H10906

NOAA FORM 76-35A

C

U.S. DEPARTMENT OF COMMERCE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

NATIONAL OCEAN SERVICE

DESCRIPTIVE REPORT

Type of Survey Hydrographic

Field No. N/A

Registry No. H-10906

LOCALITY

State Alaska

General Locality Cook Inlet

Sublocality East of North Foreland

2000

CHIEF OF PARTY

Doug Lockhart-Racal Pelagos-San Diego, CA

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DATE

NOAA FORM 77-28 (11-72)

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

REGISTER NO.
H-10906

HYDROGRAPHIC TITLE SHEET

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.
NA

State **ALASKA**

General Locality **Cook Inlet**

Sublocality **East of North Foreland**

Scale **1:20,000** Date of Survey **Jul. 23, 1999 - Aug. 15,1999**

Instructions Date **5/1/1998** Project No. **OPR-P385-KR**

Vessel **F/V Quicksilver, F/V Davidson**

Chief of Party **Doug Lockhart**

Surveyed by **Lockhart, Mckensie, Arumugum, Moyles, Busey, Woodford, Greene, Rybarski et al**

Soundings taken by echo sounder **Reson 8101**

Graphic record scaled by **RACAL PELAGOS PERSONNEL**

Graphic record checked by **RACAL PELAGOS PERSONNEL**

Evaluation by **B. Mihailov** Automated plot by **HP Design Jet 1050c**

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

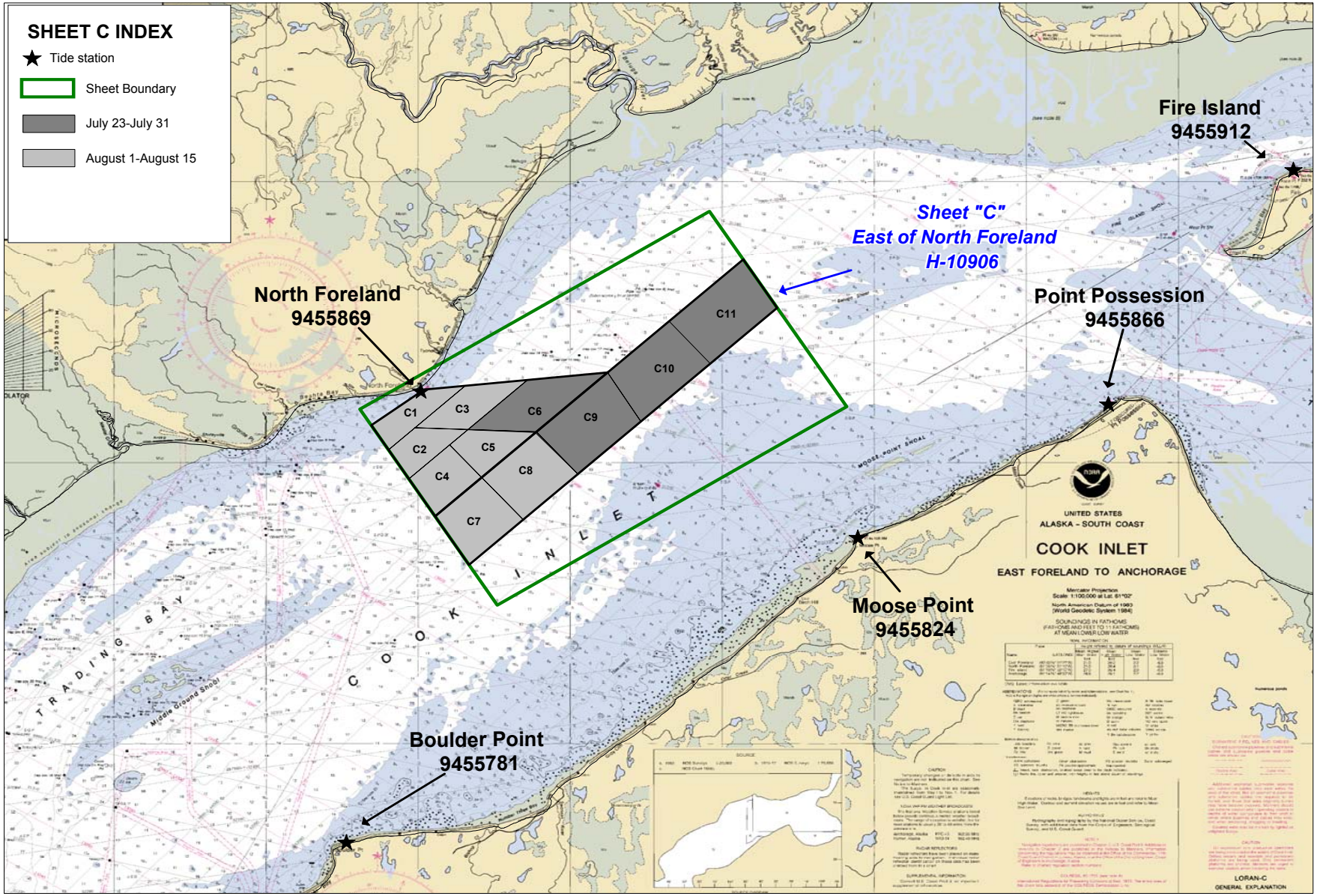
Soundings in **Fathoms and tenths** at **MLLW**

REMARKS: **The purpose of this work is to provide NOAA with modern and accurate data for Fire Island Shoal to Beluga Shoal**

PHB Revision: Report has been evaluated. Comments, revisions, and corrections are entered as endnotes.

ALL TIMES ARE RECORDED IN UTC.

RACAL PELAGOS	**LCMF INC**	**TERRA SURVEYS**
3738 RUFFIN ROAD	**139 EAST 51ST Ave.**	**1930 South Whiting Circle**
San Diego, CA	**Anchorage, AK 99503**	**Palmer, AK 99645**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UNITED STATES
ALASKA - SOUTH COAST
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GENERAL EXPLANATION

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Descriptive Report to Accompany Hydrographic Survey H-10906

Scale1: 20000
July 1999
Racal Pelagos, Inc.
R/V Davidson, F/V Quicksilver
Lead Hydrographer: Doug Lockhart

A – Project

Project Number: OPR-P385-KR-98 [2]
Registry Number: H-10906
State: Alaska
Locality: Cook Inlet
Sub-Locality: East of North Foreland
Sheet C

Original Instructions: May 01, 1998
Change 1, SOW Attachment #1, July 28,1998

The purpose of this work is to provide NOAA with modern, accurate hydrographic survey data along the shipping approaches to Anchorage, Alaska, through Cook Inlet.

B - Area Surveyed

The area surveyed is a corridor of 3.7 to 10 km in width, and approximately 25.0 km in length. The corridor runs roughly parallel to the northern shoreline of Cook Inlet. An additional trapezoidal area, extending from North Foreland to the corridor was also surveyed. The sea floor in this regain[3] is characterized with a streambed like morphology resulting from increased tidal flow rates between North and East Foreland. The Northern end of the survey area is dominated by boulders[4] while the Southern and Western sections exhibits sand waves and dunes.

Hydrographic data collection began on July 23, 1999 and ended on August 15, 1999. The total area surveyed was 44.1 square nautical miles.

Survey Limits

Work Order #4
Sheet C

Point #	Positions on NAD83	
	Degrees Latitude (N)	Degrees Longitude (W)
1	61.120264	150.809445
2	61.091641	150.772222
3	60.939820	151.110444
4	60.968495	151.147666
5	61.022304	151.217793
6	61.043411	151.159782
7	61.053504	150.958412
8	61.120264	150.809445

C - Survey Vessels

Processing Ship	R/V Davidson
Official Number	1066485
Owner	Venture Pacific Marine, Inc.
Year Built	1967
Length	153 ft
Beam	38
Draft	17.8
Tonnage	
Gross	883
Net	250
Power	2000 hp
Electrical	2x250

Survey Launch	F/V Quicksilver
Official Number	947419
Owner	Marcus Ballweber
Year Built	1989
Length	32 ft
Beam	15.5
Draft	3
Tonnage	
Gross	28
Net	15
Power	800 hp
Electrical	5 kW

R/V DAVIDSON

The R/V Davidson functioned as a hotel ship and processing lab. Whisker poles were added to both sides of the vessel at mid-ship to accommodate the survey launch and supply vessel. The survey launch, Quicksilver, used the starboard side and the supply vessel, Kazor, used the port side. A gangplank was suspended from the "A" frame on the stern of the Davidson for additional access.

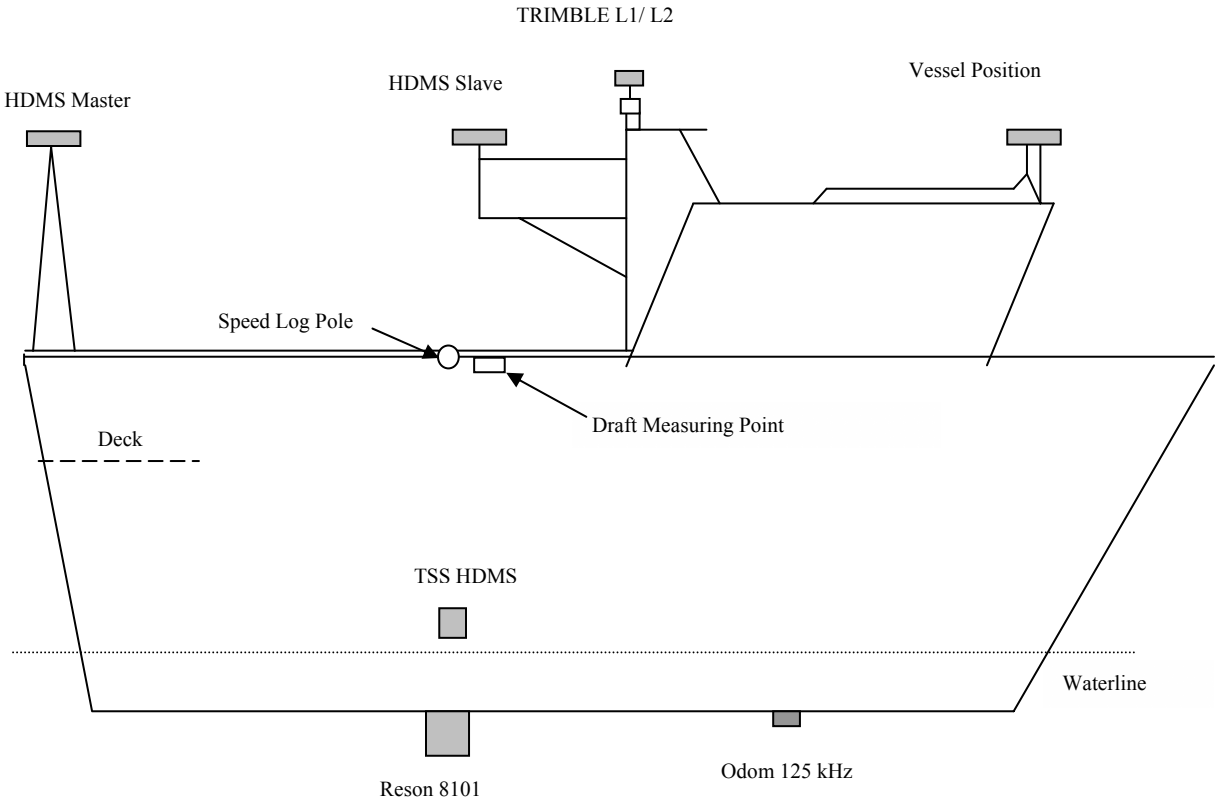
F/V QUICKSILVER

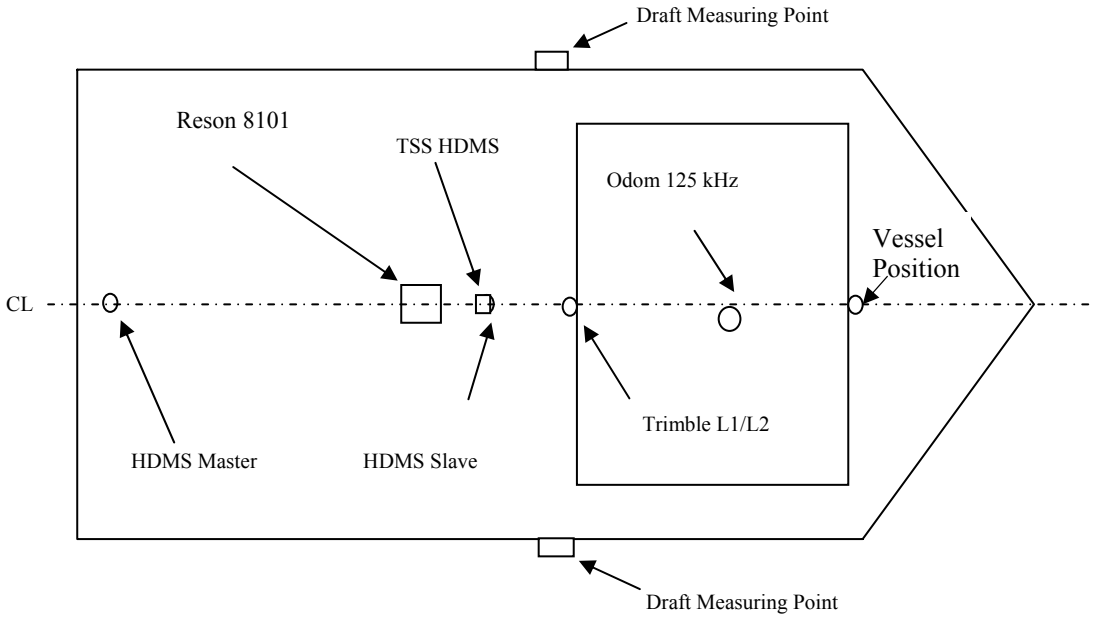
The F/V Quicksilver was refit in Seattle to accommodate a survey crew and acquisition hardware. The keel was cut just aft of mid-ship and a Reson 8101 multibeam sonar was installed. The sonar head was protected forward by a conical cowling and aft by a crescent shaped skid. The accelerometer package for a TSS HDMS was installed directly on top of the 8101 head. A 125 kHz Odom single beam transducer was installed on the starboard side of the keel, 2.69-m forward of the 8101.

