

NOAA COASTAL MAPPING PROGRAM PROJECT COMPLETION REPORT

PROJECT FL1908A-TB-C

Hillsborough Bay, Florida

Introduction

NOAA Coastal Mapping Program (CMP) Project FL1908A-TB-C provides a highly accurate database of new digital shoreline data for Hillsborough Bay, within northern Tampa Bay, Florida. Project FL1908A-TB-C is a subproject of a larger project, FL1908-TB-C which includes coverage of all of northern Tampa Bay.

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, supplemented with lidar-derived Mean High Water (MHW) and Mean Lower Low Water (MLLW) data. 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 NOAA National Geodetic Survey (NGS) formulated the Project Instructions for this project following the guidelines of the “Scope of Work, Shoreline Mapping for the Coastal Mapping Program” (SOW), Version 14A, dated October 24, 2012. The instructions discussed the project’s purpose, geographic area of coverage, scope and priority; data acquisition, processing, accuracy, and compilation requirements; product delivery and reporting instructions; and contact and communication information.

NOAA supplied the lidar-derived MHW and MLLW shapefiles to be segmented, edited, and attributed by Dewberry. NOAA also provided shapefiles depicting the shoreline to be mapped and the boundaries of the main project area.

Leading Edge Geomatics (LEG) performed the aerial imagery acquisition phase of the project. LEG was responsible for the planning, acquisition, and post-processing of aerial imagery in order to support photogrammetric processing and feature compilation. This includes the establishment of ground control, and the post-processing of airborne GPS data. In addition, LEG provided shapefiles of the flight lines and exposure centers of the imagery to be used for compilation.

Field Operations

Dewberry and LEG performed field operations that included surveying of ground control points and accuracy assessment checkpoints to support the acquisition and processing of aerial photographs and topographic-bathymetric (“topobathy”) lidar data.

A total of seventeen (17) GCPs were established in project FL1908-TB-C using real-time kinematic (RTK) GPS techniques. Survey field work was performed between December 6th and 11th, 2019. For lidar processing, all seventeen (17) GCPs were used. For aerial imagery processing, only eleven (11) of the GCPs were used. A Ground Survey Report (GS) Report is on file with other project data within the NGS Remote Sensing Division (RSD) Electronic Data Library.

The lidar acquisition phase was conducted in November and December 2019 and consisted of a total of twelve (12) lidar acquisition missions for airborne laser point cloud data covering the entire FL1908-TB-C project area with an average point density of ≥ 3 pulses per square meter and a 20% swath overlap, though only a subset of these flights collected data over the FL1908A-TB-C project area. Topobathy lidar data were captured using a RIEGL VQ880-GII lidar system for eleven of the twelve lidar acquisition flights. The remaining flight was collected using a RIEGL VQ880-G system, upgraded to have the same IR laser as that of the VQ880-GII. The topobathy lidar data was used to derive the MHW and MLLW shorelines, while the NIR data was used as an aid to develop the water surface model necessary for applying refraction corrections to the topobathy lidar data.

The aerial photography phase of the project was conducted by LEG in November 2019. A total of eleven flight lines of color-infrared imagery were acquired and tide coordinated within 25% of the Mean Range of tide around MLLW. Imagery was captured with an approximate nominal ground sample distance (GSD) of 25 cm through the use of a Vexcel UltraCam Falcon Prime M2 aerial camera with a focal length of 70.5 mm.

GPS Data Processing

GPS/IMU data were processed by LEG personnel to yield precise camera positions and orientations for direct georeferencing (DG) of the imagery. Four CORS stations (BKVL, BRTW, WACH, and ZEFR) were used for base stations on the project to process each POSAV dataset and achieve the final photo center locations. The airborne kinematic GPS and INS data were processed using Waypoint Inertial Explorer (ver. 8.70) software in December 2019. For further information refer to the Airborne Positioning and Orientation Report (APOR) that is on file with other project data within the RSD Electronic Data Library.

Lidar Data Processing

Lidar point cloud data for all the areas acquired for project FL1908-TB-C were processed from January 2020 to May 2020. Riegl RiProcess software was utilized to transform the lidar point cloud into a mapping projection and to check the calibration stability. Terrasolid software was used for assessing relative and absolute accuracies between overlapping lifts and relative with each lift, initial point cloud classification, editing of the lidar point cloud, and for classification of water surface, erroneous returns, bathymetric surface, and bare earth points. Refraction correction was performed through Dewberry's lidar processor. Additional quality control (QC), point classification, and formatting were performed 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 and MLLW tidal datums. Custom ArcGIS Scripts were used to produce bare earth MHW and MLLW digital elevation models (DEMs) at a 1-meter grid resolution and to create and format the MHW and MLLW vectors into shapefile format.

