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. H11965, H11966, H11967, H11968, H11969, H11970, H11971, H11972, H11973, H11974, H11975, H11976, & H11977

LOCALITY

State CALIFORNIA

General Locality Pacific Ocean – Northern California

Sublocality Areas Extending from Point Arena Light to Humboldt & Farallon Islands

2009

CHIEF OF PARTY

DEAN MOYLES

LIBRARY & ARCHIVES

DATE

☆U.S. GOV. PRINTING OFFICE: 1985—566-054

Title Sheet (NOAA Form 77-28)

NOAA FORM 77-28 (11-72) U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION **HYDROGRAPHIC TITLE SHEET**	REGISTER NO. H11965, H11966, H11967, H11968, H11969, H11970, H11971, H11972, H11973, H11974, H11975, H11976, & H11977
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 – Northern California

Locality Areas Extending from Point Arena Light to Humboldt & Farallon Islands

Scale NA Date of Survey 09/28/08 – 12/21/08 & 08/03/09 - 10/22/09

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)

Chief of party DEAN MOYLES

Surveyed by MOYLES, REYNOLDS, BRIGGS, FARLEY, ROKYTA, BARROW, TIXIER, CAIN, CAMERON, et al.

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

Graphic record scaled by FUGRO PELAGOS, INC. PERSONNEL

Graphic record checked by FUGRO PELAGOS, INC. PERSONNEL

Protracted by N/A Automated plot by N/A

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 areas in Northern California extending from Point Arena Light to Humboldt & the Farallon Islands.

ALL TIMES ARE RECORDED IN UTC.

FUGRO PELAGOS INC.

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A – Equipment

The F/Vs Pacific Star (with launches R2 and D2) 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 and 200 kHz. The system forms 256 or 512 beams at a 0.5° spacing (across-track) in the 400 kHz mode, and 256 beams at a 1° spacing (across-track) in the 200 kHz mode, with a maximum swath width of 128°. It also allows the operator to select equi-angle or equi-distant beam spacing. For this project both the 400 kHz and the 200 kHz systems were configured for 256 equi-angle beams. The selection of these frequencies, 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 of the Descriptive Reports).

The F/V Pacific Star was also equipped with a hull mounted Reson SeaBat 8111 multibeam echosounder system for surveying the deeper portions of the survey area. The Reson 8111 system operates at a frequency of 100 kHz and forms 101 beams at a 1.5° spacing (across-track), with 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 (see Separate 1of the Descriptive Reports).

The R/V R2 (a F/V 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 and 200 kHz. The system forms 256 or 512 beams at a 0.5° spacing (across-track) in the 400 kHz mode and 256 beams at a 1° spacing (across-track) in the 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 1of the Descriptive Report).

The R/V D2 (a Pacific Star launch) was equipped with a hull mounted Reson SeaBat 8125 multibeam echosounder. The Reson 8125 system operates at a frequency of 455 kHz and forms 240 beams at a 0.5° spacing (across-track), with 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 (see Separate 1of the Descriptive Report).

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**
Mount Type	Hull	Hull	Hull
Sonar System(s)	Reson 7125 dual frequency Reson 8111	Reson 7125 dual frequency	Reson 8125
Operated in dual-head mode	No	No	No

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 (POS MV) 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 POS MV. An Inertial Measurement Unit (IMU) provided velocity values to the POS MV allowing it to compute an inertial position based on DGPS, heading, and motion.

The POS MV 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 POS MV 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

Raw multibeam data for all vessels were collected with WinFrog Multibeam v3.08.44.04 (WFMB). WFMB ran on Windows XP Pro PCs with a dual-core Intel processor. 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 WFMB module (PosMVLogger) on the same PC logged all raw POS MV data for post-processing of vessel positions in Applanix POSPac software. WFMB also provided a coverage display for real-time QC and coverage estimation of the acquired data.

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

1. Devices: The Devices window shows the operator what hardware is attached to the PC. It also allows the operator to configure the devices, determine whether they are functioning properly, and to 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 a tabular or graphical format. Operators look here to view the status of the GPS satellite constellation and position solutions.
5. Real-time coverage can be displayed in a graphics window, by creating a multibeam echosounder (MBES) Coverage Map (referred to as a BIN file). The Coverage Map Creation Dialog window allows the operator to define a coverage area and to define the resolution of the coverage area.
6. Sound Velocity QC Dialog window is also available to the user for real-time surface sound speed monitoring. The user can input a fixed sound speed value, one obtained from the most current sound speed cast (the value closest to the sonar head) and have the software compare the surface sound speed (logged to an S7K file, real-time) against this fixed value. The SVP QC can also be configured to compute an average buffer (user defined size or window) from the real-time surface sound speed and use this as a baseline measurement for comparison.

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

PosMVLogger, an in-house POS MV logging application was used to log and provide real-time QC monitoring of the POS MV solution. The software monitored and reported high DOP spikes, DGPS outages, IMU data gaps, and file size limitations.

Fugro Pelagos' MB Survey Tools v2.00.25.0 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 log sheets in PDF format (see Separate 1of the Descriptive Report).

A complete list of software and versions used on this project is included in **Appendix I**. Refer to the "2009-MBES_Acquisition_Procedures_R0" document for a detailed processing routine with procedures used.

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 into HIPS format, and corrected soundings for sound velocity, motion, tide, and vessel offsets. It was then used to examine and reject noisy soundings. HIPS also produced the final BASE surfaces. Due to the large volume of data, final CUBE BASE surfaces were created using CARIS v 7.0 in the CARIS Spatial Archive (CSAR) format.

CARIS Notebook v3.1 was used to generate the S57 Feature Files.

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

Applanix POSPac MMS v5.2 was utilized for the post-processing of vessel dual frequency GPS data, and simultaneous base station data to calculate higher accuracy positions than those calculated in real-time.

MB Survey Tools v2.00.25.0 was used to extract True Heave from POS files and put the data into 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 was also 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 "2009-MBES_Processing_Procedures_R0" 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 Uncertainty (TPU) at the 95% confidence interval for the horizontal and vertical components of each individual sounding. The values that were entered into the CARIS HVF for the survey sensors are the specified manufacturer accuracy values and were downloaded from the CARIS website. The following is a breakdown and explanation of 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, and standard deviation values better than 0.10m.
- Gyro/Heading – All vessels were equipped with a POS MV 320 V4 and had a baseline < 4m. Therefore, a value of 0.020° was entered in the HVF as 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 0.020°.
- 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 POS MV 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 POS MV, 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 given that a POS MV with a 100 Hz output rate was in use.
- Loading – estimated vessel loading error set to 0.05m. This was the best estimate of how the measured static draft changed through the survey day.
- Draft – it was estimated that draft could be measured to within 0.01m to 0.05m; as a result, values in this range were entered, vessel dependent.
- 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 was set to 2.5 m/s.
  NOTE: These values are dynamic and vary both temporally and geographically.
- 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.

The calculated vertical and horizontal error (TPU values), were then used to create finalized CUBE (Combined Uncertainty Bathymetry Estimator) 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 WFMB to be used by CARIS, they must be converted to HDCS format using the CARIS XTF or ResonPDS converter routine. Prior to the files being converted, vessel offsets, patch test calibration values, TPU values, delta draft, and static draft were entered into the HVF.

Once converted, the SVP and TrueHeave data were loaded into each line and the line was SVP corrected in CARIS HIPS. The TPU 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 and named "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 often did 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 upon data quality and sonar used, but all filter settings used were noted on each corresponding line log (see Separate 1 of the Descriptive Report).

Raw POS MV data logged into a POS file were processed in conjunction with base station data in Applanix POSPac to produce an SBET (Smoothed Best Estimated Trajectory) file containing positioning data that was more accurate than the real-time positioning data. These SBETs were loaded into each line in CARIS HIPS which replaced the real-time navigation and GPS altitude data.

The 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. 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 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 Max meters resolution = 10 m

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

Subsets Tiles (to track areas examined) were then created in CARIS HIPS. Adjacent lines of data were examined to identify tidal busts, sound velocity 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 or were issued as a danger to navigation. Soundings were designated when they met or exceeded the criteria for designation set forth in the Specifications and Deliverables. Designation ensured soundings were carried through to the finalized BASE surfaces. Because the CUBE surface resolutions were no finer than 1m, features in shallow rocky areas were not well represented by the reference surface. In such a case, only the shoalest sounding of the most significant feature, which best represented the seabed area, was designated.

A statistical analysis of the sounding data was conducted via the CARIS Quality Control Report (QCR) routine. Crosslines 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 of the Descriptive Report.

Sounding data that passed the required quality assurance checks were used in the final BASE surfaces. All final BASE surfaces produced were created using the Single Resolution option. During final BASE surface creation in CARIS, the S-44 order option "Special Order" was selected, and the values set so that a=0.25 and b=0.00749. This constrained the area of influence of soundings to those that passed project specifications. A CARIS Finalized BASE Surface was created for each resolution using only the depth range specified for the specific resolution. Designated Soundings were also applied in the CARIS Finalized BASE Surface.

CARIS Notebook 3.1 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 normally performed every two hours. Casts were taken more frequently when deemed necessary by the lead hydrographer. The AML Smart Probes used to determine sound velocity 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 temperature.

A Brooks Ocean MVP-30 system was used on this project on the F/V Pacific Star. The system was used to collect a set of 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 a set distance above the seafloor and then be retrieved at a slower rate (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 maintain the sensor at ambient water temperature.

