

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT NH0901-CM-N

Hampton Harbor to Frost Point, New Hampshire

Introduction

Coastal Mapping Program (CMP) Project NH0901-CM-N provides highly accurate digital shoreline data for the coast of New Hampshire, from Salisbury, MA to Wallis Sands in Rye, NH. The Geographic Cell (GC) may be used in support of the NOAA Nautical Charting Program as well as geographic information systems (GIS) for coastal zone management applications.

Project Design

The Requirements Branch (RB) of the Remote Sensing Division (RSD) formulated the photographic mission instructions for this project following the guidelines of the Photo Mission Standard Operating Procedures. 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.

The original project instructions included four flight lines over the mainland to be flown at an altitude of 10,000 feet, and four lines over Isles of Shoals to be flown at 5,000 feet. In December 2010 the instructions were revised to include only the four flight lines over the mainland, and the four lines over Isles of Shoals were incorporated into a new coastal mapping project, NH1101.

Field Operations

The field operations consisted of the collection of static and kinematic Global Positioning System (GPS) data and Inertial Measurement Unit (IMU) data and the acquisition of aerial imagery. The photographic mission operations were conducted on June 4, 2011, with the NOAA King Air (N68RF) aircraft. Project imagery included four flight lines of natural color (RGB) and near-infrared (NIR) imagery acquired concurrently using an Applanix DSS-439 dual head digital camera system (two 60 mm lenses). The flight lines were each flown twice in coordination with both 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

The GPS/IMU data were processed by Remote Sensing Division (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 airborne kinematic data was processed using Applanix POSPAC (ver. 5.3.0) software on

June 29, 2011. For further information refer to the Airborne Positioning and Orientation Report (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 determined by propagating sensor EO and image measurement uncertainties through the photogrammetric collinearity equations using an Excel spreadsheet based Exterior Orientation Total Propagated Uncertainty (EO-TPU) tool developed by NGS. Using this tool, the predicted horizontal uncertainty at the 95% confidence level was calculated to be 1.4 meters.

Ten (10) published coordinates for NGS third order geodetic control points were used to test the horizontal integrity of the directly georeferenced 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 initiated by RSD Applications Branch (AB) personnel in December 2015. Digital mapping was performed using the Feature Extraction software module within SOCET SET (ver. 5.6). Feature identification and attribution within the Geographic Cell (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 NH0901-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 at the 95% confidence level. This predicted accuracy of compiled well-defined points is derived by doubling the horizontal uncertainty calculated from the EO-TPU tool. The following table provides information on the imagery used to complete this project:

Date	Time (UTC)	Roll #	Photo #s	Tide Level*
06/04/2011	12:10 – 12:12	11NC27	03801 – 03810	0.1 m
06/04/2011	12:10 – 12:12	11NR10	00996 – 01005	0.1 m
06/04/2011	12:17 – 12:21	11NC27	03820 – 03851	0.1 m
06/04/2011	12:17 – 12:21	11NR10	01015 – 01046	0.1 m
06/04/2011	12:27 – 12:28	11NC27	03852 – 03863	0.1 m
06/04/2011	12:27 – 12:28	11NR10	01047– 01058	0.1 m
06/04/2011	12:36 – 12:41	11NC27	03864 – 03895	0.2 m
06/04/2011	12:36 – 12:41	11NR10	01059 – 01090	0.2 m
06/04/2011	17:46 – 17:50	11NC28	03974 – 04005	2.6 m
06/04/2011	17:46 – 17:50	11NR11	01169 – 01200	2.6 m

06/04/2011	17:56 – 18:01	11NC28	04006 – 04037	2.6 m
06/04/2011	17:56 – 18:01	11NR11	01201 – 01232	2.6 m
06/04/2011	18:08 – 18:09	11NC28	04048 – 04057	2.6 m
06/04/2011	18:08 – 18:09	11NR11	01243 – 01252	2.6 m
06/04/2011	18:15 – 18:17	11NC28	04058 – 04069	2.6 m
06/04/2011	18:15 – 18:17	11NR11	01253 – 01264	2.6 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 from the NOS stations at Boston, MA and Fort Point, NH. The elevation of MHW in the project area varies between 2.53 – 2.74 meters above MLLW.

