The State of Utah, Department of Technology Services, Division of Integrated Technology, Automated Geographic Reference Center (AGRC) and partners are contracting with Watershed Sciences, Inc. to acquire, process, and deliver LiDAR data and derivative products that meet the specifications described in this Scope of Work.

**1. Scope of Work**

This Scope of Work (SOW) identifies the specific acquisition requirements, production specifications and standards, deliverables, and delivery schedule for LiDAR data collection and derivative data products that adhere to U. S. Geological Survey (USGS) Quality Level 1 LiDAR specifications and deliverables for the entire area defined in this agreement. The Lidar will be acquired in the Fall of 2013 with leaf-off conditions and no snow on the ground. Pricing will be based on the cost per square mile as submitted in the bid response to Solicitation # JP14002 by Watershed Sciences, Inc.

**2. Project Area and Acquisition Modifications**

**2.1** Project area: The project area is 1,352 square miles along the Wasatch Front geographic area in the greater Salt Lake County, greater Utah County, and areas along the Wasatch Fault in Sanpete County, Juab County, Davis County, Weber County, Box Elder County and Southern Idaho (Oneida County) as shown in Attachment C.

**2.2** Acquisition modifications:Any additional LiDAR data acquisitions to the project area, or any change in the project area, by either the State of Utah or the other cooperators, as part of this project, will adhere to the data deliverables, standards, specifications criteria, and inspection process described in the contract and SOW. Any changes will be attached as amendments to the contract.

**3. Performance Period and Delivery Schedule**

**3.1** Performance Period: The intent is to acquire LiDAR in the Fall of 2013 that provides the best digital representation of ground surfaces and structures with minimal obstruction by tree, shrub foliage, or snow.  For the area in Attachment C, the acquisition shall be in the Fall of 2013 maximizing leaf-off conditions and no snow on the ground (i.e., late October and/or November). (see section 6.2 for guidance on acquisition collection conditions).

**3.2** Delivery Schedule

**3.2.1**  A formal schedule of delivery will be worked out between AGRC and the Contractor, Watershed Sciences, Inc.  This schedule will include a small (10 square mile) initial pilot delivery as described in section 8.1 (selected from the area in Attachment C) to ensure that data meets the specifications and conditions included in this SOW and the final contract.  The pilot delivery area will be selected based on an agreement between the Contractor and AGRC.  AGRC and the USGS National Geospatial Technical Operations Center (NGTOC) will have 15-calendar days to review the pilot data delivery and return comments to the Contractor.

**3.2.2**  An inspection schedule for quality assurance of all products will be developed between the Contractor and AGRC.  The Contractor shall document its internal quality assurance work as described in section 5.3. AGRC will coordinate the quality assurance inspections, which will be done by two AGRC representatives.  The USGS shall inspect the LiDAR deliverables for AGRC and the LiDAR Project Steering Committee shall designate a review committee to also quality check the LiDAR products for AGRC.  The inspection period for each product delivery will be up to 60-calendar days; these inspection periods may be concurrent.  Review of any redelivery of data with corrections will be completed within 30-calendar days of receipt.  The delivery of final LiDAR products for the area in Attachment C shall be no later than May 31, 2014. Deliveries will be made to AGRC Project Manager.

**3.2.3** Data acquisition contingency. The Fall 2013 collection conditions may necessitate the possibility, due to early snowfall or other natural circumstances, a Spring 2014 acquisition by the Contractor. If this situation occurs, AGRC will work with the Contractor to facilitate the earliest Spring acquisition based on the collection conditions in section 6.2.

**4. Distinct Needs and Requirements**

**4.1**  The Contractor is responsible for applying for and obtaining all required permits, clearances, permissions, etc. for access, over-flight, or intrusion to restricted or otherwise limited ground access and/or airspace, which may be included within the requirements of this project.

**4.2**  The Contractor must tailor all metadata to accurately document positional reliability, source, and data currency.  See section 5.2 for more details on metadata requirements.

**4.3** The Contractor must acquire, process, and deliver Lidar to the requirements and specifications outlined in this SOW.

