

# Data Acquisition and Processing Report

## Arc Surveying and Mapping

### Vessel Red Witch



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# Data Acquisition and Processing Report

## Introduction

This Data Acquisition and Processing Report (DAPR) details all Arc Surveying and Mapping survey equipment and methods used to acquire and process survey data. The data and deliverables were acquired according NOS HSSD, April 2010. Survey systems and methods used during this project were also chosen based on the water depth, sea and weather conditions, and the ability of the vessel to safely navigate the area.

## A. Equipment

### A.1 Survey Launch Red Witch

Survey Launch Red Witch is a 21-ft MonArk Little Giant, and was used to acquire multibeam echosounder data, and sound velocity profiles. The launch is 8 feet wide, has a static draft of 0.61 meters, and is powered by twin 115hp Yamaha outboards.

#### Vessel Information:

Builder: Mon Ark Built: 1978 Length Overall: 21 ft. Beam: 8 ft. Draft: 1.4ft Cruising Speed 25knts  
Min/Max Survey Speed: 4-5 knots. Primary Echosounder: Side Mount Reson 7101: Sound Velocity Profiler: Odom Digibar Pro Surface Sound Velocity Probe: Reson SVP

### A.2 Sounding Equipment

Red Witch is equipped with a Reson 7101 Multibeam Swath System. The Reson 7101 operates at a frequency of 240 kHz. The Reson 7101 has 511 beams, each of which has a 1.5° beam width. The maximum ping rate of this echosounder is 50 Hz. Soundings are acquired in meters.

The sonar head contains a curved face projector (Reson 8101 transducer) and transmits a pulse of acoustic energy across the direction of travel illuminating a thin strip of seabed. The acoustic returns are picked up by the receiver section of the sonar head, amplified, digitized, and sent to the topside processor for beamforming and processing.



The processing unit performs the beamforming, bottom detection and controls the sonar head with respect to gain, ping rate and transmit angle. It also contains the interfaces for all time-critical external sensors such as attitude data, position, and the 1 PPS (pulse per second) signal. Real time velocities are also interfaced to the 7101 using a Reson SVP mounted on the transducer for initial beamforming and steering. Data is transmitted to the survey computer via Ethernet connection.

The sonar head is a side mount located on the port side of the vessel just aft of the wheel house. The sound velocity probe is mounted on transducer. The TSS VRU-210 Motion Reference Unit is mounted 0.52m starboard of the transducer. The Trimble DSM 232 DGPS antenna is mounted directly over the transducer and the SG Brown Meridian Surveyor Gyro Compass is mounted in the wheel house parallel to the keel of the vessel. This enables all the data to be collected with zero offsets other than the MRU.

### **A.3 Positioning Equipment**

#### **A.3.1 TSS VRU-210 Motion Reference Unit**

The Red Witch is equipped with TSS VRU-210 Motion Reference Unit configured thru Hypack and Hysweep Data collection software. The MRU is offset .058 meters starboard of the multibeam transducer with a zero offset fore and aft. The data string (TSS1) is sent to the survey computer via a serial connection at a rate of 40hz. The unit is fully aided using the NEMA GGA string from the Trimble DSM 232 and heading information supplied by the Gyro Compass.

#### **A.3.2 Trimble DSM232**

The Red Witch is equipped with a Trimble DSM232 integrated 12-channel GPS receiver. There are three modes: Auto-Range, which locks onto the beacon nearest the vessel, Auto-Power, which locks onto the beacon with the greatest signal strength, and Manual, which allows the user to select the desired beacon. Additionally, the DSM232 can accept differential correctors (RTCM messages) from an external source such as a user established DGPS reference station. The unit was set to receive DGPS corrections from the USCG Beacon located in Isabela Puerto Rico. The DGPS antenna is mounted directly over the transducer enabling an offset of 0.00. The DSM232 is configured in the auto-power mode to only use correctors from the strongest USCG beacon, to go off-line if the age of DGPS correctors exceeded 20 seconds, and to exclude satellites with an altitude below 8°. The 1PPS signal and the NEMA ZDA timing are sent from the unit to the Reson via interface on the 7101 processor.

