A. **Technical Specifications**

I. Data Acquisition

Returns per pulse	LIDAR instrument shall be capable of recording at least **3** returns per pulse, including 1st and last returns
On-ground laser beam diameter	Between 10 cm and 40 cm
Scan angle	**≤ 15 degrees** from nadir (±30 degrees overall). Note that this may require that the instrument be roll-compensated.
Swath overlap	Nominal 50% sidelap on adjoining swaths, i.e., survey shall be designed for 100% double coverage at planned aircraft height above ground
Design pulse density	**≥ 8 pulses/m^2** (includes swath overlap; e.g., with 50% sidelap, ≥ 4 pulse/m^2 in each swath)
GPS procedures	See **Appendix A. GPS procedures** and section **II B Difficult ground**.
Survey conditions	Leaf-off, no significant snow cover, no standing water in fields, and no flooding are desirable. In many wet parts of the Pacific Northwest there is little chance of meeting these constraints. See **Appendix B. Survey conditions**. The PSLC, in consultation with the LIDAR contractor, shall judge whether conditions are suitable for LIDAR acquisition

II. Spatial Reference Framework

Vertical Datum	NAVD88, using latest geoid model available from the National Geodetic Survey, unless otherwise specified by the PSLC
Horizontal Datum	Data referenced to NAD83 (CORS96), data labeled NAD83-HARN for GIS purposes
Projection	UTM, State Plane, or Oregon Lambert (as requested by PSLC)
Units	Meters (UTM) or survey/international feet (State Plane, Oregon Lambert)

III. Accuracy

Absolute LIDAR measurement accuracy as reported by contractor

≤ 9 cm vertical (RMSE), measured on planar, near-horizontal surfaces. See **Appendix A. GPS procedures.**

Consortium will review contractor's analysis of measurement accuracy. If independent, pre-existing ground control points are available, the Consortium may evaluate data against these points as well.

Intra-survey reproducibility Barring true surface change (e.g., tides, changes in river level, active construction, moving vehicles),

≤ 6 cm vertical (RMSE) for project as a whole

	≤ 40 cm horizontal (RMSE) for project as a whole
	Within any 500m x 500m area, **≤ 10 cm** vertical (RMSE) on near-horizontal surfaces

Evaluated by comparison of overlapping swaths.

Reproducibility of range measurements	Within any 10m x 10m area, **≤ 3 cm** (RMSE)

Evaluated by measuring departures from planarity of single-swath 1st returns from hard planar surfaces, e.g., building roofs.

IV. Completeness

Local relief, turbulence, and inability to maintain an exact flying height routinely lead to departures from survey design. For this reason minimum acceptable swath overlap and aggregate 1st-return density are specified here. Data will routinely be evaluated for completeness.

Coverage	No voids between swaths. No voids because of cloud cover or instrument failure
Swath overlap	≤ 20% no-overlap area per project. No arbitrary 1 km x 1 km square with ≥ 50% no-overlap area
Aggregate 1st return density	Barring non-scattering areas (e.g., water, wet asphalt): For entire project area, ≥ 85% design pulse density. Within any 30m x 30m area within areas of swath overlap, ≥ 50% design pulse density

1st-return density is easily evaluated automatically. However target conditions commonly lead to permissible dropouts that result in low return densities. Areas of suspected too-low return density will be inspected by a human to ensure that they are the result of target conditions and not poor survey practices.

V. Usability

Files shall be named as described in **Appendix E. File names**.

Files shall have consistent internal formats.

Contractor shall propose all details of file names and file formats that are not specified here. Proposed names and formats must be approved by PSLC.

Files may be gzip or zip compressed. Use of compression and compression type shall be uniform across a given data layer.

GIS data (ESRI grids, shapefiles) shall have complete and correct associated projection files.

All files must be readable.

