H10904

NOAA FORM 76-35A

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

DESCRIPTIVE REPORT

Type of Survey Hydrographic

Field No. G

Registry No. H-10904

LOCALITY

State Alaska

General Locality Cook Inlet

Sublocality West of Kenai to Karluk Reef

1999

CHIEF OF PARTY

Robert Kohut

NOAA FORM 77-28 (11-72)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTER NO.
	HYDROGRAPHIC TITLE SHEET	**H-10904**
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. **G**

State **Alaska**

General Locality **Cook Inlet**

Sublocality **West of Kenai to Karluk Reef**

Scale **1:10,000** Date of Survey **July 19-August 14, 1999**

Instructions Date **November 28, 1997*** Project No. **OPR-P385-KR**

Vessel **Sea Ducer**

Chief of Party **Robert Kohut**

Surveyed by **Terra Surveys, LLC**

Soundings taken by echo sounder,hand lead,pole **Reson 8101 Multibeam Echo Sounder**

Graphic record scaled by **N/A**

Graphic record checked by **N/A**

Evaluation by **C.J. Barry** Automated plot by **HP Design Jet 650C**

Verification by **C.J. Barry**

Soundings in **Fathoms and tenths** at **MLLW**

REMARKS: **Time in UTC. Revisions and marginal notes in black were generated during office processing. All separates are filed with the hydrographic data. As a result, page numbering may be interrupted or non-sequential.**

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

*** Amended May 17, 1999**

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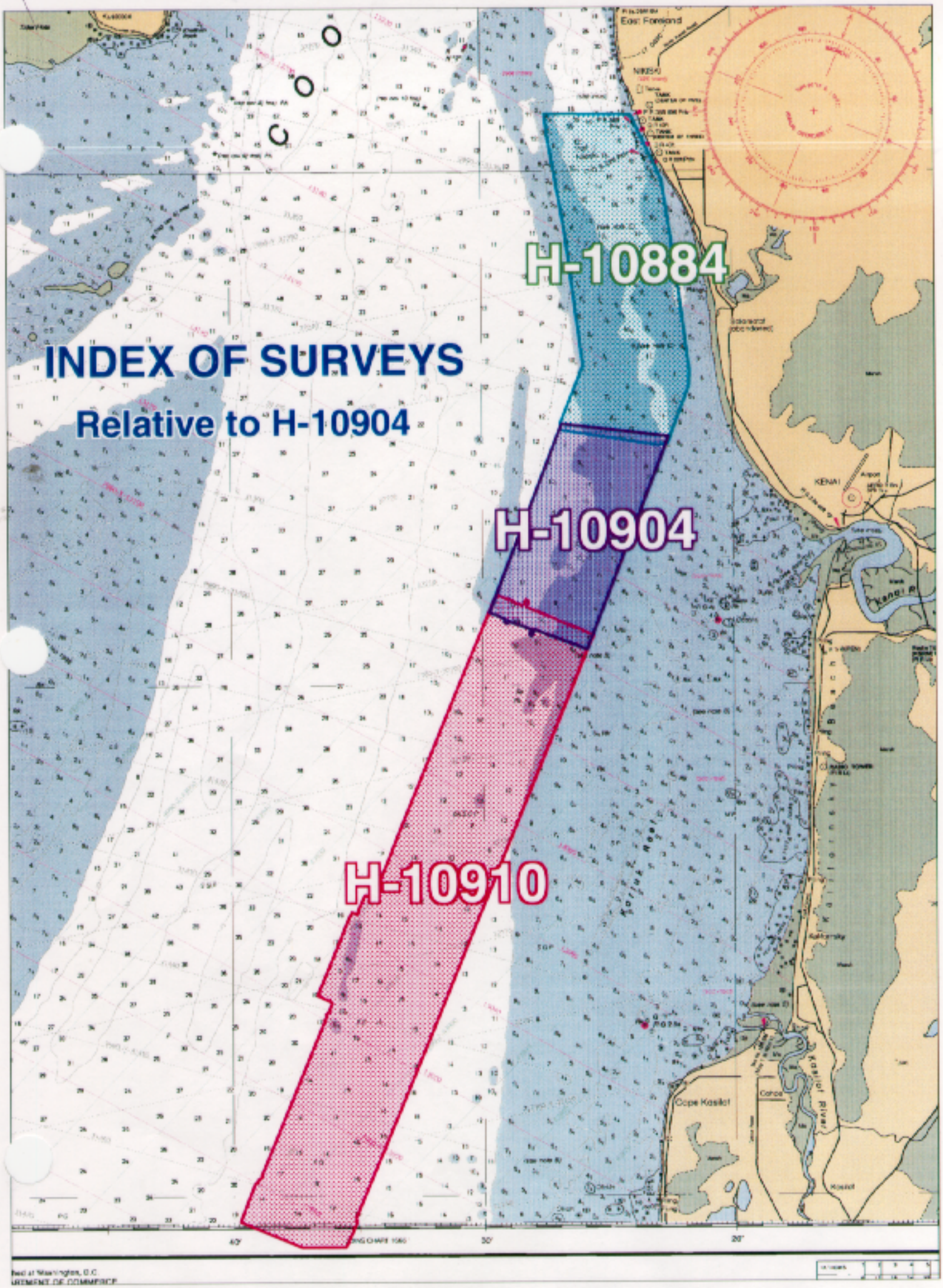
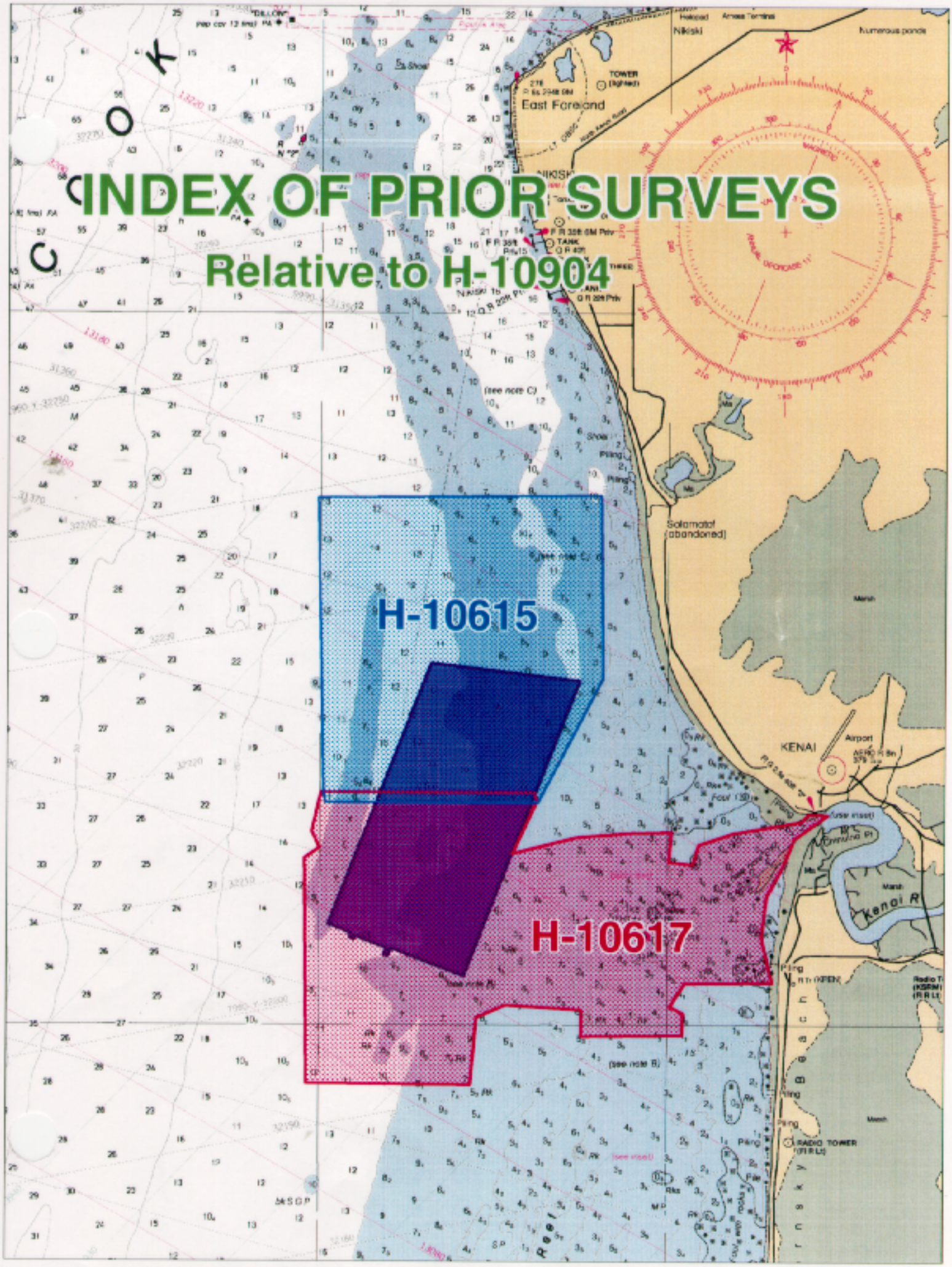
AWOIS ✓ & SURF ✓ 2-1-01 by MBH


