APPENDIX G

SCOPE OF WORK
Contractor
Contract #
Santa Clara Pueblo & Vicinity, New Mexico
Aerial Lidar & Digital Orthophotography Data Collection

Background and Project Information
The USACE Albuquerque District requires high resolution aerial lidar collection of Santa Clara Pueblo, New Mexico and the vicinity extending one (1) mile in all directions from the Pueblo's boundary. The data is to be acquired during the spring of 2015. The project will include the collection and processing of 10-cm Vertical Accuracy Class LiDAR data in LAS format as well as a combination of raster digital elevation models and additional hydrographic breaklines and also four (4) band digital orthophotography. The acquired LiDAR and digital orthophotography will be used for various planning, design, research and mapping purposes.

The specifications outlined in this document will follow the USGS Lidar Base Specifications Version 1.2. The LiDAR vertical accuracy will be tested and is required to meet ASPRS/NDEP standards.

1 Lidar General Requirements

1.1 Project Area
As mentioned above the Area of Interest (AOI) encompasses the Pueblo of Santa Clara, and the vicinity extending one (1) mile in all directions from the Pueblo's boundary constituting approximately 153 square miles. See Attachment A. The government will furnish GIS shapefiles depicting the project area as well as primary points of contact.

All lidar collection will follow the project specifications outlined below.

1.2 Contractor Proposal & Project Initiation Plan
The Contractor shall base their proposal on the entire area. A detailed project plan must be submitted for approval within 7 days of receiving notice to proceed and prior to any data acquisition activities. The plan shall consist of the following:

- Schedule (data acquisition, data processing, data delivery).
- Project personnel with contact information of the project and field operation manager(s)
- Proposed flight lines in GIS and graphic format
- Base station locations in GIS and graphic format as well as supporting NGS control information

- Proposed baseline lengths for aerial collection
- Calibration testing methodology(s)
- LiDAR collection parameters (flying height, Scan FOV full angle, pulse rate, scanner frequency, side-lap percentage, point density etc.)
- Proposed acquisition windows including maximum PDOP values
- Description of internal verification quality control processes;
  - Data validation
  - Pre-processing and accuracy check
  - Processing quality control
  - Product delivery quality control

1.3 LiDAR Data Acquisition Parameters

LiDAR data shall be collected using an approved fully calibrated system capable of collecting multiple echoes per pulse with a minimum of a first, last, and one intermediate return. The system must also be able to collect the intensity (LiDAR pulse signal strength) for each return signal.

1.3.1 Sensor Calibration

Full system calibration and routine maintenance should be up-to-date to ensure full functionality of the LiDAR system to meet and exceed project accuracies and requirements. Full calibration reports should be available if requested. Bore site calibrations shall be performed at the beginning and end of the project and as needed throughout the data collection period. Alternative testing methodologies may be used upon review and acceptance by the USACE St. Louis District POC prior to any data acquisition activities.

1.3.2 Acquisition Window and Constraints

LiDAR acquisition shall occur during leaf-off conditions in the spring of 2015. Prior consent will be required before the initial project data collection. Additionally 24 hour notice shall be given to the independent contractor POC by phone or email which is for information purposes only, not permission to proceed. Coordination between the LiDAR provider and the USACE Albuquerque district POC is required. Refer to Section 4.4 below for POCs for this coordination.

The acquisition area shall be free of snow with rivers remaining in their channels at near average heights. The contractor will coordinate will the Albuquerque District POC to insure conditions are favorable for the acquisition. Extraneous environmental conditions such as rain, fog or smoke shall be avoided.

The LiDAR provider shall ensure that the project area is fully and sufficiently covered with no data voids due to data holidays (i.e. gaps between flightlines) and/or from system malfunctions. Data voids in the bare-earth not caused by classification of geographic features shall not exceed

three times the point spacing. Data voids of this size are unacceptable and shall be sufficient reason to reject the entire sub-project dataset.

1.4 LiDAR Data Format

Mass point data shall be delivered in LAS files utilizing LAS specification version 1.2, containing all LAS items of point data record format 1. The header file should contain all system generated LAS items as defined in the Public Header Block and as a minimum must contain the "File Creation Year Day" and "File Creation Year" which will represent the final deliverable generated LAS date. The projection information for the point data must be specified in the Variable Length Record using the appropriate GeoTIFF tags.

