NOAA COASTAL MAPPING PROGRAM
PROJECT COMPLETION REPORT

PROJECT CT0401E

Thames River, Connecticut

Introduction

NOAA Coastal Mapping Program (CMP) Project CT0401E provides a highly accurate database covering the Thames River, from New London to Norwich as well as a portion of Poquetanuck Cove, Yantic River and Shetucket River. Project CT0401E is a sub-project of a larger project CT0401, which includes the entire coast of Connecticut, and parts of New York and Rhode Island.

Successful completion of this project resulted in a densification of the National Spatial Reference System (NSRS), a set of controlled metric-quality aerial photographs, and digital feature data of the coastal zone which complements the Nautical Charting Program (NCP) as well as geographic information systems (GIS) for a variety of coastal zone management applications.

The project database consists of information measured and extracted from aerial photographs and metadata related to photogrammetric compilation. Base mapping was conducted in a digital environment using stereo softcopy photogrammetry and associated cartographic practices.

Project Design

The design of project CT0401 was based on a comparison of image analysis to cartographic detail depicted on the pertinent NOAA nautical charts of the project site. The Requirements Branch (RB) of the Remote Sensing Division (RSD) formulated the CT0401 project instructions for this project. The instructions discussed the project's purpose, geographic area of coverage, scope and priority; photographic requirements; flight line priority; GPS data collection procedures and guidelines for both kinematic and static surveys; data recording and handling instructions; and contact and communication information.

RSD created a Project Layout Diagram, and flight maps. NOVA Digital Systems, Inc. created the input files for the aircraft's flight management system and provided copies of the descriptions of potential geodetic control stations at the bases of operation.

Field Operations

All field operations were in support of the larger CT0401 project, which includes this sub-project along with sub-projects CT0401A, CT0401B, CT0401C, and CT0401D. The Sanborn Map Company, Inc., a consultant of NOVA, conducted the airborne survey operations on the following dates:

Natural Color photography – September 6, 2005,
IR - MHW photography – September 5 & September 7, 2005,
IR - MLLW photography –May 22, June 18, June 21 and August 12, 2006,

All airborne collections were accomplished within the calculated MHW and MLLW tide windows. A Cessna T206 aircraft was used to acquire both the natural color photographs and the tide-coordinated MHW black and white (B+W) infrared (IR) photographs. A Piper PA31 was used to acquire the tide-coordinated MLLW B+W IR photographs. Both aircraft used the same Wild RC-30 camera (NOAA contract camera designator #26). All aerial photographs were acquired at the nominal scale of 1:30,000 with Airborne–GPS (ABGPS). Two ground-based static GPS datasets (NGS station GON-A, CORS station RVDI) were collected, during each photographic mission, as reference position data for the differential correction of the ABGPS data.

Prior to the collection of photography, twenty-six (26) GPS ground control points were set up and paneled for photo identification. Twenty-two (22) of these points were used to supplement the Airborne GPS controlled imagery and four were used as check points not used in the aero-triangulation (AT) adjustment.

Additional information concerning the field operations and results can be found in the Ground Control Report and the Final Photo Mission Report on file with the National Geodetic Survey (NGS), RSD.

GPS Data Reduction

Global Positioning System (GPS) data was processed to provide precise positions of camera centers for application as photogrammetric control in the aero-triangulation phase of the project. Acquisition, of the reference GPS stations and the ABGPS data, was executed in compliance with the NGS Shoreline Mapping Statement of Work (SOW). The GPS ground survey data were processed using Trimble® Office Geomatics software. The ABGPS data were processed using GrafNav v.7.50 software. Precise satellite ephemerides and standard meteorological data were applied during the data reduction process. GPS data reduction was completed by NOVA Digital Systems, Inc.

Aerotriangulation

A multi-block AT strategy was implemented based on emulsion/data type (Color, MHW B+W IR, MLLW B+W IR) and completed in February 2007. All photographs of the project were “bridged” using a softcopy 3D stereo photogrammetric system to establish the network of control required for the compilation phase. All image point measurements, for the AT phase, were accomplished using the Multi-Sensor Triangulation (MST) module within SOCET SET, v. 4.4. The image points, per block, were then imported into the AeroSys v.7 software for processing the analytical bundle adjustment and computing the Root Mean Square (RMS) of the Standard Deviations (SD) of all the sub-block adjusted image points. These values were then used to compute the 95% confidence circle (R) for each of the individual blocks. The table below provides information on the image point RMS, per sub-block, for the X and Y components along

with the associated R. Additional information concerning the AT process and results can be found in the AT Report on file with the NGS/RSD.

Sub-Block	RMS (x)	RMS (y)	R
Natural Color Photographs	0.234	0.260	0.6
MHW B+W IR Photographs	0.341	0.380	0.9
MLLW B+W IR Photographs	0.317	0.359	0.8

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 referenced to the North American Datum of 1983 (NAD 83).

Compilation

The data compilation phase of this project was initiated by RSD in January 2010. Digital mapping was performed using a Digital Photogrammetric Workstation 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 the project photographs 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 CT0401E were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features were compiled to meet a horizontal accuracy of 1.8 meters at the 95% confidence level. The predicted accuracy of compiled, well defined points is derived by doubling the circular error derived from aerotriangulation statistics.