#### **A.3.3 TSS Meridian Surveyor Gyro Compass**

The Red Witch is equipped with a Meridian Surveyor Gyro Compass for precise heading information. The Gyro has a dynamic heading accuracy of +/- .02deg. The Gyro is located in the wheel house and mounted parallel to the keel /centerline of the vessel. The heading information is sent to Hysweep via a serial connection and also splits to the MRU. This device also has an offset of 0.00.

#### **A.3.4 Odom Digibar Pro Velocity Probe**

The Odom Digibar Pro is used to obtain sound velocity profiles at frequent intervals during the course of the survey. Sound velocities are collected at .5 meter intervals through the water column at different locations in the survey area. These velocities are post processed into the multibeam data.

## **A.4 Software**

### **A.4.1 Acquisition Software**

#### **A.4.1.1 Hypack and Hysweep Version's 2009a**

Hypack is used for vessel navigation and line tracking during data collection. Hypack's Survey program is used to log data and is used in conjunction with Hypack's Hysweep Survey program to log vessel positioning. In addition, the hysweep interface enables the boat operator to view the nadir depths in the hypack survey data information window. The vessels DGPS system is configured in the software for positioning only. Data is saved with a .RAW extension.

#### **A.4.1.2 Hysweep 2009a**

Hysweep is used for Multibeam data collection as well as navigation. Different displays are available for the survey technician to ensure bottom coverage and real time QC of data during the survey. The MRU, Gyro and the Reson 7101 are configured in Hysweep for data collection. Data is collected on the survey computer (Dell Laptop). Survey lines were laid out at a 16m interval to ensure 200 percent bottom coverage during the survey. The files are collected with a .HSX extension these are raw multibeam files in Hysweep.

## **B. Data Processing and Quality Control**

### **B.1 Shallow-Water Multibeam Data MB MAX (Hysweep)**

Shallow-water multibeam (SWMB) data were monitored in real-time using the 2-D and 3-D data display windows in Hypack Hysweep, and the Reson controller window. The Reson 7101 control interface allows the operator the ability to control ping rate and pulse length as well as gain and power settings. The Reson 7101 control interface is virtually hands free and is typically set up prior to data collection. Adjustments to the gates can be made to ensure that false returns or outliers are eliminated during data collection. Power settings can be adjusted along dock faces or around structures to eliminate reflections or false returns. Data is also viewed in the Hysweep interface screen allowing the operator to see 3-D representations of the bottom, as well as cross section views along with pre set error displays, such as heave drift and sounding overlays to previous sweeps and numerous other QA tools built into the software. During data collection any soundings not meeting IHO standards are automatically removed .

Hypack Hysweep .HSX files are loaded into the Hysweep MB MAX multibeam data processing software at the completion of the survey. The data in the HSX file is displayed in a way that heave, pitch, roll and heading as well as positioning, velocities, and tide values for each individual line are displayed prior to integration into the sounding information from the 7101. After examination of this data it is then combined with the Reson 7101 data and the sweeps are reviewed. Typically 100 sweeps are displayed at a time and any outliers are removed with the editing tools available in MB Max. Any anomalies found during this step of the processing such as targets identified on the seafloor are saved to a Hypack target file (.TGT). Upon completion of sweep editing, all data is saved to Hysweeps .HS2 format then exported in the appropriate matrix i.e. 1mx1m grid with the minimum sounding being exported. An all file is also saved containing every data point in an ASCII format.

