

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

## ***PROJECT SC0801C***

### ***Broad River, Euhaw Creek to Coosawhatchie River, South Carolina***

#### **Introduction**

NOAA Coastal Mapping Program (CMP) Project SC0801C provides highly accurate digital shoreline data for Broad River and nearby tributaries, in South Carolina. Project SC0801C is a subproject of a larger project SC0801 which extends from St. Helena Sound inland to Huspa Creek and south from Port Royal Sound inland to Coosawhatchie River. 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**

The Requirements Branch (RB) of the Remote Sensing Division (RSD) formulated photographic mission instructions for this project following standard mission guidelines. The instructions discussed the project's purpose, geographic area of coverage, scope and priority; photographic 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 data, Inertial Measurement Unit (IMU) data, and the acquisition of aerial imagery. The photographic mission operations were conducted between October 25<sup>th</sup>, 2009 through February 27<sup>th</sup>, 2013 with the NOAA Citation II (N52RF) and King Air (N68RF) aircraft. Twenty-six flight lines of color and near-infrared (NIR) digital images were acquired concurrently with an Applanix Digital Sensor System (DSS) 439 aerial camera system with one set of color and NIR digital images acquired within tolerance of Mean High Water (MHW) and another set of color and NIR digital images acquired within tolerance of the Mean Lower Low Water (MLLW). All imagery was acquired at a nominal altitude of 10,000 feet, resulting in an approximate GSD of 0.35 meters.

Quantum Spatial, Inc. (QSI) was contracted by RSD to survey ground control points (GCPs). Eight GCPs were established within subproject SC0801C using static GPS techniques. Survey field work was performed between August and October 2017. A Ground Photo Control Report was written and is on file with other project data within the RSD Electronic Data Library.

#### **GPS 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. The final processing of kinematic GPS data using Applanix POSPAC MMS (ver. 6.1) was in performed March 2013. For more information refer to the Airborne Positioning and Orientation Reports (APOR) on file in the RSD Electronic Data Library.

## **Aerotriangulation**

Routine softcopy aerotriangulation (AT) 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 performed by QSI personnel in January 2018 utilizing a digital photogrammetric workstation (DPW), which consists of a stereo-enabled PC-based graphics workstation running the Windows 7 operating system and a suite of digital photogrammetric software known as DAT/EM Summit Evolution (ver. 7.5). The DAT/EM software was used to import the photo measurements, while the Match AT software system (ver. 5.6) was used to perform tie point measurements, both automatic and interactive, and to perform the final block adjustment. Color and NIR images were measured and adjusted as two separate blocks. The final adjustment of the blocks was accomplished by using a rigorous simultaneous least squares bundle adjustment, and analysis tools within Match AT were used to refine the AT solution and to evaluate the accuracy of the adjustment. Upon successful completion of this process, Match AT provided the standard deviations for each aerotriangulated ground point, which were used to compute a predicted horizontal circular error of 0.47 meters for the color images and 1.54 meters for the NIR images. Both of these values are based on a 95% confidence level. An AT Report was written and is on file with other project data within the RSD Electronic Data Library. Positional data is referenced to the North American Datum of 1983 (NAD83).

## **Compilation**

The data compilation phase of this project was initiated by QSI personnel in February 2018. DAT/EM Summit Evolution Professional (ver. 7.5) photogrammetric software was used to extract feature data from stereo imagery, and feature identification, capture, segmentation, and attribution occurred within an ArcMap (ver. 10.4.1) file geodatabase using DAT/EM's stereo module. Feature identification and the assignment of cartographic codes were based on image analysis of the project digital images 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 SC0801C were determined according to standard Federal Geographic Data Committee (FGDC) practices. Most cartographic features were compiled to meet a horizontal accuracy of 0.9 meters. The MLLW depth contour features extracted from the NIR imagery were compiled to meet a horizontal accuracy of 3.1 meters. These predicted accuracies of compiled well-defined points, computed at the 95% confidence level, are derived by doubling the horizontal uncertainties calculated from the AT statistics.

