

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT NY0905C

Lake Ontario, Southwick Beach to Wolfe Island, New York and Ontario

Introduction

NOAA Coastal Mapping Program (CMP) Project NY0905C provides a highly accurate database of new digital shoreline data for a portion of Lake Ontario extending from Southwick Beach, New York to Wolfe Island, Ontario. Project NY0905C is a sub-project of a larger project, NY0905, which includes shoreline mapping from Welland Canal in Ontario to Massena in the St. Lawrence River.

Successful completion of this project resulted in 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) formulated the Project Instructions for this project following the guidelines of the "Scope of Work, Shoreline Mapping for the Coastal Mapping Program" (SOW), Version 13B, dated January 08. 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.

This project used digital aerial imagery previously acquired under a contract with the National Geospatial-Intelligence Agency (NGA). The purpose of the NGA project was to produce digital ortho-rectified images maps of the U.S./Canada border regions in the Great Lakes. NOAA recognized the value of using the NGA project data for updating the nautical charts under the Coastal Mapping Program, and arranged with NGA to obtain the original stereo imagery and associated positioning data needed for photogrammetric mapping.

NOAA forwarded all of the NGA provided project imagery, aerotriangulation output data, ground control coordinates, airborne GPS and IMU data, and Photogrammetric Reports to Photo Science, Inc. in order to support photogrammetric processing and feature compilation. NOAA also provided shapefiles depicting the shoreline to be mapped, the

boundaries of the main project and sub-project compilation areas, and flight lines and exposure centers of the imagery to be used for compilation.

Field Operations

Since all source data was provided by NGA through NOAA, Photo Science, Inc. was not required to perform any field operations in connection with this NOAA project. The field operations that were performed by NGA's contractor (3001, Inc.) and their sub-contractors (Photo Science, Inc. and M.J. Harden Associates, Inc.) are described in detail in their Photogrammetric Report for AOI 54, which covers this project area. Following is a brief summary of the field operations as described in that report.

AOI 54

Field operations included the surveying of ground control points (GCPs) and the acquisition of aerial imagery. The coordinates of Seventeen (17) GCPs were established using static and rapid-static GPS techniques. Survey field work was performed between 8/21/2008 and 8/26/2008 by Photo Science, Inc. Aerial imagery was acquired using a Z/I DMC digital camera operated by 3001, Inc. and MJ Harden Associates, Inc. during seven flights between 09/25/2008 and 10/19/2008. Twenty-eight (28) lines of panchromatic, RGB, and NIR imagery were acquired at an approximate altitude of 9,840 feet above mean terrain, resulting in a nominal pan-sharpened image resolution of 0.30 meters GSD. Airborne GPS/IMU and NAVCOM VueStar data were collected during the image acquisition flights in order to determine precise camera position and orientation parameters.

GPS Data Reduction

All GPS/IMU data processing tasks were completed by M.J. Harden & Associates, Inc. and are described in detail in the Photogrammetric Report for AOI 54, which covers this project area. Following is a brief summary of the GPS/IMU data processing tasks described in that report.

Final GCP coordinate values were determined utilizing precise point positioning techniques using Applanix TerraPOS (ver. 1.2) software and the NGS Online Positioning User Service (OPUS). Though the NAVCOM VueStar system provided decimeter level GPS navigation information in real time, the airborne GPS (ABGPS) data was post-processed using TerraPOS software to improve on the real time results. The Applanix POSPac (AIR) software (ver. 5.1) was used to process the IMU data, and with the POSProc and POSEO modules, the post-processed GPS was combined with the IMU data to compute an optimally accurate navigation solution, and final exterior orientation (EO) parameters (x, y, z, omega, phi, kappa) for each photograph.

Aerotriangulation

All aerotriangulation (AT) tasks were completed by M.J. Harden & Associates, Inc. under a prior contract through NGA, and are described in detail in their Photogrammetric Report for AOI 54, which covers this project area. Following is a brief summary of the AT tasks described in that report.

Z/I Mission software (ver. 1.4.0.10) was used to export the frame exposure information collected during the flights, and convert it into ImageStation Photogrammetric Manager (ISPM) format. Intergraph ISPM software (ver. 5.2) was used to create a project from these frame exposure files. Z/I Post Processing System (PPS) software (ver. 5.3) was then utilized to produce 8-bit GeoTIFF images from the raw image data collected during the flights, and corrected EO parameters derived from ABGPS/IMU data were incorporated.

For each DMC virtual image stereo pair, correlated points were generated by an automatic point-matching algorithm using Intergraph ImageStation Automatic Triangulation (ISAT) software (ver. 5.1). Similarly, for each block of images, tie points (photo-identifiable points that occur in the overlap between adjacent flight lines) were automatically generated and GCP's were measured. The ISAT software was then used to develop a least squares bundle adjustment for each block, using the generated tie points, measured GCP's, and post-processed ABGPS/IMU solution as observations. The results of the bundle adjustment were then checked to verify compliance with the accuracy requirement of the project.

