

# Specification for North Texas Lidar Project 580-11-0916

The following table outlines the specifications for data acquisition, accuracy, spatial reference framework and deliverables.

<b>Data Acquisition</b>					
Requirement	Description	Urban	Forest	Coastal	Flood/Soils
Returns per pulse	LiDAR sensor shall be capable of recording up to 3 (or more) returns per pulse, including 1st and last returns	*	*	*	*
Scan angle	From center scan angle $\leq \pm 20$ degrees. Full scan angle $\leq 40^\circ$ .	$\leq \pm 20^\circ$	$\leq \pm 20^\circ$	$\leq \pm 20^\circ$	$\leq \pm 20^\circ$
Swath overlap	Nominal 50% side lap on adjoining swaths, i.e., survey shall be designed for 100% double coverage at planned aircraft height above ground	50%	40%	30%	30%
Design pulse density	Pulses/m <sup>2</sup> (includes swath overlap; e.g., with 50% side lap, $\geq 2$ pulse/m <sup>2</sup> in each swath)	$\geq 4$	$\geq 4$	$\geq 4$	$\geq 4$
GPS procedures	At least 2 GPS reference stations in operation during all missions, sampling positions at 1 Hz or higher frequently. CORS stations will be selected in consultation with the Texas Spatial Reference Center. Differential GPS baseline lengths shall not exceed 30 km. Differential GPS unit in aircraft shall sample position at 2 Hz or more frequently. LiDAR data shall only be acquired when GPS PDOP is $\leq 3.5$ and at least 6 satellites are in view.	*	*	*	*
Survey conditions	Leaf-off and no significant snow cover or flood conditions, as observed by state contract representatives. Cloud and fog-free between the aircraft and ground.	*	*	*	*
<b>Accuracy</b>					
		Urban	Forest	Coastal	Flood/Soils
Horizontal Accuracy	RMSE <sub>r</sub>	< 50 cm	< 75 cm	< 50 cm	< 75cm
Vertical Accuracy	RMSE <sub>z</sub>	< 10 cm	< 25 cm	< 12 cm	< 15 cm

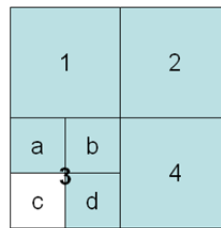
<b>Geographic Coverage and Continuity</b>	
Coverage	No voids between swaths No voids because of cloud cover or instrument failure
Swath overlap	≤ 40% no-overlap area per project
Aggregate 1 <sup>st</sup> return density	Barring non-scattering areas (e.g., open water, wet asphalt): For entire project area, ≥ 85% design pulse density Within any 30m x 30m area within areas of swath overlap, ≥ 50% design pulse density
<b>Spatial Reference Framework</b>	
Vertical Datum	NAVD88, Geoid09, unless otherwise specified
Horizontal Datum	NAD83
Projection	UTM
Vertical Units	Meters (Orthometric, NAVD88)
Horizontal Units	Meters (UTM )
<b>Deliverables</b>	
Report of Survey	Text report (.pdf, .doc, or .odt format) that describes survey methods; results; contractor's accuracy assessments, including internal consistency and absolute accuracy; file formats; file-naming schemes; tiling schemes
Aircraft trajectories (SBET files)	Aircraft position (easting, northing, elevation) and attitude (heading, pitch, roll) and GPS time recorded at regular intervals of 1 second or less. May include additional attributes. <i>ASCII text or shapefile format</i>
All-return point cloud	List of all valid returns in LAS format. For each return: GPS week, GPS second, easting, northing, elevation, intensity, return#, return classification. May include additional attributes. No duplicate entries. GPS second shall be reported to the nearest microsecond (or better). Easting, northing, and elevation shall be reported to nearest 0.01 m (nearest 0.01 ft). Classification of returns shall be as complete as is feasible (including classes: 1. Unclassified, 2. Ground, 4. Vegetation, 6. Building, 7. Low Point (noise), 9. Water and 13. Bridges-Culverts), without avoidable return misclassification. Cloud file structure shall conform to 1/16th USGS 7.5-minute quadrangle (1.875 minute by 1.875 minute, see USGS 7.5' X 7.5' Quadrangle and Quarter-Quarter-Quad example below) tiles. 300 m. buffer should be acquired surrounding the AOI, no buffer needed in between tiles.

