August 21, 2020

Shoreline Mapping Project Instructions

This document serves as the Project Instructions for Topography/Bathymetry Project STYYXX-TB-C, Lidar and Imagery Collection, Processing and Shoreline Mapping, in the state of Maryland.

1 GENERAL

These Project Instructions contain project specific information for a shoreline mapping project and take precedence over the "Scope of Work, Shoreline Mapping for the Coastal Mapping Program" (SOW), Version 15, dated January 2019. All parts of the SOW not altered in these Project Instructions remain in effect.

2 INTRODUCTION

This project is being undertaken to provide topographic/bathymetric lidar data, digital imagery, and digital shoreline for National Oceanic and Atmospheric Administration (NOAA) nautical charts and other uses. New shoreline vectors for this project will be supplied in digital form by the National Geodetic Survey (NGS). All nautical charts referred to in this document are NOAA nautical charts.

List of Acronyms

AOI……Area of Interest
APOR…… Airborne Positioning and Orientation Report
ASPRS.....American Society of Photogrammetry and Remote Sensing
AT……Aerotriangulation
CMP……...Coastal Mapping Program
CEF……Chart Evaluation File
CO ..... Contracting Officer
COR..... Contracting Officer's Representative
CORS……...…Continuously Operating Reference Stations
CRS……...….Coordinate Reference System
CUSP……..……Continually Updated Shoreline Product
EED……. Electronic Exposure Data
DEM…….....……Digital Elevation Model
DG……Direct Georeferencing
DTL……Deliverable Tracking Log
EO……Exterior Orientation
FGDC .....Federal Geographic Data Committee
GC……..Geographic Cell
GSD……..……Ground Sample Distance
IHO……International Hydrographic Organization
IWG-OCM……...Interagency Working Group on Ocean and Coastal Mapping
JALBTCX……...Joint Airborne Lidar Bathymetry Technical Center of Expertise
LAS……....LASer File Format Exchange

LIDAR..... Light Detection and Ranging
MHW……..….Mean High Water
MLLW……..……Mean Lower Low Water
NAD .....North American Datum
NIR…….……Near-Infrared
NGS……National Geodetic Survey
NAVD .....North American Vertical Datum
NAVO….……..U.S. Naval Oceanographic Office
NOAA ..... National Oceanic and Atmospheric Administration
NOS……National Ocean Service
NPS…….Nominal Pulse Spacing
NSRS……National Spatial Reference System
NSSDA ..... National Standard for Spatial Data Accuracy
NVA……Non-vegetated Vertical Accuracy
OCM……...Office of Coastal Management
PI……...……Project Instructions
PCR……..……Project Completion Report
POC……..……..Point of Contact
QA .....Quality Assurance
QC ..... Quality Control
RGB…….……..Red, Green, and Blue
RMSE ..... Root Mean Square Error
RSD……Remote Sensing Division
SITREP……....Situational Report
SOW ..... Scope of Work
TPU……...Total Propagated Uncertainty
TOMIS……..Task Order Management and Information System
USACE……United States Army Corps of Engineers
USGS……...United States Geological Survey
UTC…… ...Universal Coordinated Time
UTM……...Universal Transverse Mercator
VVA…….……..Vegetated Vertical Accuracy
WKT…….……...Well Known Text

3 OVERVIEW

The National Geodetic Survey (NGS) Remote Sensing Division (RSD) Coastal Mapping Program (CMP) requires the collection of airborne topographic/bathymetric Light Detection and Ranging (lidar) and digital camera imagery data to enable accurate and consistent measurement of the national shoreline. The shoreline is defined as the land water interface at a specific tidal datum. Topographic/bathymetric lidar is employed as an accurate, efficient way to collect data for generation of a Digital Elevation Model (DEM), which is in turn used to extract vectors for generating the tidal datum shoreline of interest. The CMP works to provide a regularly-updated and consistent national shoreline to define America's marine territorial limits and manage coastal resources. This shoreline is applied to National Oceanic

and Atmospheric Administration (NOAA) nautical charts and is considered authoritative when determining the official shoreline for the United States.

These Project Instructions define requirements for lidar and digital camera imagery data acquisition and processing to support the CMP for accurate and consistent shoreline. However, NGS recognizes there are many other uses to this data to support additional mapping, charting, geodesy services, marine debris surveys, and for other purposes in coastal states. In addition, NOAA participates with the Interagency Working Group on Ocean and Coastal Mapping (IWG-OCM) and the Committee on Marine Transportation Safety to develop common standards for airborne coastal mapping and charting data and products. These standards were developed in conjunction with the Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX) partner agencies (U.S. Army Corps of Engineers (USACE), U.S. Naval Oceanographic Office (NAVO), and the U.S. Geological Survey (USGS).

The following conventions have been adopted for this document. The term "shall" means that compliance is required. The term "should" implies that compliance is not required, but is strongly recommended. All times shall be recorded in Universal Coordinated Time (UTC).

4 REQUIREMENTS

The Contractor shall provide topographic/bathymetric lidar data and digital camera imagery for the designated areas as detailed in the provided boundary shapefiles. Three boundary shapefiles may be provided:

1. Lidar Boundary: extent for which topobathy lidar shall be acquired.

2. Project Boundary: extent for which digital camera imagery shall be acquired and shoreline work completed.

3. Sub Project Boundary: extent for which shoreline work will be subdivided into specific projects.

Data collection, processing, accuracy assessment, and delivery shall be accomplished in accordance with the following specifications. The contractor shall provide all necessary labor, equipment, material, software, and supplies to satisfactorily complete the requirements of the Project Instructions (PI).

The contractor's proposal shall provide the specific roles of the subcontractors in detail including geographical areas of responsibility. The proposal shall clearly delineate the price being paid to the subcontractor and a statement certifying that the subcontractor has agreed to the scope and pricing.

The lidar project area is approximately XXX square statute miles. There are approximately XXX linear miles of shoreline within the project area.

5 START/COMPLETION DATES

The start date shall be the date that the Contractor receives the task order award signed by the NOAA Contracting Officer. The task order completion date shall be September 30, 2020.

6 REGULATORY COMPLIANCE

The Contractor shall comply with all applicable Federal, State, and local regulations.

7 SAFETY

Operations shall be in full compliance with appropriate federal, state, county, and city safety rules and regulations.

8 DATA COVERAGE

The project areas shall be the specified area as detailed in the provided boundary shapefiles. Topographic/bathymetric lidar data shall be collected to the extent defined in the lidar boundary shapefile. Digital camera imagery data shall be collected to the extent defined in the project boundary shapefile. In the event that poor water clarity and/or related environmental factors make coverage impossible the COR shall be notified as early as possible. In addition, the contractor shall identify (textually and/or graphically) those areas where full coverage was not obtained.

9 TOPOGRAPHIC/BATHYMETRIC LIDAR DATA COLLECTION

1. Topographic/Bathymetric lidar shall be collected within the specified area detailed in the provided lidar boundary shapefile. A lidar sensor capable of collecting both topographic and bathymetric data concurrently shall be utilized. Shapefiles shall be provided to indicate the limits of the boundaries to be surveyed.

2. In the requested survey areas, bathymetric lidar data are required from the water's edge seaward from the land/water interface, to the specified extent as detailed in the provided lidar boundary shapefile or to laser extinction, whichever comes first. For shoreline mapping and modeling uses, it is particularly important to have good bathymetric data in the very shallow (0-4 m) areas. For this reason, the lidar systems, software, and processing procedures shall enable measurement of bathymetry in this very shallow region. The sensor used for this mapping shall have an operational measurement depth range equal to or greater than a 1.5 secchi depth. Sensors with segmented beams, shall also comply with these specifications. A deep channel system may be added on as a requirement with adjusted specifications.

3. The lidar can be collected day or night.

4. The contractor is encouraged to collect imagery concurrently with the bathymetric lidar to assist in editing, although not required as a deliverable.

5. It is recommended to fly at an altitude as low as possible (within the eye safety parameters established by the sensor manufacturer and applicable regulations), so as to maximize bathymetric returns. A nominal density of 3 pulses per square meter shall be met, to support the gridding of a 1 meter Ground Sample Distance (GSD) DEM. The bathymetric or submerged topographic portion of the lidar collection shall be planned for a nominal density of 3 points per square meter, although it is understood that this density may not be met due to certain environmental conditions that cannot be controlled.

6. The pulse density patterns shall be consistent with the expected sensor scanning pattern and consistent across the project.

7. NOAA's overarching objective is to obtain clean, seamless (i.e., free of gaps or discontinuities) topographic-bathymetric data across the intertidal zone and shallow nearshore zone. With this overarching objective in mind, the following decision tree shall be used for determining when to collect shoreline flight lines:

    a. Optimal environmental conditions: If the mission crew encounters optimal environmental conditions for nearshore topo-bathy mapping (defined here to mean exceptional water clarity relative to typical conditions in project site, as well as low wind and wave conditions in the surf and nearshore zones) at any time during the project, then the flight lines shall be flown immediately, to take advantage of the optimal conditions, without concern for stage of tide. If these optimal conditions yield clean, seamless topographic and bathymetric data, free of voids in the intertidal zone and near shore submerged topography, then it may be unnecessary to conduct repeat passes for that flight line; however, this shall be verified with the COR. A repeat pass is recommended to assist in filling in voids due to waves and white water.

    b. All other conditions: In the absence of optimal environmental conditions, the shoreline flight lines shall be tide coordinated to ensure the highest probability of achieving clean, seamless topo-bathy coverage across the intertidal and shallow nearshore zones. This typically requires flying each shoreline flight line twice: once +/- 2 hours around low tide and once within +/- 2 hours of high tide, as well as during favorable water clarity conditions. If the contractor wishes to propose an alternate method for achieving the overarching objective (clean, seamless data across the intertidal and shallow nearshore zones) for a particular area, the proposed method shall be discussed with the COR and NGS, and the COR's approval granted, before proceeding

8. NGS recognizes the uncertainty for bathymetric lidar success along many areas of the coast. The contractor has complete flexibility to determine the priority, location and schedule of data collection for mapping production, provided the schedule defined in

Section 22 is achieved. Contractor has the right to demobilize and remobilize at any time, provided the schedule defined in Section 22 is achieved and the resulting mapping activities are communicated with the Point of Contact (POC) for Contract Issues.

