H10833

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. NA

Registry No. H-10833

LOCALITY

State Alaska

General Locality Cook Inlet

Sublocality Northwest of Nikiski

1998

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-10833

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.
C

State **Alaska**

General Locality **Cook Inlet**

Sublocality **Northwest of Nikiski**

Scale **1:10,000** Date of Survey **July 11 - October 11, 1998**

Instructions Date **11/28/97** Project No. **OPR-P367-KR**

WO #3 signed 8/21/98 and Modification signed 12/23/99

Vessel **Sea Ducer (AK Reg "AK0691P")**

Chief of Party **Robert Kohut**

Surveyed by **Terra Surveys, LLC**

Soundings taken by echo sounder, hand lead, pole **Reson 8101 Multi-Beam Echo Sounder**

Graphic record scaled by **NA**

Graphic record checked by **NA**

Evaluation by **B. Mihailov** Automated plot by **HP Design Jet 750C**

Verification by **G. Nelson, D. Hill, B. Mihailov**

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

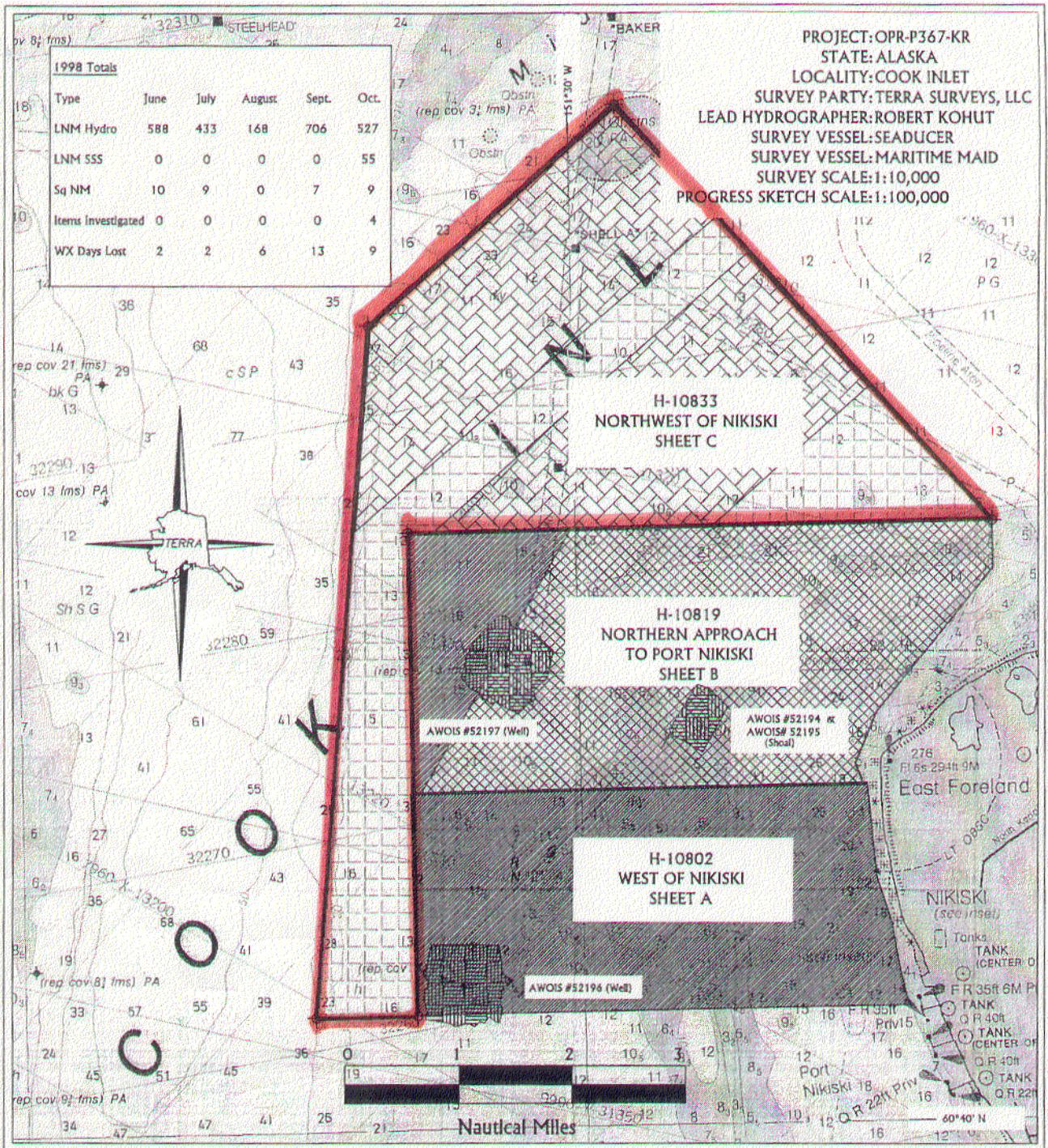
REMARKS: **Time in UTC. Revisions and marginal notes in black were generated at the Pacific Hydrographic Branch during review of the survey.**

Contractor: Terra Surveys, LLC

1930 South Whiting Circle

Palmer, AK 99645

907-745-7215



Contract 50-DGNC-8-90021

	WORK ORDER 1				WORK ORDER 2					WORK ORDER 3				WORK ORDER 4
Registry #	H-10802				H-10819					H-10833				AWOIS
Started	06/06/1998				06/29/1998					07/11/1998				10/19/1998
Completed	09/01/1998				10/07/1998					10/11/1998				10/24/1998
Month	June	July	Aug	Sept	June	July	Aug	Sept	Oct	July	Aug	Sept	Oct	Oct
Area		Holidays						Holidays		Reference Surface				
LNM Hydro	491	52	157	8	97	364	0	270	7	17	11	428	520	
LNM SSS														55
Sq NM	8.1	0	0	0	1.7	8.7	0	0	0	0	0	6.7	8.5	0.3
Items Investigated														4
WX Days Lost	2	0	6	0	0	2	0	4	0	0	0	9	5	4

INDEX OF SHEETS

Descriptive Report to Accompany Hydrographic Survey H-10833

Sheet C

Scale 1:10,000

July-October 1998

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-P367-KR, Northwest of Nikiski, Cook Inlet, Alaska, dated November 28, 1997, amended on ~~January 6, April 25, July 15,~~ and August 6 21 of 1998.

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 adjacent to four docks including one commercial multipurpose dock used primarily in oilfield support, 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 15.2 square nautical miles located near East Foreland in upper Cook Inlet. The survey covers the mostly deep water channels to the north and west of Port Nikiski.

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.

B. AREA SURVEYED

The area surveyed (Sheet C) for H-10833 covers approximately 15.2 square nautical miles to the north and west of Nikiski, Alaska. The following NAD 83 latitudes and longitudes are the hydrographic survey limits:

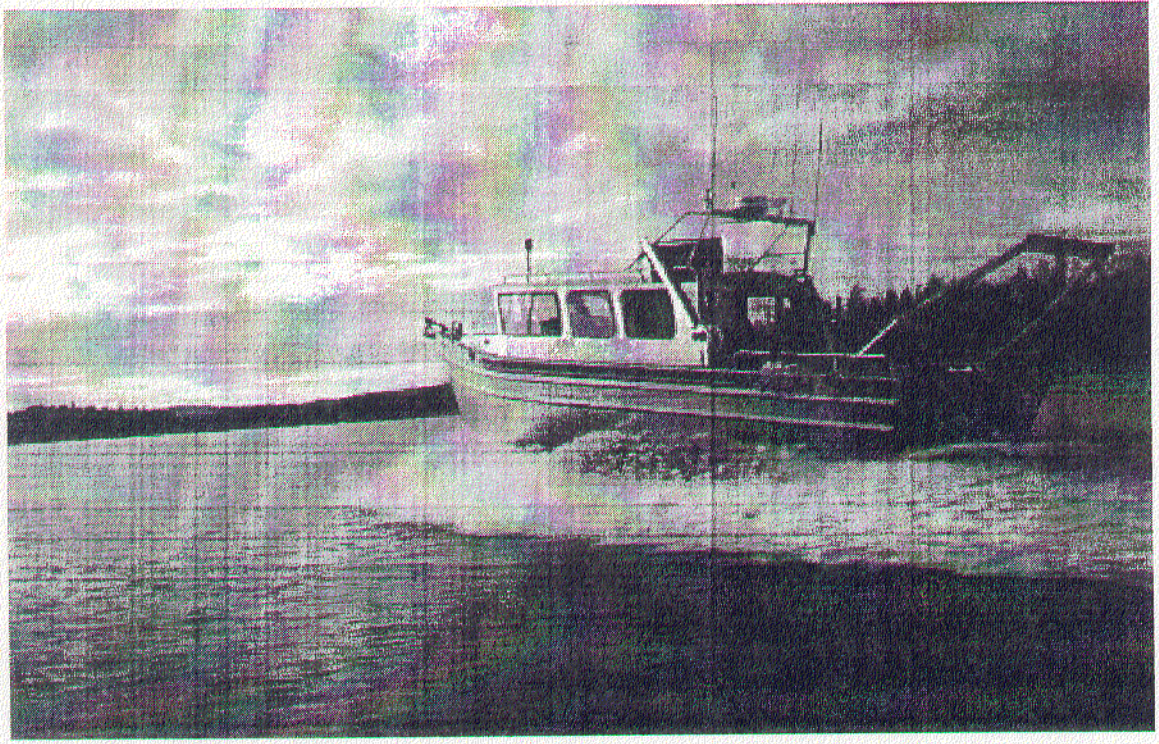
Degrees Latitude (N)		Degrees Longitude (W)	
60.754102	60/45/14.7	151.375058	151/22/30.2 27.0
60.815999	60/48/57.6	151.485888	151/29/09.2
60.784446	60/47/4.0	151.560717	151/33/38.5
60.683436	60/41/00.3	151.580433	151/34/49.5
60.683443	60/41/00.4	151.550157	151/33/00.5
60.754102	60/45/14.7	151.550159	151/33/00.5

The Index of Sheets shows the area surveyed for H-10833.

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

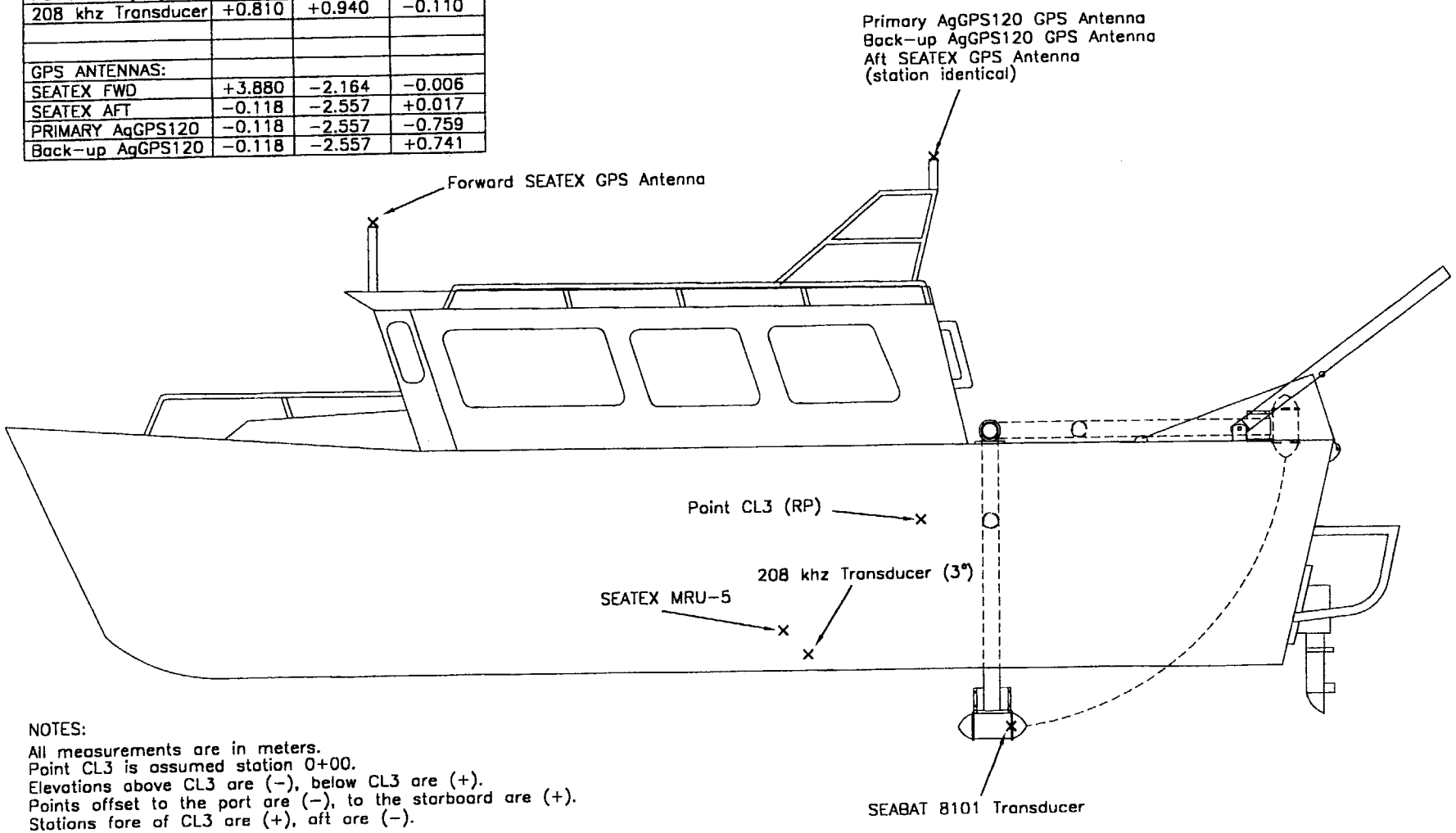


The *Sea Ducer*

The *Sea Ducer* was configured as shown on the *Sea Ducer* Instrument Locations Port, Top and Stern view drawings on the following pages.

