NOAA COASTAL MAPPING PROGRAM
PROJECT COMPLETION REPORT

PROJECT NJ1404D-TB-C

Back Bays, Great Egg Harbor Bay to Reed Bay, New Jersey

Introduction

NOAA Coastal Mapping Program (CMP) Project NJ1404D-TB-C provides a highly accurate database of new digital shoreline data for the back-bays and tidal rivers along the Jersey Shore, extending from Great Egg Harbor Bay to Reed Bay, New Jersey. Project NJ1404D-TB-C is a subproject of a larger project, NJ1404-TB-C, which includes portions of the back-bays and marshes, and some areas of outer coastline and harbors, from Arnold Point, on the Delaware River, to Reed Bay. 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

NJ1404-TB-C was designed to support the application of topographic and bathymetric (topo-bathy) data acquired under the Sandy Supplemental Topo-Bathy Project. 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 14A, dated October 24, 2012, as well as the guidelines of the "Scope of Work for Shoreline Mapping In Support of Public Law No: 113-002, Disaster Relief Appropriations Act 2013, Light Detection and Ranging (lidar) and Digital Camera Imagery Requirements." The instructions discussed the project's purpose, geographic area of coverage, scope, priority; data acquisition, processing, accuracy, and compilation requirements; product delivery and reporting instructions; and contact and communication information.

Field Operations

The field operations for NJ1404-TB-C were conducted as part of the Sandy Supplemental Topo-Bathy Project NJ1403-TB-C (south) by Dewberry Consultants, LLC. For that project Dewberry and their sub-contractors were responsible for the planning, acquisition and post-processing of aerial imagery and lidar data to support photogrammetric processing and feature compilation. This included the establishment of ground control, the post-processing of airborne GPS data and calibration of the lidar data.

Ground control points (GCPs) were established in the NJ1404-TB-C project area using a combination of traditional static, fast-static, rapid-static, real-time kinematic, and post-processed kinematic GPS techniques. Survey field work was performed between November 2013 and June 2014. A Ground Survey Report providing survey details is on file with other project data within the Remote Sensing Division (RSD) Electronic Data Library.

The aerial photography acquisition phase of the project was conducted in April 2014. A total of 16 flight lines of natural color imagery were acquired for project NJ1403-TB-C (south), within a tolerance of 25% of the mean range of tide around the Mean Lower Low Water (MLLW) tide

stage. Of the 16 flight lines acquired, portions of four were used for NJ1404D-TB-C. Imagery was captured at a nominal altitude of 10,000 feet with a ground sample distance (GSD) of 0.3 meters through the use of a large-format Intergraph Z/I Digital Mapping Camera (DMC) with a focal length of 120 mm.

The lidar acquisition was conducted between November 2013 and July 2014 and consisted of a total of 262 lidar acquisition missions for airborne laser point cloud data covering the entire Sandy project area with an average point density of ≥ 4 pulses per square meter and a 50% swath overlap. Topo-bathy green lidar and topographic near-infrared (NIR) lidar were captured in tandem through the use of three Riegl VQ-820G sensors (topo-bathy), and a Riegl 480 or two Leica ALS50-II (topographic) sensors. The topo-bathy data was used to derive the MHW and MLLW shorelines, while the NIR data was used as an aid to developing the water surface model necessary for applying refraction corrections to the topo-bathy data. For further information about all field operations see the Final Report of Survey on file within the RSD Electronic Data Library.

GPS Data Processing

Acquisition aircraft were equipped with either an Applanix POSAV Model 510 IMU and/or a dual-frequency Trimble BD960 positioning system to collect the Airborne Global Positioning System (ABGPS) and Inertial Measurement Unit (IMU) data. NGS Continuously Operating Reference Stations (CORS), and several Cooperative CORS stations, were used for base stations on the project, with at least two of these CORS stations being used to process each POSAV dataset to achieve the final photo center locations. For further information refer to the Airborne Positioning and Orientation Report (APOR) on file with other project data within the RSD Electronic Data Library.

Lidar Data Processing

Lidar point cloud data for all of the areas acquired for the Sandy Supplemental Topo-Bathy Project were processed from January 2014 to September 2015. Riegl RiProcess software was utilized to transform the lidar point cloud into a mapping projection and to check the calibration stability. Terrasolid software was used for assessing relative and absolute accuracies between overlapping lifts and relative with each lift, initial point cloud classification, editing of the lidar point cloud, and for classification of water surface, erroneous returns, bathymetric surface and bare earth points. Refraction correction was performed through Dewberry's lidar Processor. Additional quality control (QC), point classification, and formatting were performed with GeoCue, Terrasolid, and Global Mapper software. NOAA VDatum software was used to convert the vertical datum of the lidar points from NAD83 ellipsoid to local MHW and MLLW tidal datums. QTModeler and custom ArcGIS Scripts were used to produce bare earth MHW and MLLW digital elevation models (DEMs) at a 1-meter grid resolution and to create and format the MHW and MLLW vectors into shapefile format.