INDEX OF SURVEYS
Relative to H-10904
H-10884
H-10904
H-10910
Cape Kasilof
KENAI


INDEX OF PRIOR SURVEYS
Relative to H-10904
H-10615
H-10617
East Foreland
Nikiski
Numerous ponds
Salamatof
(abandoned)
KENAI
Airport
Kenai R
RADIO TOWER

Terra Surveys, LLC

Chief of Party: Robert Kohut, P.L.S. and Certified Hydrographer

A. PROJECT ✓

This navigable area survey was conducted in accordance with Hydrographic Project Instructions OPR-P385-KR, west of Kenai to Karluk Reef, Cook Inlet, Alaska, dated May 12, 1999, amended on May 26, 1999. *

The purpose of this contract is to provide NOAA with modern, accurate hydrographic survey data with which to update the nautical charts of this area. Numerous obstructions and shoaling have been reported in this area. The area is south of the KPL dock which is a petroleum dock, a liquid natural gas (LNG) dock and a loading dock for a fertilizer manufacturing plant. The area is transited by oil tankers, liquid natural gas tankers, oilfield support vessels, commercial fishing boats and tenders, tug and barge contractors and oil spill response vessels.

The project area encompasses approximately 8.11 square nautical miles located near Nikiski in upper Cook Inlet. The survey covers the mostly deep water channels west of Kenai to Karluk Reef.

A shallow water, multibeam sonar system was used to locate and determine the least depth over the obstructions and shoals as well as to determine the least depths over the entire project area. Every effort was made to ensure that the survey product could be traced to and reconstructed from the raw data.

* ORIGINAL STATEMENT OF WORK DATED NOV. 28, 1997
AMENDED (TASK ORDER) MAY 17, 1999.

B. AREA SURVEYED ✓ SEE EVAL. REPORT, SEC. B.

The area surveyed (Sheet G) for H-10904 covers approximately 8.11 square nautical miles west of Kenai to Karluk reef, Alaska. The following NAD 83 latitudes and longitudes are the hydrographic survey limits:

Degrees Latitude (N)		Degrees Longitude (W)	
✓ 60.583693	60°35.02'	151.447008	151° 26.82'
✓ 60.524599	31.48'	151.493918	29.64'
✓ 60.512545	30.75'	151.430603	25.84'
✓ 60.579283	34.76'	151.377894	22.67'
✓ 60.579387	34.76'	151.378561	22.71'

The Index of Sheets shows the area surveyed for H-10904.

C. SURVEY VESSELS ✓

The ***Sea Ducer***, a 31-foot Uscola Offshore Pilot with aluminum hull, was used for all data acquisition.

The Sea Ducer 1997 Uscola Offshore Pilot	AK ID # 0691 Hull ID # UCN0317M997
Manufacturer	Uscola Boat Works Palmer , AK
L.O.A.	31 ft.
Beam	10 ft.
Draft	1.5-2.0 ft.
Power Plant	Twin 188hp AD41/DP Volvo-Penta turbo diesels with stern drives.
Data collection power source	24vdc, 12vdc from mains 110vac from 2.4 kW Trace Inverter 110vac from 5kw Northern Lights Genset
Cruise Speed	35 knots
Fuel Cap	204 gallons
Fuel consumption	13 gal/hr @ cruise
Gross tonnage	5 short tons displacement

ADDITIONAL VESSEL INFORMATION, DIAGRAMS AND PHOTOGRAPHS ARE FILED WITH THE HYDROGRAPHIC DATA.

D. Automated Data Acquisition and Processing ✓ SEE EVAL. REPORT, SEC. D

Data Collection ✓

Multibeam data collection was performed on an Intel Pentium II PC running Reson's 6042NT Multibeam Data Collection software under Windows NT 4.0. The data collection PC received Reson 8101 bathymetry via a serial interface and Reson 8101 sonar imagery via an Ethernet interface. It received motion and attitude information (heave, pitch, roll and heading) via serial interface from the Seatex Seapath 200 system. It received position information from a Trimble Ag120 DGPS receiver that was operating on correctors received from a Trimble DSM GPS receiver set at 'Unocal' for this project. The Seapath 200 received differential correctors from another Ag120 GPS receiver tuned to the U.S. Coast Guard Beacon Kenai and its position was used as a check position.

The Reson 8101 received motion information from the Seapath 200 to aid in filtering. The motion information allowed the Reson to apply filters based on minimum and maximum depths while the vessel was experiencing roll.

Coastal Oceanographics' Hypack software was utilized for navigation and line tracking as well as for the collection of quality control statistics. The Hypack software ran on an Intel Pentium II computer under Windows NT 4.0. It obtained positioning information from an Ag120 GPS receiver receiving corrections from the DGPS base installed for this project. It received motion and position data (heave, pitch, roll, heading, latitude and longitude) from the Seapath 200. The Seapath 200 received correctors from the USCG beacon at Kenai (310Khz) and was used to confirm the local base position.

Processing Overview ✓

The Reson 6042NT software collects multibeam data in its native format, a binary file with a 'SVY' extension. The first step in processing the data was to convert the 'SVY' file to a 'XTF', Extended Triton Format, for compatibility with CARIS HIPS. This was done using the Reson 6042NT software while offline. The data was then transferred with Hypack raw navigation data files off the vessel via 2.6-gigabyte Magneto-Optical (MO) disks.

The MOs were transferred daily from the vessel to the project office for processing. The data was copied to the server for storage and archived on 4mm DAT tapes. The XTF files were converted to HIPS files using HIPS' refoXTF program. All the field sheet information was entered into the project database to be used for quality control and delta draft computations. Preliminary tides were downloaded from the NOS Internet site and a tide file was prepared for use in Caris at this time.

Once converted, the lines were reviewed in HIPS 'Line' mode for defects in positioning, motion sensor data or sounding data. The positioning data was examined for jumps in position and if necessary data was rejected without interpolation. The various sensors, including azimuth, heave, pitch, roll and tide, were also checked. If necessary, data was rejected without interpolation or in the case of small isolated spikes, rejected with interpolation. Typically no rejection was required for either the positioning or for the various sensors. The soundings were then reviewed in the Hydrographic Data Cleaning

System (HDCS) editor where the user could filter or manually reject outliers. Filters used were beam quality and a roll value or angle from nadir filters. Beams of only the highest quality were accepted. If a question arose about a possible bottom feature then beams of lesser quality were reviewed. The angle filter was used and soundings outside a 140 degree sector about nadir were rejected. Line spacing was adjusted with water depth in the field to ensure three-beam overlap on adjacent lines with a 90° swath. This underestimation of swath width ensured sufficient overlap. When reviewing the soundings, the sidescan imagery obtained from the Reson 8101 was viewed in a window on the edit screen. This allowed the hydrographer to make decisions about the veracity of questionable features with the sidescan imagery to aid them.

Following adjustment for the sound velocity profile and delta draft measured in the field, the data was beam edited in HIPS 'Line' mode. Preliminary tides for the National Ocean Service (NOS) gages at Nikiski (945-5760) and Cape Kasilof (945-5711) were applied by interpolating between gages. The water level was interpolated for each gage for the time each sounding was taken and then the two water levels were used to interpolate for the position of the sounding relative to the two gages. The next step in HIPS was to 'merge' the data. In the merge step the various sensors for motion and position of the vessel were used to compute the final position and depth of the sounding.

Following merging, the data was reviewed in the HIPS 'Subset' editor for outliers. Soundings for a geographic area from multiple lines can be viewed from several directions and flagged as 'Rejected' if deemed an outlier or as 'Outstanding' if it is a feature the user desires to track. The soundings 'Rejected' in subset mode were typically single outliers. Soundings marked as 'Outstanding' are features which rose ten percent of the water depth. In the absence of sidescan information or reports of obstructions, these features are assumed to be rocks. The status of the 'Outstanding' flag is accessible from this point to the final AutoCAD drawing.

