

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT MD0404A

Chesapeake Bay, Cambridge to Upper Hooper Island, Maryland

Introduction

National Oceanic and Atmospheric Administration (NOAA) Coastal Mapping Program Project MD0404A provides a highly accurate database of new digital shoreline data for portions of the Chesapeake Bay and surrounding coastal areas. The project area extends from Cambridge on the Choptank River to Upper Hooper Island and includes various tributaries of the Chesapeake Bay. MD0404A is a sub project of the larger project MD0404, which covers the Chesapeake Bay from Jenkins Creek in the north to the Pocomoke River.

Successful completion of this project resulted in a densification of the National Spatial Reference System (NSRS), a set of controlled metric-quality aerial photographs and digital feature data of the coastal zone which complements the Nautical Charting Program (NCP) as well as geographic information systems (GIS) for a variety of coastal zone management applications.

The project database consists of information measured and extracted from aerial photographs and metadata related to photogrammetric compilation. Base mapping was conducted in a digital environment using stereo softcopy photogrammetry and associated cartographic practices.

Project Design

The NOAA National Geodetic Survey 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", version 13B, dated January 2008. 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

Western Air Maps, Inc. (WAM) contracted the services of Metro Engineering and Surveying Co., Inc. to survey thirty-three (33) ground control points for project MD0404. The control points were photo-identifiable features and were taken from well-defined locations. Refer to the Ground Control Report for a listing of final coordinates, elevations, descriptions and a site map of the control and check points.

Aerial photography and airborne GPS data was captured by Richard Crouse & Associates (RC&A). For each photo mission RC&A captured the photography with the use of a Leica RC30 camera equipped with a Flight Navigation and Management System. The photo missions that acquired the black and white infrared (B&W IR) images were tide coordinated and captured within tolerance of either the Mean High Water (MHW) or the Mean Lower Low Water

(MLLW) tide stages. The color negative photos were flown below the MHW tide stage. All film was captured at a scale of 1:30,000. All images that were acceptable for compilation were flown between August 22nd, 2005 and April 29th, 2010. The Final Photo Mission Report and the Tabulation of Aerial Photography include complete narratives and descriptions of the methods used and results of the final datasets.

GPS Data Reduction

GPS data was processed to provide accurate positions of camera centers for application as photogrammetric control in the aerotriangulation phase of the project. For each photo exposure, the location of the camera was recorded through the use of a dual frequency GPS receiver and on several occasions IMU equipment was employed. The raw GPS data sets were processed using either GrafNAV GPS or Applanix's POSPAC post processing software, which determined the accurate trajectory of all the flight missions. The resulting values were accurate positions of the survey camera. At least two (2) Continuously Operating Reference Stations (CORS) stations were used to process each raw data set. Refer to the Airborne Positioning and Orientation Report for more detailed information.

Aerotriangulation

Routine softcopy aerotriangulation methods were applied to establish the network of precise camera positions and other control for mapping, and to provide model parameters and orientation elements required for digital compilation. This work was initiated by WAM in December 2005 utilizing a Digital Photogrammetric Workstation (DPW), which is a configuration of computer hardware, modular software components and other associated peripheral devices. The color photographs, the MHW B&W IR and MLLW B&W photographs were each measured and adjusted as separate blocks using Z/I Imaging's ISAT digital aerotriangulation software (versions 6.0.5.0 and 6.1.6.0). 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 0.3 meters for the color photographs, 0.7 meters for the MHW B&W IR photographs and 1.0 meters for the MLLW B&W IR photographs with the exception of the Watts Island block which was 0.4 meters for the MLLW B&W IR photographs based on a 95% confidence level. An Aerotriangulation Report was written and is on file with other project data within the RSD Applications Branch (AB) Project Archive.

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).

Compilation

The data compilation phase of project MD0404A was initiated by WAM in January 2006. Digital mapping was performed using a DPW in conjunction with the SOCET SET Feature Extraction software module. Feature identification and attribution within the Geographic Cell (GC) were based on image analysis of 1:30,000 scale photographs 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 MD0404A were determined according to standard Federal Geographic Data Committee (FGDC) practices. Most cartographic features were compiled to meet a horizontal accuracy of 0.6 meters at the 95% confidence level. Features compiled from the MHW B&W IR photographs meet a horizontal accuracy of 1.4 meters at the 95% confidence level. Features compiled from the MLLW B&W IR photographs meet a horizontal accuracy of 2.0 meters at the 95% confidence level. The predicted accuracy of compiled, well defined points is derived by doubling the circular error calculated from aerotriangulation statistics.

