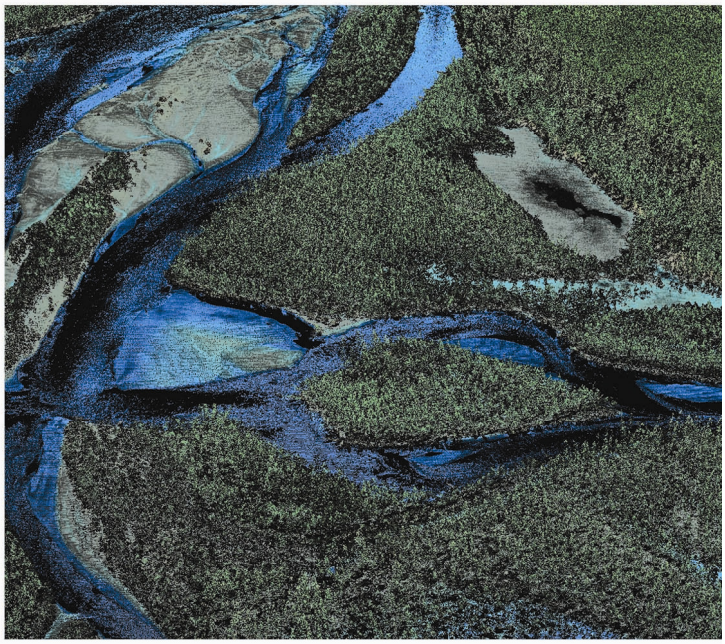
# LiDAR REMOTE SENSING

## ALASKA PIPELINE • ALASKA

(Delivery 1 – 3/9/2011)








## ALASKA DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL & GEOGRAPHICAL SURVEYS

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# LiDAR Remote Sensing Data Collection:

## Alaska Pipeline, AK

### Delivery 1

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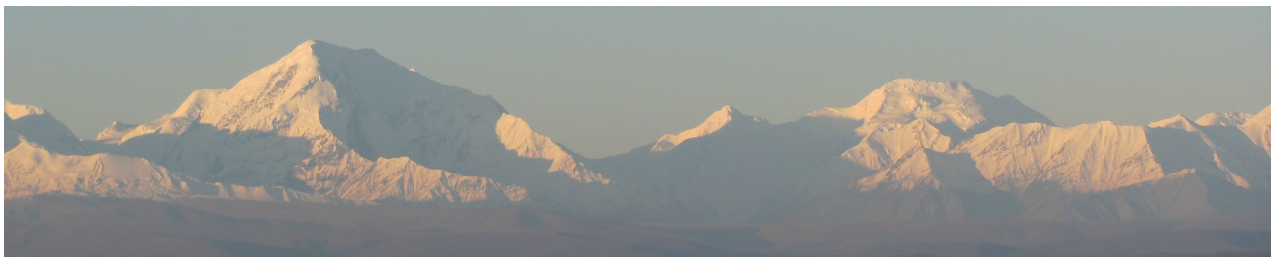
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# 1. Overview

Watershed Sciences, Inc. (WS) collected Light Detection and Ranging (LiDAR) data of the Alaska Pipeline for the Alaska Department of Natural Resources. LiDAR data for Delivery 1 was collected between September 21st and October 1st, 2010 (**Figure 1**). Delivery 1 includes 117,357 acres within the requested area. This area was expanded to include a 100m buffer to ensure complete coverage and adequate point densities around survey boundaries, resulting in 121,746 acres of delivered data. This area includes portions of the Alaska Highway east of Johnson River to Robertson River. Accuracy and density data will continue to be updated as additional data is processed.

***Figure 1.*** *Alaska Pipeline survey delivery status overview.*

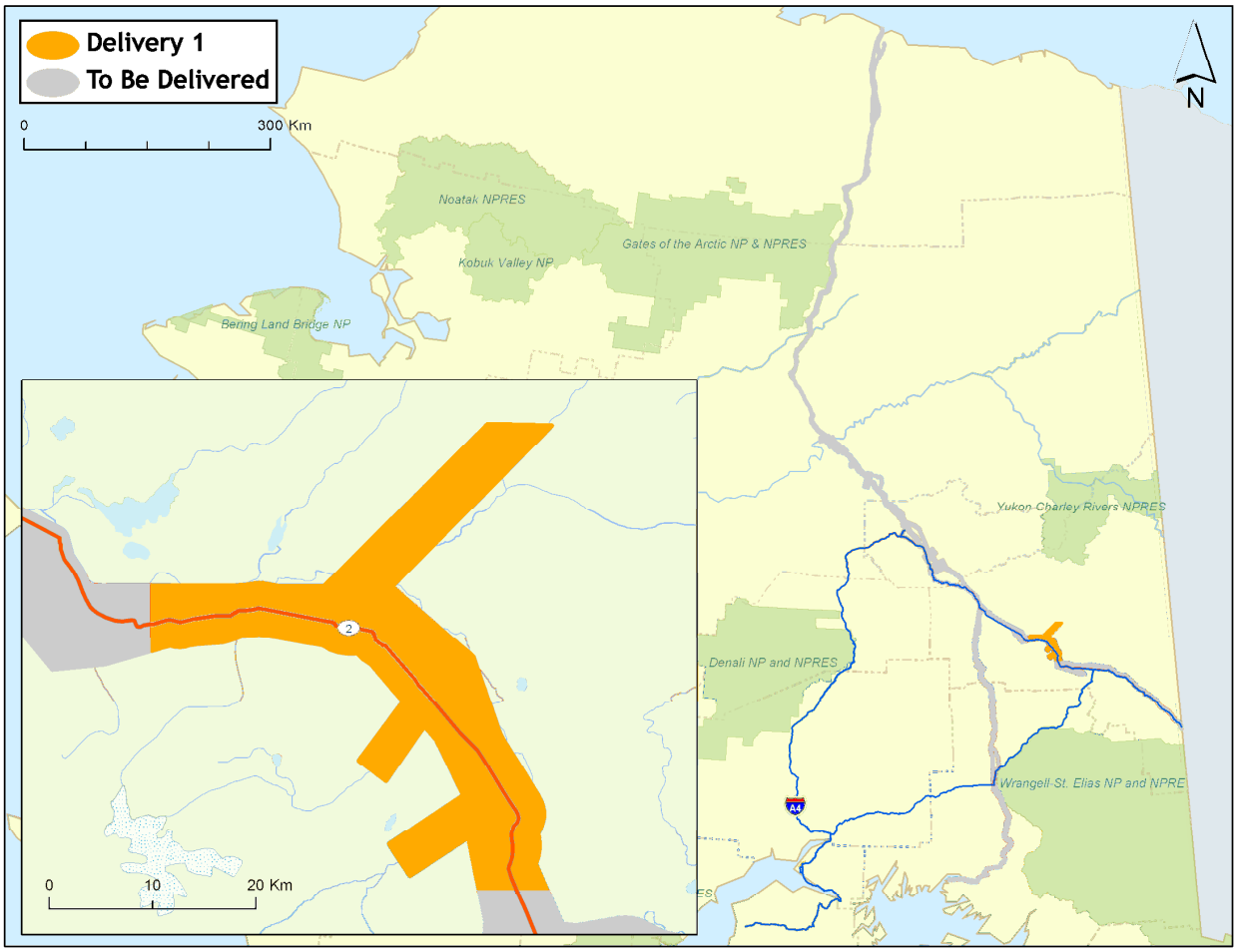



***Table 1.*** *Alaska Pipeline, LiDAR deliveries to date.*

| Delivery | UTM Zone(s) | Date | Total Acres Flown | AOI Acres |
|---|---|---|---|---|
| 1 | 6, 7 | March 9, 2010 | 121,746 | 117,357 |

# 2. Acquisition

## 2.1 Airborne Survey – Instrumentation and Methods

The LiDAR survey utilized a Leica ALS60 sensor in a Cessna Caravan 208Bs. The Leica systems were set to acquire 150000 laser pulses per second (i.e., 150 kHz pulse rate) and flown at 1500 meters above ground level (AGL), capturing a scan angle of ±14$^{o}$ from nadir when clouds and terrain permitted. With these flight parameters, the laser swath width is 638m and the laser pulse footprint is 34cm. These settings varied depending on cloud cover and terrain but were consistently adjusted to yield an average native pulse density of ≥8 pulses per square meter over terrestrial surfaces. It is not uncommon for some types of surfaces (e.g. dense vegetation or water) to return fewer pulses than the laser originally emitted. These discrepancies between 'native' and 'delivered' density will vary depending on terrain, land cover, and the prevalence of water bodies.



*The Cessna Caravan is a stable platform, ideal for flying slow and low for high density projects. A Leica ALS60 sensor head installed in the Caravan is shown on the left.*

All areas were surveyed with an opposing flight line side-lap of ≥60% (≥100% overlap) to reduce laser shadowing and increase surface laser painting. The Leica laser systems allow up to four range measurements (returns) per pulse, and all discernable laser returns were processed for the output dataset.

To accurately solve for laser point position (geographic coordinates x, y, z), the positional coordinates of the airborne sensor and the attitude of the aircraft were recorded continuously throughout the LiDAR data collection mission. Aircraft position was measured twice per second (2 Hz) by an onboard differential GPS unit. 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/sensor position and attitude data are indexed by GPS time.

## 2.2 Ground Survey – Instrumentation and Methods

### *2.2.1 Monumentation*

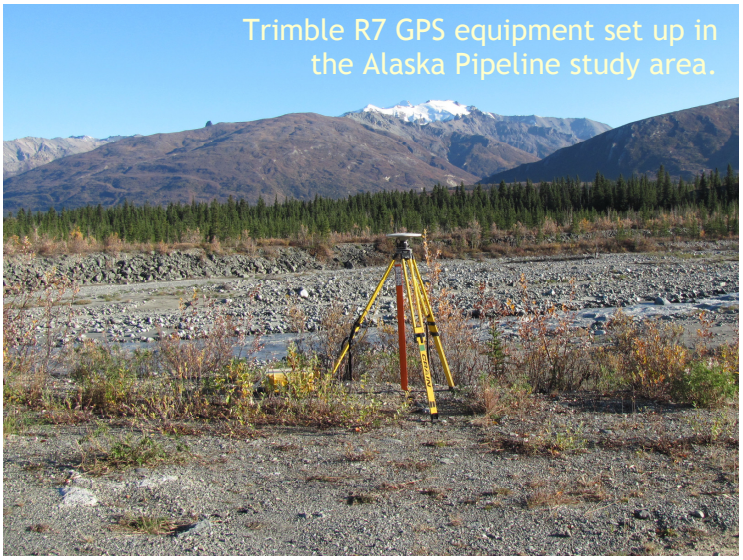



Watershed Sciences coordinated with McClintock Land Associates (MLA), Eagle River, AK (Alaska Professional Licensed Surveyor) to determine proposed monument locations to support aerial acquisition. MLA established survey control monuments for the project area based on the proposed locations and areas with reasonable access, GPS visibility and proximity to the mission area. MLA established five new monuments (**Table 1**) within the Delivery 1 area. The MLA monumentation was done with 5/8" x 30" rebar topped with a metal cap stamped with "MLA-WSI" the monument ID, and the year of establishment. MLA provided professional supervision and oversight to all survey aspects of this project, certified all monuments and provided additional independent accuracy check points (see Section 5.4, Appendix B). A full report of the survey will be provided with the final delivery report.

### *2.2.2 Control for Airborne Surveys*

During the LiDAR survey, static (1 Hz recording frequency) ground surveys were conducted over the survey control monuments. Monument coordinates are provided in **Table 1** and shown in **Figure 2** for the AOI. After the airborne survey, the static GPS data were provided to MLA for incorporation in the computation of the monument coordinates. MLA processed the static GPS data using triangulation with Continuously Operating Reference Stations (CORS). Both WSI and MLA checked coordinates using the Online Positioning User Service (OPUS[1]) to quantify daily variance. Multiple sessions were processed over the same monument to confirm antenna height measurements and reported position accuracy.

Indexed by time, these GPS data are used to correct the continuous onboard measurements of aircraft position recorded throughout the mission. Control monuments were located within 13 nautical miles of the survey area as per the contract. However, due to access constraints caused by the Tanana River near Dot Lake, baseline lengths for monuments 25A & 25B were necessarily stretched to ~14 nm to cover the very most NE corner of Delivery 1.



Trimble R7 GPS equipment set up in the Alaska Pipeline study area.

[1] Online Positioning User Service (OPUS) is run by the National Geodetic Survey to process corrected monument positions.

### *2.2.3 Instrumentation*

For this delivery area, a Trimble GPS receiver model R7 with Zephyr Geodetic antenna with ground plane was deployed for all static control. MLA provided GLONASS capable Topcon GPS receivers for additional ground survey support. A Trimble model R8 GNSS unit was used for collecting check points using real time kinematic (RTK) survey techniques. For RTK data, the collector begins recording after remaining stationary for 5 seconds then calculating the pseudo range position from at least three epochs with the relative error under 1.5cm horizontal and 2cm vertical. All GPS measurements are made with dual frequency L1-L2 receivers with carrier-phase correction.

***Table 2**. Base Station control coordinates for Alaska Pipeline Delivery 1.*

| Base Station ID | Datum: NAD83 (CORS96) | | GRS80 |
|---|---|---|---|
| | Latitude | Longitude | Ellipsoid Z (meters) |
| 24B | 63°41'23.71474"N | 144°23'17.75734"W | 429.448 |
| 25A | 63°39'38.92963"N | 144°03'59.83195"W | 434.287 |
| 25B | 63°39'13.67975"N | 144°01'04.92402"W | 441.325 |
| 26C | 63°28'37.52746"N | 143°50'09.39883"W | 514.101 |
| 26D | 63°28'31.40039"N | 143°50'12.75648"W | 507.620 |

### *2.2.3 Methodology*

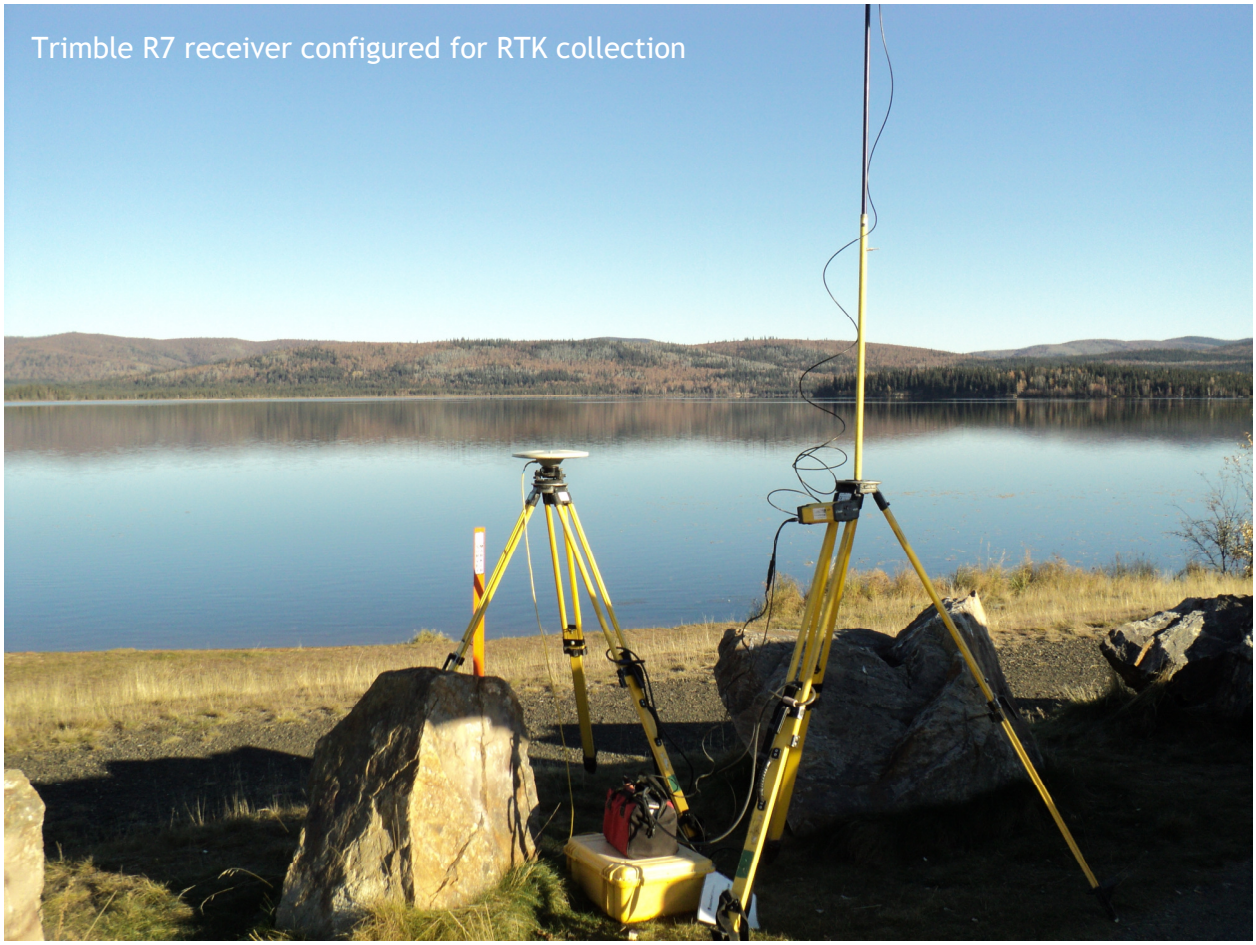



The aircraft was assigned a ground crew member with two Trimble R7 receivers and an R8 receiver. The aircraft is further supported as necessary by MLA surveyor (AK PLS) with two or more survey grade Topcon Receivers. The ground crew vehicles are equipped with standard field survey supplies and equipment including safety materials. All control monuments are observed for a minimum of two survey sessions lasting no fewer than 6 hours. At the beginning of every session the tripod and antenna are reset, resulting in two independent instrument heights and data files. Data is collected at a rate of 1Hz using a 10 degree mask on the antenna.

After the flight, the ground crew uploads the GPS data to WSI's office for QA/QC review and processing. The static GPS data were also provided to the MLA project surveyor for final computation and review of the control coordinates. MLA provided calculated geodetic positions for all control, which were then used to process LiDAR data.

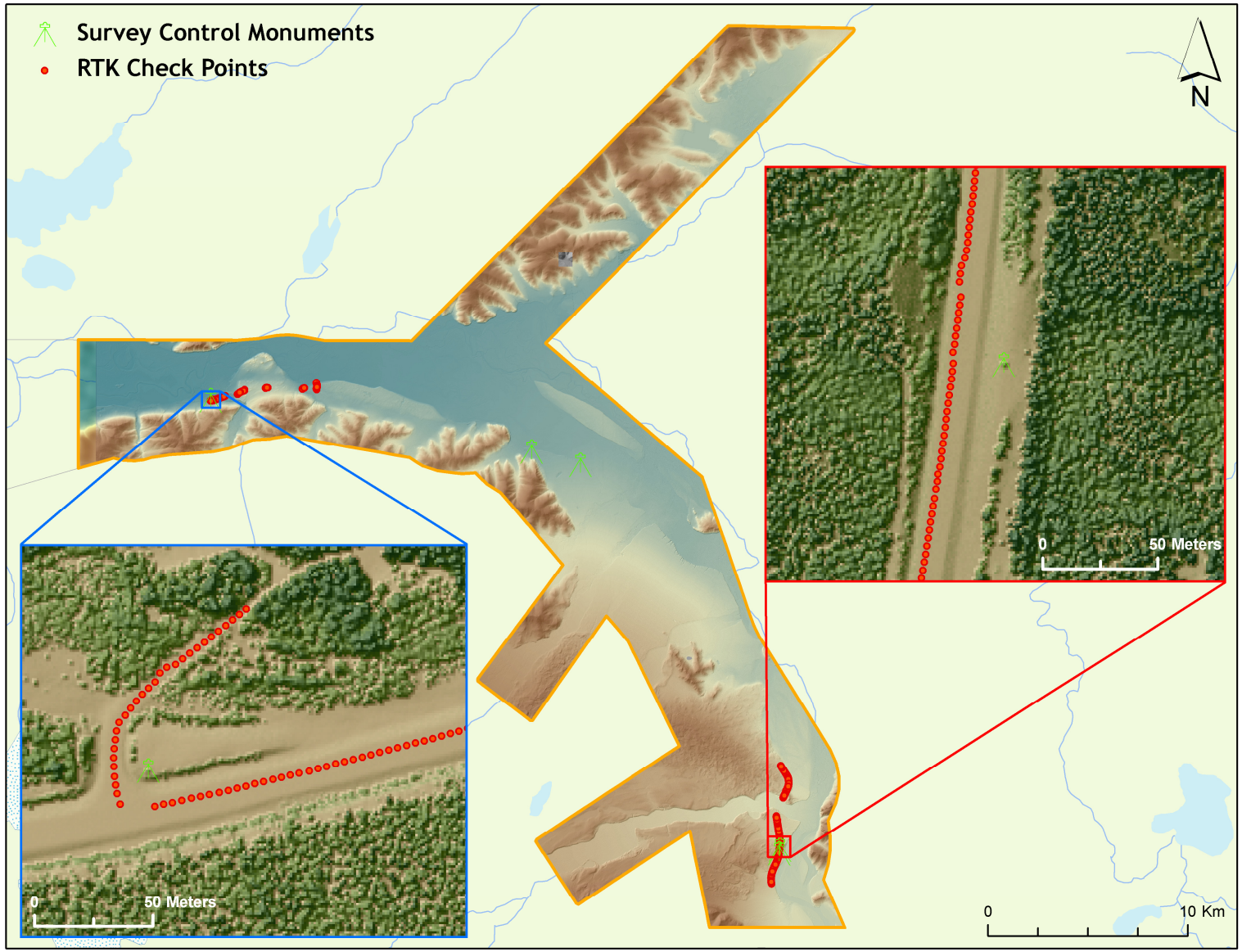
RTK and aircraft mounted GPS measurements are made during periods with PDOP[2] less than or equal to 3.0 and with at least 6 satellites in view of both a stationary reference receiver and the roving receiver. Static GPS data collected in a continuous session average the high PDOP into the final solution in the method used by CORS stations. RTK positions are collected on bare earth locations such as paved, gravel or stable dirt roads, and other locations where the ground is clearly visible (and is likely to remain visible) from the sky during the data acquisition and RTK measurement period(s).

In order to facilitate comparisons with LiDAR measurements, RTK measurements are not taken on highly reflective surfaces such as center line stripes or lane markings on roads. RTK points were taken no closer than one meter to any nearby terrain breaks such as road edges or drop offs.


Trimble R7 receiver configured for RTK collection

[2]PDOP: Point Dilution of Precision is a measure of satellite geometry, the smaller the number the better the geometry between the point and the satellites.

***Figure 2**. WSI RTK check points and control monument locations used in Delivery 1 of the Alaska Pipeline LiDAR Survey.*



# 3. LiDAR Data Processing

## 3.1 Applications and Work Flow Overview

1. Resolved kinematic corrections for aircraft position data using kinematic aircraft GPS and static ground GPS data.

   **Software:** Waypoint GPS v.8.10, Trimble Geomatics Office v.1.62
2. Developed a smoothed best estimate of trajectory (SBET) file that blends post-processed aircraft position with attitude data. Sensor head position and attitude were calculated throughout the survey. The SBET data were used extensively for laser point processing.

   **Software:** IPAS v.1.35
3. Calculated laser point position by associating SBET position to each laser point return time, scan angle, intensity, etc. Created raw laser point cloud data for the entire survey in *.las (ASPRS v. 1.2) format.

   **Software:** ALS Post Processing Software v.2.70
4. Imported raw laser points into manageable blocks (less than 500 MB) to perform manual relative accuracy calibration and filter for pits/birds. Ground points were then classified for individual flight lines (to be used for relative accuracy testing and calibration).

   **Software:** TerraScan v.10.009
5. Using ground classified points per each flight line, the relative accuracy was tested. Automated line-to-line calibrations were then performed for system attitude parameters (pitch, roll, heading), mirror flex (scale) and GPS/IMU drift. Calibrations were performed on ground classified points from paired flight lines. Every flight line was used for relative accuracy calibration.

   **Software:** TerraMatch v.10.006
6. Position and attitude data were imported. Resulting data were classified as ground and non-ground points. Statistical absolute accuracy was assessed via direct comparisons of ground classified points to ground RTK survey data. Data were then converted to orthometric elevations (NAVD88) by applying a Geoid09 correction. **Software:** TerraScan v.10.009, TerraModeler v.10.004
7. Bare Earth models were created as a triangulated surface and exported as ArcInfo ASCII grids at a 1 meter pixel resolution. Highest Hit models were created for any class at 1 meter grid spacing and exported as ArcInfo ASCII grids.

   **Software:** TerraScan v.10.009, ArcMap v. 9.3.1, TerraModeler v.10.004

## 3.2 Aircraft Kinematic GPS and IMU Data

LiDAR survey datasets were referenced to the 1 Hz static ground GPS data collected over pre-surveyed monuments with known coordinates. While surveying, the aircraft collected 2 Hz kinematic GPS data, and the onboard inertial measurement unit (IMU) collected 200 Hz aircraft attitude data. Waypoint GPS v.8.10 was used to process the kinematic corrections for the aircraft. The static and kinematic GPS data were then post-processed after the survey to obtain an accurate GPS solution and aircraft positions. IPAS v.1.35 was used to develop a trajectory file that includes corrected aircraft position and attitude information. The

trajectory data for the entire flight survey session were incorporated into a final smoothed best estimated trajectory (SBET) file that contains accurate and continuous aircraft positions and attitudes.

## 3.3 Laser Point Processing

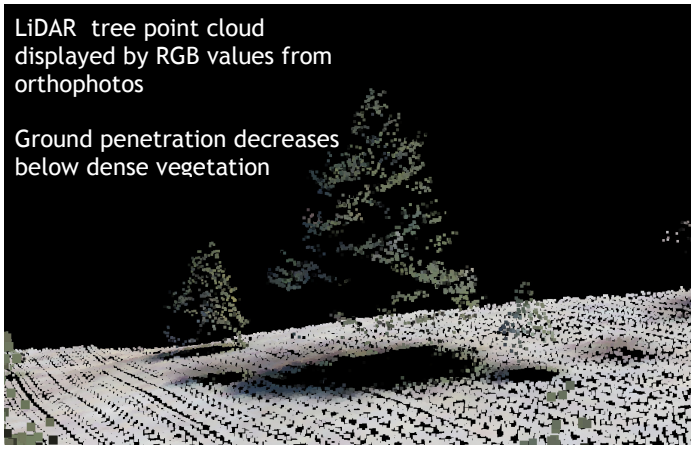
Laser point coordinates were computed using the IPAS and ALS Post Processor software suites based on independent data from the LiDAR system (pulse time, scan angle), and aircraft trajectory data (SBET). Laser point returns (first through fourth) were assigned an associated (x, y, z) coordinate along with unique intensity values (0-255). The data were output into large LAS v. 1.2 files with each point maintaining the corresponding scan angle, return number (echo), intensity, and x, y, z (easting, northing, and elevation) information.

These initial laser point files were too large for subsequent processing. To facilitate laser point processing, bins (polygons) were created to divide the dataset into manageable sizes (< 500 MB). Flightlines and LiDAR data were then reviewed to ensure complete coverage of the survey area and positional accuracy of the laser points.

Laser point data were imported into processing bins in TerraScan, and manual calibration was performed to assess the system offsets for pitch, roll, heading and scale (mirror flex). Using a geometric relationship developed by Watershed Sciences, each of these offsets was resolved and corrected if necessary.

LiDAR points were then filtered for noise, pits (artificial low points), and birds (true birds as well as erroneously high points) by screening for absolute elevation limits, isolated points and height above ground. Each bin was then manually inspected for remaining pits and birds and spurious points were removed. In a bin containing approximately 7.5-9.0 million points, an average of 50-100 points are typically found to be artificially low or high. Common sources of non-terrestrial returns are clouds, birds, vapor, haze, decks, brush piles, etc.

Internal calibration was refined using TerraMatch. Points from overlapping lines were tested for internal consistency and final adjustments were made for system misalignments (i.e., pitch, roll, heading offsets and scale). Automated sensor attitude and scale corrections yielded 3-5 cm improvements in the relative accuracy. Once system misalignments were corrected, vertical GPS drift was then resolved and removed per flight line, yielding a slight improvement (<1 cm) in relative accuracy.




The TerraScan software suite is designed specifically for classifying near-ground points (Soininen, 2004). The processing sequence began by 'removing' all points that were not 'near' the earth based on geometric constraints used to evaluate multi-return points. The resulting bare earth (ground) model was visually inspected and additional ground point modeling was performed in site-specific areas to improve ground detail. This manual editing of ground often occurs in

areas with known ground modeling deficiencies, such as: bedrock outcrops, cliffs, deeply incised stream banks, and dense vegetation. In some cases, automated ground point classification erroneously included known vegetation (i.e., understory, low/dense shrubs, etc.). These points were manually reclassified. Ground surface rasters were then developed from triangulated irregular networks (TINs) of ground points.

To develop the highest hit and vegetation models, buildings and structures were classified through automated point processing algorithms and then manually inspected and edited during the ground model inspection. Typically, manual editing of building classification was necessary where dense canopy was immediately proximate to buildings, or where structures such as utility poles or fences mimicked vegetation.

The remaining points not classified as ground, buildings, or error points were separated into two vegetation classes; Low Vegetation consisting of all returns ≤20cm from the ground, and Medium Vegetation consisting of all returns >20cm from the ground. This distinction was necessary because some potential for unclassified ground exists in the dataset. Vegetation classified returns within 20cm of the ground have higher potential to be artifacts of the dataset caused by minor offsets between flightlines (typically <10cm), isolated noise points, or abrupt discrete terrain features that did not get classified as ground (i.e. small boulders or sharp cliffs). The majority of points classified as low vegetation are valid returns, so the class was retained in the dataset to be incorporated into analyses at the user's discretion.

**Table 3.** ASPRS classification definitions for the Alaska Pipeline LiDAR survey

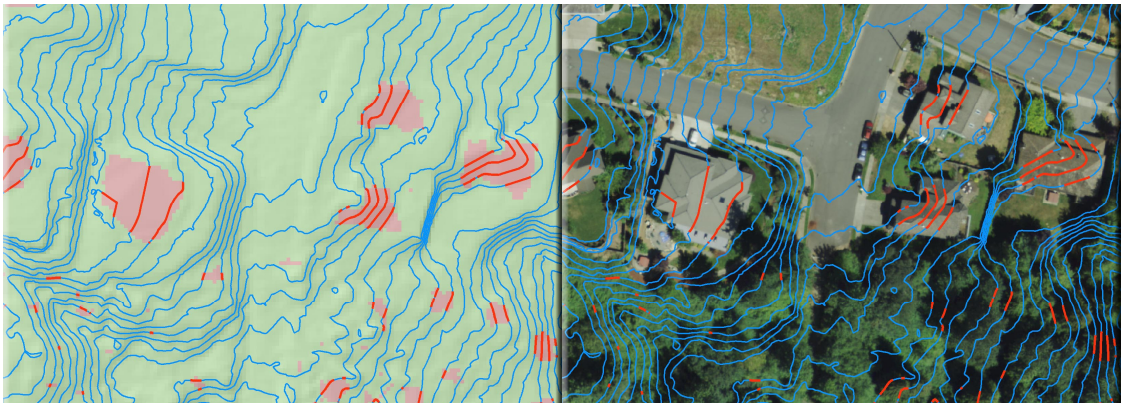
| ASPRS Class | Definition |
|---|---|
| 2 | Ground |
| 3 | Low Vegetation |
| 4 | Medium Vegetation |
| 6 | Buildings/Man-made structures |
| 7 | Noise/error points |
| 9 | Water |
| 15 | Pipeline |

## 3.4 Contour Development

Contour lines were derived at 1 meter intervals from ground-classified LiDAR point data using TerraSolid processing software in MicroStation v. 8.1. Contour generation from LiDAR point data requires a thinning operation in order to reduce contour sinuosity. Parameters for these operations are: thinning elevation bounds: +/- 0.07m; search radius: 6.09m. The thinning operation reduces point density where topographic change is minimal (flat surfaces) while preserving resolution where topographic change is present. The total sum of potential error in vertical position is equal to twice the point processing limits (0.14m) plus twice the 2-sigma absolute vertical accuracy value for this dataset.

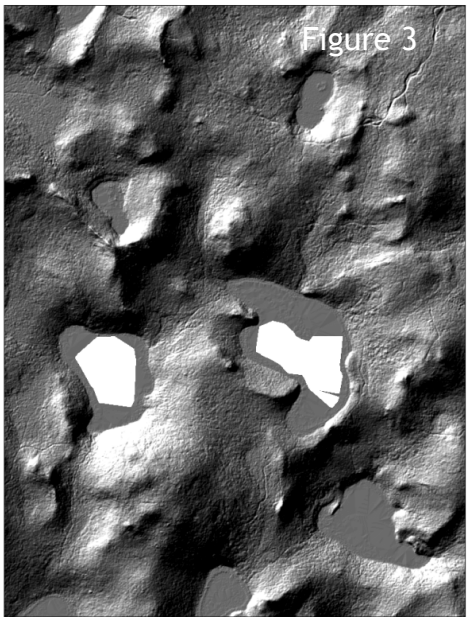
Ground point density rasters were created within MicroStation using a 1 meter step resolution and a 2 meter sampling radius. Areas with less than 0.25 ground-classified points per square meter were considered "sparse" and areas with higher densities were considered "covered". The ground point density raster data are in ESRI GRID format and have a 1 meter pixel resolution. The contour lines were intersected with ground point density raster data, allowing the addition of a confidence attribute to contour lines. Contour lines over "sparse" areas have low confidence, while contour lines over "covered" areas have a high confidence. Areas with low ground point density are commonly beneath buildings and bridges, in locations with dense vegetation, over water, and in other areas where laser penetration to the ground surface is impeded. **Figure 3** is an example of a ground point density raster and contour lines.

***Figure 3**. Elevation contours over LiDAR ground-classified point density raster (left) and true-color aerial photograph (right). Red indicates low ground point density and blue represents high density.*

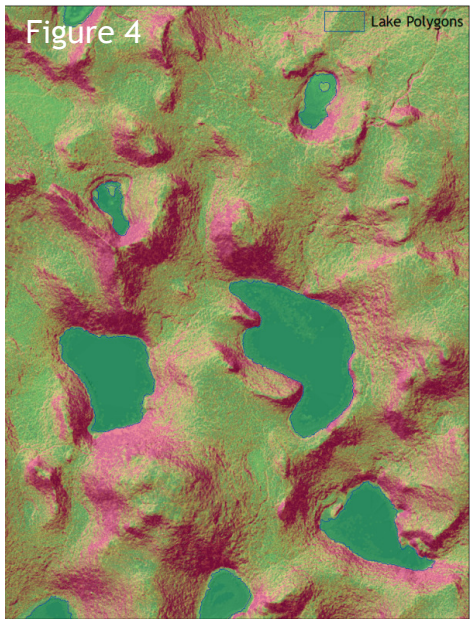


## 3.5 Hydro-Flattening

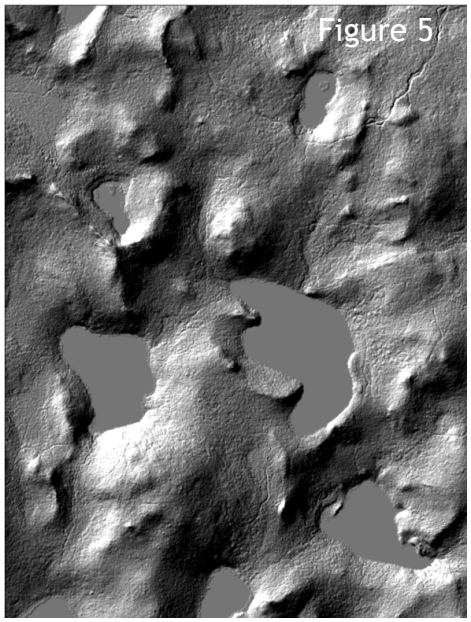
Lakes and other closed water bodies with surface area >150 $m^2$ were flattened to a consistent water level. The hydro-flattening process eliminates artifacts in the digital terrain model caused by both increased variability in ranges or dropouts in laser returns due to the low reflectivity of water [Figure 3]. As per the project specifications, rivers and streams were not hydro-flattened.




Hydro-flattening of closed water bodies was performed through a combination of automated and manual detection and adjustment techniques designed to identify lake boundaries and water levels. Boundary polygons were developed using an algorithm which weights LiDAR-derived slopes, intensities, and return densities to detect the lake edge. The lake edges were then manually reviewed and edited in a 3-D environment. Once polygons were developed, the lake elevations were computed from the filtered LiDAR returns.




Returns from the water surface within each polygon were filtered and inspected for false low points during the initial ground modeling process described previously (Section 3.4). The elevation of each lake was computed as 5-cm above the minimum elevation of filtered water surface cells within the lake polygon. This approach ensures that all spurious returns off the water surface (both artificially high and low) were excluded from lake level assessment.




Lake-boundary polygons were then incorporated into the final terrain model and enforced as hard-breaklines. The initial ground classified points falling within lake polygons were reclassified as water points [to omit them from the final ground model] and replaced with the flat water surface of the lake boundary breaklines [Figure 5].

# 4. LiDAR Accuracy Assessment

## 4.1 Laser Noise and Relative Accuracy

*Laser Noise*
For any given target, laser noise is the breadth of the data cloud per laser return (i.e., last, first, etc.). Lower intensity surfaces (roads, rooftops, still/calm water) experience higher laser noise. The laser noise range for this survey was approximately 0.02 meters.

*Relative Accuracy*
Relative accuracy refers to the internal consistency of the data set - the ability to place a laser point in the same location over multiple flight lines, GPS conditions, and aircraft attitudes. Affected by system attitude offsets, scale, and GPS/IMU drift, internal consistency is measured as the divergence between points from different flight lines within an overlapping area. Divergence is most apparent when flight lines are opposing. When the LiDAR system is well calibrated, the line-to-line divergence is low (<10 cm). See Appendix A for further information on sources of error and operational measures that can be taken to improve relative accuracy.

**Relative Accuracy Calibration Methodology**

1. Manual System Calibration: Calibration procedures for each mission require solving geometric relationships that relate measured swath-to-swath deviations to misalignments of system attitude parameters. Corrected scale, pitch, roll and heading offsets were calculated and applied to resolve misalignments. The raw divergence between lines was computed after the manual calibration was completed and reported for each survey area.
2. Automated Attitude Calibration: All data were tested and calibrated using TerraMatch automated sampling routines. Ground points were classified for each individual flight line and used for line-to-line testing. System misalignment offsets (pitch, roll and heading) and scale were solved for each individual mission and applied to respective mission datasets. The data from each mission were then blended when imported together to form the entire area of interest.
3. Automated Z Calibration: Ground points per line were used to calculate the vertical divergence between lines caused by vertical GPS drift. Automated Z calibration was the final step employed for relative accuracy calibration.

## 4.2 Absolute Accuracy

Laser point absolute accuracy is largely a function of laser noise and relative accuracy. To minimize these contributions to absolute error, a number of noise filtering and calibration procedures were performed prior to evaluating absolute accuracy. The LiDAR quality assurance process uses the data from the real-time kinematic (RTK) ground survey conducted in the AOI. For Delivery 1, a total of **2038 RTK** GPS measurements were collected on hard surfaces distributed among multiple flight swaths. Suitable and accessible hard-surfaces limited the number of RTK points able to be collected. To assess absolute accuracy the location coordinates of these known RTK ground points were compared to those calculated for the closest ground-classified laser points.

The vertical accuracy of the LiDAR data is described as the mean and standard deviation (sigma ~ $\sigma$) of divergence between LiDAR point coordinates and RTK ground survey point coordinates. To provide a sense of the model predictive power of the dataset, the root mean square error (RMSE) for vertical accuracy is also provided. These statistics assume the error distributions for x, y, and z are normally distributed, thus the skew and kurtosis of distributions are considered when evaluating error statistics.

Statements of statistical accuracy apply to fixed terrestrial surfaces only and may not be applied to areas of dense vegetation or steep terrain (See Appendix A).

# 5. Study Area Results

Summary statistics for point resolution and accuracy (relative and absolute) of the LiDAR data collected in the Alaska Delivery 1 survey area are presented below in terms of central tendency, variation around the mean, and the spatial distribution of the data (for point resolution by tile) per AOI.

The initial dataset, acquired to be ≥8 points per square meter, was filtered as described previously to remove spurious or inaccurate points. Additionally, some types of surfaces (i.e., dense vegetation, breaks in terrain, water, steep slopes) may return fewer pulses (delivered density) than the laser originally emitted (native density).

Ground classifications were derived from automated ground surface modeling and manual, supervised classifications where it was determined that the automated model had failed. Ground return densities will be lower in areas of dense vegetation, water, or buildings.

## Data Summary:

***Table 4****. LiDAR Resolution and Accuracy - Specifications and Achieved Values*

| | | Targeted | Achieved |
|---|---|---|---|
| **Resolution:** | **UTM 6** | ≥ 8 points/$m^2$ | 8.61 points/$m^2$ |
| | **UTM 7** | | 8.91 points/$m^2$ |
| **Vertical Accuracy (1 $\sigma$):** | | **<13 cm** | 2.8 cm |

## 5.1 Data Density/Resolution

**Figures 8 and 9** display the distribution of average native and ground point densities for each processing bin. Density data will continue to be updated as data is processed and delivered.

LiDAR data resolution for Alaska Pipeline, Delivery 1:

| | UTM 6 | UTM 7 |
|---|---|---|
| Average Point (First Return) Density | 8.61 points/$m^2$ | 8.91 points/$m^2$ |
| Average Ground Point Density | 2.72 points/$m^2$ | 2.99 points/$m^2$ |

***Figure 6***. *Density distribution for first return laser points for UTM 6 (A) and UTM 7 (B)*

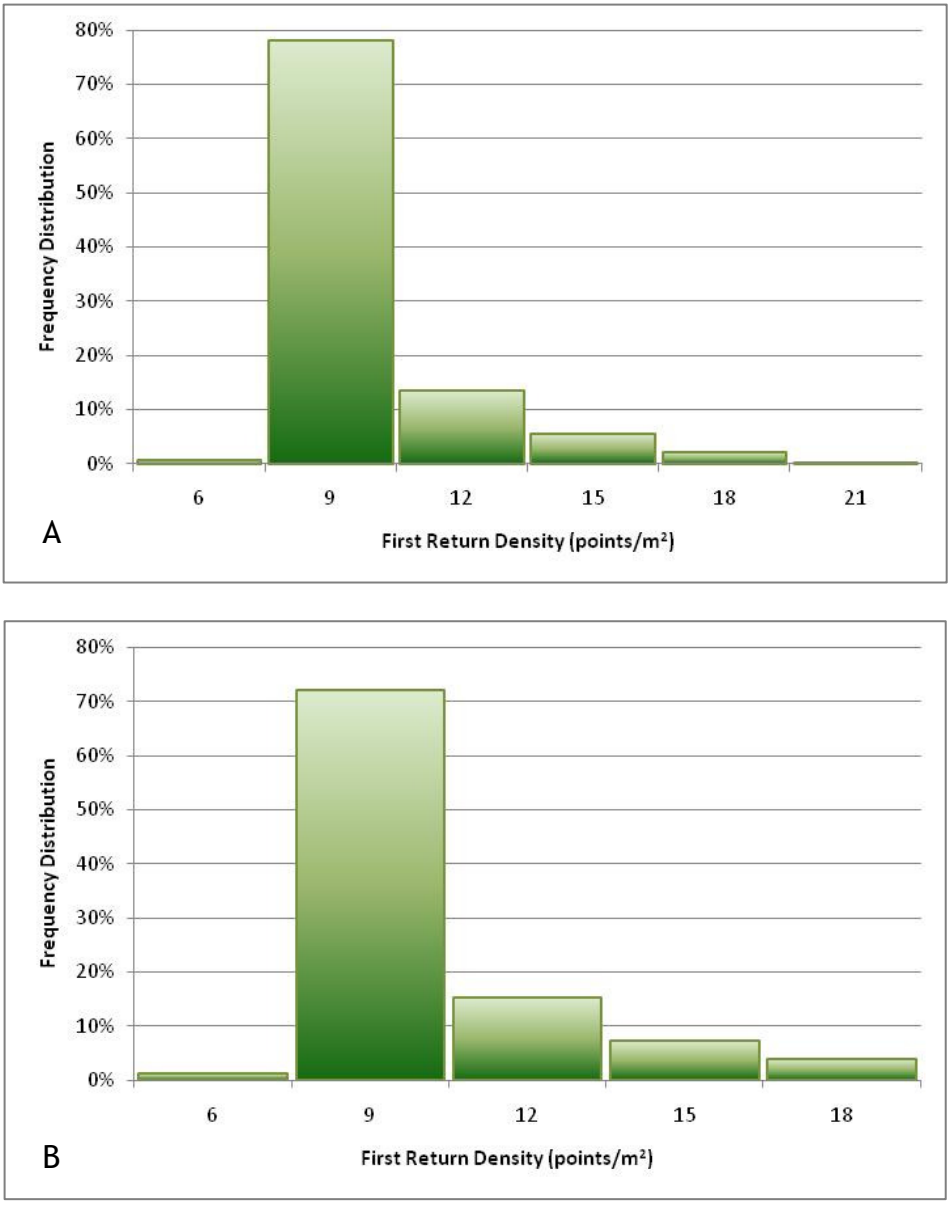


***Figure 7**. Density distribution for ground classified laser points for UTM 6 (A) and UTM 7 (B)*

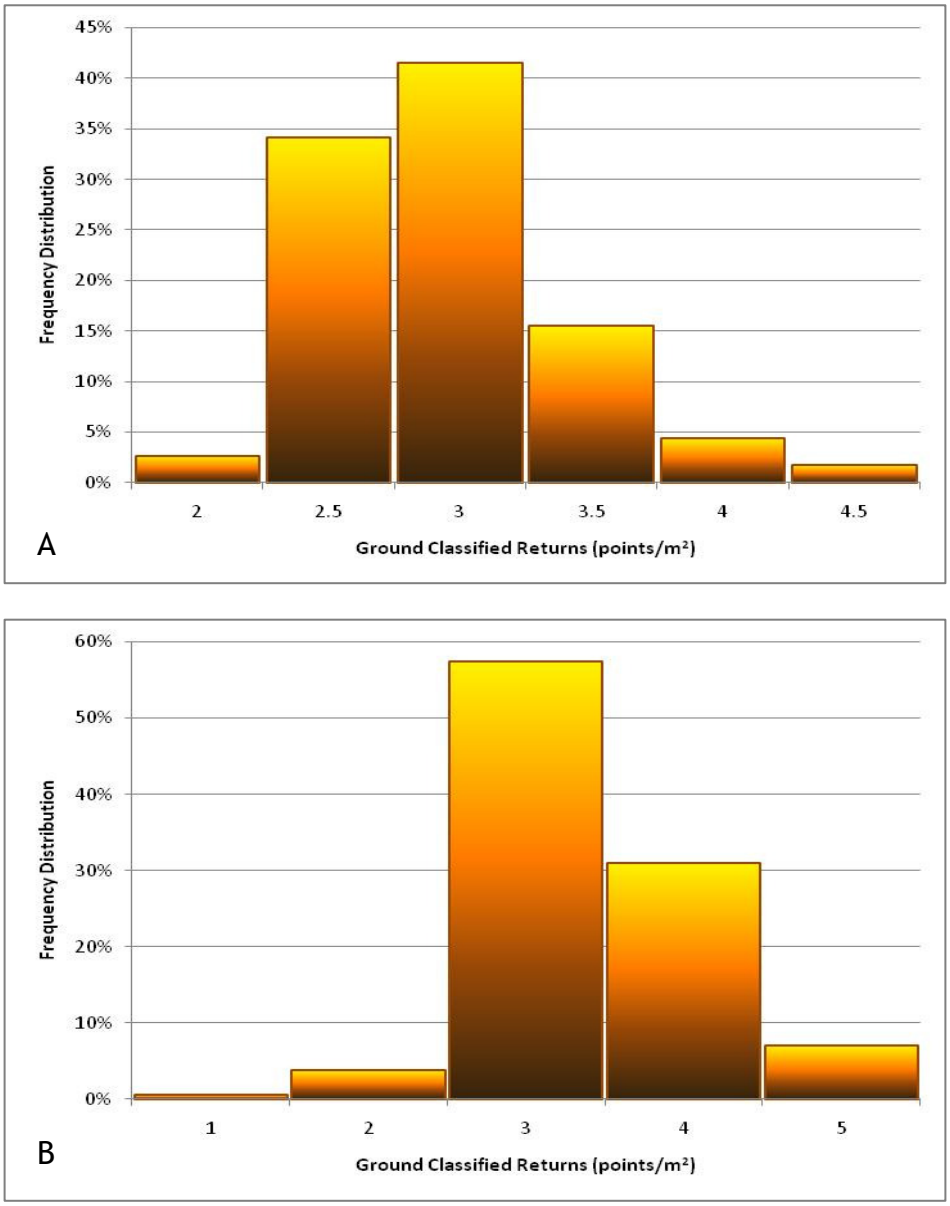
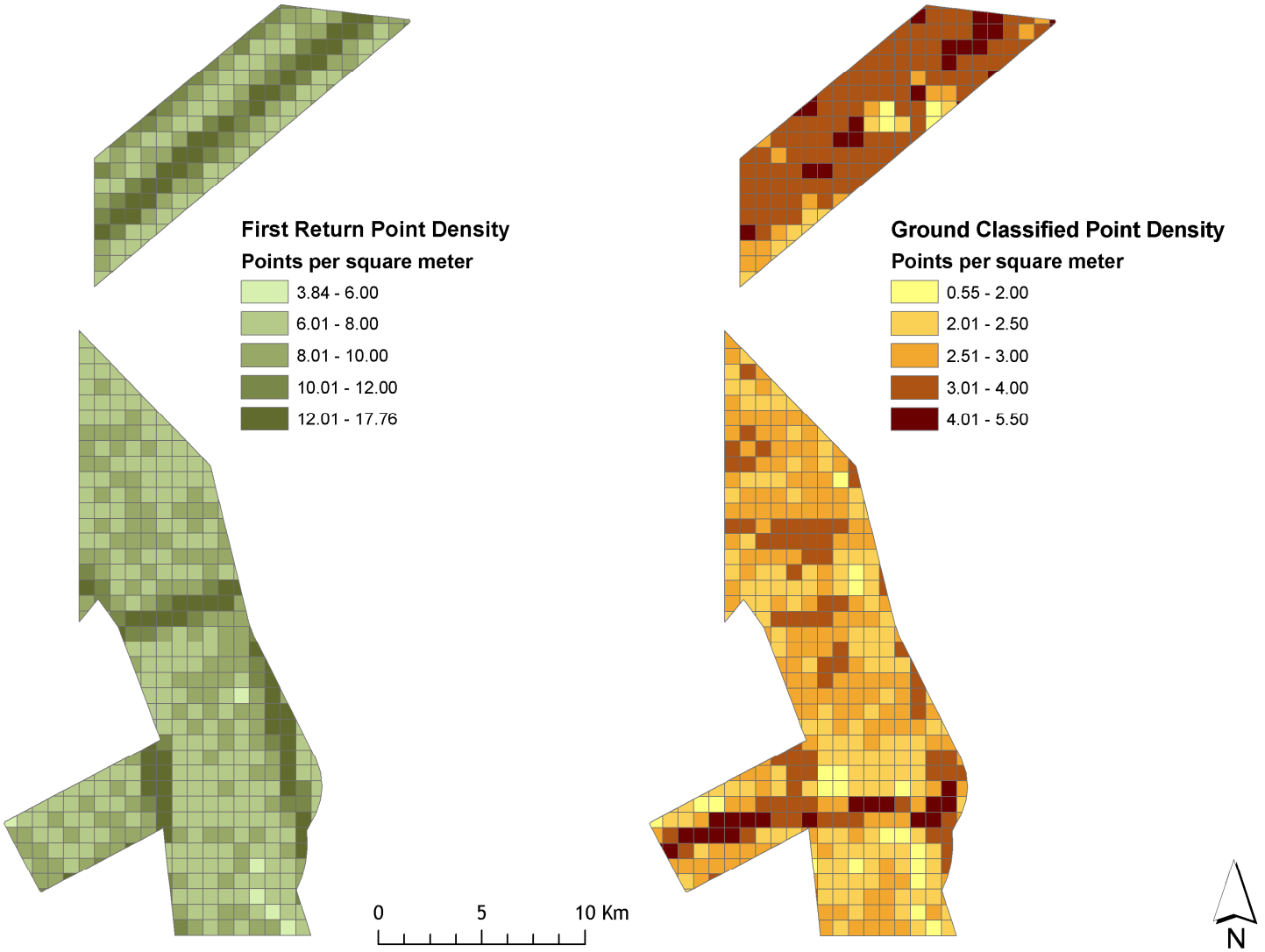


***Figure 8.*** *Density distribution map for ground and first return points by processing bin in UTM 6*



***Figure 9.*** *Density distribution map for ground and first return points by processing bin in UTM 7*

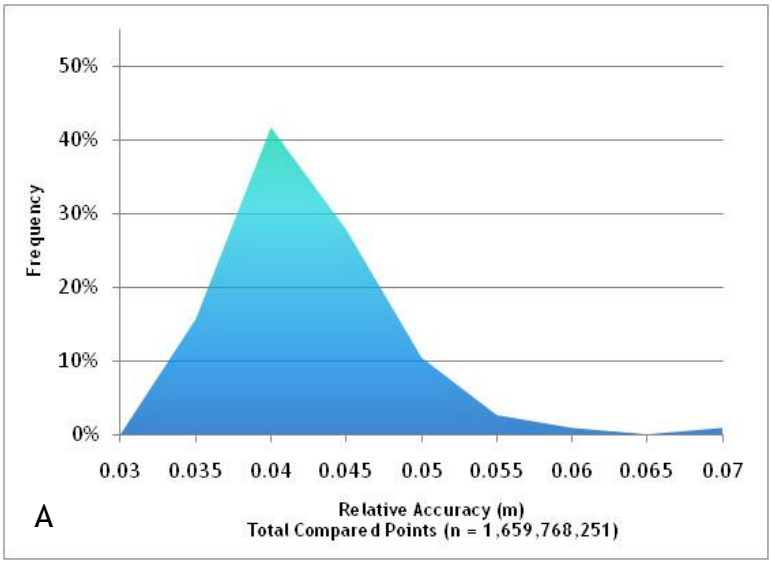


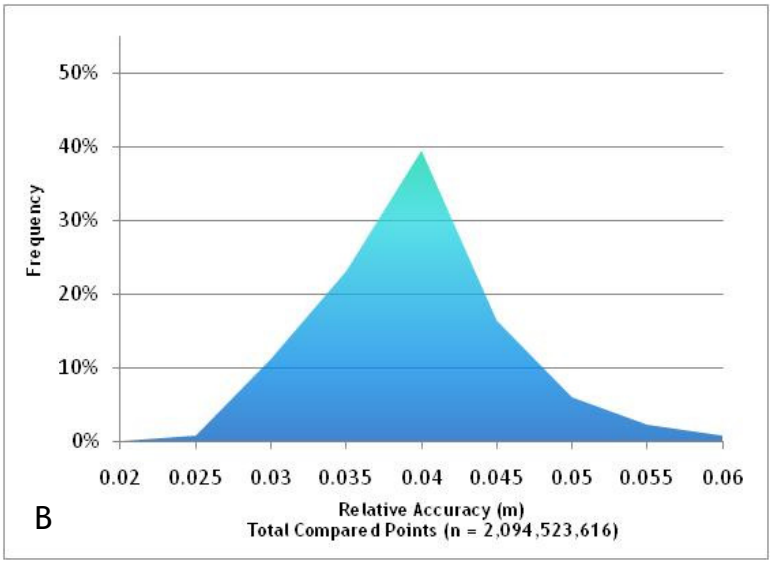
## 5.2 Relative Accuracy Calibration Results

***Table 5**. Relative accuracy statistics for Delivery 1.*

| | UTM 6 | UTM 7 |
|---|---|---|
| Project Average | 0.04m | 0.037m |
| Median Relative Accuracy | 0.038m | 0.037m |
| 1σ Relative Accuracy | 0.005m | 0.006m |
| 1.96σ Relative Accuracy | 0.011m | 0.011m |

***Figure 10**. Distribution of relative accuracies in UTM 6 (A) and 7 (B) per flight line, non slope-adjusted*



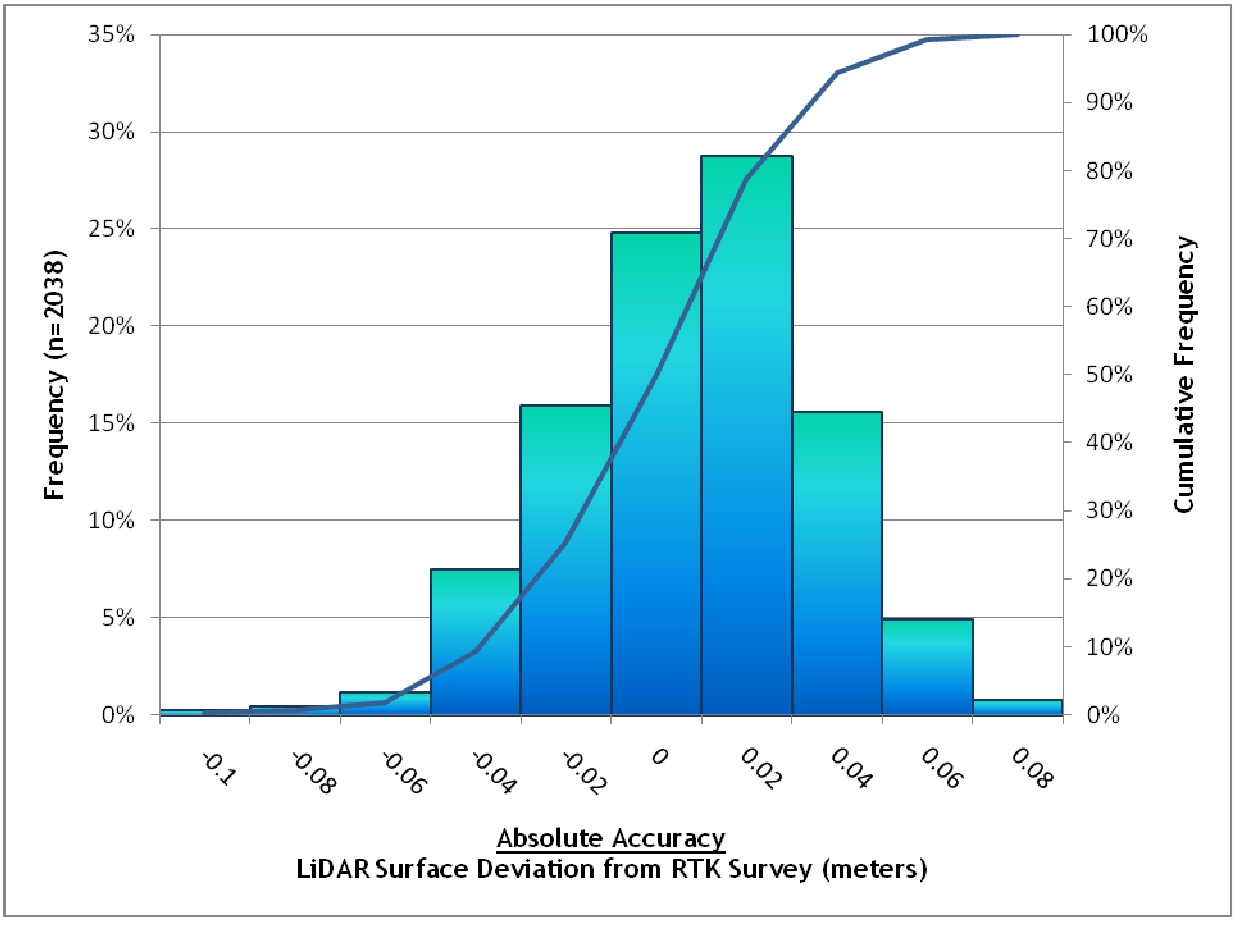
## 5.3 Absolute Accuracy

Absolute accuracies for Alaska Pipeline, Delivery 1: All data was calibrated and processed in UTM 6 and then transformed to the appropriate projection.

***Table 6.*** *Absolute Accuracy – Deviation between laser points and RTK hard surface survey points*

| RTK Survey Sample Size (n): 2038 | |
|---|---|
| Root Mean Square Error (RMSE): 0.028m | Minimum Δz = -0.119m |
| Standard Deviations<br>1 sigma (σ): 0.028m  1.96 sigma (σ): 0.054m | Maximum Δz = 0.080m |
| | Average Δz = -0.001m |

***Figure 11.*** *Absolute Accuracy - Histogram Statistics*



## 5.4 Independent Accuracy Assessment

In accordance with the project plan, McClintock Land Associates (AK PLS) collected independent (i.e. blind) check points within the survey area to provide an independent assessment of LiDAR accuracy. WSI was provided with Easting and Northing positions for points which were then assigned elevations from the LiDAR. MLA received this report and compared the LiDAR Z values to MLA's surveyed (or known) Z values.

***Table 7****. Absolute accuracy determined by the project surveyor (MLA) using "Blind" Check Points (See Appendix B for PLS report)*

| Delivery | # of Check Points | RMSE | Range |
|---|---|---|---|
| 1 | 735 | 0.062m | 0.24m |

## 7. Projection/Datum and Units

| | | |
|---|---|---|
| | **Projection:** | UTM Zone 5, 6, 7 North |
| **Datum** | **Vertical:** | NAVD88 Geoid09 |
| | **Horizontal:** | NAD83 |
| | **Units:** | meters |

## 8. Deliverables

| | |
|---|---|
| **Point Data:** | • All Returns (LAS 1.2 format)<br>• Ground Returns (LAS 1.2 format) |
| **Vector Data:** | • Project Boundary (shapefile format)<br>• Tile Index for LiDAR Points (shapefile format)<br>• Tile Index for DEMs (shapefile format)<br>• Contours (1m shapefile format, DXF format)<br>• RTK (shapefile format, .TXT format)<br>• SBETs (shapefile format, DBF format)<br>• Lake Boundaries (shapefile format) |
| **Raster Data:** | • Elevation Models (1m resolution)<br>• Hydro-flattened Bare Earth Model (ESRI GRID format)<br>• Hydro-flattened Highest Hit Model (ESRI GRID format)<br>• Hydro-flattened Vegetation Model (ESRI GRID format)<br>• Intensity Images (GeoTIFF format, 0.5m resolution) |
| **Data Report:** | • Full report containing introduction, methodology, and accuracy |

# 9. Selected Images

***Figure 12**. View across braided channels of the Tanana River near Dot Lake. Top image is Bare Earth model. Bottom image is LiDAR point cloud colored by elevation.*

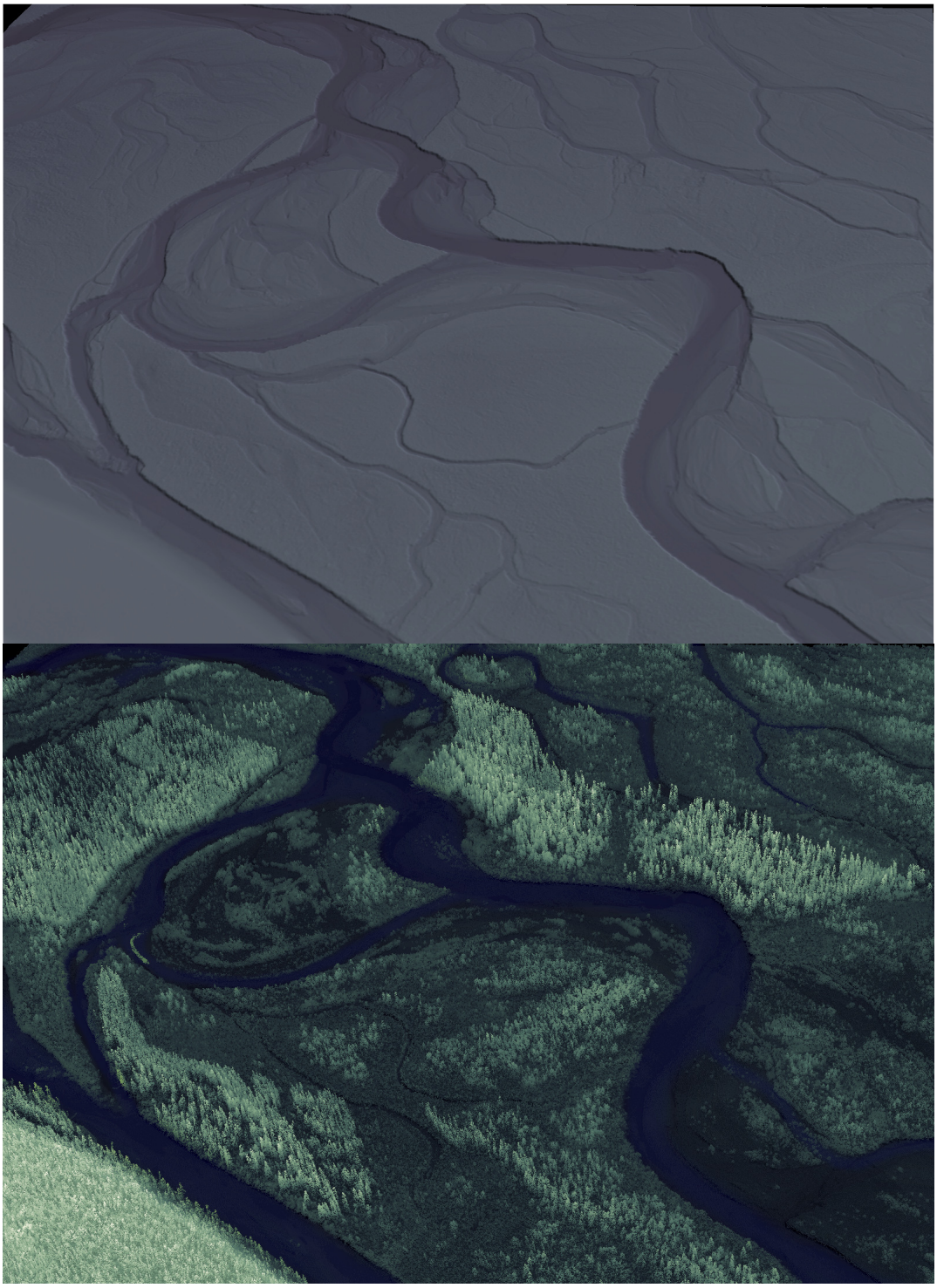


***Figure 13**. View looking west at hydro-flattened pond south of T Lake of Bare Earth model.*

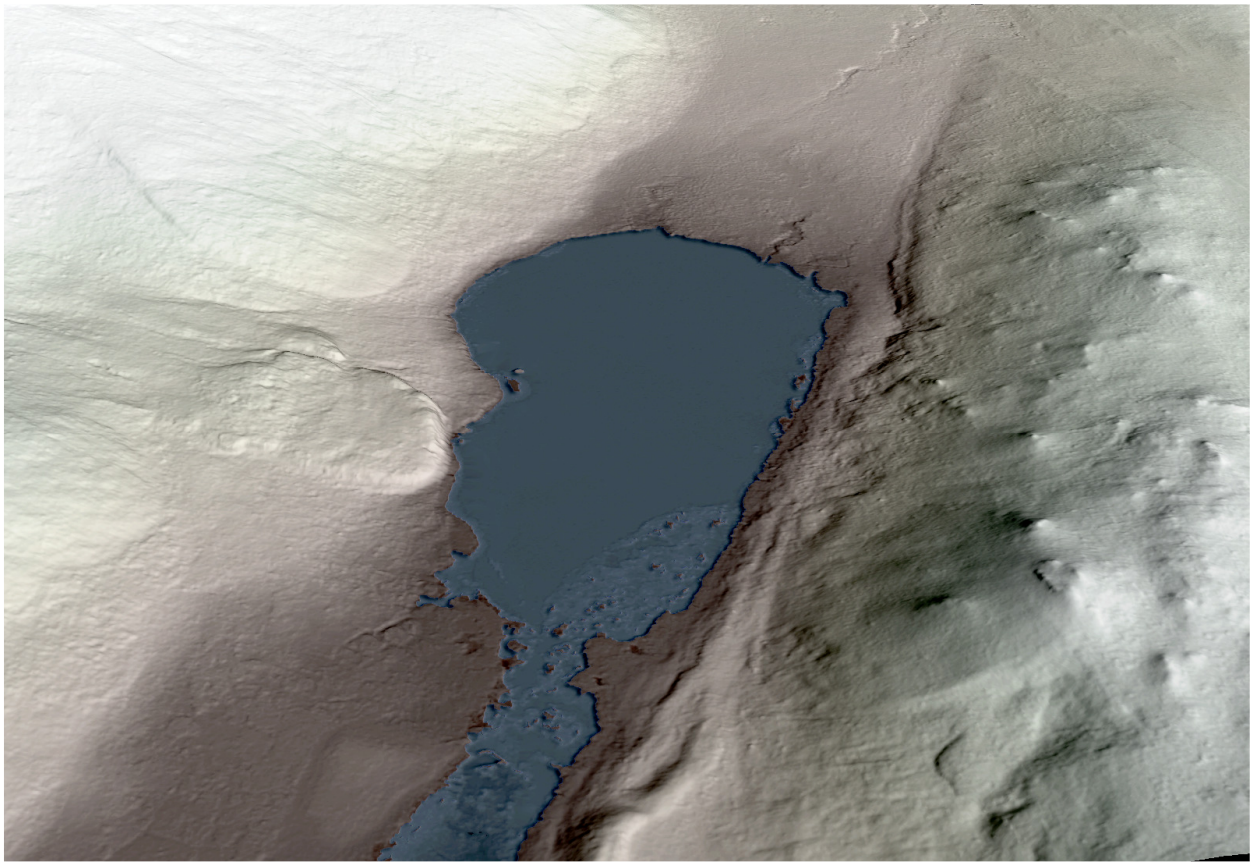
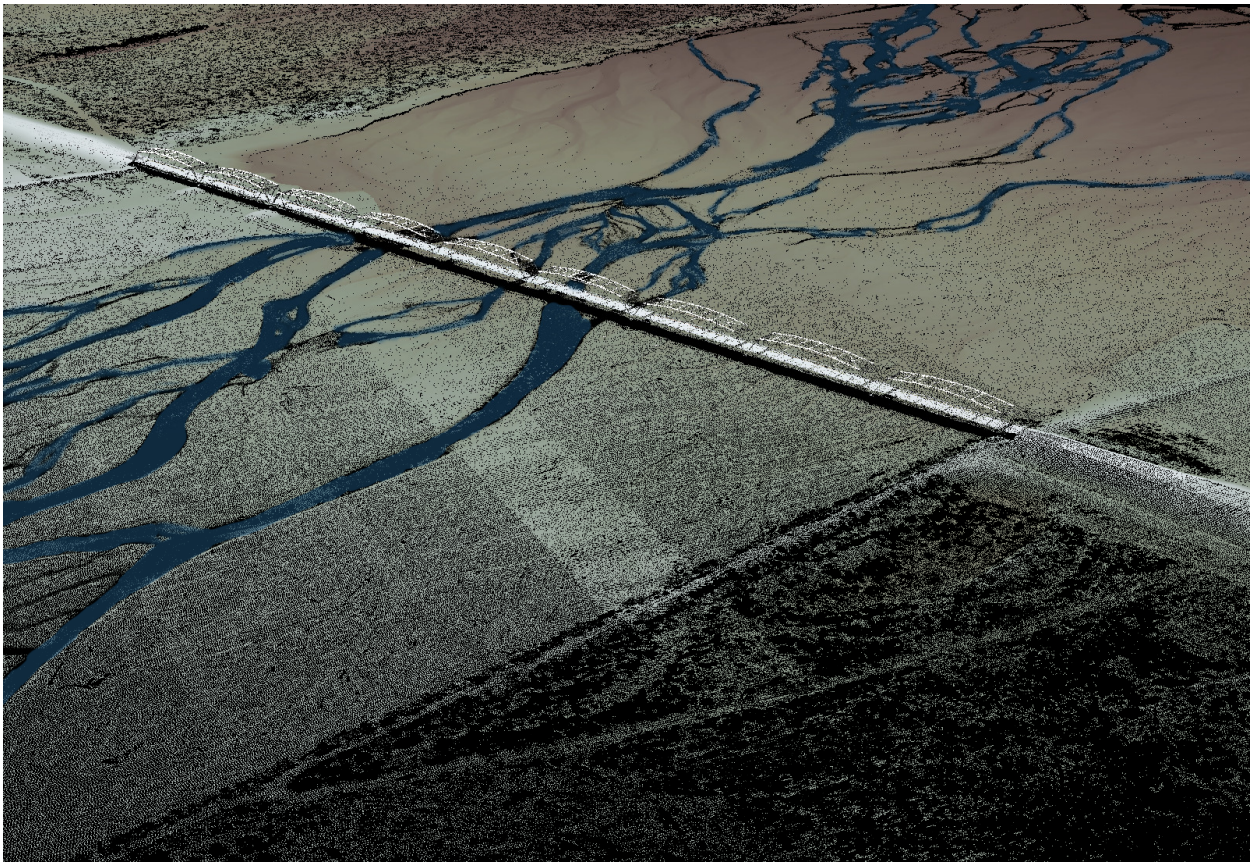


***Figure 14**. View looking north across Gerstle River along A2. Image is 3D LiDAR point cloud colored by elevation.*



# 10. Glossary

**1-sigma (σ) Absolute Deviation:** Value for which the data are within one standard deviation (approximately 68$^{th}$ percentile) of a normally distributed data set.

**1.96-sigma (σ) Absolute Deviation:** Value for which the data are within two standard deviations (approximately 95$^{th}$ percentile) of a normally distributed data set.

**Root Mean Square Error (RMSE):** A statistic used to approximate the difference between real-world points and the LiDAR points. It is calculated by squaring all the values, then taking the average of the squares and taking the square root of the average.

**Pulse Rate (PR)**: The rate at which laser pulses are emitted from the sensor; typically measured as thousands of pulses per second (kHz).

**Pulse Returns**: For every laser pulse emitted, the Leica ALS 50 Phase II system can record *up to four* wave forms reflected back to the sensor. Portions of the wave form that return earliest are the highest element in multi-tiered surfaces such as vegetation. Portions of the wave form that return last are the lowest element in multi-tiered surfaces.

**Accuracy**: The statistical comparison between known (surveyed) points and laser points. Typically measured as the standard deviation (sigma, σ) and root mean square error (RMSE).

**Intensity Values**: The peak power ratio of the laser return to the emitted laser. It is a function of surface reflectivity.

**Data Density**: A common measure of LiDAR resolution, measured as points per square meter.

**Spot Spacing**: Also a measure of LiDAR resolution, measured as the average distance between laser points.

**Nadir**: A single point or locus of points on the surface of the earth directly below a sensor as it progresses along its flight line.

**Scan Angle**: The angle from nadir to the edge of the scan, measured in degrees. Laser point accuracy typically decreases as scan angles increase.

**Overlap**: The area shared between flight lines, typically measured in percents; 100% overlap is essential to ensure complete coverage and reduce laser shadows.

**DTM / DEM**: These often-interchanged terms refer to models made from laser points. The digital elevation model (DEM) refers to all surfaces, including bare ground and vegetation, while the digital terrain model (DTM) refers only to those points classified as ground.

**Real-Time Kinematic (RTK) Survey**: GPS surveying is conducted with a GPS base station deployed over a known monument with a radio connection to a GPS rover. Both the base station and rover receive differential GPS data and the baseline correction is solved between the two. This type of ground survey is accurate to 1.5 cm or less.

# 11. Citations

Soininen, A. 2004. TerraScan User's Guide. TerraSolid.

# Appendix A

**LiDAR accuracy error sources and solutions:**

| Type of Error | Source | Post Processing Solution |
|---|---|---|
| GPS (Static/Kinematic) | Long Base Lines | None |
| | Poor Satellite Constellation | None |
| | Poor Antenna Visibility | Reduce Visibility Mask |
| Relative Accuracy | Poor System Calibration | Recalibrate IMU and sensor offsets/settings |
| | Inaccurate System | None |
| Laser Noise | Poor Laser Timing | None |
| | Poor Laser Reception | None |
| | Poor Laser Power | None |
| | Irregular Laser Shape | None |

**Operational measures taken to improve relative accuracy:**

1. Low Flight Altitude: Terrain following is employed to maintain a constant above ground level (AGL). Laser horizontal errors are a function of flight altitude above ground (i.e., ~ 1/3000$^{th}$ AGL flight altitude).
2. Focus Laser Power at narrow beam footprint: A laser return must be received by the system above a power threshold to accurately record a measurement. The strength of the laser return is a function of laser emission power, laser footprint, flight altitude and the reflectivity of the target. While surface reflectivity cannot be controlled, laser power can be increased and low flight altitudes can be maintained.
3. Reduced Scan Angle: Edge-of-scan data can become inaccurate. The scan angle was reduced to a maximum of ±15$^{o}$ from nadir, creating a narrow swath width and greatly reducing laser shadows from trees and buildings.
4. Quality GPS: Flights took place during optimal GPS conditions (e.g., 6 or more satellites and PDOP [Position Dilution of Precision] less than 3.0). Before each flight, the PDOP was determined for the survey day. During all flight times, a dual frequency DGPS base station recording at 1-second epochs was utilized and a maximum baseline length between the aircraft and the control points was less than 19 km (11.5 miles) at all times.
5. Ground Survey: Ground survey point accuracy (i.e. <1.5 cm RMSE) occurs during optimal PDOP ranges and targets a minimal baseline distance of 4 miles between GPS rover and base. Robust statistics are, in part, a function of sample size (n) and distribution. Ground survey RTK points are distributed to the extent possible throughout multiple flight lines and across the survey area.
6. 50% Side-Lap (100% Overlap): Overlapping areas are optimized for relative accuracy testing. Laser shadowing is minimized to help increase target acquisition from multiple scan angles. Ideally, with a 50% side-lap, the most nadir portion of one flight line coincides with the edge (least nadir) portion of overlapping flight lines. A minimum of 50% side-lap with terrain-followed acquisition prevents data gaps.
7. Opposing Flight Lines: All overlapping flight lines are opposing. Pitch, roll and heading errors are amplified by a factor of two relative to the adjacent flight line(s), making misalignments easier to detect and resolve.

# Appendix B

QUALITY CONTROL REVIEW SUMMARY

| | | |
|---|---|---|
| Max. Positive Elev. Deviation: | 0.162 | meters |
| Max. Negative Elev. Deviation: | -0.078 | meters |
| Elevation Deviation Range: | 0.240 | meters |
| Elevation Deviation Mean: | 0.049 | meters |
| Elevation Deviation RMSE | 0.062 | meters |

(RMSE = Root Mean Square Error)

| | | |
|---|---|---|
| Number of Check Points Used: | 735 | |
| Number of Check Points Excluded | 2 | See note below |
| Total Number of Check Points: | 737 | |

Note: The two points with the max positive and max lowest deviations were excluded from this check. See last page.

| CHECK POINTS | | | SURVEYED Elevation | LiDAR Elevation | Deviation | Include? (yes = 1) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | (Meters) | (Meters) | (no = 0) |
| 24532 | 7068535.272 | 615154.756 | 457.545 | 457.510 | 0.035 | 1 |
| 24533 | 7068537.743 | 615150.107 | 457.601 | 457.610 | -0.009 | 1 |
| 24534 | 7068566.504 | 615308.605 | 451.959 | 451.950 | 0.009 | 1 |
| 24535 | 7068568.861 | 615310.557 | 451.901 | 451.860 | 0.041 | 1 |
| 24536 | 7068571 | 615312.409 | 451.796 | 451.830 | -0.034 | 1 |
| 24537 | 7068573.521 | 615314.359 | 451.726 | 451.750 | -0.024 | 1 |
| 24538 | 7068575.75 | 615316.257 | 451.714 | 451.730 | -0.016 | 1 |
| 24539 | 7068577.74 | 615318.276 | 451.722 | 451.730 | -0.008 | 1 |
| 24540 | 7068580.032 | 615320.431 | 451.729 | 451.740 | -0.011 | 1 |
| 24541 | 7068582.047 | 615322.296 | 451.647 | 451.670 | -0.023 | 1 |
| 24542 | 7068584.076 | 615324.124 | 451.546 | 451.560 | -0.014 | 1 |
| 24543 | 7068336.258 | 615428.525 | 460.738 | 460.720 | 0.018 | 1 |
| 24544 | 7068338.603 | 615427.461 | 460.698 | 460.700 | -0.002 | 1 |
| 24545 | 7068341.219 | 615426.339 | 460.705 | 460.670 | 0.035 | 1 |
| 24546 | 7068342.63 | 615425.682 | 460.697 | 460.670 | 0.027 | 1 |
| 24547 | 7068345.312 | 615424.54 | 460.670 | 460.670 | 0.000 | 1 |
| 24548 | 7068348.124 | 615423.347 | 460.649 | 460.620 | 0.029 | 1 |
| 24549 | 7068350.674 | 615422.174 | 460.625 | 460.600 | 0.025 | 1 |
| 24550 | 7068353.251 | 615421.084 | 460.591 | 460.560 | 0.031 | 1 |
| 24551 | 7068355.612 | 615420.017 | 460.566 | 460.550 | 0.016 | 1 |
| 24552 | 7068357.871 | 615419.021 | 460.543 | 460.510 | 0.033 | 1 |
| 24553 | 7068360.53 | 615417.855 | 460.497 | 460.470 | 0.027 | 1 |
| 24554 | 7068363.153 | 615416.702 | 460.462 | 460.410 | 0.052 | 1 |
| 24555 | 7068365.614 | 615415.617 | 460.404 | 460.400 | 0.004 | 1 |
| 24556 | 7068368.256 | 615414.464 | 460.361 | 460.350 | 0.011 | 1 |
| 24557 | 7068370.843 | 615413.336 | 460.313 | 460.290 | 0.023 | 1 |
| 24558 | 7068373.388 | 615412.232 | 460.265 | 460.230 | 0.035 | 1 |
| 24559 | 7068375.725 | 615411.193 | 460.213 | 460.160 | 0.053 | 1 |
| 24560 | 7068378.431 | 615410.009 | 460.148 | 460.130 | 0.018 | 1 |
| 24561 | 7068380.828 | 615408.952 | 460.104 | 460.070 | 0.034 | 1 |
| 24562 | 7068383.331 | 615407.819 | 460.050 | 460.020 | 0.030 | 1 |
| 24563 | 7068385.788 | 615406.752 | 459.990 | 459.970 | 0.020 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 24564 | 7068330.877 | 615436.499 | 460.665 | 460.660 | 0.005 | 1 |
| 24565 | 7068330.528 | 615434.255 | 460.724 | 460.710 | 0.014 | 1 |
| 24566 | 7068329.71 | 615431.903 | 460.753 | 460.770 | -0.017 | 1 |
| 24567 | 7068328.787 | 615429.404 | 460.729 | 460.740 | -0.011 | 1 |
| 24568 | 7068327.83 | 615427.075 | 460.681 | 460.690 | -0.009 | 1 |
| 24569 | 7069046.767 | 615124.882 | 429.347 | 429.340 | 0.007 | 1 |
| 24701 | 7065101.994 | 629131.245 | 417.966 | 417.960 | 0.006 | 1 |
| 24702 | 7065740.545 | 631878.531 | 450.901 | 450.840 | 0.061 | 1 |
| 24703 | 7065744.088 | 631899.048 | 450.909 | 450.860 | 0.049 | 1 |
| 24704 | 7065746.909 | 631917.879 | 450.864 | 450.810 | 0.054 | 1 |
| 24705 | 7065752.546 | 631950.955 | 450.911 | 450.840 | 0.071 | 1 |
| 24706 | 7065705.68 | 634007.328 | 420.784 | 420.730 | 0.054 | 1 |
| 24707 | 7065707.867 | 633994.746 | 420.614 | 420.580 | 0.034 | 1 |
| 24708 | 7065709.926 | 633983.167 | 420.453 | 420.410 | 0.043 | 1 |
| 24709 | 7065767.279 | 633657.945 | 415.919 | 415.870 | 0.049 | 1 |
| 24710 | 7065769.235 | 633645.316 | 415.944 | 415.910 | 0.034 | 1 |
| 24711 | 7065771.291 | 633633.749 | 415.974 | 415.910 | 0.064 | 1 |
| 24712 | 7065880.271 | 632725.429 | 436.858 | 436.810 | 0.048 | 1 |
| 24713 | 7065866.254 | 632733.659 | 437.204 | 437.160 | 0.044 | 1 |
| 24714 | 7065862.969 | 632714.471 | 437.700 | 437.660 | 0.040 | 1 |
| 24715 | 7065859.937 | 632696.516 | 438.159 | 438.120 | 0.039 | 1 |
| 24716 | 7065681.222 | 631375.256 | 450.828 | 450.780 | 0.048 | 1 |
| 24717 | 7065680.755 | 631364.124 | 450.856 | 450.810 | 0.046 | 1 |
| 24718 | 7065680.147 | 631351.624 | 450.891 | 450.850 | 0.041 | 1 |
| 24719 | 7065679.764 | 631339.05 | 450.920 | 450.850 | 0.070 | 1 |
| 24720 | 7065203.254 | 630327.355 | 421.022 | 421.000 | 0.022 | 1 |
| 24721 | 7065195.095 | 630322.208 | 420.450 | 420.430 | 0.020 | 1 |
| 24722 | 7065186.354 | 630316.977 | 419.910 | 419.900 | 0.010 | 1 |
| 24723 | 7065405.281 | 630462.223 | 431.133 | 431.140 | -0.007 | 1 |
| 24724 | 7065413.997 | 630473.15 | 431.696 | 431.670 | 0.026 | 1 |
| 24725 | 7065423.516 | 630484.844 | 432.311 | 432.290 | 0.021 | 1 |
| 24726 | 7065538.92 | 630430.047 | 428.483 | 428.460 | 0.023 | 1 |
| 24727 | 7065534.589 | 630418.351 | 427.872 | 427.830 | 0.042 | 1 |
| 24728 | 7065529.956 | 630405.607 | 427.151 | 427.110 | 0.041 | 1 |
| 24729 | 7065348.025 | 629980.995 | 414.729 | 414.720 | 0.009 | 1 |
| 24730 | 7065351.025 | 629989.491 | 414.512 | 414.470 | 0.042 | 1 |
| 24731 | 7065353.927 | 629999.822 | 414.642 | 414.610 | 0.032 | 1 |
| 24732 | 7065346.734 | 629958.974 | 415.005 | 415.000 | 0.005 | 1 |
| 24733 | 7065094.569 | 629118.47 | 416.355 | 416.340 | 0.015 | 1 |
| 24734 | 7065111.639 | 629118.247 | 415.917 | 415.900 | 0.017 | 1 |
| 24735 | 7065129.233 | 629125.326 | 415.609 | 415.600 | 0.009 | 1 |
| 24736 | 7065018.459 | 628461.758 | 414.182 | 414.180 | 0.002 | 1 |
| 24737 | 7065017.475 | 628448.151 | 414.160 | 414.150 | 0.010 | 1 |
| 24738 | 7065016.668 | 628436.778 | 414.107 | 414.100 | 0.007 | 1 |
| 24739 | 7065032.513 | 627807.96 | 410.399 | 410.400 | -0.001 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 24740 | 7065040.195 | 627824.681 | 410.387 | 410.390 | -0.003 | 1 |
| 24741 | 7065041.262 | 627839.77 | 410.187 | 410.190 | -0.003 | 1 |
| 24742 | 7064900.818 | 626853.892 | 405.831 | 405.800 | 0.031 | 1 |
| 24743 | 7064899.608 | 626840.665 | 405.787 | 405.760 | 0.027 | 1 |
| 24744 | 7064898.412 | 626829.009 | 405.776 | 405.740 | 0.036 | 1 |
| 24745 | 7064789.149 | 626055.016 | 410.589 | 410.580 | 0.009 | 1 |
| 24746 | 7064787.351 | 626043.118 | 410.587 | 410.560 | 0.027 | 1 |
| 24747 | 7064785.467 | 626030.394 | 410.566 | 410.560 | 0.006 | 1 |
| 24748 | 7064617.485 | 625383.042 | 411.025 | 411.010 | 0.015 | 1 |
| 24749 | 7064613.453 | 625370.819 | 411.150 | 411.160 | -0.010 | 1 |
| 24750 | 7064608.531 | 625351.55 | 411.304 | 411.320 | -0.016 | 1 |
| 24751 | 7064800.234 | 624602.442 | 410.317 | 410.320 | -0.003 | 1 |
| 24752 | 7064804.595 | 624586.715 | 410.295 | 410.280 | 0.015 | 1 |
| 24753 | 7064808.831 | 624570.064 | 410.299 | 410.270 | 0.029 | 1 |
| 24754 | 7064751.11 | 623531.732 | 411.195 | 411.180 | 0.015 | 1 |
| 24755 | 7064747.475 | 623513.986 | 411.211 | 411.190 | 0.021 | 1 |
| 24756 | 7064742.469 | 623496.46 | 411.174 | 411.150 | 0.024 | 1 |
| 24757 | 7064543.41 | 623228.014 | 405.449 | 405.440 | 0.009 | 1 |
| 24758 | 7064534.913 | 623211.673 | 405.072 | 405.070 | 0.002 | 1 |
| 24759 | 7064559.407 | 623218.612 | 405.569 | 405.560 | 0.009 | 1 |
| 24760 | 7064530.031 | 622517.479 | 407.432 | 407.470 | -0.038 | 1 |
| 24761 | 7064532.428 | 622500.982 | 407.407 | 407.430 | -0.023 | 1 |
| 24762 | 7064517.494 | 622480.248 | 407.598 | 407.610 | -0.012 | 1 |
| 24763 | 7064515.51 | 622454.838 | 407.656 | 407.650 | 0.006 | 1 |
| 24764 | 7064493.919 | 622175.54 | 407.997 | 407.950 | 0.047 | 1 |
| 24765 | 7064494.61 | 622158.197 | 407.936 | 407.890 | 0.046 | 1 |
| 24766 | 7064495.206 | 622146.337 | 407.867 | 407.840 | 0.027 | 1 |
| 24767 | 7064300.131 | 621092.665 | 405.300 | 405.280 | 0.020 | 1 |
| 24768 | 7064313.996 | 621073.633 | 405.165 | 405.150 | 0.015 | 1 |
| 24769 | 7064325.959 | 621064.03 | 404.937 | 404.930 | 0.007 | 1 |
| 24770 | 7064337.775 | 621049.166 | 404.868 | 404.870 | -0.002 | 1 |
| 24771 | 7064624.326 | 620676.484 | 403.441 | 403.470 | -0.029 | 1 |
| 24772 | 7064632.734 | 620665.838 | 403.500 | 403.480 | 0.020 | 1 |
| 24773 | 7064640.386 | 620655.809 | 403.463 | 403.430 | 0.033 | 1 |
| 25000 | 7062550.105 | 645176.185 | 422.984 | 422.940 | 0.044 | 1 |
| 25001 | 7061880.489 | 647615.884 | 430.052 | 430.130 | -0.078 | 1 |
| 25100 | 7062548.721 | 645176.83 | 423.016 | 422.940 | 0.076 | 1 |
| 25101 | 7062526.503 | 645163.362 | 424.398 | 424.340 | 0.058 | 1 |
| 25102 | 7062524.241 | 645161.352 | 424.272 | 424.230 | 0.042 | 1 |
| 25103 | 7062523.044 | 645160.131 | 424.200 | 424.130 | 0.070 | 1 |
| 25104 | 7062521.502 | 645158.531 | 424.119 | 424.070 | 0.049 | 1 |
| 25105 | 7062519.575 | 645156.555 | 424.010 | 423.960 | 0.050 | 1 |
| 25106 | 7062485.879 | 645197.254 | 424.021 | 423.970 | 0.051 | 1 |
| 25107 | 7062489.71 | 645198.368 | 424.172 | 424.150 | 0.022 | 1 |
| 25108 | 7062493.81 | 645198.348 | 424.296 | 424.250 | 0.046 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 25109 | 7062498.196 | 645198.208 | 424.393 | 424.370 | 0.023 | 1 |
| 25110 | 7062502.048 | 645198.289 | 424.347 | 424.330 | 0.017 | 1 |
| 25111 | 7062506.672 | 645198.463 | 424.195 | 424.170 | 0.025 | 1 |
| 25112 | 7062510.902 | 645198.742 | 424.020 | 423.990 | 0.030 | 1 |
| 25113 | 7062515.111 | 645199.12 | 423.836 | 423.820 | 0.016 | 1 |
| 25114 | 7062518.568 | 645199.251 | 423.673 | 423.630 | 0.043 | 1 |
| 25115 | 7062522.56 | 645199.675 | 423.393 | 423.400 | -0.007 | 1 |
| 25116 | 7062526.785 | 645200.184 | 423.173 | 423.140 | 0.033 | 1 |
| 25117 | 7062531.356 | 645200.176 | 423.002 | 422.980 | 0.022 | 1 |
| 25118 | 7062535.999 | 645200.336 | 422.979 | 422.950 | 0.029 | 1 |
| 25119 | 7062540.872 | 645200.588 | 423.010 | 422.970 | 0.040 | 1 |
| 25120 | 7062545.366 | 645200.638 | 422.972 | 422.940 | 0.032 | 1 |
| 25121 | 7062549.703 | 645201.066 | 422.915 | 422.860 | 0.055 | 1 |
| 25122 | 7062553.714 | 645201.335 | 422.892 | 422.840 | 0.052 | 1 |
| 25123 | 7062557.916 | 645201.569 | 422.920 | 422.860 | 0.060 | 1 |
| 25124 | 7062562.217 | 645201.926 | 422.919 | 422.880 | 0.039 | 1 |
| 25125 | 7062566.556 | 645202.128 | 422.910 | 422.860 | 0.050 | 1 |
| 25126 | 7062571.145 | 645202.067 | 422.882 | 422.830 | 0.052 | 1 |
| 25127 | 7062575.415 | 645201.831 | 422.903 | 422.830 | 0.073 | 1 |
| 25128 | 7062580.075 | 645201.526 | 422.937 | 422.870 | 0.067 | 1 |
| 25129 | 7062584.277 | 645200.853 | 422.947 | 422.890 | 0.057 | 1 |
| 25130 | 7062588.416 | 645200.071 | 422.980 | 422.940 | 0.040 | 1 |
| 25131 | 7062592.745 | 645198.803 | 422.987 | 422.940 | 0.047 | 1 |
| 25132 | 7062597.497 | 645197.131 | 423.040 | 422.980 | 0.060 | 1 |
| 25133 | 7062704.75 | 644840.438 | 423.992 | 423.960 | 0.032 | 1 |
| 25134 | 7062701.759 | 644838.557 | 424.067 | 424.030 | 0.037 | 1 |
| 25135 | 7062698.484 | 644836.567 | 424.081 | 424.050 | 0.031 | 1 |
| 25136 | 7062695.535 | 644834.846 | 424.023 | 423.990 | 0.033 | 1 |
| 25137 | 7062691.883 | 644832.647 | 423.904 | 423.860 | 0.044 | 1 |
| 25138 | 7062688.299 | 644830.034 | 423.733 | 423.690 | 0.043 | 1 |
| 25139 | 7062684.768 | 644827.517 | 423.458 | 423.420 | 0.038 | 1 |
| 25140 | 7062681.284 | 644824.999 | 423.033 | 423.000 | 0.033 | 1 |
| 25141 | 7062677.818 | 644822.755 | 422.712 | 422.650 | 0.062 | 1 |
| 25142 | 7062674.284 | 644820.414 | 422.449 | 422.390 | 0.059 | 1 |
| 25143 | 7062670.683 | 644817.868 | 422.408 | 422.360 | 0.048 | 1 |
| 25144 | 7062667.308 | 644815.148 | 422.407 | 422.360 | 0.047 | 1 |
| 25145 | 7062663.661 | 644812.486 | 422.467 | 422.410 | 0.057 | 1 |
| 25146 | 7062659.644 | 644809.518 | 422.493 | 422.430 | 0.063 | 1 |
| 25147 | 7062656.062 | 644806.656 | 422.488 | 422.430 | 0.058 | 1 |
| 25148 | 7062652.542 | 644803.886 | 422.532 | 422.460 | 0.072 | 1 |
| 25149 | 7062648.798 | 644801.14 | 422.535 | 422.470 | 0.065 | 1 |
| 25150 | 7062645.167 | 644798.562 | 422.593 | 422.530 | 0.063 | 1 |
| 25151 | 7062641.815 | 644796.126 | 422.547 | 422.500 | 0.047 | 1 |
| 25152 | 7062637.864 | 644793.323 | 422.643 | 422.580 | 0.063 | 1 |
| 25153 | 7062634.623 | 644791.104 | 422.682 | 422.620 | 0.062 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 25154 | 7062630.926 | 644788.411 | 422.672 | 422.630 | 0.042 | 1 |
| 25155 | 7062627.429 | 644785.849 | 422.701 | 422.660 | 0.041 | 1 |
| 25156 | 7062623.843 | 644783.242 | 422.775 | 422.730 | 0.045 | 1 |
| 25157 | 7062620.449 | 644780.789 | 422.773 | 422.720 | 0.053 | 1 |
| 25158 | 7062616.895 | 644778.01 | 422.767 | 422.730 | 0.037 | 1 |
| 25159 | 7062613.187 | 644775.358 | 422.803 | 422.760 | 0.043 | 1 |
| 25160 | 7062609.38 | 644772.732 | 422.823 | 422.790 | 0.033 | 1 |
| 25161 | 7062605.488 | 644769.975 | 422.865 | 422.810 | 0.055 | 1 |
| 25162 | 7062601.652 | 644767.349 | 422.905 | 422.840 | 0.065 | 1 |
| 25163 | 7062597.696 | 644764.528 | 422.908 | 422.860 | 0.048 | 1 |
| 25164 | 7062593.631 | 644761.6 | 422.930 | 422.880 | 0.050 | 1 |
| 25165 | 7062589.696 | 644758.582 | 422.921 | 422.880 | 0.041 | 1 |
| 25166 | 7062585.719 | 644755.656 | 422.937 | 422.890 | 0.047 | 1 |
| 25167 | 7062581.782 | 644752.985 | 422.948 | 422.880 | 0.068 | 1 |
| 25168 | 7062578.132 | 644750.328 | 422.986 | 422.940 | 0.046 | 1 |
| 25169 | 7062574.385 | 644747.393 | 423.000 | 422.920 | 0.080 | 1 |
| 25170 | 7062570.688 | 644744.674 | 422.985 | 422.920 | 0.065 | 1 |
| 25171 | 7062567.017 | 644741.934 | 422.968 | 422.900 | 0.068 | 1 |
| 25172 | 7062563.247 | 644739.288 | 422.970 | 422.910 | 0.060 | 1 |
| 25173 | 7062559.657 | 644736.496 | 423.010 | 422.930 | 0.080 | 1 |
| 25174 | 7062555.75 | 644733.623 | 423.050 | 422.990 | 0.060 | 1 |
| 25175 | 7062552.145 | 644730.997 | 423.076 | 423.000 | 0.076 | 1 |
| 25176 | 7062548.484 | 644728.37 | 423.126 | 423.030 | 0.096 | 1 |
| 25177 | 7062544.809 | 644725.633 | 423.162 | 423.070 | 0.092 | 1 |
| 25178 | 7062541.588 | 644723.194 | 423.224 | 423.140 | 0.084 | 1 |
| 25179 | 7062537.896 | 644720.453 | 423.341 | 423.260 | 0.081 | 1 |
| 25180 | 7062534.331 | 644717.801 | 423.434 | 423.360 | 0.074 | 1 |
| 25181 | 7062530.352 | 644714.944 | 423.475 | 423.380 | 0.095 | 1 |
| 25182 | 7062526.574 | 644712.049 | 423.571 | 423.490 | 0.081 | 1 |
| 25183 | 7062523.123 | 644709.481 | 423.630 | 423.550 | 0.080 | 1 |
| 25184 | 7062519.406 | 644706.709 | 423.748 | 423.670 | 0.078 | 1 |
| 25185 | 7062515.717 | 644704.002 | 423.868 | 423.770 | 0.098 | 1 |
| 25186 | 7062512.004 | 644701.39 | 423.892 | 423.810 | 0.082 | 1 |
| 25187 | 7062508.282 | 644698.583 | 423.886 | 423.810 | 0.076 | 1 |
| 25188 | 7062504.605 | 644696.081 | 423.974 | 423.890 | 0.084 | 1 |
| 25189 | 7062500.512 | 644693.12 | 424.101 | 424.030 | 0.071 | 1 |
| 25190 | 7062496.678 | 644690.536 | 424.256 | 424.180 | 0.076 | 1 |
| 25191 | 7062492.797 | 644687.753 | 424.336 | 424.270 | 0.066 | 1 |
| 25192 | 7062488.705 | 644685.126 | 424.446 | 424.380 | 0.066 | 1 |
| 25193 | 7062484.636 | 644682.401 | 424.497 | 424.440 | 0.057 | 1 |
| 25194 | 7062480.435 | 644679.844 | 424.633 | 424.560 | 0.073 | 1 |
| 25195 | 7062476.485 | 644677.601 | 424.831 | 424.770 | 0.061 | 1 |
| 25196 | 7062472.189 | 644675.406 | 425.108 | 425.040 | 0.068 | 1 |
| 25197 | 7062468.026 | 644673.415 | 425.274 | 425.220 | 0.054 | 1 |
| 25198 | 7062463.893 | 644671.735 | 425.600 | 425.550 | 0.050 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 25199 | 7062459.808 | 644670.412 | 426.123 | 426.080 | 0.043 | 1 |
| 25200 | 7062455.668 | 644669.611 | 426.557 | 426.500 | 0.057 | 1 |
| 25201 | 7062451.295 | 644668.954 | 426.949 | 426.870 | 0.079 | 1 |
| 25202 | 7062446.859 | 644668.528 | 427.315 | 427.270 | 0.045 | 1 |
| 25203 | 7062442.379 | 644668.358 | 427.714 | 427.670 | 0.044 | 1 |
| 25204 | 7062437.647 | 644668.487 | 428.143 | 428.080 | 0.063 | 1 |
| 25205 | 7062433.074 | 644669.115 | 428.531 | 428.450 | 0.081 | 1 |
| 25206 | 7062428.679 | 644670.098 | 428.930 | 428.880 | 0.050 | 1 |
| 25207 | 7062424.431 | 644671.213 | 429.350 | 429.280 | 0.070 | 1 |
| 25208 | 7062419.775 | 644672.59 | 429.752 | 429.690 | 0.062 | 1 |
| 25209 | 7062415.631 | 644673.995 | 430.137 | 430.070 | 0.067 | 1 |
| 25210 | 7062411.377 | 644675.566 | 430.539 | 430.470 | 0.069 | 1 |
| 25211 | 7062407.207 | 644677.086 | 430.946 | 430.900 | 0.046 | 1 |
| 25212 | 7062402.877 | 644678.695 | 431.302 | 431.230 | 0.072 | 1 |
| 25213 | 7062398.546 | 644680.306 | 431.787 | 431.700 | 0.087 | 1 |
| 25214 | 7062394.375 | 644682.068 | 432.212 | 432.120 | 0.092 | 1 |
| 25215 | 7062390.35 | 644683.721 | 432.599 | 432.520 | 0.079 | 1 |
| 25216 | 7062386.456 | 644685.345 | 433.006 | 432.920 | 0.086 | 1 |
| 25217 | 7062382.456 | 644687.063 | 433.454 | 433.380 | 0.074 | 1 |
| 25218 | 7062378.562 | 644688.782 | 433.887 | 433.820 | 0.067 | 1 |
| 25219 | 7062374.583 | 644690.532 | 434.373 | 434.320 | 0.053 | 1 |
| 25220 | 7062370.686 | 644692.113 | 434.866 | 434.800 | 0.066 | 1 |
| 25221 | 7062366.624 | 644693.757 | 435.360 | 435.300 | 0.060 | 1 |
| 25222 | 7062361.288 | 644695.995 | 435.919 | 435.860 | 0.059 | 1 |
| 25223 | 7062357.778 | 644697.403 | 436.295 | 436.230 | 0.065 | 1 |
| 25224 | 7062353.835 | 644698.864 | 436.687 | 436.630 | 0.057 | 1 |
| 25225 | 7062349.655 | 644700.809 | 437.212 | 437.160 | 0.052 | 1 |
| 25226 | 7062345.699 | 644702.423 | 437.735 | 437.670 | 0.065 | 1 |
| 25227 | 7062340.614 | 644704.711 | 438.298 | 438.250 | 0.048 | 1 |
| 25228 | 7062336.616 | 644706.431 | 438.749 | 438.700 | 0.049 | 1 |
| 25229 | 7062332.85 | 644708.098 | 439.175 | 439.110 | 0.065 | 1 |
| 25230 | 7062328.841 | 644709.727 | 439.657 | 439.570 | 0.087 | 1 |
| 25231 | 7062324.804 | 644711.46 | 440.104 | 440.030 | 0.074 | 1 |
| 25232 | 7062320.713 | 644713.14 | 440.523 | 440.460 | 0.063 | 1 |
| 25233 | 7062316.23 | 644715.148 | 440.976 | 440.910 | 0.066 | 1 |
| 25234 | 7062311.668 | 644716.833 | 441.386 | 441.310 | 0.076 | 1 |
| 25235 | 7062307.269 | 644718.569 | 441.799 | 441.750 | 0.049 | 1 |
| 25236 | 7062302.969 | 644720.311 | 442.211 | 442.160 | 0.051 | 1 |
| 25237 | 7062298.811 | 644721.847 | 442.637 | 442.560 | 0.077 | 1 |
| 25238 | 7062294.782 | 644723.521 | 443.053 | 442.980 | 0.073 | 1 |
| 25239 | 7062290.553 | 644725.213 | 443.466 | 443.400 | 0.066 | 1 |
| 25240 | 7062285.866 | 644727.102 | 444.020 | 443.940 | 0.080 | 1 |
| 25241 | 7062281.512 | 644728.693 | 444.478 | 444.430 | 0.048 | 1 |
| 25242 | 7062277.464 | 644730.174 | 444.900 | 444.850 | 0.050 | 1 |
| 25243 | 7062273.345 | 644731.856 | 445.325 | 445.250 | 0.075 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 25244 | 7062269.063 | 644733.561 | 445.805 | 445.740 | 0.065 | 1 |
| 25245 | 7062264.707 | 644735.208 | 446.283 | 446.210 | 0.073 | 1 |
| 25246 | 7062260.567 | 644736.774 | 446.714 | 446.640 | 0.074 | 1 |
| 25247 | 7062256.251 | 644738.39 | 447.160 | 447.080 | 0.080 | 1 |
| 25248 | 7062252.036 | 644740.062 | 447.590 | 447.520 | 0.070 | 1 |
| 25249 | 7062247.939 | 644741.704 | 448.013 | 447.930 | 0.083 | 1 |
| 25250 | 7062243.561 | 644743.562 | 448.461 | 448.380 | 0.081 | 1 |
| 25251 | 7062239.074 | 644745.266 | 448.891 | 448.800 | 0.091 | 1 |
| 25252 | 7062234.611 | 644747.042 | 449.317 | 449.230 | 0.087 | 1 |
| 25253 | 7062230.086 | 644748.925 | 449.758 | 449.650 | 0.108 | 1 |
| 25254 | 7062225.481 | 644750.853 | 450.210 | 450.130 | 0.080 | 1 |
| 25255 | 7062220.812 | 644752.799 | 450.654 | 450.550 | 0.104 | 1 |
| 25256 | 7062216.558 | 644754.61 | 451.032 | 450.960 | 0.072 | 1 |
| 25257 | 7062212.213 | 644756.367 | 451.465 | 451.400 | 0.065 | 1 |
| 25258 | 7062207.703 | 644758.172 | 451.936 | 451.850 | 0.086 | 1 |
| 25259 | 7062203.084 | 644759.903 | 452.418 | 452.330 | 0.088 | 1 |
| 25260 | 7062198.876 | 644761.004 | 452.834 | 452.750 | 0.084 | 1 |
| 25261 | 7062194.59 | 644762.528 | 453.273 | 453.180 | 0.093 | 1 |
| 25262 | 7062190.312 | 644763.968 | 453.711 | 453.630 | 0.081 | 1 |
| 25263 | 7062185.856 | 644765.38 | 454.168 | 454.100 | 0.068 | 1 |
| 25264 | 7062181.646 | 644766.627 | 454.604 | 454.530 | 0.074 | 1 |
| 25265 | 7062176.859 | 644767.767 | 455.099 | 455.010 | 0.089 | 1 |
| 25266 | 7062172.577 | 644768.562 | 455.501 | 455.420 | 0.081 | 1 |
| 25267 | 7062168.36 | 644769.28 | 455.936 | 455.830 | 0.106 | 1 |
| 25268 | 7062164.166 | 644769.888 | 456.363 | 456.280 | 0.083 | 1 |
| 25269 | 7062159.763 | 644770.443 | 456.826 | 456.750 | 0.076 | 1 |
| 25270 | 7062155.375 | 644770.892 | 457.286 | 457.200 | 0.086 | 1 |
| 25271 | 7062150.908 | 644771.377 | 457.679 | 457.590 | 0.089 | 1 |
| 25272 | 7062146.629 | 644771.835 | 458.034 | 457.970 | 0.064 | 1 |
| 25273 | 7062142.338 | 644772.017 | 458.438 | 458.370 | 0.068 | 1 |
| 25274 | 7062137.844 | 644772.247 | 458.811 | 458.750 | 0.061 | 1 |
| 25275 | 7062132.988 | 644772.534 | 459.262 | 459.180 | 0.082 | 1 |
| 25276 | 7062128.47 | 644772.608 | 459.701 | 459.640 | 0.061 | 1 |
| 25277 | 7062123.76 | 644772.639 | 460.181 | 460.080 | 0.101 | 1 |
| 25278 | 7062119.693 | 644772.687 | 460.521 | 460.470 | 0.051 | 1 |
| 25279 | 7062115.432 | 644772.818 | 460.937 | 460.840 | 0.097 | 1 |
| 25280 | 7062111.257 | 644772.947 | 461.354 | 461.240 | 0.114 | 1 |
| 25281 | 7062106.934 | 644773.264 | 461.695 | 461.650 | 0.045 | 1 |
| 25282 | 7062102.743 | 644773.777 | 462.173 | 462.090 | 0.083 | 1 |
| 25283 | 7062097.979 | 644774.341 | 462.723 | 462.610 | 0.113 | 1 |
| 25284 | 7062093.534 | 644775.293 | 463.177 | 463.090 | 0.087 | 1 |
| 25285 | 7062089.13 | 644776.544 | 463.598 | 463.490 | 0.108 | 1 |
| 25286 | 7062085.174 | 644778.073 | 463.941 | 463.880 | 0.061 | 1 |
| 25287 | 7062080.986 | 644780.007 | 464.404 | 464.330 | 0.074 | 1 |
| 25288 | 7062076.934 | 644782.073 | 464.823 | 464.720 | 0.103 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 25289 | 7062073.413 | 644784.48 | 465.256 | 465.170 | 0.086 | 1 |
| 25290 | 7062069.889 | 644786.938 | 465.730 | 465.620 | 0.110 | 1 |
| 25291 | 7062066.268 | 644790.008 | 466.160 | 466.080 | 0.080 | 1 |
| 25292 | 7062062.816 | 644793.35 | 466.561 | 466.480 | 0.081 | 1 |
| 25293 | 7062059.834 | 644796.874 | 466.959 | 466.910 | 0.049 | 1 |
| 25294 | 7062057.221 | 644800.633 | 467.434 | 467.330 | 0.104 | 1 |
| 25295 | 7062054.729 | 644804.656 | 467.916 | 467.840 | 0.076 | 1 |
| 25296 | 7062052.629 | 644808.332 | 468.405 | 468.320 | 0.085 | 1 |
| 25297 | 7062050.4 | 644812.028 | 468.920 | 468.810 | 0.110 | 1 |
| 25298 | 7062048.297 | 644815.832 | 469.333 | 469.240 | 0.093 | 1 |
| 25299 | 7062045.891 | 644820.103 | 469.815 | 469.730 | 0.085 | 1 |
| 25300 | 7062043.612 | 644824.073 | 470.241 | 470.170 | 0.071 | 1 |
| 25301 | 7062041.032 | 644828.085 | 470.679 | 470.610 | 0.069 | 1 |
| 25302 | 7062038.452 | 644832.034 | 471.168 | 471.090 | 0.078 | 1 |
| 25303 | 7062035.638 | 644835.695 | 471.615 | 471.530 | 0.085 | 1 |
| 25304 | 7062032.544 | 644839.158 | 472.104 | 472.010 | 0.094 | 1 |
| 25305 | 7062029.061 | 644842.134 | 472.549 | 472.450 | 0.099 | 1 |
| 25306 | 7062025.325 | 644844.897 | 472.976 | 472.920 | 0.056 | 1 |
| 25307 | 7062021.202 | 644847.25 | 473.439 | 473.350 | 0.089 | 1 |
| 25308 | 7062016.626 | 644848.962 | 473.892 | 473.800 | 0.092 | 1 |
| 25309 | 7062011.92 | 644850.604 | 474.362 | 474.310 | 0.052 | 1 |
| 25310 | 7062007.545 | 644851.843 | 474.893 | 474.800 | 0.093 | 1 |
| 25311 | 7062002.913 | 644853.165 | 475.453 | 475.340 | 0.113 | 1 |
| 25312 | 7061998.454 | 644854.179 | 475.902 | 475.820 | 0.082 | 1 |
| 25313 | 7061993.898 | 644855.223 | 476.369 | 476.280 | 0.089 | 1 |
| 25314 | 7061989.458 | 644856.335 | 476.826 | 476.730 | 0.096 | 1 |
| 25315 | 7061984.99 | 644857.446 | 477.277 | 477.190 | 0.087 | 1 |
| 25316 | 7061980.716 | 644858.425 | 477.704 | 477.630 | 0.074 | 1 |
| 25317 | 7061976.267 | 644859.509 | 478.187 | 478.110 | 0.077 | 1 |
| 25318 | 7061972.066 | 644860.502 | 478.604 | 478.530 | 0.074 | 1 |
| 25319 | 7061967.911 | 644861.596 | 479.028 | 478.950 | 0.078 | 1 |
| 25320 | 7061963.31 | 644862.723 | 479.452 | 479.380 | 0.072 | 1 |
| 25321 | 7061958.933 | 644863.916 | 479.844 | 479.800 | 0.044 | 1 |
| 25322 | 7061954.403 | 644865.072 | 480.284 | 480.180 | 0.104 | 1 |
| 25323 | 7061949.983 | 644866.209 | 480.700 | 480.600 | 0.100 | 1 |
| 25324 | 7061945.577 | 644867.284 | 481.125 | 481.030 | 0.095 | 1 |
| 25325 | 7061940.754 | 644868.499 | 481.624 | 481.540 | 0.084 | 1 |
| 25326 | 7061936.637 | 644869.483 | 482.004 | 481.950 | 0.054 | 1 |
| 25327 | 7061931.969 | 644870.69 | 482.541 | 482.470 | 0.071 | 1 |
| 25328 | 7061927.557 | 644871.844 | 483.019 | 482.950 | 0.069 | 1 |
| 25329 | 7061923.318 | 644872.928 | 483.465 | 483.390 | 0.075 | 1 |
| 25330 | 7061919.098 | 644873.915 | 483.890 | 483.820 | 0.070 | 1 |
| 25331 | 7061914.719 | 644874.991 | 484.335 | 484.270 | 0.065 | 1 |
| 25332 | 7061910.35 | 644876.142 | 484.766 | 484.710 | 0.056 | 1 |
| 25333 | 7061906.017 | 644877.281 | 485.209 | 485.180 | 0.029 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 25334 | 7061901.663 | 644878.423 | 485.653 | 485.560 | 0.093 | 1 |
| 25335 | 7061897.364 | 644879.386 | 486.072 | 486.030 | 0.042 | 1 |
| 25336 | 7061893.308 | 644880.471 | 486.548 | 486.440 | 0.108 | 1 |
| 25337 | 7061889.038 | 644881.487 | 486.984 | 486.900 | 0.084 | 1 |
| 25338 | 7061884.763 | 644882.499 | 487.446 | 487.370 | 0.076 | 1 |
| 25339 | 7061880.305 | 644883.648 | 487.946 | 487.880 | 0.066 | 1 |
| 25340 | 7061875.679 | 644884.652 | 488.492 | 488.400 | 0.092 | 1 |
| 25341 | 7061871.236 | 644885.575 | 489.007 | 488.930 | 0.077 | 1 |
| 25342 | 7061866.814 | 644886.627 | 489.510 | 489.440 | 0.070 | 1 |
| 25343 | 7061862.138 | 644887.692 | 489.957 | 489.900 | 0.057 | 1 |
| 25344 | 7061857.315 | 644888.278 | 490.515 | 490.380 | 0.135 | 1 |
| 25345 | 7061852.844 | 644888.88 | 490.926 | 490.830 | 0.096 | 1 |
| 25346 | 7061847.952 | 644889.532 | 491.335 | 491.220 | 0.115 | 1 |
| 25347 | 7061843.642 | 644890.126 | 491.752 | 491.660 | 0.092 | 1 |
| 25348 | 7061838.978 | 644890.617 | 492.188 | 492.100 | 0.088 | 1 |
| 25349 | 7061834.318 | 644891.217 | 492.655 | 492.550 | 0.105 | 1 |
| 25350 | 7061829.773 | 644892.027 | 493.064 | 492.960 | 0.104 | 1 |
| 25351 | 7061825.319 | 644892.783 | 493.493 | 493.370 | 0.123 | 1 |
| 25352 | 7061821.013 | 644893.52 | 493.925 | 493.810 | 0.115 | 1 |
| 25353 | 7061816.852 | 644894.391 | 494.328 | 494.250 | 0.078 | 1 |
| 25354 | 7061812.436 | 644895.191 | 494.824 | 494.740 | 0.084 | 1 |
| 25355 | 7061807.998 | 644896.316 | 495.342 | 495.230 | 0.112 | 1 |
| 25356 | 7061803.694 | 644897.373 | 495.793 | 495.700 | 0.093 | 1 |
| 25357 | 7061799.585 | 644898.56 | 496.247 | 496.140 | 0.107 | 1 |
| 25358 | 7061795.378 | 644899.801 | 496.724 | 496.610 | 0.114 | 1 |
| 25359 | 7061790.686 | 644901.303 | 497.191 | 497.100 | 0.091 | 1 |
| 25360 | 7061785.936 | 644902.692 | 497.687 | 497.610 | 0.077 | 1 |
| 25361 | 7061781.357 | 644904.328 | 498.187 | 498.080 | 0.107 | 1 |
| 25362 | 7061776.437 | 644906.096 | 498.676 | 498.570 | 0.106 | 1 |
| 25363 | 7061771.821 | 644907.712 | 499.130 | 499.050 | 0.080 | 1 |
| 25364 | 7061767.35 | 644909.304 | 499.574 | 499.520 | 0.054 | 1 |
| 25365 | 7061762.863 | 644910.892 | 500.069 | 499.960 | 0.109 | 1 |
| 25366 | 7061758.023 | 644912.494 | 500.519 | 500.410 | 0.109 | 1 |
| 25367 | 7061753.472 | 644914.038 | 500.886 | 500.780 | 0.106 | 1 |
| 25368 | 7061749.078 | 644915.466 | 501.237 | 501.170 | 0.067 | 1 |
| 25369 | 7061744.904 | 644916.939 | 501.599 | 501.510 | 0.089 | 1 |
| 25370 | 7061740.445 | 644918.485 | 502.064 | 501.970 | 0.094 | 1 |
| 25371 | 7061736.164 | 644919.634 | 502.462 | 502.400 | 0.062 | 1 |
| 25372 | 7061731.681 | 644921.183 | 502.901 | 502.780 | 0.121 | 1 |
| 25373 | 7061727.122 | 644922.808 | 503.310 | 503.200 | 0.110 | 1 |
| 25375 | 7061718.245 | 644926.153 | 504.202 | 504.060 | 0.142 | 1 |
| 25376 | 7061714.22 | 644928.226 | 504.640 | 504.520 | 0.120 | 1 |
| 25377 | 7061710.461 | 644930.397 | 504.974 | 504.870 | 0.104 | 1 |
| 25378 | 7061706.834 | 644933.324 | 505.380 | 505.240 | 0.140 | 1 |
| 25379 | 7061702.775 | 644935.937 | 506.012 | 505.890 | 0.122 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 25380 | 7061699.394 | 644939.124 | 506.580 | 506.480 | 0.100 | 1 |
| 25381 | 7061696.502 | 644942.703 | 507.142 | 507.050 | 0.092 | 1 |
| 25382 | 7061693.967 | 644946.492 | 507.671 | 507.570 | 0.101 | 1 |
| 25383 | 7061691.678 | 644950.336 | 508.153 | 508.050 | 0.103 | 1 |
| 25384 | 7061689.717 | 644954.484 | 508.644 | 508.490 | 0.154 | 1 |
| 25385 | 7061688.54 | 644958.936 | 509.037 | 508.920 | 0.117 | 1 |
| 25386 | 7061687.732 | 644963.496 | 509.414 | 509.310 | 0.104 | 1 |
| 25387 | 7061687.444 | 644968.099 | 509.764 | 509.660 | 0.104 | 1 |
| 25388 | 7061687.306 | 644972.766 | 510.153 | 510.060 | 0.093 | 1 |
| 25389 | 7061687.368 | 644977.156 | 510.513 | 510.450 | 0.063 | 1 |
| 25390 | 7061687.67 | 644981.773 | 510.961 | 510.880 | 0.081 | 1 |
| 25391 | 7061687.747 | 644986.062 | 511.390 | 511.290 | 0.100 | 1 |
| 25392 | 7061687.989 | 644990.879 | 511.829 | 511.740 | 0.089 | 1 |
| 25393 | 7061688.261 | 644995.202 | 512.225 | 512.160 | 0.065 | 1 |
| 25394 | 7061688.49 | 644999.546 | 512.652 | 512.560 | 0.092 | 1 |
| 25395 | 7061688.668 | 645003.705 | 513.018 | 512.950 | 0.068 | 1 |
| 25396 | 7061688.789 | 645007.86 | 513.396 | 513.320 | 0.076 | 1 |
| 25397 | 7061688.905 | 645012.032 | 513.803 | 513.710 | 0.093 | 1 |
| 25398 | 7061688.858 | 645016.498 | 514.232 | 514.160 | 0.072 | 1 |
| 25399 | 7061688.776 | 645020.992 | 514.664 | 514.590 | 0.074 | 1 |
| 25400 | 7061688.675 | 645025.82 | 515.147 | 515.060 | 0.087 | 1 |
| 25401 | 7061688.349 | 645030.357 | 515.589 | 515.530 | 0.059 | 1 |
| 25402 | 7061687.757 | 645034.741 | 516.048 | 515.960 | 0.088 | 1 |
| 25403 | 7061687.08 | 645039.314 | 516.542 | 516.470 | 0.072 | 1 |
| 25404 | 7061686.299 | 645043.771 | 517.030 | 516.940 | 0.090 | 1 |
| 25405 | 7061685.028 | 645048.431 | 517.529 | 517.460 | 0.069 | 1 |
| 25406 | 7061683.455 | 645052.676 | 517.938 | 517.860 | 0.078 | 1 |
| 25407 | 7061681.621 | 645057.197 | 518.360 | 518.260 | 0.100 | 1 |
| 25408 | 7061679.858 | 645061.183 | 518.722 | 518.630 | 0.092 | 1 |
| 25409 | 7061677.791 | 645065.597 | 519.157 | 519.070 | 0.087 | 1 |
| 25410 | 7061675.648 | 645069.732 | 519.561 | 519.510 | 0.051 | 1 |
| 25411 | 7061673.068 | 645073.647 | 520.061 | 519.960 | 0.101 | 1 |
| 25412 | 7061670.491 | 645077.192 | 520.521 | 520.440 | 0.081 | 1 |
| 25413 | 7061667.606 | 645081.051 | 520.970 | 520.890 | 0.080 | 1 |
| 25414 | 7061665.006 | 645084.657 | 521.408 | 521.310 | 0.098 | 1 |
| 25415 | 7061662.294 | 645088.348 | 521.816 | 521.740 | 0.076 | 1 |
| 25416 | 7061659.882 | 645091.934 | 522.255 | 522.150 | 0.105 | 1 |
| 25417 | 7061657.06 | 645095.823 | 522.722 | 522.630 | 0.092 | 1 |
| 25418 | 7061653.853 | 645099.812 | 523.232 | 523.140 | 0.092 | 1 |
| 25419 | 7061650.69 | 645103.717 | 523.707 | 523.640 | 0.067 | 1 |
| 25420 | 7061647.708 | 645107.591 | 524.196 | 524.140 | 0.056 | 1 |
| 25421 | 7061645.012 | 645111.557 | 524.704 | 524.620 | 0.084 | 1 |
| 25422 | 7061641.968 | 645115.268 | 525.232 | 525.140 | 0.092 | 1 |
| 25423 | 7061639.353 | 645118.722 | 525.702 | 525.600 | 0.102 | 1 |
| 25424 | 7061636.247 | 645122.955 | 526.247 | 526.170 | 0.077 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 25425 | 7061633.198 | 645126.788 | 526.818 | 526.710 | 0.108 | 1 |
| 25426 | 7061630.158 | 645130.506 | 527.339 | 527.260 | 0.079 | 1 |
| 25427 | 7061627.407 | 645134.249 | 527.881 | 527.770 | 0.111 | 1 |
| 25428 | 7061624.51 | 645138.087 | 528.371 | 528.260 | 0.111 | 1 |
| 25429 | 7061621.479 | 645142.029 | 528.863 | 528.770 | 0.093 | 1 |
| 25430 | 7061618.62 | 645145.975 | 529.398 | 529.280 | 0.118 | 1 |
| 25431 | 7061615.835 | 645149.995 | 529.889 | 529.760 | 0.129 | 1 |
| 25432 | 7061613.355 | 645153.645 | 530.315 | 530.200 | 0.115 | 1 |
| 25433 | 7061610.677 | 645158.065 | 530.833 | 530.730 | 0.103 | 1 |
| 25434 | 7061608.476 | 645162.232 | 531.310 | 531.180 | 0.130 | 1 |
| 25435 | 7061606.69 | 645166.116 | 531.670 | 531.540 | 0.130 | 1 |
| 25436 | 7061605.065 | 645170.339 | 532.082 | 531.920 | 0.162 | 1 |
| 25437 | 7061603.855 | 645174.504 | 532.371 | 532.260 | 0.111 | 1 |
| 25438 | 7061602.883 | 645178.753 | 532.732 | 532.610 | 0.122 | 1 |
| 25439 | 7061602.126 | 645183.279 | 533.214 | 533.100 | 0.114 | 1 |
| 25440 | 7061601.348 | 645187.654 | 533.644 | 533.550 | 0.094 | 1 |
| 25441 | 7061601.201 | 645191.592 | 534.030 | 533.930 | 0.100 | 1 |
| 25442 | 7061601.447 | 645196.139 | 534.412 | 534.340 | 0.072 | 1 |
| 25443 | 7061601.971 | 645200.42 | 534.932 | 534.860 | 0.072 | 1 |
| 25444 | 7061602.789 | 645204.381 | 535.424 | 535.340 | 0.084 | 1 |
| 25445 | 7061603.971 | 645208.599 | 535.893 | 535.800 | 0.093 | 1 |
| 25446 | 7061605.456 | 645212.719 | 536.320 | 536.230 | 0.090 | 1 |
| 25447 | 7061607.283 | 645216.871 | 536.727 | 536.630 | 0.097 | 1 |
| 25448 | 7061609.309 | 645220.641 | 537.235 | 537.150 | 0.085 | 1 |
| 25449 | 7061611.357 | 645224.675 | 537.749 | 537.720 | 0.029 | 1 |
| 25450 | 7061613.567 | 645228.588 | 538.353 | 538.230 | 0.123 | 1 |
| 25451 | 7061616.057 | 645232.261 | 538.748 | 538.680 | 0.068 | 1 |
| 25452 | 7061618.543 | 645235.957 | 539.190 | 539.100 | 0.090 | 1 |
| 25453 | 7061621.22 | 645239.308 | 539.571 | 539.500 | 0.071 | 1 |
| 25454 | 7061624.109 | 645242.429 | 540.006 | 539.920 | 0.086 | 1 |
| 25455 | 7061626.872 | 645245.515 | 540.430 | 540.360 | 0.070 | 1 |
| 25456 | 7061629.995 | 645248.614 | 540.867 | 540.790 | 0.077 | 1 |
| 25457 | 7061632.974 | 645251.698 | 541.281 | 541.230 | 0.051 | 1 |
| 25458 | 7061635.993 | 645254.601 | 541.688 | 541.600 | 0.088 | 1 |
| 25459 | 7061639.227 | 645257.734 | 542.072 | 541.990 | 0.082 | 1 |
| 25460 | 7061642.396 | 645260.637 | 542.444 | 542.360 | 0.084 | 1 |
| 25461 | 7061645.683 | 645263.742 | 542.812 | 542.730 | 0.082 | 1 |
| 25462 | 7061648.955 | 645266.718 | 543.225 | 543.150 | 0.075 | 1 |
| 25463 | 7061652.29 | 645269.783 | 543.669 | 543.570 | 0.099 | 1 |
| 25464 | 7061655.598 | 645272.68 | 544.100 | 544.000 | 0.100 | 1 |
| 25465 | 7061658.943 | 645275.659 | 544.517 | 544.440 | 0.077 | 1 |
| 25466 | 7061662.041 | 645278.437 | 544.920 | 544.820 | 0.100 | 1 |
| 25467 | 7061665.105 | 645281.246 | 545.307 | 545.220 | 0.087 | 1 |
| 25468 | 7061668.44 | 645284.173 | 545.785 | 545.690 | 0.095 | 1 |
| 25469 | 7061671.632 | 645286.865 | 546.199 | 546.110 | 0.089 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 25470 | 7061675.018 | 645289.607 | 546.631 | 546.540 | 0.091 | 1 |
| 25471 | 7061678.132 | 645292.121 | 547.068 | 547.000 | 0.068 | 1 |
| 25472 | 7061681.491 | 645294.582 | 547.524 | 547.450 | 0.074 | 1 |
| 25473 | 7061684.767 | 645297.122 | 547.973 | 547.890 | 0.083 | 1 |
| 25474 | 7061689.254 | 645300.23 | 548.581 | 548.490 | 0.091 | 1 |
| 25475 | 7061693.245 | 645302.82 | 549.096 | 549.010 | 0.086 | 1 |
| 25476 | 7061697.294 | 645305.241 | 549.580 | 549.490 | 0.090 | 1 |
| 25477 | 7061701.987 | 645307.946 | 550.094 | 549.990 | 0.104 | 1 |
| 25478 | 7061706.858 | 645310.66 | 550.622 | 550.540 | 0.082 | 1 |
| 25479 | 7061711.664 | 645313.168 | 551.143 | 551.060 | 0.083 | 1 |
| 25480 | 7061716.264 | 645315.101 | 551.614 | 551.540 | 0.074 | 1 |
| 25481 | 7061721.1 | 645317.256 | 552.138 | 552.040 | 0.098 | 1 |
| 25482 | 7061726.302 | 645319.239 | 552.665 | 552.590 | 0.075 | 1 |
| 25483 | 7061731.515 | 645321.263 | 553.184 | 553.110 | 0.074 | 1 |
| 25484 | 7061736.059 | 645322.897 | 553.615 | 553.530 | 0.085 | 1 |
| 25485 | 7061740.945 | 645325.057 | 554.061 | 553.970 | 0.091 | 1 |
| 25486 | 7061745.481 | 645327.635 | 554.517 | 554.450 | 0.067 | 1 |
| 25487 | 7061749.368 | 645331.189 | 555.020 | 554.950 | 0.070 | 1 |
| 25488 | 7061752.529 | 645335.231 | 555.458 | 555.380 | 0.078 | 1 |
| 25489 | 7061754.594 | 645340.256 | 555.845 | 555.770 | 0.075 | 1 |
| 25490 | 7061755.325 | 645345.891 | 556.244 | 556.160 | 0.084 | 1 |
| 25491 | 7061753.93 | 645351.589 | 556.648 | 556.580 | 0.068 | 1 |
| 25492 | 7061751.328 | 645356.506 | 557.021 | 556.970 | 0.051 | 1 |
| 25493 | 7061747.96 | 645360.474 | 557.331 | 557.270 | 0.061 | 1 |
| 25494 | 7061744.16 | 645364.554 | 557.656 | 557.590 | 0.066 | 1 |
| 25495 | 7061739.017 | 645366.147 | 557.975 | 557.920 | 0.055 | 1 |
| 25496 | 7061733.713 | 645366.642 | 558.180 | 558.090 | 0.090 | 1 |
| 25497 | 7061728.737 | 645365.354 | 558.347 | 558.260 | 0.087 | 1 |
| 25498 | 7061724.08 | 645363.803 | 558.462 | 558.400 | 0.062 | 1 |
| 25499 | 7061719.299 | 645362.001 | 558.602 | 558.540 | 0.062 | 1 |
| 25500 | 7061714.647 | 645360.048 | 558.792 | 558.720 | 0.072 | 1 |
| 25501 | 7062440.473 | 646117.914 | 425.492 | 425.490 | 0.002 | 1 |
| 25502 | 7062437.41 | 646114.682 | 425.582 | 425.550 | 0.032 | 1 |
| 25503 | 7062434.357 | 646111.279 | 425.563 | 425.540 | 0.023 | 1 |
| 25504 | 7062431.23 | 646107.921 | 425.532 | 425.510 | 0.022 | 1 |
| 25505 | 7062428.12 | 646104.034 | 425.499 | 425.480 | 0.019 | 1 |
| 25506 | 7062424.974 | 646101.073 | 425.538 | 425.480 | 0.058 | 1 |
| 25507 | 7062421.995 | 646097.826 | 425.495 | 425.500 | -0.005 | 1 |
| 25508 | 7062418.793 | 646094.561 | 425.515 | 425.460 | 0.055 | 1 |
| 25509 | 7062415.836 | 646091.338 | 425.492 | 425.460 | 0.032 | 1 |
| 25510 | 7062413.083 | 646087.939 | 425.478 | 425.470 | 0.008 | 1 |
| 25511 | 7062410.234 | 646084.605 | 425.480 | 425.450 | 0.030 | 1 |
| 25512 | 7062407.478 | 646081.271 | 425.478 | 425.470 | 0.008 | 1 |
| 25513 | 7062404.657 | 646077.98 | 425.490 | 425.480 | 0.010 | 1 |
| 25514 | 7062401.764 | 646074.557 | 425.505 | 425.500 | 0.005 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 25515 | 7062398.927 | 646071.31 | 425.519 | 425.520 | -0.001 | 1 |
| 25516 | 7062395.896 | 646068.096 | 425.514 | 425.490 | 0.024 | 1 |
| 25517 | 7062393.696 | 646063.175 | 425.500 | 425.470 | 0.030 | 1 |
| 25518 | 7062390.38 | 646059.84 | 425.508 | 425.480 | 0.028 | 1 |
| 25519 | 7062386.911 | 646056.421 | 425.518 | 425.500 | 0.018 | 1 |
| 25520 | 7062383.243 | 646053.271 | 425.537 | 425.510 | 0.027 | 1 |
| 25521 | 7062380.282 | 646049.815 | 425.517 | 425.490 | 0.027 | 1 |
| 25522 | 7062377.278 | 646046.384 | 425.500 | 425.490 | 0.010 | 1 |
| 25523 | 7062374.483 | 646043.362 | 425.506 | 425.480 | 0.026 | 1 |
| 25524 | 7062371.635 | 646040.111 | 425.484 | 425.470 | 0.014 | 1 |
| 25525 | 7062369.023 | 646037.093 | 425.471 | 425.470 | 0.001 | 1 |
| 25526 | 7062366.217 | 646033.878 | 425.452 | 425.450 | 0.002 | 1 |
| 25527 | 7062363.124 | 646030.27 | 425.458 | 425.440 | 0.018 | 1 |
| 25528 | 7062360.28 | 646026.681 | 425.436 | 425.450 | -0.014 | 1 |
| 25529 | 7062357.344 | 646023.147 | 425.472 | 425.430 | 0.042 | 1 |
| 25530 | 7062354.257 | 646019.493 | 425.433 | 425.420 | 0.013 | 1 |
| 25531 | 7062351.209 | 646016.029 | 425.439 | 425.410 | 0.029 | 1 |
| 25532 | 7062348.271 | 646012.61 | 425.411 | 425.400 | 0.011 | 1 |
| 25533 | 7062345.341 | 646009.148 | 425.404 | 425.380 | 0.024 | 1 |
| 25534 | 7062342.325 | 646005.696 | 425.393 | 425.370 | 0.023 | 1 |
| 25535 | 7062339.282 | 646002.147 | 425.382 | 425.360 | 0.022 | 1 |
| 25536 | 7062336.245 | 645998.555 | 425.366 | 425.340 | 0.026 | 1 |
| 25537 | 7062333.349 | 645995.201 | 425.369 | 425.340 | 0.029 | 1 |
| 25538 | 7062330.335 | 645991.677 | 425.366 | 425.330 | 0.036 | 1 |
| 25539 | 7062327.065 | 645987.889 | 425.344 | 425.320 | 0.024 | 1 |
| 25540 | 7062324.019 | 645984.296 | 425.308 | 425.290 | 0.018 | 1 |
| 25541 | 7062320.999 | 645980.818 | 425.287 | 425.260 | 0.027 | 1 |
| 25542 | 7062318.201 | 645977.516 | 425.293 | 425.260 | 0.033 | 1 |
| 25543 | 7062315.406 | 645974.258 | 425.283 | 425.240 | 0.043 | 1 |
| 25544 | 7062312.673 | 645971.106 | 425.292 | 425.260 | 0.032 | 1 |
| 25545 | 7062309.826 | 645967.782 | 425.290 | 425.270 | 0.020 | 1 |
| 25546 | 7062306.998 | 645964.529 | 425.296 | 425.280 | 0.016 | 1 |
| 25547 | 7062304.053 | 645961.146 | 425.300 | 425.300 | 0.000 | 1 |
| 25548 | 7062301.215 | 645957.987 | 425.328 | 425.300 | 0.028 | 1 |
| 25549 | 7062298.428 | 645954.765 | 425.336 | 425.300 | 0.036 | 1 |
| 25550 | 7062295.57 | 645951.371 | 425.338 | 425.310 | 0.028 | 1 |
| 25551 | 7062292.664 | 645947.857 | 425.322 | 425.290 | 0.032 | 1 |
| 25552 | 7062290.139 | 645944.819 | 425.329 | 425.310 | 0.019 | 1 |
| 25553 | 7062287.36 | 645941.62 | 425.348 | 425.330 | 0.018 | 1 |
| 25554 | 7062284.577 | 645938.234 | 425.365 | 425.360 | 0.005 | 1 |
| 25555 | 7062281.276 | 645934.288 | 425.402 | 425.380 | 0.022 | 1 |
| 25556 | 7062277.922 | 645930.446 | 425.457 | 425.420 | 0.037 | 1 |
| 25557 | 7062275.017 | 645927.054 | 425.456 | 425.450 | 0.006 | 1 |
| 25558 | 7062272.076 | 645923.628 | 425.452 | 425.440 | 0.012 | 1 |
| 25559 | 7062269.222 | 645920.41 | 425.476 | 425.450 | 0.026 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 25560 | 7062266.695 | 645917.366 | 425.497 | 425.470 | 0.027 | 1 |
| 25561 | 7062263.213 | 645914.045 | 425.493 | 425.480 | 0.013 | 1 |
| 25562 | 7062259.787 | 645909.519 | 425.525 | 425.490 | 0.035 | 1 |
| 25563 | 7062256.521 | 645905.849 | 425.548 | 425.520 | 0.028 | 1 |
| 25564 | 7062253.502 | 645902.237 | 425.581 | 425.540 | 0.041 | 1 |
| 25565 | 7062250.639 | 645898.67 | 425.575 | 425.540 | 0.035 | 1 |
| 25566 | 7062247.757 | 645895.199 | 425.596 | 425.550 | 0.046 | 1 |
| 25567 | 7062244.87 | 645891.883 | 425.640 | 425.610 | 0.030 | 1 |
| 25568 | 7062241.886 | 645888.475 | 425.665 | 425.630 | 0.035 | 1 |
| 25569 | 7062238.831 | 645884.878 | 425.704 | 425.670 | 0.034 | 1 |
| 25570 | 7062235.959 | 645881.67 | 425.733 | 425.700 | 0.033 | 1 |
| 25571 | 7062233.113 | 645878.383 | 425.753 | 425.720 | 0.033 | 1 |
| 25572 | 7062229.999 | 645874.833 | 425.771 | 425.740 | 0.031 | 1 |
| 25573 | 7062226.875 | 645871.182 | 425.786 | 425.760 | 0.026 | 1 |
| 25574 | 7062223.897 | 645867.664 | 425.810 | 425.780 | 0.030 | 1 |
| 25575 | 7062220.898 | 645864.201 | 425.856 | 425.810 | 0.046 | 1 |
| 25576 | 7062217.833 | 645860.756 | 425.870 | 425.820 | 0.050 | 1 |
| 25577 | 7062214.94 | 645857.215 | 425.900 | 425.850 | 0.050 | 1 |
| 25578 | 7062212.023 | 645853.702 | 425.924 | 425.880 | 0.044 | 1 |
| 25579 | 7062209.132 | 645850.542 | 425.943 | 425.900 | 0.043 | 1 |
| 25580 | 7062205.988 | 645847.196 | 425.986 | 425.930 | 0.056 | 1 |
| 25581 | 7062203.12 | 645843.415 | 426.021 | 425.980 | 0.041 | 1 |
| 25582 | 7062200.37 | 645840.015 | 426.048 | 426.000 | 0.048 | 1 |
| 25583 | 7062197.388 | 645836.484 | 426.071 | 426.030 | 0.041 | 1 |
| 25584 | 7062194.298 | 645832.82 | 426.098 | 426.070 | 0.028 | 1 |
| 25585 | 7062191.422 | 645829.29 | 426.113 | 426.070 | 0.043 | 1 |
| 25586 | 7062188.437 | 645825.881 | 426.134 | 426.120 | 0.014 | 1 |
| 25587 | 7062185.49 | 645822.381 | 426.177 | 426.120 | 0.057 | 1 |
| 25588 | 7062182.58 | 645818.911 | 426.183 | 426.150 | 0.033 | 1 |
| 25589 | 7062179.454 | 645815.333 | 426.193 | 426.160 | 0.033 | 1 |
| 25590 | 7062176.318 | 645811.687 | 426.205 | 426.180 | 0.025 | 1 |
| 25591 | 7062173.313 | 645808.335 | 426.219 | 426.180 | 0.039 | 1 |
| 25592 | 7062170.311 | 645804.951 | 426.228 | 426.180 | 0.048 | 1 |
| 25593 | 7062167.319 | 645801.413 | 426.251 | 426.190 | 0.061 | 1 |
| 25594 | 7062164.163 | 645797.696 | 426.260 | 426.220 | 0.040 | 1 |
| 25595 | 7062161.295 | 645794.133 | 426.258 | 426.220 | 0.038 | 1 |
| 25596 | 7062158.695 | 645790.834 | 426.259 | 426.200 | 0.059 | 1 |
| 25597 | 7062155.699 | 645787.264 | 426.269 | 426.200 | 0.069 | 1 |
| 25598 | 7062152.807 | 645783.882 | 426.292 | 426.230 | 0.062 | 1 |
| 25599 | 7062149.72 | 645780.323 | 426.311 | 426.250 | 0.061 | 1 |
| 25600 | 7062146.246 | 645776.502 | 426.337 | 426.290 | 0.047 | 1 |
| 25601 | 7062143.216 | 645773.051 | 426.386 | 426.320 | 0.066 | 1 |
| 25602 | 7062140.203 | 645769.49 | 426.423 | 426.380 | 0.043 | 1 |
| 25603 | 7062135.898 | 645764.297 | 426.503 | 426.420 | 0.083 | 1 |
| 25604 | 7062132.862 | 645760.629 | 426.572 | 426.520 | 0.052 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 25605 | 7062129.884 | 645757.103 | 426.626 | 426.590 | 0.036 | 1 |
| 25606 | 7062125.617 | 645753.868 | 426.673 | 426.640 | 0.033 | 1 |
| 25607 | 7062121.857 | 645751.397 | 426.702 | 426.670 | 0.032 | 1 |
| 25608 | 7062117.209 | 645750.594 | 426.745 | 426.700 | 0.045 | 1 |
| 25609 | 7062112.76 | 645750.101 | 426.726 | 426.710 | 0.016 | 1 |
| 25610 | 7062110.21 | 645749.07 | 426.678 | 426.650 | 0.028 | 1 |
| 25611 | 7057686.203 | 649359.732 | 462.534 | 462.510 | 0.024 | 1 |
| 25612 | 7057684.233 | 649356.723 | 462.611 | 462.610 | 0.001 | 1 |
| 25613 | 7059348.811 | 647930.898 | 453.330 | 453.270 | 0.060 | 1 |
| 25614 | 7059346.979 | 647927.952 | 453.411 | 453.370 | 0.041 | 1 |
| 25615 | 7059344.945 | 647924.891 | 453.360 | 453.310 | 0.050 | 1 |
| 25616 | 7059343.202 | 647922.231 | 453.256 | 453.230 | 0.026 | 1 |
| 25617 | 7059341.658 | 647919.879 | 453.235 | 453.190 | 0.045 | 1 |
| 25618 | 7059339.289 | 647916.645 | 453.168 | 453.120 | 0.048 | 1 |
| 25619 | 7064245.769 | 640622.044 | 430.259 | 430.260 | -0.001 | 1 |
| 25620 | 7064243.306 | 640619.301 | 430.326 | 430.310 | 0.016 | 1 |
| 25621 | 7064241.355 | 640617.291 | 430.304 | 430.340 | -0.036 | 1 |
| 25622 | 7064238.542 | 640615.073 | 430.262 | 430.260 | 0.002 | 1 |
| 25623 | 7063985.779 | 642019.325 | 419.961 | 419.930 | 0.031 | 1 |
| 25624 | 7063983.389 | 642019.456 | 420.074 | 420.060 | 0.014 | 1 |
| 25625 | 7063980.592 | 642020.128 | 420.238 | 420.230 | 0.008 | 1 |
| 25626 | 7063977.233 | 642021.07 | 420.412 | 420.380 | 0.032 | 1 |
| 25627 | 7063973.682 | 642022.054 | 420.311 | 420.310 | 0.001 | 1 |
| 25628 | 7063969.542 | 642024.008 | 419.949 | 419.970 | -0.021 | 1 |
| 25629 | 7063965.924 | 642025.184 | 419.589 | 419.590 | -0.001 | 1 |
| 25630 | 7063962.292 | 642025.889 | 419.203 | 419.230 | -0.027 | 1 |
| 25631 | 7062548.722 | 645176.821 | 423.012 | 422.940 | 0.072 | 1 |
| 25701 | 7061879.474 | 647617.034 | 430.112 | 430.170 | -0.058 | 1 |
| 25702 | 7061898.787 | 647630.95 | 429.934 | 429.940 | -0.006 | 1 |
| 25703 | 7061867.916 | 647621.968 | 430.635 | 430.660 | -0.025 | 1 |
| 25704 | 7061875.664 | 647592.184 | 430.248 | 430.270 | -0.022 | 1 |
| 25705 | 7061883.48 | 647562.033 | 430.339 | 430.360 | -0.021 | 1 |
| 25706 | 7061893.123 | 647525.616 | 430.665 | 430.710 | -0.045 | 1 |
| 25707 | 7061905.172 | 647479.57 | 430.721 | 430.770 | -0.049 | 1 |
| 25708 | 7061919.915 | 647435.844 | 430.721 | 430.730 | -0.009 | 1 |
| 25709 | 7061934.704 | 647398.402 | 430.677 | 430.700 | -0.023 | 1 |
| 25710 | 7061966.451 | 647318.907 | 430.376 | 430.410 | -0.034 | 1 |
| 25711 | 7061990.139 | 647258.497 | 430.238 | 430.280 | -0.042 | 1 |
| 25712 | 7062011.863 | 647203.311 | 429.737 | 429.750 | -0.013 | 1 |
| 25713 | 7062041.101 | 647128.487 | 429.194 | 429.230 | -0.036 | 1 |
| 25714 | 7062081.614 | 647025.623 | 428.801 | 428.810 | -0.009 | 1 |
| 25715 | 7062111.546 | 646949.138 | 428.710 | 428.710 | 0.000 | 1 |
| 25716 | 7062148.395 | 646855.338 | 428.449 | 428.460 | -0.011 | 1 |
| 25717 | 7062175.4 | 646786.848 | 428.191 | 428.180 | 0.011 | 1 |
| 25718 | 7062207.72 | 646704.878 | 427.901 | 427.930 | -0.029 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 25719 | 7062260.934 | 646558.02 | 427.669 | 427.680 | -0.011 | 1 |
| 25720 | 7062289.085 | 646496.8 | 427.000 | 427.030 | -0.030 | 1 |
| 25721 | 7062308.523 | 646447.835 | 426.798 | 426.830 | -0.032 | 1 |
| 25722 | 7062319.231 | 646411.49 | 426.659 | 426.660 | -0.001 | 1 |
| 25723 | 7062343.445 | 646358.343 | 425.940 | 425.960 | -0.020 | 1 |
| 25724 | 7062364.715 | 646303.927 | 425.766 | 425.760 | 0.006 | 1 |
| 25725 | 7062378.689 | 646260.127 | 425.923 | 425.950 | -0.027 | 1 |
| 25726 | 7062401.995 | 646208.46 | 425.550 | 425.570 | -0.020 | 1 |
| 25727 | 7062418.618 | 646166.424 | 425.443 | 425.470 | -0.027 | 1 |
| 25728 | 7062436.937 | 646112.376 | 425.527 | 425.550 | -0.023 | 1 |
| 25729 | 7059363.05 | 647900.707 | 453.123 | 453.120 | 0.003 | 1 |
| 25730 | 7059376.881 | 647889.675 | 453.068 | 453.050 | 0.018 | 1 |
| 25731 | 7059412.261 | 647874.205 | 453.167 | 453.180 | -0.013 | 1 |
| 25732 | 7059373.45 | 647906.6 | 453.293 | 453.280 | 0.013 | 1 |
| 25733 | 7059342.354 | 647919.018 | 453.179 | 453.180 | -0.001 | 1 |
| 25734 | 7059331.202 | 647942.748 | 453.405 | 453.410 | -0.005 | 1 |
| 25735 | 7059408.037 | 647876.779 | 453.191 | 453.220 | -0.029 | 1 |
| 25736 | 7059491.344 | 647803.62 | 452.792 | 452.810 | -0.018 | 1 |
| 25737 | 7059602.853 | 647707.685 | 451.907 | 451.920 | -0.013 | 1 |
| 25738 | 7059631.002 | 647683.563 | 451.576 | 451.570 | 0.006 | 1 |
| 25739 | 7059702.222 | 647576.843 | 448.195 | 448.200 | -0.005 | 1 |
| 25740 | 7059780.356 | 647555.486 | 449.576 | 449.600 | -0.024 | 1 |
| 25741 | 7059920.147 | 647435.262 | 447.702 | 447.700 | 0.002 | 1 |
| 25742 | 7060069.454 | 647307.166 | 446.522 | 446.530 | -0.008 | 1 |
| 25743 | 7060210.011 | 647186.359 | 445.600 | 445.570 | 0.030 | 1 |
| 25744 | 7060349.157 | 647070.107 | 444.503 | 444.490 | 0.013 | 1 |
| 25745 | 7060423.815 | 647002.747 | 443.975 | 443.950 | 0.025 | 1 |
| 25746 | 7060563.286 | 646882.823 | 442.720 | 442.700 | 0.020 | 1 |
| 25747 | 7060638.618 | 646818.44 | 441.950 | 441.930 | 0.020 | 1 |
| 25748 | 7060779.101 | 646697.664 | 440.428 | 440.420 | 0.008 | 1 |
| 25749 | 7060900.158 | 646595.95 | 439.196 | 439.180 | 0.016 | 1 |
| 25750 | 7061030.394 | 646492.888 | 437.654 | 437.650 | 0.004 | 1 |
| 25751 | 7061150.726 | 646378.661 | 436.514 | 436.490 | 0.024 | 1 |
| 25752 | 7061201.892 | 646431.423 | 435.286 | 435.310 | -0.024 | 1 |
| 25753 | 7061320.068 | 646233.128 | 434.646 | 434.620 | 0.026 | 1 |
| 25754 | 7061433.21 | 646147.7 | 433.246 | 433.270 | -0.024 | 1 |
| 25755 | 7061461.063 | 646114.51 | 433.152 | 433.160 | -0.008 | 1 |
| 25756 | 7061505.745 | 646085.362 | 432.529 | 432.530 | -0.001 | 1 |
| 25757 | 7061580.681 | 646009.463 | 431.889 | 431.880 | 0.009 | 1 |
| 25758 | 7061701.549 | 645905.602 | 430.646 | 430.650 | -0.004 | 1 |
| 25759 | 7061709.636 | 645922.03 | 430.442 | 430.430 | 0.012 | 1 |
| 25760 | 7061752.031 | 645971.556 | 429.952 | 429.960 | -0.008 | 1 |
| 25761 | 7061765.454 | 645847.95 | 429.908 | 429.920 | -0.012 | 1 |
| 25762 | 7061860.843 | 645768.982 | 428.913 | 428.930 | -0.017 | 1 |
| 25764 | 7062010.122 | 645640.679 | 427.280 | 427.310 | -0.030 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 25765 | 7062084.31 | 645575.831 | 426.420 | 426.420 | 0.000 | 1 |
| 25766 | 7062178.784 | 645508.199 | 425.430 | 425.420 | 0.010 | 1 |
| 25767 | 7062186.703 | 645486.008 | 425.231 | 425.250 | -0.019 | 1 |
| 25768 | 7062207.187 | 645481.201 | 424.872 | 424.850 | 0.022 | 1 |
| 25769 | 7062267.818 | 645411.805 | 424.407 | 424.410 | -0.003 | 1 |
| 25770 | 7062333.116 | 645352.41 | 424.055 | 424.050 | 0.005 | 1 |
| 25771 | 7062368.364 | 645336.268 | 423.933 | 423.910 | 0.023 | 1 |
| 25772 | 7062380.561 | 645309.915 | 424.020 | 424.000 | 0.020 | 1 |
| 25773 | 7062507.021 | 645194.858 | 424.252 | 424.250 | 0.002 | 1 |
| 25774 | 7062549.413 | 645177.551 | 422.953 | 422.970 | -0.017 | 1 |
| 25775 | 7062589.83 | 645092.018 | 424.418 | 424.420 | -0.002 | 1 |
| 25776 | 7062594.797 | 645061.196 | 424.239 | 424.240 | -0.001 | 1 |
| 25777 | 7062614.916 | 645046.171 | 424.317 | 424.330 | -0.013 | 1 |
| 25778 | 7062609.975 | 644963.704 | 421.486 | 421.490 | -0.004 | 1 |
| 25779 | 7062621.51 | 644971.713 | 422.969 | 422.960 | 0.009 | 1 |
| 25780 | 7062707.228 | 644930.357 | 422.445 | 422.430 | 0.015 | 1 |
| 25781 | 7062719.756 | 644962.8 | 422.710 | 422.690 | 0.020 | 1 |
| 25782 | 7062722.896 | 644982.07 | 422.750 | 422.740 | 0.010 | 1 |
| 25783 | 7062727.737 | 645004.024 | 422.658 | 422.710 | -0.052 | 1 |
| 25784 | 7062723.285 | 644902.913 | 422.143 | 422.140 | 0.003 | 1 |
| 25785 | 7062753.74 | 644714.948 | 424.209 | 424.170 | 0.039 | 1 |
| 25786 | 7062794.476 | 644639.45 | 424.163 | 424.180 | -0.017 | 1 |
| 25787 | 7062848.203 | 644555.913 | 423.876 | 423.910 | -0.034 | 1 |
| 25788 | 7062856.392 | 644545.044 | 423.917 | 423.930 | -0.013 | 1 |
| 25789 | 7062865.606 | 644532.617 | 423.966 | 423.960 | 0.006 | 1 |
| 25790 | 7062932.611 | 644448.907 | 424.145 | 424.130 | 0.015 | 1 |
| 25791 | 7062947.893 | 644432.435 | 424.136 | 424.130 | 0.006 | 1 |
| 25792 | 7062963.421 | 644416.133 | 424.028 | 424.050 | -0.022 | 1 |
| 25374 | 7061722.296 | 644924.533 | 503.826 | 503.630 | 0.196 | 0 |
| 25763 | 7061935.256 | 645705.271 | 427.771 | 428.120 | -0.349 | 0 |

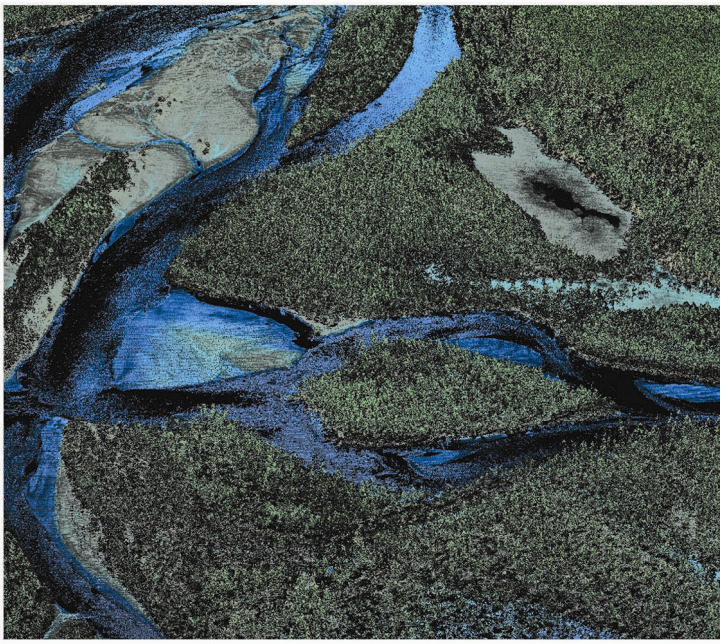
# LiDAR REMOTE SENSING

## ALASKA PIPELINE • ALASKA

(Delivery 2 – 3/31/2011)








## ALASKA DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

**TRENT HUBBARD** - 3354 College Road - Fairbanks, AK 99709

**WATERSHED SCIENCES** • 517 SW 2nd Street, Suite 400 - Corvallis, OR 97333

# LiDAR Remote Sensing Data Collection:

## Alaska Pipeline, AK

### Delivery 2

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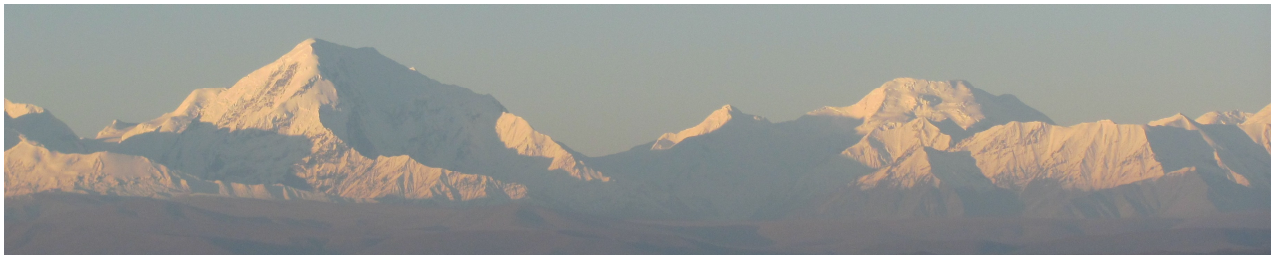
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# 1. Overview

Watershed Sciences, Inc. (WS) is collecting Light Detection and Ranging (LiDAR) data of the Alaska Pipeline for the Alaska Department of Natural Resources. LiDAR data for Delivery 2 was collected between September 17th and 22nd, 2010 (**Figure 1**). Delivery 2 includes 94,885 acres within the requested area. This area was expanded to include a 100m buffer to ensure complete coverage and adequate point densities around survey boundaries, resulting in 99,594 acres of delivered data. This area includes portions of the Alaska Highway east of Johnson River to Robertson River. Accuracy and density data will continue to be updated as additional data is processed.

***Figure 1.*** *Alaska Pipeline survey delivery status overview.*

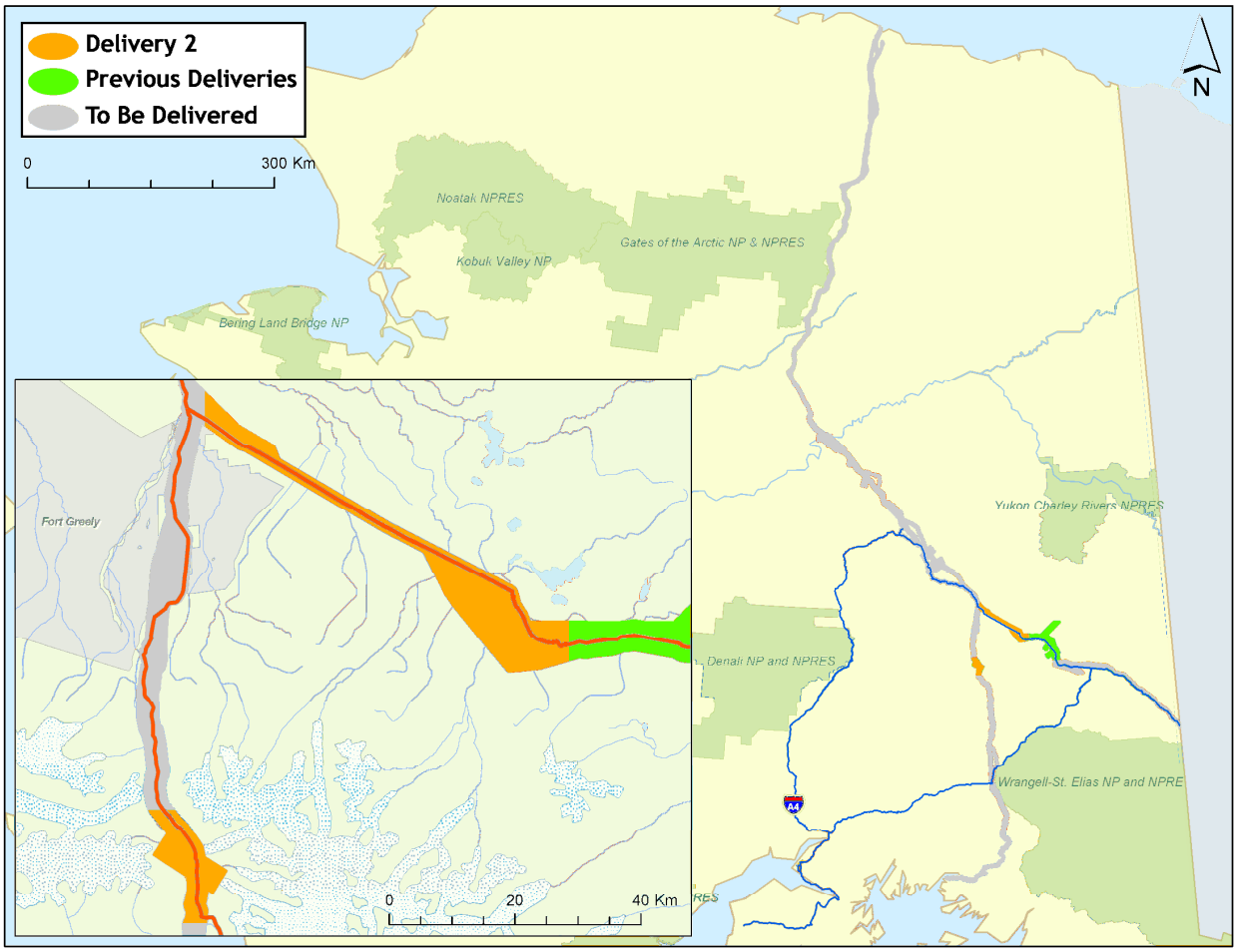



***Table 1.*** *Alaska Pipeline, LiDAR deliveries to date.*

| Delivery | UTM Zone(s) | Date | Total Acres Flown | AOI Acres |
|---|---|---|---|---|
| 1 | 6, 7 | March 9, 2011 | 121,746 | 117,357 |
| 2 | 6 | March 31, 2011 | 99,594 | 94,885 |

# 2. Acquisition

## 2.1 Airborne Survey – Instrumentation and Methods

The LiDAR survey utilized a Leica ALS60 sensor in a Cessna Caravan 208Bs. The Leica systems were set to acquire 150,000 laser pulses per second (i.e., 150 kHz pulse rate) and flown at 1500 meters above ground level (AGL), capturing a scan angle of ±14$^{o}$ from nadir when clouds and terrain permitted. With these flight parameters, the laser swath width is 638m and the laser pulse footprint is 34cm. These settings varied depending on cloud cover and terrain but were consistently adjusted to yield an average native pulse density of ≥8 pulses per square meter over terrestrial surfaces. It is not uncommon for some types of surfaces (e.g. dense vegetation or water) to return fewer pulses than the laser originally emitted. These discrepancies between 'native' and 'delivered' density will vary depending on terrain, land cover, and the prevalence of water bodies.



*The Cessna Caravan is a stable platform, ideal for flying slow and low for high density projects. A Leica ALS60 sensor head installed in the Caravan is shown on the left.*

All areas were surveyed with an opposing flight line side-lap of ≥60% (≥100% overlap) to reduce laser shadowing and increase surface laser painting. The Leica laser systems allow up to four range measurements (returns) per pulse, and all discernable laser returns were processed for the output dataset.

To accurately solve for laser point position (geographic coordinates x, y, z), the positional coordinates of the airborne sensor and the attitude of the aircraft were recorded continuously throughout the LiDAR data collection mission. Aircraft position was measured twice per second (2 Hz) by an onboard differential GPS unit. 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/sensor position and attitude data are indexed by GPS time.

## 2.2 Ground Survey – Instrumentation and Methods

### *2.2.1 Monumentation*




Watershed Sciences coordinated with McClintock Land Associates (MLA, Alaska Professional Licensed Surveyor), of Eagle River, AK to determine proposed monument locations to support aerial acquisition. MLA established survey control monuments for the project area based on the proposed locations, areas with reasonable access, GPS visibility and proximity to the mission area. MLA established six new monuments (**Table 2**) within the Delivery 2 area. The MLA monumentation was done with 5/8" x 30" rebar topped with a metal cap stamped with "MLA-WSI" the monument ID, and the year of establishment. MLA provided professional supervision and oversight to all survey aspects of this project, certified all monuments and provided additional independent accuracy check points (see Section 5.4, Appendix B). A full report of the survey will be provided with the final delivery report.

### *2.2.2 Control for Airborne Surveys*

During the LiDAR survey, static (1 Hz recording frequency) ground surveys were conducted over the survey control monuments. Monument coordinates are provided in **Table 2** and shown in **Figure 2** for the current delivery. After the airborne survey, the static GPS data were provided to MLA for incorporation in the computation of the monument coordinates. MLA processed the static GPS data using triangulation with Continuously Operating Reference Stations (CORS). Both WSI and MLA checked coordinates using the Online Positioning User Service (OPUS[1]) to quantify daily variance. Multiple sessions were processed over the same monument to confirm antenna height measurements and reported position accuracy.

Indexed by time, these GPS data are used to correct the continuous onboard measurements of aircraft position recorded throughout the mission. Control monuments were located within 13 nautical miles of the survey area as per the contract.



Trimble R7 GPS equipment set up in the Alaska Pipeline study area.

[1] Online Positioning User Service (OPUS) is run by the National Geodetic Survey to process corrected monument positions.

### *2.2.3 Instrumentation*

For this delivery area, a Trimble GPS receiver model R7 with Zephyr Geodetic antenna with ground plane was deployed for all static control. MLA provided GLONASS capable Topcon GPS receivers for additional ground survey support. A Trimble model R8 GNSS unit was used for collecting check points using real time kinematic (RTK) survey techniques. For RTK data, the collector begins recording after remaining stationary for 5 seconds then calculating the pseudo range position from at least three epochs with the relative error under 1.5cm horizontal and 2cm vertical. All GPS measurements are made with dual frequency L1-L2 receivers with carrier-phase correction.

***Table 2**. Base Station control coordinates for Alaska Pipeline Delivery 2.*

| Base Station ID | Datum: NAD83 (CORS96) | | GRS80 |
|---|---|---|---|
| | Latitude | Longitude | Ellipsoid Z (meters) |
| 23A | 63° 57'13.61834"N | 145° 26'02.43978"W | 392.625 |
| 23B | 63° 56'15.08428"N | 145° 22'23.29928"W | 390.701 |
| 24A | 63° 45'41.10286"N | 144° 41'50.18781"W | 425.715 |
| 24C | 63° 50'00.74069"N | 144° 58'57.42576"W | 429.057 |
| 32A | 63° 24'02.43810"N | 145° 44'05.42835"W | 773.965 |
| 32B | 63° 22'25.12575"N | 145° 43'52.67022"W | 779.773 |

### *2.2.3 Methodology*

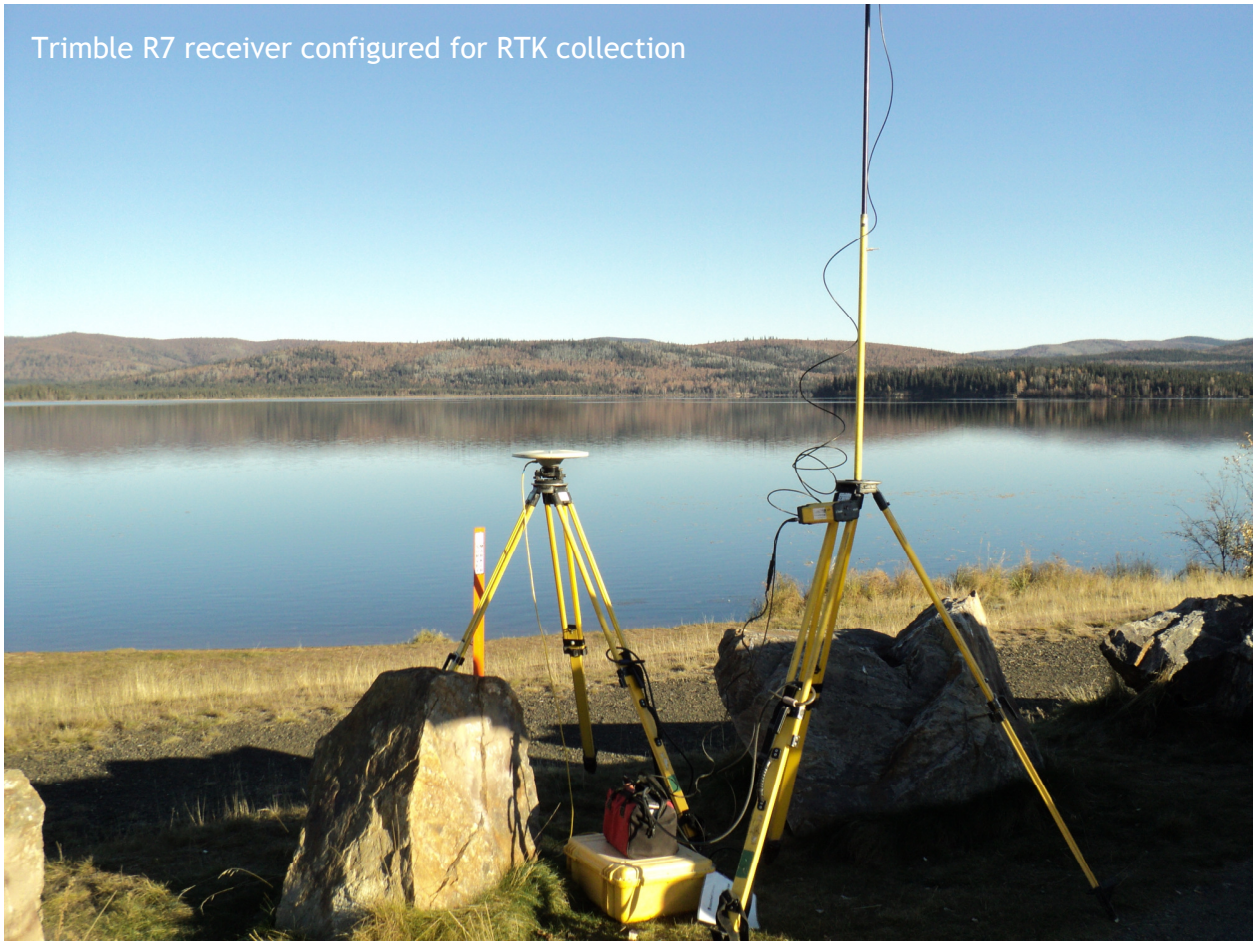



The aircraft was assigned a ground crew member with two Trimble R7 receivers and an R8 receiver. The aircraft is further supported as necessary by an MLA surveyor (AK PLS) with two or more survey grade Topcon Receivers. The ground crew vehicles are equipped with standard field survey supplies and equipment including safety materials. All control monuments are observed for a minimum of two survey sessions lasting no fewer than 6 hours. At the beginning of every session the tripod and antenna are reset, resulting in two independent instrument heights and data files. Data is collected at a rate of 1Hz using a 10 degree mask on the antenna.

After the flight, the ground crew uploads the GPS data to WSI's office for QA/QC review and processing. The static GPS data were also provided to the MLA project surveyor for final computation and review of the control coordinates. MLA provided calculated geodetic positions for all controls, which were then used to process LiDAR data.

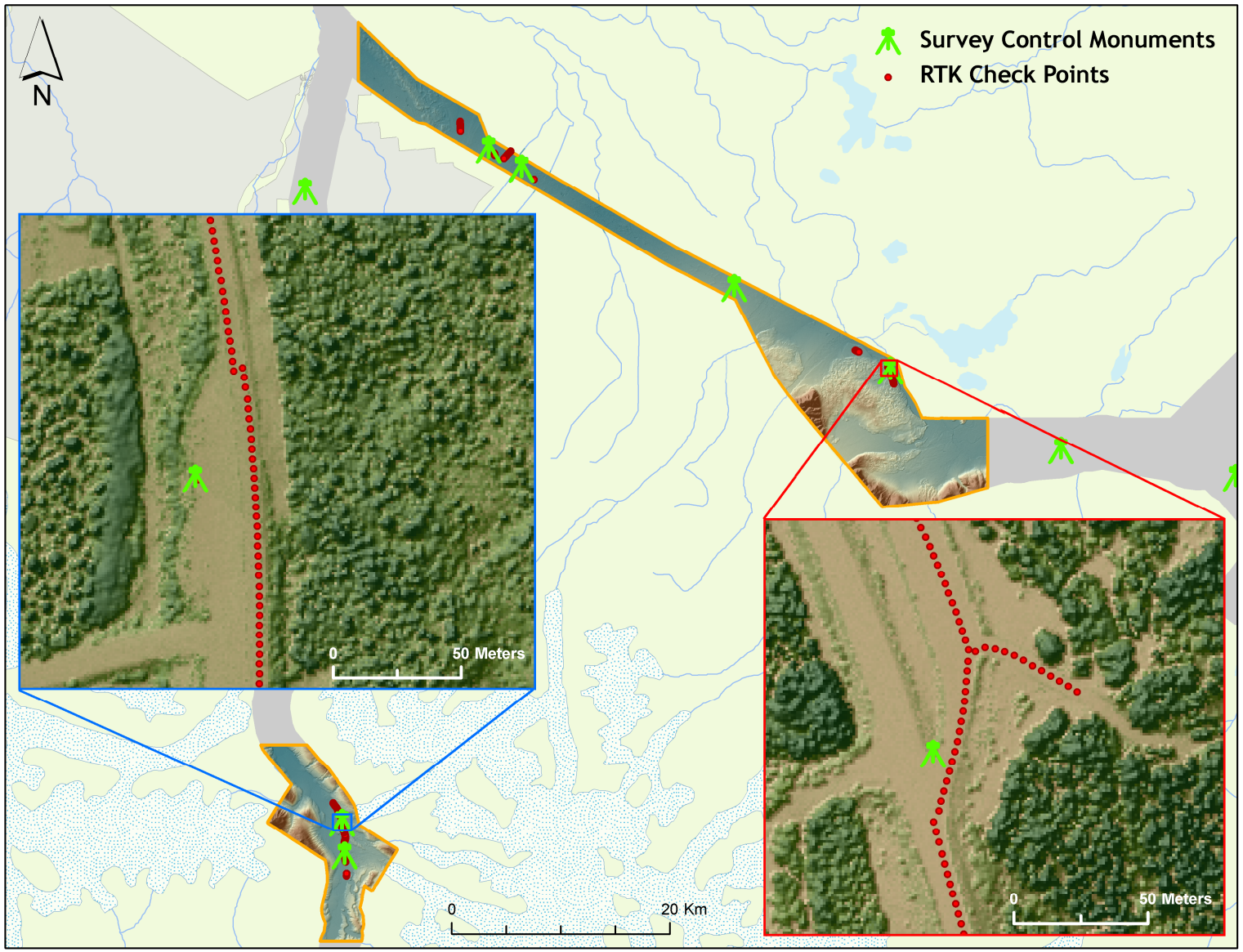
RTK and aircraft mounted GPS measurements are made during periods with PDOP[2] less than or equal to 3.0 and with at least 6 satellites in view of both a stationary reference receiver and the roving receiver. Static GPS data collected in a continuous session average the high PDOP into the final solution in the method used by CORS stations. RTK positions are collected on bare earth locations such as paved, gravel or stable dirt roads, and other locations where the ground is clearly visible (and is likely to remain visible) from the sky during the data acquisition and RTK measurement period(s).

In order to facilitate comparisons with LiDAR measurements, RTK measurements are not taken on highly reflective surfaces such as center line stripes or lane markings on roads. RTK points were taken no closer than one meter to any nearby terrain breaks such as road edges or drop offs.


Trimble R7 receiver configured for RTK collection

[2]PDOP: Point Dilution of Precision is a measure of satellite geometry, the smaller the number the better the geometry between the point and the satellites.

***Figure 2**. WSI RTK check points and control monument locations used in Delivery 2 of the Alaska Pipeline LiDAR Survey.*



# 3. LiDAR Data Processing

## 3.1 Applications and Work Flow Overview

1. Resolved kinematic corrections for aircraft position data using kinematic aircraft GPS and static ground GPS data.

   **Software:** Waypoint GPS v.8.10, Trimble Geomatics Office v.1.62
2. Developed a smoothed best estimate of trajectory (SBET) file that blends post-processed aircraft position with attitude data. Sensor head position and attitude were calculated throughout the survey. The SBET data were used extensively for laser point processing.

   **Software:** IPAS v.1.35
3. Calculated laser point position by associating SBET position to each laser point return time, scan angle, intensity, etc. Created raw laser point cloud data for the entire survey in *.las (ASPRS v. 1.2) format.

   **Software:** ALS Post Processing Software v.2.70
4. Imported raw laser points into manageable blocks (less than 500 MB) to perform manual relative accuracy calibration and filter for pits/birds. Ground points were then classified for individual flight lines (to be used for relative accuracy testing and calibration).

   **Software:** TerraScan v.10.009
5. Using ground classified points per each flight line, the relative accuracy was tested. Automated line-to-line calibrations were then performed for system attitude parameters (pitch, roll, heading), mirror flex (scale) and GPS/IMU drift. Calibrations were performed on ground classified points from paired flight lines. Every flight line was used for relative accuracy calibration.

   **Software:** TerraMatch v.10.006
6. Position and attitude data were imported. Resulting data were classified as ground and non-ground points. Statistical absolute accuracy was assessed via direct comparisons of ground classified points to ground RTK survey data. Data were then converted to orthometric elevations (NAVD88) by applying a Geoid09 correction. **Software:** TerraScan v.10.009, TerraModeler v.10.004
7. Bare Earth models were created as a triangulated surface and exported as ArcInfo ASCII grids at a 1 meter pixel resolution. Highest Hit models were created for any class at 1 meter grid spacing and exported as ArcInfo ASCII grids. Vegetation models were created for all vegetation points 20cm and above the ground model at a 1m grid spacing and exported as ArcInfo ASCII grids.

   **Software:** TerraScan v.10.009, ArcMap v. 9.3.1, TerraModeler v.10.004

## 3.2 Aircraft Kinematic GPS and IMU Data

LiDAR survey datasets were referenced to the 1 Hz static ground GPS data collected over pre-surveyed monuments with known coordinates. While surveying, the aircraft collected 2 Hz kinematic GPS data, and the onboard inertial measurement unit (IMU) collected 200 Hz aircraft attitude data. Waypoint GPS v.8.10 was used to process the kinematic corrections for the aircraft. The static and kinematic GPS data were then post-processed after the survey to

obtain an accurate GPS solution and aircraft positions. IPAS v.1.35 was used to develop a trajectory file that includes corrected aircraft position and attitude information. The trajectory data for the entire flight survey session were incorporated into a final smoothed best estimated trajectory (SBET) file that contains accurate and continuous aircraft positions and attitudes.

## 3.3 Laser Point Processing

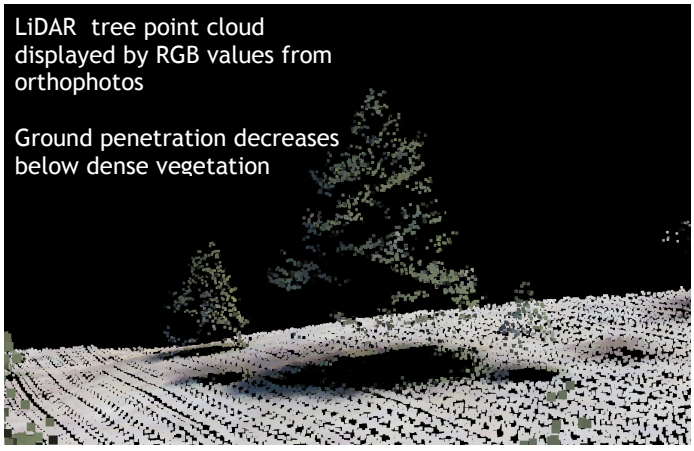
Laser point coordinates were computed using the IPAS and ALS Post Processor software suites based on independent data from the LiDAR system (pulse time, scan angle), and aircraft trajectory data (SBET). Laser point returns (first through fourth) were assigned an associated (x, y, z) coordinate along with unique intensity values (0-255). The data were output into large LAS v. 1.2 files with each point maintaining the corresponding scan angle, return number (echo), intensity, and x, y, z (easting, northing, and elevation) information.

These initial laser point files were too large for subsequent processing. To facilitate laser point processing, bins (polygons) were created to divide the dataset into manageable sizes (< 500 MB). Flightlines and LiDAR data were then reviewed to ensure complete coverage of the survey area and positional accuracy of the laser points.

Laser point data were imported into processing bins in TerraScan, and manual calibration was performed to assess the system offsets for pitch, roll, heading and scale (mirror flex). Using a geometric relationship developed by Watershed Sciences, each of these offsets was resolved and corrected if necessary.

LiDAR points were then filtered for noise, pits (artificial low points), and birds (true birds as well as erroneously high points) by screening for absolute elevation limits, isolated points and height above ground. Each bin was then manually inspected for remaining pits and birds and spurious points were removed. In a bin containing approximately 7.5-9.0 million points, an average of 50-100 points are typically found to be artificially low or high. Common sources of non-terrestrial returns are clouds, birds, vapor, haze, decks, brush piles, etc.

Internal calibration was refined using TerraMatch. Points from overlapping lines were tested for internal consistency and final adjustments were made for system misalignments (i.e., pitch, roll, heading offsets and scale). Automated sensor attitude and scale corrections yielded 3-5 cm improvements in the relative accuracy. Once system misalignments were corrected, vertical GPS drift was then resolved and removed per flight line, yielding a slight improvement (<1 cm) in relative accuracy.




The TerraScan software suite is designed specifically for classifying near-ground points (Soininen, 2004). The processing sequence began by 'removing' all points that were not 'near' the earth based on geometric constraints used to evaluate

multi-return points. The resulting bare earth (ground) model was visually inspected and additional ground point modeling was performed in site-specific areas to improve ground detail. This manual editing of ground often occurs in areas with known ground modeling deficiencies, such as: bedrock outcrops, cliffs, deeply incised stream banks, and dense vegetation. In some cases, automated ground point classification erroneously included known vegetation (i.e., understory, low/dense shrubs, etc.). These points were manually reclassified. Ground surface rasters were then developed from triangulated irregular networks (TINs) of ground points.

To develop the highest hit and vegetation models, buildings and structures were classified through automated point processing algorithms and then manually inspected and edited during the ground model inspection. Typically, manual editing of building classification was necessary where dense canopy was immediately proximate to buildings, or where structures such as utility poles or fences mimicked vegetation.

The remaining points not classified as ground, buildings, or error points were separated into two vegetation classes; Low Vegetation consisting of all returns ≤20cm from the ground, and Medium Vegetation consisting of all returns >20cm from the ground. This distinction was necessary because some potential for unclassified ground exists in the dataset. Vegetation classified returns within 20cm of the ground have higher potential to be artifacts of the dataset caused by minor offsets between flightlines (typically <10cm), isolated noise points, or abrupt discrete terrain features that did not get classified as ground (i.e. small boulders or sharp cliffs). The majority of points classified as low vegetation are valid returns, so the class was retained in the dataset to be incorporated into analyses at the user's discretion.

**Table 3.** ASPRS classification definitions for the Alaska Pipeline LiDAR survey

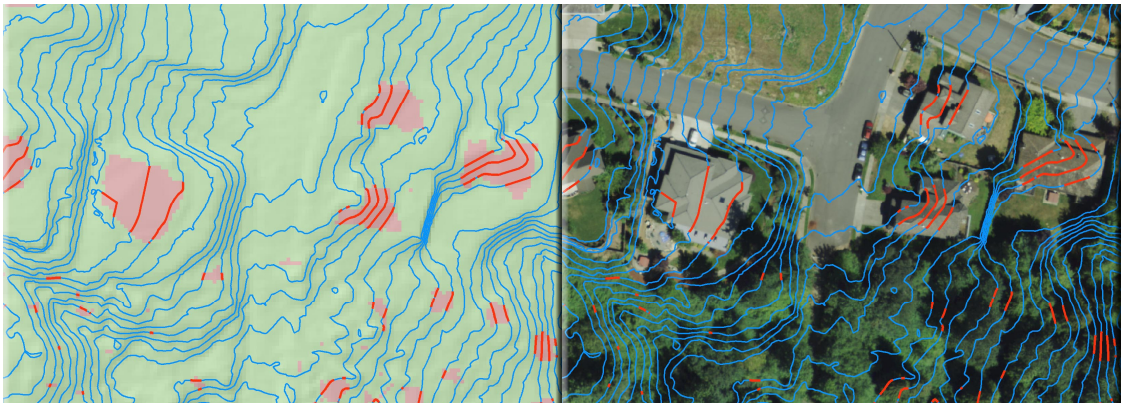
| ASPRS Class | Definition |
|---|---|
| 2 | Ground |
| 3 | Low Vegetation |
| 4 | Medium Vegetation |
| 6 | Buildings/Man-made structures |
| 7 | Noise/error points |
| 9 | Water |
| 15 | Pipeline |

## 3.4 Contour Development

Contour lines were derived at 1 meter intervals from ground-classified LiDAR point data using TerraSolid processing software in MicroStation v. 8.1. Contour generation from LiDAR point data requires a thinning operation in order to reduce contour sinuosity. Parameters for these operations are: thinning elevation bounds: +/- 0.07m; search radius: 6.09m. The thinning operation reduces point density where topographic change is minimal (flat surfaces) while preserving resolution where topographic change is present. The total sum of potential error in vertical position is equal to twice the point processing limits (0.14m) plus twice the 2-sigma absolute vertical accuracy value for this dataset.

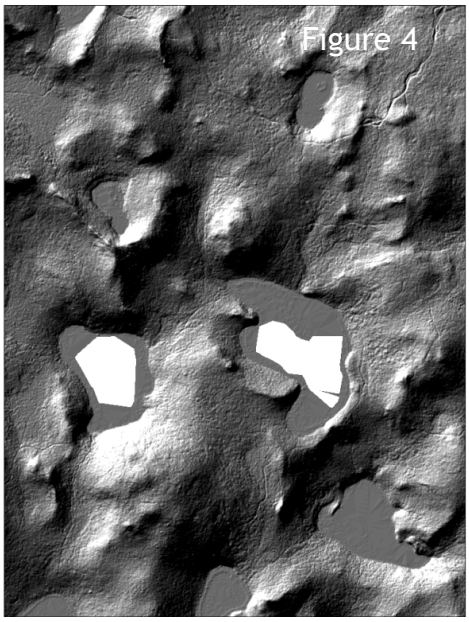
Ground point density rasters were created within MicroStation using a 1 meter step resolution and a 2 meter sampling radius. Areas with less than 0.25 ground-classified points per square meter were considered "sparse" and areas with higher densities were considered "covered". The ground point density raster data are in ESRI GRID format and have a 1 meter pixel resolution. The contour lines were intersected with ground point density raster data, allowing the addition of a confidence attribute to contour lines. Contour lines over "sparse" areas have low confidence, while contour lines over "covered" areas have a high confidence. Areas with low ground point density are commonly beneath buildings and bridges, in locations with dense vegetation, over water, and in other areas where laser penetration to the ground surface is impeded. **Figure 3** is an example of a ground point density raster and contour lines.

***Figure 3**. Elevation contours over LiDAR ground-classified point density raster (left) and true-color aerial photograph (right). Red indicates low ground point density and blue represents high density.*

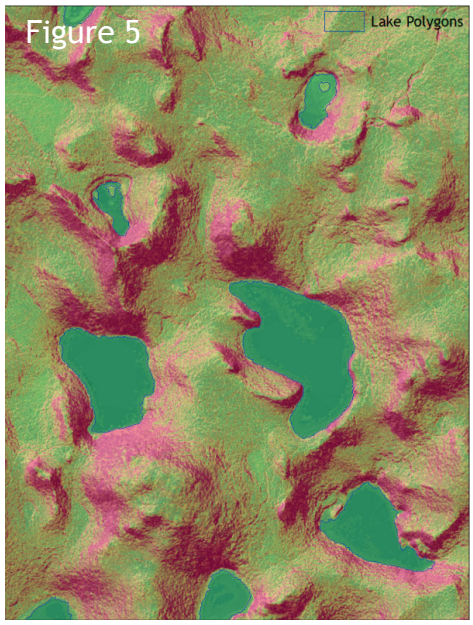


## 3.5 Hydro-Flattening

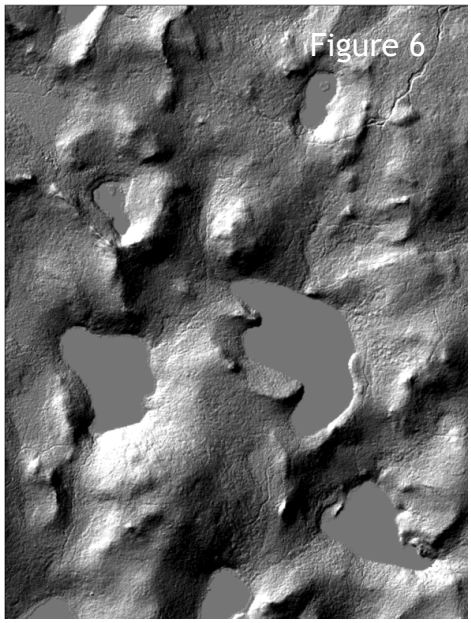
Lakes and other closed water bodies with surface area >150 $m^2$ were flattened to a consistent water level. The hydro-flattening process eliminates artifacts in the digital terrain model caused by both increased variability in ranges or dropouts in laser returns due to the low reflectivity of water (**Figure 4**). As per the project specifications, rivers and streams were not hydro-flattened.




Hydro-flattening of closed water bodies was performed through a combination of automated and manual detection and adjustment techniques designed to identify lake boundaries and water levels. Boundary polygons were developed using an algorithm which weights LiDAR-derived slopes, intensities, and return densities to detect the lake edge. The lake edges were then manually reviewed and edited in a 3-D environment. Once polygons were developed, the lake elevations were computed from the filtered LiDAR returns (**Figure 5**).




Returns from the water surface within each polygon were filtered and inspected for false low points during the initial ground modeling process described previously (Section 3.3). The elevation of each lake was computed as 5-cm above the minimum elevation of filtered water surface cells within the lake polygon. This approach ensures that all spurious returns off the water surface (both artificially high and low) were excluded from lake level assessment.




Lake-boundary polygons were then incorporated into the final terrain model and enforced as hard-breaklines. The initial ground classified points falling within lake polygons were reclassified as water points [to omit them from the final ground model] and replaced with the flat water surface of the lake boundary hydrolines (**Figure 6**).

# 4. LiDAR Accuracy Assessment

## 4.1 Laser Noise and Relative Accuracy

*Laser Noise*
For any given target, laser noise is the breadth of the data cloud per laser return (i.e., last, first, etc.). Lower intensity surfaces (roads, rooftops, still/calm water) experience higher laser noise. The laser noise range for this survey was approximately 0.02 meters.

*Relative Accuracy*
Relative accuracy refers to the internal consistency of the data set - the ability to place a laser point in the same location over multiple flight lines, GPS conditions, and aircraft attitudes. Affected by system attitude offsets, scale, and GPS/IMU drift, internal consistency is measured as the divergence between points from different flight lines within an overlapping area. Divergence is most apparent when flight lines are opposing. When the LiDAR system is well calibrated, the line-to-line divergence is low (<10 cm). See Appendix A for further information on sources of error and operational measures that can be taken to improve relative accuracy.

**Relative Accuracy Calibration Methodology**

1. Manual System Calibration: Calibration procedures for each mission require solving geometric relationships that relate measured swath-to-swath deviations to misalignments of system attitude parameters. Corrected scale, pitch, roll and heading offsets were calculated and applied to resolve misalignments. The raw divergence between lines was computed after the manual calibration was completed and reported for each survey area.
2. Automated Attitude Calibration: All data were tested and calibrated using TerraMatch automated sampling routines. Ground points were classified for each individual flight line and used for line-to-line testing. System misalignment offsets (pitch, roll and heading) and scale were solved for each individual mission and applied to respective mission datasets. The data from each mission were then blended when imported together to form the entire area of interest.
3. Automated Z Calibration: Ground points per line were used to calculate the vertical divergence between lines caused by vertical GPS drift. Automated Z calibration was the final step employed for relative accuracy calibration.

## 4.2 Absolute Accuracy

Laser point absolute accuracy is largely a function of laser noise and relative accuracy. To minimize these contributions to absolute error, a number of noise filtering and calibration procedures were performed prior to evaluating absolute accuracy. The LiDAR quality assurance process uses the data from the real-time kinematic (RTK) ground survey conducted in the AOI. For Delivery 2, **2512 RTK** GPS measurements were collected on hard surfaces distributed among multiple flight swaths for a total of 4550 points across all delivered data. Suitable and accessible hard-surfaces limited the number of RTK points able to be collected. To assess absolute accuracy the location coordinates of these known RTK ground points were compared to those calculated for the closest ground-classified laser points.

The vertical accuracy of the LiDAR data is described as the mean and standard deviation (sigma ~ $\sigma$) of divergence between LiDAR point coordinates and RTK ground survey point coordinates. To provide a sense of the model predictive power of the dataset, the root mean square error (RMSE) for vertical accuracy is also provided. These statistics assume the error distributions for x, y, and z are normally distributed, thus the skew and kurtosis of distributions are considered when evaluating error statistics.

Statements of statistical accuracy apply to fixed terrestrial surfaces only and may not be applied to areas of dense vegetation or steep terrain (See Appendix A).

# 5. Study Area Results

Summary statistics for point resolution and accuracy (relative and absolute) of the LiDAR data collected in the Alaska Delivery 2 survey area have been added to previously delivered data. Cumulative results are presented below in terms of central tendency, variation around the mean, and the spatial distribution of the data (for point resolution by processing bin).

The initial dataset, acquired to be ≥8 points per square meter, was filtered as described previously to remove spurious or inaccurate points. Additionally, some types of surfaces (i.e., dense vegetation, breaks in terrain, water, steep slopes) may return fewer pulses (delivered density) than the laser originally emitted (native density).

Ground classifications were derived from automated ground surface modeling and manual, supervised classifications where it was determined that the automated model had failed. Ground return densities will be lower in areas of dense vegetation, water, or buildings.

## Data Summary:

***Table 4****. LiDAR Resolution and Accuracy - Specifications and Achieved Values*

| | | Targeted | Achieved |
|---|---|---|---|
| **Resolution:** | **UTM 6** | ≥ 8 points/$m^2$ | 8.97 points/$m^2$ |
| | **UTM 7** | | 8.91 points/$m^2$ |
| **Vertical Accuracy (1 σ):** | | <13 cm | 3.0 cm |

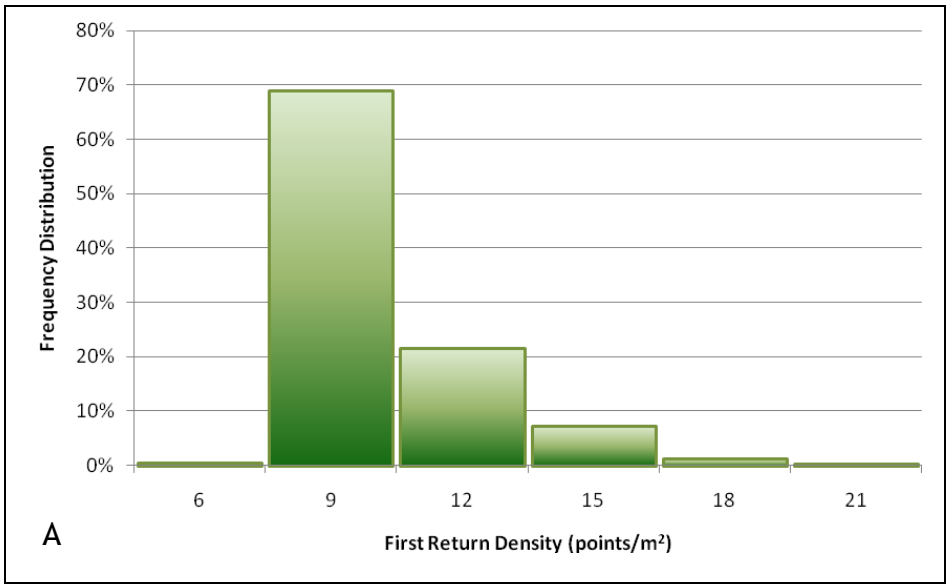
## 5.1 Data Density/Resolution

**Figures 9 - 12** display the distribution of average native and ground point densities for each processing bin. Density data will continue to be updated as data is processed and delivered.

LiDAR data resolution for Alaska Pipeline deliveries to date:

| | UTM 6 | UTM 7 |
|---|---|---|
| Average Point (First Return) Density | 8.97 points/$m^2$ | 8.91 points/$m^2$ |
| Average Ground Point Density | 2.71 points/$m^2$ | 2.99 points/$m^2$ |

***Figure 7***. *Density distribution for first return laser points for UTM 6 (A) and UTM 7 (B)*



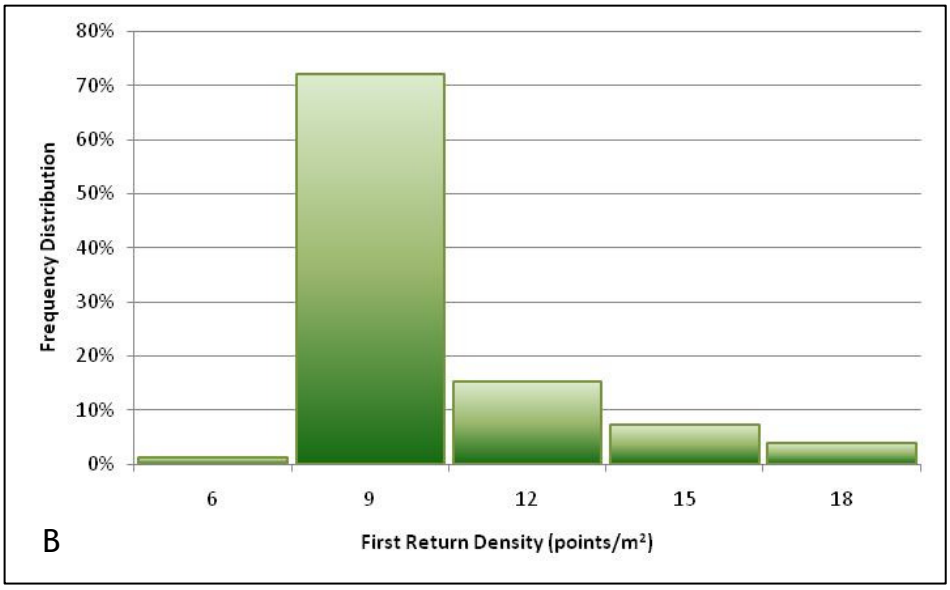



***Figure 8**. Density distribution for ground classified laser points for UTM 6 (A) and UTM 7 (B)*

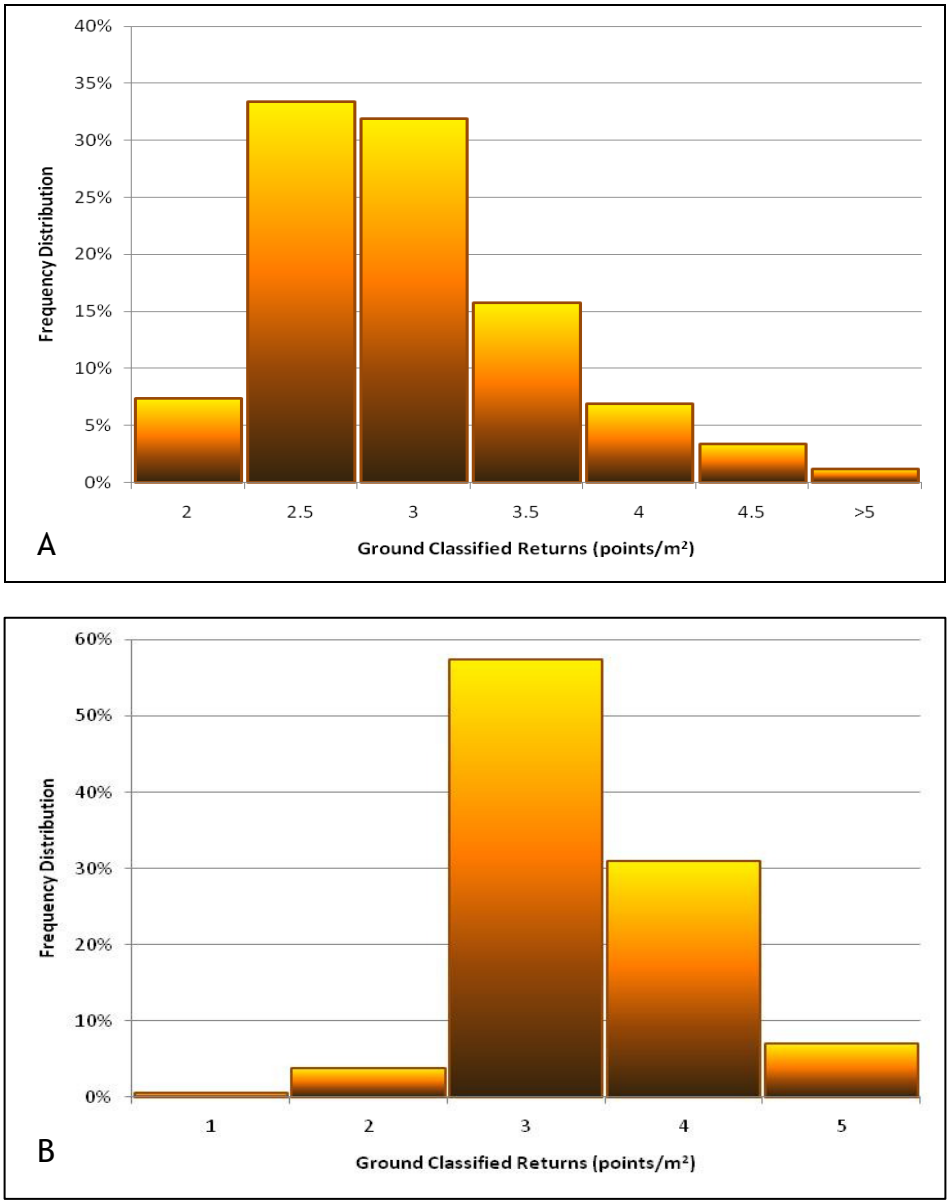


***Figure 9.*** *Density distribution map for ground and first return points by processing bin in Delivery 1, UTM 6*



***Figure 10***. *Density distribution map for ground and first return points by processing bin in Delivery 1, UTM 7*

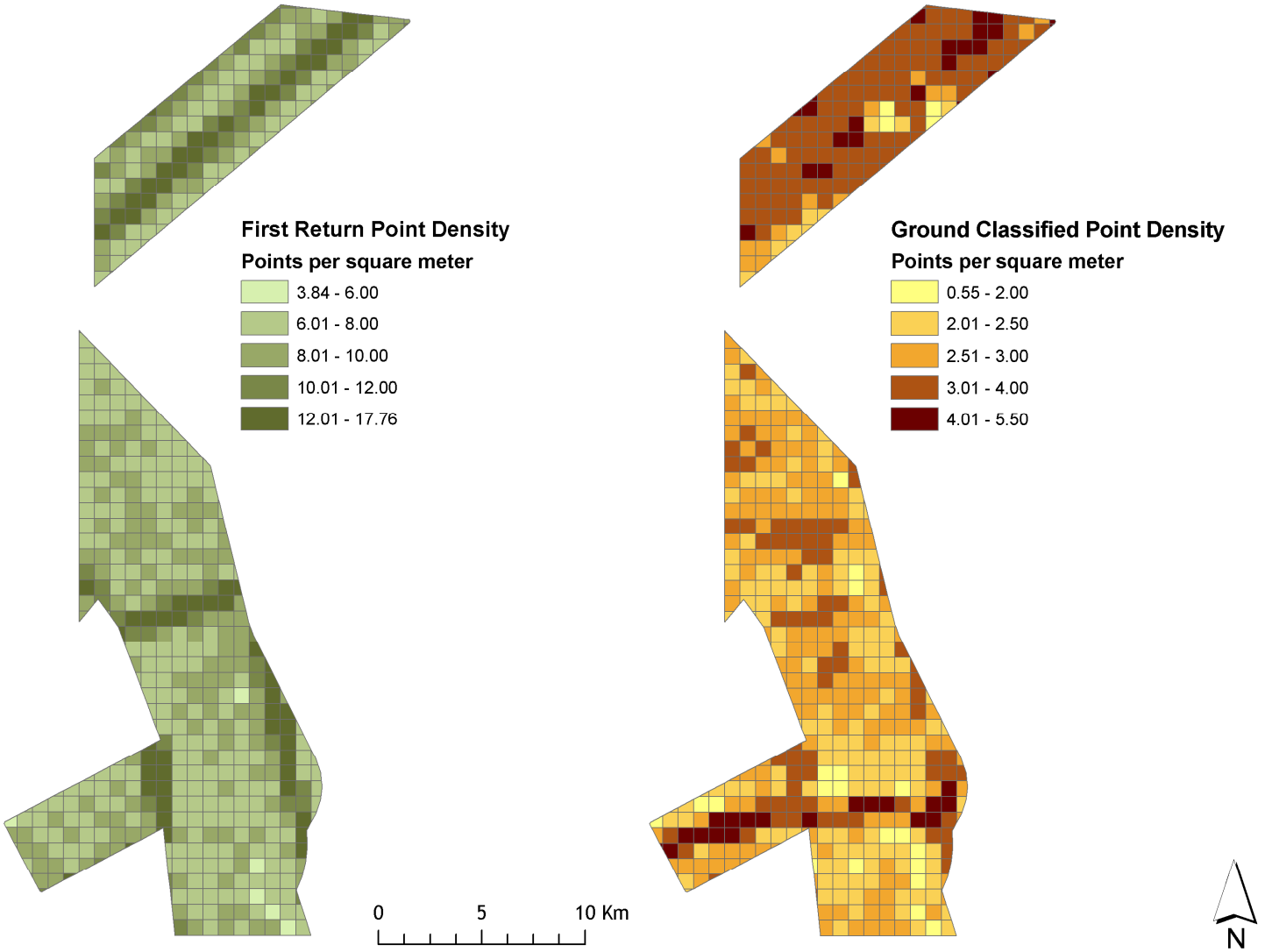


***Figure 11.*** *Density distribution map for ground points by processing bin in Delivery 2, UTM 6*

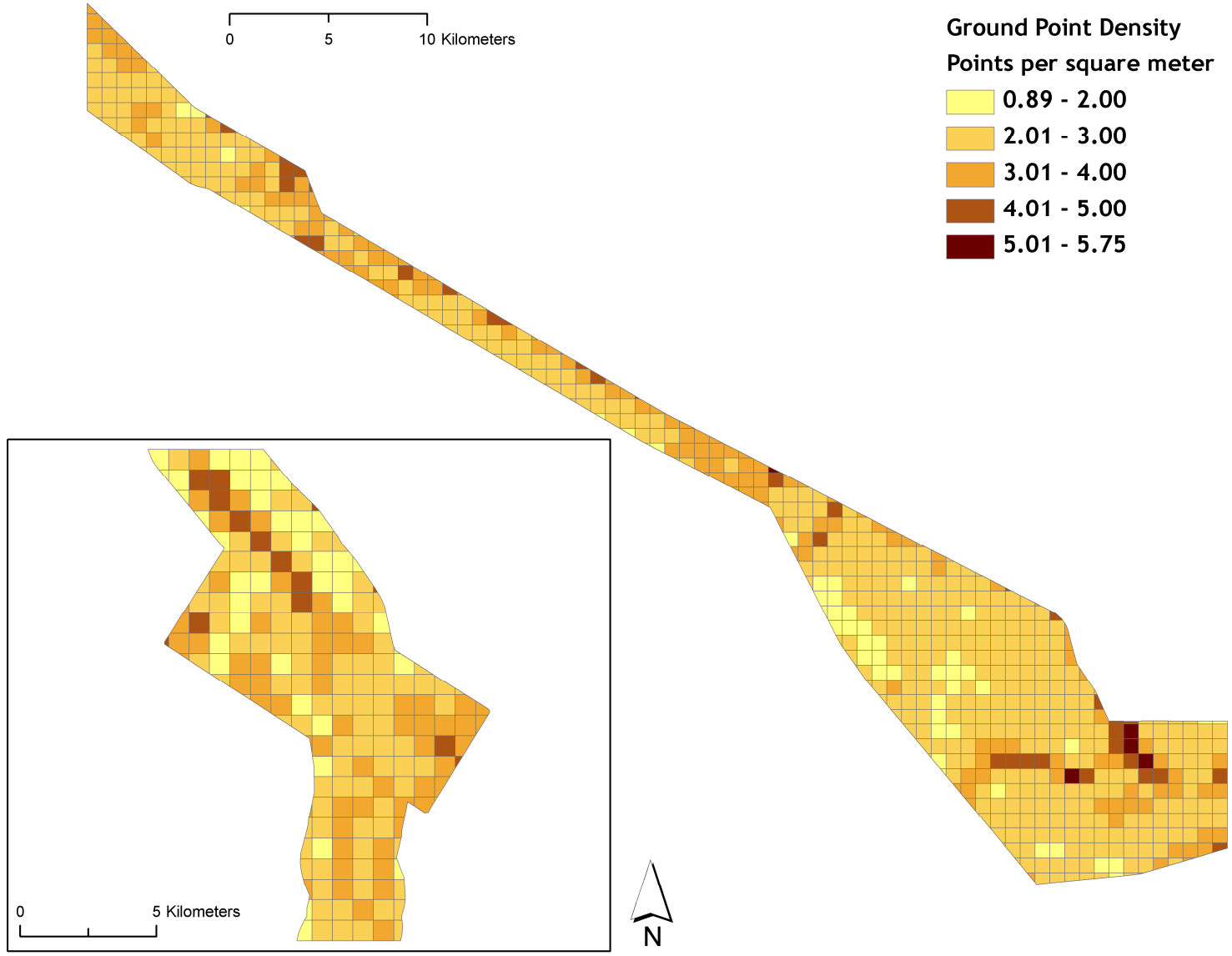
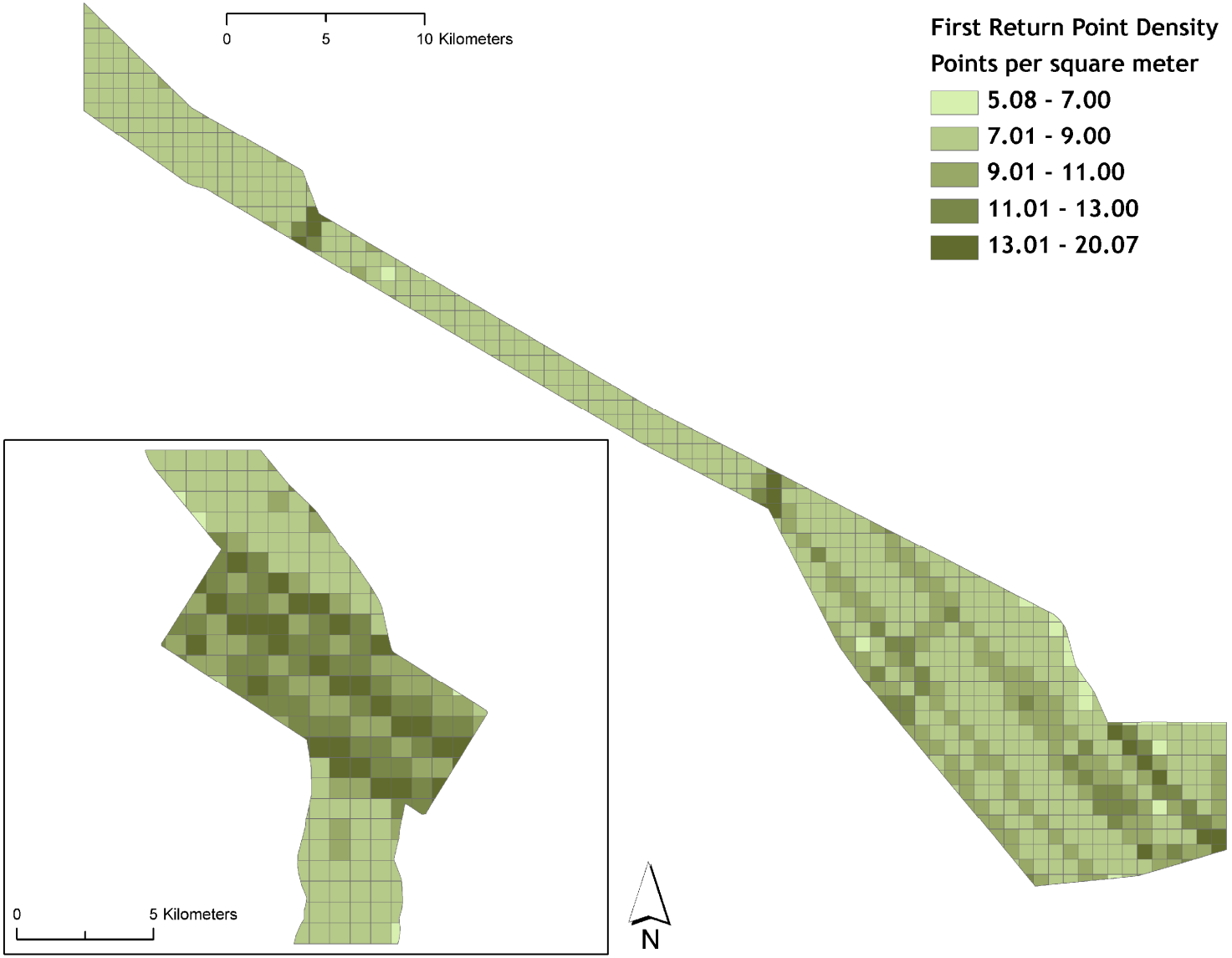


***Figure 12**. Density distribution map for first return points by processing bin in Delivery 2, UTM 6*

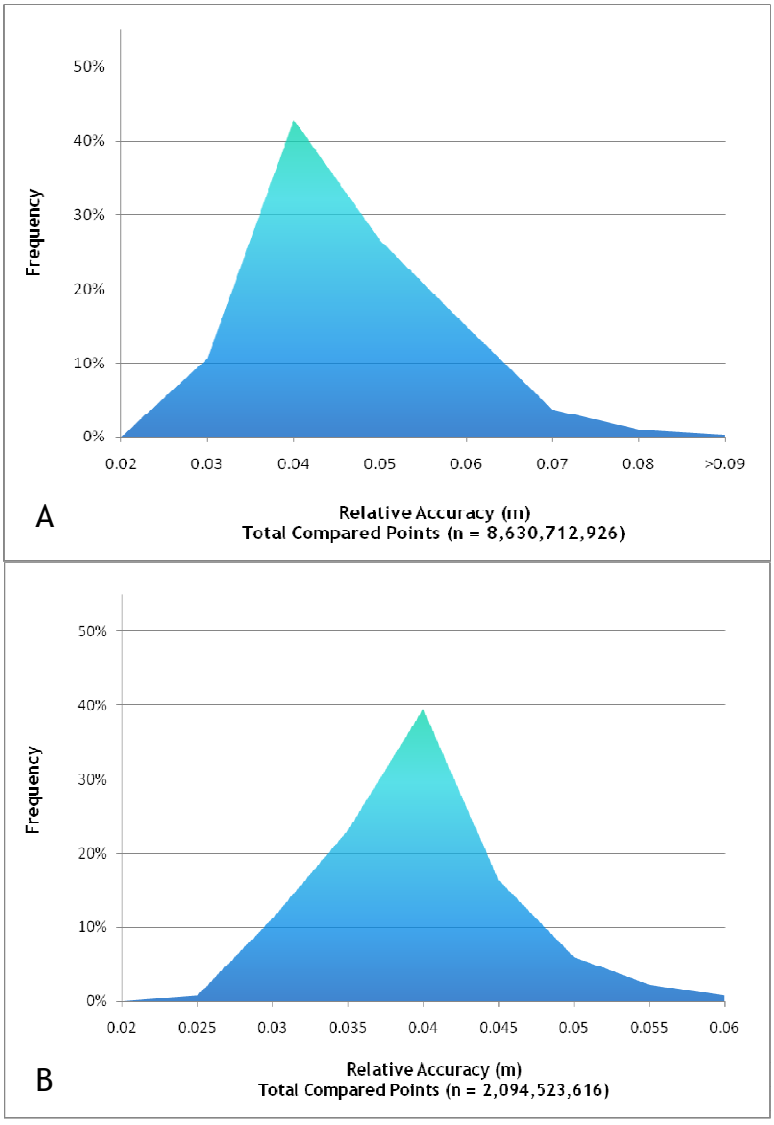


## 5.2 Relative Accuracy Calibration Results

***Table 5**. Cumulative relative accuracy statistics for Alaska Pipeline deliveries to date.*

| | UTM 6 | UTM 7 |
|---|---|---|
| Project Average | 0.041m | 0.037m |
| Median Relative Accuracy | 0.039m | 0.037m |
| 1σ Relative Accuracy | 0.010m | 0.006m |
| 1.96σ Relative Accuracy | 0.020m | 0.011m |

***Figure 13**. Distribution of cumulative relative accuracies in UTM 6 (A) and 7 (B) per flight line, non slope-adjusted*



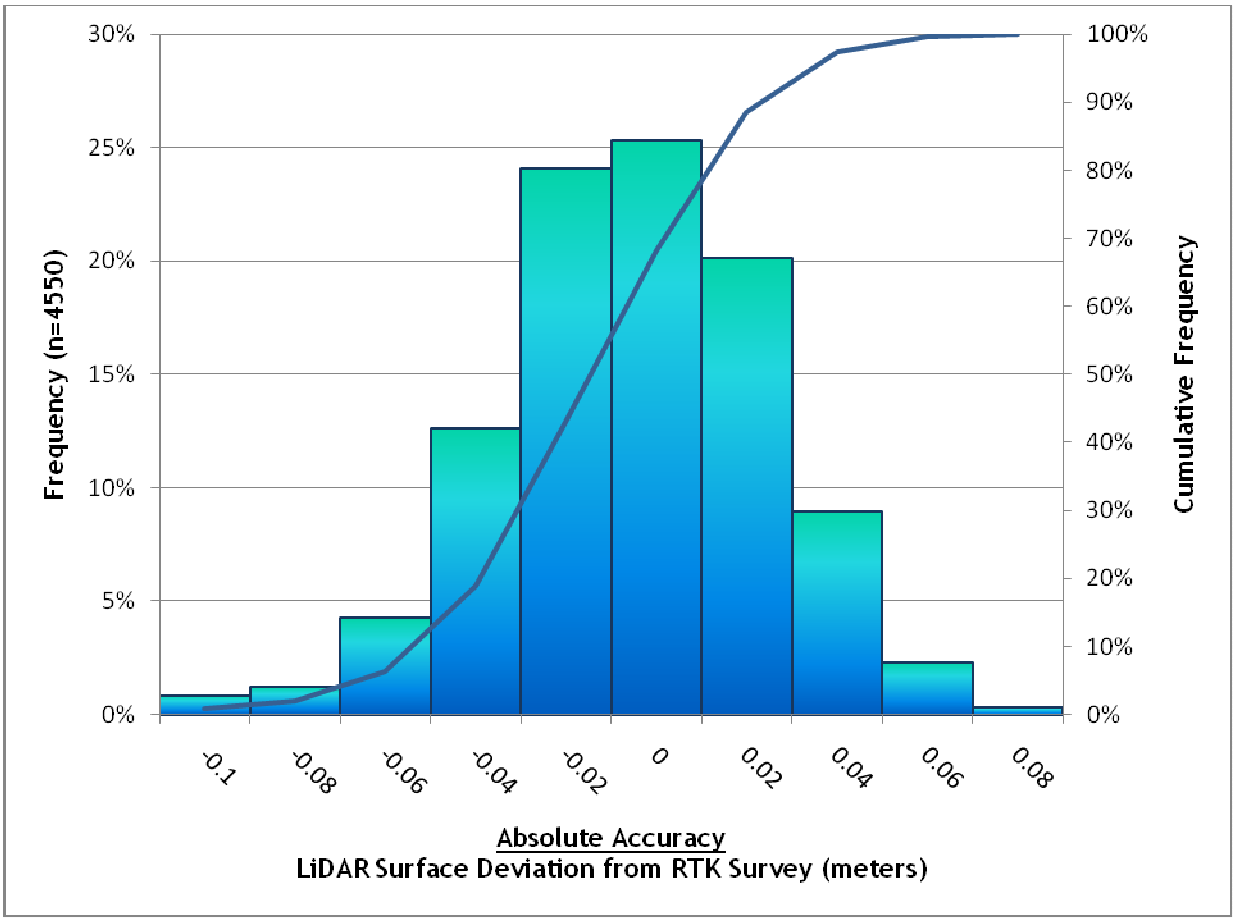
## 5.3 Absolute Accuracy

Absolute accuracies for Alaska Pipeline deliveries to date: All data was calibrated and processed in UTM 6 and then transformed to the appropriate projection.

***Table 6**. Absolute Accuracy - Deviation between laser points and RTK hard surface survey points*

| RTK Survey Sample Size (n): 4550 | |
|---|---|
| Root Mean Square Error (RMSE): 0.033m | Minimum Δz = -0.151m |
| Standard Deviations<br>1 sigma (σ): 0.030m 1.96 sigma (σ): 0.059m | Maximum Δz = 0.080m |
| | Average Δz = -0.014m |

***Figure 14**. Absolute Accuracy - Histogram Statistics*



## 5.4 Independent Accuracy Assessment

In accordance with the project plan, McClintock Land Associates (AK PLS) collected independent (i.e. blind) check points within the survey area to provide an independent assessment of LiDAR accuracy. WSI was provided with Easting and Northing positions for points which were then assigned elevations from the LiDAR. MLA received this report and compared the LiDAR Z values to MLA's surveyed (or known) Z values.

***Table 7**. Absolute accuracy determined by the project surveyor (MLA) using "Blind" Check Points (See Appendix B for PLS report)*

| Delivery | # of Check Points | RMSE | Range |
|---|---|---|---|
| 1 | 735 | 0.062m | 0.240m |
| 2 | 1096 | 0.035m | 0.204m |

## 7. Projection/Datum and Units

| | | |
|---|---|---|
| | **Projection:** | UTM Zone 5, 6, 7 North |
| **Datum** | **Vertical:** | NAVD88 Geoid09 |
| | **Horizontal:** | NAD83 |
| | **Units:** | meters |

## 8. Deliverables

| | |
|---|---|
| **Point Data:** | • All Returns (LAS 1.2 format)<br>• Ground Returns (LAS 1.2 format) |
| **Vector Data:** | • Project Boundary (shapefile format)<br>• Tile Index for LiDAR Points (shapefile format)<br>• Tile Index for DEMs (shapefile format)<br>• Contours (1m shapefile format, DXF format)<br>• RTK (shapefile format, .TXT format)<br>• SBETs (shapefile format, DBF format)<br>• Lake Boundaries (shapefile format) |
| **Raster Data:** | • Elevation Models (1m resolution)<br>  • Hydro-flattened Bare Earth Model (ESRI GRID format)<br>  • Highest Hit Model (ESRI GRID format)<br>  • Vegetation Model (ESRI GRID format)<br>  • nDSM Model (ESRI GRID format)<br>• Intensity Images (GeoTIFF format, 0.5m resolution)<br>• Vegetation Metrics (5m resolution)<br>  • Canopy Cover (ESRI GRID format)<br>  • Coefficient of Variation (ESRI GRID format)<br>  • Mean Elevation (ESRI GRID format) |
| **Data Report:** | • Full report containing introduction, methodology, and accuracy |

# 9. Selected Images

***Figure 15**. View across braided channels of the Tanana River near Dot Lake. Top image is Bare Earth model. Bottom image is LiDAR point cloud colored by elevation.*

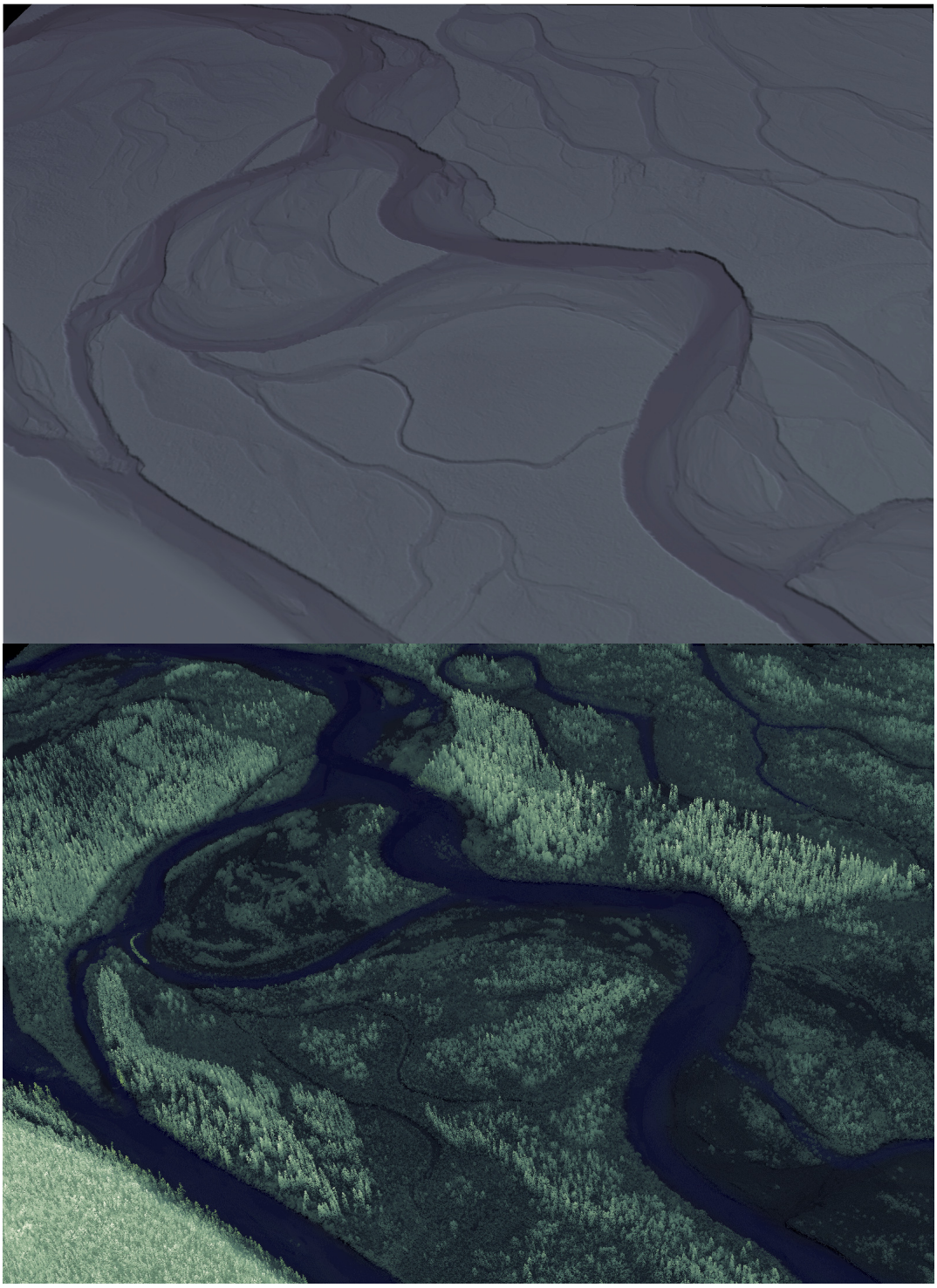


***Figure 16**. View looking west at hydro-flattened pond south of T Lake in the Bare Earth model.*

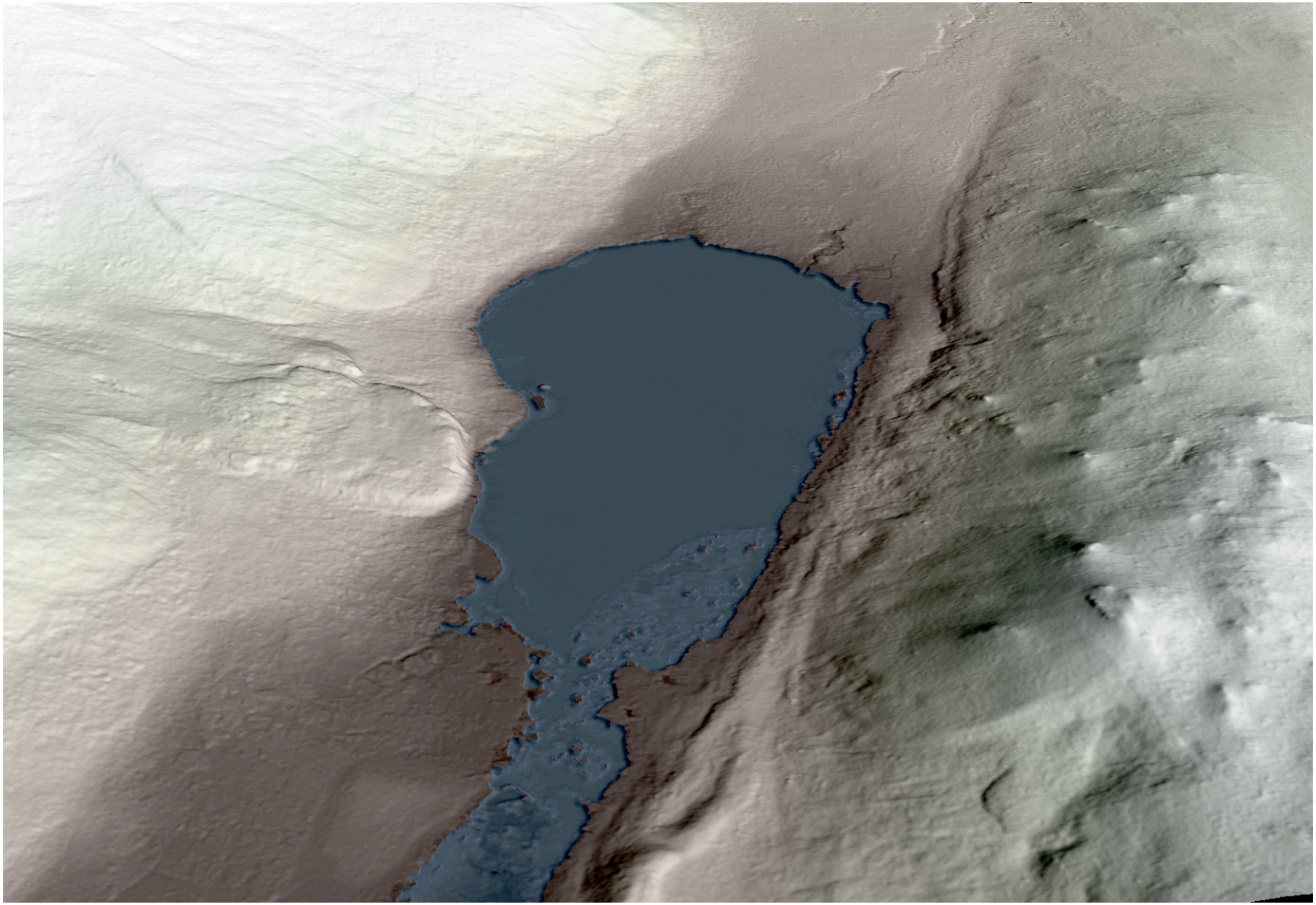


***Figure 17****. View looking north across Gerstle River along A2. Image is 3D LiDAR point cloud colored by elevation.*

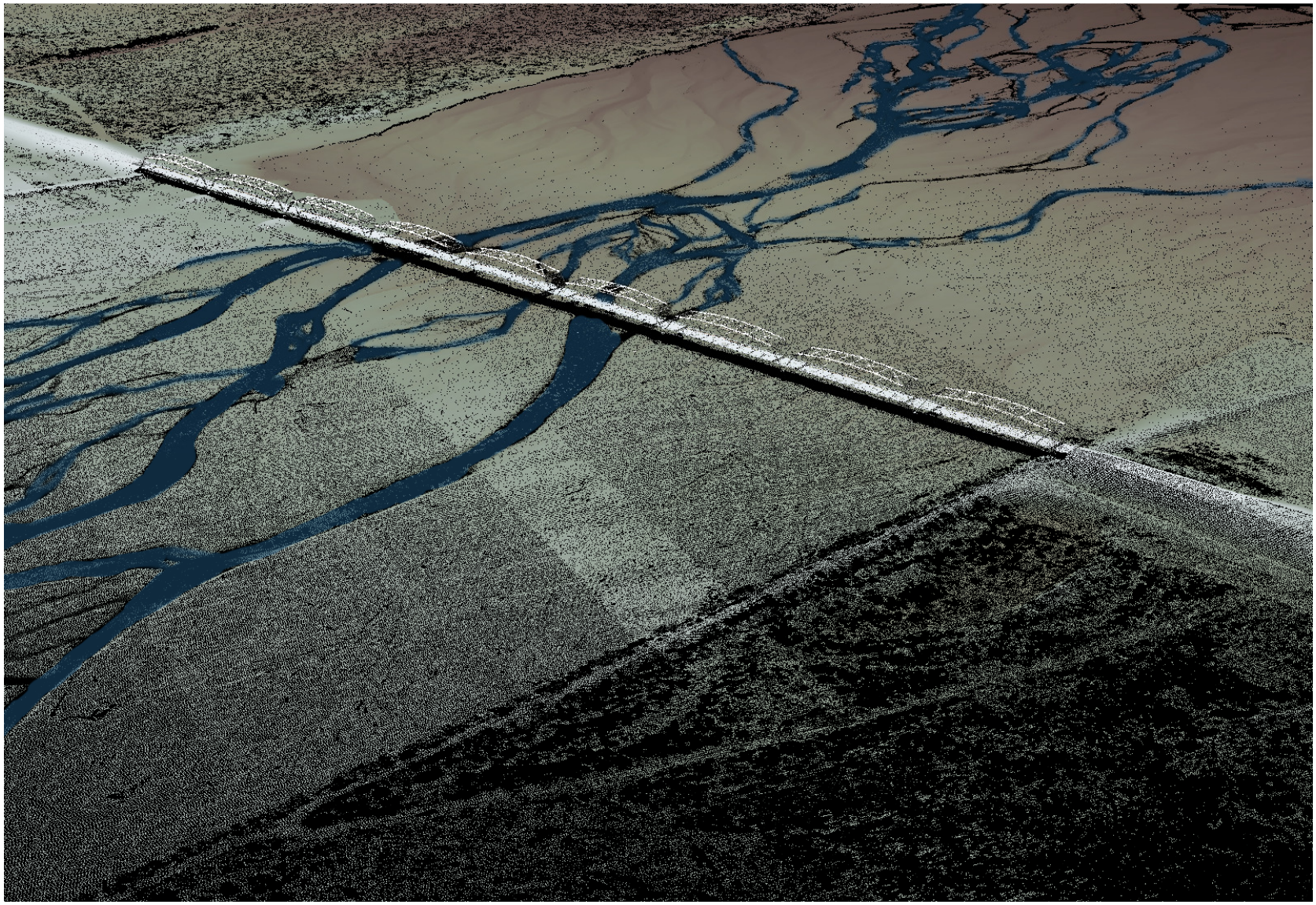


***Figure 18**. Northern end of above ground pipeline near Trims Camp along Hwy 4.*

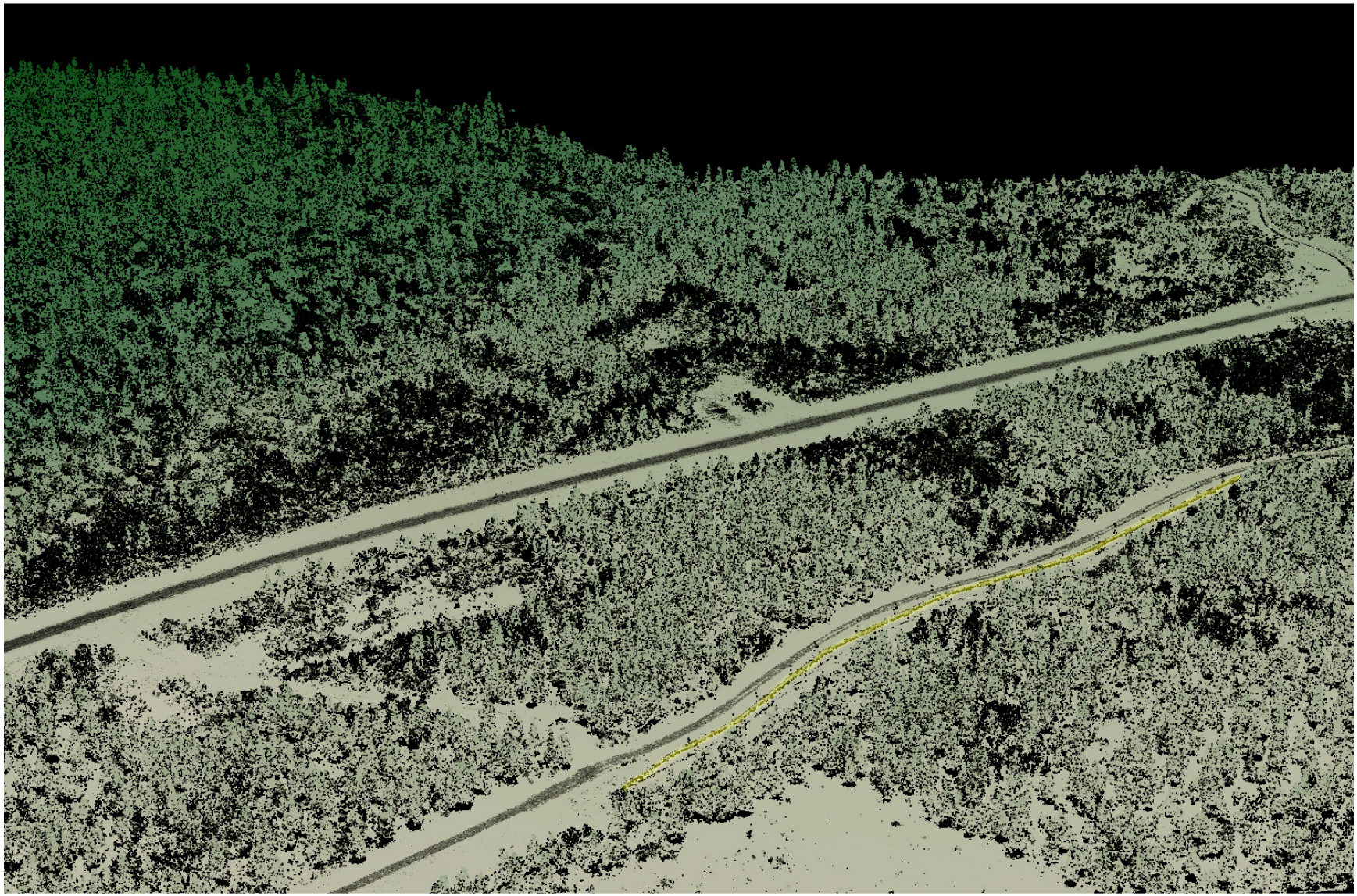
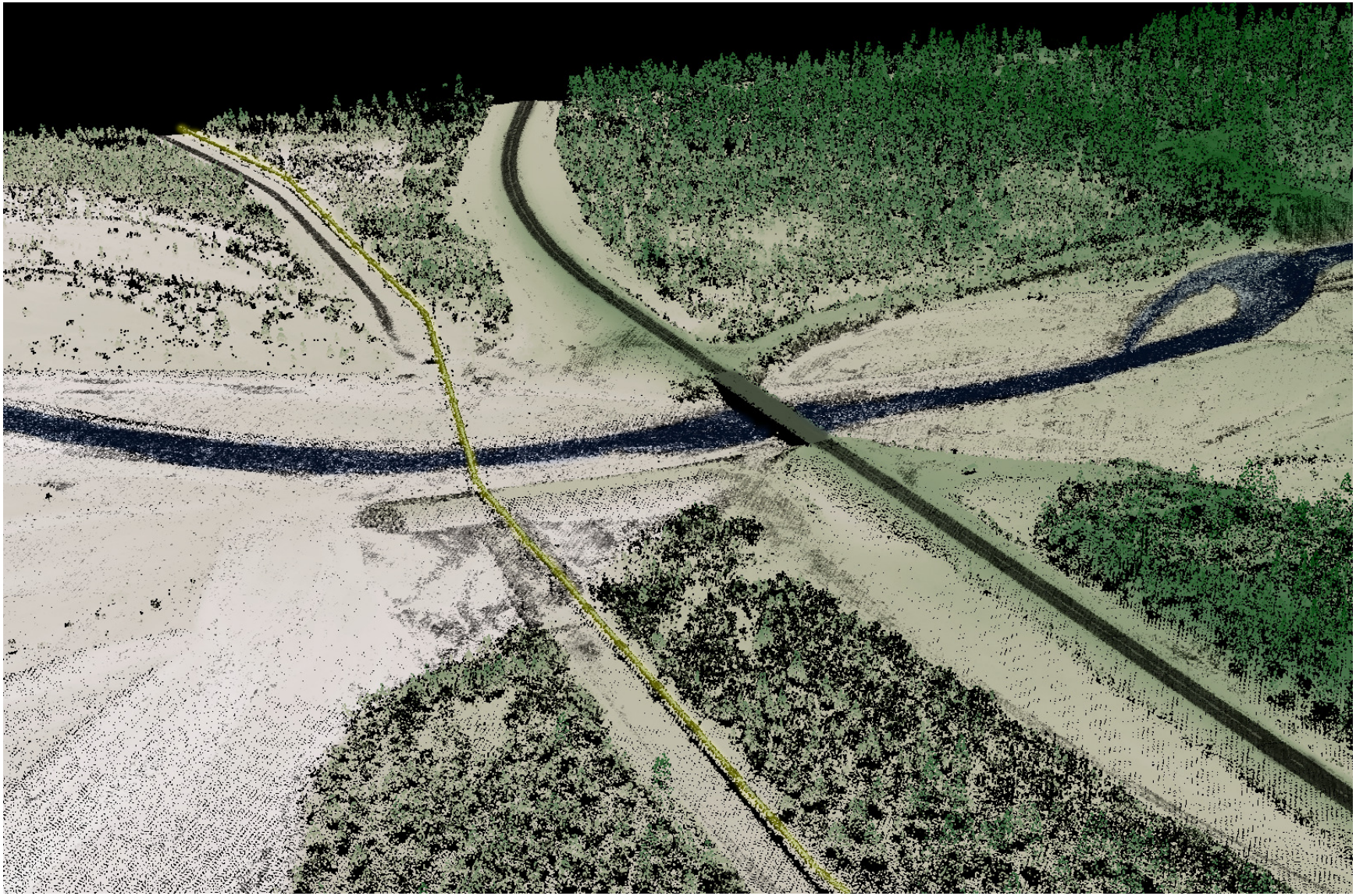


***Figure 19**. View looking North of Pipeline and Hwy 4 as they cross Miller Creek.*



# 10. Glossary

**1-sigma (σ) Absolute Deviation:** Value for which the data are within one standard deviation (approximately 68$^{th}$ percentile) of a normally distributed data set.

**1.96-sigma (σ) Absolute Deviation:** Value for which the data are within two standard deviations (approximately 95$^{th}$ percentile) of a normally distributed data set.

**Root Mean Square Error (RMSE):** A statistic used to approximate the difference between real-world points and the LiDAR points. It is calculated by squaring all the values, then taking the average of the squares and taking the square root of the average.

**Pulse Rate (PR)**: The rate at which laser pulses are emitted from the sensor; typically measured as thousands of pulses per second (kHz).

**Pulse Returns**: For every laser pulse emitted, the Leica ALS 50 Phase II system can record *up to four* wave forms reflected back to the sensor. Portions of the wave form that return earliest are the highest element in multi-tiered surfaces such as vegetation. Portions of the wave form that return last are the lowest element in multi-tiered surfaces.

**Accuracy**: The statistical comparison between known (surveyed) points and laser points. Typically measured as the standard deviation (sigma, σ) and root mean square error (RMSE).

**Intensity Values**: The peak power ratio of the laser return to the emitted laser. It is a function of surface reflectivity.

**Data Density**: A common measure of LiDAR resolution, measured as points per square meter.

**Spot Spacing**: Also a measure of LiDAR resolution, measured as the average distance between laser points.

**Nadir**: A single point or locus of points on the surface of the earth directly below a sensor as it progresses along its flight line.

**Scan Angle**: The angle from nadir to the edge of the scan, measured in degrees. Laser point accuracy typically decreases as scan angles increase.

**Overlap**: The area shared between flight lines, typically measured in percents; 100% overlap is essential to ensure complete coverage and reduce laser shadows.

**DTM / DEM**: These often-interchanged terms refer to models made from laser points. The digital elevation model (DEM) refers to all surfaces, including bare ground and vegetation, while the digital terrain model (DTM) refers only to those points classified as ground.

**Real-Time Kinematic (RTK) Survey**: GPS surveying is conducted with a GPS base station deployed over a known monument with a radio connection to a GPS rover. Both the base station and rover receive differential GPS data and the baseline correction is solved between the two. This type of ground survey is accurate to 1.5 cm or less.

# 11. Citations

Soininen, A. 2004. TerraScan User's Guide. TerraSolid.

# Appendix A

**LiDAR accuracy error sources and solutions:**

| Type of Error | Source | Post Processing Solution |
|---|---|---|
| GPS (Static/Kinematic) | Long Base Lines | None |
| | Poor Satellite Constellation | None |
| | Poor Antenna Visibility | Reduce Visibility Mask |
| Relative Accuracy | Poor System Calibration | Recalibrate IMU and sensor offsets/settings |
| | Inaccurate System | None |
| Laser Noise | Poor Laser Timing | None |
| | Poor Laser Reception | None |
| | Poor Laser Power | None |
| | Irregular Laser Shape | None |

**Operational measures taken to improve relative accuracy:**

1. Low Flight Altitude: Terrain following is employed to maintain a constant above ground level (AGL). Laser horizontal errors are a function of flight altitude above ground (i.e., ~ 1/3000$^{th}$ AGL flight altitude).
2. Focus Laser Power at narrow beam footprint: A laser return must be received by the system above a power threshold to accurately record a measurement. The strength of the laser return is a function of laser emission power, laser footprint, flight altitude and the reflectivity of the target. While surface reflectivity cannot be controlled, laser power can be increased and low flight altitudes can be maintained.
3. Reduced Scan Angle: Edge-of-scan data can become inaccurate. The scan angle was reduced to a maximum of ±15$^{o}$ from nadir, creating a narrow swath width and greatly reducing laser shadows from trees and buildings.
4. Quality GPS: Flights took place during optimal GPS conditions (e.g., 6 or more satellites and PDOP [Position Dilution of Precision] less than 3.0). Before each flight, the PDOP was determined for the survey day. During all flight times, a dual frequency DGPS base station recording at 1-second epochs was utilized and a maximum baseline length between the aircraft and the control points was less than 19 km (11.5 miles) at all times.
5. Ground Survey: Ground survey point accuracy (i.e. <1.5 cm RMSE) occurs during optimal PDOP ranges and targets a minimal baseline distance of 4 miles between GPS rover and base. Robust statistics are, in part, a function of sample size (n) and distribution. Ground survey RTK points are distributed to the extent possible throughout multiple flight lines and across the survey area.
6. 50% Side-Lap (100% Overlap): Overlapping areas are optimized for relative accuracy testing. Laser shadowing is minimized to help increase target acquisition from multiple scan angles. Ideally, with a 50% side-lap, the most nadir portion of one flight line coincides with the edge (least nadir) portion of overlapping flight lines. A minimum of 50% side-lap with terrain-followed acquisition prevents data gaps.
7. Opposing Flight Lines: All overlapping flight lines are opposing. Pitch, roll and heading errors are amplified by a factor of two relative to the adjacent flight line(s), making misalignments easier to detect and resolve.

