

*Please provide the following information, and submit to the NOAA DM Plan Repository.*

**Reference to Master DM Plan (if applicable)**

*As stated in Section IV, Requirement 1.3, DM Plans may be hierarchical. If this DM Plan inherits provisions from a higher-level DM Plan already submitted to the Repository, then this more-specific Plan only needs to provide information that differs from what was provided in the Master DM Plan.*

URL of higher-level DM Plan (if any) as submitted to DM Plan Repository:

**1. General Description of Data to be Managed****1.1. Name of the Data, data collection Project, or data-producing Program:**

2018 WA DNR Topobathy Lidar: Tacoma Water Service Area - Green River, WA

**1.2. Summary description of the data:**

No metadata record was provided with the data. This record is populated with information from the Quantum Spatial, Inc. technical report downloaded from the Washington Dept. of Natural Resources Washington Lidar Portal. The technical report is available for download from the link provided in the URL section of this metadata record.

In September 2017, Quantum Spatial (QSI) was contracted by the Washington State Department of Natural Resources (WADNR) to collect topobathymetric Light Detection and Ranging (LiDAR) data in the spring of 2018 for the Tacoma Water Service Area: Green River site in western Washington. The Tacoma Water Service Area: Green River area of interest stretches from the Green River Water Filtration Facility upriver past the town of Lester into Stampede Pass. Traditional near-infrared (NIR) LiDAR was fully integrated with green wavelength (bathymetric) LiDAR in order to provide a comprehensive topobathymetric LiDAR dataset. This contract also incorporates LiDAR data collection and processing over additional nearby sites, including the Green River Watershed (for forestry analytics) and the Tacoma Water Service Area. Data were collected to aid WADNR in assessing the channel morphology, topographic, and geophysical properties of the study area.

In addition to these lidar point data, the bare earth Digital Elevation Models (DEM) created from the lidar point data are also available. These data are available for custom download at the link provided in the URL section of this metadata record.

**1.3. Is this a one-time data collection, or an ongoing series of measurements?**

One-time data collection

**1.4. Actual or planned temporal coverage of the data:**

2018-05-27 to 2018-05-28

**1.5. Actual or planned geographic coverage of the data:**

W: -121.853599, E: -121.387685, N: 47.326135, S: 47.191638

**1.6. Type(s) of data:**

*(e.g., digital numeric data, imagery, photographs, video, audio, database, tabular data, etc.)*

Model (digital)

**1.7. Data collection method(s):**

*(e.g., satellite, airplane, unmanned aerial system, radar, weather station, moored buoy, research vessel, autonomous underwater vehicle, animal tagging, manual surveys, enforcement activities, numerical model, etc.)*

**1.8. If data are from a NOAA Observing System of Record, indicate name of system:****1.8.1. If data are from another observing system, please specify:****2. Point of Contact for this Data Management Plan (author or maintainer)****2.1. Name:**

NOAA Office for Coastal Management (NOAA/OCM)

**2.2. Title:**

Metadata Contact

**2.3. Affiliation or facility:**

NOAA Office for Coastal Management (NOAA/OCM)

**2.4. E-mail address:**

coastal.info@noaa.gov

**2.5. Phone number:**

(843) 740-1202

**3. Responsible Party for Data Management**

*Program Managers, or their designee, shall be responsible for assuring the proper management of the data produced by their Program. Please indicate the responsible party below.*

**3.1. Name:****3.2. Title:**

Data Steward

**4. Resources**

*Programs must identify resources within their own budget for managing the data they produce.*

**4.1. Have resources for management of these data been identified?**

Yes

**4.2. Approximate percentage of the budget for these data devoted to data management (specify percentage or "unknown"):**

Unknown

**5. Data Lineage and Quality**

*NOAA has issued Information Quality Guidelines for ensuring and maximizing the quality, objectivity, utility, and integrity of information which it disseminates.*

**5.1. Processing workflow of the data from collection or acquisition to making it publicly accessible**

*(describe or provide URL of description):*

Lineage Statement:

The NOAA Office for Coastal Management (OCM) downloaded the LAZ files from the Washington Lidar Portal.