The classification codes will follow the ASPRS Standard LiDAR Point Classes utilizing the following:

- Class 1 – Unclassified
- Class 2 – Ground
- Class 3 – Vegetation
- Class 8 – Model Key (Reduced Ground class dataset)
- Class 9 – Water
- Class 10 – Reserved
- Class 12 – Overlap points exceeding scan angles of +/- 20 degrees

Class 1 will be used for feature points that are not in Classes 2, 3, 5, 8, 9, 10, and 12.

Class 2 will be used for feature points that represent the bare-earth.

Class 3 will be used for feature points that represent vegetation. (1 meter and above Bare Earth).

Class 8 will be a reduced ground classification dataset (Can be used for generation of contours).

Class 9 will be used for feature points that represent water.

Class 10 will be reserved.

Class 12 Overlapping points between flight strips that exceed +/- 20 degrees scan angles

No points shall be deleted from the LAS file.

Bare-earth classification shall adhere to the follow specifications using both automated and manual filtering classification routines:

- 90% of artifacts classified
- 95% of outliers classified
- 97% of vegetation classified

Special attention must be applied to the classification process due to the geographic nature of the project area. Dense vegetation data voids must also be minimized by the automatic removal process and "over smoothing" due to aggressive classification must be avoided.

1.4.1 Lidar Check Points

The contractor shall collect check points for verification and ground truthing of the processed bare earth surface. The contractor shall collect a minimum of 30 (thirty) ground control survey points with 20 points selected in open terrain and 10 points in vegetated areas. The open terrain points shall be randomly selected throughout the project area. This will allow for an overall project comparison. These points shall be used as a ground truth comparison for the LIDAR data. Points shall not be taken on slopes greater than 10%. These ground truth points shall be compared to the bare earth surface (raw points) developed from the LIDAR data and the differences shall be published within the report of survey. Check points in open terrain should meet the 10 cm $RMSE_z$ requirement in order to achieve Non-vegetated Vertical Accuracy (NVA) of 19.6 cm at the 95% confidence level. The accuracy of the other land coverage types shall be reported according to ASPRS 2014 methodology which uses the 95th percentile testing method for all vegetated land cover categories in order to achieve Vegetated Vertical Accuracy (VVA) of 30 cm at the 95th percentile. These surveyed check points shall be withheld and **NOT** used as calibration points during the processing-production phases of this task order. The points collected will be used as verification only of the processed bare-earth LIDAR points. Any differences beyond the accuracy requirements will be discussed and resolved by the contractor.

The $RMSE_z$ shall be calculated as the square root of the average of the set of squared differences between the LiDAR data set coordinate values and QA/QC check point coordinate values from an independent source of higher accuracy. If the differences are normally distributed and average zero, 95 percent of any sufficiently large sample should be less than 1.96 times the $RMSE_z$ which equals the NVA statistic for the LiDAR dataset being tested.

1.4.2 Additional Breakline Specifications

The funding partners have requested additional requirements regarding breakline collection. Following the USGS Lidar Base Specification Version 1.2, it is required to change the minimum size of lakes-ponds collected from 2 acres to 1 acre. Additionally, 100 ft wide streams will be changed to a minimum of 50ft.

1.5 Ground Control

All surveys conducted under this project shall be referenced to National Geodetic Survey (NGS) control monuments in the National Spatial Reference System (NSRS) using appropriate horizontal and vertical control having published network accuracy values. Ideally check point surveys should utilize or tie into the same base station control monuments used for the aerial acquisition to eliminate the possibility of discrepancies between different control stations. Base station locations should be the "best" horizontal (second order or better) and vertical (third order or better) available and have a stability of "C" or better. In the event that no suitable base station monuments exist, new primary ground control will be required and shall conform to the Standards and Specifications for Geodetic Control Networks (1984), Federal Geodetic Control Committee (FGCC). Primary control monuments established with GPS shall meet or exceed NOS NGS-58 "Guidelines for Establishing GPS-Derived Ellipsoid Heights (Standards: 2 cm and 5 cm)" using the appropriate latest geoid model (Currently Geoid12a) and should be monumented to maintain stability. Ground control stations are expected to have a local network accuracy at the 95% confidence level of 2 cm horizontally and vertically. Sound geodetic principles should be applied when establishing new stations and must include the appropriate supporting documentation such as processing reports, minimally and constrained 3-D least squares adjustment, pictures of the station, etc.

