013	190
07/10/2013	191
07/11/2013	192

Table 3: Dates of Hydrography

B. Data Acquisition and Processing

B.1 Equipment and Vessels

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

B.1.1 Vessels

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

Hull ID	***Luna Sea***	***My Marie***
LOA	12.8 meters	12.8 meters
Draft	1.4 meters	0.5 meters

Table 4: Vessels Used

The Luna Sea is an aluminum-hulled vessel owned and operated by TerraSond of Palmer, Alaska. Prior to beginning survey operations a hull-mounted transducer was installed. It acquired all hydrographic data for the project.

The My Marie is an aluminum-hulled landing craft vessel owned and operated by Hylite Fabrication of Palmer, Alaska. It was used to deploy and retrieve SeaBird bottom mounted pressure tide gauges and bubbler tide gauge orifices anchors. My Marie was not used for hydrographic data collection.

B.1.2 Equipment

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

Manufacturer	Model	Type
Odom Hydrographic Systems	Echotrac CV100	SBES
Applanix	POSMV 320 V4	Positioning and Attitude System
AML Oceanographic	AML SV+	Sound Speed System
Odom Hydrographic Systems	Digibar Pro	Sound Speed System
Sea-Bird Electronics	SBE 26+	Submerged Tide Gauge
Trimble	5700	Positioning System (Check)
Trimble	NETRS	Positioning System (Base Station)
DAA WaterLOG	H350XL	Tide Gauge

Table 5: Major Systems Used

Equipment configurations, operations, and data acquisition and processing are described in the DAPR.

B.2 Quality Control

B.2.1 Crosslines

Crosslines, acquired for this survey, totalled 8% of mainscheme acquisition.

Of the 1044.3 nautical miles of single beam data collected, 77.5 nautical miles were crosslines. This translates into 8.02% of the single beam mileage, which meets requirements in the 2013 Hydrographic Survey Specifications and Deliverables (HSSD) for set-line spacing surveys. General agreement between mainscheme and crosslines is good.

To evaluate crossline to mainscheme agreement, CARIS HIPS' crossline comparison (QC Report) function was utilized. In CARIS HIPS, a 4 m resolution BASE surface was created from mainscheme-only data. Each crossline was then run through the QC Report process, which calculated the difference between each accepted crossline sounding and the BASE surface (depth layer). Crosslines with at least 95% of soundings comparing to within IHO Order 1 were considered to "pass", while those with less than 95% of soundings comparing to within IHO Order 1 were considered to "fail".

Overall, 95.8% of all crossline soundings compare to the mainscheme surface within IHO Order 1 or better. On a line-by-line basis, of 90 crosslines collected, 72 pass while 18 fail. Nine of the failures were marginal

(with 90% or better passing IHO Order 1); while nine others had higher failure rates (61% to 89% passing IHO Order 1).

Crosslines failing QC were examined to determine the cause and rule out any misapplications of depth correctors. Failures were found to correlate to length of time between mainscheme and crossline acquisition (indicating bottom change), rough bottom topography, or a combination.

A good example of QC failure due to bottom change is shown in figure 2, which shows large amount of bottom change over a period of 7 days in the vicinity of Point MacKenzie, an area known to be especially highly changeable. In fact the area is currently undergoing a multi-year study by the USACE due to its high rate of change.

Other failures occur on lines that appear overall to have good agreement between mainscheme and crosslines but still fail the QC comparison routine. These failures are common in bottom types showing significant topographical variance such as sand wave areas and steep slopes, and are attributable to known issues of statistical comparisons on slopes when comparing soundings to gridded surfaces. A common example of QC failures due to this cause is shown in figure 3.

Despite the disagreements of some of the crosslines, the data represents the seafloor at the time of the survey and is acceptable for charting. Refer to the project DAPR for more details concerning analysis methodology. Refer to Separate II: Digital Data for the detailed Crossline QC Reports.

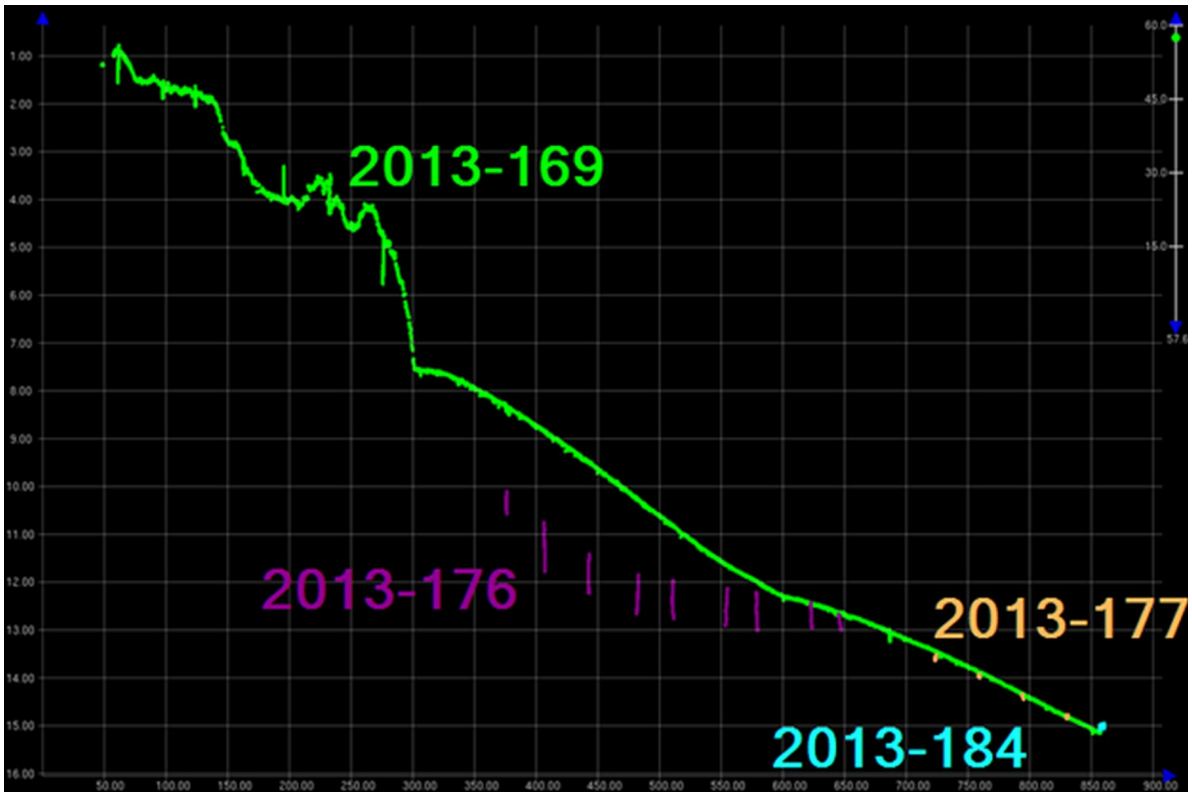

Figure 2: Example from CARIS subset mode of a crossline that fails QC due to bottom change. Run up to 7 days apart, up to 2.3 meters of vertical separation is evident. Data is colored and labeled by Julian day of collection. Green line is the crossline (line 1AXL-2013LU1692131_0).

