

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

## ***PROJECT FL1302A-CM-N***

### ***Bridges Intersecting Okeechobee Waterway, Florida***

#### **Introduction**

Coastal Mapping Program (CMP) Project FL1302A-CM-N provides highly accurate digital shoreline data for portions of the Okeechobee Waterway, including portions within the Caloosahatchee River and Canal and the St Lucie Canal, in Florida. In particular, the Geographic Cell (GC) provides compilation of the precise locations and alignments of several bridges that cross the Okeechobee Waterway within the extents of the project. The GC may be used in support of the NOAA Nautical Charting Program (NCP) as well as geographic information systems (GIS) for coastal zone management applications.

#### **Project Design**

Project FL1302A-CM-N was designed per a request from the Marine Chart Division (MCD) of the Office of Coast Survey, NOAA, using source imagery acquired for a larger acquisition project FL1302-CU-N, designed by the Requirements Branch (RB) of the Remote Sensing Division (RSD) to support the Continually Updated Shoreline Product (CUSP), a seamless shoreline database. Photographic mission instructions formulated by RB followed the guidelines of the Photo Mission Standard Operating Procedures, and included the project's purpose, geographic coverage, image requirements, Global Positioning System (GPS) data collection procedures, data recording/handling instructions, and mission communication protocols. Flight maps and input files for the aircraft flight management system were also created by RB.

Subsequent to initial compilation tasks, newer imagery was obtained in order to provide the latest alignment of a bridge span recently replaced. For this purpose a natural color orthomosaic of Leica ADS-100 imagery, with a spatial resolution of 1 meter, was obtained through the National Agriculture Imagery Program (NAIP). Further information on this imagery is available in the NAIP metadata obtained with the imagery, which is on file with other project data within the RSD Electronic Data Library.

#### **Field Operations**

Field operations for FL1302-CU-N consisted of the collection of static and kinematic GPS data and Inertial Measurement Unit (IMU) data, and the acquisition of digital aerial imagery. Aerial survey operations were conducted from March – May 2013 with the NOAA King Air aircraft, and included color and near-infrared (NIR) imagery flown concurrently with an Applanix DSS-439 dual camera system. A subset of eleven strips (out of forty total) were used in sub-project FL1302A-CM-N. All imagery was flown at a nominal altitude of 10,000 feet, resulting in an approximate ground sample distance (GSD) of 0.35 meters. The NIR images were not used for this project.

## Direct Georeferencing Data Processing

GPS/IMU data were processed by RSD personnel to yield precise camera positions and orientations for direct georeferencing (DG) of the imagery. A local GPS base station was established for use as a reference station for kinematic GPS processing operations. The position of the base station was determined using the NGS Online Processing User Service (OPUS), which computed fixed baseline solutions from nearby CORS stations. Airborne kinematic data was processed using Applanix POSPac (ver. 6.1) software in April and May 2013. For further information refer to the Airborne Positioning and Orientation Reports (APOR) on file with other project data within the RSD Electronic Data Library.

The processed GPS/IMU data were used to derive precise exterior orientation (EO) values of the camera centers required for digital feature extraction. The predicted horizontal accuracy of the imagery used for this project was determined by propagating sensor EO and image measurement uncertainties through the photogrammetric collinearity equations using an Exterior Orientation Total Propagated Uncertainty (EO-TPU) tool developed by NGS. Using this tool, the predicted horizontal uncertainty at the 95% confidence level was calculated to be 1.39 meters. NGS third order geodetic control was used to verify horizontal integrity of the DG data.

## Compilation

Compilation of feature data was accomplished by a member of AB in May 2019. Shoreline features previously compiled from monoscopic orthoimagery for the CUSP program were extracted from the CUSP database and reformatted to create a GC. Additional feature data of significance to nautical charting was compiled in the GC from stereoscopic imagery using the Feature Extraction module of BAE Systems' SOCET SET (ver. 5.6) photogrammetric software. Feature identification and the assignment of cartographic codes were based on analysis of the project images and information extracted from the appropriate NOAA Nautical Charts 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 FL1302A-CM-N were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features extracted from DSS imagery were compiled to meet a horizontal accuracy of 2.8 meters at the 95% confidence level. This predicted accuracy of compiled well-defined points measured during the compilation phase was derived by doubling the horizontal uncertainty calculated from the EO-TPU tool. Features extracted from NAIP ortho imagery were compiled to meet a horizontal accuracy of 6 meters at the 95% confidence level, a figure representing the level of accuracy claimed by the image provider.

The table below provides detailed information on the image sources used.

Aerial / DSS				
Date	Time (UTC)	Roll #	Strip / Photo #s	Water Level*
03-21-2013	13:22 – 13:25	13NC05	50-038 / 581 – 595	n/a
03-21-2013	13:27 – 13:29	13NC05	50-040 / 596 – 608	n/a

03-21-2013	13:35 – 13:39	13NC05	50-039 / 617 – 639	n/a
03-21-2013	13:46 – 13:49	13NC05	50-037 / 640 – 653	n/a
03-21-2013	14:05	13NC05	50-026 / 704 – 706	n/a
03-21-2013	14:48 – 14:51	13NC05	50-023 / 810 – 824	n/a
05-09-2013	15:08 – 15:13	13NC29	50-003 / 5509 – 5544	n/a
05-09-2013	15:18 – 15:23	13NC29	50-004 / 5545 – 5578	n/a
05-09-2013	15:28 – 15:33	13NC29	50-005 / 5579 – 5610	n/a
05-09-2013	15:36 – 15:38	13NC29	50-006 / 5611 – 5621	n/a
05-09-2013	15:43	13NC29	50-007 / 5625 – 5627	n/a
<b>NAIP Ortho</b>				
<b>Sensor</b>	<b>Source File Name</b>	<b>Acquisition Date /Time (GMT)</b>	<b>Water Level*</b>	
ADS-100	ortho_1-1_1n_s_fl085_2017_1.sid	2017-12-11 / 14:20 – 14:37	n/a	

\* No water levels are provided since the project area is considered non-tidal.

