

ACTION SHEET
CITY COUNCIL COMMITTEE MEETING OF 03/25/15
ITEM FROM FINANCE COMMITTEE MEETING OF 03/16/15

ISSUE:

12. Request for Approval of Memorandum of Understanding – Terrain Mapping and Orthophotography for ITT Division; Santa Fe County and Approval of Budget Increase in the Amount of \$75,000 in Water Fund. (Renee Martinez)

FINANCE COMMITTEE ACTION: APPROVED AS DISCUSSION ITEM

Approved Memorandum of Understanding for Terrain Mapping and Orthophotography for ITT division with Santa Fe County and approval of budget increase in the amount of \$75,000 in water fund.

FUNDING SOURCE: 5300.52300.510340

SPECIAL CONDITIONS OR AMENDMENTS

STAFF FOLLOW-UP:

VOTE	FOR	AGAINST	ABSTAIN
COUNCILOR TRUJILLO	X		
COUNCILOR RIVERA	X		
COUNCILOR LINDELL	X		
COUNCILOR MAESTAS	X		
CHAIRPERSON DOMINGUEZ			

3-17-14

City of Santa Fe, New Mexico

memo

DATE: February 20, 2015

TO: Finance Committee/ City Council

VIA: Renée Martínez, ITT Department Director *RM*
Oscar Rodriguez, Finance Director *OR*
Robert Rodarte, Purchasing Director *RR*
2/23/15

FROM: Yodel M Catanach, Telecommunication Specialist *ymc*

RE: **Memorandum of Understanding between Santa Fe County and City of Santa Fe for Terrain Mapping and Orthophotography**

SUMMARY:

We request approval of the attached Memorandum of Understanding between Santa Fe County and City of Santa Fe for Terrain Mapping and Orthophotography. The County procured the Light Detection and Ranging (LiDAR) Data and Digital Orthophotography Imagery (DOI). The City of Santa Fe plans to use the imagery acquired and requests to partner with Santa Fe County to assist in funding a portion of the LiDAR and DOI projects.

The funds allocated for the Santa Fe County LiDAR Project is in Water Division Business Unit and Line Item 5300.52300.510340 in the amount of \$75, 000. We are requesting your approval of this MOU and passing its consideration on to the Governing Body.

ACTION REQUESTED

ITT Department requests approval of Memorandum of Understanding between Santa Fe County and City of Santa Fe for Terrain Mapping and Orthophotography.

**MEMORANDUM OF UNDERSTANDING
BETWEEN SANTA FE COUNTY AND
THE CITY OF SANTA FE
FOR TERRAIN MAPPING AND ORTHOPHOTOGRAPHY**

THIS MEMORANDUM OF UNDERSTANDING (hereinafter "Agreement") is entered on this _____ day of _____ 2015, by and between Santa Fe County (hereinafter referred to as "the County"), a New Mexico political subdivision, and the City of Santa Fe, New Mexico (hereinafter referred to as "the City").

WHEREAS, in the spirit of cooperation, mutual respect and service to the residents of Santa Fe County and the City of Santa Fe, this Agreement confirms the parties' commitment and mutual cooperation which recognizes that the partnering activities between government entities may produce community benefits beyond what might be produced independently; and

WHEREAS, the County utilizes terrain mapping and orthophotography to support County business functions including real property assessment, terrain management, land development code compliance, project and infrastructure planning, floodplain mapping, stormwater management, vegetation analysis, land use and community planning activities; and

WHEREAS, the County has procured light detection and ranging (LiDAR) data for approximately 2,600 to 3,400 square miles within north central New Mexico as well as Digital Orthophotography Imagery (DOI) and the City of Santa Fe has similar needs and uses for these types of data and wishes to partner with Santa Fe County to assist in funding a portion of the LiDAR and DOI projects in exchange for sharing of this data; and

WHEREAS, the purpose of this MOU is to provide the duties and responsibilities of the City and County with respect to the expenditure and management of the terrain mapping and orthophotography project.

NOW, THEREFORE, IT IS MUTUALLY AGREED BETWEEN THE PARTIES AS FOLLOWS:

1. DUTIES OF THE PARTIES

A. The County shall:

- 1) Serve as a fiscal agent for the funds identified in this Agreement and maintain all financial records pertaining to the program and expenditure of funds.
- 2) Provide copies of the collection, production and delivery data of the 2014 LiDAR Project to the City. The data shall include:
 - a. Classified LiDAR point clouds;
 - b. TIN-based DTMs;
 - c. Bare-earth DEM;

- d. Breaklines;
 - e. Contours; and
 - f. Documentation of system calibration, collection and processing methods, survey methods, Quality Assurance (QA), Accuracy Testing and Reporting, and metadata
- 3) Provide to the City Digital Ortho Imagery (DOI) of the 2014 Orthophotography Project to include:
- a. Photo index consisting of ESRI shapefiles of photo center points and "footprint" polygons; and
 - b. Digital orthophotography: One set of the DOI raster image data files in both ECW and TIFF file formats and associated world files and metadata file(s) provided on an external hard drive.

B. The City shall:

- 1) Within sixty (60) days of the execution of this Agreement, provide funding in the amount of Seventy Five Thousand Dollars (\$75,000.00) to supplement the cost of the County's 2014 LiDAR and DOI projects.

2. EFFECTIVE DATE AND TERM

This Agreement shall, upon due execution by all parties, become effective as of the date first written above and shall terminate one (1) year later, unless earlier terminated pursuant to Section 3 (Termination) or Section 6 (Appropriations and Authorizations). The County has the option to extend the contract for one (1) additional year upon the approval of the County. The County may exercise this option by submitting a written notice to the City that the Agreement will be extended an additional year. The notice must be submitted to the City at least sixty (60) days prior to expiration of the initial Agreement.

3. TERMINATION

This Agreement may be terminated by either party upon delivery of a written notice to other party at least thirty (30) days prior to the intended date of termination. By such termination, neither party may nullify nor void any obligations incurred prior to termination. The City may not by such termination avoid its obligation to reimburse the County for unavoidable and appropriate costs to which the County was obligated prior to termination by the City. The County will request reimbursement for such unavoidable and appropriate costs in accordance with Paragraph 1.B.1).

4. LIABILITY

Neither party shall responsible for liability incurred as a result of the other party's acts or omissions in connection with this Agreement. Any liability incurred in connection with

this Agreement is subject to the immunities and limitations of the New Mexico Tort Claims Act, § 41-4-1, *et seq.*, NMSA 1978, as amended.

5. AMENDMENT

This Agreement shall not be altered, changed or amended except by an instrument in writing executed by the parties hereto.

6. APPROPRIATIONS

The terms of this Agreement are contingent upon sufficient appropriations and authorization being made by the Legislature of the State of New Mexico and the governing bodies of the City and the County for performance of this Agreement. If sufficient appropriations and authorizations are not made, this Agreement shall terminate upon written notice being given from one party to the other. Any party's decision as to whether sufficient appropriations are available shall be accepted by the other party and shall be final.

7. GOVERNING LAW

This Agreement shall be governed by, and constructed in accordance with, the laws of New Mexico.

8. ACCOUNTABILITY

During the term of this Agreement and for a period of three (3) years thereafter, each of the parties will maintain accurate and complete records of all disbursements made and monies received by each under this Agreement; and, upon receipt of reasonable written request, each shall make such records available to the other party and to the public, including federal, state or local authority during regular business hours.

9. NO THIRD PARTY BENEFICIARIES

Nothing in this Agreement, express or implied, is intended to confer any rights, remedies, claims or interests upon a person not a party to this Agreement.

10. ENTIRE AGREEMENT

This Agreement represents the entire understanding between the City and the County and supersedes any prior agreements or understandings with respect to the subject of this Agreement. No changes, amendments or alterations to this Agreement will be effective until in writing and signed by the parties.

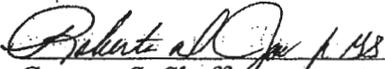
IN WITNESS WHEREOF the parties have duly executed this Agreement as of the dates written below.

SANTA FE COUNTY:

Katherine Miller
Santa Fe County Manager

Date

APPROVED AS TO FORM



Gregory S. Shaffer
Santa Fe County Attorney

2/11/15

Date

FINANCE DEPARTMENT

Teresa C. Martinez
Santa Fe County Finance Director

Date

CITY OF SANTA FE:

Javier Gonzales, Mayor

Date

ATTEST

Yolanda Y. Vigil, City Clerk

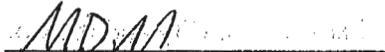
Date

APPROVED

Oscar S. Rodriguez, City Finance Director

Date

APPROVED AS TO FORM:



Kelley Brennan, City Attorney

2/23/15

Date

**Exhibit A
Expanded for Breakdown of Unit Costs and Optional Services**

Santa Fe County 2014 Cost Estimate and Rate Schedule		BREAKDOWN OF UNIT COSTS			OPTIONAL HYDRO-ENFORCEMENT WORK			
Task	Fee	BASE COST (W/O GRT)	BASE AREA (SQ. MI.)	COST PER SQ. MI.	PROJECTED DENSITY AT SPECIFIED DENSITY	AVERAGED COST (DENSITY AVERAGE)	BASE AREA (SQ. MI.)	AVERAGE COST PER SQ. MI.
Phase IA - Source Data Acquisition								
Aerial Mission Planning/Ground Photo Control								
Aerial Mission Photo Control								
Blue Book per Measurement (not feasible in this window?)		\$ 22,488.40	2,210					
		not estimated						
Aerial Photography - minimum 2,210 sq miles								
Eagle UltraCAM 0.5" resolution								
Delivery								
Flight Lines/plan, control layout map, and data (raw imagery), photo centers, photopoints (photo index), camera calibration								
		\$ 65,136.20	2,210					
Sub-Total		\$ 87,624.60	2,210	\$ 39.65				
MMGR @ 7.000%		\$ 6,133.72						
TOTAL		\$ 93,758.32						
Subtotal for Aerial Photography Acquisition =>								
Phase IB - LiDAR Data Acquisition								
Aerial LiDAR Survey Mission with Airborne GPS Control and IMU								
Task	Minimum Fee							
LiDAR Mission Ground Control								
LiDAR Acquisition 02 (Minimum Area - 2,600 Square Miles)	\$ 11,884.12		2,600					
LiDAR Acquisition 02 (Maximum Area - 3,400 Square Miles)	\$ 364,360.48		2,600					
Raw Point Cloud Collection 02 (MPS = 0.7m)								
Delivery								
Flight Lines and data, raw point cloud								
Option B - 3mm Esabyte Tape (per set)								
Sub-Total		\$ 376,044.60	2,600	\$ 144.63				
MMGR @ 7.000%		\$ 26,323.12						
TOTAL		\$ 402,367.72						
Subtotal for LiDAR (terrain) Acquisition =>								
Phase II - Data Production								
Task	Labor Hours	rate	Fee					
A.1) Analytical Aero Triangulation	220	see detail	\$ 30,113.30	\$ 13.63				
B.1) Classified Point Cloud - ortho area	920	see detail	\$ 108,423.30	\$ 41.70				
B.2) Bare-Earth DEM - ortho area	120	see detail	\$ 13,948.00	\$ 5.36				
B.3) Break lines (as required for specified ortho production area)								
A.2) Orthophotocopy (2087 sq m)								
Optional Hydro-Enforcement - 3D Stream Lines								
B.4.a) Light Density Stream Collection	0.5 hrs per	\$ 139.83 /Section	\$ 35,792.05	\$ 17.15			2,087	
B.4.b) Moderate Density Stream Collection	4 hrs per	\$ 41.87 /Section						
B.4.c) Heavy Density Stream Collection	8 hrs per	\$ 334.92 /Section						
B.5) TIN & DTM	0.15 hrs per	\$ 669.84 /Section						
B.6) 1 foot Contours	0.33 hrs per	\$ 27.63 /Section						
B.7) Optional Planimetrics	0.75 hrs per	\$ 62.80 /Section						
B.7.a) Light Building Collection	6 hrs per	\$ 502.38 /Section						
B.7.b) Moderate Building Collection	6 hrs per	\$ 837.30 /Section						
B.7.c) Heavy Building Collection	10 hrs per							
Sub-Total			\$ 188,726.65	\$ 302.31				
MMGR @ 7.000%			\$ 13,179.37	\$ 21.16				
TOTAL			\$ 201,906.02	\$ 323.48				
Partial Subtotal for Data Production =>								
Phase III - Hydro-Enforcement								
Task	Labor Hours	rate	Fee					
Hydro-Enforcement								
Sub-Total			\$ 1,541,563.20	\$ 651.19				
MMGR @ 7.000%			\$ 107,909.42	\$ 45.56				
TOTAL			\$ 1,649,472.63	\$ 696.77				
Subtotal for Hydro-Enforcement =>								
Grand Total								
			\$ 735,823.21	\$ 302.31				
			\$ 51,507.63	\$ 21.16				
			\$ 787,330.84	\$ 323.48				
Subtotal for all work =>								
Summary								
			\$ 1,541,563.20	\$ 651.19				
			\$ 107,909.42	\$ 45.56				
			\$ 1,649,472.63	\$ 696.77				
Subtotal for all work =>								
Notes								
This total represents an ESTIMATED total project cost with an averaged cost applied to Hydro-Enforcement work.								
NOTE: this \$1.65 million is well beyond approved budget.								
These final project costs will depend on the optional amount of Hydro-Enforcement work that the City and County choose to have done.								

Santa Fe County 2014 Regional LiDAR Project Scope of Work

Summary

Santa Fe County (“the County”) directs Bohannon Huston, Inc. (“Contractor”) to acquire and process light detection and ranging (LiDAR) data for approximately 2,600 to 3,400 square miles within north central New Mexico. The project area of interest is made up of urbanized areas, surface irrigated riparian areas, badlands, high desert plains and mountainous landscapes. Elevation ranges from 5,400 to 13,000 feet above mean sea level.

Purposes

This LiDAR project is undertaken to support activities such as the following (this list is not exhaustive):

- Urban, community and regional planning
- Project and infrastructure planning
- Project reporting
- Floodplain mapping
- Stormwater management
- Vegetation analysis
- Change detection
- Initial project reviews

Geographic Extent

The project area is described on *Exhibit A - Proposed LiDAR Project Area*. The project includes a minimum area of approximately 2,600 square miles that may be expanded pending additional cooperator participation as well as final per unit acquisition and production costs. The minimum project area covers the entirety of Santa Fe County, New Mexico and extends outward to capture the entirety of several hydrological unit sub-basins.

Data coverage areas shall be exceeded by a buffer of 300 feet (± 10 feet) on all sides, beyond any stated project boundary.

It should be noted that Santa Fe County will also fly 6-inch resolution imagery in these areas in spring 2014 (see *Exhibit B - Proposed Ortho Photo Project Area*). The LiDAR derived products (e.g., bare earth surface) requested as part of this project must support orthorectification of this imagery, and image and LiDAR flight schedules have to be coordinated by the Contractor accordingly.

Exhibit C, *Santa Fe County 2014 Cost Estimate and Rate Schedule*, outlines the mutually agreed costs according to rates set forth in State of New Mexico State Purchasing Price Agreement, Contract No. 10-000-00-0051 BS.

Exhibit D, *Deliverable Table*, summarizes project deliverables required for completion of both the 2014 Santa Fe County Digital OrthoPhotography Project and 2014 Regional LiDAR Project.

Services to be Rendered

Overview

In general terms, the collection, production and delivery of the products and services to be provided by the Contractor include the following:

- Raw LiDAR data;
- Classified LiDAR point clouds;
- TIN-based DTMs;

- Bare-earth DEM;
- Breaklines;
- Control points;
- Contours;
- Documentation of system calibration, collection and processing methods, survey methods, QA, Accuracy Testing and Reporting, and metadata;

Project management services that include progress tracking and regular communication to the Santa Fe County Project Manager and the Santa Fe County orthoimagery vendor (when requested).

Weekly reports of collection progress.

The Contractor shall furnish all materials, supervision, labor, equipment, and transportation, unless otherwise specified in this RFP to complete the following tasks and deliver the listed products.

LIDAR collection and data processing shall adhere at minimum to the USGS, National Geospatial Program, Lidar Base Specification Version 1.0, (2012) standard, as posted at <http://pubs.usgs.gov/tm/11b4/>.

In addition the Contractor shall adhere to FEMA, Procedure Memorandum No. 61 - Standards for Lidar and Other High Quality Digital Topography, as posted at <http://www.fema.gov/media-library/assets/documents/19742?id=4345>, as applicable to "Hydro-Enforcement".

Both standards are herewith incorporated into this RFP by this reference.

Respondents are invited to present alternative proposals that cause improvements in the horizontal and/or vertical accuracies of the products, even if these proposals exceed stated standards. Each such alternative proposal shall be brief, concentrating mainly on the specific aspects that cause such improvements, plus the impact on pricing.

Respondent shall describe the following in their response: LiDAR spot size and spot spread, number of returns, intensity values, NPS, data voids, spatial distribution, scan angle, accuracy, overlap, collection conditions etc.)

Clarification, emphasis on and additions to these specifications are noted below.

LIDAR Collection Requirements

Nominal Pulse Spacing/Point Density

The LiDAR data for the entire project area are to be collected at a Nominal Pulse Spacing (NPS) of 0.7 meter or less. This corresponds to a point density of approximately 2 points per square meter. In general, this target NPS of 0.7 meter or less should not be achieved through swath overlap or multiple passes.

Raw Point Cloud Requirements:

Format: Fully compliant LAS v1.3 format

If full waveform data are collected, delivery of the waveform packets is required. LAS v1.3 deliverables with waveform data are to use external auxiliary files with the extension .wdp for the storage of waveform packet data..

Georeference information shall 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 return.

Intensity values shall retain native radiometric resolution. The signal strength (intensity) of each return pulse shall be recorded.

Signal Returns: The LiDAR system shall be configured to collect multiple returns per pulse, with a minimum of a first return and a last return and at least one additional intermediate return (minimum 3 returns). All returns captured during acquisition shall be delivered. Return number shall be recorded. Data Voids within a single swath are not acceptable, except:

- where caused by water bodies.
- where caused by areas of low near infra-red (NIR) reflectivity such as asphalt or composition roofing.
- where appropriately filled-in by another swath.

Spatial Distribution: The spatial distribution of geometrically usable points is expected to be uniform and free from clustering. Although it is understood that LiDAR instruments do not produce regularly gridded points, collections should be planned and executed to produce a first-return point cloud that approaches a regular lattice of points, rather than a collection of widely spaced high density profiles of the terrain.

Scan Angle: For oscillating mirror LiDAR systems, the scan angle must be $\leq \pm 20$ degrees from nadir or full scan angle ≤ 40 degrees. Otherwise, scan angle must be ≤ 30 degrees.