Dewberry utilized a variety of software for lidar data processing, including TerraScan, TerraModeler, Esri ArcGIS (ver.10.2.2), LAStools, and proprietary software. Data processing included additional quality checks and accuracy assessments of the preliminary swath data, point classification, automated and manual editing of the lidar tiles, QA/QC, and final formatting of the LAS tiles. The final processed lidar products that were delivered to RSD included a fully classified point cloud, 1-meter resolution tiled topobathy bare earth models, tiled clipped topobathy bare earth models, tiled topobathy standard deviation models in ERDAS imagine file format, 1-meter resolution tiled DZ orthos in GeoTiff format, a bathymetric void polygon shapefile, an area of interest shapefile, a lidar tile index shapefile, a DEM tile index shapefile, and FGDC compliant metadata files.

RSD received classified lidar tiles covering the project area and used NOAA VDatum software to convert the vertical datum of the lidar points from NAD83 ellipsoid to local MHW and MLLW tidal datums. QT Modeler and custom ArcGIS Scripts were used to produce bare earth MHW and MLLW digital elevation models at a 1-meter grid resolution and to create and format the MHW and MLLW vectors into shapefile format.

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 at 541,135 sample sites in the project area (481,217 points for MHW and 59,918 points for MLLW sites) to determine the uncertainty of the vectors. Based on this assessment the MHW lidar derived shoreline vectors meet a horizontal accuracy of 1.2 meters at the 95% confidence level, and the MLLW lidar derived shoreline vectors meet a horizontal accuracy of 2.3 meters at the 95% confidence level. For further information on the lidar processing refer to the Final Report of Survey on file with other project data within the RSD Electronic Data Library.

Aerotriangulation

The aerotriangulation (AT) phase of the project was completed by LEG in July 2020 using digital AT methods to establish the network of photogrammetric control required for the compilation phase. Inpho Match-AT software was used to perform automatic point measurements and interactive point measurements of tie points.

The Root Mean Square (RMS) of the standard deviations in both X and Y directions were calculated and used to determine a predicted horizontal circular error at the 95% confidence level. The predicted horizontal accuracy for FL1908-TB-C is 0.13 meter. An AT Report is on file with other project data within the RSD Electronic Data Library.

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

Compilation

The data compilation phase of project FL1908A-TB-C was completed by Dewberry personnel in November 2020. NGS supplied the lidar derived MHW and MLLW shapefiles to be edited, attributed and generalized. Additional features were manually compiled from stereo imagery.

Digital mapping was performed with the SOCET for ArcGIS module of BAE's SOCET SET (ver. 5.6) photogrammetric software suite. This enabled compilation of features into an Esri geodatabase, where topological and attribution relationships could be enforced. Once compilation was complete, the geodatabase features were exported to shapefile format. 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 subproject FL1908A-TB-C were determined according to standard Federal Geographic Data Committee (FGDC) practices. Cartographic features compiled from images adjusted via AT were compiled to meet a horizontal accuracy of 0.3 meters at the 95% confidence level. This predicted accuracy of compiled, well defined points is derived by doubling the circular error calculated from the AT and AGPS statistics.

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

Date	Time (UTC)	Flight Line	Images	Tide Level *
19-Nov-2019	16:58 – 17:01	42-004	091 – 108	0.4 m
19-Nov-2019	17:04 – 17:09	42-005	109 – 127	0.4 m
19-Nov-2019	17:20 – 17:24	42-006	166 – 184	0.4 m
19-Nov-2019	17:26 – 17:32	42-007	185 – 204	0.4 m
19-Nov-2019	17:42 – 17:46	42-008	239 – 256	0.3 m
19-Nov-2019	17:49 – 17:52	42-009	257 – 268	0.3 m
19-Nov-2019	17:59 – 18:00	42-010	290 – 294	0.3 m
19-Nov-2019	18:12 – 18:14	42-001	303 – 314	0.3 m
19-Nov-2019	18:16 – 18:20	42-003	315 – 329	0.3 m

* Tide levels are given in meters above MLLW and were calculated using the Pydro software tool with a TCARI grid referenced to verified observations from various NOS gauges in the vicinity of the project. The elevation of the MHW tidal datum in the project area ranges between 0.63 – 0.71 meters above MLLW.

Quality Control / Final Review

Quality control tasks were conducted during all phases of project completion by a senior member of Dewberry. The final QC review was completed in January 2021. The review process included analysis of AT 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 (ver. 10.8.1) software. All project data was evaluated for compliance to CMP requirements.