Fugro Pelagos' MB Survey Tools was used to check the profiles graphically for spikes or other anomalies and to produce an 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 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 logging L1/L2 GPS data. The line was first run heading into the current at the lowest possible engine RPMs, then re-run moving with the current at the same RPMs, stopping at the original starting point to obtain an additional three minutes of static L1/L2 GPS data. This pattern was repeated for additional lines 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.

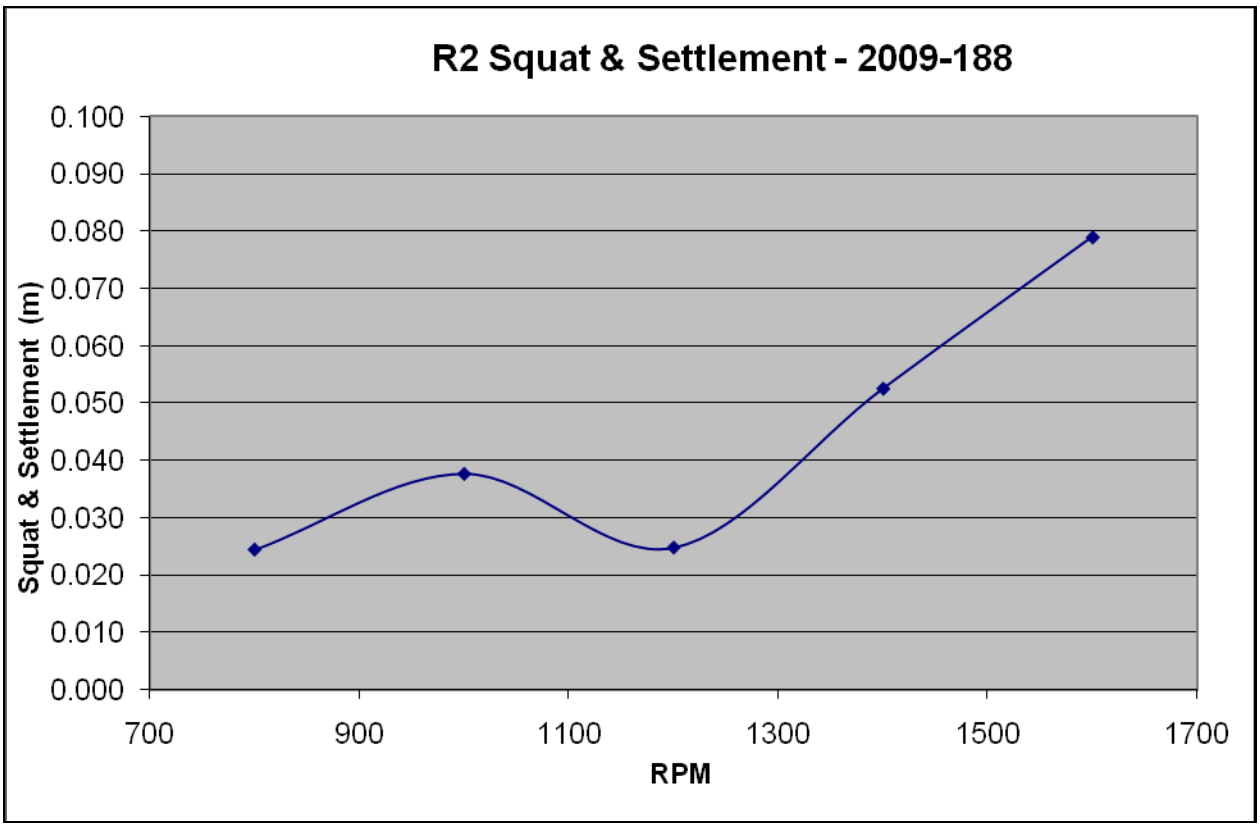

Figure 1 – R2 Dynamic Draft

Table 2 – R2 Squat Settlement Results

R2 DYNAMIC DRAFT CORRECTORS		
Speed (kts)	RPM	Settlement
4.1	800	0.025
4.9	1000	0.028
5.6	1200	0..025
6.3	1400	0.053
6.9	1600	0.079

The squat settlement test for the R/V R2 was conducted near San Francisco, CA. on July 7, 2009 (Julian Day 188).

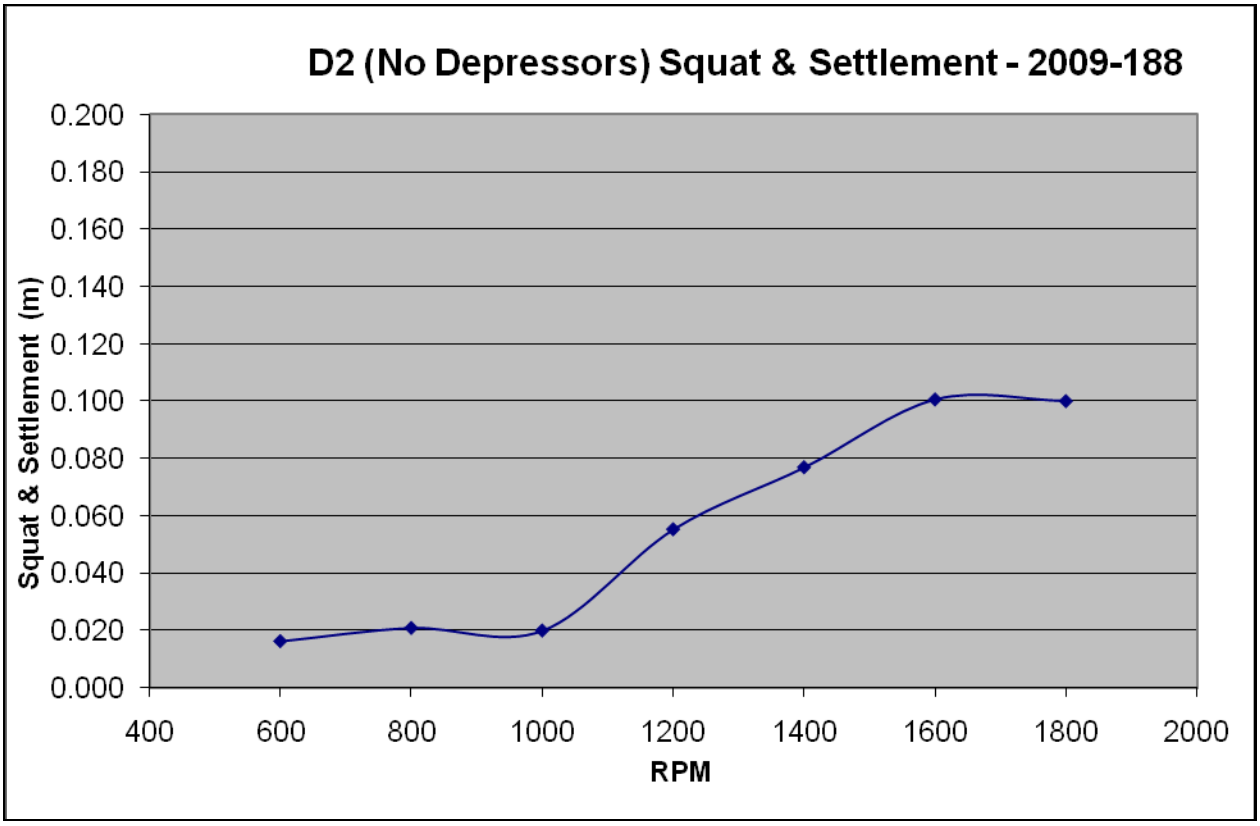

Figure 2 – D2 (No Depressors) Dynamic Draft

Table 3 – D2 (No Depressors) Squat Settlement Results

D2 DYNAMIC DRAFT CORRECTORS		
Speed (kts)	RPM	Settlement
3.1	600	0.016
3.9	800	0.021
4.9	1000	0.020
5.6	1200	0.055
6.3	1400	0.077
6.7	1600	0.100
7.2	1800	0. 100