Initially, two Novatel antennas were installed for positioning and heading. One directly over the 8101 and accelerometers, the other forward 5.28-m. The aft antenna was used for both the vessel position and as the HDMS master antenna. The forward antenna functioned as the HDMS secondary. During survey operations in Sheet A, degrading HDMS performance resulted in a new antenna configuration. On May 25, 1999, a third antenna was installed above the vessel stern. This antenna was then used as the HDMS master. The center antenna became the HDMS secondary, and the forward antenna was used for vessel position.

A speed log to aid settlement calculations was installed on a pole mount on the starboard side of the Quicksilver. This mount also held an Odom Digibar that was used to monitor surface sound velocities. Two ALM Smart Probe SV&P sensors were deployed from a davit on the starboard side using a small hydraulic winch mounted near the stern.

The quicksilver was fitted with depressors during final mobilization in Homer. These devices are simply weighted, bird shaped pieces of steel that hang in the water on either side of the vessel. The depressor's primary function is to reduce vessel roll. The Quicksilver was operated with the depressors deployed or stowed depending on the needs of the survey crew. Beginning on May 13, depressor status was noted on all survey line logs.





D - Automated Data Acquisition and Processing

ACQUISITION

The primary data set, positions, attitudes, and soundings, was collected with Racal Pelagos' Winfrog Multibeam (WFMB) integrated navigation software. WFMB operated on a Pentium based PC running Windows NT and used a Novatel GPS card for positioning. Digiboard serial interface cards were installed to provide serial ports for all devices.

The WFMB software package uses the 1 PPS output from the Novatel card to continually synchronize the PC clock with GPS time. During timing tests prior to the survey, WFMB was shown to have approximately a 4 millisecond RMS error between the ping and attitude time stamps.

The following windows are available in WFMB for the operator to monitor data quality:

Devices: The Devices window shows the operator which hardware is attached to the PC. It also allows the operator to configure the devices, determine whether they are functioning properly and view data received.

Graphic: The Graphic window shows navigation information in plan view. This includes vessel position, survey lines, and background plots and charts.

Vehicle: The Vehicle window can be configured to show any tabular navigation information required. Typically, this window displays position, time, line name, heading, HDOP, speed over ground, distance to start of line, distance to end of line, and distance off line. Many other data items are selectable.

Calculation: The Calculation window is used to look at specific data items in tabular or graph format. Operators look here to view 1PPS performance, singlebeam to nadir multibeam comparisons, GPS satellite constellations, and position solutions.

Waterfall: The Waterfall display can be configured to view bathymetric or side scan data.

Profile: The Profile window displays the current multibeam profile and the vessel attitude.

Ping Scroller: The Ping Scroller window displays the current profile and a short history of profiles. The profile scrolls down the window and can be filtered by beam number and quality.

QC View: The QC View window displays binned soundings in plan view. The bin size is user defined and can be filtered by beam number and quality.

3-D View: The 3-D window displays a 3-D mesh of the current line of profiles. The mesh can be rotated to a user-specified angle and vertical exaggeration.

Winfrog Multibeam writes XTF, RAW, and DAT files. The XTF files contain all multibeam bathymetry, position, attitude, and heading data required by CARIS to process the soundings. The RAW and DAT files contain position, RTCM, HDOP, singlebeam, speed log, attitude, and heading data as well as event records. The DAT files were not used in the processing on this survey. The RAW files were used for position QC and speed through the water requirements.

Sound velocity profile data from the AML Smart Probes was acquired using Procomm. Data from the SeaBird CTD was acquired using the SeaBird TERM19 program.

PROCESSING

Soundings

All sounding data was processed using Universal Systems CARIS HIPS on Unix workstations running Sun Solaris V7. Three separate filter settings were used during processing: 1783, 1783nad, and 1783nad55. All three used a 5-degree minimum angle filter and rejected all soundings with a quality flag other than 3. Setting file 1783 rejected beams 1-11 and 90-101. File 1782NAD rejected beams greater than 60 degrees past nadir and 1783NAD55 rejected beams greater than 55 degrees past nadir. The filter setting used on each line were noted on the line log. Shallow biased sounding were imported into CARIS work files on a ten meter grid then over-write suppressed for the preliminary smooth sheet.

In high noise areas additional filters may have been applied to specific screens or entire lines. In these instances, the additional filters are noted on the line logs.

Task specific processing was developed for sound velocity corrections and settlement. Tidal correctors were zoned using the CARIS utility in NOAA's HP Tools suite.

Navigation

Raw navigation records were recorded by Winfrog along with ancillary data such as heave, pitch, roll, heading, and speed through the water. Ribbit, a Racal-Pelagos software tool created specifically to manipulate Winfrog files, was used to view and extract individual data items from the raw navigation record. Immediately after each line survey line was run, the acquisition crew opened the raw records and examined position, speed over ground, HDOP, and heave records. Ribbit was also used to extract speed log data for the settlement calculation.

Sound Velocity Corrections

Due to the high data rates and slow descent and assent velocities, far more data was collected on each cast then was required. In addition, the AML probes report data to two decimal places and CARIS only uses one decimal place in depth and velocity. A custom utility was written using Wolfram Research Mathematica to reduce the raw SVP data to the maximum resolution required by CARIS.

Along with reducing the SVP data to CARIS resolution, the program, SVP_05, also compared the profiles from the two separate probes. Before SVP-05 was run, individual profiles were hand edited and split into files for the down and up portions of each cast. Hand editing was restricted to removing data points during the three-minute temperature equilibrium period. A basic algorithm for SVP_05 follows:

1) Read in data from the down and up casts from both probes (four files).
2) Covert pressure to depth and sort on order of increasing depth.
3) Decimate data to contain only one data point for any given 0.01-meter depth increment.
4) Generate an interpolation table for each of the four profiles.
5) Using the interpolation tables, build four new profiles with data points for every 0.01-meters of the total depth.
6) Average the interpolated down and up casts for each probe, resulting in two profiles with 0.01-meter depth resolution.
7) Smooth profiles using a moving median filter with a span of 11 data points (0.11-meter). The moving median filter was applied repeatedly until a constant profile was reached.
8) Calculate the RMS error between the smoothed profiles.
9) Decimate the profile to 0.1-meter depth changes and 0.1-meter/second velocity changes.
10) Plot the results and output final profiles.

The output from SVP_05 was appended to the project SVP file for CARIS, 1783.svp. A ray-bending program was written to test the error in soundings resulting from using the raw profiles and the processed profiles output from SVP_05. Random spot checks showed the error to be at most 0.0015-meters for a beam 60-degrees off nadir.

The RMS error between the two probes stayed below 0.20-m/s. This resulted in a 0.001-m error on beam 99 for cast 1999-148-1221 (this cast was complete for Sheet A , H-10892).

Settlement

A settlement curve was calculated for the F/V Quicksilver using RTK derived elevations. The curve was calibrated to engine RPM and speed log output. To estimate settlement, RPM values were hand logged for each line. Changes in RPM while on line were also noted in the line log. A file was created to store time and RPM values. In Microsoft Excel, a polynomial fit through the settlement curve was used to create a time versus settlement file from the RPM file. This file was appended to the project draft file for use by CARIS.

See Section H., Corrections to soundings for additional information on sound velocity profiles, settlement, and speed log calculations.

E - Side Scan Sonar

Towed side scan sonar operations were not required by this contract. [5]

F - Sounding Equipment

System	Manufacturer	Model	Serial Number
Multibeam echo sounder	Reson	SeaBat 8101 Processor	19245
		SeaBat 8101 Transducer	19245
Echo Sounder	Odom	DF3100MKII	9646
		125 kHz Transducer	PN910

Both sounders were installed prior to the start of the survey and were in use for the duration. No faults of any kind were observed on the sounding equipment during the survey. The singlebeam echo sounder was used at 125 kHz for the entire survey.

The Reson 8101 was operated at a range of 75 and 100 meters for Sheet C. See the individual Line Log sheets for additional details. Water depth varied from about 62 meters to 4 meters. Line orientation was along the length of swath C, roughly southwest to northeast. Survey lines were defined every 5 meters across track. Before the start of each line, the survey crew chooses the best line to maximize production and maintain coverage. Actual line spacing varied between 25 and 120 meters.

Along track, coverage was planned at 2 pings per meter. This was ensured by monitoring range and speed over ground. Maximum survey speeds were about 10 knots. Slower speeds, around 8 knots were more common. At the 75-meter range, the SeaBat acquires 10 pings per second. Ten knots corresponds to about 5 meters/second resulting in 2 pings per meter.

Sounding quality assurance tools consisted of the ping, waterfall, 3-D, ping scroller displays along with the Q/C Bin View and singlebeam to nadir beam comparison. The waterfall and ping displays allow the operator to view the data on a ping by ping basis. The Q/C Bin View display shows a plan view of tide corrected, motion compensated soundings. This view allows the operator to look across line for systematic error.

The singlebeam to multibeam nadir comparison was completed on each survey shift. This comparison looks for gross errors between the two sounders. Bar checks of the singlebeam and nadir multibeam were also completed when weather and currents allowed.

G - Corrections to Soundings

SOUND VELOCITY PROFILES

Sound velocity casts were done nominally every two hours during multibeam acquisition. Due to the high tidal currents, the sound velocity profiles were variable both geographically and temporally.

Sound Velocity Probes			
Make	**Model**	**Serial Number**	**Calibration Date**
Applied Microsystems Ltd.	Smart Sound Velocity and Pressure	4298-SV&P	3-February-1999
Applied Microsystems Ltd.	Smart Sound Velocity and Pressure	4300-SV&P	3-February-1999
Sea-Bird Electronics, Inc	SBE 19 SEACAT	193520-290	25-March-1999

The AML Smart Probes used for velocity correctors deliver 8 samples-per-second consisting of a pressure and velocity pair. For each cast, probes were held at the surface for two minutes for temperature equilibrium. The probes were then lowered and raised slowly (about 0.2 m/s) to maintain equilibrium. Between casts, the probes were stored in a barrel of fresh water to minimize salt-water corrosion and to help hold them at ambient water temperatures.

Data from the following casts were used to determine velocity correctors:

CAST #	DATE (UTC)	JULIAN DAY	TIME (UTC)	DEPTH (m)	NORTHING (m)	EASTING (m)
1	07/23/99	1999-204	12:13		6772777	634896
2			16:50	20.9	6770845	615417
3			18:47	20.7	6772862	618019
4			21:47	29.95	6772621	634075
5			23:33	28.21	6775501	620709
6	07/24/99	1999-205	01:53	25.93	6775348	620189
7			04:12	25.13	6775415	619759
8			06:30	23.81	6775751	619788
9			10:04	24.0	6771124	614931
10			12:24	24.0	6771826	615403
11			14:24	27.0	6776717	620177
12			17:05	27.0	6776973	619998
13			20:41	20.72	6772653	615223
14			23:23	24.44	6772506	614901
15	07/25/99	1999-206	01:20	30.99	6776544	618915
16			03:48	30.57	6777089	618684
17			05:51	28.0	6772808	614445
18			12:15	34.0	6772521	613375
19			15:15	28.0	6777073	617933
20			16:57	28.0		
21			20:47	27.87	6773917	613892
22			22:47	24.35	6777967	618340
23	07/26/99	1999-207	01:08	31.53	6773881	613699