9. A major consideration in bathymetric lidar acquisition is water clarity, as high turbidity can hinder or preclude lidar acquisition in many areas of the U.S. The contractors is responsible for monitoring water clarity conditions in the project sites and determining suitable times for acquisition. Second, as water clarity in a region can vary on time scales from minutes to hours, seasons, and longer, it is important to continually assess local weather events (e.g., rain or winds that can increase turbidity), tides, currents, and other factors that can affect the probability of success of bathymetric lidar acquisition.

10. In areas where water conditions are deemed unsuitable for lidar collection, conditions shall be monitored in an attempt to seize any opportunity to collect valid data. Some locations may require acquisition opportunities at a significantly different time period to investigate different conditions. Subsequent efforts shall be made to collect valid data, at the discretion of the contractor. The contractor shall communicate results with the POC for Contract Issues.

11. The bathymetric lidar requirement may be eliminated from a task order in areas where persistent turbidity or weather conditions prohibit successful bathymetric lidar data collection. In geographical areas where requirements are eliminated, the eliminated coverage for this area will be utilized to cover other NGS requirements.

12. In areas where bathymetric lidar requirements are eliminated, the topographic lidar portion shall be collected in accordance with the specifications stated herein, as well as the flight line that intersects the shoreline with specification adhered to as stated in section 7.4.b.

13. Bathymetric lidar points shall meet a vertical RMSE of $QL2_B$ specified in the National Coastal Mapping Strategy 1.0 Document (https://iocm.noaa.gov/iwg/IWG-OCM-Final-Coastal-Mapping-Strategy-2018-with-cover.pdf). Table 1 below documents this specification. This SOW does not require International Hydrographic Organization (IHO) feature detection standards to be met, as stated in IHO S-44 TVU standards for Order 1b surveys. However, any seafloor features (e.g., wrecks or submerged rocks) identified in the data are of interest to NOAA and shall not be removed. Vertical positions of subaerial (i.e., topographic) points shall meet the 10 cm accuracy class standard for elevation data as specified in the APSRS Positional Accuracy Standards for Digital Geospatial Data Edition, 1, Version 1.0 – November, 2014. Testing and reporting of vertical accuracies shall follow the procedures for the Non-vegetated Vertical Accuracy (NVA) at the 95% confidence level in all non-vegetated land cover categories combined and reports of the Vegetated Vertical Accuracy (VVA) at the 95th percentile in all vegetated land cover categories combined stated in the Standard. A copy of this specification may be found at: https://www.asprs.org/a/society/committees/standards/Positional_Accuracy_Standards.pdf

Table 1. Quality level definitions for bathymetric lidar. These definitions are applicable for areas submerged at the time of survey.

Bathy Lidar Quality Level	**Source**	**Vertical accuracy coefficients a,b as in sqrt(a^2+(b*d)^2))**	**Nominal Pulse Spacing (m)**	**Point Density (pt/m^2)**	**Example Applications**
$QL0_B$	Bathymetric Lidar	0.25, 0.0075	≤0.7	≥2.0	Detailed site surveys requiring the highest accuracy and highest resolution seafloor definition; dredging and inshore engineering surveys; high-resolution surveys of ports and harbors
$QL1_B$	Bathymetric Lidar	0.25, 0.0075	≤2.0	≥0.25	
$QL2_B$	Bathymetric Lidar	0.30, 0.0130	≤0.7	≥2.0	Charting surveys; regional sediment management General bathymetric mapping; coastal science and management applications Change analysis; deepwater surveys, environmental analysis
$QL3_B$	Bathymetric Lidar	0.30, 0.0130	≤20	≥0.25	
$QL4_B$	Bathymetric Lidar	0.50, 0.0130	≤5.0	≥0.04	Recon/planning; all general applications not requiring higher resolution and accuracy

14. Horizontal positions shall be accurate to ≤0.5m ($RMSE_r$).

15. Horizontal Datum - All positions shall be tied to the NSRS via processing with respect to the NGS-managed Continuously Operating Reference Stations (CORS) network, and referenced to NAD83(2011) epoch:2010. The appropriate Universal Transverse Mercator (UTM) coordinate system and zone as designated in the tiling scheme provided shall be used. This datum and coordinate system must be used throughout the survey project for everything that has a position or for which a position is to be determined. Those documents used for comparisons, such as charts, junctional surveys, and prior surveys, must be referenced or converted to NAD 83. In addition, all software used on a survey must contain the correct datum parameters.

16. Vertical Datum: All positions shall be tied to the NSRS via processing with respect to the NGS managed CORS network, and referenced to NAD83(2011)epoch:2010 ellipsoidal heights in meters.

17. For QA/QC purposes, one cross line is required every 30 kilometers. In areas of the coast where natural or artificial barriers prevent aircraft operations, the cross line(s) shall be collected at the nearest possible location to the required interval, but no closer than 8 kilometers to an adjacent planned cross line.

18. Flight lines shall have a minimum of 20% planned sidelap with adjacent flight lines.

19. In areas where valid bathymetric data are obtained, topographic data should be collected such that the resulting bathymetric and topographic lidar data may be merged later with no discontinuity. Prudence should be exercised by the contractor to ensure the final bathymetric and topographic data submitted are in agreement with one another.

20. Data gaps due to aircraft motion or building shadows shall be re-flown to fill the voids.

21. The contractor shall make reasonable "best efforts" to fill voids due to white water and breaking waves near the land-water interface.

22. If airspace restrictions are anticipated or known, the contractor shall coordinate with NGS for any needed assistance in obtaining clearance(s). If clearance cannot be obtained, survey requirements within these areas shall be eliminated and the task order shall be modified in a similar manner as presented in Section 9.11.

23. Intensity values are required for each return. Intensity values, normalized to 16-bit, linear rescaling. See LAS specification version 1.4-R13 (ASPRS 2011).

24. Atmospheric conditions shall be cloud and fog-free between the aircraft and ground during all collection operations.

25. Ground conditions shall be snow free.

26. **Lidar Boresight and Calibration Report (Deliverable 1.2)** shall be delivered

    - Please refer to the following template: Boresight_and_Calibration_lidar_report_template_v1.0.1.pdf

27. **Lidar Flight Line Shapefiles (Deliverable 1.5)** shall be delivered

    - The Horizontal Datum shall be positioned to the NSRS via processing with respect to the NGS managed CORS network, and referenced to

NAD83(2011)epoch:2010. The appropriate UTM coordinate system and zone shall be used.

28. **Lidar Flight Reports (Deliverable 2.3)** shall be delivered

29. **Lidar Data Coverage Files (Deliverable 2.4)** shall be delivered

    One file shall be produced per project area that shows areas where valid data were collected. The file shall be an elevation raster in GeoTiff format with 5m pixel resolution.

    The Horizontal Datum shall be positioned to the NSRS via processing with respect to the NGS managed CORS network, and referenced to NAD83(2011)epoch:2010. The appropriate UTM coordinate system and zone shall be used.

    The Vertical Datum should be positioned to the NSRS via processing with respect to the NGS managed CORS network, and referenced to NAD83(2011)epoch:2010 ellipsoidal heights in meters.

    The base naming convention for these files will be "ProjectID_lascoverage".

10 DIGITAL CAMERA IMAGERY DATA COLLECTION

The following section has been modified from the ***Version 15 Scope of Work for Shoreline Mapping under the NOAA Coastal Mapping Program, Attachment Z, Digital Aerial Camera Usage & Data Processing for the CMP***. Unless otherwise stated below, all other specifications should be adhered to unless discussed with the COR and NGS, and the COR's approval granted, before proceeding.

1. The sensor shall be a geometrically stable and calibrated camera system suitable to use for high-accuracy photogrammetric mapping.

2. RGB/NIR images should be collected in a manner to provide stereo coverage of the area detailed in the provided project boundary shapefile. Any imagery collected for this project, outside of the ground swath defined, shall not be deleted. Since the imagery will likely be collected at a higher altitude, covering a larger swath than the project boundary, all imagery of the sensor falling outside of the project boundary shall be processed and shall not be clipped to the project boundary.

3. SIDELAP – Adjacent images shall have a minimum sidelap of 30% of the mean image cross-track width.

4. ENDLAP – Consecutive images in a flight line shall have a minimum endlap of 60% of the mean image along-track width.

5. RGB/NIR images should be collected in a manner to produce a resulting ortho-mosaic with a 25cm GSD.

6. WEATHER - Digital imaging shall not be conducted when clouds or cloud shadow obscure the land-water interface or features of navigational significance in the scene. The land-water interface shall not be obscured by snow, ice, smoke, haze, etc. Storm systems and events (e.g. hurricanes, northeasters, and frontal boundaries) that may cause an increase in water levels, tidal heights, and wave activity shall be avoided. Efforts to avoid sun glare shall be taken.

7. TIME OF DAY - Time of day for digital camera imagery is determined by the sun angle which shall not be less than 25 degrees above the horizon at the time of exposure. If imagery is collected between the months of November and February, the sun angle requirement shall not be less than 20 degrees.

8. Collection of the lidar data is the first priority of this task order and should not be precluded by meeting the RGB/NIR Imagery collection parameters above. The RGB/NIR imagery shall be collected within one month of the lidar collection and within +\- 3 hours around low tide. The temporal period may be relaxed in certain circumstances based on prior approval from the POC for Contract Issues.

9. Digital orthoimagery must be produced to meet ASPRS Accuracy Standards for 45.00 cm RMSEx and RMSEy Horizontal Accuracy Class. A copy of this specification may be found at: https://www.asprs.org/a/society/committees/standards/Positional_Accuracy_Standards.pdf

10. Horizontal Datum - All positions will be tied to the NSRS via processing with respect to the NGS managed CORS network, and referenced to NAD83(2011)epoch:2010. The appropriate UTM coordinate system and zone as designated in the tiling scheme provided shall be used. This datum and coordinate system must be used throughout the survey project for everything that has a position or for which a position is to be determined. Those documents used for comparisons, such as charts, junctional surveys, and prior surveys, must be referenced or converted to NAD 83. In addition, all software used on a survey must contain the correct datum parameters.

