H11557

NOAA FORM 76-35A

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

DESCRIPTIVE REPORT

H11557

Type of Survey Hydrographic/Lidar

Project No. OPR-I305-KRL-06

Registry No. H11557

LOCALITY

State Puerto Rico

General Locality Southwest Puerto Rico

Sublocality 11 NM Southwest of Punta Guaniquilla

2006

HYDROGRAPHER
MARK SINCLAIR

CHIEF OF PARTY
DARREN STEPHENSON

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DATE

HYDROGRAPHIC TITLE SHEET

NOAA FORM 77-28U.S. DEPARTMENT OF COMMERCE (11-72) NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION **HYDROGRAPHIC TITLE SHEET**	REGISTRY NO. **H11557**
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. **N/A**

State: Puerto Rico

General Locality: Southwest Puerto Rico

Sub-Locality: 11 NM West of Punta Guaniquilla

Scale: 1:10,000 **Date of Survey:** April 7 to May 15, 2006

Instructions dated: February 8, 2006 **Project No:** OPR-I305-KRL-06

Vessel: Tenix LADS Aircraft, VH – LCL

Hydrographer: M.J. Sinclair **Chief of Party:** D.J. Stephenson

Surveyed by: M.S. Hawkins, J.K. Young, B. McWilliam, M. Blackbourn

Soundings taken by echo sounder, hand lead, pole: Laser Airborne Depth Sounder

Graphic record scaled by: J.K. Young, L.R. Chamberlain, V. Sicari and B. Weidman

Graphic records checked by: S.R. Ramsay and J.G. Guilford

Protracted by: N/A **Automated plot** N/A

Verification by: ***NOAA Atlantic Hydrographic Branch (comments in bold, red, italic font)***

Soundings in: Meters ***Fathoms*** at MLLW

REMARKS: Contract # NC-NJ3000-4-00010 01.

Contractor: Tenix LADS, Incorporated, 925 Tommy Munro Dr., Suite J, Biloxi, MS 39532

Sub contractor: John Oswald and Associates, 12001 Audubon Dr, Anchorage, AK 99516

Times: All times are recorded in UTC.

Purpose: The purpose of this survey is to provide NOAA with modern, accurate hydrographic survey data with which to update the nautical charts of the assigned area.

Projection is UTM Zone 19.

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DESCRIPTIVE REPORT TO ACCOMPANY

HYDROGRAPHIC SURVEY H11557

SCALE 1:10,000, SURVEYED IN 2006

TENIX LADS AIRCRAFT, VH-LCL

TENIX LADS, INC. (TLI)

MARK SINCLAIR, HYDROGRAPHER

PROJECT
Project Number: OPR-I305-KRL-06 **Original:** DG 133C-03-CQ-0011
Date of Instructions: February 8, 2006 **Task Order:** T0008

Date of Supplemental Instructions:
- Site visit by NOAA on September 12–13, 2006 to TLI to discuss the data delivery under the new Specifications and deliverables
- Email dated January 07, 2006 regarding rocks awash

Sheet Number: A
Registry Number: H11557

PURPOSE

To provide NOAA with modern, accurate hydrographic survey data with which to update the nautical charts of the assigned area.

A. AREA SURVEYED

Between April 7 and May 15, 2006 the LADS Mk II aircraft deployed to Puerto Rico for the project OPR-I305-KRL-06. During this period twenty-one survey sorties were flown under Task Order 8, Southwest Puerto Rico. Survey operations covered 11 survey registry numbers. This Descriptive Report describes Sheet A, which covers 11 NM West of Punta Guaniquilla, Southwest Puerto Rico (see Figure 1 and Figure 2). ***Concur.***

On April 15, crosslines through and to the north of H11557 survey area identified the suitability of the area for lidar acquisition. These results were discussed with COTR and an extension to the survey area occurred under a modification to the task order. This enabled lidar coverage to extend to the extent of the reef structure as indicated in Figure 2. ***Concur.***

Environmental factors such as wind strength and direction, cloud cover, high ground and water clarity influenced the area of data acquisition on a daily basis. See section B.2 Quality. ***Concur.***

The planned and actual linear miles sounded for the areas are provided at Appendix III. The sheet limits are as follows for Sheet A:

	Latitude (NAD 83)	Longitude (NAD 83)
NW corner	18° 10' 56.28" N	67° 27' 04.03" W
SE corner	17° 59' 31.11" N	67° 27' 51.68" W

Concur.

