Cover Sheet (NOAA Form 76-35A)

NOAA FORM 76-35A

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

Data Acquisition and Processing Report

Type of Survey HYDROGRAPHIC

Field No M-L906-KR-08

Registry No. H11875, H11876, H11877, H11878, H11879, H11880, H11881, H11882, H11883, H11891, H11950, H11951, H11952, H11953

LOCALITY

State CALIFORNIA

General Locality Pacific Ocean – Southern California

Sublocality Areas Extending from Point Arguello to Ocean Beach

2008

CHIEF OF PARTY

DEAN MOYLES

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DATE

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Title Sheet (NOAA Form 77-28)

NOAA FORM 77-28 (11-72) U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTER NO.
HYDROGRAPHIC TITLE SHEET	H11875, H11876, H11877, H11878, H11879, H11880, H11881, H11882, H11883, H11891, H11950, H11951, H11952, H11953
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.

State CALIFORNIA

General Locality Pacific Ocean – Southern California

Locality Areas extending from Point Arguello to Ocean Beach

Scale NA Date of Survey 05/04/08 – 09/05/08

Instructions dated July 7, 2008 Project No. M-L906-KR-08

Vessel F/V PACIFIC STAR (556510), R/V R2 (623241), R/V D2 (647782), R/V QUICKSILVER (947419), R/V LOCATOR (CF4540NB)

Chief of party DEAN MOYLES

Surveyed by ORTHMANN, MOYLES, REYNOLDS, BRIGGS, GILL, MOUNT, FARLEY, POECKERT, ZURITA, BARROW, TODD, TIDEY, TIXIER, STEWART, CAMERON, ET AL

Soundings taken by echo sounder, hand lead, pole RESON SEABAT 7125 (R2, D2, PACIFIC STAR, QUICKSILVER, HULL MOUNT, LOCATOR POLL MOUNT), RESON SEABAT 8111 (PACIFIC STAR HULL MOUNT, LOCATOR POLL MOUNT), RESON SEABAT 8125 (LOCATOR POLL MOUNT)

Graphic record scaled by FUGRO PELAGOS, INC. PERSONNEL

Graphic record checked by FUGRO PELAGOS, INC. PERSONNEL

Protracted by N/A Automated plot by HP DESIGN JET 500

Verification by

Soundings in METERS at MLLW

REMARKS: The purpose of this work is to provide NOAA with modern and accurate hydrographic survey data for the area in Southern California from Point Arguello to Ocean Beach

ALL TIMES ARE RECORDED IN UTC.

FUGRO PELAGOS INC.
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NOAA FORM 77-28 SUPERSEDES FORM C & GS-537 U.S. GOVERNMENT PRINTING OFFICE: 1986 - 652-007/41215

A – Equipment

The vessels F/V Pacific Star (with launches R2 and D2), R/V Quicksilver, and R/V Locator acquired all sounding data for this project. The equipment list and vessel descriptions are included in Appendices I and II.

SOUNDING EQUIPMENT

The F/V Pacific Star was equipped with a hull mounted Reson SeaBat 7125 dual-frequency multibeam echosounder system during the M-L906-KR-08 project. The Reson 7125 system operates at two user-selectable frequencies of 400 or 200 kHz. The system forms 256 or 512 beams at a spacing of 0.5° (across-track) in 400 kHz mode and 256 beams at a spacing of 1° (across-track) in 200 kHz mode, with a maximum swath width of 128°. It also allows the operator to select equi-angle or equi-distant beam spacing. Various combinations of these modes of operation were used during this project. The selection of these modes as well as range scale, gain, power level, ping rates, etc. were a function of water depth and data quality and were noted on the survey line logs (see Separate 1.)

The F/V Pacific Star was also equipped with a hull mounted Reson SeaBat 8111 multibeam echosounder system for surveying deeper portions of the survey areas. The Reson 8111 system operates at a frequency of 100 kHz and forms 101 beams at a spacing of 1.5° (across-track), with a maximum swath coverage of 150°. Sonar settings such as range scale, gain, power level, ping rates, etc. were a function of water depth and data quality and we noted on the survey line logs (Separate 1).

The R/V R2 (a Pacific Star launch) was equipped with a hull mounted Reson SeaBat 7125 dual-frequency multibeam echosounder system during the M-L906-KR-08 project. The Reson 7125 system operates at two user-selectable frequencies of 400 or 200 kHz. The system forms 256 or 512 beams at a spacing of 0.5° (across-track) in 400 kHz mode and 256 beams at a spacing of 1° (across-track) in 200 kHz mode, with a maximum swath width of 128°. It also allows the operator to select equi-angle or equi-distant beam spacing. Various combinations of these modes of operation were used during this project. The selection of these modes as well as range scale, gain, power level, ping rates, etc. were a function of water depth and data quality and were noted on the survey line logs (see Separate 1.)

The R/V D2 (a Pacific Star launch) was equipped with a hull mounted Reson SeaBat 7125 single-frequency multibeam echosounder system during the M-L906-KR-08 project. The Reson 7125 system operates at a frequency of 400 kHz. The system forms 256 or 512 beams at a spacing of 0.5° (across-track) with a maximum swath width of 128°. It also allows the operator to select equi-angle or equi-distant beam spacing. For this project the system operated in 256 beam equi-distant mode. Operating modes as well as range scale, gain, power level, ping rates, etc. were a function of water depth and data quality and were noted on the survey line logs (see Separate 1.)

The R/V Quicksilver was equipped with a hull mounted Reson SeaBat 7125 dual-frequency multibeam echosounder system during the M-L906-KR-08 project. The Reson 7125 system operates at two user-selectable frequencies of 400 or 200 kHz. The system forms 256 or 512 beams at a spacing of 0.5° (across-track) in 400 kHz mode and 256 beams at a spacing of 1° (across-track) in 200 kHz mode, with a maximum swath width of 128°. It also allows the operator to select equi-angle or equi-distant beam spacing. Various combinations of these modes of operation were used during this project. For a limited time this vessel was equipped with two 7125 sonars operating in dual-head mode. The selection of these modes as well as range scale, gain, power level, ping rates, etc. were a function of water depth and data quality and were noted on the survey line logs (see Separate 1.)

The R/V Locator was equipped with a pole mounted Reson SeaBat 7125 dual-frequency multibeam echosounder system during the M-L906-KR-08 project. The Reson 7125 system operates at two user-selectable frequencies of 400 or 200 kHz. The system forms 256 or 512 beams at a spacing of 0.5° (across-track) in 400 kHz mode and 256 beams at a spacing of 1° (across-track) in 200 kHz mode, with a maximum swath width of 128°. It also allows the operator to select equi-angle or equi-distant beam spacing. Various combinations of these modes of operation were used during this project. For a limited time this vessel was equipped with two 7125 sonars operating in dual-head mode. The selection of these modes as well as range scale, gain, power level, ping rates, etc. were a function of water depth and data quality and were noted on the survey line logs (see Separate 1.)

The R/V Locator was also equipped briefly with a pole mounted Reson SeaBat 8111 multibeam echosounder system for surveying deeper portions of the survey areas. The Reson 8111 system operates at a frequency of 100 kHz and forms 101 beams at a spacing of 1.5° (across-track), with a maximum swath coverage of 150°. Sonar settings such as range scale, gain, power level, ping rates, etc. were a function of water depth and data quality and were noted on the survey line logs (Separate 1).

The R/V Locator was also equipped with a pole mounted Reson SeaBat 8125 multibeam echosounder. The Reson 8125 system operates at a frequency of 455 kHz and forms 240 beams at a spacing of 0.5° (across-track), with a maximum swath coverage of 120°. Sonar settings such as range scale, gain, power level, ping rates, etc. were a function of water depth and data quality and were noted on the survey line logs (Separate 1).

The line orientation for the all vessels was generally parallel to the coastline and bathymetric contours in the area. The line spacing depended on the water depth and data quality, with an average spacing of two to three times water depth.

The following table summarizes the sonar models and configurations used on each survey vessel.

Table 1 – Vessel Sonar Summary

Vessel Sonar Summary					
Vessel	**Pacific Star**	**R2**	**D2**	**Quicksilver**	**Locator**
Mount Type	Hull	Hull	Hull	Hull	Pole
Sonar System(s)	Reson 7125 dual frequency Reson 8111	Reson 7125 single frequency (400 kHz)	Reson 7125 dual frequency	Reson 7125 dual frequency	Reson 7125 dual frequency Reson 8125 Reson 8111
Operated in dual-head mode	No	No	No	Yes, briefly	Yes, briefly (7125)

SIDE SCAN SONAR

Towed Side Scan Sonar (SSS) operations were not required by this contract. Backscatter and beam imagery snippet data from all multibeam systems were logged and processed separately for the State of California but were not required by NOAA.

POSITIONING EQUIPMENT

All vessels were equipped with an Applanix Position and Orientation System for Marine Vessels (POSMV) 320 V4 to calculate positions. Position was determined in real time using a Trimble Zephyr L1/L2 GPS antenna, which was connected to a Trimble BD950 L1/L2 GPS card residing in the POSMV. An Inertial Measurement Unit (IMU) provided velocity values to the POSMV allowing it to compute an inertial position based on DGPS, heading, and motion.

The POSMV was configured to accept differential corrections which were output from a CSI MBX-3 DGPS receiver that was tuned to the closest or strongest USCG DGPS station.

The POSMV controller software's real-time QC displays were monitored throughout the survey to ensure that the positional accuracies specified in the NOS Hydrographic Surveys Specifications and Deliverables were achieved. These include, but are not limited to the following: GPS Status, Position Accuracy, Receiver Status (which included HDOP) and Satellite Status.

SOFTWARE

Acquisition

All raw multibeam data for all vessels were collected with Winfrog Multibeam v3.08.23 Winfrog Multibeam ran on Windows XP Pro PCs with a quad-core Intel processors. Data from the Reson 8111 and 8125 sonars were logged in the XTF file format while data from the Reson 7125 sonars were logged in the S7K format. These XTF and S7K files contain all multibeam bathymetry, position, attitude, heading and UTC time stamp data required by CARIS to process the soundings. A separate Winfrog module on the same PC logged all raw POSMV data for post-processing of vessel positions in Applanix POSPac software. Winfrog also provided a coverage display for real time QC and coverage estimation of the acquired data.

WinFrog offers the following display windows for operators to monitor data quality:

1. 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 received data.
2. Graphic: The Graphic window shows navigation information in plan view. This includes vessel position, survey lines, background vector plots and raster charts.
3. 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.
4. Calculation: The Calculation window is used to look at specific data items in tabular or graphical format. Operators look here to view the status of the GPS satellite constellation and position solutions.

Applanix POSMV V4 controller software was used to monitor the POSMV system. The software has various displays that allow the operator to check real time position, attitude, and heading accuracies and status. POSMV configuration and calibration, when necessary, was also done using this program.

Fugro Pelagos' MBSurvey Tools v2.00.11.0 was used to aid in file administration and reporting during data acquisition. This program created a daily file that contained survey line, SVP and static draft records. These logs were stored digitally in a database format and later used to create the logsheets in PDF format located in Separate 1.

Processing

All Soundings were processed using CARIS (Computer Aided Resource Information System) HIPS (Hydrographic Information Processing System) v6.1. HIPS converted the XTF and S7K files to HIPS format, corrected soundings for sound velocity, motion, tide, and vessel offsets, and

was used to examine and reject noisy soundings. HIPS produced the final BASE surfaces as well.

CARIS Notebook v3.0 was used to generate the S57 Feature Files.

ESRI ArcMap 9.3 was utilized for survey planning, reviewing coverage plots, creating fill-in lines and crosslines, and progress sketches.

Applanix POSPac v4.3 and POSPac MMS v5.1 were utilized for post-processing the vessel dual frequency GPS data with simultaneous base station data to calculate higher accuracy positions then those calculated in real time.

MB Survey Tools v2.00.11.0 was used to extract True Heave from POS files in to a text format acceptable to the CARIS Generic Data Parser. This was only utilized when the CARIS Load True Heave routine in HIPS failed to import.

MB Survey Tools allowed processors reviewing the data to track changes and add comments while processing. MB Survey Tools also was used to process all sound velocity profiles and put them into CARIS format.

A complete list of software and versions used on this project is included in Appendix I. Refer to the "2008-NOAAProcessing Procedures" document for a detailed processing routine with procedures used.