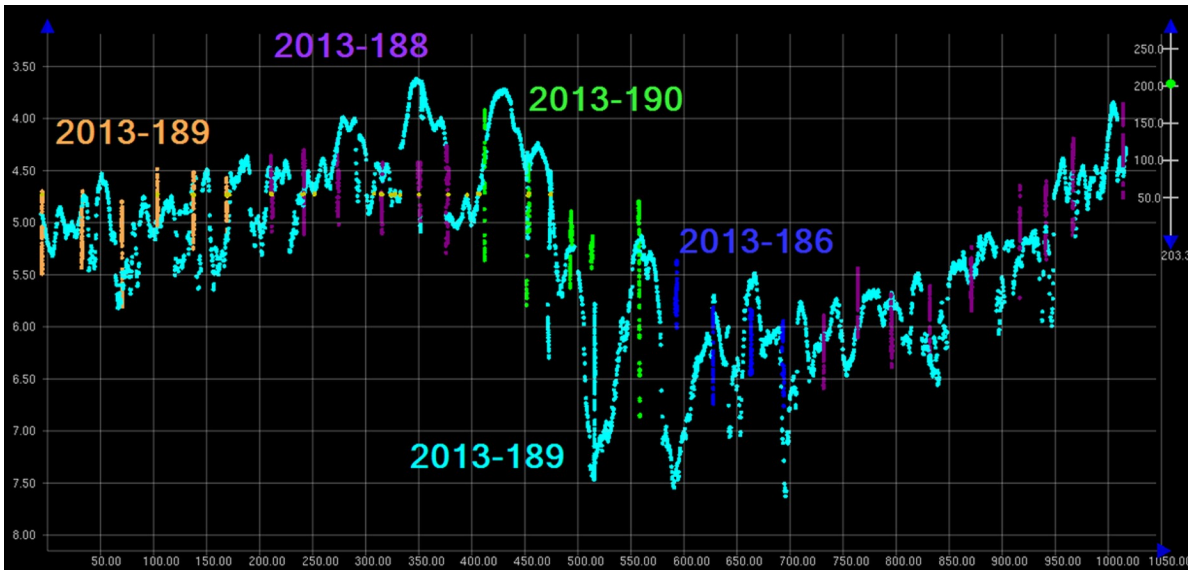

Figure 3: Example from CARIS subset mode of a crossline that fails QC in a sandwave area. Only 78% of soundings on the crossline (cyan line 1AXL-2013-LU1911634_0) pass CARIS HIPS QC report routine at IHO Order 1 despite apparently good agreement.

B.2.2 Uncertainty

All soundings were assigned a horizontal and vertical value for estimated total propagated uncertainty (TPU). The parameters and methods used for computation of sounding uncertainty are detailed in the project DAPR -- no deviations from occurred.

The BASE surface was finalized in CARIS HIPS so that the final uncertainty value for the each grid cell is the greater of either standard deviation or uncertainty. The uncertainty layer of the final surface was then examined for areas of uncertainty that exceeded IHO Order 1.

For the final surface, uncertainty of the grid cells ranged from 0.327 to 1.303 m, with an average of 0.401 m. Relatively few exceeded IHO Order 1. Those that exceeded IHO Order 1 were found to be on steep slopes, areas with rough bottom topography such as sand waves, and areas showing bottom change due to differences in time of survey acquisition creating a high standard deviation of the soundings contributing to the grid cell, especially considering the relatively large (4 m) bin size used. Despite a high uncertainty of these grid cells, the contributing soundings have TPU’s that are within IHO Order 1. Figure 4 shows the distribution of surface uncertainty.