# Appendix B

# Alaska Gasline LiDAR Project
# Delivery 2 - All Points

*Watershed Sciences, Inc.*
*McClintock Land Associates, Inc.*

QUALITY CONTROL REVIEW SUMMARY

| | | |
|---|---|---|
| Max. Positive Elev. Deviation: | 0.140 | meters |
| Max. Negative Elev. Deviation: | -0.096 | meters |
| Elevation Deviation Range: | 0.236 | meters |
| Elevation Deviation Mean: | 0.019 | meters |
| Elevation Deviation RMSE | 0.035 | meters |

(RMSE = Root Mean Square Error)

| | | |
|---|---|---|
| Number of Check Points Used: | 1098 | |
| Number of Check Points Excluded | 0 | See note below |
| Total Number of Check Points: | 1098 | |

Note: No points were excluded from this check.

| CHECK POINTS | | | SURVEYED Elevation | LiDAR Elevation | Deviation | Include? (yes = 1) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | (Meters) | (Meters) | (no = 0) |
| 123 | 7092806.079 | 576716.539 | 381.260 | 381.250 | 0.010 | 1 |
| 124 | 7072476.157 | 613572.042 | 414.145 | 414.190 | -0.045 | 1 |
| 223 | 7091069.363 | 579744.362 | 379.297 | 379.310 | -0.013 | 1 |
| 324 | 7080033.607 | 599248.58 | 417.528 | 417.540 | -0.012 | 1 |
| 23001 | 7091056.401 | 579726.702 | 380.351 | 380.390 | -0.039 | 1 |
| 23002 | 7091049.302 | 579746.375 | 380.263 | 380.290 | -0.027 | 1 |
| 23003 | 7091038.919 | 579763.825 | 380.177 | 380.190 | -0.013 | 1 |
| 23004 | 7091031.064 | 579777.48 | 380.092 | 380.140 | -0.048 | 1 |
| 23005 | 7091023.494 | 579790.272 | 380.035 | 380.080 | -0.045 | 1 |
| 23006 | 7091015.955 | 579803.162 | 379.998 | 380.030 | -0.032 | 1 |
| 23007 | 7091033.74 | 579815.123 | 378.676 | 378.690 | -0.014 | 1 |
| 23008 | 7091050.519 | 579825.244 | 378.424 | 378.520 | -0.096 | 1 |
| 23009 | 7091007.293 | 579817.321 | 379.909 | 379.950 | -0.041 | 1 |
| 23010 | 7090998.187 | 579833.176 | 379.838 | 379.870 | -0.032 | 1 |
| 23011 | 7090988.952 | 579849.617 | 379.735 | 379.770 | -0.035 | 1 |
| 23012 | 7090978.074 | 579867.502 | 379.586 | 379.610 | -0.024 | 1 |
| 23013 | 7090964.32 | 579890.349 | 379.422 | 379.450 | -0.028 | 1 |
| 23014 | 7090963.152 | 579889.585 | 379.448 | 379.480 | -0.032 | 1 |
| 23015 | 7090961.278 | 579888.562 | 379.412 | 379.430 | -0.018 | 1 |
| 23016 | 7090973.491 | 579867.784 | 379.548 | 379.600 | -0.052 | 1 |
| 23017 | 7090980.56 | 579856.144 | 379.647 | 379.690 | -0.043 | 1 |
| 23018 | 7090987.987 | 579843.422 | 379.736 | 379.790 | -0.054 | 1 |
| 23019 | 7090998.48 | 579825.524 | 379.855 | 379.890 | -0.035 | 1 |
| 23020 | 7091010.905 | 579804.302 | 379.982 | 380.010 | -0.028 | 1 |
| 23021 | 7091012.604 | 579804.961 | 380.012 | 380.040 | -0.028 | 1 |
| 23022 | 7091022.685 | 579783.661 | 380.065 | 380.090 | -0.025 | 1 |
| 23023 | 7091030.703 | 579770.309 | 380.117 | 380.160 | -0.043 | 1 |
| 23024 | 7091042.337 | 579751.12 | 380.202 | 380.250 | -0.048 | 1 |
| 23025 | 7091053.746 | 579731.704 | 380.317 | 380.380 | -0.063 | 1 |
| 23026 | 7091055.05 | 579732.337 | 380.352 | 380.400 | -0.048 | 1 |
| 23027 | 7090877.252 | 580033.231 | 379.068 | 379.100 | -0.032 | 1 |
| 23028 | 7090868.49 | 580028.96 | 378.989 | 379.010 | -0.021 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 23029 | 7090854.061 | 580016.875 | 378.560 | 378.570 | -0.010 | 1 |
| 23030 | 7090841.567 | 580004.128 | 378.845 | 378.890 | -0.045 | 1 |
| 23031 | 7090827.28 | 579989.167 | 378.728 | 378.760 | -0.032 | 1 |
| 23032 | 7090812.132 | 579974.301 | 379.086 | 379.100 | -0.014 | 1 |
| 23033 | 7090796.608 | 579959.069 | 379.931 | 379.960 | -0.029 | 1 |
| 23034 | 7090781.407 | 579942.139 | 380.528 | 380.570 | -0.042 | 1 |
| 23035 | 7090471.915 | 580730.238 | 378.471 | 378.490 | -0.019 | 1 |
| 23036 | 7090465.808 | 580744.139 | 378.442 | 378.460 | -0.018 | 1 |
| 23037 | 7090452.917 | 580766.662 | 378.471 | 378.490 | -0.019 | 1 |
| 23038 | 7090442.226 | 580785.385 | 378.507 | 378.510 | -0.003 | 1 |
| 23039 | 7090428.089 | 580805.388 | 378.551 | 378.560 | -0.009 | 1 |
| 23040 | 7090420.827 | 580821.495 | 378.577 | 378.590 | -0.013 | 1 |
| 23041 | 7090406.717 | 580845.249 | 378.673 | 378.690 | -0.017 | 1 |
| 23042 | 7090393.741 | 580868.33 | 378.718 | 378.720 | -0.002 | 1 |
| 23043 | 7090380.306 | 580891.31 | 378.718 | 378.730 | -0.012 | 1 |
| 23044 | 7090368.844 | 580910.607 | 378.734 | 378.740 | -0.006 | 1 |
| 23045 | 7090343.026 | 580908.853 | 378.603 | 378.620 | -0.017 | 1 |
| 23046 | 7090324.654 | 580898.604 | 377.661 | 377.640 | 0.021 | 1 |
| 23047 | 7090306.479 | 580888.064 | 376.700 | 376.670 | 0.030 | 1 |
| 23048 | 7090350.701 | 580942.245 | 378.791 | 378.790 | 0.001 | 1 |
| 23049 | 7090338.018 | 580962.633 | 378.816 | 378.860 | -0.044 | 1 |
| 23050 | 7090319.72 | 580993.69 | 378.839 | 378.840 | -0.001 | 1 |
| 23051 | 7091460.263 | 579038.78 | 380.246 | 380.270 | -0.024 | 1 |
| 23052 | 7091467.26 | 579023.173 | 380.279 | 380.300 | -0.021 | 1 |
| 23053 | 7091471.245 | 579015.973 | 380.279 | 380.320 | -0.041 | 1 |
| 23054 | 7091474.69 | 579017.925 | 380.279 | 380.330 | -0.051 | 1 |
| 23055 | 7091483.628 | 578995.053 | 380.294 | 380.370 | -0.076 | 1 |
| 23056 | 7091496.496 | 578973.39 | 380.432 | 380.470 | -0.038 | 1 |
| 23057 | 7091499.318 | 578975.084 | 380.446 | 380.480 | -0.034 | 1 |
| 23058 | 7091497.918 | 578974.364 | 380.459 | 380.510 | -0.051 | 1 |
| 23059 | 7091501.264 | 578957.907 | 380.411 | 380.420 | -0.009 | 1 |
| 23060 | 7091511.97 | 578946.928 | 380.501 | 380.530 | -0.029 | 1 |
| 23061 | 7091524.918 | 578924.407 | 380.516 | 380.530 | -0.014 | 1 |
| 23062 | 7091540.105 | 578902.246 | 380.578 | 380.610 | -0.032 | 1 |
| 23063 | 7091536.396 | 578912.625 | 380.513 | 380.550 | -0.037 | 1 |
| 23064 | 7091529.418 | 578924.262 | 380.523 | 380.570 | -0.047 | 1 |
| 23065 | 7091528.428 | 578932.97 | 380.458 | 380.440 | 0.018 | 1 |
| 23066 | 7091643.429 | 578760.709 | 380.126 | 380.150 | -0.024 | 1 |
| 23099 | 7091069.363 | 579744.362 | 379.297 | 379.310 | -0.013 | 1 |
| 23100 | 7091069.363 | 579744.362 | 379.297 | 379.310 | -0.013 | 1 |
| 23101 | 7091068.447 | 579745.569 | 379.249 | 379.290 | -0.041 | 1 |
| 23102 | 7091060.437 | 579722.989 | 380.407 | 380.440 | -0.033 | 1 |
| 23103 | 7091058.166 | 579726.951 | 380.400 | 380.410 | -0.010 | 1 |
| 23104 | 7091055.887 | 579730.95 | 380.374 | 380.400 | -0.026 | 1 |
| 23105 | 7091053.571 | 579734.827 | 380.359 | 380.400 | -0.041 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 23106 | 7091051.3 | 579738.794 | 380.340 | 380.360 | -0.020 | 1 |
| 23107 | 7091048.889 | 579742.849 | 380.311 | 380.340 | -0.029 | 1 |
| 23108 | 7091046.485 | 579746.958 | 380.298 | 380.310 | -0.012 | 1 |
| 23109 | 7091044.25 | 579750.817 | 380.280 | 380.290 | -0.010 | 1 |
| 23110 | 7091041.742 | 579755.072 | 380.250 | 380.280 | -0.030 | 1 |
| 23111 | 7090866.169 | 580027.395 | 378.946 | 378.950 | -0.004 | 1 |
| 23112 | 7090868.766 | 580028.971 | 378.996 | 379.020 | -0.024 | 1 |
| 23113 | 7090872.082 | 580030.885 | 378.961 | 378.960 | 0.001 | 1 |
| 23114 | 7090878.586 | 580034.167 | 379.112 | 379.140 | -0.028 | 1 |
| 23115 | 7090876.504 | 580037.747 | 379.107 | 379.120 | -0.013 | 1 |
| 23116 | 7090874.698 | 580040.932 | 379.103 | 379.090 | 0.013 | 1 |
| 23117 | 7090873.025 | 580043.75 | 379.086 | 379.110 | -0.024 | 1 |
| 23118 | 7090871.041 | 580047.062 | 379.091 | 379.110 | -0.019 | 1 |
| 23119 | 7090868.98 | 580050.684 | 379.089 | 379.120 | -0.031 | 1 |
| 23120 | 7090867.768 | 580052.805 | 379.095 | 379.100 | -0.005 | 1 |
| 23121 | 7090863.971 | 580059.143 | 379.059 | 379.100 | -0.041 | 1 |
| 23122 | 7090047.413 | 580850.525 | 380.327 | 380.320 | 0.007 | 1 |
| 23123 | 7090043.994 | 580848.17 | 380.320 | 380.320 | 0.000 | 1 |
| 23124 | 7090040.239 | 580845.93 | 380.345 | 380.350 | -0.005 | 1 |
| 23125 | 7090036.826 | 580843.933 | 380.363 | 380.370 | -0.007 | 1 |
| 23126 | 7090033.169 | 580841.522 | 380.398 | 380.390 | 0.008 | 1 |
| 23127 | 7090029.574 | 580839.257 | 380.402 | 380.410 | -0.008 | 1 |
| 23128 | 7090025.98 | 580836.935 | 380.390 | 380.390 | 0.000 | 1 |
| 23129 | 7090022.466 | 580834.597 | 380.407 | 380.410 | -0.003 | 1 |
| 23130 | 7090018.916 | 580832.251 | 380.419 | 380.400 | 0.019 | 1 |
| 23131 | 7090015.846 | 580830.178 | 380.410 | 380.400 | 0.010 | 1 |
| 23132 | 7089748.745 | 580658.93 | 381.508 | 381.520 | -0.012 | 1 |
| 23133 | 7089745.191 | 580656.6 | 381.537 | 381.560 | -0.023 | 1 |
| 23134 | 7089741.616 | 580654.161 | 381.558 | 381.560 | -0.002 | 1 |
| 23135 | 7089738.143 | 580651.799 | 381.563 | 381.560 | 0.003 | 1 |
| 23136 | 7089734.207 | 580649.342 | 381.571 | 381.580 | -0.009 | 1 |
| 23137 | 7089730.555 | 580646.954 | 381.574 | 381.580 | -0.006 | 1 |
| 23138 | 7089726.917 | 580644.588 | 381.592 | 381.590 | 0.002 | 1 |
| 23139 | 7089722.978 | 580641.94 | 381.607 | 381.600 | 0.007 | 1 |
| 23140 | 7089719.076 | 580639.455 | 381.622 | 381.610 | 0.012 | 1 |
| 23141 | 7089466.07 | 580477.887 | 383.262 | 383.240 | 0.022 | 1 |
| 23142 | 7089462.575 | 580475.641 | 383.279 | 383.240 | 0.039 | 1 |
| 23143 | 7089459.166 | 580473.463 | 383.343 | 383.320 | 0.023 | 1 |
| 23144 | 7089455.436 | 580471.137 | 383.386 | 383.390 | -0.004 | 1 |
| 23145 | 7089451.953 | 580468.92 | 383.430 | 383.420 | 0.010 | 1 |
| 23146 | 7089448.413 | 580466.628 | 383.448 | 383.460 | -0.012 | 1 |
| 23147 | 7089444.62 | 580464.071 | 383.480 | 383.480 | 0.000 | 1 |
| 23148 | 7090339.354 | 580906.887 | 378.555 | 378.540 | 0.015 | 1 |
| 23149 | 7090342.666 | 580908.709 | 378.606 | 378.610 | -0.004 | 1 |
| 23150 | 7090346.185 | 580910.681 | 378.662 | 378.680 | -0.018 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 23151 | 7090349.072 | 580912.454 | 378.652 | 378.650 | 0.002 | 1 |
| 23152 | 7090352.516 | 580914.403 | 378.650 | 378.630 | 0.020 | 1 |
| 23153 | 7090355.543 | 580916.133 | 378.668 | 378.660 | 0.008 | 1 |
| 23154 | 7090353.807 | 580919.282 | 378.674 | 378.680 | -0.006 | 1 |
| 23155 | 7090351.847 | 580922.105 | 378.687 | 378.670 | 0.017 | 1 |
| 23156 | 7090350.176 | 580924.988 | 378.672 | 378.670 | 0.002 | 1 |
| 23157 | 7090436.47 | 581101.427 | 375.637 | 375.660 | -0.023 | 1 |
| 23158 | 7090439.158 | 581103.043 | 375.650 | 375.680 | -0.030 | 1 |
| 23159 | 7090441.849 | 581104.839 | 375.657 | 375.680 | -0.023 | 1 |
| 23160 | 7090444.511 | 581106.565 | 375.658 | 375.670 | -0.012 | 1 |
| 23161 | 7090447.36 | 581108.381 | 375.657 | 375.660 | -0.003 | 1 |
| 23162 | 7090450.117 | 581110.165 | 375.652 | 375.660 | -0.008 | 1 |
| 23163 | 7089908.993 | 582396.869 | 371.482 | 371.490 | -0.008 | 1 |
| 23164 | 7089906.265 | 582394.423 | 371.558 | 371.570 | -0.012 | 1 |
| 23165 | 7089903.705 | 582392.154 | 371.611 | 371.640 | -0.029 | 1 |
| 23166 | 7089900.713 | 582389.426 | 371.666 | 371.700 | -0.034 | 1 |
| 23167 | 7089898.011 | 582386.87 | 371.735 | 371.750 | -0.015 | 1 |
| 23168 | 7089895.122 | 582384.142 | 371.803 | 371.830 | -0.027 | 1 |
| 23169 | 7089892.135 | 582381.333 | 371.840 | 371.880 | -0.040 | 1 |
| 23170 | 7089829.857 | 582322.407 | 372.721 | 372.720 | 0.001 | 1 |
| 23171 | 7089827.252 | 582319.885 | 372.791 | 372.780 | 0.011 | 1 |
| 23172 | 7089824.435 | 582317.121 | 372.851 | 372.840 | 0.011 | 1 |
| 23173 | 7089821.908 | 582314.773 | 372.898 | 372.900 | -0.002 | 1 |
| 23174 | 7089819.353 | 582312.274 | 372.972 | 372.950 | 0.022 | 1 |
| 23175 | 7089816.359 | 582309.496 | 373.033 | 373.040 | -0.007 | 1 |
| 23176 | 7089813.389 | 582306.633 | 373.101 | 373.110 | -0.009 | 1 |
| 23177 | 7089810.698 | 582304.107 | 373.139 | 373.150 | -0.011 | 1 |
| 23178 | 7089670.631 | 582180.168 | 373.528 | 373.510 | 0.018 | 1 |
| 23179 | 7089668.111 | 582177.815 | 373.524 | 373.540 | -0.016 | 1 |
| 23180 | 7089665.487 | 582175.179 | 373.586 | 373.560 | 0.026 | 1 |
| 23181 | 7089662.806 | 582172.542 | 373.612 | 373.630 | -0.018 | 1 |
| 23182 | 7089659.799 | 582169.555 | 373.667 | 373.670 | -0.003 | 1 |
| 23183 | 7089640.699 | 582152.478 | 374.765 | 374.770 | -0.005 | 1 |
| 23184 | 7089638.909 | 582155.46 | 374.758 | 374.760 | -0.002 | 1 |
| 23185 | 7089636.784 | 582159.107 | 374.770 | 374.760 | 0.010 | 1 |
| 23186 | 7089635.186 | 582161.846 | 374.767 | 374.760 | 0.007 | 1 |
| 23187 | 7089633.535 | 582164.687 | 374.761 | 374.760 | 0.001 | 1 |
| 23188 | 7089632.001 | 582167.415 | 374.764 | 374.760 | 0.004 | 1 |
| 23189 | 7089630.358 | 582170.238 | 374.772 | 374.780 | -0.008 | 1 |
| 23190 | 7089628.879 | 582172.676 | 374.768 | 374.790 | -0.022 | 1 |
| 23191 | 7089627.408 | 582175.106 | 374.768 | 374.760 | 0.008 | 1 |
| 23192 | 7088848.626 | 583323.929 | 373.644 | 373.670 | -0.026 | 1 |
| 23193 | 7088846.017 | 583321.612 | 373.676 | 373.710 | -0.034 | 1 |
| 23194 | 7088843.454 | 583319.756 | 373.696 | 373.720 | -0.024 | 1 |
| 23195 | 7088840.754 | 583317.911 | 373.760 | 373.780 | -0.020 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 23196 | 7088837.978 | 583316.298 | 373.786 | 373.790 | -0.004 | 1 |
| 23197 | 7088835.374 | 583314.553 | 373.828 | 373.850 | -0.022 | 1 |
| 23198 | 7088832.69 | 583312.683 | 373.847 | 373.890 | -0.043 | 1 |
| 23199 | 7088829.525 | 583310.657 | 373.897 | 373.920 | -0.023 | 1 |
| 23200 | 7088826.284 | 583308.68 | 373.929 | 373.940 | -0.011 | 1 |
| 23201 | 7088787.027 | 583283.365 | 374.567 | 374.590 | -0.023 | 1 |
| 23202 | 7088784.793 | 583281.191 | 374.573 | 374.610 | -0.037 | 1 |
| 23203 | 7088781.821 | 583278.181 | 374.593 | 374.640 | -0.047 | 1 |
| 23204 | 7088779.044 | 583275.281 | 374.552 | 374.560 | -0.008 | 1 |
| 23205 | 7088776.498 | 583272.91 | 374.545 | 374.570 | -0.025 | 1 |
| 23206 | 7088773.609 | 583270.177 | 374.576 | 374.610 | -0.034 | 1 |
| 23207 | 7088770.604 | 583267.308 | 374.622 | 374.650 | -0.028 | 1 |
| 23208 | 7088926.065 | 583375.129 | 374.221 | 374.210 | 0.011 | 1 |
| 23209 | 7088924.069 | 583378.525 | 374.241 | 374.250 | -0.009 | 1 |
| 23210 | 7088922.098 | 583381.873 | 374.270 | 374.260 | 0.010 | 1 |
| 23211 | 7088920.536 | 583384.647 | 374.294 | 374.290 | 0.004 | 1 |
| 23212 | 7088586.091 | 583989.037 | 373.696 | 373.700 | -0.004 | 1 |
| 23213 | 7088589.051 | 583990.704 | 373.665 | 373.650 | 0.015 | 1 |
| 23214 | 7088591.785 | 583992.323 | 373.648 | 373.630 | 0.018 | 1 |
| 23215 | 7088594.51 | 583993.804 | 373.618 | 373.620 | -0.002 | 1 |
| 23216 | 7088597.253 | 583995.551 | 373.790 | 373.650 | 0.140 | 1 |
| 23217 | 7088600.016 | 583997.063 | 373.692 | 373.700 | -0.008 | 1 |
| 23218 | 7088602.958 | 583998.779 | 373.696 | 373.700 | -0.004 | 1 |
| 23219 | 7088572.315 | 583980.785 | 374.233 | 374.220 | 0.013 | 1 |
| 23220 | 7088570.347 | 583983.937 | 374.230 | 374.200 | 0.030 | 1 |
| 23221 | 7088568.626 | 583986.879 | 374.210 | 374.190 | 0.020 | 1 |
| 23222 | 7088566.863 | 583989.865 | 374.197 | 374.190 | 0.007 | 1 |
| 23223 | 7088565.174 | 583992.843 | 374.174 | 374.180 | -0.006 | 1 |
| 23224 | 7088563.487 | 583995.73 | 374.166 | 374.160 | 0.006 | 1 |
| 23225 | 7088561.831 | 583998.595 | 374.160 | 374.150 | 0.010 | 1 |
| 23226 | 7088560.217 | 584001.352 | 374.165 | 374.150 | 0.015 | 1 |
| 23227 | 7088558.727 | 584003.894 | 374.150 | 374.130 | 0.020 | 1 |
| 23228 | 7088194.155 | 584628.006 | 372.662 | 372.670 | -0.008 | 1 |
| 23229 | 7088195.726 | 584625.254 | 372.664 | 372.670 | -0.006 | 1 |
| 23230 | 7088197.182 | 584622.821 | 372.685 | 372.690 | -0.005 | 1 |
| 23231 | 7088198.783 | 584620.138 | 372.684 | 372.690 | -0.006 | 1 |
| 23232 | 7088200.19 | 584617.609 | 372.691 | 372.700 | -0.009 | 1 |
| 23233 | 7088201.68 | 584615.078 | 372.700 | 372.690 | 0.010 | 1 |
| 23234 | 7088203.076 | 584612.717 | 372.694 | 372.710 | -0.016 | 1 |
| 23235 | 7088204.308 | 584610.527 | 372.708 | 372.720 | -0.012 | 1 |
| 23236 | 7091628.401 | 578751.116 | 380.623 | 380.620 | 0.003 | 1 |
| 23237 | 7091629.895 | 578748.421 | 380.630 | 380.620 | 0.010 | 1 |
| 23238 | 7091631.49 | 578745.806 | 380.626 | 380.620 | 0.006 | 1 |
| 23239 | 7091632.999 | 578743.157 | 380.634 | 380.640 | -0.006 | 1 |
| 23240 | 7091635.099 | 578739.622 | 380.618 | 380.640 | -0.022 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 23241 | 7091636.767 | 578736.76 | 380.612 | 380.620 | -0.008 | 1 |
| 23242 | 7091638.667 | 578733.509 | 380.603 | 380.600 | 0.003 | 1 |
| 23243 | 7091640.622 | 578730.14 | 380.602 | 380.610 | -0.008 | 1 |
| 23244 | 7091642.505 | 578726.953 | 380.605 | 380.600 | 0.005 | 1 |
| 23245 | 7091644.298 | 578723.767 | 380.614 | 380.610 | 0.004 | 1 |
| 23246 | 7091646.101 | 578720.726 | 380.617 | 380.610 | 0.007 | 1 |
| 23247 | 7091647.859 | 578717.695 | 380.622 | 380.610 | 0.012 | 1 |
| 23248 | 7091649.613 | 578714.716 | 380.629 | 380.630 | -0.001 | 1 |
| 23249 | 7091651.334 | 578711.858 | 380.629 | 380.620 | 0.009 | 1 |
| 23250 | 7092595.184 | 578687.762 | 374.064 | 374.040 | 0.024 | 1 |
| 23251 | 7092592.544 | 578684.933 | 374.091 | 374.070 | 0.021 | 1 |
| 23252 | 7092589.664 | 578682.051 | 374.134 | 374.130 | 0.004 | 1 |
| 23253 | 7092586.623 | 578679.192 | 374.181 | 374.160 | 0.021 | 1 |
| 23254 | 7092583.673 | 578676.559 | 374.246 | 374.240 | 0.006 | 1 |
| 23255 | 7092580.875 | 578673.806 | 374.292 | 374.270 | 0.022 | 1 |
| 23256 | 7092578.073 | 578671.071 | 374.337 | 374.330 | 0.007 | 1 |
| 23257 | 7092575.217 | 578668.377 | 374.377 | 374.350 | 0.027 | 1 |
| 23258 | 7092572.484 | 578665.645 | 374.414 | 374.390 | 0.024 | 1 |
| 23259 | 7092569.89 | 578663.17 | 374.462 | 374.430 | 0.032 | 1 |
| 23260 | 7092266.25 | 578375.912 | 377.106 | 377.090 | 0.016 | 1 |
| 23261 | 7092263.633 | 578373.263 | 377.107 | 377.100 | 0.007 | 1 |
| 23262 | 7092260.731 | 578370.374 | 377.125 | 377.110 | 0.015 | 1 |
| 23263 | 7092257.945 | 578367.735 | 377.134 | 377.120 | 0.014 | 1 |
| 23264 | 7092255.104 | 578364.975 | 377.149 | 377.120 | 0.029 | 1 |
| 23265 | 7092252.232 | 578362.166 | 377.144 | 377.130 | 0.014 | 1 |
| 23266 | 7092249.512 | 578359.543 | 377.155 | 377.140 | 0.015 | 1 |
| 23267 | 7092246.738 | 578356.864 | 377.149 | 377.140 | 0.009 | 1 |
| 23268 | 7092243.993 | 578354.208 | 377.161 | 377.140 | 0.021 | 1 |
| 23269 | 7092241.377 | 578351.666 | 377.158 | 377.150 | 0.008 | 1 |
| 23270 | 7092074.405 | 578192.658 | 379.126 | 379.110 | 0.016 | 1 |
| 23271 | 7092072.203 | 578190.267 | 379.162 | 379.150 | 0.012 | 1 |
| 23272 | 7092069.772 | 578187.845 | 379.224 | 379.230 | -0.006 | 1 |
| 23273 | 7092067.156 | 578185.251 | 379.287 | 379.280 | 0.007 | 1 |
| 23274 | 7092065.083 | 578183.148 | 379.347 | 379.320 | 0.027 | 1 |
| 23275 | 7092062.549 | 578180.45 | 379.408 | 379.390 | 0.018 | 1 |
| 23276 | 7093198.845 | 577354.517 | 375.859 | 375.860 | -0.001 | 1 |
| 23277 | 7093194.338 | 577354.641 | 375.892 | 375.870 | 0.022 | 1 |
| 23278 | 7093190.212 | 577354.873 | 375.896 | 375.890 | 0.006 | 1 |
| 23279 | 7093186.819 | 577355.052 | 375.917 | 375.910 | 0.007 | 1 |
| 23280 | 7093183.991 | 577355.206 | 375.929 | 375.900 | 0.029 | 1 |
| 23281 | 7092808.392 | 577364.842 | 377.995 | 378.010 | -0.015 | 1 |
| 23282 | 7092804.261 | 577364.776 | 378.059 | 378.040 | 0.019 | 1 |
| 23283 | 7092800.458 | 577364.776 | 378.071 | 378.070 | 0.001 | 1 |
| 23284 | 7092796.473 | 577364.804 | 378.065 | 378.070 | -0.005 | 1 |
| 23285 | 7092792.403 | 577364.884 | 378.070 | 378.080 | -0.010 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 23286 | 7092788.926 | 577364.885 | 378.130 | 378.120 | 0.010 | 1 |
| 23287 | 7092785.039 | 577365.009 | 378.151 | 378.140 | 0.011 | 1 |
| 23288 | 7092546.705 | 577368.216 | 379.846 | 379.820 | 0.026 | 1 |
| 23289 | 7092543.105 | 577368.044 | 379.889 | 379.880 | 0.009 | 1 |
| 23290 | 7092539.055 | 577368.086 | 379.949 | 379.940 | 0.009 | 1 |
| 23291 | 7092535.107 | 577368.068 | 380.017 | 380.000 | 0.017 | 1 |
| 23292 | 7092530.968 | 577367.992 | 380.077 | 380.080 | -0.003 | 1 |
| 23293 | 7092527.436 | 577368.027 | 380.158 | 380.160 | -0.002 | 1 |
| 23294 | 7092816.572 | 576718.622 | 382.325 | 382.340 | -0.015 | 1 |
| 23295 | 7092818.508 | 576715.313 | 382.332 | 382.330 | 0.002 | 1 |
| 23296 | 7092820.203 | 576712.39 | 382.334 | 382.350 | -0.016 | 1 |
| 23297 | 7092822.05 | 576709.232 | 382.358 | 382.350 | 0.008 | 1 |
| 23298 | 7092823.523 | 576706.727 | 382.350 | 382.350 | 0.000 | 1 |
| 23299 | 7092824.811 | 576704.47 | 382.357 | 382.360 | -0.003 | 1 |
| 23300 | 7093207.511 | 575999.194 | 381.402 | 381.390 | 0.012 | 1 |
| 23301 | 7093209.099 | 575996.107 | 381.345 | 381.360 | -0.015 | 1 |
| 23302 | 7093211.026 | 575992.667 | 381.312 | 381.300 | 0.012 | 1 |
| 23303 | 7093212.622 | 575989.141 | 381.258 | 381.280 | -0.022 | 1 |
| 23304 | 7093214.28 | 575985.674 | 381.211 | 381.250 | -0.039 | 1 |
| 23305 | 7093216.199 | 575982.037 | 381.207 | 381.230 | -0.023 | 1 |
| 23306 | 7093217.919 | 575978.637 | 381.194 | 381.220 | -0.026 | 1 |
| 23307 | 7093219.658 | 575975.267 | 381.195 | 381.210 | -0.015 | 1 |
| 23308 | 7093221.451 | 575972.047 | 381.207 | 381.210 | -0.003 | 1 |
| 23309 | 7093223.384 | 575968.758 | 381.196 | 381.210 | -0.014 | 1 |
| 23310 | 7093225.22 | 575965.262 | 381.196 | 381.220 | -0.024 | 1 |
| 23311 | 7093227.154 | 575961.657 | 381.196 | 381.200 | -0.004 | 1 |
| 23312 | 7093229.13 | 575957.975 | 381.210 | 381.190 | 0.020 | 1 |
| 23313 | 7093231.019 | 575954.664 | 381.203 | 381.210 | -0.007 | 1 |
| 24000 | 7072476.157 | 613572.042 | 414.145 | 414.190 | -0.045 | 1 |
| 24002 | 7080033.607 | 599248.58 | 417.528 | 417.540 | -0.012 | 1 |
| 24100 | 7072477.104 | 613573.239 | 414.094 | 414.090 | 0.004 | 1 |
| 24101 | 7072473.165 | 613553.523 | 413.807 | 413.790 | 0.017 | 1 |
| 24102 | 7072472.118 | 613550.745 | 413.719 | 413.690 | 0.029 | 1 |
| 24103 | 7072470.595 | 613547.179 | 413.558 | 413.550 | 0.008 | 1 |
| 24104 | 7072468.778 | 613543.329 | 413.292 | 413.270 | 0.022 | 1 |
| 24105 | 7072467.038 | 613539.859 | 412.982 | 412.960 | 0.022 | 1 |
| 24106 | 7072466.436 | 613536.744 | 412.635 | 412.630 | 0.005 | 1 |
| 24107 | 7072464.576 | 613532.909 | 412.141 | 412.110 | 0.031 | 1 |
| 24108 | 7072462.708 | 613529.047 | 411.746 | 411.740 | 0.006 | 1 |
| 24109 | 7072460.677 | 613525.512 | 411.451 | 411.430 | 0.021 | 1 |
| 24110 | 7072457.554 | 613522.85 | 411.101 | 411.080 | 0.021 | 1 |
| 24111 | 7072455.302 | 613519.116 | 410.714 | 410.680 | 0.034 | 1 |
| 24112 | 7072453.218 | 613515.412 | 410.267 | 410.240 | 0.027 | 1 |
| 24113 | 7072451.272 | 613511.79 | 409.977 | 409.940 | 0.037 | 1 |
| 24114 | 7072450.923 | 613507.255 | 409.844 | 409.810 | 0.034 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 24115 | 7072449.389 | 613503.248 | 409.461 | 409.460 | 0.001 | 1 |
| 24116 | 7072447.595 | 613498.94 | 409.042 | 409.010 | 0.032 | 1 |
| 24117 | 7072445.693 | 613494.791 | 408.579 | 408.590 | -0.011 | 1 |
| 24118 | 7072443.971 | 613490.934 | 408.129 | 408.150 | -0.021 | 1 |
| 24119 | 7072442.404 | 613487.091 | 407.693 | 407.680 | 0.013 | 1 |
| 24120 | 7072440.711 | 613483.072 | 407.322 | 407.300 | 0.022 | 1 |
| 24121 | 7072438.823 | 613479.038 | 406.966 | 406.940 | 0.026 | 1 |
| 24122 | 7072436.798 | 613475.071 | 406.617 | 406.620 | -0.003 | 1 |
| 24123 | 7072434.763 | 613471.006 | 406.296 | 406.300 | -0.004 | 1 |
| 24124 | 7072432.553 | 613466.94 | 406.081 | 406.080 | 0.001 | 1 |
| 24125 | 7072430.341 | 613463.146 | 405.951 | 405.970 | -0.019 | 1 |
| 24126 | 7072427.892 | 613459.374 | 405.882 | 405.900 | -0.018 | 1 |
| 24127 | 7072425.378 | 613455.698 | 405.873 | 405.850 | 0.023 | 1 |
| 24128 | 7072422.403 | 613452.055 | 405.833 | 405.810 | 0.023 | 1 |
| 24129 | 7072419.77 | 613448.496 | 405.743 | 405.740 | 0.003 | 1 |
| 24130 | 7072417.429 | 613444.907 | 405.673 | 405.680 | -0.007 | 1 |
| 24131 | 7072415.776 | 613440.925 | 405.653 | 405.650 | 0.003 | 1 |
| 24132 | 7072414.358 | 613436.782 | 405.671 | 405.680 | -0.009 | 1 |
| 24133 | 7072413.13 | 613432.605 | 405.647 | 405.650 | -0.003 | 1 |
| 24134 | 7072411.133 | 613428.618 | 405.688 | 405.710 | -0.022 | 1 |
| 24135 | 7073158.166 | 612731.424 | 411.687 | 411.660 | 0.027 | 1 |
| 24136 | 7073159.931 | 612728.035 | 411.693 | 411.650 | 0.043 | 1 |
| 24137 | 7073162.065 | 612723.846 | 411.679 | 411.640 | 0.039 | 1 |
| 24138 | 7073164.122 | 612719.771 | 411.653 | 411.620 | 0.033 | 1 |
| 24139 | 7073166.422 | 612715.414 | 411.624 | 411.580 | 0.044 | 1 |
| 24140 | 7073168.427 | 612711.378 | 411.645 | 411.580 | 0.065 | 1 |
| 24141 | 7073170.55 | 612707.328 | 411.617 | 411.580 | 0.037 | 1 |
| 24142 | 7073172.434 | 612703.536 | 411.617 | 411.580 | 0.037 | 1 |
| 24143 | 7073174.355 | 612699.586 | 411.620 | 411.570 | 0.050 | 1 |
| 24144 | 7073176.464 | 612695.654 | 411.616 | 411.550 | 0.066 | 1 |
| 24145 | 7073178.405 | 612691.78 | 411.604 | 411.590 | 0.014 | 1 |
| 24146 | 7073180.446 | 612687.797 | 411.617 | 411.550 | 0.067 | 1 |
| 24147 | 7073182.486 | 612683.84 | 411.597 | 411.550 | 0.047 | 1 |
| 24148 | 7073184.721 | 612679.393 | 411.585 | 411.550 | 0.035 | 1 |
| 24149 | 7073186.739 | 612675.425 | 411.596 | 411.520 | 0.076 | 1 |
| 24150 | 7073188.646 | 612671.785 | 411.571 | 411.520 | 0.051 | 1 |
| 24151 | 7073190.573 | 612667.967 | 411.570 | 411.510 | 0.060 | 1 |
| 24152 | 7073192.438 | 612664.284 | 411.551 | 411.510 | 0.041 | 1 |
| 24153 | 7073194.645 | 612659.986 | 411.541 | 411.540 | 0.001 | 1 |
| 24154 | 7073196.456 | 612656.315 | 411.528 | 411.490 | 0.038 | 1 |
| 24155 | 7073198.389 | 612652.565 | 411.523 | 411.470 | 0.053 | 1 |
| 24156 | 7073200.28 | 612648.876 | 411.520 | 411.490 | 0.030 | 1 |
| 24157 | 7073202.069 | 612645.345 | 411.528 | 411.490 | 0.038 | 1 |
| 24158 | 7073203.967 | 612641.661 | 411.528 | 411.470 | 0.058 | 1 |
| 24159 | 7073205.764 | 612638.138 | 411.522 | 411.460 | 0.062 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 24160 | 7073207.568 | 612634.747 | 411.525 | 411.500 | 0.025 | 1 |
| 24161 | 7073209.517 | 612631.033 | 411.518 | 411.450 | 0.068 | 1 |
| 24162 | 7073211.489 | 612627.379 | 411.510 | 411.470 | 0.040 | 1 |
| 24163 | 7073213.409 | 612623.644 | 411.487 | 411.460 | 0.027 | 1 |
| 24164 | 7073215.259 | 612620.008 | 411.470 | 411.400 | 0.070 | 1 |
| 24165 | 7073217.08 | 612616.395 | 411.441 | 411.400 | 0.041 | 1 |
| 24166 | 7073218.882 | 612612.814 | 411.475 | 411.410 | 0.065 | 1 |
| 24167 | 7073220.693 | 612609.226 | 411.500 | 411.460 | 0.040 | 1 |
| 24168 | 7073222.542 | 612605.573 | 411.519 | 411.470 | 0.049 | 1 |
| 24169 | 7073224.511 | 612601.746 | 411.535 | 411.470 | 0.065 | 1 |
| 24170 | 7073226.47 | 612597.906 | 411.542 | 411.490 | 0.052 | 1 |
| 24171 | 7073227.931 | 612594.989 | 411.549 | 411.500 | 0.049 | 1 |
| 24172 | 7073227.842 | 612595.184 | 411.545 | 411.500 | 0.045 | 1 |
| 24173 | 7073229.655 | 612591.579 | 411.534 | 411.490 | 0.044 | 1 |
| 24174 | 7073231.423 | 612588.097 | 411.537 | 411.480 | 0.057 | 1 |
| 24175 | 7073233.419 | 612584.272 | 411.524 | 411.460 | 0.064 | 1 |
| 24176 | 7073235.215 | 612580.652 | 411.520 | 411.450 | 0.070 | 1 |
| 24177 | 7073237.045 | 612576.974 | 411.511 | 411.480 | 0.031 | 1 |
| 24178 | 7073238.809 | 612573.569 | 411.532 | 411.480 | 0.052 | 1 |
| 24179 | 7073240.675 | 612569.946 | 411.534 | 411.490 | 0.044 | 1 |
| 24180 | 7073242.429 | 612566.464 | 411.521 | 411.500 | 0.021 | 1 |
| 24181 | 7073244.125 | 612563.159 | 411.499 | 411.470 | 0.029 | 1 |
| 24182 | 7073246.072 | 612559.492 | 411.490 | 411.440 | 0.050 | 1 |
| 24183 | 7073247.893 | 612555.886 | 411.468 | 411.420 | 0.048 | 1 |
| 24184 | 7073249.81 | 612552.168 | 411.460 | 411.420 | 0.040 | 1 |
| 24185 | 7073251.637 | 612548.53 | 411.426 | 411.410 | 0.016 | 1 |
| 24186 | 7073253.169 | 612545.591 | 411.441 | 411.400 | 0.041 | 1 |
| 24187 | 7073254.943 | 612542.093 | 411.430 | 411.380 | 0.050 | 1 |
| 24188 | 7073256.696 | 612538.634 | 411.424 | 411.400 | 0.024 | 1 |
| 24189 | 7073258.413 | 612535.223 | 411.425 | 411.390 | 0.035 | 1 |
| 24190 | 7073260.241 | 612531.667 | 411.412 | 411.360 | 0.052 | 1 |
| 24191 | 7073262.056 | 612528.12 | 411.374 | 411.330 | 0.044 | 1 |
| 24192 | 7073263.788 | 612524.707 | 411.369 | 411.330 | 0.039 | 1 |
| 24193 | 7073265.483 | 612521.377 | 411.367 | 411.320 | 0.047 | 1 |
| 24194 | 7073267.287 | 612517.849 | 411.360 | 411.310 | 0.050 | 1 |
| 24195 | 7073269.041 | 612514.405 | 411.365 | 411.340 | 0.025 | 1 |
| 24196 | 7073270.723 | 612511.085 | 411.374 | 411.340 | 0.034 | 1 |
| 24197 | 7073272.437 | 612507.74 | 411.391 | 411.350 | 0.041 | 1 |
| 24198 | 7073274.109 | 612504.414 | 411.389 | 411.360 | 0.029 | 1 |
| 24199 | 7073275.826 | 612501.038 | 411.400 | 411.370 | 0.030 | 1 |
| 24200 | 7073277.506 | 612497.726 | 411.425 | 411.390 | 0.035 | 1 |
| 24201 | 7073279.297 | 612494.224 | 411.420 | 411.400 | 0.020 | 1 |
| 24202 | 7073281.052 | 612490.771 | 411.424 | 411.400 | 0.024 | 1 |
| 24203 | 7073282.783 | 612487.409 | 411.441 | 411.400 | 0.041 | 1 |
| 24204 | 7073284.571 | 612483.973 | 411.442 | 411.390 | 0.052 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 24205 | 7073286.244 | 612480.633 | 411.446 | 411.390 | 0.056 | 1 |
| 24206 | 7073288.015 | 612477.212 | 411.439 | 411.380 | 0.059 | 1 |
| 24207 | 7073287.57 | 612478.148 | 411.434 | 411.400 | 0.034 | 1 |
| 24208 | 7073289.433 | 612474.447 | 411.446 | 411.360 | 0.086 | 1 |
| 24209 | 7073291.366 | 612470.696 | 411.430 | 411.360 | 0.070 | 1 |
| 24210 | 7073293.143 | 612467.193 | 411.396 | 411.360 | 0.036 | 1 |
| 24211 | 7073294.887 | 612463.793 | 411.389 | 411.350 | 0.039 | 1 |
| 24212 | 7073296.637 | 612460.354 | 411.364 | 411.300 | 0.064 | 1 |
| 24213 | 7073298.446 | 612456.757 | 411.376 | 411.330 | 0.046 | 1 |
| 24214 | 7073300.171 | 612453.317 | 411.396 | 411.330 | 0.066 | 1 |
| 24215 | 7073301.833 | 612450.015 | 411.391 | 411.350 | 0.041 | 1 |
| 24216 | 7073303.576 | 612446.565 | 411.404 | 411.380 | 0.024 | 1 |
| 24217 | 7073305.327 | 612443.187 | 411.435 | 411.390 | 0.045 | 1 |
| 24218 | 7073307.068 | 612439.744 | 411.435 | 411.400 | 0.035 | 1 |
| 24219 | 7073308.762 | 612436.382 | 411.435 | 411.370 | 0.065 | 1 |
| 24220 | 7073310.433 | 612433.118 | 411.440 | 411.420 | 0.020 | 1 |
| 24221 | 7073312.178 | 612429.714 | 411.445 | 411.400 | 0.045 | 1 |
| 24222 | 7073313.838 | 612426.425 | 411.447 | 411.410 | 0.037 | 1 |
| 24223 | 7073314.718 | 612424.505 | 411.456 | 411.390 | 0.066 | 1 |
| 24224 | 7073316.673 | 612420.907 | 411.454 | 411.400 | 0.054 | 1 |
| 24225 | 7073318.304 | 612417.711 | 411.447 | 411.430 | 0.017 | 1 |
| 24226 | 7073318.627 | 612417.085 | 411.456 | 411.410 | 0.046 | 1 |
| 24227 | 7073320.485 | 612413.45 | 411.456 | 411.410 | 0.046 | 1 |
| 24228 | 7073322.252 | 612410.001 | 411.455 | 411.390 | 0.065 | 1 |
| 24229 | 7073323.996 | 612406.57 | 411.461 | 411.390 | 0.071 | 1 |
| 24230 | 7073325.689 | 612403.202 | 411.451 | 411.400 | 0.051 | 1 |
| 24231 | 7073327.531 | 612399.653 | 411.445 | 411.390 | 0.055 | 1 |
| 24232 | 7073329.2 | 612396.367 | 411.437 | 411.400 | 0.037 | 1 |
| 24233 | 7073330.795 | 612393.224 | 411.426 | 411.390 | 0.036 | 1 |
| 24234 | 7073332.601 | 612389.721 | 411.425 | 411.370 | 0.055 | 1 |
| 24235 | 7073334.342 | 612386.322 | 411.409 | 411.370 | 0.039 | 1 |
| 24236 | 7073336.073 | 612382.909 | 411.392 | 411.350 | 0.042 | 1 |
| 24237 | 7073337.642 | 612379.691 | 411.396 | 411.320 | 0.076 | 1 |
| 24238 | 7073339.482 | 612376.168 | 411.370 | 411.340 | 0.030 | 1 |
| 24239 | 7073341.288 | 612372.625 | 411.349 | 411.310 | 0.039 | 1 |
| 24240 | 7073342.934 | 612369.311 | 411.328 | 411.300 | 0.028 | 1 |
| 24241 | 7073344.633 | 612366.003 | 411.326 | 411.300 | 0.026 | 1 |
| 24242 | 7073346.346 | 612362.605 | 411.318 | 411.280 | 0.038 | 1 |
| 24243 | 7073347.978 | 612359.443 | 411.298 | 411.250 | 0.048 | 1 |
| 24244 | 7073349.531 | 612356.286 | 411.264 | 411.200 | 0.064 | 1 |
| 24245 | 7073351.187 | 612353.001 | 411.242 | 411.200 | 0.042 | 1 |
| 24246 | 7073352.979 | 612349.514 | 411.217 | 411.190 | 0.027 | 1 |
| 24247 | 7073354.663 | 612346.179 | 411.194 | 411.140 | 0.054 | 1 |
| 24248 | 7073356.398 | 612342.772 | 411.161 | 411.120 | 0.041 | 1 |
| 24249 | 7073358.105 | 612339.443 | 411.178 | 411.080 | 0.098 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 24250 | 7073359.827 | 612336.04 | 411.116 | 411.040 | 0.076 | 1 |
| 24251 | 7073361.509 | 612332.739 | 411.080 | 411.040 | 0.040 | 1 |
| 24252 | 7073363.17 | 612329.496 | 411.028 | 410.980 | 0.048 | 1 |
| 24253 | 7073364.861 | 612326.201 | 410.978 | 410.930 | 0.048 | 1 |
| 24254 | 7073366.506 | 612323.004 | 410.938 | 410.880 | 0.058 | 1 |
| 24255 | 7073366.748 | 612322.238 | 410.919 | 410.870 | 0.049 | 1 |
| 24256 | 7073368.51 | 612318.758 | 410.876 | 410.820 | 0.056 | 1 |
| 24257 | 7073370.228 | 612315.372 | 410.847 | 410.770 | 0.077 | 1 |
| 24258 | 7073371.924 | 612312.034 | 410.803 | 410.730 | 0.073 | 1 |
| 24259 | 7073373.641 | 612308.638 | 410.762 | 410.710 | 0.052 | 1 |
| 24260 | 7073375.344 | 612305.272 | 410.713 | 410.670 | 0.043 | 1 |
| 24261 | 7073377.033 | 612302.012 | 410.675 | 410.610 | 0.065 | 1 |
| 24262 | 7073378.748 | 612298.61 | 410.619 | 410.580 | 0.039 | 1 |
| 24263 | 7073380.398 | 612295.381 | 410.561 | 410.510 | 0.051 | 1 |
| 24264 | 7073382.101 | 612292.028 | 410.491 | 410.450 | 0.041 | 1 |
| 24265 | 7073383.687 | 612288.678 | 410.434 | 410.400 | 0.034 | 1 |
| 24266 | 7073385.247 | 612285.632 | 410.384 | 410.360 | 0.024 | 1 |
| 24267 | 7073386.892 | 612282.359 | 410.313 | 410.270 | 0.043 | 1 |
| 24268 | 7073388.371 | 612279.487 | 410.251 | 410.220 | 0.031 | 1 |
| 24269 | 7073390.024 | 612276.248 | 410.183 | 410.140 | 0.043 | 1 |
| 24270 | 7073391.76 | 612272.829 | 410.105 | 410.050 | 0.055 | 1 |
| 24271 | 7073393.519 | 612269.398 | 410.015 | 410.000 | 0.015 | 1 |
| 24272 | 7073395.263 | 612266.014 | 409.953 | 409.930 | 0.023 | 1 |
| 24273 | 7073396.987 | 612262.665 | 409.859 | 409.820 | 0.039 | 1 |
| 24274 | 7073397.451 | 612261.848 | 409.846 | 409.800 | 0.046 | 1 |
| 24275 | 7073399.326 | 612258.113 | 409.746 | 409.700 | 0.046 | 1 |
| 24276 | 7073400.777 | 612255.253 | 409.665 | 409.630 | 0.035 | 1 |
| 24277 | 7073402.57 | 612251.829 | 409.577 | 409.520 | 0.057 | 1 |
| 24278 | 7073404.225 | 612248.589 | 409.482 | 409.450 | 0.032 | 1 |
| 24279 | 7073405.243 | 612246.563 | 409.410 | 409.380 | 0.030 | 1 |
| 24280 | 7073406.775 | 612243.561 | 409.355 | 409.320 | 0.035 | 1 |
| 24281 | 7073408.274 | 612240.59 | 409.261 | 409.240 | 0.021 | 1 |
| 24282 | 7073409.723 | 612237.705 | 409.188 | 409.150 | 0.038 | 1 |
| 24283 | 7073411.208 | 612234.795 | 409.095 | 409.070 | 0.025 | 1 |
| 24284 | 7073412.678 | 612231.858 | 409.021 | 408.990 | 0.031 | 1 |
| 24285 | 7073413.181 | 612230.896 | 408.999 | 408.960 | 0.039 | 1 |
| 24286 | 7073414.915 | 612227.472 | 408.909 | 408.870 | 0.039 | 1 |
| 24287 | 7073416.431 | 612224.468 | 408.816 | 408.780 | 0.036 | 1 |
| 24288 | 7073417.879 | 612221.666 | 408.728 | 408.720 | 0.008 | 1 |
| 24289 | 7073418.714 | 612220.015 | 408.678 | 408.630 | 0.048 | 1 |
| 24290 | 7073420.506 | 612216.418 | 408.568 | 408.530 | 0.038 | 1 |
| 24291 | 7073422.114 | 612213.325 | 408.474 | 408.440 | 0.034 | 1 |
| 24292 | 7073423.577 | 612210.427 | 408.378 | 408.360 | 0.018 | 1 |
| 24293 | 7073425.004 | 612207.738 | 408.296 | 408.260 | 0.036 | 1 |
| 24294 | 7073426.368 | 612205.065 | 408.210 | 408.170 | 0.040 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 24295 | 7073427.71 | 612202.383 | 408.126 | 408.080 | 0.046 | 1 |
| 24296 | 7073428.96 | 612199.943 | 408.026 | 408.010 | 0.016 | 1 |
| 24297 | 7073429.238 | 612199.241 | 408.010 | 407.990 | 0.020 | 1 |
| 24298 | 7073431.041 | 612195.867 | 407.900 | 407.860 | 0.040 | 1 |
| 24299 | 7073432.436 | 612193.074 | 407.805 | 407.780 | 0.025 | 1 |
| 24300 | 7073433.699 | 612190.522 | 407.729 | 407.700 | 0.029 | 1 |
| 24301 | 7073435.047 | 612187.925 | 407.631 | 407.590 | 0.041 | 1 |
| 24302 | 7073436.326 | 612185.382 | 407.540 | 407.480 | 0.060 | 1 |
| 24303 | 7072477.105 | 613573.236 | 414.090 | 414.080 | 0.010 | 1 |
| 24401 | 7072477.003 | 613573.305 | 414.134 | 414.110 | 0.024 | 1 |
| 24402 | 7072447.208 | 613570.909 | 414.020 | 413.990 | 0.030 | 1 |
| 24403 | 7072450.386 | 613570.003 | 414.028 | 414.010 | 0.018 | 1 |
| 24404 | 7072453.634 | 613569.04 | 414.056 | 414.010 | 0.046 | 1 |
| 24405 | 7072457.34 | 613567.996 | 414.080 | 414.040 | 0.040 | 1 |
| 24406 | 7072461.171 | 613566.904 | 414.080 | 414.080 | 0.000 | 1 |
| 24407 | 7072464.966 | 613565.812 | 414.109 | 414.070 | 0.039 | 1 |
| 24408 | 7072468.337 | 613564.779 | 414.122 | 414.090 | 0.032 | 1 |
| 24409 | 7072471.481 | 613563.819 | 414.157 | 414.110 | 0.047 | 1 |
| 24410 | 7072504.859 | 613583.518 | 414.000 | 413.960 | 0.040 | 1 |
| 24411 | 7072507.9 | 613582.528 | 414.038 | 414.010 | 0.028 | 1 |
| 24412 | 7072511.723 | 613581.451 | 414.065 | 414.060 | 0.005 | 1 |
| 24413 | 7072515.198 | 613580.407 | 414.148 | 414.120 | 0.028 | 1 |
| 24414 | 7072518.661 | 613579.38 | 414.147 | 414.140 | 0.007 | 1 |
| 24415 | 7072521.949 | 613578.207 | 414.172 | 414.150 | 0.022 | 1 |
| 24416 | 7072525.616 | 613577.245 | 414.192 | 414.190 | 0.002 | 1 |
| 24417 | 7072528.745 | 613576.188 | 414.174 | 414.200 | -0.026 | 1 |
| 24418 | 7072532.091 | 613575.102 | 414.198 | 414.210 | -0.012 | 1 |
| 24419 | 7072535.759 | 613573.759 | 414.206 | 414.210 | -0.004 | 1 |
| 24420 | 7072538.758 | 613572.54 | 414.222 | 414.230 | -0.008 | 1 |
| 24421 | 7072542.191 | 613571.231 | 414.245 | 414.250 | -0.005 | 1 |
| 24422 | 7072545.072 | 613570.174 | 414.269 | 414.250 | 0.019 | 1 |
| 24423 | 7072548.124 | 613569.006 | 414.273 | 414.270 | 0.003 | 1 |
| 24424 | 7072551.635 | 613567.854 | 414.287 | 414.250 | 0.037 | 1 |
| 24425 | 7072555.204 | 613566.594 | 414.300 | 414.290 | 0.010 | 1 |
| 24426 | 7072558.391 | 613565.571 | 414.314 | 414.270 | 0.044 | 1 |
| 24427 | 7072561.81 | 613564.738 | 414.302 | 414.270 | 0.032 | 1 |
| 24428 | 7072565.33 | 613563.929 | 414.308 | 414.260 | 0.048 | 1 |
| 24429 | 7072568.791 | 613563.362 | 414.303 | 414.270 | 0.033 | 1 |
| 24430 | 7072572.663 | 613562.942 | 414.280 | 414.230 | 0.050 | 1 |
| 24431 | 7072509.48 | 613804.528 | 394.508 | 394.440 | 0.068 | 1 |
| 24432 | 7072511.895 | 613802.855 | 394.609 | 394.570 | 0.039 | 1 |
| 24433 | 7072514.296 | 613800.87 | 394.685 | 394.620 | 0.065 | 1 |
| 24434 | 7072516.447 | 613798.627 | 394.804 | 394.760 | 0.044 | 1 |
| 24435 | 7072518.28 | 613796.341 | 394.922 | 394.840 | 0.082 | 1 |
| 24436 | 7072520.181 | 613793.947 | 394.958 | 394.910 | 0.048 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 24437 | 7073147.736 | 612751.921 | 411.714 | 411.680 | 0.034 | 1 |
| 24438 | 7073149.317 | 612748.923 | 411.709 | 411.670 | 0.039 | 1 |
| 24439 | 7073150.779 | 612746.017 | 411.691 | 411.670 | 0.021 | 1 |
| 24440 | 7073152.145 | 612743.305 | 411.698 | 411.670 | 0.028 | 1 |
| 24441 | 7073153.514 | 612740.679 | 411.708 | 411.660 | 0.048 | 1 |
| 24442 | 7073154.958 | 612737.892 | 411.714 | 411.660 | 0.054 | 1 |
| 24443 | 7073156.453 | 612734.802 | 411.695 | 411.670 | 0.025 | 1 |
| 24444 | 7073157.699 | 612732.306 | 411.695 | 411.660 | 0.035 | 1 |
| 24445 | 7073159.101 | 612729.779 | 411.690 | 411.670 | 0.020 | 1 |
| 24446 | 7073160.221 | 612727.526 | 411.658 | 411.640 | 0.018 | 1 |
| 24447 | 7073161.583 | 612724.651 | 411.691 | 411.640 | 0.051 | 1 |
| 24448 | 7073162.827 | 612722.269 | 411.669 | 411.610 | 0.059 | 1 |
| 24449 | 7073164.074 | 612719.903 | 411.654 | 411.620 | 0.034 | 1 |
| 24450 | 7074185.754 | 610715.496 | 405.668 | 405.660 | 0.008 | 1 |
| 24451 | 7074187.067 | 610712.89 | 405.673 | 405.640 | 0.033 | 1 |
| 24452 | 7074188.403 | 610710.257 | 405.639 | 405.600 | 0.039 | 1 |
| 24453 | 7074189.848 | 610707.409 | 405.613 | 405.590 | 0.023 | 1 |
| 24454 | 7074191.215 | 610704.763 | 405.573 | 405.570 | 0.003 | 1 |
| 24455 | 7074192.848 | 610701.342 | 405.548 | 405.520 | 0.028 | 1 |
| 24456 | 7074194.269 | 610698.706 | 405.523 | 405.490 | 0.033 | 1 |
| 24457 | 7074195.576 | 610696.109 | 405.496 | 405.470 | 0.026 | 1 |
| 24458 | 7074196.794 | 610693.784 | 405.486 | 405.460 | 0.026 | 1 |
| 24459 | 7074198.048 | 610691.372 | 405.465 | 405.440 | 0.025 | 1 |
| 24460 | 7074199.298 | 610688.915 | 405.453 | 405.400 | 0.053 | 1 |
| 24461 | 7074200.505 | 610686.486 | 405.413 | 405.390 | 0.023 | 1 |
| 24462 | 7074201.777 | 610683.993 | 405.396 | 405.380 | 0.016 | 1 |
| 24463 | 7074202.889 | 610681.805 | 405.379 | 405.350 | 0.029 | 1 |
| 24464 | 7074204.144 | 610679.427 | 405.354 | 405.320 | 0.034 | 1 |
| 24465 | 7074205.284 | 610677.109 | 405.313 | 405.280 | 0.033 | 1 |
| 24466 | 7074206.326 | 610675.089 | 405.292 | 405.260 | 0.032 | 1 |
| 24467 | 7074207.396 | 610672.851 | 405.253 | 405.230 | 0.023 | 1 |
| 24468 | 7074208.883 | 610670.048 | 405.233 | 405.210 | 0.023 | 1 |
| 24469 | 7074210.07 | 610667.731 | 405.202 | 405.160 | 0.042 | 1 |
| 24470 | 7075071.727 | 608911.787 | 399.163 | 399.140 | 0.023 | 1 |
| 24471 | 7075078.669 | 608953.201 | 398.861 | 398.840 | 0.021 | 1 |
| 24472 | 7075078.184 | 608950.842 | 398.851 | 398.840 | 0.011 | 1 |
| 24473 | 7075077.696 | 608948.327 | 398.839 | 398.840 | -0.001 | 1 |
| 24474 | 7075077.304 | 608945.783 | 398.840 | 398.830 | 0.010 | 1 |
| 24475 | 7075634.337 | 607888.867 | 404.067 | 404.020 | 0.047 | 1 |
| 24476 | 7075632.147 | 607887.229 | 404.128 | 404.080 | 0.048 | 1 |
| 24477 | 7075630.128 | 607885.865 | 404.171 | 404.110 | 0.061 | 1 |
| 24478 | 7075627.891 | 607884.707 | 404.138 | 404.060 | 0.078 | 1 |
| 24479 | 7075632.019 | 607895.8 | 404.045 | 403.980 | 0.065 | 1 |
| 24480 | 7075633.046 | 607893.791 | 404.032 | 403.980 | 0.052 | 1 |
| 24481 | 7075635.425 | 607889.546 | 404.032 | 403.990 | 0.042 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 24482 | 7075636.432 | 607887.441 | 404.021 | 403.970 | 0.051 | 1 |
| 24483 | 7075635.191 | 607737.157 | 401.832 | 401.800 | 0.032 | 1 |
| 24484 | 7075634.672 | 607735.256 | 401.844 | 401.800 | 0.044 | 1 |
| 24485 | 7075634.214 | 607732.799 | 401.736 | 401.740 | -0.004 | 1 |
| 24486 | 7074434.487 | 610216.467 | 402.915 | 402.890 | 0.025 | 1 |
| 24487 | 7074437.152 | 610217.828 | 402.965 | 402.950 | 0.015 | 1 |
| 24488 | 7074443.286 | 610220.704 | 402.914 | 402.900 | 0.014 | 1 |
| 24489 | 7074440.716 | 610219.278 | 402.961 | 402.940 | 0.021 | 1 |
| 24490 | 7074437.884 | 610220.732 | 402.992 | 403.000 | -0.008 | 1 |
| 24491 | 7074437.297 | 610221.852 | 403.009 | 403.000 | 0.009 | 1 |
| 24492 | 7074435.994 | 610224.393 | 403.008 | 402.990 | 0.018 | 1 |
| 24493 | 7074434.679 | 610227.058 | 402.999 | 402.980 | 0.019 | 1 |
| 24494 | 7074433.396 | 610229.604 | 402.986 | 402.980 | 0.006 | 1 |
| 24495 | 7074432.258 | 610231.892 | 402.987 | 402.990 | -0.003 | 1 |
| 24496 | 7074431.05 | 610234.26 | 402.986 | 402.960 | 0.026 | 1 |
| 24497 | 7074429.767 | 610236.645 | 402.993 | 402.980 | 0.013 | 1 |
| 24498 | 7074428.389 | 610239.453 | 402.990 | 402.960 | 0.030 | 1 |
| 24499 | 7074427.119 | 610241.819 | 402.979 | 402.980 | -0.001 | 1 |
| 24500 | 7074425.841 | 610244.382 | 402.991 | 402.980 | 0.011 | 1 |
| 24501 | 7073691.895 | 611672.595 | 405.023 | 405.000 | 0.023 | 1 |
| 24502 | 7073694.331 | 611673.499 | 405.095 | 405.070 | 0.025 | 1 |
| 24503 | 7073696.487 | 611674.503 | 405.152 | 405.130 | 0.022 | 1 |
| 24504 | 7073698.891 | 611675.729 | 405.120 | 405.080 | 0.040 | 1 |
| 24505 | 7073701.161 | 611676.913 | 405.066 | 405.050 | 0.016 | 1 |
| 24506 | 7073687.299 | 611669.493 | 404.856 | 404.820 | 0.036 | 1 |
| 24507 | 7073684.898 | 611668.228 | 404.797 | 404.740 | 0.057 | 1 |
| 24508 | 7073682.188 | 611666.927 | 404.700 | 404.670 | 0.030 | 1 |
| 24509 | 7070047.724 | 613955.519 | 465.688 | 465.610 | 0.078 | 1 |
| 24510 | 7070050.748 | 613956.286 | 465.661 | 465.640 | 0.021 | 1 |
| 24511 | 7070053.961 | 613957.057 | 465.681 | 465.680 | 0.001 | 1 |
| 24512 | 7070057.102 | 613957.846 | 465.790 | 465.740 | 0.050 | 1 |
| 24513 | 7070060.051 | 613958.68 | 465.763 | 465.730 | 0.033 | 1 |
| 24514 | 7070063.033 | 613959.648 | 465.793 | 465.740 | 0.053 | 1 |
| 24515 | 7070066.111 | 613960.378 | 465.773 | 465.740 | 0.033 | 1 |
| 24516 | 7070069.093 | 613959.987 | 465.748 | 465.750 | -0.002 | 1 |
| 24517 | 7070072.299 | 613959.718 | 465.756 | 465.740 | 0.016 | 1 |
| 24518 | 7070075.567 | 613959.114 | 465.750 | 465.720 | 0.030 | 1 |
| 24519 | 7070078.54 | 613958.571 | 465.734 | 465.700 | 0.034 | 1 |
| 24520 | 7070081.203 | 613958.047 | 465.731 | 465.710 | 0.021 | 1 |
| 24521 | 7070648.972 | 614063.613 | 449.279 | 449.250 | 0.029 | 1 |
| 24522 | 7070645.757 | 614065.796 | 449.257 | 449.230 | 0.027 | 1 |
| 24523 | 7070642.773 | 614067.513 | 449.238 | 449.210 | 0.028 | 1 |
| 24524 | 7070640.104 | 614069.025 | 449.239 | 449.200 | 0.039 | 1 |
| 24525 | 7070637.399 | 614070.575 | 449.245 | 449.200 | 0.045 | 1 |
| 24526 | 7070634.053 | 614072.704 | 449.261 | 449.230 | 0.031 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 24527 | 7070636.912 | 614058.808 | 449.192 | 449.150 | 0.042 | 1 |
| 24528 | 7070637.94 | 614060.753 | 449.238 | 449.200 | 0.038 | 1 |
| 24529 | 7070639.751 | 614062.835 | 449.254 | 449.220 | 0.034 | 1 |
| 24530 | 7070641.431 | 614065.298 | 449.273 | 449.250 | 0.023 | 1 |
| 24531 | 7070643.001 | 614067.616 | 449.241 | 449.210 | 0.031 | 1 |
| 24532 | 7068535.272 | 615154.756 | 457.545 | 457.490 | 0.055 | 1 |
| 24533 | 7068537.743 | 615150.107 | 457.601 | 457.590 | 0.011 | 1 |
| 24534 | 7068566.504 | 615308.605 | 451.959 | 451.930 | 0.029 | 1 |
| 24535 | 7068568.861 | 615310.557 | 451.901 | 451.840 | 0.061 | 1 |
| 24536 | 7068571 | 615312.409 | 451.796 | 451.810 | -0.014 | 1 |
| 24537 | 7068573.521 | 615314.359 | 451.726 | 451.730 | -0.004 | 1 |
| 24538 | 7068575.75 | 615316.257 | 451.714 | 451.710 | 0.004 | 1 |
| 24539 | 7068577.74 | 615318.276 | 451.722 | 451.710 | 0.012 | 1 |
| 24540 | 7068580.032 | 615320.431 | 451.729 | 451.720 | 0.009 | 1 |
| 24541 | 7068582.047 | 615322.296 | 451.647 | 451.650 | -0.003 | 1 |
| 24542 | 7068584.076 | 615324.124 | 451.546 | 451.540 | 0.006 | 1 |
| 24543 | 7068336.258 | 615428.525 | 460.738 | 460.700 | 0.038 | 1 |
| 24544 | 7068338.603 | 615427.461 | 460.698 | 460.680 | 0.018 | 1 |
| 24545 | 7068341.219 | 615426.339 | 460.705 | 460.650 | 0.055 | 1 |
| 24546 | 7068342.63 | 615425.682 | 460.697 | 460.650 | 0.047 | 1 |
| 24547 | 7068345.312 | 615424.54 | 460.670 | 460.650 | 0.020 | 1 |
| 24548 | 7068348.124 | 615423.347 | 460.649 | 460.600 | 0.049 | 1 |
| 24549 | 7068350.674 | 615422.174 | 460.625 | 460.580 | 0.045 | 1 |
| 24550 | 7068353.251 | 615421.084 | 460.591 | 460.540 | 0.051 | 1 |
| 24551 | 7068355.612 | 615420.017 | 460.566 | 460.530 | 0.036 | 1 |
| 24552 | 7068357.871 | 615419.021 | 460.543 | 460.490 | 0.053 | 1 |
| 24553 | 7068360.53 | 615417.855 | 460.497 | 460.450 | 0.047 | 1 |
| 24554 | 7068363.153 | 615416.702 | 460.462 | 460.390 | 0.072 | 1 |
| 24555 | 7068365.614 | 615415.617 | 460.404 | 460.380 | 0.024 | 1 |
| 24556 | 7068368.256 | 615414.464 | 460.361 | 460.330 | 0.031 | 1 |
| 24557 | 7068370.843 | 615413.336 | 460.313 | 460.270 | 0.043 | 1 |
| 24558 | 7068373.388 | 615412.232 | 460.265 | 460.210 | 0.055 | 1 |
| 24559 | 7068375.725 | 615411.193 | 460.213 | 460.140 | 0.073 | 1 |
| 24560 | 7068378.431 | 615410.009 | 460.148 | 460.110 | 0.038 | 1 |
| 24561 | 7068380.828 | 615408.952 | 460.104 | 460.050 | 0.054 | 1 |
| 24562 | 7068383.331 | 615407.819 | 460.050 | 460.000 | 0.050 | 1 |
| 24563 | 7068385.788 | 615406.752 | 459.990 | 459.950 | 0.040 | 1 |
| 24564 | 7068330.877 | 615436.499 | 460.665 | 460.640 | 0.025 | 1 |
| 24565 | 7068330.528 | 615434.255 | 460.724 | 460.690 | 0.034 | 1 |
| 24566 | 7068329.71 | 615431.903 | 460.753 | 460.750 | 0.003 | 1 |
| 24567 | 7068328.787 | 615429.404 | 460.729 | 460.720 | 0.009 | 1 |
| 24568 | 7068327.83 | 615427.075 | 460.681 | 460.670 | 0.011 | 1 |
| 24569 | 7069046.767 | 615124.882 | 429.347 | 429.330 | 0.017 | 1 |
| 24570 | 7069610.521 | 614769.389 | 438.516 | 438.500 | 0.016 | 1 |
| 24571 | 7069611.671 | 614771.242 | 438.575 | 438.550 | 0.025 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 24572 | 7069612.824 | 614773.073 | 438.621 | 438.580 | 0.041 | 1 |
| 24573 | 7069614.016 | 614774.902 | 438.628 | 438.600 | 0.028 | 1 |
| 24574 | 7069615.487 | 614777.507 | 438.599 | 438.580 | 0.019 | 1 |
| 24575 | 7069616.058 | 614771.765 | 438.621 | 438.560 | 0.061 | 1 |
| 24576 | 7069618.047 | 614770.435 | 438.637 | 438.580 | 0.057 | 1 |
| 24577 | 7069620.153 | 614769.007 | 438.654 | 438.580 | 0.074 | 1 |
| 24578 | 7069622.366 | 614767.52 | 438.624 | 438.570 | 0.054 | 1 |
| 24579 | 7069624.415 | 614766.119 | 438.611 | 438.570 | 0.041 | 1 |
| 24580 | 7069626.401 | 614764.776 | 438.588 | 438.540 | 0.048 | 1 |
| 24581 | 7069628.401 | 614763.424 | 438.572 | 438.530 | 0.042 | 1 |
| 24582 | 7069630.723 | 614761.899 | 438.566 | 438.510 | 0.056 | 1 |
| 24583 | 7069633.212 | 614760.167 | 438.522 | 438.460 | 0.062 | 1 |
| 24584 | 7069635.433 | 614758.621 | 438.513 | 438.450 | 0.063 | 1 |
| 24585 | 7069637.489 | 614757.231 | 438.476 | 438.420 | 0.056 | 1 |
| 24586 | 7069639.584 | 614755.785 | 438.465 | 438.420 | 0.045 | 1 |
| 24587 | 7069641.791 | 614754.231 | 438.439 | 438.400 | 0.039 | 1 |
| 24588 | 7069644.121 | 614752.693 | 438.421 | 438.380 | 0.041 | 1 |
| 24589 | 7069646.046 | 614751.35 | 438.410 | 438.350 | 0.060 | 1 |
| 24590 | 7069648.326 | 614749.833 | 438.381 | 438.360 | 0.021 | 1 |
| 24591 | 7069650.492 | 614748.324 | 438.369 | 438.320 | 0.049 | 1 |
| 24592 | 7069652.641 | 614746.886 | 438.348 | 438.320 | 0.028 | 1 |
| 24593 | 7069654.743 | 614745.442 | 438.342 | 438.280 | 0.062 | 1 |
| 24594 | 7069656.872 | 614743.992 | 438.319 | 438.270 | 0.049 | 1 |
| 24595 | 7069658.709 | 614742.79 | 438.309 | 438.240 | 0.069 | 1 |
| 24596 | 7069660.87 | 614741.309 | 438.281 | 438.230 | 0.051 | 1 |
| 24597 | 7071520.514 | 613823.103 | 431.793 | 431.740 | 0.053 | 1 |
| 24598 | 7071520.093 | 613820.536 | 431.828 | 431.780 | 0.048 | 1 |
| 24599 | 7071519.495 | 613818.126 | 431.865 | 431.810 | 0.055 | 1 |
| 24600 | 7071519.043 | 613816.033 | 431.827 | 431.790 | 0.037 | 1 |
| 24601 | 7071518.383 | 613813.018 | 431.779 | 431.740 | 0.039 | 1 |
| 24602 | 7072323.647 | 613431.142 | 405.796 | 405.750 | 0.046 | 1 |
| 24603 | 7072326.51 | 613431.198 | 405.764 | 405.740 | 0.024 | 1 |
| 24604 | 7072329.563 | 613431.038 | 405.704 | 405.680 | 0.024 | 1 |
| 24605 | 7072332.783 | 613431.057 | 405.622 | 405.610 | 0.012 | 1 |
| 24606 | 7072335.784 | 613431.04 | 405.578 | 405.550 | 0.028 | 1 |
| 24607 | 7072338.627 | 613430.917 | 405.522 | 405.510 | 0.012 | 1 |
| 24608 | 7072341.317 | 613430.692 | 405.519 | 405.500 | 0.019 | 1 |
| 24609 | 7072343.424 | 613430.491 | 405.507 | 405.470 | 0.037 | 1 |
| 24610 | 7072345.885 | 613430.301 | 405.474 | 405.450 | 0.024 | 1 |
| 24611 | 7072348.409 | 613430.063 | 405.489 | 405.480 | 0.009 | 1 |
| 24612 | 7072350.866 | 613429.857 | 405.542 | 405.530 | 0.012 | 1 |
| 24613 | 7072353.348 | 613429.608 | 405.601 | 405.570 | 0.031 | 1 |
| 24614 | 7072355.888 | 613429.377 | 405.630 | 405.580 | 0.050 | 1 |
| 24615 | 7072358.062 | 613429.179 | 405.600 | 405.580 | 0.020 | 1 |
| 24762 | 7064517.494 | 622480.248 | 407.598 | 407.600 | -0.002 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 24763 | 7064515.51 | 622454.838 | 407.656 | 407.650 | 0.006 | 1 |
| 24764 | 7064493.919 | 622175.54 | 407.997 | 407.950 | 0.047 | 1 |
| 24765 | 7064494.61 | 622158.197 | 407.936 | 407.890 | 0.046 | 1 |
| 24766 | 7064495.206 | 622146.337 | 407.867 | 407.840 | 0.027 | 1 |
| 24767 | 7064300.131 | 621092.665 | 405.300 | 405.280 | 0.020 | 1 |
| 24768 | 7064313.996 | 621073.633 | 405.165 | 405.150 | 0.015 | 1 |
| 24769 | 7064325.959 | 621064.03 | 404.937 | 404.910 | 0.027 | 1 |
| 24770 | 7064337.775 | 621049.166 | 404.868 | 404.860 | 0.008 | 1 |
| 24771 | 7064624.326 | 620676.484 | 403.441 | 403.460 | -0.019 | 1 |
| 24772 | 7064632.734 | 620665.838 | 403.500 | 403.480 | 0.020 | 1 |
| 24773 | 7064640.386 | 620655.809 | 403.463 | 403.440 | 0.023 | 1 |
| 124101 | 7080032.522 | 599249.634 | 417.579 | 417.570 | 0.009 | 1 |
| 124102 | 7080049.983 | 599256.47 | 418.268 | 418.230 | 0.038 | 1 |
| 124103 | 7080053.216 | 599258.342 | 418.335 | 418.300 | 0.035 | 1 |
| 124104 | 7080056.259 | 599259.903 | 418.331 | 418.310 | 0.021 | 1 |
| 124105 | 7080059.161 | 599261.41 | 418.270 | 418.250 | 0.020 | 1 |
| 124106 | 7080057.812 | 599252.863 | 418.384 | 418.350 | 0.034 | 1 |
| 124107 | 7080059.812 | 599249.013 | 418.388 | 418.340 | 0.048 | 1 |
| 124108 | 7080061.561 | 599245.504 | 418.397 | 418.360 | 0.037 | 1 |
| 124109 | 7080063.401 | 599241.81 | 418.405 | 418.370 | 0.035 | 1 |
| 124110 | 7080065.305 | 599238.281 | 418.416 | 418.360 | 0.056 | 1 |
| 124111 | 7080067.174 | 599234.592 | 418.422 | 418.390 | 0.032 | 1 |
| 124112 | 7080069.106 | 599230.775 | 418.423 | 418.390 | 0.033 | 1 |
| 124113 | 7080071.01 | 599227.233 | 418.435 | 418.370 | 0.065 | 1 |
| 124114 | 7080072.894 | 599223.372 | 418.442 | 418.410 | 0.032 | 1 |
| 124115 | 7080074.659 | 599220.005 | 418.446 | 418.410 | 0.036 | 1 |
| 124116 | 7078698.463 | 602245.735 | 407.356 | 407.340 | 0.016 | 1 |
| 124117 | 7078694.391 | 602243.915 | 407.394 | 407.360 | 0.034 | 1 |
| 124118 | 7078690.227 | 602241.672 | 407.387 | 407.360 | 0.027 | 1 |
| 124119 | 7078685.955 | 602239.737 | 407.395 | 407.390 | 0.005 | 1 |
| 124120 | 7078681.369 | 602237.185 | 407.453 | 407.440 | 0.013 | 1 |
| 124121 | 7078677.749 | 602235.186 | 407.487 | 407.460 | 0.027 | 1 |
| 124122 | 7078673.698 | 602232.618 | 407.534 | 407.500 | 0.034 | 1 |
| 124123 | 7078669.338 | 602230.144 | 407.574 | 407.540 | 0.034 | 1 |
| 124124 | 7078665.268 | 602227.66 | 407.601 | 407.600 | 0.001 | 1 |
| 124125 | 7078660.625 | 602224.873 | 407.652 | 407.630 | 0.022 | 1 |
| 124126 | 7078656.193 | 602222.365 | 407.719 | 407.690 | 0.029 | 1 |
| 124127 | 7078652.056 | 602219.655 | 407.761 | 407.730 | 0.031 | 1 |
| 124128 | 7078647.799 | 602216.893 | 407.770 | 407.730 | 0.040 | 1 |
| 124129 | 7078643.484 | 602214.2 | 407.760 | 407.730 | 0.030 | 1 |
| 124130 | 7078639.063 | 602211.464 | 407.825 | 407.790 | 0.035 | 1 |
| 124131 | 7078634.435 | 602208.909 | 407.901 | 407.870 | 0.031 | 1 |
| 124132 | 7078629.961 | 602206.395 | 407.957 | 407.920 | 0.037 | 1 |
| 124133 | 7078626.644 | 602204.741 | 407.982 | 407.960 | 0.022 | 1 |
| 124134 | 7078622.358 | 602202.965 | 408.035 | 408.000 | 0.035 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 124135 | 7078617.606 | 602201.572 | 408.077 | 408.060 | 0.017 | 1 |
| 124136 | 7078612.808 | 602200.088 | 408.137 | 408.110 | 0.027 | 1 |
| 124137 | 7078608.029 | 602198.6 | 408.217 | 408.190 | 0.027 | 1 |
| 124138 | 7078603.176 | 602197.322 | 408.212 | 408.200 | 0.012 | 1 |
| 124139 | 7078598.926 | 602195.321 | 408.339 | 408.320 | 0.019 | 1 |
| 124140 | 7078594.792 | 602193.656 | 408.438 | 408.420 | 0.018 | 1 |
| 124141 | 7078590.27 | 602191.75 | 408.497 | 408.480 | 0.017 | 1 |
| 124142 | 7078586.108 | 602189.368 | 408.439 | 408.420 | 0.019 | 1 |
| 124143 | 7078581.934 | 602186.68 | 408.627 | 408.620 | 0.007 | 1 |
| 124144 | 7078784.637 | 601745.412 | 413.182 | 413.150 | 0.032 | 1 |
| 124145 | 7078780.585 | 601742.82 | 413.271 | 413.230 | 0.041 | 1 |
| 124146 | 7078775.765 | 601740.657 | 413.186 | 413.170 | 0.016 | 1 |
| 124147 | 7078771.603 | 601738.922 | 413.117 | 413.080 | 0.037 | 1 |
| 124148 | 7078766.94 | 601737.422 | 413.030 | 412.980 | 0.050 | 1 |
| 124149 | 7078762.286 | 601735.734 | 412.892 | 412.870 | 0.022 | 1 |
| 124150 | 7078757.652 | 601733.845 | 412.750 | 412.720 | 0.030 | 1 |
| 124151 | 7078753.02 | 601731.902 | 412.595 | 412.540 | 0.055 | 1 |
| 124152 | 7078748.756 | 601730.03 | 412.363 | 412.310 | 0.053 | 1 |
| 124153 | 7078744.516 | 601728.483 | 412.158 | 412.130 | 0.028 | 1 |
| 124154 | 7078740.128 | 601726.929 | 412.024 | 411.960 | 0.064 | 1 |
| 124155 | 7078735.632 | 601725.641 | 411.857 | 411.790 | 0.067 | 1 |
| 124156 | 7078731.034 | 601724.431 | 411.685 | 411.620 | 0.065 | 1 |
| 124157 | 7078725.739 | 601723.73 | 411.444 | 411.420 | 0.024 | 1 |
| 124158 | 7078720.319 | 601723.707 | 411.229 | 411.160 | 0.069 | 1 |
| 124159 | 7078714.927 | 601724.134 | 410.989 | 410.930 | 0.059 | 1 |
| 124160 | 7078709.823 | 601724.595 | 410.775 | 410.730 | 0.045 | 1 |
| 124161 | 7078704.246 | 601725.184 | 410.598 | 410.550 | 0.048 | 1 |
| 124162 | 7078699.298 | 601726.052 | 410.464 | 410.430 | 0.034 | 1 |
| 124163 | 7078694.3 | 601726.857 | 410.357 | 410.350 | 0.007 | 1 |
| 124164 | 7078688.583 | 601727.825 | 410.308 | 410.260 | 0.048 | 1 |
| 124165 | 7078683.025 | 601728.813 | 410.303 | 410.250 | 0.053 | 1 |
| 124166 | 7078677.014 | 601729.432 | 410.272 | 410.230 | 0.042 | 1 |
| 124167 | 7078671.474 | 601729.543 | 410.319 | 410.250 | 0.069 | 1 |
| 124168 | 7078665.69 | 601728.82 | 410.229 | 410.220 | 0.009 | 1 |
| 124169 | 7078660.554 | 601727.387 | 410.270 | 410.240 | 0.030 | 1 |
| 124170 | 7078653.859 | 601726.563 | 410.367 | 410.310 | 0.057 | 1 |
| 124171 | 7078649.265 | 601722.87 | 410.375 | 410.340 | 0.035 | 1 |
| 124172 | 7078645.359 | 601719.009 | 410.410 | 410.390 | 0.020 | 1 |
| 124173 | 7078641.532 | 601714.547 | 410.477 | 410.440 | 0.037 | 1 |
| 124174 | 7078638.325 | 601709.807 | 410.552 | 410.550 | 0.002 | 1 |
| 124175 | 7078633.053 | 601702.219 | 411.040 | 410.990 | 0.050 | 1 |
| 124176 | 7078629.912 | 601697.454 | 411.340 | 411.240 | 0.100 | 1 |
| 124177 | 7078626.812 | 601692.928 | 411.455 | 411.440 | 0.015 | 1 |
| 124178 | 7078623.793 | 601688.605 | 411.607 | 411.540 | 0.067 | 1 |
| 124179 | 7078620.844 | 601684.09 | 411.674 | 411.630 | 0.044 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 124180 | 7078617.922 | 601679.806 | 411.722 | 411.660 | 0.062 | 1 |
| 124181 | 7078615.036 | 601675.218 | 411.701 | 411.660 | 0.041 | 1 |
| 124182 | 7078612.127 | 601670.752 | 411.741 | 411.660 | 0.081 | 1 |
| 124183 | 7078609.071 | 601666.234 | 411.734 | 411.700 | 0.034 | 1 |
| 124184 | 7078606.056 | 601661.919 | 411.818 | 411.760 | 0.058 | 1 |
| 124185 | 7078603.232 | 601657.595 | 411.847 | 411.810 | 0.037 | 1 |
| 124186 | 7078600.264 | 601652.945 | 411.989 | 411.960 | 0.029 | 1 |
| 124187 | 7078597.565 | 601648.884 | 412.019 | 412.050 | -0.031 | 1 |
| 124188 | 7078594.492 | 601644.339 | 412.141 | 412.150 | -0.009 | 1 |
| 124189 | 7078591.6 | 601639.962 | 412.250 | 412.230 | 0.020 | 1 |
| 124190 | 7078588.514 | 601635.272 | 412.323 | 412.280 | 0.043 | 1 |
| 124191 | 7078577.311 | 601618.981 | 412.454 | 412.440 | 0.014 | 1 |
| 124192 | 7078574.202 | 601614.473 | 412.463 | 412.490 | -0.027 | 1 |
| 124193 | 7078571.269 | 601610.068 | 412.522 | 412.520 | 0.002 | 1 |
| 124194 | 7078568.569 | 601605.699 | 412.526 | 412.520 | 0.006 | 1 |
| 124195 | 7078565.573 | 601601.218 | 412.543 | 412.530 | 0.013 | 1 |
| 124196 | 7078561.938 | 601596.194 | 412.580 | 412.550 | 0.030 | 1 |
| 124197 | 7078559.14 | 601591.713 | 412.576 | 412.610 | -0.034 | 1 |
| 124198 | 7078556.056 | 601587.272 | 412.712 | 412.700 | 0.012 | 1 |
| 124199 | 7078553.507 | 601583.36 | 412.835 | 412.830 | 0.005 | 1 |
| 124200 | 7078550.265 | 601579.184 | 413.034 | 413.020 | 0.014 | 1 |
| 124201 | 7078547.551 | 601574.778 | 413.296 | 413.290 | 0.006 | 1 |
| 124202 | 7078544.549 | 601570.304 | 413.550 | 413.540 | 0.010 | 1 |
| 124203 | 7078541.499 | 601565.957 | 413.828 | 413.810 | 0.018 | 1 |
| 124204 | 7078538.236 | 601561.439 | 414.126 | 414.130 | -0.004 | 1 |
| 124205 | 7078535.218 | 601556.722 | 414.406 | 414.430 | -0.024 | 1 |
| 124206 | 7078532.036 | 601552.209 | 414.690 | 414.700 | -0.010 | 1 |
| 124207 | 7078528.973 | 601547.813 | 414.842 | 414.830 | 0.012 | 1 |
| 124208 | 7078525.879 | 601543.412 | 414.799 | 414.780 | 0.019 | 1 |
| 124209 | 7078522.744 | 601539.171 | 414.650 | 414.640 | 0.010 | 1 |
| 124210 | 7078520.137 | 601535.725 | 414.516 | 414.510 | 0.006 | 1 |
| 124211 | 7078513.814 | 601527.019 | 414.428 | 414.430 | -0.002 | 1 |
| 124212 | 7078510.648 | 601522.257 | 414.459 | 414.470 | -0.011 | 1 |
| 124213 | 7078508.138 | 601518.784 | 414.609 | 414.620 | -0.011 | 1 |
| 124214 | 7078505.373 | 601514.595 | 414.858 | 414.840 | 0.018 | 1 |
| 124215 | 7078501.857 | 601509.712 | 415.150 | 415.150 | 0.000 | 1 |
| 124216 | 7078499.071 | 601505.25 | 415.483 | 415.480 | 0.003 | 1 |
| 124217 | 7078494.353 | 601499.324 | 415.996 | 415.990 | 0.006 | 1 |
| 124218 | 7078491.594 | 601494.918 | 416.294 | 416.290 | 0.004 | 1 |
| 124219 | 7078488.866 | 601490.613 | 416.535 | 416.540 | -0.005 | 1 |
| 124220 | 7078485.799 | 601486.09 | 416.714 | 416.710 | 0.004 | 1 |
| 124221 | 7078482.987 | 601482.231 | 416.832 | 416.870 | -0.038 | 1 |
| 124222 | 7078479.263 | 601476.945 | 417.007 | 417.000 | 0.007 | 1 |
| 124223 | 7078476.372 | 601472.646 | 417.095 | 417.080 | 0.015 | 1 |
| 124224 | 7078473.422 | 601468.179 | 417.203 | 417.200 | 0.003 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 124225 | 7078469.57 | 601462.414 | 417.296 | 417.260 | 0.036 | 1 |
| 124226 | 7078466.506 | 601458.283 | 417.388 | 417.320 | 0.068 | 1 |
| 124227 | 7078463.891 | 601454.206 | 417.288 | 417.340 | -0.052 | 1 |
| 124228 | 7078461.694 | 601451.195 | 417.285 | 417.270 | 0.015 | 1 |
| 124229 | 7078450.392 | 601434.853 | 416.801 | 416.800 | 0.001 | 1 |
| 124230 | 7078445.118 | 601426.993 | 416.597 | 416.620 | -0.023 | 1 |
| 124231 | 7078442.341 | 601422.845 | 416.509 | 416.490 | 0.019 | 1 |
| 124232 | 7078439.56 | 601418.716 | 416.430 | 416.420 | 0.010 | 1 |
| 124233 | 7078437.004 | 601415.076 | 416.349 | 416.320 | 0.029 | 1 |
| 124234 | 7078434.068 | 601410.959 | 416.293 | 416.300 | -0.007 | 1 |
| 124235 | 7078431.191 | 601406.633 | 416.193 | 416.220 | -0.027 | 1 |
| 124236 | 7078428.129 | 601402.533 | 416.149 | 416.170 | -0.021 | 1 |
| 124237 | 7078425.503 | 601398.723 | 416.191 | 416.210 | -0.019 | 1 |
| 124238 | 7078422.941 | 601394.925 | 416.235 | 416.240 | -0.005 | 1 |
| 124239 | 7078418.701 | 601388.702 | 416.295 | 416.320 | -0.025 | 1 |
| 124240 | 7078415.467 | 601384.466 | 416.310 | 416.320 | -0.010 | 1 |
| 124241 | 7078412.73 | 601380.373 | 416.528 | 416.400 | 0.128 | 1 |
| 124242 | 7078409.404 | 601376.294 | 416.427 | 416.450 | -0.023 | 1 |
| 124243 | 7078406.77 | 601372.316 | 416.496 | 416.500 | -0.004 | 1 |
| 124244 | 7078402.383 | 601366.784 | 416.532 | 416.550 | -0.018 | 1 |
| 124245 | 7078399.847 | 601362.841 | 416.548 | 416.550 | -0.002 | 1 |
| 124246 | 7078397.01 | 601358.555 | 416.525 | 416.550 | -0.025 | 1 |
| 124247 | 7078394.34 | 601354.548 | 416.513 | 416.510 | 0.003 | 1 |
| 124248 | 7078391.478 | 601350.515 | 416.503 | 416.490 | 0.013 | 1 |
| 124249 | 7078388.612 | 601346.304 | 416.507 | 416.520 | -0.013 | 1 |
| 124250 | 7078385.865 | 601342.157 | 416.541 | 416.550 | -0.009 | 1 |
| 124251 | 7078382.937 | 601338.416 | 416.612 | 416.600 | 0.012 | 1 |
| 124252 | 7078380.301 | 601334.087 | 416.691 | 416.700 | -0.009 | 1 |
| 124253 | 7078377.719 | 601329.934 | 416.775 | 416.790 | -0.015 | 1 |
| 124254 | 7078375.09 | 601325.874 | 416.861 | 416.890 | -0.029 | 1 |
| 124255 | 7078372.326 | 601321.891 | 416.953 | 416.970 | -0.017 | 1 |
| 124256 | 7078369.709 | 601318.021 | 416.925 | 416.950 | -0.025 | 1 |
| 124257 | 7078367.115 | 601314.239 | 416.848 | 416.870 | -0.022 | 1 |
| 124258 | 7078364.649 | 601310.491 | 416.756 | 416.780 | -0.024 | 1 |
| 124259 | 7078362.099 | 601306.623 | 416.618 | 416.650 | -0.032 | 1 |
| 124260 | 7078358.935 | 601302.237 | 416.632 | 416.580 | 0.052 | 1 |
| 124261 | 7078356.312 | 601298.009 | 416.488 | 416.510 | -0.022 | 1 |
| 124262 | 7078353.716 | 601294.083 | 416.460 | 416.510 | -0.050 | 1 |
| 124263 | 7078351.099 | 601290.345 | 416.439 | 416.460 | -0.021 | 1 |
| 124264 | 7078348.38 | 601286.459 | 416.367 | 416.380 | -0.013 | 1 |
| 124265 | 7078346.265 | 601283.217 | 416.284 | 416.350 | -0.066 | 1 |
| 124266 | 7078337.529 | 601270.701 | 416.510 | 416.560 | -0.050 | 1 |
| 124267 | 7078334.822 | 601266.443 | 416.584 | 416.600 | -0.016 | 1 |
| 124268 | 7078331.038 | 601260.773 | 416.679 | 416.700 | -0.021 | 1 |
| 124269 | 7078328.228 | 601256.625 | 416.724 | 416.730 | -0.006 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 124270 | 7078325.43 | 601252.344 | 416.854 | 416.830 | 0.024 | 1 |
| 124271 | 7078322.774 | 601248.551 | 416.886 | 416.890 | -0.004 | 1 |
| 124272 | 7078320.028 | 601244.664 | 416.954 | 416.950 | 0.004 | 1 |
| 124273 | 7078316.966 | 601240.628 | 417.062 | 417.030 | 0.032 | 1 |
| 124274 | 7078314.317 | 601236.556 | 417.088 | 417.080 | 0.008 | 1 |
| 124275 | 7078311.518 | 601232.049 | 417.093 | 417.100 | -0.007 | 1 |
| 124276 | 7078308.392 | 601227.774 | 417.095 | 417.120 | -0.025 | 1 |
| 124277 | 7078305.681 | 601223.716 | 417.123 | 417.130 | -0.007 | 1 |
| 124278 | 7078302.83 | 601219.583 | 417.154 | 417.170 | -0.016 | 1 |
| 124279 | 7078300.1 | 601215.714 | 417.158 | 417.190 | -0.032 | 1 |
| 124280 | 7078297.423 | 601211.602 | 417.225 | 417.250 | -0.025 | 1 |
| 124281 | 7078294.412 | 601207.42 | 417.294 | 417.290 | 0.004 | 1 |
| 124282 | 7078291.377 | 601203.119 | 417.307 | 417.350 | -0.043 | 1 |
| 124283 | 7078288.475 | 601198.78 | 417.363 | 417.380 | -0.017 | 1 |
| 124284 | 7078285.712 | 601194.695 | 417.407 | 417.420 | -0.013 | 1 |
| 124285 | 7078282.3 | 601189.548 | 417.492 | 417.500 | -0.008 | 1 |
| 124286 | 7078279.272 | 601185.114 | 417.536 | 417.580 | -0.044 | 1 |
| 124287 | 7078276.486 | 601180.823 | 417.616 | 417.650 | -0.034 | 1 |
| 124288 | 7078273.369 | 601176.326 | 417.705 | 417.730 | -0.025 | 1 |
| 124289 | 7078270.596 | 601172.439 | 417.790 | 417.810 | -0.020 | 1 |
| 124290 | 7078267.571 | 601168.289 | 417.853 | 417.860 | -0.007 | 1 |
| 124291 | 7078265.013 | 601165.401 | 417.890 | 417.930 | -0.040 | 1 |
| 124292 | 7078262.031 | 601160.607 | 417.986 | 418.010 | -0.024 | 1 |
| 124293 | 7078259.005 | 601156.154 | 418.069 | 418.090 | -0.021 | 1 |
| 124294 | 7078255.708 | 601151.6 | 418.141 | 418.140 | 0.001 | 1 |
| 124295 | 7078252.491 | 601147.059 | 418.163 | 418.190 | -0.027 | 1 |
| 124296 | 7078249.691 | 601142.923 | 418.233 | 418.230 | 0.003 | 1 |
| 124297 | 7078246.896 | 601138.993 | 418.281 | 418.300 | -0.019 | 1 |
| 124298 | 7078243.87 | 601134.818 | 418.364 | 418.370 | -0.006 | 1 |
| 124299 | 7078241.061 | 601130.883 | 418.431 | 418.450 | -0.019 | 1 |
| 124300 | 7078237.967 | 601126.436 | 418.534 | 418.550 | -0.016 | 1 |
| 124301 | 7078234.955 | 601122.096 | 418.620 | 418.640 | -0.020 | 1 |
| 124302 | 7078232.071 | 601118.017 | 418.726 | 418.740 | -0.014 | 1 |
| 124303 | 7078229.127 | 601113.634 | 418.799 | 418.820 | -0.021 | 1 |
| 124304 | 7078226.065 | 601108.923 | 418.854 | 418.870 | -0.016 | 1 |
| 124305 | 7078222.787 | 601104.279 | 418.927 | 418.910 | 0.017 | 1 |
| 124306 | 7078219.505 | 601099.458 | 418.941 | 418.960 | -0.019 | 1 |
| 124307 | 7078216.41 | 601095.213 | 418.994 | 418.990 | 0.004 | 1 |
| 124308 | 7078213.397 | 601090.69 | 419.002 | 419.040 | -0.038 | 1 |
| 124309 | 7078210.385 | 601085.992 | 419.086 | 419.070 | 0.016 | 1 |
| 124310 | 7078207.271 | 601081.56 | 419.096 | 419.080 | 0.016 | 1 |
| 124311 | 7078204.598 | 601077.711 | 419.151 | 419.160 | -0.009 | 1 |
| 124312 | 7078201.975 | 601073.831 | 419.215 | 419.190 | 0.025 | 1 |
| 124313 | 7078199.395 | 601070.617 | 419.231 | 419.240 | -0.009 | 1 |
| 124314 | 7078196.378 | 601066.31 | 419.313 | 419.300 | 0.013 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 124315 | 7078193.162 | 601061.459 | 419.372 | 419.360 | 0.012 | 1 |
| 124316 | 7078189.987 | 601056.545 | 419.420 | 419.400 | 0.020 | 1 |
| 124317 | 7078186.895 | 601052.24 | 419.465 | 419.440 | 0.025 | 1 |
| 124318 | 7078183.81 | 601047.844 | 419.515 | 419.500 | 0.015 | 1 |
| 124319 | 7078180.71 | 601043.151 | 419.578 | 419.560 | 0.018 | 1 |
| 124320 | 7078177.851 | 601039.148 | 419.661 | 419.640 | 0.021 | 1 |
| 124321 | 7078174.945 | 601034.776 | 419.704 | 419.670 | 0.034 | 1 |
| 124322 | 7078172.211 | 601030.761 | 419.769 | 419.740 | 0.029 | 1 |
| 124323 | 7078169.379 | 601026.603 | 419.816 | 419.790 | 0.026 | 1 |
| 124324 | 7078166.374 | 601022.095 | 419.863 | 419.850 | 0.013 | 1 |
| 124325 | 7078163.34 | 601017.814 | 419.964 | 419.950 | 0.014 | 1 |
| 124326 | 7078160.504 | 601013.632 | 420.027 | 420.020 | 0.007 | 1 |
| 124327 | 7078157.379 | 601009.354 | 420.095 | 420.070 | 0.025 | 1 |
| 124328 | 7078154.243 | 601005.016 | 420.183 | 420.150 | 0.033 | 1 |
| 124329 | 7078150.887 | 601000.513 | 420.257 | 420.250 | 0.007 | 1 |
| 124330 | 7078148.035 | 600996.144 | 420.340 | 420.350 | -0.010 | 1 |
| 124331 | 7078144.736 | 600991.339 | 420.448 | 420.440 | 0.008 | 1 |
| 124332 | 7078141.685 | 600986.89 | 420.544 | 420.500 | 0.044 | 1 |
| 124333 | 7078138.769 | 600982.696 | 420.605 | 420.570 | 0.035 | 1 |
| 124334 | 7078135.543 | 600978.021 | 420.636 | 420.600 | 0.036 | 1 |
| 124335 | 7078132.27 | 600973.202 | 420.671 | 420.650 | 0.021 | 1 |
| 124336 | 7078129 | 600968.967 | 420.728 | 420.680 | 0.048 | 1 |
| 124337 | 7078126.517 | 600964.884 | 420.716 | 420.710 | 0.006 | 1 |
| 124338 | 7078123.363 | 600960.698 | 420.796 | 420.760 | 0.036 | 1 |
| 124339 | 7078120.424 | 600956.083 | 420.862 | 420.830 | 0.032 | 1 |
| 124340 | 7078117.539 | 600951.741 | 420.890 | 420.870 | 0.020 | 1 |
| 124341 | 7078114.723 | 600947.535 | 420.933 | 420.920 | 0.013 | 1 |
| 124342 | 7078111.878 | 600943.202 | 421.007 | 420.980 | 0.027 | 1 |
| 124343 | 7078109.108 | 600938.919 | 421.067 | 421.020 | 0.047 | 1 |
| 124344 | 7078105.7 | 600933.96 | 421.139 | 421.090 | 0.049 | 1 |
| 124345 | 7078101.575 | 600929.09 | 421.197 | 421.210 | -0.013 | 1 |
| 124346 | 7078097.606 | 600923.465 | 421.337 | 421.300 | 0.037 | 1 |
| 124347 | 7078086.883 | 600907.42 | 421.598 | 421.560 | 0.038 | 1 |
| 124348 | 7078083.815 | 600903.011 | 421.671 | 421.640 | 0.031 | 1 |
| 124349 | 7078078.775 | 600895.711 | 421.732 | 421.700 | 0.032 | 1 |
| 124350 | 7078076.056 | 600891.563 | 421.775 | 421.730 | 0.045 | 1 |
| 124351 | 7078072.353 | 600886.397 | 421.861 | 421.810 | 0.051 | 1 |
| 124352 | 7078069.051 | 600881.652 | 421.906 | 421.890 | 0.016 | 1 |
| 124353 | 7078066.258 | 600877.455 | 421.998 | 421.940 | 0.058 | 1 |
| 124354 | 7078063.35 | 600873.191 | 422.065 | 422.010 | 0.055 | 1 |
| 124355 | 7078060.393 | 600868.898 | 422.104 | 422.090 | 0.014 | 1 |
| 124356 | 7078054.168 | 600859.729 | 422.240 | 422.180 | 0.060 | 1 |
| 124357 | 7078051.26 | 600855.466 | 422.230 | 422.190 | 0.040 | 1 |
| 124358 | 7078048.001 | 600850.483 | 422.252 | 422.230 | 0.022 | 1 |
| 124359 | 7078045.329 | 600846.461 | 422.340 | 422.280 | 0.060 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 124360 | 7078041.877 | 600841.57 | 422.386 | 422.350 | 0.036 | 1 |
| 124361 | 7078037.857 | 600836.639 | 422.423 | 422.400 | 0.023 | 1 |
| 124362 | 7078035.228 | 600832.311 | 422.498 | 422.480 | 0.018 | 1 |
| 124363 | 7078032.321 | 600828.01 | 422.587 | 422.540 | 0.047 | 1 |
| 124364 | 7078029.306 | 600823.712 | 422.627 | 422.630 | -0.003 | 1 |
| 124365 | 7078026.062 | 600819.287 | 422.710 | 422.660 | 0.050 | 1 |
| 124366 | 7078023.01 | 600814.894 | 422.797 | 422.760 | 0.037 | 1 |
| 124367 | 7078020.277 | 600810.539 | 422.859 | 422.820 | 0.039 | 1 |
| 124368 | 7078017.468 | 600806.386 | 422.942 | 422.890 | 0.052 | 1 |
| 124369 | 7078014.6 | 600802.148 | 423.027 | 422.980 | 0.047 | 1 |
| 124370 | 7078011.551 | 600797.812 | 423.089 | 423.060 | 0.029 | 1 |
| 124371 | 7078006.353 | 600790.16 | 423.261 | 423.200 | 0.061 | 1 |
| 124372 | 7077999.125 | 600780.171 | 423.378 | 423.360 | 0.018 | 1 |
| 124373 | 7077996.181 | 600775.769 | 423.434 | 423.420 | 0.014 | 1 |
| 124374 | 7077992.773 | 600771.206 | 423.511 | 423.490 | 0.021 | 1 |
| 124375 | 7077989.897 | 600766.797 | 423.581 | 423.560 | 0.021 | 1 |
| 124376 | 7077986.929 | 600762.356 | 423.665 | 423.620 | 0.045 | 1 |
| 124377 | 7077983.204 | 600757.103 | 423.742 | 423.710 | 0.032 | 1 |
| 124378 | 7077979.711 | 600751.718 | 423.854 | 423.800 | 0.054 | 1 |
| 124379 | 7077976.73 | 600747.513 | 423.932 | 423.890 | 0.042 | 1 |
| 124380 | 7077973.608 | 600743.26 | 424.025 | 423.980 | 0.045 | 1 |
| 124381 | 7077969.343 | 600737.021 | 424.156 | 424.120 | 0.036 | 1 |
| 124382 | 7077965.907 | 600731.885 | 424.218 | 424.170 | 0.048 | 1 |
| 124383 | 7077962.776 | 600727.324 | 424.268 | 424.220 | 0.048 | 1 |
| 124384 | 7077959.731 | 600722.861 | 424.289 | 424.230 | 0.059 | 1 |
| 124385 | 7077956.736 | 600718.606 | 424.338 | 424.250 | 0.088 | 1 |
| 124386 | 7077952.315 | 600712.676 | 424.365 | 424.360 | 0.005 | 1 |
| 124387 | 7077947.826 | 600704.543 | 424.525 | 424.460 | 0.065 | 1 |
| 124388 | 7077939.494 | 600694.632 | 424.602 | 424.560 | 0.042 | 1 |
| 124389 | 7077936.874 | 600690.46 | 424.662 | 424.620 | 0.042 | 1 |
| 124390 | 7077930.601 | 600681.678 | 424.784 | 424.750 | 0.034 | 1 |
| 124391 | 7077921.402 | 600668.435 | 424.943 | 424.910 | 0.033 | 1 |
| 124392 | 7077918.194 | 600663.701 | 424.959 | 424.910 | 0.049 | 1 |
| 124393 | 7077915.277 | 600659.368 | 425.029 | 424.990 | 0.039 | 1 |
| 124394 | 7077912.287 | 600654.976 | 425.044 | 425.020 | 0.024 | 1 |
| 124395 | 7077905.976 | 600645.497 | 425.166 | 425.110 | 0.056 | 1 |
| 124396 | 7077903.085 | 600641.182 | 425.258 | 425.170 | 0.088 | 1 |
| 124397 | 7077899.992 | 600637.091 | 425.340 | 425.280 | 0.060 | 1 |
| 124398 | 7077896.944 | 600632.404 | 425.450 | 425.400 | 0.050 | 1 |
| 124399 | 7077894.102 | 600628.202 | 425.542 | 425.480 | 0.062 | 1 |
| 124400 | 7077891.087 | 600623.85 | 425.667 | 425.630 | 0.037 | 1 |
| 124401 | 7077887.892 | 600619.274 | 425.813 | 425.760 | 0.053 | 1 |
| 124402 | 7077884.42 | 600614.455 | 425.924 | 425.900 | 0.024 | 1 |
| 124403 | 7077881.381 | 600610.191 | 425.994 | 425.950 | 0.044 | 1 |
| 124404 | 7077878.62 | 600605.924 | 426.029 | 425.980 | 0.049 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 124405 | 7077875.734 | 600601.578 | 426.064 | 426.040 | 0.024 | 1 |
| 124406 | 7077869.334 | 600592.483 | 426.121 | 426.080 | 0.041 | 1 |
| 124407 | 7077866.219 | 600587.602 | 426.125 | 426.100 | 0.025 | 1 |
| 124408 | 7077859.769 | 600578.334 | 426.185 | 426.130 | 0.055 | 1 |
| 124409 | 7077859.774 | 600578.327 | 426.224 | 426.130 | 0.094 | 1 |
| 124410 | 7077853.431 | 600568.895 | 426.264 | 426.200 | 0.064 | 1 |
| 124411 | 7077850.345 | 600564.29 | 426.289 | 426.240 | 0.049 | 1 |
| 124412 | 7077847.339 | 600559.944 | 426.319 | 426.290 | 0.029 | 1 |
| 124413 | 7077841.189 | 600551.153 | 426.479 | 426.440 | 0.039 | 1 |
| 124414 | 7077838.273 | 600546.749 | 426.566 | 426.530 | 0.036 | 1 |
| 124415 | 7077835.19 | 600542.431 | 426.594 | 426.600 | -0.006 | 1 |
| 124416 | 7077832.037 | 600537.96 | 426.717 | 426.690 | 0.027 | 1 |
| 124417 | 7077829.2 | 600533.769 | 426.775 | 426.700 | 0.075 | 1 |
| 124418 | 7077826.499 | 600529.711 | 426.774 | 426.770 | 0.004 | 1 |
| 124419 | 7077813.564 | 600511.568 | 426.953 | 426.890 | 0.063 | 1 |
| 124420 | 7077810.43 | 600507.034 | 427.045 | 426.990 | 0.055 | 1 |
| 124421 | 7077807.307 | 600502.685 | 427.136 | 427.080 | 0.056 | 1 |
| 124422 | 7077801.18 | 600493.919 | 427.331 | 427.280 | 0.051 | 1 |
| 124423 | 7077797.976 | 600489.511 | 427.422 | 427.360 | 0.062 | 1 |
| 124424 | 7077794.911 | 600484.739 | 427.483 | 427.420 | 0.063 | 1 |
| 124425 | 7077791.498 | 600479.845 | 427.555 | 427.480 | 0.075 | 1 |
| 124426 | 7077787.875 | 600474.438 | 427.582 | 427.560 | 0.022 | 1 |
| 124427 | 7077784.675 | 600469.79 | 427.656 | 427.610 | 0.046 | 1 |
| 124428 | 7077781.368 | 600465.159 | 427.704 | 427.680 | 0.024 | 1 |
| 124429 | 7077778.236 | 600460.678 | 427.768 | 427.740 | 0.028 | 1 |
| 124430 | 7077775.193 | 600456.014 | 427.819 | 427.760 | 0.059 | 1 |
| 124431 | 7077772.092 | 600451.564 | 427.819 | 427.810 | 0.009 | 1 |
| 124432 | 7077769.019 | 600447.011 | 427.885 | 427.840 | 0.045 | 1 |
| 124433 | 7077765.851 | 600442.281 | 427.936 | 427.890 | 0.046 | 1 |
| 124434 | 7077762.762 | 600437.879 | 428.017 | 427.970 | 0.047 | 1 |
| 124435 | 7077759.52 | 600433.28 | 428.102 | 428.090 | 0.012 | 1 |
| 124436 | 7077756.48 | 600428.72 | 428.199 | 428.150 | 0.049 | 1 |
| 124437 | 7077752.967 | 600423.792 | 428.246 | 428.220 | 0.026 | 1 |
| 124438 | 7077749.3 | 600419.024 | 428.329 | 428.290 | 0.039 | 1 |
| 124439 | 7077746.185 | 600414.364 | 428.364 | 428.350 | 0.014 | 1 |
| 124440 | 7077742.98 | 600409.662 | 428.441 | 428.430 | 0.011 | 1 |
| 124441 | 7077739.928 | 600405.293 | 428.489 | 428.480 | 0.009 | 1 |
| 124442 | 7077728.489 | 600388.497 | 428.725 | 428.720 | 0.005 | 1 |
| 124443 | 7077721.969 | 600379.356 | 428.942 | 428.920 | 0.022 | 1 |
| 124444 | 7077715.955 | 600370.808 | 429.104 | 429.080 | 0.024 | 1 |
| 124445 | 7077712.771 | 600366.223 | 429.171 | 429.150 | 0.021 | 1 |
| 124446 | 7077703.323 | 600352.616 | 429.296 | 429.290 | 0.006 | 1 |
| 124447 | 7077699.948 | 600347.534 | 429.316 | 429.300 | 0.016 | 1 |
| 124448 | 7077696.582 | 600342.737 | 429.329 | 429.300 | 0.029 | 1 |
| 124449 | 7077690.174 | 600333.534 | 429.394 | 429.370 | 0.024 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 124450 | 7077687.137 | 600329.057 | 429.439 | 429.400 | 0.039 | 1 |
| 124451 | 7077683.915 | 600324.669 | 429.492 | 429.460 | 0.032 | 1 |
| 124452 | 7077670.885 | 600305.832 | 429.797 | 429.770 | 0.027 | 1 |
| 124453 | 7077667.75 | 600301.322 | 429.862 | 429.840 | 0.022 | 1 |
| 124454 | 7077664.66 | 600296.776 | 429.894 | 429.870 | 0.024 | 1 |
| 124455 | 7077654.812 | 600282.909 | 430.161 | 430.120 | 0.041 | 1 |
| 124456 | 7077651.774 | 600278.424 | 430.203 | 430.200 | 0.003 | 1 |
| 124457 | 7077636.818 | 600256.797 | 430.628 | 430.610 | 0.018 | 1 |
| 124458 | 7077626.053 | 600241.859 | 430.941 | 430.890 | 0.051 | 1 |
| 124459 | 7077622.67 | 600236.913 | 431.050 | 431.000 | 0.050 | 1 |
| 124460 | 7077616.06 | 600226.995 | 431.144 | 431.100 | 0.044 | 1 |
| 124461 | 7077612.985 | 600222.289 | 431.174 | 431.130 | 0.044 | 1 |
| 124462 | 7077609.814 | 600217.561 | 431.216 | 431.170 | 0.046 | 1 |
| 124463 | 7077606.657 | 600212.954 | 431.268 | 431.240 | 0.028 | 1 |
| 124464 | 7077603.475 | 600208.254 | 431.357 | 431.320 | 0.037 | 1 |
| 124465 | 7077596.061 | 600197.496 | 431.504 | 431.480 | 0.024 | 1 |
| 124466 | 7077592.971 | 600192.894 | 431.571 | 431.540 | 0.031 | 1 |
| 124467 | 7077589.875 | 600188.31 | 431.618 | 431.580 | 0.038 | 1 |
| 124468 | 7077586.631 | 600183.586 | 431.654 | 431.620 | 0.034 | 1 |
| 124469 | 7077572.671 | 600163.225 | 431.874 | 431.820 | 0.054 | 1 |
| 124470 | 7077569.245 | 600158.204 | 431.872 | 431.820 | 0.052 | 1 |
| 124471 | 7077566.345 | 600154.037 | 431.946 | 431.890 | 0.056 | 1 |
| 124472 | 7077563.558 | 600149.718 | 431.992 | 431.930 | 0.062 | 1 |
| 124473 | 7077559.742 | 600144.226 | 432.018 | 431.950 | 0.068 | 1 |
| 124474 | 7077556.985 | 600140.229 | 432.104 | 432.050 | 0.054 | 1 |
| 124475 | 7077554.264 | 600136.35 | 432.180 | 432.140 | 0.040 | 1 |
| 124476 | 7077545.542 | 600123.931 | 432.383 | 432.330 | 0.053 | 1 |
| 124477 | 7077542.815 | 600120.169 | 432.465 | 432.400 | 0.065 | 1 |
| 124478 | 7077539.723 | 600115.503 | 432.522 | 432.480 | 0.042 | 1 |
| 124479 | 7077518.969 | 600085.515 | 432.780 | 432.730 | 0.050 | 1 |
| 124480 | 7080032.509 | 599249.633 | 417.570 | 417.570 | 0.000 | 1 |

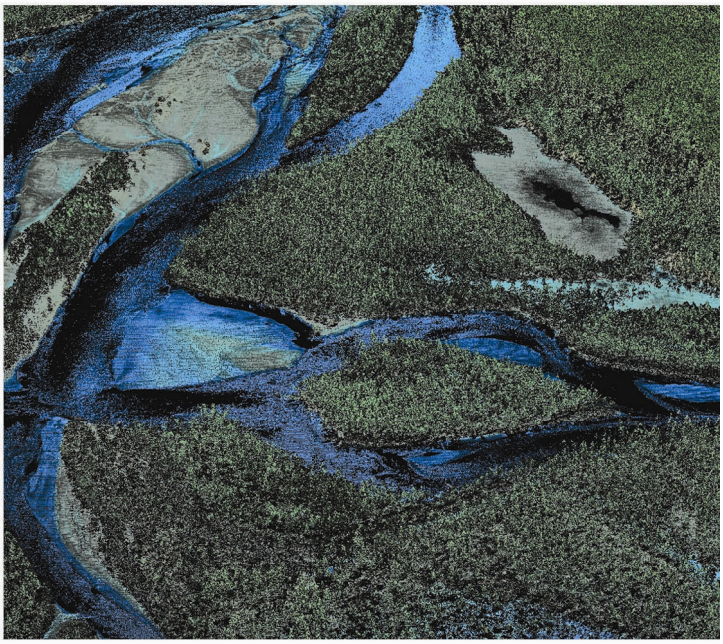
# LiDAR REMOTE SENSING

## ALASKA PIPELINE • ALASKA

(Delivery 3 – 5/23/2011)








## ALASKA DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

**TRENT HUBBARD** - 3354 College Road - Fairbanks, AK 99709

**WATERSHED SCIENCES** • 517 SW 2nd Street, Suite 400 - Corvallis, OR 97333

# LiDAR Remote Sensing Data Collection:

## Alaska Pipeline, AK

### Delivery 3

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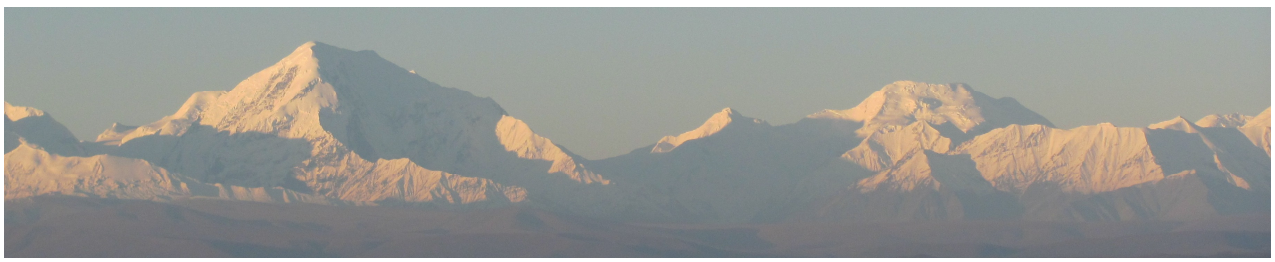
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# 1. Overview

Watershed Sciences, Inc. (WS) is collecting Light Detection and Ranging (LiDAR) data of the Alaska Pipeline for the Alaska Department of Natural Resources. LiDAR data for Delivery 3 was collected between October 2nd and 4th, 2010 (**Figure 1**). Delivery 3 includes 39,744 acres within the requested area. This area was expanded to include a 100m buffer to ensure complete coverage and adequate point densities around survey boundaries, resulting in 43,976 acres of delivered data. This area includes portions of the Alaska Highway 2 east of the Tetlin Junction to Paradise Hill. Accuracy and density data will continue to be updated as additional data is processed.

***Figure 1.*** *Alaska Pipeline survey delivery status overview.*

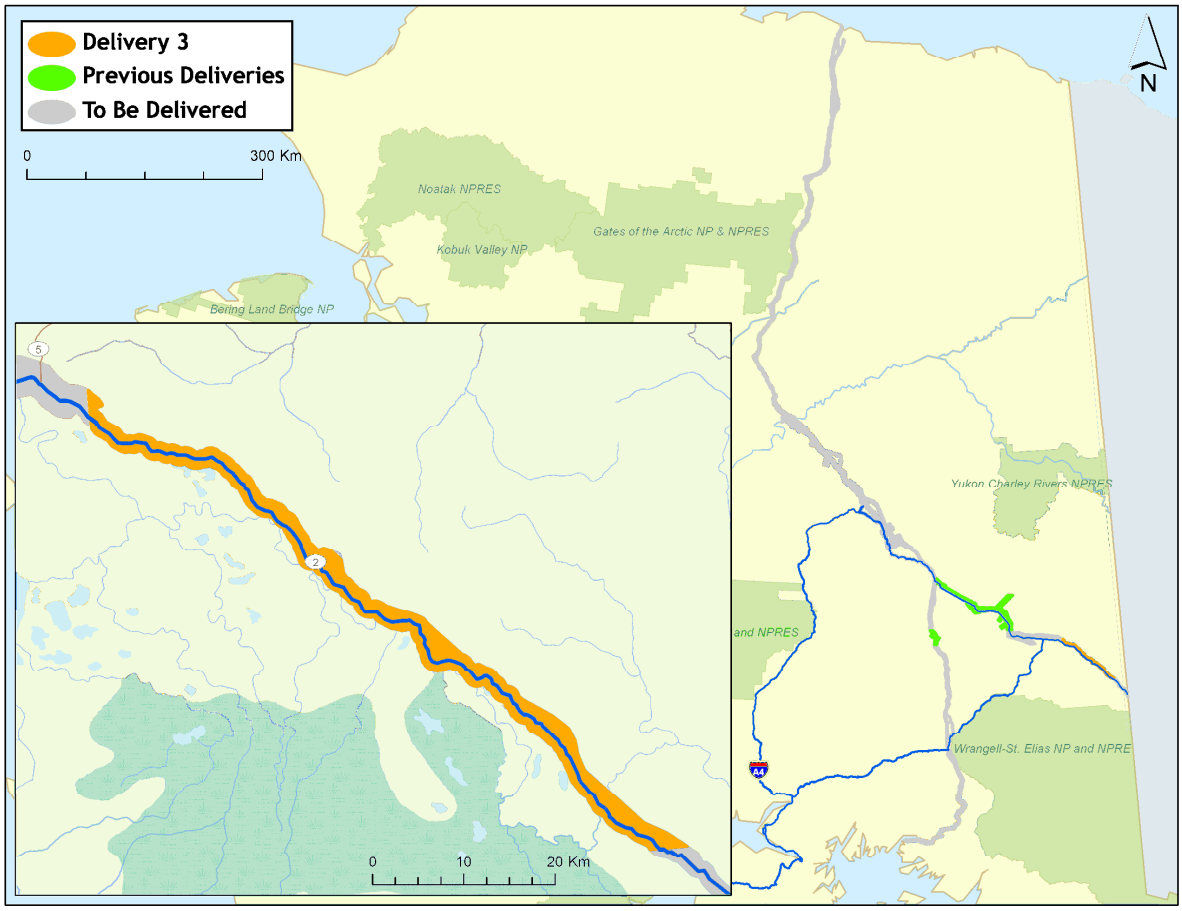



***Table 1.*** *Alaska Pipeline, LiDAR deliveries to date.*

| Delivery | UTM Zone(s) | Date | Total Acres Flown | AOI Acres |
|---|---|---|---|---|
| **1** | 6, 7 | March 9, 2011 | 121,746 | 117,357 |
| **2** | 6 | March 31, 2011 | 99,594 | 94,885 |
| **3** | 7 | May 23, 2011 | 43,976 | 39,744 |

# 2. Acquisition

## 2.1 Airborne Survey – Instrumentation and Methods

The LiDAR survey utilized a Leica ALS60 sensor in a Cessna Caravan 208Bs. The Leica systems were set to acquire 150,000 laser pulses per second (i.e., 150 kHz pulse rate) and flown at 1500 meters above ground level (AGL), capturing a scan angle of ±14$^{o}$ from nadir when clouds and terrain permitted. With these flight parameters, the laser swath width is 638m and the laser pulse footprint is 34cm. These settings varied depending on cloud cover and terrain but were consistently adjusted to yield an average native pulse density of ≥8 pulses per square meter over terrestrial surfaces. It is not uncommon for some types of surfaces (e.g. dense vegetation or water) to return fewer pulses than the laser originally emitted. These discrepancies between 'native' and 'delivered' density will vary depending on terrain, land cover, and the prevalence of water bodies.



*The Cessna Caravan is a stable platform, ideal for flying slow and low for high density projects. A Leica ALS60 sensor head installed in the Caravan is shown on the left.*

All areas were surveyed with an opposing flight line side-lap of ≥60% (≥100% overlap) to reduce laser shadowing and increase surface laser painting. The Leica laser systems allow up to four range measurements (returns) per pulse, and all discernable laser returns were processed for the output dataset.

To accurately solve for laser point position (geographic coordinates x, y, z), the positional coordinates of the airborne sensor and the attitude of the aircraft were recorded continuously throughout the LiDAR data collection mission. Aircraft position was measured twice per second (2 Hz) by an onboard differential GPS unit. 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/sensor position and attitude data are indexed by GPS time.

## 2.2 Ground Survey – Instrumentation and Methods

### *2.2.1 Monumentation*




Watershed Sciences coordinated with McClintock Land Associates (MLA, Alaska Professional Licensed Surveyor), of Eagle River, AK to determine proposed monument locations to support aerial acquisition. MLA established survey control monuments for the project area based on the proposed locations, areas with reasonable access, GPS visibility and proximity to the mission area. MLA established eight new monuments (**Table 2**) within the Delivery 3 calibration area. The MLA monumentation was done with 5/8" x 30" rebar topped with a metal cap stamped with "MLA-WSI" the monument ID, and the year of establishment. MLA provided professional supervision and oversight to all survey aspects of this project, certified all monuments and provided additional independent accuracy check points (see Section 5.4, Appendix B). A full report of the survey will be provided with the final delivery report.

### *2.2.2 Control for Airborne Surveys*

During the LiDAR survey, static (1 Hz recording frequency) ground surveys were conducted over the survey control monuments. Monument coordinates are provided in **Table 2** and shown in **Figure 2** for the current delivery. After the airborne survey, the static GPS data were provided to MLA for incorporation in the computation of the monument coordinates. MLA processed the static GPS data using triangulation with Continuously Operating Reference Stations (CORS). Both WSI and MLA checked coordinates using the Online Positioning User Service (OPUS[1]) to quantify daily variance. Multiple sessions were processed over the same monument to confirm antenna height measurements and reported position accuracy.

Indexed by time, these GPS data are used to correct the continuous onboard measurements of aircraft position recorded throughout the mission. Control monuments were located within 13 nautical miles of the survey area as per the contract.



Trimble R7 GPS equipment set up in the Alaska Pipeline study area.

[1] Online Positioning User Service (OPUS) is run by the National Geodetic Survey to process corrected monument positions.

### *2.2.3 Instrumentation*

For this delivery area, a Trimble GPS receiver model R7 with Zephyr Geodetic antenna with ground plane was deployed for all static control. MLA provided GLONASS capable Topcon GPS receivers for additional ground survey support. A Trimble model R8 GNSS unit was used for collecting check points using real time kinematic (RTK) survey techniques. For RTK data, the collector begins recording after remaining stationary for 5 seconds then calculating the pseudo range position from at least three epochs with the relative error under 1.5cm horizontal and 2cm vertical. All GPS measurements are made with dual frequency L1-L2 receivers with carrier-phase correction.

***Table 2.*** *Base Station control coordinates for Alaska Pipeline Delivery 3.*

| Base Station ID | Datum: NAD83 (CORS96) | | GRS80 |
|---|---|---|---|
| | Latitude | Longitude | Ellipsoid Z (meters) |
| 28A | 63°17'08.79311"N | 142°31'06.34750"W | 578.968 |
| 28B | 63°10'28.09305"N | 142°08'35.28302"W | 563.941 |
| 28C | 63°19'05.80483"N | 142°38'13.08701"W | 528.825 |
| 29A | 63°03'10.20715"N | 141°51'07.91911"W | 532.287 |
| 29A1 | 63°03'17.39325"N | 141°53'00.09760"W | 534.442 |
| 29B | 63°02'12.72074"N | 141°49'26.08673"W | 546.644 |
| 30A | 62°46'38.44063"N | 141°15'09.15433"W | 664.108 |
| 30B | 62°45'45.94099"N | 141°13'40.69444"W | 642.402 |

### *2.2.3 Methodology*

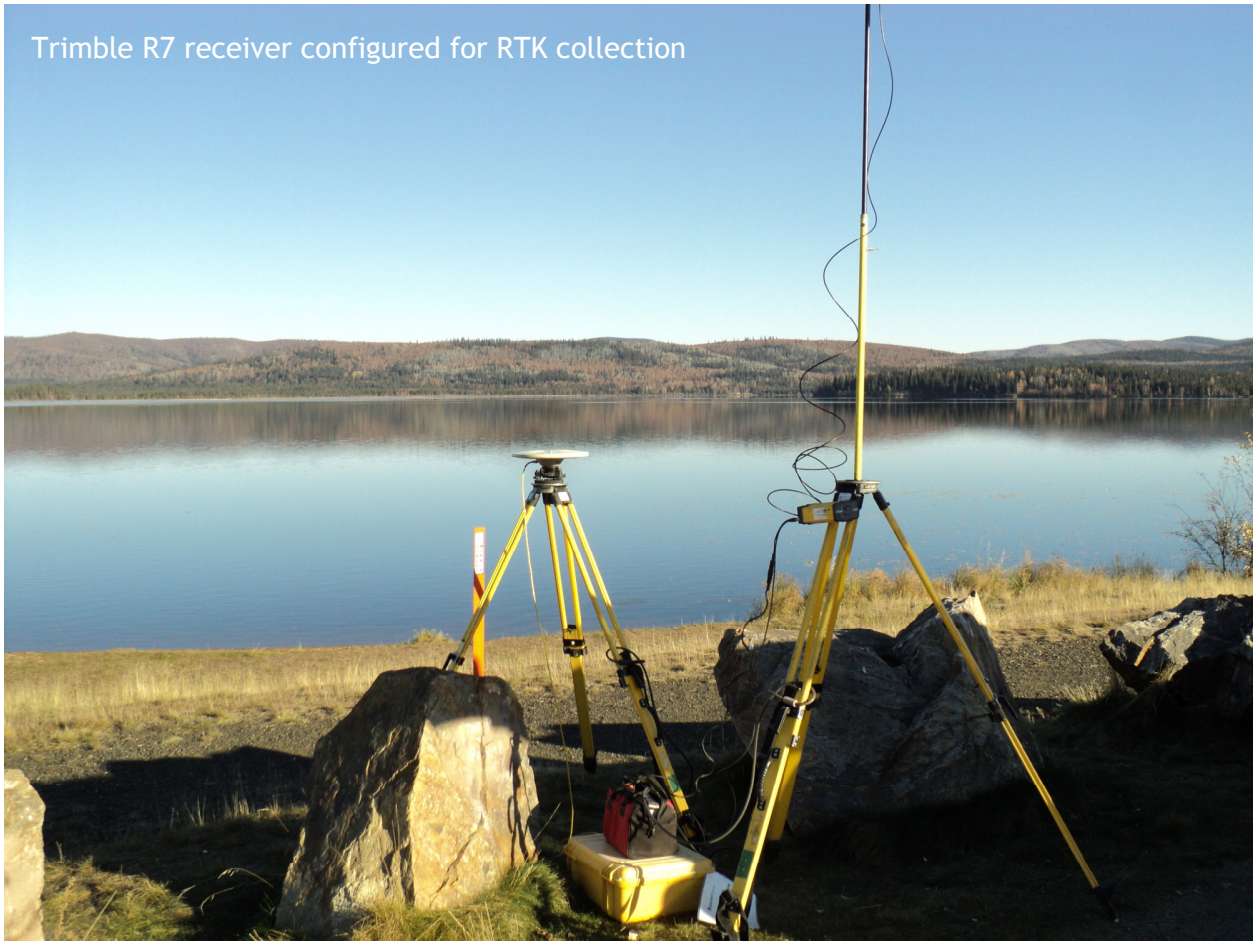



The aircraft was assigned a ground crew member with two Trimble R7 receivers and an R8 receiver. The aircraft is further supported as necessary by an MLA surveyor (AK PLS) with two or more survey grade Topcon Receivers. The ground crew vehicles are equipped with standard field survey supplies and equipment including safety materials. All control monuments are observed for a minimum of two survey sessions lasting no fewer than 6 hours. At the beginning of every session the tripod and antenna are reset, resulting in two independent instrument heights and data files. Data is collected at a rate of 1Hz using a 10 degree mask on the antenna.

After the flight, the ground crew uploads the GPS data to WSI's office for QA/QC review and processing. The static GPS data were also provided to the MLA project surveyor for final computation and review of the control coordinates. MLA provided calculated geodetic positions for all controls, which were then used to process LiDAR data.

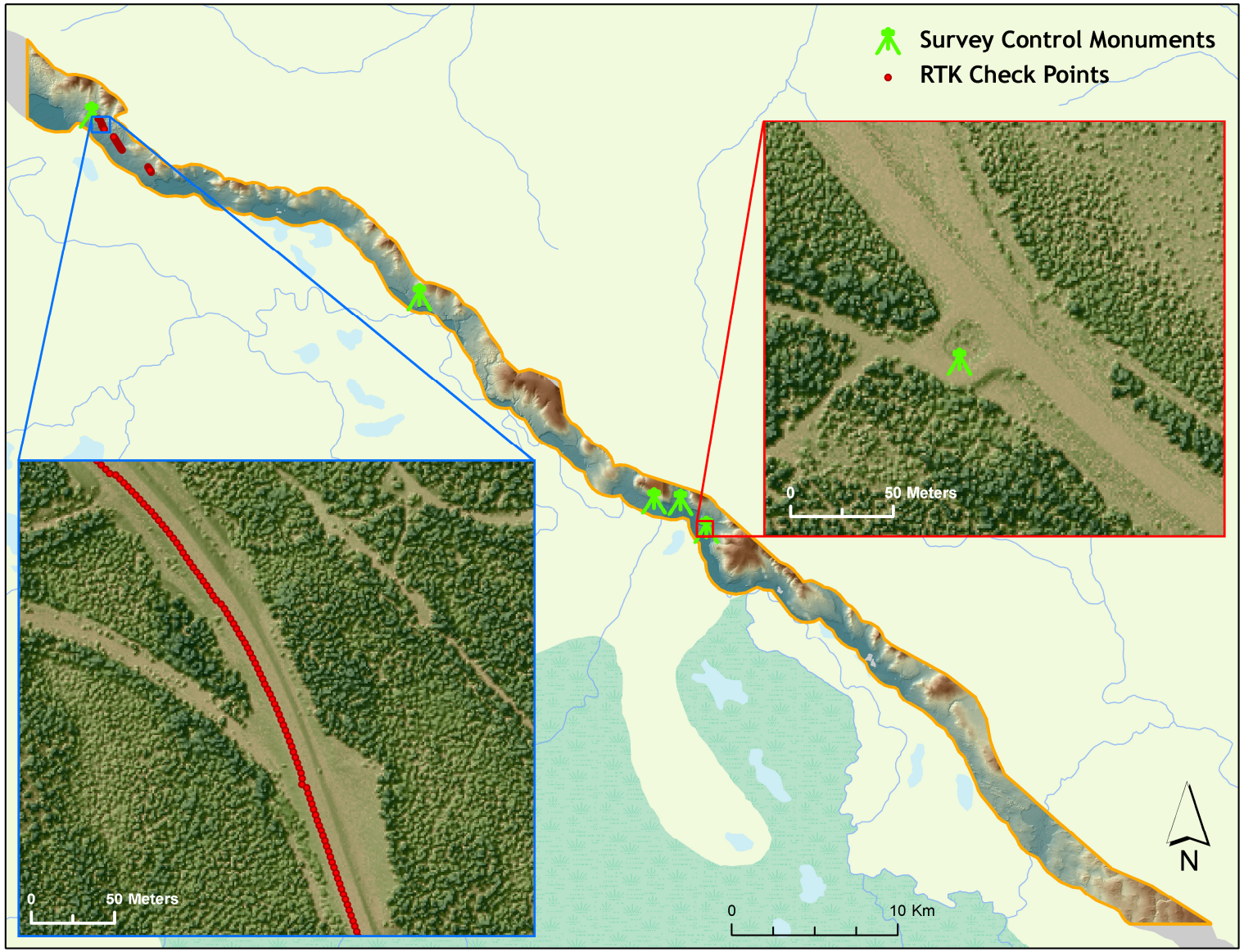
RTK and aircraft mounted GPS measurements are made during periods with PDOP[2] less than or equal to 3.0 and with at least 6 satellites in view of both a stationary reference receiver and the roving receiver. Static GPS data collected in a continuous session average the high PDOP into the final solution in the method used by CORS stations. RTK positions are collected on bare earth locations such as paved, gravel or stable dirt roads, and other locations where the ground is clearly visible (and is likely to remain visible) from the sky during the data acquisition and RTK measurement period(s).

In order to facilitate comparisons with LiDAR measurements, RTK measurements are not taken on highly reflective surfaces such as center line stripes or lane markings on roads. RTK points were taken no closer than one meter to any nearby terrain breaks such as road edges or drop offs.


Trimble R7 receiver configured for RTK collection

[2]PDOP: Point Dilution of Precision is a measure of satellite geometry, the smaller the number the better the geometry between the point and the satellites.

***Figure 2**. WSI RTK check points and control monument locations used in Delivery 3 of the Alaska Pipeline LiDAR Survey.*



# 3. LiDAR Data Processing

## 3.1 Applications and Work Flow Overview

1. Resolved kinematic corrections for aircraft position data using kinematic aircraft GPS and static ground GPS data.

   **Software:** Waypoint GPS v.8.10, Trimble Geomatics Office v.1.62
2. Developed a smoothed best estimate of trajectory (SBET) file that blends post-processed aircraft position with attitude data. Sensor head position and attitude were calculated throughout the survey. The SBET data were used extensively for laser point processing.

   **Software:** IPAS v.1.35
3. Calculated laser point position by associating SBET position to each laser point return time, scan angle, intensity, etc. Created raw laser point cloud data for the entire survey in *.las (ASPRS v. 1.2) format.

   **Software:** ALS Post Processing Software v.2.70
4. Imported raw laser points into manageable blocks (less than 500 MB) to perform manual relative accuracy calibration and filter for pits/birds. Ground points were then classified for individual flight lines (to be used for relative accuracy testing and calibration).

   **Software:** TerraScan v.10.009
5. Using ground classified points per each flight line, the relative accuracy was tested. Automated line-to-line calibrations were then performed for system attitude parameters (pitch, roll, heading), mirror flex (scale) and GPS/IMU drift. Calibrations were performed on ground classified points from paired flight lines. Every flight line was used for relative accuracy calibration.

   **Software:** TerraMatch v.10.006
6. Position and attitude data were imported. Resulting data were classified as ground and non-ground points. Statistical absolute accuracy was assessed via direct comparisons of ground classified points to ground RTK survey data. Data were then converted to orthometric elevations (NAVD88) by applying a Geoid09 correction. **Software:** TerraScan v.10.009, TerraModeler v.10.004
7. Bare Earth models were created as a triangulated surface and exported as ArcInfo ASCII grids at a 1 meter pixel resolution. Highest Hit models were created for any class at 1 meter grid spacing and exported as ArcInfo ASCII grids. Vegetation models were created for all vegetation points 20cm and above the ground model at a 1m grid spacing and exported as ArcInfo ASCII grids.

   **Software:** TerraScan v.10.009, ArcMap v. 9.3.1, TerraModeler v.10.004

## 3.2 Aircraft Kinematic GPS and IMU Data

LiDAR survey datasets were referenced to the 1 Hz static ground GPS data collected over pre-surveyed monuments with known coordinates. While surveying, the aircraft collected 2 Hz kinematic GPS data, and the onboard inertial measurement unit (IMU) collected 200 Hz aircraft attitude data. Waypoint GPS v.8.10 was used to process the kinematic corrections for the aircraft. The static and kinematic GPS data were then post-processed after the survey to

obtain an accurate GPS solution and aircraft positions. IPAS v.1.35 was used to develop a trajectory file that includes corrected aircraft position and attitude information. The trajectory data for the entire flight survey session were incorporated into a final smoothed best estimated trajectory (SBET) file that contains accurate and continuous aircraft positions and attitudes.

## 3.3 Laser Point Processing

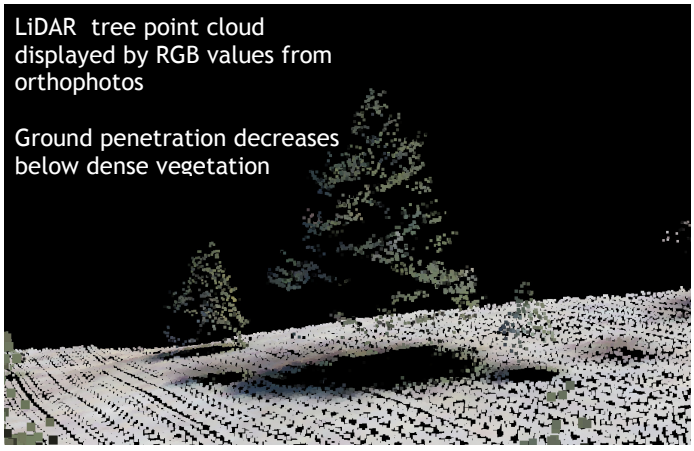
Laser point coordinates were computed using the IPAS and ALS Post Processor software suites based on independent data from the LiDAR system (pulse time, scan angle), and aircraft trajectory data (SBET). Laser point returns (first through fourth) were assigned an associated (x, y, z) coordinate along with unique intensity values (0-255). The data were output into large LAS v. 1.2 files with each point maintaining the corresponding scan angle, return number (echo), intensity, and x, y, z (easting, northing, and elevation) information.

These initial laser point files were too large for subsequent processing. To facilitate laser point processing, bins (polygons) were created to divide the dataset into manageable sizes (< 500 MB). Flightlines and LiDAR data were then reviewed to ensure complete coverage of the survey area and positional accuracy of the laser points.

Laser point data were imported into processing bins in TerraScan, and manual calibration was performed to assess the system offsets for pitch, roll, heading and scale (mirror flex). Using a geometric relationship developed by Watershed Sciences, each of these offsets was resolved and corrected if necessary.

LiDAR points were then filtered for noise, pits (artificial low points), and birds (true birds as well as erroneously high points) by screening for absolute elevation limits, isolated points and height above ground. Each bin was then manually inspected for remaining pits and birds and spurious points were removed. In a bin containing approximately 7.5-9.0 million points, an average of 50-100 points are typically found to be artificially low or high. Common sources of non-terrestrial returns are clouds, birds, vapor, haze, decks, brush piles, etc.

Internal calibration was refined using TerraMatch. Points from overlapping lines were tested for internal consistency and final adjustments were made for system misalignments (i.e., pitch, roll, heading offsets and scale). Automated sensor attitude and scale corrections yielded 3-5 cm improvements in the relative accuracy. Once system misalignments were corrected, vertical GPS drift was then resolved and removed per flight line, yielding a slight improvement (<1 cm) in relative accuracy.




The TerraScan software suite is designed specifically for classifying near-ground points (Soininen, 2004). The processing sequence began by 'removing' all points that were not 'near' the earth based on geometric constraints used to evaluate

multi-return points. The resulting bare earth (ground) model was visually inspected and additional ground point modeling was performed in site-specific areas to improve ground detail. This manual editing of ground often occurs in areas with known ground modeling deficiencies, such as: bedrock outcrops, cliffs, deeply incised stream banks, and dense vegetation. In some cases, automated ground point classification erroneously included known vegetation (i.e., understory, low/dense shrubs, etc.). These points were manually reclassified. Ground surface rasters were then developed from triangulated irregular networks (TINs) of ground points.

To develop the highest hit and vegetation models, buildings and structures were classified through automated point processing algorithms and then manually inspected and edited during the ground model inspection. Typically, manual editing of building classification was necessary where dense canopy was immediately proximate to buildings, or where structures such as utility poles or fences mimicked vegetation.

The remaining points not classified as ground, buildings, or error points were separated into two vegetation classes; Low Vegetation consisting of all returns ≤20cm from the ground, and Medium Vegetation consisting of all returns >20cm from the ground. This distinction was necessary because some potential for unclassified ground exists in the dataset. Vegetation classified returns within 20cm of the ground have higher potential to be artifacts of the dataset caused by minor offsets between flightlines (typically <10cm), isolated noise points, or abrupt discrete terrain features that did not get classified as ground (i.e. small boulders or sharp cliffs). The majority of points classified as low vegetation are valid returns, so the class was retained in the dataset to be incorporated into analyses at the user's discretion.

**Table 3.** ASPRS classification definitions for the Alaska Pipeline LiDAR survey

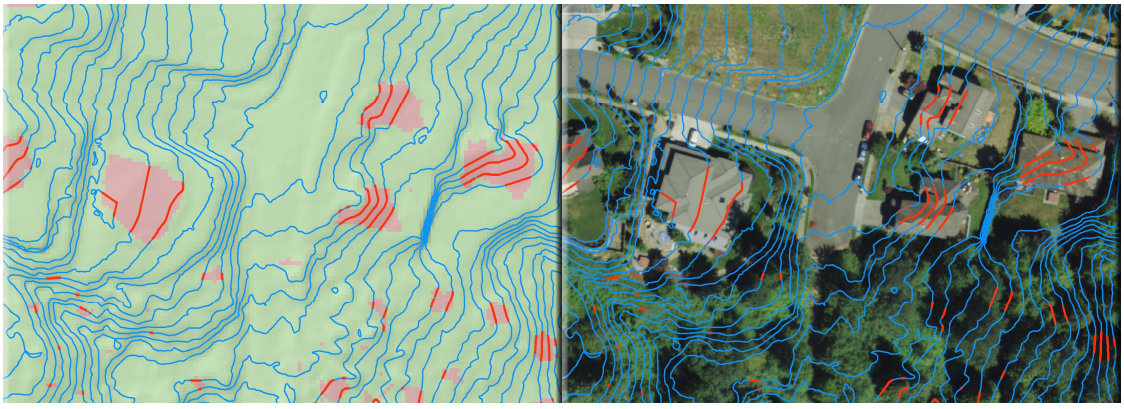
| ASPRS Class | Definition |
|---|---|
| 2 | Ground |
| 3 | Low Vegetation |
| 4 | Medium Vegetation |
| 6 | Buildings/Man-made structures |
| 7 | Noise/error points |
| 9 | Water |
| 15 | Pipeline |

## 3.4 Contour Development

Contour lines were derived at 1 meter intervals from ground-classified LiDAR point data using TerraSolid processing software in MicroStation v. 8.1. Contour generation from LiDAR point data requires a thinning operation in order to reduce contour sinuosity. Parameters for these operations are: thinning elevation bounds: +/- 0.07m; search radius: 6.09m. The thinning operation reduces point density where topographic change is minimal (flat surfaces) while preserving resolution where topographic change is present. The total sum of potential error in vertical position is equal to twice the point processing limits (0.14m) plus twice the 2-sigma absolute vertical accuracy value for this dataset.

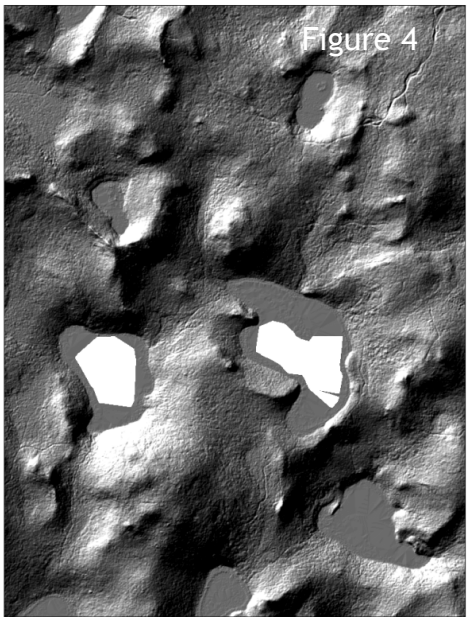
Ground point density rasters were created within MicroStation using a 1 meter step resolution and a 2 meter sampling radius. Areas with less than 0.25 ground-classified points per square meter were considered "sparse" and areas with higher densities were considered "covered". The ground point density raster data are in ESRI GRID format and have a 1 meter pixel resolution. The contour lines were intersected with ground point density raster data, allowing the addition of a confidence attribute to contour lines. Contour lines over "sparse" areas have low confidence, while contour lines over "covered" areas have a high confidence. Areas with low ground point density are commonly beneath buildings and bridges, in locations with dense vegetation, over water, and in other areas where laser penetration to the ground surface is impeded. **Figure 3** is an example of a ground point density raster and contour lines.

***Figure 3**. Elevation contours over LiDAR ground-classified point density raster (left) and true-color aerial photograph (right). Red indicates low ground point density and blue represents high density.*

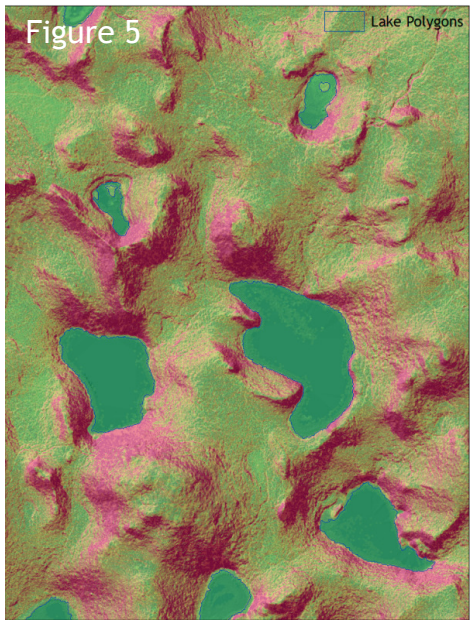


## 3.5 Hydro-Flattening

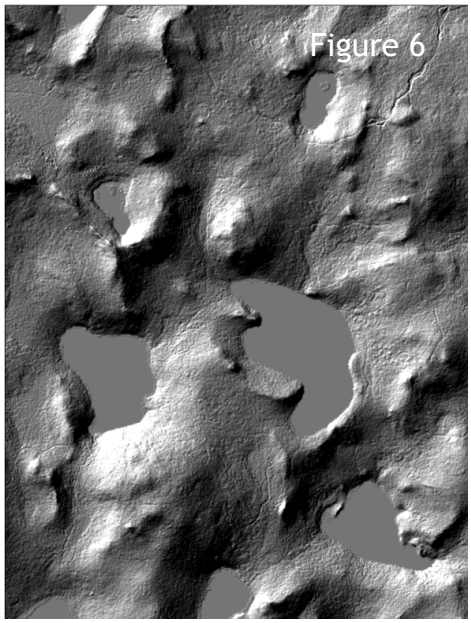
Lakes and other closed water bodies with surface area >150 $m^2$ were flattened to a consistent water level. The hydro-flattening process eliminates artifacts in the digital terrain model caused by both increased variability in ranges or dropouts in laser returns due to the low reflectivity of water (**Figure 4**). As per the project specifications, rivers and streams were not hydro-flattened.




Hydro-flattening of closed water bodies was performed through a combination of automated and manual detection and adjustment techniques designed to identify lake boundaries and water levels. Boundary polygons were developed using an algorithm which weights LiDAR-derived slopes, intensities, and return densities to detect the lake edge. The lake edges were then manually reviewed and edited in a 3-D environment. Once polygons were developed, the lake elevations were computed from the filtered LiDAR returns (**Figure 5**).




Returns from the water surface within each polygon were filtered and inspected for false low points during the initial ground modeling process described previously (Section 3.3). The elevation of each lake was computed as 5-cm above the minimum elevation of filtered water surface cells within the lake polygon. This approach ensures that all spurious returns off the water surface (both artificially high and low) were excluded from lake level assessment.




Lake-boundary polygons were then incorporated into the final terrain model and enforced as hard-breaklines. The initial ground classified points falling within lake polygons were reclassified as water points [to omit them from the final ground model] and replaced with the flat water surface of the lake boundary hydrolines (**Figure 6**).

# 4. LiDAR Accuracy Assessment

## 4.1 Laser Noise and Relative Accuracy

*Laser Noise*
For any given target, laser noise is the breadth of the data cloud per laser return (i.e., last, first, etc.). Lower intensity surfaces (roads, rooftops, still/calm water) experience higher laser noise. The laser noise range for this survey was approximately 0.02 meters.

*Relative Accuracy*
Relative accuracy refers to the internal consistency of the data set - the ability to place a laser point in the same location over multiple flight lines, GPS conditions, and aircraft attitudes. Affected by system attitude offsets, scale, and GPS/IMU drift, internal consistency is measured as the divergence between points from different flight lines within an overlapping area. Divergence is most apparent when flight lines are opposing. When the LiDAR system is well calibrated, the line-to-line divergence is low (<10 cm). See Appendix A for further information on sources of error and operational measures that can be taken to improve relative accuracy.

**Relative Accuracy Calibration Methodology**

1. Manual System Calibration: Calibration procedures for each mission require solving geometric relationships that relate measured swath-to-swath deviations to misalignments of system attitude parameters. Corrected scale, pitch, roll and heading offsets were calculated and applied to resolve misalignments. The raw divergence between lines was computed after the manual calibration was completed and reported for each survey area.
2. Automated Attitude Calibration: All data were tested and calibrated using TerraMatch automated sampling routines. Ground points were classified for each individual flight line and used for line-to-line testing. System misalignment offsets (pitch, roll and heading) and scale were solved for each individual mission and applied to respective mission datasets. The data from each mission were then blended when imported together to form the entire area of interest.
3. Automated Z Calibration: Ground points per line were used to calculate the vertical divergence between lines caused by vertical GPS drift. Automated Z calibration was the final step employed for relative accuracy calibration.

## 4.2 Absolute Accuracy

Laser point absolute accuracy is largely a function of laser noise and relative accuracy. To minimize these contributions to absolute error, a number of noise filtering and calibration procedures were performed prior to evaluating absolute accuracy. The LiDAR quality assurance process uses the data from the real-time kinematic (RTK) ground survey conducted in the AOI. For Delivery 3, **602 RTK** GPS measurements were collected on hard surfaces distributed among multiple flight swaths for a total of 5152 points across all delivered data. Suitable and accessible hard-surfaces limited the number of RTK points able to be collected. To assess absolute accuracy the location coordinates of these known RTK ground points were compared to those calculated for the closest ground-classified laser points.

The vertical accuracy of the LiDAR data is described as the mean and standard deviation (sigma ~ $\sigma$) of divergence between LiDAR point coordinates and RTK ground survey point coordinates. To provide a sense of the model predictive power of the dataset, the root mean square error (RMSE) for vertical accuracy is also provided. These statistics assume the error distributions for x, y, and z are normally distributed, thus the skew and kurtosis of distributions are considered when evaluating error statistics.

Statements of statistical accuracy apply to fixed terrestrial surfaces only and may not be applied to areas of dense vegetation or steep terrain (See Appendix A).

# 5. Study Area Results

Summary statistics for point resolution and accuracy (relative and absolute) of the LiDAR data collected in the Alaska Delivery 3 survey area have been added to previously delivered data. Cumulative results are presented below in terms of central tendency, variation around the mean, and the spatial distribution of the data (for point resolution by processing bin).

The initial dataset, acquired to be ≥8 points per square meter, was filtered as described previously to remove spurious or inaccurate points. Additionally, some types of surfaces (i.e., dense vegetation, breaks in terrain, water, steep slopes) may return fewer pulses (delivered density) than the laser originally emitted (native density).

Ground classifications were derived from automated ground surface modeling and manual, supervised classifications where it was determined that the automated model had failed. Ground return densities will be lower in areas of dense vegetation, water, or buildings.

## Data Summary:

***Table 4****. LiDAR Resolution and Accuracy - Specifications and Achieved Values*

| | | Targeted | Achieved |
|---|---|---|---|
| **Resolution:** | **UTM 6** | ≥ 8 points/$m^2$ | 8.97 points/$m^2$ |
| | **UTM 7** | | 8.68 points/$m^2$ |
| **Vertical Accuracy (1 σ):** | | <13 cm | 3.1 cm |

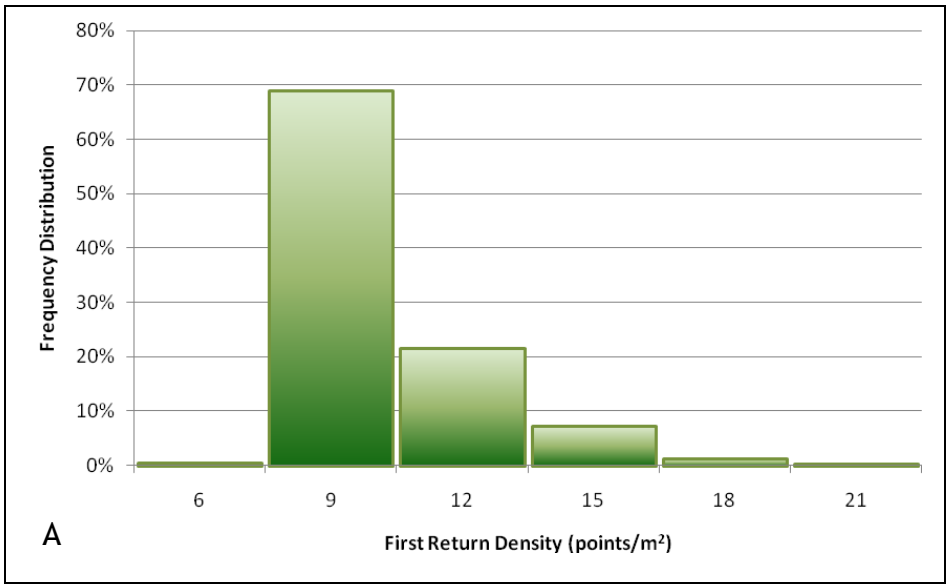
## 5.1 Data Density/Resolution

**Figures 9 - 12** display the distribution of average native and ground point densities for each processing bin. Density data will continue to be updated as data is processed and delivered.

LiDAR data resolution for Alaska Pipeline deliveries to date:

| | UTM 6 | UTM 7 |
|---|---|---|
| Average Point (First Return) Density | 8.97 points/$m^2$ | 8.68 points/$m^2$ |
| Average Ground Point Density | 2.71 points/$m^2$ | 2.90 points/$m^2$ |

***Figure 7**. Density distribution for first return laser points for UTM 6 (A) and UTM 7 (B)*



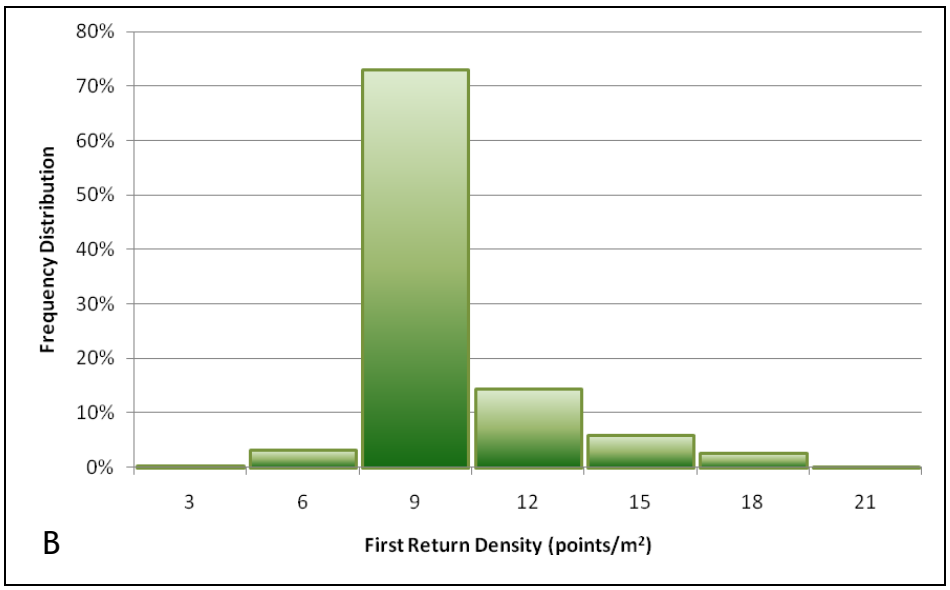



***Figure 8**. Density distribution for ground classified laser points for UTM 6 (A) and UTM 7 (B)*

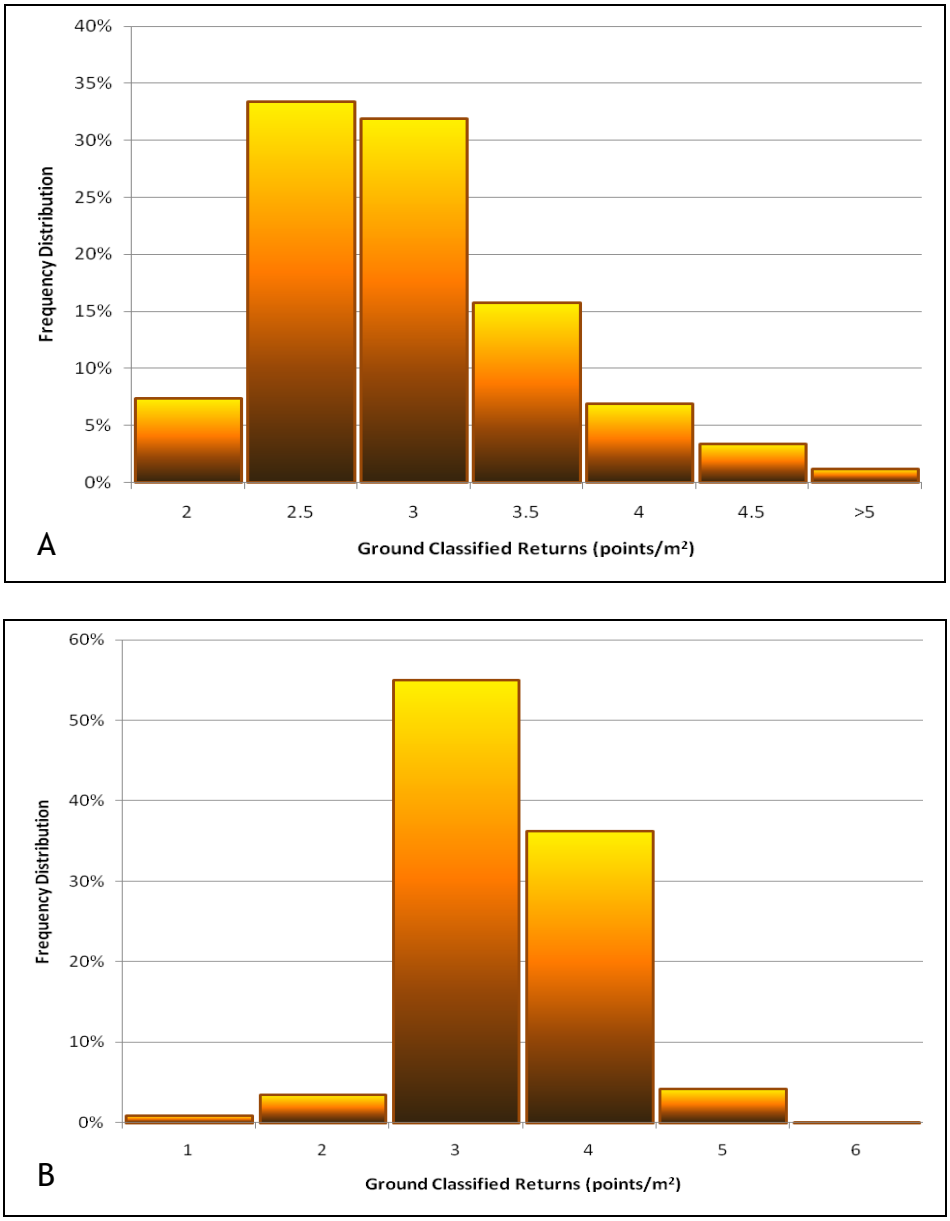


***Figure 9.*** *Density distribution map for ground and first return points by processing bin in Delivery 1, UTM 6*

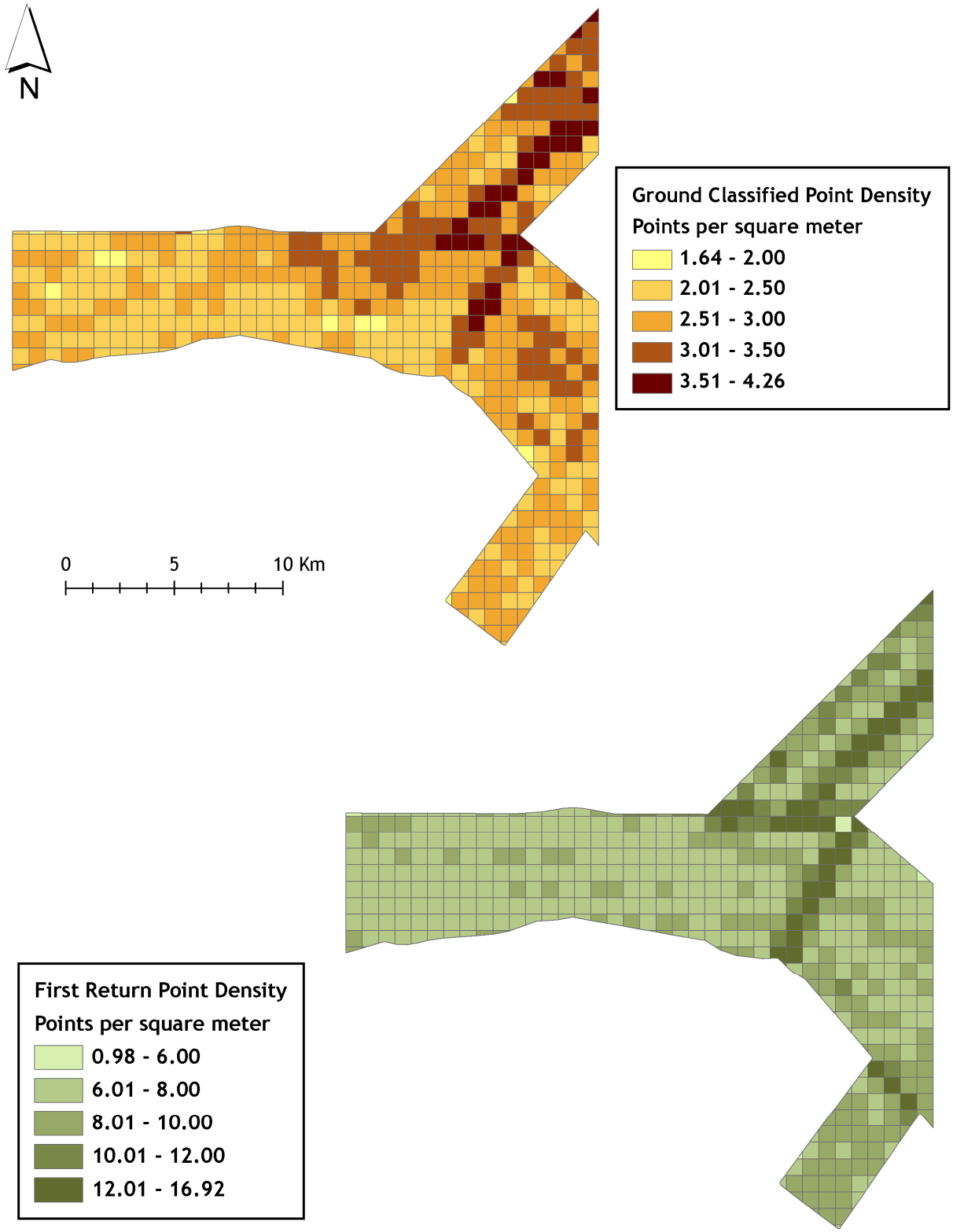


***Figure 10***. *Density distribution map for ground and first return points by processing bin in Delivery 1, UTM 7*

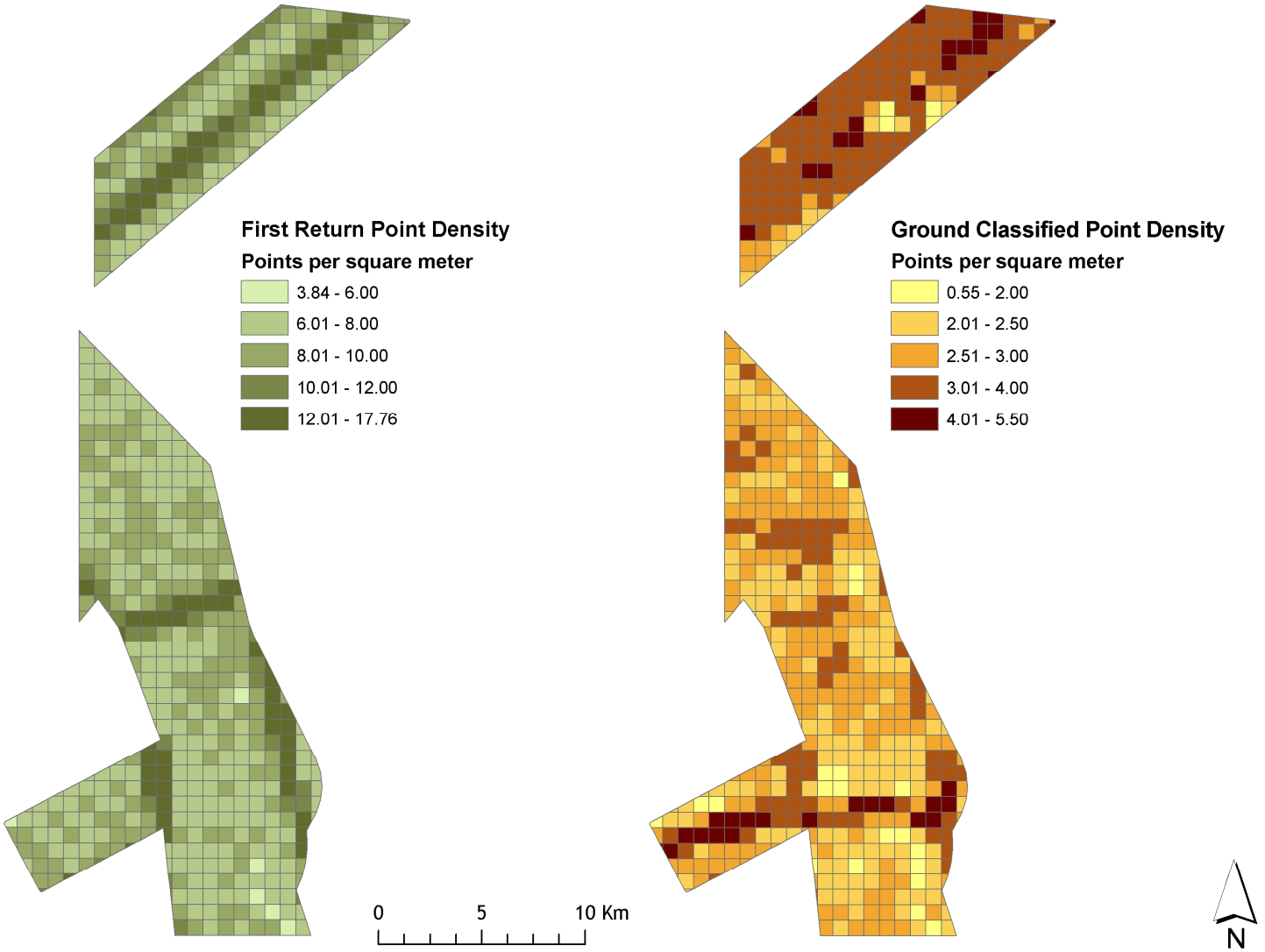


***Figure 11.*** *Density distribution map for ground points by processing bin in Delivery 2, UTM 6*

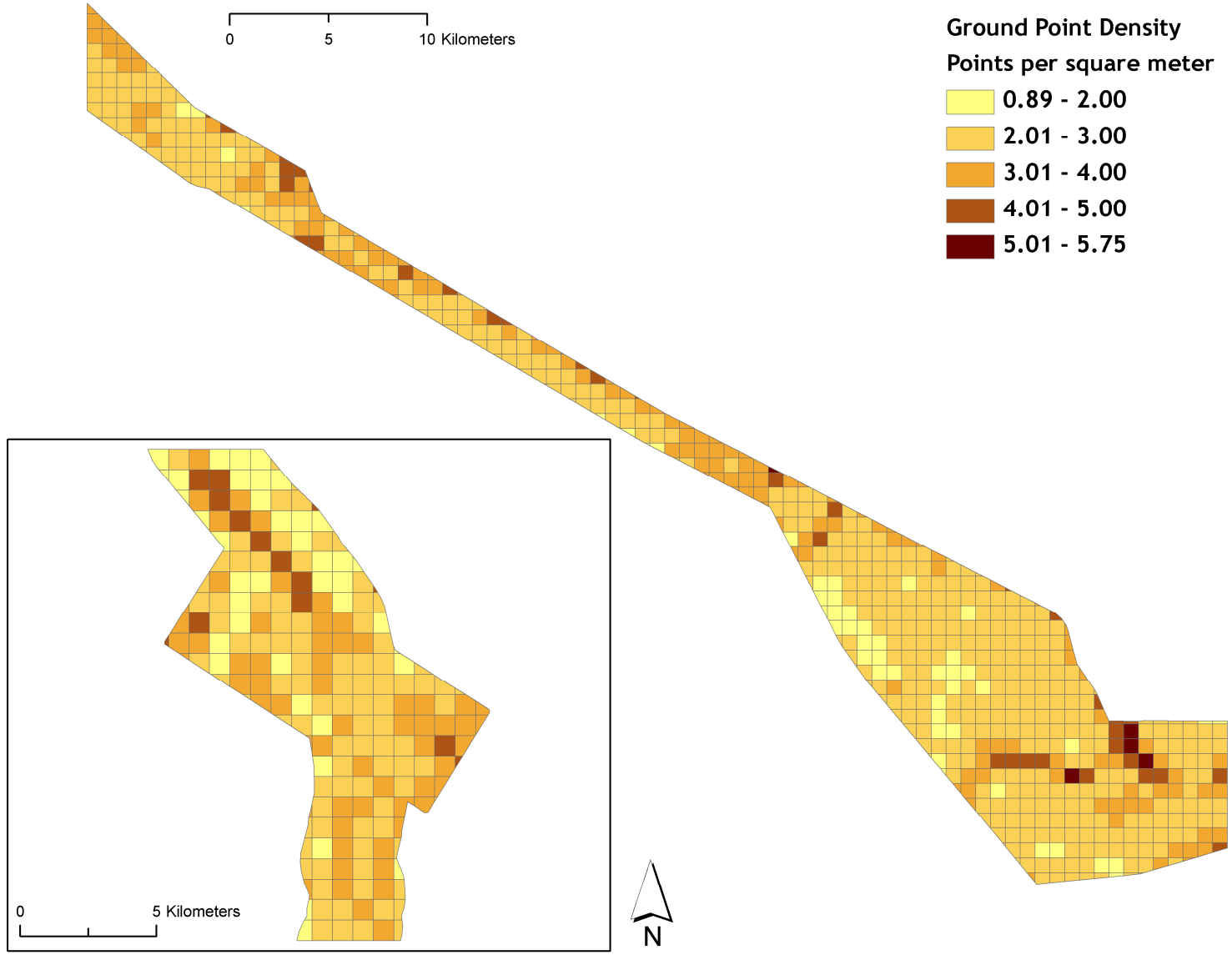


***Figure 12**. Density distribution map for first return points by processing bin in Delivery 2, UTM 6*

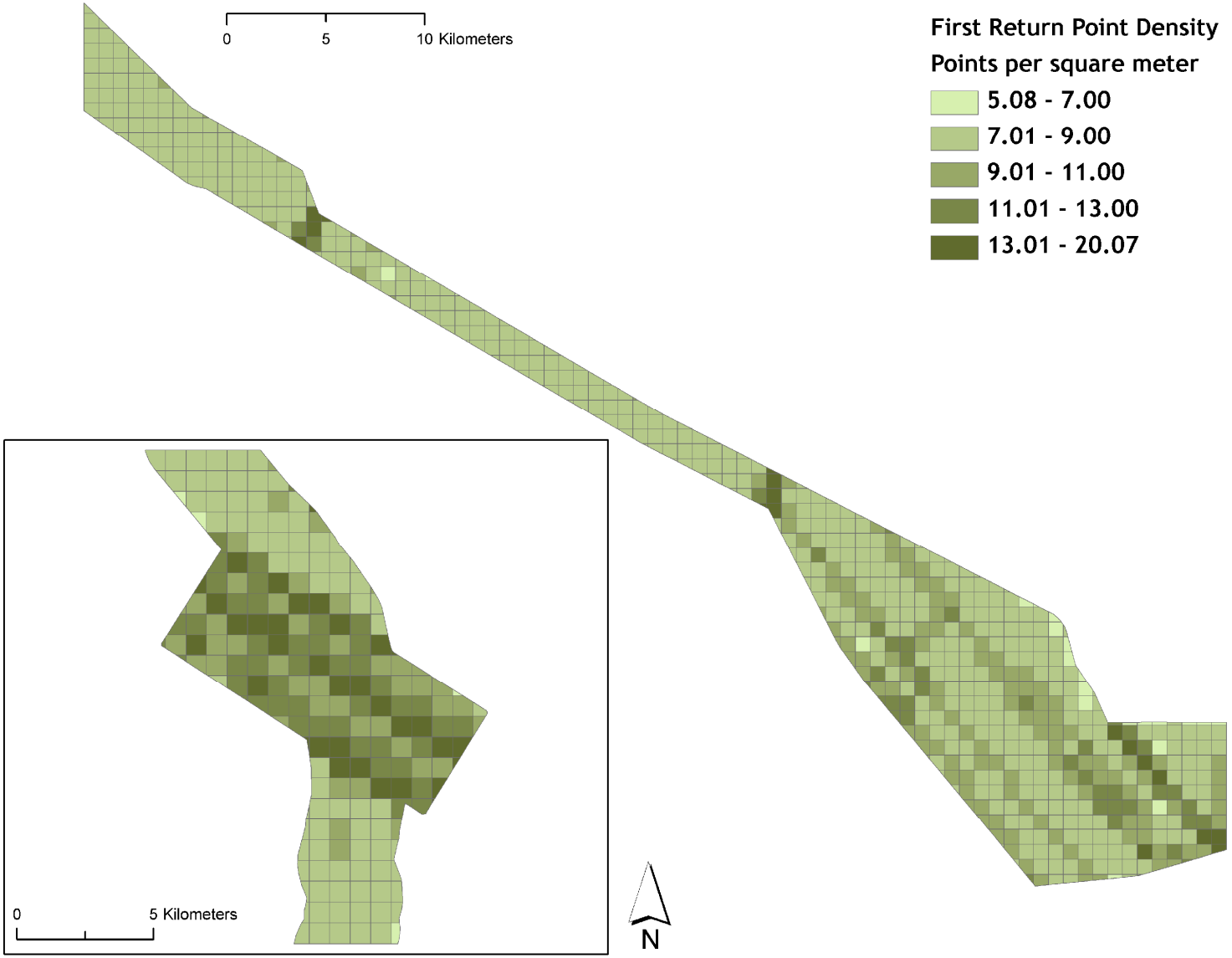
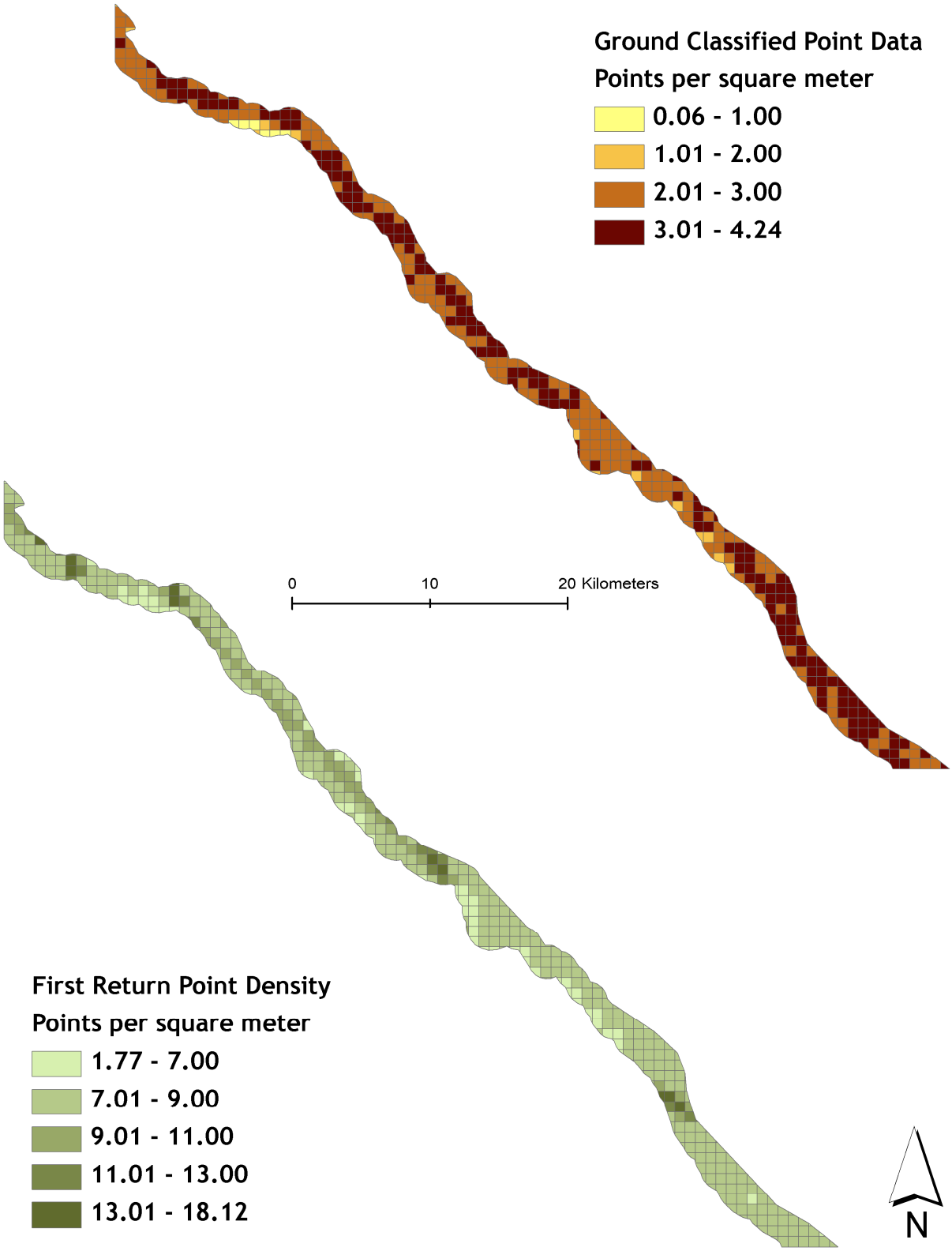


***Figure 13**. Density distribution map for first return points by processing bin in Delivery 3, UTM 7*

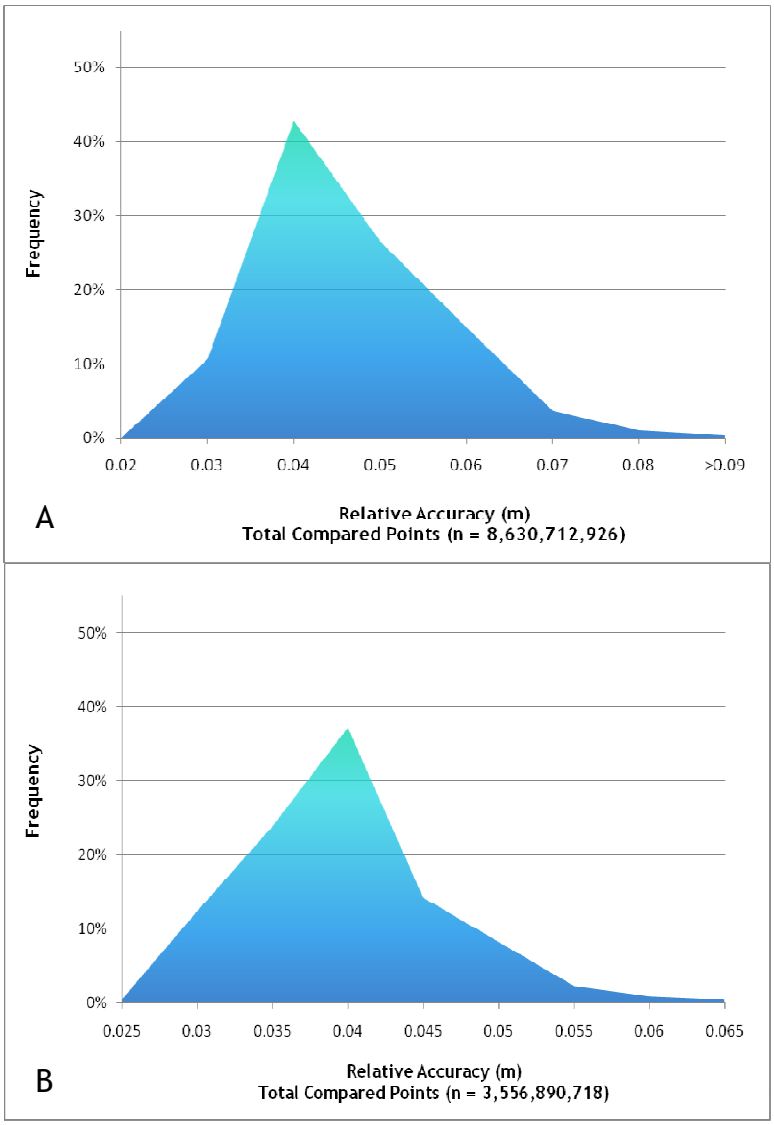


## 5.2 Relative Accuracy Calibration Results

***Table 5**. Cumulative relative accuracy statistics for Alaska Pipeline deliveries to date.*

| | UTM 6 | UTM 7 |
|---|---|---|
| Project Average | 0.041m | 0.037m |
| Median Relative Accuracy | 0.039m | 0.037m |
| 1σ Relative Accuracy | 0.010m | 0.006m |
| 1.96σ Relative Accuracy | 0.020m | 0.012m |

***Figure 14**. Distribution of cumulative relative accuracies in UTM 6 (A) and UTM 7 (B) per flight line, non slope-adjusted*



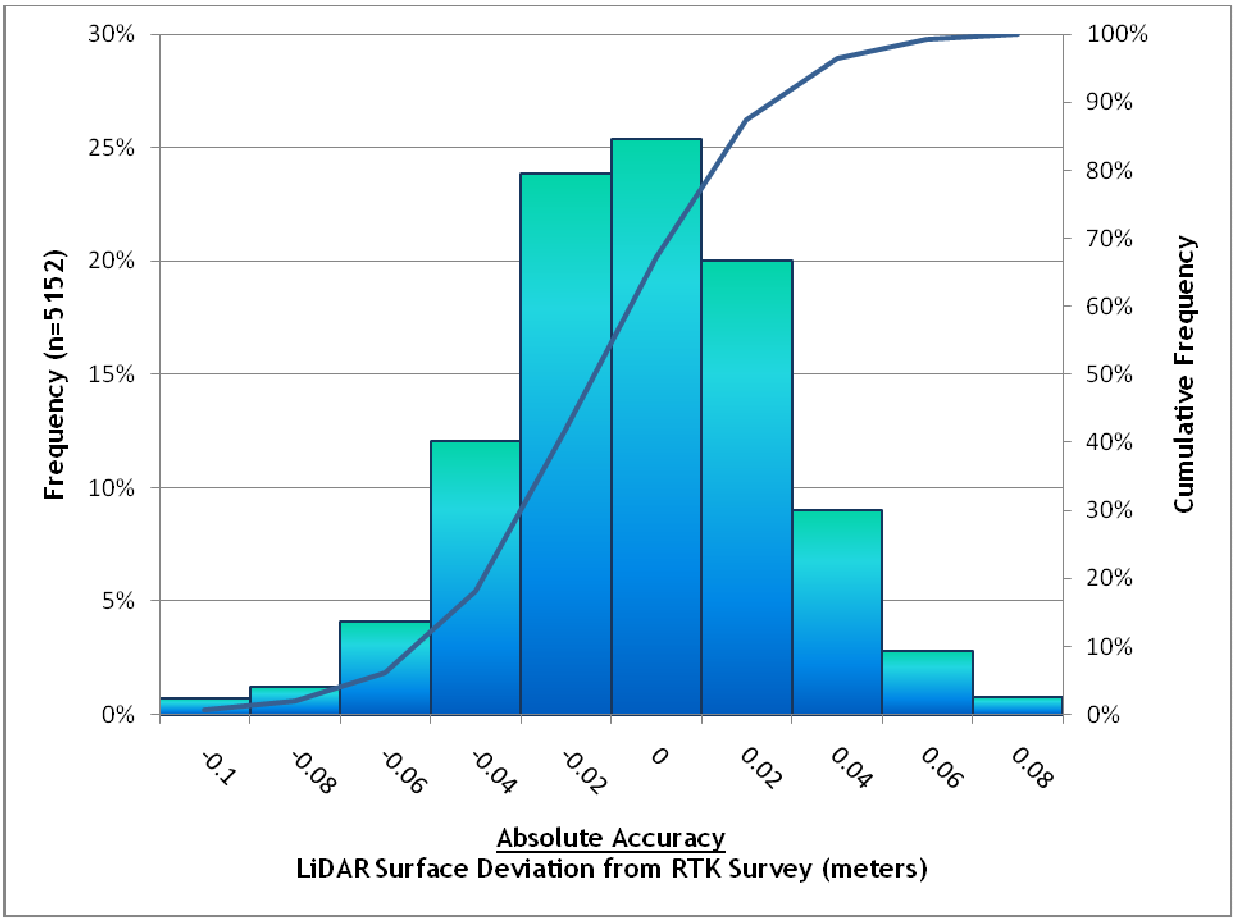
## 5.3 Absolute Accuracy

Absolute accuracies for Alaska Pipeline deliveries to date: All data was calibrated and processed in UTM 6 and then transformed to the appropriate projection.

***Table 6**. Absolute Accuracy - Deviation between laser points and RTK hard surface survey points*

| RTK Survey Sample Size (n): 5152 | |
|---|---|
| Root Mean Square Error (RMSE): 0.033m | Minimum Δz = -0.151m |
| Standard Deviations<br>1 sigma (σ): 0.031m 1.96 sigma (σ): 0.060m | Maximum Δz = 0.086m |
| | Average Δz = -0.013m |

***Figure 15**. Absolute Accuracy - Histogram Statistics*



## 5.4 Independent Accuracy Assessment

In accordance with the project plan, McClintock Land Associates (AK PLS) collected independent (i.e. blind) check points within the survey area to provide an independent assessment of LiDAR accuracy. WSI was provided with Easting and Northing positions for points which were then assigned elevations from the LiDAR. MLA received this report and compared the LiDAR Z values to MLA's surveyed (or known) Z values.

***Table 7**. Absolute accuracy determined by the project surveyor (MLA) using "Blind" Check Points (See Appendix B for PLS report)*

| Delivery | # of Check Points | RMSE | Range |
|---|---|---|---|
| 1 | 735 | 0.062m | 0.240m |
| 2 | 1096 | 0.035m | 0.204m |
| 3 | 1088 | 0.078m | 0.182m |

## 7. Projection/Datum and Units

| | | |
|---|---|---|
| | **Projection:** | UTM Zone 5, 6, 7 North |
| **Datum** | **Vertical:** | NAVD88 Geoid09 |
| | **Horizontal:** | NAD83 |
| | **Units:** | meters |

## 8. Deliverables

| | |
|---|---|
| **Point Data:** | • All Returns (LAS 1.2 format)<br>• Ground Returns (LAS 1.2 format) |
| **Vector Data:** | • Project Boundary (shapefile format)<br>• Tile Index for LiDAR Points (shapefile format)<br>• Tile Index for DEMs (shapefile format)<br>• Contours (1m shapefile format, DXF format)<br>• RTK (shapefile format, .TXT format)<br>• SBETs (shapefile format, DBF format)<br>• Lake Boundaries (shapefile format) |
| **Raster Data:** | • Elevation Models (1m resolution)<br>  • Hydro-flattened Bare Earth Model (ESRI GRID format)<br>  • Highest Hit Model (ESRI GRID format)<br>  • Vegetation Model (ESRI GRID format)<br>  • nDSM Model (ESRI GRID format)<br>• Intensity Images (GeoTIFF format, 0.5m resolution)<br>• Vegetation Metrics (5m resolution)<br>  • Canopy Cover (ESRI GRID format)<br>  • Coefficient of Variation (ESRI GRID format)<br>  • Mean Elevation (ESRI GRID format) |
| **Data Report:** | • Full report containing introduction, methodology, and accuracy |

# 9. Selected Images

***Figure 16**. View across braided channels of the Tanana River near Dot Lake. Top image is Bare Earth model. Bottom image is LiDAR point cloud colored by elevation.*

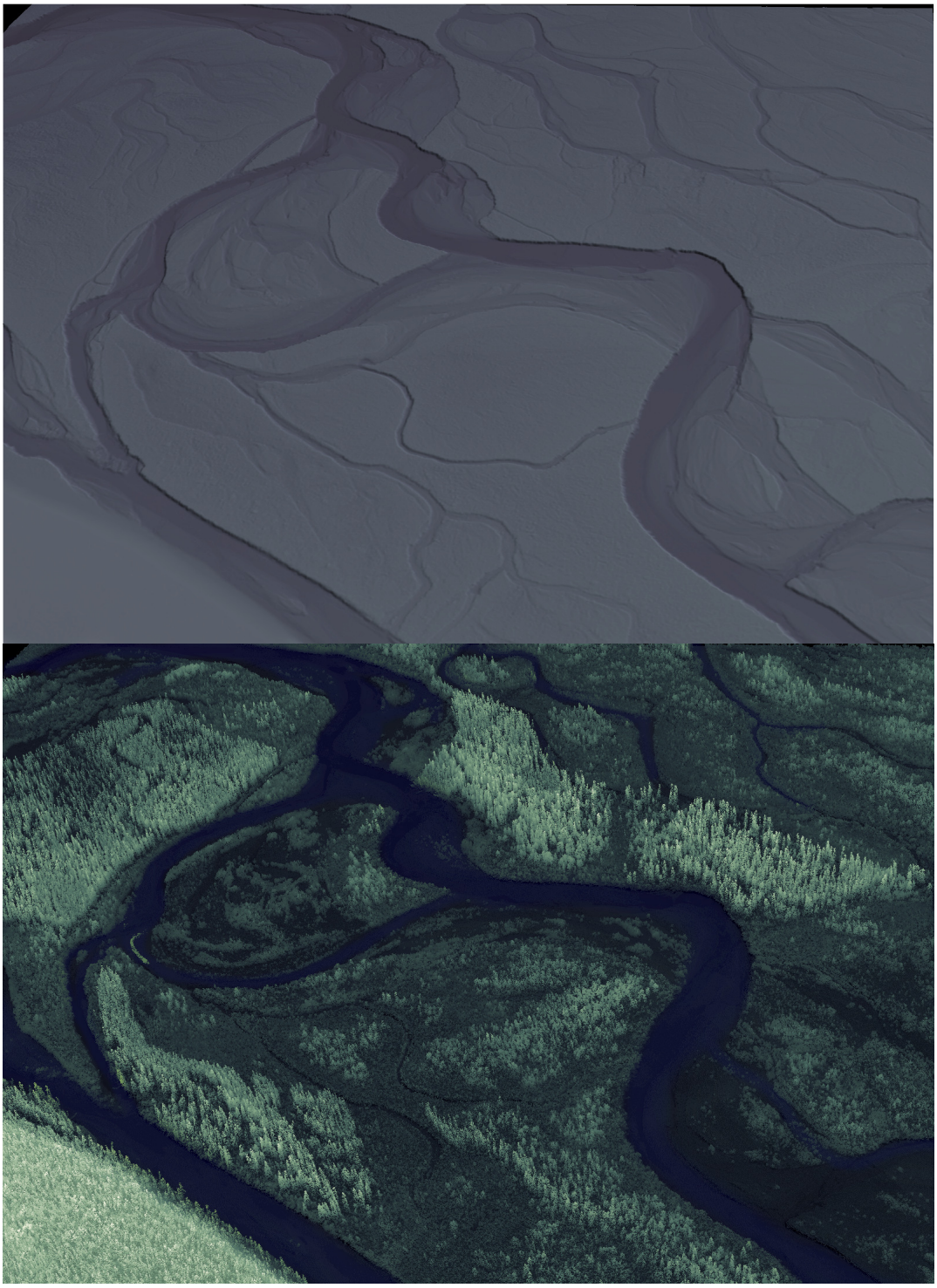


***Figure 17**. View looking west at hydro-flattened pond south of T Lake in the Bare Earth model.*

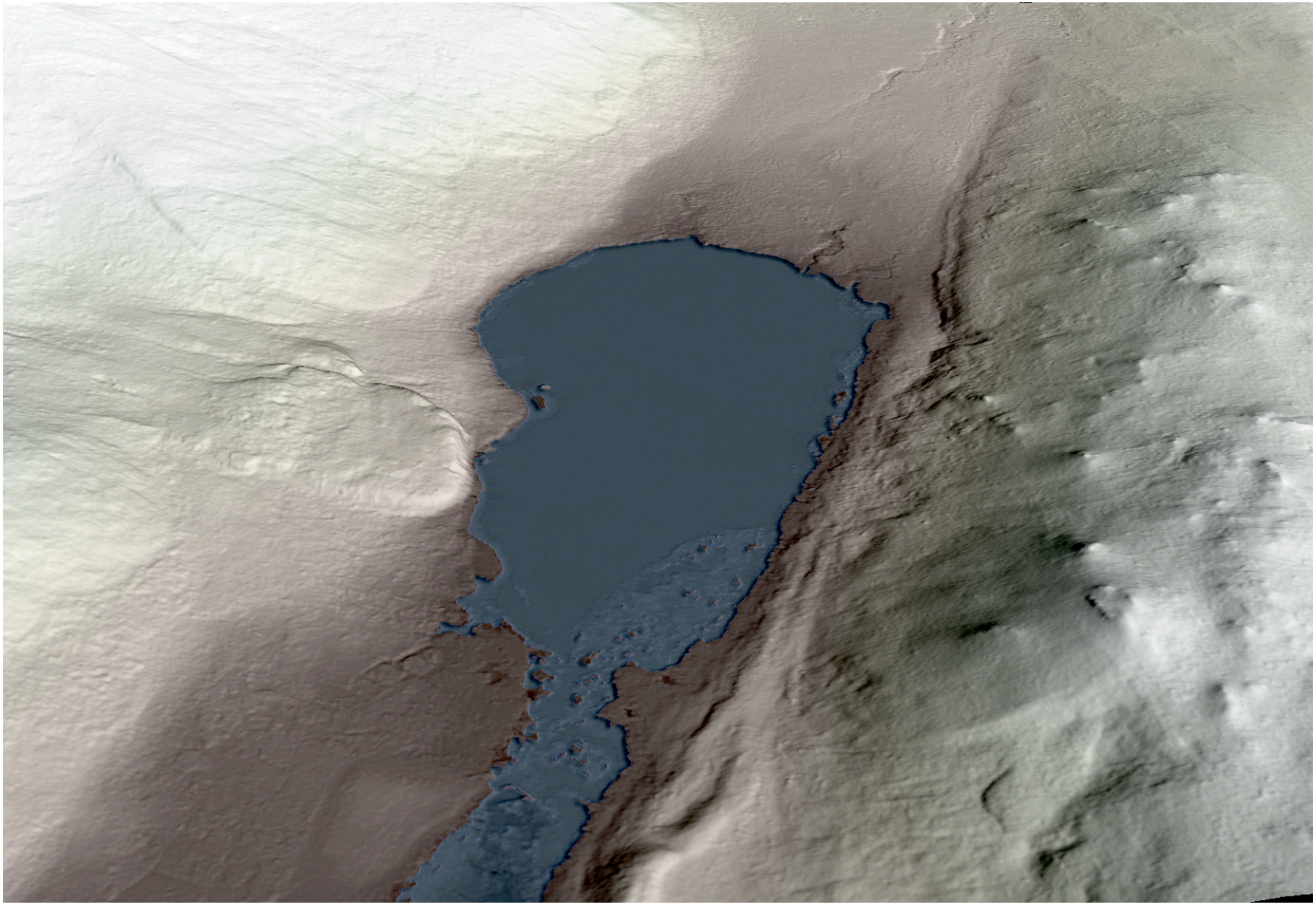


***Figure 18**. View looking north across Gerstle River along A2. Image is 3D LiDAR point cloud colored by elevation.*

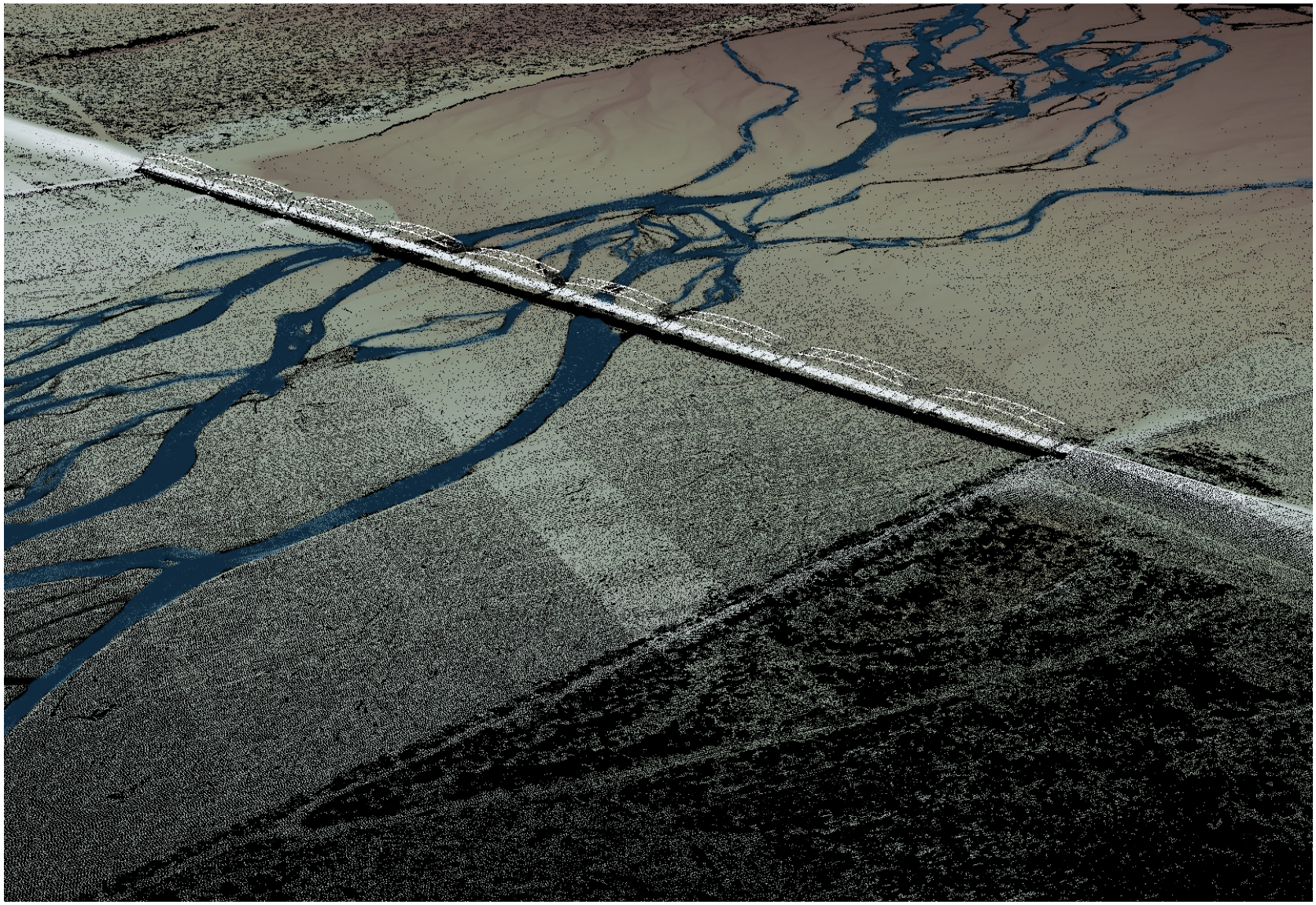


***Figure 19**. Northern end of above ground pipeline near Trims Camp along Hwy 4.*

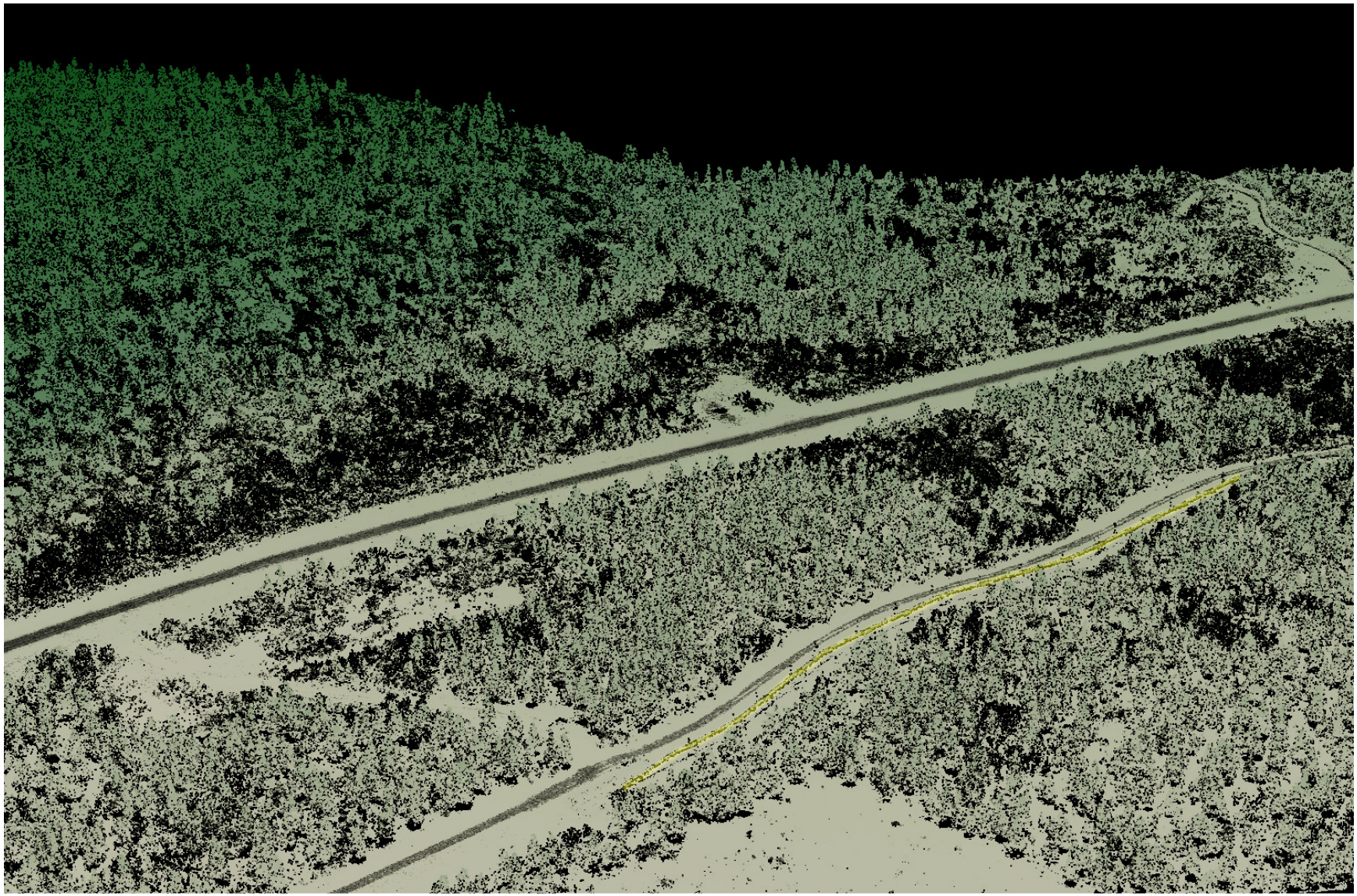


***Figure 20**. View looking North of Pipeline and Hwy 4 as they cross Miller Creek.*

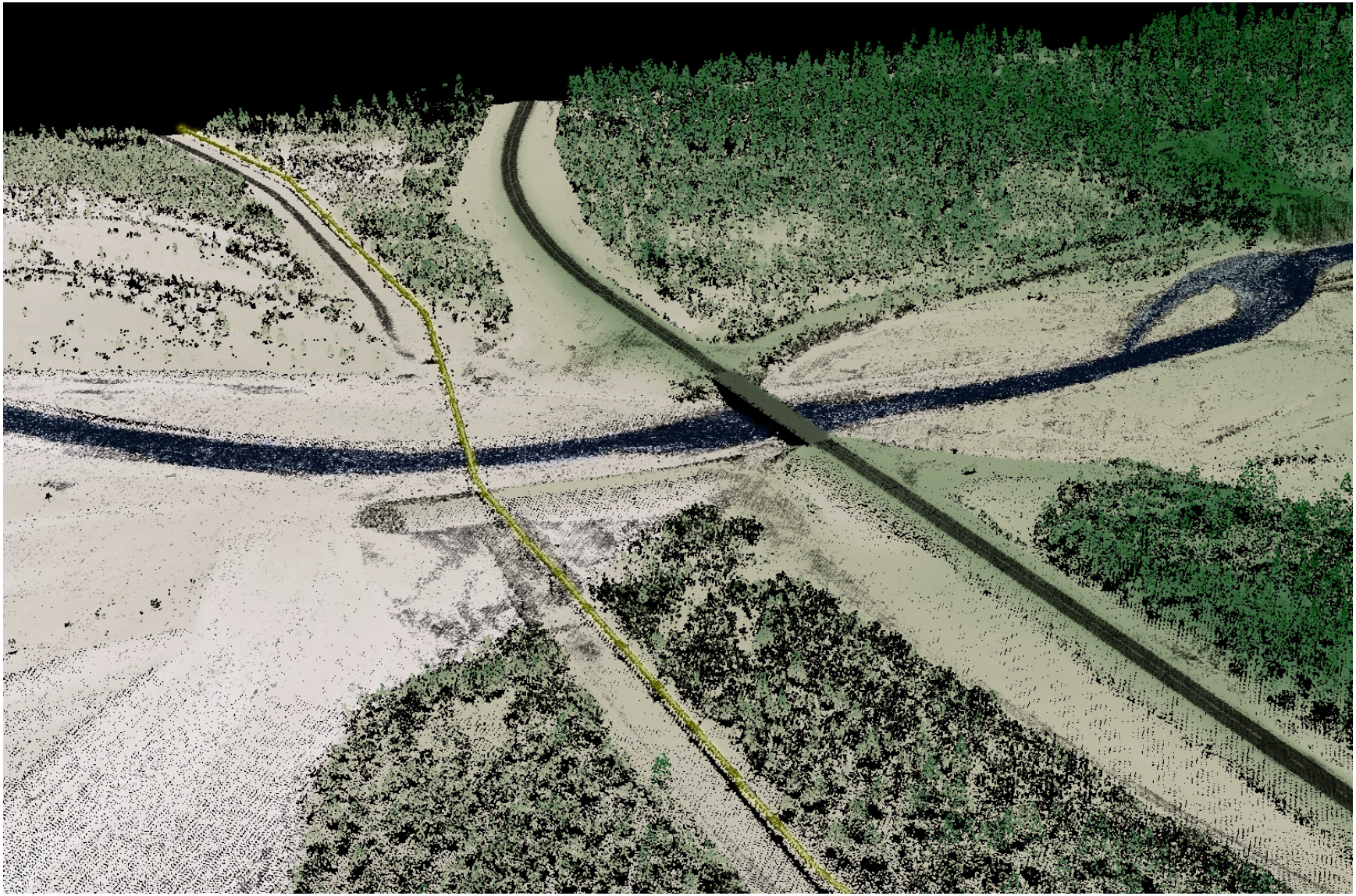


***Figure 21**. View looking Northeast across Hwy 2, just east of Tetlin Junction. Top image is Bare Earth model colored by elevation. Bottom image is Highest Hit model.*

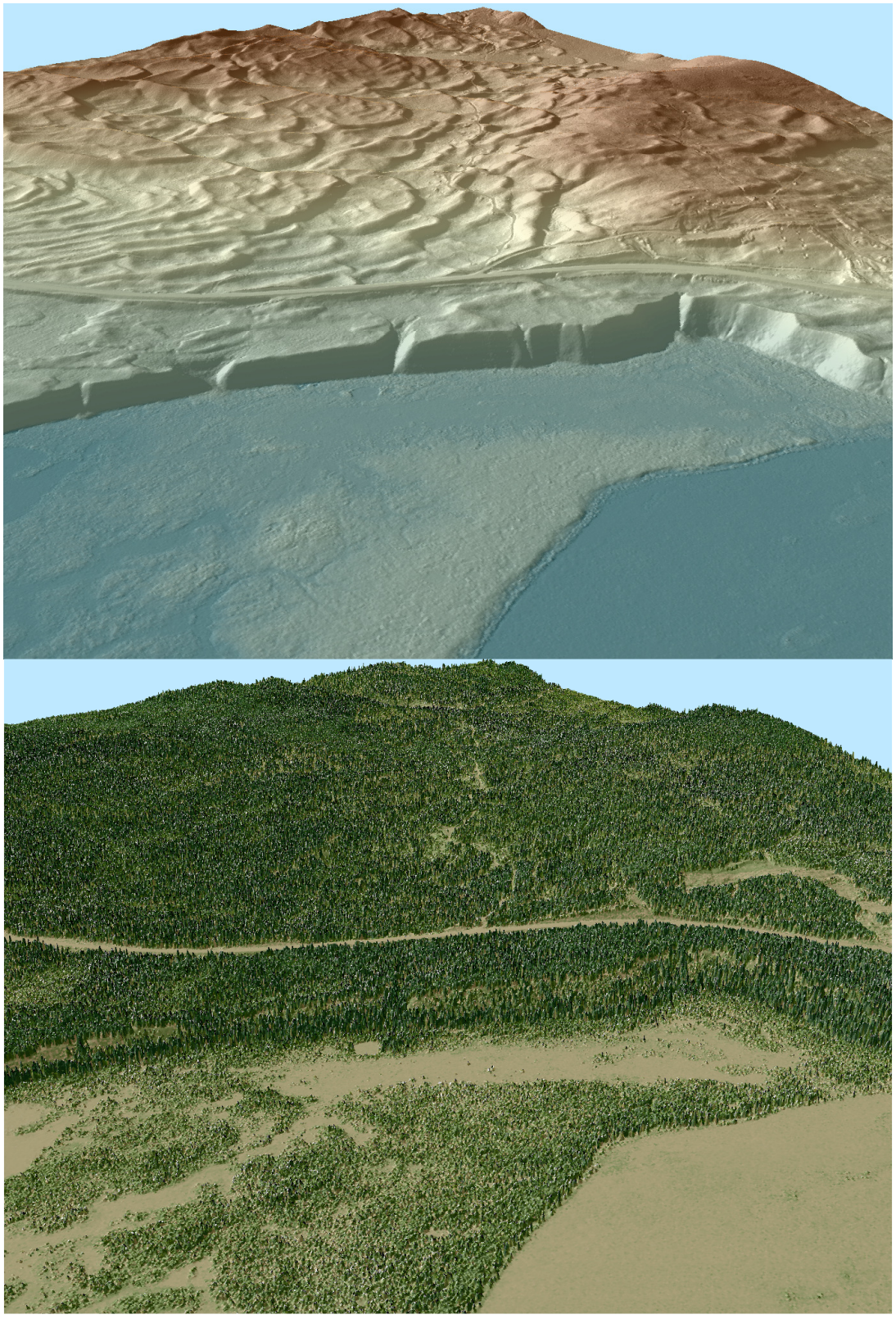
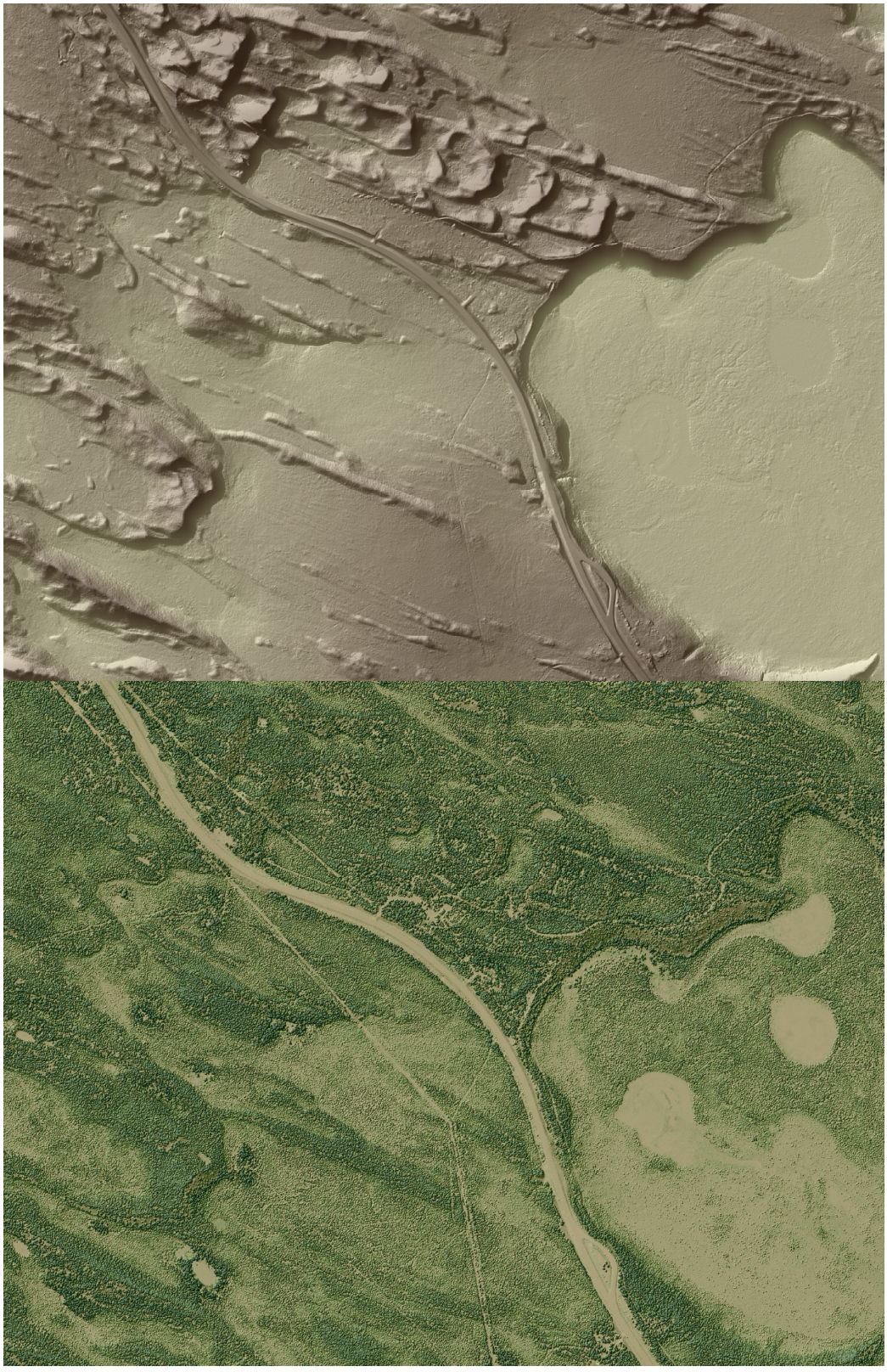


***Figure 22**. Hwy 2, west of where it crosses Gardiner River. Top image is Bare Earth model colored by elevation. Bottom image is Highest Hit model.*



# 10. Glossary

**1-sigma (σ) Absolute Deviation:** Value for which the data are within one standard deviation (approximately 68$^{th}$ percentile) of a normally distributed data set.

**1.96-sigma (σ) Absolute Deviation:** Value for which the data are within two standard deviations (approximately 95$^{th}$ percentile) of a normally distributed data set.

**Root Mean Square Error (RMSE):** A statistic used to approximate the difference between real-world points and the LiDAR points. It is calculated by squaring all the values, then taking the average of the squares and taking the square root of the average.

**Pulse Rate (PR)**: The rate at which laser pulses are emitted from the sensor; typically measured as thousands of pulses per second (kHz).

**Pulse Returns**: For every laser pulse emitted, the Leica ALS 50 Phase II system can record *up to four* wave forms reflected back to the sensor. Portions of the wave form that return earliest are the highest element in multi-tiered surfaces such as vegetation. Portions of the wave form that return last are the lowest element in multi-tiered surfaces.

**Accuracy**: The statistical comparison between known (surveyed) points and laser points. Typically measured as the standard deviation (sigma, σ) and root mean square error (RMSE).

**Intensity Values**: The peak power ratio of the laser return to the emitted laser. It is a function of surface reflectivity.

**Data Density**: A common measure of LiDAR resolution, measured as points per square meter.

**Spot Spacing**: Also a measure of LiDAR resolution, measured as the average distance between laser points.

**Nadir**: A single point or locus of points on the surface of the earth directly below a sensor as it progresses along its flight line.

**Scan Angle**: The angle from nadir to the edge of the scan, measured in degrees. Laser point accuracy typically decreases as scan angles increase.

**Overlap**: The area shared between flight lines, typically measured in percents; 100% overlap is essential to ensure complete coverage and reduce laser shadows.

**DTM / DEM**: These often-interchanged terms refer to models made from laser points. The digital elevation model (DEM) refers to all surfaces, including bare ground and vegetation, while the digital terrain model (DTM) refers only to those points classified as ground.

**Real-Time Kinematic (RTK) Survey**: GPS surveying is conducted with a GPS base station deployed over a known monument with a radio connection to a GPS rover. Both the base station and rover receive differential GPS data and the baseline correction is solved between the two. This type of ground survey is accurate to 1.5 cm or less.

# 11. Citations

Soininen, A. 2004. TerraScan User's Guide. TerraSolid.

# Appendix A

**LiDAR accuracy error sources and solutions:**

| Type of Error | Source | Post Processing Solution |
|---|---|---|
| GPS (Static/Kinematic) | Long Base Lines | None |
| | Poor Satellite Constellation | None |
| | Poor Antenna Visibility | Reduce Visibility Mask |
| Relative Accuracy | Poor System Calibration | Recalibrate IMU and sensor offsets/settings |
| | Inaccurate System | None |
| Laser Noise | Poor Laser Timing | None |
| | Poor Laser Reception | None |
| | Poor Laser Power | None |
| | Irregular Laser Shape | None |

**Operational measures taken to improve relative accuracy:**

1. Low Flight Altitude: Terrain following is employed to maintain a constant above ground level (AGL). Laser horizontal errors are a function of flight altitude above ground (i.e., ~ 1/3000$^{th}$ AGL flight altitude).
2. Focus Laser Power at narrow beam footprint: A laser return must be received by the system above a power threshold to accurately record a measurement. The strength of the laser return is a function of laser emission power, laser footprint, flight altitude and the reflectivity of the target. While surface reflectivity cannot be controlled, laser power can be increased and low flight altitudes can be maintained.
3. Reduced Scan Angle: Edge-of-scan data can become inaccurate. The scan angle was reduced to a maximum of ±15$^{o}$ from nadir, creating a narrow swath width and greatly reducing laser shadows from trees and buildings.
4. Quality GPS: Flights took place during optimal GPS conditions (e.g., 6 or more satellites and PDOP [Position Dilution of Precision] less than 3.0). Before each flight, the PDOP was determined for the survey day. During all flight times, a dual frequency DGPS base station recording at 1-second epochs was utilized and a maximum baseline length between the aircraft and the control points was less than 19 km (11.5 miles) at all times.
5. Ground Survey: Ground survey point accuracy (i.e. <1.5 cm RMSE) occurs during optimal PDOP ranges and targets a minimal baseline distance of 4 miles between GPS rover and base. Robust statistics are, in part, a function of sample size (n) and distribution. Ground survey RTK points are distributed to the extent possible throughout multiple flight lines and across the survey area.
6. 50% Side-Lap (100% Overlap): Overlapping areas are optimized for relative accuracy testing. Laser shadowing is minimized to help increase target acquisition from multiple scan angles. Ideally, with a 50% side-lap, the most nadir portion of one flight line coincides with the edge (least nadir) portion of overlapping flight lines. A minimum of 50% side-lap with terrain-followed acquisition prevents data gaps.
7. Opposing Flight Lines: All overlapping flight lines are opposing. Pitch, roll and heading errors are amplified by a factor of two relative to the adjacent flight line(s), making misalignments easier to detect and resolve.

# Appendix B

# Alaska Gasline LiDAR Project
# Delivery 3 - All Points

*Watershed Sciences, Inc.*
*McClintock Land Associates, Inc.*

QUALITY CONTROL REVIEW SUMMARY

| | | |
|---|---|---|
| Max. Positive Elev. Deviation: | 0.021 | meters |
| Max. Negative Elev. Deviation: | -0.161 | meters |
| Elevation Deviation Range: | 0.182 | meters |
| Elevation Deviation Mean: | -0.071 | meters |
| Elevation Deviation RMSE | 0.078 | meters |

(RMSE = Root Mean Square Error)

| | | |
|---|---|---|
| Number of Check Points Used: | 1088 | |
| Number of Check Points Excluded | 0 | See note below |
| Total Number of Check Points: | 1088 | |

Note: No points were excluded from this check.