Following the 'Subset' editor, the data was exported to a binary file format developed by Terra Surveys. The data was then sorted into one meter square cells. Each cell collected information on the number of soundings in that cell, the average depth for the cell and the shoalest sounding for each cell with it's corresponding sounding ID number for later retrieval. The average depth for each square meter is exported to an ASCII file which can be read into the Caris Editor, a **G**eographic **I**nformation **S**ystem (GIS) and inspected for coverage. In the Caris Editor, the soundings are displayed and a DTM constructed to show holes in the data. Areas requiring additional coverage were outlined and fill in lines were chosen, data collected and edited as described.

Once coverage was complete for the project, the data was exported from the Caris HIPS files to a database. During the export, the angle from nadir that the sounding was taken at was determined and the athwartships footprint size was calculated. This information with all the flags from Caris HIPS are maintained in the database. After transfer to the database the soundings were tide adjusted using the same interpolation scheme described above using the Final Verified tides from the NOS gage at Nikiski (945-5760) and Cape Kasilof (945-5711). These tides were down loaded from the NOS Internet site. The tide was applied equally to all soundings within each profile. Following the tide adjustment, soundings were flagged as rejected if the footprint was deemed to large for the required

rejected if the footprint was deemed too large for the required shoal detection or the angle at which the sounding was taken was outside of the acceptable swath. The athwartships footprint was maintained at 2 meters or less down to 30 meters (MLLW) and at 10% of water depth or less (tide reduced) below 30 meters. The angle from nadir was maintained at less than 60° for most of this survey. Crossline statistics indicated that the allowable angle could be raised to 72° in water depths less than 30 meters (MLLW) and was not applicable in water depths greater than 30 meters (MLLW). These wider nadir angles were used to reaccept a limited number of soundings in a small area devoid of soundings. The accepted soundings were within expected accuracy standards and footprint size.

An average of the acceptable soundings within each square meter was then exported to the Caris Editor as a tide adjusted final data set. The cleaned cross lines were exported to the Caris Editor in their entirety. The combined data was used for cross line analysis, tide zone analysis and coverage plots.

All accepted soundings were checked for overplot removal. Deeper soundings that would overplot the shoalest soundings were then suppressed. The unsuppressed soundings were then exported to AutoCAD. The unsuppressed soundings, which had been flagged by the operators as 'Outstanding', were placed on a separate layer in AutoCAD for identification on the drawing as rocks.* All of the plotted soundings in AutoCAD contain an identification number, as well as it's beam number, profile number and line name; which allows tracing the sounding back to the database and thus back through all steps to collection. A histogram of unsuppressed soundings was generated from the database. The data was also exported to AutoCAD for trackline plots, which depict the track of the sonar head.

Quality Control ✓

The raw navigation files from Hypack were used for quality assurance. The files were processed using Terra Survey's Multibeam Suite to summarize the start and end times of lines, distance traveled, average vessel speed, minimum number of satellites and maximum HDOP encountered. The lines were then checked for the several conditions that could cause disqualification. Disqualification could be due to going too fast for the appropriate range scale causing insufficient sounding density, or inadequate GPS caused by less than 4 satellites or when the Horizontal Dilution of Precision (HDOP) was greater than 2.5.

Lines were also disqualified by the Caris HIPS operators if they were excessively noisy or had missing data due to improper filtering in the collection process.

Software Summary ✓

SeaBat 6042 Software produced by Reson was used for all multibeam data acquisition. Coastal Oceanographics Hypack was used for navigation and quality control. Caris Hips, a processing program developed by Universal System Ltd., was used for multibeam post processing and quality assurance. Terra Surveys in house programs were used for quality control, generating 'delta draft' files, tide adjustments, sounding suppression and data export.

* BASED ON THE PHB CRITERIA THAT IN ORDER TO BE DISTINGUISHED AS A SUBMERGED ROCK A SOUNDING MUST BE AT LEAST TWO FATHOMS SHOALER THAN SURROUNDING DEPTHS, ALL SOUNDINGS IDENTIFIED BY THE CONTRACTOR AS ROCKS, EXCEPT ONE, WERE RE-CLASSIFIED AS SOUNDINGS. ON THE SMOOTH SHEET, THE CONTRACTOR'S "RK" DESIGNATIONS WERE EXCESSED TO LEVEL 63 IN MICROSTATION

The following table lists software used for data supporting this survey:

Program Name	Version	Date	Usage and Dates Used
Reson/SeaBat 6042 NT	5.20 L	5/19/99	6/12/99 through completion. Multibeam data collection software
Coastal Oceanographics, Inc/Hypack	8.9	4/16/96 5/19/98	Navigation and collection of quality control and statistical data.
Tides and Currents	2.2	11/26/96	Predicted Tides
Caris Hips	4.32b	4/16/99	Multibeam Data Processing.
Caris Editor	4.31	8/26/98	Data Visualization, manipulation
Caris Tools	4.31	9/3/98	Data Manipulation, Contouring
Corpscon	5.11.01	2/2/99	Coordinate Conversion
Geocalc	4	1993	Coordinate Conversion
Trimble/DSMCHAT	3.2	94-96	Configure AgGPS120 GPS receiver
Seapath	1.02.04	10/05/99	Seapath 200 Firmware
Winzip	6.0	91-95	Compressing and transferring large data files
Trimble/Probeacon		9/12/94	PC interface for AgGPS 120
Power Desk Utilities 98	3.032	6/26/98	File management
ACAD MAP 3	3	7/14/98	Drafting
Quicksurf	5.1	6/26/97	Surface modeling, contouring
Corpscon	5.11	6/10/98	Coordinate Conversion
Wizard	5.07RF	3/4/98	Tide data down load, programming and calibration for the MicroTide tide gage
Endeco 1150OPS Endeco 1150RPT		5/23/90 2/28/91	Tide data download, programming and calibration for the Endeco tide gage
Terra Surveys HPTools		5/98 – 10/98	Inhouse program for generation of line and gps quality statistics
Microsoft SQL Server	6.5	8/19/97	Database server for storage and manipulation of sounding data.
Terra Surveys Multibeam Suite		6/98 – 11/98	Suite of programs for transfer of data from Caris HIPS to SQL Server and tide adjustment, determination of acceptable data, sounding suppression, trackline generation and export to Caris Editor.
Seatex MRC	2.53	12/3/98	PC Interface to Seatex MRU-5
Seapath Control Center	1.01.01		PC Interface to Seatex Seapath 200
Microsoft Access	97		Database Management
Microsoft Excel	97		Spreadsheet Program
Microsoft Word	97		Word Processing Software

Microsoft Visual Basic	6.0		Programming Language & Tools
Windows NT Server	Server 4.0		Operating System
Service Pack	4		Operating System
MS-DOS	6.22		Operating System
TEXTPAD32	V3.2.2		Text Viewing & Editing
RCMCONF	V1.33	1997	Radio Modem Config Program
SVP Process	1.00	5/24/99	SVP Program/Data Collection
Windows NT Workstation	4.0		Operating System

E. SONAR EQUIPMENT (Towed sidescan) ✓

No SONAR equipment (towed sidescan) was used on this survey.

F. SOUNDING EQUIPMENT ✓

The survey vessel, *Sea Ducer* was equipped with a Reson SeaBat 8101 multibeam echo sounder system. The system's two main components consist of a surface processor (serial 16118) and transducer head (serial 089604).

Soundings were recorded in meters and corrected for the speed of sound through water from multiple daily measurements of the water column profile (see Section G). Depths encountered in the survey range from 12.9 meters/ 7.1 fathoms (Latitude 60.567879 ° N, Longitude 151.402258 ° W), to 26.28 meters/ 14.4 fathoms (Latitude 60.575022 ° N, Longitude 151.451649° W), at MLLW based on verified tide data from the Nikiski Gage (945-5760).

Metric leadlines were used for depth comparison with the depth sounder. Leadlines were constructed from metric fiberglass survey tapes with 24 or 36 ounce lead balls attached such that the bottom of the ball was at the zero mark. Leadline comparisons were conducted a minimum of once weekly by simultaneously reading the draft marks on the sonar head pole, the leadline depth (typically 3-6 meters) and the depth from the 8101. The comparison was made with the formula:

Error = Leadline Depth – Draft – 8101 Depth

G. Corrections to Soundings ✓

The following methods were used to determine, evaluate and apply corrections to soundings.

Speed of sound through water ✓

The velocity of sound through water was determined by a minimum of two casts per day with the following two instruments.

Velocimeter (sound velocity, temperature and depth profiler)	*SVPlus* (standard instrument with 50 dBar pressure sensor and 350 ms temperature sensor)
Manufacturer	Applied Microsystems Ltd. Sydney, British Columbia, Canada
Serial number	**3279**
Pressure Calibration Temperature Calibration Distilled Water Sound Calibration Voltage Calibration	4/01/99 by Applied Microsystems Ltd. 4/01/99 by Applied Microsystems Ltd. 4/01/99 by Applied Microsystems Ltd. 4/01/99 by Applied Microsystems Ltd.

