

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

## ***PROJECT MI0806***

### ***Leland, Michigan***

#### **Introduction**

NOAA Coastal Mapping Program (CMP) Project MI0806 provides a highly accurate database of new digital shoreline data for the portion of Lake Michigan in the vicinity of Leland, Michigan.

Successful completion of this project resulted in a densification of the National Spatial Reference System (NSRS), a set of controlled metric-quality digital aerial images, 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 digital aerial images 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 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 Procedure. The instructions discussed the project's purpose, geographic area of coverage, scope and priority; image 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.

#### **Field Operations**

The field operations consisted of the collection of static and kinematic GPS and Inertial Measurement Unit (IMU) data and the acquisition of digital aerial imagery. The photographic mission operations were conducted on May 9, 2008, with the NOAA Cessna Citation II (N52RF) aircraft. Two strips of natural color digital images consisting of five images each for a total of ten images were acquired through use of an Applanix DSS-439 dual camera with a 60 mm lens at an approximate ground sample distance (GSD) of 0.31 meters. Black & White Infrared (IR) images were also collected in tandem with the color imagery, but they were not used in this project.

A temporary GPS base station was established at the Cherry Capital Airport (TVC) using static GPS positioning techniques. Airborne kinematic GPS/IMU data was collected to determine precise camera positions and orientations in order to establish a control network necessary for aerotriangulation. Data collection operations were conducted in accordance with the GPS Controlled Photogrammetry Field Operations Manual. No ground control survey operations were required for this project.

## **GPS Data Reduction**

GPS and IMU data was processed by RSD personnel to provide precise positions of camera centers for application as photogrammetric control in the aerotriangulation phase of project completion. The static GPS base station data was processed in May 2008 using the NGS Online Processing User Service (OPUS). The airborne kinematic data was processed using Applanix POSPAC (ver. 4.4) software in June 2008. For further information refer to the Airborne Positioning and Orientation Report (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 RSD personnel in June 2009 utilizing a Digital Photogrammetric Workstation (DPW), which is a configuration of computer hardware, modular software components, and other associated peripheral devices. The color photographs were measured and adjusted as a single block using BAE Systems SOCET SET (version 5.4.1) photogrammetric suite in conjunction with the Multi-Sensor Triangulation (MST) software module. Upon successful completion of the aerotriangulation process, the MST software provided the standard deviations of the residuals for each aerotriangulated ground point, which were used to compute a predicted horizontal circular error of 0.34 meters 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, 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 this project was initiated by RSD in July 2009. 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 the aerial photographs and information extracted from the appropriate NOAA nautical charts, US 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 MI0806 were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were compiled to meet a horizontal accuracy of 0.7 meters at the 95% confidence level. The predicted accuracy of compiled, well defined points is derived by doubling the circular error calculated from the aerotriangulation statistics.

The following table provides information on the digital imagery used in the project completion:

Date	Time (UTC)	Roll Number	Photo Numbers	Resolution (GSD)	Lake Level*
09-May-2008	20:57-20:57	08NC16	3383-3387	0.31 m	176.0
09-May-2008	21:01-21:01	08NC16	3388-3392	0.31 m	176.0

\*Lake levels are given in meters above IGLD 1985 and are based on actual observations recorded by the NOS gauge at Port Inland, Michigan at the time of photography.

### **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 August 2009. 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 9.2 software. All project data was evaluated for compliance to CMP requirements.

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

14912, Platte Bay to Leland, MI, 1:80,000, 17<sup>th</sup> Ed., May 2003  
with Leland Inset, 1:5,000

### **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 GC10782 file contents, attached to PCR

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

- Project database
- GC10782 in shapefile format
- Digital copy of the PCR in Adobe PDF format
- Chart Evaluation File in shapefile format