Process Steps:

- Planning: In preparation for data collection, QSI reviewed the project area and developed a specialized flight plan to ensure complete coverage of the Tacoma Water Service Area: Green River LiDAR study area at the target combined point density of greater than or equal to 12.0 points/m<sup>2</sup>. Acquisition parameters including orientation relative to terrain, flight altitude, pulse rate, scan angle, and ground speed were adapted to optimize flight paths and flight times while meeting all contract specifications. Factors such as satellite constellation availability and weather windows must be considered during the planning stage. Any weather hazards or conditions affecting the flights were continuously monitored due to their potential impact on the daily success of airborne and ground operations. In addition, logistical considerations including private property access, potential air space restrictions, channel flow rates, and water clarity were reviewed.
- Ground Survey Points Ground control surveys, including monumentation and ground survey points (GSPs), were conducted to support the airborne acquisition. Ground control data were used to geospatially correct the aircraft positional coordinate data and to perform quality assurance checks on final LiDAR data. Ground survey points were collected using real time kinematic (RTK), post-processed kinematic (PPK), and fast-static (FS) survey techniques. A QSI Trimble R7 base unit or the WSRN RTN broadcasted a kinematic correction to a roving Trimble R8 GNSS or Trimble R6 GNSS receiver. All GSP measurements were made during periods with a Position Dilution of Precision (PDOP) of less than or equal to 3.0 with at least six satellites in view of the stationary and roving receivers. When collecting RTK and PPK data, the rover records data while stationary for five seconds, then calculates the pseudorange position using at least three one-second epochs. FS surveys record observations for up to fifteen minutes on each GSP in order to support longer baselines for post-processing. Relative errors for any GSP position must be less than 1.5 cm horizontal and 2.0 cm vertical in order to be accepted. GSPs were collected in areas where good satellite visibility was achieved on paved roads and other hard surfaces such as gravel or packed dirt roads. GSP

measurements were not taken on highly reflective surfaces such as center line stripes or lane markings on roads due to the increased noise seen in the laser returns over these surfaces. GSPs were collected within as many flightlines as possible; however the distribution of GSPs depended on ground access constraints and base station locations and may not be equitably distributed throughout the study area. Base Stations Base stations were used for collection of ground survey points using real time kinematic (RTK), post processed kinematic (PPK), and fast static (FS) survey techniques. Base station locations were selected with consideration for satellite visibility, field crew safety, and optimal location for GSP coverage. QSI established one monument and utilized four permanent base stations from the Washington State Reference Network (WSRN) for the Tacoma Water Service Area: Green River project. QSI's professional land surveyor, Mark Meade (WAPLS#54019) oversaw and certified the establishment of all monuments and the ground survey. QSI collected static Global Navigation Satellite System (GNSS) occupations (1 Hz recording frequency) for the base station locations. During post-processing, the static GNSS data were triangulated with nearby Continuously Operating Reference Stations (CORS) using the Online Positioning User Service (OPUS1) for precise positioning to ensure alignment with the National Spatial Reference System (NSRS). Multiple independent sessions for each position were processed to confirm height measurements and to refine positional accuracy. Monuments were established according to the national standard for geodetic control networks, as specified in the Federal Geographic Data Committee (FGDC) Geospatial Positioning Accuracy Standards for geodetic networks. This standard provides guidelines for classification of monument quality at the 95% confidence interval as a basis for comparing the quality of one control network to another. For the Tacoma Water Service Area: Green River topobathymetric LiDAR project, the monument coordinates contributed no more than 2.8 cm of positional error to the geolocation of the final ground survey points and LiDAR, with 95% confidence.

- Airborne Survey The LiDAR survey was accomplished using a Riegl VQ-820G green laser system combined with an Optech Orion-H NIR laser system dually mounted in a Cessna Caravan. The Riegl VQ-820-G uses a green wavelength (532 nm) laser that is capable of collecting high resolution vegetation and topography data, as well as penetrating the water surface with minimal spectral absorption by water. The recorded waveform enables range measurements for all discernible targets for a given pulse. The typical number of returns digitized from a single pulse range from 1 to 7 for the Tacoma Water Service Area: Green River project area. The Optech laser system can record unlimited range measurements (returns) per pulse, but typically does not record more than 5 returns per pulse. It is not uncommon for some types of surfaces (e.g., dense vegetation or water) to return fewer pulses to the LiDAR sensor than the laser originally emitted. The discrepancy between first return and overall delivered density will vary depending on terrain, land cover, and the prevalence of water bodies. All discernible laser returns were processed for the output dataset. All areas were surveyed with an opposing flight line side-lap of greater than or equal to 50 percent (greater than or equal to 100 percent overlap)

in order to reduce laser shadowing and increase surface laser painting. To accurately solve for laser point position (geographic coordinates x, y and z), the positional coordinates of the airborne sensor and the attitude of the aircraft were recorded continuously throughout the LiDAR data collection mission. Position of the aircraft was measured twice per second (2 Hz) by an onboard differential GPS unit, and aircraft attitude was measured 200 times per second (200 Hz) as pitch, roll and yaw (heading) from an onboard inertial measurement unit (IMU). To allow for post-processing correction and calibration, aircraft and sensor position and attitude data are indexed by GPS time.