Ground (bare-earth) surface model	<p>Digital elevation model of ground surface, interpolated using a triangulated irregular network from identified ground points and breaklines. To restrict data to ground elevations only, the LiDAR acquisition vendor must remove elevation points on vegetation, bridges, buildings, and other structures. The bare-earth DEM, with the minimum regular point spacing, no greater than 5 meters, allowed by the data in eastings and northings. Depressions (sinks), natural or man-made, are not to be filled (as in hydro-conditioning and hydro-enforcement). Elevation values must be floating point, not integer.</p> <p>Water bodies (ponds and lakes), wide streams and rivers (“double-line”), and other non-tidal water bodies as defined in Section III 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 ~2 acre in area (equivalent to a round pond ~350’ in diameter), to all streams that are nominally wider than 100’, and to all non-tidal boundary waters bordering the project area regardless of size. Development of hydro-flattening breaklines for streams less than 100’ is encouraged. The methodology used for hydro-flattening is left at the discretion of the LiDAR vendor, use of the breaklines for DEM creation and classification is encouraged.</p> <p>Surface models shall have no tiling artifacts, no gaps and no artificial smoothing at tile boundaries. Areas outside survey boundary shall be coded as NoData. Internal voids (e.g., open water areas) may be coded as NoData.</p>
Hydro-Flattening Breaklines	<p>All breaklines developed for use in hydro-flattening shall be delivered as a 3D shapefile.</p> <p>Each shapefile will include properly formatted and accurate georeference information in the companion .prj file.</p> <p>Breakline elevations will use the same coordinate reference system (horizontal and vertical) and units as the LiDAR point delivery.</p> <p>Breakline delivery may be as a continuous layer or in tiles, at the discretion of the data producer. Tiled deliveries must edge-match seamlessly in both the horizontal and vertical.</p> <p>Hydro-flattening refers to DRAFT USGS Base LiDAR Specification Version 13. The intent of these breaklines is to accurately depict water feature surfaces having a continuous surface elevation.</p>
Intensity image	<p>Raster image of 1st-return intensity GeoTIFF, 1 m pixel size in 1/4th USGS 7.5-minute quadrangle (3.75 minute by 3.75 minute) tiles. Intensity images (return signal strength in native radiometric resolution for first return) should typically contain Dn values ranging from 0-100 or greater for 80% of areas with diverse land cover conditions. Intensity images must have the projection parameters defined.</p>
Formal metadata	<p>FGDC compliant, tile level metadata for tiled products and project level metadata for non-tiled datasets.</p>

File Naming Convention. i.e.  
 USGS Quarter Quad:  
 "360125\_3\_C" Sample  
 naming system:

USGS 7.5 min Quad:

360125



File Name Prefix:

360125\_3\_C

### Usability

- Files shall conform to the specified File Naming Convention outlined above. (USGS Quad, Quarter-Quad and Quarter-Quarter-Quad Codes)
- Files shall have consistent internal formats
- Files may be gzip or zip compressed. Use of compression shall be uniform across a given data layer
- Contractor shall propose file-naming schemes and all details of file formats that are not specified here. Proposed naming schemes and formats must be approved by contracting agency
- Ancillary geographic feature data represented as vector data types (ESRI grids, shapefiles) shall have complete and correct associated projection files
- All files must be readable

### Intellectual Property Rights

The contracting agency shall have unrestricted rights to all delivered reports and data. The contracting agency expects to place reports and data in the public domain.

## **LiDAR Categories of the State and Areas of Interest (AOI)**

The specifications for this Statement of Work are divided into four general categories: Urban, Coastal, Flood/Soils, and Forest. A generalized map of the state is provided for reference below and depicts the specifications generally intended to be applied in the respective areas.

Urban collections are established to allow for greater point densities that can support greater detail and additional derivative products and deliverables. Similarly, the Forest type is defined to support additional point densities to increase canopy penetration as well as potentially support studies of the canopy point class as a separate 3D feature. The coastal category is associated with specifications that are intended to provide greater accuracies in low relief areas subject to coastal storms and hurricanes. The Flood/Soils class is designed to allow for data that supports flood mapping as well as soil surveys.

All of the areas identified are expected to support detailed flood mapping. Far West Texas and the Panhandle are unspecified at this time due to the availability of technologies other than LiDAR to produce elevation data intended for inclusion into the state elevation data set. AOIs for LiDAR may be identified in this region as opportunities and requirements arise.

