

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT CA0606

Port of Richmond, California

Introduction

NOAA Coastal Mapping Program (CMP) Project CA0606 provides a highly accurate database of new digital shoreline data for the port of Richmond, California, and the surrounding area. 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 design of Project CA0606 was accomplished by the Requirements Branch (RB) of the Remote Sensing Division (RSD) in response to the need for timely updates to the NOAA Electronic Navigational Chart (ENC) series. Project requirements were formulated as a result of analysis conducted within the Coast and Shoreline Change Analysis Program (CSCAP), in which NOAA nautical chart products are compared to contemporary high resolution satellite imagery in order to ascertain the need for more current shoreline data. Refer to the RB Memorandum of January 29, 2007, "Results of CSCAP Change Analysis for Richmond, California (CA0606)" for details of the chart comparison process.

Field Operations

The field operations consisted of the collection of static and kinematic Global Positioning System (GPS) data and the acquisition of aerial imagery. The photographic mission operations were conducted on November 6th, 2006, with the NOAA Cessna Citation II aircraft. Two strips (30-1 and 30-2) of natural color photographs were acquired through use of a Wild RC-30 camera with the NOS "A" lens cone at the nominal scale of 1:30,000. The collection of these photographs was not coordinated with local tides.

The base station was established at Oakland International Airport using static GPS. Airborne kinematic GPS data was collected in conjunction with Inertial Measurement Unit (IMU) data to determine precise camera positions and orientations. GPS data collection operations were conducted in accordance with the GPS Controlled Photogrammetry Field Operations Manual.

GPS Data Reduction

The GPS/IMU data was processed 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 December 2006 using the NGS Online Processing User Service (OPUS) software to compute fixed baseline

solutions from three CORS stations. The final NAD83 position reported by OPUS was the average of these three baseline solutions. The airborne kinematic data was processed using Applanix POSGPS (ver. 4.3) software in April 2007. An Airborne Positioning and Orientation Report (APOR) was written and is on file with other project data within the RSD Applications Branch (AB) Project Archive.

Aerotriangulation

Routine softcopy aerotriangulation methods were applied to establish the 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 Applications Branch (AB) personnel in May 2007 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 two separate blocks using BAE Systems' SOCET SET (version 5.3) photogrammetric software in conjunction with the Multi-Sensor Triangulation Package (MST) aerotriangulation software. Upon successful completion of the aerotriangulation process, the MST software provided the RMS of the standard deviations of the residuals for each aerotriangulated ground point which were used to compute an overall predicted horizontal circular error of 0.8 meters based on a 95% confidence level. An Aerotriangulation Report and accuracy assessment were written and are 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 based on the UTM Coordinate System (Zone 10) and is referenced to the North American Datum of 1983 (NAD 83).

Compilation

The data compilation phase of this project was accomplished by AB CMP personnel in May 2007. 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 1:30,000 scale 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 Project CA0606 were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were compiled to meet a horizontal accuracy of 1.6 meters at the 95% confidence level. This predicted accuracy of compiled, well defined points is computed by doubling the circular error derived from aerotriangulation statistics.

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

Date	Time (UTC)	Roll Number	Photo Numbers	Scale (Nominal)	Tide Level*
11-06-06	19:50:20 - 19:57:26	06ACN18	2830-2839	1:30,000	2.1 - 2.2

* Tide levels are given in meters above MLLW, and are based on actual observations recorded by the NOS tide gauge at San Francisco (ID 9414290), with offsets calculated at various substations around the project area. The elevation of the MHW tidal datum in the project area is equal to 1.7 m above MLLW.

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 May 2007. The review process included analysis of aerotriangulation results and assessment of the identification and attribution of cartographic features 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 9.1 software. All project data was evaluated for compliance to CMP requirements.

Comparisons of the largest scale NOAA nautical charts with digital 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:

18649 Entrance to San Francisco Bay, CA, 1:40,000, 65th Ed., Jul./06

18653 Angel Island to Pt. San Pedro, CA, 1:20,000, 10th Ed., Jul./05

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 GC10671 file contents, attached to PCR
- Hardcopy of the CSCAP evaluation memorandum

Remote Sensing Division Electronic Data Library

- Project Database
- GC10671 in ESRI shapefile format
- Digital copy of the PCR in Adobe PDF format
- Chart Evaluation File (CEF) in shapefile format