| CHECK POINTS | | | SURVEYED Elevation | LiDAR Elevation | Deviation | Include? (yes = 1) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | (Meters) | (Meters) | (no = 0) |
| 129 | 6991761.642 | 456912.874 | 520.758 | 520.830 | -0.072 | 1 |
| 228 | 7005540.811 | 442445.432 | 552.591 | 552.680 | -0.089 | 1 |
| 229 | 6989963.933 | 458320.186 | 535.132 | 535.130 | 0.002 | 1 |
| 329 | 6992005.304 | 455340.522 | 522.899 | 522.940 | -0.041 | 1 |
| 28000 | 7005540.811 | 442445.432 | 552.591 | 552.680 | -0.089 | 1 |
| 28001 | 7000721.857 | 446356.108 | 604.878 | 604.930 | -0.052 | 1 |
| 28002 | 7000735.437 | 446348.814 | 604.199 | 604.290 | -0.091 | 1 |
| 28003 | 7000747.453 | 446347.208 | 603.722 | 603.790 | -0.068 | 1 |
| 28004 | 7001837.339 | 446059.099 | 598.014 | 598.090 | -0.076 | 1 |
| 28005 | 7001854.578 | 446048.49 | 597.860 | 597.950 | -0.090 | 1 |
| 28006 | 7001871.304 | 446037.869 | 597.683 | 597.760 | -0.077 | 1 |
| 28007 | 7002436.079 | 445677.972 | 583.952 | 584.050 | -0.098 | 1 |
| 28008 | 7002424.678 | 445685.028 | 584.405 | 584.500 | -0.095 | 1 |
| 28009 | 7002413.924 | 445691.875 | 584.814 | 584.890 | -0.076 | 1 |
| 28010 | 7003360.509 | 445251.823 | 560.767 | 560.880 | -0.113 | 1 |
| 28011 | 7003368.831 | 445245.902 | 560.575 | 560.660 | -0.085 | 1 |
| 28012 | 7003380.357 | 445240.887 | 560.243 | 560.350 | -0.107 | 1 |
| 28013 | 7003392.037 | 445235.789 | 559.884 | 559.980 | -0.096 | 1 |
| 28014 | 7004139.307 | 444594.345 | 563.590 | 563.690 | -0.100 | 1 |
| 28015 | 7004149.171 | 444576.035 | 564.437 | 564.530 | -0.093 | 1 |
| 28016 | 7004159.1 | 444558.241 | 565.262 | 565.340 | -0.078 | 1 |
| 28017 | 7004179.254 | 444550.619 | 565.700 | 565.800 | -0.100 | 1 |
| 28018 | 7004829.077 | 444074.425 | 568.892 | 568.980 | -0.088 | 1 |
| 28019 | 7004838.814 | 444068.506 | 569.326 | 569.430 | -0.104 | 1 |
| 28020 | 7004849.906 | 444062.226 | 569.890 | 569.990 | -0.100 | 1 |
| 28021 | 7005311.617 | 443412.707 | 587.979 | 588.100 | -0.121 | 1 |
| 28022 | 7005293.78 | 443418.914 | 587.935 | 588.020 | -0.085 | 1 |
| 28023 | 7005272.561 | 443422.45 | 586.641 | 586.720 | -0.079 | 1 |
| 28024 | 7005496.629 | 442668.419 | 559.132 | 559.200 | -0.068 | 1 |
| 28025 | 7005496.528 | 442645.818 | 558.420 | 558.510 | -0.090 | 1 |
| 28026 | 7005497.338 | 442625.015 | 557.673 | 557.800 | -0.127 | 1 |
| 28027 | 7005948.877 | 442011.369 | 544.350 | 544.430 | -0.080 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 28028 | 7005958.671 | 442001.335 | 544.043 | 544.120 | -0.077 | 1 |
| 28029 | 7005966.542 | 441993.229 | 543.774 | 543.870 | -0.096 | 1 |
| 28030 | 7006392.256 | 441556.381 | 541.300 | 541.410 | -0.110 | 1 |
| 28031 | 7006401.184 | 441547.037 | 541.392 | 541.480 | -0.088 | 1 |
| 28032 | 7006411.461 | 441536.627 | 541.522 | 541.580 | -0.058 | 1 |
| 28033 | 7005541.464 | 442444.034 | 552.548 | 552.610 | -0.062 | 1 |
| 28034 | 7006834.353 | 441307.223 | 559.353 | 559.410 | -0.057 | 1 |
| 28035 | 7006848.689 | 441301.253 | 560.188 | 560.270 | -0.082 | 1 |
| 28036 | 7006863.048 | 441295.027 | 561.022 | 561.090 | -0.068 | 1 |
| 28037 | 7007568.869 | 440995.113 | 571.232 | 571.330 | -0.098 | 1 |
| 28038 | 7007583.905 | 440988.239 | 570.920 | 571.020 | -0.100 | 1 |
| 28039 | 7007600.426 | 440981.229 | 570.678 | 570.770 | -0.092 | 1 |
| 28040 | 7008112.166 | 440764.874 | 586.473 | 586.570 | -0.097 | 1 |
| 28041 | 7008124.912 | 440759.032 | 587.141 | 587.240 | -0.099 | 1 |
| 28042 | 7008137.256 | 440753.76 | 587.745 | 587.840 | -0.095 | 1 |
| 28043 | 7008511.423 | 440622.465 | 601.822 | 601.940 | -0.118 | 1 |
| 28044 | 7008526.068 | 440611.623 | 602.494 | 602.610 | -0.116 | 1 |
| 28045 | 7008542.753 | 440596.647 | 603.089 | 603.210 | -0.121 | 1 |
| 28046 | 7008785.309 | 440088.767 | 594.480 | 594.570 | -0.090 | 1 |
| 28047 | 7008792.933 | 440081.407 | 594.226 | 594.350 | -0.124 | 1 |
| 28048 | 7008803.713 | 440072.154 | 593.890 | 593.990 | -0.100 | 1 |
| 28099 | 7005540.811 | 442445.432 | 552.591 | 552.680 | -0.089 | 1 |
| 28100 | 7005541.622 | 442444.138 | 552.649 | 552.670 | -0.021 | 1 |
| 28101 | 7006253.158 | 441758.548 | 539.240 | 539.300 | -0.060 | 1 |
| 28102 | 7006250.377 | 441756.579 | 539.176 | 539.250 | -0.074 | 1 |
| 28103 | 7006245.913 | 441754.723 | 539.424 | 539.500 | -0.076 | 1 |
| 28104 | 7006243.779 | 441752.588 | 539.422 | 539.510 | -0.088 | 1 |
| 28105 | 7006241.683 | 441750.165 | 539.403 | 539.480 | -0.077 | 1 |
| 28106 | 7006240.15 | 441747.542 | 539.393 | 539.490 | -0.097 | 1 |
| 28107 | 7006238.175 | 441745.378 | 539.418 | 539.500 | -0.082 | 1 |
| 28108 | 7006236.286 | 441743.507 | 539.443 | 539.530 | -0.087 | 1 |
| 28109 | 7006233.739 | 441741.052 | 539.393 | 539.490 | -0.097 | 1 |
| 28110 | 7006230.839 | 441738.665 | 539.341 | 539.480 | -0.139 | 1 |
| 28111 | 7006227.458 | 441735.848 | 539.756 | 539.830 | -0.074 | 1 |
| 28112 | 7006225.617 | 441734.217 | 540.021 | 540.100 | -0.079 | 1 |
| 28113 | 7006223.551 | 441732.083 | 540.081 | 540.170 | -0.089 | 1 |
| 28114 | 7006220.961 | 441729.584 | 540.070 | 540.150 | -0.080 | 1 |
| 28115 | 7006218.569 | 441727.187 | 539.999 | 540.070 | -0.071 | 1 |
| 28116 | 7008111.103 | 440761.536 | 586.392 | 586.490 | -0.098 | 1 |
| 28117 | 7008111.843 | 440764.578 | 586.455 | 586.550 | -0.095 | 1 |
| 28118 | 7008112.862 | 440767.99 | 586.432 | 586.520 | -0.088 | 1 |
| 28119 | 7008114.045 | 440770.683 | 586.370 | 586.470 | -0.100 | 1 |
| 28120 | 7008115.266 | 440772.878 | 586.305 | 586.420 | -0.115 | 1 |
| 28121 | 7008116.579 | 440775.082 | 586.227 | 586.340 | -0.113 | 1 |
| 28122 | 7008117.847 | 440777.14 | 586.214 | 586.290 | -0.076 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 28123 | 7008119.131 | 440779.258 | 586.289 | 586.360 | -0.071 | 1 |
| 28124 | 7008120.403 | 440781.2 | 586.315 | 586.370 | -0.055 | 1 |
| 28125 | 7008121.439 | 440782.893 | 586.296 | 586.350 | -0.054 | 1 |
| 28126 | 7008123.045 | 440784.686 | 586.209 | 586.340 | -0.131 | 1 |
| 28127 | 7008557.431 | 440587.779 | 603.374 | 603.460 | -0.086 | 1 |
| 28128 | 7008555.396 | 440585.684 | 603.303 | 603.400 | -0.097 | 1 |
| 28129 | 7008553.449 | 440584.288 | 603.245 | 603.350 | -0.105 | 1 |
| 28130 | 7008551.454 | 440582.92 | 603.189 | 603.270 | -0.081 | 1 |
| 28131 | 7008549.352 | 440581.34 | 603.116 | 603.200 | -0.084 | 1 |
| 28132 | 7008551.435 | 440532.508 | 601.250 | 601.330 | -0.080 | 1 |
| 28133 | 7008553.304 | 440534.089 | 601.390 | 601.480 | -0.090 | 1 |
| 28134 | 7008555.357 | 440535.814 | 601.549 | 601.640 | -0.091 | 1 |
| 28135 | 7008557.167 | 440537.486 | 601.695 | 601.770 | -0.075 | 1 |
| 28136 | 7008559.209 | 440539.107 | 601.862 | 601.950 | -0.088 | 1 |
| 28137 | 7008560.938 | 440540.618 | 602.002 | 602.100 | -0.098 | 1 |
| 28138 | 7008562.841 | 440542.26 | 602.195 | 602.270 | -0.075 | 1 |
| 28139 | 7008564.743 | 440543.842 | 602.424 | 602.510 | -0.086 | 1 |
| 28140 | 7008566.577 | 440545.498 | 602.671 | 602.750 | -0.079 | 1 |
| 28141 | 7008568.509 | 440547.212 | 602.911 | 603.000 | -0.089 | 1 |
| 28142 | 7008570.671 | 440548.84 | 603.124 | 603.220 | -0.096 | 1 |
| 28143 | 7008572.649 | 440550.558 | 603.294 | 603.380 | -0.086 | 1 |
| 28144 | 7008574.424 | 440551.775 | 603.401 | 603.500 | -0.099 | 1 |
| 28145 | 7009435.255 | 439718.239 | 577.254 | 577.310 | -0.056 | 1 |
| 28146 | 7009436.827 | 439720.04 | 577.538 | 577.600 | -0.062 | 1 |
| 28147 | 7009438.827 | 439722.621 | 577.748 | 577.820 | -0.072 | 1 |
| 28148 | 7009441.078 | 439723.56 | 577.849 | 577.930 | -0.081 | 1 |
| 28149 | 7009443.001 | 439725.365 | 577.887 | 577.980 | -0.093 | 1 |
| 28150 | 7009445.232 | 439727.386 | 577.910 | 578.000 | -0.090 | 1 |
| 28151 | 7009447.579 | 439729.567 | 577.849 | 577.940 | -0.091 | 1 |
| 28152 | 7009480.54 | 439708.213 | 579.055 | 579.140 | -0.085 | 1 |
| 28153 | 7009478.919 | 439706.006 | 579.007 | 579.090 | -0.083 | 1 |
| 28154 | 7009477.422 | 439704.003 | 578.982 | 579.060 | -0.078 | 1 |
| 28155 | 7009476.032 | 439702.269 | 578.995 | 579.070 | -0.075 | 1 |
| 28156 | 7009474.713 | 439700.51 | 579.043 | 579.120 | -0.077 | 1 |
| 28157 | 7009472.894 | 439697.525 | 579.082 | 579.180 | -0.098 | 1 |
| 28158 | 7009470.878 | 439695.012 | 579.033 | 579.110 | -0.077 | 1 |
| 28159 | 7009482.554 | 439710.51 | 579.096 | 579.190 | -0.094 | 1 |
| 28160 | 7009484.482 | 439711.94 | 579.213 | 579.320 | -0.107 | 1 |
| 28161 | 7009486.354 | 439713.1 | 579.288 | 579.390 | -0.102 | 1 |
| 28162 | 7009488.179 | 439713.872 | 579.378 | 579.470 | -0.092 | 1 |
| 28163 | 7010987.243 | 438321.967 | 528.416 | 528.510 | -0.094 | 1 |
| 28164 | 7010988.126 | 438322.745 | 528.454 | 528.550 | -0.096 | 1 |
| 28165 | 7010989.89 | 438324.162 | 528.526 | 528.600 | -0.074 | 1 |
| 28166 | 7010991.695 | 438325.757 | 528.562 | 528.660 | -0.098 | 1 |
| 28167 | 7010993.366 | 438326.95 | 528.526 | 528.620 | -0.094 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 28168 | 7010994.884 | 438328.173 | 528.472 | 528.610 | -0.138 | 1 |
| 28169 | 7010996.44 | 438329.476 | 528.484 | 528.590 | -0.106 | 1 |
| 28170 | 7010997.769 | 438330.797 | 528.463 | 528.580 | -0.117 | 1 |
| 28171 | 7010999.332 | 438332.186 | 528.437 | 528.520 | -0.083 | 1 |
| 28172 | 7011000.977 | 438332.743 | 528.398 | 528.520 | -0.122 | 1 |
| 28173 | 7011002.837 | 438333.252 | 528.317 | 528.420 | -0.103 | 1 |
| 28174 | 7011011.38 | 438333.419 | 528.472 | 528.580 | -0.108 | 1 |
| 28175 | 7011013.646 | 438334.04 | 528.565 | 528.670 | -0.105 | 1 |
| 28176 | 7011746.798 | 437361.575 | 533.442 | 533.490 | -0.048 | 1 |
| 28177 | 7011744.766 | 437360.141 | 533.321 | 533.360 | -0.039 | 1 |
| 28178 | 7011742.45 | 437358.808 | 533.171 | 533.240 | -0.069 | 1 |
| 28179 | 7011740.291 | 437357.644 | 533.037 | 533.100 | -0.063 | 1 |
| 28180 | 7011737.897 | 437356.409 | 532.855 | 532.910 | -0.055 | 1 |
| 28181 | 7011748.53 | 437361.393 | 533.314 | 533.390 | -0.076 | 1 |
| 28182 | 7011751.206 | 437361.399 | 532.969 | 533.030 | -0.061 | 1 |
| 28183 | 7011753.938 | 437361.606 | 532.502 | 532.580 | -0.078 | 1 |
| 28184 | 7011756.407 | 437361.957 | 532.184 | 532.270 | -0.086 | 1 |
| 28185 | 7011758.521 | 437362.744 | 531.818 | 531.940 | -0.122 | 1 |
| 28186 | 7011760.881 | 437363.399 | 531.484 | 531.580 | -0.096 | 1 |
| 28187 | 7011616.447 | 435132.557 | 520.501 | 520.580 | -0.079 | 1 |
| 28188 | 7011618.796 | 435133.761 | 520.479 | 520.510 | -0.031 | 1 |
| 28189 | 7011620.679 | 435135.032 | 520.402 | 520.440 | -0.038 | 1 |
| 28190 | 7011622.55 | 435136.196 | 520.342 | 520.400 | -0.058 | 1 |
| 28191 | 7011624.251 | 435137.262 | 520.291 | 520.350 | -0.059 | 1 |
| 28192 | 7011625.81 | 435138.367 | 520.235 | 520.300 | -0.065 | 1 |
| 28193 | 7011627.66 | 435139.593 | 520.181 | 520.250 | -0.069 | 1 |
| 28194 | 7011629.409 | 435140.826 | 520.137 | 520.180 | -0.043 | 1 |
| 28195 | 7011631.377 | 435142.18 | 520.157 | 520.210 | -0.053 | 1 |
| 28196 | 7011633.194 | 435143.461 | 520.215 | 520.270 | -0.055 | 1 |
| 28197 | 7011634.929 | 435144.719 | 520.287 | 520.290 | -0.003 | 1 |
| 28198 | 7011636.663 | 435145.966 | 520.353 | 520.390 | -0.037 | 1 |
| 28199 | 7011638.234 | 435147.124 | 520.426 | 520.470 | -0.044 | 1 |
| 28200 | 7011639.767 | 435148.299 | 520.468 | 520.510 | -0.042 | 1 |
| 28201 | 7011641.25 | 435149.404 | 520.527 | 520.560 | -0.033 | 1 |
| 28202 | 7011642.902 | 435150.718 | 520.527 | 520.590 | -0.063 | 1 |
| 28203 | 7011644.569 | 435151.952 | 520.478 | 520.560 | -0.082 | 1 |
| 28204 | 7011646.257 | 435153.193 | 520.456 | 520.540 | -0.084 | 1 |
| 28205 | 7012014.965 | 434742.796 | 526.297 | 526.350 | -0.053 | 1 |
| 28206 | 7012016.738 | 434743.905 | 526.250 | 526.300 | -0.050 | 1 |
| 28207 | 7012018.31 | 434745.137 | 526.238 | 526.320 | -0.082 | 1 |
| 28208 | 7012019.815 | 434746.399 | 526.263 | 526.310 | -0.047 | 1 |
| 28209 | 7012021.461 | 434747.724 | 526.261 | 526.310 | -0.049 | 1 |
| 28210 | 7012022.99 | 434749.028 | 526.237 | 526.290 | -0.053 | 1 |
| 28211 | 7012024.577 | 434750.315 | 526.224 | 526.270 | -0.046 | 1 |
| 28212 | 7012026.152 | 434751.591 | 526.218 | 526.270 | -0.052 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 28213 | 7012027.715 | 434752.875 | 526.193 | 526.230 | -0.037 | 1 |
| 28214 | 7012029.323 | 434754.038 | 526.161 | 526.220 | -0.059 | 1 |
| 28215 | 7012030.964 | 434755.203 | 526.138 | 526.190 | -0.052 | 1 |
| 28216 | 7012032.539 | 434756.363 | 526.113 | 526.160 | -0.047 | 1 |
| 28217 | 7012028.36 | 434656.38 | 518.578 | 518.630 | -0.052 | 1 |
| 28218 | 7012030.156 | 434657.303 | 518.716 | 518.780 | -0.064 | 1 |
| 28219 | 7012031.936 | 434658.301 | 518.842 | 518.910 | -0.068 | 1 |
| 28220 | 7012033.66 | 434659.192 | 518.962 | 519.020 | -0.058 | 1 |
| 28221 | 7012035.393 | 434660.139 | 519.085 | 519.140 | -0.055 | 1 |
| 28222 | 7012037.125 | 434661.145 | 519.207 | 519.270 | -0.063 | 1 |
| 28223 | 7012039.08 | 434662.237 | 519.239 | 519.320 | -0.081 | 1 |
| 28224 | 7012040.97 | 434663.443 | 519.264 | 519.350 | -0.086 | 1 |
| 28225 | 7012042.571 | 434664.47 | 519.287 | 519.350 | -0.063 | 1 |
| 28226 | 7012044.334 | 434665.667 | 519.281 | 519.350 | -0.069 | 1 |
| 28227 | 7012046.047 | 434666.824 | 519.256 | 519.320 | -0.064 | 1 |
| 28228 | 7012047.703 | 434667.942 | 519.250 | 519.330 | -0.080 | 1 |
| 28229 | 7012049.514 | 434669.089 | 519.263 | 519.340 | -0.077 | 1 |
| 28230 | 7012051.192 | 434670.269 | 519.306 | 519.350 | -0.044 | 1 |
| 28231 | 7012052.776 | 434671.519 | 519.359 | 519.410 | -0.051 | 1 |
| 28232 | 7012054.563 | 434672.994 | 519.457 | 519.500 | -0.043 | 1 |
| 28233 | 7012056.428 | 434674.493 | 519.579 | 519.630 | -0.051 | 1 |
| 28234 | 7012058.068 | 434675.93 | 519.718 | 519.760 | -0.042 | 1 |
| 28235 | 7012059.859 | 434677.32 | 519.899 | 519.940 | -0.041 | 1 |
| 28236 | 7012061.601 | 434678.847 | 520.091 | 520.140 | -0.049 | 1 |
| 28237 | 7012063.452 | 434680.375 | 520.375 | 520.420 | -0.045 | 1 |
| 28238 | 7012065.005 | 434681.916 | 520.642 | 520.700 | -0.058 | 1 |
| 28239 | 7012066.477 | 434683.561 | 520.951 | 521.010 | -0.059 | 1 |
| 28240 | 7012067.69 | 434685.635 | 521.321 | 521.340 | -0.019 | 1 |
| 28241 | 7012068.948 | 434687.952 | 521.652 | 521.700 | -0.048 | 1 |
| 28242 | 7012069.743 | 434690.382 | 521.998 | 522.050 | -0.052 | 1 |
| 28243 | 7012070.416 | 434692.744 | 522.391 | 522.420 | -0.029 | 1 |
| 28244 | 7012070.769 | 434695.128 | 522.750 | 522.830 | -0.080 | 1 |
| 28245 | 7013164.763 | 430670.909 | 534.146 | 534.230 | -0.084 | 1 |
| 28246 | 7013166.709 | 430672.682 | 534.179 | 534.230 | -0.051 | 1 |
| 28247 | 7013169.531 | 430675.398 | 534.069 | 534.160 | -0.091 | 1 |
| 28248 | 7013171.561 | 430676.578 | 534.001 | 534.130 | -0.129 | 1 |
| 28249 | 7013173.461 | 430677.757 | 533.991 | 534.060 | -0.069 | 1 |
| 28250 | 7013174.044 | 430681.717 | 533.967 | 534.050 | -0.083 | 1 |
| 28251 | 7013175.863 | 430682.935 | 533.923 | 534.040 | -0.117 | 1 |
| 28252 | 7013151.31 | 430674.816 | 534.591 | 534.700 | -0.109 | 1 |
| 28253 | 7012525.036 | 432912.432 | 551.500 | 551.580 | -0.080 | 1 |
| 28254 | 7012522.423 | 432913.098 | 551.366 | 551.420 | -0.054 | 1 |
| 28255 | 7012520.45 | 432913.601 | 551.241 | 551.310 | -0.069 | 1 |
| 28256 | 7012518.408 | 432914.215 | 551.097 | 551.160 | -0.063 | 1 |
| 28257 | 7012516.692 | 432914.712 | 550.992 | 551.040 | -0.048 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 28258 | 7012514.988 | 432915.438 | 550.853 | 550.880 | -0.027 | 1 |
| 28259 | 7012513.242 | 432915.731 | 550.423 | 550.510 | -0.087 | 1 |
| 28260 | 7012511.488 | 432916.41 | 550.098 | 550.150 | -0.052 | 1 |
| 28261 | 7012509.689 | 432917.473 | 549.883 | 549.950 | -0.067 | 1 |
| 28262 | 7012507.686 | 432918.565 | 549.830 | 549.930 | -0.100 | 1 |
| 28263 | 7012505.572 | 432919.925 | 549.798 | 549.890 | -0.092 | 1 |
| 28264 | 7012503.862 | 432920.581 | 549.760 | 549.840 | -0.080 | 1 |
| 28265 | 7012502.024 | 432921.285 | 549.667 | 549.760 | -0.093 | 1 |
| 28266 | 7012501.736 | 432923.968 | 549.561 | 549.660 | -0.099 | 1 |
| 28267 | 7012501.428 | 432926.547 | 549.486 | 549.560 | -0.074 | 1 |
| 28268 | 7012501.156 | 432929.193 | 549.414 | 549.490 | -0.076 | 1 |
| 28269 | 7012501.112 | 432931.767 | 549.382 | 549.430 | -0.048 | 1 |
| 28270 | 7012501.05 | 432934.354 | 549.310 | 549.400 | -0.090 | 1 |
| 28271 | 7012501.003 | 432936.975 | 549.314 | 549.350 | -0.036 | 1 |
| 28272 | 7012500.971 | 432939.257 | 549.260 | 549.340 | -0.080 | 1 |
| 28273 | 7012500.881 | 432941.774 | 549.180 | 549.270 | -0.090 | 1 |
| 28274 | 7012500.817 | 432944.155 | 549.143 | 549.210 | -0.067 | 1 |
| 28275 | 7012500.751 | 432946.758 | 549.071 | 549.120 | -0.049 | 1 |
| 28276 | 7012500.674 | 432949.095 | 548.977 | 549.050 | -0.073 | 1 |
| 28277 | 7012500.563 | 432951.47 | 548.903 | 548.960 | -0.057 | 1 |
| 28278 | 7012500.269 | 432953.876 | 548.761 | 548.860 | -0.099 | 1 |
| 28279 | 7012500.034 | 432956.361 | 548.664 | 548.750 | -0.086 | 1 |
| 28280 | 7012499.808 | 432958.679 | 548.575 | 548.640 | -0.065 | 1 |
| 28281 | 7012499.605 | 432961.13 | 548.436 | 548.540 | -0.104 | 1 |
| 28282 | 7012499.407 | 432963.589 | 548.337 | 548.400 | -0.063 | 1 |
| 28283 | 7012499.363 | 432966.253 | 548.229 | 548.310 | -0.081 | 1 |
| 28284 | 7012499.15 | 432968.689 | 548.117 | 548.180 | -0.063 | 1 |
| 28285 | 7012499.071 | 432971.143 | 547.988 | 548.070 | -0.082 | 1 |
| 28286 | 7012499.085 | 432973.671 | 547.904 | 547.970 | -0.066 | 1 |
| 28287 | 7012499.111 | 432976.207 | 547.796 | 547.870 | -0.074 | 1 |
| 28288 | 7012499.173 | 432978.94 | 547.684 | 547.760 | -0.076 | 1 |
| 28289 | 7012498.993 | 432981.483 | 547.550 | 547.650 | -0.100 | 1 |
| 28290 | 7012498.661 | 432984.327 | 547.410 | 547.490 | -0.080 | 1 |
| 28291 | 7012498.361 | 432986.835 | 547.229 | 547.330 | -0.101 | 1 |
| 28292 | 7012498.017 | 432989.378 | 547.054 | 547.120 | -0.066 | 1 |
| 28293 | 7012497.617 | 432991.849 | 546.876 | 547.000 | -0.124 | 1 |
| 28294 | 7012497.367 | 432994.576 | 546.754 | 546.820 | -0.066 | 1 |
| 28295 | 7012497.163 | 432997.059 | 546.655 | 546.730 | -0.075 | 1 |
| 28296 | 7012496.756 | 432999.497 | 546.533 | 546.620 | -0.087 | 1 |
| 28297 | 7012496.488 | 433001.977 | 546.417 | 546.500 | -0.083 | 1 |
| 28298 | 7012496.241 | 433004.578 | 546.289 | 546.370 | -0.081 | 1 |
| 28299 | 7012496.02 | 433006.955 | 546.156 | 546.240 | -0.084 | 1 |
| 28300 | 7012495.769 | 433009.226 | 545.956 | 546.030 | -0.074 | 1 |
| 28301 | 7012495.316 | 433011.521 | 545.747 | 545.820 | -0.073 | 1 |
| 28302 | 7010149.839 | 439032.832 | 555.098 | 555.200 | -0.102 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 28303 | 7010149.297 | 439032.27 | 555.163 | 555.250 | -0.087 | 1 |
| 28304 | 7010148.368 | 439030.102 | 555.284 | 555.360 | -0.076 | 1 |
| 28305 | 7010147.02 | 439028.585 | 555.431 | 555.520 | -0.089 | 1 |
| 28306 | 7010145.756 | 439026.794 | 555.555 | 555.650 | -0.095 | 1 |
| 28307 | 7010144.223 | 439024.846 | 555.710 | 555.800 | -0.090 | 1 |
| 28308 | 7010152.39 | 439032.355 | 554.835 | 554.960 | -0.125 | 1 |
| 28309 | 7010153.902 | 439034.197 | 554.731 | 554.860 | -0.129 | 1 |
| 28310 | 7010155.418 | 439036.101 | 554.685 | 554.810 | -0.125 | 1 |
| 28311 | 7010156.805 | 439038.392 | 554.739 | 554.860 | -0.121 | 1 |
| 28312 | 7010157.624 | 439040.807 | 554.859 | 554.970 | -0.111 | 1 |
| 28313 | 7010158.125 | 439043.113 | 555.111 | 555.210 | -0.099 | 1 |
| 28314 | 7010158.159 | 439046.05 | 555.457 | 555.530 | -0.073 | 1 |
| 28315 | 7010158.24 | 439048.539 | 555.738 | 555.820 | -0.082 | 1 |
| 28316 | 7010158.488 | 439051.049 | 556.064 | 556.180 | -0.116 | 1 |
| 28317 | 7010158.023 | 439053.652 | 556.453 | 556.530 | -0.077 | 1 |
| 28318 | 7005543.513 | 442446.884 | 553.120 | 553.200 | -0.080 | 1 |
| 28319 | 7005545.362 | 442447.974 | 552.989 | 553.080 | -0.091 | 1 |
| 28320 | 7005547.082 | 442448.922 | 552.857 | 552.960 | -0.103 | 1 |
| 28321 | 7005548.838 | 442449.834 | 552.732 | 552.830 | -0.098 | 1 |
| 28322 | 7005550.67 | 442450.873 | 552.609 | 552.700 | -0.091 | 1 |
| 28323 | 7005552.501 | 442451.817 | 552.473 | 552.560 | -0.087 | 1 |
| 28324 | 7005271.583 | 443422.413 | 586.564 | 586.640 | -0.076 | 1 |
| 28325 | 7005274.551 | 443421.665 | 586.778 | 586.840 | -0.062 | 1 |
| 28326 | 7005277.417 | 443420.92 | 586.968 | 587.050 | -0.082 | 1 |
| 28327 | 7005280.168 | 443420.251 | 587.134 | 587.240 | -0.106 | 1 |
| 28328 | 7005282.401 | 443419.65 | 587.261 | 587.350 | -0.089 | 1 |
| 28329 | 7005286.082 | 443419.192 | 587.446 | 587.540 | -0.094 | 1 |
| 28330 | 7005289.583 | 443419.049 | 587.696 | 587.770 | -0.074 | 1 |
| 28331 | 7005292.817 | 443419.191 | 587.901 | 587.990 | -0.089 | 1 |
| 28332 | 7005295.904 | 443419.308 | 588.023 | 588.130 | -0.107 | 1 |
| 28333 | 7005298.788 | 443418.565 | 588.095 | 588.190 | -0.095 | 1 |
| 28334 | 7005301.415 | 443417.234 | 588.101 | 588.210 | -0.109 | 1 |
| 28335 | 7005304.116 | 443416.251 | 588.115 | 588.220 | -0.105 | 1 |
| 28336 | 7005306.543 | 443416.805 | 588.155 | 588.260 | -0.105 | 1 |
| 28337 | 7005308.767 | 443417.724 | 588.135 | 588.260 | -0.125 | 1 |
| 28338 | 7005311.445 | 443418.748 | 588.083 | 588.180 | -0.097 | 1 |
| 28339 | 7005317.167 | 443410.625 | 587.790 | 587.890 | -0.100 | 1 |
| 28340 | 7005319.92 | 443410.778 | 587.749 | 587.850 | -0.101 | 1 |
| 28341 | 7005322.117 | 443411.512 | 587.800 | 587.890 | -0.090 | 1 |
| 28342 | 7004390.356 | 444351.635 | 571.499 | 571.620 | -0.121 | 1 |
| 28343 | 7004389.31 | 444349.577 | 571.443 | 571.530 | -0.087 | 1 |
| 28344 | 7004388.658 | 444347.255 | 571.418 | 571.510 | -0.092 | 1 |
| 28345 | 7004387.894 | 444344.931 | 571.482 | 571.580 | -0.098 | 1 |
| 28346 | 7004387.319 | 444342.745 | 571.517 | 571.610 | -0.093 | 1 |
| 28347 | 7004386.543 | 444340.393 | 571.545 | 571.650 | -0.105 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 28348 | 7004385.756 | 444338.029 | 571.524 | 571.620 | -0.096 | 1 |
| 28349 | 7004384.95 | 444335.61 | 571.483 | 571.560 | -0.077 | 1 |
| 28350 | 7004384.356 | 444333.447 | 571.420 | 571.500 | -0.080 | 1 |
| 28351 | 7004383.62 | 444331.162 | 571.322 | 571.420 | -0.098 | 1 |
| 28352 | 7004382.608 | 444329.242 | 571.222 | 571.330 | -0.108 | 1 |
| 28353 | 7004381.931 | 444327.058 | 571.133 | 571.210 | -0.077 | 1 |
| 28354 | 7004381.111 | 444324.821 | 570.957 | 571.070 | -0.113 | 1 |
| 28355 | 7004379.674 | 444322.569 | 570.812 | 570.910 | -0.098 | 1 |
| 28356 | 7004378.225 | 444320.386 | 570.690 | 570.790 | -0.100 | 1 |
| 28357 | 7004376.699 | 444318.139 | 570.551 | 570.640 | -0.089 | 1 |
| 28358 | 7004375.144 | 444315.729 | 570.420 | 570.500 | -0.080 | 1 |
| 28359 | 7004373.643 | 444313.489 | 570.294 | 570.350 | -0.056 | 1 |
| 28360 | 7004371.946 | 444310.9 | 570.123 | 570.200 | -0.077 | 1 |
| 28361 | 7004370.196 | 444308.372 | 569.955 | 570.030 | -0.075 | 1 |
| 28362 | 7004368.169 | 444305.919 | 569.737 | 569.820 | -0.083 | 1 |
| 28363 | 7004366.39 | 444303.003 | 569.500 | 569.570 | -0.070 | 1 |
| 28364 | 7004364.626 | 444300.513 | 569.289 | 569.360 | -0.071 | 1 |
| 28365 | 7004362.778 | 444298.154 | 569.064 | 569.140 | -0.076 | 1 |
| 28366 | 7004360.433 | 444295.594 | 568.808 | 568.880 | -0.072 | 1 |
| 28367 | 7004358.396 | 444293.076 | 568.533 | 568.620 | -0.087 | 1 |
| 28368 | 7004356.151 | 444290.68 | 568.276 | 568.370 | -0.094 | 1 |
| 28369 | 7004354.09 | 444288.57 | 568.026 | 568.090 | -0.064 | 1 |
| 28370 | 7004351.859 | 444286.17 | 567.756 | 567.830 | -0.074 | 1 |
| 28371 | 7002778.323 | 445497.299 | 572.687 | 572.790 | -0.103 | 1 |
| 28372 | 7002779.048 | 445499.321 | 572.710 | 572.800 | -0.090 | 1 |
| 28373 | 7002779.829 | 445501.402 | 572.724 | 572.820 | -0.096 | 1 |
| 28374 | 7002780.689 | 445503.286 | 572.704 | 572.820 | -0.116 | 1 |
| 28375 | 7002781.497 | 445505.147 | 572.669 | 572.760 | -0.091 | 1 |
| 28376 | 7002782.276 | 445507.275 | 572.633 | 572.730 | -0.097 | 1 |
| 28377 | 7002783.104 | 445509.151 | 572.595 | 572.690 | -0.095 | 1 |
| 28378 | 7002783.869 | 445511.56 | 572.582 | 572.670 | -0.088 | 1 |
| 28379 | 7002784.609 | 445513.835 | 572.561 | 572.660 | -0.099 | 1 |
| 28380 | 6999337.938 | 446914.821 | 640.731 | 640.820 | -0.089 | 1 |
| 28381 | 6999339.734 | 446915.577 | 640.754 | 640.850 | -0.096 | 1 |
| 28382 | 6999341.659 | 446916.335 | 640.761 | 640.850 | -0.089 | 1 |
| 28383 | 6999343.493 | 446916.989 | 640.790 | 640.860 | -0.070 | 1 |
| 28384 | 6999345.378 | 446917.829 | 640.792 | 640.870 | -0.078 | 1 |
| 28385 | 6999346.949 | 446918.422 | 640.780 | 640.850 | -0.070 | 1 |
| 28386 | 6999348.487 | 446919.096 | 640.665 | 640.750 | -0.085 | 1 |
| 28387 | 6999350.142 | 446919.472 | 640.551 | 640.640 | -0.089 | 1 |
| 28388 | 6999351.672 | 446920.104 | 640.448 | 640.520 | -0.072 | 1 |
| 28389 | 6999353.272 | 446920.872 | 640.333 | 640.430 | -0.097 | 1 |
| 28390 | 6999355.403 | 446921.927 | 640.225 | 640.310 | -0.085 | 1 |
| 28391 | 6999356.643 | 446922.352 | 640.146 | 640.240 | -0.094 | 1 |
| 28392 | 7003972.363 | 444909.856 | 549.815 | 549.890 | -0.075 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 28393 | 7003970.469 | 444907.914 | 549.727 | 549.830 | -0.103 | 1 |
| 28394 | 7003968.436 | 444906.225 | 549.662 | 549.740 | -0.078 | 1 |
| 28395 | 7003966.422 | 444904.833 | 549.561 | 549.640 | -0.079 | 1 |
| 28396 | 7005541.61 | 442444.125 | 552.643 | 552.660 | -0.017 | 1 |
| 29000 | 6991761.642 | 456912.874 | 520.758 | 520.830 | -0.072 | 1 |
| 29001 | 6989977.555 | 458310.015 | 535.968 | 535.980 | -0.012 | 1 |
| 29002 | 6989964.609 | 458306.022 | 535.011 | 535.040 | -0.029 | 1 |
| 29003 | 6989955.785 | 458320.603 | 535.379 | 535.420 | -0.041 | 1 |
| 29004 | 6989954.584 | 458359.196 | 537.425 | 537.430 | -0.005 | 1 |
| 29005 | 6989969.442 | 458347.368 | 537.406 | 537.410 | -0.004 | 1 |
| 29006 | 6989985.062 | 458335.48 | 537.264 | 537.260 | 0.004 | 1 |
| 29007 | 6989999.972 | 458324.635 | 537.006 | 537.010 | -0.004 | 1 |
| 29008 | 6990015.246 | 458314.071 | 536.610 | 536.620 | -0.010 | 1 |
| 29009 | 6990014.229 | 458319.502 | 536.500 | 536.500 | 0.000 | 1 |
| 29010 | 6989998.722 | 458330.14 | 536.894 | 536.910 | -0.016 | 1 |
| 29011 | 6989983.502 | 458341.21 | 537.157 | 537.170 | -0.013 | 1 |
| 29012 | 6989969.453 | 458352.006 | 537.309 | 537.290 | 0.019 | 1 |
| 29013 | 6990951.025 | 458270.262 | 548.441 | 548.490 | -0.049 | 1 |
| 29014 | 6990955.403 | 458237.161 | 546.264 | 546.280 | -0.016 | 1 |
| 29015 | 6990936.911 | 458242.333 | 546.543 | 546.560 | -0.017 | 1 |
| 29016 | 6990922.236 | 458246.815 | 546.732 | 546.760 | -0.028 | 1 |
| 29017 | 6990920.71 | 458239.218 | 546.166 | 546.210 | -0.044 | 1 |
| 29018 | 6990939.125 | 458234.179 | 546.028 | 546.080 | -0.052 | 1 |
| 29019 | 6990956.738 | 458228.852 | 545.852 | 545.910 | -0.058 | 1 |
| 29020 | 6990975.006 | 458223.199 | 545.839 | 545.900 | -0.061 | 1 |
| 29021 | 6990978.154 | 458230.349 | 545.983 | 546.010 | -0.027 | 1 |
| 29022 | 6990989.58 | 458263.144 | 549.302 | 549.330 | -0.028 | 1 |
| 29023 | 6990971.011 | 458264.963 | 548.787 | 548.820 | -0.033 | 1 |
| 29024 | 6990952.414 | 458266.082 | 548.205 | 548.230 | -0.025 | 1 |
| 29025 | 6990952.617 | 458270.341 | 548.508 | 548.550 | -0.042 | 1 |
| 29026 | 6990952.832 | 458280.734 | 548.053 | 548.110 | -0.057 | 1 |
| 29027 | 6990965.826 | 458280.123 | 548.560 | 548.620 | -0.060 | 1 |
| 29028 | 6991738.629 | 457738.418 | 604.027 | 604.060 | -0.033 | 1 |
| 29029 | 6991721.386 | 457747.486 | 602.743 | 602.750 | -0.007 | 1 |
| 29030 | 6991707.261 | 457756.185 | 601.572 | 601.580 | -0.008 | 1 |
| 29031 | 6991693.652 | 457765.88 | 600.549 | 600.580 | -0.031 | 1 |
| 29032 | 6991680.588 | 457776.376 | 599.521 | 599.570 | -0.049 | 1 |
| 29033 | 6991668.092 | 457786.912 | 598.660 | 598.680 | -0.020 | 1 |
| 29034 | 6991656.329 | 457797.591 | 597.878 | 597.930 | -0.052 | 1 |
| 29035 | 6991644.113 | 457808.944 | 596.888 | 596.920 | -0.032 | 1 |
| 29036 | 6991632.678 | 457819.787 | 595.917 | 595.950 | -0.033 | 1 |
| 29037 | 6991621.287 | 457830.752 | 595.057 | 595.090 | -0.033 | 1 |
| 29038 | 6991609.631 | 457841.799 | 594.112 | 594.160 | -0.048 | 1 |
| 29039 | 6991597.982 | 457852.804 | 593.011 | 593.070 | -0.059 | 1 |
| 29040 | 6991586.649 | 457863.41 | 592.053 | 592.090 | -0.037 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 29041 | 6991575.108 | 457874.346 | 591.134 | 591.170 | -0.036 | 1 |
| 29042 | 6991563.644 | 457885.256 | 590.150 | 590.210 | -0.060 | 1 |
| 29043 | 6991552.502 | 457896.19 | 589.260 | 589.280 | -0.020 | 1 |
| 29044 | 6991543.139 | 457905.336 | 588.471 | 588.490 | -0.019 | 1 |
| 29045 | 6991533.267 | 457915.307 | 587.601 | 587.640 | -0.039 | 1 |
| 29046 | 6991630.537 | 457607.213 | 552.853 | 552.920 | -0.067 | 1 |
| 29047 | 6991637.75 | 457602.462 | 553.040 | 553.090 | -0.050 | 1 |
| 29048 | 6991641.955 | 457593.134 | 553.137 | 553.160 | -0.023 | 1 |
| 29049 | 6991646.338 | 457584.963 | 553.121 | 553.170 | -0.049 | 1 |
| 29050 | 6991642.62 | 457577.48 | 552.802 | 552.850 | -0.048 | 1 |
| 29051 | 6991635.502 | 457571.007 | 552.076 | 552.150 | -0.074 | 1 |
| 29052 | 6991633.353 | 457581.066 | 552.480 | 552.540 | -0.060 | 1 |
| 29053 | 6991641.014 | 457582.581 | 552.937 | 552.990 | -0.053 | 1 |
| 29054 | 6991632.762 | 457590.115 | 552.659 | 552.700 | -0.041 | 1 |
| 29055 | 6991685.529 | 456620.977 | 527.467 | 527.530 | -0.063 | 1 |
| 29056 | 6991692.28 | 456620.899 | 527.403 | 527.420 | -0.017 | 1 |
| 29057 | 6991693.157 | 456624.603 | 527.382 | 527.420 | -0.038 | 1 |
| 29058 | 6991688.649 | 456625.534 | 527.473 | 527.490 | -0.017 | 1 |
| 29059 | 6991682.987 | 456627.179 | 527.600 | 527.640 | -0.040 | 1 |
| 29060 | 6991681.699 | 456622.766 | 527.658 | 527.680 | -0.022 | 1 |
| 29061 | 6991672.616 | 456619.621 | 528.031 | 528.070 | -0.039 | 1 |
| 29062 | 6991676.363 | 456635.195 | 527.887 | 527.910 | -0.023 | 1 |
| 29063 | 6991680.101 | 456649.913 | 527.684 | 527.710 | -0.026 | 1 |
| 29064 | 6991684.228 | 456665.315 | 527.416 | 527.460 | -0.044 | 1 |
| 29065 | 6991680.542 | 456666.229 | 527.415 | 527.440 | -0.025 | 1 |
| 29066 | 6991676.245 | 456649.711 | 527.742 | 527.750 | -0.008 | 1 |
| 29067 | 6991672.356 | 456633.879 | 528.007 | 528.030 | -0.023 | 1 |
| 29068 | 6991668.516 | 456618.367 | 528.217 | 528.240 | -0.023 | 1 |
| 29069 | 6991963.103 | 455397.997 | 522.095 | 522.140 | -0.045 | 1 |
| 29070 | 6991932.963 | 455430.406 | 521.940 | 521.980 | -0.040 | 1 |
| 29071 | 6991924.743 | 455442.337 | 521.879 | 521.910 | -0.031 | 1 |
| 29072 | 6991921.936 | 455456.448 | 521.957 | 522.000 | -0.043 | 1 |
| 29073 | 6991925.21 | 455454.372 | 521.958 | 521.980 | -0.022 | 1 |
| 29074 | 6991670.822 | 456382.638 | 525.411 | 525.440 | -0.029 | 1 |
| 29075 | 6991672.105 | 456375.295 | 525.241 | 525.270 | -0.029 | 1 |
| 29076 | 6991666.573 | 456374.428 | 525.527 | 525.550 | -0.023 | 1 |
| 29077 | 6991663.896 | 456389.942 | 525.820 | 525.860 | -0.040 | 1 |
| 29078 | 6991661.766 | 456404.709 | 526.161 | 526.210 | -0.049 | 1 |
| 29079 | 6991659.7 | 456419.979 | 526.585 | 526.610 | -0.025 | 1 |
| 29080 | 6991655.989 | 456419.404 | 526.799 | 526.840 | -0.041 | 1 |
| 29081 | 6991658.244 | 456403.434 | 526.331 | 526.360 | -0.029 | 1 |
| 29082 | 6991660.721 | 456387.718 | 525.949 | 526.000 | -0.051 | 1 |
| 29083 | 6991663.271 | 456372.766 | 525.662 | 525.720 | -0.058 | 1 |
| 29084 | 6991666.463 | 456357.697 | 525.340 | 525.400 | -0.060 | 1 |
| 29085 | 6991670.083 | 456341.94 | 524.984 | 525.030 | -0.046 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 29086 | 6991673.791 | 456342.991 | 524.801 | 524.860 | -0.059 | 1 |
| 29087 | 6991669.954 | 456358.614 | 525.153 | 525.200 | -0.047 | 1 |
| 29088 | 6991681.891 | 456376.931 | 524.669 | 524.740 | -0.071 | 1 |
| 29089 | 6991688.039 | 456378.67 | 524.733 | 524.780 | -0.047 | 1 |
| 29090 | 6991687.205 | 456382.257 | 524.745 | 524.780 | -0.035 | 1 |
| 29091 | 6991679.182 | 456381.799 | 524.903 | 524.970 | -0.067 | 1 |
| 29092 | 6991679.313 | 456378.909 | 524.864 | 524.910 | -0.046 | 1 |
| 29093 | 6991684.116 | 456379.731 | 524.786 | 524.830 | -0.044 | 1 |
| 29094 | 6991688.7 | 456380.455 | 524.741 | 524.770 | -0.029 | 1 |
| 29099 | 6991761.642 | 456912.874 | 520.758 | 520.830 | -0.072 | 1 |
| 29100 | 6991761.012 | 456911.472 | 520.738 | 520.770 | -0.032 | 1 |
| 29101 | 6991949.883 | 455406.951 | 521.980 | 522.040 | -0.060 | 1 |
| 29102 | 6991951.879 | 455408.263 | 522.012 | 522.080 | -0.068 | 1 |
| 29103 | 6991954.019 | 455409.776 | 522.059 | 522.100 | -0.041 | 1 |
| 29104 | 6991956.133 | 455411.038 | 522.107 | 522.170 | -0.063 | 1 |
| 29105 | 6991958.299 | 455412.499 | 522.143 | 522.210 | -0.067 | 1 |
| 29106 | 6991960.305 | 455413.672 | 522.169 | 522.230 | -0.061 | 1 |
| 29107 | 6991962.063 | 455415.013 | 522.212 | 522.260 | -0.048 | 1 |
| 29108 | 6991963.897 | 455416.266 | 522.252 | 522.300 | -0.048 | 1 |
| 29109 | 6991965.866 | 455417.557 | 522.301 | 522.340 | -0.039 | 1 |
| 29110 | 6991967.402 | 455418.608 | 522.295 | 522.340 | -0.045 | 1 |
| 29111 | 6991974.541 | 455424.161 | 522.176 | 522.220 | -0.044 | 1 |
| 29112 | 6991972.812 | 455423.108 | 522.209 | 522.260 | -0.051 | 1 |
| 29113 | 6991971.101 | 455421.837 | 522.250 | 522.290 | -0.040 | 1 |
| 29114 | 6991969.241 | 455420.746 | 522.269 | 522.330 | -0.061 | 1 |
| 29115 | 6993495.152 | 452719.671 | 590.932 | 590.980 | -0.048 | 1 |
| 29116 | 6993496.786 | 452720.468 | 590.857 | 590.900 | -0.043 | 1 |
| 29117 | 6993498.558 | 452721.33 | 590.744 | 590.780 | -0.036 | 1 |
| 29118 | 6993500.144 | 452722.027 | 590.649 | 590.710 | -0.061 | 1 |
| 29119 | 6993501.991 | 452722.868 | 590.537 | 590.610 | -0.073 | 1 |
| 29120 | 6993503.745 | 452723.652 | 590.440 | 590.480 | -0.040 | 1 |
| 29121 | 6993505.112 | 452724.399 | 590.364 | 590.380 | -0.016 | 1 |
| 29122 | 6993493.691 | 452719.474 | 590.932 | 590.960 | -0.028 | 1 |
| 29123 | 6993491.872 | 452718.278 | 590.895 | 590.940 | -0.045 | 1 |
| 29124 | 6993490.136 | 452717.348 | 590.816 | 590.870 | -0.054 | 1 |
| 29125 | 6993488.586 | 452716.722 | 590.714 | 590.730 | -0.016 | 1 |
| 29126 | 6991921.958 | 455480.638 | 522.039 | 522.070 | -0.031 | 1 |
| 29127 | 6991923.292 | 455477.92 | 522.047 | 522.060 | -0.013 | 1 |
| 29128 | 6991924.681 | 455475.215 | 522.059 | 522.100 | -0.041 | 1 |
| 29129 | 6991926.153 | 455472.687 | 522.066 | 522.100 | -0.034 | 1 |
| 29130 | 6991927.731 | 455469.838 | 522.084 | 522.110 | -0.026 | 1 |
| 29131 | 6991929.201 | 455467.325 | 522.075 | 522.120 | -0.045 | 1 |
| 29132 | 6991930.579 | 455464.763 | 522.072 | 522.120 | -0.048 | 1 |
| 29133 | 6991931.94 | 455462.037 | 522.069 | 522.100 | -0.031 | 1 |
| 29134 | 6991933.723 | 455459.203 | 522.092 | 522.130 | -0.038 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 29135 | 6991935.246 | 455456.828 | 522.109 | 522.150 | -0.041 | 1 |
| 29136 | 6991936.711 | 455454.406 | 522.117 | 522.140 | -0.023 | 1 |
| 29137 | 6991938.196 | 455452.069 | 522.133 | 522.150 | -0.017 | 1 |
| 29138 | 6991939.602 | 455449.838 | 522.146 | 522.180 | -0.034 | 1 |
| 29139 | 6991941.005 | 455447.61 | 522.142 | 522.180 | -0.038 | 1 |
| 29140 | 6991942.552 | 455445.292 | 522.151 | 522.190 | -0.039 | 1 |
| 29141 | 6991943.962 | 455443.256 | 522.167 | 522.220 | -0.053 | 1 |
| 29142 | 6991945.446 | 455440.984 | 522.181 | 522.230 | -0.049 | 1 |
| 29143 | 6991947.004 | 455438.902 | 522.193 | 522.230 | -0.037 | 1 |
| 29144 | 6991948.517 | 455436.754 | 522.192 | 522.240 | -0.048 | 1 |
| 29145 | 6991950.143 | 455434.557 | 522.197 | 522.230 | -0.033 | 1 |
| 29146 | 6991951.745 | 455432.598 | 522.204 | 522.260 | -0.056 | 1 |
| 29147 | 6991953.262 | 455430.421 | 522.213 | 522.260 | -0.047 | 1 |
| 29148 | 6991954.793 | 455428.395 | 522.214 | 522.260 | -0.046 | 1 |
| 29149 | 6991956.352 | 455426.325 | 522.223 | 522.270 | -0.047 | 1 |
| 29150 | 6991957.883 | 455424.265 | 522.230 | 522.270 | -0.040 | 1 |
| 29151 | 6991959.316 | 455422.27 | 522.239 | 522.270 | -0.031 | 1 |
| 29152 | 6991960.916 | 455420.015 | 522.254 | 522.280 | -0.026 | 1 |
| 29153 | 6991962.495 | 455417.852 | 522.256 | 522.290 | -0.034 | 1 |
| 29154 | 6991964.107 | 455415.542 | 522.266 | 522.300 | -0.034 | 1 |
| 29155 | 6991965.703 | 455413.407 | 522.276 | 522.300 | -0.024 | 1 |
| 29156 | 6991967.376 | 455411.271 | 522.273 | 522.300 | -0.027 | 1 |
| 29157 | 6991968.861 | 455409.167 | 522.275 | 522.320 | -0.045 | 1 |
| 29158 | 6991970.395 | 455406.965 | 522.278 | 522.310 | -0.032 | 1 |
| 29159 | 6991971.956 | 455404.748 | 522.270 | 522.300 | -0.030 | 1 |
| 29160 | 6991973.422 | 455402.547 | 522.272 | 522.320 | -0.048 | 1 |
| 29161 | 6991974.867 | 455400.585 | 522.283 | 522.330 | -0.047 | 1 |
| 29162 | 6991976.376 | 455398.566 | 522.295 | 522.330 | -0.035 | 1 |
| 29163 | 6991977.994 | 455396.108 | 522.301 | 522.340 | -0.039 | 1 |
| 29164 | 6991979.586 | 455393.841 | 522.317 | 522.350 | -0.033 | 1 |
| 29165 | 6991981.379 | 455391.49 | 522.331 | 522.360 | -0.029 | 1 |
| 29166 | 6991982.997 | 455389.354 | 522.359 | 522.390 | -0.031 | 1 |
| 29167 | 6991984.574 | 455387.383 | 522.376 | 522.420 | -0.044 | 1 |
| 29168 | 6991986.21 | 455385.339 | 522.386 | 522.430 | -0.044 | 1 |
| 29169 | 6991987.82 | 455383.291 | 522.395 | 522.440 | -0.045 | 1 |
| 29170 | 6991989.548 | 455381.075 | 522.414 | 522.450 | -0.036 | 1 |
| 29171 | 6991991.261 | 455378.96 | 522.431 | 522.450 | -0.019 | 1 |
| 29172 | 6991993.214 | 455376.589 | 522.450 | 522.490 | -0.040 | 1 |
| 29173 | 6991994.836 | 455374.384 | 522.456 | 522.500 | -0.044 | 1 |
| 29174 | 6991996.356 | 455372.197 | 522.471 | 522.500 | -0.029 | 1 |
| 29175 | 6991998.106 | 455369.921 | 522.487 | 522.520 | -0.033 | 1 |
| 29176 | 6992000.074 | 455367.662 | 522.494 | 522.530 | -0.036 | 1 |
| 29177 | 6992002.028 | 455365.652 | 522.512 | 522.550 | -0.038 | 1 |
| 29178 | 6992003.926 | 455363.846 | 522.526 | 522.540 | -0.014 | 1 |
| 29179 | 6992005.972 | 455361.76 | 522.545 | 522.580 | -0.035 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 29180 | 6992007.806 | 455359.746 | 522.567 | 522.600 | -0.033 | 1 |
| 29181 | 6992009.902 | 455357.905 | 522.595 | 522.620 | -0.025 | 1 |
| 29182 | 6992012.28 | 455356.44 | 522.636 | 522.680 | -0.044 | 1 |
| 29183 | 6992014.767 | 455354.759 | 522.697 | 522.730 | -0.033 | 1 |
| 29184 | 6992016.949 | 455353.243 | 522.744 | 522.780 | -0.036 | 1 |
| 29185 | 6992018.595 | 455351.15 | 522.786 | 522.810 | -0.024 | 1 |
| 29186 | 6992020.169 | 455349.069 | 522.817 | 522.850 | -0.033 | 1 |
| 29187 | 6992021.844 | 455346.886 | 522.845 | 522.890 | -0.045 | 1 |
| 29188 | 6992023.356 | 455344.896 | 522.866 | 522.890 | -0.024 | 1 |
| 29189 | 6992024.955 | 455342.878 | 522.877 | 522.920 | -0.043 | 1 |
| 29190 | 6992026.41 | 455340.925 | 522.904 | 522.940 | -0.036 | 1 |
| 29191 | 6992027.981 | 455338.858 | 522.935 | 522.960 | -0.025 | 1 |
| 29192 | 6992029.479 | 455336.904 | 522.955 | 523.010 | -0.055 | 1 |
| 29193 | 6992030.881 | 455334.986 | 522.984 | 523.030 | -0.046 | 1 |
| 29194 | 6992032.325 | 455333.132 | 523.015 | 523.050 | -0.035 | 1 |
| 29195 | 6992033.83 | 455331.116 | 523.048 | 523.100 | -0.052 | 1 |
| 29196 | 6992035.306 | 455329.194 | 523.083 | 523.140 | -0.057 | 1 |
| 29197 | 6992036.772 | 455327.283 | 523.118 | 523.170 | -0.052 | 1 |
| 29198 | 6992038.239 | 455325.359 | 523.160 | 523.230 | -0.070 | 1 |
| 29199 | 6992039.586 | 455323.575 | 523.203 | 523.250 | -0.047 | 1 |
| 29200 | 6992040.958 | 455321.795 | 523.242 | 523.310 | -0.068 | 1 |
| 29201 | 6991544.095 | 457564.149 | 549.694 | 549.730 | -0.036 | 1 |
| 29202 | 6991546.001 | 457564.969 | 549.750 | 549.780 | -0.030 | 1 |
| 29203 | 6991546.967 | 457567.902 | 549.931 | 549.980 | -0.049 | 1 |
| 29204 | 6991548.776 | 457568.69 | 549.930 | 549.970 | -0.040 | 1 |
| 29205 | 6991550.668 | 457569.372 | 549.869 | 549.910 | -0.041 | 1 |
| 29206 | 6991552.668 | 457570.225 | 549.790 | 549.840 | -0.050 | 1 |
| 29207 | 6991554.759 | 457571.153 | 549.525 | 549.620 | -0.095 | 1 |
| 29208 | 6991556.935 | 457572.297 | 549.435 | 549.500 | -0.065 | 1 |
| 29209 | 6991559.436 | 457573.35 | 549.344 | 549.400 | -0.056 | 1 |
| 29210 | 6991561.984 | 457574.513 | 549.185 | 549.230 | -0.045 | 1 |
| 29211 | 6991564.638 | 457575.65 | 549.142 | 549.200 | -0.058 | 1 |
| 29212 | 6991566.99 | 457576.408 | 549.060 | 549.100 | -0.040 | 1 |
| 29213 | 6991569.325 | 457577.411 | 548.921 | 548.970 | -0.049 | 1 |
| 29214 | 6991571.275 | 457578.418 | 548.813 | 548.870 | -0.057 | 1 |
| 29215 | 6991573.805 | 457580.002 | 548.712 | 548.750 | -0.038 | 1 |
| 29216 | 6991575.957 | 457581.346 | 548.705 | 548.740 | -0.035 | 1 |
| 29217 | 6991578.26 | 457582.937 | 548.737 | 548.780 | -0.043 | 1 |
| 29218 | 6991580.688 | 457584.797 | 548.867 | 548.890 | -0.023 | 1 |
| 29219 | 6991583.147 | 457586.519 | 549.130 | 549.150 | -0.020 | 1 |
| 29220 | 6991585.315 | 457588.108 | 549.381 | 549.420 | -0.039 | 1 |
| 29221 | 6991587.332 | 457589.659 | 549.575 | 549.610 | -0.035 | 1 |
| 29222 | 6991589.268 | 457591.254 | 549.802 | 549.830 | -0.028 | 1 |
| 29223 | 6991591.636 | 457592.67 | 550.069 | 550.110 | -0.041 | 1 |
| 29224 | 6991594.198 | 457594.107 | 550.308 | 550.330 | -0.022 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 29225 | 6991596.491 | 457595.414 | 550.502 | 550.550 | -0.048 | 1 |
| 29226 | 6991598.977 | 457597.405 | 550.719 | 550.770 | -0.051 | 1 |
| 29227 | 6991601.278 | 457599.166 | 550.930 | 550.970 | -0.040 | 1 |
| 29228 | 6991603.832 | 457600.895 | 551.152 | 551.200 | -0.048 | 1 |
| 29229 | 6991606.311 | 457602.525 | 551.334 | 551.370 | -0.036 | 1 |
| 29230 | 6991609.136 | 457604.268 | 551.547 | 551.590 | -0.043 | 1 |
| 29231 | 6991611.77 | 457605.284 | 551.676 | 551.750 | -0.074 | 1 |
| 29232 | 6991614.279 | 457606.431 | 551.866 | 551.900 | -0.034 | 1 |
| 29233 | 6991616.708 | 457607.703 | 552.029 | 552.100 | -0.071 | 1 |
| 29234 | 6991619.401 | 457609.141 | 552.302 | 552.340 | -0.038 | 1 |
| 29235 | 6991622.024 | 457610.282 | 552.540 | 552.620 | -0.080 | 1 |
| 29236 | 6991624.727 | 457611.649 | 552.640 | 552.720 | -0.080 | 1 |
| 29237 | 6991627.151 | 457612.884 | 552.686 | 552.750 | -0.064 | 1 |
| 29238 | 6991629.431 | 457614.186 | 552.722 | 552.780 | -0.058 | 1 |
| 29239 | 6991631.772 | 457615.421 | 552.771 | 552.840 | -0.069 | 1 |
| 29240 | 6991633.998 | 457616.788 | 552.972 | 553.020 | -0.048 | 1 |
| 29241 | 6989159.296 | 458724.026 | 560.067 | 560.140 | -0.073 | 1 |
| 29242 | 6989158.551 | 458726.728 | 560.055 | 560.150 | -0.095 | 1 |
| 29243 | 6989158.042 | 458728.813 | 560.042 | 560.130 | -0.088 | 1 |
| 29244 | 6989157.862 | 458730.888 | 560.047 | 560.140 | -0.093 | 1 |
| 29245 | 6989157.526 | 458733.03 | 560.059 | 560.100 | -0.041 | 1 |
| 29246 | 6989157.191 | 458735.561 | 560.173 | 560.210 | -0.037 | 1 |
| 29247 | 6989156.497 | 458738.423 | 560.420 | 560.450 | -0.030 | 1 |
| 29248 | 6989156.436 | 458741.016 | 560.726 | 560.740 | -0.014 | 1 |
| 29249 | 6989156.89 | 458743.639 | 561.034 | 561.060 | -0.026 | 1 |
| 29250 | 6989157.454 | 458746.559 | 561.397 | 561.390 | 0.007 | 1 |
| 29251 | 6989158.414 | 458749.596 | 561.657 | 561.660 | -0.003 | 1 |
| 29252 | 6989159.087 | 458752.129 | 561.848 | 561.850 | -0.002 | 1 |
| 29253 | 6989160.486 | 458754.727 | 562.046 | 562.030 | 0.016 | 1 |
| 29254 | 6989161.502 | 458756.918 | 562.241 | 562.240 | 0.001 | 1 |
| 29255 | 6989162.875 | 458759.415 | 562.533 | 562.540 | -0.007 | 1 |
| 29256 | 6989164.348 | 458761.742 | 562.781 | 562.800 | -0.019 | 1 |
| 29257 | 6989165.766 | 458764.105 | 562.957 | 563.010 | -0.053 | 1 |
| 29258 | 6989166.795 | 458766.544 | 563.154 | 563.190 | -0.036 | 1 |
| 29259 | 6989168.162 | 458768.827 | 563.364 | 563.410 | -0.046 | 1 |
| 29260 | 6989169.745 | 458771.636 | 563.565 | 563.630 | -0.065 | 1 |
| 29261 | 6989124.347 | 458926.404 | 579.289 | 579.290 | -0.001 | 1 |
| 29262 | 6989124.829 | 458923.984 | 579.290 | 579.340 | -0.050 | 1 |
| 29263 | 6989125.094 | 458921.218 | 579.286 | 579.330 | -0.044 | 1 |
| 29264 | 6989125.281 | 458918.612 | 579.192 | 579.250 | -0.058 | 1 |
| 29265 | 6989125.546 | 458916.107 | 579.063 | 579.110 | -0.047 | 1 |
| 29266 | 6989125.879 | 458913.926 | 578.917 | 578.950 | -0.033 | 1 |
| 29267 | 6989126.249 | 458911.856 | 578.746 | 578.820 | -0.074 | 1 |
| 29268 | 6989126.532 | 458909.512 | 578.672 | 578.700 | -0.028 | 1 |
| 29269 | 6989127.031 | 458907.282 | 578.589 | 578.620 | -0.031 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 29270 | 6989127.119 | 458904.953 | 578.454 | 578.500 | -0.046 | 1 |
| 29271 | 6989127.376 | 458902.677 | 578.319 | 578.380 | -0.061 | 1 |
| 29272 | 6989127.665 | 458900.502 | 578.186 | 578.240 | -0.054 | 1 |
| 29273 | 6989127.809 | 458898.13 | 578.072 | 578.110 | -0.038 | 1 |
| 29274 | 6989128.197 | 458895.933 | 577.929 | 577.970 | -0.041 | 1 |
| 29275 | 6989128.631 | 458893.634 | 577.802 | 577.860 | -0.058 | 1 |
| 29276 | 6989129.096 | 458891.261 | 577.658 | 577.710 | -0.052 | 1 |
| 29277 | 6989129.326 | 458888.999 | 577.576 | 577.630 | -0.054 | 1 |
| 29278 | 6989129.689 | 458886.554 | 577.476 | 577.490 | -0.014 | 1 |
| 29279 | 6989129.994 | 458883.998 | 577.402 | 577.450 | -0.048 | 1 |
| 29280 | 6989130.327 | 458881.616 | 577.345 | 577.360 | -0.015 | 1 |
| 29281 | 6989130.724 | 458879.262 | 577.268 | 577.280 | -0.012 | 1 |
| 29282 | 6989131.051 | 458876.967 | 577.111 | 577.140 | -0.029 | 1 |
| 29283 | 6989131.411 | 458874.776 | 577.007 | 577.060 | -0.053 | 1 |
| 29284 | 6989131.823 | 458872.076 | 576.888 | 576.920 | -0.032 | 1 |
| 29285 | 6989132.236 | 458869.279 | 576.793 | 576.840 | -0.047 | 1 |
| 29286 | 6989132.789 | 458866.595 | 576.725 | 576.750 | -0.025 | 1 |
| 29287 | 6989133.216 | 458864.226 | 576.703 | 576.750 | -0.047 | 1 |
| 29288 | 6989133.967 | 458861.951 | 576.632 | 576.650 | -0.018 | 1 |
| 29289 | 6989134.868 | 458859.862 | 576.508 | 576.520 | -0.012 | 1 |
| 29290 | 6989135.988 | 458857.565 | 576.300 | 576.330 | -0.030 | 1 |
| 29291 | 6989136.755 | 458855.44 | 576.171 | 576.160 | 0.011 | 1 |
| 29292 | 6989138.119 | 458853.377 | 575.888 | 575.890 | -0.002 | 1 |
| 29293 | 6989139.425 | 458851.254 | 575.631 | 575.610 | 0.021 | 1 |
| 29294 | 6989140.754 | 458849.558 | 575.316 | 575.300 | 0.016 | 1 |
| 29295 | 6989142.411 | 458847.767 | 574.918 | 574.930 | -0.012 | 1 |
| 29296 | 6989144.074 | 458846.206 | 574.618 | 574.610 | 0.008 | 1 |
| 29297 | 6989146.061 | 458845.018 | 574.245 | 574.240 | 0.005 | 1 |
| 29298 | 6989148.027 | 458843.267 | 573.855 | 573.840 | 0.015 | 1 |
| 29299 | 6989149.749 | 458841.79 | 573.523 | 573.510 | 0.013 | 1 |
| 29300 | 6989151.526 | 458840.495 | 573.214 | 573.200 | 0.014 | 1 |
| 29301 | 6989153.425 | 458839.785 | 572.876 | 572.900 | -0.024 | 1 |
| 29302 | 6989155.394 | 458839.04 | 572.525 | 572.570 | -0.045 | 1 |
| 29303 | 6989157.498 | 458837.949 | 572.124 | 572.150 | -0.026 | 1 |
| 29304 | 6989159.427 | 458836.48 | 571.736 | 571.800 | -0.064 | 1 |
| 29305 | 6989161.323 | 458835.48 | 571.476 | 571.540 | -0.064 | 1 |
| 29306 | 6989163.405 | 458834.115 | 571.188 | 571.240 | -0.052 | 1 |
| 29307 | 6989165.407 | 458832.855 | 570.892 | 570.930 | -0.038 | 1 |
| 29308 | 6989167.202 | 458831.36 | 570.603 | 570.640 | -0.037 | 1 |
| 29309 | 6989169.07 | 458829.827 | 570.277 | 570.350 | -0.073 | 1 |
| 29310 | 6989170.97 | 458828.59 | 570.006 | 570.070 | -0.064 | 1 |
| 29311 | 6989172.778 | 458826.882 | 569.691 | 569.750 | -0.059 | 1 |
| 29312 | 6989174.729 | 458825.184 | 569.346 | 569.400 | -0.054 | 1 |
| 29313 | 6989176.926 | 458823.642 | 568.988 | 569.050 | -0.062 | 1 |
| 29314 | 6989179.519 | 458822.08 | 568.587 | 568.630 | -0.043 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 29315 | 6989181.777 | 458820.485 | 568.247 | 568.320 | -0.073 | 1 |
| 29316 | 6989183.304 | 458818.469 | 567.905 | 567.950 | -0.045 | 1 |
| 29317 | 6989184.159 | 458816.094 | 567.546 | 567.610 | -0.064 | 1 |
| 29318 | 6989184.856 | 458813.588 | 567.186 | 567.230 | -0.044 | 1 |
| 29319 | 6989185.155 | 458811.035 | 566.849 | 566.920 | -0.071 | 1 |
| 29320 | 6989185.297 | 458808.822 | 566.570 | 566.640 | -0.070 | 1 |
| 29321 | 6989184.306 | 458806.013 | 566.277 | 566.340 | -0.063 | 1 |
| 29322 | 6989183.515 | 458803.355 | 565.992 | 566.050 | -0.058 | 1 |
| 29323 | 6989182.873 | 458801.193 | 565.779 | 565.850 | -0.071 | 1 |
| 29324 | 6989181.266 | 458798.595 | 565.495 | 565.570 | -0.075 | 1 |
| 29325 | 6989179.879 | 458795.736 | 565.247 | 565.320 | -0.073 | 1 |
| 29326 | 6989179.191 | 458793.152 | 565.010 | 565.090 | -0.080 | 1 |
| 29327 | 6989177.53 | 458790.937 | 564.817 | 564.910 | -0.093 | 1 |
| 29328 | 6989176.242 | 458788.022 | 564.681 | 564.730 | -0.049 | 1 |
| 29329 | 6989175.114 | 458785.766 | 564.586 | 564.630 | -0.044 | 1 |
| 29330 | 6989174.019 | 458783.45 | 564.441 | 564.500 | -0.059 | 1 |
| 29331 | 6989173.051 | 458781.018 | 564.228 | 564.290 | -0.062 | 1 |
| 29332 | 6989172.228 | 458778.84 | 564.069 | 564.120 | -0.051 | 1 |
| 29333 | 6989171.552 | 458776.359 | 563.862 | 563.930 | -0.068 | 1 |
| 29334 | 6989170.741 | 458774.146 | 563.738 | 563.780 | -0.042 | 1 |
| 29335 | 6989169.453 | 458772.76 | 563.642 | 563.710 | -0.068 | 1 |
| 29336 | 6991761.009 | 456911.467 | 520.728 | 520.770 | -0.042 | 1 |
| 29399 | 6989963.933 | 458320.186 | 535.132 | 535.130 | 0.002 | 1 |
| 29400 | 6989962.573 | 458319.467 | 535.125 | 535.210 | -0.085 | 1 |
| 29401 | 6991246.149 | 458134.082 | 558.140 | 558.270 | -0.130 | 1 |
| 29402 | 6991242.53 | 458137.607 | 558.017 | 558.110 | -0.093 | 1 |
| 29403 | 6991238.503 | 458140.401 | 557.846 | 557.940 | -0.094 | 1 |
| 29404 | 6991235.356 | 458143.696 | 557.761 | 557.870 | -0.109 | 1 |
| 29405 | 6991232.164 | 458147.087 | 557.686 | 557.800 | -0.114 | 1 |
| 29406 | 6991228.81 | 458150.385 | 557.605 | 557.700 | -0.095 | 1 |
| 29407 | 6991225.173 | 458153.447 | 557.465 | 557.560 | -0.095 | 1 |
| 29408 | 6991221.933 | 458156.899 | 557.396 | 557.460 | -0.064 | 1 |
| 29409 | 6991218.629 | 458160.165 | 557.295 | 557.410 | -0.115 | 1 |
| 29410 | 6991215.033 | 458163.568 | 557.184 | 557.300 | -0.116 | 1 |
| 29411 | 6991211.302 | 458167.365 | 557.064 | 557.170 | -0.106 | 1 |
| 29412 | 6991207.658 | 458170.383 | 556.945 | 557.050 | -0.105 | 1 |
| 29413 | 6991203.888 | 458173.417 | 556.809 | 556.920 | -0.111 | 1 |
| 29414 | 6991200.037 | 458176.492 | 556.693 | 556.810 | -0.117 | 1 |
| 29415 | 6991196.411 | 458179.274 | 556.566 | 556.660 | -0.094 | 1 |
| 29416 | 6991192.652 | 458182.154 | 556.411 | 556.540 | -0.129 | 1 |
| 29417 | 6991188.899 | 458185.226 | 556.248 | 556.390 | -0.142 | 1 |
| 29418 | 6991185.277 | 458187.988 | 556.101 | 556.220 | -0.119 | 1 |
| 29419 | 6991181.428 | 458190.81 | 555.952 | 556.080 | -0.128 | 1 |
| 29420 | 6991176.872 | 458194.935 | 555.794 | 555.910 | -0.116 | 1 |
| 29421 | 6991172.514 | 458197.573 | 555.628 | 555.760 | -0.132 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 29422 | 6991168.512 | 458199.726 | 555.487 | 555.620 | -0.133 | 1 |
| 29423 | 6991164.64 | 458202.315 | 555.367 | 555.500 | -0.133 | 1 |
| 29424 | 6991160.592 | 458204.935 | 555.252 | 555.360 | -0.108 | 1 |
| 29425 | 6991156.716 | 458207.414 | 555.149 | 555.250 | -0.101 | 1 |
| 29426 | 6991152.617 | 458209.984 | 555.023 | 555.130 | -0.107 | 1 |
| 29427 | 6991148.841 | 458212.423 | 554.906 | 555.010 | -0.104 | 1 |
| 29428 | 6991144.725 | 458214.88 | 554.757 | 554.870 | -0.113 | 1 |
| 29429 | 6991140.694 | 458217.879 | 554.651 | 554.770 | -0.119 | 1 |
| 29430 | 6991137.688 | 458218.937 | 554.518 | 554.650 | -0.132 | 1 |
| 29431 | 6991133.528 | 458221.214 | 554.382 | 554.510 | -0.128 | 1 |
| 29432 | 6991129.197 | 458223.544 | 554.216 | 554.350 | -0.134 | 1 |
| 29433 | 6991125.08 | 458225.784 | 554.050 | 554.170 | -0.120 | 1 |
| 29434 | 6991120.96 | 458227.96 | 553.890 | 554.020 | -0.130 | 1 |
| 29435 | 6991116.918 | 458230.181 | 553.741 | 553.860 | -0.119 | 1 |
| 29436 | 6991113.077 | 458232.089 | 553.615 | 553.710 | -0.095 | 1 |
| 29437 | 6991109.052 | 458234.076 | 553.452 | 553.570 | -0.118 | 1 |
| 29438 | 6991105.138 | 458236.125 | 553.309 | 553.440 | -0.131 | 1 |
| 29439 | 6991101.611 | 458237.63 | 553.178 | 553.300 | -0.122 | 1 |
| 29440 | 6991097.22 | 458239.446 | 553.019 | 553.110 | -0.091 | 1 |
| 29441 | 6991093.081 | 458241.089 | 552.871 | 552.980 | -0.109 | 1 |
| 29442 | 6991088.695 | 458242.901 | 552.719 | 552.830 | -0.111 | 1 |
| 29443 | 6991084.658 | 458244.523 | 552.582 | 552.690 | -0.108 | 1 |
| 29444 | 6991080.677 | 458246.083 | 552.446 | 552.550 | -0.104 | 1 |
| 29445 | 6991076.489 | 458247.638 | 552.322 | 552.420 | -0.098 | 1 |
| 29446 | 6991072.454 | 458249.017 | 552.184 | 552.290 | -0.106 | 1 |
| 29447 | 6991067.674 | 458250.622 | 552.023 | 552.100 | -0.077 | 1 |
| 29448 | 6991063.06 | 458252.134 | 551.878 | 551.960 | -0.082 | 1 |
| 29449 | 6991058.891 | 458254.324 | 551.794 | 551.910 | -0.116 | 1 |
| 29450 | 6991054.932 | 458255.306 | 551.663 | 551.780 | -0.117 | 1 |
| 29451 | 6991049.607 | 458256.458 | 551.483 | 551.570 | -0.087 | 1 |
| 29452 | 6991045.113 | 458257.863 | 551.385 | 551.490 | -0.105 | 1 |
| 29453 | 6991040.339 | 458259.164 | 551.257 | 551.360 | -0.103 | 1 |
| 29454 | 6991036.136 | 458260.21 | 551.125 | 551.230 | -0.105 | 1 |
| 29455 | 6991031.563 | 458261.382 | 551.010 | 551.140 | -0.130 | 1 |
| 29456 | 6991027.007 | 458262.453 | 550.874 | 551.000 | -0.126 | 1 |
| 29457 | 6991022.647 | 458263.228 | 550.729 | 550.840 | -0.111 | 1 |
| 29458 | 6991017.857 | 458264.185 | 550.574 | 550.700 | -0.126 | 1 |
| 29459 | 6991015.128 | 458265.135 | 550.505 | 550.640 | -0.135 | 1 |
| 29460 | 6991008.692 | 458266.357 | 550.275 | 550.410 | -0.135 | 1 |
| 29461 | 6991003.836 | 458267.2 | 550.101 | 550.210 | -0.109 | 1 |
| 29462 | 6990999.189 | 458267.741 | 549.943 | 550.070 | -0.127 | 1 |
| 29463 | 6990995.028 | 458268.157 | 549.800 | 549.900 | -0.100 | 1 |
| 29464 | 6990990.809 | 458268.708 | 549.658 | 549.770 | -0.112 | 1 |
| 29465 | 6990986.115 | 458269.333 | 549.508 | 549.650 | -0.142 | 1 |
| 29466 | 6990981.85 | 458269.798 | 549.396 | 549.530 | -0.134 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 29467 | 6990976.939 | 458270.403 | 549.281 | 549.390 | -0.109 | 1 |
| 29468 | 6990972.369 | 458270.83 | 549.153 | 549.270 | -0.117 | 1 |
| 29469 | 6990967.812 | 458271.076 | 549.005 | 549.160 | -0.155 | 1 |
| 29470 | 6990962.917 | 458271.363 | 548.854 | 548.980 | -0.126 | 1 |
| 29471 | 6990958.321 | 458271.657 | 548.706 | 548.840 | -0.134 | 1 |
| 29472 | 6990953.567 | 458271.819 | 548.544 | 548.680 | -0.136 | 1 |
| 29473 | 6990948.859 | 458271.975 | 548.378 | 548.490 | -0.112 | 1 |
| 29474 | 6990943.959 | 458272.115 | 548.207 | 548.340 | -0.133 | 1 |
| 29475 | 6990938.913 | 458272.106 | 548.030 | 548.150 | -0.120 | 1 |
| 29476 | 6990933.903 | 458272.2 | 547.849 | 547.970 | -0.121 | 1 |
| 29477 | 6990929.208 | 458271.964 | 547.694 | 547.820 | -0.126 | 1 |
| 29478 | 6990924.266 | 458271.87 | 547.562 | 547.670 | -0.108 | 1 |
| 29479 | 6990919.388 | 458271.555 | 547.425 | 547.540 | -0.115 | 1 |
| 29480 | 6990914.707 | 458271.32 | 547.304 | 547.410 | -0.106 | 1 |
| 29481 | 6990910.068 | 458270.959 | 547.171 | 547.300 | -0.129 | 1 |
| 29482 | 6990905.296 | 458270.511 | 547.064 | 547.180 | -0.116 | 1 |
| 29483 | 6990900.648 | 458270.053 | 546.942 | 547.050 | -0.108 | 1 |
| 29484 | 6990895.589 | 458269.661 | 546.825 | 546.910 | -0.085 | 1 |
| 29485 | 6990890.814 | 458268.963 | 546.709 | 546.810 | -0.101 | 1 |
| 29486 | 6990885.961 | 458268.262 | 546.596 | 546.680 | -0.084 | 1 |
| 29487 | 6990881.415 | 458267.693 | 546.487 | 546.580 | -0.093 | 1 |
| 29488 | 6990876.658 | 458266.964 | 546.368 | 546.490 | -0.122 | 1 |
| 29489 | 6990871.985 | 458266.261 | 546.262 | 546.350 | -0.088 | 1 |
| 29490 | 6990867.404 | 458265.461 | 546.151 | 546.250 | -0.099 | 1 |
| 29491 | 6990862.929 | 458264.677 | 546.027 | 546.110 | -0.083 | 1 |
| 29492 | 6990858.315 | 458264.023 | 545.930 | 546.030 | -0.100 | 1 |
| 29493 | 6990852.533 | 458262.729 | 545.759 | 545.880 | -0.121 | 1 |
| 29494 | 6990848.299 | 458261.868 | 545.659 | 545.770 | -0.111 | 1 |
| 29495 | 6990843.055 | 458260.763 | 545.531 | 545.620 | -0.089 | 1 |
| 29496 | 6990838.705 | 458259.895 | 545.419 | 545.510 | -0.091 | 1 |
| 29497 | 6990833.811 | 458258.697 | 545.281 | 545.380 | -0.099 | 1 |
| 29498 | 6990828.972 | 458257.503 | 545.172 | 545.240 | -0.068 | 1 |
| 29499 | 6990824.796 | 458256.379 | 545.015 | 545.130 | -0.115 | 1 |
| 29500 | 6990820.756 | 458255.373 | 544.900 | 545.010 | -0.110 | 1 |
| 29501 | 6990815.981 | 458254.091 | 544.748 | 544.860 | -0.112 | 1 |
| 29502 | 6990811.237 | 458252.701 | 544.584 | 544.700 | -0.116 | 1 |
| 29503 | 6990806.206 | 458251.339 | 544.456 | 544.580 | -0.124 | 1 |
| 29504 | 6990801.462 | 458249.985 | 544.294 | 544.380 | -0.086 | 1 |
| 29505 | 6990797.154 | 458248.717 | 544.144 | 544.250 | -0.106 | 1 |
| 29506 | 6990792.643 | 458247.427 | 543.979 | 544.100 | -0.121 | 1 |
| 29507 | 6990787.788 | 458246.052 | 543.844 | 543.920 | -0.076 | 1 |
| 29508 | 6990782.793 | 458244.665 | 543.692 | 543.800 | -0.108 | 1 |
| 29509 | 6990777.946 | 458243.333 | 543.564 | 543.670 | -0.106 | 1 |
| 29510 | 6990773.126 | 458241.959 | 543.425 | 543.530 | -0.105 | 1 |
| 29511 | 6990768.261 | 458240.542 | 543.316 | 543.430 | -0.114 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 29512 | 6990763.552 | 458239.112 | 543.201 | 543.330 | -0.129 | 1 |
| 29513 | 6990759.077 | 458237.816 | 543.127 | 543.210 | -0.083 | 1 |
| 29514 | 6990754.592 | 458236.535 | 543.009 | 543.120 | -0.111 | 1 |
| 29515 | 6990750.313 | 458235.338 | 542.940 | 543.050 | -0.110 | 1 |
| 29516 | 6990746.128 | 458234.092 | 542.902 | 542.970 | -0.068 | 1 |
| 29517 | 6990741.763 | 458232.833 | 542.815 | 542.930 | -0.115 | 1 |
| 29518 | 6990737.187 | 458231.625 | 542.759 | 542.860 | -0.101 | 1 |
| 29519 | 6990732.663 | 458230.266 | 542.695 | 542.800 | -0.105 | 1 |
| 29520 | 6990728.11 | 458229.124 | 542.640 | 542.720 | -0.080 | 1 |
| 29521 | 6990723.611 | 458227.796 | 542.559 | 542.660 | -0.101 | 1 |
| 29522 | 6990718.96 | 458226.428 | 542.456 | 542.580 | -0.124 | 1 |
| 29523 | 6990714.294 | 458225.145 | 542.412 | 542.520 | -0.108 | 1 |
| 29524 | 6990709.851 | 458223.824 | 542.348 | 542.440 | -0.092 | 1 |
| 29525 | 6990705.19 | 458222.397 | 542.267 | 542.380 | -0.113 | 1 |
| 29526 | 6990700.694 | 458221.112 | 542.201 | 542.300 | -0.099 | 1 |
| 29527 | 6990695.768 | 458219.631 | 542.105 | 542.230 | -0.125 | 1 |
| 29528 | 6990691.443 | 458218.445 | 542.032 | 542.150 | -0.118 | 1 |
| 29529 | 6990686.804 | 458217.16 | 541.931 | 542.030 | -0.099 | 1 |
| 29530 | 6990682.124 | 458215.803 | 541.848 | 541.960 | -0.112 | 1 |
| 29531 | 6990677.167 | 458214.988 | 541.708 | 541.830 | -0.122 | 1 |
| 29532 | 6990671.712 | 458213.418 | 541.570 | 541.680 | -0.110 | 1 |
| 29533 | 6990666.625 | 458211.971 | 541.490 | 541.600 | -0.110 | 1 |
| 29534 | 6990662.148 | 458210.969 | 541.456 | 541.540 | -0.084 | 1 |
| 29535 | 6990656.16 | 458209.328 | 541.372 | 541.480 | -0.108 | 1 |
| 29536 | 6990651.27 | 458208.109 | 541.322 | 541.420 | -0.098 | 1 |
| 29537 | 6990646.294 | 458206.687 | 541.239 | 541.330 | -0.091 | 1 |
| 29538 | 6990641.084 | 458205.324 | 541.162 | 541.240 | -0.078 | 1 |
| 29539 | 6990636.183 | 458204.14 | 541.068 | 541.170 | -0.102 | 1 |
| 29540 | 6990631.591 | 458203.083 | 540.992 | 541.080 | -0.088 | 1 |
| 29541 | 6990626.779 | 458201.989 | 540.931 | 541.010 | -0.079 | 1 |
| 29542 | 6990622.27 | 458201.055 | 540.860 | 540.950 | -0.090 | 1 |
| 29543 | 6990618.104 | 458200.137 | 540.802 | 540.910 | -0.108 | 1 |
| 29544 | 6990613.455 | 458199.178 | 540.753 | 540.820 | -0.067 | 1 |
| 29545 | 6990608.817 | 458198.168 | 540.640 | 540.750 | -0.110 | 1 |
| 29546 | 6990603.764 | 458197.14 | 540.521 | 540.610 | -0.089 | 1 |
| 29547 | 6990598.973 | 458196.195 | 540.399 | 540.510 | -0.111 | 1 |
| 29548 | 6990594.115 | 458195.305 | 540.256 | 540.370 | -0.114 | 1 |
| 29549 | 6990589.212 | 458194.425 | 540.140 | 540.240 | -0.100 | 1 |
| 29550 | 6990584.294 | 458193.582 | 539.995 | 540.130 | -0.135 | 1 |
| 29551 | 6990579.583 | 458192.856 | 539.854 | 539.980 | -0.126 | 1 |
| 29552 | 6990574.801 | 458192.203 | 539.722 | 539.820 | -0.098 | 1 |
| 29553 | 6990569.883 | 458191.334 | 539.597 | 539.710 | -0.113 | 1 |
| 29554 | 6990565.041 | 458190.78 | 539.486 | 539.590 | -0.104 | 1 |
| 29555 | 6990560.301 | 458190.106 | 539.363 | 539.490 | -0.127 | 1 |
| 29556 | 6990555.55 | 458189.514 | 539.267 | 539.380 | -0.113 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 29557 | 6990550.718 | 458188.877 | 539.155 | 539.270 | -0.115 | 1 |
| 29558 | 6990546.054 | 458188.303 | 539.054 | 539.170 | -0.116 | 1 |
| 29559 | 6990541.218 | 458187.76 | 538.964 | 539.080 | -0.116 | 1 |
| 29560 | 6990536.367 | 458187.331 | 538.857 | 538.980 | -0.123 | 1 |
| 29561 | 6990531.696 | 458186.743 | 538.767 | 538.880 | -0.113 | 1 |
| 29562 | 6990526.868 | 458186.347 | 538.653 | 538.760 | -0.107 | 1 |
| 29563 | 6990521.887 | 458185.823 | 538.534 | 538.640 | -0.106 | 1 |
| 29564 | 6990516.96 | 458185.417 | 538.418 | 538.520 | -0.102 | 1 |
| 29565 | 6990512.257 | 458185.122 | 538.285 | 538.400 | -0.115 | 1 |
| 29566 | 6990507.567 | 458184.877 | 538.137 | 538.260 | -0.123 | 1 |
| 29567 | 6990502.216 | 458184.571 | 537.990 | 538.080 | -0.090 | 1 |
| 29568 | 6990495.75 | 458184.224 | 537.837 | 537.950 | -0.113 | 1 |
| 29569 | 6990490.382 | 458184.01 | 537.708 | 537.820 | -0.112 | 1 |
| 29570 | 6990485.129 | 458183.741 | 537.563 | 537.660 | -0.097 | 1 |
| 29571 | 6990480.202 | 458183.552 | 537.422 | 537.540 | -0.118 | 1 |
| 29572 | 6990475.063 | 458183.374 | 537.265 | 537.390 | -0.125 | 1 |
| 29573 | 6990469.868 | 458183.265 | 537.106 | 537.230 | -0.124 | 1 |
| 29574 | 6990464.828 | 458183.112 | 536.949 | 537.070 | -0.121 | 1 |
| 29575 | 6990459.599 | 458183.023 | 536.777 | 536.900 | -0.123 | 1 |
| 29576 | 6990454.658 | 458182.871 | 536.611 | 536.740 | -0.129 | 1 |
| 29577 | 6990449.695 | 458182.84 | 536.443 | 536.560 | -0.117 | 1 |
| 29578 | 6990445.013 | 458182.893 | 536.262 | 536.390 | -0.128 | 1 |
| 29579 | 6990439.939 | 458183.014 | 536.069 | 536.200 | -0.131 | 1 |
| 29580 | 6990434.718 | 458182.746 | 535.892 | 536.050 | -0.158 | 1 |
| 29581 | 6990429.652 | 458182.796 | 535.699 | 535.860 | -0.161 | 1 |
| 29582 | 6990424.914 | 458182.917 | 535.529 | 535.670 | -0.141 | 1 |
| 29583 | 6990420.22 | 458183.23 | 535.360 | 535.480 | -0.120 | 1 |
| 29584 | 6990415.108 | 458183.409 | 535.166 | 535.310 | -0.144 | 1 |
| 29585 | 6990410.206 | 458183.579 | 534.952 | 535.100 | -0.148 | 1 |
| 29586 | 6990405.209 | 458184.352 | 534.733 | 534.870 | -0.137 | 1 |
| 29587 | 6990399.476 | 458184.419 | 534.568 | 534.690 | -0.122 | 1 |
| 29588 | 6990394.191 | 458184.502 | 534.389 | 534.510 | -0.121 | 1 |
| 29589 | 6990389.272 | 458184.715 | 534.246 | 534.390 | -0.144 | 1 |
| 29590 | 6990383.985 | 458184.922 | 534.094 | 534.210 | -0.116 | 1 |
| 29591 | 6990378.622 | 458185.421 | 533.949 | 534.060 | -0.111 | 1 |
| 29592 | 6990373.593 | 458185.996 | 533.796 | 533.920 | -0.124 | 1 |
| 29593 | 6990368.81 | 458186.61 | 533.625 | 533.760 | -0.135 | 1 |
| 29594 | 6990364.048 | 458187.101 | 533.456 | 533.580 | -0.124 | 1 |
| 29595 | 6990359.768 | 458187.569 | 533.321 | 533.440 | -0.119 | 1 |
| 29596 | 6990355.416 | 458188.154 | 533.190 | 533.300 | -0.110 | 1 |
| 29597 | 6990351.115 | 458188.696 | 533.062 | 533.150 | -0.088 | 1 |
| 29598 | 6990345.867 | 458189.596 | 532.900 | 533.020 | -0.120 | 1 |
| 29599 | 6990341.409 | 458190.241 | 532.785 | 532.900 | -0.115 | 1 |
| 29600 | 6990336.964 | 458190.87 | 532.691 | 532.790 | -0.099 | 1 |
| 29601 | 6990332.437 | 458190.425 | 532.632 | 532.720 | -0.088 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 29602 | 6990327.931 | 458190.975 | 532.543 | 532.650 | -0.107 | 1 |
| 29603 | 6990323.827 | 458191.568 | 532.472 | 532.570 | -0.098 | 1 |
| 29604 | 6990319.255 | 458192.357 | 532.369 | 532.490 | -0.121 | 1 |
| 29605 | 6990314.584 | 458193.138 | 532.272 | 532.380 | -0.108 | 1 |
| 29606 | 6990310.5 | 458193.799 | 532.209 | 532.310 | -0.101 | 1 |
| 29607 | 6990306.064 | 458194.607 | 532.123 | 532.230 | -0.107 | 1 |
| 29608 | 6990301.951 | 458195.44 | 532.058 | 532.170 | -0.112 | 1 |
| 29609 | 6990297.2 | 458196.286 | 531.979 | 532.100 | -0.121 | 1 |
| 29610 | 6990292.488 | 458197.327 | 531.915 | 532.050 | -0.135 | 1 |
| 29611 | 6990287.941 | 458198.409 | 531.873 | 531.990 | -0.117 | 1 |
| 29612 | 6990283.466 | 458199.377 | 531.829 | 531.940 | -0.111 | 1 |
| 29613 | 6990278.857 | 458200.58 | 531.794 | 531.880 | -0.086 | 1 |
| 29614 | 6990275.341 | 458203.709 | 531.612 | 531.710 | -0.098 | 1 |
| 29615 | 6990271.099 | 458205.031 | 531.520 | 531.640 | -0.120 | 1 |
| 29616 | 6990265.342 | 458205.617 | 531.505 | 531.610 | -0.105 | 1 |
| 29617 | 6990260.066 | 458206.825 | 531.498 | 531.600 | -0.102 | 1 |
| 29618 | 6990255.074 | 458208.348 | 531.507 | 531.600 | -0.093 | 1 |
| 29619 | 6990250.533 | 458210.415 | 531.480 | 531.570 | -0.090 | 1 |
| 29620 | 6990247.169 | 458211.139 | 531.485 | 531.600 | -0.115 | 1 |
| 29621 | 6990241.752 | 458212.54 | 531.491 | 531.590 | -0.099 | 1 |
| 29622 | 6990237.329 | 458213.732 | 531.482 | 531.570 | -0.088 | 1 |
| 29623 | 6990232.875 | 458214.32 | 531.494 | 531.560 | -0.066 | 1 |
| 29624 | 6990228.099 | 458215.272 | 531.486 | 531.570 | -0.084 | 1 |
| 29625 | 6990223.777 | 458216.681 | 531.455 | 531.570 | -0.115 | 1 |
| 29626 | 6990219.613 | 458218.02 | 531.442 | 531.550 | -0.108 | 1 |
| 29627 | 6990215.917 | 458220.568 | 531.370 | 531.460 | -0.090 | 1 |
| 29628 | 6990211.195 | 458222.508 | 531.362 | 531.460 | -0.098 | 1 |
| 29629 | 6990207.132 | 458223.942 | 531.380 | 531.470 | -0.090 | 1 |
| 29630 | 6990202.634 | 458224.897 | 531.470 | 531.560 | -0.090 | 1 |
| 29631 | 6990196.245 | 458227.358 | 531.538 | 531.620 | -0.082 | 1 |
| 29632 | 6990191.425 | 458229.027 | 531.597 | 531.700 | -0.103 | 1 |
| 29633 | 6990186.782 | 458230.667 | 531.688 | 531.780 | -0.092 | 1 |
| 29634 | 6990181.636 | 458232.179 | 531.788 | 531.870 | -0.082 | 1 |
| 29635 | 6990176.523 | 458233.107 | 531.862 | 531.960 | -0.098 | 1 |
| 29636 | 6990171.969 | 458234.917 | 531.914 | 531.990 | -0.076 | 1 |
| 29637 | 6990167.521 | 458236.657 | 531.983 | 532.050 | -0.067 | 1 |
| 29638 | 6990162.93 | 458238.434 | 532.065 | 532.140 | -0.075 | 1 |
| 29639 | 6990158.938 | 458240.469 | 532.107 | 532.200 | -0.093 | 1 |
| 29640 | 6990154.508 | 458242.897 | 532.154 | 532.250 | -0.096 | 1 |
| 29641 | 6990150.368 | 458244.672 | 532.232 | 532.320 | -0.088 | 1 |
| 29642 | 6990145.595 | 458246.775 | 532.332 | 532.410 | -0.078 | 1 |
| 29643 | 6990141.506 | 458249.606 | 532.393 | 532.480 | -0.087 | 1 |
| 29644 | 6990136.065 | 458251.627 | 532.550 | 532.640 | -0.090 | 1 |
| 29645 | 6990131.296 | 458253.7 | 532.696 | 532.780 | -0.084 | 1 |
| 29646 | 6990126.886 | 458255.749 | 532.826 | 532.910 | -0.084 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 29647 | 6990122.54 | 458257.792 | 532.957 | 533.040 | -0.083 | 1 |
| 29648 | 6990118.476 | 458259.75 | 533.064 | 533.150 | -0.086 | 1 |
| 29649 | 6990114.06 | 458261.813 | 533.162 | 533.260 | -0.098 | 1 |
| 29650 | 6990109.99 | 458263.679 | 533.275 | 533.370 | -0.095 | 1 |
| 29651 | 6990104.986 | 458266.012 | 533.446 | 533.540 | -0.094 | 1 |
| 29652 | 6990100.336 | 458268.553 | 533.597 | 533.670 | -0.073 | 1 |
| 29653 | 6990095.838 | 458270.987 | 533.741 | 533.830 | -0.089 | 1 |
| 29654 | 6990091.106 | 458273.415 | 533.926 | 534.010 | -0.084 | 1 |
| 29655 | 6990086.534 | 458275.926 | 534.092 | 534.180 | -0.088 | 1 |
| 29656 | 6990081.895 | 458278.368 | 534.266 | 534.330 | -0.064 | 1 |
| 29657 | 6990077.307 | 458280.811 | 534.410 | 534.510 | -0.100 | 1 |
| 29658 | 6990072.858 | 458283.245 | 534.562 | 534.640 | -0.078 | 1 |
| 29659 | 6990068.551 | 458285.705 | 534.703 | 534.780 | -0.077 | 1 |
| 29660 | 6990064.252 | 458288.097 | 534.829 | 534.910 | -0.081 | 1 |
| 29661 | 6990060.05 | 458290.636 | 534.938 | 535.050 | -0.112 | 1 |
| 29662 | 6990055.641 | 458293.136 | 535.077 | 535.180 | -0.103 | 1 |
| 29663 | 6990051.333 | 458295.847 | 535.224 | 535.310 | -0.086 | 1 |
| 29664 | 6990046.937 | 458298.666 | 535.341 | 535.430 | -0.089 | 1 |
| 29665 | 6990042.738 | 458301.317 | 535.482 | 535.560 | -0.078 | 1 |
| 29666 | 6990038.496 | 458303.701 | 535.626 | 535.710 | -0.084 | 1 |
| 29667 | 6990034.264 | 458306.549 | 535.768 | 535.850 | -0.082 | 1 |
| 29668 | 6990030.123 | 458309.208 | 535.896 | 535.980 | -0.084 | 1 |
| 29669 | 6990026.127 | 458311.951 | 536.035 | 536.110 | -0.075 | 1 |
| 29670 | 6990022.023 | 458314.761 | 536.165 | 536.240 | -0.075 | 1 |
| 29671 | 6990017.948 | 458317.637 | 536.287 | 536.360 | -0.073 | 1 |
| 29672 | 6990014.015 | 458320.483 | 536.403 | 536.470 | -0.067 | 1 |
| 29673 | 6990009.875 | 458323.23 | 536.533 | 536.610 | -0.077 | 1 |
| 29674 | 6990006.039 | 458326.312 | 536.614 | 536.690 | -0.076 | 1 |
| 29675 | 6989996.145 | 458323.79 | 537.088 | 537.170 | -0.082 | 1 |
| 29676 | 6989991.163 | 458327.525 | 537.179 | 537.240 | -0.061 | 1 |
| 29677 | 6989987.347 | 458331.195 | 537.205 | 537.280 | -0.075 | 1 |
| 29678 | 6989983.29 | 458334.117 | 537.255 | 537.320 | -0.065 | 1 |
| 29679 | 6989979.57 | 458337.343 | 537.285 | 537.360 | -0.075 | 1 |
| 29680 | 6989975.599 | 458340.372 | 537.330 | 537.390 | -0.060 | 1 |
| 29681 | 6989972.095 | 458343.015 | 537.360 | 537.420 | -0.060 | 1 |
| 29682 | 6989968.637 | 458345.689 | 537.379 | 537.450 | -0.071 | 1 |
| 29683 | 6989965.188 | 458348.408 | 537.412 | 537.480 | -0.068 | 1 |
| 29684 | 6989961.772 | 458351.402 | 537.390 | 537.470 | -0.080 | 1 |
| 29685 | 6989958.271 | 458354.134 | 537.380 | 537.490 | -0.110 | 1 |
| 29686 | 6989954.729 | 458356.886 | 537.370 | 537.470 | -0.100 | 1 |
| 29687 | 6987724.102 | 458986.149 | 555.437 | 555.470 | -0.033 | 1 |
| 29688 | 6987729.639 | 458985.937 | 555.486 | 555.530 | -0.044 | 1 |
| 29689 | 6987734.695 | 458985.606 | 555.574 | 555.620 | -0.046 | 1 |
| 29690 | 6987740.017 | 458985.119 | 555.663 | 555.690 | -0.027 | 1 |
| 29691 | 6987744.933 | 458984.764 | 555.706 | 555.740 | -0.034 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 29692 | 6987749.851 | 458984.338 | 555.778 | 555.790 | -0.012 | 1 |
| 29693 | 6987754.846 | 458983.988 | 555.834 | 555.850 | -0.016 | 1 |
| 29694 | 6987759.588 | 458983.79 | 555.900 | 555.900 | 0.000 | 1 |
| 29695 | 6987764.49 | 458983.589 | 555.993 | 556.020 | -0.027 | 1 |
| 29696 | 6987769.449 | 458983.302 | 556.079 | 556.090 | -0.011 | 1 |
| 29697 | 6987774.275 | 458982.999 | 556.172 | 556.200 | -0.028 | 1 |
| 29698 | 6987781.027 | 458982.399 | 556.323 | 556.350 | -0.027 | 1 |
| 29699 | 6987786.19 | 458982.435 | 556.433 | 556.460 | -0.027 | 1 |
| 29700 | 6987791.219 | 458982.4 | 556.549 | 556.560 | -0.011 | 1 |
| 29701 | 6987796.216 | 458982.359 | 556.686 | 556.710 | -0.024 | 1 |
| 29702 | 6987801.306 | 458982.289 | 556.836 | 556.840 | -0.004 | 1 |
| 29703 | 6987806.454 | 458982.337 | 556.967 | 556.970 | -0.003 | 1 |
| 29704 | 6987811.436 | 458982.305 | 557.089 | 557.130 | -0.041 | 1 |
| 29705 | 6987816.184 | 458982.261 | 557.213 | 557.250 | -0.037 | 1 |
| 29706 | 6987821.303 | 458982.377 | 557.385 | 557.380 | 0.005 | 1 |
| 29707 | 6987826.032 | 458982.333 | 557.478 | 557.500 | -0.022 | 1 |
| 29708 | 6987830.866 | 458982.326 | 557.594 | 557.640 | -0.046 | 1 |
| 29709 | 6987835.764 | 458981.504 | 557.747 | 557.770 | -0.023 | 1 |
| 29710 | 6987841.328 | 458982.266 | 557.896 | 557.940 | -0.044 | 1 |
| 29711 | 6987846.3 | 458982.346 | 558.047 | 558.070 | -0.023 | 1 |
| 29712 | 6987850.928 | 458982.404 | 558.205 | 558.230 | -0.025 | 1 |
| 29713 | 6987855.794 | 458982.398 | 558.392 | 558.420 | -0.028 | 1 |
| 29714 | 6987862.28 | 458982.328 | 558.668 | 558.670 | -0.002 | 1 |
| 29715 | 6987867.653 | 458982.848 | 558.882 | 558.930 | -0.048 | 1 |
| 29716 | 6987872.644 | 458983.119 | 559.055 | 559.110 | -0.055 | 1 |
| 29717 | 6987877.642 | 458983.227 | 559.227 | 559.280 | -0.053 | 1 |
| 29718 | 6987882.416 | 458983.39 | 559.385 | 559.430 | -0.045 | 1 |
| 29719 | 6987887.698 | 458983.146 | 559.550 | 559.580 | -0.030 | 1 |
| 29720 | 6987892.377 | 458982.925 | 559.659 | 559.700 | -0.041 | 1 |
| 29721 | 6987898.085 | 458983.382 | 559.909 | 559.990 | -0.081 | 1 |
| 29722 | 6987903.323 | 458983.741 | 560.161 | 560.210 | -0.049 | 1 |
| 29723 | 6987908.234 | 458984.027 | 560.423 | 560.450 | -0.027 | 1 |
| 29724 | 6987913.144 | 458984.184 | 560.638 | 560.700 | -0.062 | 1 |
| 29725 | 6987918.194 | 458984.358 | 560.853 | 560.920 | -0.067 | 1 |
| 29726 | 6987923.196 | 458984.175 | 561.041 | 561.090 | -0.049 | 1 |
| 29727 | 6987929.423 | 458984.417 | 561.301 | 561.350 | -0.049 | 1 |
| 29728 | 6987934.818 | 458984.65 | 561.539 | 561.620 | -0.081 | 1 |
| 29729 | 6987940.092 | 458984.856 | 561.773 | 561.810 | -0.037 | 1 |
| 29730 | 6987944.697 | 458985.169 | 561.964 | 562.030 | -0.066 | 1 |
| 29731 | 6987949.248 | 458985.298 | 562.156 | 562.200 | -0.044 | 1 |
| 29732 | 6987953.759 | 458985.351 | 562.335 | 562.390 | -0.055 | 1 |
| 29733 | 6987958.185 | 458985.354 | 562.489 | 562.560 | -0.071 | 1 |
| 29734 | 6987963.001 | 458985.377 | 562.668 | 562.730 | -0.062 | 1 |
| 29735 | 6987967.836 | 458985.247 | 562.838 | 562.880 | -0.042 | 1 |
| 29736 | 6987972.091 | 458985.33 | 562.998 | 563.040 | -0.042 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 29737 | 6987976.615 | 458985.127 | 563.167 | 563.210 | -0.043 | 1 |
| 29738 | 6987981.865 | 458985.306 | 563.372 | 563.400 | -0.028 | 1 |
| 29739 | 6987986.57 | 458985.482 | 563.538 | 563.590 | -0.052 | 1 |
| 29740 | 6987991.287 | 458985.548 | 563.670 | 563.720 | -0.050 | 1 |
| 29741 | 6987995.853 | 458985.575 | 563.764 | 563.810 | -0.046 | 1 |
| 29742 | 6988000.446 | 458985.631 | 563.856 | 563.900 | -0.044 | 1 |
| 29743 | 6988004.934 | 458985.694 | 563.931 | 563.970 | -0.039 | 1 |
| 29744 | 6988009.277 | 458985.395 | 564.013 | 564.060 | -0.047 | 1 |
| 29745 | 6988013.752 | 458985.303 | 564.117 | 564.160 | -0.043 | 1 |
| 29746 | 6988020.76 | 458985.283 | 564.252 | 564.290 | -0.038 | 1 |
| 29747 | 6988026.295 | 458985.461 | 564.366 | 564.420 | -0.054 | 1 |
| 29748 | 6988030.752 | 458985.421 | 564.437 | 564.470 | -0.033 | 1 |
| 29749 | 6988035.492 | 458985.586 | 564.516 | 564.550 | -0.034 | 1 |
| 29750 | 6988040.088 | 458985.729 | 564.574 | 564.610 | -0.036 | 1 |
| 29751 | 6988044.893 | 458985.868 | 564.651 | 564.700 | -0.049 | 1 |
| 29752 | 6988049.797 | 458986.07 | 564.774 | 564.830 | -0.056 | 1 |
| 29753 | 6988054.685 | 458986.167 | 564.921 | 564.980 | -0.059 | 1 |
| 29754 | 6988059.828 | 458986.304 | 565.114 | 565.150 | -0.036 | 1 |
| 29755 | 6988065.096 | 458986.456 | 565.278 | 565.340 | -0.062 | 1 |
| 29756 | 6988070.113 | 458986.573 | 565.481 | 565.520 | -0.039 | 1 |
| 29757 | 6988075.083 | 458986.708 | 565.666 | 565.720 | -0.054 | 1 |
| 29758 | 6988080.011 | 458986.834 | 565.850 | 565.900 | -0.050 | 1 |
| 29759 | 6988084.834 | 458987.048 | 565.998 | 566.060 | -0.062 | 1 |
| 29760 | 6988089.756 | 458987.298 | 566.179 | 566.230 | -0.051 | 1 |
| 29761 | 6988094.587 | 458987.5 | 566.346 | 566.400 | -0.054 | 1 |
| 29762 | 6988099.338 | 458987.6 | 566.503 | 566.570 | -0.067 | 1 |
| 29763 | 6988104.065 | 458987.686 | 566.668 | 566.720 | -0.052 | 1 |
| 29764 | 6988108.747 | 458986.806 | 566.796 | 566.850 | -0.054 | 1 |
| 29765 | 6988113.383 | 458986.941 | 566.950 | 566.980 | -0.030 | 1 |
| 29766 | 6988116.901 | 458987.231 | 567.096 | 567.120 | -0.024 | 1 |
| 29767 | 6988122.477 | 458987.604 | 567.288 | 567.310 | -0.022 | 1 |
| 29768 | 6988127.406 | 458987.737 | 567.457 | 567.490 | -0.033 | 1 |
| 29769 | 6988134.785 | 458987.649 | 567.742 | 567.780 | -0.038 | 1 |
| 29770 | 6988140.334 | 458987.898 | 567.949 | 567.990 | -0.041 | 1 |
| 29771 | 6988145.032 | 458987.999 | 568.100 | 568.130 | -0.030 | 1 |
| 29772 | 6988151.6 | 458987.731 | 568.291 | 568.310 | -0.019 | 1 |
| 29773 | 6988156.889 | 458988.418 | 568.453 | 568.500 | -0.047 | 1 |
| 29774 | 6988163.858 | 458988.229 | 568.607 | 568.640 | -0.033 | 1 |
| 29775 | 6988169.663 | 458988.523 | 568.764 | 568.810 | -0.046 | 1 |
| 29776 | 6988175.323 | 458988.655 | 568.968 | 569.010 | -0.042 | 1 |
| 29777 | 6988180.151 | 458988.821 | 569.134 | 569.170 | -0.036 | 1 |
| 29778 | 6988185.012 | 458988.924 | 569.261 | 569.300 | -0.039 | 1 |
| 29779 | 6988189.492 | 458989.133 | 569.397 | 569.430 | -0.033 | 1 |
| 29780 | 6988194.619 | 458989.372 | 569.567 | 569.610 | -0.043 | 1 |
| 29781 | 6988199.314 | 458989.487 | 569.696 | 569.730 | -0.034 | 1 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | LiDAR Elevation (Meters) | Deviation (Meters) | Include? (yes = 1) (no = 0) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 29782 | 6988203.678 | 458989.47 | 569.770 | 569.820 | -0.050 | 1 |
| 29783 | 6988208.486 | 458989.479 | 569.873 | 569.920 | -0.047 | 1 |
| 29784 | 6988213.314 | 458989.653 | 570.011 | 570.060 | -0.049 | 1 |
| 29785 | 6988217.868 | 458989.721 | 570.133 | 570.170 | -0.037 | 1 |
| 29786 | 6988222.272 | 458989.801 | 570.279 | 570.330 | -0.051 | 1 |
| 29787 | 6988226.88 | 458989.635 | 570.423 | 570.480 | -0.057 | 1 |
| 29788 | 6988231.348 | 458989.647 | 570.565 | 570.620 | -0.055 | 1 |
| 29789 | 6988235.784 | 458989.661 | 570.704 | 570.740 | -0.036 | 1 |
| 29790 | 6988240.188 | 458989.516 | 570.839 | 570.890 | -0.051 | 1 |
| 29791 | 6988244.6 | 458989.366 | 570.968 | 571.010 | -0.042 | 1 |
| 29792 | 6988249.021 | 458989.314 | 571.077 | 571.120 | -0.043 | 1 |
| 29793 | 6988253.407 | 458989.176 | 571.166 | 571.200 | -0.034 | 1 |
| 29794 | 6988256.988 | 458988.364 | 571.198 | 571.230 | -0.032 | 1 |
| 29795 | 6988262.428 | 458988.357 | 571.332 | 571.380 | -0.048 | 1 |
| 29796 | 6988267.284 | 458987.978 | 571.430 | 571.480 | -0.050 | 1 |
| 29797 | 6988271.716 | 458987.793 | 571.528 | 571.590 | -0.062 | 1 |
| 29798 | 6988276.13 | 458987.366 | 571.623 | 571.680 | -0.057 | 1 |
| 29799 | 6988280.722 | 458986.955 | 571.706 | 571.790 | -0.084 | 1 |
| 29800 | 6988285.322 | 458986.377 | 571.807 | 571.890 | -0.083 | 1 |
| 29801 | 6988289.944 | 458985.737 | 571.912 | 571.990 | -0.078 | 1 |
| 29802 | 6988294.637 | 458984.965 | 572.013 | 572.100 | -0.087 | 1 |

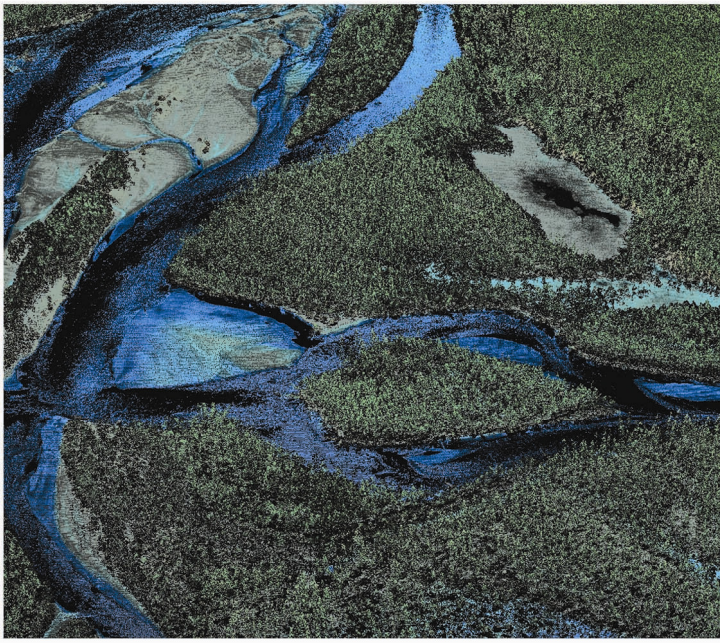
# LiDAR REMOTE SENSING

## ALASKA PIPELINE • ALASKA

(Delivery 4 – 7/29/2011)








## ALASKA DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

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# LiDAR Remote Sensing Data Collection:

## Alaska Pipeline, AK

### Delivery 4

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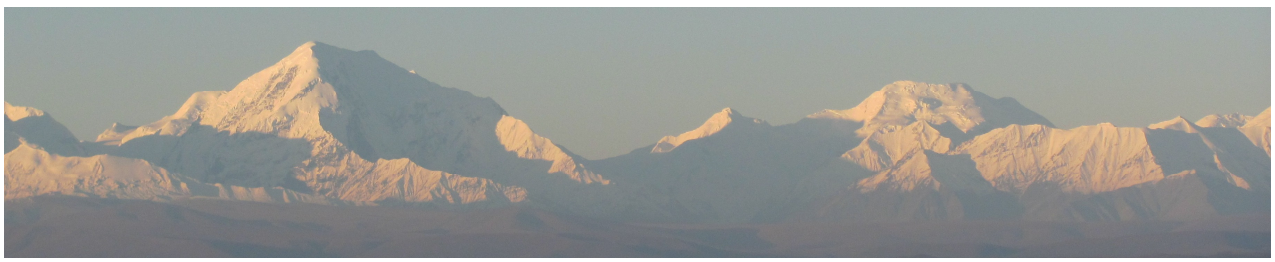
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# 1. Overview

Watershed Sciences, Inc. (WS) collected Light Detection and Ranging (LiDAR) data of the Alaska Pipeline for the Alaska Department of Natural Resources. LiDAR data for Delivery 4 was collected between May 17th and 26th, 2011 (**Figure 1**). Delivery 4 includes 159,433 acres within the requested area. This area was expanded to include a 100m buffer to ensure complete coverage and adequate point densities around survey boundaries, resulting in 168,823 acres of delivered data. This area includes portions of the Alaska Highway 2 from North Pole to just north of Delta Junction. Accuracy and density data will continue to be updated as additional data is processed.

***Figure 1***. *Alaska Pipeline survey delivery status overview.*

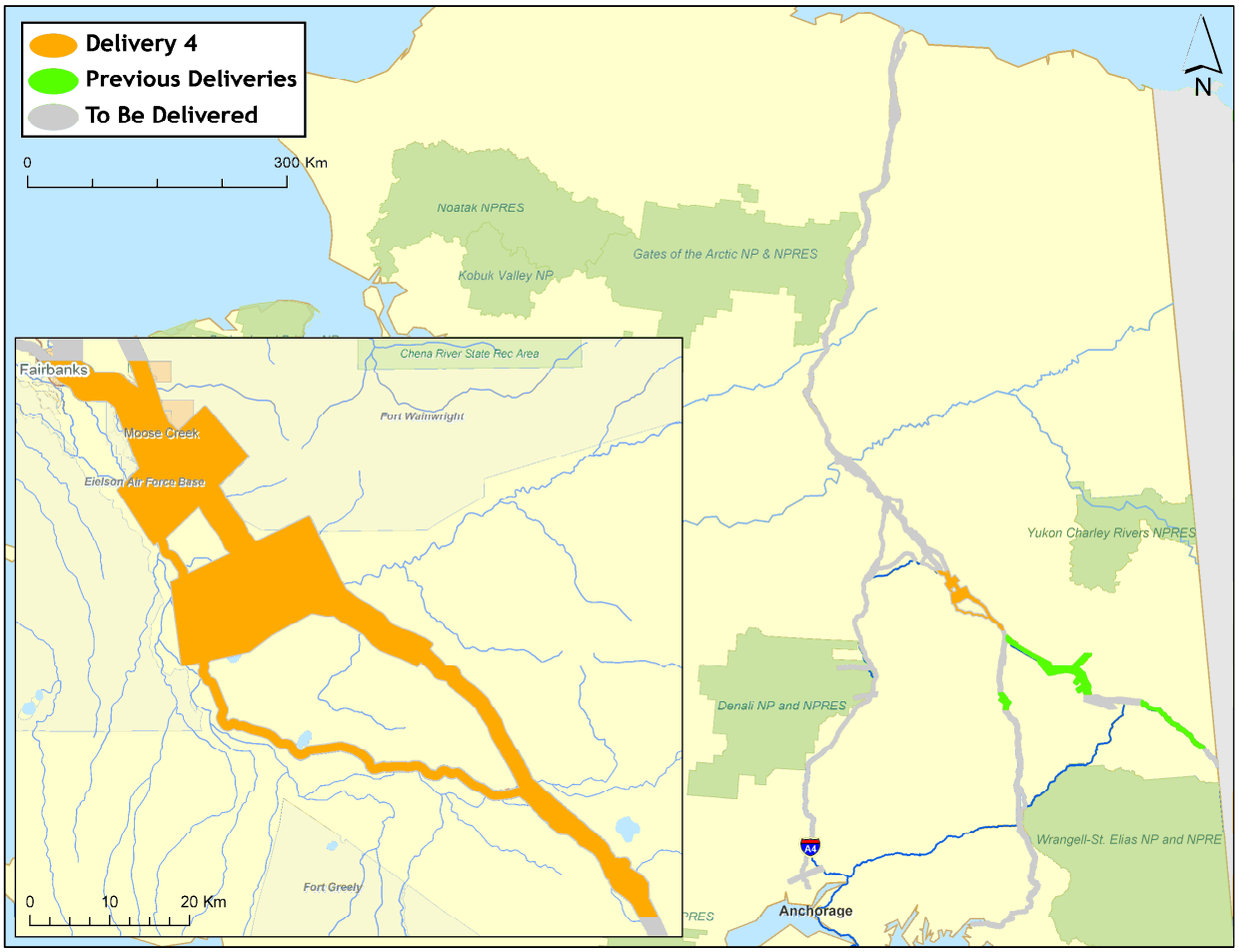


***Table 1**. Alaska Pipeline, LiDAR deliveries to date.*

| Delivery | UTM Zone(s) | Date | Total Acres Flown | AOI Acres |
|---|---|---|---|---|
| **1** | 6, 7 | March 9, 2011 | 121,746 | 117,357 |
| **2** | 6 | March 31, 2011 | 99,594 | 94,885 |
| **3** | 7 | May 23, 2011 | 43,976 | 39,744 |
| **4** | 6 | July 29, 2011 | 168,823 | 159,433 |

# 2. Acquisition

## 2.1 Airborne Survey – Instrumentation and Methods

The LiDAR survey utilized a Leica ALS60 sensor in a Cessna Caravan 208Bs. The Leica systems were set to acquire 150,000 laser pulses per second (i.e., 150 kHz pulse rate) and flown at 1500 meters above ground level (AGL), capturing a scan angle of ±14° from nadir when clouds and terrain permitted. With these flight parameters, the laser swath width is 638m and the laser pulse footprint is 34cm. These settings varied depending on cloud cover and terrain but were consistently adjusted to yield an average native pulse density of ≥8 pulses per square meter over terrestrial surfaces. It is not uncommon for some types of surfaces (e.g. dense vegetation or water) to return fewer pulses than the laser originally emitted. These discrepancies between 'native' and 'delivered' density will vary depending on terrain, land cover, and the prevalence of water bodies.



*The Cessna Caravan is a stable platform, ideal for flying slow and low for high density projects. A Leica ALS60 sensor head installed in the Caravan is shown on the left.*

All areas were surveyed with an opposing flight line side-lap of ≥60% (≥100% overlap) to reduce laser shadowing and increase surface laser painting. The Leica laser systems allow up

to four range measurements (returns) per pulse, and all discernable laser returns were processed for the output dataset.

To accurately solve for laser point position (geographic coordinates x, y, z), the positional coordinates of the airborne sensor and the attitude of the aircraft were recorded continuously throughout the LiDAR data collection mission. Aircraft position was measured twice per second (2 Hz) by an onboard differential GPS unit. 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/sensor position and attitude data are indexed by GPS time.

## 2.2 Ground Survey – Instrumentation and Methods

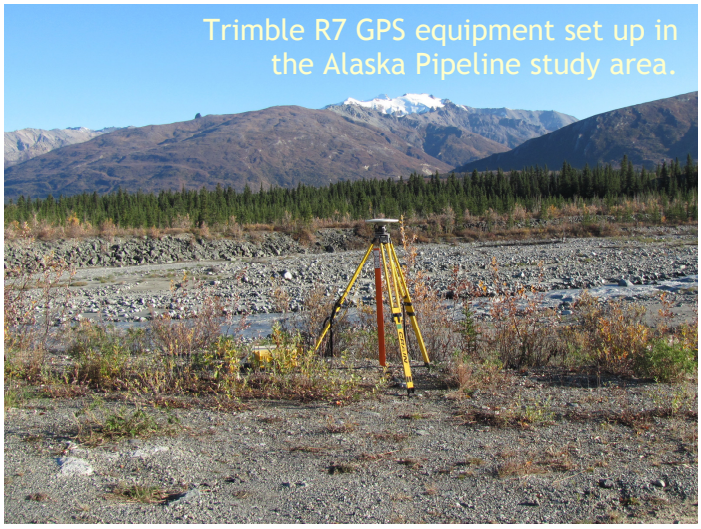
### *2.2.1 Monumentation*




Watershed Sciences coordinated with McClintock Land Associates (MLA, Alaska Professional Licensed Surveyor), of Eagle River, AK to determine proposed monument locations to support aerial acquisition. MLA established survey control monuments for the project area based on the proposed locations, areas with reasonable access, GPS visibility and proximity to the mission area. MLA established ten new monuments (**Table 2**) within the Delivery 4 calibration area. The MLA monumentation was done with 5/8" x 30" rebar topped with a metal cap stamped with "MLA-WSI" the monument ID, and the year of establishment. MLA provided professional supervision and oversight to all survey aspects of this project, certified all monuments and provided additional independent accuracy check points (see Section 5.4, Appendix B). A full report of the survey will be provided with the final delivery report.

### *2.2.2 Control for Airborne Surveys*

During the LiDAR survey, static (1 Hz recording frequency) ground surveys were conducted over the survey control monuments.


Trimble R7 GPS equipment set up in the Alaska Pipeline study area.

All control monuments were observed for a minimum of two survey sessions lasting no fewer than 4 hours. At the beginning of every session the tripod and antenna were reset, resulting in two independent instrument heights and data files. Data was collected at a rate of 1Hz using a 10 degree mask on the antenna.

After the airborne survey, the static GPS data were provided to MLA for

incorporation in the computation of the monument coordinates. MLA processed the static GPS data using triangulation with Continuously Operating Reference Stations (CORS). Both WSI and MLA checked coordinates using the Online Positioning User Service (OPUS[1]) to quantify daily variance. MLA provided calculated geodetic positions for all controls.

Indexed by time, these GPS data were used to correct the continuous onboard measurements of aircraft position recorded throughout the mission. Control monuments were located within 13 nautical miles of the survey area as per the contract.

***Table 2**. Base Station control coordinates for Alaska Pipeline Delivery 4.*

| Base Station ID | Datum: NAD83 (CORS96) | | GRS80 |
|---|---|---|---|
| | Latitude | Longitude | Ellipsoid Z (meters) |
| 19A | 64° 43' 22.99489 | 147° 14' 41.47093 | 177.362 |
| 19B | 64° 43' 01.97218 | 147° 12' 10.09804 | 169.639 |
| 19C | 64° 35' 36.78551 | 147° 03' 31.50690 | 186.159 |
| 20A | 64° 30' 56.06254 | 146° 58' 27.42852 | 205.443 |
| 20B | 64° 29' 41.41049 | 146° 58' 21.16775 | 205.853 |
| 21A | 64° 18' 16.65540 | 146° 40' 03.86273 | 258.486 |
| 21B | 64° 18' 35.93285 | 146° 31' 35.89827 | 352.181 |
| 22A | 64° 12' 29.03935 | 145° 56' 50.46314 | 308.524 |
| 22B | 64° 11' 57.22189 | 145° 55' 23.24779 | 308.511 |
| 22C | 64° 04' 12.11723 | 145° 42' 10.18804 | 365.759 |

### *2.2.3 Instrumentation*

For this survey, a Trimble GPS receiver model R7 with Zephyr Geodetic antenna with ground plane was deployed for all static control. A Trimble model R8 GNSS unit was used for collecting check points using real time kinematic (RTK) survey techniques. All GPS measurements were made with dual frequency L1-L2 receivers with carrier-phase correction.

The aircraft was assigned a ground crew member with two Trimble R7 receivers and an R8 receiver. The ground crew vehicles are equipped with standard field survey supplies and equipment including safety materials. The aircraft was further supported, as necessary, by an MLA surveyor (AK PLS) with two or more survey grade Topcon Receivers.

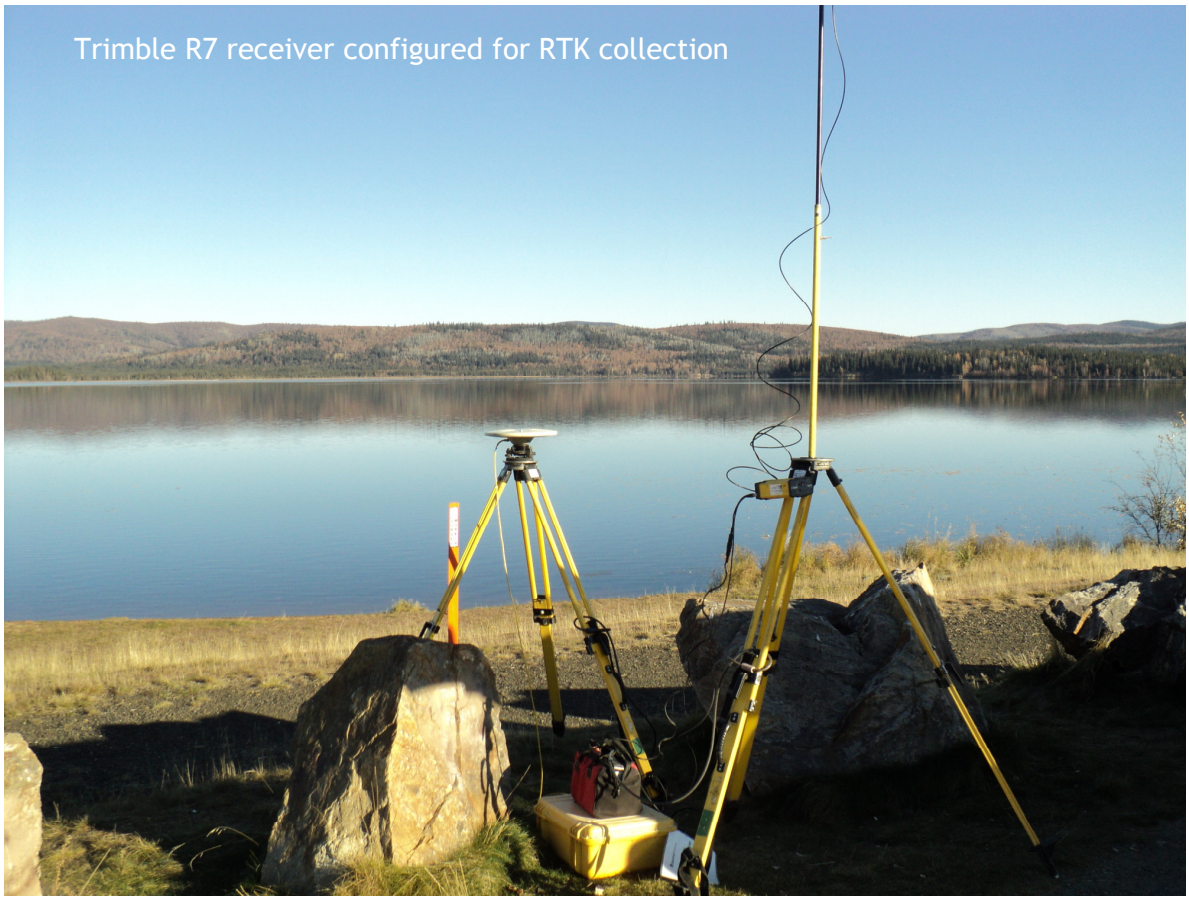
[1] Online Positioning User Service (OPUS) is run by the National Geodetic Survey to process corrected monument positions.

### *2.2.3 Methodology*

RTK and aircraft mounted GPS measurements were made during periods with PDOP[2] less than or equal to 3.0 and with at least 6 satellites in view of both a stationary reference receiver and the roving receiver. Static GPS data collected in a continuous session average the high PDOP into the final solution in the method used by CORS stations.

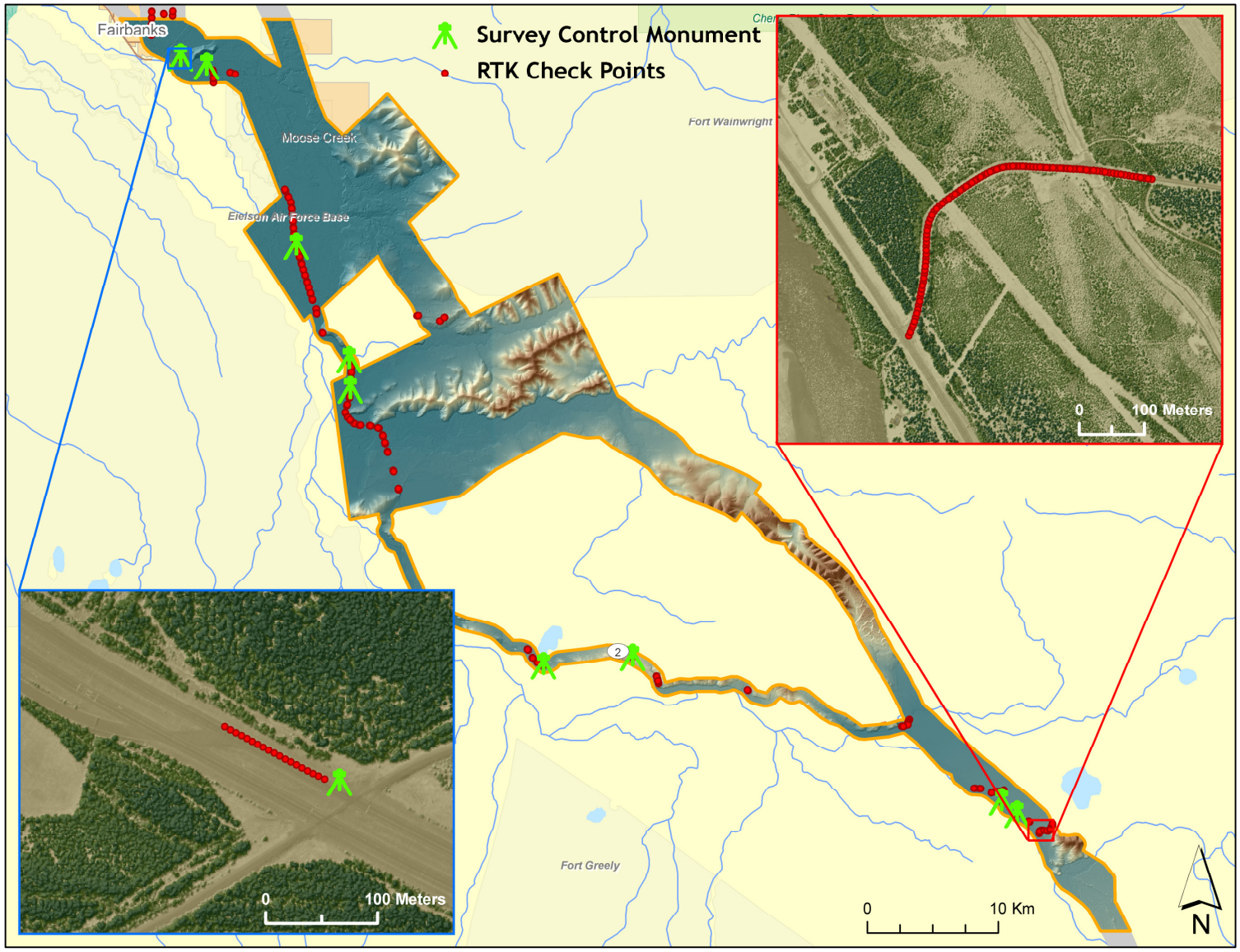
For RTK data, the collector begins recording after remaining stationary for 5 seconds then calculating the pseudo range position from at least three epochs with the relative error under 1.5cm horizontal and 2cm vertical. RTK positions are collected on bare earth locations such as paved, gravel or stable dirt roads, and other locations where the ground is clearly visible (and is likely to remain visible) from the sky during the data acquisition and RTK measurement period(s).

In order to facilitate comparisons with LiDAR measurements, RTK measurements were not taken on highly reflective surfaces such as center line stripes or lane markings on roads. RTK points were taken no closer than one meter to any nearby terrain breaks such as road edges or drop offs.


Trimble R7 receiver configured for RTK collection

[2]PDOP: Point Dilution of Precision is a measure of satellite geometry, the smaller the number the better the geometry between the point and the satellites.

***Figure 2**. WSI RTK check points and control monument locations used in Delivery 4 of the Alaska Pipeline LiDAR Survey.*



# 3. LiDAR Data Processing

## 3.1 Applications and Work Flow Overview

1. Resolved kinematic corrections for aircraft position data using kinematic aircraft GPS and static ground GPS data.

   **Software:** Waypoint GPS v.8.10, Trimble Geomatics Office v.1.62
2. Developed a smoothed best estimate of trajectory (SBET) file that blends post-processed aircraft position with attitude data. Sensor head position and attitude were calculated throughout the survey. The SBET data were used extensively for laser point processing.

   **Software:** IPAS v.1.35
3. Calculated laser point position by associating SBET position to each laser point return time, scan angle, intensity, etc. Created raw laser point cloud data for the entire survey in *.las (ASPRS v. 1.2) format.

   **Software:** ALS Post Processing Software v.2.70
4. Imported raw laser points into manageable blocks (less than 500 MB) to perform manual relative accuracy calibration and filter for pits/birds. Ground points were then classified for individual flight lines (to be used for relative accuracy testing and calibration).

   **Software:** TerraScan v.11.009
5. Using ground classified points per each flight line, the relative accuracy was tested. Automated line-to-line calibrations were then performed for system attitude parameters (pitch, roll, heading), mirror flex (scale) and GPS/IMU drift. Calibrations were performed on ground classified points from paired flight lines. Every flight line was used for relative accuracy calibration.

   **Software:** TerraMatch v.11.006
6. Position and attitude data were imported. Resulting data were classified as ground and non-ground points. Statistical absolute accuracy was assessed via direct comparisons of ground classified points to ground RTK survey data. Data were then converted to orthometric elevations (NAVD88) by applying a Geoid09 correction. **Software:** TerraScan v.11.009, TerraModeler v.11.004
7. Bare Earth models were created as a triangulated surface and exported as ArcInfo ASCII grids at a 1 meter pixel resolution. Highest Hit models were created for any class at 1 meter grid spacing and exported as ArcInfo ASCII grids. Vegetation models were created for all vegetation points 20cm and above the ground model at a 1m grid spacing and exported as ArcInfo ASCII grids.

   **Software:** TerraScan v.11.009, ArcMap v. 9.3.1, TerraModeler v.11.004

## 3.2 Aircraft Kinematic GPS and IMU Data

LiDAR survey datasets were referenced to the 1 Hz static ground GPS data collected over pre-surveyed monuments with known coordinates. While surveying, the aircraft collected 2 Hz kinematic GPS data, and the onboard inertial measurement unit (IMU) collected 200 Hz aircraft attitude data. Waypoint GPS v.8.10 was used to process the kinematic corrections for the aircraft. The static and kinematic GPS data were then post-processed after the survey to

obtain an accurate GPS solution and aircraft positions. IPAS v.1.35 was used to develop a trajectory file that includes corrected aircraft position and attitude information. The trajectory data for the entire flight survey session were incorporated into a final smoothed best estimated trajectory (SBET) file that contains accurate and continuous aircraft positions and attitudes.

## 3.3 Laser Point Processing

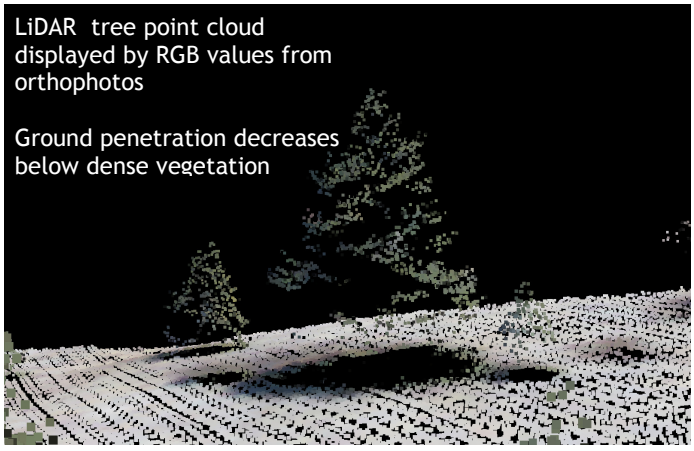
Laser point coordinates were computed using the IPAS and ALS Post Processor software suites based on independent data from the LiDAR system (pulse time, scan angle), and aircraft trajectory data (SBET). Laser point returns (first through fourth) were assigned an associated (x, y, z) coordinate along with unique intensity values (0-255). The data were output into large LAS v. 1.2 files with each point maintaining the corresponding scan angle, return number (echo), intensity, and x, y, z (easting, northing, and elevation) information.

These initial laser point files were too large for subsequent processing. To facilitate laser point processing, bins (polygons) were created to divide the dataset into manageable sizes (< 500 MB). Flightlines and LiDAR data were then reviewed to ensure complete coverage of the survey area and positional accuracy of the laser points.

Laser point data were imported into processing bins in TerraScan, and manual calibration was performed to assess the system offsets for pitch, roll, heading and scale (mirror flex). Using a geometric relationship developed by Watershed Sciences, each of these offsets was resolved and corrected if necessary.

LiDAR points were then filtered for noise, pits (artificial low points), and birds (true birds as well as erroneously high points) by screening for absolute elevation limits, isolated points and height above ground. Each bin was then manually inspected for remaining pits and birds and spurious points were removed. In a bin containing approximately 7.5-9.0 million points, an average of 50-100 points are typically found to be artificially low or high. Common sources of non-terrestrial returns are clouds, birds, vapor, haze, decks, brush piles, etc.

Internal calibration was refined using TerraMatch. Points from overlapping lines were tested for internal consistency and final adjustments were made for system misalignments (i.e., pitch, roll, heading offsets and scale). Automated sensor attitude and scale corrections yielded 3-5 cm improvements in the relative accuracy. Once system misalignments were corrected, vertical GPS drift was then resolved and removed per flight line, yielding a slight improvement (<1 cm) in relative accuracy.




The TerraScan software suite is designed specifically for classifying near-ground points (Soininen, 2004). The processing sequence began by 'removing' all points that were not 'near' the earth based on geometric constraints used to evaluate

multi-return points. The resulting bare earth (ground) model was visually inspected and additional ground point modeling was performed in site-specific areas to improve ground detail. This manual editing of ground often occurs in areas with known ground modeling deficiencies, such as: bedrock outcrops, cliffs, deeply incised stream banks, and dense vegetation. In some cases, automated ground point classification erroneously included known vegetation (i.e., understory, low/dense shrubs, etc.). These points were manually reclassified. Ground surface rasters were then developed from triangulated irregular networks (TINs) of ground points.

To develop the highest hit and vegetation models, buildings and structures were classified through automated point processing algorithms and then manually inspected and edited during the ground model inspection. Typically, manual editing of building classification was necessary where dense canopy was immediately proximate to buildings, or where structures such as utility poles or fences mimicked vegetation.

The remaining points not classified as ground, buildings, or error points were separated into two vegetation classes; Low Vegetation consisting of all returns ≤20cm from the ground, and Medium Vegetation consisting of all returns >20cm from the ground. This distinction was necessary because some potential for unclassified ground exists in the dataset. Vegetation classified returns within 20cm of the ground have higher potential to be artifacts of the dataset caused by minor offsets between flightlines (typically <10cm), isolated noise points, or abrupt discrete terrain features that did not get classified as ground (i.e. small boulders or sharp cliffs). The majority of points classified as low vegetation are valid returns, so the class was retained in the dataset to be incorporated into analyses at the user's discretion.

**Table 3.** ASPRS classification definitions for the Alaska Pipeline LiDAR survey

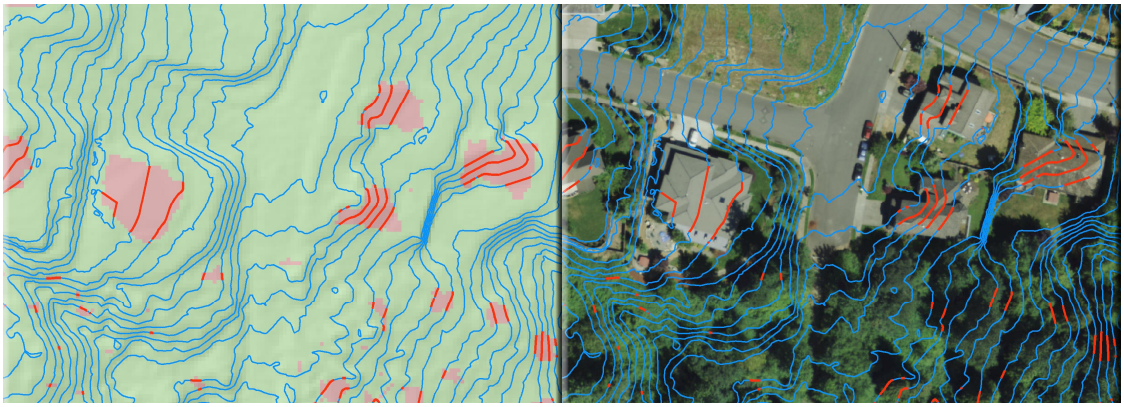
| ASPRS Class | Definition |
|---|---|
| 2 | Ground |
| 3 | Low Vegetation |
| 4 | Medium Vegetation |
| 6 | Buildings/Man-made structures |
| 7 | Noise/error points |
| 9 | Water |
| 15 | Pipeline |

## 3.4 Contour Development

Contour lines were derived at 1 meter intervals from ground-classified LiDAR point data using TerraSolid processing software in MicroStation v. 8.1. Contour generation from LiDAR point data requires a thinning operation in order to reduce contour sinuosity. Parameters for these operations are: thinning elevation bounds: +/- 0.07m; search radius: 6.09m. The thinning operation reduces point density where topographic change is minimal (flat surfaces) while preserving resolution where topographic change is present. The total sum of potential error in vertical position is equal to twice the point processing limits (0.14m) plus twice the 2-sigma absolute vertical accuracy value for this dataset.

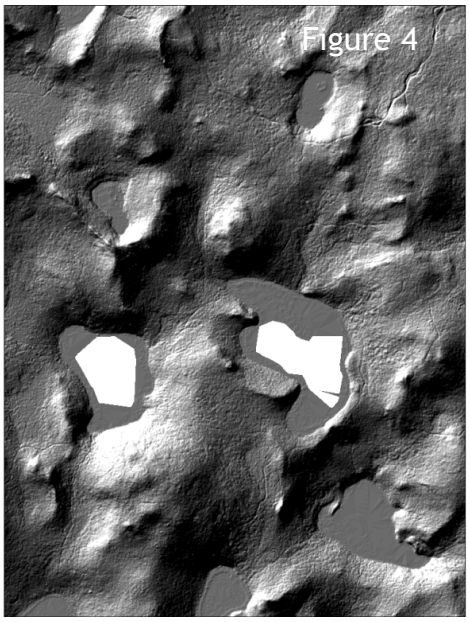
Ground point density rasters were created within MicroStation using a 1 meter step resolution and a 2 meter sampling radius. Areas with less than 0.25 ground-classified points per square meter were considered "sparse" and areas with higher densities were considered "covered". The ground point density raster data are in ESRI GRID format and have a 1 meter pixel resolution. The contour lines were intersected with ground point density raster data, allowing the addition of a confidence attribute to contour lines. Contour lines over "sparse" areas have low confidence, while contour lines over "covered" areas have a high confidence. Areas with low ground point density are commonly beneath buildings and bridges, in locations with dense vegetation, over water, and in other areas where laser penetration to the ground surface is impeded. **Figure 3** is an example of a ground point density raster and contour lines.

***Figure 3**. Elevation contours over LiDAR ground-classified point density raster (left) and true-color aerial photograph (right). Red indicates low ground point density and blue represents high density.*

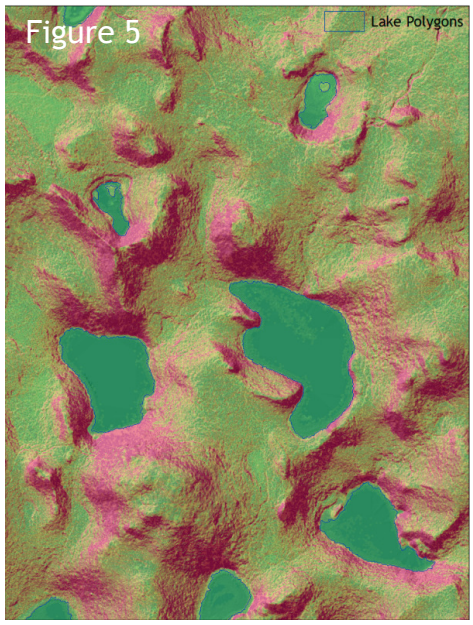


## 3.5 Hydro-Flattening

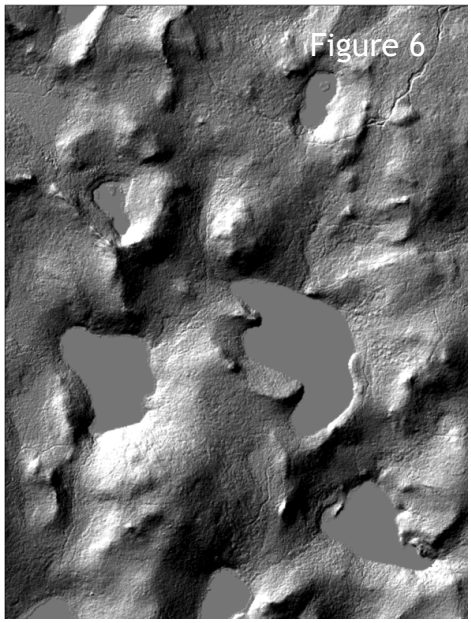
Lakes and other closed water bodies with surface area >150 $m^2$ were flattened to a consistent water level. The hydro-flattening process eliminates artifacts in the digital terrain model caused by both increased variability in ranges or dropouts in laser returns due to the low reflectivity of water (**Figure 4**). As per the project specifications, rivers and streams were not hydro-flattened.




Hydro-flattening of closed water bodies was performed through a combination of automated and manual detection and adjustment techniques designed to identify lake boundaries and water levels. Boundary polygons were developed using an algorithm which weights LiDAR-derived slopes, intensities, and return densities to detect the lake edge. The lake edges were then manually reviewed and edited in a 3-D environment. Once polygons were developed, the lake elevations were computed from the filtered LiDAR returns (**Figure 5**).




Returns from the water surface within each polygon were filtered and inspected for false low points during the initial ground modeling process described previously (Section 3.3). The elevation of each lake was computed as 5-cm above the minimum elevation of filtered water surface cells within the lake polygon. This approach ensures that all spurious returns off the water surface (both artificially high and low) were excluded from lake level assessment.




Lake-boundary polygons were then incorporated into the final terrain model and enforced as hard-breaklines. The initial ground classified points falling within lake polygons were reclassified as water points [to omit them from the final ground model] and replaced with the flat water surface of the lake boundary hydrolines (**Figure 6**).

# 4. LiDAR Accuracy Assessment

## 4.1 Laser Noise and Relative Accuracy

*Laser Noise*
For any given target, laser noise is the breadth of the data cloud per laser return (i.e., last, first, etc.). Lower intensity surfaces (roads, rooftops, still/calm water) experience higher laser noise. The laser noise range for this survey was approximately 0.02 meters.

*Relative Accuracy*
Relative accuracy refers to the internal consistency of the data set - the ability to place a laser point in the same location over multiple flight lines, GPS conditions, and aircraft attitudes. Affected by system attitude offsets, scale, and GPS/IMU drift, internal consistency is measured as the divergence between points from different flight lines within an overlapping area. Divergence is most apparent when flight lines are opposing. When the LiDAR system is well calibrated, the line-to-line divergence is low (<10 cm). See Appendix A for further information on sources of error and operational measures that can be taken to improve relative accuracy.

**Relative Accuracy Calibration Methodology**

1. Manual System Calibration: Calibration procedures for each mission require solving geometric relationships that relate measured swath-to-swath deviations to misalignments of system attitude parameters. Corrected scale, pitch, roll and heading offsets were calculated and applied to resolve misalignments. The raw divergence between lines was computed after the manual calibration was completed and reported for each survey area.
2. Automated Attitude Calibration: All data were tested and calibrated using TerraMatch automated sampling routines. Ground points were classified for each individual flight line and used for line-to-line testing. System misalignment offsets (pitch, roll and heading) and scale were solved for each individual mission and applied to respective mission datasets. The data from each mission were then blended when imported together to form the entire area of interest.
3. Automated Z Calibration: Ground points per line were used to calculate the vertical divergence between lines caused by vertical GPS drift. Automated Z calibration was the final step employed for relative accuracy calibration.

## 4.2 Absolute Accuracy

Laser point absolute accuracy is largely a function of laser noise and relative accuracy. To minimize these contributions to absolute error, a number of noise filtering and calibration procedures were performed prior to evaluating absolute accuracy. The LiDAR quality assurance process uses the data from the real-time kinematic (RTK) ground survey conducted in the AOI. For Delivery 4, **1713 RTK** GPS measurements were collected on hard surfaces distributed among multiple flight swaths for a total of 6865 points across all delivered data. Suitable and accessible hard-surfaces limited the number of RTK points able to be collected. To assess absolute accuracy the location coordinates of these known RTK ground points were compared to those calculated for the closest ground-classified laser points.

The vertical accuracy of the LiDAR data is described as the mean and standard deviation (sigma ~ $\sigma$) of divergence between LiDAR point coordinates and RTK ground survey point coordinates. To provide a sense of the model predictive power of the dataset, the root mean square error (RMSE) for vertical accuracy is also provided. These statistics assume the error distributions for x, y, and z are normally distributed, thus the skew and kurtosis of distributions are considered when evaluating error statistics.

Statements of statistical accuracy apply to fixed terrestrial surfaces only and may not be applied to areas of dense vegetation or steep terrain (See Appendix A).

# 5. Study Area Results

Summary statistics for point resolution and accuracy (relative and absolute) of the LiDAR data collected in the Alaska Pipeline Delivery 4 survey area have been added to previously delivered data. Cumulative results are presented below in terms of central tendency, variation around the mean, and the spatial distribution of the data (for point resolution by processing bin).

The initial dataset, acquired to be ≥8 points per square meter, was filtered as described previously to remove spurious or inaccurate points. Additionally, some types of surfaces (i.e., dense vegetation, breaks in terrain, water, steep slopes) may return fewer pulses (delivered density) than the laser originally emitted (native density).

Ground classifications were derived from automated ground surface modeling and manual, supervised classifications where it was determined that the automated model had failed. Ground return densities will be lower in areas of dense vegetation, water, or buildings.

## Data Summary:

***Table 4****. LiDAR Resolution and Accuracy - Specifications and Achieved Values*

| | | Targeted | Achieved |
|---|---|---|---|
| **Resolution:** | **UTM 6** | ≥ 8 points/$m^2$ | 8.55 points/$m^2$ |
| | **UTM 7** | | 8.68 points/$m^2$ |
| **Vertical Accuracy (1 $\sigma$):** | | <13 cm | 3.4 cm |

## 5.1 Data Density/Resolution

**Figures 9 - 12** display the distribution of average native and ground point densities for each processing bin. Density data will continue to be updated as data is processed and delivered.

LiDAR data resolution for Alaska Pipeline deliveries to date:

| | UTM 6 | UTM 7 |
|---|---|---|
| Average Point (First Return) Density | 8.55 points/$m^2$ | 8.68 points/$m^2$ |
| Average Ground Point Density | 2.57 points/$m^2$ | 2.90 points/$m^2$ |

***Figure 7**. Density distribution for first return laser points for UTM 6 (A) and UTM 7 (B)*

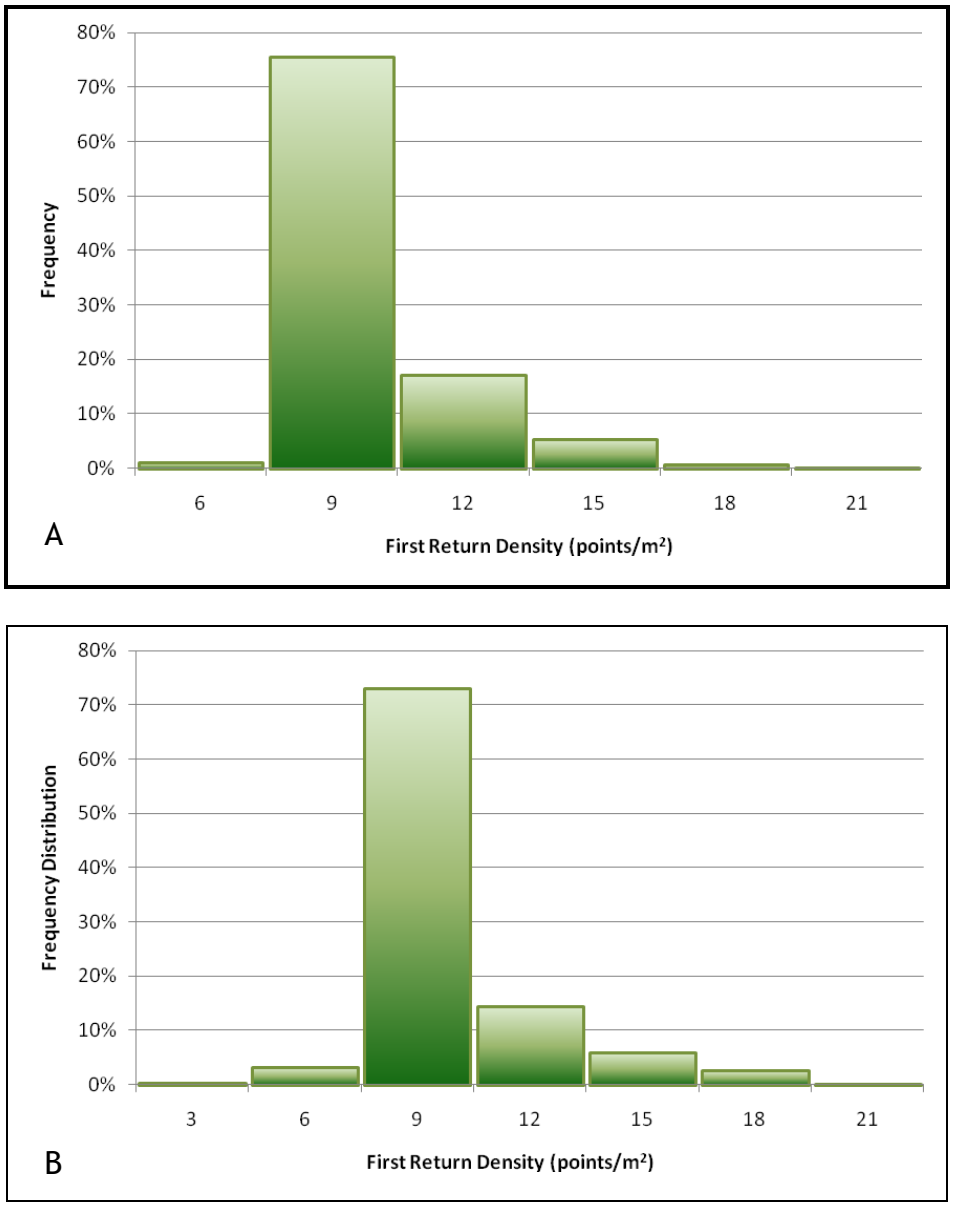


***Figure 8.*** *Density distribution for ground classified laser points for UTM 6 (A) and UTM 7 (B)*

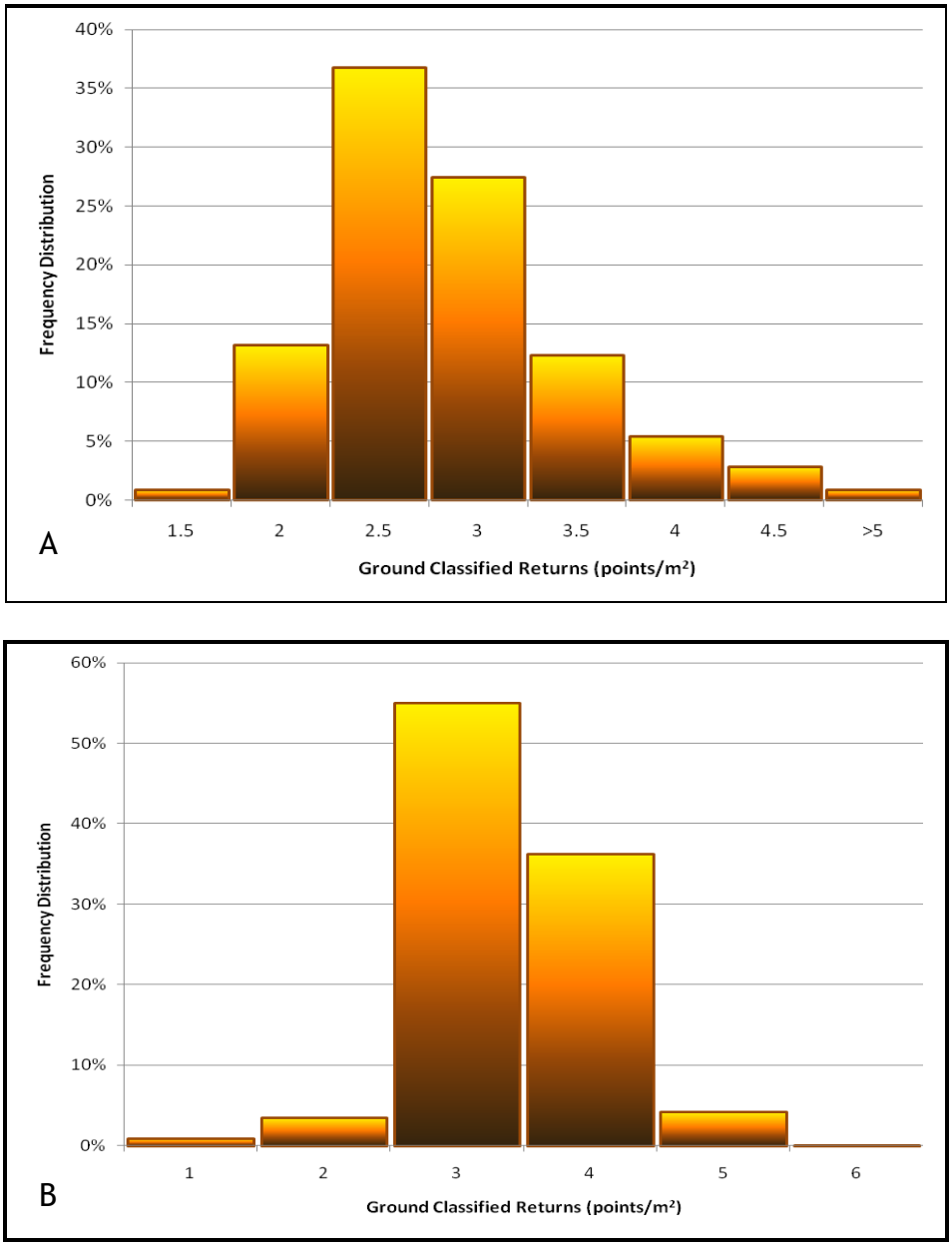


***Figure 9.*** *Density distribution map for ground and first return points by processing bin in Delivery 1, UTM 6*



***Figure 10***. *Density distribution map for ground and first return points by processing bin in Delivery 1, UTM 7*

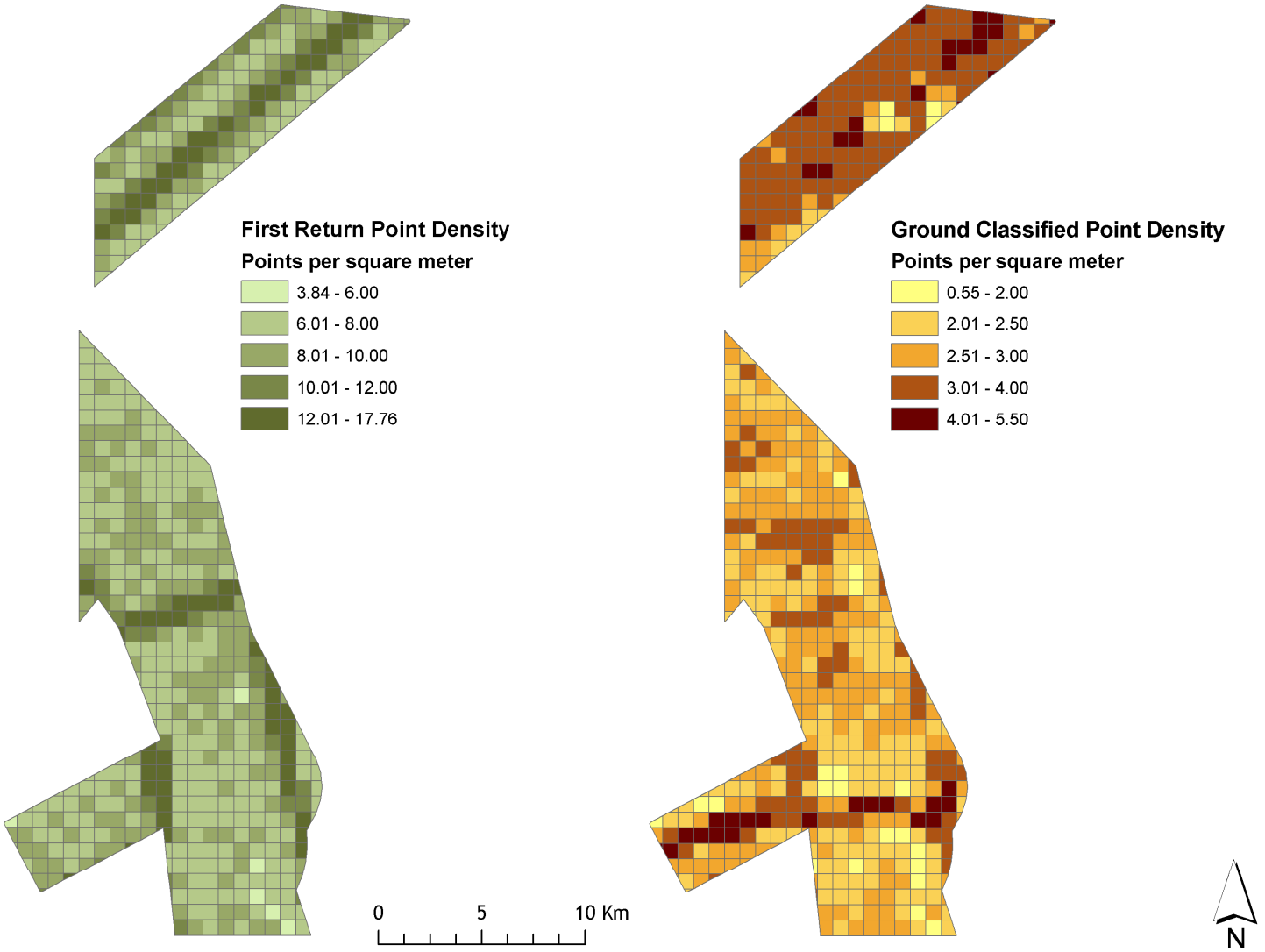


***Figure 11.*** *Density distribution map for ground points by processing bin in Delivery 2, UTM 6*

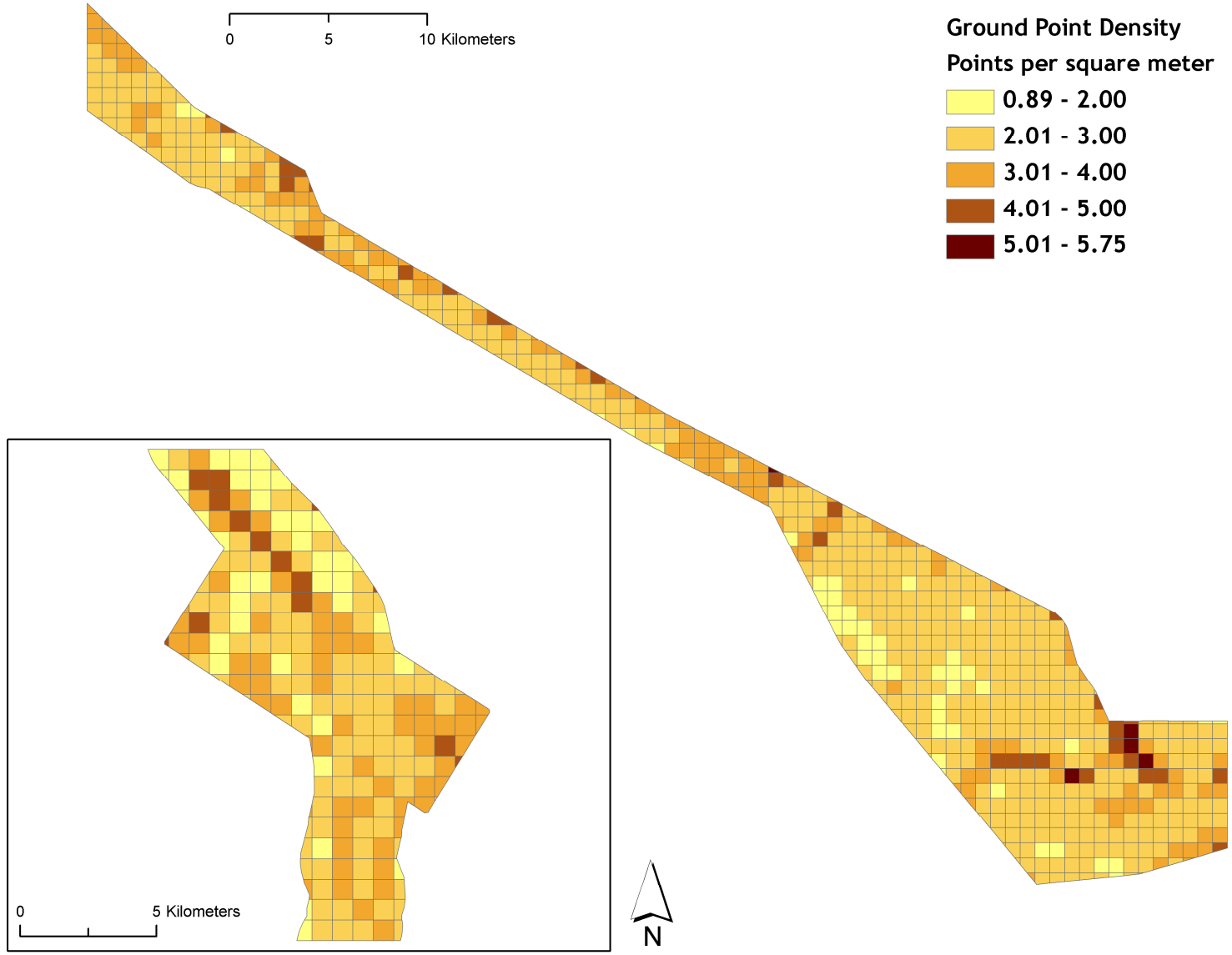


***Figure 12**. Density distribution map for first return points by processing bin in Delivery 2, UTM 6*

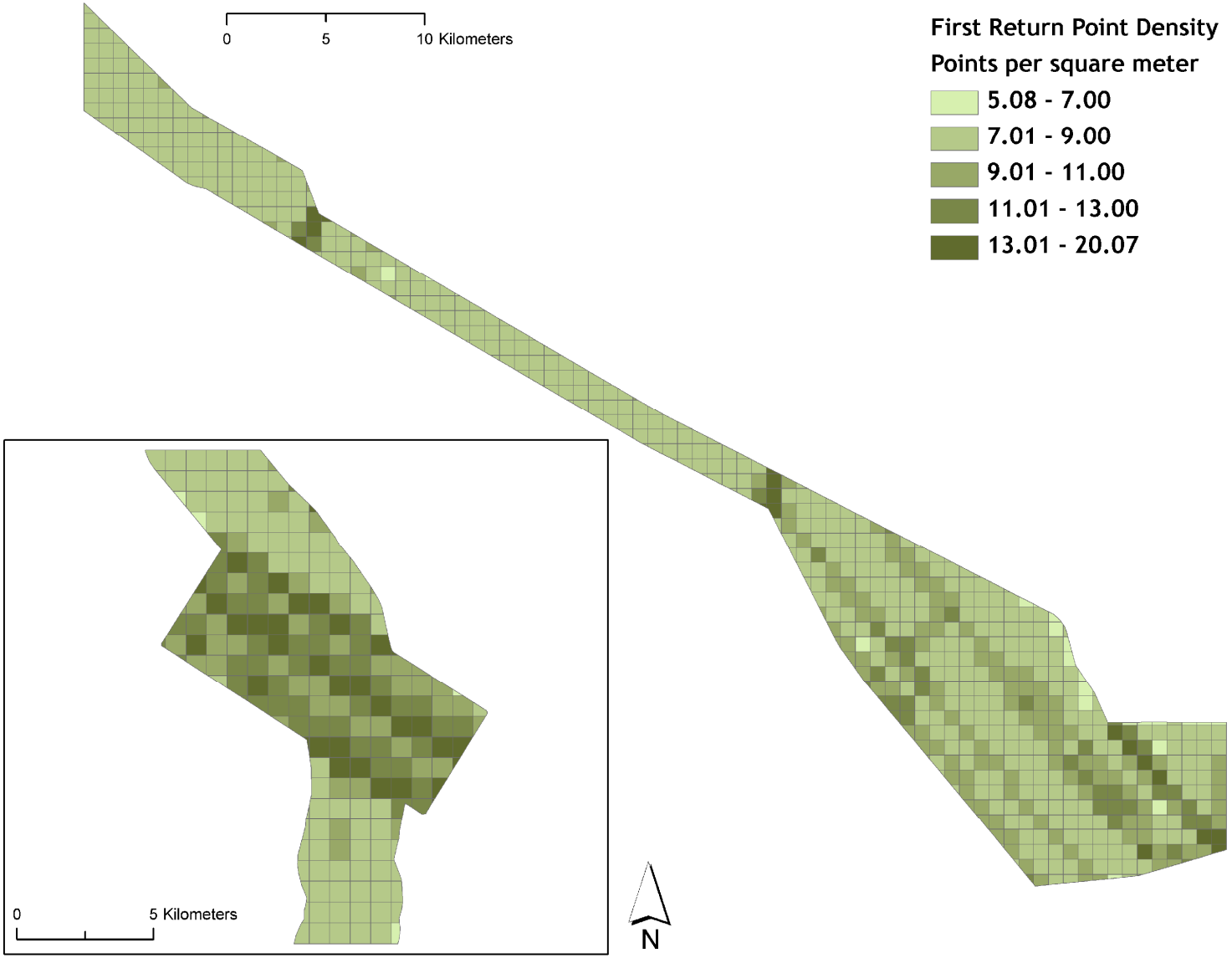


***Figure 13***. *Density distribution map for ground and first return points by processing bin in Delivery 3, UTM 7*

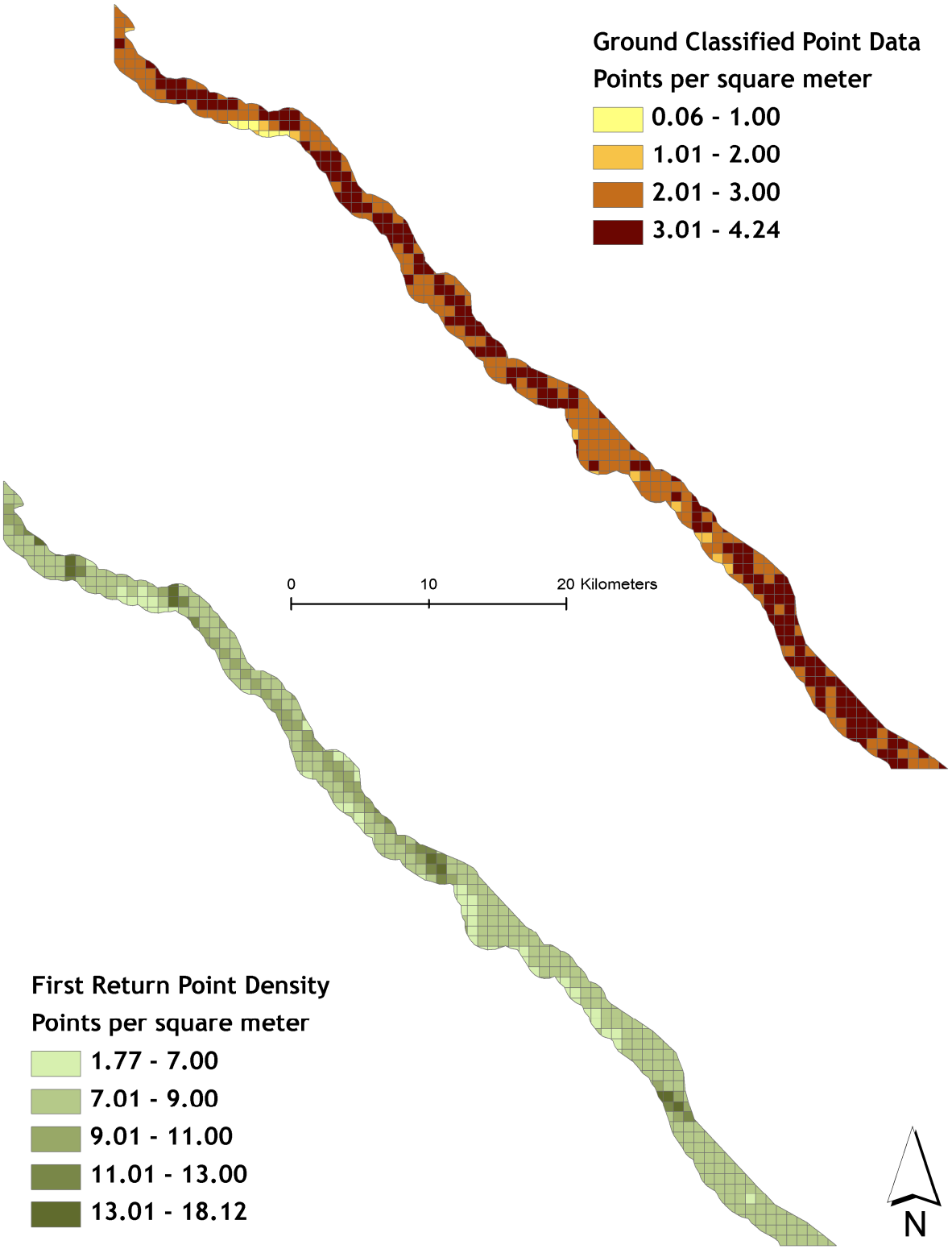
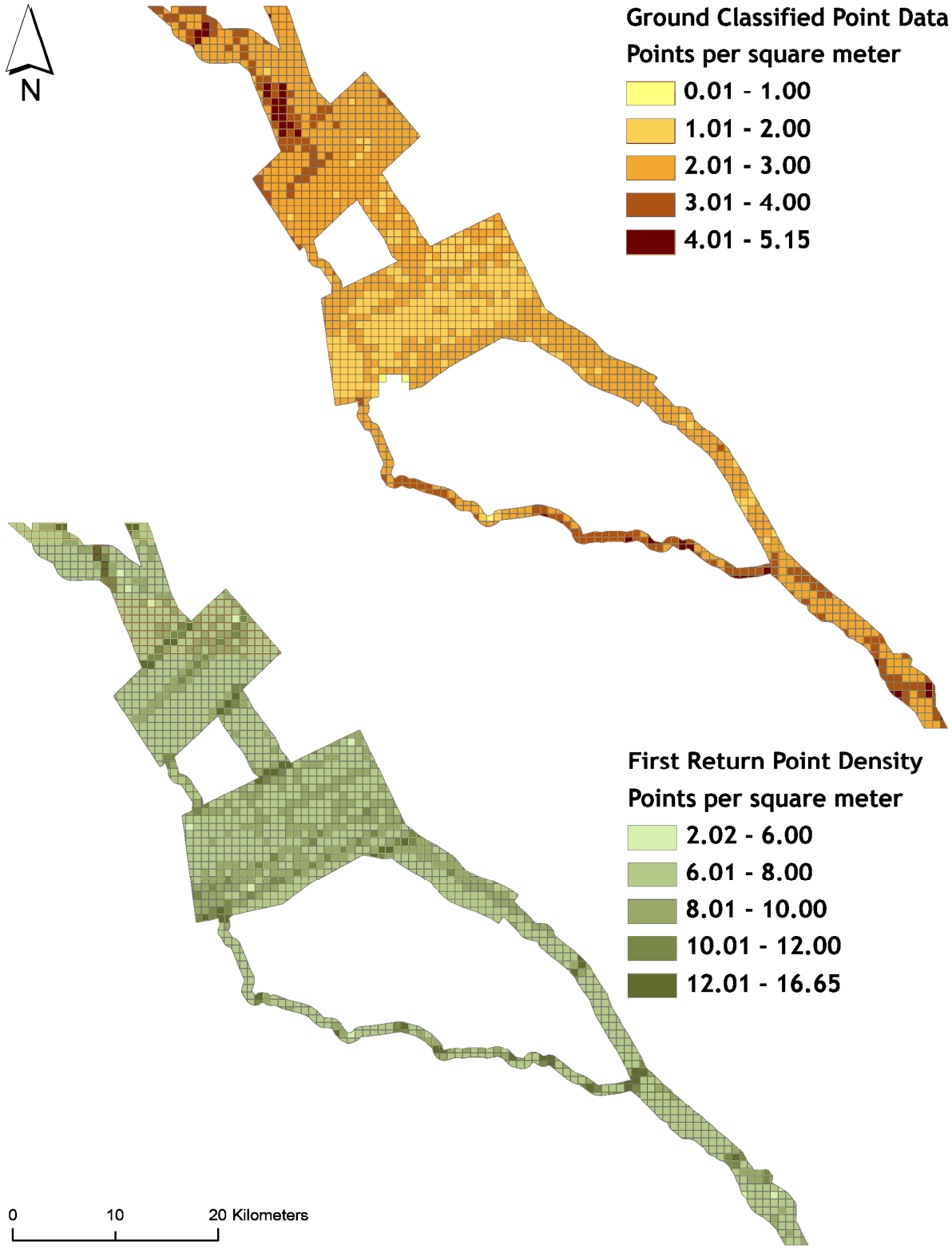


***Figure 14.*** *Density distribution map for ground and first return points by processing bin in Delivery 4, UTM 6*

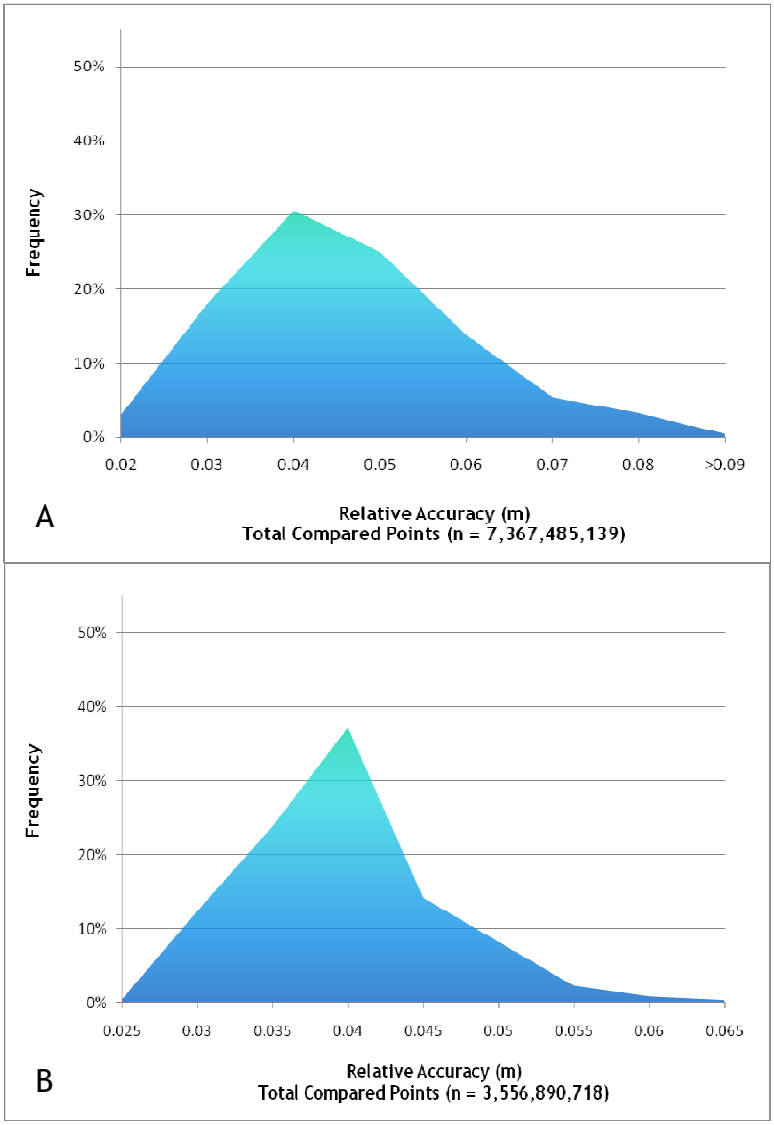


## 5.2 Relative Accuracy Calibration Results

***Table 5**. Cumulative relative accuracy statistics for Alaska Pipeline deliveries to date.*

| | UTM 6 | UTM 7 |
|---|---|---|
| Project Average | 0.038m | 0.037m |
| Median Relative Accuracy | 0.039m | 0.037m |
| 1σ Relative Accuracy | 0.013m | 0.006m |
| 1.96σ Relative Accuracy | 0.026m | 0.012m |

***Figure 15**. Distribution of cumulative relative accuracies in UTM 6 (A) and UTM 7 (B) per flight line, non slope-adjusted*



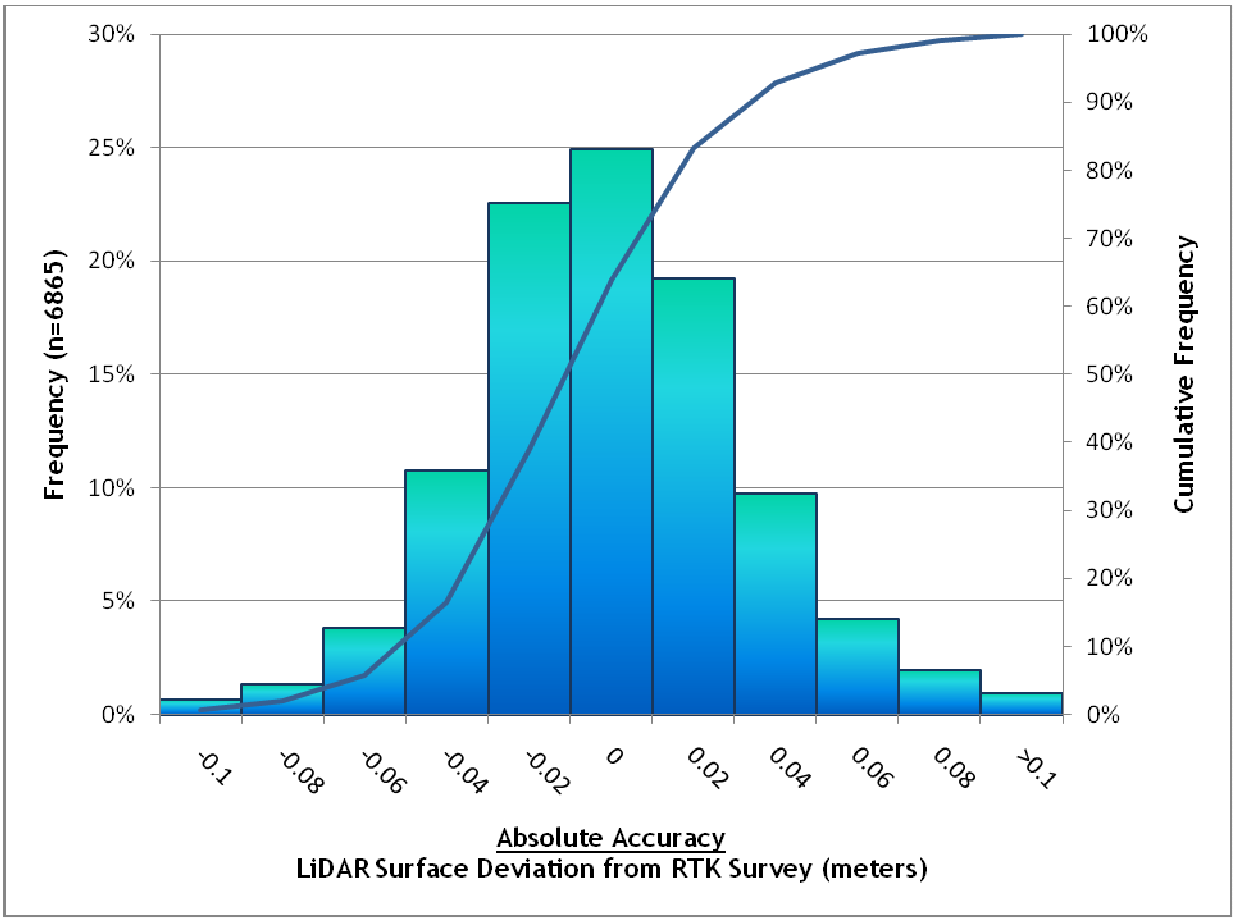
## 5.3 Absolute Accuracy

Absolute accuracies for Alaska Pipeline deliveries to date: All data was calibrated and processed in UTM 6 and then transformed to the appropriate projection.

***Table 6**. Absolute Accuracy - Deviation between laser points and RTK hard surface survey points*

| RTK Survey Sample Size (n): 6865 | |
|---|---|
| Root Mean Square Error (RMSE): 0.035m | Minimum Δz = -0.151m |
| Standard Deviations<br>1 sigma (σ): 0.033m 1.96 sigma (σ): 0.066m | Maximum Δz = 0.116m |
| | Average Δz = -0.009m |

***Figure 16**. Absolute Accuracy - Histogram Statistics*



## 5.4 Independent Accuracy Assessment

In accordance with the project plan, McClintock Land Associates (AK PLS) collected independent (i.e. blind) check points within the survey area to provide an independent assessment of LiDAR accuracy. WSI was provided with Easting and Northing positions for points which were then assigned elevations from the LiDAR. MLA received this report and compared the LiDAR Z values to MLA's surveyed (or known) Z values.

***Table 7**. Absolute accuracy determined by the project surveyor (MLA) using "Blind" Check Points (See Appendix B for PLS report)*

| Delivery | # of Check Points | RMSE | Range |
|---|---|---|---|
| 1 | 735 | 0.062m | 0.240m |
| 2 | 1096 | 0.035m | 0.204m |
| 3 | 1088 | 0.078m | 0.182m |
| 4 | 730 | 0.039m | 0.394m |

## 7. Projection/Datum and Units

| | | |
|---|---|---|
| | **Projection:** | UTM Zone 5, 6, 7 North |
| **Datum** | **Vertical:** | NAVD88 Geoid09 |
| | **Horizontal:** | NAD83 |
| | **Units:** | meters |

## 8. Deliverables

| | |
|---|---|
| **Point Data:** | • All Returns (LAS 1.2 format)<br>• Ground Returns (LAS 1.2 format) |
| **Vector Data:** | • Project Boundary (shapefile format)<br>• Tile Index for LiDAR Points (shapefile format)<br>• Tile Index for DEMs (shapefile format)<br>• Contours (1m shapefile format, DXF format)<br>• RTK (shapefile format, .TXT format)<br>• SBETs (shapefile format, DBF format)<br>• Lake Boundaries (shapefile format) |
| **Raster Data:** | • Elevation Models (1m resolution)<br>  • Hydro-flattened Bare Earth Model (ESRI GRID format)<br>  • Highest Hit Model (ESRI GRID format)<br>  • Vegetation Model (ESRI GRID format)<br>  • nDSM Model (ESRI GRID format)<br>• Intensity Images (GeoTIFF format, 0.5m resolution)<br>• Vegetation Metrics (5m resolution)<br>  • Canopy Cover (ESRI GRID format)<br>  • Coefficient of Variation (ESRI GRID format)<br>  • Mean Elevation (ESRI GRID format) |
| **Data Report:** | • Full report containing introduction, methodology, and accuracy |

# 9. Selected Images

***Figure 17****. View across braided channels of the Tanana River near Dot Lake. Top image is Bare Earth model. Bottom image is LiDAR point cloud colored by elevation.*

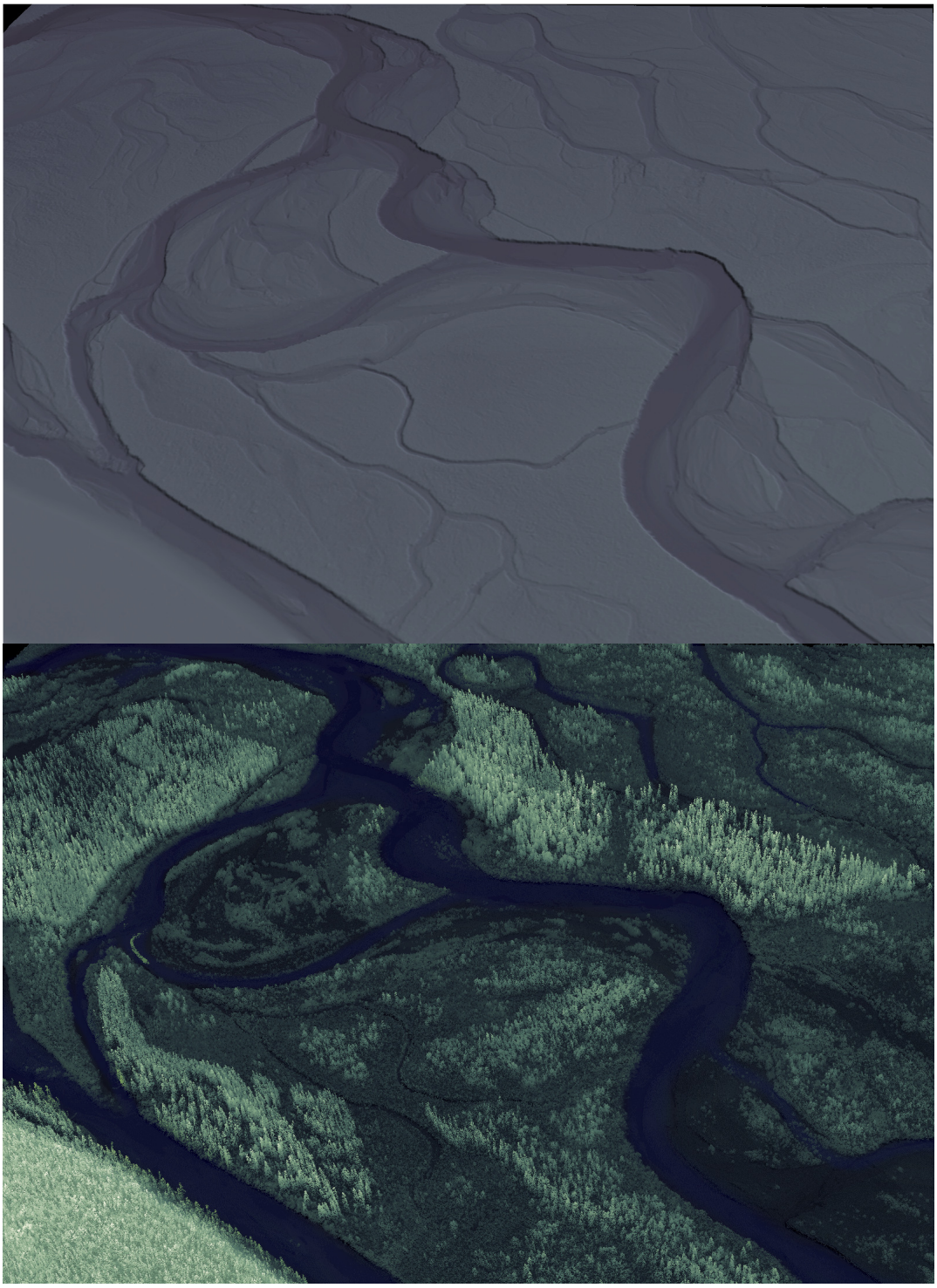


***Figure 18**. View looking west at hydro-flattened pond south of T Lake in the Bare Earth model.*

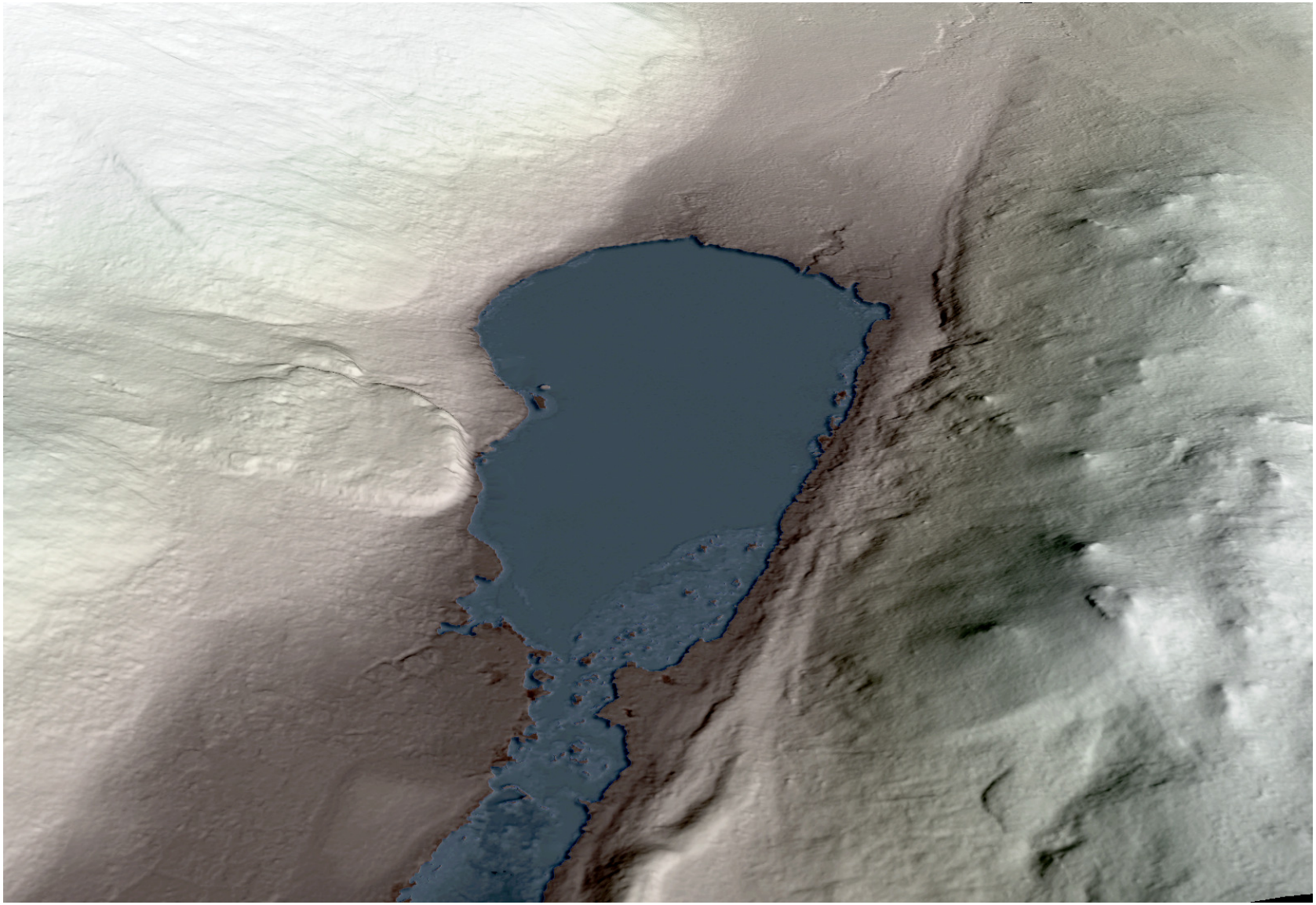


***Figure 19**. View looking north across Gerstle River along A2. Image is 3D LiDAR point cloud colored by elevation.*

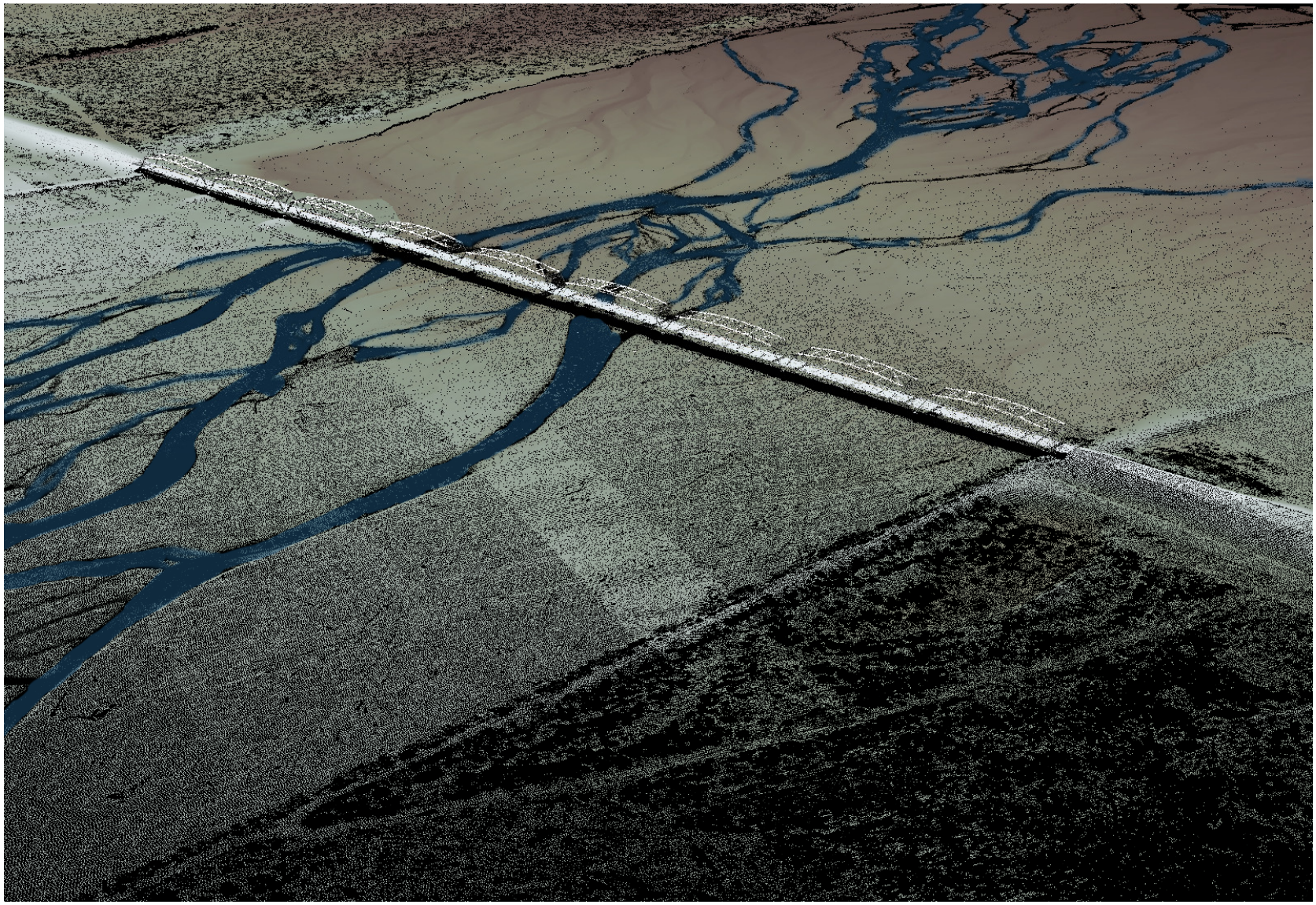


***Figure 20**. Northern end of above ground pipeline near Trims Camp along Hwy 4.*

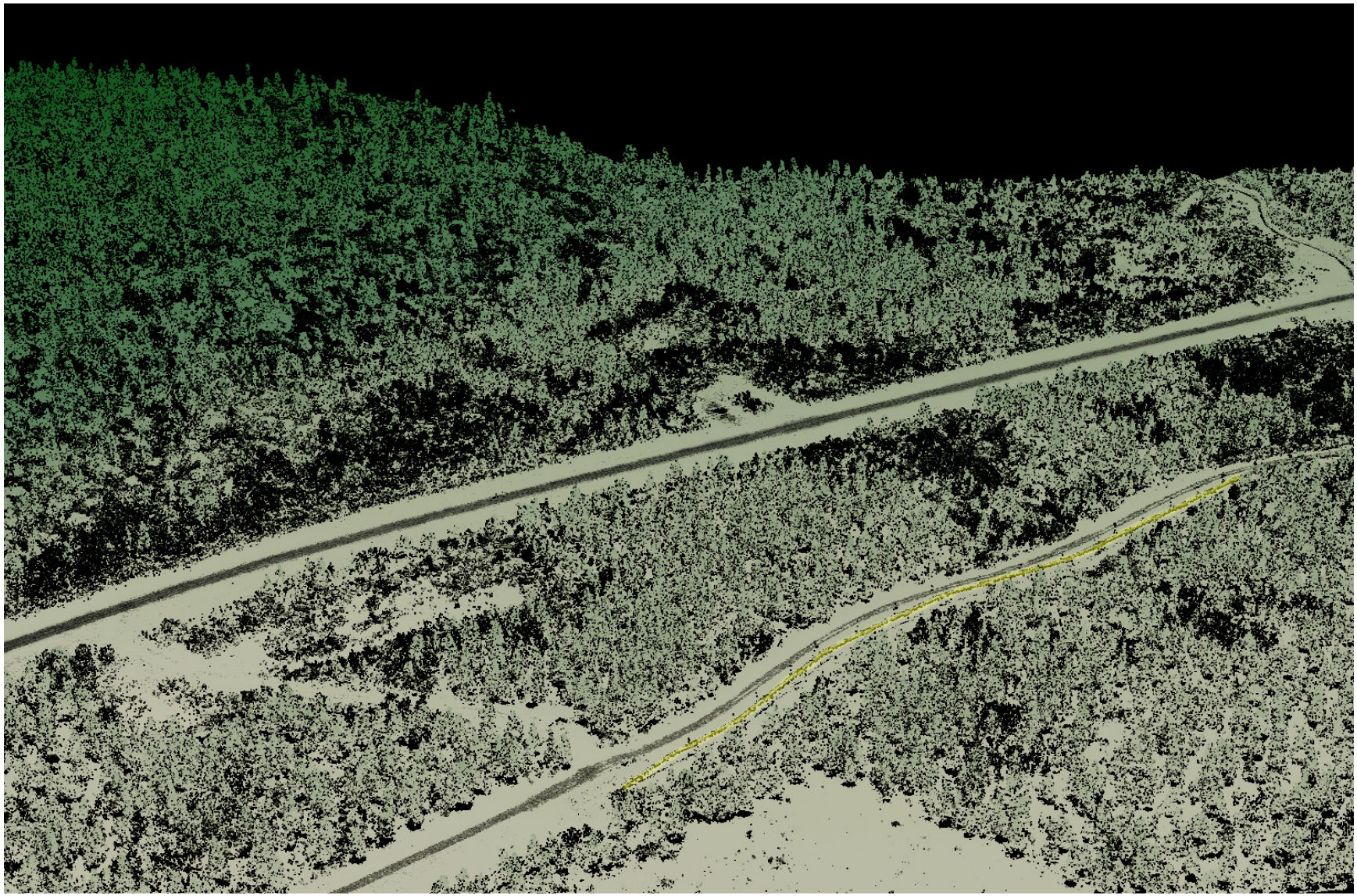


***Figure 21**. View looking North of Pipeline and Hwy 4 as they cross Miller Creek.*

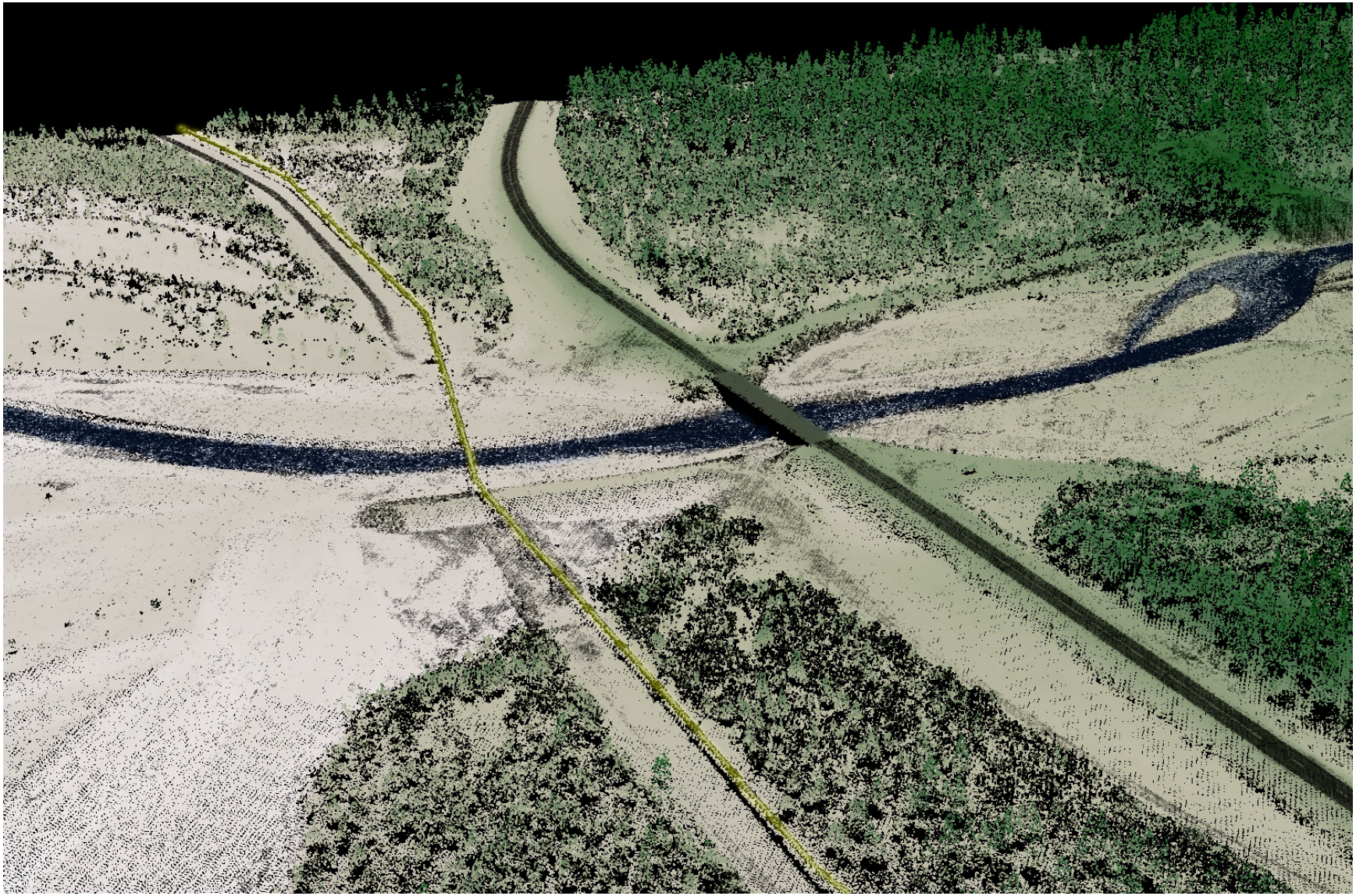


***Figure 22**. View looking Northeast across Hwy 2, just east of Tetlin Junction. Top image is Bare Earth model colored by elevation. Bottom image is Highest Hit model.*

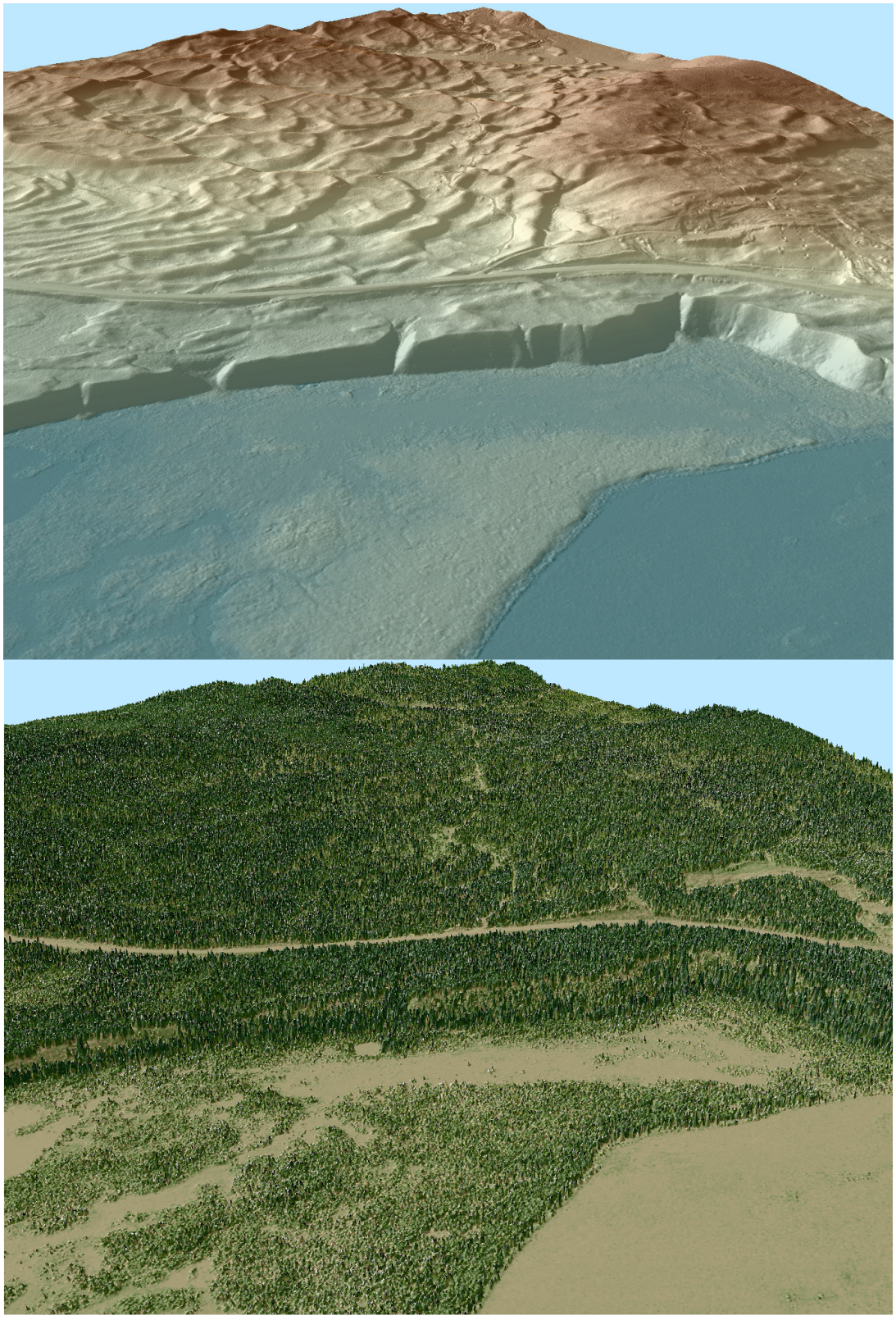
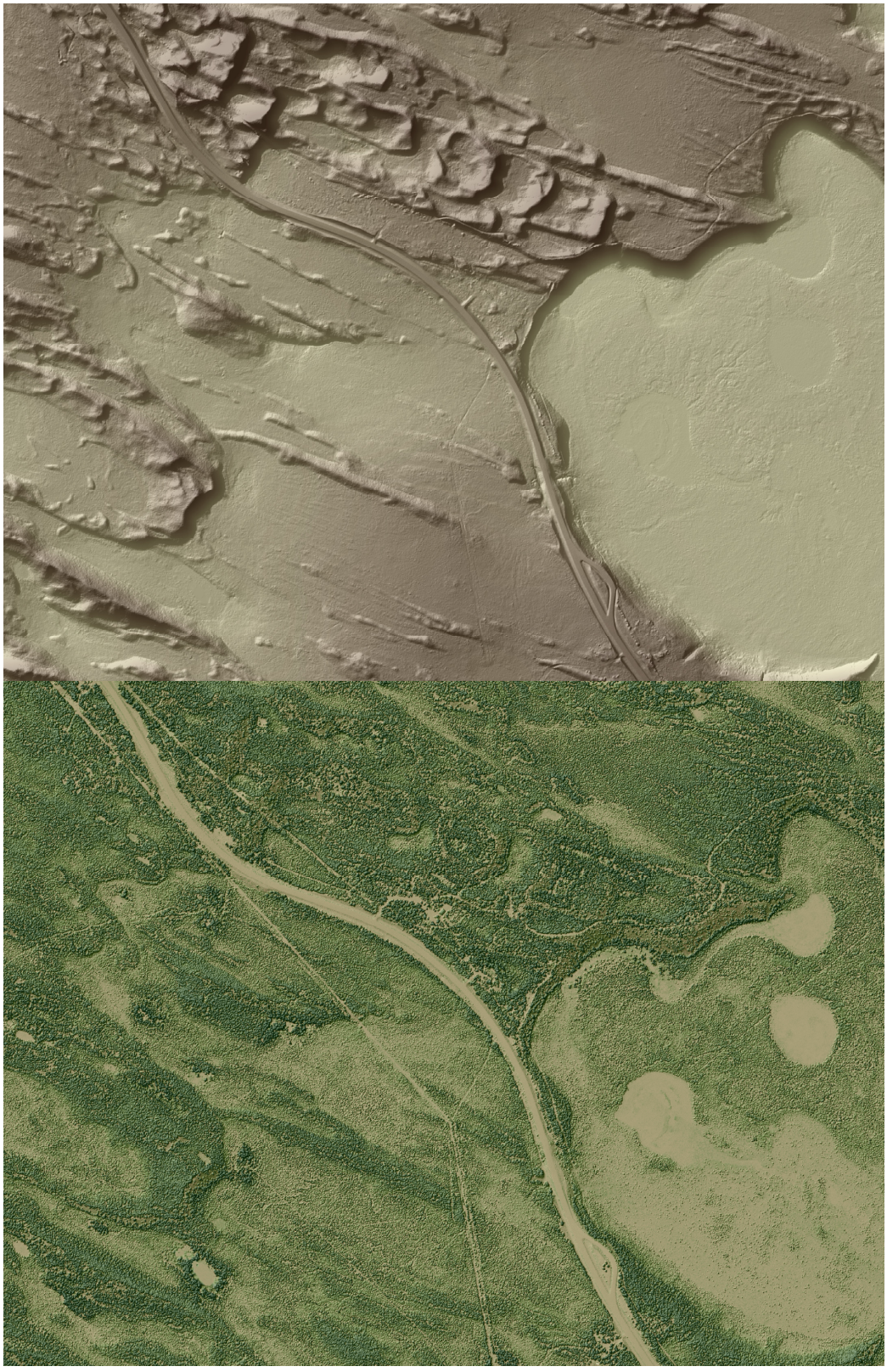


***Figure 23**. Hwy 2, west of where it crosses Gardiner River. Top image is Bare Earth model colored by elevation. Bottom image is Highest Hit model.*



# 10. Glossary

**1-sigma (σ) Absolute Deviation:** Value for which the data are within one standard deviation (approximately 68$^{th}$ percentile) of a normally distributed data set.

**1.96-sigma (σ) Absolute Deviation:** Value for which the data are within two standard deviations (approximately 95$^{th}$ percentile) of a normally distributed data set.

**Root Mean Square Error (RMSE):** A statistic used to approximate the difference between real-world points and the LiDAR points. It is calculated by squaring all the values, then taking the average of the squares and taking the square root of the average.

**Pulse Rate (PR)**: The rate at which laser pulses are emitted from the sensor; typically measured as thousands of pulses per second (kHz).

**Pulse Returns**: For every laser pulse emitted, the Leica ALS 50 Phase II system can record *up to four* wave forms reflected back to the sensor. Portions of the wave form that return earliest are the highest element in multi-tiered surfaces such as vegetation. Portions of the wave form that return last are the lowest element in multi-tiered surfaces.

**Accuracy**: The statistical comparison between known (surveyed) points and laser points. Typically measured as the standard deviation (sigma, σ) and root mean square error (RMSE).

**Intensity Values**: The peak power ratio of the laser return to the emitted laser. It is a function of surface reflectivity.

**Data Density**: A common measure of LiDAR resolution, measured as points per square meter.

**Spot Spacing**: Also a measure of LiDAR resolution, measured as the average distance between laser points.

**Nadir**: A single point or locus of points on the surface of the earth directly below a sensor as it progresses along its flight line.

**Scan Angle**: The angle from nadir to the edge of the scan, measured in degrees. Laser point accuracy typically decreases as scan angles increase.

**Overlap**: The area shared between flight lines, typically measured in percents; 100% overlap is essential to ensure complete coverage and reduce laser shadows.

**DTM / DEM**: These often-interchanged terms refer to models made from laser points. The digital elevation model (DEM) refers to all surfaces, including bare ground and vegetation, while the digital terrain model (DTM) refers only to those points classified as ground.

**Real-Time Kinematic (RTK) Survey**: GPS surveying is conducted with a GPS base station deployed over a known monument with a radio connection to a GPS rover. Both the base station and rover receive differential GPS data and the baseline correction is solved between the two. This type of ground survey is accurate to 1.5 cm or less.

# 11. Citations

Soininen, A. 2004. TerraScan User's Guide. TerraSolid.

# Appendix A

**LiDAR accuracy error sources and solutions:**

| Type of Error | Source | Post Processing Solution |
|---|---|---|
| GPS (Static/Kinematic) | Long Base Lines | None |
| | Poor Satellite Constellation | None |
| | Poor Antenna Visibility | Reduce Visibility Mask |
| Relative Accuracy | Poor System Calibration | Recalibrate IMU and sensor offsets/settings |
| | Inaccurate System | None |
| Laser Noise | Poor Laser Timing | None |
| | Poor Laser Reception | None |
| | Poor Laser Power | None |
| | Irregular Laser Shape | None |

**Operational measures taken to improve relative accuracy:**

1. Low Flight Altitude: Terrain following is employed to maintain a constant above ground level (AGL). Laser horizontal errors are a function of flight altitude above ground (i.e., ~ 1/3000$^{th}$ AGL flight altitude).
2. Focus Laser Power at narrow beam footprint: A laser return must be received by the system above a power threshold to accurately record a measurement. The strength of the laser return is a function of laser emission power, laser footprint, flight altitude and the reflectivity of the target. While surface reflectivity cannot be controlled, laser power can be increased and low flight altitudes can be maintained.
3. Reduced Scan Angle: Edge-of-scan data can become inaccurate. The scan angle was reduced to a maximum of ±15$^{o}$ from nadir, creating a narrow swath width and greatly reducing laser shadows from trees and buildings.
4. Quality GPS: Flights took place during optimal GPS conditions (e.g., 6 or more satellites and PDOP [Position Dilution of Precision] less than 3.0). Before each flight, the PDOP was determined for the survey day. During all flight times, a dual frequency DGPS base station recording at 1-second epochs was utilized and a maximum baseline length between the aircraft and the control points was less than 19 km (11.5 miles) at all times.
5. Ground Survey: Ground survey point accuracy (i.e. <1.5 cm RMSE) occurs during optimal PDOP ranges and targets a minimal baseline distance of 4 miles between GPS rover and base. Robust statistics are, in part, a function of sample size (n) and distribution. Ground survey RTK points are distributed to the extent possible throughout multiple flight lines and across the survey area.
6. 50% Side-Lap (100% Overlap): Overlapping areas are optimized for relative accuracy testing. Laser shadowing is minimized to help increase target acquisition from multiple scan angles. Ideally, with a 50% side-lap, the most nadir portion of one flight line coincides with the edge (least nadir) portion of overlapping flight lines. A minimum of 50% side-lap with terrain-followed acquisition prevents data gaps.
7. Opposing Flight Lines: All overlapping flight lines are opposing. Pitch, roll and heading errors are amplified by a factor of two relative to the adjacent flight line(s), making misalignments easier to detect and resolve.

# Appendix B

QUALITY CONTROL REVIEW SUMMARY

| | | |
|---|---|---|
| Max. Positive Elev. Deviation: | 0.205 | meters |
| Max. Negative Elev. Deviation: | -0.189 | meters |
| Elevation Deviation Range: | 0.394 | meters |
| Elevation Deviation Mean: | -0.007 | meters |
| Elevation Deviation RMSE | 0.039 | meters |

(RMSE = Root Mean Square Error)

| | | |
|---|---|---|
| Number of Check Points Used: | 730 | |
| Number of Check Points Excluded | 1 | See note below |
| Total Number of Check Points: | 731 | |

Note: Outlying check point #1949 which was 0.49m high was excluded. Survey error, rather than LiDAR error, is suspected.

| CHECK POINTS | | | SURVEYED Elevation | | LiDAR Elevation | Deviation | Include? (yes = 1) |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | DESCRIPTOR | (Meters) | (Meters) | (no = 0) |
| 1600 | 7119657.478 | 552295.068 | 297.82 | 22B20100919SAC | 297.91 | -0.09 | 1 |
| 1601 | 7119658.549 | 552304.986 | 298.76 | 22B20100919SAR | 298.78 | -0.02 | 1 |
| 1602 | 7119671.787 | 552288.898 | 298.63 | 22B20100919SAR | 298.64 | -0.01 | 1 |
| 1603 | 7119684.404 | 552274.028 | 298.52 | 22B20100919SAR | 298.55 | -0.03 | 1 |
| 1604 | 7119697.912 | 552258.253 | 298.39 | 22B20100919SAR | 298.43 | -0.04 | 1 |
| 1605 | 7119711.83 | 552243.084 | 298.24 | 22B20100919SAR | 298.28 | -0.04 | 1 |
| 1606 | 7119714.611 | 552245.745 | 298.16 | 22B20100919SAR | 298.19 | -0.03 | 1 |
| 1607 | 7119700.037 | 552262.051 | 298.28 | 22B20100919SAR | 298.31 | -0.03 | 1 |
| 1608 | 7119687.23 | 552276.697 | 298.38 | 22B20100919SAR | 298.42 | -0.04 | 1 |
| 1609 | 7119672.771 | 552293.712 | 298.46 | 22B20100919SAR | 298.49 | -0.03 | 1 |
| 1610 | 7119659.677 | 552309.615 | 298.60 | 22B20100919SAR | 298.65 | -0.05 | 1 |
| 1611 | 7120633.595 | 551092.416 | 298.36 | 22B20100919SGR | 298.42 | -0.06 | 1 |
| 1612 | 7120639.773 | 551084.328 | 298.35 | 22B20100919SGR | 298.41 | -0.06 | 1 |
| 1613 | 7120649.05 | 551073.161 | 298.28 | 22B20100919SGR | 298.38 | -0.10 | 1 |
| 1614 | 7120658.876 | 551063.566 | 298.29 | 22B20100919SGR | 298.36 | -0.07 | 1 |
| 1615 | 7120660.543 | 551053.61 | 297.58 | 22B20100919OG | 297.61 | -0.03 | 1 |
| 1616 | 7120668.606 | 551040.747 | 297.92 | 22B20100919OG | 297.96 | -0.04 | 1 |
| 1617 | 7120681.372 | 551033.614 | 297.61 | 22B20100919OG | 297.65 | -0.04 | 1 |
| 1618 | 7120694.403 | 551037.716 | 298.28 | 22B20100919SAR | 298.30 | -0.02 | 1 |
| 1619 | 7120704.365 | 551024.63 | 298.28 | 22B20100919SAR | 298.32 | -0.05 | 1 |
| 1620 | 7120714.391 | 551013.141 | 298.23 | 22B20100919SAR | 298.26 | -0.03 | 1 |
| 1621 | 7120700.627 | 551023.39 | 298.27 | 22B20100919SAR | 298.30 | -0.03 | 1 |
| 1622 | 7120687.857 | 551039.015 | 298.31 | 22B20100919SAR | 298.35 | -0.04 | 1 |
| 1623 | 7120676.581 | 551052.585 | 298.38 | 22B20100919SAR | 298.42 | -0.04 | 1 |
| 1624 | 7120656.733 | 551077.056 | 298.45 | 22B20100919SAR | 298.50 | -0.05 | 1 |
| 1625 | 7120645.01 | 551090.796 | 298.50 | 22B20100919SAR | 298.55 | -0.05 | 1 |
| 1626 | 7119283.627 | 552944.224 | 300.12 | 22B20100919SAR | 300.17 | -0.05 | 1 |
| 1627 | 7119284.297 | 552939.425 | 299.76 | 22B20100919SGR | 299.78 | -0.02 | 1 |
| 1628 | 7119289.615 | 552927.596 | 299.26 | 22B20100919SGR | 299.33 | -0.07 | 1 |
| 1629 | 7119294.884 | 552913.905 | 299.20 | 22B20100919SGR | 299.25 | -0.05 | 1 |
| 1630 | 7119295.695 | 552900.738 | 299.18 | 22B20100919SGR | 299.18 | 0.00 | 1 |
| 1631 | 7119300.388 | 552883.581 | 298.97 | 22B20100919SGR | 298.98 | -0.02 | 1 |
| 1632 | 7119314.551 | 552837.094 | 298.93 | 22B20100919SGR | 298.95 | -0.02 | 1 |
| 1633 | 7119320.657 | 552820.863 | 299.18 | 22B20100919SAR | 299.16 | 0.02 | 1 |
| 1634 | 7119327.346 | 552800.768 | 299.22 | 22B20100919SAR | 299.24 | -0.02 | 1 |
| 1635 | 7119332.474 | 552784.854 | 299.25 | 22B20100919SAR | 299.23 | 0.02 | 1 |
| 1636 | 7119340.488 | 552760.907 | 299.26 | 22B20100919SAR | 299.26 | 0.00 | 1 |
| 1637 | 7119350.038 | 552739.98 | 299.20 | 22B20100919SAR | 299.21 | -0.01 | 1 |
| 1638 | 7119358.052 | 552723.856 | 299.14 | 22B20100919SAR | 299.13 | 0.01 | 1 |
| 1639 | 7119485.627 | 552581.572 | 299.14 | 22B20100919SAR | 299.18 | -0.04 | 1 |

| CHECK POINTS | | | SURVEYED Elevation | | LiDAR Elevation | Deviation | Include? (yes = 1) |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | DESCRIPTOR | (Meters) | (Meters) | (no = 0) |
| 1640 | 7119496.639 | 552583.627 | 299.70 | 22B20100919SAR | 299.73 | -0.03 | 1 |
| 1641 | 7119489.85 | 552597.054 | 299.72 | 22B20100919SAR | 299.75 | -0.03 | 1 |
| 1642 | 7119482.435 | 552610.967 | 299.74 | 22B20100919SAR | 299.76 | -0.02 | 1 |
| 1643 | 7119475.882 | 552624.011 | 299.72 | 22B20100919SAR | 299.72 | 0.00 | 1 |
| 1644 | 7119467.63 | 552639.312 | 299.72 | 22B20100919SAR | 299.74 | -0.03 | 1 |
| 1645 | 7119460.944 | 552652.563 | 299.75 | 22B20100919SAR | 299.76 | -0.01 | 1 |
| 1646 | 7119452.973 | 552667.685 | 299.73 | 22B20100919SAR | 299.78 | -0.05 | 1 |
| 1647 | 7119429.623 | 552711.666 | 299.83 | 22B20100919SAR | 299.85 | -0.02 | 1 |
| 1648 | 7119420.323 | 552729.005 | 299.79 | 22B20100919SAR | 299.81 | -0.02 | 1 |
| 1649 | 7119410.31 | 552748.031 | 299.84 | 22B20100919SAR | 299.88 | -0.04 | 1 |
| 1650 | 7119400.788 | 552765.125 | 299.90 | 22B20100919SAR | 299.92 | -0.02 | 1 |
| 1651 | 7119390.731 | 552783.444 | 299.96 | 22B20100919SAR | 299.98 | -0.03 | 1 |
| 1652 | 7119375.253 | 552810.69 | 300.09 | 22B20100919SAR | 300.12 | -0.03 | 1 |
| 1653 | 7119364.678 | 552829.57 | 300.22 | 22B20100919SAR | 300.24 | -0.02 | 1 |
| 1654 | 7119354.04 | 552847.443 | 300.31 | 22B20100919SAR | 300.36 | -0.05 | 1 |
| 1655 | 7119342.486 | 552866.439 | 300.43 | 22B20100919SAR | 300.46 | -0.03 | 1 |
| 1656 | 7119330.989 | 552885.939 | 300.42 | 22B20100919SAR | 300.47 | -0.05 | 1 |
| 1657 | 7119317.199 | 552907.771 | 300.51 | 22B20100919SAR | 300.55 | -0.04 | 1 |
| 1658 | 7119304.948 | 552927.577 | 300.53 | 22B20100919SAR | 300.58 | -0.05 | 1 |
| 1659 | 7119294.404 | 552950.687 | 300.57 | 22B20100919SAR | 300.62 | -0.05 | 1 |
| 1660 | 7119286.984 | 552962.386 | 300.65 | 22B20100919SAR | 300.69 | -0.04 | 1 |
| 1661 | 7119143.022 | 553168.095 | 301.33 | 22B20100919SAR | 301.39 | -0.06 | 1 |
| 1662 | 7119134.941 | 553162.981 | 300.78 | 22B20100919SAR | 300.82 | -0.04 | 1 |
| 1663 | 7119124.992 | 553159.463 | 300.17 | 22B20100919SGR | 300.21 | -0.04 | 1 |
| 1664 | 7119110.388 | 553163.36 | 299.67 | 22B20100919SGR | 299.77 | -0.10 | 1 |
| 1900 | 7176954.768 | 490335.422 | 159.98 | 19B20100920SAC | 160.01 | -0.03 | 1 |
| 1901 | 7176948.869 | 490334.142 | 160.253 | 19B20100920SAR | 160.22 | 0.03 | 1 |
| 1902 | 7176957.885 | 490312.669 | 160.232 | 19B20100920SAR | 160.22 | 0.01 | 1 |
| 1903 | 7176968.392 | 490295.057 | 160.146 | 19B20100920SAR | 160.16 | -0.01 | 1 |
| 1904 | 7176976.1 | 490276.307 | 160.167 | 19B20100920SAR | 160.16 | 0.01 | 1 |
| 1905 | 7176983.33 | 490258.27 | 160.165 | 19B20100920SAR | 160.14 | 0.03 | 1 |
| 1906 | 7176990.119 | 490240.68 | 160.231 | 19B20100920SAR | 160.22 | 0.01 | 1 |
| 1907 | 7176997.252 | 490222.867 | 160.152 | 19B20100920SAR | 160.14 | 0.01 | 1 |
| 1908 | 7177003.859 | 490205.674 | 160.122 | 19B20100920SAR | 160.12 | 0.00 | 1 |
| 1909 | 7177010.545 | 490188.116 | 160.163 | 19B20100920SAR | 160.15 | 0.01 | 1 |
| 1910 | 7177017.557 | 490170.152 | 160.162 | 19B20100920SAR | 160.15 | 0.01 | 1 |
| 1911 | 7177024.153 | 490153.047 | 160.188 | 19B20100920SAR | 160.19 | 0.00 | 1 |
| 1912 | 7177351.336 | 489233.093 | 161.619 | 19B20100920SGR | 161.58 | 0.04 | 1 |
| 1913 | 7177349.842 | 489240.274 | 161.604 | 19B20100920SGR | 161.56 | 0.04 | 1 |
| 1914 | 7177352.946 | 489241.144 | 161.638 | 19B20100920SGR | 161.60 | 0.04 | 1 |
| 1915 | 7177356.883 | 489232.524 | 161.787 | 19B20100920SGR | 161.77 | 0.02 | 1 |
| 1916 | 7177361.84 | 489224.617 | 161.733 | 19B20100920SGR | 161.72 | 0.01 | 1 |
| 1917 | 7177366.211 | 489215.76 | 161.573 | 19B20100920SGR | 161.52 | 0.05 | 1 |
| 1918 | 7177371.02 | 489208.043 | 161.379 | 19B20100920SGR | 161.34 | 0.04 | 1 |
| 1919 | 7177372.082 | 489198.978 | 160.934 | 19B20100920SGR | 160.94 | -0.01 | 1 |
| 1920 | 7177363.753 | 489201.465 | 161.304 | 19B20100920SGR | 161.26 | 0.04 | 1 |
| 1921 | 7177361.497 | 489211.17 | 161.585 | 19B20100920SGR | 161.53 | 0.06 | 1 |
| 1922 | 7177358.371 | 489221.174 | 161.78 | 19B20100920SGR | 161.73 | 0.05 | 1 |
| 1923 | 7177352.848 | 489227.725 | 161.648 | 19B20100920SGR | 161.60 | 0.05 | 1 |
| 1924 | 7177456.609 | 488582.827 | 159.931 | 19B20100920SAR | 159.90 | 0.03 | 1 |
| 1925 | 7177462.378 | 488567.446 | 159.751 | 19B20100920SAR | 159.76 | -0.01 | 1 |
| 1926 | 7176608.603 | 490843.426 | 159.288 | 19B20100920SGR | 159.31 | -0.02 | 1 |
| 1927 | 7176599.936 | 490846.473 | 159.206 | 19B20100920SGR | 159.24 | -0.03 | 1 |

| CHECK POINTS | | | SURVEYED Elevation | | LiDAR Elevation | Deviation | Include? (yes = 1) |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | DESCRIPTOR | (Meters) | (Meters) | (no = 0) |
| 1928 | 7176591.048 | 490850.488 | 159.167 | 19B20100920SGR | 159.21 | -0.04 | 1 |
| 1929 | 7176583.035 | 490854.399 | 159.145 | 19B20100920SGR | 159.21 | -0.06 | 1 |
| 1930 | 7176587.163 | 490862.241 | 159.389 | 19B20100920SGR | 159.40 | -0.01 | 1 |
| 1931 | 7176595.683 | 490857.256 | 159.325 | 19B20100920SGR | 159.35 | -0.03 | 1 |
| 1932 | 7176604.011 | 490853.635 | 159.282 | 19B20100920SGR | 159.32 | -0.04 | 1 |
| 1933 | 7176613.153 | 490851.004 | 159.306 | 19B20100920SGR | 159.33 | -0.02 | 1 |
| 1934 | 7176622.119 | 490848.08 | 159.32 | 19B20100920SGR | 159.28 | 0.04 | 1 |
| 1935 | 7176630.517 | 490844.995 | 159.239 | 19B20100920SGR | 159.24 | 0.00 | 1 |
| 1936 | 7176625.844 | 490837.05 | 159.234 | 19B20100920SGR | 159.18 | 0.05 | 1 |
| 1937 | 7176617.135 | 490840.058 | 159.303 | 19B20100920SGR | 159.26 | 0.04 | 1 |
| 1938 | 7176609.064 | 490843.756 | 159.275 | 19B20100920SGR | 159.31 | -0.03 | 1 |
| 1939 | 7176149.058 | 490834.727 | 156.882 | 19B20100920SGR | 156.87 | 0.01 | 1 |
| 1940 | 7176140.628 | 490836.041 | 156.787 | 19B20100920SGR | 156.81 | -0.02 | 1 |
| 1941 | 7176133.748 | 490838.809 | 156.789 | 19B20100920SGR | 156.75 | 0.04 | 1 |
| 1942 | 7176137.39 | 490845.729 | 156.964 | 19B20100920SGR | 156.95 | 0.01 | 1 |
| 1943 | 7176146.096 | 490844.757 | 156.921 | 19B20100920SGR | 156.91 | 0.01 | 1 |
| 1944 | 7176153.645 | 490848.266 | 157.01 | 19B20100920SGR | 156.98 | 0.03 | 1 |
| 1945 | 7176140.923 | 490859.832 | 158.683 | 19B20100920SAR | 158.64 | 0.04 | 1 |
| 1946 | 7176126.314 | 490859.769 | 158.75 | 19B20100920SAR | 158.73 | 0.02 | 1 |
| 1947 | 7176107.558 | 490859.723 | 158.803 | 19B20100920SAR | 158.76 | 0.04 | 1 |
| 1948 | 7176089.026 | 490859.222 | 158.899 | 19B20100920SAR | 158.86 | 0.04 | 1 |
| 1950 | 7176072.195 | 490863.152 | 159.049 | 19B20100920SAR | 158.95 | 0.10 | 1 |
| 1951 | 7176087.874 | 490863.478 | 158.924 | 19B20100920SAR | 158.87 | 0.05 | 1 |
| 1952 | 7176104.295 | 490863.726 | 158.825 | 19B20100920SAR | 158.79 | 0.03 | 1 |
| 1953 | 7176122.666 | 490863.694 | 158.78 | 19B20100920SAR | 158.73 | 0.05 | 1 |
| 1954 | 7176141.619 | 490863.423 | 158.674 | 19B20100920SAR | 158.66 | 0.01 | 1 |
| 1955 | 7176352.963 | 491587.923 | 160.184 | 19B20100920SAR | 160.18 | 0.00 | 1 |
| 1956 | 7176360.105 | 491571.329 | 160.189 | 19B20100920SAR | 160.17 | 0.02 | 1 |
| 1957 | 7176368.036 | 491554.096 | 160.183 | 19B20100920SAR | 160.17 | 0.01 | 1 |
| 1958 | 7176375.163 | 491538.085 | 160.211 | 19B20100920SAR | 160.18 | 0.03 | 1 |
| 1959 | 7176344.924 | 491605.483 | 160.188 | 19B20100920SAR | 160.19 | 0.00 | 1 |
| 1960 | 7176337.187 | 491622.006 | 160.236 | 19B20100920SAR | 160.19 | 0.05 | 1 |
| 1961 | 7176878.715 | 490897.908 | 158.143 | 19B20100920SGR | 158.12 | 0.02 | 1 |
| 1962 | 7176875.146 | 490910.689 | 158.158 | 19B20100920SGR | 158.13 | 0.03 | 1 |
| 1963 | 7176871.289 | 490922.255 | 158.087 | 19B20100920SGR | 158.08 | 0.01 | 1 |
| 1964 | 7176883.441 | 490922.776 | 158.379 | 19B20100920SGR | 158.38 | 0.00 | 1 |
| 1965 | 7176886.71 | 490913.324 | 158.356 | 19B20100920SGR | 158.34 | 0.02 | 1 |
| 1966 | 7176895.469 | 490911.013 | 158.436 | 19B20100920SGR | 158.38 | 0.06 | 1 |
| 1967 | 7176908.04 | 490909.194 | 158.392 | 19B20100920SGR | 158.35 | 0.04 | 1 |
| 1968 | 7176908.911 | 490898.879 | 158.27 | 19B20100920SGR | 158.24 | 0.03 | 1 |
| 1969 | 7176896.607 | 490898.848 | 158.383 | 19B20100920SGR | 158.36 | 0.02 | 1 |
| 2000 | 7152157.299 | 501319.008 | 195.64 | 20B20100920SAC | 195.66 | -0.02 | 1 |
| 2001 | 7156350.571 | 499311.768 | 187.06 | 20B20100920SPR | 186.85 | 0.21 | 1 |
| 2002 | 7156338.696 | 499325.034 | 186.92 | 20B20100920SPR | 186.90 | 0.01 | 1 |
| 2003 | 7156331.205 | 499334.389 | 186.95 | 20B20100920SPR | 186.91 | 0.04 | 1 |
| 2004 | 7156325.351 | 499342.323 | 186.94 | 20B20100920SPR | 186.90 | 0.04 | 1 |
| 2005 | 7155932.634 | 500248.207 | 188.63 | 20B20100920SPR | 188.62 | 0.00 | 1 |
| 2006 | 7155923.611 | 500256.325 | 188.65 | 20B20100920SPR | 188.68 | -0.03 | 1 |
| 2007 | 7155914.847 | 500263.827 | 188.67 | 20B20100920SPR | 188.72 | -0.05 | 1 |
| 2008 | 7155260.62 | 500879.927 | 196.55 | 20B20100920SPR | 196.50 | 0.05 | 1 |
| 2009 | 7155249.554 | 500886.37 | 196.35 | 20B20100920SPR | 196.36 | -0.01 | 1 |
| 2010 | 7155239.317 | 500892.604 | 196.20 | 20B20100920SPR | 196.19 | 0.01 | 1 |
| 2014 | 7155052.05 | 501289.491 | 196.29 | 20B20100920SGR | 196.38 | -0.09 | 1 |

| CHECK POINTS | | | SURVEYED Elevation | | LiDAR Elevation | Deviation | Include? (yes = 1) |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | DESCRIPTOR | (Meters) | (Meters) | (no = 0) |
| 2015 | 7155051.936 | 501279.413 | 196.22 | 20B20100920SGR | 196.32 | -0.10 | 1 |
| 2016 | 7155051.761 | 501262.069 | 196.15 | 20B20100920SGR | 196.27 | -0.12 | 1 |
| 2017 | 7154907.073 | 500924.222 | 191.26 | 20B20100920SPR | 191.26 | 0.00 | 1 |
| 2018 | 7154904.609 | 500919.996 | 191.27 | 20B20100920SPR | 191.18 | 0.09 | 1 |
| 2019 | 7154885.618 | 500933.255 | 191.50 | 20B20100920SPR | 191.43 | 0.07 | 1 |
| 2020 | 7154869.086 | 500944.775 | 191.58 | 20B20100920SPR | 191.57 | 0.01 | 1 |
| 2021 | 7155465.465 | 500526.396 | 188.52 | 20B20100920SPR | 188.42 | 0.10 | 1 |
| 2022 | 7155451.684 | 500534.738 | 188.51 | 20B20100920SPR | 188.48 | 0.03 | 1 |
| 2023 | 7155438.509 | 500543.124 | 188.54 | 20B20100920SPR | 188.53 | 0.01 | 1 |
| 2024 | 7154466.758 | 501235.23 | 195.36 | 20B20100920CK_20A_5'o/s | 195.41 | -0.05 | 1 |
| 2025 | 7154469.354 | 501224.342 | 195.68 | 20B20100920SPR | 195.68 | 0.00 | 1 |
| 2026 | 7154454.408 | 501234.949 | 195.91 | 20B20100920SPR | 195.90 | 0.01 | 1 |
| 2027 | 7154437.599 | 501246.581 | 196.19 | 20B20100920SPR | 196.14 | 0.05 | 1 |
| 2028 | 7154652.949 | 504176.535 | 213.85 | 20B20100920SGR | 213.85 | 0.00 | 1 |
| 2029 | 7154652.47 | 504163.912 | 213.40 | 20B20100920SGR | 213.43 | -0.03 | 1 |
| 2030 | 7154652.38 | 504155.014 | 213.09 | 20B20100920SGR | 213.11 | -0.02 | 1 |
| 2037 | 7154241.242 | 501382.248 | 198.32 | 20B20100920SPR | 198.34 | -0.02 | 1 |
| 2038 | 7154247.965 | 501372.962 | 198.16 | 20B20100920SPR | 198.10 | 0.06 | 1 |
| 2039 | 7154232.223 | 501380.523 | 198.03 | 20B20100920SPR | 197.97 | 0.06 | 1 |
| 2040 | 7154214.114 | 501388.673 | 197.73 | 20B20100920SPR | 197.66 | 0.07 | 1 |
| 2041 | 7153073.968 | 501373.913 | 195.89 | 20B20100920SPR | 195.83 | 0.06 | 1 |
| 2042 | 7153053.283 | 501372.37 | 195.89 | 20B20100920SPR | 195.87 | 0.01 | 1 |
| 2043 | 7153029.448 | 501370.733 | 195.83 | 20B20100920SPR | 195.80 | 0.03 | 1 |
| 2044 | 7152155.803 | 501318.488 | 195.66 | 20B20100920CK_20B_5'o/s | 195.68 | -0.02 | 1 |
| 2045 | 7152168.271 | 501310.009 | 196.36 | 20B20100920SPR | 196.33 | 0.03 | 1 |
| 2046 | 7152150.326 | 501308.437 | 196.43 | 20B20100920SPR | 196.42 | 0.01 | 1 |
| 2047 | 7152133.566 | 501307.516 | 196.53 | 20B20100920SPR | 196.52 | 0.01 | 1 |
| 2048 | 7151239.898 | 501188.754 | 195.99 | 20B20100920SPR | 196.01 | -0.02 | 1 |
| 2049 | 7151220.323 | 501181.347 | 196.14 | 20B20100920SPR | 196.12 | 0.02 | 1 |
| 2050 | 7151207.802 | 501176.156 | 196.19 | 20B20100920SPR | 196.15 | 0.04 | 1 |
| 2051 | 7150459.412 | 500927.159 | 201.23 | 20B20100920SPR | 201.26 | -0.03 | 1 |
| 2052 | 7150441.1 | 500928.324 | 201.10 | 20B20100920SPR | 201.14 | -0.04 | 1 |
| 2053 | 7150425.219 | 500928.785 | 201.03 | 20B20100920SPR | 201.04 | -0.01 | 1 |
| 2054 | 7146552.137 | 504431.859 | 215.38 | 20B20100920SPR | 215.32 | 0.06 | 1 |
| 2055 | 7146565.077 | 504428.309 | 215.28 | 20B20100920SPR | 215.22 | 0.06 | 1 |
| 2056 | 7146578.48 | 504424.29 | 215.20 | 20B20100920SPR | 215.16 | 0.04 | 1 |
| 2057 | 7145986.334 | 504596.455 | 217.16 | 20B20100920SPR | 217.13 | 0.03 | 1 |
| 2100 | 7131642.211 | 522896.142 | 341.64 | 21B20100920SAC | 341.69 | -0.05 | 1 |
| 2101 | 7131640.872 | 522896.784 | 341.61 | 21B20100920CK_21B_5'o/s | 341.70 | -0.09 | 1 |
| 2102 | 7131641.934 | 522869.063 | 342.00 | 21B20100920SPR | 342.01 | -0.01 | 1 |
| 2103 | 7131636.141 | 522883.22 | 341.74 | 21B20100920SPR | 341.76 | -0.02 | 1 |
| 2104 | 7131627.946 | 522901.772 | 341.40 | 21B20100920SPR | 341.44 | -0.04 | 1 |
| 2105 | 7130165.127 | 524747.295 | 286.09 | 21B20100920SPR | 286.11 | -0.02 | 1 |
| 2106 | 7130175.57 | 524742.054 | 286.35 | 21B20100920SPR | 286.35 | 0.00 | 1 |
| 2107 | 7130192.844 | 524734.018 | 286.75 | 21B20100920SPR | 286.75 | 0.00 | 1 |
| 2108 | 7130456.116 | 524494.693 | 294.47 | 21B20100920SPR | 294.51 | -0.04 | 1 |
| 2109 | 7130467.678 | 524483.455 | 295.08 | 21B20100920SPR | 295.09 | -0.01 | 1 |
| 2110 | 7130482.1 | 524468.937 | 296.14 | 21B20100920SPR | 296.20 | -0.06 | 1 |
| 2111 | 7130978.218 | 523954.322 | 325.92 | 21B20100920SPR | 325.95 | -0.03 | 1 |
| 2112 | 7130987.515 | 523943.358 | 326.11 | 21B20100920SPR | 326.17 | -0.06 | 1 |
| 2113 | 7131002.288 | 523925.212 | 326.42 | 21B20100920SPR | 326.44 | -0.02 | 1 |
| 2114 | 7131394.115 | 523310.408 | 336.89 | 21B20100920SPR | 336.92 | -0.03 | 1 |
| 2115 | 7131406.407 | 523289.971 | 337.13 | 21B20100920SPR | 337.17 | -0.04 | 1 |

| CHECK POINTS | | | SURVEYED Elevation | | LiDAR Elevation | Deviation | Include? (yes = 1) |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | DESCRIPTOR | (Meters) | (Meters) | (no = 0) |
| 2116 | 7131419.303 | 523268.784 | 337.39 | 21B20100920SPR | 337.42 | -0.03 | 1 |
| 2117 | 7131822.952 | 522245.861 | 356.18 | 21B20100920SPR | 356.22 | -0.04 | 1 |
| 2118 | 7131819.944 | 522257.175 | 356.01 | 21B20100920SPR | 356.02 | -0.01 | 1 |
| 2119 | 7131816.604 | 522268.619 | 355.77 | 21B20100920SPR | 355.79 | -0.02 | 1 |
| 2130 | 7131994.655 | 521631.761 | 355.90 | 21B20100920SPR | 355.91 | -0.01 | 1 |
| 2131 | 7132001.388 | 521606.628 | 355.08 | 21B20100920SPR | 355.09 | -0.01 | 1 |
| 2132 | 7132007.881 | 521583.988 | 354.34 | 21B20100920SPR | 354.34 | 0.00 | 1 |
| 2133 | 7132107.976 | 521152.647 | 331.06 | 21B20100920SPR | 331.06 | 0.00 | 1 |
| 2134 | 7132108.476 | 521135.698 | 330.12 | 21B20100920SPR | 330.12 | 0.00 | 1 |
| 2135 | 7132108.469 | 521116.604 | 329.06 | 21B20100920SPR | 329.09 | -0.03 | 1 |
| 2136 | 7131985.529 | 520337.562 | 300.44 | 21B20100920SPR | 300.47 | -0.03 | 1 |
| 2137 | 7131982.197 | 520317.301 | 299.77 | 21B20100920SPR | 299.81 | -0.04 | 1 |
| 2138 | 7131978.81 | 520297.36 | 299.12 | 21B20100920SPR | 299.16 | -0.04 | 1 |
| 2139 | 7131852.017 | 519573.337 | 288.65 | 21B20100920SPR | 288.68 | -0.03 | 1 |
| 2140 | 7131848.533 | 519548.591 | 288.29 | 21B20100920SPR | 288.31 | -0.02 | 1 |
| 2141 | 7131844.695 | 519525.245 | 287.99 | 21B20100920SPR | 288.03 | -0.04 | 1 |
| 2142 | 7131759.837 | 518754.503 | 284.18 | 21B20100920SPR | 284.20 | -0.02 | 1 |
| 2143 | 7131752.001 | 518755.507 | 284.39 | 21B20100920SPR | 284.41 | -0.02 | 1 |
| 2144 | 7131750.335 | 518740.059 | 284.10 | 21B20100920SPR | 284.14 | -0.04 | 1 |
| 2145 | 7131756.887 | 518733.961 | 283.83 | 21B20100920SPR | 283.86 | -0.04 | 1 |
| 2146 | 7131747.303 | 518715.868 | 283.73 | 21B20100920SPR | 283.76 | -0.03 | 1 |
| 2147 | 7131632.977 | 517728.459 | 257.46 | 21B20100920SPR | 257.52 | -0.06 | 1 |
| 2148 | 7131631.428 | 517704.176 | 257.44 | 21B20100920SPR | 257.48 | -0.04 | 1 |
| 2149 | 7131624.939 | 517683.223 | 257.36 | 21B20100920SPR | 257.39 | -0.03 | 1 |
| 2150 | 7131576.824 | 517163.896 | 253.63 | 21B20100920SPR | 253.66 | -0.03 | 1 |
| 2151 | 7131580.813 | 517149.811 | 253.76 | 21B20100920SPR | 253.77 | -0.01 | 1 |
| 2152 | 7131571.697 | 517149.538 | 253.39 | 21B20100920SPR | 253.45 | -0.06 | 1 |
| 2153 | 7131566.002 | 517133.925 | 253.17 | 21B20100920SPR | 253.24 | -0.07 | 1 |
| 2163 | 7131172.369 | 516721.768 | 254.69 | 21B20100920SPR | 254.70 | -0.01 | 1 |
| 2164 | 7131163.51 | 516703.193 | 254.62 | 21B20100920SPR | 254.66 | -0.04 | 1 |
| 2165 | 7131155.74 | 516685.301 | 254.41 | 21B20100920SPR | 254.45 | -0.04 | 1 |
| 2166 | 7130996.182 | 516171.703 | 247.64 | 21B20100920SPR | 247.63 | 0.01 | 1 |
| 2167 | 7130995.826 | 516148.591 | 247.58 | 21B20100920SPR | 247.64 | -0.06 | 1 |
| 2168 | 7130993.693 | 516123.594 | 247.47 | 21B20100920SPR | 247.51 | -0.04 | 1 |
| 2169 | 7130995.084 | 516100.264 | 247.79 | 21B20100920SPR | 247.83 | -0.04 | 1 |
| 2170 | 7131001.548 | 516073.012 | 247.95 | 21B20100920CK_21A_5'o/s | 248.06 | -0.11 | 1 |
| 2171 | 7131443.358 | 515424.816 | 258.72 | 21B20100920SPR | 258.72 | 0.00 | 1 |
| 2172 | 7131457.484 | 515410.153 | 258.60 | 21B20100920SPR | 258.66 | -0.06 | 1 |
| 2173 | 7131472.422 | 515394.853 | 258.34 | 21B20100920SPR | 258.38 | -0.04 | 1 |
| 2174 | 7132230.323 | 514948.532 | 251.73 | 21B20100920SGR | 251.79 | -0.06 | 1 |
| 2175 | 7132238.142 | 514943.107 | 251.47 | 21B20100920SGR | 251.55 | -0.08 | 1 |
| 2176 | 7132243.15 | 514933.261 | 251.04 | 21B20100920SGR | 251.11 | -0.07 | 1 |
| 2177 | 7132238.936 | 514898.119 | 250.77 | 21B20100920SPR | 250.83 | -0.06 | 1 |
| 2178 | 7132217.406 | 514920.298 | 251.61 | 21B20100920SPR | 251.68 | -0.07 | 1 |
| 2179 | 7132205.391 | 514931.82 | 252.05 | 21B20100920SPR | 252.11 | -0.06 | 1 |
| 2180 | 7132468.168 | 514339.976 | 241.91 | 21B20100920SPR | 241.98 | -0.07 | 1 |
| 2181 | 7132472.105 | 514318.128 | 241.85 | 21B20100920SPR | 241.92 | -0.07 | 1 |
| 2182 | 7132475.19 | 514296.803 | 241.75 | 21B20100920SPR | 241.84 | -0.09 | 1 |
| 2183 | 7132461.4 | 513699.539 | 243.61 | 21B20100920SPR | 243.65 | -0.04 | 1 |
| 2184 | 7132469.259 | 513682.099 | 243.56 | 21B20100920SPR | 243.59 | -0.03 | 1 |
| 2185 | 7132467.702 | 513669.694 | 243.82 | 21B20100920SPR | 243.88 | -0.06 | 1 |
| 2186 | 7132987.46 | 513005.442 | 257.89 | 21B20100920SPR | 257.82 | 0.07 | 1 |
| 2187 | 7133000.303 | 512992.417 | 258.45 | 21B20100920SPR | 258.50 | -0.05 | 1 |

| CHECK POINTS | | | SURVEYED Elevation | | LiDAR Elevation | Deviation | Include? (yes = 1) |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | DESCRIPTOR | (Meters) | (Meters) | (no = 0) |
| 2188 | 7133013.405 | 512979.148 | 259.13 | 21B20100920SPR | 259.25 | -0.12 | 1 |
| 2189 | 7133482.265 | 512460.932 | 267.19 | 21B20100920SPR | 267.28 | -0.09 | 1 |
| 2190 | 7133496.343 | 512439.375 | 267.88 | 21B20100920SPR | 268.07 | -0.19 | 1 |
| 2191 | 7133508.125 | 512419.936 | 268.59 | 21B20100920SPR | 268.70 | -0.11 | 1 |
| 2192 | 7133744.705 | 511877.712 | 285.15 | 21B20100920SPR | 285.24 | -0.09 | 1 |
| 2193 | 7133749.028 | 511865.458 | 285.42 | 21B20100920SPR | 285.47 | -0.06 | 1 |
| 2194 | 7133753.055 | 511853.413 | 285.60 | 21B20100920SPR | 285.67 | -0.07 | 1 |
| 2195 | 7133954.002 | 511126.482 | 302.01 | 21B20100920SPR | 302.08 | -0.07 | 1 |
| 2196 | 7133956.407 | 511113.842 | 302.29 | 21B20100920SPR | 302.34 | -0.05 | 1 |
| 2197 | 7133958.955 | 511101.813 | 302.54 | 21B20100920SPR | 302.55 | -0.01 | 1 |
| 2198 | 7133939.766 | 511095.332 | 303.22 | 21B20100920SPR | 303.24 | -0.02 | 1 |
| 2199 | 7133945.324 | 511070.321 | 303.61 | 21B20100920SPR | 303.65 | -0.04 | 1 |
| 2200 | 7133950.753 | 511045.231 | 303.93 | 21B20100920SPR | 304.01 | -0.08 | 1 |
| 3700 | 7131002.247 | 516074.358 | 248.00 | 21A20110517SAC21A | 247.99 | 0.01 | 1 |
| 3701 | 7130995.65 | 516084.512 | 248.01 | 21A20110517SPR | 247.99 | 0.02 | 1 |
| 3702 | 7130989.597 | 516115.402 | 247.59 | 21A20110517SPR | 247.57 | 0.02 | 1 |
| 3703 | 7130987.1 | 516149.546 | 247.42 | 21A20110517SPR | 247.40 | 0.02 | 1 |
| 3704 | 7130998.198 | 516186.762 | 247.79 | 21A20110517SPR | 247.77 | 0.02 | 1 |
| 3705 | 7130999.211 | 516220.976 | 248.36 | 21A20110517SPR | 248.36 | 0.00 | 1 |
| 3706 | 7130977.231 | 516231.141 | 249.07 | 21A20110517SPR | 249.07 | 0.00 | 1 |
| 3707 | 7130969.294 | 516231.57 | 249.54 | 21A20110517SPR | 249.56 | -0.02 | 1 |
| 3708 | 7130961.25 | 516179.724 | 249.13 | 21A20110517SPR | 249.13 | 0.00 | 1 |
| 3709 | 7130959.234 | 516130.418 | 249.27 | 21A20110517SPR | 249.28 | -0.01 | 1 |
| 3710 | 7130962.087 | 516094.678 | 249.30 | 21A20110517SPR | 249.31 | -0.01 | 1 |
| 3711 | 7130972.89 | 516046.697 | 249.10 | 21A20110517SPR | 249.08 | 0.02 | 1 |
| 3712 | 7133958.074 | 511017.48 | 304.10 | 21A20110517SPR | 304.10 | 0.00 | 1 |
| 3713 | 7133944.157 | 511053.719 | 303.93 | 21A20110517SPR | 303.94 | -0.01 | 1 |
| 3714 | 7133720.268 | 511904.877 | 284.38 | 21A20110517SPR | 284.41 | -0.03 | 1 |
| 3715 | 7133754.444 | 511856.429 | 285.56 | 21A20110517SPR | 285.61 | -0.05 | 1 |
| 3716 | 7133736.785 | 511914.923 | 284.36 | 21A20110517SPR | 284.37 | -0.01 | 1 |
| 3717 | 7133734.124 | 511914.36 | 284.40 | 21A20110517SPR | 284.42 | -0.02 | 1 |
| 3718 | 7133714.209 | 511947.035 | 283.58 | 21A20110517SPR | 283.61 | -0.03 | 1 |
| 3719 | 7133703.457 | 511981.14 | 282.69 | 21A20110517SPR | 282.72 | -0.03 | 1 |
| 3720 | 7133695.498 | 511996.804 | 282.19 | 21A20110517SPR | 282.23 | -0.04 | 1 |
| 3721 | 7133692.011 | 512031.189 | 281.24 | 21A20110517SPR | 281.26 | -0.02 | 1 |
| 3722 | 7133704.296 | 511997.709 | 282.23 | 21A20110517SPR | 282.26 | -0.03 | 1 |
| 3723 | 7133716.244 | 511964.185 | 283.13 | 21A20110517SPR | 283.18 | -0.05 | 1 |
| 3724 | 7133730.314 | 511933.328 | 283.92 | 21A20110517SPR | 283.94 | -0.02 | 1 |
| 3725 | 7133185.341 | 512800.444 | 264.50 | 21A20110517SPR | 264.50 | 0.00 | 1 |
| 3726 | 7133202.899 | 512782.562 | 264.74 | 21A20110517SPR | 264.75 | -0.01 | 1 |
| 3727 | 7133226.023 | 512759.352 | 265.03 | 21A20110517SPR | 265.03 | 0.00 | 1 |
| 3728 | 7133231.36 | 512765.592 | 265.04 | 21A20110517SPR | 265.07 | -0.03 | 1 |
| 3729 | 7133213.003 | 512786.826 | 264.78 | 21A20110517SPR | 264.79 | -0.01 | 1 |
| 3730 | 7133191.471 | 512805.785 | 264.53 | 21A20110517SPR | 264.54 | -0.01 | 1 |
| 3731 | 7133167.612 | 512829.609 | 264.18 | 21A20110517SPR | 264.20 | -0.02 | 1 |
| 3732 | 7133137.594 | 512860.059 | 263.61 | 21A20110517SPR | 263.63 | -0.02 | 1 |
| 3733 | 7133108.7 | 512889.083 | 262.88 | 21A20110517SPR | 262.90 | -0.02 | 1 |
| 3734 | 7133097.334 | 512892.559 | 262.66 | 21A20110517SPR | 262.65 | 0.00 | 1 |
| 3735 | 7133121.454 | 512868.654 | 263.34 | 21A20110517SPR | 263.34 | 0.00 | 1 |
| 3736 | 7133147.541 | 512842.278 | 263.91 | 21A20110517SPR | 263.93 | -0.02 | 1 |
| 3737 | 7133171.879 | 512817.712 | 264.35 | 21A20110517SPR | 264.35 | 0.00 | 1 |
| 3738 | 7132461.716 | 513693.33 | 243.73 | 21A20110517SPR | 243.74 | -0.01 | 1 |
| 3739 | 7132467.242 | 513659.088 | 244.06 | 21A20110517SPR | 244.08 | -0.02 | 1 |

| CHECK POINTS | | | SURVEYED Elevation | | LiDAR Elevation | Deviation | Include? (yes = 1) |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | DESCRIPTOR | (Meters) | (Meters) | (no = 0) |
| 3740 | 7132476.689 | 513654.982 | 243.73 | 21A20110517SPR | 243.74 | -0.01 | 1 |
| 3741 | 7132525.11 | 513699.484 | 241.81 | 21A20110517SGR | 241.82 | -0.01 | 1 |
| 3742 | 7132429.937 | 513707.395 | 240.91 | 21A20110517SGR | 240.92 | -0.01 | 1 |
| 3743 | 7132355.133 | 513822.112 | 239.06 | 21A20110517SGR | 239.07 | -0.01 | 1 |
| 3744 | 7132308.525 | 514045.594 | 236.20 | 21A20110517SGR | 236.23 | -0.03 | 1 |
| 3745 | 7132297.76 | 514035.269 | 236.25 | 21A20110517SGR | 236.25 | 0.00 | 1 |
| 3746 | 7132286.405 | 514049.392 | 236.26 | 21A20110517SGR | 236.26 | 0.00 | 1 |
| 3747 | 7132228.68 | 514962.002 | 251.95 | 21A20110517SGR | 251.95 | 0.00 | 1 |
| 3748 | 7132231.025 | 514983.715 | 252.29 | 21A20110517SGR | 252.27 | 0.02 | 1 |
| 3749 | 7132245.778 | 515084.749 | 252.48 | 21A20110517SGR | 252.53 | -0.05 | 1 |
| 3750 | 7132265.926 | 515041.086 | 252.15 | 21A20110517SGR | 252.19 | -0.04 | 1 |
| 3751 | 7132257.03 | 515000.535 | 251.88 | 21A20110517SGR | 251.86 | 0.01 | 1 |
| 3752 | 7132210.391 | 514938.75 | 252.37 | 21A20110517SPR | 252.40 | -0.03 | 1 |
| 3753 | 7132178 | 514957.057 | 253.14 | 21A20110517SPR | 253.14 | 0.00 | 1 |
| 3754 | 7132173.688 | 514953.881 | 252.87 | 21A20110517SPR | 252.88 | -0.01 | 1 |
| 3755 | 7132199.629 | 514931.234 | 251.95 | 21A20110517SPR | 251.98 | -0.03 | 1 |
| 3756 | 7132223 | 514907.92 | 251.06 | 21A20110517SPR | 251.07 | -0.01 | 1 |
| 3757 | 7132231.41 | 514910.528 | 251.34 | 21A20110517SPR | 251.36 | -0.02 | 1 |
| 3758 | 7131573.414 | 515285.996 | 256.61 | 21A20110517SPR | 256.62 | -0.01 | 1 |
| 3759 | 7131597.082 | 515265.171 | 256.14 | 21A20110517SPR | 256.14 | 0.00 | 1 |
| 3760 | 7131600.689 | 515269.686 | 255.85 | 21A20110517SPR | 255.84 | 0.01 | 1 |
| 3761 | 7131573.093 | 515294.133 | 256.38 | 21A20110517SPR | 256.39 | -0.01 | 1 |
| 3762 | 7131548.318 | 515317.918 | 256.84 | 21A20110517SPR | 256.86 | -0.02 | 1 |
| 3763 | 7131546.016 | 515312.65 | 257.01 | 21A20110517SPR | 257.00 | 0.00 | 1 |
| 3764 | 7130693.935 | 515960.172 | 263.15 | 21A20110517SPR | 263.10 | 0.04 | 1 |
| 3765 | 7130686.463 | 515959.621 | 263.47 | 21A20110517SPR | 263.41 | 0.06 | 1 |
| 3766 | 7132102.835 | 521018.859 | 323.61 | 21A20110517SPR | 323.60 | 0.01 | 1 |
| 3767 | 7132097.028 | 521018.651 | 323.25 | 21A20110517SPR | 323.25 | 0.00 | 1 |
| 3768 | 7132095.669 | 520975.498 | 321.01 | 21A20110517SPR | 321.00 | 0.01 | 1 |
| 3769 | 7132090.753 | 520975.331 | 320.76 | 21A20110517SPR | 320.73 | 0.02 | 1 |
| 3770 | 7131929.328 | 520039.505 | 297.09 | 21A20110517SPR | 297.05 | 0.04 | 1 |
| 3771 | 7131934.45 | 520035.236 | 297.03 | 21A20110517SPR | 297.04 | -0.01 | 1 |
| 3772 | 7131760.541 | 518757.75 | 284.26 | 21A20110517SPR | 284.26 | 0.00 | 1 |
| 3773 | 7131757.672 | 518724.41 | 283.69 | 21A20110517SPR | 283.68 | 0.01 | 1 |
| 3774 | 7131741.231 | 518723.925 | 283.79 | 21A20110517SPR | 283.80 | -0.01 | 1 |
| 3775 | 7131747.816 | 518759.406 | 284.44 | 21A20110517SPR | 284.45 | -0.01 | 1 |
| 3776 | 7131752.571 | 518795.403 | 284.93 | 21A20110517SPR | 284.91 | 0.02 | 1 |
| 3777 | 7131758.805 | 518805.09 | 285.02 | 21A20110517SPR | 285.01 | 0.01 | 1 |
| 3778 | 7131659.645 | 517951.99 | 261.49 | 21A20110517SPR | 261.49 | 0.00 | 1 |
| 3779 | 7131651.739 | 517952.422 | 261.53 | 21A20110517SPR | 261.52 | 0.01 | 1 |
| 3780 | 7131646.783 | 517911.61 | 260.04 | 21A20110517SPR | 260.05 | -0.01 | 1 |
| 3781 | 7131654.304 | 517910.61 | 260.05 | 21A20110517SPR | 260.06 | -0.01 | 1 |
| 3782 | 7132045.637 | 517172.379 | 246.27 | 21A20110517SGR | 246.31 | -0.04 | 1 |
| 3783 | 7132044.036 | 517202.685 | 246.91 | 21A20110517SGR | 246.92 | -0.01 | 1 |
| 3784 | 7132028.754 | 517202.686 | 246.91 | 21A20110517SGR | 246.94 | -0.03 | 1 |
| 3785 | 7131919.146 | 517178.064 | 247.28 | 21A20110517SGR | 247.28 | 0.00 | 1 |
| 3786 | 7131899.14 | 517174.409 | 247.30 | 21A20110517SGR | 247.29 | 0.01 | 1 |
| 3787 | 7131572.051 | 517140.146 | 253.53 | 21A20110517SPR | 253.52 | 0.00 | 1 |
| 3788 | 7131577.871 | 517168.848 | 253.72 | 21A20110517SPR | 253.72 | 0.00 | 1 |
| 3789 | 7131576.489 | 517180.318 | 253.63 | 21A20110517SPR | 253.60 | 0.03 | 1 |
| 3790 | 7131565.635 | 517145.786 | 253.14 | 21A20110517SPR | 253.10 | 0.03 | 1 |
| 3791 | 7131552.862 | 517114.773 | 252.64 | 21A20110517SPR | 252.65 | -0.01 | 1 |
| 3792 | 7131551.094 | 517101.696 | 252.73 | 21A20110517SPR | 252.70 | 0.03 | 1 |

| CHECK POINTS | | | SURVEYED Elevation | | LiDAR Elevation | Deviation | Include? (yes = 1) |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | DESCRIPTOR | (Meters) | (Meters) | (no = 0) |
| 3793 | 7131144.517 | 516646.2 | 253.84 | 21A20110517SPR | 253.84 | 0.00 | 1 |
| 3794 | 7131139.857 | 516648.477 | 253.85 | 21A20110517SPR | 253.83 | 0.02 | 1 |
| 3795 | 7131122.382 | 516607.244 | 253.27 | 21A20110517SPR | 253.27 | 0.00 | 1 |
| 3796 | 7131127.346 | 516604.752 | 253.26 | 21A20110517SPR | 253.25 | 0.01 | 1 |
| 3797 | 7130999.686 | 516075.897 | 248.16 | 21A20110517CHECK | 248.15 | 0.00 | 1 |
| 3798 | 7130999.692 | 516075.903 | 248.15 | 21A20110517CHECK | 248.15 | 0.00 | 1 |
| 3800 | 7119657.498 | 552295.057 | 297.82 | 22B2011051722BSAC | 297.92 | -0.10 | 1 |
| 3801 | 7119678.379 | 552281.698 | 298.58 | 22B20110517SPR | 298.57 | 0.01 | 1 |
| 3802 | 7119695.747 | 552260.326 | 298.43 | 22B20110517SPR | 298.45 | -0.02 | 1 |
| 3803 | 7119713.249 | 552241.175 | 298.25 | 22B20110517SPR | 298.26 | -0.01 | 1 |
| 3804 | 7119724.734 | 552227.585 | 298.13 | 22B20110517SPR | 298.13 | 0.00 | 1 |
| 3805 | 7119725.649 | 552234.531 | 298.08 | 22B20110517SPR | 298.11 | -0.03 | 1 |
| 3806 | 7119704.732 | 552257.976 | 298.23 | 22B20110517SPR | 298.25 | -0.02 | 1 |
| 3807 | 7119678.176 | 552288.79 | 298.40 | 22B20110517SPR | 298.39 | 0.01 | 1 |
| 3808 | 7119659.267 | 552311.39 | 298.59 | 22B20110517SPR | 298.62 | -0.03 | 1 |
| 3809 | 7119640.979 | 552335.612 | 298.79 | 22B20110517SPR | 298.81 | -0.02 | 1 |
| 3810 | 7119619.592 | 552366.412 | 298.99 | 22B20110517SPR | 298.99 | 0.00 | 1 |
| 3811 | 7119604.143 | 552391.5 | 299.11 | 22B20110517SPR | 299.13 | -0.02 | 1 |
| 3812 | 7119599.873 | 552388.068 | 299.31 | 22B20110517SPR | 299.35 | -0.04 | 1 |
| 3813 | 7119617.381 | 552359.947 | 299.20 | 22B20110517SPR | 299.23 | -0.03 | 1 |
| 3814 | 7119641.119 | 552325.799 | 298.98 | 22B20110517SPR | 299.00 | -0.02 | 1 |
| 3815 | 7120091.208 | 551501.705 | 300.23 | 22B20110517SPR | 300.24 | -0.01 | 1 |
| 3816 | 7120076.284 | 551519.946 | 300.26 | 22B20110517SPR | 300.27 | -0.01 | 1 |
| 3817 | 7120067.089 | 551523.541 | 300.56 | 22B20110517SPR | 300.59 | -0.03 | 1 |
| 3818 | 7120086.132 | 551499.232 | 300.58 | 22B20110517SPR | 300.60 | -0.02 | 1 |
| 3819 | 7120107.992 | 551475.094 | 300.53 | 22B20110517SPR | 300.54 | -0.01 | 1 |
| 3820 | 7120112.462 | 551477.971 | 300.24 | 22B20110517SPR | 300.25 | -0.01 | 1 |
| 3821 | 7120627.332 | 551106.049 | 298.58 | 22B20110517CHECK | 298.60 | -0.02 | 1 |
| 3822 | 7120632.594 | 551103.317 | 298.57 | 22B20110517SPR | 298.61 | -0.04 | 1 |
| 3823 | 7120652.766 | 551080.168 | 298.46 | 22B20110517SPR | 298.50 | -0.04 | 1 |
| 3824 | 7120654.997 | 551085.961 | 298.46 | 22B20110517SPR | 298.50 | -0.04 | 1 |
| 3825 | 7120629.775 | 551115.07 | 298.69 | 22B20110517SPR | 298.70 | -0.01 | 1 |
| 3826 | 7120609.297 | 551137.768 | 298.74 | 22B20110517SPR | 298.78 | -0.04 | 1 |
| 3827 | 7120609.08 | 551129.901 | 298.67 | 22B20110517SPR | 298.69 | -0.02 | 1 |
| 3828 | 7121281.513 | 550325.332 | 293.89 | 22B20110517SPR | 293.95 | -0.06 | 1 |
| 3829 | 7121295.034 | 550301.666 | 293.66 | 22B20110517SPR | 293.69 | -0.03 | 1 |
| 3830 | 7119288.238 | 552952.071 | 300.57 | 22B20110517SPR | 300.63 | -0.06 | 1 |
| 3831 | 7119266.777 | 552984.451 | 300.67 | 22B20110517SPR | 300.72 | -0.05 | 1 |
| 3832 | 7119251.118 | 553004.262 | 300.72 | 22B20110517SPR | 300.78 | -0.06 | 1 |
| 3833 | 7119250.591 | 553017.06 | 300.86 | 22B20110517SPR | 300.93 | -0.07 | 1 |
| 3834 | 7119269.162 | 552990.162 | 300.75 | 22B20110517SPR | 300.80 | -0.05 | 1 |
| 3835 | 7119295.184 | 552949.503 | 300.57 | 22B20110517SPR | 300.62 | -0.05 | 1 |
| 3836 | 7118411.923 | 553831.347 | 303.64 | 22B20110517SPR | 303.67 | -0.03 | 1 |
| 3837 | 7118426.293 | 553818.771 | 303.51 | 22B20110517SPR | 303.55 | -0.04 | 1 |
| 3838 | 7118472.482 | 553786.57 | 303.24 | 22B20110517SPR | 303.31 | -0.07 | 1 |
| 3839 | 7118478.684 | 553775.585 | 303.20 | 22B20110517SPR | 303.24 | -0.04 | 1 |
| 3840 | 7118444.307 | 554245.447 | 302.99 | 22B20110517SPR | 303.01 | -0.02 | 1 |
| 3841 | 7119660.551 | 552297.347 | 298.83 | 22B20110517CHECK | 298.87 | -0.04 | 1 |
| 3842 | 7119660.548 | 552297.347 | 298.83 | 22B20110517CHECK | 298.87 | -0.04 | 1 |
| 3843 | 7119660.555 | 552297.356 | 298.85 | 22B20110517CHECK | 298.87 | -0.02 | 1 |
| 4100 | 7154468.17 | 501234.516 | 195.27 | 20A2011051820ASAC | 195.37 | -0.10 | 1 |
| 4101 | 7154683.167 | 501078.693 | 192.75 | 20A20110518SPR | 192.76 | -0.01 | 1 |
| 4102 | 7154658.273 | 501093.216 | 192.88 | 20A20110518SPR | 192.84 | 0.03 | 1 |

| CHECK POINTS | | | SURVEYED Elevation | | LiDAR Elevation | Deviation | Include? (yes = 1) |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | DESCRIPTOR | (Meters) | (Meters) | (no = 0) |
| 4103 | 7154616.165 | 501125.696 | 193.15 | 20A20110518SPR | 193.14 | 0.01 | 1 |
| 4104 | 7154591.235 | 501142.907 | 193.30 | 20A20110518SPR | 193.32 | -0.02 | 1 |
| 4105 | 7154563.438 | 501159.629 | 193.68 | 20A20110518SPR | 193.66 | 0.02 | 1 |
| 4106 | 7154536.01 | 501178.985 | 194.22 | 20A20110518SPR | 194.17 | 0.05 | 1 |
| 4108 | 7154473.664 | 501225.314 | 195.59 | 20A20110518SPR | 195.62 | -0.03 | 1 |
| 4109 | 7154465.949 | 501231.595 | 195.71 | 20A20110518CHECK | 195.72 | -0.01 | 1 |
| 4110 | 7154459.574 | 501225.655 | 195.76 | 20A20110518SPR | 195.77 | -0.01 | 1 |
| 4112 | 7154525.014 | 501179.847 | 194.40 | 20A20110518SPR | 194.32 | 0.08 | 1 |
| 4113 | 7154555.143 | 501158.599 | 193.79 | 20A20110518SPR | 193.75 | 0.04 | 1 |
| 4114 | 7154581.357 | 501140.209 | 193.41 | 20A20110518SPR | 193.35 | 0.06 | 1 |
| 4115 | 7154609.718 | 501120.262 | 193.21 | 20A20110518SPR | 193.19 | 0.02 | 1 |
| 4116 | 7154646.316 | 501094.833 | 192.88 | 20A20110518SPR | 192.88 | 0.00 | 1 |
| 4117 | 7154679.369 | 501071.457 | 192.75 | 20A20110518SPR | 192.69 | 0.06 | 1 |
| 4118 | 7154661.408 | 501024.924 | 191.65 | 20A20110518SGR | 191.70 | -0.05 | 1 |
| 4119 | 7154698.279 | 501058.318 | 192.61 | 20A20110518SPR | 192.56 | 0.05 | 1 |
| 4120 | 7154700.689 | 501062.488 | 192.64 | 20A20110518SPR | 192.63 | 0.01 | 1 |
| 4121 | 7154910.594 | 500916.563 | 191.13 | 20A20110518SPR | 191.07 | 0.06 | 1 |
| 4122 | 7154894.391 | 500930.749 | 191.33 | 20A20110518SPR | 191.33 | 0.00 | 1 |
| 4123 | 7154891.887 | 500923.314 | 191.27 | 20A20110518SPR | 191.26 | 0.01 | 1 |
| 4124 | 7154912.131 | 500908.819 | 191.01 | 20A20110518SPR | 190.97 | 0.04 | 1 |
| 4125 | 7154927.272 | 500952.598 | 193.44 | 20A20110518SGR | 193.49 | -0.05 | 1 |
| 4126 | 7154998.981 | 500961.216 | 194.92 | 20A20110518SGR | 194.97 | -0.05 | 1 |
| 4127 | 7155032.301 | 500960.881 | 195.13 | 20A20110518SGR | 195.17 | -0.04 | 1 |
| 4128 | 7155051.76 | 500961.36 | 195.23 | 20A20110518SGR | 195.26 | -0.03 | 1 |
| 4129 | 7155052.34 | 501132.769 | 195.70 | 20A20110518SGR | 195.72 | -0.02 | 1 |
| 4130 | 7155051.55 | 501148.056 | 195.56 | 20A20110518SGR | 195.56 | 0.00 | 1 |
| 4131 | 7155449.329 | 500541.831 | 188.38 | 20A20110518SPR | 188.36 | 0.01 | 1 |
| 4132 | 7155422.834 | 500558.948 | 188.41 | 20A20110518SPR | 188.38 | 0.03 | 1 |
| 4133 | 7155420.494 | 500554.178 | 188.51 | 20A20110518SPR | 188.44 | 0.07 | 1 |
| 4134 | 7155473.423 | 500520.645 | 188.55 | 20A20110518SPR | 188.48 | 0.07 | 1 |
| 4135 | 7155525.522 | 500490.052 | 188.79 | 20A20110518SPR | 188.75 | 0.04 | 1 |
| 4136 | 7155575.432 | 500462.89 | 188.96 | 20A20110518SPR | 188.93 | 0.03 | 1 |
| 4137 | 7155627.259 | 500435.296 | 188.93 | 20A20110518SPR | 188.97 | -0.04 | 1 |
| 4138 | 7155674.084 | 500410.797 | 188.92 | 20A20110518SPR | 188.93 | -0.01 | 1 |
| 4139 | 7155667.725 | 500420.493 | 188.97 | 20A20110518SPR | 188.95 | 0.02 | 1 |
| 4140 | 7155622.316 | 500444.042 | 188.95 | 20A20110518SPR | 188.96 | -0.02 | 1 |
| 4141 | 7155592.242 | 500459.932 | 188.89 | 20A20110518SPR | 188.86 | 0.02 | 1 |
| 4142 | 7155557.116 | 500478.63 | 188.78 | 20A20110518SPR | 188.78 | 0.00 | 1 |
| 4143 | 7155524.16 | 500496.759 | 188.64 | 20A20110518SPR | 188.61 | 0.03 | 1 |
| 4144 | 7155494.757 | 500513.724 | 188.46 | 20A20110518SPR | 188.43 | 0.03 | 1 |
| 4145 | 7155476.825 | 500560.482 | 187.74 | 20A20110518SPR | 187.80 | -0.06 | 1 |
| 4146 | 7155450.617 | 500614.513 | 188.25 | 20A20110518SPR | 188.26 | -0.01 | 1 |
| 4147 | 7155433.758 | 500666.096 | 190.01 | 20A20110518SPR | 190.06 | -0.05 | 1 |
| 4148 | 7155426.302 | 500711.08 | 192.72 | 20A20110518SPR | 192.74 | -0.02 | 1 |
| 4149 | 7155412.638 | 500756.615 | 195.47 | 20A20110518SPR | 195.51 | -0.04 | 1 |
| 4150 | 7155366.602 | 500815.054 | 197.69 | 20A20110518SPR | 197.72 | -0.03 | 1 |
| 4151 | 7156222.181 | 499640.659 | 186.60 | 20A20110518SPR | 186.59 | 0.01 | 1 |
| 4152 | 7156229.635 | 499604.73 | 186.58 | 20A20110518SPR | 186.57 | 0.01 | 1 |
| 4153 | 7156238.438 | 499562.257 | 186.67 | 20A20110518SPR | 186.68 | -0.01 | 1 |
| 4154 | 7156247.487 | 499520.912 | 186.90 | 20A20110518SPR | 186.86 | 0.03 | 1 |
| 4155 | 7156256.766 | 499481.555 | 187.01 | 20A20110518SPR | 186.98 | 0.03 | 1 |
| 4156 | 7156270.323 | 499441.16 | 187.01 | 20A20110518SPR | 187.00 | 0.01 | 1 |
| 4157 | 7156270.327 | 499441.159 | 187.01 | 20A20110518SPR | 187.00 | 0.01 | 1 |

| CHECK POINTS | | | SURVEYED Elevation | | LiDAR Elevation | Deviation | Include? (yes = 1) |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | DESCRIPTOR | (Meters) | (Meters) | (no = 0) |
| 4158 | 7156293.261 | 499392.261 | 187.00 | 20A20110518SPR | 186.97 | 0.03 | 1 |
| 4159 | 7156321.048 | 499347.343 | 186.95 | 20A20110518SPR | 186.91 | 0.04 | 1 |
| 4160 | 7156346.061 | 499315.821 | 186.92 | 20A20110518SPR | 186.88 | 0.04 | 1 |
| 4161 | 7156372.965 | 499287.453 | 186.90 | 20A20110518SPR | 186.88 | 0.02 | 1 |
| 4162 | 7156402.618 | 499261.126 | 186.86 | 20A20110518SPR | 186.84 | 0.01 | 1 |
| 4163 | 7156433.611 | 499237.991 | 186.70 | 20A20110518SPR | 186.71 | -0.01 | 1 |
| 4164 | 7156359.011 | 499309.268 | 186.60 | 20A20110518SPR | 186.56 | 0.04 | 1 |
| 4165 | 7156315.963 | 499364.939 | 186.60 | 20A20110518SPR | 186.59 | 0.01 | 1 |
| 4166 | 7156252.493 | 499522.446 | 186.68 | 20A20110518SPR | 186.68 | 0.00 | 1 |
| 4167 | 7156243.13 | 499567.349 | 186.59 | 20A20110518SPR | 186.58 | 0.01 | 1 |
| 4168 | 7156230.407 | 499627.833 | 186.64 | 20A20110518SPR | 186.63 | 0.01 | 1 |
| 4169 | 7154241.186 | 501370.786 | 197.85 | 20A20110518SPR | 197.79 | 0.06 | 1 |
| 4170 | 7154246.834 | 501377.247 | 198.30 | 20A20110518SPR | 198.31 | -0.01 | 1 |
| 4171 | 7154246.248 | 501412.03 | 197.42 | 20A20110518SPR | 197.45 | -0.03 | 1 |
| 4172 | 7154246.971 | 501444.97 | 196.61 | 20A20110518SPR | 196.62 | -0.01 | 1 |
| 4173 | 7154247.783 | 501478.467 | 196.76 | 20A20110518SPR | 196.76 | 0.00 | 1 |
| 4174 | 7154247.047 | 501511.413 | 196.97 | 20A20110518SPR | 196.94 | 0.03 | 1 |
| 4175 | 7154247.892 | 501545.341 | 196.96 | 20A20110518SPR | 196.94 | 0.02 | 1 |
| 4176 | 7154247.822 | 501578.882 | 197.02 | 20A20110518SPR | 197.02 | 0.00 | 1 |
| 4177 | 7154247.536 | 501612.939 | 196.95 | 20A20110518SPR | 196.94 | 0.00 | 1 |
| 4178 | 7154247.549 | 501645.808 | 196.54 | 20A20110518SPR | 196.53 | 0.01 | 1 |
| 4179 | 7154247.587 | 501682.169 | 196.15 | 20A20110518SPR | 196.16 | -0.01 | 1 |
| 4180 | 7154247.091 | 501713.251 | 195.72 | 20A20110518SPR | 195.69 | 0.03 | 1 |
| 4181 | 7153478.126 | 501400.356 | 196.30 | 20A20110518SPR | 196.27 | 0.03 | 1 |
| 4182 | 7153509.214 | 501402.281 | 196.27 | 20A20110518SPR | 196.24 | 0.03 | 1 |
| 4183 | 7153545.496 | 501402.396 | 196.15 | 20A20110518SPR | 196.12 | 0.03 | 1 |
| 4184 | 7153576.045 | 501406.781 | 196.17 | 20A20110518SPR | 196.11 | 0.06 | 1 |
| 4185 | 7153573.182 | 501412.211 | 196.16 | 20A20110518SPR | 196.09 | 0.06 | 1 |
| 4186 | 7153534.867 | 501409.629 | 196.22 | 20A20110518SPR | 196.14 | 0.08 | 1 |
| 4187 | 7153504.683 | 501407.557 | 196.27 | 20A20110518SPR | 196.19 | 0.08 | 1 |
| 4188 | 7153474.947 | 501405.595 | 196.30 | 20A20110518SPR | 196.21 | 0.09 | 1 |
| 4189 | 7154465.944 | 501231.603 | 195.71 | 20A20110518CHECK | 195.72 | -0.01 | 1 |
| 4190 | 7154465.943 | 501231.601 | 195.71 | 20A20110518CHECK | 195.72 | -0.01 | 1 |
| 4191 | 7154465.941 | 501231.598 | 195.71 | 20A20110518CHECK | 195.72 | -0.01 | 1 |
| 4200 | 7154468.17 | 501234.516 | 195.27 | 20A20110519STATS20ASAC | 195.37 | -0.10 | 1 |
| 4201 | 7157777.033 | 509005.787 | 332.11 | 20A20110519STATSSGR | 332.08 | 0.03 | 1 |
| 4202 | 7157775.544 | 508975.702 | 331.36 | 20A20110519STATSSGR | 331.35 | 0.01 | 1 |
| 4203 | 7157677.622 | 508485.884 | 310.52 | 20A20110519STATSSGR | 310.53 | -0.01 | 1 |
| 4204 | 7157686.812 | 508495.997 | 310.69 | 20A20110519STATSSGR | 310.70 | -0.01 | 1 |
| 4205 | 7157488.35 | 507975.655 | 283.23 | 20A20110519STATSSGR | 283.23 | 0.00 | 1 |
| 4206 | 7157477.023 | 508004.9 | 284.57 | 20A20110519STATSSPR | 284.56 | 0.00 | 1 |
| 4207 | 7156780.112 | 498933.446 | 184.14 | 20A20110519STATSSGR | 184.17 | -0.03 | 1 |
| 4208 | 7156749.669 | 498889.873 | 184.10 | 20A20110519STATSSGR | 184.04 | 0.06 | 1 |
| 4209 | 7150012.673 | 501164.763 | 196.64 | 20A20110519STATSSPR | 196.65 | -0.01 | 1 |
| 4210 | 7149873.27 | 501309.53 | 196.51 | 20A20110519STATSSPR | 196.51 | 0.00 | 1 |
| 4211 | 7152157.732 | 501313.172 | 196.33 | 20A20110519STATSCHECK2( | 196.31 | 0.01 | 1 |
| 4300 | 7120622.601 | 551102.366 | 297.85 | 22A2011051822ASAC | 297.95 | -0.10 | 1 |
| 4301 | 7120634.611 | 551101.201 | 298.54 | 22A20110518SPR | 298.59 | -0.05 | 1 |
| 4302 | 7120660.04 | 551071.535 | 298.44 | 22A20110518SPR | 298.48 | -0.04 | 1 |
| 4303 | 7120664.026 | 551074.949 | 298.45 | 22A20110518SPR | 298.50 | -0.05 | 1 |
| 4304 | 7120645.269 | 551097.069 | 298.55 | 22A20110518SPR | 298.59 | -0.04 | 1 |
| 4305 | 7121286.962 | 550319.337 | 293.84 | 22A20110518SPR | 293.88 | -0.04 | 1 |
| 4306 | 7121277.594 | 550311.345 | 293.52 | 22A20110518SPR | 293.59 | -0.07 | 1 |

| CHECK POINTS | | | SURVEYED Elevation | | LiDAR Elevation | Deviation | Include? (yes = 1) |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | DESCRIPTOR | (Meters) | (Meters) | (no = 0) |
| 4307 | 7121295.592 | 550285.198 | 293.34 | 22A20110518SPR | 293.39 | -0.05 | 1 |
| 4308 | 7121312.637 | 550259.276 | 293.15 | 22A20110518SPR | 293.21 | -0.06 | 1 |
| 4309 | 7121328.935 | 550233.997 | 293.03 | 22A20110518SPR | 293.07 | -0.04 | 1 |
| 4310 | 7121345.947 | 550206.192 | 292.88 | 22A20110518SPR | 292.95 | -0.07 | 1 |
| 4311 | 7121352.207 | 550210.808 | 293.08 | 22A20110518SPR | 293.13 | -0.05 | 1 |
| 4312 | 7121336.137 | 550238.073 | 293.23 | 22A20110518SPR | 293.28 | -0.05 | 1 |
| 4313 | 7121318.343 | 550266.182 | 293.40 | 22A20110518SPR | 293.45 | -0.05 | 1 |
| 4314 | 7121299.345 | 550294.685 | 293.58 | 22A20110518SPR | 293.64 | -0.06 | 1 |
| 4315 | 7121312.624 | 550350.346 | 292.32 | 22A20110518SGR | 292.38 | -0.06 | 1 |
| 4316 | 7121340.632 | 550389.016 | 292.59 | 22A20110518SGR | 292.64 | -0.06 | 1 |
| 4317 | 7121351.046 | 550438.006 | 292.71 | 22A20110518SGR | 292.76 | -0.06 | 1 |
| 4318 | 7121462.297 | 551240.795 | 293.29 | 22A20110518SGR | 293.34 | -0.05 | 1 |
| 4319 | 7121480.039 | 551255.932 | 293.13 | 22A20110518SGR | 293.16 | -0.03 | 1 |
| 4320 | 7121515.929 | 551280.62 | 293.19 | 22A20110518SGR | 293.25 | -0.06 | 1 |
| 4321 | 7121505.049 | 551293.317 | 293.23 | 22A20110518SGR | 293.26 | -0.03 | 1 |
| 4322 | 7121535.186 | 551259.349 | 293.09 | 22A20110518SGR | 293.14 | -0.05 | 1 |
| 4323 | 7121634.504 | 549126.638 | 293.00 | 22A20110518SPR | 293.13 | -0.13 | 1 |
| 4324 | 7121633.406 | 549173.496 | 293.63 | 22A20110518SPR | 293.73 | -0.10 | 1 |
| 4325 | 7121632.481 | 549208.294 | 293.93 | 22A20110518SPR | 294.01 | -0.08 | 1 |
| 4326 | 7121629.24 | 549135.002 | 293.17 | 22A20110518SPR | 293.27 | -0.10 | 1 |
| 4327 | 7121630.694 | 549076.045 | 292.41 | 22A20110518SPR | 292.47 | -0.06 | 1 |
| 4328 | 7121633.088 | 549013.049 | 291.76 | 22A20110518SPR | 291.85 | -0.09 | 1 |
| 4329 | 7121995.617 | 548449.617 | 289.24 | 22A20110518SPR | 289.35 | -0.12 | 1 |
| 4330 | 7122002.823 | 548434.592 | 289.11 | 22A20110518SPR | 289.20 | -0.09 | 1 |
| 4331 | 7120627.326 | 551106.048 | 298.56 | 22A20110518CHECK | 298.60 | -0.04 | 1 |
| 4332 | 7120627.321 | 551106.046 | 298.56 | 22A20110518CHECK | 298.60 | -0.04 | 1 |
| 4600 | 7152157.299 | 501319.008 | 195.64 | 20B2011052020BSAC | 195.66 | -0.02 | 1 |
| 4601 | 7152152.347 | 501311.983 | 196.38 | 20B20110520SPR | 196.35 | 0.03 | 1 |
| 4602 | 7151447.861 | 501253.121 | 194.58 | 20B20110520SPR | 194.56 | 0.02 | 1 |
| 4603 | 7151432.536 | 501247.972 | 194.58 | 20B20110520SPR | 194.52 | 0.06 | 1 |
| 4604 | 7151411.699 | 501246.303 | 194.84 | 20B20110520SPR | 194.79 | 0.05 | 1 |
| 4605 | 7151395.938 | 501240.288 | 194.85 | 20B20110520SPR | 194.79 | 0.06 | 1 |
| 4606 | 7151374.068 | 501235.353 | 195.02 | 20B20110520SPR | 194.94 | 0.08 | 1 |
| 4607 | 7151357.885 | 501231.474 | 195.15 | 20B20110520SPR | 195.08 | 0.07 | 1 |
| 4608 | 7151360.402 | 501225.895 | 194.87 | 20B20110520SPR | 194.82 | 0.05 | 1 |
| 4609 | 7151375.167 | 501229.909 | 194.78 | 20B20110520SPR | 194.71 | 0.07 | 1 |
| 4610 | 7151390.807 | 501233.475 | 194.65 | 20B20110520SPR | 194.57 | 0.08 | 1 |
| 4611 | 7151405.88 | 501236.838 | 194.55 | 20B20110520SPR | 194.49 | 0.06 | 1 |
| 4612 | 7151422.817 | 501240.448 | 194.41 | 20B20110520SPR | 194.38 | 0.03 | 1 |
| 4613 | 7151442.164 | 501244.056 | 194.26 | 20B20110520SPR | 194.22 | 0.04 | 1 |
| 4614 | 7150773.487 | 500996.291 | 198.96 | 20B20110520SPR | 198.96 | 0.00 | 1 |
| 4615 | 7150756.973 | 500992.083 | 199.12 | 20B20110520SPR | 199.12 | 0.00 | 1 |
| 4616 | 7150740.231 | 500987.605 | 199.29 | 20B20110520SPR | 199.29 | 0.00 | 1 |
| 4617 | 7150725.021 | 500983.93 | 199.45 | 20B20110520SPR | 199.45 | 0.00 | 1 |
| 4618 | 7150710.67 | 500980.064 | 199.61 | 20B20110520SPR | 199.63 | -0.02 | 1 |
| 4619 | 7150692.443 | 500975.319 | 199.78 | 20B20110520SPR | 199.81 | -0.03 | 1 |
| 4620 | 7150695.583 | 500967.875 | 199.83 | 20B20110520SPR | 199.84 | -0.01 | 1 |
| 4621 | 7150714.665 | 500972.894 | 199.66 | 20B20110520SPR | 199.63 | 0.03 | 1 |
| 4622 | 7150729.542 | 500976.781 | 199.48 | 20B20110520SPR | 199.47 | 0.01 | 1 |
| 4623 | 7150749.157 | 500981.614 | 199.29 | 20B20110520SPR | 199.26 | 0.03 | 1 |
| 4624 | 7150767.168 | 500986.486 | 199.13 | 20B20110520SPR | 199.10 | 0.03 | 1 |
| 4625 | 7150420.033 | 500926.49 | 201.10 | 20B20110520SPR | 201.12 | -0.02 | 1 |
| 4626 | 7150436.172 | 500925.412 | 201.22 | 20B20110520SPR | 201.27 | -0.05 | 1 |

| CHECK POINTS | | | SURVEYED Elevation | | LiDAR Elevation | Deviation | Include? (yes = 1) |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | DESCRIPTOR | (Meters) | (Meters) | (no = 0) |
| 4627 | 7150451.851 | 500927.01 | 201.21 | 20B20110520SPR | 201.20 | 0.01 | 1 |
| 4628 | 7150467.21 | 500924.658 | 201.41 | 20B20110520SPR | 201.42 | -0.01 | 1 |
| 4629 | 7150484.264 | 500924.822 | 201.42 | 20B20110520SPR | 201.44 | -0.02 | 1 |
| 4630 | 7153040.325 | 501298.172 | 194.59 | 20B20110520SGR | 194.54 | 0.05 | 1 |
| 4631 | 7153015.8 | 501292.035 | 194.72 | 20B20110520SGR | 194.71 | 0.01 | 1 |
| 4632 | 7152995.362 | 501293.903 | 194.52 | 20B20110520SGR | 194.53 | -0.01 | 1 |
| 4633 | 7153035.989 | 501271.237 | 194.29 | 20B20110520SGR | 194.33 | -0.04 | 1 |
| 4634 | 7153034.397 | 501254.019 | 194.16 | 20B20110520SGR | 194.18 | -0.02 | 1 |
| 4635 | 7153035.46 | 501237.349 | 193.95 | 20B20110520SGR | 193.97 | -0.02 | 1 |
| 4636 | 7152157.746 | 501313.179 | 196.37 | 20B20110520CHECK | 196.31 | 0.06 | 1 |
| 4637 | 7152157.734 | 501313.181 | 196.37 | 20B20110520CHECK | 196.30 | 0.07 | 1 |
| 4638 | 7152157.739 | 501313.172 | 196.36 | 20B20110520CHECK | 196.31 | 0.05 | 1 |
| 4650 | 7152157.299 | 501319.008 | 195.64 | 20B20110520STATS20BSAC | 195.66 | -0.02 | 1 |
| 4651 | 7149388.356 | 503520.328 | 199.57 | 20B20110520STATSSGR | 199.47 | 0.10 | 1 |
| 4652 | 7149428.552 | 503566.929 | 199.82 | 20B20110520STATSSGR | 199.74 | 0.08 | 1 |
| 4653 | 7146667.006 | 504389.754 | 214.66 | 20B20110520STATSSPR | 214.64 | 0.02 | 1 |
| 4654 | 7143392.975 | 504515.656 | 250.18 | 20B20110520STATSSPR | 250.15 | 0.03 | 1 |
| 4655 | 7144166.664 | 504944.133 | 240.67 | 20B20110520STATSSPR | 240.63 | 0.04 | 1 |
| 4656 | 7146140.948 | 504420.056 | 207.41 | 20B20110520STATSSGR | 207.41 | 0.00 | 1 |
| 4700 | 7177612.634 | 488334.165 | 157.731 | 19A2011052119ASAC | 157.75 | -0.02 | 1 |
| 4701 | 7177604.325 | 488335.038 | 158 | 19A20110521SPR | 157.98 | 0.02 | 1 |
| 4702 | 7178192.866 | 487490.915 | 161.477 | 19A20110521SPR | 161.49 | -0.01 | 1 |
| 4703 | 7178183.431 | 487503.396 | 161.626 | 19A20110521SPR | 161.63 | 0.00 | 1 |
| 4704 | 7178172.202 | 487518.034 | 161.717 | 19A20110521SPR | 161.72 | 0.00 | 1 |
| 4705 | 7178162.411 | 487530.936 | 161.791 | 19A20110521SPR | 161.78 | 0.01 | 1 |
| 4706 | 7178152.091 | 487544.478 | 161.912 | 19A20110521SPR | 161.91 | 0.00 | 1 |
| 4707 | 7178123.938 | 487519.851 | 161.869 | 19A20110521SPR | 161.87 | 0.00 | 1 |
| 4708 | 7178134.376 | 487506.463 | 161.803 | 19A20110521SPR | 161.80 | 0.00 | 1 |
| 4709 | 7178143.628 | 487494.274 | 161.72 | 19A20110521SPR | 161.71 | 0.01 | 1 |
| 4710 | 7178153.991 | 487480.153 | 161.585 | 19A20110521SPR | 161.58 | 0.00 | 1 |
| 4711 | 7178164.172 | 487466.66 | 161.436 | 19A20110521SPR | 161.42 | 0.02 | 1 |
| 4712 | 7178646.028 | 486898.87 | 155.166 | 19A20110521SPR | 155.16 | 0.01 | 1 |
| 4713 | 7178635.113 | 486913.009 | 155.194 | 19A20110521SPR | 155.20 | -0.01 | 1 |
| 4714 | 7178625.164 | 486925.65 | 155.222 | 19A20110521SPR | 155.23 | -0.01 | 1 |
| 4715 | 7178615.871 | 486937.929 | 155.239 | 19A20110521SPR | 155.24 | 0.00 | 1 |
| 4716 | 7178606.584 | 486950.334 | 155.24 | 19A20110521SPR | 155.24 | 0.00 | 1 |
| 4717 | 7178575.239 | 486923.525 | 154.942 | 19A20110521SPR | 154.97 | -0.03 | 1 |
| 4718 | 7178586.366 | 486909.018 | 154.923 | 19A20110521SPR | 154.91 | 0.01 | 1 |
| 4719 | 7178596.391 | 486895.912 | 154.919 | 19A20110521SPR | 154.93 | -0.01 | 1 |
| 4720 | 7178606.634 | 486882.461 | 154.905 | 19A20110521SPR | 154.93 | -0.03 | 1 |
| 4721 | 7178614.608 | 486872.188 | 154.908 | 19A20110521SPR | 154.90 | 0.01 | 1 |
| 4722 | 7179155.019 | 486239.187 | 154.096 | 19A20110521SPR | 154.10 | 0.00 | 1 |
| 4723 | 7177609.914 | 488332.462 | 157.961 | 19A20110521CHECK | 157.97 | -0.01 | 1 |
| 4724 | 7179063.206 | 486291.072 | 154.414 | 19A20110521SPR | 154.42 | -0.01 | 1 |
| 4725 | 7179056.384 | 486300.654 | 154.436 | 19A20110521SPR | 154.44 | 0.00 | 1 |
| 4726 | 7179048.933 | 486310.353 | 154.429 | 19A20110521SPR | 154.45 | -0.02 | 1 |
| 4727 | 7179041.186 | 486320.499 | 154.414 | 19A20110521SPR | 154.40 | 0.01 | 1 |
| 4728 | 7179033.555 | 486330.013 | 154.381 | 19A20110521SPR | 154.38 | 0.00 | 1 |
| 4729 | 7179025.375 | 486339.43 | 154.359 | 19A20110521SPR | 154.37 | -0.01 | 1 |
| 4730 | 7179015.757 | 486350.007 | 154.318 | 19A20110521SPR | 154.31 | 0.01 | 1 |
| 4731 | 7179007.75 | 486359.392 | 154.294 | 19A20110521SPR | 154.31 | -0.02 | 1 |
| 4732 | 7178999.452 | 486369.067 | 154.263 | 19A20110521SPR | 154.29 | -0.03 | 1 |
| 4733 | 7179744.174 | 485449.259 | 157.265 | 19A20110521SPR | 157.30 | -0.04 | 1 |

| CHECK POINTS | | | SURVEYED Elevation | | LiDAR Elevation | Deviation | Include? (yes = 1) |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | DESCRIPTOR | (Meters) | (Meters) | (no = 0) |
| 4734 | 7179754.828 | 485436.289 | 157.749 | 19A20110521SPR | 157.76 | -0.01 | 1 |
| 4735 | 7179763.561 | 485423.722 | 158.136 | 19A20110521SPR | 158.17 | -0.03 | 1 |
| 4736 | 7179772.923 | 485411.334 | 158.561 | 19A20110521SPR | 158.55 | 0.01 | 1 |
| 4737 | 7179782.931 | 485398.311 | 158.887 | 19A20110521SPR | 158.91 | -0.02 | 1 |
| 4738 | 7179792.27 | 485386.387 | 159.201 | 19A20110521SPR | 159.22 | -0.02 | 1 |
| 4739 | 7179800.96 | 485374.855 | 159.48 | 19A20110521SPR | 159.47 | 0.01 | 1 |
| 4740 | 7179810.609 | 485362.142 | 159.7 | 19A20110521SPR | 159.71 | -0.01 | 1 |
| 4741 | 7179809.176 | 485366.018 | 159.622 | 19A20110521SPR | 159.65 | -0.03 | 1 |
| 4742 | 7178863.942 | 487923.308 | 156.154 | 19A20110521SPR | 156.13 | 0.02 | 1 |
| 4743 | 7178884.734 | 487919.803 | 155.799 | 19A20110521SPR | 155.82 | -0.02 | 1 |
| 4744 | 7178898.026 | 487902.938 | 155.173 | 19A20110521SPR | 155.18 | -0.01 | 1 |
| 4745 | 7178886.073 | 487892.639 | 155.209 | 19A20110521SPR | 155.21 | 0.00 | 1 |
| 4746 | 7178872.233 | 487883.735 | 155.299 | 19A20110521SPR | 155.30 | 0.00 | 1 |
| 4747 | 7178858.228 | 487875.437 | 155.272 | 19A20110521SPR | 155.29 | -0.02 | 1 |
| 4748 | 7178846.673 | 487886.419 | 155.543 | 19A20110521SPR | 155.54 | 0.00 | 1 |
| 4749 | 7178859.11 | 487893.532 | 155.591 | 19A20110521SPR | 155.58 | 0.01 | 1 |
| 4750 | 7178872.901 | 487902.163 | 155.551 | 19A20110521SPR | 155.56 | -0.01 | 1 |
| 4751 | 7178882.89 | 487911.559 | 155.54 | 19A20110521SPR | 155.52 | 0.02 | 1 |
| 4752 | 7179355.478 | 488356.937 | 155.81 | 19A20110521SPR | 155.80 | 0.01 | 1 |
| 4753 | 7179342.255 | 488347.299 | 155.822 | 19A20110521SPR | 155.82 | 0.00 | 1 |
| 4754 | 7179329.62 | 488337.759 | 155.831 | 19A20110521SPR | 155.83 | 0.00 | 1 |
| 4755 | 7179316.463 | 488328.173 | 155.846 | 19A20110521SPR | 155.84 | 0.01 | 1 |
| 4756 | 7179302.043 | 488317.492 | 155.852 | 19A20110521SPR | 155.88 | -0.03 | 1 |
| 4757 | 7179298.851 | 488309.713 | 155.855 | 19A20110521SPR | 155.89 | -0.03 | 1 |
| 4758 | 7179328.793 | 488371.699 | 161.457 | 19A20110521SGR | 161.47 | -0.01 | 1 |
| 4759 | 7179338.113 | 488381.728 | 161.395 | 19A20110521SGR | 161.43 | -0.03 | 1 |
| 4760 | 7179352.45 | 488388.774 | 161.438 | 19A20110521SGR | 161.46 | -0.02 | 1 |
| 4761 | 7179361.268 | 488401.561 | 161.335 | 19A20110521SGR | 161.31 | 0.03 | 1 |
| 4762 | 7180009.637 | 488874.75 | 161.701 | 19A20110521SGR | 161.67 | 0.03 | 1 |
| 4763 | 7180023.256 | 488884.297 | 161.695 | 19A20110521SGR | 161.69 | 0.00 | 1 |
| 4764 | 7180001.81 | 488872.371 | 161.634 | 19A20110521SGR | 161.60 | 0.03 | 1 |
| 4765 | 7179988.441 | 488859.037 | 161.681 | 19A20110521SGR | 161.67 | 0.01 | 1 |
| 4766 | 7179978.195 | 488851.051 | 161.652 | 19A20110521SGR | 161.65 | 0.00 | 1 |
| 4767 | 7179967.223 | 488846.179 | 161.654 | 19A20110521SGR | 161.65 | 0.00 | 1 |
| 4768 | 7179948.577 | 488832.691 | 161.589 | 19A20110521SGR | 161.58 | 0.01 | 1 |
| 4769 | 7179939.472 | 488826.546 | 161.544 | 19A20110521SGR | 161.55 | -0.01 | 1 |
| 4770 | 7179922.87 | 488810.959 | 161.645 | 19A20110521SGR | 161.63 | 0.02 | 1 |
| 4771 | 7179915.464 | 488807.383 | 161.64 | 19A20110521SGR | 161.62 | 0.02 | 1 |
| 4772 | 7177300.433 | 489136.016 | 160.23 | 19A20110521SPR | 160.23 | 0.00 | 1 |
| 4773 | 7177296.378 | 489150.876 | 160.251 | 19A20110521SPR | 160.21 | 0.04 | 1 |
| 4774 | 7177291.476 | 489166.938 | 160.227 | 19A20110521SPR | 160.20 | 0.03 | 1 |
| 4775 | 7177287.628 | 489181.801 | 160.216 | 19A20110521SPR | 160.18 | 0.04 | 1 |
| 4776 | 7177283.236 | 489197.979 | 160.22 | 19A20110521SPR | 160.21 | 0.01 | 1 |
| 4777 | 7177278.349 | 489213.562 | 160.215 | 19A20110521SPR | 160.20 | 0.02 | 1 |
| 4778 | 7177315.933 | 489217.164 | 160.192 | 19A20110521SPR | 160.20 | -0.01 | 1 |
| 4779 | 7177320.241 | 489202.153 | 160.183 | 19A20110521SPR | 160.19 | -0.01 | 1 |
| 4780 | 7177324.686 | 489187.063 | 160.185 | 19A20110521SPR | 160.16 | 0.03 | 1 |
| 4781 | 7177328.821 | 489172.886 | 160.186 | 19A20110521SPR | 160.18 | 0.01 | 1 |
| 4782 | 7177069.703 | 489916.591 | 160.185 | 19A20110521SPR | 160.17 | 0.02 | 1 |
| 4783 | 7177074.474 | 489902.103 | 160.167 | 19A20110521SPR | 160.18 | -0.01 | 1 |
| 4784 | 7177079.889 | 489886.414 | 160.146 | 19A20110521SPR | 160.15 | 0.00 | 1 |
| 4785 | 7177084.738 | 489871.528 | 160.158 | 19A20110521SPR | 160.18 | -0.02 | 1 |
| 4786 | 7177089.577 | 489857.083 | 160.158 | 19A20110521SPR | 160.18 | -0.02 | 1 |

| CHECK POINTS | | | SURVEYED Elevation | | LiDAR Elevation | Deviation | Include? (yes = 1) |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | DESCRIPTOR | (Meters) | (Meters) | (no = 0) |
| 4787 | 7177126.076 | 489865.553 | 160.179 | 19A20110521SPR | 160.20 | -0.02 | 1 |
| 4788 | 7177121.094 | 489880.352 | 160.182 | 19A20110521SPR | 160.20 | -0.02 | 1 |
| 4789 | 7177115.48 | 489896.988 | 160.178 | 19A20110521SPR | 160.20 | -0.02 | 1 |
| 4790 | 7177110.03 | 489913.896 | 160.158 | 19A20110521SPR | 160.18 | -0.02 | 1 |
| 4791 | 7177104.457 | 489930.215 | 160.193 | 19A20110521SPR | 160.18 | 0.01 | 1 |
| 4792 | 7177099.845 | 489942.605 | 160.201 | 19A20110521SPR | 160.21 | -0.01 | 1 |
| 4793 | 7176744.215 | 490717.059 | 160.206 | 19A20110521SPR | 160.19 | 0.02 | 1 |
| 4794 | 7176701.173 | 490799.717 | 160.09 | 19A20110521SPR | 160.08 | 0.01 | 1 |
| 4795 | 7176673.659 | 490798.677 | 159.985 | 19A20110521SPR | 159.95 | 0.04 | 1 |
| 4796 | 7176657.621 | 490805.571 | 159.878 | 19A20110521SPR | 159.87 | 0.01 | 1 |
| 4797 | 7176624.293 | 490824.995 | 159.566 | 19A20110521SPR | 159.56 | 0.01 | 1 |
| 4798 | 7176607.885 | 490831.742 | 159.457 | 19A20110521SPR | 159.41 | 0.05 | 1 |
| 4799 | 7176593.63 | 490833.126 | 159.318 | 19A20110521SPR | 159.31 | 0.01 | 1 |
| 4800 | 7176953.298 | 490334.688 | 160.164 | 19A20110521CHECK19B | 160.15 | 0.01 | 1 |
| 4801 | 7176954.757 | 490335.42 | 160.001 | 19A2011052119B | 160.02 | -0.02 | 1 |
| 4802 | 7176951.044 | 490337.794 | 160.185 | 19A20110521SPR | 160.16 | 0.03 | 1 |
| 4803 | 7176946.195 | 490350.966 | 160.176 | 19A20110521SPR | 160.14 | 0.04 | 1 |
| 4804 | 7176941.4 | 490363.379 | 160.173 | 19A20110521SPR | 160.18 | -0.01 | 1 |
| 4805 | 7177392.096 | 489161.686 | 157.373 | 19A20110521SGR | 157.36 | 0.01 | 1 |
| 4806 | 7177412.213 | 489149.626 | 156.993 | 19A20110521SGR | 156.95 | 0.04 | 1 |
| 4807 | 7177469.254 | 489124.867 | 156.843 | 19A20110521SGR | 156.82 | 0.02 | 1 |
| 4808 | 7177562.081 | 489096.765 | 156.509 | 19A20110521SGR | 156.50 | 0.01 | 1 |
| 4809 | 7177614.225 | 489067.896 | 155.793 | 19A20110521SGR | 155.78 | 0.01 | 1 |
| 4810 | 7177635.461 | 489065.782 | 156.155 | 19A20110521SGR | 156.14 | 0.02 | 1 |
| 4811 | 7177657.153 | 489058.567 | 156.239 | 19A20110521SGR | 156.20 | 0.04 | 1 |
| 4812 | 7177723.926 | 489058.675 | 156.705 | 19A20110521SGR | 156.71 | 0.00 | 1 |
| 4813 | 7177756.098 | 489071.378 | 156.53 | 19A20110521SGR | 156.53 | 0.00 | 1 |
| 4814 | 7177783.223 | 489092.007 | 156.606 | 19A20110521SGR | 156.61 | 0.00 | 1 |
| 4815 | 7177784.412 | 489118.8 | 156.46 | 19A20110521SGR | 156.47 | -0.01 | 1 |
| 4816 | 7177776.949 | 489154.437 | 156.561 | 19A20110521SGR | 156.57 | -0.01 | 1 |
| 4817 | 7177768.072 | 489188.115 | 157.217 | 19A20110521SGR | 157.20 | 0.02 | 1 |
| 4818 | 7177749.702 | 489225.804 | 159.59 | 19A20110521SGR | 159.56 | 0.03 | 1 |
| 4819 | 7177709.058 | 489230.658 | 162.787 | 19A20110521SGR | 162.84 | -0.05 | 1 |
| 4820 | 7177658.896 | 489216.97 | 165.539 | 19A20110521SGR | 165.54 | 0.00 | 1 |
| 4821 | 7177602.032 | 489226.606 | 169.848 | 19A20110521SGR | 169.87 | -0.02 | 1 |
| 4822 | 7177549.225 | 489228.908 | 174.794 | 19A20110521SGR | 174.79 | 0.00 | 1 |
| 4823 | 7177490.846 | 489218.098 | 180.981 | 19A20110521SGR | 181.00 | -0.02 | 1 |
| 4824 | 7177452.127 | 489259.743 | 188.505 | 19A20110521SGR | 188.53 | -0.03 | 1 |
| 4825 | 7177491.705 | 489285.409 | 190.916 | 19A20110521SGR | 190.90 | 0.02 | 1 |
| 4826 | 7177529.45 | 489297.479 | 191.279 | 19A20110521SGR | 191.27 | 0.01 | 1 |
| 4827 | 7177561.121 | 489311.232 | 190.834 | 19A20110521SGR | 190.83 | 0.00 | 1 |
| 4828 | 7177582.474 | 489320.041 | 190.947 | 19A20110521SGR | 190.93 | 0.02 | 1 |
| 4829 | 7177622.146 | 489334.619 | 192.47 | 19A20110521SGR | 192.45 | 0.02 | 1 |
| 4830 | 7177662.855 | 489351.473 | 194.914 | 19A20110521SGR | 194.91 | 0.00 | 1 |
| 4831 | 7177702.936 | 489366.529 | 198.289 | 19A20110521SGR | 198.27 | 0.02 | 1 |
| 4832 | 7177745.15 | 489379.982 | 202.542 | 19A20110521SGR | 202.51 | 0.03 | 1 |
| 4833 | 7177812.909 | 489406.563 | 209.974 | 19A20110521SGR | 209.95 | 0.02 | 1 |
| 4834 | 7177860.697 | 489421.965 | 215.283 | 19A20110521SGR | 215.23 | 0.05 | 1 |
| 4835 | 7177918.776 | 489453.4 | 221.529 | 19A20110521SGR | 221.48 | 0.05 | 1 |
| 4836 | 7177947.968 | 489488.619 | 225.838 | 19A20110521SGR | 225.85 | -0.01 | 1 |
| 4837 | 7177950.836 | 489632.304 | 238.896 | 19A20110521SGR | 238.89 | 0.01 | 1 |
| 4838 | 7177950.342 | 489668.286 | 240.543 | 19A20110521SGR | 240.53 | 0.01 | 1 |
| 4839 | 7177609.923 | 488332.466 | 157.971 | 19A20110521CHECK | 157.97 | 0.00 | 1 |

| CHECK POINTS | | | SURVEYED Elevation | | LiDAR Elevation | Deviation | Include? (yes = 1) |
|---|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | DESCRIPTOR | (Meters) | (Meters) | (no = 0) |
| 4840 | 7177609.912 | 488332.465 | 157.969 | 19A20110521CHECK | 157.97 | 0.00 | 1 |

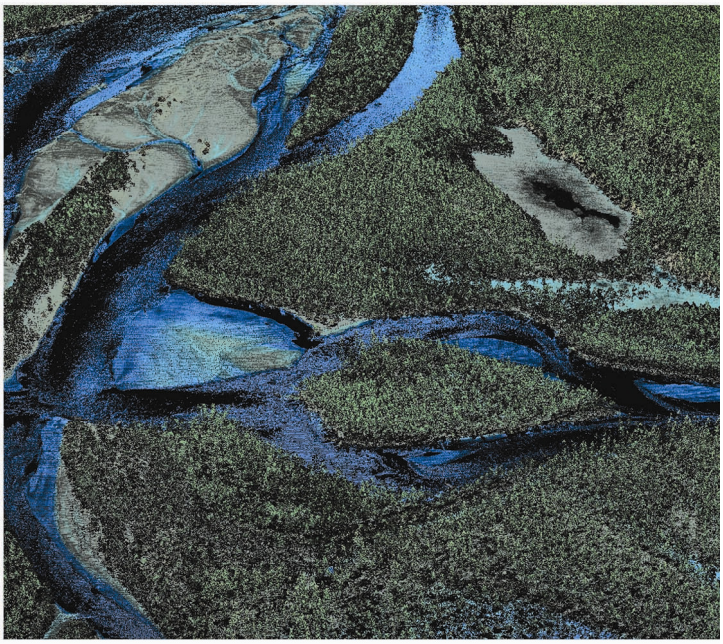
# LiDAR REMOTE SENSING

## ALASKA PIPELINE • ALASKA

(Delivery 5– 8/31/2011)








## ALASKA DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

**TRENT HUBBARD** - 3354 College Road - Fairbanks, AK 99709

**WATERSHED SCIENCES** • 517 SW 2nd Street, Suite 400 - Corvallis, OR 97333

# LiDAR Remote Sensing Data Collection:

## Alaska Pipeline, AK

### Delivery 5

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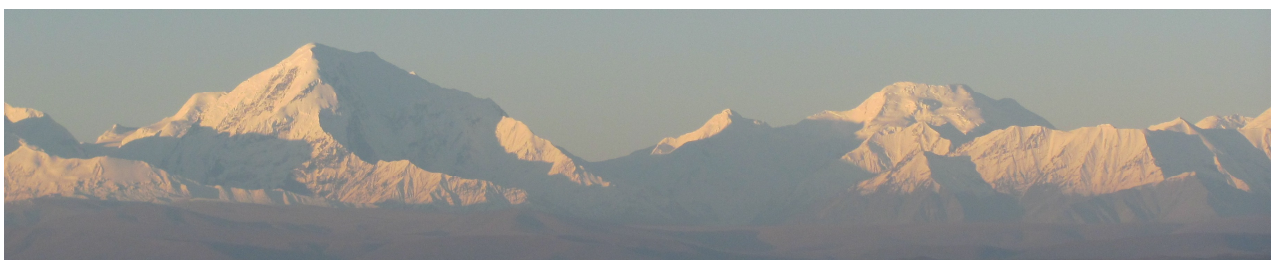
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# 1. Overview

Watershed Sciences, Inc. (WS) collected Light Detection and Ranging (LiDAR) data of the Alaska Pipeline for the Alaska Department of Natural Resources. LiDAR data for Delivery 5 was collected between May 17th and June 16th, 2011 (**Figure 1**). Delivery 5 includes 226,450 acres within the requested area. This area was expanded to include a 100m buffer to ensure complete coverage and adequate point densities around survey boundaries, resulting in 247,206 acres of delivered data. This area covers all UTM Zone 5 portions of the project, including the lower portions of the Southwest branch from Anchorage, AK to Denali National Park and along State Hwy 11 from Five Mile Airport to north of Wiseman, AK. Accuracy and density data will continue to be updated as additional data is processed.

