

# **NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT**

## ***PROJECT RI1401-TB-C***

### ***Stonington to Horseneck Point***

### ***Connecticut, Rhode Island, and Massachusetts***

#### **Introduction**

NOAA Coastal Mapping Program (CMP) Project RI1401-TB-C provides a highly accurate database of new digital shoreline data for portions of Block Island and Rhode Island Sounds. The project extends from Stonington, Connecticut to Horseneck Point, Massachusetts and covers the entire outer coast shoreline of Rhode Island, including Block Island. The Geographic Cell (GC) may be used in support of the NOAA Nautical Charting Program (NCP) as well as geographic information systems (GIS) for a variety of coastal zone management applications.

#### **Project Design**

RI1401-TB-C was designed to provide updated shoreline for areas impacted by Hurricane Sandy. The Requirements Branch (RB) of the Remote Sensing Division (RSD) formulated the Project Instructions for this project following the guidelines of the “Scope of Work, Shoreline Mapping for the Coastal Mapping Program” (SOW), Version 14A, dated October 24, 2012, as well as the guidelines of the Scope of Work titled “Light Detection and Ranging (LIDAR) and Digital Camera Imagery Requirements, USVI, Massachusetts and Rhode Island” developed jointly by NGS and the Coastal Services Center (CSC). The instructions discussed the project’s purpose, geographic area of coverage, scope and priority; data acquisition, processing, accuracy, and compilation requirements; product delivery and reporting instructions; and contact and communication information.

#### **Field Operations**

Quantum Spatial, Inc. (QSI) conducted the field operations for RI1401-TB-C, including the surveying of ground control points (GCPs) and the acquisition and processing of aerial imagery and topo-bathymetric LIDAR. QSI established three new monuments, and utilized four existing NGS monuments, using traditional static GPS surveying techniques, for use as reference stations in subsequent airborne and ground surveys. A total of 61 photo-identifiable points, including 54 GCPs and 7 check points, were surveyed using a combination of, fast-static, rapid-static, real-time kinematic, and post-processed kinematic GPS techniques. Twenty of the photo points used in project RI1401-TB-C had been previously surveyed by Photo Science Inc. (one of QSI’s predecessor companies) between May 18, 2011 and May 20, 2011 in support of a USGS Orthophoto project. QSI surveyed the other 41 photo points used in the project between July 16, 2014 and August 7, 2014. A combined Ground Survey Report for both the 2011 and 2014 surveys is on file with other project data within the RSD Electronic Data Library.

The aerial photography acquisition phase of the project was conducted by QSI on August 18, 2014. A total of nine flight lines of natural color imagery were acquired within a tolerance of 25% of the Mean Lower Low Water (MLLW) tide stage. Imagery was captured with an approximate nominal ground sample distance (GSD) of 0.3 meters through the use of a large

format Intergraph Z/I Digital Mapping Camera (DMC) with a focal length of 120 mm.

The topo-bathy LIDAR acquisition was conducted from July 17, 2014 through August 9, 2014 and consisted of 22 LIDAR acquisition missions that collected airborne laser point cloud data. LIDAR was captured with an approximate nominal point density of  $\geq 4$  pulses per square meter through the use of the Riegl VQ-820G topographic-bathymetric (topo-bathy) sensor dually mounted with either a Leica ALS50 or a Riegl VQ-420 Near Infrared (NIR) sensor. QSI utilized two different flight plans based on the survey altitude in order to capture the best shallow-water topo-bathy dataset possible. Near-shore flight lines were acquired at an above-ground level (AGL) of 600 meters while flight plans over water were acquired at an AGL of 300 meters. In order to achieve a seamless topo-bathy coverage across the intertidal and shallow nearshore zones each shoreline flightline was required to be collected twice: once within 20% of the range of the MLLW tide stage and once within 30% of mean high water (MHW) tide stage. For further information refer to the Rhode Island Final Technical Data Report on file with other project data within the RSD Electronic Data Library.

### **GPS Data Reduction**

Each acquisition aircraft used by QSI was equipped with either an Applanix POSAV Model 510 IMU or a dual frequency Trimble BD960 to collect the Airborne Global Positioning System (ABGPS) and Inertial Measurement Unit (IMU) data. NGS Continuously Operated Reference Stations (CORS) and several cooperative CORS stations were used for base stations on the project with at least two of these CORS stations being used to process each POSAV dataset to achieve the final image center locations. For further information refer to the Airborne Positioning and Orientation Report (APOR) on file with other project data within the RSD Electronic Data Library.

### **Aerotriangulation**

The aerotriangulation (AT) phase of the project was performed by QSI using digital AT methods to establish the network of photogrammetric control required for the compilation phase. The aerial images were adjusted in two separate blocks. Block One covered the mainland and Block Two covered only Block Island. The Intergraph ImageStation Automatic Triangulation (ISAT) software (ver. 6.1) was used to perform automatic point measurements and interactive point measurements of pass points and tie points. Upon successful completion of the aerotriangulation process, the ISAT software provided the RMS of the standard deviations of the residuals for each aerotriangulated ground point which were used to compute a predicted horizontal circular error at the 95% confidence level of 0.32 meters for Block One and 0.21 meters for Block Two. An Aerotriangulation Report was written to provide detailed information on this phase of project completion, and is on file with other project data within the RSD Electronic Data Library.