Velocimeter (sound velocity, temperature and depth profiler)	*SVPlus* (standard instrument with 50 dBar pressure sensor and 350 ms temperature sensor)
Manufacturer	Applied Microsystems Ltd. Sydney, British Columbia, Canada
Serial number	**3259**
Pressure Calibration Temperature Calibration Distilled Water Sound Calibration Battery Calibration	3/24/99 by Applied Microsystems Ltd. 3/24/99 by Applied Microsystems Ltd. 3/24/99 by Applied Microsystems Ltd. 3/24/99 by Applied Microsystems Ltd.

The following instrument was operated at the surface.

Velocimeter (sound velocity, temperature and depth profiler)	*Smart SV&P* (standard instrument with 50 dBar pressure sensor)
Manufacturer	Applied Microsystems Ltd. Sydney, British Columbia, Canada
Serial number	**4177**
Certificate of Authenticity	6/12/98 by Applied Microsystems Ltd.

Copies of the manufacturer's calibration reports are included in Appendix G.

The velocimeters were programmed for a sample rate of 1 sample per second during casts, and 1 sample per minute for the continuous monitoring of the work area. Terra Surveys' SVP programs and downloads the velocimeters for each cast and provided graphs and statistics on cast comparisons both on the vessel and also in the office. Dual casts were done a minimum of once a day for comparison between velocimeters and typically three times a day. During survey operations, the *Smart SV&P* measured the sound velocity once per minute and Terra Surveys' SVP program alerted the user if the sound velocity varied more than a user selected amount indicating that another cast should be taken. The casts were taken as deep as possible and geographically distributed to satisfy the 95% anticipated water depth and represent local and diurnal variability.

Processing Procedures ✓

The velocimeter raw pressure data was converted to depths in meters in a data base using Foronoff and Saunder's formula as provided by Applied Microsytems Ltd. The formula is as follows:

P=pressure in decibars

x=sin(latitude/57.29578)

X=x^2

Gr=9.780318*(1+(0.0052788+0.0000236*X)*X+0.000001029*X

D=(((-0.00000000000000182*P+0.0000000002279)*P+9.72659)*P

Depth=D/Gr

The data was thinned to one velocity per meter of depth and converted to a CARIS format where the profile corrections were applied to the soundings. CARIS applies the most recent velocity cast in the file so the newest correctors were always being used. The following Sound Velocity Profile Summary* shows the casts, their positions and the maximum depths of each cast. See Appendix J for listings of each cast.

*FILED WITH THE HYDROGRAPHIC DATA

Instrument Corrections ✓

No special instrument corrections were made.

Corrections determined from bar checks and vertical casts. ✓

Metric lead lines were used for depth comparison with the depth sounder. Lead lines were constructed from metric fiberglass survey tapes with 24 or 36-ounce lead balls attached such that the bottom of the ball was at the zero mark. Lead line comparisons were conducted a minimum of once weekly by simultaneously reading the draft marks on the sonar head pole, the lead line depth (typically 3-6 meters) and the depth from the 8101. The comparison was made with the formula:

Error = Lead line Depth – Draft – 8101 Depth

The lead lines are summarized in the table on the following page.

* FILED WITH THE HYDROGRAPHIC DATA

Static Draft ✓

A metric adhesive rod face was adhered to the sides of the hull and the multibeam pole for daily readings of the vessel draft. The tapes were calibrated to read the depth of the sonar head. The draft was recorded twice daily. The draft readings were incorporated into a database, which included the date and time, line name, and engine RPM. From the database and the measured offsets for the boat, the distance from the boat's reference point to the water line was computed for every line, this was then adjusted by the expected settlement computed using the logged engine RPM and compiled into a delta draft file used by CARIS.

Settlement ✓

Measurements for the Squat and Settlement were conducted near Salamatof in the work area, using **O**n **T**he **F**ly **R**eal **T**ime **K**inematic (OTF-RTK) GPS survey procedures. The measurements were conducted with two Trimble 7400MSi's on the *Sea Ducer* and a Trimble 4000SSi as a base station. Pacific Crest Radio modems were used to transmit the correctors to the vessel.

Two Trimble 7400MSi antennas were installed on the Sea Ducer. One antenna was installed near the bow and one on the aft swim deck, both on the centerline of the vessel. The relationship of these antennas to the vessel baseline was surveyed and recorded.

Three files were collected during each test; one ASCII file was recorded for each of the two Kinematic GPS Receivers. These files contained the National Marine Electronics Association (NMEA) "GGK" string, a GPS output string which contains the time, position, ellipsoid height, HDOP and mode. The third file was collected using Coastal Hypack which logged the attitude information from the Seapath 200. The *Sea Ducer's* attitude and elevations were recorded at rest and at various RPM settings to determine vessel dynamics. The static data for the vessel at rest was observed as a baseline and used to correct for tide changes with a starting and ending tide. The results of the measurements were compiled in a spreadsheet. A graph depicting vessel settlement and speed at various RPM settings is shown on the following page.* The vessel dynamics appear to react, as any small launch would be expected. At low RPMs (speed), the aft lowers, the bow rises, and the vessel settles into the water. As the RPM is increased the settlement increases to a point where the hull begins to plane. At the upper end of the useable survey speeds (3400 RPM) the vessels reference point is actually 6 cm above its elevation at rest.

The daily draft readings and engine RPM values were recorded on the written line notes. These values were then entered into the Project Control Database on a daily basis and used to generate the delta draft file for 'CARIS'.

* FILED WITH THE HYDROGRAPHIC DATA

Heave, Roll and Pitch ✓

The Seatex Seapath 200 sensor system was used to determine heave, roll and pitch as well as azimuth and position.

Manufacturer :	Seatex
Model :	Seapath 200 m320-00
Seapath Serial number:	0299
Motion Reference Unit:	MRU-5
MRU Serial number:	299cus
Manufacturers stated accuracy:	
Heading:	0.05° 1σ (4 meter baseline)
Roll and Pitch:	0.05° 1σ
Heave:	0.05 meters 1σ
Position Accuracy:	2 meters 2σ

Tide Correctors ✓

In accordance with section 6.1 of the statement of work, the NOS tide station at Nikiski, Alaska (945-5760) and Cape Kasilof (945-5711) were used as the source for the MLLW datum for this project. No supplemental gauges were installed. The unverified (preliminary) 6-minute data was downloaded from NOS database via the Internet and applied during the CARIS post processing routine. A height corrector was applied to the preliminary data to reference tides to MLLW rather then station datum, as the data was provided. Tides were interpolated between the two gages for each sounding during adjustment. The tide each gage at the time each sounding was taken was determined and then the two water levels were used to interpolate a tide based on the relative positions of the two gages and the sounding.

Verified 6-minute tides were acquired from NOS after the survey was completed. The verified tide data was downloaded from the Ocean Products and Services Division (OPSD) World Wide Web site (http://www.opsd.nos.noaa.gov). The same correction procedure described above is used again during transfer of the soundings from CARIS to the sounding database. After determining the tide for each profile, the associated soundings were adjusted for the final tide.

H. Control Stations ✓

The horizontal control datum for this project is North American Datum of 1983 (NAD 83). All software, comparisons of junctions and prior surveys referenced NAD 83.

All data provided in NAD 27 was translated to NAD 83. The National Ocean Service Automated Wreck and Obstruction Information System (AWOIS) data was converted from NAD 27 to NAD 83 with Corpscon coordinate conversion program.

A control survey was performed to establish coordinates for a station set named UNOCAL. This station was used to send differential correctors to the *Sea Ducer* survey vessel during their survey of Sheets of F and G. Along with UNOCAL the United States Coast Guard (USCG) DGPS Beacon at Kenai was used during hydrographic operations for horizontal positions and confidence checks.

The NGS second order station NIK was used as a DGPS performance check site. NAD 83 Geographic Coordinates for these horizontal control stations are found in Appendix C. * A summary of the control survey follows.

GPS Processing for control station UNOCAL ✓

Purpose: The purpose of this survey and processing was to establish a coordinate for the station named UNOCAL set by Terra Surveys, LLC. This station was used to send differential correctors to the *Sea Ducer* survey vessel during their survey of Sheets of F and G.

Procedure: The survey was performed on May 27, 1999 and involved the observation of four different points. Two of the stations (NIKI USCG A and T 81 RESET) observed are first order NGS control monuments. Station NIK is a second order monument and was observed as a check. Data sheets for these control points can be found in Appendix C of this report or on the worldwide web at the following URL www.ngs.noaa.gov . UNOCAL was the fourth station observed.