***Figure 1***. *Alaska Pipeline survey delivery status overview.*

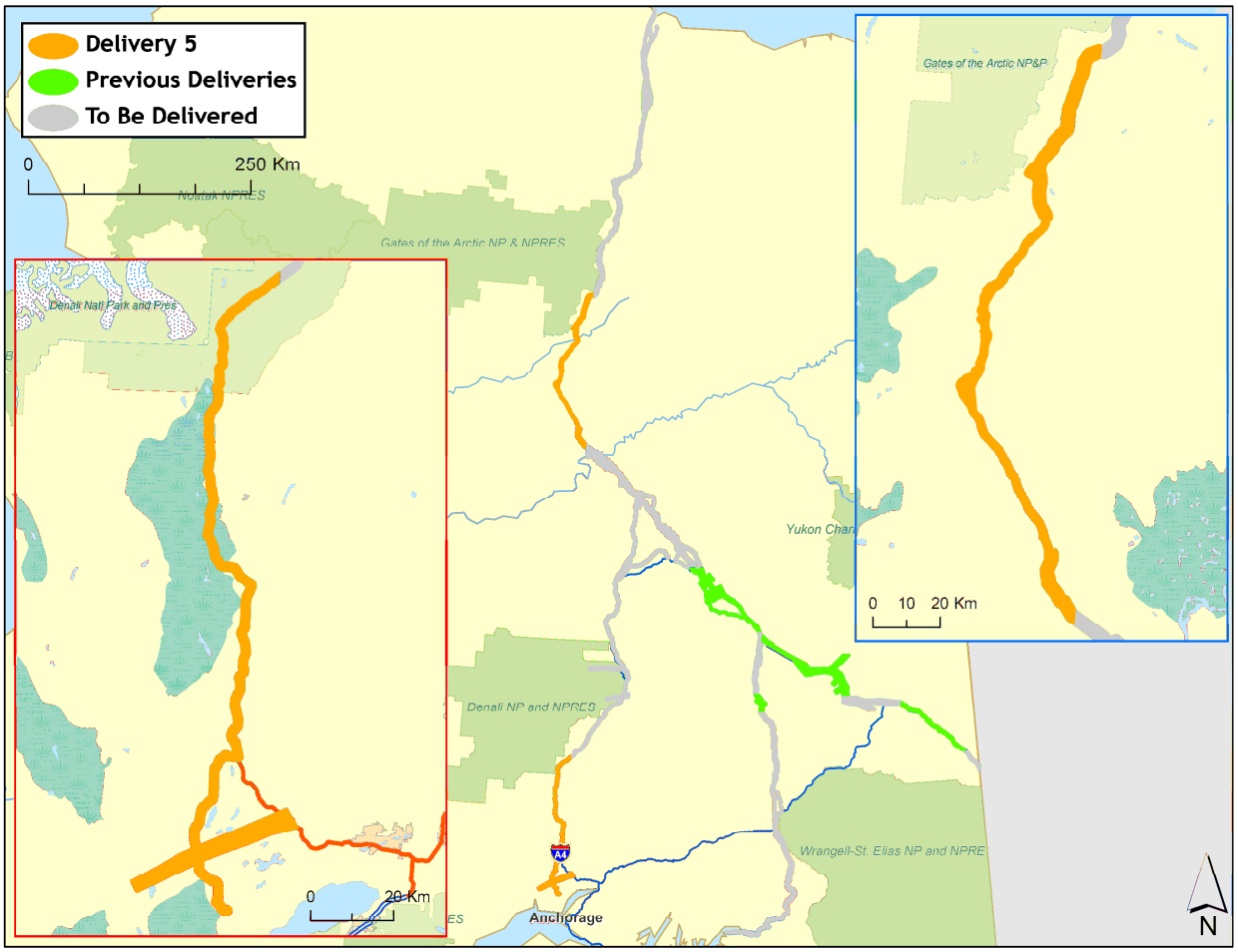


***Table 1**. Alaska Pipeline, LiDAR deliveries to date.*

| Delivery | UTM Zone(s) | Date | Total Acres Flown | AOI Acres |
|---|---|---|---|---|
| **1** | 6, 7 | March 9, 2011 | 121,746 | 117,357 |
| **2** | 6 | March 31, 2011 | 99,594 | 94,885 |
| **3** | 7 | May 23, 2011 | 43,976 | 39,744 |
| **4** | 6 | July 29, 2011 | 168,823 | 159,433 |
| **5** | 5 | August, 31, 2011 | 247,206 | 226,450 |

# 2. Acquisition

## 2.1 Airborne Survey – Instrumentation and Methods

The LiDAR survey utilized a Leica ALS60 sensor in a Cessna Caravan 208Bs. The Leica systems were set to acquire 150,000 laser pulses per second (i.e., 150 kHz pulse rate) and flown at 1500 meters above ground level (AGL), capturing a scan angle of ±14$^{o}$ from nadir when clouds and terrain permitted. With these flight parameters, the laser swath width is 638m and the laser pulse footprint is 34cm. These settings varied depending on cloud cover and terrain but were consistently adjusted to yield an average native pulse density of ≥8 pulses per square meter over terrestrial surfaces. It is not uncommon for some types of surfaces (e.g. dense vegetation or water) to return fewer pulses than the laser originally emitted. These discrepancies between 'native' and 'delivered' density will vary depending on terrain, land cover, and the prevalence of water bodies.



*The Cessna Caravan is a stable platform, ideal for flying slow and low for high density projects. A Leica ALS60 sensor head installed in the Caravan is shown on the left.*

All areas were surveyed with an opposing flight line side-lap of ≥60% (≥100% overlap) to reduce laser shadowing and increase surface laser painting. The Leica laser systems allow up to four range measurements (returns) per pulse, and all discernable laser returns were processed for the output dataset.

To accurately solve for laser point position (geographic coordinates x, y, z), the positional coordinates of the airborne sensor and the attitude of the aircraft were recorded continuously throughout the LiDAR data collection mission. Aircraft position was measured twice per second (2 Hz) by an onboard differential GPS unit. 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/sensor position and attitude data are indexed by GPS time.

## 2.2 Ground Survey – Instrumentation and Methods

### *2.2.1 Monumentation*




Watershed Sciences coordinated with McClintock Land Associates (MLA, Alaska Professional Licensed Surveyor), of Eagle River, AK to determine proposed monument locations to support aerial acquisition. MLA established survey control monuments for the project area based on the proposed locations, areas with reasonable access, GPS visibility and proximity to the mission area. MLA established 30 new monuments (**Table 2**) within the Delivery 5 calibration area. The MLA monumentation was done with 5/8" x 30" rebar topped with a metal cap stamped with "MLA-WSI" the monument ID, and the year of establishment. MLA provided professional supervision and oversight to all survey aspects of this project, certified all monuments and provided additional independent accuracy check points (see Section 5.4, Appendix B). A full report of the survey will be provided with the final delivery report.

### *2.2.2 Control for Airborne Surveys*

During the LiDAR survey, static (1 Hz recording frequency) ground surveys were conducted over the survey control monuments.

All control monuments were observed for a minimum of two survey sessions lasting no fewer than 4 hours. At the beginning of every session the tripod and antenna were reset, resulting in two independent instrument heights and data files. Data was collected at a rate of 1Hz using a 10 degree mask on the antenna.


Trimble R7 GPS equipment set up in the Alaska Pipeline study area.

After the airborne survey, the static GPS data were provided to MLA for incorporation in the computation of the monument coordinates. MLA processed the static GPS data using triangulation with Continuously Operating Reference Stations (CORS). Both WSI and MLA checked coordinates using the Online Positioning User Service (OPUS[1]) to quantify daily variance. MLA provided calculated geodetic positions for all controls.

Indexed by time, these GPS data were used to correct the continuous onboard measurements of aircraft position recorded throughout the mission. Control monuments were located within 13 nautical miles of the survey area as per the contract.

***Table 2**. Base Station control coordinates for Alaska Pipeline Delivery 5.*

| Base Station ID | Datum: NAD83 (CORS96) | | GRS80 |
|---|---|---|---|
| | Latitude | Longitude | Ellipsoid Z (meters) |
| 9 A | 67 38 44.37095 | 149 44 19.18264 | 441.322 |
| 9 B | 67 37 03.11551 | 149 47 42.14426 | 431.5965 |
| 9 C | 67 26 22.91437 | 150 04 42.17762 | 378.733 |
| 9 D | 67 24 56.76224 | 150 03 57.45230 | 413.0805 |
| 10 A | 67 14 42.63416 | 150 12 48.93421 | 321.991 |
| 10 B | 67 12 28.22856 | 150 15 54.15311 | 407.734 |
| 10 C | 67 14 33.93124 | 150 12 53.49361 | 321.702 |
| 11 A | 66 51 24.29315 | 150 33 50.26978 | 321.502 |
| 11 B | 66 53 42.49911 | 150 30 24.19484 | 357.642 |
| 12 A | 66 35 01.51125 | 150 45 39.22797 | 498.797 |
| 12 B | 66 33 20.49618 | 150 48 44.22162 | 349.546 |
| 13 A | 66 16 56.68205 | 150 21 53.76969 | 539.594 |
| 13 B | 66 16 56.68205 | 150 21 53.76969 | 569.613 |
| 14 A | 65 58 31.83194 | 149 59 57.53743 | 192.462 |
| 14 B | 65 56 43.26422 | 149 54 10.72872 | 190.6235 |
| 14 C | 65 52 46.69362 | 143 42 52.36332 | 103.2275 |
| 42 A | 61 31 54.28180 | 150 05 59.49078 | 74.735 |
| 42 B | 61 32 06.09893 | 150 06 22.44100 | 70.725 |
| 42 C | 61 37 30.34310 | 149 48 01.11813 | 86.158 |
| 43 A | 61 45 35.19995 | 150 03 21.98346 | 70.805 |
| 43 B | 61 44 51.93860 | 150 02 45.10456 | 75.625 |
| 43 C | 61 44 51.74093 | 150 03 01.79508 | 74.845 |
| 44 A | 62 08 18.48987 | 150 03 12.27746 | 113.849 |

[1] Online Positioning User Service (OPUS) is run by the National Geodetic Survey to process corrected monument positions.

| | | | |
|---|---|---|---|
| 44 B | 62 08 50.98324 | 150 04 48.37762 | 118.288 |
| 45 A | 62 18 44.32984 | 150 13 57.75190 | 121.535 |
| 45 B | 62 20 51.08093 | 150 15 02.57338 | 138.611 |
| 46 A | 62 33 36.51426 | 150 13 39.09936 | 228.794 |
| 46 B | 62 35 29.43034 | 150 14 16.00123 | 209.918 |
| 47 A | 62 43 50.67840 | 150 10 06.89068 | 258.6735 |
| 47 B | 62 44 36.63946 | 150 08 13.09042 | 269.5815 |

### *2.2.3 Instrumentation*

For this survey, a Trimble GPS receiver model R7 with Zephyr Geodetic antenna with ground plane was deployed for all static control. A Trimble model R8 GNSS unit was used for collecting check points using real time kinematic (RTK) survey techniques. All GPS measurements were made with dual frequency L1-L2 receivers with carrier-phase correction.

The aircraft was assigned a ground crew member with two Trimble R7 receivers and an R8 receiver. The ground crew vehicles are equipped with standard field survey supplies and equipment including safety materials. The aircraft was further supported, as necessary, by an MLA surveyor (AK PLS) with two or more survey grade Topcon Receivers.

### *2.2.4 Methodology*

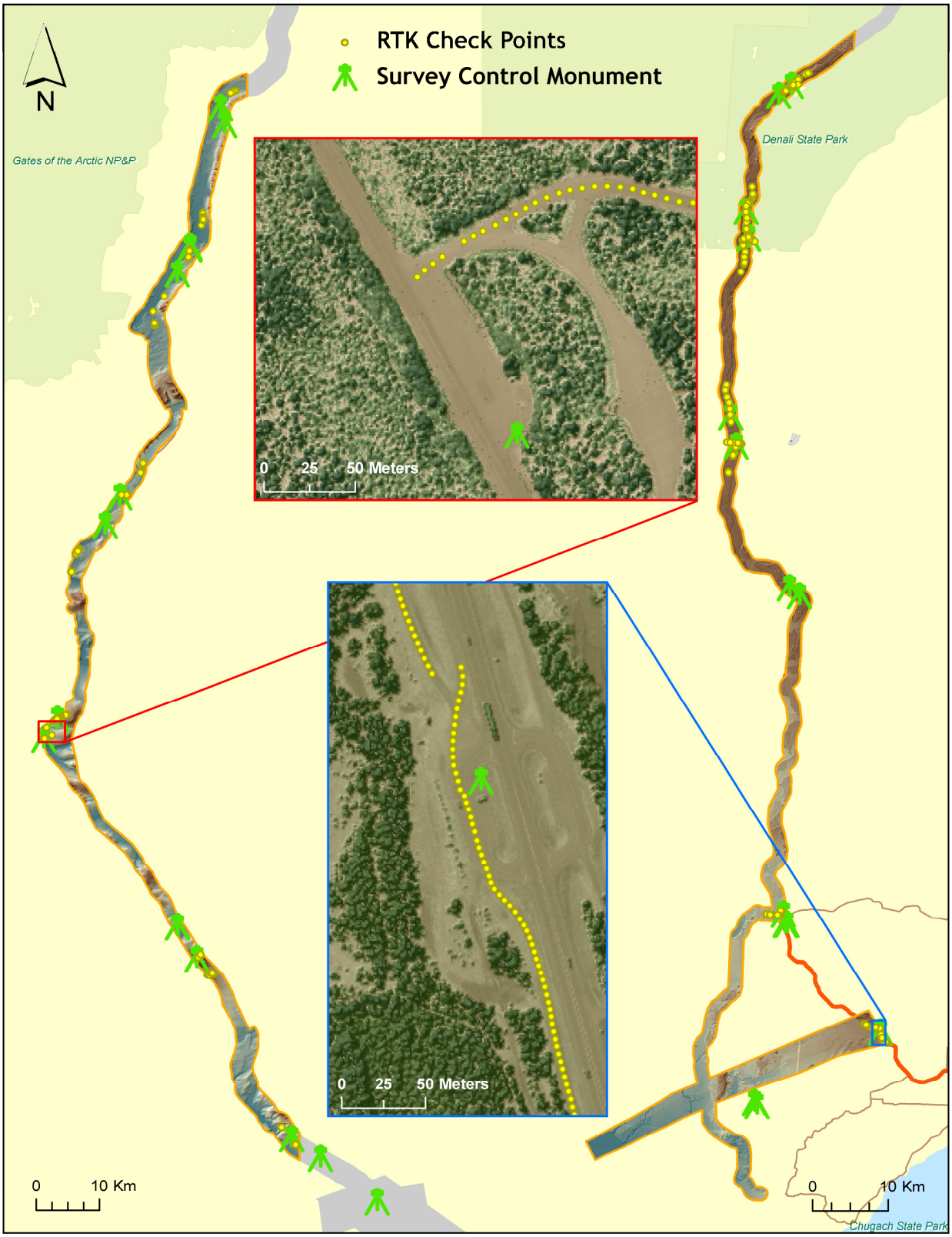
RTK and aircraft mounted GPS measurements were made during periods with PDOP[2] less than or equal to 3.0 and with at least 6 satellites in view of both a stationary reference receiver and the roving receiver. Static GPS data collected in a continuous session average the high PDOP into the final solution in the method used by CORS stations.

For RTK data, the collector begins recording after remaining stationary for 5 seconds then calculating the pseudo range position from at least three epochs with the relative error under 1.5cm horizontal and 2cm vertical. RTK positions are collected on bare earth locations such as paved, gravel or stable dirt roads, and other locations where the ground is clearly visible (and is likely to remain visible) from the sky during the data acquisition and RTK measurement period(s).

In order to facilitate comparisons with LiDAR measurements, RTK measurements were not taken on highly reflective surfaces such as center line stripes or lane markings on roads. RTK points were taken no closer than one meter to any nearby terrain breaks such as road edges or drop offs.

[2]PDOP: Point Dilution of Precision is a measure of satellite geometry, the smaller the number the better the geometry between the point and the satellites.

***Figure 2.*** *WSI RTK check points and control monument locations used in Delivery 5 of the Alaska Pipeline LiDAR Survey.*



# 3. LiDAR Data Processing

## 3.1 Applications and Work Flow Overview

1. Resolved kinematic corrections for aircraft position data using kinematic aircraft GPS and static ground GPS data.

   **Software:** Waypoint GPS v.8.10, Trimble Geomatics Office v.1.62
2. Developed a smoothed best estimate of trajectory (SBET) file that blends post-processed aircraft position with attitude data. Sensor head position and attitude were calculated throughout the survey. The SBET data were used extensively for laser point processing.

   **Software:** IPAS v.1.35
3. Calculated laser point position by associating SBET position to each laser point return time, scan angle, intensity, etc. Created raw laser point cloud data for the entire survey in *.las (ASPRS v. 1.2) format.

   **Software:** ALS Post Processing Software v.2.70
4. Imported raw laser points into manageable blocks (less than 500 MB) to perform manual relative accuracy calibration and filter for pits/birds. Ground points were then classified for individual flight lines (to be used for relative accuracy testing and calibration).

   **Software:** TerraScan v.11.009
5. Using ground classified points per each flight line, the relative accuracy was tested. Automated line-to-line calibrations were then performed for system attitude parameters (pitch, roll, heading), mirror flex (scale) and GPS/IMU drift. Calibrations were performed on ground classified points from paired flight lines. Every flight line was used for relative accuracy calibration.

   **Software:** TerraMatch v.11.006
6. Position and attitude data were imported. Resulting data were classified as ground and non-ground points. Statistical absolute accuracy was assessed via direct comparisons of ground classified points to ground RTK survey data. Data were then converted to orthometric elevations (NAVD88) by applying a Geoid09 correction. **Software:** TerraScan v.11.009, TerraModeler v.11.004
7. Bare Earth models were created as a triangulated surface and exported as ArcInfo ASCII grids at a 1 meter pixel resolution. Highest Hit models were created for any class at 1 meter grid spacing and exported as ArcInfo ASCII grids. Vegetation models were created for all vegetation points 20cm and above the ground model at a 1m grid spacing and exported as ArcInfo ASCII grids.

   **Software:** TerraScan v.11.009, ArcMap v. 9.3.1, TerraModeler v.11.004

## 3.2 Aircraft Kinematic GPS and IMU Data

LiDAR survey datasets were referenced to the 1 Hz static ground GPS data collected over pre-surveyed monuments with known coordinates. While surveying, the aircraft collected 2 Hz kinematic GPS data, and the onboard inertial measurement unit (IMU) collected 200 Hz aircraft attitude data. Waypoint GPS v.8.10 was used to process the kinematic corrections for the aircraft. The static and kinematic GPS data were then post-processed after the survey to

obtain an accurate GPS solution and aircraft positions. IPAS v.1.35 was used to develop a trajectory file that includes corrected aircraft position and attitude information. The trajectory data for the entire flight survey session were incorporated into a final smoothed best estimated trajectory (SBET) file that contains accurate and continuous aircraft positions and attitudes.

## 3.3 Laser Point Processing

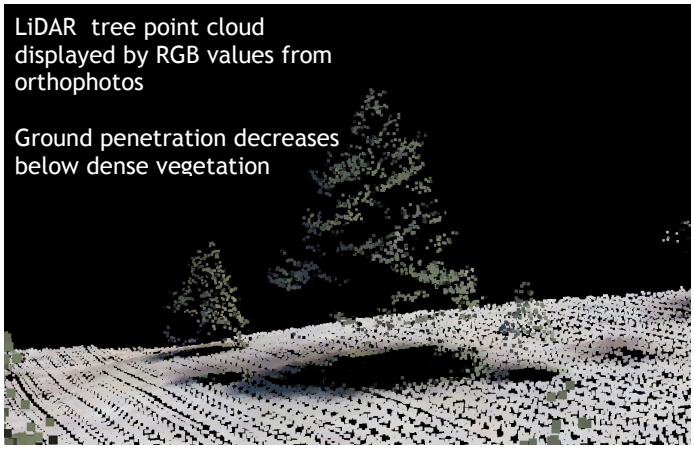
Laser point coordinates were computed using the IPAS and ALS Post Processor software suites based on independent data from the LiDAR system (pulse time, scan angle), and aircraft trajectory data (SBET). Laser point returns (first through fourth) were assigned an associated (x, y, z) coordinate along with unique intensity values (0-255). The data were output into large LAS v. 1.2 files with each point maintaining the corresponding scan angle, return number (echo), intensity, and x, y, z (easting, northing, and elevation) information.

These initial laser point files were too large for subsequent processing. To facilitate laser point processing, bins (polygons) were created to divide the dataset into manageable sizes (< 500 MB). Flightlines and LiDAR data were then reviewed to ensure complete coverage of the survey area and positional accuracy of the laser points.

Laser point data were imported into processing bins in TerraScan, and manual calibration was performed to assess the system offsets for pitch, roll, heading and scale (mirror flex). Using a geometric relationship developed by Watershed Sciences, each of these offsets was resolved and corrected if necessary.

LiDAR points were then filtered for noise, pits (artificial low points), and birds (true birds as well as erroneously high points) by screening for absolute elevation limits, isolated points and height above ground. Each bin was then manually inspected for remaining pits and birds and spurious points were removed. In a bin containing approximately 7.5-9.0 million points, an average of 50-100 points are typically found to be artificially low or high. Common sources of non-terrestrial returns are clouds, birds, vapor, haze, decks, brush piles, etc.

Internal calibration was refined using TerraMatch. Points from overlapping lines were tested for internal consistency and final adjustments were made for system misalignments (i.e., pitch, roll, heading offsets and scale). Automated sensor attitude and scale corrections yielded 3-5 cm improvements in the relative accuracy. Once system misalignments were corrected, vertical GPS drift was then resolved and removed per flight line, yielding a slight improvement (<1 cm) in relative accuracy.




The TerraScan software suite is designed specifically for classifying near-ground points (Soininen, 2004). The processing sequence began by 'removing' all points that were not 'near' the earth based on geometric constraints used to evaluate

multi-return points. The resulting bare earth (ground) model was visually inspected and additional ground point modeling was performed in site-specific areas to improve ground detail. This manual editing of ground often occurs in areas with known ground modeling deficiencies, such as: bedrock outcrops, cliffs, deeply incised stream banks, and dense vegetation. In some cases, automated ground point classification erroneously included known vegetation (i.e., understory, low/dense shrubs, etc.). These points were manually reclassified. Ground surface rasters were then developed from triangulated irregular networks (TINs) of ground points.

To develop the highest hit and vegetation models, buildings and structures were classified through automated point processing algorithms and then manually inspected and edited during the ground model inspection. Typically, manual editing of building classification was necessary where dense canopy was immediately proximate to buildings, or where structures such as utility poles or fences mimicked vegetation.

The remaining points not classified as ground, buildings, or error points were separated into two vegetation classes; Low Vegetation consisting of all returns ≤20cm from the ground, and Medium Vegetation consisting of all returns >20cm from the ground. This distinction was necessary because some potential for unclassified ground exists in the dataset. Vegetation classified returns within 20cm of the ground have higher potential to be artifacts of the dataset caused by minor offsets between flightlines (typically <10cm), isolated noise points, or abrupt discrete terrain features that did not get classified as ground (i.e. small boulders or sharp cliffs). The majority of points classified as low vegetation are valid returns, so the class was retained in the dataset to be incorporated into analyses at the user's discretion.

**Table 3.** ASPRS classification definitions for the Alaska Pipeline LiDAR survey

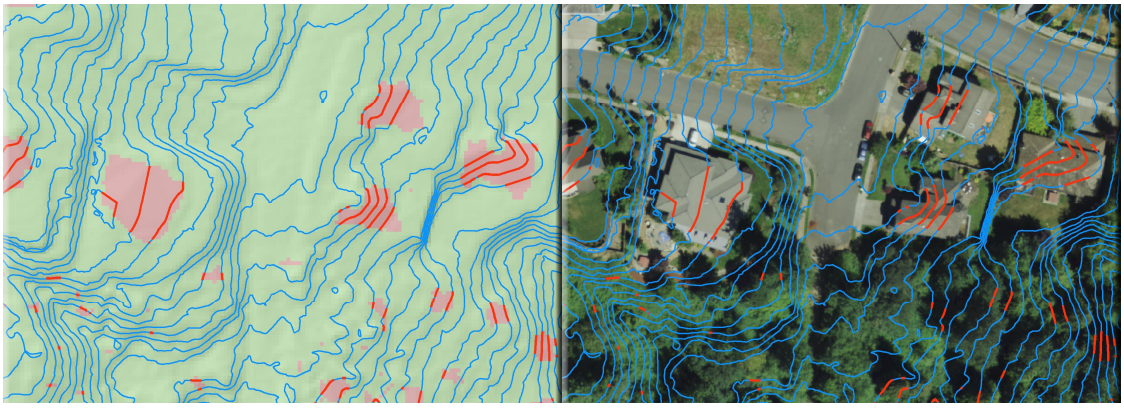
| ASPRS Class | Definition |
|---|---|
| 2 | Ground |
| 3 | Low Vegetation |
| 4 | Medium Vegetation |
| 6 | Buildings/Man-made structures |
| 7 | Noise/error points |
| 9 | Water |
| 15 | Pipeline |

## 3.4 Contour Development

Contour lines were derived at 1 meter intervals from ground-classified LiDAR point data using TerraSolid processing software in MicroStation v. 8.1. Contour generation from LiDAR point data requires a thinning operation in order to reduce contour sinuosity. Parameters for these operations are: thinning elevation bounds: +/- 0.07m; search radius: 6.09m. The thinning operation reduces point density where topographic change is minimal (flat surfaces) while preserving resolution where topographic change is present. The total sum of potential error in vertical position is equal to twice the point processing limits (0.14m) plus twice the 2-sigma absolute vertical accuracy value for this dataset.

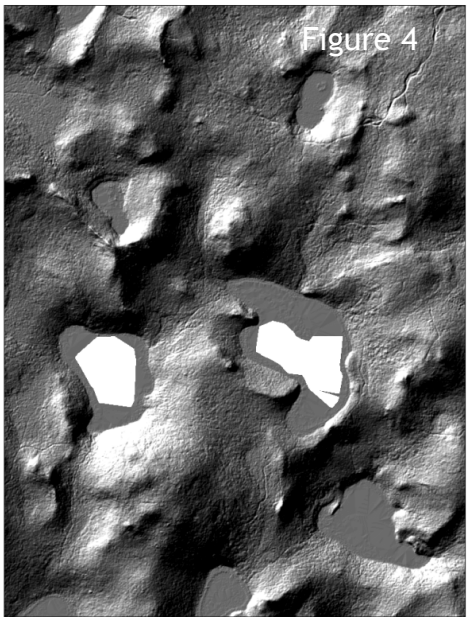
Ground point density rasters were created within MicroStation using a 1 meter step resolution and a 2 meter sampling radius. Areas with less than 0.25 ground-classified points per square meter were considered "sparse" and areas with higher densities were considered "covered". The ground point density raster data are in ESRI GRID format and have a 1 meter pixel resolution. The contour lines were intersected with ground point density raster data, allowing the addition of a confidence attribute to contour lines. Contour lines over "sparse" areas have low confidence, while contour lines over "covered" areas have a high confidence. Areas with low ground point density are commonly beneath buildings and bridges, in locations with dense vegetation, over water, and in other areas where laser penetration to the ground surface is impeded. **Figure 3** is an example of a ground point density raster and contour lines.

***Figure 3**. Elevation contours over LiDAR ground-classified point density raster (left) and true-color aerial photograph (right). Red indicates low ground point density and blue represents high density.*

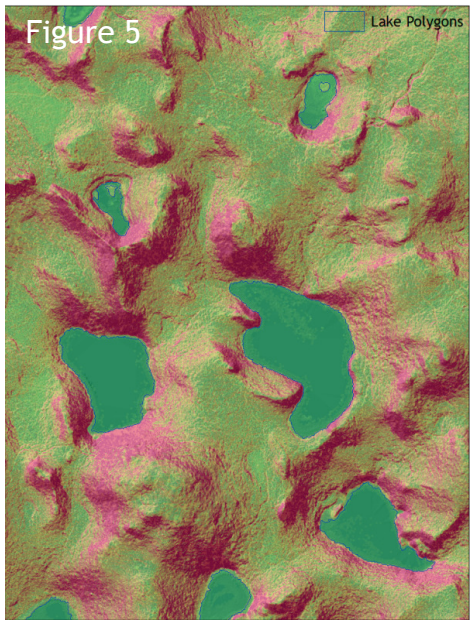


## 3.5 Hydro-Flattening

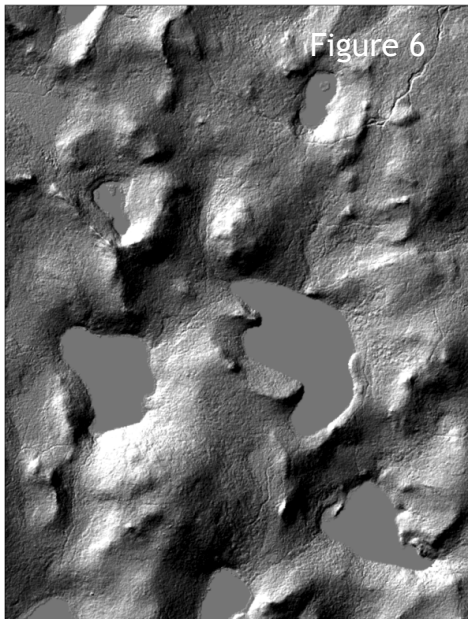
Lakes and other closed water bodies with surface area >150 $m^2$ were flattened to a consistent water level. The hydro-flattening process eliminates artifacts in the digital terrain model caused by both increased variability in ranges or dropouts in laser returns due to the low reflectivity of water (**Figure 4**). As per the project specifications, rivers and streams were not hydro-flattened.




Hydro-flattening of closed water bodies was performed through a combination of automated and manual detection and adjustment techniques designed to identify lake boundaries and water levels. Boundary polygons were developed using an algorithm which weights LiDAR-derived slopes, intensities, and return densities to detect the lake edge. The lake edges were then manually reviewed and edited in a 3-D environment. Once polygons were developed, the lake elevations were computed from the filtered LiDAR returns (**Figure 5**).




Returns from the water surface within each polygon were filtered and inspected for false low points during the initial ground modeling process described previously (Section 3.3). The elevation of each lake was computed as 5-cm above the minimum elevation of filtered water surface cells within the lake polygon. This approach ensures that all spurious returns off the water surface (both artificially high and low) were excluded from lake level assessment.




Lake-boundary polygons were then incorporated into the final terrain model and enforced as hard-breaklines. The initial ground classified points falling within lake polygons were reclassified as water points [to omit them from the final ground model] and replaced with the flat water surface of the lake boundary hydrolines (**Figure 6**).

# 4. LiDAR Accuracy Assessment

## 4.1 Laser Noise and Relative Accuracy

*Laser Noise*
For any given target, laser noise is the breadth of the data cloud per laser return (i.e., last, first, etc.). Lower intensity surfaces (roads, rooftops, still/calm water) experience higher laser noise. The laser noise range for this survey was approximately 0.02 meters.

*Relative Accuracy*
Relative accuracy refers to the internal consistency of the data set - the ability to place a laser point in the same location over multiple flight lines, GPS conditions, and aircraft attitudes. Affected by system attitude offsets, scale, and GPS/IMU drift, internal consistency is measured as the divergence between points from different flight lines within an overlapping area. Divergence is most apparent when flight lines are opposing. When the LiDAR system is well calibrated, the line-to-line divergence is low (<10 cm). See Appendix A for further information on sources of error and operational measures that can be taken to improve relative accuracy.

**Relative Accuracy Calibration Methodology**

1. Manual System Calibration: Calibration procedures for each mission require solving geometric relationships that relate measured swath-to-swath deviations to misalignments of system attitude parameters. Corrected scale, pitch, roll and heading offsets were calculated and applied to resolve misalignments. The raw divergence between lines was computed after the manual calibration was completed and reported for each survey area.
2. Automated Attitude Calibration: All data were tested and calibrated using TerraMatch automated sampling routines. Ground points were classified for each individual flight line and used for line-to-line testing. System misalignment offsets (pitch, roll and heading) and scale were solved for each individual mission and applied to respective mission datasets. The data from each mission were then blended when imported together to form the entire area of interest.
3. Automated Z Calibration: Ground points per line were used to calculate the vertical divergence between lines caused by vertical GPS drift. Automated Z calibration was the final step employed for relative accuracy calibration.

## 4.2 Absolute Accuracy

Laser point absolute accuracy is largely a function of laser noise and relative accuracy. To minimize these contributions to absolute error, a number of noise filtering and calibration procedures were performed prior to evaluating absolute accuracy. The LiDAR quality assurance process uses the data from the real-time kinematic (RTK) ground survey conducted in the AOI. For Delivery 5, **3918 RTK** GPS measurements were collected on hard surfaces distributed among multiple flight swaths for a total of 10,783 points across all delivered data. Suitable and accessible hard-surfaces limited the number and distribution of RTK points able to be collected. To assess absolute accuracy the location coordinates of these known RTK ground points were compared to those calculated for the closest ground-classified laser points.

The vertical accuracy of the LiDAR data is described as the mean and standard deviation (sigma ~ $\sigma$) of divergence between LiDAR point coordinates and RTK ground survey point coordinates. To provide a sense of the model predictive power of the dataset, the root mean square error (RMSE) for vertical accuracy is also provided. These statistics assume the error distributions for x, y, and z are normally distributed, thus the skew and kurtosis of distributions are considered when evaluating error statistics.

Statements of statistical accuracy apply to fixed terrestrial surfaces only and may not be applied to areas of dense vegetation or steep terrain (See Appendix A).

## 5. Study Area Results

Summary statistics for point resolution and accuracy (relative and absolute) of the LiDAR data collected in the Alaska Pipeline Delivery 5 survey area have been added to previously delivered data. Cumulative results are presented below in terms of central tendency, variation around the mean, and the spatial distribution of the data (for point resolution by processing bin).

The initial dataset, acquired to be ≥8 points per square meter, was filtered as described previously to remove spurious or inaccurate points. Additionally, some types of surfaces (i.e., dense vegetation, breaks in terrain, water, steep slopes) may return fewer pulses (delivered density) than the laser originally emitted (native density).

Ground classifications were derived from automated ground surface modeling and manual, supervised classifications where it was determined that the automated model had failed. Ground return densities will be lower in areas of dense vegetation, water, or buildings.

### Data Summary:

***Table 4****. LiDAR Resolution and Accuracy - Specifications and Achieved Values*

| | | Targeted | Achieved |
|---|---|---|---|
| **Resolution:** | **UTM 5** | ≥ 8 points/$m^2$ | 8.60 points/$m^2$ |
| | **UTM 6** | | 8.55 points/$m^2$ |
| | **UTM 7** | | 8.68 points/$m^2$ |
| **Vertical Accuracy (1 $\sigma$):** | | <13 cm | 3.3 cm |

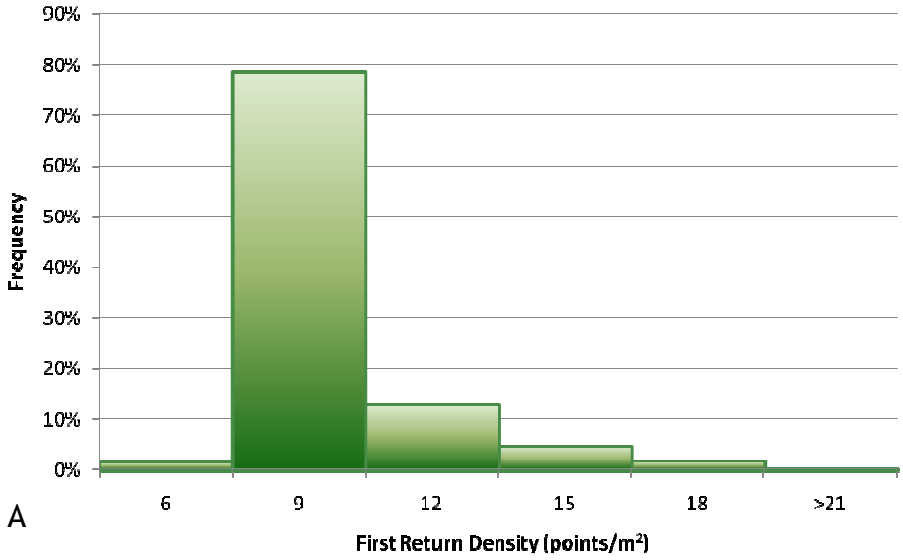
## 5.1 Data Density/Resolution

**Figures 10 - 17** display the distribution of average native and ground point densities for each processing bin. Density data will continue to be updated as data is processed and delivered.

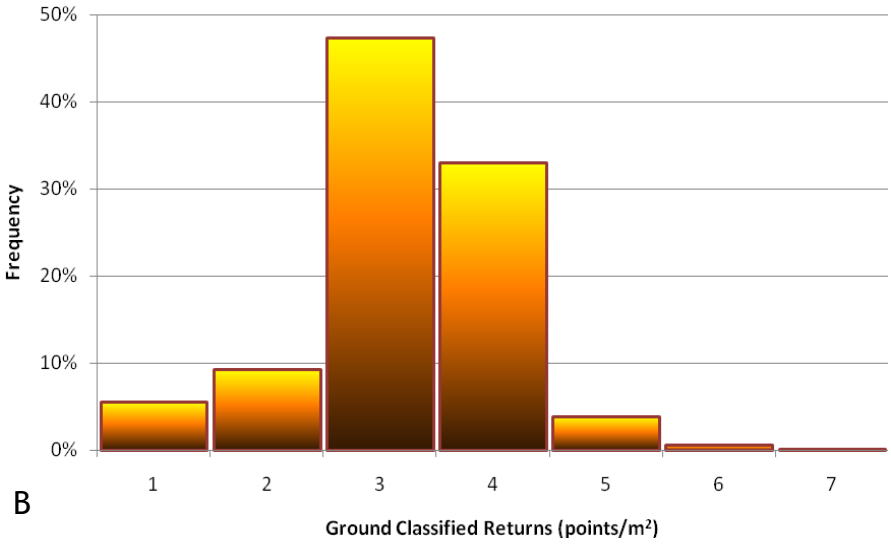
LiDAR data resolution for Alaska Pipeline deliveries to date:

| | UTM 5 | UTM 6 | UTM 7 |
|---|---|---|---|
| Average Point (First Return) Density | 8.60 points/$m^2$ | 8.55 points/$m^2$ | 8.68 points/$m^2$ |
| Average Ground Point Density | 2.72 points/$m^2$ | 2.57 points/$m^2$ | 2.90 points/$m^2$ |

***Figure 7**. Density distribution for first return (A) and ground classified (B) laser points for UTM 5*

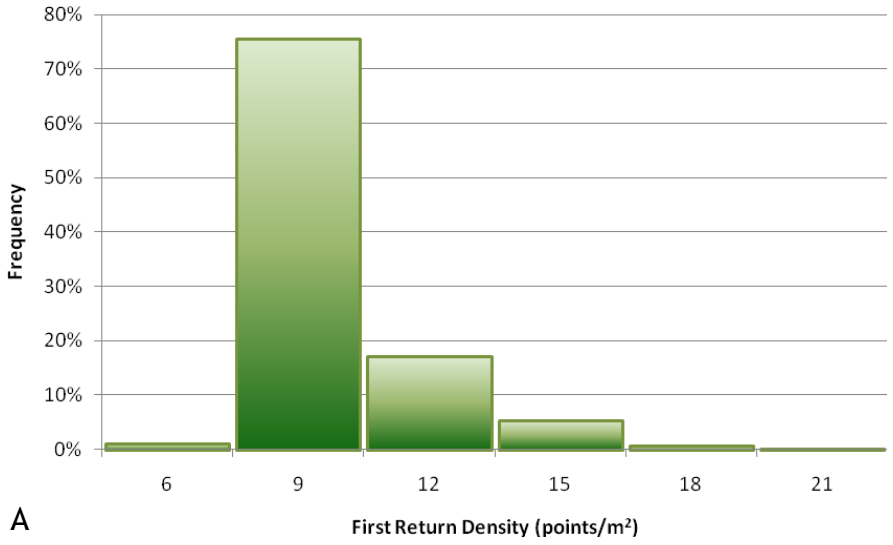



A

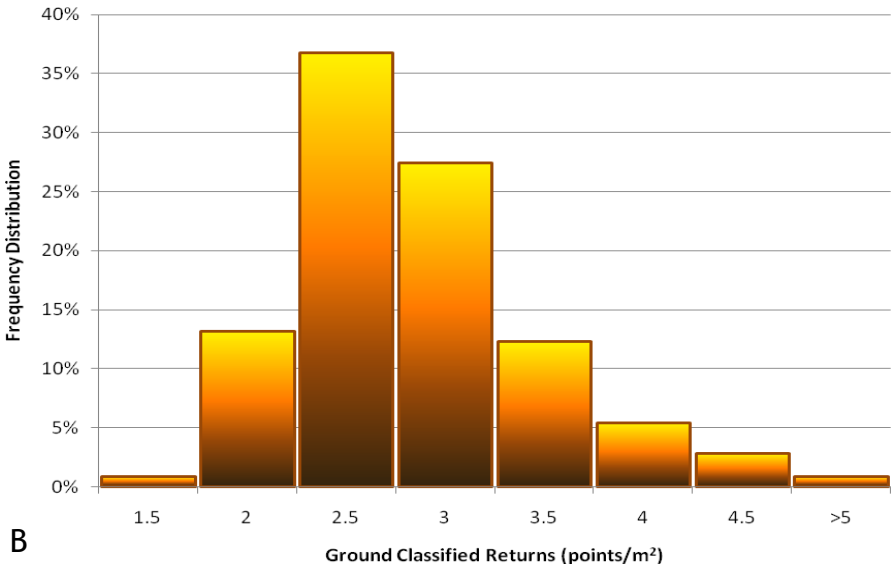



B

***Figure 8.*** *Density distribution for first return (A) and ground classified (B) laser points for UTM 6*




A




B

***Figure 9**. Density distribution for first return (A) and ground classified (B) laser points for UTM 7*

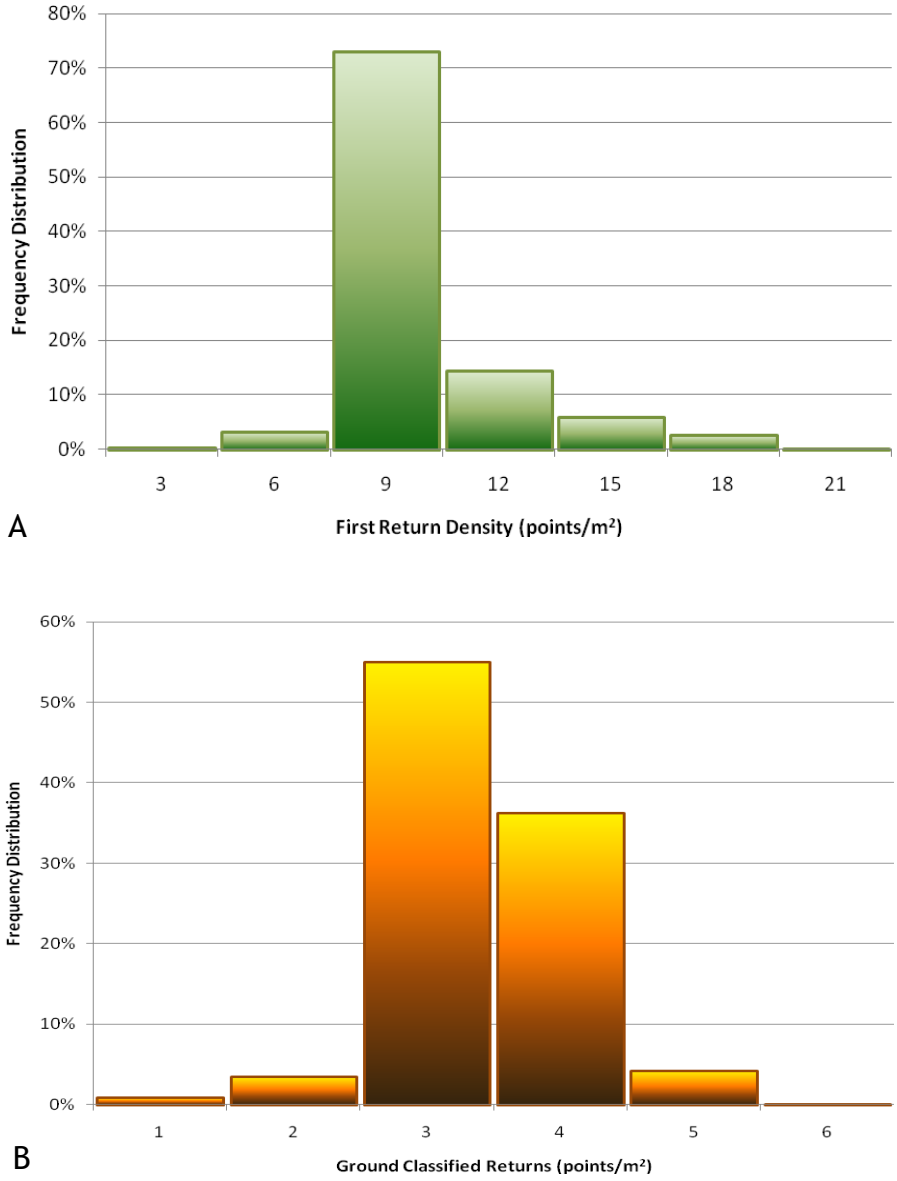


***Figure 10.*** *Density distribution map for ground and first return points by processing bin in Delivery 1, UTM 6*

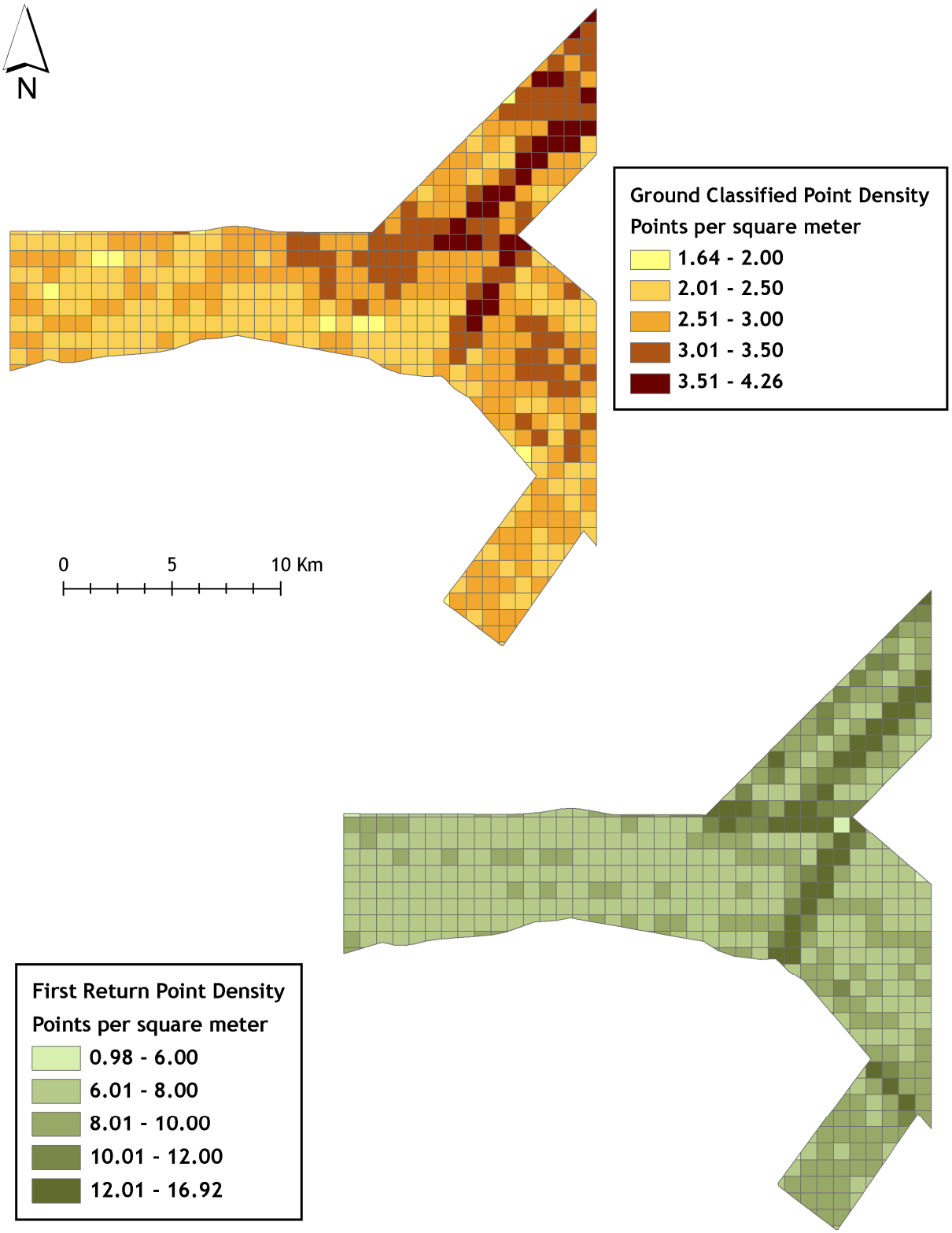


***Figure 11.*** *Density distribution map for ground and first return points by processing bin in Delivery 1, UTM 7*

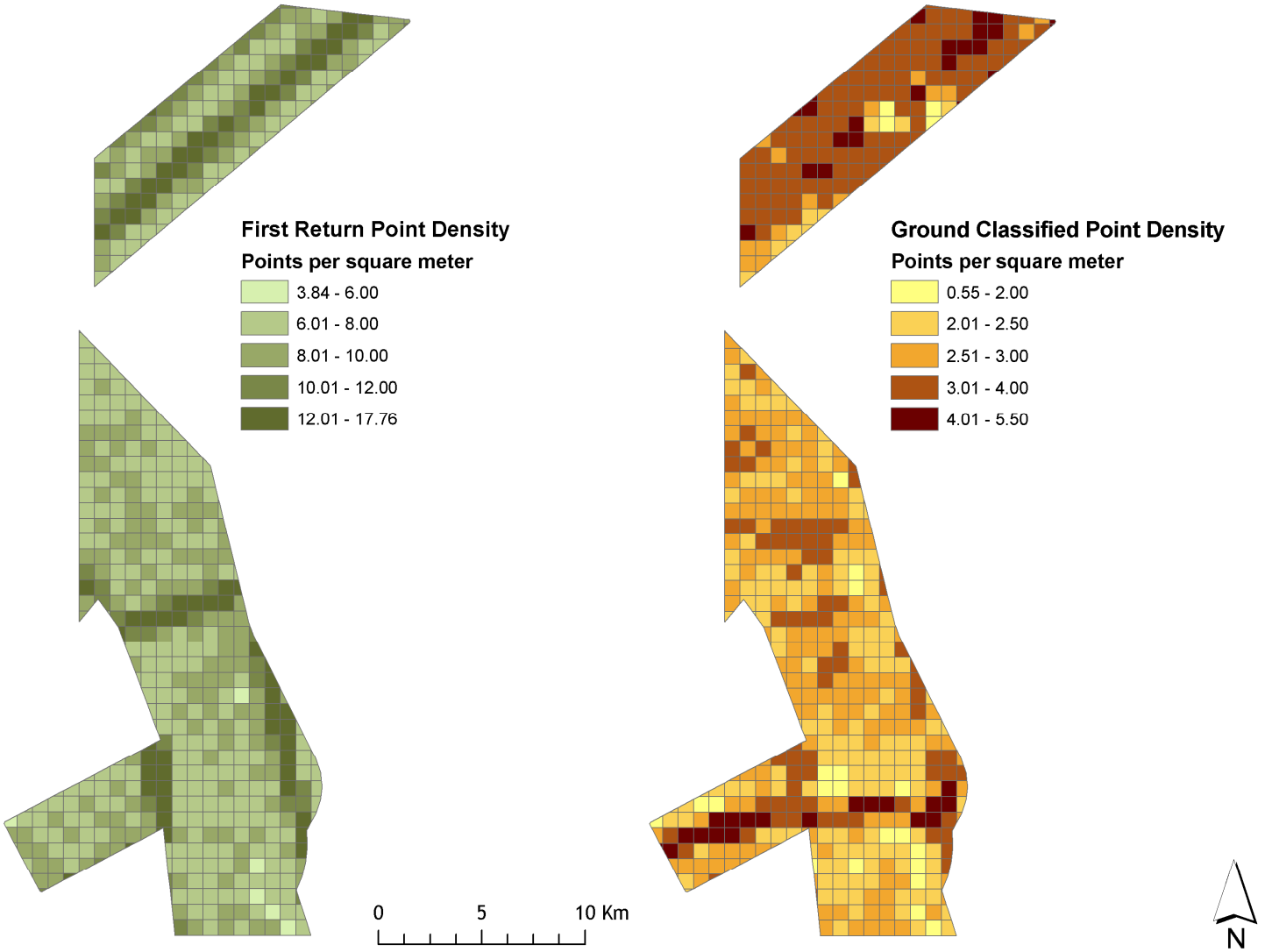


***Figure 12.*** *Density distribution map for ground points by processing bin in Delivery 2, UTM 6*

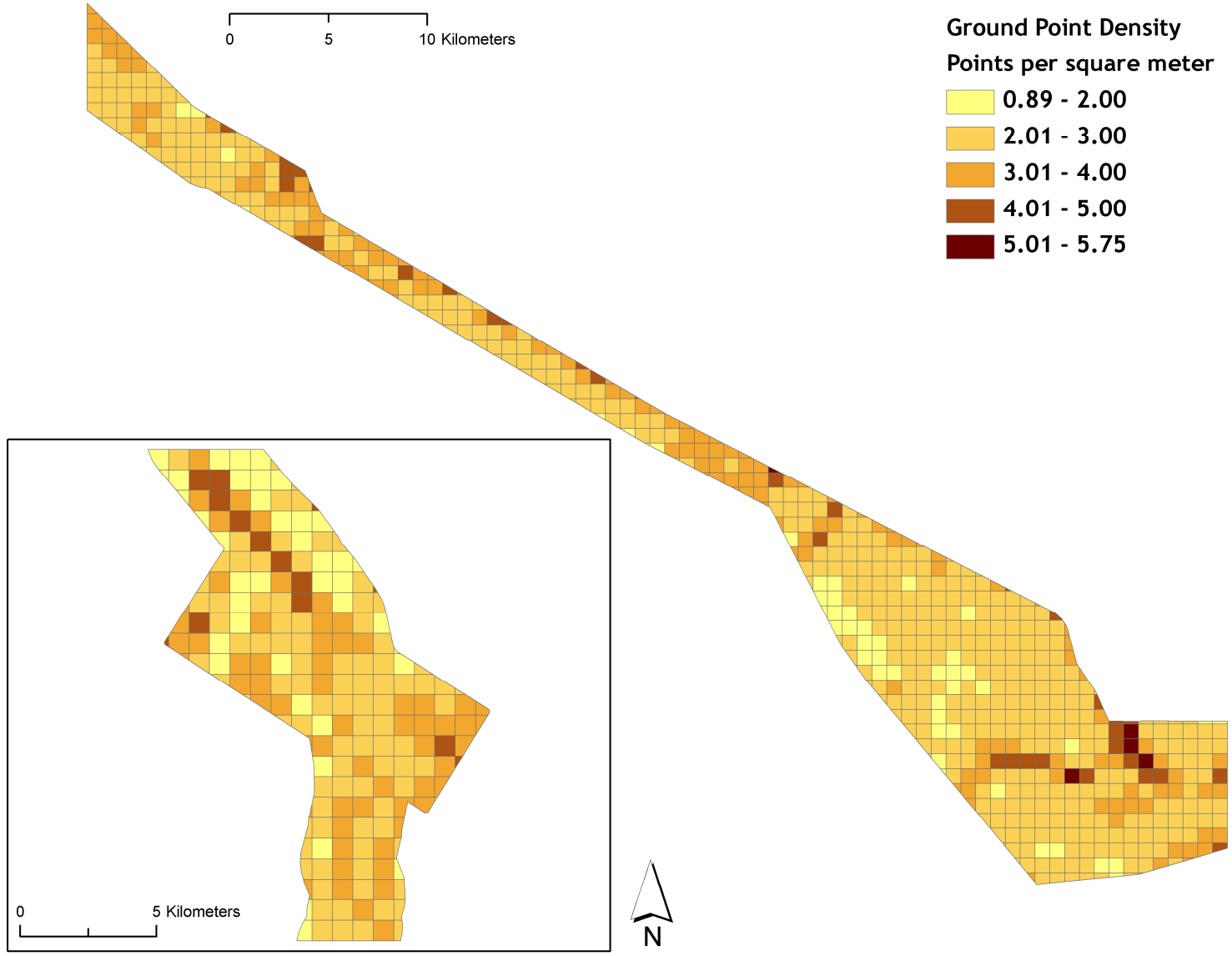


***Figure 13***. *Density distribution map for first return points by processing bin in Delivery 2, UTM 6*

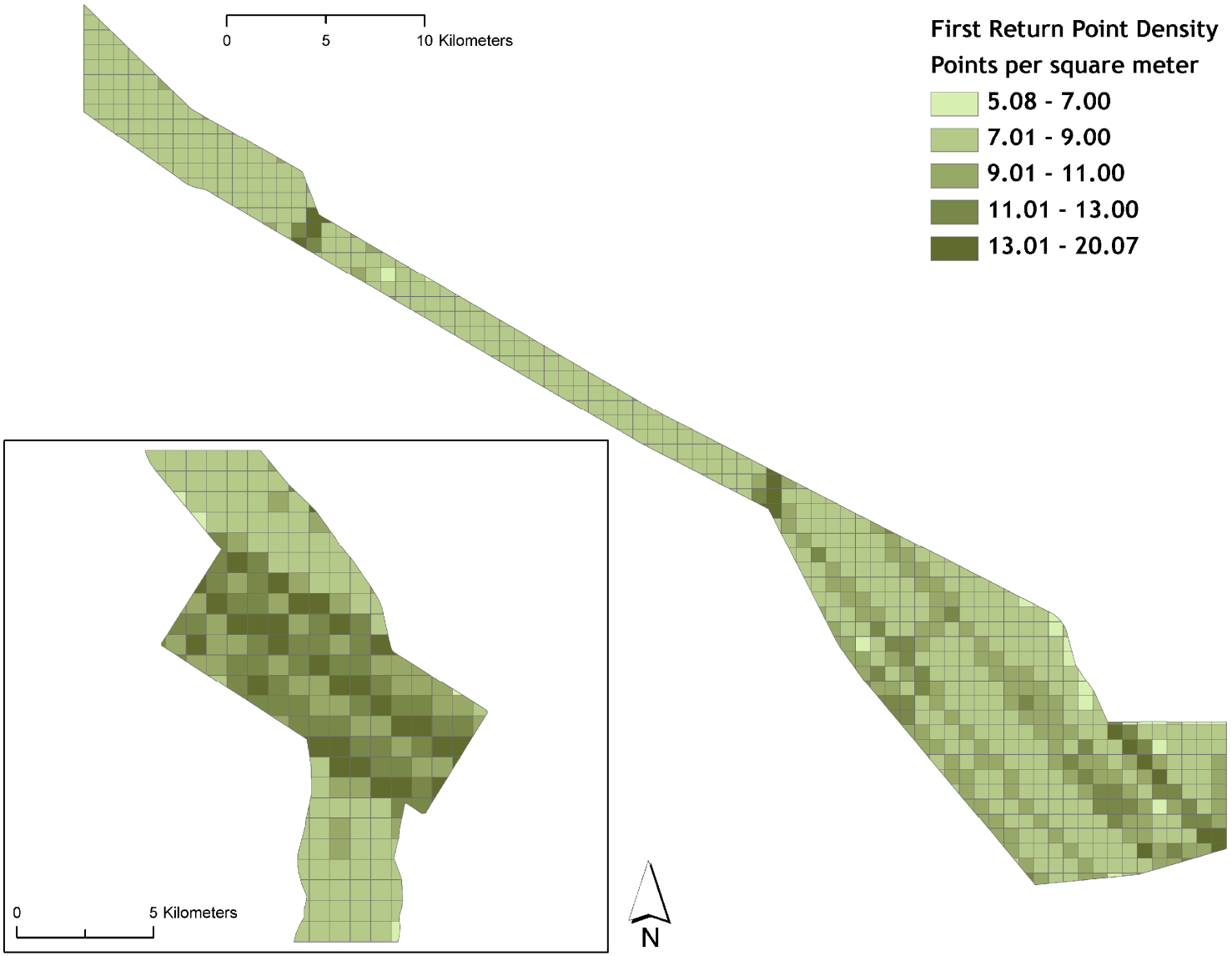


***Figure 14**. Density distribution map for ground and first return points by processing bin in Delivery 3, UTM 7*

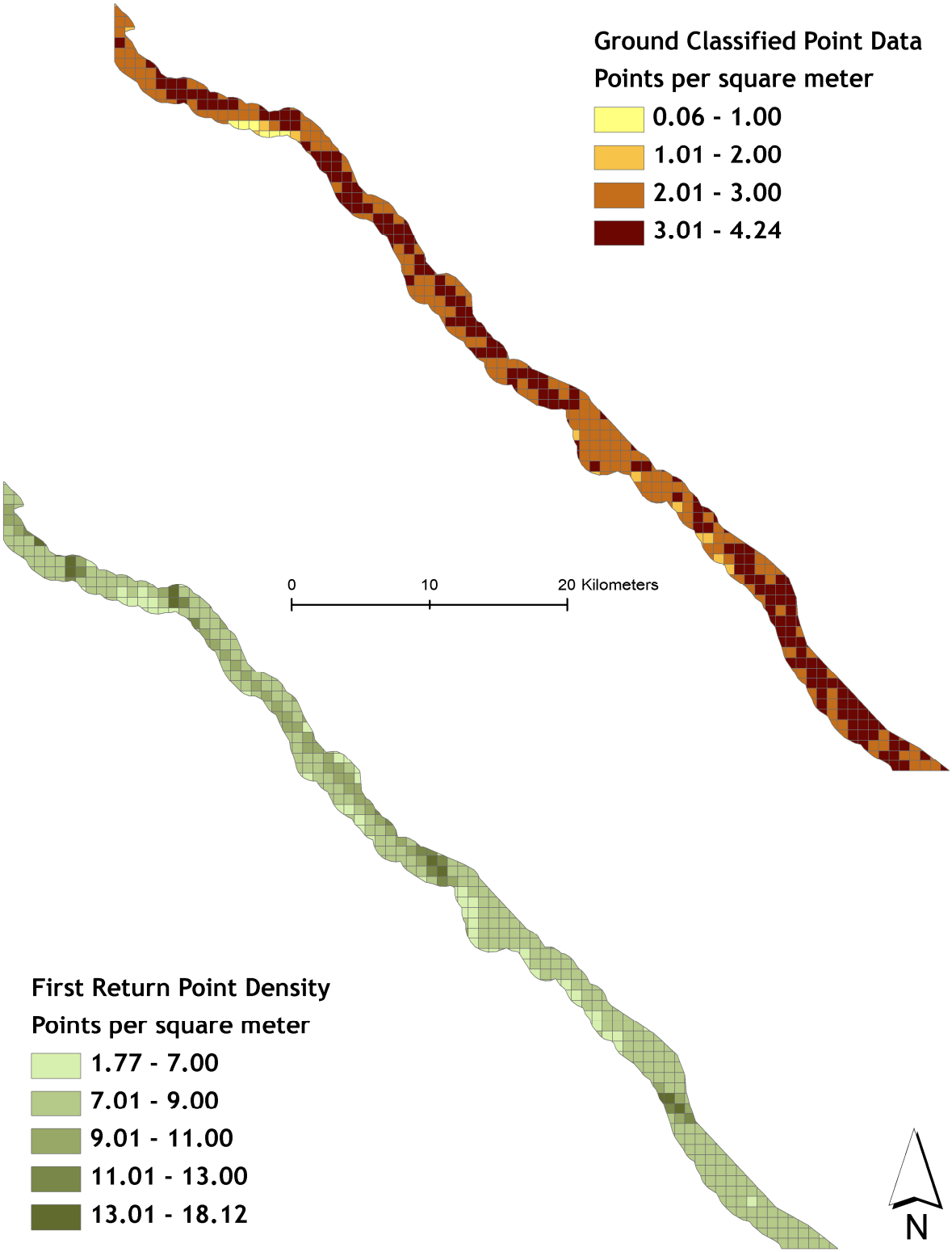


***Figure 15**. Density distribution map for ground and first return points by processing bin in Delivery 4, UTM 6*

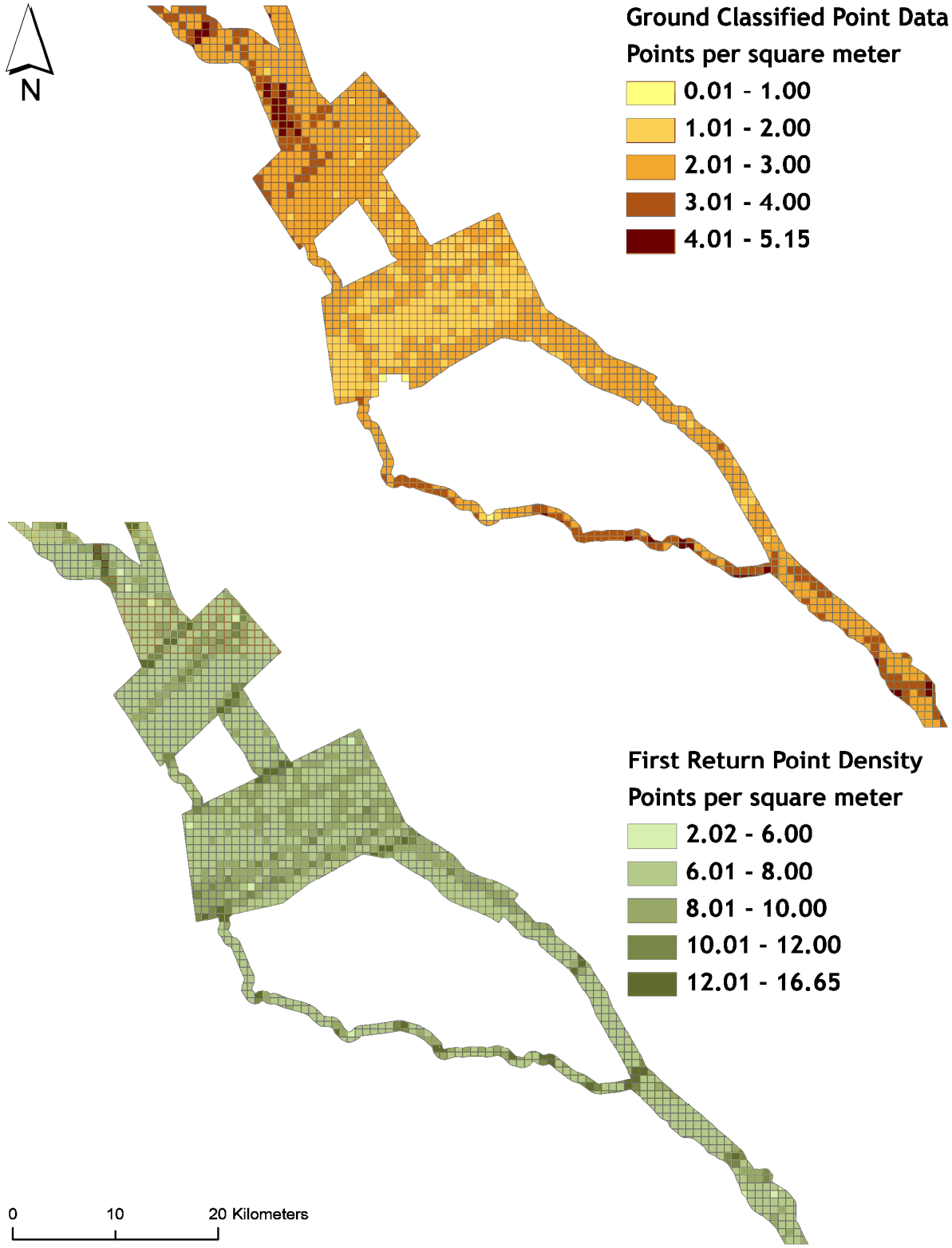


***Figure 16**. Density distribution map for ground classified points by processing bin in Delivery 5, UTM 5*



***Figure 17.*** *Density distribution map for first return points by processing bin in Delivery 5, UTM 5*

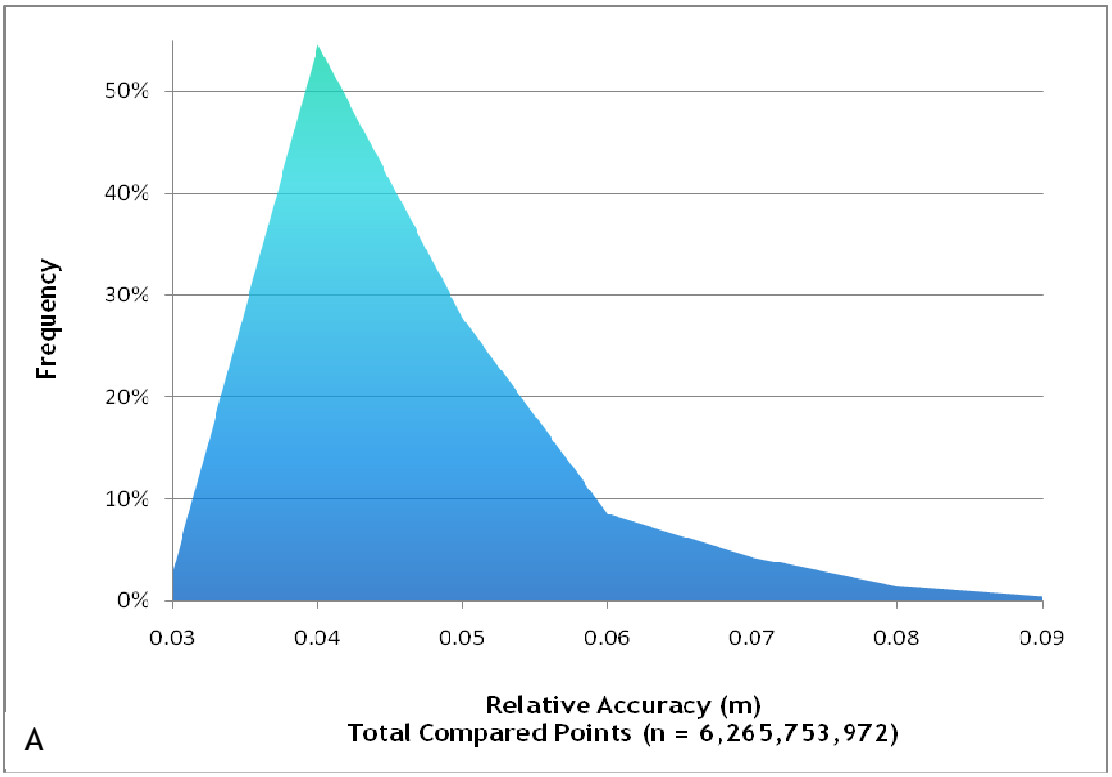


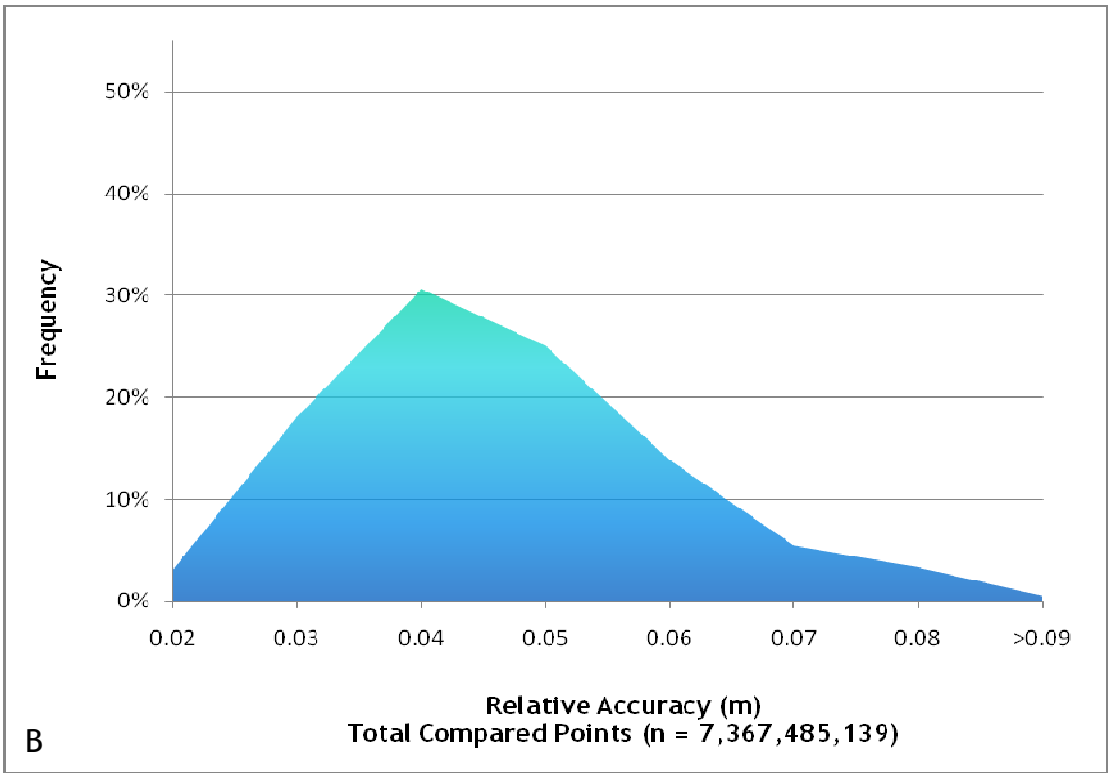
## 5.2 Relative Accuracy Calibration Results

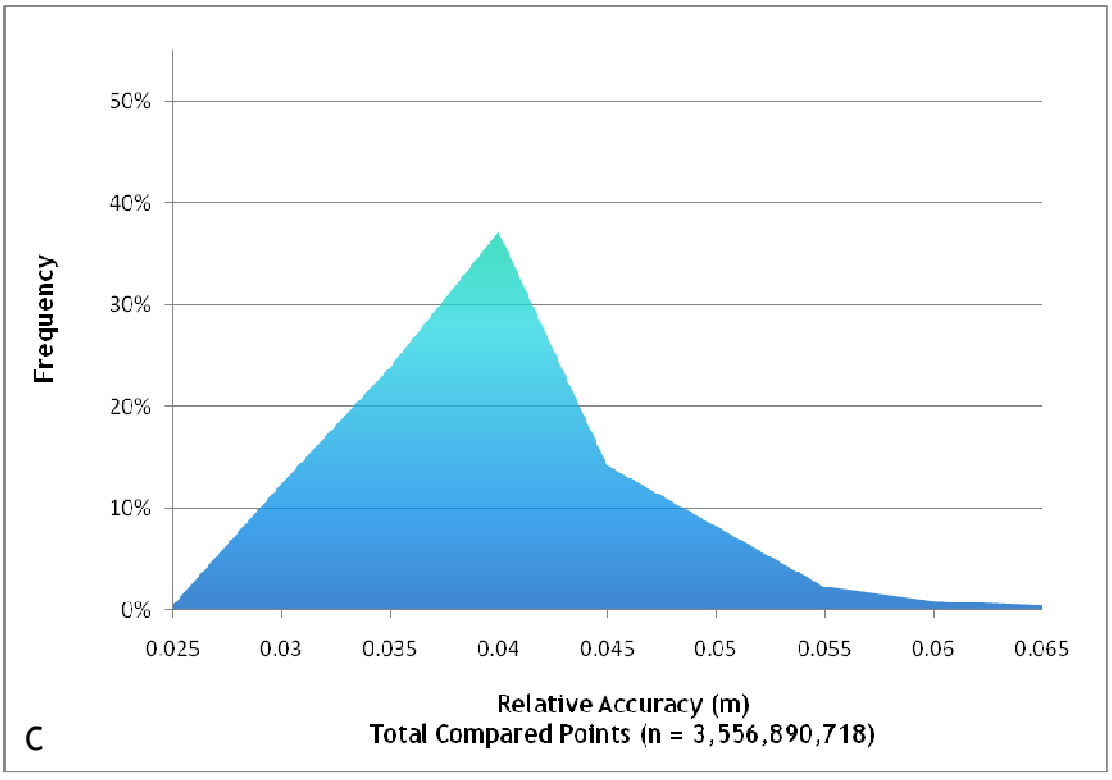
***Table 5**. Cumulative relative accuracy statistics for Alaska Pipeline deliveries to date.*

| | UTM 5 | UTM 6 | UTM 7 |
|---|---|---|---|
| Project Average | 0.039m | 0.038m | 0.037m |
| Median Relative Accuracy | 0.039m | 0.039m | 0.037m |
| 1σ Relative Accuracy | 0.010m | 0.013m | 0.006m |
| 1.96σ Relative Accuracy | 0.019m | 0.026m | 0.012m |

***Figure 18**. Distribution of cumulative relative accuracies in UTM5 (A) UTM 6 (B) and UTM 7 (C) per flight line, non slope-adjusted*




50%
40%
30%
20%
10%
0%
Frequency
0.02
0.03
0.04
0.05
0.06
0.07
0.08
>0.09
Relative Accuracy (m)
Total Compared Points (n = 7,367,485,139)
B


50%
40%
30%
20%
10%
0%
Frequency
0.025
0.03
0.035
0.04
0.045
0.05
0.055
0.06
0.065
Relative Accuracy (m)
Total Compared Points (n = 3,556,890,718)
C

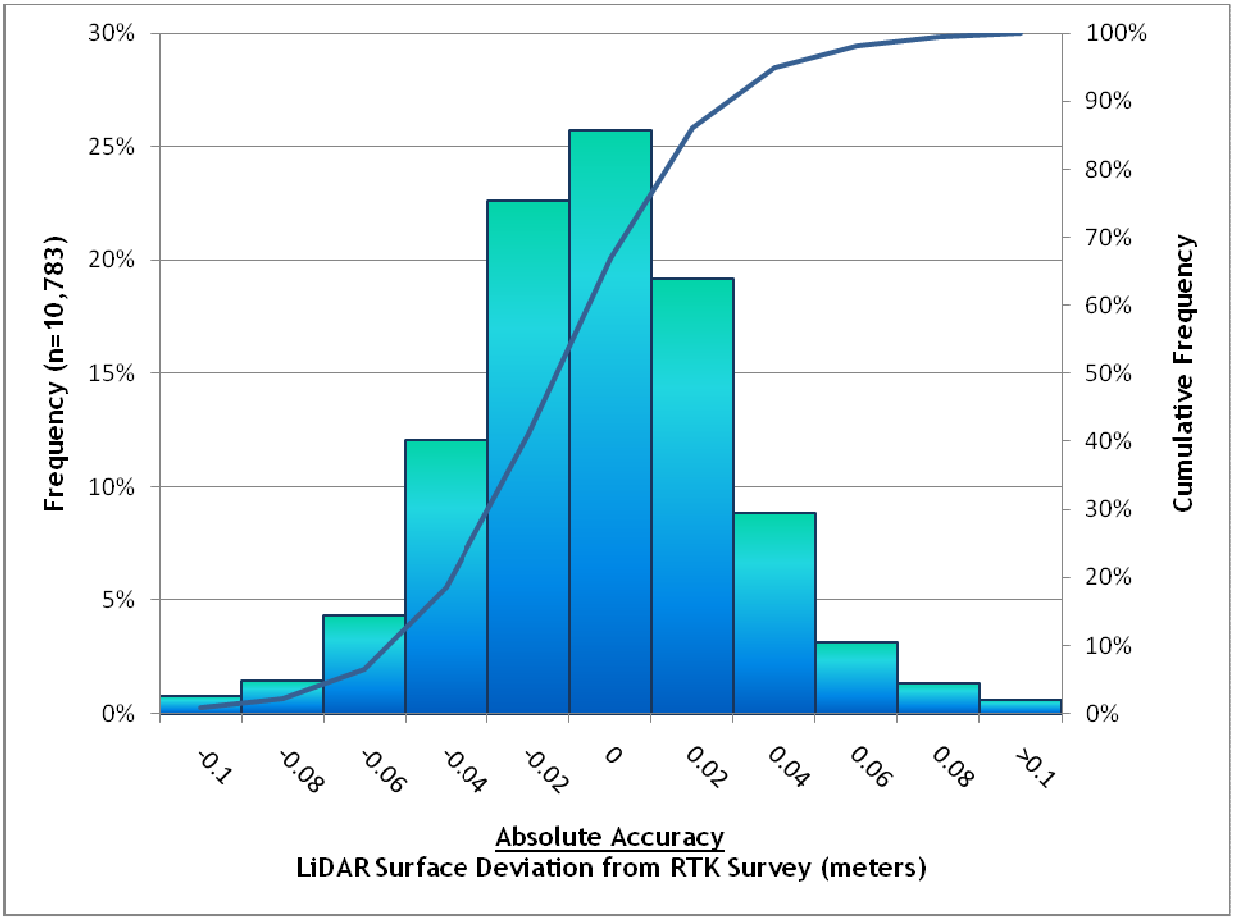
## 5.3 Absolute Accuracy

Absolute accuracies for Alaska Pipeline deliveries to date: All data was calibrated and processed in UTM 6 and then transformed to the appropriate projection.

***Table 6**. Absolute Accuracy - Deviation between laser points and RTK hard surface survey points*

| RTK Survey Sample Size (n): 10,783 | |
|---|---|
| Root Mean Square Error (RMSE): 0.035m | Minimum Δz = -0.151m |
| Standard Deviations<br>1 sigma (σ): 0.033m 1.96 sigma (σ): 0.064m | Maximum Δz = 0.116m |
| | Average Δz = -0.012m |

***Figure 19**. Absolute Accuracy - Histogram Statistics*



## 5.4 Independent Accuracy Assessment

In accordance with the project plan, McClintock Land Associates (AK PLS) collected independent (i.e. blind) check points within the survey area to provide an independent assessment of LiDAR accuracy. WSI was provided with Easting and Northing positions for points which were then assigned elevations from the LiDAR. MLA received this report and compared the LiDAR Z values to MLA's surveyed (or known) Z values.

***Table 7**. Absolute accuracy determined by the project surveyor (MLA) using "Blind" Check Points (See Appendix B for PLS report)*

| Delivery | # of Check Points | RMSE | Range |
|---|---|---|---|
| 1 | 735 | 0.062m | 0.240m |
| 2 | 1096 | 0.035m | 0.204m |
| 3 | 1088 | 0.078m | 0.182m |
| 4 | 730 | 0.039m | 0.394m |
| 5 | 2293 | 0.073m | 0.567m |

## 6. Projection/Datum and Units

| | | |
|---|---|---|
| | **Projection:** | UTM Zone 5, 6, 7 North |
| **Datum** | **Vertical:** | NAVD88 Geoid09 |
| | **Horizontal:** | NAD83 |
| | **Units:** | meters |

## 7. Deliverables

| | |
|---|---|
| **Point Data:** | • All Returns (LAS 1.2 format)<br>• Ground Returns (LAS 1.2 format) |
| **Vector Data:** | • Project Boundary (shapefile format)<br>• Tile Index for LiDAR Points (shapefile format)<br>• Tile Index for DEMs (shapefile format)<br>• Contours (1m shapefile format, DXF format)<br>• RTK (shapefile format, .TXT format)<br>• SBETs (shapefile format, DBF format)<br>• Lake Boundaries (shapefile format) |
| **Raster Data:** | • Elevation Models (1m resolution)<br>  • Hydro-flattened Bare Earth Model (ESRI GRID format)<br>  • Highest Hit Model (ESRI GRID format)<br>  • Vegetation Model (ESRI GRID format)<br>  • nDSM Model (ESRI GRID format)<br>• Intensity Images (GeoTIFF format, 0.5m resolution)<br>• Vegetation Metrics (5m resolution)<br>  • Canopy Cover (ESRI GRID format)<br>  • Coefficient of Variation (ESRI GRID format)<br>  • Mean Elevation (ESRI GRID format) |
| **Data Report:** | • Full report containing introduction, methodology, and accuracy |

# 8. Selected Images

***Figure 20**. View across braided channels of the Tanana River near Dot Lake. Top image is Bare Earth model. Bottom image is LiDAR point cloud colored by elevation.*

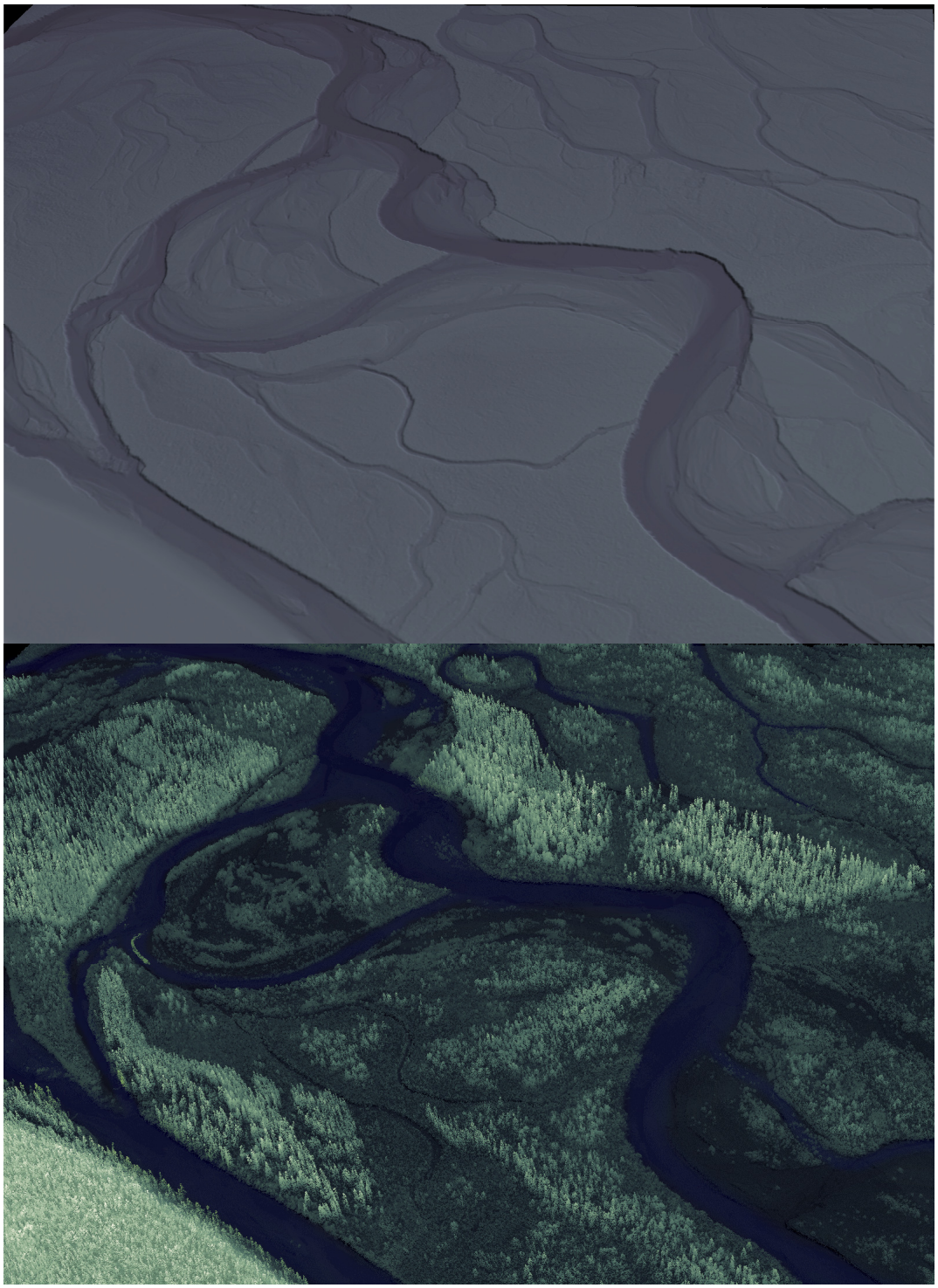


***Figure 21**. View looking west at hydro-flattened pond south of T Lake in the Bare Earth model.*

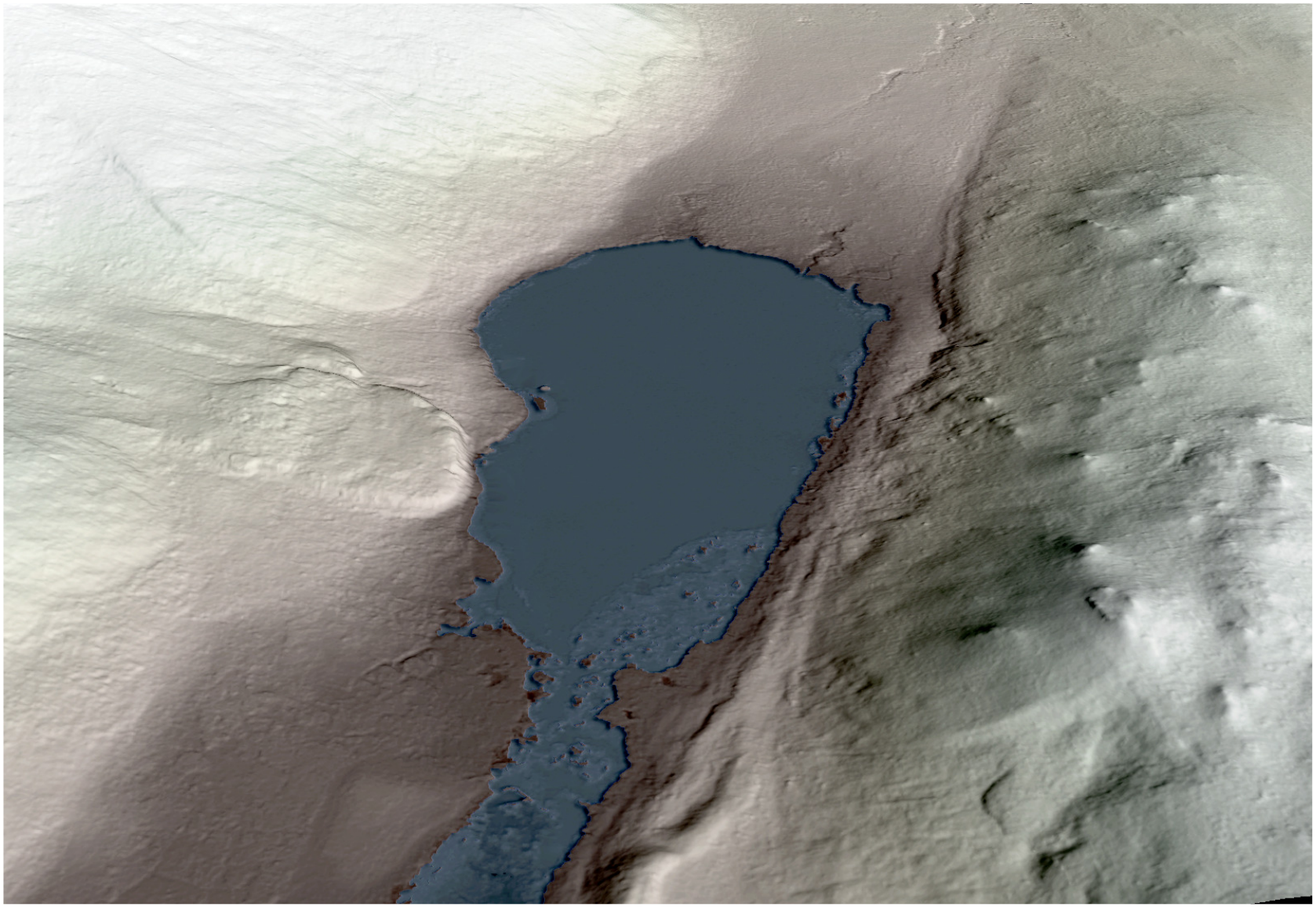


***Figure 22**. View looking north across Gerstle River along A2. Image is 3D LiDAR point cloud colored by elevation.*

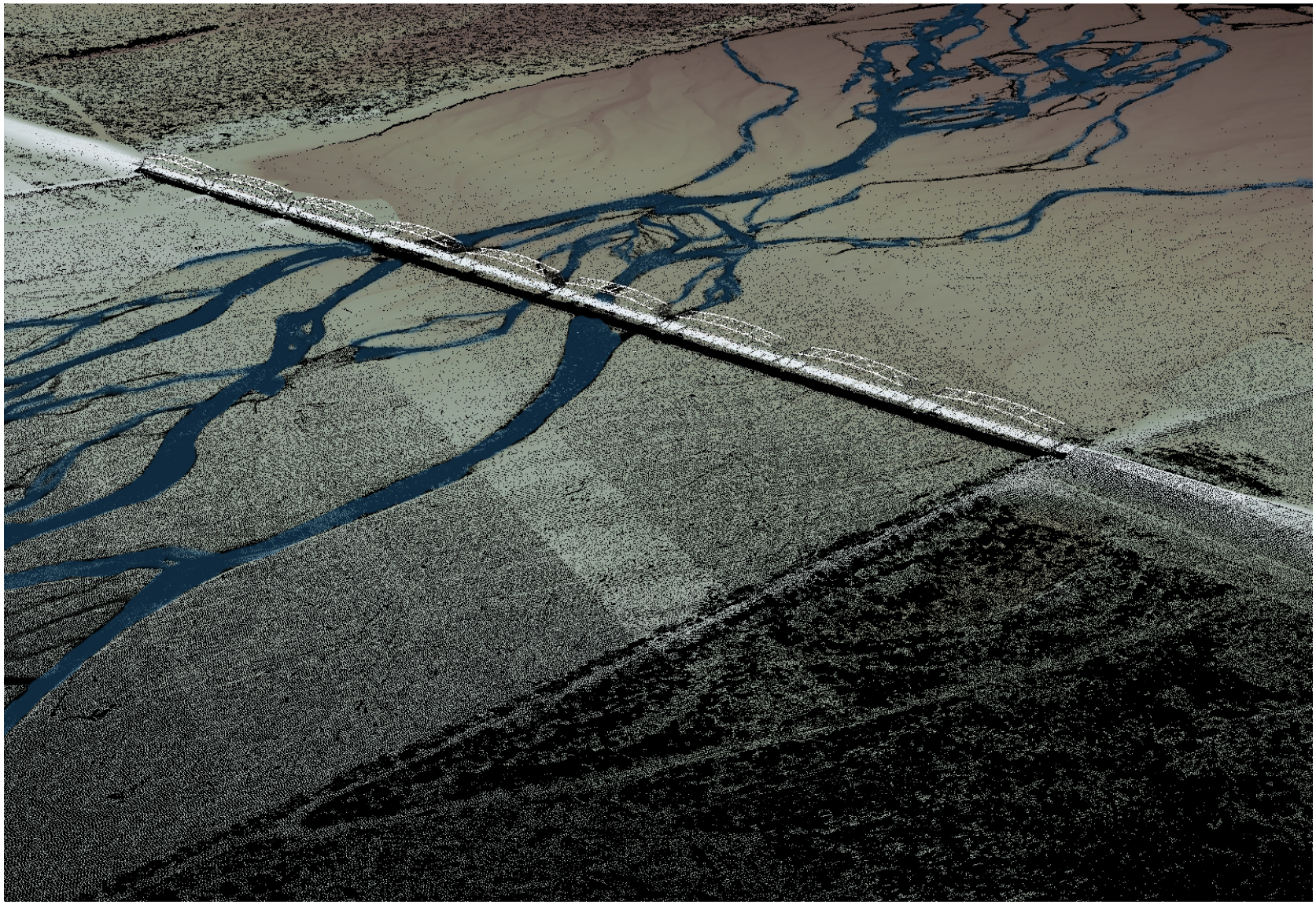


***Figure 23**. Northern end of above ground pipeline near Trims Camp along Hwy 4.*

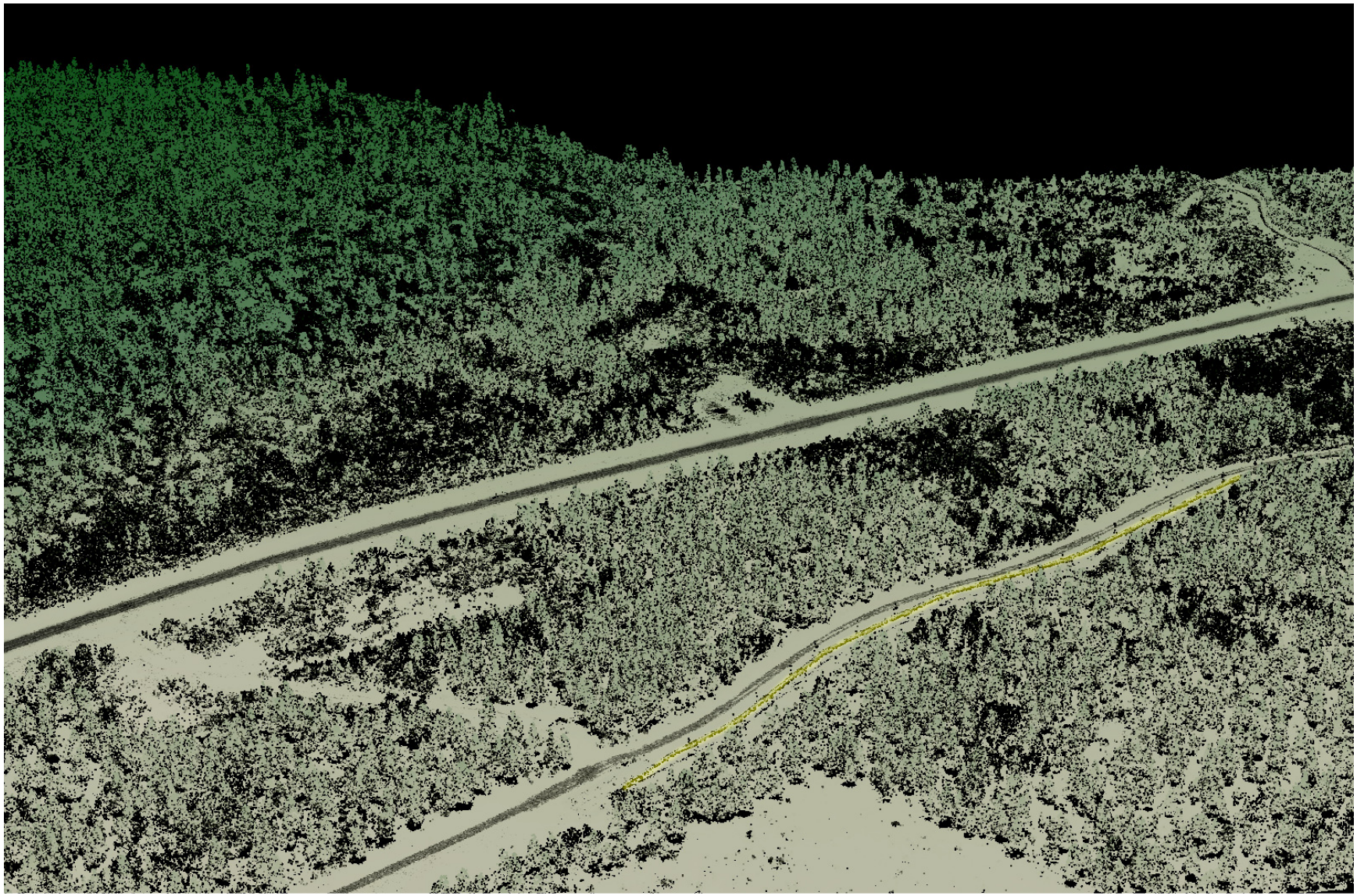


***Figure 24**. View looking North of Pipeline and Hwy 4 as they cross Miller Creek.*

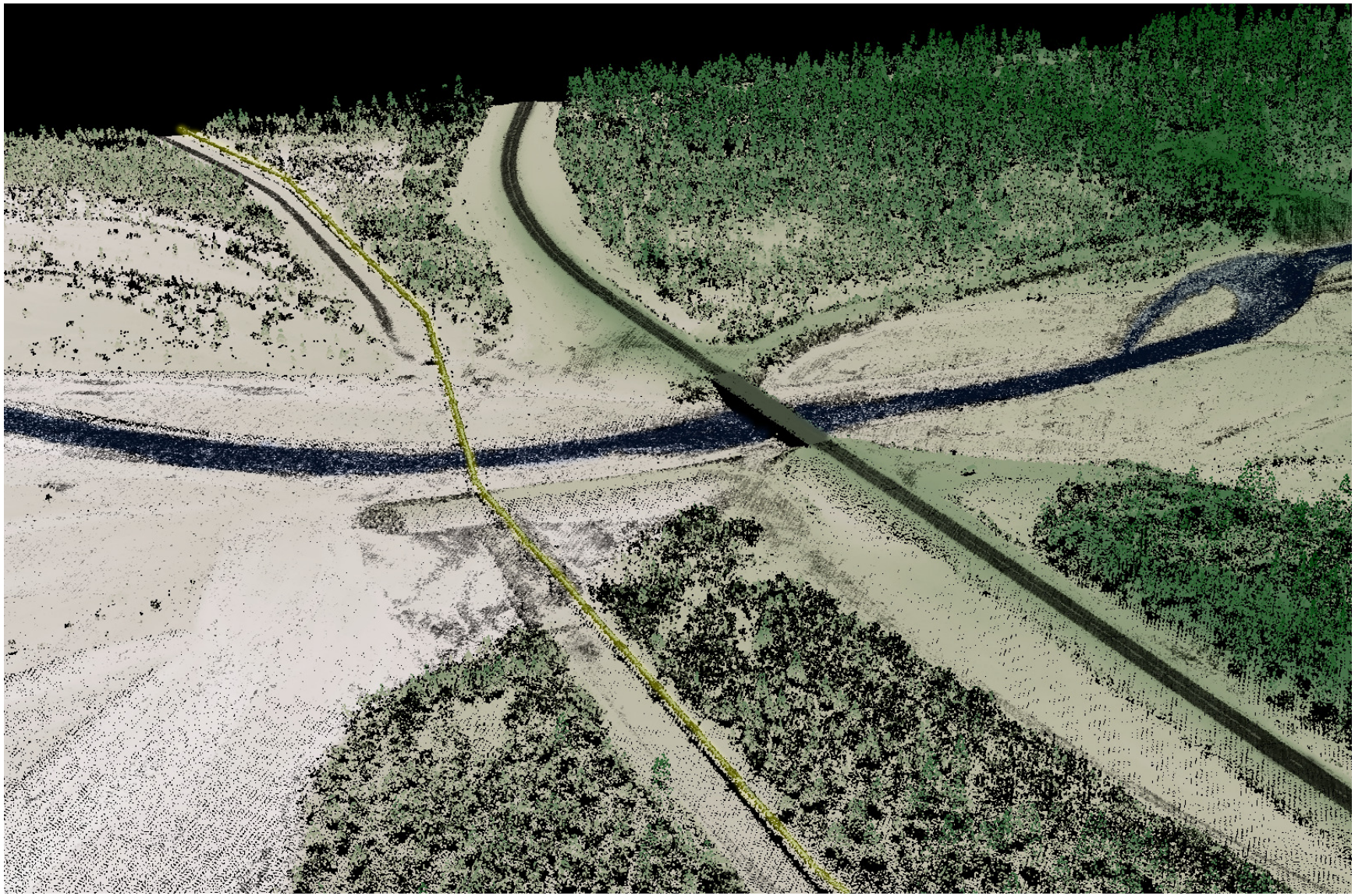


***Figure 25**. View looking Northeast across Hwy 2, just east of Tetlin Junction. Top image is Bare Earth model colored by elevation. Bottom image is Highest Hit model.*

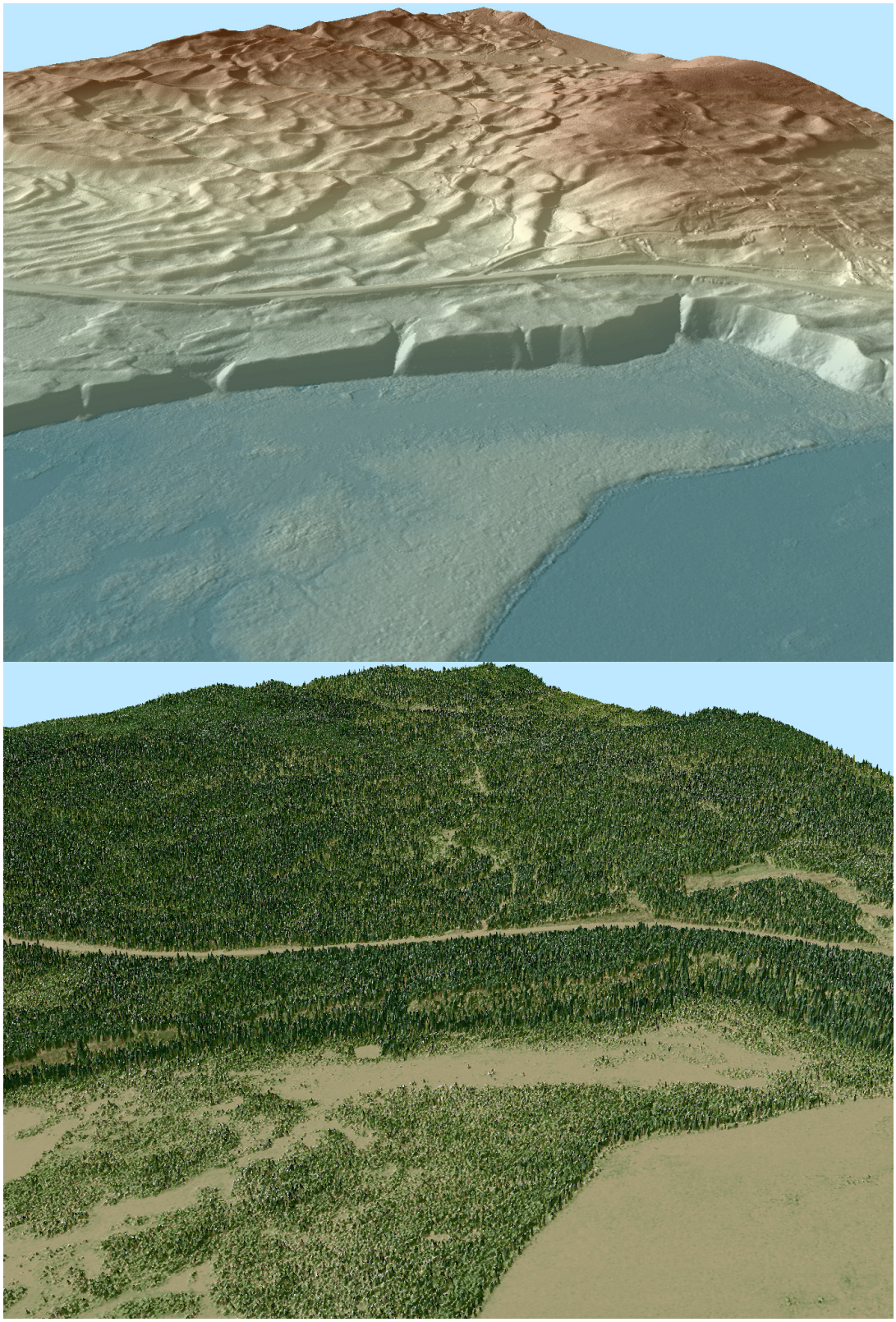


***Figure 26**. Hwy 2, west of where it crosses Gardiner River. Top image is Bare Earth model colored by elevation. Bottom image is Highest Hit model.*

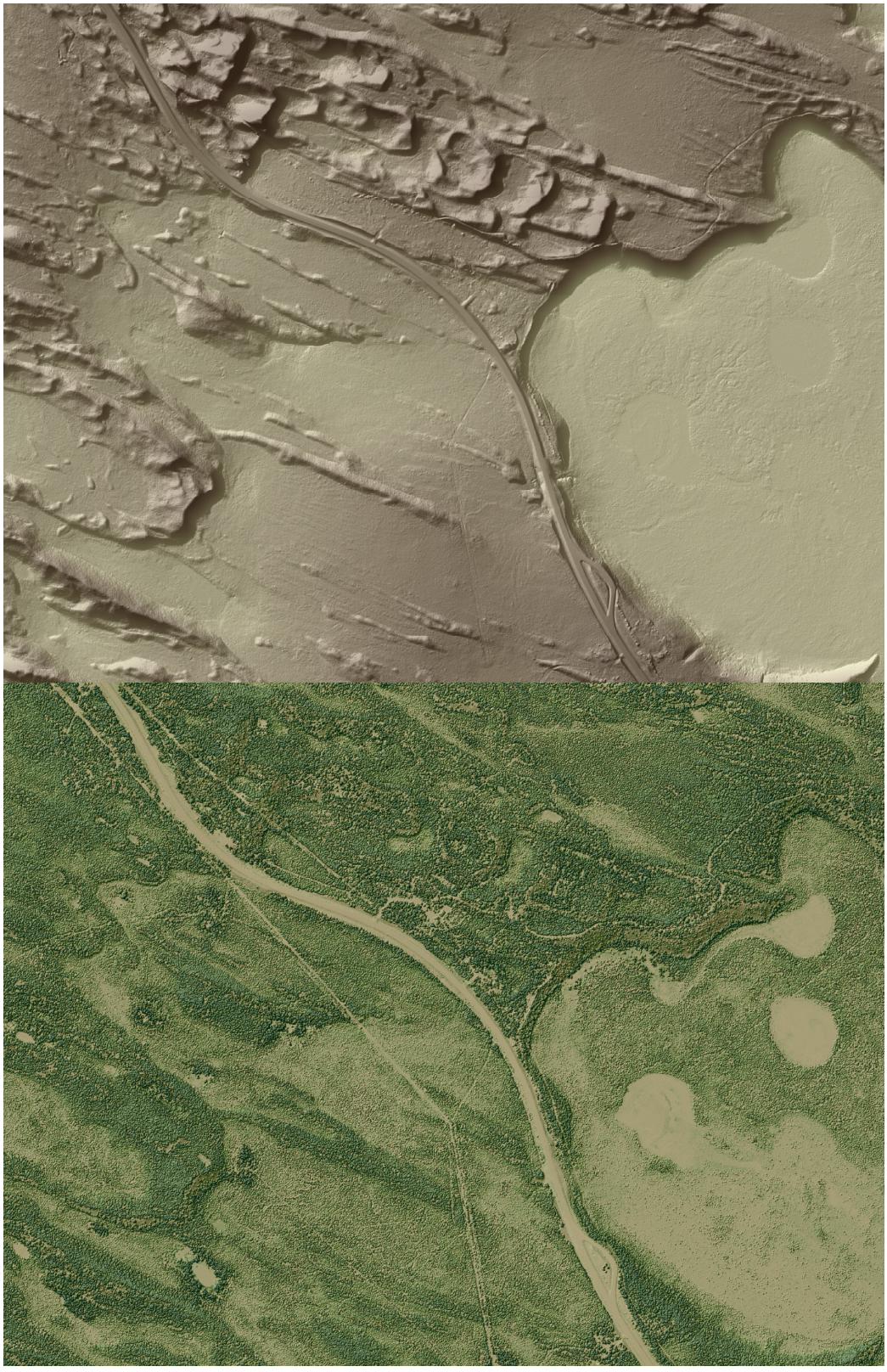
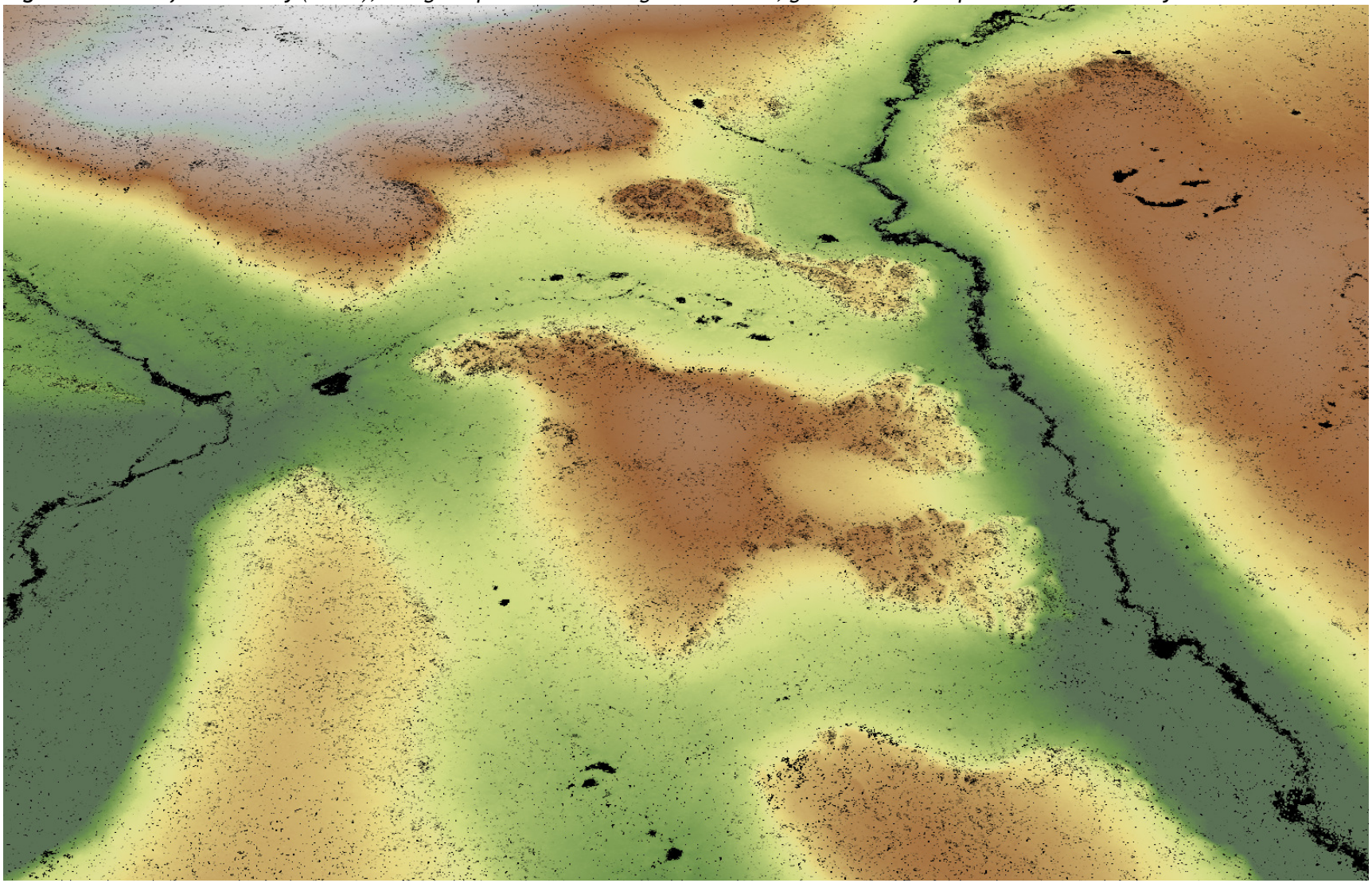


***Figure 27**. East of Dalton Hwy (SR-11), along Chapman Creek. Image is 3D LiDAR, ground classified point cloud colored by elevation.*



# 9. Glossary

**1-sigma (σ) Absolute Deviation:** Value for which the data are within one standard deviation (approximately 68$^{th}$ percentile) of a normally distributed data set.

**1.96-sigma (σ) Absolute Deviation:** Value for which the data are within two standard deviations (approximately 95$^{th}$ percentile) of a normally distributed data set.

**Root Mean Square Error (RMSE):** A statistic used to approximate the difference between real-world points and the LiDAR points. It is calculated by squaring all the values, then taking the average of the squares and taking the square root of the average.

**Pulse Rate (PR)**: The rate at which laser pulses are emitted from the sensor; typically measured as thousands of pulses per second (kHz).

**Pulse Returns**: For every laser pulse emitted, the Leica ALS 50 Phase II system can record *up to four* wave forms reflected back to the sensor. Portions of the wave form that return earliest are the highest element in multi-tiered surfaces such as vegetation. Portions of the wave form that return last are the lowest element in multi-tiered surfaces.

**Accuracy**: The statistical comparison between known (surveyed) points and laser points. Typically measured as the standard deviation (sigma, σ) and root mean square error (RMSE).

**Intensity Values**: The peak power ratio of the laser return to the emitted laser. It is a function of surface reflectivity.

**Data Density**: A common measure of LiDAR resolution, measured as points per square meter.

**Spot Spacing**: Also a measure of LiDAR resolution, measured as the average distance between laser points.

**Nadir**: A single point or locus of points on the surface of the earth directly below a sensor as it progresses along its flight line.

**Scan Angle**: The angle from nadir to the edge of the scan, measured in degrees. Laser point accuracy typically decreases as scan angles increase.

**Overlap**: The area shared between flight lines, typically measured in percents; 100% overlap is essential to ensure complete coverage and reduce laser shadows.

**DTM / DEM**: These often-interchanged terms refer to models made from laser points. The digital elevation model (DEM) refers to all surfaces, including bare ground and vegetation, while the digital terrain model (DTM) refers only to those points classified as ground.

**Real-Time Kinematic (RTK) Survey**: GPS surveying is conducted with a GPS base station deployed over a known monument with a radio connection to a GPS rover. Both the base station and rover receive differential GPS data and the baseline correction is solved between the two. This type of ground survey is accurate to 1.5 cm or less.

# 10. Citations

Soininen, A. 2004. TerraScan User's Guide. TerraSolid.

# Appendix A

**LiDAR accuracy error sources and solutions:**

| Type of Error | Source | Post Processing Solution |
|---|---|---|
| GPS (Static/Kinematic) | Long Base Lines | None |
| | Poor Satellite Constellation | None |
| | Poor Antenna Visibility | Reduce Visibility Mask |
| Relative Accuracy | Poor System Calibration | Recalibrate IMU and sensor offsets/settings |
| | Inaccurate System | None |
| Laser Noise | Poor Laser Timing | None |
| | Poor Laser Reception | None |
| | Poor Laser Power | None |
| | Irregular Laser Shape | None |

**Operational measures taken to improve relative accuracy:**

1. Low Flight Altitude: Terrain following is employed to maintain a constant above ground level (AGL). Laser horizontal errors are a function of flight altitude above ground (i.e., ~ 1/3000$^{th}$ AGL flight altitude).
2. Focus Laser Power at narrow beam footprint: A laser return must be received by the system above a power threshold to accurately record a measurement. The strength of the laser return is a function of laser emission power, laser footprint, flight altitude and the reflectivity of the target. While surface reflectivity cannot be controlled, laser power can be increased and low flight altitudes can be maintained.
3. Reduced Scan Angle: Edge-of-scan data can become inaccurate. The scan angle was reduced to a maximum of ±15$^{o}$ from nadir, creating a narrow swath width and greatly reducing laser shadows from trees and buildings.
4. Quality GPS: Flights took place during optimal GPS conditions (e.g., 6 or more satellites and PDOP [Position Dilution of Precision] less than 3.0). Before each flight, the PDOP was determined for the survey day. During all flight times, a dual frequency DGPS base station recording at 1-second epochs was utilized and a maximum baseline length between the aircraft and the control points was less than 19 km (11.5 miles) at all times.
5. Ground Survey: Ground survey point accuracy (i.e. <1.5 cm RMSE) occurs during optimal PDOP ranges and targets a minimal baseline distance of 4 miles between GPS rover and base. Robust statistics are, in part, a function of sample size (n) and distribution. Ground survey RTK points are distributed to the extent possible throughout multiple flight lines and across the survey area.
6. 50% Side-Lap (100% Overlap): Overlapping areas are optimized for relative accuracy testing. Laser shadowing is minimized to help increase target acquisition from multiple scan angles. Ideally, with a 50% side-lap, the most nadir portion of one flight line coincides with the edge (least nadir) portion of overlapping flight lines. A minimum of 50% side-lap with terrain-followed acquisition prevents data gaps.
7. Opposing Flight Lines: All overlapping flight lines are opposing. Pitch, roll and heading errors are amplified by a factor of two relative to the adjacent flight line(s), making misalignments easier to detect and resolve.