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

Date	Time (UTC)	Color		NIR		Tide Level*
		Roll	Strip/Images	Roll	Strip/Images	
11-04-09	16:23-16:25	09NC19	50-019 / 05651-05664	09NR20	50-019 / 05495-05508	2.5 – 2.7 m
11-04-09	16:38-16:40	09NC19	50-018 / 05726-05739	09NR20	50-018 / 05570-05583	2.4 – 2.6 m
11-04-09	16:44-16:46	09NC19	50-020 / 05740-05752	09NR20	50-020 / 05584-05596	2.3 – 2.6 m
11-05-09	16:58-17:00	09NC20	50-017 / 05813-05825	09NR21	50-017 / 05657-05669	2.6 – 2.8 m
11-05-09	17:05-17:07	09NC20	50-016 / 05826-05836	09NR21	50-016 / 05670-05680	2.7 m
11-05-09	17:23-17:25	09NC20	50-015 / 05915-05923	09NR21	50-015 / 05759-05767	2.6 m
11-06-09	17:56-17:58	09NC12	50-021 / 04163-04174	09NR13	50-021 / 04007-04018	2.5 – 2.7 m
11-07-09	15:36-15:39	09NC21	50-014 / 05987-06005	09NR22	50-014 / 05831-05849	2.3 – 2.4 m
11-08-09	17:26-17:29	09NC23	50-007 / 06169-06185	09NR24	50-007 / 06013-0629	2.4 – 2.5 m
11-08-09	17:48-17:51	09NC23	50-013 / 06287-06305	09NR24	50-013 / 06131-06149	2.1 – 2.6 m
11-08-09	17:54-17:57	09NC23	50-010 / 06306-06327	09NR24	50-010 / 06150-06171	2.5 – 2.7 m
11-08-09	18:16-18:19	09NC23	50-009 / 06435-06454	09NR24	50-009 / 06279-06298	2.6 – 2.7 m
11-08-09	18:23-18:26	09NC23	50-008 / 06455-06472	09NR24	50-008 / 06299-06316	2.6 – 2.7 m
11-08-09	18:45-18:48	09NC23	50-012 / 06575-06595	09NR24	50-012 / 06419-06439	2.3 – 2.8 m
11-08-09	18:52-18:55	09NC23	50-011 / 06596-06618	09NR24	50-011 / 06440-06462	2.6 – 2.8 m
03-25-10	15:24-15:26	10NC37	50-021 / 16685-16697	10NR28	50-021 / 14081-14093	0.1 m
03-25-10	15:32-15:34	10NC37	50-020 / 16698-16710	10NR28	50-020 / 14094-14106	0.1 m
03-25-10	15:48-15:58	10NC37	50-019 / 16766-16784	10NR28	50-019 / 14169-14189	0.1 – 0.2 m
03-30-10	20:14-20:15	10NC38	50-007 / 16883-16892	10NR29	50-007 / 14279-14288	0.0 m
03-31-10	20:57-20:59	10NC39	50-008 / 17171-17188	10NR30	50-008 / 14567-14584	-0.1 – 0.0 m
03-31-10	21:08	10NC39	50-014 / 17203-17207	10NR30	50-014 / 14599-14603	0.1 m
03-31-10	21:31-21:33	10NC39	50-015 / 17280-17289	10NR30	50-015 / 14676-14685	-0.3 m
04-01-10	21:03-21:05	10NC41	50-018 / 17675-17688	10NR32	50-018 / 15071-15084	0.0 – 0.1 m
04-01-10	21:22-21:23	10NC41	50-016 / 17759-17761	10NR32	50-016 / 15155-15157	0.1 m
01-20-12	17:04-17:06	12NC03	50-017 / 00543-00554	12NR02	50-017 / 00202-00213	0.2 – 0.3 m
01-20-12	17:25-17:28	12NC03	50-014 / 00580-00595	12NR02	50-014 / 00239-00254	0.1 m
01-20-12	17:52-17:54	12NC03	50-016 / 00603-00612	12NR02	50-016 / 00262-00271	0.0 – 0.1 m
01-20-12	18:00-18:01	12NC03	50-007 / 00613-00621	12NR02	50-007 / 00272-00280	0.1 m
03-06-12	18:52	12NC19	50-009 / 05150-05153	12NR10	50-009 / 02189-02192	0.2 m
03-06-12	19:00-19:01	12NC19	50-011 / 05182-05186	12NR10	50-011 / 02221-02225	0.2 m
09-24-12	14:25-14:28	12NC77	50-013 / 28370-28389	12NR60	50-013 / 15135-15154	0.3 – 0.5 m
09-24-12	14:37-14:39	12NC77	50-012 / 28416-28433	12NR60	50-012 / 15181-15198	0.3 – 0.5 m

02-27-13	21:02-21:04	13NC01	50-010 / 00100-00115	13NR01	50-010 / 00100-00115	0.0 – 0.1 m
02-27-13	21:09-21:12	13NC01	50-009 / 00117-00132	13NR01	50-009 / 00117-00132	0.0 – 0.1 m
02-27-13	21:19	13NC01	50-010 / 00133-00136	13NR01	50-010 / 00133-00136	-0.1 – 0.0 m
02-27-13	20:54-20:57	13NC01	50-011 / 00076-00094	13NR01	50-011 / 00076-00094	0.0 – 0.1 m
02-27-13	21:01-21:02	13NC01	50-010 / 00096-00099	13NR01	50-010 / 00096-00099	0.1 m

\* Tide levels are given in meters above MLLW and were calculated using the Pydro software tool with a TCARI grid referenced to verified water level observations at NOS gauges throughout the project area. The height of the MHW tidal datum in the project area is approximately 2.02 – 2.53 meters above MLLW.