11. **Camera Boresight Calibration Report (Deliverable 1.1)** shall be delivered

    - Please refer to the following template: Boresight_and_Calibration_camera_report_template_v1.0.1.pdf

12. **Planned Imagery Flight Line Shapefiles (Deliverable 1.3)** shall be delivered

    - The Horizontal Datum shall be positioned to the NSRS via processing with respect to the NGS managed CORS network, and referenced to

NAD83(2011)epoch:2010. The appropriate UTM coordinate system and zone shall be used.

- Attribute Table shall have the following information provided:

Field	Title	Format	Description	Example	Data Type	Width
1	Project	XXXX	Project ID	TX1803	Text	11
2	FlightLine	sc-nnn	Scale and flight line ID	59-001	Text	6

13. **Planned Imagery Footprint Shapefiles (Deliverable 1.4)** shall be delivered

    - The Horizontal Datum shall be positioned to the NSRS via processing with respect to the NGS managed CORS network, and referenced to NAD83(2011)epoch:2010. The appropriate UTM coordinate system and zone shall be used.

    - Attribute Table shall have the following information provided:

Field	Title	Format	Description	Example	Data Type	Width
1	Project	XXXX	Project ID	TX1803	Text	11
2	FlightLine	sc-nnn	Scale and flight line ID	59-001	Text	6

14. **Shapefile depicting footprint of acquired imagery {Frame/Line Scanner} (Deliverable 2.1) s**hall be delivered with an attribute table formatted and populated with the data required to replace the EED2 file deliverable.

    - Spatial reference of shapefile should be in a Geographic Coordinate System referenced to NAD83(2011)epoch:2010.

Frame Camera Specifications:
The contractor is required to supply one (1) shapefile file per lift. The field format of the attribute table is absolutely critical because this is the file that will be utilized for importing into, and populating, the FIF.

Frame Camera EED2 Naming Convention: "ProjectName_frame_date&liftid__EED2.shp" (example: TX1803-TB-C_frame_20170607001_EED2.shp).
Date and Lift ID: shall be formatted as: YYYYMMDDid
Id: should be 3 numerical characters starting at 001.

Field#	Title	Format	Description	Sample Field Length
1	Time	ttttt.ttt	GPS week seconds	0 to 604,800
2	ImageID	dssfff_sssss	See image naming convention below *	930001_00001
3	Latitude	dd.ffffff	decimal degrees, north is positive	-90 to 90
4	Longitude	ddd.ffffff	decimal degrees, west is negative	-180 to 180
5	Heading	hhh.h	Heading in decimal degrees	0 to 360
6	Altitude	ffffff	Meters above mean sea level	up to 6 digits
7	Project	pppppppp	Root project ID as provided	TX1803
8	FlightLine	sc-nnn	Scale, sequential number at that scale **	59-001
9	Tide_Stage	ttttt	Planned tide stage coordination ***	MLLW, etc.
10	Date	dd-MMM-yyyy	day-MONTH-year (month in CAPS)	07-Jun-2017
11	GroundElev	fffff	Ground elevation of target features ****	-400 to 9000
12	Reflight	tttttt	Code for line to refly/reflown *****	up to 7 characters
13	Recommend	T	Recommended for use in compilation? ******	1 character (Y, N, or D)
14	Notes	tttttt	Information of note about flightline *******	
15	Camera	ttttt	Camera Model	UltraCam
16	SN	Ttttt	Camera SN#	10554

* ImageID is also to be the name of the image file but w/o extension (e.g. 930001_00001.tif → ImageId 930001_00001)

ImageID NAMING CONVENTION – All contractor acquired frame imagery shall follow a STRIP_FRAME image naming convention as follows: **930001_00001**

The STRIP (prefix) is a **6-digit** designator, where: Digit **1** holds Data Type as defined:

1 = color/non-tide coordinated 2 = IR/MHW
3 = IR/MLLW
4 = IR/non-tide coordinated 5 = color/MHW
6 = color/MLLW
7 = multispectral/MHW
8 = multispectral/MLLW
9 = multispectral/non-tide coordinated

Digits **2-3** hold Image Scale (flying height / focal length)

Digits **4-6** hold the unique Flight Line ID which shall match the corresponding flight line in the planned imagery shapefiles, and the same flight line ID shall be used even when a line is patched or reflown.

Digits **7-11** holds the unique frame id of the **project**. Frame id will start with "00001" for the first acquired image frame and increase by +1 for each image acquired for that project with no skips or repeats. Frame ID will **not** reset to "00001" if the contractor acquires imagery with multiple cameras or acquires imagery that spans multiple years.

Note that any tide stage other than MHW or MLLW is considered non-tide coordinated

** Scale = flying height/focal length, expressed in thousands w/o "1:xx," (e.g. 1:30,000 = 30)

sequential number = nth line in the project at that scale (e.g. 30-001 is the 1st line at 1:30,000 in the project). Note, this flight line ID shall match the corresponding flight line in the planned imagery shapefiles, and the same flight line ID shall be used even when a line is patched or reflown.

*** Acceptable values: MHW, MLLW, BMHW (below MHW), MSL, NONE (no tide coordination, imagery collected within +/- 3 hours of low tide, or tide stage N/A)

**** Ground Eleva is generally “0” for coastal mapping projects, the lake elevation for Great Lakes projects, or the airport elevation for airport mapping projects.

***** Acceptable values: ToRefly (line will be reflown), Refly (line reflown), ToPatch (selected images will be reflown), Patch (images reflown, partial line), or <blank> if none of the above apply. Also see Notes field.

****** When lines are reflown/patched. This flag indicates which line is recommended for use. Acceptable values are: Y (recommended), N (not acceptable), D (duplicate acceptable but not recommended)

******* If a line is patched or reflown, the contractor will document what frames were used to patch or were reflown in the notes field and in the acquisition summary.

Frame Camera Shapefile Structure

Visible	Read Only	Field Name	Alias	Data Type	Allow NULL	Highlight	Number Format	Default	Precision	Scale	Length
☑	☑	FID	FID	Object ID	☐	☐	Numeric		0	0	
☑	☐	Shape	Shape	Geometry	☐	☐			0	0	
☑	☐	Time	Time	Double	☐	☐	Numeric		0	0	
☑	☐	ImageId	ImageId	Text	☐	☐			0	0	254
☑	☐	Latitude	Latitude	Double	☐	☐	Numeric		0	0	
☑	☐	Longitude	Longitude	Double	☐	☐	Numeric		0	0	
☑	☐	Heading	Heading	Double	☐	☐	Numeric		0	0	
☑	☐	Altitude	Altitude	Long	☐	☐	Numeric		10	0	
☑	☐	Project	Project	Text	☐	☐			0	0	254
☑	☐	FlightLine	FlightLine	Text	☐	☐			0	0	254
☑	☐	Tide_Stage	Tide_Stage	Text	☐	☐			0	0	254
☑	☐	Date	Date	Text	☐	☐			0	0	254
☑	☐	GroundElev	GroundElev	Long	☐	☐	Numeric		10	0	
☑	☐	Reflight	Reflight	Text	☐	☐			0	0	254
☑	☐	Recommend	Recommend	Text	☐	☐			0	0	254
☑	☐	Notes	Notes	Text	☐	☐			0	0	254
☑	☐	Camera	Camera	Text	☐	☐			0	0	254
☑	☐	SN	SN	Text	☐	☐			0	0	254

Line Scanner Specifications:

The contractor is required to supply one (1) individual shapefile per project when a line scanner is utilized. We will require one shapefile based on a project, unlike the frame cameras where we require one (shapefile) per lift. The field format of the attribute table is absolutely critical because this is the file that will be utilized for importing into, and populating, the FIF.

Line Scanner EED2 Naming Convention: "ProjectName_linescanner_EED2.shp" (example: TX1803-TB-C_linescanner_EED2.shp)
Each project must have an individual EED2 shapefile.

Field#	Title	Format	Description	Sample Field Length
1	TimeStart	ttttt.ttt	GPS week seconds	0 to 604,800
2	TimeEnd	ttttt.ttt	GPS week seconds	0 to 604,800
3	LineID	dssfff	See image naming convention below *	959001
4	Lat_Beg	dd.ffffff	decimal degrees, north is positive	-90 to 90
5	Lon_Beg	ddd.ffffff	decimal degrees, west is negative	-180 to 180
6	Lat_End	dd.ffffff	decimal degrees, north is positive	-90 to 90
7	Lon_End	ddd.ffffff	decimal degrees, west is negative	-180 to 180
8	Heading	hhh.h	Heading in decimal degrees	0 to 360
9	Altitude	ffffff	Meters above mean sea level	up to 6 digits
10	Project	pppppppp	Root project ID as provided	TX1803
11	FlightLine	sc-nnn	Scale and flight line ID **	59-001
12	Tide_Stage	ttttt	Planned tide stage coordination ***	MLLW, etc.
13	Date	dd-MMM-yyyy	day-MONTH-year (month in CAPS)	07-JUN-2017
14	Reflight	tttttt	Code for line to refly/reflown *****	up to 7 characters
15	Recommended	T	Recommended for use in compilation? ******	1 character (Y, N, or D)
16	Notes	tttttt	Information of note about flightline *******	
17	ScnrHead	ttttt	Line Scanner Model	SH100
18	SN	ttttt	Line Scanner SN#	10554

* LineID naming convention as follows: **959001**

The LineID is a **6-digit** designator, where: Digit **1** holds Data Type as defined:

1 = color/non-tide coordinated 2 = IR/MHW
3 = IR/MLLW
4 = IR/non-tide coordinated 5 = color/MHW
6 = color/MLLW
7 = multispectral/MHW
8 = multispectral/MLLW
9 = multispectral/non-tide coordinated

Digits **2-3** hold Image Scale (flying height / focal length)
Digits **4-6** hold the unique Flight Line ID which shall match the corresponding flight line in the planned imagery shapefiles, and the same flight line ID shall be used even when a line is patched or reflown.

Note that any tide stage other than MHW or MLLW is considered non-tide coordinated

** Scale = flying height/focal length, expressed in thousands w/o “1:xx,” (e.g. 1:59,000 = 59); flight line ID = nth line in the project at that scale (e.g. 59-001 is the 1st line at 1:59,000 in the project). Note, this flight line ID shall match the corresponding flight line in the planned imagery shapefiles, and the same flight line ID shall be used even when a line is patched or reflown.