# Appendix B

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 9200 | 7386759.737 | 599279.655 | 491.27 | 12A20110602FAC | 491.17 | 0.10 |
| 9201 | 7386771.81 | 599269.388 | 492.80 | 12A20110602SPR | 492.74 | 0.06 |
| 9202 | 7386783.26 | 599281.761 | 493.61 | 12A20110602SPR | 493.52 | 0.09 |
| 9203 | 7386788.506 | 599295.342 | 494.38 | 12A20110602SPR | 494.29 | 0.09 |
| 9204 | 7386794.095 | 599308.683 | 495.22 | 12A20110602SPR | 495.14 | 0.08 |
| 9205 | 7386799.424 | 599322.534 | 496.06 | 12A20110602SPR | 496.00 | 0.06 |
| 9206 | 7386803.909 | 599338.629 | 497.03 | 12A20110602SPR | 496.96 | 0.07 |
| 9207 | 7386810.584 | 599351.145 | 497.72 | 12A20110602SPR | 497.63 | 0.09 |
| 9208 | 7387040.524 | 599886.992 | 507.12 | 12A20110602SPR | 507.08 | 0.04 |
| 9209 | 7387046.952 | 599900.265 | 506.89 | 12A20110602SPR | 506.82 | 0.07 |
| 9210 | 7387054.143 | 599914.809 | 506.58 | 12A20110602SPR | 506.53 | 0.05 |
| 9211 | 7387059.903 | 599928.894 | 506.32 | 12A20110602SPR | 506.31 | 0.01 |
| 9212 | 7387060.213 | 599942.268 | 506.05 | 12A20110602SPR | 506.01 | 0.04 |
| 9213 | 7387066.423 | 599955.353 | 505.71 | 12A20110602SPR | 505.70 | 0.01 |
| 9214 | 7387073.459 | 599968.738 | 505.34 | 12A20110602SPR | 505.34 | 0.00 |
| 9215 | 7386727.064 | 599282.376 | 489.82 | 12A20110602SGR | 489.74 | 0.08 |
| 9216 | 7386687.224 | 599298.143 | 488.69 | 12A20110602SGR | 488.62 | 0.07 |
| 9217 | 7386646.58 | 599313.728 | 487.42 | 12A20110602SGR | 487.32 | 0.10 |
| 9218 | 7386618.796 | 599325.16 | 486.77 | 12A20110602SGR | 486.62 | 0.15 |
| 9219 | 7386587.6 | 599332.117 | 486.10 | 12A20110602SGR | 485.97 | 0.13 |
| 9220 | 7386559.794 | 599343.458 | 485.89 | 12A20110602SGR | 485.77 | 0.12 |
| 9221 | 7386532.133 | 599357.331 | 485.99 | 12A20110602SGR | 485.83 | 0.16 |
| 9222 | 7386504.399 | 599370.231 | 485.80 | 12A20110602SGR | 485.66 | 0.14 |
| 9223 | 7386476.679 | 599386.202 | 486.16 | 12A20110602SGR | 486.04 | 0.12 |
| 9224 | 7386450.346 | 599402.512 | 486.92 | 12A20110602SGR | 486.78 | 0.14 |
| 9225 | 7386418.894 | 599423.394 | 488.14 | 12A20110602SGR | 488.05 | 0.09 |
| 9226 | 7386384.183 | 599444.67 | 489.57 | 12A20110602SGR | 489.50 | 0.07 |
| 9227 | 7386357.568 | 599466.139 | 491.02 | 12A20110602SGR | 490.91 | 0.11 |
| 9228 | 7386330.036 | 599484.075 | 492.76 | 12A20110602SGR | 492.68 | 0.08 |
| 9229 | 7386295.739 | 599497.675 | 495.00 | 12A20110602SGR | 494.91 | 0.08 |
| 9230 | 7386267.773 | 599522.664 | 497.05 | 12A20110602SGR | 496.94 | 0.11 |
| 9231 | 7386237.804 | 599541.948 | 498.73 | 12A20110602SGR | 498.65 | 0.08 |
| 9232 | 7386208.362 | 599558.06 | 500.04 | 12A20110602SGR | 499.94 | 0.10 |
| 9233 | 7386179.153 | 599574.108 | 501.40 | 12A20110602SGR | 501.31 | 0.09 |
| 9234 | 7386150.694 | 599589.419 | 502.61 | 12A20110602SGR | 502.54 | 0.07 |
| 9235 | 7386123.668 | 599606.326 | 503.79 | 12A20110602SGR | 503.73 | 0.06 |
| 9236 | 7386095.989 | 599624.565 | 505.37 | 12A20110602SGR | 505.31 | 0.06 |
| 9237 | 7386068.669 | 599641.355 | 507.01 | 12A20110602SGR | 506.94 | 0.07 |
| 9238 | 7386040.481 | 599660.634 | 508.63 | 12A20110602SGR | 508.55 | 0.08 |
| 9239 | 7386018.11 | 599683.8 | 509.44 | 12A20110602SGR | 509.36 | 0.08 |
| 9240 | 7386003.989 | 599712.299 | 509.92 | 12A20110602SGR | 509.85 | 0.06 |
| 9241 | 7386005.169 | 599745.487 | 510.48 | 12A20110602SGR | 510.40 | 0.08 |
| 9242 | 7386004.832 | 599780.292 | 512.90 | 12A20110602SGR | 512.84 | 0.06 |
| 9243 | 7386016.655 | 599820.952 | 516.30 | 12A20110602SGR | 516.23 | 0.07 |
| 9244 | 7386023.422 | 599861.943 | 518.87 | 12A20110602SGR | 518.81 | 0.06 |
| 9245 | 7386021.319 | 599894.748 | 520.00 | 12A20110602SGR | 519.96 | 0.04 |
| 9246 | 7386020.275 | 599928.956 | 520.29 | 12A20110602SGR | 520.25 | 0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 9247 | 7386018.85 | 599961.334 | 520.39 | 12A20110602SGR | 520.32 | 0.07 |
| 9248 | 7386016.855 | 599998.269 | 522.34 | 12A20110602SGR | 522.31 | 0.03 |
| 9249 | 7386028.887 | 600029.823 | 525.44 | 12A20110602SGR | 525.40 | 0.04 |
| 9250 | 7386056.941 | 600065.961 | 531.28 | 12A20110602SGR | 531.22 | 0.06 |
| 9251 | 7386082.281 | 600103.386 | 535.86 | 12A20110602SGR | 535.83 | 0.03 |
| 9252 | 7386107.908 | 600137.675 | 538.86 | 12A20110602SGR | 538.83 | 0.02 |
| 9253 | 7386127.003 | 600179.839 | 541.72 | 12A20110602SGR | 541.70 | 0.02 |
| 9254 | 7386135.691 | 600223.453 | 543.59 | 12A20110602SGR | 543.56 | 0.03 |
| 9255 | 7386134.228 | 600271.98 | 543.07 | 12A20110602SGR | 543.00 | 0.07 |
| 9256 | 7386127.707 | 600323.265 | 543.29 | 12A20110602SGR | 543.23 | 0.06 |
| 9257 | 7386123.905 | 600356.77 | 543.44 | 12A20110602SGR | 543.39 | 0.05 |
| 9258 | 7386117.236 | 600423.488 | 544.09 | 12A20110602SGR | 544.10 | -0.01 |
| 9259 | 7386100.058 | 600529.83 | 546.05 | 12A20110602SGR | 546.02 | 0.03 |
| 9260 | 7386768.153 | 599272.119 | 492.58 | 12A20110602CHECK | 492.51 | 0.07 |
| 9261 | 7386768.14 | 599272.123 | 492.59 | 12A20110602CHECK | 492.51 | 0.08 |
| 9300 | 7383552.661 | 597111.552 | 341.99 | 12B20110603FAC | 342.01 | -0.02 |
| 9301 | 7400015.343 | 602971.011 | 308.76 | 12B20110603SGR | 308.78 | -0.02 |
| 9302 | 7401551 | 602923.455 | 285.48 | 12B20110603SGR | 285.43 | 0.05 |
| 9303 | 7401896.314 | 602636.746 | 309.49 | 12B20110603SGR | 309.51 | -0.02 |
| 9304 | 7401787.697 | 602949.708 | 296.96 | 12B20110603SGR | 296.92 | 0.04 |
| 10000 | 7480702.488 | 625704.403 | 405.55 | 9D201009249D | 405.51 | 0.04 |
| 10001 | 7480701.16 | 625705.059 | 405.63 | 9D20100924CK_9D_5'o/s | 405.55 | 0.08 |
| 10002 | 7480686.122 | 625707.391 | 405.17 | 9D20100924SGR | 405.10 | 0.07 |
| 10003 | 7480688.997 | 625717.93 | 405.15 | 9D20100924SGR | 405.09 | 0.06 |
| 10004 | 7480691.91 | 625730.882 | 405.08 | 9D20100924SGR | 405.06 | 0.02 |
| 10005 | 7480281.474 | 625712.386 | 396.78 | 9D20100924SGR | 396.75 | 0.03 |
| 10006 | 7480270.953 | 625717.222 | 396.97 | 9D20100924SGR | 396.92 | 0.04 |
| 10007 | 7480271.273 | 625704.332 | 396.90 | 9D20100924SGR | 396.90 | 0.00 |
| 10008 | 7480510.388 | 625729.4 | 396.40 | 9D20100924SGR | 396.33 | 0.07 |
| 10009 | 7480520.015 | 625735.548 | 396.44 | 9D20100924SGR | 396.40 | 0.04 |
| 10010 | 7480524.641 | 625727.718 | 396.27 | 9D20100924SGR | 396.21 | 0.06 |
| 10011 | 7480740.393 | 625199.456 | 395.50 | 9D20100924SPR | 395.44 | 0.06 |
| 10012 | 7480724.875 | 625195.867 | 395.62 | 9D20100924SPR | 395.56 | 0.06 |
| 10013 | 7480709.106 | 625192.149 | 395.69 | 9D20100924SPR | 395.61 | 0.08 |
| 10014 | 7480959.517 | 625240.722 | 391.80 | 9D20100924SPR | 391.71 | 0.09 |
| 10015 | 7480970.283 | 625241.33 | 391.40 | 9D20100924SPR | 391.35 | 0.05 |
| 10016 | 7480979.601 | 625241.31 | 390.99 | 9D20100924SPR | 390.90 | 0.09 |
| 10017 | 7481643.721 | 625137.796 | 381.35 | 9D20100924SPR | 381.28 | 0.07 |
| 10018 | 7481655.39 | 625139.273 | 381.52 | 9D20100924SPR | 381.48 | 0.04 |
| 10019 | 7481667.543 | 625140.769 | 381.68 | 9D20100924SPR | 381.62 | 0.06 |
| 10020 | 7482321.63 | 625223.531 | 388.33 | 9D20100924SPR | 388.27 | 0.06 |
| 10021 | 7482332.861 | 625224.939 | 388.38 | 9D20100924SPR | 388.28 | 0.10 |
| 10022 | 7482344.376 | 625226.289 | 388.33 | 9D20100924SPR | 388.25 | 0.08 |
| 10023 | 7482976.812 | 625138.033 | 371.04 | 9D20100924SPR | 370.93 | 0.11 |
| 10024 | 7482986.019 | 625132.08 | 370.77 | 9D20100924SPR | 370.67 | 0.10 |
| 10025 | 7482994.467 | 625126.559 | 370.60 | 9D20100924SPR | 370.53 | 0.07 |
| 10026 | 7483365.354 | 624984.842 | 371.42 | 9D20100924SGR | 371.31 | 0.11 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10027 | 7483360.668 | 625001.277 | 371.51 | 9D20100924SGR | 371.42 | 0.09 |
| 10028 | 7483355.319 | 625019.143 | 371.39 | 9D20100924SGR | 371.32 | 0.07 |
| 10029 | 7483342.338 | 625045.319 | 371.31 | 9D20100924CK_9C_5'o/s | 371.22 | 0.08 |
| 10030 | 7483797.539 | 625192.642 | 372.37 | 9D20100924SPR | 372.26 | 0.11 |
| 10031 | 7483808.719 | 625198.715 | 372.36 | 9D20100924SPR | 372.30 | 0.06 |
| 10032 | 7483819.238 | 625204.431 | 372.38 | 9D20100924SPR | 372.29 | 0.09 |
| 10033 | 7484292.121 | 625460.068 | 372.88 | 9D20100924SPR | 372.79 | 0.09 |
| 10034 | 7484302.648 | 625465.8 | 372.89 | 9D20100924SPR | 372.81 | 0.08 |
| 10035 | 7484313.927 | 625471.964 | 372.89 | 9D20100924SPR | 372.80 | 0.09 |
| 10036 | 7484772.3 | 625774.339 | 374.16 | 9D20100924SPR | 374.10 | 0.06 |
| 10037 | 7484781.922 | 625781.725 | 374.18 | 9D20100924SPR | 374.12 | 0.06 |
| 10038 | 7484791.746 | 625789.197 | 374.19 | 9D20100924SPR | 374.06 | 0.13 |
| 10039 | 7485232.026 | 626138.769 | 374.43 | 9D20100924SPR | 374.37 | 0.06 |
| 10040 | 7485240.863 | 626147.14 | 374.40 | 9D20100924SPR | 374.35 | 0.05 |
| 10041 | 7485249.88 | 626155.515 | 374.37 | 9D20100924SPR | 374.32 | 0.05 |
| 10042 | 7485667.095 | 626575.311 | 375.78 | 9D20100924SPR | 375.78 | 0.00 |
| 10043 | 7485675.876 | 626586.789 | 375.93 | 9D20100924SPR | 375.92 | 0.01 |
| 10044 | 7485683.255 | 626596.435 | 376.10 | 9D20100924SPR | 376.04 | 0.06 |
| 10045 | 7485872.246 | 627002.319 | 376.19 | 9D20100924SPR | 376.08 | 0.11 |
| 10046 | 7485876.351 | 627013.006 | 376.23 | 9D20100924SPR | 376.08 | 0.15 |
| 10047 | 7485880.807 | 627023.834 | 376.29 | 9D20100924SPR | 376.15 | 0.14 |
| 10048 | 7486085.525 | 627551.578 | 378.53 | 9D20100924SPR | 378.47 | 0.06 |
| 10049 | 7486088.365 | 627563.139 | 378.54 | 9D20100924SPR | 378.46 | 0.08 |
| 10050 | 7486092.041 | 627576.633 | 378.53 | 9D20100924SPR | 378.49 | 0.03 |
| 10051 | 7486526.582 | 628192.721 | 379.45 | 9D20100924SPR | 379.32 | 0.13 |
| 10052 | 7486533.466 | 628201.078 | 379.42 | 9D20100924SPR | 379.32 | 0.10 |
| 10053 | 7486540.167 | 628208.871 | 379.48 | 9D20100924SPR | 379.36 | 0.12 |
| 10078 | 7482635.355 | 624113.001 | 367.24 | 9D20100924SGR | 367.13 | 0.11 |
| 10079 | 7482629.586 | 624107.759 | 367.36 | 9D20100924SGR | 367.22 | 0.14 |
| 10080 | 7482625.236 | 624103.493 | 367.44 | 9D20100924SGR | 367.32 | 0.12 |
| 10081 | 7481830.191 | 623974.808 | 363.61 | 9D20100924SGR | 363.51 | 0.10 |
| 10082 | 7481820.156 | 623969.096 | 363.56 | 9D20100924SGR | 363.48 | 0.08 |
| 10083 | 7481810.084 | 623964.378 | 363.58 | 9D20100924SGR | 363.46 | 0.12 |
| 10090 | 7481726.547 | 623495.192 | 392.48 | 9D20100924SGR | 392.36 | 0.12 |
| 10091 | 7481719.684 | 623490.474 | 392.13 | 9D20100924SGR | 392.04 | 0.09 |
| 10092 | 7481714.316 | 623486.414 | 391.75 | 9D20100924SGR | 391.67 | 0.08 |
| 10093 | 7480232.735 | 623876.042 | 360.26 | 9D20100924SGR | 360.22 | 0.04 |
| 10094 | 7480224.606 | 623879.947 | 360.26 | 9D20100924SGR | 360.24 | 0.02 |
| 10095 | 7480215.655 | 623882.184 | 360.31 | 9D20100924SGR | 360.27 | 0.04 |
| 10096 | 7479644.59 | 623657.413 | 360.24 | 9D20100924SGR | 360.18 | 0.06 |
| 10097 | 7479657.606 | 623661.625 | 360.52 | 9D20100924SGR | 360.44 | 0.08 |
| 10098 | 7479655.941 | 623650.871 | 360.40 | 9D20100924SGR | 360.37 | 0.03 |
| 10099 | 7479146.914 | 623155.04 | 356.88 | 9D20100924SGR | 356.81 | 0.07 |
| 10100 | 7479154.907 | 623163.084 | 356.99 | 9D20100924SGR | 356.90 | 0.09 |
| 10101 | 7479161.596 | 623170.407 | 357.13 | 9D20100924SGR | 356.98 | 0.15 |
| 10102 | 7480177.585 | 625065.982 | 394.75 | 9D20100924SPR | 394.71 | 0.04 |
| 10103 | 7480166.156 | 625062.964 | 394.60 | 9D20100924SPR | 394.53 | 0.07 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10104 | 7480155.986 | 625060.724 | 394.47 | 9D20100924SPR | 394.38 | 0.09 |
| 10105 | 7478997.934 | 624593.044 | 385.59 | 9D20100924SPR | 385.50 | 0.08 |
| 10106 | 7478987.174 | 624589.583 | 385.31 | 9D20100924SPR | 385.23 | 0.08 |
| 10107 | 7478975.845 | 624586.338 | 385.04 | 9D20100924SPR | 384.98 | 0.06 |
| 10108 | 7478001.272 | 624279.256 | 382.62 | 9D20100924SPR | 382.57 | 0.05 |
| 10109 | 7477990.735 | 624273.454 | 382.83 | 9D20100924SPR | 382.83 | 0.00 |
| 10110 | 7477979.837 | 624268.207 | 383.10 | 9D20100924SPR | 383.08 | 0.02 |
| 10111 | 7477126.195 | 623877.054 | 372.86 | 9D20100924SPR | 372.79 | 0.07 |
| 10112 | 7477115.876 | 623873.716 | 372.91 | 9D20100924SPR | 372.83 | 0.08 |
| 10113 | 7477103.828 | 623870.197 | 373.01 | 9D20100924SPR | 372.94 | 0.07 |
| 10114 | 7476386.141 | 623668.841 | 377.39 | 9D20100924SPR | 377.32 | 0.07 |
| 10115 | 7476375.164 | 623665.223 | 377.23 | 9D20100924SPR | 377.12 | 0.11 |
| 10116 | 7476365.185 | 623661.857 | 377.04 | 9D20100924SPR | 376.96 | 0.08 |
| 10117 | 7475557.068 | 623403.505 | 372.56 | 9D20100924SPR | 372.51 | 0.05 |
| 10118 | 7475544.747 | 623401.626 | 372.75 | 9D20100924SPR | 372.69 | 0.06 |
| 10119 | 7475532.949 | 623399.779 | 372.97 | 9D20100924SPR | 372.89 | 0.08 |
| 10120 | 7474617.114 | 623375.209 | 367.51 | 9D20100924SPR | 367.46 | 0.05 |
| 10121 | 7474604.79 | 623374.889 | 367.31 | 9D20100924SPR | 367.25 | 0.06 |
| 10122 | 7474592.662 | 623374.559 | 367.15 | 9D20100924SPR | 367.07 | 0.08 |
| 10123 | 7473861.603 | 623185.022 | 365.08 | 9D20100924SPR | 365.02 | 0.06 |
| 10124 | 7473849.552 | 623181.239 | 365.17 | 9D20100924SPR | 365.10 | 0.07 |
| 10125 | 7473837.348 | 623177.352 | 365.21 | 9D20100924SPR | 365.16 | 0.05 |
| 10126 | 7472966.877 | 622954.554 | 360.72 | 9D20100924SPR | 360.62 | 0.09 |
| 10127 | 7472954.979 | 622953.72 | 360.39 | 9D20100924SPR | 360.31 | 0.07 |
| 10128 | 7472944.259 | 622952.732 | 360.10 | 9D20100924SPR | 360.00 | 0.10 |
| 10200 | 7457151.441 | 618200.53 | 400.12 | 10B20100924SAC | 399.99 | 0.13 |
| 10201 | 7451364.957 | 614476.688 | 290.60 | 10B20100924SPR | 290.61 | -0.01 |
| 10202 | 7451374.45 | 614481.729 | 290.66 | 10B20100924SPR | 290.62 | 0.04 |
| 10203 | 7451386.111 | 614487.688 | 290.63 | 10B20100924SPR | 290.57 | 0.06 |
| 10204 | 7452147.178 | 614887.547 | 292.60 | 10B20100924SPR | 292.57 | 0.03 |
| 10205 | 7452157.101 | 614892.777 | 292.62 | 10B20100924SPR | 292.59 | 0.03 |
| 10206 | 7452166.948 | 614898 | 292.55 | 10B20100924SPR | 292.57 | -0.02 |
| 10207 | 7453027.378 | 615349.673 | 294.33 | 10B20100924SPR | 294.36 | -0.03 |
| 10208 | 7453038.068 | 615355.205 | 294.35 | 10B20100924SPR | 294.36 | -0.01 |
| 10209 | 7453049.22 | 615361.013 | 294.37 | 10B20100924SPR | 294.37 | 0.00 |
| 10210 | 7453534.024 | 616017.11 | 327.16 | 10B20100924SPR | 327.16 | 0.00 |
| 10211 | 7453538.038 | 616029.507 | 327.59 | 10B20100924SPR | 327.62 | -0.03 |
| 10212 | 7453541.534 | 616040.163 | 327.92 | 10B20100924SPR | 327.89 | 0.03 |
| 10213 | 7454113.394 | 616709.228 | 350.37 | 10B20100924SPR | 350.37 | 0.00 |
| 10214 | 7454122.842 | 616716.534 | 350.39 | 10B20100924SPR | 350.38 | 0.01 |
| 10215 | 7454132.093 | 616723.467 | 350.34 | 10B20100924SPR | 350.33 | 0.01 |
| 10216 | 7454831.257 | 617234.618 | 356.83 | 10B20100924SPR | 356.83 | 0.00 |
| 10217 | 7454841.474 | 617242.216 | 356.87 | 10B20100924SPR | 356.88 | -0.01 |
| 10218 | 7454851.421 | 617249.525 | 356.96 | 10B20100924SPR | 356.98 | -0.03 |
| 10219 | 7455679.151 | 617663.552 | 314.66 | 10B20100924SPR | 314.63 | 0.03 |
| 10220 | 7455689.891 | 617668.242 | 314.54 | 10B20100924SPR | 314.51 | 0.03 |
| 10221 | 7455700.328 | 617672.203 | 314.47 | 10B20100924SPR | 314.44 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10222 | 7456343.453 | 617916.091 | 351.22 | 10B20100924SPR | 351.18 | 0.03 |
| 10223 | 7456354.778 | 617920.484 | 351.82 | 10B20100924SPR | 351.77 | 0.05 |
| 10224 | 7456366.195 | 617924.716 | 352.38 | 10B20100924SPR | 352.37 | 0.01 |
| 10225 | 7457152.448 | 618199.482 | 399.96 | 10B20100924CK_10B_5'o/s | 399.95 | 0.01 |
| 10226 | 7457146.112 | 618184.658 | 400.61 | 10B20100924SPR | 400.60 | 0.01 |
| 10227 | 7457154.812 | 618186.555 | 400.57 | 10B20100924SPR | 400.54 | 0.03 |
| 10228 | 7457169.117 | 618188.691 | 400.43 | 10B20100924SPR | 400.42 | 0.01 |
| 10229 | 7457706.828 | 618281.186 | 396.15 | 10B20100924SPR | 396.16 | -0.01 |
| 10230 | 7457718.47 | 618283.164 | 395.88 | 10B20100924SPR | 395.87 | 0.00 |
| 10231 | 7457729.967 | 618285.296 | 395.58 | 10B20100924SPR | 395.58 | 0.00 |
| 10232 | 7458647.825 | 618777.278 | 386.37 | 10B20100924SPR | 386.39 | -0.02 |
| 10233 | 7458653.609 | 618788.72 | 386.08 | 10B20100924SPR | 386.10 | -0.02 |
| 10234 | 7458658.796 | 618799.215 | 385.79 | 10B20100924SPR | 385.79 | 0.00 |
| 10235 | 7459016.529 | 619510.094 | 367.38 | 10B20100924SPR | 367.39 | -0.01 |
| 10236 | 7459022.79 | 619520.095 | 367.77 | 10B20100924SPR | 367.81 | -0.04 |
| 10237 | 7459028.161 | 619529.704 | 368.25 | 10B20100924SPR | 368.29 | -0.04 |
| 10238 | 7459970.804 | 620029.128 | 315.11 | 10B20100924SPR | 315.11 | 0.00 |
| 10239 | 7459982.086 | 620031.082 | 314.94 | 10B20100924SPR | 314.89 | 0.05 |
| 10240 | 7459994.133 | 620032.619 | 314.78 | 10B20100924SPR | 314.76 | 0.02 |
| 10241 | 7460633.904 | 620117.369 | 314.01 | 10B20100924SPR | 313.97 | 0.04 |
| 10242 | 7460646.776 | 620119.116 | 314.01 | 10B20100924SPR | 313.99 | 0.02 |
| 10243 | 7460659.11 | 620120.887 | 314.04 | 10B20100924SPR | 314.01 | 0.03 |
| 10244 | 7461359.908 | 620375.826 | 315.09 | 10B20100924SPR | 315.05 | 0.04 |
| 10245 | 7461368.244 | 620384.496 | 315.08 | 10B20100924SPR | 315.04 | 0.04 |
| 10246 | 7461376.997 | 620393.563 | 315.05 | 10B20100924SPR | 314.98 | 0.07 |
| 10247 | 7461825.702 | 620887.063 | 317.88 | 10B20100924SPR | 317.88 | 0.00 |
| 10248 | 7461832.352 | 620896.997 | 318.14 | 10B20100924SPR | 318.11 | 0.03 |
| 10249 | 7461839.373 | 620907.449 | 318.51 | 10B20100924SPR | 318.49 | 0.02 |
| 10250 | 7462209.906 | 621457.283 | 324.73 | 10B20100924SPR | 324.68 | 0.05 |
| 10251 | 7462216.623 | 621467.613 | 324.82 | 10B20100924SPR | 324.76 | 0.06 |
| 10252 | 7462223.726 | 621478.362 | 324.87 | 10B20100924SPR | 324.83 | 0.04 |
| 10253 | 7462290.544 | 621376.261 | 324.20 | 10B20100924SGR | 324.17 | 0.03 |
| 10254 | 7462276.684 | 621371.703 | 324.06 | 10B20100924SGR | 324.04 | 0.02 |
| 10255 | 7462266.092 | 621360.238 | 323.93 | 10B20100924SGR | 323.91 | 0.02 |
| 10256 | 7462126.231 | 621701.509 | 322.54 | 10B20100924SGR | 322.54 | 0.00 |
| 10257 | 7462134.283 | 621711.027 | 322.64 | 10B20100924SGR | 322.60 | 0.04 |
| 10258 | 7462141.18 | 621697.226 | 322.67 | 10B20100924SGR | 322.64 | 0.03 |
| 10259 | 7462108.686 | 621929.899 | 324.65 | 10B20100924SGR | 324.56 | 0.09 |
| 10260 | 7462098.7 | 621919.467 | 324.55 | 10B20100924SGR | 324.52 | 0.03 |
| 10261 | 7462103.176 | 621901.773 | 324.57 | 10B20100924SGR | 324.55 | 0.01 |
| 10262 | 7462271.925 | 621879.325 | 326.07 | 10B20100924SGR | 326.03 | 0.04 |
| 10263 | 7462260.263 | 621886.823 | 325.36 | 10B20100924SGR | 325.32 | 0.04 |
| 10264 | 7462251.362 | 621883.337 | 324.72 | 10B20100924SGR | 324.69 | 0.03 |
| 10265 | 7461680.448 | 620327.589 | 315.20 | 10B20100924SGR | 315.22 | -0.02 |
| 10266 | 7461672.214 | 620306.394 | 314.95 | 10B20100924SGR | 314.94 | 0.01 |
| 10267 | 7461655.984 | 620313.808 | 314.91 | 10B20100924SGR | 314.93 | -0.02 |
| 10268 | 7461410.602 | 620236.243 | 314.39 | 10B20100924CK_10A_5'o/s | 314.41 | -0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10269 | 7462697.402 | 620905.231 | 318.67 | 10B20100924SGR | 318.65 | 0.02 |
| 10270 | 7462717.312 | 620900.388 | 318.69 | 10B20100924SGR | 318.67 | 0.02 |
| 10271 | 7462724.754 | 620918.867 | 318.76 | 10B20100924SGR | 318.75 | 0.01 |
| 10272 | 7462584.717 | 620964.026 | 318.98 | 10B20100924SGR | 319.05 | -0.07 |
| 10273 | 7462604.793 | 620969.456 | 318.98 | 10B20100924SGR | 319.01 | -0.03 |
| 10274 | 7462603.151 | 620950.689 | 318.91 | 10B20100924SGR | 318.93 | -0.02 |
| 10275 | 7462399.134 | 621664.665 | 326.41 | 10B20100924SPR | 326.35 | 0.06 |
| 10276 | 7462413.299 | 621673.266 | 326.40 | 10B20100924SPR | 326.41 | -0.01 |
| 10277 | 7462423.612 | 621680.801 | 326.46 | 10B20100924SPR | 326.45 | 0.01 |
| 10278 | 7463248.593 | 621908.133 | 328.07 | 10B20100924SPR | 328.10 | -0.03 |
| 10279 | 7463261.012 | 621909.564 | 328.02 | 10B20100924SPR | 328.05 | -0.03 |
| 10280 | 7463273.407 | 621911.007 | 327.99 | 10B20100924SPR | 328.00 | -0.01 |
| 10300 | 7421875.694 | 609157.336 | 350.01 | 11B20100924SAC | 350.03 | -0.02 |
| 10301 | 7421877.067 | 609157.24 | 350.04 | 11B20100924CK_11B_5'o/s | 350.05 | -0.01 |
| 10302 | 7421858.841 | 609157.613 | 351.34 | 11B20100924SPR | 351.38 | -0.04 |
| 10303 | 7421870.424 | 609165.594 | 351.45 | 11B20100924SPR | 351.44 | 0.01 |
| 10304 | 7421881.676 | 609174.199 | 351.51 | 11B20100924SPR | 351.50 | 0.01 |
| 10305 | 7422136.55 | 609824.23 | 375.75 | 11B20100924SPR | 375.75 | 0.00 |
| 10306 | 7422135.067 | 609836.1 | 376.10 | 11B20100924SPR | 376.10 | 0.00 |
| 10307 | 7422133.748 | 609847.678 | 376.44 | 11B20100924SPR | 376.48 | -0.04 |
| 10308 | 7422786.988 | 610641.114 | 383.56 | 11B20100924SPR | 383.54 | 0.02 |
| 10309 | 7422798.826 | 610646.738 | 383.95 | 11B20100924SPR | 383.95 | 0.00 |
| 10310 | 7422810.014 | 610652.079 | 384.36 | 11B20100924SPR | 384.36 | 0.00 |
| 10311 | 7422820.941 | 610657.299 | 384.71 | 11B20100924SPR | 384.71 | 0.00 |
| 10312 | 7423630.106 | 611121.676 | 408.35 | 11B20100924SPR | 408.35 | 0.00 |
| 10313 | 7423638.567 | 611131.017 | 408.14 | 11B20100924SPR | 408.14 | 0.00 |
| 10314 | 7423646.571 | 611139.255 | 407.95 | 11B20100924SPR | 407.94 | 0.01 |
| 10315 | 7424174.814 | 611767.367 | 398.32 | 11B20100924SPR | 398.37 | -0.05 |
| 10316 | 7424185.357 | 611775.677 | 397.93 | 11B20100924SPR | 397.96 | -0.03 |
| 10317 | 7424193.809 | 611782.721 | 397.58 | 11B20100924SPR | 397.60 | -0.03 |
| 10318 | 7424809.061 | 612101.821 | 401.02 | 11B20100924SPR | 400.98 | 0.04 |
| 10319 | 7424820.412 | 612106.259 | 400.88 | 11B20100924SPR | 400.87 | 0.01 |
| 10320 | 7424831.604 | 612110.496 | 400.73 | 11B20100924SPR | 400.70 | 0.03 |
| 10321 | 7425751.735 | 612443.027 | 397.00 | 11B20100924SPR | 397.01 | -0.01 |
| 10322 | 7425763.032 | 612447.52 | 397.07 | 11B20100924SPR | 397.10 | -0.03 |
| 10323 | 7425773.137 | 612451.255 | 397.13 | 11B20100924SPR | 397.14 | -0.01 |
| 10324 | 7426417.283 | 612683.613 | 405.04 | 11B20100924SPR | 405.05 | -0.01 |
| 10325 | 7426430.417 | 612688.162 | 405.24 | 11B20100924SPR | 405.23 | 0.01 |
| 10326 | 7426441.899 | 612692.364 | 405.45 | 11B20100924SPR | 405.48 | -0.03 |
| 10327 | 7427055.291 | 612817.306 | 410.08 | 11B20100924SPR | 410.08 | 0.00 |
| 10328 | 7427066.687 | 612817.138 | 410.07 | 11B20100924SPR | 410.11 | -0.04 |
| 10329 | 7427079.168 | 612816.922 | 410.20 | 11B20100924SPR | 410.24 | -0.05 |
| 10330 | 7421239.383 | 608704.6 | 339.39 | 11B20100924SPR | 339.39 | 0.00 |
| 10331 | 7421229.537 | 608697.017 | 338.94 | 11B20100924SPR | 338.95 | -0.01 |
| 10332 | 7421220.669 | 608690.442 | 338.41 | 11B20100924SPR | 338.40 | 0.00 |
| 10333 | 7420466.963 | 608320.489 | 328.93 | 11B20100924SPR | 328.92 | 0.01 |
| 10334 | 7420455.295 | 608316.129 | 328.89 | 11B20100924SPR | 328.88 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10335 | 7420444.976 | 608312.418 | 328.84 | 11B20100924SPR | 328.84 | 0.00 |
| 10336 | 7419561.385 | 607859.852 | 323.79 | 11B20100924SPR | 323.81 | -0.02 |
| 10337 | 7419548.813 | 607855.268 | 323.71 | 11B20100924SPR | 323.72 | -0.01 |
| 10338 | 7419537.081 | 607850.563 | 323.63 | 11B20100924SPR | 323.65 | -0.02 |
| 10339 | 7418807.549 | 607291.358 | 322.48 | 11B20100924SPR | 322.47 | 0.01 |
| 10340 | 7418797.32 | 607286.774 | 322.48 | 11B20100924SPR | 322.50 | -0.02 |
| 10341 | 7418786.781 | 607282.241 | 322.45 | 11B20100924SPR | 322.50 | -0.05 |
| 10342 | 7418101.768 | 607030.849 | 321.28 | 11B20100924SPR | 321.27 | 0.01 |
| 10343 | 7418089.881 | 607026.431 | 321.38 | 11B20100924SPR | 321.37 | 0.01 |
| 10344 | 7418078.852 | 607022.366 | 321.36 | 11B20100924SPR | 321.39 | -0.03 |
| 10345 | 7417499.546 | 606819.55 | 313.91 | 11B20100924CK_11A | 313.92 | -0.01 |
| 10346 | 7417497.011 | 606809.038 | 314.59 | 11B20100924SPR | 314.56 | 0.03 |
| 10347 | 7417485.526 | 606804.717 | 314.49 | 11B20100924SPR | 314.49 | 0.00 |
| 10348 | 7417473.86 | 606800.433 | 314.34 | 11B20100924SPR | 314.32 | 0.02 |
| 10349 | 7416816.936 | 606503.118 | 317.70 | 11B20100924SPR | 317.73 | -0.03 |
| 10350 | 7416805.922 | 606498.026 | 317.45 | 11B20100924SPR | 317.49 | -0.05 |
| 10351 | 7416795.366 | 606492.917 | 317.27 | 11B20100924SPR | 317.29 | -0.02 |
| 10352 | 7416370.774 | 606181.578 | 305.98 | 11B20100924SPR | 305.99 | -0.01 |
| 10353 | 7416362.783 | 606171.263 | 305.85 | 11B20100924SPR | 305.86 | -0.01 |
| 10354 | 7416354.334 | 606160.122 | 305.70 | 11B20100924SPR | 305.70 | 0.00 |
| 10355 | 7415985.048 | 605681.937 | 301.76 | 11B20100924SPR | 301.76 | 0.00 |
| 10356 | 7415977.149 | 605671.883 | 301.72 | 11B20100924SPR | 301.71 | 0.00 |
| 10357 | 7415970.024 | 605662.443 | 301.70 | 11B20100924SPR | 301.68 | 0.02 |
| 10400 | 7348875.857 | 621302.161 | 561.79 | 13B2010092313A | 561.79 | 0.00 |
| 10401 | 7383568.193 | 597107.458 | 342.76 | 13B20100924SGR | 342.77 | -0.01 |
| 10402 | 7383582.839 | 597098.442 | 342.68 | 13B20100924SGR | 342.69 | -0.01 |
| 10403 | 7383602.048 | 597086.226 | 342.42 | 13B20100924SGR | 342.42 | 0.00 |
| 10404 | 7383627.116 | 597070.464 | 341.82 | 13B20100924SGR | 341.82 | 0.00 |
| 10405 | 7383646.512 | 597061.201 | 341.76 | 13B20100924SGR | 341.76 | 0.00 |
| 10406 | 7383659.335 | 597083.494 | 343.72 | 13B20100924SGR | 343.74 | -0.02 |
| 10407 | 7383669.403 | 597101.493 | 345.08 | 13B20100924SGR | 345.04 | 0.04 |
| 10408 | 7383679.893 | 597118.677 | 346.29 | 13B20100924SGR | 346.29 | 0.00 |
| 10409 | 7383688.035 | 597137.725 | 347.62 | 13B20100924SGR | 347.63 | -0.01 |
| 10410 | 7383690.513 | 597163.962 | 349.53 | 13B20100924SGR | 349.48 | 0.05 |
| 10411 | 7383687.147 | 597184.347 | 351.07 | 13B20100924SGR | 350.95 | 0.12 |
| 10412 | 7383679.495 | 597215.497 | 353.43 | 13B20100924SGR | 353.30 | 0.13 |
| 10413 | 7383674.394 | 597145.27 | 347.78 | 13B20100924SGR | 347.82 | -0.04 |
| 10414 | 7383640.803 | 597149.33 | 347.57 | 13B20100924SGR | 347.52 | 0.05 |
| 10415 | 7383617.864 | 597164.045 | 348.40 | 13B20100924SGR | 348.36 | 0.04 |
| 10416 | 7383598.604 | 597173.606 | 348.85 | 13B20100924SGR | 348.81 | 0.04 |
| 10417 | 7383568.85 | 597159.274 | 347.74 | 13B20100924SGR | 347.72 | 0.02 |
| 10418 | 7383555.264 | 597186.435 | 348.88 | 13B20100924SGR | 348.89 | -0.01 |
| 10419 | 7383525.498 | 597193.338 | 347.83 | 13B20100924SGR | 347.91 | -0.08 |
| 10420 | 7383485.24 | 597191.551 | 344.35 | 13B20100924SGR | 344.50 | -0.15 |
| 10421 | 7383458.032 | 597189.287 | 341.56 | 13B20100924SGR | 341.67 | -0.11 |
| 10422 | 7383429.203 | 597170.155 | 339.08 | 13B20100924SGR | 339.11 | -0.03 |
| 10423 | 7383443.059 | 597157.63 | 339.82 | 13B20100924SAR | 339.85 | -0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10424 | 7383472.305 | 597141.415 | 340.88 | 13B20100924SAR | 340.92 | -0.04 |
| 10425 | 7383537.876 | 597105.852 | 342.01 | 13B20100924SAR | 342.02 | -0.01 |
| 10426 | 7384303.583 | 596988.08 | 320.95 | 13B20100924SAR | 320.92 | 0.03 |
| 10427 | 7384333.712 | 597000.65 | 319.95 | 13B20100924SAR | 319.94 | 0.01 |
| 10428 | 7384362.854 | 597012.817 | 318.95 | 13B20100924SAR | 318.93 | 0.02 |
| 10429 | 7384365.009 | 597007.158 | 318.92 | 13B20100924SAR | 318.82 | 0.10 |
| 10430 | 7384394.243 | 597019.159 | 317.64 | 13B20100924SAR | 317.55 | 0.09 |
| 10431 | 7384423.258 | 597031.918 | 316.26 | 13B20100924SAR | 316.17 | 0.09 |
| 10432 | 7384451.766 | 597043.866 | 314.89 | 13B20100924SAR | 314.79 | 0.10 |
| 10433 | 7384484.899 | 597057.948 | 313.29 | 13B20100924SAR | 313.19 | 0.10 |
| 10434 | 7384507.993 | 597067.863 | 312.19 | 13B20100924SAR | 312.13 | 0.06 |
| 10435 | 7384540.838 | 597082.384 | 310.63 | 13B20100924SAR | 310.56 | 0.07 |
| 10436 | 7384539.393 | 597086.287 | 310.62 | 13B20100924SAR | 310.60 | 0.02 |
| 10437 | 7384567.167 | 597097.938 | 309.27 | 13B20100924SAR | 309.19 | 0.08 |
| 10438 | 7384595.422 | 597109.937 | 307.73 | 13B20100924SAR | 307.71 | 0.02 |
| 10439 | 7384625.023 | 597122.456 | 306.23 | 13B20100924SAR | 306.18 | 0.05 |
| 10440 | 7385615.795 | 597905.559 | 377.70 | 13B20100924SAR | 377.67 | 0.03 |
| 10441 | 7385640.016 | 597941.91 | 379.81 | 13B20100924SAR | 379.81 | 0.00 |
| 10442 | 7385656.832 | 597968.004 | 381.02 | 13B20100924SAR | 381.04 | -0.02 |
| 10443 | 7382728.759 | 597547.492 | 291.01 | 13B20100924SAR | 291.11 | -0.10 |
| 10444 | 7382699.889 | 597562.685 | 288.89 | 13B20100924SAR | 288.99 | -0.10 |
| 10445 | 7382670.467 | 597578.937 | 286.22 | 13B20100924SAR | 286.38 | -0.16 |
| 10446 | 7381676.844 | 597977.007 | 259.39 | 13B20100924SAR | 259.38 | 0.01 |
| 10448 | 7381582.274 | 598011.637 | 260.41 | 13B20100924SAR | 260.39 | 0.02 |
| 10449 | 7381529.817 | 598030.088 | 263.37 | 13B20100924SAR | 263.30 | 0.06 |
| 10450 | 7381476.14 | 598049.681 | 266.07 | 13B20100924SAR | 266.04 | 0.03 |
| 10451 | 7381427.133 | 598067.61 | 268.90 | 13B20100924SAR | 268.83 | 0.07 |
| 10452 | 7381377.253 | 598085.72 | 271.39 | 13B20100924SAR | 271.35 | 0.04 |
| 10453 | 7381388.125 | 598078.89 | 270.76 | 13B20100924SAR | 270.76 | 0.00 |
| 10454 | 7379513.737 | 599850.448 | 296.52 | 13B20100924SGR | 296.50 | 0.02 |
| 10455 | 7379531.847 | 599864.445 | 295.29 | 13B20100924SGR | 295.25 | 0.04 |
| 10456 | 7379574.847 | 599899.735 | 293.52 | 13B20100924SGR | 293.50 | 0.02 |
| 10457 | 7379617.278 | 599935.174 | 292.09 | 13B20100924SGR | 292.02 | 0.07 |
| 10458 | 7379496.52 | 599833.894 | 298.60 | 13B20100924SGR | 298.51 | 0.09 |
| 10459 | 7379479.754 | 599819.198 | 300.96 | 13B20100924SGR | 300.90 | 0.06 |
| 10460 | 7379457.326 | 599839.726 | 301.96 | 13B20100924SGR | 301.91 | 0.05 |
| 10461 | 7379431.851 | 599852.112 | 303.22 | 13B20100924SAR | 303.17 | 0.05 |
| 10462 | 7379391.067 | 599889.971 | 304.77 | 13B20100924SAR | 304.72 | 0.05 |
| 10463 | 7379430.032 | 599845.539 | 303.22 | 13B20100924SAR | 303.21 | 0.01 |
| 10464 | 7378108.13 | 600910.844 | 395.91 | 13B20100924SAR | 395.75 | 0.16 |
| 10465 | 7378093.605 | 600923.339 | 397.13 | 13B20100924SAR | 397.03 | 0.10 |
| 10466 | 7378129.529 | 600897.22 | 394.15 | 13B20100924SAR | 394.04 | 0.11 |
| 10467 | 7378153.654 | 600875.787 | 391.60 | 13B20100924SAR | 391.47 | 0.13 |
| 10468 | 7378180.179 | 600857.32 | 389.06 | 13B20100924SAR | 388.92 | 0.14 |
| 10469 | 7378208.934 | 600837.244 | 386.34 | 13B20100924SAR | 386.21 | 0.13 |
| 10470 | 7378230.25 | 600822.728 | 384.41 | 13B20100924SAR | 384.30 | 0.11 |
| 10471 | 7378255.481 | 600804.408 | 382.23 | 13B20100924SAR | 382.10 | 0.13 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10472 | 7378272.536 | 600791.543 | 380.67 | 13B20100924SAR | 380.57 | 0.10 |
| 10473 | 7378284.56 | 600783.078 | 379.66 | 13B20100924SAR | 379.58 | 0.08 |
| 10474 | 7378287.712 | 600787.957 | 379.74 | 13B20100924SAR | 379.61 | 0.13 |
| 10475 | 7378325.618 | 600761.432 | 376.58 | 13B20100924SAR | 376.45 | 0.13 |
| 10476 | 7378312.872 | 600771.437 | 377.68 | 13B20100924SAR | 377.57 | 0.11 |
| 10477 | 7348875.857 | 621302.161 | 561.79 | 13B2010092413B | 561.79 | 0.00 |
| 10478 | 7348876.336 | 621287.888 | 562.41 | 13B20100924SGR | 562.54 | -0.13 |
| 10479 | 7348896.109 | 621312.843 | 562.11 | 13B20100924SGR | 562.22 | -0.11 |
| 10480 | 7348912.567 | 621334.55 | 561.83 | 13B20100924SGR | 561.97 | -0.14 |
| 10481 | 7348930.423 | 621363.384 | 561.50 | 13B20100924SGR | 561.65 | -0.15 |
| 10482 | 7348944.76 | 621391.791 | 561.27 | 13B20100924SGR | 561.40 | -0.13 |
| 10483 | 7348958.922 | 621419.786 | 560.81 | 13B20100924SGR | 560.96 | -0.15 |
| 10484 | 7348977.699 | 621451.173 | 559.95 | 13B20100924SGR | 560.07 | -0.12 |
| 10485 | 7349002.042 | 621478.359 | 559.66 | 13B20100924SGR | 559.81 | -0.15 |
| 10486 | 7349014.285 | 621487.436 | 559.61 | 13B20100924SGR | 559.74 | -0.13 |
| 10487 | 7349034.608 | 621504.65 | 560.04 | 13B20100924SGR | 560.17 | -0.13 |
| 10488 | 7349016.827 | 621493.956 | 559.63 | 13B20100924SGR | 559.76 | -0.13 |
| 10489 | 7348999.857 | 621471.677 | 559.76 | 13B20100924SGR | 559.88 | -0.12 |
| 10490 | 7348983.82 | 621454.095 | 559.78 | 13B20100924SGR | 559.94 | -0.16 |
| 10491 | 7348966.089 | 621425.774 | 560.59 | 13B20100924SGR | 560.72 | -0.13 |
| 10492 | 7348956.414 | 621409.35 | 560.95 | 13B20100924SGR | 561.08 | -0.13 |
| 10493 | 7348937.502 | 621369.701 | 561.44 | 13B20100924SGR | 561.57 | -0.13 |
| 10494 | 7348892.782 | 621299.148 | 562.24 | 13B20100924SGR | 562.36 | -0.12 |
| 10495 | 7348872.571 | 621271.73 | 562.34 | 13B20100924SGR | 562.46 | -0.12 |
| 10496 | 7348857.175 | 621303.934 | 563.36 | 13B20100924SGR | 563.49 | -0.13 |
| 10497 | 7348835.989 | 621348.138 | 564.12 | 13B20100924SGR | 564.22 | -0.10 |
| 10498 | 7348822.19 | 621376.649 | 564.10 | 13B20100924SGR | 564.20 | -0.10 |
| 10499 | 7348808.454 | 621404.711 | 563.64 | 13B20100924SGR | 563.76 | -0.12 |
| 10500 | 7348791.612 | 621431.529 | 562.64 | 13B20100924SGR | 562.77 | -0.13 |
| 10501 | 7348794.238 | 621433.511 | 562.75 | 13B20100924SGR | 562.91 | -0.16 |
| 10502 | 7348781.305 | 621458.809 | 561.63 | 13B20100924SGR | 561.75 | -0.12 |
| 10503 | 7348766.067 | 621484.887 | 560.06 | 13B20100924SGR | 560.20 | -0.14 |
| 10504 | 7348743.478 | 621522.78 | 557.60 | 13B20100924SGR | 557.75 | -0.15 |
| 10505 | 7348737.362 | 621531.28 | 556.97 | 13B20100924SGR | 557.14 | -0.17 |
| 10506 | 7348320.506 | 621979.291 | 527.32 | 13B20100924SGR | 527.44 | -0.12 |
| 10507 | 7348288.735 | 622012.852 | 524.25 | 13B20100924SGR | 524.37 | -0.12 |
| 10508 | 7348247.528 | 622055.294 | 519.51 | 13B20100924SGR | 519.64 | -0.13 |
| 10509 | 7348206.272 | 622097.561 | 514.52 | 13B20100924SGR | 514.64 | -0.12 |
| 10510 | 7348164.291 | 622140.352 | 509.18 | 13B20100924SGR | 509.30 | -0.12 |
| 10511 | 7348120.701 | 622185.433 | 503.77 | 13B20100924SGR | 503.90 | -0.13 |
| 10512 | 7348118.914 | 622182.909 | 503.75 | 13B20100924SGR | 503.84 | -0.09 |
| 10513 | 7347110.207 | 623222.23 | 426.35 | 13B20100924SGR | 426.52 | -0.17 |
| 10514 | 7347087.529 | 623246.562 | 426.54 | 13B20100924SGR | 426.73 | -0.19 |
| 10515 | 7347064.102 | 623271.067 | 426.48 | 13B20100924SGR | 426.67 | -0.19 |
| 10516 | 7347038.71 | 623297.675 | 426.49 | 13B20100924SGR | 426.65 | -0.16 |
| 10517 | 7347015.327 | 623321.248 | 426.67 | 13B20100924SGR | 426.84 | -0.17 |
| 10518 | 7346990.539 | 623347.175 | 426.46 | 13B20100924SGR | 426.61 | -0.15 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10519 | 7346954.99 | 623383.366 | 426.16 | 13B20100924SGR | 426.35 | -0.19 |
| 10520 | 7349611.563 | 620955.25 | 505.99 | 13B20100924SGR | 506.10 | -0.11 |
| 10521 | 7349639.552 | 620939.606 | 505.14 | 13B20100924SGR | 505.33 | -0.19 |
| 10522 | 7349667.625 | 620922.947 | 504.54 | 13B20100924SGR | 504.69 | -0.15 |
| 10523 | 7349694.506 | 620907.313 | 504.24 | 13B20100924SGR | 504.37 | -0.13 |
| 10524 | 7349696.294 | 620909.652 | 504.16 | 13B20100924SGR | 504.33 | -0.17 |
| 10525 | 7349722.275 | 620892.328 | 504.23 | 13B20100924SGR | 504.41 | -0.18 |
| 10526 | 7349748.802 | 620875.875 | 504.45 | 13B20100924SGR | 504.62 | -0.17 |
| 10527 | 7349766.284 | 620866.183 | 504.55 | 13B20100924SGR | 504.70 | -0.15 |
| 10528 | 7349794.43 | 620849.338 | 504.62 | 13B20100924SGR | 504.79 | -0.17 |
| 10529 | 7349824.384 | 620831.78 | 504.80 | 13B20100924SGR | 504.96 | -0.16 |
| 10530 | 7349852.862 | 620815.26 | 504.79 | 13B20100924SGR | 504.98 | -0.19 |
| 10531 | 7349851.128 | 620812.618 | 504.68 | 13B20100924SGR | 504.85 | -0.17 |
| 10532 | 7349854.197 | 620818.092 | 504.67 | 13B20100924SGR | 504.89 | -0.22 |
| 10533 | 7351223.418 | 620036.55 | 531.90 | 13B20100924SGR | 532.04 | -0.14 |
| 10534 | 7351218.662 | 620029.658 | 532.11 | 13B20100924SGR | 532.26 | -0.15 |
| 10535 | 7351246.182 | 620013.697 | 532.55 | 13B20100924SGR | 532.71 | -0.16 |
| 10536 | 7351237.749 | 619999.949 | 532.43 | 13B20100924SGR | 532.60 | -0.17 |
| 10537 | 7351265.135 | 619983.915 | 532.69 | 13B20100924SGR | 532.84 | -0.15 |
| 10538 | 7351277.088 | 619997.113 | 532.84 | 13B20100924SGR | 532.98 | -0.14 |
| 10539 | 7351304.458 | 619979.72 | 532.83 | 13B20100924SGR | 532.97 | -0.14 |
| 10540 | 7351296.224 | 619965.089 | 532.65 | 13B20100924SGR | 532.82 | -0.17 |
| 10541 | 7351326.001 | 619948.893 | 532.24 | 13B20100924SGR | 532.37 | -0.13 |
| 10542 | 7351328.731 | 619947.339 | 532.16 | 13B20100924SGR | 532.30 | -0.14 |
| 10543 | 7351337.853 | 619962.148 | 532.27 | 13B20100924SGR | 532.41 | -0.14 |
| 10544 | 7351368.535 | 619944.892 | 531.28 | 13B20100924SGR | 531.42 | -0.14 |
| 10545 | 7351360.87 | 619929.059 | 531.21 | 13B20100924SGR | 531.34 | -0.13 |
| 10546 | 7351372.103 | 619923.042 | 530.79 | 13B20100924SGR | 530.91 | -0.13 |
| 10547 | 7353856.336 | 618275.539 | 532.20 | 13B20100924SAR | 532.35 | -0.15 |
| 10548 | 7353882.485 | 618257.041 | 532.28 | 13B20100924SAR | 532.41 | -0.13 |
| 10549 | 7353887.958 | 618241.127 | 531.88 | 13B20100924SAR | 532.07 | -0.19 |
| 10550 | 7353889.537 | 618243.917 | 532.23 | 13B20100924SAR | 532.36 | -0.13 |
| 10551 | 7353921.951 | 618221.827 | 532.15 | 13B20100924SAR | 532.32 | -0.17 |
| 10552 | 7353948.437 | 618203.687 | 531.94 | 13B20100924SAR | 532.09 | -0.15 |
| 10553 | 7353974.939 | 618185.377 | 531.72 | 13B20100924SAR | 531.84 | -0.12 |
| 10554 | 7354000.129 | 618168.134 | 531.33 | 13B20100924SAR | 531.48 | -0.15 |
| 10555 | 7354003.538 | 618172.348 | 531.30 | 13B20100924SAR | 531.43 | -0.13 |
| 10556 | 7383554.354 | 597111.043 | 342.11 | 13B2010092412B | 342.10 | 0.01 |
| 10700 | 6943113.551 | 641833.335 | 198.91 | 46B2011061346BFAC | 198.96 | -0.05 |
| 10701 | 6943136.717 | 641843.718 | 199.71 | 46B20110613SPR | 199.70 | 0.01 |
| 10702 | 6943118.701 | 641850.366 | 199.62 | 46B20110613SPR | 199.58 | 0.04 |
| 10703 | 6943102.592 | 641853.752 | 199.56 | 46B20110613SPR | 199.52 | 0.04 |
| 10704 | 6943086.855 | 641853.185 | 199.62 | 46B20110613SPR | 199.59 | 0.03 |
| 10705 | 6943105.557 | 641841.34 | 199.61 | 46B20110613SPR | 199.56 | 0.05 |
| 10706 | 6943746.096 | 641793.293 | 210.61 | 46B20110613SPR | 210.59 | 0.02 |
| 10707 | 6943760.289 | 641789.021 | 211.27 | 46B20110613SPR | 211.27 | 0.00 |
| 10708 | 6943775.45 | 641792.552 | 211.50 | 46B20110613SPR | 211.49 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10709 | 6943790.785 | 641788.857 | 212.13 | 46B20110613SPR | 212.13 | 0.00 |
| 10710 | 6944333.26 | 642058.273 | 211.08 | 46B20110613SPR | 211.07 | 0.01 |
| 10711 | 6944347.442 | 642064.631 | 210.83 | 46B20110613SPR | 210.85 | -0.02 |
| 10712 | 6944356.674 | 642077.539 | 210.53 | 46B20110613SPR | 210.50 | 0.03 |
| 10713 | 6944369.501 | 642082.741 | 210.22 | 46B20110613SPR | 210.20 | 0.02 |
| 10714 | 6944829.457 | 642444.721 | 199.96 | 46B20110613SPR | 199.95 | 0.01 |
| 10715 | 6944848.22 | 642449.832 | 200.27 | 46B20110613SPR | 200.21 | 0.06 |
| 10716 | 6944861.514 | 642460.883 | 200.88 | 46B20110613SPR | 200.81 | 0.07 |
| 10717 | 6944881.446 | 642465.421 | 201.19 | 46B20110613SPR | 201.15 | 0.04 |
| 10718 | 6945471.056 | 642514.134 | 203.71 | 46B20110613SPR | 203.68 | 0.03 |
| 10719 | 6945484.566 | 642507.757 | 203.51 | 46B20110613SPR | 203.46 | 0.05 |
| 10720 | 6945498.725 | 642508.867 | 203.42 | 46B20110613SPR | 203.37 | 0.05 |
| 10721 | 6945509.882 | 642502.914 | 203.29 | 46B20110613SPR | 203.26 | 0.03 |
| 10722 | 6946200.411 | 642377.664 | 186.34 | 46B20110613SPR | 186.30 | 0.04 |
| 10723 | 6946215.041 | 642370.509 | 185.81 | 46B20110613SPR | 185.76 | 0.05 |
| 10724 | 6946234.247 | 642370.538 | 185.15 | 46B20110613SPR | 185.09 | 0.06 |
| 10725 | 6946249.339 | 642364.353 | 184.56 | 46B20110613SPR | 184.51 | 0.05 |
| 10726 | 6946907.908 | 642212.945 | 173.65 | 46B20110613SPR | 173.64 | 0.01 |
| 10727 | 6946922.209 | 642209.512 | 173.67 | 46B20110613SPR | 173.65 | 0.02 |
| 10728 | 6946936.231 | 642205.985 | 173.70 | 46B20110613SPR | 173.66 | 0.04 |
| 10729 | 6946920.756 | 642200.141 | 173.49 | 46B20110613SPR | 173.46 | 0.03 |
| 10730 | 6947490.846 | 642099.631 | 192.61 | 46B20110613SPR | 192.58 | 0.03 |
| 10731 | 6947504.709 | 642095.115 | 193.20 | 46B20110613SPR | 193.17 | 0.03 |
| 10732 | 6947518.416 | 642098.577 | 193.36 | 46B20110613SPR | 193.34 | 0.02 |
| 10733 | 6947533.009 | 642095.169 | 193.87 | 46B20110613SPR | 193.86 | 0.01 |
| 10734 | 6948103.352 | 642229.763 | 194.43 | 46B20110613SPR | 194.39 | 0.04 |
| 10735 | 6948117.987 | 642238.19 | 194.32 | 46B20110613SPR | 194.28 | 0.04 |
| 10736 | 6948135.402 | 642239.329 | 194.16 | 46B20110613SPR | 194.14 | 0.02 |
| 10737 | 6948148.34 | 642247.059 | 194.03 | 46B20110613SPR | 193.98 | 0.05 |
| 10738 | 6948881.738 | 642443.223 | 209.46 | 46B20110613SPR | 209.48 | -0.02 |
| 10739 | 6948899.758 | 642440.172 | 210.00 | 46B20110613SPR | 210.00 | 0.00 |
| 10740 | 6948914.156 | 642444.436 | 210.80 | 46B20110613SPR | 210.80 | 0.00 |
| 10741 | 6948931.523 | 642440.915 | 211.28 | 46B20110613SPR | 211.25 | 0.03 |
| 10742 | 6949436.028 | 642342.223 | 218.67 | 46B20110613SPR | 218.62 | 0.05 |
| 10743 | 6949449.417 | 642334.704 | 218.66 | 46B20110613SPR | 218.61 | 0.05 |
| 10744 | 6949466.97 | 642333.893 | 218.55 | 46B20110613SPR | 218.51 | 0.04 |
| 10745 | 6949479.501 | 642326.699 | 218.46 | 46B20110613SPR | 218.43 | 0.03 |
| 10746 | 6950326.376 | 642153.773 | 209.74 | 46B20110613SPR | 209.71 | 0.03 |
| 10747 | 6950340.859 | 642149.276 | 209.83 | 46B20110613SPR | 209.77 | 0.06 |
| 10748 | 6950356.507 | 642152.927 | 209.78 | 46B20110613SPR | 209.68 | 0.10 |
| 10749 | 6950374.457 | 642148.648 | 209.84 | 46B20110613SPR | 209.81 | 0.03 |
| 10750 | 6950853.547 | 642141.138 | 207.65 | 46B20110613SPR | 207.58 | 0.07 |
| 10751 | 6950870.222 | 642135.996 | 207.16 | 46B20110613SPR | 207.12 | 0.04 |
| 10752 | 6950884.042 | 642138.438 | 207.13 | 46B20110613SPR | 207.07 | 0.06 |
| 10753 | 6950896.219 | 642133.053 | 206.69 | 46B20110613SPR | 206.67 | 0.02 |
| 10754 | 6951567.165 | 641917.769 | 211.10 | 46B20110613SPR | 211.04 | 0.06 |
| 10755 | 6951581.631 | 641907.968 | 211.41 | 46B20110613SPR | 211.40 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10756 | 6951605.091 | 641903.832 | 211.72 | 46B20110613SPR | 211.70 | 0.02 |
| 10757 | 6951548.618 | 641920.299 | 210.75 | 46B20110613SPR | 210.75 | 0.00 |
| 10758 | 6952156.445 | 641698.395 | 217.93 | 46B20110613SPR | 217.89 | 0.04 |
| 10759 | 6952142.274 | 641700.852 | 217.71 | 46B20110613SPR | 217.64 | 0.07 |
| 10760 | 6952131.088 | 641709.66 | 217.71 | 46B20110613SPR | 217.65 | 0.06 |
| 10761 | 6952114.412 | 641712.64 | 217.44 | 46B20110613SPR | 217.42 | 0.02 |
| 10762 | 6952694.768 | 641381.061 | 223.28 | 46B20110613SPR | 223.19 | 0.09 |
| 10763 | 6952682.779 | 641383.921 | 223.18 | 46B20110613SPR | 223.08 | 0.10 |
| 10764 | 6952669.825 | 641396.317 | 223.01 | 46B20110613SPR | 222.95 | 0.06 |
| 10765 | 6942619.566 | 641968.962 | 201.63 | 46B20110613SPR | 201.65 | -0.02 |
| 10766 | 6942606.974 | 641976.042 | 201.79 | 46B20110613SPR | 201.80 | -0.01 |
| 10767 | 6942592.916 | 641975.7 | 201.80 | 46B20110613SPR | 201.79 | 0.01 |
| 10768 | 6942582.268 | 641981.976 | 202.01 | 46B20110613SPR | 201.98 | 0.03 |
| 10769 | 6941492.632 | 642015.356 | 192.34 | 46B20110613SPR | 192.31 | 0.03 |
| 10770 | 6941512.382 | 642027.989 | 192.50 | 46B20110613SPR | 192.49 | 0.01 |
| 10771 | 6941497.761 | 642029.762 | 192.77 | 46B20110613SPR | 192.77 | 0.00 |
| 10772 | 6941484.706 | 642023.63 | 192.82 | 46B20110613SPR | 192.79 | 0.03 |
| 10773 | 6941467.725 | 642023.499 | 193.15 | 46B20110613SPR | 193.10 | 0.05 |
| 10774 | 6940793.346 | 642104.5 | 196.31 | 46B20110613SPR | 196.33 | -0.02 |
| 10775 | 6940786.98 | 642116.183 | 195.83 | 46B20110613SPR | 195.79 | 0.04 |
| 10776 | 6940773.809 | 642123.694 | 195.38 | 46B20110613SPR | 195.33 | 0.05 |
| 10777 | 6940766.818 | 642136.155 | 194.90 | 46B20110613SPR | 194.85 | 0.05 |
| 10778 | 6940365.469 | 642265.005 | 175.53 | 46B20110613SPR | 175.52 | 0.01 |
| 10779 | 6940349.123 | 642262.533 | 175.16 | 46B20110613SPR | 175.14 | 0.02 |
| 10780 | 6940336.439 | 642252.481 | 174.74 | 46B20110613SPR | 174.73 | 0.01 |
| 10781 | 6940321.944 | 642251.106 | 174.50 | 46B20110613SPR | 174.48 | 0.02 |
| 10782 | 6940334.492 | 642271.274 | 174.90 | 46B20110613SPR | 174.90 | 0.00 |
| 10783 | 6940326.33 | 642283.177 | 175.17 | 46B20110613SPR | 175.15 | 0.02 |
| 10784 | 6940328.851 | 642285.948 | 175.24 | 46B20110613SPR | 175.22 | 0.02 |
| 10785 | 6940338.285 | 642275.139 | 174.98 | 46B20110613SPR | 174.96 | 0.02 |
| 10786 | 6939862.268 | 642080.309 | 172.50 | 46B20110613SPR | 172.45 | 0.05 |
| 10787 | 6939843.527 | 642080.853 | 172.78 | 46B20110613SPR | 172.77 | 0.01 |
| 10788 | 6939827.484 | 642073.66 | 172.74 | 46B20110613SPR | 172.76 | -0.02 |
| 10789 | 6939808.614 | 642073.366 | 173.28 | 46B20110613SPR | 173.25 | 0.03 |
| 10790 | 6940020.297 | 642397.37 | 196.57 | 46B20110613SPR | 196.48 | 0.09 |
| 10791 | 6940008.395 | 642403.779 | 197.11 | 46B20110613SPR | 197.08 | 0.03 |
| 10792 | 6939994.12 | 642402.461 | 197.78 | 46B20110613SPR | 197.76 | 0.02 |
| 10793 | 6939983.15 | 642408.405 | 198.12 | 46B20110613SPR | 198.09 | 0.03 |
| 10794 | 6939647.104 | 642509.9 | 217.65 | 46B20110613CK_SPIKE | 217.67 | -0.02 |
| 10795 | 6939602.177 | 642559.316 | 220.99 | 46B20110613SPR | 220.97 | 0.02 |
| 10796 | 6939614.87 | 642553.501 | 219.99 | 46B20110613SPR | 219.99 | 0.00 |
| 10797 | 6939589.764 | 642579.411 | 222.62 | 46B20110613SPR | 222.59 | 0.03 |
| 10798 | 6939579.16 | 642591.47 | 223.84 | 46B20110613SPR | 223.81 | 0.03 |
| 10799 | 6939576.459 | 642608.193 | 224.88 | 46B20110613SPR | 224.86 | 0.02 |
| 10800 | 6939568.643 | 642621.749 | 225.94 | 46B20110613SPR | 225.92 | 0.02 |
| 10801 | 6939566.958 | 642640.662 | 227.17 | 46B20110613SPR | 227.15 | 0.02 |
| 10802 | 6939535.307 | 642728.425 | 233.69 | 46B20110613SPR | 233.63 | 0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10803 | 6939524.882 | 642740.575 | 234.80 | 46B20110613SPR | 234.77 | 0.03 |
| 10804 | 6939440.716 | 642836.995 | 240.02 | 46B20110613SPR | 240.05 | -0.03 |
| 10805 | 6939421.931 | 642842.907 | 240.88 | 46B20110613SPR | 240.90 | -0.02 |
| 10814 | 6939094.694 | 642678.084 | 237.02 | 46B20110613SPR | 236.98 | 0.04 |
| 10815 | 6939120.005 | 642616.646 | 233.75 | 46B20110613SPR | 233.73 | 0.02 |
| 10816 | 6939134.83 | 642624.99 | 234.24 | 46B20110613SPR | 234.21 | 0.03 |
| 10817 | 6939123.778 | 642629.575 | 234.38 | 46B20110613SPR | 234.38 | 0.00 |
| 10829 | 6943116.603 | 641833.49 | 198.30 | 46B20110613CK_SPIKE | 198.34 | -0.04 |
| 11000 | 6836584.78 | 669598.38 | 78.63 | 42C2011051342CSAC | 78.61 | 0.02 |
| 11001 | 6835534.163 | 669931.747 | 84.99 | 42C20110513SPR | 85.01 | -0.02 |
| 11002 | 6835553.946 | 669921.264 | 84.49 | 42C20110513SPR | 84.50 | -0.01 |
| 11003 | 6836050.167 | 669773.81 | 80.16 | 42C20110513SPR | 80.17 | -0.01 |
| 11004 | 6836070.051 | 669767.981 | 80.23 | 42C20110513SPR | 80.25 | -0.02 |
| 11005 | 6836090.842 | 669761.869 | 80.30 | 42C20110513SPR | 80.31 | -0.01 |
| 11006 | 6836156.184 | 670037.428 | 78.30 | 42C20110513SPR | 78.32 | -0.02 |
| 11007 | 6836157.316 | 670057.207 | 78.42 | 42C20110513SPR | 78.41 | 0.01 |
| 11008 | 6836158.886 | 670077.847 | 78.50 | 42C20110513SPR | 78.50 | 0.00 |
| 11009 | 6836538.421 | 669598.346 | 79.15 | 42C20110513SPR | 79.15 | 0.00 |
| 11010 | 6836556.813 | 669593.641 | 79.24 | 42C20110513SPR | 79.24 | 0.00 |
| 11011 | 6836574.312 | 669589.152 | 79.25 | 42C20110513SPR | 79.26 | -0.01 |
| 11012 | 6836587.573 | 669597.284 | 78.67 | 42C20110513SSP | 78.71 | -0.04 |
| 11013 | 6837136.05 | 669324.288 | 81.18 | 42C20110513SPR | 81.23 | -0.05 |
| 11014 | 6837147.117 | 669303.479 | 81.15 | 42C20110513SPR | 81.19 | -0.04 |
| 11015 | 6837152.956 | 669283.55 | 81.02 | 42C20110513SPR | 81.04 | -0.03 |
| 11016 | 6837081.991 | 668637.227 | 77.06 | 42C20110513SPR | 77.07 | -0.01 |
| 11017 | 6837079.333 | 668618.3 | 76.97 | 42C20110513SPR | 76.96 | 0.01 |
| 11018 | 6837076.806 | 668599.422 | 76.89 | 42C20110513SPR | 76.88 | 0.01 |
| 11019 | 6835515.804 | 669942.646 | 85.46 | 42C20110513SPR | 85.49 | -0.03 |
| 11100 | 6894040.52 | 652159.209 | 109.11 | 44B2011051444BSAC | 109.05 | 0.06 |
| 11101 | 6892950.342 | 654168.697 | 115.48 | 44B20110514SPR | 115.58 | -0.10 |
| 11102 | 6892935.729 | 654183.565 | 115.69 | 44B20110514SPR | 115.79 | -0.10 |
| 11103 | 6892765.659 | 654482.089 | 115.24 | 44B20110514SPR | 115.33 | -0.09 |
| 11104 | 6892749.071 | 654461.676 | 115.13 | 44B20110514SPR | 115.26 | -0.13 |
| 11105 | 6892743.758 | 654450.283 | 115.00 | 44B20110514SPR | 115.09 | -0.09 |
| 11106 | 6893176.167 | 653419.157 | 107.70 | 44B20110514SPR | 107.80 | -0.10 |
| 11107 | 6893186.183 | 653402.873 | 107.86 | 44B20110514SPR | 107.97 | -0.11 |
| 11108 | 6893200.588 | 653382.933 | 108.00 | 44B20110514SPR | 108.11 | -0.11 |
| 11109 | 6893673.745 | 652816.763 | 110.51 | 44B20110514SPR | 110.60 | -0.09 |
| 11110 | 6893684.339 | 652798.772 | 110.51 | 44B20110514SPR | 110.63 | -0.12 |
| 11111 | 6893693.24 | 652784.388 | 110.51 | 44B20110514SPR | 110.63 | -0.12 |
| 11112 | 6894011.526 | 652182.723 | 109.28 | 44B20110514SPR | 109.40 | -0.12 |
| 11113 | 6894019.03 | 652164.279 | 109.20 | 44B20110514SPR | 109.29 | -0.09 |
| 11114 | 6894026.401 | 652145.357 | 109.21 | 44B20110514SPR | 109.31 | -0.11 |
| 11115 | 6894043.573 | 652159.161 | 108.96 | 44B20110514SSP | 109.07 | -0.11 |
| 11116 | 6894438.179 | 651582.938 | 109.48 | 44B20110514SPR | 109.60 | -0.12 |
| 11117 | 6894452.86 | 651572.042 | 109.36 | 44B20110514SPR | 109.47 | -0.11 |
| 11118 | 6894468.059 | 651560.813 | 109.27 | 44B20110514SPR | 109.41 | -0.14 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 11119 | 6892965.84 | 654157.24 | 115.55 | 44B20110514SPR | 115.66 | -0.11 |
| 11200 | 6915920.968 | 642326.101 | 129.04 | 45B2011051445BSAC | 129.03 | 0.00 |
| 11201 | 6915930.208 | 642296.921 | 128.71 | 45B20110514SPR | 128.67 | 0.04 |
| 11202 | 6915952.672 | 642297.089 | 128.68 | 45B20110514SPR | 128.59 | 0.09 |
| 11203 | 6915969.841 | 642293.996 | 128.54 | 45B20110514SPR | 128.47 | 0.07 |
| 11204 | 6915986.969 | 642291.658 | 128.43 | 45B20110514SPR | 128.34 | 0.09 |
| 11205 | 6916734.057 | 642164.322 | 129.20 | 45B20110514SPR | 129.10 | 0.10 |
| 11206 | 6916753.517 | 642161.299 | 129.20 | 45B20110514SPR | 129.13 | 0.07 |
| 11207 | 6916774.446 | 642157.305 | 129.23 | 45B20110514SPR | 129.12 | 0.11 |
| 11208 | 6917441.644 | 642038.274 | 132.90 | 45B20110514SPR | 132.80 | 0.10 |
| 11209 | 6917460.573 | 642033.793 | 133.11 | 45B20110514SPR | 133.00 | 0.11 |
| 11210 | 6917480.553 | 642028.411 | 133.32 | 45B20110514SPR | 133.25 | 0.07 |
| 11211 | 6918077.076 | 641770.322 | 140.89 | 45B20110514SPR | 140.79 | 0.10 |
| 11212 | 6918096.176 | 641760.984 | 141.26 | 45B20110514SPR | 141.18 | 0.08 |
| 11213 | 6918110.798 | 641752.72 | 141.54 | 45B20110514SPR | 141.44 | 0.09 |
| 11214 | 6915446.491 | 642379.22 | 130.07 | 45B20110514SPR | 130.02 | 0.05 |
| 11215 | 6915428.582 | 642382.313 | 130.13 | 45B20110514SPR | 130.08 | 0.05 |
| 11216 | 6915407.658 | 642386.078 | 130.19 | 45B20110514SPR | 130.14 | 0.05 |
| 11217 | 6914783.427 | 642627.158 | 124.73 | 45B20110514SPR | 124.66 | 0.07 |
| 11218 | 6914762.937 | 642638.493 | 124.42 | 45B20110514SPR | 124.37 | 0.05 |
| 11219 | 6914747.097 | 642646.924 | 124.21 | 45B20110514SPR | 124.18 | 0.03 |
| 11220 | 6914261.894 | 642861.878 | 119.57 | 45B20110514SPR | 119.51 | 0.06 |
| 11221 | 6914225.626 | 642870.659 | 119.54 | 45B20110514SPR | 119.50 | 0.04 |
| 11222 | 6915924.031 | 642326.242 | 129.24 | 45B20110514SSP | 129.24 | 0.00 |
| 11223 | 6915924.024 | 642326.242 | 129.25 | 45B20110514SSP | 129.24 | 0.00 |
| 11300 | 6943113.551 | 641833.335 | 198.91 | 46B2011051446BSAC | 198.96 | -0.05 |
| 11301 | 6943113.551 | 641833.335 | 198.91 | 46B2011051446BSAC | 198.96 | -0.05 |
| 11302 | 6943133.525 | 641844.056 | 199.73 | 46B20110514SPR | 199.69 | 0.04 |
| 11303 | 6943150.997 | 641841.471 | 199.77 | 46B20110514SPR | 199.74 | 0.03 |
| 11304 | 6943226.617 | 641747.049 | 200.18 | 46B20110514SPR | 200.12 | 0.06 |
| 11305 | 6943210.84 | 641749.553 | 200.00 | 46B20110514SPR | 199.98 | 0.02 |
| 11306 | 6943189.138 | 641750.93 | 199.77 | 46B20110514SPR | 199.69 | 0.08 |
| 11307 | 6943116.595 | 641833.506 | 198.19 | 46B20110514SSP | 198.34 | -0.16 |
| 11308 | 6943731.586 | 641793.561 | 210.01 | 46B20110514SPR | 210.13 | -0.12 |
| 11309 | 6943753.732 | 641792.961 | 210.73 | 46B20110514SPR | 210.83 | -0.10 |
| 11310 | 6943772.064 | 641792.675 | 211.28 | 46B20110514SPR | 211.38 | -0.10 |
| 11311 | 6944399.776 | 642113.729 | 209.02 | 46B20110514SPR | 209.14 | -0.12 |
| 11312 | 6944417.06 | 642127.774 | 208.35 | 46B20110514SPR | 208.41 | -0.06 |
| 11313 | 6942757.834 | 641934.059 | 200.62 | 46B20110514SPR | 200.69 | -0.07 |
| 11314 | 6942738.78 | 641938.807 | 200.73 | 46B20110514SPR | 200.80 | -0.07 |
| 11315 | 6942720.41 | 641943.379 | 200.80 | 46B20110514SPR | 200.90 | -0.10 |
| 11316 | 6942320.237 | 642022.336 | 200.18 | 46B20110514SPR | 200.27 | -0.09 |
| 11317 | 6942300.928 | 642023.859 | 199.82 | 46B20110514SPR | 199.93 | -0.11 |
| 11318 | 6942280.769 | 642025.348 | 199.41 | 46B20110514SPR | 199.50 | -0.09 |
| 11319 | 6941707.674 | 642050.921 | 191.78 | 46B20110514SPR | 191.81 | -0.03 |
| 11320 | 6941680.266 | 642049.426 | 191.63 | 46B20110514SPR | 191.71 | -0.08 |
| 11321 | 6941662.395 | 642048.056 | 191.59 | 46B20110514SPR | 191.66 | -0.07 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 11322 | 6941236.298 | 641963.57 | 195.50 | 46B20110514SPR | 195.59 | -0.09 |
| 11323 | 6941219.137 | 641959.211 | 195.76 | 46B20110514SPR | 195.80 | -0.04 |
| 11324 | 6941200.427 | 641954.787 | 195.96 | 46B20110514SPR | 196.08 | -0.12 |
| 11325 | 6939207.917 | 642623.019 | 235.19 | 46B20110514SPR | 235.31 | -0.13 |
| 11326 | 6939226.383 | 642621.647 | 235.12 | 46B20110514SPR | 235.23 | -0.11 |
| 11327 | 6939243.119 | 642618.22 | 234.71 | 46B20110514SPR | 234.82 | -0.11 |
| 11328 | 6939644.067 | 642509.562 | 217.84 | 46B20110514SAC | 217.96 | -0.13 |
| 11329 | 6943113.977 | 641847.711 | 199.69 | 46B20110514SPR | 199.66 | 0.03 |
| 11330 | 6943116.599 | 641833.516 | 198.36 | 46B20110514SSP | 198.34 | 0.02 |
| 11503 | 6850093.478 | 655382.36 | 62.37 | 43C20110518SAR | 62.27 | 0.10 |
| 11504 | 6850065.12 | 655397.798 | 62.34 | 43C20110518SAR | 62.28 | 0.05 |
| 11505 | 6850056.264 | 655386.192 | 62.31 | 43C20110518SAR | 62.25 | 0.06 |
| 11506 | 6850053.467 | 655372.605 | 62.27 | 43C20110518SAR | 62.19 | 0.08 |
| 11507 | 6850093.925 | 655345.446 | 61.83 | 43C20110518SAR | 61.77 | 0.05 |
| 11508 | 6850097.413 | 655353.737 | 62.18 | 43C20110518SGR | 62.12 | 0.06 |
| 11509 | 6850165.786 | 655306.909 | 62.76 | 43C20110518SAR | 62.71 | 0.05 |
| 11510 | 6850184.869 | 655320.19 | 62.83 | 43C20110518SAR | 62.78 | 0.05 |
| 11511 | 6850217.017 | 655324.188 | 63.69 | 43C20110518OG | 63.61 | 0.08 |
| 11512 | 6850178.836 | 655342.413 | 60.99 | 43C20110518OG | 60.93 | 0.06 |
| 11513 | 6850121.967 | 655390.273 | 64.38 | 43C20110518OG | 64.31 | 0.07 |
| 11514 | 6850124.381 | 655430.076 | 64.38 | 43C20110518SAR | 64.32 | 0.06 |
| 11515 | 6850189.926 | 655437.976 | 64.36 | 43C20110518SGR | 64.29 | 0.07 |
| 11516 | 6850204.532 | 655469.379 | 64.32 | 43C20110518SGR | 64.27 | 0.05 |
| 11517 | 6850308.325 | 655498.985 | 64.13 | 43C20110518PADC | 64.08 | 0.05 |
| 11518 | 6850290.7 | 655456.17 | 64.23 | 43C20110518SAR | 64.17 | 0.06 |
| 11519 | 6850283.41 | 655428.238 | 64.40 | 43C20110518SGR | 64.36 | 0.03 |
| 11520 | 6850162.328 | 655417.715 | 64.75 | 43C20110518SGR | 64.68 | 0.07 |
| 11521 | 6850609.541 | 655106.18 | 63.88 | 43C20110518SAR | 63.84 | 0.04 |
| 11522 | 6850590.75 | 655095.858 | 64.23 | 43C20110518SAR | 64.19 | 0.04 |
| 11523 | 6851184.664 | 655781.477 | 60.34 | 43C20110518SAR | 60.28 | 0.06 |
| 11524 | 6851162.973 | 655771.858 | 61.27 | 43C20110518SGR | 61.21 | 0.06 |
| 11525 | 6851146.454 | 655766.876 | 61.07 | 43C20110518SGR | 61.04 | 0.03 |
| 11526 | 6851181.855 | 655709.91 | 59.72 | 43C20110518SAR | 59.68 | 0.04 |
| 11527 | 6851330.712 | 655007.34 | 50.96 | 43C20110518SAR | 50.91 | 0.05 |
| 11528 | 6851351.409 | 655086.242 | 53.45 | 43C20110518SAR | 53.40 | 0.05 |
| 11529 | 6851325.701 | 654969.552 | 50.62 | 43C20110518SAR | 50.55 | 0.07 |
| 11530 | 6851322.508 | 654945.924 | 50.47 | 43C20110518SAR | 50.42 | 0.05 |
| 11531 | 6851286.38 | 654954.995 | 50.24 | 43C20110518SGR | 50.18 | 0.06 |
| 11532 | 6851360.848 | 654936.98 | 49.96 | 43C20110518SGR | 49.91 | 0.05 |
| 11533 | 6851074 | 654923.041 | 53.24 | 43C20110518SGR | 53.18 | 0.06 |
| 11534 | 6851066.857 | 654950.117 | 53.60 | 43C20110518SGR | 53.52 | 0.08 |
| 11535 | 6850626.108 | 653865.953 | 60.28 | 43C20110518SGR | 60.19 | 0.09 |
| 11536 | 6850602.454 | 653862.597 | 59.43 | 43C20110518SGR | 59.35 | 0.08 |
| 11537 | 6850682.351 | 653843.339 | 61.47 | 43C20110518SAR | 61.37 | 0.10 |
| 11538 | 6850701.273 | 653840.859 | 61.31 | 43C20110518SAR | 61.24 | 0.07 |
| 11539 | 6850692.015 | 653860.764 | 61.34 | 43C20110518SAR | 61.27 | 0.07 |
| 11540 | 6850696.243 | 653880.474 | 61.19 | 43C20110518SAR | 61.13 | 0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 11541 | 6851080.61 | 653832.364 | 58.47 | 43C20110518SGR | 58.38 | 0.09 |
| 11542 | 6851105.377 | 653852.414 | 58.73 | 43C20110518SGR | 58.63 | 0.10 |
| 11543 | 6851078.859 | 653873.116 | 59.28 | 43C20110518OG | 59.22 | 0.06 |
| 11544 | 6851328.603 | 653944.186 | 61.14 | 43C20110518SGR | 61.09 | 0.05 |
| 11545 | 6851324.438 | 653935.689 | 60.98 | 43C20110518SAR | 60.92 | 0.06 |
| 11546 | 6851293.442 | 653917.158 | 61.02 | 43C20110518SGR | 60.96 | 0.06 |
| 11547 | 6850653.424 | 653032.051 | 59.35 | 43C20110518SAR | 59.34 | 0.01 |
| 11548 | 6850635.296 | 653007.411 | 59.36 | 43C20110518SAR | 59.36 | 0.00 |
| 11549 | 6850621.31 | 653010.209 | 59.19 | 43C20110518OG | 59.15 | 0.04 |
| 11550 | 6850636.272 | 652995.847 | 59.39 | 43C20110518SGR | 59.41 | -0.02 |
| 11551 | 6850828.645 | 651944.838 | 58.93 | 43C20110518SAR | 58.92 | 0.01 |
| 11552 | 6850022.118 | 651868.796 | 56.85 | 43C20110518SAR | 56.88 | -0.03 |
| 11553 | 6849634.314 | 651886.713 | 58.28 | 43C20110518SAR | 58.24 | 0.04 |
| 11554 | 6851651.624 | 654707.759 | 48.02 | 43C20110518PADC | 47.95 | 0.06 |
| 11555 | 6851656.41 | 654696.358 | 48.01 | 43C20110518PADC | 47.98 | 0.03 |
| 11556 | 6851677.805 | 654672.072 | 47.77 | 43C20110518SGR | 47.71 | 0.06 |
| 11557 | 6851693.021 | 654667.711 | 47.52 | 43C20110518OG | 47.44 | 0.08 |
| 11558 | 6851662.345 | 654791.137 | 51.42 | 43C20110518SAR | 51.36 | 0.06 |
| 11559 | 6851706.154 | 654778.445 | 51.79 | 43C20110518SAR | 51.74 | 0.05 |
| 11560 | 6851709.847 | 654785.615 | 52.07 | 43C20110518SAR | 52.00 | 0.07 |
| 11562 | 6851809.126 | 654757.929 | 52.10 | 43C20110518SAR | 52.05 | 0.05 |
| 11563 | 6851798.369 | 654715.303 | 48.35 | 43C20110518SAR | 48.30 | 0.05 |
| 11564 | 6851777.293 | 654647.865 | 47.60 | 43C20110518SGR | 47.53 | 0.07 |
| 11565 | 6851776.703 | 654615.16 | 47.51 | 43C20110518SGR | 47.44 | 0.07 |
| 11566 | 6851750.35 | 654589.632 | 46.22 | 43C20110518SGR | 46.14 | 0.08 |
| 11567 | 6851773.081 | 654511.075 | 46.85 | 43C20110518SGR | 46.77 | 0.08 |
| 11568 | 6851852.499 | 654758.362 | 51.68 | 43C20110518SAR | 51.62 | 0.06 |
| 11569 | 6851868.814 | 654753.501 | 51.50 | 43C20110518SAR | 51.43 | 0.07 |
| 11602 | 6813729.675 | 654954.343 | 44.49 | 42B20110517SAC | 44.50 | -0.01 |
| 11701 | 6813729.675 | 654954.343 | 44.49 | 42D2011051742DSAC | 44.50 | -0.01 |
| 11705 | 6813729.388 | 654951.635 | 44.43 | 42D20110517CHK_42D_SSP | 44.45 | -0.02 |
| 11706 | 6814964.168 | 653160.389 | 33.87 | 42D20110517SGR | 33.95 | -0.08 |
| 11707 | 6814940.974 | 653201.955 | 34.50 | 42D20110517SGR | 34.57 | -0.07 |
| 11708 | 6814914.569 | 653211.993 | 35.16 | 42D20110517OG | 35.27 | -0.11 |
| 11709 | 6814972.056 | 653163.654 | 33.96 | 42D20110517SGR | 34.05 | -0.09 |
| 11710 | 6815008.112 | 653230.989 | 35.12 | 42D20110517SGR | 35.19 | -0.07 |
| 11711 | 6815038.124 | 653268.622 | 34.99 | 42D20110517SGR | 35.06 | -0.08 |
| 11712 | 6815089.651 | 653305.12 | 33.48 | 42D20110517OG | 33.57 | -0.09 |
| 11713 | 6815156.909 | 653353.18 | 33.15 | 42D20110517SGR | 33.24 | -0.09 |
| 11714 | 6815242.964 | 653380.872 | 32.63 | 42D20110517SGR | 32.74 | -0.11 |
| 11715 | 6815267.381 | 653380.234 | 32.31 | 42D20110517OG | 32.38 | -0.07 |
| 11716 | 6815030.052 | 653769.115 | 37.10 | 42D20110517SGR | 37.17 | -0.07 |
| 11717 | 6815073.708 | 653743.216 | 37.41 | 42D20110517SGR | 37.47 | -0.06 |
| 11718 | 6815020.106 | 653718.402 | 36.82 | 42D20110517SGR | 36.86 | -0.04 |
| 11719 | 6814998.904 | 653667.048 | 36.62 | 42D20110517SGR | 36.67 | -0.05 |
| 11720 | 6815016.051 | 653630.385 | 36.38 | 42D20110517SGR | 36.48 | -0.10 |
| 11721 | 6815023.938 | 653598.272 | 36.25 | 42D20110517SGR | 36.34 | -0.09 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 11722 | 6813730.227 | 654825.982 | 43.68 | 42D20110517SGR | 43.68 | 0.00 |
| 11723 | 6813714.026 | 654859.257 | 43.62 | 42D20110517SGR | 43.60 | 0.02 |
| 11724 | 6813711.529 | 654780.588 | 43.52 | 42D20110517SGR | 43.51 | 0.01 |
| 11725 | 6813724.321 | 654758.112 | 43.30 | 42D20110517SGR | 43.32 | -0.02 |
| 11726 | 6813704.848 | 654696.799 | 42.90 | 42D20110517SGR | 42.89 | 0.01 |
| 11727 | 6813701.777 | 654587.127 | 42.30 | 42D20110517SGR | 42.32 | -0.02 |
| 11728 | 6813763.871 | 655928.57 | 46.81 | 42D20110517SGR | 46.73 | 0.08 |
| 11729 | 6813699.151 | 655933.748 | 48.90 | 42D20110517SGR | 48.84 | 0.06 |
| 11730 | 6813700.433 | 655923.208 | 48.76 | 42D20110517SGR | 48.68 | 0.08 |
| 11733 | 6813814.302 | 656254.482 | 49.70 | 42D20110517SGR | 49.61 | 0.09 |
| 11734 | 6813833.274 | 656232.482 | 50.22 | 42D20110517SGR | 50.13 | 0.09 |
| 11735 | 6836587.572 | 669597.246 | 78.62 | 42D20110517CHK_42C_SSP | 78.71 | -0.09 |
| 11736 | 6836581.566 | 669581.002 | 79.14 | 42D20110517SAR | 79.22 | -0.08 |
| 11737 | 6836530.551 | 669600.183 | 79.08 | 42D20110517SAR | 79.13 | -0.05 |
| 11738 | 6836478.674 | 669631.229 | 78.91 | 42D20110517SAR | 78.94 | -0.03 |
| 11739 | 6836366.592 | 669657.85 | 79.31 | 42D20110517SAR | 79.38 | -0.07 |
| 11740 | 6836358.111 | 669639.368 | 77.65 | 42D20110517SGR | 77.73 | -0.08 |
| 11741 | 6836628.827 | 669583.958 | 79.49 | 42D20110517SAR | 79.52 | -0.03 |
| 11742 | 6836712.434 | 669543.928 | 77.20 | 42D20110517SAR | 77.27 | -0.07 |
| 11743 | 6836748.504 | 669531.718 | 77.26 | 42D20110517OG | 77.30 | -0.04 |
| 11744 | 6836618.127 | 669638.135 | 79.30 | 42D20110517SAR | 79.37 | -0.07 |
| 11745 | 6836729.564 | 669597.062 | 77.67 | 42D20110517SAR | 77.70 | -0.03 |
| 11746 | 6836572.443 | 669648.207 | 79.14 | 42D20110517SAR | 79.20 | -0.06 |
| 11747 | 6836539.477 | 669660.254 | 79.13 | 42D20110517SAR | 79.18 | -0.06 |
| 11748 | 6836524.432 | 669637.57 | 79.89 | 42D20110517SAR | 79.94 | -0.05 |
| 11749 | 6836536.937 | 669625.451 | 79.78 | 42D20110517SAR | 79.84 | -0.06 |
| 11750 | 6837518.044 | 667230.29 | 90.91 | 42D20110517SAR | 91.08 | -0.17 |
| 11751 | 6837539.241 | 667224.164 | 90.02 | 42D20110517SAR | 90.18 | -0.16 |
| 11752 | 6837497.719 | 667296.983 | 91.84 | 42D20110517SAR | 91.98 | -0.14 |
| 11753 | 6837447.409 | 667352.333 | 93.41 | 42D20110517SAR | 93.58 | -0.17 |
| 11754 | 6837403.915 | 667439.516 | 92.37 | 42D20110517SAR | 92.55 | -0.18 |
| 11755 | 6837311.473 | 668221.128 | 102.04 | 42D20110517SGR | 102.16 | -0.12 |
| 11756 | 6837240.122 | 667795.482 | 79.12 | 42D20110517SAR | 79.26 | -0.14 |
| 11757 | 6837216.554 | 667846.142 | 77.96 | 42D20110517SAR | 78.08 | -0.12 |
| 11758 | 6837199.688 | 667847.607 | 78.50 | 42D20110517SAR | 78.64 | -0.14 |
| 11759 | 6837168.155 | 667863.014 | 76.64 | 42D20110517OG | 76.82 | -0.18 |
| 11760 | 6836975.882 | 668482.981 | 75.32 | 42D20110517PADC | 75.42 | -0.10 |
| 11761 | 6837046.996 | 668467.133 | 75.97 | 42D20110517SAR | 76.10 | -0.13 |
| 11762 | 6837055.553 | 668543.413 | 76.25 | 42D20110517SAR | 76.36 | -0.11 |
| 11763 | 6837082.308 | 668550.197 | 76.32 | 42D20110517SAR | 76.45 | -0.13 |
| 11764 | 6837067.041 | 668468.892 | 75.92 | 42D20110517SAR | 76.05 | -0.13 |
| 11765 | 6837136.668 | 669167.029 | 78.90 | 42D20110517SAR | 78.96 | -0.06 |
| 11766 | 6837170.345 | 669168.204 | 80.40 | 42D20110517SAR | 80.44 | -0.04 |
| 11767 | 6837170.514 | 669221.845 | 80.21 | 42D20110517SAR | 80.28 | -0.07 |
| 11768 | 6837162.735 | 669258.674 | 80.92 | 42D20110517SAR | 80.99 | -0.07 |
| 11769 | 6837150.338 | 669305.108 | 81.23 | 42D20110517SAR | 81.31 | -0.09 |
| 11777 | 6837130.355 | 669290.464 | 79.77 | 42D20110517SAR | 79.85 | -0.08 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 11778 | 6837141.669 | 669243.567 | 79.43 | 42D20110517SAR | 79.50 | -0.07 |
| 11779 | 6836587.574 | 669597.244 | 78.61 | 42D20110517CHK_42C_SSP | 78.71 | -0.10 |
| 11780 | 6836587.568 | 669597.245 | 78.61 | 42D20110517CHK_42C_SSP | 78.71 | -0.10 |
| 11783 | 6813729.377 | 654951.641 | 44.43 | 42D20110517CHK_42D_SSP | 44.45 | -0.02 |
| 11800 | 6894040.52 | 652159.209 | 109.11 | 43C2011051944BFAC | 109.05 | 0.06 |
| 11802 | 6894117.18 | 652137.965 | 110.25 | 43C20110519SAR | 110.25 | 0.00 |
| 11803 | 6894208.918 | 652131.248 | 108.97 | 43C20110519SGR | 108.94 | 0.03 |
| 11804 | 6894247.065 | 652133.524 | 109.12 | 43C20110519SGR | 109.10 | 0.02 |
| 11805 | 6894271.63 | 652128.117 | 109.48 | 43C20110519PADC | 109.45 | 0.03 |
| 11806 | 6894038.189 | 652164.08 | 109.10 | 43C20110519SAR | 109.07 | 0.03 |
| 11807 | 6894013.003 | 652179.544 | 109.38 | 43C20110519SAR | 109.37 | 0.01 |
| 11808 | 6893991.382 | 652224.654 | 109.62 | 43C20110519SAR | 109.61 | 0.01 |
| 11809 | 6893961.716 | 652234.815 | 107.78 | 43C20110519SGR | 107.76 | 0.02 |
| 11810 | 6893725.131 | 652710.519 | 110.49 | 43C20110519SAR | 110.45 | 0.04 |
| 11811 | 6893727.637 | 652728.072 | 110.65 | 43C20110519SAR | 110.62 | 0.03 |
| 11812 | 6893610.128 | 652730.33 | 108.26 | 43C20110519SGR | 108.25 | 0.01 |
| 11813 | 6893660.095 | 652787.446 | 108.93 | 43C20110519SDR | 108.88 | 0.05 |
| 11814 | 6893660.687 | 652830.346 | 110.65 | 43C20110519SAR | 110.64 | 0.01 |
| 11815 | 6893654.381 | 652848.179 | 110.64 | 43C20110519SAR | 110.62 | 0.02 |
| 11816 | 6893707.594 | 652760.781 | 110.64 | 43C20110519SAR | 110.63 | 0.01 |
| 11817 | 6894522.515 | 651512.053 | 108.95 | 43C20110519SAR | 108.94 | 0.01 |
| 11818 | 6894512.779 | 651524.93 | 109.15 | 43C20110519SAR | 109.12 | 0.03 |
| 11819 | 6894509.995 | 651560.74 | 110.01 | 43C20110519OG | 109.96 | 0.05 |
| 11820 | 6894490.183 | 651538.566 | 109.21 | 43C20110519SAR | 109.17 | 0.04 |
| 11821 | 6894501.662 | 651498.544 | 109.83 | 43C20110519SGR | 109.82 | 0.01 |
| 11822 | 6895010.637 | 651006.761 | 100.24 | 43C20110519SAR | 100.21 | 0.03 |
| 11823 | 6895021.086 | 651021.65 | 99.26 | 43C20110519SGR | 99.23 | 0.03 |
| 11824 | 6895290.739 | 650858.863 | 102.97 | 43C20110519SAR | 102.94 | 0.03 |
| 11825 | 6895301.91 | 650849.207 | 103.13 | 43C20110519SAR | 103.11 | 0.02 |
| 11826 | 6895271.719 | 650841.563 | 102.29 | 43C20110519SGR | 102.25 | 0.04 |
| 11827 | 6895679.847 | 650756.517 | 108.04 | 43C20110519SGR | 107.99 | 0.05 |
| 11828 | 6895708.101 | 651392.603 | 113.86 | 43C20110519SGR | 113.81 | 0.05 |
| 11829 | 6895667.515 | 651409.071 | 112.59 | 43C20110519SGR | 112.57 | 0.02 |
| 11830 | 6895708.117 | 650615.871 | 109.87 | 43C20110519SGR | 109.83 | 0.04 |
| 11831 | 6895693.282 | 650588.843 | 110.78 | 43C20110519SAR | 110.75 | 0.03 |
| 11832 | 6895731.489 | 650552.492 | 111.26 | 43C20110519SAR | 111.22 | 0.04 |
| 11833 | 6895794.694 | 650505.482 | 111.14 | 43C20110519SAR | 111.14 | 0.00 |
| 11834 | 6894369.557 | 652982.441 | 113.70 | 43C20110519SGR | 113.65 | 0.05 |
| 11835 | 6894168.897 | 652989.161 | 111.53 | 43C20110519SGR | 111.48 | 0.05 |
| 11836 | 6894194.781 | 653302.823 | 114.74 | 43C20110519SGR | 114.70 | 0.04 |
| 11837 | 6893300.744 | 653349.222 | 106.06 | 43C20110519SGR | 106.04 | 0.02 |
| 11838 | 6893334.886 | 653345.075 | 106.05 | 43C20110519SAR | 106.01 | 0.04 |
| 11839 | 6893252.734 | 653351.696 | 107.52 | 43C20110519SAR | 107.50 | 0.02 |
| 11840 | 6893163.262 | 653417.488 | 108.26 | 43C20110519SAR | 108.22 | 0.04 |
| 11841 | 6893132.032 | 653933.138 | 113.43 | 43C20110519SGR | 113.38 | 0.05 |
| 11842 | 6893158.065 | 654012.97 | 113.57 | 43C20110519SGR | 113.53 | 0.04 |
| 11843 | 6893088.277 | 654007.68 | 115.10 | 43C20110519SAR | 115.07 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 11844 | 6893111.732 | 653930.906 | 112.83 | 43C20110519SAR | 112.82 | 0.01 |
| 11845 | 6892938.697 | 654225.585 | 114.08 | 43C20110519SAR | 114.04 | 0.04 |
| 11846 | 6892957.323 | 654258.012 | 113.77 | 43C20110519SAR | 113.73 | 0.04 |
| 11847 | 6892970.663 | 654281.489 | 112.96 | 43C20110519SGR | 112.91 | 0.05 |
| 11848 | 6892959.365 | 654279.526 | 113.58 | 43C20110519PADC | 113.23 | 0.35 |
| 11849 | 6892973.12 | 654164.2 | 116.28 | 43C20110519SAR | 116.25 | 0.03 |
| 11850 | 6892927.547 | 654122.379 | 114.26 | 43C20110519SGR | 114.22 | 0.04 |
| 11851 | 6892597.868 | 654418.846 | 112.58 | 43C20110519SGR | 112.55 | 0.03 |
| 11852 | 6892595.143 | 654428.351 | 112.66 | 43C20110519SAR | 112.57 | 0.09 |
| 11853 | 6892602.256 | 654486.291 | 112.56 | 43C20110519SGR | 112.51 | 0.05 |
| 11854 | 6892528.989 | 654455.481 | 112.51 | 43C20110519SAR | 112.47 | 0.04 |
| 11855 | 6892522.054 | 654484.052 | 112.47 | 43C20110519SGR | 112.44 | 0.03 |
| 11856 | 6893421.128 | 654743.086 | 115.03 | 43C20110519SAR | 114.99 | 0.04 |
| 11857 | 6893507.85 | 654712.38 | 116.61 | 43C20110519SAR | 116.57 | 0.04 |
| 11858 | 6893452.371 | 654671.455 | 115.26 | 43C20110519SGR | 115.22 | 0.04 |
| 11859 | 6893420.577 | 654776.311 | 114.91 | 43C20110519SGR | 114.86 | 0.05 |
| 11860 | 6894043.554 | 652159.151 | 109.09 | 43C20110519CHK_44B_FSP | 109.07 | 0.02 |
| 11863 | 6894043.563 | 652159.154 | 109.11 | 43C20110519CHK_44B_FSP | 109.07 | 0.04 |
| 11864 | 6894087.379 | 652132.177 | 109.48 | 43C20110519SGR | 109.48 | 0.00 |
| 11906 | 6850284.506 | 655252.352 | 63.24 | 43B20110513SPR | 63.29 | -0.05 |
| 11907 | 6850303.086 | 655239.83 | 63.36 | 43B20110513SPR | 63.40 | -0.05 |
| 11908 | 6850319.697 | 655229.123 | 63.43 | 43B20110513SPR | 63.48 | -0.05 |
| 11909 | 6851054.849 | 654973.153 | 54.13 | 43B20110513SPR | 54.19 | -0.06 |
| 12000 | 6915920.968 | 642326.101 | 129.04 | 45B2011061545BFAC | 129.03 | 0.00 |
| 12014 | 6915924.021 | 642326.251 | 129.27 | 45B20110615CK_SPIKE | 129.24 | 0.03 |
| 12015 | 6915924.013 | 642326.25 | 129.25 | 45B20110615CK_SPIKE | 129.24 | 0.01 |
| 12016 | 6917830.357 | 641886.523 | 136.89 | 45B20110615SPR | 136.81 | 0.08 |
| 12017 | 6917843.648 | 641883.211 | 137.02 | 45B20110615SPR | 136.99 | 0.03 |
| 12018 | 6917853.784 | 641878.636 | 137.13 | 45B20110615SPR | 137.07 | 0.06 |
| 12019 | 6917864.234 | 641869.6 | 137.30 | 45B20110615SPR | 137.25 | 0.05 |
| 12020 | 6917846.631 | 641874.774 | 137.10 | 45B20110615SPR | 137.04 | 0.06 |
| 12021 | 6917842.326 | 641859.587 | 138.07 | 45B20110615SGR | 138.01 | 0.06 |
| 12022 | 6917839.179 | 641842.176 | 139.90 | 45B20110615SGR | 139.84 | 0.06 |
| 12023 | 6917837.318 | 641825.968 | 141.60 | 45B20110615SGR | 141.54 | 0.06 |
| 12024 | 6917836.283 | 641806.692 | 142.66 | 45B20110615SGR | 142.56 | 0.10 |
| 12025 | 6917835.252 | 641790.383 | 142.52 | 45B20110615SGR | 142.47 | 0.05 |
| 12026 | 6917833.824 | 641773.233 | 142.46 | 45B20110615SGR | 142.41 | 0.05 |
| 12027 | 6917831.492 | 641754.728 | 142.35 | 45B20110615SGR | 142.29 | 0.06 |
| 12028 | 6917836.202 | 641744.704 | 142.38 | 45B20110615SGR | 142.29 | 0.09 |
| 12029 | 6917812.552 | 641748.882 | 142.50 | 45B20110615SGR | 142.41 | 0.09 |
| 12030 | 6917831.598 | 641700.729 | 140.84 | 45B20110615SGR | 140.79 | 0.05 |
| 12031 | 6917831.865 | 641618.3 | 142.91 | 45B20110615SGR | 142.85 | 0.06 |
| 12032 | 6917829.905 | 641603.987 | 142.74 | 45B20110615SGR | 142.68 | 0.06 |
| 12033 | 6917828.948 | 641592.538 | 142.94 | 45B20110615SGR | 142.72 | 0.22 |
| 12034 | 6921174.716 | 641482.32 | 154.02 | 45B20110615SGR | 153.93 | 0.09 |
| 12035 | 6921188.895 | 641471.072 | 154.30 | 45B20110615SGR | 154.24 | 0.05 |
| 12036 | 6921189.017 | 641478.634 | 154.23 | 45B20110615SGR | 154.18 | 0.05 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12037 | 6921202.641 | 641482.522 | 154.29 | 45B20110615SGR | 154.17 | 0.12 |
| 12038 | 6921214.99 | 641478.894 | 154.50 | 45B20110615SGR | 154.42 | 0.08 |
| 12039 | 6922322.29 | 641646.742 | 154.89 | 45B20110615SGR | 154.77 | 0.12 |
| 12040 | 6922298.664 | 641636.413 | 154.31 | 45B20110615SGR | 154.28 | 0.03 |
| 12041 | 6922299.332 | 641631.829 | 154.35 | 45B20110615SGR | 154.31 | 0.03 |
| 12042 | 6922297.279 | 641646.358 | 154.46 | 45B20110615SGR | 154.35 | 0.11 |
| 12043 | 6915924.022 | 642326.215 | 129.23 | 45B20110615CK_SPIKE | 129.24 | -0.01 |
| 12255 | 7319282.879 | 637090.093 | 170.41 | 14B20100925SGR | 170.48 | -0.07 |
| 12256 | 7319288.473 | 637080.277 | 170.67 | 14B20100925SGR | 170.73 | -0.06 |
| 12257 | 7319293.437 | 637070.754 | 170.92 | 14B20100925SGR | 170.97 | -0.06 |
| 12258 | 7319947.003 | 636583.186 | 201.54 | 14B20100925SGR | 201.64 | -0.10 |
| 12259 | 7319927.771 | 636594.225 | 200.99 | 14B20100925SGR | 201.06 | -0.07 |
| 12300 | 7320440.658 | 636279.679 | 184.64 | 14A2011053114AFAC | 184.68 | -0.04 |
| 12301 | 7320451.852 | 636296.387 | 186.28 | 14A20110532SGR | 186.31 | -0.03 |
| 12302 | 7320465.797 | 636288.508 | 187.12 | 14A20110533SGR | 187.14 | -0.02 |
| 12303 | 7320479.87 | 636281.081 | 188.09 | 14A20110534SGR | 188.12 | -0.03 |
| 12304 | 7320493.983 | 636272.999 | 189.06 | 14A20110535SGR | 189.09 | -0.03 |
| 12305 | 7320507.231 | 636265.397 | 189.89 | 14A20110536SGR | 189.93 | -0.04 |
| 12306 | 7320521.178 | 636256.75 | 190.64 | 14A20110537SGR | 190.67 | -0.03 |
| 12307 | 7320536.372 | 636251.484 | 191.48 | 14A20110538SGR | 191.52 | -0.04 |
| 12308 | 7321060.977 | 635791.125 | 245.65 | 14A20110539SGR | 245.69 | -0.04 |
| 12309 | 7321070.92 | 635777.544 | 247.22 | 14A20110540SGR | 247.23 | -0.01 |
| 12310 | 7321084.583 | 635769.943 | 248.46 | 14A20110541SGR | 248.49 | -0.03 |
| 12311 | 7321097.279 | 635760.09 | 249.91 | 14A20110542SGR | 249.94 | -0.03 |
| 12312 | 7321109.803 | 635747.668 | 251.62 | 14A20110543SGR | 251.63 | -0.01 |
| 12313 | 7321123.104 | 635738.614 | 253.08 | 14A20110544SGR | 253.07 | 0.01 |
| 12314 | 7321137.386 | 635729.16 | 254.63 | 14A20110545SGR | 254.61 | 0.02 |
| 12315 | 7321587.545 | 635493.091 | 258.06 | 14A20110546SGR | 258.02 | 0.04 |
| 12316 | 7321553.417 | 635510.797 | 259.34 | 14A20110547SGR | 259.34 | 0.00 |
| 12317 | 7321538.485 | 635518.212 | 259.88 | 14A20110548SGR | 259.87 | 0.01 |
| 12318 | 7321524.764 | 635525.307 | 260.38 | 14A20110549SGR | 260.39 | -0.01 |
| 12319 | 7321510.549 | 635532.024 | 260.87 | 14A20110550SGR | 260.87 | 0.00 |
| 12320 | 7321495.968 | 635539.005 | 261.32 | 14A20110551SGR | 261.33 | -0.01 |
| 12321 | 7321481.434 | 635546.596 | 261.66 | 14A20110552SGR | 261.65 | 0.01 |
| 12322 | 7322240.998 | 634734.353 | 227.44 | 14A20110553SGR | 227.41 | 0.03 |
| 12323 | 7322285.953 | 634731.546 | 233.26 | 14A20110554SGR | 233.21 | 0.05 |
| 12324 | 7319933.123 | 636589.228 | 201.18 | 14A20110555SGR | 201.19 | -0.01 |
| 12325 | 7319945.377 | 636582.063 | 201.52 | 14A20110556SGR | 201.53 | -0.01 |
| 12326 | 7319957.548 | 636575.103 | 201.82 | 14A20110557SGR | 201.82 | 0.00 |
| 12327 | 7319969.801 | 636568.016 | 202.09 | 14A20110558SGR | 202.08 | 0.01 |
| 12328 | 7319982.503 | 636560.919 | 202.34 | 14A20110559SGR | 202.34 | 0.00 |
| 12329 | 7319994.924 | 636553.982 | 202.57 | 14A20110560SGR | 202.59 | -0.02 |
| 12330 | 7320007.581 | 636546.688 | 202.76 | 14A20110561SGR | 202.77 | -0.01 |
| 12331 | 7319297.848 | 637058.305 | 171.29 | 14A20110562SGR | 171.27 | 0.02 |
| 12332 | 7320444.118 | 636277.886 | 184.87 | 14A20110563CHECK | 184.90 | -0.03 |
| 12333 | 7320444.122 | 636277.891 | 184.87 | 14A20110564CHECK | 184.90 | -0.03 |
| 12500 | 7348875.857 | 621302.161 | 561.79 | 13B2011060113BFAC | 561.79 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12501 | 7348885.2 | 621293.302 | 562.45 | 13B20110601SGR | 562.39 | 0.06 |
| 12502 | 7348865.517 | 621292.633 | 563.11 | 13B20110601SGR | 563.04 | 0.07 |
| 12503 | 7348859.601 | 621307.326 | 563.49 | 13B20110601SGR | 563.42 | 0.07 |
| 12504 | 7348851.408 | 621321.289 | 563.91 | 13B20110601SGR | 563.85 | 0.06 |
| 12505 | 7348845.768 | 621336.512 | 564.14 | 13B20110601SGR | 564.07 | 0.07 |
| 12506 | 7348837.718 | 621351.405 | 564.28 | 13B20110601SGR | 564.20 | 0.08 |
| 12507 | 7348829.962 | 621367.074 | 564.28 | 13B20110601SGR | 564.21 | 0.07 |
| 12508 | 7348900.421 | 621316.908 | 562.23 | 13B20110601SGR | 562.18 | 0.05 |
| 12509 | 7348910.926 | 621332.712 | 562.02 | 13B20110601SGR | 561.98 | 0.04 |
| 12510 | 7348929.106 | 621359.057 | 561.72 | 13B20110601SGR | 561.69 | 0.02 |
| 12511 | 7348943.24 | 621391.317 | 561.45 | 13B20110601SGR | 561.40 | 0.05 |
| 12512 | 7348959.073 | 621422.27 | 560.96 | 13B20110601SGR | 560.92 | 0.04 |
| 12513 | 7348977.514 | 621451.579 | 560.14 | 13B20110601SGR | 560.10 | 0.04 |
| 12514 | 7349000.95 | 621479.683 | 559.81 | 13B20110601SGR | 559.78 | 0.03 |
| 12515 | 7349042.218 | 621508.739 | 560.37 | 13B20110601SGR | 560.33 | 0.04 |
| 12516 | 7349070.285 | 621531.993 | 560.97 | 13B20110601SGR | 560.95 | 0.01 |
| 12517 | 7349095.162 | 621551.467 | 561.24 | 13B20110601SGR | 561.17 | 0.07 |
| 12518 | 7349117.1 | 621574.748 | 561.38 | 13B20110601SGR | 561.30 | 0.08 |
| 12519 | 7349136.672 | 621600.946 | 561.71 | 13B20110601SGR | 561.62 | 0.09 |
| 12520 | 7349162.343 | 621633.259 | 562.14 | 13B20110601SGR | 562.02 | 0.12 |
| 12521 | 7349185.307 | 621672.488 | 563.06 | 13B20110601SGR | 563.00 | 0.06 |
| 12522 | 7349208.505 | 621705.286 | 564.01 | 13B20110601SGR | 563.94 | 0.07 |
| 12523 | 7349231.015 | 621742.401 | 565.24 | 13B20110601SGR | 565.16 | 0.08 |
| 12524 | 7349252.217 | 621777.658 | 565.99 | 13B20110601SGR | 565.92 | 0.07 |
| 12525 | 7349271.203 | 621809.623 | 566.86 | 13B20110601SGR | 566.81 | 0.05 |
| 12526 | 7349306.64 | 621854.695 | 567.99 | 13B20110601SGR | 567.94 | 0.05 |
| 12527 | 7349335.123 | 621867.918 | 568.15 | 13B20110601SGR | 568.09 | 0.06 |
| 12528 | 7348405.407 | 621891.028 | 533.10 | 13B20110601SGR | 533.08 | 0.02 |
| 12529 | 7348416.876 | 621879.663 | 533.64 | 13B20110601SGR | 533.63 | 0.01 |
| 12530 | 7348429.042 | 621866.988 | 534.20 | 13B20110601SGR | 534.16 | 0.04 |
| 12531 | 7348439.117 | 621854.305 | 534.62 | 13B20110601SGR | 534.57 | 0.05 |
| 12532 | 7348450.585 | 621842.408 | 535.07 | 13B20110601SGR | 535.04 | 0.03 |
| 12533 | 7348465.761 | 621832.652 | 535.70 | 13B20110601SGR | 535.67 | 0.03 |
| 12534 | 7348477.88 | 621813.893 | 536.32 | 13B20110601SGR | 536.25 | 0.07 |
| 12535 | 7346690.51 | 623625.098 | 420.84 | 13B20110601SGR | 420.74 | 0.10 |
| 12536 | 7346662.468 | 623607.301 | 423.35 | 13B20110601SGR | 423.24 | 0.11 |
| 12537 | 7346618.062 | 623576.258 | 428.08 | 13B20110601SGR | 427.96 | 0.12 |
| 12538 | 7346589.21 | 623552.495 | 431.63 | 13B20110601SGR | 431.52 | 0.11 |
| 12539 | 7346534.38 | 623516.806 | 437.25 | 13B20110601SGR | 437.23 | 0.02 |
| 12540 | 7346490.906 | 623487.882 | 441.37 | 13B20110601SGR | 441.32 | 0.05 |
| 12541 | 7346398.52 | 623422.439 | 452.85 | 13B20110601SGR | 452.84 | 0.01 |
| 12542 | 7346375.512 | 623405.178 | 455.45 | 13B20110601SGR | 455.38 | 0.07 |
| 12543 | 7346335.438 | 623372.706 | 460.62 | 13B20110601SGR | 460.61 | 0.01 |
| 12544 | 7346284.694 | 623327.893 | 468.29 | 13B20110601SGR | 468.26 | 0.03 |
| 12545 | 7346258.09 | 623295.996 | 473.78 | 13B20110601SGR | 473.75 | 0.03 |
| 12546 | 7346248.475 | 623262.242 | 478.04 | 13B20110601SGR | 478.04 | 0.00 |
| 12547 | 7346262.828 | 623190.555 | 486.24 | 13B20110601SGR | 486.21 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12548 | 7346271.342 | 623158.088 | 489.25 | 13B20110601SGR | 489.20 | 0.05 |
| 12549 | 7346283.009 | 623107.677 | 493.74 | 13B20110601SGR | 493.74 | 0.00 |
| 12550 | 7346296.672 | 623067.025 | 498.29 | 13B20110601SGR | 498.25 | 0.04 |
| 12551 | 7346648.681 | 623698.458 | 419.92 | 13B20110601SGR | 419.77 | 0.15 |
| 12552 | 7346639.169 | 623713.063 | 419.93 | 13B20110601SGR | 419.83 | 0.10 |
| 12553 | 7346627.389 | 623724.541 | 419.95 | 13B20110601SGR | 419.83 | 0.12 |
| 12554 | 7346615.387 | 623736.279 | 419.82 | 13B20110601SGR | 419.71 | 0.11 |
| 12555 | 7346603.919 | 623748.229 | 419.52 | 13B20110601SGR | 419.42 | 0.10 |
| 12556 | 7346591.523 | 623760.158 | 419.06 | 13B20110601SGR | 418.98 | 0.08 |
| 12557 | 7346580.84 | 623771.628 | 418.57 | 13B20110601SGR | 418.49 | 0.08 |
| 12558 | 7350120.133 | 620664.371 | 510.75 | 13B20110601SGR | 510.74 | 0.01 |
| 12559 | 7350107.395 | 620672.753 | 510.42 | 13B20110601SGR | 510.40 | 0.02 |
| 12560 | 7350094.237 | 620680.65 | 510.09 | 13B20110601SGR | 510.07 | 0.02 |
| 12561 | 7350080.951 | 620688.276 | 509.79 | 13B20110601SGR | 509.73 | 0.06 |
| 12562 | 7350067.462 | 620695.917 | 509.51 | 13B20110601SGR | 509.48 | 0.03 |
| 12563 | 7350051.215 | 620704.266 | 509.16 | 13B20110601SGR | 509.12 | 0.04 |
| 12564 | 7350037.855 | 620711.948 | 508.79 | 13B20110601SGR | 508.75 | 0.04 |
| 12565 | 7348877.919 | 621297.905 | 562.19 | 13B20110601CHECK | 562.15 | 0.04 |
| 12566 | 7348877.919 | 621297.899 | 562.19 | 13B20110601CHECK | 562.15 | 0.04 |
| 12600 | 7353879.024 | 618244.288 | 531.77 | 13A2011053013AFAC | 531.74 | 0.03 |
| 12601 | 7353883.647 | 618249.193 | 532.43 | 13A20110530SPR | 532.40 | 0.03 |
| 12602 | 7353896.403 | 618240.228 | 532.41 | 13A20110530SPR | 532.38 | 0.03 |
| 12603 | 7353908.237 | 618232.125 | 532.42 | 13A20110530SPR | 532.38 | 0.03 |
| 12604 | 7353922.48 | 618221.881 | 532.34 | 13A20110530SPR | 532.33 | 0.01 |
| 12605 | 7353936.583 | 618212.538 | 532.25 | 13A20110530SPR | 532.20 | 0.04 |
| 12606 | 7353949.145 | 618202.916 | 532.11 | 13A20110530SPR | 532.06 | 0.05 |
| 12607 | 7353962.745 | 618193.622 | 531.98 | 13A20110530SPR | 531.97 | 0.01 |
| 12608 | 7354661.355 | 617705.932 | 505.61 | 13A20110530SPR | 505.56 | 0.05 |
| 12609 | 7354674.913 | 617696.543 | 505.38 | 13A20110530SPR | 505.34 | 0.04 |
| 12610 | 7354691.651 | 617684.847 | 505.01 | 13A20110530SPR | 504.98 | 0.02 |
| 12611 | 7354705.309 | 617674.953 | 504.72 | 13A20110530SPR | 504.67 | 0.04 |
| 12612 | 7354719.156 | 617666.116 | 504.42 | 13A20110530SPR | 504.37 | 0.05 |
| 12613 | 7354732.499 | 617657.179 | 504.12 | 13A20110530SPR | 504.07 | 0.05 |
| 12614 | 7354745.918 | 617647.454 | 503.92 | 13A20110530SPR | 503.89 | 0.03 |
| 12615 | 7355373.243 | 617207.365 | 501.06 | 13A20110530SPR | 500.96 | 0.10 |
| 12616 | 7355317.763 | 617251.686 | 504.85 | 13A20110530SPR | 504.82 | 0.03 |
| 12617 | 7355304.366 | 617261.295 | 505.47 | 13A20110530SPR | 505.46 | 0.01 |
| 12618 | 7355290.858 | 617270.832 | 506.09 | 13A20110530SPR | 506.06 | 0.03 |
| 12619 | 7355277.74 | 617279.868 | 506.65 | 13A20110530SPR | 506.61 | 0.04 |
| 12620 | 7355264.137 | 617289.375 | 507.18 | 13A20110530SPR | 507.14 | 0.04 |
| 12621 | 7355250.227 | 617299.08 | 507.66 | 13A20110530SPR | 507.61 | 0.04 |
| 12622 | 7356403.257 | 616567.119 | 514.30 | 13A20110530SPR | 514.24 | 0.06 |
| 12623 | 7356385.893 | 616570.101 | 514.40 | 13A20110530SPR | 514.35 | 0.05 |
| 12624 | 7356370.852 | 616572.633 | 514.30 | 13A20110530SPR | 514.23 | 0.07 |
| 12625 | 7356356.212 | 616575.774 | 514.09 | 13A20110530SPR | 514.05 | 0.04 |
| 12626 | 7356340.426 | 616579.889 | 513.68 | 13A20110530SPR | 513.65 | 0.03 |
| 12627 | 7356325.135 | 616584.255 | 513.34 | 13A20110530SPR | 513.31 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12628 | 7356311.083 | 616589.355 | 512.96 | 13A20110530SPR | 512.92 | 0.04 |
| 12629 | 7356323.241 | 616295.124 | 532.58 | 13A20110530SGR | 532.52 | 0.06 |
| 12630 | 7356317.066 | 616275.284 | 534.03 | 13A20110530SGR | 533.99 | 0.04 |
| 12631 | 7356310.701 | 616258.348 | 535.37 | 13A20110530SGR | 535.30 | 0.07 |
| 12632 | 7356303.992 | 616239.459 | 536.75 | 13A20110530SGR | 536.70 | 0.05 |
| 12633 | 7356298.246 | 616224.501 | 537.95 | 13A20110530SGR | 537.92 | 0.03 |
| 12634 | 7356293.684 | 616208.53 | 539.17 | 13A20110530SGR | 539.11 | 0.06 |
| 12635 | 7356286.72 | 616189.061 | 540.57 | 13A20110530SGR | 540.50 | 0.07 |
| 12636 | 7359112.665 | 614973.45 | 565.49 | 13A20110530SPR | 565.42 | 0.07 |
| 12637 | 7359090.161 | 614992.13 | 565.55 | 13A20110530SPR | 565.49 | 0.06 |
| 12638 | 7360336.28 | 614135.071 | 567.16 | 13A20110530SPR | 567.11 | 0.05 |
| 12639 | 7360350.202 | 614128.258 | 567.64 | 13A20110530SPR | 567.57 | 0.07 |
| 12640 | 7360367.621 | 614125.94 | 568.19 | 13A20110530SPR | 568.17 | 0.02 |
| 12641 | 7360383.829 | 614123.457 | 568.72 | 13A20110530SPR | 568.67 | 0.05 |
| 12642 | 7360399.822 | 614121.176 | 569.22 | 13A20110530SPR | 569.18 | 0.04 |
| 12643 | 7360415.204 | 614119.16 | 569.69 | 13A20110530SPR | 569.68 | 0.01 |
| 12644 | 7360429.156 | 614117.063 | 570.10 | 13A20110530SPR | 570.07 | 0.03 |
| 12645 | 7360313.855 | 614188.594 | 565.62 | 13A20110530SGR | 565.58 | 0.04 |
| 12646 | 7360317.154 | 614213.834 | 566.12 | 13A20110530SGR | 566.08 | 0.04 |
| 12647 | 7360321.469 | 614248.961 | 566.43 | 13A20110530SGR | 566.38 | 0.05 |
| 12648 | 7360323.718 | 614275.842 | 566.20 | 13A20110530SGR | 566.17 | 0.03 |
| 12649 | 7360326.76 | 614304.894 | 565.93 | 13A20110530SGR | 565.87 | 0.06 |
| 12650 | 7360329.387 | 614338.758 | 565.55 | 13A20110530SGR | 565.47 | 0.08 |
| 12651 | 7360985.45 | 614003.253 | 611.14 | 13A20110530SPR | 611.05 | 0.09 |
| 12652 | 7360999.756 | 613996.073 | 611.86 | 13A20110530SPR | 611.76 | 0.10 |
| 12653 | 7361014.384 | 613989.266 | 612.53 | 13A20110530SPR | 612.43 | 0.10 |
| 12654 | 7361029.89 | 613980.547 | 613.24 | 13A20110530SPR | 613.13 | 0.11 |
| 12655 | 7361045.046 | 613973.878 | 613.99 | 13A20110530SPR | 613.89 | 0.10 |
| 12656 | 7361058.729 | 613967.269 | 614.68 | 13A20110530SPR | 614.59 | 0.09 |
| 12657 | 7361072.702 | 613960.271 | 615.35 | 13A20110530SPR | 615.25 | 0.10 |
| 12658 | 7353173.919 | 618746.354 | 489.50 | 13A20110530SPR | 489.48 | 0.02 |
| 12659 | 7353189.192 | 618735.847 | 490.66 | 13A20110530SPR | 490.64 | 0.02 |
| 12660 | 7353203.101 | 618726.547 | 491.74 | 13A20110530SPR | 491.69 | 0.05 |
| 12661 | 7353217.151 | 618716.856 | 492.77 | 13A20110530SPR | 492.75 | 0.02 |
| 12662 | 7353229.836 | 618707.101 | 493.71 | 13A20110530SPR | 493.68 | 0.03 |
| 12663 | 7353243.307 | 618697.748 | 494.61 | 13A20110530SPR | 494.58 | 0.03 |
| 12664 | 7353256.913 | 618688.417 | 495.53 | 13A20110530SPR | 495.50 | 0.03 |
| 12665 | 7352560.239 | 619049.603 | 461.32 | 13A20110530SPR | 461.29 | 0.03 |
| 12666 | 7352543.214 | 619053.703 | 460.94 | 13A20110530SPR | 460.94 | 0.00 |
| 12667 | 7352526.154 | 619057.124 | 460.64 | 13A20110530SPR | 460.62 | 0.02 |
| 12668 | 7352509.623 | 619060.981 | 460.35 | 13A20110530SPR | 460.34 | 0.01 |
| 12669 | 7352492.626 | 619065.262 | 460.12 | 13A20110530SPR | 460.10 | 0.02 |
| 12670 | 7352581.251 | 619046.169 | 461.59 | 13A20110530SPR | 461.58 | 0.00 |
| 12671 | 7352597.133 | 619042.277 | 461.88 | 13A20110530SPR | 461.86 | 0.02 |
| 12672 | 7352578.846 | 619086.716 | 459.36 | 13A20110530SGR | 459.36 | 0.00 |
| 12673 | 7352629.788 | 619198.609 | 457.00 | 13A20110530SGR | 456.97 | 0.03 |
| 12674 | 7352645.029 | 619219.999 | 456.65 | 13A20110530SGR | 456.62 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12675 | 7351907.535 | 619512.589 | 494.29 | 13A20110530SPR | 494.26 | 0.03 |
| 12676 | 7351894.98 | 619523.253 | 495.32 | 13A20110530SPR | 495.27 | 0.05 |
| 12677 | 7351941.87 | 619541.159 | 491.92 | 13A20110530SGR | 491.89 | 0.03 |
| 12678 | 7351962.381 | 619567.759 | 491.41 | 13A20110530SGR | 491.41 | 0.00 |
| 12679 | 7351981.499 | 619595.975 | 490.57 | 13A20110530SGR | 490.55 | 0.02 |
| 12680 | 7351995.548 | 619615.938 | 489.74 | 13A20110530SGR | 489.72 | 0.01 |
| 12681 | 7351298.556 | 619974.525 | 533.14 | 13A20110530SPR | 533.09 | 0.05 |
| 12682 | 7351312.537 | 619965.305 | 532.92 | 13A20110530SPR | 532.92 | 0.00 |
| 12683 | 7351327.825 | 619957.246 | 532.67 | 13A20110530SPR | 532.65 | 0.02 |
| 12684 | 7351342.702 | 619948.654 | 532.30 | 13A20110530SPR | 532.28 | 0.02 |
| 12685 | 7351356.901 | 619940.194 | 531.88 | 13A20110530SPR | 531.85 | 0.02 |
| 12686 | 7351370.908 | 619932.592 | 531.36 | 13A20110530SPR | 531.34 | 0.02 |
| 12687 | 7351384.554 | 619924.537 | 530.80 | 13A20110530SPR | 530.78 | 0.02 |
| 12688 | 7353881.022 | 618249.328 | 532.41 | 13A20110530CHECK | 532.36 | 0.05 |
| 12689 | 7353881.021 | 618249.328 | 532.41 | 13A20110530CHECK | 532.36 | 0.05 |
| 12690 | 7353881.016 | 618249.326 | 532.39 | 13A20110530CHECK | 532.36 | 0.03 |
| 12700 | 7417499.408 | 606819.515 | 313.91 | 11A2011060211AFAC | 313.90 | 0.01 |
| 12701 | 7417503.064 | 606814.04 | 314.64 | 11A20110602SPR | 314.58 | 0.06 |
| 12702 | 7417489.351 | 606808.393 | 314.53 | 11A20110602SPR | 314.49 | 0.04 |
| 12703 | 7417475.18 | 606803.058 | 314.32 | 11A20110602SPR | 314.28 | 0.04 |
| 12704 | 7417461.323 | 606797.473 | 314.14 | 11A20110602SPR | 314.09 | 0.05 |
| 12705 | 7417447.463 | 606792.147 | 313.91 | 11A20110602SPR | 313.88 | 0.03 |
| 12706 | 7417433.237 | 606786.575 | 313.73 | 11A20110602SPR | 313.69 | 0.04 |
| 12707 | 7417418.962 | 606780.913 | 313.60 | 11A20110602SPR | 313.55 | 0.05 |
| 12708 | 7416744.243 | 606473.876 | 315.89 | 11A20110602SPR | 315.84 | 0.05 |
| 12709 | 7416728.372 | 606466.491 | 315.52 | 11A20110602SPR | 315.47 | 0.05 |
| 12710 | 7416714.603 | 606459.258 | 315.38 | 11A20110602SPR | 315.34 | 0.04 |
| 12711 | 7416699.758 | 606452.902 | 315.29 | 11A20110602SPR | 315.24 | 0.05 |
| 12712 | 7416685.305 | 606445.872 | 315.27 | 11A20110602SPR | 315.22 | 0.05 |
| 12713 | 7416669.513 | 606438.392 | 315.33 | 11A20110602SPR | 315.31 | 0.02 |
| 12714 | 7416655.061 | 606431.255 | 315.42 | 11A20110602SPR | 315.40 | 0.02 |
| 12715 | 7416146.457 | 605896.652 | 303.39 | 11A20110602SPR | 303.37 | 0.02 |
| 12716 | 7416136.902 | 605883.846 | 303.28 | 11A20110602SPR | 303.25 | 0.03 |
| 12717 | 7416125.267 | 605870.603 | 303.14 | 11A20110602SPR | 303.09 | 0.05 |
| 12718 | 7416114.313 | 605856.262 | 303.05 | 11A20110602SPR | 303.01 | 0.04 |
| 12719 | 7416104.1 | 605841.637 | 302.95 | 11A20110602SPR | 302.92 | 0.03 |
| 12720 | 7416094.128 | 605829.209 | 302.85 | 11A20110602SPR | 302.81 | 0.04 |
| 12721 | 7416085.112 | 605815.935 | 302.82 | 11A20110602SPR | 302.80 | 0.02 |
| 12722 | 7415388.872 | 605206.911 | 299.13 | 11A20110602SPR | 299.08 | 0.05 |
| 12723 | 7415403.576 | 605213.273 | 299.13 | 11A20110602SPR | 299.09 | 0.04 |
| 12724 | 7415417.794 | 605220.022 | 299.13 | 11A20110602SPR | 299.10 | 0.03 |
| 12725 | 7415433.041 | 605225.609 | 299.08 | 11A20110602SPR | 299.05 | 0.03 |
| 12726 | 7415448.266 | 605231.513 | 299.16 | 11A20110602SPR | 299.09 | 0.07 |
| 12727 | 7415463.276 | 605237.69 | 299.21 | 11A20110602SPR | 299.16 | 0.05 |
| 12728 | 7415478.715 | 605243.703 | 299.31 | 11A20110602SPR | 299.25 | 0.06 |
| 12729 | 7414900.249 | 604762.149 | 296.77 | 11A20110602SPR | 296.71 | 0.06 |
| 12730 | 7414891.337 | 604748.579 | 296.63 | 11A20110602SPR | 296.59 | 0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12731 | 7414883.006 | 604734.671 | 296.51 | 11A20110602SPR | 296.46 | 0.05 |
| 12732 | 7414874.692 | 604720.342 | 296.40 | 11A20110602SPR | 296.35 | 0.05 |
| 12733 | 7414866.18 | 604705.723 | 296.23 | 11A20110602SPR | 296.18 | 0.05 |
| 12734 | 7414857.541 | 604691.887 | 296.11 | 11A20110602SPR | 296.05 | 0.06 |
| 12735 | 7414849.223 | 604678.124 | 295.97 | 11A20110602SPR | 295.94 | 0.03 |
| 12736 | 7414541.047 | 604021.224 | 294.03 | 11A20110602SPR | 293.98 | 0.04 |
| 12737 | 7414545.915 | 604036.637 | 294.25 | 11A20110602SPR | 294.22 | 0.03 |
| 12738 | 7414550.724 | 604051.923 | 294.47 | 11A20110602SPR | 294.41 | 0.05 |
| 12739 | 7414555.107 | 604067.921 | 294.64 | 11A20110602SPR | 294.61 | 0.03 |
| 12740 | 7414560.229 | 604083.408 | 294.83 | 11A20110602SPR | 294.80 | 0.03 |
| 12741 | 7414565.993 | 604098.798 | 294.96 | 11A20110602SPR | 294.93 | 0.03 |
| 12742 | 7414570.946 | 604114.303 | 295.09 | 11A20110602SPR | 295.04 | 0.05 |
| 12743 | 7414105.005 | 603093.602 | 291.96 | 11A20110602SPR | 291.94 | 0.02 |
| 12744 | 7414118.174 | 603103.77 | 292.11 | 11A20110602SPR | 292.10 | 0.00 |
| 12745 | 7414129.991 | 603117.333 | 292.16 | 11A20110602SPR | 292.13 | 0.03 |
| 12746 | 7414142.171 | 603127.924 | 292.26 | 11A20110602SPR | 292.23 | 0.03 |
| 12747 | 7414153.794 | 603138.822 | 292.27 | 11A20110602SPR | 292.22 | 0.05 |
| 12748 | 7414166.528 | 603149.688 | 292.33 | 11A20110602SPR | 292.29 | 0.04 |
| 12749 | 7414177.811 | 603161.76 | 292.39 | 11A20110602SPR | 292.35 | 0.03 |
| 12750 | 7413086.323 | 602361.834 | 298.45 | 11A20110602SPR | 298.40 | 0.05 |
| 12751 | 7413099.627 | 602372.113 | 298.32 | 11A20110602SPR | 298.26 | 0.06 |
| 12752 | 7413112.671 | 602381.016 | 298.12 | 11A20110602SPR | 298.08 | 0.04 |
| 12753 | 7413127.761 | 602391.868 | 297.73 | 11A20110602SPR | 297.70 | 0.03 |
| 12754 | 7413140.129 | 602401.063 | 297.44 | 11A20110602SPR | 297.40 | 0.04 |
| 12755 | 7413153.307 | 602410.655 | 296.92 | 11A20110602SPR | 296.86 | 0.06 |
| 12756 | 7413166.217 | 602419.837 | 296.39 | 11A20110602SPR | 296.33 | 0.06 |
| 12757 | 7417502.83 | 606816.6 | 314.57 | 11A20110602CHECK | 314.51 | 0.06 |
| 12758 | 7417502.827 | 606816.597 | 314.57 | 11A20110602CHECK | 314.51 | 0.06 |
| 12759 | 7417502.848 | 606816.605 | 314.59 | 11A20110602CHECK | 314.51 | 0.08 |
| 12800 | 7421875.517 | 609157.257 | 350.02 | 11B2011060311BFAC | 350.03 | -0.01 |
| 12801 | 7421870.329 | 609165.511 | 351.49 | 11B20110603SPR | 351.43 | 0.06 |
| 12802 | 7421883.114 | 609174.855 | 351.56 | 11B20110603SPR | 351.50 | 0.06 |
| 12803 | 7421894.871 | 609183.804 | 351.67 | 11B20110603SPR | 351.62 | 0.05 |
| 12804 | 7421907.226 | 609192.233 | 351.79 | 11B20110603SPR | 351.75 | 0.04 |
| 12805 | 7421918.789 | 609201.175 | 351.98 | 11B20110603SPR | 351.94 | 0.04 |
| 12806 | 7421933.655 | 609212.255 | 352.15 | 11B20110603SPR | 352.09 | 0.06 |
| 12807 | 7421946.193 | 609222.106 | 352.39 | 11B20110603SPR | 352.34 | 0.05 |
| 12815 | 7421912.683 | 608544.411 | 356.78 | 11B20110603SGR | 356.79 | -0.01 |
| 12816 | 7421908.613 | 608556.935 | 356.75 | 11B20110603SGR | 356.76 | -0.01 |
| 12817 | 7421910.622 | 608577.183 | 357.34 | 11B20110603SGR | 357.39 | -0.05 |
| 12818 | 7421909.258 | 608593.085 | 358.73 | 11B20110603SGR | 358.79 | -0.06 |
| 12819 | 7421903.96 | 608609.573 | 360.43 | 11B20110603SGR | 360.46 | -0.03 |
| 12820 | 7421900.514 | 608625.469 | 361.90 | 11B20110603SGR | 361.94 | -0.04 |
| 12821 | 7421896.016 | 608640.687 | 362.66 | 11B20110603SGR | 362.67 | -0.01 |
| 12822 | 7421857.313 | 608856.994 | 361.94 | 11B20110603SGR | 361.92 | 0.02 |
| 12823 | 7421854.379 | 608844.497 | 362.40 | 11B20110603SGR | 362.36 | 0.04 |
| 12824 | 7421861.819 | 608870.62 | 361.45 | 11B20110603SGR | 361.43 | 0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12825 | 7421868.662 | 608886.283 | 360.81 | 11B20110603SGR | 360.76 | 0.05 |
| 12826 | 7421879.799 | 608897.574 | 360.35 | 11B20110603SGR | 360.32 | 0.03 |
| 12827 | 7421891.386 | 608906.702 | 360.00 | 11B20110603SGR | 359.94 | 0.06 |
| 12828 | 7421903.666 | 608917.402 | 359.59 | 11B20110603SGR | 359.53 | 0.06 |
| 12829 | 7421991.081 | 609081.362 | 353.51 | 11B20110603SGR | 353.45 | 0.06 |
| 12830 | 7421993.269 | 609064.469 | 354.40 | 11B20110603SGR | 354.36 | 0.04 |
| 12831 | 7421989.147 | 609047.783 | 355.07 | 11B20110603SGR | 355.02 | 0.05 |
| 12832 | 7421984.266 | 609034.438 | 355.32 | 11B20110603SGR | 355.29 | 0.03 |
| 12833 | 7421974.422 | 609023.52 | 355.51 | 11B20110603SGR | 355.45 | 0.06 |
| 12834 | 7421964.284 | 609010.21 | 355.96 | 11B20110603SGR | 355.91 | 0.05 |
| 12835 | 7421955.453 | 608998.529 | 356.44 | 11B20110603SGR | 356.41 | 0.03 |
| 12836 | 7422480.121 | 610495.315 | 379.19 | 11B20110603SPR | 379.12 | 0.07 |
| 12837 | 7422466.676 | 610488.955 | 379.16 | 11B20110603SPR | 379.11 | 0.04 |
| 12838 | 7422452.864 | 610482.4 | 379.13 | 11B20110603SPR | 379.05 | 0.08 |
| 12839 | 7422438.059 | 610475.416 | 378.97 | 11B20110603SPR | 378.93 | 0.04 |
| 12840 | 7422423.488 | 610468.592 | 378.73 | 11B20110603SPR | 378.66 | 0.07 |
| 12841 | 7422407.094 | 610460.527 | 378.59 | 11B20110603SPR | 378.54 | 0.04 |
| 12842 | 7422393.081 | 610453.858 | 378.73 | 11B20110603SPR | 378.69 | 0.04 |
| 12843 | 7423291.431 | 610886.473 | 398.19 | 11B20110603SPR | 398.15 | 0.04 |
| 12844 | 7423274.944 | 610877.414 | 397.67 | 11B20110603SPR | 397.62 | 0.05 |
| 12845 | 7423260.067 | 610870.544 | 397.10 | 11B20110603SPR | 397.07 | 0.03 |
| 12846 | 7423246.411 | 610863.696 | 396.62 | 11B20110603SPR | 396.59 | 0.03 |
| 12847 | 7423231.968 | 610857.81 | 396.19 | 11B20110603SPR | 396.14 | 0.05 |
| 12848 | 7423212.352 | 610848.245 | 395.66 | 11B20110603SPR | 395.60 | 0.06 |
| 12849 | 7423197.149 | 610839.897 | 395.34 | 11B20110603SPR | 395.31 | 0.03 |
| 12850 | 7423179.933 | 610833.159 | 394.89 | 11B20110603SPR | 394.86 | 0.03 |
| 12851 | 7423911.466 | 611463.107 | 401.62 | 11B20110603SPR | 401.58 | 0.04 |
| 12852 | 7423901.999 | 611451.667 | 401.59 | 11B20110603SPR | 401.55 | 0.04 |
| 12853 | 7423892.8 | 611441.136 | 401.46 | 11B20110603SPR | 401.40 | 0.06 |
| 12854 | 7423882.531 | 611427.471 | 401.18 | 11B20110603SPR | 401.12 | 0.06 |
| 12855 | 7423873.857 | 611416.382 | 400.98 | 11B20110603SPR | 400.92 | 0.06 |
| 12856 | 7423864.599 | 611404.465 | 400.79 | 11B20110603SPR | 400.72 | 0.07 |
| 12857 | 7423855.186 | 611392.968 | 400.63 | 11B20110603SPR | 400.57 | 0.06 |
| 12858 | 7424611.892 | 612031.098 | 397.74 | 11B20110603SPR | 397.71 | 0.03 |
| 12859 | 7424598.547 | 612025.762 | 397.23 | 11B20110603SPR | 397.16 | 0.06 |
| 12860 | 7424584.923 | 612020.705 | 396.31 | 11B20110603SPR | 396.25 | 0.06 |
| 12861 | 7424570.953 | 612015.483 | 395.38 | 11B20110603SPR | 395.31 | 0.07 |
| 12862 | 7424556.704 | 612010.762 | 394.57 | 11B20110603SPR | 394.51 | 0.06 |
| 12863 | 7424541.487 | 612004.862 | 393.67 | 11B20110603SPR | 393.62 | 0.05 |
| 12864 | 7424527.383 | 611999.108 | 393.09 | 11B20110603SPR | 393.01 | 0.07 |
| 12865 | 7422126.702 | 609908.855 | 378.34 | 11B20110603SPR | 378.31 | 0.03 |
| 12866 | 7422127.995 | 609893.764 | 377.67 | 11B20110603SPR | 377.65 | 0.02 |
| 12867 | 7422129.984 | 609878.693 | 377.17 | 11B20110603SPR | 377.13 | 0.04 |
| 12868 | 7422130.579 | 609864.408 | 376.85 | 11B20110603SPR | 376.82 | 0.03 |
| 12869 | 7422132.432 | 609850.488 | 376.55 | 11B20110603SPR | 376.50 | 0.05 |
| 12870 | 7422133.927 | 609836.395 | 376.12 | 11B20110603SPR | 376.09 | 0.03 |
| 12871 | 7422135.393 | 609821.732 | 375.67 | 11B20110603SPR | 375.66 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12872 | 7421142.069 | 608639.944 | 334.30 | 11B20110603SPR | 334.26 | 0.04 |
| 12873 | 7421130.522 | 608630.779 | 334.08 | 11B20110603SPR | 334.03 | 0.05 |
| 12874 | 7421118.179 | 608621.723 | 333.91 | 11B20110603SPR | 333.88 | 0.03 |
| 12875 | 7421106.154 | 608612.606 | 333.78 | 11B20110603SPR | 333.74 | 0.04 |
| 12876 | 7421093.26 | 608602.693 | 333.64 | 11B20110603SPR | 333.62 | 0.02 |
| 12877 | 7421080.822 | 608593.49 | 333.50 | 11B20110603SPR | 333.43 | 0.06 |
| 12878 | 7421068.64 | 608584.46 | 333.33 | 11B20110603SPR | 333.29 | 0.04 |
| 12879 | 7421137.221 | 608660.238 | 333.43 | 11B20110603SGR | 333.40 | 0.03 |
| 12880 | 7421126.898 | 608689.388 | 332.82 | 11B20110603SGR | 332.81 | 0.01 |
| 12881 | 7421114.197 | 608717.47 | 332.68 | 11B20110603SGR | 332.64 | 0.04 |
| 12882 | 7421102.279 | 608759.063 | 332.23 | 11B20110603SGR | 332.20 | 0.03 |
| 12883 | 7421093.342 | 608792.821 | 332.40 | 11B20110603SGR | 332.38 | 0.02 |
| 12884 | 7421086.891 | 608830.62 | 332.55 | 11B20110603SGR | 332.52 | 0.03 |
| 12885 | 7421070.801 | 608871.551 | 332.92 | 11B20110603SGR | 332.87 | 0.05 |
| 12886 | 7421055.3 | 608898.695 | 333.34 | 11B20110603SGR | 333.33 | 0.01 |
| 12887 | 7420444.478 | 608317.508 | 328.93 | 11B20110603SPR | 328.89 | 0.04 |
| 12888 | 7420429.667 | 608312.128 | 328.89 | 11B20110603SPR | 328.83 | 0.06 |
| 12889 | 7420414.662 | 608306.458 | 328.81 | 11B20110603SPR | 328.77 | 0.04 |
| 12890 | 7420400.376 | 608301.293 | 328.75 | 11B20110603SPR | 328.71 | 0.04 |
| 12891 | 7420385.743 | 608295.665 | 328.68 | 11B20110603SPR | 328.64 | 0.04 |
| 12892 | 7420372.339 | 608289.892 | 328.59 | 11B20110603SPR | 328.57 | 0.02 |
| 12893 | 7420358.519 | 608283.384 | 328.52 | 11B20110603SPR | 328.51 | 0.01 |
| 12894 | 7419741.035 | 607905.441 | 324.65 | 11B20110603SPR | 324.63 | 0.02 |
| 12895 | 7419757.949 | 607909.079 | 324.76 | 11B20110603SPR | 324.72 | 0.04 |
| 12896 | 7419773.192 | 607912.953 | 324.88 | 11B20110603SPR | 324.86 | 0.02 |
| 12897 | 7419787.133 | 607916.488 | 324.97 | 11B20110603SPR | 324.91 | 0.05 |
| 12898 | 7419801.869 | 607920.321 | 325.05 | 11B20110603SPR | 325.05 | 0.00 |
| 12899 | 7419816.214 | 607924.129 | 325.15 | 11B20110603SPR | 325.14 | 0.01 |
| 12900 | 7419831.871 | 607927.917 | 325.28 | 11B20110603SPR | 325.26 | 0.02 |
| 12901 | 7419109.775 | 607501.162 | 322.43 | 11B20110603SPR | 322.42 | 0.01 |
| 12902 | 7419121.04 | 607510.956 | 322.47 | 11B20110603SPR | 322.44 | 0.03 |
| 12903 | 7419132.704 | 607521.626 | 322.53 | 11B20110603SPR | 322.51 | 0.02 |
| 12904 | 7419144.036 | 607531.577 | 322.58 | 11B20110603SPR | 322.56 | 0.02 |
| 12905 | 7419155.314 | 607541.707 | 322.62 | 11B20110603SPR | 322.59 | 0.03 |
| 12906 | 7419166.189 | 607551.449 | 322.64 | 11B20110603SPR | 322.61 | 0.03 |
| 12907 | 7419177.386 | 607562.061 | 322.69 | 11B20110603SPR | 322.67 | 0.02 |
| 12908 | 7418286.696 | 607095.403 | 319.97 | 11B20110603SPR | 319.94 | 0.03 |
| 12909 | 7418301.503 | 607101.362 | 319.84 | 11B20110603SPR | 319.82 | 0.02 |
| 12910 | 7418313.768 | 607105.851 | 319.74 | 11B20110603SPR | 319.71 | 0.03 |
| 12911 | 7418330.308 | 607112.114 | 319.62 | 11B20110603SPR | 319.58 | 0.04 |
| 12912 | 7418345.234 | 607116.945 | 319.44 | 11B20110603SPR | 319.42 | 0.02 |
| 12913 | 7418360.463 | 607122.603 | 319.49 | 11B20110603SPR | 319.46 | 0.03 |
| 12914 | 7418375.604 | 607128.228 | 319.41 | 11B20110603SPR | 319.37 | 0.03 |
| 12915 | 7421870.806 | 609162.249 | 351.34 | 11B20110603CHECK | 351.30 | 0.04 |
| 12916 | 7421870.805 | 609162.247 | 351.35 | 11B20110603CHECK | 351.30 | 0.05 |
| 12917 | 7421870.8 | 609162.247 | 351.33 | 11B20110603CHECK | 351.30 | 0.02 |
| 13000 | 7461137.149 | 620193.72 | 314.13 | 10C2011060410CSAC | 314.11 | 0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13001 | 7461136.494 | 620206.692 | 314.17 | 10C20110604SPR | 314.13 | 0.04 |
| 13002 | 7461151.315 | 620213.742 | 314.19 | 10C20110604SPR | 314.15 | 0.04 |
| 13003 | 7461165.208 | 620220.367 | 314.26 | 10C20110604SPR | 314.22 | 0.04 |
| 13004 | 7461179.25 | 620226.377 | 314.45 | 10C20110604SPR | 314.45 | 0.00 |
| 13005 | 7461192.612 | 620234.2 | 314.52 | 10C20110604SPR | 314.49 | 0.03 |
| 13006 | 7461204.715 | 620241.156 | 314.58 | 10C20110604SPR | 314.56 | 0.02 |
| 13007 | 7461216.382 | 620248.239 | 314.63 | 10C20110604SPR | 314.61 | 0.02 |
| 13008 | 7461647.231 | 620670.622 | 316.01 | 10C20110604SPR | 315.98 | 0.03 |
| 13009 | 7461658.018 | 620682.373 | 316.06 | 10C20110604SPR | 316.01 | 0.05 |
| 13010 | 7461669.319 | 620694.088 | 316.05 | 10C20110604SPR | 315.99 | 0.06 |
| 13011 | 7461679.929 | 620705.555 | 316.06 | 10C20110604SPR | 316.01 | 0.05 |
| 13012 | 7461690.833 | 620715.986 | 316.11 | 10C20110604SPR | 316.07 | 0.04 |
| 13013 | 7461701.575 | 620727.421 | 316.23 | 10C20110604SPR | 316.18 | 0.05 |
| 13014 | 7461712.555 | 620738.632 | 316.31 | 10C20110604SPR | 316.28 | 0.03 |
| 13015 | 7462208.155 | 621451.164 | 324.60 | 10C20110604SPR | 324.55 | 0.05 |
| 13016 | 7462217.07 | 621463.949 | 324.71 | 10C20110604SPR | 324.69 | 0.02 |
| 13017 | 7462225.994 | 621477.445 | 324.82 | 10C20110604SPR | 324.77 | 0.05 |
| 13018 | 7462234.664 | 621490.659 | 324.91 | 10C20110604SPR | 324.88 | 0.03 |
| 13019 | 7462243.529 | 621504.326 | 325.03 | 10C20110604SPR | 325.00 | 0.03 |
| 13020 | 7462252.284 | 621517.145 | 325.15 | 10C20110604SPR | 325.12 | 0.03 |
| 13021 | 7462260.924 | 621529.354 | 325.24 | 10C20110604SPR | 325.21 | 0.03 |
| 13022 | 7463136.102 | 621892.703 | 328.43 | 10C20110604SPR | 328.39 | 0.04 |
| 13023 | 7463151.998 | 621894.716 | 328.37 | 10C20110604SPR | 328.30 | 0.07 |
| 13024 | 7463170.34 | 621896.697 | 328.32 | 10C20110604SPR | 328.28 | 0.04 |
| 13025 | 7463185.511 | 621898.384 | 328.28 | 10C20110604SPR | 328.24 | 0.04 |
| 13026 | 7463201.416 | 621900.284 | 328.26 | 10C20110604SPR | 328.23 | 0.03 |
| 13027 | 7463216.614 | 621902.106 | 328.22 | 10C20110604SPR | 328.19 | 0.02 |
| 13028 | 7463234.563 | 621903.94 | 328.16 | 10C20110604SPR | 328.09 | 0.07 |
| 13029 | 7463840.216 | 621930.927 | 327.69 | 10C20110604SPR | 327.66 | 0.03 |
| 13030 | 7463855.642 | 621929.402 | 327.64 | 10C20110604SPR | 327.60 | 0.04 |
| 13031 | 7463872.04 | 621927.353 | 327.62 | 10C20110604SPR | 327.59 | 0.03 |
| 13032 | 7463887.8 | 621925.356 | 327.57 | 10C20110604SPR | 327.54 | 0.03 |
| 13033 | 7463903.319 | 621923.844 | 327.53 | 10C20110604SPR | 327.50 | 0.03 |
| 13034 | 7463918.421 | 621922.278 | 327.50 | 10C20110604SPR | 327.45 | 0.05 |
| 13035 | 7463933.963 | 621920.377 | 327.44 | 10C20110604SPR | 327.41 | 0.03 |
| 13036 | 7464749.12 | 622037.562 | 332.72 | 10C20110604SPR | 332.67 | 0.05 |
| 13037 | 7464761.37 | 622048.651 | 333.04 | 10C20110604SPR | 333.01 | 0.03 |
| 13038 | 7464774.567 | 622056.241 | 333.29 | 10C20110604SPR | 333.25 | 0.04 |
| 13039 | 7464789.019 | 622064.345 | 333.60 | 10C20110604SPR | 333.52 | 0.08 |
| 13040 | 7464802.364 | 622072.123 | 333.87 | 10C20110604SPR | 333.82 | 0.05 |
| 13041 | 7464821.932 | 622083.224 | 334.32 | 10C20110604SPR | 334.24 | 0.08 |
| 13042 | 7464835.905 | 622090.963 | 334.61 | 10C20110604SPR | 334.60 | 0.01 |
| 13043 | 7465513.146 | 622303.886 | 343.73 | 10C20110604SPR | 343.65 | 0.08 |
| 13044 | 7465535.403 | 622303.265 | 343.64 | 10C20110604SPR | 343.56 | 0.08 |
| 13045 | 7465551.052 | 622302.712 | 343.56 | 10C20110604SPR | 343.51 | 0.05 |
| 13046 | 7465568.071 | 622302.337 | 343.50 | 10C20110604SPR | 343.39 | 0.11 |
| 13047 | 7465583.657 | 622301.882 | 343.44 | 10C20110604SPR | 343.35 | 0.09 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13048 | 7465599.124 | 622301.491 | 343.42 | 10C20110604SPR | 343.32 | 0.10 |
| 13049 | 7465614.675 | 622300.993 | 343.39 | 10C20110604SPR | 343.33 | 0.06 |
| 13050 | 7466424.701 | 622278.051 | 342.87 | 10C20110604SPR | 342.84 | 0.03 |
| 13051 | 7466442.477 | 622277.758 | 342.93 | 10C20110604SPR | 342.94 | -0.01 |
| 13052 | 7466458.551 | 622277.839 | 343.01 | 10C20110604SPR | 343.01 | 0.00 |
| 13053 | 7466474.185 | 622277.176 | 343.04 | 10C20110604SPR | 343.02 | 0.02 |
| 13054 | 7466489.263 | 622277.441 | 343.06 | 10C20110604SPR | 343.06 | 0.00 |
| 13055 | 7466504.977 | 622276.299 | 343.06 | 10C20110604SPR | 343.04 | 0.02 |
| 13056 | 7466520.199 | 622276.076 | 343.09 | 10C20110604SPR | 343.06 | 0.02 |
| 13057 | 7467182.76 | 622155.736 | 343.62 | 10C20110604SPR | 343.58 | 0.04 |
| 13058 | 7467197.908 | 622152.618 | 343.64 | 10C20110604SPR | 343.58 | 0.06 |
| 13059 | 7467213.26 | 622150.56 | 343.67 | 10C20110604SPR | 343.56 | 0.11 |
| 13060 | 7467231.453 | 622145.661 | 343.64 | 10C20110604SPR | 343.56 | 0.08 |
| 13061 | 7467245.844 | 622143.05 | 343.64 | 10C20110604SPR | 343.55 | 0.09 |
| 13062 | 7467260.763 | 622139.803 | 343.67 | 10C20110604SPR | 343.59 | 0.08 |
| 13063 | 7467275.87 | 622136.461 | 343.68 | 10C20110604SPR | 343.57 | 0.11 |
| 13064 | 7468212.662 | 621940.088 | 331.70 | 10C20110604SPR | 331.55 | 0.15 |
| 13065 | 7468230.141 | 621940.741 | 331.71 | 10C20110604SPR | 331.61 | 0.10 |
| 13066 | 7468250.745 | 621933.47 | 331.77 | 10C20110604SPR | 331.69 | 0.08 |
| 13067 | 7468269.564 | 621932.355 | 331.80 | 10C20110604SPR | 331.69 | 0.11 |
| 13068 | 7468285.048 | 621924.618 | 331.84 | 10C20110604SPR | 331.73 | 0.11 |
| 13069 | 7468300.013 | 621925.148 | 331.86 | 10C20110604SPR | 331.77 | 0.09 |
| 13070 | 7468314.658 | 621920.328 | 331.90 | 10C20110604SPR | 331.82 | 0.08 |
| 13071 | 7462631.648 | 621110.756 | 319.43 | 10C20110604SGR | 319.41 | 0.02 |
| 13072 | 7462631.652 | 621110.75 | 319.43 | 10C20110604SGR | 319.41 | 0.01 |
| 13073 | 7462661.865 | 621108.785 | 319.32 | 10C20110604SGR | 319.31 | 0.01 |
| 13074 | 7462693.584 | 621108.834 | 319.14 | 10C20110604SGR | 319.13 | 0.01 |
| 13075 | 7462725.92 | 621107.564 | 318.95 | 10C20110604SGR | 318.90 | 0.05 |
| 13076 | 7462757.853 | 621103.239 | 318.91 | 10C20110604SGR | 318.92 | -0.01 |
| 13077 | 7462789.096 | 621100.052 | 318.90 | 10C20110604SGR | 318.91 | -0.01 |
| 13078 | 7462803.035 | 621079.135 | 319.18 | 10C20110604SGR | 319.15 | 0.03 |
| 13079 | 7462820.474 | 621021.625 | 317.79 | 10C20110604SGR | 317.77 | 0.02 |
| 13080 | 7462838.164 | 620987.425 | 317.58 | 10C20110604SGR | 317.53 | 0.05 |
| 13081 | 7462844.273 | 620938.901 | 319.08 | 10C20110604SGR | 319.08 | 0.00 |
| 13082 | 7462819.21 | 620897.888 | 318.77 | 10C20110604SGR | 318.74 | 0.03 |
| 13083 | 7462778.525 | 620928.192 | 318.72 | 10C20110604SGR | 318.71 | 0.01 |
| 13084 | 7462754.943 | 620943.86 | 318.64 | 10C20110604SGR | 318.63 | 0.01 |
| 13085 | 7462687.673 | 620987.719 | 319.22 | 10C20110604SGR | 319.22 | 0.00 |
| 13086 | 7462666.219 | 621017.226 | 319.27 | 10C20110604SGR | 319.28 | -0.01 |
| 13087 | 7462645.752 | 621044.412 | 319.62 | 10C20110604SGR | 319.60 | 0.02 |
| 13088 | 7462616.535 | 621088.436 | 319.97 | 10C20110604SGR | 319.95 | 0.02 |
| 13089 | 7462489.55 | 621397.432 | 321.80 | 10C20110604SGR | 321.80 | 0.00 |
| 13090 | 7462481.876 | 621411.849 | 321.92 | 10C20110604SGR | 321.88 | 0.04 |
| 13091 | 7462474.016 | 621427.274 | 322.09 | 10C20110604SGR | 322.04 | 0.05 |
| 13092 | 7462465.663 | 621442.797 | 322.28 | 10C20110604SGR | 322.27 | 0.01 |
| 13093 | 7462458.035 | 621457.625 | 322.50 | 10C20110604SGR | 322.51 | -0.01 |
| 13094 | 7462445.275 | 621481.301 | 322.77 | 10C20110604SGR | 322.77 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13095 | 7462438.719 | 621493.607 | 323.00 | 10C20110604SGR | 322.97 | 0.03 |
| 13096 | 7462183.872 | 621900.685 | 324.12 | 10C20110604SGR | 324.10 | 0.02 |
| 13097 | 7462189.516 | 621929.394 | 324.41 | 10C20110604SGR | 324.36 | 0.05 |
| 13098 | 7462206.739 | 621961.948 | 324.44 | 10C20110604SGR | 324.43 | 0.01 |
| 13099 | 7462217.385 | 621992.283 | 324.38 | 10C20110604SGR | 324.35 | 0.03 |
| 13100 | 7462245.095 | 622048.744 | 324.66 | 10C20110604SGR | 324.63 | 0.03 |
| 13101 | 7462270.519 | 622091.687 | 324.74 | 10C20110604SGR | 324.72 | 0.02 |
| 13102 | 7462295.853 | 622149.326 | 325.16 | 10C20110604SGR | 325.12 | 0.04 |
| 13103 | 7462309.73 | 622181.133 | 325.52 | 10C20110604SGR | 325.50 | 0.02 |
| 13104 | 7462326.943 | 622219.836 | 326.34 | 10C20110604SGR | 326.32 | 0.02 |
| 13105 | 7462342.726 | 622248.002 | 326.39 | 10C20110604SGR | 326.37 | 0.02 |
| 13106 | 7462366.373 | 622271.868 | 326.80 | 10C20110604SGR | 326.79 | 0.01 |
| 13107 | 7462404.79 | 622305.387 | 329.98 | 10C20110604SGR | 329.95 | 0.03 |
| 13108 | 7462419.58 | 622319.086 | 330.21 | 10C20110604SGR | 330.22 | -0.01 |
| 13109 | 7462444.245 | 622363.35 | 331.03 | 10C20110604SGR | 330.97 | 0.06 |
| 13110 | 7461133.373 | 620203.332 | 314.25 | 10C20110604CHECK | 314.20 | 0.05 |
| 13111 | 7461133.379 | 620203.341 | 314.25 | 10C20110604CHECK | 314.20 | 0.05 |
| 13112 | 7461408.881 | 620236.262 | 314.37 | 10C2011060411A | 314.35 | 0.02 |
| 13113 | 7417499.409 | 606819.516 | 313.91 | 10C20110604FAC | 313.90 | 0.01 |
| 13114 | 7434569.303 | 618327.199 | 403.67 | 10C20110604SGR | 403.62 | 0.05 |
| 13115 | 7435956.571 | 617985.411 | 328.14 | 10C20110604SGR | 328.10 | 0.04 |
| 13116 | 7436104.751 | 618054.891 | 328.45 | 10C20110604SGR | 328.41 | 0.04 |
| 13117 | 7437739.008 | 617357.43 | 460.29 | 10C20110604SGR | 460.19 | 0.10 |
| 13118 | 7438255.859 | 617316.411 | 493.76 | 10C20110604SGR | 493.68 | 0.08 |
| 13119 | 7438148.946 | 617182.52 | 469.13 | 10C20110604SGR | 469.04 | 0.09 |
| 13200 | 7457151.428 | 618200.525 | 400.16 | 10B2011060510BDOT_MON | 399.99 | 0.16 |
| 13201 | 7457151.294 | 618186.317 | 400.62 | 10B20110605SPR | 400.57 | 0.05 |
| 13202 | 7457136.263 | 618184.087 | 400.69 | 10B20110605SPR | 400.64 | 0.05 |
| 13203 | 7457121.663 | 618181.339 | 400.65 | 10B20110605SPR | 400.57 | 0.08 |
| 13204 | 7457107.066 | 618178.582 | 400.55 | 10B20110605SPR | 400.51 | 0.04 |
| 13205 | 7457092.908 | 618175.954 | 400.33 | 10B20110605SPR | 400.25 | 0.08 |
| 13206 | 7457079.262 | 618173.064 | 400.01 | 10B20110605SPR | 399.94 | 0.06 |
| 13207 | 7457065.568 | 618170.628 | 399.58 | 10B20110605SPR | 399.50 | 0.08 |
| 13208 | 7456355.49 | 617921.743 | 351.92 | 10B20110605SPR | 351.85 | 0.07 |
| 13209 | 7456341.7 | 617916.098 | 351.18 | 10B20110605SPR | 351.09 | 0.09 |
| 13210 | 7456327.322 | 617911.129 | 350.28 | 10B20110605SPR | 350.17 | 0.11 |
| 13211 | 7456313.017 | 617905.393 | 349.30 | 10B20110605SPR | 349.23 | 0.06 |
| 13212 | 7456299.52 | 617900.146 | 348.39 | 10B20110605SPR | 348.34 | 0.05 |
| 13213 | 7456285.514 | 617895.071 | 347.43 | 10B20110605SPR | 347.34 | 0.09 |
| 13214 | 7456271.037 | 617889.421 | 346.28 | 10B20110605SPR | 346.22 | 0.06 |
| 13215 | 7455808.082 | 617685.505 | 316.07 | 10B20110605SGR | 315.99 | 0.07 |
| 13216 | 7455832.357 | 617667.135 | 319.17 | 10B20110605SGR | 319.04 | 0.13 |
| 13217 | 7455858.221 | 617654.688 | 319.82 | 10B20110605SGR | 319.70 | 0.12 |
| 13218 | 7455890.194 | 617638.264 | 320.52 | 10B20110605SGR | 320.42 | 0.10 |
| 13219 | 7455910.495 | 617615.391 | 320.29 | 10B20110605SGR | 320.19 | 0.10 |
| 13220 | 7455923.633 | 617588.091 | 318.91 | 10B20110605SGR | 318.83 | 0.07 |
| 13221 | 7455941.346 | 617561.193 | 317.94 | 10B20110605SGR | 317.86 | 0.08 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13222 | 7455961.423 | 617541.048 | 317.70 | 10B20110605SGR | 317.65 | 0.05 |
| 13223 | 7455988.803 | 617522.108 | 317.56 | 10B20110605SGR | 317.53 | 0.03 |
| 13224 | 7456022.192 | 617506.143 | 318.43 | 10B20110605SGR | 318.36 | 0.07 |
| 13225 | 7456052.356 | 617498.582 | 318.10 | 10B20110605SGR | 318.04 | 0.06 |
| 13226 | 7456083.268 | 617491.173 | 313.91 | 10B20110605SGR | 313.85 | 0.06 |
| 13227 | 7456115.221 | 617484.646 | 310.03 | 10B20110605SGR | 309.96 | 0.07 |
| 13228 | 7456171.19 | 617474.572 | 303.32 | 10B20110605SGR | 303.23 | 0.09 |
| 13229 | 7456265.429 | 617440.479 | 300.95 | 10B20110605SGR | 300.83 | 0.12 |
| 13230 | 7454863.581 | 617262.172 | 357.14 | 10B20110605SPR | 357.09 | 0.05 |
| 13231 | 7454850.363 | 617251.681 | 357.07 | 10B20110605SPR | 357.00 | 0.07 |
| 13232 | 7454837.79 | 617242.202 | 356.95 | 10B20110605SPR | 356.87 | 0.07 |
| 13233 | 7454824.359 | 617232.4 | 356.81 | 10B20110605SPR | 356.76 | 0.05 |
| 13234 | 7454810.999 | 617223.031 | 356.68 | 10B20110605SPR | 356.61 | 0.07 |
| 13235 | 7454796.921 | 617212.088 | 356.57 | 10B20110605SPR | 356.50 | 0.07 |
| 13236 | 7454784.654 | 617202.515 | 356.39 | 10B20110605SPR | 356.33 | 0.06 |
| 13237 | 7454128.826 | 616722.217 | 350.40 | 10B20110605SPR | 350.32 | 0.08 |
| 13238 | 7454116.28 | 616713.227 | 350.41 | 10B20110605SPR | 350.34 | 0.07 |
| 13239 | 7454102.838 | 616703.194 | 350.34 | 10B20110605SPR | 350.27 | 0.07 |
| 13240 | 7454089.758 | 616693.516 | 350.05 | 10B20110605SPR | 349.98 | 0.07 |
| 13241 | 7454075.918 | 616682.836 | 349.74 | 10B20110605SPR | 349.69 | 0.05 |
| 13242 | 7454063.322 | 616673.5 | 349.26 | 10B20110605SPR | 349.18 | 0.08 |
| 13243 | 7454050.641 | 616664.11 | 348.58 | 10B20110605SPR | 348.51 | 0.07 |
| 13244 | 7453601.746 | 616182.382 | 332.21 | 10B20110605SPR | 332.13 | 0.08 |
| 13245 | 7453595.544 | 616166.689 | 332.02 | 10B20110605SPR | 331.92 | 0.10 |
| 13246 | 7453587.668 | 616152.145 | 331.80 | 10B20110605SPR | 331.72 | 0.08 |
| 13247 | 7453580.887 | 616135.427 | 331.37 | 10B20110605SPR | 331.30 | 0.07 |
| 13248 | 7453574.152 | 616121.371 | 330.97 | 10B20110605SPR | 330.92 | 0.05 |
| 13249 | 7453567.33 | 616106.409 | 330.38 | 10B20110605SPR | 330.31 | 0.07 |
| 13250 | 7453560.228 | 616091.136 | 329.64 | 10B20110605SPR | 329.55 | 0.09 |
| 13251 | 7453235.414 | 615473.36 | 295.20 | 10B20110605SPR | 295.14 | 0.06 |
| 13252 | 7453222.06 | 615464.2 | 295.11 | 10B20110605SPR | 295.08 | 0.03 |
| 13253 | 7453209.798 | 615454.946 | 295.13 | 10B20110605SPR | 295.06 | 0.07 |
| 13254 | 7453197.446 | 615446.364 | 295.14 | 10B20110605SPR | 295.10 | 0.04 |
| 13255 | 7453184.68 | 615437.824 | 295.17 | 10B20110605SPR | 295.12 | 0.05 |
| 13256 | 7453171.95 | 615429.924 | 295.08 | 10B20110605SPR | 295.04 | 0.04 |
| 13257 | 7453158.858 | 615422.256 | 295.03 | 10B20110605SPR | 294.95 | 0.08 |
| 13258 | 7452690.037 | 615175.573 | 293.65 | 10B20110605SPR | 293.57 | 0.08 |
| 13259 | 7452677.944 | 615166.484 | 293.64 | 10B20110605SPR | 293.56 | 0.08 |
| 13260 | 7452663.55 | 615160.817 | 293.55 | 10B20110605SPR | 293.47 | 0.08 |
| 13261 | 7452650.231 | 615153.613 | 293.49 | 10B20110605SPR | 293.39 | 0.10 |
| 13262 | 7452637.161 | 615146.89 | 293.45 | 10B20110605SPR | 293.36 | 0.09 |
| 13263 | 7452623.58 | 615139.414 | 293.44 | 10B20110605SPR | 293.34 | 0.10 |
| 13264 | 7452609.655 | 615132.182 | 293.45 | 10B20110605SPR | 293.36 | 0.09 |
| 13265 | 7451943.134 | 614782.404 | 292.41 | 10B20110605SPR | 292.33 | 0.08 |
| 13266 | 7451929.365 | 614771.532 | 292.40 | 10B20110605SPR | 292.33 | 0.07 |
| 13267 | 7451914.354 | 614762.351 | 292.31 | 10B20110605SPR | 292.25 | 0.06 |
| 13268 | 7451898.953 | 614754.342 | 292.28 | 10B20110605SPR | 292.25 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13269 | 7451883.461 | 614745.961 | 292.24 | 10B20110605SPR | 292.20 | 0.04 |
| 13270 | 7451869.433 | 614739.094 | 292.18 | 10B20110605SPR | 292.14 | 0.04 |
| 13271 | 7451856.277 | 614731.744 | 292.10 | 10B20110605SPR | 292.03 | 0.07 |
| 13272 | 7458080.098 | 618353.738 | 391.19 | 10B20110605SPR | 391.14 | 0.05 |
| 13273 | 7458093.841 | 618358.887 | 391.19 | 10B20110605SPR | 391.14 | 0.05 |
| 13274 | 7458108.211 | 618364.906 | 391.25 | 10B20110605SPR | 391.19 | 0.06 |
| 13275 | 7458123.195 | 618369.602 | 391.30 | 10B20110605SPR | 391.27 | 0.03 |
| 13276 | 7458138.848 | 618376.513 | 391.27 | 10B20110605SPR | 391.22 | 0.05 |
| 13277 | 7458152.889 | 618383.743 | 391.17 | 10B20110605SPR | 391.13 | 0.04 |
| 13278 | 7458165.909 | 618389.724 | 391.14 | 10B20110605SPR | 391.10 | 0.04 |
| 13279 | 7458768.157 | 619011.167 | 379.12 | 10B20110605SPR | 379.06 | 0.06 |
| 13280 | 7458774.37 | 619024.772 | 378.75 | 10B20110605SPR | 378.71 | 0.04 |
| 13281 | 7458780.985 | 619037.871 | 378.32 | 10B20110605SPR | 378.28 | 0.04 |
| 13282 | 7458788.279 | 619052.065 | 377.80 | 10B20110605SPR | 377.72 | 0.07 |
| 13283 | 7458795.242 | 619065.692 | 377.28 | 10B20110605SPR | 377.24 | 0.04 |
| 13284 | 7458801.835 | 619079.553 | 376.81 | 10B20110605SPR | 376.75 | 0.06 |
| 13285 | 7458808.187 | 619092.391 | 376.39 | 10B20110605SPR | 376.30 | 0.09 |
| 13286 | 7459459.255 | 620593.164 | 355.47 | 10B20110605SGR | 355.42 | 0.04 |
| 13287 | 7459453.043 | 620611.278 | 356.94 | 10B20110605SGR | 356.89 | 0.05 |
| 13288 | 7459445.546 | 620625.108 | 357.76 | 10B20110605SGR | 357.67 | 0.09 |
| 13289 | 7459439.831 | 620647.422 | 358.85 | 10B20110605SGR | 358.77 | 0.08 |
| 13290 | 7459444.757 | 620663.908 | 359.60 | 10B20110605SGR | 359.52 | 0.08 |
| 13291 | 7459378.957 | 620121.426 | 366.61 | 10B20110605SGR | 366.53 | 0.08 |
| 13292 | 7459369.603 | 620107.459 | 367.17 | 10B20110605SGR | 367.11 | 0.06 |
| 13293 | 7459360.676 | 620095.019 | 367.85 | 10B20110605SGR | 367.76 | 0.09 |
| 13294 | 7459351.791 | 620083.238 | 368.31 | 10B20110605SGR | 368.24 | 0.07 |
| 13295 | 7459343.268 | 620071.097 | 368.72 | 10B20110605SGR | 368.64 | 0.07 |
| 13296 | 7459250.163 | 619841.583 | 374.93 | 10B20110605SGR | 374.85 | 0.07 |
| 13297 | 7459242.097 | 619856.108 | 374.76 | 10B20110605SGR | 374.68 | 0.08 |
| 13298 | 7459236.113 | 619869.196 | 374.39 | 10B20110605SGR | 374.33 | 0.06 |
| 13299 | 7459233.178 | 619892.958 | 373.84 | 10B20110605SGR | 373.76 | 0.08 |
| 13300 | 7459240.166 | 619923.319 | 373.27 | 10B20110605SGR | 373.20 | 0.06 |
| 13301 | 7457152.246 | 618188.168 | 400.61 | 10B20110605CHECK | 400.57 | 0.04 |
| 13302 | 7457152.243 | 618188.169 | 400.60 | 10B20110605CHECK | 400.57 | 0.03 |
| 13303 | 7457152.254 | 618188.175 | 400.59 | 10B20110605CHECK | 400.57 | 0.02 |
| 13304 | 7470301.252 | 622200.59 | 341.25 | 10B20110605DOT_MON | 341.23 | 0.02 |
| 13305 | 7469650.721 | 622045.121 | 338.30 | 10B20110605FAC | 338.41 | -0.11 |
| 13400 | 7480702.503 | 625704.405 | 405.55 | 09D2011060609DFAC | 405.51 | 0.04 |
| 13401 | 7480598.737 | 625162.199 | 396.00 | 09D20110606SPR | 395.93 | 0.07 |
| 13402 | 7480612.83 | 625165.637 | 395.97 | 09D20110606SPR | 395.92 | 0.05 |
| 13403 | 7480626.326 | 625168.617 | 395.92 | 09D20110606SPR | 395.88 | 0.04 |
| 13404 | 7480638.907 | 625171.447 | 395.89 | 09D20110606SPR | 395.80 | 0.09 |
| 13405 | 7480653.062 | 625174.691 | 395.85 | 09D20110606SPR | 395.78 | 0.07 |
| 13406 | 7480667.471 | 625177.98 | 395.82 | 09D20110606SPR | 395.73 | 0.09 |
| 13407 | 7480682.039 | 625181.432 | 395.77 | 09D20110606SPR | 395.73 | 0.04 |
| 13408 | 7480696.871 | 625184.66 | 395.72 | 09D20110606SPR | 395.68 | 0.04 |
| 13409 | 7480711.412 | 625188.116 | 395.66 | 09D20110606SPR | 395.62 | 0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13410 | 7480717.818 | 625207.066 | 395.25 | 09D20110606SGR | 395.21 | 0.04 |
| 13411 | 7480709.02 | 625235.385 | 392.80 | 09D20110606SGR | 392.78 | 0.02 |
| 13412 | 7480698.495 | 625263.764 | 391.70 | 09D20110606SGR | 391.65 | 0.05 |
| 13413 | 7480686.16 | 625292.098 | 392.91 | 09D20110606SGR | 392.88 | 0.03 |
| 13414 | 7480674.54 | 625319.713 | 393.77 | 09D20110606SGR | 393.74 | 0.03 |
| 13415 | 7480663.196 | 625349.452 | 393.55 | 09D20110606SGR | 393.52 | 0.03 |
| 13416 | 7480652.511 | 625377.601 | 393.09 | 09D20110606SGR | 393.03 | 0.06 |
| 13417 | 7480644.648 | 625409.936 | 393.28 | 09D20110606SGR | 393.21 | 0.07 |
| 13418 | 7480632.549 | 625438.299 | 394.39 | 09D20110606SGR | 394.31 | 0.07 |
| 13419 | 7480627.306 | 625467.947 | 395.36 | 09D20110606SGR | 395.32 | 0.04 |
| 13420 | 7480621.576 | 625498.148 | 396.31 | 09D20110606SGR | 396.25 | 0.06 |
| 13421 | 7480618.202 | 625536.434 | 397.40 | 09D20110606SGR | 397.35 | 0.05 |
| 13422 | 7480615.236 | 625567.505 | 397.45 | 09D20110606SGR | 397.39 | 0.06 |
| 13423 | 7480614.02 | 625601.929 | 399.00 | 09D20110606SGR | 398.95 | 0.05 |
| 13424 | 7480606.152 | 625637.397 | 400.11 | 09D20110606SGR | 400.07 | 0.04 |
| 13425 | 7480597.457 | 625670.516 | 398.90 | 09D20110606SGR | 398.86 | 0.04 |
| 13426 | 7480580.361 | 625696.666 | 396.04 | 09D20110606SGR | 395.99 | 0.05 |
| 13427 | 7480565.843 | 625719.298 | 395.88 | 09D20110606SGR | 395.81 | 0.07 |
| 13428 | 7480603.421 | 625129.177 | 396.46 | 09D20110606SGR | 396.41 | 0.05 |
| 13429 | 7480615.283 | 625098.625 | 394.63 | 09D20110606SGR | 394.56 | 0.07 |
| 13430 | 7480612.396 | 625065.589 | 393.54 | 09D20110606SGR | 393.50 | 0.04 |
| 13431 | 7480599.709 | 625034.251 | 393.93 | 09D20110606SGR | 393.86 | 0.07 |
| 13432 | 7480586.156 | 625006.205 | 394.66 | 09D20110606SGR | 394.58 | 0.08 |
| 13433 | 7480576.652 | 624973.477 | 396.13 | 09D20110606SGR | 396.05 | 0.08 |
| 13434 | 7480576.244 | 624944.83 | 397.37 | 09D20110606SGR | 397.30 | 0.07 |
| 13435 | 7480584.662 | 624910.677 | 399.17 | 09D20110606SGR | 399.09 | 0.08 |
| 13436 | 7480592.038 | 624874.326 | 399.98 | 09D20110606SGR | 399.92 | 0.06 |
| 13437 | 7480600.324 | 624845.152 | 400.67 | 09D20110606SGR | 400.60 | 0.07 |
| 13438 | 7480607.21 | 624815.643 | 400.21 | 09D20110606SGR | 400.12 | 0.08 |
| 13439 | 7480614.794 | 624785.833 | 400.24 | 09D20110606SGR | 400.15 | 0.09 |
| 13440 | 7480626.557 | 624741.011 | 401.42 | 09D20110606SGR | 401.35 | 0.07 |
| 13441 | 7480635.637 | 624705.319 | 401.57 | 09D20110606SGR | 401.49 | 0.08 |
| 13442 | 7480642.736 | 624675.369 | 401.52 | 09D20110606SGR | 401.45 | 0.07 |
| 13443 | 7479691.254 | 624943.529 | 391.78 | 09D20110606SPR | 391.68 | 0.10 |
| 13444 | 7479676.848 | 624937.023 | 391.84 | 09D20110606SPR | 391.75 | 0.08 |
| 13445 | 7479662.958 | 624930.301 | 391.90 | 09D20110606SPR | 391.83 | 0.07 |
| 13446 | 7479648.951 | 624923.211 | 391.98 | 09D20110606SPR | 391.92 | 0.06 |
| 13447 | 7479635.026 | 624916.084 | 392.07 | 09D20110606SPR | 392.00 | 0.07 |
| 13448 | 7479621.161 | 624908.991 | 392.14 | 09D20110606SPR | 392.07 | 0.07 |
| 13449 | 7479606.487 | 624901.364 | 392.21 | 09D20110606SPR | 392.12 | 0.09 |
| 13450 | 7478761.739 | 624542.532 | 383.73 | 09D20110606SPR | 383.67 | 0.06 |
| 13451 | 7478746.918 | 624539.367 | 383.68 | 09D20110606SPR | 383.57 | 0.11 |
| 13452 | 7478732.117 | 624536.019 | 383.58 | 09D20110606SPR | 383.56 | 0.02 |
| 13453 | 7478717.512 | 624532.919 | 383.48 | 09D20110606SPR | 383.39 | 0.09 |
| 13454 | 7478701.311 | 624529.34 | 383.34 | 09D20110606SPR | 383.27 | 0.07 |
| 13455 | 7478686.246 | 624525.741 | 383.18 | 09D20110606SPR | 383.08 | 0.10 |
| 13456 | 7478671.765 | 624522.693 | 383.02 | 09D20110606SPR | 382.96 | 0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13457 | 7477661.138 | 624115.25 | 383.28 | 09D20110606SPR | 383.22 | 0.06 |
| 13458 | 7477648.568 | 624108.531 | 383.12 | 09D20110606SPR | 383.07 | 0.05 |
| 13459 | 7477635.103 | 624101.995 | 382.94 | 09D20110606SPR | 382.86 | 0.08 |
| 13460 | 7477621.693 | 624095.337 | 382.69 | 09D20110606SPR | 382.62 | 0.07 |
| 13461 | 7477608.575 | 624088.791 | 382.51 | 09D20110606SPR | 382.45 | 0.06 |
| 13462 | 7477595.114 | 624082.023 | 382.28 | 09D20110606SPR | 382.22 | 0.06 |
| 13463 | 7477581.486 | 624075.33 | 382.02 | 09D20110606SPR | 381.97 | 0.05 |
| 13464 | 7477676.94 | 624077.945 | 380.54 | 09D20110606SGR | 380.47 | 0.07 |
| 13465 | 7477684.864 | 624046.727 | 378.81 | 09D20110606SGR | 378.76 | 0.05 |
| 13466 | 7477685.696 | 624019.286 | 377.28 | 09D20110606SGR | 377.22 | 0.06 |
| 13467 | 7477686.826 | 623987.741 | 376.04 | 09D20110606SGR | 375.98 | 0.06 |
| 13468 | 7477689.654 | 623956.764 | 374.94 | 09D20110606SGR | 374.87 | 0.07 |
| 13469 | 7477687.26 | 623926.028 | 374.22 | 09D20110606SGR | 374.16 | 0.06 |
| 13470 | 7477680.85 | 623888.053 | 373.59 | 09D20110606SGR | 373.51 | 0.07 |
| 13471 | 7476817.986 | 623794.718 | 377.81 | 09D20110606SPR | 377.75 | 0.06 |
| 13472 | 7476803.149 | 623790.525 | 377.89 | 09D20110606SPR | 377.81 | 0.08 |
| 13473 | 7476788.055 | 623786.297 | 377.96 | 09D20110606SPR | 377.86 | 0.09 |
| 13474 | 7476773.536 | 623782.097 | 377.97 | 09D20110606SPR | 377.92 | 0.05 |
| 13475 | 7476758.572 | 623777.861 | 377.99 | 09D20110606SPR | 377.91 | 0.08 |
| 13476 | 7476743.507 | 623773.724 | 377.96 | 09D20110606SPR | 377.90 | 0.06 |
| 13477 | 7476728.237 | 623769.547 | 377.91 | 09D20110606SPR | 377.85 | 0.06 |
| 13478 | 7476144.126 | 623567.177 | 369.38 | 09D20110606SPR | 369.34 | 0.04 |
| 13479 | 7476126.444 | 623558.216 | 368.94 | 09D20110606SPR | 368.87 | 0.06 |
| 13480 | 7476110.739 | 623550.718 | 368.60 | 09D20110606SPR | 368.54 | 0.06 |
| 13481 | 7476096.711 | 623543.804 | 368.34 | 09D20110606SPR | 368.29 | 0.05 |
| 13482 | 7476082.532 | 623536.614 | 368.14 | 09D20110606SPR | 368.08 | 0.06 |
| 13483 | 7476068.678 | 623529.599 | 367.99 | 09D20110606SPR | 367.94 | 0.05 |
| 13484 | 7476055.124 | 623523.369 | 367.87 | 09D20110606SPR | 367.82 | 0.05 |
| 13485 | 7475367.015 | 623390.477 | 374.06 | 09D20110606SPR | 373.99 | 0.07 |
| 13486 | 7475350.447 | 623389.943 | 374.02 | 09D20110606SPR | 373.94 | 0.08 |
| 13487 | 7475333.945 | 623389.513 | 373.95 | 09D20110606SPR | 373.88 | 0.07 |
| 13488 | 7475317.609 | 623389.365 | 373.85 | 09D20110606SPR | 373.80 | 0.05 |
| 13489 | 7475301.356 | 623388.985 | 373.77 | 09D20110606SPR | 373.70 | 0.06 |
| 13490 | 7475285.039 | 623388.746 | 373.64 | 09D20110606SPR | 373.57 | 0.07 |
| 13491 | 7475268.903 | 623388.155 | 373.50 | 09D20110606SPR | 373.43 | 0.07 |
| 13492 | 7474722.333 | 623379.117 | 368.98 | 09D20110606SPR | 368.92 | 0.06 |
| 13493 | 7474706.703 | 623378.675 | 368.77 | 09D20110606SPR | 368.70 | 0.07 |
| 13494 | 7474691.74 | 623378.565 | 368.54 | 09D20110606SPR | 368.47 | 0.07 |
| 13495 | 7474676.431 | 623378.328 | 368.31 | 09D20110606SPR | 368.26 | 0.05 |
| 13496 | 7474660.477 | 623378.184 | 368.07 | 09D20110606SPR | 368.03 | 0.04 |
| 13497 | 7474644.34 | 623377.33 | 367.86 | 09D20110606SPR | 367.78 | 0.08 |
| 13498 | 7474628.46 | 623377.575 | 367.64 | 09D20110606SPR | 367.58 | 0.06 |
| 13499 | 7473723.658 | 623144.532 | 365.38 | 09D20110606SPR | 365.35 | 0.03 |
| 13500 | 7473708.697 | 623139.659 | 365.38 | 09D20110606SPR | 365.33 | 0.05 |
| 13501 | 7473693.661 | 623134.905 | 365.38 | 09D20110606SPR | 365.32 | 0.06 |
| 13502 | 7473677.814 | 623130.015 | 365.33 | 09D20110606SPR | 365.28 | 0.05 |
| 13503 | 7473662.409 | 623124.935 | 365.28 | 09D20110606SPR | 365.22 | 0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13504 | 7473647.083 | 623120.494 | 365.18 | 09D20110606SPR | 365.11 | 0.07 |
| 13505 | 7473631.905 | 623115.809 | 365.09 | 09D20110606SPR | 365.06 | 0.03 |
| 13506 | 7473068.537 | 622960.649 | 362.59 | 09D20110606SPR | 362.55 | 0.04 |
| 13507 | 7473084.138 | 622961.708 | 362.78 | 09D20110606SPR | 362.69 | 0.09 |
| 13508 | 7473100.068 | 622962.894 | 362.89 | 09D20110606SPR | 362.83 | 0.06 |
| 13509 | 7473115.507 | 622964.588 | 362.92 | 09D20110606SPR | 362.88 | 0.04 |
| 13510 | 7473130.943 | 622966.201 | 362.96 | 09D20110606SPR | 362.89 | 0.07 |
| 13511 | 7473146.359 | 622969.107 | 362.91 | 09D20110606SPR | 362.83 | 0.08 |
| 13512 | 7473161.183 | 622971.822 | 362.90 | 09D20110606SPR | 362.81 | 0.09 |
| 13513 | 7481596.62 | 623826.132 | 363.72 | 09D20110606SGR | 363.62 | 0.09 |
| 13514 | 7481613.551 | 623833.383 | 363.78 | 09D20110606SGR | 363.64 | 0.14 |
| 13515 | 7481629.261 | 623840.87 | 363.82 | 09D20110606SGR | 363.73 | 0.09 |
| 13516 | 7481641.866 | 623849.662 | 363.90 | 09D20110606SGR | 363.78 | 0.12 |
| 13517 | 7481656.261 | 623856.582 | 363.92 | 09D20110606SGR | 363.82 | 0.10 |
| 13518 | 7481670.42 | 623862.621 | 363.93 | 09D20110606SGR | 363.83 | 0.10 |
| 13519 | 7481683.414 | 623869.859 | 363.90 | 09D20110606SGR | 363.77 | 0.13 |
| 13520 | 7482435.131 | 624103.964 | 366.43 | 09D20110606SGR | 366.33 | 0.10 |
| 13521 | 7482449.746 | 624098.475 | 366.72 | 09D20110606SGR | 366.57 | 0.15 |
| 13522 | 7482463.761 | 624090.714 | 367.11 | 09D20110606SGR | 366.99 | 0.12 |
| 13523 | 7482477.446 | 624082.982 | 367.56 | 09D20110606SGR | 367.42 | 0.13 |
| 13524 | 7482492.156 | 624075.867 | 368.06 | 09D20110606SGR | 367.92 | 0.14 |
| 13525 | 7482507.357 | 624072.039 | 368.27 | 09D20110606SGR | 368.13 | 0.13 |
| 13526 | 7482521.605 | 624069.723 | 368.31 | 09D20110606SGR | 368.19 | 0.12 |
| 13527 | 7482536.87 | 624068.57 | 368.34 | 09D20110606SGR | 368.20 | 0.14 |
| 13528 | 7482927.074 | 624442.346 | 367.23 | 09D20110606SGR | 367.15 | 0.08 |
| 13529 | 7482938.658 | 624453.281 | 367.43 | 09D20110606SGR | 367.31 | 0.12 |
| 13530 | 7482951.685 | 624462.988 | 367.49 | 09D20110606SGR | 367.36 | 0.13 |
| 13531 | 7482965.143 | 624472.99 | 367.55 | 09D20110606SGR | 367.45 | 0.10 |
| 13532 | 7482976.802 | 624484.213 | 367.71 | 09D20110606SGR | 367.56 | 0.15 |
| 13533 | 7482986.648 | 624495.924 | 367.82 | 09D20110606SGR | 367.69 | 0.13 |
| 13534 | 7482994.831 | 624510.559 | 367.93 | 09D20110606SGR | 367.80 | 0.13 |
| 13535 | 7483100.319 | 624881.769 | 369.72 | 09D20110606SGR | 369.61 | 0.11 |
| 13536 | 7483114.711 | 624889.72 | 369.62 | 09D20110606SGR | 369.52 | 0.10 |
| 13537 | 7483128.82 | 624897.09 | 369.51 | 09D20110606SGR | 369.40 | 0.11 |
| 13538 | 7483142.472 | 624901.734 | 369.43 | 09D20110606SGR | 369.35 | 0.08 |
| 13539 | 7483158.028 | 624905.964 | 369.49 | 09D20110606SGR | 369.40 | 0.09 |
| 13540 | 7483172.885 | 624909.08 | 369.56 | 09D20110606SGR | 369.46 | 0.10 |
| 13541 | 7483187.248 | 624913.027 | 369.65 | 09D20110606SGR | 369.56 | 0.08 |
| 13542 | 7480697.591 | 625706.628 | 405.60 | 09D20110606CHECK | 405.46 | 0.14 |
| 13543 | 7480697.591 | 625706.617 | 405.57 | 09D20110606CHECK | 405.46 | 0.11 |
| 13544 | 7481590.686 | 625128.775 | 380.80 | 09D20110606SPR | 380.73 | 0.07 |
| 13545 | 7481606.126 | 625130.788 | 380.92 | 09D20110606SPR | 380.82 | 0.10 |
| 13546 | 7481621.069 | 625132.618 | 381.06 | 09D20110606SPR | 380.99 | 0.07 |
| 13547 | 7481636.397 | 625134.406 | 381.23 | 09D20110606SPR | 381.15 | 0.08 |
| 13548 | 7481651.229 | 625136.403 | 381.42 | 09D20110606SPR | 381.35 | 0.07 |
| 13549 | 7481666.276 | 625138.475 | 381.64 | 09D20110606SPR | 381.57 | 0.07 |
| 13550 | 7481682.804 | 625140.075 | 381.90 | 09D20110606SPR | 381.82 | 0.08 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13551 | 7481589.01 | 625088.258 | 379.94 | 09D20110606SGR | 379.87 | 0.07 |
| 13552 | 7481595.291 | 625057.556 | 379.99 | 09D20110606SGR | 379.88 | 0.11 |
| 13553 | 7481606.967 | 625025.571 | 379.93 | 09D20110606SGR | 379.84 | 0.09 |
| 13554 | 7481618.833 | 624996.105 | 379.20 | 09D20110606SGR | 379.13 | 0.07 |
| 13555 | 7481630.991 | 624967.245 | 378.72 | 09D20110606SGR | 378.61 | 0.11 |
| 13556 | 7481644.273 | 624937.14 | 378.53 | 09D20110606SGR | 378.44 | 0.09 |
| 13557 | 7481657.119 | 624907.444 | 378.42 | 09D20110606SGR | 378.34 | 0.08 |
| 13558 | 7481663.907 | 624874.492 | 377.68 | 09D20110606SGR | 377.57 | 0.11 |
| 13559 | 7481669.586 | 624841.728 | 377.44 | 09D20110606SGR | 377.35 | 0.09 |
| 13560 | 7481672.562 | 624805.585 | 377.73 | 09D20110606SGR | 377.66 | 0.07 |
| 13561 | 7481676.55 | 624776.073 | 377.74 | 09D20110606SGR | 377.66 | 0.08 |
| 13562 | 7482355.696 | 625223.053 | 388.24 | 09D20110606SPR | 388.14 | 0.10 |
| 13563 | 7482371.249 | 625225.193 | 388.06 | 09D20110606SPR | 387.97 | 0.08 |
| 13564 | 7482387.284 | 625227.154 | 387.83 | 09D20110606SPR | 387.74 | 0.09 |
| 13565 | 7482402.481 | 625228.977 | 387.57 | 09D20110606SPR | 387.45 | 0.12 |
| 13566 | 7482418.492 | 625231.024 | 387.27 | 09D20110606SPR | 387.17 | 0.10 |
| 13567 | 7482434.263 | 625232.95 | 386.92 | 09D20110606SPR | 386.84 | 0.08 |
| 13568 | 7482450.121 | 625234.78 | 386.56 | 09D20110606SPR | 386.48 | 0.08 |
| 13569 | 7482998.15 | 625124.636 | 370.57 | 09D20110606SPR | 370.44 | 0.13 |
| 13570 | 7482985.717 | 625132.634 | 370.81 | 09D20110606SPR | 370.67 | 0.14 |
| 13571 | 7482972.867 | 625141.15 | 371.13 | 09D20110606SPR | 371.02 | 0.11 |
| 13572 | 7482960.121 | 625149.315 | 371.51 | 09D20110606SPR | 371.43 | 0.08 |
| 13573 | 7482947.521 | 625157.551 | 371.96 | 09D20110606SPR | 371.87 | 0.09 |
| 13574 | 7482934.896 | 625165.864 | 372.49 | 09D20110606SPR | 372.40 | 0.09 |
| 13575 | 7482922.485 | 625174.356 | 373.10 | 09D20110606SPR | 373.01 | 0.09 |
| 13576 | 7481060.439 | 623809.941 | 362.16 | 09D20110606SGR | 362.06 | 0.10 |
| 13577 | 7481044.927 | 623810.422 | 362.11 | 09D20110606SGR | 362.00 | 0.11 |
| 13578 | 7481030.057 | 623811.58 | 361.98 | 09D20110606SGR | 361.91 | 0.07 |
| 13579 | 7481014.108 | 623812.688 | 361.86 | 09D20110606SGR | 361.74 | 0.12 |
| 13580 | 7480997.294 | 623813.474 | 361.74 | 09D20110606SGR | 361.64 | 0.10 |
| 13581 | 7480979.861 | 623813.163 | 361.71 | 09D20110606SGR | 361.61 | 0.10 |
| 13582 | 7480965.217 | 623811.833 | 361.84 | 09D20110606SGR | 361.73 | 0.11 |
| 13583 | 7480341.082 | 623821.788 | 360.78 | 09D20110606SGR | 360.67 | 0.11 |
| 13584 | 7480325.119 | 623827.222 | 360.70 | 09D20110606SGR | 360.63 | 0.07 |
| 13585 | 7480310.674 | 623834.021 | 360.61 | 09D20110606SGR | 360.50 | 0.11 |
| 13586 | 7480295.09 | 623840.421 | 360.53 | 09D20110606SGR | 360.44 | 0.09 |
| 13587 | 7480279.859 | 623848.73 | 360.43 | 09D20110606SGR | 360.33 | 0.10 |
| 13588 | 7480264.701 | 623855.732 | 360.36 | 09D20110606SGR | 360.30 | 0.06 |
| 13589 | 7480248.624 | 623862.756 | 360.28 | 09D20110606SGR | 360.16 | 0.12 |
| 13590 | 7480235.167 | 623870.67 | 360.27 | 09D20110606SGR | 360.18 | 0.08 |
| 13591 | 7480221.865 | 623876.755 | 360.30 | 09D20110606SGR | 360.20 | 0.10 |
| 13592 | 7480206.707 | 623881.908 | 360.37 | 09D20110606SGR | 360.29 | 0.08 |
| 13593 | 7480189.922 | 623876.566 | 360.53 | 09D20110606SGR | 360.44 | 0.09 |
| 13594 | 7480130.178 | 623843.759 | 362.35 | 09D20110606SGR | 362.24 | 0.11 |
| 13595 | 7480113.957 | 623843.699 | 362.32 | 09D20110606SGR | 362.22 | 0.10 |
| 13596 | 7480099.058 | 623845.165 | 362.32 | 09D20110606SGR | 362.23 | 0.09 |
| 13597 | 7480081.258 | 623848.114 | 361.95 | 09D20110606SGR | 361.87 | 0.08 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13598 | 7480071.022 | 623850.459 | 361.92 | 09D20110606SGR | 361.80 | 0.12 |
| 13599 | 7479649.166 | 623662.984 | 360.41 | 09D20110606SGR | 360.31 | 0.10 |
| 13600 | 7479635.022 | 623640.408 | 360.19 | 09D20110606SGR | 360.04 | 0.15 |
| 13601 | 7479625.606 | 623627.895 | 360.12 | 09D20110606SGR | 360.00 | 0.12 |
| 13602 | 7479615.52 | 623616.257 | 360.05 | 09D20110606SGR | 359.94 | 0.11 |
| 13603 | 7479602.671 | 623602.617 | 359.96 | 09D20110606SGR | 359.85 | 0.11 |
| 13604 | 7479591.03 | 623590.526 | 359.87 | 09D20110606SGR | 359.78 | 0.09 |
| 13605 | 7479581.442 | 623578.139 | 359.73 | 09D20110606SGR | 359.63 | 0.10 |
| 13606 | 7479568.069 | 623567.83 | 359.63 | 09D20110606SGR | 359.52 | 0.11 |
| 13607 | 7479555.514 | 623555.46 | 359.58 | 09D20110606SGR | 359.48 | 0.10 |
| 13608 | 7479542.354 | 623543.464 | 359.50 | 09D20110606SGR | 359.42 | 0.08 |
| 13609 | 7479531.465 | 623530.882 | 359.46 | 09D20110606SGR | 359.37 | 0.09 |
| 13610 | 7479515.648 | 623517.252 | 359.30 | 09D20110606SGR | 359.17 | 0.13 |
| 13611 | 7479503.958 | 623504.298 | 359.22 | 09D20110606SGR | 359.10 | 0.12 |
| 13612 | 7479491.69 | 623493.185 | 359.12 | 09D20110606SGR | 359.02 | 0.10 |
| 13613 | 7479480.65 | 623480.765 | 359.06 | 09D20110606SGR | 358.96 | 0.10 |
| 13614 | 7479469.172 | 623469.592 | 358.96 | 09D20110606SGR | 358.87 | 0.09 |
| 13615 | 7479457.152 | 623458.11 | 358.81 | 09D20110606SGR | 358.73 | 0.08 |
| 13616 | 7479444.651 | 623445.706 | 358.69 | 09D20110606SGR | 358.59 | 0.10 |
| 13617 | 7479432.632 | 623433.464 | 358.63 | 09D20110606SGR | 358.56 | 0.07 |
| 13618 | 7479418.803 | 623422.121 | 358.53 | 09D20110606SGR | 358.44 | 0.09 |
| 13619 | 7479407.932 | 623410.363 | 358.51 | 09D20110606SGR | 358.39 | 0.12 |
| 13620 | 7479395.218 | 623397.621 | 358.49 | 09D20110606SGR | 358.37 | 0.12 |
| 13621 | 7479384.203 | 623387.789 | 358.42 | 09D20110606SGR | 358.32 | 0.10 |
| 13622 | 7480697.596 | 625706.618 | 405.56 | 09D20110606CHECK | 405.46 | 0.10 |
| 13623 | 7480697.597 | 625706.614 | 405.57 | 09D20110606CHECK | 405.46 | 0.11 |
| 13700 | 7483342.851 | 625046.838 | 371.29 | 09C2011060709CFAC | 371.21 | 0.08 |
| 13729 | 7486693.552 | 628529.046 | 379.85 | 09C20110607SPR | 379.76 | 0.09 |
| 13730 | 7486687.873 | 628513.078 | 379.78 | 09C20110607SPR | 379.72 | 0.06 |
| 13731 | 7486682.343 | 628497.283 | 379.70 | 09C20110607SPR | 379.66 | 0.04 |
| 13732 | 7486676.435 | 628480.83 | 379.65 | 09C20110607SPR | 379.57 | 0.08 |
| 13733 | 7486670.989 | 628465.324 | 379.61 | 09C20110607SPR | 379.58 | 0.03 |
| 13734 | 7486665.559 | 628450.166 | 379.61 | 09C20110607SPR | 379.54 | 0.07 |
| 13735 | 7486660.136 | 628434.872 | 379.61 | 09C20110607SPR | 379.51 | 0.10 |
| 13736 | 7486232.884 | 627915.146 | 379.13 | 09C20110607SPR | 379.05 | 0.08 |
| 13737 | 7486221.68 | 627902.258 | 379.04 | 09C20110607SPR | 379.01 | 0.03 |
| 13738 | 7486211.003 | 627888.589 | 378.96 | 09C20110607SPR | 378.96 | 0.00 |
| 13739 | 7486200.334 | 627875.063 | 378.97 | 09C20110607SPR | 378.95 | 0.02 |
| 13740 | 7486189.791 | 627859.882 | 378.98 | 09C20110607SPR | 378.92 | 0.06 |
| 13741 | 7486180.565 | 627845.779 | 378.98 | 09C20110607SPR | 378.94 | 0.04 |
| 13742 | 7486172.799 | 627832.267 | 378.98 | 09C20110607SPR | 378.98 | 0.00 |
| 13743 | 7485928.783 | 627138.873 | 377.39 | 09C20110607SPR | 377.30 | 0.09 |
| 13744 | 7485921.678 | 627122.426 | 377.28 | 09C20110607SPR | 377.19 | 0.09 |
| 13745 | 7485915.367 | 627107.241 | 377.17 | 09C20110607SPR | 377.08 | 0.09 |
| 13746 | 7485908.332 | 627089.597 | 376.99 | 09C20110607SPR | 376.92 | 0.07 |
| 13747 | 7485901.734 | 627074.032 | 376.80 | 09C20110607SPR | 376.68 | 0.12 |
| 13748 | 7485895.201 | 627058.469 | 376.60 | 09C20110607SPR | 376.49 | 0.11 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13749 | 7485888.897 | 627042.857 | 376.42 | 09C20110607SPR | 376.33 | 0.09 |
| 13750 | 7485552.465 | 626458.456 | 375.34 | 09C20110607SPR | 375.25 | 0.09 |
| 13751 | 7485540.317 | 626446.496 | 375.30 | 09C20110607SPR | 375.22 | 0.08 |
| 13752 | 7485528.957 | 626434.786 | 375.29 | 09C20110607SPR | 375.20 | 0.09 |
| 13753 | 7485517.039 | 626423.044 | 375.25 | 09C20110607SPR | 375.19 | 0.06 |
| 13754 | 7485505.458 | 626411.695 | 375.22 | 09C20110607SPR | 375.17 | 0.05 |
| 13755 | 7485493.774 | 626399.836 | 375.20 | 09C20110607SPR | 375.12 | 0.08 |
| 13756 | 7485482.199 | 626388.401 | 375.16 | 09C20110607SPR | 375.11 | 0.05 |
| 13757 | 7484444.653 | 625546.08 | 373.30 | 09C20110607SPR | 373.21 | 0.09 |
| 13758 | 7484430.475 | 625537.829 | 373.24 | 09C20110607SPR | 373.15 | 0.09 |
| 13759 | 7484415.886 | 625529.729 | 373.16 | 09C20110607SPR | 373.07 | 0.09 |
| 13760 | 7484401.111 | 625521.492 | 373.09 | 09C20110607SPR | 372.95 | 0.14 |
| 13761 | 7484386.841 | 625513.72 | 373.04 | 09C20110607SPR | 372.95 | 0.09 |
| 13762 | 7484372.349 | 625505.852 | 372.97 | 09C20110607SPR | 372.86 | 0.10 |
| 13763 | 7484358.638 | 625498.689 | 372.90 | 09C20110607SPR | 372.83 | 0.07 |
| 13764 | 7484344.242 | 625490.868 | 372.88 | 09C20110607SPR | 372.79 | 0.09 |
| 13765 | 7483345.441 | 625039.936 | 371.48 | 09C20110607CHECK | 371.41 | 0.07 |
| 13766 | 7483345.433 | 625039.94 | 371.48 | 09C20110607CHECK | 371.41 | 0.07 |
| 13767 | 7483345.442 | 625039.939 | 371.50 | 09C20110607CHECK | 371.41 | 0.09 |
| 13800 | 7417499.409 | 606819.516 | 313.91 | 11A2011060411AFAC | 313.90 | 0.01 |
| 13801 | 7434569.303 | 618327.199 | 403.68 | 11A20110604SGR | 403.62 | 0.06 |
| 13802 | 7435956.571 | 617985.411 | 328.15 | 11A20110604SGR | 328.10 | 0.05 |
| 13803 | 7436104.751 | 618054.891 | 328.46 | 11A20110604SGR | 328.41 | 0.04 |
| 13804 | 7437739.008 | 617357.43 | 460.30 | 11A20110604SGR | 460.19 | 0.11 |
| 13805 | 7438255.859 | 617316.411 | 493.77 | 11A20110604SGR | 493.68 | 0.09 |
| 13806 | 7438148.946 | 617182.52 | 469.14 | 11A20110604SGR | 469.04 | 0.10 |
| 13900 | 7383552.661 | 597111.551 | 341.98 | 12B2011060312BFAC | 342.01 | -0.03 |
| 13901 | 7401551 | 602923.454 | 285.47 | 12B20110603SGR | 285.43 | 0.04 |
| 13902 | 7401787.697 | 602949.707 | 296.95 | 12B20110603SGR | 296.92 | 0.03 |
| 13903 | 7400015.343 | 602971.01 | 308.75 | 12B20110603SGR | 308.78 | -0.03 |
| 13904 | 7401896.314 | 602636.745 | 309.48 | 12B20110603SGR | 309.51 | -0.03 |
| 14000 | 7386759.737 | 599279.655 | 491.27 | 12A2011060212AFAC | 491.17 | 0.10 |
| 14001 | 7386771.81 | 599269.388 | 492.80 | 12A20110602SPR | 492.74 | 0.06 |
| 14002 | 7386783.26 | 599281.761 | 493.61 | 12A20110602SPR | 493.52 | 0.09 |
| 14003 | 7386788.506 | 599295.342 | 494.38 | 12A20110602SPR | 494.29 | 0.09 |
| 14004 | 7386794.095 | 599308.683 | 495.22 | 12A20110602SPR | 495.14 | 0.08 |
| 14005 | 7386799.424 | 599322.534 | 496.06 | 12A20110602SPR | 496.00 | 0.06 |
| 14006 | 7386803.909 | 599338.629 | 497.03 | 12A20110602SPR | 496.96 | 0.07 |
| 14007 | 7386810.584 | 599351.145 | 497.72 | 12A20110602SPR | 497.63 | 0.09 |
| 14008 | 7387040.524 | 599886.992 | 507.12 | 12A20110602SPR | 507.08 | 0.04 |
| 14009 | 7387046.952 | 599900.265 | 506.89 | 12A20110602SPR | 506.82 | 0.07 |
| 14010 | 7387054.143 | 599914.809 | 506.58 | 12A20110602SPR | 506.53 | 0.05 |
| 14011 | 7387059.903 | 599928.894 | 506.32 | 12A20110602SPR | 506.31 | 0.01 |
| 14012 | 7387060.213 | 599942.268 | 506.05 | 12A20110602SPR | 506.01 | 0.04 |
| 14013 | 7387066.423 | 599955.353 | 505.71 | 12A20110602SPR | 505.70 | 0.01 |
| 14014 | 7387073.459 | 599968.738 | 505.34 | 12A20110602SPR | 505.34 | 0.00 |
| 14015 | 7386727.064 | 599282.376 | 489.82 | 12A20110602SGR | 489.74 | 0.08 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14016 | 7386687.224 | 599298.143 | 488.69 | 12A20110602SGR | 488.62 | 0.07 |
| 14017 | 7386646.58 | 599313.728 | 487.42 | 12A20110602SGR | 487.32 | 0.10 |
| 14018 | 7386618.796 | 599325.16 | 486.77 | 12A20110602SGR | 486.62 | 0.15 |
| 14019 | 7386587.6 | 599332.117 | 486.10 | 12A20110602SGR | 485.97 | 0.13 |
| 14020 | 7386559.794 | 599343.458 | 485.89 | 12A20110602SGR | 485.77 | 0.12 |
| 14021 | 7386532.133 | 599357.331 | 485.99 | 12A20110602SGR | 485.83 | 0.16 |
| 14022 | 7386504.399 | 599370.231 | 485.80 | 12A20110602SGR | 485.66 | 0.14 |
| 14023 | 7386476.679 | 599386.202 | 486.16 | 12A20110602SGR | 486.04 | 0.12 |
| 14024 | 7386450.346 | 599402.512 | 486.92 | 12A20110602SGR | 486.78 | 0.14 |
| 14025 | 7386418.894 | 599423.394 | 488.14 | 12A20110602SGR | 488.05 | 0.09 |
| 14026 | 7386384.183 | 599444.67 | 489.57 | 12A20110602SGR | 489.50 | 0.07 |
| 14027 | 7386357.568 | 599466.139 | 491.02 | 12A20110602SGR | 490.91 | 0.11 |
| 14028 | 7386330.036 | 599484.075 | 492.76 | 12A20110602SGR | 492.68 | 0.08 |
| 14029 | 7386295.739 | 599497.675 | 495.00 | 12A20110602SGR | 494.91 | 0.08 |
| 14030 | 7386267.773 | 599522.664 | 497.05 | 12A20110602SGR | 496.94 | 0.11 |
| 14031 | 7386237.804 | 599541.948 | 498.73 | 12A20110602SGR | 498.65 | 0.08 |
| 14032 | 7386208.362 | 599558.06 | 500.04 | 12A20110602SGR | 499.94 | 0.10 |
| 14033 | 7386179.153 | 599574.108 | 501.40 | 12A20110602SGR | 501.31 | 0.09 |
| 14034 | 7386150.694 | 599589.419 | 502.61 | 12A20110602SGR | 502.54 | 0.07 |
| 14035 | 7386123.668 | 599606.326 | 503.79 | 12A20110602SGR | 503.73 | 0.06 |
| 14036 | 7386095.989 | 599624.565 | 505.37 | 12A20110602SGR | 505.31 | 0.06 |
| 14037 | 7386068.669 | 599641.355 | 507.01 | 12A20110602SGR | 506.94 | 0.07 |
| 14038 | 7386040.481 | 599660.634 | 508.63 | 12A20110602SGR | 508.55 | 0.08 |
| 14039 | 7386018.11 | 599683.8 | 509.44 | 12A20110602SGR | 509.36 | 0.08 |
| 14040 | 7386003.989 | 599712.299 | 509.92 | 12A20110602SGR | 509.85 | 0.06 |
| 14041 | 7386005.169 | 599745.487 | 510.48 | 12A20110602SGR | 510.40 | 0.08 |
| 14042 | 7386004.832 | 599780.292 | 512.90 | 12A20110602SGR | 512.84 | 0.06 |
| 14043 | 7386016.655 | 599820.952 | 516.30 | 12A20110602SGR | 516.23 | 0.07 |
| 14044 | 7386023.422 | 599861.943 | 518.87 | 12A20110602SGR | 518.81 | 0.06 |
| 14045 | 7386021.319 | 599894.748 | 520.00 | 12A20110602SGR | 519.96 | 0.04 |
| 14046 | 7386020.275 | 599928.956 | 520.29 | 12A20110602SGR | 520.25 | 0.04 |
| 14047 | 7386018.85 | 599961.334 | 520.39 | 12A20110602SGR | 520.32 | 0.07 |
| 14048 | 7386016.855 | 599998.269 | 522.34 | 12A20110602SGR | 522.31 | 0.03 |
| 14049 | 7386028.887 | 600029.823 | 525.44 | 12A20110602SGR | 525.40 | 0.04 |
| 14050 | 7386056.941 | 600065.961 | 531.28 | 12A20110602SGR | 531.22 | 0.06 |
| 14051 | 7386082.281 | 600103.386 | 535.86 | 12A20110602SGR | 535.83 | 0.03 |
| 14052 | 7386107.908 | 600137.675 | 538.86 | 12A20110602SGR | 538.83 | 0.02 |
| 14053 | 7386127.003 | 600179.839 | 541.72 | 12A20110602SGR | 541.70 | 0.02 |
| 14054 | 7386135.691 | 600223.453 | 543.59 | 12A20110602SGR | 543.56 | 0.03 |
| 14055 | 7386134.228 | 600271.98 | 543.07 | 12A20110602SGR | 543.00 | 0.07 |
| 14056 | 7386127.707 | 600323.265 | 543.29 | 12A20110602SGR | 543.23 | 0.06 |
| 14057 | 7386123.905 | 600356.77 | 543.44 | 12A20110602SGR | 543.39 | 0.05 |
| 14058 | 7386117.236 | 600423.488 | 544.09 | 12A20110602SGR | 544.10 | -0.01 |
| 14059 | 7386100.058 | 600529.83 | 546.05 | 12A20110602SGR | 546.02 | 0.03 |
| 14060 | 7386768.153 | 599272.119 | 492.58 | 12A20110602CHECK | 492.51 | 0.07 |
| 14061 | 7386768.14 | 599272.123 | 492.59 | 12A20110602CHECK | 492.51 | 0.08 |
| 14100 | 7383552.661 | 597111.551 | 341.98 | 12B2011060112BFAC | 342.01 | -0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14101 | 7383554.159 | 597106.195 | 342.08 | 12B20110601CHECK,SPR | 342.09 | -0.01 |
| 14102 | 7383557.344 | 597086.806 | 342.02 | 12B20110601SPR | 342.02 | 0.00 |
| 14103 | 7383573.677 | 597078.867 | 342.02 | 12B20110601SPR | 342.02 | 0.00 |
| 14104 | 7383586.286 | 597071.027 | 341.85 | 12B20110601SPR | 341.85 | 0.00 |
| 14105 | 7383600.243 | 597063.3 | 341.58 | 12B20110601SPR | 341.59 | -0.01 |
| 14106 | 7383614.342 | 597056.483 | 341.32 | 12B20110601SPR | 341.31 | 0.01 |
| 14107 | 7383628.634 | 597048.808 | 341.04 | 12B20110601SPR | 341.04 | 0.00 |
| 14108 | 7383646.058 | 597059.995 | 341.63 | 12B20110601SPR | 341.65 | -0.02 |
| 14109 | 7383660.558 | 597083.62 | 343.75 | 12B20110601SGR | 343.74 | 0.01 |
| 14110 | 7383676.5 | 597111.198 | 345.75 | 12B20110601SGR | 345.75 | 0.00 |
| 14111 | 7383688.619 | 597140.193 | 347.79 | 12B20110601SGR | 347.80 | -0.01 |
| 14112 | 7383659.259 | 597145.68 | 347.45 | 12B20110601SGR | 347.43 | 0.02 |
| 14113 | 7383630.575 | 597158.624 | 348.06 | 12B20110601SGR | 348.07 | -0.01 |
| 14114 | 7383605.44 | 597177.42 | 348.84 | 12B20110601SGR | 348.83 | 0.01 |
| 14115 | 7383573.217 | 597192.875 | 349.45 | 12B20110601SGR | 349.44 | 0.00 |
| 14116 | 7383541.998 | 597198.967 | 348.84 | 12B20110601SGR | 348.83 | 0.01 |
| 14117 | 7383509.587 | 597195.348 | 346.75 | 12B20110601SGR | 346.76 | -0.01 |
| 14118 | 7383477.997 | 597194.216 | 343.76 | 12B20110601SGR | 343.76 | 0.00 |
| 14119 | 7383445.86 | 597189.624 | 340.63 | 12B20110601SGR | 340.64 | -0.01 |
| 14120 | 7383429.497 | 597173.819 | 339.00 | 12B20110601SGR | 338.99 | 0.01 |
| 14121 | 7383676.34 | 597399.755 | 367.03 | 12B20110601SGR | 366.99 | 0.04 |
| 14122 | 7383683.801 | 597414.056 | 368.33 | 12B20110601SGR | 368.31 | 0.02 |
| 14123 | 7383692.65 | 597430.149 | 369.66 | 12B20110601SGR | 369.65 | 0.00 |
| 14124 | 7383701.369 | 597454.369 | 371.63 | 12B20110601SGR | 371.61 | 0.02 |
| 14125 | 7383711.968 | 597474.271 | 373.12 | 12B20110601SGR | 373.07 | 0.05 |
| 14126 | 7383723.986 | 597488.422 | 373.66 | 12B20110601SGR | 373.62 | 0.04 |
| 14127 | 7383727.531 | 597504.91 | 374.85 | 12B20110601SGR | 374.80 | 0.05 |
| 14128 | 7384006.826 | 598031.402 | 408.81 | 12B20110601SGR | 408.83 | -0.02 |
| 14129 | 7384035.316 | 598084.924 | 412.37 | 12B20110601SGR | 412.36 | 0.01 |
| 14130 | 7384049.448 | 598112.735 | 414.47 | 12B20110601SGR | 414.45 | 0.02 |
| 14131 | 7384065.926 | 598143.477 | 416.67 | 12B20110601SGR | 416.63 | 0.04 |
| 14132 | 7384081.81 | 598175.117 | 418.59 | 12B20110601SGR | 418.55 | 0.03 |
| 14133 | 7384098.838 | 598211.024 | 420.69 | 12B20110601SGR | 420.65 | 0.04 |
| 14134 | 7384130.732 | 598267.458 | 423.91 | 12B20110601SGR | 423.89 | 0.02 |
| 14135 | 7384146.832 | 598297.882 | 425.67 | 12B20110601SGR | 425.65 | 0.02 |
| 14136 | 7384162.707 | 598328.543 | 427.21 | 12B20110601SGR | 427.17 | 0.04 |
| 14137 | 7384180.547 | 598367.286 | 428.64 | 12B20110601SGR | 428.57 | 0.06 |
| 14138 | 7384215.385 | 598430.737 | 431.28 | 12B20110601SGR | 431.20 | 0.08 |
| 14139 | 7384228.191 | 598459.029 | 432.35 | 12B20110601SGR | 432.31 | 0.04 |
| 14140 | 7384233.48 | 598488.933 | 433.76 | 12B20110601SGR | 433.68 | 0.08 |
| 14141 | 7384235.369 | 598523.326 | 435.66 | 12B20110601SGR | 435.62 | 0.04 |
| 14142 | 7384229.692 | 598561.215 | 438.09 | 12B20110601SGR | 438.02 | 0.07 |
| 14143 | 7384226.638 | 598594.001 | 440.17 | 12B20110601SGR | 440.11 | 0.06 |
| 14144 | 7384221.39 | 598625.434 | 442.08 | 12B20110601SGR | 442.03 | 0.05 |
| 14145 | 7384219.551 | 598659.949 | 444.08 | 12B20110601SGR | 444.04 | 0.04 |
| 14146 | 7384214.398 | 598692.127 | 446.09 | 12B20110601SGR | 445.99 | 0.10 |
| 14147 | 7384211.583 | 598729.619 | 448.18 | 12B20110601SGR | 448.15 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14148 | 7384206.753 | 598764.566 | 449.91 | 12B20110601SGR | 449.88 | 0.03 |
| 14149 | 7384197.447 | 598826.008 | 452.89 | 12B20110601SGR | 452.83 | 0.06 |
| 14150 | 7384193.904 | 598857.091 | 454.13 | 12B20110601SGR | 454.08 | 0.05 |
| 14151 | 7384307.103 | 596989.392 | 320.83 | 12B20110601SPR | 320.83 | 0.00 |
| 14152 | 7384291.475 | 596983.073 | 321.28 | 12B20110601SPR | 321.28 | 0.00 |
| 14153 | 7384276.231 | 596976.866 | 321.77 | 12B20110601SPR | 321.75 | 0.02 |
| 14154 | 7384261.435 | 596970.732 | 322.24 | 12B20110601SPR | 322.23 | 0.01 |
| 14155 | 7384245.67 | 596964.306 | 322.71 | 12B20110601SPR | 322.71 | 0.00 |
| 14156 | 7384229.331 | 596958.093 | 323.14 | 12B20110601SPR | 323.15 | -0.01 |
| 14157 | 7384213.862 | 596952.414 | 323.65 | 12B20110601SPR | 323.65 | 0.00 |
| 14158 | 7386331.761 | 598605.038 | 435.42 | 12B20110601SPR | 435.36 | 0.06 |
| 14159 | 7386344.608 | 598615.916 | 436.54 | 12B20110601SPR | 436.48 | 0.06 |
| 14160 | 7386357.386 | 598625.522 | 437.59 | 12B20110601SPR | 437.54 | 0.05 |
| 14161 | 7386370.909 | 598636.433 | 438.87 | 12B20110601SPR | 438.82 | 0.05 |
| 14162 | 7386383.463 | 598646.407 | 440.05 | 12B20110601SPR | 440.01 | 0.04 |
| 14163 | 7386395.825 | 598656.488 | 441.25 | 12B20110601SPR | 441.18 | 0.06 |
| 14164 | 7386372.189 | 598640.143 | 439.19 | 12B20110601SPR | 439.12 | 0.07 |
| 14165 | 7385698.999 | 598025.413 | 383.76 | 12B20110601SPR | 383.72 | 0.03 |
| 14166 | 7385708.49 | 598039.196 | 384.38 | 12B20110601SPR | 384.36 | 0.02 |
| 14167 | 7385718.044 | 598053.895 | 385.05 | 12B20110601SPR | 385.01 | 0.04 |
| 14168 | 7385730.748 | 598072.862 | 385.87 | 12B20110601SPR | 385.85 | 0.02 |
| 14169 | 7385688.151 | 598018.905 | 383.25 | 12B20110601SPR | 383.23 | 0.02 |
| 14170 | 7385678.476 | 598003.547 | 382.60 | 12B20110601SPR | 382.53 | 0.07 |
| 14171 | 7385669.634 | 597990.301 | 382.02 | 12B20110601SPR | 381.94 | 0.08 |
| 14172 | 7385278.127 | 597424.333 | 331.36 | 12B20110601SPR | 331.33 | 0.03 |
| 14173 | 7385289.551 | 597435.683 | 332.80 | 12B20110601SPR | 332.79 | 0.01 |
| 14174 | 7385300.845 | 597447.75 | 334.28 | 12B20110601SPR | 334.26 | 0.02 |
| 14175 | 7385313.41 | 597457.644 | 335.80 | 12B20110601SPR | 335.79 | 0.01 |
| 14176 | 7385322.474 | 597469.816 | 337.13 | 12B20110601SPR | 337.13 | 0.00 |
| 14177 | 7385334.849 | 597480.033 | 338.68 | 12B20110601SPR | 338.68 | 0.00 |
| 14178 | 7385349.357 | 597497.431 | 340.68 | 12B20110601SPR | 340.69 | -0.01 |
| 14179 | 7382704.189 | 597553.8 | 289.56 | 12B20110601SPR | 289.57 | -0.01 |
| 14180 | 7382717.375 | 597546.778 | 290.48 | 12B20110601SPR | 290.49 | -0.01 |
| 14181 | 7382732.628 | 597538.304 | 291.67 | 12B20110601SPR | 291.65 | 0.02 |
| 14182 | 7382747.104 | 597530.646 | 292.69 | 12B20110601SPR | 292.68 | 0.01 |
| 14183 | 7382761.492 | 597522.351 | 293.65 | 12B20110601SPR | 293.65 | 0.00 |
| 14184 | 7382776.046 | 597514.62 | 294.65 | 12B20110601SPR | 294.65 | 0.00 |
| 14185 | 7382790.678 | 597506.865 | 295.72 | 12B20110601SPR | 295.71 | 0.01 |
| 14186 | 7381576.32 | 598013.637 | 260.64 | 12B20110601SPR | 260.64 | 0.00 |
| 14187 | 7381560.696 | 598019.035 | 261.37 | 12B20110601SPR | 261.39 | -0.02 |
| 14188 | 7381544.842 | 598029.866 | 262.48 | 12B20110601SPR | 262.51 | -0.03 |
| 14189 | 7381528.493 | 598036.019 | 263.45 | 12B20110601SPR | 263.47 | -0.02 |
| 14190 | 7381513.234 | 598041.224 | 264.33 | 12B20110601SPR | 264.35 | -0.02 |
| 14191 | 7381496.406 | 598047.19 | 265.16 | 12B20110601SPR | 265.15 | 0.01 |
| 14192 | 7381481.414 | 598052.99 | 265.86 | 12B20110601SPR | 265.86 | 0.00 |
| 14193 | 7381066.506 | 598298.355 | 275.99 | 12B20110601SPR | 275.98 | 0.01 |
| 14194 | 7381054.472 | 598309.455 | 276.00 | 12B20110601SPR | 276.01 | -0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14195 | 7381042.68 | 598321.049 | 275.96 | 12B20110601SPR | 275.97 | -0.01 |
| 14196 | 7381030.166 | 598332.322 | 275.89 | 12B20110601SPR | 275.91 | -0.02 |
| 14197 | 7381017.845 | 598343.723 | 275.81 | 12B20110601SPR | 275.82 | -0.01 |
| 14198 | 7381002.731 | 598353.441 | 275.70 | 12B20110601SPR | 275.69 | 0.01 |
| 14199 | 7380989.53 | 598371.039 | 275.61 | 12B20110601SPR | 275.62 | -0.01 |
| 14200 | 7380323.315 | 598997.437 | 281.48 | 12B20110601SPR | 281.47 | 0.01 |
| 14201 | 7380334.441 | 598985.559 | 281.40 | 12B20110601SPR | 281.37 | 0.03 |
| 14202 | 7380346.713 | 598974.389 | 281.25 | 12B20110601SPR | 281.21 | 0.04 |
| 14203 | 7380359.214 | 598961.665 | 281.10 | 12B20110601SPR | 281.08 | 0.02 |
| 14204 | 7380372.951 | 598949.018 | 280.98 | 12B20110601SPR | 280.95 | 0.03 |
| 14205 | 7380386.054 | 598936.301 | 280.88 | 12B20110601SPR | 280.86 | 0.02 |
| 14206 | 7380397.079 | 598925.885 | 280.79 | 12B20110601SPR | 280.75 | 0.04 |
| 14207 | 7379459.747 | 599823.605 | 302.09 | 12B20110601SPR | 302.07 | 0.02 |
| 14208 | 7379448.242 | 599834.567 | 302.51 | 12B20110601SPR | 302.48 | 0.03 |
| 14209 | 7379435.006 | 599844.925 | 303.06 | 12B20110601SPR | 303.03 | 0.03 |
| 14210 | 7379422.08 | 599859.241 | 303.57 | 12B20110601SPR | 303.56 | 0.01 |
| 14211 | 7379407.665 | 599872.238 | 304.20 | 12B20110601SPR | 304.19 | 0.01 |
| 14212 | 7379395.671 | 599884.02 | 304.59 | 12B20110601SPR | 304.59 | 0.00 |
| 14213 | 7379383.638 | 599894.789 | 305.02 | 12B20110601SPR | 304.99 | 0.03 |
| 14214 | 7379495.219 | 599835.977 | 298.44 | 12B20110601SGR | 298.43 | 0.01 |
| 14215 | 7379513.115 | 599851.55 | 296.52 | 12B20110601SGR | 296.49 | 0.03 |
| 14216 | 7379539.291 | 599873.128 | 294.81 | 12B20110601SGR | 294.79 | 0.01 |
| 14217 | 7379564.64 | 599893.222 | 293.71 | 12B20110601SGR | 293.70 | 0.01 |
| 14218 | 7379588.596 | 599913.474 | 293.21 | 12B20110601SGR | 293.20 | 0.01 |
| 14219 | 7379614.954 | 599933.961 | 292.12 | 12B20110601SGR | 292.09 | 0.03 |
| 14220 | 7379638.636 | 599954.711 | 290.99 | 12B20110601SGR | 290.96 | 0.03 |
| 14221 | 7379664.239 | 599975.646 | 290.02 | 12B20110601SGR | 290.04 | -0.02 |
| 14222 | 7379687.846 | 599995.428 | 290.01 | 12B20110601SGR | 290.03 | -0.02 |
| 14223 | 7379701.923 | 600010.994 | 289.98 | 12B20110601SGR | 289.99 | -0.01 |
| 14224 | 7378329.137 | 600757.916 | 376.14 | 12B20110601SPR | 376.11 | 0.03 |
| 14225 | 7378314.235 | 600768.032 | 377.43 | 12B20110601SPR | 377.42 | 0.01 |
| 14226 | 7378299.199 | 600778.725 | 378.64 | 12B20110601SPR | 378.65 | -0.01 |
| 14227 | 7378285.048 | 600788.592 | 379.81 | 12B20110601SPR | 379.82 | -0.01 |
| 14228 | 7378270.613 | 600799.435 | 381.00 | 12B20110601SPR | 380.98 | 0.02 |
| 14229 | 7378256.411 | 600809.058 | 382.28 | 12B20110601SPR | 382.28 | 0.00 |
| 14230 | 7378242.245 | 600815.542 | 383.41 | 12B20110601SPR | 383.38 | 0.02 |
| 14231 | 7376502.73 | 602043.065 | 595.80 | 12B20110601SGR | 595.73 | 0.07 |
| 14232 | 7376489.215 | 602050.939 | 596.91 | 12B20110601SGR | 596.83 | 0.08 |
| 14233 | 7376476.188 | 602060.372 | 598.02 | 12B20110601SGR | 597.96 | 0.06 |
| 14234 | 7376462.813 | 602069.978 | 599.18 | 12B20110601SGR | 599.11 | 0.07 |
| 14235 | 7376449.82 | 602079.422 | 600.28 | 12B20110601SGR | 600.20 | 0.08 |
| 14236 | 7376436.216 | 602089.543 | 601.35 | 12B20110601SGR | 601.28 | 0.07 |
| 14237 | 7376423.929 | 602097.789 | 602.19 | 12B20110601SGR | 602.13 | 0.06 |
| 14238 | 7376411.136 | 602106.517 | 603.05 | 12B20110601SGR | 602.98 | 0.07 |
| 14239 | 7376396.801 | 602116.429 | 603.97 | 12B20110601SGR | 603.89 | 0.08 |
| 14240 | 7376383.531 | 602126.071 | 604.71 | 12B20110601SGR | 604.65 | 0.06 |
| 14241 | 7376368.513 | 602136.333 | 605.38 | 12B20110601SGR | 605.30 | 0.08 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14242 | 7383554.16 | 597106.188 | 342.08 | 12B20110601CHECK | 342.09 | -0.01 |
| 14300 | 7353879.024 | 618244.288 | 531.77 | 13A2011053113AFAC | 531.74 | 0.03 |
| 14301 | 7320440.658 | 636279.679 | 184.64 | 13A2011053114AFAC | 184.68 | -0.04 |
| 14302 | 7371037.857 | 605664.395 | 381.89 | 13A20110531SGR | 381.85 | 0.04 |
| 14303 | 7371355.763 | 605399.289 | 388.83 | 13A20110531SGR | 388.75 | 0.08 |
| 14304 | 7371531.598 | 605723.553 | 390.51 | 13A20110531SGR | 390.43 | 0.07 |
| 14305 | 7370806.184 | 605752.193 | 389.34 | 13A20110531SGR | 389.27 | 0.07 |
| 14306 | 7335001.15 | 628249.933 | 215.16 | 13A20110531SGR | 215.17 | -0.01 |
| 14307 | 7333717.453 | 628783.97 | 231.30 | 13A20110531SGR | 231.31 | -0.01 |
| 14308 | 7331738.194 | 628161.141 | 223.59 | 13A20110531SGR | 223.61 | -0.02 |
| 14309 | 7331643.929 | 628306.415 | 223.59 | 13A20110531SGR | 223.58 | 0.01 |
| 14310 | 7329876.266 | 628465.916 | 245.80 | 13A20110531SGR | 245.78 | 0.02 |
| 14311 | 7329792.567 | 628507.818 | 248.62 | 13A20110531SGR | 248.63 | -0.01 |
| 14400 | 6912040.872 | 643425.633 | 112.12 | 45A2011061345AFAC | 112.09 | 0.03 |
| 14401 | 6912066.934 | 643414.878 | 112.47 | 45A20110613SPR | 112.46 | 0.01 |
| 14402 | 6912048.577 | 643409.287 | 112.13 | 45A20110613SPR | 112.10 | 0.03 |
| 14403 | 6912034.491 | 643411.341 | 112.25 | 45A20110613SPR | 112.23 | 0.02 |
| 14404 | 6912018.058 | 643405.367 | 111.99 | 45A20110613SPR | 111.96 | 0.03 |
| 14405 | 6911488.363 | 643293.144 | 112.22 | 45A20110613SPR | 112.24 | -0.02 |
| 14406 | 6911475.229 | 643286.257 | 112.16 | 45A20110613SPR | 112.14 | 0.02 |
| 14407 | 6911460.886 | 643286.926 | 112.12 | 45A20110613SPR | 112.12 | -0.01 |
| 14408 | 6911446.375 | 643279.658 | 112.04 | 45A20110613SPR | 112.04 | 0.00 |
| 14411 | 6911425.827 | 642325.55 | 116.17 | 45A20110613SGR | 116.12 | 0.05 |
| 14412 | 6911442.379 | 642707.809 | 113.13 | 45A20110613SGR | 113.06 | 0.07 |
| 14413 | 6911443.026 | 642720.621 | 113.12 | 45A20110613SGR | 113.08 | 0.04 |
| 14414 | 6911443.686 | 642733.579 | 113.14 | 45A20110613SGR | 113.09 | 0.05 |
| 14415 | 6910658.07 | 643103.416 | 109.43 | 45A20110613SPR | 109.43 | 0.00 |
| 14416 | 6910641.541 | 643103.404 | 109.34 | 45A20110613SPR | 109.30 | 0.04 |
| 14417 | 6910627.905 | 643096.654 | 109.21 | 45A20110613SPR | 109.18 | 0.03 |
| 14418 | 6910609.759 | 643096.409 | 109.09 | 45A20110613SPR | 109.09 | 0.00 |
| 14419 | 6909720.496 | 642893.347 | 108.98 | 45A20110613SPR | 108.97 | 0.01 |
| 14420 | 6909704.775 | 642894.012 | 108.93 | 45A20110613SPR | 108.89 | 0.04 |
| 14421 | 6909687.052 | 642886.175 | 108.90 | 45A20110613SPR | 108.86 | 0.04 |
| 14422 | 6909671.219 | 642886.542 | 108.85 | 45A20110613SPR | 108.82 | 0.03 |
| 14423 | 6908907.256 | 642714.043 | 108.33 | 45A20110613SPR | 108.25 | 0.08 |
| 14424 | 6908888.892 | 642715.595 | 108.11 | 45A20110613SPR | 108.05 | 0.06 |
| 14425 | 6908870.686 | 642709.399 | 108.32 | 45A20110613SPR | 108.30 | 0.02 |
| 14426 | 6908853.146 | 642712.026 | 108.09 | 45A20110613SPR | 108.03 | 0.06 |
| 14427 | 6908020.271 | 642870.737 | 106.00 | 45A20110613SPR | 105.96 | 0.04 |
| 14428 | 6908007.064 | 642878.199 | 106.05 | 45A20110613SPR | 106.03 | 0.02 |
| 14429 | 6907992.963 | 642877.393 | 106.08 | 45A20110613SPR | 106.03 | 0.05 |
| 14430 | 6907977.4 | 642885.529 | 106.18 | 45A20110613SPR | 106.13 | 0.05 |
| 14431 | 6907029.974 | 643107.11 | 107.02 | 45A20110613SPR | 106.96 | 0.06 |
| 14432 | 6912477.069 | 643365.14 | 113.90 | 45A20110613SPR | 113.91 | -0.01 |
| 14433 | 6912457.778 | 643359.69 | 114.14 | 45A20110613SPR | 114.15 | -0.01 |
| 14434 | 6912476.454 | 643351.063 | 113.91 | 45A20110613SPR | 113.89 | 0.02 |
| 14435 | 6912492.278 | 643343.473 | 113.76 | 45A20110613SPR | 113.74 | 0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14436 | 6912475.538 | 643329.4 | 113.61 | 45A20110613SPR | 113.57 | 0.04 |
| 14437 | 6912489.244 | 643654.84 | 109.51 | 45A20110613SGR | 109.47 | 0.04 |
| 14438 | 6912490.114 | 643669.254 | 109.50 | 45A20110613SGR | 109.47 | 0.03 |
| 14439 | 6912490.564 | 643683.6 | 109.50 | 45A20110613SGR | 109.49 | 0.01 |
| 14440 | 6912481.507 | 643917.35 | 109.60 | 45A20110613SGR | 109.57 | 0.03 |
| 14441 | 6912478.104 | 643933.306 | 109.60 | 45A20110613SGR | 109.56 | 0.04 |
| 14442 | 6912474.825 | 643946.446 | 109.65 | 45A20110613SGR | 109.59 | 0.06 |
| 14443 | 6912420.904 | 644162.891 | 108.84 | 45A20110613SGR | 108.82 | 0.02 |
| 14444 | 6912424.68 | 644148.365 | 108.95 | 45A20110613SGR | 108.95 | 0.00 |
| 14445 | 6912426.551 | 644134.148 | 109.03 | 45A20110613SGR | 109.02 | 0.01 |
| 14446 | 6912469.307 | 643133.859 | 114.79 | 45A20110613SPR | 114.79 | 0.00 |
| 14447 | 6912465.971 | 643119.956 | 114.86 | 45A20110613SPR | 114.82 | 0.04 |
| 14448 | 6912468.141 | 643104.741 | 114.86 | 45A20110613SPR | 114.84 | 0.02 |
| 14449 | 6912464.844 | 643090.89 | 114.95 | 45A20110613SPR | 114.90 | 0.05 |
| 14450 | 6912459.499 | 642874.341 | 115.29 | 45A20110613SPR | 115.25 | 0.03 |
| 14451 | 6912456.086 | 642863.309 | 115.27 | 45A20110613SPR | 115.24 | 0.03 |
| 14452 | 6912458.679 | 642849.68 | 115.31 | 45A20110613SPR | 115.29 | 0.02 |
| 14453 | 6912454.329 | 642826.141 | 115.54 | 45A20110613SPR | 115.49 | 0.05 |
| 14454 | 6912446.993 | 642547.217 | 119.58 | 45A20110613SPR | 119.56 | 0.02 |
| 14455 | 6912444.559 | 642561.119 | 119.50 | 45A20110613SPR | 119.47 | 0.03 |
| 14456 | 6912448.129 | 642573.665 | 119.52 | 45A20110613SPR | 119.42 | 0.09 |
| 14457 | 6912445.654 | 642592.959 | 119.45 | 45A20110613SPR | 119.38 | 0.07 |
| 14458 | 6912826.982 | 643228.502 | 116.66 | 45A20110613SPR | 116.64 | 0.02 |
| 14459 | 6912840.439 | 643219.645 | 116.76 | 45A20110613SPR | 116.72 | 0.04 |
| 14460 | 6912855.954 | 643217.978 | 116.84 | 45A20110613SPR | 116.73 | 0.11 |
| 14461 | 6912868.114 | 643208.972 | 116.81 | 45A20110613SPR | 116.79 | 0.02 |
| 14462 | 6913402.891 | 643024.244 | 118.07 | 45A20110613SPR | 118.07 | 0.00 |
| 14463 | 6913419.351 | 643014.679 | 118.26 | 45A20110613SPR | 118.21 | 0.05 |
| 14464 | 6913437.819 | 643012.909 | 118.30 | 45A20110613SPR | 118.27 | 0.03 |
| 14465 | 6913458.958 | 643002.648 | 118.39 | 45A20110613SPR | 118.41 | -0.02 |
| 14466 | 6914189.019 | 642879.981 | 119.54 | 45A20110613SPR | 119.53 | 0.01 |
| 14467 | 6914209.65 | 642872.315 | 119.40 | 45A20110613SPR | 119.41 | -0.02 |
| 14468 | 6914225.151 | 642873.124 | 119.62 | 45A20110613SPR | 119.59 | 0.03 |
| 14469 | 6914237.959 | 642866.698 | 119.48 | 45A20110613SPR | 119.44 | 0.04 |
| 14470 | 6914817.484 | 642612.919 | 125.09 | 45A20110613SPR | 125.05 | 0.04 |
| 14471 | 6914830.438 | 642602.082 | 125.25 | 45A20110613SPR | 125.26 | -0.01 |
| 14472 | 6914844.846 | 642598.276 | 125.45 | 45A20110613SPR | 125.42 | 0.03 |
| 14473 | 6914860.643 | 642585.237 | 125.68 | 45A20110613SPR | 125.66 | 0.02 |
| 14474 | 6915422.217 | 642387.501 | 130.04 | 45A20110613SPR | 130.00 | 0.04 |
| 14475 | 6915406.631 | 642386.229 | 130.21 | 45A20110613SPR | 130.15 | 0.06 |
| 14476 | 6915393.661 | 642392.608 | 130.13 | 45A20110613SPR | 130.13 | 0.00 |
| 14477 | 6915382.119 | 642390.559 | 130.27 | 45A20110613SPR | 130.24 | 0.03 |
| 14478 | 6915915.68 | 642303.485 | 128.79 | 45A20110613SPR | 128.71 | 0.08 |
| 14479 | 6915931.946 | 642296.615 | 128.69 | 45A20110613SPR | 128.64 | 0.05 |
| 14480 | 6915947.636 | 642297.843 | 128.66 | 45A20110613SPR | 128.61 | 0.05 |
| 14481 | 6915961.2 | 642295.546 | 128.59 | 45A20110613SPR | 128.57 | 0.02 |
| 14482 | 6915960.48 | 642292.073 | 128.58 | 45A20110613SPR | 128.55 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14483 | 6915924.007 | 642326.225 | 129.26 | 45A20110613CK_SPIKE | 129.24 | 0.02 |
| 14484 | 6916463.703 | 642206.468 | 129.33 | 45A20110613SPR | 129.23 | 0.10 |
| 14485 | 6916487.696 | 642206.035 | 129.24 | 45A20110613SPR | 129.24 | 0.00 |
| 14486 | 6916500.843 | 642200.192 | 129.29 | 45A20110613SPR | 129.19 | 0.09 |
| 14487 | 6916518.685 | 642200.94 | 129.26 | 45A20110613SPR | 129.21 | 0.05 |
| 14488 | 6916523.964 | 642199.992 | 129.25 | 45A20110613SPR | 129.18 | 0.07 |
| 14489 | 6917094.983 | 642102.786 | 129.26 | 45A20110613SPR | 129.21 | 0.05 |
| 14490 | 6917110.813 | 642096.103 | 129.38 | 45A20110613SPR | 129.32 | 0.06 |
| 14491 | 6917127.887 | 642093.208 | 129.50 | 45A20110613SPR | 129.41 | 0.09 |
| 14492 | 6917142.156 | 642090.698 | 129.61 | 45A20110613SPR | 129.55 | 0.06 |
| 14493 | 6912041.137 | 643422.58 | 112.30 | 45A20110613CK_SPIKE | 112.33 | -0.03 |
| 14494 | 6923101.326 | 641751.664 | 166.67 | 45A20110613SPR | 166.66 | 0.01 |
| 14495 | 6955835.501 | 642134.703 | 227.00 | 45A20110613SPR | 227.00 | 0.00 |
| 14496 | 6900487.239 | 644528.798 | 97.25 | 45A20110613SPR | 97.17 | 0.08 |
| 14497 | 6922296.226 | 641632.685 | 154.20 | 45A20110613SPR | 154.16 | 0.04 |
| 14498 | 6943113.551 | 641833.335 | 198.91 | 45A20110613FAC | 198.96 | -0.05 |
| 14500 | 6939644.065 | 642509.549 | 217.94 | 46A2011061446AFAC,FAC | 217.96 | -0.02 |
| 14501 | 6939647.096 | 642509.891 | 217.64 | 46A2011061446A_CK_SPIKE | 217.67 | -0.03 |
| 14502 | 6940082.025 | 642143.238 | 173.42 | 46A20110614SPR | 173.42 | 0.00 |
| 14503 | 6940061.448 | 642138.938 | 173.35 | 46A20110614SPR | 173.37 | -0.02 |
| 14504 | 6940055.732 | 642136.73 | 173.32 | 46A20110614SPR | 173.34 | -0.02 |
| 14505 | 6940043.083 | 642126.529 | 173.47 | 46A20110614SPR | 173.47 | 0.00 |
| 14506 | 6940025.712 | 642124.063 | 173.25 | 46A20110614SPR | 173.24 | 0.01 |
| 14507 | 6939556.453 | 641939.155 | 182.88 | 46A20110614SPR | 182.82 | 0.06 |
| 14508 | 6939543.388 | 641932.925 | 183.49 | 46A20110614SPR | 183.47 | 0.02 |
| 14509 | 6939535.177 | 641920.011 | 183.75 | 46A20110614SPR | 183.68 | 0.07 |
| 14510 | 6939522.167 | 641914.058 | 184.34 | 46A20110614SPR | 184.30 | 0.04 |
| 14511 | 6939285.204 | 641711.456 | 192.87 | 46A20110614SPR | 192.85 | 0.02 |
| 14512 | 6939271.932 | 641708.824 | 192.90 | 46A20110614SPR | 192.90 | 0.00 |
| 14513 | 6939259.889 | 641699.479 | 193.39 | 46A20110614SPR | 193.37 | 0.02 |
| 14514 | 6939234.528 | 641692.038 | 193.76 | 46A20110614SPR | 193.71 | 0.05 |
| 14515 | 6938877.545 | 641728.937 | 211.47 | 46A20110614SPR | 211.48 | -0.01 |
| 14516 | 6938862.24 | 641741.835 | 212.23 | 46A20110614SPR | 212.22 | 0.01 |
| 14517 | 6938849.888 | 641744.207 | 212.93 | 46A20110614SPR | 212.91 | 0.02 |
| 14518 | 6938842.296 | 641752.472 | 213.31 | 46A20110614SPR | 213.30 | 0.01 |
| 14519 | 6938462.627 | 641957.536 | 219.89 | 46A20110614SPR | 219.85 | 0.04 |
| 14520 | 6938451.702 | 641968.172 | 219.87 | 46A20110614SPR | 219.86 | 0.01 |
| 14521 | 6938437.797 | 641971.739 | 219.89 | 46A20110614SPR | 219.89 | 0.00 |
| 14522 | 6938422.526 | 641984.502 | 219.86 | 46A20110614SPR | 219.87 | -0.01 |
| 14523 | 6938017.544 | 642197.327 | 216.01 | 46A20110614SPR | 215.98 | 0.03 |
| 14524 | 6938003.224 | 642206.394 | 216.04 | 46A20110614SPR | 216.06 | -0.02 |
| 14525 | 6937987.571 | 642207.544 | 215.66 | 46A20110614SPR | 215.66 | 0.00 |
| 14526 | 6937971.802 | 642215.983 | 215.73 | 46A20110614SPR | 215.76 | -0.03 |
| 14527 | 6937610.36 | 642176.389 | 214.33 | 46A20110614SPR | 214.32 | 0.00 |
| 14528 | 6937594.954 | 642175.134 | 214.33 | 46A20110614SPR | 214.34 | -0.01 |
| 14529 | 6937581.931 | 642166.406 | 214.44 | 46A20110614SPR | 214.44 | 0.00 |
| 14530 | 6937561.678 | 642163.574 | 214.47 | 46A20110614SPR | 214.46 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14531 | 6937712.448 | 641892.976 | 221.13 | 46A20110614SGR | 221.09 | 0.04 |
| 14532 | 6937704.632 | 641899.512 | 220.91 | 46A20110614SGR | 220.86 | 0.05 |
| 14533 | 6937717.164 | 641906.861 | 220.29 | 46A20110614SGR | 220.28 | 0.01 |
| 14534 | 6937642.786 | 642004.532 | 215.92 | 46A20110614SGR | 215.90 | 0.02 |
| 14535 | 6937640.532 | 642016.673 | 215.65 | 46A20110614SGR | 215.66 | -0.01 |
| 14536 | 6937637.493 | 642030.357 | 215.45 | 46A20110614SGR | 215.48 | -0.03 |
| 14537 | 6937030.612 | 642191.22 | 211.81 | 46A20110614SPR | 211.74 | 0.07 |
| 14538 | 6937017.731 | 642199.462 | 211.64 | 46A20110614SPR | 211.61 | 0.02 |
| 14539 | 6937003.557 | 642200.068 | 211.49 | 46A20110614SPR | 211.49 | 0.00 |
| 14540 | 6936985.538 | 642209.67 | 211.41 | 46A20110614SPR | 211.37 | 0.04 |
| 14541 | 6936266.45 | 642230.053 | 216.42 | 46A20110614SPR | 216.36 | 0.06 |
| 14542 | 6936251.941 | 642231.279 | 216.44 | 46A20110614SPR | 216.45 | -0.01 |
| 14543 | 6936231.694 | 642223.754 | 216.46 | 46A20110614SPR | 216.47 | -0.01 |
| 14544 | 6936209.145 | 642223.735 | 216.42 | 46A20110614SPR | 216.42 | 0.00 |
| 14545 | 6935667.073 | 642121.946 | 212.87 | 46A20110614SPR | 212.90 | -0.03 |
| 14546 | 6935646.244 | 642121.579 | 212.79 | 46A20110614SPR | 212.78 | 0.01 |
| 14547 | 6935633.231 | 642114.11 | 212.61 | 46A20110614SPR | 212.61 | 0.00 |
| 14548 | 6935603.853 | 642110.498 | 212.47 | 46A20110614SPR | 212.52 | -0.05 |
| 14549 | 6935006.514 | 641834.537 | 207.97 | 46A20110614SPR | 207.91 | 0.06 |
| 14550 | 6934992.422 | 641830.648 | 207.86 | 46A20110614SPR | 207.84 | 0.02 |
| 14551 | 6934979.685 | 641819.062 | 207.76 | 46A20110614SPR | 207.72 | 0.04 |
| 14552 | 6934965.562 | 641814.829 | 207.63 | 46A20110614SPR | 207.57 | 0.06 |
| 14553 | 6934322.316 | 641435.209 | 202.89 | 46A20110614SPR | 202.84 | 0.05 |
| 14554 | 6934302.529 | 641428.45 | 202.73 | 46A20110614SPR | 202.71 | 0.02 |
| 14555 | 6934288.173 | 641415.616 | 202.58 | 46A20110614SPR | 202.54 | 0.04 |
| 14556 | 6934262.881 | 641405.417 | 202.26 | 46A20110614SPR | 202.23 | 0.03 |
| 14557 | 6933458.573 | 640931.858 | 195.92 | 46A20110614SPR | 195.92 | 0.00 |
| 14558 | 6933467.821 | 640941.922 | 195.81 | 46A20110614SPR | 195.82 | -0.01 |
| 14559 | 6933488.732 | 640949.751 | 195.65 | 46A20110614SPR | 195.63 | 0.02 |
| 14560 | 6933498.921 | 640959.943 | 195.43 | 46A20110614SPR | 195.42 | 0.01 |
| 14561 | 6932908.27 | 640621.273 | 204.27 | 46A20110614SPR | 204.20 | 0.06 |
| 14562 | 6932894.876 | 640619.748 | 204.45 | 46A20110614SPR | 204.36 | 0.09 |
| 14563 | 6932874.743 | 640606.975 | 204.93 | 46A20110614SPR | 204.84 | 0.09 |
| 14564 | 6932854.954 | 640602.146 | 205.22 | 46A20110614SPR | 205.17 | 0.05 |
| 14565 | 6932539.766 | 640501.233 | 207.81 | 46A20110614SPR | 207.75 | 0.06 |
| 14566 | 6932556.622 | 640504.764 | 208.07 | 46A20110614SPR | 207.96 | 0.11 |
| 14567 | 6932571.686 | 640508.026 | 208.26 | 46A20110614SPR | 208.22 | 0.04 |
| 14568 | 6932587.858 | 640511.664 | 208.45 | 46A20110614SPR | 208.37 | 0.08 |
| 14569 | 6931913.297 | 640436.676 | 203.83 | 46A20110614SPR | 203.76 | 0.07 |
| 14570 | 6931899.926 | 640435.299 | 203.99 | 46A20110614SPR | 203.96 | 0.03 |
| 14571 | 6931881.107 | 640437.494 | 204.22 | 46A20110614SPR | 204.12 | 0.10 |
| 14572 | 6931859.149 | 640435.884 | 204.45 | 46A20110614SPR | 204.41 | 0.04 |
| 14573 | 6931848.219 | 640430.962 | 204.58 | 46A20110614SPR | 204.54 | 0.04 |
| 14574 | 6930990.212 | 640414.04 | 211.79 | 46A20110614SPR | 211.74 | 0.05 |
| 14575 | 6931006.546 | 640411.597 | 211.79 | 46A20110614SPR | 211.73 | 0.06 |
| 14576 | 6930973.674 | 640415.585 | 211.80 | 46A20110614SPR | 211.72 | 0.08 |
| 14577 | 6930946.116 | 640405.794 | 211.96 | 46A20110614SPR | 211.90 | 0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14578 | 6930983.506 | 640400.589 | 212.07 | 46A20110614SPR | 212.01 | 0.06 |
| 14579 | 6931005.33 | 640397.704 | 212.07 | 46A20110614SPR | 211.98 | 0.09 |
| 14580 | 6929847.641 | 640658.604 | 197.29 | 46A20110614SPR | 197.23 | 0.06 |
| 14581 | 6929868.632 | 640657.549 | 197.02 | 46A20110614SPR | 196.95 | 0.07 |
| 14582 | 6929872.92 | 640652.944 | 196.97 | 46A20110614SPR | 196.89 | 0.08 |
| 14583 | 6929891.98 | 640651.766 | 196.73 | 46A20110614SPR | 196.69 | 0.04 |
| 14584 | 6929891.117 | 640648.334 | 196.77 | 46A20110614SPR | 196.71 | 0.06 |
| 14585 | 6943116.603 | 641833.489 | 198.28 | 46A2011061446B_CK_SPIKE | 198.34 | -0.06 |
| 14586 | 6930286.518 | 640911.019 | 189.36 | 46A20110614FAC | 189.38 | -0.02 |
| 14587 | 6926619.221 | 641030.774 | 178.66 | 46A20110614 | 178.59 | 0.07 |
| 14588 | 6930068.856 | 640836.916 | 188.35 | 46A20110614 | 188.30 | 0.05 |
| 14589 | 6930532.096 | 640997.591 | 189.03 | 46A20110614 | 188.96 | 0.07 |
| 14590 | 6921359.801 | 640781.213 | 168.46 | 46A20110614 | 168.38 | 0.08 |
| 14591 | 6923081.8 | 641839.606 | 166.11 | 46A20110614 | 166.04 | 0.07 |
| 14592 | 6917812.203 | 641225.98 | 137.03 | 46A20110614 | 137.01 | 0.02 |
| 14593 | 6917823.774 | 641479.497 | 145.35 | 46A20110614 | 145.32 | 0.03 |
| 14594 | 6925717.272 | 641158.183 | 180.38 | 46A20110614 | 180.36 | 0.02 |
| 14600 | 6958769.082 | 644703.764 | 246.88 | 47A2011061647AFAC | 246.87 | 0.01 |
| 14601 | 6958772.065 | 644721.368 | 247.47 | 47A20110616SPR | 247.45 | 0.02 |
| 14602 | 6958768.559 | 644732.787 | 247.78 | 47A20110616SPR | 247.78 | 0.00 |
| 14603 | 6958773.595 | 644744.446 | 247.84 | 47A20110616SPR | 247.84 | 0.00 |
| 14604 | 6958752.865 | 644719.674 | 247.74 | 47A20110616SPR | 247.75 | -0.01 |
| 14605 | 6958736.332 | 644699.488 | 247.63 | 47A20110616SPR | 247.63 | 0.00 |
| 14606 | 6958743.766 | 644702.754 | 247.64 | 47A20110616SPR | 247.62 | 0.02 |
| 14607 | 6958750.898 | 644696.292 | 247.34 | 47A20110616SPR | 247.34 | 0.00 |
| 14608 | 6958346.222 | 644216.52 | 239.32 | 47A20110616SPR | 239.32 | 0.00 |
| 14609 | 6958334.175 | 644207.886 | 239.04 | 47A20110616SPR | 238.99 | 0.05 |
| 14610 | 6958322.782 | 644188.055 | 238.53 | 47A20110616SPR | 238.54 | -0.01 |
| 14611 | 6958311.796 | 644180.067 | 238.28 | 47A20110616SPR | 238.28 | 0.00 |
| 14612 | 6957827.535 | 643582.709 | 214.38 | 47A20110616SPR | 214.39 | -0.01 |
| 14613 | 6957816.587 | 643575.485 | 213.96 | 47A20110616SPR | 213.96 | 0.00 |
| 14614 | 6957812.131 | 643563.849 | 213.55 | 47A20110616SPR | 213.51 | 0.04 |
| 14615 | 6957800.489 | 643555.514 | 213.07 | 47A20110616SPR | 213.08 | -0.01 |
| 14616 | 6957239.141 | 643188.983 | 215.16 | 47A20110616SPR | 215.12 | 0.04 |
| 14617 | 6957220.536 | 643188.981 | 215.19 | 47A20110616SPR | 215.19 | 0.00 |
| 14618 | 6957207.394 | 643182.667 | 215.14 | 47A20110616SPR | 215.16 | -0.02 |
| 14619 | 6957193.372 | 643183.862 | 215.14 | 47A20110616SPR | 215.13 | 0.01 |
| 14620 | 6956808.732 | 643047.879 | 212.39 | 47A20110616SPR | 212.36 | 0.03 |
| 14621 | 6956793.299 | 643043.017 | 212.26 | 47A20110616SPR | 212.27 | -0.01 |
| 14622 | 6956782.993 | 643031.988 | 211.73 | 47A20110616SPR | 211.71 | 0.01 |
| 14623 | 6956769.536 | 643027.575 | 211.59 | 47A20110616SPR | 211.57 | 0.02 |
| 14624 | 6956481.408 | 642784.892 | 215.12 | 47A20110616SPR | 215.11 | 0.01 |
| 14625 | 6956490.791 | 642791.575 | 214.69 | 47A20110616SPR | 214.69 | 0.00 |
| 14626 | 6956495.335 | 642802.556 | 214.66 | 47A20110616SPR | 214.63 | 0.03 |
| 14627 | 6956504.503 | 642808.142 | 214.23 | 47A20110616SPR | 214.24 | -0.01 |
| 14628 | 6956000.737 | 642216.339 | 220.75 | 47A20110616SPR | 220.72 | 0.03 |
| 14629 | 6955987.656 | 642213.547 | 221.19 | 47A20110616SPR | 221.20 | -0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14630 | 6955970.083 | 642198.937 | 221.95 | 47A20110616SPR | 221.88 | 0.07 |
| 14631 | 6955947.298 | 642190.651 | 222.81 | 47A20110616SPR | 222.81 | 0.00 |
| 14632 | 6955592.259 | 641985.797 | 234.86 | 47A20110616SPR | 234.84 | 0.02 |
| 14633 | 6955576.541 | 641980.914 | 235.08 | 47A20110616SPR | 235.05 | 0.03 |
| 14634 | 6955564.383 | 641969.811 | 235.08 | 47A20110616SPR | 235.06 | 0.02 |
| 14635 | 6955552.981 | 641966.992 | 235.21 | 47A20110616SPR | 235.17 | 0.04 |
| 14636 | 6955128.57 | 641629.714 | 235.49 | 47A20110616SPR | 235.47 | 0.02 |
| 14637 | 6955136.221 | 641640.104 | 235.28 | 47A20110616SPR | 235.28 | 0.00 |
| 14638 | 6955148.856 | 641645.139 | 235.32 | 47A20110616SPR | 235.32 | 0.00 |
| 14639 | 6955156.366 | 641656.184 | 235.11 | 47A20110616SPR | 235.10 | 0.01 |
| 14640 | 6955814.411 | 642136.371 | 225.92 | 7A20110616FBC_DOT_GPS_ | 225.92 | 0.00 |
| 14641 | 6955814.425 | 642136.371 | 225.91 | 7A20110616FBC_DOT_GPS_ | 225.92 | -0.01 |
| 14642 | 6959113.197 | 645160.07 | 253.87 | 47A20110616SPR | 253.85 | 0.02 |
| 14643 | 6959127.633 | 645171.494 | 254.09 | 47A20110616SPR | 254.09 | 0.00 |
| 14644 | 6959135.786 | 645187.81 | 254.40 | 47A20110616SPR | 254.36 | 0.04 |
| 14645 | 6959151.121 | 645200.43 | 254.64 | 47A20110616SPR | 254.65 | -0.01 |
| 14646 | 6959625.603 | 645725.278 | 262.38 | 47A20110616SPR | 262.35 | 0.03 |
| 14647 | 6959638.799 | 645731.14 | 262.19 | 47A20110616SPR | 262.16 | 0.03 |
| 14648 | 6959647.701 | 645743.134 | 262.16 | 47A20110616SPR | 262.12 | 0.03 |
| 14649 | 6959659.688 | 645748.629 | 262.03 | 47A20110616SPR | 262.01 | 0.02 |
| 14650 | 6960261.877 | 646252.316 | 257.66 | 47A2011061647B_CK_SPIKE | 257.64 | 0.02 |
| 14651 | 6960253.152 | 646232.359 | 258.32 | 47A20110616SPR | 258.31 | 0.01 |
| 14652 | 6960267.99 | 646239.203 | 258.21 | 47A20110616SPR | 258.21 | 0.00 |
| 14653 | 6960277.24 | 646251.722 | 258.15 | 47A20110616SPR | 258.14 | 0.01 |
| 14654 | 6960291.109 | 646257.934 | 258.13 | 47A20110616SPR | 258.09 | 0.04 |
| 14655 | 6960270.652 | 646261.793 | 258.10 | 47A20110616SPR | 258.07 | 0.03 |
| 14656 | 6960266.723 | 646274.515 | 258.11 | 47A20110616SPR | 258.06 | 0.05 |
| 14657 | 6960433.628 | 646884.618 | 245.54 | 47A20110616SPR | 245.52 | 0.02 |
| 14658 | 6960424.16 | 646874.365 | 245.49 | 47A20110616SPR | 245.46 | 0.03 |
| 14659 | 6960417.957 | 646862.982 | 245.37 | 47A20110616SPR | 245.35 | 0.02 |
| 14660 | 6960320.783 | 646686.074 | 242.29 | 47A20110616SPR | 242.27 | 0.01 |
| 14661 | 6960318.326 | 646673.446 | 241.74 | 47A20110616SPR | 241.70 | 0.04 |
| 14662 | 6960315.794 | 646660.034 | 241.11 | 47A20110616SPR | 241.10 | 0.01 |
| 14663 | 6960467.169 | 646496.93 | 260.02 | 47A20110616SPR | 260.00 | 0.02 |
| 14664 | 6960465.536 | 646508.012 | 260.29 | 47A20110616SPR | 260.27 | 0.02 |
| 14665 | 6960479.784 | 646503.946 | 259.73 | 47A20110616SPR | 259.71 | 0.02 |
| 14666 | 6960598.879 | 646629.398 | 261.29 | 47A20110616SPR | 261.31 | -0.02 |
| 14667 | 6960610.412 | 646637.024 | 261.54 | 47A20110616SPR | 261.51 | 0.03 |
| 14668 | 6960608.479 | 646645.161 | 261.78 | 47A20110616SPR | 261.79 | -0.01 |
| 14669 | 6960622.001 | 646652.252 | 261.98 | 47A20110616SPR | 261.99 | -0.01 |
| 14670 | 6960774.241 | 646707.641 | 260.80 | 47A20110616SPR | 260.81 | -0.01 |
| 14671 | 6960770.438 | 646688.025 | 260.56 | 47A20110616SPR | 260.55 | 0.01 |
| 14672 | 6960786.293 | 646699.947 | 260.92 | 47A20110616SPR | 260.89 | 0.03 |
| 14673 | 6960796.357 | 646716.296 | 261.21 | 47A20110616SPR | 261.21 | 0.00 |
| 14674 | 6960806.338 | 646721.659 | 261.39 | 47A20110616SPR | 261.38 | 0.01 |
| 14675 | 6961313.085 | 647289.541 | 273.67 | 47A20110616SPR | 273.66 | 0.01 |
| 14676 | 6961324.294 | 647296.417 | 273.69 | 47A20110616SPR | 273.65 | 0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14677 | 6961333.591 | 647312.26 | 273.59 | 47A20110616SPR | 273.58 | 0.01 |
| 14678 | 6961346.686 | 647320.723 | 273.57 | 47A20110616SPR | 273.52 | 0.05 |
| 14679 | 6961844.241 | 647883.51 | 275.27 | 47A20110616SPR | 275.27 | 0.00 |
| 14680 | 6961855.607 | 647891.971 | 275.54 | 47A20110616SPR | 275.52 | 0.02 |
| 14681 | 6961860.542 | 647904.557 | 275.55 | 47A20110616SPR | 275.54 | 0.01 |
| 14682 | 6961871.141 | 647912.654 | 275.81 | 47A20110616SPR | 275.81 | 0.00 |
| 14683 | 6962228.817 | 648609.709 | 303.29 | 47A20110616SPR | 303.22 | 0.07 |
| 14684 | 6962227.769 | 648598.876 | 302.86 | 47A20110616SPR | 302.84 | 0.02 |
| 14685 | 6962217.792 | 648585.686 | 302.54 | 47A20110616SPR | 302.49 | 0.05 |
| 14686 | 6962215.037 | 648569.722 | 302.00 | 47A20110616SPR | 301.96 | 0.04 |
| 14687 | 6962441.288 | 648939.887 | 312.79 | 47A20110616SPR | 312.77 | 0.02 |
| 14688 | 6962428.198 | 648929.467 | 312.84 | 47A20110616SPR | 312.83 | 0.01 |
| 14689 | 6962419.283 | 648911.386 | 312.53 | 47A20110616SPR | 312.49 | 0.04 |
| 14690 | 6962407.657 | 648903.209 | 312.55 | 47A20110616SPR | 312.52 | 0.03 |
| 14691 | 6962943.468 | 649598.558 | 309.65 | 47A20110616SPR | 309.64 | 0.01 |
| 14692 | 6962941.902 | 649583.307 | 309.83 | 47A20110616SPR | 309.83 | 0.00 |
| 14693 | 6962955.381 | 649593.472 | 309.94 | 47A20110616SPR | 309.91 | 0.02 |
| 14694 | 6962964.299 | 649611.224 | 310.05 | 47A20110616SPR | 310.01 | 0.04 |
| 14695 | 6962975.698 | 649619.341 | 310.16 | 47A20110616SPR | 310.11 | 0.05 |
| 14696 | 6963296.436 | 650034.413 | 317.75 | 47A20110616SPR | 317.69 | 0.06 |
| 14697 | 6963307.207 | 650041.621 | 317.87 | 47A20110616SPR | 317.84 | 0.03 |
| 14698 | 6963322.112 | 650066.533 | 318.35 | 47A20110616SPR | 318.33 | 0.02 |
| 14699 | 6958769.214 | 644700.773 | 246.39 | 47A2011061647A_CK_SPIKE | 246.38 | 0.01 |
| 14700 | 6958769.183 | 644700.749 | 246.39 | 47A20110616CK_SPIKE | 246.38 | 0.01 |
| 14800 | 6958769.082 | 644703.764 | 246.88 | 47AFAC | 246.87 | 0.01 |
| 14807 | 6953991.089 | 641186.828 | 231.89 | 47A20110616STATS | 231.86 | 0.03 |
| 14808 | 6964388.058 | 651237.651 | 349.59 | 47A20110616STATS | 349.52 | 0.07 |
| 14809 | 6965500.114 | 652316.65 | 359.42 | 47A20110616STATS | 359.40 | 0.02 |
| 14810 | 6966564.063 | 653491.749 | 377.06 | 47A20110616STATS | 377.12 | -0.06 |
| 14821 | 6953967.105 | 641180.127 | 231.75 | 47A20110616STATS | 231.71 | 0.04 |
| 14822 | 6964371.58 | 651222.867 | 349.39 | 47A20110616STATS | 349.36 | 0.03 |
| 14823 | 6965488.237 | 652303.688 | 359.27 | 47A20110616STATS | 359.21 | 0.06 |
| 14824 | 6966547.334 | 653473.375 | 376.83 | 47A20110616STATS | 376.77 | 0.06 |
| 14832 | 6954004.848 | 641190.763 | 231.95 | 47A20110616STATS | 231.88 | 0.07 |
| 14833 | 6964404.83 | 651252.42 | 349.68 | 47A20110616STATS | 349.65 | 0.03 |
| 14834 | 6965507.692 | 652325.274 | 359.53 | 47A20110616STATS | 359.50 | 0.03 |
| 14835 | 6966573.162 | 653502.097 | 377.31 | 47A20110616STATS | 377.29 | 0.02 |

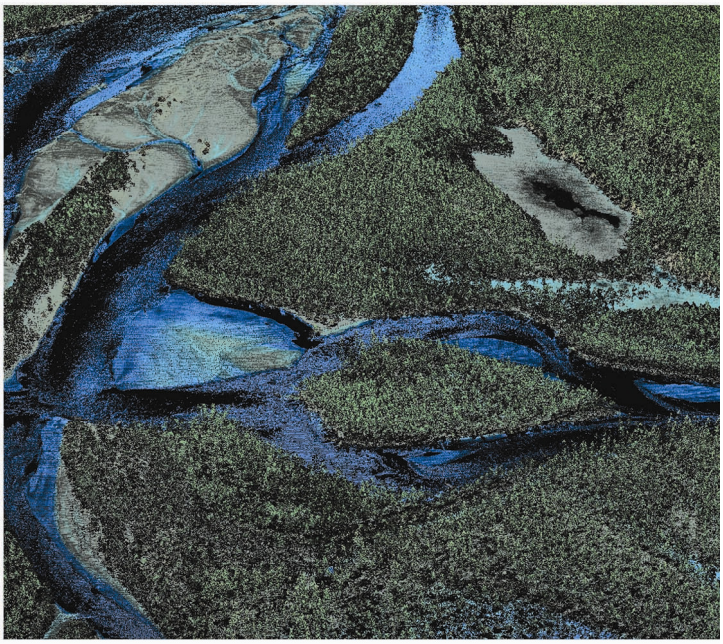
# LiDAR REMOTE SENSING

## ALASKA PIPELINE • ALASKA

(Delivery 6– 9/30/2011)








## ALASKA DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

**TRENT HUBBARD** - 3354 College Road - Fairbanks, AK 99709

**WATERSHED SCIENCES** • 517 SW 2nd Street, Suite 400 - Corvallis, OR 97333

# LiDAR Remote Sensing Data Collection:

## Alaska Pipeline, AK

### Delivery 6

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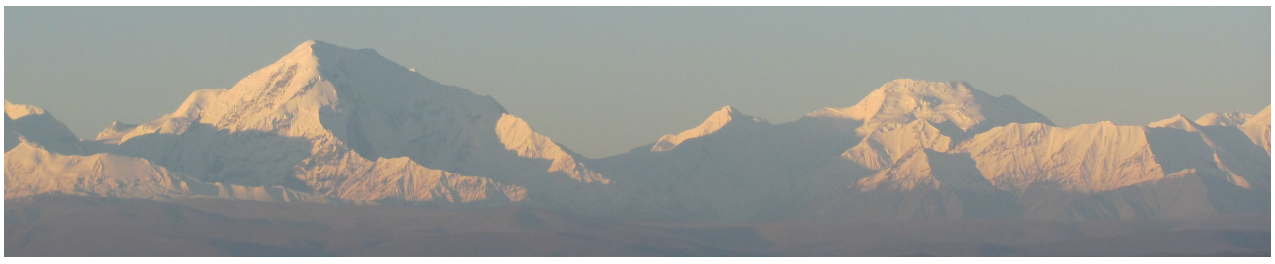
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# 1. Overview

Watershed Sciences, Inc. (WS) collected Light Detection and Ranging (LiDAR) data of the Alaska Pipeline for the Alaska Department of Natural Resources. LiDAR data for Delivery 6 was collected between May 22th and May 31st, 2011 (**Figure 1**). Delivery 6 includes 293,337 acres within the requested area. This area was expanded to include a 100m buffer to ensure complete coverage and adequate point densities around survey boundaries, resulting in 309,216 acres of delivered data. This area follows Dalton Highway from near the Five Mile Airstrip southeast to North Pole, AK. Accuracy and density data will continue to be updated as additional data is processed.

***Figure 1***. *Alaska Pipeline survey delivery status overview.*

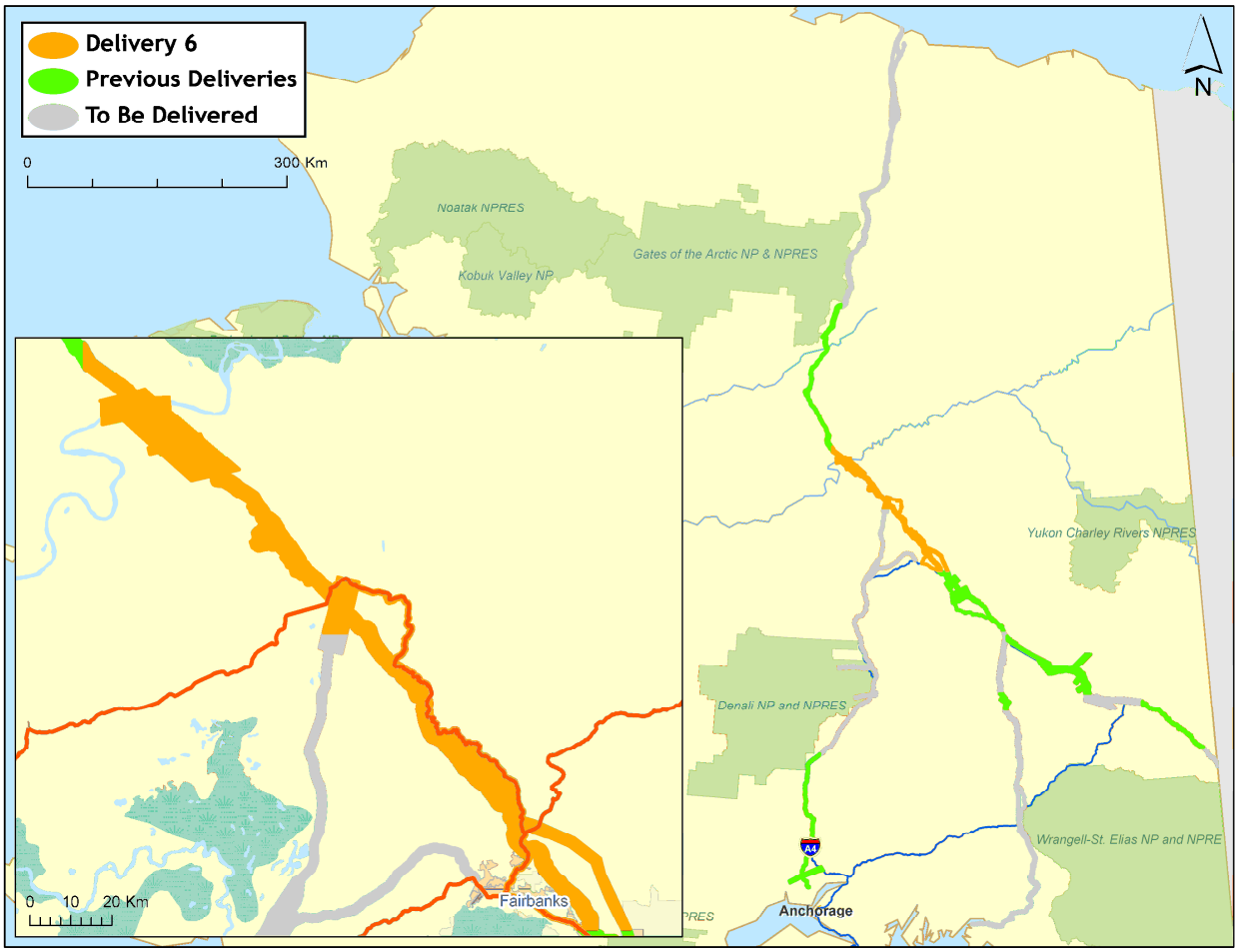


***Table 1**. Alaska Pipeline, LiDAR deliveries to date.*

| Delivery | UTM Zone(s) | Date | Total Acres Flown | AOI Acres |
|---|---|---|---|---|
| **1** | 6, 7 | March 9, 2011 | 121,746 | 117,357 |
| **2** | 6 | March 31, 2011 | 99,594 | 94,885 |
| **3** | 7 | May 23, 2011 | 43,976 | 39,744 |
| **4** | 6 | July 29, 2011 | 168,823 | 159,433 |
| **5** | 5 | August 31, 2011 | 247,206 | 226,450 |
| **6** | 6 | September, 2011 | 309,216 | 293,337 |

# 2. Acquisition

## 2.1 Airborne Survey – Instrumentation and Methods

The LiDAR survey utilized a Leica ALS60 sensor in a Cessna Caravan 208Bs. The Leica systems were set to acquire 150,000 laser pulses per second (i.e., 150 kHz pulse rate) and flown at 1500 meters above ground level (AGL), capturing a scan angle of ±14$^{o}$ from nadir when clouds and terrain permitted. With these flight parameters, the laser swath width is 638m and the laser pulse footprint is 34cm. These settings varied depending on cloud cover and terrain but were consistently adjusted to yield an average native pulse density of ≥8 pulses per square meter over terrestrial surfaces. It is not uncommon for some types of surfaces (e.g. dense vegetation or water) to return fewer pulses than the laser originally emitted. These discrepancies between 'native' and 'delivered' density will vary depending on terrain, land cover, and the prevalence of water bodies.

*The Cessna Caravan is a stable platform, ideal for flying slow and low for high density projects. A Leica ALS60 sensor head installed in the Caravan is shown on the left.*



All areas were surveyed with an opposing flight line side-lap of ≥60% (≥100% overlap) to reduce laser shadowing and increase surface laser painting. The Leica laser systems allow up to four range measurements (returns) per pulse, and all discernable laser returns were processed for the output dataset.

To accurately solve for laser point position (geographic coordinates x, y, z), the positional coordinates of the airborne sensor and the attitude of the aircraft were recorded continuously throughout the LiDAR data collection mission. Aircraft position was measured twice per second (2 Hz) by an onboard differential GPS unit. 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/sensor position and attitude data are indexed by GPS time.

## 2.2 Ground Survey – Instrumentation and Methods

### *2.2.1 Monumentation*




Watershed Sciences coordinated with McClintock Land Associates (MLA, Alaska Professional Licensed Surveyor), of Eagle River, AK to determine proposed monument locations to support aerial acquisition. MLA established survey control monuments for the project area based on the proposed locations, areas with reasonable access, GPS visibility and proximity to the mission area. MLA established 17 new monuments (**Table 2**) within the Delivery 6 calibration area. The MLA monumentation was done with 5/8" x 30" rebar topped with a metal cap stamped with "MLA-WSI" the monument ID, and the year of establishment. MLA provided professional supervision and oversight to all survey aspects of this project, certified all monuments and provided additional independent accuracy check points (see Section 5.4, Appendix B). A full report of the survey will be provided with the final delivery report.

### *2.2.2 Control for Airborne Surveys*

During the LiDAR survey, static (1 Hz recording frequency) ground surveys were conducted over the survey control monuments.

All control monuments were observed for a minimum of two survey sessions lasting no fewer than 4 hours. At the beginning of every session the tripod and antenna were reset, resulting in two independent instrument heights and data files. Data was collected at a rate of 1Hz using a 10 degree mask on the antenna.


Trimble R7 GPS equipment set up in the Alaska Pipeline study area.

After the airborne survey, the static GPS data were provided to MLA for incorporation in the computation of the monument coordinates. MLA processed the static GPS data using triangulation with Continuously Operating Reference Stations (CORS). Both WSI and MLA checked coordinates using the Online Positioning User Service (OPUS[1]) to quantify daily variance. MLA provided calculated geodetic positions for all controls.

Indexed by time, these GPS data were used to correct the continuous onboard measurements of aircraft position recorded throughout the mission. Control monuments were located within 13 nautical miles of the survey area as per the contract.

***Table 2**. Base Station control coordinates for Alaska Pipeline Delivery 6.*

| Base Station ID | Datum: NAD83 (CORS96) | | GRS80 |
|---|---|---|---|
| | Latitude | Longitude | Ellipsoid Z (meters) |
| 14 A | 149 59 57.53764 | 65 58 31.83203 | 192.457 |
| 14 B | 149 54 10.72892 | 65 56 43.26422 | 190.626 |
| 14 C | 149 42 52.36352 | 65 52 46.69368 | 103.218 |
| 15 A | 149 26 58.05535 | 65 47 36.58808 | 410.76 |
| 15 B | 149 24 47.80439 | 65 47 23.01274 | 534.334 |
| 16 A | 148 48 29.22709 | 65 31 05.75044 | 206.483 |
| 16 B | 148 44 58.21015 | 65 30 15.89336 | 460.361 |
| 17 A | 148 18 45.14357 | 65 19 39.83636 | 153.663 |
| 17 B | 148 16 12.25033 | 65 19 14.92353 | 284.953 |
| 17 C | 147 54 42.81782 | 65 09 32.70605 | 303.411 |
| 17 D | 147 51 40.17510 | 65 08 34.24652 | 316.946 |
| 17 E | 147 54 46.58363 | 65 09 33.85677 | 306.06 |
| 18 A | 147 31 15.72889 | 64 53 32.26290 | 224.271 |
| 18 B | 147 32 38.56133 | 64 53 30.70665 | 198.493 |
| 19 A | 147 14 41.47093 | 64 43 22.99489 | 167.362 |
| 19 B | 147 12 10.09804 | 64 43 01.97218 | 169.639 |
| 19 C | 147 03 31.50690 | 64 35 36.78551 | 186.159 |

[1] Online Positioning User Service (OPUS) is run by the National Geodetic Survey to process corrected monument positions.

### *2.2.3 Instrumentation*

For this survey, a Trimble GPS receiver model R7 with Zephyr Geodetic antenna with ground plane was deployed for all static control. A Trimble model R8 GNSS unit was used for collecting check points using real time kinematic (RTK) survey techniques. All GPS measurements were made with dual frequency L1-L2 receivers with carrier-phase correction.

The aircraft was assigned a ground crew member with two Trimble R7 receivers and an R8 receiver. The ground crew vehicles are equipped with standard field survey supplies and equipment including safety materials. The aircraft was further supported, as necessary, by an MLA surveyor (AK PLS) with two or more survey grade Topcon Receivers.

### *2.2.4 Methodology*

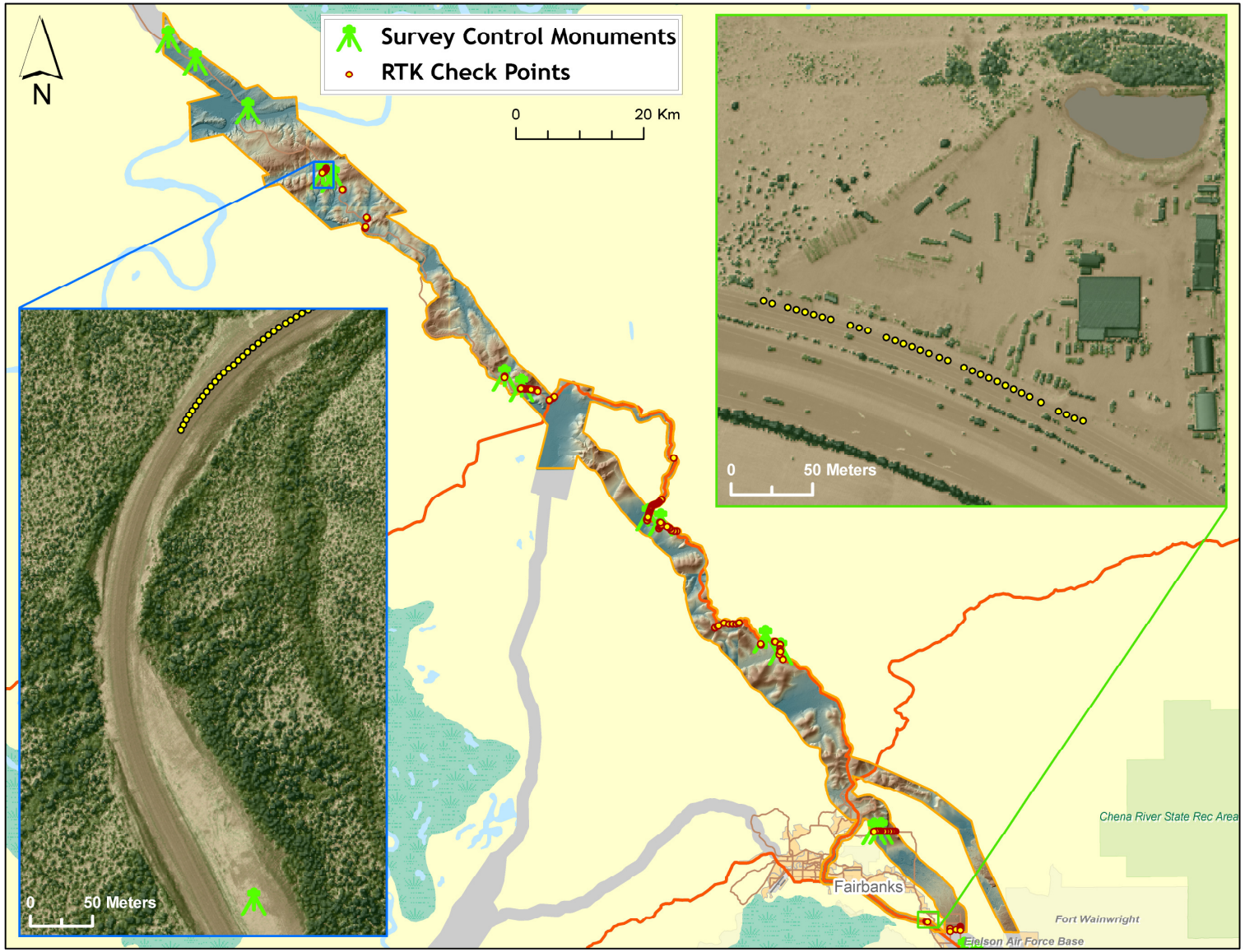
RTK and aircraft mounted GPS measurements were made during periods with PDOP[2] less than or equal to 3.0 and with at least 6 satellites in view of both a stationary reference receiver and the roving receiver. Static GPS data collected in a continuous session average the high PDOP into the final solution in the method used by CORS stations.

For RTK data, the collector begins recording after remaining stationary for 5 seconds then calculating the pseudo range position from at least three epochs with the relative error under 1.5cm horizontal and 2cm vertical. RTK positions are collected on bare earth locations such as paved, gravel or stable dirt roads, and other locations where the ground is clearly visible (and is likely to remain visible) from the sky during the data acquisition and RTK measurement period(s).

In order to facilitate comparisons with LiDAR measurements, RTK measurements were not taken on highly reflective surfaces such as center line stripes or lane markings on roads. RTK points were taken no closer than one meter to any nearby terrain breaks such as road edges or drop offs.

[2]PDOP: Point Dilution of Precision is a measure of satellite geometry, the smaller the number the better the geometry between the point and the satellites.

***Figure 2**. WSI RTK check points and control monument locations used in Delivery 6 of the Alaska Pipeline LiDAR Survey.*



# 3. LiDAR Data Processing

## 3.1 Applications and Work Flow Overview

1. Resolved kinematic corrections for aircraft position data using kinematic aircraft GPS and static ground GPS data.

   **Software:** Waypoint GPS v.8.10, Trimble Geomatics Office v.1.62
2. Developed a smoothed best estimate of trajectory (SBET) file that blends post-processed aircraft position with attitude data. Sensor head position and attitude were calculated throughout the survey. The SBET data were used extensively for laser point processing.

   **Software:** IPAS v.1.35
3. Calculated laser point position by associating SBET position to each laser point return time, scan angle, intensity, etc. Created raw laser point cloud data for the entire survey in *.las (ASPRS v. 1.2) format.

   **Software:** ALS Post Processing Software v.2.70
4. Imported raw laser points into manageable blocks (less than 500 MB) to perform manual relative accuracy calibration and filter for pits/birds. Ground points were then classified for individual flight lines (to be used for relative accuracy testing and calibration).

   **Software:** TerraScan v.11.009
5. Using ground classified points per each flight line, the relative accuracy was tested. Automated line-to-line calibrations were then performed for system attitude parameters (pitch, roll, heading), mirror flex (scale) and GPS/IMU drift. Calibrations were performed on ground classified points from paired flight lines. Every flight line was used for relative accuracy calibration.

   **Software:** TerraMatch v.11.006
6. Position and attitude data were imported. Resulting data were classified as ground and non-ground points. Statistical absolute accuracy was assessed via direct comparisons of ground classified points to ground RTK survey data. Data were then converted to orthometric elevations (NAVD88) by applying a Geoid09 correction. **Software:** TerraScan v.11.009, TerraModeler v.11.004
7. Bare Earth models were created as a triangulated surface and exported as ArcInfo ASCII grids at a 1 meter pixel resolution. Highest Hit models were created for any class at 1 meter grid spacing and exported as ArcInfo ASCII grids. Vegetation models were created for all vegetation points 20cm and above the ground model at a 1m grid spacing and exported as ArcInfo ASCII grids.

   **Software:** TerraScan v.11.009, ArcMap v. 9.3.1, TerraModeler v.11.004

## 3.2 Aircraft Kinematic GPS and IMU Data

LiDAR survey datasets were referenced to the 1 Hz static ground GPS data collected over pre-surveyed monuments with known coordinates. While surveying, the aircraft collected 2 Hz kinematic GPS data, and the onboard inertial measurement unit (IMU) collected 200 Hz aircraft attitude data. Waypoint GPS v.8.10 was used to process the kinematic corrections for the aircraft. The static and kinematic GPS data were then post-processed after the survey to

obtain an accurate GPS solution and aircraft positions. IPAS v.1.35 was used to develop a trajectory file that includes corrected aircraft position and attitude information. The trajectory data for the entire flight survey session were incorporated into a final smoothed best estimated trajectory (SBET) file that contains accurate and continuous aircraft positions and attitudes.

## 3.3 Laser Point Processing

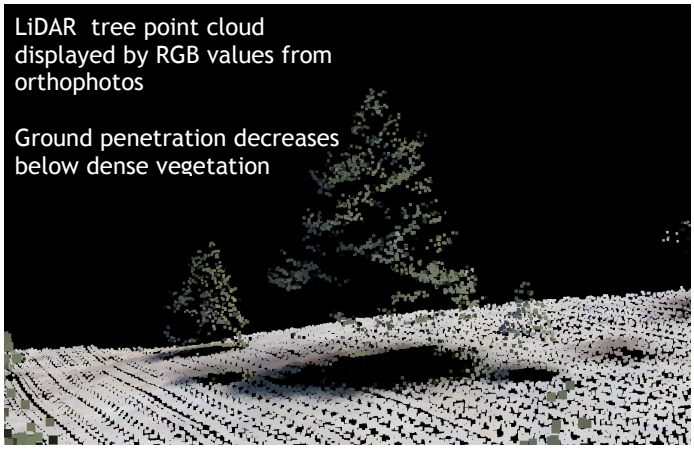
Laser point coordinates were computed using the IPAS and ALS Post Processor software suites based on independent data from the LiDAR system (pulse time, scan angle), and aircraft trajectory data (SBET). Laser point returns (first through fourth) were assigned an associated (x, y, z) coordinate along with unique intensity values (0-255). The data were output into large LAS v. 1.2 files with each point maintaining the corresponding scan angle, return number (echo), intensity, and x, y, z (easting, northing, and elevation) information.

These initial laser point files were too large for subsequent processing. To facilitate laser point processing, bins (polygons) were created to divide the dataset into manageable sizes (< 500 MB). Flightlines and LiDAR data were then reviewed to ensure complete coverage of the survey area and positional accuracy of the laser points.

Laser point data were imported into processing bins in TerraScan, and manual calibration was performed to assess the system offsets for pitch, roll, heading and scale (mirror flex). Using a geometric relationship developed by Watershed Sciences, each of these offsets was resolved and corrected if necessary.

LiDAR points were then filtered for noise, pits (artificial low points), and birds (true birds as well as erroneously high points) by screening for absolute elevation limits, isolated points and height above ground. Each bin was then manually inspected for remaining pits and birds and spurious points were removed. In a bin containing approximately 7.5-9.0 million points, an average of 50-100 points are typically found to be artificially low or high. Common sources of non-terrestrial returns are clouds, birds, vapor, haze, decks, brush piles, etc.

Internal calibration was refined using TerraMatch. Points from overlapping lines were tested for internal consistency and final adjustments were made for system misalignments (i.e., pitch, roll, heading offsets and scale). Automated sensor attitude and scale corrections yielded 3-5 cm improvements in the relative accuracy. Once system misalignments were corrected, vertical GPS drift was then resolved and removed per flight line, yielding a slight improvement (<1 cm) in relative accuracy.




The TerraScan software suite is designed specifically for classifying near-ground points (Soininen, 2004). The processing sequence began by 'removing' all points that were not 'near' the earth based on geometric constraints used to evaluate

multi-return points. The resulting bare earth (ground) model was visually inspected and additional ground point modeling was performed in site-specific areas to improve ground detail. This manual editing of ground often occurs in areas with known ground modeling deficiencies, such as: bedrock outcrops, cliffs, deeply incised stream banks, and dense vegetation. In some cases, automated ground point classification erroneously included known vegetation (i.e., understory, low/dense shrubs, etc.). These points were manually reclassified. Ground surface rasters were then developed from triangulated irregular networks (TINs) of ground points.

To develop the highest hit and vegetation models, buildings and structures were classified through automated point processing algorithms and then manually inspected and edited during the ground model inspection. Typically, manual editing of building classification was necessary where dense canopy was immediately proximate to buildings, or where structures such as utility poles or fences mimicked vegetation.

The remaining points not classified as ground, buildings, or error points were separated into two vegetation classes; Low Vegetation consisting of all returns ≤20cm from the ground, and Medium Vegetation consisting of all returns >20cm from the ground. This distinction was necessary because some potential for unclassified ground exists in the dataset. Vegetation classified returns within 20cm of the ground have higher potential to be artifacts of the dataset caused by minor offsets between flightlines (typically <10cm), isolated noise points, or abrupt discrete terrain features that did not get classified as ground (i.e. small boulders or sharp cliffs). The majority of points classified as low vegetation are valid returns, so the class was retained in the dataset to be incorporated into analyses at the user's discretion.

**Table 3.** ASPRS classification definitions for the Alaska Pipeline LiDAR survey

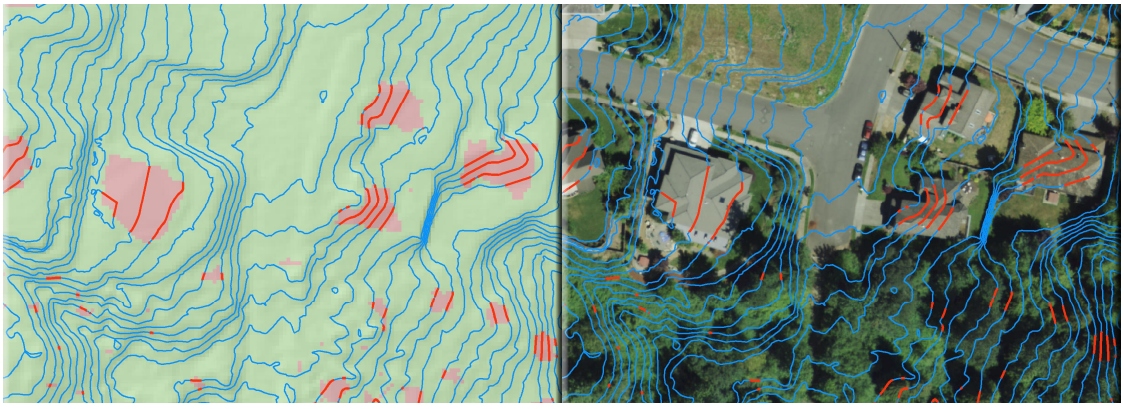
| ASPRS Class | Definition |
|---|---|
| 2 | Ground |
| 3 | Low Vegetation |
| 4 | Medium Vegetation |
| 6 | Buildings/Man-made structures |
| 7 | Noise/error points |
| 9 | Water |
| 15 | Pipeline |

## 3.4 Contour Development

Contour lines were derived at 1 meter intervals from ground-classified LiDAR point data using TerraSolid processing software in MicroStation v. 8.1. Contour generation from LiDAR point data requires a thinning operation in order to reduce contour sinuosity. Parameters for these operations are: thinning elevation bounds: +/- 0.07m; search radius: 6.09m. The thinning operation reduces point density where topographic change is minimal (flat surfaces) while preserving resolution where topographic change is present. The total sum of potential error in vertical position is equal to twice the point processing limits (0.14m) plus twice the 2-sigma absolute vertical accuracy value for this dataset.

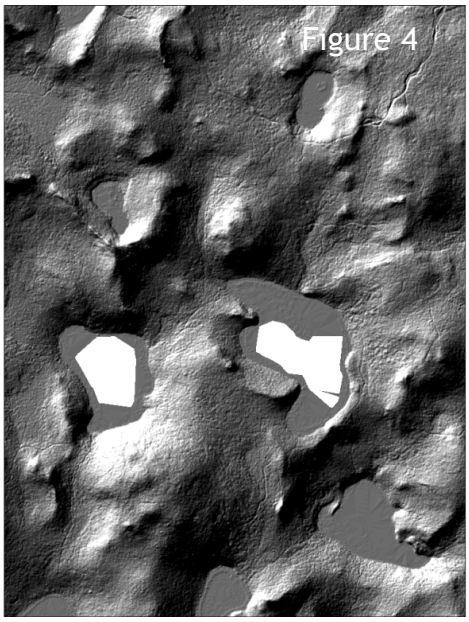
Ground point density rasters were created within MicroStation using a 1 meter step resolution and a 2 meter sampling radius. Areas with less than 0.25 ground-classified points per square meter were considered "sparse" and areas with higher densities were considered "covered". The ground point density raster data are in ESRI GRID format and have a 1 meter pixel resolution. The contour lines were intersected with ground point density raster data, allowing the addition of a confidence attribute to contour lines. Contour lines over "sparse" areas have low confidence, while contour lines over "covered" areas have a high confidence. Areas with low ground point density are commonly beneath buildings and bridges, in locations with dense vegetation, over water, and in other areas where laser penetration to the ground surface is impeded. **Figure 3** is an example of a ground point density raster and contour lines.

***Figure 3**. Elevation contours over LiDAR ground-classified point density raster (left) and true-color aerial photograph (right). Red indicates low ground point density and blue represents high density.*

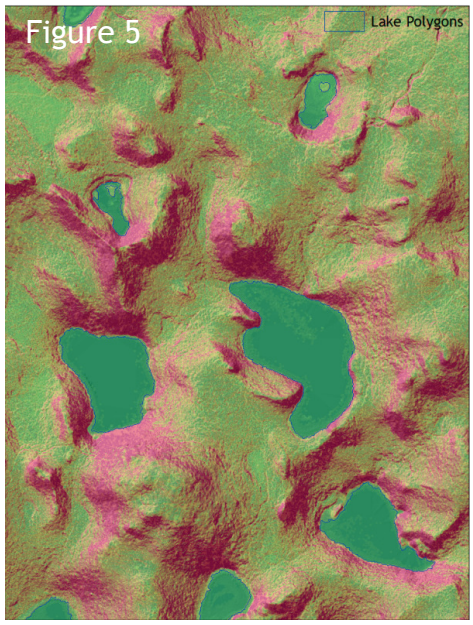


## 3.5 Hydro-Flattening

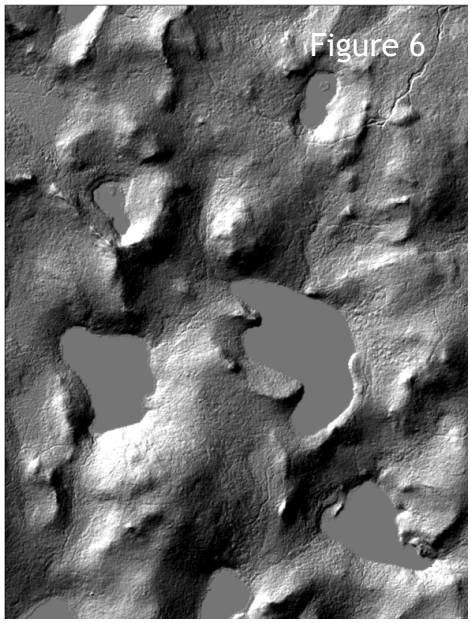
Lakes and other closed water bodies with surface area >150 $m^2$ were flattened to a consistent water level. The hydro-flattening process eliminates artifacts in the digital terrain model caused by both increased variability in ranges or dropouts in laser returns due to the low reflectivity of water (**Figure 4**). As per the project specifications, rivers and streams were not hydro-flattened.




Hydro-flattening of closed water bodies was performed through a combination of automated and manual detection and adjustment techniques designed to identify lake boundaries and water levels. Boundary polygons were developed using an algorithm which weights LiDAR-derived slopes, intensities, and return densities to detect the lake edge. The lake edges were then manually reviewed and edited in a 3-D environment. Once polygons were developed, the lake elevations were computed from the filtered LiDAR returns (**Figure 5**).




Returns from the water surface within each polygon were filtered and inspected for false low points during the initial ground modeling process described previously (Section 3.3). The elevation of each lake was computed as 5-cm above the minimum elevation of filtered water surface cells within the lake polygon. This approach ensures that all spurious returns off the water surface (both artificially high and low) were excluded from lake level assessment.




Lake-boundary polygons were then incorporated into the final terrain model and enforced as hard-breaklines. The initial ground classified points falling within lake polygons were reclassified as water points [to omit them from the final ground model] and replaced with the flat water surface of the lake boundary hydrolines (**Figure 6**).

# 4. LiDAR Accuracy Assessment

## 4.1 Laser Noise and Relative Accuracy

*Laser Noise*
For any given target, laser noise is the breadth of the data cloud per laser return (i.e., last, first, etc.). Lower intensity surfaces (roads, rooftops, still/calm water) experience higher laser noise. The laser noise range for this survey was approximately 0.02 meters.

*Relative Accuracy*
Relative accuracy refers to the internal consistency of the data set - the ability to place a laser point in the same location over multiple flight lines, GPS conditions, and aircraft attitudes. Affected by system attitude offsets, scale, and GPS/IMU drift, internal consistency is measured as the divergence between points from different flight lines within an overlapping area. Divergence is most apparent when flight lines are opposing. When the LiDAR system is well calibrated, the line-to-line divergence is low (<10 cm). See Appendix A for further information on sources of error and operational measures that can be taken to improve relative accuracy.

**Relative Accuracy Calibration Methodology**

1. Manual System Calibration: Calibration procedures for each mission require solving geometric relationships that relate measured swath-to-swath deviations to misalignments of system attitude parameters. Corrected scale, pitch, roll and heading offsets were calculated and applied to resolve misalignments. The raw divergence between lines was computed after the manual calibration was completed and reported for each survey area.
2. Automated Attitude Calibration: All data were tested and calibrated using TerraMatch automated sampling routines. Ground points were classified for each individual flight line and used for line-to-line testing. System misalignment offsets (pitch, roll and heading) and scale were solved for each individual mission and applied to respective mission datasets. The data from each mission were then blended when imported together to form the entire area of interest.
3. Automated Z Calibration: Ground points per line were used to calculate the vertical divergence between lines caused by vertical GPS drift. Automated Z calibration was the final step employed for relative accuracy calibration.

## 4.2 Absolute Accuracy

Laser point absolute accuracy is largely a function of laser noise and relative accuracy. To minimize these contributions to absolute error, a number of noise filtering and calibration procedures were performed prior to evaluating absolute accuracy. The LiDAR quality assurance process uses the data from the real-time kinematic (RTK) ground survey conducted in the AOI. For Delivery 6, **2010 RTK** GPS measurements were collected on hard surfaces distributed among multiple flight swaths for a total of 12,793 points across all delivered data. Suitable and accessible hard-surfaces limited the number and distribution of RTK points able to be collected. To assess absolute accuracy the location coordinates of these known RTK ground points were compared to those calculated for the closest ground-classified laser points.

The vertical accuracy of the LiDAR data is described as the mean and standard deviation (sigma ~ $\sigma$) of divergence between LiDAR point coordinates and RTK ground survey point coordinates. To provide a sense of the model predictive power of the dataset, the root mean square error (RMSE) for vertical accuracy is also provided. These statistics assume the error distributions for x, y, and z are normally distributed, thus the skew and kurtosis of distributions are considered when evaluating error statistics.

Statements of statistical accuracy apply to fixed terrestrial surfaces only and may not be applied to areas of dense vegetation or steep terrain (See Appendix A).

# 5. Study Area Results

Summary statistics for point resolution and accuracy (relative and absolute) of the LiDAR data collected in the Alaska Pipeline Delivery 6 survey area have been added to previously delivered data. Cumulative results are presented below in terms of central tendency, variation around the mean, and the spatial distribution of the data (for point resolution by processing bin).

The initial dataset, acquired to be ≥8 points per square meter, was filtered as described previously to remove spurious or inaccurate points. Additionally, some types of surfaces (i.e., dense vegetation, breaks in terrain, water, steep slopes) may return fewer pulses (delivered density) than the laser originally emitted (native density).

Ground classifications were derived from automated ground surface modeling and manual, supervised classifications where it was determined that the automated model had failed. Ground return densities will be lower in areas of dense vegetation, water, or buildings.

## Data Summary:

***Table 4****. LiDAR Resolution and Accuracy - Specifications and Achieved Values*

| | | Targeted | Achieved |
|---|---|---|---|
| **Resolution:** | **UTM 5** | ≥ 8 points/$m^2$ | 8.60 points/$m^2$ |
| | **UTM 6** | | 8.67 points/$m^2$ |
| | **UTM 7** | | 8.68 points/$m^2$ |
| **Vertical Accuracy (1 $\sigma$):** | | <13 cm | 3.4 cm |

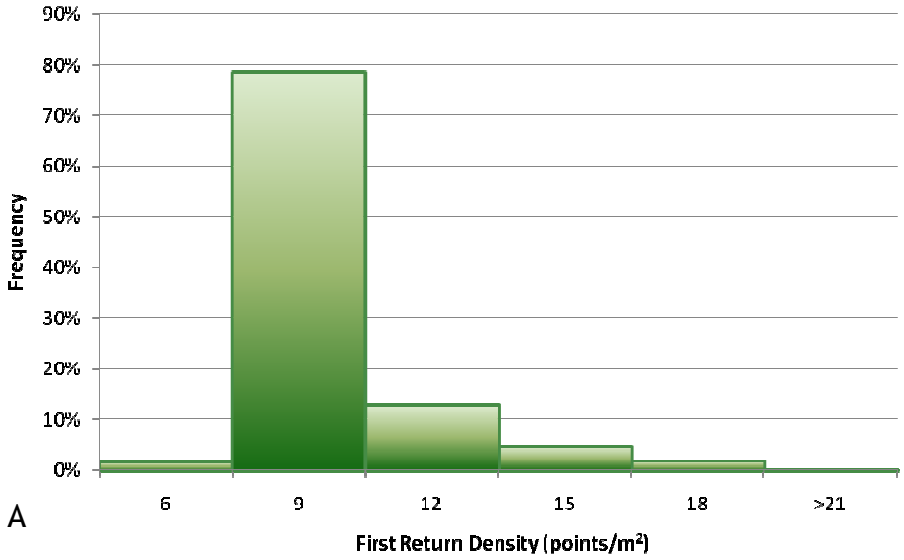
## 5.1 Data Density/Resolution

**Figures 10 - 17** display the distribution of average native and ground point densities for each processing bin. Density data will continue to be updated as data is processed and delivered.

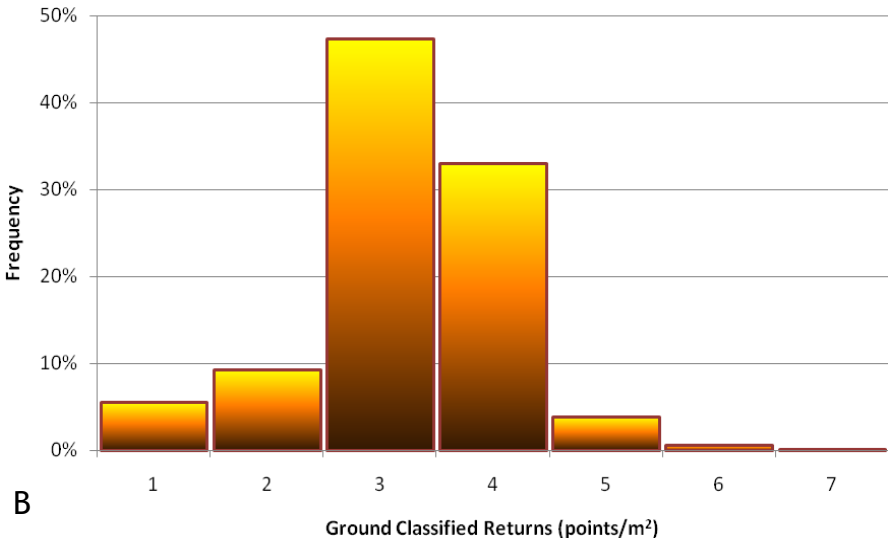
LiDAR data resolution for Alaska Pipeline deliveries to date:

| | UTM 5 | UTM 6 | UTM 7 |
|---|---|---|---|
| Average Point (First Return) Density | 8.60 points/$m^2$ | 8.67 points/$m^2$ | 8.68 points/$m^2$ |
| Average Ground Point Density | 2.72 points/$m^2$ | 2.49 points/$m^2$ | 2.90 points/$m^2$ |

***Figure 7**. Density distribution for first return (A) and ground classified (B) laser points for UTM 5*




A




B

***Figure 8.*** *Density distribution for first return (A) and ground classified (B) laser points for UTM 6*

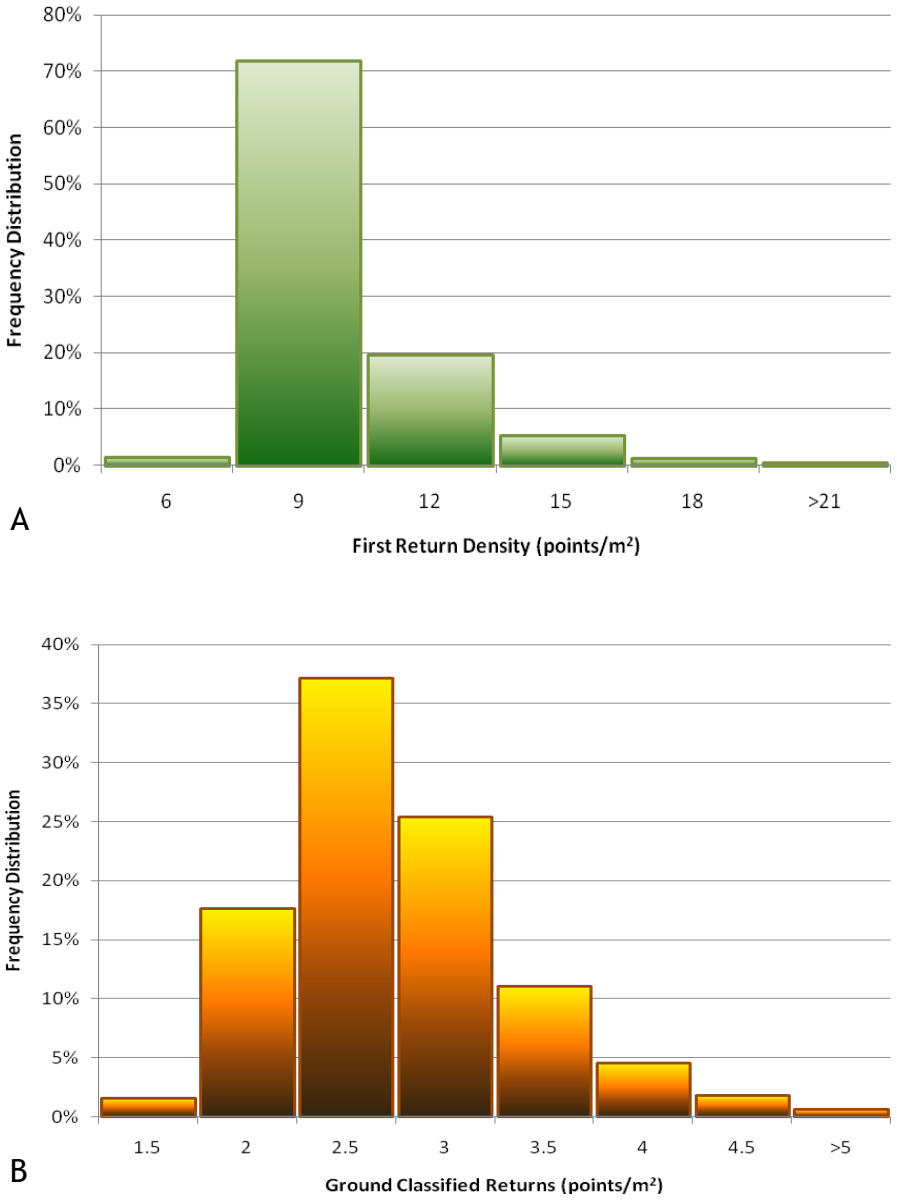


***Figure 9**. Density distribution for first return (A) and ground classified (B) laser points for UTM 7*

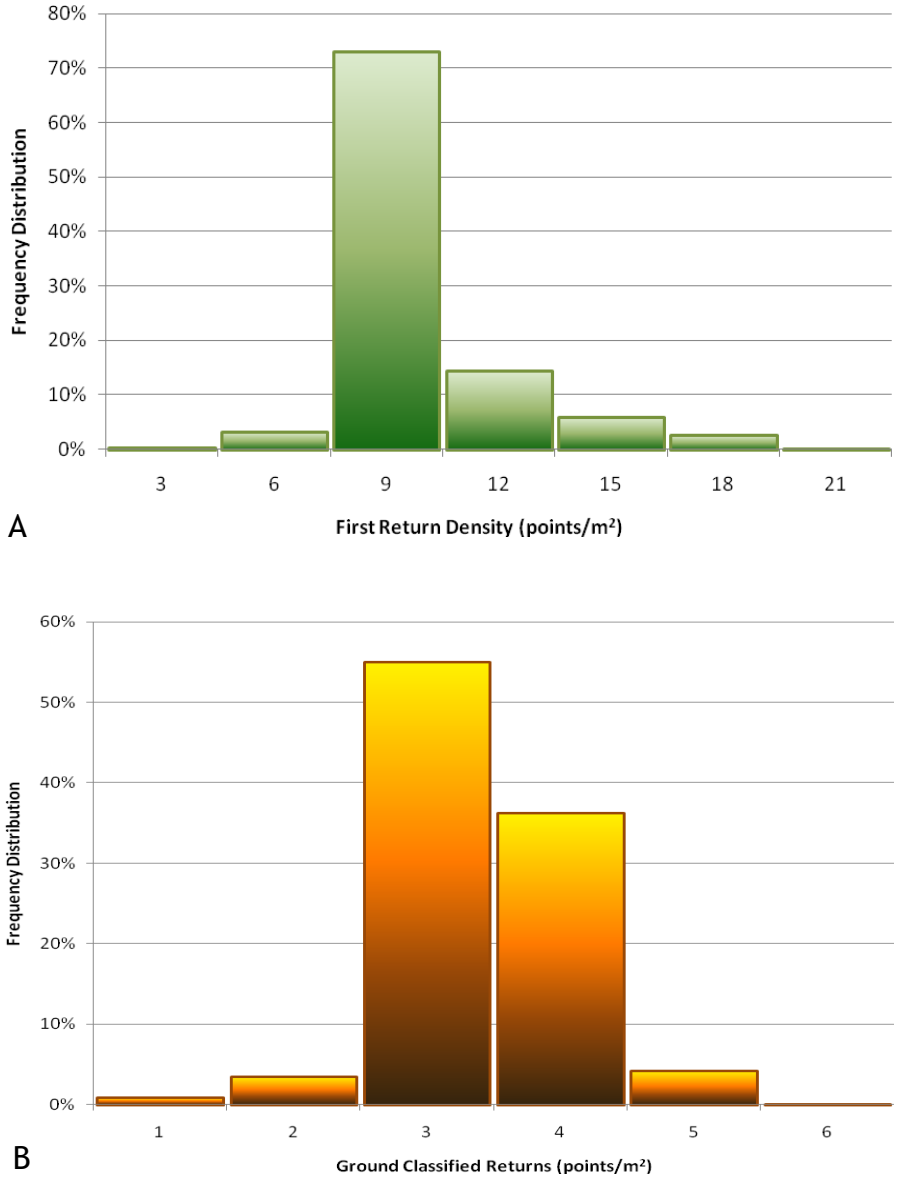


***Figure 10.*** *Density distribution map for ground and first return points by processing bin in Delivery 1, UTM 6*

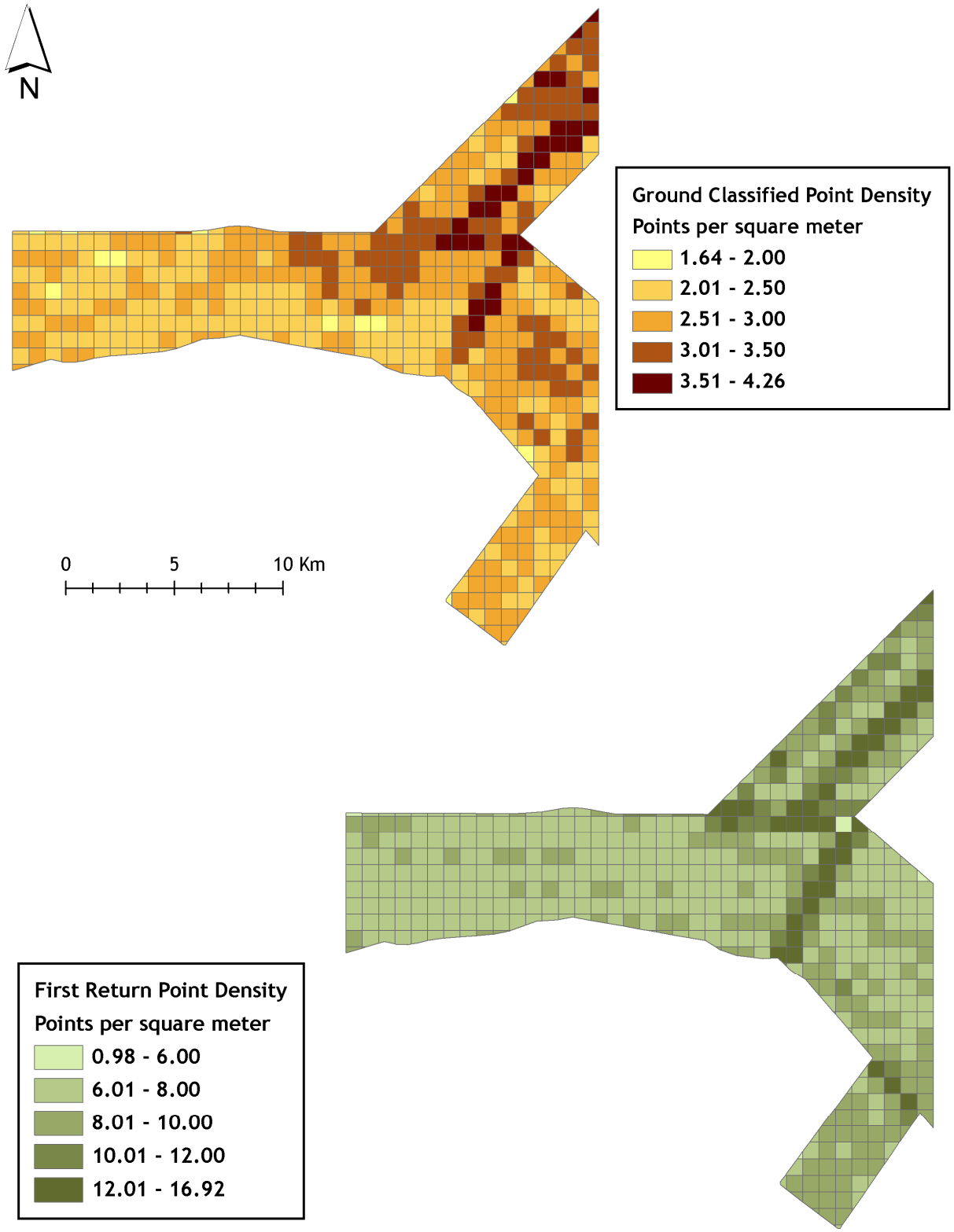


***Figure 11.*** *Density distribution map for ground and first return points by processing bin in Delivery 1, UTM 7*

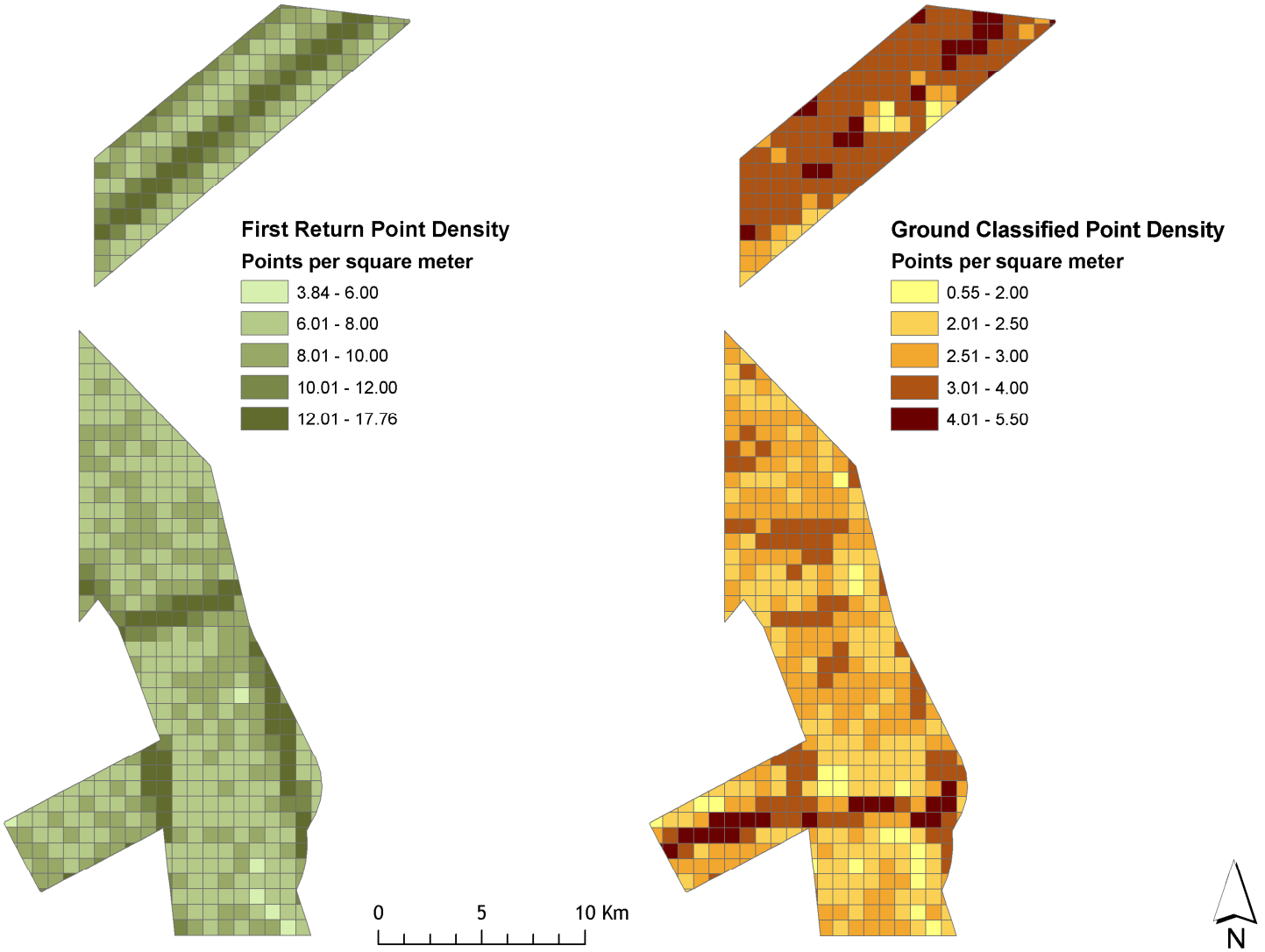


***Figure 12.*** *Density distribution map for ground points by processing bin in Delivery 2, UTM 6*

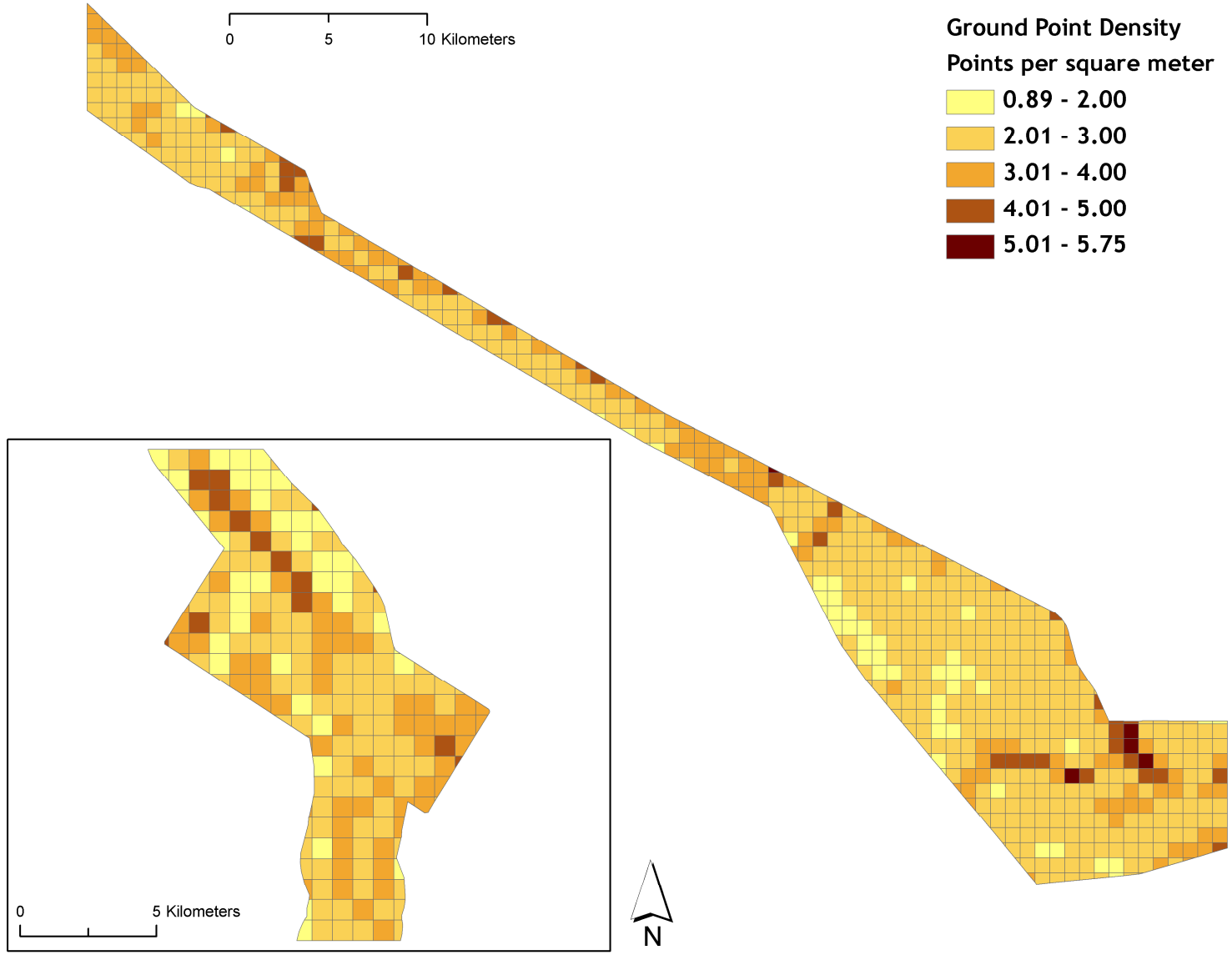


***Figure 13***. *Density distribution map for first return points by processing bin in Delivery 2, UTM 6*

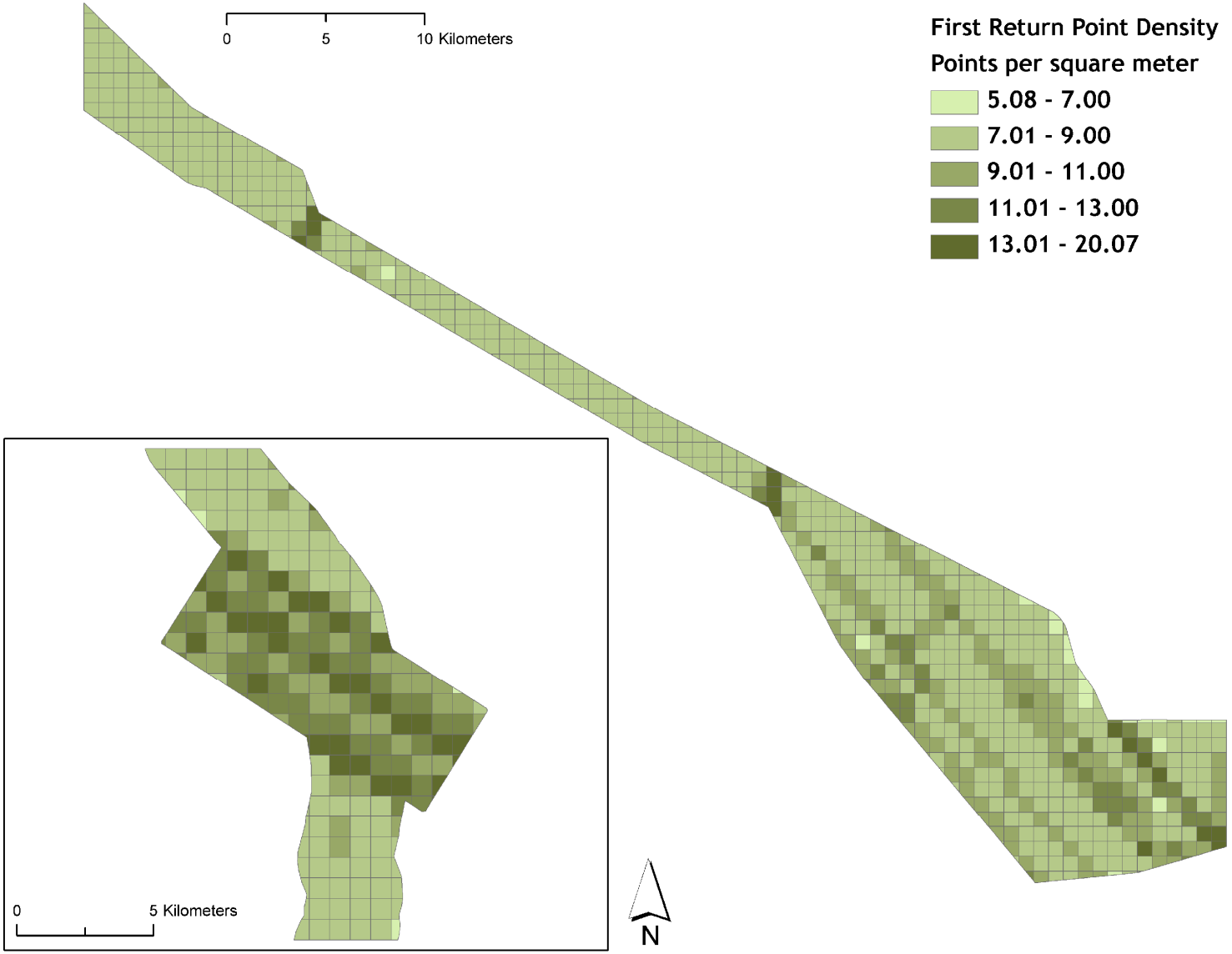


***Figure 14**. Density distribution map for ground and first return points by processing bin in Delivery 3, UTM 7*

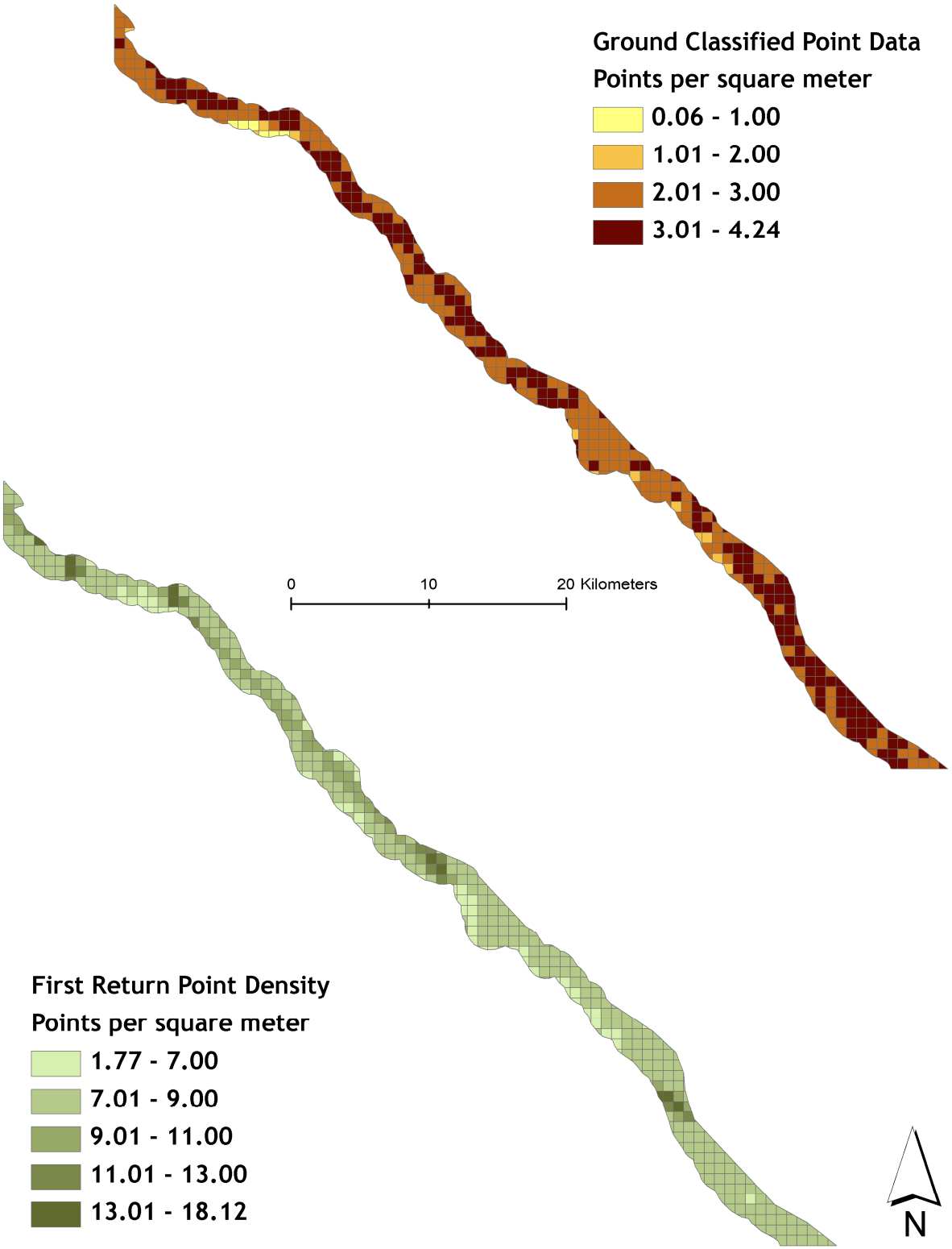


***Figure 15**. Density distribution map for ground and first return points by processing bin in Delivery 4, UTM 6*

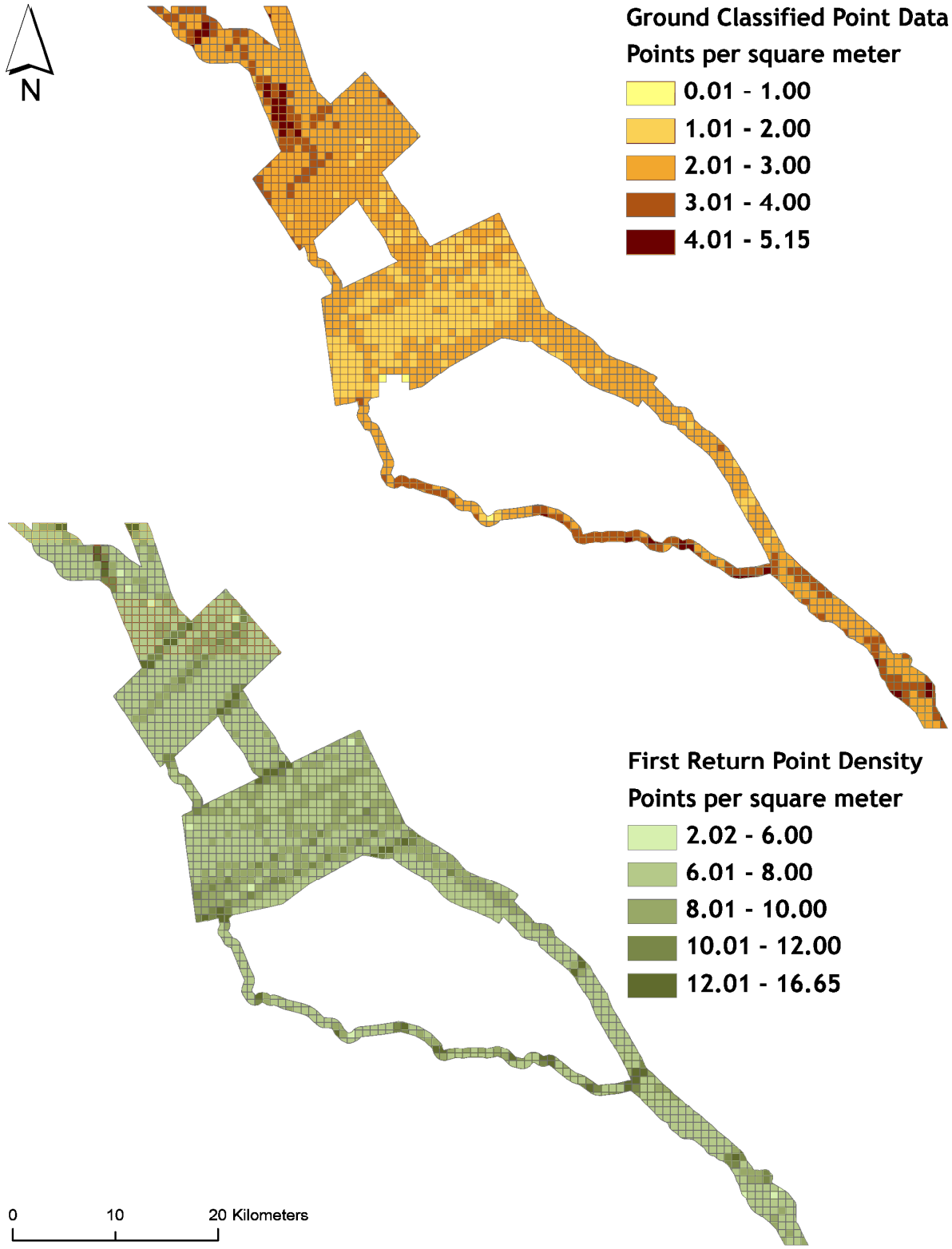


***Figure 16**. Density distribution map for ground classified points by processing bin in Delivery 5, UTM 5*



***Figure 17.*** *Density distribution map for first return points by processing bin in Delivery 5, UTM 5*



***Figure 18**. Density distribution map for ground classified points by processing bin in Delivery 6, UTM 6*

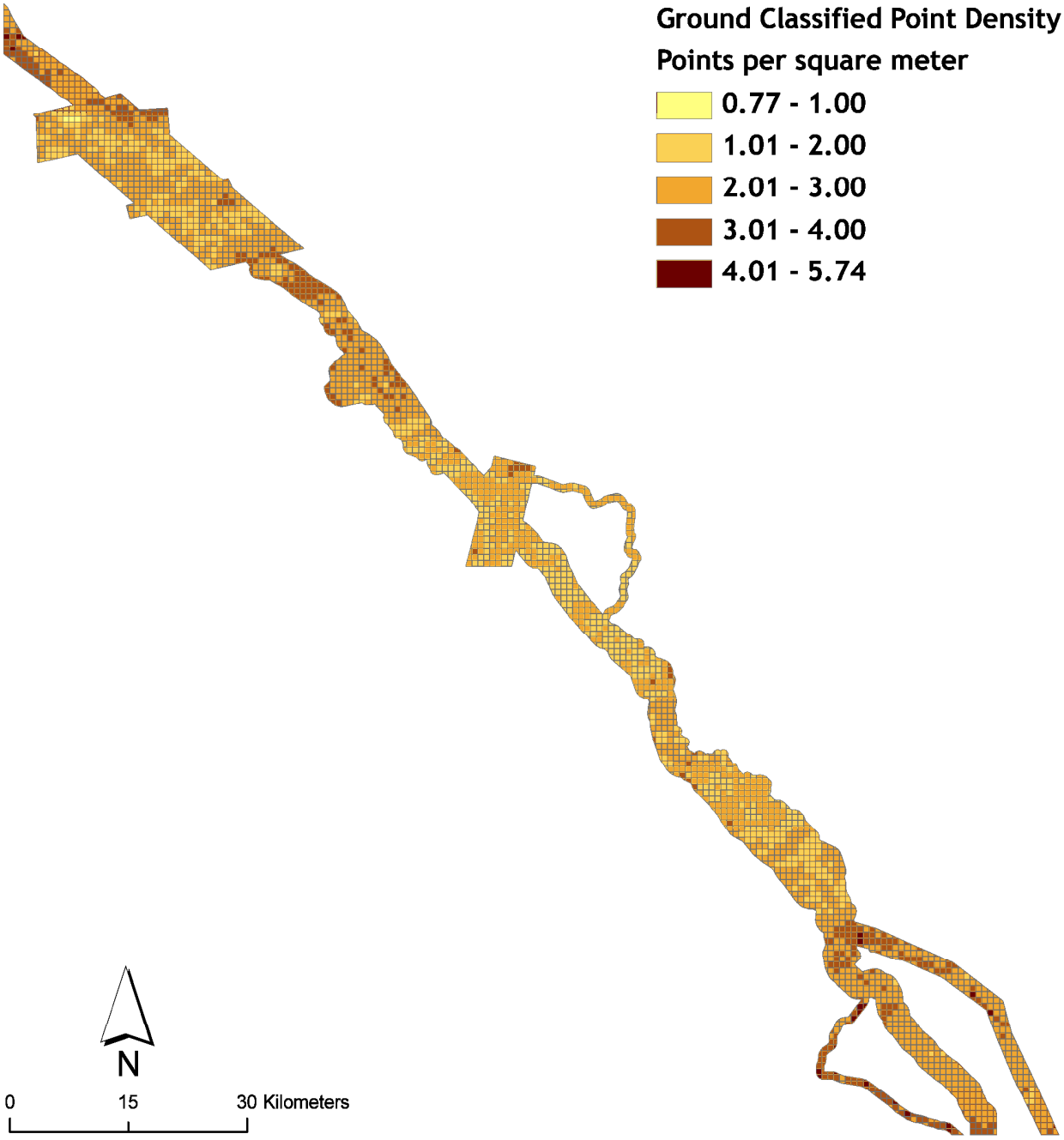
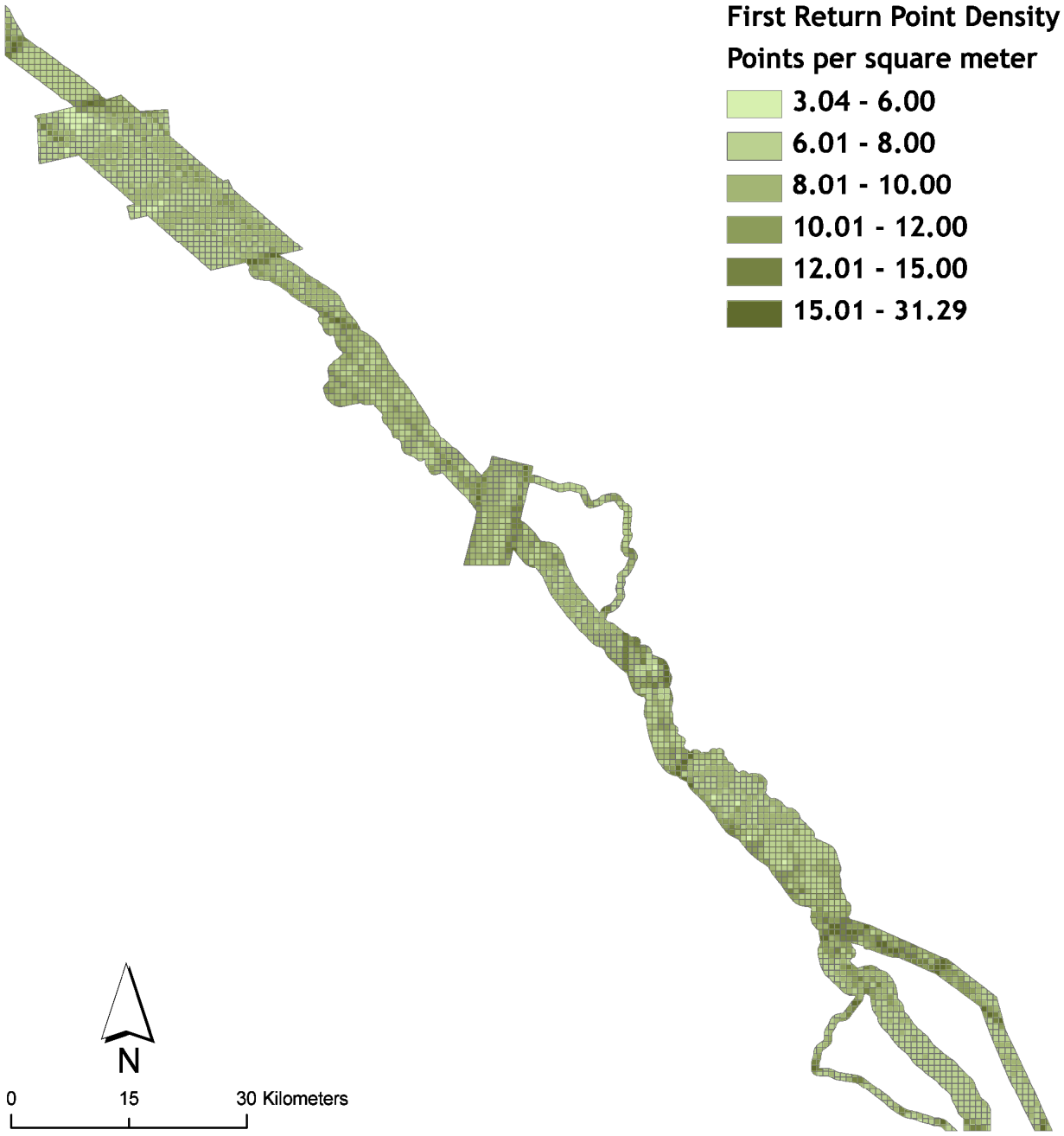


***Figure 19**. Density distribution map for first return points by processing bin in Delivery 6, UTM 6*

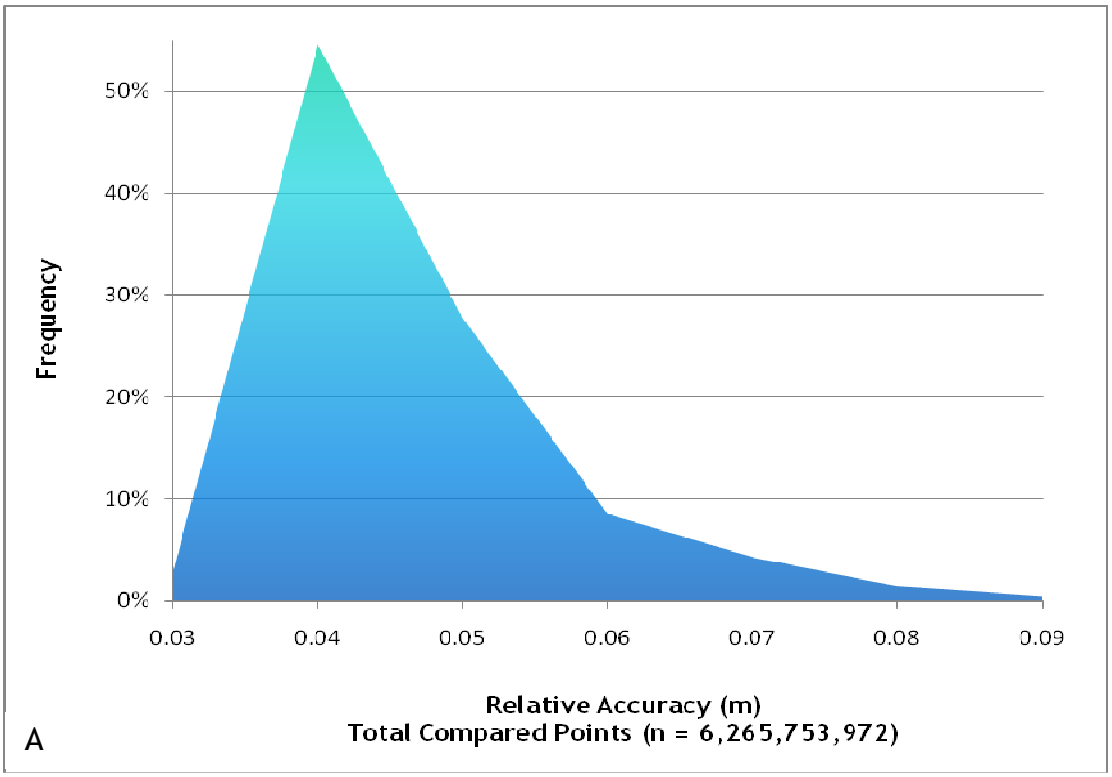


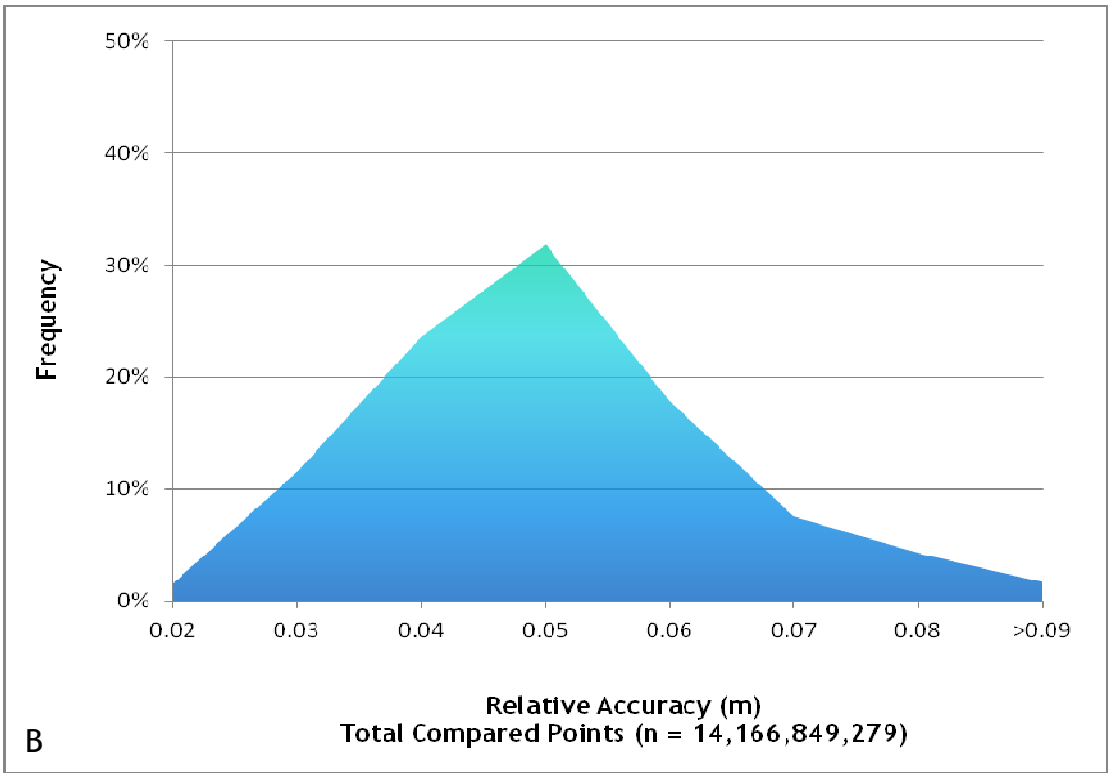
## 5.2 Relative Accuracy Calibration Results

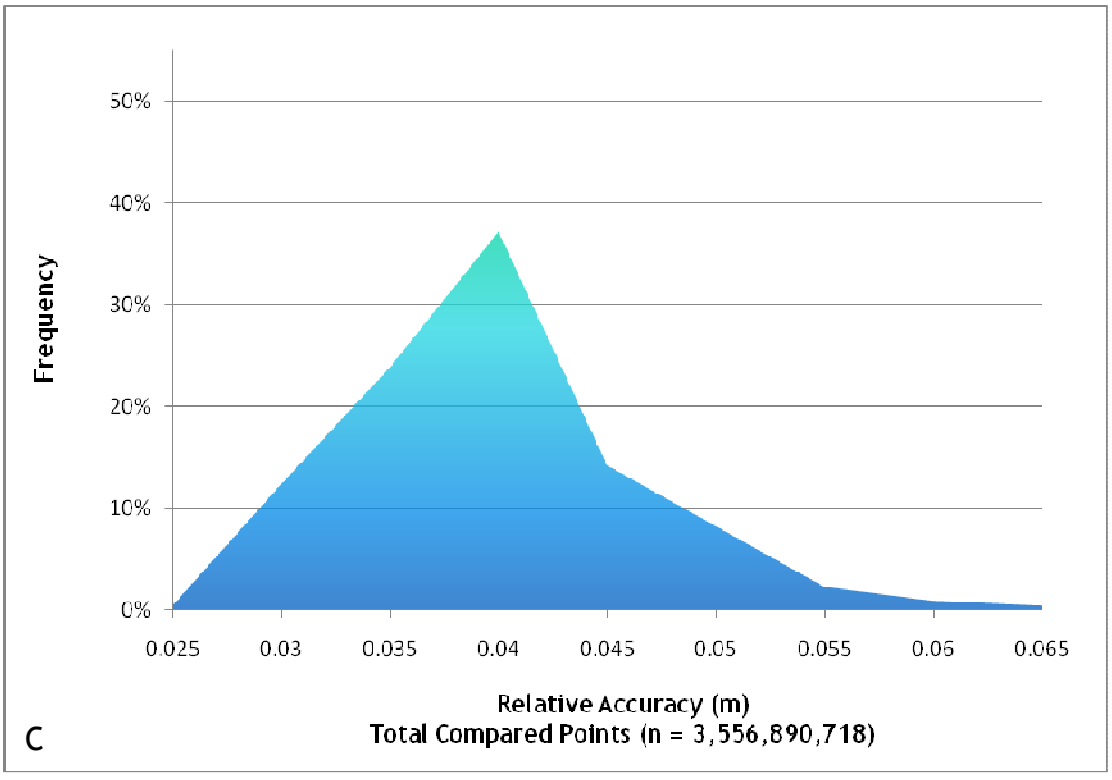
***Table 5**. Cumulative relative accuracy statistics for Alaska Pipeline deliveries to date.*

| | UTM 5 | UTM 6 | UTM 7 |
|---|---|---|---|
| Project Average | 0.039m | 0.039m | 0.037m |
| Median Relative Accuracy | 0.039m | 0.044m | 0.037m |
| 1σ Relative Accuracy | 0.010m | 0.014m | 0.006m |
| 1.96σ Relative Accuracy | 0.019m | 0.027m | 0.012m |

***Figure 20**. Distribution of cumulative relative accuracies in UTM5 (A) UTM 6 (B) and UTM 7 (C) per flight line, non slope-adjusted*




50%
40%
30%
20%
10%
0%
Frequency
0.02
0.03
0.04
0.05
0.06
0.07
0.08
>0.09
Relative Accuracy (m)
Total Compared Points (n = 14,166,849,279)
B


50%
40%
30%
20%
10%
0%
Frequency
0.025
0.03
0.035
0.04
0.045
0.05
0.055
0.06
0.065
Relative Accuracy (m)
Total Compared Points (n = 3,556,890,718)
C

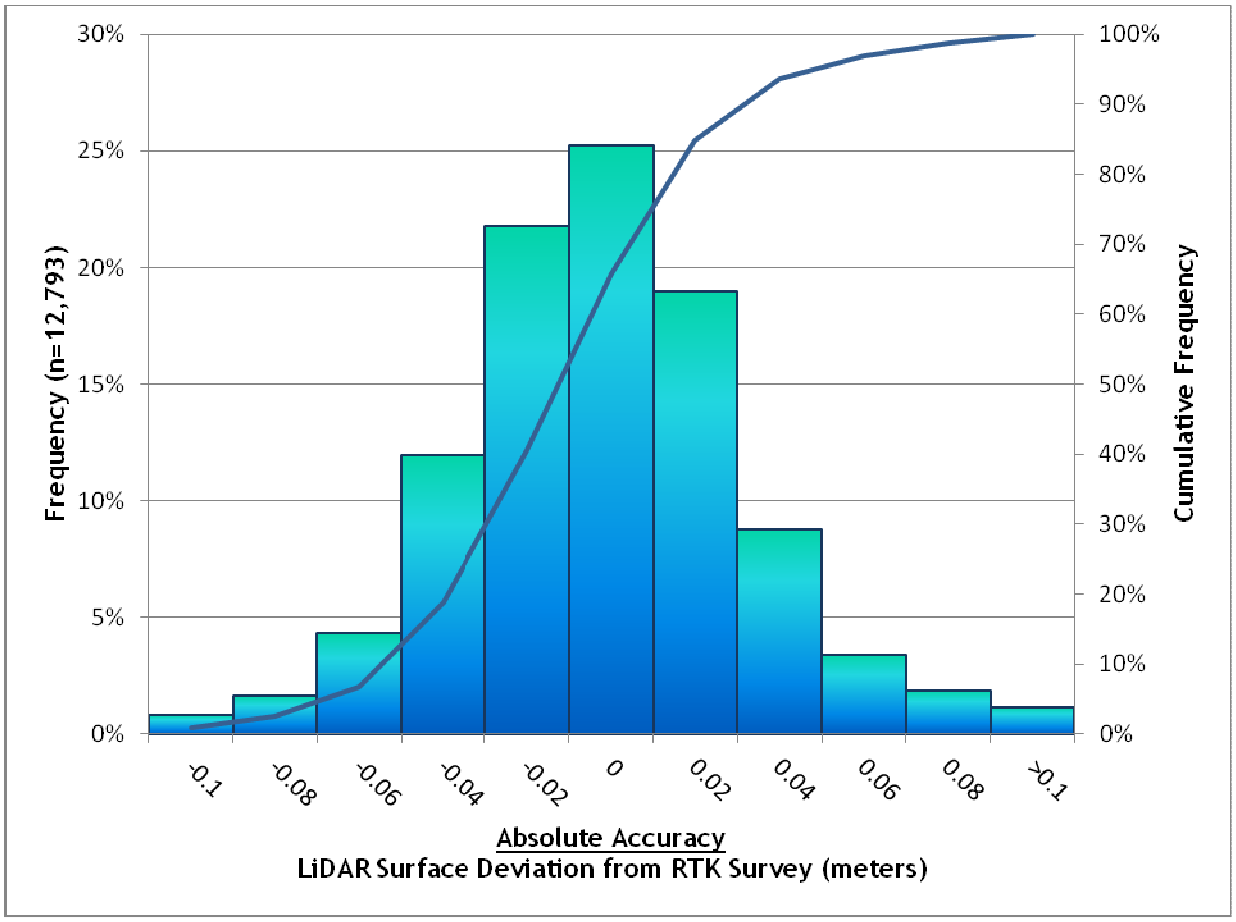
## 5.3 Absolute Accuracy

Absolute accuracies for Alaska Pipeline deliveries to date: All data was calibrated and processed in UTM 6 and then transformed to the appropriate projection.

***Table 6.*** *Absolute Accuracy - Deviation between laser points and RTK hard surface survey points*

| RTK Survey Sample Size (n): 12,793 | |
|---|---|
| Root Mean Square Error (RMSE): 0.036m | Minimum Δz = -0.151m |
| Standard Deviations<br>1 sigma (σ): 0.034m 1.96 sigma (σ): 0.067m | Maximum Δz = 0.116m |
| | Average Δz = -0.011m |

***Figure 21.*** *Absolute Accuracy - Histogram Statistics*



## 5.4 Independent Accuracy Assessment

In accordance with the project plan, McClintock Land Associates (AK PLS) collected independent (i.e. blind) check points within the survey area to provide an independent assessment of LiDAR accuracy. WSI was provided with Easting and Northing positions for points which were then assigned elevations from the LiDAR. MLA received this report and compared the LiDAR Z values to MLA's surveyed (or known) Z values.