## Quality Control / Final Review

Quality control (QC) tasks were conducted by a senior member of RSD. The final QC review was completed in June 2019. The review process consisted of an assessment of the identification and attribution of cartographic features 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. 10.6.1). 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 chart was used in the comparison process:

- 11428, Okeechobee Waterway St. Lucie Inlet to Fort Myers, FL, 37<sup>th</sup> Ed., Nov. 2015

## End Products and Deliverables

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

### Remote Sensing Division Electronic Data Library

- Project database
- GC11500 in shapefile format
- Project Completion Report (PCR)
- CEF in shapefile format

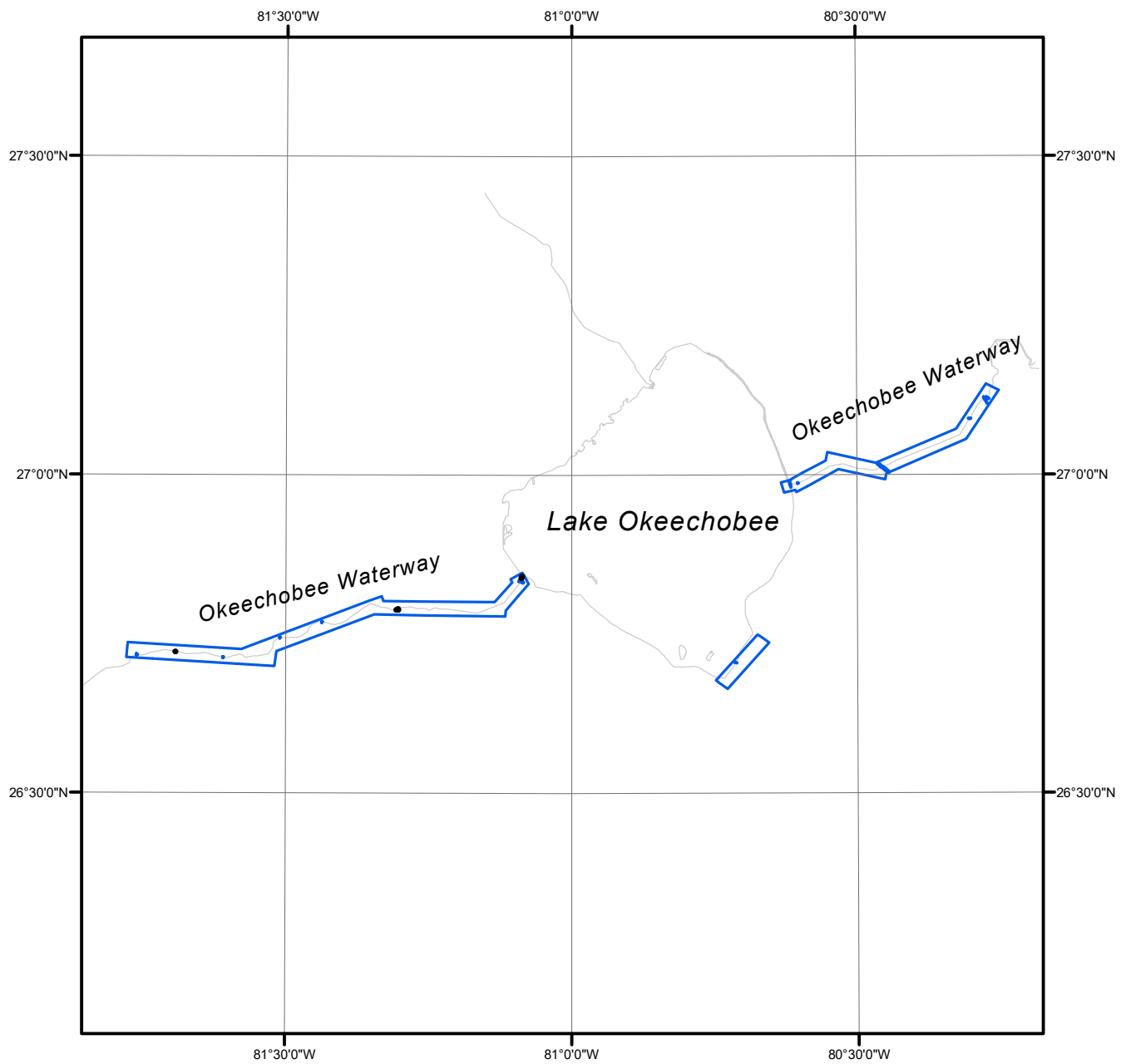
### NOAA Shoreline Data Explorer

- GC11500 in shapefile format
- Metadata file for GC11500
- PCR in Adobe PDF format

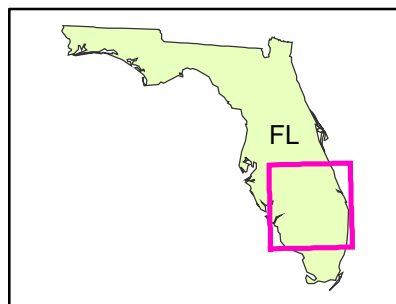
## End of Report

# BRIDGES INTERSECTING OKEECHOBEE WATERWAY

## FLORIDA



Overview



FL1302A-CM-N

GC11500