Processing: Processing and adjustment of the data was performed using Trimble's GPSurvey version 2.35a. All data acquired in the survey was loaded and processed with the exception of NIKIA-3.dat. The NIKIA-3.dat file represents an observation of only 20 minutes and the surveyor specifies not use it in his notes.

* FILED WITH THE HYDROGRAPHIC DATA

Adjustment: The adjustment was performed in two stages. The first stage was a minimally constrained adjustment of NIKI USCG A, T81 RESET, and UNOCAL. The published coordinate of NIKI USCG A was held fixed, and the adjustment was performed in order to obtain an adjusted coordinate on T 81 RESET. A fully constrained adjustment using all four stations was performed next. NIKI USCG A's published coordinate and T 81 RESET's adjusted value were held fixed. This process returned a final coordinate value for UNOCAL. Results are displayed in the following table.

COORDINATE ADJUSTMENT SUMMARY

NETWORK = Nikiski_Bas

TIME = Thu Sep 23 15:58:39 1999

Datum = NAD-83

Coordinate System = Geographic

Zone = Global

Network Adjustment Constraints:

2 fixed coordinates in y

2 fixed coordinates in x

Name	Latitude	Longitude	Status
UNOCAL	60° 40' 22.350756"	151° 23' 01.069064"	Float
NIK	60° 40' 58.634420"	151° 23' 57.232039"	Float
NIKI USCGS A	60° 40' 26.187010"	151° 20' 53.609190"	Fixed
T81RESET	60° 34' 05.601845"	151° 15' 00.152199"	Fixed

HORIZONTAL CONTROL SUPPORTING DOCUMENTS FILED WITH THE HYDROGRAPHIC DATA

I. Hydrographic Position Control ✓SEE EVAL. REPORT, SEC. I

Position Accuracy ✓

Differential Global Positioning System (DGPS) provided the basis of hydrographic positions throughout the survey. The total horizontal positional error falls within 10 meters at the 95% confidence level for all features in this project. A fixed-point DGPS Performance Check was performed to confirm this accuracy standard and a graphical analysis of the check is included in Appendix H.

In addition to the accuracy of the DGPS system, the accuracy of the sounding position depends on the following:

Characteristics of the multibeam system
Depth of water
Accuracy of heave, pitch, roll, and heading measurements
Accuracy that latencies are accounted for and applied
Accuracy and reliability of the of Sound Velocity Profile (SVP)

Position Control ✓

Differential GPS (DGPS) provided hydrographic position control throughout this survey. The following stations were used for project control:

Reference station	NGS PID	CORS ID	USCG DGPS Beacon Frequency	Horizontal Order
UNOCAL	-	-	-	-
Kenai 1 CORS L1 Phase Center	**AB6390**	**Kenai_19960131**	**310 kHz**	**CORS**
NIK	**TT0543**	-	-	**SECOND**

A local Differential Global Positioning System (DGPS) station named UNOCAL was established and used as primary horizontal positioning. Along with UNOCAL the United States Coast Guard (USCG) DGPS Beacon at Kenai was used during hydrographic operations for horizontal positions and confidence checks. Control station "NIK" was used as a DGPS performance check site.

DGPS Performance Check ✓

The National Geodetic Service (NGS) station "NIK" was used as a fixed-point DGPS performance check site during a 24 hour observation period. The local station UNOCAL and USCG Kenai DGPS beacon was checked against the fixed position of "NIK". A Trimble Ag120 DGPS receiver, capable of receiving beacon correctors in the **R**adio **T**echnical **C**ommission **M**arine (RTCM) format was placed on control station "NIK". It computed a differentially corrected position at a rate of one per second and output a **N**ational **M**arine **E**lectronics **A**ssociation (NMEA 0183) "GGA" message once per second to a logging computer. The computed position was compared to the control point's published position. A graphical analysis of this data is found in Appendix H.

The local DGPS station UNOCAL along with Kenai USCG differential navigation beacon were used for horizontal survey positions and confidence checks during hydrographic operations. A confidence check was performed by simultaneously receiving positions on the vessel from the two different stations. When UNOCAL correctors were used for primary positioning, Kenai was used as a confidence check. Data supporting the confidence checks and the positioning criteria can be found in Appendix H.

Positioning Equipment ✓

The following GPS equipment was used:

Equipment Location	Type of Receiver/Antenna	Receiver serial No.	Compact Dome Antenna serial No.
UNOCAL	Ag120/Trimble	0220062265	0220061904
Aft	SEATEX/Trimble	Seapath-0361	0220125667
Kenai	Ag120/Trimble	0220058481	0220061841
Forward	SEATEX/Trimble	Seapath-0361	0220157019

Refer to diagrams included in Section C (Vessels) for the instrument locations on the *Sea Ducer.* *

HDOP spikes due to atmospheric conditions or satellite constellation configurations were rare. Spikes that did occur were caught either in the field and no further data was collected or by the quality control procedures in the office using the recorded data. There were no unusual atmospheric conditions that affected data quality. The only malfunctions involving positioning equipment were the result of power outages. Surveying would continue when power was restored.

Systematic errors were resolved during pre-survey testing with configuration modifications to the AgGPS120, Reson, and Seatex Seapath 200 systems until results proved reasonable. Detailed configuration settings are listed in Appendix G.*

Prior to field season, all sensor locations were established and a precise conventional survey of the vessel was performed utilizing a Theodolite / EDM and steel chain. From this, sensor offsets, stationing and elevations were determined and applied to the appropriate sensor or processing stage. The origin point (RP) of the vessel was called CL3 and the position of the multibeam sonar transducer was called Seabat 8101.

* FILED WITH THE HYDROGRAPHIC DATA

J. SHORELINE ✓

Not applicable

K. Crosslines ✓

Following reduction of the sounding data a DTM was created in the Caris Editor. First the soundings within the database that had not been rejected either in editing or in the database due to footprint size, angle or beam number were gridded on a 1 meter interval. Gridding involved extracting and averaging soundings within each 1 meter by 1 meter area and averaging the depths. A record was then output with the average depth and the coordinates for the center of the cell. This set of records comprised 28,577,838 points and was imported to the Caris Editor. A regular DTM was created using a 2 meter cell size and a radius of 3 meters. Each cell within the regular DTM was a weighted average of the soundings within a 3 meter radius of the cell center. Weighting within the radius was based on the distance from the center of the cell with closer soundings given higher weights. After a DTM was made each crossline was compared to the DTM two ways. The accepted soundings (not rejected in editing) were compared by beam number and by angle.

An artifact in the swath was found in parts of the data where the swath appeared to be "cupped". When this appeared the outer beams of the swath were lower than the center. The source of the "cupping" was not determined although it could be related to either bottom material type or power and gain settings of the Reson 8101 sounder. The "cupping" did not degrade the data used for coverage and the smooth sheet to the degree that the data became unacceptable.

The accuracy required for this survey was that 90% of the soundings used have an error of 0.3 meters or 1% of water depth whichever is greater. An equivalent error budget is allowed for water level corrections for a total error budget of 0.6 meters or 2%, whichever is greater. The table below summarizes the crossline statistics. The columns labeled 90% are either the largest angle or outboard beam numbers which had 90% or greater compliance with the required accuracy. The statistics are summarized on the next page. *

Refer to the report "Crosslines" for the statistics found in this process. The file naming indicates whether the data was accepted by angle or beam, followed by the line name.

Examples are:

ana164053 This file name is for line 164053 and uses data accepted by angle.

bma164053 This file name is for line 164053 and uses data accepted by beam number

For data organized by angle, user number 1 contains soundings with an angle between 0° and 1°, user number 2 has soundings with an angle between 1° and 2° and so on.

For data organized by beam, the user number equals the Reson 8101 beam number.

*FILED WITH THE HYDROGRAPHIC DATA

L. Junctions ✓ SEE EVAL. REPORT, SEC. L

Survey H-10904 was compared with survey H-10833, a 1:10,000 scale survey covering the area immediately to the north. Agreement between the surveys was very good with the majority of the soundings agreeing within 0.2 fathoms. No adjustment or reconciliation is necessary. DO NOT CONCUR

SURVEY H-10904 JUNCTIONS WITH H-10884 TO THE NORTH. SURVEY H-10833 (1998), 1:10,000, COVERS THE AREA NORTH AND WEST OF H-10819, WEST OF EAST FORELAND, APPROXIMATELY 15 NM NORTH OF H-10904.

M. Comparison with Prior Surveys ✓ SEE EVAL. REPORT, SEC. M

Comparison with prior surveys was not required under this contract. See Section N for comparison to the nautical chart.