Vertical Accuracy Requirements: LIDAR shall meet or exceed the vertical accuracies as established by the National Digital Elevation Program (NDEP) guidelines and subsequently adopted by the American Society for Photogrammetry and Remote Sensing (ASPRS). As a minimum, resulting vertical project accuracies have to satisfy the following:

- For the unclassified LIDAR point cloud, using the NDEP/ASPRS methodology:
 - Fundamental Vertical Accuracy (FVA) ≤ 18.2 centimeters (cm) Accuracyz (ACCz), 95 percent (9.25 cm Root Mean Square Error (RMSE)z).
- For the derived DEM and TIN, using the NDEP/ASPRS methodology:
 - Fundamental Vertical Accuracy (FVA) ≤ 18.2 cm ACCz, 95 percent (9.25cm RMSEz);
 - Consolidated Vertical Accuracy (CVA) ≤ 36.3 cm, 95th percentile, and
 - Supplemental Vertical Accuracy (SVA) ≤ 36.3 cm, 95th percentile.

Positional Accuracy Validation: The absolute and relative accuracy of the data, both horizontal and vertical, relative to known control, shall be verified prior to classification and subsequent product development. A detailed report of this validation is a required deliverable.

Relative Accuracy Requirements: Relative accuracy shall be:

- ≤ 7 cm RMSEz within individual swaths
- ≤ 10 cm RMSEz or within swath overlap (between adjacent swaths).

Accuracy Reporting: Data shall meet or exceed the National Standard for Spatial Database Accuracy (NSSDA) accuracy standards. The NSSDA standards specify that vertical accuracy be reported at the 95 percent confidence level for data tested by an independent source of higher accuracy. For example the metadata statement shall read, "Tested ___ (meters, feet) vertical accuracy at 95 percent confidence

level.” This reporting shall include bare-earth FVA for Point Cloud Data and DEMs, plus multiple SVAs and CVA.

Control shall be based on a state-of-the-art Airborne Global Positioning/Inertial Measurement Unit or AGPS/IMU solution and processing techniques. An AGPS PDOP of 3.2 (or smaller) shall be respected during LiDAR collection.

Supplemental Ground Control in the form of differentially corrected GPS Ground Control shall be used to supplement the Airborne GPS/IMU positional accuracy (horizontal and vertical). The supplemental control used for the LiDAR acquisition shall utilize as much of the same control as used for the orthophotography mapping portion of this project as is reasonably possible.

Flight lines shall have a side overlap of 20-30%, as required to ensure there are no data gaps between the usable portions of the swaths. Collections in high relief terrain are expected to require greater overlap. Any data that show gaps between the geometrically usable portions of the swaths will be rejected.

Swaths: Full swaths shall be delivered - all collected points are to be delivered. Long swaths (those which result in a LAS file larger than 2GB) shall be split into segments. Each swath shall have one cross-tie at the beginning, one at the approximate center, and one at the end. Each such segment shall be regarded as a unique swath. In addition;

- Each sub-swath will retain the original File Source ID of the original complete swath.
- Points within each sub-swath will retain the Point Source ID of the original complete swath.
- Each sub-swath file will be named identically to the original complete swath, with the addition of an ordered alphabetic suffix to the name (“-a”, “-b” ... “-n”). The order of the named sub-swaths shall be consistent with the collection order of the points (“-a” will be the chronological beginning of the swath; “-n” will be the chronological end of the swath).
- Point families shall be maintained intact within each sub-swath.
- Sub-swaths should be broken at the edge of the scan line.
- Other swath segmentation criteria may be acceptable subject to prior approval.

Note that the above-mentioned Santa Fe County imagery collection effort will be flown in a North-South direction.

Scope of Collection: All collected swaths are to be delivered as part of the raw data deliverable. This includes calibration swaths and cross-ties. This in no way requires or implies that calibration swath data are to be included in product generation. All collected points are to be delivered. No points are to be deleted from the swath LAS files. Excepted from this are extraneous data outside of the buffered project area (aircraft turns, transit between the collection area and airport, transit between fill-in areas, etc.). These points may be permanently removed. Busted swaths that are being completely discarded by the vendor and re-flown do not need to be delivered.

Flight Window: Collection window shall be between the contract execution date and Fall 2014. Schedule will be determined based on aerial imagery acquisition and the method for acquisition and processing proposed by the Contractor. The collection window can be negotiated and adjusted based on the needs of the Santa Fe County 2014 aerial imagery acquisition. Change to the schedule must be agreed to by Santa Fe County and the Contractor. Atmospheric conditions shall be such that they are:

- Cloud, smoke, precipitation and fog-free between the aircraft and ground
- Snow free; very light, un-drifted snow may be acceptable in special cases, with prior approval.
- Free of water inundation.
- Vegetation is leaf-off, but not required as long as penetration is sufficient to create a bare-earth data and products at the specified accuracies

LIDAR Deliverable Requirements

Datums

The deliverables should be supplied to Santa Fe County in the following projections:

NAD83 HARN State Plane New Mexico Central (3002), US Survey Feet

UTM NAD83 HARN Zone 13, Meters

All project areas fall within one single UTM zone.

Data should reference the most recent Geoid model approved by the NGS, to two decimal places.

Classified Point Cloud:

All processing should be carried out with the understanding that all point deliverables are required to be in fully compliant LAS v1.3 format. Contractor shall deliver a classified LiDAR point cloud containing the following:

- Georeference information included in LAS header;
- Intensity values in native radiometric resolution;
- Point families shall be maintained intact through all processing before tiling. Multiple returns from a given pulse will be stored in sequential (collected) order.
- Tiled delivery, without overlap;

Classification Scheme (minimum):

- Code 1 – Processed, but unclassified
- Code 2 – Bare-earth ground
- Code 7 – Noise (low or high, manually identified, if needed)
- Code 9 – Water
- Code 10 – Ignored Ground (in proximity of breaklines)

ALL points not identified as Withheld are to be classified.

No points in the classified LAS deliverable will be assigned Class = 0.

Use of the ASPRS/LAS Overlap classification (Class=12) is prohibited.

If overlap points are required to be differentiated by the data producer or cooperating partner; the points must be identified using a method that does not interfere with their classification. The technique used to identify overlap must be clearly described in the project metadata files.

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

Note: Class 7, Noise, is included as a convenience for the data producer. It is not required that all "noise" be assigned to Class 7.

Note: Class 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.

Contractor shall perform point cloud classification services to build a bare-earth and other point classes as specified for LAS format 1.3. This includes the "ignore" layer surrounding breaklines.

Hydro Flattening Requirements

All water-surface areas that are acquired shall be hydro-flattened according to the above-mentioned USGS specifications (USGS, National Geospatial Program, Lidar Base Specification Version 1.0, 2012).

Hydro-Enforcement Requirements

Santa Fe County desires to improve the spatial accuracy of its surface stream vector data layer. In order to accomplish this goal, the County requests that respondents submit cost proposals for optional hydro-enforcement work as follows:

In areas where digital ortho photos are to be produced (see *Exhibit B - Proposed Ortho Photo Project Area*) the Contractor will construct single-line hydro feature breaklines and other breaklines as necessary to produce an improved DTM surface to support high accuracy orthorectification. Respondents should provide per square mile costs estimates for this additional work based upon high, medium and low density stream channel presence within a given area (e.g., square mile).

Should the option to produce single-line hydro feature (stream) breaklines be exercised by Santa Fe County, the following guidelines must be met:

- All vertices along single-line stream breaklines must be at or below the immediately surrounding terrain.
- Single-line stream breaklines are not to be used to introduce cuts into the DEM at road crossings (culverts), dams, or other such features, however, elevated bridges are to be removed from the DTM.
- All breaklines used to modify the surface are to be delivered as an ESRI shapefile (PolylineZ or PolygonZ as appropriate to the type of feature represented) with the DEMs.
- Each shapefile will include properly formatted and accurate georeference information. All shapefiles must include a correct and properly formatted *.prj file.
- Breaklines must use the same coordinate reference system (horizontal and vertical) and units as the LiDAR point delivery.
- Breakline delivery may be as a continuous layer or in tiles, at the discretion of the data producer. In the case of tiled deliveries, all features must edge-match exactly across tile boundaries in both the horizontal (X-Y) and vertical (Z) spatial locations.

TIN

Contractor shall build a TIN from the point cloud and use it to generate three deliverables:

1. A non-gridded DTM - to be used for orthorectification of the project's 2014 imagery
2. A gridded DEM - suitable for use in the USGS 1/27-arc-second DEM (NED)
3. Contours, in ortho production areas only

TIN-Based Digital Terrain Models (Non-Gridded DTMs)

Contractor shall build TIN-based DTMs to be used for the orthorectification of the Santa Fe County 2014 imagery.

Bare Earth Surface (Gridded DEM)

- Contractor shall build one DEM to satisfy USGS NED (1/27-arc-second DEM) requirements for all areas;
- Delivery in an industry-standard, GIS-compatible, 32-bit floating point raster format (ERDAS .IMG preferred):

- Georeference information shall be included in raster file;
- DEM 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 of the bare earth surface raster data shall be similar (plus or minus 10%) to the one specified for the raw point cloud above. Depressions (sinks), natural or man-made, are not to be filled (as in hydro-conditioning and hydro-enforcement) except for in specified project areas;
- Water Bodies (ponds and lakes), wide streams and rivers ("double-line"), and other non-tidal water bodies shall have been hydro-flattened within the DEM, subject to the USGS specifications. The DEM will be processed and supplemented with 3D operator-generated breaklines as necessary to meet the USGS specifications.

Contours

Contractor shall cut contours as specified, using the TIN-based DTM datasets.