B – Quality Control

In the CARIS Hips Vessel File (HVF), error estimates for all survey sensors were entered. These error estimates were used in CARIS to calculate the Total Propagated Error (TPE) at the 95% confidence interval for the horizontal and vertical components for each individual sounding. The values that were input in the CARIS HVF file for the survey sensors are the specified manufacturer accuracy values and were downloaded from the CARIS website http://www.caris.com/tpe/. The following is a breakdown and explanation on the manufacturer and Fugro Pelagos-derived values used in the error model:

- Navigation – a value of 0.10 m was entered for the positional accuracy. This value was selected since all positions were post processed, with all X, Y standard deviations better than 0.10m. Note, however, that this was overridden on most lines by adding RMS directly in to the CARIS lines.
- Gyro/Heading – All vessels were equipped with a POSMV 320 V4 and had a baseline <4m, so therefore a value of 0.020 was entered in the HVF per manufacturer specs.
- Heave – The heave percentage of amplitude was set to 5% and the Heave was set to 0.05m, as per manufacturer specs.
- Pitch and Roll - As per the manufacturer accuracy values, both were set to 0.02 degrees.
- Timing – All data were time stamped when created (not when logged) using a single

clock/epoch (Pelagos Precise Timing method). Position, attitude (including TrueHeave) and heading were all time stamped in the POSMV on the UTC epoch. This UTC string was also sent to the Reson processor, via a serial string (ZDA+1 PPS on 7125 systems), to sync the Reson with the POSMV, thus yielding timing accuracies on the order of 1 ms. Therefore a timing error of 0.001 seconds was entered for all sensors on all vessels.

- All vessel and sensor offsets were derived via conventional surveying techniques (Total Station) while the vessels were dry docked. The results yielded standard deviations of 0.005m to 0.010m, vessel and survey dependent.
- Vessel speed – set to 0.10 m/s since a POSMV with 50 Hz output rate was in use.
- Loading – estimated vessel loading error set to 0.05m. This was the best estimate of how the static draft measured changed through the survey day. In reality the GPSTide method used negates some of this error but it was still entered to factor in some of the GPS altitude error component.
- Draft – it was estimated that draft could be measured to within 0.01m to 0.05m, therefore values in this range were entered, vessel dependent. Again, the GPSTide method negates some of this error but it was still entered to factor in some of the GPS altitude error component.
- Delta Draft – a values of 0.02m was entered since this was the standard deviation of the PPK GPS processing of the squat-settlement test.
- Tide error was set to 0.10 m. This value was selected since RMS for GPS altitude was typically better than this.
- Sound Speed Values were set to 1 m/s, surface velocity set to 2.5 m/s
- MRU Align StdDev for the Gyro and Roll/Pitch were set to 0.10° since this is the estimated misalignment between the IMU and the vessel reference frame.

Dynamic positioning error root mean squares (RMS) values were also loaded in to each line to give a better error estimate that takes changes in positioning error into account. The files containing the RMS values were created by Applanix POSPac during the GPS post-processing phase.

The calculated vertical and horizontal error or TPE values were then used to create finalized CUBE surfaces that used only soundings meeting or exceeding project accuracy specifications.

An overview of the data processing flow follows:

In order for the XTF and S7K files collected by Winfrog to be used by CARIS, they must be converted to HDCS format using CARIS' XTF or ResonPDS converter routines. Prior to the files being converted, vessel offsets, patch test calibration values, TPE values, delta draft, and static draft were entered into the HVF.

Once converted, the SVP and TrueHeave data were loaded into each line and then the line was SVP corrected in CARIS HIPS. The TPE was then computed for each sounding and the attitude, navigation and bathymetry data for each individual line were examined for noise, as well as to ensure the completeness and correctness of the data set.

A filter settings file was formalized called "60-012.hff". This filter rejected all soundings falling greater than 60° from nadir, and soundings flagged as low quality by the Reson multibeam system. Note that "rejected" does not mean the sounding was deleted – it was instead flagged as bad so that it would not be used in subsequent processing, such as surface creation. Data flagged as rejected due to the angle from nadir parameters did often contain valid data but were flagged to remove noise and speed the processing flow. Valid data were manually reaccepted into the data set occasionally during line and subset editing to fill data gaps.

Filter settings were often modified based open data quality and sonar used, but all filter settings used were noted on each corresponding line log (refer to Separate 1).

Raw POSMV data logged in to a POS file were processed in conjunction with base station data in Applanix POSPac to produce an SBET file containing positioning data that was more accurate then the real time positioning data. These SBETs were loaded in to each line in CARIS HIPS which replaced the real time navigation and GPS altitude data.

CARIS HIPS' GPSTide function was then run to compute a MLLW tide that utilized the GPS altitude, vessel heave, vessel waterline offsets, and VDatum NAD83 to MLLW grids.

The lines were then merged, using the GPSTide option. Combined Uncertainty Bathymetry Estimator (CUBE) surfaces were then created at varying resolutions depending on the depth range. The following depth thresholds were used on this project.

- Depth Threshold: 0 to 22 meters resolution = 0.5 m
- Depth Threshold: 20 to 33 meters resolution = 1 m
- Depth Threshold: 30 to 45 meters resolution = 1.5 m
- Depth Threshold: 40 to 84 meters resolution = 2 m
- Depth Threshold: 80 to 100 meters resolution = 4 m
- Depth Threshold: 90 to 250 meters resolution = 5 m
- Depth Threshold: 230 to 1000 meters resolution = 10 m

Deviations from these thresholds, if any, are detailed in the appropriate DR.

Subsets Tiles (to track area examined) were then created in CARIS HIPS. Adjacent lines of data were examined to identify tidal busts, sound velocity errors, and roll errors, as well as to reject any remaining noise in the data set that adversely affected the CUBE surface.

While examining the data in subset mode soundings were designated wherever the CUBE surface did not adequately depict the shoalest point of a feature. Soundings were designated when they met or exceeded the criteria for designation set forth in the Specifications and Deliverables. Designation ensured they were carried through to the finalized BASE surfaces.

A statistical analysis of the sounding data was conducted via the CARIS Quality Control Report (QCR) routine. Tie lines were run in each sheet and were compared with lines acquired from the

main-scheme lines where applicable. The Quality Control Reports are located in Separate 4.

Sounding data that passed the required quality assurance checks were used in the final BASE surfaces. During final BASE surface creation in CARIS, the S-44 order option "User Defined" was selected, and the values set so that a=0.20 and b=0.01. This constrained the area of influence of soundings to those that passed project specifications.

CARIS Notebook 3.0 (w/SP1) was utilized to produce the S57 feature file. Seabed Area (SBDARE) polygon objects were picked from areas with obvious rocky bottom topography from the BASE surfaces. Meta-Coverage (M_COV) and Meta-Quality (M_QUAL) objects were defined as required using the extents of the multibeam BASE surfaces.

C - Corrections to Soundings

SOUND VELOCITY PROFILES

Sound velocity casts were performed nominally every two hours. The AML Smart Probes used to determine sound velocities sampled at a rate of ten velocity and pressure observation pairs a second. For each cast, the probes were held at the surface for one to two minutes to achieve temperature equilibrium. The probes were then lowered and raised at a rate of 1 m/s. Between casts, the sound velocity sensors were stored in fresh water to minimize salt-water corrosion and to hold them at ambient water temperatures.

A Brooks Ocean MVP-30 system was used on this project on the F/V Pacific Star. Normally the system was used to collect a set of between three to five sound velocity profiles on a single line, then two hours later another set of profiles, to build a grid of sound velocity profiles. The MVP towfish (which utilized an AML Smart Probe) would free-fall rapidly to just off the seafloor and then be reeled in very slowly (about 0.5 m / second), producing most of its data on the up-cast. When not deployed, the towfish with sound velocity sensor was stored in fresh water to minimize salt-water corrosion and to hold it at ambient water temperatures.

Fugro Pelagos' Multibeam SurveyTools was used to check the profiles graphically for spikes or other anomalies and to produce a SVP file compatible with CARIS HIPS.

Refer to Appendix III for SVP Calibration Reports.

SETTLEMENT CURVE

Squat-settlement tests were performed on all vessels to obtain dynamic draft correctors. Note that in the GPSTide method of tidal corrections used on this project, dynamic draft correctors are not necessary since the computed altitudes include the dynamic draft component of sonar change in

depth. The values below were used for tides versus GPSTide comparisons only, and were not applied to any survey data.

The squat-settlement tests were performed by first establishing a 1000 meter line in the direction of the current. The survey vessel sat static at one end of the line for three minutes while logging L1/L2 GPS data. The line was then run heading north at lowest possible engine RPM then the same line run south at the same RPM, stopping at the south end of the line to obtain an additional three minutes of static L1/L2 GPS data. The line was then run again in the same pattern at incrementing vessel RPMs.

All measurements were corrected for heave, pitch, roll, and reduced to the vessel's common reference point (CRP). Static measurements observed at the end of each line set were used to compute a tide curve for tidal corrections. After post-processing with base station data in Applanix POSPac, a settlement curve of dynamic draft correctors was computed.

The squat settlement test for the R/V Locator was conducted near San Diego, CA, on May 12, 2008 (Julian Day 133).

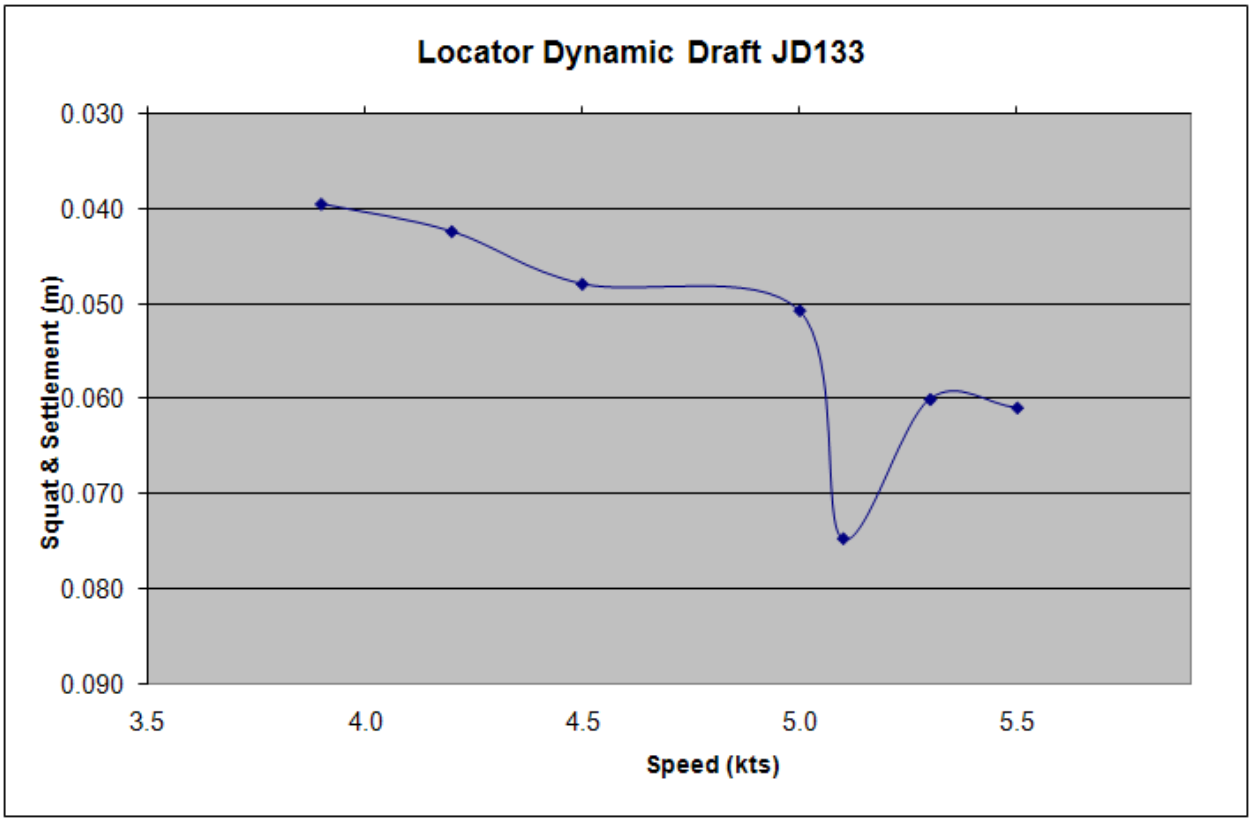


Figure 1 – Locator Dynamic Draft

Table 2 – Locator Squat Settlement Results

LOCATOR DYNAMIC DRAFT CORRECTORS		
Speed (kts)	RPM	Settlement
3.9	1500	0.039
4.2	1600	0.042
4.5	1700	0.048
5.0	1800	0.051
5.1	1900	0.075
5.3	2000	0.060
5.5	2100	0.061

The squat settlement test for the R/V Quicksilver was conducted near Santa Barbara, CA, on August 17, 2008 (Julian Day 230).