## Quality Control / Final Review

Quality control tasks were conducted during all phases of project completion by a senior member of QSI. The final QC review was completed in February 2019. The review process included analysis of AT 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 color and NIR images and compiled project data resulted in creation of the Chart Evaluation File (CEF). The following nautical charts were used in the comparison process:

- 11513, St Helena Sound to Savannah River, 28<sup>th</sup> Ed., Jul. 2018
- 11516, Port Royal Sound and Inland Passages, 32<sup>nd</sup> Ed., Dec. 2013
- 11519, Parts of Coosaw and Broad Rivers, 13<sup>th</sup> Ed., May 2014

## 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
- Ground Photo Control Report
- Airborne Positioning and Orientation Report (APOR)
- Aerotriangulation Report
- GC11322 in shapefile format
- Project Completion Report (PCR)
- CEF in shapefile format

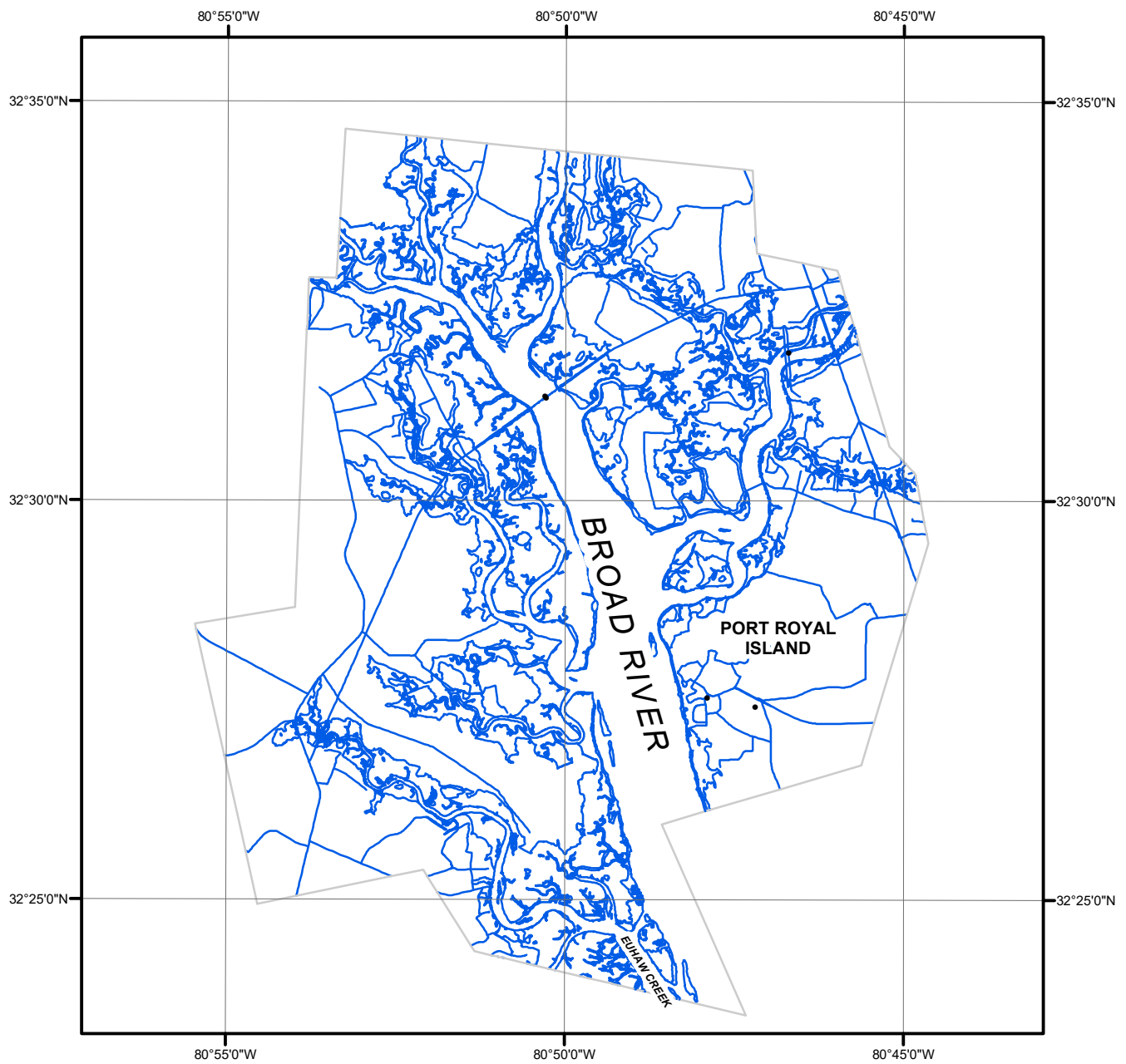
### NOAA Shoreline Data Explorer

- GC11322 in shapefile format
- Metadata file for GC11322
- PCR in Adobe PDF format

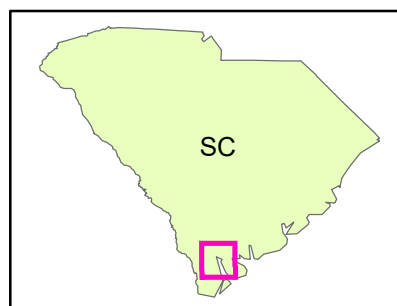
## End of Report

# BROAD RIVER, EUHAW CREEK TO COOSAWHATCHIE RIVER

## SOUTH CAROLINA



Overview



SC0801C

GC11322