***Table 7**. Absolute accuracy determined by the project surveyor (MLA) using "Blind" Check Points (See Appendix B for PLS report)*

| Delivery | # of Check Points | RMSE | Range |
|---|---|---|---|
| 1 | 735 | 0.062m | 0.240m |
| 2 | 1096 | 0.035m | 0.204m |
| 3 | 1088 | 0.078m | 0.182m |
| 4 | 730 | 0.039m | 0.394m |
| 5 | 2293 | 0.073m | 0.567m |
| 6 | 1510 | 0.050m | 0.730m |

## 6. Projection/Datum and Units

| | | |
|---|---|---|
| | **Projection:** | UTM Zone 5, 6, 7 North |
| **Datum** | **Vertical:** | NAVD88 Geoid09 |
| | **Horizontal:** | NAD83 |
| | **Units:** | meters |

## 7. Deliverables

| | |
|---|---|
| **Point Data:** | • All Returns (LAS 1.2 format)<br>• Ground Returns (LAS 1.2 format) |
| **Vector Data:** | • Project Boundary (shapefile format)<br>• Tile Index for LiDAR Points (shapefile format)<br>• Tile Index for DEMs (shapefile format)<br>• Contours (1m shapefile format, DXF format)<br>• RTK (shapefile format, .TXT format)<br>• SBETs (shapefile format, DBF format)<br>• Lake Boundaries (shapefile format) |
| **Raster Data:** | • Elevation Models (1m resolution)<br>  • Hydro-flattened Bare Earth Model (ESRI GRID format)<br>  • Highest Hit Model (ESRI GRID format)<br>  • Vegetation Model (ESRI GRID format)<br>  • nDSM Model (ESRI GRID format)<br>• Intensity Images (GeoTIFF format, 0.5m resolution)<br>• Vegetation Metrics (5m resolution)<br>  • Canopy Cover (ESRI GRID format)<br>  • Coefficient of Variation (ESRI GRID format)<br>  • Mean Elevation (ESRI GRID format) |
| **Data Report:** | • Full report containing introduction, methodology, and accuracy |

# 8. Selected Images

***Figure 22**. Castle Mountain Fault system northeast of Flathorn Lake. Top image is bare earth model, bottom image is bare earth overlain with slope calculations.*

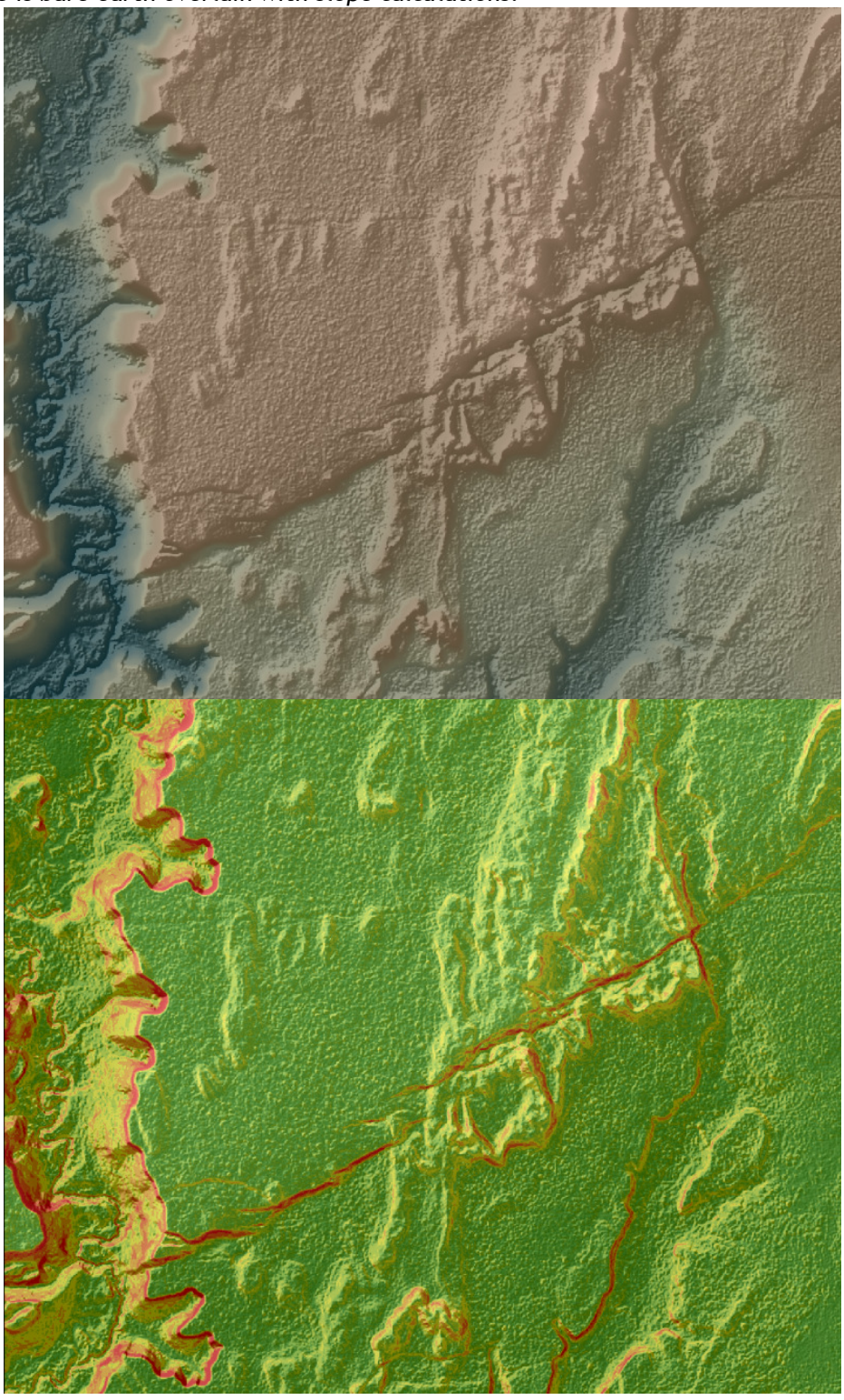


***Figure 23**. View across braided channels of the Tanana River near Dot Lake. Top image is Bare Earth model. Bottom image is LiDAR point cloud colored by elevation.*

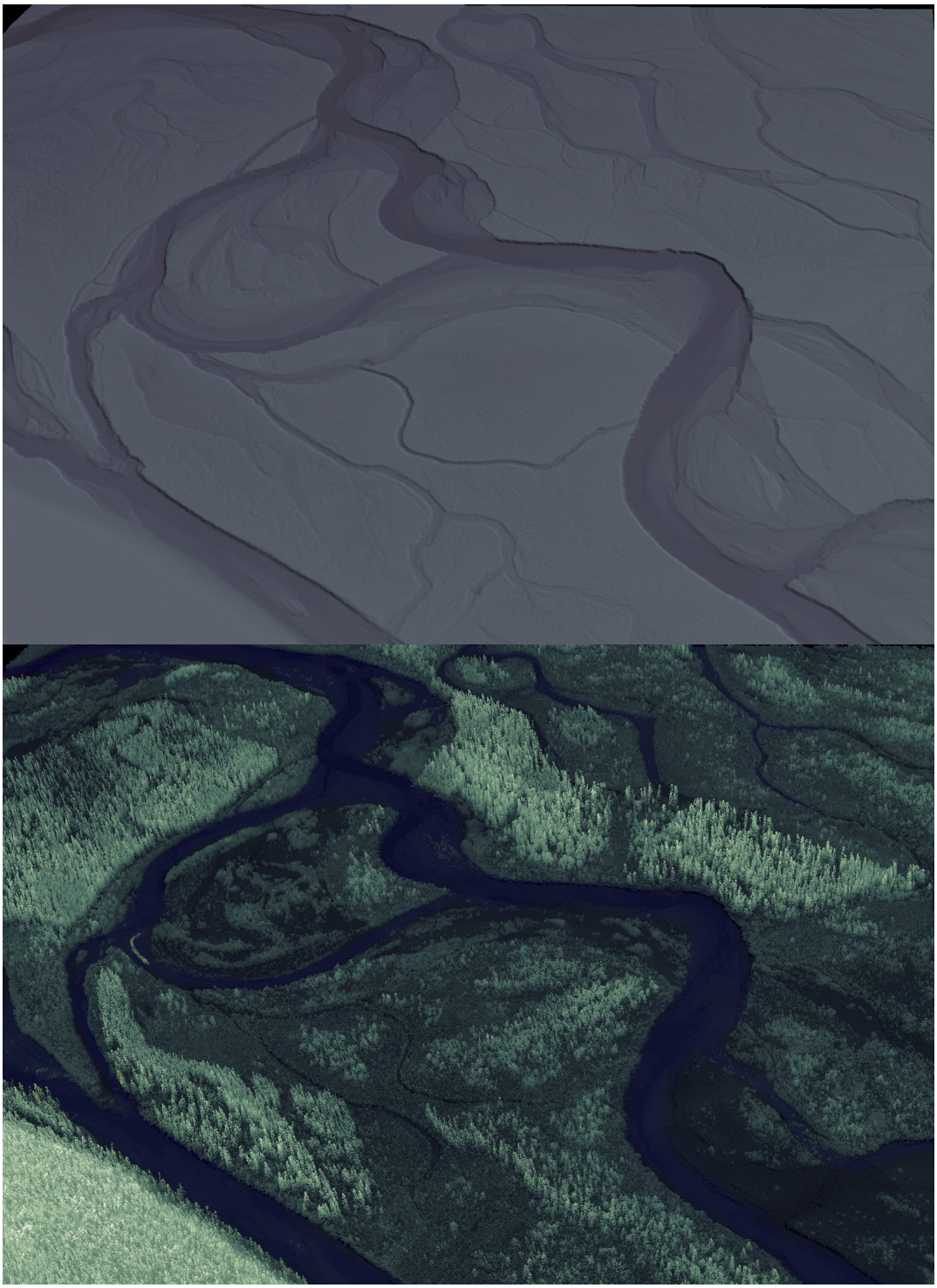


***Figure 24**. View looking north across Gerstle River along A2. Image is 3D LiDAR point cloud colored by elevation.*

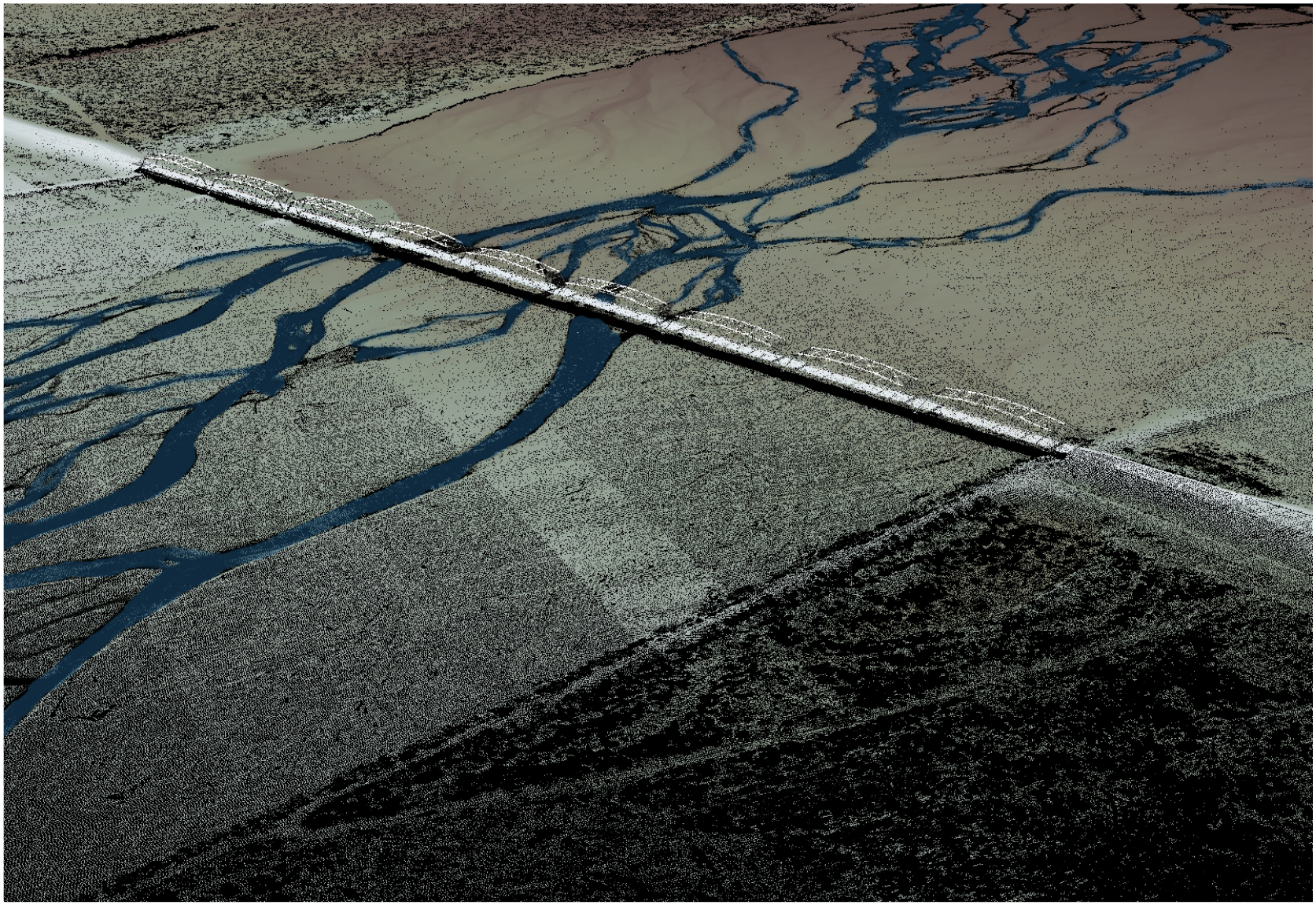


***Figure 25**. Northern end of above ground pipeline near Trims Camp along Hwy 4.*

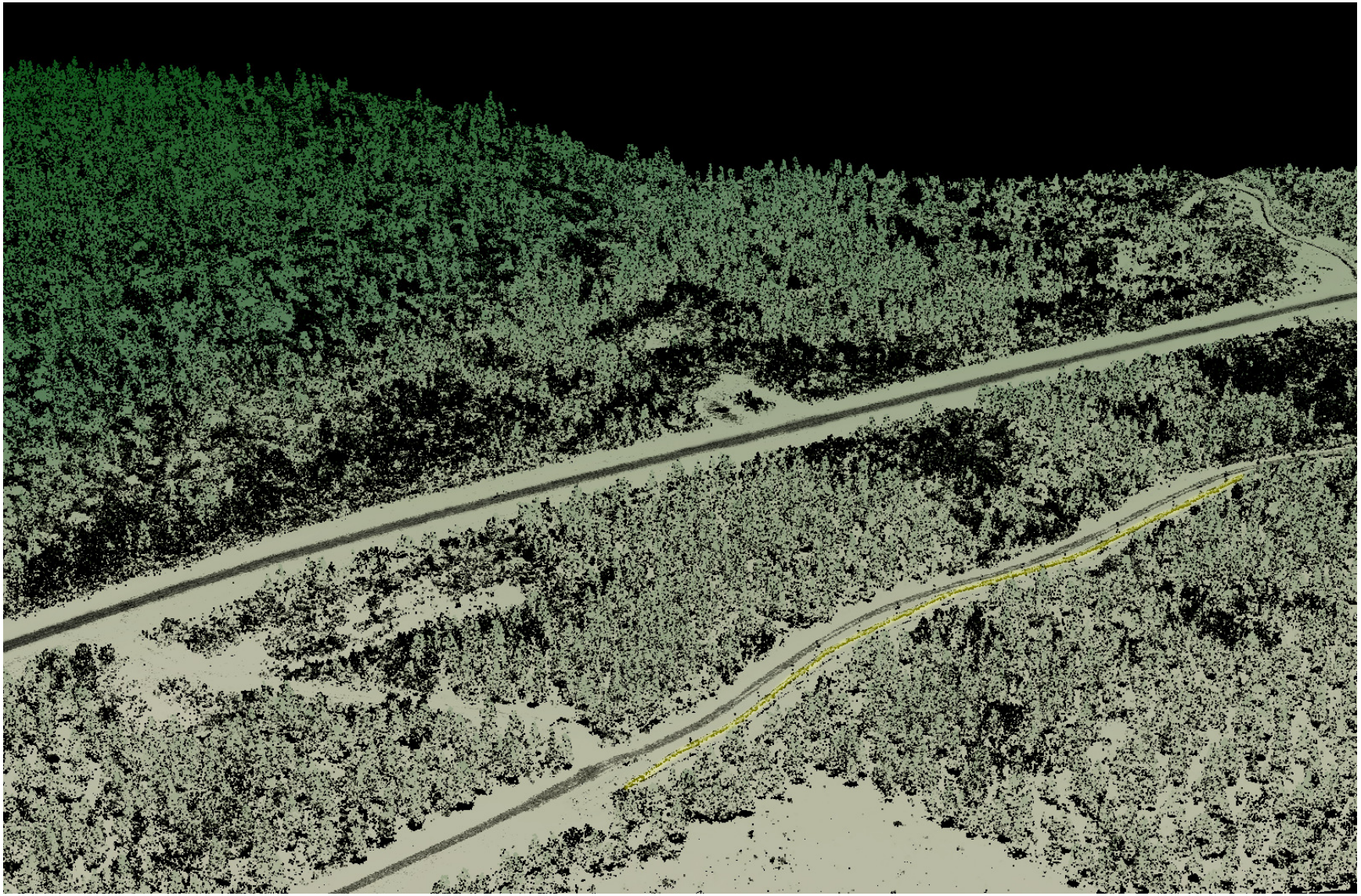


***Figure 26**. View looking North of Pipeline and Hwy 4 as they cross Miller Creek.*

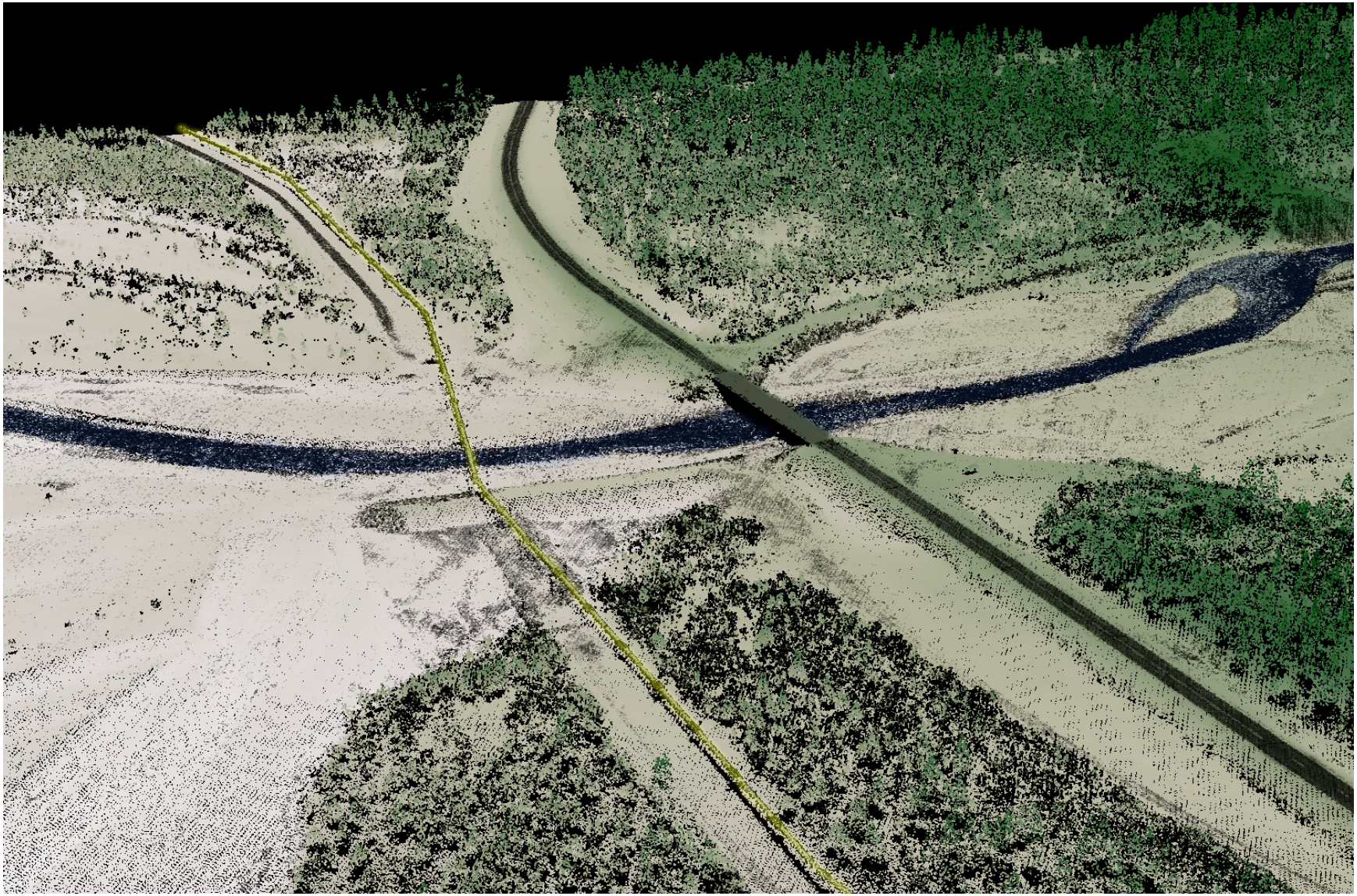


***Figure 27**. View looking Northeast across Hwy 2, just east of Tetlin Junction. Top image is Bare Earth model colored by elevation. Bottom image is Highest Hit model.*

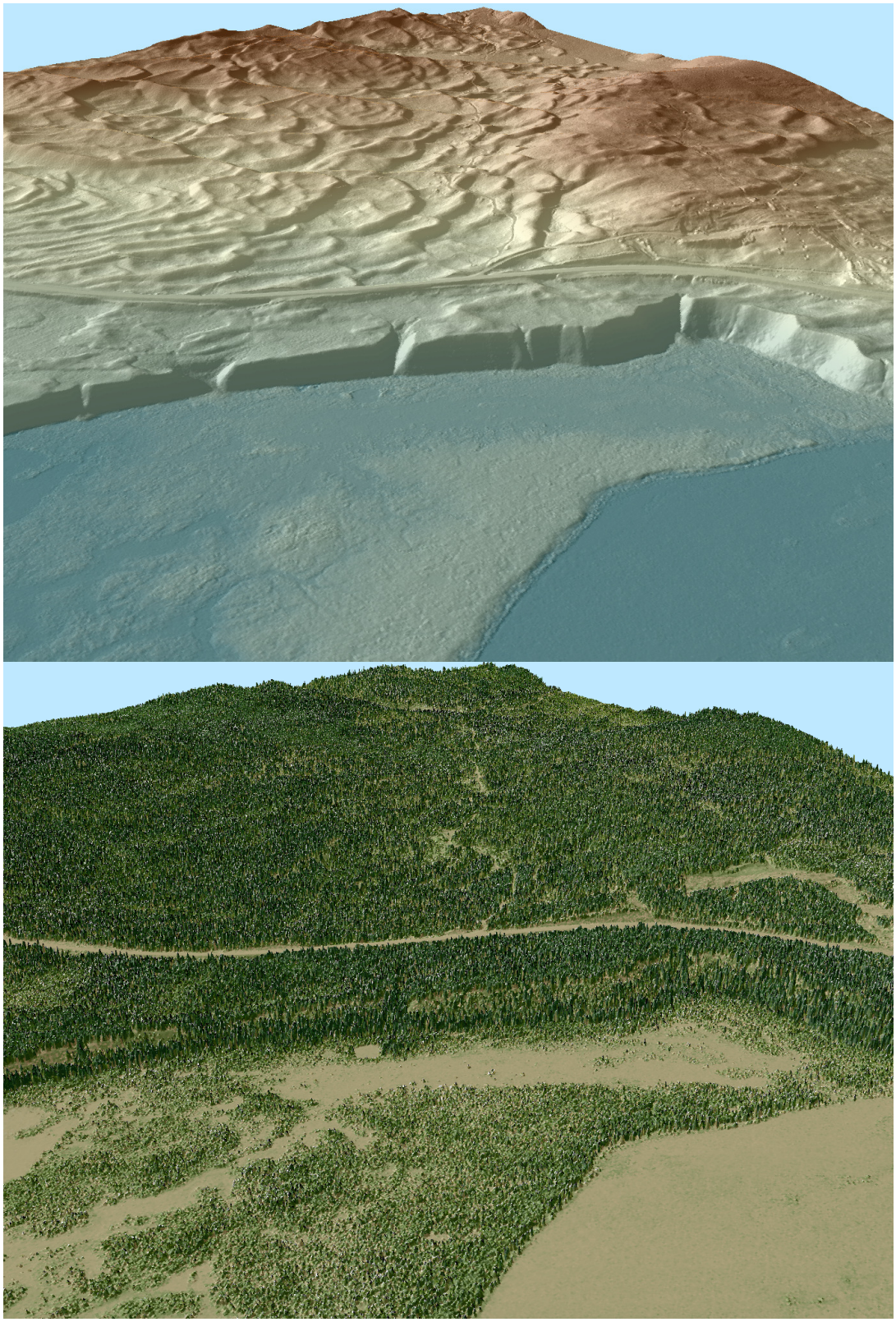


***Figure 28**. Hwy 2, west of where it crosses Gardiner River. Top image is Bare Earth model colored by elevation. Bottom image is Highest Hit model.*

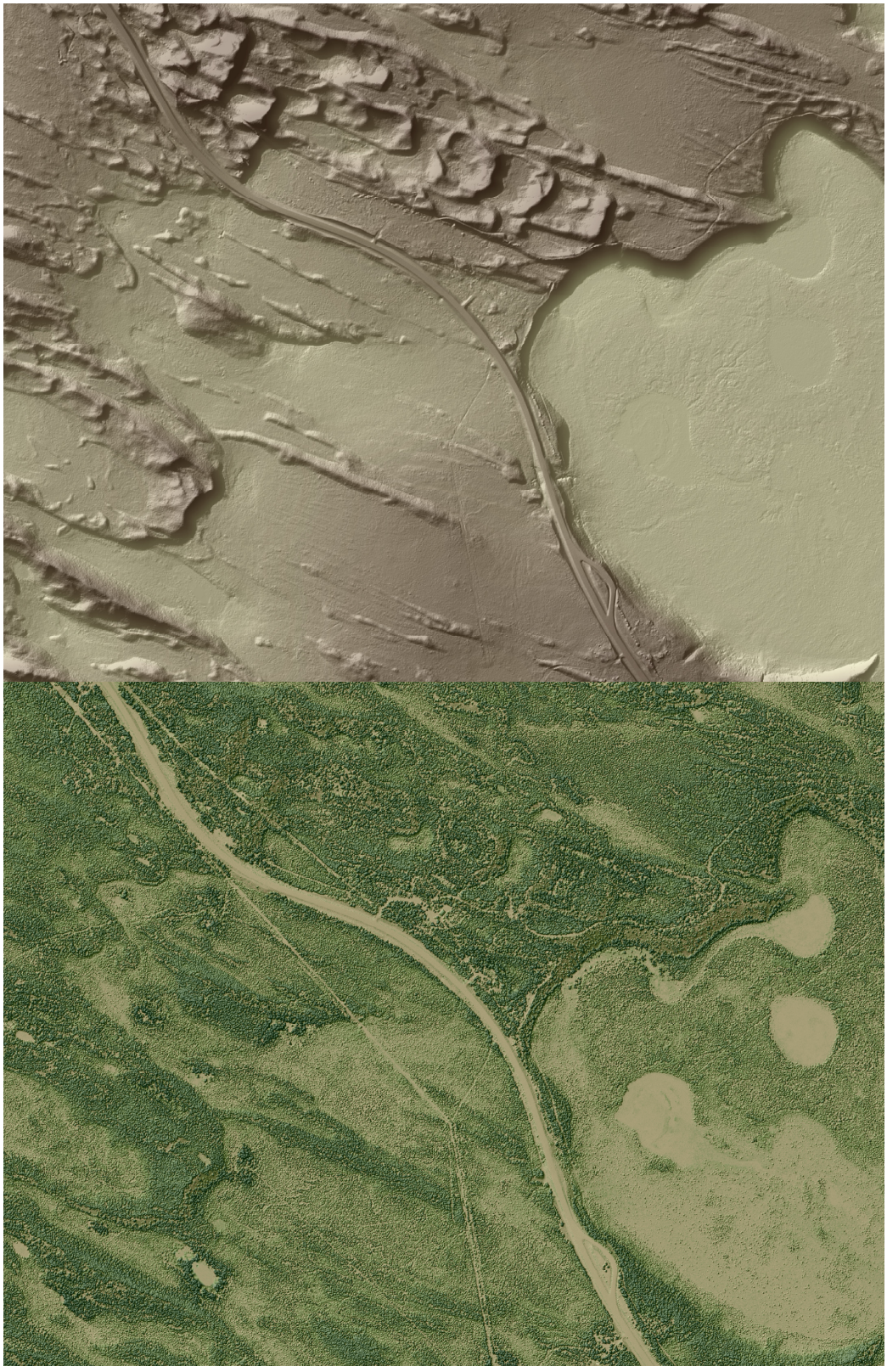
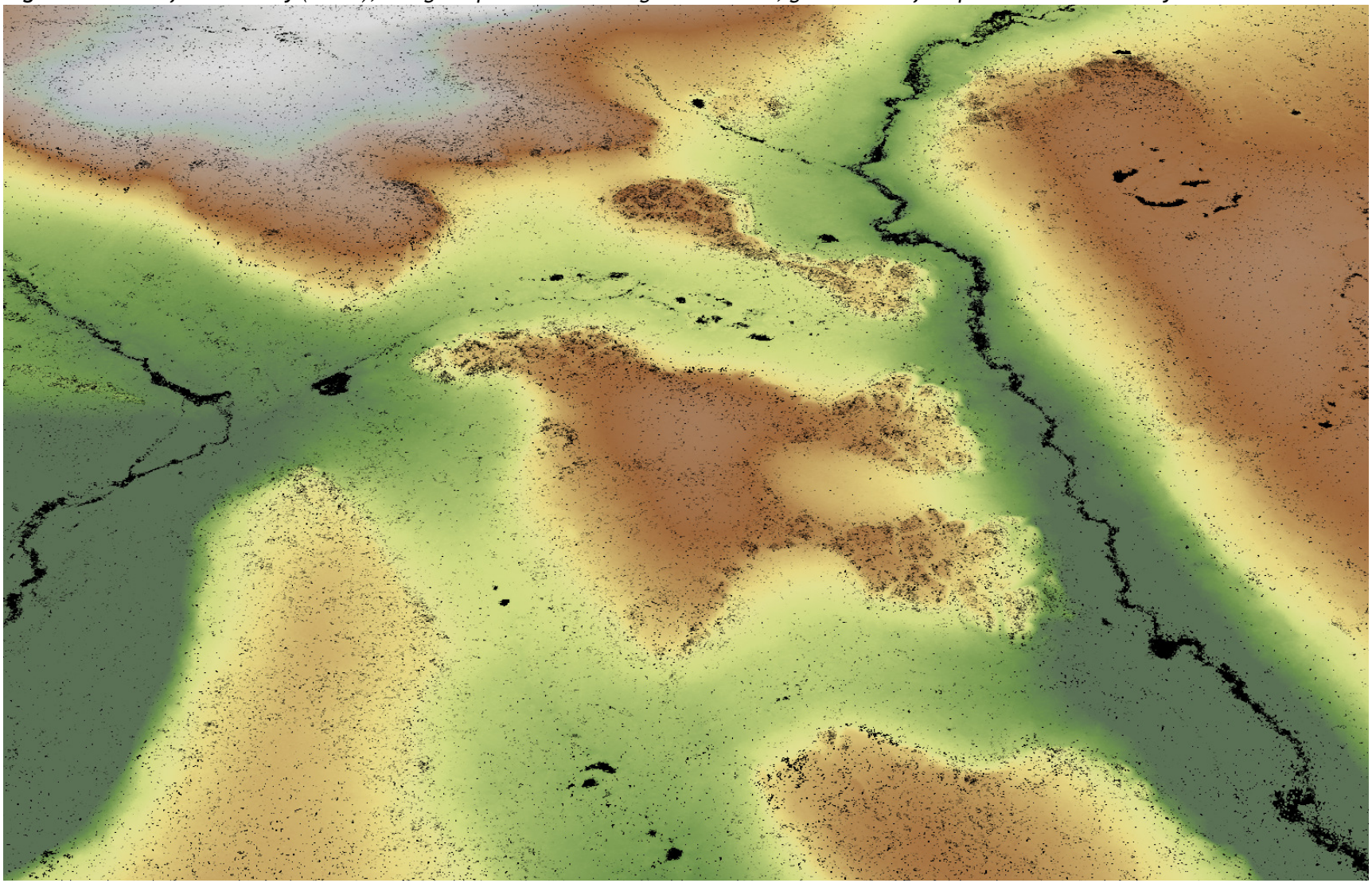


***Figure 29**. East of Dalton Hwy (SR-11), along Chapman Creek. Image is 3D LiDAR, ground classified point cloud colored by elevation.*



# 9. Glossary

**1-sigma (σ) Absolute Deviation:** Value for which the data are within one standard deviation (approximately 68$^{th}$ percentile) of a normally distributed data set.

**1.96-sigma (σ) Absolute Deviation:** Value for which the data are within two standard deviations (approximately 95$^{th}$ percentile) of a normally distributed data set.

**Root Mean Square Error (RMSE):** A statistic used to approximate the difference between real-world points and the LiDAR points. It is calculated by squaring all the values, then taking the average of the squares and taking the square root of the average.

**Pulse Rate (PR)**: The rate at which laser pulses are emitted from the sensor; typically measured as thousands of pulses per second (kHz).

**Pulse Returns**: For every laser pulse emitted, the Leica ALS 50 Phase II system can record *up to four* wave forms reflected back to the sensor. Portions of the wave form that return earliest are the highest element in multi-tiered surfaces such as vegetation. Portions of the wave form that return last are the lowest element in multi-tiered surfaces.

**Accuracy**: The statistical comparison between known (surveyed) points and laser points. Typically measured as the standard deviation (sigma, σ) and root mean square error (RMSE).

**Intensity Values**: The peak power ratio of the laser return to the emitted laser. It is a function of surface reflectivity.

**Data Density**: A common measure of LiDAR resolution, measured as points per square meter.

**Spot Spacing**: Also a measure of LiDAR resolution, measured as the average distance between laser points.

**Nadir**: A single point or locus of points on the surface of the earth directly below a sensor as it progresses along its flight line.

**Scan Angle**: The angle from nadir to the edge of the scan, measured in degrees. Laser point accuracy typically decreases as scan angles increase.

**Overlap**: The area shared between flight lines, typically measured in percents; 100% overlap is essential to ensure complete coverage and reduce laser shadows.

**DTM / DEM**: These often-interchanged terms refer to models made from laser points. The digital elevation model (DEM) refers to all surfaces, including bare ground and vegetation, while the digital terrain model (DTM) refers only to those points classified as ground.

**Real-Time Kinematic (RTK) Survey**: GPS surveying is conducted with a GPS base station deployed over a known monument with a radio connection to a GPS rover. Both the base station and rover receive differential GPS data and the baseline correction is solved between the two. This type of ground survey is accurate to 1.5 cm or less.

# 10. Citations

Soininen, A. 2004. TerraScan User's Guide. TerraSolid.

# Appendix A

**LiDAR accuracy error sources and solutions:**

| Type of Error | Source | Post Processing Solution |
|---|---|---|
| GPS (Static/Kinematic) | Long Base Lines | None |
| | Poor Satellite Constellation | None |
| | Poor Antenna Visibility | Reduce Visibility Mask |
| Relative Accuracy | Poor System Calibration | Recalibrate IMU and sensor offsets/settings |
| | Inaccurate System | None |
| Laser Noise | Poor Laser Timing | None |
| | Poor Laser Reception | None |
| | Poor Laser Power | None |
| | Irregular Laser Shape | None |

**Operational measures taken to improve relative accuracy:**

1. Low Flight Altitude: Terrain following is employed to maintain a constant above ground level (AGL). Laser horizontal errors are a function of flight altitude above ground (i.e., ~ 1/3000$^{th}$ AGL flight altitude).
2. Focus Laser Power at narrow beam footprint: A laser return must be received by the system above a power threshold to accurately record a measurement. The strength of the laser return is a function of laser emission power, laser footprint, flight altitude and the reflectivity of the target. While surface reflectivity cannot be controlled, laser power can be increased and low flight altitudes can be maintained.
3. Reduced Scan Angle: Edge-of-scan data can become inaccurate. The scan angle was reduced to a maximum of ±15$^{o}$ from nadir, creating a narrow swath width and greatly reducing laser shadows from trees and buildings.
4. Quality GPS: Flights took place during optimal GPS conditions (e.g., 6 or more satellites and PDOP [Position Dilution of Precision] less than 3.0). Before each flight, the PDOP was determined for the survey day. During all flight times, a dual frequency DGPS base station recording at 1-second epochs was utilized and a maximum baseline length between the aircraft and the control points was less than 19 km (11.5 miles) at all times.
5. Ground Survey: Ground survey point accuracy (i.e. <1.5 cm RMSE) occurs during optimal PDOP ranges and targets a minimal baseline distance of 4 miles between GPS rover and base. Robust statistics are, in part, a function of sample size (n) and distribution. Ground survey RTK points are distributed to the extent possible throughout multiple flight lines and across the survey area.
6. 50% Side-Lap (100% Overlap): Overlapping areas are optimized for relative accuracy testing. Laser shadowing is minimized to help increase target acquisition from multiple scan angles. Ideally, with a 50% side-lap, the most nadir portion of one flight line coincides with the edge (least nadir) portion of overlapping flight lines. A minimum of 50% side-lap with terrain-followed acquisition prevents data gaps.
7. Opposing Flight Lines: All overlapping flight lines are opposing. Pitch, roll and heading errors are amplified by a factor of two relative to the adjacent flight line(s), making misalignments easier to detect and resolve.

# Appendix B

# Alaska Gasline LiDAR Project
# Delivery 6

*Watershed Sciences, Inc.*
*McClintock Land Associates, Inc.*

QUALITY CONTROL REVIEW SUMMARY

| | | |
|---|---|---|
| Max. Positive Elev. Deviation: | 0.24 | meters |
| Max. Negative Elev. Deviation: | -0.49 | meters |
| Elevation Deviation Range: | 0.73 | meters |
| Elevation Deviation Mean: | -0.01 | meters |
| **Elevation Deviation RMSE** | **0.05** | **meters** |

(RMSE = Root Mean Square Error)

| | |
|---|---|
| Number of Check Points Used: | 1510.00 |
| Number of Check Points Excluded | 0.00 |
| Total Number of Check Points: | 1510.00 |

| CHECK POINTS | | | SURVEYED Elevation | | LiDAR Elevation | Deviation |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | DESCRIPTOR | (Meters) | (Meters) |
| 29 | 7320437.561 | 363782.442 | 184.62 | CP-14A | 184.68 | -0.06 |
| 30 | 7316873.111 | 367999.568 | 182.69 | CP-14B | 182.77 | -0.08 |
| 31 | 7299077.797 | 387951.894 | 402.21 | CP-15A | 402.28 | -0.07 |
| 32 | 7298593.656 | 389590.147 | 525.8 | CP-15B | 525.85 | -0.05 |
| 33 | 7267416.735 | 416399.741 | 197.37 | CP-16A | 197.49 | -0.12 |
| 34 | 7265796.998 | 419066.498 | 451.45 | CP-16B | 451.47 | -0.02 |
| 35 | 7245616.823 | 438867.829 | 144.64 | CP-17A | 144.77 | -0.13 |
| 36 | 7244805.122 | 440830.171 | 275.92 | CP-17B | 276.01 | -0.09 |
| 37 | 7226493.14 | 457255.24 | 293.91 | CP-17C | 293.91 | 0.00 |
| 38 | 7224650.076 | 459608.55 | 307.53 | CP-17D | 307.45 | 0.08 |
| 39 | 7196552.746 | 475331.033 | 214.85 | CP-18A | 214.89 | -0.04 |
| 40 | 7196513.727 | 474241.274 | 189.08 | CP-18B | 189.1 | -0.02 |
| 133 | 7320437.686 | 363782.411 | 184.64 | CP-14 A | 184.68 | -0.04 |
| 134 | 7316873.226 | 367999.53 | 182.727 | CP-14 B | 182.78 | -0.05 |
| 135 | 7309170.453 | 376246.552 | 95.121 | CP-14 C | 95.12 | 0.00 |
| 136 | 7299077.857 | 387951.871 | 402.197 | CP-15 A | 402.27 | -0.07 |
| 137 | 7298593.727 | 389590.126 | 525.749 | CP-15 B | 525.85 | -0.10 |
| 138 | 7267416.736 | 416399.766 | 197.609 | CP-16 A | 197.49 | 0.12 |
| 139 | 7265797.054 | 419066.474 | 451.487 | CP-16 B | 451.48 | 0.01 |
| 140 | 7245616.831 | 438867.837 | 144.646 | CP-17 A | 144.77 | -0.12 |
| 141 | 7244805.161 | 440830.163 | 275.889 | CP-17 B | 276.01 | -0.12 |
| 142 | 7226493.171 | 457255.207 | 293.956 | CP-17 C | 293.91 | 0.05 |
| 143 | 7224650.096 | 459608.552 | 307.516 | CP-17 D | 307.45 | 0.07 |
| 144 | 7226529.501 | 457206.691 | 296.604 | CP-17 E | 296.59 | 0.01 |
| 145 | 7196552.758 | 475331.023 | 214.888 | CP-18 A | 214.9 | -0.01 |
| 146 | 7196513.751 | 474241.244 | 189.113 | CP-18 B | 189.1 | 0.01 |
| 1800 | 7196513.751 | 474241.244 | 189.113 | 18B20100920SAC | 189.1 | 0.01 |
| 1801 | 7196506.408 | 474243.1 | 188.91 | 18B20100921CHK | 189.27 | -0.36 |
| 1802 | 7196513.357 | 474258.817 | 189.73 | 18B20100922SAR | 189.75 | -0.02 |
| 1803 | 7196521.162 | 474278.801 | 190.323 | 18B20100923SAR | 190.36 | -0.04 |
| 1804 | 7196527.713 | 474295.109 | 190.712 | 18B20100924SAR | 190.75 | -0.04 |
| 1805 | 7196533.595 | 474313.427 | 191.073 | 18B20100925SAR | 191.11 | -0.04 |
| 1806 | 7196539.592 | 474332.131 | 191.417 | 18B20100926SAR | 191.43 | -0.01 |
| 1807 | 7196545.446 | 474352.065 | 191.889 | 18B20100927SAR | 191.94 | -0.05 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 1808 | 7196565.515 | 474373.616 | 192.387 | 18B20100928SGR | 192.32 | 0.07 |
| 1809 | 7196571.222 | 474372.269 | 192.095 | 18B20100929SGR | 192.09 | 0.00 |
| 1810 | 7196579.914 | 474370.592 | 191.911 | 18B20100930SGR | 191.87 | 0.04 |
| 1811 | 7196587.063 | 474369.355 | 191.759 | 18B20100931SGR | 191.75 | 0.01 |
| 1812 | 7196540.657 | 474378.331 | 191.897 | 18B20100932SAR | 191.93 | -0.03 |
| 1813 | 7196536.275 | 474360.811 | 191.496 | 18B20100933SAR | 191.52 | -0.02 |
| 1814 | 7196531.264 | 474342.943 | 191.144 | 18B20100934SAR | 191.15 | -0.01 |
| 1815 | 7196525.85 | 474325.331 | 190.732 | 18B20100935SAR | 190.76 | -0.03 |
| 1816 | 7196519.882 | 474307.585 | 190.402 | 18B20100936SAR | 190.44 | -0.04 |
| 1817 | 7196513.538 | 474289.959 | 190.063 | 18B20100937SAR | 190.09 | -0.03 |
| 1818 | 7196506.006 | 474270.308 | 189.497 | 18B20100938SAR | 189.52 | -0.02 |
| 1819 | 7196498.636 | 474252.704 | 188.966 | 18B20100939SAR | 189 | -0.03 |
| 1820 | 7196490.963 | 474235.252 | 188.5 | 18B20100940SAR | 188.51 | -0.01 |
| 1834 | 7197983.304 | 473953.984 | 210.839 | 18B20100954SGR | 210.84 | 0.00 |
| 1835 | 7197984.21 | 473963.186 | 210.506 | 18B20100955SGR | 210.55 | -0.04 |
| 1836 | 7197985.036 | 473977.261 | 210.149 | 18B20100956SGR | 210.21 | -0.06 |
| 1837 | 7197989.668 | 473993.016 | 210.09 | 18B20100957SGR | 210.14 | -0.05 |
| 1838 | 7197989.04 | 473984.966 | 210.058 | 18B20100958SGR | 210.17 | -0.11 |
| 1839 | 7197988.46 | 473976.444 | 210.22 | 18B20100959SGR | 210.28 | -0.06 |
| 1840 | 7197987.94 | 473968.183 | 210.404 | 18B20100960SGR | 210.43 | -0.03 |
| 1841 | 7197987.373 | 473960.104 | 210.616 | 18B20100961SGR | 210.65 | -0.03 |
| 1842 | 7197369.745 | 474633.524 | 232.588 | 18B20100962SGR | 232.6 | -0.01 |
| 1843 | 7197364.716 | 474650.977 | 233.355 | 18B20100963SGR | 233.38 | -0.03 |
| 1844 | 7197361.283 | 474668.083 | 234.399 | 18B20100964SGR | 234.4 | 0.00 |
| 1845 | 7197360.178 | 474686.183 | 235.679 | 18B20100965SGR | 235.69 | -0.01 |
| 1846 | 7197359.639 | 474704.426 | 237.016 | 18B20100966SGR | 237.04 | -0.02 |
| 1847 | 7197359.728 | 474722.818 | 238.536 | 18B20100967SGR | 238.57 | -0.03 |
| 1848 | 7197359.961 | 474741.496 | 240.323 | 18B20100968SGR | 240.34 | -0.02 |
| 1849 | 7197360.568 | 474759.679 | 241.976 | 18B20100969SGR | 241.99 | -0.01 |
| 1850 | 7197360.99 | 474776.926 | 242.863 | 18B20100970SGR | 242.91 | -0.05 |
| 1851 | 7197361.276 | 474794.216 | 243.145 | 18B20100971SGR | 243.18 | -0.03 |
| 1852 | 7197362.782 | 474774.796 | 242.886 | 18B20100972SGR | 242.91 | -0.02 |
| 1853 | 7197363.354 | 474768.255 | 242.595 | 18B20100973SGR | 242.65 | -0.06 |
| 1854 | 7197359.349 | 475218.256 | 275.383 | 18B20100974SAR | 275.39 | -0.01 |
| 1855 | 7197363.634 | 475218.641 | 275.642 | 18B20100975SAR | 275.67 | -0.03 |
| 1856 | 7197365.296 | 475226.353 | 275.933 | 18B20100976SGR | 275.97 | -0.04 |
| 1857 | 7197367.844 | 475234.611 | 276.229 | 18B20100977SAR | 276.27 | -0.04 |
| 1858 | 7197352.401 | 475234.516 | 275.143 | 18B20100978SAR | 275.17 | -0.03 |
| 1859 | 7197331.077 | 475231.73 | 272.663 | 18B20100979SAR | 272.63 | 0.03 |
| 1860 | 7197312.564 | 475233.085 | 270.598 | 18B20100980SAR | 270.68 | -0.08 |
| 1861 | 7197296.13 | 475232.897 | 269.023 | 18B20100981SAR | 269.02 | 0.00 |
| 1862 | 7197278.2 | 475233.017 | 267.386 | 18B20100982SAR | 267.41 | -0.02 |
| 1863 | 7197260.416 | 475233.935 | 265.96 | 18B20100983SAR | 265.98 | -0.02 |
| 1864 | 7197242.414 | 475235.845 | 264.747 | 18B20100984SAR | 264.76 | -0.01 |
| 1865 | 7197224.9 | 475239.036 | 263.862 | 18B20100985SAR | 263.88 | -0.02 |
| 1866 | 7197207.147 | 475244.415 | 263.043 | 18B20100986SAR | 263.01 | 0.03 |
| 1867 | 7197167.961 | 475259.508 | 260.936 | 18B20100987SAR | 260.96 | -0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 1868 | 7197159.851 | 475262.737 | 260.728 | 18B20100988SAR | 260.55 | 0.18 |
| 1869 | 7196571.96 | 475170.187 | 218.555 | 18B20100989SAR | 218.6 | -0.04 |
| 1870 | 7196571.714 | 475188.493 | 218.425 | 18B20100990SAR | 218.45 | -0.02 |
| 1871 | 7196571.496 | 475205.003 | 218.193 | 18B20100991SAR | 218.21 | -0.02 |
| 1872 | 7196560.545 | 475205.083 | 218.205 | 18B20100992SAR | 218.23 | -0.02 |
| 1873 | 7196560.33 | 475187.462 | 218.352 | 18B20100993SAR | 218.44 | -0.09 |
| 1874 | 7196550.37 | 475181.275 | 218.3 | 18B20100994SAR | 218.3 | 0.00 |
| 1875 | 7196550.31 | 475176.478 | 218.369 | 18B20100995SAR | 218.35 | 0.02 |
| 1876 | 7196537.576 | 475178.73 | 217.879 | 18B20100996SGR | 217.88 | 0.00 |
| 1877 | 7196520.415 | 475179.317 | 217.202 | 18B20100997SGR | 217.2 | 0.00 |
| 1878 | 7196503.067 | 475179.317 | 216.287 | 18B20100998SGR | 216.29 | 0.00 |
| 1879 | 7196479.949 | 475178.534 | 214.326 | 18B20100999SGR | 214.37 | -0.04 |
| 1880 | 7196561.043 | 475154.8 | 218.728 | 18B20101000SAR | 218.75 | -0.02 |
| 1881 | 7196557.588 | 475140.682 | 218.77 | 18B20101001SAR | 218.78 | -0.01 |
| 1882 | 7196555.288 | 475141.056 | 218.75 | 18B20101002SAR | 218.75 | 0.00 |
| 1883 | 7196554.503 | 475147.211 | 218.679 | 18B20101003SAR | 218.68 | 0.00 |
| 1884 | 7196532.521 | 475067.761 | 224.34 | 18B20101004SGR | 224.37 | -0.03 |
| 1885 | 7196532.222 | 475048.242 | 225.07 | 18B20101005SGR | 225.08 | -0.01 |
| 1886 | 7196531.955 | 475025.772 | 225.528 | 18B20101006SGR | 225.53 | 0.00 |
| 1887 | 7196532.053 | 475017.582 | 225.472 | 18B20101007SGR | 225.47 | 0.00 |
| 1888 | 7196532.337 | 475009.479 | 225.273 | 18B20101008SGR | 225.25 | 0.02 |
| 3500 | 7244805.122 | 440830.171 | 275.92 | 17B20100925SAC | 276.01 | -0.09 |
| 3501 | 7245042.663 | 440554.543 | 277.249 | 17B20100925SGR | 277.17 | 0.08 |
| 3502 | 7245038.242 | 440574.523 | 276.885 | 17B20100925SGR | 276.81 | 0.07 |
| 3503 | 7245027.514 | 440598.767 | 276.517 | 17B20100925SGR | 276.51 | 0.01 |
| 3504 | 7245009.735 | 440623.36 | 276.323 | 17B20100925SGR | 276.23 | 0.09 |
| 3505 | 7244988.251 | 440648.369 | 276.066 | 17B20100925SGR | 276.01 | 0.06 |
| 3506 | 7244966.529 | 440672.3 | 275.988 | 17B20100925SGR | 275.89 | 0.10 |
| 3507 | 7244944.668 | 440695.461 | 275.938 | 17B20100925SGR | 275.94 | 0.00 |
| 3508 | 7244922.676 | 440718.613 | 275.9 | 17B20100925SGR | 275.84 | 0.06 |
| 3509 | 7244902.563 | 440739.788 | 275.635 | 17B20100925SGR | 275.61 | 0.02 |
| 3510 | 7244880.23 | 440763.437 | 275.437 | 17B20100925SGR | 275.43 | 0.01 |
| 3511 | 7244857.841 | 440787.13 | 275.492 | 17B20100925SGR | 275.45 | 0.04 |
| 3512 | 7244836.226 | 440810.101 | 275.664 | 17B20100925SGR | 275.61 | 0.05 |
| 3513 | 7244816.085 | 440831.81 | 275.877 | 17B20100925SGR | 275.86 | 0.02 |
| 3514 | 7244802.315 | 440840.476 | 275.74 | 17B20100925SGR | 275.75 | -0.01 |
| 3515 | 7244785.113 | 440842.588 | 275.567 | 17B20100925SAR | 275.54 | 0.03 |
| 3516 | 7244764.349 | 440882.666 | 277.335 | 17B20100925SAR | 277.28 | 0.06 |
| 3517 | 7244746.739 | 440909.349 | 278.474 | 17B20100925SAR | 278.42 | 0.05 |
| 3518 | 7244727.252 | 440934.02 | 279.328 | 17B20100925SAR | 279.31 | 0.02 |
| 3519 | 7244704.352 | 440959.035 | 279.852 | 17B20100925SAR | 279.83 | 0.02 |
| 3520 | 7244682.689 | 440982.061 | 280.159 | 17B20100925SAR | 280.12 | 0.04 |
| 3521 | 7244655.341 | 441011.201 | 280.193 | 17B20100925SAR | 280.22 | -0.03 |
| 3522 | 7244633.244 | 441034.498 | 279.942 | 17B20100925SAR | 279.97 | -0.03 |
| 3523 | 7244613.582 | 441054.861 | 279.624 | 17B20100925SAR | 279.6 | 0.02 |
| 3524 | 7244589.513 | 441080.35 | 279.188 | 17B20100925SAR | 279.17 | 0.02 |
| 3525 | 7244547.274 | 441089.323 | 278.906 | 17B20100925SGR | 278.9 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 3526 | 7244523.828 | 441067.026 | 279.713 | 17B20100925SGR | 279.71 | 0.00 |
| 3527 | 7244520.982 | 441064.408 | 279.885 | 17B20100925SGR | 279.91 | -0.03 |
| 3528 | 7244517.546 | 441061.07 | 280.088 | 17B20100925SGR | 280.14 | -0.05 |
| 3529 | 7244485.969 | 441029.921 | 282.66 | 17B20100925SGR | 282.72 | -0.06 |
| 3530 | 7244461.719 | 441005.765 | 284.575 | 17B20100925SGR | 284.62 | -0.05 |
| 3531 | 7244423.878 | 440968.238 | 286.735 | 17B20100925SGR | 286.76 | -0.02 |
| 3532 | 7244393.75 | 440938.462 | 286.812 | 17B20100925SGR | 286.8 | 0.01 |
| 3533 | 7244376.721 | 440921.209 | 286.64 | 17B20100925SGR | 286.65 | -0.01 |
| 3534 | 7244341.243 | 440890.317 | 286.235 | 17B20100925SGR | 286.21 | 0.03 |
| 3535 | 7244320.168 | 440875.057 | 285.853 | 17B20100925SGR | 285.8 | 0.05 |
| 3536 | 7244290.443 | 440855.525 | 285.129 | 17B20100925SGR | 285.13 | 0.00 |
| 3537 | 7244263.759 | 440839.763 | 284.739 | 17B20100925SGR | 284.72 | 0.02 |
| 3538 | 7244170.525 | 441809.715 | 288.756 | 17B20100925SAR | 288.78 | -0.02 |
| 3539 | 7244161.253 | 441839.216 | 289.914 | 17B20100925SAR | 289.92 | -0.01 |
| 3540 | 7244140.599 | 441890.027 | 291.875 | 17B20100925SAR | 291.88 | 0.00 |
| 3541 | 7244126.8 | 441917.412 | 292.967 | 17B20100925SAR | 292.97 | 0.00 |
| 3542 | 7244119.208 | 441930.593 | 293.473 | 17B20100925SAR | 293.5 | -0.03 |
| 3543 | 7244102.831 | 441958.201 | 294.666 | 17B20100925SAR | 294.66 | 0.01 |
| 3544 | 7244088.154 | 441983.187 | 295.744 | 17B20100925SAR | 295.73 | 0.01 |
| 3545 | 7244072.505 | 442009.437 | 296.773 | 17B20100925SAR | 296.75 | 0.02 |
| 3546 | 7244063.2 | 442025.067 | 297.464 | 17B20100925SAR | 297.44 | 0.02 |
| 3547 | 7243718.233 | 442425.254 | 316.203 | 17B20100925SAR | 316.19 | 0.01 |
| 3548 | 7243728.861 | 442439.196 | 318.422 | 17B20100925SGR | 318.37 | 0.05 |
| 3549 | 7243703.205 | 442406.133 | 315.876 | 17B20100925SGR | 315.9 | -0.02 |
| 3550 | 7243708.875 | 442408.835 | 316.035 | 17B20100925SAR | 316.01 | 0.03 |
| 3551 | 7244860.752 | 440425.715 | 259.531 | 17B20100925SGR | 259.48 | 0.05 |
| 3552 | 7244852.296 | 440424.99 | 258.971 | 17B20100925SGR | 258.93 | 0.04 |
| 3553 | 7244848.599 | 440423.631 | 258.883 | 17B20100925SAR | 258.84 | 0.04 |
| 3554 | 7244844.598 | 440427.013 | 259.005 | 17B20100925SAR | 258.98 | 0.02 |
| 3555 | 7244839.222 | 440426.543 | 259.094 | 17B20100925SAR | 259.06 | 0.03 |
| 3556 | 7244842.22 | 440390.863 | 257.794 | 17B20100925SAR | 257.74 | 0.05 |
| 3557 | 7244843.592 | 440359.326 | 256.691 | 17B20100925SAR | 256.62 | 0.07 |
| 3558 | 7244843.545 | 440335.951 | 255.815 | 17B20100925SAR | 255.78 | 0.03 |
| 3559 | 7244841.004 | 440302.305 | 254.512 | 17B20100925SAR | 254.49 | 0.02 |
| 3560 | 7244835.437 | 440268.008 | 253.155 | 17B20100925SAR | 253.14 | 0.02 |
| 3561 | 7244827.424 | 440232.545 | 251.762 | 17B20100925SAR | 251.7 | 0.06 |
| 3562 | 7244822.411 | 440215.095 | 251.063 | 17B20100925SAR | 251.01 | 0.05 |
| 3563 | 7244811.871 | 440184.658 | 249.762 | 17B20100925SAR | 249.71 | 0.05 |
| 3600 | 7224650.076 | 459608.55 | 307.53 | 17D20100926SAC | 307.45 | 0.08 |
| 3601 | 7224697.75 | 459624.948 | 305.611 | 17D20100926SGR | 305.51 | 0.10 |
| 3602 | 7224714.845 | 459628.35 | 305.118 | 17D20100926SGR | 305.06 | 0.06 |
| 3603 | 7224740.298 | 459633.64 | 304.645 | 17D20100926SGR | 304.57 | 0.07 |
| 3604 | 7224733.991 | 459645.048 | 304.44 | 17D20100926SGR | 304.39 | 0.05 |
| 3605 | 7224717.31 | 459655.998 | 305.2 | 17D20100926SGR | 305.13 | 0.07 |
| 3606 | 7224696.713 | 459672.325 | 305.835 | 17D20100926SGR | 305.78 | 0.06 |
| 3607 | 7224687.727 | 459682.614 | 306.555 | 17D20100926SGR | 306.5 | 0.06 |
| 3608 | 7224697.947 | 459701.816 | 307.506 | 17D20100926SGR | 307.43 | 0.08 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 3609 | 7224704.683 | 459719.722 | 308.312 | 17D20100926SGR | 308.29 | 0.02 |
| 3610 | 7224713.178 | 459710.486 | 307.797 | 17D20100926SGR | 307.74 | 0.06 |
| 3611 | 7224738.885 | 459733.201 | 309.492 | 17D20100926SGR | 309.43 | 0.06 |
| 3612 | 7224754.023 | 459760.855 | 314.303 | 17D20100926SGR | 314.15 | 0.15 |
| 3613 | 7224742.686 | 459739.326 | 310.3 | 17D20100926SGR | 310.22 | 0.08 |
| 3614 | 7224676.909 | 459620.18 | 305.989 | 17D20100926SGR | 305.9 | 0.09 |
| 3615 | 7224643.315 | 459609.397 | 307.868 | 17D20100926SGR | 307.8 | 0.07 |
| 3616 | 7224614.602 | 459595.27 | 309.875 | 17D20100926SGR | 309.75 | 0.13 |
| 3617 | 7224600.929 | 459577.007 | 311.794 | 17D20100926SAR | 311.74 | 0.05 |
| 3618 | 7224576.475 | 459561.782 | 313.576 | 17D20100926SAR | 313.49 | 0.09 |
| 3619 | 7224555.482 | 459545.597 | 315.063 | 17D20100926SAR | 315.02 | 0.04 |
| 3620 | 7224528.87 | 459523.833 | 316.986 | 17D20100926SAR | 316.94 | 0.05 |
| 3621 | 7224517.44 | 459514.545 | 317.793 | 17D20100926SAR | 317.77 | 0.02 |
| 3622 | 7224505.352 | 459505.421 | 318.584 | 17D20100926SAR | 318.55 | 0.03 |
| 3623 | 7224500.1 | 459493.576 | 319.553 | 17D20100926SAR | 319.46 | 0.09 |
| 3624 | 7225295.17 | 459569.758 | 269.323 | 17D20100926SAR | 269.25 | 0.07 |
| 3625 | 7225295.394 | 459578.989 | 269.356 | 17D20100926SGR | 269.31 | 0.05 |
| 3626 | 7225305.204 | 459594.879 | 270.185 | 17D20100926SGR | 270.16 | 0.02 |
| 3627 | 7225344.033 | 459618.263 | 272.22 | 17D20100926SGR | 272.16 | 0.06 |
| 3628 | 7225343.496 | 459625.598 | 272.037 | 17D20100926SGR | 271.97 | 0.07 |
| 3629 | 7225368.271 | 459634.863 | 271.757 | 17D20100926SAR | 271.71 | 0.05 |
| 3630 | 7225399.219 | 459658.065 | 270.674 | 17D20100926SAR | 270.63 | 0.04 |
| 3631 | 7225411.192 | 459667.045 | 270.206 | 17D20100926SAR | 270.13 | 0.08 |
| 3632 | 7225433.572 | 459688.182 | 269.41 | 17D20100926SAR | 269.34 | 0.07 |
| 3633 | 7225449.649 | 459685.039 | 269.285 | 17D20100926SAR | 269.23 | 0.06 |
| 3634 | 7225465.154 | 459691.237 | 268.915 | 17D20100926SAR | 268.87 | 0.05 |
| 3635 | 7225469.554 | 459714.202 | 268.091 | 17D20100926SAR | 267.99 | 0.10 |
| 3636 | 7225458.969 | 459701.015 | 268.757 | 17D20100926SAR | 268.69 | 0.07 |
| 3637 | 7225303.531 | 459565.218 | 269.087 | 17D20100926SAR | 269.02 | 0.07 |
| 3638 | 7225310.821 | 459558.618 | 268.923 | 17D20100926SAR | 268.86 | 0.06 |
| 3641 | 7225404.859 | 459584.566 | 266.51 | 17D20100926SAR | 266.43 | 0.08 |
| 3642 | 7225419.282 | 459588.599 | 266.226 | 17D20100926SAR | 266.16 | 0.07 |
| 3643 | 7225439.602 | 459594.366 | 265.92 | 17D20100926SAR | 265.86 | 0.06 |
| 3644 | 7225468.969 | 459600.912 | 265.719 | 17D20100926SAR | 265.64 | 0.08 |
| 3645 | 7225498.521 | 459604.36 | 265.853 | 17D20100926SAR | 265.81 | 0.04 |
| 3646 | 7225531.65 | 459605.572 | 265.957 | 17D20100926SAR | 265.9 | 0.06 |
| 3647 | 7225572.459 | 459602.105 | 266.163 | 17D20100926SAR | 266.06 | 0.10 |
| 3648 | 7225588.122 | 459603.686 | 266.532 | 17D20100926SAR | 266.4 | 0.13 |
| 3649 | 7225622.414 | 459594.192 | 266.718 | 17D20100926SAR | 266.62 | 0.10 |
| 3650 | 7226007.212 | 459222.497 | 274.252 | 17D20100926SGR | 274.17 | 0.08 |
| 3651 | 7225997.131 | 459213.067 | 272.978 | 17D20100926OG | 273.02 | -0.04 |
| 3652 | 7225981.239 | 459197.278 | 273.153 | 17D20100926OG | 273.28 | -0.13 |
| 3653 | 7226016.476 | 459222.426 | 274.886 | 17D20100926OG | 274.83 | 0.06 |
| 3654 | 7226019.837 | 459225.004 | 275.327 | 17D20100926SAR | 275.25 | 0.08 |
| 3655 | 7226023.045 | 459227.187 | 275.473 | 17D20100926SAR | 275.42 | 0.05 |
| 3656 | 7226025.794 | 459223.769 | 275.629 | 17D20100926SAR | 275.56 | 0.07 |
| 3657 | 7226177.479 | 458563.039 | 303.68 | 17D20100926SAR | 303.65 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 3658 | 7226177.122 | 458547.467 | 304.291 | 17D20100926SAR | 304.25 | 0.04 |
| 3659 | 7226175.905 | 458518.972 | 305.648 | 17D20100926SAR | 305.6 | 0.05 |
| 3660 | 7226174.99 | 458500.794 | 306.251 | 17D20100926SAR | 306.21 | 0.04 |
| 3661 | 7226170.51 | 458501.128 | 306.096 | 17D20100926SAR | 306.07 | 0.03 |
| 3662 | 7226172.469 | 458478.859 | 307.07 | 17D20100926SAR | 307.03 | 0.04 |
| 3663 | 7226170.165 | 458457.066 | 308.01 | 17D20100926SAR | 307.96 | 0.05 |
| 3664 | 7226167.636 | 458426.331 | 309.301 | 17D20100926SAR | 309.26 | 0.04 |
| 3665 | 7226164.495 | 458396.136 | 310.614 | 17D20100926SAR | 310.57 | 0.04 |
| 3666 | 7226162.156 | 458370.481 | 311.842 | 17D20100926SAR | 311.8 | 0.04 |
| 3667 | 7226159.455 | 458341.392 | 313.119 | 17D20100926SAR | 313.09 | 0.03 |
| 3668 | 7226156.299 | 458304.583 | 314.582 | 17D20100926SAR | 314.55 | 0.03 |
| 3669 | 7226154.213 | 458283.882 | 315.478 | 17D20100926SAR | 315.34 | 0.14 |
| 3670 | 7226124.131 | 457900.707 | 326.179 | 17D20100926SGR | 326.13 | 0.05 |
| 3671 | 7226129.147 | 457892.269 | 326.823 | 17D20100926SGR | 326.81 | 0.01 |
| 3672 | 7226155.644 | 457890.42 | 330.1 | 17D20100926SGR | 330.08 | 0.02 |
| 3673 | 7226125.392 | 457889.827 | 326.402 | 17D20100926SGR | 326.36 | 0.04 |
| 3674 | 7226395.852 | 457307.483 | 297.14 | 17D20100926SAR | 297.11 | 0.03 |
| 3675 | 7226184.328 | 456728.922 | 322.28 | 17D20100926SAR | 322.2 | 0.08 |
| 3676 | 7226168.48 | 456715.765 | 323.389 | 17D20100926SAR | 323.32 | 0.07 |
| 3677 | 7226143.526 | 456696.085 | 325.245 | 17D20100926SAR | 325.19 | 0.06 |
| 3678 | 7226122.406 | 456678.922 | 326.722 | 17D20100926SAR | 326.69 | 0.03 |
| 3679 | 7226112.206 | 456670.797 | 327.454 | 17D20100926SAR | 327.39 | 0.06 |
| 3680 | 7226102.561 | 456654.188 | 328.336 | 17D20100926SAR | 328.28 | 0.06 |
| 3681 | 7226074.166 | 456641.001 | 330.204 | 17D20100926SAR | 330.15 | 0.05 |
| 3682 | 7226043.281 | 456616.867 | 332.388 | 17D20100926SAR | 332.36 | 0.03 |
| 3683 | 7226019.064 | 456597.22 | 334.078 | 17D20100926SAR | 334.07 | 0.01 |
| 3684 | 7225996.033 | 456579.21 | 335.606 | 17D20100926SAR | 335.59 | 0.02 |
| 3685 | 7225975.667 | 456562.682 | 336.839 | 17D20100926SAR | 336.83 | 0.01 |
| 3686 | 7225937.288 | 456532.571 | 339.1 | 17D20100926SAR | 339.07 | 0.03 |
| 3687 | 7225930.016 | 456520.768 | 339.466 | 17D20100926SAR | 339.48 | -0.01 |
| 3688 | 7225935.369 | 456516.038 | 339.537 | 17D20100926SGR | 339.53 | 0.01 |
| 3689 | 7225945.049 | 456503.161 | 340.99 | 17D20100926SGR | 340.95 | 0.04 |
| 3690 | 7225951.277 | 456495.338 | 341.837 | 17D20100926SGR | 341.8 | 0.04 |
| 3691 | 7225937.037 | 456515.631 | 339.609 | 17D20100926SGR | 339.58 | 0.03 |
| 3692 | 7225933.207 | 456520.14 | 339.346 | 17D20100926SGR | 339.34 | 0.01 |
| 3693 | 7225934.266 | 456522.479 | 339.289 | 17D20100926SGR | 339.27 | 0.02 |
| 3694 | 7225932.189 | 456522.169 | 339.377 | 17D20100926SAR | 339.36 | 0.02 |
| 3695 | 7226493.086 | 457255.539 | 293.379 | 17D2010092617C | 293.87 | -0.49 |
| 4900 | 7196513.751 | 474241.244 | 189.113 | 18B2011052218BSAC | 189.1 | 0.01 |
| 4901 | 7196503.948 | 474228.832 | 188.916 | 18B20110522SPR | 188.9 | 0.02 |
| 4902 | 7196489.407 | 474198.069 | 188.16 | 18B20110522SPR | 188.14 | 0.02 |
| 4903 | 7196475.834 | 474170.787 | 187.656 | 18B20110522SPR | 187.67 | -0.01 |
| 4904 | 7196461.335 | 474141.186 | 187.24 | 18B20110522SPR | 187.23 | 0.01 |
| 4905 | 7196447.308 | 474112.967 | 187.117 | 18B20110522SPR | 187.1 | 0.02 |
| 4906 | 7196426.87 | 474071.049 | 187.3 | 18B20110522SPR | 187.33 | -0.03 |
| 4907 | 7196412.973 | 474042.714 | 187.722 | 18B20110522SPR | 187.73 | -0.01 |
| 4908 | 7196393.582 | 474002.739 | 188.305 | 18B20110522SPR | 188.31 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 4909 | 7196376.164 | 473967.326 | 189.454 | 18B20110522SPR | 189.5 | -0.05 |
| 4910 | 7196353.593 | 473921.26 | 191.228 | 18B20110522SPR | 191.3 | -0.07 |
| 4911 | 7196325.194 | 473863.172 | 193.85 | 18B20110522SPR | 193.89 | -0.04 |
| 4912 | 7196560.298 | 474906.634 | 215.965 | 18B20110522SPR | 215.96 | 0.00 |
| 4913 | 7196560.339 | 474923.319 | 216.425 | 18B20110522SPR | 216.42 | 0.01 |
| 4914 | 7196559.997 | 474939.726 | 216.862 | 18B20110522SPR | 216.85 | 0.01 |
| 4915 | 7196559.828 | 474956.197 | 217.243 | 18B20110522SPR | 217.27 | -0.03 |
| 4916 | 7196559.702 | 474974.185 | 217.607 | 18B20110522SPR | 217.6 | 0.01 |
| 4917 | 7196559.524 | 474990.595 | 217.911 | 18B20110522SPR | 217.9 | 0.01 |
| 4918 | 7196576.899 | 474991.159 | 217.941 | 18B20110522SPR | 217.97 | -0.03 |
| 4919 | 7196577.037 | 474974.909 | 217.632 | 18B20110522SPR | 217.64 | -0.01 |
| 4920 | 7196577.21 | 474957.939 | 217.301 | 18B20110522SPR | 217.29 | 0.01 |
| 4921 | 7196577.335 | 474941.294 | 216.912 | 18B20110522SPR | 216.92 | -0.01 |
| 4922 | 7196577.753 | 474920.157 | 216.363 | 18B20110522SPR | 216.37 | -0.01 |
| 4923 | 7196549.538 | 475712.551 | 215.174 | 18B20110522SPR | 215.16 | 0.01 |
| 4924 | 7196549.073 | 475729.202 | 215.351 | 18B20110522SPR | 215.34 | 0.01 |
| 4925 | 7196548.506 | 475745.08 | 215.478 | 18B20110522SPR | 215.49 | -0.01 |
| 4926 | 7196548.272 | 475760.968 | 215.544 | 18B20110522SPR | 215.56 | -0.02 |
| 4927 | 7196547.773 | 475777.02 | 215.595 | 18B20110522SPR | 215.61 | -0.02 |
| 4928 | 7196568.368 | 475775.786 | 215.609 | 18B20110522SPR | 215.64 | -0.03 |
| 4929 | 7196568.78 | 475759.993 | 215.592 | 18B20110522SPR | 215.59 | 0.00 |
| 4930 | 7196568.803 | 475741.507 | 215.509 | 18B20110522SPR | 215.5 | 0.01 |
| 4931 | 7196569.177 | 475726.088 | 215.337 | 18B20110522SPR | 215.33 | 0.01 |
| 4932 | 7196569.303 | 475710.621 | 215.14 | 18B20110522SPR | 215.13 | 0.01 |
| 4933 | 7196555.221 | 475330.964 | 215.147 | 18B20110522CHECK18A | 215.14 | 0.01 |
| 4934 | 7196555.884 | 475328.661 | 215.244 | 18B20110522SPR | 215.25 | -0.01 |
| 4935 | 7196556.138 | 475313.74 | 215.718 | 18B20110522SPR | 215.74 | -0.02 |
| 4936 | 7196556.311 | 475297.124 | 216.214 | 18B20110522SPR | 216.25 | -0.04 |
| 4937 | 7196556.464 | 475281.038 | 216.658 | 18B20110522SPR | 216.69 | -0.03 |
| 4938 | 7196556.666 | 475265.032 | 217.033 | 18B20110522SPR | 217.06 | -0.03 |
| 4939 | 7196574.093 | 475265.822 | 217.011 | 18B20110522SPR | 217.04 | -0.03 |
| 4940 | 7196574.097 | 475281.505 | 216.636 | 18B20110522SPR | 216.66 | -0.02 |
| 4941 | 7196573.616 | 475299.221 | 216.169 | 18B20110522SPR | 216.18 | -0.01 |
| 4942 | 7196573.551 | 475315.51 | 215.647 | 18B20110522SPR | 215.69 | -0.04 |
| 4943 | 7196573.267 | 475331.374 | 215.166 | 18B20110522SPR | 215.2 | -0.03 |
| 4944 | 7197361.873 | 475220.096 | 275.652 | 18B20110522SGR | 275.66 | -0.01 |
| 4945 | 7197383.513 | 475230.242 | 277.601 | 18B20110522SGR | 277.62 | -0.02 |
| 4946 | 7197404.362 | 475229.601 | 279.969 | 18B20110522SGR | 279.97 | 0.00 |
| 4947 | 7197432.161 | 475220.518 | 283.503 | 18B20110522SGR | 283.53 | -0.03 |
| 4948 | 7197459.654 | 475202.4 | 286.577 | 18B20110522SGR | 286.59 | -0.01 |
| 4949 | 7197485.5 | 475181.544 | 289.136 | 18B20110522SGR | 289.17 | -0.03 |
| 4950 | 7197518.481 | 475155.381 | 292.014 | 18B20110522SGR | 292.01 | 0.00 |
| 4951 | 7197541.382 | 475131.132 | 293.19 | 18B20110522SGR | 293.17 | 0.02 |
| 4952 | 7197751.991 | 474993.386 | 298.912 | 18B20110522SGR | 298.92 | -0.01 |
| 4953 | 7197734.754 | 474983.579 | 298.114 | 18B20110522SGR | 298.12 | -0.01 |
| 4954 | 7197716.384 | 474985.277 | 297.796 | 18B20110522SGR | 297.78 | 0.02 |
| 4955 | 7197697.308 | 474989.016 | 297.741 | 18B20110522SGR | 297.74 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 4956 | 7197681.422 | 474994.37 | 297.836 | 18B20110522SGR | 297.85 | -0.01 |
| 4957 | 7197693.378 | 474994.431 | 297.625 | 18B20110522SGR | 297.63 | 0.00 |
| 4958 | 7197715.284 | 474990.039 | 297.72 | 18B20110522SGR | 297.72 | 0.00 |
| 4959 | 7197733.117 | 474987.387 | 298.07 | 18B20110522SGR | 298.1 | -0.03 |
| 4960 | 7198412.208 | 474987.71 | 345.919 | 18B20110522SGR | 345.89 | 0.03 |
| 4961 | 7198397.535 | 474987.973 | 345.893 | 18B20110522SGR | 345.87 | 0.02 |
| 4962 | 7198375.087 | 474987.874 | 345.575 | 18B20110522SGR | 345.57 | 0.00 |
| 4963 | 7198361.405 | 474987.095 | 345.314 | 18B20110522SGR | 345.27 | 0.04 |
| 4964 | 7198348.041 | 474988.845 | 344.915 | 18B20110522SGR | 344.87 | 0.05 |
| 4965 | 7198876.215 | 474866.176 | 373.411 | 18B20110522SGR | 373.35 | 0.06 |
| 4966 | 7198863.65 | 474873.187 | 372.52 | 18B20110522SGR | 372.5 | 0.02 |
| 4967 | 7198848.227 | 474879.968 | 371.175 | 18B20110522SGR | 371.15 | 0.03 |
| 4968 | 7198833.648 | 474886.903 | 369.846 | 18B20110522SGR | 369.79 | 0.06 |
| 4969 | 7198821.774 | 474891.495 | 368.76 | 18B20110522SGR | 368.7 | 0.06 |
| 4970 | 7198804.257 | 474898.371 | 367.019 | 18B20110522SGR | 366.98 | 0.04 |
| 4971 | 7198890.421 | 474854.813 | 373.957 | 18B20110522SGR | 373.9 | 0.06 |
| 4972 | 7198916.714 | 474613.708 | 351.569 | 18B20110522SGR | 351.52 | 0.05 |
| 4973 | 7198905.231 | 474623.161 | 350.782 | 18B20110522SGR | 350.75 | 0.03 |
| 4974 | 7198892.806 | 474630.971 | 349.488 | 18B20110522SGR | 349.47 | 0.02 |
| 4975 | 7198881.461 | 474642.235 | 347.954 | 18B20110522SGR | 347.94 | 0.01 |
| 4976 | 7198866.734 | 474651.28 | 346.212 | 18B20110522SGR | 346.17 | 0.04 |
| 4977 | 7198855.653 | 474661.874 | 344.902 | 18B20110522SGR | 344.82 | 0.08 |
| 4978 | 7198929.064 | 474603.804 | 351.923 | 18B20110522SGR | 351.89 | 0.03 |
| 4979 | 7196510.666 | 474242.544 | 189.406 | 18B20110522CHECK | 189.4 | 0.01 |
| 4980 | 7196510.665 | 474242.557 | 189.398 | 18B20110522CHECK | 189.4 | 0.00 |
| 4990 | 7196513.751 | 474241.244 | 189.113 | 18B20110522STATSFAC | 189.1 | 0.01 |
| 4991 | 7195461.685 | 489707.755 | 152.549 | 18B20110522STATSPK | 152.54 | 0.01 |
| 4992 | 7195705.863 | 488244.767 | 151.186 | 18B20110522STATSPK | 151.21 | -0.02 |
| 4993 | 7188695.708 | 466246.109 | 135.668 | 18B20110522STATSPK | 135.72 | -0.05 |
| 4994 | 7188882.456 | 466234.069 | 135.596 | 18B20110522STATSPK | 135.6 | 0.00 |
| 5000 | 7316873.111 | 367999.568 | 182.69 | 14B2010092514BSAC | 182.77 | -0.08 |
| 5001 | 7311415.782 | 374150.019 | 119.869 | 14B20100925SGR | 119.94 | -0.07 |
| 5002 | 7311422.641 | 374143.747 | 118.988 | 14B20100925SGR | 119.02 | -0.03 |
| 5003 | 7311430.299 | 374136.215 | 117.912 | 14B20100925SGR | 117.99 | -0.08 |
| 5004 | 7311945.912 | 373686.45 | 105.858 | 14B20100925SGR | 105.89 | -0.03 |
| 5005 | 7313918.573 | 371547.591 | 138.246 | 14B20100925SGR | 138.41 | -0.16 |
| 5006 | 7313925.16 | 371539.405 | 138.383 | 14B20100925SGR | 138.49 | -0.11 |
| 5007 | 7313932.178 | 371531.542 | 138.451 | 14B20100925SGR | 138.53 | -0.08 |
| 5008 | 7314416.787 | 371048.601 | 152.665 | 14B20100925SGR | 152.77 | -0.11 |
| 5009 | 7314424.843 | 371041.429 | 152.728 | 14B20100925SGR | 152.83 | -0.10 |
| 5010 | 7314432.589 | 371035.11 | 152.794 | 14B20100925SGR | 152.89 | -0.10 |
| 5011 | 7315034.055 | 370532.426 | 159.898 | 14B20100925SGR | 159.93 | -0.03 |
| 5012 | 7315023.745 | 370548.571 | 159.862 | 14B20100925SGR | 159.91 | -0.05 |
| 5013 | 7315035.773 | 370548.387 | 159.901 | 14B20100925SGR | 159.95 | -0.05 |
| 5014 | 7315296.529 | 370309.082 | 172.184 | 14B20100925SGR | 172.26 | -0.08 |
| 5015 | 7315305.356 | 370300.327 | 172.427 | 14B20100925SGR | 172.48 | -0.05 |
| 5016 | 7315313.611 | 370292.412 | 172.595 | 14B20100925SGR | 172.67 | -0.07 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5017 | 7315679.536 | 369930.079 | 177.229 | 14B20100925SGR | 177.3 | -0.07 |
| 5018 | 7315688.193 | 369921.467 | 177.556 | 14B20100925SGR | 177.64 | -0.08 |
| 5019 | 7315696.426 | 369913.823 | 177.89 | 14B20100925SGR | 177.96 | -0.07 |
| 5020 | 7315938.818 | 369562.525 | 185.975 | 14B20100925SGR | 186.04 | -0.06 |
| 5021 | 7315943.618 | 369554.488 | 185.695 | 14B20100925SGR | 185.81 | -0.12 |
| 5022 | 7315948.084 | 369546.725 | 185.514 | 14B20100925SGR | 185.61 | -0.10 |
| 5023 | 7316018.72 | 369835.334 | 202.709 | 14B20100925SGR | 202.8 | -0.09 |
| 5024 | 7316029.493 | 369829.74 | 202.497 | 14B20100925SGR | 202.61 | -0.11 |
| 5025 | 7316029.884 | 369843.761 | 202.773 | 14B20100925SGR | 202.85 | -0.08 |
| 5026 | 7316167.451 | 370237.276 | 195.902 | 14B20100925SGR | 196.11 | -0.21 |
| 5027 | 7316179.755 | 370232.095 | 196.048 | 14B20100925SGR | 196.25 | -0.20 |
| 5028 | 7316166.446 | 370220.956 | 195.919 | 14B20100925SGR | 196.12 | -0.20 |
| 5029 | 7316142.513 | 370135.957 | 197.033 | 14B20100925SGR | 197.08 | -0.05 |
| 5030 | 7316142.837 | 370125.117 | 197.315 | 14B20100925SGR | 197.4 | -0.09 |
| 5031 | 7316155.365 | 370130.391 | 197.781 | 14B20100925SGR | 197.87 | -0.09 |
| 5032 | 7316241.325 | 369060.443 | 182.382 | 14B20100925SGR | 182.45 | -0.07 |
| 5033 | 7316247.292 | 369051.13 | 182.107 | 14B20100925SGR | 182.17 | -0.06 |
| 5034 | 7316253.164 | 369041.917 | 181.684 | 14B20100925SGR | 181.77 | -0.09 |
| 5035 | 7316640.179 | 368399.673 | 188.691 | 14B20100925SGR | 188.78 | -0.09 |
| 5036 | 7316646.54 | 368389.145 | 188.631 | 14B20100925SGR | 188.73 | -0.10 |
| 5037 | 7316652.276 | 368379.944 | 188.55 | 14B20100925SGR | 188.66 | -0.11 |
| 5038 | 7316871.871 | 368014.4 | 183.865 | 14B20100925SGR | 183.92 | -0.05 |
| 5039 | 7316879.004 | 368002.942 | 183.756 | 14B20100925SGR | 183.82 | -0.06 |
| 5040 | 7316886.123 | 367991.954 | 183.718 | 14B20100925SGR | 183.76 | -0.04 |
| 5041 | 7316874.089 | 367998.367 | 182.724 | 14B20100925CK_14B_5'o/s | 182.76 | -0.04 |
| 5042 | 7317262.827 | 367367.196 | 182.769 | 14B20100925SGR | 182.79 | -0.02 |
| 5043 | 7317270.201 | 367355.303 | 182.156 | 14B20100925SGR | 182.22 | -0.06 |
| 5044 | 7317277.44 | 367343.455 | 181.727 | 14B20100925SGR | 181.79 | -0.06 |
| 5045 | 7317260.272 | 367332.355 | 180.393 | B20100925FAC_MULLIKIN_5 | 180.49 | -0.10 |
| 5046 | 7317758.991 | 366727.43 | 169.913 | 14B20100925SGR | 169.95 | -0.04 |
| 5047 | 7317748.475 | 366735.072 | 170.04 | 14B20100925SGR | 170.08 | -0.04 |
| 5048 | 7317738.938 | 366742.036 | 170.142 | 14B20100925SGR | 170.19 | -0.05 |
| 5049 | 7318718.861 | 365556.803 | 163.062 | 14B20100925SGR | 163.17 | -0.11 |
| 5050 | 7318723.48 | 365546.019 | 162.992 | 14B20100925SGR | 163.11 | -0.12 |
| 5051 | 7318727.415 | 365535.954 | 162.835 | 14B20100925SGR | 162.92 | -0.08 |
| 5052 | 7318915.214 | 364957.437 | 155.268 | 14B20100925SGR | 155.37 | -0.10 |
| 5053 | 7318920.061 | 364946.569 | 155.192 | 14B20100925SGR | 155.34 | -0.15 |
| 5054 | 7318924.88 | 364936.597 | 155.225 | 14B20100925SGR | 155.31 | -0.09 |
| 5055 | 7319207.8 | 364478.531 | 170.408 | 14B20100925SGR | 170.48 | -0.07 |
| 5056 | 7319214.305 | 364469.295 | 170.67 | 14B20100925SGR | 170.73 | -0.06 |
| 5057 | 7319220.156 | 364460.29 | 170.916 | 14B20100925SGR | 170.97 | -0.05 |
| 5058 | 7319917.3 | 364037.374 | 201.545 | 14B20100925SGR | 201.64 | -0.09 |
| 5059 | 7319897.102 | 364046.526 | 200.989 | 14B20100925SGR | 201.06 | -0.07 |
| 5100 | 7298593.656 | 389590.147 | 525.75 | 15B2010092515B | 525.85 | -0.10 |
| 5101 | 7292550.513 | 393738.531 | 205.285 | 15B20100925SGR | 205.32 | -0.03 |
| 5102 | 7292557.931 | 393729.842 | 205.347 | 15B20100925SGR | 205.44 | -0.09 |
| 5103 | 7292564.709 | 393722.332 | 205.408 | 15B20100925SGR | 205.51 | -0.10 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5104 | 7293024.09 | 393206.656 | 228.727 | 15B20100925SGR | 228.84 | -0.11 |
| 5105 | 7293031.628 | 393198.502 | 229.21 | 15B20100925SGR | 229.3 | -0.09 |
| 5106 | 7293039.736 | 393189.97 | 229.711 | 15B20100925SGR | 229.83 | -0.12 |
| 5107 | 7293304.739 | 392515.422 | 254.566 | 15B20100925SGR | 254.63 | -0.06 |
| 5108 | 7293298.391 | 392505.42 | 255.033 | 15B20100925SGR | 255.1 | -0.07 |
| 5109 | 7293292.213 | 392496.231 | 255.462 | 15B20100925SGR | 255.55 | -0.09 |
| 5110 | 7293659.299 | 391569.018 | 269.806 | 15B20100925SGR | 269.84 | -0.03 |
| 5111 | 7293674.474 | 391574.59 | 270.187 | 15B20100925SGR | 270.24 | -0.05 |
| 5112 | 7293685.463 | 391578.475 | 270.454 | 15B20100925SGR | 270.49 | -0.04 |
| 5113 | 7294315.445 | 391817.039 | 276.68 | 15B20100925SPR | 276.69 | -0.01 |
| 5114 | 7294326.933 | 391821.973 | 276.497 | 15B20100925SPR | 276.53 | -0.03 |
| 5115 | 7294337.83 | 391825.986 | 276.294 | 15B20100925SPR | 276.32 | -0.03 |
| 5116 | 7295004.877 | 391293.914 | 292.435 | 15B20100925SPR | 292.47 | -0.04 |
| 5117 | 7295012.962 | 391284.49 | 292.612 | 15B20100925SPR | 292.65 | -0.04 |
| 5118 | 7295020.473 | 391275.663 | 292.755 | 15B20100925SPR | 292.82 | -0.06 |
| 5119 | 7295026.335 | 391287.576 | 292.058 | 15B20100925FAC_GPS157 | 292.16 | -0.10 |
| 5120 | 7295533.225 | 390663.219 | 301.198 | 15B20100925SPR | 301.24 | -0.04 |
| 5121 | 7295540.34 | 390655.094 | 301.473 | 15B20100925SPR | 301.54 | -0.07 |
| 5122 | 7295549.437 | 390644.402 | 301.882 | 15B20100925SPR | 301.94 | -0.06 |
| 5123 | 7296075.267 | 390687.894 | 321.183 | 15B20100925SPR | 321.24 | -0.06 |
| 5124 | 7296083.479 | 390695.8 | 321.584 | 15B20100925SPR | 321.62 | -0.04 |
| 5125 | 7296092.258 | 390704.291 | 322.016 | 15B20100925SPR | 322.06 | -0.04 |
| 5126 | 7296580.663 | 391174.1 | 355.836 | 15B20100925SPR | 355.94 | -0.10 |
| 5127 | 7296588.343 | 391181.876 | 356.444 | 15B20100925SPR | 356.55 | -0.11 |
| 5128 | 7296595.658 | 391189.114 | 357.043 | 15B20100925SPR | 357.14 | -0.10 |
| 5129 | 7296983.162 | 391029.93 | 390.414 | 15B20100925SGR | 390.5 | -0.09 |
| 5130 | 7296989.502 | 391038.177 | 390.512 | 15B20100925SGR | 390.61 | -0.10 |
| 5131 | 7296996.544 | 391047.103 | 390.644 | 15B20100925SGR | 390.74 | -0.10 |
| 5132 | 7297124.146 | 391344.079 | 377.054 | 15B20100925SPR | 377.13 | -0.08 |
| 5133 | 7297136.389 | 391341.28 | 377.116 | 15B20100925SPR | 377.23 | -0.11 |
| 5134 | 7297147.566 | 391338.407 | 377.164 | 15B20100925SPR | 377.24 | -0.08 |
| 5135 | 7297597.216 | 390816.602 | 422.012 | 15B20100925SPR | 422.11 | -0.10 |
| 5136 | 7297601.812 | 390802.99 | 423.032 | 15B20100925SPR | 423.11 | -0.08 |
| 5137 | 7297606.287 | 390789.254 | 424.092 | 15B20100925SPR | 424.18 | -0.09 |
| 5138 | 7298178.123 | 390562.617 | 470.686 | 15B20100925SPR | 470.76 | -0.07 |
| 5139 | 7298192.966 | 390556.813 | 471.783 | 15B20100925SPR | 471.82 | -0.04 |
| 5140 | 7298208.066 | 390549.749 | 472.954 | 15B20100925SPR | 473 | -0.05 |
| 5141 | 7298669.108 | 389999.511 | 519.282 | 15B20100925SPR | 519.31 | -0.03 |
| 5142 | 7298674.838 | 389988.864 | 520.022 | 15B20100925SPR | 520.06 | -0.04 |
| 5143 | 7298679.754 | 389978.469 | 520.754 | 15B20100925SPR | 520.84 | -0.09 |
| 5144 | 7298683.438 | 389748.142 | 529.12 | 15B20100925SPR | 529.19 | -0.07 |
| 5145 | 7298693.023 | 389748.56 | 528.936 | 15B20100925SPR | 529.01 | -0.07 |
| 5146 | 7298689.951 | 389737.037 | 528.918 | 15B20100925SPR | 529.02 | -0.10 |
| 5147 | 7298669.65 | 389700.418 | 528.672 | 15B20100925SPR | 528.78 | -0.11 |
| 5148 | 7298651.992 | 389694.549 | 528.856 | 15B20100925SPR | 528.94 | -0.08 |
| 5149 | 7298656.915 | 389677.816 | 528.453 | 15B20100925SPR | 528.59 | -0.14 |
| 5150 | 7298594.435 | 389591.48 | 525.765 | 15B20100925CK_15B_5'o/s | 525.88 | -0.12 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5151 | 7298581.392 | 389595.256 | 526.602 | 15B20100925SPR | 526.69 | -0.09 |
| 5152 | 7298586.579 | 389604.318 | 526.957 | 15B20100925SPR | 527.06 | -0.10 |
| 5153 | 7298590.285 | 389610.753 | 527.2 | 15B20100925SPR | 527.3 | -0.10 |
| 5154 | 7298085.694 | 388696.009 | 482.247 | 15B20100925SPR | 482.28 | -0.03 |
| 5155 | 7298079.239 | 388683.937 | 481.455 | 15B20100925SPR | 481.5 | -0.05 |
| 5156 | 7298073.286 | 388672.59 | 480.767 | 15B20100925SPR | 480.8 | -0.03 |
| 5157 | 7298446.852 | 388157.293 | 441.194 | 15B20100925SPR | 441.22 | -0.03 |
| 5158 | 7298458.255 | 388155.887 | 440.679 | 15B20100925SPR | 440.71 | -0.03 |
| 5159 | 7298472.674 | 388154.285 | 440.021 | 15B20100925SPR | 440.07 | -0.05 |
| 5160 | 7299017.525 | 387946.679 | 401.313 | 15B20100925SPR | 401.33 | -0.02 |
| 5161 | 7299027.583 | 387941.309 | 400.544 | 15B20100925SPR | 400.58 | -0.04 |
| 5162 | 7299038.217 | 387935.718 | 399.683 | 15B20100925SPR | 399.71 | -0.03 |
| 5163 | 7299076.26 | 387951.816 | 402.228 | 15B20100925CK_15A_5'o/s | 402.29 | -0.06 |
| 5164 | 7299648.056 | 388167.504 | 345.217 | 15B20100925SPR | 345.3 | -0.08 |
| 5165 | 7299654.939 | 388176.984 | 344.406 | 15B20100925SPR | 344.5 | -0.09 |
| 5166 | 7300372.018 | 388381.333 | 334.929 | 15B20100925SPR | 334.94 | -0.01 |
| 5167 | 7300381.921 | 388372.403 | 334.78 | 15B20100925SPR | 334.81 | -0.03 |
| 5168 | 7300396.059 | 388361.417 | 334.501 | 15B20100925SPR | 334.5 | 0.00 |
| 5169 | 7300958.497 | 387914.851 | 349.964 | 15B20100925SPR | 349.97 | -0.01 |
| 5170 | 7300969.246 | 387906.717 | 350.415 | 15B20100925SPR | 350.45 | -0.03 |
| 5171 | 7300978.906 | 387899.496 | 350.8 | 15B20100925SPR | 350.82 | -0.02 |
| 5172 | 7301603.456 | 387522.906 | 393.834 | 15B20100925SPR | 393.84 | -0.01 |
| 5173 | 7301614.834 | 387517.651 | 394.697 | 15B20100925SPR | 394.72 | -0.02 |
| 5174 | 7301626.072 | 387512.582 | 395.577 | 15B20100925SPR | 395.53 | 0.05 |
| 5175 | 7302425.888 | 386971.928 | 444.52 | 15B20100925SPR | 444.52 | 0.00 |
| 5176 | 7302437.435 | 386967.409 | 445.468 | 15B20100925SPR | 445.49 | -0.02 |
| 5177 | 7302450.307 | 386961.457 | 446.494 | 15B20100925SPR | 446.5 | -0.01 |
| 5178 | 7303114.914 | 386320.089 | 483.434 | 15B20100925SPR | 483.45 | -0.02 |
| 5179 | 7303123.547 | 386314.195 | 484.027 | 15B20100925SPR | 484.02 | 0.01 |
| 5180 | 7303134.446 | 386305.555 | 484.728 | 15B20100925SPR | 484.77 | -0.04 |
| 5181 | 7303481.211 | 385507.078 | 545.922 | 15B20100925SPR | 545.95 | -0.03 |
| 5182 | 7303469.112 | 385498.714 | 546.84 | 15B20100925SPR | 546.85 | -0.01 |
| 5183 | 7303457.094 | 385490.847 | 547.747 | 15B20100925SPR | 547.76 | -0.01 |
| 5184 | 7303021.086 | 384983.071 | 574.476 | 15B20100925SPR | 574.5 | -0.02 |
| 5185 | 7303017.539 | 384970.358 | 574.63 | 15B20100925SPR | 574.68 | -0.05 |
| 5186 | 7303014.842 | 384960.305 | 574.807 | 15B20100925SPR | 574.86 | -0.05 |
| 5187 | 7302800.189 | 384182.589 | 596.417 | 15B20100925SPR | 596.43 | -0.01 |
| 5188 | 7302795.445 | 384167.919 | 596.218 | 15B20100925SPR | 596.21 | 0.01 |
| 5189 | 7302791.523 | 384156.683 | 596.035 | 15B20100925SPR | 596.03 | 0.00 |
| 5190 | 7302445.251 | 383672.507 | 581.982 | 15B20100925SPR | 582.02 | -0.04 |
| 5191 | 7302450.979 | 383682.852 | 582.123 | 15B20100925SPR | 582.15 | -0.03 |
| 5192 | 7302457.374 | 383692.095 | 582.125 | 15B20100925SPR | 582.18 | -0.05 |
| 5200 | 7265796.998 | 419066.498 | 451.45 | 16B20100925l6B | 451.47 | -0.02 |
| 5201 | 7265806.502 | 419066.903 | 452.224 | 16B20100925SGR | 452.22 | 0.00 |
| 5202 | 7265813.967 | 419097.399 | 450.438 | 16B20100925SGR | 450.4 | 0.04 |
| 5203 | 7265816.184 | 419122.967 | 448.858 | 16B20100925SGR | 448.85 | 0.01 |
| 5204 | 7265812.27 | 419150.861 | 447.245 | 16B20100925SGR | 447.26 | -0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5205 | 7265795.195 | 419204.118 | 444.481 | 16B20100925SGR | 444.47 | 0.01 |
| 5206 | 7265779.364 | 419251.553 | 441.716 | 16B20100925SGR | 441.72 | 0.00 |
| 5207 | 7265760.636 | 419307.841 | 437.49 | 16B20100925SGR | 437.45 | 0.04 |
| 5208 | 7265740.843 | 419331.099 | 434.522 | 16B20100925SGR | 434.51 | 0.01 |
| 5209 | 7265731.7 | 419343.461 | 433.231 | 16B20100925SGR | 433.22 | 0.01 |
| 5210 | 7265731.73 | 419358.881 | 431.81 | 16B20100925SGR | 431.8 | 0.01 |
| 5211 | 7265741.856 | 419363.826 | 432.179 | 16B20100925SGR | 432.13 | 0.05 |
| 5212 | 7265724.22 | 419416.741 | 425.981 | 16B20100925SGR | 425.93 | 0.05 |
| 5213 | 7265706.966 | 419467.379 | 420.237 | 16B20100925SGR | 420.21 | 0.03 |
| 5214 | 7265706.595 | 419468.623 | 420.121 | 16B20100925SGR | 420.1 | 0.02 |
| 5215 | 7265705.351 | 419472.379 | 419.772 | 16B20100925SGR | 419.75 | 0.02 |
| 5216 | 7265688.653 | 419525.662 | 415.777 | 16B20100925SGR | 415.79 | -0.01 |
| 5217 | 7265677.415 | 419570.765 | 413.293 | 16B20100925SGR | 413.33 | -0.04 |
| 5218 | 7265669.737 | 419624.292 | 411.719 | 16B20100925SGR | 411.72 | 0.00 |
| 5219 | 7265668.08 | 419648.646 | 411.197 | 16B20100925SGR | 411.24 | -0.04 |
| 5220 | 7265613.155 | 420573.494 | 342.859 | 16B20100925SGR | 342.88 | -0.02 |
| 5221 | 7265625.423 | 420557.473 | 344.775 | 16B20100925SGR | 344.79 | -0.02 |
| 5222 | 7265638.924 | 420529.496 | 348.239 | 16B20100925SGR | 348.29 | -0.05 |
| 5223 | 7265646.053 | 420506.325 | 349.135 | 16B20100925SGR | 349.19 | -0.06 |
| 5224 | 7265670.142 | 420478.006 | 353.651 | 16B20100925SGR | 353.67 | -0.02 |
| 5225 | 7265688.803 | 420460.158 | 356.597 | 16B20100925SGR | 356.61 | -0.01 |
| 5226 | 7265611.544 | 420489.036 | 343.403 | 16B20100925SGR | 343.43 | -0.03 |
| 5227 | 7265609.421 | 420505.074 | 343.269 | 16B20100925SGR | 343.29 | -0.02 |
| 5228 | 7265607.39 | 420520.211 | 343.069 | 16B20100925SGR | 343.09 | -0.02 |
| 5229 | 7265604.804 | 420536.665 | 342.698 | 16B20100925SGR | 342.69 | 0.01 |
| 5230 | 7265601.241 | 420565.257 | 342.082 | 16B20100925SGR | 342.07 | 0.01 |
| 5231 | 7265598.105 | 420591.387 | 341.734 | 16B20100925SGR | 341.73 | 0.00 |
| 5232 | 7265594.685 | 420618.749 | 341.253 | 16B20100925SGR | 341.3 | -0.05 |
| 5233 | 7265591.215 | 420649.149 | 340.218 | 16B20100925SGR | 340.26 | -0.04 |
| 5234 | 7265588.096 | 420679.28 | 338.689 | 16B20100925SGR | 338.67 | 0.02 |
| 5235 | 7265590.476 | 420679.57 | 338.67 | 16B20100925SGR | 338.69 | -0.02 |
| 5236 | 7265187.393 | 421657.248 | 314.356 | 16B20100925SGR | 314.35 | 0.01 |
| 5237 | 7265150.445 | 421675.296 | 315.11 | 16B20100925SGR | 315.14 | -0.03 |
| 5238 | 7265120.89 | 421690.35 | 315.075 | 16B20100925SGR | 315.08 | 0.00 |
| 5239 | 7265078.604 | 421712.101 | 314.311 | 16B20100925SGR | 314.3 | 0.01 |
| 5240 | 7265034.986 | 421737.05 | 313.291 | 16B20100925SGR | 313.29 | 0.00 |
| 5241 | 7264999.125 | 421764.2 | 313.086 | 16B20100925SGR | 313.07 | 0.02 |
| 5242 | 7264976.285 | 421786.811 | 313.242 | 16B20100925SGR | 313.23 | 0.01 |
| 5243 | 7264965.06 | 421799.37 | 313.443 | 16B20100925SGR | 313.45 | -0.01 |
| 5244 | 7264955.678 | 421811.491 | 313.643 | 16B20100925SGR | 313.63 | 0.01 |
| 5245 | 7264938.911 | 421836 | 314.161 | 16B20100925SGR | 314.17 | -0.01 |
| 5246 | 7264927.71 | 421853.574 | 314.55 | 16B20100925SGR | 314.57 | -0.02 |
| 5247 | 7264913.256 | 421879.081 | 315.063 | 16B20100925SGR | 315.06 | 0.00 |
| 5248 | 7264903.731 | 421896.164 | 315.143 | 16B20100925SGR | 315.1 | 0.04 |
| 5249 | 7264852.234 | 421958.307 | 314.181 | 16B20100925SGR | 314.2 | -0.02 |
| 5250 | 7264837.45 | 421948.022 | 314.546 | 16B20100925SGR | 314.57 | -0.02 |
| 5251 | 7264818.291 | 421934.019 | 315.072 | 16B20100925SGR | 315.09 | -0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5252 | 7264799.721 | 421921.297 | 315.53 | 16B20100925SGR | 315.57 | -0.04 |
| 5253 | 7264785.645 | 421912.919 | 315.777 | 16B20100925SGR | 315.79 | -0.01 |
| 5254 | 7264755.834 | 421898.725 | 316.427 | 16B20100925SGR | 316.48 | -0.05 |
| 5255 | 7264735.4 | 421891.51 | 317.015 | 16B20100925SGR | 317.07 | -0.06 |
| 5256 | 7264712.784 | 421884.812 | 317.881 | 16B20100925SGR | 317.94 | -0.06 |
| 5257 | 7264698.449 | 421881.081 | 318.478 | 16B20100925SGR | 318.51 | -0.03 |
| 5258 | 7264668.363 | 421873.348 | 319.66 | 16B20100925SGR | 319.7 | -0.04 |
| 5259 | 7265417.609 | 418417.126 | 417.746 | 16B20100925SGR | 417.77 | -0.02 |
| 7001 | 7267416.736 | 416399.766 | 197.609 | 16A2011052416ASAC | 197.49 | 0.12 |
| 7002 | 7267413.197 | 416415.559 | 196.385 | 16A20110524CHECK | 196.36 | 0.02 |
| 7003 | 7267429.707 | 416409.775 | 198.239 | 16A20110524SGR | 198.17 | 0.07 |
| 7004 | 7267451.431 | 416406.857 | 200.164 | 16A20110524SGR | 200.13 | 0.03 |
| 7005 | 7267480.615 | 416406.679 | 202.29 | 16A20110524SGR | 202.31 | -0.02 |
| 7006 | 7267507.101 | 416410.335 | 204.013 | 16A20110524SGR | 204.02 | -0.01 |
| 7007 | 7267536.375 | 416416.883 | 206.333 | 16A20110524SGR | 206.32 | 0.01 |
| 7008 | 7267566.168 | 416425.814 | 207.673 | 16A20110524SGR | 207.68 | -0.01 |
| 7009 | 7267617.799 | 416453.079 | 208.513 | 16A20110524SGR | 208.5 | 0.01 |
| 7010 | 7267671.402 | 416476.121 | 209.118 | 16A20110524SGR | 209.08 | 0.04 |
| 7011 | 7267725.192 | 416506.021 | 209.785 | 16A20110524SGR | 209.78 | 0.00 |
| 7012 | 7267778.765 | 416531.162 | 209.842 | 16A20110524SGR | 209.84 | 0.00 |
| 7013 | 7267832.951 | 416558.911 | 209.621 | 16A20110524SGR | 209.59 | 0.03 |
| 7014 | 7267890.502 | 416586.472 | 210.745 | 16A20110524SGR | 210.71 | 0.03 |
| 7015 | 7267944.259 | 416615.041 | 211.369 | 16A20110524SGR | 211.35 | 0.02 |
| 7016 | 7268001.573 | 416642.738 | 211.62 | 16A20110524SGR | 211.62 | 0.00 |
| 7017 | 7268061.235 | 416670.369 | 214.04 | 16A20110524SGR | 214.02 | 0.02 |
| 7018 | 7268116.318 | 416700.099 | 216.429 | 16A20110524SGR | 216.39 | 0.04 |
| 7019 | 7268176.761 | 416729.083 | 216.836 | 16A20110524SGR | 216.8 | 0.04 |
| 7020 | 7268234.682 | 416757.474 | 217.733 | 16A20110524SGR | 217.7 | 0.03 |
| 7021 | 7268292.544 | 416787.745 | 219.058 | 16A20110524SGR | 219.05 | 0.01 |
| 7022 | 7268353.467 | 416820.021 | 221.483 | 16A20110524SGR | 221.46 | 0.02 |
| 7023 | 7268411.23 | 416848.102 | 218.32 | 16A20110524SGR | 218.34 | -0.02 |
| 7024 | 7268471.404 | 416876.456 | 215.851 | 16A20110524SGR | 215.85 | 0.00 |
| 7025 | 7268537.366 | 416912.72 | 215.893 | 16A20110524SGR | 215.86 | 0.03 |
| 7026 | 7268596.03 | 416941.297 | 216.152 | 16A20110524SGR | 216.16 | -0.01 |
| 7027 | 7268654.976 | 416969.953 | 216.146 | 16A20110524SGR | 216.15 | 0.00 |
| 7028 | 7268716.453 | 417018.397 | 217.917 | 16A20110524SGR | 217.87 | 0.05 |
| 7029 | 7268749.552 | 417005.545 | 219.278 | 16A20110524SGR | 219.28 | 0.00 |
| 7030 | 7266974.576 | 415991.829 | 247.592 | 16A20110524SGR | 247.56 | 0.03 |
| 7031 | 7266972.809 | 415976.036 | 248.338 | 16A20110524SGR | 248.31 | 0.03 |
| 7032 | 7266973.2 | 415960.756 | 248.988 | 16A20110524SGR | 248.97 | 0.02 |
| 7033 | 7266976.479 | 415944.439 | 249.403 | 16A20110524SGR | 249.38 | 0.02 |
| 7034 | 7266981.486 | 415928.244 | 249.455 | 16A20110524SGR | 249.46 | 0.00 |
| 7035 | 7266986.103 | 415913.868 | 249.331 | 16A20110524SGR | 249.31 | 0.02 |
| 7036 | 7266810.487 | 417001.257 | 248.86 | 16A20110524SGR | 248.81 | 0.05 |
| 7037 | 7266793.588 | 417005.427 | 250.585 | 16A20110524SGR | 250.54 | 0.05 |
| 7038 | 7266776.708 | 417015.255 | 252.556 | 16A20110524SGR | 252.51 | 0.05 |
| 7039 | 7266761.482 | 417019.204 | 254.262 | 16A20110524SGR | 254.22 | 0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 7040 | 7266744.835 | 417022.037 | 256.137 | 16A20110524SGR | 256.11 | 0.03 |
| 7041 | 7266729.535 | 417022.039 | 257.639 | 16A20110524SGR | 257.62 | 0.02 |
| 7042 | 7266069.749 | 417124.096 | 318.243 | 16A20110524SGR | 318.16 | 0.08 |
| 7043 | 7266089.73 | 417115.185 | 316.747 | 16A20110524SGR | 316.69 | 0.06 |
| 7044 | 7266106.703 | 417106.882 | 315.502 | 16A20110524SGR | 315.46 | 0.04 |
| 7045 | 7266121.162 | 417099.887 | 314.387 | 16A20110524SGR | 314.35 | 0.04 |
| 7046 | 7266136.226 | 417092.196 | 313.293 | 16A20110524SGR | 313.27 | 0.02 |
| 7047 | 7266150.531 | 417086.878 | 312.306 | 16A20110524SGR | 312.27 | 0.04 |
| 7048 | 7266164.191 | 417082.093 | 311.306 | 16A20110524SGR | 311.24 | 0.07 |
| 7049 | 7265434.835 | 417476.507 | 390.36 | 16A20110524SGR | 390.3 | 0.06 |
| 7050 | 7265419.924 | 417472.151 | 392.176 | 16A20110524SGR | 392.14 | 0.04 |
| 7051 | 7265404.079 | 417472.642 | 394.076 | 16A20110524SGR | 394.04 | 0.04 |
| 7052 | 7265387.303 | 417476.024 | 396.169 | 16A20110524SGR | 396.1 | 0.07 |
| 7053 | 7265374.427 | 417483.139 | 397.76 | 16A20110524SGR | 397.69 | 0.07 |
| 7054 | 7265359.203 | 417489.098 | 399.761 | 16A20110524SGR | 399.7 | 0.06 |
| 7055 | 7265343.525 | 417495.439 | 401.919 | 16A20110524SGR | 401.87 | 0.05 |
| 7056 | 7265334.463 | 417507.359 | 403.529 | 16A20110524SGR | 403.47 | 0.06 |
| 7057 | 7265321.125 | 417517.904 | 405.648 | 16A20110524SGR | 405.59 | 0.06 |
| 7058 | 7265308.401 | 417531.704 | 407.663 | 16A20110524SGR | 407.6 | 0.06 |
| 7059 | 7267413.185 | 416415.551 | 196.382 | 16A20110524CHECK | 196.36 | 0.02 |
| 7060 | 7267413.191 | 416415.555 | 196.388 | 16A20110524CHECK | 196.36 | 0.03 |
| 7300 | 7298593.727 | 389590.126 | 525.749 | 15B2011052515BFAC | 525.85 | -0.10 |
| 7301 | 7265797.054 | 419066.474 | 451.487 | 15B2011052516BFAC | 451.48 | 0.01 |
| 7302 | 7298458.204 | 388151.569 | 440.708 | 15B20110525SAR | 440.73 | -0.02 |
| 7303 | 7298457.242 | 388139.016 | 439.818 | 15B20110525SGR | 439.84 | -0.02 |
| 7304 | 7298376.738 | 388178.155 | 442.481 | 15B20110525OG | 442.52 | -0.04 |
| 7305 | 7298384.133 | 388163.862 | 443.528 | 15B20110525SAR | 443.52 | 0.01 |
| 7306 | 7298331.683 | 388166.725 | 444.927 | 15B20110525SAR | 444.97 | -0.04 |
| 7307 | 7301787.908 | 387436.91 | 405.381 | 15B20110525SAR | 405.38 | 0.00 |
| 7308 | 7301768.752 | 387442.205 | 404.568 | 15B20110525SAR | 404.58 | -0.01 |
| 7309 | 7301757.479 | 387436.57 | 402.705 | 15B20110525OG | 402.72 | -0.02 |
| 7310 | 7301762.769 | 387406.978 | 409.4 | 15B20110525OG | 409.43 | -0.03 |
| 7311 | 7301799.737 | 387356.752 | 410.536 | 15B20110525OG | 410.59 | -0.05 |
| 7312 | 7301911.14 | 387317.286 | 408.068 | 15B20110525SGR | 408.06 | 0.01 |
| 7313 | 7302155.2 | 387066.705 | 430.795 | 15B20110525SAR | 430.78 | 0.02 |
| 7314 | 7302196.293 | 387041.026 | 433.505 | 15B20110525SAR | 433.51 | 0.00 |
| 7315 | 7302342.28 | 386998.232 | 438.66 | 15B20110525SAR | 438.66 | 0.00 |
| 7316 | 7302237.923 | 387054.337 | 440.996 | 15B20110525OG | 441.08 | -0.08 |
| 7317 | 7300565.107 | 388220.891 | 331.43 | 15B20110525SAR | 331.46 | -0.03 |
| 7318 | 7300584.135 | 388191.272 | 330.433 | 15B20110525SGR | 330.44 | -0.01 |
| 7319 | 7300505.999 | 388272.946 | 332.449 | 15B20110525SAR | 332.43 | 0.02 |
| 7320 | 7300441.76 | 388320.389 | 333.582 | 15B20110525SAR | 333.61 | -0.03 |
| 7321 | 7300395.869 | 388336.447 | 332.949 | 15B20110525OG | 333.01 | -0.06 |
| 7322 | 7299636.617 | 388149.012 | 346.753 | 15B20110525SAR | 346.85 | -0.10 |
| 7323 | 7298610.958 | 389622.547 | 527.489 | 15B20110525SAR | 527.59 | -0.10 |
| 7324 | 7298597.552 | 389632.371 | 527.824 | 15B20110525SAR | 527.92 | -0.10 |
| 7325 | 7298601.303 | 389577.942 | 525.907 | 15B20110525SGR | 525.95 | -0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 7326 | 7298652.256 | 389591.9 | 533.932 | 15B20110525OG | 534.04 | -0.11 |
| 7327 | 7298649.327 | 389639.989 | 527.793 | 15B20110525SAR | 527.85 | -0.06 |
| 7328 | 7298662.136 | 389687.09 | 528.578 | 15B20110525SAR | 528.68 | -0.10 |
| 7329 | 7298641.319 | 389711.065 | 529.15 | 15B20110525SAR | 529.22 | -0.07 |
| 7330 | 7298585.349 | 390109.293 | 510.452 | 15B20110525SAR | 510.52 | -0.07 |
| 7331 | 7298555.484 | 390154.243 | 507.152 | 15B20110525SAR | 507.2 | -0.05 |
| 7332 | 7298522.566 | 390181.8 | 504.276 | 15B20110525SGR | 504.31 | -0.03 |
| 7333 | 7298504.326 | 390220.239 | 502.043 | 15B20110525SAR | 502.1 | -0.06 |
| 7334 | 7298471.57 | 390286.528 | 498.212 | 15B20110525OG | 498.32 | -0.11 |
| 7335 | 7297674.274 | 390676.589 | 433.647 | 15B20110525SAR | 433.72 | -0.07 |
| 7336 | 7297660.982 | 390668.178 | 433.141 | 15B20110525SGR | 433.2 | -0.06 |
| 7337 | 7297668.664 | 390638.647 | 435.113 | 15B20110525OG | 435.19 | -0.08 |
| 7338 | 7297710.508 | 390616.347 | 440.747 | 15B20110525OG | 440.82 | -0.07 |
| 7339 | 7297016.662 | 391380.885 | 374.195 | 15B20110525SGR | 374.28 | -0.08 |
| 7340 | 7297009.804 | 391371.858 | 374.685 | 15B20110525SAR | 374.81 | -0.13 |
| 7341 | 7296859.493 | 391392.874 | 368.382 | 15B20110525SGR | 368.48 | -0.10 |
| 7342 | 7296860.937 | 391384.44 | 368.726 | 15B20110525SAR | 368.83 | -0.10 |
| 7343 | 7296938.94 | 391017.876 | 390.53 | 15B20110525SGR | 390.63 | -0.10 |
| 7344 | 7296895.725 | 391073.699 | 388.951 | 15B20110525SGR | 389.04 | -0.09 |
| 7345 | 7296848.362 | 391013.497 | 391.463 | 15B20110525SGR | 391.55 | -0.09 |
| 7346 | 7299077.867 | 387951.871 | 402.2 | .5B20110525CHK_15A_actua | 402.27 | -0.07 |
| 7347 | 7298594.092 | 389587.14 | 525.681 | 15B20110525CHK_15B_SSP | 525.74 | -0.06 |
| 7348 | 7265665.711 | 420479.316 | 352.933 | 15B20110525SGR | 352.92 | 0.01 |
| 7349 | 7265638.725 | 420529.092 | 348.281 | 15B20110525SGR | 348.29 | -0.01 |
| 7350 | 7265622.003 | 420558.904 | 344.456 | 15B20110525SGR | 344.46 | 0.00 |
| 7351 | 7265600.01 | 420582.536 | 341.919 | 15B20110525SGR | 341.89 | 0.03 |
| 7352 | 7265618.335 | 420537.031 | 343.669 | 15B20110525OG | 343.68 | -0.01 |
| 7353 | 7265794.126 | 419066.592 | 451.121 | 15B20110525CHK_16B_SSP | 451.14 | -0.02 |
| 7354 | 7265794.141 | 419066.594 | 451.104 | 15B20110525CHK_16B_SSP | 451.15 | -0.05 |
| 7355 | 7298594.1 | 389587.119 | 525.686 | 15B20110525CHK_15B_SSP | 525.74 | -0.05 |
| 7400 | 7299077.857 | 387951.871 | 402.197 | 15A2011052615AFAC | 402.27 | -0.07 |
| 7401 | 7286045.536 | 402496.087 | 415.692 | 15A20110526RRSPIKE | 415.69 | 0.00 |
| 7402 | 7286044.265 | 402493.297 | 415.58 | A20110526CHK_RR_Spike_1 | 415.57 | 0.01 |
| 7403 | 7303081.677 | 385220.88 | 571.35 | 15A20110526SAR | 571.42 | -0.07 |
| 7404 | 7303096.512 | 385185.874 | 570.327 | 15A20110526SGR | 570.41 | -0.08 |
| 7405 | 7303251.611 | 386205.706 | 490.456 | 15A20110526SGR | 490.5 | -0.04 |
| 7406 | 7303235.724 | 386202.82 | 488.454 | 15A20110526OG | 488.52 | -0.07 |
| 7407 | 7303197.524 | 386236.122 | 486.953 | 15A20110526OG | 487 | -0.05 |
| 7408 | 7303203.368 | 386251.167 | 488.278 | 15A20110526SAR | 488.31 | -0.03 |
| 7409 | 7303167.739 | 386274.396 | 486.76 | 15A20110526SAR | 486.82 | -0.06 |
| 7410 | 7303157.088 | 386265.084 | 484.764 | 15A20110526SGR | 484.86 | -0.10 |
| 7411 | 7302448.579 | 386943.817 | 445.593 | 15A20110526SGR | 445.67 | -0.08 |
| 7412 | 7302429.254 | 386955.165 | 443.778 | 15A20110526OG | 443.86 | -0.08 |
| 7413 | 7302429.284 | 386966.988 | 444.704 | 15A20110526SAR | 444.76 | -0.06 |
| 7414 | 7302408.838 | 386978.37 | 443.018 | 15A20110526SAR | 443.07 | -0.05 |
| 7415 | 7302378.19 | 386983.479 | 440.789 | 15A20110526SAR | 440.82 | -0.03 |
| 7416 | 7302503.476 | 386923.612 | 450.686 | 15A20110526SAR | 450.71 | -0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 7417 | 7302531.261 | 386904.683 | 452.797 | 15A20110526SAR | 452.82 | -0.02 |
| 7418 | 7302553.076 | 386875.761 | 454.218 | 15A20110526SAR | 454.24 | -0.02 |
| 7419 | 7301920.625 | 387330.504 | 409.505 | 15A20110526SAR | 409.53 | -0.02 |
| 7420 | 7301061.724 | 387836.002 | 354.337 | 15A20110526SAR | 354.39 | -0.05 |
| 7421 | 7301050.935 | 387847.835 | 353.682 | 15A20110526SAR | 353.74 | -0.06 |
| 7422 | 7299766.518 | 388312.365 | 332.384 | 15A20110526SGR | 332.45 | -0.07 |
| 7423 | 7299780.581 | 388326.748 | 330.862 | 15A20110526OG | 331.01 | -0.15 |
| 7424 | 7299800.564 | 388364.053 | 322.586 | 15A20110526OG | 322.7 | -0.11 |
| 7425 | 7299822.379 | 388359.003 | 328.043 | 15A20110526OG | 328.15 | -0.11 |
| 7426 | 7299834.289 | 388356.853 | 329.16 | 15A20110526SAR | 329.26 | -0.10 |
| 7427 | 7299858.385 | 388371.881 | 328.354 | 15A20110526SAR | 328.43 | -0.08 |
| 7428 | 7299866.972 | 388365.658 | 327.096 | 15A20110526OG | 327.2 | -0.10 |
| 7429 | 7299832.761 | 388335.83 | 328.246 | 15A20110526OG | 328.37 | -0.12 |
| 7430 | 7299810.543 | 388319.638 | 329.519 | 15A20110526SGR | 329.63 | -0.11 |
| 7431 | 7290078.13 | 398086.668 | 239.236 | 15A20110526SGR | 239.26 | -0.02 |
| 7432 | 7290051.309 | 398089.047 | 240.735 | 15A20110526SAR | 240.78 | -0.04 |
| 7433 | 7290072.778 | 398105.552 | 239.269 | 15A20110526SAR | 239.3 | -0.03 |
| 7434 | 7290139.518 | 398122.923 | 234.526 | 15A20110526SGR | 234.58 | -0.05 |
| 7435 | 7290147.911 | 398147.275 | 234.492 | 15A20110526SAR | 234.53 | -0.04 |
| 7436 | 7288811.439 | 399945.555 | 283.631 | 15A20110526SGR | 283.66 | -0.03 |
| 7437 | 7288820.797 | 399952.682 | 283.677 | 15A20110526SGR | 283.7 | -0.02 |
| 7438 | 7288820.801 | 399952.68 | 283.683 | 15A20110526SGR | 283.7 | -0.02 |
| 7439 | 7288820.796 | 399952.678 | 283.674 | 15A20110526SGR | 283.7 | -0.03 |
| 7440 | 7288848.4 | 399965.102 | 284.213 | 15A20110526SAR | 284.23 | -0.02 |
| 7441 | 7288877.839 | 399974.886 | 284.265 | 15A20110526SGR | 284.31 | -0.05 |
| 7442 | 7288917.039 | 399992.208 | 285.618 | 15A20110526SGR | 285.63 | -0.01 |
| 7443 | 7288754.044 | 399920.837 | 282.816 | 15A20110526SGR | 282.86 | -0.04 |
| 7444 | 7288677.594 | 399882.137 | 282.998 | 15A20110526SGR | 283.03 | -0.03 |
| 7445 | 7288574.326 | 399841.358 | 282.059 | 15A20110526SGR | 282.08 | -0.02 |
| 7446 | 7288515.829 | 399817.375 | 281.856 | 15A20110526SGR | 281.89 | -0.03 |
| 7447 | 7288449.454 | 399788.975 | 282.512 | 15A20110526SGR | 282.52 | -0.01 |
| 7448 | 7288382.836 | 399759.438 | 283.88 | 15A20110526SGR | 283.89 | -0.01 |
| 7449 | 7288315.044 | 399729.887 | 287.988 | 15A20110526SGR | 288.01 | -0.02 |
| 7450 | 7287606.663 | 402468.189 | 313.785 | 15A20110526SGR | 313.8 | -0.01 |
| 7451 | 7287603.22 | 402459.905 | 313.735 | 15A20110526SGR | 313.79 | -0.06 |
| 7452 | 7284276.651 | 403540.811 | 147.102 | 15A20110526SGR | 147.11 | -0.01 |
| 7453 | 7284269.969 | 403555.858 | 147.363 | 15A20110526SGR | 147.38 | -0.02 |
| 7456 | 7282953.105 | 404378.178 | 239.918 | 15A20110526SAR | 239.97 | -0.05 |
| 7457 | 7282953.368 | 404388.416 | 240.246 | 15A20110526SAR | 240.26 | -0.01 |
| 7458 | 7282933.527 | 404366.231 | 238.544 | 15A20110526SGR | 238.56 | -0.02 |
| 7459 | 7282902.401 | 404357.747 | 237.182 | 15A20110526SGR | 237.19 | -0.01 |
| 7460 | 7282186.898 | 406339.679 | 389.356 | 15A20110526SAR | 389.35 | 0.01 |
| 7461 | 7282198.547 | 406357.337 | 389.184 | 15A20110526SAR | 389.2 | -0.02 |
| 7462 | 7282106.698 | 406361.063 | 393.041 | 15A20110526SGR | 393.04 | 0.00 |
| 7463 | 7282099.389 | 406391.985 | 393.316 | 15A20110526OG | 393.32 | 0.00 |
| 7464 | 7282062.385 | 406421.029 | 401.481 | 15A20110526SGR | 401.45 | 0.03 |
| 7465 | 7282093.899 | 406380.457 | 394.689 | 15A20110526SAR | 394.67 | 0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 7466 | 7286903.465 | 402508.598 | 364.437 | 15A20110526SGR | 364.39 | 0.05 |
| 7467 | 7286941.233 | 402510.685 | 362.589 | 15A20110526SGR | 362.56 | 0.03 |
| 7468 | 7286961.621 | 402510.315 | 361.401 | 15A20110526SGR | 361.36 | 0.04 |
| 7469 | 7286191.618 | 402466.835 | 414.742 | 15A20110526SGR | 414.74 | 0.00 |
| 7470 | 7286162.701 | 402484.973 | 415.605 | 15A20110526SGR | 415.6 | 0.00 |
| 7471 | 7286145.098 | 402464.429 | 415.84 | 15A20110526SGR | 415.84 | 0.00 |
| 7472 | 7286111.072 | 402592.986 | 417.109 | 15A20110526SGR | 417.08 | 0.03 |
| 7473 | 7286044.274 | 402493.304 | 415.551 | A20110526CHK_RR_Spike_1 | 415.57 | -0.02 |
| 7474 | 7299073.554 | 387953.599 | 402.261 | A20110526CHK_16A_WSI_S | 402.35 | -0.09 |
| 7475 | 7299073.569 | 387953.569 | 402.272 | A20110526CHK_16A_WSI_S | 402.35 | -0.08 |
| 7476 | 7265797.054 | 419066.474 | 451.487 | 15A20110526STATIC 16B | 451.48 | 0.01 |
| 7500 | 7226529.501 | 457206.691 | 296.604 | 17E2011052717E | 296.59 | 0.01 |
| 7501 | 7226539.944 | 457220.88 | 295.257 | 17E20110527SGR | 295.27 | -0.01 |
| 7502 | 7226526.999 | 457208.415 | 296.387 | E20110527CHK_17E_RR_Spi | 296.42 | -0.03 |
| 7503 | 7226527.007 | 457208.414 | 296.394 | E20110527CHK_17E_RR_Spi | 296.42 | -0.03 |
| 9000 | 7320437.686 | 363782.411 | 184.64 | 14A2011053114AFAC | 184.68 | -0.04 |
| 9001 | 7320447.232 | 363800.112 | 186.282 | 14A20110531SGR | 186.31 | -0.03 |
| 9002 | 7320461.866 | 363793.601 | 187.121 | 14A20110531SGR | 187.14 | -0.02 |
| 9003 | 7320476.585 | 363787.552 | 188.093 | 14A20110531SGR | 188.12 | -0.03 |
| 9004 | 7320491.405 | 363780.855 | 189.064 | 14A20110531SGR | 189.09 | -0.03 |
| 9005 | 7320505.318 | 363774.552 | 189.893 | 14A20110531SGR | 189.93 | -0.04 |
| 9006 | 7320520.028 | 363767.278 | 190.641 | 14A20110531SGR | 190.67 | -0.03 |
| 9007 | 7320535.656 | 363763.487 | 191.479 | 14A20110531SGR | 191.52 | -0.04 |
| 9008 | 7321101.835 | 363355.342 | 245.653 | 14A20110531SGR | 245.69 | -0.04 |
| 9009 | 7321113.03 | 363342.773 | 247.22 | 14A20110531SGR | 247.23 | -0.01 |
| 9010 | 7321127.357 | 363336.511 | 248.463 | 14A20110531SGR | 248.49 | -0.03 |
| 9011 | 7321140.936 | 363327.917 | 249.905 | 14A20110531SGR | 249.94 | -0.03 |
| 9012 | 7321154.59 | 363316.747 | 251.615 | 14A20110531SGR | 251.63 | -0.01 |
| 9013 | 7321168.694 | 363309.005 | 253.076 | 14A20110531SGR | 253.07 | 0.01 |
| 9014 | 7321183.815 | 363300.959 | 254.632 | 14A20110531SGR | 254.61 | 0.02 |
| 9015 | 7321654.467 | 363108.969 | 258.063 | 14A20110531SGR | 258.02 | 0.04 |
| 9016 | 7321618.804 | 363123.335 | 259.336 | 14A20110531SGR | 259.34 | 0.00 |
| 9017 | 7321603.232 | 363129.289 | 259.879 | 14A20110531SGR | 259.87 | 0.01 |
| 9018 | 7321588.895 | 363135.041 | 260.382 | 14A20110531SGR | 260.39 | -0.01 |
| 9019 | 7321574.104 | 363140.369 | 260.874 | 14A20110531SGR | 260.87 | 0.00 |
| 9020 | 7321558.922 | 363145.925 | 261.318 | 14A20110531SGR | 261.33 | -0.01 |
| 9021 | 7321543.73 | 363152.093 | 261.658 | 14A20110531SGR | 261.65 | 0.01 |
| 9024 | 7319902.906 | 364042.067 | 201.175 | 14A20110531SGR | 201.19 | -0.01 |
| 9025 | 7319915.787 | 364036.105 | 201.517 | 14A20110531SGR | 201.53 | -0.01 |
| 9026 | 7319928.568 | 364030.34 | 201.821 | 14A20110531SGR | 201.82 | 0.00 |
| 9027 | 7319941.441 | 364024.455 | 202.092 | 14A20110531SGR | 202.08 | 0.01 |
| 9028 | 7319954.764 | 364018.604 | 202.341 | 14A20110531SGR | 202.34 | 0.00 |
| 9029 | 7319967.791 | 364012.884 | 202.573 | 14A20110531SGR | 202.59 | -0.02 |
| 9030 | 7319981.086 | 364006.833 | 202.756 | 14A20110531SGR | 202.77 | -0.01 |
| 9031 | 7319225.735 | 364448.322 | 171.287 | 14A20110531SGR | 171.27 | 0.02 |
| 9032 | 7320441.301 | 363780.957 | 184.868 | 14A20110531CHECK | 184.9 | -0.03 |
| 9033 | 7320441.305 | 363780.961 | 184.865 | 14A20110531CHECK | 184.9 | -0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 9100 | 7316873.226 | 367999.53 | 182.727 | 14B2011052914BFAC | 182.78 | -0.05 |
| 9101 | 7316878.982 | 368002.968 | 183.818 | 14B20110529SGR | 183.82 | 0.00 |
| 9102 | 7316888.574 | 367987.553 | 183.806 | 14B20110529SGR | 183.8 | 0.01 |
| 9103 | 7316898.056 | 367971.368 | 183.942 | 14B20110529SGR | 183.94 | 0.00 |
| 9104 | 7316908.282 | 367955.653 | 184.17 | 14B20110529SGR | 184.15 | 0.02 |
| 9105 | 7316917.335 | 367941.209 | 184.402 | 14B20110529SGR | 184.39 | 0.01 |
| 9106 | 7316925.349 | 367927.017 | 184.745 | 14B20110529SGR | 184.72 | 0.03 |
| 9107 | 7316933.042 | 367913.067 | 185.149 | 14B20110529SGR | 185.14 | 0.01 |
| 9108 | 7316941.665 | 367899.059 | 185.601 | 14B20110529SGR | 185.59 | 0.01 |
| 9109 | 7316949.941 | 367885.74 | 186.035 | 14B20110529SGR | 186.02 | 0.01 |
| 9110 | 7316957.948 | 367872.195 | 186.525 | 14B20110529SGR | 186.52 | 0.00 |
| 9111 | 7317261.473 | 367366.552 | 182.746 | 14B20110529SGR | 182.74 | 0.01 |
| 9112 | 7317269.781 | 367352.968 | 182.088 | 14B20110529SGR | 182.09 | 0.00 |
| 9113 | 7317278.593 | 367339.202 | 181.618 | 14B20110529SGR | 181.61 | 0.01 |
| 9114 | 7317286.732 | 367325.858 | 181.251 | 14B20110529SGR | 181.25 | 0.00 |
| 9115 | 7317295.128 | 367312.269 | 180.964 | 14B20110529SGR | 180.97 | -0.01 |
| 9116 | 7317304.073 | 367297.825 | 180.814 | 14B20110529SGR | 180.82 | -0.01 |
| 9117 | 7317313.513 | 367283.39 | 180.839 | 14B20110529SGR | 180.85 | -0.01 |
| 9118 | 7317322.142 | 367269.22 | 180.934 | 14B20110529SGR | 180.92 | 0.01 |
| 9119 | 7317330.733 | 367254.66 | 180.917 | 14B20110529SGR | 180.93 | -0.01 |
| 9120 | 7317339.564 | 367240.406 | 181.019 | 14B20110529SGR | 181 | 0.02 |
| 9121 | 7317842.048 | 366664.25 | 170.044 | 14B20110529SGR | 170.08 | -0.04 |
| 9122 | 7318629.46 | 367394.46 | 262.617 | 14B20110529SGR | 262.67 | -0.05 |
| 9123 | 7318631.386 | 367415.752 | 263.461 | 14B20110529SGR | 263.54 | -0.08 |
| 9124 | 7318637.545 | 367431.88 | 264.131 | 14B20110529SGR | 264.22 | -0.09 |
| 9125 | 7318646.904 | 367447.038 | 265.389 | 14B20110529SGR | 265.46 | -0.07 |
| 9126 | 7318659.19 | 367459.581 | 266.578 | 14B20110529SGR | 266.64 | -0.06 |
| 9127 | 7318673.821 | 367466.309 | 267.319 | 14B20110529SGR | 267.39 | -0.07 |
| 9128 | 7318686.354 | 367473.18 | 267.622 | 14B20110529SGR | 267.69 | -0.07 |
| 9129 | 7318704.296 | 367478.328 | 267.882 | 14B20110529SGR | 267.95 | -0.07 |
| 9130 | 7318718.768 | 367481.082 | 268.031 | 14B20110529SGR | 268.1 | -0.07 |
| 9131 | 7316597.039 | 368476.023 | 187.852 | 14B20110529SGR | 187.86 | -0.01 |
| 9132 | 7316588.565 | 368488.281 | 187.676 | 14B20110529SGR | 187.69 | -0.01 |
| 9133 | 7316581.042 | 368500.617 | 187.338 | 14B20110529SGR | 187.35 | -0.01 |
| 9134 | 7316573.269 | 368513.609 | 186.853 | 14B20110529SGR | 186.86 | -0.01 |
| 9135 | 7316564.93 | 368526.825 | 186.206 | 14B20110529SGR | 186.2 | 0.01 |
| 9136 | 7316556.811 | 368540 | 185.439 | 14B20110529SGR | 185.45 | -0.01 |
| 9137 | 7316549.041 | 368553.764 | 184.718 | 14B20110529SGR | 184.73 | -0.01 |
| 9138 | 7316540.704 | 368567.617 | 184.188 | 14B20110529SGR | 184.2 | -0.01 |
| 9139 | 7316532.643 | 368580.872 | 183.781 | 14B20110529SGR | 183.8 | -0.02 |
| 9140 | 7316523.823 | 368595.848 | 183.325 | 14B20110529SGR | 183.36 | -0.04 |
| 9141 | 7316143.376 | 369219.544 | 184.467 | 14B20110529SGR | 184.46 | 0.01 |
| 9142 | 7316152.904 | 369206.597 | 184.436 | 14B20110529SGR | 184.43 | 0.01 |
| 9143 | 7316159.406 | 369193.008 | 184.229 | 14B20110529SGR | 184.24 | -0.01 |
| 9144 | 7316168.107 | 369178.906 | 184.044 | 14B20110529SGR | 184.06 | -0.02 |
| 9145 | 7316176.466 | 369165.061 | 183.846 | 14B20110529SGR | 183.85 | 0.00 |
| 9146 | 7316184.301 | 369151.857 | 183.592 | 14B20110529SGR | 183.61 | -0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 9147 | 7316192.535 | 369138.506 | 183.36 | 14B20110529SGR | 183.38 | -0.02 |
| 9148 | 7316200.456 | 369125.208 | 183.128 | 14B20110529SGR | 183.16 | -0.03 |
| 9149 | 7316208.548 | 369112.009 | 182.913 | 14B20110529SGR | 182.96 | -0.05 |
| 9150 | 7316217.722 | 369098.133 | 182.728 | 14B20110529SGR | 182.76 | -0.03 |
| 9151 | 7315841.277 | 369722.34 | 187.39 | 14B20110529SGR | 187.38 | 0.01 |
| 9152 | 7315849.982 | 369707.335 | 187.547 | 14B20110529SGR | 187.55 | 0.00 |
| 9153 | 7315858.048 | 369694.099 | 187.643 | 14B20110529SGR | 187.65 | -0.01 |
| 9154 | 7315865.616 | 369681.595 | 187.712 | 14B20110529SGR | 187.69 | 0.02 |
| 9155 | 7315871.89 | 369668.808 | 187.703 | 14B20110529SGR | 187.7 | 0.00 |
| 9156 | 7316003.863 | 369837.797 | 203.112 | 14B20110529SGR | 203.14 | -0.03 |
| 9157 | 7316011.732 | 369824.612 | 202.827 | 14B20110529SGR | 202.86 | -0.03 |
| 9158 | 7316019.275 | 369810.383 | 202.432 | 14B20110529SGR | 202.44 | -0.01 |
| 9159 | 7316025.256 | 369797.278 | 201.928 | 14B20110529SGR | 201.97 | -0.04 |
| 9160 | 7316031.595 | 369783.432 | 201.209 | 14B20110529SGR | 201.23 | -0.02 |
| 9161 | 7316035.545 | 369769.844 | 200.392 | 14B20110529SGR | 200.41 | -0.02 |
| 9162 | 7316039.601 | 369755.118 | 199.292 | 14B20110529SGR | 199.32 | -0.03 |
| 9163 | 7316044.882 | 369740.777 | 197.971 | 14B20110529SGR | 197.99 | -0.02 |
| 9164 | 7316047.204 | 369726.48 | 196.907 | 14B20110529SGR | 196.92 | -0.01 |
| 9165 | 7316045.031 | 369710.687 | 195.739 | 14B20110529SGR | 195.77 | -0.03 |
| 9166 | 7316875.955 | 368001.246 | 183.708 | 14B20110529CHECK | 183.72 | -0.01 |
| 9167 | 7316875.952 | 368001.245 | 183.714 | 14B20110529CHECK | 183.72 | -0.01 |
| 9200 | 7309170.453 | 376246.552 | 95.121 | 14C2011052814CFAC | 95.12 | 0.00 |
| 9201 | 7309183.402 | 376247.543 | 95.536 | 14C20110528SGR | 95.53 | 0.01 |
| 9202 | 7309173.886 | 376276.947 | 95.537 | 14C20110528SGR | 95.53 | 0.01 |
| 9203 | 7309164.973 | 376301.079 | 95.421 | 14C20110528SGR | 95.43 | -0.01 |
| 9204 | 7309144.657 | 376320.395 | 94.943 | 14C20110528SGR | 94.94 | 0.00 |
| 9205 | 7309123.419 | 376308.875 | 94.868 | 14C20110528SGR | 94.87 | 0.00 |
| 9206 | 7309097.652 | 376315.602 | 95.33 | 14C20110528SGR | 95.33 | 0.00 |
| 9207 | 7309075.234 | 376338.276 | 95.204 | 14C20110528SGR | 95.19 | 0.01 |
| 9208 | 7309054.456 | 376357.821 | 95.058 | 14C20110528SGR | 95.05 | 0.01 |
| 9209 | 7309032.893 | 376379.544 | 95.085 | 14C20110528SGR | 95.09 | -0.01 |
| 9210 | 7309011.833 | 376402.073 | 94.822 | 14C20110528SGR | 94.85 | -0.03 |
| 9211 | 7308995.298 | 376427.809 | 94.736 | 14C20110528SGR | 94.72 | 0.02 |
| 9212 | 7308979.405 | 376454.641 | 94.809 | 14C20110528SGR | 94.84 | -0.03 |
| 9213 | 7308964.467 | 376481.929 | 95.125 | 14C20110528SGR | 95.13 | 0.00 |
| 9214 | 7309247.959 | 375967.329 | 94.616 | 14C20110528SGR | 94.61 | 0.01 |
| 9215 | 7309259.674 | 375940.225 | 94.586 | 14C20110528SGR | 94.58 | 0.01 |
| 9216 | 7309273.959 | 375912.789 | 94.522 | 14C20110528SGR | 94.5 | 0.02 |
| 9217 | 7309292.297 | 375880.251 | 94.344 | 14C20110528SGR | 94.35 | -0.01 |
| 9218 | 7309307.964 | 375856.191 | 94.377 | 14C20110528SGR | 94.38 | 0.00 |
| 9219 | 7309324.416 | 375829.34 | 94.437 | 14C20110528SGR | 94.43 | 0.01 |
| 9220 | 7309344.32 | 375800.188 | 94.258 | 14C20110528SGR | 94.25 | 0.01 |
| 9221 | 7309358.6 | 375769.414 | 93.902 | 14C20110528SGR | 93.88 | 0.02 |
| 9222 | 7309346.819 | 375736.146 | 93.467 | 14C20110528SGR | 93.47 | 0.00 |
| 9223 | 7309325.933 | 375712.161 | 93.41 | 14C20110528SGR | 93.38 | 0.03 |
| 9224 | 7309297.796 | 375718.894 | 93.009 | 14C20110528SGR | 93.02 | -0.01 |
| 9225 | 7309283.266 | 375739.897 | 93.085 | 14C20110528SGR | 93.08 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 9226 | 7309282.536 | 375770.339 | 94.034 | 14C20110528SGR | 94.03 | 0.00 |
| 9227 | 7309278.152 | 375802.827 | 94.593 | 14C20110528SGR | 94.61 | -0.02 |
| 9228 | 7309257.522 | 375833.403 | 94.997 | 14C20110528SGR | 95.02 | -0.02 |
| 9229 | 7309242.886 | 375861.346 | 95.117 | 14C20110528SGR | 95.13 | -0.01 |
| 9230 | 7309225.01 | 375889.685 | 94.981 | 14C20110528SGR | 95.01 | -0.03 |
| 9231 | 7309212.113 | 375917.113 | 94.572 | 14C20110528SGR | 94.58 | -0.01 |
| 9232 | 7309194.397 | 375949.389 | 94.508 | 14C20110528SGR | 94.5 | 0.01 |
| 9233 | 7309176.836 | 375974.717 | 94.007 | 14C20110528SGR | 94 | 0.01 |
| 9234 | 7309154.916 | 375988.818 | 93.441 | 14C20110528SGR | 93.4 | 0.04 |
| 9235 | 7309132.686 | 375977.759 | 92.333 | 14C20110528SGR | 92.35 | -0.02 |
| 9236 | 7309183.668 | 376004.231 | 93.678 | 14C20110528SGR | 93.68 | 0.00 |
| 9237 | 7309209.328 | 376020.216 | 94.738 | 14C20110528SGR | 94.74 | 0.00 |
| 9238 | 7309203.243 | 376053.24 | 95.069 | 14C20110528SGR | 95.08 | -0.01 |
| 9239 | 7309192.817 | 376088.071 | 95.194 | 14C20110528SGR | 95.19 | 0.00 |
| 9240 | 7309175.138 | 376122.452 | 96.125 | 14C20110528SGR | 96.15 | -0.03 |
| 9241 | 7309147.282 | 376108.927 | 96.947 | 14C20110528SPR | 96.98 | -0.03 |
| 9242 | 7309119.98 | 376094.471 | 98.632 | 14C20110528SPR | 98.64 | -0.01 |
| 9243 | 7309098.358 | 376082.228 | 100.382 | 14C20110528SPR | 100.42 | -0.04 |
| 9247 | 7309231.957 | 375994.568 | 94.802 | 14C20110528SGR | 94.81 | -0.01 |
| 9248 | 7309254.342 | 375981.749 | 94.749 | 14C20110528SGR | 94.77 | -0.02 |
| 9249 | 7309760.576 | 376139.456 | 97.212 | 14C20110528SGR | 97.19 | 0.02 |
| 9250 | 7309772.576 | 376131.871 | 97.216 | 14C20110528SGR | 97.2 | 0.02 |
| 9251 | 7309785.512 | 376124.324 | 97.256 | 14C20110528SGR | 97.25 | 0.01 |
| 9252 | 7309799.342 | 376115.5 | 97.267 | 14C20110528SGR | 97.27 | 0.00 |
| 9253 | 7309812.214 | 376106.81 | 97.313 | 14C20110528SGR | 97.33 | -0.02 |
| 9254 | 7310169.207 | 375580.126 | 98.818 | 14C20110528SGR | 98.83 | -0.01 |
| 9255 | 7310176.378 | 375566.832 | 98.858 | 14C20110528SGR | 98.84 | 0.02 |
| 9256 | 7310183.631 | 375553.822 | 98.749 | 14C20110528SGR | 98.74 | 0.01 |
| 9257 | 7310190.665 | 375541.022 | 98.481 | 14C20110528SGR | 98.45 | 0.03 |
| 9258 | 7310197.618 | 375527.761 | 98.084 | 14C20110528SGR | 98.06 | 0.02 |
| 9259 | 7310580.018 | 374844.91 | 105.846 | 14C20110528SGR | 105.83 | 0.02 |
| 9260 | 7310590.061 | 374832.986 | 105.688 | 14C20110528SGR | 105.63 | 0.06 |
| 9261 | 7310600.343 | 374820.793 | 105.693 | 14C20110528SGR | 105.68 | 0.01 |
| 9262 | 7310610.296 | 374809.345 | 105.786 | 14C20110528SGR | 105.78 | 0.01 |
| 9263 | 7310619.428 | 374797.173 | 106.05 | 14C20110528SGR | 106.01 | 0.04 |
| 9264 | 7311116.761 | 374396.405 | 138.338 | 14C20110528SGR | 138.33 | 0.01 |
| 9265 | 7311128.855 | 374387.677 | 138.381 | 14C20110528SGR | 138.39 | -0.01 |
| 9266 | 7311141.201 | 374377.867 | 138.319 | 14C20110528SGR | 138.3 | 0.02 |
| 9267 | 7311153.386 | 374368.414 | 138.107 | 14C20110528SGR | 138.08 | 0.03 |
| 9268 | 7311165.374 | 374359.719 | 137.807 | 14C20110528SGR | 137.78 | 0.03 |
| 9269 | 7308358.086 | 375652.508 | 151.496 | 14C20110528SPR | 151.49 | 0.01 |
| 9270 | 7308372.98 | 375661.079 | 150.595 | 14C20110528SPR | 150.59 | 0.00 |
| 9271 | 7308387.111 | 375668.448 | 149.641 | 14C20110528SPR | 149.65 | -0.01 |
| 9272 | 7308402.991 | 375679.137 | 148.511 | 14C20110528SPR | 148.5 | 0.01 |
| 9273 | 7308430.514 | 375695.252 | 146.775 | 14C20110528SPR | 146.78 | 0.00 |
| 9274 | 7308458.451 | 375711.117 | 144.994 | 14C20110528SPR | 145.01 | -0.02 |
| 9277 | 7307603.969 | 375081.357 | 196.666 | 14C20110528SGR | 196.62 | 0.05 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 9278 | 7307608.452 | 375067.094 | 196.784 | 14C20110528SGR | 196.72 | 0.06 |
| 9279 | 7307589.881 | 375134.305 | 195.91 | 14C20110528SGR | 195.88 | 0.03 |
| 9280 | 7307570.476 | 375160.029 | 197.255 | 14C20110528SGR | 197.21 | 0.04 |
| 9281 | 7307551.482 | 375181.834 | 198.949 | 14C20110528SGR | 198.91 | 0.04 |
| 9282 | 7307533.615 | 375201.525 | 199.589 | 14C20110528SGR | 199.56 | 0.03 |
| 9283 | 7307507.408 | 375225.584 | 197.335 | 14C20110528SGR | 197.28 | 0.06 |
| 9284 | 7307666.683 | 374983.934 | 200.593 | 14C20110528SGR | 200.54 | 0.05 |
| 9285 | 7307670.22 | 374973.297 | 200.511 | 14C20110528SGR | 200.44 | 0.07 |
| 9286 | 7307665.319 | 374998.041 | 200.578 | 14C20110528SGR | 200.52 | 0.06 |
| 9287 | 7307653.251 | 375005.347 | 199.96 | 14C20110528SGR | 199.94 | 0.02 |
| 9288 | 7305979.448 | 375932.71 | 319.839 | 14C20110528SGR | 319.8 | 0.04 |
| 9289 | 7305990.885 | 375923.867 | 318.405 | 14C20110528SGR | 318.35 | 0.05 |
| 9290 | 7306002.445 | 375914.211 | 316.825 | 14C20110528SGR | 316.77 | 0.06 |
| 9291 | 7306013.657 | 375905.254 | 315.317 | 14C20110528SGR | 315.24 | 0.08 |
| 9292 | 7305962.847 | 375947.931 | 321.715 | 14C20110528SGR | 321.67 | 0.04 |
| 9293 | 7305949.561 | 375959.564 | 323.093 | 14C20110528SGR | 323.04 | 0.05 |
| 9294 | 7309168.039 | 376244.636 | 94.687 | 14C20110528CHECK | 94.72 | -0.03 |
| 9295 | 7309168.039 | 376244.647 | 94.693 | 14C20110528CHECK | 94.72 | -0.03 |
| 10500 | 7244805.161 | 440830.163 | 275.889 | 17B2011052317BFAC | 276.01 | -0.12 |
| 10501 | 7244792.772 | 440837.086 | 275.398 | 17B20110523SPR | 275.42 | -0.02 |
| 10502 | 7244782.279 | 440849.895 | 275.855 | 17B20110523SPR | 275.84 | 0.02 |
| 10503 | 7244775.613 | 440863.065 | 276.417 | 17B20110523SPR | 276.4 | 0.02 |
| 10504 | 7244768.521 | 440876.152 | 277.026 | 17B20110523SPR | 277.01 | 0.02 |
| 10505 | 7244761.287 | 440888.387 | 277.557 | 17B20110523SPR | 277.53 | 0.03 |
| 10506 | 7244753.188 | 440891.532 | 277.59 | 17B20110523SPR | 277.58 | 0.01 |
| 10507 | 7244757.901 | 440884.229 | 277.281 | 17B20110523SPR | 277.27 | 0.01 |
| 10508 | 7244765.627 | 440871.313 | 276.689 | 17B20110523SPR | 276.69 | 0.00 |
| 10509 | 7244772.913 | 440857.868 | 276.095 | 17B20110523SPR | 276.08 | 0.02 |
| 10510 | 7244779.616 | 440843.787 | 275.476 | 17B20110523SPR | 275.47 | 0.01 |
| 10511 | 7244707.629 | 439913.086 | 236.359 | 17B20110523SPR | 236.32 | 0.04 |
| 10512 | 7244713.727 | 439928.191 | 237.145 | 17B20110523SPR | 237.1 | 0.05 |
| 10513 | 7244719.735 | 439943.651 | 237.904 | 17B20110523SPR | 237.87 | 0.03 |
| 10514 | 7244725.664 | 439958.726 | 238.661 | 17B20110523SPR | 238.65 | 0.01 |
| 10515 | 7244731.107 | 439972.735 | 239.375 | 17B20110523SPR | 239.36 | 0.01 |
| 10516 | 7244728.792 | 439981.267 | 239.723 | 17B20110523SPR | 239.72 | 0.00 |
| 10517 | 7244723.347 | 439967.124 | 239.006 | 17B20110523SPR | 239.01 | 0.00 |
| 10518 | 7244717.088 | 439951.049 | 238.196 | 17B20110523SPR | 238.17 | 0.03 |
| 10519 | 7244711.808 | 439937.178 | 237.503 | 17B20110523SPR | 237.49 | 0.01 |
| 10520 | 7244706.128 | 439922.715 | 236.744 | 17B20110523SPR | 236.72 | 0.02 |
| 10521 | 7244238.188 | 441526.877 | 278.476 | 17B20110523SPR | 278.48 | 0.00 |
| 10522 | 7244242.383 | 441513.796 | 277.974 | 17B20110523SPR | 277.98 | -0.01 |
| 10523 | 7244247.032 | 441499.805 | 277.439 | 17B20110523SPR | 277.44 | 0.00 |
| 10524 | 7244251.826 | 441486.124 | 276.955 | 17B20110523SPR | 276.94 | 0.01 |
| 10525 | 7244256.083 | 441475.273 | 276.584 | 17B20110523SPR | 276.6 | -0.02 |
| 10526 | 7244264.869 | 441467.582 | 276.093 | 17B20110523SPR | 276.06 | 0.03 |
| 10527 | 7244258.848 | 441482.523 | 276.539 | 17B20110523SPR | 276.51 | 0.03 |
| 10528 | 7244252.486 | 441499.57 | 277.149 | 17B20110523SPR | 277.15 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10529 | 7244247.198 | 441514.836 | 277.748 | 17B20110523SPR | 277.74 | 0.01 |
| 10530 | 7244242.763 | 441530.03 | 278.32 | 17B20110523SPR | 278.32 | 0.00 |
| 10531 | 7243905.235 | 442257.804 | 307.624 | 17B20110523SPR | 307.6 | 0.02 |
| 10532 | 7243914.478 | 442247.096 | 307.076 | 17B20110523SPR | 307.05 | 0.03 |
| 10533 | 7243925.314 | 442236.492 | 306.542 | 17B20110523SPR | 306.52 | 0.02 |
| 10534 | 7243934.059 | 442224.222 | 305.892 | 17B20110523SPR | 305.87 | 0.02 |
| 10535 | 7243943.903 | 442212.107 | 305.379 | 17B20110523SPR | 305.33 | 0.05 |
| 10536 | 7243952.714 | 442209.384 | 305.249 | 17B20110523SPR | 305.15 | 0.10 |
| 10537 | 7243942.974 | 442221.862 | 305.809 | 17B20110523SPR | 305.74 | 0.07 |
| 10538 | 7243933.062 | 442233.693 | 306.385 | 17B20110523SPR | 306.29 | 0.09 |
| 10539 | 7243923.063 | 442245.092 | 306.998 | 17B20110523SPR | 306.95 | 0.05 |
| 10540 | 7243912.454 | 442257.056 | 307.616 | 17B20110523SPR | 307.57 | 0.05 |
| 10541 | 7243901.732 | 442268.536 | 308.17 | 17B20110523SPR | 308.14 | 0.03 |
| 10542 | 7242559.444 | 443805.562 | 386.692 | 17B20110523SPR | 386.71 | -0.02 |
| 10543 | 7242898.761 | 443458.075 | 375.79 | 17B20110523SPR | 375.78 | 0.01 |
| 10544 | 7242884.855 | 443459.21 | 376.322 | 17B20110523SPR | 376.34 | -0.02 |
| 10545 | 7242870.041 | 443461.321 | 376.881 | 17B20110523SPR | 376.87 | 0.01 |
| 10546 | 7242855.51 | 443463.785 | 377.392 | 17B20110523SPR | 377.36 | 0.03 |
| 10547 | 7242841.634 | 443466.812 | 377.844 | 17B20110523SPR | 377.83 | 0.01 |
| 10548 | 7242831.437 | 443463.93 | 378.384 | 17B20110523SPR | 378.36 | 0.02 |
| 10549 | 7242846.956 | 443460.128 | 377.906 | 17B20110523SPR | 377.89 | 0.02 |
| 10550 | 7242861.846 | 443457.288 | 377.407 | 17B20110523SPR | 377.39 | 0.02 |
| 10551 | 7242876.551 | 443455.257 | 376.867 | 17B20110523SPR | 376.87 | 0.00 |
| 10552 | 7242890.925 | 443453.322 | 376.324 | 17B20110523SPR | 376.31 | 0.01 |
| 10553 | 7244537.223 | 441083.33 | 279.013 | 17B20110523SGR | 279.07 | -0.06 |
| 10554 | 7244514.582 | 441058.242 | 280.264 | 17B20110523SGR | 280.33 | -0.07 |
| 10555 | 7244491.268 | 441035.46 | 282.161 | 17B20110523SGR | 282.25 | -0.09 |
| 10556 | 7244467.002 | 441013.983 | 284.023 | 17B20110523SGR | 284.07 | -0.05 |
| 10557 | 7244443.757 | 440988.786 | 285.725 | 17B20110523SGR | 285.76 | -0.03 |
| 10558 | 7244422.343 | 440967.515 | 286.744 | 17B20110523SGR | 286.8 | -0.06 |
| 10559 | 7244400.945 | 440944.176 | 286.794 | 17B20110523SGR | 286.86 | -0.07 |
| 10560 | 7244337.543 | 440889.314 | 286.108 | 17B20110523SGR | 286.14 | -0.03 |
| 10561 | 7244282.984 | 440852.222 | 284.997 | 17B20110523SGR | 285.06 | -0.06 |
| 10562 | 7244247.209 | 440831.525 | 284.429 | 17B20110523SGR | 284.47 | -0.04 |
| 10563 | 7244166.532 | 440779.636 | 283.017 | 17B20110523SGR | 283.02 | 0.00 |
| 10564 | 7244109.31 | 440745.112 | 282.174 | 17B20110523SGR | 282.21 | -0.04 |
| 10565 | 7244080.002 | 440726.337 | 281.647 | 17B20110523SGR | 281.71 | -0.06 |
| 10566 | 7244051.692 | 440707.373 | 280.84 | 17B20110523SGR | 280.95 | -0.11 |
| 10567 | 7244026.533 | 440686.667 | 279.911 | 17B20110523SGR | 279.96 | -0.05 |
| 10568 | 7244823.726 | 440822.56 | 275.797 | 17B20110523SGR | 275.8 | 0.00 |
| 10569 | 7244846.145 | 440799.546 | 275.581 | 17B20110523SGR | 275.5 | 0.08 |
| 10570 | 7244868.379 | 440775.834 | 275.412 | 17B20110523SGR | 275.34 | 0.07 |
| 10571 | 7244890.727 | 440753.973 | 275.484 | 17B20110523SGR | 275.44 | 0.04 |
| 10572 | 7244910.991 | 440730.892 | 275.751 | 17B20110523SGR | 275.73 | 0.02 |
| 10573 | 7244931.662 | 440708.253 | 275.98 | 17B20110523SGR | 275.9 | 0.08 |
| 10574 | 7244958.382 | 440683.728 | 275.96 | 17B20110523SGR | 275.92 | 0.04 |
| 10575 | 7244978.435 | 440659.711 | 276.051 | 17B20110523SGR | 276.01 | 0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10576 | 7244994.007 | 440642.566 | 276.12 | 17B20110523SGR | 276.08 | 0.04 |
| 10577 | 7244794.344 | 440826.766 | 274.916 | 17B20110523CHECK | 274.93 | -0.01 |
| 10578 | 7244794.339 | 440826.765 | 274.909 | 17B20110523CHECK | 274.93 | -0.02 |
| 10600 | 7224650.096 | 459608.552 | 307.516 | 17D2011052317DFAC | 307.45 | 0.07 |
| 10601 | 7224652.178 | 459601.386 | 308.533 | 17D20110523CHECK | 308.44 | 0.09 |
| 10602 | 7224652.296 | 459599.08 | 308.412 | 17D20110523SPR | 308.31 | 0.10 |
| 10603 | 7224634.813 | 459593.674 | 309.646 | 17D20110523SPR | 309.51 | 0.14 |
| 10604 | 7224621.447 | 459587.969 | 310.494 | 17D20110523SPR | 310.33 | 0.16 |
| 10605 | 7224606.241 | 459580.803 | 311.487 | 17D20110523SPR | 311.3 | 0.19 |
| 10606 | 7224592.122 | 459572.498 | 312.485 | 17D20110523SPR | 312.43 | 0.06 |
| 10607 | 7224579.916 | 459564.389 | 313.351 | 17D20110523SPR | 313.28 | 0.07 |
| 10608 | 7224577.263 | 459556.694 | 313.465 | 17D20110523SPR | 313.38 | 0.08 |
| 10609 | 7224590.589 | 459565.476 | 312.48 | 17D20110523SPR | 312.41 | 0.07 |
| 10610 | 7224602.783 | 459573.062 | 311.601 | 17D20110523SPR | 311.48 | 0.12 |
| 10611 | 7224616.36 | 459579.985 | 310.675 | 17D20110523SPR | 310.52 | 0.16 |
| 10612 | 7224633.128 | 459587.341 | 309.515 | 17D20110523SPR | 309.4 | 0.12 |
| 10613 | 7224646.872 | 459592.503 | 308.572 | 17D20110523SPR | 308.46 | 0.11 |
| 10614 | 7223903.037 | 459579.273 | 348.385 | 17D20110523SPR | 348.35 | 0.03 |
| 10615 | 7223890.915 | 459588.845 | 348.893 | 17D20110523SPR | 348.86 | 0.03 |
| 10616 | 7223878.843 | 459598.477 | 349.298 | 17D20110523SPR | 349.27 | 0.03 |
| 10617 | 7223866.527 | 459608.23 | 349.722 | 17D20110523SPR | 349.66 | 0.06 |
| 10618 | 7223855.001 | 459617.211 | 350.112 | 17D20110523SPR | 350.08 | 0.03 |
| 10619 | 7223872.743 | 459608.775 | 349.597 | 17D20110523SPR | 349.56 | 0.04 |
| 10620 | 7223895.075 | 459591.246 | 348.877 | 17D20110523SPR | 348.83 | 0.05 |
| 10621 | 7223909.969 | 459579.604 | 348.253 | 17D20110523SPR | 348.24 | 0.01 |
| 10622 | 7225699.715 | 459558.22 | 267.313 | 17D20110523SPR | 267.16 | 0.15 |
| 10623 | 7225686.761 | 459565.958 | 267.17 | 17D20110523SPR | 267.07 | 0.10 |
| 10624 | 7225673.099 | 459573.532 | 267.026 | 17D20110523SPR | 266.96 | 0.07 |
| 10625 | 7225659.741 | 459580.23 | 266.906 | 17D20110523SPR | 266.81 | 0.10 |
| 10626 | 7225645.535 | 459585.808 | 266.877 | 17D20110523SPR | 266.8 | 0.08 |
| 10627 | 7225636.592 | 459585.054 | 266.609 | 17D20110523SPR | 266.52 | 0.09 |
| 10628 | 7225652.056 | 459578.659 | 266.656 | 17D20110523SPR | 266.58 | 0.08 |
| 10629 | 7225665.355 | 459571.854 | 266.677 | 17D20110523SPR | 266.58 | 0.10 |
| 10630 | 7225680.939 | 459563.757 | 266.833 | 17D20110523SPR | 266.75 | 0.08 |
| 10631 | 7225694.366 | 459555.642 | 266.941 | 17D20110523SPR | 266.88 | 0.06 |
| 10632 | 7226164.54 | 458733.512 | 295.438 | 17D20110523SPR | 295.37 | 0.07 |
| 10633 | 7226161.619 | 458750.073 | 294.459 | 17D20110523SPR | 294.44 | 0.02 |
| 10634 | 7226159.079 | 458765.72 | 293.588 | 17D20110523SPR | 293.56 | 0.03 |
| 10635 | 7226156.164 | 458782.255 | 292.718 | 17D20110523SPR | 292.64 | 0.08 |
| 10636 | 7226153.274 | 458798.164 | 291.801 | 17D20110523SPR | 291.73 | 0.07 |
| 10637 | 7226147.487 | 458803.486 | 291.474 | 17D20110523SPR | 291.43 | 0.04 |
| 10638 | 7226150.109 | 458787.894 | 292.35 | 17D20110523SPR | 292.28 | 0.07 |
| 10639 | 7226152.796 | 458772.625 | 293.16 | 17D20110523SPR | 293.09 | 0.07 |
| 10640 | 7226155.532 | 458756.562 | 293.981 | 17D20110523SPR | 293.91 | 0.07 |
| 10641 | 7226158.597 | 458739.451 | 294.95 | 17D20110523SPR | 294.92 | 0.03 |
| 10642 | 7226128.702 | 458006.076 | 325.29 | 17D20110523SPR | 325.22 | 0.07 |
| 10643 | 7226130.198 | 458021.031 | 324.929 | 17D20110523SPR | 324.89 | 0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10644 | 7226131.517 | 458036.302 | 324.513 | 17D20110523SPR | 324.46 | 0.05 |
| 10645 | 7226133.16 | 458053.417 | 323.91 | 17D20110523SPR | 323.88 | 0.03 |
| 10646 | 7226134.302 | 458068.459 | 323.343 | 17D20110523SPR | 323.23 | 0.11 |
| 10647 | 7226130.595 | 458078.521 | 322.939 | 17D20110523SPR | 322.83 | 0.11 |
| 10648 | 7226129.269 | 458062.221 | 323.597 | 17D20110523SPR | 323.56 | 0.04 |
| 10649 | 7226127.3 | 458042.805 | 324.321 | 17D20110523SPR | 324.29 | 0.03 |
| 10650 | 7226125.749 | 458026.767 | 324.802 | 17D20110523SPR | 324.76 | 0.04 |
| 10651 | 7226124.236 | 458011.255 | 325.195 | 17D20110523SPR | 325.16 | 0.03 |
| 10652 | 7226458.307 | 457242.149 | 293.052 | 17D20110523SPR | 293.01 | 0.04 |
| 10653 | 7226447.323 | 457253.773 | 293.59 | 17D20110523SPR | 293.47 | 0.12 |
| 10654 | 7226435.358 | 457265.217 | 294.42 | 17D20110523SPR | 294.4 | 0.02 |
| 10655 | 7226423.57 | 457276.025 | 295.122 | 17D20110523SPR | 295.1 | 0.02 |
| 10656 | 7226412.233 | 457286.551 | 295.802 | 17D20110523SPR | 295.76 | 0.04 |
| 10657 | 7226403.335 | 457288.412 | 296.198 | 17D20110523SPR | 296.21 | -0.01 |
| 10658 | 7226414.626 | 457278.194 | 295.452 | 17D20110523SPR | 295.43 | 0.02 |
| 10659 | 7226427.005 | 457266.695 | 294.66 | 17D20110523SPR | 294.6 | 0.06 |
| 10660 | 7226438.708 | 457254.569 | 293.599 | 17D20110523SPR | 293.49 | 0.11 |
| 10661 | 7226450.191 | 457242.222 | 292.921 | 17D20110523SPR | 292.86 | 0.06 |
| 10662 | 7226469.532 | 457249.31 | 293.33 | 17D20110523SPR | 293.22 | 0.11 |
| 10663 | 7226482.487 | 457251.406 | 293.488 | 17D20110523CHECK17C | 293.43 | 0.06 |
| 10664 | 7226481.596 | 457242.368 | 292.989 | 17D20110523SPR | 292.98 | 0.01 |
| 10665 | 7226100.995 | 456662.021 | 328.278 | 17D20110523SPR | 328.22 | 0.06 |
| 10666 | 7226113.291 | 456671.643 | 327.358 | 17D20110523SPR | 327.35 | 0.01 |
| 10667 | 7226125.671 | 456681.331 | 326.48 | 17D20110523SPR | 326.4 | 0.08 |
| 10668 | 7226138.693 | 456691.52 | 325.596 | 17D20110523SPR | 325.55 | 0.05 |
| 10669 | 7226150.829 | 456701.207 | 324.718 | 17D20110523SPR | 324.63 | 0.09 |
| 10670 | 7226153.383 | 456709.321 | 324.277 | 17D20110523SPR | 324.19 | 0.09 |
| 10671 | 7226140.488 | 456699.361 | 325.248 | 17D20110523SPR | 325.21 | 0.04 |
| 10672 | 7226127.789 | 456689.005 | 326.144 | 17D20110523SPR | 326.09 | 0.05 |
| 10673 | 7226114.094 | 456678.289 | 327.082 | 17D20110523SPR | 327.05 | 0.03 |
| 10674 | 7226099.443 | 456666.673 | 328.164 | 17D20110523SPR | 328.1 | 0.06 |
| 10675 | 7226161.788 | 456131.221 | 360.562 | 17D20110523SPR | 360.5 | 0.06 |
| 10676 | 7226146.332 | 456134.508 | 360.08 | 17D20110523SPR | 359.96 | 0.12 |
| 10677 | 7226130.721 | 456138.298 | 359.501 | 17D20110523SPR | 359.38 | 0.12 |
| 10678 | 7226115.499 | 456142.763 | 358.877 | 17D20110523SPR | 358.8 | 0.08 |
| 10679 | 7226100.112 | 456148.314 | 358.223 | 17D20110523SPR | 358.2 | 0.02 |
| 10680 | 7226089.136 | 456147.313 | 358.137 | 17D20110523SPR | 358.05 | 0.09 |
| 10681 | 7226104.11 | 456141.748 | 358.73 | 17D20110523SPR | 358.64 | 0.09 |
| 10682 | 7226119.879 | 456136.773 | 359.364 | 17D20110523SPR | 359.28 | 0.08 |
| 10683 | 7226139.446 | 456131.329 | 360.114 | 17D20110523SPR | 360.02 | 0.09 |
| 10684 | 7226153.988 | 456127.891 | 360.581 | 17D20110523SPR | 360.55 | 0.03 |
| 10685 | 7226965.374 | 455673.258 | 399.553 | 17D20110523SPR | 399.53 | 0.02 |
| 10686 | 7226952.134 | 455682.304 | 398.96 | 17D20110523SPR | 398.93 | 0.03 |
| 10687 | 7226936.408 | 455693.992 | 398.161 | 17D20110523SPR | 398.1 | 0.06 |
| 10688 | 7226923.188 | 455703.751 | 397.551 | 17D20110523SPR | 397.51 | 0.04 |
| 10689 | 7226910.494 | 455714.594 | 396.858 | 17D20110523SPR | 396.8 | 0.06 |
| 10690 | 7226901.331 | 455716.566 | 396.684 | 17D20110523SPR | 396.68 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10691 | 7226914.306 | 455705.973 | 397.355 | 17D20110523SPR | 397.29 | 0.06 |
| 10692 | 7226928.214 | 455695.317 | 398.028 | 17D20110523SPR | 397.99 | 0.04 |
| 10693 | 7226942.214 | 455684.533 | 398.729 | 17D20110523SPR | 398.68 | 0.05 |
| 10694 | 7226962.92 | 455670.252 | 399.713 | 17D20110523SPR | 399.65 | 0.06 |
| 10695 | 7227738.047 | 455132.533 | 427.752 | 17D20110523SPR | 427.67 | 0.08 |
| 10696 | 7227735.56 | 455124.132 | 427.959 | 17D20110523SPR | 427.91 | 0.05 |
| 10697 | 7227740.556 | 455106.729 | 428.561 | 17D20110523SPR | 428.49 | 0.07 |
| 10698 | 7227745.021 | 455090.452 | 429.163 | 17D20110523SPR | 429.11 | 0.05 |
| 10699 | 7227749.049 | 455073.95 | 429.769 | 17D20110523SPR | 429.72 | 0.05 |
| 10700 | 7227754.4 | 455054.258 | 430.465 | 17D20110523SPR | 430.39 | 0.07 |
| 10701 | 7227760.241 | 455034.165 | 431.189 | 17D20110523SPR | 431.13 | 0.06 |
| 10702 | 7227764.963 | 455018.229 | 431.777 | 17D20110523SPR | 431.71 | 0.07 |
| 10703 | 7227770.315 | 455002.452 | 432.302 | 17D20110523SPR | 432.23 | 0.07 |
| 10704 | 7227776.397 | 454987.758 | 432.728 | 17D20110523SPR | 432.66 | 0.07 |
| 10705 | 7228474.468 | 454177.58 | 473.34 | 17D20110523SPR | 473.27 | 0.07 |
| 10706 | 7228474.639 | 454160.326 | 473.725 | 17D20110523SPR | 473.64 | 0.09 |
| 10707 | 7228479.353 | 454104.971 | 474.79 | 17D20110523SPR | 474.75 | 0.04 |
| 10708 | 7228491.004 | 454085.207 | 474.93 | 17D20110523SPR | 474.94 | -0.01 |
| 10709 | 7228498.545 | 454070.952 | 475.007 | 17D20110523SPR | 474.99 | 0.02 |
| 10710 | 7228507.108 | 454057.174 | 475.083 | 17D20110523SPR | 475.07 | 0.01 |
| 10711 | 7228516.832 | 454044.234 | 475.131 | 17D20110523SPR | 475.13 | 0.00 |
| 10712 | 7228529.242 | 454033.024 | 475.04 | 17D20110523SPR | 475.03 | 0.01 |
| 10713 | 7228540.814 | 454022.166 | 475.019 | 17D20110523SPR | 475.02 | 0.00 |
| 10714 | 7228553.246 | 454009.616 | 475.072 | 17D20110523SPR | 475.03 | 0.04 |
| 10715 | 7225821.892 | 456473.969 | 340.769 | 17D20110523SGR | 340.74 | 0.03 |
| 10716 | 7225769.092 | 456504.393 | 337.553 | 17D20110523SGR | 337.52 | 0.03 |
| 10717 | 7225710.422 | 456536.344 | 334.233 | 17D20110523SGR | 334.17 | 0.06 |
| 10718 | 7225654.265 | 456571.446 | 330.208 | 17D20110523SGR | 330.2 | 0.01 |
| 10719 | 7225595.384 | 456603.115 | 326.498 | 17D20110523SGR | 326.42 | 0.08 |
| 10720 | 7225537.947 | 456636.667 | 322.522 | 17D20110523SGR | 322.47 | 0.05 |
| 10721 | 7225481.585 | 456669.806 | 320.026 | 17D20110523SGR | 319.96 | 0.07 |
| 10722 | 7225422.786 | 456702.857 | 317.725 | 17D20110523SGR | 317.64 | 0.09 |
| 10723 | 7225364.161 | 456736.291 | 315.374 | 17D20110523SGR | 315.34 | 0.03 |
| 10724 | 7225304.322 | 456766.484 | 312.873 | 17D20110523SGR | 312.84 | 0.03 |
| 10725 | 7225249.723 | 456801.921 | 310.67 | 17D20110523SGR | 310.64 | 0.03 |
| 10726 | 7225192.286 | 456834.155 | 308.659 | 17D20110523SGR | 308.59 | 0.07 |
| 10727 | 7225134.081 | 456867.201 | 306.291 | 17D20110523SGR | 306.23 | 0.06 |
| 10728 | 7225073.936 | 456899.072 | 303.616 | 17D20110523SGR | 303.54 | 0.08 |
| 10729 | 7225014.919 | 456932.891 | 301.83 | 17D20110523SGR | 301.75 | 0.08 |
| 10730 | 7224954.272 | 456969.236 | 298.923 | 17D20110523SGR | 298.82 | 0.10 |
| 10731 | 7224893.718 | 457001.497 | 296.546 | 17D20110523SGR | 296.46 | 0.09 |
| 10732 | 7224832.503 | 457033.277 | 293.93 | 17D20110523SGR | 293.84 | 0.09 |
| 10733 | 7224770.749 | 457056.976 | 291.042 | 17D20110523SGR | 290.94 | 0.10 |
| 10734 | 7224703.772 | 457069.434 | 287.925 | 17D20110523SGR | 287.83 | 0.10 |
| 10735 | 7224635.838 | 457076.023 | 284.51 | 17D20110523SGR | 284.41 | 0.10 |
| 10736 | 7224567.124 | 457078.4 | 281.033 | 17D20110523SGR | 280.95 | 0.08 |
| 10737 | 7224496.938 | 457076.557 | 279.035 | 17D20110523SGR | 278.97 | 0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10738 | 7224415.81 | 457073.419 | 276.102 | 17D20110523SGR | 276.03 | 0.07 |
| 10739 | 7224352.62 | 457059.151 | 274.994 | 17D20110523SGR | 274.82 | 0.17 |
| 10740 | 7224292.597 | 457029.471 | 273.307 | 17D20110523SGR | 273.22 | 0.09 |
| 10741 | 7224239.858 | 456985.523 | 270.864 | 17D20110523SGR | 270.74 | 0.12 |
| 10742 | 7224199.648 | 456932.02 | 267.184 | 17D20110523SGR | 267.1 | 0.08 |
| 10743 | 7224652.191 | 459601.383 | 308.538 | 17D20110523CHECK | 308.44 | 0.10 |
| 10744 | 7224652.178 | 459601.387 | 308.535 | 17D20110523CHECK | 308.44 | 0.10 |
| 10800 | 7267416.736 | 416399.766 | 197.609 | 16A2011052416AFAC | 197.49 | 0.12 |
| 10801 | 7267413.197 | 416415.559 | 196.385 | 16A20110524CHECK | 196.36 | 0.02 |
| 10802 | 7267429.707 | 416409.775 | 198.239 | 16A20110524SGR | 198.17 | 0.07 |
| 10803 | 7267451.431 | 416406.857 | 200.164 | 16A20110524SGR | 200.13 | 0.03 |
| 10804 | 7267480.615 | 416406.679 | 202.29 | 16A20110524SGR | 202.31 | -0.02 |
| 10805 | 7267507.101 | 416410.335 | 204.013 | 16A20110524SGR | 204.02 | -0.01 |
| 10806 | 7267536.375 | 416416.883 | 206.333 | 16A20110524SGR | 206.32 | 0.01 |
| 10807 | 7267566.168 | 416425.814 | 207.673 | 16A20110524SGR | 207.68 | -0.01 |
| 10808 | 7267617.799 | 416453.079 | 208.513 | 16A20110524SGR | 208.5 | 0.01 |
| 10809 | 7267671.402 | 416476.121 | 209.118 | 16A20110524SGR | 209.08 | 0.04 |
| 10810 | 7267725.192 | 416506.021 | 209.785 | 16A20110524SGR | 209.78 | 0.00 |
| 10811 | 7267778.765 | 416531.162 | 209.842 | 16A20110524SGR | 209.84 | 0.00 |
| 10812 | 7267832.951 | 416558.911 | 209.621 | 16A20110524SGR | 209.59 | 0.03 |
| 10813 | 7267890.502 | 416586.472 | 210.745 | 16A20110524SGR | 210.71 | 0.03 |
| 10814 | 7267944.259 | 416615.041 | 211.369 | 16A20110524SGR | 211.35 | 0.02 |
| 10815 | 7268001.573 | 416642.738 | 211.62 | 16A20110524SGR | 211.62 | 0.00 |
| 10816 | 7268061.235 | 416670.369 | 214.04 | 16A20110524SGR | 214.02 | 0.02 |
| 10817 | 7268116.318 | 416700.099 | 216.429 | 16A20110524SGR | 216.39 | 0.04 |
| 10818 | 7268176.761 | 416729.083 | 216.836 | 16A20110524SGR | 216.8 | 0.04 |
| 10819 | 7268234.682 | 416757.474 | 217.733 | 16A20110524SGR | 217.7 | 0.03 |
| 10820 | 7268292.544 | 416787.745 | 219.058 | 16A20110524SGR | 219.05 | 0.01 |
| 10821 | 7268353.467 | 416820.021 | 221.483 | 16A20110524SGR | 221.46 | 0.02 |
| 10822 | 7268411.23 | 416848.102 | 218.32 | 16A20110524SGR | 218.34 | -0.02 |
| 10823 | 7268471.404 | 416876.456 | 215.851 | 16A20110524SGR | 215.85 | 0.00 |
| 10824 | 7268537.366 | 416912.72 | 215.893 | 16A20110524SGR | 215.86 | 0.03 |
| 10825 | 7268596.03 | 416941.297 | 216.152 | 16A20110524SGR | 216.16 | -0.01 |
| 10826 | 7268654.976 | 416969.953 | 216.146 | 16A20110524SGR | 216.15 | 0.00 |
| 10827 | 7268716.453 | 417018.397 | 217.917 | 16A20110524SGR | 217.87 | 0.05 |
| 10828 | 7268749.552 | 417005.545 | 219.278 | 16A20110524SGR | 219.28 | 0.00 |
| 10829 | 7266974.576 | 415991.829 | 247.592 | 16A20110524SGR | 247.56 | 0.03 |
| 10830 | 7266972.809 | 415976.036 | 248.338 | 16A20110524SGR | 248.31 | 0.03 |
| 10831 | 7266973.2 | 415960.756 | 248.988 | 16A20110524SGR | 248.97 | 0.02 |
| 10832 | 7266976.479 | 415944.439 | 249.403 | 16A20110524SGR | 249.38 | 0.02 |
| 10833 | 7266981.486 | 415928.244 | 249.455 | 16A20110524SGR | 249.46 | 0.00 |
| 10834 | 7266986.103 | 415913.868 | 249.331 | 16A20110524SGR | 249.31 | 0.02 |
| 10835 | 7266810.487 | 417001.257 | 248.86 | 16A20110524SGR | 248.81 | 0.05 |
| 10836 | 7266793.588 | 417005.427 | 250.585 | 16A20110524SGR | 250.54 | 0.05 |
| 10837 | 7266776.708 | 417015.255 | 252.556 | 16A20110524SGR | 252.51 | 0.05 |
| 10838 | 7266761.482 | 417019.204 | 254.262 | 16A20110524SGR | 254.22 | 0.04 |
| 10839 | 7266744.835 | 417022.037 | 256.137 | 16A20110524SGR | 256.11 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10840 | 7266729.535 | 417022.039 | 257.639 | 16A20110524SGR | 257.62 | 0.02 |
| 10841 | 7266069.749 | 417124.096 | 318.243 | 16A20110524SGR | 318.16 | 0.08 |
| 10842 | 7266089.73 | 417115.185 | 316.747 | 16A20110524SGR | 316.69 | 0.06 |
| 10843 | 7266106.703 | 417106.882 | 315.502 | 16A20110524SGR | 315.46 | 0.04 |
| 10844 | 7266121.162 | 417099.887 | 314.387 | 16A20110524SGR | 314.35 | 0.04 |
| 10845 | 7266136.226 | 417092.196 | 313.293 | 16A20110524SGR | 313.27 | 0.02 |
| 10846 | 7266150.531 | 417086.878 | 312.306 | 16A20110524SGR | 312.27 | 0.04 |
| 10847 | 7266164.191 | 417082.093 | 311.306 | 16A20110524SGR | 311.24 | 0.07 |
| 10848 | 7265434.835 | 417476.507 | 390.36 | 16A20110524SGR | 390.3 | 0.06 |
| 10849 | 7265419.924 | 417472.151 | 392.176 | 16A20110524SGR | 392.14 | 0.04 |
| 10850 | 7265404.079 | 417472.642 | 394.076 | 16A20110524SGR | 394.04 | 0.04 |
| 10851 | 7265387.303 | 417476.024 | 396.169 | 16A20110524SGR | 396.1 | 0.07 |
| 10852 | 7265374.427 | 417483.139 | 397.76 | 16A20110524SGR | 397.69 | 0.07 |
| 10853 | 7265359.203 | 417489.098 | 399.761 | 16A20110524SGR | 399.7 | 0.06 |
| 10854 | 7265343.525 | 417495.439 | 401.919 | 16A20110524SGR | 401.87 | 0.05 |
| 10855 | 7265334.463 | 417507.359 | 403.529 | 16A20110524SGR | 403.47 | 0.06 |
| 10856 | 7265321.125 | 417517.904 | 405.648 | 16A20110524SGR | 405.59 | 0.06 |
| 10857 | 7265308.401 | 417531.704 | 407.663 | 16A20110524SGR | 407.6 | 0.06 |
| 10858 | 7267413.185 | 416415.551 | 196.382 | 16A20110524CHECK | 196.36 | 0.02 |
| 10859 | 7267413.191 | 416415.555 | 196.388 | 16A20110524CHECK | 196.36 | 0.03 |
| 10900 | 7245616.831 | 438867.837 | 144.646 | 17A2011052417AFAC | 144.77 | -0.12 |
| 10901 | 7245613.403 | 438857.317 | 145.311 | 17A20110524SPR | 145.35 | -0.04 |
| 10902 | 7245598.762 | 438851.08 | 145.33 | 17A20110524SPR | 145.34 | -0.01 |
| 10903 | 7245583.382 | 438846.669 | 145.333 | 17A20110524SPR | 145.36 | -0.03 |
| 10904 | 7245569.127 | 438842.479 | 145.359 | 17A20110524SPR | 145.4 | -0.04 |
| 10905 | 7245555.522 | 438838.468 | 145.422 | 17A20110524SPR | 145.39 | 0.03 |
| 10906 | 7245548.45 | 438831.177 | 145.248 | 17A20110524SPR | 145.28 | -0.03 |
| 10907 | 7245562.855 | 438835.186 | 145.259 | 17A20110524SPR | 145.28 | -0.02 |
| 10908 | 7245577.109 | 438839.238 | 145.258 | 17A20110524SPR | 145.31 | -0.05 |
| 10909 | 7245592.613 | 438843.588 | 145.287 | 17A20110524SPR | 145.31 | -0.02 |
| 10910 | 7245606.868 | 438847.547 | 145.286 | 17A20110524SPR | 145.35 | -0.06 |
| 10911 | 7245838.588 | 438886.257 | 143.342 | 17A20110524SGR | 143.35 | -0.01 |
| 10912 | 7245823.435 | 438857.134 | 143.107 | 17A20110524SGR | 143.13 | -0.02 |
| 10913 | 7245813.406 | 438837.331 | 143.009 | 17A20110524SGR | 142.99 | 0.02 |
| 10914 | 7245797.247 | 438809.37 | 142.705 | 17A20110524SPR | 142.71 | 0.00 |
| 10915 | 7245789.549 | 438780.57 | 142.23 | 17A20110524SPR | 142.24 | -0.01 |
| 10916 | 7245785.5 | 438749.494 | 142.28 | 17A20110524SPR | 142.29 | -0.01 |
| 10917 | 7245793.328 | 438701.727 | 142.339 | 17A20110524SPR | 142.36 | -0.02 |
| 10918 | 7245811.524 | 438644.049 | 142.207 | 17A20110524SPR | 142.19 | 0.02 |
| 10919 | 7245825.941 | 438586.244 | 141.935 | 17A20110524SPR | 141.95 | -0.01 |
| 10920 | 7245827.087 | 438526.468 | 141.989 | 17A20110524SGR | 142.02 | -0.03 |
| 10921 | 7245806.944 | 438468.497 | 141.525 | 17A20110524SGR | 141.52 | 0.00 |
| 10922 | 7245771.278 | 438419.17 | 141 | 17A20110524SGR | 140.94 | 0.06 |
| 10923 | 7245732.193 | 438370.058 | 141.15 | 17A20110524SGR | 141.16 | -0.01 |
| 10924 | 7245695.559 | 438321.525 | 140.7 | 17A20110524SGR | 140.7 | 0.00 |
| 10925 | 7245648.166 | 438284.428 | 140.091 | 17A20110524SGR | 140.08 | 0.01 |
| 10926 | 7245599.393 | 438250.049 | 139.704 | 17A20110524SGR | 139.71 | -0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10927 | 7245547.774 | 438217.03 | 139.238 | 17A20110524SGR | 139.22 | 0.02 |
| 10928 | 7245500.362 | 438176.762 | 138.527 | 17A20110524SGR | 138.53 | 0.00 |
| 10929 | 7245455.646 | 438134.685 | 138.438 | 17A20110524SGR | 138.46 | -0.02 |
| 10930 | 7245441.082 | 438114.984 | 138.553 | 17A20110524SGR | 138.57 | -0.02 |
| 10931 | 7245471.503 | 438088.653 | 138.677 | 17A20110524SGR | 138.67 | 0.01 |
| 10932 | 7245518.631 | 438047.733 | 138.964 | 17A20110524SGR | 138.98 | -0.02 |
| 10933 | 7245840.177 | 438914.845 | 144.845 | 17A20110524SPR | 144.9 | -0.06 |
| 10934 | 7245854.085 | 438918.909 | 144.843 | 17A20110524SPR | 144.91 | -0.07 |
| 10935 | 7245859.822 | 438925.412 | 144.896 | 17A20110524SPR | 144.93 | -0.03 |
| 10936 | 7245850.348 | 438922.907 | 144.889 | 17A20110524SPR | 144.93 | -0.04 |
| 10937 | 7246575.705 | 439152.138 | 149.905 | 17A20110524SPR | 149.91 | 0.00 |
| 10938 | 7246561.897 | 439146.849 | 149.76 | 17A20110524SPR | 149.74 | 0.02 |
| 10939 | 7246546.979 | 439140.828 | 149.577 | 17A20110524SPR | 149.56 | 0.02 |
| 10940 | 7246534.836 | 439135.791 | 149.517 | 17A20110524SPR | 149.49 | 0.03 |
| 10941 | 7246521.539 | 439130.535 | 149.408 | 17A20110524SPR | 149.4 | 0.01 |
| 10942 | 7246516.013 | 439122.892 | 149.484 | 17A20110524SPR | 149.48 | 0.00 |
| 10943 | 7246530.105 | 439128.713 | 149.556 | 17A20110524SPR | 149.57 | -0.01 |
| 10944 | 7246544.067 | 439133.945 | 149.653 | 17A20110524SPR | 149.62 | 0.03 |
| 10945 | 7246558.225 | 439139.717 | 149.754 | 17A20110524SPR | 149.75 | 0.00 |
| 10946 | 7246573.663 | 439147.097 | 149.944 | 17A20110524SPR | 149.93 | 0.01 |
| 10947 | 7245619.242 | 438867.512 | 145.155 | 17A20110524CHECK | 145.22 | -0.06 |
| 10948 | 7245619.242 | 438867.507 | 145.17 | 17A20110524CHECK | 145.22 | -0.05 |
| 10949 | 7245619.244 | 438867.502 | 145.17 | 17A20110524CHECK | 145.22 | -0.05 |
| 10950 | 7245619.241 | 438867.504 | 145.163 | 17A20110524CHECK | 145.22 | -0.06 |
| 10951 | 7245622.414 | 438867.368 | 145.171 | 17A20110524SPR | 145.25 | -0.08 |
| 10952 | 7247645.646 | 440076.877 | 175.914 | 17A20110524SPR | 175.94 | -0.03 |
| 10953 | 7247651.519 | 440090.895 | 176.428 | 17A20110524SPR | 176.5 | -0.07 |
| 10954 | 7247656.397 | 440104.376 | 176.906 | 17A20110524SPR | 176.97 | -0.06 |
| 10955 | 7247662.231 | 440118.704 | 177.417 | 17A20110524SPR | 177.45 | -0.03 |
| 10956 | 7247667.792 | 440132.899 | 177.907 | 17A20110524SPR | 177.96 | -0.05 |
| 10957 | 7247665.396 | 440141.95 | 178.126 | 17A20110524SPR | 178.17 | -0.04 |
| 10958 | 7247659.752 | 440127.725 | 177.634 | 17A20110524SPR | 177.63 | 0.00 |
| 10959 | 7247654.801 | 440114.315 | 177.183 | 17A20110524SPR | 177.22 | -0.04 |
| 10960 | 7247649.227 | 440101.132 | 176.701 | 17A20110524SPR | 176.73 | -0.03 |
| 10961 | 7247643.604 | 440086.299 | 176.168 | 17A20110524SPR | 176.18 | -0.01 |
| 10962 | 7247989.618 | 440627.37 | 198.292 | 17A20110524SPR | 198.32 | -0.03 |
| 10963 | 7248000.34 | 440638.978 | 199.109 | 17A20110524SPR | 199.14 | -0.03 |
| 10964 | 7248011.304 | 440650.743 | 199.981 | 17A20110524SPR | 200 | -0.02 |
| 10965 | 7248023.452 | 440663.029 | 200.882 | 17A20110524SPR | 200.89 | -0.01 |
| 10966 | 7248034.148 | 440674.178 | 201.676 | 17A20110524SPR | 201.72 | -0.04 |
| 10967 | 7248036.555 | 440685.027 | 202.196 | 17A20110524SPR | 202.18 | 0.02 |
| 10968 | 7248026.159 | 440673.785 | 201.403 | 17A20110524SPR | 201.37 | 0.03 |
| 10969 | 7248015.499 | 440662.413 | 200.609 | 17A20110524SPR | 200.6 | 0.01 |
| 10970 | 7248004.796 | 440651.131 | 199.792 | 17A20110524SPR | 199.78 | 0.01 |
| 10971 | 7247994.118 | 440639.822 | 198.979 | 17A20110524SPR | 198.92 | 0.06 |
| 10972 | 7248309.896 | 440965.635 | 222.903 | 17A20110524SPR | 222.84 | 0.06 |
| 10973 | 7248320.839 | 440973.993 | 223.617 | 17A20110524SPR | 223.57 | 0.05 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10974 | 7248333.398 | 440983.394 | 224.459 | 17A20110524SPR | 224.43 | 0.03 |
| 10975 | 7248345.748 | 440991.726 | 225.284 | 17A20110524SPR | 225.27 | 0.01 |
| 10976 | 7248358.853 | 441000.044 | 226.095 | 17A20110524SPR | 226.03 | 0.06 |
| 10977 | 7248372.157 | 441008.124 | 226.885 | 17A20110524SPR | 226.81 | 0.07 |
| 10978 | 7248385.187 | 441015.86 | 227.627 | 17A20110524SPR | 227.6 | 0.03 |
| 10979 | 7248399.203 | 441023.186 | 228.468 | 17A20110524SPR | 228.38 | 0.09 |
| 10980 | 7248412.822 | 441029.805 | 229.232 | 17A20110524SPR | 229.2 | 0.03 |
| 10981 | 7248427.771 | 441037.168 | 230.177 | 17A20110524SPR | 230.12 | 0.06 |
| 10982 | 7248442.221 | 441043.493 | 230.954 | 17A20110524SPR | 230.9 | 0.05 |
| 10983 | 7248456.381 | 441049.255 | 231.68 | 17A20110524SPR | 231.65 | 0.03 |
| 10984 | 7248471.433 | 441054.985 | 232.448 | 17A20110524SPR | 232.42 | 0.03 |
| 10985 | 7248486.363 | 441060.645 | 233.245 | 17A20110524SPR | 233.21 | 0.03 |
| 10986 | 7248501.17 | 441065.906 | 234.013 | 17A20110524SPR | 234 | 0.01 |
| 10987 | 7248516.634 | 441071.313 | 234.823 | 17A20110524SPR | 234.82 | 0.00 |
| 10988 | 7248530.88 | 441076.067 | 235.638 | 17A20110524SPR | 235.64 | 0.00 |
| 10989 | 7248546.048 | 441081.576 | 236.508 | 17A20110524SPR | 236.48 | 0.03 |
| 10990 | 7248562.35 | 441087.608 | 237.398 | 17A20110524SPR | 237.38 | 0.02 |
| 10991 | 7248577.631 | 441093.59 | 238.262 | 17A20110524SPR | 238.22 | 0.04 |
| 10992 | 7245254.501 | 438678.88 | 154.151 | 17A20110524SPR | 154.16 | -0.01 |
| 10993 | 7245236.918 | 438678.799 | 155.15 | 17A20110524SPR | 155.18 | -0.03 |
| 10994 | 7245221.157 | 438680.423 | 155.949 | 17A20110524SPR | 155.95 | 0.00 |
| 10995 | 7245204.488 | 438683.46 | 156.833 | 17A20110524SPR | 156.85 | -0.02 |
| 10996 | 7245189.494 | 438687.353 | 157.625 | 17A20110524SPR | 157.63 | 0.00 |
| 10997 | 7245175.649 | 438692.131 | 158.425 | 17A20110524SPR | 158.4 | 0.03 |
| 10998 | 7245161.799 | 438696.864 | 159.257 | 17A20110524SPR | 159.2 | 0.06 |
| 10999 | 7245133.044 | 438707.18 | 160.93 | 17A20110524SPR | 160.88 | 0.05 |
| 11000 | 7245119.338 | 438712.194 | 161.761 | 17A20110524SPR | 161.73 | 0.03 |
| 11001 | 7245102.528 | 438718.283 | 162.827 | 17A20110524SPR | 162.79 | 0.04 |
| 11002 | 7245619.252 | 438867.515 | 145.18 | 17A20110524CHECK | 145.22 | -0.04 |
| 11003 | 7245619.243 | 438867.508 | 145.18 | 17A20110524CHECK | 145.22 | -0.04 |
| 11004 | 7245619.241 | 438867.505 | 145.145 | 17A20110524CHECK | 145.22 | -0.07 |
| 11200 | 7196552.758 | 475331.023 | 214.888 | 18A2011052618AFAC | 214.9 | -0.01 |
| 11201 | 7196555.21 | 475330.981 | 215.146 | 18A20110526CHECK | 215.14 | 0.01 |
| 11202 | 7196555.776 | 475324.335 | 215.392 | 18A20110526SPR | 215.4 | -0.01 |
| 11203 | 7196555.945 | 475309.608 | 215.841 | 18A20110526SPR | 215.85 | -0.01 |
| 11204 | 7196556.19 | 475292.578 | 216.365 | 18A20110526SPR | 216.39 | -0.02 |
| 11205 | 7196556.458 | 475278.319 | 216.734 | 18A20110526SPR | 216.73 | 0.00 |
| 11206 | 7196556.449 | 475263.489 | 217.084 | 18A20110526SPR | 217.09 | -0.01 |
| 11207 | 7196573.931 | 475264.492 | 217.058 | 18A20110526SPR | 217.05 | 0.01 |
| 11208 | 7196573.974 | 475277.884 | 216.741 | 18A20110526SPR | 216.76 | -0.02 |
| 11209 | 7196573.947 | 475292.797 | 216.35 | 18A20110526SPR | 216.35 | 0.00 |
| 11210 | 7196573.662 | 475308.131 | 215.901 | 18A20110526SPR | 215.92 | -0.02 |
| 11211 | 7196573.435 | 475323.822 | 215.419 | 18A20110526SPR | 215.44 | -0.02 |
| 11212 | 7196573.191 | 475338.006 | 214.945 | 18A20110526SPR | 214.94 | 0.00 |
| 11213 | 7196510.676 | 474242.561 | 189.411 | 18A20110526CHECK18B | 189.4 | 0.01 |
| 11214 | 7196543.191 | 476027.383 | 211.104 | 18A20110526SPR | 211.1 | 0.00 |
| 11215 | 7196543.315 | 476012.895 | 211.615 | 18A20110526SPR | 211.61 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 11216 | 7196543.646 | 475997.833 | 212.113 | 18A20110526SPR | 212.11 | 0.00 |
| 11217 | 7196541.602 | 475983.316 | 212.529 | 18A20110526SPR | 212.51 | 0.02 |
| 11218 | 7196541.626 | 475967.855 | 212.991 | 18A20110526SPR | 212.99 | 0.00 |
| 11219 | 7196541.922 | 475952.931 | 213.402 | 18A20110526SPR | 213.39 | 0.01 |
| 11220 | 7196565.744 | 475953.983 | 213.497 | 18A20110526SPR | 213.47 | 0.03 |
| 11221 | 7196565.86 | 475968.503 | 213.105 | 18A20110526SPR | 213.09 | 0.01 |
| 11222 | 7196565.614 | 475983.169 | 212.649 | 18A20110526SPR | 212.62 | 0.03 |
| 11223 | 7196565.161 | 475998.633 | 212.155 | 18A20110526SPR | 212.15 | 0.00 |
| 11224 | 7196564.529 | 476014.027 | 211.646 | 18A20110526SPR | 211.63 | 0.02 |
| 11225 | 7196563.991 | 476027.827 | 211.13 | 18A20110526SPR | 211.13 | 0.00 |
| 11226 | 7196534.738 | 477044.117 | 166.542 | 18A20110526SPR | 166.48 | 0.06 |
| 11227 | 7196534.946 | 477029.52 | 166.505 | 18A20110526SPR | 166.45 | 0.06 |
| 11228 | 7196535.313 | 477013.931 | 166.408 | 18A20110526SPR | 166.36 | 0.05 |
| 11229 | 7196547.299 | 477014.616 | 166.443 | 18A20110526SPR | 166.41 | 0.03 |
| 11230 | 7196546.965 | 477030.563 | 166.58 | 18A20110526SPR | 166.52 | 0.06 |
| 11231 | 7196546.814 | 477045.864 | 166.56 | 18A20110526SPR | 166.51 | 0.05 |
| 11232 | 7196546.831 | 477064.013 | 166.494 | 18A20110526SPR | 166.43 | 0.06 |
| 11233 | 7196546.726 | 477080.763 | 166.466 | 18A20110526SPR | 166.42 | 0.05 |
| 11234 | 7196533.967 | 477080.37 | 166.505 | 18A20110526SPR | 166.45 | 0.06 |
| 11235 | 7196534.211 | 477064.801 | 166.447 | 18A20110526SPR | 166.39 | 0.06 |
| 11248 | 7196555.231 | 475330.977 | 215.18 | 18A20110526CHECK | 215.14 | 0.04 |
| 11249 | 7196555.241 | 475330.982 | 215.155 | 18A20110526CHECK | 215.14 | 0.02 |
| 11250 | 7196555.221 | 475330.975 | 215.154 | 18A20110526CHECK | 215.14 | 0.01 |
| 11251 | 7196555.214 | 475330.982 | 215.146 | 18A20110526CHECK | 215.14 | 0.01 |
| 11252 | 7192193.606 | 479169.033 | 141.262 | 18A20110526SGR | 141.2 | 0.06 |
| 11253 | 7192368.058 | 478955.249 | 141.585 | 18A20110526SGR | 141.53 | 0.06 |
| 11254 | 7192351.727 | 478979.697 | 141.283 | 18A20110526SGR | 141.25 | 0.03 |
| 11255 | 7192351.725 | 478979.704 | 141.277 | 18A20110526SGR | 141.25 | 0.03 |
| 13300 | 7245616.831 | 438867.837 | 144.646 | 17A2011052817AFC | 144.77 | -0.12 |
| 13301 | 7232438.429 | 447127.839 | 530.53 | 17A20110528SPK | 530.41 | 0.12 |
| 13302 | 7250542.158 | 441413.275 | 283.09 | 17A20110528SAR | 283.09 | 0.00 |
| 13303 | 7250513.619 | 441402.151 | 282.539 | 17A20110528SAR | 282.57 | -0.03 |
| 13304 | 7250475.67 | 441392.131 | 281.98 | 17A20110528SAR | 281.98 | 0.00 |
| 13305 | 7249322.28 | 441548.066 | 278.585 | 17A20110528SAR | 278.6 | -0.02 |
| 13306 | 7249048.628 | 441392.924 | 262.633 | 17A20110528SGR | 262.62 | 0.01 |
| 13307 | 7249027.849 | 441380.527 | 261.756 | 17A20110528SGR | 261.71 | 0.05 |
| 13308 | 7249019.673 | 441386.781 | 262.816 | 17A20110528SAR | 262.82 | 0.00 |
| 13309 | 7249071.79 | 441420.78 | 265.655 | 17A20110528SAR | 265.67 | -0.02 |
| 13310 | 7248714.441 | 441150.665 | 245.069 | 17A20110528SGR | 245.09 | -0.02 |
| 13311 | 7248761.785 | 441169.624 | 248.933 | 17A20110528SGR | 248.92 | 0.01 |
| 13312 | 7248768.092 | 441200.913 | 248.019 | 17A20110528OG | 248.09 | -0.07 |
| 13313 | 7248757.944 | 441207.235 | 248.77 | 17A20110528SAR | 248.81 | -0.04 |
| 13314 | 7248683.065 | 441147.361 | 244.555 | 17A20110528SAR | 244.6 | -0.04 |
| 13315 | 7248312.213 | 441009.009 | 223.553 | 17A20110528SGR | 223.46 | 0.09 |
| 13316 | 7248351.772 | 441048.959 | 225.761 | 17A20110528SGR | 225.67 | 0.09 |
| 13317 | 7248305.931 | 440961.259 | 222.536 | 17A20110528SAR | 222.51 | 0.03 |
| 13318 | 7248279.39 | 440938.771 | 220.697 | 17A20110528SAR | 220.68 | 0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13319 | 7247817.962 | 440080.828 | 184.702 | 17A20110528SGR | 184.79 | -0.09 |
| 13320 | 7247766.75 | 440080.151 | 181.463 | 17A20110528SGR | 181.53 | -0.07 |
| 13321 | 7247715.221 | 440108.703 | 177.697 | 17A20110528SGR | 177.73 | -0.03 |
| 13322 | 7247663.414 | 440072.531 | 175.791 | 17A20110528SGR | 175.81 | -0.02 |
| 13323 | 7247645.118 | 440078.508 | 175.985 | 17A20110528SAR | 176.02 | -0.03 |
| 13324 | 7247358.049 | 439468.402 | 164.135 | 17A20110528SAR | 164.16 | -0.03 |
| 13325 | 7247331.756 | 439457.783 | 163.489 | 17A20110528SAR | 163.47 | 0.02 |
| 13326 | 7247390.774 | 439488.358 | 164.56 | 17A20110528SGR | 164.59 | -0.03 |
| 13327 | 7246784.441 | 439232.125 | 154.64 | 17A20110528SAR | 154.65 | -0.01 |
| 13328 | 7246705.473 | 439203.923 | 152.562 | 17A20110528SAR | 152.57 | -0.01 |
| 13329 | 7246640.932 | 439174.087 | 151.035 | 17A20110528SAR | 151.07 | -0.03 |
| 13330 | 7246540.924 | 439137.464 | 149.584 | 17A20110528SAR | 149.58 | 0.00 |
| 13331 | 7246455.724 | 439103.41 | 148.9 | 17A20110528SAR | 148.9 | 0.00 |
| 13332 | 7245835.113 | 438914.556 | 144.926 | 17A20110528SAR | 145.01 | -0.08 |
| 13333 | 7245863.861 | 438925.985 | 144.892 | 17A20110528SAR | 144.93 | -0.04 |
| 13334 | 7245837.875 | 438884.307 | 143.275 | 17A20110528SGR | 143.33 | -0.06 |
| 13335 | 7245801.1 | 438815.705 | 142.844 | 17A20110528SAR | 142.86 | -0.02 |
| 13336 | 7245788.091 | 438739.045 | 142.177 | 17A20110528SAR | 142.2 | -0.02 |
| 13337 | 7245806.421 | 438661.237 | 142.313 | 17A20110528SAR | 142.3 | 0.01 |
| 13338 | 7245826.862 | 438581.918 | 141.872 | 17A20110528SAR | 141.87 | 0.00 |
| 13339 | 7245821.366 | 438501.978 | 141.781 | 17A20110528SAR | 141.79 | -0.01 |
| 13340 | 7245784.528 | 438435.088 | 141.212 | 17A20110528SAR | 141.21 | 0.00 |
| 13341 | 7245698.097 | 438324 | 140.717 | 17A20110528SAR | 140.73 | -0.01 |
| 13342 | 7245630.839 | 438273.108 | 139.804 | 17A20110528SAR | 139.8 | 0.00 |
| 13343 | 7245535.413 | 438207.917 | 139.061 | 17A20110528SAR | 139.08 | -0.02 |
| 13344 | 7245468.16 | 438148.792 | 138.536 | 17A20110528SGR | 138.55 | -0.01 |
| 13345 | 7245441.169 | 438114.719 | 138.526 | 17A20110528SGR | 138.56 | -0.03 |
| 13346 | 7245847.104 | 439004.313 | 143.712 | 17A20110528SGR | 143.66 | 0.05 |
| 13347 | 7245637.893 | 438882.487 | 143.578 | 17A20110528SAR | 143.58 | 0.00 |
| 13348 | 7245659.167 | 438958.245 | 142.873 | 17A20110528SGR | 142.85 | 0.02 |
| 13349 | 7245691.098 | 439001.535 | 144.837 | 17A20110528SGR | 144.86 | -0.02 |
| 13350 | 7245581.491 | 438869.397 | 142.546 | 17A20110528SGR | 142.54 | 0.01 |
| 13351 | 7245582.4 | 438845.974 | 145.363 | 17A20110528SAR | 145.36 | 0.00 |
| 13352 | 7245516.828 | 438822.786 | 145.428 | 17A20110528SAR | 145.4 | 0.03 |
| 13353 | 7245453.15 | 438784.6 | 145.253 | 17A20110528SAR | 145.25 | 0.00 |
| 13354 | 7245357.974 | 438709.977 | 148.054 | 17A20110528SAR | 148.12 | -0.07 |
| 13355 | 7245291.29 | 438697.507 | 150.76 | 17A20110528SGR | 150.78 | -0.02 |
| 13356 | 7245252.367 | 438674.406 | 154.552 | 17A20110528SAR | 154.61 | -0.06 |
| 13357 | 7245254.746 | 438750.02 | 182.756 | 17A20110528SGR | 182.78 | -0.02 |
| 13358 | 7245230.936 | 438753.432 | 184.102 | 17A20110528SGR | 184.14 | -0.04 |
| 13359 | 7245184.211 | 438880.244 | 208.697 | 17A20110528SGR | 208.72 | -0.02 |
| 13360 | 7232435.38 | 447127.614 | 530.383 | A20110528CHK_PK106_16d_ | 530.36 | 0.02 |
| 13361 | 7232434.18 | 447132.477 | 530.465 | 17A20110528OG | 530.42 | 0.05 |
| 13362 | 7232558.894 | 447053.452 | 529.881 | 17A20110528SAR | 529.75 | 0.13 |
| 13363 | 7232577.166 | 447048.957 | 529.772 | 17A20110528SAR | 529.85 | -0.08 |
| 13364 | 7232560.425 | 447042.781 | 528.928 | 17A20110528OG | 528.96 | -0.03 |
| 13365 | 7233460.684 | 446842.237 | 502.547 | 17A20110528SAR | 502.66 | -0.11 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13366 | 7233401.428 | 446799.717 | 504.629 | 17A20110528SAR | 504.72 | -0.09 |
| 13367 | 7233369.403 | 446776.647 | 505.39 | 17A20110528SAR | 505.43 | -0.04 |
| 13368 | 7235385.776 | 446831.073 | 360.971 | 17A20110528SAR | 361.25 | -0.28 |
| 13369 | 7233025.23 | 446512.227 | 498.263 | 17A20110528SGR | 498.25 | 0.01 |
| 13370 | 7233078.965 | 446512.859 | 497.307 | 17A20110528SGR | 497.4 | -0.09 |
| 13371 | 7233139.941 | 446513.883 | 495.086 | 17A20110528SGR | 495.26 | -0.17 |
| 13372 | 7233325.885 | 446511.331 | 483.814 | 17A20110528SGR | 484.04 | -0.23 |
| 13373 | 7232984.872 | 446520.204 | 498.689 | 17A20110528SGR | 498.7 | -0.01 |
| 13374 | 7232847.011 | 446552.225 | 496.325 | 17A20110528SGR | 496.23 | 0.09 |
| 13375 | 7232711.056 | 446582.515 | 490.732 | 17A20110528SGR | 490.59 | 0.14 |
| 13376 | 7233159.233 | 446695.44 | 511.59 | 17A20110528SAR | 511.72 | -0.13 |
| 13377 | 7233143.77 | 446688.391 | 512.144 | 17A20110528SGR | 512.27 | -0.13 |
| 13378 | 7233095.128 | 446696.182 | 513.591 | 17A20110528SAR | 513.69 | -0.10 |
| 13379 | 7233127.007 | 446677.932 | 511.971 | 17A20110528SGR | 511.89 | 0.08 |
| 13380 | 7233097.648 | 446616.027 | 505.977 | 17A20110528SGR | 505.81 | 0.17 |
| 13381 | 7232300.339 | 448499.41 | 533.315 | 17A20110528SGR | 533.24 | 0.08 |
| 13382 | 7232278.296 | 448500.885 | 533.09 | 17A20110528SGR | 533.09 | 0.00 |
| 13383 | 7232256.497 | 448491.414 | 532.905 | 17A20110528SGR | 533.06 | -0.15 |
| 13384 | 7232206.14 | 448356.143 | 534.032 | 17A20110528SGR | 534.11 | -0.08 |
| 13385 | 7232198.812 | 448321.448 | 533.235 | 17A20110528SAR | 533.44 | -0.21 |
| 13386 | 7232233.548 | 448325.634 | 530.947 | 17A20110528SAR | 531.12 | -0.17 |
| 13387 | 7231609.192 | 448052.498 | 566.912 | 17A20110528SAR | 566.99 | -0.08 |
| 13388 | 7231655.932 | 448024.067 | 565.559 | 17A20110528SAR | 565.65 | -0.09 |
| 13389 | 7231710.939 | 448042.889 | 563.755 | 17A20110528SAR | 563.9 | -0.14 |
| 13390 | 7231563.226 | 448106.611 | 568.16 | 17A20110528SAR | 568.34 | -0.18 |
| 13391 | 7231567.901 | 448081.481 | 567.634 | 17A20110528SAR | 567.4 | 0.23 |
| 13392 | 7231551.87 | 448042.152 | 563.018 | 17A20110528SGR | 562.92 | 0.10 |
| 13393 | 7231551.406 | 447941.601 | 553.712 | 17A20110528SGR | 553.67 | 0.04 |
| 13394 | 7231552.98 | 447869.785 | 546.791 | 17A20110528SGR | 546.66 | 0.13 |
| 13395 | 7231522.381 | 447736.117 | 533.992 | 17A20110528SGR | 533.92 | 0.07 |
| 13396 | 7231506.215 | 447671.229 | 528.309 | 17A20110528SGR | 528.16 | 0.15 |
| 13397 | 7231485.556 | 447611.112 | 522.532 | 17A20110528SGR | 522.34 | 0.19 |
| 13398 | 7231330.8 | 447456.077 | 501.264 | 17A20110528SGR | 501.03 | 0.23 |
| 13399 | 7231280.493 | 447392.385 | 492.647 | 17A20110528SGR | 492.43 | 0.22 |
| 13400 | 7231198.241 | 447283.433 | 477.816 | 17A20110528SGR | 477.58 | 0.24 |
| 13401 | 7231127.136 | 447135.005 | 462.096 | 17A20110528SGR | 462 | 0.10 |
| 13402 | 7231121.997 | 447007.486 | 451.136 | 17A20110528SGR | 451.01 | 0.13 |
| 13403 | 7231197.836 | 446976.029 | 452.744 | 17A20110528SGR | 452.62 | 0.12 |
| 13404 | 7231264.281 | 446954.358 | 451.663 | 17A20110528SGR | 451.72 | -0.06 |
| 13405 | 7231054.256 | 448963.715 | 569.344 | 17A20110528SAR | 569.28 | 0.06 |
| 13406 | 7231072.316 | 448924.901 | 568.814 | 17A20110528SAR | 568.62 | 0.19 |
| 13407 | 7231099.371 | 448891.451 | 568.555 | 17A20110528SAR | 568.52 | 0.04 |
| 13408 | 7231104.705 | 448891.507 | 568.553 | 17A20110528SAR | 568.57 | -0.02 |
| 13409 | 7231044.671 | 449008.098 | 569.883 | 17A20110528SAR | 569.95 | -0.07 |
| 13410 | 7230054.688 | 449061.634 | 619.915 | 17A20110528SAR | 619.99 | -0.07 |
| 13411 | 7230046.735 | 449088.849 | 621.504 | 17A20110528SAR | 621.56 | -0.06 |
| 13412 | 7228709.397 | 449485.681 | 674.201 | 17A20110528SAR | 674.33 | -0.13 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13413 | 7228624.944 | 449554.339 | 673.162 | 17A20110528SAR | 673.28 | -0.12 |
| 13414 | 7228593.977 | 449527.186 | 672.003 | 17A20110528SGR | 671.92 | 0.08 |
| 13415 | 7228609.87 | 449507.589 | 672.566 | 17A20110528OG | 672.41 | 0.16 |
| 13416 | 7228184.004 | 449130.893 | 691.293 | 17A20110528SGR | 691.3 | -0.01 |
| 13417 | 7228211.256 | 449259.994 | 690.053 | 17A20110528SGR | 690.06 | -0.01 |
| 13418 | 7228232.683 | 449162.656 | 688.452 | 17A20110528SGR | 688.51 | -0.06 |
| 13419 | 7228280.746 | 449262.228 | 684.526 | 17A20110528SGR | 684.74 | -0.21 |
| 13420 | 7228297.882 | 449293.806 | 681.601 | 17A20110528SGR | 681.91 | -0.31 |
| 13421 | 7228426.787 | 449389.852 | 671.24 | 17A20110528SGR | 671.34 | -0.10 |
| 13422 | 7228480.445 | 449431.077 | 669.532 | 17A20110528SGR | 669.61 | -0.08 |
| 13423 | 7228739.901 | 449618.675 | 680.909 | 17A20110528SGR | 680.76 | 0.15 |
| 13424 | 7228743.761 | 449592.531 | 680.231 | 17A20110528SGR | 680.11 | 0.12 |
| 13425 | 7232435.378 | 447127.61 | 530.379 | 17A20110528SPK | 530.36 | 0.02 |
| 13426 | 7245619.248 | 438867.505 | 145.159 | 17A20110528CHK_17A_FPK | 145.22 | -0.06 |
| 13427 | 7245619.237 | 438867.501 | 145.158 | 17A20110528CHK_17A_FPK | 145.22 | -0.06 |
| 13428 | 7251275.342 | 441570.885 | 298.769 | 17A20110528SAR | 298.82 | -0.05 |
| 13429 | 7320437.686 | 363782.411 | 184.64 | 17A20110528FAC14A | 184.68 | -0.04 |
| 13430 | 7309170.453 | 376246.552 | 95.121 | 17A2011052814CFAC | 95.12 | 0.00 |
| 13431 | 7298593.727 | 389590.126 | 525.749 | 17A2011052815BFAC | 525.85 | -0.10 |

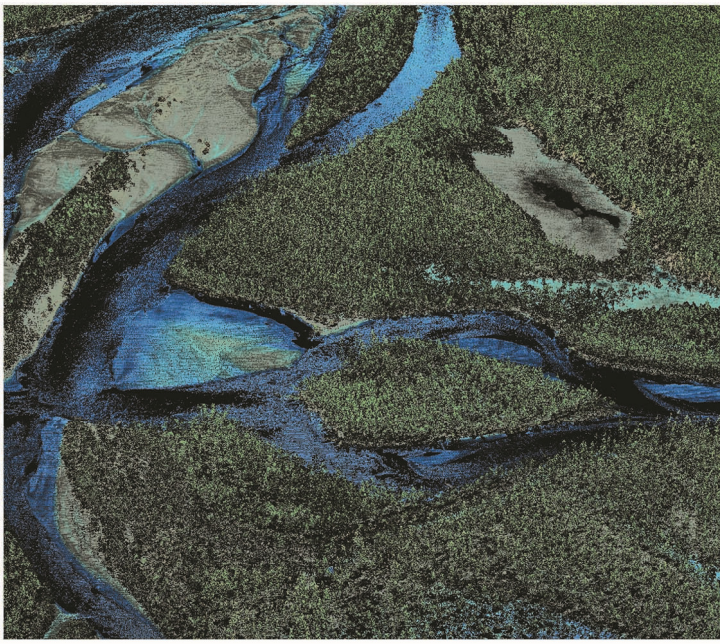
# LiDAR REMOTE SENSING

## ALASKA PIPELINE • ALASKA

(Delivery 7– 10/31/2011)








## ALASKA DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

**TRENT HUBBARD** - 3354 College Road - Fairbanks, AK 99709

**WATERSHED SCIENCES** • 517 SW 2nd Street, Suite 400 - Corvallis, OR 97333

# LiDAR Remote Sensing Data Collection:

## Alaska Pipeline, AK

### Delivery 7

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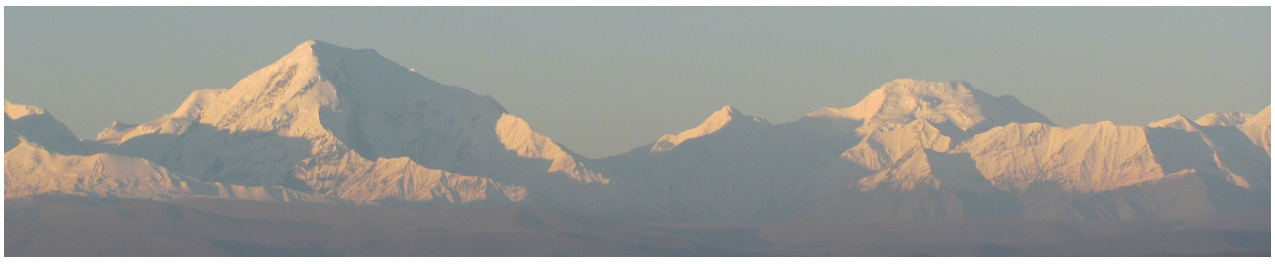
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# 1. Overview

Watershed Sciences, Inc. (WS) collected Light Detection and Ranging (LiDAR) data of the Alaska Pipeline for the Alaska Department of Natural Resources. LiDAR data for Delivery 7 was collected between May 20th and July 6th, 2011 (**Figure 1**). Delivery 7 includes 239,477 acres within the requested area. This area was expanded to include a 100m buffer to ensure complete coverage and adequate point densities around survey boundaries, resulting in 262,279 acres of delivered data. This area completes the 2011 add-on area following Parks Hwy (Hwy 3).

***Figure 1***. *Alaska Pipeline survey delivery status overview.*

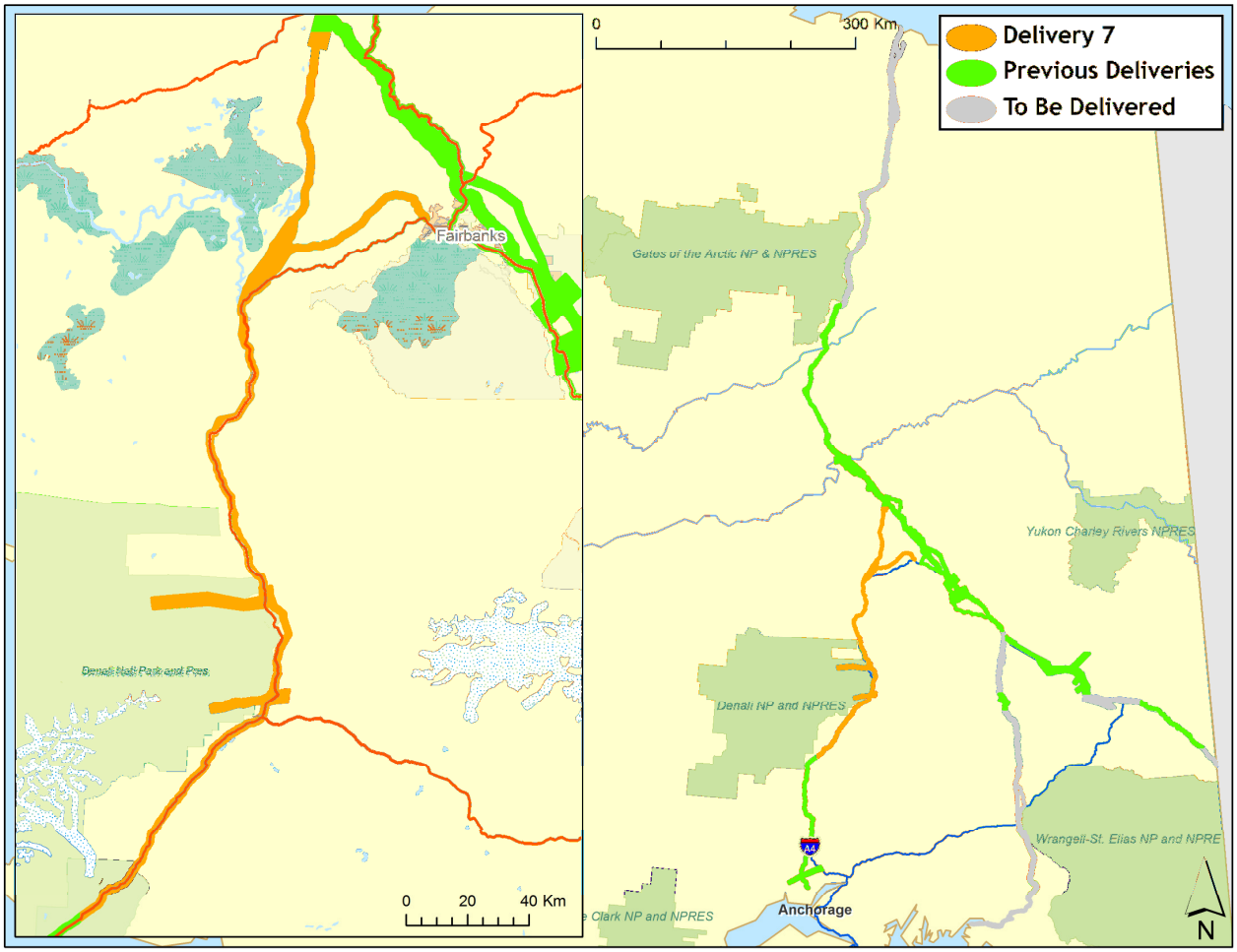


***Table 1**. Alaska Pipeline, LiDAR deliveries to date.*

| Delivery | UTM Zone(s) | Date | Total Acres Flown | AOI Acres |
|---|---|---|---|---|
| **1** | 6, 7 | March 9, 2011 | 121,746 | 117,357 |
| **2** | 6 | March 31, 2011 | 99,594 | 94,885 |
| **3** | 7 | May 23, 2011 | 43,976 | 39,744 |
| **4** | 6 | July 29, 2011 | 168,823 | 159,433 |
| **5** | 5 | August 31, 2011 | 247,206 | 226,450 |
| **6** | 6 | September 30, 2011 | 309,216 | 293,337 |
| **7** | 6 | October 31, 2011 | 262,279 | 239,477 |

# 2. Acquisition

## 2.1 Airborne Survey – Instrumentation and Methods

The LiDAR survey utilized a Leica ALS60 sensor in a Cessna Caravan 208Bs. The Leica systems were set to acquire 150,000 laser pulses per second (i.e., 150 kHz pulse rate) and flown at 1500 meters above ground level (AGL), capturing a scan angle of ±14$^{o}$ from nadir when clouds and terrain permitted. With these flight parameters, the laser swath width is 638m and the laser pulse footprint is 34cm. These settings varied depending on cloud cover and terrain but were consistently adjusted to yield an average native pulse density of ≥8 pulses per square meter over terrestrial surfaces. It is not uncommon for some types of surfaces (e.g. dense vegetation or water) to return fewer pulses than the laser originally emitted. These discrepancies between 'native' and 'delivered' density will vary depending on terrain, land cover, and the prevalence of water bodies.

*The Cessna Caravan is a stable platform, ideal for flying slow and low for high density projects. A Leica ALS60 sensor head installed in the Caravan is shown on the left.*



All areas were surveyed with an opposing flight line side-lap of ≥60% (≥100% overlap) to reduce laser shadowing and increase surface laser painting. The Leica laser systems allow up to four range measurements (returns) per pulse, and all discernable laser returns were processed for the output dataset.

To accurately solve for laser point position (geographic coordinates x, y, z), the positional coordinates of the airborne sensor and the attitude of the aircraft were recorded continuously throughout the LiDAR data collection mission. Aircraft position was measured twice per second (2 Hz) by an onboard differential GPS unit. 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/sensor position and attitude data are indexed by GPS time.

## 2.2 Ground Survey – Instrumentation and Methods

### *2.2.1 Monumentation*




Watershed Sciences coordinated with McClintock Land Associates (MLA, Alaska Professional Licensed Surveyor), of Eagle River, AK to determine proposed monument locations to support aerial acquisition. MLA established survey control monuments for the project area based on the proposed locations, areas with reasonable access, GPS visibility and proximity to the mission area. MLA established 29 new monuments (**Table 2**) within the Delivery 7 calibration area. The MLA monumentation was done with 5/8" x 30" rebar topped with a metal cap stamped with "MLA-WSI" the monument ID, and the year of establishment. MLA provided professional supervision and oversight to all survey aspects of this project, certified all monuments and provided additional independent accuracy check points (see Section 5.4, Appendix B). A full report of the survey will be provided with the final delivery report.

### *2.2.2 Control for Airborne Surveys*

During the LiDAR survey, static (1 Hz recording frequency) ground surveys were conducted over the survey control monuments.

All control monuments were observed for a minimum of two survey sessions lasting no fewer than 4 hours. At the beginning of every session the tripod and antenna were reset, resulting in two independent instrument heights and data files. Data was collected at a rate of 1Hz using a 10 degree mask on the antenna.


Trimble R7 GPS equipment set up in the Alaska Pipeline study area.

After the airborne survey, the static GPS data were provided to MLA for incorporation in the computation of the monument coordinates. MLA processed the static GPS data using triangulation with Continuously Operating Reference Stations (CORS). Both WSI and MLA checked coordinates using the Online Positioning User Service (OPUS[1]) to quantify daily variance. MLA provided calculated geodetic positions for all controls.

Indexed by time, these GPS data were used to correct the continuous onboard measurements of aircraft position recorded throughout the mission. Control monuments were located within 13 nautical miles of the survey area as per the contract.

***Table 2**. Base Station control coordinates for Alaska Pipeline Delivery 7.*

| Base Station ID | Datum: NAD83 (CORS96) | | GRS80 |
|---|---|---|---|
| | Latitude | Longitude | Ellipsoid Z (meters) |
| 47 A | 62 43 50.67823 | 150 10 06.89052 | 258.676 |
| 47 B | 62 44 36.63942 | 150 08 13.0917 | 269.579 |
| 48 A | 62 57 08.99370 | 149 39 25.52397 | 513.29 |
| 48 B | 63 00 02.04731 | 149 36 29.84427 | 597.067 |
| 49 A | 63 10 24.98391 | 149 23 00.05526 | 653.356 |
| 49 B | 63 11 19.83863 | 149 21 36.77712 | 653.719 |
| 50 A | 63 23 09.84969 | 148 54 31.21071 | 669.945 |
| 50 B | 63 25 38.41222 | 148 52 38.41421 | 649.213 |
| 51 A | 63 43 40.50218 | 148 53 15.31496 | 498.645 |
| 51 B | 63 44 18.67359 | 148 53 16.71060 | 487.527 |
| 51 C | 63 51 09.36984 | 149 00 39.18523 | 526.569 |
| 52 A | 63 44 24.03517 | 149 17 29.11153 | 802.442 |
| 52 B | 63 42 54.44282 | 149 14 45.71312 | 854.847 |
| 52 C | 63 42 53.91273 | 149 15 13.77093 | 852.169 |
| 53 A | 64 02 14.79762 | 149 09 17.08377 | 354.516 |
| 53 B | 64 02 55.01242 | 149 10 32.10628 | 356.941 |
| 54 A | 64 23 21.52478 | 149 00 48.59573 | 151.401 |
| 54 B | 64 24 24.91673 | 149 01 02.58659 | 148.414 |
| 54 C | 64 13 09.71938 | 149 15 46.19578 | 239.277 |
| 54 D | 64 19 32.62100 | 149 02 09.98215 | 170.6 |
| 54 G | 64 23 18.74845 | 149 00 49.88118 | 151.374 |
| 55 A | 64 40 07.24012 | 148 56 01.92703 | 138.887 |

[1] Online Positioning User Service (OPUS) is run by the National Geodetic Survey to process corrected monument positions.

| | | | |
|---|---|---|---|
| 55 B | 64 39 49.88511 | 148 56 53.72027 | 128.968 |
| 56 A | 64 48 29.22930 | 148 25 42.86148 | 137.394 |
| 56 B | 64 48 32.72775 | 148 25 22.52888 | 138.718 |
| 57 A | 64 58 52.06891 | 148 39 04.01715 | 113.153 |
| 57 B | 64 58 55.34496 | 148 39 03.66944 | 112.549 |
| 58 A | 64 54 27.55892 | 147 56 55.34797 | 185.172 |
| 58 B | 64 54 44.84660 | 147 56 32.42844 | 183.314 |

### *2.2.3 Instrumentation*

For this survey, a Trimble GPS receiver model R7 with Zephyr Geodetic antenna with ground plane was deployed for all static control. A Trimble model R8 GNSS unit was used for collecting check points using real time kinematic (RTK) survey techniques. All GPS measurements were made with dual frequency L1-L2 receivers with carrier-phase correction.

The aircraft was assigned a ground crew member with two Trimble R7 receivers and an R8 receiver. The ground crew vehicles are equipped with standard field survey supplies and equipment including safety materials. The aircraft was further supported, as necessary, by an MLA surveyor (AK PLS) with two or more survey grade Topcon Receivers.

### *2.2.4 Methodology*

RTK and aircraft mounted GPS measurements were made during periods with PDOP[2] less than or equal to 3.0 and with at least 6 satellites in view of both a stationary reference receiver and the roving receiver. Static GPS data collected in a continuous session average the high PDOP into the final solution in the method used by CORS stations.

For RTK data, the collector begins recording after remaining stationary for 5 seconds then calculating the pseudo range position from at least three epochs with the relative error under 1.5cm horizontal and 2cm vertical. RTK positions are collected on bare earth locations such as paved, gravel or stable dirt roads, and other locations where the ground is clearly visible (and is likely to remain visible) from the sky during the data acquisition and RTK measurement period(s).

In order to facilitate comparisons with LiDAR measurements, RTK measurements were not taken on highly reflective surfaces such as center line stripes or lane markings on roads. RTK points were taken no closer than one meter to any nearby terrain breaks such as road edges or drop offs.

[2]PDOP: Point Dilution of Precision is a measure of satellite geometry, the smaller the number the better the geometry between the point and the satellites.

***Figure 2**. WSI RTK check points and control monument locations used in Delivery 7 of the Alaska Pipeline LiDAR Survey.*



# 3. LiDAR Data Processing

## 3.1 Applications and Work Flow Overview

1. Resolved kinematic corrections for aircraft position data using kinematic aircraft GPS and static ground GPS data.

   **Software:** Waypoint GPS v.8.10, Trimble Geomatics Office v.1.62
2. Developed a smoothed best estimate of trajectory (SBET) file that blends post-processed aircraft position with attitude data. Sensor head position and attitude were calculated throughout the survey. The SBET data were used extensively for laser point processing.

   **Software:** IPAS v.1.35
3. Calculated laser point position by associating SBET position to each laser point return time, scan angle, intensity, etc. Created raw laser point cloud data for the entire survey in *.las (ASPRS v. 1.2) format.

   **Software:** ALS Post Processing Software v.2.70
4. Imported raw laser points into manageable blocks (less than 500 MB) to perform manual relative accuracy calibration and filter for pits/birds. Ground points were then classified for individual flight lines (to be used for relative accuracy testing and calibration).

   **Software:** TerraScan v.11.009
5. Using ground classified points per each flight line, the relative accuracy was tested. Automated line-to-line calibrations were then performed for system attitude parameters (pitch, roll, heading), mirror flex (scale) and GPS/IMU drift. Calibrations were performed on ground classified points from paired flight lines. Every flight line was used for relative accuracy calibration.

   **Software:** TerraMatch v.11.006
6. Position and attitude data were imported. Resulting data were classified as ground and non-ground points. Statistical absolute accuracy was assessed via direct comparisons of ground classified points to ground RTK survey data. Data were then converted to orthometric elevations (NAVD88) by applying a Geoid09 correction. **Software:** TerraScan v.11.009, TerraModeler v.11.004
7. Bare Earth models were created as a triangulated surface and exported as ArcInfo ASCII grids at a 1 meter pixel resolution. Highest Hit models were created for any class at 1 meter grid spacing and exported as ArcInfo ASCII grids. Vegetation models were created for all vegetation points 20cm and above the ground model at a 1m grid spacing and exported as ArcInfo ASCII grids.

   **Software:** TerraScan v.11.009, ArcMap v. 9.3.1, TerraModeler v.11.004

## 3.2 Aircraft Kinematic GPS and IMU Data

LiDAR survey datasets were referenced to the 1 Hz static ground GPS data collected over pre-surveyed monuments with known coordinates. While surveying, the aircraft collected 2 Hz kinematic GPS data, and the onboard inertial measurement unit (IMU) collected 200 Hz aircraft attitude data. Waypoint GPS v.8.10 was used to process the kinematic corrections for the aircraft. The static and kinematic GPS data were then post-processed after the survey to

obtain an accurate GPS solution and aircraft positions. IPAS v.1.35 was used to develop a trajectory file that includes corrected aircraft position and attitude information. The trajectory data for the entire flight survey session were incorporated into a final smoothed best estimated trajectory (SBET) file that contains accurate and continuous aircraft positions and attitudes.

## 3.3 Laser Point Processing

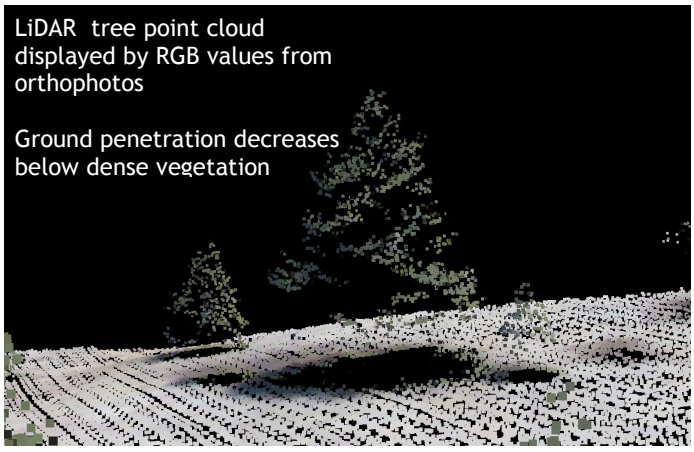
Laser point coordinates were computed using the IPAS and ALS Post Processor software suites based on independent data from the LiDAR system (pulse time, scan angle), and aircraft trajectory data (SBET). Laser point returns (first through fourth) were assigned an associated (x, y, z) coordinate along with unique intensity values (0-255). The data were output into large LAS v. 1.2 files with each point maintaining the corresponding scan angle, return number (echo), intensity, and x, y, z (easting, northing, and elevation) information.

These initial laser point files were too large for subsequent processing. To facilitate laser point processing, bins (polygons) were created to divide the dataset into manageable sizes (< 500 MB). Flightlines and LiDAR data were then reviewed to ensure complete coverage of the survey area and positional accuracy of the laser points.

Laser point data were imported into processing bins in TerraScan, and manual calibration was performed to assess the system offsets for pitch, roll, heading and scale (mirror flex). Using a geometric relationship developed by Watershed Sciences, each of these offsets was resolved and corrected if necessary.

LiDAR points were then filtered for noise, pits (artificial low points), and birds (true birds as well as erroneously high points) by screening for absolute elevation limits, isolated points and height above ground. Each bin was then manually inspected for remaining pits and birds and spurious points were removed. In a bin containing approximately 7.5-9.0 million points, an average of 50-100 points are typically found to be artificially low or high. Common sources of non-terrestrial returns are clouds, birds, vapor, haze, decks, brush piles, etc.

Internal calibration was refined using TerraMatch. Points from overlapping lines were tested for internal consistency and final adjustments were made for system misalignments (i.e., pitch, roll, heading offsets and scale). Automated sensor attitude and scale corrections yielded 3-5 cm improvements in the relative accuracy. Once system misalignments were corrected, vertical GPS drift was then resolved and removed per flight line, yielding a slight improvement (<1 cm) in relative accuracy.




The TerraScan software suite is designed specifically for classifying near-ground points (Soininen, 2004). The processing sequence began by 'removing' all points that were not 'near' the earth based on geometric constraints used to evaluate

multi-return points. The resulting bare earth (ground) model was visually inspected and additional ground point modeling was performed in site-specific areas to improve ground detail. This manual editing of ground often occurs in areas with known ground modeling deficiencies, such as: bedrock outcrops, cliffs, deeply incised stream banks, and dense vegetation. In some cases, automated ground point classification erroneously included known vegetation (i.e., understory, low/dense shrubs, etc.). These points were manually reclassified. Ground surface rasters were then developed from triangulated irregular networks (TINs) of ground points.

To develop the highest hit and vegetation models, buildings and structures were classified through automated point processing algorithms and then manually inspected and edited during the ground model inspection. Typically, manual editing of building classification was necessary where dense canopy was immediately proximate to buildings, or where structures such as utility poles or fences mimicked vegetation.

The remaining points not classified as ground, buildings, or error points were separated into two vegetation classes; Low Vegetation consisting of all returns ≤20cm from the ground, and Medium Vegetation consisting of all returns >20cm from the ground. This distinction was necessary because some potential for unclassified ground exists in the dataset. Vegetation classified returns within 20cm of the ground have higher potential to be artifacts of the dataset caused by minor offsets between flightlines (typically <10cm), isolated noise points, or abrupt discrete terrain features that did not get classified as ground (i.e. small boulders or sharp cliffs). The majority of points classified as low vegetation are valid returns, so the class was retained in the dataset to be incorporated into analyses at the user's discretion.

**Table 3.** ASPRS classification definitions for the Alaska Pipeline LiDAR survey

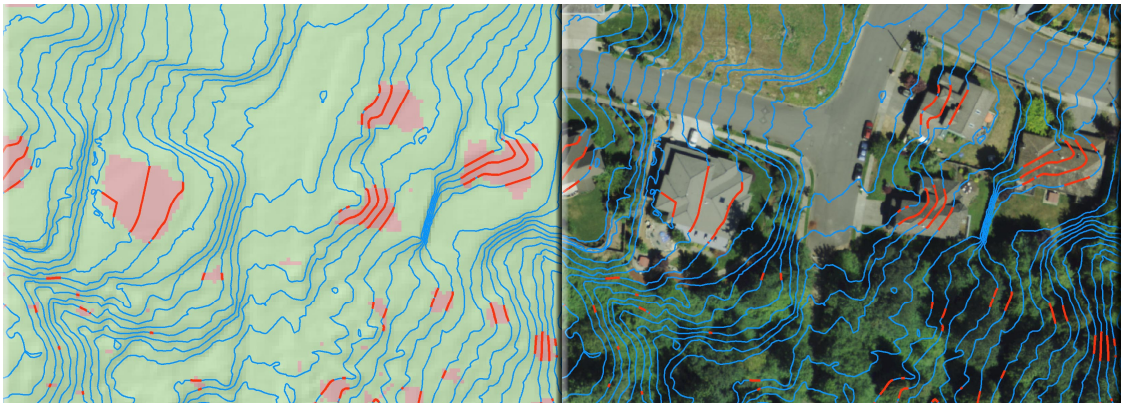
| ASPRS Class | Definition |
|---|---|
| 2 | Ground |
| 3 | Low Vegetation |
| 4 | Medium Vegetation |
| 6 | Buildings/Man-made structures |
| 7 | Noise/error points |
| 9 | Water |
| 15 | Pipeline |

## 3.4 Contour Development

Contour lines were derived at 1 meter intervals from ground-classified LiDAR point data using TerraSolid processing software in MicroStation v. 8.1. Contour generation from LiDAR point data requires a thinning operation in order to reduce contour sinuosity. Parameters for these operations are: thinning elevation bounds: +/- 0.07m; search radius: 6.09m. The thinning operation reduces point density where topographic change is minimal (flat surfaces) while preserving resolution where topographic change is present. The total sum of potential error in vertical position is equal to twice the point processing limits (0.14m) plus twice the 2-sigma absolute vertical accuracy value for this dataset.

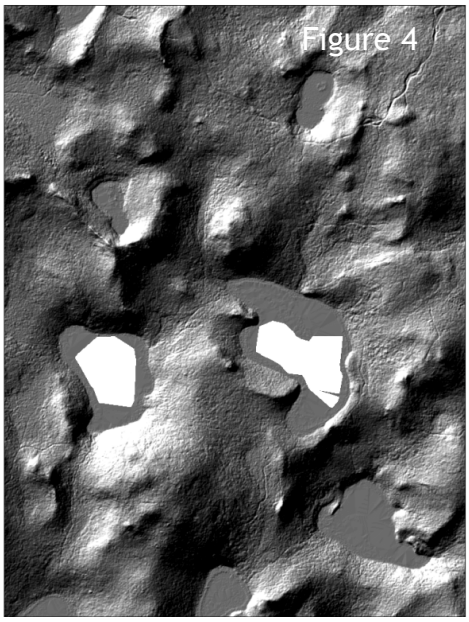
Ground point density rasters were created within MicroStation using a 1 meter step resolution and a 2 meter sampling radius. Areas with less than 0.25 ground-classified points per square meter were considered "sparse" and areas with higher densities were considered "covered". The ground point density raster data are in ESRI GRID format and have a 1 meter pixel resolution. The contour lines were intersected with ground point density raster data, allowing the addition of a confidence attribute to contour lines. Contour lines over "sparse" areas have low confidence, while contour lines over "covered" areas have a high confidence. Areas with low ground point density are commonly beneath buildings and bridges, in locations with dense vegetation, over water, and in other areas where laser penetration to the ground surface is impeded. **Figure 3** is an example of a ground point density raster and contour lines.

***Figure 3**. Elevation contours over LiDAR ground-classified point density raster (left) and true-color aerial photograph (right). Red indicates low ground point density and blue represents high density.*

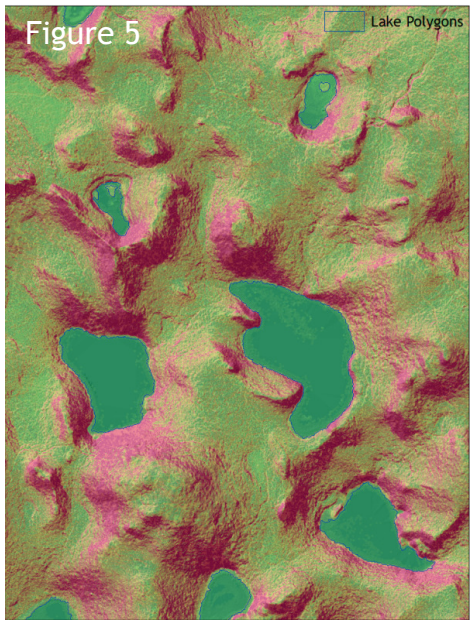


## 3.5 Hydro-Flattening

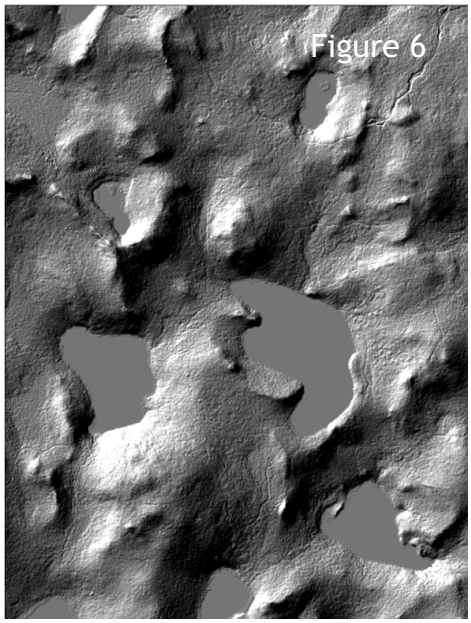
Lakes and other closed water bodies with surface area >150 $m^2$ were flattened to a consistent water level. The hydro-flattening process eliminates artifacts in the digital terrain model caused by both increased variability in ranges or dropouts in laser returns due to the low reflectivity of water (**Figure 4**). As per the project specifications, rivers and streams were not hydro-flattened.




Hydro-flattening of closed water bodies was performed through a combination of automated and manual detection and adjustment techniques designed to identify lake boundaries and water levels. Boundary polygons were developed using an algorithm which weights LiDAR-derived slopes, intensities, and return densities to detect the lake edge. The lake edges were then manually reviewed and edited in a 3-D environment. Once polygons were developed, the lake elevations were computed from the filtered LiDAR returns (**Figure 5**).




Returns from the water surface within each polygon were filtered and inspected for false low points during the initial ground modeling process described previously (Section 3.3). The elevation of each lake was computed as 5-cm above the minimum elevation of filtered water surface cells within the lake polygon. This approach ensures that all spurious returns off the water surface (both artificially high and low) were excluded from lake level assessment.




Lake-boundary polygons were then incorporated into the final terrain model and enforced as hard-breaklines. The initial ground classified points falling within lake polygons were reclassified as water points [to omit them from the final ground model] and replaced with the flat water surface of the lake boundary hydrolines (**Figure 6**).

# 4. LiDAR Accuracy Assessment

## 4.1 Laser Noise and Relative Accuracy

*Laser Noise*
For any given target, laser noise is the breadth of the data cloud per laser return (i.e., last, first, etc.). Lower intensity surfaces (roads, rooftops, still/calm water) experience higher laser noise. The laser noise range for this survey was approximately 0.02 meters.

*Relative Accuracy*
Relative accuracy refers to the internal consistency of the data set - the ability to place a laser point in the same location over multiple flight lines, GPS conditions, and aircraft attitudes. Affected by system attitude offsets, scale, and GPS/IMU drift, internal consistency is measured as the divergence between points from different flight lines within an overlapping area. Divergence is most apparent when flight lines are opposing. When the LiDAR system is well calibrated, the line-to-line divergence is low (<10 cm). See Appendix A for further information on sources of error and operational measures that can be taken to improve relative accuracy.

**Relative Accuracy Calibration Methodology**

1. Manual System Calibration: Calibration procedures for each mission require solving geometric relationships that relate measured swath-to-swath deviations to misalignments of system attitude parameters. Corrected scale, pitch, roll and heading offsets were calculated and applied to resolve misalignments. The raw divergence between lines was computed after the manual calibration was completed and reported for each survey area.
2. Automated Attitude Calibration: All data were tested and calibrated using TerraMatch automated sampling routines. Ground points were classified for each individual flight line and used for line-to-line testing. System misalignment offsets (pitch, roll and heading) and scale were solved for each individual mission and applied to respective mission datasets. The data from each mission were then blended when imported together to form the entire area of interest.
3. Automated Z Calibration: Ground points per line were used to calculate the vertical divergence between lines caused by vertical GPS drift. Automated Z calibration was the final step employed for relative accuracy calibration.

## 4.2 Absolute Accuracy

Laser point absolute accuracy is largely a function of laser noise and relative accuracy. To minimize these contributions to absolute error, a number of noise filtering and calibration procedures were performed prior to evaluating absolute accuracy. The LiDAR quality assurance process uses the data from the real-time kinematic (RTK) ground survey conducted in the AOI. For Delivery 7, **4791 RTK** GPS measurements were collected on hard surfaces distributed among multiple flight swaths for a total of 17,584 points across all delivered data. Suitable and accessible hard-surfaces limited the number and distribution of RTK points able to be collected. To assess absolute accuracy the location coordinates of these known RTK ground points were compared to those calculated for the closest ground-classified laser points.

The vertical accuracy of the LiDAR data is described as the mean and standard deviation (sigma ~ $\sigma$) of divergence between LiDAR point coordinates and RTK ground survey point coordinates. To provide a sense of the model predictive power of the dataset, the root mean square error (RMSE) for vertical accuracy is also provided. These statistics assume the error distributions for x, y, and z are normally distributed, thus the skew and kurtosis of distributions are considered when evaluating error statistics.

Statements of statistical accuracy apply to fixed terrestrial surfaces only and may not be applied to areas of dense vegetation or steep terrain (See Appendix A).

# 5. Study Area Results

Summary statistics for point resolution and accuracy (relative and absolute) of the LiDAR data collected in the Alaska Pipeline Delivery 7 survey area have been added to previously delivered data. Cumulative results are presented below in terms of central tendency, variation around the mean, and the spatial distribution of the data (for point resolution by processing bin).

The initial dataset, acquired to be ≥8 points per square meter, was filtered as described previously to remove spurious or inaccurate points. Additionally, some types of surfaces (i.e., dense vegetation, breaks in terrain, water, steep slopes) may return fewer pulses (delivered density) than the laser originally emitted (native density).

Ground classifications were derived from automated ground surface modeling and manual, supervised classifications where it was determined that the automated model had failed. Ground return densities will be lower in areas of dense vegetation, water, or buildings.

## Data Summary:

***Table 4****. LiDAR Resolution and Accuracy - Specifications and Achieved Values*

| | | Targeted | Achieved |
|---|---|---|---|
| **Resolution:** | **UTM 5** | ≥ 8 points/$m^2$ | 8.60 points/$m^2$ |
| | **UTM 6** | | 8.72 points/$m^2$ |
| | **UTM 7** | | 8.68 points/$m^2$ |
| **Vertical Accuracy (1 $\sigma$):** | | <13 cm | 3.4 cm |

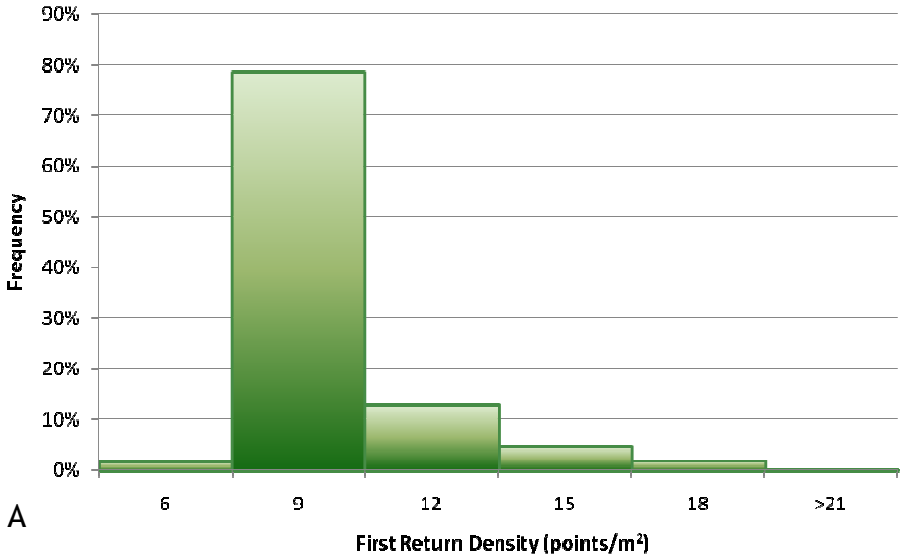
## 5.1 Data Density/Resolution

**Figures 10 - 17** display the distribution of average native and ground point densities for each processing bin. Density data will continue to be updated as data is processed and delivered.