B. Deliverables

Report of Survey	Text report that describes survey methods; results; contractor's accuracy assessments, including internal reproducibility and absolute accuracy; file formats; file-naming schemes; tiling schemes. *.pdf, .odt, or .doc format*

Aircraft trajectories Aircraft position (easting, northing, elevation) and attitude (heading, pitch, roll) and GPS time recorded at regular intervals of 1 second or less. May include additional attributes, including PDOP and estimated positional and velocity errors. May be clipped to project area.
ASCII text or shapefile+.dbf format

Ground control points List of all ground control points (GCPs) and their positions as determined by the contractor. For each GCP: ID, easting, northing, orthometric height, and survey method. May include additional attributes such as ellipsoidal height and description of the ground surface (e.g., asphalt, short grass, forest floor).

Shapefile+.dbf format

All-return point cloud List of all valid returns. For each return: Posix time, easting, northing, elevation, intensity, return#, return classification. May include additional attributes. No duplicate entries. Time shall be reported to the nearest microsecond or better. Easting, northing, and elevation shall be reported to nearest 0.01 m (nearest 0.01 ft). **Classification of returns shall be as complete as is feasible and without avoidable return misclassification;** see **Appendix D. Return classification**.
LAS 1.2 or greater, using Point Data Record format 1 or 3. LAS files shall have all fields populated, including all return attributes identified above.
Conformance to return classification requirement will be evaluated by visual inspection of large-scale shaded-relief images of ground surface model.
1/100th USGS 7.5-minute quadrangle (0.75 minute by 0.75 minute) tiles; see ***Appendix C. Tiling scheme***

Ground point list List of X,Y,Z coordinates of all identified ground points.
ASCII text. 1/100th USGS 7.5-minute quadrangle (0.75 minute by 0.75 minute) tiles; see ***Appendix C. Tiling scheme***

Ground (bare-earth) surface model Raster of ground surface, interpolated via triangulated irregular network from identified ground points. Surface models shall have no tiling artifacts and no gaps at tile boundaries. Areas outside survey boundary shall be coded as NoData. Internal voids (e.g., open water areas) may be coded as NoData.
Idealization of the landscape in the course of constructing surface models should be avoided. In particular, the triangulated irregular networks from which ground surface raster models are interpolated should not include breaklines derived from other data sources.
*ESRI floating point grid, 3 ft (1m) cell size, snapped to (0,0), 1/4th USGS 7.5-minute quadrangle (3.75 minute by 3.75 minute) tile**,** Z values shall not be rounded or truncated; see* ***Appendix C. Tiling scheme****.*

First-return (highest-hit) surface model Raster of first-return surface, cell heights are highest first return within that cell, cells without first returns shall be coded as NoData.
ESRI floating point grid, 3 ft (1m) cell size, snapped to (0,0), 1/4th USGS 7.5-minute quadrangle (3.75 minute by 3.75 minute) tile, Z values shall not be rounded or truncated; see ***Appendix C. Tiling scheme***

Formal metadata See **Appendix F. Instructions on formal metadata**

C. Optional Deliverables

Intensity image Raster image of 1st-return intensity.
TIFF, 3 ft (1m) pixel size, 1/4th USGS 7.5-minute quadrangle (3.75 minute by 3.75 minute) tiles; see Appendix C. Tiling scheme

Contours 1-ft or 2-ft contours. AutoCAD .dxf or ESRI shapefile format.
1/4th USGS 7.5-minute quadrangle (3.75 minute by 3.75 minute) tiles; *see* ***Appendix C. Tiling scheme***

D. Exceptional costs

Upon arrangement, data for intertidal areas shall be acquired at low tide stages. If this requirement significantly restricts permissible survey times, contractor and PSLC may negotiate a surcharge, not to exceed 100% of the per-area cost, for such surveys.

Hydroflattening (removal of elevation artifacts in water bodies in bare-earth DEMs) may be specified for some surveys. PSLC shall specify in detail how hydro-flattening will be performed, including the treatment of longitudinal and lateral gradients in stream-surface elevations and the treatment of tidal water bodies that have multiple true elevations. Deliverables for hydroflattening shall include breaklines and a 2nd, hydroflattened bare-earth DEM. Contractor and PSLC will negotiate a surcharge for hydroflattening.

