

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT CA1213A

San Francisco Bay Bridge, California

Introduction

NOAA Coastal Mapping Program (CMP) Project CA1213A provides a highly accurate dataset of coastal feature data including the San Francisco Bay Bridge and shorelines in the immediate vicinity. Project CA1213A is a subproject of a larger project CA1213, which covers the eastern and southern portions of the San Francisco Bay from Carquinez Strait to the Golden Gate. 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

Project CA1213A was designed in response to a request from the Marine Chart Division (MCD) of the Office of Coast Survey, NOAA. Photographic mission instructions for CA1213 were formulated by the Requirements Branch (RB) of the Remote Sensing Division (RSD) following the guidelines of RSD's Photo Mission Standard Operating Procedures. The instructions discussed the project's purpose, geographic area of coverage, scope and priority, image requirements, Global Positioning System (GPS) data collection procedures and guidelines, instructions for data recording and handling, and mission communication protocols. RB created a Project Layout Diagram, flight maps and input files for the aircraft flight management system.

Field Operations

Field operations for CA1213 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 April 17, 2013 through February 24, 2014 with the NOAA King Air aircraft (N68RF). Project imagery included thirty-four (34) flight lines of natural color and near-infrared (NIR) imagery acquired concurrently using an Applanix DSS-439 dual head digital camera system (two 60 mm lenses), in coordination with both MLLW and MHW tide levels. All imagery was acquired at a nominal altitude of 10,000 feet, resulting in an approximate ground sample distance (GSD) of 0.35 meters.

Direct Georeferencing Data Processing

The GPS/IMU data for Project CA1213 were processed by RSD personnel to yield precise camera positions and orientations. GPS base stations were established for use as a reference stations for kinematic GPS processing operations. The positions of base stations were determined using the NGS Online Processing User Service (OPUS), which computed fixed baseline solutions from nearby CORS stations. The airborne kinematic data was processed using POSPac MMS 6.1 GPS/IMU software in May and November 2013 and POSPac MMS 6.2 in March 2014. For further information refer to the Airborne Positioning and Orientation Reports (APOR)

on file with other project data within the RSD Applications Branch (AB) Project Archive.

For Project CA1213A, no aerial triangulation processing was conducted. Upon completion of the processing of GPS/IMU data, the processed data were used to derive precise exterior orientation (EO) values of the camera centers required for digital feature extraction. A predicted horizontal accuracy of the imagery was determined by propagating sensor EO and image measurement uncertainties through the photogrammetric collinearity equations using an Excel spreadsheet based 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 1.3 meters for the imagery subset used to compile data for CA1213A.

Published coordinates for NGS third order geodetic control points on San Francisco Bay Bridge (piers 2, 3, and 4) were used to verify the horizontal integrity of the directly georeferenced (DG) imagery. Stereo-models were examined for parallax and found to be acceptable.

Compilation

The data compilation phase of this project was accomplished by RSD Applications Branch (AB) personnel in April 2014. Digital mapping was performed using the Feature Extraction software module within SOCET SET (ver. 5.6). Feature identification and attribution within the GC were based on image analysis of the aerial imagery and information extracted from the largest scale NOAA nautical chart 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 CA1213A were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were compiled to meet a horizontal accuracy of 2.7 meters. This predicted accuracy of well-defined points measured during the compilation phase was derived by doubling the imagery accuracy computed from the EO-TPU tool.

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

Date	Time (UTC)	Roll #	Flight Line / Photo #s	Tide Level*
4/23/2013	18:01	13NC16	50-010 / 3590 – 3593 † (C11364893, C11364901, C11364909, C11364917)	1.6 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 the time of photography from various NOS gauges in the vicinity of the project. The elevation of the MHW tidal datum in the project area is 1.71 m. above MLLW.

† Original DSS image IDs. Imagery not renamed to strip/frame designation at time of project execution.

Quality Control / Final Review

Quality control tasks were conducted during all phases of project completion by a senior member of RSD. The final QC review was completed in April 2014. The review process included

analysis of the DG 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 9.3.1 software. All project data was evaluated for compliance to CMP requirements.