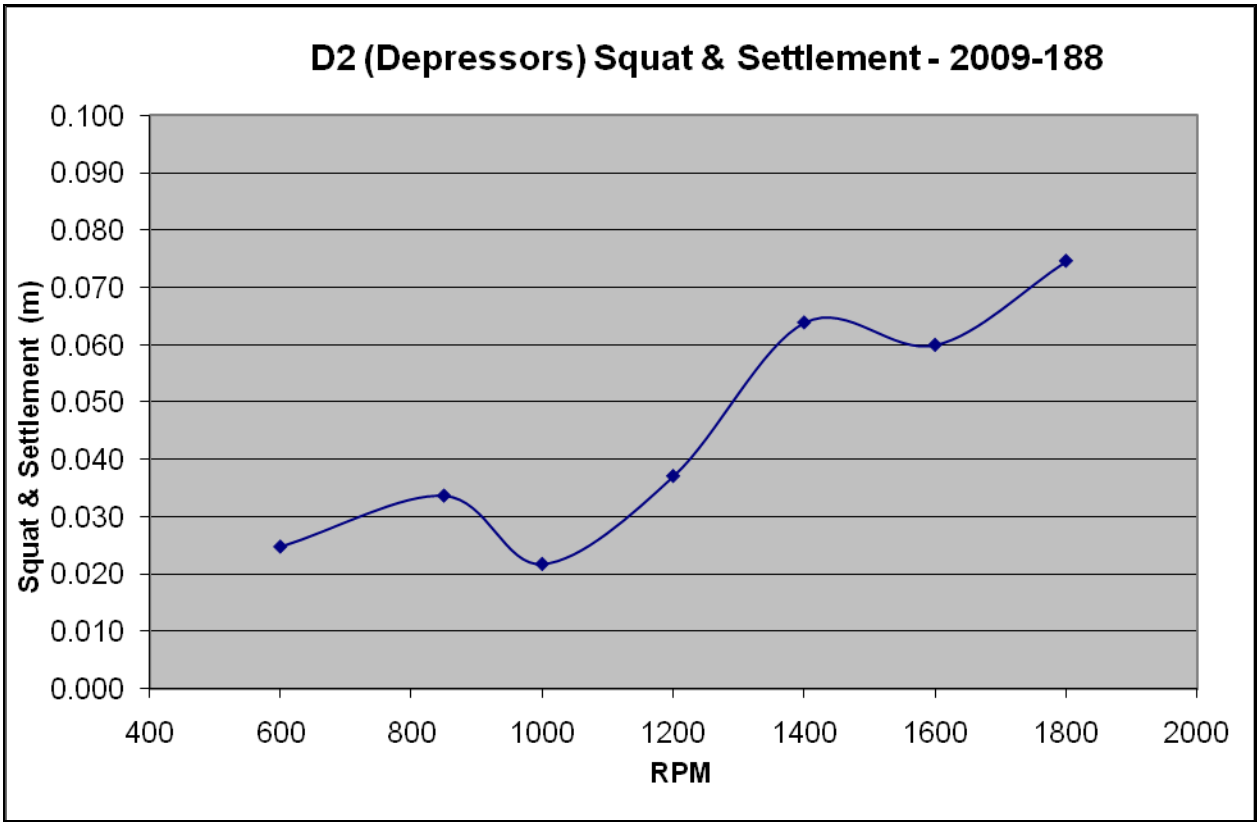

Figure 3 – D2 (Depressors) Dynamic Draft

Table 4 – D2 (Depressors) Squat Settlement Results

D2 DYNAMIC DRAFT CORRECTORS		
Speed (kts)	RPM	Settlement
3.1	600	0.025
3.4	800	0.034
4.2	1000	0.022
4.9	1200	0.037
5.6	1400	0.064
6.3	1600	0.060
6.9	1800	0. 075

The squat settlement test for the R/V D2 was conducted near San Francisco, CA. on July 7, 2009 (Julian Day 188).

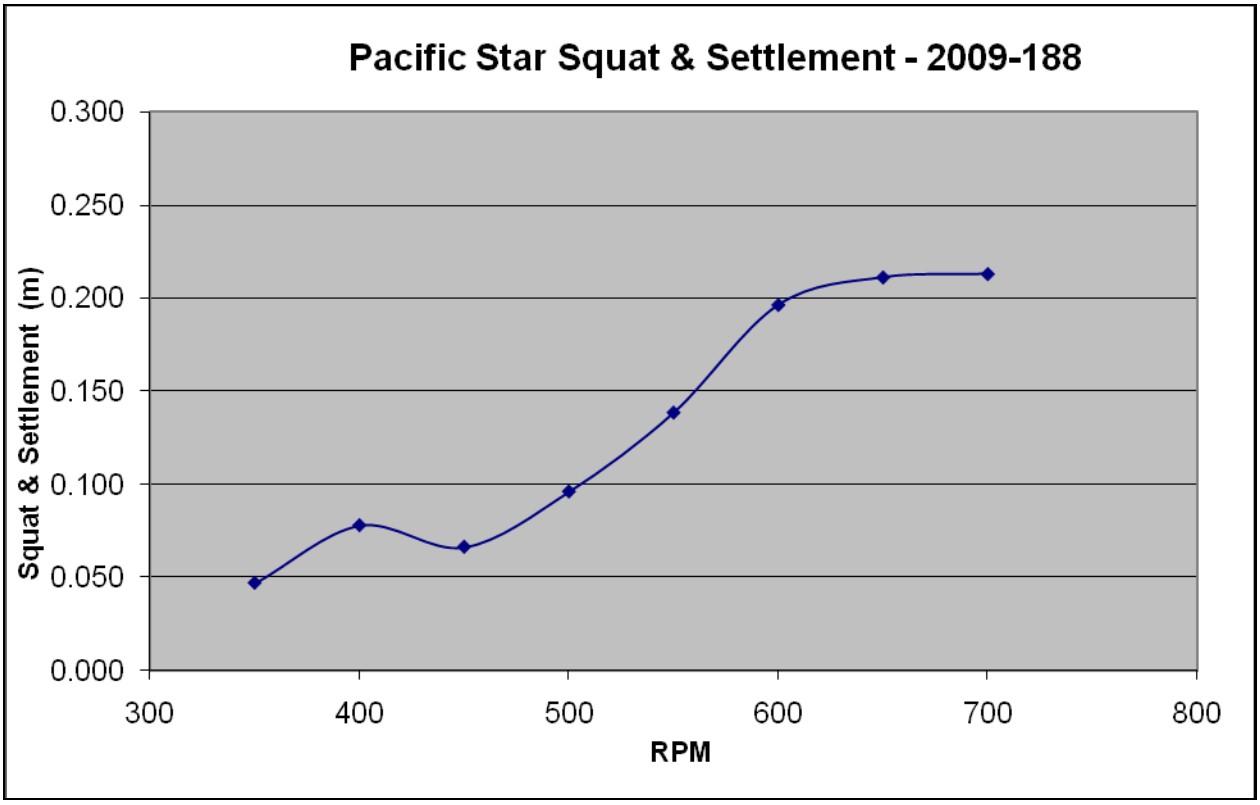

Figure 4 – Pacific Star Dynamic Draft

Table 5 – Pacific Star Squat Settlement Results

Pacific Star DYNAMIC DRAFT CORRECTORS		
Speed (kts)	RPM	Settlement
5.2	350	0.047
6.7	450	0.066
7.4	500	0.096
8.1	550	0.138
8.9	600	0.196
9.5	650	0.211
10.1	700	0.213

The squat settlement test for the F/V Pacific Star was conducted near San Francisco, CA. on July 7, 2009 (Julian Day 188).

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.

Table 6 - Draft Measurements for the R/V R2

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
1	297	10/23/2008	16:29	-0.23
2	298	10/24/2008	14:44	-0.29
3	330	11/25/2008	15:31	-0.2
4	332	11/27/2008	15:59	-0.2
5	333	11/28/2008	15:31	-0.2
6	334	11/29/2008	20:29	-0.19
7	335	11/30/2008	17:01	-0.18
8	336	12/1/2008	16:09	-0.2
9	337	12/2/2008	15:52	-0.19
10	338	12/3/2008	18:10	-0.18
11	339	12/4/2008	15:39	-0.2
12	340	12/5/2008	17:46	-0.2
13	341	12/6/2008	15:40	-0.19
14	342	12/7/2008	15:08	-0.19
15	344	12/9/2008	16:57	-0.2
16	345	12/10/2008	15:28	-0.19
17	351	12/16/2008	16:55	-0.2
18	354	12/19/2008	17:40	-0.19
19	355	12/20/2008	16:00	-0.2
20	219	8/7/2009	15:35	-0.28
21	222	8/10/2009	17:35	-0.23
22	223	8/11/2009	15:43	-0.29
23	224	8/12/2009	14:21	-0.26
24	225	8/13/2009	14:20	-0.24
25	227	8/15/2009	14:38	-0.31
26	229	8/17/2009	14:43	-0.25
27	230	8/18/2009	14:15	-0.34
28	232	8/20/2009	15:08	-0.27
29	234	8/22/2009	15:08	-0.27
30	236	8/24/2009	14:15	-0.27
31	237	8/25/2009	18:49	-0.29

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
32	238	8/26/2009	14:48	-0.26
33	239	8/27/2009	14:37	-0.27
34	240	8/28/2009	14:30	-0.26
35	242	8/30/2009	14:28	-0.26
36	243	8/31/2009	14:33	-0.27
37	244	9/1/2009	14:20	-0.27
38	245	9/2/2009	15:02	-0.27
39	246	9/3/2009	14:28	-0.28
40	247	9/4/2009	14:54	-0.27
41	248	9/5/2009	14:24	-0.28
42	249	9/6/2009	14:33	-0.28
43	250	9/7/2009	18:01	-0.26
44	251	9/8/2009	16:16	-0.26
45	252	9/9/2009	14:40	-0.29
46	252	9/9/2009	14:40	-0.29
47	253	9/10/2009	20:08	-0.25
48	254	9/11/2009	15:18	-0.29
49	255	9/12/2009	14:20	-0.26
50	256	9/13/2009	14:19	-0.28
51	258	9/15/2009	14:28	-0.26
52	261	9/18/2009	15:44	-0.27
53	262	9/19/2009	14:15	-0.28
54	270	9/27/2009	22:19	-0.26
55	271	9/28/2009	14:13	-0.21
56	272	9/29/2009	15:30	-0.25
57	274	10/1/2009	15:00	-0.23
58	278	10/5/2009	14:27	-0.22
59	279	10/6/2009	14:49	-0.24
60	280	10/7/2009	15:39	-0.23
61	281	10/8/2009	14:35	-0.24
62	281	10/8/2009	23:02	-0.22
63	282	10/9/2009	14:20	-0.22
64	283	10/10/2009	14:20	-0.24
65	284	10/11/2009	14:15	-0.23
66	285	10/12/2009	14:25	-0.24
67	289	10/16/2009	14:24	-0.21
68	290	10/17/2009	14:35	-0.26
69	291	10/18/2009	14:21	-0.23
70	292	10/19/2009	14:15	-0.24

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
71	293	10/20/2009	14:25	-0.25
72	294	10/21/2009	14:25	-0.23