*** Acceptable values: MHW, MLLW, BMHW (below MHW), MSL, NONE (no tide coordination, imagery collected within +/- 3 hours of low tide, or tide stage N/A)

***** Acceptable values: ToRefly (line will be reflown), Refly (line reflown), ToPatch (selected image will be reflown), Patch (image reflown, partial line), or <blank> if none of the above apply. If a line is patched or reflown, the contractor needs to document what frames were used to patch or reflown in the notes attribute column and in the acquisition summary.

****** When lines are reflown/patched. This flag indicates which line is recommended for use. Acceptable values are: Y (recommended), N (not acceptable), D (duplicate acceptable but not recommended)

******* If a line is patched or reflown, the contractor will document what frames were used to patch or reflown in this section. If a line is patched or reflown, the contractor needs to document what frames were used to patch or reflown in the notes attribute column and in the acquisition summary.

Line Scanner Shapefile Structure

Visible	Read Only	Field Name	Alias	Data Type	Allow NULL	Highlight	Number Format	Default	Precision	Scale	Length
☑	☑	FID	FID	Object ID	☐	☐	Numeric		0	0	
☑	☐	Shape	Shape	Geometry	☐	☐			0	0	
☑	☐	TimeStart	TimeStart	Double	☐	☐	Numeric		0	0	
☑	☐	TimeEnd	TimeEnd	Double	☐	☐	Numeric		0	0	
☑	☐	LineID	LineID	Text	☐	☐			0	0	254
☑	☐	Lat_Beg	Lat_Beg	Double	☐	☐	Numeric		0	0	
☑	☐	Lon_Beg	Lon_Beg	Double	☐	☐	Numeric		0	0	
☑	☐	Lat_End	Lat_End	Double	☐	☐	Numeric		0	0	
☑	☐	Lon_End	Lon_End	Double	☐	☐	Numeric		0	0	
☑	☐	Heading	Heading	Double	☐	☐	Numeric		0	0	
☑	☐	Altitude	Altitude	Long	☐	☐	Numeric		10	0	
☑	☐	Project	Project	Text	☐	☐			0	0	254
☑	☐	FlightLine	FlightLine	Text	☐	☐			0	0	254
☑	☐	Tide_Stage	Tide_Stage	Text	☐	☐			0	0	254
☑	☐	Date	Date	Text	☐	☐			0	0	254
☑	☐	Reflight	Reflight	Text	☐	☐			0	0	254
☑	☐	Recommend	Recommend	Text	☐	☐			0	0	254
☑	☐	Notes	Notes	Text	☐	☐			0	0	254
☑	☐	ScnrHead	ScnrHead	Text	☐	☐			0	0	254
☑	☐	SN	SN	Text	☐	☐			0	0	254

15. **Imagery Flight Reports (Deliverable 2.2)** shall be delivered

    Please see attachment Z of Version 15 Scope of Work for Shoreline Mapping under the NOAA Coastal Mapping Program, which deals with these deliverables with regard to digital cameras.

    FLIGHT REPORTS – Submit the completed, original Digital Camera Acquisition Log with the data, and a copy to NGS via TOMIS. For a sample Log see Annex 2. (Use the latest version of NGS' Log for digital imagery.

11 TOPOGRAPHIC/BATHYMETRIC LIDAR POINT CLOUD CLEANING, CLASSIFICATION, AND MERGE

GOAL: To clean, classify, and merge the collected topographic and bathymetric data acquired along the designated project boundaries. An integrated topographic-bathymetric point cloud dataset is an important component in understanding the land-sea interface and effectively adapting to sea level rise, mitigating impacts from natural hazards, storm surges, and flooding, as well as preserving the integrity of coastal habitats and resources.

The topographic and bathymetric point clouds shall be cleaned so that all outliers in the raw data are classified to the appropriate LAS classification scheme as detailed below. Outliers include obvious noise or clutter in the data such as returns from birds or atmospheric particles, or due to electronic noise; however be careful to not reclassify real features, such as offshore rocks, as class 7 or 18 respectively. In the LAS file, no points shall be permanently removed; rather they should be assigned to **the LAS withheld and overlap bits appropriately**. Outlier, blunders, geometrically unreliable points, and any other points the data producer deems unusable are to be identified using the withheld bit flag, according to the latest LAS Specification Version (https://www.asprs.org/divisions-committees/lidar-division/laser-las-file-format-exchange-activities). Use of the overlap bit flag is intended to identify overage points, which are described as those points within a given swath that would be excluded when constructing a coverage with a uniform depth of swaths at any location within the project.

1. The LAS point cloud shall be bare earth processed for the topographic portion of the data set, with the classification scheme stated below utilized at a minimum. Jetties and groins exposed above the water line and attached to land shall be classified as bare earth. Any jetty and groin detached from land and submerged, shall be classified as submerged topography. All points representative of submerged topography below a water surface shall be classified as bathymetric points (e.g., seafloor or riverbed).

2. Point classification is to be consistent across the entire project. Noticeable variations in the character, texture, or quality of the classification between tiles, swaths, lifts, or other non-natural divisions will be cause for rejection of the entire deliverable.

3. Topographic and bathymetric lidar data shall be merged to form a single LAS point cloud. The merged LAS elevation data set shall be from the lidar project data available along the entire designated lidar boundary

4. Horizontal Datum - All positions shall be tied to the NSRS via processing with respect to the NGS managed CORS network, and referenced to NAD83(2011)epoch:2010. The appropriate UTM coordinate system and zone as designated in the tiling scheme provided shall be used. This datum and coordinate system shall be used throughout the survey project for everything that has a position or for which a position is to be determined. Those documents used for comparisons, such as charts, junctional surveys, and prior surveys, shall be referenced or converted to NAD 83. In addition, all software used on a survey must contain the correct datum parameters.

5. Vertical Datum: All positions shall be tied to the NSRS via processing with respect to te NGS managed CORS network, and referenced to NAD83(2011)epoch:2010 ellipsoidal heights in meters.

6. **LAS files (Deliverable 6.1)** shall be delivered

   All project swaths, returns, and collected points, fully calibrated, adjusted to ground, and

classified, by tiles. Project swaths exclude calibration swaths and other swaths not used, or intended to be used, in product generation. LAS files should be delivered in LAS 1.4 format.

All returns shall be delivered (including vegetation, buildings, etc.) with obvious error points assigned to **the LAS withheld and overlap bits appropriately**. The LAS file public header block shall include all required fields according to the latest LAS Specification Version (https://www.asprs.org/divisions-committees/lidar-division/laser-las-file-format-exchange-activities)

Georeferenced information included in LAS header (OGC WKT). In accordance with LAS specification Version 1.4 - R13 published 15 July 2013, the Coordinate Reference System (CRS) shall be represented in each LAS file using OGC (2001) dialect of Well Known Text (WKT) (www.opengeospatial.org/standards/ct, document # 01-009). ESRI WKT, ISO or OGC (2015) dialects are not accepted. Refer to USGS Lidar Base Specification v2.1 Coordinate Reference System, Well-Known Text for more detail.

See the LAS v1.4 Specification for additional information. The Point Source ID field must be filled out for each record. Point families (multiple return "children" of a single "parent" pulse) shall be maintained intact through all processing before tiling. Multiple returns from a given pulse shall be stored in sequential (collected) order. Each point in the LAS file shall also include the return number, number of returns from the pulse, time, scan angle, and intensity values (native radiometric resolution).

The Point Data Record Format 6 shall be used. The topographic points shall be bare earth processed with the following classification scheme utilized at a minimum. All points representative of submerged topography below a water surface shall be classified as bathymetric point (e.g., seafloor or riverbed). The following classification scheme shall be utilized unless otherwise discussed and approved with NOAA. Classification that might be utilized during processing, that does not conform to the classification scheme below, must be moved back to Class 1, Processed, but unclassified.

Classification Value	Meaning
1	Processed, but unclassified
2	Bare-earth ground
7	Low Noise (low or high; manually identified, if necessary)
9	Water Surface (topographic sensor)
18	High Noise (high manually identified, if necessary)

40	Bathymetric point (e.g., seafloor or riverbed; also known as submerged topography)
41	Water surface (sea/river/lake surface from bathymetric or topographic-bathymetric lidar; distinct from Point Class 9, which is used in topographic-only lidar and only designates "water," not "water surface")
42	Derived water surface (synthetic water surface location used in computing refraction at water surface)
43	Submerged object, not otherwise specified (e.g., wreck, rock, submerged piling)
44	IHO S-57 object, not otherwise specified
64	Submerged Aquatic Vegetation
65	Denotes bathymetric bottom temporal changes from varying lifts, not utilized in bathymetric point class

Tiles shall be 500m x 500m

Tiled delivery, without overlap, using the Project Tiling Scheme. The base naming convention for these files will be "YYYY_XXXXXXe_YYYYYYYn_las. Coordinates refer to the upper left corner of the tile. A shapefile defining extents may be provided by NOAA if requested. YYYY in the naming convention shall be designated as the year when acquisition begins.

GPS times are to be recorded as Adjusted GPS Time, at a precision sufficient to allow unique timestamps for each return. Adjusted GPS Time is defined to be Standard (or satellite) GPS time minus 1e-9. See the LAS Specification for more detail.

One FGDC compliant metadata file, in xml format, is required for the project

7. **Finalized lidar trajectory (Deliverable 6.5)**

NGS requires a custom final lidar trajectory file to calculate the total propagated uncertainty of bathymetric lidar data.

