Acquisition + Processing
Pope / Hardin

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February 27, 2014

CLIENT CONTACT: Mr. Matt Edmonson
UIUC Facilities & Services, Planning Division
Physical Plant Service Building
1501 S Oak Street
Champaign, IL 61820

RE: PSSU14R19 Photogrammetry and LiDAR Services – Retainer Agreement 2014-0446

Quantum Spatial Preliminary Project Number – ___ Acquisition of Airborne LiDAR and Post Processing of LiDAR Datasets for Hardin and Pope Counties in Illinois

Dear Mr. Edmonson:

The following responds to the request for Retainer Services from Quantum Spatial, Inc. for the Illinois Height Modernization Program (ILHMP), which is managed by the Illinois State Geological Survey (ISGS). The Photogrammetry service activities response has been broken down into two separate phases. This submittal is for;

(1) Pope and Hardin Data Acquisition: project data acquisition of Light Detection and Ranging (LiDAR) data and initial processing and data quality assurance (QA) and quality control (QC) to validate the quality of newly acquired data.

(2) Pope and Hardin Data Processing: for all data processing to create contract deliverables including las classification, generation of data derivative products, creation of metadata and reports, and final delivery of all data.

This proposal includes a detailed scope of work for the services required to complete data acquisition and processing, the timeline for data acquisition through final delivery, and itemized proposed service fee.

PHASE 1 ACQUISITION STATEMENT OF WORK:

Project Area Description
LiDAR data will be acquired for Hardin and Pope Counties in Southern Illinois. Approximately 710-square miles of LiDAR will be collected including a 1 tile buffer around the project area including the bluff area along the Ohio River.

Project data will be collected at a nominal pulse spacing (NPS) of 0.70 meters, or 2 - points per square meter with 51 % swath overlap (4 - points per square meter including swath overlap)
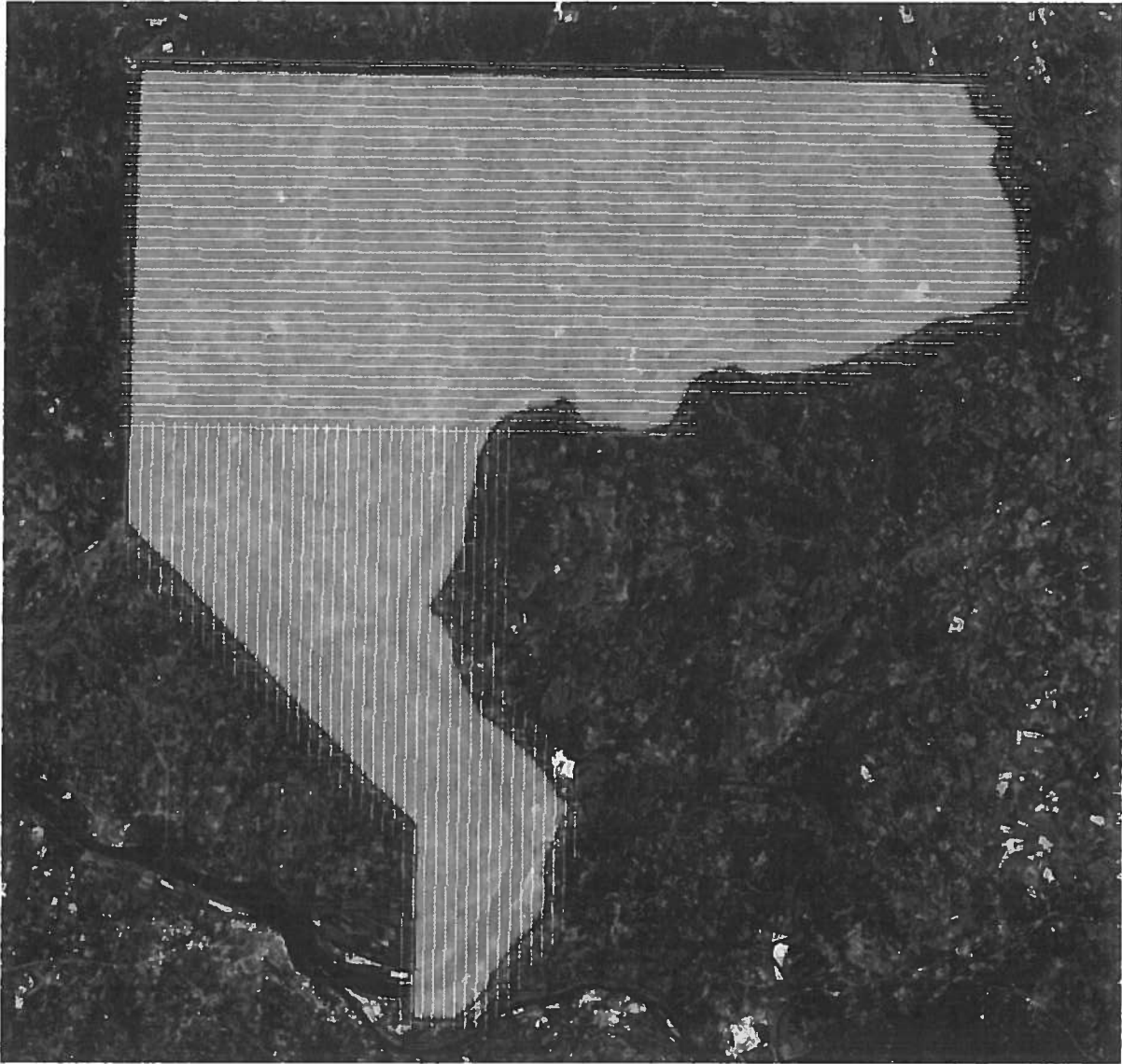
The approximate project boundary was defined by the GIS data layer provided by Janet Holden of ISGS. The intention is for this project to extend beyond the county boundary by a single index tile.