SEA DUCER INSTRUMENT LOCATIONS
(PORT VIEW)

Desc.	Station	Elev.	Offset
SEABAT 8101	−0.634	+1.471	+1.587
SEATEX MRU−5	+0.988	+0.767	0.000
Point CL3 (RP)	0.000	0.000	0.000
208 khz Transducer	+0.810	+0.940	−0.110
GPS ANTENNAS:			
SEATEX FWD	+3.880	−2.164	−0.006
SEATEX AFT	−0.118	−2.557	+0.017
PRIMARY AgGPS120	−0.118	−2.557	−0.759
Back−up AgGPS120	−0.118	−2.557	+0.741

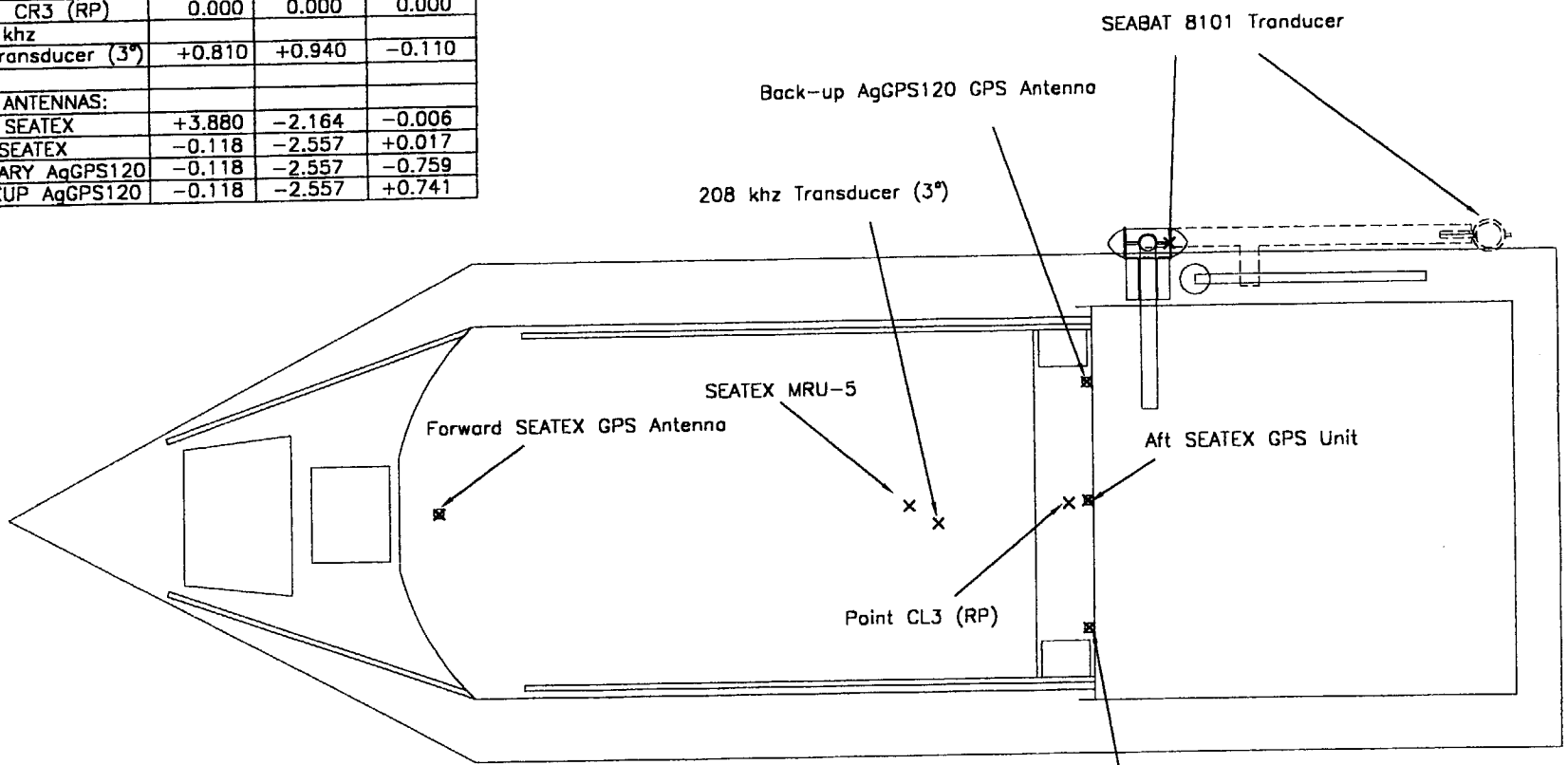


NOTES:
All measurements are in meters.
Point CL3 is assumed station 0+00.
Elevations above CL3 are (−), below CL3 are (+).
Points offset to the port are (−), to the starboard are (+).
Stations fore of CL3 are (+), aft are (−).

SEA DUCER INSTRUMENT LOCATIONS

(TOP VIEW)

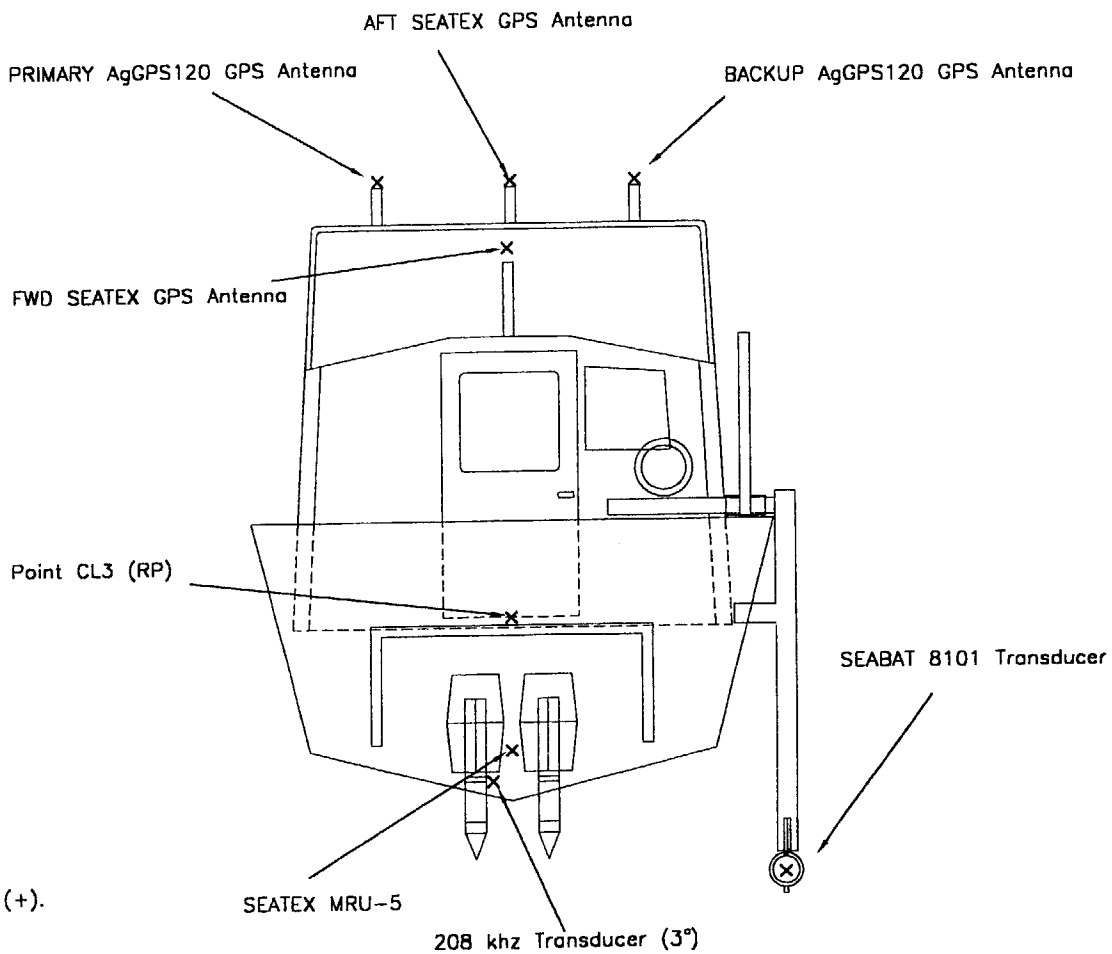
Desc.	Station	Elev.	Offset
SEABAT 8101	−0.634	+1.471	+1.587
SEATEX MRU−5	+0.988	+0.767	0.000
Point CR3 (RP)	0.000	0.000	0.000
208 khz			
Transducer (3°)	+0.810	+0.940	−0.110
GPS ANTENNAS:			
FWD SEATEX	+3.880	−2.164	−0.006
AFT SEATEX	−0.118	−2.557	+0.017
PRIMARY AgGPS120	−0.118	−2.557	−0.759
BACKUP AgGPS120	−0.118	−2.557	+0.741



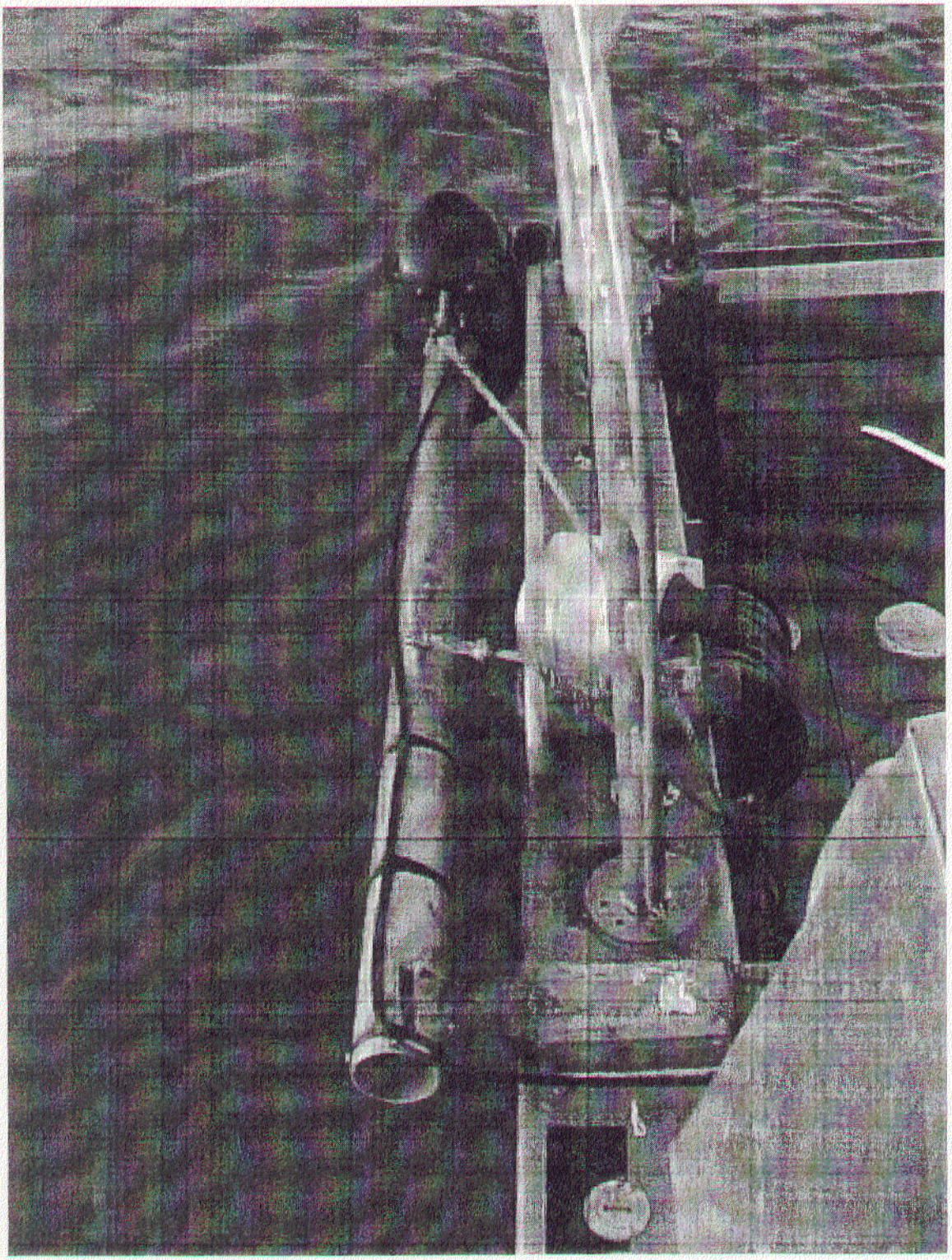
NOTES:
All measurements are in meters.
Point CL3 is assumed station 0+00.
Elevations above CL3 are (−), below CL3 are (+).
Points offset to the port are (−), to the starboard are (+).
Stations fore of CL3 are (+), aft are (−).

SEA DUCER INSTRUMENT LOCATIONS
(STERN VIEW)

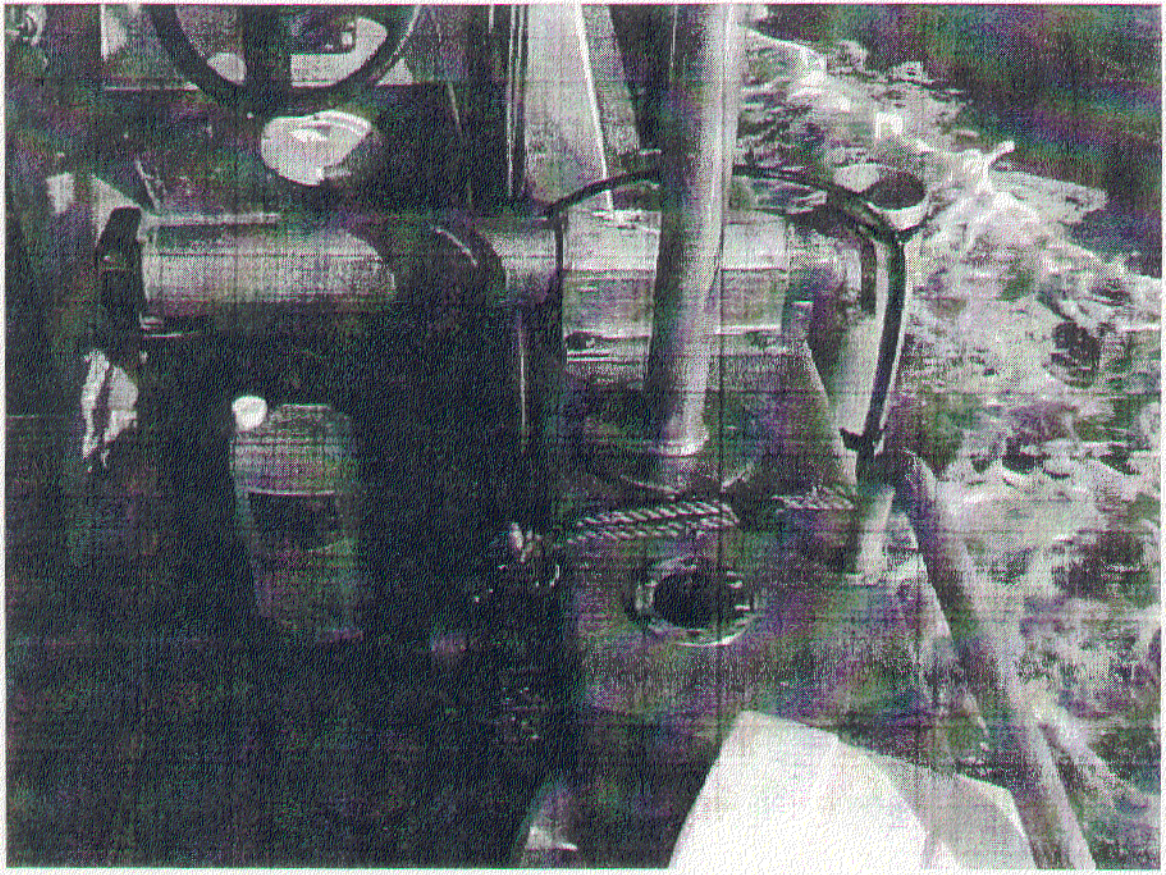
Desc.	Station	Elev.	Offset
SEABAT 8101	−0.634	+1.471	+1.587
SEATEX MRU−5	+0.988	+0.767	0.000
Point CL3 (RP)	0.000	0.000	0.000
208 khz Transducer (3°)	+0.810	+0.940	−0.110
GPS ANTENNAS:			
FWD SEATEX	+3.880	−2.164	−0.006
AFT SEATEX	−0.118	−2.557	+0.017
PRIMARY AgGPS120	−0.118	−2.557	−0.759
BACKUP AgGPS120	−0.118	−2.557	+0.741