Below are the file specifications to be used when creating the custom final lidar trajectory file:

Field	Units	Decimal Digits	Fixed_Width	Example
GPS_Time	Seconds of the Week	3	15	443761.007
Latitude	Decimal Degrees (signed)	9	15	25.91041581
Longitude	Decimal Degrees (signed)	9	15	-80.27374127
Easting	Meters	6	15	572738.5306
Northing	Meters	6	15	2865964.467
Ellipsoid height	Meters	6	15	-22.030716
Roll	Degrees	6	15	0.164098
Pitch	Degrees	6	15	-0.652004
Heading	Degrees	6	15	40.729064
Easting Std Dev	Meters	6	15	0.014370
Northing Std Dev	Meters	6	15	0.014375
height Std Dev	Meters	6	15	0.022889
Roll Std Dev	Degrees	6	15	0.007312
Pitch Std Dev	Degrees	6	15	0.007322
Heading Std Dev	Degrees	6	15	0.048906

- File Type = Text File (*.txt)
- Naming Convention: The file should have the date of the lift at the beginning of the name as YYYYMMDD. (example: 20200810_lift01.txt”
- Tab delimited fields
- All trajectory records should be included.
- Example of final lidar trajectory file:

312893.009	27.982174366	-82.017294045	399957.664379	3095644.473679	16.479067	0.737617	-1.793393	0.634255	0.019255	0.016695	0.040799	0.007651	0.007725	0
312893.014	27.982174333	-82.017294048	399957.664061	3095644.470059	16.476599	0.738486	-1.792294	0.633842	0.019233	0.016675	0.040766	0.007651	0.007724	0
312893.019	27.982174333	-82.017294048	399957.664082	3095644.470017	16.476616	0.739130	-1.790979	0.633651	0.019211	0.016655	0.040733	0.007651	0.007724	0
312893.024	27.982174332	-82.017294047	399957.664102	3095644.469976	16.476627	0.739542	-1.790544	0.633885	0.019189	0.016636	0.040700	0.007650	0.007724	0
312893.029	27.982174332	-82.017294047	399957.664119	3095644.469935	16.476631	0.739523	-1.790325	0.633898	0.019166	0.016616	0.040667	0.007650	0.007724	0
312893.034	27.982174332	-82.017294047	399957.664131	3095644.469896	16.476628	0.739081	-1.790318	0.633471	0.019144	0.016596	0.040634	0.007650	0.007724	0
312893.039	27.982174331	-82.017294047	399957.664140	3095644.469859	16.476618	0.738196	-1.790533	0.633260	0.019122	0.016576	0.040601	0.007650	0.007723	0
312893.044	27.982174331	-82.017294047	399957.664149	3095644.469821	16.476606	0.737085	-1.791188	0.633261	0.019100	0.016557	0.040569	0.007649	0.007723	0
312893.049	27.982174331	-82.017294047	399957.664161	3095644.469782	16.476595	0.735742	-1.791630	0.633703	0.019078	0.016537	0.040536	0.007649	0.007723	0
312893.054	27.982174330	-82.017294047	399957.664177	3095644.469742	16.476589	0.734849	-1.791629	0.633714	0.019055	0.016517	0.040503	0.007649	0.007723	0
312893.059	27.982174330	-82.017294046	399957.664194	3095644.469704	16.476590	0.734838	-1.791407	0.633508	0.019033	0.016497	0.040470	0.007649	0.007722	0
312893.064	27.982174330	-82.017294046	399957.664217	3095644.469668	16.476599	0.735263	-1.790967	0.633305	0.019011	0.016478	0.040437	0.007648	0.007722	0
312893.069	27.982174329	-82.017294046	399957.664242	3095644.469633	16.476612	0.736344	-1.790089	0.633108	0.018989	0.016458	0.040404	0.007648	0.007722	0
312893.074	27.982174329	-82.017294046	399957.664266	3095644.469599	16.476628	0.737855	-1.788777	0.633135	0.018967	0.016438	0.040371	0.007648	0.007722	0
312893.079	27.982174329	-82.017294046	399957.664287	3095644.469567	16.476642	0.739148	-1.787684	0.633159	0.018945	0.016418	0.040339	0.007648	0.007721	0

- The Horizontal Datum shall be positioned to the NSRS via processing with respect to the NGS managed CORS network, and referenced to

NAD83(2011)epoch:2010. The appropriate UTM coordinate system and zone shall be used.

8. **Total Propagated Uncertainty (TPU)**
   NOAA NGS and partners have a growing interest in extending the use of topographic/bathymetric lidar data collected throughout the coastal zone for nautical chart updates. To support nautical charting, these data must include total propagated uncertainty (TPU) which accounts for all contributing measurement uncertainties. The contractor will calculate TPU using parametric uncertainty estimates calculated using NOAA's TPU tool "cBlue." Delivery will be:

   - Outputs from the cBlue tool
   - 1m x 1m raster models (GeoTIFF format).
   - The Horizontal Datum shall be positioned to the NSRS via processing with respect to the NGS managed CORS network, and referenced to NAD83(2011)epoch:2010. The appropriate UTM coordinate system and zone shall be used.

9. **Normalized Seabed Reflectance**
   Correction performed to raw intensity values from the bathymetric lidar returns to account for attenuation due to depth and angle of incidence. The return intensity values will be further normalized to account for swath-to-swath variability and the corrected values stored in the standard LAS 1.4 deliverable. The normalized bathymetric return intensities will provide the baselines for generating benthic habitat maps in the study areas without the need for rigorous radiometric calibration. The benthic habitat maps will support analysis of seagrass availability and potentially provide spatially continuous baseline data for monitoring nearshore aquatic habitats.

   - The Horizontal Datum shall be positioned to the NSRS via processing with respect to the NGS managed CORS network, and referenced to NAD83(2011)epoch:2010. The appropriate UTM coordinate system and zone shall be used.

12 TOPOGRAPHIC/BATHYMETRIC MERGED DEM CREATION

The contractor shall provide a consistent resolution merged DEM data set from high quality elevation data acquired along the entire project area. The contractor shall prepare a detailed work plan defining their process for performing the data merge and where and how they intend to fill in the data voids.

Issues to consider:

- Data gaps
- Interpolation of points/DEMs
- Size of water bodies, rivers to consider

1. **Topographic/Bathymetric Merged DEM (Deliverable 6.3)** shall be delivered
   The following specifications shall be utilized:

   - The DEM shall include LAS classes 2, 40, 43, and 45 as specified above. The contractor shall contact NOAA and discuss whether to include or discard class 64, dependent on circumstance of environment.

   - Cloud Optimized GeoTIFF format

   - Compression (deflate)

   - The Horizontal Datum shall be positioned to the NSRS via processing with respect to the NGS managed CORS network, and referenced to NAD83(2011)epoch:2010. The appropriate UTM coordinate system and zone shall be used.

   - Vertical datum: NAVD88 or Orthometric Datum supported by NGS GEOID model (The most recent NGS GEOID available for the project area shall be utilized)

   - Resolution: 1 meter

   - Vertical Units: Meters

   - Tiles shall be 5000m x 5000m, without overlap

   - The base naming convention for these files will be "YYYY_XXXXXXe_YYYYYYYn_dem.tif". Coordinates refer to the upper left corner of the tile.

- A shapefile defining tile extents may be provided by NOAA if requested.

- Void areas (i.e., areas outside the project boundary but within the tiling scheme) shall be coded using a unique "NODATA" value = -999999. This value shall be identified in the appropriate location within the file header.

- One FGDC compliant metadata file, in xml format, is required for the project

- If TPU is **not** included as a deliverable, then the contractor shall also provide a confidence layer (standard deviation of all ground or bathymetric points located within a 1 meter cell size).

- The contractor shall provide a data void layer showing all areas within the AOI where there is no data.

DIGITAL CAMERA IMAGERY DATA PROCESSING

1. Aerotriangulation is required for these projects. The Aerotriangulation of images entirely over water is not required.

2. **RGB/NIR Stereo Imagery (Deliverable 4.1)** shall be delivered as:

    - Uncompressed Developed Images (*.tif),

    Stereo Imagery shall be delivered in a format capable of loading into BAE's SocetSet or GXP software products. The contractor shall pay special attention to follow all naming conventions in accordance with the following:

    Below is the updated aerial image ID naming convention, associated with SOW 15, in the FILE NAMING CONVENTION section. All Imagery, Products and Reports for this Task Order shall comply with the following imagery naming convention rules:

    ImageID NAMING CONVENTION (Frame Camera) – All contractor acquired frame imagery shall follow a STRIP_FRAME image naming convention as follows:
    930001_00001

    The STRIP (prefix) is a **6-digit** designator, where: Digit
    1 holds Data Type as defined:
    1 = color/non-tide coordinated 2 = IR/MHW
    3 = IR/MLLW
    4 = IR/non-tide coordinated
    5 = color/MHW

6 = color/MLLW
7 = multispectral/MHW
8 = multispectral/MLLW
9 = multispectral/non-tide coordinated

Digits **2-3** hold Image Scale (flying height / focal length)
Digits **4-6** hold the unique flight line #
Digits **7-11** holds the **unique frame id** of the **project**. Frame id will start with "00001" for the first acquired image frame and increase by +1 for each image acquired for that project with no skips or repeats. Frame ID will **not** reset to "00001" if the contractor acquires imagery with multiple cameras or acquires imagery that spans multiple years.

Note that any tide stage other than MHW or MLLW is considered non-tide coordinated for this purpose, including imagery collected within +/- 3 hours of low tide.

If a Line Scanner is proposed for acquisition, the contractor will be required to coordinate with NOAA prior to acquisition, on how to define the various radiometry and viewing perspectives of the sensor for the FRAME (suffix).

If utilizing a line scanner there will be a seven digit suffix which will be used to identify the viewing angle (first two digits) and a unique frame ID for that view angle.

Stereo NAMING CONVENTION (Line Scanner Only)– All contractors acquiring line scanner imagery shall follow a STRIP_FRAME image naming convention for stereo models as follows: **930001_BL00001**

The STRIP (prefix) is a **6-digit** designator, where: Digit
1 holds Data Type as defined:
1 = color/non-tide coordinated 2 = IR/MHW
3 = IR/MLLW
4 = IR/non-tide coordinated
5 = color/MHW
6 = color/MLLW
7 = multispectral/MHW
8 = multispectral/MLLW
9 = multispectral/non-tide coordinated

Digits **2-3** hold Image Scale (flying height / focal length)
Digits **4-6** hold the unique Flight Line ID which shall match the corresponding flight line in the planned imagery shapefiles, and the same flight line ID shall be used even when a line is patched or reflown.
Digits **7-8** identify the stereo view angle of the line scanner (BL= Backward look; NL= Nadir look; FL= Forward look)
Digits **9-13** holds the **unique frame id** of the **project**. Frame id will start with "00001" for the first stereo view look model and increase by +1 for each stereo view look model for that project with no skips or repeats. Frame ID will **not** reset to "00001" for a view look if the contractor acquires imagery with multiple cameras or acquires imagery that spans

multiple years.