Contours will be generated for all project areas where digital orthophotography is produced. Contour interval ("ci") will be 1 foot isolines.

Non-crossing contour lines will be developed from the completed TIN-based DTM so that vertical accuracy is maintained (plus or minus 10%).

Every fifth contour line (10 foot isolines) shall be an attributed index contour (INDEX = 1

All contour lines shall be solid and unbroken features within each separate tile.

Elevation values are assigned to the contour lines and carried as integer attributes.

Delivery and Tiling

Contractor shall provide all deliverables that are produced from LiDAR data (other than LiDAR swaths), such as TINs, DTMs, DEMs, and contours in the formats as outlined below.

All project area boundaries are understood to include the specified buffer.

Tiles which lie completely within the project area shall be complete to the tile edges.

The deliverables should be supplied to Santa Fe County in the following manner:

- The classified point cloud data shall be delivered as tiles as UTM and State Plane datasets, as described below.
- The contour data shall be delivered as a State Plane dataset, as described below.

UTM Datasets

Tiles shall be 1500 x 1500 meters named on the even UTM lines derived from the southwest corner of each tile using the last digit of the UTM zone, the three digits of the west UTM line, and four digits from the south UTM line. For example: zwwwssss

Where z = last digit of UTM zone

www = west limit in thousands

ssss = south limit in thousands

- Tiled deliverables shall conform to the tiling scheme, without added overlap.
- Tiling scheme will be used for all tiled deliverables in this projection.
- Tiled deliverables shall edge-match seamlessly in both the horizontal and vertical.
- All tiles shall be completely filled in (even if it covers only a portion of the buffer).

State Plane Datasets

Tiles shall be 1 mile x 1 mile approximately, based upon Public Land Survey System sections, and labeled according to the Santa Fe County tiling schemes which will be provided to the contractor. This tiling scheme will be used for all tiled deliverables.

Tiled deliverables shall edge-match seamlessly in both the horizontal and vertical, as applicable.

Control and Calibration Points

The contractor shall deliver all control and reference points used to validate the point data and derivative products. They shall be delivered in ESRI shapefile (.shp) format with associated FGDC-compliant metadata.

Extents

The contractor shall deliver a geo-referenced, digital, spatial representation of the precise extents of each delivered dataset. This should reflect the extents of the actual LIDAR source or derived product data, exclusive of Triangular Irregular Network (TIN) artifacts or raster NODATA areas. A union of tile boundaries or minimum bounding rectangle is not acceptable. An ESRI Polygon shapefile is preferred.

Documentation

Project Plan

- Delivered before the flights.
- Outlines the proposed methodology for collection and processing.
- Includes risk mitigation strategies and contingency planning.

System Calibration Report

- Delivered before the flights.

Collection Report

- Includes mission planning and flight logs.
- Includes study area PDOP, mission date, time, flight altitude, airspeed, scan angle, scan rate, laser pulse rates.
- Statistical report summarizing the results of the airborne GPS adjustment and the overall accuracy of the adjusted IMU data.

Survey Report

- A record of field work procedures.
- A record of horizontal and vertical datums utilized.

Processing Report

- Data derivation and adjustments.
- Classification information.
- Product generation methodology.
- Hydro-flattening and enforcement information.
- Any problems encountered and solutions used in resolving such problems.

QA Report

- Quality assurance procedures and results.
- Verification of vertical and positional accuracy of the point cloud and derivatives.
- Detailed explanation of the data validation process.
- Discussion of artifacts and their causes.

FGDC compliant, XML format metadata for:

- Overall project
- Each lift
- Classified point data
- Bare-Earth DEM
- TIN-based DTMs

- Breaklines
- Contours
- Control Points

Please see the USGS LIDAR Metadata Example provided in the USGS specifications above.

Independent Quality Control (QC)

The Contractor should be aware that Santa Fe County may request independent verification of the deliverables to ensure that project specifications are met. The QC party would perform the following actions:

- Estimate the vertical accuracy of the control points at the 95% confidence interval;
- Estimate the vertical accuracy of the bare-earth classification against independent check points;
- Perform system verification, laser range verification, and AGPS/IMU verification (proper PDOP, etc.);
- Check that point cloud classifications were done correctly;
- Check that flight lines were flown as planned;
- Confirm that all collected LiDAR data are covered by the resulting swaths as specified, together with the required cross-ties;
- Confirm the GPS baseline lengths;
- All files are readable in CAD and ArcGIS;
- All files are named correctly;
- Confirm that the data covers the entire project area;
- Confirm that the data has no unacceptable data voids (e.g. due to incorrect flight heights, clouds, or improper flight lines);
- Confirm that the NPS adheres to project specifications; assessment will be made against single swath, first (or applicable last) return data located within the geometrically usable center portion (typically ~90%) of each swath. In order to ensure uniform densities throughout the data set:
 - A regular grid, with cell size equal to the design NPS will be laid over the data.
 - At least 90% of the cells in the grid shall contain at least 1 LiDAR point.
 - Clustering will be tested against the 1st return only data
 - Acceptable data voids identified elsewhere in this specification are excluded.
- Confirm that the horizontal and vertical datums adhere to the project specification;
- Confirm that the projection and units adhere to the project specification;
- Confirm that the LAS files are in a consistent version and have proper header information;
- Confirm that each point in the point cloud has the appropriate attributes (GPS times, coordinates, elevation, intensity, return number, return classification);
- Confirm that all points are classified into the specified scheme;
- Ensure there are no seam lines between flight swaths;
- Ensure metadata is complete;
- Confirm that DEMs have correct names and have the correct post spacing;
- Confirm that contours are at the correct interval and are indexed and labeled. Ensure no crossing contours; and
- Ensure that hydro flattening is correct by confirming that lake and pond breaklines are a constant elevation, that streams have a continuous downstream flow (no stair steps), and water points are correctly identified.

Term

The awarded contract will begin on the date it is signed and ends, unless sooner terminated under the Terms and Conditions of the Contract or extended by a contract amendment, on June 30, 2015.

Access Agreements:

The successful Contractor shall provide written notification to the County on the number and locations of ground control points used in this project. The Contractor shall determine land ownership encompassing those locations and as required, obtain site access permission. The Contractor shall notify landowners and coordinate with the appropriate personnel prior to on-site or over-site activities. The Contractor shall be solely responsible for the requisite filing of flight plans and obtaining appropriate permissions from the FAA and other agencies as necessary.

Option for Subsequent Partnerships

To the extent that other governmental jurisdictions are legally able to participate in cooperative purchasing endeavors, member jurisdictions may choose to directly contract with the Contractor for additional and related products independently of Santa Fe County.

In such case, the terms of the contract between the Contractor and Santa Fe County shall be honored, even though Santa Fe County will not be facilitating the additional deliverables. The vendor shall deal directly with the jurisdiction concerning payments, disputes, and other topics related to the additional products. Santa Fe County shall have no responsibility or liability to the vendor, the requesting jurisdiction or any other party in connection with any such direct purchase or performance of an additional product.

All partnerships pursued without Santa Fe County facilitation shall not interfere with the work requested through this RFP. Additional products that are independently requested are developed after deliverables for the scope of work mentioned herein are completed.

Through this Option of Subsequent Partnerships, the partners could work directly with the Santa Fe County LiDAR vendor, based on the quotes given in the pricing form, to attain that data.

Project Timeline

Below is a preliminary timeline. This is subject to change based on the timing and coordination with the aerial imagery acquisition that will be occurring in the spring and summer. A final schedule will be produced and included in the contract.

January 2014 Partners receive budget approvals, which determines if the project can begin

February 2014 Statement of Work is written; contract finalized

March 2014 Kick-off meeting

April - June 2014 LIDAR Acquisition (may or may not be coordinated with aerial imagery flights)