For aerial acquisition, one base station capable of collecting dual frequency data at 1 Hz is required. Baseline lengths to achieve the desired accuracy should not exceed 25 miles. For quality control, forward and reverse processing of the trajectories should yield similar results and these comparisons should be made available if requested. Additionally other quality statistics from the airborne GPS/IMU processing such as DOP values, resolved ambiguity reports, accelerometer and gyro drift and scale factors etc. should be made available if requested.

1.6 Accuracy

1.6.1 Absolute Accuracy Testing and Reporting

The bare-earth LiDAR DTM will be tested using the ASPRS (2014) Positional Accuracy Standards for Digital Geospatial Data.

$Accuracy_r = RMSE_r$ X 1.7308, and $Accuracy_z = RMSE_z$ X 1.9600 = Non-vegetated Vertical Accuracy (NVA) at the 95% confidence level.

However the RMSE is only valid when the errors follow a normal distribution which may not always be the case with LiDAR data particularly in vegetated land cover categories. Therefore the data in vegetated areas will be tested using the ASPRS 2014 standards that mandate the use of Vegetated Vertical Accuracy (VVA) for all vegetated land cover categories combined, based on the 95th percentile of the absolute values of all errors in vegetated areas. Whereas the NVA is calculated at the 95 percent confidence level as a function of $RMSE_z$ x 1.96, VVA is calculated

at the 95th percentile, where 95% of elevations errors have elevation errors equal to or less that the 95th percentile.

The vertical accuracy of LiDAR data tested with the ASPRS 2014 method shall be documented by both of the following statements:

> Tested___(meters, feet) Non-vegetated Vertical Accuracy (NVA) at 95% confidence level in all open and non-vegetated land cover categories combined using $RMSE_z$ x 1.9600
>
> Tested___(meters, feet) Vegetated Vertical Accuracy (VVA) at 95th percentile in all vegetated land cover categories combined using the absolute value 95th percentile error.

It is the intent of the USACE to test the horizontal accuracy of LiDAR data if possible utilizing the intensity imagery and the full point cloud with intensity values. Consistent with ASPRS (2014) standards, for horizontal accuracy testing of LiDAR data sets, at least half of the NVA vertical check points should be located at the ends of paint stripes or other point features visible on the LiDAR intensity image, allowing them to double as horizontal check points. The ends of paint stripes on concrete or asphalt surfaces are normally visible on LiDAR intensity images, as are 90-degree corners of different reflectivity, e.g., a sidewalk corner adjoining a grass surface. It is the data provider's responsibility to establish appropriate methodologies, applicable to the technologies used, to either test of estimate the horizontal accuracy of LiDAR data consistent with procedures specified in the ASPRS (2014) Positional Accuracy Standards for Digital Geospatial Data (Appendix D of USACE EM 1110-1-1000, Photogrammetric and LiDAR Mapping).

When LiDAR intensity images identify the ends of paint stripes or other point features, horizontal accuracy testing can be performed in the same manner as horizontal accuracy testing of digital orthophotos or planimetric features.

Alternatively, as explained in Appendix D (paragraphs 7.10 and B.6 of Annex B) of USACE EM 1110-1-1000, Photogrammetric and LiDAR Mapping, the following formula provides an estimate for the horizontal accuracy for LiDAR data, assuming that flying altitude and manufacturer estimates for the accuracy of the GPS and IMU are known:

$$Lidar\ Horizontal\ Error\ (RMSE_r) = \sqrt{(GPS\ positional\ error)^2 + \left(\frac{\tan(IMU\ error)}{0.55894170}\ x\ flying\ altitude\right)^2}$$

The above formula considers flying altitude (in meters), GPS errors (radial, in cm), IMU errors (in decimal degrees) and other factors such as ranging and timing errors. For example, if the radial horizontal positional error of the GPS is assumed to be equal to 0.11314m (based on 0.08

m in either X or Y) and the IMU error is 0.00427 degree in roll, pitch and heading, per manufacturer specifications, the "produced to meet" horizontal accuracy of LiDAR data acquired from an altitude of 2,000 meters above mean terrain would have an $RMSE_r$ of 29 cm.

The horizontal accuracy of LiDAR data shall be documented by either of the following statements:

Tested ___(meters, feet) horizontal accuracy at 95% confidence level, or

Produced to meet___ (meters, feet) horizontal accuracy at 95% confidence level

1.6.2 Relative Accuracy

The vertical accuracy testing uses survey measurements at discrete locations to compute the errors which verify the absolute error. This coupled with relative accuracy (e.g. how one point fits relative to the next, and how one flight line fits relative to the adjacent line) defines the combined accuracy of the dataset. Data therefore should not have discontinuities between adjacent flight lines or corn rows of undulating elevations due to mismatches and sensor anomalies.