CAST #	DATE (UTC)	JULIAN DAY	TIME (UTC)	DEPTH (m)	NORTHING (m)	EASTING (m)
24			03:22	28.88	6773611	613477
25			12:19	29.5	6773059	613254
26			13:52	31.0	6772864	612981
27			16:53	39.0	6771374	611927
28			20:58	24.52	6773489	614177
29			22:58	34.00	6769933	610850
30	07/27/99	1999-208	00:51	30.5	6773096	614781
31			03:27	38.19	6769209	611255
32			05:27	27.52	6772793	614669
33			10:17	32.0	6773105	614045
34			13:51	31.0	3770754	617449
35			15:15	31.0	6773577	615796
36			23:40	37.13	6771275	611347
37	07/28/99	1999-209	01:47	40.58	6768668	611125
38			03:29	26.2	6772724	615663
39			05:26	43.57	6768044	611033
40			09:32	20	6772205	615515
41			11:00	24	6770213	613668
42			12:59	40	6768145	611675
43			15:23	43	6767558	611449
44			16:42	34	6768747	612907
45			20:41	18.76	6771401	615311
46			22:27	33.99	6767638	612026
47			00:46	21.73	6771429	616271
48			03:09	36.61	6767234	612041
49			05:08	42.64	6763873	608737
50	07/29/99	1999-210	09:20	18	6767914	613927
51			10:59	47	6765917	608995
52			13:31	53	6763929	608172
53			15:39	56	6765250	609100
54			16:41	52	6765957	609720
55			20:48	31.42	6769216	612306
56			22:36	48.67	6767708	608266
57			23:59	37.27	6764461	607241
58	07/30/99	1999-211	02:56	41.53	6764564	607350
59			04:40	39.20	6769501	611938
60			10:20	33	6770096	612013
61			12:22	32	6764884	606533
62			13:47	32	6765197	606618
63			15:11	35	6765093	606482
64			16:37	32	6766458	607718
65			18:14	35	6769986	611096
66			21:30	27.3	6770292	610090
67			22:53	31.3	6770271	611102
68	07/31/99	1999-212	00:33	30.5	6765624	606425
69			02:10	29.4	6765769	606335
70			03:37	29.5	6765704	606008
71			05:18	36.9	6770688	610632
72			09:41	28	6771189	610875
73			10:49	25	6768563	608189
74			13:01	25	6765992	605382

CAST #	DATE (UTC)	JULIAN DAY	TIME (UTC)	DEPTH (m)	NORTHING (m)	EASTING (m)
75			14:23	28	6766003	605224
76			15:43	30	6765933	604930
77			16:28	34	6768846	607739
78			17:42	32	6770446	609190
79			22:35	31.5	6771257	609758
80			23:58	28.1	6770930	609329
81	08/01/99	1999-213	01:55	29.2	6765921	604261
82			03:26	31.4	6765842	603957
83			05:18	34.4	6770886	608801
84			09:38	30	6769732	610261
85			11:17	28	6767310	602693
86			12:31	27	6765953	603332
87			14:07	32	6766496	603804
88			16:01	34	6765830	603057
89			17:52	38	6770223	607324
90			20:57	38	6770340	606886
91			22:53	35.9	6770400	607063
92	08/02/99	1999-214	00:30	24.7	6766243	602555
93			01:40	33.6	6765903	602136
94			03:37	45.3	6764294	607742
95			04:58	28.9	6772960	615412
96			08:47	35	6770236	606250
97			10:26	31	6770858	606739
98			11:51	29	6770776	606616
99			13:37	31	6770062	605717
100			15:47	28	6765072	605546
101			17:40	38	6765478	600924
102			20:38	32.4	6769476	604709
103			23:02	28.7	6769929	604837
104	08/03/99	1999-215	00:31	26.6	6770027	604841
105			01:51	27.8	6766239	600824
106			03:12	29.2	6766064	600543
107			05:16	31.3	6766587	601136
108			09:19	28	6770218	604523
109			10:57	31	6770364	604260
110			12:13	28	6770441	604341
111			13:37	23	6766273	600015
112			15:39	25	6765760	599186
113			17:07	28	6765634	598897
114			18:03	26	6766389	599540
115			20:35	32.2	6770090	603419
116			22:27	27.2	6769578	602371
117	08/04/99	1999-216	00:13	27.4	6769797	602482
118			01:42	11.9	6766123	596074
119			03:58	44.3	6763345	607172
120			05:20	30.5	6767864	606139
121			08:53	32	6770065	602672
122			11:09	24	6770081	602502
123			12:15	25	6770154	602540
124			13:45	24	6769998	602407
125			15:19	21	6765132	597156

CAST #	DATE (UTC)	JULIAN DAY	TIME (UTC)	DEPTH (m)	NORTHING (m)	EASTING (m)
126			16:12	22	6767845	599876
127			18:26	23	6765043	596866
128			21:10	24.07	6770343	602341
129			23:11	19.8	6769893	601701
130	08/05/99	1999-217	09:20	26	6769795	601813
131			12:13	21	6769081	600543
132			14:01	16	6769863	601282
133			23:01	16.91	6770688	602056
134	08/06/99	1999-218	00:55	19.22	6769759	601160
135			02:54	18.21	6769542	596575
136			04:48	16.56	6766875	597772
137			07:22	19.22	6764843	596105
138			09:48	27	6768220	599647
139			11:33	26	6768182	598954
140			13:02	23	6768451	599385
141			14:08	15	6768577	599206
142			14:57	10	6768772	599337
143			15:55	12	6765987	596360
144			17:27	12	6766179	596416
145			18:47	24	6767176	597343
146			21:18	26.61	6767819	598478
147			23:03	25.52	6767710	598520
148	08/07/99	1999-219	00:58	18.75	6766864	596964
149			02:36	27.27	6764702	597170
150			04:24	25.68	6754473	596920
151			06:34	31.37	6764093	597042
152			09:04	39	6765403	602412
153			10:21	50	6763963	599915
154			11:19	28	6766750	600072
155			12:59	24	6767210	600681
156			14:49	24	6767131	600935
157			15:52	24	6767401	601253
158			17:45	24	6767000	601002
159			21:15	28.14	6766522	600810
160			23:11	26.48	6766679	601286
161	08/08/99	1999-220	00:31	35.86	6765222	600122
162			02:40	42.58	6762881	597996
163			05:06	27.38	6767519	602770
164			09:06	39	6764738	600603
165			10:27	43	6764516	600404
166			11:35	47	6764498	600698
167			12:36	49	6764541	601052
168			14:16	39	6767209	604097
169			15:59	33	6767338	604389
170			16:56	33	6767154	604235
171			18:23	28	6767034	604329
172			20:43	25.79	6766420	604383
173			22:46	51.23	6763675	601061
174	08/09/99	1999-221	00:54	28.77	6766783	604881
175			02:40	36.84	6763884	602178
176			04:40	27.69	6766601	605114

CAST #	DATE (UTC)	JULIAN DAY	TIME (UTC)	DEPTH (m)	NORTHING (m)	EASTING (m)
177			06:27	31.09	6763611	602282
178			09:19	27	6763222	601944
179			10:54	32	6763017	601816
180			11:55	34	6763030	601695
181			13:40	23	6763109	602381
182			15:13	30	6767061	606674
183			16:27	29	6766895	606622
184			18:09	25	6764623	604678
185			19:12	25	6767046	606794
186			21:04	40.16	6763954	599256
187			23:10	36.48	6765365	600791
188	08/10/99	1999-222	01:13	37.62	6765469	601473
189			03:08	40.20	6765387	601803
190			05:02	57.74	6762293	599476
191			06:41	36.93	6765806	602676
192			08:55	34	6764806	601941
193			10:36	31	6761264	598674
194			11:52	37	6761025	598700
195			12:54	37	6760908	598856
196			14:30	34	6761079	599351
197			15:53	32	6764734	603265
198			17:21	29	6764708	603333
199			18:38	24	6764653	603431
200			20:53	26.16	6764711	603699
201	08/11/99	1999-223	01:32	25.98	6764235	603467
202			03:37	26.16	6763693	602890
203			05:15	34.21	6760557	599781
204			09:08	27	6765443	599763
205			09:34	23	6763054	602748
206			10:53	23	6762486	602424
207			12:29	26	6762519	602469
208	08/11/99	1999-223	14:38	25	6762322	602490
209			15:50	29	6765043	605458
210			19:11	25	6766678	607400
211			20:41	28.41	6763117	601959
212			22:56	22.46	6762071	603047
213	08/12/99	1999-224	01:30	26.09	6761463	602777
214			03:36	29.95	6761521	603207
215			05:37	26.91	6761897	603981
216			09:59	33	6765988	608327
217			12:06	29	6761071	603779
218			13:32	28	6760771	603389
219			15:30	30	6760689	603627
220			18:30	49	6765433	608801
221			20:46	24.17	6762233	604624
222			22:47	46.16	6765201	608681
223	08/13/99	1999-225	00:37	52.81	6764559	608416
224			02:51	33.49	6760135	604221
225			04:26	47.26	6764363	608943
226			06:31	44.56	6764754	609562
227			08:50	28	6764288	602939

CAST #	DATE (UTC)	JULIAN DAY	TIME (UTC)	DEPTH (m)	NORTHING (m)	EASTING (m)
228			09:59	29	6764873	603666
229			11:36	35.2	6761366	606221
230			13:33	25	6756856	601501
231			15:41	25	6756886	601344
232			17:47	41	6761749	605964
233			21:33	27.07	6765312	599890
234			22:15	16.72	6758035	601862
235	08/14/99	1999-226	00:19	22.46	6757332	600953
236			01:55	32.20	6761756	605332
237			03:58	27.62	6757429	600834
238			05:58	24.02	6758232	601289
239			08:56	34	6762926	601629
240			10:30	21	6759274	602179
241			12:23	26	6758173	600765
242			14:53	32	6758278	600413
243			16:56	32	6758541	600398
244			18:13	34	6762751	604383
245			20:32	24.39	6763329	604700
246			22:55	18.68	6763519	604637
247	08/15/99	1999-227	00:28	20.96	6762932	603858
248			02:45	38.13	6759048	599522
249			04:15	25.83	6763300	603732
250			06:05	28.47	6763287	603227
251			09:53	33	6764957	609883
252			10:46	26	6765676	602214

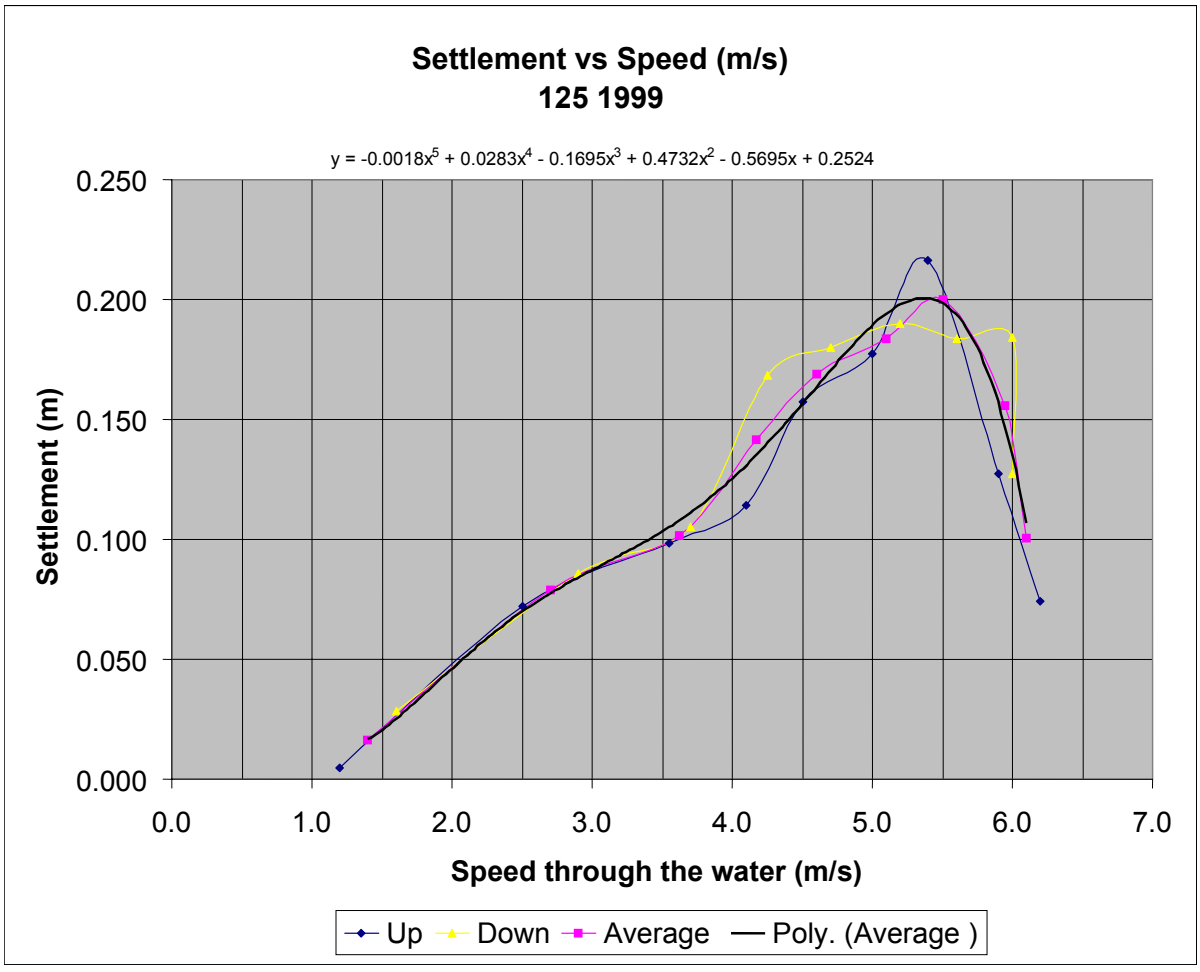
SETTLEMENT CURVE

A settlement curve for the Quicksilver was calculated from RTK GPS derived altitude data. The tests were run in Kachemak Bay. Trimble receivers were used for the base station and remote. RTK positions and altitudes were logged using Winfrog Multibeam every second.