Table 7 - Draft Measurements for the R/V D2

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
1	275	10/1/2008	16:45	-0.19
2	280	10/6/2008	15:51	-0.2
3	295	10/21/2008	14:18	-0.19
4	296	10/22/2008	14:05	-0.2
5	297	10/23/2008	14:55	-0.2
6	298	10/24/2008	14:34	-0.2
7	316	11/11/2008	18:16	-0.22
8	330	11/25/2008	15:28	-0.25
9	332	11/27/2008	15:58	-0.22
10	333	11/28/2008	15:24	-0.21
11	334	11/29/2008	20:38	-0.22
12	335	11/30/2008	16:56	-0.21
13	336	12/1/2008	16:08	-0.21
14	337	12/2/2008	15:25	-0.2
15	338	12/3/2008	19:07	-0.18
16	339	12/4/2008	15:43	-0.16
17	341	12/6/2008	15:48	-0.2
18	341	12/6/2008	0:03	-0.18
19	343	12/8/2008	15:34	-0.2
20	344	12/9/2008	17:10	-0.2
21	345	12/10/2008	16:06	-0.18
22	351	12/16/2008	16:50	-0.22
23	352	12/17/2008	18:39	-0.2
24	354	12/19/2008	17:45	-0.17
25	355	12/20/2008	15:35	-0.2
26	222	8/10/2009	17:29	-0.18
27	223	8/11/2009	15:30	-0.16
28	224	8/12/2009	14:23	-0.16
29	225	8/13/2009	14:24	-0.17
30	227	8/15/2009	14:39	-0.16
31	228	8/16/2009	14:17	-0.17
32	229	8/17/2009	14:22	-0.18
33	231	8/19/2009	14:49	-0.19

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
34	232	8/20/2009	15:27	-0.19
35	233	8/21/2009	14:47	-0.18
36	234	8/22/2009	14:58	-0.2
37	236	8/24/2009	14:30	-0.19
38	237	8/25/2009	15:01	-0.19
39	238	8/26/2009	14:49	-0.19
40	239	8/27/2009	14:32	-0.2
41	240	8/28/2009	14:29	-0.19
42	242	8/30/2009	14:27	-0.2
43	243	8/31/2009	14:55	-0.24
44	244	9/1/2009	14:31	-0.22
45	245	9/2/2009	15:08	-0.22
46	246	9/3/2009	15:08	-0.21
47	247	9/4/2009	15:24	-0.21
48	248	9/5/2009	14:41	-0.2
49	249	9/6/2009	15:05	-0.24
50	250	9/7/2009	18:32	-0.2
51	251	9/8/2009	15:19	-0.2
52	253	9/10/2009	20:30	-0.18
53	254	9/11/2009	14:56	-0.18
54	255	9/12/2009	14:51	-0.15
55	256	9/13/2009	14:20	-0.24
56	258	9/15/2009	14:28	-0.25
57	259	9/16/2009	14:24	-0.26
58	261	9/18/2009	15:48	-0.25
59	262	9/19/2009	14:16	-0.25
60	270	9/28/2009	22:22	-0.23
61	271	9/28/2009	14:23	-0.25
62	272	9/29/2009	14:15	-0.25
63	274	10/1/2009	14:35	-0.23
64	278	10/5/2009	14:50	-0.21
65	279	10/6/2009	14:31	-0.27
66	280	10/7/2009	15:44	-0.21
67	281	10/8/2009	14:59	-0.21
68	282	10/9/2009	14:49	-0.17
69	283	10/10/2009	14:29	-0.17
70	284	10/11/2009	14:44	-0.17
71	285	10/12/2009	14:34	-0.17
72	289	10/16/2009	14:28	-0.17

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
73	290	10/17/2009	14:32	-0.17
74	291	10/18/2009	15:40	-0.17
75	292	10/19/2009	14:23	-0.17
76	293	10/20/2009	14:35	-0.18
77	294	10/21/2009	14:27	-0.17

Table 8 - Draft Measurements for the F/V Pacific Star

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
1	280	10/6/2008	22:51	-2.04
2	280	10/6/2008	15:46	-2.09
3	289	10/15/2008	06:03	-1.90
4	298	10/24/2008	03:19	-2.09
5	309	11/4/2008	22:50	-1.87
6	331	11/26/2008	05:00	-1.94
7	332	11/27/2008	16:15	-1.82
8	337	12/2/2008	19:24	-1.82
9	338	12/3/2008	06:52	-2.03
10	345	12/10/2008	04:19	-1.96
11	351	12/16/2008	23:10	-1.98
12	357	12/21/2008	01:00	-1.96
13	215	8/3/2009	01:57	-2.15
14	216	8/4/2009	01:32	-2.16
15	217	8/5/2009	02:05	-2.20
16	219	8/7/2009	19:33	-2.17
17	219	8/7/2009	15:30	-2.14
18	221	8/9/2009	21:33	-2.11
19	222	8/10/2009	17:31	-2.02
20	223	8/11/2009	15:33	-2.03
21	223	8/11/2009	02:06	-2.16
22	224	8/12/2009	20:44	-2.10
23	224	8/12/2009	14:30	-2.01
24	224	8/12/2009	02:02	-1.98
25	225	8/13/2009	14:26	-1.98
26	226	8/14/2009	01:58	-2.06
27	227	8/15/2009	14:39	-2.01
28	228	8/16/2009	14:20	-1.96
29	228	8/16/2009	01:59	-2.14
30	229	8/17/2009	14:24	-2.01

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
31	229	8/17/2009	01:34	-2.07
32	230	8/18/2009	14:19	-2.09
33	230	8/18/2009	02:05	-1.99
34	231	8/19/2009	01:54	-2.06
35	231	8/19/2009	14:27	-1.95
36	232	8/20/2009	15:05	-2.03
37	232	8/20/2009	01:34	-1.98
38	233	8/21/2009	14:29	-1.98
39	233	8/21/2009	02:11	-2.08
40	234	8/22/2009	15:03	-2.05
41	234	8/22/2009	01:52	-2.01
42	235	8/23/2009	00:49	-2.02
43	236	8/24/2009	14:20	-2.01
44	237	8/25/2009	18:36	-2.02
45	237	8/25/2009	02:47	-2.08
46	241	8/29/2009	00:14	-2.28
47	243	8/31/2009	14:47	-2.20
48	243	8/31/2009	01:34	-2.24
49	244	9/1/2009	14:26	-2.21
50	244	9/1/2009	01:49	-2.16
51	245	9/2/2009	01:27	-2.24
52	245	9/2/2009	16:57	-2.14
53	246	9/3/2009	01:53	-2.12
54	246	9/3/2009	14:24	-2.17
55	247	9/4/2009	14:39	-2.06
56	247	9/4/2009	02:34	-2.03
57	248	9/5/2009	14:38	-2.13
58	248	9/5/2009	01:45	-2.21
59	249	9/6/2009	14:36	-2.15
60	249	9/6/2009	01:49	-2.05
61	250	9/7/2009	18:38	-2.16
62	251	9/8/2009	16:42	-2.10
63	251	9/8/2009	02:06	-2.05
64	252	9/9/2009	14:48	-2.14
65	252	9/9/2009	21:51	-2.15
66	253	9/10/2009	20:10	-2.13
67	254	9/11/2009	15:15	-2.20
68	255	9/12/2009	14:32	-2.11
69	255	9/12/2009	02:15	-2.13

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
70	256	9/13/2009	14:20	-2.10
71	258	9/15/2009	14:28	-1.98
72	261	9/18/2009	15:50	-2.08
73	262	9/19/2009	14:15	-2.01
74	262	9/19/2009	01:59	-2.19
75	263	9/20/2009	00:22	-2.16
76	270	9/27/2009	22:26	-2.01
77	271	9/28/2009	14:24	-2.00
78	271	9/28/2009	02:16	-1.99
79	272	9/29/2009	23:16	-1.96
80	272	9/29/2009	15:42	-2.23
81	272	9/29/2009	01:48	-2.02
82	274	10/1/2009	14:40	-1.98
83	274	10/1/2009	02:59	-2.19
84	276	10/3/2009	14:09	-2.21
85	278	10/5/2009	14:33	-1.90
86	279	10/6/2009	14:34	-1.96
87	279	10/6/2009	00:45	-2.03
88	280	10/7/2009	21:02	-1.92
89	280	10/7/2009	15:25	-2.06
90	280	10/7/2009	02:05	-2.08
91	281	10/8/2009	23:10	-2.06
92	281	10/8/2009	18:14	-2.06
93	281	10/8/2009	14:41	-1.96
94	282	10/9/2009	01:47	-2.13
95	282	10/10/2009	14:50	-2.09
96	283	10/10/2009	02:08	-2.09
97	283	10/10/2009	14:25	-2.02
98	284	10/11/2009	01:55	-2.04
99	285	10/12/2009	20:12	-2.07
100	285	10/12/2009	01:44	-2.03
101	289	10/16/2009	14:27	-2.16
102	290	10/17/2009	01:45	-2.08
103	290	10/17/2009	23:41	-2.21
104	290	10/17/2009	14:28	-2.16
105	291	10/18/2009	15:40	-2.02
106	292	10/19/2009	14:25	-2.07
107	292	10/19/2009	01:36	-2.14
108	293	10/20/2009	14:30	-2.12

DRAFT #	JULIAN DAY	DATE (UTC)	TIME (UTC)	DEPTH (m)
109	293	10/20/2009	01:45	-2.19
110	294	10/21/2009	14:20	-2.15
111	294	10/21/2009	01:10	-2.09
112	295	10/22/2009	00:57	-2.19

TIDES

All sounding data were first reduced to mean lower low water (MLLW) using preliminary tidal data. Preliminary tides were used in the initial stage of 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 into each line in CARIS HIPS, replacing the real-time GPS altitude with a post-processed GPS altitude. See the Horizontal and Vertical Control Report for more 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, and vessel heave. This 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 into 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 utilizes the waterline offset and heave compensation 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".