E. Difficult ground

Areas of extreme local relief and (or) poor access are more difficult to survey because of (1) inability to maintain a near-constant aircraft height above ground, (2) occasional occultation of the GPS satellite constellation, (3) difficulty in adequately distributing GPS base stations and ground control points, and (4) within-swath variations in ground elevation that exceed the depth of field of the LIDAR instrument. In such circumstances it may be advisable to relax the specifications laid out in this Request for Proposals. Any such relaxation must be approved by the PSLC and may be associated with a lower price to be negotiated between the PSLC and the Contractor.

F. Delivery Schedule (review carefully)

The final delivery shall be made no later than 110 working days from end of data acquisition. Contractor is encouraged to deliver products sequentially as they become available rather than all at one time. The PSLC will review and accept/reject products within 30 days of delivery. The contractor should propose a preferred delivery schedule.

Following a thorough Quality Assessment by PSLC staff, data will be accepted or rejected based on specifications in this RFP. If it is determined that the delivered LIDAR data are insufficient to meet the RFP specifications, the contractor will be required to reprocess and/or re-fly problem areas.

G. Intellectual Property Rights

The PSLC shall have unrestricted rights to all delivered reports and data. The PSLC expects to place reports and data in the public domain. This specification places no restrictions on the contractor's rights to resell data or derivative products as the contractor sees fit.

Appendix A. GPS procedures

All GPS measurements shall be made with dual frequency L1-L2 receivers with carrier-phase correction. All GPS measurements shall be made during periods with PDOP $\leq$3.0 and with at least 6 satellites in common view of both a stationary reference receiver and the roving receiver.

Stationary reference receivers shall be located at existing National Geodetic Survey (NGS) marks or at new marks. Marks shall be established and certified to the appropriate State standards and statutes, shall be tied to monuments published through NGS, and the monuments shall have been surveyed or re-surveyed within 2 years of the LIDAR survey. In the case of an existing mark, its location shall be verified by processing one GPS session of at least two hours duration and comparing the computed position with the position published by NGS. Each new mark shall be located by tying to one or more NGS Continuously Operating Reference Stations (CORS) by static GPS methods. If the distance to the nearest CORS is less than 80 km, use at least 2 independent GPS sessions, each at least 2 hours long. If the distance to the nearest CORS is greater than 80 km, use at least 2 sessions each at least 4 hours long.

At least two GPS reference receivers shall be in operation during all LIDAR missions, sampling positions at $\geq$1 Hz. The roving GPS receiver in the aircraft shall sample positions at $\geq$2 Hz. Differential GPS baseline lengths shall be no longer than 30 km.

Ground control points (GCPs), used for both survey calibration and assessment of absolute vertical accuracy, shall be established using GPS and (or) other techniques that are expected to result in accuracies of 1.5 cm (RMSE) or better. Strongly clustered GCPs are useful, perhaps even desirable, for calibration. Vertical accuracy shall be assessed by calculating and averaging the distances between a subset of at least 30 GCPs that are <u>not</u> clustered and a surface interpolated from LIDAR 1^{st} returns. At least 20% of flight line swaths should contain points in this subset and the maximum distance between these GCPs should be no less than one-half the maximum distance across the survey area.

The *Report of Survey* shall document the identity, published position, and measured position of all existing NGS marks used for reference stations. The locations of new marks shall be described, along with their measured positions and the identity and published positions of CORS to which their locations were tied. The *Report of Survey* shall describe the technique(s) used to establish GCPs and document the positions and residuals of all GCPs used to evaluate survey accuracy.

Appendix B. Survey conditions

For almost all purposes, including description of the forest canopy, the best possible ground model is of paramount importance. LIDAR data should be acquired in conditions that maximize the potential quality of the ground model.

The acquisition period should reflect a balance between several constraints:

- Low PDOP and visibility of a sufficient number of satellites.
- *No snow cover with average thickness greater than 6 inches or with thickness variations greater than 1 foot.* In areas of winter snow cover, the melting snow pack in late Spring and early Summer has large thickness variations. Spring acquisitions are thus rarely acceptable. Light early-season snowfall (no more than a few inches) often improves ground model quality by knocking down low brush and improving ground reflectivity. Late Fall acquisitions can provide excellent results. Data should not be acquired in Winter when there is significant snow pack. This constraint may dictate acquisition during leaf-on conditions.