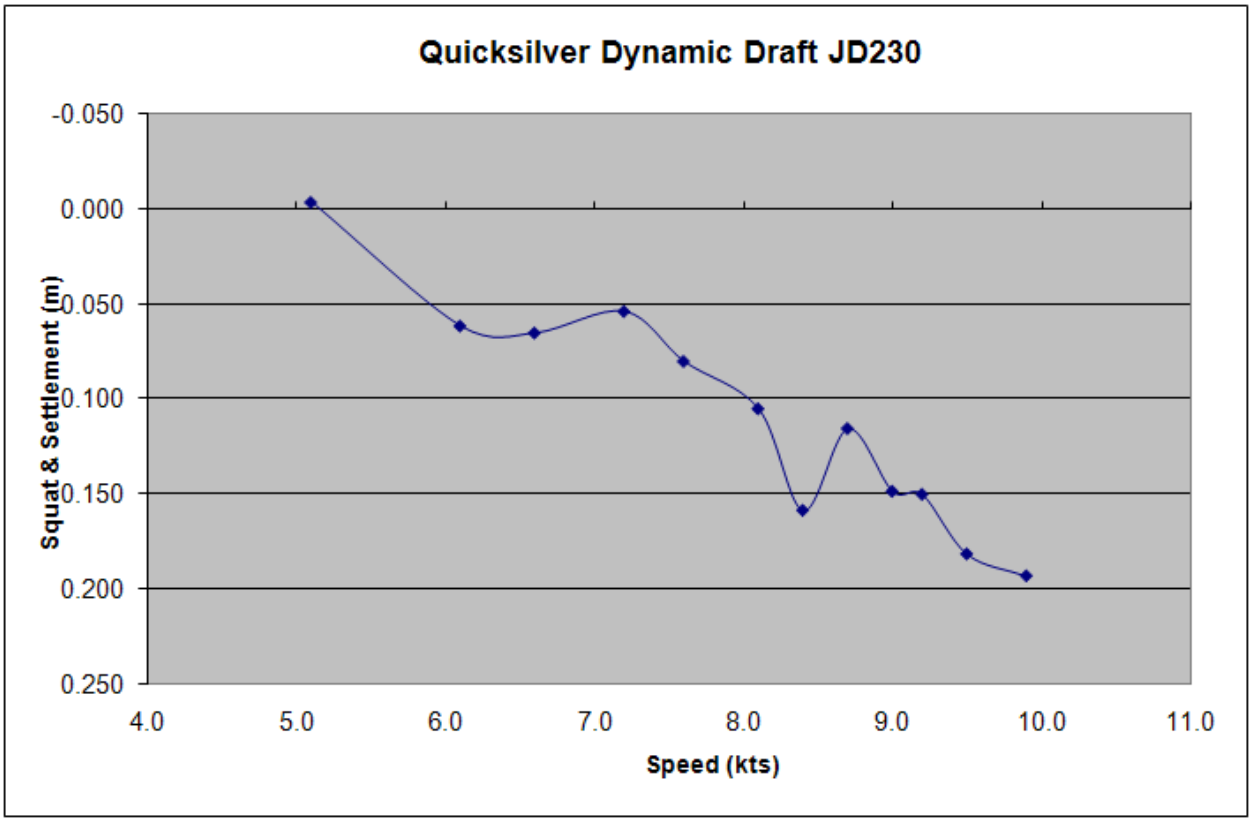


Figure 1 – Quicksilver Dynamic Draft

Table 3 – Quicksilver Squat Settlement Results

QUICKSILVER DYNAMIC DRAFT CORRECTORS		
Speed (kts)	RPM	Settlement
5.1	750	-0.003
6.1	850	0.062
6.6	950	0.065
7.2	1050	0.054
7.6	1150	0.080
8.1	1250	0.105
8.4	1350	0.158
8.7	1450	0.115
9.0	1550	0.148
9.2	1650	0.150
9.5	1750	0.181
9.9	1850	0.193

The squat settlement test for the R/V R2 was conducted near Eureka, CA, on November 1, 2008 (Julian Day 306).

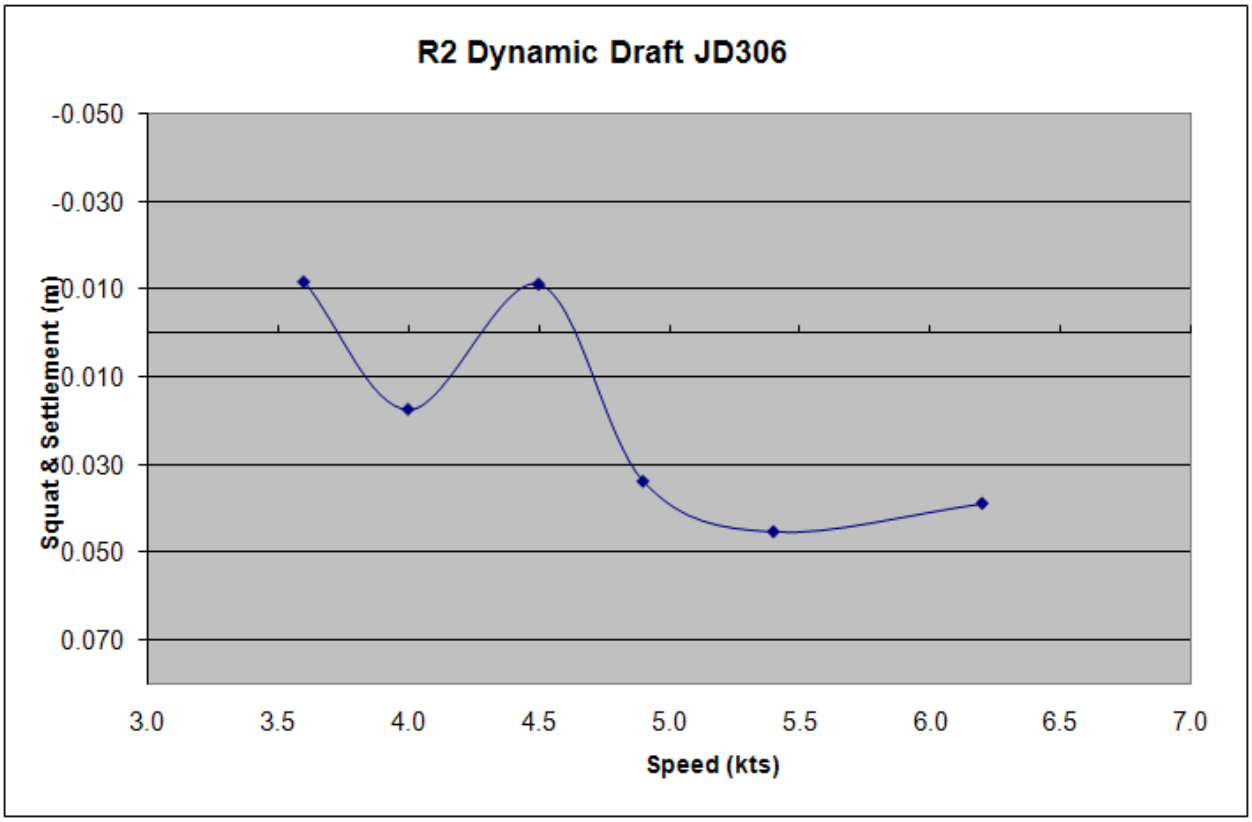


Figure 1 – R2 Dynamic Draft

Table 4 – R2 Squat Settlement Results

R2 DYNAMIC DRAFT CORRECTORS		
Speed (kts)	RPM	Settlement
3.6	400	-0.012
4.0	525	0.017
4.5	750	-0.011
4.9	1000	0.034
5.4	1200	0.045
6.2	1300	0.039

The squat settlement test for the R/V D2 was conducted near Eureka, CA, on November 1, 2008 (Julian Day 306).

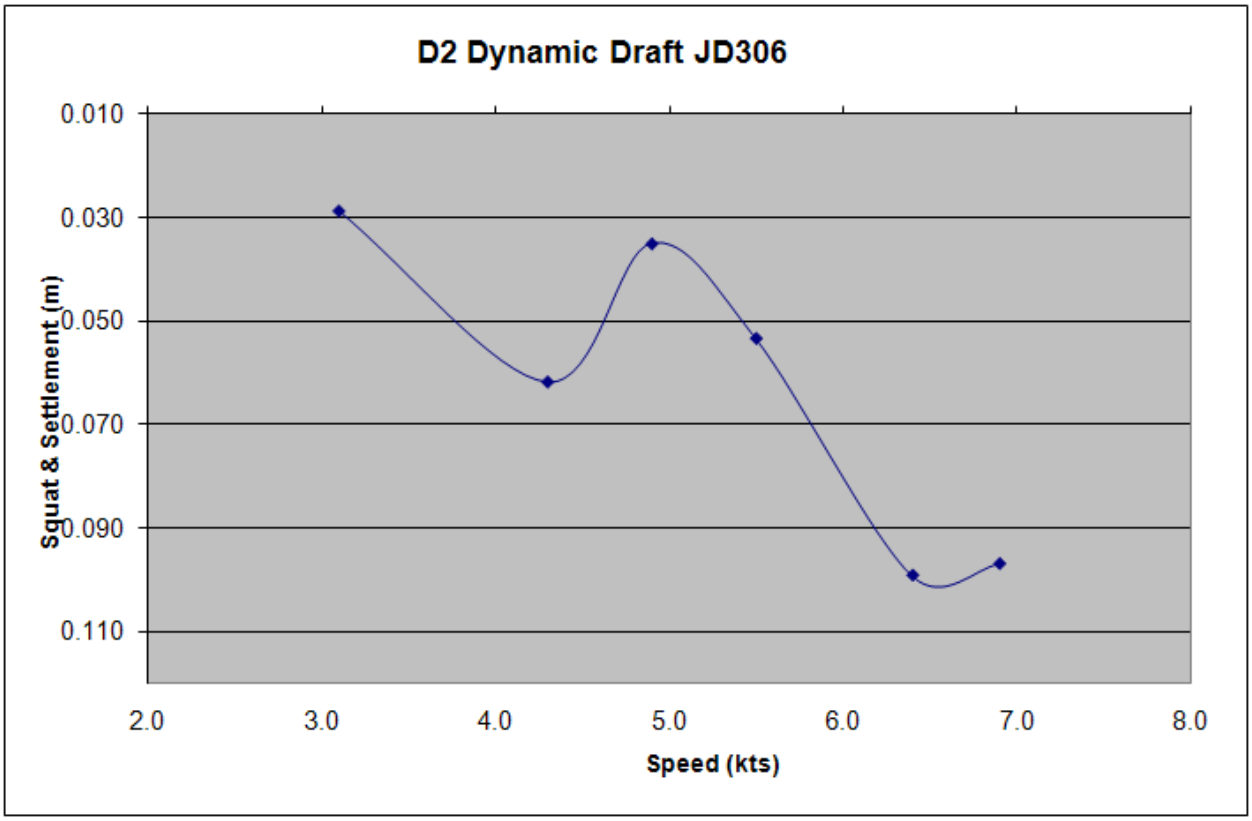


Figure 1 – D2 Dynamic Draft

Table 5 – D2 Squat Settlement Results

D2 DYNAMIC DRAFT CORRECTORS		
Speed (kts)	RPM	Settlement
3.1	600	0.029
4.3	800	0.062
4.9	1000	0.035
5.5	1200	0.053
6.4	1400	0.099
6.9	1600	0.097

The squat settlement test for the F/V Pacific Star was conducted near Eureka, CA, on November 25, 2008 (Julian Day 330).

