

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT WA1406C-CM-N

Puget Sound, Nisqually Reach to Case Inlet, Washington

Introduction

NOAA Coastal Mapping Program (CMP) Project WA1406C-CM-N provides a highly accurate database of new digital shoreline data for Puget Sound, from Nisqually Reach to Case Inlet, in Washington. This is a subproject of a larger imagery acquisition project, WA1406-CM-N, which provides coverage of Southern Puget Sound from Vashon Island to Oakland Bay, Washington. 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

Photographic mission instructions for WA1406-CM-N were formulated by the Requirements Branch (RB) of the Remote Sensing Division (RSD) following the guidelines of the 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

The field operations for Project WA1406-CM-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 August 2014 through June 2016, and included 49 flight lines of natural color (RGB) and near-infrared (NIR) imagery acquired concurrently with Applanix DSS 439 (2014 imagery) and DSS 580/560 (2016 imagery) dual cameras on the NOAA King Air aircraft (N68RF) in coordination with both the Mean High Water (MHW) and Mean Lower Low Water (MLLW) tide stages. For subproject WA1406C-CM-N, a subset of thirteen flight lines were used. All imagery was acquired at a nominal altitude of 10,500 feet resulting in an approximate Ground Sample Distance (GSD) that varies between 0.33 – 0.37 meters depending on the camera used and imagery type acquired.

Direct Georeferencing Data Processing

The 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 Airborne kinematic data for project WA1406-CM-N was processed using Applanix POSPac MMS (ver.6.2 and

ver.7.1) software from September 2014 to September 2016. For further information refer to the Airborne Positioning and Orientation Reports (APORs) 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 was calculated 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 for imagery used in subproject WA1406C-CM-N was calculated to be 0.85 meters. All positional data is referenced to the North American Datum of 1983 (NAD83).

NGS third order control was used to verify the horizontal integrity of the DG data. All stereo models were examined and found to have acceptable levels of parallax for mapping purposes.

Compilation

The data compilation phase of this project was completed by RSD Applications Branch (AB) personnel in August 2021. 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 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 WA1406C-CM-N were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features compiled from directly georeferenced images were compiled to meet a horizontal accuracy of 1.7 meters, a predicted accuracy of well-defined points measured during the compilation phase, derived by doubling the imagery accuracy computed from the EO-TPU tool.

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

Date	Time (UTC)	RGB Imagery		NIR Imagery		Tide Level*
		Roll	Strip / Images	Roll	Strip / Images	
8/25/14	19:19-19:20	14NC74	53-036 / 17456-17459	14NR65	53-036 / 14204-14207	0.2
8/25/14	19:35-19:36	14NC74	53-041 / 17506-17512	14NR65	53-041 / 14254-14260	0.2
8/25/14	19:55-19:59	14NC74	53-008 / 17543-17566	14NR65	53-008 / 14291-14314	0.3
8/25/14	20:12-20:14	14NC74	53-010 / 17591-17605	14NR65	53-010 / 14339-14353	0.4
5/7/16	00:14-00:15	16VC50	53-041 / 12572-12577	16VR50	53-041 / 12575-12580	3.8
5/7/16	00:19-00:23	16VC50	53-007 / 12578-12601	16VR50	53-007 / 12582-12605	3.8 – 4.0
5/7/16	00:27-00:31	16VC50	53-008 / 12602-12625	16VR50	53-008 / 12606-12629	4.0 - 3.9
5/7/16	00:35-00:36	16VC50	53-038 / 12626-12630	16VR50	53-038 / 12630-12634	3.9
5/7/16	00:47-00:48	16VC50	53-036 / 12676-12680	16VR50	53-036 / 12680-12684	4.0

5/7/16	18:00-18:01	16VC51	53-038 / 12718-12722	16VR51	53-038 / 12722-12726	0.2
5/7/16	18:07-18:10	16VC51	53-007 / 12723-12746	16VR51	53-007 / 12727-12750	0.1 - 0.2
5/7/16	18:15-18:17	16VC51	53-011 / 12747-12758	16VR51	53-011 / 12751-12762	0.2 - 0.0
5/7/16	18:23-18:27	16VC51	53-022 / 12759-12785	16VR51	53-022 / 12763-12789	-0.1 - 0.0
5/7/16	18:32-18:34	16VC51	53-017 / 12786-12802	16VR51	53-017 / 12790-12806	-0.2 - 0.0
5/7/16	18:40-18:43	16VC51	53-019 / 12803-12825	16VR51	53-019 / 12807-12829	-0.2
5/7/16	18:47-18:50	16VC51	53-016 / 12826-12843	16VR51	53-016 / 12830-12847	-0.2 - -0.3
5/7/16	18:54-18:56	16VC51	53-033 / 12844-12859	16VR51	53-033 / 12848-12863	-0.4
5/7/16	21:06-21:07	16VC52	53-005 / 12901-12910	16VR52	53-005 / 12905-12914	-0.2
5/8/16	00:46-00:47	16VC53	53-011 / 13065-13076	16VR53	53-011 / 13069-13080	3.7 - 3.9
5/8/16	00:52-00:54	16VC53	53-010 / 13079-13093	16VR53	53-010 / 13083-13097	3.9
5/10/16	15:15-15:18	16VC55	53-019 / 13172-13194	16VR55	53-019 / 13176-13198	4.1 - 4.0
5/10/16	15:23-15:26	16VC55	53-016 / 13195-13212	16VR55	53-016 / 13199-13216	4.0 - 4.1
5/10/16	15:31-15:33	16VC55	53-033 / 13213-13228	16VR55	53-033 / 13217-13232	4.1
5/10/16	15:38-15:39	16VC55	53-005 / 13229-13238	16VR55	53-005 / 13233-13242	4.0
5/10/16	15:44-15:47	16VC55	53-017 / 13242-13258	16VR55	53-017 / 13246-13262	4.0
5/10/16	15:52-15:56	16VC55	53-022 / 13259-13285	16VR55	53-022 / 13263-13289	3.8 - 4.0

* 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. The height of the MHW tidal datum in the project area varies between 3.86 – 4.06 meters above MLLW.