Observed Tide data and Zoning were used only for comparison with the GPSTides. See each

survey's Descriptive Report for specific results of the Verified Smoothed 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 POS MV 320 V4 on all vessels. The system calculated heading by inversing between two Trimble GPS generated antenna positions. An Inertia Motion Unit (IMU), which measured vessel attitude, accelerations and velocities, was mounted directly above the multibeam transducer. The operational accuracy specifications for this system, as documented by the manufacturer, are as follows:

Table 9 - POS MV Specifications

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

CALIBRATIONS

Multibeam

For all vessel 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 10.

Table 10 - Patch Test Results Summary

Vessel	Patch Test Day[1]	MB Sonar	Timing Error	Pitch Offset	Roll Offset	Azimuth Offset
Pacific Star	2008-234	7125 200 kHz (256 mode)	0	-1.31	-0.43	-0.97
	2008-282	7125 200 kHz (256 mode)	0	-1.28	-0.47	-3.20
	2009-159	7125 200 kHz (256 mode)	0	-0.40	-0.18	-2.20

[1] Julian day the actual test was done is listed, may be pre-dated in CARIS HVF to cover lines run before patch test.

Pacific Star	2008-234	7125 400 kHz (256 mode)	0	-1.30	-0.54	-0.64
	2008-282	7125 400 kHz (256 mode)	0	-1.25	-0.56	-3.00
	2009-159	7125 400 kHz (256 mode)	0	-0.45	-0.33	-2.00
Pacific Star	2008-233	8111	0	-0.70	-0.08	0.60
	2008-282	8111	0	-1.20	-0.08	-2.20
	2009-250	8111	0	-0.60	0.23	0.80
R2	2008-235	7125 200 kHz (256 mode)	0	2.05	0.58	-0.80
	2008-323	7125 200 kHz (256 mode)	0	0.90	0.97	-0.70
	2009-165	7125 200 kHz (256 mode)	0	0.60	0.74	-1.20
R2	2008-235	7125 400 kHz (256 mode)	0	0.91	0.49	-1.59
	2008-301	7125 400 kHz (256 mode)	0	0.91	0.34	-1.59
	2008-323	7125 400 kHz (256 mode)	0	1.35	0.89	-1.60
	2009-165	7125 400 kHz (256 mode)	0	1.55	0.77	-2.65
D2	2008-257	8125	0	0.80	1.44	0.20
	2009-165	8125	0	-2.90	1.84	1.90

Additional Sounding Techniques

None used.

D - Approval Sheet

Approval Sheet

For

H11965, H11966, H11967, H11968, H11969, H11970, H11971, H11972, H11973, H11974, H11975, H11976, & H11977

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 (2009-MBES_Acquisition_Procedures_R0);
Fugro Pelagos, Inc. Processing Procedures (2009-MBES_Processing_Procedures_R0)

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,

David D Briggs,
Lead Hydrographer
Fugro Pelagos, Inc.
April 16, 2010

4/16/2010

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David D Briggs
Lead Hydrographer

Appendix I – Equipment List and Software Versions

Equipment

Table 11 - Equipment List (Pacific Star, R2 & D2)

Description	Ast_SerialNumber
AML SV PLUS VELOCITY PROBE (MVP)	7523
AML SV PLUS VELOCITY PROBE (MVP)	7522
AML SV PLUS VELOCITY PROBE 1000DBAR	4431
AML SV PLUS VELOCITY PROBE 1000DBAR	4820
AML SV PLUS VELOCITY PROBE 1000DBAR	4656
AML SV PLUS VELOCITY PROBE 1000DBAR	5282
AML SV PLUS VELOCITY PROBE 1000DBAR	5283
AML SV PLUS VELOCITY PROBE 1000DBAR	5385
AML SV PLUS VELOCITY PROBE 1000DBAR	5354
AML SV PLUS VELOCITY PROBE 1000DBAR	5353
ANTENNA CELLULAR DUAL BAND 3DB	BGR602956
ANTENNA CELLULAR DUAL BAND 3DB	BGR602957
ANTENNA CELLULAR DUAL BAND 9DB	BGR602958
ANTENNA CELLULAR DUAL BAND 9DB	BGR602959
ANTENNA CELLULAR DUAL BAND 9DB	BGR602960
ANTENNA CELLULAR DUAL BAND 9DB	BGR602994
ANTENNA CELLULAR DUAL BAND 9DB	BGR602995
APPLANIX IMU 200	49
APPLANIX IMU 200	231
APPLANIX IMU 200	730
APPLANIX POS MV PROCESSOR L1/L2(RTK)	2151
APPLANIX POS MV PROCESSOR L1/L2(RTK)	2354
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)	10599
BROOKE OCEAN MVP-30 SSFF (FISH)	10598
BROOKE OCEAN MVP-30 TOW BLOCK	10596
BROOKE OCEAN MVP-30 WINCH	10595
CCTV CAMERA, DECK CAMERA	E030210380038
CCTV CAMERA, DECK CAMERA	E030210380040

Description	Ast_SerialNumber
CCTV DISPLAY	chb08504
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602489
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602562
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602603
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602604
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602605
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602606
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602608
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602832
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602834
COMPUTER RACKMOUNT PC (FPI-ACQUISITION)	BGR602835
DATA RADIO CELLULAR AMPLIFIER	323041
DATA RADIO CELLULAR AMPLIFIER	801245d7041199707
DATA TRANSFER HARD DRIVE	600037473
DATA TRANSFER HARD DRIVE	600037474
DATA TRANSFER HARD DRIVE	600037536
DATA TRANSFER HARD DRIVE	600037476
DATA TRANSFER HARD DRIVE	600037484
DATA TRANSFER HARD DRIVE	600037482
DATA TRANSFER HARD DRIVE	600037471
DATA TRANSFER HARD DRIVE	600037479
DATA TRANSFER HARD DRIVE	600037475
DATA TRANSFER HARD DRIVE	600037469
DATA TRANSFER HARD DRIVE	600037540
DONGLE ARCGIS ARCVIEW (ESRI)	37152209-VIEW1
DONGLE ARCGIS ARCVIEW (ESRI)	37152209-VIEW2
DONGLE BLUEMARBLE DESK	253857
DONGLE CARIS - NT (HIPS/SIPS)	CW9604871
DONGLE CARIS - NT (HIPS/SIPS)	CW9604873
DONGLE CARIS - NT (HIPS/SIPS)	CW9604665
DONGLE CARIS - NT (HIPS/SIPS)	CW9604894
DONGLE WINFROG	BGR602946
DONGLE WINFROG	BGR602947
DONGLE WINFROG	BGR602948
DONGLE WINFROG	BGR602949
ETHENET TELEMETRY , FROGLINK I/O	
GPS ANTENNA L1/L2	12561426
GPS ANTENNA L1/L2	60001982
GPS ANTENNA L1/L2	12697293

Description	Ast_SerialNumber
GPS ANTENNA L1/L2	60008160
GPS ANTENNA L1/L2	60124972
GPS ANTENNA L1/L2	60125052
GPS ANTENNA L1/L2	60186871
GPS ANTENNA L1/L2	60187495
GPS ANTENNA L1/L2 STARFIX SPOT	NZT070200049
GPS ANTENNA L1/L2 STARFIX SPOT	NZT070200047
GPS ANTENNA L1/L2 STARFIX SPOT	NZT07420009
GPS ANTENNA L1/L2 STARFIX SPOT	NZT07420011
GPS ANTENNA L1/L2 STARFIX SPOT	NZT08130058
GPS ANTENNA L1/L2 STARFIX SPOT	NZT08130051
GPS ANTENNA L1/L2 STARFIX SPOT	NZT08130069
GPS ANTENNA L1/L2 STARFIX SPOT	NZT08130062
GPS BEACON ANTENNA CSI MBL-3	9845-2643-0001
GPS BEACON ANTENNA CSI MBL-3	994-3051-0001
GPS BEACON ANTENNA CSI MBL-3	9932-4356-0002
GPS CSI CDA ANTENNA	0634-31116-0022
GPS CSI CDA ANTENNA	0640-31662-0020
GPS CSI CDA ANTENNA	0640-31662-0017
GPS CSI CDA ANTENNA	0748-5628-0162
GPS CSI MBX-3 COASTGUARD RECEIVER	9834-2211-0001
GPS CSI MBX-3 COASTGUARD RECEIVER	0042-7227-0001
GPS CSI MBX-3 COASTGUARD RECEIVER	9833-2166-0001
GPS CSI MBX-3 COASTGUARD RECEIVER	9834-2211-0002
GPS CSI MBX-3 COASTGUARD RECEIVER	9920-3754-0001
GPS CSI MBX-3 COASTGUARD RECEIVER	9913-3442-0001
GPS CSI MBX-3 COASTGUARD RECEIVER	0314-11467-0001
GPS RECEIVER L1/L2 STARFIX XP/HP	NBVO7080003
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV07080024
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV07120016
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV07120002
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV08200008
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV08200006
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV08200007
GPS RECEIVER L1/L2 STARFIX XP/HP	NBV08200005
GRAB SAMPLER	
GRAB SAMPLER	
GRAB SAMPLER	
INMARSAT PHONE ANTENNA CONTROL UNIT DAC-2202	TBA1