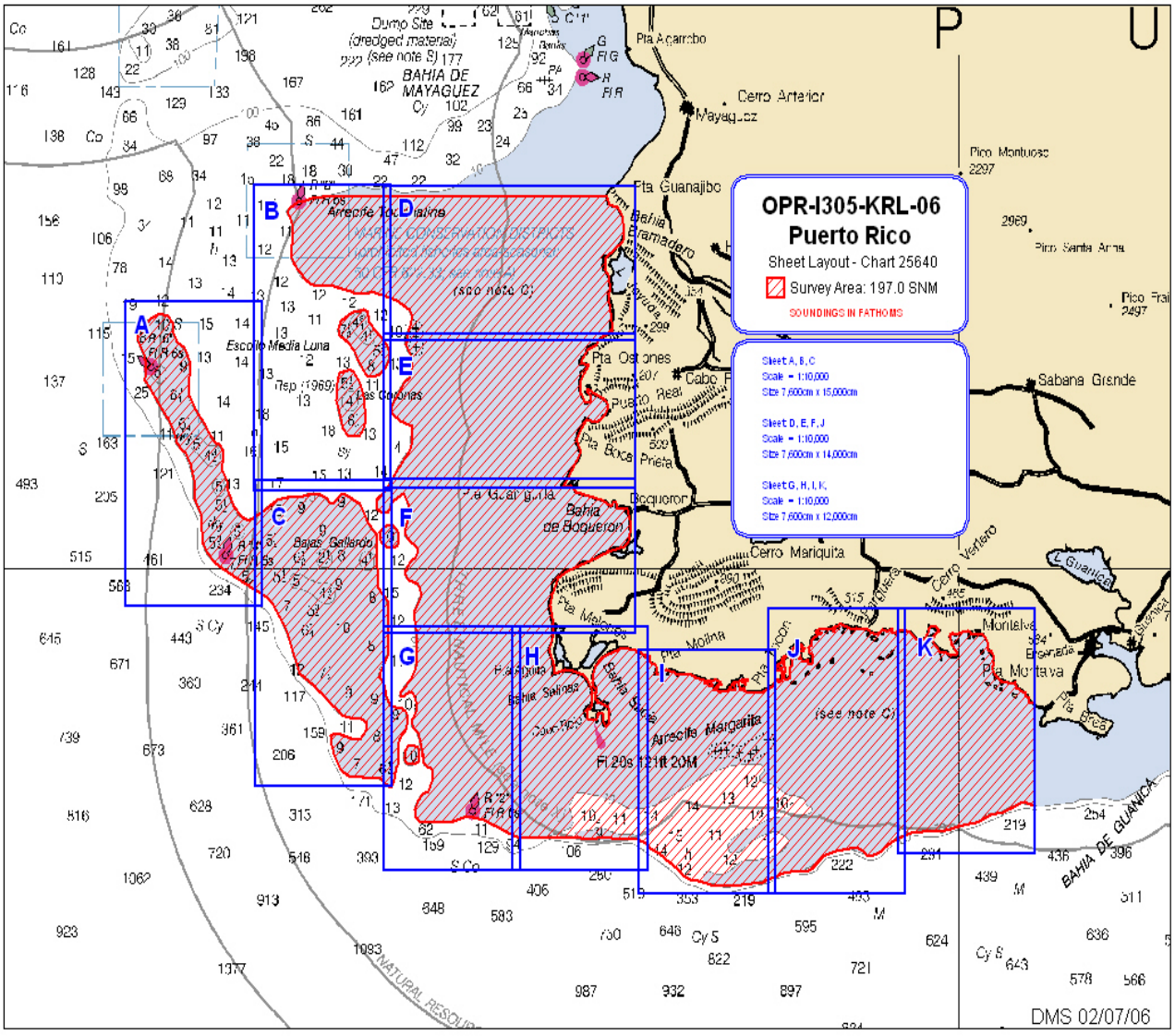


Figure 1 - Task Order 8 OPR-I305-KRL-06

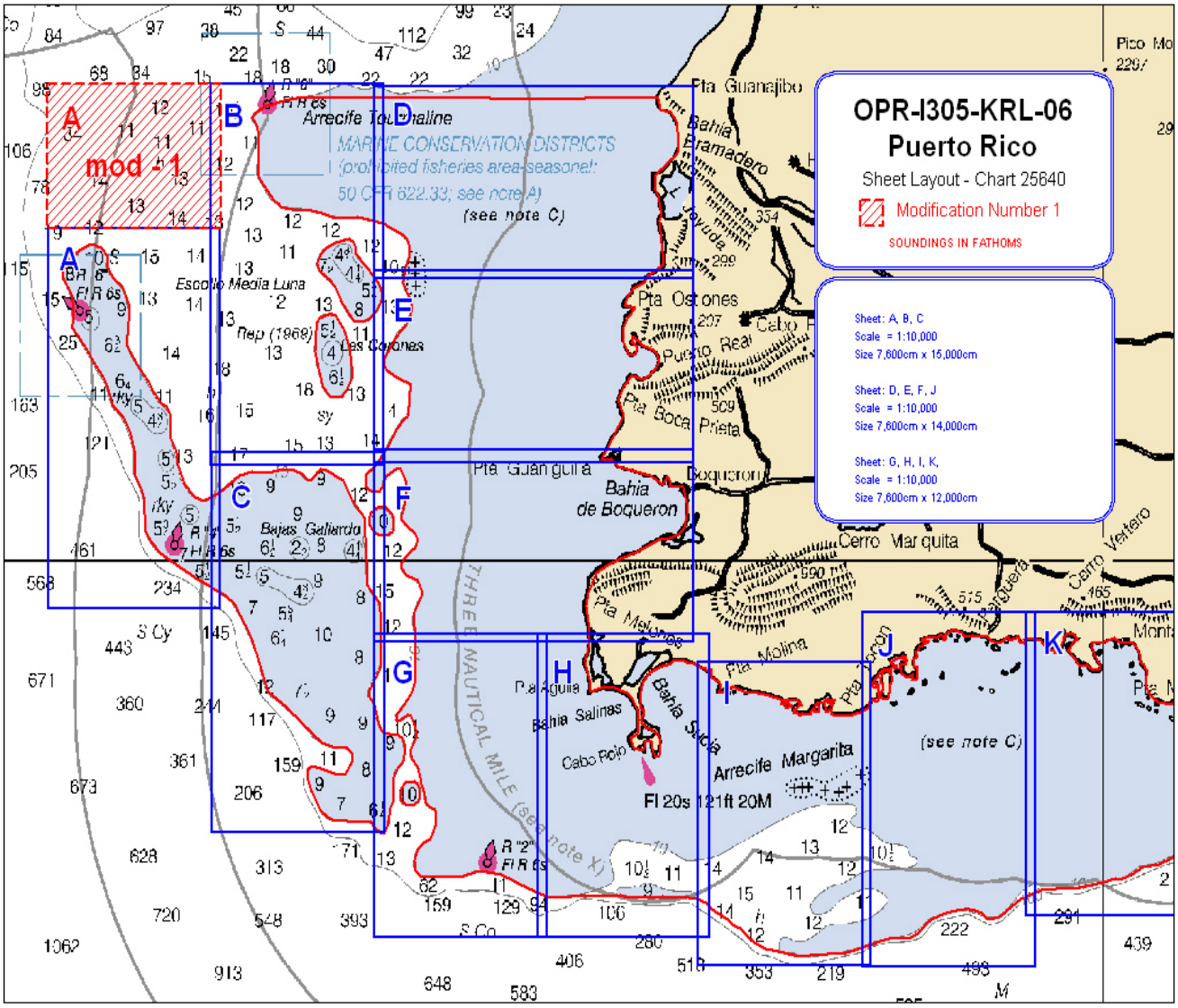


Figure 2 – Task Order 8 OPR-I305-KRL-06 Modification 1

B. DATA ACQUISITION AND PROCESSING *See also Evaluation Report.*

Refer to the Data Acquisition and Processing Report* for a detailed description of the equipment, processing and quality control procedures. A general description and items specific to this survey are discussed in the following sections.

B.1 EQUIPMENT

Data collection was conducted using the LADS Mk II Airborne System, data processing using the LADS Mk II Ground System and data visualization, quality control and final products using Caris HIPS and SIPS 6.0.2, CARIS BASE editor 2.0.

A prototype Digital Imagery Capture system was installed at the commencement of this survey which allowed digital images from the downward looking video to be captured.

B.1.1 Airborne System

The LADS Mk II Airborne System (AS) consists of a Dash 8-200 series aircraft which has a transit speed of 250 knots at altitudes of up to 25,000 feet and an endurance of up to eight hours. Survey operations are conducted from heights between 1,200 and 2,200 feet at ground speeds between 140 and 175 knots. The aircraft is fitted with a Nd: YAG laser which is eye safe in accordance with ANSI Z136.1-2000, American National Standard for Safe Use of Lasers. The laser operates at 900 Hertz from a stabilized platform to provide a number of different spot spacings.

Green laser pulses are scanned beneath the aircraft in a rectilinear pattern. The pulses are reflected from the land, sea surface, within the water column and from the seabed. The height of the aircraft is determined by the infra-red laser return, which is supplemented by the inertial height from the Attitude and Heading Reference System and GPS height. Real-time positioning is obtained by an Ashtech GG24 GPS receiver combined with Wide Area DGPS provided by the Fugro Omnistar to provide a differentially corrected position. Ashtech Z12 GPS receivers are also provided as part of the Airborne System and Ground Systems to log KGPS data on the aircraft and at a locally established GPS base station. For more details on the airborne system refer to the Data Acquisition and Processing Report*.

B.1.2 Ground System

The LADS Mk II Ground System (GS) 'Gandalf' was used to conduct data processing in the field. Gandalf consists of a portable Compaq Alpha ES40 Series 3 processor server with 1 GB EEC RAM, 764 GB disk space, digital linear tape (DLT) drives and magazines, digital audio tape (DAT) drive, CD ROM drive and is networked to up to 12 Compaq 1.5 GHz PCs and a HP 800ps Design Jet Plotter, printers and QC workstations. Gandalf was transported to the deployment site. Quality control checks and editing of the data were conducted on GS 'Katrina' in the Biloxi office. ***Filed with original field records.***

The GS supports survey planning, data processing, quality control and data export. The GS component also includes a KGPS base station, which provides independent post-processed position and height data. A comprehensive description of the GS is provided in the Data

Acquisition and Processing Report*. For more details on the Ground System refer to the Data Acquistion and Processing Report*.

B.2 QUALITY CONTROL

B.2.1 Data Density

The survey area was sounded at 4x4 meter laser spot spacing with main lines of sounding spaced at 80 meters, which provided the required 200% coverage. ***Concur.***

Through the survey area three crosslines were flown and the results of the crossline comparisons and the overlap show agreement within expected tolerances. ***Concur.***

At the sea surface the footprint of the laser beam is approximately 2.5 meters in diameter. As the beam passes through the water column it slowly diverges due to scattering. It should be noted that at 4x4 meter laser spot spacing there is a gap of between 1 to 1.5 meters between the illuminated area of adjacent soundings at the sea surface. There is a possibility that small objects in shallow water along the coastline may fall between consecutive 4x4 meter soundings and not be detected. ***Concur.***

B.2.2 Water Clarity

The water clarity in the survey area was ideal for laser bathymetry, with laser penetration. Water depths to 55 meters being achieved before the reef dropped off quickly. Consistent depths of 35-40 meters were achieved throughout the survey area. ***Concur.***

B.2.3 Uncertainty values

For this survey area, global horizontal and vertical uncertainties have been assigned based on the defined horizontal and vertical error budget as determined and stated in the Vertical and Horizontal Control Report*. The assigned horizontal uncertainty is 2.78 meters and the assigned vertical uncertainty is 0.4 meters. ***Concur.***

However when the calculated grid node standard deviation is greater than the assigned vertical uncertainty the standard deviation is used as the uncertainty value. This has occurred in areas of high relief such as the predominant reef existing in the south of the survey area. In some cases the standard deviation may exceed IHO order 1 limits. This could be attributed to the 3 meter grid resolution that has been used. ***Concur. *Filed with original field records.***

B.2.4 Data Management

The database is identified as follows:

Database Name	General Locality	Sheet(s)
06_3CaboRojo	Southwest Puerto Rico	A

A detailed table of survey line numbers is presented in the Data Acquisition and Processing Report*.

B.2.5 Data Acquisition

Survey operations were planned when suitable weather conditions prevailed. The first survey sortie was flown on April 9, 2006.

In general, the aircraft departed at 0700 hours local time, prior to the build up of thunderstorms in the early afternoon.

B.2.6 Sea Conditions - Sea State, Waves, Swell, White Water

The sea state ranged from 1 to 3 throughout the survey and was generally between states 1 and 2 as determined from the Beaufort Wind Scale. This did not affect data quality.

Calm seas were experienced on occasions in the sheltered bays along the west and south coasts. Depending on the wind direction, calm seas occurred inshore of exposed reefs as well. Under such calm conditions the sea may become glassy which degrades the sea surface model. Long period swell was not significant during the survey, however an allowance has been made in the assessment of accuracy.

B.2.7 Gaps and Features in the Data

The ground system supports interactive tagging of soundings by operators using S-57 compliant and user defined tags. These tags are used to identify gaps in the data due to environmental and man made features and also for features that it is deemed require further examination. For this survey area only two features were tagged, being the navigation buoys as described in D.1.7. There were no gaps tagged or features tagged that require further investigation.

B.2.8 Nature of the Seabed

The H11557 lidar survey area is located approximately 11 NM west of Punta Guaniquilla between approximate latitudes of 18° 10.94’ N and 17° 59.55’ N. **Concur.**

A coral reef exists in the south which is very undulating and is comprised of many coral outcrops before the reef drops off into deep water to the west. To the north and northeast of the reef the seabed is relatively flat until it drops off into deep water. **Concur.**

B.2.9 Topography

The LADS Mk II system can measure topographic heights up to 50 meters elevation, subject to the depth / topographic logging window selected. For this survey, a 20 meter topographic height logging window was selected. As a result, the coastline was surveyed and elevations up to 20 meters were measured. For this survey area there are no drying heights.

Filed with original field records.

B.2.10 Datums

Upon the completion of each flight the GPS data logged on the aircraft and at the base station was processed to determine the post-processed KGPS position and height of the aircraft. This data is used in the calculation of the sea surface datum.

B.2.11 Wind

Survey operations were conducted in wind strengths of up to 20 knots during the survey. In general, the wind strength during the time of survey was around 10 knots from the southwest.

During the morning the wind would increase slightly.

B.2.12 Cloud

Low cloud was not a significant factor for the survey. During the early afternoon the clouds would build up over land and move offshore. This increased towards the end of the survey. The effects of low cloud were managed as follows:

a. Limited weather forecasts were available for the actual survey area. Weather conditions were interpolated from generic weather internet sites and local media weather forecasts.
b. For long term trends the National Weather Service in San Juan provided information.
c. An internet site showed the current San Juan radar. This proved invaluable during the later part of the survey to monitor the movement of thunderstorms. This internet site is http://www.wundergroud.com/radar/.

B.2.13 Effects of High Ground

For this survey the high ground was not an issue and the majority of the survey lines were flown at 1,600 feet.

B.2.14 Receiver Gain

Changes in gain levels in the Airborne System automatically accommodate for changes in the sea surface, water column and seabed conditions. In some areas, after long over land passages, low gain levels were initially set on passing back over the water. Where this has been identified in the data these lines were reflown from the opposite direction to improve the coverage.

B.2.15 Raw Laser Waveforms

The raw laser waveforms in very complex areas, such as coral reefs, become dispersed and in such areas the bottom object detection algorithm in the GS was used to define the extents and least depth features.

In areas of turbidity the raw laser waveform is analyzed and the area defined as turbidity using GS gap tagging functions.

B.2.16 Data Processing

The data was processed at the operating site in San Juan on the return from each sortie. Final validation, checking, QC, approving and products were conducted in Biloxi, MS.

B.2.17 Progress Sketches

Progress sketches were provided to NOAA on a bi-weekly basis, copies of which can be found in Appendix III. ***Concur with clarification. Appendix III contains the final Progress Sketch.***

B.3 CORRECTIONS TO SOUNDINGS

Refer to the Data Acquisition and Processing Report* for a description of corrections to soundings, which demonstrates that corrections to the soundings were being applied correctly.

There were no deviations from the corrections described therein. ***Concur.***

B.4 DATA PROCESSING

One BASE Surface covers the entire survey area. A grid resolution of 3m was used for the BASE Surface. Grid resolution does not change relative to depth as the laser pulse spot size stays relatively constant regardless of depth. The 3m grid provides the greatest amount of detail that can be supported based on the data density.