The lidar point cloud was compared to higher accuracy ground control points to determine vertical uncertainties of the data set and then compared to the morphologic slope around the derived shoreline at 16,127 sample sites in the New Jersey project area (8,673 points for MHW and 7,454 points for MLLW sites) to determine the uncertainty of the vectors. Based on this assessment the MHW lidar-derived shoreline vectors meet a horizontal accuracy ranging from 1.0 to 2.8 meters at the 95% confidence level, and the MLLW lidar derived shoreline vectors meet a horizontal accuracy ranging from 1.3 to 4.2 meters at the 95% confidence level.

Aerotriangulation

The overall Sandy Supplemental Topo-Bathy project was divided into two parts for aerotriangulation (AT) purposes: a southern section and a northern section. Project NJ1404-TB-C was included in the southern section. The AT phase of the project was performed using digital AT methods to establish the network of photogrammetric control required for the compilation phase. The Intergraph ImageStation Automatic Triangulation (ISAT) software (ver. 6.1) was used to perform automatic point measurements and interactive point measurements of tie points. For further information see the AT South Report for the Sandy Supplemental Topo-Bathy project on file with other project data within the RSD Electronic Data Library.

The Root Mean Square (RMS) of the standard deviations in both X and Y directions were calculated and used to determine a predicted horizontal circular error at the 95% confidence level (95% CE) of 0.17 meters for the NJ1403 (south) sub-block. The project database consists of project parameters and options, camera calibration data, airborne GPS control 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). Stereo-models were examined and found to have acceptable levels of parallax for mapping purposes.

Compilation

The data compilation phase of project NJ1404D-TB-C was completed by Dewberry personnel in December 2017. NGS supplied the lidar-derived MHW and MLLW shapefiles to be edited, attributed and generalized. Additional features were then manually compiled using stereo imagery. This work was accomplished using the SOCET for ArcGIS module of BAE's SOCET GXP photogrammetric software. This enabled compilation of features into an Esri Geodatabase where topological and attribution relationships could be enforced. Once compilation was complete, the geodatabase features were exported to shapefile format. 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 NJ1404D-TB-C were determined according to standard Federal Geographic Data Committee (FGDC) practices. Stereo compiled cartographic features were compiled to meet a horizontal accuracy of 0.3 meters at the 95% confidence level. This predicted accuracy of compiled, well defined points is derived by doubling the circular error calculated from the aerotriangulation statistics. The lidar-derived features had horizontal accuracies that varied depending on shoreline type between 1.7 and 2.4 meters.

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

Date	Time (UTC)	Roll ID	Line ID	AT Frame ID	Index Frame ID	Tide Level*
4/9/2014	14:29 – 14:30	1436M12	30-233	0006 – 0011	2811 – 2816	0.3 m
4/9/2014	14:45 – 14:47	1436M12	30-232	0056 – 0069	2857 – 2870	0.3 m
4/20/2014	21:16 – 21:20	1436M14	30-231	0049 – 0073	3626 – 3650	0.5 m

4/21/2014	12:52 – 12:55	1436M15	30-230	0052 – 0074	3829 – 3851	0.1 m

* Water levels are given in meters above MLLW and are based on verified observations recorded by the NOS tide gauge at: Atlantic City – Station ID: 8534720 and Cape May - Station ID: 8536110 in New Jersey. The height of the MHW tidal datum in the project area varies between 1.18 – 1.28 meters above MLLW.

Quality Control / Final Review

Quality control tasks were conducted during all phases of project completion by a senior member of Dewberry. The final QC review was completed in August 2018. 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 (ver. 10.7.1) software. All project data was evaluated for compliance to CMP requirements.

