

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

## ***PROJECT MA1101D-CM-N***

### ***Barnstable Harbor, Massachusetts***

#### **Introduction**

NOAA Coastal Mapping Program (CMP) Project MA1101D-CM-N provides a highly accurate database of new digital shoreline data for Barnstable Harbor, Massachusetts. Project MA1101D-CM-N is a subproject of a larger project, MA1101-CM-N, which covers Cape Cod and Cape Cod Bay. 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**

Photographic mission instructions for MA1101-CM-N were formulated by the Requirements Branch (RB) of the Remote Sensing Division (RSD) following the guidelines of the Photo Mission Standard Operating Procedures. The instructions discussed the project's purpose, geographic area of coverage, scope and priority, image requirements, Global Positioning System (GPS) data collection procedures and guidelines, instructions for data recording and handling, and mission communication protocols. RB created a Project Layout Diagram, flight maps and input files for the aircraft flight management system.

#### **Field Operations**

The field operations consisted of the collection of static and kinematic GPS data and Inertial Measurement Unit (IMU) data, and the acquisition of digital aerial imagery. Aerial survey operations for Project MA1101-CM-N were conducted from June 2011 through October 2014 with the NOAA King Air aircraft (N68RF). Project imagery used for sub-project MA1101D-CM-N included portions of six (6) flight lines of natural color (RGB) and near-infrared (NIR) imagery acquired concurrently using an Applanix DSS 439 dual head digital camera system. The imagery was collected in coordination with both the Mean High Water (MHW) and Mean Lower Low Water (MLLW) tide stages. All imagery was acquired at a nominal altitude of 10,000 feet, resulting in an approximate ground sample distance (GSD) of 0.35 meters.

#### **Direct Georeferencing Data Processing**

GPS/IMU data were processed by RSD personnel to yield precise camera positions and orientations for direct georeferencing (DG) of the imagery. A local GPS base station was established for use as a reference station for kinematic GPS processing operations. The position of the base station was determined using the NGS Online Processing User Service (OPUS), which computed fixed baseline solutions from nearby CORS stations. Airborne kinematic data for subproject MA1101D-CM-N was processed using Applanix POSPAC MMS (ver. 6.1) software in August 2012 and Applanix POSPAC MMS (ver. 6.2) software in August 2013. For further information refer to the Airborne Positioning and Orientation Reports (APOR) on file

with other project data within the RSD Electronic Data Library.

The processed GPS/IMU data were used to derive precise exterior orientation (EO) values of the camera centers required for digital feature extraction. The predicted horizontal accuracy of the imagery was calculated using an Exterior Orientation Total Propagated Uncertainty (EO-TPU ver. 2.1) tool developed by NGS. Using this tool, the predicted horizontal uncertainty at the 95% confidence level was calculated to be 1.4 meters.

NGS third order control was used to verify the horizontal integrity of the DG data. All stereo models were examined and found to have acceptable levels of parallax for mapping purposes.

## Compilation

The data compilation phase of this project was accomplished by RSD AB personnel in March 2019. Digital mapping was performed using the Feature Extraction software module within SOCET SET (ver. 5.6). Feature identification and attribution within the GC were based on image analysis of the aerial imagery and information extracted from the largest scale NOAA nautical charts 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 MA1101D-CM-N were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were compiled to meet a horizontal accuracy of 2.8 meters. This predicted accuracy of well-defined points measured during the compilation phase was derived by doubling the imagery accuracy computed from the EO-TPU tool.

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

Date	Time (UTC)	Color Imagery		Infrared Imagery		Tide Level*
		Roll	Images	Roll	Images	
7/17/2012	15:10 – 15:12	12NC46	12006 – 12018	12NR32	7443 – 7455	2.8 m
7/17/2012	15:17 – 15:19	12NC46	12019 – 12031	12NR32	7456 – 7468	2.7 – 2.8 m
7/17/2012	15:24 – 15:25	12NC46	12032 – 12040	12NR32	7469 – 7477	2.7 m
7/21/2012	16:38 – 16:39	12NC48	12352 – 12360	12NR34	7789 – 7797	2.8 m
7/21/2012	18:03 – 18:06	12NC48	12592 – 12610	12NR34	8029 – 8047	3.0 m
7/21/2012	18:22 – 18:25	12NC48	12632 – 12651	12NR34	8069 – 8088	2.9 m
7/18/2013	17:38 – 17:39	13NC42	9581 – 9589	13NR37	8256 – 8264	0.2 m
7/18/2013	17:45 – 17:46	13NC42	9590 – 9602	13NR37	8265 – 8277	0.2 m
7/18/2013	17:58 – 17:59	13NC42	9654 – 9662	13NR37	8329 – 8337	0.3 m
7/18/2013	18:04 – 18:06	13NC42	9663 – 9675	13NR37	8338 – 8350	0.3 m

7/18/2013	18:11 – 18:14	13NC42	9676 – 9694	13NR37	8351 – 8369	0.3 m
7/20/2013	19:11 – 19:15	13NC44	9827 – 9846	13NR39	8502 – 8521	0.1 m

\*Tide levels are given in meters above MLLW and were calculated using the Pydro software tool with a TCARI grid referenced to verified water level observations at NOS gauges. The height of the MHW tidal datum in the project area varies between 2.97 – 3.01 meters above MLLW.