The following table provides information on aerial photographs used to complete this project:

Date	Time (UTC)	Roll Number	Photo Numbers	Scale (nominal)	Tide Level*
9-6-05	15:24-15:29	0526CN02	0211-0221	1:30,000	0.8 m
9-6-05	15:33-15:38	0526CN02	0222-0232	1:30,000	0.8 m
5-22-06	14:58-15:05	0626R01	0005-0015	1:30,000	0.1 m
5-22-06	15:13-15:19	0626R01	0016-0026	1:30,000	0.1 m

*****NOTE: Tide levels are given in meters above MLLW and are based on actual observations at the New London, CT station, with corrections applied to the Norwich, CT sub-stations. The mean tide range in the project area is 0.8 meters.

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 2010. The review process included analysis of aerotriangulation 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 9.2 software. All project data was evaluated for compliance to CMP requirements.

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

Chart 12372, Thames River, CT, 1:20,000 scale, 34th Ed., Nov./06
Chart 13213, Bailey Point to Smith Cove, CT, 1:5,000 scale, 41st Ed., Mar./04

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 GC10810 file contents, attached to PCR

Remote Sensing Division Electronic Data Library

- Project database
- GC10810 in shapefile format
- Digital copy of the PCR in Adobe PDF format
- CEF in shapefile format

NOAA Shoreline Data Explorer

- GC10810 in shapefile format
- Metadata file for GC10810
- Digital copy of the PCR in Adobe PDF format

End of Report

THAMES RIVER

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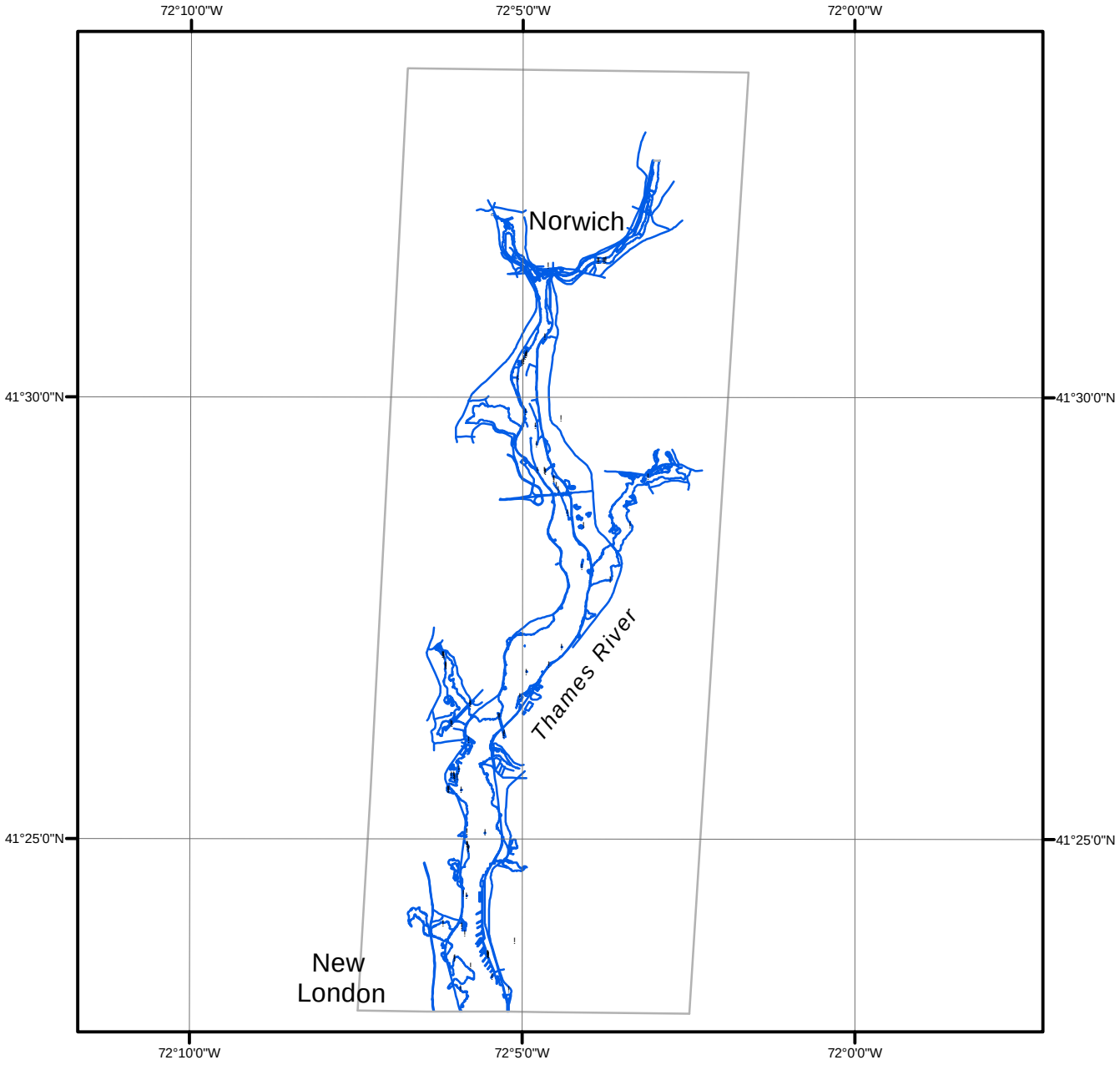
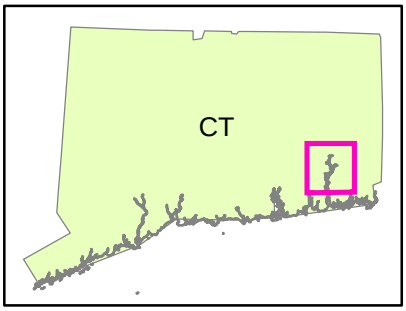


Overview



CT0401E

GC10810