**4.4**  The Contractor is encouraged to deliver the Lidar and derivatives, adhering to the specifications herein, that are acceptable the first time to avoid re-deliveries and repeated Quality Assurance (QA) procedures by the AGRC and the USGS NGTOC.

**5. Data Processing, Handling, and Deliverables**

**5.1** Data Processing and Handling. See the USGS National Geospatial Program (NGP) *Lidar Base Specifications Version 1.0* (USGS, 2012) (<http://pubs.usgs.gov/tm/11b4/>) “Data Processing and Handling” section (pages #5-7) for requirements on the processing and handling of the LiDAR data.

**5.2** Metadata. Descriptive information about the project to include textual reports, graphics, supporting shapefiles, and Federal Geographic Data Committee (FGDC) compliant metadata files are required. See *National Spatial Data Infrastructure (NSDI) Content Standards for Digital Geospatial Metadata (FGDC, 1998) and Lidar Base Specifications Version 1.0* (USGS, 2012) “Metadata” section (pages #9-10) for metadata requirements for this project.

**5.3** Contractor’s Project History Report/Folder. The Contractor will compile and provide a Project History Report/Folder upon conclusion of the LiDAR acquisition. This folder will be used by the USGS in the final inspection process (see section 8). The report/folder, submitted in either *.pdf* and/or *.doc* format, will contain, at a minimum, the following:

* + The negotiated Statement of Work (SOW) between AGRC and the Contractor.
  + All production guidance received from AGRC to include all written guidance from telephone conferences, emails, or contractual modifications, or any other source.
  + LiDAR acquisition methods, results, Contractor's accuracy assessments, including internal reproducibility and absolute accuracy, file formats, file-naming schemes, and tiling schemes.
  + All internal quality control checklists.
  + Internal quality control error calls and the corrective actions taken to correct the error(s).
  + All Contractor quality assurance (QA) validation reports/error reports and accuracy reports, generated from internal software QA programs demonstrating that the data meets requirements as stated in the SOW.
* The documentation for the identity, published position, and measured position of all existing National Geodetic Survey (NGS) marks used for reference stations (see section 7.8.2).

**5.4** Aircraft trajectories (SBET (smooth, best, estimated trajectory) files). Aircraft position (easting, northing, elevation), angles and rotations (heading, pitch, and roll) and GPS time recorded at regular intervals of ≤ 1 second. May include additional attributes (*ASCII text or shape file + .dbf format*). This information will be retained and included as part of the Contractor’s Project History Report/Folder as described in the preceding section.

**5.5** Raw Point Cloud. Delivery of the raw point cloud is a standard requirement for the USGS NGP LiDAR projects. Raw point cloud deliverables include the following items:

* + All swaths, returns, and collected points, fully calibrated and adjusted to ground, by swath.
  + Fully compliant LASer (LAS) file format v1.3, Point Data Record Format 1, 3, 4, or 5.
* LAS v1.3 deliverables with waveform data are to use external auxiliary files with the extension *.wdp* for the storage of waveform packet data. See the *LAS Specification v1.3* for additional information (American Society for Photogrammetry and Remote Sensing (ASPRS), 2009).
  + Correct and properly formatted georeference information must be included in all LAS file headers.
  + Global Positioning System (GPS) times are to be recorded as Adjusted GPS Time, at a precision sufficient to allow unique timestamps for each pulse. Adjusted GPS Time is defined to be Standard (or satellite) GPS time minus 1\*109. See the *LAS Specification v1.3* for more detail (ASPRS, 2009).
  + Intensity values (native radiometric resolution).
* One file per swath, one swath per file, file size not to exceed 2 gigabytes (GB), as described in the “Swath Size and Segmentation” section (page 6) of the *Lidar Base Specifications Version 1.0* (USGS, 2012).
* Vertical accuracy of the LiDAR point data will be assessed and reported in accordance with the guidelines developed by the National Digital Elevation Program (NDEP) and subsequently adopted by the ASPRS. The complete guidelines are in section 1.5.1.1 “Vertical Accuracy” of the *NDEP Guidelines for Digital Elevation Data* (NDEP, 2004).
* Vertical accuracy requirements using the NDEP/ASPRS methodology for the point cloud are Fundamental Vertical Accuracy (FVA) ≤ 18.1 centimeter (cm) Accuracy (ACCz), 95% confidence level (9.25 cm Root Mean Square Error (RMSEz)).