  High mountain areas with permanent snow cover cannot meet this constraint and typically have severe weather and access (for ground GPS work) constraints. The optimal acquisition time for such areas is likely to be late Summer or early Fall. If high mountains are interspersed with large low-elevation valleys, much of the target area may have to be flown twice, once in late Summer (minimal snow cover and good weather) and once in the late Fall and Winter leaf-off period.

- *Adequate chance of sufficient intervals without rain, fog, or low clouds within the specified acquisition period.* Weather records for the target area should demonstrate that, within the planned acquisition period, there is an acceptable chance that the aggregate duration of clear periods (each of sufficient duration to field a LIDAR flight) will be sufficient to complete planned acquisition flights with the available crews and equipment. Many parts of the Pacific Northwest have such frequent rain, fog, and (or) low clouds that this constraint trumps all others.
- *No tall grain.* Discrete-return LIDAR instruments will not obtain ground returns beneath closed-cover green corn or small grains. Data should be acquired after harvest or before grains reach significant closure (for corn) and height (for small grains). Row crops are less problematic.
- *No extensive standing water.* In rainy, low-relief areas, this constraint may rule out acquisition during much of the leaf-off season. In low-relief valleys, data should not be acquired when overbank areas are flooded.
- *Low stream flow.* For low-relief valleys with unconfined streams, it is very useful to have ground models which support accurate prediction of the wetted area at various river stages. This dictates acquisition of LIDAR data in low-flow conditions. If this constraint is operable, permissible gauge heights should be specified for each major stream in the target area. In streams that have steep banks (including most leveed streams) or that lie in confined valleys, changes in river stage cause little change in the underwater area and there is little benefit to requiring acquisition in low-flow conditions.
- *No significant deciduous leaf cover.* Deciduous foliage substantially reduces the fraction of laser pulses that yield ground returns. In lowlands west of the Cascade Range, this typically restricts acquisition to the months of December, January, February, and March. In some years, and in some locales, earlier or later acquisitions may be acceptable. Even where the forest is almost entirely evergreen there is usually significant deciduous vegetation along streams, where there is usually the greatest need for accurate ground models.
- *Low tide.* In nearshore areas it may be desirable to restrict acquisition of data for intertidal areas to periods when the predicted (or observed) water level is less than some defined value; or to require collection of data for all areas down to a defined elevation. This will significantly contract the available acquisition window and thus usually increase the cost of survey.
- *Availability of funding.* Public agency funding often disappears at the end of the fiscal year or biennium. This may drive acquisition in less than optimal conditions.
- *Immediate need for data.*

In many parts of the Pacific Northwest all of these constraints cannot be met and some compromise is necessary. Compromises in acquisition conditions *will* compromise data quality, but it should be remembered that a less-than-perfect LIDAR bare-earth model is likely to be far better than a model derived from any other data source. Where an adequate ground model already exists and the primary survey target is the forest canopy it may be appropriate to acquire LIDAR data during flooded, snow-covered, and (or) leaf-on conditions.

RFPs, proposals, and contracts for acquisition of LIDAR data should clearly specify acceptable acquisition conditions, including their likely calendar duration and probability of occurrence, as these greatly impact the cost of obtaining data.

We suggest that realistic constraints for the Pacific Northwest are:

- All areas: adequate PDOP and satellite visibility, no flooding
- High mountains (above 6,000 feet elevation): After August 15 and without significant new snow cover (see above) below 8,000 feet elevation. Earlier surveys permissible if all winter snow is melted.
- Puget Lowland, southern Georgia Basin, east slope Coast Range, eastern and northern Olympic Mountains: Leaf off, no significant snow cover
- Willamette Valley (with extensive flats and extensive agriculture): No extensive standing water, no tall grains.
- Columbia Plateau: No tall grains, no significant snow cover.
- Interior mountains (east slope Cascades, Okanogan Highlands, Blue Mountains): No significant snow cover, no tall grains
- Northern Basin and Range: No significant snow cover