A Chart Evaluation File (CEF) resulted from the comparison of source imagery and compiled project data with the largest scale NOAA nautical chart covering the project area:

18650, San Francisco Bay, 1:20,000, 57th Ed., Dec./13

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 Data Acquisition Summary for CA1213A
- Hardcopy of the APOR for data used in CA1213A
- Hardcopy of the Project Completion Report (PCR)
- Page-size graphic plot of GC11067 file contents, attached to PCR

Remote Sensing Division Electronic Data Library

- Project database
- GC11067 in shapefile format
- Digital copy of the PCR in Adobe PDF format
- CEF in shapefile format

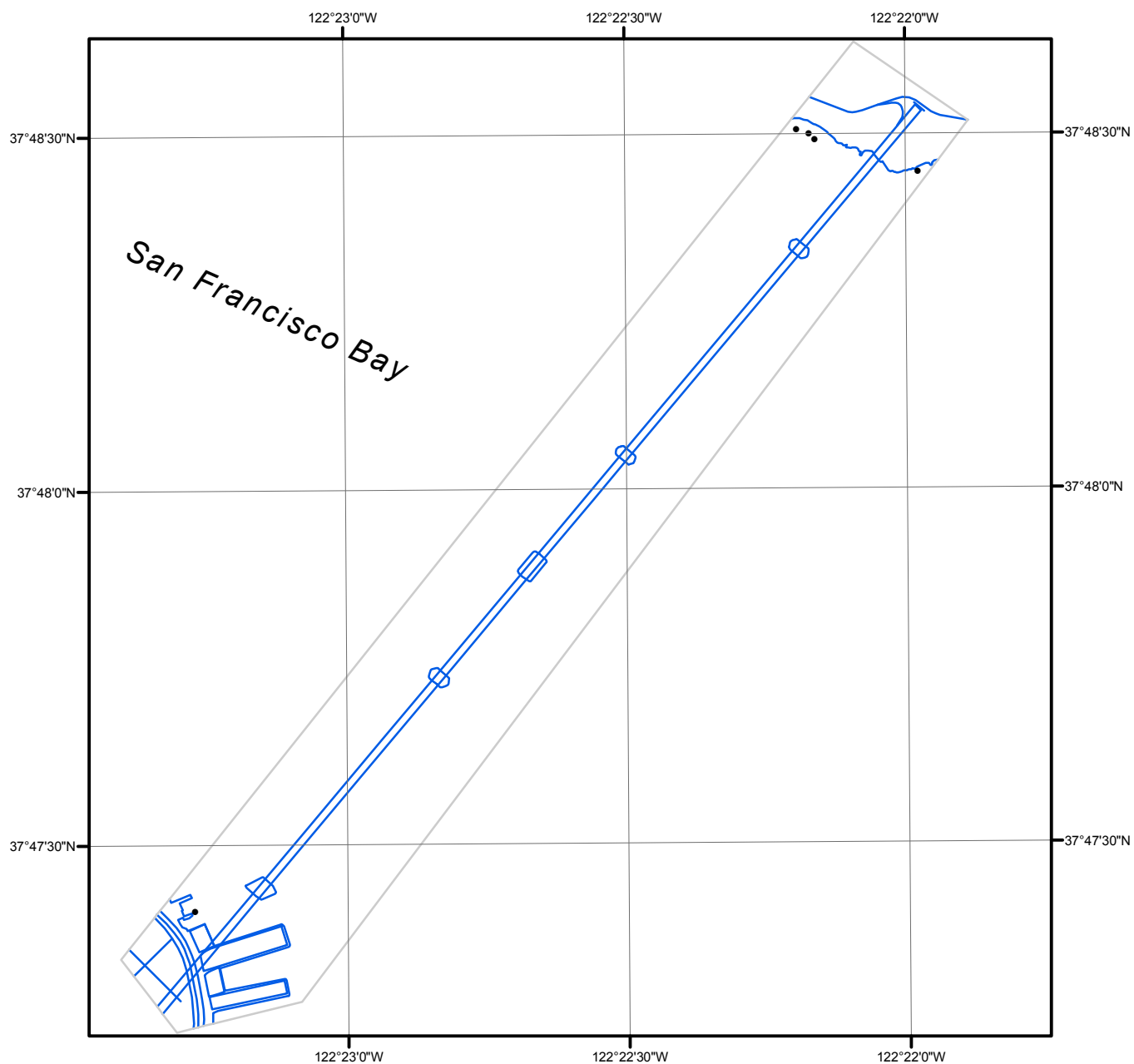
NOAA Shoreline Data Explorer

- GC11067 in shapefile format
- Metadata file for GC11067
- Digital copy of the PCR in Adobe PDF format

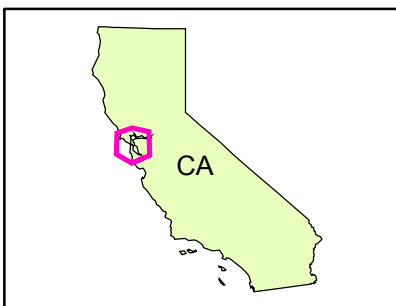
End of Report

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CALIFORNIA



Overview



CA1213A

GC11067