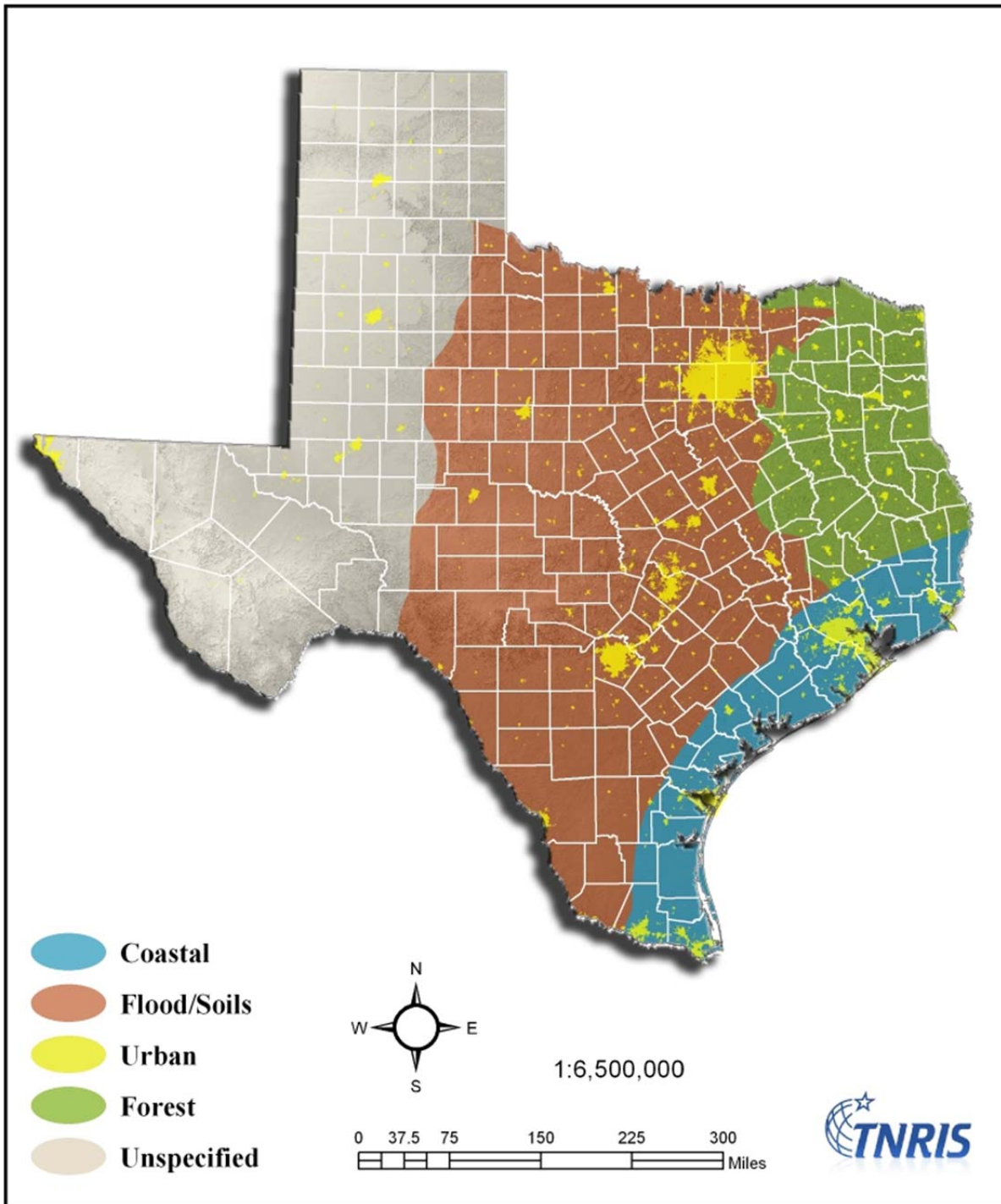
This Statement of Work establishes areas of interests defined by USGS quarter-quarter quadrangle grids.