Quality Control / Final Review

Quality control tasks were conducted during all phases of project completion by AB personnel. The final QC review was completed in February 2016. 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 Esri's ArcGIS 10.2.2 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:

- 13274, Portsmouth Harbor to Boston Harbor, 1:40,000 scale, 28th Ed., Apr. 2011
- 13278, Portsmouth to Cape Ann, 1:80,000 scale, 28th Ed., Aug. 2013
Including 1:30,000 scale Hampton Harbor inset
- 13283, Portsmouth Harbor, 1:20,000 scale, 23rd Ed., Dec. 2014

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

- Airborne Positioning and Orientation Report (APOR)
- Project database
- GC11189 in shapefile format
- Project Completion Report (PCR)
- Chart Evaluation File in shapefile format

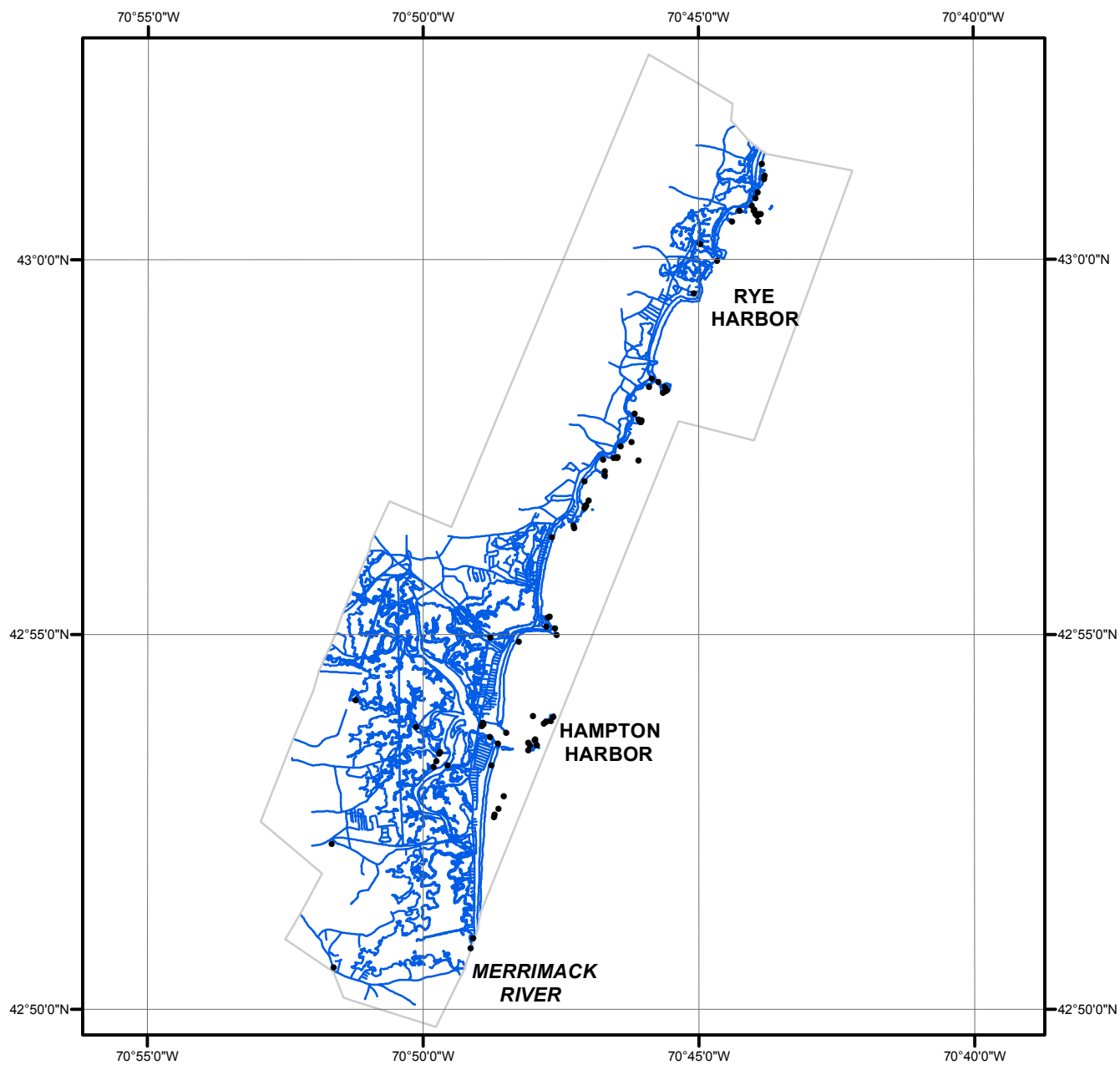
NOAA Shoreline Data Explorer

- GC11189 in shapefile format
- Metadata file for GC11189
- Digital copy of the PCR in Adobe PDF format

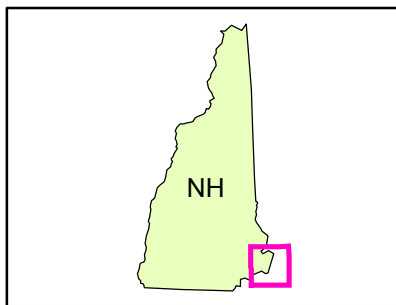
End of Report

HAMPTON HARBOR TO FROST POINT

NEW HAMPSHIRE



Overview



NH0901-CM-N

GC11189