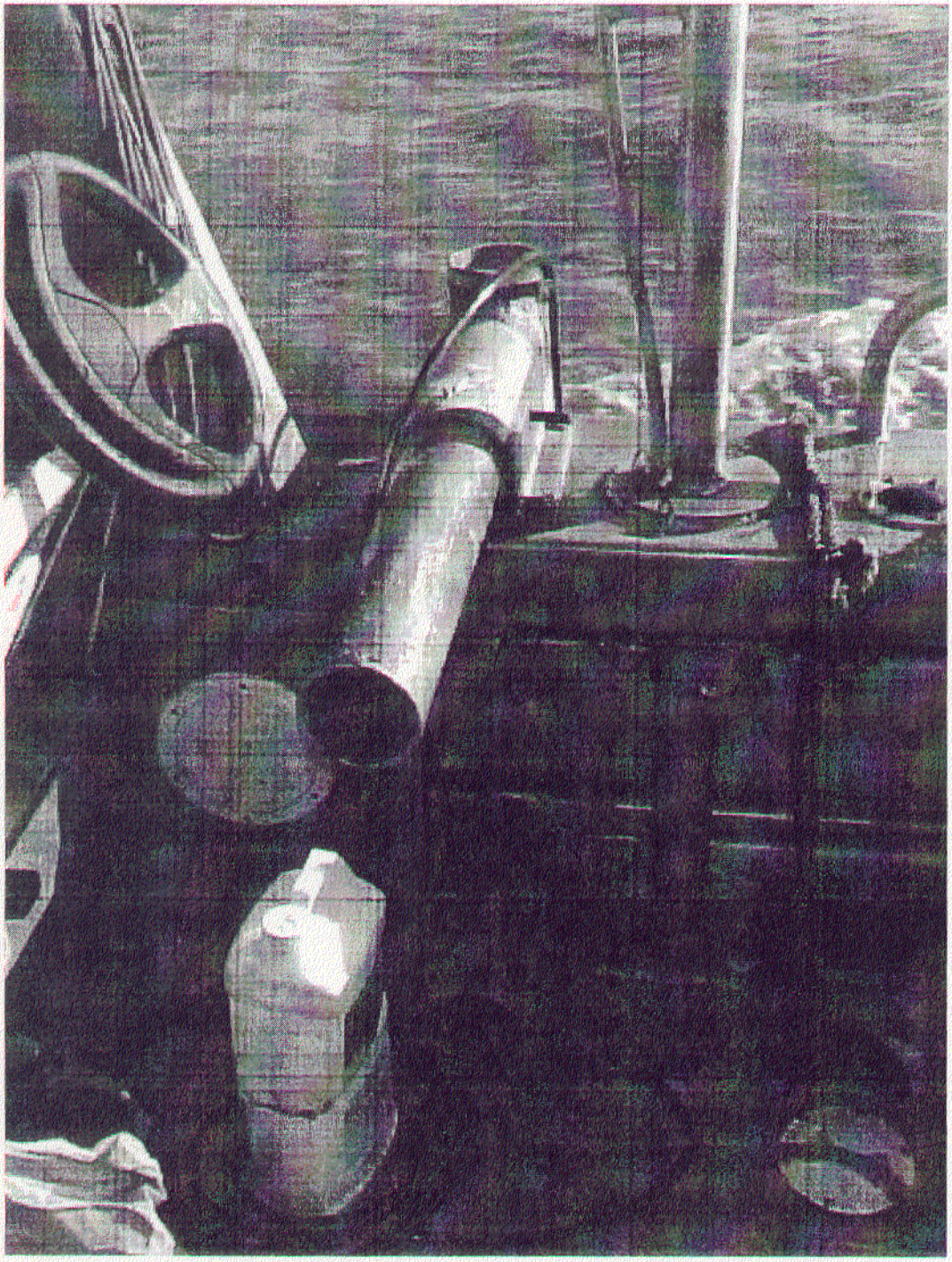
NOTES:
All measurements are in meters.
Point CL3 is assumed station 0+00.
Elevations above CL3 are (−), below CL3 are (+).
Points offset to the port are (−), to the starboard are (+).
Stations fore of CL3 are (+), aft are (−).



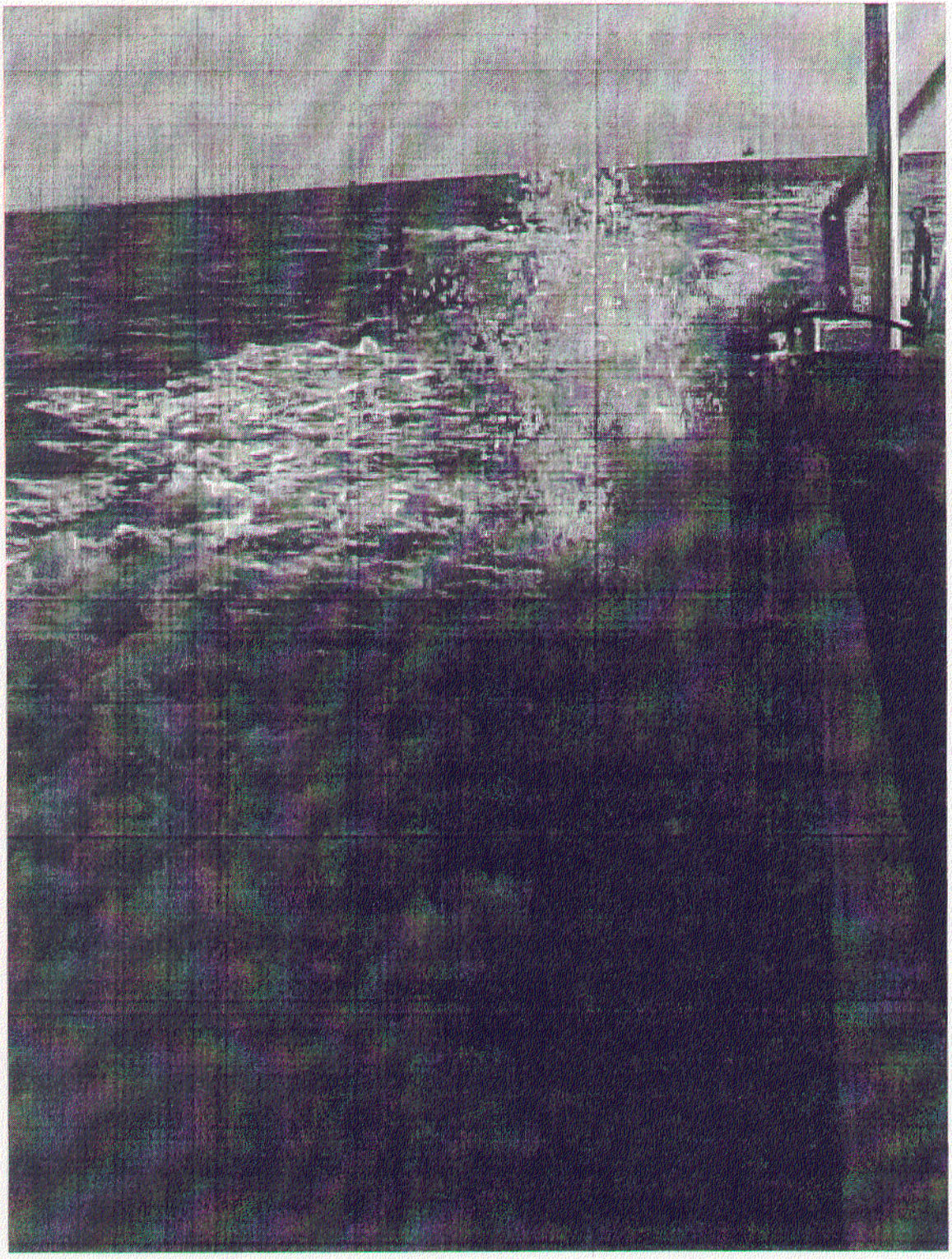
Sonar Head Pole Mount from bow while out of water



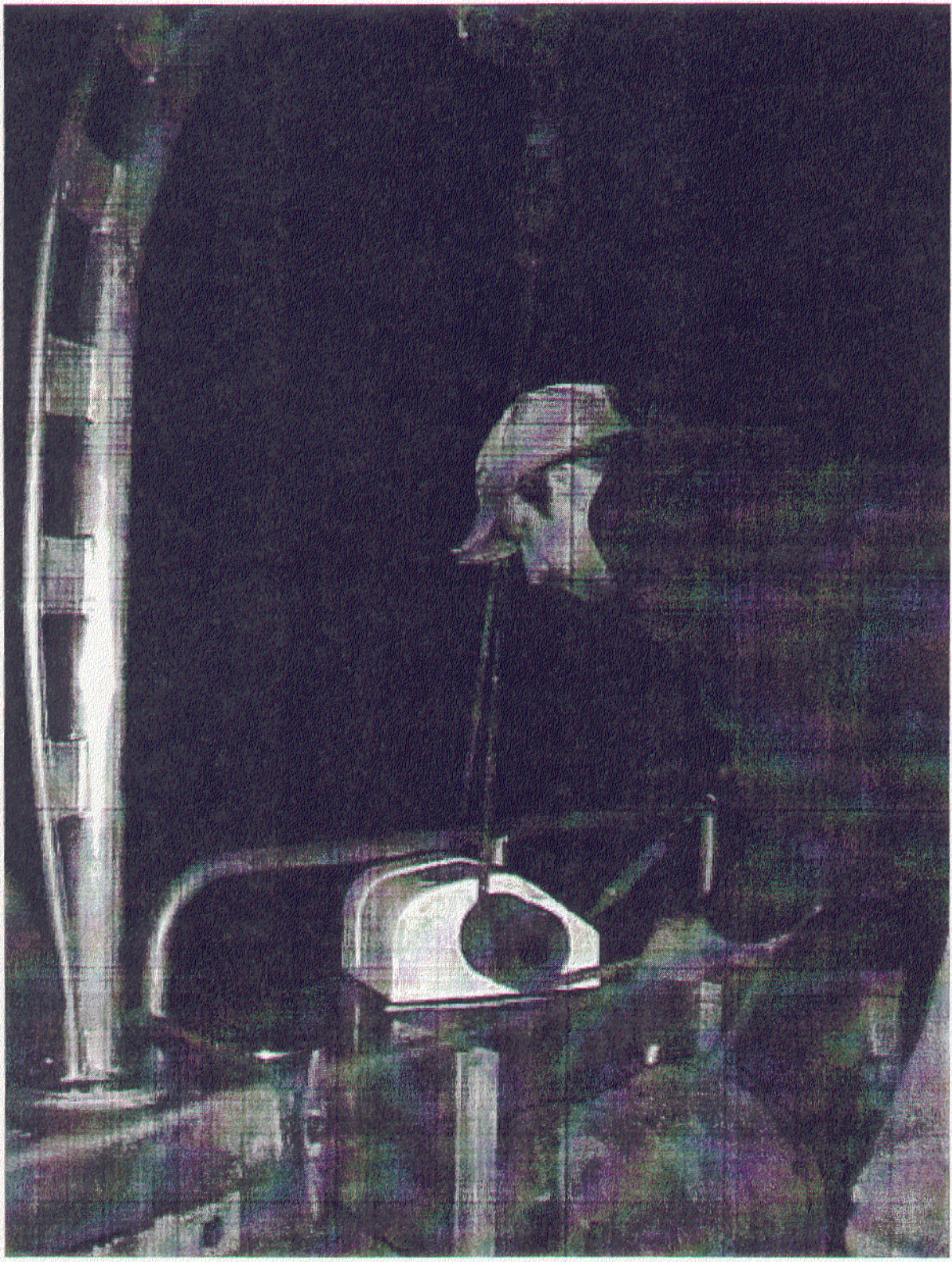
Sonar Head Pole Mount from stern while deployed



Sonar Head Pole Mount from deck while deployed



Sonar Head Pole Mount from bow while underway



Retrieving Sonar Head Pole Mount

Two Seapath 200 GPS antennas were mounted on centerline 4 meters apart over the cabin. Two AgGPS120 GPS antennas were mounted on the radar rack to port and starboard of the rear Seapath 200 antennae. The Seatex Motion Reference Unit (MRU-5) was mounted on centerline, forward of the rear cabin bulkhead and below the deck. The *Sea Ducer* also has three single beam transducers mounted in a sea chest amidships on centerline.