B.5 DATA FORMATS

Data is provided in the following formats:

- Digital S-57 feature file. ***Concur.***
- Caris BASE surface. ***Concur.***
- Caris compatible data. LADS soundings and waveforms, which can be imported into Caris HIPS. ***Concur.***
- Tidal Data provided in ASCII, xls and CSV formats. ***Concur.***
- Digital georeferenced image in .tif format. ***Concur.***

Refer to the Data Acquisition and Processing Report* for specific details. ****Filed with original field records.***

B.6 BENCHMARKS

The depth benchmark areas were identified on the first survey sortie and two benchmark lines were planned. The benchmark areas were used to check the performance of the LADS Mk II system for the I305 project including this H11557 survey. These benchmarks were surveyed to check the ongoing LADS Mk II system accuracy.

The location of the benchmark lines and the position of the benchmark areas are detailed in the Separates. ***Concur.***

Either one or both benchmark lines were flown during each sortie. The total number of benchmarks compared during the survey was 86. Benchmark comparisons were conducted after the application of final verified tides. Comparison summaries are also provided in the Separates. ***Concur.***

The LADS data is compared against the gridded benchmark surface in the GS and statistics are generated which include the number of points compared, the mean depth difference (MDD) and the standard deviation (SD) between the data sets. The benchmark comparison function compares the data against the benchmark surface, and as this data is unedited it may contain noise normally removed during the validation process, which is flagged as the shoalest and deepest differences.

B.6.1 Mean Depth Differences (MDD) and Standard Deviation (SD)

The averages of the mean depth differences and standard deviation for each benchmark run are as follows:

Benchmarks on the first line

GS ID	BM Name	Nominal Depth	MDD	SD
1	BM_1	13 m	-0.02 +/- 0.05	0.09 +/- 0.02
2	BM_2	8 m	-0.13 +/- 0.10	0.09 +/- 0.01
3	BM_3	22 m	-0.08 +/- 0.07	0.09 +/- 0.01

Benchmarks on the second line

GS ID	BM Name	Nominal Depth	MDD	SD
4	BM_4	12 m	-0.11 +/- 0.09	0.10 +/- 0.01
5	BM_5	9 m	-0.03 +/- 0.05	0.09 +/- 0.01

These results are within expected tolerances and show that the LADS Mk II depth performance was within specifications.

B.7 CROSSLINES

Seven crosslines were planned to be used for the crossline comparisons. Areas were selected where common data existed and ideally where the seabed was reasonably flat. This minimizes the apparent differences in depths due to minor positional differences in steeper areas of seabed. ***Concur.***

Due to the teathered TARS balloon located on the southwest coast of Puerto Rico, the two planned lines in this area were not flown.

Three lines along the south coast were flown to obtain additional coverage and were used for crossline comparisons in this area.

The western end of three crosslines were sounded at 4x4 meter laser spot spacings throughout the H11557 survey area as follows:

Line 1001.0.1	56 crossline intersections.	Through the north of the sheet 11 NM West of Punta Guaniquilla
Line 1002.0.1	64 crossline intersections.	Through the middle of the sheet 11 NM West of Punta Guaniquilla
Line 1003.0.1	15 crossline intersections.	Through the south of the sheet 11 NM West of Punta Guaniquilla

B.7.1 Mean Depth Differences (MDD) and Standard Deviation (SD)

The averages of the mean depth differences and standard deviation for each crossline are as follows:

Run No.	Comparisons	Mean Confidence	*Average MDD*	*Average SD*
1001.0.1	84705	5.3	-0.01 +/- 0.06	0.09 +/- 0.02
1002.0.1	103356	5.8	-0.06 +/- 0.06	0.10+/- 0.03
1003.0.1	25618	6.3	-0.02 +/- 0.04	0.10 +/- 0.02

Crossline comparison details are provided in Appendix V of the Separates. ***Concur.***

All results are consistent with IHO Order-1 depth accuracy. ***Concur.***

B.8 POSITION CHECKS

Two independent positioning systems were used during the survey. Real-time positions were determined by autonomous GPS. A post-processed KGPS position was also determined relative to a local GPS base station that was established on the rooftop of the Courtyard Marriott Hotel in San Juan. The post-processed KGPS position solutions were applied to each sounding during post-processing and the height used in the datum filter.

Position checks were conducted prior to, during and following data collection as follows:

a. DGPS Site Confirmation. A 24-hour certification was conducted of the local GPS base station established on the roof of the Courtyard Marriott Hotel in San Juan. The results reveal that the local GPS base station is free from site specific problems such as multipath and obstructions.

b. Static Position Check. Prior to commencing data collection the coordinates of the aircraft GPS antenna were determined relative to four NGS-CORS Base Stations in the southeast Puerto Rico area. Data was then logged by each LADS Mk II positioning system enabling the positions to be checked against the known NGS-CORS control points. The accuracy of the post processed KGPS solution during the static position check was 0.133 meters (95% confidence). The results and details of the static position check are enclosed in the Vertical and Horizontal Control Report*.

c. Dynamic Position Check. During each sortie GPS data was logged on the aircraft and at the local GPS base station. This provided a check between the real-time and post-processed GPS position solutions. The mean difference between the real-time and post-processed position was 0.873 meters, with an average standard deviation of 0.206. Details are provided in the Vertical and Horizontal Control Report*.

d. Navigation Position Check. Navigation checks were also conducted over a coordinated point on the roof of the terminal at Mayaguez airport. This enabled the known position of the structure to be checked against the image on the downward looking video. This provided a gross error check of position. The mean error was 1.9 meters with a standard deviation of 3.62 meters. Details are provided in the Separates.

e. Position Confidence. The position quality was also monitored by checking a post-processed position confidence (C3), which is determined from the AS platform error, GPS error and residual errors between the actual GPS positions and aircraft position as determined from the line of best fit. No position anomalies were detected.

The position checks were within the expected tolerances and showed that the positioning systems were functioning correctly. ***Filed with original field records.***

C. VERTICAL AND HORIZONTAL CONTROL *See also Evaluation Report.*

Refer to the Vertical and Horizontal Control Report* for a detailed description of the vertical and horizontal control used during this survey. A summary of vertical and horizontal control for the survey follows.

C.1 VERTICAL CONTROL

Vertical control for the survey was based on the Mean Lower Low Water tidal datum (MLLW). The operating National Water Level Observation Network (NWLON) station at Magueyes Island (9759110) located at the eastern extent of the survey area served as preliminary vertical control. ***Concur.***

A subordinate tide station at Punta Guanajibo (9759421) located at the northern extent of the survey area was installed and operated for the duration of the survey. Upon completion of the survey the datum was established for the subordinate gauge and the final verified tides for both the subordinate and NWLON tide gauges provided the vertical control. ***Concur.***

Station details are as follows:

		WGS84	
Gauge	**Location**	**Latitude**	**Longitude**
9759110	Magueyes Island	17° 58.3' N	67° 02.8' W
9759421	Punta Guanajibo	18° 09.6’ N	67° 10.9’ W

C.2 ZONING

NOAA supplied tide zones that cover the extent of the survey area, with time and range correctors relative to the Magueyes Island tide station. ***Concur.*** These are as follows:

Tide Zone	GS Identifier	Time Corrector	Range Corrector	Reference Station
PRS15	1	-18 minutes	1.59	9759110
PRS14	2	-18 minutes	1.45	9759110
PRS13	3	-18 minutes	1.23	9759110
PRS12	4	-18 minutes	1.09	9759110
PRS11	5	-24 minutes	1.01	9759110
PRS10	6	-24 minutes	0.94	9759110
PRS9	7	-24 minutes	0.94	9759110
PRS9A	8	-18 minutes	0.94	9759110
PRS8	9	-6 minutes	0.94	9759110
PRS7	10	0 minutes	0.94	9759110

The proposed final tide zoning was computed once the datum for the subordinate tide gauge was established. The proposed final zoning is a combination of both the NWLON gauge in

Filed with original field records.

which the zoning in the southern part of the survey area was derived and the subordinate gauge, which provided zoning for the western part of the survey area. ***Concur.*** The proposed final zoning areas are as follows:

Tide Zone	GS Identifier	Time Corrector	Range Corrector	Reference Station
JOA14	1/2	0 minutes	x 1.00	9759421
JOA13	3	0 minutes	x 0.90	9759421
JOA12	4	0 minutes	x 0.85	9759421
JOA11	5	-6 minutes	x 0.81	9759421
JOA10	6	-6 minutes	x 0.77	9759421
JOA09	7	-24 minutes	x 0.94	9759110
JOA09A	8	-18 minutes	x 0.94	9759110
JOA08	9	-6 minutes	x 0.94	9759110
JOA07	10	0 minutes	x 0.94	9759110

An analysis of crosslines and overlaps of the mainlines of soundings concluded that tide zoning was adequate and therefore the proposed final tide zoning correctors have been considered to be the final zoning correctors for the survey. ***Concur.***

The verified tides supplied by NOAA were independently checked by John Oswald and Associates. Once the data was checked a fifth degree polynomial was applied to the tidal data and this data was then supplied to Tenix LADS Inc. for the application of tides. ***Concur.***

The preliminary tide zone areas were adopted as the final tide zone areas. The range and time correctors changed, as zones JOA10-JOA14 are relative to the subordinate tide station. ***Concur.***

For final processing, the time and amplitude correctors were applied to the tidal data delivered by John Oswald and Associates. Soundings were then reduced to MLLW using these corrected tides. ***Concur.***

The data was viewed across the zone boundaries which once again validated the final verified tides and zoning. ***Concur.***

C.3 HORIZONTAL CONTROL

Data collection and processing were conducted on the Airborne and Ground Systems in World Geodetic System (WGS84) on Universal Transverse Mercator (Northern Hemisphere) projection UTM (N) in Zone 19, Central Meridian 69° West. All units are in meters. This data was post-processed and all soundings are relative to the North American Datum 1983 (NAD83). ***Concur.***

C.3.1 LADS Local GPS Base Station – Puerto Rico

Real-time positions were determined using an Ashtech GG24 GPS receiver aided by Wide Area Differential GPS (WADGPS). A local GPS base station was coordinated by John Oswald and Associates on the roof of the Courtyard Marriott Hotel, San Juan on March 7, 2006.

The derived NAD83 coordinates for the local GPS base station, are:

NAD 83		**UTM (N) Zone 8**		
Latitude (N)	Longitude (W)	Easting (m)	Northing (m)	Ellipsoidal Height (m)
18° 27’ 20.277”	066° 04’ 56.271”	808 179.880	2 043 081.721	13.599

Post-processed KGPS positions were determined off-line using data logged at the local GPS base station and on the aircraft. This data was processed through Ashtech PNAV software to calculate both a DGPS and KGPS position solution. The post processed KGPS positions were then imported into the GS and applied to all soundings. This provided increased sounding position accuracy and horizontal redundancy.

The local GPS base station site was checked for obstructions and multipath over a 24 hour period on April 20 and April 21, 2006. The results outlined in the Vertical and Horizontal Control Report reveal that the local GPS base station site is free from site specific problems such as multipath and obstructions.