The windward, wet west slope of the Coast Range, western Olympic Mountains, and western Cascade foothills present a special problem. At low elevations (below ~3,000 feet), large fractions of these regions are covered with deciduous forest in logged areas and along valley bottoms and do not have a high probability of clear weather during the leaf-off season. Above ~3,000 feet there may be little chance of leaf-off conditions without significant snow cover during any given year. High- and low-elevation areas are intermixed and are not economically surveyed at different times. We suggest requiring leaf-off, no snow cover acquisition with a high likelihood that a survey cannot be completed in any given year unless—and this will commonly be the case—funding requirements and data needs require the planning of leaf-on, no snow cover acquisition.

Unless acquisition contracts specifically require collection of data within a certain time period, data collection shall be deferred until conditions are suitable and there shall be no penalties for failure to acquire data because of the lack of suitable conditions. **Unless otherwise specified, the PSLC (in consultation with the LIDAR contractor) shall judge whether conditions are suitable for LIDAR acquisition.**

Appendix C. Tiling scheme

A good tiling scheme has the following attributes: (1) tile boundaries can be computed readily, (2) adjacent tiles can be identified easily, (3) and tile names have meaning to the casual user. Tiles based on the Public Land Survey System meet attribute (3) but fail (1) miserably. Arbitrary tiling schemes (numbering from left to right and top to bottom, river miles, etc.) typically fail (1), often fail (2), and usually fail (3). Square tiles with boundaries at, for example, 1000 m intervals and named by northing and easting values of the SW corner meet (1) and (2) nicely, fail (3), and have the additional defect of being tied to a particular coordinate system—if the dataset is reprojected much of the utility of this naming scheme is lost. We thus specify a tiling scheme based on USGS 7.5-minute quadrangles, as tile boundaries can be computed without additional information, the names of adjacent tiles can be computed (though with difficulty), and tile names have some meaning.

Data shall be delivered in tiles that are rectangular in geographic coordinates, correspond to standard USGS 7.5-minute quadrangles and divisions thereof, and are named according to the scheme

qAAOOORCQ	(quarter-quadrangle, 3.75 minute by 3.75 minute region)
qAAOOORCQNN	(1/100th quadrangle, 0.75 minute by 0.75 minute region)

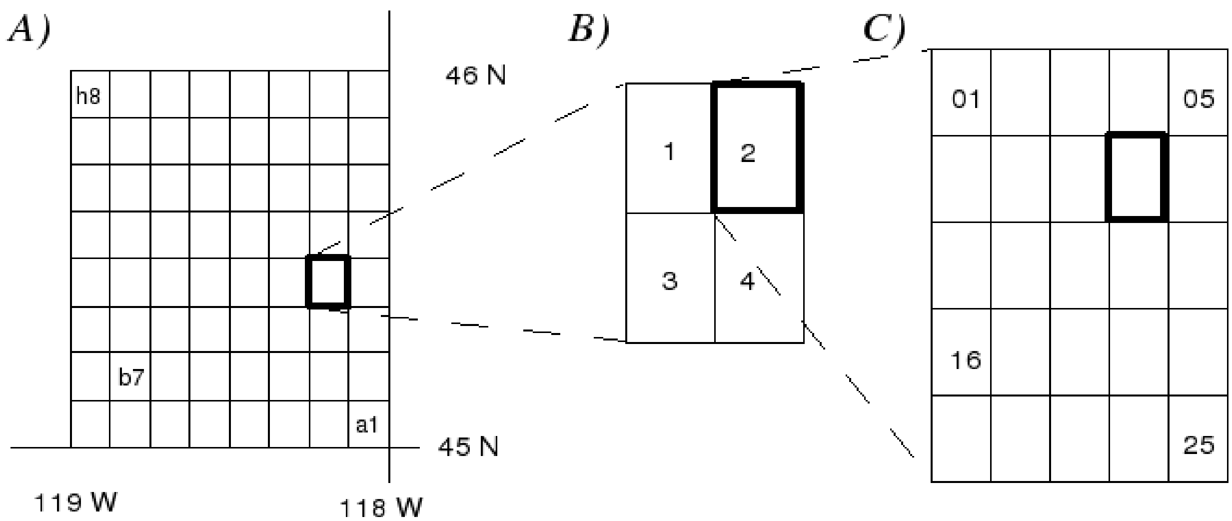
where

AA is the integer north latitude of the SE corner of the 1° x 1° region that contains the quadrangle,