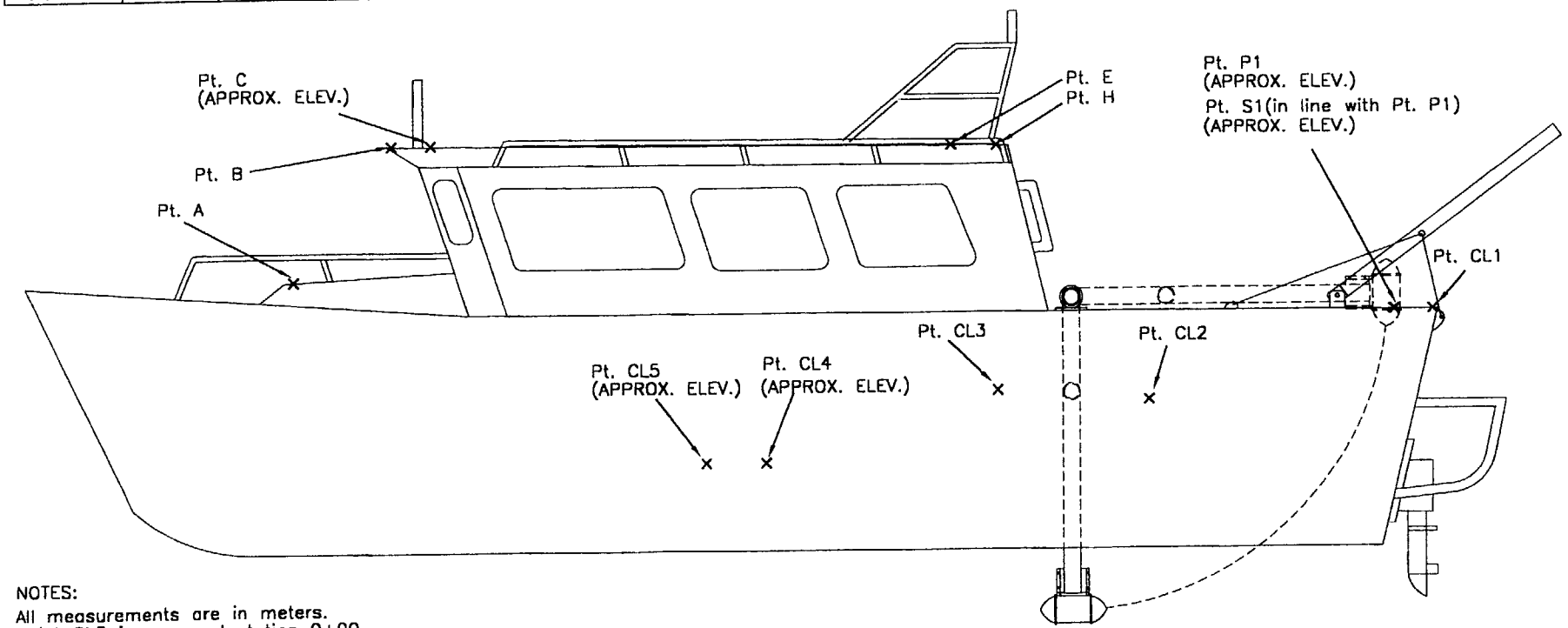
Control positions on the *Sea Ducer* are the result of surveys done both in Terra Surveys' shop using conventional surveying equipment and in the field using the survey points (punch marks) set during the original survey. The original survey involved leveling the boat on its trailer such that the apparent water line found on the hull was level. Elevation and location were then obtained using an automatic level, a digital total station, and steel chain. Punch marks were made and named for later use as equipment was mounted.

Metric adhesive rod face was adhered to the sides of the hull and also to the multibeam pole for daily readings of vessel draft.

The *Sea Ducer's* survey power was provided by a 12/24vdc alternator on each of the mains connected to a bank of batteries for dc power and a 2.4 kW Trace inverter for 110ac. A back up, 5 kW diesel generator was also available but not typically used.

SEA DUCER SURVEY POINTS
(PORT VIEW)

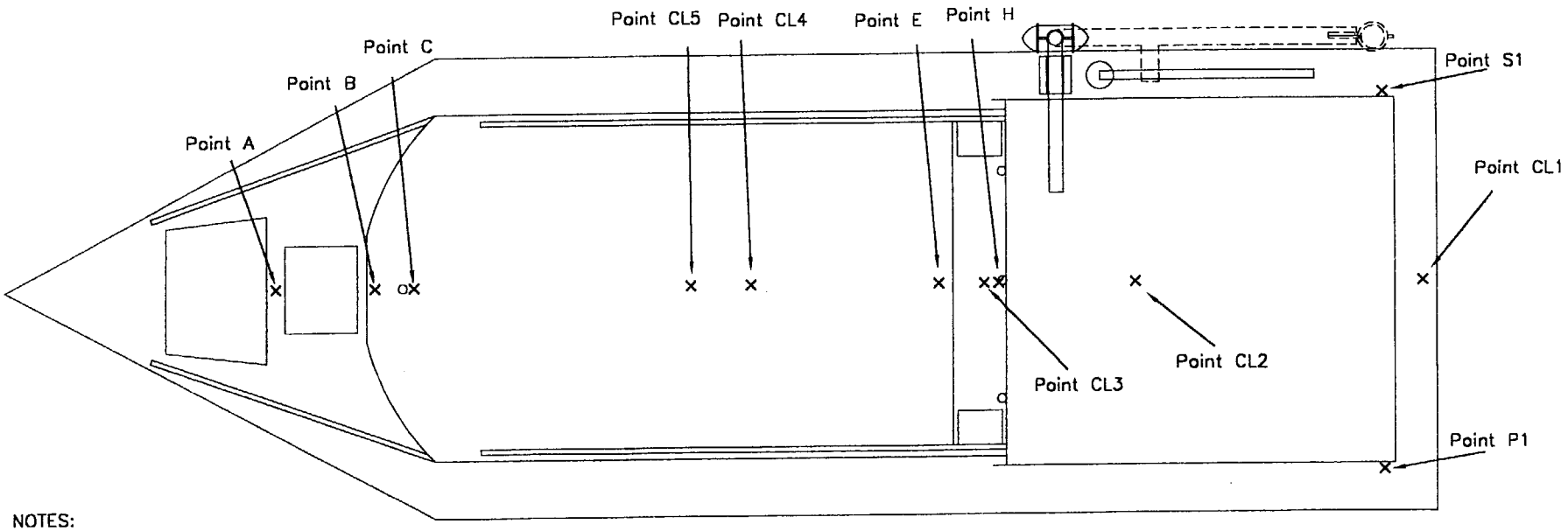
Pt.	Station	Elev.	Keel
CL1	−2.89	−0.518	+0.003
CL2	−1.015	+0.073	0.000
CL3 (RP)	0.000	0.000	+0.003
CL4	+1.561	N/A	0.000
CL5	+1.963	N/A	0.000
A	+4.720	−0.936	0.000
B	+4.066	−1.680	0.000
C	+3.805	N/A	0.000
E	+0.306	−1.649	0.000
H	−0.098	−1.643	0.000
S1	−2.630	N/A	+1.247
P1	−2.637	N/A	−1.244



NOTES:
All measurements are in meters.
Point CL3 is assumed station 0+00.
Elevations above CL3 are (−), below CL3 are (+).
Points offset to the port are (−), to the starboard are (+).
Stations fore of CL3 are (+), aft are (−).

Pt.	Station	Elev.	Keel
CL1	−2.890	−0.518	+0.003
CL2	−1.015	+0.073	0.000
CL3 (RP)	0.000	0.000	+0.003
CL4	+1.561	N/A	0.000
CL5	+1.963	N/A	0.000
A	+4.720	−0.936	0.000
B	+4.066	−1.680	0.000
C	+3.805	N/A	0.000
E	+0.306	−1.649	0.000
H	−0.098	−1.643	0.000
S1	−2.630	N/A	+1.247
P1	−2.637	N/A	−1.244

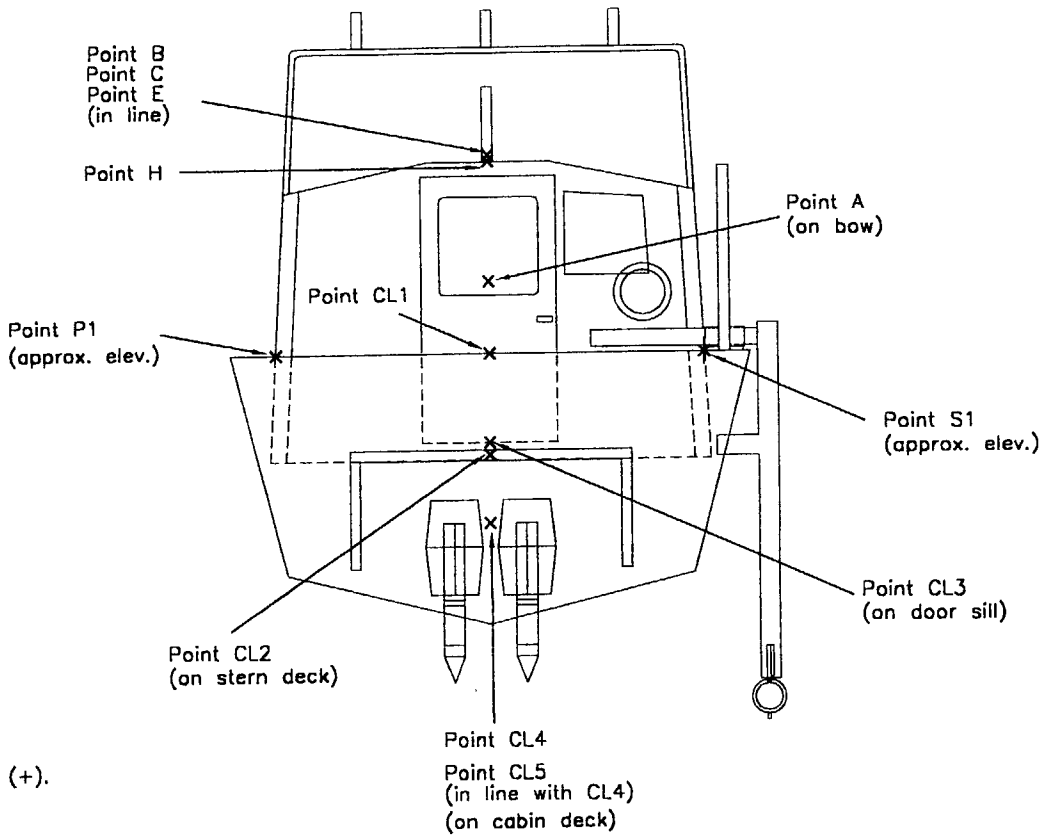
SEA DUCER SURVEY POINTS
(TOP VIEW)



NOTES:
All measurements are in meters.
Point CL3 is assumed station 0+00.
Elevations above CL3 are (−), below CL3 are (+).
Points offset to the port are (−), to the starboard are (+).
Stations fore of CL3 are (+), aft are (−).

SEA DUCER SURVEY POINTS
(STERN VIEW)

Pt.	Station	Elev.	Keel
CL1	−2.890	−0.518	+0.003
CL2	−1.015	+0.073	0.000
CL3 (RP)	0.000	0.000	+0.003
CL4	+1.561	N/A	0.000
CL5	+1.963	N/A	0.000
A	+4.720	−0.936	0.000
B	+4.066	−1.680	0.000
C	+3.805	N/A	0.000
E	+0.306	−1.649	0.000
H	−0.098	−1.643	0.000
S1	−2.630	N/A	+1.247
P1	−2.637	N/A	−1.244



NOTES:
All measurements are in meters.
Point CL3 is assumed station 0+00.
Elevations above CL3 are (−), below CL3 are (+).
Points offset to the port are (−), to the starboard are (+).
Stations fore of CL3 are (+), aft are (−).

D. Automated Data Acquisition and Processing

Data Collection

Multibeam data collection was performed on a 333 MHz Pentium II PC running Reson's 6042 Multibeam Data Collection software under Windows 95. 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 position information (heave, pitch, roll, heading, latitude and longitude) via serial interface from the Seatex Seapath 200 system. The Seapath 200 received differential correctors from an Ag120 GPS receiver tuned to the U.S. Coast Guard Beacon Kenai.

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 a 200mhz Pentium computer. It received motion and position data (heave, pitch, roll, heading, latitude and longitude) from the Seapath 200. It also received a check position from a second Ag120 GPS receiver receiving differential correctors from the U.S. Coast Guard Beacons Kodiak or Cape Hinchinbrook.

Processing Overview

The Reson 6042 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', **E**xtended **T**riton **F**ormat, for compatibility with CARIS HIPS. This was done using the Reson 6042 software while offline. The data was then transferred in Hypack raw navigation data files off the vessel via 2.6-gigabyte **M**agneto-**O**ptical (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.

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, beam number and (when implemented by Universal) 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. Initially, beam filters were overused resulting in some data after editing

yielding only 61 beams per profile. This practice was quickly discarded and only the beam filtering necessary to speed processing was performed, typically 5 to 15 outer beams on each side. The implementation of an angle filter by Universal was used when available and soundings outside a 100 degree sector about nadir were rejected by filter after that. 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 measured in the field, the data was beam edited in **HIPS** 'Line' mode. Preliminary tides for the National Ocean Service (NOS) gage at Nikiski (945-5760) were applied without zoning. 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 drawing.

Following the 'Subset' editor, the data was exported to the Caris Editor, a **G**eographic **I**nformation **S**ystem (GIS) and inspected for coverage. In the Caris Editor, the soundings were displayed and the operator zoomed and panned along each line to check for sufficient overlap between adjacent lines and gaps within the line. 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 tide zone for each profile was determined, 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 zoning scheme provided and the Final Verified tides from the NOS gage at Nikiski (945-5760). These tides were down loaded from the NOS internet site. The tide was applied equally to all soundings within each profile. A new tidal datum was provided after final processing was complete and the data was reprocessed starting from the merge step. Ten percent of the subsets were reviewed as a check. This 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 DTM was created and rechecked for coverage.

Following the tide adjustment, soundings were flagged as rejected if the footprint was deemed to 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 50° for most of this survey. Crossline statistics indicated that the allowable angle could be raised to 58° in water depths less than 30 meters (MLLW) and to 55° 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, 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 HPTools to summarize the start and end times of lines, distance traveled, average vessel speed, minimum number of satellites and maximum HDOP encountered. There were some incidences when the Hypack log was inadvertently turned off during the running of a line. In these instances, the lineal nautical mileage and speed were computed from the XTF files. The lines were then checked for the several conditions that could cause disqualification. Disqualification could be due to going to fast for the range scale used 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. Caris Hips, a processing program developed by Universal System Ltd., was used for all multibeam post processing and quality assurance.

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. - CONCUR

F. SOUNDING EQUIPMENT ✓

The survey vessel, *Sea Ducer* was equipped with a Reson SeaBat 8101 multibeam echo sounder system (serial # 85100120). The system's two main components consist of a surface processor (serial # 13983) and transducer head (serial # 049710).

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 14.08 meters/7.7 fathoms (Latitude 60.776034° N, Longitude 151.433107° W), to 61.78 meters/33.8 fathoms (Latitude 60.685805° N, Longitude 151.581131° 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

The multibeam did experience a fault during the survey. While checking raw data from the unit ("snapshots"), Reson engineers discovered a bad beam former on the starboard side. The unit was shipped to Reson in California on August 19, 1998, and was back in service on August 25, 1998. Reson's engineers found a broken trace on a circuit board controlling the beam forming for the four outermost beams on the starboard side. Those beams are not included in the smooth sheet.