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

- 11416, Tampa Bay Northern Section, 16th Ed., Oct. 2020

End Products and Deliverables

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

RSD Electronic Data Library

- Project database
- Ground Survey Reports
- Airborne Positioning and Orientation Report (APOR)
- AT Report
- Photo Acquisition Status Final Report
- Topobathy Final Report of Survey
- GC11527 in shapefile format
- Project Completion Report (PCR)
- CEF in shapefile format

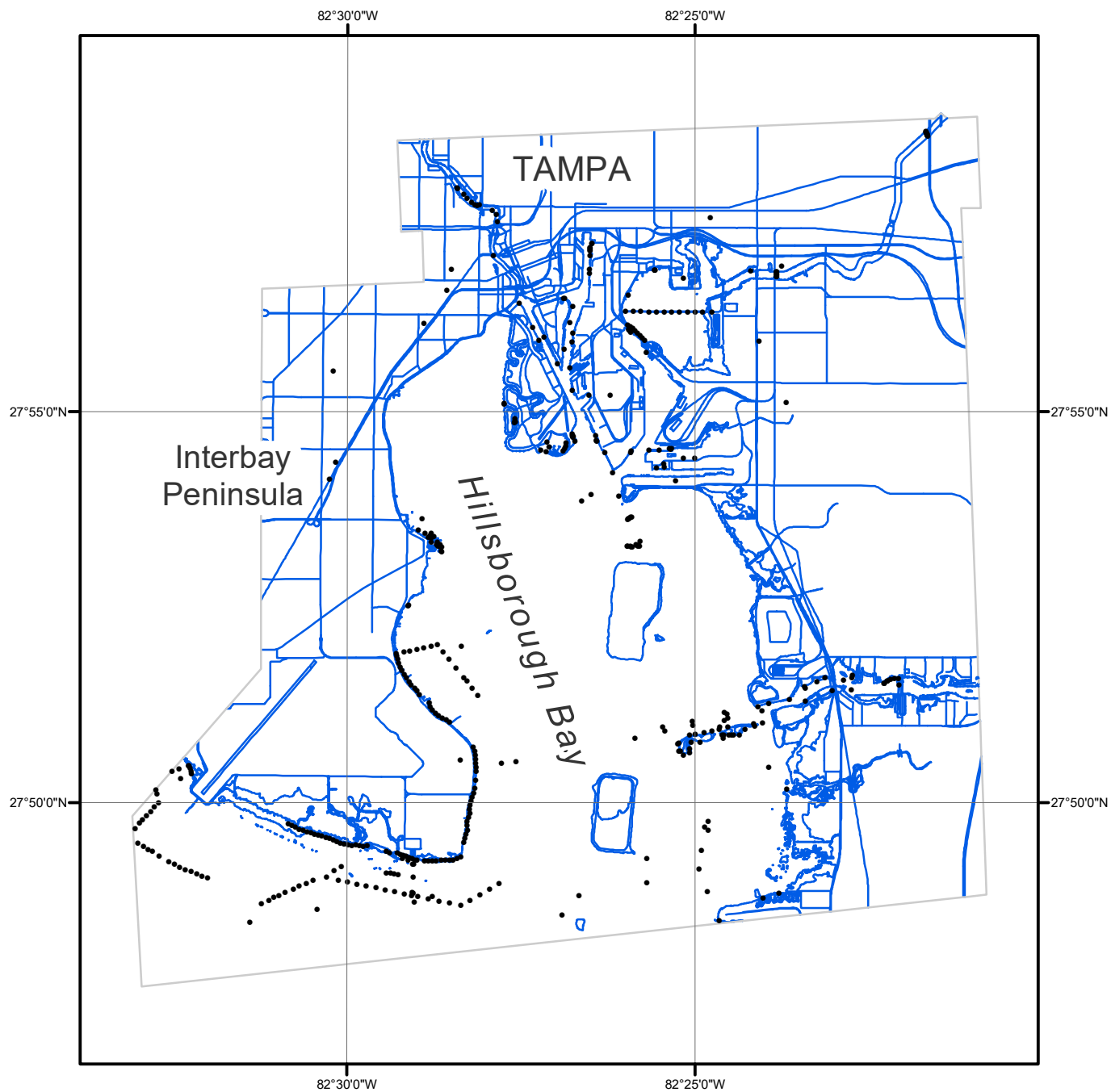
NOAA Shoreline Data Explorer

- GC11527 in shapefile format
- Metadata file for GC11527
- PCR in Adobe PDF format

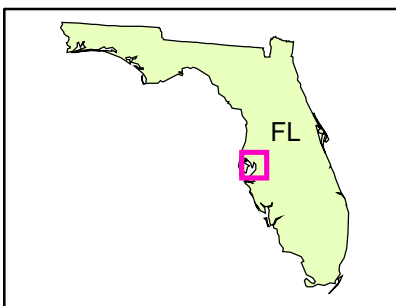
End of Report

HILLSBOROUGH BAY

FLORIDA



Overview



FL1908A-TB-C

GC11527