**5.6** Classified Point Cloud. Delivery of a classified point cloud is a standard requirement for USGS NGP LiDAR projects. Classified point cloud deliverables include the following items:

* All project swaths, returns, and collected points, fully calibrated, adjusted to ground, and classified, by tiles (see section 5.10 for Project Tiling Scheme). Project swaths exclude calibration swaths, cross-ties, and other swaths not used, or intended to be used, in product generation.
* Fully compliant LAS v1.3, Point Data Record Format 1, 3, 4, or 5.
* LAS v1.3 deliverables with waveform data are to use external auxiliary files with the extension *.wdp* for the storage of waveform packet data. See *LAS Specification Version 1.3* (ASPRS, 2009) for additional information.
* Correct and properly formatted georeference information must be included in all LAS file headers.
* GPS times are to be recorded as Adjusted GPS Time, at a precision sufficient to allow unique timestamps for each pulse.
* Intensity values (native radiometric resolution).
* Tiled delivery, without overlap, using Project Tiling Scheme (section 5.10).
* No overlap points coded as class 12.
* Classification Scheme (minimum) as listed in the following ‘Minimum Classified Point Cloud Classification Scheme’ table:

|  |  |
| --- | --- |
| **Code/Class** | **Description** |
| 1 | Processed, but unclassified |
| 2 | Bare-earth ground |
| 7a | Noise (low or high; manually identified; if needed) |
| 9 | Water |
| 10b | Ignored Ground (Breakline proximity) |
| 11 | Withheld (if the Withheld bit is not implemented in processing software) |

aClass 7, Noise, is included as an adjunct to the Withheld bit. All noise points are to be identified using one of these two methods.

bClass 10, Ignored Ground, is 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.

* No more than 0.5% of points in any 1 km x 1 km area possess a demonstrably erroneous classification value.

**5.7** Bare-Earth Surface (Raster Digital Elevation Model (DEM)): Delivery of a bare-earth Digital Elevation Model is a standard requirement for USGS LiDAR projects. Bare-earth deliverables will include the following:

* Bare-earth DEM with hydro-flattening (see section 5.7.1 Hydro-Flattened DEMs).
* Cell size no greater than 0.5 meters and no less than the design Nominal Pulse Spacing (NPS).
* Delivery in an industry-standard, GIS-compatible, 32-bit floating point raster format (ERDAS *.img* preferred).
* Georeference information shall be included in each raster file.
* Tiled delivery, without overlap.
* DEM tiles will show no edge artifacts or mismatch. A quilted appearance in the overall project DEM surface, whether caused by differences in processing quality or character between tiles, swaths, lifts, or other non-natural divisions, will be cause for rejection of the entire deliverable.
* Void areas shall be coded using a unique ‘NODATA’ value. This value shall be identified in the appropriate location within the raster file header or external support files (for example, *.aux*).
* Vertical accuracy (RMSEz) of the bare-earth surface will be assessed and reported in accordance with the guidelines developed by the NDEP and subsequently adopted by the ASPRS. The complete guidelines are in section “1.5.1.1 Vertical Accuracy” of the *NDEP Guidelines for Digital Elevation Data* (NDEP, 2004).
* The following thresholds represent the minimum vertical accuracy requirements using the NDEP/ASPRS methodology:
  + - FVA ≤ 18.1 cm ACCz, 95% Confidence Level (9.25 cm RMSEz)
    - Consolidated Vertical Accuracy (CVA) ≤ 26.9 cm, 95th percentile
    - Supplemental Vertical Accuracy (SVA) ≤ 26.9 cm, 95th percentile
    - All Quality Assurance/Quality Control (QA/QC) analysis materials and results are to be delivered to AGRC.
    - Depressions (sinks), natural or man-made, are not to be filled (as in hydro-conditioning).

**5.7.1** Hydro-Flattened DEMs. The NED requires a hydro-flattened ‘topographic’ bare-earth elevation surface, i.e. a grid of bare-earth elevations (z-values) at regularly spaced intervals where water bodies (lake and ponds) are leveled and streams and rivers are conditioned for continuous downhill flow.

