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**DEPARTMENT OF PUBLIC WORKS - Engineering Division**

**MEMO**

TO: Members of the Municipal Services Committee  
FROM: Ross Buetow, Deputy Director of Public Works  
SUBJECT: 2015 Aerial Imagery/LiDAR Contract Award  
DATE: February 17, 2015

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In 2006, the Common Council approved a ten-year agreement between the City and Quantum Spatial (a.k.a. Aerometric, Incorporated) for orthophotography and mapping services, with specific scopes of services and their related contracts to be approved on an annual basis. At the end of 2015, we will have reached the end of the originally approved contract term. To date, Quantum Spatial has provided a very high level of quality technical services and the City has been very satisfied with our professional relationship.

For our 2015 project, we are requesting approval for all necessary field work (i.e. flights, ground control and aerial imagery) to obtain complete LiDAR (*Light Detection and Ranging*) data coverage for all of Appleton (see attached Figure 1). In addition to the field work described above, the project scope also includes the creation of 1-foot contour maps prepared to USGS map accuracy standards along with tree height classifications for the entire city. The LiDAR process will essentially provide a complete three-dimensional point cloud representation of the City's ground surface, which can be used by City Engineering and GIS staff for numerous subsequent stormwater and mapping applications. We are able to pursue the LiDAR project in 2015 because the City's GIS staff has already obtained updated 2014 Digital Orthophotos from Outagamie and Calumet Counties late last year.

We are hereby requesting to award the 2015 Aerial Imagery/LiDAR Contract to Quantum Spatial in an amount not to exceed \$50,000 (our approved 2015 budget amount), based on the attached scope of services provided by Quantum Spatial.

Thank you for your consideration.



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February 13, 2015

Mr. Ross M. Buetow, Deputy Director  
City of Appleton, Department of Public Works  
100 North Appleton Street  
Appleton, Wisconsin 54911

Re: 2015 Light Detection and Ranging Data Collection and Processing Program

Dear Mr. Buetow:

During the recent past we have met to discuss a program for development of Professional Terrain Surface Development. Participating in these discussions were members of your staff interested in elements of this proposed project.

It has been determined the project will be developed based upon the criteria associated with the United States Geological Survey LiDAR Base Specification Version 1.1 This document supercedes the previous FEMA specifications. The final contours will be processed to meet National Map Accuracy Standards.

This correspondence will summarize our offering, based upon the discussions conducted at your office on January 28, 2015. During our meeting we jointly identified a base project which will result in deliverables which will include:

- 1) City-wide collection of Light Detecting and Ranging (LiDAR) data sets to facilitate terrain surface processing and contour development.
- 2) Completion of the appropriate field surveying procedures to develop accuracy testing check points to confirm the final terrain surface data to be developed in conjunction with final LiDAR processing.

The project will be prepared with the appropriate reporting documentation developed for you. This means going forward, the project acquisition criteria will be accepted by USGS for use in High Accuracy Terrain Surface mapping.

Our approach recommends specific technologies that we believe are most appropriate, practical, cost effective, and advantageous to achieve the outcomes required by your office.

We propose to deploy our LiDAR sensor technology to collect laser point returns required for digital terrain model (DTM) surfaces, and contour data, as opposed to using a traditional photogrammetric method. The following correspondence will describe, in detail, the processes that we expect to undertake.

## PROJECT AREAS

The graphic below and defined as Figure 1 is a representation of the LiDAR acquisition area and the corresponding flight lines to cover the project area. This includes the appropriate buffer to ensure complete coverage of the project. Additionally, Table 1 details the flight parameters.