On April 12, 2006 static position checks of the LADS Mk II positioning systems were undertaken. The results outlined in the Vertical and Horizontal Control Report* revealed no gross errors and that all positioning systems functioned correctly.

During each sortie, GPS data was logged both on the aircraft and at the local GPS base station, which enabled a post-processed KGPS position solution to be determined. These positions were then compared to the position determined by the real-time positioning system. This dynamic positioning check provided quality control of the positioning systems and the positional differences were within tolerance for the survey. These differences are tabulated in the Vertical and Horizontal Control Report*.

Navigation position checks were attempted over the terminal at the Mayaguez airport during each sortie when suitable weather conditions prevailed. Following each sortie the logged aircraft position was processed against the downward looking video record to determine the difference in position at the time of overflight. This provided a gross error check on the aircraft positioning.

The tabulated results are presented in the Vertical and Horizontal Control Report* and revealed that the positioning systems functioned to within expectations. ***Filed with original field records.***

D. RESULTS AND RECOMMENDATIONS

Recommendations for charting action for registry number H11557 is provided in sections D.1.1 to D.1.8 below.

D.1 CHART COMPARISON – REGISTRY NUMBER H11557

H11557 was compared to:

ENC US4PR60M compiled from Raster Chart 25671, 18th Edition, updated application date March 2003, at scale 1:100,000, corrected through NM March 22, 2003 and LNM March 4, 2003.

This chart was downloaded from the NOAA Office of Coast Survey – NOAA Raster NavigationalCharts download website (http://chartmaker.ncd.noaa.gov/mcd/ENC/download.htm.) on February 10, 2006.

Recommendations for charting action are described in section D.1.2 Charted Depths and Features and in the Chart Comparison Spreadsheet under section D.1.5.

D.1.1 Dangers to Navigation

No dangers to navigation were reported. ***Concur.***

D.1.2 Charted Depths and Features

Survey H11557 covers part of NOAA ENC US4PR60M approximately 11NM west of Punta Guaniquilla. From the Source Diagram the area covered by the western part of survey area H11557 was covered by NOS surveys between 1970 and 1989, the inshore eastern part of the survey area was covered by NOS surveys between 1900 and 1939, presumably by leadline. Partial bottom coverage was achieved in both areas. The area surveyed is represented in considerably more detail than is currently shown on the chart. ***Concur.***

Some 66 significant differences between the chart and the survey have been identified. Specific recommendations for these differences are described in the chart comparison spreadsheet. An expanded version of the spreadsheet is included digitally with the survey report on the USB hard drive. The digital .xls version contains information that may be useful for planning of boat sounding and is easy to download into other survey packages (H11557_V1_chartcomp.xls). ***Concur.***

The chart comparison was conducted by reviewing the ENC, raster chart, BASE surface and the S-57 feature file. For each item identified, screen dumps of the Local Area Display and Raw Waveform Display were extracted from the LADS Mk II Ground System. These have been reviewed in order to make the following assessments:

a. Type of Feature

b. Further Examination Recommended

c. Charting Recommendation

d. Remarks

Each chart comparison was categorized as follows:

1. New shoal found
2. Charted shoal disproved / not found

The fields in the Chart Comparison Spreadsheet have been developed from experience learned and feedback received from previous lidar surveys in Alaska, witnessing survey operations in NOAA ship Rainier and from meetings at PHB and UNH. They have been designed for ease of use and to minimize double handling of data and transcription. Continued feedback is welcomed in order to develop these formats in order to achieve further efficiencies in data handling.

D.1.3 AWOIS

No AWOIS were assigned to this Task Order. ***Concur.***

D.1.4 Additional Boatwork Inside Lidar Area

No additional boat work was considered necessary within the extents of lidar coverage for this survey area. ***Concur.***

D.1.5 Chart Comparison Spreadsheet

			CHARTED			SURVEYED						
Sequence No	**Shoal No**	**Category**	**Charted Depth (meters)**	**NAD 83 Latitude N (DMS)**	**NAD 83 Longitude W (DMS)**	**Surveyed Depth (meters)**	**NAD 83 Latitude N (DMS)**	**NAD 83 Longitude W (DMS)**	**Type of Feature**	**Further Examination Recommended**	**Charting Recommendation**	**Remarks** **All items covered by 4x4m laser spot spacing at 200% lidar coverage.**
1	A1	1				11.8	18° 0' 14.6495"	67° 23' 0.3916"	Rk	N	Insert	Note: 11.8 Rk 225m ESE, 14.8 Rk 310m SW. ***Do not concur. Within rocky area. Chart sounding data.***
2	A2	1				12	18° 0' 23.625"	67° 23' 14.361"	Rk	N	Insert	Note: 13.8 Rk 240m S, 11.8 Rk 200m NW, 14.6 Rk 260m W. ***Do not concur. Within rocky area. Chart sounding data.***
3	A3	1				12.7	18° 0' 35.4294"	67° 22' 52.3862"	Rk	N	Insert	Note: 13.8 Rk 245m NNW, 13.6 Rk 340m NW, 12.9 Rk 450m NW. ***Do not concur. Within rocky area. Chart sounding data.***
4	A4	1				16.2	18° 1' 2.4132"	67° 23' 38.971"	Rk	N	Insert	Note: 16.3 Rk 175m NNW, 11.6 Rk 410m ENE. ***Do not concur. Within rocky area. Chart sounding data.***
5	A5	1				13.9	18° 1' 8.8061"	67° 22' 51.3894"	Rk	N	Insert	Note: 14.8 Rk 175m SSW, 15.9 Rk 360m SW, 15.5 Rk 145m WNW. ***Do not concur. Within rocky area. Chart sounding data.***
6	A6	2	18.2	18° 1' 18"	67° 22' 56"	16.5	18° 1' 19.3768"	67° 22' 56.0935"	Rk	N	Replace	Note: 15.9 Rk 200m W, 15.9 Rk 320m WNW. ***Do not concur. Within rocky area. Chart sounding data.***

Shoal Categories
1-New Shoal Found
2-Charted Shoal Disproved / Not Found

			CHARTED			SURVEYED						
Sequence No	Shoal No	Category	Charted Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)	Surveyed Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)	Type of Feature	Further Examination Recommended	Charting Recommendation	Remarks All items covered by 4x4m laser spot spacing at 200% lidar coverage.
7	A7	1				15.3	18° 1' 12.1361"	67° 23' 12.5218"	Rk	N	Insert	Note: 15.4 Rk 260m SE, 15.3 Rk 120m NNE. ***Do not concur. Within rocky area. Chart sounding data.***
8	A8	1				12.3	18° 1' 16.6444"	67° 23' 26.4772"	Rk	N	Insert	***Do not concur. Within rocky area. Chart sounding data.***
9	A9	1				16.5	18° 1' 15.6367"	67° 23' 42.346"	Rk	N	Insert	Note: 16.6 Rk 135m S, 16.1 Rk 195m N. ***Do not concur. Within rocky area. Chart sounding data.***
10	A10	1				15	18° 1' 38.1781"	67° 23' 48.8317"	Rk	N	Insert	Note: 16.3 Rk 280m SSE, 16.5 Rk 230m SE, 16.2 Rk 155m N, 15.2 Rk 345m NNW. ***Do not concur. Within rocky area. Chart sounding data.***
11	A11	1				10.9	18° 1' 36.0242"	67° 23' 21.7082"	Rk	N	Insert	Note: 11.0 Rk 190m W, 11.3 Rk 295m SW, 11.3 Rk 300m WNW, 11.6 Rk 300m SE. ***Do not concur. Within rocky area. Chart sounding data.***
12	A12	1				11.5	18° 1’ 43.078”	67° 23' 14.6003"	Rk	N	Insert	***Do not concur. Within rocky area. Chart sounding data.***
13	A13	1				14.6	18° 1' 57.306"	67° 23' 5.8283"	Rk	N	Insert	***Do not concur. Within rocky area. Chart sounding data.***
14	A14	1				15.3	18° 2' 38.2319"	67° 24' 12.7282"	Rk	N	Insert	Note: 16.0 Rk 400m SSE. ***Do not concur. Within rocky area. Chart sounding data.***

Shoal Categories
1-New Shoal Found
2-Charted Shoal Disproved / Not Found

			CHARTED			SURVEYED						
Sequence No	Shoal No	Category	Charted Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)	Surveyed Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)	Type of Feature	Further Examination Recommended	Charting Recommendation	Remarks All items covered by 4x4m laser spot spacing at 200% lidar coverage.
15	A15					11.7	18° 2' 9.4913"	67° 23' 31.0654"	Rk	N	Insert	Note: 12.7 Rk 190m SW. ***Do not concur. Within rocky area. Chart sounding data.***
16	A16	2	21.9	18° 2' 30"	67° 22' 57"	18.1	18° 2' 31.5136"	67° 23' 0.996"	Rk	N	Replace	Note: 19.7 Rk 270m SE. ***Do not concur. Within rocky area. Chart sounding data.***
17	A17	1				9.4	18° 2' 47.7218"	67° 23' 44.0131"	Rk	N	Insert	Note: 9.9 Rk 290m SW, 9.7 Rk 350m SE, 9.8 Rk 235m N. ***Do not concur. Within rocky area. Chart sounding data.***
18	A18	1				14.3	18° 3' 26.4676"	67° 24' 33.0466"	Rk	N	Insert	***Do not concur. Within rocky area. Chart sounding data.***
19	A19	1				10.3	18° 3' 3.586"	67° 23' 45.4229"	Rk	N	Insert	***Do not concur. Within rocky area. Chart sounding data.***
20	A20	2	23.7	18° 2' 53"	67° 24' 33"	20	18° 2' 50.2897"	67° 24' 29.3062"	Rk	N	Replace	***Do not concur. Within rocky area. Chart sounding data.***
21	A21	1				16.4	18° 2' 55.3042"	67° 24' 21.4852"	Rk	N	Insert	Note: 17.1 Rk 160m NNW, 18.0 Rk 190m S. ***Do not concur. Within rocky area. Chart sounding data.***
22	A22					10.2	18° 3' 25.1212"	67° 24' 7.3991"	Rk	N	Insert	Note: 11.0 Rk 350m W, 10.8 Rk 215m NW, 10.2 Rk 146m S. ***Do not concur. Within rocky area. Chart sounding data.***