Description	Ast_SerialNumber
INMARSAT PHONE MODEM CI1300 IDU	0678
INMARSAT PHONE MOUNTING MAST	BGR602916
INMARSAT PHONE SEATEL 6006KU-7 RADOME	MRHS0088F
INMARSAT PHONE TERMINAL MOUNTING STRIP	TBA2
LAPTOP PC	4WJ4R51
LAPTOP PC	hb2pbg1
LAPTOP PC	462H691
MONITOR FLATSCREEN (1600X1200) LCD	mx0c9536466346ci4e6l
MONITOR FLATSCREEN (1600X1200) LCD	s7y301944ga
MONITOR FLATSCREEN (1600X1200) LCD	s7y301942ga
MONITOR FLATSCREEN (1600X1200) LCD	s7y301948ga
MONITOR FLATSCREEN (1600X1200) LCD	s7y301954ga
MONITOR FLATSCREEN (1600X1200) LCD	s82303878ga
MONITOR FLATSCREEN (1600X1200) LCD	s82303872ga
MONITOR FLATSCREEN (1600X1200) LCD	s82303873ga
MONITOR FLATSCREEN (1600X1200) LCD	s82303881ga
MONITOR FLATSCREEN (1600X1200) LCD	s82303816ga
MONITOR FLATSCREEN (1600X1200) LCD	s82303883ga
MONITOR FLATSCREEN (1600X1200) LCD	s82303880ga
MONITOR FLATSCREEN (1600X1200) LCD	s82303874ga
MONITOR FLATSCREEN (1600X1200) LCD	s82303882ga
MONITOR FLATSCREEN (1600X1200) LCD	s82303875ga
MONITOR FLATSCREEN (1600X1200) LCD	S87311453GA
MONITOR FLATSCREEN (1600X1200) LCD	S87311390GA
MONITOR FLATSCREEN (1600X1200) LCD	S87311381GA
MONITOR FLATSCREEN (1920X1200) LCD	84104171NA
MONITOR FLATSCREEN (1920X1200) LCD	S84104409NA
MONITOR FLATSCREEN (1920X1200) LCD	S84104440NA
MONITOR FLATSCREEN (1920X1200) LCD	S84104419NA
MONITOR FLATSCREEN (1920X1200) LCD	S84104041NA
MONITOR FLATSCREEN (1920X1200) LCD	87106354NA
NETWORK ATTACHED STORAGE	NA0000000413215
NETWORK ATTACHED STORAGE	30012669
NETWORK ATTACHED STORAGE	PMC 643620109071
NETWORK ATTACHED STORAGE (SMART) NETAPP 3050	JW0000000071173
NETWORK HUB/SWITCH 8 PORT MANAGED	FOC1234U1WQ
NETWORK HUB/SWITCH 8 PORT MANAGED	FOC1229U620
PRINTER LASER	CNJC84X053
RESON NAVISOUND SVP 70	2007073

Description	Ast_SerialNumber
RESON NAVISOUND SVP 70	4506001
RESON SEABAT 7125 200KHZ PROJECTOR	0408001
RESON SEABAT 7125 200KHZ PROJECTOR	4408352
RESON SEABAT 7125 400KHZ PROJECTOR	5006392
RESON SEABAT 7125 400KHZ PROJECTOR	5006396
RESON SEABAT 7125 RECEIVE ARRAY	4107007
RESON SEABAT 7125 RECEIVE ARRAY	2507038
RESON SEABAT 71-P LCU	1515004
RESON SEABAT 71-P LCU	1515008
RESON SEABAT 71-P PROCESSOR	4707090
RESON SEABAT 71-P PROCESSOR	4707082
RESON SEABAT 8111 RECEIVER ARRAY	0100056
RESON SEABAT 8111 TRANSCEIVER	23745
RESON SEABAT 8111 TRANSMIT ARRAY	2104019
RESON SEABAT 8125 TRANSDUCER	0802100
RESON SEABAT PROCESSOR RESON 81-P	23279
RESON SEABAT PROCESSOR RESON 81-P	36746
RESON SVP-C TOPSIDE (8125)	74548
ROUTER	jmx0623k950
ROUTER	68-2618-01
SLIP RING IEC	3259-0601
SLIP RING IEC	4103-0000-0702
SLIP RING IEC	9-25-87-K714
TOOL KIT	
UHF ANTENNA	
UHF ANTENNA	
UHF ANTENNA	
UHF ANTENNA	
UHF, radio modem	075004322
UHF, radio modem	075004326
UHF, radio modem	075004327
UHF, radio modem	075004328
UPS UNIT < 3KVA	9507CY00M535701502
UPS UNIT < 3KVA	9507CY00M535701508
UPS UNIT < 3KVA	9507CY00M535701488
UPS UNIT < 3KVA	9507cy0om535701448
UPS UNIT < 3KVA	9507cy0om535701489
UPS UNIT < 3KVA	9507cy0om535701496
UPS UNIT < 3KVA	9721BY0SM678800096

Description	Ast_SerialNumber
UPS UNIT < 3KVA	9721BY0SM678800227
UPS UNIT > 3KVA	9536ALCSM583100588
UPS UNIT > 3KVA	9642ALCSM653400138
UPS UNIT > 3KVA	9642ALCSM653400264
UPS UNIT > 3KVA	9651ALCSM653400151
UPS UNIT > 3KVA	9651ALCSM653400159
UW COLOUR CAMERA	v08b00647ntsc
UW COLOUR CAMERA	V08B20769NTSC
VHF ANTENNA	BGR602770
VHF BASE STATION	44003775
VHF BASE STATION	1207629
WINCH (MVP-30) SPARES KIT	
WINCH HYDRAULIC MEDIUM / SMALL TOW	101-1008-009
WINCH HYDRAULIC MEDIUM TOW	
COMPUTER DELL PC (PROCESSING)	21DFQB1
COMPUTER DELL PC (PROCESSING)	4454KC1
COMPUTER DELL PC (PROCESSING)	6FS5ZC1
DATA SYSTEMS	
DONGLE CARIS - NT (HIPS/SIPS)	CW9604869
DONGLE CARIS - NT (HIPS/SIPS)	CW9604872
DONGLE CARIS - NT (HIPS/SIPS)	CW9604894
DONGLE CARIS - NT (HIPS/SIPS)	CW9604705
DONGLE CARIS - NT (HIPS/SIPS)	CW9605434
DONGLE C-MAP	ET30021
DONGLE POS GPS	7212
DONGLE POS GPS	7346
DONGLE POS PAC	464-1650
DONGLE POS PAC	495-1740
MONITOR FLATSCREEN (1920X1200) LCD	CN-0CC3024663367B21RS
MONITOR FLATSCREEN (1920X1200) LCD	mx0ju436742628692wcs
MONITOR FLATSCREEN (1920X1200) LCD	mx0ju436742628692tns
MONITOR FLATSCREEN (1920X1200) LCD	mx0ju436742628692tks
MONITOR FLATSCREEN (1920X1200) LCD	mx0ju436742628692wrs
MONITOR FLATSCREEN (1920X1200) LCD	mx0ju436742628692tds

Software

Table 12 - Software List (Pacific Star, R2, D2, & Processing Center)

Software Package	Version	Service Pack	Hotfix
Fugro Pelagos Winfrog Multibeam	3.08.44.14	N/A	N/A
Fugro Pelagos MBSurvey Tools	2.00.25.00	N/A	N/A
Fugro Pelagos POSMVLogger	1.0	N/A	N/A
CARIS HIPS/SIPS	6.1	2	1-4 & 6-8
CARIS HIPS/SIPS	7.0	1	1-4
CARIS Notebook	3.1	0	1
CARIS Bathy DataBASE	2.3	0	1-16
ESRI ArcGIS	9.3.1	N/A	N/A
Applanix POS MV V4 Controller	3	N/A	N/A
Applanix POSPac MMS	5.2	1	N/A
IVS Fledermaus	6.7.0	N/A	N/A
Nobeltec Tides and Currents	3.5.107	N/A	N/A
Microsoft Office	2007 Professional	N/A	N/A
Microsoft Windows	XP Professional	3	N/A
Helios Software Solutions Textpad	5.2.0	N/A	N/A
IrfanView	3.98	N/A	N/A

Appendix II – Vessel Descriptions

F/V Pacific Star

The F/V Pacific Star (Figure 5), 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 survey launches, R2 and D2. Access doors and infrastructure were built to facilitate access to the launches.

On the Pacific Star, Reson Seabat 7125 and 8111 multibeam sonars were mounted, approximately midship, in a drop keel attached to the ship's hull (Figure 8). Placement was governed by the best estimate of the vessel's center of gravity. The inertial measurement unit (IMU) accelerometer package for a POS MV was installed inside the hull directly above the Reson 7125.