For datasets requiring a $RMSE_z$ of 10 cm, no offsets or cornrows should be greater than 16 cm.

Data exceeding these amounts may not cause the whole dataset to fail but may cause specific areas to be rejected.

1.7 Datums and Projections

The horizontal datum shall be referenced to NAD83 datum.

The vertical datum shall be referenced to the NAVD88 datum.

The Projection is New Mexico State Plane Central, units in survey feet with 2-decimal point precision.

1.8 Metadata and Reports

Metadata compliant with the Federal Geographic Data Committee's (FGDC) Content Standard for Digital Geospatial Metadata is required in extensible markup language (.xml) format. Metadata should be created on a project level deliverable.

Metadata shall include as a minimum the following sections;

- Identification Information

- Data quality information (this section will be updated after the quantitative assessment) and must include all process steps.
- Spatial Data Organization Information
- Spatial Reference Information
- Entity and Attribute Information
- Metadata Reference Information

Metadata fields shall also include as a minimum;

- Date of acquisitions
- System type and system collection parameters (flying height, Scan FOV full angle, pulse rate, scanner frequency, side-lap percentage, point density etc.)
- Nominal point density
- Calibration procedures
- Base station control information

Metadata may also be supplemented with projects reports where the report conveys additional information not suitable for metadata. If surveying to establish new stations was performed, a survey report is required.

1.9 Media and Data Ownership

All LiDAR data and supplemental products will be delivered on USB external hard drives and will become the property of the government. All media and data collected under this contract shall be the sole property of the Santa Clara Tribe and will be distributed selectively by Pueblo personnel. No restrictions shall be placed on the data by the LiDAR provider.

2 Project Specific Requirements

Resolution of LiDAR – 0.707 meter Nominal Pulse Spacing (NPS) minimum to achieve Nominal Pulse Density (NPD) of 2 points per square meter (ppsm) from a single swath. To prevent clustering effects and to ensure uniform densities through the dataset, generate a density grid from the data with cell size equal to the NPS times 2 (i.e., 1.414). Ensure that at least 90 percent of the cells in the 1.414 meter grid contain at least one LiDAR point.

Accuracy

> **Non-vegetated Vertical Accuracy (NVA) will meet or exceed 19.6 cm at the 95% confidence level based on 10 cm $RMSE_z$ in open terrain. This accuracy is suitable for generation of 1-foot contours, if required.**

Vegetated Vertical Accuracy (VVA) will meet or exceed 30 cm at the 95th percentile for all vegetated land cover categories combined.

If vegetation is so dense that the VVA specification cannot be satisfied, "low confidence areas" will be delivered as two-dimensional (2D) polygons based on guidance in section C.8, Low Confidence Polygons, of the ASPRS (2014) Positional Accuracy Standards for Digital Geospatial Data, a copy of which is at Appendix D of USACE EM 1110-1-1000, Photogrammetric and LiDAR Mapping.

Vertical accuracy should be tested by the LiDAR provider's internal check points for validation purposes but will be tested using vertical check points supplied by the partners of this project and performed by independent contractor to define the final vertical accuracy.

Horizontal accuracy will meet or exceed 0.6 m $RMSE_r$ ($Accuracy_r$ = 1.04 m at the 95% confidence level).

Data format – classified LAS as defined in the General Requirements. An intensity image in Imagine .img format, 8-bit dataset will be provided.

Digital Elevation Models – shall be created using an appropriate interpolation method to produce 2' (foot) resolution DEM's (with no null values). DEM's shall be referenced to the same horizontal and vertical datums as the LAS. DEM's will be in Imagine .IMG 32-bit floating point format and tiles will be edge joined and seamless within the project. Cells must be aligned and be fully contained within each tile. Water bodies greater than 2 acres in size will be hydro-flattened as defined in the USGS Lidar Base Specifications v1.2.

Tile scheme – the tile scheme shall be (3,000 foot x 3,000 foot) and be proposed by the contractor for approval. Each auxiliary product shall have the similar naming structure.

FGDC metadata – Project based metadata as defined in the General Requirements will be required for the LAS data as well as the Digital Elevation Models and Intensity Image.