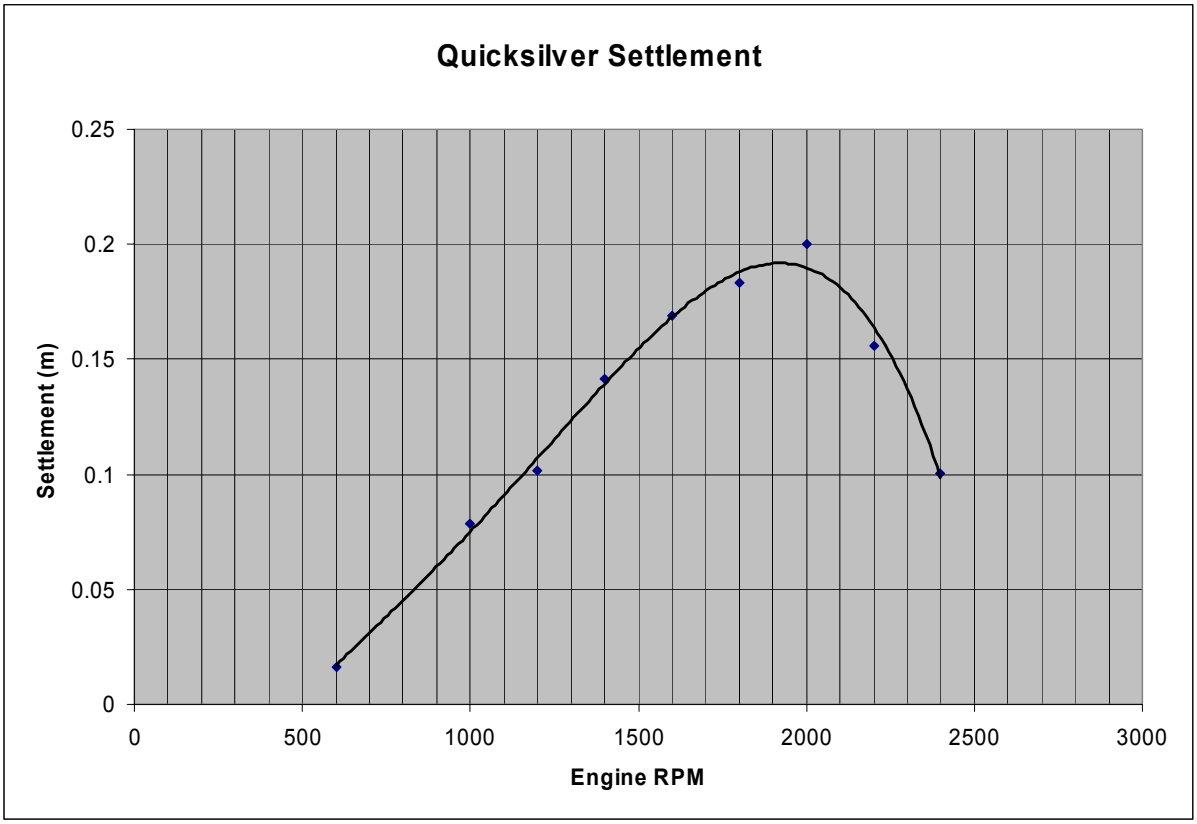
For the Settlement tests, a 500-meter line in the direction of the current was established. The survey vessel occupied the west end of the line for two minutes, logging RTK data. The line was then run heading east at 600 RPM then west at 600 RPM. The survey vessel again occupied the west end of the line. This scenario was repeated in increments of 200 RPM up to 2400 RPM. The test was run initially with the depressors stowed and repeated with the depressors deployed.

Measurements were directly over the transducer and reduced to the vessel CRP. Consequently, vessel squat had no effect on transducer elevation. Static measurements at the end of the line were used to establish tidal correctors. All data sets were corrected for heave, pitch and roll and reduced to the vessel's common reference point.

The following graph shows the original settlement curve generated from the Kachemak Bay data on Julian day 125 (5/5/99). In the legend, Up refers to the depressors in the stowed position, Down refers to the depressors in the deployed position. The Average curve is the mean value of the up and down curves. The Poly curve is a 5th order polynomial fit of the average curve, used to generate the dynamic draft values for processing.



For this survey, the RPM based settlement curve was used exclusively. Vessel RPM was hand logged for each survey line and settlement values were appended to the dynamic draft file for times just prior to SOL events and after EOL events. The following plot shows the relationship between settlement and engine RPM.



STATIC DRAFT

Static draft was measured from tabs on both sides of the vessel, the average was taken, and then the correction to the common reference point was applied. The table below shows the draft values used in data processing.

DRAFT #	DATE (UTC)	JULIAN DAY	TIME (UTC)	DRAFT (m)
1	07/23/99	1999-204	12:15	-0.018
2	07/23/99	1999-204	21:47	-0.020
3	07/24/99	1999-205	10:10	-0.023
4	07/24/99	1999-205	20:40	-0.010
5	07/25/99	1999-206	12:18	-0.023
6	07/25/99	1999-206	20:47	0.002
7	07/26/99	1999-207	12:20	-0.028
8	07/26/99	1999-207	20:58	-0.01
9	07/27/99	1999-208	10:20	-0.033
10	07/27/99	1999-208	23:40	-0.01
11	07/28/99	1999-209	09:40	-0.023
12	07/28/99	1999-210	05:20	-0.023
13	07/29/99	1999-210	09:25	0.007
14	07/29/99	1999-210	20:44	0.008

DRAFT #	DATE (UTC)	JULIAN DAY	TIME (UTC)	DRAFT (m)
15	07/30/99	1999-211	21:25	0.003
16	07/31/99	1999-212	09:45	-0.023
17	07/31/99	1999-212	22:33	0.008
18	08/01/99	1999/213	09:45	-0.013
19	08/01/99	1999-213	20:55	0.008
20	08/02/99	1999-214	09:45	-0.013
21	08/02/99	1999/214	20:33	0.013
22	08/03/99	1999-215	09:45	-0.003
23	08/03/99	1999-215	20:29	0.013
24	08/04/99	1999-216	08:58	-0.018
25	08/05/99	1999-217	09:19	-0.013
26	08/06/99	1999-218	00:55	-0.008
27	08/06/99	1999-218	08:58	-0.008
28	08/06/99	1999-218	21:20	-0.003
29	08/07/99	1999-219	08:58	0.002
30	08/07/99	1999-219	21:15	-0.003
31	08/09/99	1999-221	09:22	-0.003
32	08/10/99	1999-222	01:13	0.002
33	08/10/99	1999-222	08:58	-0.003
34	08/10/99	1999-222	20:53	0.002
35	08/11/99	1999-223	08:00	0
36	08/12/99	1999-224	03:36	0.002
37	08/12/99	1999-224	10:04	-0.023
38	08/12/99	1999-224	22:47	0.002
39	08/13/99	1999-225	21:33	-0.003
40	08/14/99	1999-226	15:00	-0.013
41	08/15/99	1999-227	02:45	-0.008

TIDES [6]

During processing, sounding were reduced to MLLW using data from 3 tide gauges. These gauges were operated by a sub-contractor, LCMF, and the data was delivered to the processing ship at the end of every Julian day.

Gauge	Location	Latitude	Longitude
9455869	North Foreland	61.0425	150.1636
9455912	Fire Island	61.1731	150.2061
9455821	Moose Point	60.9564	150.6833
9455781	Boulder Point	60.7761	151.2450

The gauge at Pt. Possession was operational during the survey but had not been in place long enough to have a datum. Consequently, it was not used for any of the processing.

Tidal zones for this survey were defined after preliminary survey work in the fall of 1998 (SOL 52-DGNC-8-90028, Task Order #1). The zones used have generally the same shape as the NOAA preliminary zones in the survey area but form a finer mesh. The maximum time difference across any zone boundary in the new scheme was 2 minutes. The following plot shows the area around Sheet C and the tide zone layout.

ADJUSTMENT TO STATIC DRAFT

An incorrect offset was initially used to calculate the static draft applied to all soundings collected on the F/V Quicksilver on this sheet. The offset error produced in a 42-cm underestimation of draft and a resultant 42-cm underestimation of depth.

The F/V Quicksilver was surveyed during systems installation in Seattle from 4/11/1999 to 4/15/1999. Tabs were welded to the Port and Starboard gunwales to aid in the measurement of static draft. The vertical offsets from the common reference point (CRP) on top of the motion reference unit (MRU) to tabs were surveyed as:

Port	1.824 m
Stbd	1.849 m

These values were entered in the vessel-offset sheet and later included in this descriptive report. The two values were averaged (1.836) for entry to the acquisition system. However, the data were collected and processed using a vertical offset of 1.416, instead of the proper value of 1.836. This error was corrected by applying a constant offset in the CARIS work file. The following data flow was used:

1- Add a value of 1.378 feet to all the work file soundings
2- Generate a DTM
3- Create contours
4- Export soundings and contours to smooth sheet
5- Hand edit contours
6- Verify dangers to navigation and chart comparison

Using this method, the CARIS HDCS files remain in error. The CARIS work file and the smooth sheet are correct. [7]