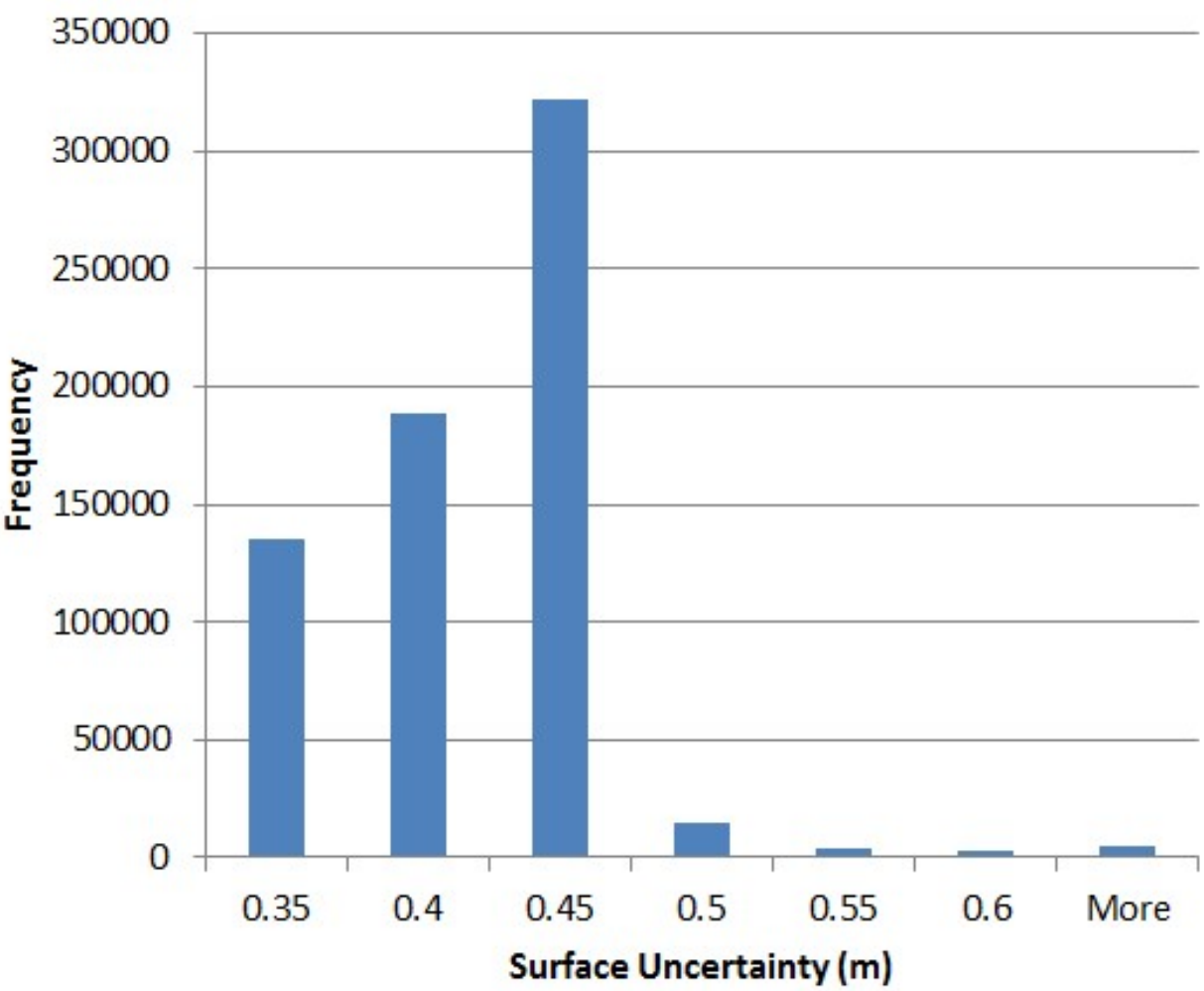

Figure 4: Surface Uncertainty Histogram

B.2.3 Junctions

This survey junctions with two contemporary surveys. However, survey junction examinations were not required or undertaken for this project.

Note: This survey also overlaps work done in 2013 under USACE contract in the vicinity of Point MacKenzie shoal. A comparison with the USACE data was not undetaken. The USACE area is shown in figure 7.

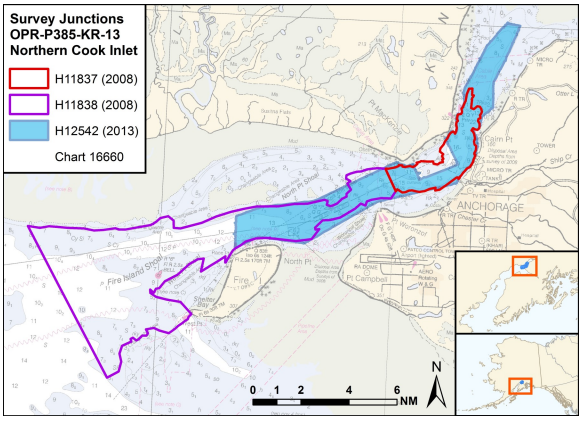

Figure 5: Survey Junctions.

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H11837	1:10000	2008	Terrasond, Ltd.	W
H11838	1:20000	2008	Terrasond, Ltd.	SW

Table 6: Junctioning Surveys

H11837

This junction was not examined.

H11838

This junction was not examined.

Surveys H11837 and H11838 have been applied to the chart and are prior surveys.

B.2.4 Sonar QC Checks

Echosounder confidence checks consisting of bar checks, lead-lines, and acoustic comparisons were undertaken on this project. Checks were planned on a weekly basis though unexpected mechanical or environmental issues often caused their postponement.

Three bar checks were completed (on JD173, JD182, and JD189). Bar checks served as a check on real-time and processing depth accuracy and were also used to refine the sonar acoustic center offset. Results were excellent, comparing on average to 0.01 m or better of the actual bar depth.

Two lead line comparisons were completed (on JD182 and JD189). Several others were attempted but were unsuccessful in this high current area. These compared to within 0.20 m or better of the sonar depth, which was deemed satisfactory given the comparison conditions.

Finally, echo sounder comparisons were undertaken, whereby the repeatability of collecting data over the same seafloor was checked by running the same line on separate occasions. Three comparisons were completed (on JD169, JD177, and JD190). Agreement was very good overall, especially in sections of the line that appear to have harder or more stable seafloor. In some sections of the line differences of up to 1 meter over time was apparent and attributed to bottom change.

Refer to the bar check, lead line, and echosounder comparison result logs available in Separate I: Acquisition and Processing Logs for specific results. Refer to the project DAPR for methods used to acquire and process sonar system (and all other) quality control checks.

B.2.5 Equipment Effectiveness

Sound speed probe SN#3259 malfunctioned on JD173. It had been factory calibrated prior to survey operations and had been outputting reasonable corrections until JD173 when for unknown reasons it began to produce obviously erroneous values. This issue did not impact data quality since the system was immediately removed from the project and a calibrated spare (SN#3279) was used in its place. Erroneous values from the instrument were not used for the correction of any soundings.

An incorrect lever arm setting in the POSMV resulted in erroneous heave and TrueHeave (offset from the actual value by 0.05 to 0.10 m) to be output by the system, affecting lines collected on JD166 through JD170. The setting caused the system to compute “remote” heave correct in amplitude and phase but not averaging to zero, as desired. All lines run after JD170 used the correct setting and are unaffected. Additionally, all affected lines were fully corrected for the issue in processing. Affected lines will not appear in CARIS HIPS to have a TrueHeave sensor, but TrueHeave has been loaded as “Heave”. Additional details are available in Section B.3.2 of the DAPR. Note that this issue was resolved in both acquisition and processing and does not adversely affect the submitted data.

B.2.6 Factors Affecting Soundings

One of the two tide gauges installed at Goose Creek tide station experienced outages and stability issues due to extreme sedimentation and current at the site. Final sounding data quality was unaffected by the issue because one gauge at the site continued to run uninterrupted while alternate mounting options for the affected tide gauge orifice were employed. Furthermore, the survey vessel avoided working in the eastern portion of the project area whenever the second gauge was undergoing repair. Refer to the project Horizontal and Vertical Control Report (HVCR) and its attachments for more details.