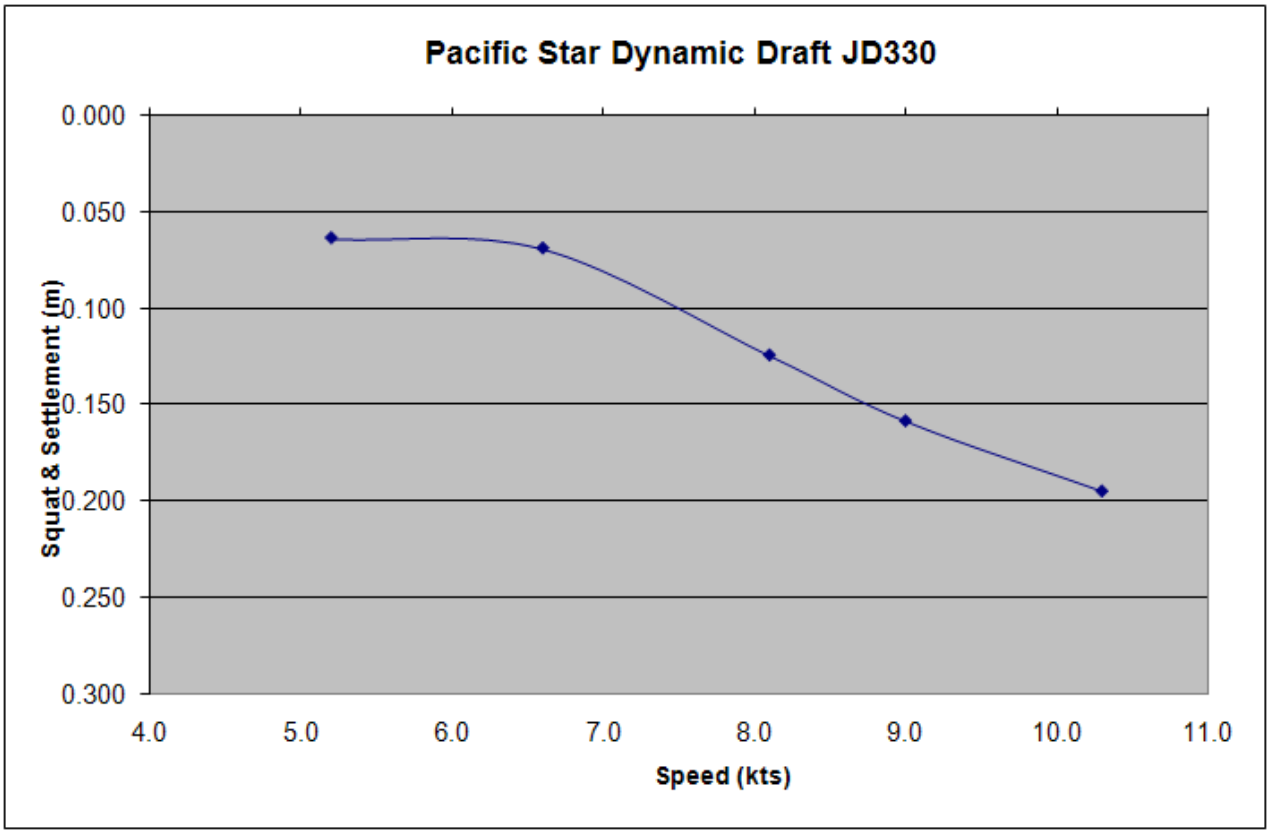


Table 6 – Pacific Star Squat Settlement Results

Pacific Star DYNAMIC DRAFT CORRECTORS		
Speed (kts)	RPM	Settlement
5.2	350	0.064
6.6	450	0.069
8.1	550	0.124
9.0	600	0.158
9.7	650	0.176
10.3	700	0.195

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 tables below show the static draft values measured for all vessels. Note that the GPSTide method of tidal corrections used on this project negates static draft measurements as final correctors (see Tide section); however, their use was still necessary in the HVF to specify sonar depth so CARIS could apply the proper sound velocity profile.

Table 7 - Draft Measurements for the R/V Locator

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	RP to Waterline (+ down)
1	125	5/4/2008	16:34	2.05
2	126	5/5/2008	15:16	2.06
3	127	5/6/2008	16:35	2.06
4	128	5/7/2008	15:24	2.05
5	129	5/8/2008	14:40	2.05
6	130	5/9/2008	15:34	2.06
7	131	5/10/2008	15:53	2.06
8	132	5/11/2008	14:25	2.06
9	133	5/12/2008	21:29	2.05
10	133	5/12/2008	14:39	2.06
11	134	5/13/2008	14:07	2.06
12	137	5/16/2008	15:32	0.08
13	138	5/17/2008	7:24	0.00
14	138	5/17/2008	13:59	1.60
15	139	5/18/2008	14:02	0.10
16	140	5/19/2008	13:57	0.10
17	141	5/20/2008	14:03	1.61

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	RP to Waterline (+ down)
18	142	5/21/2008	13:54	1.60
19	145	5/24/2008	13:47	1.60
20	146	5/25/2008	13:45	1.60
21	147	5/26/2008	13:45	1.60
22	149	5/28/2008	13:46	1.60
23	150	5/29/2008	13:48	1.60
24	152	5/31/2008	14:38	1.60
25	153	6/1/2008	14:35	1.60
26	154	6/2/2008	15:40	1.60
27	155	6/3/2008	16:50	1.59
28	157	6/5/2008	22:32	1.60
29	158	6/6/2008	13:49	1.60
30	159	6/7/2008	14:30	1.59
31	160	6/8/2008	13:41	1.59
32	161	6/9/2008	13:38	1.60
33	162	6/10/2008	13:30	0.08
34	196	7/14/2008	13:51	1.55

Table 8 - Draft Measurements for the R/V Quicksilver

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	RP to Waterline (+ down)
1	143	5/22/2008	17:19	-0.42
2	144	5/23/2008	15:37	-0.43
3	145	5/24/2008	16:45	-0.42
4	146	5/25/2008	15:00	-0.42
5	147	5/26/2008	19:17	-0.42
6	148	5/27/2008	20:40	-0.42
7	149	5/28/2008	19:41	-0.44
8	150	5/29/2008	15:55	-0.44
9	151	5/30/2008	16:45	-0.44
10	152	5/31/2008	14:15	-0.46
11	153	6/1/2008	14:13	-0.44
12	154	6/2/2008	15:43	-0.48
13	155	6/3/2008	13:39	-0.46
14	156	6/4/2008	14:50	-0.43
15	159	6/7/2008	15:18	-0.43
16	160	6/8/2008	16:01	-0.43

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	RP to Waterline (+ down)
17	161	6/9/2008	14:40	-0.42
18	162	6/10/2008	14:34	-0.42
19	163	6/11/2008	14:34	-0.42
20	164	6/12/2008	14:43	-0.41
21	165	6/13/2008	23:15	-0.39
22	166	6/14/2008	14:45	-0.44
23	167	6/15/2008	14:00	-0.45
24	168	6/16/2008	13:58	-0.44
25	169	6/17/2008	13:55	-0.42
26	170	6/18/2008	15:33	-0.41
27	170	6/18/2008	16:13	-0.44
28	171	6/19/2008	14:25	-0.44
29	171	6/19/2008	20:21	-0.46
30	172	6/20/2008	07:49	-0.44
31	173	6/21/2008	08:23	-0.42
32	174	6/22/2008	07:00	-0.40
33	174	6/22/2008	07:40	-0.40
34	174	6/22/2008	20:32	-0.44
35	175	6/23/2008	20:06	-0.43
36	176	6/24/2008	07:20	-0.40
37	176	6/24/2008	20:46	-0.42
38	177	6/25/2008	08:22	-0.43
39	178	6/26/2008	11:04	-0.41
40	178	6/26/2008	20:01	-0.40
41	179	6/27/2008	14:00	-0.43
42	180	6/28/2008	13:20	-0.44
43	181	6/29/2008	15:25	-0.44
44	182	6/30/2008	13:18	-0.43
45	183	7/1/2008	13:10	-0.43
46	184	7/2/2008	13:19	-0.42
47	185	7/3/2008	13:12	-0.42
48	186	7/4/2008	13:20	-0.41
49	187	7/5/2008	14:30	-0.45
50	188	7/6/2008	13:15	-0.44
51	189	7/7/2008	13:22	-0.44
52	190	7/8/2008	13:10	-0.43
53	191	7/9/2008	13:15	-0.44
54	192	7/10/2008	13:41	-0.42
55	194	7/12/2008	00:49	-0.45

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	RP to Waterline (+ down)
56	194	7/12/2008	14:00	-0.45
57	195	7/13/2008	14:11	-0.42
58	196	7/14/2008	14:14	-0.42
59	196	7/14/2008	22:05	-0.42
60	197	7/15/2008	16:37	-0.41
61	198	7/16/2008	07:25	-0.37
62	198	7/16/2008	20:55	-0.45
63	199	7/17/2008	19:25	-0.43
64	200	7/18/2008	07:18	-0.43
65	201	7/19/2008	18:57	-0.38
66	202	7/20/2008	07:45	-0.42
67	203	7/21/2008	06:59	-0.41
68	203	7/21/2008	07:22	-0.40
69	204	7/22/2008	07:01	-0.39
70	204	7/22/2008	07:46	-0.39
71	204	7/22/2008	19:30	-0.39
72	204	7/22/2008	20:06	-0.44
73	205	7/23/2008	19:00	-0.43
74	206	7/24/2008	04:57	-0.42
75	206	7/24/2008	07:48	-0.43
76	206	7/24/2008	20:15	-0.44
77	208	7/26/2008	07:20	-0.40
78	208	7/26/2008	20:00	-0.44
79	209	7/27/2008	07:22	-0.42
80	209	7/27/2008	20:00	-0.44
81	210	7/28/2008	09:07	-0.43
82	211	7/29/2008	07:45	-0.42
83	211	7/29/2008	20:42	-0.46
84	212	7/30/2008	12:42	-0.44
85	213	7/31/2008	06:51	-0.43
86	213	7/31/2008	07:33	-0.43
87	213	7/31/2008	19:46	-0.43
88	214	8/1/2008	07:20	-0.40
89	215	8/2/2008	07:00	-0.46
90	215	8/2/2008	19:20	-0.45
91	216	8/3/2008	07:20	-0.43
92	216	8/3/2008	19:41	-0.43
93	217	8/4/2008	07:20	-0.40
94	217	8/4/2008	20:22	-0.46

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	RP to Waterline (+ down)
95	218	8/5/2008	07:17	-0.44
96	218	8/5/2008	17:45	-0.43
97	219	8/6/2008	07:15	-0.40
98	220	8/7/2008	07:30	-0.45
99	221	8/8/2008	14:27	-0.43
100	222	8/9/2008	07:30	-0.42
101	222	8/9/2008	20:30	-0.42
102	223	8/10/2008	07:20	-0.40
103	223	8/10/2008	20:50	-0.45
104	224	8/11/2008	07:26	-0.44
105	224	8/11/2008	19:30	-0.43
106	225	8/12/2008	17:40	-0.43
107	225	8/12/2008	20:00	-0.43
108	226	8/13/2008	07:44	-0.41
109	226	8/13/2008	19:50	-0.45
110	227	8/14/2008	07:39	-0.42
111	227	8/14/2008	20:54	-0.43
112	229	8/16/2008	07:31	-0.40
113	230	8/17/2008	08:12	-0.41
114	230	8/17/2008	21:50	-0.45
115	231	8/18/2008	11:51	-0.38
116	231	8/18/2008	20:00	-0.40

Table 9 - Draft Measurements for the F/V Pacific Star

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	RP to Waterline (+ down)
1	233	8/20/2008	19:00	-1.97
2	235	8/22/2008	01:30	-1.93
3	236	8/23/2008	02:01	-1.89
4	237	8/24/2008	16:16	-1.90
5	238	8/25/2008	04:09	-1.92
6	238	8/25/2008	14:57	-1.91
7	239	8/26/2008	02:17	-1.97
8	239	8/26/2008	14:03	-1.97
9	240	8/27/2008	13:35	-1.96
10	240	8/27/2008	16:13	-1.97
11	240	8/27/2008	17:20	-1.96
12	241	8/28/2008	02:07	-1.93
13	241	8/28/2008	14:16	-1.93

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	RP to Waterline (+ down)
14	242	8/29/2008	14:32	-1.79
15	243	8/30/2008	02:21	-1.85
16	243	8/30/2008	14:31	-1.83
17	244	8/31/2008	02:18	-1.83
18	244	8/31/2008	15:11	-1.85
19	245	9/1/2008	01:48	-1.82
20	245	9/1/2008	15:12	-1.87
21	246	9/2/2008	01:58	-1.83
22	247	9/3/2008	14:36	-1.83
23	248	9/4/2008	00:55	-1.81
24	248	9/4/2008	14:14	-1.87
25	249	9/5/2008	01:37	-1.85

Table 10 - Draft Measurements for the R/V R2

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	RP to Waterline (+ down)
1	237	8/24/2008	00:58	-0.24
2	240	8/27/2008	15:17	-0.22
3	241	8/28/2008	14:24	-0.22
4	243	8/30/2008	14:23	-0.24
5	244	8/31/2008	15:36	-0.24
6	245	9/1/2008	17:36	-0.23
7	246	9/2/2008	14:38	-0.27
8	247	9/3/2008	14:47	-0.24

Table 11 - Draft Measurements for the R/V D2

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	RP to Waterline (+ down)
1	233	8/20/2008	16:08	-0.20
2	235	8/22/2008	15:05	-0.20
3	239	8/26/2008	14:05	-0.20
4	240	8/27/2008	14:30	-0.20
5	241	8/28/2008	14:10	-0.21
6	242	8/29/2008	14:29	-0.20
7	244	8/31/2008	15:07	-0.20
8	245	9/1/2008	14:57	-0.20
9	247	9/3/2008	14:29	-0.20
10	248	9/4/2008	14:15	-0.19

TIDES

All sounding data were initially reduced to MLLW using predicted tidal data. Predicted tides were used for preliminary processing only.

Final tidal corrections for this project were GPS-derived. POS files logged continuously during data acquisition on each vessel were post-processed using Applanix POSPac software with concurrent onshore dual-frequency base station data and/or precise timing and ephemeris files to create a smoothed best estimate of trajectory (SBET) file. The SBET was then loaded in to each line in CARIS HIPS, replacing the real time GPS altitude with a post-processed GPS altitude. See the Horizontal and Vertical Control Report more for details concerning SBET generation.

The CARIS GPSTide function was then run on each line, computing tidal corrections by utilizing the GPS altitude, corrected for waterline offsets as well as vessel heave. It reduced the altitude to MLLW by use of NAD83 to MLLW offset grids produced by NOAA's VDatum software.