The project has been designed to acquire LiDAR coverage to provide complete tile coverage of the 710 - square mile AOI.

LiDAR ACQUISITION SCOPE OF WORK:

The LiDAR data will be collected and post processed following the steps outlined in our original Statement of Qualifications.   All collection and initial post processing will be compliant with U.S. Geological Survey National Geospatial Program LiDAR Base Specification, Version 1.0 (see http://pubs.er.usgs.gov/publication/tm11B3).

LiDAR data will be collected upon notice to proceed. Data will be collected cloud and fog free between the aircraft and ground. The ground will be snow free and no unusual flooding or inundation is allowed in the floodplain and upland areas. The acquisition will occur Spring 2014 during leaf-off conditions. The ultimate goal for this project is to acquire the data during Spring 2014 leaf-off conditions if feasible. If weather or ground conditions impede the collection, Quantum Spatial will work with ISGS to negotiate a project delay to Fall 2014.

This project was planned using a Leica ALS70 LiDAR sensor.

Field Survey

The ground base station operations will be closely coordinated and controlled, and that all aspects of data quality will be monitored throughout the production and delivery process. Quantum Spatial will be responsible for ground control points. We will field survey approximately 30 points in open, flat areas randomly distributed throughout the project area for use as LiDAR QA, QC check points. An additional 100 points shall be surveyed in each of the five vegetative classes within the Hardin and Pope project area to be used as FEMA required quality test points. GPS establishes precise geodetic control points using satellites and ground-based receivers to triangulate extremely accurate geographic coordinates on the earth's surface. Points will be accurate to better than 3x the anticipated accuracy of the LiDAR data.

