

EXHIBIT A: Scope of Work and Compensation

Scope of Work

I Deliverables

a. Pre-Flight Deliverables

Prior to data collection, CONTRACTOR must submit:

- (1) A map showing the study area boundaries and planned flight path, at a medium scale (1:50,000) or small scale (1:100,000). Map shall identify which GPS ground control points are used as base stations on particular flight path's and areas.
- (2) Data sheets documenting vertical & horizontal accuracy of selected GPS base points.
- (3) Documentation specifying altitude, airspeed, scan angle, scan rate, LiDAR pulse rate, receiver return mode, swath width, percent sidelap between swaths, average along-track and cross-track shot spacing per swath, and other flight and equipment information deemed appropriate, and
- (4) A plot of PDOP as a function of time during the data collection period indicating times when data will not be acquired due to high PDOP.

b. Post-Project Deliverables

Following a schedule detailed in Section C, CONTRACTOR must submit:

- (1) For all acquired laser returns a data record that includes:
 - (a) Time-stamp, (i.e. date and time of acquisition indicated so as to uniquely identify each laser shot),
 - (b) x,y,z geolocation for each return with x and y position in US Survey Feet referenced to the Washington State Plane Coordinate System, North Zone, NAD83, 1991 Adjustment, and z reported in Feet both as ellipsoid (WGS-84) and orthometric (NAVD-88) elevations derived from the National Geodetic Survey Geoid Model Geoid99 available from the NGS at:
www.ngs.noaa.gov/GEOID/GEOID99/geoid99.html,
 - (c) scan angle for the laser shot,
 - (d) the laser shot return number (1, 2, 3, or 4), and

- (e) return type, which at a minimum indicates those returns which were included in derivation of the ground surface DEM (item Ab(2)) but, if available, will indicate additional types such as returns used in derivation of building polygons (item Ab(6)).
- (2) DEM gridded at 6ft easting and northing postings of the orthometric elevations for all returns identified as being from the ground, derived using gridprocessing and referenced to Washington State Plane Coordinates as noted in Ab(1)
- (3) Shaded relief rendition of the 6ft, ground surface DEM as paper maps at 1:12,000 scale referenced to Washington State Plane Coordinates as noted in Ab(1). The maps shall show greyscale hillshade with illumination from an azimuth and inclination to be established in consultation with COUNTY. Digital files shall also be provided on CD in HP-RTL pre-ripped format
- (4) DEM gridded at 6ft easting and northing postings of the orthometric elevation for all returns from the upper-most surface (i.e., first-return from canopy and structure tops, and ground where there is no vegetation or structures), derived using gridprocessing and referenced to Washington State Plane Coordinates as noted in Ab(1).
- (5) Time-stamped GPS aircraft x,y,z trajectory, using the same time-stamp as noted in Ab(1), with x and y referenced to Washington State Plane easting and northing and with quality metrics such as, but not necessarily limited to, the PDOP and estimated RMS error at each GPS epoch,
- (6) Polygon shape-files for structures that are 30 m or greater in height and that have a roof area of 500 sq m or greater, and
- (7) Final reports documenting system calibration, instrument acquisition parameters, GPS ground control, data processing procedures, and validation of data quality demonstrating that specifications in D have been met.

B Delivery Format

The following specifications shall apply to all data deliveries

Coordinates:	Double Precision
Digital Media:	CD ROM
Digital Media Format:	Binary compressed ASCII, gzip compression format for deliverables .Ab (1,5 & 6) ArcInfo Grid file in export format gzip compressed for deliverables in .Ab (2, 3, & 4,)
Maximum File Size:	200 megabytes uncompressed unless otherwise specified by COUNTY
Transmittal:	Shall include listing of all filenames and applicable project area per attachment 1 (map)
Hardcopy Media:	Paper
Hardcopy Scale:	1:12000
Number of Copies:	Seven copies of all deliverables.

C Schedule

Field data acquisition must be completed by mid-March, prior to leaf on conditions.