OOO is the integer west longitude of the SE corner of the 1° x 1° region, R is the row, labeled from a to h, south to north, and C is the column, labeled from 1 to 8, east to west. That is, in diagram A below of the 1° x 1° region with a southeast corner at latitude 45N, longitude 118W, the highlighted quadrangle is q45118d2.

Q is the quadrangle quadrant, which shall be numbered west-to-east, north-to-south, as is shown in diagram B. That is, the highlighted quarter-quadrangle tile in diagram B is q45118d22.

QNN identifies the 1/100th quadrangle, which shall be labeled by numbering the 25 divisions of each quarter-quadrangle west-to-east, north-to-south, as shown in diagram C. That is, the highlighted tile in diagram C is q45118d2209.



Appendix D. Return classification

We are unaware of any method for cheaply and accurately quantifying the accuracy of LIDAR return classification. In the absence of such a method, we specify that “Classification of returns shall be as complete as is feasible and without avoidable misclassification.” We recognize that this specification is weak and look forward to discovery of a method for routinely quantifying the accuracy of return classification.

Definition of “feasible” and “avoidable” may require dialog between the contractor and the PSLC. Dialog may also be necessary to establish the appropriate trade-off between automatic identification of most vegetation returns and failure to identify ground returns at landscape corners.

Returns from burn piles, stumps, downed logs, and almost all buildings shall be classified as vegetation, structure, not-ground, or left unclassified. Returns from highway embankments, retaining walls, bridge abutments, earthen berms, boulders, and plow ridges and furrows shall be classified as ground or left unclassified. Automatic return classification procedures tend to not identify bridges and overpasses as ground and this is encouraged, for the resulting ground models will be more hydrologically correct.

Return classification procedures shall be documented in the Report of Survey and in formal metadata insofar as is possible without revealing trade secrets. Classification codes shall be defined in the Report of Survey and in formal metadata, with careful attention to the distinction between not-ground and unclassified.

Appendix E. File names

Names of data files shall be composed of the tile name followed, in some cases, by a suffix that denotes the data layer and (or) the file format. In some cases this name shall have additional suffixes that denote an export file and (or) file compression.

For the quarter-quadrangle q45123a31 and constituent 1/100th-quadrangle tile q45123a3101, these are the names of data files:

all-return point cloud

q45123a3101.las	(LAS file)

ground (bare-earth) surface model

q45123a31be	(ESRI grid name)
q45123a31be.e00	(ESRI export file)
q45123a31be.e00.gz	(gzip compressed ESRI export file)
q45123a31be.e00.zip	(zip compressed ESRI export file)

first-return (highest-hit) surface model

q45123a31hh	(ESRI grid name)
q45123a31hh.e00	(ESRI export file)
q45123a31hh.e00.gz	(gzip compressed ESRI export file)
q45123a31hh.e00.zip	(zip compressed ESRI export file)

ground point list

q45123a3101.txt	(ASCII)
q45123a3101.txt.gz	(gzip compressed ASCII file)
q45123a3101.txt.zip	(zip compressed ASCII file)

first-return (highest-hit) intensity image

q45123a31hh.tif	(TIFF image; with accompanying .tfw file)

ground (bare-earth) contours

q45123a31.dxf (CAD .dxf file)

q45123a31.dxf.gz (gzip compressed .dxf file)

q45123a31.dxf.zip (zip compressed .dxf file)

q45123a31.shp (ESRI shapefile; with accompanying .dbf, .shx files)

q45123a31.shp.zip (zip compressed ESRI shapefile: includes .shp, .shx, .dbf files)

All deliveries shall use the same format for similar data. The contractor shall not deliver grids on one occasion and equivalent .e00 files on another, or zipped files on one occasion and gzipped files on another.