The Photogrammetric Reports provided by NGA's contractor included accuracy analyses of their resultant orthophoto images, but did not include full accuracy assessments of the least squares bundle adjustments. Therefore Photo Science used the ISAT output "control" files, which were provided with the rest of the project data, to compute the horizontal accuracy according to NOAA specifications. The ISAT "control" file provided the standard deviations of the residuals for each aerotriangulated ground point. From these standard deviation values the root-mean-square (RMS) for both X and Y coordinates was computed, and these were used to compute a predicted horizontal circular error at the 95% confidence level of 0.3 meters for AOI 54.

Positional data for AOI 54 is referenced to UTM Zone 18N, North American Datum of 1983 (NAD83).

Compilation

The data compilation phase of the project was initiated by Photo Science, Inc. in February 2010. Digital mapping was performed using a DPW in conjunction with the SOCET SET version 5.4.1 Feature Extraction software module, and was based on interpretation of the project imagery, and on information extracted from the appropriate NOAA nautical charts and other ancillary sources. Photo Science Inc. ensured all compiled features were tied properly and matched the existing attribution. 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 NY0905C were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features in AOI 54 were compiled to meet a horizontal accuracy of 0.6 meters at the 95% confidence level. The predicted accuracy of compiled, well defined points is calculated by doubling the

circular error derived from the aerotriangulation statistics.

The following table provides information on aerial photographs used in the project completion:

Date	Time (UTC)	AOI Block	Line Number	Photo Numbers	GSD (nominal)	Lake Level*
9-25-2008	18:45-18:45	54	92001	01-05	0.30 m.	74.7 m.
10-10-2008	14:55-15:01	54	92012	21-56	0.30 m.	74.6 m.
10-10-2008	16:18-16:25	54	92011	16-50	0.30m.	74.6 m.
10-10-2008	16:35-16:42	54	92013	24-61	0.30 m.	74.6 m.
10-10-2008	17:21-17:28	54	92014	27-65	0.30 m.	74.6 m.
10-10-2008	17:40-17:49	54	92010	13-66	0.30 m.	74.6 m.
10-10-2008	18:25-18:36	54	92009	09-65	0.30 m.	74.6 m.
10-10-2008	18:41-18:51	54	92008	07-63	0.30 m.	74.6 m.
10-11-2008	14:42-15:53	54	92018	39-72	0.30 m.	74.6 m.
10-11-2008	16:50-16:57	54	92017	37-71	0.30 m.	74.6 m.
10-11-2008	18:06-18:12	54	92015	31-67	0.30 m.	74.6 m.
10-11-2008	18:30-18:36	54	92019	41-73	0.30 m.	74.6 m.
10-11-2008	18:43-18:46	54	92020	42-59	0.30 m.	74.6 m.
10-12-2008	14:59-15:01	54	92021	41-50	0.30 m.	74.6 m.
10-12-2008	15:37-15:37	54	92022	44-49	0.30 m.	74.6 m.
10-19-2008	14:45-14:50	54	92006	22-54	0.30 m.	74.5 m.
10-19-2008	15:36-17:33	54	92005	22-44	0.30 m.	74.5 m.
10-19-2008	16:10-16:16	54	92007	22-59	0.30 m.	74.5 m.
10-19-2008	16:27-16:30	54	92002	03-23	0.30 m.	74.5 m.
10-19-2008	17:22-17:26	54	92004	11-33	0.30 m.	74.5 m.
4-16-2009	16:10-16:15	54	92016	36-69	0.30 m.	75.1 m.

* Lake water levels are given in meters above IGLD 1985 and are based on verified observations at the Cape Vincent station in New York. The Low Water Datum (LWD) for the portion of Lake Ontario covered by this project is 74.2 m above IGLD 1985.

Quality Control / Final Review

Quality control tasks were conducted during all phases of project completion. The final QC review was completed in November 2010. 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 Arc GIS 9.3 software. All project data was evaluated for compliance to CMP requirements.