LiDAR Specifications and Flight Plan

LiDAR Flight Preliminary Parameters – 2ppsm 51% overlap	
Point Density	2 ppm (SPS) 4 ppm (DPS)
Accuracy	9.25 cm or better
Flight Altitude	6889 ft. AGL
Airspeed	Average 150 kts
Laser Repetition Rate (prf)	261 kHz
Scan Frequency	39.1 Hz
Total Scan Angle	40°
Overlap	51 %
Swath Width	1528 m
Flight Lines	79

INITIAL LiDAR POST PROCESSING:

Data Validation

For field quality control purposes, after each flight, the LiDAR datasets are field checked for data acquisition swath coverage and as a preliminary GPS review. Both horizontal and vertical aircraft position and orientation are verified and reviewed using the flight plan to ensure proper coverage of LiDAR data. The in-office processing steps are similar to the field processing with the addition of GPS data quality reports generation. Inertial Measuring Unit (IMU) data is processed and checked for gyro bias, systematic errors, as well as positional error. The GPS trajectory of the survey aircraft is post-processed and the smoothed best estimated trajectory (SBET) is calculated combining the post-processed GPS solution with IMU and lever arm measurements.

PHASE TWO – LiDAR PROCESSING STATEMENT OF WORK:

Project Area Description

LiDAR data will be processed for both Hardin and Pope Counties. Approximately 710-square miles of LiDAR will be processed; this includes a 1 tile buffer around the project area including the bluff area along the Ohio River.

Project data will be processed at a nominal pulse spacing (NPS) of 0.70 meters, or 2 - points per square meter with 51 % swath overlap (4 - points per square meter including swath overlap). The data will be accurate to 9.25 RMSEz and meet USGS QL2.
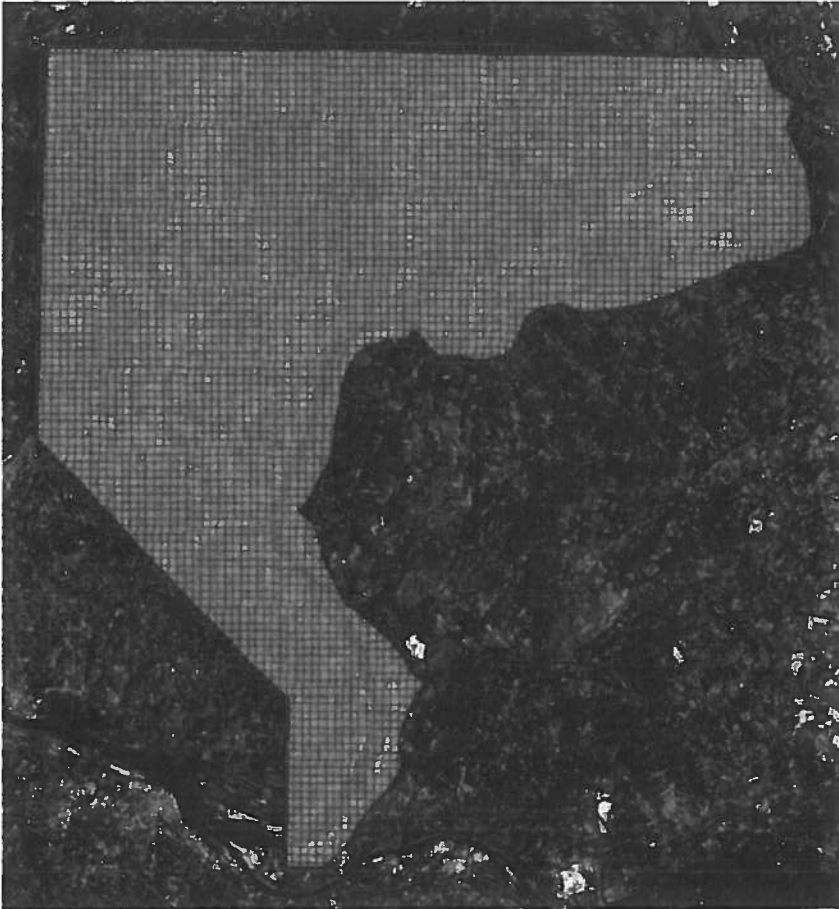
Quantum Spatial will perform all tasks related to the processing of Airborne Light Detection and Ranging (LiDAR) data for a project area encompassing approximately 710-square miles of Hardin and Pope Counties in Illinois. The task list includes, but will not be limited to: complete LiDAR data point cloud classification and data processing to generate hydro-flattened digital elevation models, perform data QA/QC, and compile related metadata, FOCUS report, and GIS tile index data.