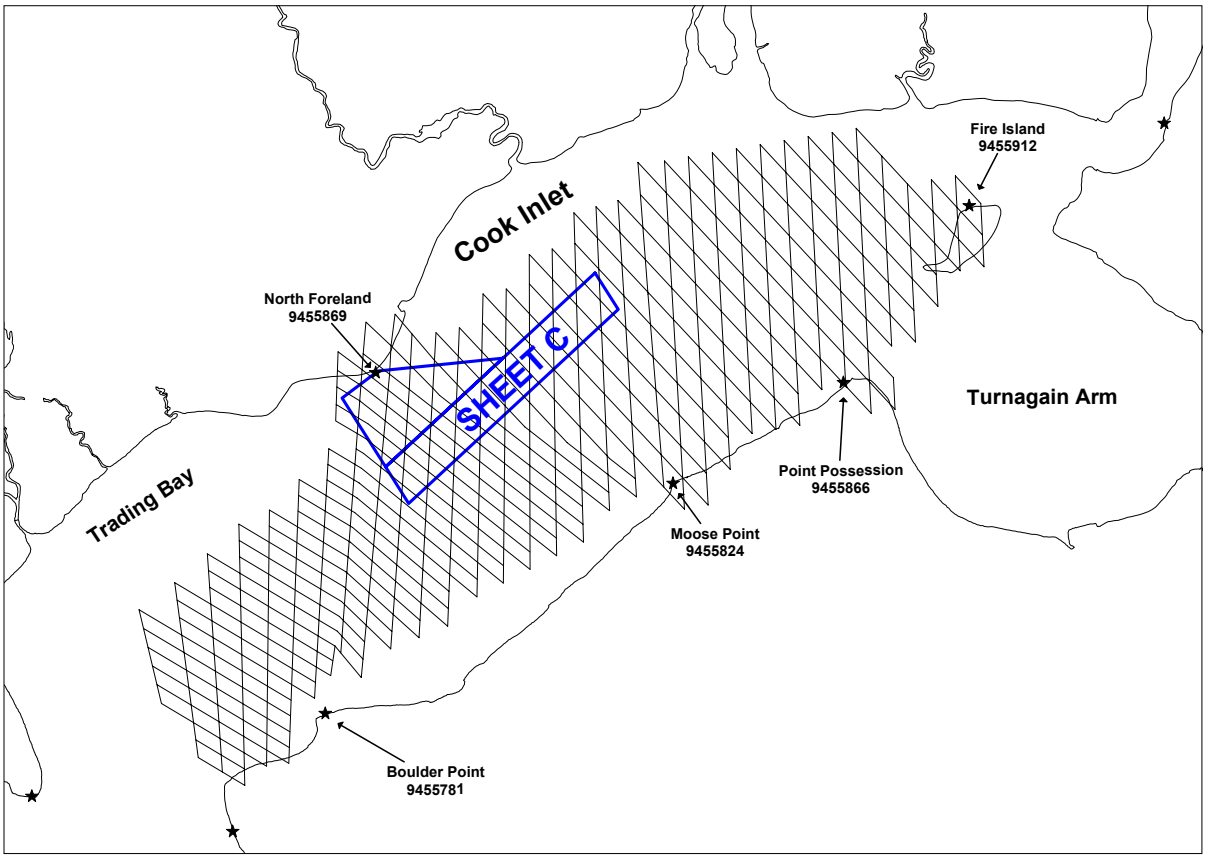


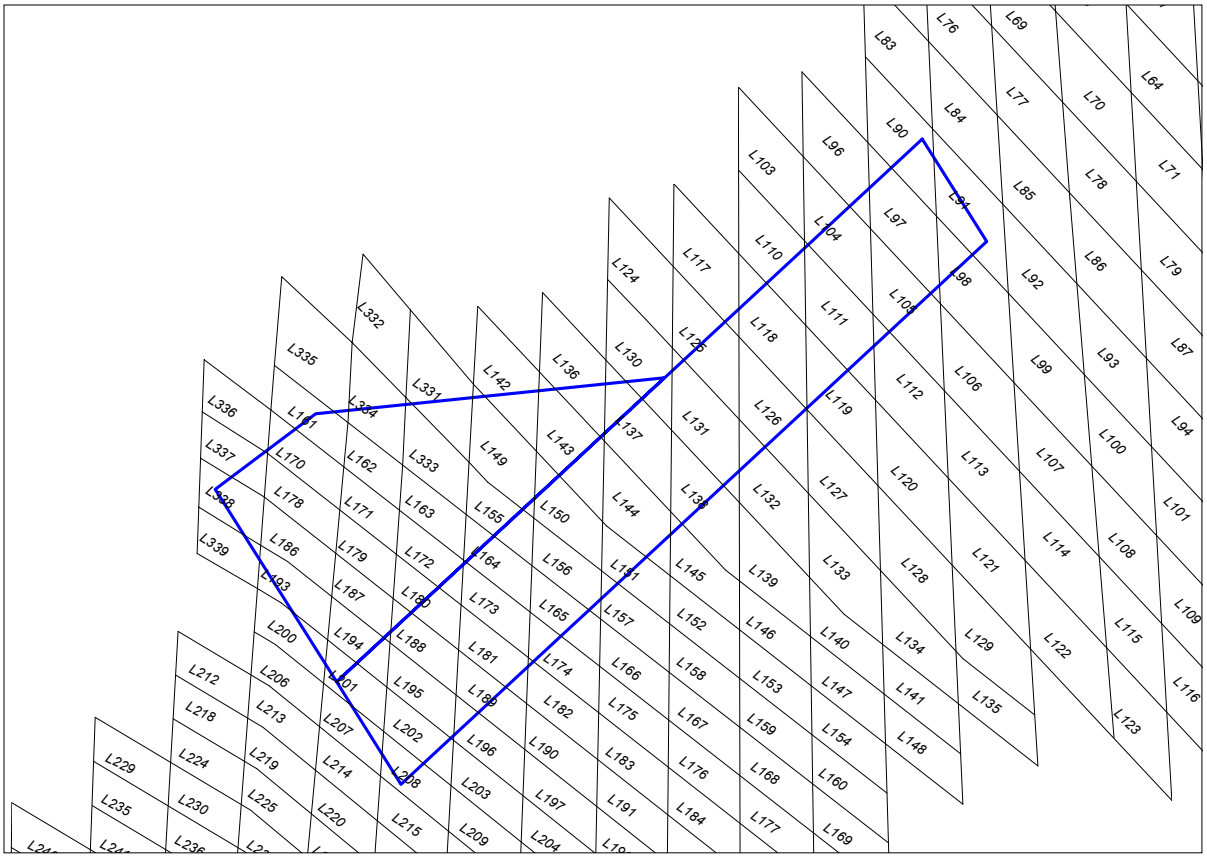
Table of tide zones used in Sheet C processing.

LCM F	Primary Reference		Time	Range		Secondary Reference		Time	Range	LCM F
Zone	Name	Number	mins	Ratio		Name	Number	mins	Ratio	Zone
90	Moose Pt	9455824	8	0.967		N. F'land	9455869	22	1.106	90
91	Moose Pt	9455824	8	0.978		N. F'land	9455869	22	1.118	91
96	Moose Pt	9455824	6	0.956		N. F'land	9455869	20	1.094	96
97	Moose Pt	9455824	6	0.967		N. F'land	9455869	20	1.106	97
98	Moose Pt	9455824	6	0.978		N. F'land	9455869	20	1.118	98
104	N. F'land	9455869	18	1.094		Moose Pt	9455824	4	0.956	104
105	N. F'land	9455869	18	1.106		Moose Pt	9455824	4	0.967	105
110	N. F'land	9455869	16	1.081		Moose Pt	9455824	2	0.946	110
111	N. F'land	9455869	16	1.094		Moose Pt	9455824	2	0.956	111
112	N. F'land	9455869	16	1.106		Moose Pt	9455824	2	0.967	112
117	N. F'land	9455869	14	1.069		Moose Pt	9455824	0	0.935	117
118	N. F'land	9455869	14	1.081		Moose Pt	9455824	0	0.946	118
119	N. F'land	9455869	14	1.094		Moose Pt	9455824	0	0.956	119

125	N. F'land	9455869	12	1.069		Moose Pt	9455824	-2	0.935	125
126	N. F'land	9455869	12	1.081		Moose Pt	9455824	-2	0.946	126
127	Moose Pt	9455824	-2	0.956		N. F'land	9455869	12	1.094	127
130	N. F'land	9455869	10	1.058		Moose Pt	9455824	-4	0.925	130
131	N. F'land	9455869	10	1.069		Moose Pt	9455824	-4	0.935	131
132	N. F'land	9455869	10	1.081		Moose Pt	9455824	-4	0.946	132
136	N. F'land	9455869	8	1.046		Moose Pt	9455824	-6	0.914	136
137	N. F'land	9455869	8	1.058		Moose Pt	9455824	-6	0.925	137
138	N. F'land	9455869	8	1.069		Moose Pt	9455824	-6	0.935	138
143	N. F'land	9455869	6	1.046		Moose Pt	9455824	-8	0.914	143
144	N. F'land	9455869	6	1.058		Moose Pt	9455824	-8	0.925	144
145	N. F'land	9455869	6	1.069		Moose Pt	9455824	-8	0.935	145
149	N. F'land	9455869	4	1.034		Moose Pt	9455824	-10	0.904	149
150	N. F'land	9455869	4	1.046		Moose Pt	9455824	-10	0.914	150
151	N. F'land	9455869	4	1.058		Moose Pt	9455824	-10	0.925	151
155	N. F'land	9455869	2	1.034		Moose Pt	9455824	-12	0.904	155
156	N. F'land	9455869	2	1.046		Moose Pt	9455824	-12	0.914	156
157	N. F'land	9455869	2	1.058		Moose Pt	9455824	-12	0.925	157
161	N. F'land	9455869	0	1.000		Moose Pt	9455824	-14	0.874	161
162	N. F'land	9455869	0	1.011		Moose Pt	9455824	-14	0.884	162
163	N. F'land	9455869	0	1.023		Moose Pt	9455824	-14	0.894	163
164	N. F'land	9455869	0	1.034		Moose Pt	9455824	-14	0.904	164
165	N. F'land	9455869	0	1.046		Moose Pt	9455824	-14	0.914	165
170	N. F'land	9455869	-2	1.000		Moose Pt	9455824	-16	0.874	170
171	N. F'land	9455869	-2	1.011		Moose Pt	9455824	-16	0.884	171
172	N. F'land	9455869	-2	1.023		Moose Pt	9455824	-16	0.894	172
173	N. F'land	9455869	-2	1.034		Moose Pt	9455824	-16	0.904	173
174	N. F'land	9455869	-2	1.046		Moose Pt	9455824	-16	0.914	174
178	N. F'land	9455869	-4	1.000		Boulder	9455781	42	1.011	178
179	N. F'land	9455869	-4	1.011		Moose Pt	9455824	-18	0.884	179
180	N. F'land	9455869	-4	1.023		Moose Pt	9455824	-18	0.894	180
181	N. F'land	9455869	-4	1.034		Moose Pt	9455824	-18	0.904	181
182	N. F'land	9455869	-4	1.046		Moose Pt	9455824	-18	0.914	182
186	N. F'land	9455869	-6	1.000		Boulder	9455781	40	1.011	186
187	N. F'land	9455869	-6	1.011		Boulder	9455781	40	1.023	187
188	N. F'land	9455869	-6	1.023		Moose Pt	9455824	-20	0.894	188
189	N. F'land	9455869	-6	1.034		Moose Pt	9455824	-20	0.904	189
193	N. F'land	9455869	-8	1.000		Boulder	9455781	38	1.011	193
194	N. F'land	9455869	-8	1.011		Boulder	9455781	38	1.023	194
195	N. F'land	9455869	-8	1.023		Boulder	9455781	38	1.034	195
196	N. F'land	9455869	-8	1.034		Moose Pt	9455824	-22	0.904	196
200	N. F'land	9455869	-10	1.000		Boulder	9455781	36	1.011	200
201	N. F'land	9455869	-10	1.011		Boulder	9455781	36	1.023	201
202	N. F'land	9455869	-10	1.023		Boulder	9455781	36	1.034	202
207	N. F'land	9455869	-12	1.011		Boulder	9455781	34	1.023	207
208	N. F'land	9455869	-12	1.023		Boulder	9455781	34	1.034	208
331	N. F'land	9455869	4	1.023		Moose Pt	9455824	-10	0.894	331
333	N. F'land	9455869	2	1.023		Moose Pt	9455824	-12	0.894	333
334	N. F'land	9455869	2	1.011		Moose Pt	9455824	-12	0.884	334

335	N. F'land	9455869	2	1.000		Moose Pt	9455824	-12	0.874	335
336	N. F'land	9455869	-2	0.990		Moose Pt	9455824	-16	0.870	336
337	N. F'land	9455869	-4	0.990		Moose Pt	9455824	-18	0.870	337
338	N. F'land	9455869	-6	0.990		Moose Pt	9455824	-20	0.870	338
339	N. F'land	9455869	-8	0.990		Moose Pt	9455824	-22	0.870	339

Tide Zones in Sheet C.



Tidal data for a twenty-four hour period was assembled by LCMF and emailed to the Davidson at the end of every day, UTC. A cumulative file for each gauge was updated each day by appending the new data. HPTools (ver. 8.9.5) was used to calculate zoned tidal correctors using CARIS navigation files. The output from HPTools was appended to the project tide file, 1783.tide.

VESSEL ATTITUDE: HEADING, HEAVE, PITCH, AND ROLL

Survey vessel heading and attitude was measured by a TSS HDMS. The HDMS calculated heading from two Novatel GPS generated positions. Attitude was measured by an accelerometer block mounted in the hull of the vessel just over the multibeam transducer. Manufacturers accuracy's for this systems are:

TSS HDMS Accuracy	
Pitch and Roll	0.035°
Heading	0.05°
Heave	5% or 5-cm over 20 seconds

The heave filter in the HDMS was set to 100 seconds. All lines were run with a 2-minute run-in to insure that the heave was stable.

The patch test calibration values used to reduce all soundings on this sheet were as follows:

Patch Test Results July 23rd, 1999 (1999-204)		
Test	**CARIS Session**	**Mean Correction**
Navigation Timing Error	Patch_072399_Nava	0.00 seconds
Pitch Offset	Patch_072399_Pitcha	0.64°
Azimuth Offset	Patch_072399_Yawa Patch_072399_Yawb	1.50°
Roll Offset	Patch_072399_Rolla	-0.23°

H - Hydrographic Position Control

The horizontal control datum for this survey was the North American Datum of 1983 (NAD83). All positions were originally collected in WGS84 and transformed to NAD83 during HIPS worksheet creation. Note, however, that HIPS makes no distinction between WGS84 and NAD83 so the transformation amounts to nothing more than a name change.

Winfrog was configured to write three separate positions into its .RAW files. These were the 303 Pseudorange Console (PR-Console), the 303 Console (Console), and the 300 Quicksilver. The 303 records are always raw antenna positions and do not include vessel offsets or Kalman filtering. The 300 record includes both antenna offsets and filtering. For this survey, however, the antenna offset was set to zero and the Kalman filter was disabled.

The PR-Console and Console are independently calculated pseudorange positions. PR-Console is generated by Winfrog as the weighted arithmetic average of the pseudorange positions calculated from the three separate RTCM sources listed below. The Console position is the pseudorange position calculated on the NovAtel card using a single RTCM source, in this case, the Kenai USCG station.

Winfrog attached the PR-Console position to the bathymetry data in the .XTF files. This position was taken as a reasonable estimate of true position and was checked against the Console and Quicksilver positions at the end of every line for gross error. This method of positioning amounts to a real time verification of the RTCM sources since at least two RTCM sources would have to fail independently in a contrived manner to generate an erroneous position that appeared reasonable.

Offsets are used in Winfrog for display purposes only. Offset values were applied to the data in CARIS HDCS as specified in the vessel configuration file. Vessel offsets used are shown in the following table.

Quicksilver Vessel Offsets				
From	**To**	**X**	**Y**	**Z**
CRP	HDMS Accelerometer	0.000	0.000	0.000
CRP	8101 Transducer	0.000	0.000	0.570
CRP	Odom Transducer	0.140	2.690	0.450
CRP	Navigation GPS Antenna	5.280	-0.030	-4.680
CRP	HDMS Master Antenna	-2.807	0.003	-4.730
CRP	HDMS Slave Antenna	0.081	-0.005	-4.69
CRP	Draft Measuring Point, Port	0.270	-2.357	-1.824

CRP	Draft Measuring Point, Starboard	0.270	2.333	-1.849

Axis used: X positive toward bow
Y positive toward Starboard
Z positive in to the water

All units are meters.

The following GPS equipment was used:

GPS Receivers

Model	Serial Number	Location	Use
Novatel GPS Card , PC Series	450056	Winfrog Nav PC	Primary Navigation

Differential Correction Receivers

Rx. No.	Model	Serial Number	Antenna Serial Number
1	CSI MBX-3	9830-2023-0001	9830-2023-0003
2	CSI-MBX-3	9834-221-0002	9841-2496-0004
3	Yaesu	7m350-84	N/A

Three sources for differential corrections were used. Two of these were U.S Coast Guard stations in Kenai and Kodiak. The third station was installed and maintained by Racal Pelagos near the OSK dock in Nikiski. All three stations were used in a weighted solution. The weights assigned in Winfrog increase as the data becomes less desirable. As indicated in the table below, the Kenai and Nikiski stations were both given equally high preferences. The Kodiak was only used as a backup in this scenario.