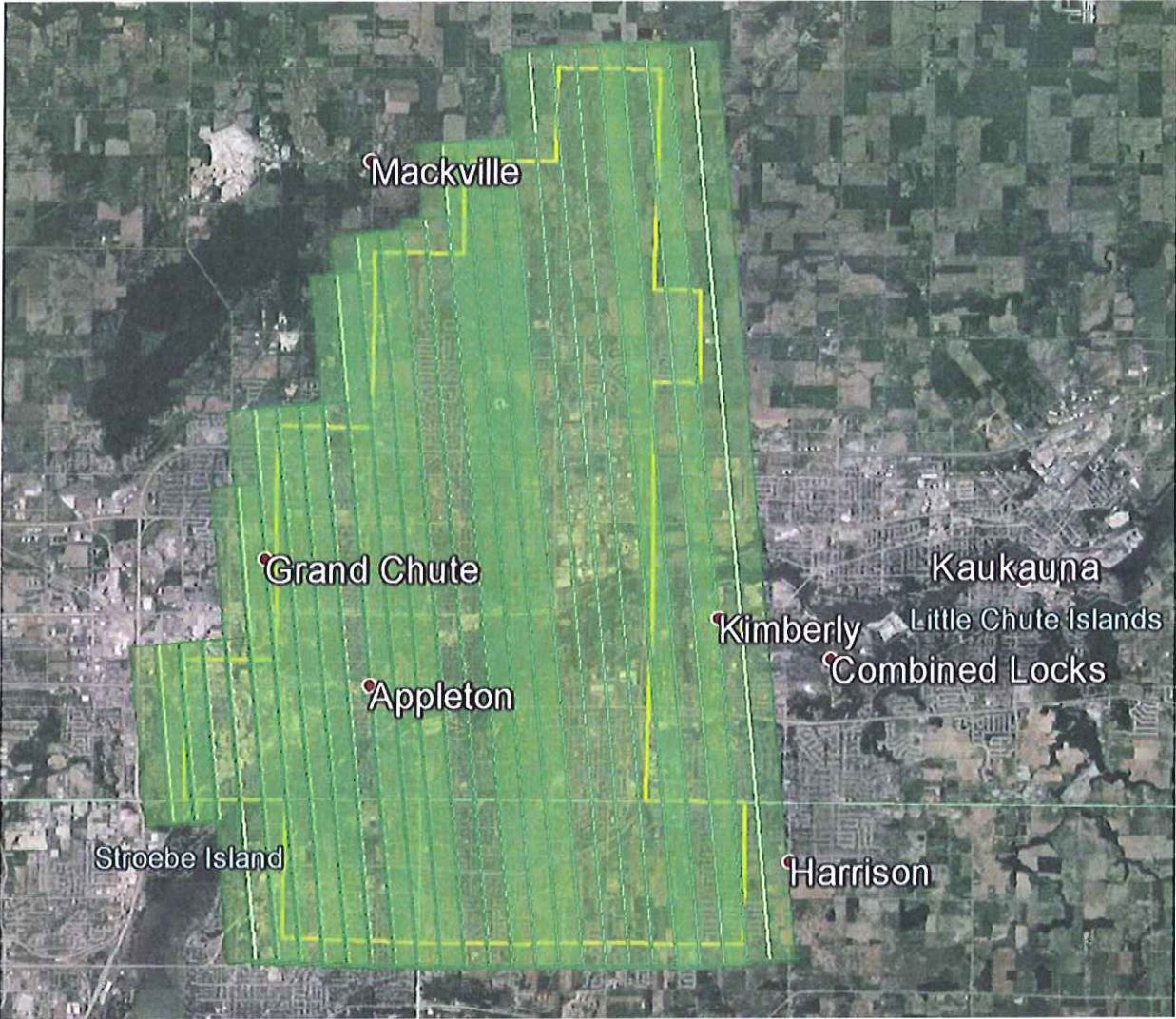


Figure 1: Project area and flight lines overlaid on project area

Winnebago	
	Base
Flight altitude (AGL)	1600 meters
Rep Rate	350.2 KHZ
Scan frequency	64.41 Hz
Scan half angle	15 degrees
Air Speed	140-160 knots
Scan full angle	30 degrees
Swath width	857 meters
Overlap	50% side lap (100% overlap)
point density average	8 ppm (including overlap)
Required point density	5 ppm (single swath)
Anticipated Acquisitions	1
Line spacing	735.4 meters

Table 1: Collection Parameters

## DIGITAL TERRAIN COLLECTION AND PROCESSING

During our discussions we have agreed that Light Detection and Ranging (LiDAR) is the most appropriate technology and method to achieve your elevation data objectives. Airborne LiDAR uses advanced laser technology to measure elevation, with each light pulse return registered precisely in space. LiDAR technology offers the most accurate, expedient, and cost effective way to capture wide-area elevation information to support the creation of highly detailed digital terrain models (DTMs).

LiDAR data sets contain vast amounts of information. The data is 100 % digital from the point of capture and may be directly processed to produce service items such as detailed bare-earth elevation models, contour maps, DTM and TIN data sets, breakline data, three-dimensional topographic images, and more. All of the topographic deliverables that you may require can be reliably and efficiently generated through the LiDAR project approach we are proposing.

We would utilize one of our four Leica ALS-70HP LiDAR sensors for your program. These systems are extremely accurate and capable of providing data well within your accuracy requirements. The Leica ALS -70HP, although capable of operating at 500 kHz, will operate at 350 kHz for this project as indicated in Table 1. This system uses spit-beam and multi-pulse technology to improve the point density and accuracy. The system is capable of identifying up to seven returns for a single pulse. Additionally, the beam divergence on this system creates a pulse footprint of about 10 to 17 cm in diameter when it enters a vegetation canopy. This greatly improves the probability of a pulse reaching the ground. This is especially important in areas of vegetation and tall trees. Not all systems do this.

Our Leica LiDAR system also includes a real-time flight planning, flight tracking, navigation, and acquisition system, with built-in QA/QC. Our LiDAR system contains a Global Positioning System (GPS) receiver, as well as an Inertial Measuring Unit (IMU). These highly accurate measuring tools provide the essential LiDAR positions and orientations necessary to develop the data to intermediate products and final deliverables.

We have determined the altitude that is best suited for your deliverables and accuracy given the City of Appleton's local geographic conditions. This has been calculated at approximately 1,600 meters AMT (Above Mean Terrain) as indicated in the table. The prescribed LiDAR mission would consist of 26 north-south passes. Additional perpendicular flight lines would be flown for validation and calibration.

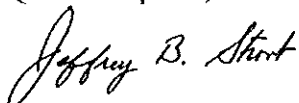
## FEE ESTIMATES

The fee for LiDAR data capture and processing point cloud status, DTM, break line, 3D contour QC testing, FOCUS Report development, and tree height classification for the 34.8 square mile area will be \$50,000. We anticipate all services shall be completed and delivered not-later-than December 15, 2015.

We trust this proposed scope of **Professional Photogrammetric Survey services** is in accordance with our discussions and your expectations. We look forward to the opportunity to again provide our services for the City of Appleton.

As always, should you have any questions please do not hesitate to contact me at your convenience. Please contact me at 920-457-3631.

Sincerely,  
Quantum Spatial, Inc.



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