Delivery Phases of products to COUNTY for Quality Control checking shall be divided into 4 areas (see map: Attachment 1)

Area 1 Kitsap County Area A
Area 2 Kitsap County Area B
Area 3 Seattle Area
Area 4 USGS/NASA/PSRC Areas

Delivery of each of the areas is to be phased in time to provide COUNTY an opportunity to review, and accept or reject the deliverables for area sequentially, rather than delivering all deliverables at one time. The final delivery shall be made no later than 110 working days from end of data acquisition (March 15). COUNTY shall review and accept/reject products within 30 days of delivery. CONTRACTOR should propose a preferred delivery schedule.

Following a thorough Quality Control review by Consortium staff, data will be accepted or rejected-based on specifications in the RFP. If it is determined the acquired LiDAR data is insufficient to meet the RFP specifications, CONTRACTOR will be required to re-fly those areas identified as deficient between December 1, 2000 and March 15, 2001 to avoid leaf on conditions.

D Technical Specifications

The LiDAR data shall be acquired meeting the following specifications:

- (1) The average cross-track and along-track spacing of laser pulses yielding valid ranges shall be no larger than 2 m, where a valid range is considered to be to the ground or to vegetation, buildings or structures on the ground.
- (2) The cross-track and along-track spacing at the 90% frequency of occurrence of laser pulses yielding valid ranges shall be no larger than 4 m,
- (3) The laser ranging data shall be acquired using a LiDAR system that collects first and last returns, or multiple returns, for each laser pulse,
- (4) Data collection will not be conducted while there is snow cover on the ground nor during inclement weather conditions (high winds, rain, fog, low cloud cover) that would significantly diminish the quality of the data, and
- (5) Geodetic GPS Base Station locations shall be control points in the Washington State High Accuracy Reference Network (HARN) on points with Orthometric heights determined by differential leveling. CONTRACTOR shall contract with a local GPS surveyor for consulting support in regards to establishing additional base station control points and field verification procedures, per item D(6). CONTRACTOR shall

provide a report of which base points were used on particular flights and areas. Information on HARN points may be obtained from the Washington State NGS Advisor:

Gary Perasso
National Geodetic Survey
5521 44th Ct SE
Lacey, WA 98503
(360) 705 7247 voice
(360) 705 6835 fax
perassg@wsdot.wa.gov

In the event there is insufficient density of HARN points in a particular area, CONTRACTOR may:

- a) Utilize the Washington State DOT control network. See <http://wsdot.wa.gov/monument/>
 - b) Establish horizontal control as necessary adjusted to the HARN utilizing dual frequency receivers with surveys done to at least Third-order, Class 1 specifications as promulgated by the Federal Geodetic Control Subcommittee (FGCS). Vertical control shall be established using differential levels according to third-order Class 1 FGCS Specs. Vertical control shall be tied to NGS benchmarks on NAVD88 Datum.
 - c) CONTRACTOR shall use a minimum of 2 GPS base stations on all data acquisition flights.
- (6) The ground surface DEM (Deliverable Ab(2)) shall have vertical accuracy no larger than 30 cm root mean square error (RMSE), using the NSSDA definition where RMSE is the square root of the average of the set of squared differences between elevation values from an independent source of higher accuracy and linearly interpolated elevations in the DEM for identical points.

Quality Control/Quality Assurance (QC/QA) of the LIDAR-derived data, demonstrating that the technical specifications are met, is primarily the responsibility of CONTRACTOR. COUNTY or its designee may perform additional QC/QA testing. CONTRACTOR must field verify the vertical accuracy of the ground surface DEM to ensure that the RMSE requirement is satisfied for all major ground cover categories that predominate within the project area. The main categories of ground cover that CONTRACTOR must separately evaluate and report on the DEM accuracy for shall be:

- a) Bare-earth and low grass (e.g., plowed fields, lawns, golf courses);
- b) High grass and crops (e.g., hay fields, corn fields, wheat fields);
- c) Fully covered by coniferous trees (e.g. softwood forests);
- d) Fully covered by deciduous trees (e.g. hardwoods forests); and
- e) Urban areas (high, dense manmade structures).