3 Product Deliveries

All LAS LiDAR products will be delivered in V1.2 format.

a) All LiDAR points classifies (point cloud) with return number in LAS format. LAS file must also have flight information and flight acquisition date and projection information defined. Files to be broken up into approved tile scheme.

b) RMSE error report in Microsoft Excel format. All surveyed control points in both Excel and ESRI formats containing point number, XYZ fields. Digital pictures to also be provided for each control point surveyed. Include classification where control point lands under. (ex. Bare ground, high vegetation, etc.)

c) Bare-Earth points in LAS format, DEM in ESRI Grid format (floating point ex. 100.24) suitable for 1' (foot) contour generation, projection information must be defined on each grid and file. Files to be broken up into approved tile scheme. Collected breaklines will be include-incorporated into the ESRI grid product.

d) Bare-Earth Triangulated Irregular Network (TIN), in ESRI V10 format. All breaklines produced will be included with the TIN product. Files to be broken up into approved tile scheme.

e) Model Key Points in LAS format, DEM in ESRI Grid format (floating point ex. 100.24) suitable for 1' (foot) contour generation, projection information must be defined on each grid and file. Files to be broken up into approved tile scheme. Collected breaklines will be include-incorporated into the ESRI grid product.

f) Model Key Triangulated Irregular Network (TIN), in ESRI V10 format. All breaklines produced will be included with the TIN product. Files to be broken up into approved tile scheme.

g) Vegetation class in LAS format, tiled according to approved tile scheme.

h) First return points in .LAS format, DEM in ESRI Grid format (floating point ex. 100.24), projection information must be defined on each grid and file. Files to be tiled according to approved tile scheme. ESRI multipoint feature class in shapefile format, non-tiled and created for the entire project area.

i) Last return points in .LAS format, tiled according to approved tile scheme. ESRI multipoint feature class in shapefile format, non-tiled and created for the entire project area. Also include appropriate projection definition

j) An ESRI geodatabase of hydro-flattened breaklines with (z field) in attribute table, retaining all 3D information. These breaklines will be placed in a hydro breakline feature class.

k) An ESRI geodatabases of the channel-canal breaklines outlined in section 1.4.2 with (z field) in the attribute table, retaining all 3D information. These breaklines will be placed in a channel breakline feature class. These breaklines will be placed in the same geodatabase as the hydro-flattened breaklines outlined in section 3.j.

l) Tile Index in shapefile format in proper coordinate system with tile names in attribute table.

m) ESRI shapefile of flight lines as flown. Flight dates included in the attribute table.

3.1 TIN Data: Digital terrain model data is required in a TIN (Triangulated Irregular Network) form.

- The triangles from the TIN files will be represented as ESRI v 10.0 terrain file format.
- The triangles on the border of each file will have common unit of resolution (UOR) values with triangles in adjoining files where applicable.
- Duplicate triangles in adjoining files are unacceptable.
- There should be no other data in these files.
- All points outside the neat TIN limits, such as control points and check points must be deleted from that particular file.
- Terrain model must indicate the actual terrain unaffected by structures, e.g. bridges, etc.

4. Orthophotography General Requirements

Project Area

The project area consists of approximately one hundred and fifty three (153) square miles as defined graphically in Appendix A and available in ESRI GIS shape file format. The government will furnish GIS shapefiles depicting the project area as well as primary points of contact.

5. Work to be performed by the Contractor

Contractor shall provide equipment, supplies, facilities, and personnel to accomplish the following work:

a. The Contractor shall develop a project plan that will provide 4-band natural color (RGB) and color infrared (CIR) imagery , for the project area that meet or exceed the horizontal accuracy requirements for 0.5’ pixel resolution orthophotos and 1”=100’ (1:1200-scale) mapping. The final products will be referenced to New Mexico State Plane, Central (FIPS 3002), U.S. Survey Feet. Vertical Datum will be NAVD88.

b. The Contractor will fly 4-band photography for the area shown in Attachment A. The photography will be flown to achieve a GSD ≤ 0.5’. The digital photography will be acquired during spring leaf on conditions, free of cloud cover, cloud shadows, snow, smoke and visible haze. Aerial imagery will be acquired during spring of 2015 timeframe using a large format digital camera equipped with airborne GPS and IMU. The contractor will coordinate with

a Santa Clara point of contact (POC) and USACE to determine the best acquisition timeframe. Aerial photography shall conform to the current requirements and specifications of the contract under which this task order is being issued. The collected ABGPS and IMU data will be used to help orient the aerial imagery for orthorectification.