The following table provides information on images used in the completion of this project:

| Date | Time (UTC) | Roll Number | Photo Numbers | Scale (nominal) | Tide Level* |
|-------------|-------------------|--------------------|----------------------|------------------------|--------------------|
| 8/22/2005 | 13:35 – 13:38 | 0528CN01 | 001 – 006 | 1:30,000 | 0.3 |
| 8/22/2005 | 13:46 – 13:55 | 0528CN01 | 007 – 023 | 1:30,000 | 0.3 – 0.2 |
| 8/22/2005 | 14:01 – 14:11 | 0528CN01 | 026 – 042 | 1:30,000 | 0.2 – 0.3 |
| 8/22/2005 | 14:14 – 14:20 | 0528CN01 | 043 – 055 | 1:30,000 | 0.3 – 0.2 |
| 8/22/2005 | 14:52 – 14:57 | 0528CN01 | 103 – 112 | 1:30,000 | 0.2 – 0.3 |
| 8/22/2005 | 15:01 – 15:04 | 0528CN01 | 113 – 120 | 1:30,000 | 0.3 – 0.2 |
| 3/19/2006 | 15:16 – 15:18 | 0624R01 | 087 – 092 | 1:30,000 | 0.0 – (-0.1) |
| 3/19/2006 | 15:36 – 15:45 | 0624R01 | 093 – 108 | 1:30,000 | (-0.1) – 0.0 |
| 3/19/2006 | 15:50 – 15:54 | 0624R01 | 109 – 118 | 1:30,000 | 0.0 – (-0.1) |
| 3/19/2006 | 16:10 – 16:17 | 0624R01 | 129 – 140 | 1:30,000 | (-0.1) – 0.0 |
| 3/19/2006 | 16:23 – 16:26 | 0624R01 | 141 – 149 | 1:30,000 | 0.1 – (-0.1) |
| 3/19/2006 | 16:54 – 16:57 | 0624R01 | 164 – 169 | 1:30,000 | 0.1 – (-0.1) |
| 5/24/2006 | 18:36 – 18:38 | 0627R08 | 902 – 908 | 1:30,000 | 0.5 |
| 10/4/2006 | 18:16 – 18:20 | 0627R11 | 1156 – 1164 | 1:30,000 | 0.4 |
| 10/4/2006 | 18:24 – 18:29 | 0627R11 | 1165 – 1175 | 1:30,000 | 0.5 – 0.3 |
| 10/4/2006 | 18:36 – 18:39 | 0627R11 | 1176 – 1181 | 1:30,000 | 0.4 |
| 10/4/2006 | 19:16 – 19:21 | 0627R11 | 1209 – 1218 | 1:30,000 | 0.5 |
| 10/4/2006 | 19:45 – 19:47 | 0627R11 | 1242 – 1246 | 1:30,000 | 0.3 – 0.4 |
| 11/4/2006 | 18:24 – 18:25 | 0627R13 | 1367 – 1370 | 1:30,000 | 0.5 |
| 5/29/2007 | 19:21 – 19:23 | 0728R01 | 082 – 086 | 1:30,000 | 0.4 |
| 5/29/2007 | 19:29 – 19:31 | 0728R01 | 095 – 098 | 1:30,000 | 0.4 |
| 7/11/2008 | 14:42 – 14:43 | 0828R01 | 001 – 004 | 1:30,000 | 0.5 |
| 10/5/2008 | 14:15 – 14:17 | 0828R03 | 253 – 256 | 1:30,000 | 0.5 |

| | | | | | |
|-----------|---------------|---------|-----------|----------|-----|
| 2/9/2009 | 17:02 – 17:03 | 0927R01 | 121 – 122 | 1:30,000 | 0.1 |
| 4/30/2010 | 14:48 – 14:50 | 1027R02 | 080 – 085 | 1:30,000 | 0.1 |

* Tide levels are given in meters above MLLW and are based on actual observations at the Cambridge and Solomon Island tide stations with corrections applied to various tide zones throughout the project area. The height of MHW in the project area varies between 0.42 to 0.56 meters above MLLW.

Quality Control / Final Review

Quality control (QC) tasks were conducted during all phases of project completion by a senior member of WAM. The final QC review was completed in October 2012. 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 ESRI ArcGIS (version 10.1) software. All project data was evaluated for compliance to requirements.