On JD178 the survey crew experienced unusual difficulty maintaining a bottom lock in one of the deeper portion of the survey area (approximately 45 m depth) near 61-15-48 N, 149-53-25 W. The echosounder could not maintain bottom lock, probably due to a combination of bottom type and excessive current. The issue did not have an effect on final sounding data quality since the area was re-surveyed successfully later in the project under lower-current conditions.

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: 12 hours

Upper Cook Inlet is a dynamic area experiencing strong tidal currents, generally resulting in mixing of the water column. Indeed this survey found the variance between subsequent sound speed profiles to be minimal and consistent with well-mixed conditions.

Casts were taken with an Applied Microsystems (AML) SV+ probe every 12 hours (once per shift) during acquisition. Most casts were completed in the central portion of the survey area, as a best average location. The probe was lowered by hand as deep as possible, extending to the sea floor in most cases.

Sound speed profiles were applied with the “nearest in distance within time” method in CARIS HIPS, with time set to 12 hours.

B.2.8 Coverage Equipment and Methods

To achieve 40 m line spacing, a line plan with lines parallel to the channel and spaced at 35 m was established and ran. A spacing of 35 m was selected to allow for line driving variance and difficulties.

To achieve the project limits or 4 m contour (whichever came first) the project extents and tide-corrected depths were displayed in real-time in the navigation software (HYPACK). Acquisition on the actively tracked survey line was halted when the project limits or 4 m contour was reached.

During acquisition, vessel speed was minimized—typically running at 8 knots or less depending on current—to maximize along-track ping density. A coverage grid updated in real time by HYPACK acquisition was used to confirm along-track data coverage. Note that the extreme current of up to 6 knots in the area often caused survey speeds to exceed 8 knots, though the survey data still meets data density requirements.

Following processing and cleaning of erroneous soundings, a CARIS BASE surface with a resolution of 4 m was created and examined to confirm line coverage and minimal depth achievement. CUBE parameters that ensured a maximum propagation distance of the grid resolution divided by #2 (per the 2013 HSSD) were used in creating the surface.

B.3 Echo Sounding Corrections

B.3.1 Corrections to Echo Soundings

Corrections applied to echo soundings are detailed in the project DAPR. No deviations occurred.

B.3.2 Calibrations

Calibrations were undertaken as described in the DAPR, no deviations occurred.

B.4 Backscatter

As a single beam survey, multibeam backscatter was not collected for this project.

B.5 Data Processing

B.5.1 Software Updates

There were no software configuration changes after the DAPR was submitted.

The following Feature Object Catalog was used: V5.3.2

Data processing methods and software are described in the DAPR.

B.5.2 Surfaces

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

Surface Name	Surface Type	Resolution	Depth Range	Surface Parameter	Purpose
H12542_SB_4m_MLLW	SBES	4 meters	0 meters - 50 meters	NOAA_4m	SBES Set Line Spacing

Table 7: Submitted Surfaces

The final depth information for this survey was submitted as a CARIS BASE surface which best represented the sea floor at the time of the 2013 survey. The surface was created from fully processed soundings with all final corrections applied.

The surface, named “H12542_SB_4m_MLLW”, was created using CUBE parameters that ensured a maximum propagation distance of the grid resolution divided by #2. 4 m was selected as the resolution, per the requirements for set line spaced single beam in the HSSD. Horizontal projection was selected as UTM Zone 6 North, NAD 1983.

A single CARIS HOB file was submitted (H12542_FFF.HOB) with the survey deliverables as well. No features or bottom samples were assigned to this survey, however, the HOB file contains meta-data not represented in the depth grid. Each object is encoded with mandatory S-57 attributes, additional attributes and NOAA Extended Attributes (V#5.3.2).

Refer to the DAPR for more detailed discussion of the steps followed when acquiring and processing the 2013 survey data, including the surface creation and finalizing processes.

A 4 meter base surface was created during Survey Acceptance Review for analysis and compilation.

C. Vertical and Horizontal Control

Additional information discussing the vertical or horizontal control for this survey can be found in the accompanying HVCR.

C.1 Vertical Control

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

Non-Standard Vertical Control Methods Used:

Constant Separation

Ellipsoid to Chart Datum Separation File:

OPR-P385-KR-13_Sep_Model_MLLW-NAD83(2011)

Note: "Constant Separation" was selected as the separation method, however, a custom model was used.

All sounding data was tide corrected using ellipsoid-referenced surveying techniques (ERS) to MLLW using a model of ellipsoid to MLLW separation values. Discrete tide zones were also developed for the project but were used for comparison purposes only. ERS had a clear advantage for minimizing tide error over discrete tide zones in this extreme tidal regime. Note that a copy of the CARIS data corrected with the discrete tide zones is included with the survey deliverables for comparison purposes only.

The separation model was developed by TerraSond's tides subcontractor, JOA Surveys LLC. For data points in the model, JOA established the separation between the NAD83 ellipsoid and MLLW at the continuously operating NWON tide station Anchorage, AK (945-5920) and the installed tide stations at Fire Island, AK (945-5912), and Goose Creek (945-5963) as well as short-duration bottom mounted tide gauges deployed by TerraSond at four sites throughout the project area. The separation model, which is included with the project CARIS and ERS deliverables, was applied using CARIS HIPS' "Compute GPSTide" routine to all lines. MLLW to NAD83 ellipsoid separations in this sheet ranged from 2.142 m to 3.238 m at an estimated error of 0.153 m to 0.206 m.

A comparison of the data corrected with ERS and discrete tide zones is included in Separate I.

C.2 Horizontal Control

The horizontal datum for this project is North American Datum of 1983 (NAD83).

The projection used for this project is UTM Zone 6 N.

The following PPK methods were used for horizontal control:

Single Base

The following user installed stations were used for horizontal control:

HVCR Site ID	Base Station ID
POA2	POA2

Table 8: User Installed Base Stations

The project base station (POA2) broadcast RTK positions for real time and preliminary positioning. All RTK positions were replaced in processing with PPK positions.

C.3 Additional Horizontal or Vertical Control Issues

3.3.1 ERS to Discrete Tide Zones Comparison Report

A comparison of the data corrected with ERS and discrete tide zones is included in Separate I.

D. Results and Recommendations

D.1 Chart Comparison

The chart comparison for H12542 was performed by examining all Raster Navigational Charts (RNCs) and Electronic Navigation Charts (ENCs) that intersect the survey area.