c. One flight line index shall be produced for all photography. The index shall be a black-line print of the quad sheets (1:100,000) with the flight lines and beginning and ending frames noted. Alternatively, flight plans can be provided on digital base maps overlaid with planned flight lines and photo centers to achieve the desired forward overlap and sidelap.

d. The Contractor shall process the imagery for development of a 0.5’ (foot) pixel resolution digital orthomosaic.

e. The Contractor will develop a fully analytical aerotriangulation adjustment for the GPS control and aerial imagery/airborne GPS. The contractor may use soft copy instrumentation for point selection and measurement. The final adjusted control network must reference the New Mexico State Plane, Central (FIPS 3002) Feet, with NAVD88 vertical datum. The contractor will prepare a digital report and will submit copies of the completed report to the USACE St. Louis POC, USACE Albuquerque, and the Santa Clara GIS Department POC.

f. The Contractor shall orthorectify the imagery to the bare earth lidar surface product described above in section 3-d to create a digital orthomosaic for the entire project area. The Contractor will employ software techniques to radiometrically process the orthophotos to ensure maximum tone and contrast balance between adjacent tiles. The final digital orthophoto map tiles will be delivered in uncompressed TIF/TFW format. Both RGB and CIR products will be delivered.

g. The Contractor shall use a 3000 foot by 3000 foot tiling scheme for the product, and tile the final product according to an agreed upon naming convention and produce the final digital product in GEOTiff format with world files (.tfw) for each tile.

h. The Contractor will produce a metadata file compliant with the Federal Geographic Data Committee (FGDC) Content Standards for Digital Geospatial Metadata for the imagery produced. The COE will provide a Metadata generation package (CORPSMET) to generate this file upon request by the Contractor or the Contractor can use software of their choice as long as the FGDC compliant Metadata is produced. One (1) overall metadata file for the project is sufficient.

i. NSSDA accuracy:

A report shall be prepared for the orthophoto imagery. Twenty photo identifiable survey check points will also be collected for NSSDA reporting. Examples of locations include corner of sidewalk intersections, parking paint stripes, driveway corners, concrete pads, etc. The surveyed points and $RMSE_r$ horizontal results will be compared in a table with photo identifiable points located, referenced, and surveyed to a class 3 (three) accuracy or better.

Total check points for this task order (both LIDAR and imagery) will be 50 points.

6. Orthophoto Delivery items:

a. One flight line/ tile index provided as an ESRI shapefile and PDF.

b. One digital copy of each 0.5' (foot) GSD, RGB and CIR ortho tile on USB hard drive or other suitable media. All media becomes property of the Government.

c. Project level Metadata shall comply with the current Federal Geographic Data Committee Content Standards for Digital Geospatial Metadata. ESRI ArcCatalog may be used to create the Metadata records. These Metadata records shall be constructed with sufficient quality to pass through the USGS Metadata Compiler with less than three errors. All products generated must be identified in the metadata.

d. One (1) overall Mr. Sid (Generation 3) file of entire area to be provided at 20:1 compression. Both RGB and CIR products will be a separate Mr. Sid delivery.

e. AT reports signed by the responsible triangulation team member. Summary of AT results and RMSE errors for bundle adjustment, photographic measurement, tie point and control/check points. Report on any significant misfits encountered at control points and procedures taken to analyze and rectify such misfits.

f. A Survey report in NSSDA format.

7 Deliveries and Performance

7.1 Deliveries

All transportation charges and costs appurtenant thereto, are a subsidiary obligation of the Contractor for which no separate payment will be made. DELIVERIES OR PERFORMANCE shall begin immediately after receiving notice to proceed.

- Delivery shall be sent via FEDEX or UPS at the Contractors expense and made according to the following schedule:

- Final delivery of all products shall be completed by **June 30, 2015.** Incremental delivery and acceptance of blocks of data is required to receive partial payment.

- Work will commence immediately after award and notice to proceed by COE contracting officer.

Deliver all survey data requested in the survey specifications, check feature data, and any additional survey information developed and or collected for the project.

The Contractor shall return all manuscript copies; horizontal and vertical control information, to the government when the project is completed.

The Contractor shall notify the above consignee at least 48 hours in advance of the date on which to expect delivery of the items. St. Louis District, COE personnel at the designated delivery points will provide necessary assistance between the hours of 8:00 a.m. and 4:30 p.m., Monday through Friday, for accepting delivery of materials. Delivery shall be made at the location designated below in Section 4.4.