**5.7.1.1** Requirements. The methodology used for hydro-flattening is at the discretion of the contractor, but needs to meet the following requirements (See the “Hydro-Flattening” section and Appendices 2 “Guidelines” and 3 “Hydro-Flattening Reference” in the USGS *Lidar Base Specifications Version 1.0*  for detailed discussions concerning hydro-flattening):

* All polygon water bodies (lakes & reservoirs > 2 acres, wide streams > 100 ft. across) flattened to give a pleasing aesthetic appearance.
  + - Water bodies (ponds and lakes), wide streams and rivers (double-line), and other non-tidal water bodies as defined in the *Lidar Base Specifications Version 1.0* (USGS, 2012) “Hydro-Flattening” section (pages 7-9) are to be hydro-flattened within the DEM.
    - Hydro-flattening applied to all water impoundments, natural or man-made, that are larger than 2 acres in area (approximately equal to a round pond 350 feet in diameter), to all streams that are nominally wider than 100 feet, and to all non-tidal boundary waters bordering the project area regardless of size.
* The bare-earth DEM data should keep intact all road culverts and similar features, regardless of size, defined as having earth between the road surface and the top of the structure.

**5.7.2** Breaklines. All breaklines used for hydro-flattening are to be delivered in a shapefile and/or geodatabase format as specified in this SOW. See *Lidar Base Specifications Version 1.0* (USGS, 2012) “Breaklines” section (page 12) for breakline requirements.

**5.8** First return surface model. Raster of first returns (e.g., highest hit), including 0.5 m grid (*ESRI grid format*).

**5.9** Intensity images. 0.5 m resolution orthorectified intensity images (*GeoTIFF format*).

**5.10** Project Tiling Scheme. A single non-overlapped tiling scheme will be established and agreed upon by AGRC, the Contractor, and the USGS before collection. This scheme will be used for ALL tiled deliverables.

* Tile size is required to be an integer multiple of the cell size of raster deliverables.
* Tiles are required to be sized using the same units as the coordinate system of the data.
* Tiles are required to be indexed in X and Y to an integer multiple of the tile’s X-Y dimensions.
* All tiled deliverables will conform to the Project Tiling Scheme, without added overlap.
* Tiled deliverables will edge-match seamlessly and without gaps.

**5.10.1** Tiling for the LiDAR deliverables will bebased on the U.S. National Grid (FGDC, 2001) and should be named according to the U.S. National Grid System based on SW corner. Tiles shall be 2,000 meter x 2,000 meter tiles with the exception of tiles around the periphery of the project area that are better suited for 1,000 meter x 1,000 meter tiles. 1,000 meter x 1,000 meter tiles shall also be used for the .las point cloud files.

**5.10.2** Tiles split by project boundary shall be completed to their full extent. **The extent of LiDAR coverage over the project area shall be sufficient to ensure void areas do not exist within the project area.  Void areas within tiles and within the project area are not acceptable.**

**5.11** Delivery Medium and Format. Deliverables shall be delivered on USB 2 compatible portable (removable) hard drives. Delivery tiles shall be accompanied by an index shapefile, of the tiles delivered, suitable for loading into ArcMap v10 or later.

**5.12** Additional deliverable requirements.

* All data and products associated with contract deliverables will meet or exceed relevant National Standard for Spatial Data Accuracy (NSSDA) standards. See *NSDI Geospatial Positioning Accuracy Standards, Part 3: National Standard for Spatial Data Accuracy* (FGDC, 1998).
* At the completion of the project, after all deliverables have been accepted by AGRC and USGS, the Contractor will deliver hard drives containing all the finalized deliverables for the project.

**6. Data Acquisition Requirements and Collection Conditions**

The following acquisition requirements and collection conditions apply to the project area:

**6.1** Acquisition requirements.

* Returns per pulse: Multiple returns (≥3), including 1st and last returns.
* On-ground laser beam diameter: ≤ 20 cm.
* Scan angle: ≤ ± 20º from nadir. Scan angle will support horizontal and vertical accuracy within the requirements as specified below.
* Swath overlap: ≥ 50% side-lap for adjoining swaths (to achieve full double coverage). See section 7.4 below.
* GPS procedures: See section 7.8 below.