Shoal Categories
1-New Shoal Found
2-Charted Shoal Disproved / Not Found

			CHARTED			SURVEYED						
Sequence No	Shoal No	Category	Charted Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)	Surveyed Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)	Type of Feature	Further Examination Recommended	Charting Recommendation	Remarks All items covered by 4x4m laser spot spacing at 200% lidar coverage.
23	A23	1				11	18° 3' 34.7069"	67° 24' 6.934"	Rk	N	Insert	Note:12.1 Rk 330m E, 11.5 Rk 250m N. ***Do not concur. Within rocky area. Chart sounding data.***
24	A24	1				14.9	18° 3' 45.8449"	67° 23' 41.6206"	Rk	N	Insert	Note; 16.2 Rk 260m SE, 16.3 Rk 270m NW, 15.0 Rk 230m W. ***Do not concur. Within rocky area. Chart sounding data.***
25	A25	2	20.1	18° 1' 18"	67° 22' 56"	18.5	18° 3' 24.8285"	67° 23' 15.878"	Rk	N	Replace	Note: 17.0 Rk 180m W, 16.8 Rk 320m WSW. ***Do not concur. Within rocky area. Chart sounding data.***
26	A26	1				16.7	18° 3' 38.3447"	67° 23' 29.3755"	Rk	N	Insert	***Do not concur. Within rocky area. Chart sounding data.***
27	A27	1				15.6	18° 4' 2.3081"	67° 23' 56.4608"	Rk	N	Insert	Note: 15.7 Rk 235m WSW, 15.3 Rk 210m SSW. ***Do not concur. Within rocky area. Chart sounding data.***
28	A28	2	20.1	18° 4' 10"	67° 24' 2"	17.2	18° 4' 8.4778"	67° 24' 2.1913"	Rk	N	Replace	Note: 15.8 Rk 250m W. ***Do not concur. Within rocky area. Chart sounding data.***
29	A29	1				12.7	18° 3' 51.2201"	67° 24' 38.7356"	Rk	N	Insert	Note: 11.6 Rk 250m ENE, 14.1 Rk 250m WNW. ***Do not concur. Within rocky area. Chart sounding data.***
30	A30					16.3	18° 3' 42.696"	67° 24' 47.2748"	Rk	N	Insert	***Do not concur. Within rocky area. Chart sounding data.***

Shoal Categories
1-New Shoal Found
2-Charted Shoal Disproved / Not Found

			CHARTED			SURVEYED						
Sequence No	Shoal No	Category	Charted Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)	Surveyed Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)	Type of Feature	Further Examination Recommended	Charting Recommendation	Remarks All items covered by 4x4m laser spot spacing at 200% lidar coverage.
31	A31	2	20.1	18° 3' 58"	67° 25' 2"	16.9	18° 3' 59.0047"	67° 24' 59.4788"	Rk	N	Replace	Note: 15.1 Rk 140m NNW.1 ***Do not concur. Within rocky area. Chart sounding data.***
32	A32	1				13.2	18° 4' 4.237"	67° 24' 54.4547"	Rk	N	Insert	Note: 13.5 Rk 125m NW. ***Do not concur. Within rocky area. Chart sounding data.***
33	A33	1				26.2	18° 4' 3.4972"	67° 25' 18.2284"	Rk	N	Insert	***Do not concur. Within rocky area. Chart sounding data.***
34	A34	2	21.9	18° 4' 22"	67° 25' 17"	17	18° 4' 23.4671"	67° 25' 14.3288"	Rk	N	Replace	Note: 19.1 Rk 225m SSE, 12.9 Rk 400m ESE. ***Do not concur. Within rocky area. Chart sounding data.***
35	A35	1				12.3	18° 4' 10.0229"	67° 24' 40.887"	Rk	N	Insert	Note: 12.4 Rk 245m NW. ***Do not concur. Within rocky area. Chart sounding data.***
36	A36	1				16.5	18° 4' 32.7918"	67° 24' 4.5004"	Rk	N	Insert	Note: 16.9 Rk 110m S. ***Do not concur. Within rocky area. Chart sounding data.***
37	A37	1				13.8	18° 4' 35.9191"	67° 24' 22.621"	Rk	N	Insert	Note: 13.9 Rk 290m SSW, 14.5 Rk 90m NW. ***Do not concur. Within rocky area. Chart sounding data.***
38	A38	1				11.4	18° 4' 35.8604"	67° 24' 43.7508"	Rk	N	Insert	Note: 13.1 Rk 300m NNE. ***Do not concur. Within rocky area. Chart sounding data.***

Shoal Categories
1-New Shoal Found
2-Charted Shoal Disproved / Not Found

			CHARTED			SURVEYED						
Sequence No	Shoal No	Category	Charted Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)	Surveyed Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)	Type of Feature	Further Examination Recommended	Charting Recommendation	Remarks All items covered by 4x4m laser spot spacing at 200% lidar coverage.
39	A39	1				11.9	18° 4' 43.325"	67° 25' 13.1585"	Rk	N	Insert	Note: 13.4 Rk 300m SSE, 12.0 Rk 240m E. ***Do not concur. Within rocky area. Chart sounding data.***
40	A40	1				28.6	18° 4' 50.6611"	67° 25' 39.1861"	Rk	N	Insert	***Do not concur. Within rocky area. Chart sounding data.***
41	A41	1				28.6	18° 5' 1.4521"	67° 25' 51.3703"	Rk	N	Insert	Note: 29.0 Rk 225m N. ***Do not concur. Within rocky area. Chart sounding data.***
42	A42	1				10.2	18° 4' 59.822"	67° 25' 12.886"	Rk	N	Insert	***Do not concur. Within rocky area. Chart sounding data.***
43	A43	2	16.4	18° 5' 13"	67° 24' 44"	14.7	18° 5' 13.151"	67° 24' 47.5153"	Rk	N	Replace	Note: 13.6 Rk 300m S. ***Do not concur. Within rocky area. Chart sounding data.***
44	A44	1				14.7	18° 4' 45.2953"	67° 24' 15.2532"	Rk	N	Insert	Note: 14.9 Rk 330m NW. ***Do not concur. Within rocky area. Chart sounding data.***
45	A45	1				14.8	18° 4' 56.6641"	67° 24' 22.6868"	Rk	N	Insert	Note: 14.8 Rk 400m NNW. ***Do not concur. Within rocky area. Chart sounding data.***
46	A46	1				15.3	18° 5' 21.2438"	67° 24' 35.3394"	Rk	N	Insert	Note: 15.8 Rk 480m ESE. ***Do not concur. Within rocky area. Chart sounding data.***

Shoal Categories
1-New Shoal Found
2-Charted Shoal Disproved / Not Found

			CHARTED			SURVEYED						
Sequence No	Shoal No	Category	Charted Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)	Surveyed Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)	Type of Feature	Further Examination Recommended	Charting Recommendation	Remarks All items covered by 4x4m laser spot spacing at 200% lidar coverage.
47	A47	1				15.1	18° 5' 27.6119"	67° 25' 3.0558"	Rk	N	Insert	Note: 15.2 Rk 375m ENE, 15.9 Rk 110m SE. ***Do not concur. Within rocky area. Chart sounding data.***
48	A48	1				11.7	18° 5' 23.3358"	67° 25' 25.7974"	Rk	N	Insert	***Do not concur. Within rocky area. Chart sounding data.***
49	A49	1				30.8	18° 5' 24.5159"	67° 25' 57.045"	Rk	N	Insert	Note: 32.0 Rk 310m S. ***Do not concur. Within rocky area. Chart sounding data.***
50	A50	2	35	18° 5' 38"	67° 25' 42"	17.7	18° 5' 40.5182"	67° 25' 38.1553"	Slope	N	Remove	***Concur.***
51	A51	1				13.9	18° 5' 43.1898"	67° 25' 25.0525"	Rk	N	Insert	Note: 12.5 Rk 390m SE. ***Do not concur. Within rocky area. Chart sounding data.***
52	A52	1				14.9	18° 5' 43.7078"	67° 25' 1.3908"	Rk	N	Insert	Note: 14.8 Rk 190m E. ***Do not concur. Within rocky area. Chart sounding data.***
53	A53	1				16.8	18° 5' 44.057"	67° 24' 26.0762"	Rk	N	Insert	Note: 16.6 Rk 440m SE. ***Do not concur. Within rocky area. Chart sounding data.***
54	A54	1				16.2	18° 6' 1.66"	67° 24' 35.325"	Rk	N	Insert	Note: 16.4 Rk 500m NW. ***Do not concur. Within rocky area. Chart sounding data.***
55	A55	1				12.7	18° 6' 6.2993"	67° 25' 27.7817"	Rk	N	Insert	Note: 13.2 Rk 340m E, 14.7 Rk 365m NE. ***Do not concur. Within rocky area.***

Shoal Categories
1-New Shoal Found
2-Charted Shoal Disproved / Not Found

			CHARTED			SURVEYED						
Sequence No	Shoal No	Category	Charted Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)	Surveyed Depth (meters)	NAD 83 Latitude N (DMS)	NAD 83 Longitude W (DMS)	Type of Feature	Further Examination Recommended	Charting Recommendation	Remarks All items covered by 4x4m laser spot spacing at 200% lidar coverage.
												Chart sounding data.
56	A56	1				27.1	18° 5' 47.7406"	67° 25' 59.552"	Rk	N	Insert	Note: 29.2 Rk 350m N. ***Do not concur. Within rocky area. Chart sounding data.***
57	A57	1				17.4	18° 6' 26.2915"	67° 25' 5.3684"	Rk	N	Insert	Note: 17.2 Rk m SE. ***Do not concur. Within rocky area. Chart sounding data.***
58	A58	1				21.6	18° 6' 46.2661"	67° 25' 16.181"	Rk	N	Insert	***Do not concur. Insignificant.***
59	A59	1				20.6	18° 6' 57.5248"	67° 24' 50.1678"	Rk	N	Insert	***Do not concur. Insignificant.***
60	A60	1				25.4	18° 8' 16.9609"	67° 25' 8.72"	Rk	N	Insert	Note: 25.7 Rk 330m S, 25.6 Rk 340m NNW. ***Do not concur. Within rocky area. Chart sounding data.***
61	A61	2	27.4	18° 8' 43"	67° 25' 7"	24.9	18° 8' 43.606"	67° 25' 2.6414"	Rk	N	Replace	Note: 24.9 Rk 320m ENE. ***Do not concur. Within rocky area. Chart sounding data.***
62	A62	1				20	18° 8' 48.8771"	67° 24' 25.9589"	Rk	N	Insert	Note: 22.1 Rk 330m S. ***Do not concur. Within rocky area. Chart sounding data.***
63	A63	1				22.5	18° 8' 27.11"	67° 24' 29.952"	Rk	N	Insert	***Do not concur. Within rocky area. Chart sounding data.***
64	A64	1				19.4	18° 8' 40.7101"	67° 23' 7.3129"	Rk	N	Insert	***Do not concur. Insignificant.***
65	A65	1				19.5	18° 8' 52.6067"	67° 23' 24.7729"	Rk	N	Insert	***Do not concur. Insignificant.***

Shoal Categories
1-New Shoal Found
2-Charted Shoal Disproved / Not Found

			CHARTED			SURVEYED						
Sequence No	**Shoal No**	**Category**	**Charted Depth (meters)**	**NAD 83 Latitude N (DMS)**	**NAD 83 Longitude W (DMS)**	**Surveyed Depth (meters)**	**NAD 83 Latitude N (DMS)**	**NAD 83 Longitude W (DMS)**	**Type of Feature**	**Further Examination Recommended**	**Charting Recommendation**	**Remarks** **All items covered by 4x4m laser spot spacing at 200% lidar coverage.**
66	A66	1				22.9	18° 6' 12.7865"	67° 23' 39.7748"	Rk	N	Insert	***Do not concur. Insignificant.***

D.1.6 Features Requiring Investigation

No features requiring further investigation were identified for this survey. ***Concur.***

D.1.7 Aid To Navigation

During the survey two navigation aids were detected by lidar for H11557. ***Concur.*** These two navigational aids have been identified from the published light list, 'Atlantic and Gulf Coasts', Volume 111, 2006, which includes Puerto Rico. The published positions are as follows:

Light List Number	Name	Latitude (N)	Longitude (W)
32305	Canal de la Mona East Shoal Lighted Buoy 4	18° 00' 24"	67° 23' 00"
32310	Canal de la Mona East Shoal Lighted Buoy 6	18° 05' 18"	67° 25' 24"

Each buoy was detected 5 times on two different survey lines and the mean position of the buoys was determined.