Quality Control / Final Review

Quality control tasks were conducted during all phases of project completion by a senior member of the CMP. The final QC review was completed in September 2021. 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. 10.8.1). All project data was evaluated for compliance to CMP requirements

Comparisons of the largest scale NOAA nautical charts with source imagery and compiled project data resulted in creation of the Chart Evaluation File (CEF). The following ENC's were used in the comparison process:

- US4WA10M, 38th Ed., Jan. 2020
- US5WA23M, 14th Ed., Dec. 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

- Project database

- Airborne Positioning and Orientation Reports
- GC11684 in shapefile format
- Project Completion Report (PCR)
- CEF in shapefile format

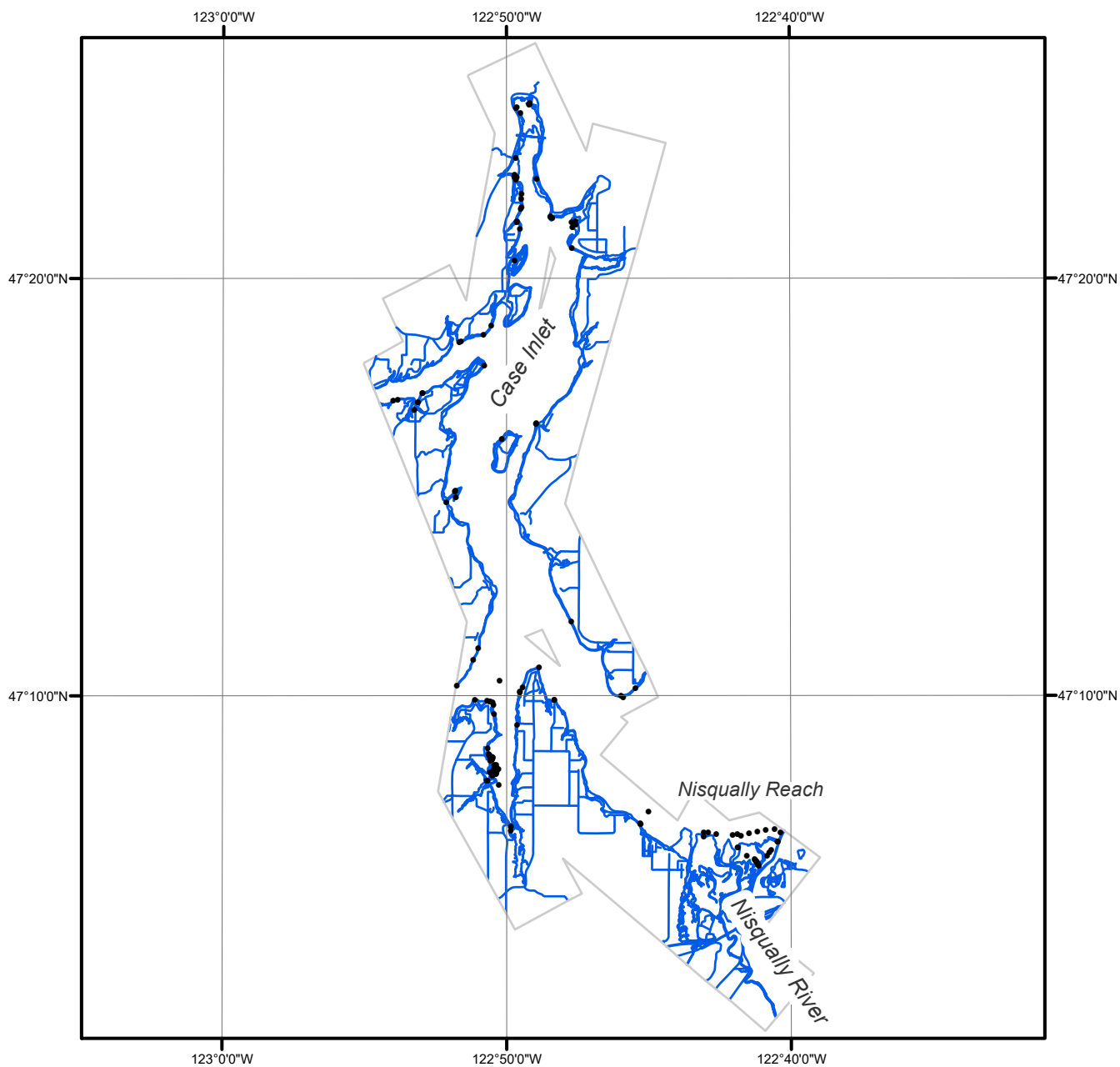
NOAA Shoreline Data Explorer

- GC11684 in shapefile format
- Metadata file for GC11684
- PCR in Adobe PDF format

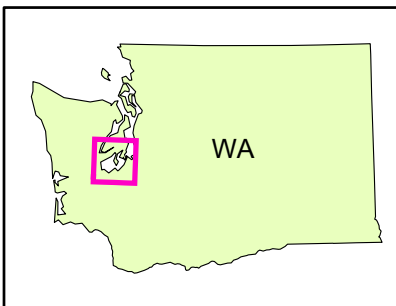
End of Report

PUGET SOUND, NISQUALLY REACH TO CASE INLET

WASHINGTON



Overview



WA1406C-CM-N

GC11684