Processing of LiDAR data deliverables will be in conformance with the project scope of work defined by ISGS for the referenced Counties. The ISGS requested data and derivative data deliverables will be compliant with U.S. Geological Survey National Geospatial Program LiDAR Base Specification, Version

1.0. Data deliverables will be in conformance with recent IDOT data deliveries in las, dgn, dat, and tin formats from previous Quantum Spatial contracts for airborne LiDAR for IDOT District 4 and IDOT District 5. Data will meet USGS QL 2.

LiDAR PROCESSING SCOPE OF WORK:

The LiDAR data will be processed following the steps outlined in our original Statement of Qualifications. All processing will be compliant with U.S. Geological Survey National Geospatial Program LiDAR Base Specification, Version 1.0 (see http://pubs.er.usgs.gov/publication/tm11B3). LiDAR data will be processed once data has been verified after data collection.

Data Classification
The LiDAR filtering process encompasses a series of automated and manual steps to classify the point cloud data set. Our team works closely with USGS and uses the USGS NGP LiDAR Base Specifications v1.0-based LiDAR data classification scheme requested by ISGS. LAS data will be provided in ASPRS version 1.2 or 1.3 per USGS specifications.
The LiDAR classification process encompasses a series of automated and manual steps to classify the point cloud data set. Every Illinois County will be reviewed separately due to unique land cover and cultural features. Hardin and Pope are rural counties in the southern portion of the state (an area known as Little Egypt). These counties are heavily vegetated with rolling terrain. These characteristics were thoroughly evaluated by Quantum Spatial at the onset of the project to ensure that the cost estimation is correct and appropriate automated filters are applied and that subsequent manual filtering yields correctly classified data. Our filtering process uses finely tuned algorithms to automatically identify and classify features that have an extremely high probability of being non-ground features such as vegetation or structures. Feature classification codes are listed below.

Classified Point Cloud

Code:	Description:	
0	Created, never classified	
1	Unclassified1	
2	Ground	
3	Low Vegetation	[numeric cutoff values to be provided by INHS]
4	Medium Vegetation	[numeric cutoff values to be provided by INHS]
5	High Vegetation	[numeric cutoff values to be provided by INHS]
6	Building	
7	Low Point (noise)	
8	Model Key-point (mass point)	

Breaklines
All breaklines developed for use in hydro-flattening will be delivered as an ESRI feature class, Polyline Z or Polygon Z format, as appropriate to the type of feature represented. ESRI file geodatabase format is required. Breaklines should be as a continuous layer and must use the same horizontal and vertical coordinate reference system and units as the LiDAR point delivery. Hydroflattening will be in conformance with USGS version 1.0.

Metadata

Project-level metadata shall be delivered that fully comply with Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM) format standard in XML format. Metadata will describe the project, data acquisition methods, system calibration, processing methods, and statistical validation process and results. Project documentation will include control point and flight diagram information from the LiDAR acquisition flight.   All metadata will run through the USGS validation services website (http://geo-nsdi.er.usgs.gov/validation) prior to delivery.

QA/QC and FOCUS Reporting

Quality Assurance (QA) and Quality Control (QC) steps are incorporated throughout the entire LiDAR process to ensure that project requirements and industry standards are met. The LiDAR FOCUS report is a quality assurance solution that reports on a comprehensive set of testing and reporting tools. A number of the tests provided in these reports are required in Version 1.0 of the USGS Base LiDAR Specifications and FEMA PM 61. The project summary within FOCUS includes a detailed accounting of LAS versioning, projection, datum, units, point formats, return information, point classification, the location of high and low points, and other useful project information on a tile-by-tile basis. There is also a detailed accounting and intuitive graphic for the final calibration of the elevation surface.

