Statewide Coastal Monitoring Program

I. REGIONAL DATA COLLECTION and PROCESSING PLAN

March 2001

Office of Beaches and Coastal Systems
Department of Environmental Protection
State of Florida

Statewide Coastal Monitoring Program

I. REGIONAL DATA COLLECTION and PROCESSING PLAN

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FOREWORD

The Office of Beaches and Coastal Systems (OBCS) is responsible for programs for the protection and management of beaches and coastal systems of the State of Florida. This responsibility includes the accurate measurement and analysis of data to document the condition of the State's beaches and coastal systems, in particular the status of beach erosion, for the purposes of managing coastal development and natural resources.

The Regional Data Collection and Processing component of the Statewide Coastal Monitoring Program is the first volume to address statewide monitoring in the State of Florida and outlines the minimum data collection effort necessary to accomplish the OBCS program goals. It includes a combination of in-house and contracted work efforts which provide for complete statewide coverage of the OBCS program jurisdictional areas on a four-year cycle.

This plan is a living document designed to be modified on an as needed basis. It will require annual review in order to re-address issues such as frequency of data collection, methodology, and implementation of new technologies as well as program budgets. This plan is largely an internal OBCS program document. However, contract scope-of-works and technical specifications are included for incorporation into contracts for outside work. This first statewide monitoring volume, or report, does not include analysis aspects of coastal monitoring which is a significant component of the total monitoring effort. This report also does not include geotechnical nor environmental components.

This monitoring program was initially intended to only address comprehensive statewide monitoring and not include specific project monitoring. Project monitoring programs are generally developed on a project by project basis. As a result of budgetary constraints, it will be necessary for the OBCS to work cooperatively with local governments as well as the U.S.Army Corps of Engineers to consolidate some of the project monitoring and other area-wide monitoring with the statewide monitoring program.

The OBCS formed a Monitoring Plan Technical Committee to address statewide monitoring which consisted of the following staff:

Mark Leadon, PE, Chairman	Gene Chalecki, PE
Tom Watters, PLS	Bob Brantley, PE
Ken Jones, PE, PBS&J	

This report was prepared by Mark Leadon, Tom Watters, Gary Watry, and Emmett Foster of the OBCS staff, and Ken Jones and Bruce Myhre, PE, of PBS&J, Inc.

APPROVED BY

Alfred B. Devereaux, Jr., Director

Mar 9, 2001

Date Approved

Office of Beaches and Coastal Systems

Statewide Coastal Monitoring Program

I. Regional Data Collection and Processing

PLAN SUMMARY

1.0 Background

The Office of Beaches and Coastal Systems (OBCS) has an extensive history of coastal data acquisition along Florida's sandy coastal shores dating back to the early 1970's. Initial data acquisition was primarily to support the coastal construction control line program. Historic shoreline position data was subsequently assembled documenting shoreline change back to the late 1800's. In more recent years, data collection by OBCS has become an increasingly integral part of the State's beach management and erosion control program.

The predominant focus of OBCS data collection efforts has been beach and offshore profile survey data and aerial photography on a county-by-county basis. Recent emphasis on regional sediment management has shifted the data collection effort to a more regional approach. The current monitoring data collection plan is to acquire data on a more regional basis, with a combined OBCS in-house staff and contracted services survey team collecting survey data for one-quarter of the State's sandy coast each year. Acquisition and processing of digital aerial photography will be performed through contracted services for the same quarter of the State each year as well.

The OBCS will continue to collect post-storm survey and photographic data, but will plan to contract out that data collection in the future. As funds become available, a more active program of bathymetric data collection at tidal inlets within each quarterly data acquisition region will be undertaken by OBCS survey staff with assistance of contracted survey services. Newer technologies such as Light Detection and Ranging (LIDAR), Scanning Hydrographic Operational Airborne Lidar Survey (SHOALS), multi-beam, and others will be further explored and incorporated as appropriate.

This plan addresses the data collection and processing portion of the OBCS statewide monitoring program. This plan is intended to provide OBCS with detail scheduling and planning of its statewide data collection program as well as standard procedures and specifications for data collection and processing. It is important to establish that the monitoring plan, in its entirety, must include an analytical component outlining how acquired data is to be quality-controlled, analyzed and put in use to provide feedback to the beach management and regulatory programs and associated outside interests. The analytical portion of the monitoring plan is not addressed in this volume and will be addressed in a subsequent volume of the Statewide Coastal Monitoring Program. The Statewide Monitoring Program also includes the incorporation of a wave and weather data collection and analysis component in order to allow for correlation of coastal geomorphic change to wave and wind forcing.

2.0 Statement of Monitoring Policy

DATA COLLECTION AND PROCESSING

It is the policy of the Office of Beaches and Coastal Systems (OBCS) to acquire, review, maintain, and make available to the OBCS staff and the general public high-quality, accurate synoptic coastal data for the purpose of monitoring Florida's beaches and coastal systems in support of Florida's comprehensive beach management programs as defined in Chapter 161, F.S.

The OBCS will acquire field data consisting of bathymetry, topography, and rectified aerial photography over one quarter of the state under the program on an annual basis. This will allow for comprehensive statewide data collection every four years of the beaches and nearshore areas historically surveyed over the entire state. In addition, a wave and weather data collection program will be implemented to further define those parameters affecting coastal processes and morphology. Future data collection may consider expanded coverage to include designated inlets.

This program, along with specific project and area-wide monitoring, supports the needs of the public and the agency for data required to characterize long-term erosion trends, perform beach management planning, conduct regulatory reviews related to the coastal construction control lines (CCCL) and joint coastal permitting (JCP), and review and documentation of hurricane and storm impacts to Florida's beaches and coastal systems.

3.0 Purpose of Data Collection and Processing Plan

The purpose of this plan is to define and compile data collection requirements and technical and contract standards and specifications for data acquisition and processing. This plan provides a strategy for systematic, statewide physical monitoring of the Florida beaches and coastal systems for beach management and regulatory purposes. The plan also acknowledges a strategy for post-storm data collection and processing in order to perform analyses to assess storm erosion and impacts to the coastal areas.

4.0 Data Components

Data components contained in this plan include the following:

Topographic and Bathymetric Survey
Digital Aerial Photography and Videography
Laser Technologies
Wave and Weather Information

Associated technical specifications are included for the first three listed data components. The OBCS will continue to collect conventional topographic and bathymetric survey data to ensure consistency and reliability of the OBCS survey database. Survey accuracy

standards are provided in Appendix II. Extensive LIDAR and SHOALS data has been collected throughout most of the State and added to the OBCS database. The OBCS has not opted for substitution of LIDAR in place of conventional survey data, but will continue to consider incorporation of the LIDAR and SHOALS technologies into the statewide data collection effort, particularly with regard to post-storm survey data acquisition, as appropriate. Other alternative technologies are also being considered.

Digital aerial photography is collected by OBCS at a pixel resolution of 0.4 to 0.7 feet, which is considered to be high resolution producing very clear images. This resolution could be rectified at a 1:1200 scale (1 inch = 100 ft.) with a root mean square (RMS) error of 3.3 feet. Due to cost and time limitations, the rectification is done at 1:2400 (1 inch = 200 ft.) with a RMS error of 6.67 feet.

An OBCS wave and weather information program was initiated in August of 2000 through contract with Florida State University and Surfbreak Engineering Sciences, Inc. Initial first-year work in 2000/01 is to perform wave data collection field tests along the central Atlantic Coast of Florida using directional wave gages and to perform wave hindcast modeling and calibration. Future proposed work is to include development of a statewide wave hindcast database and a statewide wave gaging program.

Other coastal resource monitoring information important to the State's total beach management program effort, such as geologic/geotechnical and environmental, is not included in this plan..

5.0 Statewide Monitoring Schedule

This plan outlines a schedule for statewide data collection and processing for a six year period which includes 2000-2005. Work performed in 2000 and the first part of 2001 included completion of processing of post-hurricane aerial photography of the north and central east coast of Florida obtained in the fall of 1999.

New data collection under the Statewide Coastal Monitoring Program will begin in January 2001. Scheduled data collection and processing by the OBCS for the projected 6-year period is shown in Table 1 on the following page. Data will be obtained for one quarter of the State each year on a recurring cycle. State funding for the monitoring program is based on a fiscal year cycle for planning and budgeting purposes; however, the actual regional monitoring will be conducted on calendar year cycles in a manner more consistent with favorable weather conditions.

Based on budgetary constraints, the statewide monitoring program will incorporate project and area-wide monitoring into the program where possible to accomplish planned monitoring within the available budget. Planned data collection includes digital aerial photography, conventional topographic and hydrographic surveying, and a wave and weather program. Aerial videography of part or all of the State will be obtained on an annual basis by the OBCS. Future monitoring may include bathymetric surveys of selected coastal inlets as funding allows.

Table 1. 6-Year Data Collection and Processing Schedule

Year	Location	Data Collection & Processing
2000	East Coast (Nassau – Martin)	Digital Aerial Photography (Processing only) Videography Conventional Survey (DEP Profiles) (Nassau-Flagler) Wave Program
2001	SW (Pinellas – Collier)	Digital Aerial Photography Aerial Videography Conventional Survey (DEP Profiles) Wave Program
2002	SE (Brevard - Dade)	Digital Aerial Photography Aerial Videography Conventional Survey (DEP Profiles) Wave Program
2003	NE (Nassau – Volusia)	Digital Aerial Photography Aerial Videography Conventional Survey (DEP Profiles) Wave program
2004	NW (Escambia – Franklin)	Digital Aerial Photography Aerial Videography Conventional Survey (DEP Profiles) Wave program
2005	SW (Pinellas – Collier)	Digital Aerial Photography Aerial Videography Conventional Survey (DEP Profiles) Wave program

Note: Data collection and processing may include incorporation of project and area-wide monitoring to be coordinated and funded through local government sponsors into the statewide monitoring program.

New technologies such as LIDAR and SHOALS will be incorporated as appropriate.

Future monitoring may include bathymetric surveys of inlets using multi-beam.

6.0 Technical Specifications

Standard technical specifications for data collection and processing by or for the OBCS have been established and are contained in Appendix II. Technical specifications are included for aerial photography acquisition and rectification, conventional topographic and bathymetric surveying, laser-technology topographic and bathymetric surveying, ground control surveying, and videography. The technical specifications, and in particular the product deliverables, have been incorporated into an accompanying set of standardized scope-of-work documents which are contained in Appendix I.

The contract scope-of-works are designed to be combined with and incorporate standardized technical specifications compiled in Appendix II. These documents will provide an efficient and consistent method for contracting for data collection and processing services.

7.0 Plan Accessing and Updating

The Regional Data Collection and Processing Plan will be available from the OBCS in Adobe Acrobat (.pdf) format through the OBCS internet web site. The address for the site is: http://myflorida.com

This Plan will be reviewed and updated on an annual basis. In addition to revisions to monitoring schedules and components, technical specifications will be revised and updated as new concepts and technologies become available and/or as organizational and budgetary changes occur within the OBCS.

Additional components of the overall Statewide Monitoring Program, such as an analytical plan, will be added to the total program as they are completed. Input and involvement in development and updating of this program and these documents by the technical community and the general public is welcome and encouraged.

Statewide Coastal Monitoring Program
REGIONAL DATA COLLECTION
and PROCESSING PLAN

APPENDIX I CONTRACT SCOPE-OF-WORKS

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Note: Section Number Corresponds to Associated Technical Specification in Appendix II

SCOPE OF WORK
ACQUISITION OF AERIAL PHOTOGRAPHY

Objective
The Department of Environmental Protection, Office of Beaches and Coastal Systems (OBCS) requires the acquisition of black and white aerial photography along portions of the coast of Florida. This work will also entail acquisition and scanning of the aerial photographs. The acquired images shall be obtained at 1" = 500', negative scale.

Project Area
The project area is the coastline of Florida as shown on Attachment A.
(type specific locate here)
Number of Photos
Approximately 3.35 photos per mile will be acquired.

Work Activities
The Contractor shall provide all necessary materials and equipment to perform the required work activity. The Contractor must also supply the supervisory, professional, and technical services personnel required to manage, survey, document, and process all data associated with the acquisition and scanning of the aerial photography. All work shall be in accordance with the OBCS Monitoring Plan Technical Specifications 01000.

The OBCS will provide the contractor with the following data and/or information:
- All ground control support, unless specified in the contract to be acquired by the Contactor
- Waypoint file of required flightline

The Contractor will provide:
- All equipment, material, and personnel necessary to perform the work
- All ground control support, if specified in the contract to be acquired by the Contactor

Deliverables
All deliverables shall be in accordance with the OBCS Monitoring Plan Technical Specifications 01000.

A summary of these deliverables is as follows:
<u>Hardcopy Products</u>
Pre-Flight
- Flight Plan Map
- Camera Calibration Report
- OBCS Personnel Movement Plan

Post-Flight
- Ground Control Report

- Flight Report including the Flight Log, Weather Log, and the Tide Log.
- Negatives, if requested.
- Photo index map
- One set of 9x9 contact prints
- Report on the scanning procedures and quality of the final images, including pixel resolution
- One reproducible (velum or mylar) photo index print per flight.

Digital Products

- Scanned images for each acquired photograph in TIF format (uncompressed). The digital images shall be delivered on CD.

Schedule

Annual Monitoring (if applicable)
The Contractor will activate and acquire the aerial photography within 7 days of Notice to Proceed, subject to the weather conditions in accordance with the weather log. The Contractor will provide all deliverables within 45 days of aerial photography acquisition. The OBCS will review the deliverables and notify the Contractor within 30 days if any changes are required. The Contractor will have 30 days to make the required changes.

Post-Storm Monitoring (if applicable)
The Contractor will activate and acquire the aerial photography within 4 days of Notice to Proceed, subject to the weather conditions in accordance with the weather log.

The Contractor will provide intermediate deliverables within 7 days of aerial photography acquisition (within 11 days from Notice to Proceed). The intermediate deliverables shall include one (1) set of contact prints and one (1) set of unrectified scanned images.

The Contractor will provide final deliverables within 30 days of aerial photography acquisition (within 34 days from Notice to Proceed). The final deliverables shall include all deliverables not included with the intermediate deliverables.

END OF SECTION

SCOPE OF WORK
RECTIFICATION OF AERIAL PHOTOGRAPHY

Objective

The Department of Environmental Protection, Office of Beaches and Coastal Systems (OBCS) requires the rectification of aerial photography acquired along portions of the coast of Florida. This work will entail the rectification of 9 x 9 digital images to meet 1" to 500" and clipped digital images into OBCS layout sheets from previously acquired aerial photographs. The final digital rectified, clipped images shall meet National Mapping Accuracy Standards (NMAS) for 1"= 200'.

Project Area

The project area is the coastline in Florida as shown on Attachment A.

Number of Photos

Approximately 3.35 digital photos per mile will be delivered to the Contractor. Final delivery by the Contractor to OBCS will include the full set of rectified digital photos and 1.6 clipped digital images per mile.

Work Activities

The Contractor shall provide all necessary materials and equipment to perform the required work activity. The Contractor must also supply the supervisory, professional, and technical services personnel required to manage, survey, document, and process all data associated with the rectification and hardcopy production of the aerial photography. All work shall be in accordance with the OBCS Monitoring Plan Technical Specifications 01100.