7.2 Unauthorized Direction
Reference Contract Clause 52.243-1 Changes-Fixed Price (August 1987) Alternate III (1984): Only the Contracting Officer has authority to change the contract or issue a task order. No price or completion date changes can be made without approval from the Contracting Officer in advance of commencing work. The Contractor shall not accept directions from any Government employee or otherwise, other than the Contracting Officer, that would involve a change to the contract cost or final completion date.

7.3 Time Extensions
Reference Contract Clause Section H Special Contract Requirements Item 2: If the schedules indicated in section 7, Deliveries and Performance, are exceeded due to causes beyond the control and without the fault or negligence of the A-E, as determined by the Contracting Officer, this task order will be modified in writing and the completion date will be extended one calendar day for each calendar day of delay. The A-E shall notify the Government of such delays.

Requests for time extensions for an individual task order should be forwarded to the Contracting Officer no later than fourteen (14) days preceding the completion date shown on the task order.

7.4 Shipment
Shipments shall be made to:

Contact Names, Shipping Addresses, e-mail, phone #

8 Inspection

Inspection of the data deliverables including accuracy and quality assurance will be performed by the independent contractor to ensure conformance to these specifications. If the inspection reveals deficiencies or defects the data or issues will be required to be resolved at no additional cost to the 23D CES or the COE. Initial inspections does not relieve the LiDAR provider from the responsibility to correct defective work with no further cost to 23D CES for a period of one year following initial acceptance. If the finished items are found to be in full compliance with the specifications, they will be accepted. The acceptance of any item by an inspector shall not preclude subsequent rejection if such an item is later found to be defective. Inspection of the finished items to determine their conformance to the specifications will be made by a representative of the Contracting Officer upon delivery to the destination. If the inspection reveals any defect or deviation in the manufacture of the items which would make them unfit for the purpose intended, the Contractor will be required to satisfactorily remedy such conditions at no additional cost to the St. Louis District, COE.

9 Reference Documents

The National Standard for Spatial Data Accuracy (NSSDA) is a Federal Geographic Data Committee (FGDC) standard that federal agencies are suppose to use in determining geospatial accuracy.

http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/part3/chapter3

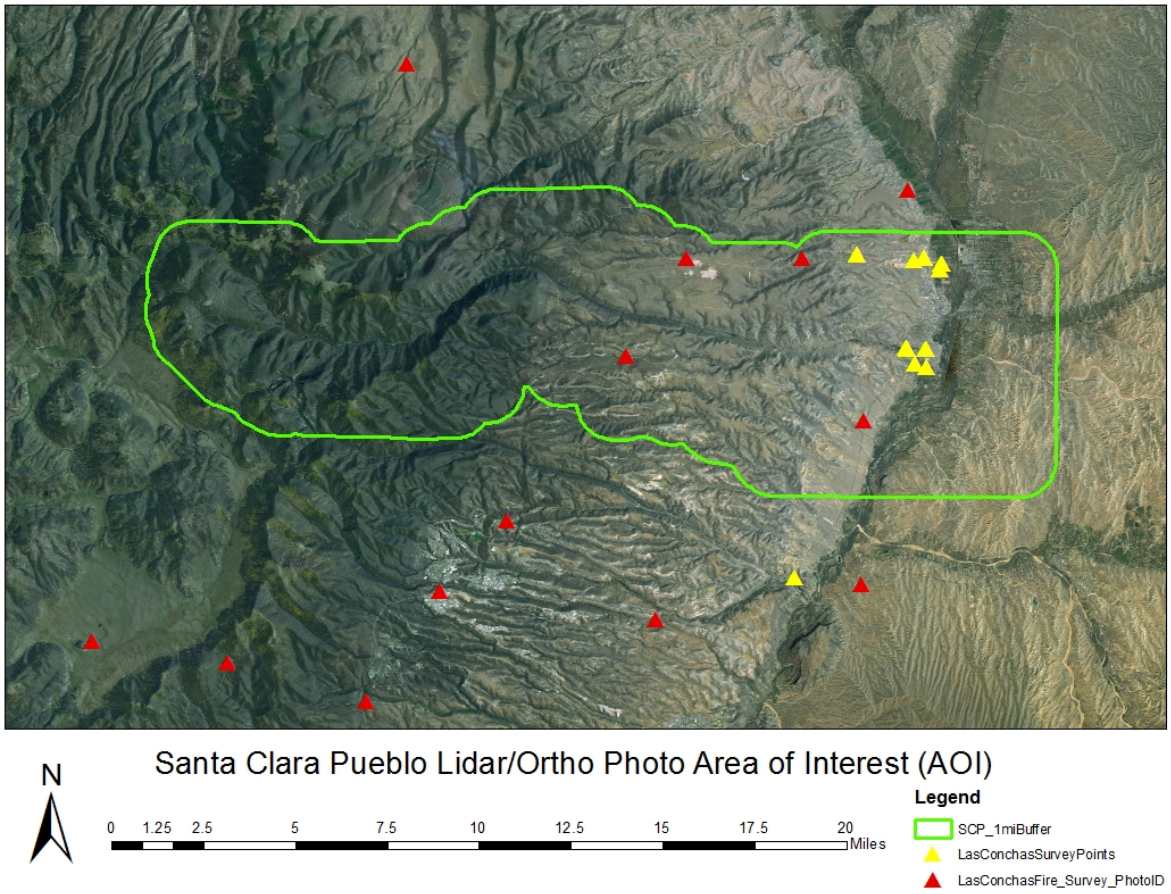
American Society for Photogrammetry and Remote Sensing (ASPRS) Positional Accuracy Standards for Digital Geospatial Data (2014). See Appendix C, USACE EM 1110-1-1000, Photogrammetric and Lidar Mapping.