## C. Corrections to Echo Soundings

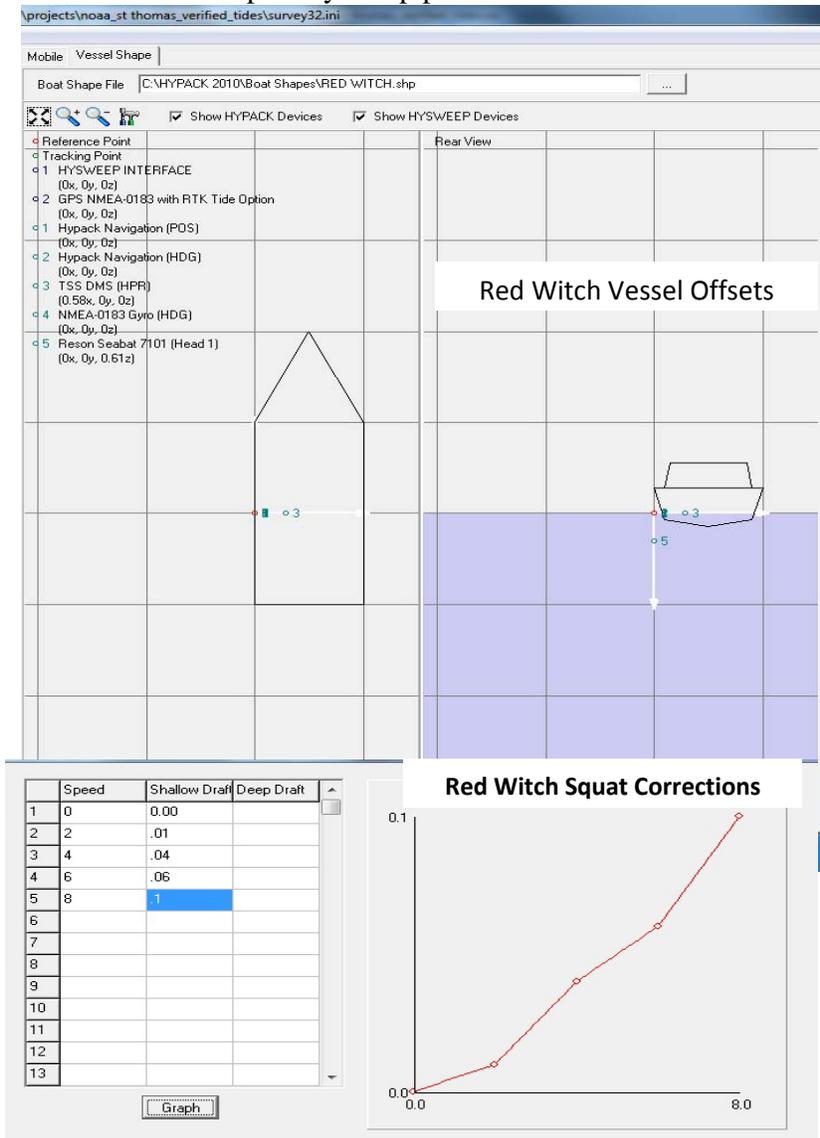
### C.1. Sound Velocity

As stated above sound velocity data is collected real time at the transducer via RESON SVP sound velocity probe attached directly to the transducer.

The Odom digibar Pro is used to collect sound velocity profiles throughout the water column during the survey and is incorporated into the data during post processing. \*See page 8 & 9 for calibration report.

### C.2. Vessel Offsets and Dynamic Draft Corrections

Angular offsets and navigation timing errors of the multibeam system were determined using a patch test. A series of calibration lines are run and processed using Hysweeps Patch test program. The test was conducted following the re-installation of the multibeam transducer. These values were entered into the device setup in Hysweep prior to data collection.



#### Static Draft/Bar Check

Bar Depth	Measured Depth	Beam Samples	Min	Max	Ave	Diff	
2.00	2.00						
		107	16	1.93	2.01	1.96	0.04
		108	32	1.93	2.05	1.99	0.01
		109	44	1.89	2.06	1.98	0.02
		110	49	1.91	2.07	1.97	0.03
		111	49	1.88	2.08	1.97	0.03
		112	49	1.81	2.13	1.97	0.03
		113	46	1.89	2.12	1.99	0.01
		114	49	1.89	2.12	1.99	0.01
		115	48	1.78	2.10	1.97	0.03
		116	47	1.81	3.48	2.04	-0.04
		117	49	1.88	3.52	2.11	-0.11
		118	49	1.63	3.23	2.04	-0.04
		119	49	1.86	2.14	1.99	0.01
		120	47	1.59	2.25	2.00	0.00
		121	49	1.62	2.14	1.98	0.02
		122	47	1.68	2.25	1.98	0.02
		123	46	1.68	3.04	2.01	-0.01
		124	47	1.80	3.36	2.02	-0.02
		125	47	1.85	3.50	2.04	-0.04
		126	45	1.64	2.16	1.97	0.03
		127	23	1.78	2.11	1.96	0.04
		128	11	1.84	2.03	1.93	0.07

### **C.3 Heave, Pitch, Roll, Heading, and Timing**

The TSS VRU-210 provided attitude data to Hypack, which is stored in the HSX multibeam file. Attitude data quality is monitored while surveying by monitoring the Hysweep device interface. Alarms are triggered when accuracy values fall below user-defined values.