The OBCS will provide the Contractor (unless acquired by the Contractor for OBCS) with the following data and/or information:

- OBCS sheet layouts (for clipping of rectified images)
- Scanned digital images of the project area
- Camera calibration report
- Ground control data, unless specified in the contract to be acquired by the Contractor
- Ground control report, unless specified in the contract to be acquired by the Contractor

The Contractor will provide:

- All equipment, material, and personnel necessary to perform the contracted work, unless otherwise specified by OBCS
- All Deliverables listed below, as well as any other information specified in the contract

Deliverables

All deliverables shall be in accordance with the OBCS Monitoring Plan Technical Specifications, Section 01100. A summary of these deliverables is as follows:

Hardcopy Products

- Photo Processing Report
- Surveyor's Report

Digital Products

- Raster files in TIF (with associated world file) format for the 9"x9" rectified digital images (uncompressed) in NAD 83/90 State Plane Coordinates (feet). The images shall be delivered on CD.
- Raster files in TIF (with associated world file) format for the clipped rectified digital images (uncompressed) in NAD 83/90 State Plane Coordinates (feet). The images shall be delivered on CD.
- If specified by OBCS, a seamless digital mosaic of the clipped rectified digital images over the project area, or by County depending on the contract Scope of Work. The images shall be delivered on CD.
- Final ground control report including a listing of all established ground control targets and feature points including point name, X, Y, and Z coordinates, and the .dwg line drawing as required in the Photo Processing Report.
- Complete federally compliant metadata file for each image in accordance with standards set forth by the Federal Geographic Data Committee (reference document 01100.1.03.C. The metadata file shall be delivered on CD.

Schedule

Annual Monitoring

The Contractor will begin the aerial photography rectification within 7 days of Notice to Proceed. The Contractor will provide all deliverables within 45 days. The OBCS will review the deliverables and notify the Contractor within 30 days if any changes are required. The Contractor will have 30 days to make the required changes.

Post-Storm Monitoring

The Contractor will activate and acquire the aerial photography within 4 days of Notice to Proceed, subject to the weather conditions in accordance with the weather log.

The Contractor will provide intermediate deliverables within 7 days of aerial photography acquisition (within 11 days from Notice to Proceed). The intermediate deliverables shall include one (1) set of contact prints and one (1) set of unrectified scanned images.

The Contractor will provide final deliverables within 30 days of aerial photography acquisition (within 34 days from Notice to Proceed). The final deliverables shall include all deliverables not included with the intermediate deliverables.

END OF SECTION

SCOPE OF WORK
VIDEOGRAPHY

Objective

The Department of Environmental Protection, Office of Beaches and Coastal Systems (OBCS) requires the acquisition of videography along portions of the coast of Florida.

Project Area

The project area is the coastline in Florida as shown on Attachment A.

Work Activities

The Contractor shall provide all necessary materials and equipment to perform the required work activity. The Contractor must also supply the supervisory, professional, and technical services personnel required to manage, document, and process all data associated with the acquisition, videography, and hardcopy production of the videography. All work shall be in accordance with the OBCS Monitoring Plan Technical Specifications 01200.

The OBCS will provide the contractor with the following data and/or information:

- OBCS personnel for directing helicopter pilot.

The Contractor will provide:

- All equipment, materials, and personnel necessary to perform the work.

Deliverables

All deliverables shall be in accordance with the OBCS Monitoring Plan Technical Specifications 01200.

A summary of these deliverables is as follows:

- Two (2) sets of Betacam videotapes
- Three (3) copy sets on VHS video tape
- One (1) copy Hi-8mm videotape

Schedule

The Contractor will activate and acquire the videography within 7 days of Notice to Proceed, subject to the weather conditions. The Contractor will provide the deliverables within 14 days of videography acquisition. The OBCS will review the deliverables and notify the Contractor within 30 days if any changes are required. The Contractor will have 30 days to make the required changes.

SCOPE OF WORK
TOPOGRAPHIC SURVEYING

Objective
The Department of Environmental Protection, Office of Beaches and Coastal Systems (OBCS) requires the acquisition of topographic survey data along portions of the coast of Florida.

Project Area
The project area is the coastline of Florida as shown on Attachment A.

Work Activities
The Contractor shall provide all necessary materials and equipment to perform the required work activity. The Contractor must also supply the supervisory, professional, and technical services personnel required to manage, document, and process all data associated with the acquisition and processing of topographic survey data. All work shall be in accordance with the OBCS Monitoring Plan Technical Specifications 02000.

The OBCS will provide the contractor with the following data and/or information:
- OBCS reference profile line base data (coordinate, elevation and azimuth)

The Contractor will provide:
- All required ground control
- All equipment, materials, and personnel necessary to perform the work

Deliverables
All required data shall be provided in the following datum; HARN, NAD 83/90 State Plane Coordinates in feet, plus NAVD 88 elevations in feet. Alternative datums will be considered, but must be agreed upon by OBCS prior to commencing survey work. All deliverables shall be in accordance with the OBCS Monitoring Plan Technical Specifications 02000.

<u>Hardcopy Products</u>
- Report from the surveyor certifying that the survey meets the OBCS technical specifications
- Copies of all checked, standard field books, all computation and reduction files, analog and digital data, automated data collection files, and abstracted final positions shall be provided to the OBCS.
- Surveyor report with regard to monumentation.
- A quality control/quality assurance report detailing a QA/QC procedure and any findings, corrections, and results of that procedure, including cross-sectional plots of each profile and plan view plot of the data with an approximate mean high water (MHW) contour.

<u>Digital Products</u>
- ACSII file containing raw x, y, and z profile data points, if x,y,z data is collected..
- ACSII files containing the profile data processed into the DEP x, y, z, format, if x,y,z data is

collected, and the DEP distance and depth format. All DEP formats include data as well as header record.

- An ASCII file containing the monument identification, stamping, coordinates, elevations, and any new TBM monument and/or revisions.
- Digital copy of cross-section and plan view data plots.
- Digital photos.
- Federally-compliant metadata.

Schedule

Annual Monitoring

The Contractor will activate and acquire the survey data within 7 days of Notice to Proceed, subject to the weather conditions. The Contractor will provide the deliverables within 30 days of the survey data acquisition. The OBCS will review the deliverables and notify the Contractor within 30 days if any changes are required. The Contractor will have 30 days to make the required changes.

Post-Storm Monitoring

The Contractor will activate and acquire the survey data within 4 days of Notice to Proceed, subject to the weather conditions. The Contractor will provide the deliverables within 26 days of the survey data acquisition (within 30 days from Notice to Proceed).

SCOPE OF WORK
BATHYMETRIC SURVEYING

Objective

The Department of Environmental Protection, Office of Beaches and Coastal Systems (OBCS) requires the acquisition of bathymetric survey data along portions of the coast of Florida.

Project Area

The project area is the coastline of Florida as shown on Attachment A.

Work Activities

The Contractor shall provide all necessary manpower, materials and equipment to perform the required work activity. The Contractor must also supply the supervisory, professional, and technical services personnel required to manage, document, and process all data associated with the acquisition and processing of bathymetric survey data. All work shall be in accordance with the OBCS Monitoring Plan Technical Specification 02100.

The OBCS will provide the contractor with the following data and/or information:

- A listing of the latest available OBCS reference point and control point coordinates, elevations, and profile bearings

The Contractor will provide:

- All required ground control
- All equipment, materials, and personnel necessary to perform the work

Deliverables

All deliverables shall be in accordance with the OBCS Monitoring Plan Technical Specifications 02100, unless otherwise specified or modified in an attachment to this Scope of Work by OBCS.

A listing of these deliverables are as follows:

<u>Hardcopy Products</u>

Pre-Survey

A. Procedural Control Document (See Section 2.01D6).

Post-Survey

A. Report from the surveyor certifying that the survey meets the OBCS Technical Standards and Florida minimum technical standards, Chapter 61G17-6, Florida Administrative Code.

B. Copies of all standard field books, all computation and reduction, analog and digital offshore data (raw and processed), automated data collection files, raw and processed digital and

adjusted GPS files, and abstracted final position depths and distances from reference points shall be provided to the OBCS.

C. A quality control /quality assurance report detailing the procedures used and any findings, corrections, and results of that procedure.

Digital Products

All required data shall be provided in the following datums: HARN, NAD 83/90 State Plane Coordinates in feet, plus NAVD 88 elevations in feet. Alternative datums will be considered, but must be agreed upon by OBCS prior to commencing survey work.

A. ASCII file containing raw x, y, and z profile data points.
B. ASCII files containing the profile data processed into the DEP x, y, z, format, and the DEP distance and depth format. All DEP formats include data as well as header records. If the same Contractor is performing both onshore and offshore surveys, regardless of any subcontracting, then the Contractor shall provide DEP formatted files in the following versions: onshore profiles, offshore profiles, and combined on and offshore profiles.
C. An ASCII file containing the monument identification, stamping, coordinates, elevations, and any new TBM monument and/or revisions.
D. Digital copies of cross-section and plan view data point location and elevation plots, as DWG or DXF files.
E. Federally-compliant metadata.

Schedule

The Contractor will begin work after receiving the Notice to Proceed, subject to the weather conditions. The Contractor will provide the deliverables within 45 days of completion of the survey data acquisition. The OBCS will review the deliverables and notify the Contractor within 30 days if any changes are required. The Contractor will have 30 days to make the required changes.

SCOPE OF WORK
PHOTO CONTROL POINT TARGETING AND ACQUISITION

Objective

The Department of Environmental Protection, Office of Beaches and Coastal Systems (OBCS) requires the targeting, acquisition and processing for horizontal and vertical ground control, which is used in conjunction with aerial photography to produce rectified aerial photographs for the Office of Beaches and Coastal Systems (OBCS), along selected portions of the coast of Florida. The photo control point targeting and acquisition shall meet the OBCS Monitoring Plan Technical Specification 02200.

Project Area

The project area is the coastline of Florida as shown in Attachment A.

Number of Control Points

The number of control points per mile as set forth in the OBCS Monitoring Plan Technical Specification 02200.

Work Activities

The Contractor shall provide and/or purchase all necessary materials and equipment to perform the required work activity. The project ground control requirements may be shared by both the Contractor and OBCS. Determination of final scope of work will be negotiated with OBCS and adjusted based on available funds for this contract. The Contractor must also supply supervisory, professional, and technical services personnel required to manage, survey, document, and process all data associated with the targeting and acquisition of the ground control points. All work shall be in accordance with the OBCS Monitoring Plan Technical Specification 02200.

The OBCS will provide the contractor with the following data and/or information:

- The OBCS Basic Control Network in digital and hardcopy format.
- Waypoint file of the associated aerial photography flightline

The Contractor will provide:

- All equipment, material, and personnel necessary to perform the work

Deliverables

All deliverables shall be in accordance with the OBCS Monitoring Plan Technical Specifications 02200.

A summary of these deliverables is as follows:

Hardcopy Products

Pre-Flight

- General Report on the Ground Control methodology and results
- Contact prints showing the ground control points
- Adjusted control point report

Digital Products

- Control point CAD file

Schedule

The Contractor will mobilize ground control crews and set targets in coordination with OBCS personnel as required to obtain the aerial photography. The Contractor will provide all deliverables within 45 days of aerial each photography acquisition. The OBCS will review the deliverables and notify the Contractor within 30 days if the deliverables meet project requirements. The Contractor will have 30 days to make required revisions.

SCOPE OF WORK
LIDAR TOPOGRAPHIC MAPPING

Objective

The Department of Environmental Protection, Office of Beaches and Coastal Systems (OBCS) requires the acquisition, GPS control, post processing, and quality control/quality assurance for the acquisition of topographic data using LIDAR technology, including simultaneous aerial photography acquisition along portions of the coast of Florida.

Project Area

The project area is the coastline in Florida as shown on Attachment A.

Work Activities

The Contractor shall provide all necessary materials and equipment to perform the required work activity. The Contractor must also supply the supervisory, professional, and technical services personnel required to manage, survey, document, and process all data associated with the acquisition, processing, and hardcopy production of the LIDAR topographic mapping. All work shall be in accordance with the OBCS Monitoring Plan Technical Specifications 03000.

The OBCS will provide the contractor with the following data and/or information:

- OBCS flightline waypoints
- OBCS reference profile line base data (coordinate, elevation and azimuth)
- All ground control support

The Contractor will provide:

- All equipment, material, and personnel necessary to perform the work
- Simultaneous acquisition of aerial photography

Deliverables

All deliverables shall be in accordance with the OBCS Monitoring Plan Technical Specifications 03000.

A summary of these deliverables is as follows:

- Proposed flight plan map.
- Ground control report.
- System calibration report.
- Artifact report.
- QA/QC report.
- Raw processed ellipsoid heights, x, y, and z data points with intensity data in ASCII file format.
- Height Bios file in ASCII file format.

- Complete Federally Compliant Metadata file for each image in accordance with Section 03000 (1.03) D Reference b.
- Unfiltered Processed data file in ASCII file format.
- Filtered Processed Clipped data file in ASCII file format.
- Bare Earth Contours in DXF file format.
- Additional DXF files from “thinned” data.
- Profile Lines in ASCII file format
- Report on the data processing procedures.
- LIDAR system data report.
- Post flight report.
- Plan outlining conventional ground survey profiles for LIDAR ground truthing.
- Photo index map, 1 set of contract prints in TIF format.

Schedule

Post-Storm Monitoring

The contractor will provide the OBCS with a proposed flight plan map, ground control report and ground truthing plan to include conventional ground surveys a minimum of 3 days prior to planned flight. The Contractor will activate and acquire the aerial photography within 7 days of Notice to Proceed, subject to the weather conditions in accordance with the weather log. The Contractor will provide final deliverables within 45 days of LIDAR acquisition. The OBCS will review the deliverables and notify the Contractor within 30 days if any changes are required. The Contractor will have 30 days to make the required changes.

SCOPE OF WORK
LIDAR BATHYMETRIC MAPPING

Objective

The Department of Environmental Protection, Office of Beaches and Coastal Systems (OBCS) requires the acquisition, GPS control, post processing and quality control/quality assurance for the acquisition of bathymetric data using LIDAR technology along portions of the coast of Florida.

Project Area

The project area is the coastline in Florida as shown on Attachment A.

Work Activities

The Contractor shall provide all necessary materials and equipment to perform the required work activity. The Contractor must also supply the supervisory, professional, and technical services personnel required to manage, survey, document, and process all data associated with the acquisition, processing, and hardcopy production of the LIDAR bathymetric mapping. All work shall be in accordance with the OBCS Monitoring Plan Technical Specifications 03100.

The OBCS will provide the contractor with the following data and/or information:

- OBCS flightline waypoints
- OBCS reference profile line base data (coordinate, elevation and azimuth)
- All ground control support

The Contractor will provide:

- All equipment, material, and personnel necessary to perform the work.

Deliverables

All deliverables shall be in accordance with the OBCS Monitoring Plan Technical Specifications 03100.

A summary of these deliverables is as follows:

- Proposed flight plan map with comparison of profile data
- Ground Control report
- System Calibration report.
- QA/QC report.
- Raw processed ellipsoid heights, x, y, and z data points with intensity data in ASCII file format.
- Height Bios file in ASCII file format
- Complete Federally Compliant Metadata file for each image in accordance with section 03100 (1.03) D Reference b.

- Unfiltered Processed data file in ASCII file format.
- Filtered Processed data file in ASCII file format.
- Contours Map in DXF file format.
- Additional DXF files from “thinned” data.
- Profile Lines in ASCII file format
- LIDAR System data report
- Post- Flight report
- Data Processing report on the data processing procedures.
- Plan outlining conventional ground survey profiles for LIDAR ground truthing.

Schedule

The contractor will provide the OBCS with a proposed flight plan map, ground control report and ground truthing plan to include conventional ground surveys a minimum of 3 days prior to planned flight. The Contractor will activate and acquire the aerial photography within 7 days of Notice to Proceed, subject to the weather conditions in accordance with the weather log. The Contractor will provide final deliverables within 45 days of LIDAR acquisition. The OBCS will review the deliverables and notify the Contractor within 30 days if any changes are required. The Contractor will have 30 days to make the required changes.

Statewide Coastal Monitoring Program
REGIONAL DATA COLLECTION and PROCESSING PLAN

APPENDIX II TECHNICAL SPECIFICATIONS

Table Of Contents

SECTION 01000

AERIAL PHOTOGRAPHY ACQUISITION

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Work described in this section includes the acquisition, horizontal and vertical control (either by conventional or GPS methods), and scanning of aerial photography for the Office of Beaches and Coastal Systems (OBCS).

B. Purpose – The purpose of the acquired aerial photography is to provide data and other products for coastal regulatory and management activities along the coast of Florida.