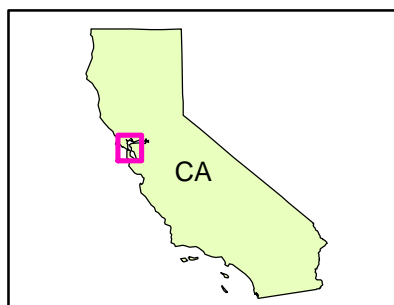
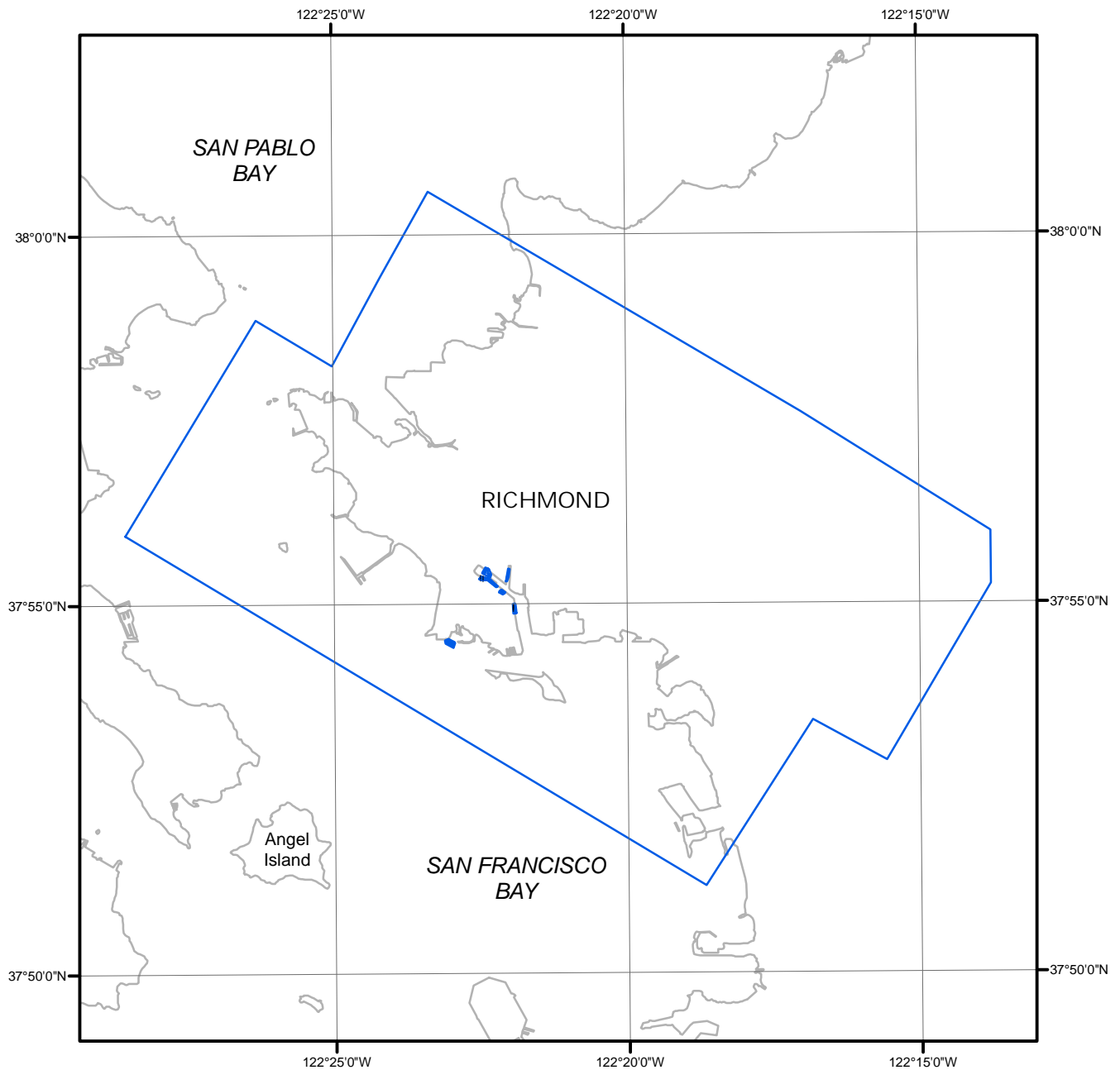
NOAA Shoreline Data Explorer

- GC10671 in shapefile format
- Metadata file for GC10671
- Digital copy of the PCR in Adobe PDF format

End of Report

PORT OF RICHMOND

CALIFORNIA



CA0606

GC10671