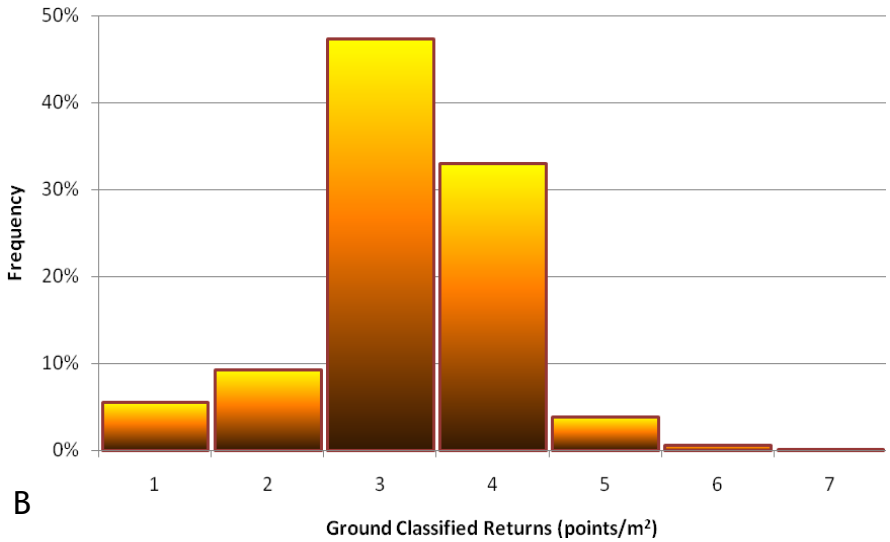
LiDAR data resolution for Alaska Pipeline deliveries to date:

| | UTM 5 | UTM 6 | UTM 7 |
|---|---|---|---|
| Average Point (First Return) Density | 8.60 points/$m^2$ | 8.72 points/$m^2$ | 8.68 points/$m^2$ |
| Average Ground Point Density | 2.72 points/$m^2$ | 2.50 points/$m^2$ | 2.90 points/$m^2$ |

***Figure 7**. Density distribution for first return (A) and ground classified (B) laser points for UTM 5*

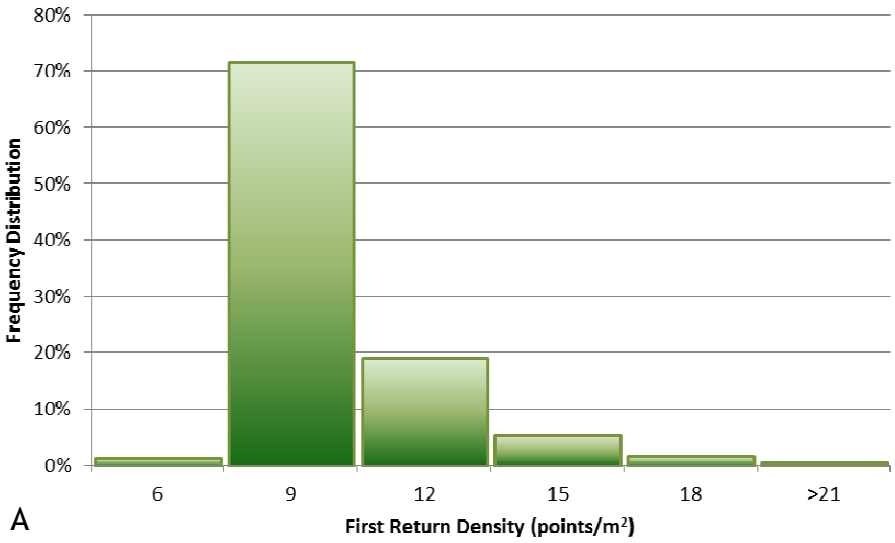



A

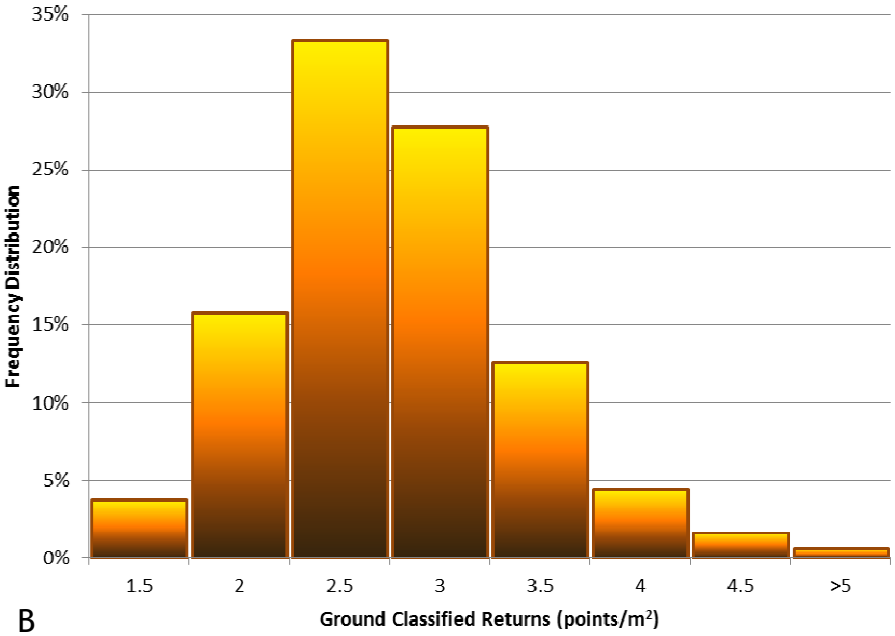



B

***Figure 8.*** *Density distribution for first return (A) and ground classified (B) laser points for UTM 6*




A




B

***Figure 9**. Density distribution for first return (A) and ground classified (B) laser points for UTM 7*

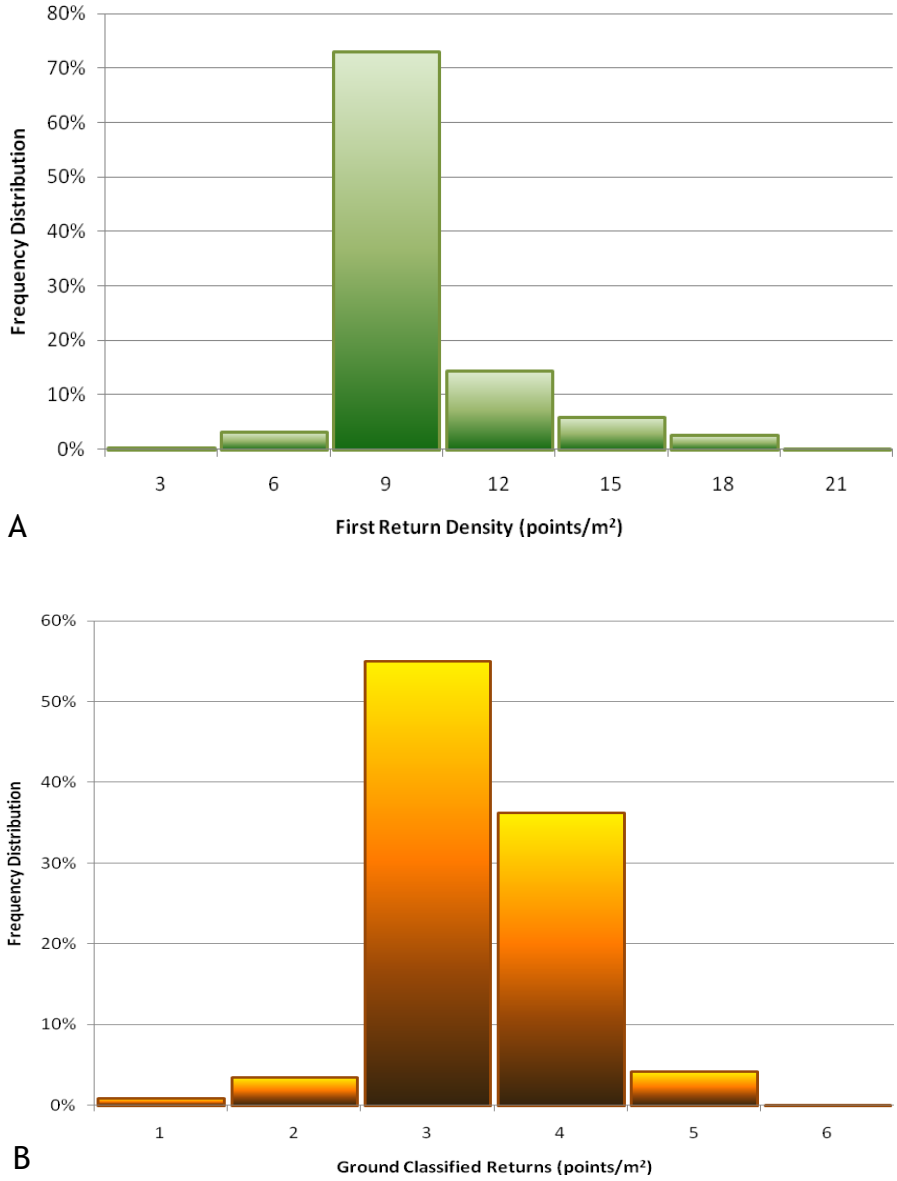


***Figure 10**. Density distribution map for ground and first return points by processing bin in Delivery 1, UTM 6*



***Figure 11.*** *Density distribution map for ground and first return points by processing bin in Delivery 1, UTM 7*

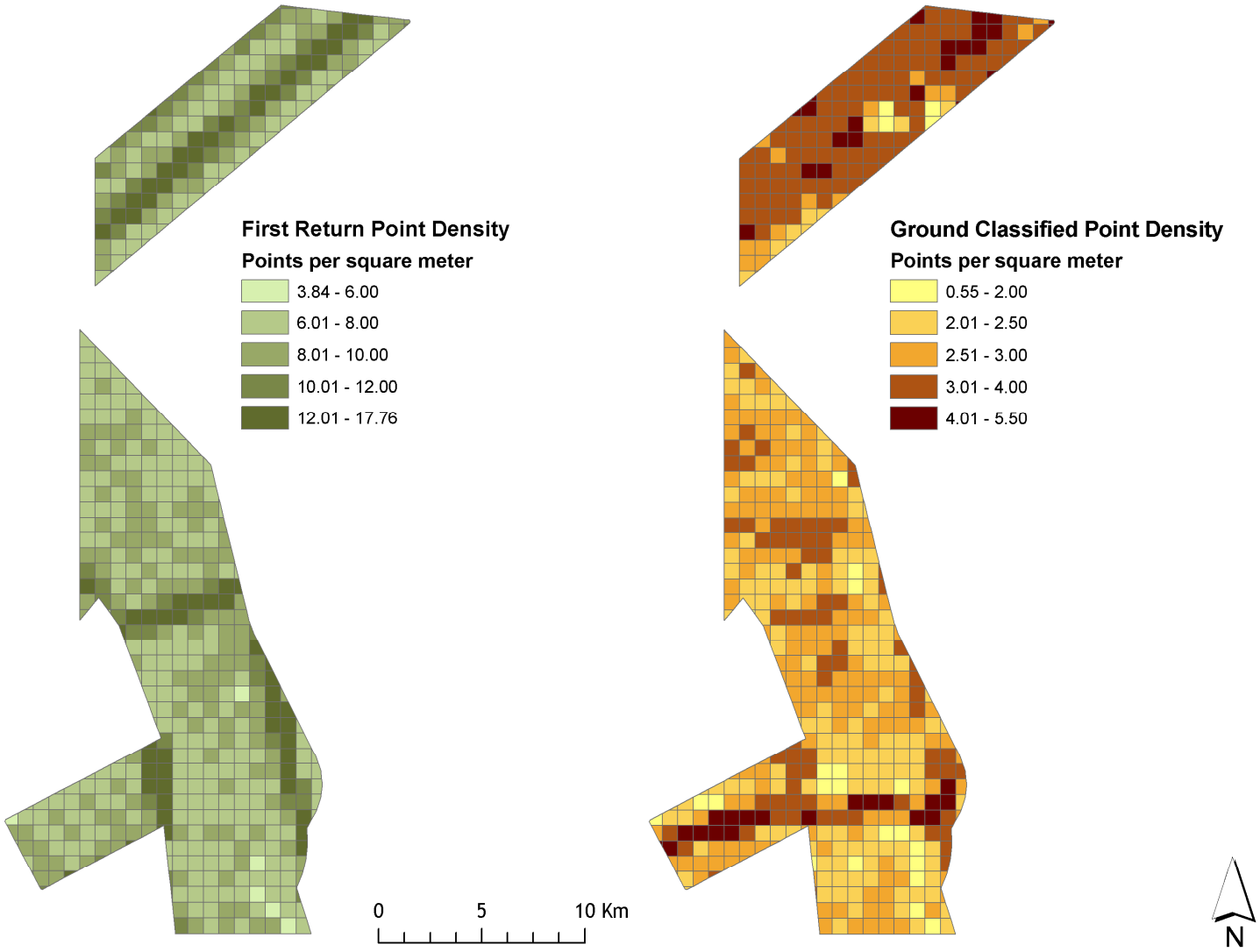


***Figure 12.*** *Density distribution map for ground points by processing bin in Delivery 2, UTM 6*

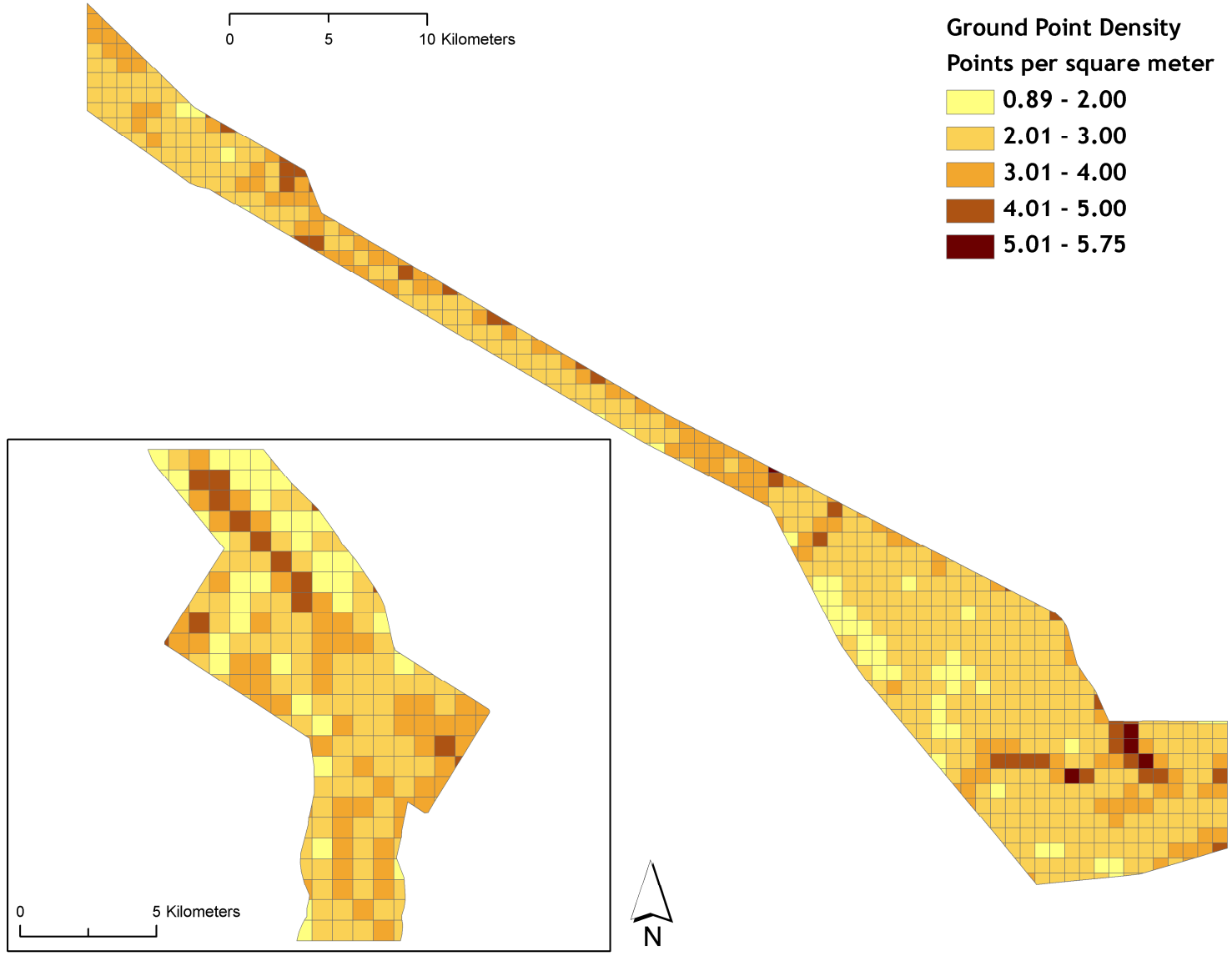


***Figure 13***. *Density distribution map for first return points by processing bin in Delivery 2, UTM 6*

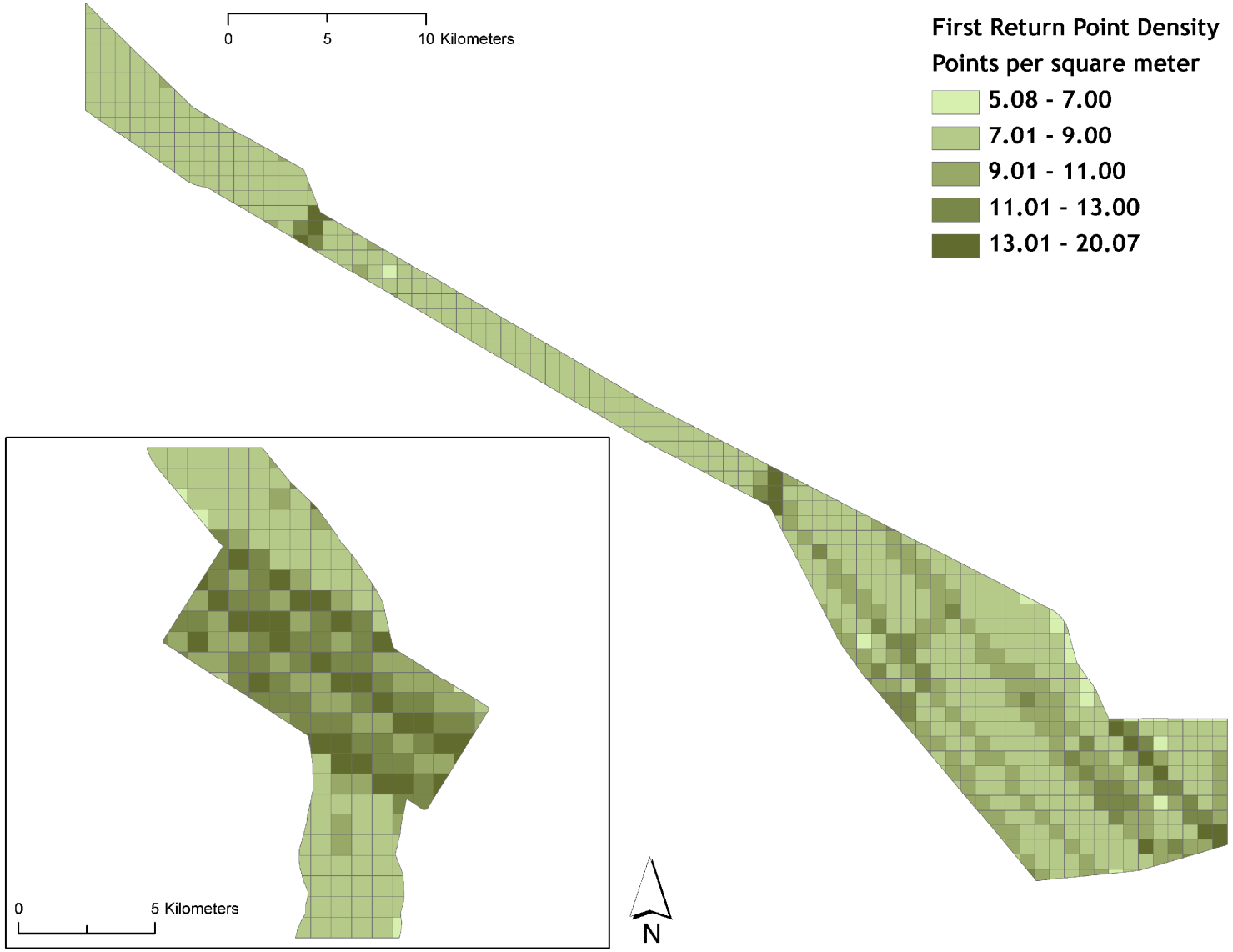


***Figure 14**. Density distribution map for ground and first return points by processing bin in Delivery 3, UTM 7*

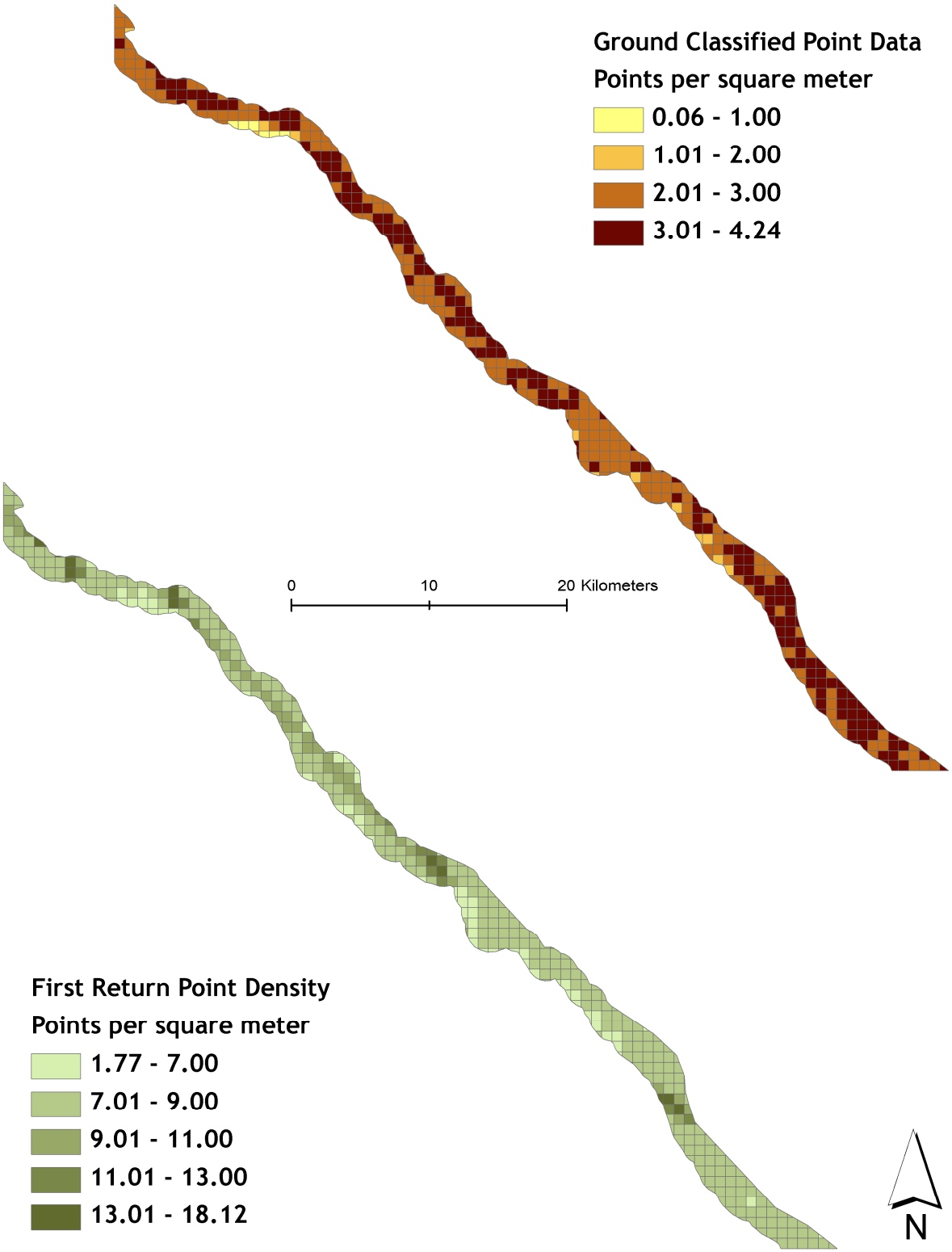


***Figure 15**. Density distribution map for ground and first return points by processing bin in Delivery 4, UTM 6*

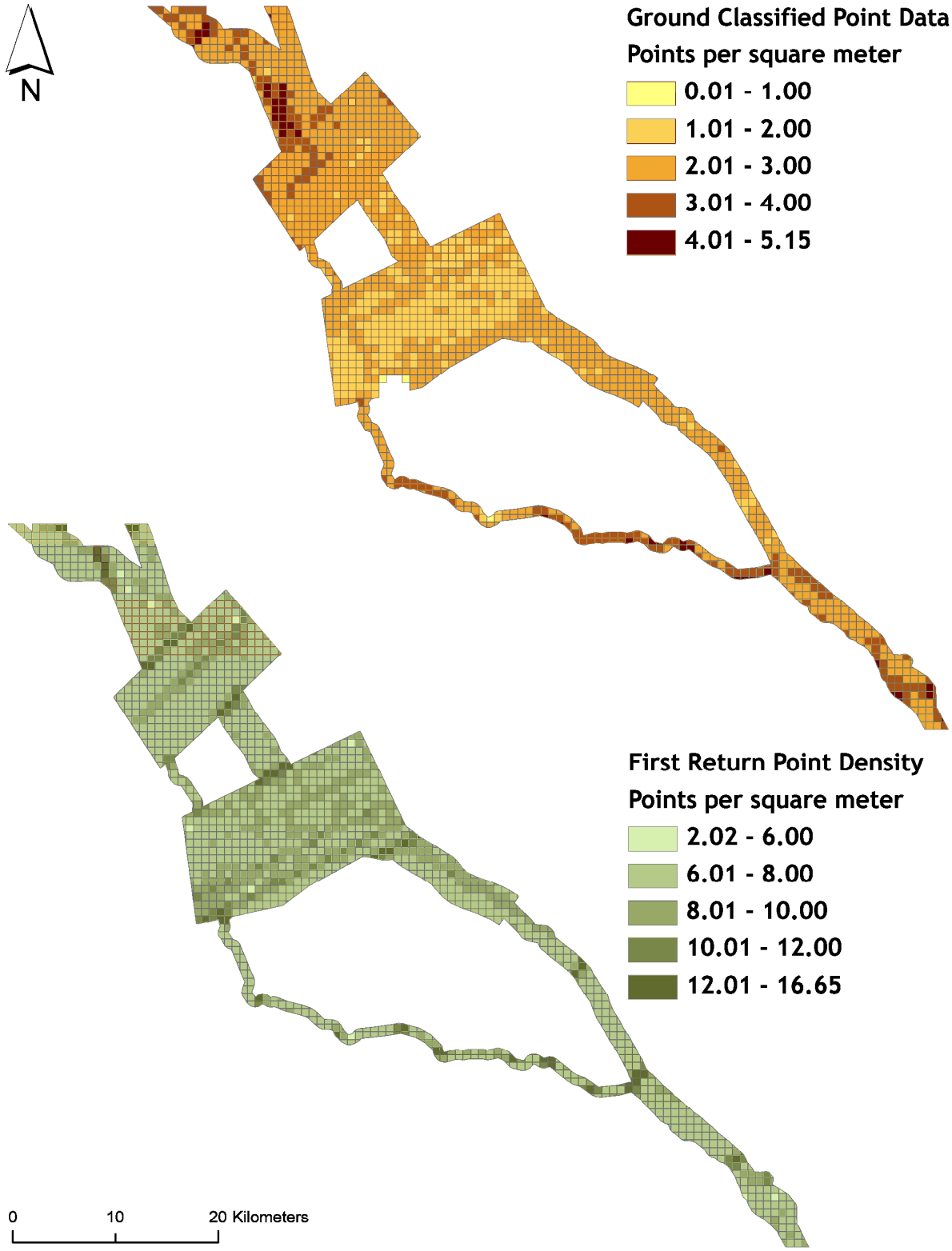


***Figure 16**. Density distribution map for ground classified points by processing bin in Delivery 5, UTM 5*



***Figure 17.*** *Density distribution map for first return points by processing bin in Delivery 5, UTM 5*

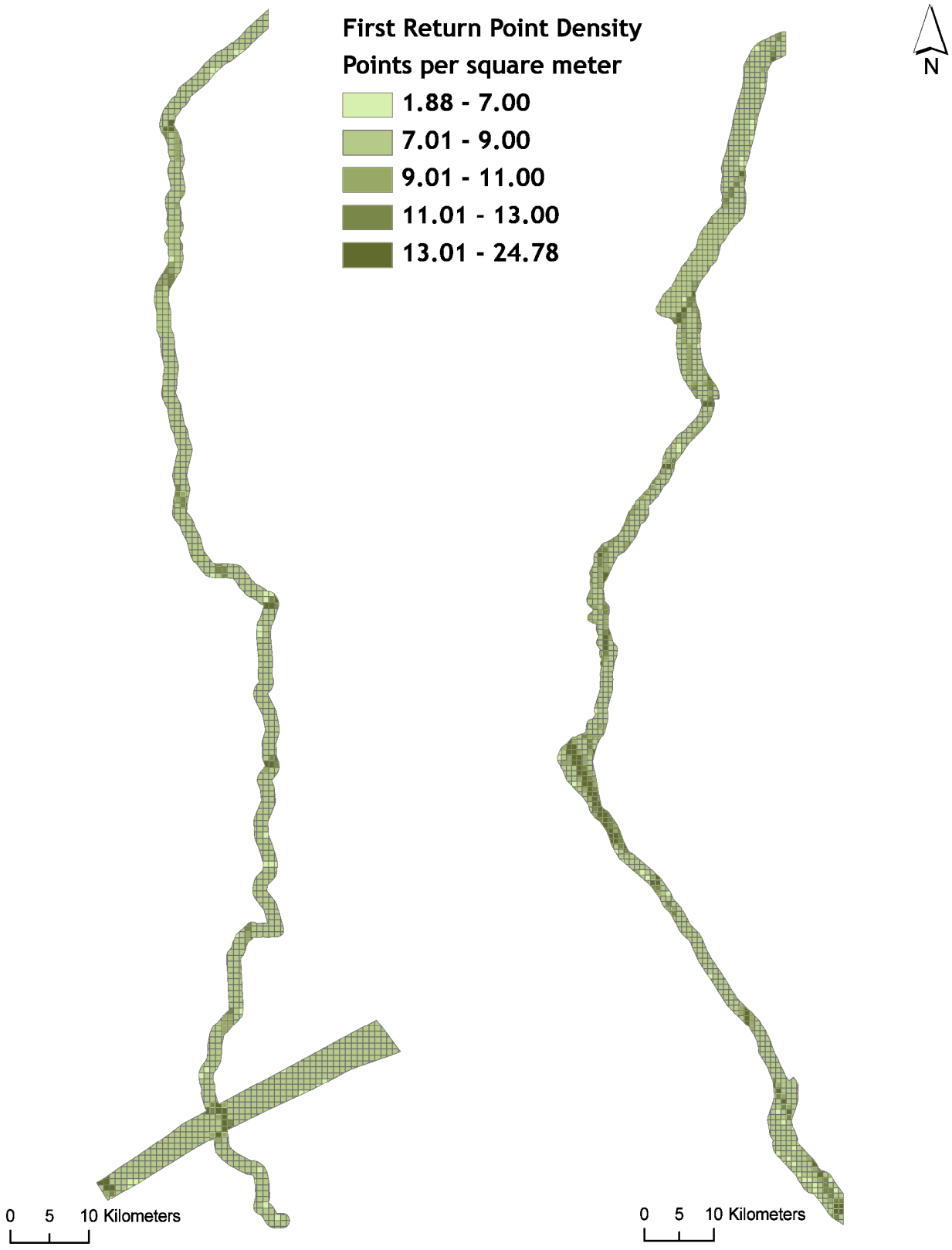


***Figure 18**. Density distribution map for ground classified points by processing bin in Delivery 6, UTM 6*

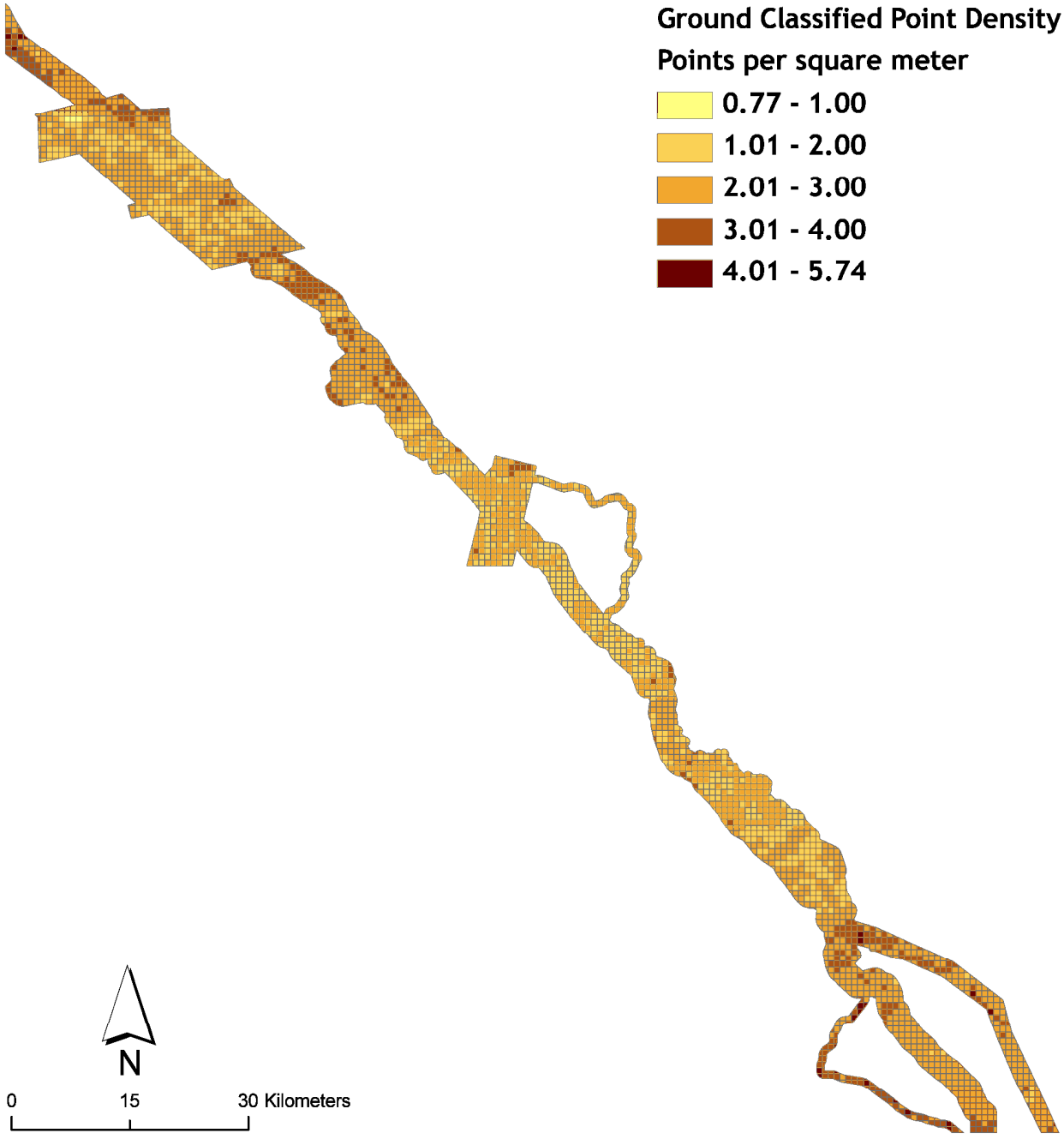


***Figure 19**. Density distribution map for first return points by processing bin in Delivery 6, UTM 6*

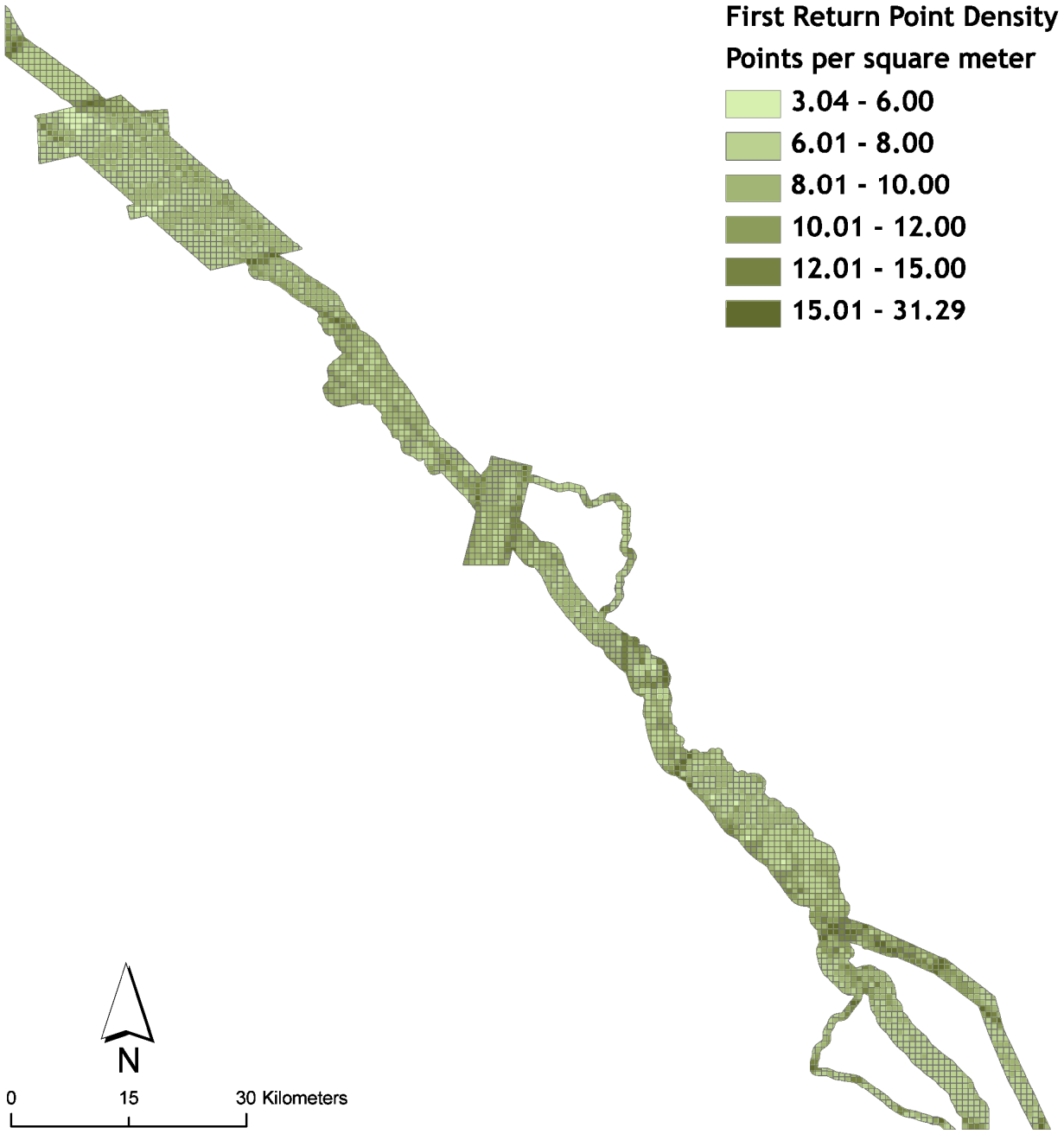


***Figure 20**. Density distribution map for ground classified points by processing bin in Delivery 7, UTM 6*

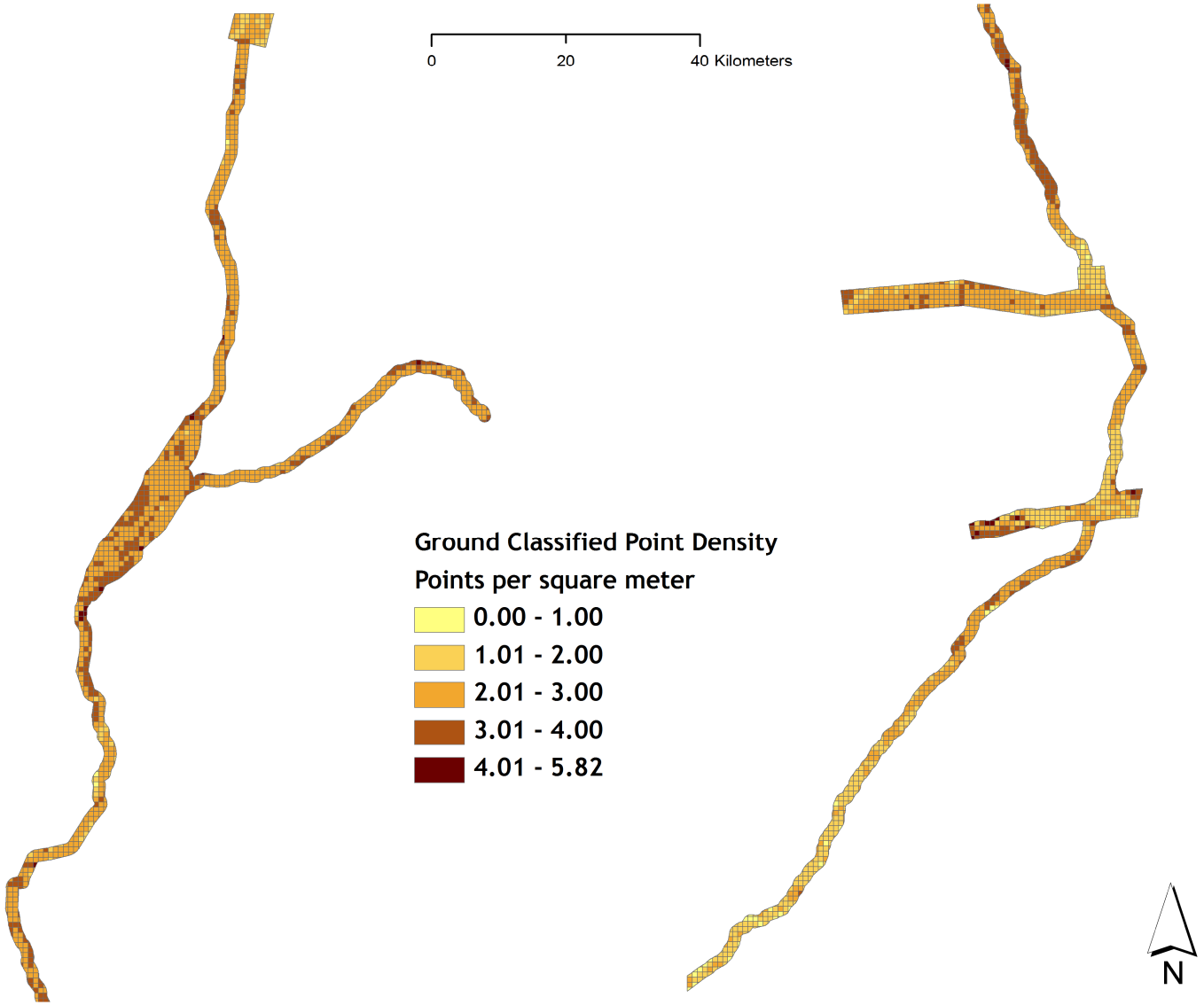


***Figure 21**. Density distribution map for first return points by processing bin in Delivery 7, UTM 6*

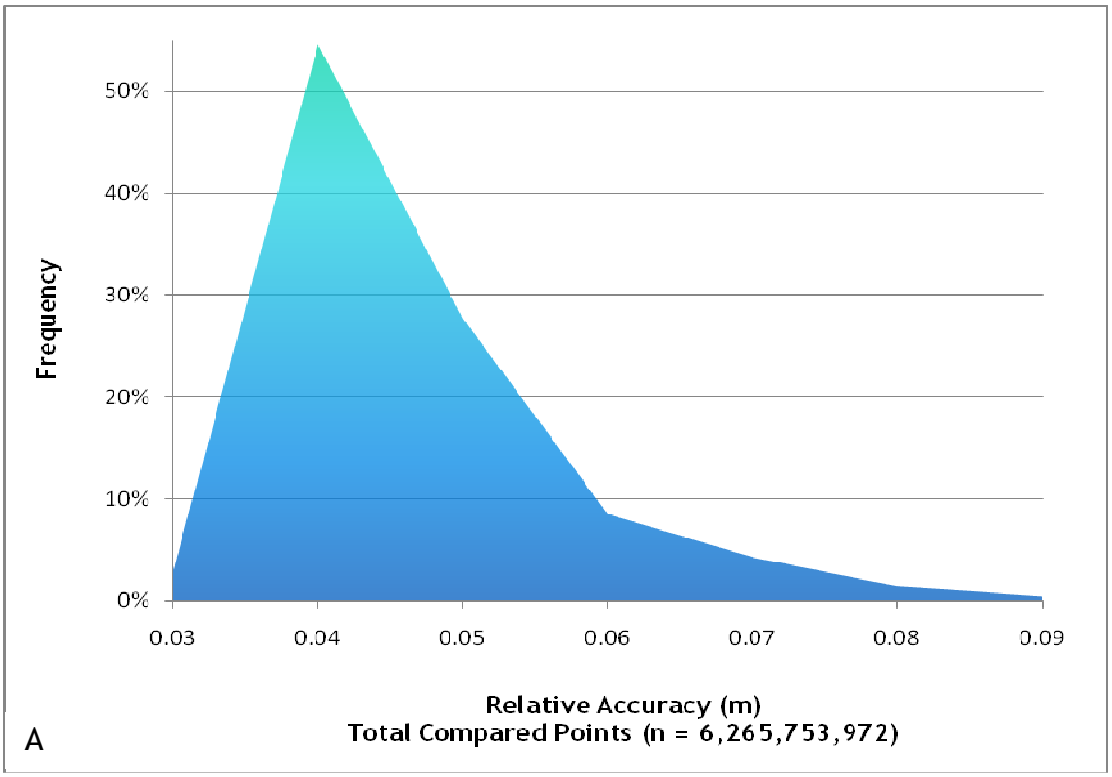


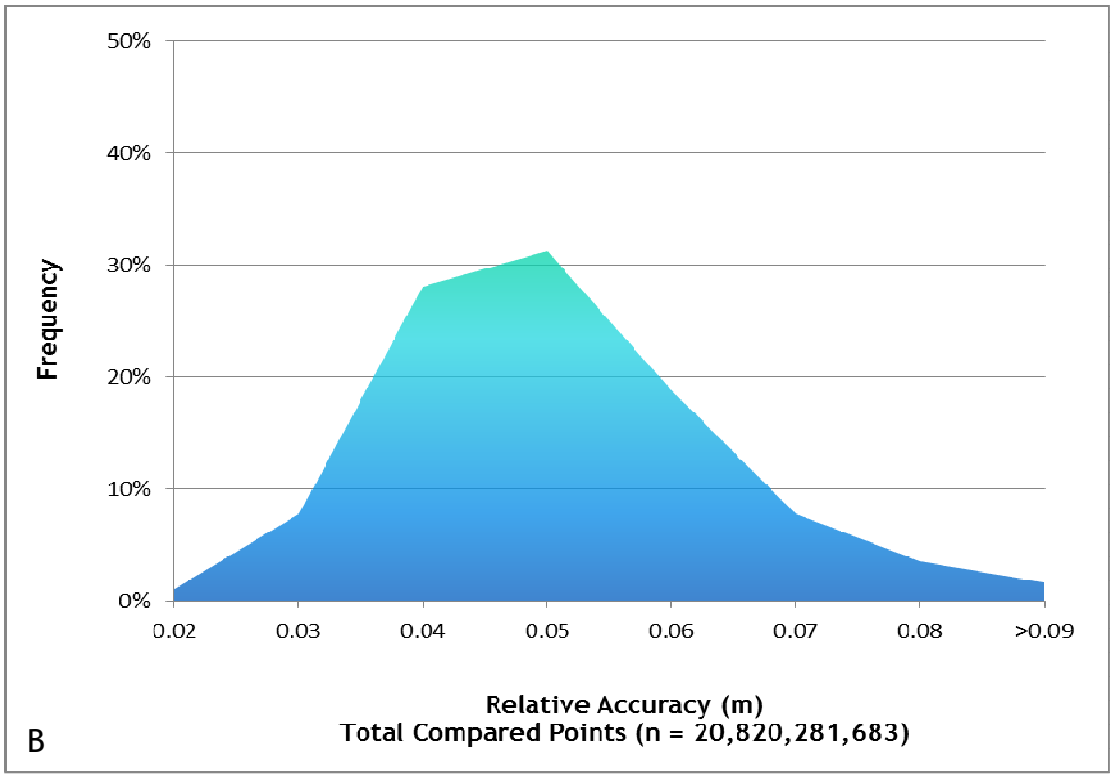
## 5.2 Relative Accuracy Calibration Results

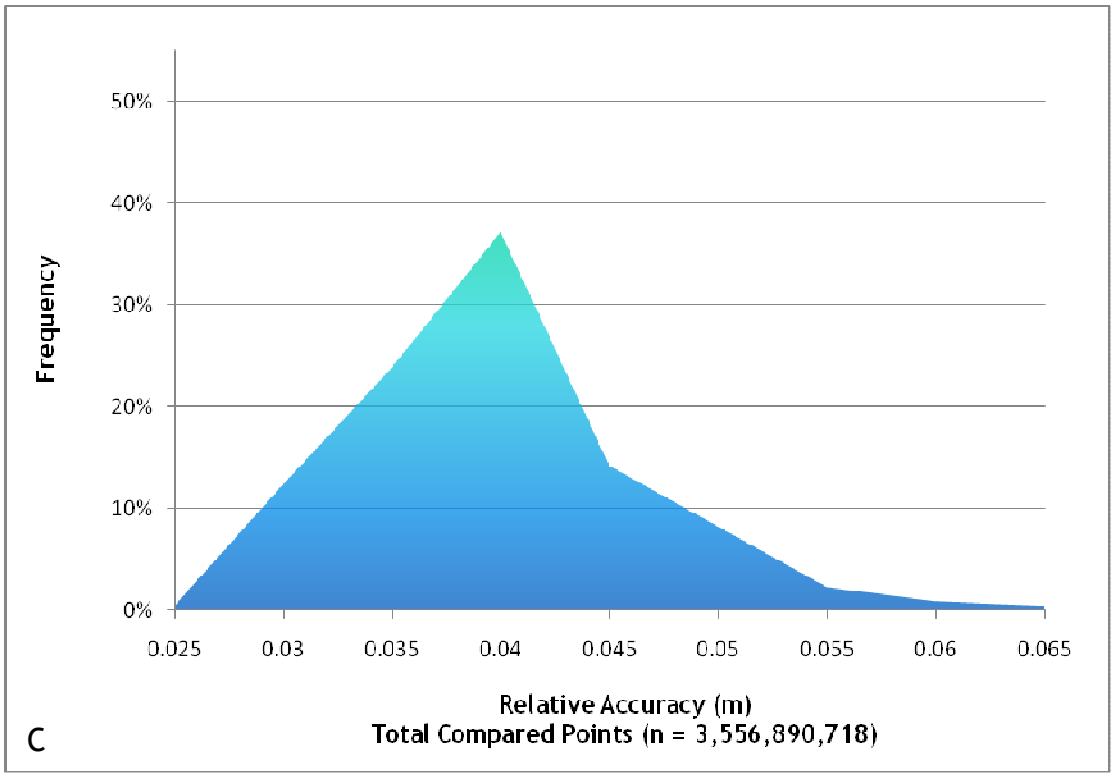
***Table 5**. Cumulative relative accuracy statistics for Alaska Pipeline deliveries to date.*

| | UTM 5 | UTM 6 | UTM 7 |
|---|---|---|---|
| Project Average | 0.039m | 0.046m | 0.037m |
| Median Relative Accuracy | 0.039m | 0.044m | 0.037m |
| 1σ Relative Accuracy | 0.010m | 0.013m | 0.006m |
| 1.96σ Relative Accuracy | 0.019m | 0.026m | 0.012m |

***Figure 22**. Distribution of cumulative relative accuracies in UTM5 (A) UTM 6 (B) and UTM 7 (C) per flight line, non slope-adjusted*




50%
40%
30%
20%
10%
0%
Frequency
0.02
0.03
0.04
0.05
0.06
0.07
0.08
>0.09
Relative Accuracy (m)
Total Compared Points (n = 20,820,281,683)
B


50%
40%
30%
20%
10%
0%
Frequency
0.025
0.03
0.035
0.04
0.045
0.05
0.055
0.06
0.065
Relative Accuracy (m)
Total Compared Points (n = 3,556,890,718)
C

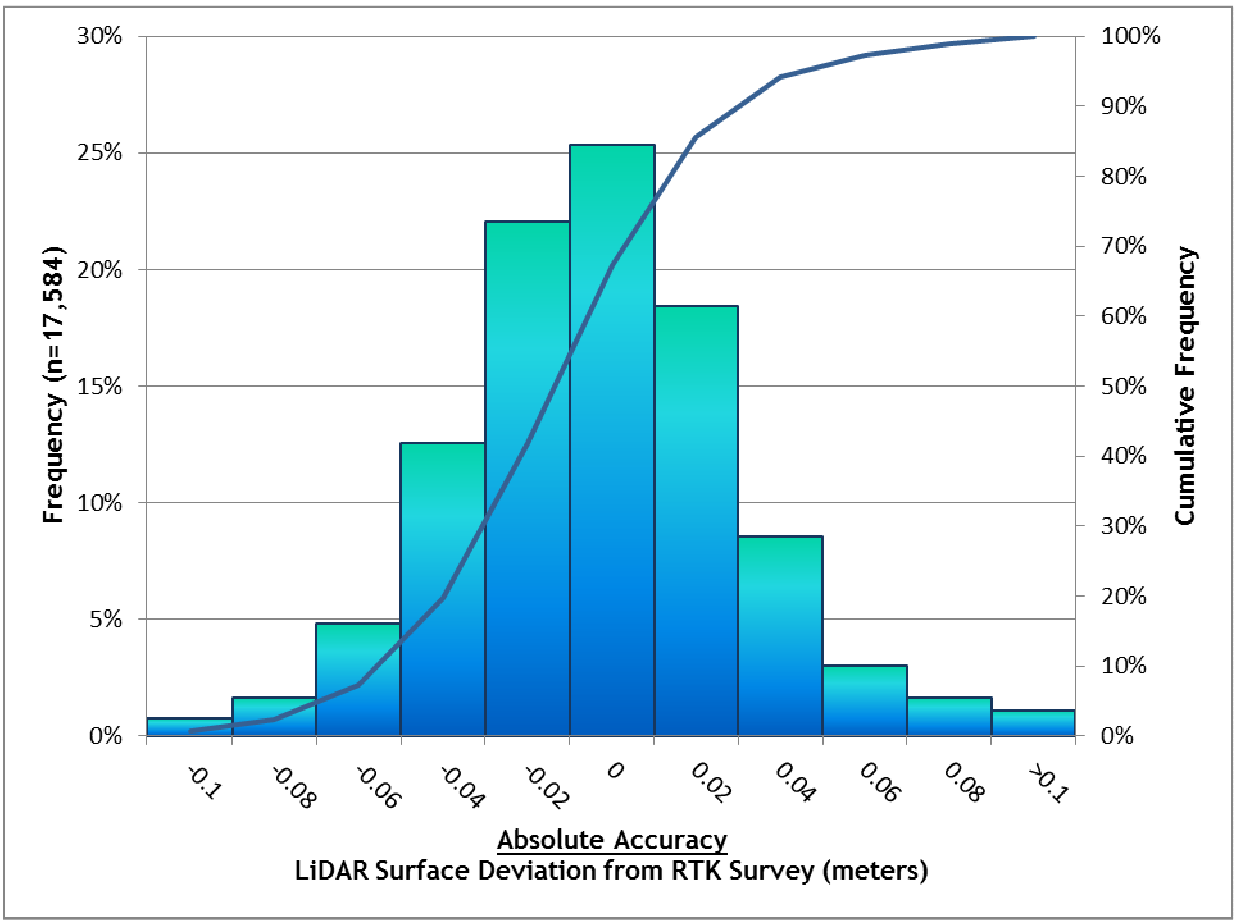
## 5.3 Absolute Accuracy

Absolute accuracies for Alaska Pipeline deliveries to date: All data was calibrated and processed in UTM 6 and then transformed to the appropriate projection.

***Table 6**. Absolute Accuracy - Deviation between laser points and RTK hard surface survey points*

| RTK Survey Sample Size (n): 17,584 | |
|---|---|
| Root Mean Square Error (RMSE): 0.036m | Minimum Δz = -0.151m |
| Standard Deviations<br>1 sigma (σ): 0.034m 1.96 sigma (σ): 0.067m | Maximum Δz = 0.122m |
| | Average Δz = -0.012m |

***Figure 23**. Absolute Accuracy - Histogram Statistics*



## 5.4 Independent Accuracy Assessment

In accordance with the project plan, McClintock Land Associates (AK PLS) collected independent (i.e. blind) check points within the survey area to provide an independent assessment of LiDAR accuracy. WSI was provided with Easting and Northing positions for points which were then assigned elevations from the LiDAR. MLA received this report and compared the LiDAR Z values to MLA's surveyed (or known) Z values.

***Table 7**. Absolute accuracy determined by the project surveyor (MLA) using "Blind" Check Points (See Appendix B for PLS report)*

| Delivery | # of Check Points | RMSE | Range |
|---|---|---|---|
| 1 | 735 | 0.062m | 0.240m |
| 2 | 1096 | 0.035m | 0.204m |
| 3 | 1088 | 0.078m | 0.182m |
| 4 | 730 | 0.039m | 0.394m |
| 5 | 2293 | 0.073m | 0.567m |
| 6 | 1510 | 0.050m | 0.730m |
| 7 | 1858 | 0.060m | 0.880m |

## 6. Projection/Datum and Units

| | | |
|---|---|---|
| | **Projection:** | UTM Zone 5, 6, 7 North |
| **Datum** | **Vertical:** | NAVD88 Geoid09 |
| | **Horizontal:** | NAD83 |
| | **Units:** | meters |

## 7. Deliverables

| | |
|---|---|
| **Point Data:** | • All Returns (LAS 1.2 format)<br>• Ground Returns (LAS 1.2 format) |
| **Vector Data:** | • Project Boundary (shapefile format)<br>• Tile Index for LiDAR Points (shapefile format)<br>• Tile Index for DEMs (shapefile format)<br>• Contours (1m shapefile format, DXF format)<br>• RTK (shapefile format, .TXT format)<br>• SBETs (shapefile format, DBF format)<br>• Lake Boundaries (shapefile format) |
| **Raster Data:** | • Elevation Models (1m resolution)<br>  • Hydro-flattened Bare Earth Model (ESRI GRID format)<br>  • Highest Hit Model (ESRI GRID format)<br>  • Vegetation Model (ESRI GRID format)<br>  • nDSM Model (ESRI GRID format)<br>• Intensity Images (GeoTIFF format, 0.5m resolution)<br>• Vegetation Metrics (5m resolution)<br>  • Canopy Cover (ESRI GRID format)<br>  • Coefficient of Variation (ESRI GRID format)<br>  • Mean Elevation (ESRI GRID format) |
| **Data Report:** | • Full report containing introduction, methodology, and accuracy |

# 8. Selected Images

***Figure 24**. Castle Mountain Fault system northeast of Flathorn Lake. Top image is bare earth model, bottom image is bare earth overlain with slope calculations.*

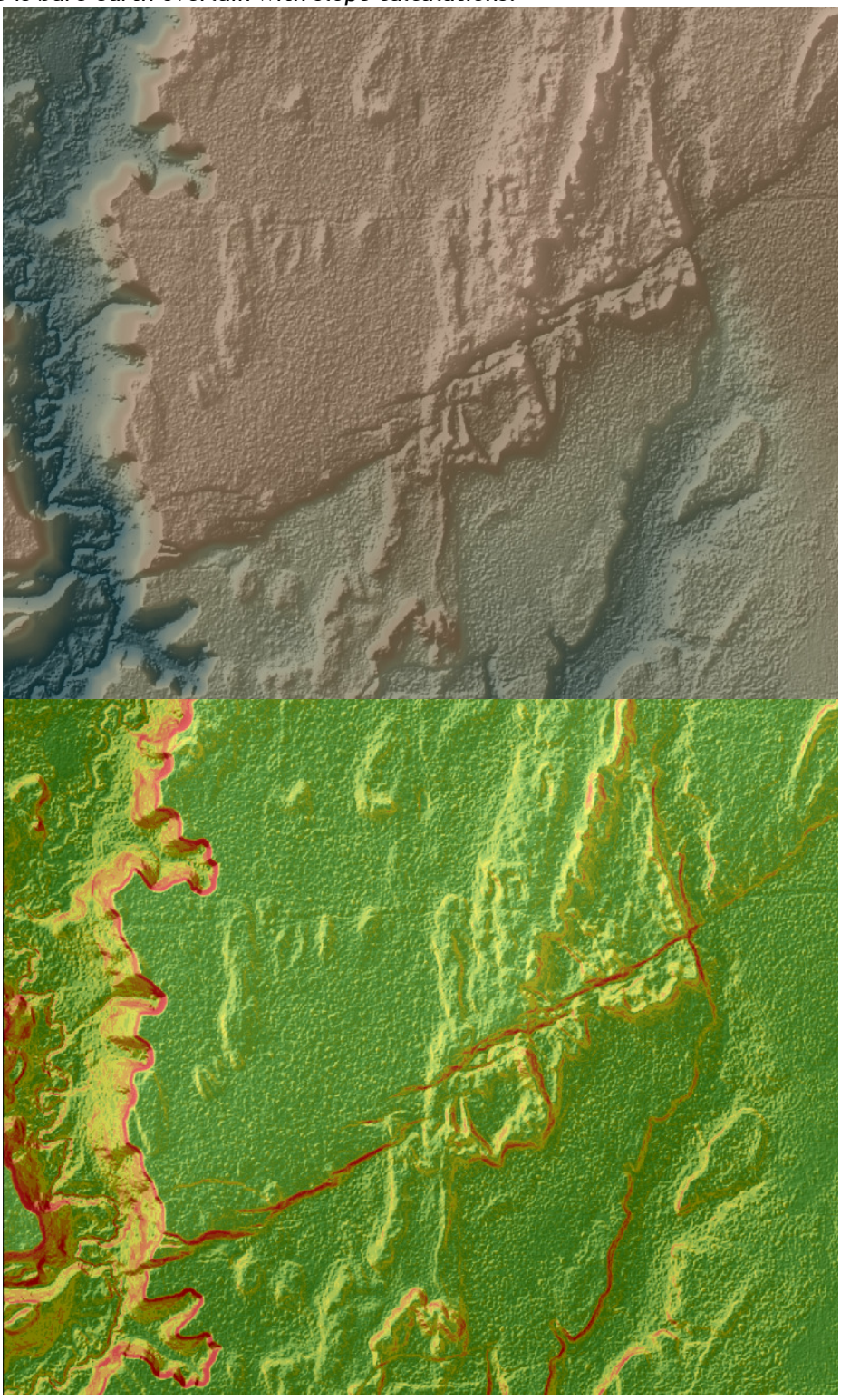


***Figure 25**. View across braided channels of the Tanana River near Dot Lake. Top image is Bare Earth model. Bottom image is LiDAR point cloud colored by elevation.*

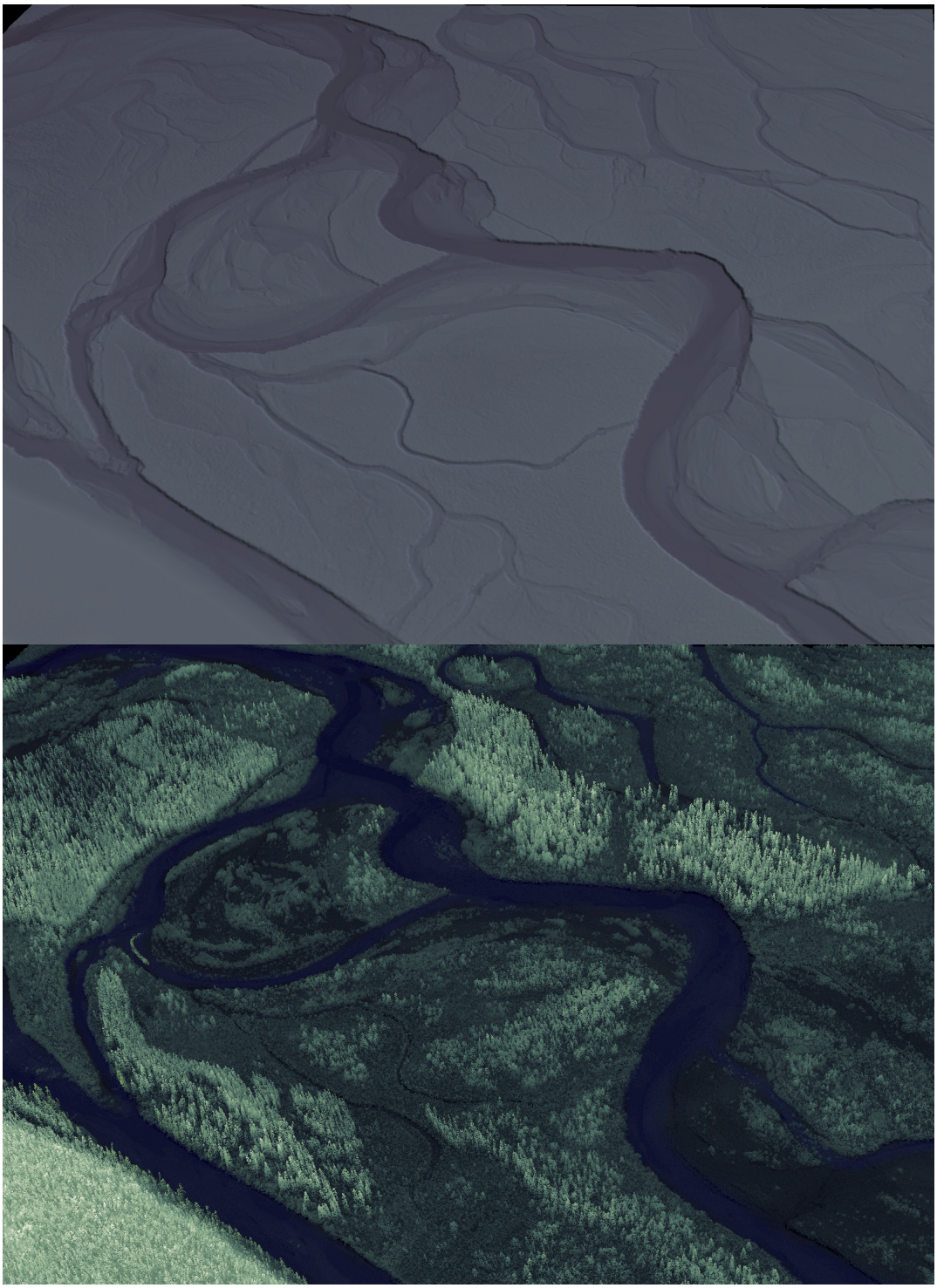


***Figure 26**. View looking north across Gerstle River along A2. Image is 3D LiDAR point cloud colored by elevation.*

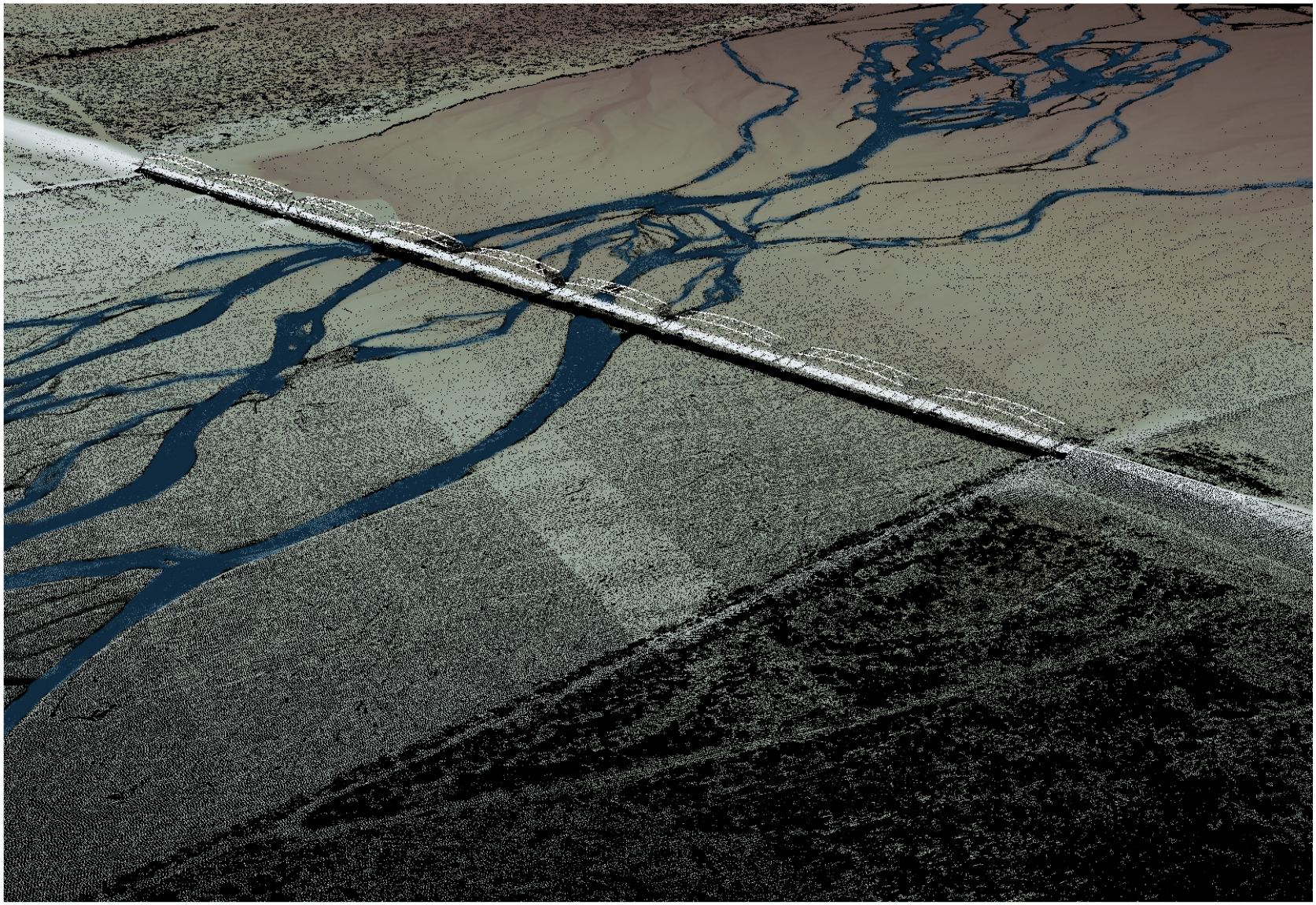


***Figure 27**. Northern end of above ground pipeline near Trims Camp along Hwy 4.*

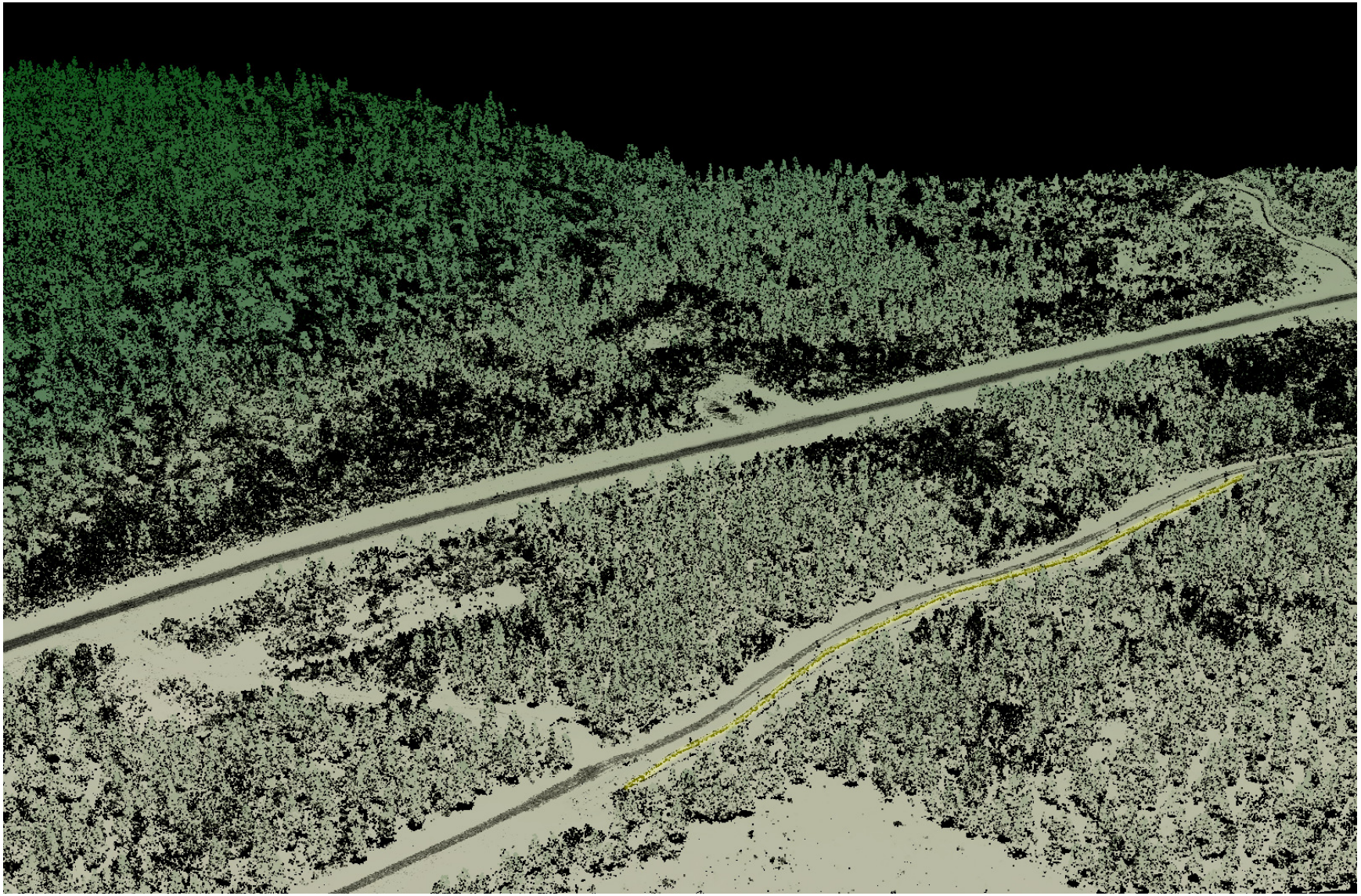


***Figure 28**. View looking North of Pipeline and Hwy 4 as they cross Miller Creek.*

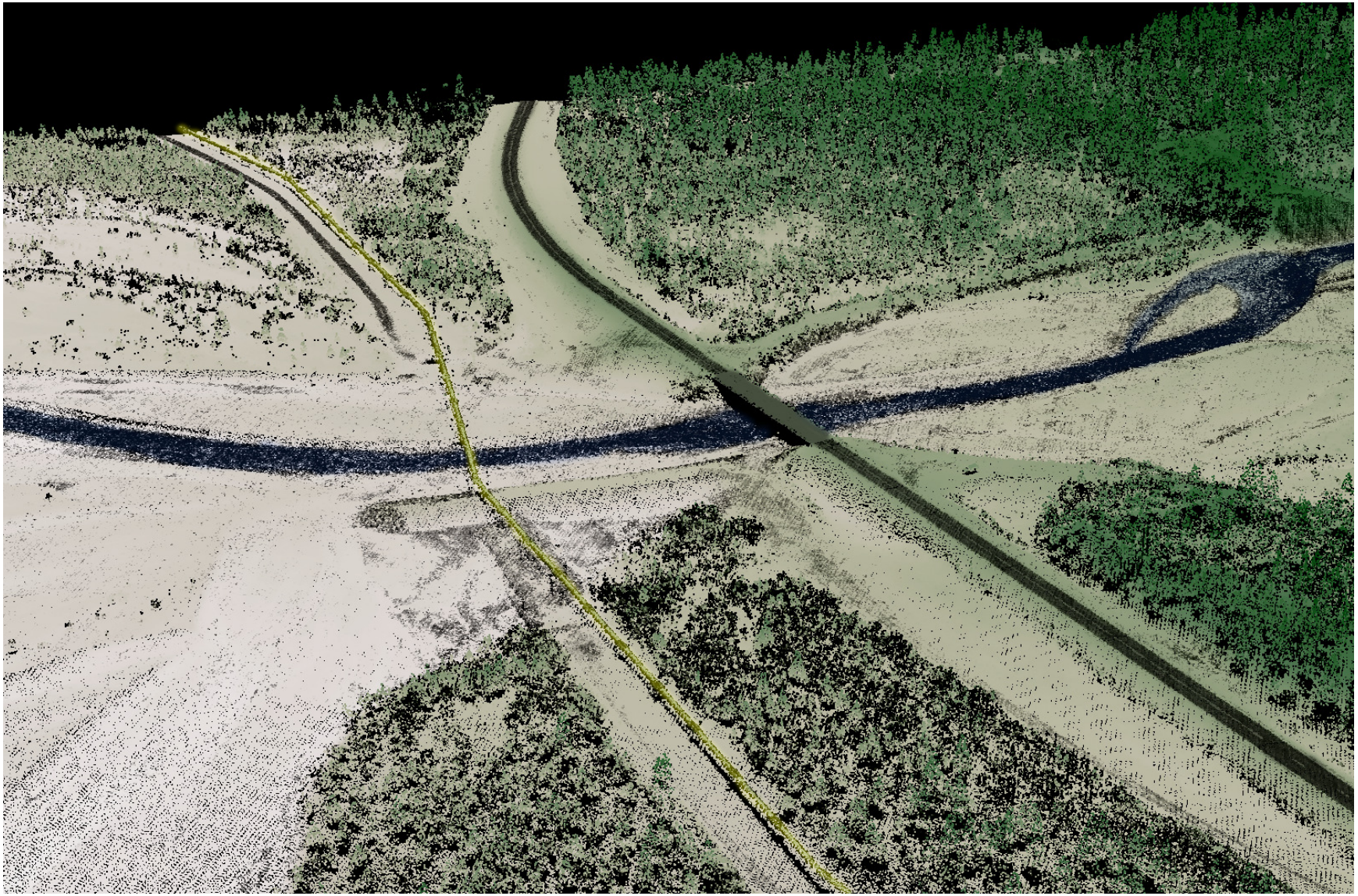


***Figure 29**. View looking Northeast across Hwy 2, just east of Tetlin Junction. Top image is Bare Earth model colored by elevation. Bottom image is Highest Hit model.*

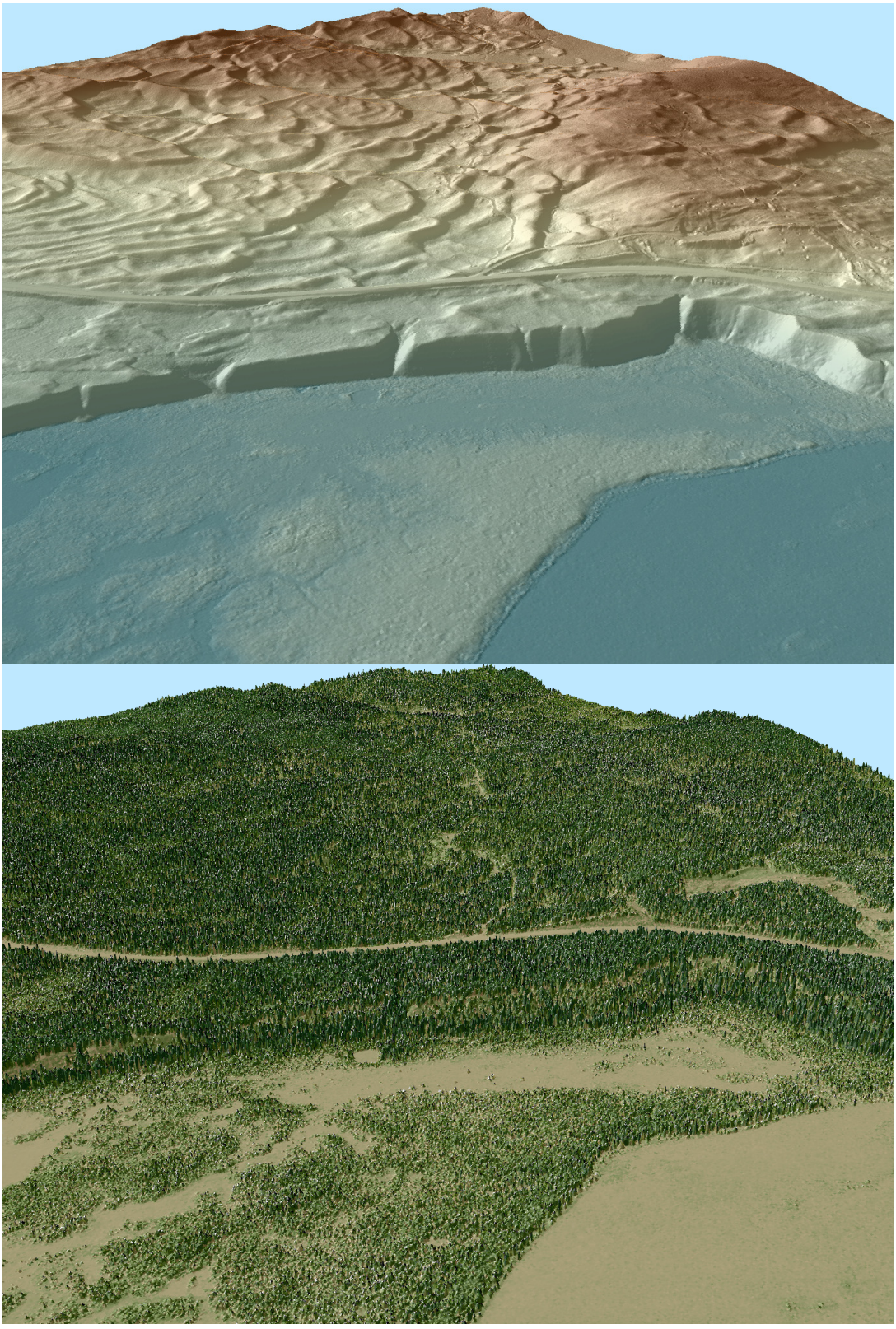


***Figure 30**. Hwy 2, west of where it crosses Gardiner River. Top image is Bare Earth model colored by elevation. Bottom image is Highest Hit model.*

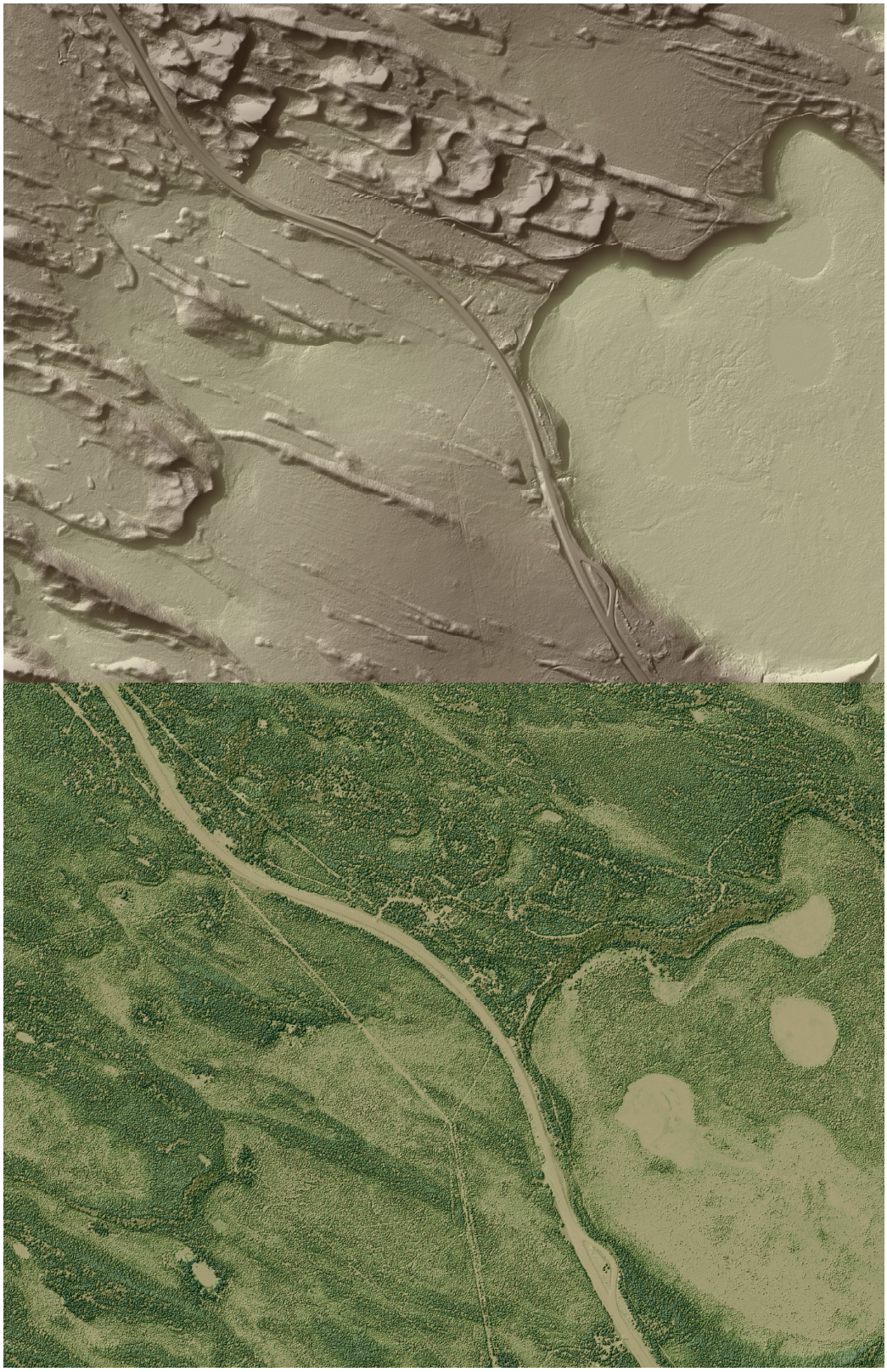
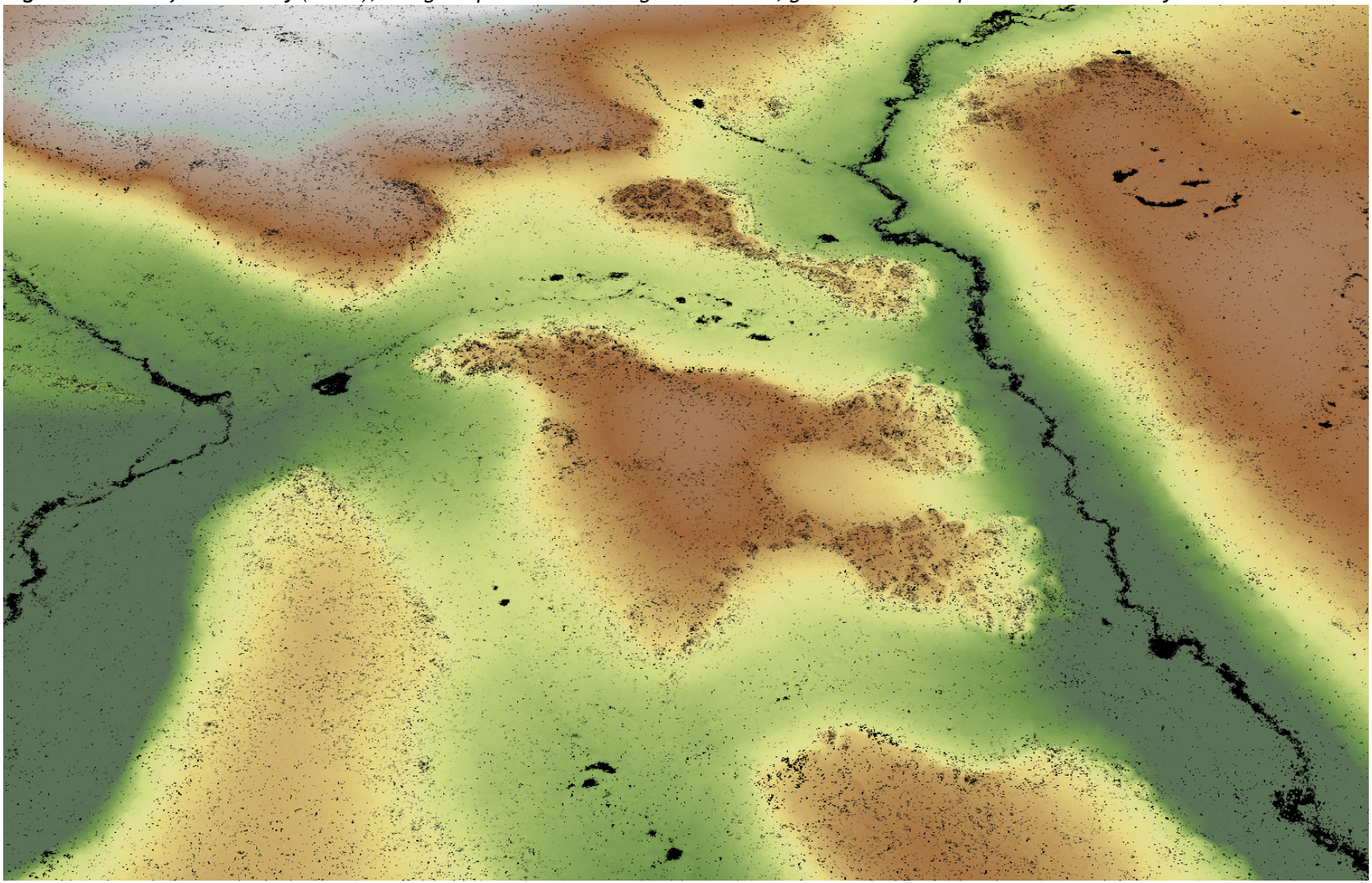


***Figure 31**. East of Dalton Hwy (SR-11), along Chapman Creek. Image is 3D LiDAR, ground classified point cloud colored by elevation.*



# 9. Glossary

**1-sigma (σ) Absolute Deviation:** Value for which the data are within one standard deviation (approximately 68$^{th}$ percentile) of a normally distributed data set.

**1.96-sigma (σ) Absolute Deviation:** Value for which the data are within two standard deviations (approximately 95$^{th}$ percentile) of a normally distributed data set.

**Root Mean Square Error (RMSE):** A statistic used to approximate the difference between real-world points and the LiDAR points. It is calculated by squaring all the values, then taking the average of the squares and taking the square root of the average.

**Pulse Rate (PR)**: The rate at which laser pulses are emitted from the sensor; typically measured as thousands of pulses per second (kHz).

**Pulse Returns**: For every laser pulse emitted, the Leica ALS 50 Phase II system can record *up to four* wave forms reflected back to the sensor. Portions of the wave form that return earliest are the highest element in multi-tiered surfaces such as vegetation. Portions of the wave form that return last are the lowest element in multi-tiered surfaces.

**Accuracy**: The statistical comparison between known (surveyed) points and laser points. Typically measured as the standard deviation (sigma, σ) and root mean square error (RMSE).

**Intensity Values**: The peak power ratio of the laser return to the emitted laser. It is a function of surface reflectivity.

**Data Density**: A common measure of LiDAR resolution, measured as points per square meter.

**Spot Spacing**: Also a measure of LiDAR resolution, measured as the average distance between laser points.

**Nadir**: A single point or locus of points on the surface of the earth directly below a sensor as it progresses along its flight line.

**Scan Angle**: The angle from nadir to the edge of the scan, measured in degrees. Laser point accuracy typically decreases as scan angles increase.

**Overlap**: The area shared between flight lines, typically measured in percents; 100% overlap is essential to ensure complete coverage and reduce laser shadows.

**DTM / DEM**: These often-interchanged terms refer to models made from laser points. The digital elevation model (DEM) refers to all surfaces, including bare ground and vegetation, while the digital terrain model (DTM) refers only to those points classified as ground.

**Real-Time Kinematic (RTK) Survey**: GPS surveying is conducted with a GPS base station deployed over a known monument with a radio connection to a GPS rover. Both the base station and rover receive differential GPS data and the baseline correction is solved between the two. This type of ground survey is accurate to 1.5 cm or less.

# 10. Citations

Soininen, A. 2004. TerraScan User's Guide. TerraSolid.

# Appendix A

**LiDAR accuracy error sources and solutions:**

| Type of Error | Source | Post Processing Solution |
|---|---|---|
| GPS (Static/Kinematic) | Long Base Lines | None |
| | Poor Satellite Constellation | None |
| | Poor Antenna Visibility | Reduce Visibility Mask |
| Relative Accuracy | Poor System Calibration | Recalibrate IMU and sensor offsets/settings |
| | Inaccurate System | None |
| Laser Noise | Poor Laser Timing | None |
| | Poor Laser Reception | None |
| | Poor Laser Power | None |
| | Irregular Laser Shape | None |

**Operational measures taken to improve relative accuracy:**

1. Low Flight Altitude: Terrain following is employed to maintain a constant above ground level (AGL). Laser horizontal errors are a function of flight altitude above ground (i.e., ~ 1/3000$^{th}$ AGL flight altitude).
2. Focus Laser Power at narrow beam footprint: A laser return must be received by the system above a power threshold to accurately record a measurement. The strength of the laser return is a function of laser emission power, laser footprint, flight altitude and the reflectivity of the target. While surface reflectivity cannot be controlled, laser power can be increased and low flight altitudes can be maintained.
3. Reduced Scan Angle: Edge-of-scan data can become inaccurate. The scan angle was reduced to a maximum of ±15$^{o}$ from nadir, creating a narrow swath width and greatly reducing laser shadows from trees and buildings.
4. Quality GPS: Flights took place during optimal GPS conditions (e.g., 6 or more satellites and PDOP [Position Dilution of Precision] less than 3.0). Before each flight, the PDOP was determined for the survey day. During all flight times, a dual frequency DGPS base station recording at 1-second epochs was utilized and a maximum baseline length between the aircraft and the control points was less than 19 km (11.5 miles) at all times.
5. Ground Survey: Ground survey point accuracy (i.e. <1.5 cm RMSE) occurs during optimal PDOP ranges and targets a minimal baseline distance of 4 miles between GPS rover and base. Robust statistics are, in part, a function of sample size (n) and distribution. Ground survey RTK points are distributed to the extent possible throughout multiple flight lines and across the survey area.
6. 50% Side-Lap (100% Overlap): Overlapping areas are optimized for relative accuracy testing. Laser shadowing is minimized to help increase target acquisition from multiple scan angles. Ideally, with a 50% side-lap, the most nadir portion of one flight line coincides with the edge (least nadir) portion of overlapping flight lines. A minimum of 50% side-lap with terrain-followed acquisition prevents data gaps.
7. Opposing Flight Lines: All overlapping flight lines are opposing. Pitch, roll and heading errors are amplified by a factor of two relative to the adjacent flight line(s), making misalignments easier to detect and resolve.

# Appendix B

# Alaska Gasline LiDAR Project
# Delivery 7

*Watershed Sciences, Inc.*
*McClintock Land Associates, Inc.*

QUALITY CONTROL REVIEW SUMMARY

| | | |
|---|---|---|
| Max. Positive Elev. Deviation: | 0.58 | meters |
| Max. Negative Elev. Deviation: | -0.29 | meters |
| Elevation Deviation Range: | 0.88 | meters |
| Elevation Deviation Mean: | 0.04 | meters |
| **Elevation Deviation RMSE** | **0.06** | **meters** |

(RMSE = Root Mean Square Error)

| | |
|---|---|
| Number of Check Points Used: | 1858.00 |
| Number of Check Points Excluded | 0.00 |
| Total Number of Check Points: | 1858.00 |

| CHECK POINTS | | | SURVEYED Elevation | | LiDAR Elevation | Deviation |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | DESCRIPTOR | (Meters) | (Meters) |
| 215 | 6983080.812 | 365221.296 | 500.21 | CP-48A | 500.22 | -0.01 |
| 216 | 6988332.074 | 367912.833 | 583.814 | CP-48B | 583.78 | 0.03 |
| 217 | 7007159.597 | 380015.278 | 639.554 | CP-49A | 639.53 | 0.02 |
| 218 | 7008813.467 | 381241.877 | 639.876 | CP-49B | 639.79 | 0.09 |
| 219 | 7030025.787 | 404610.534 | 655.922 | 50 A | 655.94 | -0.02 |
| 220 | 7034576.202 | 406310.819 | 635.155 | CP-50B | 635.22 | -0.07 |
| 221 | 7068072.801 | 406787.558 | 485.033 | CP-51 A | 485.05 | -0.02 |
| 222 | 7069254.473 | 406803.331 | 473.937 | CP-51 B | 473.87 | 0.07 |
| 223 | 7082146.99 | 401137.89 | 513.62 | CP-51 C | 513.55 | 0.07 |
| 224 | 7070071.827 | 386899.817 | 788.806 | 52 A | 788.76 | 0.05 |
| 225 | 7067220.458 | 389041.918 | 841.051 | 52 B | 841.09 | -0.04 |
| 226 | 7067217.619 | 388656.43 | 838.37 | 52C | 838.36 | 0.01 |
| 227 | 7102966.067 | 394763.079 | 342.643 | CP-53 A | 342.78 | -0.14 |
| 228 | 7104244.898 | 393788.082 | 345.148 | CP-53 B | 345.13 | 0.02 |
| 229 | 7141936.225 | 402900.47 | 141.079 | CP-54 A | 141.12 | -0.04 |
| 230 | 7143903.722 | 402775.413 | 138.164 | CP-54 B | 138.16 | 0.00 |
| 231 | 7123411.791 | 390206.243 | 228.458 | CP-54 C | 228.46 | 0.00 |
| 232 | 7134888.04 | 401583.522 | 160.058 | CP-54 D | 160.01 | 0.05 |
| 233 | 7141850.863 | 402880.531 | 141.046 | CP-54 G | 141.08 | -0.03 |
| 234 | 7172938.471 | 407688.334 | 129.417 | CP-55 A | 129.43 | -0.01 |
| 236 | 7187835.539 | 432154.915 | 127.673 | CP-56 A | 127.46 | 0.21 |
| 237 | 7187937.779 | 432425.543 | 128.996 | CP-56 B | 128.95 | 0.05 |
| 240 | 7198499.597 | 455109.038 | 175.644 | CP-58 A | 175.62 | 0.02 |
| 241 | 7199030.23 | 455418.244 | 173.791 | CP 58 B | 173.85 | -0.06 |
| 8900 | 7008813.467 | 381241.877 | 639.881 | 49B2011051549BSAC | 639.79 | 0.09 |
| 8901 | 7008814.531 | 381216.083 | 639.342 | 49B20110515SPR | 639.27 | 0.07 |
| 8902 | 7008829.687 | 381229.319 | 639.464 | 49B20110515SPR | 639.41 | 0.05 |
| 8903 | 7008842.224 | 381240.001 | 639.586 | 49B20110515SPR | 639.54 | 0.05 |
| 8904 | 7008455.494 | 380923.978 | 637.748 | 49B20110515SPR | 637.7 | 0.05 |
| 8905 | 7008439.987 | 380913.978 | 637.786 | 49B20110515SPR | 637.74 | 0.05 |
| 8906 | 7008424.424 | 380904.484 | 637.828 | 49B20110515SPR | 637.76 | 0.07 |
| 8907 | 7007908.065 | 380630.606 | 638.43 | 49B20110515SPR | 638.37 | 0.06 |
| 8908 | 7007892.55 | 380620.494 | 638.398 | 49B20110515SPR | 638.34 | 0.06 |
| 8909 | 7007875.062 | 380607.811 | 638.287 | 49B20110515SPR | 638.26 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 8910 | 7007422.578 | 380262.206 | 641.013 | 49B20110515SPR | 640.97 | 0.04 |
| 8911 | 7007407.518 | 380250.898 | 640.956 | 49B20110515SPR | 640.91 | 0.05 |
| 8912 | 7007394.988 | 380240.783 | 640.903 | 49B20110515SPR | 640.85 | 0.05 |
| 8913 | 7007155.297 | 380019.026 | 639.648 | 49B20110515SPR | 639.62 | 0.03 |
| 8914 | 7007140.753 | 380008.246 | 639.393 | 49B20110515SPR | 639.33 | 0.06 |
| 8915 | 7007124.889 | 380001.314 | 638.992 | 49B20110515SPR | 638.91 | 0.08 |
| 8916 | 7007156.777 | 380014.064 | 639.528 | 49B20110515SSP | 639.48 | 0.05 |
| 8917 | 7006604.421 | 379737.866 | 626.433 | 49B20110515SPR | 626.37 | 0.06 |
| 8918 | 7006588.611 | 379732.896 | 626.006 | 49B20110515SPR | 625.95 | 0.06 |
| 8919 | 7006571.058 | 379726.337 | 625.454 | 49B20110515SPR | 625.4 | 0.05 |
| 8920 | 7009289.541 | 381621.143 | 641.527 | 49B20110515SPR | 641.46 | 0.07 |
| 8921 | 7009308.462 | 381637.69 | 641.416 | 49B20110515SPR | 641.36 | 0.06 |
| 8922 | 7009322.729 | 381649.715 | 641.368 | 49B20110515SPR | 641.29 | 0.08 |
| 8923 | 7009701.777 | 382006.513 | 640.838 | 49B20110515SPR | 640.8 | 0.04 |
| 8924 | 7009713.219 | 382019.141 | 640.762 | 49B20110515SPR | 640.76 | 0.00 |
| 8925 | 7009726.189 | 382033.213 | 640.748 | 49B20110515SPR | 640.69 | 0.06 |
| 8926 | 7010116.132 | 382452.802 | 639.427 | 49B20110515SPR | 639.38 | 0.05 |
| 8927 | 7010127.749 | 382465.353 | 639.557 | 49B20110515SPR | 639.5 | 0.06 |
| 8928 | 7010139.205 | 382477.811 | 639.602 | 49B20110515SPR | 639.52 | 0.08 |
| 8929 | 7010395.883 | 382753.221 | 640.245 | 49B20110515SPR | 640.19 | 0.05 |
| 8930 | 7010408.375 | 382765.105 | 639.956 | 49B20110515SPR | 639.91 | 0.05 |
| 8931 | 7010422.357 | 382777.581 | 639.575 | 49B20110515SPR | 639.54 | 0.04 |
| 8932 | 7010959.38 | 383241.889 | 635.978 | 49B20110515SPR | 635.93 | 0.05 |
| 8933 | 7010970.551 | 383256.906 | 636.62 | 49B20110515SPR | 636.6 | 0.02 |
| 8934 | 7010980.964 | 383271.531 | 637.121 | 49B20110515SPR | 637.1 | 0.02 |
| 8935 | 7011421.362 | 383869.903 | 643.291 | 49B20110515SPR | 643.26 | 0.03 |
| 8936 | 7011434.124 | 383887.553 | 643.508 | 49B20110515SPR | 643.48 | 0.03 |
| 8937 | 7011445.078 | 383902.025 | 643.675 | 49B20110515SPR | 643.65 | 0.02 |
| 8938 | 7011821.309 | 384405.798 | 649.335 | 49B20110515SPR | 649.31 | 0.03 |
| 8939 | 7011834.633 | 384420.984 | 649.502 | 49B20110515SPR | 649.47 | 0.03 |
| 8940 | 7011847.658 | 384435.546 | 649.642 | 49B20110515SPR | 649.61 | 0.03 |
| 8941 | 7012259.897 | 384890.949 | 658.407 | 49B20110515SPR | 658.37 | 0.04 |
| 8942 | 7012272.143 | 384904.628 | 658.657 | 49B20110515SPR | 658.63 | 0.03 |
| 8943 | 7012284.892 | 384918.441 | 658.915 | 49B20110515SPR | 658.88 | 0.03 |
| 8944 | 7012729.329 | 385342.512 | 655.584 | 49B20110515SPR | 655.56 | 0.02 |
| 8945 | 7012745.321 | 385356.484 | 655.247 | 49B20110515SPR | 655.23 | 0.02 |
| 8946 | 7012764.014 | 385366.897 | 654.865 | 49B20110515SPR | 654.85 | 0.01 |
| 8947 | 7008816.309 | 381242.94 | 639.763 | 49B20110515SSP | 639.73 | 0.03 |
| 11111 | 7207204.443 | 421516.462 | 103.865 | 57B20110525SGR | 103.83 | 0.03 |
| 11112 | 7207188.668 | 421530.412 | 103.928 | 57B20110525SGR | 103.87 | 0.06 |
| 11113 | 7207181.931 | 421551.266 | 103.705 | 57B20110525SGR | 103.66 | 0.05 |
| 11114 | 7207176.349 | 421569.812 | 103.911 | 57B20110525SGR | 103.84 | 0.07 |
| 11115 | 7207172.506 | 421589.429 | 104.022 | 57B20110525SGR | 103.98 | 0.04 |
| 11116 | 7207167.718 | 421607.364 | 103.729 | 57B20110525SGR | 103.68 | 0.05 |
| 11117 | 7207163.557 | 421630.508 | 103.727 | 57B20110525SGR | 103.66 | 0.07 |
| 11118 | 7207155.549 | 421659.038 | 103.888 | 57B20110525SGR | 103.86 | 0.03 |
| 14200 | 7172422.451 | 406985.237 | 119.507 | 55B2011051755BSAC | 119.51 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14201 | 7172414.169 | 406996.909 | 121.482 | 55B20110517SPR | 121.46 | 0.02 |
| 14202 | 7172424.921 | 407009.513 | 121.32 | 55B20110517SPR | 121.32 | 0.00 |
| 14203 | 7172437.763 | 407024.774 | 121.132 | 55B20110517SPR | 121.11 | 0.02 |
| 14204 | 7172449.633 | 407038.513 | 120.988 | 55B20110517SPR | 120.96 | 0.03 |
| 14205 | 7172120.764 | 406657.992 | 134.247 | 55B20110517SPR | 134.21 | 0.04 |
| 14206 | 7172108.497 | 406643.957 | 134.433 | 55B20110517SPR | 134.42 | 0.01 |
| 14207 | 7172095.452 | 406628.695 | 134.665 | 55B20110517SPR | 134.66 | 0.00 |
| 14208 | 7171758.612 | 406239.368 | 141.175 | 55B20110517SPR | 141.13 | 0.05 |
| 14209 | 7171747.063 | 406226.524 | 141.391 | 55B20110517SPR | 141.36 | 0.03 |
| 14210 | 7171735.682 | 406213.462 | 141.615 | 55B20110517SPR | 141.57 | 0.05 |
| 14211 | 7171392.935 | 405817.428 | 151.743 | 55B20110517SPR | 151.68 | 0.06 |
| 14212 | 7171381.308 | 405803.27 | 152.556 | 55B20110517SPR | 152.52 | 0.04 |
| 14213 | 7171369.764 | 405790.896 | 153.399 | 55B20110517SPR | 153.32 | 0.08 |
| 14214 | 7171005.373 | 405369.485 | 175.839 | 55B20110517SPR | 175.77 | 0.07 |
| 14215 | 7170991.398 | 405352.874 | 175.929 | 55B20110517SPR | 175.87 | 0.06 |
| 14216 | 7170979.813 | 405339.567 | 175.943 | 55B20110517SPR | 175.88 | 0.06 |
| 14217 | 7172615.158 | 407236.201 | 120.921 | 55B20110517SPR | 120.88 | 0.04 |
| 14218 | 7172627.334 | 407250.559 | 121.048 | 55B20110517SPR | 121.04 | 0.01 |
| 14219 | 7172639.465 | 407264.627 | 121.115 | 55B20110517SPR | 121.09 | 0.02 |
| 14220 | 7172937.588 | 407691.244 | 129.283 | 55B20110517SSP | 129.31 | -0.03 |
| 14221 | 7172930.083 | 407692.77 | 129.668 | 55B20110517SPR | 129.65 | 0.02 |
| 14222 | 7172925.446 | 407674.849 | 129.158 | 55B20110517SPR | 129.16 | 0.00 |
| 14223 | 7172920.381 | 407657.13 | 128.706 | 55B20110517SPR | 128.69 | 0.02 |
| 14234 | 7172425.47 | 406985.864 | 119.539 | 55B20110517SSP | 119.52 | 0.02 |
| 14235 | 7172425.428 | 406985.882 | 119.53 | 55B20110517SSP | 119.52 | 0.01 |
| 14301 | 6983080.833 | 365221.294 | 500.17 | 48AFAC | 500.23 | -0.06 |
| 14302 | 6970307.85 | 352535.096 | 410.113 | 47A20110616STATS | 410.09 | 0.02 |
| 14303 | 6972377.207 | 353548.379 | 378.02 | 47A20110616STATS | 378.03 | -0.01 |
| 14304 | 6973814.157 | 354272.098 | 366.423 | 47A20110616STATS | 366.44 | -0.02 |
| 14305 | 6974767.854 | 355648.014 | 377.139 | 47A20110616STATS | 377.17 | -0.03 |
| 14306 | 6975043.711 | 357212.172 | 357.149 | 47A20110616STATS | 357.12 | 0.03 |
| 14310 | 6966515.513 | 347549.841 | 377.055 | 47A20110616STATS | 377.12 | -0.06 |
| 14311 | 6967560.496 | 348982.094 | 391.821 | 47A20110616STATS | 391.78 | 0.04 |
| 14312 | 6968288.231 | 350019.483 | 402.447 | 47A20110616STATS | 402.39 | 0.06 |
| 14313 | 6969235.814 | 351515.49 | 425.971 | 47A20110616STATS | 425.95 | 0.02 |
| 14314 | 6968273.891 | 350005.171 | 402.373 | 47A20110616STATS | 402.32 | 0.05 |
| 14315 | 6969239.705 | 351508.205 | 426.18 | 47A20110616STATS | 426.2 | -0.02 |
| 14316 | 6970288.988 | 352525.372 | 410.397 | 47A20110616STATS | 410.38 | 0.02 |
| 14317 | 6972358.179 | 353544.614 | 377.942 | 47A20110616STATS | 377.91 | 0.03 |
| 14318 | 6973821.269 | 354296.293 | 366.42 | 47A20110616STATS | 366.46 | -0.04 |
| 14319 | 6974753.52 | 355638.413 | 377.039 | 47A20110616STATS | 377.08 | -0.04 |
| 14320 | 6975050.902 | 357202.178 | 357.105 | 47A20110616STATS | 357.12 | -0.01 |
| 14324 | 6966500.566 | 347529.992 | 376.832 | 47A20110616STATS | 376.77 | 0.06 |
| 14325 | 6967559.096 | 348973.67 | 391.92 | 47A20110616STATS | 391.91 | 0.01 |
| 14326 | 6969245.591 | 351518.575 | 426.283 | 47A20110616STATS | 426.27 | 0.01 |
| 14327 | 6970320.023 | 352541.445 | 410.019 | 47A20110616STATS | 409.97 | 0.05 |
| 14328 | 6972389.433 | 353550.715 | 378.071 | 47A20110616STATS | 378.09 | -0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14329 | 6973819.446 | 354284.372 | 366.498 | 47A20110616STATS | 366.52 | -0.02 |
| 14330 | 6974779.096 | 355655.508 | 377.223 | 47A20110616STATS | 377.24 | -0.02 |
| 14331 | 6975054.962 | 357219.326 | 357.032 | 47A20110616STATS | 357.02 | 0.01 |
| 14335 | 6966523.611 | 347560.991 | 377.21 | 47A20110616STATS | 377.29 | -0.08 |
| 14336 | 6967568.038 | 348988.416 | 392.023 | 47A20110616STATS | 392.02 | 0.00 |
| 14337 | 6968298.122 | 350029.156 | 402.639 | 47A20110616STATS | 402.59 | 0.05 |
| 14400 | 7008813.467 | 381241.877 | 639.876 | 49B2011061849BFAC | 639.79 | 0.09 |
| 14401 | 7015303.302 | 386970.592 | 667.523 | 49B20110618RR_XING | 667.51 | 0.01 |
| 14402 | 7016001.519 | 386689.46 | 685.022 | 49B20110618SPR | 684.98 | 0.04 |
| 14403 | 7016013.181 | 386692.714 | 685.414 | 49B20110618SPR | 685.37 | 0.04 |
| 14404 | 7016022.434 | 386704.761 | 685.487 | 49B20110618SPR | 685.47 | 0.02 |
| 14405 | 7016037.27 | 386711.022 | 685.825 | 49B20110618SPR | 685.77 | 0.06 |
| 14406 | 7016543.539 | 387107.798 | 689.857 | 49B20110618SPR | 689.83 | 0.03 |
| 14407 | 7016560.125 | 387115.944 | 690.051 | 49B20110618SPR | 690.03 | 0.02 |
| 14408 | 7016569.275 | 387127.42 | 690.131 | 49B20110618SPR | 690.12 | 0.01 |
| 14409 | 7016581.388 | 387132.187 | 690.233 | 49B20110618SPR | 690.23 | 0.00 |
| 14410 | 7016910.354 | 387402.879 | 693.285 | 49B20110618SPR | 693.26 | 0.02 |
| 14411 | 7016922.577 | 387409.324 | 693.49 | 49B20110618SPR | 693.47 | 0.02 |
| 14412 | 7016931.294 | 387422.664 | 693.499 | 49B20110618SPR | 693.48 | 0.02 |
| 14413 | 7016943.068 | 387429.06 | 693.737 | 49B20110618SPR | 693.69 | 0.05 |
| 14414 | 7017195.94 | 387692.153 | 696.221 | 49B20110618SPR | 696.16 | 0.06 |
| 14415 | 7017191.463 | 387673.774 | 696.319 | 49B20110618SPR | 696.27 | 0.05 |
| 14416 | 7017180.501 | 387657.903 | 696.14 | 49B20110618SPR | 696.14 | 0.00 |
| 14417 | 7017272.927 | 387747.768 | 697.096 | 49B20110618SPR | 697.07 | 0.03 |
| 14418 | 7017258.225 | 387738.443 | 696.99 | 49B20110618SPR | 696.96 | 0.03 |
| 14419 | 7017245.406 | 387740.854 | 696.714 | 49B20110618SPR | 696.68 | 0.03 |
| 14420 | 7017672.211 | 388139.516 | 699.002 | 49B20110618SPR | 698.96 | 0.04 |
| 14421 | 7017684.401 | 388146.098 | 699.122 | 49B20110618SPR | 699.07 | 0.05 |
| 14422 | 7017691.491 | 388157.963 | 699.204 | 49B20110618SPR | 699.17 | 0.03 |
| 14423 | 7017706.872 | 388167.705 | 699.331 | 49B20110618SPR | 699.28 | 0.05 |
| 14424 | 7018224.432 | 388555.42 | 706.882 | 49B20110618SPR | 706.9 | -0.02 |
| 14425 | 7018240.957 | 388558.863 | 707.251 | 49B20110618SPR | 707.24 | 0.01 |
| 14426 | 7018256.642 | 388571.056 | 707.721 | 49B20110618SPR | 707.71 | 0.01 |
| 14427 | 7018269.691 | 388573.065 | 708.035 | 49B20110618SPR | 707.98 | 0.05 |
| 14428 | 7018731.111 | 388801.021 | 713.696 | 49B20110618SPR | 713.64 | 0.06 |
| 14429 | 7018747.825 | 388804.213 | 713.821 | 49B20110618SPR | 713.82 | 0.00 |
| 14430 | 7018758.625 | 388814.362 | 713.924 | 49B20110618SPR | 713.89 | 0.03 |
| 14431 | 7018772.169 | 388816.082 | 713.972 | 49B20110618SPR | 713.96 | 0.01 |
| 14432 | 7019457.882 | 389001.309 | 717.917 | 49B20110618SPR | 717.9 | 0.02 |
| 14433 | 7019474.05 | 388995.066 | 717.947 | 49B20110618SPR | 717.92 | 0.03 |
| 14434 | 7019487.738 | 388996.886 | 717.981 | 49B20110618SPR | 717.97 | 0.01 |
| 14435 | 7019507.058 | 388990.441 | 718.07 | 49B20110618SPR | 718.02 | 0.05 |
| 14436 | 7020048.666 | 389118.336 | 723.548 | 49B20110618SPR | 723.55 | 0.00 |
| 14437 | 7020063.384 | 389124.112 | 723.706 | 49B20110618SPR | 723.7 | 0.01 |
| 14438 | 7020072.096 | 389134.871 | 723.791 | 49B20110618SPR | 723.79 | 0.00 |
| 14439 | 7020084.947 | 389139.735 | 723.926 | 49B20110618SPR | 723.91 | 0.02 |
| 14440 | 7020475.312 | 389429.3 | 726.161 | 49B20110618SPR | 726.13 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14441 | 7020490.592 | 389435.619 | 726.218 | 49B20110618SPR | 726.18 | 0.04 |
| 14442 | 7020499.861 | 389446.587 | 726.242 | 49B20110618SPR | 726.22 | 0.02 |
| 14443 | 7020513.373 | 389452.243 | 726.314 | 49B20110618SPR | 726.3 | 0.01 |
| 14444 | 7021005.762 | 389938.76 | 730.471 | 49B20110618SPR | 730.44 | 0.03 |
| 14445 | 7021020.866 | 389950.75 | 730.619 | 49B20110618SPR | 730.59 | 0.03 |
| 14446 | 7021031.231 | 389969.492 | 730.814 | 49B20110618SPR | 730.79 | 0.02 |
| 14447 | 7021044.409 | 389979.334 | 730.938 | 49B20110618SPR | 730.92 | 0.02 |
| 14448 | 7021350.41 | 390353.575 | 736.262 | 49B20110618SPR | 736.24 | 0.02 |
| 14449 | 7021366.327 | 390366.668 | 736.358 | 49B20110618SPR | 736.33 | 0.03 |
| 14450 | 7021374.814 | 390382.728 | 736.455 | 49B20110618SPR | 736.46 | 0.00 |
| 14451 | 7021387.126 | 390391.964 | 736.534 | 49B20110618SPR | 736.5 | 0.03 |
| 14452 | 7021710.732 | 390787.496 | 737.097 | 49B20110618SPR | 737.09 | 0.01 |
| 14453 | 7021722.614 | 390796.017 | 736.987 | 49B20110618SPR | 736.98 | 0.01 |
| 14454 | 7021727.845 | 390808.388 | 736.896 | 49B20110618SPR | 736.88 | 0.02 |
| 14455 | 7021738.858 | 390816.489 | 736.808 | 49B20110618SPR | 736.79 | 0.02 |
| 14456 | 7022077.457 | 391247.777 | 731.613 | 49B20110618SPR | 731.61 | 0.00 |
| 14457 | 7022091.651 | 391261.774 | 731.621 | 49B20110618SPR | 731.62 | 0.00 |
| 14458 | 7022097.138 | 391275.23 | 731.521 | 49B20110618SPR | 731.53 | -0.01 |
| 14459 | 7022074.057 | 391236.65 | 731.758 | 49B20110618SPR | 731.73 | 0.03 |
| 14460 | 7022063.995 | 391227.984 | 731.735 | 49B20110618SPR | 731.73 | 0.00 |
| 14461 | 7008816.301 | 381242.935 | 639.775 | 49B20110618CK_SPIKE | 639.73 | 0.04 |
| 14500 | 7008813.467 | 381241.877 | 639.876 | 49B2011061849BFAC | 639.79 | 0.09 |
| 14501 | 7019515.498 | 389000.128 | 717.374 | 49B20110618 | 717.55 | -0.18 |
| 14502 | 7030025.796 | 404610.536 | 655.939 | 49B20110618FAC | 655.94 | 0.00 |
| 14503 | 7015303.295 | 386970.585 | 667.535 | 49B20110618 | 667.51 | 0.02 |
| 14504 | 7022079.766 | 391256.744 | 731.468 | 49B20110618 | 731.45 | 0.02 |
| 14505 | 7017245.405 | 387740.856 | 696.702 | 49B20110618 | 696.68 | 0.02 |
| 14600 | 7030025.787 | 404610.534 | 655.922 | 50A2011061850AFAC | 655.94 | -0.02 |
| 14601 | 7022095.47 | 391273.055 | 731.551 | 50A20110618SPR | 731.53 | 0.02 |
| 14602 | 7022107.149 | 391283.98 | 731.514 | 50A20110618SPR | 731.51 | 0.00 |
| 14603 | 7022113.29 | 391299.172 | 731.403 | 50A20110618SPR | 731.41 | -0.01 |
| 14604 | 7022079.769 | 391256.739 | 731.483 | 50A20110618SPR | 731.45 | 0.03 |
| 14605 | 7022360.339 | 391655.757 | 729.161 | 50A20110618SPR | 729.12 | 0.04 |
| 14606 | 7022373.72 | 391666.943 | 728.849 | 50A20110618SPR | 728.8 | 0.05 |
| 14607 | 7022378.006 | 391680.94 | 728.592 | 50A20110618SPR | 728.55 | 0.04 |
| 14608 | 7022392.532 | 391694.366 | 728.224 | 50A20110618SPR | 728.17 | 0.05 |
| 14609 | 7022674.928 | 392107.847 | 729.919 | 50A20110618SPR | 729.93 | -0.01 |
| 14610 | 7022683.021 | 392112.701 | 729.914 | 50A20110618SPR | 729.88 | 0.03 |
| 14611 | 7022691.04 | 392124.502 | 729.923 | 50A20110618SPR | 729.88 | 0.04 |
| 14612 | 7022693.359 | 392134.466 | 729.927 | 50A20110618SPR | 729.87 | 0.06 |
| 14613 | 7023332.866 | 392741.338 | 739.141 | 50A20110618SPR | 739.11 | 0.03 |
| 14614 | 7023337.852 | 392731.145 | 739.335 | 50A20110618SPR | 739.33 | 0.00 |
| 14615 | 7023332.727 | 392717.243 | 739.511 | 50A20110618SPR | 739.49 | 0.02 |
| 14616 | 7023353.731 | 392746.751 | 739.431 | 50A20110618SPR | 739.38 | 0.05 |
| 14617 | 7023358.536 | 392760.174 | 739.435 | 50A20110618SPR | 739.43 | 0.00 |
| 14618 | 7023348.835 | 392761.348 | 739.282 | 50A20110618SPR | 739.27 | 0.01 |
| 14619 | 7023715.072 | 393241.113 | 726.732 | 50A20110618SPR | 726.72 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14620 | 7023701.259 | 393240.406 | 727.3 | 50A20110618SPR | 727.29 | 0.01 |
| 14621 | 7023710.464 | 393251.559 | 727.265 | 50A20110618SPR | 727.23 | 0.03 |
| 14622 | 7023945.475 | 392914.073 | 735.793 | 50A20110618SGR_RY_CL | 735.76 | 0.03 |
| 14623 | 7024588.531 | 393936.594 | 732.819 | 50A20110618SGR_RY_CL | 732.81 | 0.01 |
| 14624 | 7024215.545 | 393347.776 | 736.371 | 50A20110618SGR_RY_CL | 736.33 | 0.04 |
| 14625 | 7024389.037 | 393908.733 | 724.34 | 50A20110618SPR | 724.3 | 0.04 |
| 14626 | 7024399.309 | 393916.085 | 724.238 | 50A20110618SPR | 724.19 | 0.05 |
| 14627 | 7024416.62 | 393946.104 | 723.887 | 50A20110618SPR | 723.86 | 0.03 |
| 14628 | 7024425.584 | 393952.516 | 723.75 | 50A20110618SPR | 723.76 | -0.01 |
| 14629 | 7024977.901 | 394602.253 | 733.396 | 50A20110618SPR | 733.39 | 0.01 |
| 14630 | 7024987.589 | 394609.893 | 733.696 | 50A20110618SPR | 733.69 | 0.01 |
| 14631 | 7024994.358 | 394628.658 | 733.478 | 50A20110618SPR | 733.46 | 0.02 |
| 14632 | 7025008.267 | 394646.612 | 733.721 | 50A20110618SPR | 733.7 | 0.02 |
| 14633 | 7025286.974 | 395223.886 | 723.411 | 50A20110618SPR | 723.39 | 0.02 |
| 14634 | 7025299.25 | 395235.099 | 723.254 | 50A20110618SPR | 723.25 | 0.00 |
| 14635 | 7025305.088 | 395251.539 | 723.206 | 50A20110618SPR | 723.19 | 0.02 |
| 14636 | 7025314.93 | 395259.274 | 723.161 | 50A20110618SPR | 723.14 | 0.02 |
| 14637 | 7025854.692 | 396111.848 | 714.321 | 50A20110618SPR | 714.31 | 0.01 |
| 14638 | 7025859.534 | 396099.939 | 714.538 | 50A20110618SPR | 714.53 | 0.01 |
| 14639 | 7025854.072 | 396083.124 | 714.619 | 50A20110618SPR | 714.62 | 0.00 |
| 14640 | 7025882.519 | 396131.496 | 714.619 | 50A20110618SPR | 714.61 | 0.01 |
| 14641 | 7025875.739 | 396126.403 | 714.551 | 50A20110618SPR | 714.53 | 0.02 |
| 14642 | 7025866.593 | 396131.057 | 714.359 | 50A20110618SPR | 714.34 | 0.02 |
| 14643 | 7026474.204 | 397103.815 | 701.703 | 50A20110618SPR | 701.65 | 0.05 |
| 14644 | 7026486.286 | 397113.02 | 701.708 | 50A20110618SPR | 701.69 | 0.02 |
| 14645 | 7026493.215 | 397127.595 | 701.722 | 50A20110618SPR | 701.71 | 0.01 |
| 14646 | 7026504.081 | 397135.467 | 701.727 | 50A20110618SPR | 701.72 | 0.01 |
| 14647 | 7026962.229 | 397906.021 | 699.846 | 50A20110618SPR | 699.84 | 0.01 |
| 14648 | 7026973.652 | 397922.249 | 699.781 | 50A20110618SPR | 699.77 | 0.01 |
| 14649 | 7026977.186 | 397937.971 | 699.695 | 50A20110618SPR | 699.68 | 0.02 |
| 14650 | 7026985.948 | 397948.385 | 699.62 | 50A20110618SPR | 699.61 | 0.01 |
| 14651 | 7027308.435 | 398652.206 | 699.523 | 50A20110618SPR | 699.51 | 0.01 |
| 14652 | 7027318.884 | 398666.085 | 699.552 | 50A20110618SPR | 699.54 | 0.01 |
| 14653 | 7027321.597 | 398681.071 | 699.609 | 50A20110618SPR | 699.61 | 0.00 |
| 14654 | 7027330.045 | 398691.672 | 699.628 | 50A20110618SPR | 699.6 | 0.03 |
| 14655 | 7027667.321 | 399460.586 | 702.898 | 50A20110618SPR | 702.9 | 0.00 |
| 14656 | 7027675.436 | 399468.954 | 702.785 | 50A20110618SPR | 702.78 | 0.00 |
| 14657 | 7027677.428 | 399483.948 | 702.761 | 50A20110618SPR | 702.77 | -0.01 |
| 14658 | 7027686.509 | 399495.076 | 702.427 | 50A20110618SPR | 702.42 | 0.01 |
| 14659 | 7028209.595 | 400050.237 | 680.452 | 50A20110618SPR | 680.45 | 0.00 |
| 14660 | 7028218.805 | 400052.251 | 680.768 | 50A20110618SPR | 680.75 | 0.02 |
| 14661 | 7028224.564 | 400060.771 | 681.107 | 50A20110618SPR | 681.07 | 0.04 |
| 14662 | 7028234.094 | 400063.569 | 681.451 | 50A20110618SPR | 681.44 | 0.01 |
| 14663 | 7028539.242 | 400707.712 | 694.44 | 50A20110618SPR | 694.41 | 0.03 |
| 14664 | 7028546.141 | 400718.443 | 694.524 | 50A20110618SPR | 694.49 | 0.03 |
| 14665 | 7028546.332 | 400730.903 | 694.6 | 50A20110618SPR | 694.59 | 0.01 |
| 14666 | 7028553.852 | 400743.643 | 694.725 | 50A20110618SPR | 694.71 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14667 | 7028774.725 | 401474.893 | 695.82 | 50A20110618SPR | 695.81 | 0.01 |
| 14668 | 7028782.56 | 401489.011 | 695.621 | 50A20110618SPR | 695.63 | -0.01 |
| 14669 | 7028782.311 | 401503.423 | 695.096 | 50A20110618SPR | 695.12 | -0.02 |
| 14670 | 7028790.198 | 401519.834 | 694.81 | 50A20110618SPR | 694.87 | -0.06 |
| 14671 | 7028882.765 | 402304.042 | 666.267 | 50A20110618SPR | 666.28 | -0.01 |
| 14672 | 7028869.982 | 402293.926 | 666.937 | 50A20110618SPR | 666.93 | 0.01 |
| 14673 | 7028864.554 | 402286.405 | 667.35 | 50A20110618SPR | 667.36 | -0.01 |
| 14674 | 7028871.112 | 402313.596 | 666.745 | 50A20110618SPR | 666.75 | 0.00 |
| 14675 | 7028877.427 | 402323.361 | 666.321 | 50A20110618SPR | 666.31 | 0.01 |
| 14676 | 7028887.562 | 402328.734 | 665.8 | 50A20110618SPR | 665.81 | -0.01 |
| 14677 | 7029280.23 | 403284.044 | 664.151 | 50A20110618SPR | 664.17 | -0.02 |
| 14678 | 7029288.163 | 403293.396 | 663.972 | 50A20110618SPR | 664.02 | -0.05 |
| 14679 | 7029290.241 | 403306.846 | 663.735 | 50A20110618SPR | 663.8 | -0.06 |
| 14680 | 7029299.283 | 403318.486 | 663.537 | 50A20110618SPR | 663.56 | -0.02 |
| 14681 | 7029628.868 | 404099.272 | 658.89 | 50A20110618SPR | 658.89 | 0.00 |
| 14682 | 7029638.199 | 404112.179 | 658.872 | 50A20110618SPR | 658.89 | -0.02 |
| 14683 | 7029640.335 | 404126.592 | 658.859 | 50A20110618SPR | 658.88 | -0.02 |
| 14684 | 7029649.808 | 404137.922 | 658.784 | 50A20110618SPR | 658.81 | -0.03 |
| 14685 | 7030054.372 | 404644.971 | 656.529 | 50A20110618SPR | 656.55 | -0.02 |
| 14686 | 7030047.816 | 404635.395 | 656.618 | 50A20110618SPR | 656.64 | -0.02 |
| 14687 | 7030035.642 | 404631.352 | 656.669 | 50A20110618SPR | 656.68 | -0.01 |
| 14688 | 7030028.667 | 404621.287 | 656.739 | 50A20110618SPR | 656.73 | 0.01 |
| 14691 | 7030491.754 | 404994.038 | 654.13 | 50A20110618SPR | 654.16 | -0.03 |
| 14692 | 7030500.668 | 404985.939 | 654.36 | 50A20110618SPR | 654.38 | -0.02 |
| 14693 | 7030503.136 | 404970.743 | 654.618 | 50A20110618SPR | 654.64 | -0.02 |
| 14694 | 7030518.52 | 404979.58 | 654.502 | 50A20110618SPR | 654.53 | -0.03 |
| 14695 | 7030490.361 | 404964.157 | 654.633 | 50A20110618SPR | 654.64 | -0.01 |
| 14696 | 7030398.257 | 405230.147 | 655.498 | 50A20110618SPR | 655.52 | -0.02 |
| 14697 | 7030396.751 | 405243.726 | 655.628 | 50A20110618SPR | 655.67 | -0.04 |
| 14698 | 7030388.824 | 405254.977 | 655.671 | 50A20110618SPR | 655.73 | -0.06 |
| 14699 | 7030387.712 | 405266.51 | 655.778 | 50A20110618SPR | 655.84 | -0.06 |
| 14700 | 7030280.998 | 405526.464 | 657.953 | 50A20110618SPR | 658 | -0.05 |
| 14701 | 7030278.046 | 405542.973 | 658.115 | 50A20110618SPR | 658.15 | -0.03 |
| 14702 | 7030269.761 | 405554.144 | 658.259 | 50A20110618SPR | 658.25 | 0.01 |
| 14703 | 7030201.234 | 405727.443 | 660.114 | 50A20110618SPR | 660.14 | -0.03 |
| 14704 | 7030198.924 | 405742.482 | 660.256 | 50A20110618SPR | 660.32 | -0.06 |
| 14705 | 7030190.589 | 405754.578 | 660.315 | 50A20110618SPR | 660.35 | -0.03 |
| 14706 | 7030189.196 | 405767.314 | 660.431 | 50A20110618SPR | 660.46 | -0.03 |
| 14707 | 7030512.539 | 404953.281 | 654.121 | 50A20110618SPR | 654.13 | -0.01 |
| 14708 | 7030516.093 | 404934.046 | 653.946 | 50A20110618SPR | 653.97 | -0.02 |
| 14709 | 7030643.179 | 404619.714 | 651.682 | 50A20110618SPR | 651.7 | -0.02 |
| 14710 | 7030644.497 | 404608.129 | 651.595 | 50A20110618SPR | 651.59 | 0.00 |
| 14711 | 7030652.491 | 404595.676 | 651.529 | 50A20110618SPR | 651.53 | 0.00 |
| 14712 | 7030655.068 | 404581.279 | 651.388 | 50A20110618SPR | 651.37 | 0.02 |
| 14713 | 7030730.291 | 404400.551 | 650.054 | 50A20110618SPR | 650.04 | 0.01 |
| 14714 | 7030723.033 | 404409.821 | 650.127 | 50A20110618SPR | 650.11 | 0.02 |
| 14715 | 7030720.965 | 404423.835 | 650.198 | 50A20110618SPR | 650.21 | -0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14716 | 7030713.3 | 404434.161 | 650.301 | 50A20110618SPR | 650.31 | -0.01 |
| 14717 | 7030831.227 | 404144.613 | 648.541 | 50A20110618SPR | 648.54 | 0.00 |
| 14718 | 7030833.549 | 404132.172 | 648.644 | 50A20110618SPR | 648.6 | 0.04 |
| 14721 | 7030977.148 | 405320.308 | 652.509 | 50A20110618SPR | 652.54 | -0.03 |
| 14722 | 7030990.273 | 405324.997 | 652.426 | 50A20110618SPR | 652.46 | -0.03 |
| 14723 | 7031003.676 | 405339.032 | 652.324 | 50A20110618SPR | 652.37 | -0.05 |
| 14724 | 7031017.94 | 405345.046 | 652.23 | 50A20110618SPR | 652.23 | 0.00 |
| 14725 | 7031513.762 | 405630.231 | 648.254 | 50A20110618SPR | 648.3 | -0.05 |
| 14726 | 7031533.444 | 405631.259 | 648.07 | 50A20110618SPR | 648.1 | -0.03 |
| 14727 | 7031545.728 | 405639.013 | 647.999 | 50A20110618SPR | 648.05 | -0.05 |
| 14728 | 7031560.058 | 405638.74 | 647.857 | 50A20110618SPR | 647.91 | -0.05 |
| 14729 | 7032177.091 | 405818.949 | 643.767 | 50A20110618SPR | 643.78 | -0.01 |
| 14730 | 7032189.008 | 405818.405 | 643.703 | 50A20110618SPR | 643.73 | -0.03 |
| 14731 | 7032202.206 | 405826.147 | 643.663 | 50A20110618SPR | 643.66 | 0.00 |
| 14732 | 7032213.376 | 405825.704 | 643.617 | 50A20110618SPR | 643.62 | 0.00 |
| 14733 | 7032839.549 | 405978.525 | 639.155 | 50A20110618SPR | 639.14 | 0.01 |
| 14734 | 7032856.688 | 405980.953 | 638.964 | 50A20110618SPR | 638.99 | -0.03 |
| 14735 | 7032875.929 | 405986.113 | 638.836 | 50A20110618SPR | 638.87 | -0.03 |
| 14736 | 7032887.595 | 405990.328 | 638.775 | 50A20110618SPR | 638.79 | -0.01 |
| 14737 | 7032883.779 | 405992.602 | 638.777 | 50A20110618FAC_DOT | 638.77 | 0.01 |
| 14738 | 7033602.985 | 406171.446 | 639.209 | 50A20110618SPR | 639.23 | -0.02 |
| 14739 | 7033616.617 | 406171.174 | 639.077 | 50A20110618SPR | 639.04 | 0.04 |
| 14740 | 7033626.72 | 406177.468 | 639.186 | 50A20110618SPR | 639.19 | 0.00 |
| 14741 | 7033643.624 | 406178.204 | 639.076 | 50A20110618SPR | 639.04 | 0.04 |
| 14742 | 7034044.01 | 406220.804 | 638.506 | 50A20110618SPR | 638.44 | 0.07 |
| 14743 | 7034056.222 | 406220.363 | 638.537 | 50A20110618SPR | 638.5 | 0.04 |
| 14744 | 7034076.898 | 406234.201 | 638.056 | 50A20110618SPR | 638.03 | 0.03 |
| 14745 | 7034077.974 | 406230.223 | 638.217 | 50A20110618SPR | 638.17 | 0.05 |
| 14746 | 7034013.013 | 406208.664 | 638.941 | 50A20110618SPR | 638.89 | 0.05 |
| 14747 | 7034000.62 | 406210.051 | 638.766 | 50A20110618SPR | 638.77 | 0.00 |
| 14748 | 7034575.004 | 406313.559 | 635.321 | 50A20110618CK_SPIKE | 635.31 | 0.01 |
| 14749 | 7035248.665 | 406737.608 | 631.43 | 50A20110618SPR | 631.35 | 0.08 |
| 14750 | 7035232.525 | 406731.913 | 631.332 | 50A20110618SPR | 631.26 | 0.07 |
| 14751 | 7035215.778 | 406717.296 | 631.588 | 50A20110618SPR | 631.54 | 0.05 |
| 14752 | 7035205.857 | 406716.248 | 631.458 | 50A20110618SPR | 631.39 | 0.07 |
| 14753 | 7035628.162 | 407239.025 | 627.308 | 50A20110618SPR | 627.26 | 0.05 |
| 14754 | 7035639.93 | 407245.979 | 627.21 | 50A20110618SPR | 627.12 | 0.09 |
| 14755 | 7035643.946 | 407256.103 | 627.16 | 50A20110618SPR | 627.09 | 0.07 |
| 14756 | 7035654.314 | 407261.663 | 627.104 | 50A20110618SPR | 627.04 | 0.06 |
| 14757 | 7035923.331 | 407517.436 | 624.673 | 50A20110618SPR | 624.56 | 0.11 |
| 14758 | 7035933.559 | 407526.322 | 624.6 | 50A20110618SPR | 624.5 | 0.10 |
| 14759 | 7035942.541 | 407535.679 | 624.524 | 50A20110618SPR | 624.43 | 0.09 |
| 14760 | 7035950.763 | 407545.671 | 624.509 | 50A20110618SPR | 624.38 | 0.13 |
| 14761 | 7036387.431 | 408076.361 | 622.36 | 50A20110618SPR | 622.25 | 0.11 |
| 14762 | 7036399.488 | 408086.065 | 622.345 | 50A20110618SPR | 622.28 | 0.07 |
| 14763 | 7036405.739 | 408100.357 | 622.269 | 50A20110618SPR | 622.16 | 0.11 |
| 14764 | 7036416.057 | 408108.226 | 622.243 | 50A20110618SPR | 622.16 | 0.08 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14765 | 7036780.514 | 408587.061 | 620.376 | 50A20110618SPR | 620.3 | 0.08 |
| 14766 | 7036786.067 | 408600.278 | 620.304 | 50A20110618SPR | 620.26 | 0.04 |
| 14767 | 7036797.002 | 408609.021 | 620.275 | 50A20110618SPR | 620.24 | 0.03 |
| 14768 | 7036802.401 | 408621.81 | 620.245 | 50A20110618SPR | 620.2 | 0.04 |
| 14769 | 7037158.002 | 409089.313 | 619.42 | 50A20110618SPR | 619.34 | 0.08 |
| 14770 | 7037170.568 | 409099.006 | 619.36 | 50A20110618SPR | 619.26 | 0.10 |
| 14771 | 7037175.351 | 409111.674 | 619.277 | 50A20110618SPR | 619.17 | 0.11 |
| 14772 | 7037188.54 | 409122.651 | 619.249 | 50A20110618SPR | 619.14 | 0.11 |
| 14773 | 7037394.327 | 409451.766 | 617.266 | 50A20110618SPR | 617.22 | 0.05 |
| 14774 | 7037403.713 | 409462.102 | 617.366 | 50A20110618SPR | 617.27 | 0.10 |
| 14775 | 7037406.087 | 409476.291 | 617.174 | 50A20110618SPR | 617.09 | 0.08 |
| 14776 | 7037415.185 | 409486.725 | 617.202 | 50A20110618SPR | 617.13 | 0.07 |
| 14777 | 7037593.533 | 409878.182 | 617.436 | 50A20110618SPR | 617.37 | 0.07 |
| 14778 | 7037603.896 | 409889.538 | 617.449 | 50A20110618SPR | 617.38 | 0.07 |
| 14779 | 7037609.031 | 409906.708 | 617.806 | 50A20110618SPR | 617.75 | 0.06 |
| 14780 | 7037619.383 | 409915.99 | 617.76 | 50A20110618SPR | 617.68 | 0.08 |
| 14781 | 7037914.311 | 410101.173 | 632.093 | 50A20110618SPR | 631.99 | 0.10 |
| 14782 | 7037930.376 | 410098.218 | 632.779 | 50A20110618SPR | 632.7 | 0.08 |
| 14783 | 7037954.377 | 410102.394 | 634.459 | 50A20110618SPR | 634.42 | 0.04 |
| 14784 | 7037967.294 | 410097.971 | 634.958 | 50A20110618SPR | 634.89 | 0.07 |
| 14785 | 7038325.06 | 409989.86 | 656.211 | 50A20110618SPR | 656.15 | 0.06 |
| 14786 | 7038341.106 | 409987.606 | 656.555 | 50A20110618SPR | 656.52 | 0.03 |
| 14787 | 7038360.519 | 409986.491 | 656.767 | 50A20110618SPR | 656.69 | 0.08 |
| 14788 | 7038377.888 | 409986.546 | 656.776 | 50A20110618SPR | 656.73 | 0.05 |
| 14789 | 7038118.113 | 410432.315 | 691.586 | 50A20110618SGR | 691.56 | 0.03 |
| 14790 | 7038123.718 | 410418.271 | 689.7 | 50A20110618SGR | 689.62 | 0.08 |
| 14791 | 7038128.016 | 410406.156 | 688.464 | 50A20110618SGR | 688.41 | 0.05 |
| 14792 | 7038204.582 | 410270.978 | 674.703 | 50A20110618SGR | 674.68 | 0.02 |
| 14793 | 7038212.568 | 410258.673 | 673.512 | 50A20110618SGR | 673.45 | 0.06 |
| 14794 | 7038220.134 | 410246.715 | 672.32 | 50A20110618SGR | 672.27 | 0.05 |
| 14795 | 7038323.098 | 410107.406 | 663.476 | 50A20110618SGR | 663.41 | 0.07 |
| 14796 | 7038333.949 | 410101.102 | 663.112 | 50A20110618SGR | 663.02 | 0.09 |
| 14797 | 7038347.847 | 410092.871 | 662.525 | 50A20110618SGR | 662.45 | 0.07 |
| 14798 | 7038440.489 | 410028.772 | 655.429 | 50A20110618SPR | 655.38 | 0.05 |
| 14799 | 7038428.648 | 410020.352 | 655.462 | 50A20110618SPR | 655.42 | 0.04 |
| 14800 | 7038444.889 | 410015.103 | 655.448 | 50A20110618SPR | 655.38 | 0.07 |
| 14801 | 7038454.057 | 410018.341 | 655.559 | 50A20110618SPR | 655.48 | 0.08 |
| 14802 | 7038795.684 | 409848.443 | 647.295 | 50A20110618SPR | 647.21 | 0.08 |
| 14803 | 7038805.813 | 409840.939 | 647.341 | 50A20110618SPR | 647.22 | 0.12 |
| 14804 | 7038816.841 | 409838.403 | 647.326 | 50A20110618SPR | 647.21 | 0.12 |
| 14805 | 7038828.294 | 409830.376 | 647.245 | 50A20110618SPR | 647.14 | 0.11 |
| 14806 | 7038837.267 | 409818.759 | 647.141 | 50A20110618SPR | 647.07 | 0.07 |
| 14807 | 7039128.042 | 409615.469 | 638.468 | 50A20110618SPR | 638.34 | 0.13 |
| 14808 | 7039141.418 | 409611.244 | 637.799 | 50A20110618SPR | 637.69 | 0.11 |
| 14809 | 7039155.567 | 409600.804 | 637 | 50A20110618SPR | 636.88 | 0.12 |
| 14810 | 7039121.386 | 409620.261 | 638.791 | 50A20110618SPR | 638.72 | 0.07 |
| 14811 | 7030286.45 | 405638.458 | 659.269 | 50A20110618SPR | 659.3 | -0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14812 | 7030351.533 | 405640.915 | 658.683 | 50A20110618SPR | 658.71 | -0.03 |
| 14813 | 7030454.512 | 405644.215 | 658.07 | 50A20110618SPR | 658.14 | -0.07 |
| 14814 | 7030573.735 | 405645.667 | 657.218 | 50A20110618SPR | 657.29 | -0.07 |
| 14815 | 7030694.16 | 405652.52 | 655.922 | 50A20110618SPR | 655.99 | -0.07 |
| 14816 | 7030752.346 | 405638.086 | 654.799 | 50A20110618SPR | 654.86 | -0.06 |
| 14817 | 7030756.775 | 405499.506 | 653.927 | 50A20110618SPR | 654 | -0.07 |
| 14818 | 7030758.806 | 405397.372 | 653.211 | 50A20110618SPR | 653.27 | -0.06 |
| 14819 | 7030632.434 | 405337.32 | 654.387 | 50A20110618SPR | 654.42 | -0.03 |
| 14820 | 7030489.611 | 405281.021 | 655.54 | 50A20110618SPR | 655.58 | -0.04 |
| 14821 | 7030417.038 | 405252.247 | 655.468 | 50A20110618SPR | 655.51 | -0.04 |
| 14822 | 7030812.08 | 405656.748 | 654.281 | 50A20110618SPR | 654.34 | -0.06 |
| 14824 | 7031138.705 | 405666.553 | 650.423 | 50A20110618SPR | 650.46 | -0.04 |
| 14825 | 7031296.681 | 405674.631 | 649.012 | 50A20110618SPR | 649.03 | -0.02 |
| 14826 | 7031474.019 | 405678.553 | 647.927 | 50A20110618SPR | 647.98 | -0.05 |
| 14827 | 7031554.782 | 405669.863 | 647.874 | 50A20110618SPR | 647.93 | -0.06 |
| 14828 | 7031558.273 | 405492.642 | 647.036 | 50A20110618SGR | 647.05 | -0.01 |
| 14829 | 7031568.217 | 405375.683 | 647.391 | 50A20110618SGR | 647.42 | -0.03 |
| 14830 | 7031563.663 | 405418.965 | 647.095 | 50A20110618SGR | 647.13 | -0.03 |
| 14831 | 7031549.289 | 405571.813 | 647.554 | 50A20110618SGR | 647.54 | 0.01 |
| 14832 | 7030183.327 | 405620.207 | 659.053 | 50A20110618SGR | 659.09 | -0.04 |
| 14833 | 7030088.64 | 405599.569 | 659.285 | 50A20110618SGR | 659.33 | -0.05 |
| 14834 | 7029985.917 | 405576.274 | 659.268 | 50A20110618SGR | 659.3 | -0.03 |
| 14835 | 7029885.091 | 405552.791 | 659.808 | 50A20110618SGR | 659.83 | -0.02 |
| 14836 | 7029794.549 | 405532.638 | 660.178 | 50A20110618SGR | 660.2 | -0.02 |
| 14837 | 7029658.402 | 404291.43 | 659.209 | 50A20110618SGR | 659.25 | -0.04 |
| 14838 | 7029617.99 | 404378.502 | 659.518 | 50A20110618SGR | 659.54 | -0.02 |
| 14839 | 7029626.601 | 404573.921 | 660.656 | 50A20110618SGR | 660.65 | 0.01 |
| 14840 | 7029667.604 | 404655.98 | 666.401 | 50A20110618SGR | 666.42 | -0.02 |
| 14843 | 7022086.869 | 391253.991 | 731.665 | 50A20110618SPR | 731.64 | 0.02 |
| 14900 | 7030025.787 | 404610.534 | 655.922 | 50A2011070650AFAC | 655.94 | -0.02 |
| 14901 | 7029641.416 | 404130.666 | 658.853 | 50A20110706SPR | 658.82 | 0.03 |
| 14902 | 7029648.357 | 404146.676 | 658.797 | 50A20110706SPR | 658.81 | -0.01 |
| 14903 | 7029654.507 | 404160.706 | 658.774 | 50A20110706SPR | 658.76 | 0.01 |
| 14904 | 7029660.579 | 404174.808 | 658.745 | 50A20110706SPR | 658.73 | 0.01 |
| 14905 | 7029666.48 | 404188.312 | 658.702 | 50A20110706SPR | 658.68 | 0.02 |
| 14906 | 7029672.478 | 404202.417 | 658.653 | 50A20110706SPR | 658.64 | 0.01 |
| 14907 | 7029678.17 | 404216.271 | 658.631 | 50A20110706SPR | 658.62 | 0.01 |
| 14908 | 7029683.947 | 404230.113 | 658.611 | 50A20110706SPR | 658.59 | 0.02 |
| 14909 | 7029689.946 | 404243.933 | 658.605 | 50A20110706SPR | 658.58 | 0.02 |
| 14910 | 7029694.287 | 404259.006 | 658.656 | 50A20110706SPR | 658.64 | 0.02 |
| 14911 | 7028885.736 | 402345.499 | 665.765 | 50A20110706SPR | 665.76 | 0.00 |
| 14912 | 7028881.011 | 402331.223 | 666.077 | 50A20110706SPR | 666.09 | -0.01 |
| 14913 | 7028876.575 | 402316.41 | 666.416 | 50A20110706SPR | 666.41 | 0.01 |
| 14914 | 7028872.886 | 402302.67 | 666.689 | 50A20110706SPR | 666.7 | -0.01 |
| 14915 | 7028869.415 | 402288.46 | 667.036 | 50A20110706SPR | 667.05 | -0.01 |
| 14916 | 7028866.699 | 402273.816 | 667.389 | 50A20110706SPR | 667.41 | -0.02 |
| 14917 | 7028862.658 | 402253.26 | 667.875 | 50A20110706SPR | 667.92 | -0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14918 | 7028859.846 | 402237.338 | 668.089 | 50A20110706SPR | 668.11 | -0.02 |
| 14919 | 7028857.916 | 402222.529 | 668.348 | 50A20110706SPR | 668.37 | -0.02 |
| 14920 | 7028856.162 | 402207.71 | 668.666 | 50A20110706SPR | 668.67 | 0.00 |
| 14921 | 7027676.866 | 399484.122 | 702.813 | 50A20110706SPR | 702.79 | 0.02 |
| 14922 | 7027670.728 | 399470.458 | 702.902 | 50A20110706SPR | 702.88 | 0.02 |
| 14923 | 7027665.12 | 399457.422 | 702.923 | 50A20110706SPR | 702.92 | 0.00 |
| 14924 | 7027659.606 | 399444.574 | 702.978 | 50A20110706SPR | 702.95 | 0.03 |
| 14925 | 7027654.119 | 399432.24 | 703.042 | 50A20110706SPR | 703.01 | 0.03 |
| 14926 | 7027646.76 | 399416.021 | 703.063 | 50A20110706SPR | 703.06 | 0.00 |
| 14927 | 7027641.163 | 399403.026 | 703.04 | 50A20110706SPR | 703.02 | 0.02 |
| 14928 | 7027635.444 | 399389.682 | 702.962 | 50A20110706SPR | 702.93 | 0.03 |
| 14929 | 7027635.065 | 399376.002 | 702.886 | 50A20110706SPR | 702.86 | 0.03 |
| 14930 | 7027629.555 | 399362.191 | 702.786 | 50A20110706SPR | 702.76 | 0.03 |
| 14931 | 7027623.486 | 399349.701 | 702.759 | 50A20110706SPR | 702.73 | 0.03 |
| 14932 | 7030027.448 | 404611.868 | 655.985 | 50A20110706CHECK | 655.98 | 0.00 |
| 14933 | 7030027.451 | 404611.868 | 655.993 | 50A20110706CHECK | 655.98 | 0.01 |
| 15000 | 7068305.177 | 387760.923 | 829.022 | 52D2010706FAC,52DFAC | 829.05 | -0.03 |
| 15001 | 7068293.939 | 387751.34 | 828.82 | 52D2010706SPR | 828.77 | 0.05 |
| 15002 | 7068281.152 | 387759.017 | 829.023 | 52D2010706SPR | 828.98 | 0.04 |
| 15003 | 7068268.259 | 387766.832 | 829.221 | 52D2010706SPR | 829.16 | 0.06 |
| 15004 | 7068255.998 | 387774.032 | 829.442 | 52D2010706SPR | 829.39 | 0.05 |
| 15005 | 7068243.424 | 387781.727 | 829.687 | 52D2010706SPR | 829.62 | 0.07 |
| 15006 | 7068231.001 | 387789.448 | 829.947 | 52D2010706SPR | 829.89 | 0.06 |
| 15007 | 7068218.683 | 387797.011 | 830.211 | 52D2010706SPR | 830.15 | 0.06 |
| 15008 | 7068206.542 | 387804.518 | 830.463 | 52D2010706SPR | 830.39 | 0.07 |
| 15009 | 7068194.37 | 387812.07 | 830.661 | 52D2010706SPR | 830.62 | 0.04 |
| 15010 | 7068181.964 | 387819.807 | 830.925 | 52D2010706SPR | 830.85 | 0.07 |
| 15011 | 7068303.027 | 387744.825 | 828.687 | 52D2010706SPR | 828.61 | 0.08 |
| 15012 | 7068316.149 | 387736.79 | 828.465 | 52D2010706SPR | 828.38 | 0.09 |
| 15013 | 7068328.593 | 387728.226 | 828.258 | 52D2010706SPR | 828.19 | 0.07 |
| 15014 | 7068342.01 | 387717.838 | 827.953 | 52D2010706SPR | 827.87 | 0.08 |
| 15015 | 7068352.755 | 387708.308 | 827.611 | 52D2010706SPR | 827.53 | 0.08 |
| 15016 | 7068362.98 | 387698.535 | 827.226 | 52D2010706SPR | 827.17 | 0.06 |
| 15017 | 7068372.926 | 387687.97 | 826.767 | 52D2010706SPR | 826.67 | 0.10 |
| 15018 | 7068378.55 | 387674.805 | 826.116 | 52D2010706SPR | 826.05 | 0.07 |
| 15019 | 7068388.128 | 387662.651 | 825.518 | 52D2010706SPR | 825.44 | 0.08 |
| 15020 | 7068396.602 | 387651.105 | 824.89 | 52D2010706SPR | 824.85 | 0.04 |
| 15021 | 7067710.638 | 388220.033 | 845.525 | 52D2010706SPR | 845.44 | 0.08 |
| 15022 | 7067717.791 | 388207.223 | 845.249 | 52D2010706SPR | 845.15 | 0.10 |
| 15023 | 7067724.666 | 388195.172 | 844.984 | 52D2010706SPR | 844.88 | 0.10 |
| 15024 | 7067731.551 | 388182.957 | 844.678 | 52D2010706SPR | 844.59 | 0.09 |
| 15025 | 7067738.721 | 388170.422 | 844.322 | 52D2010706SPR | 844.22 | 0.10 |
| 15026 | 7067746.698 | 388155.361 | 843.887 | 52D2010706SPR | 843.77 | 0.12 |
| 15027 | 7067753.202 | 388143.749 | 843.542 | 52D2010706SPR | 843.45 | 0.09 |
| 15028 | 7067759.974 | 388131.767 | 843.176 | 52D2010706SPR | 843.08 | 0.10 |
| 15029 | 7067766.952 | 388119.698 | 842.8 | 52D2010706SPR | 842.71 | 0.09 |
| 15030 | 7067773.97 | 388107.538 | 842.407 | 52D2010706SPR | 842.3 | 0.11 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 15031 | 7068802.782 | 387325.814 | 806.008 | 52D2010706SPR | 805.9 | 0.11 |
| 15032 | 7068785.122 | 387324.722 | 805.668 | 52D2010706SPR | 805.56 | 0.11 |
| 15033 | 7068768.147 | 387325.019 | 805.399 | 52D2010706SPR | 805.28 | 0.12 |
| 15034 | 7068752.717 | 387324.803 | 805.267 | 52D2010706SPR | 805.17 | 0.10 |
| 15035 | 7068734.053 | 387325.083 | 805.264 | 52D2010706SPR | 805.16 | 0.10 |
| 15036 | 7068715.181 | 387325.422 | 805.583 | 52D2010706SPR | 805.48 | 0.10 |
| 15037 | 7068699.899 | 387325.954 | 806.013 | 52D2010706SPR | 805.91 | 0.10 |
| 15038 | 7068691.28 | 387325.747 | 806.345 | 52D2010706SPR | 806.23 | 0.12 |
| 15039 | 7068673.838 | 387328.139 | 807.043 | 52D2010706SPR | 806.94 | 0.10 |
| 15040 | 7068659.185 | 387331.505 | 807.633 | 52D2010706SPR | 807.5 | 0.13 |
| 15041 | 7069248.857 | 387160.289 | 827.666 | 52D2010706SPR | 827.54 | 0.13 |
| 15042 | 7069253.556 | 387146.984 | 827.773 | 52D2010706SPR | 827.7 | 0.07 |
| 15043 | 7069262.48 | 387135.175 | 827.724 | 52D2010706SPR | 827.64 | 0.08 |
| 15044 | 7069274.605 | 387125.721 | 827.672 | 52D2010706SPR | 827.6 | 0.07 |
| 15045 | 7069289.07 | 387114.919 | 827.568 | 52D2010706SPR | 827.48 | 0.09 |
| 15046 | 7069301.285 | 387107.535 | 827.365 | 52D2010706SPR | 827.29 | 0.08 |
| 15047 | 7069313.853 | 387101.279 | 827.071 | 52D2010706SPR | 826.98 | 0.09 |
| 15048 | 7069329.597 | 387094.161 | 826.714 | 52D2010706SPR | 826.64 | 0.07 |
| 15049 | 7069343.307 | 387088.755 | 826.422 | 52D2010706SPR | 826.33 | 0.09 |
| 15050 | 7069359.126 | 387081.97 | 826.074 | 52D2010706SPR | 825.98 | 0.09 |
| 15051 | 7070071.818 | 386899.841 | 788.875 | 52D2010706CK | 788.77 | 0.11 |
| 15052 | 7070071.826 | 386899.838 | 788.878 | 52D20107065APKNAIL | 788.77 | 0.11 |
| 15053 | 7070057.483 | 386892.308 | 788.595 | 52D2010706SPR | 788.53 | 0.07 |
| 15054 | 7070047.69 | 386902.645 | 789.181 | 52D2010706SPR | 789.06 | 0.12 |
| 15055 | 7070033.662 | 386907.5 | 789.862 | 52D2010706SPR | 789.77 | 0.09 |
| 15056 | 7070019.407 | 386911.919 | 790.717 | 52D2010706SPR | 790.6 | 0.12 |
| 15057 | 7070005.183 | 386915.356 | 791.53 | 52D2010706SPR | 791.41 | 0.12 |
| 15058 | 7069989.69 | 386918.653 | 792.414 | 52D2010706SPR | 792.29 | 0.12 |
| 15059 | 7069975.217 | 386919.991 | 793.181 | 52D2010706SPR | 793.09 | 0.09 |
| 15060 | 7069960.121 | 386920.474 | 793.648 | 52D2010706SPR | 793.56 | 0.09 |
| 15061 | 7069945.837 | 386916.977 | 794.007 | 52D2010706SPR | 793.89 | 0.12 |
| 15062 | 7069934.002 | 386909.523 | 793.847 | 52D2010706SPR | 793.75 | 0.10 |
| 15063 | 7069923.096 | 386901.165 | 793.526 | 52D2010706SPR | 793.44 | 0.09 |
| 15064 | 7069911.538 | 386887.713 | 793.151 | 52D2010706SPR | 793.07 | 0.08 |
| 15065 | 7069901.653 | 386866.661 | 793.39 | 52D2010706SPR | 793.29 | 0.10 |
| 15066 | 7069909.786 | 386854.329 | 792.939 | 52D2010706SPR | 792.84 | 0.10 |
| 15067 | 7069919.467 | 386843.761 | 792.545 | 52D2010706SPR | 792.45 | 0.09 |
| 15068 | 7069927.703 | 386831.939 | 792.308 | 52D2010706SPR | 792.2 | 0.11 |
| 15069 | 7069937.443 | 386817.969 | 792.304 | 52D2010706SPR | 792.19 | 0.11 |
| 15070 | 7067217.608 | 388656.453 | 838.428 | 52D201070652BPKNAIL | 838.36 | 0.07 |
| 15071 | 7067223.513 | 388657.467 | 838.403 | 52D2010706SPR | 838.34 | 0.06 |
| 15072 | 7068298.188 | 387749.53 | 828.746 | 52D2010706CHECK | 828.66 | 0.09 |
| 15073 | 7068298.175 | 387749.5 | 828.744 | 52D2010706CHECK | 828.66 | 0.08 |
| 15100 | 7034576.202 | 406310.819 | 635.188 | 50B-51A2011061950BFAC,FA | 635.22 | -0.03 |
| 15101 | 7068072.801 | 406787.558 | 485.033 | 50B-51A2011061951AFAC,FA | 485.05 | -0.02 |
| 15102 | 7034574.968 | 406313.598 | 635.317 | 50B-51A20110619CK_SPIKE | 635.31 | 0.01 |
| 15103 | 7054503.738 | 411157.457 | 660.794 | 50B-51A20110619SPR | 660.76 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 15104 | 7036240.901 | 407876.126 | 622.496 | B-51A20110619FAC_DOT_21 | 622.4 | 0.10 |
| 15105 | 7054514.495 | 411159.873 | 660.716 | 50B-51A20110619SPR | 660.67 | 0.05 |
| 15106 | 7039837.539 | 409377.525 | 626.329 | 50B-51A20110619SPR | 626.24 | 0.09 |
| 15107 | 7054525.857 | 411171.33 | 660.558 | 50B-51A20110619SPR | 660.52 | 0.04 |
| 15108 | 7039823.461 | 409374.903 | 626.363 | 50B-51A20110619SPR | 626.3 | 0.06 |
| 15109 | 7054538.094 | 411174.478 | 660.493 | 50B-51A20110619SPR | 660.45 | 0.04 |
| 15110 | 7039811.552 | 409379.814 | 626.433 | 50B-51A20110619SPR | 626.36 | 0.07 |
| 15111 | 7054987.247 | 411434.487 | 656.271 | 50B-51A20110619SPR | 656.23 | 0.04 |
| 15112 | 7039800.655 | 409377.326 | 626.486 | 50B-51A20110619SPR | 626.4 | 0.09 |
| 15113 | 7055006.417 | 411438.422 | 655.911 | 50B-51A20110619SPR | 655.9 | 0.01 |
| 15114 | 7040436.178 | 409299.576 | 614.924 | 50B-51A20110619SPR | 614.83 | 0.09 |
| 15115 | 7055019.758 | 411447.952 | 655.719 | 50B-51A20110619SPR | 655.72 | 0.00 |
| 15116 | 7040424.425 | 409300.731 | 615.205 | 50B-51A20110619SPR | 615.11 | 0.10 |
| 15117 | 7055032.48 | 411449.217 | 655.426 | 50B-51A20110619SPR | 655.44 | -0.01 |
| 15118 | 7040416.467 | 409308.177 | 615.79 | 50B-51A20110619SPR | 615.71 | 0.08 |
| 15120 | 7040401.003 | 409309.847 | 616.085 | 50B-51A20110619SPR | 616.02 | 0.07 |
| 15122 | 7041127.547 | 409316.728 | 614.066 | 50B-51A20110619SPR | 613.97 | 0.10 |
| 15124 | 7041117.534 | 409311.779 | 613.622 | 50B-51A20110619SPR | 613.51 | 0.11 |
| 15126 | 7041105.007 | 409313.38 | 613.589 | 50B-51A20110619SPR | 613.53 | 0.06 |
| 15128 | 7041090.647 | 409307.255 | 613.118 | 50B-51A20110619SPR | 612.98 | 0.14 |
| 15130 | 7041552.652 | 409286.919 | 619.051 | 50B-51A20110619SPR | 618.96 | 0.09 |
| 15132 | 7041539.064 | 409284.237 | 619.019 | 50B-51A20110619SPR | 618.94 | 0.08 |
| 15134 | 7041526.584 | 409283.253 | 618.988 | 50B-51A20110619SPR | 618.91 | 0.08 |
| 15136 | 7041512.439 | 409283.888 | 618.989 | 50B-51A20110619SPR | 618.9 | 0.09 |
| 15138 | 7042486.869 | 409593.844 | 613.672 | 50B-51A20110619SPR | 613.58 | 0.09 |
| 15140 | 7042499.33 | 409588.172 | 613.801 | 50B-51A20110619SPR | 613.76 | 0.04 |
| 15142 | 7042512.981 | 409589.469 | 614.068 | 50B-51A20110619SPR | 613.96 | 0.11 |
| 15144 | 7042523.755 | 409583.994 | 614.298 | 50B-51A20110619SPR | 614.22 | 0.08 |
| 15146 | 7043418.178 | 409680.936 | 619.707 | 50B-51A20110619SPR | 619.61 | 0.10 |
| 15147 | 7066367.641 | 406615.787 | 546.351 | 50B-51A20110619SPR | 546.3 | 0.05 |
| 15148 | 7043431.278 | 409684.441 | 619.45 | 50B-51A20110619SPR | 619.35 | 0.10 |
| 15149 | 7066378.04 | 406607.171 | 546.209 | 50B-51A20110619SPR | 546.17 | 0.04 |
| 15150 | 7043444.303 | 409689.312 | 619.21 | 50B-51A20110619SPR | 619.17 | 0.04 |
| 15151 | 7066642.492 | 406492.161 | 542.459 | 50B-51A20110619SPR | 542.44 | 0.02 |
| 15152 | 7045753.442 | 410199.909 | 599.114 | 50B-51A20110619SPR | 599.04 | 0.07 |
| 15153 | 7066664.976 | 406477.728 | 542.079 | 50B-51A20110619SPR | 542.05 | 0.03 |
| 15154 | 7045759.196 | 410194.44 | 599.113 | 50B-51A20110619SPR | 599.06 | 0.05 |
| 15155 | 7066676.916 | 406476.635 | 541.922 | 50B-51A20110619SPR | 541.89 | 0.03 |
| 15156 | 7045768.141 | 410196.676 | 599.08 | 50B-51A20110619SPR | 599 | 0.08 |
| 15157 | 7066686.112 | 406468.266 | 541.767 | 50B-51A20110619SPR | 541.71 | 0.06 |
| 15158 | 7045778.604 | 410190.696 | 599.103 | 50B-51A20110619SPR | 598.99 | 0.11 |
| 15159 | 7066939.664 | 406359.14 | 538.316 | 50B-51A20110619SPR | 538.27 | 0.05 |
| 15160 | 7046850.024 | 410310.326 | 597.923 | 50B-51A20110619SPR | 597.84 | 0.08 |
| 15161 | 7066947.067 | 406351.547 | 538.407 | 50B-51A20110619SPR | 538.37 | 0.04 |
| 15162 | 7046860.752 | 410302.958 | 597.724 | 50B-51A20110619SPR | 597.68 | 0.04 |
| 15163 | 7066957.83 | 406351.051 | 538.105 | 50B-51A20110619SPR | 538.09 | 0.01 |
| 15164 | 7046871.924 | 410303.932 | 597.748 | 50B-51A20110619SPR | 597.68 | 0.07 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 15165 | 7066968.307 | 406342.529 | 538.197 | 50B-51A20110619SPR | 538.17 | 0.03 |
| 15166 | 7046886.676 | 410295.269 | 597.642 | 50B-51A20110619SPR | 597.6 | 0.04 |
| 15167 | 7067416.795 | 406399.068 | 520.637 | 50B-51A20110619SPR | 520.58 | 0.06 |
| 15168 | 7047808.02 | 410064.853 | 596.824 | 50B-51A20110619SPR | 596.74 | 0.08 |
| 15169 | 7067429.154 | 406399.649 | 520.003 | 50B-51A20110619SPR | 519.94 | 0.06 |
| 15170 | 7047794.98 | 410063.977 | 596.89 | 50B-51A20110619SPR | 596.85 | 0.04 |
| 15171 | 7067435.976 | 406407.132 | 519.54 | 50B-51A20110619SPR | 519.49 | 0.05 |
| 15172 | 7047783.309 | 410069.646 | 596.889 | 50B-51A20110619SPR | 596.82 | 0.07 |
| 15173 | 7067451.795 | 406409.428 | 518.715 | 50B-51A20110619SPR | 518.64 | 0.08 |
| 15174 | 7047768.821 | 410069.248 | 596.863 | 50B-51A20110619SPR | 596.82 | 0.04 |
| 15175 | 7067716.658 | 406524.833 | 503.101 | 50B-51A20110619SPR | 503.06 | 0.04 |
| 15176 | 7067728.504 | 406525.731 | 502.654 | 50B-51A20110619SPR | 502.58 | 0.07 |
| 15177 | 7067740.53 | 406534.592 | 501.768 | 50B-51A20110619SPR | 501.72 | 0.05 |
| 15178 | 7067758.091 | 406538.585 | 500.936 | 50B-51A20110619SPR | 500.89 | 0.05 |
| 15179 | 7068102.592 | 406828.921 | 485.401 | 50B-51A20110619SPR | 485.37 | 0.03 |
| 15180 | 7068111.149 | 406831.818 | 485.364 | 50B-51A20110619SPR | 485.29 | 0.07 |
| 15181 | 7068155.986 | 406831.761 | 484.918 | 50B-51A20110619SPR | 484.88 | 0.04 |
| 15182 | 7068157.759 | 406823.269 | 485.423 | 50B-51A20110619SPR | 485.42 | 0.00 |
| 15183 | 7068165.969 | 406879.207 | 485.273 | 50B-51A20110619SPR | 485.23 | 0.04 |
| 15184 | 7068171.052 | 406894.751 | 485.337 | 50B-51A20110619SPR | 485.31 | 0.03 |
| 15185 | 7068181 | 406898.448 | 485.294 | 50B-51A20110619SPR | 485.25 | 0.04 |
| 15186 | 7068411.57 | 407050.041 | 484.898 | 50B-51A20110619SPR | 484.9 | 0.00 |
| 15187 | 7068422.473 | 407048.068 | 484.462 | 50B-51A20110619SPR | 484.45 | 0.01 |
| 15188 | 7068439.99 | 407054.846 | 484.263 | 50B-51A20110619SPR | 484.26 | 0.00 |
| 15189 | 7068450.447 | 407051.652 | 483.823 | 50B-51A20110619SPR | 483.81 | 0.01 |
| 15190 | 7068842.463 | 406959.416 | 474.091 | 50B-51A20110619SPR | 474.02 | 0.07 |
| 15191 | 7068866.386 | 406951.313 | 473.729 | 50B-51A20110619SPR | 473.65 | 0.08 |
| 15192 | 7068882.581 | 406945.842 | 473.527 | 50B-51A20110619SPR | 473.47 | 0.06 |
| 15193 | 7068887.935 | 406933.889 | 473.296 | 50B-51A20110619SPR | 473.2 | 0.10 |
| 15194 | 7068875.038 | 406938.245 | 473.423 | 50B-51A20110619SPR | 473.38 | 0.04 |
| 15195 | 7068861.13 | 406943.055 | 473.712 | 50B-51A20110619SPR | 473.63 | 0.08 |
| 15196 | 7068861.157 | 406943.076 | 473.707 | 50B-51A20110619SPR | 473.62 | 0.09 |
| 15197 | 7069307.63 | 406751.179 | 476.887 | 50B-51A20110619SPR | 476.81 | 0.08 |
| 15198 | 7069318.941 | 406745.425 | 477.512 | 50B-51A20110619SPR | 477.42 | 0.09 |
| 15199 | 7069331.764 | 406737.791 | 478.192 | 50B-51A20110619SPR | 478.05 | 0.14 |
| 15200 | 7069343.122 | 406733.694 | 478.844 | 50B-51A20110619SPR | 478.72 | 0.12 |
| 15201 | 7069901.703 | 406409.027 | 494.731 | 50B-51A20110619SPR | 494.65 | 0.08 |
| 15202 | 7069914.418 | 406400.926 | 494.078 | 50B-51A20110619SPR | 494.03 | 0.05 |
| 15203 | 7069928.199 | 406392.763 | 493.304 | 50B-51A20110619SPR | 493.24 | 0.06 |
| 15204 | 7069937.987 | 406386.687 | 492.746 | 50B-51A20110619SPR | 492.71 | 0.04 |
| 15205 | 7070289.458 | 406227.67 | 484.516 | 50B-51A20110619SPR | 484.48 | 0.04 |
| 15206 | 7070303.074 | 406226.575 | 484.498 | 50B-51A20110619SPR | 484.44 | 0.06 |
| 15207 | 7070322.239 | 406224.914 | 484.396 | 50B-51A20110619SPR | 484.32 | 0.08 |
| 15208 | 7070323.948 | 406212.174 | 484.814 | 50B-51A20110619SPR | 484.75 | 0.06 |
| 15209 | 7070299.015 | 406213.509 | 484.961 | 50B-51A20110619SPR | 484.91 | 0.05 |
| 15210 | 7070657.109 | 406296.799 | 471.915 | 50B-51A20110619SPR | 471.85 | 0.06 |
| 15211 | 7070673.557 | 406300.223 | 471.079 | 50B-51A20110619SPR | 471.02 | 0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 15212 | 7070669.999 | 406292.435 | 470.933 | 50B-51A20110619SPR | 470.9 | 0.03 |
| 15213 | 7070655.055 | 406288.059 | 471.695 | 50B-51A20110619SPR | 471.6 | 0.09 |
| 15214 | 7071213.753 | 406326.705 | 454.754 | 50B-51A20110619SPR | 454.67 | 0.08 |
| 15215 | 7071205.75 | 406321.045 | 454.593 | 50B-51A20110619SPR | 454.55 | 0.04 |
| 15216 | 7071186.926 | 406321.014 | 455.065 | 50B-51A20110619SPR | 454.99 | 0.07 |
| 15217 | 7071174.13 | 406312.973 | 455.004 | 50B-51A20110619SPR | 454.95 | 0.05 |
| 15218 | 7071668.505 | 406134.798 | 454.702 | 50B-51A20110619SPR | 454.61 | 0.09 |
| 15219 | 7071661.608 | 406145.229 | 454.819 | 50B-51A20110619SPR | 454.75 | 0.07 |
| 15220 | 7071643.88 | 406153.267 | 454.522 | 50B-51A20110619SPR | 454.46 | 0.06 |
| 15221 | 7071637.655 | 406162.059 | 454.659 | 50B-51A20110619SPR | 454.63 | 0.03 |
| 15222 | 7072180.97 | 405923.117 | 456.884 | 50B-51A20110619SPR | 456.87 | 0.01 |
| 15223 | 7072190.473 | 405917.275 | 456.7 | 50B-51A20110619SPR | 456.67 | 0.03 |
| 15224 | 7072210.478 | 405917.591 | 456.946 | 50B-51A20110619SPR | 456.93 | 0.02 |
| 15225 | 7072226.907 | 405909.456 | 456.807 | 50B-51A20110619SPR | 456.76 | 0.05 |
| 15226 | 7072635.293 | 405777.015 | 458.292 | 50B-51A20110619SPR | 458.26 | 0.03 |
| 15227 | 7072649.237 | 405768.397 | 458.599 | 50B-51A20110619SPR | 458.59 | 0.01 |
| 15228 | 7072663.104 | 405768.475 | 458.437 | 50B-51A20110619SPR | 458.44 | 0.00 |
| 15229 | 7072674.555 | 405761.552 | 458.758 | 50B-51A20110619SPR | 458.76 | 0.00 |
| 15230 | 7073062.071 | 405798.043 | 458.37 | 50B-51A20110619SPR | 458.31 | 0.06 |
| 15231 | 7073078.949 | 405798.059 | 458.178 | 50B-51A20110619SPR | 458.11 | 0.07 |
| 15232 | 7073091.045 | 405805.633 | 457.881 | 50B-51A20110619SPR | 457.82 | 0.06 |
| 15233 | 7073101.447 | 405804.033 | 457.755 | 50B-51A20110619SPR | 457.68 | 0.07 |
| 15234 | 7073811.384 | 405871.025 | 449.056 | 50B-51A20110619SPR | 449 | 0.06 |
| 15235 | 7073823.471 | 405868.037 | 449.359 | 50B-51A20110619SPR | 449.33 | 0.03 |
| 15236 | 7073832.356 | 405872.88 | 450.006 | 50B-51A20110619SPR | 449.95 | 0.06 |
| 15237 | 7073841.734 | 405869.557 | 450.185 | 50B-51A20110619SPR | 450.1 | 0.08 |
| 15238 | 7074661.213 | 405590.292 | 446.581 | 50B-51A20110619SPR | 446.53 | 0.05 |
| 15239 | 7074669.657 | 405583.426 | 446.69 | 50B-51A20110619SPR | 446.65 | 0.04 |
| 15240 | 7074681.514 | 405584.308 | 446.9 | 50B-51A20110619SPR | 446.86 | 0.04 |
| 15241 | 7074691.394 | 405577.274 | 447.207 | 50B-51A20110619SPR | 447.14 | 0.07 |
| 15242 | 7075522.14 | 405309.871 | 481.946 | 50B-51A20110619SPR | 481.91 | 0.04 |
| 15243 | 7075538.949 | 405303.866 | 482.678 | 50B-51A20110619SPR | 482.6 | 0.08 |
| 15244 | 7075554.591 | 405300.144 | 483.37 | 50B-51A20110619SPR | 483.3 | 0.07 |
| 15245 | 7075570.296 | 405296.784 | 484.22 | 50B-51A20110619SPR | 484.19 | 0.03 |
| 15246 | 7076021.188 | 405178.565 | 492.117 | 50B-51A20110619SPR | 492.05 | 0.07 |
| 15247 | 7076008.187 | 405181.13 | 492.007 | 50B-51A20110619SPR | 491.9 | 0.11 |
| 15248 | 7075998.762 | 405190.91 | 492.206 | 50B-51A20110619SPR | 492.13 | 0.08 |
| 15249 | 7075985.773 | 405193.203 | 492.069 | 50B-51A20110619SPR | 492.01 | 0.06 |
| 15250 | 7076566.701 | 404667.83 | 479.566 | 50B-51A20110619SPR | 479.45 | 0.12 |
| 15251 | 7076555.805 | 404682.933 | 479.098 | 50B-51A20110619SPR | 479.01 | 0.09 |
| 15254 | 7076562.856 | 404667.148 | 479.5 | 50B-51A20110619SPR | 479.41 | 0.09 |
| 15255 | 7076708.426 | 404115.814 | 506.173 | 50B-51A20110619SPR | 506.08 | 0.09 |
| 15256 | 7076704.069 | 404128.65 | 505.906 | 50B-51A20110619SPR | 505.83 | 0.08 |
| 15257 | 7076704.519 | 404161.979 | 505.075 | 50B-51A20110619SPR | 504.96 | 0.12 |
| 15258 | 7076708.889 | 404151.992 | 505.389 | 50B-51A20110619SPR | 505.29 | 0.10 |
| 15259 | 7068635.651 | 405459.806 | 531.633 | 50B-51A20110619SPR | 531.57 | 0.06 |
| 15260 | 7068645.729 | 405397.282 | 533.707 | 50B-51A20110619SPR | 533.7 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 15261 | 7068575.306 | 405383.636 | 534.219 | 50B-51A20110619SPR | 534.21 | 0.01 |
| 15262 | 7068491.428 | 405304.854 | 536.119 | 50B-51A20110619SPR | 536.08 | 0.04 |
| 15263 | 7068522.655 | 405251.481 | 538.04 | 50B-51A20110619SPR | 538 | 0.04 |
| 15264 | 7068595.755 | 405295.917 | 538.069 | 50B-51A20110619SPR | 538.02 | 0.05 |
| 15265 | 7068548.861 | 405299.069 | 536.946 | 50B-51A20110619SPR | 536.91 | 0.04 |
| 15266 | 7068488.351 | 405266.616 | 537.398 | 50B-51A20110619SPR | 537.35 | 0.05 |
| 15267 | 7068440.357 | 405254.438 | 536.902 | 50B-51A20110619SPR | 536.84 | 0.06 |
| 15268 | 7068651.602 | 405292.503 | 539.506 | 50B-51A20110619SPR | 539.48 | 0.03 |
| 15269 | 7068676.349 | 405251.044 | 540.228 | 50B-51A20110619SPR | 540.16 | 0.07 |
| 15270 | 7068640.261 | 405253.841 | 540.334 | 50B-51A20110619SPR | 540.32 | 0.01 |
| 15271 | 7068730.475 | 405448.221 | 532.448 | 50B-51A20110619SPR | 532.38 | 0.07 |
| 15272 | 7068560.67 | 405490.651 | 529.677 | 50B-51A20110619SPR | 529.65 | 0.03 |
| 15273 | 7068409.284 | 405469.919 | 529.924 | 50B-51A20110619SPR | 529.89 | 0.03 |
| 15274 | 7068295.815 | 405416.335 | 529.8 | 50B-51A20110619SPR | 529.81 | -0.01 |
| 15275 | 7068287.879 | 405467.075 | 528.112 | 50B-51A20110619SPR | 528.11 | 0.00 |
| 15276 | 7068360.572 | 405461.669 | 529.099 | 50B-51A20110619SPR | 529.1 | 0.00 |
| 15277 | 7068602.036 | 405495.783 | 530.046 | 50B-51A20110619SPR | 529.97 | 0.08 |
| 15278 | 7068738.222 | 405453.532 | 532.485 | 50B-51A20110619SPR | 532.4 | 0.09 |
| 15279 | 7068266.176 | 405190.238 | 533.617 | 50B-51A20110619SPR | 533.59 | 0.03 |
| 15280 | 7068039.747 | 405076.235 | 540.115 | 50B-51A20110619SPR | 540.08 | 0.03 |
| 15281 | 7067986.938 | 404951.022 | 542.783 | 50B-51A20110619SPR | 542.77 | 0.01 |
| 15282 | 7067920.811 | 404670.227 | 554.006 | 50B-51A20110619SPR | 553.98 | 0.03 |
| 15283 | 7067834.234 | 404454.598 | 574.03 | 50B-51A20110619SPR | 574.02 | 0.01 |
| 15284 | 7067794.857 | 404184.525 | 598.719 | 50B-51A20110619SPR | 598.65 | 0.07 |
| 15285 | 7067720.072 | 403868.462 | 618.66 | 50B-51A20110619SPR | 618.64 | 0.02 |
| 15286 | 7067645.137 | 403566.127 | 629.609 | 50B-51A20110619SPR | 629.58 | 0.03 |
| 15287 | 7067544.405 | 403368.344 | 632.854 | 50B-51A20110619SPR | 632.27 | 0.58 |
| 15288 | 7067580.858 | 403175.06 | 629.29 | 50B-51A20110619SPR | 629.24 | 0.05 |
| 15289 | 7067523.694 | 402975.95 | 633.42 | 50B-51A20110619SPR | 633.43 | -0.01 |
| 15290 | 7067523.842 | 402770.141 | 645.524 | 50B-51A20110619SPR | 645.52 | 0.00 |
| 15291 | 7067415.62 | 402447.434 | 656.503 | 50B-51A20110619SPR | 656.43 | 0.07 |
| 15292 | 7067327.648 | 402133.822 | 668.038 | 50B-51A20110619SPR | 668 | 0.04 |
| 15293 | 7067230.801 | 401897.531 | 667.889 | 50B-51A20110619SPR | 667.9 | -0.01 |
| 15294 | 7067115.578 | 401625.574 | 669.198 | 50B-51A20110619SPR | 669.13 | 0.07 |
| 15295 | 7066933.371 | 401090.139 | 688.903 | 50B-51A20110619SPR | 688.86 | 0.04 |
| 15296 | 7067031.83 | 401335.607 | 677.591 | 50B-51A20110619SPR | 677.55 | 0.04 |
| 15297 | 7067072.478 | 401546.905 | 669.604 | 50B-51A20110619SPR | 669.56 | 0.04 |
| 15298 | 7067188.99 | 401764.763 | 668.683 | 50B-51A20110619SPR | 668.6 | 0.08 |
| 15299 | 7067289.463 | 402009.967 | 668.319 | 50B-51A20110619SPR | 668.27 | 0.05 |
| 15300 | 7066999.337 | 400778.338 | 704.499 | 50B-51A20110619SPR | 704.45 | 0.05 |
| 15301 | 7067072.186 | 400573.878 | 714.589 | 50B-51A20110619SPR | 714.53 | 0.06 |
| 15302 | 7066963.893 | 400231.728 | 723.598 | 50B-51A20110619SPR | 723.55 | 0.05 |
| 15303 | 7066914.134 | 399992.053 | 728.641 | 50B-51A20110619SPR | 728.58 | 0.06 |
| 15304 | 7066909.803 | 399965.828 | 729.261 | 50B-51A20110619SPR | 729.19 | 0.07 |
| 15305 | 7066974.826 | 399705.285 | 740.989 | 50B-51A20110619SPR | 740.91 | 0.08 |
| 15306 | 7066958.233 | 399620.973 | 744.764 | 50B-51A20110619SPR | 744.68 | 0.08 |
| 15307 | 7066875.212 | 399440.081 | 747.261 | 50B-51A20110619SPR | 747.19 | 0.07 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 15308 | 7066917.746 | 399201.354 | 762.192 | 50B-51A20110619SPR | 762.11 | 0.08 |
| 15309 | 7067027.697 | 398959.034 | 776.241 | 50B-51A20110619SPR | 776.16 | 0.08 |
| 15310 | 7067065.399 | 398649.697 | 790.07 | 50B-51A20110619SPR | 789.98 | 0.09 |
| 15311 | 7067078.296 | 398290.804 | 797.992 | 50B-51A20110619SPR | 797.93 | 0.06 |
| 15312 | 7067095.703 | 398022.411 | 799.325 | 50B-51A20110619SPR | 799.28 | 0.05 |
| 15313 | 7067118.267 | 397729.407 | 815.99 | 50B-51A20110619SPR | 815.93 | 0.06 |
| 15314 | 7067092.282 | 397466.917 | 823.209 | 50B-51A20110619SPR | 823.15 | 0.06 |
| 15315 | 7066847.703 | 397205.897 | 832.925 | 50B-51A20110619SPR | 832.9 | 0.02 |
| 15316 | 7066853.785 | 397220.457 | 831.699 | 50B-51A20110619SPR | 831.68 | 0.02 |
| 15317 | 7066859.934 | 397231.672 | 830.675 | 50B-51A20110619SPR | 830.66 | 0.01 |
| 15318 | 7066850.493 | 397234.053 | 830.032 | -51A20110619FAC_FHA_MC | 830.05 | -0.02 |
| 15319 | 7066850.485 | 397234.046 | 830.031 | -51A20110619FAC_FHA_MC | 830.05 | -0.02 |
| 15320 | 7068854.573 | 405423.058 | 533.584 | 50B-51A20110619SPR | 533.53 | 0.05 |
| 15321 | 7069076.612 | 405449.375 | 527.559 | 50B-51A20110619SPR | 527.41 | 0.15 |
| 15322 | 7069090.39 | 405483.081 | 526.302 | 50B-51A20110619SPR | 526.19 | 0.11 |
| 15323 | 7069098.541 | 405496.984 | 525.729 | 50B-51A20110619SPR | 525.62 | 0.11 |
| 15324 | 7069125.956 | 405613.618 | 521.862 | 50B-51A20110619SPR | 521.73 | 0.13 |
| 15325 | 7069142.297 | 405782.279 | 516.274 | 50B-51A20110619SPR | 516.17 | 0.10 |
| 15326 | 7069145.027 | 405969.448 | 513.908 | 50B-51A20110619SPR | 513.81 | 0.10 |
| 15327 | 7069097.078 | 406142.455 | 513.298 | 50B-51A20110619SPR | 513.18 | 0.12 |
| 15328 | 7069115.253 | 406303.139 | 512.383 | 50B-51A20110619SPR | 512.28 | 0.10 |
| 15329 | 7069171.81 | 406490.189 | 511.894 | 50B-51A20110619SPR | 511.78 | 0.11 |
| 15330 | 7069105.488 | 406529.564 | 512.442 | 50B-51A20110619SPR | 512.34 | 0.10 |
| 15331 | 7069055.42 | 406441.969 | 512.994 | 50B-51A20110619SPR | 512.93 | 0.06 |
| 15332 | 7069004.875 | 406434.434 | 512.717 | 50B-51A20110619SPR | 512.65 | 0.07 |
| 15333 | 7069087 | 406532.734 | 511.921 | 50B-51A20110619SPR | 511.79 | 0.13 |
| 15334 | 7069136.19 | 406565.452 | 511.78 | 50B-51A20110619SPR | 511.67 | 0.11 |
| 15335 | 7069006.368 | 406280.857 | 513.032 | 50B-51A20110619SPR | 512.91 | 0.12 |
| 15336 | 7068857.987 | 406405.9 | 504.412 | 50B-51A20110619SPR | 504.36 | 0.05 |
| 15337 | 7068692.012 | 406444.568 | 498.363 | 50B-51A20110619SPR | 498.29 | 0.07 |
| 15338 | 7068763.427 | 406326.315 | 499.713 | 50B-51A20110619SPR | 499.66 | 0.05 |
| 15339 | 7049558.674 | 409651.667 | 607.815 | 50B-51A20110619 | 607.76 | 0.06 |
| 15340 | 7068694.315 | 406198.499 | 501.369 | 50B-51A20110619SPR | 501.35 | 0.02 |
| 15341 | 7049576.577 | 409657.996 | 608.138 | 50B-51A20110619 | 608.11 | 0.03 |
| 15342 | 7068673.214 | 406292.47 | 499.788 | 50B-51A20110619SPR | 499.76 | 0.03 |
| 15343 | 7049587.489 | 409661.791 | 608.346 | 50B-51A20110619 | 608.3 | 0.05 |
| 15344 | 7068684.003 | 406357.95 | 498.873 | 50B-51A20110619SPR | 498.79 | 0.08 |
| 15345 | 7051363.066 | 410225.556 | 644.413 | 50B-51A20110619 | 644.41 | 0.00 |
| 15346 | 7068548.705 | 406486.708 | 499.136 | 50B-51A20110619SPR | 499.1 | 0.04 |
| 15347 | 7051385.777 | 410230.293 | 644.089 | 50B-51A20110619 | 644.07 | 0.02 |
| 15348 | 7068408.635 | 406495.836 | 497.102 | 50B-51A20110619SPR | 497.07 | 0.03 |
| 15349 | 7051402.15 | 410234.074 | 643.877 | 50B-51A20110619 | 643.87 | 0.01 |
| 15350 | 7068326.504 | 406308.525 | 498.637 | 50B-51A20110619SPR | 498.63 | 0.01 |
| 15351 | 7053117.498 | 410396.956 | 652.944 | 50B-51A20110619 | 652.9 | 0.04 |
| 15352 | 7068249.426 | 406233.463 | 500.417 | 50B-51A20110619SPR | 500.39 | 0.03 |
| 15353 | 7053137.307 | 410401.283 | 652.877 | 50B-51A20110619 | 652.82 | 0.06 |
| 15354 | 7068302.05 | 406409.692 | 496.953 | 50B-51A20110619SPR | 496.91 | 0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 15355 | 7053151.087 | 410404.245 | 652.833 | 50B-51A20110619 | 652.79 | 0.04 |
| 15356 | 7068357.42 | 406449.325 | 497.129 | 50B-51A20110619SPR | 497.07 | 0.06 |
| 15357 | 7068683.521 | 406458.658 | 498.834 | 50B-51A20110619SPR | 498.8 | 0.03 |
| 15358 | 7068589.587 | 406545.422 | 498.823 | 50B-51A20110619SPR | 498.82 | 0.00 |
| 15359 | 7068398.59 | 406643.342 | 496.729 | 50B-51A20110619SPR | 496.71 | 0.02 |
| 15360 | 7068214.995 | 406806.246 | 488.101 | 50B-51A20110619SPR | 488.04 | 0.06 |
| 15361 | 7068203.652 | 406817.562 | 487.665 | 50B-51A20110619SPR | 487.63 | 0.04 |
| 15400 | 7067220.458 | 389041.918 | 841.051 | 52B20110519552BFAC | 841.09 | -0.04 |
| 15401 | 7067220.076 | 389025.045 | 842.113 | 52B20110519SPR | 842.13 | -0.02 |
| 15402 | 7067210.201 | 389039.778 | 841.454 | 52B20110519SPR | 841.47 | -0.02 |
| 15403 | 7067202.872 | 389053.139 | 840.845 | 52B20110519SPR | 840.87 | -0.02 |
| 15404 | 7067107.022 | 389330.269 | 841.148 | 52B20110519SPR | 841.19 | -0.04 |
| 15405 | 7067098.333 | 389350.747 | 841.971 | 52B20110519SPR | 842.03 | -0.06 |
| 15406 | 7067090.851 | 389368.357 | 842.742 | 52B20110519SPR | 842.79 | -0.05 |
| 15407 | 7066992.525 | 389655.126 | 854.783 | 52B20110519SPR | 854.83 | -0.05 |
| 15408 | 7066987.508 | 389673.469 | 855.364 | 52B20110519SPR | 855.41 | -0.05 |
| 15409 | 7066981.97 | 389691.863 | 855.941 | 52B20110519SPR | 855.98 | -0.04 |
| 15410 | 7066891.114 | 389998.953 | 868.43 | 52B20110519SPR | 868.47 | -0.04 |
| 15411 | 7066885.625 | 390015.99 | 869.144 | 52B20110519SPR | 869.18 | -0.04 |
| 15412 | 7066880.473 | 390033.785 | 869.852 | 52B20110519SPR | 869.87 | -0.02 |
| 15413 | 7066792.606 | 390454.829 | 883.579 | 52B20110519SPR | 883.64 | -0.06 |
| 15414 | 7066790.844 | 390472.838 | 884.108 | 52B20110519SPR | 884.14 | -0.03 |
| 15415 | 7066788.846 | 390492.466 | 884.664 | 52B20110519SPR | 884.72 | -0.06 |
| 15416 | 7066745.491 | 390899.585 | 897.596 | 52B20110519SPR | 897.65 | -0.05 |
| 15417 | 7066743.195 | 390922.72 | 898.344 | 52B20110519SPR | 898.38 | -0.04 |
| 15418 | 7066740.802 | 390942.048 | 898.944 | 52B20110519SPR | 898.98 | -0.04 |
| 15419 | 7066699.204 | 391332.581 | 909.671 | 52B20110519SPR | 909.71 | -0.04 |
| 15420 | 7066697.009 | 391352.712 | 910.044 | 52B20110519SPR | 910.07 | -0.03 |
| 15421 | 7066694.986 | 391371.969 | 910.365 | 52B20110519SPR | 910.39 | -0.02 |
| 15422 | 7067446.841 | 388697.424 | 849.226 | 52B20110519SPR | 849.27 | -0.04 |
| 15423 | 7067438.452 | 388712.515 | 849.015 | 52B20110519SPR | 849.05 | -0.03 |
| 15424 | 7067430.021 | 388727.797 | 848.785 | 52B20110519SPR | 848.8 | -0.01 |
| 15425 | 7067229.653 | 388650.03 | 838.472 | 52B20110519SPR | 838.55 | -0.08 |
| 15426 | 7067242.248 | 388640.179 | 838.802 | 52B20110519SPR | 838.84 | -0.04 |
| 15427 | 7067255.492 | 388631.652 | 839.202 | 52B20110519SPR | 839.21 | -0.01 |
| 15428 | 7067217.612 | 388656.426 | 838.355 | 52B20110519SPK | 838.36 | 0.00 |
| 15429 | 7067223.488 | 388652.439 | 838.391 | 52B20110519SPK | 838.41 | -0.02 |
| 15430 | 7068995.323 | 385464.932 | 889.436 | 52B20110519SGR | 889.44 | 0.00 |
| 15431 | 7068989.614 | 385447.868 | 890.526 | 52B20110519SGR | 890.55 | -0.02 |
| 15432 | 7068984.682 | 385407.738 | 892.947 | 52B20110519SGR | 892.93 | 0.02 |
| 15433 | 7069214.666 | 384130.829 | 954.971 | 52B20110519SGR | 954.97 | 0.00 |
| 15434 | 7069221.366 | 384111.245 | 955.986 | 52B20110519SGR | 955.95 | 0.04 |
| 15435 | 7069223.989 | 384102.198 | 956.354 | 52B20110519SGR | 956.35 | 0.00 |
| 15436 | 7068865.978 | 383633.544 | 958.69 | 52B20110519SGR | 958.69 | 0.00 |
| 15437 | 7068877.25 | 383645.452 | 958.691 | 52B20110519SGR | 958.66 | 0.03 |
| 15438 | 7067216.461 | 389039.497 | 841.337 | 52B20110519SPK | 841.33 | 0.01 |
| 15500 | 7067217.619 | 388656.43 | 838.377 | 52C2011062152CFAC | 838.36 | 0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 15501 | 7066576.711 | 395709.161 | 885.107 | 52C20110621TRIANGLE | 885.08 | 0.03 |
| 15502 | 7066569.535 | 395672.657 | 885.768 | 52C20110621SPR | 885.75 | 0.02 |
| 15503 | 7066551.941 | 395609.414 | 887.38 | 52C20110621SPR | 887.39 | -0.01 |
| 15504 | 7066539.112 | 395540.765 | 889.035 | 52C20110621SPR | 889.01 | 0.02 |
| 15505 | 7066521.073 | 395475.779 | 891.059 | 52C20110621SPR | 891.01 | 0.05 |
| 15506 | 7066504.395 | 395391.171 | 894.599 | 52C20110621SPR | 894.56 | 0.04 |
| 15507 | 7066488.133 | 395333.173 | 897.267 | 52C20110621SPR | 897.22 | 0.05 |
| 15508 | 7066472.038 | 395250.247 | 900.915 | 52C20110621SPR | 900.86 | 0.05 |
| 15509 | 7066449.848 | 395167.619 | 904.632 | 52C20110621SPR | 904.62 | 0.01 |
| 15510 | 7066436.179 | 395089.528 | 907.688 | 52C20110621SPR | 907.65 | 0.04 |
| 15511 | 7066435.981 | 394982.891 | 911.326 | 52C20110621SPR | 911.31 | 0.02 |
| 15512 | 7066459.485 | 394907.221 | 914.227 | 52C20110621SPR | 914.21 | 0.02 |
| 15513 | 7066480.588 | 394825.18 | 917.794 | 52C20110621SPR | 917.74 | 0.05 |
| 15514 | 7066509.855 | 394737.381 | 920.807 | 52C20110621SPR | 920.76 | 0.05 |
| 15515 | 7066526.617 | 394670.62 | 922.908 | 52C20110621SPR | 922.89 | 0.02 |
| 15516 | 7066556.09 | 394581.244 | 925.418 | 52C20110621SPR | 925.4 | 0.02 |
| 15517 | 7066571.915 | 394500.566 | 927.424 | 52C20110621SPR | 927.39 | 0.03 |
| 15518 | 7066606.319 | 394492.082 | 928.238 | 52C20110621FAC_FHA_MP9 | 928.25 | -0.01 |
| 15519 | 7066606.317 | 394492.075 | 928.232 | 52C20110621FAC_FHA_MP9 | 928.25 | -0.02 |
| 15520 | 7066606.93 | 394411.182 | 929.221 | 52C20110621SPR | 929.22 | 0.00 |
| 15521 | 7066628.042 | 394324.151 | 930.681 | 52C20110621SPR | 930.66 | 0.02 |
| 15522 | 7066652.035 | 394225.464 | 931.156 | 52C20110621SPR | 931.15 | 0.01 |
| 15523 | 7066677.774 | 394098.857 | 931.898 | 52C20110621SPR | 931.89 | 0.01 |
| 15524 | 7066693.796 | 394004.082 | 933.341 | 52C20110621SPR | 933.32 | 0.02 |
| 15525 | 7066721.565 | 393868.359 | 932.407 | 52C20110621SPR | 932.37 | 0.04 |
| 15526 | 7066748.799 | 393750.37 | 932.142 | 52C20110621SPR | 932.09 | 0.05 |
| 15527 | 7066767.059 | 393643.65 | 930.242 | 52C20110621SPR | 930.22 | 0.02 |
| 15528 | 7066800.572 | 393492.714 | 924.773 | 52C20110621SPR | 924.73 | 0.04 |
| 15529 | 7066800.574 | 393492.715 | 924.772 | 52C20110621SPR | 924.73 | 0.04 |
| 15530 | 7066807.174 | 393363.928 | 921.179 | 52C20110621SPR | 921.15 | 0.03 |
| 15531 | 7066796.848 | 393238.825 | 916.096 | 52C20110621SPR | 916.08 | 0.02 |
| 15532 | 7066775.557 | 393129.494 | 913.927 | 52C20110621SPR | 913.9 | 0.03 |
| 15533 | 7066759.818 | 393017.283 | 913.643 | 52C20110621SPR | 913.61 | 0.03 |
| 15534 | 7066743.867 | 392939.035 | 913.652 | 52C20110621SPR | 913.65 | 0.00 |
| 15535 | 7066725.096 | 392807.35 | 916.359 | 52C20110621SPR | 916.33 | 0.03 |
| 15536 | 7066704.784 | 392704.578 | 916.721 | 52C20110621SPR | 916.68 | 0.04 |
| 15537 | 7066698.401 | 392647.268 | 916.814 | 52C20110621SPR | 916.81 | 0.00 |
| 15538 | 7066698.125 | 392601.838 | 916.795 | 52C20110621SPR | 916.81 | -0.01 |
| 15539 | 7066678.614 | 392530.924 | 916.963 | 52C20110621SPR | 916.96 | 0.00 |
| 15540 | 7066654.6 | 392406.992 | 917.166 | 52C20110621SPR | 917.18 | -0.01 |
| 15541 | 7066636.249 | 392277.864 | 917.393 | 52C20110621SPR | 917.38 | 0.01 |
| 15542 | 7066630.038 | 392141.329 | 916.295 | 52C20110621SPR | 916.31 | -0.01 |
| 15543 | 7066641.881 | 392012.155 | 915.554 | 52C20110621SPR | 915.57 | -0.02 |
| 15544 | 7066634.809 | 391936.471 | 916.102 | 52C20110621SPR | 916.11 | -0.01 |
| 15545 | 7066652.241 | 391855.815 | 916.98 | 52C20110621SPR | 916.96 | 0.02 |
| 15546 | 7066661.602 | 391693.779 | 915.383 | 52C20110621SPR | 915.36 | 0.02 |
| 15547 | 7066677.042 | 391576.52 | 913.49 | 52C20110621SPR | 913.48 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 15548 | 7066687.928 | 391520.462 | 912.678 | 52C20110621SPR | 912.68 | 0.00 |
| 15549 | 7066688.147 | 391471.327 | 911.953 | 52C20110621SPR | 911.98 | -0.03 |
| 15550 | 7066696.542 | 391391.018 | 910.668 | 52C20110621SPR | 910.69 | -0.02 |
| 15551 | 7066710.317 | 391232.556 | 907.329 | 52C20110621SPR | 907.34 | -0.01 |
| 15552 | 7066723.875 | 391134.916 | 904.523 | 52C20110621SPR | 904.55 | -0.03 |
| 15553 | 7066735.528 | 391024.378 | 901.361 | 52C20110621SPR | 901.39 | -0.03 |
| 15554 | 7066744.031 | 390916.834 | 898.18 | 52C20110621SPR | 898.2 | -0.02 |
| 15555 | 7066757.968 | 390814.609 | 894.908 | 52C20110621SPR | 894.95 | -0.04 |
| 15556 | 7066767.005 | 390727.98 | 892.055 | 52C20110621SPR | 892.06 | 0.00 |
| 15557 | 7066772.237 | 390651.148 | 889.634 | 52C20110621SPR | 889.69 | -0.06 |
| 15558 | 7066788.113 | 390529.674 | 885.696 | 52C20110621SPR | 885.71 | -0.01 |
| 15559 | 7066797.047 | 390416.666 | 882.358 | 52C20110621SPR | 882.37 | -0.01 |
| 15560 | 7066817.355 | 390271.601 | 876.792 | 52C20110621SPR | 876.83 | -0.04 |
| 15561 | 7066847.061 | 390149.838 | 873.2 | 52C20110621SPR | 873.22 | -0.02 |
| 15562 | 7066875.003 | 390064.954 | 870.968 | 52C20110621SPR | 870.97 | 0.00 |
| 15563 | 7066885.621 | 389992.627 | 868.132 | 52C20110621SPR | 868.18 | -0.05 |
| 15564 | 7066913.972 | 389932.715 | 865.628 | 52C20110621SPR | 865.62 | 0.01 |
| 15565 | 7066944.533 | 389818.225 | 860.556 | 52C20110621SPR | 860.58 | -0.02 |
| 15566 | 7066984.464 | 389694.937 | 856.026 | 52C20110621SPR | 856.05 | -0.02 |
| 15567 | 7067015.832 | 389578.308 | 852.401 | 52C20110621SPR | 852.42 | -0.02 |
| 15568 | 7067046.23 | 389488.006 | 848.679 | 52C20110621SPR | 848.68 | 0.00 |
| 15569 | 7067083.648 | 389385.131 | 843.572 | 52C20110621SPR | 843.59 | -0.02 |
| 15570 | 7067131.047 | 389284.364 | 839.485 | 52C20110621SPR | 839.5 | -0.01 |
| 15571 | 7067162.791 | 389195.45 | 837.52 | 52C20110621SPR | 837.53 | -0.01 |
| 15572 | 7067193.128 | 389089.679 | 839.368 | 52C20110621SPR | 839.35 | 0.02 |
| 15573 | 7067216.477 | 389039.492 | 841.351 | 52C2011062152B_CK_PK | 841.33 | 0.02 |
| 15574 | 7067261.947 | 388972.292 | 844.808 | 52C20110621SPR | 844.79 | 0.02 |
| 15575 | 7067341.656 | 388877.843 | 848.367 | 52C20110621SPR | 848.35 | 0.02 |
| 15576 | 7067393.349 | 388794.507 | 848.222 | 52C20110621SPR | 848.19 | 0.03 |
| 15577 | 7067440.39 | 388715.916 | 849.08 | 52C20110621SPR | 849.07 | 0.01 |
| 15578 | 7067387.635 | 388682.786 | 845.237 | 52C20110621SPR | 845.22 | 0.02 |
| 15579 | 7067325.773 | 388620.009 | 841.718 | 52C20110621SPR | 841.69 | 0.03 |
| 15580 | 7067228.935 | 388651.847 | 838.498 | 52C20110621SPR | 838.51 | -0.01 |
| 15581 | 7067223.515 | 388652.437 | 838.439 | 52C20110621CK_PK | 838.41 | 0.03 |
| 15582 | 7067271.307 | 388693.462 | 840.591 | 52C20110621SPR | 840.56 | 0.03 |
| 15583 | 7067369.151 | 388702.127 | 844.432 | 52C20110621SPR | 844.39 | 0.04 |
| 15584 | 7067503.035 | 388603.086 | 850.417 | 52C20110621SPR | 850.39 | 0.03 |
| 15585 | 7067541.421 | 388527.52 | 850.238 | 52C20110621SPR | 850.22 | 0.02 |
| 15586 | 7067621.333 | 388389.521 | 848.21 | 52C20110621SPR | 848.18 | 0.03 |
| 15587 | 7067686.778 | 388266.009 | 846.342 | 52C20110621SPR | 846.3 | 0.04 |
| 15588 | 7067781.513 | 388102.323 | 841.95 | 52C20110621SPR | 841.9 | 0.05 |
| 15589 | 7067852.732 | 388021.785 | 839.343 | 52C20110621SPR | 839.29 | 0.05 |
| 15590 | 7068008.314 | 387927.153 | 835.185 | 52C20110621SPR | 835.15 | 0.03 |
| 15591 | 7068112.153 | 387859.315 | 832.263 | 52C20110621SPR | 832.22 | 0.04 |
| 15592 | 7068232.034 | 387788.59 | 829.89 | 52C20110621SPR | 829.86 | 0.03 |
| 15593 | 7068335.605 | 387722.086 | 828.041 | 52C20110621SPR | 828.01 | 0.03 |
| 15594 | 7068393.773 | 387660.89 | 825.378 | 52C20110621SPR | 825.33 | 0.05 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 15595 | 7068453.588 | 387556.734 | 819.994 | 52C20110621SPR | 819.94 | 0.05 |
| 15596 | 7068513.129 | 387462.661 | 815.835 | 52C20110621SPR | 815.77 | 0.07 |
| 15597 | 7068553.079 | 387396.002 | 813.054 | 52C20110621SPR | 813 | 0.05 |
| 15598 | 7068677.951 | 387328.647 | 806.794 | 52C20110621SPR | 806.73 | 0.06 |
| 15599 | 7068760.044 | 387329.591 | 805.265 | 52C20110621SPR | 805.18 | 0.09 |
| 15600 | 7068914.724 | 387308.842 | 813.117 | 52C20110621SPR | 813.02 | 0.10 |
| 15601 | 7069090.517 | 387293.297 | 824.483 | 52C20110621SPR | 824.4 | 0.08 |
| 15602 | 7069231.356 | 387231.107 | 826.513 | 52C20110621SPR | 826.49 | 0.02 |
| 15603 | 7069268.685 | 387141.92 | 827.42 | 52C20110621SPR | 827.38 | 0.04 |
| 15604 | 7069386.565 | 387071.875 | 825.309 | 52C20110621SPR | 825.29 | 0.02 |
| 15605 | 7069513.771 | 387002.617 | 818.64 | 52C20110621SPR | 818.61 | 0.03 |
| 15606 | 7069654.166 | 386907.014 | 808.321 | 52C20110621SPR | 808.32 | 0.00 |
| 15607 | 7069738.082 | 386861.956 | 803.759 | 52C20110621SPR | 803.71 | 0.05 |
| 15608 | 7069874.285 | 386876.519 | 794.957 | 52C20110621SPR | 794.92 | 0.04 |
| 15609 | 7069948.984 | 386918.059 | 793.909 | 52C20110621SPR | 793.87 | 0.04 |
| 15610 | 7070035.585 | 386906.337 | 789.649 | 52C20110621SPR | 789.62 | 0.03 |
| 15611 | 7070071.832 | 386899.816 | 788.834 | 52C2011062152A | 788.76 | 0.07 |
| 15612 | 7070071.829 | 386899.825 | 788.824 | 52C2011062152A | 788.77 | 0.05 |
| 15613 | 7070061.885 | 386889.616 | 788.42 | 52C2011062152A_CK_PK | 788.4 | 0.02 |
| 15614 | 7070061.887 | 386889.609 | 788.418 | 52C2011062152A_CK_PK | 788.4 | 0.02 |
| 15615 | 7069917.379 | 386852.142 | 792.806 | 52C20110621SPR | 792.79 | 0.02 |
| 15620 | 7069961.547 | 386667.201 | 794.292 | 52C20110621SPR | 794.24 | 0.05 |
| 15621 | 7069938.825 | 386609.637 | 798.601 | 52C20110621SPR | 798.56 | 0.04 |
| 15622 | 7069912.269 | 386516.962 | 806.946 | 52C20110621SGR | 806.89 | 0.06 |
| 15623 | 7069932.716 | 386440.841 | 812.623 | 52C20110621SGR | 812.59 | 0.03 |
| 15624 | 7069950.061 | 386366.22 | 816.963 | 52C20110621SGR | 816.88 | 0.08 |
| 15625 | 7069858.418 | 386276.889 | 822.908 | 52C20110621SGR | 822.84 | 0.07 |
| 15626 | 7069766.183 | 386217.57 | 828.943 | 52C20110621SGR | 828.9 | 0.04 |
| 15627 | 7069669.436 | 386134.834 | 835.609 | 52C20110621SGR | 835.56 | 0.05 |
| 15628 | 7069563.993 | 386054.325 | 841.692 | 52C20110621SGR | 841.67 | 0.02 |
| 15629 | 7069517.368 | 386021.555 | 844.907 | 52C20110621SGR | 844.86 | 0.05 |
| 15630 | 7069418.335 | 385929.815 | 851.486 | 52C20110621SGR | 851.45 | 0.04 |
| 15631 | 7069311.84 | 385852.278 | 858.325 | 52C20110621SGR | 858.28 | 0.05 |
| 15632 | 7069216.378 | 385771.532 | 865.971 | 52C20110621SGR | 865.92 | 0.05 |
| 15633 | 7069101.453 | 385662.687 | 876.517 | 52C20110621SGR | 876.45 | 0.07 |
| 15634 | 7069022.019 | 385529.937 | 885.74 | 52C20110621SGR | 885.68 | 0.06 |
| 15635 | 7068981.918 | 385374.767 | 894.953 | 52C20110621SGR | 894.87 | 0.08 |
| 15636 | 7068985.533 | 385285.834 | 899.81 | 52C20110621SGR | 899.74 | 0.07 |
| 15637 | 7069001.722 | 385186.276 | 904.707 | 52C20110621SGR | 904.65 | 0.06 |
| 15638 | 7069020.591 | 385086.043 | 909.34 | 52C20110621SGR | 909.3 | 0.04 |
| 15639 | 7069073.169 | 384940.39 | 917.298 | 52C20110621SGR | 917.28 | 0.02 |
| 15640 | 7069047.716 | 384847.502 | 920.188 | 52C20110621SGR | 920.16 | 0.03 |
| 15641 | 7069059.378 | 384701.259 | 926.535 | 52C20110621SGR | 926.49 | 0.04 |
| 15642 | 7069141.536 | 384594.163 | 933.328 | 52C20110621SGR | 933.33 | 0.00 |
| 15643 | 7069192.971 | 384454.832 | 940.707 | 52C20110621SGR | 940.68 | 0.03 |
| 15644 | 7069192.012 | 384354.301 | 945.293 | 52C20110621SGR | 945.22 | 0.07 |
| 15645 | 7069196.492 | 384210.725 | 951.29 | 52C20110621SGR | 951.28 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 15646 | 7069239.85 | 384041.727 | 958.85 | 52C20110621SGR | 958.83 | 0.02 |
| 15647 | 7069178.897 | 383890.317 | 960.186 | 52C20110621SGR | 960.13 | 0.06 |
| 15648 | 7069039.769 | 383793.776 | 959.448 | 52C20110621SGR | 959.41 | 0.04 |
| 15649 | 7068917.427 | 383681.691 | 958.714 | 52C20110621SGR | 958.67 | 0.04 |
| 15650 | 7068840.94 | 383574.623 | 958.173 | 52C20110621SGR | 958.11 | 0.06 |
| 15651 | 7068868.993 | 383460.854 | 956.766 | 52C20110621SGR | 956.71 | 0.06 |
| 15652 | 7068989.022 | 383307.745 | 952.6 | 52C20110621SGR | 952.55 | 0.05 |
| 15653 | 7069088.626 | 383184.187 | 951.666 | 52C20110621SGR | 951.6 | 0.07 |
| 15654 | 7069152.482 | 383069.617 | 951.883 | 52C20110621SGR | 951.87 | 0.01 |
| 15655 | 7069013.996 | 382988.529 | 952.876 | 52C20110621SGR | 952.82 | 0.06 |
| 15656 | 7068793.453 | 382945.456 | 949.869 | 52C20110621SGR | 949.85 | 0.02 |
| 15657 | 7068663.589 | 382976.566 | 948.197 | 52C20110621SGR | 948.18 | 0.02 |
| 15658 | 7068511.521 | 382980.296 | 948.229 | 52C20110621SGR | 948.15 | 0.08 |
| 15659 | 7068359.329 | 382886.514 | 947.28 | 52C20110621SGR | 947.3 | -0.02 |
| 15660 | 7068282.722 | 382731.9 | 945.56 | 52C20110621SGR | 945.53 | 0.03 |
| 15661 | 7068200.659 | 382557.289 | 944.351 | 52C20110621SGR | 944.31 | 0.04 |
| 15662 | 7068250.057 | 382423.597 | 944.008 | 52C20110621SGR | 943.95 | 0.06 |
| 15663 | 7068340.977 | 382317.107 | 941.334 | 52C20110621SGR | 941.32 | 0.01 |
| 15664 | 7068265.277 | 382270.787 | 941.193 | 52C20110621SGR | 941.12 | 0.07 |
| 15665 | 7068139.784 | 382190.226 | 944.828 | 52C20110621SGR | 944.79 | 0.04 |
| 15666 | 7067995.08 | 382079.73 | 947.802 | 52C20110621SGR | 947.76 | 0.04 |
| 15667 | 7067928.104 | 381983.939 | 947.496 | 52C20110621SGR | 947.47 | 0.03 |
| 15668 | 7067821.1 | 381944.578 | 944.957 | 52C20110621SGR | 944.95 | 0.01 |
| 15669 | 7067731.183 | 381932.519 | 943.227 | 52C20110621SGR | 943.19 | 0.04 |
| 15670 | 7067649.791 | 381860.738 | 941.279 | 52C20110621SGR | 941.21 | 0.07 |
| 15671 | 7067677.446 | 381740.758 | 936.202 | 52C20110621SGR | 936.17 | 0.03 |
| 15672 | 7067730.593 | 381624.313 | 930.018 | 52C20110621SGR | 930 | 0.02 |
| 15673 | 7067836.615 | 381488.151 | 924.212 | 52C20110621SGR | 924.18 | 0.03 |
| 15674 | 7067879.848 | 381307.68 | 916.23 | 52C20110621SGR | 916.2 | 0.03 |
| 15675 | 7068913.413 | 378467.539 | 748.056 | 52C20110621SGR | 748.03 | 0.03 |
| 15676 | 7068971.76 | 378561.272 | 747.884 | 52C20110621SGR | 747.82 | 0.06 |
| 15677 | 7067215.848 | 377086.669 | 784.571 | 52C20110621SGR | 784.56 | 0.01 |
| 15678 | 7067174.914 | 377056.582 | 787.312 | 52C20110621SGR | 787.28 | 0.03 |
| 15679 | 7067131.152 | 377018.379 | 790.184 | 52C20110621SGR | 790.15 | 0.03 |
| 15680 | 7067074.339 | 376968.108 | 793.883 | 52C20110621SGR | 793.88 | 0.00 |
| 15681 | 7067039.341 | 376938.325 | 796.282 | 52C20110621SGR | 796.28 | 0.00 |
| 15682 | 7067000.111 | 376891.574 | 799.739 | 52C20110621SGR | 799.76 | -0.02 |
| 15683 | 7066976.773 | 376830.424 | 803.352 | 52C20110621SGR | 803.39 | -0.04 |
| 15684 | 7066958.222 | 376778.238 | 806.059 | 52C20110621SGR | 806.07 | -0.01 |
| 15685 | 7066943.29 | 376714.845 | 809.078 | 52C20110621SGR | 809.04 | 0.04 |
| 15686 | 7066969.068 | 376628.523 | 814.07 | 52C20110621SGR | 814.05 | 0.02 |
| 15687 | 7067005.863 | 376535.93 | 816.927 | 52C20110621SGR | 816.91 | 0.02 |
| 15688 | 7067067.603 | 376355.967 | 818.978 | 52C20110621SGR | 818.92 | 0.06 |
| 15689 | 7066576.75 | 395709.137 | 885.1 | 52C20110621TRIANGLE | 885.07 | 0.03 |
| 15690 | 7067453.545 | 374232.37 | 726.285 | 52C20110621 | 726.26 | 0.02 |
| 15691 | 7068431.09 | 377837.488 | 753.252 | 52C20110621 | 753.18 | 0.07 |
| 15692 | 7068477.493 | 377842.988 | 752.396 | 52C20110621 | 752.65 | -0.25 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 15693 | 7067468.348 | 374239.965 | 725.729 | 52C20110621 | 726.02 | -0.29 |
| 15700 | 7104244.898 | 393788.082 | 345.148 | 53B2011051653BSAC | 345.13 | 0.02 |
| 15701 | 7104247.96 | 393788.205 | 344.762 | 53B20110517SSP | 344.74 | 0.02 |
| 15702 | 7104242.106 | 393779.251 | 345.747 | 53B20110518SPR | 345.72 | 0.03 |
| 15703 | 7104229.921 | 393786.546 | 345.845 | 53B20110519SPR | 345.81 | 0.04 |
| 15704 | 7104216.05 | 393794.798 | 345.953 | 53B20110520SPR | 345.93 | 0.02 |
| 15705 | 7104823.746 | 393433.556 | 340.78 | 53B20110521SPR | 340.75 | 0.03 |
| 15706 | 7104842.818 | 393422.234 | 340.631 | 53B20110522SPR | 340.59 | 0.04 |
| 15707 | 7104857.481 | 393413.177 | 340.473 | 53B20110523SPR | 340.44 | 0.03 |
| 15708 | 7105430.794 | 393147.839 | 334.576 | 53B20110524SPR | 334.58 | 0.00 |
| 15709 | 7105446.103 | 393140.988 | 334.46 | 53B20110525SPR | 334.47 | -0.01 |
| 15710 | 7105462.483 | 393134.255 | 334.442 | 53B20110526SPR | 334.4 | 0.04 |
| 15711 | 7105956.781 | 392872.096 | 332.846 | 53B20110527SPR | 332.83 | 0.02 |
| 15712 | 7105972.057 | 392863.939 | 332.709 | 53B20110528SPR | 332.68 | 0.03 |
| 15713 | 7105989.87 | 392854.603 | 332.556 | 53B20110529SPR | 332.54 | 0.02 |
| 15714 | 7106547.195 | 392684.281 | 327.573 | 53B20110530SPR | 327.55 | 0.02 |
| 15715 | 7106566.447 | 392684.251 | 327.377 | 53B20110531SPR | 327.35 | 0.03 |
| 15716 | 7106584.992 | 392684.825 | 327.116 | 53B20110532SPR | 327.11 | 0.01 |
| 15717 | 7107280.929 | 392642.37 | 323.835 | 53B20110533SPR | 323.83 | 0.00 |
| 15718 | 7107297.395 | 392638.138 | 323.784 | 53B20110534SPR | 323.8 | -0.02 |
| 15719 | 7107314.604 | 392633.183 | 323.692 | 53B20110535SPR | 323.69 | 0.00 |
| 15720 | 7107830.304 | 392355.376 | 321.573 | 53B20110536SPR | 321.57 | 0.00 |
| 15721 | 7107844.295 | 392343.927 | 321.461 | 53B20110537SPR | 321.5 | -0.04 |
| 15722 | 7107857.884 | 392333.103 | 321.401 | 53B20110538SPR | 321.44 | -0.04 |
| 15723 | 7108409.35 | 391889.9 | 317.479 | 53B20110539SPR | 317.49 | -0.01 |
| 15724 | 7108427.187 | 391874.499 | 317.375 | 53B20110540SPR | 317.38 | 0.00 |
| 15725 | 7108441.889 | 391863.781 | 317.233 | 53B20110541SPR | 317.24 | -0.01 |
| 15726 | 7108802.785 | 391591.066 | 310.928 | 53B20110542SPR | 310.94 | -0.01 |
| 15727 | 7108821.702 | 391576.16 | 310.52 | 53B20110543SPR | 310.52 | 0.00 |
| 15728 | 7108834.281 | 391570.324 | 310.118 | 53B20110544SPR | 310.14 | -0.02 |
| 15729 | 7103837.012 | 394053.583 | 350.67 | 53B20110545SPR | 350.68 | -0.01 |
| 15730 | 7103824.58 | 394064.271 | 350.863 | 53B20110546SPR | 350.83 | 0.03 |
| 15731 | 7103811.737 | 394074.845 | 351.04 | 53B20110547SPR | 351 | 0.04 |
| 15732 | 7103465.037 | 394360.524 | 351.271 | 53B20110548SPR | 351.24 | 0.03 |
| 15733 | 7103452.039 | 394370.904 | 350.916 | 53B20110549SPR | 350.93 | -0.01 |
| 15734 | 7103438.408 | 394382.661 | 350.617 | 53B20110550SPR | 350.6 | 0.02 |
| 15735 | 7102967.148 | 394760.189 | 342.571 | 53B20110551SSP | 342.47 | 0.10 |
| 15736 | 7102973.358 | 394766.433 | 342.965 | 53B20110552SPR | 342.95 | 0.01 |
| 15737 | 7102960.882 | 394777.848 | 342.845 | 53B20110553SPR | 342.84 | 0.01 |
| 15738 | 7102948.476 | 394788.961 | 342.8 | 53B20110554SPR | 342.8 | 0.00 |
| 15800 | 7143903.722 | 402775.413 | 138.164 | 54B2011062554BFAC | 138.16 | 0.00 |
| 15801 | 7139519.666 | 401798.052 | 147.301 | 54B20110625SPR | 147.25 | 0.05 |
| 15802 | 7139642.153 | 402037.294 | 147.273 | 54B20110625SPR | 147.23 | 0.04 |
| 15803 | 7139696.598 | 402085.8 | 147.016 | 54B20110625SPR | 146.95 | 0.07 |
| 15804 | 7139915.877 | 402171.545 | 146.159 | 54B20110625SPR | 146.07 | 0.09 |
| 15805 | 7139965.949 | 402178.632 | 145.671 | 54B20110625SPR | 145.59 | 0.08 |
| 15806 | 7140215.392 | 402214.472 | 144.983 | 54B20110625SPR | 144.85 | 0.13 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 15807 | 7140412.12 | 402260.368 | 144.771 | 54B20110625SPR | 144.68 | 0.09 |
| 15808 | 7140744.743 | 402396.508 | 144.44 | 54B20110625SPR | 144.31 | 0.13 |
| 15809 | 7141051.715 | 402580.042 | 143.275 | 54B20110625SPR | 143.17 | 0.11 |
| 15810 | 7141196.621 | 402663.128 | 142.777 | 54B20110625SPR | 142.75 | 0.03 |
| 15811 | 7141357.895 | 402736.091 | 142.503 | 54B20110625SPR | 142.47 | 0.03 |
| 15812 | 7141509.715 | 402787.598 | 142.393 | 54B20110625SPR | 142.36 | 0.03 |
| 15813 | 7141729.04 | 402840.274 | 141.932 | 54B20110625SPR | 141.92 | 0.01 |
| 15814 | 7141859.431 | 402869.887 | 141.852 | 54B20110625SPR | 141.83 | 0.02 |
| 15815 | 7141847.792 | 402863.717 | 141.88 | 54B20110625SPR | 141.85 | 0.03 |
| 15816 | 7141835.336 | 402864.526 | 141.9 | 54B20110625SPR | 141.9 | 0.00 |
| 15817 | 7141824.077 | 402858.446 | 141.912 | 54B20110625SPR | 141.89 | 0.02 |
| 15818 | 7141848.129 | 402879.223 | 140.987 | 54B20110625CK_SPIKE | 141.03 | -0.04 |
| 15819 | 7141848.135 | 402879.227 | 140.998 | 54B20110625CK_SPIKE | 141.03 | -0.03 |
| 15820 | 7141963.807 | 402893.652 | 141.715 | 54B20110625SPR | 141.66 | 0.06 |
| 15821 | 7142148.143 | 402935.466 | 141.436 | 54B20110625SPR | 141.41 | 0.03 |
| 15822 | 7142405.009 | 402993.605 | 141.282 | 54B20110625SPR | 141.22 | 0.06 |
| 15823 | 7142571.931 | 403018.241 | 141.017 | 54B20110625SPR | 140.99 | 0.03 |
| 15824 | 7142886.29 | 402983.737 | 140.137 | 54B20110625SPR | 140.11 | 0.03 |
| 15825 | 7143155.836 | 402931.942 | 139.341 | 54B20110625SPR | 139.3 | 0.04 |
| 15826 | 7143411.893 | 402882.715 | 138.934 | 54B20110625SPR | 138.86 | 0.07 |
| 15827 | 7143740.924 | 402812.141 | 139.031 | 54B20110625SPR | 138.98 | 0.05 |
| 15828 | 7143895.326 | 402760.88 | 138.807 | 54B20110625SPR | 138.77 | 0.04 |
| 15829 | 7143883.482 | 402761.282 | 138.709 | 54B20110625SPR | 138.67 | 0.04 |
| 15830 | 7143869.589 | 402770.132 | 138.857 | 54B20110625SPR | 138.85 | 0.01 |
| 15831 | 7143853.865 | 402772.332 | 138.809 | 54B20110625SPR | 138.75 | 0.06 |
| 15832 | 7143906.717 | 402775.95 | 137.986 | 54B20110625CK_SPIKE | 137.99 | 0.00 |
| 15833 | 7143906.716 | 402775.946 | 137.988 | 54B20110625CK_SPIKE | 137.99 | 0.00 |
| 15834 | 7143973.595 | 402728.955 | 138.639 | 54B20110625SPR | 138.59 | 0.05 |
| 15835 | 7144224.079 | 402620.903 | 138.282 | 54B20110625SPR | 138.22 | 0.06 |
| 15836 | 7144403.788 | 402530.722 | 137.997 | 54B20110625SPR | 137.94 | 0.06 |
| 15837 | 7144621.383 | 402369.757 | 136.841 | 54B20110625SPR | 136.78 | 0.06 |
| 15838 | 7144833.436 | 402208.786 | 136.323 | 54B20110625SPR | 136.25 | 0.07 |
| 15839 | 7145082.406 | 402026.83 | 135.971 | 54B20110625SPR | 135.91 | 0.06 |
| 15840 | 7145358.198 | 401946.426 | 135.476 | 54B20110625SPR | 135.43 | 0.05 |
| 15841 | 7145748.6 | 401979.334 | 133.843 | 54B20110625SPR | 133.78 | 0.06 |
| 15842 | 7146133.501 | 401969.233 | 133.377 | 54B20110625SPR | 133.35 | 0.03 |
| 15843 | 7146386.995 | 401814.281 | 132.821 | 54B20110625SPR | 132.77 | 0.05 |
| 15844 | 7146622.839 | 401606.313 | 132.107 | 54B20110625SPR | 132.06 | 0.05 |
| 15845 | 7146847.208 | 401420.345 | 131.688 | 54B20110625SPR | 131.62 | 0.07 |
| 15846 | 7147303.33 | 401277.819 | 130.742 | 54B20110625SPR | 130.66 | 0.08 |
| 15847 | 7147551.399 | 401249.162 | 130.244 | 54B20110625SPR | 130.19 | 0.05 |
| 15848 | 7147852.733 | 401214.797 | 129.399 | 54B20110625SPR | 129.34 | 0.06 |
| 15849 | 7148164.988 | 401178.662 | 129.217 | 54B20110625SPR | 129.14 | 0.08 |
| 15850 | 7148792.597 | 401209.874 | 128.411 | 54B20110625SPR | 128.37 | 0.04 |
| 15851 | 7149105.005 | 401257.787 | 128.116 | 54B20110625SPR | 128.05 | 0.07 |
| 15852 | 7149385.952 | 401301.166 | 128.069 | 54B20110625SPR | 128.04 | 0.03 |
| 15853 | 7149761.565 | 401357.722 | 128.341 | 54B20110625SPR | 128.28 | 0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 15854 | 7149920.112 | 401382.396 | 127.612 | 54B20110625SPR | 127.54 | 0.07 |
| 15855 | 7139513.606 | 401787.899 | 147.251 | 54B20110625SPR | 147.21 | 0.04 |
| 15900 | 7123411.788 | 390206.243 | 228.462 | 54C2011062454CFAC | 228.46 | 0.00 |
| 15901 | 7119162.942 | 388411.07 | 254.16 | 54C20110624CK_PK | 254.15 | 0.01 |
| 15902 | 7119162.939 | 388411.053 | 254.155 | 54C20110624CK_PK | 254.16 | 0.00 |
| 15903 | 7119169.854 | 388405.421 | 254.165 | 54C20110624SPR | 254.14 | 0.03 |
| 15904 | 7119176.842 | 388399.165 | 254.102 | 54C20110624SPR | 254.08 | 0.02 |
| 15905 | 7119187.171 | 388400.402 | 254.008 | 54C20110624SPR | 254 | 0.01 |
| 15906 | 7119200.603 | 388392.644 | 253.862 | 54C20110624SPR | 253.86 | 0.00 |
| 15907 | 7119914.579 | 388335.213 | 243.93 | 54C20110624SPR | 243.9 | 0.03 |
| 15908 | 7119927.742 | 388332.208 | 243.722 | 54C20110624SPR | 243.74 | -0.02 |
| 15909 | 7119936.184 | 388336.636 | 243.604 | 54C20110624SPR | 243.59 | 0.01 |
| 15910 | 7119943.72 | 388332.973 | 243.474 | 54C20110624SPR | 243.5 | -0.03 |
| 15911 | 7120142.106 | 388356.157 | 241.479 | 54C20110624SPR | 241.47 | 0.01 |
| 15912 | 7120160.812 | 388349.726 | 241.647 | 54C20110624SPR | 241.64 | 0.01 |
| 15913 | 7120419.203 | 388364.671 | 239.974 | 54C20110624SPR | 239.95 | 0.02 |
| 15914 | 7120622.93 | 388376.422 | 238.369 | 54C20110624SPR | 238.34 | 0.03 |
| 15915 | 7120842.344 | 388389.286 | 236.501 | 54C20110624SPR | 236.5 | 0.00 |
| 15916 | 7121111.539 | 388404.763 | 232.754 | 54C20110624SPR | 232.74 | 0.01 |
| 15917 | 7121404.085 | 388420.92 | 234.276 | 54C20110624SPR | 234.23 | 0.05 |
| 15918 | 7121660.24 | 388428.053 | 235.397 | 54C20110624SPR | 235.33 | 0.07 |
| 15919 | 7121837.746 | 388431.089 | 235.555 | 54C20110624SPR | 235.51 | 0.05 |
| 15920 | 7122107.921 | 388435.289 | 235 | 54C20110624SPR | 234.96 | 0.04 |
| 15921 | 7122365.959 | 388430.93 | 234.418 | 54C20110624SPR | 234.41 | 0.01 |
| 15922 | 7122630.815 | 388398.933 | 232.861 | 54C20110624SPR | 232.88 | -0.02 |
| 15923 | 7123014.024 | 388529.445 | 223.25 | 54C20110624SPR | 223.17 | 0.08 |
| 15924 | 7123190.389 | 388771.623 | 219.109 | 54C20110624SPR | 219.05 | 0.06 |
| 15925 | 7123218.847 | 388873.219 | 219.901 | 54C20110624SPR | 219.87 | 0.03 |
| 15926 | 7123230.118 | 388954.966 | 220.583 | 54C20110624SPR | 220.55 | 0.03 |
| 15927 | 7123248.94 | 389092.355 | 222.085 | 54C20110624SPR | 222.06 | 0.03 |
| 15928 | 7123253.538 | 389123.305 | 222.431 | 54C20110624SPR | 222.42 | 0.01 |
| 15929 | 7123310.077 | 389563.367 | 223.889 | 54C20110624SPR | 223.88 | 0.01 |
| 15930 | 7123323.601 | 389664.185 | 225.45 | 54C20110624SPR | 225.43 | 0.02 |
| 15931 | 7123258.476 | 389582.321 | 220.661 | 54C20110624SPR | 220.66 | 0.00 |
| 15932 | 7123259.889 | 389597.346 | 220.572 | 54C20110624SPR | 220.58 | -0.01 |
| 15933 | 7123261.539 | 389618.676 | 220.567 | 54C20110624SPR | 220.57 | 0.00 |
| 15934 | 7123339.091 | 389782.47 | 227.784 | 54C20110624SPR | 227.76 | 0.02 |
| 15935 | 7123355.255 | 389905.155 | 229.288 | 54C20110624SPR | 229.28 | 0.01 |
| 15936 | 7123380.305 | 390096.492 | 229.65 | 54C20110624SPR | 229.65 | 0.00 |
| 15937 | 7123380.003 | 390219.095 | 228.329 | 54C20110624SPR | 228.35 | -0.02 |
| 15938 | 7123207.499 | 390217.433 | 222.346 | 54C20110624SGR | 222.33 | 0.02 |
| 15939 | 7123019.291 | 390392.043 | 223.369 | 54C20110624SGR | 223.35 | 0.02 |
| 15940 | 7122966.635 | 390453.791 | 224.425 | 54C20110624SGR | 224.42 | 0.01 |
| 15941 | 7122900.507 | 390531.011 | 225.342 | 54C20110624SGR | 225.33 | 0.01 |
| 15945 | 7123477.351 | 390216.087 | 226.666 | 54C20110624SGR | 226.66 | 0.01 |
| 15946 | 7123566.031 | 390219.026 | 221.585 | 54C20110624SGR | 221.6 | -0.01 |
| 15947 | 7123658.726 | 390221.895 | 218.862 | 54C20110624SGR | 218.87 | -0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 15948 | 7123422.933 | 390214.48 | 228.234 | 54C20110624SPR | 228.21 | 0.02 |
| 15949 | 7123414.629 | 390207.315 | 228.414 | 54C20110624CK_PK | 228.43 | -0.02 |
| 15950 | 7123399.901 | 390221.927 | 228.554 | 54C20110624SPR | 228.55 | 0.00 |
| 15951 | 7123398.097 | 390240.533 | 228.293 | 54C20110624SPR | 228.31 | -0.02 |
| 15952 | 7123414.594 | 390358.501 | 226.287 | 54C20110624SPR | 226.27 | 0.02 |
| 15953 | 7123447.838 | 390518.527 | 223.113 | 54C20110624SPR | 223.11 | 0.00 |
| 15954 | 7123547.996 | 390734.492 | 219.375 | 54C20110624SPR | 219.36 | 0.01 |
| 15955 | 7123691.005 | 390904.771 | 218.238 | 54C20110624SPR | 218.23 | 0.01 |
| 15956 | 7124336.413 | 390936.82 | 213.952 | 54C20110624SPR | 213.9 | 0.05 |
| 15957 | 7124295.125 | 390946.783 | 216.164 | 54C20110624SPR | 216.12 | 0.04 |
| 15958 | 7124295.15 | 390946.796 | 216.164 | 54C20110624SGR | 216.12 | 0.04 |
| 15959 | 7124337.28 | 390937.989 | 213.956 | 54C20110624SGR | 213.95 | 0.01 |
| 15960 | 7124249.77 | 391011.524 | 216.207 | 54C20110624SGR | 216.19 | 0.02 |
| 15963 | 7123861.205 | 390912.779 | 217.455 | 54C20110624SGR | 217.43 | 0.03 |
| 15964 | 7124078.869 | 390933.269 | 216.917 | 54C20110624SGR | 216.89 | 0.03 |
| 15965 | 7124236.637 | 390949.169 | 216.266 | 54C20110624SGR | 216.25 | 0.02 |
| 15975 | 7126975.439 | 393747.666 | 198.09 | 54C20110624SPR | 198.08 | 0.01 |
| 15976 | 7127322.851 | 394076.029 | 195.563 | 54C20110624SPR | 195.56 | 0.00 |
| 15977 | 7127349.182 | 394091.501 | 195.469 | 54C20110624CK_SPIKE | 195.47 | 0.00 |
| 15978 | 7127349.057 | 394088.295 | 195.541 | 54C20110624CK_PK | 195.54 | 0.00 |
| 15979 | 7127359.378 | 394113.869 | 195.572 | 54C20110624SPR | 195.56 | 0.01 |
| 15980 | 7127362.815 | 394125.284 | 195.327 | 54C20110624SPR | 195.31 | 0.02 |
| 15981 | 7127587.333 | 394488.942 | 194.518 | 54C20110624SPR | 194.49 | 0.03 |
| 15982 | 7127595.915 | 394508.936 | 194.494 | 54C20110624SPR | 194.48 | 0.01 |
| 15983 | 7127777.052 | 395029.402 | 194.584 | 54C20110624SPR | 194.55 | 0.03 |
| 15984 | 7127774.203 | 395038.016 | 194.423 | 54C20110624SPR | 194.4 | 0.02 |
| 15985 | 7123414.655 | 390207.329 | 228.439 | 54C20110624CK_PK | 228.44 | 0.00 |
| 16000 | 7187835.539 | 432154.915 | 127.673 | 56A20110517FAC,56AFAC | 127.46 | 0.21 |
| 16001 | 7187831.577 | 432128.407 | 127.982 | 56A20110517SGR | 127.99 | -0.01 |
| 16002 | 7187815.588 | 432136.64 | 127.78 | 56A20110517SGR | 127.77 | 0.01 |
| 16003 | 7187799.352 | 432143.305 | 127.112 | 56A20110517SGR | 127.12 | -0.01 |
| 16004 | 7187940.748 | 432425.13 | 129.163 | 56A20110517SSP | 129.13 | 0.03 |
| 16005 | 7187879.671 | 432442.533 | 125.148 | 56A20110517SGR | 125.14 | 0.01 |
| 16006 | 7187878.729 | 432454.242 | 125.117 | 56A20110517SGR | 125.09 | 0.03 |
| 16007 | 7187877.466 | 432428.291 | 125.366 | 56A20110517SGR | 125.35 | 0.02 |
| 16008 | 7187668.99 | 432580.1 | 123.963 | 56A20110517SGR | 123.98 | -0.02 |
| 16009 | 7187648.294 | 432574.696 | 124.641 | 56A20110517SGR | 124.64 | 0.00 |
| 16012 | 7187614.003 | 432564.144 | 124.828 | 56A20110517SGR | 124.81 | 0.02 |
| 16013 | 7187600.355 | 432560.177 | 124.744 | 56A20110517SGR | 124.71 | 0.03 |
| 16014 | 7187425.372 | 432545.559 | 126.196 | 56A20110517SGR | 126.22 | -0.02 |
| 16015 | 7187408.75 | 432549.526 | 126.376 | 56A20110517SGR | 126.4 | -0.02 |
| 16016 | 7187393.301 | 432553.56 | 126.408 | 56A20110517SGR | 126.42 | -0.01 |
| 16017 | 7187211.537 | 432600.885 | 127.566 | 56A20110517SGR | 127.62 | -0.05 |
| 16018 | 7187192.46 | 432607.853 | 128.039 | 56A20110517SGR | 128.08 | -0.04 |
| 16019 | 7187168.534 | 432612.562 | 129.32 | 56A20110517SGR | 129.34 | -0.02 |
| 16023 | 7187841.351 | 431867.457 | 131.788 | 56A20110517SGR | 131.81 | -0.02 |
| 16024 | 7187835.09 | 431856.145 | 131.655 | 56A20110517SGR | 131.66 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 16025 | 7187825.019 | 431841.987 | 131.518 | 56A20110517SGR | 131.53 | -0.01 |
| 16026 | 7187778.294 | 431626.431 | 132.96 | 56A20110517SGR | 132.94 | 0.02 |
| 16027 | 7187785.981 | 431609.311 | 133.287 | 56A20110517SGR | 133.3 | -0.01 |
| 16028 | 7187793.779 | 431589.953 | 133.693 | 56A20110517SGR | 133.72 | -0.03 |
| 16029 | 7187736.86 | 431396.458 | 135.866 | 56A20110517SGR | 135.9 | -0.03 |
| 16030 | 7187726.94 | 431382.076 | 136.343 | 56A20110517SGR | 136.39 | -0.05 |
| 16031 | 7187715.563 | 431367.823 | 136.967 | 56A20110517SGR | 137.01 | -0.04 |
| 16032 | 7187835.317 | 432158.002 | 127.419 | 56A20110517SSP | 127.46 | -0.04 |
| 16100 | 6988332.074 | 367912.833 | 583.814 | 48B2011051548BSAC | 583.78 | 0.03 |
| 16101 | 6988325.3 | 367924.281 | 584.46 | 48B20110515SPR | 584.44 | 0.02 |
| 16102 | 6988312.585 | 367910.927 | 584.369 | 48B20110515SPR | 584.35 | 0.02 |
| 16103 | 6988298.477 | 367895.785 | 584.2 | 48B20110515SPR | 584.18 | 0.02 |
| 16104 | 6988843.517 | 368272.2 | 570.208 | 48B20110515SPR | 570.16 | 0.05 |
| 16105 | 6988861.446 | 368281.53 | 569.644 | 48B20110515SPR | 569.59 | 0.05 |
| 16106 | 6988876.499 | 368289.328 | 569.206 | 48B20110515SPR | 569.16 | 0.05 |
| 16107 | 6989362.272 | 368610.259 | 573.941 | 48B20110515SPR | 573.92 | 0.02 |
| 16108 | 6989379.806 | 368620.166 | 573.978 | 48B20110515SPR | 573.96 | 0.02 |
| 16109 | 6989396.464 | 368629.816 | 574.069 | 48B20110515SPR | 574.03 | 0.04 |
| 16110 | 6989951.221 | 368941.191 | 572.118 | 48B20110515SPR | 572.11 | 0.01 |
| 16111 | 6989967.77 | 368950.405 | 572.046 | 48B20110515SPR | 572.04 | 0.01 |
| 16112 | 6989990.365 | 368961.393 | 571.954 | 48B20110515SPR | 571.96 | -0.01 |
| 16113 | 6990521.67 | 368985.049 | 561.129 | 48B20110515SPR | 561.13 | 0.00 |
| 16114 | 6990539.648 | 368984.283 | 560.612 | 48B20110515SPR | 560.61 | 0.00 |
| 16115 | 6990558.62 | 368983.598 | 559.985 | 48B20110515SPR | 559.95 | 0.03 |
| 16116 | 6991240.809 | 369036.853 | 543.389 | 48B20110515SPR | 543.39 | 0.00 |
| 16117 | 6991257.913 | 369044.418 | 542.485 | 48B20110515SPR | 542.47 | 0.01 |
| 16118 | 6991278.488 | 369053.584 | 541.37 | 48B20110515SPR | 541.36 | 0.01 |
| 16119 | 6991817.772 | 369127.647 | 529.899 | 48B20110515SPR | 529.87 | 0.03 |
| 16120 | 6991840.665 | 369126.087 | 529.617 | 48B20110515SPR | 529.55 | 0.07 |
| 16121 | 6991859.525 | 369125.586 | 529.347 | 48B20110515SPR | 529.27 | 0.08 |
| 16122 | 6992504.818 | 369207.499 | 522.375 | 48B20110515SPR | 522.34 | 0.03 |
| 16123 | 6992525.656 | 369215.793 | 522.608 | 48B20110515SPR | 522.6 | 0.01 |
| 16124 | 6992543.853 | 369222.818 | 522.979 | 48B20110515SPR | 522.94 | 0.04 |
| 16125 | 6993015.496 | 369417.567 | 529.901 | 48B20110515SPR | 529.86 | 0.04 |
| 16126 | 6993037.038 | 369426.686 | 529.696 | 48B20110515SPR | 529.66 | 0.04 |
| 16127 | 6993056.834 | 369434.8 | 529.405 | 48B20110515SPR | 529.39 | 0.01 |
| 16128 | 6987923.697 | 367556.578 | 571.548 | 48B20110515SPR | 571.54 | 0.01 |
| 16129 | 6987907.874 | 367545.652 | 571.174 | 48B20110515SPR | 571.16 | 0.01 |
| 16130 | 6987890.337 | 367534.305 | 570.648 | 48B20110515SPR | 570.64 | 0.01 |
| 16131 | 6987234.478 | 367083.011 | 544.348 | 48B20110515SPR | 544.35 | 0.00 |
| 16132 | 6987218.798 | 367072.296 | 544.438 | 48B20110515SPR | 544.42 | 0.02 |
| 16133 | 6987201.971 | 367061.58 | 544.576 | 48B20110515SPR | 544.56 | 0.02 |
| 16134 | 6986695.448 | 366975.547 | 557.312 | 48B20110515SPR | 557.29 | 0.02 |
| 16135 | 6986676.591 | 366974.622 | 557.41 | 48B20110515SPR | 557.36 | 0.05 |
| 16136 | 6986658.592 | 366973.485 | 557.507 | 48B20110515SPR | 557.49 | 0.02 |
| 16137 | 6986158.649 | 366793.792 | 545.578 | 48B20110515SPR | 545.53 | 0.05 |
| 16138 | 6986176.906 | 366804.695 | 546.394 | 48B20110515SPR | 546.38 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 16139 | 6986190.209 | 366812.27 | 546.961 | 48B20110515SPR | 546.94 | 0.02 |
| 16140 | 6985076.42 | 366623.095 | 537.563 | 48B20110515SPR | 537.53 | 0.03 |
| 16141 | 6985058.236 | 366617.212 | 537.847 | 48B20110515SPR | 537.83 | 0.02 |
| 16142 | 6985040.032 | 366611.373 | 538.214 | 48B20110515SPR | 538.19 | 0.02 |
| 16143 | 6984437.827 | 366395.275 | 552.091 | 48B20110515SPR | 552.13 | -0.04 |
| 16144 | 6984421.085 | 366389.337 | 552.245 | 48B20110515SPR | 552.25 | 0.00 |
| 16145 | 6984402.959 | 366382.408 | 552.43 | 48B20110515SPR | 552.42 | 0.01 |
| 16146 | 6988334.944 | 367913.781 | 583.392 | 48B20110515SSP | 583.39 | 0.00 |
| 16200 | 7141850.863 | 402880.531 | 141.046 | 54G2011051754GFBC | 141.08 | -0.03 |
| 16201 | 7141848.12 | 402879.233 | 140.976 | 54G20110517CK_SPIKE | 141.03 | -0.05 |
| 16202 | 7147121.207 | 401304.102 | 130.933 | 54G20110517SPR | 130.88 | 0.05 |
| 16203 | 7147135.452 | 401296.495 | 131.103 | 54G20110517SPR | 131.05 | 0.05 |
| 16204 | 7147146.126 | 401298.401 | 130.893 | 54G20110517SPR | 130.82 | 0.07 |
| 16205 | 7147153.682 | 401293.248 | 131.045 | 54G20110517SPR | 130.96 | 0.08 |
| 16206 | 7147449.257 | 401260.962 | 130.531 | 54G20110517SPR | 130.52 | 0.01 |
| 16207 | 7148185.866 | 401180.082 | 129.095 | 54G20110517SPR | 129.05 | 0.04 |
| 16208 | 7148197.768 | 401175.588 | 129.178 | 54G20110517SPR | 129.1 | 0.08 |
| 16209 | 7148210.914 | 401170.996 | 129.271 | 54G20110517SPR | 129.24 | 0.03 |
| 16210 | 7148230.961 | 401169.03 | 129.292 | 54G20110517SPR | 129.25 | 0.04 |
| 16211 | 7148247.15 | 401171.202 | 129.191 | 54G20110517SPR | 129.12 | 0.07 |
| 16212 | 7148501.493 | 401171.258 | 129.182 | 54G20110517SPR | 129.07 | 0.11 |
| 16213 | 7148725.349 | 401199.764 | 128.488 | 54G20110517SPR | 128.43 | 0.06 |
| 16214 | 7148947.175 | 401233.742 | 128.294 | 54G20110517SPR | 128.23 | 0.06 |
| 16215 | 7149195.275 | 401271.58 | 128.112 | 54G20110517SPR | 128.07 | 0.04 |
| 16216 | 7149422.078 | 401306.328 | 128.104 | 54G20110517SPR | 128.03 | 0.07 |
| 16217 | 7149739.63 | 401355.048 | 128.452 | 54G20110517SPR | 128.38 | 0.07 |
| 16218 | 7150008.542 | 401396.316 | 127.338 | 54G20110517SPR | 127.28 | 0.06 |
| 16219 | 7150318.759 | 401416.161 | 126.793 | 54G20110517SPR | 126.74 | 0.05 |
| 16220 | 7150557.374 | 401358.055 | 126.679 | 54G20110517SPR | 126.63 | 0.05 |
| 16221 | 7150794.735 | 401217.101 | 126.753 | 54G20110517SPR | 126.73 | 0.02 |
| 16222 | 7151604.685 | 400043.571 | 124.416 | 54G20110517SPR | 124.37 | 0.05 |
| 16223 | 7151613.266 | 400033.058 | 124.535 | 54G20110517SPR | 124.48 | 0.05 |
| 16224 | 7151635.781 | 400016.218 | 124.396 | 54G20110517SPR | 124.34 | 0.06 |
| 16225 | 7141848.141 | 402879.227 | 140.973 | 54G20110517CK_SPIKE | 141.03 | -0.06 |
| 16300 | 7199030.23 | 455418.244 | 173.791 | 58B2011051858BFBC | 173.85 | -0.06 |
| 16301 | 7199030.427 | 455415.265 | 173.31 | 58B20110518SSP | 173.33 | -0.02 |
| 16302 | 7199018.055 | 455420.605 | 174.866 | 58B20110518SPR | 174.81 | 0.06 |
| 16303 | 7199019.787 | 455435.695 | 174.895 | 58B20110518SPR | 174.87 | 0.03 |
| 16304 | 7199021.794 | 455449.981 | 174.922 | 58B20110518SPR | 174.89 | 0.03 |
| 16305 | 7198579.921 | 455092.596 | 175.7 | 58B20110518SPR | 175.66 | 0.04 |
| 16306 | 7198563.738 | 455088.797 | 176.051 | 58B20110518SPR | 176.02 | 0.03 |
| 16307 | 7198546.425 | 455083.91 | 176.227 | 58B20110518SPR | 176.22 | 0.01 |
| 16308 | 7198502.6 | 455109.175 | 175.624 | 58B20110518SSP | 175.6 | 0.02 |
| 16309 | 7197985.358 | 454975.177 | 183.929 | 58B20110518SPR | 183.92 | 0.01 |
| 16310 | 7197966.614 | 454975.594 | 183.842 | 58B20110518SPR | 183.82 | 0.02 |
| 16311 | 7197943.56 | 454977.752 | 183.645 | 58B20110518SPR | 183.61 | 0.03 |
| 16312 | 7197525.757 | 455094.913 | 189.353 | 58B20110518SPR | 189.35 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 16313 | 7197510.011 | 455101.011 | 189.173 | 58B20110518SPR | 189.17 | 0.00 |
| 16314 | 7197489.392 | 455106.653 | 188.875 | 58B20110518SPR | 188.89 | -0.01 |
| 16315 | 7196962.664 | 455234.015 | 204.025 | 58B20110518SPR | 204.06 | -0.03 |
| 16316 | 7196944.369 | 455246.309 | 204.015 | 58B20110518SPR | 204.01 | 0.00 |
| 16317 | 7198962.788 | 455778.577 | 175.619 | 58B20110518SPR | 175.6 | 0.02 |
| 16318 | 7198958.574 | 455800.397 | 175.792 | 58B20110518SPR | 175.77 | 0.02 |
| 16319 | 7198954.712 | 455818.077 | 175.949 | 58B20110518SPR | 175.95 | 0.00 |
| 16323 | 7199353.501 | 455424.721 | 185.184 | 58B20110518SPR | 185.16 | 0.02 |
| 16324 | 7199370.582 | 455421.436 | 185.427 | 58B20110518SPR | 185.37 | 0.06 |
| 16325 | 7199387.886 | 455417.85 | 185.546 | 58B20110518SPR | 185.49 | 0.06 |
| 16326 | 7199730.589 | 455193.383 | 189.11 | 58B20110518SPR | 189.09 | 0.02 |
| 16327 | 7199740.8 | 455179.065 | 189.293 | 58B20110518SPR | 189.27 | 0.02 |
| 16328 | 7199750.102 | 455164.296 | 189.499 | 58B20110518SPR | 189.46 | 0.04 |
| 16329 | 7199924.263 | 454879.411 | 207.536 | 58B20110518SPR | 207.52 | 0.02 |
| 16330 | 7199936.553 | 454858.977 | 207.974 | 58B20110518SPR | 207.93 | 0.04 |
| 16331 | 7199946.09 | 454843.311 | 208.13 | 58B20110518SPR | 208.08 | 0.05 |
| 16332 | 7200240.325 | 454358.179 | 194.352 | 58B20110518SPR | 194.34 | 0.01 |
| 16333 | 7200249.003 | 454344.099 | 194.388 | 58B20110518SPR | 194.32 | 0.07 |
| 16334 | 7200257.495 | 454330.219 | 194.378 | 58B20110518SPR | 194.34 | 0.04 |
| 16335 | 7200265.993 | 454316.343 | 194.427 | 58B20110518SPR | 194.36 | 0.07 |
| 16336 | 7200422.371 | 453936.889 | 196.886 | 58B20110518SPR | 196.82 | 0.07 |
| 16337 | 7200416.896 | 453950.701 | 196.826 | 58B20110518SPR | 196.77 | 0.06 |
| 16338 | 7200411.356 | 453966.544 | 196.495 | 58B20110518SPR | 196.41 | 0.09 |
| 16339 | 7200363.388 | 453466.008 | 179.313 | 58B20110518SPR | 179.26 | 0.05 |
| 16340 | 7200362.175 | 453449.477 | 179.122 | 58B20110518SPR | 179.08 | 0.04 |
| 16341 | 7200360.463 | 453431.996 | 178.939 | 58B20110518SPR | 178.91 | 0.03 |
| 16342 | 7200453.146 | 453020.487 | 181.412 | 58B20110518SPR | 181.34 | 0.07 |
| 16343 | 7200464.44 | 453003.478 | 181.567 | 58B20110518SPR | 181.52 | 0.05 |
| 16344 | 7200473.463 | 452988.893 | 181.777 | 58B20110518SPR | 181.72 | 0.06 |
| 16345 | 7199800.438 | 453288.142 | 168.792 | 58B20110518SGR | 168.74 | 0.05 |
| 16346 | 7199814.982 | 453291.998 | 168.934 | 58B20110518SGR | 168.86 | 0.07 |
| 16347 | 7199835.2 | 453298.639 | 169.151 | 58B20110518SGR | 169.11 | 0.04 |
| 16400 | 7199030.23 | 455418.244 | 173.791 | 58B2011052058BFBC | 173.85 | -0.06 |
| 16402 | 7198913.504 | 455790.269 | 174.211 | 58B20110520SDR | 174.14 | 0.07 |
| 16403 | 7198902.353 | 455801.523 | 173.871 | 58B20110520OG | 173.78 | 0.09 |
| 16408 | 7199809.502 | 455130.99 | 188.337 | 58B20110520SGR | 188.29 | 0.05 |
| 16409 | 7199754.126 | 455158.424 | 189.692 | 58B20110520SAR | 189.64 | 0.05 |
| 16410 | 7199754.127 | 455158.417 | 189.702 | 58B20110520SAR | 189.64 | 0.06 |
| 16411 | 7200413.582 | 453945.279 | 196.784 | 58B20110520SAR | 196.69 | 0.09 |
| 16412 | 7200391.439 | 453998.268 | 193.77 | 58B20110520SAR | 193.68 | 0.09 |
| 16413 | 7200393.42 | 453946.356 | 192.162 | 58B20110520SAR | 192.06 | 0.10 |
| 16414 | 7200393.41 | 453946.351 | 192.148 | 58B20110520SAR | 192.06 | 0.09 |
| 16415 | 7200392.806 | 453919.473 | 191.12 | 58B20110520SAR | 191.04 | 0.08 |
| 16416 | 7199809.817 | 453290.514 | 168.894 | 58B20110520SGR | 168.8 | 0.09 |
| 16417 | 7199764.85 | 453306.024 | 168.573 | 58B20110520SGR | 168.53 | 0.04 |
| 16418 | 7199791.668 | 453286.222 | 168.721 | 58B20110520SWR | 168.65 | 0.07 |
| 16419 | 7199802.181 | 453241.053 | 167.74 | 58B20110520SGR | 167.68 | 0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 16422 | 7200476.472 | 453033.825 | 181.183 | 58B20110520SAR | 181.1 | 0.08 |
| 16423 | 7200464.315 | 453033.163 | 181.052 | 58B20110520SAR | 181 | 0.05 |
| 16424 | 7200464.322 | 453033.158 | 181.055 | 58B20110520SAR | 181 | 0.06 |
| 16425 | 7200448.601 | 453030.864 | 181.221 | 58B20110520SAR | 181.15 | 0.07 |
| 16426 | 7200464.939 | 453051.692 | 181.031 | 58B20110520OG | 180.93 | 0.10 |
| 16427 | 7198574.55 | 455087.809 | 175.785 | 58B20110520SAR | 175.73 | 0.06 |
| 16428 | 7198574.591 | 455087.798 | 175.776 | 58B20110520SAR | 175.73 | 0.05 |
| 16429 | 7198540.392 | 455086.757 | 176.303 | 58B20110520SAR | 176.24 | 0.06 |
| 16430 | 7198496.358 | 455075.408 | 176.66 | 58B20110520SAR | 176.59 | 0.07 |
| 16431 | 7198407.463 | 455055.795 | 177.298 | 58B20110520SAR | 177.23 | 0.07 |
| 16432 | 7198402.497 | 455042.13 | 177.465 | 58B20110520SAR | 177.4 | 0.06 |
| 16433 | 7198402.499 | 455042.133 | 177.468 | 58B20110520SAR | 177.4 | 0.07 |
| 16434 | 7198387.676 | 455070.545 | 177.137 | 58B20110520SDR | 177.1 | 0.04 |
| 16435 | 7198386.318 | 455065.119 | 177.032 | 58B20110520OG | 177.01 | 0.02 |
| 16436 | 7198399.8 | 455097.924 | 176.768 | 58B20110520SGR | 176.69 | 0.08 |
| 16437 | 7198420.169 | 454870.926 | 182.045 | 58B20110520SGR | 181.96 | 0.08 |
| 16438 | 7198396.024 | 454880.086 | 181.946 | 58B20110520OG | 181.91 | 0.04 |
| 16439 | 7198416.466 | 454173.729 | 200.819 | 58B20110520SGR | 200.78 | 0.04 |
| 16440 | 7198455.5 | 454180.212 | 198.58 | 58B20110520SGR | 198.51 | 0.07 |
| 16441 | 7198523.022 | 454183.098 | 196.377 | 58B20110520SGR | 196.32 | 0.06 |
| 16442 | 7198649.914 | 454186.864 | 190.372 | 58B20110520SGR | 190.32 | 0.05 |
| 16443 | 7198411.018 | 454456.553 | 196.511 | 58B20110520SGR | 196.45 | 0.06 |
| 16444 | 7198010.229 | 454974.109 | 184.053 | 58B20110520SAR | 184.02 | 0.03 |
| 16445 | 7197994.816 | 454969.946 | 184.009 | 58B20110520SGR | 183.96 | 0.05 |
| 16446 | 7198091.74 | 454815.351 | 187.501 | 58B20110520SDR | 187.46 | 0.04 |
| 16447 | 7198013.518 | 454805.601 | 187.954 | 58B20110520SGR | 187.9 | 0.05 |
| 16448 | 7198965.698 | 455784.056 | 175.719 | 58B20110520SAR | 175.67 | 0.05 |
| 16449 | 7199030.462 | 455415.282 | 173.348 | 58B20110520CHK_58B_FSP | 173.32 | 0.03 |
| 16450 | 7199030.449 | 455415.285 | 173.319 | 58B20110520CHK_58B_FSP | 173.32 | 0.00 |
| 16500 | 7187937.779 | 432425.543 | 128.996 | 56B2011052156B | 128.95 | 0.05 |
| 16501 | 7172422.451 | 406985.237 | 119.507 | 56B2011052155B | 119.51 | 0.00 |
| 16502 | 7187839.682 | 432116.221 | 128.13 | 56B20110521SDR | 128.08 | 0.05 |
| 16503 | 7187846.342 | 432053.792 | 127.92 | 56B20110521SDR | 127.9 | 0.02 |
| 16504 | 7187862.418 | 432005.715 | 128.974 | 56B20110521SDR | 128.92 | 0.05 |
| 16505 | 7187868.526 | 431978.508 | 129.921 | 56B20110521SDR | 129.84 | 0.08 |
| 16506 | 7187866.883 | 431944.057 | 131.003 | 56B20110521SDR | 130.91 | 0.09 |
| 16507 | 7187853.981 | 431890.47 | 132.345 | 56B20110521SDR | 132.27 | 0.07 |
| 16508 | 7187827.033 | 431862.195 | 131.045 | 56B20110521OG | 131.03 | 0.01 |
| 16509 | 7187808.753 | 431823.12 | 131.295 | 56B20110521SDR | 131.23 | 0.06 |
| 16510 | 7187774.985 | 431787.367 | 130.671 | 56B20110521SDR | 130.6 | 0.07 |
| 16511 | 7187751.126 | 431697.774 | 131.92 | 56B20110521SDR | 131.84 | 0.08 |
| 16512 | 7187767.623 | 431645.734 | 132.595 | 56B20110521SDR | 132.56 | 0.03 |
| 16513 | 7187802.086 | 431563.051 | 134.027 | 56B20110521SDR | 133.97 | 0.06 |
| 16514 | 7187830.622 | 431547.326 | 134.831 | 56B20110521SDR | 134.8 | 0.03 |
| 16515 | 7187785.235 | 431463.676 | 134.644 | 56B20110521SDR | 134.56 | 0.08 |
| 16516 | 7187681.814 | 431322.692 | 137.919 | 56B20110521SDR | 137.89 | 0.03 |
| 16517 | 7187615.287 | 431213.672 | 137.541 | 56B20110521SDR | 137.48 | 0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 16518 | 7187583.506 | 431123.005 | 138.212 | 56B20110521SDR | 138.17 | 0.04 |
| 16519 | 7187573.137 | 431052.101 | 138.992 | 56B20110521SDR | 138.96 | 0.03 |
| 16520 | 7187577.654 | 430989.465 | 141.037 | 56B20110521SDR | 140.98 | 0.06 |
| 16528 | 7187053.159 | 432747.906 | 140.493 | 56B20110521SDR | 140.42 | 0.07 |
| 16529 | 7187068.307 | 432686.201 | 138.968 | 56B20110521SDR | 138.92 | 0.05 |
| 16530 | 7187094.456 | 432643.614 | 135.42 | 56B20110521SDR | 135.35 | 0.07 |
| 16531 | 7187214.308 | 432600.183 | 127.574 | 56B20110521SDR | 127.54 | 0.03 |
| 16532 | 7187266.896 | 432588.292 | 126.76 | 56B20110521SDR | 126.73 | 0.03 |
| 16533 | 7187356.641 | 432565.201 | 126.418 | 56B20110521SDR | 126.38 | 0.04 |
| 16534 | 7187409.678 | 432549.045 | 126.435 | 56B20110521SDR | 126.4 | 0.03 |
| 16535 | 7187484.466 | 432534.409 | 125.532 | 56B20110521SDR | 125.46 | 0.07 |
| 16536 | 7187553.821 | 432546.751 | 124.78 | 56B20110521SDR | 124.75 | 0.03 |
| 16538 | 7187670.883 | 432579.789 | 123.99 | 56B20110521SDR | 123.95 | 0.04 |
| 16539 | 7187712.064 | 432614.236 | 124.083 | 56B20110521OG | 124.04 | 0.04 |
| 16540 | 7187871.991 | 432463.892 | 125.143 | 56B20110521OG | 125.11 | 0.03 |
| 16541 | 7187835.553 | 432154.918 | 127.673 | 56B20110521CHK_56A_actua | 127.46 | 0.21 |
| 16542 | 7187940.766 | 432425.144 | 129.217 | 56B20110521CHK_568_FSP | 129.12 | 0.10 |
| 16543 | 7172425.47 | 406985.864 | 119.532 | 56B20110521CHK_568_FSP | 119.52 | 0.01 |
| 16544 | 7187940.763 | 432425.142 | 129.213 | 56B20110521CHK_568_FSP | 129.13 | 0.08 |
| 16545 | 7172425.461 | 406985.872 | 119.542 | 56B20110521CHK_558_FSP | 119.52 | 0.02 |
| 16700 | 7196380.051 | 456185.711 | 183.292 | 58C2011052058C-150SRRSP | 183.28 | 0.01 |
| 16701 | 7196380.895 | 456182.732 | 183.376 | 58C20110520CHK_150_FSP | 183.32 | 0.06 |
| 16702 | 7196380.896 | 456182.733 | 183.369 | 58C20110520CHK_150_FSP | 183.32 | 0.05 |
| 16703 | 7196389.2 | 456193.205 | 183.77 | 58C20110520SAR | 183.73 | 0.04 |
| 16704 | 7196414.385 | 456196.142 | 182.387 | 58C20110520SGR | 182.33 | 0.06 |
| 16705 | 7196377.105 | 456241.371 | 183.561 | 58C20110520SGR | 183.53 | 0.03 |
| 16706 | 7196373.796 | 456132.558 | 184.906 | 58C20110520OG | 184.88 | 0.03 |
| 16707 | 7195856.192 | 456682.906 | 195.374 | 58C20110520SGR | 195.29 | 0.08 |
| 16708 | 7195959.14 | 456686.024 | 197.515 | 58C20110520SGR | 197.44 | 0.07 |
| 16709 | 7195342.468 | 456674.579 | 177.23 | 58C20110520SGR | 177.19 | 0.04 |
| 16710 | 7195319.722 | 456674.405 | 177.281 | 58C20110520SAR | 177.23 | 0.05 |
| 16711 | 7195339.902 | 456644.249 | 177.413 | 58C20110520SAR | 177.37 | 0.04 |
| 16712 | 7194258.033 | 457465.863 | 165.325 | 58C20110520SAR | 165.31 | 0.01 |
| 16713 | 7194272.688 | 457462.333 | 165.11 | 58C20110520SAR | 165.04 | 0.07 |
| 16715 | 7193430.263 | 458671.564 | 150.374 | 58C20110520SAR | 150.33 | 0.04 |
| 16716 | 7193388.903 | 458676.779 | 149.684 | 58C20110520SAR | 149.64 | 0.04 |
| 16717 | 7193346.807 | 458639.065 | 148.142 | 58C20110520OG | 148.09 | 0.05 |
| 16718 | 7193377.942 | 458637.404 | 149.306 | 58C20110520SGR | 149.27 | 0.04 |
| 16719 | 7193404.858 | 458659.195 | 149.927 | 58C20110520OG | 149.94 | -0.01 |
| 16800 | 7159363.433 | 399787.09 | 110.838 | 54F2011062654FSAC | 110.82 | 0.02 |
| 16801 | 7159363.682 | 399784.072 | 110.876 | 54F20110626CK_SPIKE | 110.83 | 0.05 |
| 16802 | 7159444.844 | 399870.279 | 111.774 | 54F20110626SPR | 111.72 | 0.05 |
| 16803 | 7159432.661 | 399877.216 | 112.007 | 54F20110626SPR | 111.95 | 0.06 |
| 16804 | 7159420.854 | 399879.968 | 111.856 | 54F20110626SPR | 111.78 | 0.08 |
| 16805 | 7159113.644 | 399673.145 | 110.16 | 54F20110626SPR | 110.11 | 0.05 |
| 16806 | 7159101.468 | 399675.625 | 110.323 | 54F20110626SPR | 110.27 | 0.05 |
| 16807 | 7159089.52 | 399679.202 | 110.457 | 54F20110626SPR | 110.39 | 0.07 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 16808 | 7159108.02 | 399665.886 | 110.513 | 54F20110626SPR | 110.46 | 0.05 |
| 16809 | 7159125.979 | 399653.616 | 110.501 | 54F20110626SPR | 110.46 | 0.04 |
| 16810 | 7159119.002 | 399662.768 | 110.389 | 54F20110626SPR | 110.33 | 0.06 |
| 16811 | 7159248.938 | 399589.825 | 110.469 | 54F20110626SPR | 110.45 | 0.02 |
| 16812 | 7159433.341 | 399530.141 | 110.564 | 54F20110626SPR | 110.56 | 0.00 |
| 16813 | 7159718.364 | 399514.579 | 110.135 | 54F20110626SPR | 110.1 | 0.04 |
| 16814 | 7159794.901 | 399773.227 | 110.561 | 54F20110626SPR | 110.53 | 0.03 |
| 16815 | 7159861.449 | 400172.731 | 110.495 | 54F20110626SPR | 110.49 | 0.01 |
| 16816 | 7159812.86 | 400084.186 | 110.644 | 54F20110626SPR | 110.61 | 0.03 |
| 16817 | 7159745.596 | 399964.757 | 110.801 | 54F20110626SPR | 110.79 | 0.01 |
| 16818 | 7159677.207 | 399842.824 | 111.244 | 54F20110626SPR | 111.2 | 0.04 |
| 16819 | 7159674.707 | 399841.874 | 111.226 | 54F20110626MON_CASE | 111.23 | 0.00 |
| 16820 | 7159532.151 | 399920.17 | 111.504 | 54F20110626SPR | 111.45 | 0.05 |
| 16821 | 7159880.905 | 399519.376 | 110.104 | 54F20110626SPR | 110.09 | 0.01 |
| 16822 | 7160205.64 | 399530.834 | 110.144 | 54F20110626SPR | 110.09 | 0.05 |
| 16823 | 7160449.703 | 399539.092 | 110.456 | 54F20110626SPR | 110.43 | 0.03 |
| 16824 | 7160663.946 | 399546.059 | 110.163 | 54F20110626SPR | 110.18 | -0.02 |
| 16825 | 7160884.735 | 399553.909 | 110.314 | 54F20110626SPR | 110.27 | 0.04 |
| 16826 | 7161049.275 | 399560.495 | 109.024 | 54F20110626SPR | 108.96 | 0.06 |
| 16827 | 7161200.817 | 399564.96 | 109.441 | 54F20110626SPR | 109.37 | 0.07 |
| 16828 | 7161353.332 | 399570.542 | 109.182 | 54F20110626SPR | 109.1 | 0.08 |
| 16829 | 7161509.379 | 399574.558 | 108.982 | 54F20110626SPR | 108.92 | 0.06 |
| 16830 | 7161557.902 | 399614.12 | 109.014 | 54F20110626SPR | 108.97 | 0.04 |
| 16831 | 7161558.88 | 399860.694 | 109.07 | 54F20110626SPR | 109.02 | 0.05 |
| 16832 | 7161552.7 | 400076.196 | 108.963 | 54F20110626SPR | 108.89 | 0.07 |
| 16835 | 7161238.799 | 399987.135 | 108.894 | 54F20110626SPR | 108.85 | 0.04 |
| 16836 | 7161050.097 | 399981.476 | 108.776 | 54F20110626SPR | 108.81 | -0.03 |
| 16837 | 7160888.091 | 400236.824 | 109.769 | 54F20110626SPR | 109.72 | 0.05 |
| 16838 | 7160895.492 | 400056.084 | 108.969 | 54F20110626SPR | 108.94 | 0.03 |
| 16839 | 7160901.859 | 399856.328 | 109.064 | 54F20110626SPR | 109.04 | 0.02 |
| 16840 | 7160906.55 | 399695.386 | 109.536 | 54F20110626SPR | 109.51 | 0.03 |
| 16841 | 7160912.608 | 399520.932 | 109.767 | 54F20110626SPR | 109.75 | 0.02 |
| 16842 | 7160926.633 | 399380.759 | 109.801 | 54F20110626SPR | 109.8 | 0.00 |
| 16843 | 7161292.234 | 399367.624 | 108.906 | 54F20110626SPR | 108.83 | 0.08 |
| 16844 | 7161479.496 | 399316.389 | 108.89 | 54F20110626SPR | 108.81 | 0.08 |
| 16845 | 7161570.44 | 399369.221 | 108.969 | 54F20110626SPR | 108.93 | 0.04 |
| 16846 | 7161569.275 | 399500.287 | 109.025 | 54F20110626SPR | 109.01 | 0.02 |
| 16847 | 7161034.321 | 399525.847 | 110.095 | 54F20110626SPR | 110.03 | 0.06 |
| 16848 | 7161208.954 | 399454.403 | 112.75 | 54F20110626SPR | 112.65 | 0.10 |
| 16849 | 7161448.96 | 399370.428 | 121.569 | 54F20110626SPR | 121.49 | 0.08 |
| 16850 | 7161959.722 | 399192.639 | 121.545 | 54F20110626SPR | 121.5 | 0.05 |
| 16851 | 7162191.695 | 398989.282 | 119.006 | 54F20110626SPR | 118.98 | 0.03 |
| 16852 | 7162277.325 | 398740.003 | 117.591 | 54F20110626SPR | 117.56 | 0.03 |
| 16853 | 7159031.267 | 399624.142 | 110.09 | 54F20110626SGR | 110.04 | 0.05 |
| 16854 | 7158883.724 | 399613.383 | 110.463 | 54F20110626SGR | 110.36 | 0.10 |
| 16855 | 7158764.483 | 399562.693 | 110.567 | 54F20110626SGR | 110.56 | 0.01 |
| 16856 | 7158721.009 | 399431.197 | 110.48 | 54F20110626SGR | 110.47 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 16857 | 7158555.483 | 399340.715 | 111.712 | 54F20110626SGR | 111.64 | 0.07 |
| 16858 | 7158500.998 | 399312.638 | 111.514 | 54F20110626SGR | 111.5 | 0.01 |
| 16859 | 7158474.936 | 399274.54 | 111.339 | 54F20110626SGR | 111.3 | 0.04 |
| 16860 | 7158264.723 | 399243.874 | 111.301 | 54F20110626SGR | 111.29 | 0.01 |
| 16861 | 7158120.652 | 399083.917 | 111.243 | 54F20110626SGR | 111.29 | -0.05 |
| 16862 | 7159179.907 | 399715.941 | 110.094 | 54F20110626SGR | 110.02 | 0.07 |
| 16863 | 7159246.937 | 399838.073 | 110.653 | 54F20110626SGR | 110.6 | 0.05 |
| 16864 | 7159308.893 | 399963.368 | 110.751 | 54F20110626SGR | 110.71 | 0.04 |
| 16865 | 7159244.412 | 400141.158 | 110.562 | 54F20110626SGR | 110.55 | 0.01 |
| 16875 | 7158944.884 | 399789.284 | 110.764 | 54F20110626SPR | 110.77 | -0.01 |
| 16876 | 7158688.459 | 399987.365 | 111.988 | 54F20110626SPR | 111.98 | 0.01 |
| 16877 | 7158548.064 | 400095.547 | 112.093 | 54F20110626SPR | 112.08 | 0.01 |
| 16921 | 7153296.427 | 400285.521 | 121.315 | 54F20110626SPR | 121.25 | 0.06 |
| 16922 | 7153254.41 | 400270.55 | 121.312 | 54F20110626SPR | 121.27 | 0.04 |
| 16923 | 7152920.123 | 400152.779 | 121.553 | 54F20110626SPR | 121.47 | 0.08 |
| 16924 | 7152877.922 | 400138.381 | 121.665 | 54F20110626SPR | 121.59 | 0.08 |
| 16925 | 7152634.629 | 400062.084 | 122.813 | 54F20110626SPR | 122.69 | 0.12 |
| 16926 | 7152401.348 | 400016.99 | 122.74 | 54F20110626SPR | 122.6 | 0.14 |
| 16927 | 7152387.602 | 400014.356 | 122.747 | 54F20110626SPR | 122.65 | 0.10 |
| 16928 | 7152093.073 | 399959.679 | 123.359 | 54F20110626SPR | 123.29 | 0.07 |
| 16929 | 7151408.906 | 400501.58 | 124.178 | 54F2011062654E | 124.11 | 0.07 |
| 16930 | 7151408.906 | 400501.579 | 124.169 | 54F2011062654E | 124.11 | 0.06 |
| 16931 | 7151408.905 | 400501.581 | 124.178 | 54F2011062654E | 124.11 | 0.07 |
| 16932 | 7151408.899 | 400501.592 | 124.176 | 54F2011062654E | 124.11 | 0.07 |
| 17000 | 7172422.451 | 406985.237 | 119.507 | 55B2011052255B | 119.51 | 0.00 |
| 17001 | 7172425.464 | 406985.885 | 119.541 | 55B20110522CHK_55B_FSP | 119.52 | 0.02 |
| 17002 | 7172425.459 | 406985.878 | 119.549 | 55B20110522CHK_55B_FSP | 119.52 | 0.03 |
| 17003 | 7172436.513 | 406988.008 | 120.246 | 55B20110522SAR | 120.22 | 0.03 |
| 17004 | 7172408.592 | 406959.918 | 121.01 | 55B20110522SAR | 121.01 | 0.00 |
| 17005 | 7172384.663 | 406955.242 | 122.54 | 55B20110522SAR | 122.5 | 0.04 |
| 17006 | 7172384.495 | 406938.764 | 122.781 | 55B20110522OG | 122.74 | 0.04 |
| 17007 | 7172377.531 | 406891.863 | 120.819 | 55B20110522SGR | 120.7 | 0.12 |
| 17008 | 7172464.824 | 407051.211 | 120.869 | 55B20110522SAR | 120.84 | 0.03 |
| 17009 | 7172507.971 | 407112.557 | 120.799 | 55B20110522SAR | 120.76 | 0.04 |
| 17011 | 7172926.188 | 407682.568 | 129.326 | 55B20110522SAR | 129.32 | 0.01 |
| 17012 | 7172985.054 | 407671.96 | 127.523 | 55B20110522SDR | 127.48 | 0.04 |
| 17013 | 7172987.906 | 407700.383 | 128.357 | 55B20110522OG | 128.32 | 0.04 |
| 17014 | 7172917.999 | 407723.231 | 129.788 | 55B20110522SGR | 129.73 | 0.06 |
| 17015 | 7172130.376 | 406642.52 | 133.563 | 55B20110522SGR | 133.5 | 0.06 |
| 17016 | 7172121.012 | 406651.12 | 134.188 | 55B20110522SAR | 134.16 | 0.03 |
| 17017 | 7172147.557 | 406622.105 | 132.394 | 55B20110522SGR | 132.33 | 0.06 |
| 17018 | 7172181.357 | 405618.639 | 118.874 | 55B20110522SGR | 118.84 | 0.03 |
| 17019 | 7172182.201 | 405560.879 | 118.102 | 55B20110522SGR | 118.07 | 0.03 |
| 17020 | 7172185.093 | 405488.17 | 117.346 | 55B20110522SGR | 117.31 | 0.04 |
| 17021 | 7172238.187 | 405379.099 | 116.835 | 55B20110522OG | 116.83 | 0.00 |
| 17022 | 7172221.987 | 405380.15 | 117.182 | 55B20110522SGR | 117.16 | 0.02 |
| 17023 | 7172227.156 | 405376.566 | 117.229 | 55B20110522SWR | 117.2 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 17024 | 7172411.867 | 405282.77 | 115.794 | 55B20110522SWR | 115.75 | 0.04 |
| 17025 | 7172417.672 | 405258.539 | 114.479 | 55B20110522OG | 114.44 | 0.04 |
| 17026 | 7172473.499 | 405284.041 | 115.686 | 55B20110522SGR | 115.65 | 0.04 |
| 17028 | 7172711.421 | 405283.234 | 115.532 | 55B20110522SGR | 115.51 | 0.02 |
| 17029 | 7172723.367 | 405267.607 | 115.207 | 55B20110522SGR | 115.15 | 0.06 |
| 17030 | 7173055.542 | 405303.165 | 112.11 | 55B20110522SGR | 112.07 | 0.04 |
| 17031 | 7173091.141 | 405304.183 | 111.993 | 55B20110522SGR | 111.96 | 0.03 |
| 17032 | 7173381.949 | 405312.498 | 111.177 | 55B20110522SGR | 111.08 | 0.10 |
| 17033 | 7173428.015 | 405314.393 | 110.92 | 55B20110522SGR | 110.83 | 0.09 |
| 17034 | 7173540.857 | 405316.603 | 110.934 | 55B20110522SGR | 110.85 | 0.08 |
| 17035 | 7173803.509 | 405362.894 | 111.483 | 55B20110522SGR | 111.39 | 0.09 |
| 17036 | 7173805.581 | 405397.39 | 111.731 | 55B20110522SGR | 111.63 | 0.10 |
| 17037 | 7173817.319 | 405395.441 | 110.883 | 55B20110522SDR | 110.83 | 0.05 |
| 17038 | 7173762.416 | 405324.016 | 111.051 | 55B20110522SGR | 111.01 | 0.04 |
| 17039 | 7170941.239 | 405302.173 | 175.817 | 55B20110522SAR | 175.77 | 0.05 |
| 17040 | 7170967.036 | 405346.542 | 175.613 | 55B20110522SDR | 175.52 | 0.09 |
| 17041 | 7171094.123 | 405471.857 | 173.448 | 55B20110522SAR | 173.38 | 0.07 |
| 17042 | 7171161.575 | 405549.788 | 169.375 | 55B20110522SAR | 169.29 | 0.09 |
| 17043 | 7171203.361 | 405604.628 | 165.943 | 55B20110522SAR | 165.9 | 0.04 |
| 17044 | 7171243.908 | 405645.704 | 163.089 | 55B20110522SAR | 163.03 | 0.06 |
| 17045 | 7171573.141 | 406031.768 | 144.824 | 55B20110522SAR | 144.77 | 0.05 |
| 17046 | 7171566.29 | 406037.526 | 144.14 | 55B20110522SDR | 144.12 | 0.02 |
| 17047 | 7171953.075 | 406470.375 | 137.303 | 55B20110522SAR | 137.27 | 0.03 |
| 17048 | 7171949.692 | 406483.56 | 136.554 | 55B20110522OG | 136.48 | 0.07 |
| 17100 | 7104244.898 | 393788.082 | 345.148 | 53B | 345.13 | 0.02 |
| 17101 | 7104247.943 | 393788.183 | 344.757 | CHK_53B_FSP | 344.75 | 0.01 |
| 17102 | 7069255.104 | 406803.805 | 473.94 | 53B2-20110523CHK_51B_FSI | 473.91 | 0.03 |
| 17103 | 7069257.922 | 406802.735 | 474.098 | 53B2-20110523SAR | 474.11 | -0.01 |
| 17104 | 7104232.11 | 393793.05 | 345.66 | 53B2-20110523SGR | 345.66 | 0.00 |
| 17105 | 7104271.463 | 393815.167 | 341.596 | 53B2-20110523SAR | 341.58 | 0.02 |
| 17106 | 7104283.299 | 393754.546 | 345.506 | 53B2-20110523OG | 345.46 | 0.05 |
| 17107 | 7104305.054 | 393751.392 | 344.713 | 53B2-20110523SAR | 344.69 | 0.02 |
| 17108 | 7104353.868 | 393708.566 | 345.011 | 53B2-20110523SDR | 344.98 | 0.03 |
| 17109 | 7104393.089 | 393756.732 | 335.803 | 53B2-20110523SAR | 335.77 | 0.03 |
| 17110 | 7104201.04 | 393814.534 | 345.878 | 53B2-20110523SAR | 345.86 | 0.02 |
| 17111 | 7104163.136 | 393832.769 | 346.276 | 53B2-20110523SAR | 346.22 | 0.06 |
| 17112 | 7104131.433 | 393841.121 | 346.774 | 53B2-20110523SAR | 346.73 | 0.04 |
| 17113 | 7104099.523 | 393863.79 | 347.153 | 53B2-20110523OG | 347.14 | 0.01 |
| 17114 | 7104082.586 | 393893.024 | 346.277 | 53B2-20110523SGR | 346.22 | 0.06 |
| 17115 | 7104990.334 | 393154.015 | 339.579 | 53B2-20110523SGR | 339.54 | 0.04 |
| 17116 | 7104982.139 | 393194.173 | 339.075 | 53B2-20110523SGR | 339.05 | 0.02 |
| 17117 | 7104982.846 | 393125.889 | 339.789 | 53B2-20110523SGR | 339.76 | 0.03 |
| 17118 | 7104984.166 | 393077.932 | 340.077 | 53B2-20110523SGR | 340.05 | 0.03 |
| 17119 | 7104997.411 | 392765.698 | 342.075 | 53B2-20110523SGR | 342.05 | 0.02 |
| 17120 | 7104997.365 | 392717.156 | 343.331 | 53B2-20110523SGR | 343.31 | 0.02 |
| 17121 | 7105000.164 | 392669.373 | 345.966 | 53B2-20110523SAR | 345.92 | 0.05 |
| 17122 | 7105269.178 | 393212.775 | 335.884 | 53B2-20110523SAR | 335.86 | 0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 17123 | 7105227.276 | 393225.73 | 336.389 | 53B2-20110523SGR | 336.37 | 0.02 |
| 17124 | 7105280.47 | 393224.441 | 334.95 | 53B2-20110523SAR | 334.91 | 0.04 |
| 17125 | 7105314.469 | 393195.198 | 335.357 | 53B2-20110523SAR | 335.32 | 0.04 |
| 17126 | 7105328.647 | 393185.48 | 335.194 | 53B2-20110523SAR | 335.16 | 0.03 |
| 17127 | 7105377.261 | 393169.493 | 334.834 | 53B2-20110523SAR | 334.81 | 0.02 |
| 17128 | 7105377.261 | 393169.491 | 334.846 | 53B2-20110523OG | 334.81 | 0.04 |
| 17129 | 7105410.114 | 393168.351 | 333.664 | 53B2-20110523OG | 333.64 | 0.02 |
| 17130 | 7105443.096 | 393153.636 | 333.811 | 53B2-20110523SAR | 333.78 | 0.03 |
| 17131 | 7105444.671 | 393137.58 | 334.347 | 53B2-20110523SAR | 334.33 | 0.02 |
| 17132 | 7106239.721 | 392732.291 | 330.268 | 53B2-20110523SAR | 330.28 | -0.01 |
| 17133 | 7106215.82 | 392737.879 | 330.676 | 53B2-20110523OG | 330.7 | -0.02 |
| 17134 | 7106229.366 | 392677.886 | 329.942 | 53B2-20110523OG | 330 | -0.06 |
| 17135 | 7106226.183 | 392668.276 | 330.066 | 53B2-20110523OG | 330 | 0.07 |
| 17136 | 7106244.206 | 392715.288 | 329.365 | 53B2-20110523SAR | 329.34 | 0.03 |
| 17137 | 7106210.155 | 392743.185 | 330.584 | 53B2-20110523SAR | 330.55 | 0.03 |
| 17138 | 7106337.341 | 392704.802 | 329.431 | 53B2-20110523SAR | 329.4 | 0.03 |
| 17139 | 7106354.349 | 392697.525 | 329.53 | 53B2-20110523SGR | 329.5 | 0.03 |
| 17140 | 7106920.592 | 392545.625 | 323.375 | 53B2-20110523SGR | 323.32 | 0.06 |
| 17141 | 7106897.198 | 392574.015 | 319.705 | 53B2-20110523SAR | 319.71 | 0.00 |
| 17142 | 7107158.631 | 392669.453 | 324.155 | 53B2-20110523SAR | 324.13 | 0.02 |
| 17143 | 7107199.364 | 392661.907 | 324.05 | 53B2-20110523SAR | 324.07 | -0.02 |
| 17144 | 7107249.899 | 392647.008 | 323.788 | 53B2-20110523SAR | 323.81 | -0.02 |
| 17145 | 7107292.313 | 392635.919 | 323.651 | 53B2-20110523SAR | 323.64 | 0.01 |
| 17146 | 7103528.418 | 394307.91 | 352.583 | 53B2-20110523SAR | 352.58 | 0.00 |
| 17147 | 7103563.921 | 394283.986 | 352.97 | 53B2-20110523SAR | 352.94 | 0.03 |
| 17148 | 7102847.928 | 394906.245 | 340.886 | 53B2-20110523SGR | 340.85 | 0.04 |
| 17149 | 7102842.742 | 394934.649 | 339.744 | 53B2-20110523SAR | 339.71 | 0.03 |
| 17150 | 7102832.929 | 394935.461 | 340.116 | 53B2-20110523OG | 340.1 | 0.02 |
| 17151 | 7102809.042 | 394949.64 | 338.999 | 53B2-20110523SGR | 338.97 | 0.03 |
| 17152 | 7101846.894 | 395161.022 | 306.765 | 53B2-20110523SAR | 306.74 | 0.02 |
| 17153 | 7101876.287 | 395174.737 | 305.903 | 53B2-20110523SGR | 305.84 | 0.06 |
| 17154 | 7101972.199 | 395234.149 | 302.496 | 53B2-20110523SGR | 302.42 | 0.08 |
| 17155 | 7101938.753 | 395252.846 | 302.711 | 53B2-20110523SAR | 302.67 | 0.04 |
| 17156 | 7101786.218 | 395162.505 | 308.669 | 53B2-20110523SGR | 308.61 | 0.06 |
| 17157 | 7101752.541 | 395182.858 | 309.627 | 53B2-20110523SGR | 309.57 | 0.06 |
| 17158 | 7101893.082 | 395301.463 | 302.439 | 53B2-20110523SGR | 302.43 | 0.01 |
| 17159 | 7101890.117 | 395327.05 | 302.262 | 53B2-20110523SGR | 302.2 | 0.06 |
| 17160 | 7101847.627 | 395546.289 | 301.615 | 53B2-20110523SGR | 301.62 | 0.00 |
| 17161 | 7101850.478 | 395548.665 | 301.621 | 53B2-20110523SGR | 301.6 | 0.02 |
| 17162 | 7101696.434 | 395671.136 | 301.906 | 53B2-20110523SGR | 301.88 | 0.03 |
| 17163 | 7100427.558 | 395284.649 | 320.068 | 53B2-20110523SAR | 320.04 | 0.03 |
| 17164 | 7100424.774 | 395301.05 | 321.252 | 53B2-20110523SAR | 321.22 | 0.03 |
| 17165 | 7100317.633 | 395318.795 | 325.966 | 53B2-20110523CHK_51B_FSI | 325.94 | 0.03 |
| 17166 | 7069257.917 | 406802.73 | 474.098 | 3B2-20110523CHK_53A_actu | 474.11 | -0.01 |
| 17167 | 7102966.051 | 394763.067 | 342.841 | 53B2-20110523CHK_53B_FSI | 342.78 | 0.06 |
| 17168 | 7104247.933 | 393788.192 | 344.75 | CHK_53B_FSP | 344.74 | 0.01 |
| 17500 | 7082146.99 | 401137.89 | 513.62 | 51CSAC | 513.55 | 0.07 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 17501 | 7077135.666 | 403406.06 | 538.612 | SPR | 538.5 | 0.11 |
| 17502 | 7077142.515 | 403394.24 | 538.767 | SPR | 538.65 | 0.12 |
| 17503 | 7077156.751 | 403386.991 | 538.816 | SPR | 538.7 | 0.12 |
| 17504 | 7077162.674 | 403376.108 | 538.923 | SPR | 538.78 | 0.14 |
| 17505 | 7077764.19 | 402876.148 | 516.817 | SPR | 516.77 | 0.05 |
| 17506 | 7077768.13 | 402867.8 | 516.781 | SPR | 516.68 | 0.10 |
| 17507 | 7077781.761 | 402862.219 | 516.709 | SPR | 516.64 | 0.07 |
| 17508 | 7077788.277 | 402852.837 | 516.607 | SPR | 516.54 | 0.07 |
| 17509 | 7078363.104 | 402424.447 | 532.34 | SPR | 532.25 | 0.09 |
| 17510 | 7078372.729 | 402412.546 | 532.28 | SPR | 532.18 | 0.10 |
| 17511 | 7078384.338 | 402408.301 | 532.177 | SPR | 532.11 | 0.07 |
| 17512 | 7078395.419 | 402395.579 | 532.083 | SPR | 531.99 | 0.09 |
| 17513 | 7078973.848 | 401963.918 | 534.462 | SPR | 534.35 | 0.11 |
| 17514 | 7078979.495 | 401954.455 | 534.775 | SPR | 534.68 | 0.10 |
| 17515 | 7078994.909 | 401947.362 | 535.052 | SPR | 534.94 | 0.11 |
| 17516 | 7079001.217 | 401937.951 | 535.333 | SPR | 535.26 | 0.07 |
| 17517 | 7079533.777 | 401539.636 | 538.026 | SPR | 537.95 | 0.08 |
| 17518 | 7079543.185 | 401527.787 | 538.021 | SPR | 537.99 | 0.03 |
| 17519 | 7079556.321 | 401522.363 | 538.012 | SPR | 537.92 | 0.09 |
| 17520 | 7079562.973 | 401512.202 | 538.006 | SPR | 537.93 | 0.08 |
| 17521 | 7080128.657 | 401205.835 | 543.285 | SPR | 543.23 | 0.05 |
| 17522 | 7080146.446 | 401200.521 | 543.221 | SPR | 543.13 | 0.09 |
| 17523 | 7080160.188 | 401197.496 | 543.071 | SPR | 542.97 | 0.10 |
| 17524 | 7080177.097 | 401190.504 | 542.99 | SPR | 542.91 | 0.08 |
| 17525 | 7080736.96 | 401087.349 | 538.124 | SPR | 538.06 | 0.06 |
| 17526 | 7080748.084 | 401081.289 | 538.181 | SPR | 538.08 | 0.10 |
| 17527 | 7080761.878 | 401082.516 | 538.248 | SPR | 538.16 | 0.09 |
| 17528 | 7080775.9 | 401076.128 | 538.268 | SPR | 538.2 | 0.07 |
| 17529 | 7081446.215 | 400959.113 | 540.884 | SPR | 540.79 | 0.09 |
| 17530 | 7081439.771 | 400971.392 | 540.86 | SPR | 540.8 | 0.06 |
| 17531 | 7081452.44 | 400977.792 | 540.649 | SPR | 540.58 | 0.07 |
| 17532 | 7081434.488 | 400986.116 | 540.287 | SPR | 540.22 | 0.07 |
| 17533 | 7081422.186 | 400972.37 | 540.734 | SPR | 540.65 | 0.08 |
| 17534 | 7081419.554 | 400954.299 | 541.094 | FAC_DOT_PASKS_2471 | 541.12 | -0.03 |
| 17535 | 7081419.554 | 400954.304 | 541.083 | FAC_DOT_PASKS_2471 | 541.12 | -0.04 |
| 17536 | 7081443.71 | 400944.775 | 540.871 | SPR | 540.76 | 0.11 |
| 17537 | 7081619.232 | 400570.604 | 540.348 | SPR | 540.28 | 0.07 |
| 17538 | 7081626.821 | 400563.986 | 540.573 | SPR | 540.49 | 0.08 |
| 17539 | 7081629.637 | 400553.672 | 540.783 | SPR | 540.71 | 0.07 |
| 17540 | 7081636.432 | 400548.365 | 540.927 | SPR | 540.85 | 0.08 |
| 17541 | 7081705.546 | 400436.2 | 546.706 | SPR | 546.62 | 0.09 |
| 17542 | 7081715.95 | 400421.375 | 547.191 | SPR | 547.09 | 0.10 |
| 17543 | 7081723.414 | 400416.663 | 547.16 | SPR | 547.08 | 0.08 |
| 17544 | 7081728.058 | 400405.421 | 547.006 | SPR | 546.93 | 0.08 |
| 17545 | 7081781.837 | 400227.241 | 544.693 | SPR | 544.64 | 0.05 |
| 17546 | 7081776.782 | 400216.966 | 544.761 | SPR | 544.69 | 0.07 |
| 17547 | 7081778.704 | 400205.121 | 544.822 | SPR | 544.76 | 0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 17548 | 7081773.521 | 400192.738 | 544.986 | SPR | 544.88 | 0.11 |
| 17549 | 7082143.973 | 401137.748 | 513.772 | CK_SPIKE | 513.75 | 0.02 |
| 17550 | 7082132.78 | 401128.225 | 514.51 | SPR | 514.4 | 0.11 |
| 17551 | 7082140.932 | 401124.705 | 513.875 | SPR | 513.78 | 0.10 |
| 17552 | 7082154.325 | 401123.599 | 512.972 | SPR | 512.89 | 0.08 |
| 17553 | 7082159.674 | 401132.42 | 512.931 | SPR | 512.85 | 0.08 |
| 17554 | 7082730.192 | 401043.373 | 478.955 | SPR | 478.91 | 0.04 |
| 17555 | 7082738.999 | 401035.794 | 478.413 | SPR | 478.36 | 0.05 |
| 17556 | 7082751.046 | 401036.383 | 477.835 | SPR | 477.78 | 0.06 |
| 17557 | 7082762.38 | 401028.131 | 477.179 | SPR | 477.14 | 0.04 |
| 17558 | 7083343.111 | 400824.168 | 458.705 | SPR | 458.71 | 0.00 |
| 17559 | 7083354.826 | 400815.879 | 458.643 | SPR | 458.62 | 0.02 |
| 17560 | 7083369.214 | 400814.702 | 458.514 | SPR | 458.5 | 0.01 |
| 17561 | 7083381.243 | 400806.087 | 458.459 | SPR | 458.44 | 0.02 |
| 17562 | 7083951.916 | 400709.963 | 452.251 | SPR | 452.24 | 0.01 |
| 17563 | 7083968.893 | 400711.877 | 452.267 | SPR | 452.26 | 0.01 |
| 17564 | 7083962.65 | 400698.364 | 452.652 | SPR | 452.64 | 0.01 |
| 17565 | 7084084.445 | 400574.844 | 458.522 | SPR | 458.51 | 0.01 |
| 17566 | 7084079.423 | 400585.683 | 458.066 | SPR | 458.04 | 0.03 |
| 17567 | 7084083.003 | 400562.525 | 458.92 | SPR | 458.91 | 0.01 |
| 17568 | 7084093.046 | 400575.232 | 458.614 | SPR | 458.57 | 0.04 |
| 17569 | 7084117.349 | 400303.797 | 469.884 | SPR | 469.92 | -0.04 |
| 17570 | 7084114.129 | 400291.88 | 470.14 | SPR | 470.11 | 0.03 |
| 17571 | 7084116.548 | 400280.767 | 470.169 | SPR | 470.14 | 0.03 |
| 17572 | 7084113.646 | 400270.378 | 470.177 | SPR | 470.14 | 0.04 |
| 17573 | 7084115.696 | 400027.414 | 467.57 | SPR | 467.52 | 0.05 |
| 17574 | 7084113.492 | 400014.314 | 467.874 | SPR | 467.8 | 0.07 |
| 17575 | 7084116.481 | 400000.416 | 468.27 | SPR | 468.2 | 0.07 |
| 17576 | 7084114.165 | 399987.57 | 468.59 | SPR | 468.48 | 0.11 |
| 17577 | 7084065.24 | 400698.214 | 454.121 | SPR | 454.06 | 0.06 |
| 17578 | 7084073.654 | 400680.377 | 454.733 | SPR | 454.68 | 0.05 |
| 17579 | 7084062.442 | 400668.325 | 455.009 | SPR | 454.98 | 0.03 |
| 17580 | 7084046.75 | 400673.262 | 454.761 | SPR | 454.74 | 0.02 |
| 17581 | 7083993.307 | 401019.806 | 446.623 | SPR | 446.59 | 0.03 |
| 17582 | 7083994.679 | 401032.496 | 446.284 | SPR | 446.27 | 0.01 |
| 17583 | 7083988.358 | 401043.656 | 446.081 | SPR | 446.07 | 0.01 |
| 17584 | 7083989.975 | 401056.772 | 445.691 | SPR | 445.66 | 0.03 |
| 17585 | 7084004.184 | 401335.165 | 439.361 | SPR | 439.37 | -0.01 |
| 17586 | 7084012.717 | 401345.672 | 438.874 | SPR | 438.88 | -0.01 |
| 17587 | 7084015.436 | 401360.836 | 438.783 | SPR | 438.76 | 0.02 |
| 17588 | 7084025.523 | 401372.708 | 438.239 | SPR | 438.24 | 0.00 |
| 17589 | 7084102.851 | 401519.245 | 433.94 | SPR | 433.9 | 0.04 |
| 17590 | 7084111.153 | 401526.977 | 433.601 | SPR | 433.56 | 0.04 |
| 17593 | 7084609.458 | 400752.531 | 447.835 | SPR | 447.79 | 0.04 |
| 17594 | 7084623.435 | 400748.826 | 447.337 | SPR | 447.3 | 0.04 |
| 17595 | 7084637.281 | 400752.305 | 447.09 | SPR | 447.07 | 0.02 |
| 17596 | 7084652.593 | 400748.101 | 446.504 | SPR | 446.5 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 17597 | 7085205.722 | 400543.65 | 445.084 | SPR | 445.04 | 0.04 |
| 17598 | 7085219.838 | 400535.178 | 445.176 | SPR | 445.12 | 0.06 |
| 17599 | 7085231.228 | 400523.505 | 445.154 | SPR | 445.16 | -0.01 |
| 17600 | 7085243.061 | 400516.441 | 445.169 | SPR | 445.15 | 0.02 |
| 17601 | 7084909.356 | 400387.401 | 448.766 | SPR | 448.72 | 0.05 |
| 17602 | 7084906.758 | 400375.395 | 449.536 | SPR | 449.5 | 0.04 |
| 17603 | 7084910.197 | 400366.027 | 450.12 | SPR | 450.08 | 0.04 |
| 17604 | 7084907.411 | 400355.522 | 450.777 | SPR | 450.74 | 0.04 |
| 17605 | 7084919.04 | 400279.764 | 454.226 | SPR | 454.21 | 0.02 |
| 17606 | 7084911.438 | 400269.372 | 454.493 | SPR | 454.49 | 0.00 |
| 17607 | 7084909.332 | 400281.033 | 454.374 | SPR | 454.36 | 0.01 |
| 17608 | 7084911.874 | 400290.241 | 454.102 | SPR | 454.11 | -0.01 |
| 17609 | 7085793.143 | 400186.757 | 441.179 | SPR | 441.2 | -0.02 |
| 17610 | 7085806.911 | 400173.453 | 440.863 | SPR | 440.85 | 0.01 |
| 17611 | 7085821.613 | 400169.137 | 440.601 | SPR | 440.62 | -0.02 |
| 17612 | 7085829.474 | 400160.095 | 440.433 | SPR | 440.43 | 0.00 |
| 17613 | 7086394.092 | 399821.208 | 429.438 | SPR | 429.4 | 0.04 |
| 17614 | 7086410.026 | 399806.906 | 429.074 | SPR | 429.02 | 0.05 |
| 17615 | 7086425.54 | 399801.685 | 428.847 | SPR | 428.82 | 0.03 |
| 17616 | 7086433.956 | 399792.763 | 428.645 | SPR | 428.63 | 0.01 |
| 17617 | 7086607.794 | 399691.253 | 425.407 | SPR | 425.43 | -0.02 |
| 17618 | 7086793.162 | 399578.384 | 422.637 | SPR | 422.58 | 0.06 |
| 17619 | 7086976.82 | 399444.004 | 422.14 | SPR | 422.11 | 0.03 |
| 17620 | 7087212.908 | 399246.965 | 424.793 | SPR | 424.75 | 0.04 |
| 17621 | 7087369.629 | 399115.597 | 425.96 | SPR | 425.91 | 0.05 |
| 17622 | 7087330.813 | 399062.68 | 426.448 | SPR | 426.4 | 0.05 |
| 17623 | 7087179.302 | 398979.536 | 431.883 | SPR | 431.81 | 0.07 |
| 17624 | 7087045.864 | 398773.379 | 435.473 | SPR | 435.4 | 0.07 |
| 17625 | 7086939.359 | 398579.565 | 439.96 | SPR | 439.93 | 0.03 |
| 17629 | 7087451.91 | 399115.078 | 423.908 | SPR | 423.85 | 0.06 |
| 17630 | 7087667.879 | 399162.62 | 419.078 | SPR | 419.06 | 0.02 |
| 17631 | 7087845.97 | 399237.134 | 415.166 | SPR | 415.17 | 0.00 |
| 17632 | 7088020.866 | 399326.51 | 418.371 | SPR | 418.35 | 0.02 |
| 17633 | 7088253.873 | 399464.41 | 414.632 | SPR | 414.64 | -0.01 |
| 17635 | 7087624.523 | 398902.451 | 424.601 | SPR | 424.59 | 0.01 |
| 17636 | 7087818.937 | 398739.857 | 423.397 | SPR | 423.37 | 0.03 |
| 17637 | 7088005.822 | 398582.955 | 423.082 | SPR | 423.05 | 0.03 |
| 17638 | 7088176.554 | 398441.206 | 423.363 | SPR | 423.37 | -0.01 |
| 17639 | 7088360.393 | 398298.551 | 425.1 | SPR | 425.07 | 0.03 |
| 17640 | 7088602.834 | 398112.244 | 426.858 | SPR | 426.8 | 0.06 |
| 17641 | 7088732.647 | 398012.86 | 425.03 | SPR | 425.01 | 0.02 |
| 17642 | 7088995.806 | 397815.417 | 408.61 | SPR | 408.53 | 0.08 |
| 17643 | 7089209.179 | 397756.556 | 407.411 | SPR | 407.35 | 0.06 |
| 17644 | 7089447.109 | 397767.299 | 417.721 | SPR | 417.66 | 0.06 |
| 17645 | 7089703.937 | 397710.611 | 419.003 | SPR | 418.96 | 0.04 |
| 17646 | 7089903.781 | 397628.282 | 417.436 | SPR | 417.39 | 0.05 |
| 17647 | 7090088.754 | 397551.839 | 417.398 | SPR | 417.33 | 0.07 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 17648 | 7090296.589 | 397465.771 | 418.265 | SPR | 418.23 | 0.03 |
| 17649 | 7090375.033 | 397418.92 | 419.011 | SGR | 418.98 | 0.03 |
| 17650 | 7090290.605 | 397371.694 | 436.984 | SGR | 436.9 | 0.08 |
| 17651 | 7090369.012 | 397031.956 | 462.335 | SGR | 462.32 | 0.01 |
| 17652 | 7090365.328 | 397177.045 | 454.22 | SGR | 454.17 | 0.05 |
| 17653 | 7090226.707 | 397305.754 | 454.193 | SGR | 454.17 | 0.02 |
| 17654 | 7090206.536 | 397361.581 | 447.214 | SGR | 447.17 | 0.04 |
| 17655 | 7090318.175 | 397375.476 | 434.115 | SGR | 433.99 | 0.13 |
| 17656 | 7090431.434 | 397412.749 | 418.713 | SPR | 418.67 | 0.04 |
| 17657 | 7090633.047 | 397338.84 | 416.551 | SPR | 416.48 | 0.07 |
| 17658 | 7090904.681 | 397239.943 | 413.669 | SPR | 413.61 | 0.06 |
| 17659 | 7091119.063 | 397152.858 | 412.037 | SPR | 411.98 | 0.06 |
| 17660 | 7091316.564 | 397042.597 | 414.023 | SPR | 413.95 | 0.07 |
| 17661 | 7091412.098 | 396976.402 | 415.814 | SPR | 415.73 | 0.08 |
| 17662 | 7091564.756 | 396847.855 | 420.669 | SPR | 420.59 | 0.08 |
| 17663 | 7091710.856 | 396700.634 | 426.046 | SPR | 425.98 | 0.07 |
| 17664 | 7091825.92 | 396582.433 | 430.231 | SPR | 430.16 | 0.07 |
| 17665 | 7091960.202 | 396444.493 | 435.272 | SPR | 435.19 | 0.08 |
| 17666 | 7092074.998 | 396330.586 | 437.393 | SPR | 437.33 | 0.06 |
| 17667 | 7092392.429 | 396224.391 | 431.666 | SPR | 431.62 | 0.05 |
| 17668 | 7092673.994 | 396220.467 | 425.619 | SPR | 425.56 | 0.06 |
| 17669 | 7092965.9 | 396216.161 | 413.123 | SPR | 413.09 | 0.03 |
| 17670 | 7093200.824 | 396212.179 | 407.334 | SPR | 407.31 | 0.02 |
| 17671 | 7093444.823 | 396180.477 | 406.185 | SPR | 406.14 | 0.05 |
| 17672 | 7093656.807 | 396135.224 | 406.82 | SPR | 406.77 | 0.05 |
| 17673 | 7093925.628 | 396078.472 | 412.144 | SPR | 412.05 | 0.09 |
| 17674 | 7094085.127 | 396044.244 | 413.459 | SPR | 413.37 | 0.09 |
| 17675 | 7094319.758 | 395995.09 | 411.856 | SPR | 411.78 | 0.08 |
| 17676 | 7094480.786 | 395962.092 | 411.88 | SPR | 411.73 | 0.15 |
| 17677 | 7094688.921 | 395955.585 | 412.692 | SPR | 412.6 | 0.09 |
| 17678 | 7094953.296 | 396005.369 | 413.07 | SPR | 412.97 | 0.10 |
| 17679 | 7095111.262 | 396038.96 | 411.693 | SPR | 411.62 | 0.07 |
| 17680 | 7095314.458 | 396082.347 | 409.651 | SPR | 409.52 | 0.13 |
| 17681 | 7095495.301 | 396120.725 | 408.061 | SPR | 407.95 | 0.11 |
| 17682 | 7095680.99 | 396159.799 | 405.977 | SPR | 405.86 | 0.12 |
| 17683 | 7095902.466 | 396206.648 | 399.051 | SPR | 398.93 | 0.12 |
| 17684 | 7096097.744 | 396248.275 | 389.771 | SPR | 389.66 | 0.11 |
| 17685 | 7096298.008 | 396290.905 | 378.779 | SPR | 378.68 | 0.10 |
| 17686 | 7096479.01 | 396321.286 | 374.556 | SPR | 374.48 | 0.08 |
| 17687 | 7096645.915 | 396292.395 | 370.159 | SPR | 370.08 | 0.08 |
| 17688 | 7096818.242 | 396173.57 | 358.272 | SPR | 358.21 | 0.06 |
| 17689 | 7096968.986 | 395948.41 | 350.06 | SPR | 349.96 | 0.10 |
| 17690 | 7097130.262 | 395829.397 | 346.217 | SPR | 346.08 | 0.14 |
| 17691 | 7097387.766 | 395803.746 | 340.579 | SPR | 340.49 | 0.09 |
| 17692 | 7097560.365 | 395853.859 | 335.847 | SPR | 335.77 | 0.08 |
| 17693 | 7097798.045 | 395882.604 | 330.689 | SPR | 330.61 | 0.08 |
| 17694 | 7098001.301 | 395827.217 | 330.836 | SPR | 330.74 | 0.10 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 17695 | 7098125.13 | 395763.727 | 331.246 | SPR | 331.11 | 0.14 |
| 17696 | 7098316.732 | 395664.795 | 337.148 | SPR | 337.02 | 0.13 |
| 17697 | 7098486.612 | 395581.748 | 339.011 | SPR | 338.91 | 0.10 |
| 17698 | 7098711.87 | 395525.611 | 336.568 | SPR | 336.46 | 0.11 |
| 17699 | 7098902.028 | 395500.937 | 334.336 | SPR | 334.22 | 0.12 |
| 17700 | 7099123.603 | 395472.704 | 336.503 | SPR | 336.39 | 0.11 |
| 17701 | 7099238.207 | 395457.812 | 340.129 | SPR | 340.01 | 0.12 |
| 17702 | 7099256.009 | 395471.88 | 339.647 | SGR | 339.55 | 0.10 |
| 17703 | 7099298.714 | 395579.627 | 331.21 | SGR | 331.17 | 0.04 |
| 17704 | 7099288.106 | 395702.086 | 317.478 | SGR | 317.46 | 0.02 |
| 17705 | 7099271.534 | 395808.251 | 316.839 | SGR | 316.8 | 0.04 |
| 17706 | 7099258.219 | 395898.326 | 316.573 | SGR | 316.51 | 0.06 |
| 17707 | 7099240.491 | 396021.03 | 314.828 | SGR | 314.81 | 0.02 |
| 17708 | 7099226.64 | 396122.13 | 314.365 | SGR | 314.31 | 0.06 |
| 17709 | 7099216.8 | 396194.205 | 314.645 | SGR | 314.56 | 0.08 |
| 17710 | 7099211.708 | 396242.957 | 314.819 | SGR | 314.77 | 0.05 |
| 17711 | 7099234.217 | 396279.923 | 314.027 | SGR | 313.99 | 0.04 |
| 17712 | 7099298.02 | 396307.681 | 313.638 | SGR | 313.57 | 0.07 |
| 17713 | 7099382.448 | 395439.504 | 342.477 | SPR | 342.44 | 0.04 |
| 17714 | 7099643.08 | 395405.743 | 340.356 | SPR | 340.35 | 0.01 |
| 17715 | 7099921.294 | 395369.504 | 331.687 | SPR | 331.61 | 0.08 |
| 17716 | 7100207.797 | 395332.874 | 328.325 | SPR | 328.26 | 0.06 |
| 17717 | 7100620.302 | 395279.982 | 313.486 | SPR | 313.45 | 0.04 |
| 17718 | 7100810.242 | 395255.469 | 312.011 | SPR | 311.91 | 0.10 |
| 17719 | 7101020.022 | 395228.671 | 311.571 | SPR | 311.54 | 0.03 |
| 17720 | 7101147.978 | 395212.183 | 311.657 | SPR | 311.62 | 0.04 |
| 17721 | 7101291.851 | 395193.339 | 312.08 | SPR | 312.08 | 0.00 |
| 17722 | 7101503.772 | 395166.237 | 315.123 | SPR | 315.09 | 0.03 |
| 17723 | 7101829.299 | 395169.972 | 307.136 | SPR | 307.13 | 0.01 |
| 17724 | 7102103.971 | 395222.114 | 304.696 | SPR | 304.64 | 0.06 |
| 17725 | 7102278.54 | 395252.511 | 308.381 | SPR | 308.35 | 0.03 |
| 17726 | 7102483.683 | 395233.069 | 318.376 | SPR | 318.33 | 0.05 |
| 17727 | 7102672.063 | 395133.35 | 329.437 | SPR | 329.43 | 0.01 |
| 17728 | 7102774.099 | 395022.575 | 336.808 | SPR | 336.77 | 0.04 |
| 17729 | 7102882.667 | 394865.815 | 341.422 | SPR | 341.44 | -0.02 |
| 17730 | 7104152.457 | 393842.469 | 345.955 | FAC_DOT_PARKS_2627 | 345.98 | -0.03 |
| 17731 | 7104152.448 | 393842.495 | 345.961 | FAC_DOT_PARKS_2627 | 345.98 | -0.02 |
| 17732 | 7082143.942 | 401137.767 | 513.754 | CK_SPIKE | 513.75 | 0.00 |