Table 13 - Vessel Specifications (Pacific Star)

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 5 – F/V Pacific Star

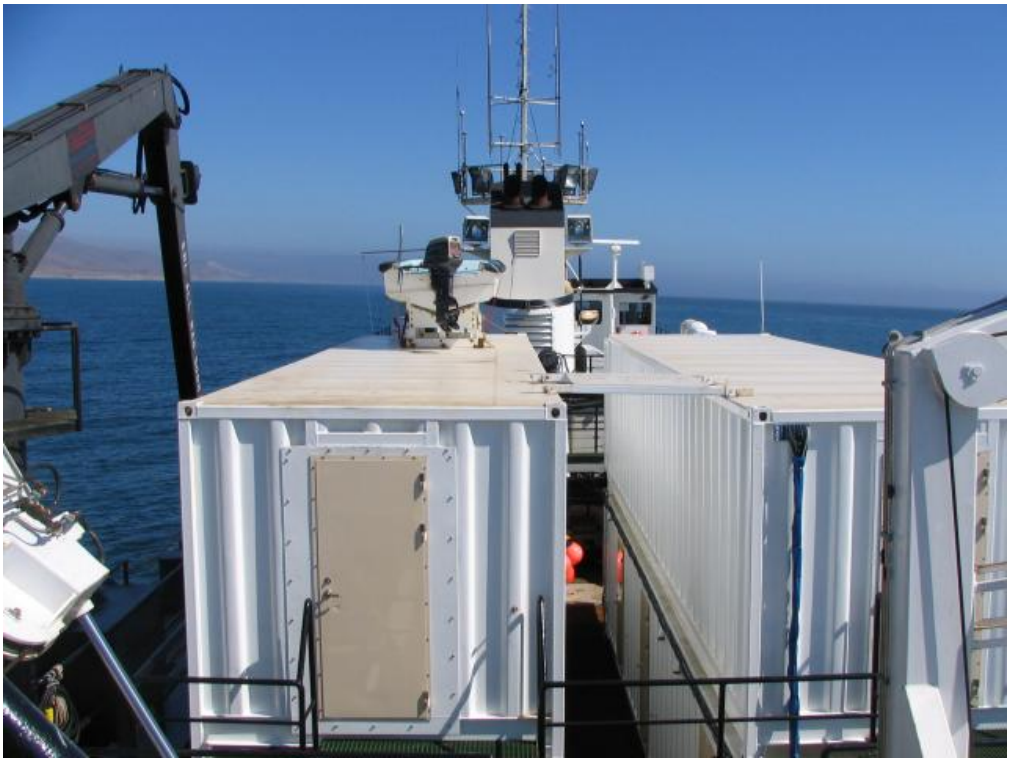


Figure 6 – F/V Pacific Star Office Containers

Figure 7 – F/V Pacific Star Davit Launch System

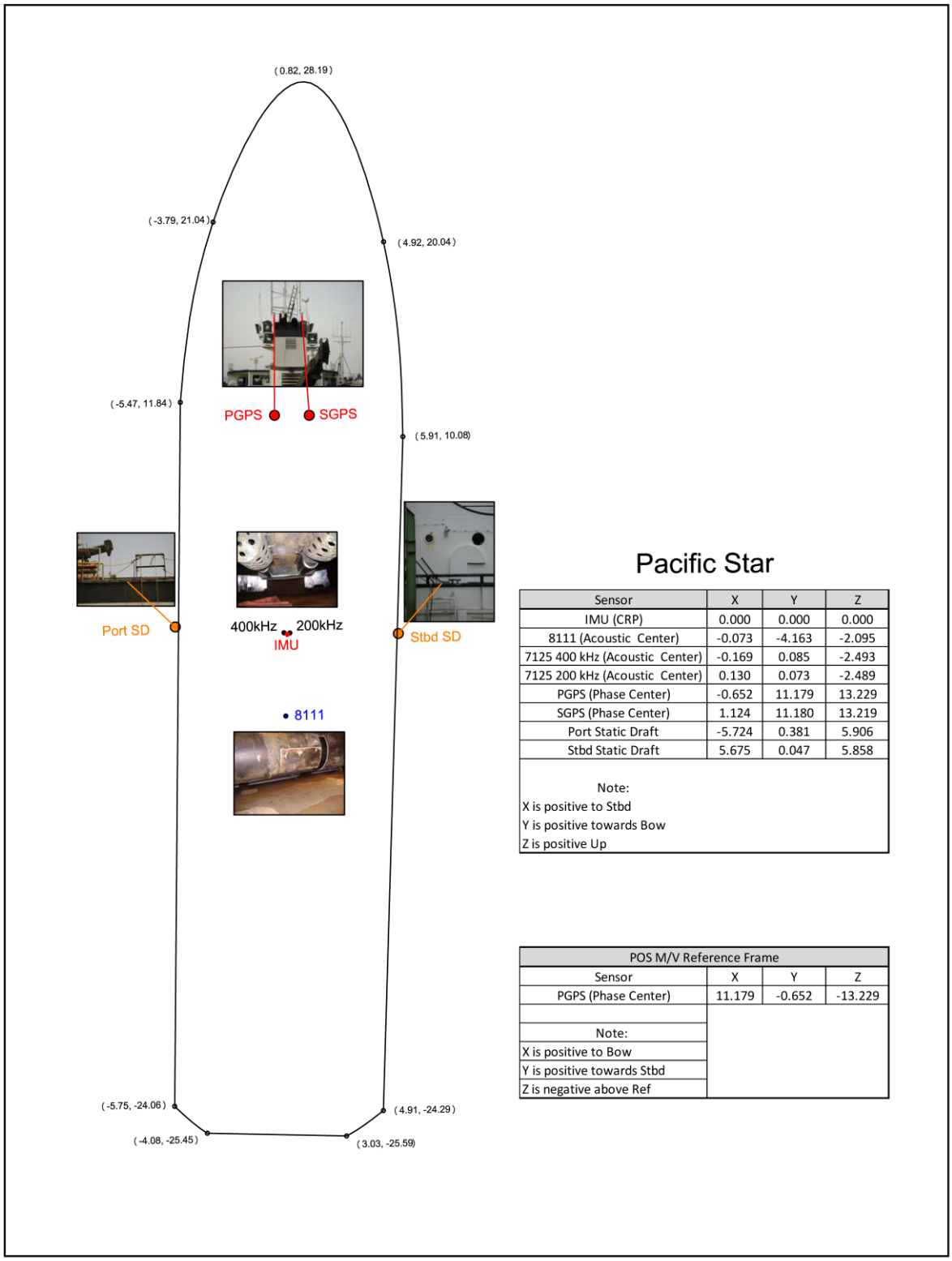
Figure 8 – F/V Pacific Star Drop Keel with 7125 and 8111 Sonar Heads

Two Trimble L1/L2 antennas were mounted above and forward from the sonars on the vessel radio mast. Offset 1.8 meters port-starboard from each other, these provided GPS data to the POS MV for position, attitude, and heading computations. The port side antenna 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 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 the 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 POS MV by entering a GPS lever arm offset. Vessel offsets used are shown in the offset diagram (Figure 9).



Pacific Star

Sensor	X	Y	Z
IMU (CRP)	0.000	0.000	0.000
8111 (Acoustic Center)	-0.073	-4.163	-2.095
7125 400 kHz (Acoustic Center)	-0.169	0.085	-2.493
7125 200 kHz (Acoustic Center)	0.130	0.073	-2.489
PGPS (Phase Center)	-0.652	11.179	13.229
SGPS (Phase Center)	1.124	11.180	13.219
Port Static Draft	-5.724	0.381	5.906
Stbd Static Draft	5.675	0.047	5.858

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

POS M/V Reference Frame			
Sensor	X	Y	Z
PGPS (Phase Center)	11.179	-0.652	-13.229

Note:
X is positive to Bow
Y is positive towards Stbd
Z is negative above Ref

Figure 9 - Pacific Star Offset Diagram

R/V R2

The R/V R2 (Figure 10), a Pacific Star launch, was modified to accommodate a survey crew and acquisition hardware. The keel was cut just aft of mid-ship and a Reson 7125 multibeam sonar was installed. A conical cowling protected the sonar head forward and aft by way of a crescent shaped skid. 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 11). 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.

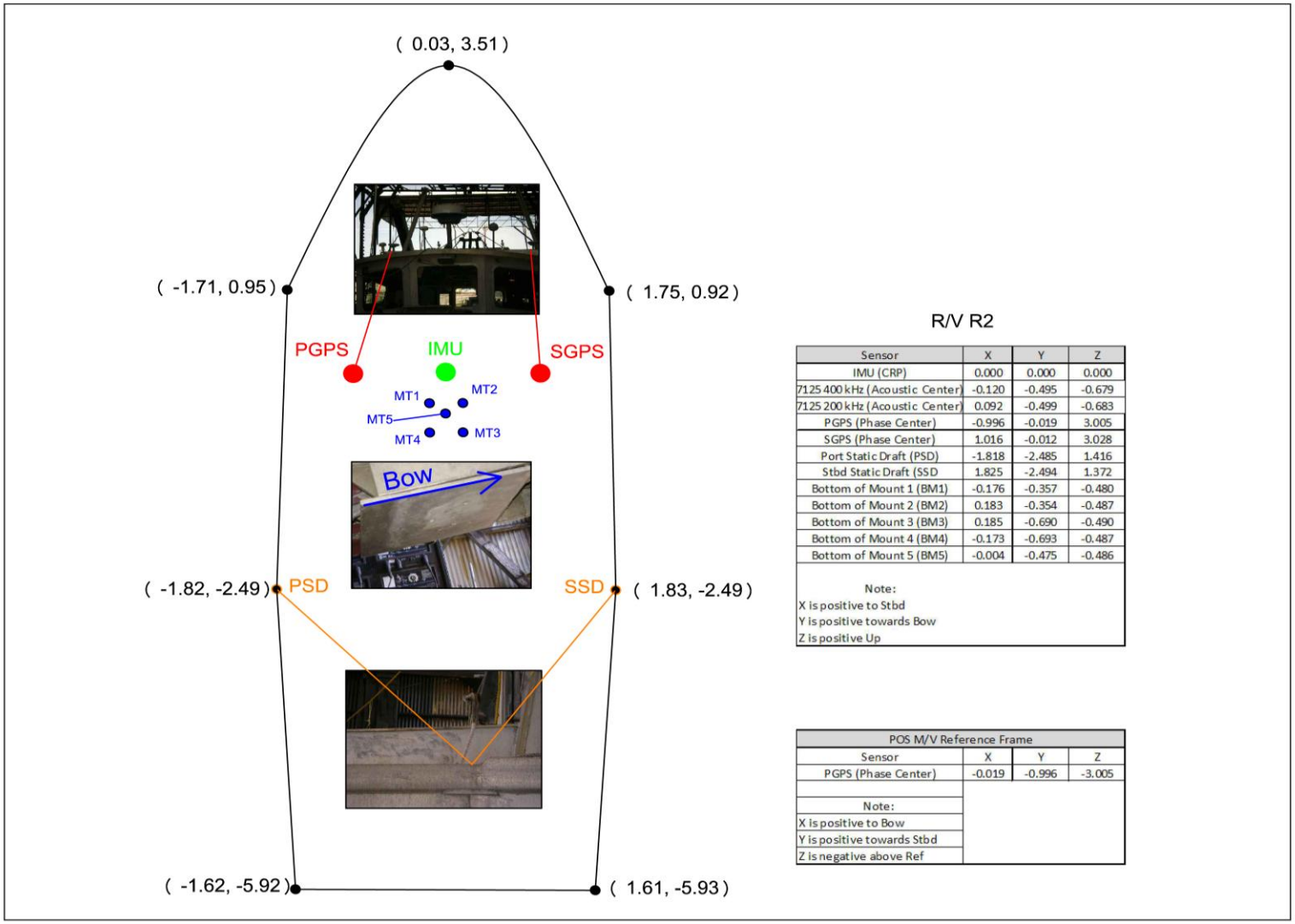
The AML Smart Probe SV&P sensors were deployed from an A-Frame on the stern using a small hydraulic winch.

