

**SCOPE OF WORK
AIRBORNE LIDAR SURVEYS
JACKSON, MARSHALL and DEKALB, COUNTIES, AL.
CONTRACTOR: WOOLPERT INC.
CONTRACT NUMBER: W91278-10-D-0101/2
EN PROJECT NUMBER: C-11-029**

1. GENERAL

1.1. Under this Task order, contractor shall provide the acquisition and processing of Lidar data in several counties in the State of Alabama where high-resolution digital topographic data will assist the Natural Resources Conservation Service (NRCS) make wetland determinations for its Wetland Reserve Program (WRP) and assist NRCS engineers design structures necessary for wetland restoration in association with that program.

1.2. The contractor's employees will at all times conduct themselves in a manner compatible with the non-personal services nature of this contractual instrument. The contractor's workforce will under no circumstances allow themselves to be under the supervision and control of a Government officer or employee.

1.3. A copy of this scope of work shall be furnished to the party chief.

2. CONTRACTOR PROPOSAL

- 2.1. The contractor's proposal letter shall state the following specifics:
- i. Name of the project and project number.
 - ii. Whether or not the requested project completion date can be met
 - iii. Name, address, phone number and registration number of the registered and surveyor who will review and certify the project
 - iv. The proposal shall show the amounts proposed by site and total cost.

3. SURVEY REQUIREMENTS

Contractor shall collect and process airborne lidar with complete coverage of Jackson, Marshall and DeKalb counties, Alabama. Contractor shall list a cost for each county as a separate line item on proposal. Collection will be done during 'leaf-off' conditions. Contractor shall collect a 100 meter buffer into adjacent counties.

1. Coordinate System:

- Alabama State Plane East with the unit of feet.

2. Vertical Accuracy:

- NSSDA RMSEZ = 15cm (NSSDA AccuracyZ 95% = 30cm) or better with respect to existing County control used for previous mapping projects and or State provided control.
- Relative accuracy of 5cm RMSEZ or better; assessment to be made swath-to-swath and within single swaths.

3. Raw 3D Point Cloud:

- Fully compliant LAS v1.2, Point Record Format 1
- Geo-reference information included in LAS header
- GPS times recorded as POSIX times with a precision sufficient to allow unique timestamps for each return.
- Intensity values (rescaled to 8-bit)
- Full swaths, all collected points are to be delivered.
- 1 file per swath, 1 swath per file, file size not to exceed 2GB

4. Classified 3D Point Cloud:

- Variable Ground Samples Distance shall be no less than 1 point per meter.
- Fully compliant LAS v1.2, Point Record Format 1
- Geo-reference information included in LAS header
- GPS times recorded as POSIX times at a precision sufficient to allow unique timestamps for each return.
- Intensity values (rescaled to 8-bit)
- Tiled delivery, without overlap (tiling scheme TBD)
- Classification Scheme:
 - 1 – Process, but unclassified
 - 2 – Bare Earth Ground
 - 7 – Noise (low or high, manually identified as needed)
 - 9 – Water
 - 10 – Ignored Ground (breakline Proximity)

Note: Class 7, Noise, is listed as a convenience for the contractor. It is not required that all “noise” be assigned to Class 7.

Note: Class 10, Ignored Ground, is intended for points previously classified as bare-earth but whose proximity to a subsequently added breakline requires that it be excluded during Digital Elevation Model (DEM) generation. The requirement to use this class is dependent on the breakline/DEM generation methodology employed.

5. 3 D Hydro Enforced Breaklines:

- All hydrographic breaklines within the 100 Year flood zone, will be collected for use in hydro-flattening of the respective DEM. All delivered breaklines will be delivered as an ESRI feature class (PolylineZ or PolygonZ format. *Contractor will be provided with the base layer for streams and rivers from the USGS National Hydrography Dataset (NHD). In addition, at a minimum, all water features shown on the latest USGS quad sheet shall be mapped. Contractor shall also use the latest commercially available free imagery from sources such as Bing or Google*

Earth to help identify water features such as ponds and lakes etc. and contractor shall cite in survey report what year and source of imagery was used to extract water features. The Hydrographic Breaklines features will include:

- Named River – navigable/non-navigable collected at water level – PolygonZ
 - Named Streams – double line greater than 15 ft wide – collected at water level – PolygonZ
 - Named Stream – single line less than 15 ft wide – collected at center line - PolylineZ
 - Ditches – double line greater than 15 ft wide – collected at water level – PolygonZ
 - Ditches – single line less than 15 ft wide – collected at center line – PolylineZ
 - Named Lakes – collected at water level – PolygonZ
 - Ponds – greater than 2 Ac – collected at water level – PolygonZ
- Breaklines will be delivered in ESRI Shape file format with companion.prj file using the same coordinate reference system (horizontal and vertical) and units as the lidar points. Breaklines will be delivered in tiles that are edge-match seamlessly in both the horizontal and vertical position. The breakline tiles will match the bare earth DEM tiles.