July- September 2014 LIDAR Processing

October - November 2014 All LIDAR and derivative deliverables due

Exhibit A - Proposed LiDAR Project Area

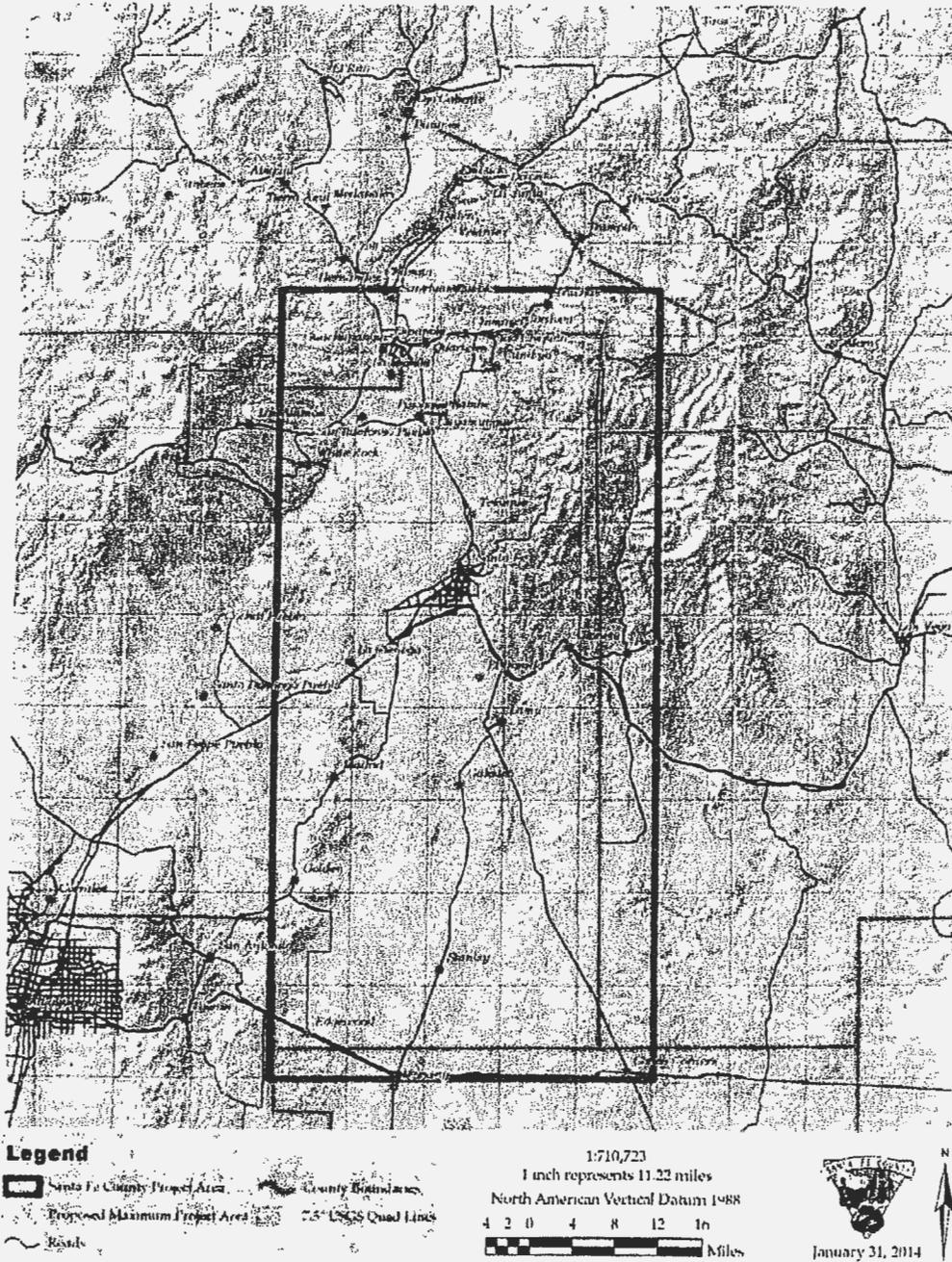


Exhibit B - Proposed Ortho Photo Project Area

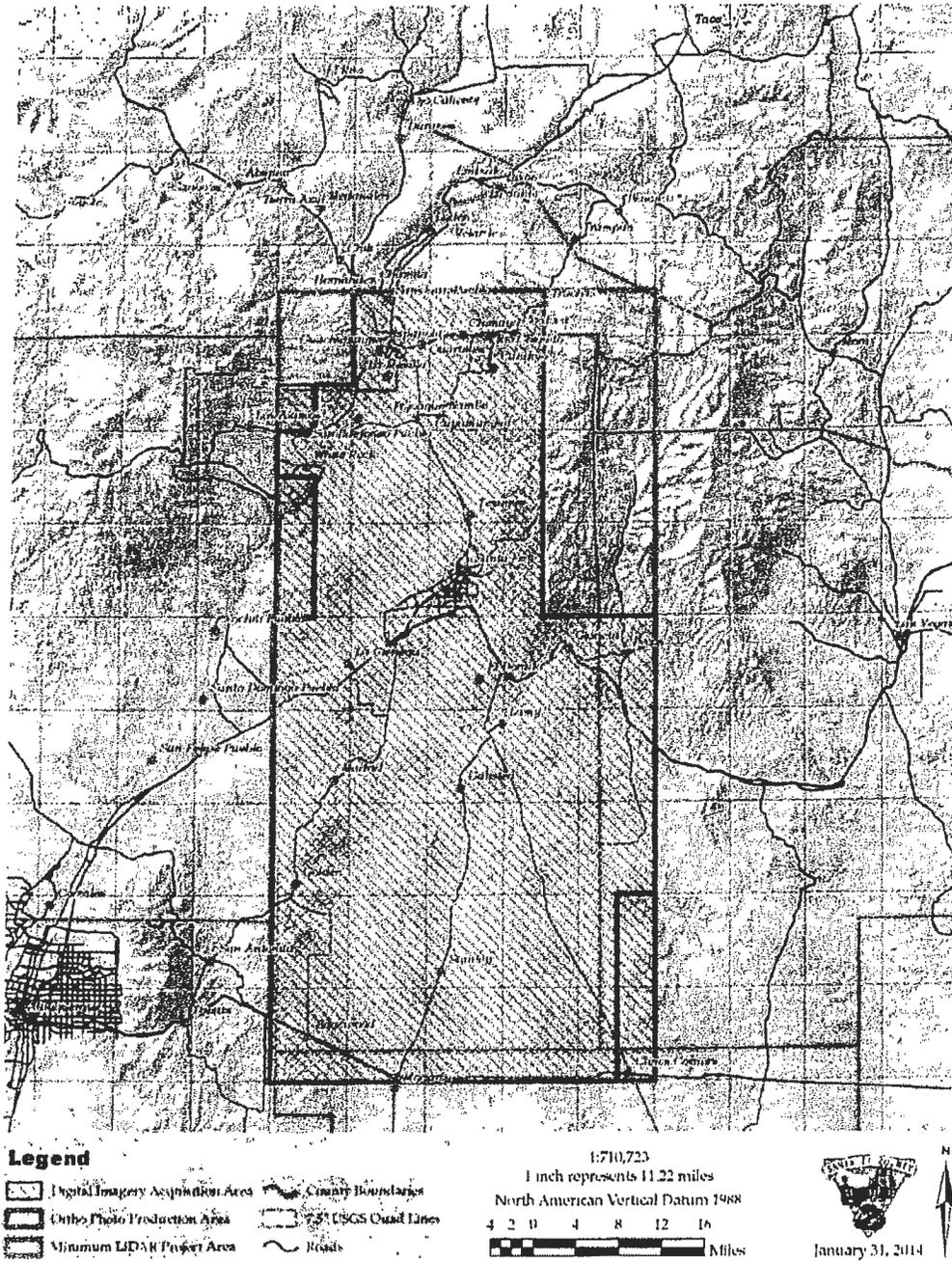


Exhibit C

Santa Fe County 2014 Cost Estimate and Rate Schedule

Phase IA - Source Data Acquisition

Task	Fee
Aerial Mission Planning/Ground Photo Control	
Aerial Mission Photo Control <i>Blue Book per Monument (not feasible in this window?)</i>	\$ 22,488.40 <i>not estimated</i>
Aerial Photography - minimum 2,210 sq miles <i>Eagle UltraCAM 0.5" resolution</i>	\$ 65,136.20
<i>Delivery</i> <i>Flight Lines/plan, control layout map, and data (raw imagery), photocenters, photofootprints (photo index), camera calibration</i>	
<i>Sub-Total</i>	\$ 87,624.60
<i>NMGRT @ 7.000%</i>	\$ 6,133.72
TOTAL	\$ 93,758.32

Phase IB - LIDAR Data Acquisition

Task	Maximum Fee	Minimum Fee
LIDAR Mission Ground Control		\$ 11,684.12
LIDAR Acquisition Q2 (Minimum Area - 2,600 Square Miles)		\$ 364,360.48
LIDAR Acquisition Q2 (Maximum Area - 3,400 Square Miles)		
Raw Point Cloud Collection Q2 (NPS = 0.7m)		
<i>Delivery</i> <i>Flight Lines and data, raw point cloud Option B - 8mm Exabyte Tape (per set)</i>		
<i>Sub-Total</i>		\$ 376,044.60
<i>NMGRT @ 7.000%</i>		\$ 26,323.12
TOTAL		\$ 402,367.72

Phase II - Data Production

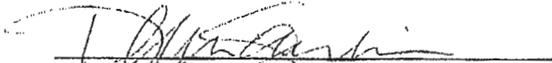
Task	Labor Hours	rate	Fee
A.1) Analytical Aero Triangulation	220	<i>see detail</i>	\$ 30,113.30
B.1) Classified Point Cloud - ortho area	920	<i>see detail</i>	\$ 108,423.30
B.2) Bare-Earth DEM - ortho area	120	<i>see detail</i>	\$ 13,948.00
B.3) Break lines (as required for specified ortho production area)		\$ 139.83 /Section	
A.2) Orthoproduction (2087 sq mi)		\$ 17.15 /Section	\$ 35,792.05
B.4) Optional Hydro-Enforcement - 3D Stream lines			
B.4.a Light Density Stream Collection		\$ 41.87 /Section	
B.4.b Moderate Density Stream Collection		\$ 334.92 /Section	
B.4.c Heavy Density Stream Collection		\$ 669.84 /Section	
B.5) TIN & DTM		\$ 12.56 /Section	
B.6) 2 foot Contours		\$ 27.63 /Section	
B.7) Optional Planimetrics			
B.7.a Light Building Collection		\$ 62.80 /Section	
B.7.b Moderate Building Collection		\$ 502.38 /Section	
B.7.c Heavy Building Collection		\$ 837.30 /Section	
<i>6) Delivery</i> <i>Multiple products depending on options exercised</i>			
<i>Total</i>			\$ 188,276.65
<i>NMGRT @ 7.000%</i>			\$ 13,179.37
TOTAL			\$ 201,456.02