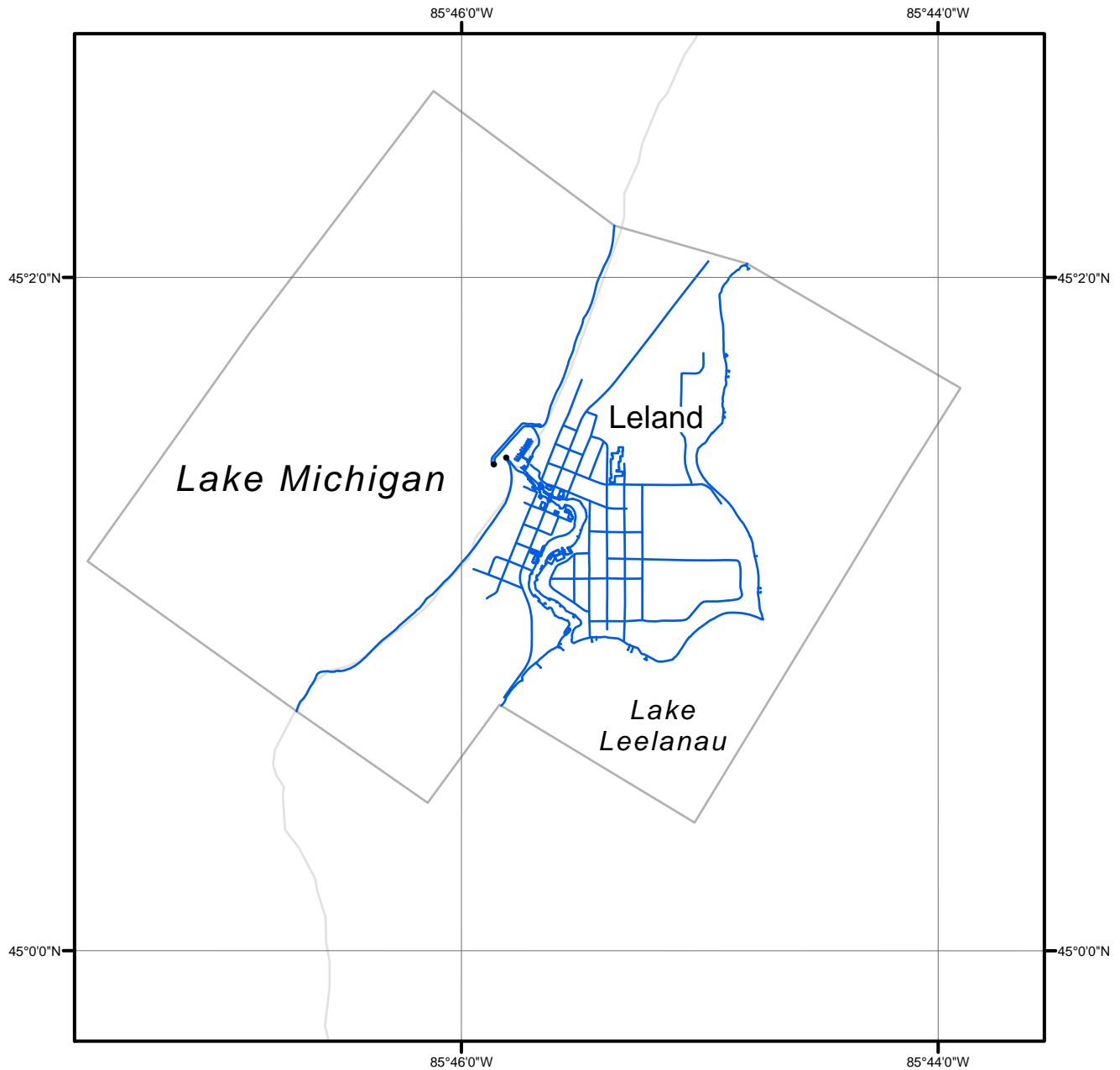
### **NOAA Shoreline Data Explorer**

- GC10782 in shapefile format
- Metadata file for GC10782
- Digital copy of the PCR in Adobe PDF format

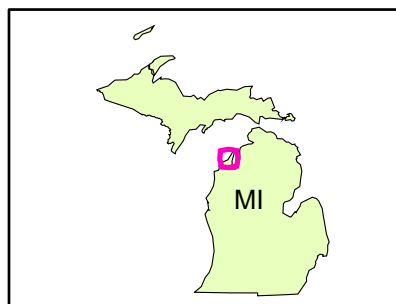
**End of Report**

# LELAND

## MICHIGAN



Overview



MI0806

GC10782