**6.2** Collection conditions.

* Acquisition shall take place in driest part of season to minimize potential for standing water interfering with quality of acquisition.
* Ground conditions must be snow free.
* Water conditions must be free of any unusual flooding or inundation.
* Leaf-off (i.e., late October and/or November).
* Atmospheric conditions must be cloud and fog-free between the aircraft and ground during all collection operations.

**6.3** Additional data acquisition requirements.

* Instrument calibrated for every mission.
* Flight plans are parallel flight lines with a cross-tie at/and or near the end of each project flightlines.

## Flight plan considers requirements for point density, terrain, PDOP (positional dilution of position), and Geomagnetic Kp Index (see <http://www-app3.gfz-potsdam.de/kp_index/description.html>).

* The intensity values (signal strength) of each return pulse will be recorded in the LAS files, in their native radiometric resolution.
* In order to prevent clustering effects and ensure uniform densities throughout the data set, a regular 1 meter x 1 meter grid will be laid over the data. At least 90% of the cells in the grid shall contain the requisite number of points per square meter (ppsm).
* The strength of the laser/sensitivity of the receiver will be sufficient to capture buildings with tar and/or pitch roofs.

#### **7. Standards, Specifications, and Requirements**

#### The following standards and specifications apply to the LiDAR acquisition:

**7.1** Quality Level 1 specifications:

* 1st return pulse density: 8 points/square meter (see section 7.4 for single swath overlap requirements).
* Nominal 1st return pulse spacing: 0.35 m.
* DEM post spacing: 0.5 m DEM post spacing.
* RMSEz: 9.25 cm (see section 7.2 below).
* Supporting contour accuracy: 1-foot.

**7.2** Accuracy.

* Vertical Accuracy Requirements: LiDAR collected under this project shall meet or exceed these vertical accuracies. Assessment procedures shall comply with NDEP guidelines.
* RMSEz = 9.25 cm.
* FVA = 18.1 cm 95% Confidence Level (Required Accuracy).
* CVA = 26.9 cm 95th Percentile (Required Accuracy).
* SVA = 26.9 cm 95th Percentile (Target Accuracy).
* Positional Accuracy Validation: the absolute and relative accuracy of the data, both horizontal and vertical, relative to known control points, shall be verified prior to classification and subsequent product development. A detailed report of this validation is a required deliverable.
* Relative Accuracy Requirements:
* Within any given swath, the relative accuracy shall be ≤ 5 cm Root Mean Square Difference (RMSDz).
* Between overlapping swaths, the relative accuracy shall be ≤ 7 cm RMSDz.

**7.3** Completeness (coverage).

* No voids within project area
* No voids between swaths.
* No voids because of cloud cover or instrument failure.
* No data voids due to system malfunctions or lack of overlap.
* For entire project area, ≥ 85% design aggregate pulse density.
  1. Single swath overlap requirements.
* 4 points / sq. meter single swath 1st return density.
* < 10% no-overlap (single coverage) area per project.
* No arbitrary 1 km x 1 km square with ≥ 20% no-overlap area.
* 4 points / sq. meter single swath 1st return density using double coverage to achieve an aggregate 8 points / sq. meter.
* Within any 30 m x 30 m area within areas of swath overlap, ≥ 60% design pulse density.
* 50+% side lap.

**7.5** Projection and mapping units.

* Projection (Coordinate System). Universal Transverse Mercator (UTM) zone 12.
* Mapping Units. Meters (UTM).

**7.6** Datums. All data collected must be tied to the datums listed below:

* Horizontal Datum. North American Datum of 1983 / High Accuracy Resolution Network adjustment (NAD83 / HARN) required.
* Vertical Datum. North American Vertical Datum 1988 (NAVD88), using latest geoid model available from the National Geodetic Survey (NGS) (e.g., GEOID12). All vertical units will be measured in meters.
* Geoid Model. The most recent NGS approved geoid model is required to perform conversions from ellipsoidal heights to orthometric heights.