The CARIS GPSTide function works as follows:

GPSTide = GPS Height – Datum Height – Heave – Waterline Offset,

Where "GPS Height" is the altitude of the vessel reference point (RP) above NAD83 that has been loaded into each line from the SBET, "Datum Height" is the offset between NAD83 and MLLW as calculated by VDatum, "Heave" is the TrueHeave that has been loaded in to each line, and "Waterline Offset" is the applicable offset between the RP and the waterline from the vessel configuration file.

Although heave and waterline offset measurements are not necessary to compute GPS Tide since altitudes of the sonar relative to a "fixed" surface (the NAD83 ellipsoid) are being calculated, they do need to be removed from the computed GPSTide as shown above since CARIS HIPS applied those corrections during sound velocity correction. Note that GPS Tide corrects for changes in sonar depth as a result of dynamic draft as well.

After GPS Tide was computed, all lines were then re-merged, selecting the merge option "Apply GPS Tide".

Tide station data were used only for comparison with the GPSTides. See each survey's Descriptive Report for specific results of the tide – GPSTide comparisons.

For more detail concerning the GPSTide method of tidal reduction see the Horizontal and Vertical Control Report.

VESSEL ATTITUDE: HEADING, HEAVE, PITCH, AND ROLL

Vessel heading and dynamic motion were measured by the Applanix POSMV 320 V4 on all vessels. The system calculated heading by inversing between two Trimble GPS generated antenna positions. An accelerometer block (the IMU), which measured vessel attitude, was mounted directly above the multibeam transducer. The operational accuracy specifications for this system, as documented by the manufacturer, are as follows:

Table 12 - POS MV Specifications

POS MV Accuracy	
Pitch and Roll	0.02°
Heading	0.02°
Heave	5% or 5-cm over 20 seconds

CALIBRATIONS

Multibeam

For all vessels and sonar configurations, patch tests were conducted to identify alignment errors (timing, pitch, heading and roll) between the motion sensor and the multibeam transducer(s). Patch test calibration values used to correct all soundings for the survey are shown in Table 4.

Table 13 - Patch Test Results Summary

Vessel	PatchTest Day[1]	Sonar	Timing Error	Pitch Offset	Roll Offset	Azimuth Offset
Pacific Star	JD234	7125 400 kHz (256 mode)	0.000	-1.300	-0.490	-0.640
		7125 200 kHz (256 mode)	0.000	-1.310	-0.430	-0.970
	JD235	8111	0.000	-0.700	-0.080	0.600
R2	JD245	7125 400 kHz (256 mode)	0.000	2.150	0.500	-1.090
		7125 200 kHz (256 mode)	0.000	2.050	0.580	-0.800
D2	JD236	7125 400 kHz (256 mode)	0.000	1.990	1.090	1.850
	JD244[2]		0.000	2.290	1.430	0.840
Locator	JD085	7125 400 kHz Port (256 dual mode)	0.000	1.300	0.350[3]	-0.800
		7125 400 kHz Stbd (256 dual mode)	0.000	0.500	0.150[4]	1.100
		7125 200 kHz (256 mode)	0.000	-0.300	0.370	-0.300

[1] Julian day the actual test was done is listed. May be pre-dated in CARIS HVF to cover lines ran before patchtest.
[2] D2 7125 sonar head was removed for troubleshooting, necessitating this repatch.
[3] +14.600 roll for rotation to port
[4] -14.300 roll for rotation to stbd

		7125 200 kHz Port (256EA dual mode)	-0.002	1.100	0.550[5]	0.200
		7125 200 kHz Stbd (256EA dual mode)	-0.002	0.400	0.250[6]	0.700
		7125 200 kHz Port (256ED dual mode)	-0.002	1.100	0.550[7]	0.200
		7125 200 kHz Stbd (256ED dual mode)	-0.002	0.400	0.250[8]	0.500
	JD158	7125 400 kHz (512 mode)	0.000	-1.200	0.200	-0.300
	JD136	8125	-0.003	0.000	0.100	-1.200
	JD137		-0.003	0.000	0.110	-1.200
	JD196	8111	0.000	0.000	1.420	-0.500
Quicksilver	JD142	7125 400 kHz Port (512 dual mode)	-0.003	-2.900	0.270[9]	-1.700
		7125 400 kHz Stbd (512 dual mode)	-0.003	-4.900	0.080[10]	-0.500
		7125 200 kHz Port (256 dual mode)	-0.003	-3.000	0.500[11]	-1.500
		7125 200 kHz Stbd (256 dual mode)	-0.003	-2.900	0.240[12]	-0.600
	JD143	7125 200 kHz Stbd (256 single tilted)	0.000	-3.950	0.250[13]	-1.100
	JD148		0.000	-3.850	0.100[14]	-0.200
	JD157	7125 200 kHz (256 mode)	0.000	-0.800	1.250	1.900
	JD166		0.000	-0.900	1.290	0.000
	JD157	7125 400 kHz (256 mode)	0.000	-0.700	1.100	0.900
	JD166		0.000	-1.500	1.200	0.900
	JD157	7125 400 kHz (512 mode)	0.000	-0.700	1.100	0.900
	JD166		0.000	-1.500	1.200	0.900

Frequent patch tests were done for the 7125 systems when they were operating in dual head mode (approximately 15° tilt to port and stbd) as various tests were done to optimize the system. In the end it was decided the dual head setup was not advantageous for this project mostly because of the limitation of along track resolution. Limited data was collected with the dual head system, consisting of data in H11875 and a small part of H11876, but resulted in the many vessel configurations listed above. Despite the decision to discontinue the use of a dual-head system, all data collected with it meets specifications.

Additional Sounding Techniques

None used.

[5] +14.600 roll for rotation to port
[6] -14.300 roll for rotation to stbd
[7] 14.600 roll for rotation to port
[8] -14.300 roll for rotation to stbd
[9] +14.590 roll for rotation to port
[10] -13.950 roll for rotation to stbd
[11] +14.590 roll for rotation to port
[12] -13.950 roll for rotation to stbd
[13] -13.950 roll for rotation to stbd
[14] -13.950 roll for rotation to stbd

D - Approval Sheet

Approval Sheet

For

H11875, H11876, H11877, H11878, H11879, H11880, H11881, H11882, H11883, H11891, H11950, H11951, H11952, H11953

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

M-L906-KR-08 Statement of Work
NOS Hydrographic Surveys Specifications and Deliverables, April 2008 Edition
Fugro Pelagos, Inc. Acquisition Procedures (2008- NOAAAcquisitionProcedures);
Fugro Pelagos, Inc. Processing Procedures (2008-NOAAProcessingProcedures);

The data were reviewed daily during acquisition and processing, and the survey is complete and adequate for its intended purpose.

This report has been reviewed and approved. All records are forwarded for final review and processing to the Chief, Pacific Hydrographic Branch.

Approved and forwarded,

Dean Moyles,
Lead Hydrographer
Fugro Pelagos, Inc. Survey Party

X Dean Moyles

Digitally signed by Dean Moyles
DN: cn=Dean Moyles, email=dmoyles@fugro.com, o=Fugro Pelagos, Inc., l=San Diego, Ca
Date: 2009.01.13 14:21:03 -08'00'

Dean Moyles
ACSM Certified

Appendix I – Equipment List and Software Versions

Equipment

Table 14 - Equipment List

Description	Ast_SerialNumber
AML SV PLUS VELOCITY PROBE (MVP)	7522
AML SV PLUS VELOCITY PROBE (MVP)	7523
AML SV PLUS VELOCITY PROBE 1000DBAR	4431
AML SV PLUS VELOCITY PROBE 1000DBAR	4656
AML SV PLUS VELOCITY PROBE 1000DBAR	4703
AML SV PLUS VELOCITY PROBE 1000DBAR	4820
AML SV PLUS VELOCITY PROBE 1000DBAR	4966
AML SV PLUS VELOCITY PROBE 1000DBAR	5282
AML SV PLUS VELOCITY PROBE 1000DBAR	5283
AML SV PLUS VELOCITY PROBE 1000DBAR	5284
AML SV PLUS VELOCITY PROBE 1000DBAR	5353
AML SV PLUS VELOCITY PROBE 1000DBAR	5354
APPLANIX IMU 200	231
APPLANIX IMU 200	241
APPLANIX IMU 200	49
APPLANIX IMU 200	730
APPLANIX IMU 200	778
APPLANIX POS MV PROCESSOR L1/L2(RTK)	2148
APPLANIX POS MV PROCESSOR L1/L2(RTK)	2151
APPLANIX POS MV PROCESSOR L1/L2(RTK)	2161
APPLANIX POS MV PROCESSOR L1/L2(RTK)	2355
APPLANIX POS MV PROCESSOR L1/L2(RTK)	2640
BROOKE OCEAN MVP-30 CONTROL I/O DECK UNIT	10597
BROOKE OCEAN MVP-30 SSFF (FISH)	10598
BROOKE OCEAN MVP-30 SSFF (FISH)	10599
BROOKE OCEAN MVP-30 TOW BLOCK	10596
BROOKE OCEAN MVP-30 WINCH	10595
COMPUTER DELL PC (PROCESSING)	1454KC1
COMPUTER DELL PC (PROCESSING)	21DFQB1
COMPUTER DELL PC (PROCESSING)	2454KC1

COMPUTER DELL PC (PROCESSING)	2FS5ZC1
COMPUTER DELL PC (PROCESSING)	4454KC1
COMPUTER DELL PC (PROCESSING)	6FS5ZC1
COMPUTER DELL PC (PROCESSING)	B354KC1
COMPUTER DELL PC (PROCESSING)	C86VP81
COMPUTER DELL PC (PROCESSING)	F354KC1
COMPUTER DELL PC (PROCESSING)	G354KC1
COMPUTER DELL PC (PROCESSING)	H354KC1
COMPUTER DELL PC (PROCESSING)	HDS5ZC1
COMPUTER RACKMOUNT (MVP)	874E50040A10050
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602498
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602562
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602564
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602603
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602604
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602606
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602607
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602608
DONGLE ARCGIS ARCVIEW (ESRI)	37114247-VIEW3
DONGLE ARCGIS ARCVIEW (ESRI)	37114247-VIEW4
DONGLE ARCGIS ARCVIEW (ESRI)	37150457
DONGLE ARCGIS ARCVIEW (ESRI)	37152209-VIEW1
DONGLE CARIS - NT (HIPS/SIPS)	CW9604665
DONGLE CARIS - NT (HIPS/SIPS)	CW9604705
DONGLE CARIS - NT (HIPS/SIPS)	CW9604869
DONGLE CARIS - NT (HIPS/SIPS)	CW9604871
DONGLE CARIS - NT (HIPS/SIPS)	CW9604872
DONGLE CARIS - NT (HIPS/SIPS)	CW9604873
DONGLE CARIS - NT (HIPS/SIPS)	CW9604894
DONGLE CARIS - NT (HIPS/SIPS)	CW9605328
DONGLE CARIS - NT (HIPS/SIPS)	CW9605663
DONGLE CARIS - NT (HIPS/SIPS)	CW9605666
DONGLE C-MAP	ET0002
DONGLE POS GPS	4096
DONGLE POS GPS	4375
DONGLE POS GPS	4915
DONGLE POS GPS	5049
DONGLE POS GPS	7346
DONGLE POS GPS	7347
DONGLE POS PAC	2061

DONGLE POS PAC	2110
DONGLE POS PAC	2220-870
DONGLE POS PAC	2257-865
DONGLE POS PAC	495-1740
DONGLE POS PAC	496-1734
DONGLE QT-MODELER	SRB10750
DONGLE WINFROG	3100369U
DONGLE WINFROG	3100375U
DONGLE WINFROG	3100429U
DONGLE WINFROG	3100433U
DONGLE WINFROG	3100442U
ETHENET TELEMETRY , FROGLINK I/O	BGR602410
GENERATOR >3000W	EZGF-1194681
GPS ANTENNA L1/L2	12561426
GPS ANTENNA L1/L2	12561441
GPS ANTENNA L1/L2	12697293
GPS ANTENNA L1/L2	60001982
GPS ANTENNA L1/L2	60008160
GPS ANTENNA L1/L2	60124972
GPS ANTENNA L1/L2	60125052
GPS ANTENNA L1/L2	60125232
GPS ANTENNA L1/L2	60186871
GPS ANTENNA L1/L2	60187495
GPS ANTENNA L1/L2 STARFIX SPOT	189
GPS ANTENNA L1/L2 STARFIX SPOT	190
GPS ANTENNA L1/L2 STARFIX SPOT	191
GPS ANTENNA L1/L2 STARFIX SPOT	30220334
GPS ANTENNA L1/L2 STARFIX SPOT	BGR602321
GPS ANTENNA L1/L2 STARFIX SPOT	NZT070200047
GPS ANTENNA L1/L2 STARFIX SPOT	NZT070200049
GPS ANTENNA L1/L2 STARFIX SPOT	NZT07420009
GPS ANTENNA L1/L2 STARFIX SPOT	NZT07420011
GPS BEACON ANTENNA CSI MBL-3	0037-7035-0002
GPS BEACON ANTENNA CSI MBL-3	9827-1866-0004
GPS BEACON ANTENNA CSI MBL-3	9834-2211-0003
GPS BEACON ANTENNA CSI MBL-3	9845-2643-0001
GPS CSI CDA ANTENNA	0634-31116-0022
GPS CSI CDA ANTENNA	0640-31662-0017
GPS CSI CDA ANTENNA	0640-31662-0020
GPS CSI CDA ANTENNA	0748-5628-0078