Data analysis has revealed a slight frown shaped swath in the 8101. This feature first became apparent in reference surface analysis and sub-set editing in CARIS HDCS. The general trend is a raised surface in the middle of the swath. Part of this feature is a nipple effect (raised ridge) generated around nadir by several beams. The nipple effect was minimized in the field by lowering the sounder gain to its lowest level without losing data, but could not be eliminated. Terra Surveys, LLC and Reson have explored possible causes for these effects throughout the project by analyzing raw data directly from the 8101 sonar head ("snapshots"). The cause of the problem was not resolved at the time of this report, but Reson does not feel the sounder is out of specifications and the problem will not cause the accuracy of the data to be out of specifications. – CONCUR

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	**3201**
Pressure Calibration Temperature Calibration Distilled Water Sound Calibration Voltage Calibration	4/30/98 by Applied Microsystems Ltd. 4/29/98 by Applied Microsystems Ltd. 4/20/98 by Applied Microsystems Ltd. 5/27/98 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	4/30/98 by Applied Microsystems Ltd. 4/29/98 by Applied Microsystems Ltd. 4/21/98 by Applied Microsystems Ltd. 4/30/98 by Applied Microsystems Ltd.

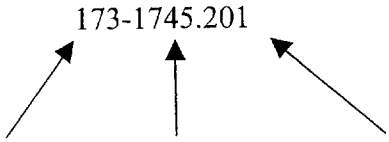
The following instrument was operated at the surface.

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**
Pressure Calibration Distilled Water Sound Calibration	6/10/98 by Applied Microsystems Ltd. 4/20/98 by Applied Microsystems Ltd.

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

The velocimeters were set at a sample rate of 15 samples per second during casts, and 1 sample per minute for the continuous monitoring of the work area. A daily log was kept to note any variance between the two velocimeters. Dual casts were done a minimum of once a day for comparison between velocimeters. During survey operations, either one of the *SVPlus* velocimeters or the *Smart SV&P* logged the sound velocity once per minute. The casts were taken as deep as possible and geographically distributed to satisfy the 95% anticipated water depth and represent local and diurnal variability. The velocimeters were manually initialized and downloaded using PROCOMM terminal software.

The sound velocity data file name convention follows:



Julian Day Time of deployment Velocimeter serial number

The naming convention incorporated the Julian day and UTC time as well as the serial number of the sensor. The office reductions then verified and reflected the true Julian day and UTC derived from the raw data header.

* Filed with the hydrographic data.

Example Raw Data header:

du 173-1745.201
SVPlus S/N 3201
New cast started on **06-23-98 at 01:50:52**
Sample rate is 1 second
Depth increment 0.50
Sound velocity increment 0.00

Julian Date and Time

Julian Day and UTC file names will reflect an 8-hour difference or be the same depending on which naming convention was used. Regardless of the naming convention used, the correct Julian day was derived directly from the raw data, and applied to the soundings in CARIS from a continuous SVP file of all the casts.

Sound Velocity Data after conversion:

File Name: C201__173-1745

Section 1998-**174**	**1:50:52**
26.7	1477.21
26.1	1477.22
25.5	1477.2
24.6	1477.18
24.0	1477.17
23.2	1477.16
22.6	1477.16

The converted file names start with C (converted) and the serial number:
C201__173-1745.

Processing Procedures

The velocimeter raw pressure data was converted to depths in meters in a spreadsheet 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 formula was checked with latitudes for the north and south extent of the survey and the resulting depths varied by millimeters so an average was used. This method was also tested against the results of Applied Microsystems Ltd. *Total System Software* and found to be identical.

The data was then 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.

SOUND VELOCITY PROFILES SUMMARY

Julian Day	Time (UTC)	Daily Confidence Check	File Name	Latitude	Longitude	Max Depth	File Used for Reduction in Caris	On Line Monitoring	Comments
192	15:39:08		192-1535.201	60-45-23	151-20-09	21.4	comp192.svp		
192	19:08:03	X	192-1905.201	60-45-39	151-20-07	19.3	comp192.svp		
192		X	192-1905.259	60-45-39	151-20-07	19.3			
192			192-60-0.201	Ref 2	Ref 2			X	tube
192	22:59:35		192-2300.259	60-45-36	151-19-50	17.6	comp192.svp		
226	17:10:14	X	226-1710.259	60-45-10.9	151-18-58.1	12.1	SV225-end.svp	X	
226		X	226-1710.201	60-45-10.9	151-18-58.1	12.2			
226			226-tube.177	WO1	WO1			X	Tube; Boat mounted S/V Probe
227	2:35:10		227-0230.259	-	-	-	SV225-end.svp		
227			227-1700.259	60-45-38	151-19-48	19.1			
227			227-1700.201	60-45-38	151-19-48	19.2			
227			227-tube.177						
238	19:58:28	X	238-2000.259	60-41-05	151-24-26	27.8	SV225-end.svp		
238		X	238-2000.201	60-41-05	151-24-26	27.8			
239	0:30:29		239-0030.259	60-43-31	151-27-08	17.2	SV225-end.svp		
239	16:55:22		239-1700.259	60-45-17.4	151-19-17.2	16.8	SV225-end.svp		
239	19:14:58	X	239-1915.259	60-41-18	151-24-35.3	31.0	SV225-end.svp		
239		X	239-1915.201	60-41-18	151-24-35.3	30.9			
239			239-tube.177	Ref.& Patch	Ref.& Patch	-		X	Tube

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 below:

Date	Draft (m)	8101 Depth (m)	Lead Line (m)	Error (m)
15 August 1998	1.09	3.56	4.63	-0.02
JD 227	1.09	3.52	4.65	-0.04
14 Sept 1998	1.09	1.00	2.03	+0.06
JD 257				
21 Sept 1998	1.10	6.47	7.53	+0.04
JD 264				
11 October 1998	1.05	5.83	6.92	+0.04
JD 284				

An alternate method of checking was used July 11th, August 29th, September 5th and 12th. The reduced nadir beam depth was compared to a reduced single beam echosounder. The data was corrected for offsets in both the horizontal and vertical planes. Sound velocity, heave, pitch, and roll corrections were also applied.

Date	8101 Depth (m)	ODOM Depth (m)	Vertical Offset (m)	Error (m)
11 July 1998 JD 192	16.35	16.91	0.53	0.03
29 August 1998 JD 241	27.89	28.45	0.53	0.03
5 Sept 1998 JD 249	26.96	27.42	0.53	0.06
12 Sept 1998 JD 255	21.74	22.24	0.53	0.03

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 a minimum of once daily and usually twice. The draft readings were incorporated in a spreadsheet, which included the date and time, line name, engine rpm and draft. From the spreadsheet data and the measured offsets for the boat, the distance from the boat's reference point to the water line was computed for every line and utilized in the HIPS Vessel Configuration File (see following discussion of settlement for more detail).

Settlement

Measurements for the Squat and Settlement were conducted near East Forelands 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) "GGA" string, a GPS output string which contains the time, position, ellipsoid height, HDOP and mode. The third file was collected using Triton ISIS 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 (RPM 2800 – 3000) the vessels reference point is actually 3-9 cm above its elevation at rest.

The daily draft readings, RPM values, and the reference point to water line distance for each line were recorded on the written line notes. A macro converted this information to a text file for insertion into the HIPS Vessel Configuration file.

Vessel Configuration File (VCF)

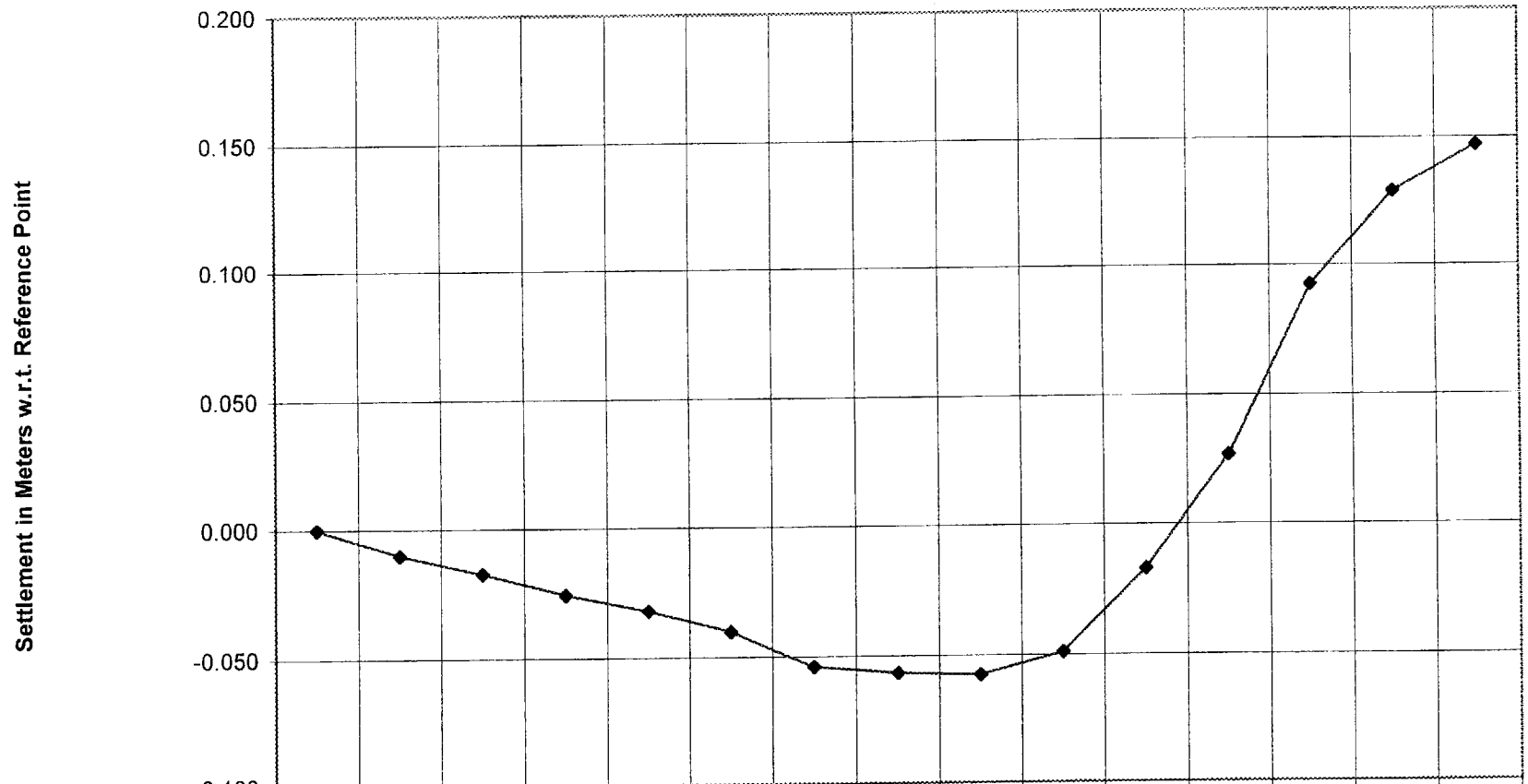
An example of the Reference Point to Water Line entry in the VCF is as follows:

```
# +-----------------------------------------+
# |                                         |
# | RP Definition                           |
# |                                         |
# +-----------------------------------------+
RPDfn
        {
        1998-157-17:10
                {
                Waterline       0.41                    # in meters
                Apply           "YES"                   # in merge
                Comment         "File=157-0000/RPM=1200/Settlement=-0.026/8101 Draft=1.040"
                Authorization " "
                }
```

The entry above is for a day when the draft (of the sonar head) was 1.04 meters and the settlement is –0.026 for an engine RPM of 1200. The resulting waterline measurement is 0.41 meters. The equation used for computation of RP definition is:

RP Definition (Waterline) = SeaBat Elevation Offset - Draft + Settlement

Sea Ducer Settlement Determination
Settlement w.r.t. Reference Point



	Rest	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400
Settlement at RPM	0.000	-0.010	-0.017	-0.026	-0.032	-0.040	-0.054	-0.057	-0.058	-0.049	-0.017	0.027	0.092	0.129	0.147
Boat Speed (Knots)	0	1.5	4.9	5.7	6.4	6.9	7.5	8	8.7	9.6	10.9	12.9	14.2	15.8	17.8

Engine RPM

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:	0361
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) was 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 of -6.067 meters was applied to the preliminary data to reference tides to MLLW (per contractor's note at web site http://www.opsd.nos.noaa.gov/aknote.html). No zoning was applied to the preliminary data.

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 time and height tidal zoning correctors listed in Appendix E* were applied during transfer of the soundings from CARIS to the SQL Server Database. After determining the tidal zone for each profile, the associated soundings were adjusted for the final tide.

* Filed with the hydrographic records.

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.

The U.S. Coast Guard Differential Navigation Beacons at Kenai, Kodiak and Cape Hinchinbrook were used during hydrographic survey operations for horizontal positions and confidence checks. The NGS second order control station, NIK, was used as a DGPS performance check site. NAD 83 Geographic Coordinates for these horizontal control stations are found in Appendix C. *

No control was set during this survey.

* Filed with the hydrographic data.

I. Hydrographic Position Control

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 **S**ound **V**elocity **P**rofile (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
Kenai 1 CORS L1 Phase Center	**AB6390**	**Kenai_19960131**	**310 kHz**	**CORS**
Kodiak1 CORS L1 Phase Center	**AB6391**	**Kod1_19960201**	**313 KHz**	**CORS**
Cape Hinchinbrook Light	**UV3680**	-	**292 KHz**	**THIRD**
NIK	**TT0543**	-	-	**SECOND**

The United States Coast Guard (USCG) Differential Global Positioning System (DGPS) Beacons at Kenai, Kodiak and Cape Hinchinbrook Light were used during hydrographic operations for horizontal positions and confidence checks. Control station "NIK" was used as a DGPS performance check site.

✳ Filed with the hydrographic data.

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 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 Kenai, Kodiak and Cape Hinchinbrook Light USCG differential navigation beacons 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 two different beacons. When Kenai correctors were used for primary positioning, Kodiak was used as a confidence check. When Kenai was down for maintenance, September 14-22, 1998, Kodiak correctors were used for primary positioning and Cape Hinchinbrook Light was used as a confidence check. The high bulkhead walls at *Sea Ducer's* Arness Dock berth precluded setting a fixed point for confidence checks because the satellites were blocked. A fixed confidence checkpoint was established at the Kenai River launch ramp for use also. 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.**
Primary	Ag120/Trimble	0220061863	0220661841
Aft	SEATEX/Trimble	Seapath-2497011	0220110175
Backup	Ag120/Trimble	0220061678	0220061769
Forward	SEATEX/Trimble	Seapath-2497011	0220109126

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

Difficulties that degraded the expected position accuracy included insufficient satellite coverage near oilrigs and multipath on very calm waters. Tracklines around oilrigs were run at an angle to the main scheme tracklines in order to insure sufficient satellite visibility and good geometry. A choke ring collar was mounted on the receiver's antenna

* Filed with the hydrographic data

to reduce multipath from flat, calm water. 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 — concur

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 52.9 million points and was imported to the Caris Editor. A regular DTM was created using a 5 meter cell size and a radius of 5 meters. Each cell within the regular DTM was a weighted average of the soundings within a 5 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 four ways. The acceptable soundings (not rejected) were compared by beam number and by angle. Then the soundings not rejected in HDCS but unusable due to having a footprint too large or an excessive launch angle were compared to the DTM using both launch angle and beam number.