The project database consists of project parameters and options, camera calibration data, interior orientation parameters, ground control parameters, adjusted exterior orientation parameters, and positional listing of all measured points. Positional data is referenced to the North American Datum of 1983 (NAD 83) and the North American Vertical Datum of 1988 (NAVD88).

### **Compilation**

The data compilation phase of project RI1401-TB-C was initiated by QSI personnel in September 2015. NGS supplied the LIDAR derived MHW and MLLW shapefiles to be edited, attributed and generalized by QSI. Additional features were then manually compiled using stereo

imagery. This work was accomplished using a Digital Photogrammetric Workstation (DPW), which consists of the Socet Set (version 5.6.0) suite of digital photogrammetric software running on a stereo-enabled PC-based workstation with the Windows 7 operating system. Feature identification, segmentation, and attribution occurred within the Socet Set Feature Extraction module and were based on imagery analysis of the processed digital images and information extracted from the appropriate NOAA Nautical Charts, the U.S. Coast Guard Light List and other ancillary sources. Feature attribution was assigned in compliance with the Coastal Cartographic Object Attribute Source Table (C-COAST), which provides the definition and attribution scheme for the full range of cartographic features pertinent to the CMP. Selected features were further modified with additional descriptive information to refine general classification.

Spatial data accuracies for project RI1401-TB-C were determined according to standard Federal Geographic Data Committee (FGDC) practices. Stereo compiled cartographic features were compiled to meet a horizontal accuracy of 0.6 meters for Block One and 0.4 meters for Block Two at the 95% confidence level. This predicted accuracy of compiled, well defined points is derived by doubling the circular error calculated from the aerotriangulation statistics.

The following table provides information on the imagery used to complete this project:

<b>Date</b>	<b>Time (UTC)</b>	<b>Flight Line</b>	<b>Photo #s</b>	<b>GSD</b>	<b>Tide Level*</b>
08/18/2014	13:10 – 13:19	30-004	0073 – 0033	0.3 m	0.3 m
08/18/2014	13:24 – 13:30	30-005	0033 – 0069	0.3 m	0.3 m
08/18/2014	13:35 – 13:41	30-003	0030 – 0001	0.3 m	0.3 – 0.4 m
08/18/2014	13:45 – 13:47	30-002	0001 – 0014	0.3 m	0.3 – 0.4 m
08/18/2014	13:50 – 13:52	30-001	0008 – 0001	0.3 m	0.3 m
08/18/2014	14:01 – 14:03	30-009	0013 – 0001	0.3 m	0.4 m
08/18/2014	14:07 – 14:09	30-007	0001 – 0010	0.3 m	0.3 m
08/18/2014	14:16 – 14:22	30-005	0032 – 0001	0.3 m	0.3 – 0.2 m
08/18/2014	14:26 – 14:31	30-004	0001 – 0032	0.3 m	0.2 – 0.4 m
08/18/2014	14:35 – 14:36	30-006	0008 – 0001	0.3 m	0.4 m
08/18/2014	15:32 – 15:35	30-008	0001 – 0014	0.3 m	0.5 – 0.7 m

\* Tide levels given in meters above MLLW and were calculated using the Pydro software tool with a TCARI grid referenced to verified water level observations at the time of photography from various NOS gauges in the vicinity of the project. The height of the MHW tidal datum in the project area varies between 0.81 and 1.10 meters above MLLW.

## **Quality Control / Final Review**

Quality control tasks were conducted during all phases of project completion by a senior member of QSI. The final QC review was completed in January 2016. The review process included analysis of aerotriangulation results and assessment of the identification and attribution of digital feature data within the GC according to image analysis and criteria defined in C-COAST. The quality control process concluded with an inspection of topological connectivity within the GC using ArcGIS 10.2 software. All project data was evaluated for compliance to CMP requirements.

Comparisons of the largest scale NOAA nautical charts with project imagery and compiled project data resulted in creation of the Chart Evaluation File (CEF). The following nautical charts were used in the comparison process:

13214, Fishers Island Sound, RI-CT-NY, 1:20,000 scale, 30th Ed., Feb. 2014  
13215, Block Isl Snd, Pt Judith to Montauk Pt, CT-RI-NY, 1:40,000 scale, 21st Ed., Sep. 2014  
13217, Block Island, RI, 1:15,000 scale, 17<sup>th</sup> Ed., Aug. 2013  
13219, Point Judith Harbor, RI, 1:15,000 scale, 14th Ed., July 2014  
13221, Narragansett Bay, RI-MA, 1:40,000 scale, 61st Ed., June 2016  
13223, Narragansett Bay, Including Newport Harbor, RI, 1:20,000 scale, 43rd Ed., June 2013  
13228, Westport River and Approaches, MA-RI, 1:20,000 scale, 13th Ed., Apr. 2016