Appendix F. Instructions on formal metadata

GIS-compatible data and files shall be explained with XML format metadata that follows the Federal Geographic Data Committee's (FGDC) Content Standard for Digital Geospatial Data. Metadata may be a single file that describes an entire survey or multiple files each of which describes a constituent part (e.g., area A, area B, area C) of the survey. Metadata shall include, but are not limited to, the following:

Color key: To be completed by agency

To be completed by contractor

Under *Identification* Information

Description, Abstract

An abstract summarizing the datasets delivered. Include project area. Include general tiling scheme (e.g., USGS 7.5 quarter quad). For each data layer, describe

Data structure and attributes, including resolution and precision

Total number of files

Time Period

Date(s) of data capture (range of dates)

For these dates, use the Current Reference: ground condition.

Status

Statement regarding completeness Status.

Spatial Domain, Bounding Coordinates and G-Polygon

Project survey area bounding coordinates in decimal degrees

Data Set Credit

Title for the name and address of the contractor who captured the data

Originator for the names of the agencies who contributed funds and participated in the acquisition of the data.

Other Citation Details for explanation of the acquisition: Agencies who participated in the contract (e.g., Kitsap County Department of Emergency Management administered the contract; Puget Sound LIDAR Consortium served as technical resource and provided quality assessment, Oregon Department of Geology and Mineral Industries coordinated the participator requests; and agencies identified under Originator participated.)

Under *Data Quality*

Process Step

Process Description for manufacturer, model, and serial number of LIDAR instrument(s). May include separate specifications for scanning laser rangefinder, inertial navigation system, and GPS unit

Value(s) of instrument parameters during survey, including

Nominal on-ground beam diameter

pulse rate

maximum number of returns recorded

minimum separation between detected returns from a single pulse, expressed as a distance

laser output power

minimum return power required to produce a return

beam wavelength

frequency of GPS sampling

frequency of IMU sampling

Nominal swath width

Nominal height of instrument above ground

Nominal single-swath pulse density

Nominal aggregate pulse density

Identity and assumed coordinates of reference survey monument(s)

Nature of vertical control (e.g., RTK GPS or water surface + tidal observations)

Calibration procedures

Return classification procedures

Positional Accuracy

Vertical Accuracy Report. Accuracy may be specified as RMSE or 95% confidence (indicate which). Vertical accuracy shall be reported for LIDAR measurements and, optionally, for the derived ground (bare-earth) surface model. XY accuracy of LIDAR measurements may also be reported. Shall include one or more of the following sections:

Accuracy as predicted by creator of survey

Accuracy as measured by creator of survey

Accuracy as verified by Consortium or independent 3rd party

Under *Spatial Data Organization Information*

Indirect Spatial Reference

Tiling scheme (if any). (e.g. ASCII data is divided into 1/100th USGS 7.5" quad)

Under *Spatial Reference Information*

Horizontal Coordinate System Definition:

Geographic Coordinate System for the captured data

Projected Coordinate System for the delivered data

Horizontal Datum for the delivered data

Ellipsoid Name (identify both the ellipsoid and the geoid model used to translate from ellipsoid to orthometric heights)

Vertical Coordinate System Definition

Datum Name

Vertical units

Under *Entity and Attribute Information*

Overview Description, Entity and Attribute Overview

Attribute descriptions if applicable (e.g. return point attributes in ASCII data or user bit field in LAS format). For all-return data, definition of return classification codes. Whether time is specified as GPS week and GPS second or Posix time. Any other relevant attribute information.

Under *Distribution Information*

Distributor

Distribution point of contact

Standard Order Process

Ordering Instructions - web location, if applicable

Fees – "There are no fees. This product is in the public domain."

Distribution Liability

Absence of intellectual property restrictions

Under *Metadata Reference Information*

Metadata Contact

Details for author(s) of metadata

Metadata Standard Name

"FGDC Content Standards for Digital Geospatial Metadata"

Metadata Standard Version

“FGDC-STD-001-1998” unless updated or otherwise substituted