- Upon completion of data acquisition, QSI processing staff initiated a suite of automated and manual techniques to process the data into the requested deliverables. Processing tasks included GPS control computations, smoothed best estimate trajectory (SBET) calculations, kinematic corrections, calculation of laser point position, sensor and data calibration for optimal relative and absolute accuracy, and LiDAR point classification. Riegl's RiProcess software was used to facilitate bathymetric return processing. Once bathymetric points were differentiated, they were spatially corrected for refraction through the water column based on the angle of incidence of the laser. QSI refracted water column points using QSI's proprietary LAS processing software, LAS Monkey. The resulting point cloud data were classified using both manual and automated techniques. Processing methodologies were tailored for the landscape. Brief descriptions of these tasks are shown below.

**Lidar Processing Steps**

**Resolve kinematic corrections for aircraft position data using kinematic aircraft GPS and static ground GPS data.** Develop a smoothed best estimate of trajectory (SBET) file that blends post-processed aircraft position with sensor head position and attitude recorded throughout the survey. Software used - POSPac MMS v.8.2

**Calculate laser point position by associating SBET position to each laser point return time, scan angle, intensity, etc.** Create raw laser point cloud data for the entire survey in \*.las (ASPRS v. 1.4) format. Convert data to orthometric elevations by applying a geoid correction. Software used - RiProcess v1.8.5

**Import raw laser points into manageable blocks to perform manual relative accuracy calibration and filter erroneous points.** Classify ground points for individual flight lines. Software used - TerraScan v.18

**Using ground classified points per each flight line, test the relative accuracy.** Perform automated line-to-line calibrations for system attitude parameters (pitch, roll, heading), mirror flex (scale) and GPS/IMU drift. Calculate calibrations on ground classified points from paired flight lines and apply results to all points in a flight line. Use every flight line for relative accuracy calibration. Software used - TerraMatch v.18 and RiProcess v1.8.5

**Apply refraction correction to all subsurface returns.** Software used - LAS Monkey 2.3.4 (QSI proprietary software)

**Classify resulting data to ground and other client designated ASPRS classifications.** Assess statistical absolute accuracy via direct comparisons of ground classified points to ground control survey data. Software used - TerraScan v.18, TerraModeler v.18

- 2022-06-22 00:00:00 - The NOAA Office for Coastal Management (OCM) downloaded this data set from the Washington Lidar Portal. The total number of files

downloaded and processed was 109. No metadata record was provided with the data. This record is populated with information from the Quantum Spatial, Inc. technical report downloaded from the Washington Dept. of Natural Resources Washington Lidar Portal. The technical report is available for download from the Washington Lidar Portal. The link is provided in the URL section of this metadata record. The data were in Washington State Plane South (NAD83 HARN), US survey feet coordinates and NAVD88 (Geoid12B) elevations in feet. From the provided report, the data were classified as: 1 - Unclassified, 2 - Ground, 7 - Low Noise, 9 - Water, 17 - Bridge Deck, 40 - Bathymetric Bottom, 41 - Water Surface, 45 - Water Column. OCM processed all classifications of points to the Digital Coast Data Access Viewer (DAV). Classes available in the DAV are: 1, 2, 7, 9, 17, 40, 41, 45. OCM performed the following processing on the data for Digital Coast storage and provisioning purposes: 1. An internal OCM script was run to check the number of points by classification and by flight ID and the gps and intensity ranges. 2. Internal OCM scripts were run on the laz files to convert from orthometric (NAVD88) elevations to ellipsoid elevations using the Geoid12B model, to convert from Washington State Plane South (NAD83 HARN), US survey feet coordinates to geographic coordinates, to convert from elevations in feet to meters, to filter out elevation values less than -200 feet, to assign the geokeys, to sort the data by gps time and zip the data to database and to the Amazon s3 bucket.