Exhibit D Deliverable Table

Deliverables	Description	Phase
Project Plan	Includes proposed methodology for collection and processing; also includes risk mitigation strategies and contingency planning.	IA & IB
System Calibration	Report must be supplied prior to flight.	IA & IB
Collection Report	Includes mission planning and flight logs; study area PDOP, mission date, time, flight altitude, airspeed, scan angle, scan rate, laser pulse rates	IA & IB
Survey Report	Includes details of the collection of control and reference points used for calibration and QA/QC.	IA & IB
Processing Report	Includes calibration information, classification information and product generation methodology.	IA & IB
QA Reports	Includes verification of vertical and positional accuracy of the point cloud and derivatives; also a detailed explanation of the validation process. Also includes artifacts and their causes.	IB
Metadata	FGDC-compliant, XML format. One for each of the following: overall project, each lift, the classified point data, photocenters, photofootprints (photo index), the bare-earth DEM, breaklines, intensity images, contours	I & II
Control and calibration points	All control and reference points used to validate the point data and derivative products. In ESRI shapefile (.shp) format with associated FGDC-compliant metadata.	IA & IB
Digital Representation of Extents	Georeferenced, digital spatial representation of the extents of each delivered dataset, in ESRI shapefile (.shp) format.	
Aerial Photo Collection	All photocenters & photofootprints (photo index). In ESRI shapefile (.shp) format with associated FGDC-compliant metadata.	IA
Raw Point Cloud	All swaths, returns, and collected points, fully calibrated, adjusted to ground, by swath, in LAS v1.3 format.	IB
Analytical Aero Triangulation	Analytical aerotriangulation solution(s), report on horizontal accuracy of the DOI	IIA.1
Classified Point Cloud	All swaths, returns, and collected points, fully calibrated, adjusted to ground, by tiles, with classification scheme, in LAS v1.3 format.	IIB.1
Bare Earth Surface (Raster DEM)	Cell size no greater than 3 meters and no less than the design NPS, in ERDAS .img format.	IIB.2
Breaklines - Extent TBD	Includes stream centerlines, drainage ditches, tops and bottoms of streambanks, ridge lines, road crowns, levees, bulkheads, seawalls, road embankments, curbs (anything that directs the flow of water); in ESRI shapefile format (PolylineZ or PolygonZ as appropriate to the type of feature represented).	IIB.3 & IIB.4
DTM - post hydro-enhancement	mass point and breakline data created post optional hydro-enhancement	IIB.5
TIN - Optional	To be used to assess the accuracy of the point cloud.	IIB.5
Contours	1 foot, in ESRI shapefile (.shp) format.	IIB.6
Planimetrics - Optional	In ESRI shapefile (PolygonZ) format	IIB.7

Acknowledgement and Acceptance of Project Scope of Work

I, Dennis Sandin, undersigned below, acknowledge and accept the Scope of Work for the 2014 Santa Fe County Digital OrthoPhotography and 2014 Regional LiDAR Project detailed herein on behalf of Bohannon Huston, Inc.



Dennis Sandin, Senior Vice President
Spatial Data, Bohannon Huston, Inc


2 27 2014
Date
2/27/2014

**Santa Fe County 2014 Digital OrthoPhotography Project
Scope of Work**

I. SCOPE OF SERVICES

A. GENERAL PROJECT INFORMATION

Santa Fe County (“the County”) directs Bohannon Huston, Inc. (“Contractor”) to provide the photo control survey, aerial survey, and rectification services necessary for the production of high resolution, 4-band (true color RGB with color infrared {CIR} band 4) digital orthoimagery (DOI) and optional planimetric mapping for selected areas of the County of Santa Fe for use in a Geographic Information System (GIS). The work completed for this project shall be suitable for the production of digital photogrammetric mapping meeting the specified accuracy requirements. Funding commitments from local partners may not be confirmed until actual unit-costs are provided. Project funders will retain ownership of the imagery and associated products.

Exhibits are attached to aid the Contractor in both understanding the scope of this project and in formulating work plans required for the Scope of Work. *Exhibit A - Proposed LiDAR Project Area* shows the overall area of interest upon a shaded relief basemap with major roads, and cities and town. The base map illustrates the variation in the elevation in the County from approximately 5400 feet along the Rio Grande to over 13,000 feet in the Sangre de Cristo Mountains.

Acquisition Area: (see *Exhibit B - Proposed Ortho Photo Project Area*) 4-band digital imagery to be collected for the production of 0.5 foot pixel resolution capable of meeting a horizontal positional accuracy of +/- 2 feet or better. Minimum acquisition area will be approximately 2,210 square miles. Acquisition area may be expanded northward in contiguous blocks contingent upon funding commitments from local cooperators in this area.

Production Area: (see *Exhibit B - Proposed Ortho Photo Project Area*) 4-band DOI to be delivered at a 0.5 foot pixel resolution capable of meeting a 95% confidence level in horizontal positional accuracy of +/- 2 feet or better at a printed map scale of 1 inch = 100 feet. Proposed minimum production area will be approximately 2,090 square miles. Production area may be expanded northward in contiguous blocks contingent upon funding commitments from local cooperators in this area. Final production areas will ultimately be determined by per unit (square mile) costs, available budget including cooperator funding, and determination on whether to exercise optional product acquisitions (e.g., planimetric mapping, high density hydro-enhancement, NGS blue booking, etc). It is fully anticipated that funds will be available for the production of an absolute minimum of 2,000 square miles of 0.5 foot pixel resolution 4-band DOI.

Santa Fe County anticipates updating surface models with a LiDAR derived, hydro-enhanced digital terrain model (DTM) to be produced in conjunction with this digital orthoimagery project. The larger extents of the 2014 LiDAR project can be seen on both Exhibits A and B.

Proposals for the optional production of Building Footprint Planimetrics are requested for the purpose of updating and extending data derived from 1992 and 2001 projects.

B. GROUND CONTROL SURVEY – PHASE IA

1. General

The Contractor shall locate and establish the necessary ground control for absolute orientation of stereo models. Digital terrain models and/or digital elevation models for this orthoimagery project will be provided by the County via its selected LiDAR contractor and shall be used in the orthophoto rectifications process. It is the

responsibility of the Contractor to identify and field survey the ground control needed to satisfy the orthophoto rectification process. The Contractor shall specify the preferred specifications of paneling or marking for photo identification. It is the Contractor's responsibility to provide the specifications, including placement, size, and shape of the panels to be used for the establishment of geodetic control in the rectification of the orthophotography.

Ground control shall be supplemented by Airborne Global Positioning/Inertial Measurement Unit or AGPS/IMU solution and processing techniques. An AGPS PDOP of 3.2 (or smaller) shall be respected during digital imagery collection.

2. Existing Control Stations

In order to ensure consistency with past projects, horizontal and vertical control for the aerial survey and derivative products must be based on the existing High Accuracy Reference Network (HARN). There are several HARN stations in the Santa Fe County vicinity:

Station Name	NGS PID	Location
DOT 4	AI5440	NMSHTD (NM State Highway & Trans. Dept.) General Office
SANTAIR	FO1673	Santa Fe Airport
SAF ARP	AC7065	Santa Fe Airport
I40 R8	FO0983	Interstate-40 (7 miles NW of Edgewood)
MORIAIR 2	EQ1151	Moriarty Airport
LOS ALAMOS	FO1671	LANL (Los Alamos National Labs) -- Tech Area 33.

For redundancy/checking and better determination of error statistics the Contractor shall simultaneously collect data on at least two of these stations during all flights. The Contractor shall use the most up to date National Geodetic Survey (NGS) values for these stations. Wherever possible, existing 1st order control monuments shall be reoccupied and paneled as required for this project.

The supplemental control used for the orthophotography acquisition shall utilize as much of the same control as used for the LiDAR mapping portion of this project as is reasonably possible.

3. New Control Stations

Should the Contractor find/determine that existing 1st order control is not adequate to accurately establish needed ground control, new control stations (monuments) may need to be established. The County would prefer that such new control stations not only be of 1st order accuracy but also that such new stations (monuments) be blue-booked with the NGS (National Geodetic Survey). Contractor should provide cost estimates for establishing and blue-booking new 1st order control monuments with the NGS as a separate, optional cost (i.e., cost per monument). The County may, at its discretion, waive this request for blue-booking new 1st order control monuments and associated cost estimates.

4. Standards and Specifications

All coordinates shall be accurately referenced to the HARN New Mexico State Plane Coordinate System, Central Zone (3002), North American Datum of 1983 [(NAD83 (HARN)] and to the North American Vertical Datum of 1988 (NAVD88) in units of US Survey Feet.

C. AERIAL IMAGERY – PHASE IA

1. General

The acquisition of digital imagery shall be planned as to be capable of meeting a 95% confidence level in horizontal positional accuracy of +/- 2 feet or better at a printed map scale of 1 inch = 100 feet for the specified areas. The imagery shall be acquired in four-band (natural color RGB in band 1 to 3 and infrared in band 4).

2. Camera

The Contractor shall define what camera make and model will be used, define how the camera will be stabilized and the precision and focal length of the camera. The Contractor shall provide a certificate showing calibration within 6 months of the flight.

3. Aerial Photography and Photographic Products

4-band digital aerial photography to cover the areas of mapping as indicated on *Exhibit B - Proposed Ortho Photo Project Area*. Aerial photography shall be in conformance with specifications established by the American Society for Photogrammetry and Remote Sensing.

