NOAA COASTAL MAPPING PROGRAM
PROJECT COMPLETION REPORT

PROJECT CA1203A-CM-N

Moss Landing Harbor, California

Introduction

NOAA Coastal Mapping Program (CMP) Project CA1203A-CM-N provides a highly accurate dataset of shoreline feature data for Moss Landing Harbor and Elkhorn Slough, California. Project CA1203A-CM-N is a subproject of a larger acquisition project, CA1203-CM-N, which extends from Lopez Rock to Pescadero Point, in California. 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 CA1203-CM-N was designed by the Requirements Branch (RB) of the Remote Sensing Division (RSD) to provide Mean Lower Low Water (MLLW)-coordinated imagery to complement topographic-bathymetric ("topobathy") lidar data obtained from the United States Army Corps of Engineers (USACE) Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX) for the development of GCs. RB formulated the photographic mission instructions for this project following the guidelines of the Photo Mission Standard Operating Procedure. 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

The field operations consisted of acquisition of aerial imagery, static and kinematic GPS data, and inertial measurement unit (IMU) data. Aerial imagery was acquired using an Applanix Digital Sensor System (DSS 439) dual camera with the NOAA King Air aircraft (N68RF) in April 2012. The image acquisition consisted of 22 lines of color (RGB) and near-infrared (NIR) imagery acquired concurrently in coordination with the MLLW tide stage. Portions of a subset of 4 lines of imagery was used for Project CA1203A-CM-N. 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 CA1203-CM-N were processed by RSD personnel to yield precise camera positions and orientations for direct georeferencing (DG) of the imagery. GPS base stations were established for use as reference stations for kinematic GPS processing. The positions of the base stations were determined using the NGS Online Processing User Service (OPUS), which computed fixed baseline solutions from nearby CORS stations. Kinematic data

was processed using POSPac MMS (ver. 5.4) GPS/IMU software in April 2012. For further information refer to the Airborne Positioning and Orientation Report (APOR) on file with other project data within the RSD Electronic Data Library.

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 the 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 1.4 meters. Stereo models were examined for parallax and found to be acceptable for use in compilation.

Compilation

The data compilation phase of Project CA1203A-CM-N was accomplished by RSD Applications Branch (AB) personnel in September 2021. The compilation incorporated Mean High Water (MHW) vector contours previously derived from the JALBTCX topobathy lidar data collected in November 2010. RSD personnel performed quality control (QC), point classification, and formatting on the lidar data with GeoCue, Terrasolid, and Global Mapper software. NOAA VDatum software was used to convert the vertical datum of the lidar points from NAD83 ellipsoid to local MHW tidal datums. QTModeler and custom ArcGIS Scripts were used to produce bare earth MHW digital elevation models (DEMs) at a 1-meter grid resolution and to create and format the MHW vectors into shapefile format. For further information on the lidar source data refer to the JALBTCX metadata on file with other project data within the RSD Electronic Data Library.

Compilation was performed using the Feature Extraction module within BAE's SOCET SET (ver. 5.6) photogrammetric software suite. 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 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 CA1203A-CM-N were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features extracted from imagery were compiled to meet a horizontal accuracy of 2.8 meters at the 95% confidence level. 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 lidar point cloud was compared to higher accuracy ground control points to determine vertical uncertainties of the data set, and then compared to the morphologic slope around the derived shoreline to determine the uncertainty of the vectors. Based on this assessment, the MHW lidar-derived shoreline vectors meet a horizontal accuracy of 3.1 meters at the 95% confidence level.

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

Date	Time (UTC)	Color Imagery		Infrared Imagery		Tide Level*
		Roll	Images	Roll	Images	
4-2-2012	22:37 – 22:38	12NC21	50-009/05704 – 05713	12NR12	50-009/02743 – 02752	0.1 m
4-2-2012	22:43 – 22:44	12NC21	50-010/05714 – 05727	12NR12	50-010/02753– 02766	0.1 m
4-3-2012	21:12 – 21:13	12NC22	50-012/05779 – 05788	12NR31	50-012/07050 – 07059	0.1 m
4-3-2012	21:22 – 21:23	12NC22	50-011/05817 – 05822	12NR31	50-011/07088 – 07093	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 from various NOS gauges in the vicinity of the project. The height of the MHW tidal datum in the project area ranges from 1.37 – 1.42 meters above MLLW.