**5.1.1. If data at different stages of the workflow, or products derived from these data, are subject to a separate data management plan, provide reference to other plan:**

**5.2. Quality control procedures employed (describe or provide URL of description):**

QSI has high standards and adheres to best practices in all efforts. In the laboratory, quality checks are built in throughout processing steps, and automated methodology allows for rapid data processing. QSI's innovation and adaptive culture rises to technical challenges and the needs of clients like Washington DNR. Reporting and communication to our clients are prioritized through regular updates and meetings.

## **6. Data Documentation**

*The EDMC Data Documentation Procedural Directive requires that NOAA data be well documented, specifies the use of ISO 19115 and related standards for documentation of new data, and provides links to resources and tools for metadata creation and validation.*

**6.1. Does metadata comply with EDMC Data Documentation directive?**

No

**6.1.1. If metadata are non-existent or non-compliant, please explain:**

Missing/invalid information:

- 1.7. Data collection method(s)
- 3.1. Responsible Party for Data Management

- 7.1.1. If data are not available or has limitations, has a Waiver been filed?
- 7.4. Approximate delay between data collection and dissemination
- 8.3. Approximate delay between data collection and submission to an archive facility

**6.2. Name of organization or facility providing metadata hosting:**

NMFS Office of Science and Technology

**6.2.1. If service is needed for metadata hosting, please indicate:****6.3. URL of metadata folder or data catalog, if known:**

<https://www.fisheries.noaa.gov/inport/item/67459>

**6.4. Process for producing and maintaining metadata**

*(describe or provide URL of description):*

Metadata produced and maintained in accordance with the NOAA Data Documentation Procedural Directive: [https://nosc.noaa.gov/EDMC/DAARWG/docs/EDMC\\_PD-Data\\_Documentation\\_v1.pdf](https://nosc.noaa.gov/EDMC/DAARWG/docs/EDMC_PD-Data_Documentation_v1.pdf)

**7. Data Access**

*NAO 212-15 states that access to environmental data may only be restricted when distribution is explicitly limited by law, regulation, policy (such as those applicable to personally identifiable information or protected critical infrastructure information or proprietary trade information) or by security requirements. The EDMC Data Access Procedural Directive contains specific guidance, recommends the use of open-standard, interoperable, non-proprietary web services, provides information about resources and tools to enable data access, and includes a Waiver to be submitted to justify any approach other than full, unrestricted public access.*

**7.1. Do these data comply with the Data Access directive?**

Yes

**7.1.1. If the data are not to be made available to the public at all, or with limitations, has a Waiver (Appendix A of Data Access directive) been filed?****7.1.2. If there are limitations to public data access, describe how data are protected from unauthorized access or disclosure:****7.2. Name of organization or facility providing data access:**

NOAA Office for Coastal Management (NOAA/OCM)

**7.2.1. If data hosting service is needed, please indicate:****7.2.2. URL of data access service, if known:**

<https://coast.noaa.gov/dataviewer/#/lidar/search/where:ID=9546/details/9546>  
<https://noaa-nos-coastal-lidar-pds.s3.amazonaws.com/laz/geoid18/9546/index.html>

**7.3. Data access methods or services offered:**

Data is available online for bulk and custom downloads.

**7.4. Approximate delay between data collection and dissemination:**

**7.4.1. If delay is longer than latency of automated processing, indicate under what authority data access is delayed:**

**8. Data Preservation and Protection**

*The NOAA Procedure for Scientific Records Appraisal and Archive Approval describes how to identify, appraise and decide what scientific records are to be preserved in a NOAA archive.*

**8.1. Actual or planned long-term data archive location:**

*(Specify NCEI-MD, NCEI-CO, NCEI-NC, NCEI-MS, World Data Center (WDC) facility, Other, To Be Determined, Unable to Archive, or No Archiving Intended)*

NCEI\_CO

**8.1.1. If World Data Center or Other, specify:****8.1.2. If To Be Determined, Unable to Archive or No Archiving Intended, explain:****8.2. Data storage facility prior to being sent to an archive facility (if any):**

Office for Coastal Management - Charleston, SC

**8.3. Approximate delay between data collection and submission to an archive facility:****8.4. How will the data be protected from accidental or malicious modification or deletion prior to receipt by the archive?**

*Discuss data back-up, disaster recovery/contingency planning, and off-site data storage relevant to the data collection*

Data is backed up to tape and to cloud storage.

**9. Additional Line Office or Staff Office Questions**

*Line and Staff Offices may extend this template by inserting additional questions in this section.*