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. - concur

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.

Refer to the report "Crosslines" for the statistics found in this process. The file naming indicates the line name, whether the data was accepted or rejected and whether organized by angle or beam number. An example is:

1580002_a_b

1580002 would be the line name.
The first character indicates whether the soundings are **A**ccepted or **R**ejected.
The second character indicates whether the data is grouped by **B**eam number or **A**ngle.

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.

The statistics are summarized below:

Line Name	Number of Soundings	Min Depth	Max Depth	Std Dev Center	0 - 30 Meters Angle From Nadir	90% Port Beam	90% Stbd Beam	> 30 Meters Angle From Nadir	90% Port Beam	90% Stbd Beam
2520026	681,436	17.50	50.24	0.19	53°	17	83	55°	12	84
2520027	976,422	19.12	44.31	0.18	54°	15	83	54°	17	85
2530000	142,688	20.42	27.64	0.12	60°	13	91	NA	NA	NA
2530001	886,801	18.67	45.04	0.18	60°	12	83	57°	10	84
2530002	965,585	18.30	49.41	0.18	65°	9	94	61°	12	93
2530003	1,043,103	10.47	51.31	0.18	65°	9	93	60°	12	90
2530004	1,254,205	16.92	47.68	0.20	64°	10	94	57°	14	92
2540001	240,011	19.72	52.10	0.24	66°	8	96	66°	8	90
2540002	410,513	15.41	52.25	0.16	72°	5	99	60°	10	90
2540005	131,342	18.95	51.49	0.15	69°	7	97	57°	10	90
2540006	191,136	22.90	50.46	0.25	57°	13	87	59°	12	90
2540007	178,377	23.01	46.66	0.22	45°	25	87	60°	9	85
2540008	268,806	19.73	59.44	0.15	55°	9	83	56°	16	86
2540009	258,352	25.76	61.06	0.38	-	14	36	-	-	-
2540013	1,086,159	14.40	43.77	0.23	63°	15	95	63°	10	93
2540014	1,211,752	17.03	43.77	0.23	60°	15	90	59°	13	91

L. Junctions See Eval Report, section L.

Survey H-10833 was compared with survey H-10802, a 1:10,000 scale survey covering the area immediately to the east of the southern arm of H-10833 and with survey H-10819, a 1:10,000 scale survey covering the area immediately to the south of the main body of H-10833. Agreement between the surveys was very good with the majority of the soundings agreeing within 0.2 fathoms. No adjustment or reconciliation is necessary.

M. Comparison with Prior Surveys ✓ See Eval Report, section M.

Not applicable. Not required by contract.

N. Comparison with the Chart ✓ See Evaluation Report, section O.

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

Chart	Scale	Edition	Date
16662	1:100,000	4th	August 31, 1996
16662 Inset	1:50,000	4th	August 31, 1996

General agreement between the chart ~~and inset on the chart~~ and this survey was good although some changes in the edges of the shoal areas was detected. This survey also found a number of rocks not noted on the chart. This is probably the result of the high sounding density of this survey. As a result the soundings found tended to both match the chart and contain higher and lower values within the same area of the chart. Survey limits are outside the limits of the inset.
Though no sidescan was collected over the area we are able to detect the location of the pipelines which connect the Dillon, Shell-A and Shell-C oil platforms since they are visible as linear anomalies in the DTM. We checked the location of the pipelines against the corridor shown on the chart and found the pipe to be on the extreme west edge of the corridor which heads north from Dillon to Shell-C. The pipe departs the corridor to the west at the southern limit of this survey. The platforms are depicted on the chart in their correct locations. The pipeline from Shell-C to Shell-A was found to depart the corridor to the east approximately 1000 meters north of Shell-C. In the remainder of this section the pipeline is located up to 160 meters east of the corridor until it rejoins at Shell-A. These location differences have been reported in separate Danger to Navigation reports. The corridor north of Shell-A contains 2 parallel pipelines that were found to be entirely inside the corridor. Near the northernmost point in this survey the pipelines became undetectable near a large rocky formation. The corridor that connects Shell-A southeastwards to the shore was found to contain two parallel pipelines entirely within the corridor. These pipelines are located along the northern edge of the corridor.

The following pages lists the positions of the Drill Rigs, and significant angle points of the located pipelines where they depart from the charted corridor. The next page lists charted soundings around which shoaler (or deeper) soundings were found.

Drill Rig Positions H-10833

Shell-A

Lat.	60°47'42.737" N	Northing	6740912.369
Long.	151°29'52.087" W	Easting	581765.2927

Shell-C

Lat.	60°45'48.365" N	Northing	6737366.332
Long.	151°30'15.495" W	Easting	581492.0279

*Positions given in NAD 83; UTM Zone 5 coordinates are in meters. Corpscon was used in the conversion.

Route of single pipeline from Southern Limit of survey to Shell-A Platform:			
Item	Latitude	Longitude	Comment
Single Pipeline	60°45'13.529"N	151°30'39.836"W	Southern limit of survey, west of corridor
Pipeline Junction	60°45'48.383"N	151°30'15.505"W	Junction at Shell-C
Single Pipeline	60°46'19.027"N	151°29'59.615"W	Pipeline departs corridor to the east
Single Pipeline	60°47'29.573"N	151°29'34.563"W	Outside of corridor SE of Shell-A
Pipeline Junction	60°47'42.766"N	151°29'52.347"W	Junction at Shell-A

H-10833 Depth in Fathoms	Latitude	Longitude	Comment on agreement with Chart
7.7	60° 46' 33.724" N	151° 25' 59.183" W	Near 8 Fathom chart 7_4
10.5	60° 47' 13.942" N	151° 27' 03.734" W	Rock near 13 fathom chart 10_3 RK
9.7	60° 46' 16.129" N	151° 28' 23.273" W	Near 11 Fathom Chart 9_4
13.8	60° 46' 48.112" N	151° 29' 04.889" W	Near 10 Fathom 1 Foot Chart 9_5 in vicinty
14.0	60° 46' 04.810" N	151° 31' 54.304" W	Near 10 Fathom 3 Feet Chart 10_3 in vicinity
14.9	60° 47' 16.535" N	151° 31' 51.104" W	Near 11 Fathom Chart 10_3 in vicinity
19.6	60° 47' 38.755" N	151° 31' 22.298" W	Near 23 Fathom chart 19
11.8	60° 47' 22.818" N	151° 32' 29.756" W	Near 17 Fathom Chart 11
24.0	60° 47' 21.639" N	151° 32' 37.865" W	On 20 Fathom curve Chart area as shown on SS
20.0	60° 48' 26.647" N	151° 28' 54.829" W	Well outside 20 Fathom curve chart area as shown on SS
30.0	60° 41' 26.996" N	151° 34' 42.209" W	Well outside 30 Fathom curve chart area as shown on smoothsheet.
27.0	60° 43' 58.222" N	151° 34' 17.665" W	On 20 fathom curve Chart area as shown on SS.

O. Not Used by Contractor ✓

P. Aids to Navigation ✓

There were no Aids to Navigation found in this survey. — CONCUR

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)	971.30
Lineal Nautical Miles of Side Scan Sonar	0
Square Nautical Miles (100% Shallow Water Multibeam Coverage)	15.2
Days of Data Acquisition	22
Total Number of Soundings	247,249,979
Number of Selected Soundings on Preliminary Smooth Sheet	24,044
Number of Detached Positions	0
Number of Bottoms Samples	63
Number of Velocity Casts	97
Number of Supplemental tide stations installed	0
Number of Horizontal Control Stations Occupied / Established	1
Number of Items Investigated	0

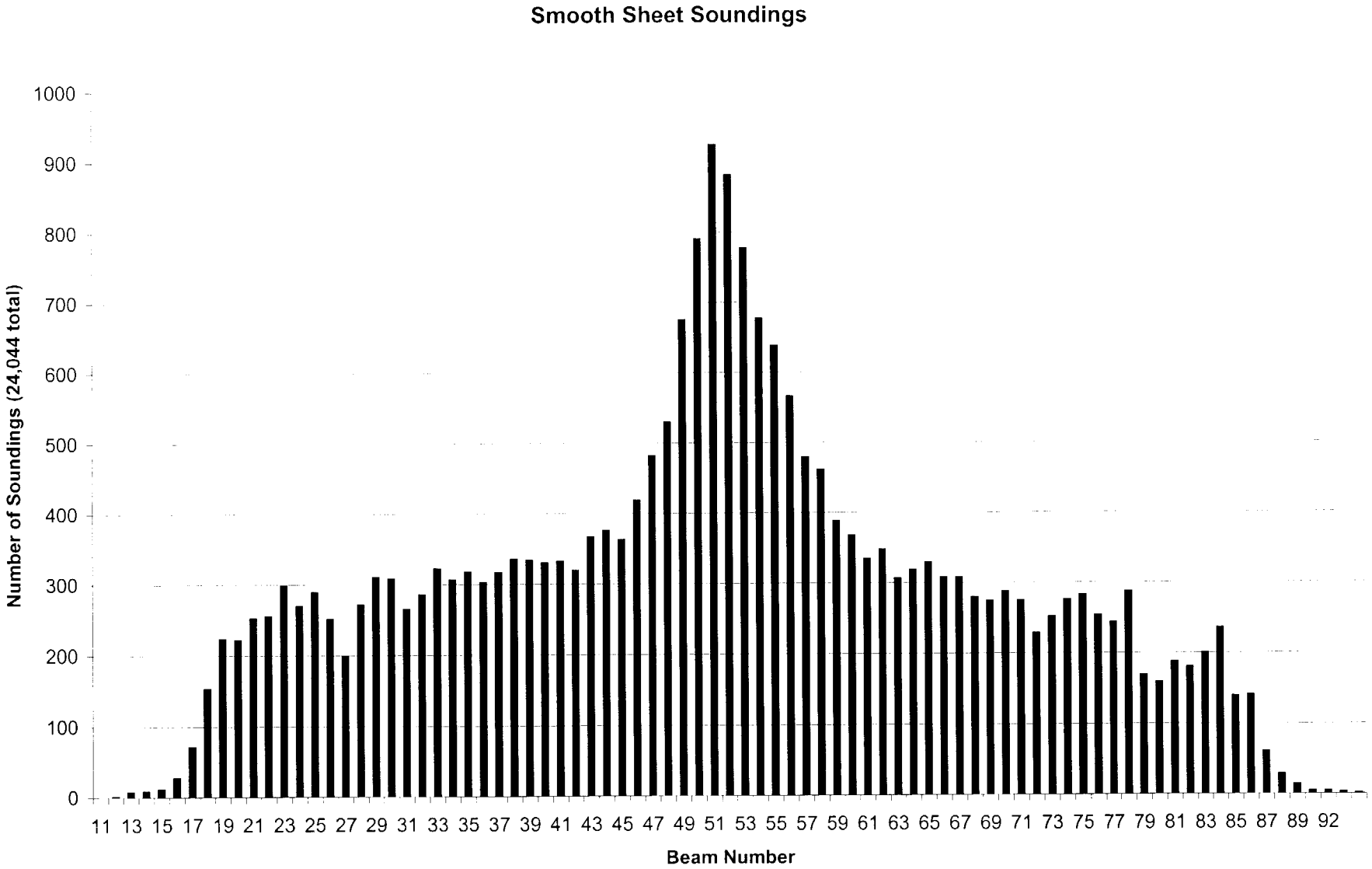
R. Miscellaneous ✓

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

Reson 8101

Beam # v.s. # of sounds on smooth sheet

Beam	Beam Count
11	1
12	7
13	8
14	11
15	27
16	71
17	153
18	223
19	222
20	252
21	255
22	298
23	269
24	289
25	251
26	199
27	271
28	310
29	308
30	265
31	285
32	322
33	306
34	317
35	302
36	316
37	335
38	333
39	330
40	332
41	319
42	366
43	375
44	362
45	418
46	481
47	529
48	675
49	790
50	924
52	777
53	677
54	638
55	566
56	479
57	461
58	388
59	367
60	334
61	347
62	306
63	318
64	329
65	307
66	307
67	279
68	274
69	287
70	274
71	228
72	251
73	275
74	282
75	253
76	243
77	287
78	169
79	159
80	187
81	180
82	200
83	235
84	139
85	140
86	60
87	28
88	14
89	4
90	4
92	2
94	1
Total	24044


Smooth Sheet Soundings
Number of Soundings (24,044 total)
1000
900
800
700
600
500
400
300
200
100
0
11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67 69 71 73 75 77 79 81 83 85 87 89 92
Beam Number

S. Recommendations ✓

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

TERRA SURVEYS LLC
Terrestrial and Sea Floor Mapping

May 21, 1999

ADVANCE INFORMATION

Commander (OAN)
Seventeenth Coast Guard District
P.O. Box 25517
Juneau, Alaska 99802-5517

Reference: NOAA Survey Number H-10833
Contract Number OPR-P367-KR

Dear Sir:

While conducting hydrographic survey operations for the approaches to Nikiski, Alaska (NOAA survey H-10833), Terra Surveys, LLC found shoal soundings and rocks either uncharted or shown deeper than this survey indicates. Attached is the Danger to Navigation Report and a section of chart 16662 indicating the position of these dangers.

Differential GPS and multibeam sonar were used to determine the position and depth. These data are preliminary and subject to office review.

Sincerely,
Terra Surveys, LLC

Thomas S. Newman, PLS
Partner

Enclosures

Cc: Gary Nelson
NOAA (COTR)

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

TERRA SURVEYS LLC
Terrestrial and Sea Floor Mapping

REPORT OF DANGER TO NAVIGATION

ADVANCE INFORMATION

Hydrographic Survey Registry: H-10833
State: Alaska
General Locality: Cook Inlet
Sublocality: Northern Approach to Port of Nikiski
Project Number: OPR-P367-KR

The following items were found during hydrographic survey operations:

Objects Discovered: Rocks and Shoal Soundings

Shoal soundings and rocks were found within the survey area, the most significant of which are listed below.