1.02 DEFINITIONS

A. Accuracy, Horizontal – A measure of the confidence that a particular location on a photo can be located to within a specified distance. For National Map Accuracy Standards (Section 01000.1.03.B), the accuracy standards for a 1:2400 scale contour map state that 90% of well-defined point features must fall within 6.7 feet of the actual ground coordinates. Areas of high relief, and areas that fall on the edge of a photo will experience greater horizontal inaccuracies.

When the final photo is viewed, it is possible to accurately measure horizontal distances on the photograph within the tolerances expressed. The accuracy tolerances are affected by a range of factors but are generally correlated with pixel size; usually, the smaller the pixel, the better spatial resolution or horizontal accuracy of the photograph.

B. Aerial Photography System - An airborne aerial photography system shall consist of a precision aerial camera, airborne Global Positioning System (GPS) with attendant GPS base station(s), and an Inertial Measuring Unit (IMU).

C. Camera Focal Length – The distance measured along the optical axis from the rear nodal point on the lens to the plane of critical focus of a very distant object.

D. Contact Prints – Prints produced directly from negatives or the equivalent prints from digital photography, 9”x 9”.

E. Contractor – The aerial survey or photogrammetric company that will provide aerial survey and/or photogrammetric services to the OBCS.

F. Crab – The condition caused by incorrect orientation of the camera with respect to the track of the aircraft. Any turning of an airplane which causes its longitudinal axis to vary from the track of the plane.

G. Flight Index – A digital (.dxf) transparent map layer in Florida State Plane Coordinate System (FSPC) indicating the principle point of each photograph exposed in an aerial survey.

H. HARN – The Florida High Accuracy Reference Network.

I. Histogram -A graphic representation of frequency distribution. For image data, the histograms indicate pixel brightness values, typically along the x-axis, and the corresponding number of pixels occurring at each brightness value, typically along the y-axis.

J. NAD 83/90 – The North American Datum 1983 adjustment of 1990, a horizontal datum.

K. CORS – The Continuously Operating Reference Station network of GPS base stations operated by the Unites States Coast Guard.

L. Scale – The relationship between a given distance on the ground and the corresponding distance on a photograph or image. Scale can be expressed in two different ways, both as ratios. The first method uses common measuring systems to relate the distance on the photo to the actual distance on the earth (e.g., 1" = 200'). The second method uses a ratio where the unit of measure is arbitrary (e.g., 1:1200). For this method meters, feet, miles, etc. can all be used as the measuring unit to relate distance on a photo or image with distance on the earth.

M. Pixel – The smallest cell size with a uniform value of an image. This digital image grain is produced in varying sizes, usually referred to in ground units such as 6 inches, 1 foot, or 3 meters. Pixels are created during the scanning of the aerial imagery and are key to establishing the resolution of the photograph/image.

N. Scanning – The process of converting analog photographs or hard copy maps into digital form.

O. Spatial Resolution – The density of pixels in an image per unit length.

P. Spectral Resolution – The width and number of bands in the electromagnetic spectrum used to produce an image.

Q. NAVD 88 – North American Vertical Datum of 1988.

R. Principle Point of a Photograph – The center point of a photograph.

S. Digital Chips – Digital scans with 30% overlap.

1.03 REFERENCE DOCUMENTS

A. Florida Department of Transportation "Specifications for Aerial Photography." Topic No.: 550-020-002-f. Effective: December 30, 1997.

B. Federal Geographic Data Committee, *Geospatial Positioning Accuracy Standards*, Parts 1, 2, and 3, Final Draft, U.S. Geological Survey, Reston, Virginia, 1998.

C. National Oceanic and Atmospheric Administration, NOAA Technical Memorandum NOS NGS-58, "Guidelines for Establishing GPS-Derived Ellipsoid Heights (Standards: 2 cm and 5 cm)," November 1997.

D. U.S. Army Corps of Engineers, Engineering Design Manual, "Photogrammetric Mapping", EM1110-1-1000, March 31, 1993.

PART 2 - EXECUTION

2.01 PRE-FLIGHT

A. A pre-flight conference is required. The conference will be held either at OBCS offices or at the Contractors office, as determined by OBCS.

B. The Contractor shall submit a proposed digital (.dxf or .dwg), coordinated (FSPC) flight plan map to the OBCS for approval prior to the pre-flight conference. The flight plan map will show flight lines, altitude of flight, scale of photography, endlap and sidelap, miles of flight line during photography, and number of exposures. The OBCS will provide a digital, coordinated waypoint file containing every other required principle point of the photographs. The flight identification number (project number) shall be shown on the flight plan map.

C. The Contractor shall submit a recent camera calibration report with the flight plan map. The OBCS reserves the right to restrict the use of any camera based upon data contained in the calibration report, or based upon operational results.

2.02 FLIGHT

A. Scale – The negatives shall be at scale of 1" = 500' (1:6000 controlled).

B. Resolution – If a digital camera is used the pixel resolution at the time of acquisition shall be no more than 0.4 feet.

C. Flight Altitude – The altitude of the aircraft used to obtain the photography shall be 3,000 feet. If a digital camera is used, the flight altitude shall be that required to obtain the required resolution.

D. Purpose – The aerial photography shall be used individually or steroescopically for studies of the project areas in regard to coastal structures, roads, terrain, etc.

E. Ground Control - Ground control will be provided either by the Contractor or by the OBCS, depending on the Scope of Work. This control will consist of targeting existing OBCS control monuments (A monuments) and range monuments (R monuments) and/or other controlled

photo identifiable points. The OBCS control points are spaced at approximately 1,000-foot intervals along the coast. Similar control will be required in areas where these monuments either do not currently exist (e.g., military bases, or locations of destroyed monuments) or are not visible from the air (e.g., canopied areas). The Contractor shall be responsible for determining if this ground control is adequate to meet the requirements of the project or if additional control is required. A minimum of six ground control points per scanned image (every other photo) is required.

Ground control also includes all necessary ground support and GPS receivers (base stations) for the required number of ground control points to be occupied during the flight. A time table for the movement of personnel and equipment, if OBCS employees are used, shall be submitted. All ground control will be based on the Florida State Plane Coordinate System, NAD83/90 adjustment and tied to the Florida High Accuracy Reference Network (HARN).

Where possible, GPS base stations shall have ellipsoid height to an accuracy of 2 centimeters relative to the Continuously Operating Reference Stations (CORS) or the HARN.

A ground control report shall be prepared and must include, at a minimum, all pertinent base station information and mission notes, including information on GPS station monument names, descriptions, coordinates, visibility diagrams, and stability. The ground control report shall also include a listing of all established ground control targets and feature points including point name, X, Y, and Z coordinates, and a .dwg line drawing in coordinate system of all target and feature points. The ground control report shall be in accordance with technical specifications of Section 02200 of this document and shall include all items listed in Part 3 of that specification.

F. Ground Control Base-Station Spacing – Ground control base stations shall be approximately 7 miles (preferred) to 12 miles (maximum) apart.

G. Camera Focal Length – The aerial photography shall be acquired with a single lens, precision aerial camera having a nominal focal length of 6 inches (152 – 154 mm) that is capable of producing negatives of high resolution quality or OBCS approved equivalent.

H. Overlap – The aerial photography shall have a minimum of 65% forward overlap. The contact prints and digital chips shall be produced at 30% forward overlap.

I. Sidelap – Generally, the aerial photography shall be acquired on a single flight line. However, areas that require more than one flight line shall have a minimum of 30% side overlap.

J. Tilt - Care shall be used to reduce tilt to a minimum of less than 5 degrees for any one photograph or 2 degrees for any 10 or more consecutive photographs, or one degree for the entire flightline.

K. Crab - Crab shall not exceed 10 degrees as measured from the flightline, as indicated, by two or more consecutive photographs.

L. Film Type - The Contractor shall use aerial film of a quality that is equal or superior to 4 mil Kodak Double-X Aerographic 2405 (Estar Base) panchromatic for all black and white photography and 2444 for all color photography. Only fresh, fine grain, dimensional stable, and safety base aerial film shall be used. Outdated film shall not be used.

M. Negatives - Negatives shall be clear and sharp in detail, fine-grained, of uniform average density, average minimum contrast, free of clouds and cloud shadows, light streaks, smoke, static marks, fog, stains, or other blemishes which would render them unsuitable for their intended purpose.

N. Dipositive – A transparent positive print intended for viewing by transmission.

O. Obscurations – Photography shall not be acquired when the ground is obscured by haze, smoke, dust, or when clouds or cloud shadows will appear on any photograph.

P. Shadows/Reflection – Photography shall minimize shadows caused by trees or topographic relief. Photography shall not be taken when the sun's inclination is less than thirty (30) degrees above the horizon.

Q. Flight Log – A flight log representing aircraft flight time shall be maintained on an hourly basis. The time of takeoff, start of photograph, end of photograph, and landing shall be recorded to the nearest of 0.1 of an hour.

R. Weather Log – A weather log shall be maintained to substantiate any delays due to inclement weather. The weather log shall be include date, location, weather report, and weather forecast from the U.S. Weather Bureau. This information may be supplemented by direct observation.

S. Airborne GPS – The aircraft used for the aerial photography acquisition shall have an airborne GPS system that provides a carrier phase position for the principle point of each photograph.

T. Tide Log – The Contractor shall maintain a tide log to substantiate any delay due to incorrect or unacceptable tides. The tide log should include the date, time, the location of the nearest NOAA tide station(s) being reported, and the tide elevation at the beginning, middle, and end of data collection as calculated for photo collection location (through interpolation between adjacent tide stations). All reported tide elevations shall be referenced to NAVD (1988).

U. Flight Time – The entire flight shall occur between one (1) hour before and one (1) hour after mean low tide in the region to be photographed, unless otherwise authorized by OBCS.

2.03 POST-FLIGHT

A. Ground Control Report – The Contractor shall submit a ground control report, as specified in Section 01000 2.02E, to the OBCS for approval

B. Flight Report – The Contractor shall submit a copy of a flight report signed by the pilot or the

aerial photographer to the OBCS for approval. The flight report shall contain the flight, tide, and weather logs. The flight log shall include a carrier phase GPS coordinate for the principle point of each photograph.

C. Fightline Tolerances – Lateral deviation of the actual flight line from those shown on the flight plans shall not exceed 0.5” on the aerial negative. Longitudinal deviation of the spot exposures from those shown on the flight plans shall not exceed 0.5” on the aerial negative. Note that 0.5” on the negative represents 250’ on the ground.

D. Accepted Exposures – Upon submittal by the contractor to the OBCS, a review of the photos will be performed to insure that all photos meet the technical requirements outlined here, and any additional requirements as given in the Scope of Work. Any photo not meeting specifications shall be reflown. On all accepted exposures, each exposure shall be edited across the exposure with the date, photo scale (expressed as a ratio, i.e., 1:6000), job number (given in the Scope of Work or contract document), flight line number and exposure number.

2.04 FILM PROCESSING

C-41 processing is required as per Kodak specifications. Each exposure shall be numbered just within the exposed area, in consecutive order throughout the entire project, starting with exposure number one on roll number one and continuing the numbering in consecutive order through all rolls exposed on the project. The approximate time and scale of the photographs shall appear on the first and last exposure of each flightline; and the month, day, and year shall appear on each exposure, just within the exposed area. The exposures shall show the roll number (R-1), date (5-6-96, etc.), scale of photography, project identification, flight line number, and the photo number, as read from left to right on each photograph and be located on the landwardmost edge of the photograph.

The negatives shall be uncut and maintained on spools and in suitable rigid containers or canisters. The outside of the containers shall be labeled with project name, geographical area, photo scale, Contractor name and address, date of photography. The contractor shall maintain storage of and provide for future access to aerial photograph negatives. The negatives, by contract, are property of the State of Florida.

A photo index map in reproducable and/or print format may be required. If required, the photo index sheet shall be produced on sheet size 24" x 36" to any readable standard engineer's or decimal scale. The map shall be prepared by photographing a montage or assembly of contact prints. The prints shall be laid in the assembly in such a way that the exposure numbers are visible. The photo index map shall have a neatly executed title showing the name of the project. This index shall be made using black and white 9" x 9" contact prints.

Diapositives shall be clear and sharp in detail, uniform in range of density and of fine grained quality and such a degree of contrast that all details of the negative will show clearly both in the shadows and the highlights as well as in the half-tones between the shadows and highlights. They shall be free from streaks, static marks, chemical stains, scratches, fingermarks, or other

deficiencies which would interfere with their intended purpose, and, if required in the OBCS Scope of Work, shall be delivered in a smooth and flat condition. Excessive variance in contrast between exposures will be cause for their rejection. An adequate variety of grades of contrast paper (medium weight R C paper) shall be used in making prints to accomplish this purpose. Rejection of diapositives will be solely at the discretion of the OBCS.

Standard processing techniques shall be used in the production of diapositives. Two sets of black and white diapositives shall be made utilizing an electronic Auto-Dodge Contact Printer equal or superior to the Log-E Contact Printer, one for the aerial triangulation, and the other for the scanning operation. The latter set must be kept free of all annotation and handled with the utmost care to ensure maximum image quality. The processing shall be done in conformance with the manufacturer's recommendations and shall have density readings determined through the use of a transmission densiometer.

Chemically reducing or intensifying of the diapositives will not be permitted, and the OBCS may have a consultant chemically and/or physically test such diapositives as deemed necessary. The diapositives shall be made direct (printing emulsion to emulsion) or as otherwise specified.

Diapositives shall be centered on 9.5 inch by 9.5 inch film which has a nominal thickness of 7 mils.

One set of contact prints shall be submitted within 5 days of the time of the flight. The contact prints shall be of uniform density and such a degree of contrast that all details of the negatives will show clearly both in the shadows and the highlights as well as in the half tones between shadows and the highlights. An adequate variety of grades of contrast paper (medium weight R C paper) shall be used in making prints to accomplish this purpose. All prints shall be clean and free from chemicals, stains, blemishes, uneven spots, air bells, light fog or streaks, static marks and other blemishes which would interfere with their intended purposes, and shall be delivered in a smooth and flat condition.

2.05 SCANNING

The digitization of the photo (diapositive) or negative, i.e. the pixel-by-pixel recording of the halftones, which converts black-and-white photos into digital gray levels, or color photos into digital spectral levels, with high geometric and radiometric accuracy camera shall be used. The scanner must produce a geometric resolution for black and white photos of 1 micron and a radiometric resolution of 256 gray levels and selectable pixel sizes of 5.5 micron to 120 micron. The scanner must produce a geometric resolution for color photos of 1 micron and a radiometric resolution of 256 color levels and selectable pixel sizes of 7.5 micron to 120 micron. The scan rate for this project is 21 micron with a pixel size of .40 feet for the black and white photography, and 21 micron with a pixel size of 0.4 feet for color photography.

Digital imagery is produced from continuous-tone imagery by scanning it into 8-bit (256 discrete-tone data sets) data sets for black and white and 24-bit, 8-bit for red, 8-bit for green,

and 8-bit for blue, (256 discrete-tone data sets) data sets for color. A properly digitized image should have a full radiometric range of values. This means the data represented in the original image should be distributed across the full radiometric range (256 discrete data slots for black and white or for color) in approximately the same proportion as it exists in the source material. Areas that are black or approaching black should have radiometric values that are zero or approaching zero, and areas that are white or approaching white should have values at or approaching 255. Likewise, areas that are dark colors should have radiometric values approaching zero, and areas that are light colors should have radiometric values approaching 255.

The important concept here is that as much of the data that is available in the source material as possible be mapped into the digitized data file and made available. The scanning technician should match the dynamic range of the source imagery to accurately reproduce the full data in the available radiometric range, and special effort should be made not to lose data by compressing it anywhere along the curve.

Any scanning system must scan a precise photogrammetric grid plate at the desired scanning resolution for the project to test for geometric quality of the scanner.

The pictorial quality of the digital image shall consist of a low contrast, overall even tone and a low grain content.

A report on the scanning procedures and quality of the final images, including pixel resolution, shall be provided to the OBCS.

