

# NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

## *PROJECT ME0801*

### *Cutts Island to Prouts Neck, Maine*

#### **Introduction**

NOAA Coastal Mapping Program (CMP) Project ME0801 provides highly accurate digital shoreline data for the coast of Maine from Cutts Island northwards to Prouts Neck. 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**

The Requirements Branch (RB) of the Remote Sensing Division (RSD) formulated photographic mission instructions for this project following standard mission guidelines. The instructions discussed the project's purpose, geographic area of coverage, scope and priority; photographic requirements; flight line priority; Global Positioning System (GPS) data collection procedures and guidelines for both kinematic and static surveys; data recording and handling instructions; and contact and communication information. RB created a Project Layout Diagram, flight maps and input files for the aircraft's flight management system.

#### **Field Operations**

The field operations consisted of the collection of static and kinematic GPS data, Inertial Measurement Unit (IMU) data, and the acquisition of aerial imagery. The photographic mission operations were conducted on June 5<sup>th</sup> and June 7<sup>th</sup>, 2011 with the NOAA King Air (N68RF) aircraft. Color and near-infrared (NIR) digital images were acquired concurrently with an Applanix Digital Sensor System (DSS) 439 aerial camera system. Eleven flight lines, the vast majority of the project, were acquired at a nominal altitude of 10,000 feet, resulting in an approximate ground sample distance (GSD) of 0.35 meters. Six flight lines over several small offshore islands were acquired nominally at 5,000 feet resulting in an approximate GSD of 0.18 meters. All imagery was acquired in strict coordination with either Mean High Water (MHW) or Mean Lower Low Water (MLLW) local tide levels.

#### **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. The final processing of kinematic GPS data using Applanix POSPAC v 5.3 was performed in June 2012. For more information refer to the Airborne Positioning and Orientation Reports (APOR) on file in the Remote Sensing Division Electronic Data Library.

The processed GPS/IMU data was 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 determined by propagating sensor EO and image measurement uncertainties through the photogrammetric collinearity equations using the Exterior Orientation Total Propagated Uncertainty (EO-TPU) tool developed by NGS. Using this tool, the predicted horizontal uncertainty at the 95% confidence level for color imagery flown at 10,000 feet was 1.48 meters, and the predicted horizontal uncertainty and for color imagery flown at 5,000 feet was 0.64 meters. Also using this tool, the predicted horizontal uncertainty at the 95% confidence level for IR imagery flown at 10,000 feet was 1.46 meters, and the predicted horizontal uncertainty and for IR imagery flown at 5,000 feet was 0.63 meters. NGS 3<sup>rd</sup> order geodetic control points were 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. Positional data is referenced to the North American Datum of 1983 (NAD 83).

## Compilation

The data compilation phase of this project was accomplished by a member of the Applications Branch (AB) of RSD in November 2017. The Feature Extraction module of BAE Systems' SOCET SET (ver. 5.6) photogrammetric software was used to extract feature data from imagery. Feature identification and the assignment of cartographic codes were based on image analysis of the project digital images and information extracted from the appropriate NOAA Nautical Charts, 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 ME0801 were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were generally compiled to meet a horizontal accuracy of 3.0 meters. However features compiled from the imagery flown at the lower altitude of 5,000 feet were compiled to meet an accuracy of 1.3 meters. These predicted accuracies of compiled well-defined points, computed at the 95% confidence level, are derived by doubling the horizontal uncertainties calculated 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	Strip/Images	Roll	Strip/Images	
5-JUN-2011	17:46 – 17:50	11NC29	50-011/4070 - 4095	11NR12	50-011/1265 - 1290	2.6-2.7
5-JUN-2011	18:00 – 18:02	11NC29	50-004/4114 - 4130	11NR12	50-004/1309 - 1325	2.6-2.7
5-JUN-2011	18:06 - 18:10	11NC29	50-010/4131 - 4156	11NR12	50-010/1326 - 1351	2.7
5-JUN-2011	18:37 – 18:40	11NC29	50-006/4271 - 4290	11NR12	50-006/1466 - 1485	2.7 – 2.8