6. **Bare Earth Surface (Raster DEM):**

- A raster DEM will be developed covering each county and tiled to Client specified size to be determined.
- Cell Size no greater than 3 meters or 10 feet, and no less than the design Nominal Pulse Spacing (NPS) of 1.0 meter.
- Delivery in a 32-bit floating point GeoTiff raster format.
- Geo-reference information shall be included in raster file
- Tiled delivery, without overlap
- DEMs tiles will show no edge artifacts or mismatch
- Void areas (i.e., areas outside the project boundary but within the tiling scheme) shall be coded using a unique “NODATA” value. This value shall be identified in the appropriate location within the file header.
- Vertical Accuracy ($RMSE_z$) of the bare earth surface is to be assessed using the methods described in the FEMA “Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix A”, Section A.8.5 paragraph 1, Section A.8.6.1, and Section A.8.6.2 (substituting the contracted vertical accuracy requirements ($RMSE_z$) for those listed in the FEMA document).
- *Note: Depressions (sinks), natural or human-induced, are not to be filled (as in hydro-conditioning and hydro-enforcement).*

Note: Water Bodies (ponds and lakes), wide streams and rivers (“double-line”), and oceans or other boundary waters are to be hydro-flattened within the DEM. Hydro-flattening shall be applied to all water impoundments, natural or man-made, that are larger than 50’ in diameter (approximately 2000 square feet), to all streams that are nominally wider than 50’, and to all boundary waters bordering the project area regardless of size.

Note: This adjustment to the DEM surface is neither “hydro-conditioning” nor “hydro-enforcement”, as defined in Digital Elevation Model Technologies and Applications:

The DEM Users Manual, 2nd Edition (Maune et al., 2007). Please refer to the section on DEM Hydro-Flattening for detailed discussion

7. LiDAR Report (composite):

- Collection Report (detailing mission planning and flight logs)
- Survey Report (detailing the collection of control and reference points used for calibration and QA/QC).
- Processing Report (detailing calibration, classification, and product generation procedures including methodology used for breakline collection and hydro-flattening [*see: Section V. DEM HYDRO-FLATTENING*]).
- QA/QC Reports (detailing the analysis, accuracy assessment and validation of:
 - The point data (absolute, within swath, and between swath)
 - The bare-earth surface (absolute)
- Control and Calibration points: All control and reference points used to calibrate, control, process, and validate the lidar point data or any derivative products are to be delivered.

8. Metadata:

- Deliverables metadata (FGDC compliant, XML format metadata). One file for each:
 - Project
 - Lift
 - Swath
 - Tiled deliverable product group (classified point data, bare-earth DEMs, [breaklines](#), etc.)

Note: Metadata files for individual tiles are not required

9. GIS Project: All data integrated in a single GIS Project.

4. CONTROL

4.1. All of the horizontal control shall be referenced to Alabama State Plane, East Zone with the units of feet and no less than third order accuracies and procedures.

4.2. Vertical: Any vertical control for work under this task order will be tied to NAVD 88 with the units of feet and no less than third order accuracies and procedures.

4.3. All of the survey points recovered and/or established during the project shall be plotted at the appropriate coordinate point in the design file and shall be identified by name or number and elevation if pertinent. A revised 977 digital form will be completed for all monuments found or set. In addition, the contractor must provide a copy of the finished final adjusted horizontal and vertical positions of all control used and/or set.

5. COMPLIANCE

5.1. Surveying and Mapping shall be in strict compliance with the pertinent sections of the EM-1110-1-1002 Survey Markers and Monumentation, EM-1110-1-1003 NAVSTAR Global Positioning System Surveying, EM-1110-1-1005 Control and

Topographic Surveying, , EM-1110-1-2909 Geospatial Data and Systems, A/E/C CADD Standards, and minimum technical standards as defined by the Alabama State Board of Professional Engineers and Land Surveyors

6. QUALITY CONTROL

6.1. It is the contractors responsibility to insure proper field and office quality control procedures are implemented and monitored, including adherence to accuracy standards, safety requirements and compliance with minimum technical standards.

6.2. Contractor shall ensure that effort is made in the field to make a courtesy notification to any affected private landowners of the survey crews activities and to ensure that private property, including shrubbery is protected during the performance of this survey.

8. SCHEDULE

8.1 The deliverable products must be accomplished and received in the Mobile District Office (CESAM-EN Survey Unit) by 1 September 2012. If for any reason the completion cannot be met, the contractor will advise the Mobile District Office, CESAM-EN (Survey Unit), by telephone (POC is Mike McBurney PLS (251) 694 4188) and confirm by email the reason for the delay. This must be submitted five days prior to the negotiated completion date with the date when the project can be submitted.