CONTRACTOR shall evenly distribute sample points throughout the project area for each cover category and not group the sample points in a small subarea. CONTRACTOR shall also ensure that the airborne data was acquired for the sample

points during times of representative PDOP conditions and not limited only to times of best PDOP conditions.

The RMSE calculated from a sample of test points will not be the RMSE of the DEM. The calculated value may be higher or it may be lower than that of the DEM. Confidence in the calculated value increases with the number of test points. If the errors (lack of accuracy) associated with the DEM are normally distributed and unbiased, the confidence in the calculated RMSE can be determined as a function of sample size. Similarly, the sample RMSE necessary to obtain 95-percent confidence that the DEM RMSE is less than 30 centimeters can also be determined as a function of sample size.

For each of the five cover categories, CONTRACTOR must test a sample of points and show the test points have an RMSE less than or equal to:

$$RMSE_{sample} \leq 30 \sqrt{\frac{(n-1) - 2.326\sqrt{n-1}}{n}}$$

where n is the number of test points in the sample.

CONTRACTOR must select a minimum of 20 test points for each of the five cover categories. For all points tested CONTRACTOR must report the location of the point (x and y position in US Survey Feet referenced to the Washington State Plane Coordinate System, North Zone, NAD83, 1991 Adjustment), its orthometric elevation from the independent source of higher accuracy (referenced to NAVD-88 datum), the method by which its elevation was independently established, the elevation at the point interpolated from the ground surface DEM (Deliverable II.A.b.3), and the cover category.

Because the definition and criterion for measuring accuracy are derived from the assumption that the test point samples come from a uniformly distributed population with zero mean, CONTRACTOR must calculate other statistics. In particular, the mean and the coefficient of skew must be calculated for each sample and reported to COUNTY. Values of the mean of the test points outside of the interval +/- 2 centimeters and/or values of the coefficient of skew outside of the interval +/- 0.5 centimeter may indicate systematic error.

Compensation

A Fixed Costs

Project Fixed Costs payable by COUNTY include:

- a. Project preparation and planning: \$ 9,972
- b. Mobilization/demobilization: 20,488
- c. Ground Surveys: 47,860
- d. Total Project Fixed Costs: \$78,320

Fixed costs may be invoiced upon completion of field data collection.

B. Variable Costs by Project Area.

Project Bid Costs			
PROJECT AREA	Square Miles	%	Total Bid Variable Costs
USGS/NASA-A*	89	12.5%	\$ 36,968
USGS/NASA-B*	256	12.5%	\$ 52,999
PSRC*	88	10%	\$ 36,602
SEATTLE*	138	14%	\$ 52,327
KITSAP A	220	24%	\$ 95,242
KITSAP B	256	27%	\$ 87,763
Sub Total:	1047	100%	\$ 361,901
Base Bid Fixed Costs:			\$ 78,320
Project Total:			\$ 440,221
Accepted Bid Total:			\$ 440,221
Work Bid For Kitsap County:			
KITSAP A	220	24%	\$ 95,242
KITSAP B	256	27%	\$ 87,763
Subtotal:			\$ 183,005
Project Fixed Costs:			\$ 78,320
Kitsap County Total:			\$ 261,325

* County is only obligated to pay costs associated with areas "Kitsap A" and "Kitsap B" and those costs set forth under A "Fixed Costs" above. Costs of other areas are listed for purposes of other sponsors of the Request For Proposal (USGS, NASA, PSRC, City of Seattle).

CONTRACTOR estimates that additional LiDAR survey work can be accomplished for approximately \$373 per square mile. This figure assumes mobilization, demobilization, planning and ground survey work, if required, is paid separately. This figure also assumes contiguous areas of fifty (50) square miles or more, with no unusual complexity.