The stereo naming convention needs to be adhered to as you break up the flight lines into multiple models/pairs due to file size constraints. The ordering of the digits that indicate the model/pair shall be sequential starting at "00001" for the first model's view and increase by +1 with no skips or repeats for the entire project. This will ensure that every stereo model frame will have a unique name for the entire project.

Example: If there are 999 frames that are broken up for each of the three looks (NL, BL, FL) for an entire project the frame ID will look as follows for each of the looks.

Look	Frame_ID_Start	Frame_ID_END
Forward Look	**FL00001**	**FL00999**
Nadir Look	**NL00001**	**NL00999**
Backward Look	**BL00001**	**BL00999**

3. **Exterior Orientation (EO) Files (Deliverable 4.3)** shall be delivered for Frame Camera systems. ***If Line Scanners are utilized instead of a Frame Camera, then support files that enable loading imagery into a Stereo Environment such as SocetSet (and additional files such as the *.ads file, *.odf file, *.cam file, etc) shall be supplied instead of an EO file for pre AT Directly Georeferenced.***

    - As a Text File (*.txt)
    - The EO file shall contain at a minimum the following fields and sequenced as shown below:
        - ID, [Image ID needs to be renamed according to the CMP naming convention (ex. 120001_99999)].
        - Time (GPS Seconds of the Week),
        - Latitude(signed Decimal Degrees),
        - Longitude (signed Decimal Degrees),
        - UTM Easting (meters),
        - UTM Northing (meters),
        - Orthometric Height (meters, utilizing the latest NGS GEOID model),
        - Omega (degrees),
        - Phi (degrees),
        - Kappa (degrees),
        - UTM Easting Standard Deviation (meters),
        - Northing Standard Deviation (meters),
        - Height Standard Deviation (meters),
        - Omega Standard Deviation (degrees),

- Phi Standard Deviation (meters),
- Kappa Standard Deviation (degrees).

4. **Airborne Positioning and Orientation Report (APOR) (Deliverable 4.8)** shall be delivered
    - Please refer to the following template: APOR_Report_Template_v2.0.0.pdf

5. **Acquisition Summary (Deliverable 4.9)** shall be delivered
    - Please refer to the following template: Acquisition_Summary_Templatev1.0.1.pdf

6. **Exterior Orientation (EO) Files (Post AT) (Deliverable 5.1)** shall be delivered for Frame Cameras. ***If Line Scanners are utilized instead of a Frame Camera, then support files that enable loading imagery into a Stereo Environment such as SocetSet (and additional files such as the *.ads file, *.odf file, *.cam file, etc) shall be supplied instead of an EO file for post AT.***

7. **Aerotriangulation Report (95%CE computed) (Deliverable 5.2)** shall be delivered
   Aerotriangulation reports are required for each project, see SOW, Attachment I. NGS requires the aerotriangulation reports and accompanying data files be completed and delivered for Government review within three weeks of the completion of aerotriangulation and before the compilation pilot area data set has been completed.

8. **RGB/NIR Ortho-mosaic Imagery (Deliverable 5.3)** shall be delivered
   One Cloud Optimized GeoTIFF ortho-mosaic is required for each tile and will contain all images collected within the tile that show land mass or fixed features in the water, such as jetties, breakwaters, etc. Areas containing no imagery will have a transparent background.

    - Cloud Optimized GeoTIFF format
    - Compression (deflate)

   Tiles shall be 3000m x 3000m

   The base naming convention for these files will be "YYYY_XXXXXXe_YYYYYYYn_orthomosaic. Coordinates refer to upper left corner of tile. A shapefile defining extents may be provided by NOAA if requested.

   These files shall be provided in GeoTIFF format and the Horizontal Datum should be positioned to the NSRS via processing with respect to the NGS managed CORS network,

and referenced to NAD83(2011)epoch:2010.

The appropriate UTM coordinate system and zone as designated in the tiling scheme provided shall be used.

One FGDC compliant metadata file, in xml format, is required for the project

13 PILOT PROJECTS

1. Pilot Area, of at least 10 km^2 including LAS, imagery, DEMs, and metadata are required.

2. Lidar Data Pilot shall include:
    - LAS
    - LAS Metadata
    - LAS Tile Index
    - DEM
    - DEM Metadata
    - DEM Tile Index
    - Bathymetric Void Shapefile
    - Standard Deviation Surface (if TPU is not included)
    - Dz Orthos
    - Finalized lidar trajectory
    - Total Propagated Uncertainty (TPU)
    - Normalized Seabed Reflectance

3. Imagery Data Pilot shall include:
    - Ortho-mosaic imagery
    - Ortho-mosaic imagery metadata
    - Ortho-mosaic imagery tile index
    - Stereo Imagery
    - Directly Georeferenced Exterior Orientation (EO) Files

4. Pilot GC Shoreline (Deliverable 5.5) shall be delivered

14 QUALITY ASSURANCE

1. The contractor shall perform quality assurance on the final topographic/bathymetric lidar merged LAS products, and provide an independent Quality Assurance Report on the qualitative and quantitative assessments of the final products as defined in Section 11 and 12.
2. The following quality control measure items shall be calculated, documented and provided within the Quality Assurance Report.

a. Bathymetric Portion of lidar Data

i. Qualitative Assessment: The contractor should employ a qualitative methodology to assess the quality of the data. The process should look for any anomalies in the data, classification errors, assure there are no obvious bias or elevation shifts between flight lines at the edges, and there are no scan pattern issues or geometric artifacts present in the data.

ii. Overlapping lines and datasets shall be compared to each other and to cross lines and the differences calculated.

iii. Elevations shall also be verified through comparison with ground survey data (15.2.d) as described below.

iv. All systematic errors shall be identified and eliminated and remaining errors should have an approximately zero-mean Normal distribution (defined here as abs(μ) < 0.05 m, and abs(skewness) < 1.0), and shall meet a vertical RMSE of $QL2_b$ specified in the Draft National Coastal Mapping Strategy 1.0 Document..

b. Topographic portion of lidar Data

i. Qualitative Assessment: The contractor should employ an interpretive based methodology to assess the quality of the data. The process should look for any anomalies in the data, classification errors, assure there are no obvious bias or elevation shifts between flight lines at the edges, and there are no scan pattern issues or artifacts present in the data.

ii. Overlapping lines and datasets shall be compared to each other and the differences computed.

iii. The relative accuracy requirements listed below shall be calculated and meet the 10 cm accuracy class standard for elevation data as specified in the APSRS Positional Accuracy Standards for Digital Geospatial Data Edition, 1, Version 1.0 – November, 2014.
   1. Within-Swath hard Surface Repeatability (Max Diff): 6 cm
   2. Swath-to-Swath Non-Veg Terrain (RMSEDz): 8 cm

iv. Elevations shall also be verified and tested through comparison with ground truth data as described below.

v. All systematic errors shall be identified and eliminated and remaining errors should have an approximately zero-mean Normal distribution

(defined here as abs(μ) < 0.05 m, and abs(skewness) < 1.0), and shall meet the 10 cm accuracy class standard for elevation data as specified in the APSRS Positional Accuracy Standards for Digital Geospatial Data Edition, 1, Version 1.0 – November, 2014. Testing and reporting of vertical accuracies shall follow the procedures for the Non-vegetated Vertical Accuracy (NVA) at the 95% confidence level in all non-vegetated land cover categories combined and reports the Vegetated Vertical Accuracy (VVA) at the 95th percentile in all vegetated land cover categories combined stated in the Standard. A copy of this specification may be found at: https://www.asprs.org/a/society/committees/standards/Positional_Accuracy_Standards.pdf

vi. The Quality Assurance report shall provide evaluation results of the point cloud accuracy for bare- earth and low grass and at least two other main categories of ground cover in the study area. For example, these additional categories could be:

1. High grass and crops (hay fields, corn fields, wheat fields);
2. Brush lands and low trees (chaparrals, mesquite, mangrove swamps);
3. Fully covered by trees (hardwoods, evergreens, mixed forests); and
4. Urban areas (high, dense man-made structures)

vii. The contractor may further subdivide and expand the above definitions to better accommodate the predominant vegetation and land cover types in the survey area. The contractor shall evenly distribute sample points throughout each category area being evaluated and not group the sample points in a small subarea.

c. Imagery

i. Qualitative Assessment: The contractor should employ an interpretive based methodology to assess the quality of the data. The process should look for any anomalies in the data, tonal quality, smears, blurs, excessive glare or noise, warping, cloud presence, mosaic lines, edge matching and feature misalignment in the data.

ii. Horizontal positions shall also be verified and tested through comparison

with ground truth data as described below.

iii. All systematic errors shall be identified and eliminated and shall meet ASPRS Accuracy Standards for 45.00 cm RMSEx and RMSEy Horizontal Accuracy Class. A copy of this specification may be found at: https://www.asprs.org/a/society/committees/standards/Positional_Accuracy_Standards.pdf

d. Ground Survey

For each acquisition region detailed in the provided lidar and project boundary shapefile, the contractor shall follow the guidance of recommended number of control/check points to be used for vertical referencing and accuracy testing of elevation datasets and for horizontal referencing and accuracy testing of digital orthoimagery data sets from the APSRS Positional Accuracy Standards for Digital Geospatial Data Edition, 1, Version 1.0 – November, 2014. The contractor shall follow the guidance for recommended number of check points based on the project area for NVA and VVA. Check points shall be distributed generally proportionally among the various land cover types in the project. The contractor shall propose a control/check point acquisition plan for the project area to the COR and NGS, and the COR's approval granted, before proceeding. All raw data, notes and logs shall be provided along with the processed results of each area.