## Quality Control / Final Review

Quality control tasks were conducted during all phases of project completion by a member of the Applications Branch. The final QC review was completed in March 2019. The review process included analysis of the DG 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 (ver. 10.5.1) software. All project data was evaluated for compliance to CMP requirements.

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

- 13246, Cape Cod Bay, 40<sup>th</sup> Ed., Oct. 2013
- 13251, Barnstable Harbor, 16<sup>th</sup> Ed., Jun. 2011

## 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

- Project database
- Airborne Positioning and Orientation Reports
- GC11461 in shapefile format
- Project Completion Report (PCR)
- CEF in shapefile format

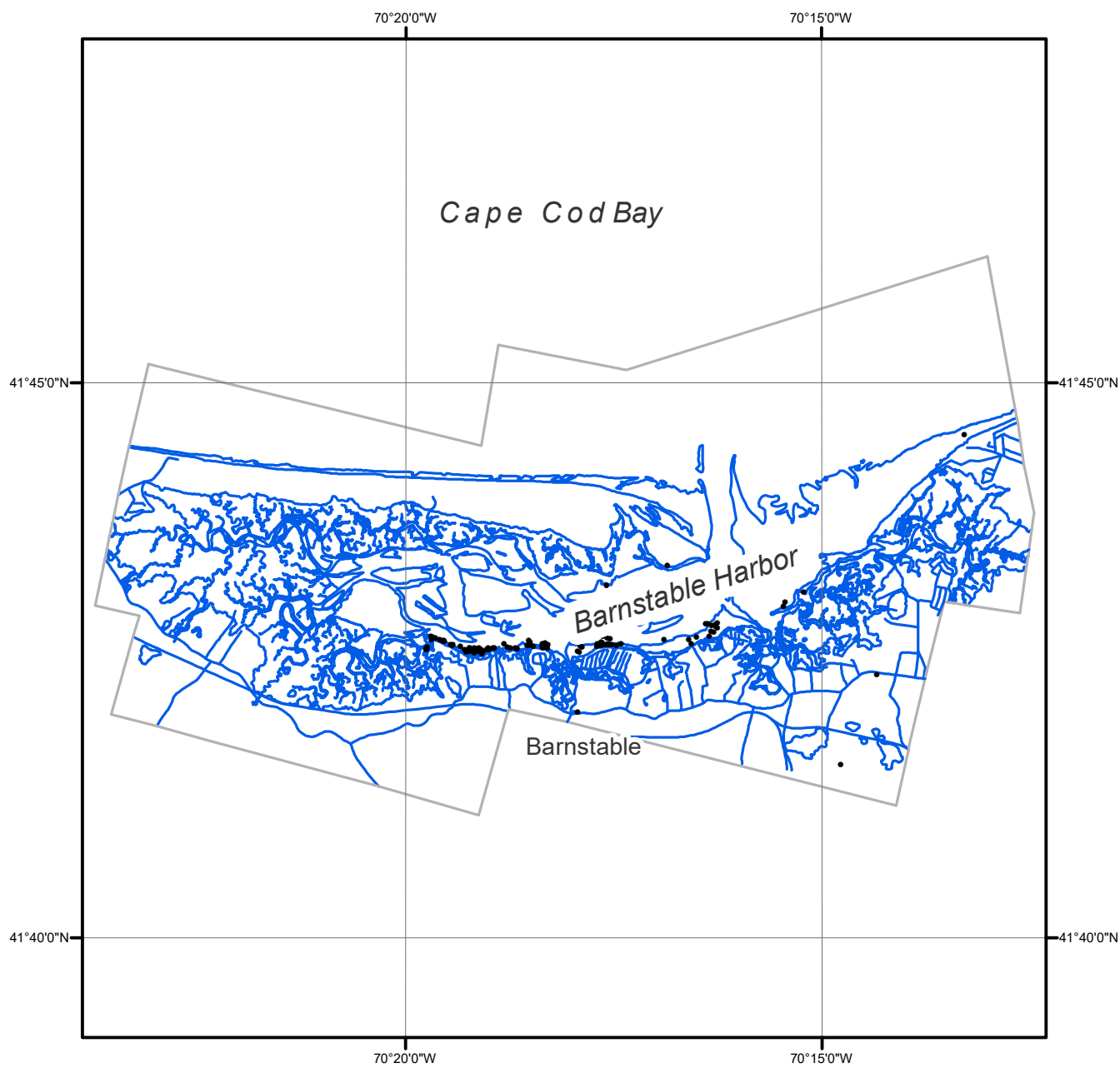
### NOAA Shoreline Data Explorer

- GC11461 in shapefile format
- Metadata file for GC11461
- PCR in Adobe PDF format

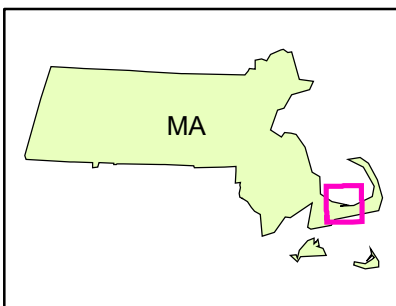
## End of Report

# BARNSTABLE HARBOR

## MASSACHUSETTS



Overview



MA1101D-CM-N

GC11461