The chart comparison was accomplished by overlaying the finalized BASE surface with shoal-biased soundings, and final feature file on the charts in CARIS HIPS. The general agreement between charted soundings and H12542 soundings was then examined and a more detailed comparison was undertaken for any shoals or other dangerous features. Results are shown in the following sections.

Dramatic change is evident between the chart and survey data, therefore, changes are only detailed in general terms. Because of the widespread change, in cases of discrepancy it is recommended that this survey supersede charted data where they overlap. However, as this survey was not a complete coverage survey, previously charted point features should be retained, and charted point feature least depths should be retained when shoaler.

NMs and LNMs:

USCG Notice to Mariners (NM) through 46/2013 were checked for updates affecting charts 16665 and 16670. None were found that were issued subsequent to issuance date of the project instructions.

USCG Local Notice to Mariners (LNM) through 45/2013 were checked for updates affecting charts 16665 and 16670 issued subsequent to issuance date of the project instructions. The following LNM items were found to affect the survey area:

1. LNM 32/13: Indicates that a "hydrographic survey conducted in June of 2012 indicates that shoaling is occurring at the southern entrance to the Cook Inlet Navigation Channel. The shoal has least depths that are as much as 10 feet above the Federally authorized project depth of 38 feet."

The notice was then updated with preliminary post-dredge channel depths in 33/13 (listed below).

2. LNM 33/13: "A Post dredge hydrographic survey conducted in July of 2013 indicates that dredging has achieved an overall project depth of at minus 35 MLLW feet. A least depth for each quarter of the channel has been established. The positions are as follows: 32.6’ - 61°12’18.95”N, 150°04’41.03”W, 34.9’ - 61°12’25.86”N, 150°04’03.28”W, 37.4’ - 61°11’35.52”N, 150°06’57.64”W, 35.1’ - 61°11’39.97”N, 150°06’30.11”W. The USACE Alaska District is in the planning process to continue dredging the Cook Inlet Navigation Channel in 2014. Questions or concerns should be directed to Anne Dollard at (907) 753-5687 or by email to anne.s.dollard@usace.army.mil."

The LNM-referenced dredging activities were still underway when this project completed. Refer to the USACE for final controlling depths in the channel. See Section D.1.8 for a image of the area and further discussion. Note: This survey found depths to be within +/- 2 feet of the depths reported in the LNM at the positions noted.

D.1.1 Raster Charts

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

Chart	Scale	Edition	Edition Date	LNM Date	NM Date
16665	1:50000	10	11/2011	11/01/2011	11/12/2011
16660	1:194154	31	04/2012	04/24/2012	04/28/2012

Table 9: Largest Scale Raster Charts

16665

Agreement of this survey and chart 16665 (and its inset) is sporadic. Overall agreement is better in the southern portion of the survey area and worse in the north, though differences are widespread throughout the data set. Items of particular interest not described elsewhere in this report are listed below.

1. Upper Knik Arm has shoaled dramatically compared to the chart. The shoaling becomes more striking as one continues up Knik Arm, it appears that the area has been filling in over time. See figure 6 for an example.

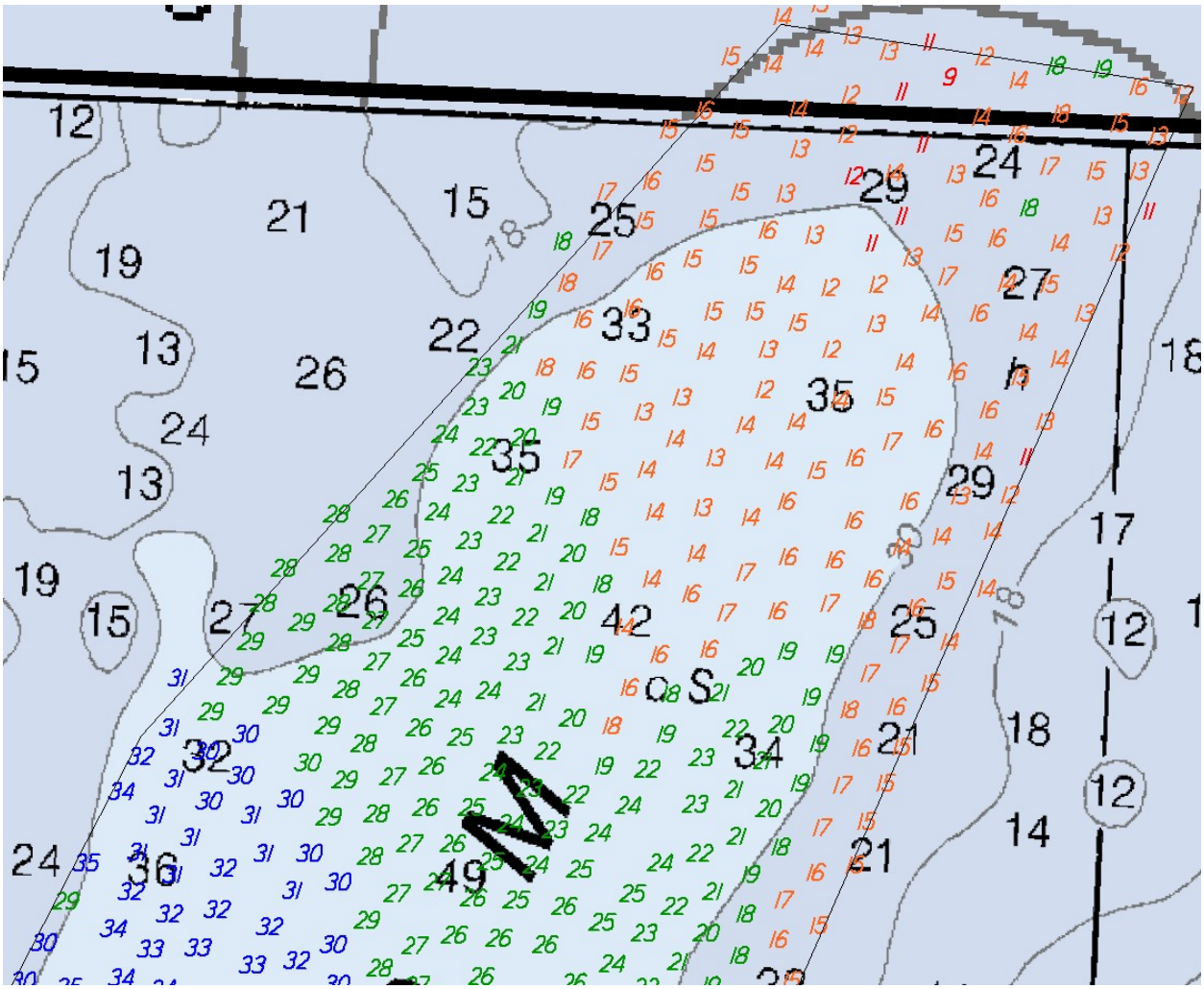

Figure 6: Example of signficant change in northern Knik Arm. Soundings from this survey (orange, green, and blue) are dramatically shoaler then the charted soundings on chart 16665. Units are feet.