Lidar:

i. The contractor shall provide control/check points, “discrete areas of ground truth” within the designated region of interest to assist in the interrogation of the bathymetric data set.

ii. The contractor shall provide control/check points, “discrete areas of ground truth” for the ground cover categories specified in sections 12.b.vi, within the designated region of interest to assist in the interrogation of the topographic data set.

iii. Spot elevations to determine the accuracy of the overall dataset should be selected on flat terrain, or on uniformly sloping terrain for 5 meters in all directions from each control/check point. Whereas flat terrain is preferable, this is not always possible. Whenever possible, terrain slope should not be steeper than a 10 percent grade and should avoid vertical artifacts or abrupt changes in elevation because horizontal errors will unduly influence the vertical RMSE calculations.

iv. The control/check points shall be collected within a temporal period, close

enough to the acquisition of data, which minimizes geomorphic change that can occur between the lidar and check points.

v. Horizontal Datum - All positions shall be tied to the NSRS via processing with respect to the NGS managed CORS network, and referenced to NAD83(2011)epoch:2010. The appropriate UTM coordinate system and zone as designated in the tiling scheme provided shall be used.

vi. Vertical Control Datum - All positions will be tied to the NSRS via processing with respect to the NGS managed CORS network, and referenced to NAD83(2011)epoch:2010 ellipsoidal heights in meters.

vii. The accuracy of the control/check points should be at a minimum, based on the ASPRS standards, at least three times better than the accuracy of the lidar they are being used to test. Documentation of all control/check points used shall be provided in the Quality Assurance Report.

Imagery:

i. The contractor shall provide horizontal control/check points at "well-defined points" within the designated region of interest to assist in the interrogation of the imagery data set.

ii. The contractor shall provide horizontal control/check points at "well-defined points" that represents a feature for which the horizontal position can be measured to a high degree of accuracy and position with respect to the geodetic datum.

iii. For testing orthoimagery, well-defined points shall not be selected on features elevated with respect to the elevation model used to rectify the imagery.

iv. The control/checkpoints shall be collected within a temporal period, close enough to the acquisition of data, which minimizes change that can occur between the imagery and checkpoints.

v. Horizontal Datum - All positions shall be tied to the NSRS via processing with respect to the NGS managed CORS network, and referenced to NAD83(2011)epoch:2010. The appropriate UTM coordinate system and zone as designated in the tiling scheme provided shall be used.

vi. The independent source of higher accuracy for control/checkpoints shall be at least three times more accurate than the required accuracy of the geospatial data set being tested.

3. **Ground Survey Report for Imagery (Deliverable 4.4)** shall be delivered
    - **Please refer to the following template:** ground_survey_report_imagery_template_v1.0.3.pdf

4. **Ground Survey Shapefile and Images for Imagery (Deliverable 4.5)** shall be delivered
    - Please refer to the following template: ground_survey_shapefile_for_imagery_addendum_v1.0.3.pdf

5. **Ground Survey Report for Lidar (Deliverable 4.6)** shall be delivered
    - Please refer to the following template: ground_survey_report_lidar_template_v1.0.4.pdf

6. **Ground Survey Shapefile and Images for Lidar (Deliverable 4.7)** shall be delivered
    - **Please refer to the following template:** ground_survey_shapefile_for_lidar_addendum_v1.0.4.pdf

7. **Quality Assurance Report (Deliverable 7.6)** shall be delivered.

The Quality Assurance Report shall detail the qualitative assessment of the cleaned, classified, and merged topographic/bathymetric point cloud deliverable, topographic/bathymetric DEMs, and Ortho- mosaic Imagery.

The Quality Assurance Report shall detail the quantitative assessment of the cleaned, classified, and merged topographic/bathymetric point cloud deliverable, topographic/bathymetric DEMs, and Ortho- mosaic Imagery to meet the following specifications:

- Lidar data shall be tested to meet a vertical RMSE of $QL2_b$ specified in the Draft National Coastal Mapping Strategy 1.0 Document.

- Ortho-mosaic imagery shall be tested to meet ASPRS Positional Accuracy Standards for Digital Geospatial Data (2014) for a 40_(cm) RMSEx / RMSEy Horizontal Accuracy Class. Actual positional accuracy was found to be RMSEx = ___ (m) and RMSEy = ___ (m) which equates to Positional Horizontal Accuracy = +/- ___ (m) at 95% confidence level.

15 LIDAR SHORELINE DELINEATION

1. Shoreline delineation will be performed by NGS/RSD from the contractor-provided, cleaned, classified and merged topographic/bathymetric lidar point cloud.

16 GEOGRAPHIC CELL SHORELINE CLEANUP, EDITING, ATTRIBUTION, AND COMPILATION

1. The NGS-performed shoreline delineation will be provided to the Contractor for cleanup, editing and feature attribution in conjunction with the project acquired imagery.

2. Scale of Depiction for GC product - For the purposes of shoreline delineation and feature depiction, the scale of compilation shall be equal to a) the largest scale of NOAA's newly reschemed band 5 ENCs or b) the scale of the largest scale chart or chart inset that includes that portion, whichever is larger (a or b). However, the Compilation Scale will be neither smaller than 1:24,000 nor larger than 1:2,500.

3. Accuracy of Depiction - All vector compilation shall meet the relative accuracy requirement of §8.5 of the SOW. Discrete point features along the shoreline shall be measured and depicted to a horizontal accuracy at the 95% confidence level as follows: for areas depicted at a scale of 1:10,000 or larger on the largest applicable scale NOAA Nautical Charts, features shall be compiled to an accuracy of 1 meter or better; for areas depicted at a chart scale less than 1:10,000 but greater than or equal to 1:40,000, features shall be compiled to an accuracy of 3 meters or better; and for all areas where the largest scale NOAA Nautical Chart coverage is smaller than 1:40,000, features shall be compiled to an accuracy of 5 meters or better. The vertical accuracy of discrete point features shall equal three meters or better.

4. Limit of Compilation - Project Boundary Shapefile

5. Subproject Areas – Subproject areas will be provided to the contractor in shapefile format. There will be between X and X compilation subproject areas.

6. **Geographic Cell Shoreline (interim format) (Deliverable 7.1)** shall be delivered

7. **Chart Evaluation File (CEF) (Deliverable 7.2)** - The Contractor shall create a CEF for each individual subproject area and it shall be submitted with the Gegraphic Cell Shoreline (interim format) deliverable.

8. **Geographic Cell Shoreline (final format) (Deliverable 7.3)** shall be delivered

9. **Project Completion Report (PCR) (Deliverable 7.5)** - The Contractor shall create a PCR for each individual subproject area.

- As new guidance is provided for shoreline compilation, a PI Compilation Addendum document will be provided.

- Please read the Common_Issues_Found_During_QA_Review_v1.0.0.pdf document that will describe common issues associated with PCR, CEF, and Shoreline Shapefiles during

the Remote Sensing Division's Quality Assurance process that we hope to minimize in future contract deliverables.

17 RECORDS AND METADATA

The contractor shall document all delivered data and data products (including options if exercised) according to Executive Order 12906 (http://www.fgdc.gov/policyandplanning/executive_order/) for the whole of the project in one metadata product. Specifically, the contractor shall deliver for all data and data products, metadata records which detail all flight lines, flight dates and times, datums, transformations, reprojections, resampling algorithms, processing steps, field records, positional accuracy, and any other pertinent information. The metadata records shall conform to the Content Standards for Digital Geospatial Metadata (FGDC-STD-001-1998) as published on May 1, 2000, by the Federal Geographic Data Committee (FGDC) or to any format that supersedes it as determined by the FGDC (http://www.fgdc.gov/metadata/csdgm/). Profiles and extensions to the standard that have been endorsed by the FGDC shall be used if they are applicable to the data or data products. The metadata records shall contain any and all elements, including those that are considered optional, wherever applicable to the data or data product. The metadata record shall contain sufficient detail to ensure the data or data product can be fully understood for future use and for posterity.

Complete metadata shall be provided for each of these products. The metadata shall be in xml format. Draft version of the metadata shall be provided to NOAA for review prior to final data submittal. An example of the minimum content that shall be included is provided as a supplement to these Project Instructions.

1. **RGB/ NIR Stereo Imagery metadata (Deliverable 4.2)** shall be delivered

2. **GeoTiff RGB/NIR Ortho-mosaic imagery metadata (Deliverable 5.4)** shall be delivered

    - Please refer to the following template: Imagery_metadata_sample_v1.0.0.xml

3. **Topographic/Bathymetric LAS metadata (Deliverable 6.2)** shall be delivered

    - Please refer to the following template: LAS_metadata_sample_v1.0.0.xml

4. **Topographic/Bathymetric DEM metadata (Deliverable 6.4)** shall be delivered

    - Please refer to the following template: DEM_metadata_sample_v1.0.0.xml

5. **Geographic Cell Shoreline metadata (Deliverable 7.4)** shall be delivered

- Please refer to the following template: GC_shoreline_sample_v1.0.1.xml

18 KICKOFF MEETINGS

The contractor shall participate in a kickoff meeting with the NOAA NGS within 30 days of contract award unless otherwise agreed upon by NOAA and the contractor. The meeting shall be held at the NOAA Headquarters in Silver Spring, MD. The contractor shall prepare an agenda for this meeting and issue meeting minutes within 7 days after the meeting.

19 CONTRACTOR COORDINATION

Communication and coordination between both the contractor and the Government is considered vital to the satisfactory accomplishment of these Project Instructions. The Contractor shall expect periodic interaction with the Government to ensure clear understanding of the anticipated products and satisfactory progress in the delivery of products.

The contractor shall submit monthly progress reports to the Government summarizing progress made and problems encountered. After submittal of each of these reports the contractor shall schedule a conference call with the government to discuss the progress of the project and any issues that need to be addressed. The contractor shall prepare and distribute an agenda for the call and shall distribute the meeting minutes within 5 days of the conclusion of the call.

20 PERFORMANCE

1. Performance of the bathymetric portion of a task order shall be on the 'best level of effort' criteria as follows: NGS recognizes that there are potential issues that may prevent data collection in the areas identified within this Scope of Work. These include, but are not limited to, terrain, weather / winds, overhanging-vegetation, white water, water clarity, air traffic control, air space restrictions, and similar. The contractor is not responsible for any gaps in coverage that are caused by such factors that are outside of the contractor's control and a best level of effort has been followed to fill those gaps.

