

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

## ***PROJECT MD0502B***

### ***Patuxent River, Maryland***

#### **Introduction**

NOAA Coastal Mapping Program (CMP) Project MD0502B provides a highly accurate database of new digital shoreline data for the Patuxent River. The project covers the Patuxent River and a portion of shoreline along the Chesapeake Bay. Project MD0502B is a sub-project of the project MD0502 which covers part of the western shoreline of the Chesapeake Bay from Rhode River south to Smith Creek along the Potomac 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 (NGS) 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” (SOW), Version 13A, dated July 2005. 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**

Tuck Mapping Solutions, Inc. (TMSI) performed the field operations for this project. Field operations included the surveying of ground control using static GPS and the acquisition of aerial imagery with airborne GPS (ABGPS) data collection. Survey field work was performed between 6/06/2005 and 6/12/2005. TMSI collected ten photo-identifiable (PID) ground control points using GPS surveying techniques in conjunction with Continuously Operating Reference Stations (CORS). Each PID was occupied twice for a minimum of two hours and fifteen minutes with a setup break in between. The one exception was station GC03 that was observed on two separate days, twice each day for two hours fifteen minutes. This data was then submitted to NGS for OPUS solutions to obtain ties to three NGS CORS stations per station per session. The OPUS solutions were constrained to the CORS stations ANP1, SOL1, and HNPT.

All aerial photography was acquired using a Leica RC30 at an altitude of 15,000 feet with a nominal scale of 1:30,000. The natural color photographs were acquired on June 8th, 9th and 23rd of 2005 and April 18th 2006 comprising eight flight lines. Black and White Infrared (B&W IR) photographs acquired at the mean high water (MHW) tide stage were acquired on April 11th and 20th and May 23rd of 2006 and May 25th of 2007. Mean Lower Low Water (MLLW) B&W IR photographs were acquired on May 23rd of 2006, October 30th of 2007 and August 30th of 2010. The same configuration of eight flight lines was used for all three sets of photography. Airborne kinematic GPS data were collected during the image acquisition in order to determine precise camera positions.

## **GPS Data Reduction**

TMSI performed the processing of the ABGPS data for project MD0502. NovAtel Waypoint GrafNav (versions 7.80.2517, 8.10.2313 and 8.30.0623) software was used to post- process the ABGPS data using both forward and reverse flight directions. Base station data from NGS CORS stations HNPT and SOL1 were included in the processing to improve the kinematic data accuracy. The forward and backward trajectories were then compared to each other to ensure acceptable accuracy and then combined to compute the final coordinates. For further information refer to the Airborne Positioning and Orientation Reports (APOR) on file with other project data within the RSD Applications Branch (AB) Project Archive.

## **Aerotriangulation**

Routine softcopy aerotriangulation methods were applied to establish a 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 TMSI in February of 2008 utilizing a Digital Photogrammetric Workstation (DPW), which is a configuration of computer hardware, modular software components and other associated peripheral devices. BAE Systems SOCET SET v. 5.4 softcopy photogrammetry suite was used for project setup and the aerotriangulation module Multi-Sensor Triangulation (MST) within SOCET SET was used to measure points and to perform the bundle adjustments. The aerotriangulation was divided into separate block adjustments. The color was one block, and both MLLW and MHW B&W IR images were in another block. Strips one and two of the MLLW B&W IR photographs were done in a third block since these strips were acquired much later. Upon successful completion of the aerotriangulation process, MST provided the standard deviations for each aerotriangulated ground point, which were used to compute a predicted horizontal circular error of 0.6 meters for the color photographs, 0.9 meters for the MLLW and MHW B&W IR photographs and 1.1 meters for strips one and two of 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 Project Archive.

The project database consists of project parameters and options, camera calibration data, interior orientation parameters, adjusted exterior orientation parameters, and a positional listing of all measured points. Positional data is referenced to the North American Datum of 1983 (NAD83).

## **Compilation**

The data compilation phase of sub-project MD0502B was initiated by Aero-Metric, Inc. in January 2010. Digital feature extraction was performed using a DPW in conjunction with

DAT/EM Systems International Summit Evolution software (ver. 6.2), and Bentley Systems MicroStation V8. Feature identification and attribution within the Geographic Cell (GC) were based on image analysis of the digital 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 MD0502B were determined according to standard Federal Geographic Data Committee (FGDC) practices. Most cartographic features were compiled to meet a horizontal accuracy of 1.2 meters at the 95% confidence level. MHW features and MLLW features were compiled to meet a horizontal accuracy of 1.8 meters at the 95% confidence level. MLLW features compiled from strips one and two of the MLLW images were compiled to meet a horizontal accuracy of 2.2 meters at the 95% confidence level. The predicted accuracy of compiled, well defined points is derived by doubling the circular error computed from aerotriangulation statistics.