16660

Agreement of this survey and chart 16660 is also sporadic. Overall agreement is better in the southern portion of the survey area and worse in the north, though differences are widespread throughout the data set. Observations of differences in chart 16665, which is the larger scale chart, are also true of 16660.

D.1.2 Electronic Navigational Charts

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

ENC	Scale	Edition	Update Application Date	Issue Date	Preliminary?
US5AK16M	1:50000	19	06/08/2011	03/18/2013	NO
US3AK1DM	1:194154	15	01/25/2011	02/01/2013	NO

Table 10: Largest Scale ENCs

US5AK16M

The same differences observed for RNC 16665 also apply to US5AK16M.

US3AK1DM

The same differences observed for RNC 16660 also apply to US5AK16M.

D.1.3 AWOIS Items

AWOIS items existed but investigation was not required. No items were found for inclusion into the database.

D.1.4 Maritime Boundary Points

No maritime boundary points were assigned for this survey.

D.1.5 Charted Features

There are no charted features labeled PA, ED, PD, or Rep. within the survey extents.

D.1.6 Uncharted Features

No uncharted features were found during this survey.

D.1.7 Dangers to Navigation

Danger to Navigation Reports are included in Appendix I of this report.

DTON reports were not included in Appendix I. The entire survey area was sent to PHB for consideration of being submitted as a DTON, but it was not submitted to MCD as such. It is commonly known (and noted on the chart) that Cook Inlet is a highly changeable area. Survey data from H12542 will update the chart with standard priority.

D.1.8 Shoal and Hazardous Features

1. Point MacKenzie Shoal (approximate center position 61-14-12 N, 149-56-34 W) was not within the survey extents. It was excluded from this project area because it was also surveyed in 2013 but under separate contract with the USACE. The shoal is undergoing a multi-year study largely due to its migration to the south into Knik Arm, with the possibility of further restricting vessel traffic and possibly requiring future dredging. For the time being pilots are able to navigate around the shoal but its migration is eroding the safety margin for vessel navigation in the area. It is recommended the depths on the shoal be updated with the latest data available from the USACE. Note that the shoal is not currently named on the NOAA charts, however given that the name is in widespread local use it is recommended it be included on the charts. This area is shown in figure 7.

2. Knik Arm Shoal (approximate center position 61-12-15 N, 150-05-12 W) has undergone extensive change. The entire shoal has shifted to the ENE, with the 30 foot contour moving up to 1 kilometer. The shoal has deepened on its west side and shoaled on its east. Dredging in the channel to the south mitigates its movement in that direction. The shoal is also shown in figure 8.

3. A number of charted rocks (symbol "Rk") exist. In all cases the charted depth of the Rk are shoaler then the depths found during this survey. However, since this survey was not a complete coverage survey it was not possible to determine the least depth on the features. It is recommended the previously charted least depths on the "Rk" features be retained.