PART 3 - PRODUCTS

3.01 GENERAL

A. All costs of products shall be borne by the Contractor.

3.02 HARD COPY PRODUCTS

Pre-Flight

A. Flight Plan Map - The approved flight plan map shall be submitted in accordance with Section 2.01B of this Technical Specification.

B. Camera Calibration Report - The camera calibration report shall be submitted in accordance with Section 2.01C of this Technical Specification.

C. OBCS Personnel Movement Plan – The Personnel Movement Plan shall be submitted in accordance with Section 2.02E of this Technical Specification.

Post-Flight

A. Ground Control Report – The ground control report shall be submitted in accordance with Section 2.03A of this Technical Specification.

B. Flight Report – The flight report shall be submitted in accordance with Section 2.03B of this Technical Specification. The following reports will be submitted as sections of this report: Flight Log (Section 2.02R), Weather Log (Section 2.02S), and the Tide Log (Section 2.02U).

C. Negatives - Photo negatives, if requested, shall be submitted in accordance with Section 2.04 of this Technical Specification.

D. Photo Index Map - A photo index map shall be submitted in accordance with Section 2.04 of this Technical Specification.

E. Contact Prints - One set of 9x9 black and white contact prints shall be submitted in accordance with Section 2.04 of this Technical Specification.

F. Scanning Report - A report on the scanning procedures and quality of the final images, including pixel resolution shall be submitted in accordance with Section 2.05 of this Technical Specification.

G. One reproducible (velum or mylar) photo index print shall be provided to OBCS per flight.

3.03 DIGITAL PRODUCTS

A. Scanned images for each acquired photograph in TIF format (uncompressed). The digital images shall be delivered on CD.

END OF SECTION

SECTION 01100

AERIAL PHOTOGRAPHY RECTIFICATION

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Work described in this section includes the rectification of scanned aerial photographs.

B. Purpose – The purpose of the aerial photography rectification is to provide data and other products for coastal regulatory and management activities along the coast of Florida.

C. A pre-rectification conference is required. The conference will be held at the Office of Beaches and Coastal Systems (OBCS) offices, or at the Contractors office if agreed to by the OBCS.

1.02 DEFINITIONS

A. Accuracy, Horizontal – A measure of the confidence that a particular location on a photo can be located to within a specified distance. For National Map Accuracy Standards (Section 1.03.B of this Technical Specification), the accuracy standards for a 1:2400 scale contour map state that 90% of well-defined point features must fall within 6.7 feet of the actual ground coordinates. Areas of high relief, and areas that fall on the edge of a photo will experience greater horizontal inaccuracies.

When the final photo is viewed, it is possible to accurately measure horizontal distances on the photograph within the tolerances expressed. The accuracy tolerances are affected by a range of factors but are generally correlated with pixel size; usually, the smaller the pixel, the better spatial resolution or horizontal accuracy of the photograph.

B. Aerotriangulation – Aerotriangulation is the simultaneous space resection and space intersection of image rays recorded by an aerial mapping camera. The spatial direction of each image on each image ray is determined by projecting the ray from the front nodal point of the camera lens through the image on the positive photograph. Conjugate image rays projected from two or more overlapping photographs intersect at the common ground points to define the three-dimensional space coordinates of each point. The entire assembly of image rays is fit to known ground control points in an adjustment process. Thus, when the adjustment is complete, ground coordinates of unknown ground points are determined by the intersection of adjusted image rays. Simultaneously with the ground point intersections, the exterior orientation of each photograph is determined by image ray resection through the camera.

C. Camera Focal Length – The distance measured along the optical axis from the rear nodal point on the lens to the plane of critical focus of a very distant object.

D. Contact Prints – Prints produced directly from negatives or the equivalent prints from digital photography, 9”x9”.

E. Contractor – The aerial survey or photogrammetric company that will provide aerial photo rectification services to the OBCS.

F. Flight Index – A transparent map overlay indicating the principle point of each photograph exposed in an aerial survey.

G. Scale – The relationship between a given distance on the ground and the corresponding distance on a photograph or image. Scale can be expressed in two different ways, both as ratios. The first method uses common measuring systems to related the distance on the photo to the actual distance on the earth (e.g., 1” = 200’). The second method uses a ratio where the unit of measure is arbitrary (e.g., 1:1200). Thus, meters, feet, miles, etc. can all be used as the measuring unit to relate distance on a photo or image with distance on the earth.

H. Pixel – The smallest cell size with a uniform value of an image. This digital image grain is produced in varying sizes, usually referred to in ground units such as 6 inches, 1 foot, or 3 meters. Pixels are created during the scanning of the aerial imagery and are key to establishing the resolution of the photograph/image.

I. HARN – The Florida High Accuracy Reference Network.

J. NAD 83/90 – The North American Datum 1983 adjustment of 1990.

K. RMSE – The root mean square error is the square root of the average of the set of squared differences between data coordinate values and coordinate values from an independent source of higher accuracy for identical points (ground control points).

L. Scanning – The process of converting analog photographs or hard copy maps into digital form.

M. Spatial Resolution – The density of pixels in an image per unit length.

N. Spectral Resolution – The width and number of bands in the electromagnetic spectrum used to produce an image.

O. Photo Processing Report - A report that includes the results of the work, explicitly addressing the rectification accuracy (RMS error files) of the 9x9 digital images and the clipped digital images, if applicable, (computational abstract) in accordance with section 2.04 of this technical specification. This report should include the methodology used to rectify the 9”x9” and clipped rectified images.

1.03 REFERENCE DOCUMENTS

A. Florida Department of Transportation "Specifications for Aerial Photography." Topic No.: 550-020-002-f. Effective: December 30, 1997.

B. Federal Geodetic Control Committee, 1989, "Multipurpose Land Information Systems, THE GUIDEBOOK, Vol. 1 and 2."

C. Federal Geographic Data Committee, 1998, "Content Standard for Digital Geospatial Metadata, FGDC-STD-001-1998."

D. U.S. Army Corps of Engineers, Engineering Design Manual, "Photogrammetric Mapping", EM1110-1-1000, March 31, 1993.

PART 2 - EXECUTION

2.01 DIGITAL AERIAL PHOTOGRAPHS

The OBCS shall provide the Contractor (unless the Contractor acquired the photography and/or ground control for the OBCS) with unrectified digital images (scanned aerial photographs), ground control data and report, carrier phase GPS positions of the principle point for each scanned photograph, camera calibration report, and OBCS sheet layout (in *.DXF format) if applicable. All data provided shall meet the technical specifications of OBCS Monitoring Plan Technical Specifications for Aerial Photography Acquisition (Appendix 01000). The unrectified digital images will be provided on CD.

All ground control data, principle point position, and OBCS sheet layouts provided to the Contractor will be based on the Florida State Plane Coordinate System, NAD83/90 tied to the HARN.

2.02 GEO-REFERENCE AND RECTIFICATION

A. 9"x9" Digital Images – The unrectified digital images provided to the Contractor shall be rectified by the Contractor to meet National Map Accuracy Standards for 1" = 500' maps (+/- 16.7 feet) by processing each pixel through photogrammetric space resection equations. This process requires as input, ground control points, aerotriangulation, and camera orientation parameters. The final pixel size shall be no greater than 0.4 feet. The rectification process should remove the crab and tilt of the aircraft.

B. Clipped Digital Images – If specified by OBCS in the contract, the 9"x9" rectified digital images shall be clipped to the OBCS sheet layout format. The clipped digital images shall meet National Map Accuracy Standards (Section 01100.1.03.B) for 1"=200' maps (+/- 6.7 feet). The final pixel size shall be no greater than 0.4 feet.

The clipped digital images may be made up of two or more images that are mosaiced together to form the final clipped image. Each separate piece of mosaic that contributes to the final

clipped image is called a “chip”. The individual chips shall be cut out of the original 9”x9” rectified image before resampling.

When two or more chips are mosaiced, the chip judged by visual inspection to have the best contrast shall be used as the reference image. The brightness values of the other chips shall be adjusted to match that of the reference chip. The join lines between the overlapping chips shall be chosen so as to minimize tonal variations. Localized adjustments of the brightness values shall be performed to minimized tonal differences between join areas.

Clipped digital images shall edge match precisely with adjacent clipped digital images, with no overlap.

2.03 IMAGE MOSAIC

The clipped digital images shall be combined to create a digital image mosaic for the project area, or for each County in the project area, if required by the contract Scope of Work. The image mosaic shall be created such that join lines between adjacent clipped digital images shall have minimize tonal variation. Localized adjustments of the brightness values shall be performed to minimized tonal differences between clipped digital images. The final seamless image mosaic(s) shall be resampled to create a digital file of approximately 500 MB.

2.04 VERIFICATION

Verification of the total photogrammetric mapping process shall be performed based upon an overlay of the photo control and the final digital rectified image during the photo control and reported in the RMSE section of the Photo Processing Report. All photo control points, panel points, pass points, and verification points shall be shown in the final line drawings required in the Ground Control Report.

The Contractor shall provide sufficient verification support documentation to validate compliance of the photography with National Map Accuracy Standards. The Contractor shall make the necessary computations to verify the correctness of all measurements and apply the proper theory of location in accordance with the law or precedent. In the event that there is inadequate ground control available, the Contractor shall provide the OBCS with a description of those areas and a list of available options; ie, aerial triangulation, additional field ground control, or utilization of existing available registered and rectified aerial photography. The OBCS will provide the Contractor with an agreed-upon solution.

PART 3 - PRODUCTS

3.01 GENERAL

A. All costs of products shall be borne by the Contractor.

3.02 HARD COPY PRODUCTS

A. Contractor shall submit a Photo Processing Report

B. Contractor shall submit Surveyor's Report

3.03 DIGITAL PRODUCTS

A. Raster files in TIF (with associated world file) format for the 9"x9" rectified digital images (uncompressed) in NAD 83/90 State Plane Coordinates (feet). The images shall be delivered on CD.

B. Raster files in TIF (with associated world file) format for the clipped rectified digital images (uncompressed) in NAD 83/90 State Plane Coordinates (feet). The images shall be delivered on CD.

C. If specified by OBCS, a seamless digital mosaic of the clipped rectified digital images over the project area, or by County depending on the contract Scope of Work. The images shall be delivered on CD.

D. Final ground control report including a listing of all established ground control targets and feature points including point name, X, Y, and Z coordinates, and the .dwg line drawing as required in the Photo Processing Report.

E. Complete federally compliant metadata file for each image in accordance with standards set forth by the Federal Geographic Data Committee (reference document 01100.1.03.C). The metadata file shall be delivered on CD.

END OF SECTION

SECTION 01200

VIDEOGRAPHY

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Work described in this section includes the acquisition and deliverables for airborne videography.

B. Purpose – The purpose of acquiring videography is to provide mapping products for beach management activities in along the coast of Florida.

C. A pre-flight conference is required. The conference will be held either at OBCS offices, or at the Contractors office, as determined by OBCS.

1.02 DEFINITIONS

A. Contractor – The company that will provide aerial videographic services to the OBCS.

1.02 REFERENCE DOCUMENTS

A. NONE

PART 2 - SPECIFICATIONS

2.01 FLIGHT/EXPOSURE WINDOW

A. Flight Window – The flight/exposure window shall be during the daylight hours and with clear skies sufficient to maintain quality control of the video. OBCS personnel shall direct the helicopter pilot as to the areas that shall be video taped.

B. Flight Delays – Circumstances that are beyond the control of the Contractor, undesirable weather conditions, etc. may delay the desired flight window from being achieved. Any variance request from the time schedule set forth herein, resulting from the aforementioned circumstances, must be requested in writing by the Contractor and be approved prior to any changes in the flight/exposure window. The submittal of a request by FAX is acceptable.

2.02 EQUIPMENT/PERSONNEL REQUIREMENTS

A. Helicopter Service – A five bladed with fiberglass bladed helicopter with aero cam or gyro mount for Betacam camera shall be used for the videography. The helicopter shall be equipped with intercom to allow for communication between the pilot and passengers. The helicopter must have a minimum of four person seating capacity, including the pilot; and include space

for mounting the Betacam camera, the camera mount, and space for the power source and camera monitor.

The helicopter must have a removable port and starboard passenger doors to accommodate changing the camera and mount for filming the east and west coastlines.

B. Miscellaneous – The helicopter, licensed/certified pilot, all insurance and material and costs, including but not limited to fuel, required for the proper operation of the aircraft shall be provided by the Contractor.

C. Videography Services Equipment: Wide angle Betacam camera with appropriate lens, filters ad the like; camera mount (aero cam or gyro mount); camera power source; monitor; and sufficient Beta and VHS video tapes for taping the areas shall be provided by the Contractor.

D. Personnel: The Contractor shall provide a certified/insured pilot experienced in flying for aerial Videography and a professional videographer experienced in aerial Videography.

PART 3 - PRODUCTS

3.01 GENERAL

A. Standards: Provide all materials required to perform the work described in this section.

B. Implementation: The work described in this section shall be considered a minimum requirement.

3.02 VIDEO TAPES

A. Two (2) master sets of Betacam video tapes. One of the masters will be formatted with date and time display burn.
B. Three (3) copy sets of VHS video tape format with sequential date and time display burn.
C. One (1) copy of Hi-8 mm video tape format with sequential date and time display burn.
D. All tapes shall be identified by date of Videography, marked as either “master” or “copy”, numbered sequentially and identify the area of the coastline presented on the tape.

END OF SECTION

SECTION 02000

TOPOGRAPHIC SURVEYING

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Work described in this section includes the acquisition, horizontal and vertical control (either by conventional or GPS methods), post processing, quality control/quality assurance, and deliverables of topographic survey data. Conventional topographic survey data shall be collected at Office of Beaches and Coastal System (OBCS) reference points, which are approximately 1,000 feet apart alongshore, or other lines or areas as described in the contract Scope of Work.

B. Purpose – The purpose of the topographic survey is to provide data and other products for coastal regulatory and management activities along the coast of Florida.

C. A pre-survey conference is required. The conference is held to review and approve the data collection and processing schedule and other information contained in the Procedural Control Document (defined below in 2.01J). The conference will be held either at OBCS offices, or at the Contractors office, as specified by OBCS. The survey schedule must demonstrate that the data collection will be consistent with a synoptic approach of timely and sequential data collection.

1.02 DEFINITIONS

A. Contractor – The company that will provide topographic survey services to the OBCS.

B. HARN – The Florida High Accuracy Reference Network.

C. NAD 83/90 – The North American Datum 1983 adjustment of 1990.

D. NAVD 88 – The North American Vertical Datum of 1988.

E. NGVD 29 – The National Geodetic Vertical Datum of 1929.

F. TBM – Temporary bench mark.

G. Control Monument or Benchmark – OBCS 2nd order or higher control point, typically but not necessarily known as an "A" station.

H. Range Monuments – OBCS reference points, spaced approximately 1000 ft apart alongshore, typically known as "R" stations.

1.03 REFERENCE DOCUMENTS

A. Federal Geographic Data Committee, Geospatial Positioning Accuracy Standards, Parts 1, 2, and 3, Final Draft, U.S. Geological Survey, Reston, Virginia, 1998.

B. National Oceanic and Atmospheric Administration, NOAA Technical Memorandum NOS NGS-58, "Guidelines for Establishing GPS-Derived Ellipsoid Heights (Standards: 2 cm and 5 cm)," November 1997.

C. Florida Minimum Technical Standards. Chapter 61G17-6, Florida Administrative Code.

D. Federal Geodetic Control Committee, "Standards and Specifications for Geodetic Control Networks", September 1984.

PART 2 - EXECUTION

2.01 DATA COLLECTION

A. Reference Monuments – The OBCS shall provide the Contractor with an ASCII data file describing the location (vertical and horizontal position) of each range monument to be surveyed. The contractor shall also be provided a listing of all horizontal and vertical control on all existing "a" monuments for control use. The Contractor shall verify the horizontal and vertical position of all found and used monuments. If a monument cannot be located, the contractor shall establish a temporary control point (TBM) at the specified reference monument location to control the profile survey. Missing monuments shall be reported to OBCS with TBM vertical and horizontal positions. Accuracy standards shall be in accordance with Section 2.01G below. All control work shall be completed prior to performing any profile surveys for a given survey area, unless otherwise approved by the OBCS.