5-JUN-2011	18:44 – 18:48	11NC29	50-008/4291 - 4315	11NR12	50-008/1486 - 1510	2.7
5-JUN-2011	18:53 - 1856	11NC29	50-007/4316 - 4338	11NR12	50-007/1511 - 1533	2.7 – 2.8
5-JUN-2011	19:00 – 19:06	11NC29	50-009/4339 - 4380	11NR12	50-009/1534 - 1575	2.6 – 2.8
5-JUN-2011	19:18 – 19:18	11NC29	25-001/4409 - 4416†	11NR12	25-001/1604 - 1611†	2.6
5-JUN-2011	19:22 – 19:23	11NC29	25-002/4417 - 4422†	11NR12	25-002/1612 - 1617†	2.6
7-JUN-2011	12:39 – 12:47	11NC30	50-003/4423 – 4480	11NR13	50-003/1618 - 1675	0.2 – 0.3
7-JUN-2011	12:52 – 13:00	11NC30	50-002/4481 - 4536	11NR13	50-002/1676 - 1731	0.2 – 0.3
7-JUN-2011	13:05 – 13:09	11NC30	50-001/4537 - 4564	11NR13	50-001/1732 - 1759	0.1
7-JUN-2011	13:15 – 13:18	11NC30	50-004/4565 - 4581	11NR13	50-004/1760 - 1776	0.1
7-JUN-2011	13:20 – 13:23	11NC30	50-006/4582 - 4601	11NR13	50-006/1777 - 1796	0.1
7-JUN-2011	13:27 – 13:33	11NC30	50-009/4602 - 4643	11NR13	50-009/1797 - 1838	0.0 – 0.1
7-JUN-2011	13:38 – 13:42	11NC30	50-011/4644 - 4669	11NR13	50-011/1839 - 1864	0.0
7-JUN-2011	13:47 – 13:50	11NC30	50-005/4670 – 4687	11NR13	50-005/1865 - 1882	0.0
7-JUN-2011	13:54 – 13:58	11NC30	50-007/4688 - 4710	11NR13	50-007/1883 - 1905	0.0
7-JUN-2011	14:02 – 14:05	11NC30	50-008/4711 - 4735	11NR13	50-008/1906 - 1930	0.0 – 0.1
7-JUN-2011	14:12 – 14:15	11NC30	50-010/4736 - 4761	11NR13	50-010/1931 - 1956	0.1
7-JUN-2011	14:20 – 14:21	11NC30	25-001/4762 - 4769†	11NR13	25-001/1957 - 1964†	0.1
7-JUN-2011	14:25 – 14:25	11NC30	25-002/4770 - 4775†	11NR13	25-002/1965 - 1970†	0.1
7-JUN-2011	14:33 – 14:34	11NC30	25-005/4776 - 4781†	11NR13	25-005/1971 - 1976†	0.1
7-JUN-2011	14:38 – 14:38	11NC30	25-006/4782 – 4787†	11NR13	25-006/1977 - 1982†	0.2
7-JUN-2011	14:42 – 14:42	11NC30	25-004/4788 – 4794†	11NR13	25-004/1983 - 1989†	0.2
7-JUN-2011	14:47 – 14:47	11NC30	25-003/4795 - 4803†	11NR13	25-003/1990 - 1998†	0.2
7-JUN-2011	19:05 – 19:05	11NC31	25-003/4804 - 4809†	11NR14	25-003/1999 - 2004†	2.7
7-JUN-2011	19:11 – 19:11	11NC31	25-004/4810 - 4815†	11NR14	25-004/2005 - 2010†	2.8
7-JUN-2011	19:15 – 19:16	11NC31	25-006/4816 - 4824†	11NR14	25-006/2011 - 2019†	2.8
7-JUN-2011	19:21 – 19:21	11NC31	25-005/4825 - 4831†	11NR14	25-005/2020 - 2026†	2.8
7-JUN-2011	19:29 – 19:38	11NC31	50-003/4832 - 4889	11NR14	50-003/2027 - 2084	2.8
7-JUN-2011	19:43 – 19:51	11NC31	50-002/4890 - 4945	11NR14	50-002/2085 - 2140	2.8
7-JUN-2011	19:56 – 19:58	11NC31	50-005/4946 - 4963	11NR14	50-005/2141 - 2158	2.8 – 2.9
7-JUN-2011	20:05 – 20:09	11NC31	50-001/4964 - 4991	11NR14	50-001/2159 - 2186	2.9

† Images are part of a subset of project imagery acquired at the lower altitude of 5,000 feet.

\* 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 throughout the project area. The height of the MHW tidal datum in the project area is approximately 2.7 - 2.8 meters above MLLW.

## **Quality Control / Final Review**

Quality control tasks were conducted during all phases of project completion by a senior member of AB. The final QC review was completed in June 2017. 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 10.5 software. All project data was evaluated for compliance to CMP requirements.