## **End Products and Deliverables**

The following specifies the location and identification of the products generated during the completion of this project:

### **Remote Sensing Division Electronic Data Library**

- Ground Survey Report
- Final Technical Data Report
- Airborne Positioning and Orientation Report (APOR)
- Aerotriangulation Report
- Project Completion Report (PCR)
- Project database
- GC11187 in shapefile format
- Chart Evaluation File in shapefile format

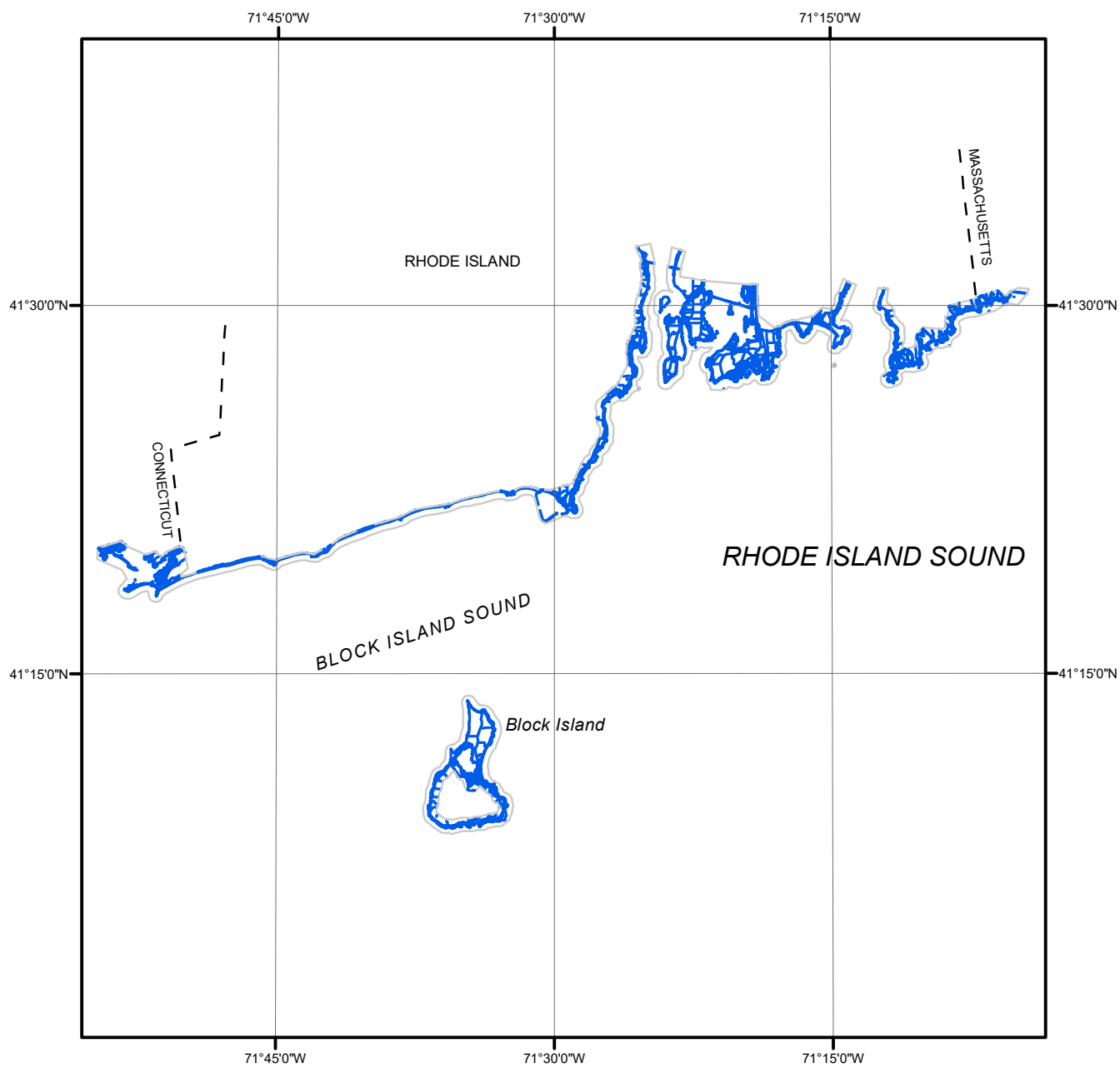
### **NOAA Shoreline Data Explorer**

- GC11187 in shapefile format
- Metadata file for GC11187
- Digital copy of the PCR

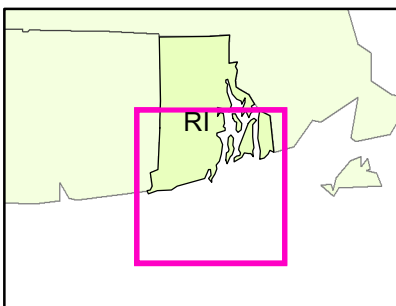
## **End of Report**

# STONINGTON TO HORSENECK POINT

## CONNECTICUT, RHODE ISLAND, AND MASSACHUSETTS



Overview



RI1401-TB-C

GC11187