Number	Line	Easting	Northing	Depth
32305	884.0.1	671 117	1 991 630	-4.3
		671 114	1 991 633	-4.5
		671 117	1 991 633	-3.7
	885.0.1	671 120	1 991 649	-3.9
		671 115	1 991 648	-4.1
	Mean	**671 117**	**1 991 639**	

Mean surveyed postion: 18° 00' 23.01" N, 67° 23' 01.35" W

Number	Line	Easting	Northing	Depth
32310	831.0.1	666 831	2 000 679	-3.9
		666 835	2 000 679	-4.1
		666 834	2 000683	-4.0
	832.0.1	666 824	2 000 672	-3.9
		666 823	2 000 676	-4.6
	Mean	**666 829**	**2 000 672**	

Mean surveyed position: 18° 05' 18.03" N, 67° 25' 24.51" W

It should be noted that the buoys were not necessarily surveyed on both the flood and ebb streams. No charting recommendations have been made.

D.1.8 Recommended Overlap With Lidar Data

The recommended overlap by surface vessels for smooth sheet H11557 is to seaward of the data coverage polygon defined by S-57 object M_COVR, CATCOV = 1.

E. APPROVAL SHEET

LETTER OF APPROVAL – OPR-I305-KRL-06

This report and the accompanying digital data are respectfully submitted.

Field operations contributing to the accomplishment of this survey were conducted under my direct supervision with frequent personal checks of progress and adequacy. This report and the accompanying digital data have been closely reviewed and are considered complete and adequate as per the Statement of Work.

Report	Submission Date
Descriptive Report – H11557	January 23, 2007

Mark Sinclair
Hydrographer
Tenix LADS Incorporated

Date: January 23, 2007

APPENDIX I – DANGERS TO NAVIGATION

No dangers to navigation were reported for this survey.

APPENDIX II – LIST OF GEOGRAPHIC NAMES

Geographical names were not checked during the survey, and no amendments are proposed.

APPENDIX III – PROGRESS SKETCH

PROGRESS SKETCH

15 May 2006

OPR-I305-KRL-06

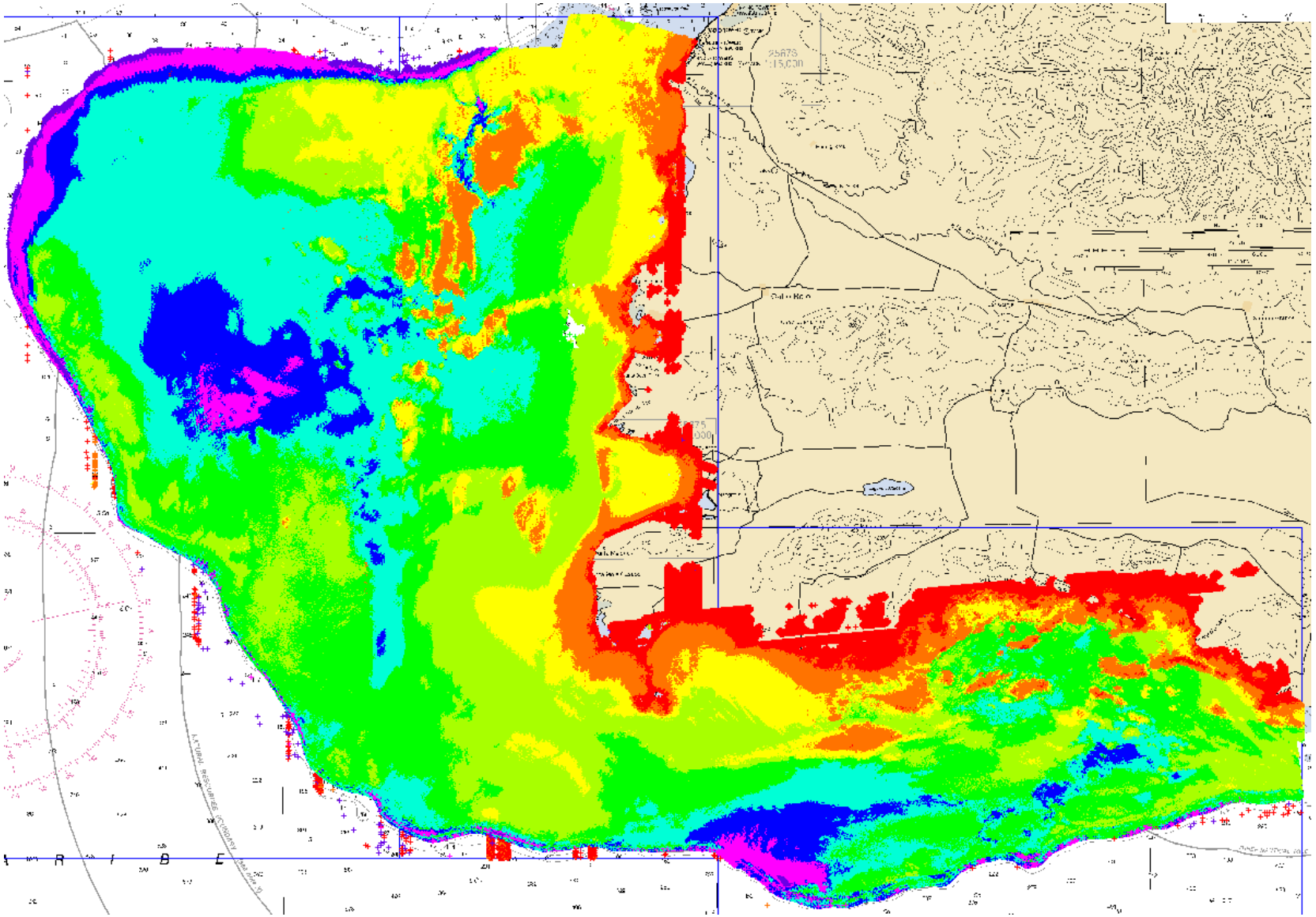
Puerto Rico
Tenix LADS Inc.
Darren Stephenson, Lead Hydrographer

Deployed to the field on April 07, 2006 and conducted the first survey sortie on April 09, 2006.

This status is of May 15, 2006 after 21 survey flights and the status includes an additional area to the west covered by the modification 1 to this task order T0008.

The area covered is 265SNM at 200% coverage.

	April	May	Total	Total Planned	% Complete
Days on project	22	15	37	36	
Line – nm - flown	7023.16	1264.44	8287.60	7581.26	109.3
Aircraft flown hours	111.1	23.0	134.1		
Aircraft on task hours	85.0	17.3	102.3		
Days with flight	17	4	21	23	91.3
No flight due to weather	0	0	0		
No flight due to system	0	0	0		
No flight due to aircraft	0	8	8		
Hours lost to weather	1.5		1.5		
Hours lost to system	2.5	1	3.5		


L I B E

APPENDIX IV – TIDES AND WATER LEVELS

Abstract of Times of Hydrography

Start and End times refer to tidal applications requirement.

Time on Task indicates actual time of task in the survey area. All times and dates are in UTC.

06_3caborojo

Date Flown	JD	Sortie No	Start Time	End Time	Time on Task
April-09-06	99	1	12:30	18:24	5:54
April-10-06	100	2	12:00	19:00	7:00
April-11-06	101	3	10:30	18:30	8:00
April-12-06	102	4	11:00	18:30	8:30
April-13-06	103	5	9:00	15:00	6:00
April-15-06	105	6	9:00	17:30	8:30
April-17-06	107	7	8:00	19:00	11:00
April-18-06	108	8	9:30	18:00	8:30
April-19-06	109	9	9:30	17:30	8:00
April-20-06	110	10	10:00	16:30	6:30
April-22-06	112	11	10:00	18:00	8:00
April-24-06	114	12	10:00	18:30	8:30
April-25-06	115	13	9:30	18:00	8:30
April-26-06	116	14	9:30	17:30	8:00
April-28-06	118	16	10:00	17:30	7:30
April-29-06	119	17	10:00	18:00	8:00
April-30-06	120	18	10:00	18:00	8:00
May-10-06	130	19	9:30	17:30	8:00
May-11-06	131	20	14:30	20:30	6:00

Abstract Times of Hydrography Continued

May-12-06	132	21	13:30	20:00	6:30
May-13-06	133	22	9:00	16:00	7:00

Magueyes Island, PR

Magueyes Island, PR: Data Inventory

Station ID: 9759110

Page Help

Datums

Click HERE for printable version

Data Units:

Feet Meters Apply Change

Nov 8 2006 12:49 ELEVATIONS ON STATION DATUM
National Ocean Service (NOAA)

Station: 9759110 T.M.: 0
W
Name: MAGUEYES ISLAND, CARIBBEAN SEA, PR Units:
Meters
Status: Accepted Epoch: 1983-
2001

Datum	Value	Description
MHHW	1.294	Mean Higher-High Water
MHW	1.292	Mean High Water
DTL	1.192	Mean Diurnal Tide Level
MTL	1.193	Mean Tide Level
MSL	1.191	Mean Sea Level
MLW	1.094	Mean Low Water
MLLW	1.091	Mean Lower-Low Water
GT	0.204	Great Diurnal Range
MN	0.198	Mean Range of Tide
DHQ	0.003	Mean Diurnal High Water Inequality
DLQ	0.003	Mean Diurnal Low Water Inequality
HWI		Greenwich High Water Interval (in Hours)
LWI		Greenwich Low Water Interval (in Hours)
NAVD		North American Vertical Datum
Maximum	1.781	Highest Water Level on Station Datum
Max Date	19980922	Date Of Highest Water Level
Max Time	05:48	Time Of Highest Water Level
Minimum	0.823	Lowest Water Level on Station Datum
Min Date	19680611	Date Of Lowest Water Level
Min Time	11:30	Time Of Lowest Water Level

To refer Water Level Heights to a Tidal Datum, apply the desired Datum Value.