B. Beach/Dune Profiles – All upland profiles including any intermediate profiles shall be collected on Florida State Plane Coordinate Systems and OBCS established grid bearings as required in the project scope of work and shall be in accordance with accuracy specifications in Section 2.01G below.

C. Ground Control/Ground Support – The Contractor shall provide all manpower and equipment as needed to complete the required topographic work.

D. Horizontal Datum - The horizontal datum shall be the HARN NAD 83/90.

E. Vertical Datum - The vertical datum shall be the NAVD 88.

F. Coordination - All operations shall be coordinated with the OBCS.

G. Accuracy – Reference monuments: The vertical accuracy of the data shall meet or exceed GPS-derived heights (5cm) standard and Chapter 61G17-6, FAC, minimum technical standards for a topographic survey (see Section 1.03B) and be verified by two (2) controlling

benchmarks. Leveling instrument shall be "PEG" tested. The horizontal accuracy of the data shall meet or exceed Geospatial Positioning Accuracy Standards, Range VIII, (maximum of 0.66 ft.) (see Section 1.03B).

Profile Data: The vertical accuracy of the topographic profile data shall meet or exceed GPS-derived heights (5cm) standard and Chapter 61G17-6, FAC, minimum technical standards for a topographic survey (see Section 1.03B), and be verified by two (2) controlling bench marks, and checked back into the reference monument at each profile line or checked into adjoining TBM, Benchmark, or reference point at each profile line. The check back method must be described in the Procedural Control Document (defined in 2.01J below).

The horizontal accuracy of the data shall meet or exceed Geospatial Positioning Accuracy Standards, Range X, (maximum of 3 ft.). GPS observations, poly-chain, electronic distance measuring (EDM) device, or stadia observation shall be used to measure distances. Redundancy in horizontal measurement is required. Redundant methods must be described in the Procedural Control Document (described in 2.01J below).

Survey accuracy shall comply with all standards contained in references in Section 02000, 1.03.

H. Data Resolution – The data shall be collected at intervals not to exceed 25 ft. and at all grade breaks and attributed items (see L. below) along the profile sufficient to accurately describe the topography at the profile locations. All rod readings shall be read and recorded to hundredth of a foot (2 decimal places).

I. Data Collection Area – The topographic data shall be collected out to a minimum depth of

–3 feet (NAVD88) and landward to the DEP monument location or approximately 150 feet landward of the vegetation line, whichever is more landward. If there is a building between the beach and the monument, then the survey should extent around the building and then back on line. If there is a road between the beach and the monument **and it is safe to do so**, then the two edges of pavement and road centerline should be surveyed, then resume normal intervals.

If the point 150 feet landward of the vegetation line can't be reached because of an obstruction, such as a building, bay water, mangroves, or other impassable vegetation or obstacle, then the survey line may be stopped at the obstacle and should be noted as such in the survey field book. Coastal armoring is generally not an impassable obstacle and is normally to be surveyed. If the DEP monument is located more than 300 feet landward of the vegetation line, then survey readings should be obtained on 100 foot intervals until approximately 200 feet landward of the vegetation line at which point normal intervals would resume.

The reference monument shall be established as the 0.0 location for recording all horizontal distances along profiles. Horizontal distances along profile lines shall be recorded as positive seaward of the monument and negative landward of the monument.

J. Procedural Control – The Contractor shall provide a document outlining a schedule for planned data collection and itemizing all procedures including quality control and instrumentation to be followed during the completion of this work, prior to the pre-survey conference. Procedural standards are outlined in reference documents listed in Section 1.03. Any deviations from procedures and standards contained within this specification shall be identified and approved by OBCS prior to conducting the survey work. Specific required information to be submitted including a quality control/quality assurance report is described in 3.01D below.

K. Ground digital photography – The Contractor shall provide three (3) digital photos at a mid-beach location at each profile line location. The 3 photos shall include one in each shore-parallel direction, and one landward toward the monument or TBM location. One additional photo of the reference monument or TBM cap shall also be taken which is sufficiently clear and/or labeled and focused to identify the point. Photos shall be provided at minimum 640 x 480 pixel resolution and provided in JPEG format.

L. Field book beach profile pages are to include the following information for each profile: Survey monument identification, stamping or TBM identification, the date of the survey, the profile azimuth (grid), the survey crew members, and attribute item identification codes as provided by OBCS below. Distance and elevation readings shall be recorded in a standard columnar arrangement on the field book pages.

Special features shall be attributed in the field book with associated distance and elevation in addition to the normal observation point at the following locations:

<u>Miscellaneous</u>

CL	Centerline of all roads, streets, dimtracks.
EP	Edge of pavement.
SW	Seawall
R	Rocks
RR	Rip rap, sand bags, manmade armor.
TP	Turning Point
TL	Trashline
WS	Wet sands shall include the time of day and time zone.
EP	Edge of Pond
RB	Renourished Beach
MP	Mulch or Peat

<u>Vegetation</u>

V1	Pioneer zone-grasses Sea Oats Beach Morning Glories Panic Grass

Railroad Vine
Beach Berry

V2 Scrub Zones

Spanish Bayonet	Yaupon
Saw Palmetto	Nickerbean
Wax Myrtle	GreenBrier
Sea Grape	Myrtle Oak
Prickly-Pear	Rosemary

V3 Forest Zone
Cabbage Palm
Pine Trees
Sand Live Oak
Magnolia
Coconut Palm

V4 Marsh/Mangrove Zone
Mangrove
Needle Rush
Saltwort
Grasswort

Note: Australian Pines can be in any zone and should be indicated by V5

M. A building or other large object on the profile bearing line shall require the profile to extend to the object on line through a series of ninety degree angles and distances around the object to a point on the other side of the object at the intersection with the established bearing line. Data is collected on the seaward side to the object before completing the transect to the water. GPS observations, offset prism, theodolite or level with horizontal circle is required for horizontal offset. GPS observations, EDM, or poly-chain is required for horizontal distances.

2.02 DATA PROCESSING

A. Topographic data collected by these methods shall have quality checks performed and verified by the surveyor in responsible charge and detailed in the itemized procedure document (see Section 2.01J).

B. The Contractor shall prepare and submit a report that describes the location of provided, found, and used monuments and TBMs including complete identification, stamping, coordinates, elevations, and profile azimuths. TBM identification shall include reference monument origin, identification, azimuth, distance down line, and TBM elevation.

PART 3 - PRODUCTS

All required data shall be collected in the following datums: HARN, NAD 83/90 State Plane Coordinates in feet, plus NAVD 88 elevations in feet. Alternative datums may be considered, but must be agreed upon by OBCS prior to commencing survey work. Survey data is to be provided in the datums in which the data is collected.

3.01 HARDCOPY PRODUCTS

Pre-Survey

A. Procedural Control Document (see Section 2.01J).

Post-Survey

A. Report from the surveyor certifying to the Department that the survey meets the OBCS technical specifications established herein (Sections 1.03 and 2.01) and minimum technical standards of Chapter 61G17-6, FAC.

B. Copies of all checked, standard field books, all computation and reduction files, analog and digital data (raw and processed), automated data collection files, and abstracted final positions shall be provided to the OBCS.

C. Surveyor report with regard to monumentation described in Section 2.02B above and including a listing of provided, found, and used monument and TBM identification, stamping, coordinates, elevations, and profile azimuths.

D. A quality control/quality assurance report detailing a QA/QC procedure and any findings, corrections, and results of that procedure, including cross-sectional plots of each profile. The cross-sectional plots to be provided shall overlay the profiles with the most recent prior profiles obtained from FDEP. Any significant discrepancies shall be identified and resolved. The scale of the cross-sectional plots shall be 1 inch = 50 feet horizontal and 1 inch = 5 feet vertical.

3.02 DIGITAL PRODUCTS

A. ASCII file containing raw x, y, and z profile data points, if x,y,z data is collected.

B. ASCII files containing the profile data processed into the DEP x, y, z, format, if x,y,z data is collected, and the DEP distance and depth format. All DEP formats include data as well as header records.

C. An ASCII file containing the monument identification, stamping, coordinates, elevations, profile azimuths, and any TBM monuments and/or revisions as described in Section 2.02B above and consistent with the report described in 3.01C above.

D. Digital photos as specified in Specification 2.01K.

E. Federally-compliant metadata.

END OF SECTION

SECTION 02100

BATHYMETRIC SURVEYING

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Work described in this section includes the acquisition, horizontal and vertical control (either by conventional or GPS methods), post processing, quality control/quality assurance, and deliverables of coastal bathymetric survey data. Bathymetric survey data shall be collected at Office of Beaches and Coastal Systems (OBCS) reference points, which are approximately 1,000 feet apart alongshore, or other lines or areas as described in the contract Scope of Work. This specification is predominantly applicable to nearshore (referred to as "offshore" herein) profile surveying and does not include full consideration of surveying in areas such as inlets and offshore borrow areas.

B. Purpose – The purpose of the bathymetric survey data is to provide data and other products for coastal regulatory and management activities along the coast of Florida.

C. A pre-survey conference is required. The conference will be held either at OBCS offices, or at the Contractors office if approved by OBCS.

1.02 DEFINITIONS

A. Contractor – The company that will provide bathymetric survey services to the OBCS.

B. HARN – The Florida High Accuracy Reference Network.

C. NAD 83/90 – The North American Datum 1983 adjustment of 1990.

D. NAVD 88 – The National American Vertical Datum of 1988.

E. NGVD 29 – The National Geodetic Vertical Datum of 1929.

F. TBM – Temporary bench mark.

G. Control Monument or Benchmark – OBCS 2nd order or higher control point, typically but not necessarily known as an "A" station.

H. Range Monuments – OBCS reference points, spaced approximately 1000 ft apart alongshore, typically known as "R" stations.

1.03 REFERENCE DOCUMENTS

A. Federal Geographic Data Committee, *Geospatial Positioning Accuracy Standards,* Parts 1, 2, and 3, Final Draft, U.S. Geological Survey, Reston, Virginia, 1998.

B. National Oceanic and Atmospheric Administration, NOAA Technical Memorandum NOS NGS-58, "Guidelines for Establishing GPS-Derived Ellipsoid Heights (Standards: 2 cm and 5 cm)," November 1997.

C. Florida Minimum Technical Standards. Chapter 61G17-6, Florida Administrative Code.

D. Hydrographic Surveying; US Army Corps of Engineers, Engineering and Design Manual, EM1110-2-1003, 1999.

E. Federal Geodetic Control Committee, "Standards and Specifications for Geodetic Control Networks", September 1984.

PART 2 - EXECUTION

2.01 DATA COLLECTION

A. General

Bathymetric surveys have historically been conducted by the use of boat-mounted echo sounding equipment (fathometer). Accuracy of bathymetric surveying has historically been subject to water level (e.g., tidal elevation) variations and sea conditions and the subsequent successful establishment of tidal correction and filtering of sea conditions. The use of kinematic GPS, including "on-the-fly" methods, has greatly increased the capability of achieving acceptable accuracy levels. Accuracy standards set forth by OBCS in this document are based on the demonstrable accuracy of these improved technologies. All bathymetric surveying shall meet or exceed accuracy levels achievable by these improved technologies. Generally these accuracy levels cannot be met using a tide guage.

B. Survey Control

All control work shall be completed prior to performing any profile surveys for a given survey area, unless otherwise specified by OBCS. All survey control shall be established as part of the onshore or upland topographic survey control work, and conducted in accordance with Section 02000, 2.01A.

1. Reference Monuments – The OBCS shall provide the Contractor with an ASCII data file describing the location (vertical and horizontal position) of each control monument to be surveyed. The Contractor shall verify the horizontal and vertical position of all found monuments. If a monument cannot be located, the contractor shall establish a temporary bench mark (TBM) at the specified reference monument location to control the profile survey. Missing monuments shall be reported to OBCS with TBM vertical and horizontal positions. Accuracy standards shall be in accordance with Section 02000,2.01A.

2. Offshore Profiles – All offshore profiles including any intermediate profiles shall be collected on Florida State Plane Coordinate Systems and OBCS established grid bearings as required in the project scope of work and shall be in accordance with accuracy specifications in Section 2.01D4 below.

3. Horizontal Datum - The horizontal datum shall be the HARN NAD 83/90.

4. Vertical Datum - The vertical datum shall be the NAVD 88.

5. Coordination - All operations shall be coordinated with the OBCS.

6. Ground Control/Ground Support – The Contractor shall provide all manpower and equipment as needed to complete the required topographic work. All GPS radio base station control or range/azimuth system control shall be established or recovered from OBCS control monuments (typically "A" stations) and shall meet or exceed Geospatial Positioning Accuracy Standards, Range VIII. Designation, stamping, description, horizontal position, and elevation (in NAVD 88) shall be provided to OBCS for all established base station control. All base station control shall have 3rd Order, Class II, vertical control based on closed-loop leveling between two existing "A" stations or other 3rd Order, or better, benchmarks.

C. Equipment and Calibration

All survey equipment shall be properly calibrated and operated as appropriate for specific work being performed in accordance with standards established in Section 1.03 D of this document. All depth measurement equipment shall be verified for accuracy at the beginning and end of each survey day. A direct depth measurement check (e.g. via pole, lead line, etc.) is to be conducted and recorded at both shallow and maximum depths relative to the work area at the beginning and end of each survey day, and more frequently if necessary.

If sea conditions preclude performing the depth check at the end of the day, sea conditions and indication of inability to perform the depth check shall be recorded and reported. At the beginning of each survey day, the last survey line of the previous day shall be repeated the following survey day to verify the measurement from the previous day. A similar check should be performed whenever a change in conditions during a survey warrants a check.

D. Data Measurement

1. Bathymetric survey data collection shall be performed as close in time as possible with the upland topographic survey data collection. Difference in time between the onshore and offshore data shall be no greater than 14 days.

2. Bathymetric survey data collection shall be conducted in calm seas. Maximum wave heights during the data collection period shall not exceed 3 feet.
3. Bathymetric survey data shall be acquired as close to time of high tide as possible, and shall extend landward far enough to ensure minimum overlap with upland survey data

of 50 feet. The offshore survey shall continue seaward collecting data at a minimum of 25 ft. intervals and extending to a minimum of 3000 feet offshore (from the most landward offshore data point) or to –30 feet (NAVD88), whichever is reached first.

4. Accuracy – Profile Data: The vertical accuracy of the profile data shall meet or exceed

   GPS-derived heights (0.2-0.5 ft.) standard (see Section 1.03B). The allowable horizontal positioning system accuracy of the data shall be within 2 feet. The allowable off-line horizontal deviation shall be within 30 feet.

5. Data Resolution – The data shall be collected at intervals not to exceed 25 ft. and at all

   grade breaks along the profile sufficient to accurately describe the bathymetry at the profile locations.

6. Procedural Control – The Contractor shall provide a document itemizing all procedures including quality control and instrumentation to be followed during the completion of this work, prior to the pre-survey conference. Procedural standards are outlined in reference documents listed in Section 1.03. Any deviations from procedures and standards contained within this specification shall be identified and approved by OBCS prior to conducting the survey work. The Contractor shall provide a quality control/quality assurance report detailing QA/QC procedures, and in the post-survey submittals shall report any findings, corrections, and results of those procedures.

2.02 DATA PROCESSING

A. All data processing shall be in accordance with National Geodetic Standards (as established by references 02100.1.03.A and 02100.1.03.B), Florida Minimum Technical Standards (reference 02000.1.03.C), requirements for a U.S. Army Corps of Engineers Class II Hydrographic Survey (with the exception that vertical accuracy shall conform to the OBCS specification in Section 2.01D4 above) (reference 02100.1.03.D), accepted survey practice, and OBCS data standards and format requirements.

PART 3 - PRODUCTS

3.01 HARDCOPY PRODUCTS

Pre-Survey

A. Procedural Control Document (See Section 2.01D6).

Post-Survey

A. Report from the surveyor certifying that the survey meets the OBCS Technical Standards and Florida minimum technical standards, Chapter 61G17-6, Florida Administrative Code.