All items listed were corrected to Mean Lower Low Water using observed tide correctors and affect charts:

Chart Number	Edition (Number / Date)
16662	5 / July 05, 1997
16663	5 / July 12, 1996
16660	27 / April 19, 1997

							Geographic Position	
ITEM	Description	RADIUS	REPORTED DEPTH			CHARTED HORIZ DATUM	LATITUDE	LONGITUDE
A	sounding	N/A	10	Fathoms	3 Feet	NAD 83	60 47' 28.545" N	151 28' 57.361" W
B	sounding	N/A	10	Fathoms	5 Feet	NAD 83	60 46' 36.835" N	151 31' 36.530" W
C	sounding	N/A	9	Fathoms	5 Feet	NAD 83	60 45' 59.793" N	151 28' 52.269" W
D	sounding	N/A	9	Fathoms	5 Feet	NAD 83	60 46' 11.138" N	151 28' 48.353" W
E	sounding	N/A	10	Fathoms	4 Feet	NAD 83	60 47' 35.411" N	151 28' 19.988" W
F	rock	N/A	10	Fathoms	2 Feet	NAD 83	60 46' 03.804" N	151 24" 17.412" W
G	rock	N/A	10	Fathoms	2 Feet	NAD 83	60 45' 48.645" N	151 25' 22.187" W
H	sounding	N/A	9	Fathoms	5 Feet	NAD 83	60 45' 29.457" N	151 26' 32.070" W
I	sounding	N/A	10	Fathoms	4 Feet	NAD 83	60 47' 17.007" N	151 27' 37.858" W
J	rock	N/A	9	Fathoms	4 Feet	NAD 83	60 47' 00.373" N	151 27' 21.415" W
K	rock	N/A	9	Fathoms	5 Feet	NAD 83	60 46' 03.920" N	151 24' 50.214" W
L	rock	N/A	9	Fathoms	2 Feet	NAD 83	60 45' 50.468" N	151 27' 11.065" W
M	rock	N/A	9	Fathoms	2 Feet	NAD 83	60 45' 34.366" N	151 31' 56.483" W
N	rock	N/A	9	Fathoms	5 Feet	NAD 83	60 47' 04.791" N	151 27' 58.082" W

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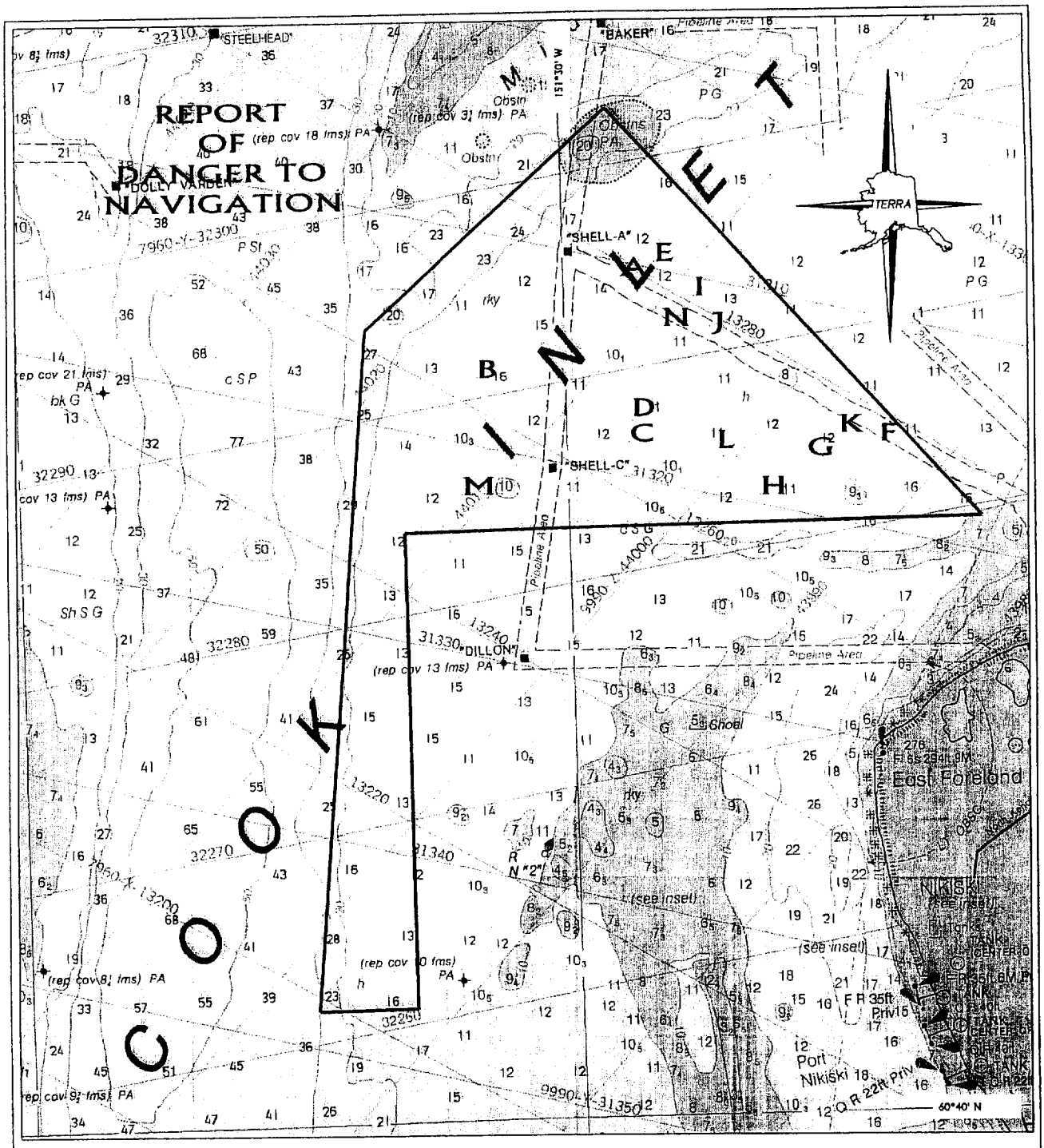

OPR-P367-KR
H-10833
Northern Approach to Port of Nikiski
Surveyed By Terra Surveys, LLC
Lead Hydrographer: Robert Kohut
Survey Vessel: Sea Ducer
Chart 16662 5th Ed., July 5, 1997
Scale of Sketch: 1:100,000
Scale of Survey 1:10,000

REFER TO ACCOMPANYING TEXT FOR ITEM DETAILS

ADVANCE INFORMATION

TERRA SURVEYS LLC
Terrestrial and Sea Floor Mapping

ADVANCE INFORMATION

May 21, 1999

Commander (OAN)
Seventeenth Coast Guard District
P.O. Box 25517
Juneau, Alaska 99802-5517

Reference: NOAA Survey Number H-10833
Contract Number OPR-P367-KR

Dear Sir:

While conducting hydrographic survey operations for the approaches to Nikiski, Alaska (NOAA survey H-10819), Terra Surveys, LLC found a pipeline outside of its charted corridor. Attached is the Danger to Navigation Report and a section of chart 16662 indicating the position of these pipelines.

Differential GPS and multibeam sonar were used to determine the position of the pipelines. These data are preliminary and subject to office review.

Sincerely,
Terra Surveys, LLC

Thomas S. Newman, PLS
Partner

Enclosures

Cc: Gary Nelson
NOAA (COTR)

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ADVANCE
INFORMATION

TERRA SURVEYS LLC
Terrestrial and Sea Floor Mapping

REPORT OF DANGER TO NAVIGATION

Hydrographic Survey Registry:	H-10833
State:	Alaska
General Locality:	Cook Inlet
Sublocality:	Northern Approach to Port of Nikiski
Project Number:	OPR-P367-KR

The following items were found during hydrographic survey operations:

Objects Discovered: Pipeline outside its charted corridor.

Within the survey area bounded by Latitude 60°45.0'N and 60°49'N and Longitudes 151°22.5'W and 151°34.0'W a pipeline which connects Shell-A and Shell-C was found outside its charted corridor. The pipeline was detected as much as 160 meters to the east of the corridor in this section. In addition, the pipeline was detected to the west of the corridor in the section between Shell-A and Dillon at the southern edge of this survey.

This affects charts:

Chart Number	Edition (Number / Date)
16662	5 / July 05, 1997
16663	5 / July 12, 1996
16660	27 / April 19, 1997

Route of single pipeline from Southern Limit of survey to Shell-A Platform:

Item	Latitude	Longitude	Comment
Single Pipeline	60°45'13.529"N	151°30'39.836"W	Southern limit of survey, west of corridor
Pipeline Junction	60°45'48.383"N	151°30'15.505"W	Junction at Shell-C
Single Pipeline	60°46'19.027"N	151°29'59.615"W	Pipeline departs corridor to the east
Single Pipeline	60°47'29.573"N	151°29'34.563"W	Outside of corridor SE of Shell-A
Pipeline Junction	60°47'42.766"N	151°29'52.347"W	Junction at Shell-A

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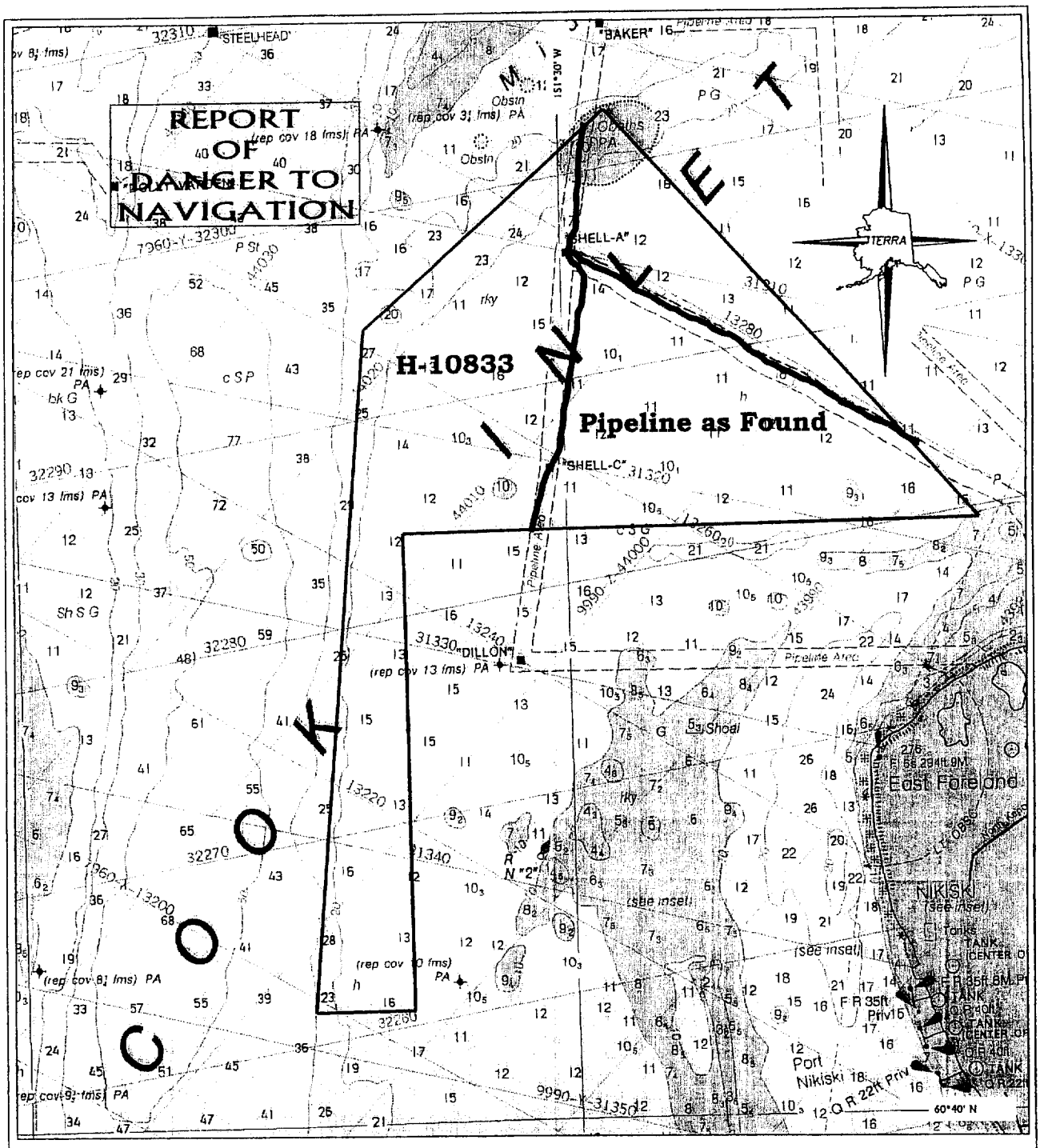

OPR-P367-KR
H-10833
Northern Approach to Port of Nikiski
Surveyed By Terra Surveys, LLC
Lead Hydrographer: Robert Kohut
Survey Vessel: Sea Ducer
Chart 16662 5th Ed., July 5, 1997
Scale of Sketch: 1:100,000
Scale of Survey 1:10,000

REFER TO ACCOMPANYING TEXT FOR ITEM DETAILS

0 1 2 3

Nautical Miles

ADVANCE INFORMATION

TERRA SURVEYS LLC
Terrestrial and Sea Floor Mapping

LETTER OF APPROVAL

REGISTRY NO. H-10833

This report and the accompanying smooth sheet are respectfully submitted.

Field operations contributing to the accomplishment of survey H-10833 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

NOAA FORM 76-155
(11-72)

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

GEOGRAPHIC NAMES

SURVEY NUMBER

H-10833

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
NIKISKI (title)	X		X							3
				Approved						4
				Dennis J. Ramestine						5
				Chief, Party						6
							NOV 14 2000			7
										8
										9
										10
										11
										12
										13
										14
										15
										16
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										22
										23
										24
										25

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-10883

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

RECORD DESCRIPTION	AMOUNT	RECORD DESCRIPTION	AMOUNT
SMOOTH SHEET		SMOOTH OVERLAYS: POS., ARC, EXCESS	2
DESCRIPTIVE REPORT		FIELD SHEETS AND OTHER OVERLAYS	

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

SHORELINE DATA

SHORELINE MAPS (List):

PHOTOBATHYMETRIC MAPS (List):

NOTES TO THE HYDROGRAPHER (List):

SPECIAL REPORTS (List):

NAUTICAL CHARTS (List): 16662, 4th Ed., 7/5/97

OFFICE PROCESSING ACTIVITIES

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

PROCESSING ACTIVITY	AMOUNTS		
	VERIFICATION	*EVALUATION*	*TOTALS*
POSITIONS ON SHEET			
POSITIONS REVISED			
SOUNDINGS REVISED			
CONTROL STATIONS REVISED			
	TIME-HOURS		
	VERIFICATION	*EVALUATION*	*TOTALS*
PRE-PROCESSING EXAMINATION	15.0		15.0
VERIFICATION OF CONTROL			
VERIFICATION OF POSITIONS			
VERIFICATION OF SOUNDINGS			
VERIFICATION OF JUNCTIONS			
APPLICATION OF PHOTOBATHYMETRY			
SHORELINE APPLICATION/VERIFICATION			
COMPILATION OF SMOOTH SHEET	139.0		139.0
COMPARISON WITH PRIOR SURVEYS AND CHARTS			
EVALUATION OF SIDE SCAN SONAR RECORDS			
EVALUATION OF WIRE DRAGS AND SWEEPS			
EVALUATION REPORT		42.0	42.0
GEOGRAPHIC NAMES			
OTHER* (Chart Compilation)		43.0	43.0
*USE OTHER SIDE OF FORM FOR REMARKS — TOTALS	154.0	85.0	239.0

Pre-processing Examination by G.Nelson	*Beginning Date* 5/9/00	*Ending Date* 5/25/00
Verification of Field Data by G. Nelson, D. Hill, B. Mihailov	*Time (Hours)* 154	*Ending Date* 11/20/00
Verification Check by Leo Mirabito	*Time (Hours)* 15.0	*Ending Date* 4/16/01
Evaluation and Analysis by B. Mihailov	*Time (Hours)* 42.0	*Ending Date* 11/30/00
Inspection by Leo Mirabito	*Time (Hours)* 3.0	*Ending Date* 4/16/01

EVALUATION REPORT

H-10833

A. PROJECT

Survey H10833 was conducted under contract 50-DGCN-8-90021 awarded on April 10, 1998. A Statement of Work (SOW), dated November 28, 1997 contains specific requirements. The purpose of this contract is 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 Survey Division (N/CS35)

B. AREA SURVEYED

The survey area is adequately described in the hydrographer's report. Page-size plots of the charted area depicting the limits of supersession accompany this report as Attachment 1.