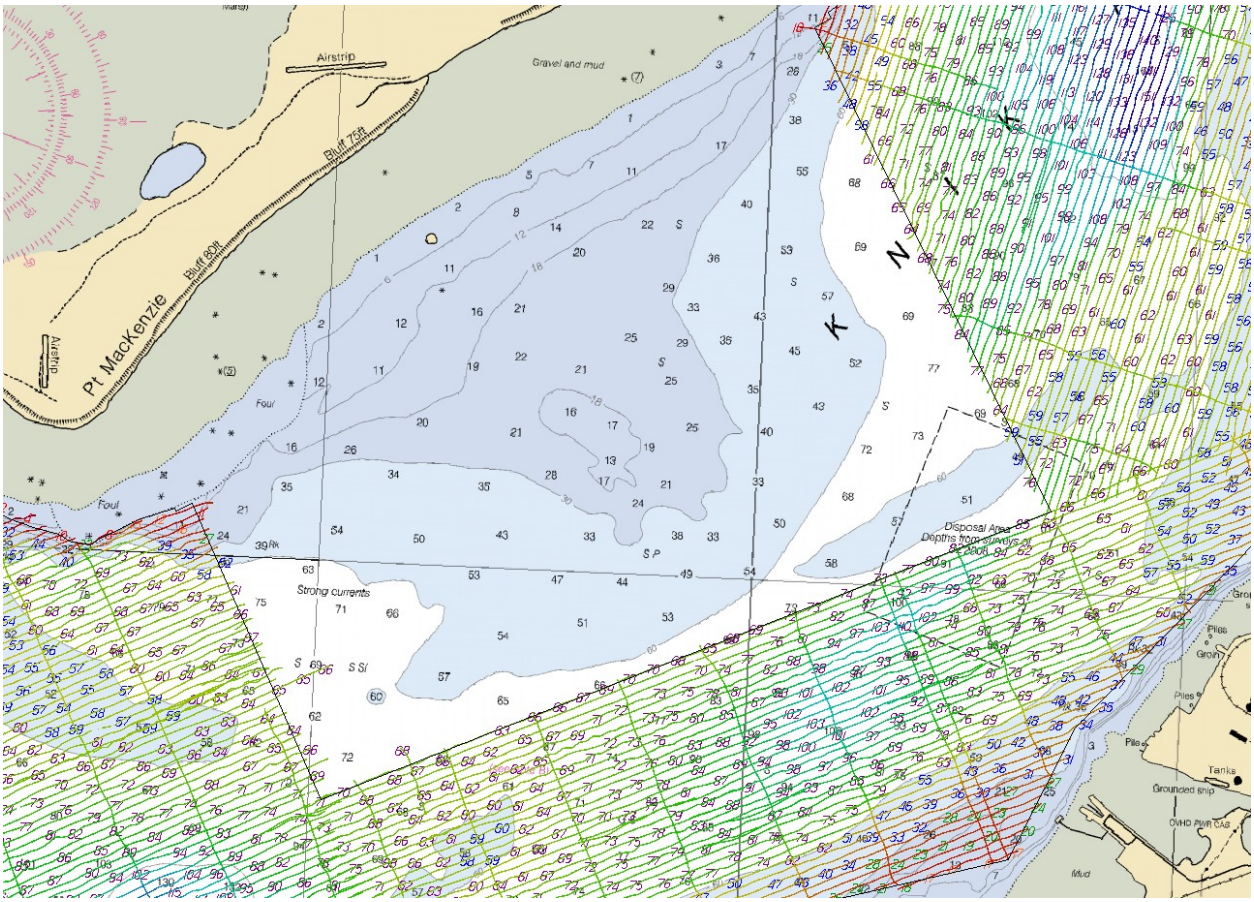

Figure 7: Point MacKenzie Shoal area, across from the Port of Anchorage. The area was surveyed in 2013 under USACE direction.

The Contractor was given a waiver for the required VBES splits that would have ensonified the rocks noted in item 3.

D.1.9 Channels

A USACE-maintained channel exists in the survey area. On chart 16665 it is denoted as having a controlling depth of "28 FEET FOR A WIDTH OF 1017 FEET JUNE 2012". The channel was actively undergoing dredging during the 2013 season, and dredging is planned to continue in 2014. It is referenced in USCG LNM 33/13, which reports a new controlling depth of 35 feet.

This survey found a least depth of 33 feet within the channel extents which is shoaler then the USACE results. However, dredging was underway during the time of this survey and the channel boundaries and depths may have subsequently changed.

It is recommended the charted controlling depth for the channel be updated according to the latest available information from the USACE from their post-dredge survey. The post-dredge survey is dated 7/16/13, which is more current than H12542.

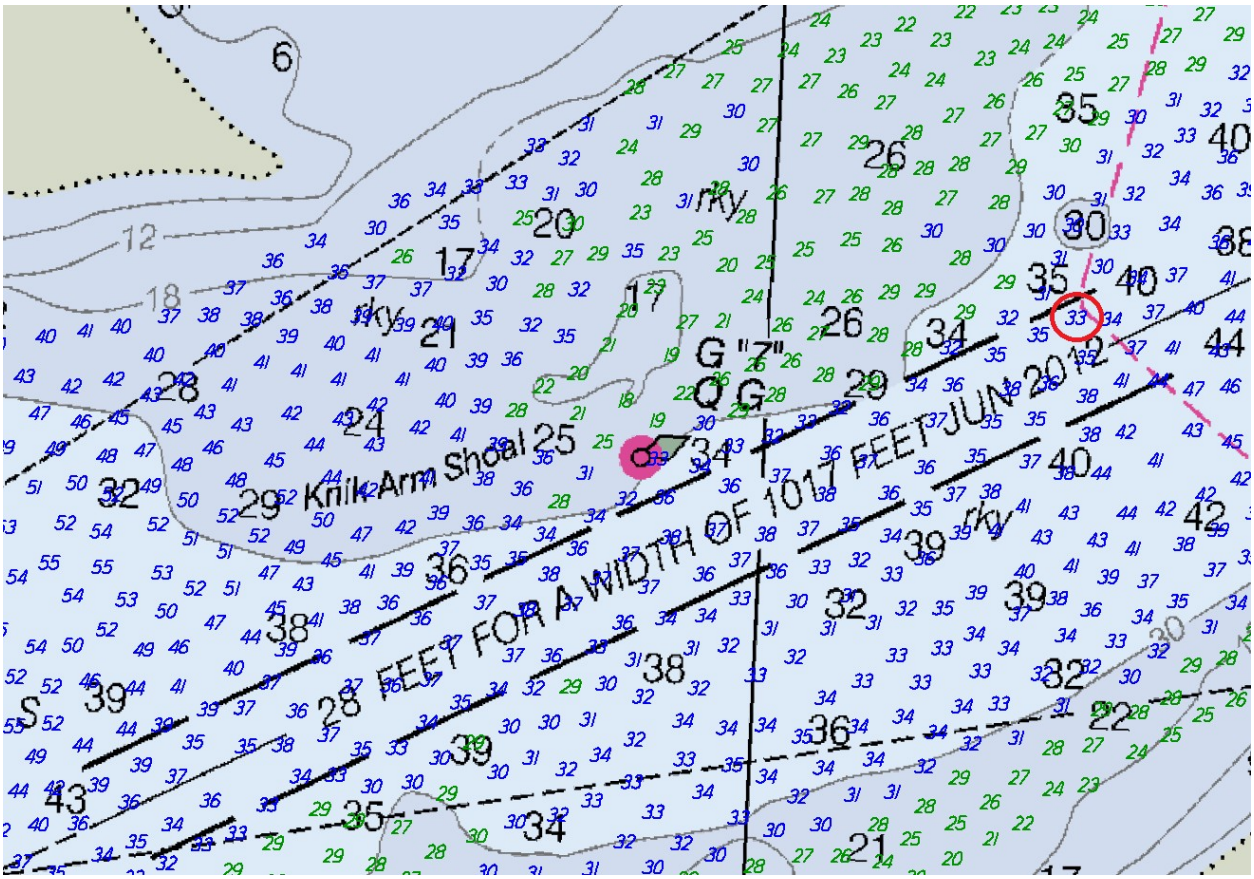

Figure 8: USACE maintained channel on chart 16665. Knik Arm Shoal is also shown. Depths from this survey are shown in blue (in feet). A least-depth of 33 feet within the charted channel is circled in red.

The USACE maintained channel is actually a safety fairway.

D.1.10 Bottom Samples

Bottom samples were not required for this survey. It is recommended that existing bottom characteristics be retained from prior surveys.

Sixty three bottom characteristics were imported from the ENC to the chart update product to be retained.

D.2 Additional Results

D.2.1 Shoreline

Shoreline verification was not required.

D.2.2 Prior Surveys

Comparison with prior surveys was not required. See Section D.1 for comparison to the existing nautical charts.

D.2.3 Aids to Navigation

No ATON investigations were specifically assigned for this project.

A total of nine ATONs either fall within or in close proximity of the survey area. All ATONs observed to be on station and serving their intended purposed. Due to daytime operations and nearly 24 hour / daylight in the summer season, not all lights could be observed.