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

- 13283, Portsmouth Harbor, 23rd Ed., Dec. 2014, scale 1:20,000
- 13286, Cape Elizabeth to Portsmouth, 32nd Ed., Dec. 2013, scale 1:80,000
- 13287, Saco Bay and Vicinity, 13th Ed., Jun. 2013, scale 1:20,000

## **End Products and Deliverables**

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

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

- Project database
- Airborne Positioning and Orientation Report (APOR)
- GC11279 in shapefile format
- Project Completion Report (PCR)
- CEF in shapefile format

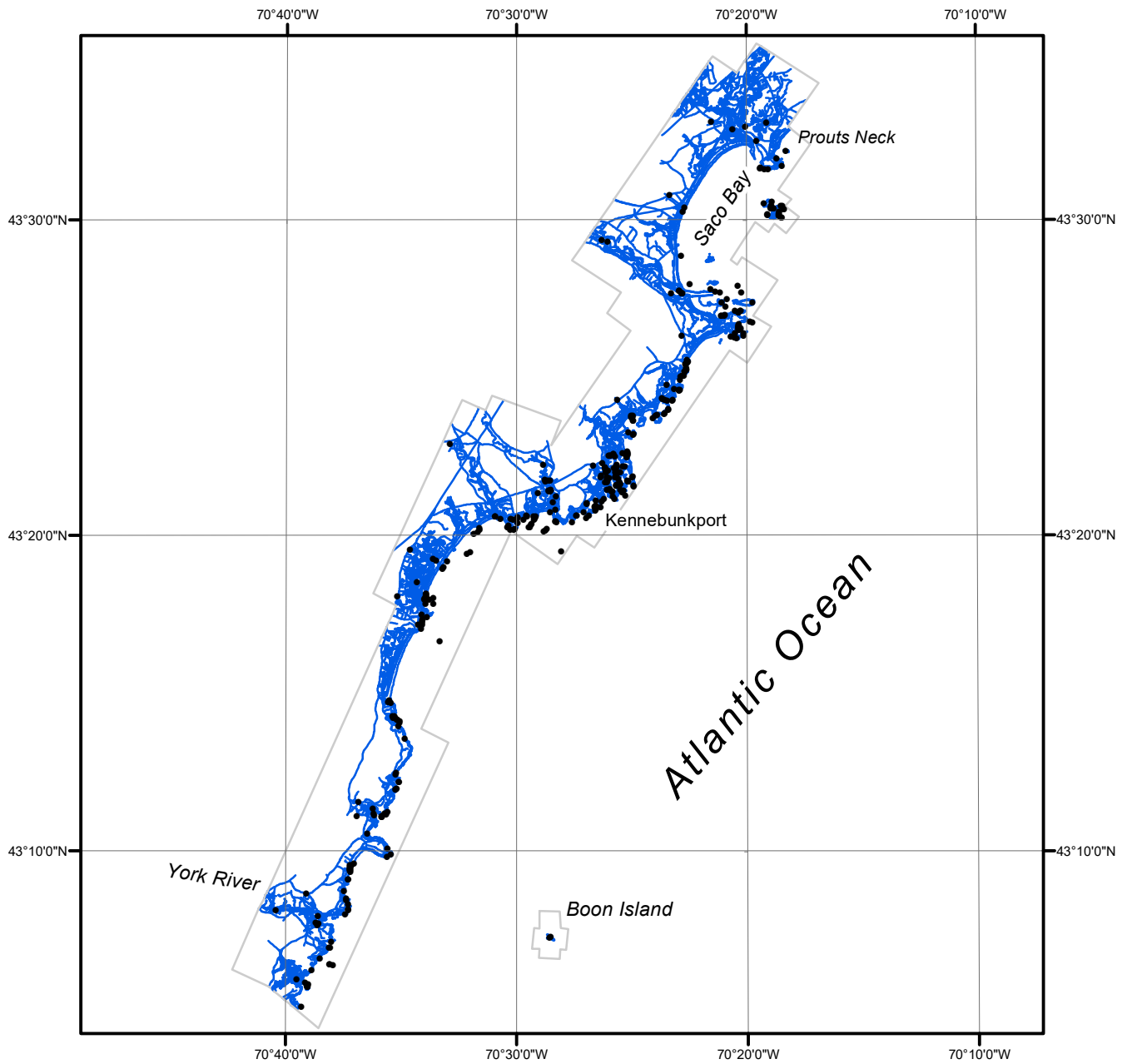
### **NOAA Shoreline Data Explorer**

- GC11279 in shapefile format
- Metadata file for GC11279
- PCR in Adobe PDF format

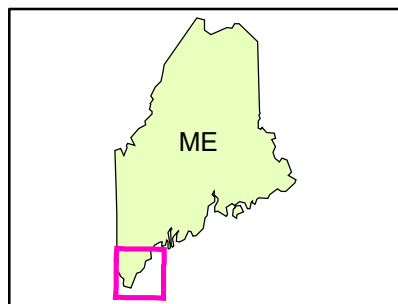
## **End of Report**

# CUTTS ISLAND TO PROUTS NECK

## MAINE



Overview



ME0801

GC11279