**7.7** Usability.

* Files shall have consistent internal formats.
* Contractor shall propose all details of file names and file formats that are not specified here. Proposed names and formats must be approved by AGRC.
* Files may be gzip or zip compressed. Use of compression shall be uniform across a given data layer.
* GIS data (ESRI grids, shapefiles) shall have complete and correct associated projection files.
* All files must be readable and free of malicious code.

**7.8** GPS Procedures.

**7.8.1** All GPS measurements shall be made with dual frequency Global Navigation Satellite System (GNSS) receivers with GLONASS. All GPS measurements shall be made during periods with PDOP ≤ 3.0 and with at least six satellites in common view of both a stationary reference receiver and the roving receiver.

**7.8.2** Stationary reference receivers shall be located at existing NGS marks or at new marks. In the case of an existing mark, its location shall be verified by processing one GPS session of at least two hours duration and comparing the computed position with the position published by NGS. Each new mark shall be located by tying to one or more NGS Continuously Operating Reference Stations (CORS) by static GPS methods. If the distance to the nearest CORS is less than 80 km, use at least two independent GPS sessions, each at least two hours long. If the distance to the nearest CORS is greater than 80 km, use at least two sessions each at least four hours long.

**7.8.3** At least two GPS reference receivers shall be in operation during all LiDAR missions, sampling positions at ≥1 Hz. The roving GPS receiver in the aircraft shall sample positions at ≥ 2 Hz. Differential GPS baseline lengths shall be no longer than 30 km. Checkpoints, ground control points (GCPs), or ground survey points used for both survey calibration and assessment of absolute vertical accuracy (section 7.9), shall be established using GPS and (or) other techniques that are expected to result in accuracies of 1.5 cm (RMSEz) or better. Strongly clustered GCPs are useful, perhaps even desirable, for calibration. Vertical accuracy shall be assessed by calculating and averaging the distances between a subset of at least 30 GCPs that are not clustered and a surface interpolated from LiDAR first returns. At least 20% of flight line swaths should contain points in this subset and the maximum distance between these GCPs should be no less than one-half the maximum distance across the survey area.

**7.8.4** The Contractor’s Project History Report/Folder (section 5.3) shall document the identity, published position, and measured position of all existing NGS marks used for reference stations. The locations of new marks shall be described, along with their measured positions and the identity and published positions of CORS to which their locations were tied. The report shall describe the technique(s) used to establish GCPs and document the positions and residuals of all GCPs used to evaluate survey accuracy.

**7.9** Ground Control Points. Two types of fundamental vertical accuracy GCP (or ground surveyed points) will be collected by the Contractor for this project: control points and checkpoints.

**7.9.1** Control points. The following requirements and guidelines pertain to control points:

* Minimum twenty (20) in each land cover class in the project area. The following three (3) land cover classes have been identified in the project area for the control points:

Brush lands and low trees (predominant land cover class in the project area, do not use Medium vegetation).

Forested areas fully covered by trees.

Urban areas with dense man-made structures.

Therefore, total minimum control points for the entire project area is sixty (60).

* Points in each land cover class are to be uniformly dispersed and proportionally collected.

**7.9.2** Checkpoints. An additional minimum of twenty (20) ‘hard surface’ checkpoints will be collected for the project area using the following criteria:

Checkpoints should be located only in open terrain (sand, rock, dirt, asphalt, concrete, etc.) where there is a high probability that the sensor will have detected the ground surface without influence from surrounding vegetation or other above ground structures (i.e. powerlines, buildings, etc.).

* The checkpoint accuracy shall satisfy a local network accuracy of 5 cm at the 95% confidence level.
* Checkpoints shall not be incorporated into the contractor’s vertical solution.

**7.9.3** Ground control validation. The above two types of ground control will be separately labeled and delivered in a shapefile format to AGRC that will be forwarded to NGTOC for the lidar data validation process (section 8). This labeling expedites the NGTOC inspection process.

**Note**: See NSSDA guidelines, *Lidar Base Specifications Version 1.0* (USGS, 2012) “Collection” section (pages 3-4), and *ASPRS Guidelines, Vertical Accuracy Reporting for Lidar Data* (ASPRS, 2004) “2.3 Selecting and Collecting Checkpoints” section (pages 7-11) for checkpoint placement in land cover classes and guidelines on checkpoints.