Reference Stations

Station	ID	Latitude	Longitude	Elev.	Freq.	Tx. Rate	Rx. No.	Weight
Kenai, USCG	292	60° 40.505’	151° 21.010’	55.56	310	100 BPS	1	1
Kodiak, USCG	294	57° 37.055’	152° 11.631’	26.53	313	100BPS	2	10
Nikiski, RPI	101	60° 44.38613’	151° 18.63855’	69.55			3	1

The Station identified above as Nikiski, RPI, was established on 22 May 1996 by a Racal-Pelagos affiliate. The station was originally identified as NCS STA “OSK”. Verification of this station was completed on 25 August 1999 using National Geodetic Survey monument KIRT (PID UW8067) as control. For verification, one Hertz positions were logged for a 24-hour period (87729 records). Results showed the Nikiski, RPI station to be 1.43 meters from its surveyed position.

Verification data for the Nikiski station can be found in Appendix F. [8]

I - Shoreline

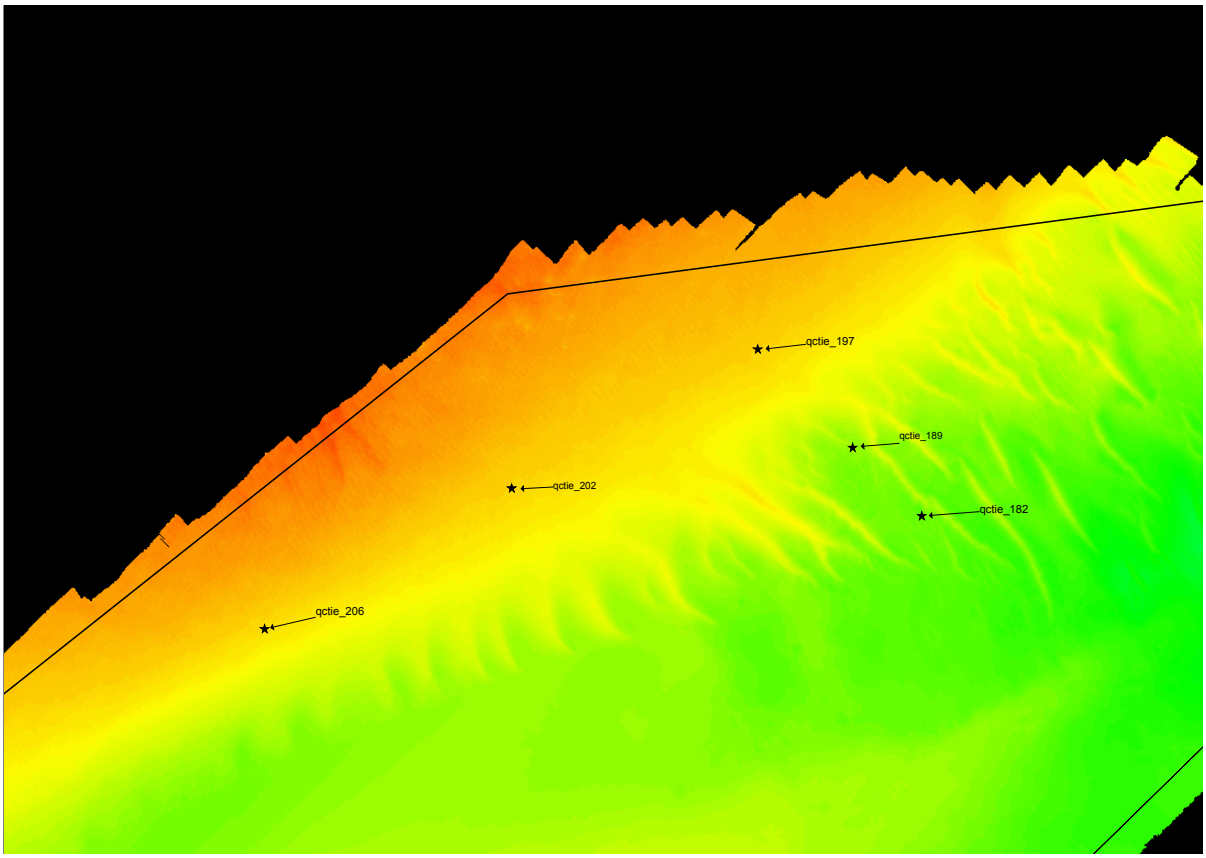
Not applicable; shoreline verification was not required. [9]

J – Crosslines

Sheet C was divided into 11 areas for survey operations. The areas, numbered 7–11 from south to north, were 3.7 km wide and ranged from 4 - 6 km in length, the remaining areas 1– 6 varied in length and width. There were ten tie lines in area C1, four in areas C3, C4, C6, five in areas C2, C5, C7, C8, C9, C10 and six in area C11. The tie lines varied in length (800 to 4700 meters). Tie lines were planned to measure 5% of the main-scheme line length. Total crossline length was 174.8 km (94.4 nautical miles) or 6.0% of the total main-scheme miles.

A total of 350 tie line crossings were examined using the CARIS HIPS Q/C report. Of these tie lines, five had failed to reach the specified vertical accuracy. The marginal crosslines were all in area 1, very near North Foreland.

CARIS File	Tie Line	Line	JD	Time	Latitude	Longitude
qctie_182	C1tie009	C100660a	217	1040	61.039547	151.146014
qctie_189	C1tie009	C100835a	217	2337	61.040701	151.148214
qctie_197	C1tie009	C101085	218	5032	61.042348	151.151358
qctie_202	C1tie008	C101220	218	0647	61.040188	151.159845
qctie_206	C1tie007	C101350	218	2159	61.037993	151.168266



The five lines listed fall within a small area in the North West corner of area C1 in Sheet C. This area is characterized by an area of sand waves and shifting sediment. Since the tie lines directly before and after those shown are well within the specification, it is reasonable to assume that the lost data quality is a result of these sand waves and shifting sediment and not instrument error. [10]

K – Junctions [11]

H-10906 (Sheet C) junctions with H-10892 (Sheet A, OPR-P385-KR-98, surveyed 5/9/99 – 6/14/99) along the northeastern end of the survey corridor. The surveys are in close agreement along their common borders. The agreement was noted in the field using the 2-meter DTM's created for coverage verification. The conformity is also apparent in the preliminary smooth sheets. [12]

L - Comparisons with Prior Surveys [13]

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

M - Item Investigation Reports [14]

No AWOIS items were assigned under this contract.

N - Comparison with the Chart [15]
Comparisons were made with the following charts

Chart No.	Edition/Date	Datum	Scale
16663	5th Ed., Jul 12, 1997	NAD 83	1:100000

DANGERS TO NAVIGATION [16]

Twenty-six dangers to navigation, typically individual boulders, were discovered in the survey area. These features are documented in Appendix A, Dangers to Navigation.

COMPARISON OF SOUNDINGS

Soundings in the entire preliminary smooth sheet are in typically good agreement with the posted soundings on the chart. There are a few new contours from boulders near the northern end of the corridor and again near the southern end. The ten-fathom contour near North Foreland has retreated at a point just off Tyonek dock. And, while it's difficult to be precise at this chart scale, it appears that the three and five fathom contours near the dock have moved offshore. [17]

O - Adequacy of the Survey [18]
The survey is a complete navigable area hydrographic survey and is adequate to supercede all prior surveys within their common areas. Data density was planned at two soundings per meter along track and demonstrated to be sufficient to detect a 2-meter square by 1-meter high shoal. Soundings fell within the error budget specified in the Statement of Work Attachment #1, Section 5.2 at greater than the 95% confidence level. More than 5 meters of overlap was maintained throughout the survey.

P - Aids to Navigation
There were no charted aids to navigation in the survey area. No uncharted aids to navigation were found in the survey area. [19]

Q - Statistics

Lineal and square miles apply to both multibeam and singlebeam coverage.

Lineal Nautical Miles	1578.3
Square Nautical Miles	44.1
Days of acquisition	24
Total number of soundings	677242168
Number of selected soundings on preliminary smooth sheet	16990
Number of detached positions	0
Number of bottom samples	0
Number of velocity casts	252
Number of tide stations installed	3

Note: Singlebeam soundings were collected on each line and are available in the digital data set in the WinFrog .RAW files. Singlebeam data was used for QC purposes only and were not processed, included in the total number of soundings and were not used in smooth sheet production.

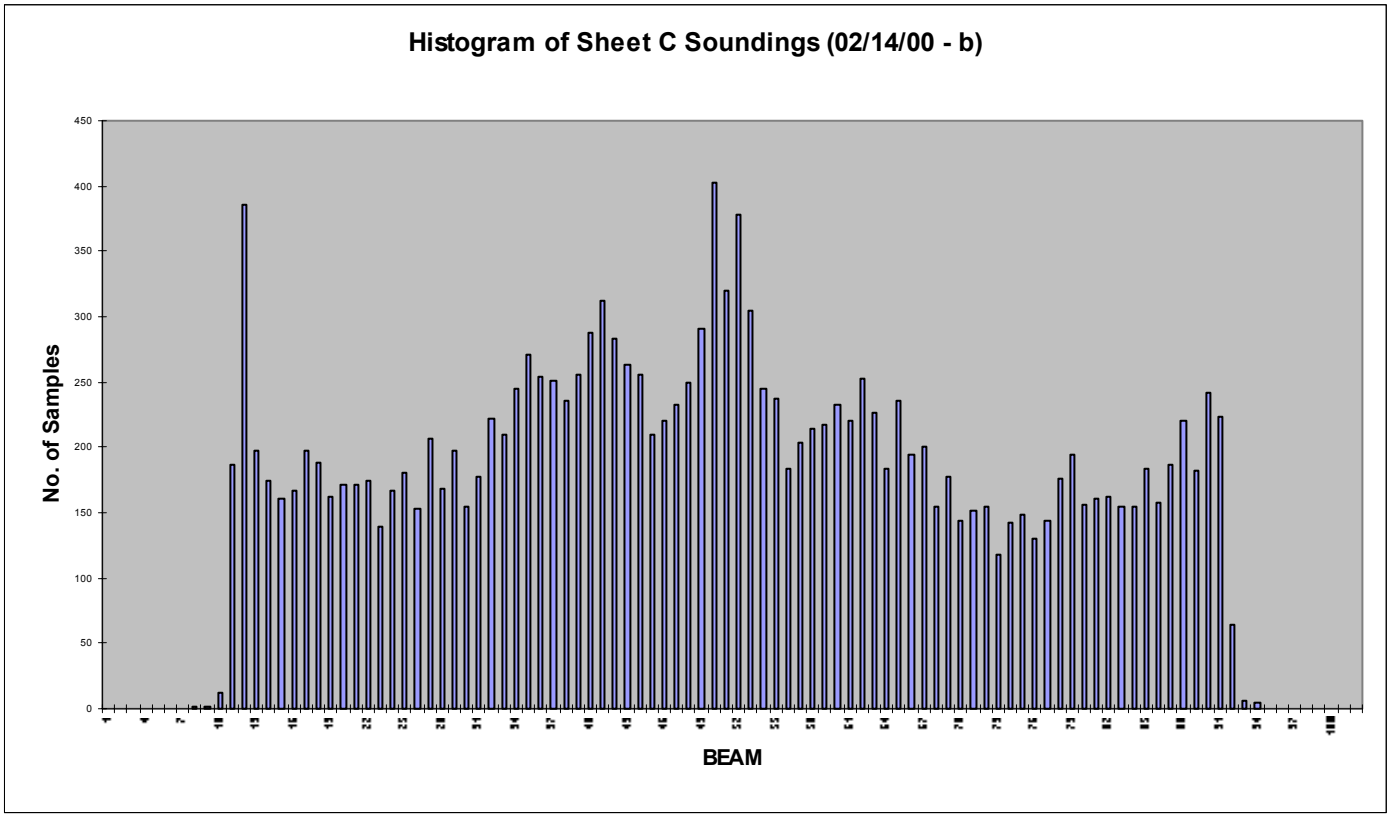
R – Miscellaneous

SMOOTH SHEET HISTOGRAM

A histogram of the selected smooth sheet soundings is displayed below. Although soundings used to compile the smooth sheet fell within the specified error budget at nearly 100% confidence, the distribution of soundings across sonar beams is not level. The distribution of soundings shows three outstanding features. First, early digitizing on the nadir beams, a common feature on the Seabat 8101 is apparent on the port side beams, 21 – 43. The gentle sloping of the histogram is the result of the amplitude detection used by the Seabat and, although mitigated by gain control, can not be avoided entirely.

The second feature is the large spike on the nadir beams 50-54. In this region, the normal amplitude detect problem associated with the Seabat is aggravated by the location of an Odom 125kHz transducer just forward of the multibeam transducer. Noise from the Odom is summed into the returns measured by the Seabat, resulting in early digitization. The small dip in the histogram on either side of the nadir spike is likely the result of a graphical shadow zone created by the shoaler nadir soundings. Once these soundings are drawn, other soundings in the very densely sampled area around nadir can not be selected.

The third feature is the large spike on the port side at beam 12. Significantly, beam 12 performs well in crossline QC checks. This feature is difficult to explain but does not appear to be the result of equipment failure, survey or processing procedures. Inspection of the smooth sheet reveals trends where beam 12 is



shoaler than the rest of the profile simply because it is up slope from all other soundings. Why beams 11 and 13 aren't similarly effected is unknown. At any rate, this trend is not pervasive enough to generate the spike seen in the histogram.