All aerial imagery shall be obtained during "leaf off" during April/early May 2014 and shall be undertaken:

- a. With the optical axis of the camera as nearly vertical as possible and in no case shall the tilt exceed 3 degrees.
- b. When atmospheric conditions are such that clear and well-defined images can be obtained. Imagery shall not be acquired when the ground is obscured by snow, clouds, cloud shadows, haze, smoke, dust and/or precipitation.
- c. At the time of day when shadows caused by topographic relief, and/or sun angle will be at or near a minimum. Aerial imagery shall not be attempted when the sun angle is less than 30 degrees above the horizon. Excessive and deep shadows may be cause for rejection of photography.
- d. With a minimum forward overlap in the line of flight averaging approximately 60% and a minimum of 30% sidelap, with greater overlap in steep terrain if needed to capture the bottoms of all canyons.
- e. The camera tilt will not be more than 3 degrees from the vertical axis at the time of image acquisition, nor shall it exceed 5 percent between successive acquisition stations.
- f. Deviation from planned flight height shall not exceed 5 percent.
- h. Efforts shall be made to ensure a uniform contrast between images, with no smears, blemishes or digital artifacts.
- i. Unacceptable aerial photography shall be reflown at no additional cost to the County. Reflight coverage must overlap accepted photography by at least two stereo-models. Photo center points and borders will be provided with reflight imagery in the same format as for initial imagery.

4. Photographic products

- a. One set of digital "raw imagery" shall be delivered to the County in either TIFF or JPEG 2000 format. File naming convention should be according to flight line number and photo/exposure number. All targeted points shall be identified. Digital "raw imagery" shall be submitted to the County for review as soon as practicable.
- b. Deliverables shall include:
 - Index of photo centers in a point layer in ESRI shapefile format.
 - Index of frame borders ("footprints") in a polygon layer in ESRI shapefile format. Each feature in these layers should include the date and time the frame was taken.

5. Access Agreements

The successful Contractor shall provide written notification to the County on the number and locations of ground control points used in this project. The Contractor shall determine land ownership encompassing those locations and as required, obtain site access permission. The Contractor shall notify landowners and coordinate with the appropriate personnel prior to on-site or over-site activities. The Contractor shall be solely responsible

for the requisite filing of flight plans and obtaining appropriate permissions from the FAA and other agencies as necessary.

D. DIGITAL ORTHOIMAGES – PHASE IIA

Digital Orthophotos shall be produced for the area shown as “Ortho Photo Production Area on *Exhibit B - Proposed Ortho Photo Project Area*. The contrast between adjoining orthophoto images shall appear to be reasonably consistent. All linear features on the ground shall appear linear, and all bridge warping shall be eliminated in the final orthorectified images, including in the infrared band.

Digital Orthoimage files shall generally be delivered in overlapping 5500 x 5500 foot tiles centered on Public Land Survey System (PLSS) sections or projected sections. A PLSS section grid layer will be provided by the County as a guide/template for image tiling. In areas where section dimensions are longer than 5300 feet (e.g. along or adjacent to correction lines) tile size shall be adjusted to extend 200 feet beyond section lines, again centered on the PLSS sections. The need for such “special” sections should be determined prior to finalization of the contract.

Digital Orthoimagery shall also be delivered as one project-wide mosaic in ECW format. Pending commitments from other local partners, project subset mosaics may be requested for City of Santa, City of Espanola and/or Rio Arriba County portions of the project. Contractor shall state whether or not production of such subset mosaics will incur additional costs, and if so, provide pricing details for project subset mosaics.

Contractor is encouraged to propose/discuss techniques which will ensure a proper mosaic of tiled imagery (e.g. tile to tile edgemarking, tile to tile uniform contrast/density, reliable cross tile measurements, etc.)

Before full production is begun, the Contractor shall provide the County with a prototype area of at least 4 square miles for quality control review. A notice to proceed for the full project will follow if all quality control checks are satisfactory. It is the sole responsibility of the County to determine the acceptability of the orthophoto product.

File structure for the raster image files will be TIFF format with Environmental Systems Research Institute (ESRI) world files AND ECW format for each tile. File naming convention should be opTTRRSS.tif for orthos & opTTRRSS.twf for worldfiles (lower case op – where TT is Township number, RR is Range number, and SS is Section number – leading zeros where applicable – ex. op100701.tif is orthophoto for Township 10, Range 7, Section 1).

FGDC (Federal Geographic Data Committee) compliant metadata will accompany the DOI files.

E. PLANIMETRIC MAPPING – Phase IIB.7

Optional planimetric mapping should be based on the DOI and shall be produced so that the position of all well-defined photogrammetrically compiled map features on the finished digital database are capable of meeting a 95% confidence level in horizontal positional accuracy of +/- 2 feet or better at a printed map scale of 1 inch = 100 feet. The Contractor is requested to provide pricing estimates for the collection of building footprint polygons attributed with building height for high medium and low density urbanized areas on a per square mile basis (per unit costs). The Contractor shall indicate their proposed methodology and equipment to be used for compiling planimetric data.

Collection via typical stereo photogrammetric methods is preferred. The County will consider alternate methods for building foot print collection and the Contractor is invited to present alternative proposals for the collection

of these data. Each such alternative proposal shall be brief, concentrating mainly on the specific aspects of the alternate method, plus the impact on pricing.

Regardless of collection methodology, delineation of building footprints shall be compiled as closed polygons attributed with building height and delivered to the County in an ESRI shapefile PolygonZ format. File naming convention to be determined. FGDC compliant metadata will accompany the planimetric files.

F. DELIVERABLES

The COUNTY shall receive the following items:

PHASE IA

1. Flight plan and control layout map, both in digital and hard copy formats.
2. Digital copy of "raw imagery" on CD-ROMs or other appropriate media, with a digital index/catalog of this imagery.
3. Photo index consisting of ESRI shapefiles of photo center points and "footprint" polygons.
4. Reports on: camera calibration, ground control, accuracy of airborne GPS, automation procedures and QC/QA measures.

PHASE IIA.1

5. Analytical aerotriangulation solution(s), horizontal accuracy of the DOI

PHASE IIA.2

6. Digital orthophotography: One set of the DOI raster image data files in both ECW and TIFF file formats and associated world files and metadata file(s) provided on an external hard drive.

PHASE IIB.7 – Optional

7. Digital planimetric mapping of building footprints: One set of the files in an ESRI shapefile PolygonZ format with associated metadata file(s) delivered on CD-ROMs or other appropriate media.

The delivery of digital orthophotography will be in phases, based on project funding.

1. Acceptance and Rejection of Products

Acceptance: Representatives of the County will be conducting in-house reviews of all products received. These include preliminary as well as final products, hard copies, and digital products. These representatives will perform all checks in a timely and orderly manner. The County may retain other CONSULTANT(s) to support this review process for all or part of this project. The Contractor shall be responsible for correcting errors or other inconsistencies that represent noncompliance with the specifications agreed to by the Contractor and the County. In no case will the completion date jointly agreed upon by the Contractor and the County be extended without the prior written approval of the County. Acceptance criteria for the primary deliverables will be categorized into data integrity verification (including format and data structure verification) and accuracy verification. After initial checking, work increments will be categorized by the County as follows:

Accepted: Orthophotography and derived products (i.e. planimetrics, etc.) that meet specifications will be formally indicated as "Accepted". Payment for work completed will not be made until the products are accepted by the County regardless of the number of edits or degree of corrections required.

Rejected: The number and character of errors detected by the County are such that the product is returned to the Contractor without complete editing. The Project Manager will formally notify the Contractor of the REJECTED status of the product. The Contractor shall edit and correct the product for resubmittal. If, at the

sole discretion of the County, there are an undue number of rejected products, the County may require the Contractor to suspend production until the problems contributing to the rejections are identified and corrected. This mechanism will be used for data sets which do not meet accuracy specifications, data integrity requirements, and/or data formatting requirements.

G. QUALITY CONTROL AND ASSURANCE

The Contractor shall provide a detailed description of the quality assurance/quality control (QA/QC) processes that will be employed in the execution of this project. The successful Contractor shall be required to provide QA/QC reports twice; once at the time of delivery of the prototype area and also at the final delivery of the remainder of the orthophotos. Included in the QA/QC reports will be airborne GPS accuracy reports, automation procedure(s) reports and other data used in this process. This information will be used by the County to support deliverable review and acceptance.

I. Project Tracking and Reporting

It is expected that several meetings between the Contractor's project management staff and the County will be required during the course of the project. The Contractor shall indicate the number of visits and the milestones or approximate schedule of such visits that are planned in the course of the project. Contractor should address significant milestones including deliveries of products and any meetings, working sessions or conferences with the County.

The Contractor shall maintain procedures throughout the project for tracking and reporting progress in the photogrammetric mapping process. Initial tasks of photography and aerial triangulation will be tracked and reported as a percentage of the total. Reporting on this phase of the project will be weekly initially and monthly once a regular production schedule is being maintained. The Contractor shall submit a written description of the project tracking procedures and systems that will be employed.

H. PROJECT SCHEDULE

Contractor shall indicate a schedule for completing each of the deliverables identified in the Scope of Work. Include the start and end dates and intermediate delivery dates for this project.