B. Copies of all standard field books, all computation and reduction, analog and digital offshore data (raw and processed), automated data collection files, raw and processed digital and adjusted GPS files, and abstracted final position depths and distances from reference points shall be provided to the OBCS.

C. A quality control /quality assurance report detailing the procedures used and any findings, corrections, and results of that procedure.

3.02 DIGITAL PRODUCTS

All required data shall be provided in the following datums: HARN, NAD 83/90 State Plane Coordinates in feet, plus NAVD 88 elevations in feet. Alternative datums will be considered, but must be agreed upon by OBCS prior to commencing survey work.

A. ASCII file containing raw x, y, and z profile data points.
B. ASCII files containing the profile data processed into the DEP x, y, z, format, and the DEP distance and depth format. All DEP formats include data as well as header records. If the same Contractor is performing both onshore and offshore surveys, regardless of any subcontracting, then the Contractor shall provide DEP formatted files in the following versions: onshore profiles, offshore profiles, and combined on and offshore profiles.
C. An ASCII file containing the monument identification, stamping, coordinates, elevations, and any new TBM monument and/or revisions.
D. Digital copies of cross-section and plan view data point location and elevation plots, as DWG or DXF files.
E. Federally-compliant metadata.

END OF SECTION

SECTION 02200

PHOTO CONTROL POINT TARGETING AND ACQUISITION

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Work described in this section includes the targeting, acquisition and processing for horizontal and vertical ground control, which is used in conjunction with aerial photography to produce rectified aerial photographs for the Office of Beaches and Coastal Systems (OBCS).

B. Purpose – The purpose of the ground control, along with associated surveying and aerial photography, is to provide data and other products for coastal regulatory and management activities along the coast of Florida.

C. A pre-flight ground control acquisition conference is required. The conference will be held either at the OBCS offices, or at the Contractors office.

1.02 DEFINITIONS

A. Accuracy, Horizontal – A measure of the confidence that a particular location on a photo can be located to within a specified distance. For National Map Accuracy Standards (Section 01000.1.03.B), the accuracy standards for a 1:2400 scale contour map state that 90% of well-defined point features must fall within 6.7 feet of the actual ground coordinates. Areas of high relief, and areas that fall on the edge of a photo will experience greater horizontal inaccuracies.

   When the final photo is viewed, it is possible to accurately measure horizontal distances on the photograph within the tolerances expressed. The accuracy tolerances are affected by a range of factors but are generally correlated with pixel size; usually, the smaller the pixel, the better spatial resolution or horizontal accuracy of the photograph.

B. CORS – The Continuously Operating Reference Station network of GPS base stations operated by the Unites States Coast Guard.

C. Contractor – The aerial survey or photogrammetric company that will provide aerial survey and/or photogrammetric services to the OBCS.

D. HARN – The Florida High Accuracy Reference Network.

E. NAD 83/90 – The North American Datum 1983 adjustment of 1990.

F. Scale – The relationship between a given distance on the ground and the corresponding distance on a photograph or image. Scale can be expressed in two different ways, both as ratios. The first method uses common measuring systems to related the distance on the photo to the actual distance on the earth (e.g., 1" = 200'). The second method uses a ratio where the unit of measure is arbitrary (e.g., 1:1200). For this method meters, feet, miles, etc. can all be used as the measuring unit to relate distance on a photo or image with distance on the earth.

1.02 REFERENCE DOCUMENTS

A. Federal Geographic Data Committee, *Geospatial Positioning Accuracy Standards*, Parts 1, 2, and 3, Final Draft, U.S. Geological Survey, Reston, Virginia, 1998.

B. National Oceanic and Atmospheric Administration, NOAA Technical Memorandum NOS NGS-58, "Guidelines for Establishing GPS-Derived Ellipsoid Heights (Standards: 2 cm and 5 cm)," November 1997.

C. National Geodetic Survey, " Guidelines for Establishing GPS –Derived Ellipsoid Heights" (Standards for 2 cm and 5cm).

D. Federal Geodetic Control Subcommittee, " Standards for Geodetic Control Networks" Classification Range IX.

PART 2 - EXECUTION

2.01 PRE-FLIGHT

A. The Contractor shall submit a proposed ground control project map to the OBCS.

B. Datum, Horizontal - The horizontal datum shall be the Florida High Accuracy Network (HARN) North American Datum (NAD) 1983 adjustment of 1990 in US Survey feet.

C. Datum, Vertical - The vertical datum shall be the National American Vertical Datum (NAVD) 88, feet.

D. Accuracy, Horizontal – Surveys performed to establish horizontal position for this specification shall meet the requirements as specified in the Federal Geodetic Control Subcommittee, " Standards for Geodetic Control Networks" Classification Range IX.

E. Accuracy, Vertical – Surveys performed to establish vertical position for this specification shall meet the requirements as specified in the National Geodetic Survey, " Guidelines for Establishing GPS –Derived Ellipsoid Heights" (Standards for 2 cm and 5cm). The Department and the contractor shall agree upon the appropriate specification prior to the execution of the contract.

2.02 GROUND CONTROL

A. Ground Control – Field surveying for photogrammetric control is generally a two-step process. The first step of the process consists of establishing a network of basic control in the project area. These basic controls consist of horizontal control monuments and benchmarks of vertical control that will serve as a reference framework for subsequent surveys. The second step involves establishing photo control by means of surveys originating from the basic control. Photo control points are the actual points appearing in the photos that are used to control photogrammetric operations.

Ground control will be provided either by the Contractor or by the OBCS, depending on the Scope of Work. This control will consist of targeting existing OBCS monuments and/or other controlled photo identifiable points. The OBCS has established a Basic Control Network (BCN) which will be provided to the contractor. The BCN includes descriptions, positions, elevations, and historic photography for each control point. In addition, the OBCS will provide a reconnaissance report identifying the existing basic control suitable for targeting. The OBCS control points are spaced at approximately 1,000-foot intervals along the coast. Similar control will be required in areas where these monuments do not currently exist (e.g., military bases). The Contractor shall be responsible for determining if this ground control is adequate to meet the requirements of the project or if additional control is required. A minimum of six ground control points per scanned image (every other photo) is required.

Ground control also includes all necessary ground support and GPS receivers (base stations) for the required number of ground control points to be occupied during the flight. A time table for the movement of personnel and equipment, if OBCS employees are used, shall be submitted. All ground control will be based on the Florida State Plane Coordinate System, NAD83/1990 adjustment and tied to the HARN.

Where possible, GPS base stations shall have ellipsoid height to an accuracy of 2 centimeters relative to the CORS, HARN, or the OBCS BCN.

A ground control report shall be prepared and must include, at a minimum, all pertinent base station information and mission notes, including information on GPS station monument names and stability.

B. Basic Control Targeting - The contractor shall place targets on all suitable identified existing basic control. Target must be of adequate size and contrast to the background surface so as to be readily identifiable on the photo image. The OBCS and the contractor shall agree upon the material, size, shape, and spacing of the basic control targets prior to the flight. The contractor shall provide adequate field survey notes to identify the placed targets during the post-flight period. At a minimum, the notes shall contain target color, assigned number, shape, and orientation. The contractor shall also provide post flight contact prints with the basic control targets pin pricked, and identified on the backside of the contact print the number assigned to the basic control target. Targets shall be maintained in place and protected from or restored after damage by man, animal, or weather until photograph has been taken. As soon as possible

after the photograph has been taken and verified of a positive result the targets shall be inspected for its condition and reported if a problem existed and then removed. In the identified problem target areas, a scheduled postmarking photo identifiable control points shall be scheduled.

C. Ground Control Base-Station Spacing – Ground control base stations shall be approximately 7 miles (preferred) to 12 miles (maximum) apart.

D. Weather Log – A weather log shall be maintained to substantiate any delays due to inclement weather. The weather log shall include date, location, weather report, and weather forecast from the U.S. Weather Bureau. This information may be supplemented by direct observation.

2.03 POST-FLIGHT

A. Postmarking Photo Identifiable Control - Post-marking photo control after the photography is flown consists of examining the photography and choosing natural image features. As specified above, the features are then located in the field and horizontal and vertical survey from the basic control monuments shall be performed. A combination of Basic Control Points and Post-marking Photo Identifiable Control Points (feature points) shall yield at least six identifiable targets per image. All targets and points shall be pin picked upon the Contractor-provided contact prints and the point identification number will be labeled upon the reverse side. A listing shall be provided by the contractor of all control and include at a minimum the point label, x position, y position, and elevation. An AutoCAD format file (most recent version) shall be prepared for each image. The file shall contain two layers, one for the point location and one for the control point label.

B. Control Report – The Contractor shall submit a copy of the control report to the OBCS for approval. The report should contain the weather logs.

PART 3 - PRODUCTS

3.01 GENERAL

A. All costs of products shall be borne by the Contractor.

3.02 HARCOPY PRODUCTS

<u>Pre-Flight</u>

A. Ground Control Project Map

<u>Post-Flight</u>

A. General Report – A report describing the project and survey procedures used including the description of the project area, location, and existing control found; description of the basic and photo control survey network geometry; description of the survey instruments and field methods used; description of the survey adjustment methods and results such as closure and

precision of adjusted position justification for any survey points omitted from the final adjusted network.

B. Contact Prints – One set of contact prints showing all control points and features points used as targets. The points should be symbolized and named on the reverse side of the image and the exact point location should be pinpricked through the print.

C. Adjusted Control Point Report – A list of the adjusted coordinates of all horizontal and vertical basic and photo control points.

3.03 DIGITAL PRODUCTS

A. Control Point CAD File – An AutoCAD file format (latest release) drawing file shall be prepared for each image in accordance with specifications in Section 2.03.A.

END OF SECTION

SECTION 03000

LIDAR TOPOGRAPHIC MAPPING & AERIAL PHOTOGRAPHY ACQUISITION

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Work described in this section includes the acquisition, vertical and horizontal control (obtained either by conventional or GPS methods), post processing, quality control/quality assurance, and deliverables for topographic survey data obtained using LIDAR technology, and the concurrent acquisition, scanning, and deliverables for aerial photography. All LIDAR topographic mapping must be accompanied by simultaneous acquisition, processing, and delivery of digital aerial photography, which complies with the OBCS Technical Specifications for Aerial Photography Acquisition and for Aerial Photography Rectification set forth in Sections 01000 and 01100 of Appendix V of this Statewide Monitoring Program document.

B. Purpose – The purpose of the topographic survey obtained by LIDAR and acquired aerial photography is to provide data and other products for coastal regulatory and management activities along the coast of Florida.

1.02 DEFINITIONS

A. Accuracy –

1) Horizontal - Accuracy is the measure of the confidence that a particular ground location taken from LIDAR derived data is within a specified distance of the actual ground location. For National Map Accuracy Standards (Section 03000.1.03.B), the accuracy standards for a 1:2400 scale contour map state that 90% of well-defined point features must fall within 6.7 feet horizontally of the actual ground coordinates. The horizontal accuracy of the data shall be no more than 3 feet at the 95% confidence level.

2) Vertical - Vertical accuracy of raw data shall be 15 cm. or less.

B. Contractor – The company that will provide LIDAR topographic mapping services to the OBCS.

C. CORS – The Continuously Operating Reference Station network of GPS base stations operated by the Unites States Coast Guard.

D. HARN – The Florida High Accuracy Reference Network.

E. LIDAR – An airborne laser system, flown aboard rotary or fixed-wing aircraft, that is used to acquire x, y, and z coordinates of terrain and terrain features that are both manmade and naturally occurring. LIDAR systems consist of an airborne Global Positioning System (GPS) with attendant GPS base station(s), an Inertial Measuring Unit (IMU), and a light-emitting scanning laser.

   The system measures ranges from the scanning laser to terrain surfaces within a scan width beneath the aircraft. The time it takes for the emitted light (LIDAR return) to reach the earth's surface and reflect back to the onboard LIDAR detector is measured to determine the range to ground. Scan widths will vary, depending on mission purpose, weather conditions, desired point density and spacing, and other factors.

   The other two components of the LIDAR system are the airborne GPS, which ascertains the in-flight three-dimensional position of the sensor, and the IMU, which delivers precise information about the attitude of the aircraft, and thus the attitude of the LIDAR sensor.

F. NAD 83/90 – The North American Datum 1983 adjustment of 1990, a horizontal datum.

G. NAVD 88 – The National American Vertical Datum of 1988.

H. NGVD 29 – The National Geodetic Vertical Datum of 1929.

I. PDOP – The Position Dilution of Precision is a measure of the accuracy of GPS. The lower the PDOP the higher the accuracy.

J. RMSE – The root mean square error is the square root of the average of the set of squared differences between data coordinate values and coordinate values from an independent source of higher accuracy for identical points.

K. Scale – The relationship between a given distance on the ground and the corresponding distance on a map. Scale can be expressed is two different ways, both as ratios. The first method uses common measuring systems to related the distance on the photo to the actual distance on the earth (e.g., 1" = 200'). The second method uses a ratio where the unit of measure is arbitrary (e.g., 1:1200). Thus, meters, feet, miles, etc. can all be used as the measuring unit to relate distance on a map with distance on the earth.

L. LIDAR TIN – A digital terrain model (DTM) for bare earth surface that is built from x,y,z data that has not been binned, gridded or thinned in any fashion. The DTM shall be established through development of a TIN (Triangular Irregular Network).

1.03 REFERENCE DOCUMENTS

A. Federal Emergency Management. Agency *Guidelines for the National Flood Insurance Program Products – Appendix 4B. AIRBORNE LIGHT DETECTION AND RANGING SYSTEMS.*

B. Federal Geographic Data Committee, *Geospatial Positioning Accuracy Standards*, Parts 1, 2, and 3, Final Draft, U.S. Geological Survey, Reston, Virginia, 1998.

C. National Oceanic and Atmospheric Administration, NOAA Technical Memorandum NOS NGS-58, "Guidelines for Establishing GPS-Derived Ellipsoid Heights (Standards: 2 cm and 5 cm)," November 1997.

D. Federal Geographic Data Committee, 1998, "Content Standard for Digital Geospatial Metadata, FGDC-STD-001-1998."

E. Florida Minimum Technical Standards. Chapter 61G17-6, Florida Administrative Code.

PART 2 - EXECUTION

2.01 PRE-FLIGHT

A. A pre-flight/data acquisition conference is required. The meeting will be held at either the Office of Beaches and Coastal Systems (OBCS) offices or at the Contractors office, as determined by OBCS.

B. Swath Centerline – Prior to the pre-flight conference, the OBCS shall provide the Contractor with a waypoint file describing the centerline for the flightline. The aircraft's trajectory will be determined by the Contractor, using phase differential kinematic processing with one second or less epoch intervals.

C. Flight Planning – At the pre-flight conference the Contractor shall submit a flight plan that includes details of the flight. This plan should include a map (e.g., USGS quad sheet) showing the project area and proposed flight path(s), documentation specifying altitude, airspeed, scan angle, scan rate, LIDAR pulse rate, and other flight and equipment information deemed appropriate, and a chart of high PDOP times, or a list showing the beginning and ending of high PDOP times.

D. Ground Control – At the pre-flight conference the Contractor shall provide a Ground Control Plan. The Ground Control Plan shall be in accordance with the ground control requirements as given in Sections 03000 2.02 A, B, C, and D below.

E. Equipment Calibration – The Contractor shall provide the OBCS with evidence of manufacturer testing and calibration. The Contractor must also submit a Systems Calibration Report that provides evidence that the total LIDAR system was calibrated prior to project initiation for the purposes of identifying and correcting systematic errors. The equipment shall have been calibrated by the manufacturer with in the previous 24 months form the date of use for the OBCS project.

2.02 DATA COLLECTION

A. Ground Control/Ground Support – Ground control will be provided either by the Contractor or by the OBCS, depending on the scope of services for each particular project. Ground control includes all necessary ground support and GPS receivers for the required number of ground control points to be occupied during data collection. A timetable for the movement of personnel and equipment, if OBCS employees are used, shall be submitted. All ground control will be based on the Florida State Plane Coordinate System, NAD83/90 tied to HARN. Where possible, GPS base stations shall have ellipsoid height to an accuracy of 5 centimeters relative to the CORS or the HARN.