LiDAR Mapping Accuracy

The LiDAR mapping provided under this proposal will meet or exceed accuracies stated below:
The vertical accuracy will be less than or equal to 9.25 cm RMSEz and meet USGS QL2 requirements. The surface will be suitable for 2-foot contour generation. Digital elevation data will be suitable for digital mapping, planning studies, and the development of precise topographic maps and digital elevation models. Data will be compliant with U.S Geological Survey National Geospatial Program LiDAR Base Specification, Version 1.0.

Due to the inherent nature of LiDAR technology, success of vegetation removal may decrease in leaf-on environments. LIDAR pulses may be naturally absorbed by water bodies or areas recently covered with asphalt or tar. These areas may result in small data voids in the DEM data.

PROJECT TEAM:

The Quantum Spatial, Inc. project team will consist of any number of qualified personnel from our pool of corporate wide personnel to fulfill the specialized requirements of the project requirements. The disciplines required to fulfill the Scope of Work are varied, thus a specific listing of personnel other than the project managers will not be known until the process is begun. Key administration, project management and production managers shall be as follows:

> Jeffrey B. Stroub, Vice President – Contract Administration
> Jennifer Whitacre – Assistant Contract Administrator
> James Young – Wide Area Project Manager
> Chris Guy – Assistant Wide Area Project Manager
> Rob Merry – Geomatics Project Manager

DELIVERY ITEMS:

All products for Hardin and Pope Counties will be delivered as a stand-alone County delivery. It will include a 1 tile buffer around the counties. All deliverables will be delivered in the tile index provided by ISGS. Deliverable formats will be verified prior to data delivery.

1. **Unclassified LiDAR Point Cloud in LAS v1.2 file format**
   a. LiDAR will be calibrated and georeferenced to NAVD88, NAD83, Illinois State Plane East, US Survey feet
   b. Data will be provided in American Society for Photogrammetry and Remote Sensing (ASPRS) Standards for LAS version 1.2
   c. Data will be provided in the existing tiling index for Illinois.

2. **Vertical Accuracy Assessment in .PDF format**
   a. Report on Fundamental, Supplemental and Consolidated Vertical Accuracy

3. **FGDC Compliant Metadata in .XML format**

4. **Classified LiDAR Point Cloud in LAS v1.2, and .DAT file formats**
   a. LiDAR will be calibrated and georeferenced to NAVD88, NAD83, Illinois State Plane East, US Survey feet
   b. Data will be provided in American Society for Photogrammetry and Remote Sensing (ASPRS) Standards for LAS version 1.2
   c. Data will be provided in the existing tiling index for Illinois.
   d. Classifications as defined in processing write up above.

5. **Break lines Provided in .DGN file format**
   a. Continuous layer
   b. Same coordinate system as LiDAR delivery

6. **TIN surface in .TIN file format**

7. **Hydroflattened DEM in .DEM file format**
   a. In compliance with USGS version 1.0

8. **Geodatabase of All Deliverables in ESRI file format**

9. **FGDC Compliant Metadata in XML format**

10. **FOCUS Report Provided in PDF and HTML format**
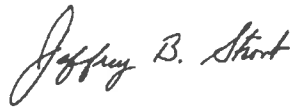
PRICING:

The fee consists of data acquisition and processing to create contract deliverables including .las classification, generation of data derivative products, creation of metadata and reports, and final delivery of all data for the combined approximate 710-square miles of Hardin and Pope Counties, Illinois.   Neither additional fees nor reimbursable costs are expected. Fees are payable to contract terms and conditions.

TOTAL FEE not to exceed:

PSSU14R19 Photogrammetry and LiDAR Services – Retainer Agreement 2014-0446
Quantum Spatial Project Number:
February 27, 2014

Respectfully Submitted,

Jeffrey B. Stroub

Jeffrey B. Stroub, CP, RLS, PPS, SP
Vice President Business Development

C: Jennifer Whitacre, GISP – Assistant Contract Administrator