TIDES

In a few cases, soundings collected during extreme low tides were removed from the data set. This typically occurred when Moose Point was the primary gauge and it went dry. In each instance, these lines were identified in subset as having a clear vertical offset from the surrounding data. While this offset was roughly 20 –30 centimeters and less that the vertical accuracy specification, it was decided that the lines misrepresented the bathymetry. New lines were run to fill in over the rejected lines.

S - Recommendations

The docking structure at Tyonek is bound to create localized changes in the bathymetry there. This survey did not quite reach the face of the dock or cover the area directly down stream from it. The area around Tyonek dock should be surveyed to complete this region [20]

T - Referral to Reports [21]

Title	Transmittal Information
Technical Report for Tidal Zoning Survey, Cook Inlet, Alaska	SOL 52-DGNC-8-90028 Task order No. 1
Quality Management Plan	Racal Pelagos, QMP-1702-01
Acquisition Procedures, Proprietary	Racal Pelagos, OP-1702-02
Processing Procedures, Proprietary	Racal Pelagos, OP-1702-03

Appendix A - Danger to Navigation

ADVANCE
INFORMATION

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
OFFICE OF COAST SURVEY
Pacific Hydrographic Branch
Seattle, Washington 98115-0070

April 3, 2000

Commander
Seventeenth Coast Guard District
Post Office Box 3-5000
Building 50-6
Juneau, Alaska 98802

Dear Sir:

During processing of the hydrographic survey H-10906 in Cook Inlet, NOAA contractor, Racal Pelagos discovered 15 dangers to navigation. The dangers affects the following charts:

Chart	Edition/Date	Datum
16660	27th, 4/19/97	NAD 83
16663	5th, 7/12/97	NAD 83

It is recommended that the enclosed Report of Dangers to Navigation be included in the Local Notice to Mariners.

Questions concerning this report should be directed to the Pacific Hydrographic Branch at (206) 526-6835

Sincerely,

James C. Gardner
Commander, NOAA
Chief, Pacific Hydrographic Branch

Enclosures

cc: NIMA
NCS/261

FILE COPY

CODE	SURNAME	DATE	CODE	SURNAME	DATE	CC
N/CS 34	Mary L. Tuttle	04/05/00				
N/CS 34	DAHO	4/3/00				

Hydrographic Survey Registry Number: H-10906

Survey Title: State: Alaska
Locality: Cook Inlet
Sublocality: East of North Foreland

Project Number: OPR-P385-KR-98

Survey Date: July-August, 2000

Features are reduced to Mean Lower Low Water using contractor verified tides from contractor tide gauges.

Affected Nautical Charts:

CHART	EDITION/DATE	DATUM
16660	27th Ed., Apr 19,1997	NAD83
16663	5th Ed., Jul 12, 1997	NAD83

The danger are the following Soundings:

ITEM	DANGER	DEPTH	LATITUDE	LONGITUDE
A	SOUNDING	7.9FM	60/57/34.301N	151/05/03.488W
B	SOUNDING	10.6FM	60/57/34.852N	151/07/59.023W
C	SOUNDING	9.4FM	60/58/48.138N	151/06/48.017W
D	SOUNDING	9.6FM	60/58/41.444N	151/05/42.414W
E	SOUNDING	7.5FM	60/59/18.673N	151/05/13.179W
F	SOUNDING	9.5FM	61/00/18.674N	151/06/00.917W
G	SOUNDING	9.0FM	61/02/02.068N	151/06/32.517W
H	SOUNDING	9.0FM	61/01/20.960N	151/08/22.576W
I	SOUNDING	7.9FM	61/01/37.708N	151/09/49.771W
J	SOUNDING	3.2FM	61/02/23.522N	151/10/15.926W
K	SOUNDING	9.0FM	61/03/19.853N	150/53/09.409W
L	SOUNDING	8.9FM	61/03/14.044N	150/51/40.564W
M	SOUNDING	9.5FM	61/04/07.384N	150/51/47.429W
N	SOUNDING	9.5FM	61/04/33.417N	150/49/06.067W
O	SOUNDING	9.6FM	61/05/29.342N	150/46/35.932W

Appendix B - Landmarks and Non-Floating Aids to Navigation Lists

There were no landmarks or non-floating aids to navigation within the survey area.

Appendix C - List of Geographic Names

No new geographic names in the survey area were discovered.

Appendix D - Tides and Water Levels

Abstract of Times of hydrography

YEAR	DAY	START TIME (UTC)	END TIME (UTC)	COMMENTS
1999	204	12:39:48	23:59:59	Patch Test and Start Sheet C
1999	205	00:00:00	23:59:59	
1999	206	00:00:00	23:59:59	
1999	207	00:00:00	23:59:59	
1999	208	00:00:00	23:59:59	
1999	209	00:00:00	23:59:59	
1999	210	00:00:00	23:59:59	
1999	211	00:00:00	23:59:59	
1999	212	00:00:00	23:59:59	
1999	213	00:00:00	23:59:59	
1999	214	00:00:00	23:59:59	
1999	215	00:00:00	23:59:59	
1999	216	00:00:00	23:59:59	
1999	217	09:30:46	23:59:59	
1999	218	00:00:00	23:59:59	
1999	219	00:00:00	23:59:59	
1999	220	00:00:00	23:59:59	
1999	221	00:00:00	23:59:59	
1999	222	00:00:00	22:07:05	
1999	223	02:08:10	23:59:59	
1999	224	00:00:00	23:59:59	
1999	225	00:00:00	23:59:59	
1999	226	00:00:00	23:59:59	
1999	227	00:00:00	11:17:34	

All time UTC.

Please refer to the Descriptive Report for H-10892 or H-10893 for the tide note for North Foreland, Fire Island, Moose Point and Point Possession tide gauges.

Appendix E - Calibration Data

Appendix F - DGPS Verification Data

The point used for the Racal Pelagos Nikiski differential station is identified alternatively as TNH PT 20 and NCS STA “OSK” in the following literature.

Appendix G - Data Processing Routine [22]

Please see proprietary document Racal Pelagos Processing Procedures, OP-1702-03, delivered separately. A data flow diagram showing generalized processing procedures and a directory structure plan are included in Separate 8.

Appendix H - Data Acquisition and Processing Software

Acquisition

Winfrog Multibeam	1.3 NOAA	5/3/99

Processing

CARIS HIPS	4.3	9/24/98 *
Chart-X	1.5.2	1/99
Mathematica	3.0.1.1x	N/A
SVP_05		5/1/99
SVP_draft		5/18/99
MapInfo Professional	5.0	N/A
HP Tools	8.9.5	N/A
Microstation SE	05.07.01.14	N/A
Ribbit Cable & Pipe	1.4	5/10/99

* See following page for details on CARIS updates and patches.

CARIS Version in Use

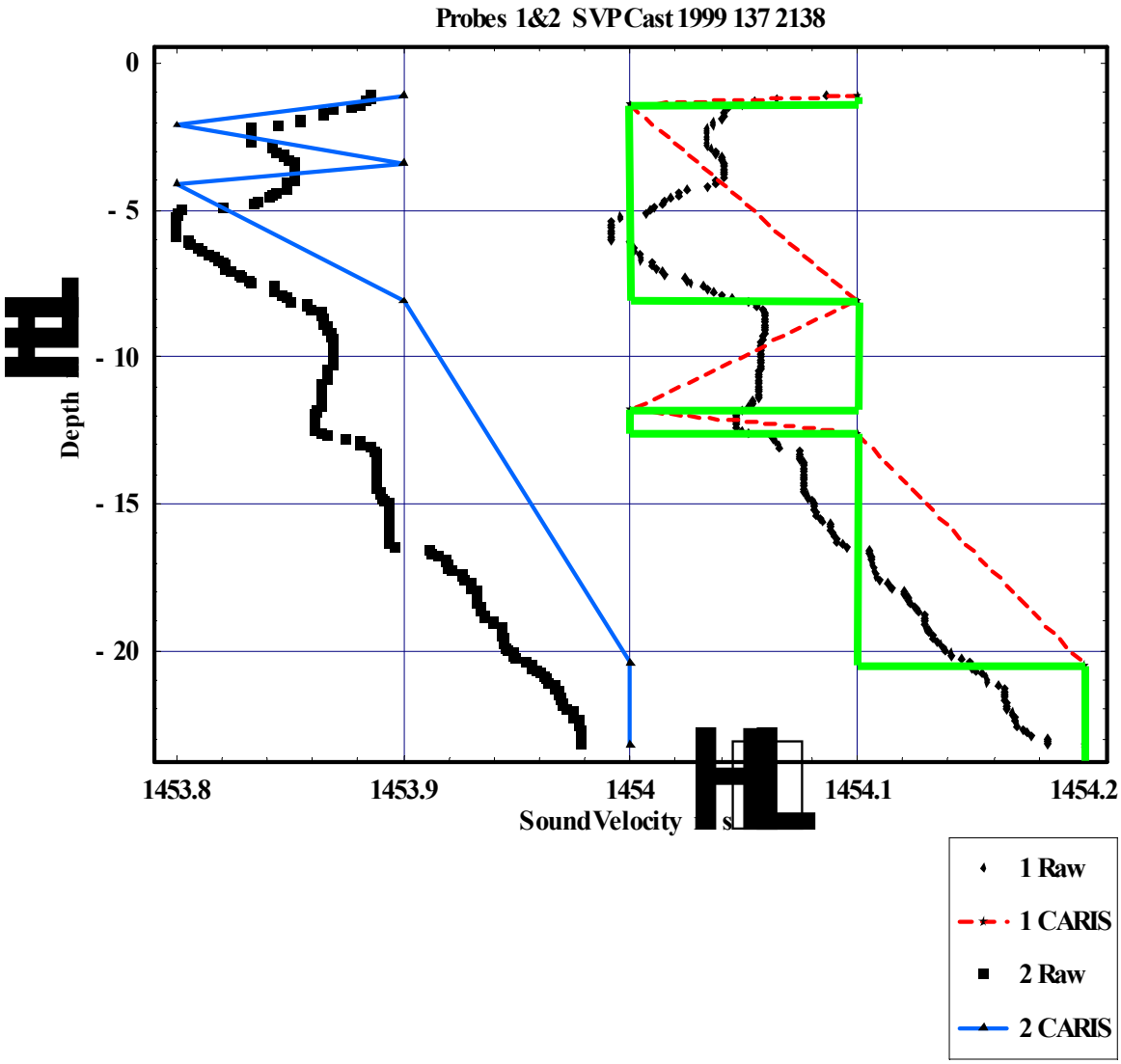
CARIS version 4.3 installed on 09-24-98.

UPDATES/PATCHES
---

xtfToHDCS	-updated 09-24-98
ConvertToHDCS	-updated 09-24-98
hdcs	-updated 09-24-98
hdcsLineMerge	-updated 09-24-98
resontoHDCS	-updated 09-24-98
ConvertToHDCS	-updated 01-21-99
HDCS	-updated 01-21-99
programSettings	-updated 01-21-99
hdcs	-updated 01-21-99
hdcsLineMerge	-updated 01-21-99
xtfToHDCS	-updated 01-21-99
bin/makehist	-updated 03-18-99
bin/refohdcs	-updated 03-18-99
bin/swathedit	-updated 03-18-99
cld/refohdcs	-updated 03-18-99
refohdcs.com	-updated 03-18-99
refohdcscl.com	-updated 03-18-99
refomany.com	-updated 03-18-99
refomanycl.com	-updated 03-18-99
refohdcs.frm	-updated 03-18-99
refohdcscl.frm	-updated 03-18-99
refomany.frm	-updated 03-18-99
refomanycl.frm	-updated 03-18-99
sys/makehist.cla	-updated 03-18-99
sys/SWATHEDIT	-updated 03-18-99
hips/bin/hdcs	-updated 04-01-99
hips/bin/hdcsLineMerge	-updated 04-01-99
hips/bin/xtftoHDCS	-updated 04-01-99
hips/sys/HDCS	-updated 04-01-99
hips/sys/ConvertToHDCS	-updated 04-01-99
hips/sys/programSettings	-updated 04-01-99
hips/form/export_dxf.frm	-updated 04-01-99
hips/com/export.com	-updated 04-01-99
hips/com/DXFcorrect.awk	-updated 04-01-99
caris/bin/sun4_2/cared.x	-updated 05-13-99
caris/system/msgfil.dat	-updated 05-13-99

Appendix I - SVP Data

The following graphs of sound velocity profiles show raw data sets from both probes in black and processed data in red and blue. Please note that CARIS HDCS has decimeter resolution in depth and 0.1 m/s resolution in velocity for its SVP calculations. Data was decimated to these values for use in CARIS. That fat green line on the graph below shows the velocity step function that is used by CARIS in its constant velocity model. On all the following graphs, the red and blue lines trace the vertices of the velocity step function. Errors induced by this approximation are described in Section D of the main body of this report.