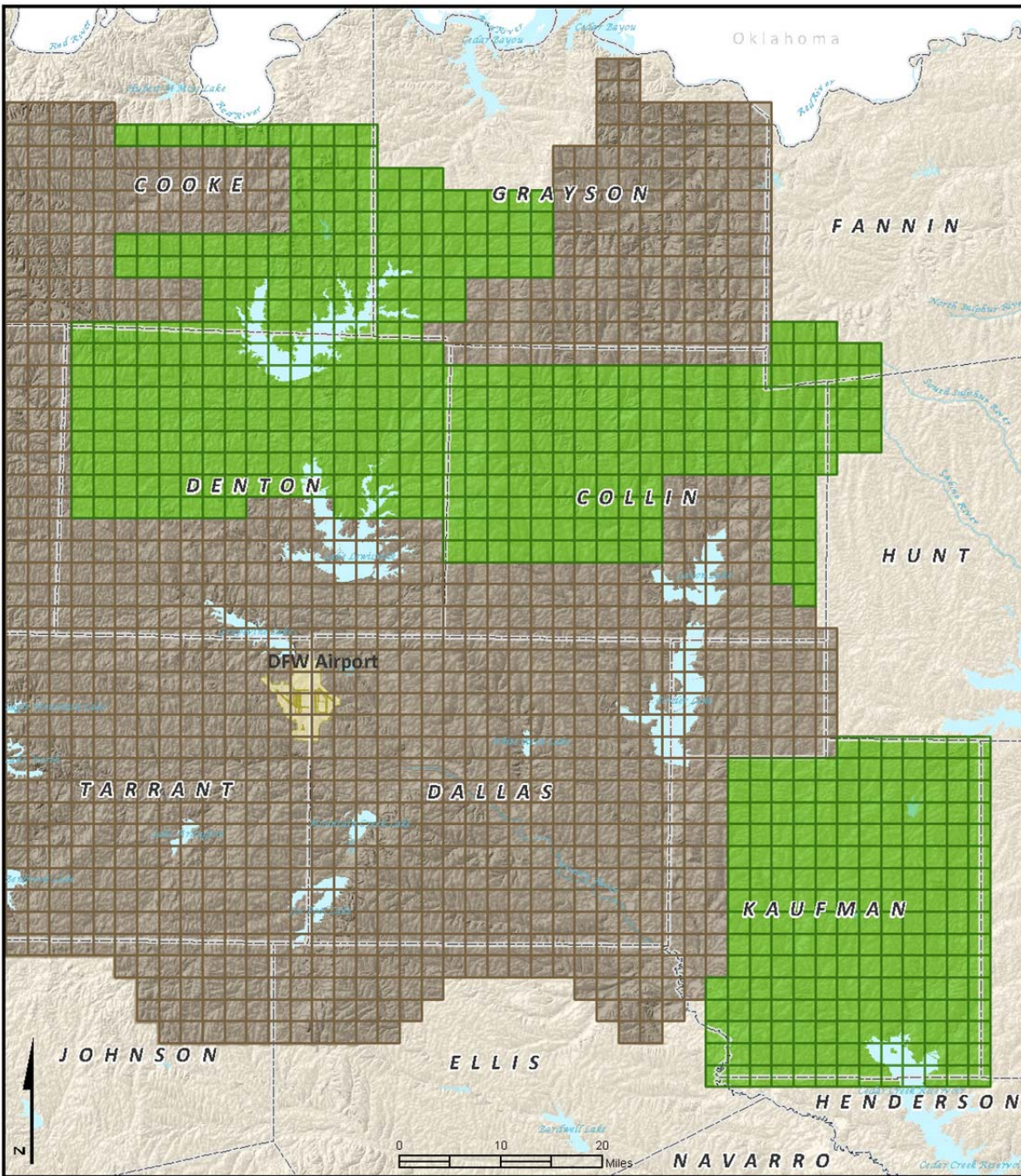
AOIs are selected based on overlaying county boundaries, 12-digit hydrologic units from the National Watershed Boundary Dataset, and urban classes from the National Land Cover Dataset. The detailed definition of each quad unit may change due to local requirements and additional derivative products determined prior to the start of an AOI project. The final project grid will be based on project funding, coverage of desired hydrographic features, and flight planning efficiencies.

The potential project areas are defined by the contiguous grid cells defined in the individual area of interest map(s). The number of 16th quads is summarized in the text below the map for each AOI.

In the summary text, the predominant general category is also described. This should be used as a guide for defining work for individual AOIs. Respondents may select AOIs in any number and arrangement they see fit.

# Texas LiDAR Categories





**Denton/Collin High Resolution Elevation Acquisition  
Area of Interest (AOI)**

HPIDS  
RFQ 580-11-0916

- Existing LiDAR Coverage
- AOI - 2373 Square Miles  
608 DO3Q