Click HERE for further station information including New Epoch products.

T I D A L D A T U M S

Tidal datums at MAGUEYES ISLAND, CARIBBEAN SEA based on:

LENGTH OF SERIES:	19 Years
TIME PERIOD:	January 1983 - December 2001
TIDAL EPOCH:	1983-2001
CONTROL TIDE STATION:	

Elevations of tidal datums referred to Mean Lower Low Water (MLLW), in METERS:

HIGHEST OBSERVED WATER LEVEL (09/22/1998)	= 0.690
MEAN HIGHER HIGH WATER (MHHW)	= 0.204
MEAN HIGH WATER (MHW)	= 0.201
MEAN TIDE LEVEL (MTL)	= 0.102
MEAN SEA LEVEL (MSL)	= 0.101
MEAN LOW WATER (MLW)	= 0.003
MEAN LOWER LOW WATER (MLLW)	= 0.000
LOWEST OBSERVED WATER LEVEL (06/11/1968)	= -0.268

National Geodetic Vertical Datum (NGVD 29)

Bench Mark Elevation Information In METERS above:

Stamping or Designation	MLLW	MHW
TIDAL BM NO 1 CAMA UPR 1955 ELEV	3.664	3.463
TIDAL BM NO 2 CAMA UPR 1955 ELEV	6.959	6.758
TIDAL BM NO 3 CAMA UPR 1955 ELEV	10.246	10.045
9110 B 1980	3.183	2.982
9110 D 1980	0.671	0.470
9110 E 1980	0.937	0.736
9110 F 1982	1.746	1.545
9110 G 1982	3.244	3.042
9110 H 1998	3.019	2.818
975 9110 J 2000	1.424	1.223

Tide Station Report

Punta Guanajibo, Puerto Rico 975-9421

Position (NAD83):	18° 09' 36"	67° 10' 53"	Time Meridian = 0° (UTC)
Owner:	Dept. de Recursos Naturales y Ambientales Laboratoria de Investigaciones Pesqueras Aida Rosario Jimenez (Director) Juan De La Cruz Rasado Cruz (Admin. Dir)		P.O. Box 3665 (mailing) Mayaguez Puerto Rico, 00681 office: (787) 833-2025
Established:	March 14, 2006		Removed: June 1, 2006
Type of station:	Tertiary		Density Observations: Yes
Prime Contractor:	Tenix LADS Inc.		Darren Stephenson, project mgr.
Tides Consultant:	John Oswald & Assoc, Anchorage, AK.		John Oswald, PLS, project mgr.
Project Numbers:	OPR-I305-KRL-2006		JOA WO No: 81
To Reach:	To reach the tide station by vehicle from the junction of Route 2 and Route 63 located about 1.6 km (1.0 mile) SW of the center of Mayaguez, proceed west on Route 63 (Avenida William C. Dunscombe) for 0.5 km (0.3 mile) to a T-intersection with Route 102, turn left on Route 102 and proceed southerly following the coast for 4.5 km (2.8 miles) to the top of a hill, continue down the hill for 0.40 km (0.25 miles) to a reverse turn on the right at the bottom of the hill, turn right on this reverse turn and proceed NWly for 0.32 km (0.20 mile) on a paved road to the security gate and guard shack. Check in with the guard to get access to the Fisheries Research property. The tide station, dock and all bench marks are inside this fenced and secured area.		
Tide House:	Established two digital bubbler tide gauges and the electronics for a radar tide gauge in 4' by 4' by 2' wood shed at the south end of a wooden dock. This dock is in poor condition, and is about 3 meters wide and 30 meters long, with a plank wood deck supported by concrete filled PVC and wood pilings. The radar gauge sensor was suspended off the damaged end of the dock, with wood and unistrut brackets. Orifices were mounted on the end of 3/4 " iron pipe attached to treated 4 by 6 timbers. These orifice boards were in turn, banded to separate concrete filled PVC pilings about 25 meters from the shore.		
Tide Gauge(s):	Three gauges: Two digital bubblers: Design Analysis (DAA) H350XL, with H355 pump, and H222 (Signal Engineering) GOES radios, with Yagi antennas. One DAA H360 Radar gauge interfaced to a DAA H350XL DCP and H222 Goes Radio with Yagi Antenna. Bubbler range is 0 >30 psi, and the radar gauge range is 0.3 > 22 m. Gauge #1 (Bubbler) H350XL S/N: 1042, Gauge #2 (Bubbler) H350XL S/N 1039, Gauge #3 (Radar) H360 S/N 1288 with H350XL S/N 1043. Two 12vdc batteries run each system are charged by individual 20 watt solar cells. GPS modules provide time syncing.		
Tide Staff	A 1.25 meter fiberglass survey rod, graduated in centimeters from 2.79 to 4.04 meters, was bolted to a 2" x 6" board which was banded to a dock piling about 15 meters from shore. A stilling well with orange float was placed next to the graduations. The tide staff was leveled directly into the primary bench mark (BM 1 1975). The base of the radar gauge was also directly leveled into the PBM.		
GPS Tie:	Static L1/L2 GPS observations made on bench mark 975 9421 A.		
Tidal Bench Marks:	4 recovered Tidal 1, Tidal 3, Tidal 4, Tidal 5	1 established 975 9421 A	Primary Bench Mark: 975 9421 Tidal 1 (975 9421 Tidal 2 searched for, not found)
Third Order Leveling:	Initial: March 13-14, 2006		Closeout: May 31, 2006

APPENDIX V – SUPPLEMENTAL SURVEY RECORDS AND CORRESPONDENCE

No supplemental survey records or correspondence is included in Appendix V.

APPENDIX VI – AWOIS

No AWOIS were assigned to this task order.

ATLANTIC HYDROGRAPHIC BRANCH
EVALUATION REPORT to ACCOMPANY
SURVEY H11557 (2006)

This Evaluation Report has been written to supplement and/or clarify the original Descriptive Report. Sections in this report refer to the corresponding sections of the Descriptive Report.

A. AREA SURVEYED

No changes from DR. However, the area chosen for compilation is a subset of the area surveyed. See below for more information.

B. DATA ACQUISITION AND PROCESSING

B.1 DATA PROCESSING

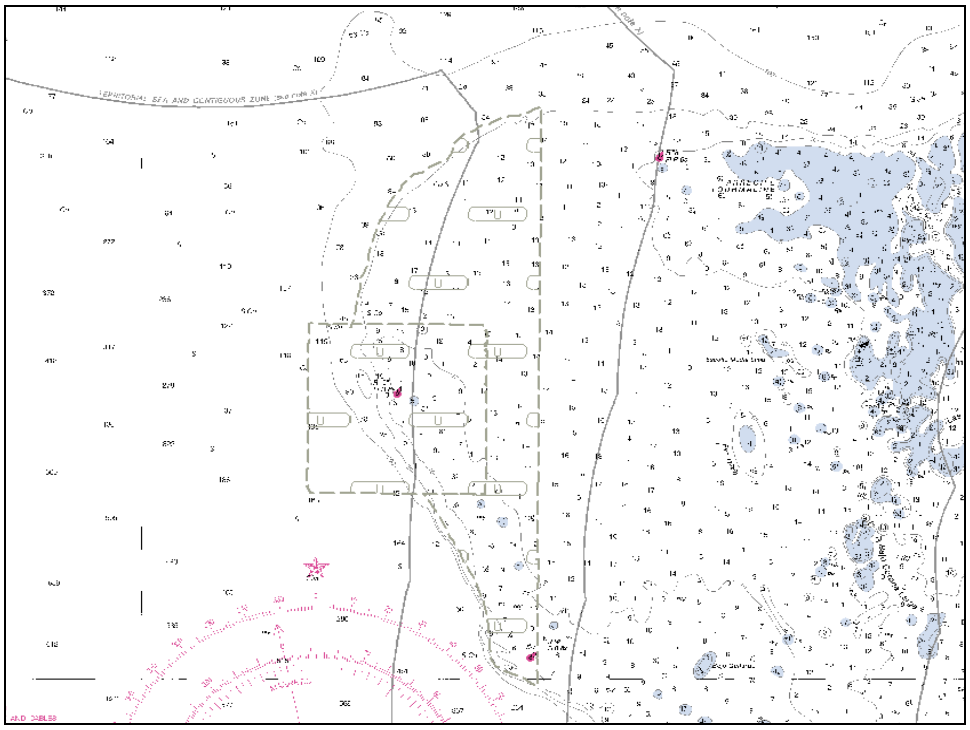
The following software was used to process data at the Atlantic Hydrographic Branch:

CARIS HIPS/SIPS version 6.1 SP2
CARIS Bathy Manager version 2.1 SP1
DKART INSPECTOR, version 5.0 Build 732 SP1
CARIS HOM version 3.3
CARIS S57 Composer version 2.0

B.2. QUALITY CONTROL

B.2.1. H-Cell

As shown in the screen capture below, H11557 shares a significant overlap with *NOAA Ship Nancy Foster* 2007 survey W00183, which has already been compiled. W00183 is a complete multibeam survey, and is more recent than H11557, hence it was decided that soundings from H11557 should not supersede those from W00183.



The Meta layers and soundings for H11557 were edited to exclude that portion encompassed by W00183. The rocky SBDARE however, is recommended to be retained for compilation, though it extends significantly within the bounds of W00183 (see below).

The final product from the review of H11557 was a 3 meter resolution surface. The shoal layer was extracted from this surface and the depth layer regenerated from the shoal layer. The resultant surface was used for chart compilation.