GPS CSI CDA ANTENNA	0748-5628-0160
GPS CSI CDA ANTENNA	0748-5628-0162
GPS CSI MBX-3 COASTGUARD RECEIVER	0042-7227-0001
GPS CSI MBX-3 COASTGUARD RECEIVER	0314-11467-0001
GPS CSI MBX-3 COASTGUARD RECEIVER	9827-1866-0002
GPS CSI MBX-3 COASTGUARD RECEIVER	9833-2166-0001
GPS CSI MBX-3 COASTGUARD RECEIVER	9834-2211-0001
GPS CSI MBX-3 COASTGUARD RECEIVER	9834-2211-0002
GPS CSI MBX-3 COASTGUARD RECEIVER	9913-3442-0001
GPS CSI MBX-3 COASTGUARD RECEIVER	9920-3754-0001
GPS RECEIVER L1/L2 STARFIX XP/HP	0225108640
GPS RECEIVER L1/L2 STARFIX XP/HP	0225108XXX
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV07080024
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV07120002
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV07120004
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV07120016
GPS RECEIVER L1/L2 STARFIX XP/HP	NBVO7080003
LAPTOP PC	BH5GD81
LAPTOP PC	GH4GD81
LAPTOP PC	hb2pbg1
NETWORK ATTACHED STORAGE	30012668
NETWORK ATTACHED STORAGE	30012669
NETWORK ATTACHED STORAGE	NA0000000413215
NETWORK ATTACHED STORAGE	SHU444430019825
NETWORK ATTACHED STORAGE (SMART) NETAPP 3050	JW0000000071173
NETWORK HUB/SWITCH 8 PORT MANAGED	FOC1229U620
NETWORK HUB/SWITCH 8 PORT MANAGED	FOC1234U1WQ
PLOTTER A0 75X	SG12M2205X
PRINTER COLOR INKJET	sg17k8300pdh
PRINTER LASER	CNJC84X04G
PRISM	BGR602576
PRISM	BGR602578
PRISM	BGR602594
RESON NAVISOUND SVP 70	2007073
RESON NAVISOUND SVP 70	4506001
RESON SEABAT 7125 200KHZ PROJECTOR	0408003
RESON SEABAT 7125 200KHZ PROJECTOR	2506008
RESON SEABAT 7125 200KHZ PROJECTOR	2506015
RESON SEABAT 7125 200KHZ PROJECTOR	4605048
RESON SEABAT 7125 400KHZ PROJECTOR	5006392

RESON SEABAT 7125 400KHZ PROJECTOR	5006396
RESON SEABAT 7125 RECEIVE ARRAY	2507038
RESON SEABAT 7125 RECEIVE ARRAY	4107007
RESON SEABAT 71-P LCU	1515004
RESON SEABAT 71-P LCU	1515008
RESON SEABAT 71-P PROCESSOR	4707082
RESON SEABAT 71-P PROCESSOR	4707090
RESON SEABAT 8111 RECEIVER ARRAY	3402015
RESON SEABAT 8111 TRANSCEIVER	23745
RESON SEABAT 8111 TRANSCEIVER	37157
RESON SEABAT 8111 TRANSMIT ARRAY	2104019
RESON SEABAT 8125 TRANSDUCER	0802100
RESON SEABAT OVERSIDE MOUNT (SMALL)	121945
RESON SEABAT PROCESSOR RESON 81-P	23279
RESON SEABAT PROCESSOR RESON 81-P	34545
RESON SEABAT PROCESSOR RESON 81-P	36746
RESON SVP-C TOPSIDE (8125)	74548
SLIP RING IEC	3259-0601
SLIP RING IEC	4101-1297-0702
SLIP RING IEC	4103-0000-0702
SLIP RING IEC	9-25-87-K714
TOTAL STATION SOKKIA	D21828
TRIBRACH	BGR124179
TRIBRACH	BGR124180
TRIBRACH	BGR602073
TRIBRACH	BGR602584
WINCH HYDRAULIC MEDIUM / SMALL TOW	BGR122174

Software

Fugro Pelagos Winfrog v3.08.23
Fugro Pelagos MBSurvey Tools v2.00.11.00
CARIS HIPS/SIPS v6.1 (w/ Service Pack 2, Hotfixes 1-4)
CARIS Notebook v3.0 (w/ Service Pack 1, Hotfixes 1-2)
ESRI ArcGIS v9.3
Applanix POSMV V4 Controller v3
Applanix POSPac 4.3 and POSPac MMS 5.1 (w/ Service Pack 1)
IVS Fledermaus v6.5.1
NOAA Chart Re-projector v2.0
Nobeltec Tides and Currents v3.5.107
Microsoft Office 2007 Professional
Microsoft Windows XP Professional (w/ Service Pack 3)
Helios Software Solutions Textpad v5.2.0
Irfanview v3.98

Appendix II – Vessel Descriptions

F/V Pacific Star

The F/V Pacific Star (Figure 2), a former Bering Sea crab fishing vessel, was modified to accommodate a survey crew, acquisition hardware, and survey launches. Living quarters and office space containers were installed on the back deck. Davits previously used on the R/V Davidson were installed near the aft end of the vessel to lift and deploy the R2 and D2 survey launches. Access doors and infrastructure were built to facilitate access to the launches.

Reson Seabat 7125 and 8111 multibeam sonars were hull mounted near the best estimate of the vessel's center of gravity, approximately midship. A drop keel was attached to the keel and protected the sonar heads forward by a crescent shaped skid (Figure 3). The inertial measurement unit (IMU) accelerometer package for a POSMV was installed inside the hull almost directly above the Reson 7125.

Table 15 - Vessel Specifications (Pacific Star)

SURVEY LAUNCH F/V PACIFIC STAR	
Owner	Pacific Star Fisheries, LLC
Official Number	556510
Length	162'
Breadth	38'
Depth	14'
Max Draft	16'
BHP Main Engines	3,000 combined BHP (1500 ea).; Two Electromotive Diesels
Gross Tonnage (US)	194
Fresh Water Capacity	24,399 Gallons
Fuel Capacity	90,112 Gallons

Figure 1 – F/V Pacific Star

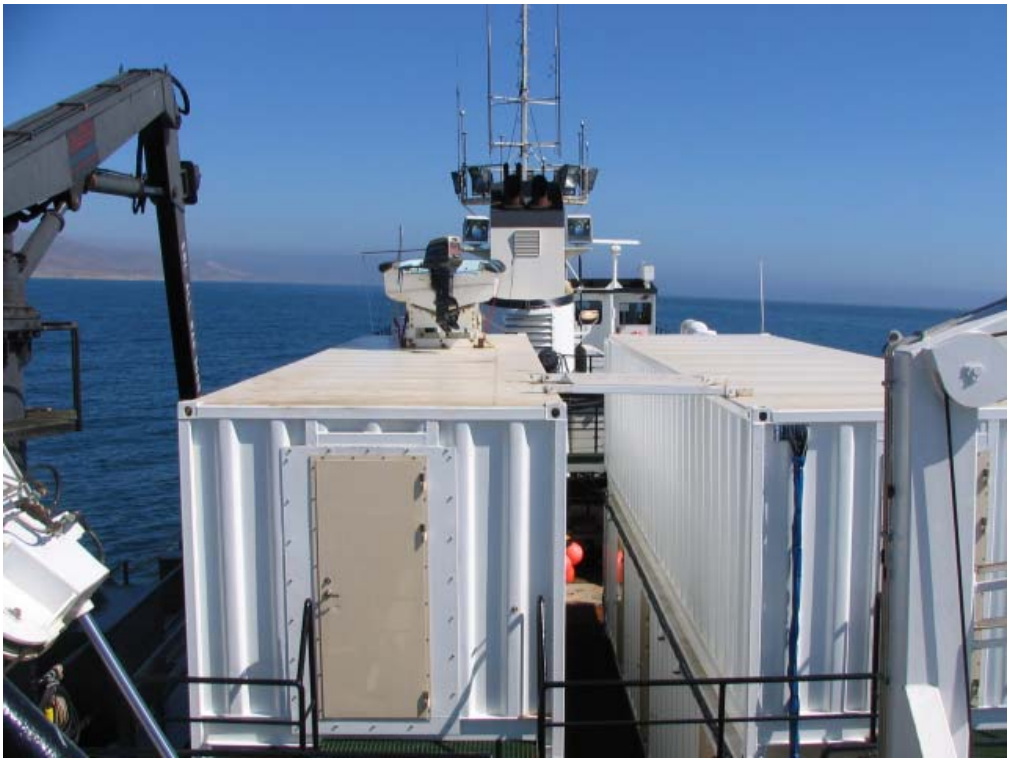


Figure 2 – F/V Pacific Star Office Containers

Figure 3 – F/V Pacific Star Davit Launch System

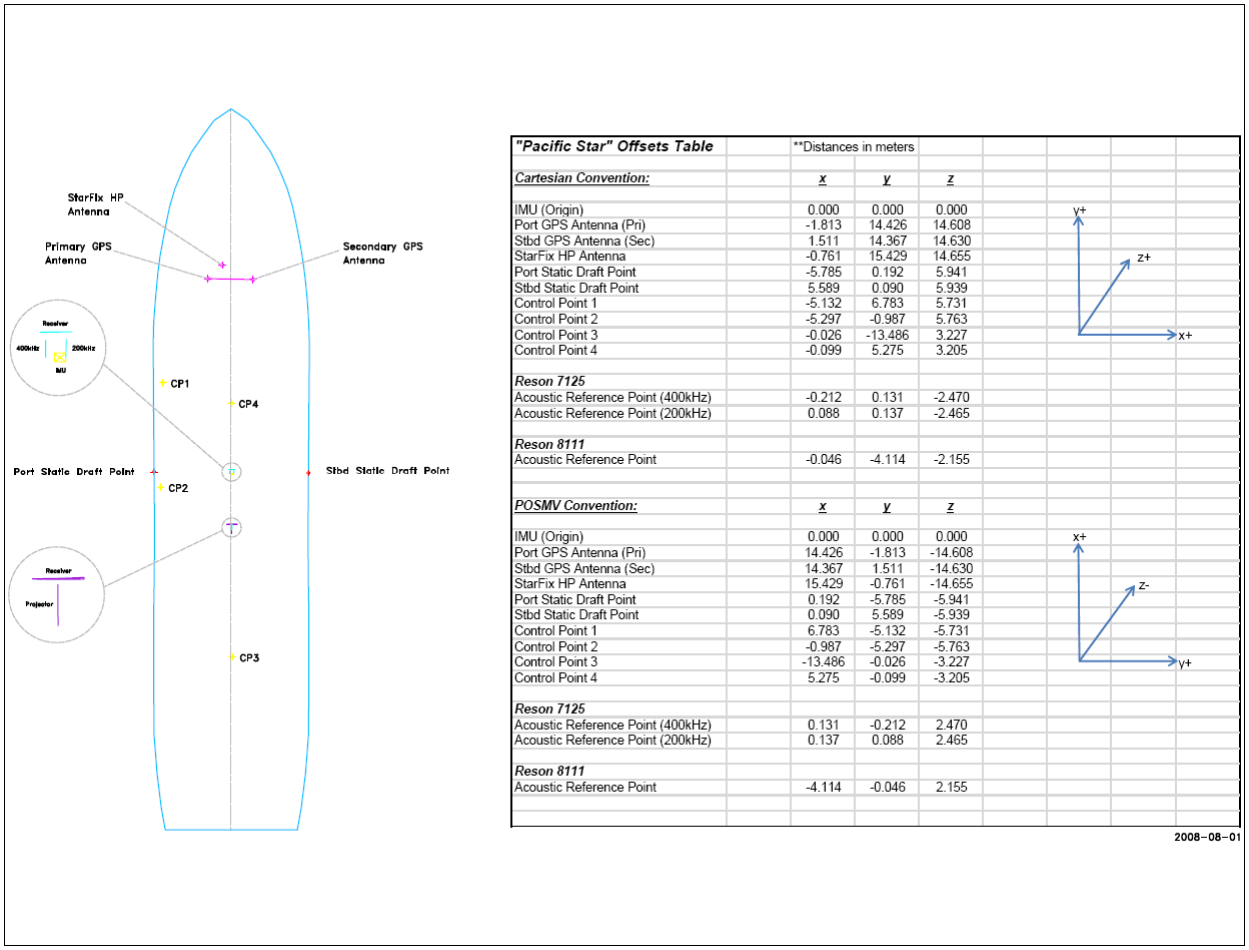
Figure 4 – F/V Pacific Star Drop Keel with 7125 and 8111 Sonar Heads

Two Trimble L1/L2 antennas were mounted above and forward from the sonars on the vessel radio mast. Offset 3.4 meters port-starboard from each other, these provided GPS data to the POSMV for position, attitude, and heading computations. The port side antenna functioned as the POSMV master antenna; the starboard side antenna functioned as the POSMV secondary.