N. Comparison with the Chart ✓ SEE EVAL. REPORT, SEC. O

This survey was compared in Autocad Map to the following charts:

Chart	Scale	Edition	Date
16662	1:100,000	4th	August 31, 1996

General agreement between the chart and this survey was good although some changes in the edges of the shoal areas were detected. CONCUR This survey also found a few rocks not noted on the chart.* This is probably the result of the high sounding density of this survey. CONCUR One area within the channel which had a 10 fathom contour and ~~soundings in the 9 fathom~~ A CHARTED 9 FM 5FT SNDG ~~range~~ was found to be 10 to 11 fathoms deep with the exception of one rock at 9.7 (9.5 CORRECTED) fathoms.** DO NOT CONCUR

H-10904 Fathoms	Latitude				Longitude				Comment On Agreement With Chart
10.0	60°	31'	12.932"	N	151°	26'	53.851"	W	Well into shallow side of 10 fathom curve
10.3	60°	31'	33.984"	N	151°	26'	41.852"	W	Inside 10 fathom curve
10.0	60°	32'	12.953"	N	151°	25'	59.414"	W	Inside 10 fathom curve
10.0	60°	32'	50.186"	N	151°	25'	41.581"	W	Well into shallow side of 10 fathom curve
10.4	60°	34'	24.494"	N	151°	25'	31.491"	W	Inside 10 fathom curve

* SEE NOTE AT BOTTOM OF PAGE 20.

** ROCK RECLASSIFIED AS SOUNDING. LOCATION: LAT. 60°32'22.5"N LONG. 151° 27'07.0"W

** TWO OTHER SOUNDINGS, EACH 9.9 METERS, ONE LOCATED 300 METERS NORTH OF THE 9.5 METER SOUNDING AND THE OTHER 150 METERS SOUTH, DEFINE THE NEW 10 FM CONTOUR ON CHART 16662.

O. Not Used by Contractor ✓

P. Aids to Navigation ✓

There were no Aids to Navigation found in this survey.

Q. Statistics ✓

The following list of statistics applies to surveying performed from the *Sea Ducer*, the only vessel used on this survey.

Lineal Nautical Miles of Sounding Lines (Shallow Water Multibeam)	516.71
Lineal Nautical Miles of Side Scan Sonar	0
Square Nautical Miles (100% Shallow Water Multibeam Coverage)	8.11
Days of data acquisition	15
Total number of soundings	138,842,579
Number of selected soundings on preliminary smooth sheet	12,172
Number of detached positions	0
Number of bottom samples	22
Number of velocity casts	66
Number of Horizontal Control Stations Occupied / Established	3/1
Number of tide stations installed	0

R. Miscellaneous ✓

This survey found the general location and depths over the shoal to be very similar to the chart. The contour smooth sheet soundings were analyzed for the number of soundings representing each beam on the Reson 8101 and are included below. *

* FILED WITH THE HYDROGRAPHIC DATA

S. Recommendations ✓

We are unaware of any planned activities involving construction or dredging within or adjacent to this area.

T. Referral to Reports ✓

NOAA PROJECT OPR-P385-KR

H-10904

Terra Surveys, LLC

- **CROSSLINE REPORTS, 1999**
- **LINE LOGS AND LINE STATISTICS, JD 200-226, 1999**
- **SOUND VELOCITY PROFILE DATA**

TERRA SURVEYS LLC
Terrestrial and Sea Floor Mapping

LETTER OF APPROVAL

REGISTRY NO. H-10904

This report and the accompanying smooth sheet are respectfully submitted.

Field operations contributing to the accomplishment of survey H-10904 were conducted under my direct supervision with frequent checks of progress and adequacy. This report and smooth sheets have been closely reviewed and are considered complete and adequate as per the Statement of Work.

Thomas S. Newman
Hydrographer
Terra Surveys, LLC
July 17th, 2000

1930 South Whiting Circle - P.O. Box 1549 - Palmer, Alaska 99645-1549 - Phone: (907) 745-7215 - Fax: (907) 745-7273 - Email: terra@terra-surveys.com - Web Site: www.terra-surveys.com

Tide Notes

The field data was corrected with the preliminary tide data from the NOS Nikiski gage (945-5760) obtained from the NOS Internet site. The preliminary data was adjusted using an offset. The offset was obtained from a note left on the Internet site for users of the Nikiski gage. During the initial editing soundings were adjusted for tide in Caris with zoned preliminary tide data.

The final tide data was obtained from the NOS internet site with the updated datum created by NOS' NWLON in 1998. Tidal zoning was later determined to be inadequate and verified tides from Nikiski (945-5760) and Cape Kasilof (945-5711) were both used to interpolate the water level for the soundings. The water level was interpolated for each gage for the time each sounding was taken and then the two water levels were used to interpolate for the position of the sounding relative to the two gages.

Tidal Zoning

The following tidal zoning was provided by NOS. This tidal zoning was compared to a Microtide bottom gage deployed in zone 461. Neither the Microtide gage nor the zoning was used to correct the soundings for this project.

Note: For time corrections, a negative (-) time correction indicates that the time of tide in that zone is earlier than (before) the predicted tides at the reference station, whereas, a positive (+) time correction indicates that the time of tide in that zone is later than (after) the predicted tides at the reference station. For height corrections, the water level heights **relative to MLLW** at the reference station are multiplied by the range ratio to estimate the water level heights relative to MLLW in the applicable zone.

```
*
* - predicted tidal zoning
*
*  tc - time corrector in minutes (- time of tide is before reference,
+ time after)
*  rr - range ratio
*
*  relative to MLLW


zone ck461 tc=-24 rr=1.00
 n 60d36.01m, w 151d25.27m
 n 60d31.6m,  w 151d24.91m
 n 60d30.83m, w 151d20.30m
 n 60d31.98m, w 151d20.15m
 n 60d33.38m, w 151d19.73m
 n 60d34.15m, w 151d18.88m
 n 60d35.53m, w 151d20.08m
 n 60d36.01m, w 151d25.27m
```

Adequacy of Zoning

Analysis of cross lines through the survey area shows that the preliminary tidal zoning was inadequate.

A Microtide pressure gage was deployed twice for approximately 30 hours per deployment to perform a check on the adequacy of the zoning. This data was not used for data reduction. Data was successfully obtained from the gage in the first deployment but not the second. The gage had taken on water internally and had to be returned to the factory for repair. The first deployment occurred in Zone 461 which is at the southern end of this sheet. The data was adjusted for atmospheric pressure using a barometer which recorded in Kenai and then compared to the NOAA preliminary tidal data for both Nikiski (945-5760) and also Cape Kasilof (945-5711). Cape Kasilof had been set for use on a subsequent sheet but the tide series overlapped the data obtained from the bottom gage.

The Microtide gage was not deployed for long enough to adequately determine a datum for the area of the deployment but was instructional in the analysis of the adequacy of zoning. A graph on the next page shows a comparison between the Microtide gage, tides from Nikiski with the zoning constants for zone 461 applied, and tides interpolated between Nikiski and Kasilof. The interpolated tides were the result of taking the instantaneous tides at both stations and interpolating between them based on the relative locations of the two NOS tide stations and the Microtide gage.

The graph contains three tide curves. The curves for the Microtide gage and the tides interpolated between Nikiski and Cape Kasilof matched best for amplitude and phase. The curve for Nikiski which had been adjusted for zone 461 underestimated the amplitude and the phase did not match as well.

Tide Adjustment

For tide adjustment data from both Nikiski (945-5760) and also Cape Kasilof (945-5711) was used. For the time of each sounding the tide was determined at each gage and then the relative positions of the two gages and the soundings were used for interpolation.

NOAA FORM 76-155
(11-72)

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

GEOGRAPHIC NAMES

SURVEY NUMBER

H-10904

Name on Survey	A ON CHART NO. 16662	B ON PREVIOUS SURVEY NO.	C ON U.S. QUADRANGLE MAPS	D FROM LOCAL INFORMATION	E ON LOCAL MAPS	F P.O. GUIDE OR MAP	G RAND MCNALLY ATLAS	H U.S. LIGHT LIST	K	
ALASKA (title)	X		X							1
COOK INLET	X		X							2
KARLUK REEF (title)	X		X							3
KENAI (title)	X		X							4
										5
										6
										7
										8
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										23
										24
										25

[redacted]

Leonard J. Pomeroy

NOV 14 2000

NOAA FORM 76-155 SUPERSEDES C&GS 197

NOAA FORM 77-27(H)
(9-83)

U.S. DEPARTMENT OF COMMERCE

HYDROGRAPHIC SURVEY STATISTICS

REGISTRY NUMBER: H-10904

RECORDS ACCOMPANYING SURVEY: To be completed when survey is processed.