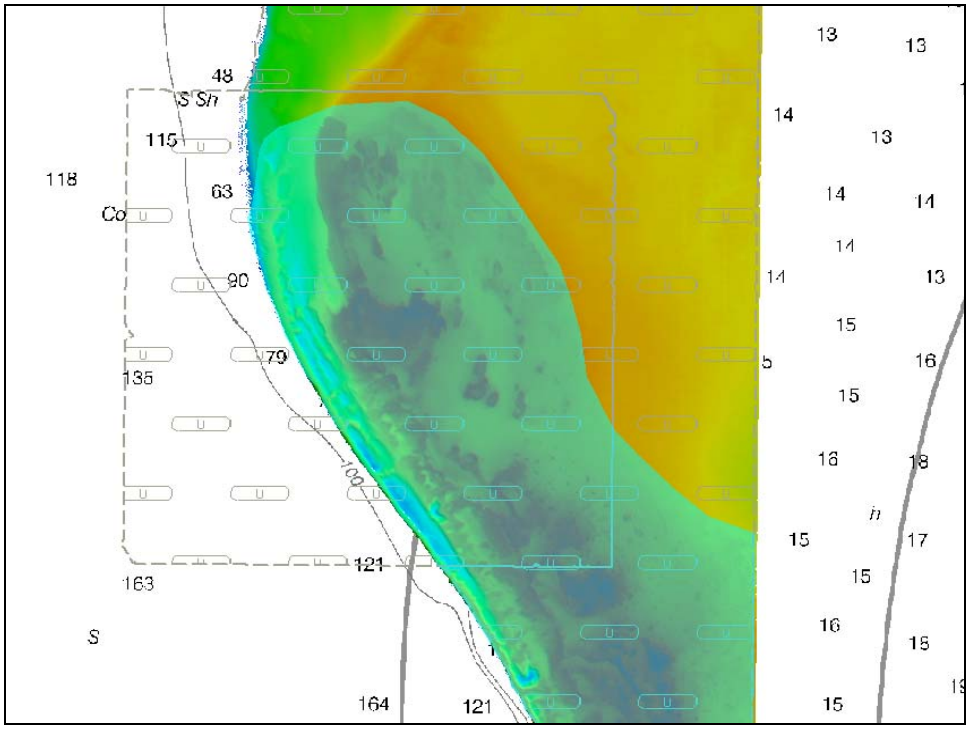
The surface was generalized into a product surface with a 5 meter resolution. The sounding selection was created from this product surface using a 50 meter radius. A filter was applied to exclude the generalized soundings. An interpolated surface was created from the sounding selection with a 100 meter radius in order to create depth contours. The interpolated surface was then shifted by -0.229 for contours of 10 fathoms or less, and -1.372 for contours greater than 10 fathoms.

The initial chart sounding selection was created by automated means. Another surface was interpolated from the dense sounding selection, with a 20 meter resolution. The chart sounding selection was created from this surface with a 700 meter radius to correlate with chart 25671 (1:100,000). Interpolated soundings were excluded from selection to ensure the selected soundings are a subset of the dense sounding set. This initial chart sounding set was then manually edited, with special attention to the rocky areas and association with soundings from previously compiled junction surveys.

The Meta layers submitted by the field unit were edited on the eastern edge such that the border aligns with H11558, and on the western edge such that the border excludes the areas where lidar bathymetric coverage was not achieved. In addition, the Meta layers were edited accordingly to exclude the area encompassed by W00183, as described above.

Bottom samples were not obtained in this survey, hence the SBDARE point objects were imported from the ENC. However, two rocky SBDARE area objects were

established from careful examination of the bathymetry. One of the rocky areas overlaps with junction survey H11558, thus its bounds were delineated to align with the existing rocky area in H11558. This rocky SBDARE also extends into the area encompassed by W00183. During the compilation of W00183, this area was not designated as a rocky area. In keeping with the methodology of designating rocky areas already practiced during the compilation of the series of Tenix Lidar Puerto Rico surveys, it is now recommended that this area be designated as rocky. The screen capture below shows the recommended rocky SBDARE, and the overlap with W00183.



Several rocks were included in the field unit-submitted feature file. The majority of these rocks lie within the bounds of the designated rocky area. These rocks are not included for compilation and are represented with chart soundings. Outside of the rocky areas, all the submitted rocks were deep enough to be considered insignificant for charting and are represented adequately with chart soundings. Thus, no rocks are recommended for charting in this survey.

The pre-compilation components included the dense sounding selection and the chart sounding selection (SOUNDG), features (DEPARE, DEPCNT, SBDARE), cartographic blue notes ($CSYMB), and Meta objects (M_COVR, M_QUAL). With the exception of the dense sounding selection and depth contours, all of the other pre-compilation components listed above were inserted into one feature layer, and this layer was exported into S-57 format in order to create the H-Cell deliverable. The dense sounding selection and depth contours were exported into S-57 format separately, and then both S-57 files were processed in Caris HOM to convert the metric units to fathoms and feet. The final products are two S-57 files, one that contains the chart soundings, the features, Meta objects, and blue notes (H11557_CS.000) and one that contains the dense sounding selection and contours (H11557_SS.000). Finally, quality assurance checks

were made utilizing both DKART Inspector version 5.0 and Caris S-57 Composer version 2.0 validation checks.

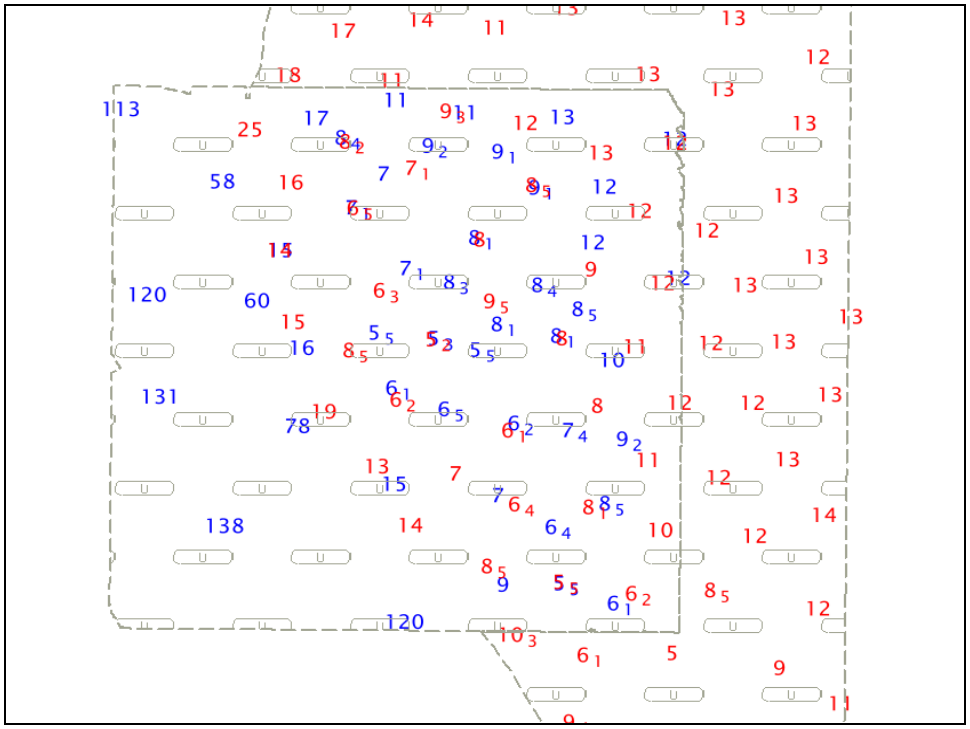
The H11557 CARIS H-Cell final deliverables include the following products:

H11557_CS.000	**1:100,000 Scale**	**H11557 H-Cell with Chart Scale Selected Soundings**
H11557_SS.000	**1:10,000 Scale**	**H11557 Selected Soundings (Survey Scale)**

B.22. Junctions

H11557 junctions with H11558 to the northeast and H11559 to the southeast. Soundings compare favorably with previously compiled survey H11558. When H11559 is compiled, another sounding comparison will be in order. These two junction surveys are fellow 2006 Tenix LADS.

As mentioned above, H11557 shares significant overlap with *NOAA Ship Nancy Foster* 2007 survey W00183, which has already been compiled. The soundings compare favorably, in similar locations usually a 1-2 feet difference is noted. The screen capture below shows the chart sounding selections (fathoms and feet) for H11557 (red font) and W00183 (blue font).



Because W00183 is complete multibeam and more recent than H11557, it was decided the soundings for H11557 would not supersede W00183.

The final junction survey is another *NOAA Ship Nancy Foster* survey, H11808. This is a complete multibeam survey from 2008 that has yet to be compiled. When this survey undergoes compilation, it will be compared to H11557 and compiled accordingly.

C. VERTICAL AND HORIZONTAL CONTROL

Final corrections were applied by the field unit and no other tidal corrections were required.

D. RESULTS AND RECOMMENDATIONS

D.1 CHART COMPARISON — 25671 (18th Edition, 03/01/2003)

Corrected through NM 02/14/2009
Corrected through LNM 02/10/2009
Scale 1:100,000

ENC Comparison — US4PR60M

West Coast of Puerto Rico
Edition 6
Application Date 2007-10-22
Issue Date 2007-10-22
Chart 25671

D.1.1 Hydrography

The hydrographer makes adequate chart comparisons in section D of the Descriptive Report, which included AHB verification notes. Also see the attached spreadsheet for a complete list of the individual features and blue notes.

D.2. ADDITIONAL RESULTS

D.2.1. Aids to Navigation

No changes from DR.

D.3. MISCELLANEOUS

Chart compilation was done by Atlantic Hydrographic Branch personnel, in Norfolk, Virginia. Compilation data will be forwarded to Marine Chart Division, Silver Spring, Maryland. See Section D.1. of this report for a list of the Raster Charts and Electronic Navigation Charts (ENC) used for compiling the present survey:

D.4. ADEQUACY OF SURVEY

The present survey is adequate to supersede the charted bathymetry within the common area. Any features not specifically addressed either in the H-Cell BASE Cell File or the Blue Notes should be retained as charted. Refer to the Descriptive Report for further recommendations by the hydrographer.

APPROVAL SHEET
H11557

Initial Approvals:

The completed survey has been inspected with regard to survey coverage, delineation of depth curves, representation of critical depths, cartographic symbolization, and verification or disproval of charted data. All revisions and additions made to the H-Cell files during survey processing have been entered in the digital data for this survey. The survey records and digital data comply with National Ocean Service and Office of Coast Survey requirements except where noted in the Descriptive Report and the Evaluation Report.

All final products have undergone a comprehensive reviews per the Hydrographic surveys Division Office Processing Manual and are verified to be accurate and complete except where noted.

Matthew J Wilson

Digitally signed by Matthew J Wilson
DN: cn=Matthew J Wilson, o=NOAA, ou=Atlantic Hydrographic Branch, email=matthew.wilson@noaa.gov, c=US
Date: 2009.03.12 14:28:22 -04'00'

Matthew J. Wilson
Physical Scientist
Atlantic Hydrographic Branch

I have reviewed the H-Cell files, accompanying data, and reports. This survey and accompanying Marine Chart Division deliverables meet National Ocean Service requirements and standards for products in support of nautical charting except where noted.

Edward Owens
2009.03.12 16:48:36
-04'00'

Approved: _____

For: **Shepard Smith**
Commander, NOAA
Chief, Atlantic Hydrographic Branch

Digitally signed by David Scharff
DN: cn=David Scharff, o=OCS, ou=NOAA, email=david.scharff@noaa.gov, c=US
Reason: AWOIS and Surf Check complete
Date: 2009.04.06 14:58:50 -04'00'