ATON Number, Light List Number, Name, Published Light Characteristic, Published Structure Characteristic

ATONS 1-2:

1, 26455, Port Mackenzie North Dolphin Light, Continuous Quick Flashing - Yellow, On dolphin
2, 26450, Port Mackenzie South Dolphin Light, Continuous Quick Flashing - Yellow, On dolphin

Observations: The two lights were not observed due to daytime operations. However, the structures were observed with the published characteristics.

ATON 3:

3,26440, Point Woronzof Range Rear Light - 300 yards, 079 deg from front light, Fixed Green, Rectangular red dayboard with a central white stripe on multi-pile structure

Observations: The light was not observed due to daytime operations. However, the structure was observed with the published characteristics.

ATON 4:

4, 26435, Point Woronzof Range Front Light, Occulting Green 4s, Rectangular red dayboard bearing a central white stripe on single pile

Observations: Light and dayboard observed with published characteristics.

ATONS 5-9:

5, 26420, Knik Arm Shoal Lighted Buoy 7, Continuous Quick Flashing Green, Green
6, 26415, Fire Island Range Rear Light - 433 yards, 242 deg from front light, Isophase White 6s, Rectangular red dayboard bearing a central black stripe on multi-pile structure

7, 26410, Fire Island Range Front Light, Continuous Quick Flashing White, Rectangular red dayboard bearing a central black stripe on multi-pile structure
8, 26405, Race Point Light, Single Flashing White 2.5s, Diamond-shaped dayboard divided into four diamond shaped colored sectors with the sectors at the side corners white and the sectors at the top and bottom corners red
9, 26390, West Point Light, Single Flashing White 6s, Diamond-shaped dayboard divided into four diamond shaped colored sectors with the sectors at the side corners white and the sectors at the top and bottom corners red

Observations: The lights were not observed due to daytime operations. However, the structures and/or buoys were observed with the published characteristics.

D.2.4 Overhead Features

No overhead features existed within the survey area.

D.2.5 Submarine Features

Charted cable areas and (individual cable routes) intersect and exist within the survey area. These were not investigated nor was it possible to observe them in the single beam data.

Two charted dredging/construction disposal areas intersect the survey area. One (centered on 61-11-10 N, 150-08-31 W) was entirely within the survey extents while the other (centered on 61-14-06 N, 149-54-59 W) lies partially within the survey area. It is recommended their depths be updated with the 2013 data.

One blue note was added recommending to update the year of survey for the disposal area located at 61-11-09N, 150-08-32W.

D.2.6 Ferry Routes and Terminals

Ferry routes and terminals do not exist within the survey area.

D.2.7 Platforms

Platforms do not exist within the survey area.

D.2.8 Significant Features

All significant features and conditions encountered have been described previously.

D.2.9 Construction and Dredging

USACE was actively dredging in the navigation channel (centered on 61-12-03 N, 150-05-18 W) south of Knik Arm Shoal during acquisition of this survey. The dredging area is fully within the extents of this survey. Dredging is planned to continue in 2014. Refer to Section D.1.7 for a summary of survey results within the channel.

Future dredging is under consideration for Point MacKenzie Shoal (centered on 61-14-03 N, 149-56-20 W).

Construction at the Port of Anchorage (centered on 61-14-38 N, 149-53-07 W) is an ongoing, multiyear project. The USACE also actively dredges the Port to maintain the necessary under keel clearance for visiting barges and freighters.

D.2.10 New Survey Recommendations

Northern Cook Inlet is highly changeable, with the last contemporary surveys having been completed in 2008. It is recommended that adjacent areas be re-surveyed.

D.2.11 New Inset Recommendations

No new insets are recommended.

E. Approval Sheet

Field operations contributing to the completion of survey H12542 were conducted under my direct supervision with frequent personal checks of progress, integrity, and adequacy.

This report, digital data, and all other accompanying records are approved. All records are forwarded for final review.

The survey data was collected in accordance with the Statement of Work and meets or exceeds the requirements set in the 2013 NOS Hydrographic Surveys and Specifications Deliverables document. This data is adequate to supersede charted data in common areas. This survey is complete and no additional work is required with the exception of any deficiencies noted in the Descriptive Report.

Report Name	Report Date Sent
OPR-P385-KR-13 Installation and Removal Reports	2013-09-29
OPR-P385-KR-13 Coast Pilot Review	2013-11-25

Approver Name	Approver Title	Approval Date	Signature
Andrew Orthmann	TerraSond Charting Program Manager	11/26/2013	Validity unknown Andrew Orthmann 2013.11.26 11:45:50 -09'00'
Marta Krynytzky	TerraSond Lead Hydrographer	11/26/2013	Validity unknown Marta Krynytzky Date: 2013.11.26 11:24:59 -09'00'

F. Table of Acronyms

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

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

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

From: Mark Lathrop - NOAA Federal [mailto:mark.t.lathrop@noaa.gov]
Sent: Tuesday, March 19, 2013 11:42
To: Andrew Orthmann
Subject: Re: OPR-P385-KR-13 PIs

4 meters is correct.

Mark

On Tue, Mar 19, 2013 at 3:41 PM, Mark Lathrop - NOAA Federal <mark.t.lathrop@noaa.gov> wrote:
4

On Tue, Mar 19, 2013 at 3:30 PM, Andrew Orthmann <aorthmann@terrasond.com> wrote:

Thanks Mark.

What is the inshore limit of hydrography? The work instructions say none defined. Tom thinks it may be 4 meters from his discussion with you last week, is that correct?

APPROVAL PAGE

H12542

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

The following products will be sent to NGDC for archive

- H12542_DR.pdf
- Collection of depth varied resolution BAGS
- Processed survey data and records
- H12542_GeoImage.pdf

The survey evaluation and verification has been conducted according current OCS Specifications.

Digitally signed by HOLMBERG.PETER.SCOTT.1365886101
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=HOLMBERG.PETER.SCOTT.1365886101
Date: 2014.07.25 12:29:43 -07'00'

Approved:_____

Peter Holmberg
Cartographic Team Lead, Pacific Hydrographic Branch

The survey has been approved for dissemination and usage of updating NOAA's suite of nautical charts.

EVANS.BENJAMIN.K.1237217094
2014.07.25 12:54:36 -07'00'

Approved:_____

LCDR Benjamin K. Evans, NOAA
Chief, Pacific Hydrographic Branch