Heidemann, Hans Karl, 2014, U.S. Geological Survey National Geospatial Program Lidar Guidelines and Base Specification Version 1.1: Reston, Virginia, U.S. Geological Survey. See Appendix E, USACE EM 1110-1-1000, Photogrammetric and Lidar Mapping.

10 Government Pricing Analysis

Attachment B shows the format for the Government's pricing analysis for this example SOW. The contractor will submit a cost proposal in this format which the Government will compare with its independent cost estimate. Government independent cost estimates, when completed, are confidential, for Government use only.

Attachment A



Attachment B – Form used for Contractor and Government Cost Estimates

Totals (153 Square Miles, Santa Clara NM) Orthos and LiDAR
Contractor
Contract #
Task Order #

DIRECT LABOR	HOURS	HOURLY RATE	LABOR COST
Project Manager	____	$____.__	$_____.__
Quality Manager	____	$____.__	$_____.__
Supervisory Photogrammetrist	____	$____.__	$_____.__
Photogrammetric Technician	____	$____.__	$_____.__
Aerial Photography Pilot	____	$____.__	$_____.__
Aerial / Sensor Operator	____	$____.__	$_____.__
GPS Engineer	____	$____.__	$_____.__
Orthophoto Technician	____	$____.__	$_____.__
GIS Technician	____	$____.__	$_____.__
LiDAR Technician	____	$____.__	$_____.__
Survey Office Engineer (PLS)	____	$____.__	$_____.__
Survey Supervisor (Party Chief)	____	$____.__	$_____.__
Survey Instrument Technician	____	$____.__	$_____.__
Subtotal--Direct Labor	**Use hourly contract rates**		**$_____A_.__**
Overhead on Direct Labor and General and Admin. (G&A) Overhead Combined	___% **Use contract OH, G&A**		**$_____B_.__**

OTHER DIRECT COSTS	UNIT	UNIT RATE	ODC COST
Aircraft (single engine) w/ABGPS/hour	___	$_____.__	$_____.__
Aircraft (twin engine piston) w/ABGPS/hour	___	$_____.__	$_____.__
Aircraft (twin engine turbine) w/ABGPS/hour	___	$_____.__	$_____.__
LIDAR sensor/hour	___	$_____.__	$_____.__
Large format digital sensor/hour	___	$_____.__	$_____.__
USB External hard drives/each	___	$_____.__	$_____.__
Travel/Lodging/Per Diem/day	___	$_____.__	$_____.__
Rental / Survey Vehicle/day	___	$_____.__	$_____.__
Subtotal—Other Direct Costs	**Use unit contract rates**		**$_____C_.__**
Subtotal--DL, OH & Other Direct Costs			**$A + $B + $C**
Profit (negotiated for individual task orders)		**___%**	**$_____D_.__**
(SUBCONTRACT) Flight (if not performed by prime contractor)			$_____E_.__
(SUBCONTRACT) Ground Control (if not performed by prime contractor)			$_____F_.__
PROJECT GRAND TOTAL			**$A + $B + $C + $D + $E + $F**

Prepared By: _____ Date: _____

Reviewed By: _____ Date: _____

Approved By: _____ Date: _____