**7.10** Supplemental ground control. Differentially corrected or real time GPS Network (RTK) GPS ground control used to supplement the airborne GPS positional adjustment shall be stored on portable media, in a non-proprietary format mutually agreeable to AGRC and the Contractor. Ground control is the responsibility of the Contractor.

**7.10.1** AGRC has a database of ground control points, collected in 2006, and will provide it to the Contractor for possible use upon request. This control is provided as a convenience to the Contractor and AGRC is in no way responsible or liable for the quality of the ground control points or the application of the control to the production of the project deliverables.

**7.10.2** AGRC maintains The Utah Reference Network of over 60 GPS Virtual Reference Stations (VRS) RTK stations and will facilitate use of this network upon request of the Contractor.

**7.11** Federal Emergency Management Agency (FEMA) (Risk MAP). LiDAR data acquired for this project will be utilized for future Risk Map projects by both the Utah Division of Emergency Management (UDEM) and FEMA. While FEMA’s LiDAR acquisition requirements are aligned with USGS specifications, as noted in this SOW, FEMA *Procedure Memorandum No. 61* (FEMA, 2010), will also be referred to for requirements and guidance for the project’s LiDAR acquisition.

**8. Inspection Process and Schedule, Quality Assessment and Acceptance**

There are three parts to the inspection, quality assessment, and acceptance process of the Contractor acquired LiDAR data: (1) pilot dataset delivery, (2) initial review and inspection of the LiDAR data by AGRC, and (3) NGTOC inspection, quality assessment, and final acceptance. All three parts will be coordinated by AGRC with the Contractor and NGTOC. The following sections explain each part:

**8.1** Preliminary pilot delivery. The Contractor will deliver a small pilot dataset to AGRC and NGTOC no later than 30-calendar days after completing the project’s area LiDAR acquisition. This pilot delivery will be a 10 square mile block of data as determined by AGRC and the Contractor. The purpose of this preliminary dataset is to ensure that the Contractor is capable of acquiring, processing, and then delivering LiDAR data as specified (sections 5, 6, and 7) in this SOW. This review will provide early feedback to the Contractor on any issues regarding the results of their acquisition and data processing.  The intent is that the pilot area review be completed before processing of the rest of the acquired LiDAR commences. To facilitate the quick review, the pilot delivery should be sent to both AGRC and NGTOC. AGRC and NGTOC will have 15-calendar days to respond back to the Contractor with feedback about the pilot delivery.

**8.2** AGRC initial inspection. After the pilot dataset has been approved by AGRC and NGTOC, the regular inspection process begins. AGRC will conduct the initial assessment (quality control) of the acquired LiDAR prior to delivery to NGTOC for inspection.

**8.3** NGTOC inspection process and schedule. The USGS inspection process begins upon delivery of the first LiDAR data block from AGRC to NGTOC.

**8.3.1** NGTOC will have 60-calendar days for the initial review of the files and return any files requiring corrections to AGRC to forward to the Contractor.

**8.3.2** The Contractor will redeliver data with corrections within 10-working days unless AGRC and the Contractor agree on a modification to this schedule.

**8.3.3** Review of the redelivery of data will be completed by USGS within 30-calendar days of receipt.

**8.3.4** If it is not possible to rework the data to correct error(s), a reflight of that area may be required.

**9. Data Release, Data Use and Distribution Rights**

**9.1** Data release. The Contractor will not release data produced as described in this SOW, to any other party or entity prior to the geodatabase processing, loading, incorporation, and USGS acceptance procedure.

**9.2** Data use and distribution rights. After final acceptance has been made, all deliverable data and documentation will be free from restrictions regarding use and distribution (the USGS requires unrestricted rights to all delivered data and reports that are placed in the public domain). Data and documentation provided under this SOW shall be in the public domain and freely distributable by Federal, State, and local government agencies.