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

<b>Date</b>	<b>Time (UTC)</b>	<b>Roll Number</b>	<b>Strip</b>	<b>Photo Numbers</b>	<b>Scale (nominal)</b>	<b>Tide Level*</b>
6-08-2005	14:25 – 14:26	0520CN03	30-004	0417 – 0419	1:30,000	0.2
6-08-2005	14:32 – 14:39	0520CN03	30-001	0420 – 0436	1:30,000	0.2 – 0.4
6-23-2005	15:10 – 15:17	0520CN04	30-002	0559 – 0575	1:30,000	0.2 – 0.1
6-23-2005	15:23 – 15:27	0520CN04	30-003	0576 – 0584	1:30,000	0.1
4-11-2006	20:05 – 20:11	0620R01	30-001	0009 – 0025	1:30,000	0.7 – 0.5
4-11-2006	20:16 – 20:20	0620R01	30-003	0026 – 0034	1:30,000	0.3 – 0.4
4-18-2006	17:46 – 17:51	0620CN01	30-005	0016 – 0026	1:30,000	0.2
4-18-2006	17:54 – 17:57	0620CN01	30-007	0027 – 0035	1:30,000	0.2
4-18-2006	18:16 – 18:19	0620CN01	30-004	0044 – 0052	1:30,000	0.2
4-20-2006	13:38 – 13:43	0620R01	30-005	0095 – 0105	1:30,000	0.5
4-20-2006	13:49 – 13:52	0620R02	30-007	0106 – 0114	1:30,000	0.5 – 0.4
4-20-2006	14:03 – 14:08	0620R02	30-004	0123 – 0134	1:30,000	0.5 – 0.4
4-20-2006	15:03 – 15:09	0620R03	30-002	0189 – 0203	1:30,000	0.6 – 0.5
5-23-2006	16:58 – 16:59	0620R04	30-002	0484 – 0485	1:30,000	0.5
5-23-2006	20:40 – 20:44	0620R04	30-003	0569 – 0577	1:30,000	0.0 – 0.1
10-30-2007	15:31 – 15:35	0720R02	30-007	0215 – 0223	1:30,000	0.1
10-30-2007	15:41 – 15:45	0720R02	30-005	0224 – 0234	1:30,000	0.1
10-30-2007	15:54 – 15:59	0720R02	30-004	0242 – 0253	1:30,000	0.1
8-30-2010	19:21 – 19:29	1020R01	30-001	0036 – 0052	1:30,000	0.3 – 0.2
8-30-2010	19:34 – 19:41	1020R01	30-002	0059 – 0075	1:30,000	0.2 – 0.3

\* Tide levels are given in meters above MLLW and are based on verified observations at the Solomons Island (#8577330) and Lower Marlboro (#8579542) reference stations with time and height offsets applied to several tide zones within the project area. The elevation of MHW in the project area varied between 0.35 – 0.68 meters.

## **Quality Control / Final Review**

Quality control (QC) for the tasks of field operations, GPS data reduction and aerotriangulation were conducted by TMSI. Quality control of the compilation task was conducted by Aero-Metric, Inc. The final QC review was completed in September 2011. 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 MicroStation software. All project data was evaluated for compliance to CMP requirements.

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

- 12264, Patuxent River and Vicinity, MD, 1:40:000 scale, 30<sup>th</sup> Ed.
- 12284, Solomons Island and Vicinity, MD, 1:10:000 scale, 16<sup>th</sup> Ed.

