

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT MA0901B-CM-N

Eastern Buzzards Bay to Waquoit Bay and Cape Cod Canal, Massachusetts

Introduction

NOAA Coastal Mapping Program (CMP) Project MA0901B-CM-N provides a highly accurate database of new digital shoreline data for a portion of the coastline along the Eastern Buzzard Bay area beginning with Cuttyhunk Island located in the western portion of the Elizabeth Islands and extending east to Waquoit Bay and portions of the Great Neck. Other areas extend west to east include Nashawena Island, Pasque Island, Naushon Island, Woodshole, and Falmouth Harbor. Extending north, the project area also includes Megansett Harbor, Scraggy Neck, Red Brook Harbor, Wings Neck, Great Neck, Long Neck, and Cape Cod Canal.

Project MA0901B-CM-N is a subproject of a larger project, MA0901-CM-N, which covers Buzzards Bay in its entirety, extending from Westport River to Waquoit Bay, Massachusetts. 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 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, 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 were conducted using the NOAA King Air (N68RF) aircraft in August 2009 and the NOAA Citation II (N52RF) aircraft in October 2009. Fifteen lines of natural color and near infrared (NIR) imagery were acquired in tandem at the Mean High Water (MHW) tide stage using an Applanix DSS-439 dual camera system. In addition, eight lines of color and NIR imagery were acquired near the Mean Lower Low Water (MLLW) tide stage. All imagery was collected 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. The airborne kinematic data was processed using Applanix POSPAC (v. 5.3.0) software in May 2011, then most of the data was reprocessed using POSPAC (v. 6.1.0) in September 2013 to achieve a tightly coupled solution. For further information refer to the Airborne Positioning and Orientation Reports (APORs) on file with other project data in the RSD Applications Branch (AB) Project Archive.

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 1.5 meters for both the color and NIR images. In addition, a full aerotriangulation (AT) was performed for the New Bedford Harbor area. From the New Bedford Harbor AT results, the 95% confidence circle was calculated as 0.8 meters. This was derived by using the root mean square (RMS) of the standard deviations of all measured and adjusted ground points. Refer to the MA0901 AT Report on file in the AB Project Archive for further details.

Several third order geodetic control points were used to verify the horizontal integrity of the DG and AT results. 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 September 2015. 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 MA0901B-CM-N were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were compiled to meet a horizontal accuracy of 3.0 meters. These predicted accuracies of well-defined points measured during the compilation phase were derived by doubling the imagery accuracy computed from the EO-TPU tool results.

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

Date	Time (UTC)	Roll #	Photo #s	~ GSD	Tide Level*
8/10/2009	15:05 – 15:06	09NC05	1266 – 1276	0.35 m	1.1
8/10/2009	15:05 – 15:06	09NR04	1152 – 1162	0.35 m	1.1
8/10/2009	15:18 – 15:20	09NC05	1285 – 1297	0.35 m	1.1
8/10/2009	15:18 – 15:20	09NR04	1171 – 1183	0.35 m	1.1
8/10/2009	15:26 – 15:31	09NC05	1298 – 1343	0.35 m	1.1
8/10/2009	15:26 – 15:31	09NR04	1184 – 1229	0.35 m	1.1
8/10/2009	15:38 – 15:45	09NC05	1344 – 1390	0.35 m	0.8 – 1.1
8/10/2009	15:38 – 15:45	09NR04	1230 – 1276	0.35 m	0.8 – 1.1
8/10/2009	15:51 – 15:53	09NC05	1391 – 1406	0.35 m	1.0 – 0.8
8/10/2009	15:51 – 15:53	09NR04	1277 – 1292	0.35 m	1.0 – 0.8
8/10/2009	16:13 – 16:15	09NC05	1435 – 1458	0.35 m	1.3 – 1.9
8/10/2009	16:13 – 16:15	09NR04	1321 – 1344	0.35 m	1.3 – 1.9
8/14/2009	18:26 – 18:27	09NC06	1525 – 1530	0.35 m	1.3 – 1.2
8/14/2009	18:26 – 18:27	09NR05	1412 – 1416	0.35 m	1.3 – 1.2
8/14/2009	18:37 – 18:40	09NC06	1568 – 1592	0.35 m	1.2 – 0.7
8/14/2009	18:37 – 18:40	09NR05	1454 – 1478	0.35 m	1.2 – 0.7
8/14/2009	19:04 – 19:07	09NC06	1593 – 1616	0.35 m	0.7
8/14/2009	19:04 – 19:07	09NR05	1479 – 1502	0.35 m	0.7
8/14/2009	19:24 – 19:28	09NC06	1617 – 1641	0.35 m	1.2
8/14/2009	19:24 – 19:28	09NR05	1503 – 1527	0.35 m	1.2
8/14/2009	19:33 – 19:35	09NC06	1642 – 1657	0.35 m	1.2
8/14/2009	19:33 – 19:35	09NR05	1528 – 1543	0.35 m	1.2
8/14/2009	19:44 – 19:47	09NC06	1658 – 1678	0.35 m	2.1 – 1.2
8/14/2009	19:44 – 19:47	09NR05	1544 – 1564	0.35 m	2.1 – 1.2
8/14/2009	19:52 – 19:54	09NC06	1679 – 1696	0.35 m	0.8
8/14/2009	19:52 – 19:54	09NR05	1565 – 1582	0.35 m	0.8
8/14/2009	19:59 – 20:01	09NC06	1697 – 1712	0.35 m	0.8