B. Post-flight Ground Control Report – A Post-flight Ground Control Report shall be prepared and must include, at a minimum, all pertinent base station information and mission notes, including information on GPS station monument names and stability. The Post-flight Ground Control Report shall be submitted as part of a Flight Report as described in Section 03000 2.02S below.

C. Ground Control Spacing – Ground control stations shall be approximately 7 miles (preferred) to 12 miles (maximum) apart.

D. Ground Control Profiles – Profiles shall be surveyed along every 6th OBCS range (approximately every 6,000') based on coordinates and azimuths provided by the OBCS. This data shall be used as part of the quality assurance/quality control work described in Section 03000 2.03G. A description of the ground control profiles shall be included with the Post-flight Ground Control Report. Plots of ground control profiles and comparison with LIDAR generated plots acquired at the same location and bearing lines as the ground control profiles are required to be in the QA/QC report as described in Section 03000 2.03G.

E. Datum, Horizontal - The horizontal datum shall be the Florida High Accuracy Network (HARN) North American Datum (NAD) 1983 adjustment of 1990.

F. Datum, Vertical - The vertical datum shall be the National American Vertical Datum (NAVD) 88.

G. GPS Window - Data collection shall be carefully planned to correspond with a GPS window of six or more satellites in view with a PDOP not to exceed 4.0.

H. Coordination - All operations shall be coordinated with the OBCS.

I. Flight Line - The pilot for the airborne LIDAR system shall maintain steerage by utilizing the waypoint file provided by OBCS with real-time on-board navigation. Prior to the flight, the Contractor shall drive the closest parallel roadway to the beach along the proposed flight line while recording GPS positions. The contractor shall provide a road map showing the proposed path.

J. Data Log - All logged data, ground and aerial, pseudo and carrier, gyro data, and LIDAR data shall be downloaded immediately upon return and input into a central processing computer. A backup file shall be created immediately after downloading.

K. Accuracy – LIDAR derived data must have the accuracy required to produce topographic maps and products that meet the National Standard for Spatial Data Accuracy (NSSDA). For the areas along the beach and primary dune system (beach areas with little or no vegetation) 1-foot contour accuracy must be met, in areas of short grass and sparse shrub 2-foot accuracy must be met, and in all other areas 4-foot accuracy must be met.

   The horizontal accuracy of the data shall be no more than 3.33+/- feet at the 95% confidence level.

L. Raw Data Postings – The raw LIDAR data density shall be a maximum of 5 feet along the LIDAR sensor path (perpendicular to the flight of the aircraft) and 25 feet between sawtooth (sensor paths in the direction of the aircraft flight) openings.

M. LIDAR Swath Area – The LIDAR data shall be collected over a 1,500’ swath measured from the mean low water line landward.

N. Flight Altitude – The flight altitude shall be that necessary to obtain the required data posting.

O. Flight Time – The entire flight shall occur between one (1) hour before and one (1) hour after mean low tide.

P. Flight Log – A flight log representing aircraft flight time shall be maintained on an hourly basis. The time of takeoff, start of LIDAR collection, end of LIDAR collection, and landing shall be recorded to the nearest 0.1 hour. The log shall be signed by the pilot of the LIDAR operator and be submitted with the flight report. The Contractor must document mission date, time flight altitude, airspeed, scan angle, scan rate, laser pulse rates, and other information deemed pertinent. The pilot for the airborne LIDAR system shall maintain steerage by utilizing the waypoint file provided by the OBCS with real-time on board navigation. A copy of the Flight Log will be submitted to OBCS

Q. Weather Log – A weather log shall be maintained to substantiate any delays due to inclement weather. The weather log shall be include date, location, weather report, and weather forecast from the U.S. Weather Bureau. This information may be supplemented by direct observation. A copy of the Weather Log will be submitted to OBCS.

R. Tide Log – The Contractor shall maintain a tide log to substantiate any delay due to incorrect or unacceptable tides. The tide log should include the date, time, the location of the nearest NOAA tide station(s) being reported, and the tide elevation at the beginning, middle, and end of data collection as calculated for photo collection location (through interpolation between adjacent tide stations). All reported tide elevations shall be referenced to NAVD (1988). A copy of the Tide Log shall be submitted to OBCS.

S. Flight Report – The Contractor shall prepare a flight report that includes the flight log, ground control report, information about GPS-derived flight tracks, provide a detailed description of final flight line parameters and GPS controls (i.e., benchmarks), and include ground truth and complementary reference data. The report shall also include on-board antenna offsets, height of instrument before and after takeoff, all GPS PDOP values, the tide log, the data log, and the weather log.

2.03 POST-FLIGHT AND DATA PROCESSING

A. Flight Report – Within 5 days of the flight, the Contractor shall submit a copy of the flight report.

B. Data Voids – Areas that are not within 25 feet of a raw LIDAR return are considered data voids, except areas within bodies of water and areas recently paved (within 24 hours) with asphalt. Raw data voids cannot exceed 5% of the project area. If the data voids do exceed 5% the contractor must acquire supplemental data in the form of additional LIDAR data or conventional survey data.

C. Unfiltered Data Processing – The raw LIDAR data, all GPS data (on board and base station), IMU data, and any other data used shall be processed to produce x, y, and z ground data points. The GPS data from the base station and the primary navigation receiver on the airborne platform shall be reduced to produce vector offset from all of the base stations to the airborne platform then least square techniques shall be used to determine best fit three dimensional positions of the airborne platform every second of the mission. Position and attitude information shall be time matched with gyro and LIDAR data to produce accurate x, y, and z positions of the LASER returns.

D. Height Bios Removal – Height bios will be removed from the data.

E. Filtered Data Processing – Artifacts are regions of anomalous elevations or variations in the LIDAR data resulting from systematic errors or environmental conditions. The Contractor shall provide an analysis of any artifacts, including height bios. The analysis shall include a description of the artifacts and the steps or processing techniques that were used to eliminate the artifacts to produce accurate x, y, and z positions of the filtered data.

F. Quality Assurance/Quality Control – The Contractor is solely responsible for the QA/QC of the processed LIDAR data. The QA/QC process shall include reviews of the flight, weather, GPS, IMU, and LIDAR data, and any other supporting data.

The QA/QC methodology shall be in accordance with the reference given in Section 03000.1.03.B, which uses the root mean square error (RMSE) to estimate vertical accuracy.

The contractor shall calculate the RMSE requirement for land cover categories as follows:
Type 1 - Beach and frontal dune areas (with little or no vegetation);

contour interval = 1 foot; vertical accuracy = 0.5

Type 2 - Short grass and sparse shrub;
contour interval = 2 foot; vertical accuracy = 1.0

Type 3 - All other areas (with higher, denser scrub vegetation);
contour interval = 4 foot; vertical accuracy = 2.0

All other land cover class shall be removed and the following procedures followed:

a. Urban areas (manmade structures excluding low elevation construction such as parking lots, streets, etc.): Structures shall be removed and the surrounding bare ground elevations shall be used to replace data within the structure footprint.
b. Areas of dense vegetation higher than 4 ft. and trees: These areas shall be marked out as a data void. If the data voids exceed 5% of the surveyed area, then the contractor must acquire supplemental data in the form of additional LIDAR data and/or conventional survey data.

It is noted that the Contractor may further subdivide these land cover categories with prior written approval from the OBCS. A report of the data processing procedures shall be submitted. The report shall include data and information on all data processing and manipulation.

The ground control profiles shall be selected throughout the project area by surveying every sixth OBCS reference monument and profile line. The OBCS will provide the contractor with all control information for the ground control profiles including coordinate locations (in Florida State Plane coordinate system) and elevations (referenced to NGVD, 1929) of applicable survey reference monuments and bearing/azimuth of all profile lines. and vertical coordinates for the ground control.

The Contractor shall use a comparison of profile points for each profile derived from the LIDAR TIN with the corresponding points from the ground control profiles. Plot overlays of the LIDAR profiles and corresponding ground control profile. A comparison shall be done of the vertical values of the LIDAR data verses the ground control profiles at each ground control profile point. A mean and standard deviation will be calculated for each category along each profile. The results shall be depicted in a table (see example below) containing a line for each comparison and will contain mean, standard deviation and maximum value above and below the ground control profile.

		Mean	S.D.	Max Value	Min Value
R001	Type 1	0.2	0.3	0.9	-0.2
	Type 2	0.5	0.4	1.4	-0.3
	Type 3	0.4	1.5	7.0	-0.5
R007	Type 1				
	Type 2				
	Type 3				
Sum	Type 1				
	Type 2				

Type 3

The Contractor also shall use the following equation to determine the sample RMSE for each of the three types of land cover.

$$RMSE_{sample} \le C\sqrt{\frac{(n-1)-2.326\sqrt{n-1}}{n}}$$

Where C = contour level accuracy (C = 0.5 for Type 1 (1-foot contours); C = 1.0 for Type 2 (2-foot contours); C = 2.0 for Type 3 (4-foot contours); and n = number of control points.

The calculated RMSE shall be less than or equal the $RMSE_{sample}$ for each land cover. The $RMSE_{sample}$ for Type 1 is 0.5, for Type 2 is 1.0 and for Type 3 is 2.0.

The QA/QC process described in this Section and the QA/QC results shall be tabulated within a QA/QC report that includes a statement verifying the processed data meets or exceeds all accuracy requirements. The QA/QC report shall be submitted to the OBCS as specified in Section 03000 3.01.

G. Profiles – The Contractor shall create profiles at all OBCS reference monuments. The OBCS will provide the Contractor with a file containing the coordinate and azimuth information for the profiling work. The OBCS reference monuments are spaced approximately 1,000' apart along the coast. The Contractor shall compare the profiles produced using LIDAR data with the profiles obtained by conventional surveying methods at each 6th range monument. Results of the comparison shall be included in the QA/QC report.

H. Contouring – All contouring shall adhere to Florida Minimum Technical Standards (Section 03000.1.03.E) and National Map Accuracy Standards (Section 03000.1.03.B). Contours shall be produced by standard Triangular Irregular Network (TIN) processing techniques with no prior binning, gridding, or any other thinning routine being applied to the data.

Different contours are required based on land cover. For the areas along the beach and primary dune system (beach areas with little or no vegetation) a 1-foot contour is required, in areas of short grass and sparse shrub a 2-foot contour on the even foot is required, and in all other areas a 4-foot contour on the even foot is required. Different symbology and coloring codes shall be applied to differentiate between the different contour intervals.

I. Obscured Areas – Maps compiled from LIDAR data shall meet all required specifications for accuracy and completeness, even in obscured areas. When there are areas where structures, brush, or tree cover obscure the ground so that elevation or topography cannot be compiled accurately, the data for these areas shall be obtained by others methods (e.g., conventional ground surveys).

J. Bare-Earth Point Model – The Contractor shall create an accurate bare-earth point model from LIDAR data. Elevation points on vegetation, bridges, buildings, and other structures that do

not represent the bare-earth shall be removed from the LIDAR-derived data prior to creating a TIN model and the contour map.

K. Data Conversions – All data conversions shall conform to National Geodetic Standards.

PART 3 - PRODUCTS

3.01 HARDCOPY PRODUCTS

Pre-Flight

A. Flight Plan – The flight report shall be submitted in accordance with Section 2.01C of this Technical Specification.

B. Ground Control Plan – The ground control plan shall be submitted in accordance with Section 2.01D of this Technical Specification.

C. System Calibration Report – The system calibration report must be submitted in accordance with Section 2.01E of this Technical Specification.

D. OBCS Personnel Movement Plan – The Personnel Movement Plan shall be submitted in accordance with Section 2.02B of this Technical Specification.

E. Flightline Road Map – The Flightline Road Map shall be submitted in accordance with Section 2.02I of this Technical Specification.

Post-Flight

F. Flight Report – The flight report shall be submitted in accordance with Section 2.03A of this Technical Specification. The following reports will be submitted as sections of this report: Flight Log (Section 2.02P), Weather Log(Section 2.02Q), and the Tide Log (Section 2.02R).

G. QA/QC Report – The QA/QC report shall be submitted in accordance with Section 2.03F of this Technical Specification. This report will include the Data Processing Report.

3.02 DIGITAL PRODUCTS

A. Raw Data – An ACSII file containing raw processed ellipsoid heights, x, y, and z data points, with intensity data attached in NAD 83/90 State Plane Coordinates in feet, plus NAVD 88 elevations in feet shall be submitted.

B. Raw Surface Contour Map – A contour map at one-foot contour intervals shall be created using the raw data set. This is a surface contour map created from the tinned LIDAR points prior to any vegetation or building removal. There will be one file per OBCS sheet layout file.

C. Height Bios File – A height bios file in ASCII format. The height bios will be determined by comparing ground control data and raw processed x, y, and z data points (see Section 2.03.C). All data will be in NAD 83/90 State Plane Coordinates in feet, plus NAVD 88 elevations in feet.

D. Metadata File – A complete digital Federal Metadata File in accordance with reference document 1.03.D.

E. Unfiltered Processed Data File – An ASCII file which has the height bios correction applied to the raw processed file for NAD 83/90 State Plane Coordinates in feet, plus NAVD88 elevations in feet. The Contractor must deliver datasets and LIDAR system data, including orthometric heights for each point in comma-delimited ACSII files in x, y, and z format. The Contractor must flag datasets from sidelap and overlap areas of separate flight lines.

F. Filtered Processed Clipped Data File – A processed data file in ASCII format which has the height bios correction applied to the raw processed file. NAD 83/90 State Plane Coordinates in feet, plus NAVD 88 elevations in feet. Using OBCS sheet layout files, the Contractor will create the ASCII files, with one file per OBCS sheet layout file.

G. Bare-Earth Contour Map – The Contractor will use filtered data with vegetation and structures removed from the processed data to create a map with one-foot, two-foot, and four-foot contours, depending on the land cover. These areas will be distinguished by creating a polygon around the different contoured areas. Areas of vegetation, structures, and other areas in which there was no data collected, will be bordered and annotated “NO DATA”. The total “NO DATA” area may not exceed 5% of the total coverage area. These files shall be in DXF format and contain both the data points and the required contours. There will be one file per OBCS sheet layout file.

H. Additional DXF Files – The Contractor shall submit additional DXF files for each OBCS sheet layout file by “thinning” the data points. These files will contain data points approximately every 100 feet and the required contours. There will be one file per OBCS sheet layout file.

I. Profile Lines – A profile line shall be cut through the TIN model at OBCS range lines. The output files will be in ASCII format, using x, y, and z data points along the OBCS range lines at intersections of the profile line and the TIN model. Ground control profiles shall be provided in an ASCII format. Both LIDAR and ground control profiles shall include OBCS header record information for each profile in OBCS format.

J. Digital Terrain Model – A gridded three-foot x, y, and z digital elevation model (DTM) shall be created using the filtered data file. There will be one DTM file per OBCS sheet layout file.

END OF SECTION

SECTION 03100

LIDAR BATHYMETRIC MAPPING

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Description – Work described in this section includes the acquisition, horizontal and vertical control (obtained by either conventional or GPS methods), post processing, quality control/quality assurance, and deliverables for the acquisition of bathymetric data using LIDAR technology.

B. Purpose – The purpose of bathymetric survey obtained by LIDAR is to provide data and other products for coastal regulatory and management activities along the coast of Florida.

1.02 DEFINITIONS

A. Accuracy – Accuracy is the measure of the confidence that a particular ground location estimated using LIDAR derived data is within a specified distance of the actual ground location. For National Map Accuracy Standards (Section 03000.1.03.B), the accuracy standards for a 1:4800 scale contour map state that 90% of well-defined point features must fall within 13.3 feet horizontally of the actual ground coordinates.

B. Contractor – The company that will provide LIDAR bathymetric mapping services to the OBCS.

C. CORS – The Continuously Operating Reference Station network of GPS base stations operated by the Unites States Coast Guard.