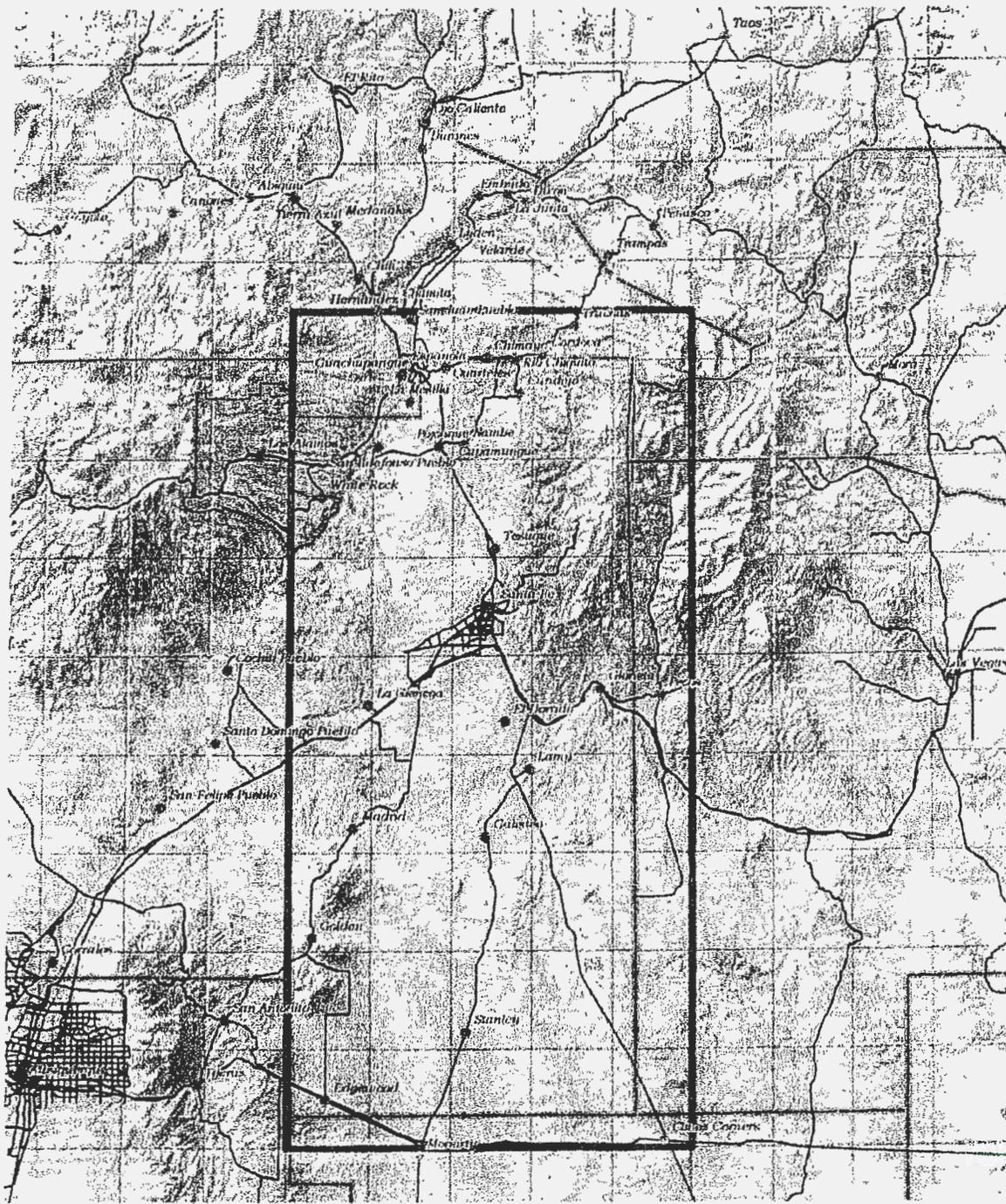
I. ALTERNATIVE PROCEDURES

I. Alternative Procedures

Due to changes, advancements, or refinements in technology, the Contractor is encouraged to propose alternative means for achieving the purposes of this project. Any recently developed techniques, products, or technologies that can deliver high quality and economical performance will be considered. Responses shall address the requests and specifications contained in this Scope of Work in addition to any alternative proposals. Any proposed alternatives must be demonstrated to be clearly superior and able to meet all project goals and requirements.

Contractor shall elaborate on any proposed exceptions. If exceptions are taken, state the general conditions involved, the exceptions taken, and alternative language.

Exhibit A - Proposed LIDAR Project Area



Legend

- Santa Fe County Project Area
- Proposed Maximum Project Area
- County Boundaries
- 7.5' USGS Quad Lines
- Roads

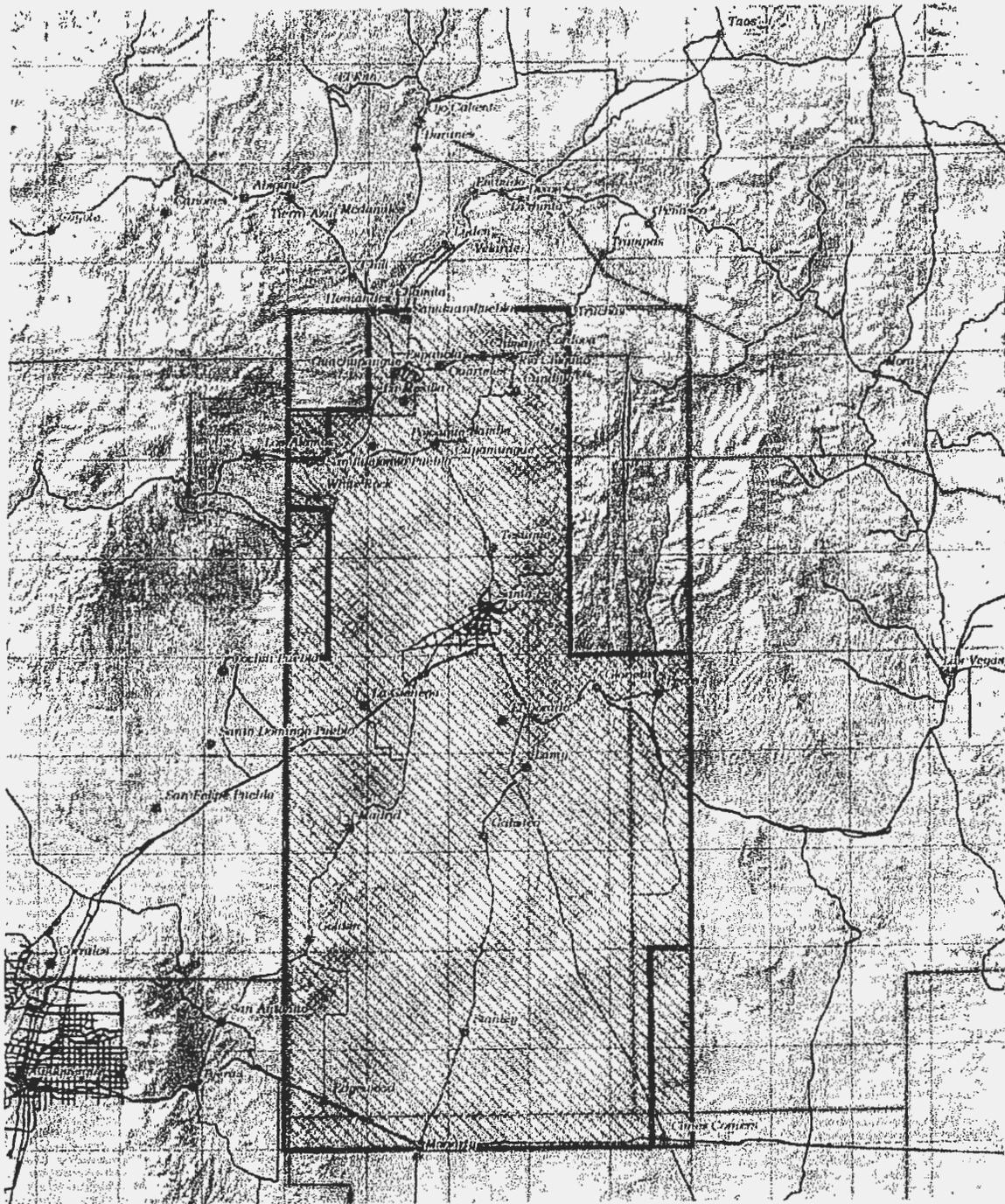
1:710,723
1 inch represents 11.22 miles
North American Vertical Datum 1988

4 2 0 4 8 12 16
Miles



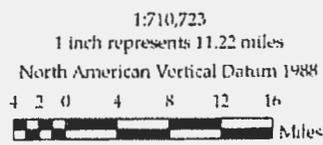
January 31, 2014

Exhibit B - Proposed Ortho Photo Project Area



Legend

- Digital Imagery Acquisition Area
- Ortho Photo Production Area
- Minimum LiDAR Project Area
- County Boundaries
- 7.5' USGS Quad Lines
- Roads



City of Santa Fe, New Mexico

BUDGET ADJUSTMENT REQUEST (BAR)

DEPARTMENT / DIVISION / SECTION / UNIT NAME				DATE
Public Utilities/Water				11/07/2014
ITEM DESCRIPTION	B.U. / LINE ITEM	SUBLEDGER <small>(Finance Dept. Use Only)</small>	INCREASE	DECREASE
Water Division	5300.52300.510340		75,000	
JUSTIFICATION: <i>(use additional page if needed)</i>			TOTAL	\$ 75,000

Increase from the Water Cash Reserves
for the Santa Fe County LiDAR Project

Maya Martinez Prepared By _____ Date _____ Division Director Date _____ Department Director Date _____	<p style="text-align: center; margin: 0;">CITY COUNCIL APPROVAL</p> <p style="text-align: center; margin: 0;"><small>City Council Approval Required</small> <input type="checkbox"/></p> <p style="text-align: center; margin: 0;"><small>City Council Approval Date</small> _____</p> <p style="text-align: center; margin: 0;"><small>Agenda Item #:</small> _____</p>	 Budget Officer _____ Date 2/27/15 Finance Director _____ Date 3-10-2014 City Manager _____ Date _____
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