RECORD DESCRIPTION	AMOUNT	RECORD DESCRIPTION	AMOUNT
)OTH SHEET	1	SMOOTH OVERLAYS: POS., ARC, EXCESS	N/A
DESCRIPTIVE REPORT	1	FIELD SHEETS AND OTHER OVERLAYS	N/A

DESCRIPTION	DEPTH/POS RECORDS	HORIZ. CONT. RECORDS	SONAR-GRAMS	PRINTOUTS	ABSTRACTS/ SOURCE DOCUMENTS	
ACCORDION FILES	1					
ENVELOPES						
VOLUMES						
CAHIERS						
BOXES				1		

SHORELINE DATA

SHORELINE MAPS (List):	N/A
PHOTOBATHYMETRIC MAPS (List):	N/A
NOTES TO THE HYDROGRAPHER (List):	N/A
SPECIAL REPORTS (List):	N/A
NAUTICAL CHARTS (List):	Chart 16662, 5th Ed., July 12, 1997

OFFICE PROCESSING ACTIVITIES

The following statistics will be submitted with the cartographer's report on the survey

PROCESSING ACTIVITY	AMOUNTS VERIFICATION	AMOUNTS EVALUATION	AMOUNTS TOTALS
POSITIONS ON SHEET			
POSITIONS REVISED			
)DINGS REVISED			
CONTROL STATIONS REVISED			

	TIME-HOURS VERIFICATION	TIME-HOURS EVALUATION	TIME-HOURS TOTALS
PRE-PROCESSING EXAMINATION	35.0		35.0
VERIFICATION OF CONTROL			
VERIFICATION OF POSITIONS			
VERIFICATION OF SOUNDINGS			
VERIFICATION OF JUNCTIONS			
APPLICATION OF PHOTOBATHYMETRY			
SHORELINE APPLICATION/VERIFICATION			
COMPILATION OF SMOOTH SHEET	36.0		36.0
COMPARISON WITH PRIOR SURVEYS AND CHARTS			
EVALUATION OF SIDE SCAN SONAR RECORDS			
EVALUATION OF WIRE DRAGS AND SWEEPS			
EVALUATION REPORT		74.0	74.0
GEOGRAPHIC NAMES			
OTHER* (Chart Compilation)		28.0	28.0
*USE OTHER SIDE OF FORM FOR REMARKS — TOTALS	71.0	102.0	173.0

Pre-processing Examination by G.Nelson	*Beginning Date* May 1,2000	*Ending Date* May 25,2000
Verification of Field Data by .Barry	*Time (Hours)* 36.0	*Ending Date* Oct.12,2000
ation Check by ~~.Hill~~ R.DAVIES	*Time (Hours)* 2	*Ending Date* 12-19-00
Evaluation and Analysis by C.Barry	*Time (Hours)* 74.0	*Ending Date* Oct.19,2000
Inspection by D.~~Hill~~ R.DAVIES	*Time (Hours)* 4	*Ending Date* 12-19-00

☆ U.S. GOVT. PRINTING OFFICE 1983: 764-006/6061

EVALUATION REPORT

H-10904

A. PROJECT

Survey H-10904 was conducted under contract 50-DGNC-8-90021, awarded on April 9, 1998. A Statement of Work (SOW), dated November 28, 1997, contains specific requirements. The purpose of the provisions of this contract are to provide NOAA with modern, accurate hydrographic survey data with which to update the existing nautical charts of the area.

This survey was conducted by Terra Surveys, LLC, of Palmer, Alaska, which is hereafter referred to as the hydrographer. Specific information pertaining to this contractor may be obtained from NOS Hydrographic Surveys Division (N/CS35).

B. AREA SURVEYED

The survey area is adequately described in the Hydrographer's report. A page-size plot of the charted area depicting the limits of supersession accompany this report as Attachment 1.

The bottom consists mainly of stones with additional components of pebbles and gravel. Depths range from 7.0 fathoms to 12.9 fathoms.

C. SURVEY VESSELS

The Hydrographer's report contains information relating to survey vessels.

D. AUTOMATED DATA ACQUISITION AND PROCESSING

Survey data was processed using USL CARIS /HIPS, the same software used by the hydrographer, and AutoCAD.

Digital data for this survey exists in CARIS/HIPS format, a database format using the .xtf extension. In addition, the smooth sheet drawing is filed in the MicroStation format, i.e., .dgn (extension). Copies of these files will be forwarded to the Hydrographic Surveys Division and a backup copy will be retained at PHB. Database records forwarded are in the Internal Data Format (IDF) and are in compliance with specifications in existence at the time of survey processing.

The drawing files necessarily contain information that is not part of the CARIS/HIPS data set such as geographic names text, line-type data, and minor symbolization. In addition, those soundings deleted from the drawing for clarity purposes remain unrevised in the CARIS/HIPS digital files to preserve the integrity of the original hydrographic data set. Cartographic codes used to describe the digital data are those authorized by Hydrographic Survey Guideline No. 35 and No. 75.

The data are plotted using a Universal Transverse Mercator projection and are depicted on a single sheet.

E. SONAR EQUIPMENT

Sonar equipment has been adequately addressed in the Hydrographer's report

F. SOUNDING EQUIPMENT

Sounding equipment has been adequately addressed in the Hydrographer's report.

G. CORRECTIONS TO SOUNDINGS

The sounding data have been reduced to Mean Lower Low Water (MLLW). The reducers include corrections for an actual tide, static draft, dynamic draft (settlement and squat), sound velocity, and heave, pitch and roll. These reducers have been reviewed and are consistent with NOS specifications.

Unverified (preliminary) tides were used for reduction of soundings during field processing. Final tide correctors were obtained by interpolating data from two tide gauges, Nikiski, Alaska, 945-5760, and Cape Kasilof, Alaska, 945-5711. See section H of the Hydrographer's report for additional information.

H. CONTROL STATIONS

Sections H and I of the Hydrographer's report contain adequate discussions of horizontal control and hydrographic positioning.

The positions of horizontal control stations used during hydrographic operations are published values based on NAD 83. The geographic positions of all survey data are based on NAD 83. The smooth sheet is annotated with a NAD 27 adjustment tick based on values determined with the NGS program NADCON. Geographic positions based on NAD 27 may be plotted on the smooth sheet utilizing the NAD 83 projection by applying the following corrections:

Latitude:	-2.072 seconds	(-64.123 meters)
Longitude:	8.040 seconds	(122.580 meters)

I. HYDROGRAPHIC POSITION CONTROL

Differential GPS (DGPS) was used to control this survey. The total horizontal position error falls within 10 meters at the 95% confidence level. DGPS performance checks were conducted in the field and found adequate.

NAD 83 is used as the horizontal datum for plotting and position computations.

Additional information concerning specific control system type, position accuracy, calibrations and system checks can be found in the Hydrographer's report and in the separates related to horizontal position control and corrections to position data.

J. SHORELINE

There is no shoreline within survey H-10904 smooth sheet area.

K. CROSSLINES

Crosslines are discussed in the Hydrographer's report.

L. JUNCTIONS

Survey H-10904 junctions with the following surveys:

Survey	Year	Scale	Area
H-10884	1999	1:10,000	North
H-10910	1999	1:20,000	South and East

The junctions with survey H-10884 and H-10910 are complete. "Joins" notes have been added to the smooth sheet where applicable. Some soundings from both junctional surveys have been transferred within the common areas of H-10904 to better delineate the bottom configuration.

The sparse appearance of data in the vicinity of Lat. 60°31'10"N, Long. 151°27'10"W, an area approximately 3200 meters square, is due to the transfer of H-10904 soundings from the smaller scale junctional survey, H-10910. Thirty-seven soundings from H-10904 were visually suppressed, and nine slightly shoaler soundings transferred from H-10910, in order to support the ten-fathom curve at the junction of the two surveys. With one exception, a 9.6 fathom shoal that does not appear on H-10904, all soundings in this area agree within 0.1 to 0.2 fathoms.

M. COMPARISON WITH PRIOR SURVEYS

Survey	Year	Scale	Datum
H-10615	1995	1:10,000	NAD 83
H-10617	1995	1:10,000	NAD 83

The present survey was compared to digital copies of H-10615 and H-10617. The registration and legibility of these prior surveys to the present survey was good. These prior surveys cover the entire area of the present survey with H-10615 covering the northern half and H-10617 the southern half.

Sounding agreement between the prior and the current surveys is good , with differences from 0.5 to 1.0 fathom. There is a general shoaling trend with H-10904 soundings reading 0.1 to 0.4 fathom shoaler than the priors. One sounding from H-10615 reads 0.8 fathom deeper than H-10904 soundings. This sounding has been carried forward to the H-10904 smooth sheet. See Section O. Comparison With Chart, for more details on this discrepancy. Numerous previously undetected shoals were also discovered during the present survey using shallow water multibeam technology.