2. Should any of the total identified linear kilometers specified in the provided lidar and/or project boundary shapefile be eliminated during the course of the project as described in Section 4, parties agree to mutually revise the stated criteria as required by the provisions of the contract.

21 DELIVERABLES

1. Property Of Data

All original data, from the instant of acquisition, and other deliverables required through this

contract including final data, are and shall remain the property of the United States Government. This includes data collection outside the project area. These items include the contractor-furnished materials.

2. Provided By Government

The government will provide to the contractor:

a. Lidar Boundary: extent for which topobathy lidar shall be acquired.

b. Project Boundary: extent for which digital camera imagery shall be acquired and shoreline work completed.

c. Sub Project Boundary: extent for which shoreline work will be subdivided into specific projects.

d. A shapefile defining tile extents (LAS, DEMs, Orthoimagery, etc.) may be provided by NOAA if requested.

e. Rejected Data – If data are rejected by NGS, NGS will send sample data upon request showing the problem areas.

3. List of Deliverables

This section contains the complete list of deliverables associated with this project, subject to change. All submitted plans shall be of sufficient detail so that the Government can verify that the contractor has a thorough understanding of the requirements of these Project Instructions. The contractor shall also complete the attached Deliverable Tracking Log (DTL) spreadsheet with a percentage of the overall task order that each deliverable represents and the proposed due date for each deliverable. This data will be used to track performance and for approval of invoices. The contractor may propose additional deliverables/ milestones in their technical proposal if they determine they are required. All deliverables, including monthly reports, shall be submitted using OCM's Task Order Management and Information System (TOMIS). The following project deliverables are required.

Work Plan – The work plan shall be part of the Technical Proposal in response to these Project Instructions. The work plan should include but is not limited to; potential base station locations, horizontal and vertical accuracy of the base stations, projected maximum baseline length for airborne trajectories, prior calibration reports, process to perform daily calibration checks, flight acquisition, etc. The plan shall be in a PDF format and shall include the major milestones and deliverables shown in Gant chart format.

a. Shapefiles - files identifying lidar and imagery acquisition flight lines shall be submitted as part of the Technical Proposal.

b. Ground Survey Plan – including detailed discussion of the number and distribution of check points to be used for vertical accuracy testing of elevation data sets and for horizontal accuracy testing of digital orthoimagery data sets, acquisition strategy and associated uncertainties of checkpoints in Microsoft Word format. Shall be submitted as part of the Technical Proposal.

c. Quality Control Plan – including detailed discussion of accuracy assessment methods/plan or other means of proving contract specifications have been met in Microsoft Word format. Shall be submitted as part of the Technical Proposal.

d. DEM Development Plan – including detailed discussion of their work plan defining their process for performing the data merge for a consistent resolution DEM, how they intend to fill in the data voids, creation of the confidence layer in Microsoft Word format. Shall be submitted as part of the Technical Proposal.

e. Project schedule - to include dates for all deliverables. Sent as the TOMIS spreadsheet in conjunction with the Technical Proposal.

On-going During Contract:

a. Daily SITREP (situational reports) as an email correspondence. Only required during the acquisition phase.

b. Weekly Reports. See Attachment G of SOW, V15.

Pre-Acquisition Imagery and Lidar:

1.1 Camera Boresight Calibration Report

1.2 Lidar Boresight and Calibration Report

1.3 Shapefiles identifying imagery acquisition flight lines

1.4 Shapefiles identifying imagery footprints

1.5 Shapefiles identifying lidar acquisition flight lines.

Post-Acquisition Files:

2.1 Shapefiles depicting footprint of acquired imagery *{Frame/Line Scanner}*

2.2 Photographic Flight Reports

2.3 Lidar Flight Reports

2.4 Data coverage images showing the extents of the lidar survey (Lidar data coverage images shall be delivered prior to delivery of elevation data.)

2.5 The raw data delivery package: shall include, but not be limited to, digital copies of all electronic and paper files generated in the course of the survey, flight sheets, field data collection sheets, raw airborne and ground GPS data, Ground Truth data, GPS processing projects, processed GPS data, project tracking files, raw airborne lidar data, flight plans in GIS or manufacturer format, processed lidar data in manufacturer directory structure and format, crossline data and an unclassified LAS 1.4 point cloud.

Pilot Data Processing:

Pilot Area, of at least 10 km^2 including LAS, imagery, DEMs, and metadata are required.

3.1 Lidar Data Pilot

3.2 Imagery Data Pilot

Stereo Imagery and Ground Surveys:

4.1 RGB/NIR Stereo Imagery

4.2 RGB/NIR Stereo Imagery metadata

4.3 Exterior Orientation (EO) Files (*.txt) ***(Original DG)***

4.4 Ground Survey Report for Imagery

4.5 Ground Survey Shapefile and Images for Imagery

4.6 Ground Survey Report for lidar

4.7 Ground Survey Shapefile and Images for lidar

4.8 Airborne Positioning and Orientation Report (APOR)

4.9 Acquisition Summary

Imagery/Pilot Shorelines:

5.1 Exterior Orientation (EO) Files (*.txt) ***(Post AT)***

5.2 Aerotriangulation Report (95% CC computed)

5.3 GeoTiff RGB/NIR Ortho-mosaic imagery

5.4 GeoTiff RGB/NIR Ortho-mosaic imagery metadata

5.5 Pilot Area Geographic Cell Shoreline (interim format) will be submitted for review and approval before progressing with further project shoreline mapping

Lidar Deliverables:

6.1 Cleaned, classified, and merged point clouds in a LAS 1.4 format

6.2 Lidar point cloud metadata

6.3 Topographic/Bathymetric DEM

6.4 Topographic/Bathymetric DEM metadata

6.5 Finalized Lidar Trajectory in defined ASCII Format

Shoreline and Reports:

7.1 Geographic Cell Shoreline (interim format)

7.2 Chart Evaluation Files (CEF)

7.3 Geographic Cell Shoreline (final format)

7.4 Geographic Cell Shoreline metadata

7.5 Project Completion Report (PCR)

7.6 Quality Assurance Report

22 PRODUCT DELIVERY SCHEDULE

1. During project acquisitions, a daily SITREP as an email correspondence shall be provided by the contractor detailing the day's acquisition activities, location, and mission status.

2. Files to show survey progress are required every other week following the start of survey. Near the end of the survey period, this frequency shall increase to 1 update per week as directed by the POC. These files shall be provided in a format compatible with ArcGIS.

3. The data coverage product files will be delivered to POC no later than 14 days from the last day of data acquisition. Please see the Data Coverage section for details of this product.

4. Data and product delivery shall be based on regions as described in paragraph 22.2.b

5. For the first two or three areas for which data are delivered, three or four (3-4) files of each product type shall be provided as examples for POC review. This review will focus on the format, structure and naming convention of the files rather than accuracy of the data contained within these files.

6. Following receipt of the sample files, the POC will review and provide comments to the Contractor within 14 days that indicate specific items that require correction or modification to format or content.

7. Final data and product delivery shall be made no later than 90 days after review comments are received by the Contractor.

8. For all other regions, the lidar data deliverables, excluding the coverage files, shall be delivered to POC no later than 120 days from the last day of data acquisition. Imagery based products shall be provided no later than 120 days from the last day of data acquisition.

9. The POC will review the final versions of the delivered data for accuracy and completeness and provide comments to the Contractor. Corrections to these issues shall be made and revised files resubmitted within 30 days.

23 PRODUCT DELIVERY ADDRESSES

The deliverables listed above shall be delivered to the COR at the following address. Technical questions shall be addressed to the Technical POC.

24 FIGURES AND MAPS

Figure 1. Exact coverage areas for Data collection are TBD

27 IT SECURITY REQUIREMENTS

The Assessment and Authorization (A&A) requirements of Clause 48 CFR 1352.239-72 do not apply, and a Security Accreditation Package is not required.

The Contractor must describe how it implements a secure data processing of the information being collected, processed (methods, equipment, hardware, IT security methodology for securing the system(s), and software) and transmitted. The Contractor must describe their process for ensuring the information being transmitted (via removable media) is free from malicious software, spyware and other unwanted code.

INFORMATION TECHNOLOGY SECURITY – The applicability of Commerce Acquisition Regulation (CAR) clause 1352.239-72, Security Requirements for Information Technology Resources (APR 2010), in the performance of NGS requirements as described herein, will be determined at the task order level. Familiarization with this clause as well as DOC IT Security Program Policy & Minimum Implementation Standards (internal access only: https://connection.commerce.gov/policy/20140528/it-security-program-policy-commerce-information-technology-requirements-and-policy) is recommended.

NOAA BUILDING SECURITY – When visiting NOAA offices, all contractors must obtain a Visitor's Pass by showing show the Security Officer a valid picture ID (drivers license, military ID, etc.). Visitors will be required to sign-in at the building security desk, process through the walk-through magnetometer, and have their items x-rayed or searched. Visitors are issued a time expiring NOAA Visitor Badge valid for one day only. For additional information see: http://www.osec.doc.gov/osy/noaa/1.htm

28 CONTACTS/COMMUNICATIONS

Contact NGS whenever questions or unusual circumstances arise. The points of contact are:

NOAA COR
NOAA National Geodetic Survey
1315 East West Highway
Silver Spring, MD 20910

NGS Technical POC
NOAA National Geodetic Survey
1315 East West Highway
Silver Spring, MD 20910

Attn: Gregory Stinner
240-533-9651
gregory.stinner@noaa.gov

Attn: Stephen White
240-533-9588
stephen.a.white@noaa.gov

NOAA Contract Specialist
NOAA Acquisition and Grants Office (AGO)
200 Granby Street, Suite 815
Norfolk, VA 23510
Attn: Michael Williams
757-441-3434
michael.j.williams@noaa.gov

29 ENCLOSURES

- Shapefiles defining the project area
- Acquisition Summary Template
- APOR Template
- Boresight and Calibration lidar Report Template
- Boresight and Calibration Camera Report Template
- Common Issues Document
- DEM Metadata Sample
- Ground Survey Report Imagery Template
- Ground Survey Report Lidar Template
- Ground Survey Shapefile for imagery addendum
- Ground Survey Shapefile for lidar addendum
- Imagery Metadata Sample
- LAS Metadata Sample
- PI Compilation Addendum
- Shoreline Metadata Sample