A Brooks Ocean MVP-30 system using an AML Smart Probe was installed and used off the stern to collect sound velocity profiles in shallow water. An AML Smart Probe with on a standard winch setup was used off the stern for deeper water and as a backup to the MVP-30.

Draft measurement tabs were installed at convenient measurement stations on both the port and starboard sides of the vessel, in line with the CRP and Reson 7125.

Offset values for the CRP to the sonar and waterline were applied to the data in CARIS HIPS as specified in the HIPS vessel file (HVF). Offsets between the GPS antennas and the CRP were applied internally by the POSMV by entering a GPS lever arm offset. Vessel offsets used are shown in the offset diagram below.



"Pacific Star" Offsets Table	**Distances in meters		
Cartesian Convention:	***x***	***y***	***z***
IMU (Origin)	0.000	0.000	0.000
Port GPS Antenna (Pri)	-1.813	14.426	14.608
Stbd GPS Antenna (Sec)	1.511	14.367	14.630
StarFix HP Antenna	-0.761	15.429	14.655
Port Static Draft Point	-5.785	0.192	5.941
Stbd Static Draft Point	5.589	0.090	5.939
Control Point 1	-5.132	6.783	5.731
Control Point 2	-5.297	-0.987	5.763
Control Point 3	-0.026	-13.486	3.227
Control Point 4	-0.099	5.275	3.205
Reson 7125			
Acoustic Reference Point (400kHz)	-0.212	0.131	-2.470
Acoustic Reference Point (200kHz)	0.088	0.137	-2.465
Reson 8111			
Acoustic Reference Point	-0.046	-4.114	-2.155
POSMV Convention:	***x***	***y***	***z***
IMU (Origin)	0.000	0.000	0.000
Port GPS Antenna (Pri)	14.426	-1.813	-14.608
Stbd GPS Antenna (Sec)	14.367	1.511	-14.630
StarFix HP Antenna	15.429	-0.761	-14.655
Port Static Draft Point	0.192	-5.785	-5.941
Stbd Static Draft Point	0.090	5.589	-5.939
Control Point 1	6.783	-5.132	-5.731
Control Point 2	-0.987	-5.297	-5.763
Control Point 3	-13.486	-0.026	-3.227
Control Point 4	5.275	-0.099	-3.205
Reson 7125			
Acoustic Reference Point (400kHz)	0.131	-0.212	2.470
Acoustic Reference Point (200kHz)	0.137	0.088	2.465
Reson 8111			
Acoustic Reference Point	-4.114	-0.046	2.155

2008-08-01

Figure 5 - Pacific Star Offset Diagram

R/V R2

The R/V R2 (Figure 6), a Pacific Star launch, was modified to accommodate a survey crew and acquisition hardware. The keel was cut just aft of mid-ship and Reson 7125 multibeam sonar was installed. A conical cowling protected the sonar head forward and aft by a crescent shaped skid (Figure 8). The accelerometer package for a POS/MV was mounted in the hull of the vessel just over the 7125 multibeam transducer head.

Two Trimble L1/L2 antennas were mounted above the 7125 and accelerometer for positioning and heading (Figure 7). The two POS/MV antennas were offset 1.0m to the port and starboard. The port side antenna (L1/L2) functioned as the POS/MV master antenna; the starboard side antenna functioned as the POS/MV secondary.

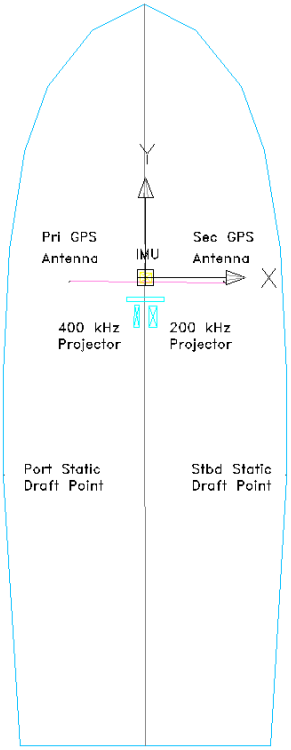
The AML Smart Probe SV&P sensors were deployed from an A-Frame on the stern using a small hydraulic winch.

Offset values were applied to the data in CARIS HIPS as specified in the vessel configuration file (VCF). Vessel offsets used are shown in the following table. Note that the VCF does not contain navigation offsets because the position provided by the POS/MV is already corrected to the CRP.

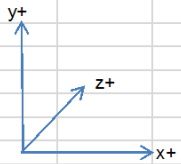
Table 16 - Vessel Specifications (R2)

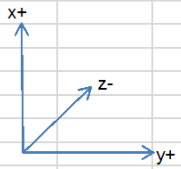
Survey Launch	**R2**
Official Number	623241
Owner	Stabbert Maritime Yacht & Ship
Year Built	1980/1982
Length	28.9 ft
Beam	12 ft
Draft	5.7 ft
Gross Ton	15
Net Ton	13
Mechanical Power	Caterpillar 3208
Electrical	Northern Lights

Figure 6 - R/V R2



"R2" Offsets Table	**Distances in meters		
Cartesian Convention:	***x***	***y***	***z***
IMU (Origin)	0.000	0.000	0.000
Port GPS Antenna (Pri)	-0.980	-0.037	3.054
Stbd GPS Antenna (Sec)	1.022	-0.066	3.027
Port Static Draft Point	-1.831	-2.539	1.388
Stbd Static Draft Point	1.802	-2.539	1.341
Acoustic Reference Point (400kHz)	-0.120	-0.495	-0.679
Acoustic Reference Point (200kHz)	0.092	-0.499	-0.683
POSMV Convention:	***x***	***y***	***z***
IMU (Origin)	0.000	0.000	0.000
Port GPS Antenna (Pri)	-0.037	-0.980	-3.054
Stbd GPS Antenna (Sec)	-0.066	1.022	-3.027
Port Static Draft Point	-2.539	-1.831	-1.388
Stbd Static Draft Point	-2.539	1.802	-1.341
Acoustic Reference Point (400kHz)	-0.495	-0.120	0.679
Acoustic Reference Point (200kHz)	-0.499	0.092	0.683





2008-08-07

Figure 7 - R2 Offset Diagram

R/V D2

The R/V D2 (Figure 6), a Pacific Star launch, was modified to accommodate a survey crew and acquisition hardware. The keel was cut just aft of mid-ship and Reson 7125 multibeam sonar was installed. A conical cowling protected the sonar head forward and aft by a crescent shaped skid (Figure 8). The accelerometer package for a POS/MV was mounted in the hull of the vessel just over the 7125 multibeam transducer head.

Two Trimble L1/L2 antennas were mounted above the 7125 and accelerometer for positioning and heading (Figure 7). The two POS/MV antennas were offset 1.0m to the port and starboard. The port side antenna (L1/L2) functioned as the POS/MV master antenna; the starboard side antenna functioned as the POS/MV secondary.

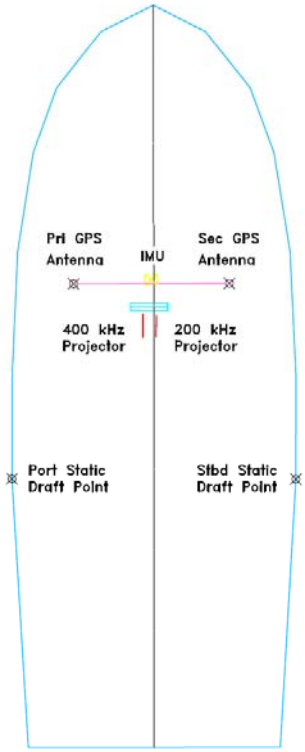
The AML Smart Probe SV&P sensors were deployed from an A-Frame on the stern using a small hydraulic winch.

Offset values were applied to the data in CARIS HIPS as specified in the vessel configuration file (VCF). Vessel offsets used are shown in the following table. Note that the VCF does not contain navigation offsets because the position provided by the POS/MV is already corrected to the CRP.

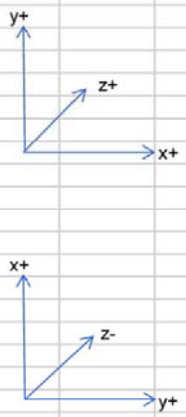
Figure 8 - R/V D2

Table 17 - Vessel Specifications (D2)

Survey Launch	**D2**
Official Number	647782
Owner	Stabbert Maritime Yacht & Ship
Year Built	1980/1982
Length	28.9 ft
Beam	12 ft
Draft	5.7 ft
Gross Ton	15
Net Ton	13
Mechanical Power	Caterpillar 3208
Electrical	Northern Lights



"D2" Offsets Table	**Distances in meters		
Cartesian Convention:	***x***	***y***	***z***
IMU (Origin)	0.000	0.000	0.000
Port GPS Antenna (Pri)	-0.995	-0.055	3.077
Stbd GPS Antenna (Sec)	1.006	-0.049	3.052
Port Static Draft Point	-1.786	-2.570	1.339
Stbd Static Draft Point	1.860	-2.575	1.280
Acoustic Reference Point (400kHz)	-0.105	-0.597	-0.741
Acoustic Reference Point (200kHz)	0.066	-0.601	-0.745
Acoustic Reference Point (8125)*	0.006	-0.765	-0.720
POSMV Convention:	***x***	***y***	***z***
IMU (Origin)	0.000	0.000	0.000
Port GPS Antenna (Pri)	-0.055	-0.995	-3.077
Stbd GPS Antenna (Sec)	-0.049	1.006	-3.052
Port Static Draft Point	-2.570	-1.786	-1.339
Stbd Static Draft Point	-2.575	1.860	-1.280
Acoustic Reference Point (400kHz)	-0.597	-0.105	0.741
Acoustic Reference Point (200kHz)	-0.601	0.066	0.745
Acoustic Reference Point (8125)*	-0.765	0.006	0.720
* Added Sept. 14/2008			



2008-07-25

Figure 9 - D2 Offset Diagram

R/V Quicksilver

The R/V Quicksilver (Figure 6), was modified to accommodate a survey crew and acquisition hardware. The keel was cut just aft of mid-ship and Reson 7125 multibeam sonar was installed. A conical cowling protected the sonar head forward and aft by a crescent shaped skid (Figure 8). The accelerometer package for a POS/MV was mounted in the hull of the vessel just over the 7125 multibeam transducer head.

For a short period of time on this project two Reson 7125 multibeam sonars were installed and operated in dual head mode. A single head, however, was used during most of the project.

Two Trimble L1/L2 antennas were mounted above the 7125 and accelerometer for positioning and heading (Figure 7). The two POS/MV antennas were offset 1.0m to the port and starboard. The port side antenna (L1/L2) functioned as the POS/MV master antenna; the starboard side antenna functioned as the POS/MV secondary.

A Brooks Ocean MVP-30 system using an AML Smart Probe was installed and used off the stern to collect sound velocity profiles in shallow water. An AML Smart Probe with on a standard winch setup was used off the stern in areas not suitable and as a backup to the MVP-30. Note: The MVP was de-mobbed after H11880 (Sheet F) and transferred to the Pacific Star.

Offset values were applied to the data in CARIS HIPS as specified in the vessel configuration file (VCF). Vessel offsets used are shown in the following table. Note that the VCF does not contain navigation offsets because the position provided by the POS/MV is already corrected to the CRP.