Differences in depths between prior and current surveys may be attributed to natural geomorphic trends in the area as well as improved hydrographic and positioning systems resulting in superior sounding coverage, positioning and sounding methods, and relative accuracy of the data acquisition techniques.

N. ITEM INVESTIGATIONS

There were no AWOIS items assigned to this survey.

O. COMPARISON WITH CHART

Survey H-10904 was compared with the following chart.

Chart	Edition	Date	Scale
16662	5th	July 5, 1997	1:100,000

With few exceptions, H-10904 soundings agree with the chart within 1 fathom, with H-10904 soundings tending neither shoaler nor deeper than charted soundings. There was, however, one charted sounding, originating from H-10615, lat. 60°33'53.5"N, long. 151°24'53"W, which is shoaler than H-10904 soundings. The charted sounding reads 7fm 2ft, while the current soundings read 8fm 1ft. The charted sounding will be retained.

a. Hydrography

Charted hydrography originates with the previously discussed prior surveys. The prior surveys have been adequately addressed in section M and require no further discussion.

Survey H-10904 is adequate to supersede charted hydrography within the charted area.

b. Dangers To Navigation

There were no dangers to navigation discovered during survey operations or office processing.

P. ADEQUACY OF SURVEY

Hydrography contained on survey H-10904 is adequate to:

a. Delineate the bottom configuration, determine least depths, and draw the required depth curves;

b. Reveal there are no significant discrepancies or anomalies requiring further investigation; and

c. Show the survey was properly controlled and soundings are correctly plotted.

The hydrographic records and reports received for processing are adequate and conform to the requirements of the Hydrographic Manual, 4th Edition, revised through Change No. 3, the Hydrographic Survey Guidelines, and the Field Procedures Manual, April 1994 Edition.

Q. AIDS TO NAVIGATION

There are no fixed or floating aids to navigation within the survey area.

There were no features of landmark value located within the area of this survey. The hydrographer made no charting recommendations for new landmarks.

R. STATISTICS

Statistics are itemized in the Hydrographer's report.

S. MISCELLANEOUS

Miscellaneous information is discussed in the Hydrographer's report. No additional miscellaneous items were noted during office processing.

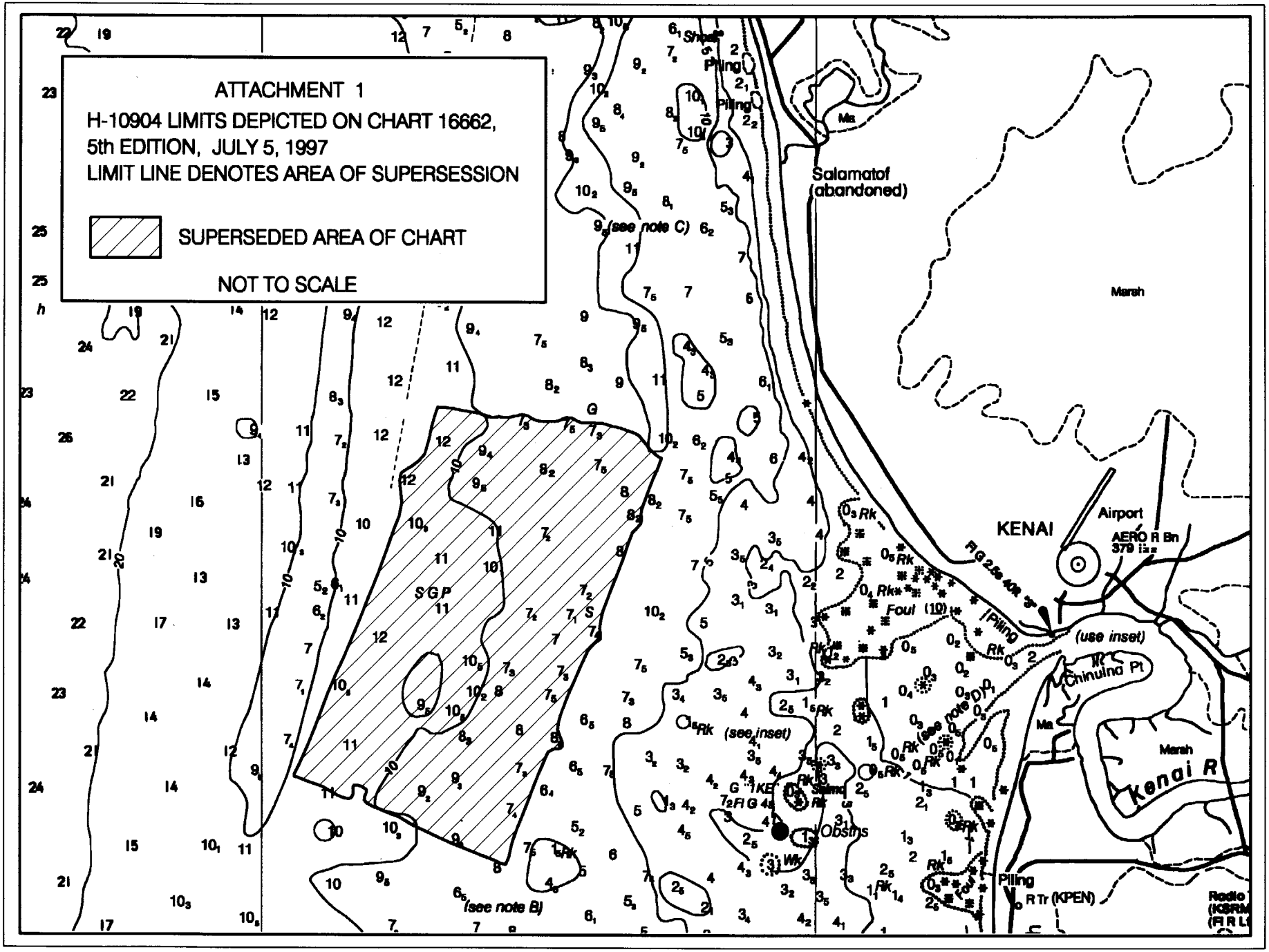
T. RECOMMENDATIONS

This is a good hydrographic survey. No additional work is recommended.

U. REFERRAL TO REPORTS

Referral to reports is discussed in the Hydrographer's report.

CJ Barry
Cartographer


ATTACHMENT 1
H-10904 LIMITS DEPICTED ON CHART 16662,
5th EDITION, JULY 5, 1997
LIMIT LINE DENOTES AREA OF SUPERSESSION
SUPERSEDED AREA OF CHART
NOT TO SCALE
Salamatof
(abandoned)
Marsh
KENAI
Airport
AERO R Bn
379 i
Foul (10)
(use inset)
Chinulna Pt
Kenai R
Obstns
(see inset)
(see note B)
(see note C)
SGP
Piling
R Tr (KPEN)

APPROVAL SHEET
H-10904

Initial Approvals:

The completed survey has been inspected with regard to survey coverage, delineation of the depth curves, development of critical depths, cartographic symbolization, comparison with prior surveys and verification or disproval of charted data. The survey records and digital data comply with NOS requirements except where noted in the Evaluation Report.

for Russ Davies Date: 12-20-00
Dennis Hill
Chief, Cartographic Team
Pacific Hydrographic Branch

I have reviewed the smooth sheet, accompanying data, and reports. This survey and accompanying digital data meet or exceed NOS requirements and standards for products in support of nautical charting except where noted in the Evaluation Report.

James C Gardner Date: 01-04-01
James C. Gardner
Captain, NOAA
Chief, Pacific Hydrographic Branch

****

Final Approval

Approved:

Samuel P. De Bow Date: February 2, 2001
Samuel De Bow
Captain, NOAA
Chief, Hydrographic Surveys Division

NOAA FORM 75-96
(10-83)

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

MARINE CHART BRANCH

RECORD OF APPLICATION TO CHARTS

FILE WITH DESCRIPTIVE REPORT OF SURVEY NO. H-10904

INSTRUCTIONS

A basic hydrographic or topographic survey supersedes all information of like nature on the uncorrected chart.

1. Letter all information.
2. In "Remarks" column cross out words that do not apply.
3. Give reasons for deviations, if any, from recommendations made under "Comparison with Charts" in the Review.

CHART	DATE	CARTOGRAPHER	REMARKS
16662	10/13/00	CJ BARRY	Full Part Before After Marine Center Approval Signed Via FULL APPLICATION OF
			Drawing No. SOUNDINGS, CURVES AND FEATURES FROM SMOOTH SHT.
			Full Part Before After Marine Center Approval Signed Via
			Drawing No.
			Full Part Before After Marine Center Approval Signed Via
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SUPERSEDES C&GS FORM 8352 WHICH MAY BE USED.