As discussed in the previous section, navigation timing error is determined using the patch test and applied to data in the Hysweep survey interface.

### **C.4 Water Level Correctors**

Soundings were reduced to Mean Lower-Low Water (MLLW) using verified tides, taken from station 9751639 Charlotte Amalia , St Thomas, VI from 2100518 to 20100520

## **D. Approval**

As Chief of Party, I have ensured that standard field surveying and processing procedures were used during this project in accordance with the Field Procedures Manual, and the NOS Hydrographic Surveys Specifications and Deliverables Manual, as updated for 2009.

I acknowledge that all of the information contained in this report is complete and accurate to the best of my knowledge.

Approved and Forwarded: \_\_\_\_\_



Frank J. Sawyer, President

**Date:**  
Oct 17, 2009

**Serial #:**  
SN:98125-101705

# DIGIBAR CALIBRATION REPORT

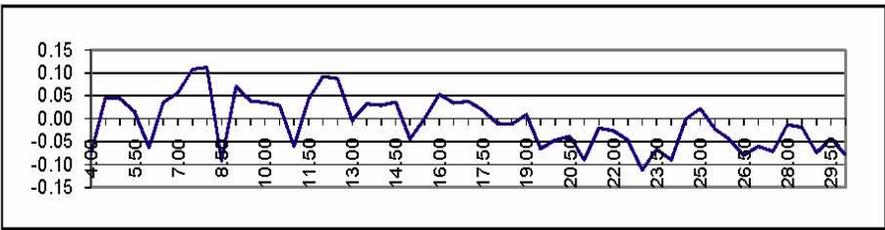
version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc.



**STANDARD DEL GROSSO H<sup>2</sup>O**

TEMP	VELOCITY	MEASURED	RES_VEL	OBS-CAL	TEMP	VELOCITY	MEASURED	RES_VEL	OBS-CAL
FREQUENCY					FREQUENCY				
4.00	1421.62	5552.12	1421.54	-0.08	17.50	1474.38	5755.20	1474.40	0.02
4.50	1423.90	5561.35	1423.95	0.05	18.00	1476.01	5761.35	1476.00	-0.01
5.00	1426.15	5570.00	1426.20	0.04	18.50	1477.62	5767.52	1477.61	-0.01
5.50	1428.38	5578.44	1428.39	0.02	19.00	1479.21	5773.70	1479.21	0.01
6.00	1430.58	5586.59	1430.51	-0.06	19.50	1480.77	5779.43	1480.71	-0.07
6.50	1432.75	5595.32	1432.79	0.04	20.00	1482.32	5785.44	1482.27	-0.05
7.00	1434.90	5603.65	1434.96	0.06	20.50	1483.84	5791.33	1483.80	-0.04
7.50	1437.02	5612.00	1437.13	0.11	21.00	1485.35	5796.91	1485.25	-0.09
8.00	1439.12	5620.07	1439.23	0.11	21.50	1486.83	5802.88	1486.81	-0.02
8.50	1441.19	5627.24	1441.09	-0.09	22.00	1488.29	5808.48	1488.27	-0.03
9.00	1443.23	5635.73	1443.30	0.07	22.50	1489.74	5813.95	1489.69	-0.05
9.50	1445.25	5643.37	1445.29	0.04	23.00	1491.16	5819.17	1491.05	-0.11
10.00	1447.25	5651.03	1447.29	0.04	23.50	1492.56	5824.74	1492.50	-0.07
10.50	1449.22	5658.58	1449.25	0.03	24.00	1493.95	5829.97	1493.86	-0.09
11.00	1451.17	5665.72	1451.11	-0.06	24.50	1495.32	5835.56	1495.31	0.00
11.50	1453.09	5673.51	1453.14	0.04	25.00	1496.66	5840.82	1496.68	0.02
12.00	1454.99	5681.00	1455.09	0.09	25.50	1497.99	5845.75	1497.97	-0.02
12.50	1456.87	5688.19	1456.96	0.09	26.00	1499.30	5850.69	1499.25	-0.05
13.00	1458.72	5694.96	1458.72	0.00	26.50	1500.59	5855.51	1500.51	-0.08
13.50	1460.55	5702.13	1460.59	0.03	27.00	1501.86	5860.47	1501.80	-0.06
14.00	1462.36	5709.06	1462.39	0.03	27.50	1503.11	5865.24	1503.04	-0.07
14.50	1464.14	5715.94	1464.18	0.04	28.00	1504.35	5870.21	1504.33	-0.01
15.00	1465.91	5722.40	1465.86	-0.04	28.50	1505.56	5874.86	1505.54	-0.02
15.50	1467.65	5729.25	1467.64	0.00	29.00	1506.76	5879.25	1506.69	-0.07
16.00	1469.36	5736.05	1469.41	0.05	29.50	1507.94	5883.91	1507.90	-0.04
16.50	1471.06	5742.49	1471.09	0.03	30.00	1509.10	5888.24	1509.03	-0.08
17.00	1472.73	5748.93	1472.77	0.04					