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

- 12316, Little Egg Harbor to Cape May, 36th Ed., Mar. 2017
- 12318, Little Egg Inlet to Hereford Inlet, 45th Ed., Apr. 2010

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)
- Ground Survey Report
- Final Report of Survey
- Aerotriangulation Report
- Project Completion Report (PCR)
- Project database
- GC11655 in shapefile format
- CEF in shapefile format

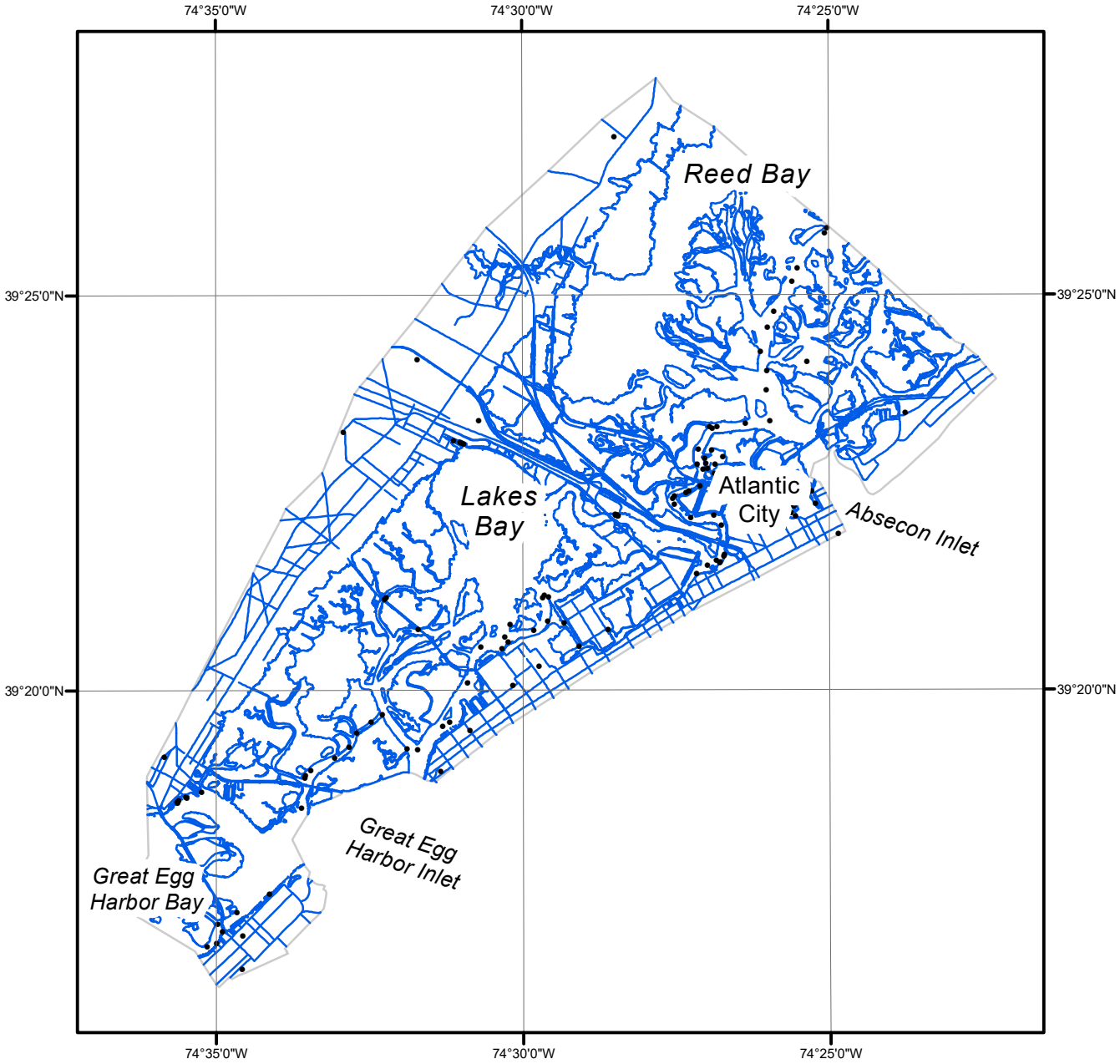
NOAA Shoreline Data Explorer

- GC11655 in shapefile format
- Metadata file for GC11655
- PCR in Adobe PDF format

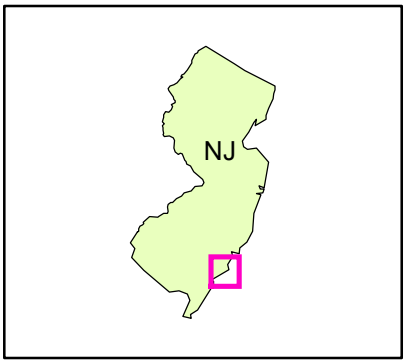
End of Report

BACK BAYS, GREAT EGG HARBOR BAY TO REED BAY

NEW JERSEY



Overview



NJ1404D-TB-C

GC11655