Date	Time (UTC)	Roll #	Photo #s	~ GSD	Tide Level*
8/14/2009	19:59 – 20:01	09NR05	1583 – 1598	0.35 m	0.8
8/14/2009	20:06 – 20:08	09NC06	1713 – 1726	0.35 m	0.8
8/14/2009	20:06 – 20:08	09NR05	1599 – 1612	0.35 m	0.8
10/14/2009	15:22 – 15:24	09NC09	2212 – 2224	0.35 m	0.2
10/14/2009	15:22 – 15:24	09NR10	2056 – 2068	0.35 m	0.2
10/14/2009	15:30 – 15:31	09NC09	2225 – 2235	0.35 m	0.2
10/14/2009	15:30 – 15:31	09NR10	2069 – 2079	0.35 m	0.2
10/14/2009	15:38 – 15:44	09NC09	2236 – 2281	0.35 m	0.2
10/14/2009	15:38 – 15:44	09NR10	2080 – 2125	0.35 m	0.2
10/14/2009	15:49 – 15:52	09NC09	2282 – 2297	0.35 m	0.2
10/14/2009	15:49 – 15:52	09NR10	2126 – 2141	0.35 m	0.2
10/14/2009	16:12 – 16:19	09NC09	2344 – 2390	0.35 m	0.2
10/14/2009	16:12 – 16:19	09NR10	2188 – 2234	0.35 m	0.2
10/14/2009	17:48 – 17:50	09NC09	2501 – 2514	0.35 m	0.2
10/14/2009	17:48 – 17:50	09NR10	2345 – 2358	0.35 m	0.2
10/14/2009	18:04 – 18:06	09NC09	2515 – 2530	0.35 m	0.1
10/14/2009	18:04 – 18:06	09NR10	2359 – 2374	0.35 m	0.1
10/14/2009	18:10 – 18:12	09NC09	2531 – 2548	0.35 m	0.1
10/14/2009	18:10 – 18:12	09NR10	2375 – 2392	0.35 m	0.1
10/14/2009	18:17 – 18:18	09NC09	2549 – 2554	0.35 m	0.2 – 0.1
10/14/2009	18:17 – 18:18	09NR10	2393 – 2398	0.35 m	0.2 – 0.1
10/21/2009	15:26 – 15:28	09NC16	4763 – 4781	0.35 m	1.4
10/21/2009	15:26 – 15:28	09NR17	4607 – 4625	0.35 m	1.4
10/21/2009	15:33 – 15:35	09NC16	4782 – 4795	0.35 m	1.4
10/21/2009	15:33 – 15:35	09NR17	4626 – 4639	0.35 m	1.4

*Tide levels are given in meters above MLLW and were calculated using the Pydro software tool with TCARI grids referenced to verified water level observations at the time of photography from NOS tide stations in the vicinity. The elevation of the MHW tidal datum in the project area varies between 0.6 – 2.7 m. 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 October 2015. 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 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:

- 13229, South Coast Cape Cod & Buzzards Bay, 1:40,000, 32nd Ed., Jun 2013
(Insets: Pasque Island, 1:12,000 scale and Cuttyhunk Harbor, 1:12,000 scale)
- 13230, Buzzards Bay, 1:40,000, 51st Ed., Apr 2012
(Inset: Buzzards Bay, 1:20,000 scale)
- 13235, Woodshole, 1:5,000, 7th Ed., Jul. 2012
- 13236, Cape Cod Canal, 1:20,000, 31st Ed., Apr 2012

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 (APOR)
- Aerotriangulation Report
- GC11103 in shapefile format
- Project Completion Report (PCR) with page-size graphic of GC11103
- CEF in shapefile format