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**Date:**  
Oct 17, 2009

**Serial #:**  
SN.98125-101705

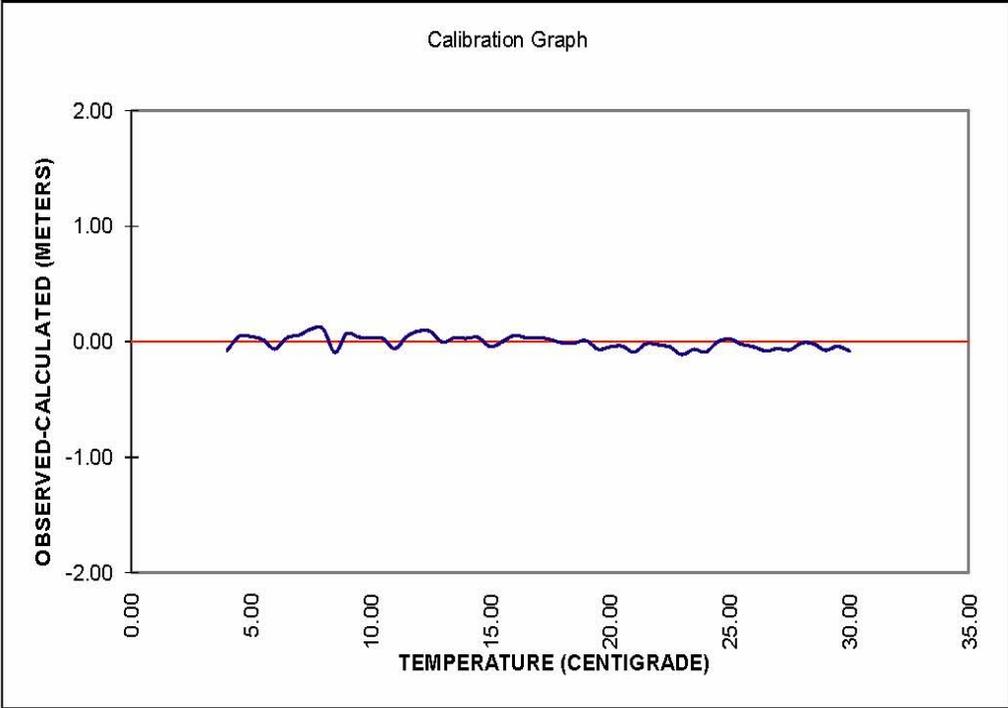
# DIGIBAR CALIBRATION REPORT

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Burn these numbers to EPROM:      Gradient                    3332  
   Intercept                    236



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