Offset values were applied to the data in CARIS HIPS as specified in the HIPS Vessel File (HVF). Vessel offsets used are shown in the offset diagram (Figure 11). Note that the HVF does not contain navigation offsets because the position provided by the POS MV is already corrected to the CRP.

Table 14 - Vessel Specifications (R2)

R/V R2	
Owner	Stabbert Maritime Yacht & Ship
Official Number	623241
Year Built	1980/1982
Length	28.9 ’
Breadth	12’
Max Draft	5.7’
Gross Ton	15
Net Ton	13
Mechanical Power	Caterpillar 3208
Electrical	Northern Lights

Figure 10 - R/V R2



R/V R2

Sensor	X	Y	Z
IMU (CRP)	0.000	0.000	0.000
7125 400 kHz (Acoustic Center)	-0.120	-0.495	-0.679
7125 200 kHz (Acoustic Center)	0.092	-0.499	-0.683
PGPS (Phase Center)	-0.996	-0.019	3.005
SGPS (Phase Center)	1.016	-0.012	3.028
Port Static Draft (PSD)	-1.818	-2.485	1.416
Stbd Static Draft (SSD	1.825	-2.494	1.372
Bottom of Mount 1 (BM1)	-0.176	-0.357	-0.480
Bottom of Mount 2 (BM2)	0.183	-0.354	-0.487
Bottom of Mount 3 (BM3)	0.185	-0.690	-0.490
Bottom of Mount 4 (BM4)	-0.173	-0.693	-0.487
Bottom of Mount 5 (BM5)	-0.004	-0.475	-0.486

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

POS M/V Reference Frame			
Sensor	X	Y	Z
PGPS (Phase Center)	-0.019	-0.996	-3.005

Note:
X is positive to Bow
Y is positive towards Stbd
Z is negative above Ref

Figure 11 - R2 Offset Diagram

R/V D2

The R/V D2 (Figure 12), a Pacific Star launch, was modified to accommodate a survey crew and acquisition hardware. The keel was cut just aft of mid-ship and a Reson 8125 multibeam sonar was installed A conical cowling protected the sonar head forward and aft by way of a crescent shaped skid. The accelerometer package for a POS MV was mounted in the hull of the vessel just over the 8125 multibeam transducer head.

Two Trimble L1/L2 antennas were mounted above the 8125 and accelerometer for positioning and heading (Figure 13). The two POS MV antennas were offset 1.0m to the port and starboard from the IMU. The port side antenna (L1/L2) functioned as the POS MV master antenna; the starboard side antenna functioned as the POS MV secondary.

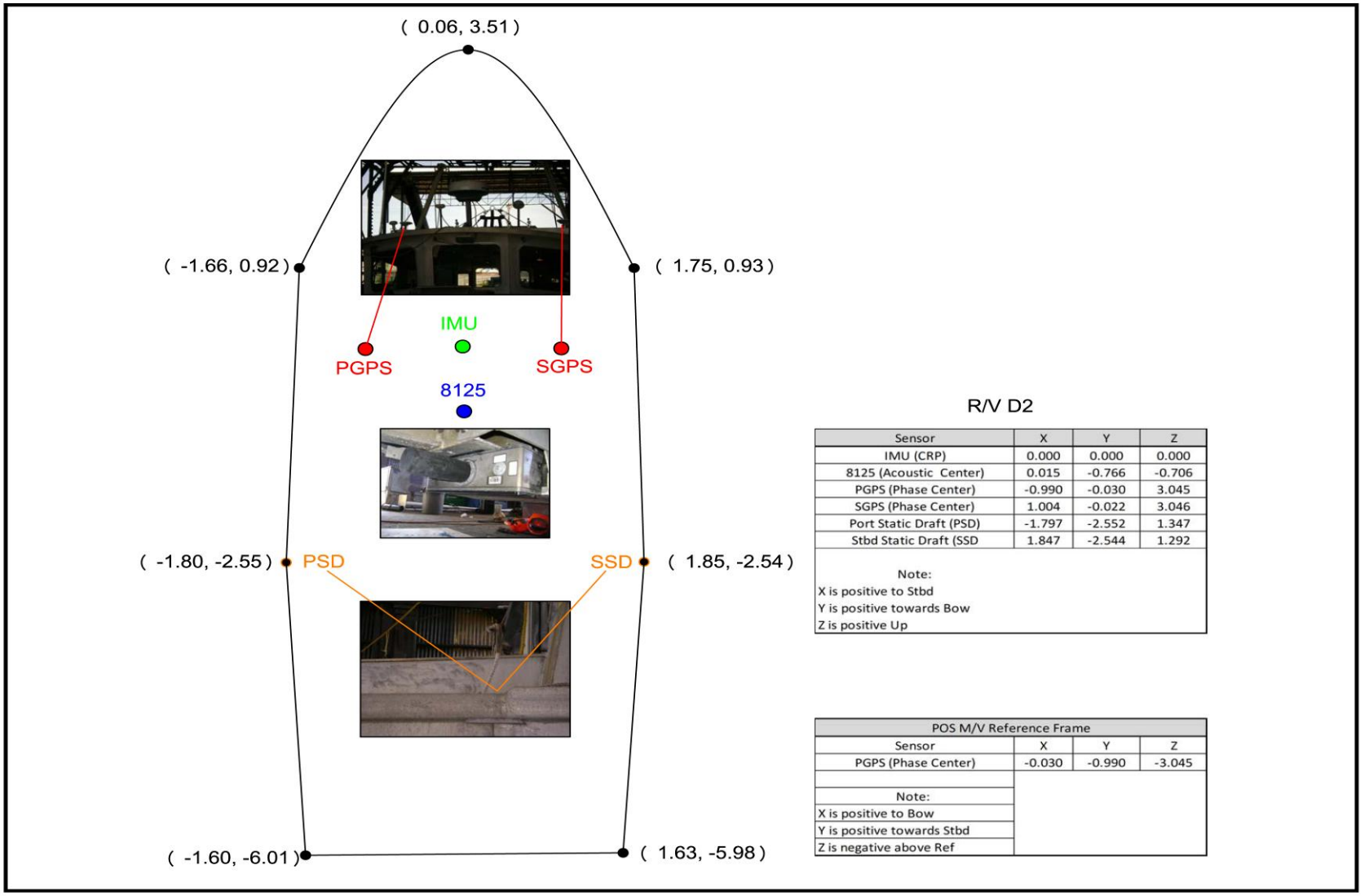
The AML Smart Probe SV&P sensors were deployed from an A-Frame on the stern using a small hydraulic winch.

Offset values were applied to the data in CARIS HIPS as specified in the HIPS Vessel File (HVF). Vessel offsets used are shown in the offset diagram (Figure 13). Note that the HVF does not contain navigation offsets because the position provided by the POS MV is already corrected to the CRP.

Table 15 - Vessel Specifications (D2)

R/V D2	
Owner	Stabbert Maritime Yacht & Ship
Official Number	647782
Year Built	1980/1982
Length	28.9 ’
Breadth	12’
Max Draft	5.7’
Gross Ton	15
Net Ton	13
Mechanical Power	Caterpillar 3208
Electrical	Northern Lights

Figure 12 - R/V D2



R/V D2

Sensor	X	Y	Z
IMU (CRP)	0.000	0.000	0.000
8125 (Acoustic Center)	0.015	-0.766	-0.706
PGPS (Phase Center)	-0.990	-0.030	3.045
SGPS (Phase Center)	1.004	-0.022	3.046
Port Static Draft (PSD)	-1.797	-2.552	1.347
Stbd Static Draft (SSD	1.847	-2.544	1.292

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

POS M/V Reference Frame			
Sensor	X	Y	Z
PGPS (Phase Center)	-0.030	-0.990	-3.045

Note:
X is positive to Bow
Y is positive towards Stbd
Z is negative above Ref

Figure 13 - D2 Offset Diagram

Appendix III – Calibration Reports

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