D. HARN – The Florida High Accuracy Reference Network.

E. LIDAR – An airborne laser system, flown aboard rotary or fixed-wing aircraft, that is used to acquire x, y, and z coordinates of bathymetry and bathymetric features that are both manmade and naturally occurring. LIDAR systems consist of an airborne Global Positioning System (GPS) with attendant GPS base station(s), an Inertial Measuring Unit (IMU), and a light-emitting scanning laser.

   The system measures ranges from the scanning laser to terrain or water surfaces within a scan width beneath the aircraft. The time it takes for the emitted light (LIDAR return) to reach the earth's surface and reflect back to the onboard LIDAR detector is measured to determine the range to ground. Scan widths will vary, depending on mission purpose, weather conditions, desired point density and spacing, and other factors.

The other two components of the LIDAR system are the airborne GPS, which ascertains the in-flight three-dimensional position of the sensor, and the IMU, which delivers precise information about the attitude of the aircraft, and thus the attitude of the LIDAR sensor.

F. NAD 83/90 – The North American Datum 1983 adjustment of 1990.

G. NAVD 88 – The National American Vertical Datum of 1988.

H. NGVD 29 – The National Geodetic Vertical Datum of 1929.

I. PDOP – The Position Dilution of Precision is a measure of the accuracy of GPS. The lower the PDOP the higher the accuracy.

J. RMSE – The root mean square error is the square root of the average of the set of squared differences between data coordinate values and coordinate values from an independent source of higher accuracy for identical points.

K. Scale – The relationship between a given distance on the ground and the corresponding distance on a map. Scale can be expressed is two different ways, both as ratios. The first method uses common measuring systems to related the distance on the photo to the actual distance on the earth (e.g., 1" = 200'). The second method uses a ratio where the unit of measure is arbitrary (e.g., 1:1200). Thus, meters, feet, miles, etc. can all be used as the measuring unit to relate distance on a map with distance on the earth.

L. LIDAR TIN – A digital elevation model (DEM) for surface (including sub-surface vegetation) that is built from x,y,z data that has not been binned, gridded or thinned in any fashion. The DEM shall be established through development of a TIN (Triangular Irregular Network).

1.03 REFERENCE DOCUMENTS

A. Federal Geographic Data Committee, *Geospatial Positioning Accuracy Standards*, Parts 1, 2, and 3, Final Draft, U.S. Geological Survey, Reston, Virginia, 1998.

B. National Oceanic and Atmospheric Administration, NOAA Technical Memorandum NOS NGS-58, "Guidelines for Establishing GPS-Derived Ellipsoid Heights (Standards: 2 cm and 5 cm)," November 1997.

C. Federal Geographic Data Committee, 1998, "Content Standard for Digital Geospatial Metadata, FGDC-STD-001-1998."

D. Florida Minimum Technical Standards. Chapter 61G17-6, Florida Administrative Code.

PART 2 - EXECUTION

2.01 PRE-FLIGHT

A. Pre-Flight Conference – A pre-flight, pre-data acquisition conference is required. The conference will be held at either the OBCS offices or at the Contractors office, as determined by OBCS staff.

B. Swath Centerline – Prior to the pre-flight conference, the OBCS shall provide the Contractor with a waypoint file describing the centerline for the flightline. The aircraft's trajectory will be determined by the Contractor, using phase differential kinematic processing with one second or less epoch intervals.

C. Flight Planning – At the pre-flight conference the Contractor shall submit a flight plan that includes details of the flight. This plan should include a map (e.g., USGS quad sheet) showing the project area and proposed flight path(s), documentation specifying altitude, airspeed, scan angle, scan rate, LIDAR pulse rate, and other flight and equipment information deemed appropriate, and a chart of high PDOP times, or a list showing the beginning and ending of high PDOP times.

D. Ground Control – At the pre-flight conference the Contractor shall provide a ground control plan. The ground control plan shall be in accordance with ground control requirements as given in Sections 03000 2.02 A, B, C, and D below.

E. Equipment Calibration – The Contractor shall provide the OBCS with evidence of manufacturer testing and calibration. The Contractor must also submit a System Calibration Report indicating that the total LIDAR system was calibrated prior to project initiation for the purposes of identifying and correcting systematic errors. The equipment shall have been calibrated by the manufacturer with in the previous 24 months form the date of use for the OBCS project.

2.02 DATA COLLECTION

A. Ground Control/Ground Support – Ground control will be provided either by the Contractor or by the OBCS, depending on the scope of services for each particular project. Ground control includes all necessary ground support and GPS receivers for the required number of ground control points to be occupied during data collection. A time table for the movement of personnel and equipment, if OBCS employees are used, shall be submitted. All ground control will be based on the Florida State Plane Coordinate System, NAD83/1990 tied to HARN.

Where possible, GPS base stations shall have ellipsoid height to an accuracy of 5 centimeters relative to the CORS or the HARN.

B. Ground Control Report – A Ground Control Report shall be prepared and must include, at a minimum, all pertinent base station information and mission notes, including information on GPS station monument names and stability, and include all ground control .

C. Ground Control Spacing – Ground control stations shall be approximately 7 miles (preferred) to 12 miles (maximum) apart.

D. Ground Control Profiles – Profiles shall be surveyed by conventional bathymetric survey methods along every 6th OBCS range (approximately every 6,000') based on coordinate and azimuths provided by the OBCS. This data shall be used as part of the quality assurance/quality control work and shall be included with the Ground Control Report.

E. Datum, Horizontal - The horizontal datum shall be the HARN NAD 83/90.

F. Datum, Vertical - The vertical datum shall be the NAVD 88.

G. GPS Window - Data collection shall be carefully planned to correspond with a GPS window of six or more satellites in view with a PDOP not to exceed 4.0.

H. Coordination - All operations shall be coordinated with the OBCS.

I. Flight Line - The pilot for the airborne LIDAR system shall maintain steerage by utilizing the waypoint file provided by OBCS with real-time on-board navigation.

J. Data Log - All logged data, ground and aerial, pseudo and carrier, gyro data, and LIDAR data shall be downloaded immediately upon return and input into a central processing computer. A backup file shall be created immediately after downloading.

K. Accuracy –

1) Horizontal - LIDAR derived data must have the accuracy required to produce bathymetric maps and products that meet the US Army Corps of Engineers Hydrographic Survey Accuracy Standards for a Class 1 survey and the International Hydrographic Organization Nautical Chart Standards. The horizontal accuracy of the data shall be no more than 10 feet at the 95% confidence level.

2) Vertical - Vertical accuracy of raw data shall be 15 cm. or less.

L. Raw Data Postings – The raw LIDAR data density shall be an average of 25 feet throughout the swath range. The distance between swaths shall be no more than 25 feet.

M. LIDAR Swath Area – The LIDAR data shall be collected for the swath area as specified in the scope of work.

N. Flight Altitude – The flight altitude shall be that necessary to obtain the required data posting.

O. Flight Log – A flight log representing aircraft flight time shall be maintained on an hourly basis. The time of takeoff, start of LIDAR collection, end of LIDAR collection, and landing shall be recorded to the nearest 0.1 hour. The log shall be signed by the pilot of the LIDAR operator and be submitted with the flight report. The Contractor must document mission date,

time flight altitude, airspeed, scan angle, scan rate, laser pulse rates, and other information deemed pertinent. The pilot for the airborne LIDAR system shall maintain steerage by utilizing the waypoint file provided by the OBCS with real-time on board navigation. A copy of the Flight Log will be submitted to OBCS

P. Weather Log – A weather log shall be maintained to substantiate any delays due to inclement weather. The weather log shall be include date, location, weather report, and weather forecast from the U.S. Weather Bureau. This information may be supplemented by direct observation. A copy of the Weather Log will be submitted to OBCS.

Q. Tide Log – The Contractor shall maintain a tide log to substantiate any delay due to incorrect or unacceptable tides. The tide log should include the date, time, the location of the nearest NOAA tide station(s) being reported, and the tide elevation at the beginning, middle, and end of data collection as calculated (through interpolation between adjacent tide stations). All reported tide elevations shall be referenced to NAVD (1988). A copy of the Tide Log shall be submitted to OBCS in a Flight Report.

R. Flight Report – The Contractor shall prepare a flight report that includes the flight log, ground control report, information about GPS-derived flight tracks, provide a detailed description of final flight line parameters and GPS controls (i.e., benchmarks), and include ground truth and complementary reference data. The report shall also include on-board antenna offsets, height of instrument before and after takeoff, all GPS PDOP values, the tide log, the data log, and the weather log.

2.03 POST-FLIGHT AND DATA PROCESSING

A. Flight Report – Within 5 days of the flight, the Contractor shall submit a copy of the flight report.

B. Data Voids – Areas that are not within 150 feet of a raw LIDAR return are considered data voids. Raw data voids cannot exceed 5% of the project area. If the data voids do exceed 5% the contractor must acquire supplemental data in the form of additional LIDAR data or conventional bathymetric survey data.

C. Unfiltered Data Processing – The raw LIDAR data, all GPS data (on board and base station), IMU data, and any other data used shall be processed to produce x, y, and z bathymetric data points. The GPS data from the base station and the primary navigation receiver on the airborne platform shall be reduced to produce vector offset from all of the base stations to the airborne platform then least square techniques shall be used to determine best fit three dimensional positions of the airborne platform every second of the mission. Position and attitude information shall be time matched with gyro and LIDAR data to produce accurate x, y, and z positions of the LASER returns.

D. Filtered Data Processing – Artifacts are regions of anomalous elevations or variations in the LIDAR data resulting from systematic errors or environmental conditions. The Contractor shall

provide an analysis of any artifacts that includes a description of the artifacts and the steps or processing techniques that were used to eliminate the artifacts to produce x, y, and z positions of the filtered data.

E. Quality Assurance/Quality Control – The Contractor is solely responsible for the QA/QC of the processed LIDAR data. The QA/QC process shall include reviews of the flight, weather, GPS, IMU, and LIDAR data, and any other supporting data.

The QA/QC methodology shall be in accordance with the reference given in Section 03000.1.03.B, which uses the root mean square error (RMSE) to estimate vertical accuracy.

The contractor shall calculate the RMSE requirement for the surface as follows:

A report of the data processing procedures shall be submitted. The report shall include data and information on all data processing and manipulation.

The ground control profiles shall be selected throughout the project area by surveying every sixth OBCS reference monument and profile line. The OBCS will provide the contractor with all control information for the ground control profiles including coordinate locations (in Florida State Plane coordinate system) and elevations (referenced to NAVD, 1988) of applicable survey reference monuments and bearing/azimuth of all profile lines and vertical coordinates for the ground control.

The Contractor shall use a comparison of profile points for each profile derived from the LIDAR TIN with the corresponding points from the ground control profiles. Plot overlays of the LIDAR profiles and corresponding ground control profile. A comparison shall be done of the vertical values of the LIDAR data verses the ground control profiles at each ground control profile point. A mean and standard deviation will be calculated along each profile. The results shall be depicted in a table (see example below) containing a line for each comparison and will contain mean, standard deviation and maximum value above and below the ground control profile.

	Mean	S.D.	Max Value	Min Value
R001	0.2	0.2	2.0	-0.1
R007				
Sum				

The Contractor also shall use the following equation to determine the sample RMSE for each of the profile lines.

$$RMSE_{sample} \le C\sqrt{\frac{(n-1)-2.326\sqrt{n-1}}{n}}$$

Where C = contour level accuracy (C = 0.5 for 1-foot contours, C = 1.0 for 2-foot contours, C = 1.5 for 3-foot contours and n = number of control points.

The calculated RMSE shall be less than or equal the $RMSE_{sample.}$ The $RMSE_{sample}$ for 1-foot contours is 0.5, for 2-foot contours is 1.0 and for 3-foot contours is 1.5.

The QA/QC process described in this Section and the QA/QC results shall be tabulated within a QA/QC report that includes a statement verifying the processed data meets or exceeds all accuracy requirements. The QA/QC report shall be submitted to the OBCS as specified in Section 03000 3.01.

F. Profiles – The Contractor shall create profiles at all OBCS reference monuments. The OBCS will provide the Contractor with a file containing the coordinate and azimuth for the profiling work. The OBCS reference monuments are spaced approximately 1,000' apart along the coast. The Contractor shall compare the profiles produced using the LIDAR data with the profiles surveyed by conventional methods. Results of the comparison shall be included in the QA/QC report, as described in Section 2.03 E above, and shall include graphical plots of ground control and LIDAR plot overlays.

G. Contouring – All contouring shall adhere to Florida Minimum Technical Standards and International Hydrographic Organization Nautical Charting Standards. Contours shall be produced by standard Triangular Irregular Network (TIN) processing techniques. A digital contour map is required.

H. Data Conversions – All data conversions shall conform to National Geodetic Standards.

PART 3 - PRODUCTS

3.01 HARCOPY PRODUCTS

Pre-Flight

A. Flight Plan – The flight report shall be submitted in accordance with Section 2.01C of this Technical Specification.

B. Ground Control Plan – The ground control plan shall be submitted in accordance with Section 2.01D of this Technical Specification.

C. System Calibration Report – The system calibration report must be submitted in accordance with Section 2.01E of this Technical Specification.

D. OBCS Personnel Movement Plan – The Personnel Movement Plan shall be submitted in accordance with Section 2.02B of this Technical Specification.

E. Flightline Road Map – The Flightline Road Map shall be submitted in accordance with Section 2.02I of this Technical Specification.

Post-Flight

F. Flight Report – The flight report shall be submitted in accordance with Section 2.03A of this Technical Specification. The following reports will be submitted as sections of this report: Flight Log (Section 2.02P), Weather Log(Section 2.02Q), and the Tide Log (Section 2.02R).

G. QA/QC Report – The QA/QC report shall be submitted in accordance with Section 2.03F of this Technical Specification. This report will include the Data Processing Report.

3.02 DIGITAL PRODUCTS

A. Raw Data – An ACSII file containing raw processed ellipsoid heights, x, y, and z data points, with intensity data attached in NAD 83/90 State Plane Coordinates in feet, plus NAVD 88 elevations in feet shall be submitted.

B. Height Bios File – A height bios file in ASCII format. The height bios will be determined by comparing ground control data and raw processed x, y, and z data points. All data will be in NAD 83/90 State Plane Coordinates in feet, plus NAVD 88 elevations in feet.

C. Metadata File – A complete digital Federal Metadata File in accordance with reference document 1.03.D.

D. Unfiltered Processed Data File – An ASCII file which has the height bios correction applied to the raw processed file for NAD 83/90 State Plane Coordinates in feet, plus NGVD88 elevations in feet. The Contractor must deliver datasets and LIDAR system data, including orthometric heights for each point in comma-delimited ACSII files in x, y, and z format. The Contractor must flag datasets from sidelap and overlap areas of separate flight lines.

E. Filtered Processed Clipped Data File – A processed data file in ASCII format which has the height bios correction applied to the raw processed file. NAD 83/90 State Plane Coordinates in feet, plus NAVD 88 elevations in feet. Using OBCS sheet layout files, the Contractor will create the ASCII files, with one file per OBCS sheet layout file.

F. Contour Map – The Contractor shall use the filtered data to create a map with one-foot or two-foot contours, where technology and data support such contour development. Areas in which no data was collected will be bordered and annotated “NO DATA”. These files shall be in DXF format and contain both the data points and the required contours. There will be one file per OBCS sheet layout file.

G. Additional DXF Files – The Contractor shall submit additional DXF files for each OBCS sheet layout file by “thinning” the data points. These files will contain data points approximately every 100 feet and the required contours. There will be one file per OBCS sheet layout file.

H. Profile Lines – A profile line shall be cut through the TIN model at OBCS range lines. The output files will be in ASCII format using x, y, and z data points along the OBCS range lines at intersections of the profile line and the TIN model.

I. Digital Elevation Model – A gridded three-foot x, y, and z digital elevation model (DEM) shall be created using the filtered data file. There will be one DEM file per OBCS sheet layout file.

END OF SECTION