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

12263, Cove Point to Sandy Point, MD, 1:80,000 scale, 56th Ed., Jun. 2012
 12264, Patuxent River and Vicinity, MD, 1:40,000 scale, 31st Ed., Jan. 2013
 12266, Choptank River and Herring Bay, 1:40,000 scale, 30th Ed., Dec. 2009

End Products and Deliverables

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

RSD Applications Branch Archive

- Hardcopy of the Airborne Positioning and Orientation Report (APOR)
- Hardcopy of the Aerotriangulation Report
- Hardcopy of the Project Completion Report (PCR)
- Page-size graphic plot of GC10755 file contents, attached to PCR

Remote Sensing Division Electronic Data Library

- Project database
- GC10755 in shapefile format
- Digital copy of the PCR in Adobe PDF format
- CEF in shapefile format

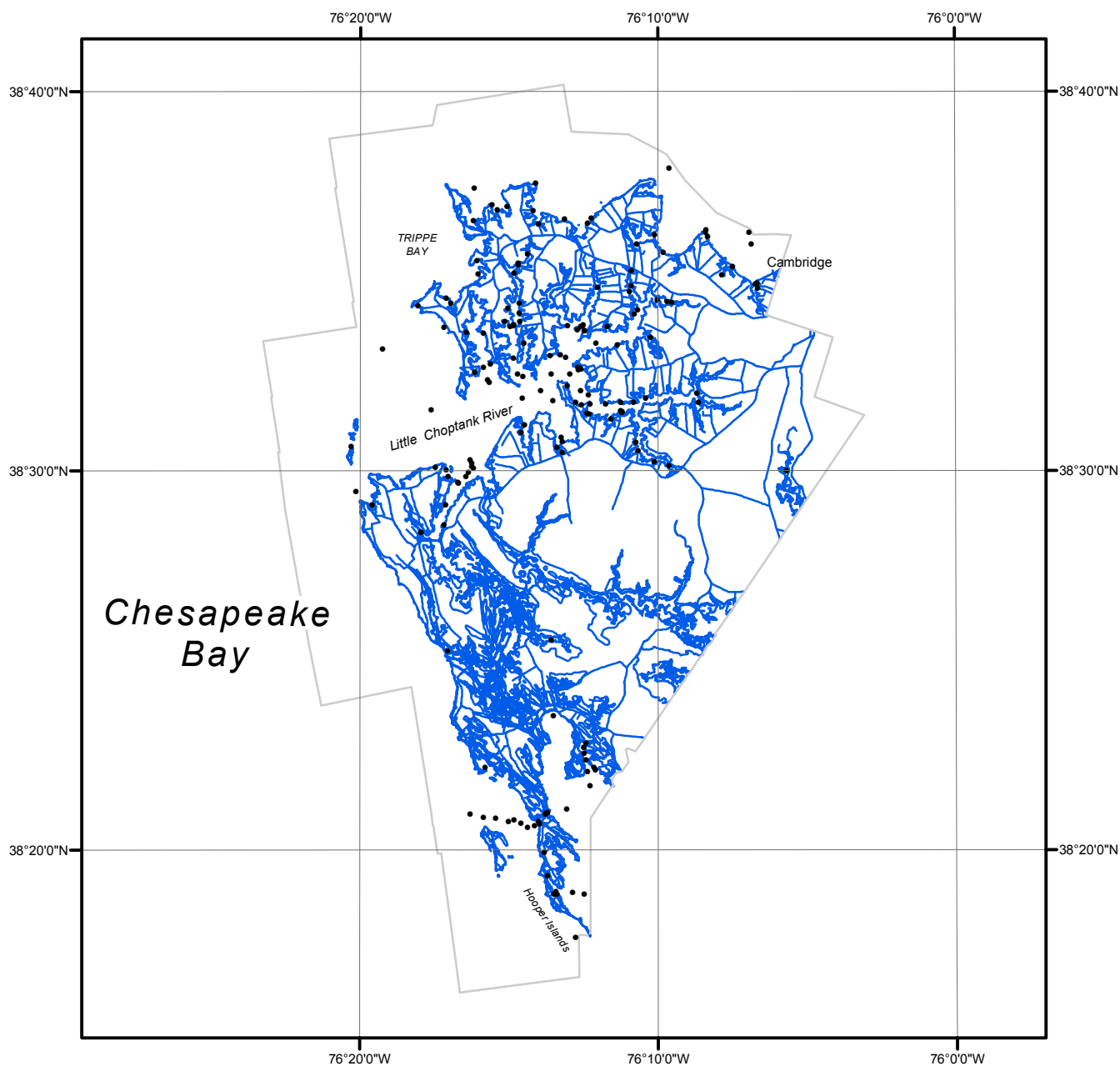
NOAA Shoreline Data Explorer

- GC10755 in shapefile format
- Metadata file for GC10755
- Digital copy of the PCR in Adobe PDF format

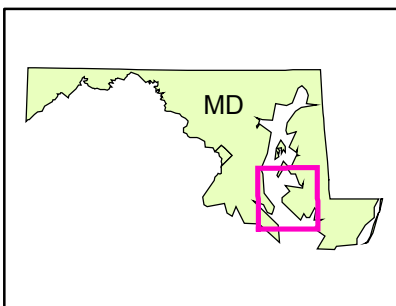
End of Report

CHESAPEAKE BAY, CAMBRIDGE TO UPPER HOOPER ISLAND

MARYLAND



Overview



MD0404A

GC10755