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

- 14774, St. Lawrence River, 1:15,000 scale, Jul /04
- 14802, Clayton to False Ducks Is., 1:80,000 scale, Oct /05
- 14811, Chaumont, Henderson and Black River Bays, 1:30,000 scale, Jan /06

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 Photogrammetric Report
- Hardcopy of the Project Completion Report (PCR)
- Page size graphic plot of GC10828 file contents, attached to PCR

Remote Sensing Division Electronic Data Library

- Project database
- GC10828 in shapefile format
- Digital copy of the PCR in Adobe PDF format
- Chart Evaluation File in shapefile format

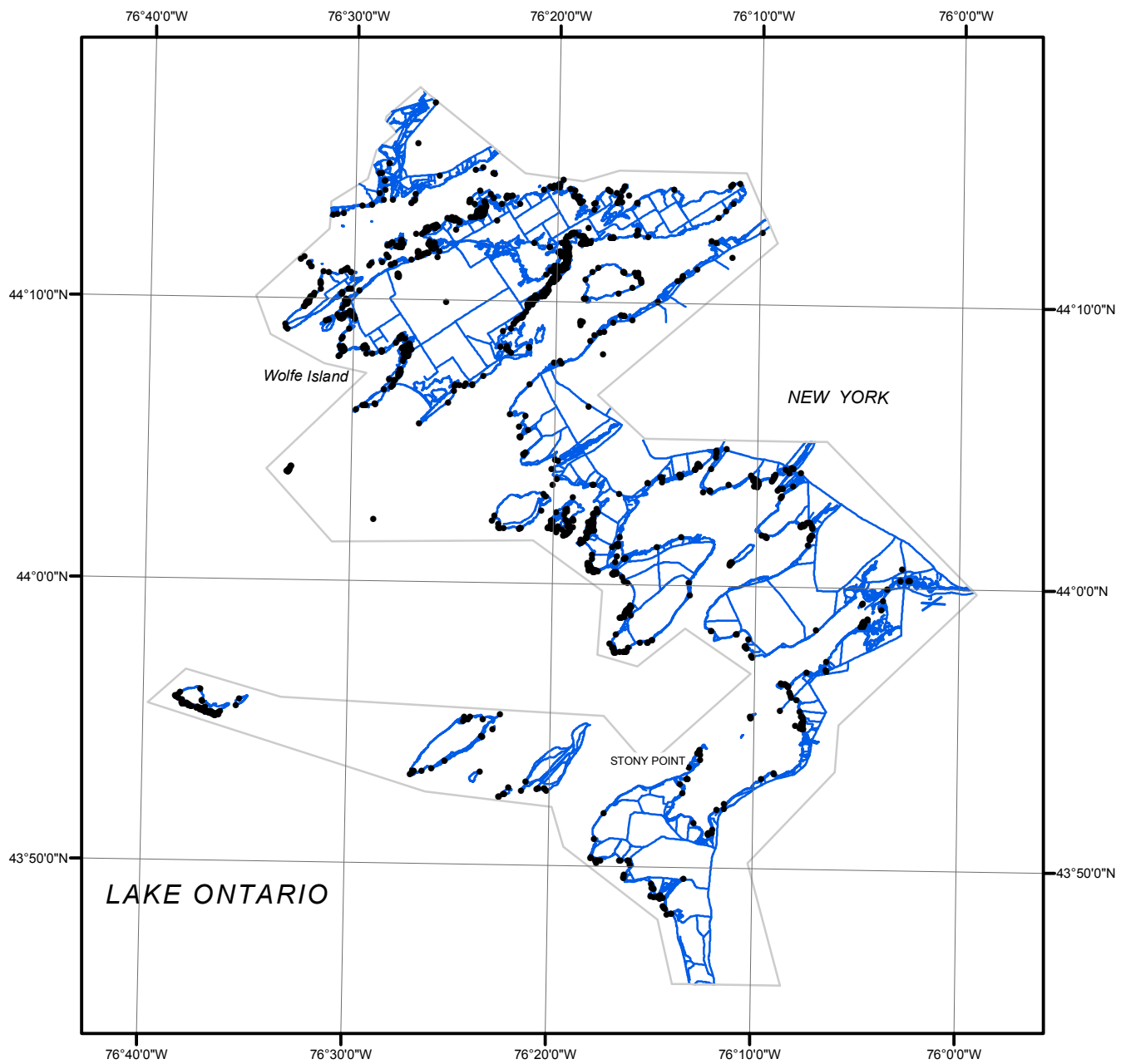
NOAA Shoreline Data Explorer

- GC10828 in shapefile format
- Metadata file for GC10828
- Digital copy of the PCR in Adobe PDF format

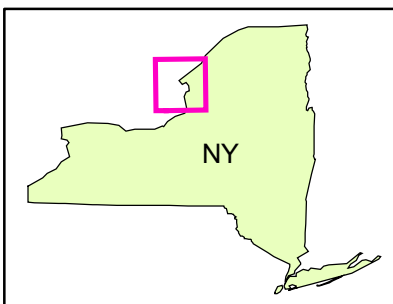
End of Report

LAKE ONTARIO, SOUTHWICK BEACH TO WOLFE ISLAND

NEW YORK- ONTARIO



Overview



NY0905C

GC10828