**10. Contact List**

|  |  |  |  |
| --- | --- | --- | --- |
| **AGENCY** | **CONTACT POSITION** | **PHONE NUMBER** | **EMAIL** |

ADMINISTRATIVE

|  |  |  |  |
| --- | --- | --- | --- |
| Utah AGRC | Bert Granberg  *Director* | 801-538-3163 | bgranberg@utah.gov |

PROJECT MANAGER

|  |  |  |  |
| --- | --- | --- | --- |
| Utah AGRC | Rick Kelson | 801-538-3237 | rkelson@utah.gov |

**11.  Project Communication**

**11.1**  Production Status Reports:  The Contractor will submit, via e-mail to AGRC Project Manager, weekly status reports for all work on the project.  Reports will include detailed information regarding the work accomplished for each production phase.  An online website may be used to provide status information.

**11.2**  An initial project meeting between AGRC and the Contractor will be scheduled after the award of the successful bid.  This meeting will ensure that both AGRC and the Contractor 1) understand the requirements to produce the deliverables, 2) review source data, and 3) make any final adjustments to technical guidance.

**11.3**  The Contractor is encouraged to teleconference regularly (weekly or as needed) with AGRC to discuss status, production, and technical issues.

**12.  Delivery Date and Timely Completion**

**12.1** AGRC and the Contractor will agree in writing to a delivery schedule for LiDAR products. Delivery date for all final LiDAR products, including any redeliveries because of quality assurance rejection, is no later than May 31, 2014. The Contractor shall not exceed this date without written agreement to a new date from AGRC. Any request for modifications of the final delivery date must be received 30 days prior to the expiration of the original date. Request will only be considered for reasons such as events outside the Contractor’s control.

**12.2** The payment schedule shall include penalties for late delivery of products.  The payment schedule will be based on 40% of the total project cost after completion of the LiDAR acquisition flights. After the completion of processing and corrections based on the quality assurance review by the LiDAR Steering Committee review group and the USGS, and delivery of the final product(s) to AGRC, payment will be made as follows.  If delivered on time as specified in the contract, another 30% of the total project cost will be paid.  There will be a 30% holdback that will be paid after that final delivery of all data and required reports and metadata deliveries are confirmed by AGRC.  If the final product(s) is not delivered on the schedule specified, there will be a 3% (of the total bid) penalty for each week the product delivery is delayed.

**13. List of Cited Specifications and Standards**

|  |  |  |  |
| --- | --- | --- | --- |
| **PROPONENT AGENCY / ORGANIZATION** | **NAME** | **PUBLISHED DATE** | **WEBSITE** |
| American Society for Photogrammetry and Remote Sensing (ASPRS) | *LAS Specification Version 1.3* | July 2009 | http://www.asprs.org/a/society/committees/standards/asprs\_las\_spec\_v13.pdf |
| US Geological Survey, National Geospatial Program (USGS NGP) | *Lidar Base Specifications Version 1.0* | 2012 | http://pubs.usgs.gov/tm/11b4/ |
| Federal Geographic Data Committee (FGDC) | *National Spatial Data Infrastructure (NSDI) Geospatial Positioning Accuracy Standards, Part 3: National Standard for Spatial Data Accuracy* | 1998 | http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/ part3/chapter3 |
| National Digital Elevation Program (NDEP) | *NDEP Guidelines for Digital Elevation Data* | May 2004 | http://www.ndep.gov/NDEP\_Elevation\_Guidelines\_Ver1\_10May2004.pdf |
| FGDC | *NSDI Content Standard for Digital Geospatial Metadata* | 1998 | http://www.fgdc.gov/standards/projects/FGDC-standards-projects/metadata/ base-metadata/v2\_0698.pdf |
| Federal Emergency Management Agency (FEMA) | *Procedure Memorandum No. 61* | 2010 | http://www.fema.gov/library/viewRecord.do?id=4345 |
| FGDC | *United States National Grid* | December 2001 | http://www.fgdc.gov/standards/projects/FGDC-standards-projects/usng/fgdc\_std\_011\_2001\_usng.pdf |

**13. Pricing**

Pricing is based on the cost of $377 per square mile, for a 1,100 to 1,399 square mile project area, submitted in the Utah LiDAR Proposal 2013 Price Matrix in the bid response to Solicitation # JP14002.