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 October 2021. 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 Esri's ArcGIS (ver. 10.8.1) desktop GIS 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 Electronic Navigational Chart (ENC) covering the project area:

- ENC US5CA50M, 10th Ed., Jun. 2018

End Products and Deliverables

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

Remote Sensing Division Electronic Data Library
- Data Acquisition Summary
- Airborne Positioning and Orientation Report (APOR)
- Project database
- GC11734 in shapefile format
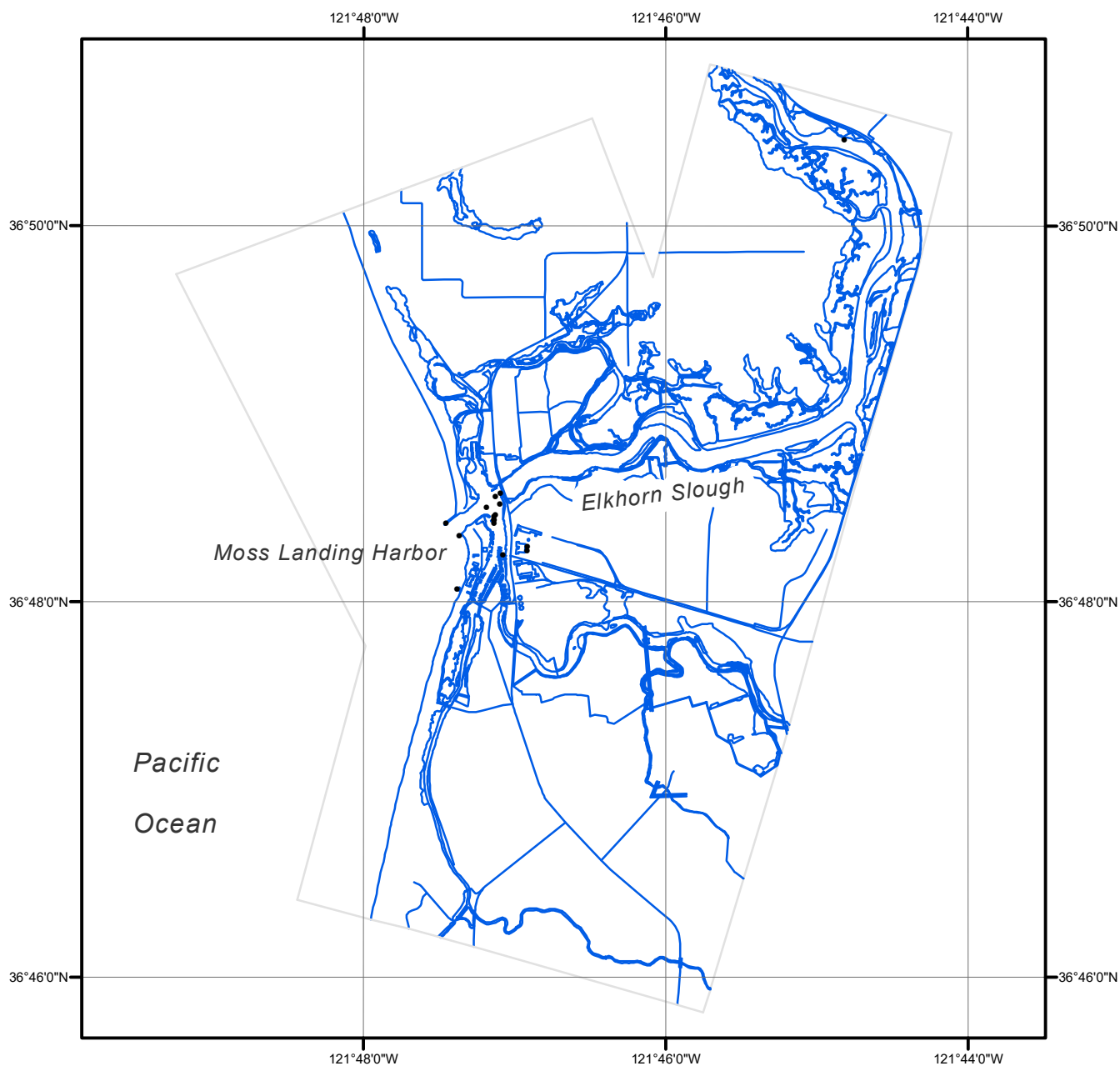- Project Completion Report (PCR)
- CEF in shapefile format

NOAA Shoreline Data Explorer
- GC11734 in shapefile format
- Metadata file for GC11734
- PCR in Adobe PDF format

End of Report

MOSS LANDING HARBOR

CALIFORNIA

121°48'0"W 121°46'0"W 121°44'0"W

36°50'0"N

36°48'0"N

36°46'0"N

Elkhorn Slough

Moss Landing Harbor

Pacific

Ocean

Overview

CA

CA1203A-CM-N

GC11734