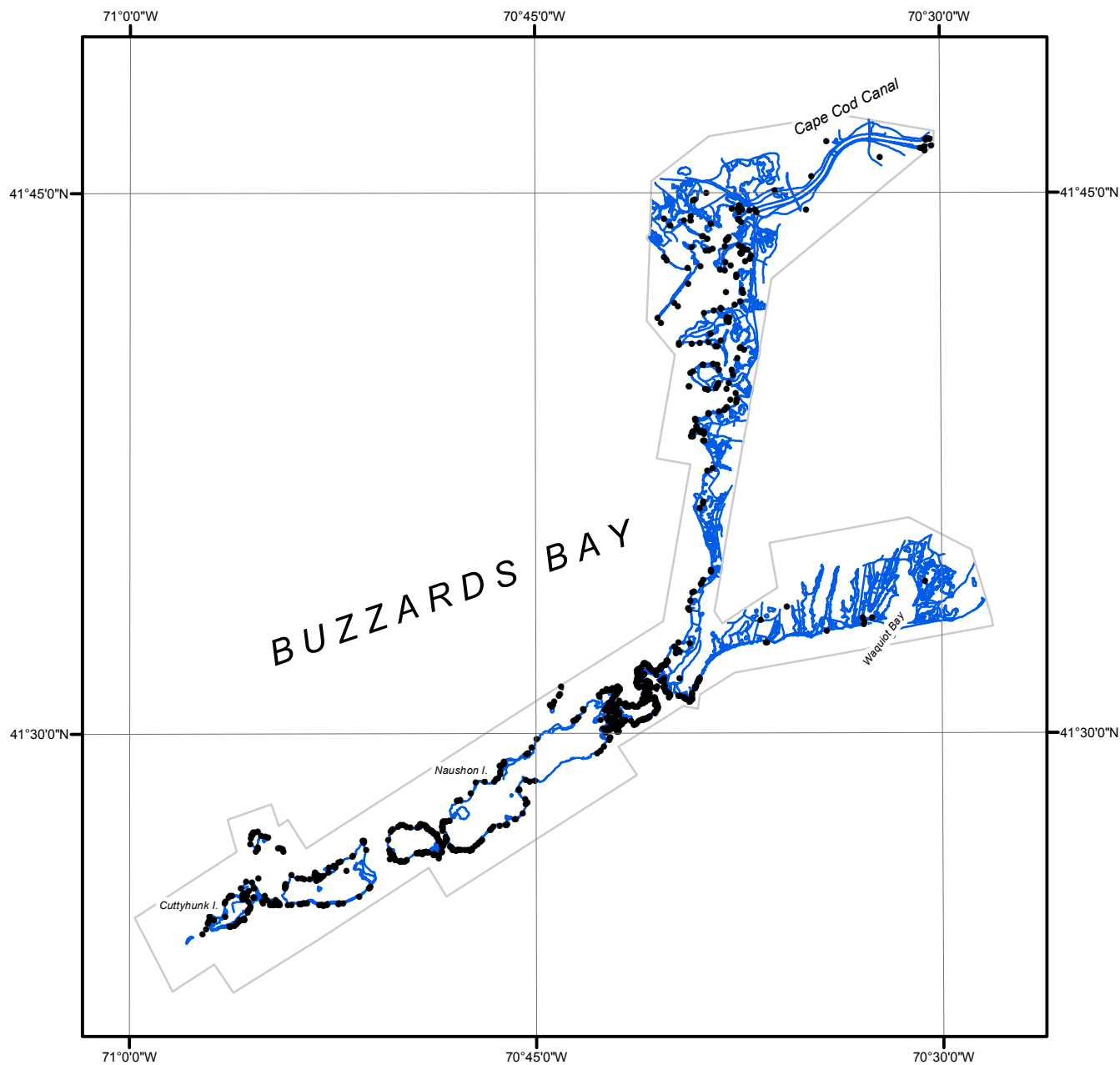
NOAA Shoreline Data Explorer

- GC11103 in shapefile format
- Metadata file for GC11103
- Digital copy of the PCR in Adobe PDF format

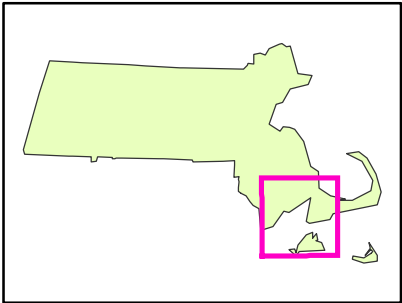
End of Report

EASTERN BUZZARDS BAY TO WAQUOIT BAY, CAPE COD CANAL

MASSACHUSETTS



Overview



MA0901B-CM-N

GC11103