Depths range from 7.7 to 33 fathoms. Bottom characteristics are sand, gravel and pebbles

C. SURVEY VESSELS

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

D. AUTOMATED DATA ACQUISITION AND PROCESSING

Hydrographic data were acquired using a Reson SEABAT 8101 shallow water multibeam system. Data acquisition and processing procedures employed in the field have been adequately documented in the hydrographer's report, section D.

Office review of survey data and the preliminary smooth sheet was accomplished at the Pacific Hydrographic Branch. The final smooth sheet was compiled with MicroStation 95.

The smooth sheet drawing is filed in the MicroStation format, i.e., dgn extension. A copy of this file has been forwarded to the Hydrographic Surveys Division and a backup copy retained at PHB.

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 the NOS Hydrographic Surveys Specifications and Deliverables.

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

E. SONAR EQUIPMENT

Towed side scan sonar was not utilized during this survey.

F. SOUNDING EQUIPMENT

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

G. CORRECTIONS TO SOUNDINGS

Soundings have been reduced to Mean Lower Low Water (MLLW), with verified tide data obtained from the Ocean Products and Services Division (OPSD) Home Page "Hydro Hot List". The approved tide correctors are zoned from Nikiski, Alaska, gage 945-5760. Further information concerning tides can be found in section G of the hydrographer's report.

Other sounding reducers include corrections for static draft, dynamic draft, sound velocity, heave, roll and pitch. These reducers have been reviewed and are consistent with NOS specifications.

H. CONTROL STATIONS

The positions of horizontal control stations used during hydrographic operations are established by Terra Surveys, LLC based on NAD 83.

The smooth sheet is annotated with an NAD27 adjustment tick based on values determined with the NGS program NADCON. Geographic positions based on NAD27 may be plotted on the smooth sheet utilizing the NAD 83 projection by applying the following corrections.

Latitude:	-2.019 seconds	(-62.484 meters)
Longitude:	8.074 seconds	(122.303 meters)

I. HYDROGRAPHIC POSITION CONTROL

Hydrographic position control has been adequately discussed in the hydrographer's report.

J. SHORELINE

There is no shoreline within the limits of survey H-10833.

K. CROSSLINES

Crosslines are adequately discussed in the hydrographer's report.

L. JUNCTIONS

Survey H-10833 junctions with the following surveys

Survey	Year	Scale	Area
H-10802	1998	1:10,000	East
H-10819	1998	1:10,000	South

The junctions with surveys H-10802 and H-10819 have not formally been completed since these surveys have been processed and forwarded for charting. However, a comparison with the present survey reveals good agreement. A few depths have been transferred to the present survey in order to better delineate the bottom configuration. "Adjoins" notes has been added to the smooth sheet to reflect this situation.

M. COMPARISON WITH PRIOR SURVEYS

Survey	Year	Scale	Datum
H-9541	1975	1:20,000	NAD 27
H-9619	1976	1:20,000	NAD 27
H-9621	1976	1:20,000	NAD 27

Prior survey H-9541, H-9619 and H-9621 covers the entire area of the present survey area. The present survey was compared to digital copies of the prior surveys. The registration of these prior surveys to the present survey was good. The legibility of the digital copies was good. Sounding agreement is good with the present survey depths shoaler by 1 to 2 fathoms. Some of this difference is caused by the adjusted vertical datum in Cook Inlet; see section G for further information of the datum adjustment. These differences are attributed to greater sounding coverage and the new vertical datum adjustment as well as the natural erosion and deposition of bottom sediments in the area.

Survey H-10833 is adequate to supersede the prior surveys within the common area.

N. ITEM INVESTIGATIONS

No AWOIS items were specifically assigned for this survey. However, during office processing AWOIS item 52426 was evaluated.

O. COMPARISON WITH CHART

Survey H-10833 was compared with the following chart.

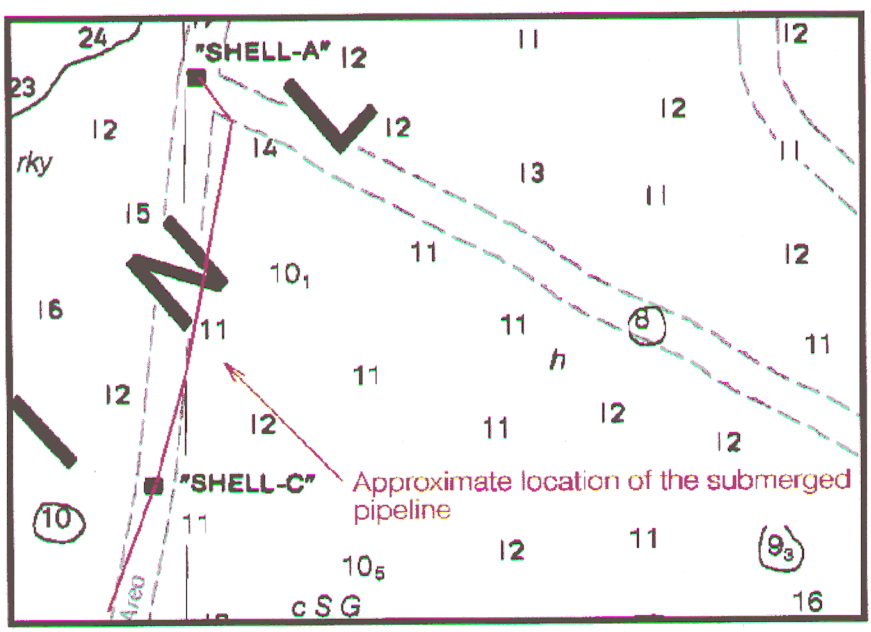
Chart	Edition	Date	Scale
16662	5th	July 5, 1997	1:100,000 and 1:50,000

a. Hydrography

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

Charted miscellaneous source data has been satisfactorily addressed during survey operations, with the exception of AWOIS item 52426.

The limits of the submerged pipeline charted between latitude 60/45/13N. longitude 151/30/40W and latitude 60/47/42N, longitude 151/29/52W, should be revised as the result of this survey. Multibeam coverage of the area reveals that the pipeline falls outside of the charted pipeline area limits. Consideration should be made on revising the submerged pipeline limits to cover the pipeline between latitude 60/45/13N, longitude 151/30/40W and latitude 60/47/30N, longitude 151/29/35W. See graphic below.



AWOIS 52426: The limits of the Obstruction PA was not fully covered by multibeam, therefore it should be retained as charted.

With the exception of the above, survey H-10833 is adequate to supersede charted hydrography within the area of coverage.

b. Dangers To Navigation

Fifteen dangers to navigation were discovered during survey operations and reported to the USCG on March 21, 1999. Copies of these reports are attached. No additional dangers were found during office processing

P. ADEQUACY OF SURVEY

The hydrography contained on survey H10833 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.

With the exception of the following the hydrographic records and reports received for processing are adequate and conform to the requirements of the NOS Hydrographic Surveys Specifications and Deliverables. dated November 29, 1997 and Statement of Work , dated November 28, 1997.
The descriptive report format does not follow the section labeling scheme specified in the Specs and Deliverables, section 8.1.3. This includes the identification of appendices.

Q. AIDS TO NAVIGATION

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

There were no features of landmark value located within the area of this survey.

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.

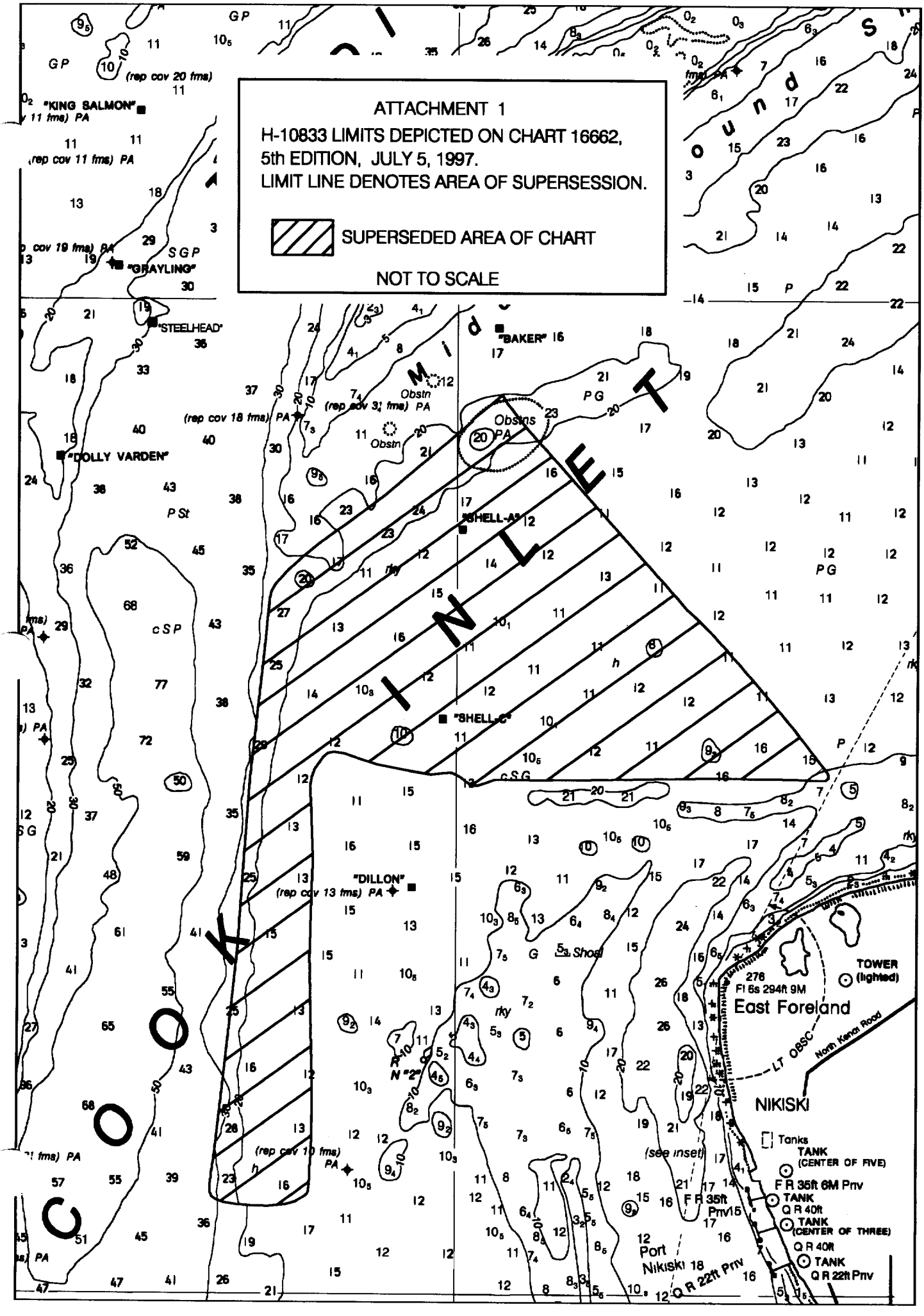
T. RECOMMENDATIONS

This is a good hydrographic survey.

U. REFERRAL TO REPORTS

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

Bob Mihailov
Cartographer


ATTACHMENT 1
H-10833 LIMITS DEPICTED ON CHART 16662,
5th EDITION, JULY 5, 1997.
LIMIT LINE DENOTES AREA OF SUPERSESSION.
SUPERSEDED AREA OF CHART
NOT TO SCALE
COOK INLET
Middle Ground Shoal
"KING SALMON"
"GRAYLING"
"STEELHEAD"
"DOLLY VARDEN"
"BAKER"
"SHELL-A"
"SHELL-C"
"DILLON"
(rep cov 20 fms)
(rep cov 11 fms) PA
(rep cov 19 fms) PA
(rep cov 18 fms) PA
(rep cov 3¼ fms) PA
(rep cov 13 fms) PA
(rep cov 10 fms) PA
Obstn
Obstns PA
PG
PSt
cSP
cSG
SGP
rky
Shoal
TOWER (lighted)
276
Fl 6s 294ft 9M
East Foreland
LT OBSC
North Kenai Road
NIKISKI
(see inset)
Tanks
TANK (CENTER OF FIVE)
F R 35ft 6M Prnv
TANK
Q R 40ft
TANK (CENTER OF THREE)
Q R 40ft
TANK
Q R 22ft Prnv
F R 35ft Prnv15
Port Nikiski 18
Q R 22ft Prnv

APPROVAL SHEET
H-10833

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 Leonard T. Pendleton Date: 5/23/01
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: 5-29-01
James C. Gardner
Captain, NOAA
Chief, Pacific Hydrographic Branch

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Final Approval

Approved:

Samuel P. de Bow Date: June 12, 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-10833

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	12/5/00	B. Mihailov	Full ~~Part~~ ~~Before~~ After Marine Center Approval Signed Via Full application
			Drawing No. of sndgs & features from Smooth Sheet.
			Full Part Before After Marine Center Approval Signed Via
			Drawing No.
			Full Part Before After Marine Center Approval Signed Via
			Drawing No.
			Full Part Before After Marine Center Approval Signed Via
			Drawing No.
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			Full Part Before After Marine Center Approval Signed Via
			Drawing No.

SUPERSEDES C&GS FORM 8352 WHICH MAY BE USED.