Table 18 - Vessel Specifications (Quicksilver)

Survey Launch	**R/V Quicksilver**
Official Number	947419
Owner	Marcus Ballweber
Year Built	1989
Length	32 ft
Beam	15.5 ft
Draft	3 ft
Gross Ton	28
Net Ton	15
Mechanical Power	860 hp
Electrical	5kW

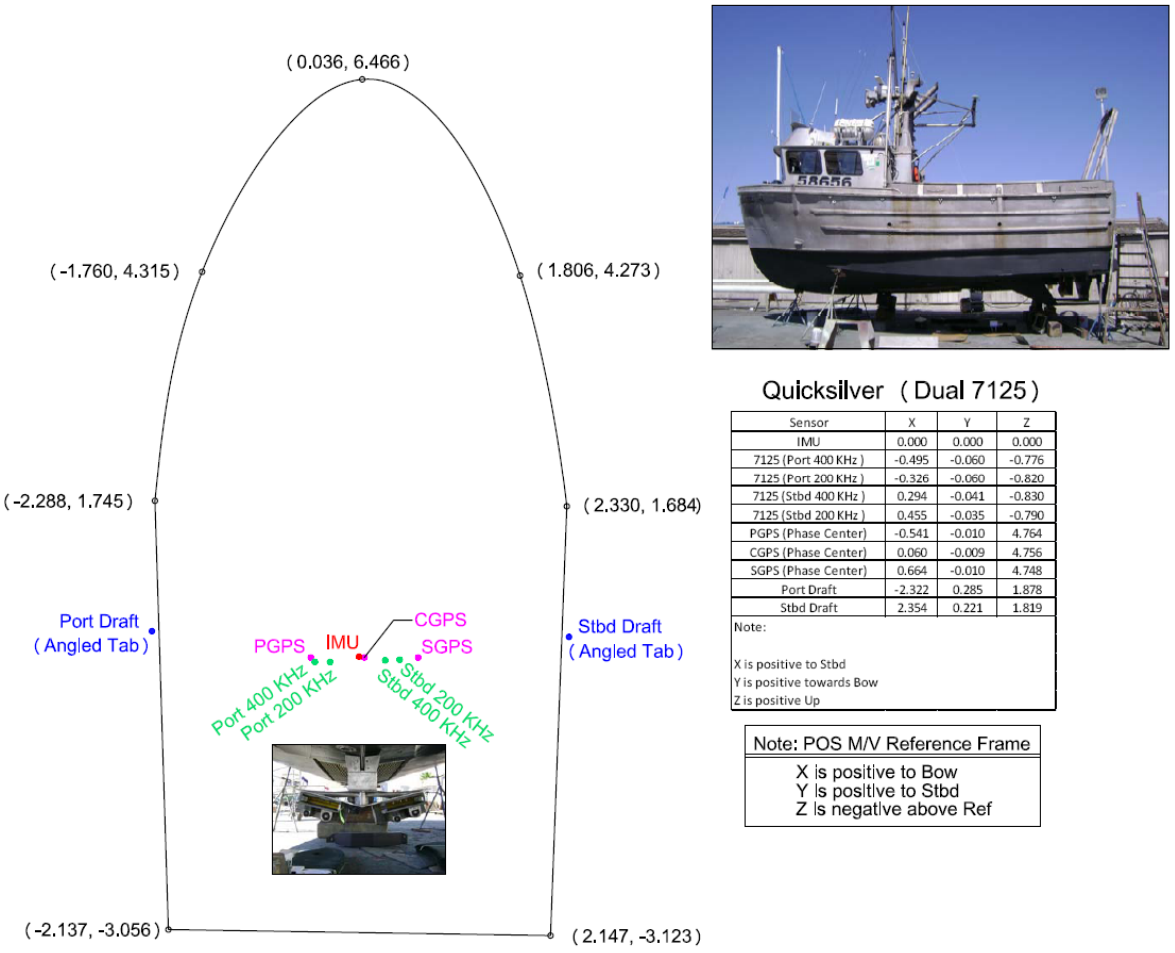
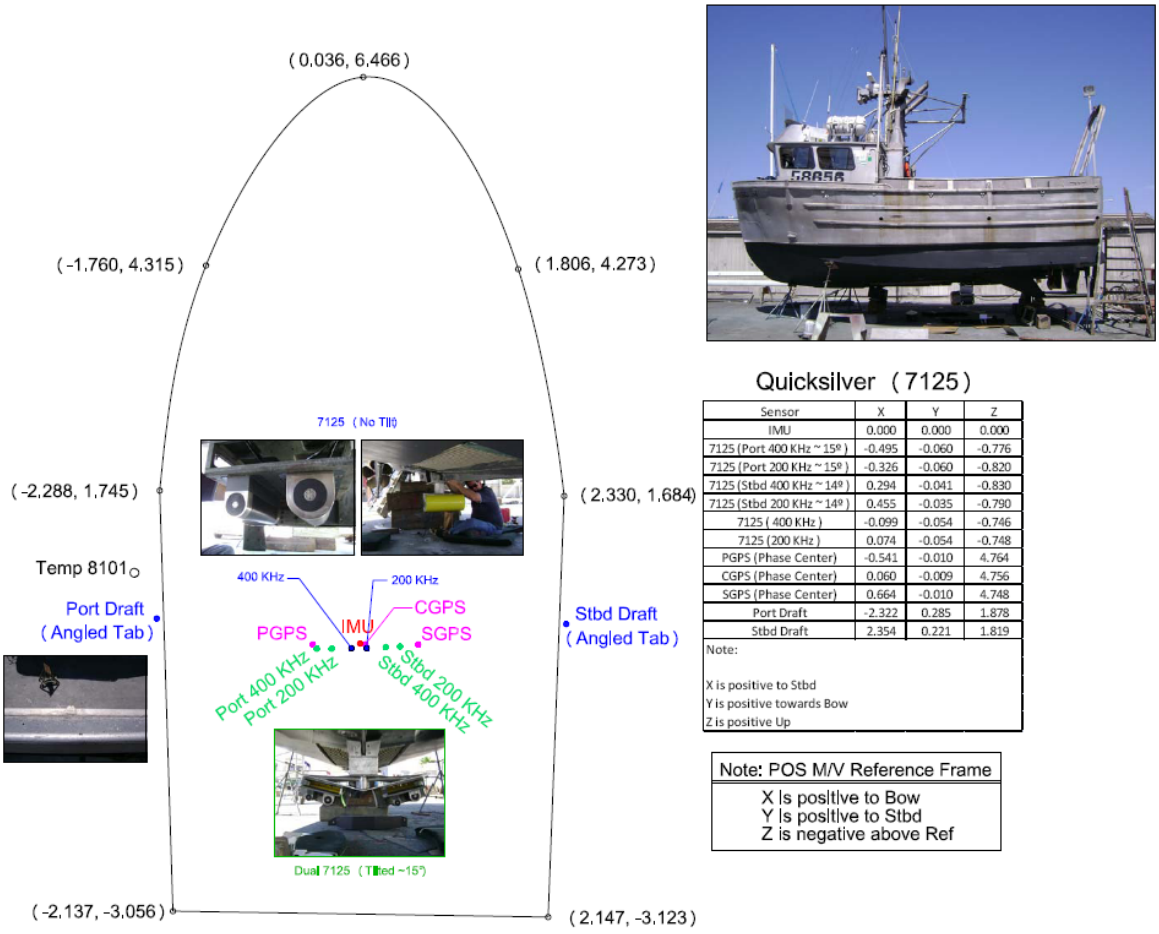


Figure 10 - Quicksilver (Dual 7125) Offset Diagram



Quicksilver (7125)

Sensor	X	Y	Z
IMU	0.000	0.000	0.000
7125 (Port 400 KHz ~ 15º)	-0.495	-0.060	-0.776
7125 (Port 200 KHz ~ 15º)	-0.326	-0.060	-0.820
7125 (Stbd 400 KHz ~ 14º)	0.294	-0.041	-0.830
7125 (Stbd 200 KHz ~ 14º)	0.455	-0.035	-0.790
7125 (400 KHz)	-0.099	-0.054	-0.746
7125 (200 KHz)	0.074	-0.054	-0.748
PGPS (Phase Center)	-0.541	-0.010	4.764
CGPS (Phase Center)	0.060	-0.009	4.756
SGPS (Phase Center)	0.664	-0.010	4.748
Port Draft	-2.322	0.285	1.878
Stbd Draft	2.354	0.221	1.819

Note:

X is positive to Stbd
Y is positive towards Bow
Z is positive Up

Note: POS M/V Reference Frame
X Is positive to Bow Y Is positive to Stbd Z is negative above Ref

Figure 11 - Quicksilver (Single 7125) Offset Diagram

R/V Locator

The R/V Locator (Figure 6), was modified to accommodate a survey crew and acquisition hardware. An over-the-side pole mount was fabricated and Reson 7125 multibeam sonar was installed. The accelerometer package for a POS/MV was mounted on the pole directly above the sonar head.

For a short period of time on this project two Reson 7125 multibeam sonars were installed and operated in dual head mode, with each being mounted to either side of the vessel, but were replaced with a single head. Reson 8125 and 8111 sonars were also used during various project phases, on the same pole mount.

Two Trimble L1/L2 antennas were mounted on the multibeam pole and accelerometer for positioning and heading (Figure 7). The two POS/MV antennas were offset 0.5m from each other. The forward antenna (L1/L2) functioned as the POS/MV master antenna; the starboard side antenna functioned as the POS/MV secondary.

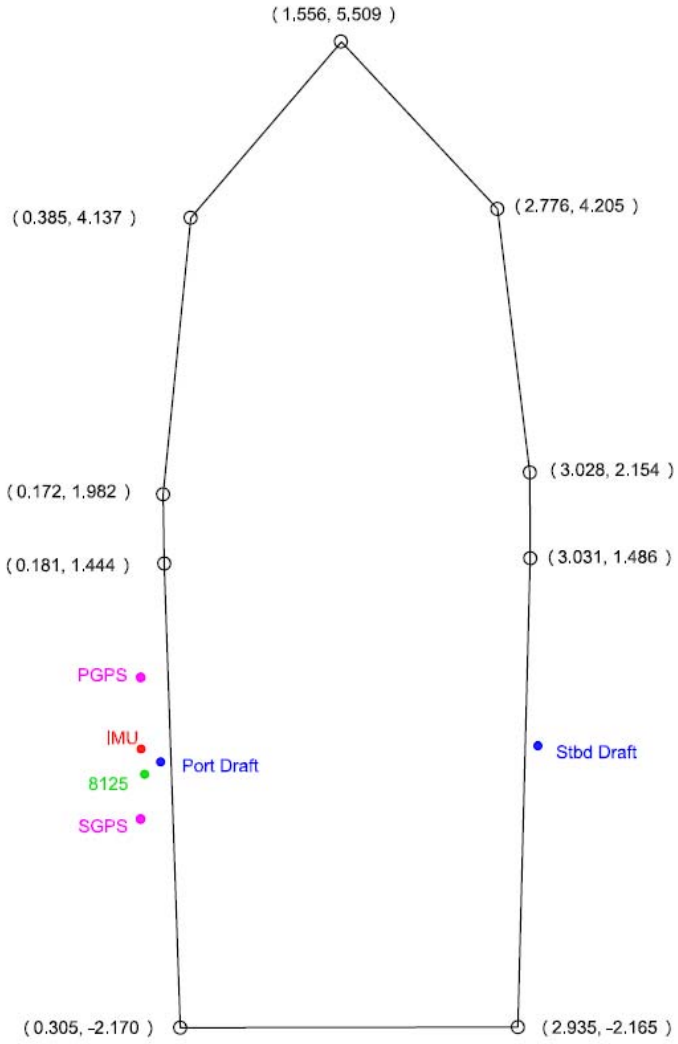
The AML Smart Probe SV&P sensors were deployed by hand.

Offset values were applied to the data in CARIS HIPS as specified in the vessel configuration file (VCF). Vessel offsets used are shown in the following table. Note that the VCF does not contain navigation offsets because the position provided by the POS/MV is already corrected to the CRP.

Table 19 - Vessel Specifications (Locator)

Survey Launch	**R/V Locator**
Official Number	CF4540NB
Owner	Fugro Pelagos, Inc.
Length	25 ft
Beam	9.5 ft
Draft	1.5 ft
Net Ton	2
Mechanical Power	Yamaha 250 HP Outboard
Electrical	3 kw Generator

Figure 12 - R/V Locator With Pole Mount



Locator (Reson 8125)

Sensor	X	Y	Z
IMU (CRP)	0.000	0.000	0.000
8125 (Acoustic Center	0.028	-0.197	-2.460
PGPS (Phase Center)	-0.002	0.558	0.267
SGPS (Phase Center)	-0.004	-0.545	0.265
Port Draft	0.152	-0.100	-0.668
Stbd Draft	3.090	0.025	-0.615

Note:
X is positive to Stbd
Y is positive towards Bow
Z is positive Up

Figure 13 - Locator (8125) Offset Diagram

In addition to the Reson 8125, Locator was equipped an 8111, single 7125, and dual 7125 at difference phases of the survey. Offsets are the same as above, with exception of the acoustic centers, shown in the following table.

Table 20 - Additional Locator Offsets

Acoustic Center	X	Y	Z
8111	0.000	-0.226	-2.196
7125 200 (Single)	1.492	-0.926	-1.034
7125 400 (Single)	-0.091	-0.061	-2.559
7125 Port (Dual)	-1.704	-0.922	-1.066
7125 Stbd (Dual)	1.492	-0.926	-1.034

Appendix III – Calibration Reports

All Calibration Reports can be found under the Appendix_III(SVP_Calibrations) directory.

Probe Serial Number / Calibration Document Filename:

4431_Calibration Certificate.pdf
4431_Pressure Calibration.pdf
4431_Sound Velocity Calibration.pdf
4656_Calibration Certificate.pdf
4656_Pressure Calibration.pdf
4656_Sound Velocity Calibration.pdf
4703_Calibration Certificate.pdf
4703_Pressure Calibration.pdf
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