Appendix J - Supplemental Correspondence

RECRD 52422 VESSLTERMS WELL HEAD CHART 16663 AREA P

CARTOCODE 0057 SNDINGCODE DEPTH 0

NATIVLAT 61/03/12.00 NATIVLON 150/54/27.00 convert NATIVDATUM 6

LAT83 61/03/10.00 LONG83 150/54/35.02 Update GP GPQUALITY Low

61 3 10 150 54 35.02 GPSOURCE Direct

LATDEC 61.052777777778 LONDEC 150.90972777778

PROJECT OPR-P385 ITEMSTATUS Assigned SEARCHTYPE Full

RADIUS 2000 INIT MBH ASSIGNED 6/4/1998

TECNIQ MB,S2,SD

Techniqnote MB

History

AWOIS ITEM 52422

HISTORY
CL1179/67--17CGD SPECIAL NOTICE; IDENTIFIED THIS WELL HEAD AS i□PAN AMERICAN COOK INLET STATE 18741 NO. 1 REPORTED IN 61/03/12N, i□150/54/27W (NAD27) WITH A REPORTED DEPTH OVER THE OBSTRUCTION OF i□87 FEET (MLLW) AND A HEIGHT ABOVE THE BOTTOM OF 6 FEET. THIS i□WELL HEAD IS DESCRIBED AS AN EXPLORATORY WELL - INACTIVE, SHUT i□IN, SUSPENDED, OR PLUGGED AND ABANDONED. THE TYPE OF SUBSURFACE i□STRUCTURE MAY BE OF VARIOUS TYPES. (ENTERED 6/98 BY MBH)

Fieldnote

No investigation was required during survey H10906. However, the object was located using 100% multibeam. The well head was located at 61/03/10.8 N, 150/54/34.6 W and covers 14 fathoms. The evaluator recommends charting the well head at this location and removing the PA designation.

Proprietary

YEARSUNK NIMANUM SYSTEMNUM 10506 Print Record

Appendix K - Approval Sheet

Approval Sheet

For

H-10906

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

OPR-P385-KR-98 statement of work and hydrographic manual;
Racal Pelagos Quality Management Plan (QMP-1702-01);
Racal Pelagos Acquisition Procedures (QMP-1702-02);
Racal Pelagos Processing Procedures (QMP-1702-03);
Technical Report for Tidal Zoning Survey, Cook Inlet, Alaska (SOL 52-DGNC-8-90028 T.O. No. 1).

The data were reviewed daily during acquisition and processing.

The digital data and supporting records have been reviewed by me, are considered complete and adequate for charting purposes, and are approved. All records are forwarded for final review and processing to the Chief, Pacific Hydrographic Branch. [23]

Approved and forwarded,

Douglas Lockhart, Racal Pelagos
Lead Hydrographer
RPI Survey Party

[1] PHB Revision – All Separates are filed with the field data with the exception of proprietary reports. Proprietary reports are filed with the Contracting Officers Technical Representative (COTR).
[2] PHB Revision – Strike through ~~98~~ and replace with 99.
[3] PHB Revision – Strike through ~~regain~~ and replace with region.
[4] PHB Revision – Areas of boulders were not noted on the smooth sheet. Boulder notations are shown on the Hdrawing as evident from the DTM.
[5] PHB Revision - Concur
[6] PHB Revision – Additional tidal information is filed with the survey records.
[7] PHB Revision – A PHB review of the smooth sheet showed the data were in compliance with specifications after application of 1.378 feet was applied to all of the work file soundings.
[8] PHB Revision – Appendix F is filed with the survey records.
[9] PHB Revision – Concur.
[10] PHB Revision – Concur-In areas of rapidly moving sand waves. The COTR has discussed this issue with the hydrographer.
[11] PHB Revision – The eastern portion of H10906 junctions with H10892 (1:20,000, 1999). The junction is complete. Sounding agreement within the junction is good. The western portion of H10906 junctions with H10924 (1:20,000,1999). The junction is complete. Sounding agreement within the junction is good. "Joins" notes were inked in by hand at PHB.
[12] PHB Revision – Concur.
[13] PHB Revision – The smooth sheet was compared to prior surveys H09539 (1975), H09648 (1976), H09697 (1977), H09698 (1977), and H10017 (1982). H-09539 covers the northwestern portion of H10906. Generally, H10906 is up to 1 fathom shoaler with shoaling of 1 to 1.5 fathoms around the North Forelands. H09648 covered the southwestern portion of H10906. In general, H10906 is .5 to 1.5 fathoms shoaler. At latitude 60° 57.6'N, longitude 151° 05.1'W, H10906 shows a 8.2 fathoms sounding in an area that shows 12 fathoms on H09648. H-09697 covers the western portion of H10906. In general, there is good agreement between the surveys. The Digital Terrain Model (DTM) from H-10906 shows some areas of high relief. In these areas H-10906 is shoaler from .5 to 2 fathoms. H-10906 shows significant shoaling around the North Foreland area, 1 to 5 fathoms. H09698 covers the eastern portion of H-10906. In general, there is very good agreement between the two surveys, 0 to .5 fathoms. A few areas showed larger differences with H10906 being .5 to 1.5 fathoms shoaler. H-10017 covers the extreme eastern portion of H-10906. In general there is good agreement between the two surveys, 0 to .5 fathoms. Two areas were 3 fathoms shoaler on H10906; latitude 61° 04.6'N, longitude 150° 49.1'W and latitude 61° 05.5'N, longitude 150° 46.6'W. Differences between the present and prior work is largely attributed to the dynamic bottom movement occurring in this part of Cook Inlet. Additional information is found in sections B and N of this report. The present survey is considered adequate to supersede the prior surveys within the common area.
[14] PHB Revision – No AWOIS items were assigned for investigation. One AWOIS item (52422) is within the survey area. A PHB review of the data in CARIS indicates the well head described in the AWOIS report is near the reported position. An updated AWOIS Report is attached to this report.
[15] PHB Revision – The Continuous Maintenance Drawings for chart 16663, last revised 4/30/02, and chart 16663 (inset), last revised 1/28/02 were used for chart comparisons during office processing. A PHB review of the survey data in CARIS subset mode clearly showed the presence of the two charted well-heads. The well heads were located very near the charted location. These well heads were not displayed on the smooth sheet. The well heads are included on the hdrawing. The first well head (AWOIS item 52422, see endnote 13) located at latitude 61° 03' 10.8"N, longitude 150° 54' 34.6W covers 14 fathoms. Position and depth were observed by the evaluator in CARIS subset mode using the final corrected full resolution data set. The evaluator recommends charting the well head at this position with the notation (cov 14 fm). The evaluator recommends removal of the PA designation. The second well head located at latitude 61° 03' 34.7N, longitude 150° 55' 09.6W covers 14 fathoms. Position and depth were observed by the evaluator in CARIS subset mode using the final corrected full resolution data set. The evaluator recommends charting the well head at this position with the notation (cov 14 fm). The evaluator recommends removal of the PA designation. A pipe with a charted depth of 10 fathoms 3 feet was located during the survey. PHB verified the location and depth of the pipe in CARIS subset mode. The smooth sheet did not have the label pipe. The label pipe was added to the smooth sheet, in ink, by hand, at PHB. The least depth is 10 fathoms 2 feet at latitude 60° 59' 56.2"N, longitude 151° 10' 07.9"W. The evaluator recommends charting a 10 fathom 2 feet sounding with a danger circle and "Pipe"

notation at the survey position. No bottom samples were required for this survey. The charted bottom samples should be retained as charted.
[16] PHB Revision – Fifteen rather than twenty-six DTONs were reported. The DTONs were reported as soundings not boulders. DTONs were reviewed at PHB. Fifteen DTONs were reported to USCG, NIMA, and N/CS261. The DTONs were reported prior to corrections being made to the final smooth sheet (See Adjustment to Static Draft, p. 16a). As a result, the reported DTONs were 1 to 3 feet too shoal. The correct values for each DTON are on the smooth sheet. The hdrawing reflects these changes.
[17] PHB Revision - See endnote 4.
[18] PHB Revision – Concur with clarification. Minor discrepancies were noted as explained in the endnotes. In addition the smooth sheet has the following discrepancy: The tenths of fathoms value should be depicted as a superscript. Instead, they are depicted as a subscript. The accuracy of the sounding values is not affected, just the plotted appearance.
[19] PHB Revision – Concur.
[20] PHB Revision – Do not concur, this area should continue to be included as a resurvey area to "The National Survey Plan" (2001) and resurveyed at an interval appropriate to local conditions and available resources.
[21] PHB Revision – See endnote 1.
[22] PHB Revision – See endnote 1.
[23] PHB Revision – See 30-DAY Acceptance Review of H10906 attached to this report.

MEMORANDUM FOR: Brian Greenawalt, NOAA
Contracting Officer's Technical Representative

FROM: Gary C. Nelson
Assistant Contracting Officer's Technical Representative
Pacific Hydrographic Branch

SUBJECT: 30-DAY Acceptance Review of H-10906

The Pacific Hydrographic Branch has conducted a 30-day acceptance review of the following contract hydrographic survey:

Registry No:	H-10906
State:	Alaska
General Locality:	Cook Inlet
Locality:	East of North Foreland
Contractor:	Racal-Pelagos
Project:	OPR-P385-KR
Contract No:	50-DGCN-8-90028
Date Received by PHB:	April 26, 2000
30 Day Review by:	May 26, 2000

The data submitted for H-10906 was reviewed for compliancy with the Statement of Work.

The 30-day review included but was not limited to the following:

1. An inventory of specified deliverables
2. A review of the SWMB Patch Test data to confirm proper bias values
3. A qualitative review of SWMB cross line comparison data.
4. An examination of the DTM, created by Racal-Pelagos, with the smooth sheet overlaid to ensure shoal areas were portrayed correctly on the smooth sheet.
5. A CARIS workfile of selected shoal soundings was created to compare with the smooth sheet. The comparison was used to verify valid shoal soundings were carried through to the smooth sheet.
6. A preliminary comparison of prior surveys and appropriate nautical charts with the smooth sheet was completed.
7. The data were reviewed for appropriate application of biases, sound velocity, and tides.
8. A preliminary review of the Descriptive Report and smooth sheet. (Note: The results of the final review will be detailed in the Evaluation Report).

Based upon the review, it is concluded that H-10906 has no major deficiencies that would deem

it out of compliance with the Statement of Work. It is recommended that H-10906 be accepted.

cc: Jim Gardner
Dennis Hill

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

U.S. DEPARTMENT OF COMMERCE

HYDROGRAPHIC SURVEY STATISTICS

REGISTRY NUMBER
H-10906

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

RECORD DESCRIPTION	AMOUNT	RECORD DESCRIPTION	AMOUNT
SMOOTH SHEET	1	SMOOTH OVERLAYS: POS., ARC, EXCESS	
DESCRIPTIVE REPORT	1	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):

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			
VERIFICATION OF CONTROL			
VERIFICATION OF POSITIONS			
VERIFICATION OF SOUNDINGS			
VERIFICATION OF JUNCTIONS			
APPLICATION OF PHOTOBATHYMETRY			
SHORELINE APPLICATION/VERIFICATION			
COMPILATION OF SMOOTH SHEET			15
COMPARISON WITH PRIOR SURVEYS AND CHARTS			
EVALUATION OF SIDE SCAN SONAR RECORDS			
EVALUATION OF WIRE DRAGS AND SWEEPS			
EVALUATION REPORT			40
GEOGRAPHIC NAMES			
OTHER (Chart Compilation)			50
*USE OTHER SIDE OF FORM FOR REMARKS — TOTALS			105

Pre-processing Examination by	*Beginning Date* 04/28/2000	*Ending Date*
Verification of Field Data by Contract Compliance By G. Nelson	*Time (Hours)* 15	*Ending Date*
Verification Check by	*Time (Hours)*	*Ending Date*
Evaluation and Analysis by G. Nelson, B. Mihailov	*Time (Hours)* 40	*Ending Date* 09/27/2003
Inspection by B.A. Olmstead	*Time (Hours)* 10	*Ending Date* 08/26/2003

* U.S. GOVT. PRINTING OFFICE 1983: 764-008/6061

APPROVAL SHEET
H10906

Initial Approvals:

The survey and associated records have been inspected with regard to survey coverage, delineation of the depth curves, development of critical depths, cartographic symbolization, and verification or disproval of charted data. The survey records and digital data comply with NOS requirements except where noted in the Descriptive Report and are adequate to supersede prior surveys and nautical charts in the common area.

Gary C. Nelson for Date: 29 Sept. 2003
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 Descriptive Report.

Date: Oct 8, 2003
John E. Lowell Jr.
Commander, NOAA
Chief, Pacific Hydrographic Branch

AWOLS ✓ & SURF ✓ 10/21/03 by MBH

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-10906

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
16663	9/12/03	G.Nelson/B.Mihaiov	Full Part Before After Marine Center Approval Signed Via Full application
			Drawing No. of soundings, curves and features
			from smooth sheet thru unset
16663	11/10/03	J Sherry/CEB	Full Part Before After Marine Center Approval Signed Via
			Drawing No. Full application of Soundings, Curves, and features through
			BP-1 81844 (Kapp) BP-1 81843 (main).
16662	11/10/03	J.Sherry/CEB	Full Part Before After Marine Center Approval Signed Via
			Drawing No. Full application of soundings, curves, and features
			through 16663.
16660	11/10/03	J. Sherry/CEB	Full Part Before After Marine Center Approval Signed Via
			Drawing No. Full application of Soundings curves and features
			through 16663
			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
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			Full Part Before After Marine Center Approval Signed Via
			Drawing No.
			Full Part Before After Marine Center Approval Signed Via
			Drawing No.

SUPERSEDES C&GS FORM 8352 WHICH MAY BE USED