## **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 of GC10881 file contents, attached to PCR

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

- Project database
- GC10881 in shapefile format
- Digital copy of the PCR in Adobe PDF format
- CEF in shapefile format

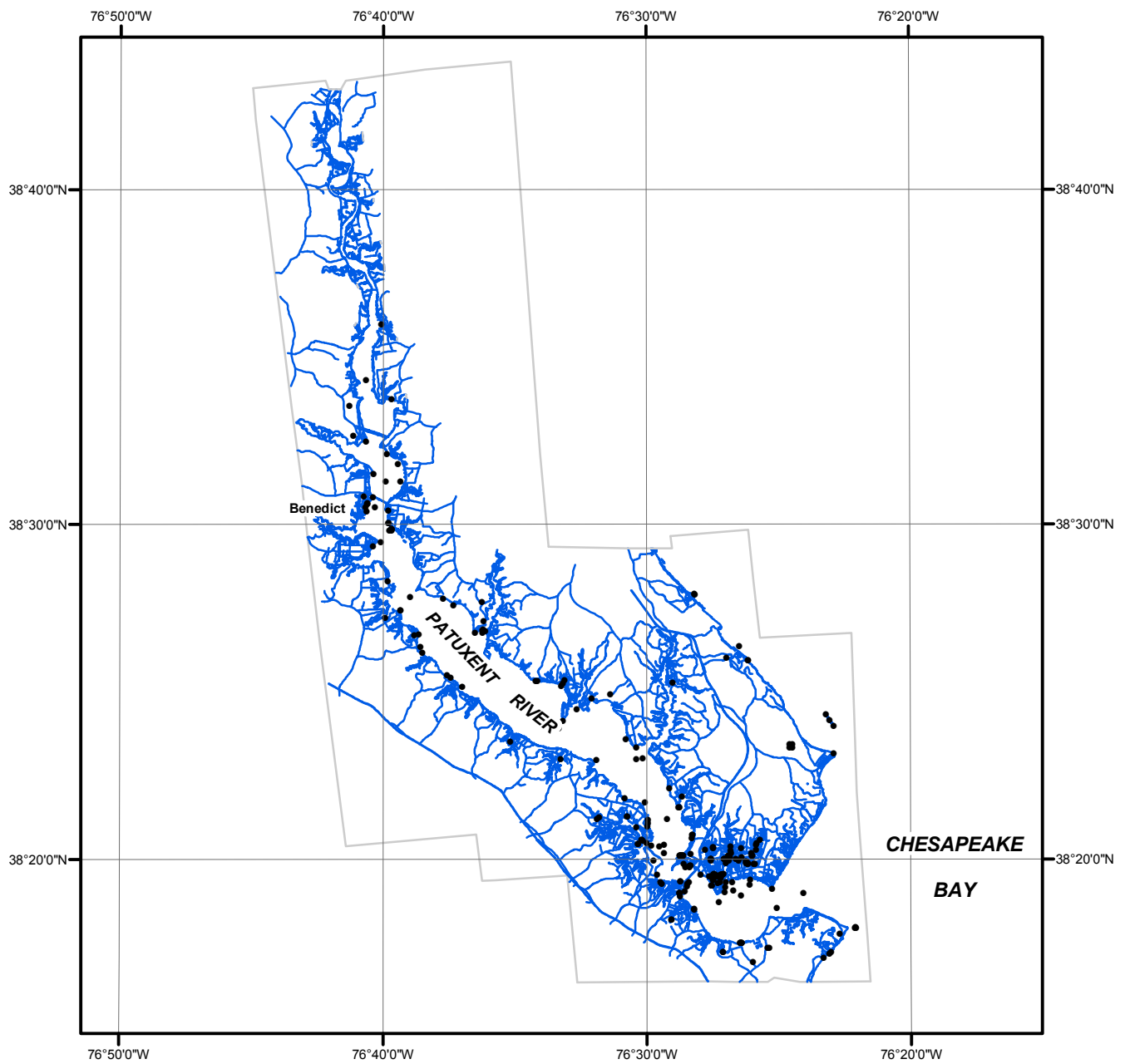
### **NOAA Shoreline Data Explorer**

- GC10881 in shapefile format
- Metadata file for GC10881
- Digital copy of the PCR in Adobe PDF format

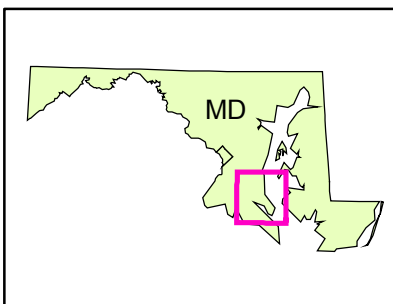
## **End of Report**

# PATUXENT RIVER

## MARYLAND



Overview



MD0502B

GC10881