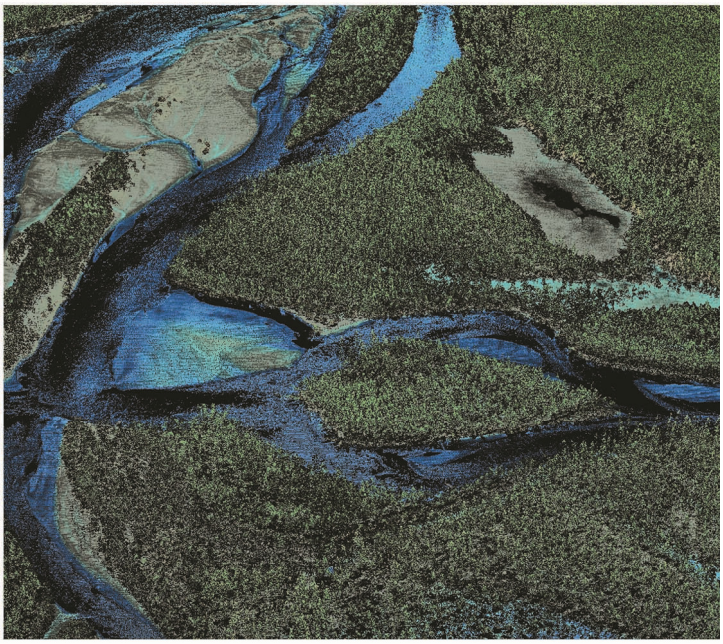
# LiDAR REMOTE SENSING

## ALASKA PIPELINE • ALASKA

(Delivery 8– 11/21/2011)








## ALASKA DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

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**WATERSHED SCIENCES** • 517 SW 2nd Street, Suite 400 - Corvallis, OR 97333

# LiDAR Remote Sensing Data Collection:

## Alaska Pipeline, AK

### Delivery 8

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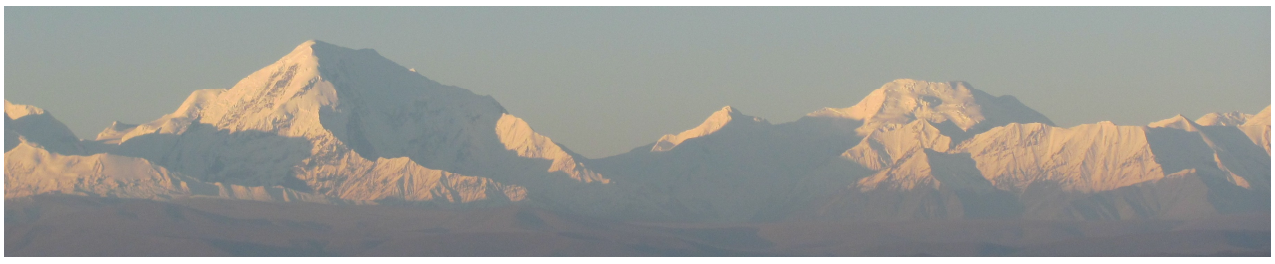
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# 1. Overview

Watershed Sciences, Inc. (WS) collected Light Detection and Ranging (LiDAR) data of the Alaska Pipeline for the Alaska Department of Natural Resources. LiDAR data for Delivery 8 was collected between October 1st and 3rd, 2010 and June 29th through July 22nd (**Figure 1**). Delivery 8 includes 149,733 acres within the requested area. This area was expanded to include a 100m buffer to ensure complete coverage and adequate point densities around survey boundaries, resulting in 156,712 acres of delivered data. This area completes the UTM 7N portion of the survey area.

***Figure 1***. *Alaska Pipeline survey delivery status overview.*

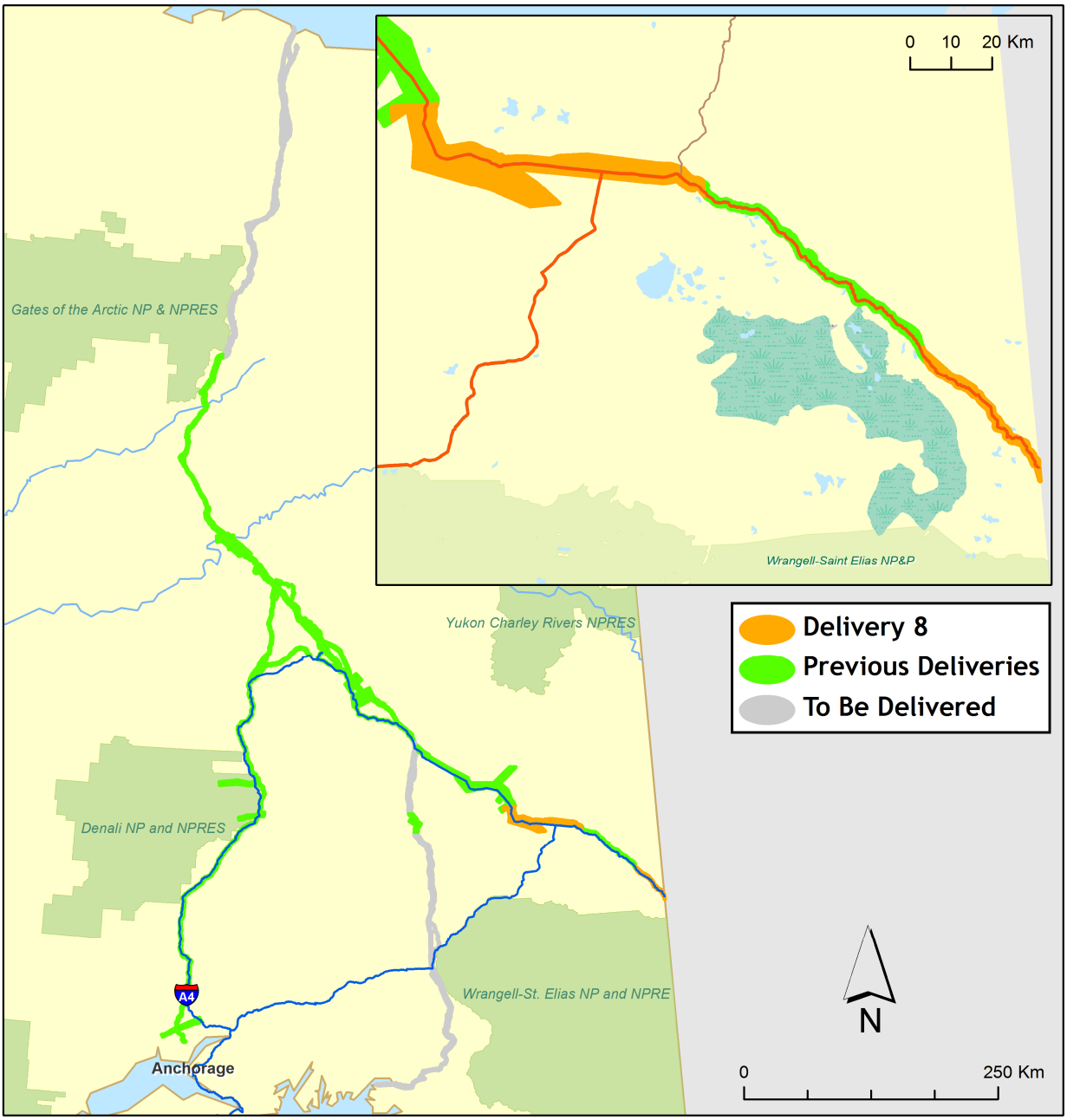


***Table 1**. Alaska Pipeline, LiDAR deliveries to date.*

| Delivery | UTM Zone(s) | Date | Total Acres Flown | AOI Acres |
|---|---|---|---|---|
| **1** | 6, 7 | March 9, 2011 | 121,746 | 117,357 |
| **2** | 6 | March 31, 2011 | 99,594 | 94,885 |
| **3** | 7 | May 23, 2011 | 43,976 | 39,744 |
| **4** | 6 | July 29, 2011 | 168,823 | 159,433 |
| **5** | 5 | August 31, 2011 | 247,206 | 226,450 |
| **6** | 6 | September 30, 2011 | 309,216 | 293,337 |
| **7** | 6 | October 31, 2011 | 262,279 | 239,477 |
| **8** | 7 | November 21, 2011 | 156,712 | 149,733 |

# 2. Acquisition

## 2.1 Airborne Survey – Instrumentation and Methods

The LiDAR survey utilized a Leica ALS60 sensor in a Cessna Caravan 208Bs. The Leica systems were set to acquire 150,000 laser pulses per second (i.e., 150 kHz pulse rate) and flown at 1500 meters above ground level (AGL), capturing a scan angle of ±14° from nadir when clouds and terrain permitted. With these flight parameters, the laser swath width is 638m and the laser pulse footprint is 34cm. These settings varied depending on cloud cover and terrain but were consistently adjusted to yield an average native pulse density of ≥8 pulses per square meter over terrestrial surfaces. It is not uncommon for some types of surfaces (e.g. dense vegetation or water) to return fewer pulses than the laser originally emitted. These discrepancies between 'native' and 'delivered' density will vary depending on terrain, land cover, and the prevalence of water bodies.

*The Cessna Caravan is a stable platform, ideal for flying slow and low for high density projects. A Leica ALS60 sensor head installed in the Caravan is shown on the left.*



All areas were surveyed with an opposing flight line side-lap of ≥60% (≥100% overlap) to reduce laser shadowing and increase surface laser painting. The Leica laser systems allow up to four range measurements (returns) per pulse, and all discernable laser returns were processed for the output dataset.

To accurately solve for laser point position (geographic coordinates x, y, z), the positional coordinates of the airborne sensor and the attitude of the aircraft were recorded continuously throughout the LiDAR data collection mission. Aircraft position was measured twice per second (2 Hz) by an onboard differential GPS unit. 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/sensor position and attitude data are indexed by GPS time.

## 2.2 Ground Survey – Instrumentation and Methods

### *2.2.1 Monumentation*




Watershed Sciences coordinated with McClintock Land Associates (MLA, Alaska Professional Licensed Surveyor), of Eagle River, AK to determine proposed monument locations to support aerial acquisition. MLA established survey control monuments for the project area based on the proposed locations, areas with reasonable access, GPS visibility and proximity to the mission area. MLA established 26 new monuments (**Table 2**) within the Delivery 8 calibration area. The MLA monumentation was done with 5/8" x 30" rebar topped with a metal cap stamped with "MLA-WSI" the monument ID, and the year of establishment. MLA provided professional supervision and oversight to all survey aspects of this project, certified all monuments and provided additional independent accuracy check points (see Section 5.4, Appendix B). A full report of the survey will be provided with the final delivery report.

### *2.2.2 Control for Airborne Surveys*

During the LiDAR survey, static (1 Hz recording frequency) ground surveys were conducted over the survey control monuments.

All control monuments were observed for a minimum of two survey sessions lasting no fewer than 4 hours. At the beginning of every session the tripod and antenna were reset, resulting in two independent instrument heights and data files. Data was collected at a rate of 1Hz using a 10 degree mask on the antenna.


Trimble R7 GPS equipment set up in the Alaska Pipeline study area.

After the airborne survey, the static GPS data were provided to MLA for incorporation in the computation of the monument coordinates. MLA processed the static GPS data using triangulation with Continuously Operating Reference Stations (CORS). Both WSI and MLA checked coordinates using the Online Positioning User Service (OPUS[1]) to quantify daily variance. MLA provided calculated geodetic positions for all controls.

Indexed by time, these GPS data were used to correct the continuous onboard measurements of aircraft position recorded throughout the mission. Control monuments were located within 13 nautical miles of the survey area as per the contract.

***Table 2**. Base Station control coordinates for Alaska Pipeline Delivery 8.*

| Base Station ID | Datum: NAD83 (CORS96) | | GRS80 |
|---|---|---|---|
| | Latitude | Longitude | Ellipsoid Z (meters) |
| 22 A | 64 12 29.03935 | 145 56 50.46314 | 308.524 |
| 22 B | 64 11 57.22189 | 145 55 23.24779 | 308.511 |
| 22 C | 64 04 12.11723 | 145 42 10.18804 | 365.759 |
| 25 A | 63 39 38.92963 | 144 03 59.83195 | 434.283 |
| 25 B | 63 39 13.67975 | 144 01 04.92402 | 441.323 |
| 26 A | 63 25 28.70024 | 143 48 57.25969 | 491.032 |
| 26 B | 63 22 57.58883 | 143 35 50.62909 | 527.711 |
| 26 C | 63 21 51.92801 | 143 30 41.87039 | 508.816 |
| 27 A | 63 22 42.53860 | 143 20 42.85339 | 483.054 |
| 27 B | 63 20 27.45032 | 143 03 39.11444 | 507.527 |
| 28 A | 63 17 08.79311 | 142 31 06.34752 | 578.973 |
| 28 B | 63 10 28.09302 | 142 08 35.28302 | 563.94 |
| 29 A | 63 03 10.20713 | 141 51 07.91916 | 532.289 |
| 29 A1 | 63 03 17.39323 | 141 53 00.09764 | 534.443 |
| 29 B | 63 02 12.72074 | 141 49 26.08677 | 546.642 |
| 30 A | 62 46 38.43969 | 141 15 09.15381 | 664.083 |
| 30 B | 62 45 45.94068 | 141 13 40.69415 | 642.396 |
| 30 C | 62 37 15.02014 | 141 00 32.31152 | 600.668 |
| 31 A | 63 41 43.19332 | 145 53 07.58068 | 550.56 |
| 31 B | 63 40 16.49445 | 145 53 05.11737 | 556.071 |
| 32 A | 63 24 02.43810 | 145 44 05.42835 | 773.965 |
| 32 B | 63 22 25.12575 | 145 43 52.67022 | 779.773 |
| 33 A | 63 09 07.87064 | 145 32 13.87861 | 999.179 |

[1] Online Positioning User Service (OPUS) is run by the National Geodetic Survey to process corrected monument positions.

| | | | |
|---|---|---|---|
| 33 B | 63 08 50.56877 | 145 32 39.60949 | 999.898 |
| 33 C | 63 19 31.49425 | 145 43 49.44023 | 783.806 |
| 33 D | 63 12 58.03022 | 145 38 39.80039 | 929.946 |

### *2.2.3 Instrumentation*

For this survey, a Trimble GPS receiver model R7 with Zephyr Geodetic antenna with ground plane was deployed for all static control. A Trimble model R8 GNSS unit was used for collecting check points using real time kinematic (RTK) survey techniques. All GPS measurements were made with dual frequency L1-L2 receivers with carrier-phase correction.

The aircraft was assigned a ground crew member with two Trimble R7 receivers and an R8 receiver. The ground crew vehicles are equipped with standard field survey supplies and equipment including safety materials. The aircraft was further supported, as necessary, by an MLA surveyor (AK PLS) with two or more survey grade Topcon Receivers.

### *2.2.4 Methodology*

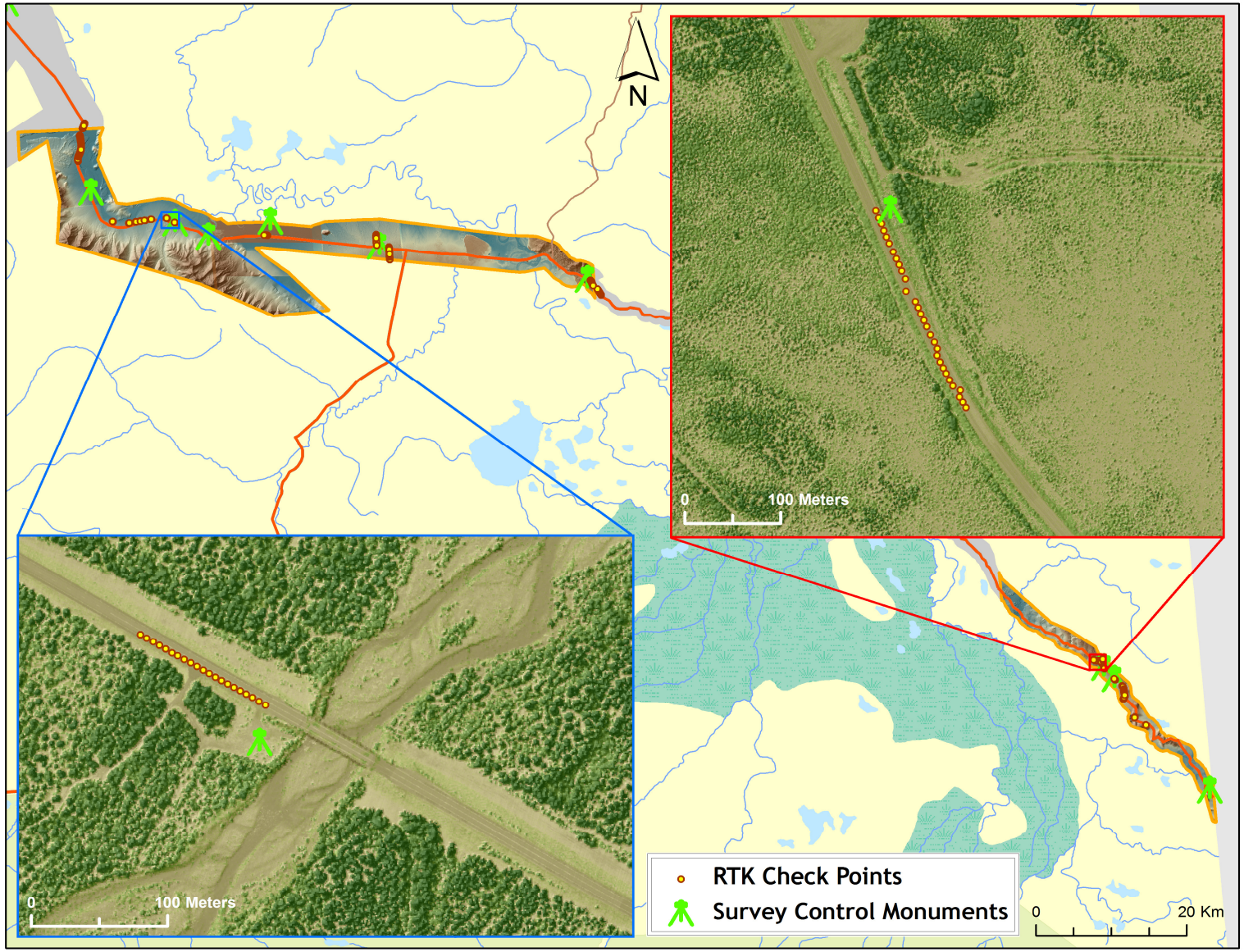
RTK and aircraft mounted GPS measurements were made during periods with PDOP[2] less than or equal to 3.0 and with at least 6 satellites in view of both a stationary reference receiver and the roving receiver. Static GPS data collected in a continuous session average the high PDOP into the final solution in the method used by CORS stations.

For RTK data, the collector begins recording after remaining stationary for 5 seconds then calculating the pseudo range position from at least three epochs with the relative error under 1.5cm horizontal and 2cm vertical. RTK positions are collected on bare earth locations such as paved, gravel or stable dirt roads, and other locations where the ground is clearly visible (and is likely to remain visible) from the sky during the data acquisition and RTK measurement period(s).

In order to facilitate comparisons with LiDAR measurements, RTK measurements were not taken on highly reflective surfaces such as center line stripes or lane markings on roads. RTK points were taken no closer than one meter to any nearby terrain breaks such as road edges or drop offs.

[2]PDOP: Point Dilution of Precision is a measure of satellite geometry, the smaller the number the better the geometry between the point and the satellites.

***Figure 2**. WSI RTK check points and control monument locations used in Delivery 8 of the Alaska Pipeline LiDAR Survey.*



# 3. LiDAR Data Processing

## 3.1 Applications and Work Flow Overview

1. Resolved kinematic corrections for aircraft position data using kinematic aircraft GPS and static ground GPS data.

   **Software:** Waypoint GPS v.8.10, Trimble Geomatics Office v.1.62
2. Developed a smoothed best estimate of trajectory (SBET) file that blends post-processed aircraft position with attitude data. Sensor head position and attitude were calculated throughout the survey. The SBET data were used extensively for laser point processing.

   **Software:** IPAS v.1.35
3. Calculated laser point position by associating SBET position to each laser point return time, scan angle, intensity, etc. Created raw laser point cloud data for the entire survey in *.las (ASPRS v. 1.2) format.

   **Software:** ALS Post Processing Software v.2.70
4. Imported raw laser points into manageable blocks (less than 500 MB) to perform manual relative accuracy calibration and filter for pits/birds. Ground points were then classified for individual flight lines (to be used for relative accuracy testing and calibration).

   **Software:** TerraScan v.11.009
5. Using ground classified points per each flight line, the relative accuracy was tested. Automated line-to-line calibrations were then performed for system attitude parameters (pitch, roll, heading), mirror flex (scale) and GPS/IMU drift. Calibrations were performed on ground classified points from paired flight lines. Every flight line was used for relative accuracy calibration.

   **Software:** TerraMatch v.11.006
6. Position and attitude data were imported. Resulting data were classified as ground and non-ground points. Statistical absolute accuracy was assessed via direct comparisons of ground classified points to ground RTK survey data. Data were then converted to orthometric elevations (NAVD88) by applying a Geoid09 correction. **Software:** TerraScan v.11.009, TerraModeler v.11.004
7. Bare Earth models were created as a triangulated surface and exported as ArcInfo ASCII grids at a 1 meter pixel resolution. Highest Hit models were created for any class at 1 meter grid spacing and exported as ArcInfo ASCII grids. Vegetation models were created for all vegetation points 20cm and above the ground model at a 1m grid spacing and exported as ArcInfo ASCII grids.

   **Software:** TerraScan v.11.009, ArcMap v. 9.3.1, TerraModeler v.11.004

## 3.2 Aircraft Kinematic GPS and IMU Data

LiDAR survey datasets were referenced to the 1 Hz static ground GPS data collected over pre-surveyed monuments with known coordinates. While surveying, the aircraft collected 2 Hz kinematic GPS data, and the onboard inertial measurement unit (IMU) collected 200 Hz aircraft attitude data. Waypoint GPS v.8.10 was used to process the kinematic corrections for the aircraft. The static and kinematic GPS data were then post-processed after the survey to

obtain an accurate GPS solution and aircraft positions. IPAS v.1.35 was used to develop a trajectory file that includes corrected aircraft position and attitude information. The trajectory data for the entire flight survey session were incorporated into a final smoothed best estimated trajectory (SBET) file that contains accurate and continuous aircraft positions and attitudes.

## 3.3 Laser Point Processing

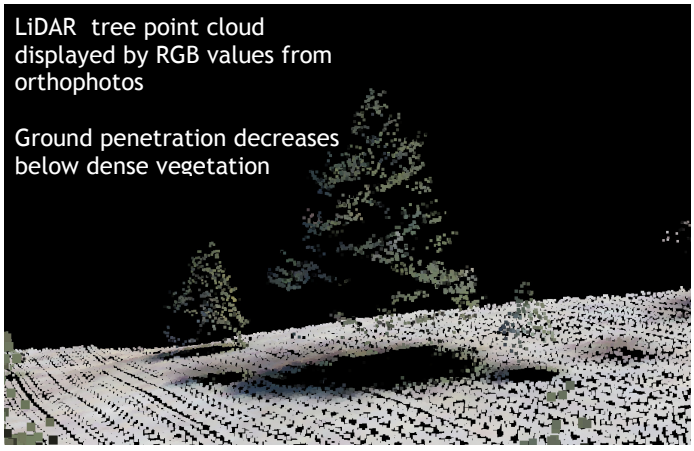
Laser point coordinates were computed using the IPAS and ALS Post Processor software suites based on independent data from the LiDAR system (pulse time, scan angle), and aircraft trajectory data (SBET). Laser point returns (first through fourth) were assigned an associated (x, y, z) coordinate along with unique intensity values (0-255). The data were output into large LAS v. 1.2 files with each point maintaining the corresponding scan angle, return number (echo), intensity, and x, y, z (easting, northing, and elevation) information.

These initial laser point files were too large for subsequent processing. To facilitate laser point processing, bins (polygons) were created to divide the dataset into manageable sizes (< 500 MB). Flightlines and LiDAR data were then reviewed to ensure complete coverage of the survey area and positional accuracy of the laser points.

Laser point data were imported into processing bins in TerraScan, and manual calibration was performed to assess the system offsets for pitch, roll, heading and scale (mirror flex). Using a geometric relationship developed by Watershed Sciences, each of these offsets was resolved and corrected if necessary.

LiDAR points were then filtered for noise, pits (artificial low points), and birds (true birds as well as erroneously high points) by screening for absolute elevation limits, isolated points and height above ground. Each bin was then manually inspected for remaining pits and birds and spurious points were removed. In a bin containing approximately 7.5-9.0 million points, an average of 50-100 points are typically found to be artificially low or high. Common sources of non-terrestrial returns are clouds, birds, vapor, haze, decks, brush piles, etc.

Internal calibration was refined using TerraMatch. Points from overlapping lines were tested for internal consistency and final adjustments were made for system misalignments (i.e., pitch, roll, heading offsets and scale). Automated sensor attitude and scale corrections yielded 3-5 cm improvements in the relative accuracy. Once system misalignments were corrected, vertical GPS drift was then resolved and removed per flight line, yielding a slight improvement (<1 cm) in relative accuracy.




The TerraScan software suite is designed specifically for classifying near-ground points (Soininen, 2004). The processing sequence began by 'removing' all points that were not 'near' the earth based on geometric constraints used to evaluate

multi-return points. The resulting bare earth (ground) model was visually inspected and additional ground point modeling was performed in site-specific areas to improve ground detail. This manual editing of ground often occurs in areas with known ground modeling deficiencies, such as: bedrock outcrops, cliffs, deeply incised stream banks, and dense vegetation. In some cases, automated ground point classification erroneously included known vegetation (i.e., understory, low/dense shrubs, etc.). These points were manually reclassified. Ground surface rasters were then developed from triangulated irregular networks (TINs) of ground points.

To develop the highest hit and vegetation models, buildings and structures were classified through automated point processing algorithms and then manually inspected and edited during the ground model inspection. Typically, manual editing of building classification was necessary where dense canopy was immediately proximate to buildings, or where structures such as utility poles or fences mimicked vegetation.

The remaining points not classified as ground, buildings, or error points were separated into two vegetation classes; Low Vegetation consisting of all returns ≤20cm from the ground, and Medium Vegetation consisting of all returns >20cm from the ground. This distinction was necessary because some potential for unclassified ground exists in the dataset. Vegetation classified returns within 20cm of the ground have higher potential to be artifacts of the dataset caused by minor offsets between flightlines (typically <10cm), isolated noise points, or abrupt discrete terrain features that did not get classified as ground (i.e. small boulders or sharp cliffs). The majority of points classified as low vegetation are valid returns, so the class was retained in the dataset to be incorporated into analyses at the user's discretion.

**Table 3.** ASPRS classification definitions for the Alaska Pipeline LiDAR survey

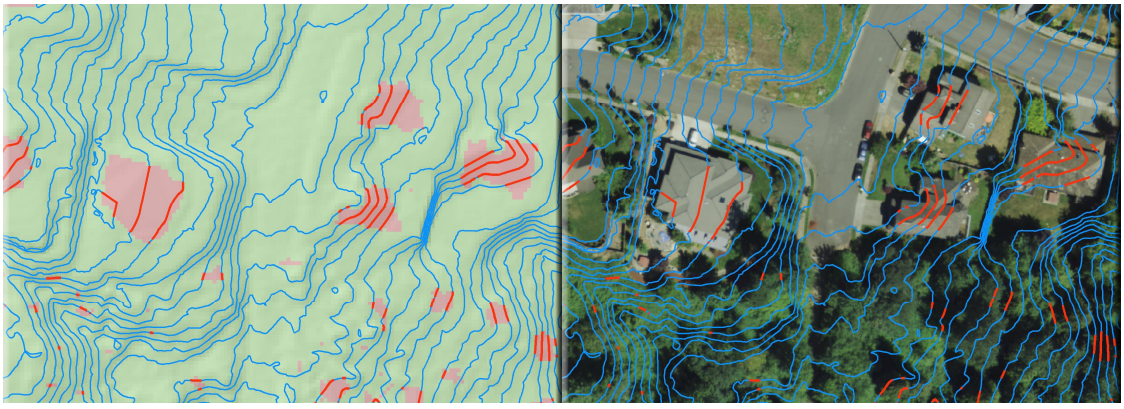
| ASPRS Class | Definition |
|---|---|
| 2 | Ground |
| 3 | Low Vegetation |
| 4 | Medium Vegetation |
| 6 | Buildings/Man-made structures |
| 7 | Noise/error points |
| 9 | Water |
| 15 | Pipeline |

## 3.4 Contour Development

Contour lines were derived at 1 meter intervals from ground-classified LiDAR point data using TerraSolid processing software in MicroStation v. 8.1. Contour generation from LiDAR point data requires a thinning operation in order to reduce contour sinuosity. Parameters for these operations are: thinning elevation bounds: +/- 0.07m; search radius: 6.09m. The thinning operation reduces point density where topographic change is minimal (flat surfaces) while preserving resolution where topographic change is present. The total sum of potential error in vertical position is equal to twice the point processing limits (0.14m) plus twice the 2-sigma absolute vertical accuracy value for this dataset.

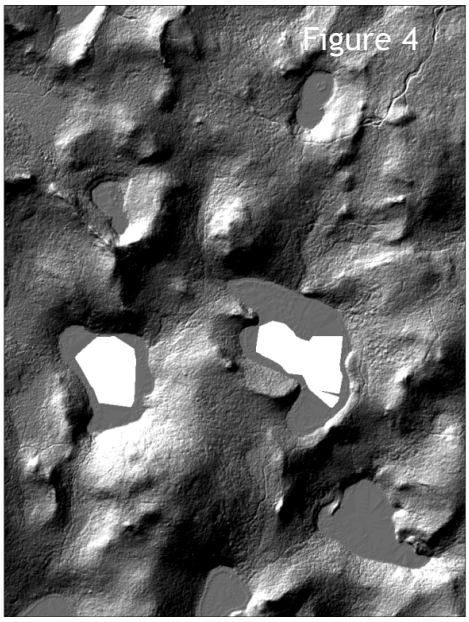
Ground point density rasters were created within MicroStation using a 1 meter step resolution and a 2 meter sampling radius. Areas with less than 0.25 ground-classified points per square meter were considered "sparse" and areas with higher densities were considered "covered". The ground point density raster data are in ESRI GRID format and have a 1 meter pixel resolution. The contour lines were intersected with ground point density raster data, allowing the addition of a confidence attribute to contour lines. Contour lines over "sparse" areas have low confidence, while contour lines over "covered" areas have a high confidence. Areas with low ground point density are commonly beneath buildings and bridges, in locations with dense vegetation, over water, and in other areas where laser penetration to the ground surface is impeded. **Figure 3** is an example of a ground point density raster and contour lines.

***Figure 3**. Elevation contours over LiDAR ground-classified point density raster (left) and true-color aerial photograph (right). Red indicates low ground point density and blue represents high density.*

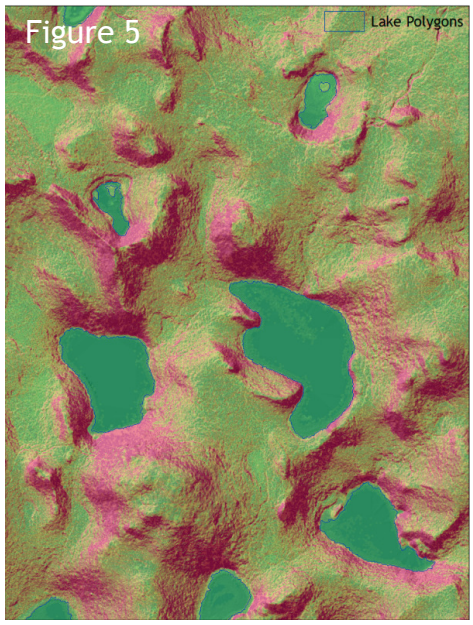


## 3.5 Hydro-Flattening

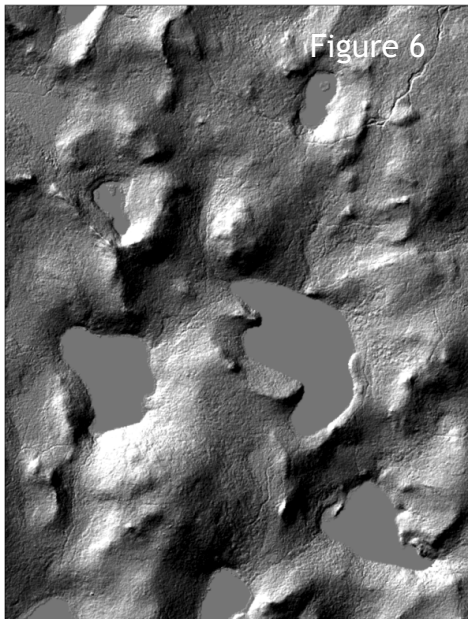
Lakes and other closed water bodies with surface area >150 $m^2$ were flattened to a consistent water level. The hydro-flattening process eliminates artifacts in the digital terrain model caused by both increased variability in ranges or dropouts in laser returns due to the low reflectivity of water (**Figure 4**). As per the project specifications, rivers and streams were not hydro-flattened.




Hydro-flattening of closed water bodies was performed through a combination of automated and manual detection and adjustment techniques designed to identify lake boundaries and water levels. Boundary polygons were developed using an algorithm which weights LiDAR-derived slopes, intensities, and return densities to detect the lake edge. The lake edges were then manually reviewed and edited in a 3-D environment. Once polygons were developed, the lake elevations were computed from the filtered LiDAR returns (**Figure 5**).




Returns from the water surface within each polygon were filtered and inspected for false low points during the initial ground modeling process described previously (Section 3.3). The elevation of each lake was computed as 5-cm above the minimum elevation of filtered water surface cells within the lake polygon. This approach ensures that all spurious returns off the water surface (both artificially high and low) were excluded from lake level assessment.




Lake-boundary polygons were then incorporated into the final terrain model and enforced as hard-breaklines. The initial ground classified points falling within lake polygons were reclassified as water points [to omit them from the final ground model] and replaced with the flat water surface of the lake boundary hydrolines (**Figure 6**).

# 4. LiDAR Accuracy Assessment

## 4.1 Laser Noise and Relative Accuracy

*Laser Noise*
For any given target, laser noise is the breadth of the data cloud per laser return (i.e., last, first, etc.). Lower intensity surfaces (roads, rooftops, still/calm water) experience higher laser noise. The laser noise range for this survey was approximately 0.02 meters.

*Relative Accuracy*
Relative accuracy refers to the internal consistency of the data set - the ability to place a laser point in the same location over multiple flight lines, GPS conditions, and aircraft attitudes. Affected by system attitude offsets, scale, and GPS/IMU drift, internal consistency is measured as the divergence between points from different flight lines within an overlapping area. Divergence is most apparent when flight lines are opposing. When the LiDAR system is well calibrated, the line-to-line divergence is low (<10 cm). See Appendix A for further information on sources of error and operational measures that can be taken to improve relative accuracy.

**Relative Accuracy Calibration Methodology**

1. Manual System Calibration: Calibration procedures for each mission require solving geometric relationships that relate measured swath-to-swath deviations to misalignments of system attitude parameters. Corrected scale, pitch, roll and heading offsets were calculated and applied to resolve misalignments. The raw divergence between lines was computed after the manual calibration was completed and reported for each survey area.
2. Automated Attitude Calibration: All data were tested and calibrated using TerraMatch automated sampling routines. Ground points were classified for each individual flight line and used for line-to-line testing. System misalignment offsets (pitch, roll and heading) and scale were solved for each individual mission and applied to respective mission datasets. The data from each mission were then blended when imported together to form the entire area of interest.
3. Automated Z Calibration: Ground points per line were used to calculate the vertical divergence between lines caused by vertical GPS drift. Automated Z calibration was the final step employed for relative accuracy calibration.

## 4.2 Absolute Accuracy

Laser point absolute accuracy is largely a function of laser noise and relative accuracy. To minimize these contributions to absolute error, a number of noise filtering and calibration procedures were performed prior to evaluating absolute accuracy. The LiDAR quality assurance process uses the data from the real-time kinematic (RTK) ground survey conducted in the AOI. For Delivery 8, **2815 RTK** GPS measurements were collected on hard surfaces distributed among multiple flight swaths for a total of 20,399 points across all delivered data. Suitable and accessible hard-surfaces limited the number and distribution of RTK points able to be collected. To assess absolute accuracy the location coordinates of these known RTK ground points were compared to those calculated for the closest ground-classified laser points.

The vertical accuracy of the LiDAR data is described as the mean and standard deviation (sigma ~ $\sigma$) of divergence between LiDAR point coordinates and RTK ground survey point coordinates. To provide a sense of the model predictive power of the dataset, the root mean square error (RMSE) for vertical accuracy is also provided. These statistics assume the error distributions for x, y, and z are normally distributed, thus the skew and kurtosis of distributions are considered when evaluating error statistics.

Statements of statistical accuracy apply to fixed terrestrial surfaces only and may not be applied to areas of dense vegetation or steep terrain (See Appendix A).

# 5. Study Area Results

Summary statistics for point resolution and accuracy (relative and absolute) of the LiDAR data collected in the Alaska Pipeline Delivery 8 survey area have been added to previously delivered data. Cumulative results are presented below in terms of central tendency, variation around the mean, and the spatial distribution of the data (for point resolution by processing bin).

The initial dataset, acquired to be ≥8 points per square meter, was filtered as described previously to remove spurious or inaccurate points. Additionally, some types of surfaces (i.e., dense vegetation, breaks in terrain, water, steep slopes) may return fewer pulses (delivered density) than the laser originally emitted (native density).

Ground classifications were derived from automated ground surface modeling and manual, supervised classifications where it was determined that the automated model had failed. Ground return densities will be lower in areas of dense vegetation, water, or buildings.

## Data Summary:

***Table 4****. LiDAR Resolution and Accuracy - Specifications and Achieved Values*

| | | Targeted | Achieved |
|---|---|---|---|
| **Resolution:** | **UTM 5** | ≥ 8 points/$m^2$ | 8.60 points/$m^2$ |
| | **UTM 6** | | 8.72 points/$m^2$ |
| | **UTM 7** | | 8.88 points/$m^2$ |
| **Vertical Accuracy (1 $\sigma$):** | | <13 cm | 3.4 cm |

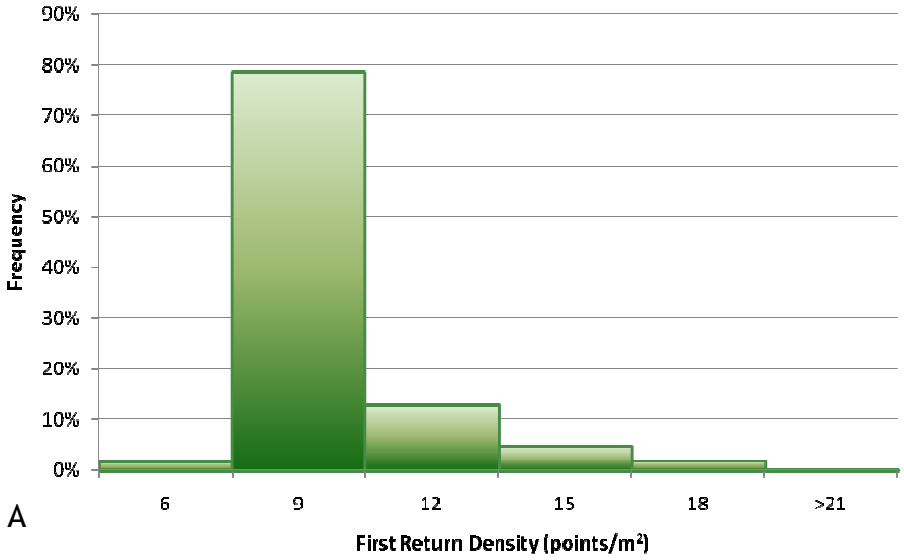
## 5.1 Data Density/Resolution

**Figures 10 - 23** display the distribution of average native and ground point densities for each processing bin. Density data will continue to be updated as data is processed and delivered.

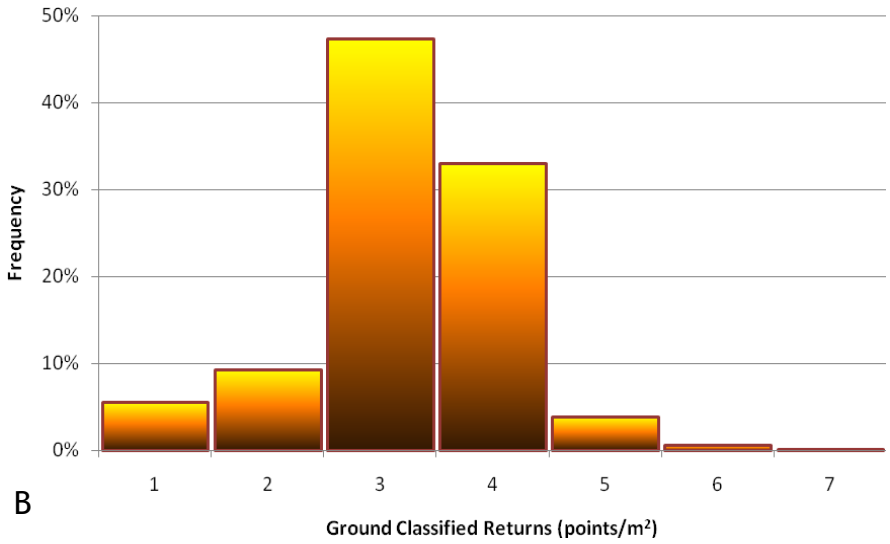
LiDAR data resolution for Alaska Pipeline deliveries to date:

| | UTM 5 | UTM 6 | UTM 7 |
|---|---|---|---|
| Average Point (First Return) Density | 8.60 points/$m^2$ | 8.72 points/$m^2$ | 8.88 points/$m^2$ |
| Average Ground Point Density | 2.72 points/$m^2$ | 2.50 points/$m^2$ | 2.78 points/$m^2$ |

***Figure 7**. Density distribution for first return (A) and ground classified (B) laser points for UTM 5*

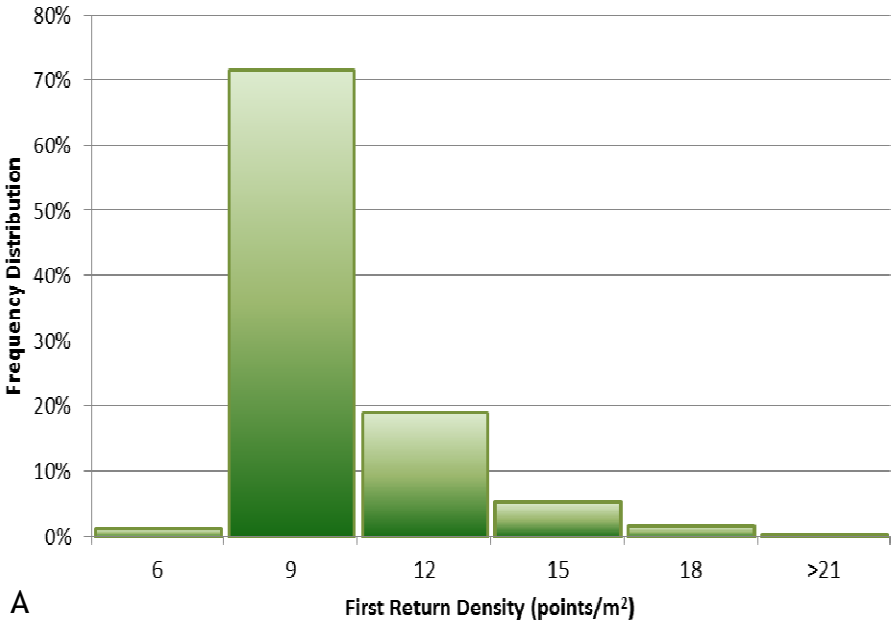



A

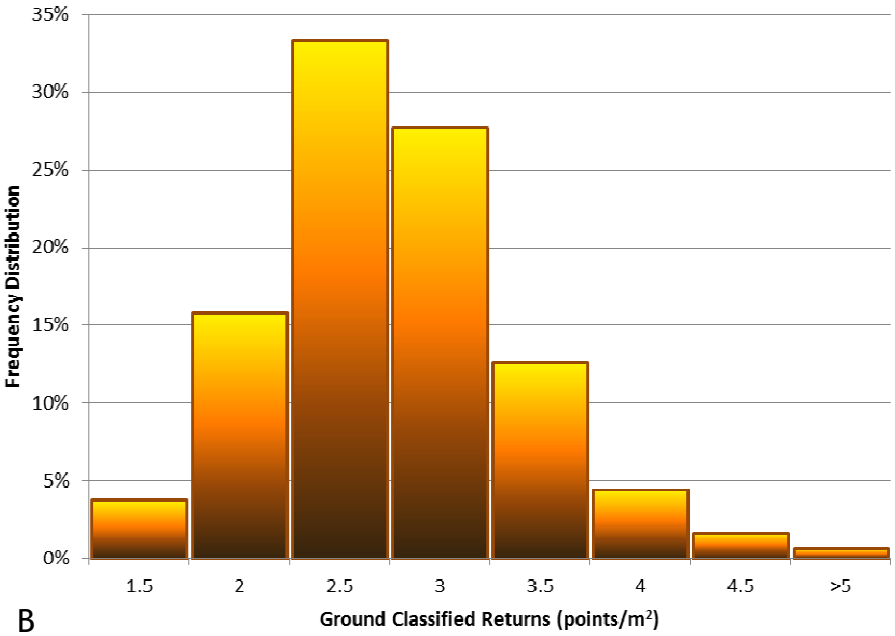



B

***Figure 8.*** *Density distribution for first return (A) and ground classified (B) laser points for UTM 6*

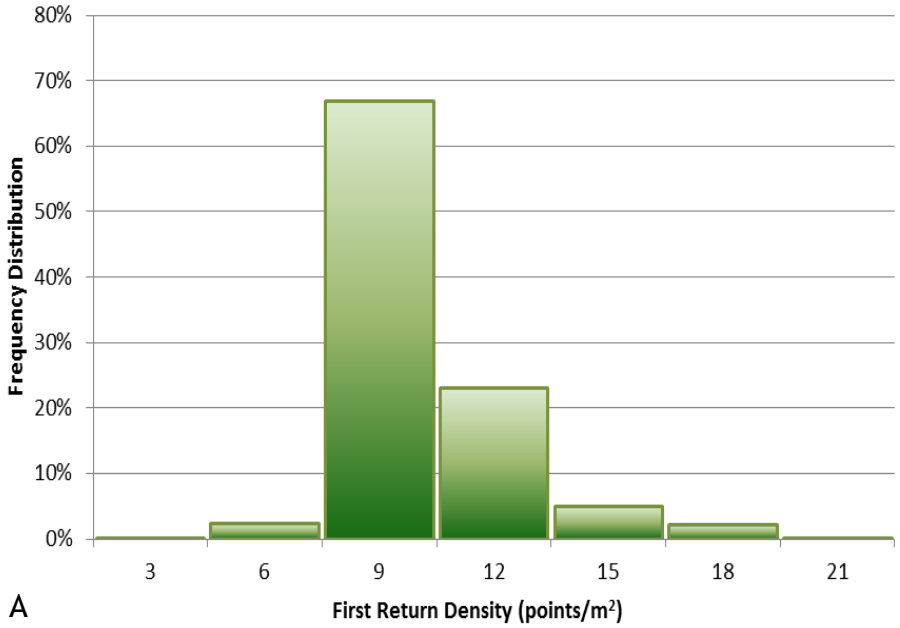



A

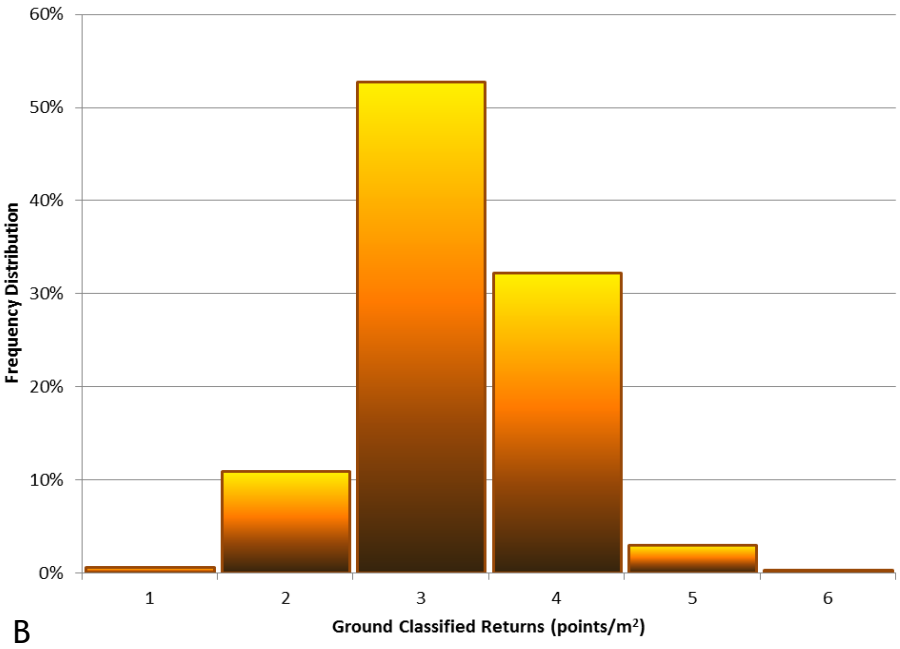



B

***Figure 9**. Density distribution for first return (A) and ground classified (B) laser points for UTM 7*




A




B

***Figure 10**. Density distribution map for ground and first return points by processing bin in Delivery 1, UTM 6*



***Figure 11.*** *Density distribution map for ground and first return points by processing bin in Delivery 1, UTM 7*

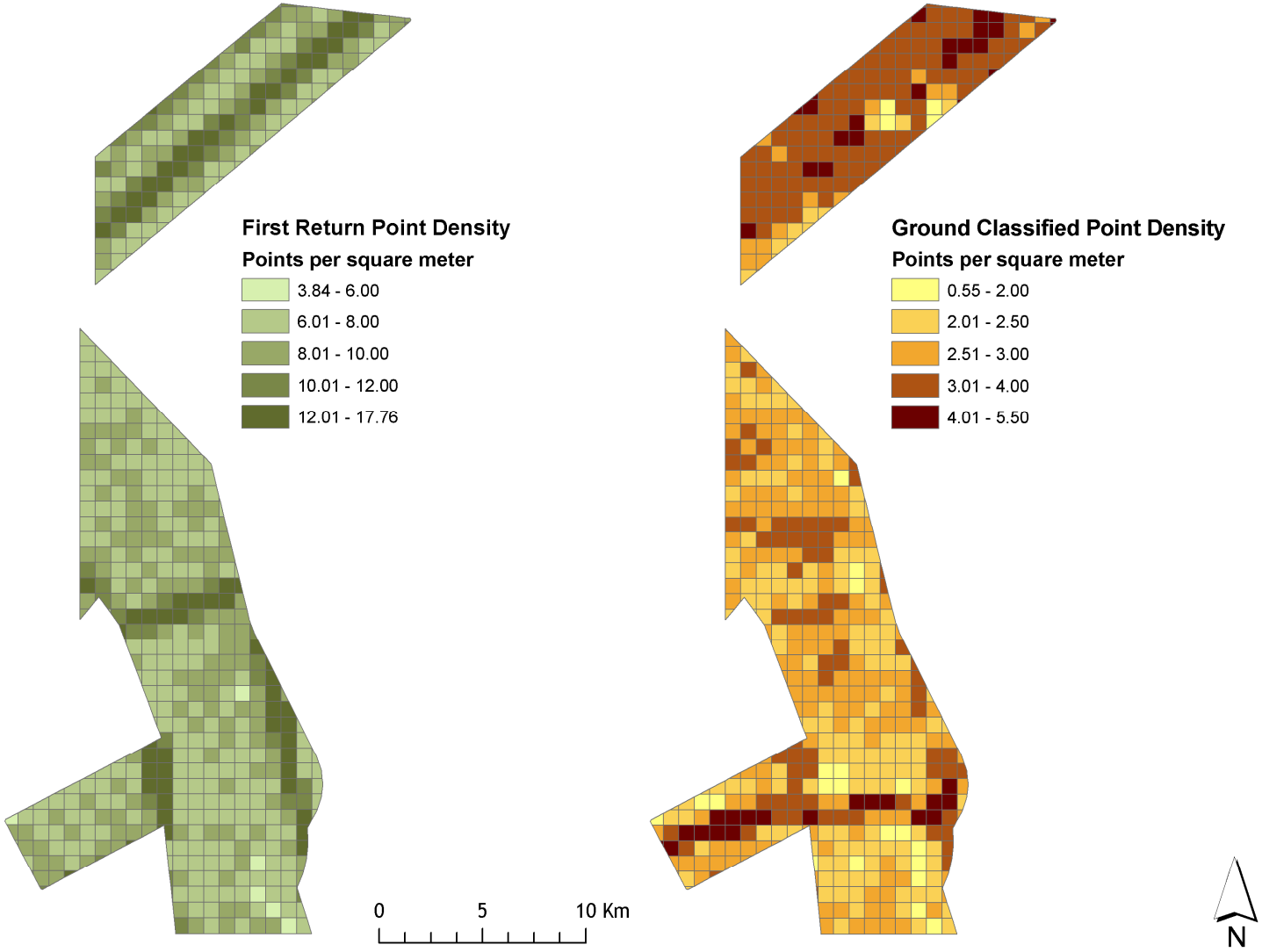


***Figure 12.*** *Density distribution map for ground points by processing bin in Delivery 2, UTM 6*

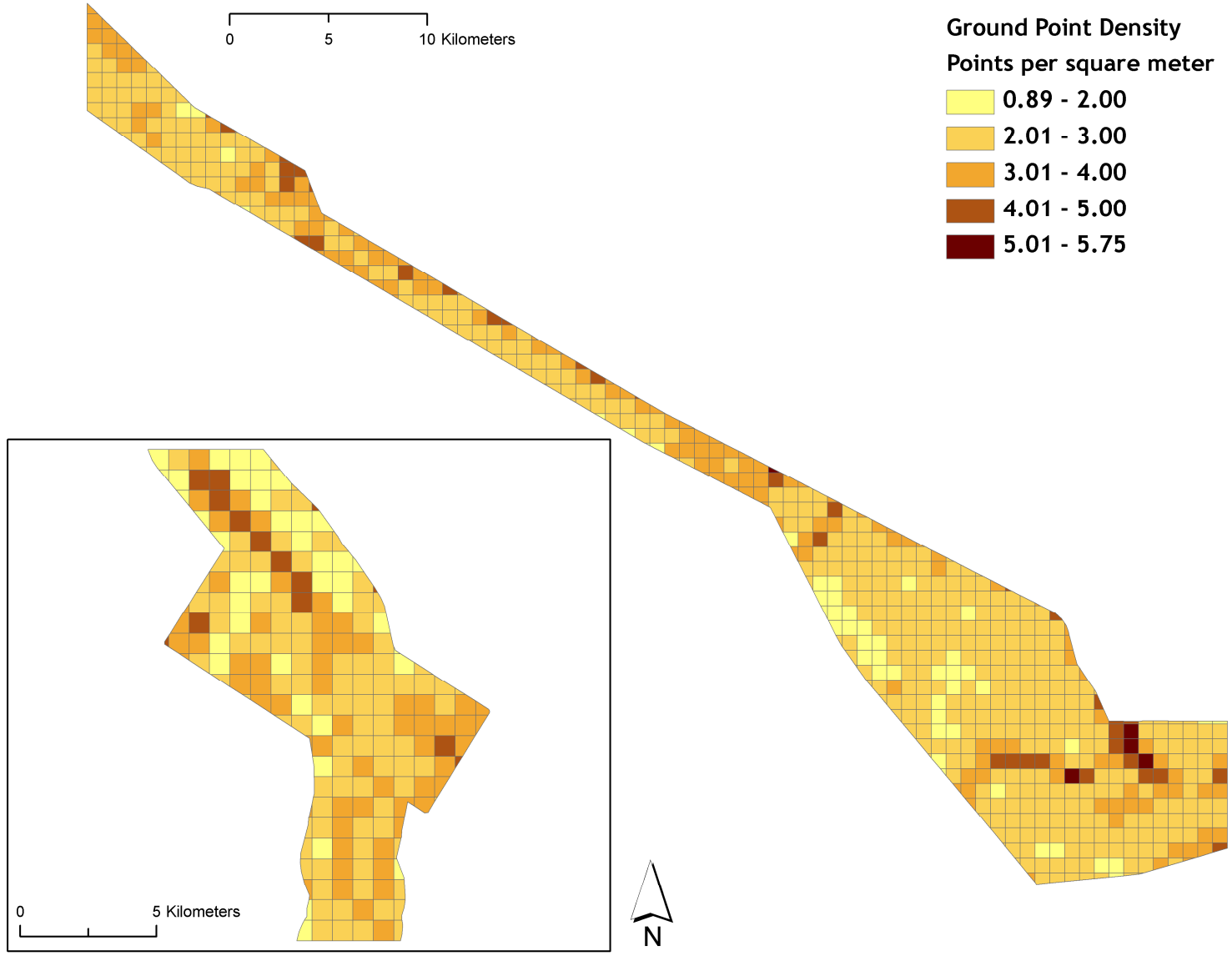


***Figure 13**. Density distribution map for first return points by processing bin in Delivery 2, UTM 6*

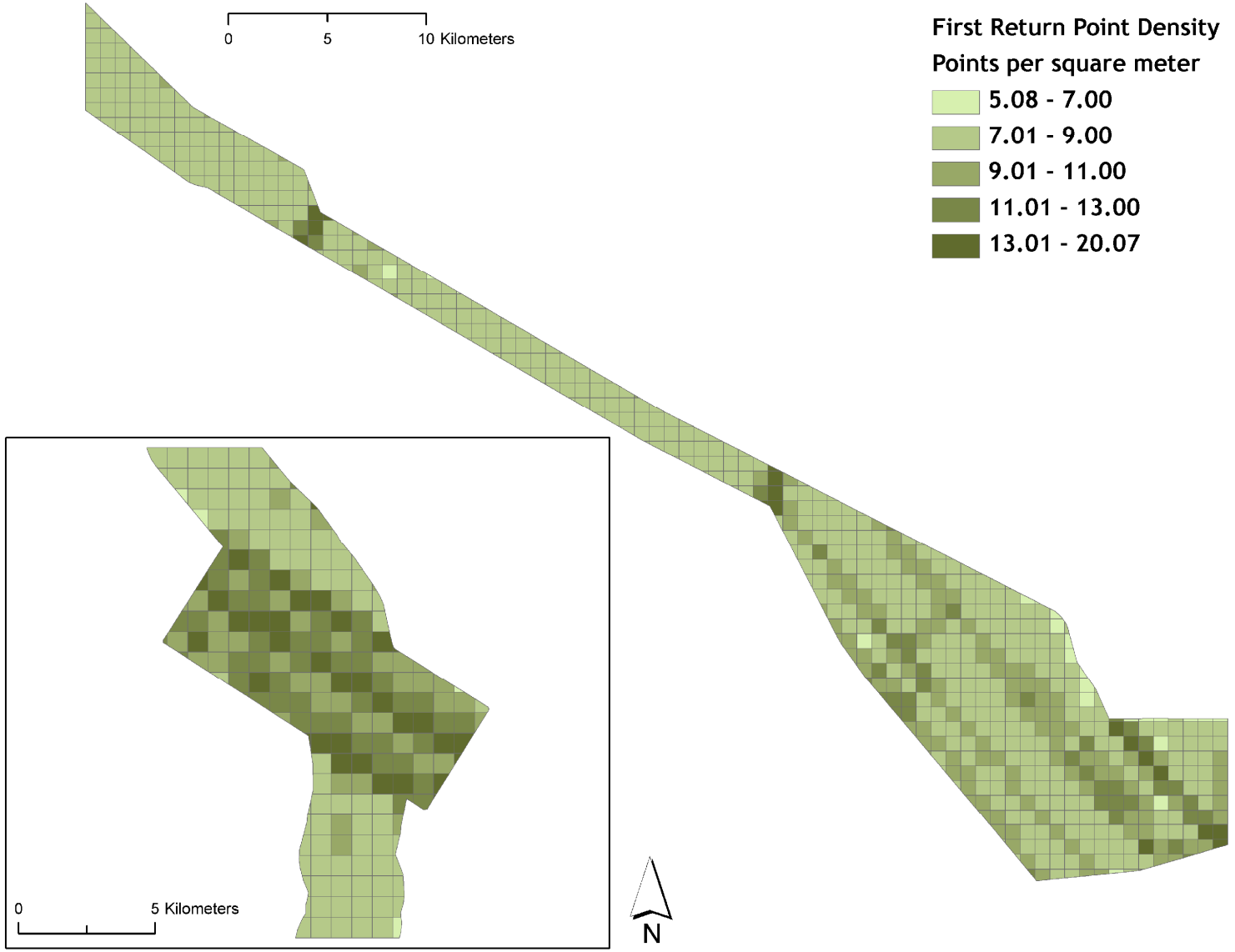


***Figure 14**. Density distribution map for ground and first return points by processing bin in Delivery 3, UTM 7*

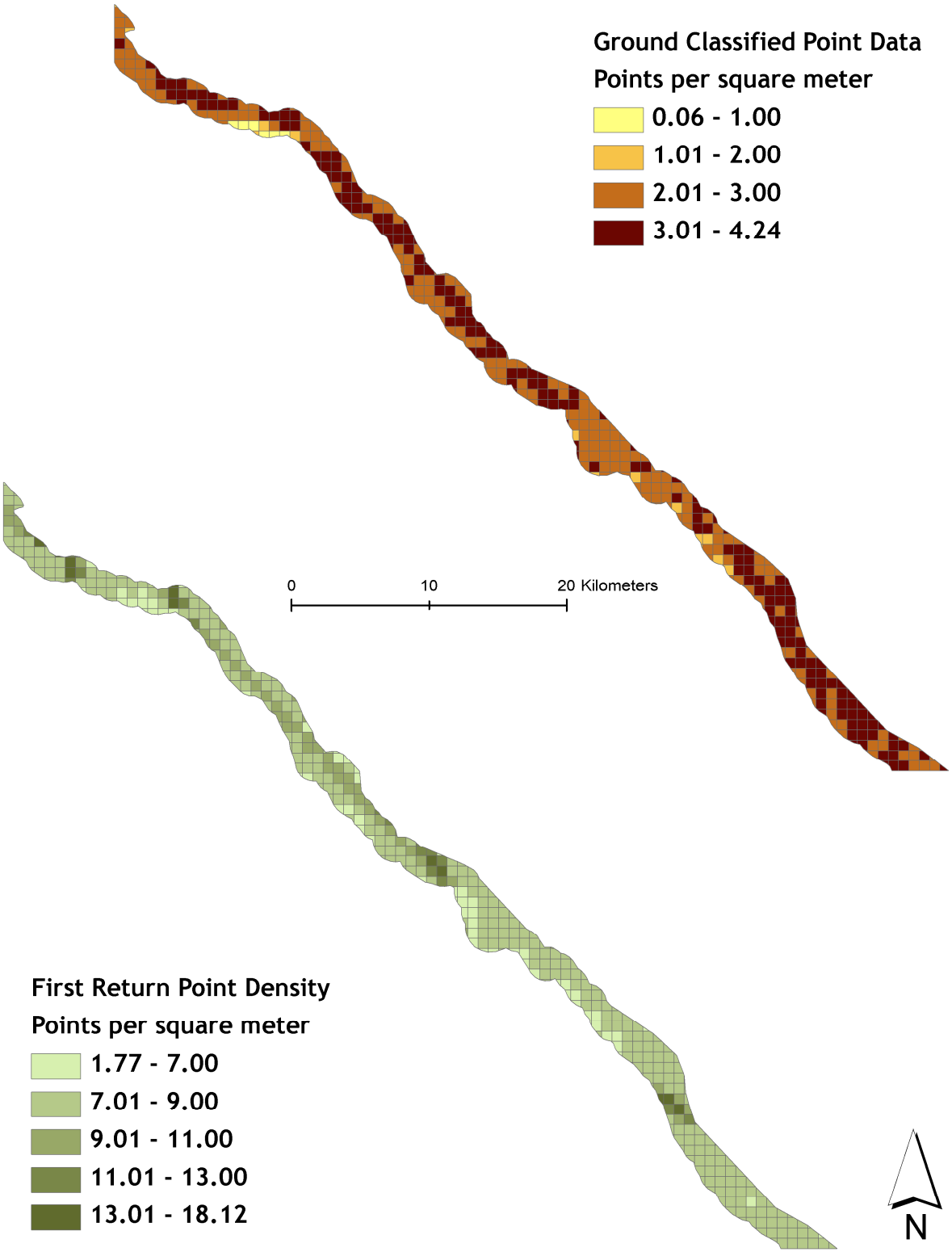


***Figure 15**. Density distribution map for ground and first return points by processing bin in Delivery 4, UTM 6*

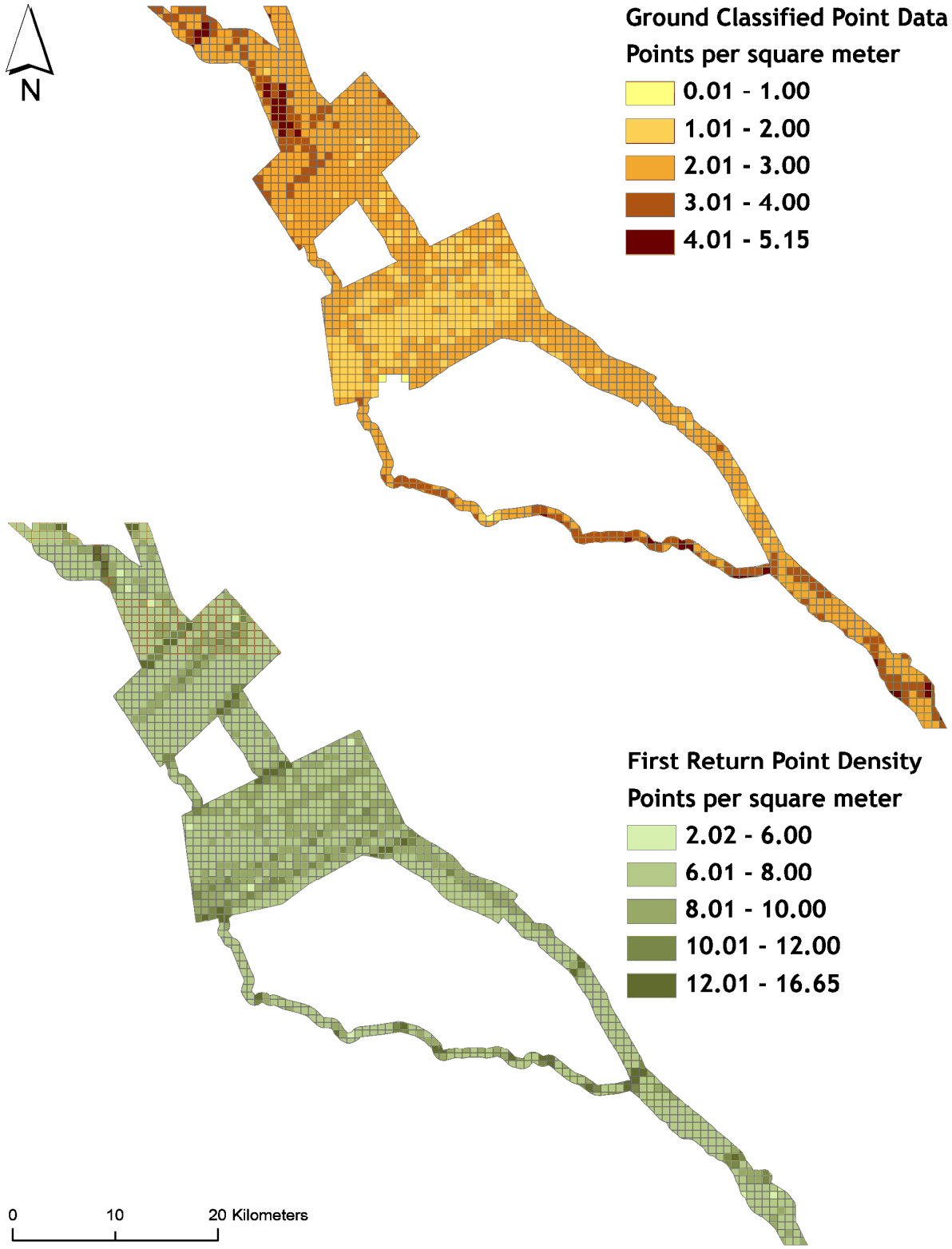


***Figure 16**. Density distribution map for ground classified points by processing bin in Delivery 5, UTM 5*



***Figure 17.*** *Density distribution map for first return points by processing bin in Delivery 5, UTM 5*



***Figure 18**. Density distribution map for ground classified points by processing bin in Delivery 6, UTM 6*

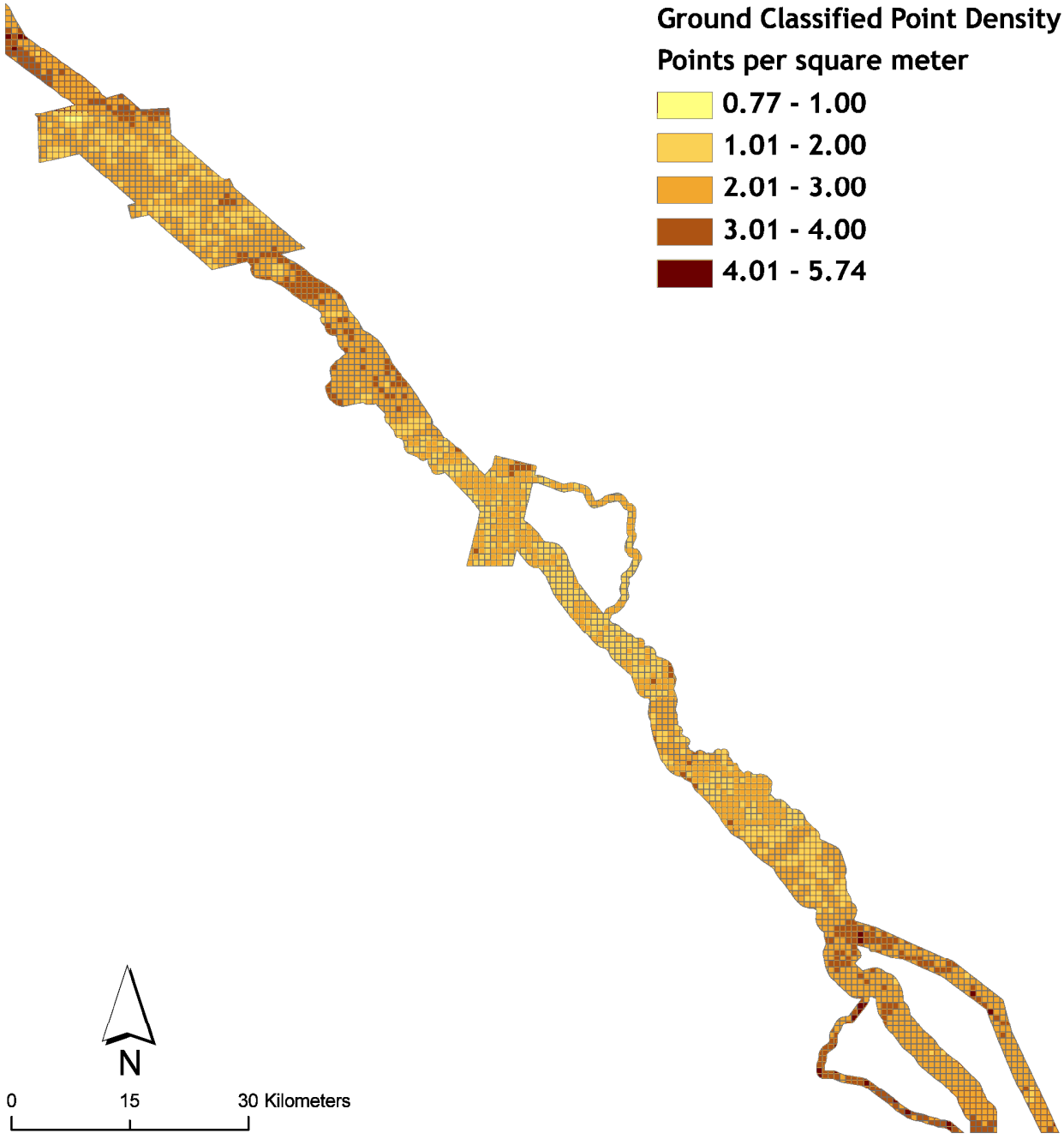


***Figure 19**. Density distribution map for first return points by processing bin in Delivery 6, UTM 6*

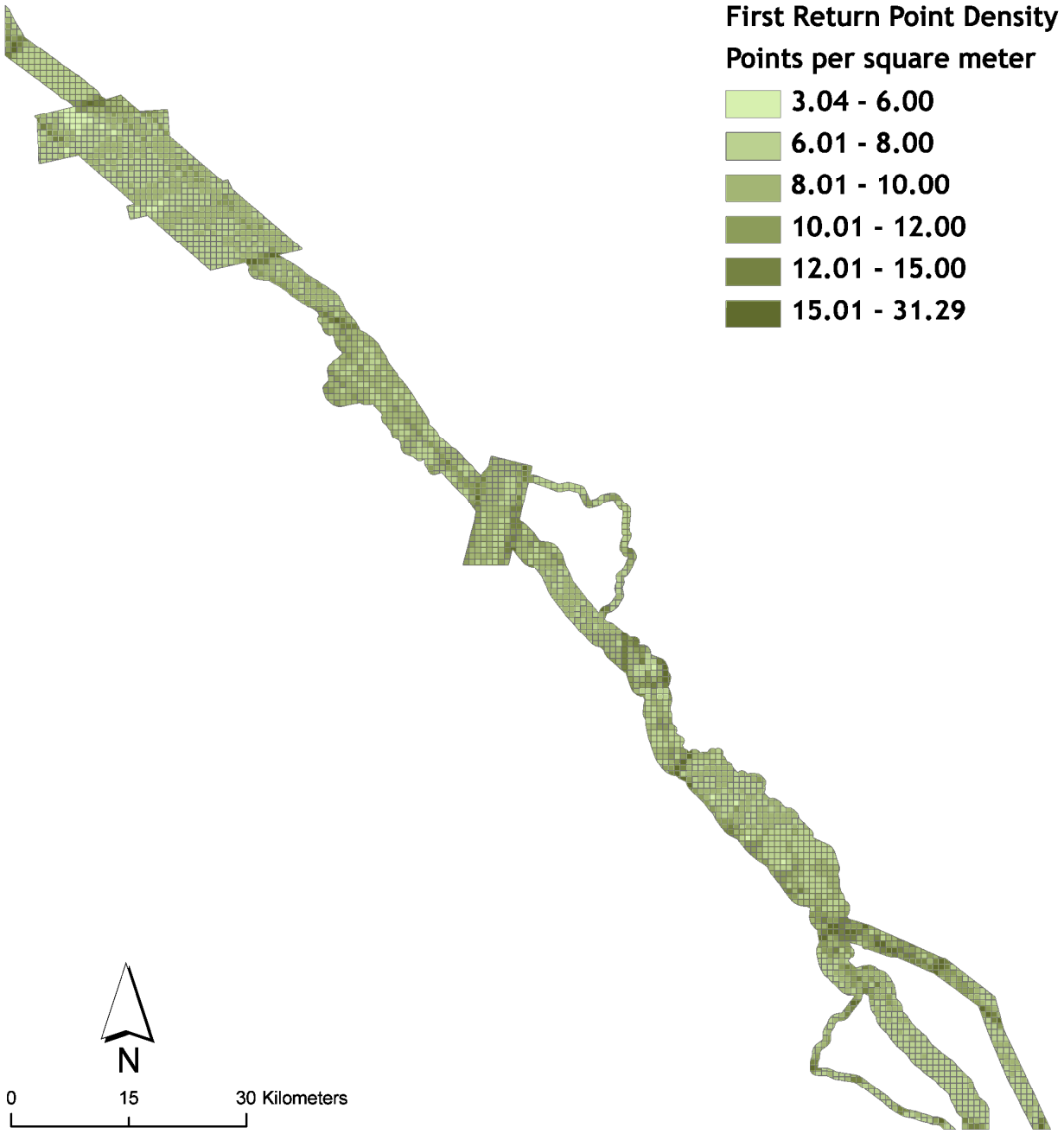


***Figure 20**. Density distribution map for ground classified points by processing bin in Delivery 7, UTM 6*

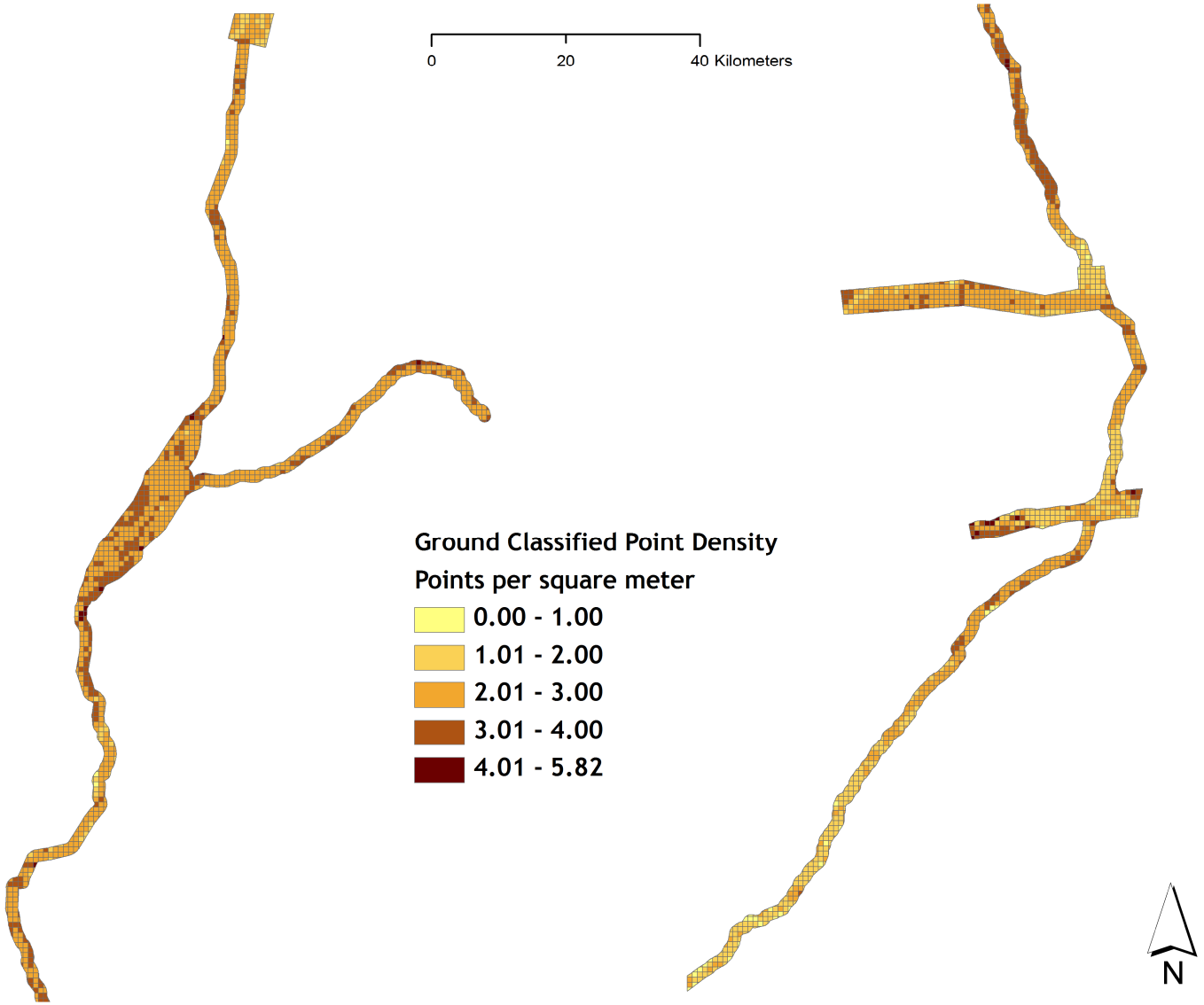


***Figure 21**. Density distribution map for first return points by processing bin in Delivery 7, UTM 6*



***Figure 22**. Density distribution map for ground classified points by processing bin in Delivery 8, UTM 7*

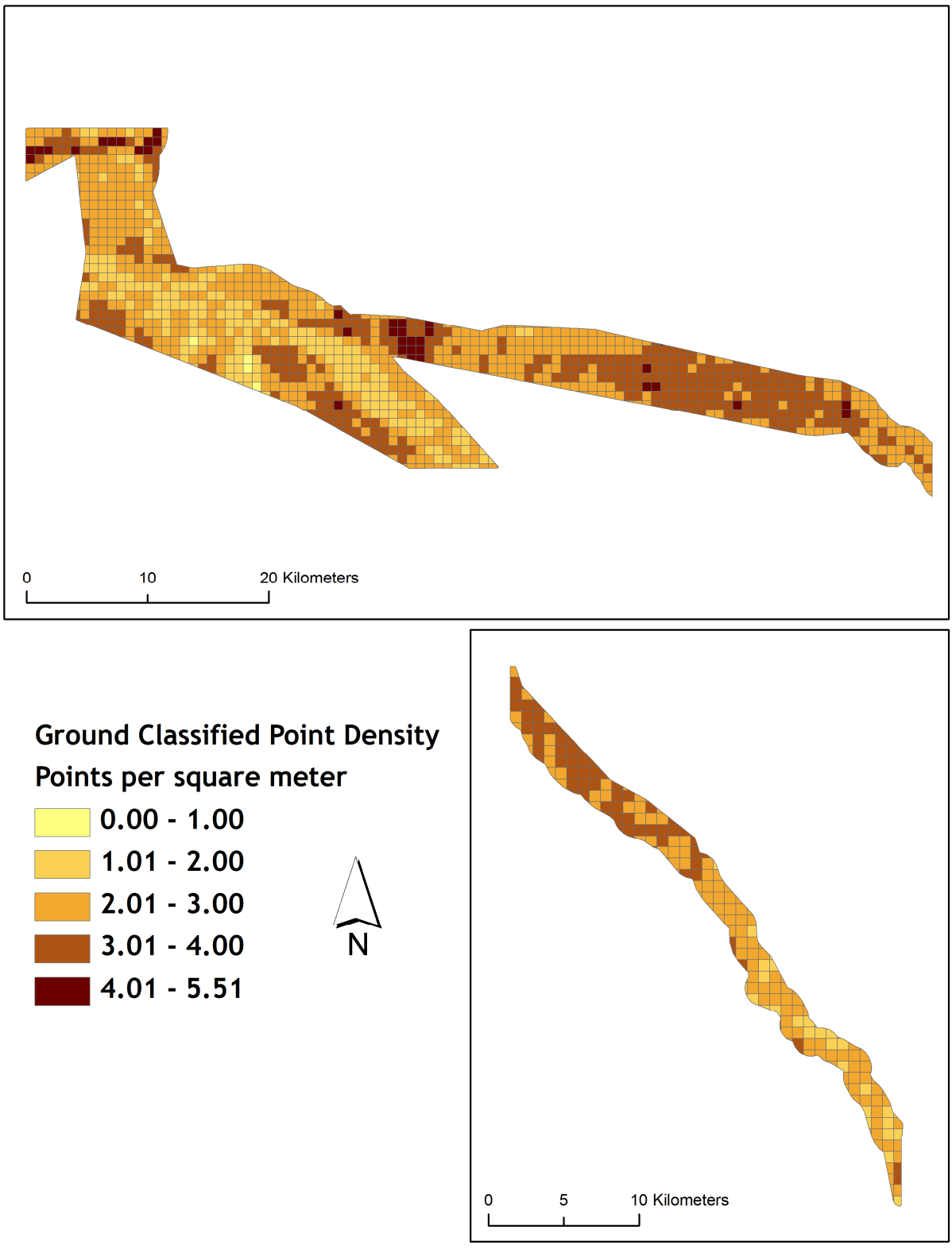
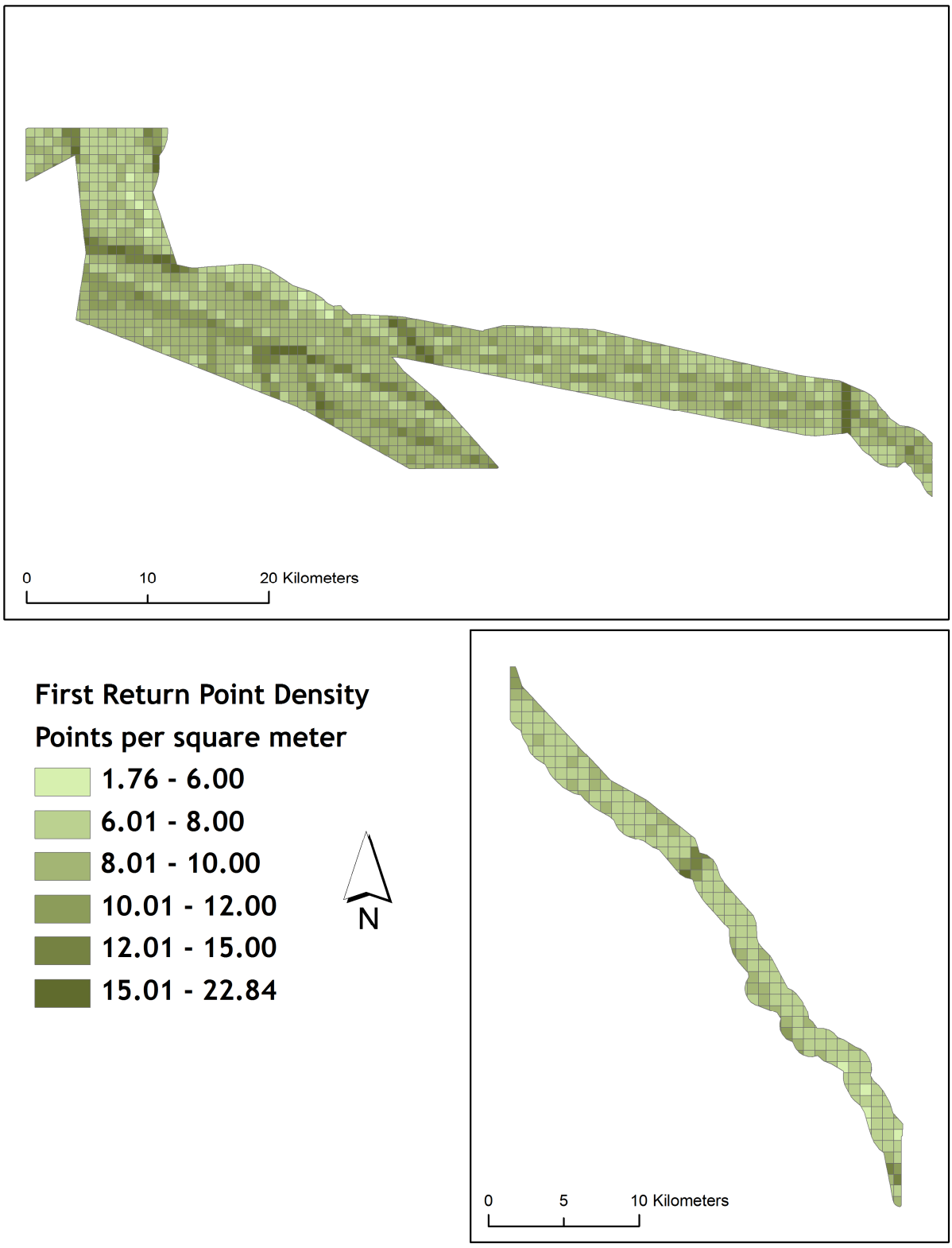


***Figure 23**. Density distribution map for first return points by processing bin in Delivery 8, UTM 7*

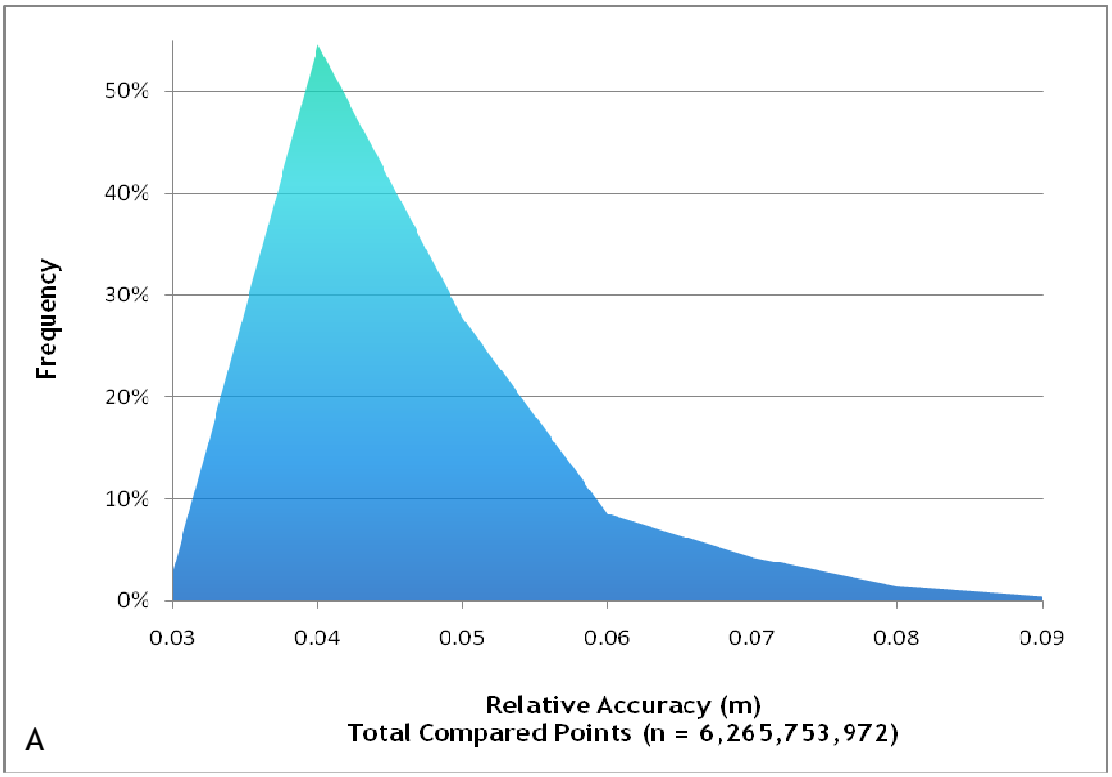


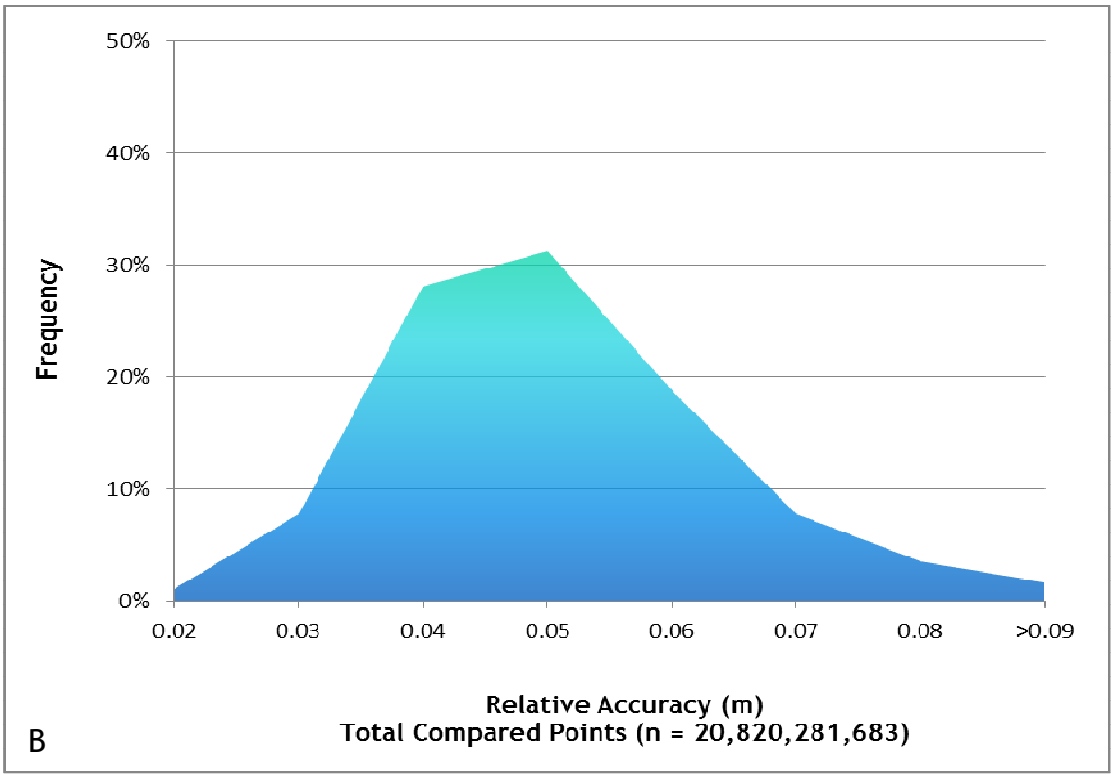
## 5.2 Relative Accuracy Calibration Results

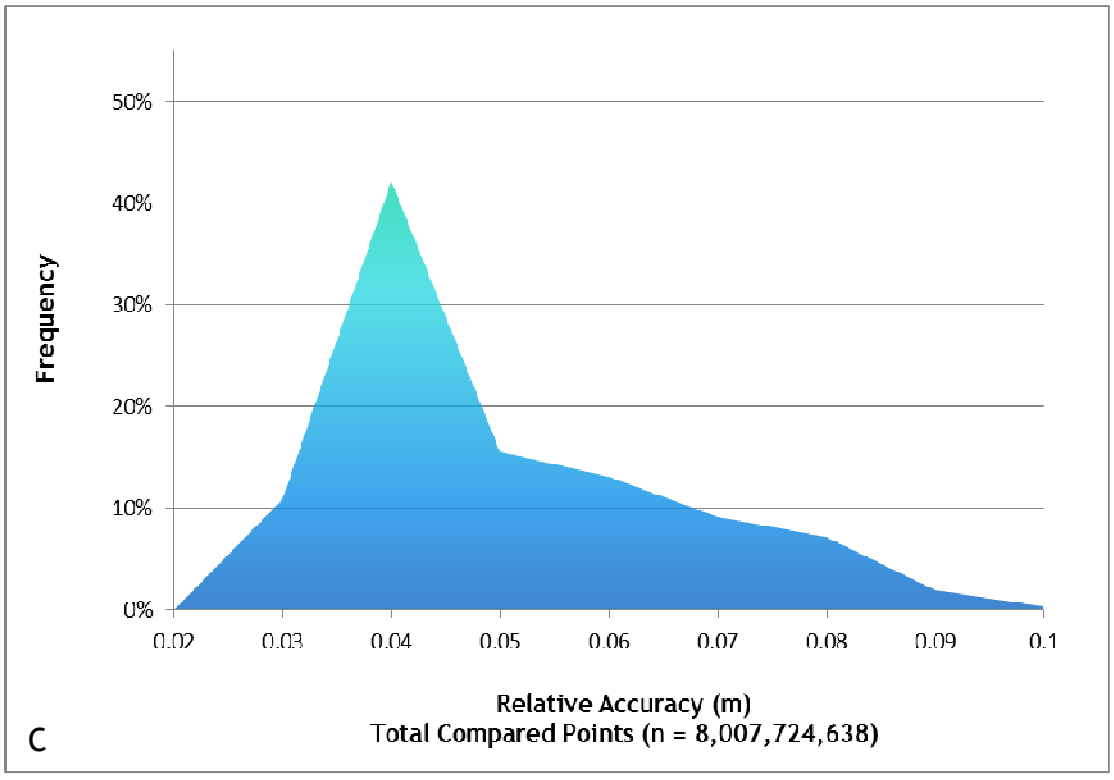
***Table 5**. Cumulative relative accuracy statistics for Alaska Pipeline deliveries to date.*

| | UTM 5 | UTM 6 | UTM 7 |
|---|---|---|---|
| Project Average | 0.039m | 0.046m | 0.036m |
| Median Relative Accuracy | 0.039m | 0.044m | 0.039m |
| 1σ Relative Accuracy | 0.010m | 0.013m | 0.015m |
| 1.96σ Relative Accuracy | 0.019m | 0.026m | 0.030m |

***Figure 24**. Distribution of cumulative relative accuracies in UTM5 (A) UTM 6 (B) and UTM 7 (C) per flight line, non slope-adjusted*




50%
40%
30%
20%
10%
0%
Frequency
0.02
0.03
0.04
0.05
0.06
0.07
0.08
>0.09
Relative Accuracy (m)
Total Compared Points (n = 20,820,281,683)
B


50%
40%
30%
20%
10%
0%
Frequency
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1
Relative Accuracy (m)
Total Compared Points (n = 8,007,724,638)
C

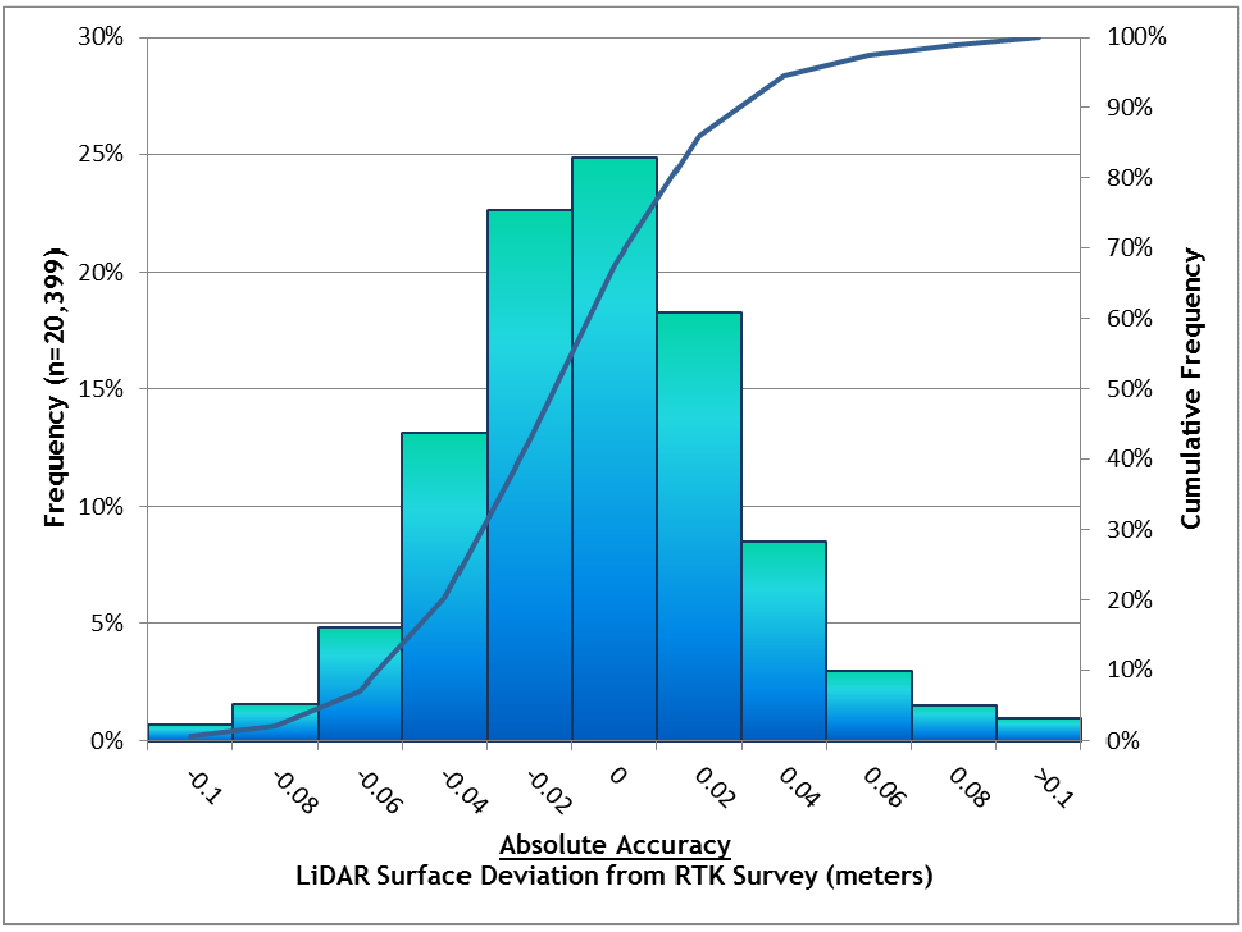
## 5.3 Absolute Accuracy

Absolute accuracies for Alaska Pipeline deliveries to date: All data was calibrated and processed in UTM 6 and then transformed to the appropriate projection.

***Table 6**. Absolute Accuracy - Deviation between laser points and RTK hard surface survey points*

| RTK Survey Sample Size (n): 20,399 | |
|---|---|
| Root Mean Square Error (RMSE): 0.036m | Minimum Δz = -0.151m |
| Standard Deviations<br>1 sigma (σ): 0.034m 1.96 sigma (σ): 0.066m | Maximum Δz = 0.122m |
| | Average Δz = -0.013m |

***Figure 25**. Absolute Accuracy - Histogram Statistics*



## 5.4 Independent Accuracy Assessment

In accordance with the project plan, McClintock Land Associates (AK PLS) collected independent (i.e. blind) check points within the survey area to provide an independent assessment of LiDAR accuracy. WSI was provided with Easting and Northing positions for points which were then assigned elevations from the LiDAR. MLA received this report and compared the LiDAR Z values to MLA's surveyed (or known) Z values.

***Table 7**. Absolute accuracy determined by the project surveyor (MLA) using "Blind" Check Points (See Appendix B for PLS report)*

| Delivery | # of Check Points | RMSE | Range |
|---|---|---|---|
| 1 | 735 | 0.062m | 0.240m |
| 2 | 1096 | 0.035m | 0.204m |
| 3 | 1088 | 0.078m | 0.182m |
| 4 | 730 | 0.039m | 0.394m |
| 5 | 2293 | 0.073m | 0.567m |
| 6 | 1510 | 0.050m | 0.730m |
| 7 | 1858 | 0.060m | 0.880m |
| 8 | 604 | 0.030m | 0.280m |

## 6. Projection/Datum and Units

| | | |
|---|---|---|
| | **Projection:** | UTM Zone 5, 6, 7 North |
| **Datum** | **Vertical:** | NAVD88 Geoid09 |
| | **Horizontal:** | NAD83 |
| | **Units:** | meters |

## 7. Deliverables

| | |
|---|---|
| **Point Data:** | • All Returns (LAS 1.2 format)<br>• Ground Returns (LAS 1.2 format) |
| **Vector Data:** | • Project Boundary (shapefile format)<br>• Tile Index for LiDAR Points (shapefile format)<br>• Tile Index for DEMs (shapefile format)<br>• Contours (1m shapefile format, DXF format)<br>• RTK (shapefile format, .TXT format)<br>• SBETs (shapefile format, DBF format)<br>• Lake Boundaries (shapefile format) |
| **Raster Data:** | • Elevation Models (1m resolution)<br>  • Hydro-flattened Bare Earth Model (ESRI GRID format)<br>  • Highest Hit Model (ESRI GRID format)<br>  • Vegetation Model (ESRI GRID format)<br>  • nDSM Model (ESRI GRID format)<br>• Intensity Images (GeoTIFF format, 0.5m resolution)<br>• Vegetation Metrics (5m resolution)<br>  • Canopy Cover (ESRI GRID format)<br>  • Coefficient of Variation (ESRI GRID format)<br>  • Mean Elevation (ESRI GRID format) |
| **Data Report:** | • Full report containing introduction, methodology, and accuracy |

# 8. Selected Images

***Figure 26**. Castle Mountain Fault system northeast of Flathorn Lake. Top image is bare earth model, bottom image is bare earth overlain with slope calculations.*

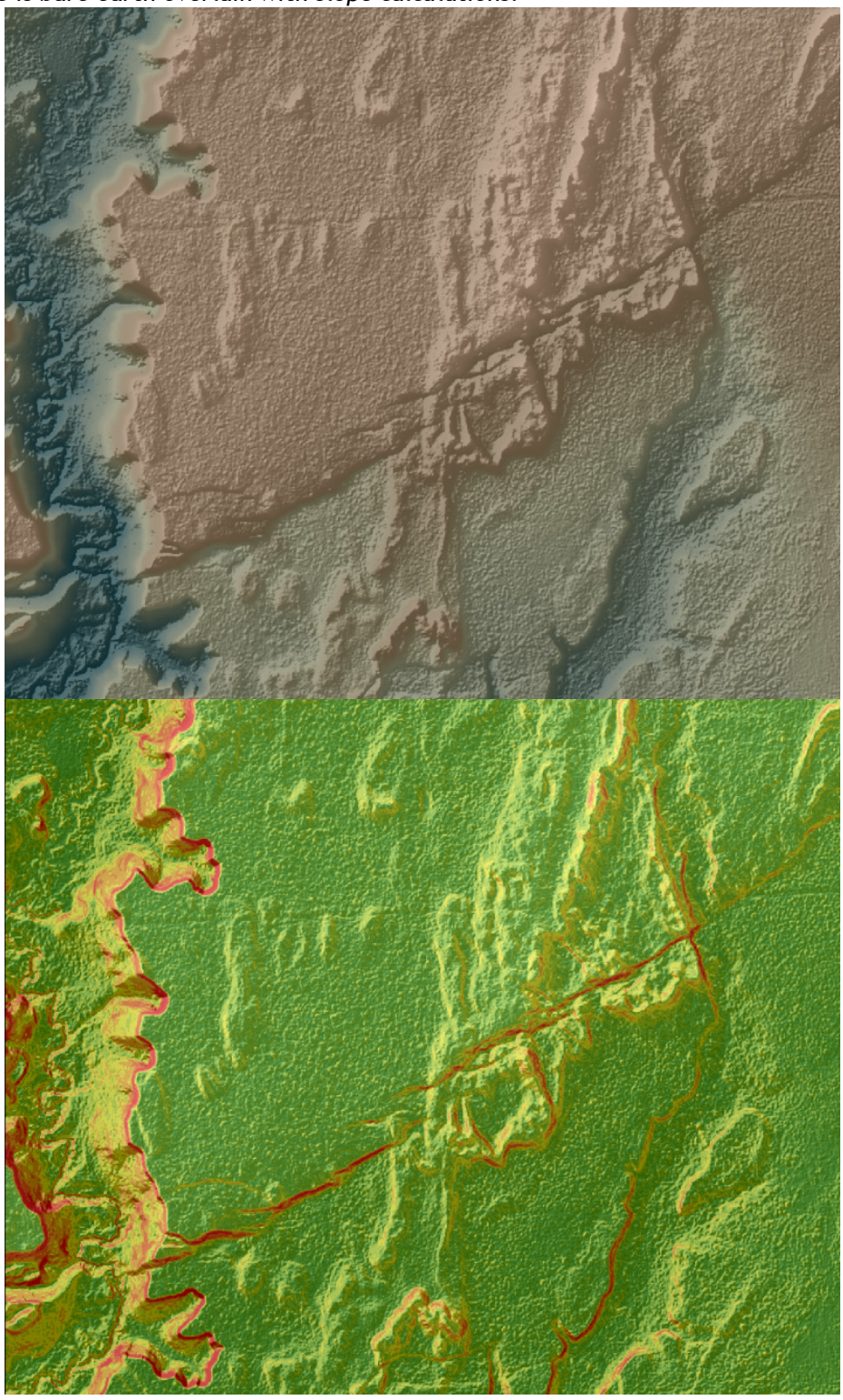


***Figure 27**. View across braided channels of the Tanana River near Dot Lake. Top image is Bare Earth model. Bottom image is LiDAR point cloud colored by elevation.*

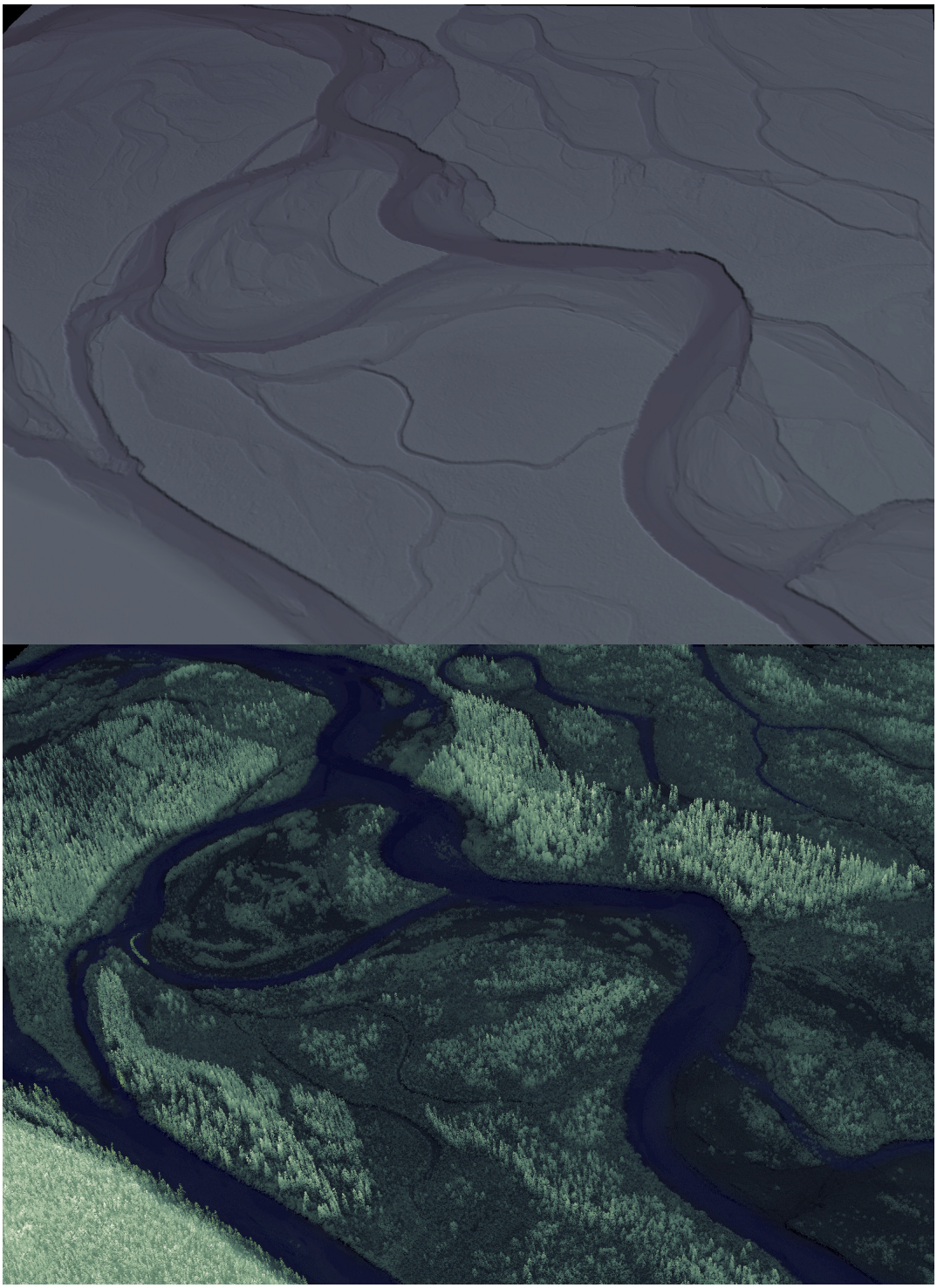


***Figure 28**. View looking north across Gerstle River along A2. Image is 3D LiDAR point cloud colored by elevation.*

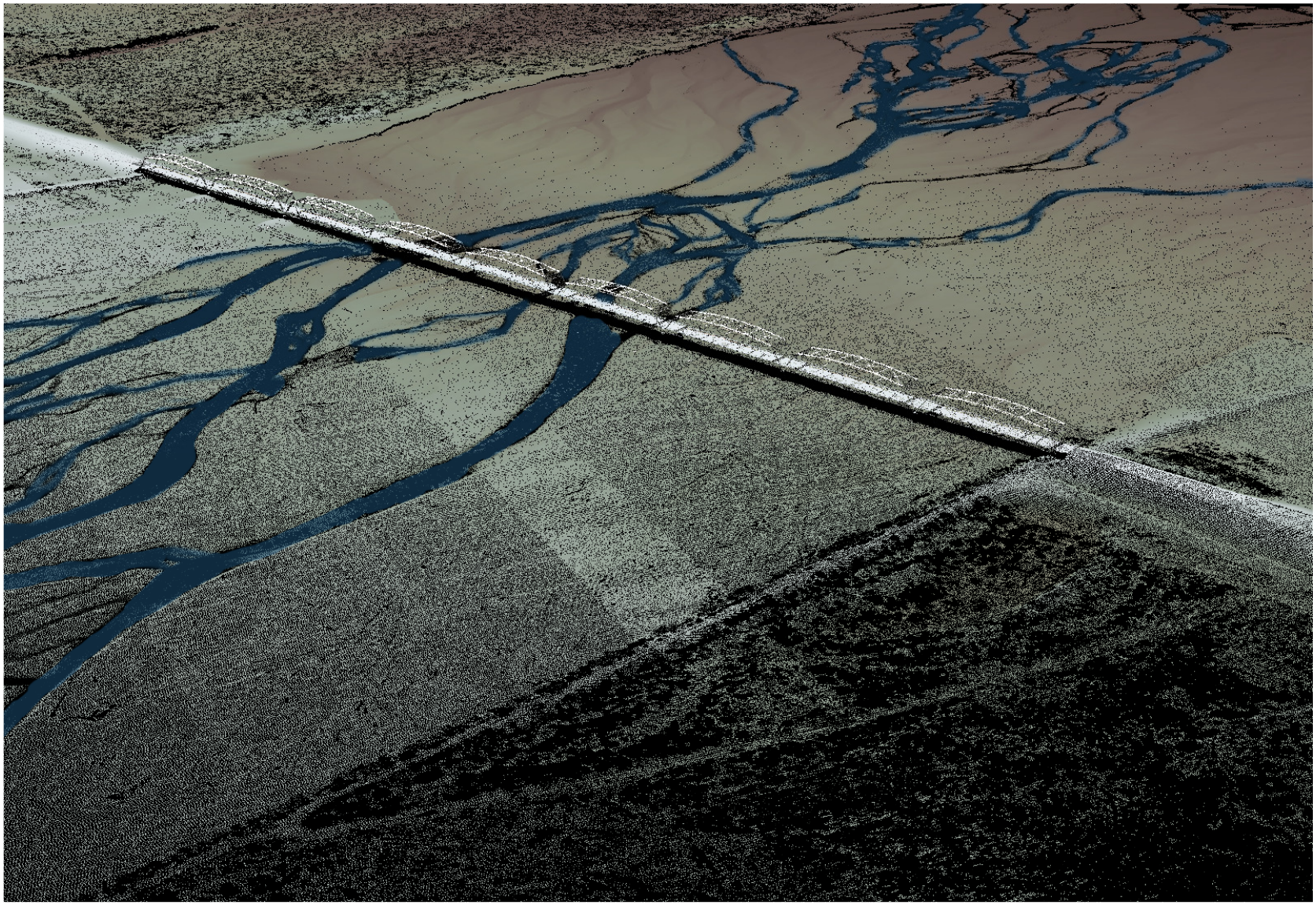


***Figure 29**. Northern end of above ground pipeline near Trims Camp along Hwy 4.*

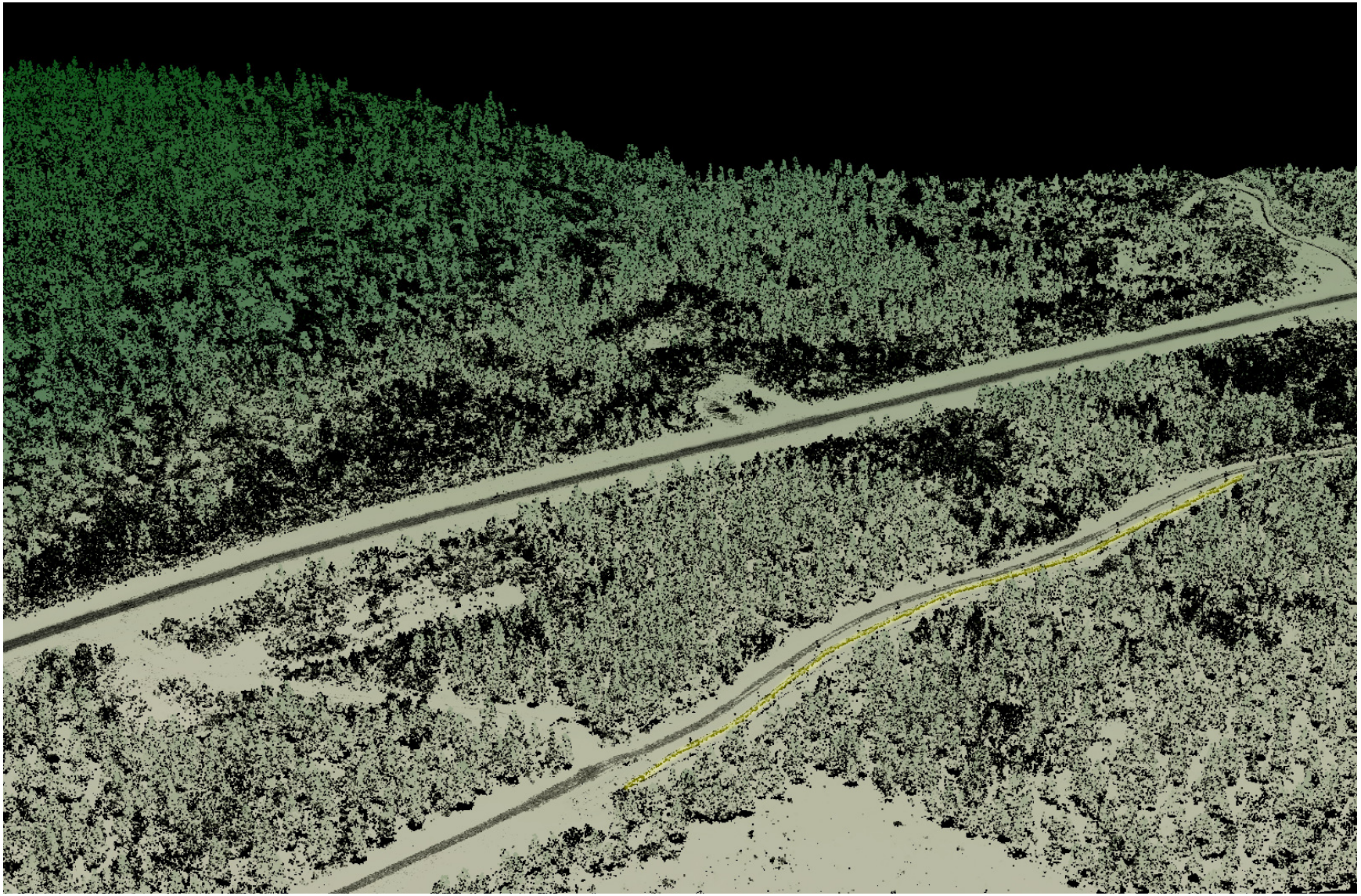


***Figure 30**. View looking North of Pipeline and Hwy 4 as they cross Miller Creek.*

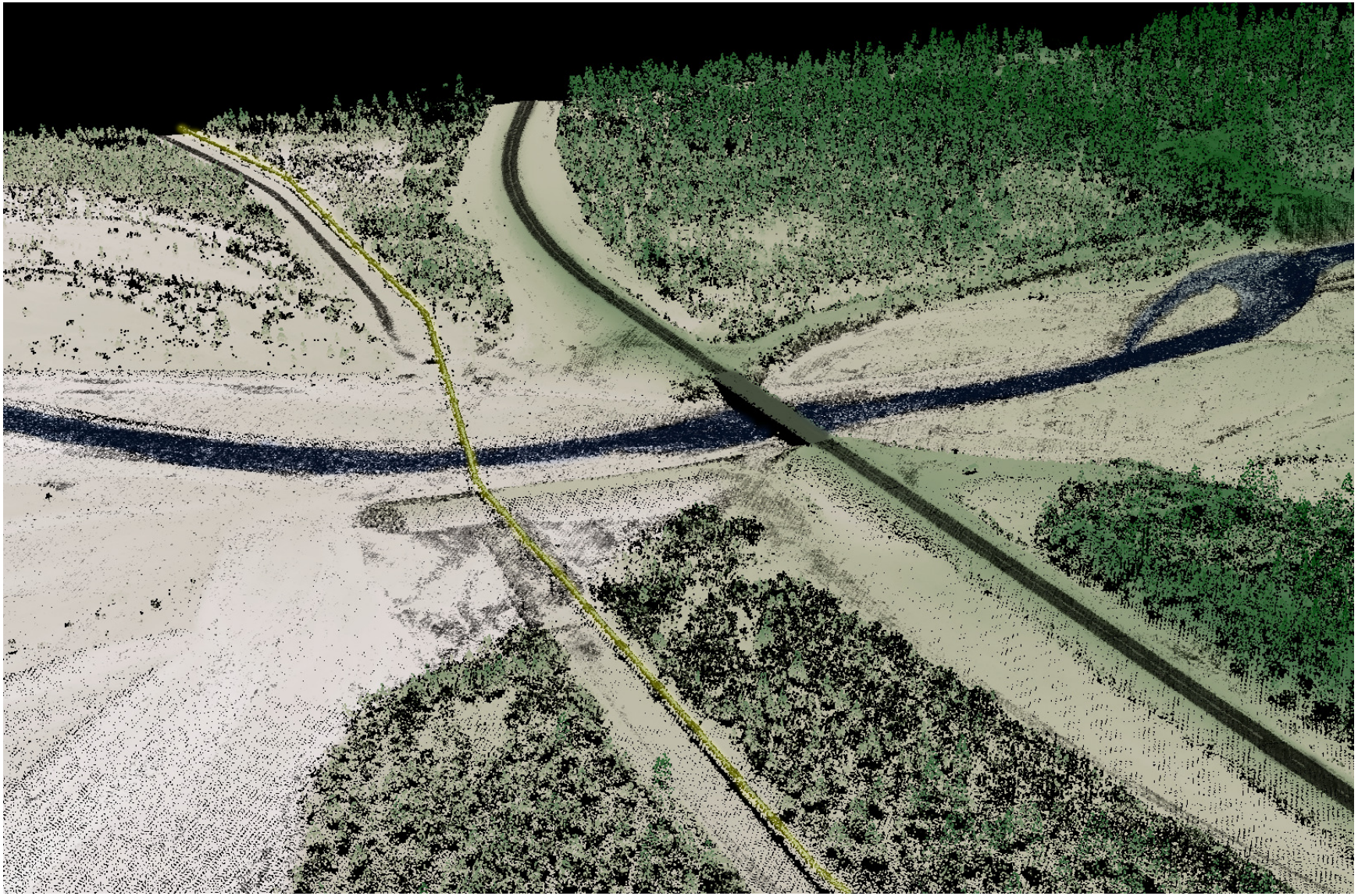


***Figure 31**. View looking Northeast across Hwy 2, just east of Tetlin Junction. Top image is Bare Earth model colored by elevation. Bottom image is Highest Hit model.*

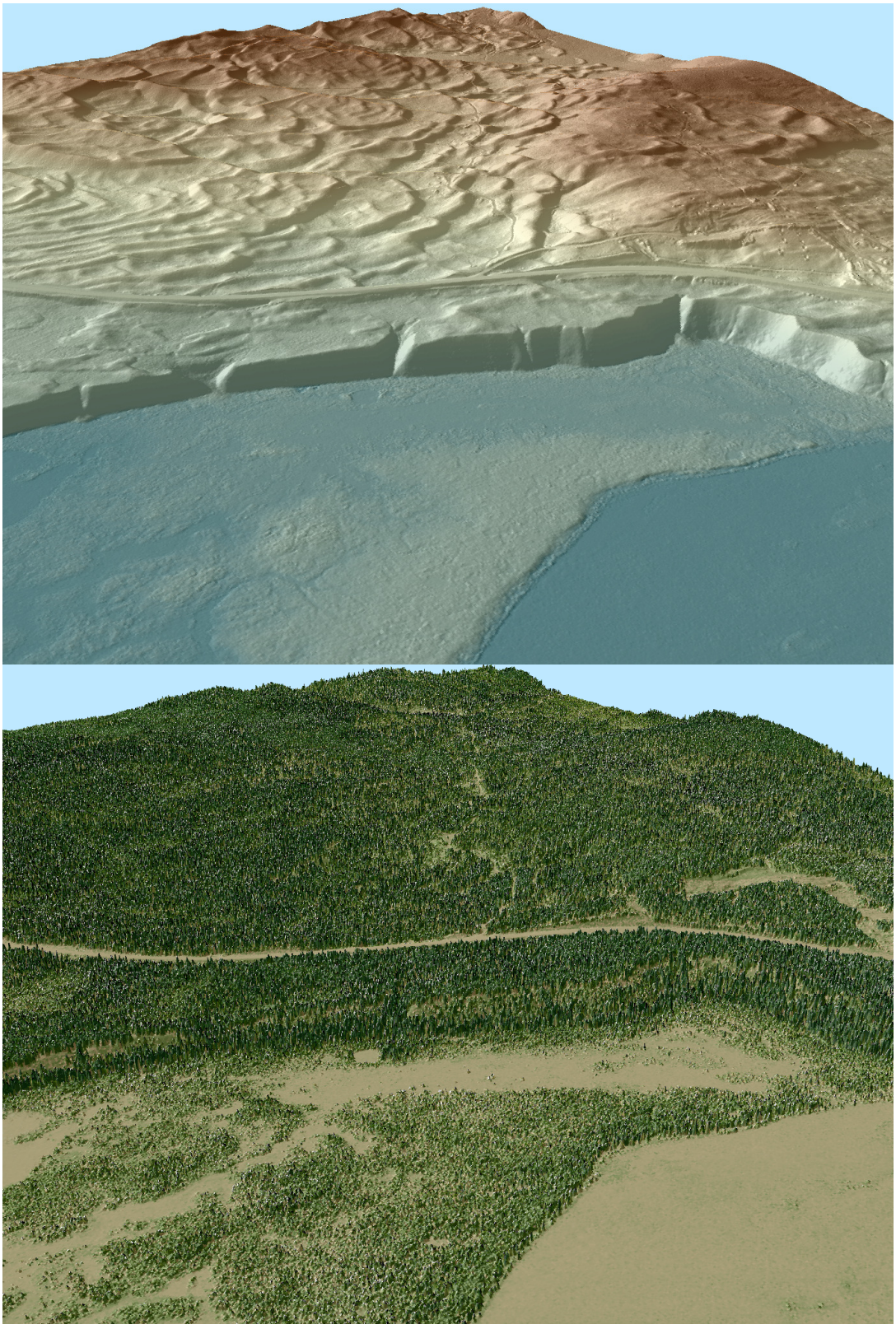


***Figure 32**. Hwy 2, west of where it crosses Gardiner River. Top image is Bare Earth model colored by elevation. Bottom image is Highest Hit model.*

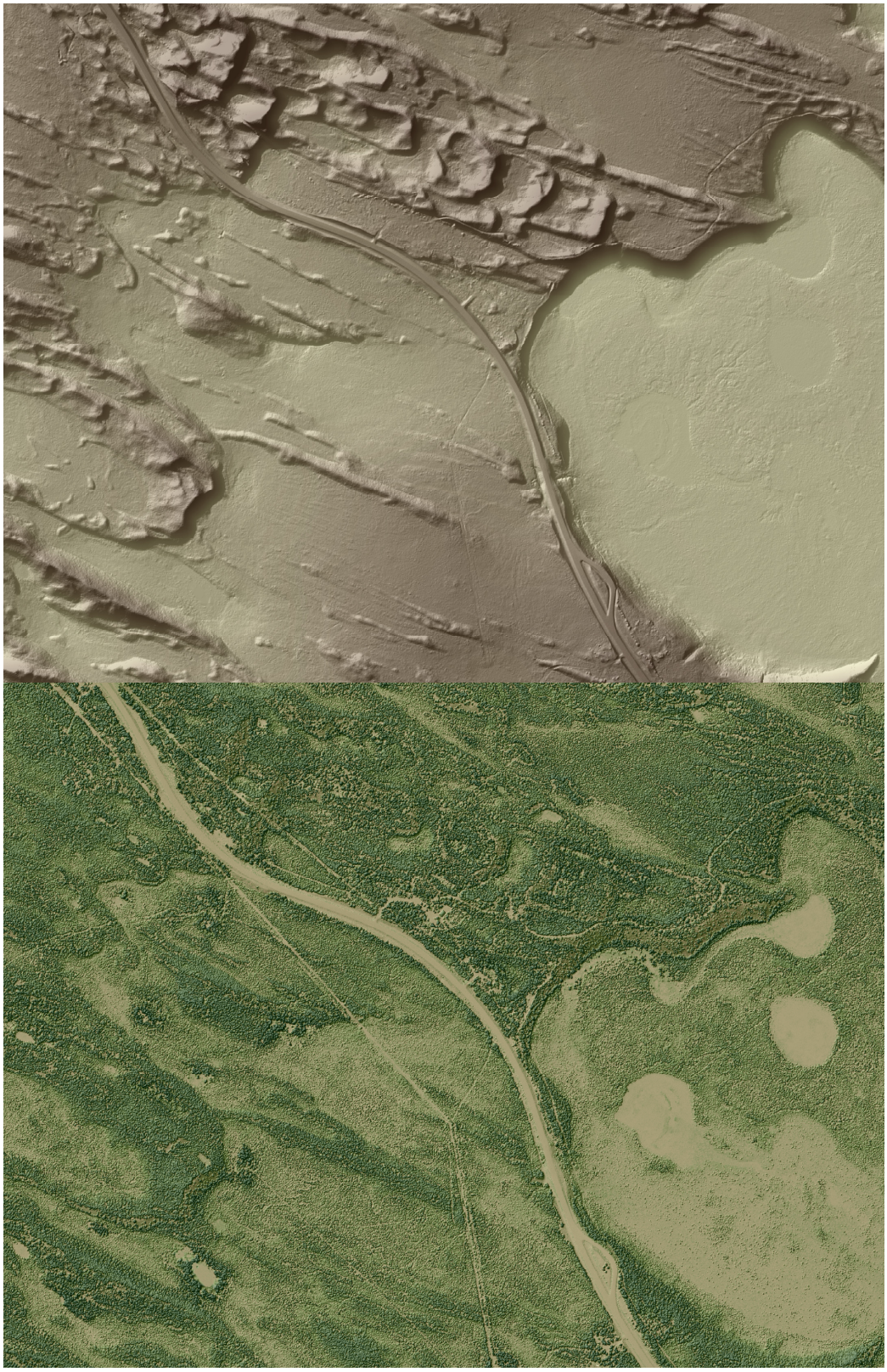
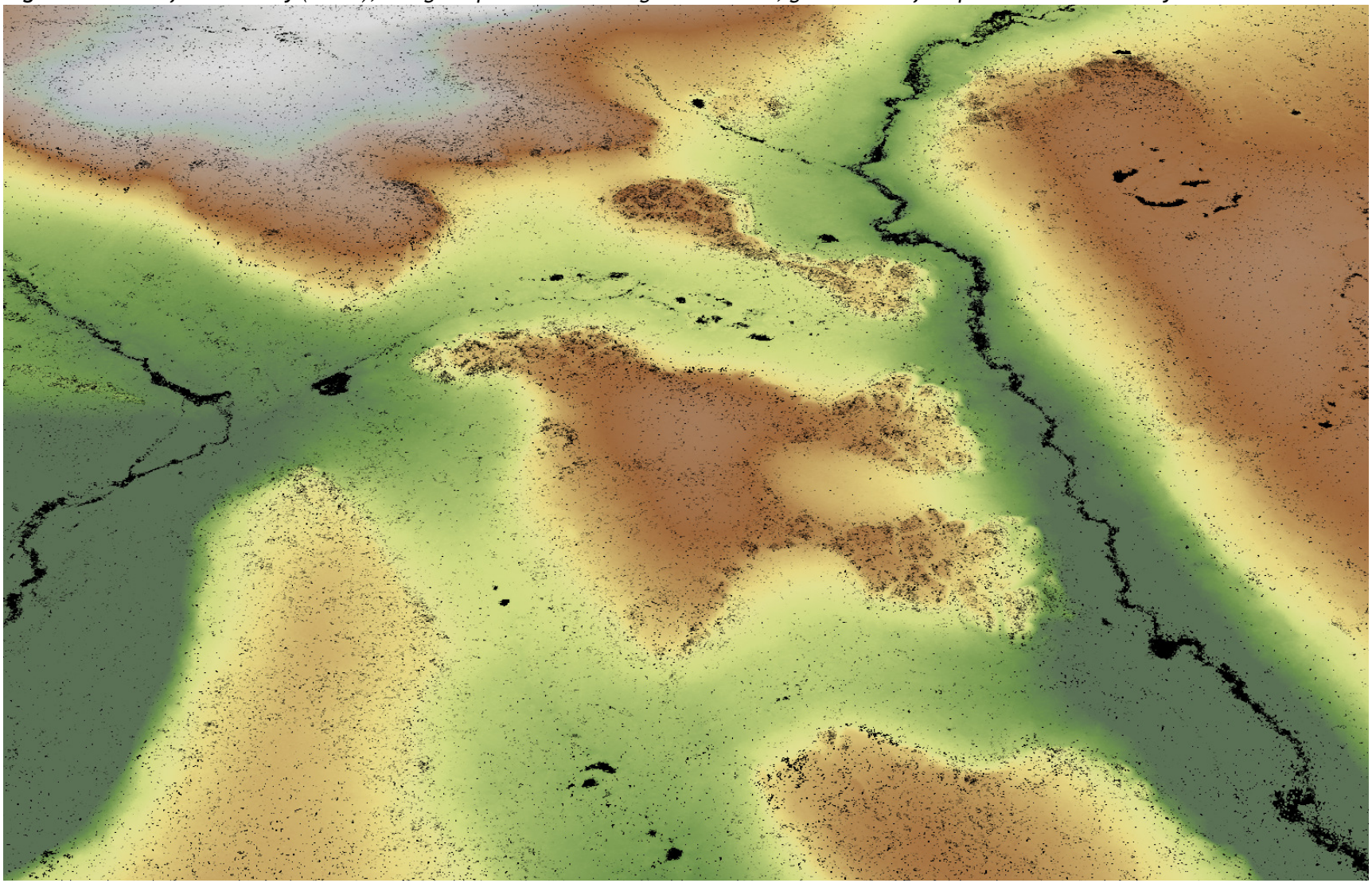


***Figure 33**. East of Dalton Hwy (SR-11), along Chapman Creek. Image is 3D LiDAR, ground classified point cloud colored by elevation.*



# 9. Glossary

**1-sigma (σ) Absolute Deviation:** Value for which the data are within one standard deviation (approximately 68$^{th}$ percentile) of a normally distributed data set.

**1.96-sigma (σ) Absolute Deviation:** Value for which the data are within two standard deviations (approximately 95$^{th}$ percentile) of a normally distributed data set.

**Root Mean Square Error (RMSE):** A statistic used to approximate the difference between real-world points and the LiDAR points. It is calculated by squaring all the values, then taking the average of the squares and taking the square root of the average.

**Pulse Rate (PR)**: The rate at which laser pulses are emitted from the sensor; typically measured as thousands of pulses per second (kHz).

**Pulse Returns**: For every laser pulse emitted, the Leica ALS 50 Phase II system can record *up to four* wave forms reflected back to the sensor. Portions of the wave form that return earliest are the highest element in multi-tiered surfaces such as vegetation. Portions of the wave form that return last are the lowest element in multi-tiered surfaces.

**Accuracy**: The statistical comparison between known (surveyed) points and laser points. Typically measured as the standard deviation (sigma, σ) and root mean square error (RMSE).

**Intensity Values**: The peak power ratio of the laser return to the emitted laser. It is a function of surface reflectivity.

**Data Density**: A common measure of LiDAR resolution, measured as points per square meter.

**Spot Spacing**: Also a measure of LiDAR resolution, measured as the average distance between laser points.

**Nadir**: A single point or locus of points on the surface of the earth directly below a sensor as it progresses along its flight line.

**Scan Angle**: The angle from nadir to the edge of the scan, measured in degrees. Laser point accuracy typically decreases as scan angles increase.

**Overlap**: The area shared between flight lines, typically measured in percents; 100% overlap is essential to ensure complete coverage and reduce laser shadows.

**DTM / DEM**: These often-interchanged terms refer to models made from laser points. The digital elevation model (DEM) refers to all surfaces, including bare ground and vegetation, while the digital terrain model (DTM) refers only to those points classified as ground.

**Real-Time Kinematic (RTK) Survey**: GPS surveying is conducted with a GPS base station deployed over a known monument with a radio connection to a GPS rover. Both the base station and rover receive differential GPS data and the baseline correction is solved between the two. This type of ground survey is accurate to 1.5 cm or less.

# 10. Citations

Soininen, A. 2004. TerraScan User's Guide. TerraSolid.

# Appendix A

**LiDAR accuracy error sources and solutions:**

| Type of Error | Source | Post Processing Solution |
|---|---|---|
| GPS (Static/Kinematic) | Long Base Lines | None |
| | Poor Satellite Constellation | None |
| | Poor Antenna Visibility | Reduce Visibility Mask |
| Relative Accuracy | Poor System Calibration | Recalibrate IMU and sensor offsets/settings |
| | Inaccurate System | None |
| Laser Noise | Poor Laser Timing | None |
| | Poor Laser Reception | None |
| | Poor Laser Power | None |
| | Irregular Laser Shape | None |

**Operational measures taken to improve relative accuracy:**

1. Low Flight Altitude: Terrain following is employed to maintain a constant above ground level (AGL). Laser horizontal errors are a function of flight altitude above ground (i.e., ~ 1/3000$^{th}$ AGL flight altitude).
2. Focus Laser Power at narrow beam footprint: A laser return must be received by the system above a power threshold to accurately record a measurement. The strength of the laser return is a function of laser emission power, laser footprint, flight altitude and the reflectivity of the target. While surface reflectivity cannot be controlled, laser power can be increased and low flight altitudes can be maintained.
3. Reduced Scan Angle: Edge-of-scan data can become inaccurate. The scan angle was reduced to a maximum of ±15$^{o}$ from nadir, creating a narrow swath width and greatly reducing laser shadows from trees and buildings.
4. Quality GPS: Flights took place during optimal GPS conditions (e.g., 6 or more satellites and PDOP [Position Dilution of Precision] less than 3.0). Before each flight, the PDOP was determined for the survey day. During all flight times, a dual frequency DGPS base station recording at 1-second epochs was utilized and a maximum baseline length between the aircraft and the control points was less than 19 km (11.5 miles) at all times.
5. Ground Survey: Ground survey point accuracy (i.e. <1.5 cm RMSE) occurs during optimal PDOP ranges and targets a minimal baseline distance of 4 miles between GPS rover and base. Robust statistics are, in part, a function of sample size (n) and distribution. Ground survey RTK points are distributed to the extent possible throughout multiple flight lines and across the survey area.
6. 50% Side-Lap (100% Overlap): Overlapping areas are optimized for relative accuracy testing. Laser shadowing is minimized to help increase target acquisition from multiple scan angles. Ideally, with a 50% side-lap, the most nadir portion of one flight line coincides with the edge (least nadir) portion of overlapping flight lines. A minimum of 50% side-lap with terrain-followed acquisition prevents data gaps.
7. Opposing Flight Lines: All overlapping flight lines are opposing. Pitch, roll and heading errors are amplified by a factor of two relative to the adjacent flight line(s), making misalignments easier to detect and resolve.

# Appendix B

# Alaska Gasline LiDAR Project
# Delivery 8

*Watershed Sciences, Inc.*
*McClintock Land Associates, Inc.*

QUALITY CONTROL REVIEW SUMMARY

| | | |
|---|---|---|
| Max. Positive Elev. Deviation: | 0.12 | meters |
| Max. Negative Elev. Deviation: | -0.16 | meters |
| Elevation Deviation Range: | 0.28 | meters |
| Elevation Deviation Mean: | 0.00 | meters |
| **Elevation Deviation RMSE** | **0.03** | **meters** |

(RMSE = Root Mean Square Error)

Total Number of Check Points: 604.00

| CHECK POINTS | | | SURVEYED Elevation | | LiDAR Elevation | Deviation |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | DESCRIPTOR | (Meters) | (Meters) |
| 63 | 7035991.84 | 359476.87 | 478.90 | CP-26A | 478.83 | 0.07 |
| 64 | 7030856.83 | 370186.89 | 515.60 | CP-26B | 515.59 | 0.01 |
| 65 | 7041876.09 | 358736.17 | 502.30 | CP-26C | 502.24 | 0.06 |
| 67 | 7025236.94 | 396844.54 | 495.98 | CP-27B | 495.93 | 0.05 |
| 68 | 7018331.64 | 423845.77 | 568.07 | CP-28A | 568.07 | 0.00 |
| 73 | 6960807.26 | 487110.75 | 652.39 | CP-30A | 652.40 | -0.01 |
| 74 | 6959177.82 | 488359.11 | 630.67 | CP-30B | 630.64 | 0.03 |
| 80 | 7041688.65 | 358681.33 | 495.81 | CP-26D | 495.97 | -0.16 |
| 81 | 7022098.58 | 417994.04 | 517.93 | CP-28C | 517.93 | 0.00 |
| 163 | 7035991.84 | 359476.88 | 478.89 | CP-26 A | 478.83 | 0.06 |
| 164 | 7030856.84 | 370186.92 | 515.58 | CP-26 B | 515.59 | -0.01 |
| 165 | 7028654.85 | 374392.04 | 496.60 | CP-26 C | 496.63 | -0.03 |
| 167 | 7025236.95 | 396844.55 | 495.97 | CP-27 B | 495.93 | 0.03 |
| 168 | 7018331.64 | 423845.77 | 568.07 | CP-28 A | 568.07 | 0.00 |
| 173 | 6960807.24 | 487110.76 | 652.36 | CP-30 A | 652.40 | -0.04 |
| 174 | 6959177.81 | 488359.12 | 630.66 | CP-30 B | 630.64 | 0.02 |
| 175 | 6943345.38 | 499539.49 | 588.91 | CP-30 C | 588.90 | 0.01 |
| 5000 | 7030856.83 | 370186.89 | 515.58 | 26B20100917SAC | 515.59 | -0.01 |
| 5001 | 7030857.84 | 370185.92 | 515.64 | 26B20100917CK_26B_5'o/s | 515.65 | -0.01 |
| 5002 | 7031399.45 | 364159.07 | 480.16 | 26B20100917SPR | 480.15 | 0.01 |
| 5003 | 7031399.62 | 364176.39 | 480.15 | 26B20100917SPR | 480.15 | 0.00 |
| 5004 | 7031400.56 | 364192.62 | 480.15 | 26B20100917SPR | 480.13 | 0.02 |
| 5005 | 7031441.70 | 364704.44 | 479.77 | 26B20100917SPR | 479.74 | 0.03 |
| 5006 | 7031442.89 | 364716.51 | 479.63 | 26B20100917SPR | 479.62 | 0.01 |
| 5007 | 7031443.81 | 364729.03 | 479.51 | 26B20100917SPR | 479.49 | 0.02 |
| 5008 | 7031659.39 | 367433.96 | 515.99 | 26B20100917SPR | 516.00 | -0.01 |
| 5009 | 7031660.34 | 367446.54 | 516.11 | 26B20100917SPR | 516.11 | 0.00 |
| 5010 | 7031661.18 | 367458.39 | 516.18 | 26B20100917SPR | 516.20 | -0.02 |
| 5011 | 7031714.85 | 368106.73 | 516.31 | 26B20100917SPR | 516.37 | -0.06 |
| 5012 | 7031715.94 | 368124.90 | 516.07 | 26B20100917SPR | 516.12 | -0.05 |
| 5013 | 7031718.09 | 368145.93 | 515.74 | 26B20100917SPR | 515.78 | -0.04 |
| 5014 | 7031686.37 | 368804.61 | 506.08 | 26B20100917SPR | 506.12 | -0.04 |
| 5015 | 7031681.89 | 368823.47 | 506.13 | 26B20100917SPR | 506.18 | -0.06 |
| 5016 | 7031677.04 | 368842.48 | 506.20 | 26B20100917SPR | 506.24 | -0.04 |
| 5017 | 7031394.79 | 369442.53 | 511.08 | 26B20100917SPR | 511.12 | -0.04 |
| 5018 | 7031383.08 | 369460.09 | 511.25 | 26B20100917SPR | 511.31 | -0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5019 | 7031369.94 | 369479.93 | 511.49 | 26B20100917SPR | 511.54 | -0.05 |
| 5020 | 7030769.10 | 370364.70 | 517.18 | 26B20100917SPR | 517.20 | -0.02 |
| 5021 | 7030759.35 | 370379.18 | 516.87 | 26B20100917SPR | 516.88 | -0.01 |
| 5022 | 7030747.86 | 370394.96 | 516.44 | 26B20100917SPR | 516.45 | -0.01 |
| 5023 | 7030270.55 | 371158.56 | 495.90 | 26B20100917SPR | 495.93 | -0.03 |
| 5024 | 7030265.22 | 371167.96 | 495.76 | 26B20100917SPR | 495.80 | -0.04 |
| 5025 | 7030258.69 | 371179.44 | 495.61 | 26B20100917SPR | 495.64 | -0.03 |
| 5026 | 7029963.69 | 371997.62 | 494.45 | 26B20100917SPR | 494.50 | -0.06 |
| 5027 | 7029958.48 | 372014.34 | 494.50 | 26B20100917SPR | 494.53 | -0.03 |
| 5028 | 7029954.56 | 372026.01 | 494.54 | 26B20100917SPR | 494.56 | -0.02 |
| 5029 | 7029744.69 | 372654.20 | 492.99 | 26B20100917SPR | 493.02 | -0.03 |
| 5030 | 7029740.34 | 372668.70 | 492.95 | 26B20100917SPR | 492.98 | -0.04 |
| 5031 | 7029733.95 | 372687.13 | 492.97 | 26B20100917SPR | 492.98 | -0.01 |
| 5032 | 7029276.18 | 373394.11 | 496.28 | 26B20100917SPR | 496.33 | -0.05 |
| 5033 | 7029259.75 | 373406.41 | 496.03 | 26B20100917SPR | 496.07 | -0.04 |
| 5034 | 7029245.70 | 373416.09 | 495.80 | 26B20100917SPR | 495.84 | -0.04 |
| 5035 | 7028690.99 | 374198.79 | 493.11 | 26B20100917SPR | 493.14 | -0.03 |
| 5036 | 7028687.71 | 374216.85 | 493.12 | 26B20100917SPR | 493.14 | -0.02 |
| 5037 | 7028684.79 | 374231.37 | 493.28 | 26B20100917SPR | 493.30 | -0.02 |
| 5038 | 7028391.26 | 374774.58 | 504.81 | 26B20100917SPR | 504.83 | -0.02 |
| 5039 | 7028382.88 | 374792.31 | 504.51 | 26B20100917SPR | 504.53 | -0.02 |
| 5040 | 7028373.87 | 374810.15 | 504.14 | 26B20100917SPR | 504.15 | -0.01 |
| 5041 | 7028239.49 | 375879.15 | 498.40 | 26B20100917SPR | 498.35 | 0.05 |
| 5042 | 7028244.52 | 375896.24 | 498.27 | 26B20100917SPR | 498.29 | -0.02 |
| 5043 | 7028249.71 | 375914.43 | 498.05 | 26B20100917SPR | 498.10 | -0.05 |
| 5044 | 7028399.89 | 377007.04 | 468.86 | 26B20100917SPR | 468.89 | -0.03 |
| 5045 | 7028400.39 | 377019.13 | 468.90 | 26B20100917SPR | 468.95 | -0.05 |
| 5046 | 7028400.87 | 377030.95 | 468.98 | 26B20100917SPR | 469.02 | -0.04 |
| 5047 | 7028422.18 | 377850.26 | 471.52 | 26B20100917SPR | 471.57 | -0.05 |
| 5048 | 7028421.52 | 377862.01 | 471.57 | 26B20100917SPR | 471.60 | -0.03 |
| 5049 | 7028420.25 | 377887.45 | 471.64 | 26B20100917SPR | 471.67 | -0.03 |
| 5050 | 7028372.28 | 378754.94 | 471.81 | 26B20100917SPR | 471.87 | -0.06 |
| 5051 | 7028372.83 | 378742.13 | 471.81 | 26B20100917SPR | 471.88 | -0.07 |
| 5052 | 7028373.52 | 378730.69 | 471.85 | 26B20100917SPR | 471.93 | -0.08 |
| 5053 | 7028633.25 | 374440.65 | 499.15 | 26B20100917SPR | 499.20 | -0.05 |
| 5054 | 7028639.59 | 374426.29 | 498.68 | 26B20100917SPR | 498.74 | -0.06 |
| 5055 | 7028644.65 | 374413.91 | 498.27 | 26B20100917SPR | 498.30 | -0.03 |
| 5056 | 7028644.62 | 374413.89 | 498.28 | 26B20100917SPR | 498.31 | -0.03 |
| 5057 | 7029980.82 | 372808.87 | 464.94 | 26B20100917SGR | 464.98 | -0.04 |
| 5058 | 7029971.57 | 372828.11 | 465.01 | 26B20100917SGR | 465.05 | -0.04 |
| 5059 | 7029971.97 | 372866.98 | 464.33 | 26B20100917SGR | 464.37 | -0.04 |
| 5060 | 7029972.80 | 372880.59 | 464.15 | 26B20100917SGR | 464.20 | -0.05 |
| 5100 | 7025236.95 | 396844.55 | 495.97 | 27B20100917SAC | 495.93 | 0.03 |
| 5101 | 7025235.59 | 396843.87 | 495.88 | 27B20100917CK_27B_o/s | 495.95 | -0.07 |
| 5102 | 7025805.52 | 394000.52 | 493.82 | 27B20100917SPR | 493.81 | 0.01 |
| 5103 | 7025808.07 | 393987.92 | 493.85 | 27B20100917SPR | 493.85 | 0.00 |
| 5104 | 7025810.30 | 393976.41 | 493.89 | 27B20100917SPR | 493.87 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5105 | 7025962.20 | 393184.89 | 492.39 | 27B20100917SPR | 492.38 | 0.01 |
| 5106 | 7025960.18 | 393196.08 | 492.38 | 27B20100917SPR | 492.39 | -0.01 |
| 5107 | 7025957.96 | 393207.08 | 492.40 | 27B20100917SPR | 492.42 | -0.02 |
| 5108 | 7025711.39 | 394490.92 | 495.61 | 27B20100917SPR | 495.60 | 0.01 |
| 5109 | 7025709.12 | 394503.03 | 495.68 | 27B20100917SPR | 495.67 | 0.01 |
| 5110 | 7025706.78 | 394514.60 | 495.77 | 27B20100917SPR | 495.76 | 0.01 |
| 5111 | 7026454.46 | 394954.16 | 492.57 | 27B20100917SGR | 492.59 | -0.02 |
| 5112 | 7026453.45 | 394972.18 | 492.50 | 27B20100917SGR | 492.51 | -0.01 |
| 5113 | 7026452.76 | 394988.62 | 492.45 | 27B20100917SGR | 492.44 | 0.01 |
| 5114 | 7026434.83 | 395503.78 | 492.46 | 27B20100917SGR | 492.46 | 0.00 |
| 5115 | 7026434.47 | 395519.51 | 492.42 | 27B20100917SGR | 492.39 | 0.03 |
| 5116 | 7026434.03 | 395536.16 | 492.47 | 27B20100917SGR | 492.46 | 0.01 |
| 5117 | 7026400.91 | 396519.43 | 493.65 | 27B20100917SPR | 493.62 | 0.03 |
| 5118 | 7026401.31 | 396532.33 | 493.47 | 27B20100917SPR | 493.44 | 0.03 |
| 5119 | 7026389.00 | 396520.18 | 493.67 | 27B20100917SPR | 493.62 | 0.05 |
| 5120 | 7026802.68 | 396544.39 | 492.17 | 27B20100917SPR | 492.18 | -0.01 |
| 5121 | 7026806.03 | 396531.21 | 491.98 | 27B20100917SPR | 492.02 | -0.04 |
| 5122 | 7026836.99 | 396536.37 | 492.14 | 27B20100917SGR | 492.12 | 0.02 |
| 5123 | 7026138.39 | 396511.77 | 494.01 | 27B20100917SPR | 494.04 | -0.03 |
| 5124 | 7026121.53 | 396511.34 | 494.17 | 27B20100917SPR | 494.17 | 0.00 |
| 5125 | 7026107.12 | 396510.98 | 494.25 | 27B20100917SPR | 494.27 | -0.02 |
| 5126 | 7025343.26 | 396485.12 | 496.07 | 27B20100917SPR | 496.04 | 0.03 |
| 5127 | 7025329.16 | 396485.75 | 496.34 | 27B20100917SPR | 496.35 | -0.01 |
| 5128 | 7025312.79 | 396486.65 | 496.04 | 27B20100917SPR | 496.03 | 0.01 |
| 5129 | 7025405.47 | 396088.08 | 496.01 | 27B20100917SPR | 496.02 | -0.01 |
| 5130 | 7025408.01 | 396074.96 | 496.03 | 27B20100917SPR | 496.05 | -0.03 |
| 5131 | 7025410.41 | 396062.71 | 496.05 | 27B20100917SPR | 496.06 | -0.01 |
| 5132 | 7025559.02 | 395286.43 | 495.41 | 27B20100917SPR | 495.42 | -0.01 |
| 5133 | 7025561.22 | 395275.28 | 495.41 | 27B20100917SPR | 495.39 | 0.01 |
| 5134 | 7025563.40 | 395263.02 | 495.40 | 27B20100917SPR | 495.38 | 0.02 |
| 5135 | 7025619.17 | 394891.23 | 495.67 | 27B20100917SPR | 495.69 | -0.02 |
| 5136 | 7025633.33 | 394898.89 | 495.68 | 27B20100917SPR | 495.69 | -0.01 |
| 5137 | 7025645.84 | 394892.27 | 495.44 | 27B20100917SPR | 495.44 | 0.00 |
| 5138 | 7024847.60 | 394854.84 | 496.51 | 27B20100917SGR | 496.55 | -0.04 |
| 5139 | 7024857.01 | 394864.94 | 496.59 | 27B20100917SGR | 496.63 | -0.04 |
| 5140 | 7024847.49 | 394872.11 | 496.53 | 27B20100917SGR | 496.59 | -0.06 |
| 5148 | 7024417.39 | 395643.22 | 497.86 | 27B20100917SGR | 497.91 | -0.05 |
| 5149 | 7024404.00 | 395644.65 | 497.82 | 27B20100917SGR | 497.90 | -0.08 |
| 5150 | 7024390.07 | 395647.44 | 497.78 | 27B20100917SGR | 497.84 | -0.06 |
| 5151 | 7024819.30 | 395670.14 | 497.39 | 27B20100917SGR | 497.40 | -0.01 |
| 5152 | 7024820.35 | 395659.04 | 497.57 | 27B20100917SGR | 497.59 | -0.02 |
| 5153 | 7024821.14 | 395648.25 | 497.55 | 27B20100917SGR | 497.56 | -0.01 |
| 5154 | 7024790.77 | 396466.03 | 497.07 | 27B20100917SGR | 497.08 | -0.01 |
| 5155 | 7024787.76 | 396479.06 | 497.12 | 27B20100917SGR | 497.11 | 0.01 |
| 5156 | 7024786.31 | 396489.41 | 497.21 | 27B20100917SGR | 497.23 | -0.02 |
| 5157 | 7023989.44 | 396430.15 | 499.99 | 27B20100917SGR | 500.06 | -0.07 |
| 5158 | 7023988.32 | 396444.30 | 499.98 | 27B20100917SGR | 500.02 | -0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5159 | 7023988.62 | 396458.69 | 500.06 | 27B20100917SGR | 500.10 | -0.04 |
| 5161 | 7023938.03 | 398054.05 | 500.37 | 27B20100917SPR | 500.41 | -0.04 |
| 5162 | 7023937.96 | 398062.03 | 500.26 | 27B20100917SPR | 500.30 | -0.04 |
| 5163 | 7023945.96 | 398055.66 | 500.28 | 27B20100917SPR | 500.31 | -0.03 |
| 5164 | 7025011.53 | 398096.19 | 497.34 | 27B20100917SPR | 497.32 | 0.02 |
| 5165 | 7025022.05 | 398091.08 | 497.46 | 27B20100917SPR | 497.42 | 0.04 |
| 5166 | 7025034.31 | 398088.69 | 497.28 | 27B20100917SPR | 497.25 | 0.03 |
| 5167 | 7026349.37 | 398126.98 | 493.76 | 27B20100917SPR | 493.74 | 0.02 |
| 5168 | 7026347.00 | 398146.54 | 493.90 | 27B20100917SPR | 493.86 | 0.04 |
| 5169 | 7026346.43 | 398162.96 | 494.12 | 27B20100917SPR | 494.10 | 0.02 |
| 5170 | 7025899.40 | 399726.01 | 495.20 | 27B20100917SPR | 495.19 | 0.01 |
| 5171 | 7025506.35 | 399713.06 | 496.76 | 27B20100917SPR | 496.77 | -0.01 |
| 5172 | 7025498.29 | 399713.10 | 496.82 | 27B20100917SPR | 496.84 | -0.02 |
| 5173 | 7025487.90 | 399713.35 | 496.86 | 27B20100917SPR | 496.86 | 0.00 |
| 5174 | 7024721.65 | 399694.39 | 498.91 | 27B20100917SPR | 498.93 | -0.02 |
| 5175 | 7024714.22 | 399694.97 | 499.03 | 27B20100917SPR | 499.05 | -0.02 |
| 5176 | 7024706.48 | 399694.98 | 498.94 | 27B20100917SPR | 498.95 | -0.01 |
| 5400 | 6959177.82 | 488359.11 | 630.67 | 30B20100918SAC | 630.64 | 0.03 |
| 5401 | 6959177.56 | 488356.64 | 630.65 | 30B20100918SSR | 630.69 | -0.05 |
| 5402 | 6959184.71 | 488350.27 | 630.58 | 30B20100918SSR | 630.62 | -0.04 |
| 5403 | 6959190.81 | 488344.13 | 630.63 | 30B20100918SSR | 630.56 | 0.07 |
| 5404 | 6959198.38 | 488347.89 | 630.62 | 30B20100918SSR | 630.63 | -0.01 |
| 5405 | 6959193.97 | 488355.94 | 630.67 | 30B20100918SSR | 630.66 | 0.01 |
| 5406 | 6959187.57 | 488362.39 | 630.68 | 30B20100918SSR | 630.67 | 0.01 |
| 5407 | 6959180.80 | 488368.75 | 630.63 | 30B20100918SSR | 630.63 | 0.00 |
| 5408 | 6959173.76 | 488363.70 | 630.70 | 30B20100918SSR | 630.70 | 0.00 |
| 5409 | 6959156.57 | 488314.76 | 627.93 | 30B20100918SAR | 627.92 | 0.01 |
| 5410 | 6959144.89 | 488325.05 | 627.61 | 30B20100918SAR | 627.61 | 0.00 |
| 5411 | 6959133.19 | 488335.33 | 627.35 | 30B20100918SAR | 627.34 | 0.01 |
| 5412 | 6959121.77 | 488345.51 | 627.16 | 30B20100918SAR | 627.16 | 0.00 |
| 5413 | 6959110.41 | 488355.51 | 627.00 | 30B20100918SAR | 626.98 | 0.01 |
| 5414 | 6958620.66 | 488786.71 | 637.05 | 30B20100918SAR | 637.05 | 0.00 |
| 5415 | 6958627.41 | 488780.74 | 637.09 | 30B20100918SAR | 637.06 | 0.03 |
| 5416 | 6958638.58 | 488770.95 | 637.13 | 30B20100918SAR | 637.10 | 0.03 |
| 5417 | 6958640.85 | 488774.32 | 637.12 | 30B20100918SAR | 637.10 | 0.01 |
| 5418 | 6958629.21 | 488784.65 | 637.09 | 30B20100918SAR | 637.09 | 0.00 |
| 5419 | 6958616.36 | 488795.83 | 637.00 | 30B20100918SAR | 636.98 | 0.02 |
| 5420 | 6958613.17 | 488793.02 | 636.99 | 30B20100918SAR | 636.98 | 0.01 |
| 5421 | 6957658.05 | 489470.50 | 640.74 | 30B20100918SAR | 640.69 | 0.04 |
| 5422 | 6957672.88 | 489470.28 | 640.88 | 30B20100918SAR | 640.85 | 0.02 |
| 5423 | 6957687.32 | 489470.34 | 641.04 | 30B20100918SAR | 641.00 | 0.04 |
| 5424 | 6957702.94 | 489470.12 | 641.17 | 30B20100918SAR | 641.15 | 0.02 |
| 5425 | 6957702.74 | 489474.05 | 641.16 | 30B20100918SAR | 641.15 | 0.01 |
| 5426 | 6957687.17 | 489473.98 | 641.00 | 30B20100918SAR | 640.97 | 0.03 |
| 5427 | 6957670.94 | 489474.09 | 640.85 | 30B20100918SAR | 640.83 | 0.02 |
| 5428 | 6957655.15 | 489474.06 | 640.72 | 30B20100918SAR | 640.68 | 0.04 |
| 5429 | 6957639.80 | 489474.52 | 640.52 | 30B20100918SAR | 640.50 | 0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5430 | 6956698.78 | 489492.51 | 619.05 | 30B20100918SAR | 618.99 | 0.06 |
| 5431 | 6956696.23 | 489495.12 | 618.99 | 30B20100918SAR | 618.94 | 0.05 |
| 5432 | 6956700.64 | 489500.45 | 619.32 | 30B20100918SAR | 619.30 | 0.02 |
| 5433 | 6956702.13 | 489504.87 | 619.60 | 30B20100918SAR | 619.58 | 0.02 |
| 5434 | 6956703.24 | 489510.91 | 620.05 | 30B20100918SAR | 620.00 | 0.05 |
| 5435 | 6956709.86 | 489509.10 | 620.10 | 30B20100918SAR | 620.06 | 0.04 |
| 5436 | 6956706.81 | 489502.64 | 619.66 | 30B20100918SAR | 619.66 | 0.00 |
| 5437 | 6956682.20 | 489481.24 | 618.44 | 30B20100918SGR | 618.39 | 0.05 |
| 5438 | 6956669.87 | 489473.72 | 618.08 | 30B20100918SGR | 618.12 | -0.04 |
| 5439 | 6956656.33 | 489465.59 | 617.92 | 30B20100918SGR | 617.94 | -0.02 |
| 5440 | 6956642.41 | 489457.05 | 617.73 | 30B20100918SGR | 617.72 | 0.00 |
| 5441 | 6956627.96 | 489448.18 | 617.41 | 30B20100918SGR | 617.36 | 0.04 |
| 5442 | 6956611.85 | 489438.29 | 616.89 | 30B20100918SGR | 616.88 | 0.01 |
| 5443 | 6955000.72 | 490705.97 | 675.25 | 30B20100918SAR | 675.24 | 0.01 |
| 5444 | 6955000.56 | 490712.62 | 675.53 | 30B20100918SAR | 675.50 | 0.02 |
| 5445 | 6954985.41 | 490716.35 | 675.94 | 30B20100918SAR | 675.95 | -0.01 |
| 5446 | 6954981.92 | 490712.20 | 675.91 | 30B20100918SAR | 675.90 | 0.01 |
| 5447 | 6954969.15 | 490718.51 | 676.44 | 30B20100918SAR | 676.49 | -0.05 |
| 5448 | 6954955.46 | 490724.24 | 677.10 | 30B20100918SAR | 677.09 | 0.00 |
| 5449 | 6954941.97 | 490729.51 | 677.70 | 30B20100918SAR | 677.69 | 0.01 |
| 5450 | 6954928.62 | 490734.36 | 678.29 | 30B20100918SAR | 678.31 | -0.02 |
| 5451 | 6954914.40 | 490738.67 | 678.87 | 30B20100918SAR | 678.87 | 0.00 |
| 5452 | 6954916.73 | 490746.35 | 679.07 | 30B20100918SAR | 679.07 | 0.00 |
| 5453 | 6954930.97 | 490742.21 | 678.48 | 30B20100918SAR | 678.48 | 0.00 |
| 5454 | 6954945.26 | 490737.33 | 677.85 | 30B20100918SAR | 677.89 | -0.04 |
| 5455 | 6954959.96 | 490731.74 | 677.28 | 30B20100918SAR | 677.23 | 0.05 |
| 5456 | 6961005.42 | 487068.52 | 661.15 | 30B20100918SGR | 661.13 | 0.02 |
| 5457 | 6961019.55 | 487062.55 | 661.48 | 30B20100918SGR | 661.46 | 0.02 |
| 5458 | 6961033.13 | 487056.61 | 662.32 | 30B20100918SGR | 662.34 | -0.02 |
| 5459 | 6961032.96 | 487044.34 | 662.48 | 30B20100918SGR | 662.52 | -0.04 |
| 5460 | 6961018.42 | 487049.27 | 661.52 | 30B20100918SGR | 661.52 | 0.00 |
| 5461 | 6961003.99 | 487054.93 | 660.90 | 30B20100918SGR | 660.90 | 0.00 |
| 5462 | 6960992.71 | 487058.97 | 660.72 | 30B20100918SGR | 660.69 | 0.02 |
| 5463 | 6960983.38 | 487053.47 | 660.38 | 30B20100918SGR | 660.37 | 0.01 |
| 5464 | 6960976.35 | 487054.94 | 660.18 | 30B20100918SGR | 660.25 | -0.07 |
| 5465 | 6960972.89 | 487066.44 | 660.14 | 30B20100918SGR | 660.14 | 0.00 |
| 5466 | 6960983.20 | 487077.25 | 660.62 | 30B20100918SGR | 660.63 | -0.01 |
| 5467 | 6960993.33 | 487088.23 | 661.04 | 30B20100918SGR | 661.04 | 0.00 |
| 5468 | 6961007.49 | 487087.52 | 661.30 | 30B20100918SGR | 661.28 | 0.02 |
| 5469 | 6961735.31 | 486351.90 | 664.88 | 30B20100918SAR | 664.87 | 0.00 |
| 5470 | 6961731.36 | 486351.12 | 664.85 | 30B20100918SAR | 664.81 | 0.04 |
| 5471 | 6961733.35 | 486342.58 | 664.64 | 30B20100918SAR | 664.61 | 0.03 |
| 5472 | 6961737.13 | 486342.88 | 664.63 | 30B20100918SAR | 664.57 | 0.06 |
| 5473 | 6961734.97 | 486356.50 | 664.99 | 30B20100918SAR | 664.99 | 0.00 |
| 5474 | 6961731.57 | 486373.71 | 665.47 | 30B20100918SAR | 665.46 | 0.00 |
| 5500 | 6960807.24 | 487110.76 | 652.36 | 30A2011062830AFAC | 652.40 | -0.04 |
| 5501 | 6960814.20 | 487092.33 | 653.94 | 30A20110628SPR | 653.95 | -0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5502 | 6960869.62 | 487072.84 | 656.07 | 30A20110628SPR | 656.09 | -0.02 |
| 5503 | 6960943.52 | 487047.84 | 659.10 | 30A20110628SPR | 659.09 | 0.01 |
| 5504 | 6960973.22 | 487043.63 | 660.38 | 30A20110628SPR | 660.36 | 0.02 |
| 5505 | 6961062.09 | 487007.62 | 665.28 | 30A20110628SPR | 665.27 | 0.01 |
| 5506 | 6961149.31 | 486977.78 | 669.75 | 30A20110628SPR | 669.73 | 0.02 |
| 5507 | 6961227.08 | 486951.27 | 673.03 | 30A20110628SPR | 673.03 | 0.00 |
| 5508 | 6961358.03 | 486906.75 | 676.91 | 30A20110628SPR | 676.89 | 0.02 |
| 5509 | 6961504.60 | 486843.00 | 679.03 | 30A20110628SPR | 679.02 | 0.01 |
| 5510 | 6961604.14 | 486757.84 | 678.41 | 30A20110628SPR | 678.37 | 0.04 |
| 5511 | 6961661.29 | 486669.80 | 676.43 | 30A20110628SPR | 676.44 | -0.01 |
| 5512 | 6961700.28 | 486552.52 | 672.67 | 30A20110628SPR | 672.68 | -0.01 |
| 5513 | 6961721.86 | 486431.33 | 667.42 | 30A20110628SPR | 667.42 | 0.00 |
| 5514 | 6961721.85 | 486431.34 | 667.43 | 30A20110628SPR | 667.42 | 0.01 |
| 5515 | 6961742.49 | 486312.02 | 664.03 | 30A20110628SPR | 664.00 | 0.03 |
| 5516 | 6961763.10 | 486193.35 | 663.26 | 30A20110628SPR | 663.21 | 0.04 |
| 5517 | 6961788.67 | 486057.99 | 664.78 | 30A20110628SPR | 664.75 | 0.02 |
| 5518 | 6961831.52 | 485950.82 | 665.93 | 30A20110628SPR | 665.92 | 0.01 |
| 5519 | 6961919.39 | 485842.00 | 666.39 | 30A20110628SPR | 666.39 | 0.00 |
| 5520 | 6962024.14 | 485752.88 | 664.75 | 30A20110628SPR | 664.73 | 0.02 |
| 5521 | 6962099.20 | 485689.82 | 662.35 | 30A20110628SPR | 662.35 | 0.00 |
| 5522 | 6962195.79 | 485608.73 | 658.94 | 30A20110628SPR | 658.94 | 0.00 |
| 5523 | 6962294.81 | 485525.93 | 656.75 | 30A20110628SPR | 656.74 | 0.01 |
| 5524 | 6962397.19 | 485440.42 | 655.80 | 30A20110628SPR | 655.83 | -0.03 |
| 5525 | 6962474.59 | 485375.67 | 655.13 | 30A20110628SPR | 655.14 | -0.01 |
| 5526 | 6962546.56 | 485315.53 | 654.92 | 30A20110628SPR | 654.92 | 0.00 |
| 5527 | 6962611.89 | 485261.17 | 656.36 | 30A20110628SPR | 656.36 | 0.00 |
| 5528 | 6962737.75 | 485155.60 | 661.90 | 30A20110628SPR | 661.90 | 0.00 |
| 5529 | 6962833.96 | 485075.08 | 665.11 | 30A20110628SPR | 665.12 | -0.01 |
| 5530 | 6962909.68 | 485011.60 | 666.27 | 30A20110628SPR | 666.28 | -0.01 |
| 5531 | 6963015.88 | 484922.58 | 665.86 | 30A20110628SPR | 665.86 | 0.00 |
| 5532 | 6963150.66 | 484809.76 | 661.90 | 30A20110628SPR | 661.91 | -0.01 |
| 5533 | 6963271.56 | 484708.51 | 655.24 | 30A20110628SPR | 655.26 | -0.02 |
| 5534 | 6963403.26 | 484597.04 | 647.32 | 30A20110628SPR | 647.32 | 0.00 |
| 5535 | 6963509.51 | 484482.29 | 640.96 | 30A20110628SPR | 640.98 | -0.02 |
| 5536 | 6963604.16 | 484331.74 | 636.76 | 30A20110628SPR | 636.80 | -0.04 |
| 5537 | 6963658.15 | 484194.12 | 635.70 | 30A20110628SPR | 635.68 | 0.02 |
| 5538 | 6963704.66 | 484038.27 | 634.63 | 30A20110628SPR | 634.64 | -0.01 |
| 5539 | 6963756.78 | 483922.98 | 633.85 | 30A20110628SPR | 633.88 | -0.03 |
| 5540 | 6963847.00 | 483792.59 | 633.89 | 30A20110628SPR | 633.88 | 0.01 |
| 5541 | 6963951.42 | 483645.72 | 636.50 | 30A20110628SPR | 636.51 | -0.01 |
| 5542 | 6963990.34 | 483591.00 | 636.70 | 30A20110628SPR | 636.69 | 0.01 |
| 5543 | 6964050.82 | 483505.70 | 636.12 | 30A20110628SPR | 636.11 | 0.01 |
| 5544 | 6964173.80 | 483326.62 | 631.57 | 30A20110628SPR | 631.58 | -0.01 |
| 5545 | 6964266.83 | 483103.11 | 622.23 | 30A20110628SPR | 622.26 | -0.03 |
| 5546 | 6964312.63 | 482943.98 | 621.99 | 30A20110628SPR | 622.01 | -0.02 |
| 5547 | 6964345.16 | 482830.83 | 625.21 | 30A20110628SPR | 625.22 | -0.01 |
| 5548 | 6964391.97 | 482683.25 | 629.53 | 30A20110628SPR | 629.53 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5549 | 6964430.86 | 482561.65 | 631.21 | 30A20110628SPR | 631.23 | -0.02 |
| 5550 | 6964470.66 | 482438.71 | 631.08 | 30A20110628SPR | 631.07 | 0.01 |
| 5551 | 6964513.47 | 482308.47 | 628.83 | 30A20110628SPR | 628.80 | 0.03 |
| 5552 | 6964691.09 | 481991.34 | 617.19 | 30A20110628SPR | 617.21 | -0.02 |
| 5553 | 6964833.74 | 481878.28 | 618.31 | 30A20110628SPR | 618.31 | 0.00 |
| 5554 | 6964954.20 | 481813.55 | 620.65 | 30A20110628SPR | 620.66 | -0.01 |
| 5555 | 6965031.18 | 481783.44 | 622.01 | 30A20110628SPR | 622.01 | 0.00 |
| 5556 | 6965139.88 | 481741.44 | 623.90 | 30A20110628SPR | 623.93 | -0.03 |
| 5557 | 6965282.28 | 481685.25 | 625.01 | 30A20110628SPR | 625.04 | -0.03 |
| 5558 | 6965328.46 | 481659.98 | 624.77 | 30A20110628SPR | 624.79 | -0.02 |
| 5559 | 6965384.00 | 481618.57 | 623.74 | 30A20110628SPR | 623.81 | -0.07 |
| 5560 | 6965777.11 | 481140.32 | 615.46 | 30A20110628SPR | 615.47 | -0.01 |
| 5561 | 6965800.38 | 481107.35 | 616.75 | 30A20110628SPR | 616.78 | -0.03 |
| 5562 | 6965842.04 | 481044.69 | 619.97 | 30A20110628SPR | 619.99 | -0.02 |
| 5563 | 6965885.19 | 480974.63 | 624.01 | 30A20110628SPR | 624.05 | -0.04 |
| 5564 | 6965931.89 | 480891.90 | 628.04 | 30A20110628SPR | 628.05 | -0.01 |
| 5565 | 6965972.46 | 480812.56 | 630.77 | 30A20110628SPR | 630.79 | -0.02 |
| 5566 | 6966023.31 | 480709.28 | 632.93 | 30A20110628SPR | 632.96 | -0.03 |
| 5567 | 6966096.77 | 480560.12 | 633.36 | 30A20110628SPR | 633.39 | -0.03 |
| 5568 | 6966139.33 | 480472.86 | 632.14 | 30A20110628SPR | 632.17 | -0.03 |
| 5569 | 6960996.34 | 487082.76 | 661.00 | 30A20110628SGR | 660.99 | 0.01 |
| 5570 | 6961025.32 | 487110.09 | 663.28 | 30A20110628SGR | 663.25 | 0.03 |
| 5571 | 6961050.66 | 487123.17 | 665.20 | 30A20110628SGR | 665.17 | 0.03 |
| 5572 | 6961079.73 | 487133.78 | 666.86 | 30A20110628SGR | 666.84 | 0.02 |
| 5573 | 6961106.18 | 487134.81 | 668.48 | 30A20110628SGR | 668.47 | 0.01 |
| 5574 | 6961130.47 | 487127.70 | 670.28 | 30A20110628SGR | 670.25 | 0.03 |
| 5575 | 6961150.09 | 487119.35 | 672.22 | 30A20110628SGR | 672.24 | -0.02 |
| 5576 | 6961173.35 | 487109.29 | 674.62 | 30A20110628SGR | 674.59 | 0.03 |
| 5577 | 6961195.40 | 487099.87 | 677.04 | 30A20110628SGR | 677.00 | 0.04 |
| 5578 | 6961215.64 | 487091.00 | 679.27 | 30A20110628SGR | 679.26 | 0.01 |
| 5579 | 6961237.71 | 487081.43 | 682.00 | 30A20110628SGR | 681.97 | 0.03 |
| 5580 | 6961264.49 | 487074.41 | 684.62 | 30A20110628SGR | 684.59 | 0.03 |
| 5581 | 6961298.05 | 487069.13 | 687.10 | 30A20110628SGR | 687.10 | 0.00 |
| 5582 | 6961324.73 | 487065.34 | 689.22 | 30A20110628SGR | 689.18 | 0.04 |
| 5583 | 6961349.87 | 487061.66 | 691.14 | 30A20110628SGR | 691.13 | 0.01 |
| 5584 | 6961377.86 | 487058.44 | 693.53 | 30A20110628SGR | 693.50 | 0.03 |
| 5585 | 6961404.83 | 487055.25 | 695.76 | 30A20110628SGR | 695.75 | 0.01 |
| 5586 | 6961445.43 | 487052.09 | 699.40 | 30A20110628SGR | 699.35 | 0.05 |
| 5587 | 6961477.16 | 487050.11 | 702.36 | 30A20110628SGR | 702.33 | 0.03 |
| 5588 | 6961513.18 | 487048.27 | 705.11 | 30A20110628SGR | 705.08 | 0.03 |
| 5589 | 6961539.81 | 487047.67 | 707.01 | 30A20110628SGR | 706.98 | 0.03 |
| 5590 | 6961571.95 | 487047.22 | 709.28 | 30A20110628SGR | 709.26 | 0.02 |
| 5591 | 6961605.51 | 487046.93 | 711.83 | 30A20110628SGR | 711.79 | 0.04 |
| 5592 | 6961631.59 | 487046.27 | 714.06 | 30A20110628SGR | 714.02 | 0.04 |
| 5593 | 6961659.16 | 487045.84 | 716.64 | 30A20110628SGR | 716.59 | 0.05 |
| 5594 | 6961687.64 | 487044.33 | 719.69 | 30A20110628SGR | 719.64 | 0.04 |
| 5595 | 6961716.50 | 487043.49 | 722.68 | 30A20110628SGR | 722.63 | 0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5596 | 6961745.16 | 487042.95 | 725.52 | 30A20110628SGR | 725.50 | 0.02 |
| 5597 | 6961774.86 | 487043.52 | 728.69 | 30A20110628SGR | 728.67 | 0.01 |
| 5598 | 6961801.11 | 487043.23 | 731.37 | 30A20110628SGR | 731.37 | 0.00 |
| 5599 | 6961844.39 | 487064.46 | 732.46 | 30A20110628SGR | 732.44 | 0.02 |
| 5600 | 6961906.29 | 487107.43 | 733.41 | 30A20110628SGR | 733.42 | -0.01 |
| 5601 | 6961928.16 | 487040.93 | 734.71 | 30A20110628SGR | 734.72 | -0.01 |
| 5602 | 6961915.35 | 486963.08 | 733.67 | 30A20110628SGR | 733.67 | 0.00 |
| 5603 | 6961968.12 | 487029.83 | 735.54 | 30A20110628SGR | 735.55 | -0.01 |
| 5604 | 6962096.34 | 487024.84 | 749.53 | 30A20110628SGR | 749.55 | -0.02 |
| 5605 | 6962083.46 | 486979.60 | 750.55 | 30A20110628SGR | 750.56 | -0.01 |
| 5606 | 6962062.75 | 486945.73 | 753.62 | 30A20110628SGR | 753.63 | -0.01 |
| 5607 | 6962048.34 | 486933.38 | 753.86 | 30A20110628SGR | 753.85 | 0.01 |
| 5608 | 6961969.29 | 487141.37 | 734.46 | 30A20110628SGR | 734.46 | 0.00 |
| 5609 | 6961963.90 | 487137.88 | 734.32 | 30A20110628SGR | 734.31 | 0.01 |
| 5610 | 6961965.29 | 487146.70 | 734.21 | 30A20110628SGR | 734.23 | -0.02 |
| 5611 | 6961786.49 | 487076.66 | 725.13 | 30A20110628SGR | 725.15 | -0.02 |
| 5612 | 6961777.73 | 487067.37 | 725.14 | 30A20110628SGR | 725.17 | -0.03 |
| 5613 | 6961766.63 | 487056.68 | 725.53 | 30A20110628SGR | 725.53 | 0.00 |
| 5614 | 6960934.58 | 487046.85 | 658.74 | 30A20110628SPR | 658.74 | 0.00 |
| 5615 | 6960842.39 | 487078.22 | 654.94 | 30A20110628SPR | 654.94 | 0.00 |
| 5616 | 6960797.39 | 487093.93 | 653.49 | 30A20110628SPR | 653.49 | 0.00 |
| 5617 | 6960713.87 | 487121.91 | 651.07 | 30A20110628SPR | 651.08 | -0.01 |
| 5618 | 6960636.74 | 487151.72 | 649.36 | 30A20110628SPR | 649.34 | 0.02 |
| 5619 | 6960538.42 | 487201.26 | 647.48 | 30A20110628SPR | 647.47 | 0.01 |
| 5620 | 6960441.17 | 487267.28 | 645.61 | 30A20110628SPR | 645.58 | 0.02 |
| 5621 | 6960367.03 | 487320.45 | 644.24 | 30A20110628SPR | 644.23 | 0.01 |
| 5622 | 6960287.00 | 487378.08 | 642.85 | 30A20110628SPR | 642.84 | 0.01 |
| 5623 | 6960219.00 | 487427.45 | 641.70 | 30A20110628SPR | 641.65 | 0.05 |
| 5624 | 6960146.27 | 487479.01 | 640.49 | 30A20110628SPR | 640.47 | 0.02 |
| 5625 | 6959869.64 | 487680.07 | 635.78 | 30A20110628SPR | 635.79 | -0.01 |
| 5626 | 6959804.88 | 487732.89 | 634.47 | 30A20110628SPR | 634.47 | 0.00 |
| 5627 | 6959728.87 | 487799.93 | 632.94 | 30A20110628SPR | 632.93 | 0.01 |
| 5628 | 6959627.23 | 487890.35 | 631.11 | 30A20110628SPR | 631.11 | 0.00 |
| 5629 | 6959542.53 | 487965.91 | 631.25 | 30A20110628SPR | 631.26 | -0.01 |
| 5630 | 6959475.78 | 488024.93 | 631.92 | 30A20110628SPR | 631.93 | -0.01 |
| 5631 | 6959387.78 | 488103.35 | 632.28 | 30A20110628SPR | 632.26 | 0.02 |
| 5632 | 6959314.78 | 488168.66 | 631.76 | 30A20110628SPR | 631.72 | 0.03 |
| 5633 | 6959213.46 | 488258.46 | 629.49 | 30A20110628SPR | 629.50 | -0.01 |
| 5634 | 6959145.34 | 488319.29 | 627.71 | 30A20110628SPR | 627.70 | 0.01 |
| 5635 | 6959147.10 | 488327.36 | 627.56 | 30A20110628CK_PK | 627.52 | 0.04 |
| 5636 | 6958999.36 | 488449.31 | 627.17 | 30A20110628SPR | 627.14 | 0.02 |
| 5637 | 6958888.86 | 488547.85 | 632.37 | 30A20110628SPR | 632.36 | 0.01 |
| 5638 | 6958783.18 | 488642.28 | 635.87 | 30A20110628SPR | 635.85 | 0.02 |
| 5639 | 6958724.17 | 488694.99 | 636.91 | 30A20110628SPR | 636.89 | 0.02 |
| 5640 | 6958612.14 | 488795.05 | 636.98 | 30A20110628SPR | 636.99 | -0.01 |
| 5641 | 6958465.24 | 488925.44 | 636.54 | 30A20110628SPR | 636.54 | 0.00 |
| 5642 | 6958371.59 | 489013.86 | 639.02 | 30A20110628SPR | 639.02 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5643 | 6958240.54 | 489147.65 | 643.96 | 30A20110628SPR | 643.94 | 0.02 |
| 5644 | 6958131.87 | 489263.98 | 645.43 | 30A20110628SPR | 645.40 | 0.03 |
| 5645 | 6958021.53 | 489374.94 | 644.61 | 30A20110628SPR | 644.60 | 0.01 |
| 5646 | 6957850.91 | 489458.62 | 642.73 | 30A20110628SPR | 642.71 | 0.02 |
| 5647 | 6957669.50 | 489470.30 | 640.84 | 30A20110628SPR | 640.79 | 0.05 |
| 5648 | 6957531.19 | 489471.08 | 638.30 | 30A20110628SPR | 638.29 | 0.01 |
| 5649 | 6957339.29 | 489473.37 | 632.49 | 30A20110628SPR | 632.46 | 0.03 |
| 5650 | 6957168.00 | 489480.53 | 626.51 | 30A20110628SPR | 626.51 | 0.00 |
| 5651 | 6956906.11 | 489497.99 | 621.68 | 30A20110628SPR | 621.65 | 0.03 |
| 5652 | 6956765.94 | 489512.62 | 620.94 | 30A20110628SPR | 620.93 | 0.01 |
| 5653 | 6956715.47 | 489520.73 | 620.47 | 30A20110628SPR | 620.45 | 0.02 |
| 5654 | 6956701.13 | 489497.53 | 619.26 | 30A20110628SPR | 619.26 | 0.00 |
| 5655 | 6956665.13 | 489470.87 | 618.04 | 30A20110628SGR | 618.04 | 0.00 |
| 5656 | 6956565.92 | 489410.02 | 615.71 | 30A20110628SGR | 615.67 | 0.04 |
| 5657 | 6956442.38 | 489334.00 | 612.78 | 30A20110628SGR | 612.74 | 0.03 |
| 5658 | 6956273.00 | 489251.05 | 608.29 | 30A20110628SGR | 608.31 | -0.02 |
| 5659 | 6956205.38 | 489254.91 | 607.62 | 30A20110628SGR | 607.59 | 0.03 |
| 5660 | 6956625.01 | 489539.43 | 619.74 | 30A20110628SPR | 619.73 | 0.01 |
| 5661 | 6956365.50 | 489622.27 | 616.47 | 30A20110628SPR | 616.46 | 0.01 |
| 5662 | 6956177.61 | 489711.60 | 616.47 | 30A20110628SPR | 616.46 | 0.01 |
| 5663 | 6956013.91 | 489815.10 | 622.15 | 30A20110628SPR | 622.16 | -0.01 |
| 5666 | 6955837.10 | 489958.57 | 630.26 | 30A20110628SPR | 630.28 | -0.02 |
| 5667 | 6955661.05 | 490122.87 | 638.35 | 30A20110628SPR | 638.34 | 0.01 |
| 5668 | 6955509.98 | 490264.00 | 648.31 | 30A20110628SPR | 648.28 | 0.02 |
| 5669 | 6955389.57 | 490376.39 | 655.40 | 30A20110628SPR | 655.40 | 0.00 |
| 5670 | 6955390.58 | 490377.76 | 655.43 | 30A20110628MON_CASE | 655.43 | 0.00 |
| 5671 | 6955268.22 | 490489.79 | 661.74 | 30A20110628SPR | 661.72 | 0.02 |
| 5672 | 6955142.43 | 490597.21 | 668.37 | 30A20110628SPR | 668.36 | 0.01 |
| 5673 | 6955017.45 | 490666.59 | 673.71 | 30A20110628SPR | 673.69 | 0.02 |
| 5674 | 6954797.77 | 490736.53 | 682.63 | 30A20110628SPR | 682.60 | 0.02 |
| 5675 | 6954803.52 | 490749.11 | 682.89 | 30A20110628SPR | 682.90 | -0.01 |
| 5676 | 6954820.32 | 490755.21 | 682.82 | 30A20110628SPR | 682.83 | -0.01 |
| 5677 | 6954843.54 | 490754.40 | 681.98 | 30A20110628SPR | 681.99 | -0.01 |
| 5678 | 6954869.53 | 490753.23 | 680.92 | 30A20110628SPR | 680.93 | -0.01 |
| 5679 | 6954900.15 | 490747.82 | 679.65 | 30A20110628SPR | 679.65 | 0.00 |
| 5680 | 6954925.34 | 490740.53 | 678.60 | 30A20110628SPR | 678.60 | 0.00 |
| 5681 | 6954952.17 | 490731.03 | 677.44 | 30A20110628SPR | 677.44 | 0.00 |
| 5682 | 6954978.00 | 490720.55 | 676.33 | 30A20110628SPR | 676.30 | 0.03 |
| 5683 | 6954997.93 | 490712.00 | 675.50 | 30A20110628SPR | 675.49 | 0.01 |
| 5684 | 6955005.88 | 490697.39 | 675.04 | 30A20110628SPR | 675.04 | 0.00 |
| 5685 | 6955002.48 | 490684.01 | 674.98 | 30A20110628SPR | 674.94 | 0.04 |
| 5686 | 6954998.08 | 490674.62 | 674.50 | 30A20110628SPR | 674.48 | 0.02 |
| 5687 | 6954953.00 | 490690.49 | 676.28 | 30A20110628SPR | 676.31 | -0.03 |
| 5688 | 6954915.82 | 490701.22 | 677.79 | 30A20110628SPR | 677.79 | 0.00 |
| 5689 | 6954874.74 | 490709.95 | 679.37 | 30A20110628SPR | 679.41 | -0.04 |
| 5690 | 6954847.64 | 490716.70 | 680.61 | 30A20110628MON_CASE | 680.60 | 0.01 |
| 5691 | 6954826.27 | 490717.67 | 681.33 | 30A20110628SPR | 681.35 | -0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5692 | 6954796.45 | 490722.35 | 682.41 | 30A20110628SPR | 682.46 | -0.05 |
| 5693 | 6954681.56 | 490739.40 | 686.15 | 30A20110628SPR | 686.15 | 0.00 |
| 5694 | 6954538.11 | 490761.10 | 687.49 | 30A20110628SPR | 687.46 | 0.03 |
| 5695 | 6954357.40 | 490788.47 | 683.84 | 30A20110628SPR | 683.85 | -0.01 |
| 5696 | 6954158.10 | 490817.20 | 673.72 | 30A20110628SPR | 673.73 | -0.01 |
| 5697 | 6953852.39 | 490616.44 | 651.16 | 30A20110628SPR | 651.14 | 0.02 |
| 5698 | 6953563.36 | 490518.92 | 631.79 | 30A20110628SPR | 631.76 | 0.02 |
| 5699 | 6953396.56 | 490623.46 | 629.69 | 30A20110628SPR | 629.68 | 0.01 |
| 5700 | 6953313.97 | 490801.78 | 627.43 | 30A20110628SPR | 627.40 | 0.03 |
| 5701 | 6953249.16 | 490970.84 | 624.40 | 30A20110628SPR | 624.40 | 0.00 |
| 5702 | 6953180.55 | 491151.35 | 621.95 | 30A20110628SPR | 621.96 | -0.01 |
| 5703 | 6953135.92 | 491267.86 | 621.62 | 30A20110628SPR | 621.65 | -0.03 |
| 5704 | 6953101.02 | 491359.93 | 622.11 | 30A20110628SPR | 622.10 | 0.01 |
| 5705 | 6953089.35 | 491357.92 | 621.81 | 30A20110628SPR | 621.82 | -0.02 |
| 5706 | 6953081.62 | 491356.89 | 621.69 | 30A20110628SGR | 621.73 | -0.04 |
| 5707 | 6953029.48 | 491392.65 | 627.15 | 30A20110628SGR | 627.17 | -0.02 |
| 5708 | 6953001.40 | 491467.53 | 635.35 | 30A20110628SGR | 635.32 | 0.03 |
| 5709 | 6952955.66 | 491535.72 | 643.69 | 30A20110628SGR | 643.70 | -0.01 |
| 5710 | 6952880.91 | 491594.68 | 653.01 | 30A20110628SGR | 653.02 | -0.01 |
| 5711 | 6952813.61 | 491649.03 | 661.67 | 30A20110628SGR | 661.67 | 0.00 |
| 5712 | 6952733.43 | 491726.63 | 672.83 | 30A20110628SGR | 672.78 | 0.05 |
| 5713 | 6952689.57 | 491813.27 | 682.60 | 30A20110628SGR | 682.58 | 0.02 |
| 5714 | 6952672.74 | 491884.77 | 687.95 | 30A20110628SGR | 687.92 | 0.03 |
| 5715 | 6952640.10 | 491953.75 | 688.49 | 30A20110628SGR | 688.46 | 0.03 |
| 5716 | 6952619.52 | 492023.98 | 686.01 | 30A20110628SGR | 685.99 | 0.02 |
| 5717 | 6952596.76 | 492078.76 | 681.76 | 30A20110628SGR | 681.74 | 0.02 |
| 5718 | 6952560.41 | 492152.12 | 671.62 | 30A20110628SGR | 671.58 | 0.04 |
| 5719 | 6952516.99 | 492210.51 | 664.18 | 30A20110628SGR | 664.12 | 0.06 |
| 5720 | 6952437.68 | 492282.13 | 650.66 | 30A20110628SGR | 650.67 | -0.01 |
| 5721 | 6953074.66 | 491427.24 | 622.33 | 30A20110628SPR | 622.34 | -0.01 |
| 5722 | 6952993.54 | 491639.93 | 622.58 | 30A20110628SPR | 622.64 | -0.06 |
| 5723 | 6952903.98 | 491873.58 | 620.90 | 30A20110628SPR | 620.93 | -0.03 |
| 5724 | 6952814.20 | 492109.45 | 624.81 | 30A20110628SPR | 624.85 | -0.04 |
| 5725 | 6952763.10 | 492227.65 | 624.14 | 30A20110628SPR | 624.17 | -0.03 |
| 5726 | 6952675.33 | 492348.46 | 620.46 | 30A20110628SPR | 620.53 | -0.07 |
| 5727 | 6952535.95 | 492464.05 | 616.09 | 30A20110628SPR | 616.09 | 0.00 |
| 5728 | 6952368.76 | 492591.68 | 609.68 | 30A20110628SPR | 609.74 | -0.06 |
| 5729 | 6952274.08 | 492663.99 | 606.02 | 30A20110628SPR | 606.07 | -0.05 |
| 5730 | 6952044.82 | 492796.83 | 594.86 | 30A20110628SPR | 594.90 | -0.04 |
| 5731 | 6951869.57 | 492880.26 | 594.61 | 30A20110628SPR | 594.61 | 0.00 |
| 5732 | 6951713.08 | 492946.41 | 602.50 | 30A20110628SPR | 602.50 | 0.00 |
| 5733 | 6951529.65 | 492953.58 | 613.50 | 30A20110628SPR | 613.54 | -0.04 |
| 5734 | 6951351.87 | 492892.71 | 624.27 | 30A20110628SPR | 624.28 | -0.01 |
| 5735 | 6951225.43 | 492840.24 | 632.36 | 30A20110628SPR | 632.35 | 0.01 |
| 5736 | 6951133.42 | 492826.08 | 638.46 | 30A20110628SPR | 638.44 | 0.01 |
| 5737 | 6950986.28 | 492881.80 | 646.85 | 30A20110628SPR | 646.83 | 0.01 |
| 5738 | 6950887.51 | 493147.62 | 652.61 | 30A20110628SPR | 652.64 | -0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5739 | 6950874.75 | 493292.35 | 652.41 | 30A20110628SPR | 652.44 | -0.03 |
| 5740 | 6950691.34 | 493489.17 | 650.69 | 30A20110628SPR | 650.69 | 0.00 |
| 5741 | 6950646.81 | 493508.08 | 650.35 | 30A20110628SPR | 650.37 | -0.02 |
| 5742 | 6950596.87 | 493535.98 | 650.15 | 30A20110628SPR | 650.14 | 0.01 |
| 5743 | 6950598.55 | 493538.08 | 650.02 | 30A20110628SPR | 649.99 | 0.02 |
| 5744 | 6950498.25 | 493612.90 | 649.52 | 30A20110628SPR | 649.51 | 0.00 |
| 5745 | 6950477.01 | 493635.26 | 649.97 | 30A20110628SPR | 649.94 | 0.03 |
| 5746 | 6950269.51 | 493670.33 | 653.28 | 30A20110628SPR | 653.25 | 0.03 |
| 5747 | 6950143.35 | 493709.42 | 657.38 | 30A20110628SPR | 657.36 | 0.02 |
| 5748 | 6950012.86 | 493828.40 | 661.42 | 30A20110628SPR | 661.43 | -0.01 |
| 5749 | 6950041.09 | 494635.13 | 653.64 | 30A20110628SPR | 653.65 | -0.01 |
| 5750 | 6950041.08 | 494635.11 | 653.64 | 30A20110628SPR | 653.65 | -0.01 |
| 5751 | 6950036.72 | 494650.72 | 653.52 | 30A20110628SPR | 653.52 | 0.00 |
| 5752 | 6950035.37 | 494667.38 | 653.41 | 30A20110628SPR | 653.43 | -0.02 |
| 5753 | 6950048.26 | 494720.49 | 653.02 | 30A20110628SPR | 653.06 | -0.04 |
| 5754 | 6948043.01 | 497079.54 | 562.10 | 30A20110628SPR | 562.15 | -0.05 |
| 5755 | 6948006.07 | 497074.95 | 562.17 | 30A20110628SPR | 562.20 | -0.03 |
| 5756 | 6947920.51 | 497053.15 | 562.00 | 30A20110628SPR | 562.03 | -0.03 |
| 5757 | 6947877.82 | 497045.37 | 562.03 | 30A20110628SPR | 562.05 | -0.02 |
| 5758 | 6946794.60 | 497519.84 | 562.76 | 30A20110628SPR | 562.79 | -0.03 |
| 5759 | 6946794.60 | 497519.84 | 562.76 | 30A20110628SPR | 562.79 | -0.03 |
| 5760 | 6946800.31 | 497513.08 | 562.77 | 30A20110628SPR | 562.81 | -0.04 |
| 5761 | 6946808.09 | 497504.78 | 562.78 | 30A20110628SPR | 562.80 | -0.02 |
| 5762 | 6946813.93 | 497509.46 | 562.63 | 30A20110628SPR | 562.70 | -0.07 |
| 5763 | 6946805.44 | 497518.58 | 562.64 | 30A20110628SPR | 562.66 | -0.02 |
| 5764 | 6946781.64 | 497536.32 | 562.71 | 30A20110628SPR | 562.77 | -0.06 |
| 5765 | 6946786.68 | 497539.99 | 562.52 | 30A20110628SPR | 562.66 | -0.14 |
| 5766 | 6960806.74 | 487113.74 | 652.35 | 30A20110628CK_SPIKE | 652.32 | 0.03 |
| 5800 | 6943345.38 | 499539.49 | 588.91 | 30C2011062830CFAC | 588.90 | 0.01 |
| 5801 | 6943299.54 | 499587.38 | 590.07 | 30C20110628SGR | 590.04 | 0.03 |
| 5802 | 6943277.91 | 499615.91 | 590.66 | 30C20110628SGR | 590.67 | -0.01 |
| 5803 | 6943248.71 | 499648.59 | 590.96 | 30C20110628SGR | 590.95 | 0.01 |
| 5804 | 6943217.54 | 499674.02 | 590.82 | 30C20110628SGR | 590.80 | 0.02 |
| 5805 | 6943179.55 | 499697.84 | 590.19 | 30C20110628SGR | 590.19 | 0.00 |
| 5806 | 6943143.48 | 499716.86 | 589.00 | 30C20110628SGR | 589.01 | -0.01 |
| 5807 | 6943104.87 | 499733.69 | 587.50 | 30C20110628SGR | 587.48 | 0.02 |
| 5808 | 6943069.60 | 499748.97 | 586.05 | 30C20110628SGR | 586.06 | -0.01 |
| 5809 | 6943032.16 | 499765.72 | 584.23 | 30C20110628SGR | 584.24 | -0.01 |
| 5810 | 6943000.78 | 499779.68 | 582.50 | 30C20110628SGR | 582.48 | 0.02 |
| 5811 | 6942968.49 | 499793.94 | 580.76 | 30C20110628SGR | 580.75 | 0.01 |
| 5812 | 6942936.15 | 499808.47 | 579.03 | 30C20110628SGR | 579.04 | -0.01 |
| 5813 | 6942910.11 | 499819.88 | 577.63 | 30C20110628SGR | 577.60 | 0.02 |
| 5814 | 6942881.47 | 499832.77 | 575.97 | 30C20110628SGR | 575.96 | 0.01 |
| 5815 | 6942850.90 | 499846.40 | 574.23 | 30C20110628SGR | 574.23 | 0.00 |
| 5816 | 6942826.20 | 499857.94 | 572.91 | 30C20110628SGR | 572.91 | 0.00 |
| 5817 | 6942802.80 | 499869.69 | 571.57 | 30C20110628SGR | 571.56 | 0.01 |
| 5818 | 6942780.76 | 499882.47 | 570.33 | 30C20110628SGR | 570.30 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5819 | 6942746.15 | 499905.60 | 568.82 | 30C20110628SGR | 568.79 | 0.03 |
| 5820 | 6942728.73 | 499919.88 | 567.87 | 30C20110628SGR | 567.87 | 0.00 |
| 5821 | 6942727.02 | 499926.54 | 567.48 | 30C20110628SGR | 567.46 | 0.02 |
| 5822 | 6942720.79 | 499926.74 | 567.52 | 30C20110628SGR | 567.53 | -0.01 |
| 5825 | 6942739.34 | 499915.94 | 568.09 | 30C20110628SGR | 568.09 | 0.00 |
| 5826 | 6942720.23 | 499917.41 | 567.82 | 30C20110628SGR | 567.80 | 0.02 |
| 5827 | 6942722.74 | 499900.76 | 567.47 | 30C20110628SGR | 567.47 | 0.00 |
| 5828 | 6942735.25 | 499888.09 | 568.04 | 30C20110628SGR | 568.05 | -0.01 |
| 5829 | 6942751.75 | 499877.39 | 568.90 | 30C20110628SGR | 568.90 | 0.00 |
| 5830 | 6942764.86 | 499868.66 | 569.56 | 30C20110628SGR | 569.58 | -0.02 |
| 5831 | 6942780.12 | 499860.97 | 570.48 | 30C20110628SGR | 570.49 | -0.01 |
| 5832 | 6942792.81 | 499865.28 | 571.29 | 30C20110628SGR | 571.28 | 0.01 |
| 5833 | 6942770.74 | 499893.60 | 569.54 | 30C20110628SGR | 569.51 | 0.03 |
| 5834 | 6942797.01 | 499877.69 | 570.84 | 30C20110628SGR | 570.82 | 0.02 |
| 5835 | 6942820.77 | 499864.76 | 572.35 | 30C20110628SGR | 572.34 | 0.01 |
| 5836 | 6942840.58 | 499855.33 | 573.51 | 30C20110628SGR | 573.46 | 0.05 |
| 5837 | 6942866.25 | 499843.97 | 574.99 | 30C20110628SGR | 574.95 | 0.04 |
| 5838 | 6942893.43 | 499831.89 | 576.54 | 30C20110628SGR | 576.52 | 0.02 |
| 5839 | 6942928.33 | 499816.34 | 578.53 | 30C20110628SGR | 578.50 | 0.03 |
| 5840 | 6942960.48 | 499801.93 | 580.25 | 30C20110628SGR | 580.22 | 0.03 |
| 5841 | 6942987.21 | 499790.01 | 581.68 | 30C20110628SGR | 581.67 | 0.01 |
| 5842 | 6943027.49 | 499771.77 | 583.93 | 30C20110628SGR | 583.90 | 0.03 |
| 5843 | 6943066.83 | 499754.42 | 585.85 | 30C20110628SGR | 585.86 | -0.01 |
| 5844 | 6943103.92 | 499738.51 | 587.45 | 30C20110628SGR | 587.45 | 0.00 |
| 5845 | 6943132.83 | 499725.87 | 588.63 | 30C20110628SGR | 588.64 | -0.01 |
| 5846 | 6943166.67 | 499709.68 | 589.96 | 30C20110628SGR | 589.97 | -0.01 |
| 5847 | 6943197.46 | 499691.89 | 590.74 | 30C20110628SGR | 590.74 | 0.00 |
| 5848 | 6943226.09 | 499673.01 | 591.03 | 30C20110628SGR | 590.99 | 0.04 |
| 5849 | 6943247.63 | 499658.90 | 591.28 | 30C20110628SGR | 591.26 | 0.02 |
| 5850 | 6943270.26 | 499649.48 | 591.19 | 30C20110628SGR | 591.16 | 0.03 |
| 5851 | 6943284.72 | 499641.30 | 590.99 | 30C20110628SGR | 590.99 | 0.00 |
| 5852 | 6943337.89 | 499552.19 | 589.33 | 30C20110628CK_PK | 589.32 | 0.01 |
| 5853 | 6946777.57 | 497540.98 | 562.71 | 30C20110628SPR | 562.71 | 0.00 |
| 5854 | 6946805.06 | 497508.35 | 562.82 | 30C20110628SPR | 562.81 | 0.01 |
| 5855 | 6946843.07 | 497485.50 | 562.36 | 30C20110628SPR | 562.37 | -0.01 |
| 5856 | 6946943.00 | 497409.34 | 562.19 | 30C20110628SPR | 562.20 | -0.01 |
| 5857 | 6947139.71 | 497297.33 | 561.83 | 30C20110628SPR | 561.88 | -0.05 |
| 5858 | 6947283.53 | 497215.60 | 561.82 | 30C20110628SPR | 561.86 | -0.04 |
| 5859 | 6947422.05 | 497137.17 | 561.93 | 30C20110628SPR | 561.95 | -0.02 |
| 5860 | 6947560.34 | 497075.14 | 561.86 | 30C20110628SPR | 561.88 | -0.02 |
| 5861 | 6947757.13 | 497041.13 | 561.52 | 30C20110628SPR | 561.51 | 0.01 |
| 5862 | 6947939.27 | 497061.75 | 561.87 | 30C20110628SPR | 561.89 | -0.02 |
| 5863 | 6948096.87 | 497103.33 | 562.38 | 30C20110628SPR | 562.37 | 0.01 |
| 5864 | 6948243.53 | 497134.55 | 562.77 | 30C20110628SPR | 562.74 | 0.03 |
| 5865 | 6948389.76 | 497127.12 | 563.11 | 30C20110628SPR | 563.13 | -0.02 |
| 5866 | 6948499.86 | 497089.63 | 563.22 | 30C20110628SPR | 563.22 | 0.00 |
| 5867 | 6948623.02 | 497029.76 | 563.72 | 30C20110628SPR | 563.73 | -0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5868 | 6948737.55 | 496945.83 | 567.21 | 30C20110628SPR | 567.23 | -0.02 |
| 5869 | 6948799.92 | 496847.06 | 571.01 | 30C20110628SPR | 571.03 | -0.02 |
| 5870 | 6948851.39 | 496705.74 | 575.27 | 30C20110628SPR | 575.26 | 0.01 |
| 5871 | 6948909.20 | 496558.45 | 580.29 | 30C20110628SPR | 580.30 | -0.01 |
| 5872 | 6949019.13 | 496383.32 | 585.25 | 30C20110628SPR | 585.23 | 0.02 |
| 5873 | 6949124.12 | 496229.40 | 590.14 | 30C20110628SPR | 590.19 | -0.05 |
| 5874 | 6949221.60 | 496065.26 | 595.04 | 30C20110628SPR | 595.08 | -0.04 |
| 5875 | 6949304.69 | 495915.87 | 600.87 | 30C20110628SPR | 600.85 | 0.02 |
| 5876 | 6949394.51 | 495753.04 | 607.93 | 30C20110628SPR | 607.95 | -0.02 |
| 5877 | 6949452.90 | 495610.06 | 613.47 | 30C20110628SPR | 613.48 | -0.01 |
| 5878 | 6949503.63 | 495446.69 | 619.66 | 30C20110628SPR | 619.73 | -0.08 |
| 5879 | 6949559.31 | 495324.68 | 624.69 | 30C20110628SPR | 624.76 | -0.07 |
| 5880 | 6949637.89 | 495221.71 | 629.45 | 30C20110628SPR | 629.46 | -0.01 |
| 5881 | 6949746.48 | 495115.98 | 634.61 | 30C20110628SPR | 634.62 | -0.01 |
| 5882 | 6949846.89 | 495018.41 | 639.95 | 30C20110628SPR | 639.95 | 0.00 |
| 5883 | 6949953.57 | 494913.60 | 645.84 | 30C20110628SPR | 645.87 | -0.03 |
| 5884 | 6950017.47 | 494826.97 | 649.77 | 30C20110628SPR | 649.83 | -0.06 |
| 5885 | 6950060.17 | 494720.81 | 653.81 | 30C20110628SPR | 653.86 | -0.05 |
| 5886 | 6950073.93 | 494605.54 | 655.49 | 30C20110628SPR | 655.49 | 0.00 |
| 5887 | 6950051.52 | 494463.51 | 654.68 | 30C20110628SPR | 654.67 | 0.01 |
| 5888 | 6950014.06 | 494300.70 | 653.72 | 30C20110628SPR | 653.76 | -0.04 |
| 5889 | 6949981.10 | 494156.56 | 655.17 | 30C20110628SPR | 655.19 | -0.02 |
| 5890 | 6949959.71 | 494045.04 | 657.72 | 30C20110628SPR | 657.79 | -0.07 |
| 5891 | 6949975.81 | 493913.35 | 660.91 | 30C20110628SPR | 660.95 | -0.04 |
| 5892 | 6950043.35 | 493793.71 | 660.71 | 30C20110628SPR | 660.71 | 0.00 |
| 5893 | 6950207.05 | 493686.80 | 654.85 | 30C20110628SPR | 654.91 | -0.06 |
| 5894 | 6950387.84 | 493666.60 | 650.81 | 30C20110628SPR | 650.85 | -0.04 |
| 5895 | 6950524.38 | 493609.20 | 650.24 | 30C20110628SPR | 650.32 | -0.08 |
| 5896 | 6950621.89 | 493526.16 | 649.91 | 30C20110628SPR | 650.00 | -0.09 |
| 5897 | 6950773.31 | 493449.28 | 651.48 | 30C20110628SPR | 651.51 | -0.03 |
| 5898 | 6950867.90 | 493323.88 | 652.30 | 30C20110628SPR | 652.30 | 0.00 |
| 5899 | 6950887.99 | 493224.58 | 652.72 | 30C20110628SPR | 652.71 | 0.01 |
| 5900 | 6950893.25 | 493092.38 | 652.73 | 30C20110628SPR | 652.70 | 0.03 |
| 5901 | 6950905.96 | 493004.47 | 651.73 | 30C20110628SPR | 651.72 | 0.01 |
| 5902 | 6950762.29 | 492763.95 | 658.51 | 30C20110628SGR | 658.48 | 0.03 |
| 5903 | 6950736.79 | 492816.57 | 659.81 | 30C20110628SGR | 659.82 | -0.01 |
| 5904 | 6950787.92 | 492836.33 | 660.58 | 30C20110628SGR | 660.55 | 0.03 |
| 5905 | 6950723.82 | 492847.10 | 660.77 | 30C20110628SGR | 660.72 | 0.05 |
| 5906 | 6950721.25 | 492901.45 | 660.15 | 30C20110628SGR | 660.03 | 0.12 |
| 5907 | 6950746.37 | 492949.49 | 658.66 | 30C20110628SGR | 658.59 | 0.07 |
| 5908 | 6950766.59 | 492976.16 | 657.92 | 30C20110628SGR | 657.89 | 0.02 |
| 5909 | 6949105.71 | 496477.08 | 598.94 | 30C20110628SGR | 598.96 | -0.02 |
| 5910 | 6949088.02 | 496474.32 | 598.34 | 30C20110628SGR | 598.36 | -0.02 |
| 5911 | 6949069.47 | 496459.35 | 597.82 | 30C20110628SGR | 597.84 | -0.02 |
| 5912 | 6949068.73 | 496480.13 | 597.69 | 30C20110628SGR | 597.72 | -0.03 |
| 5913 | 6949090.75 | 496493.04 | 598.44 | 30C20110628SGR | 598.49 | -0.05 |
| 5914 | 6948972.85 | 496557.54 | 584.32 | 30C20110628SGR | 584.33 | -0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5915 | 6948997.05 | 496564.87 | 584.81 | 30C20110628SGR | 584.80 | 0.01 |
| 5916 | 6943400.99 | 499340.67 | 579.82 | 0C20110628FAC_DOT_AK_122 | 579.77 | 0.05 |
| 5917 | 6943337.87 | 499552.18 | 589.34 | 30C20110628CK_PK | 589.32 | 0.02 |
| 5918 | 6943337.87 | 499552.18 | 589.32 | 30C20110628CK_PK | 589.32 | 0.00 |

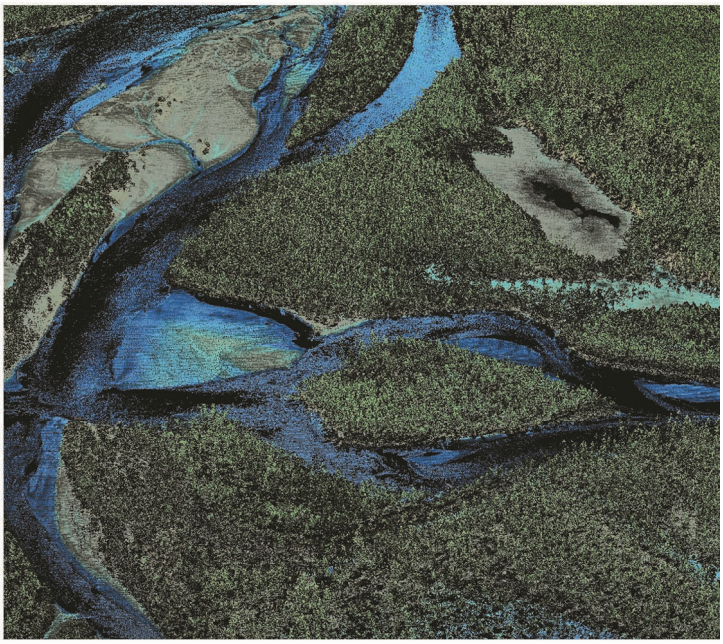
# LiDAR REMOTE SENSING

## ALASKA PIPELINE • ALASKA

(Delivery 9– 12/20/2011)








## ALASKA DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

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# LiDAR Remote Sensing Data Collection:

## Alaska Pipeline, AK

### Delivery 9

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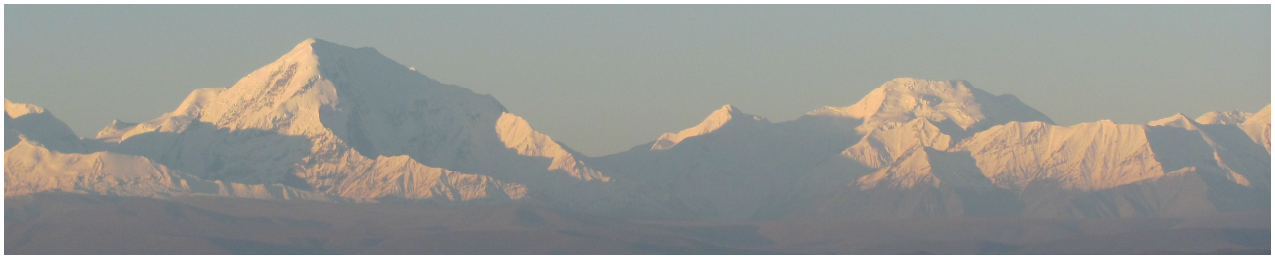
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# 1. Overview

Watershed Sciences, Inc. (WS) collected Light Detection and Ranging (LiDAR) data of the Alaska Pipeline for the Alaska Department of Natural Resources. LiDAR data for Delivery 9 was collected between September 17th and 23rd, 2010 and May 17th through June 27th (**Figure 1**). Delivery 9 includes 167,164 acres within the requested area. This area was expanded to include a 100m buffer to ensure complete coverage and adequate point densities around survey boundaries, resulting in 176,783 acres of delivered data covering Delta Junction south along Richardson Hwy (4) to Sourdough Creek.

***Figure 1***. *Alaska Pipeline survey delivery status overview.*

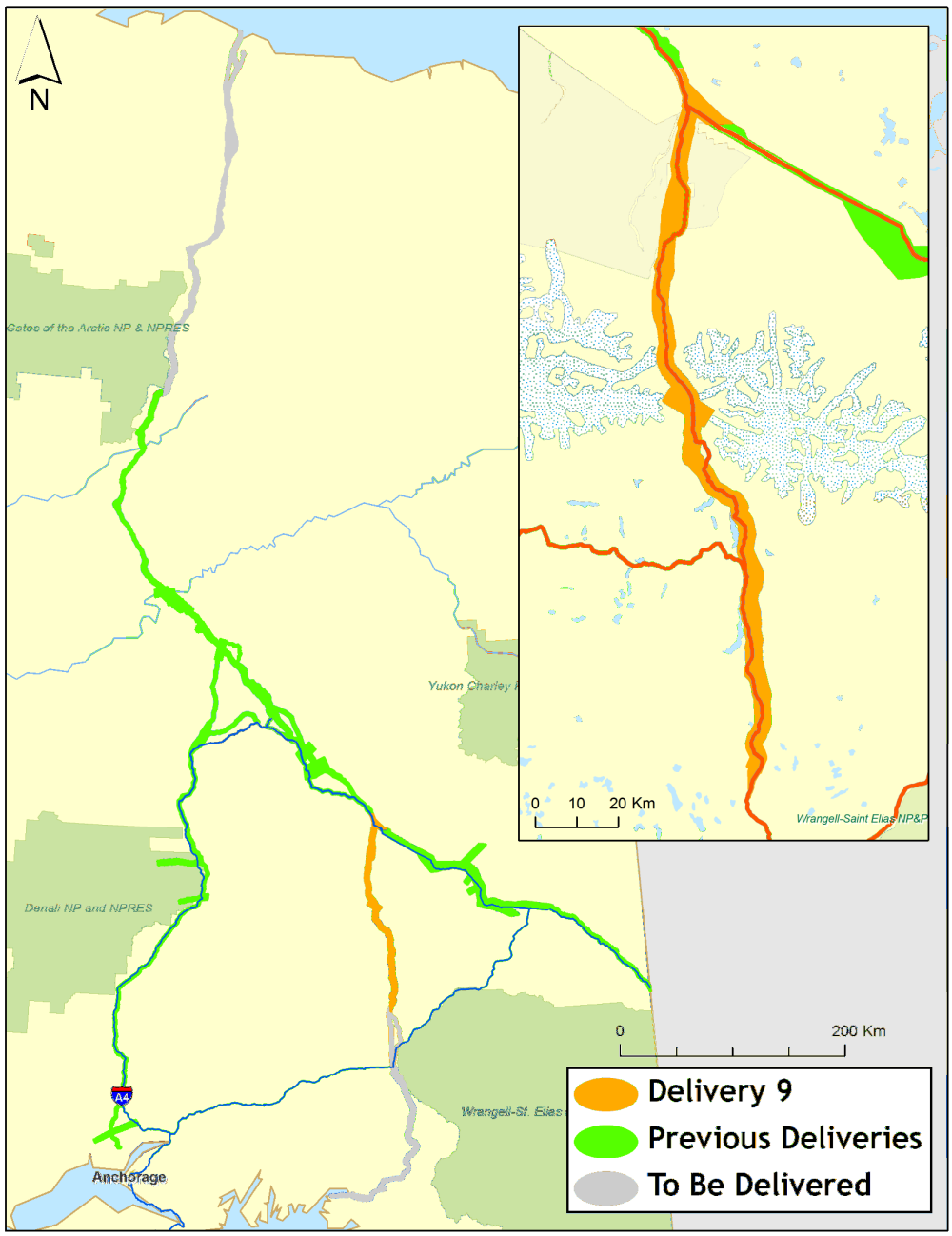


***Table 1**. Alaska Pipeline, LiDAR deliveries to date.*

| Delivery | UTM Zone(s) | Date | Total Acres Flown | AOI Acres |
|---|---|---|---|---|
| **1** | 6, 7 | March 9, 2011 | 121,746 | 117,357 |
| **2** | 6 | March 31, 2011 | 99,594 | 94,885 |
| **3** | 7 | May 23, 2011 | 43,976 | 39,744 |
| **4** | 6 | July 29, 2011 | 168,823 | 159,433 |
| **5** | 5 | August 31, 2011 | 247,206 | 226,450 |
| **6** | 6 | September 30, 2011 | 309,216 | 293,337 |
| **7** | 6 | October 31, 2011 | 262,279 | 239,477 |
| **8** | 7 | November 21, 2011 | 156,712 | 149,733 |
| **9** | 6 | December 20, 2011 | 176,785 | 167,164 |

# 2. Acquisition

## 2.1 Airborne Survey – Instrumentation and Methods

The LiDAR survey utilized a Leica ALS60 sensor in a Cessna Caravan 208Bs. The Leica systems were set to acquire 150,000 laser pulses per second (i.e., 150 kHz pulse rate) and flown at 1500 meters above ground level (AGL), capturing a scan angle of ±14$^{o}$ from nadir when clouds and terrain permitted. With these flight parameters, the laser swath width is 638m and the laser pulse footprint is 34cm. These settings varied depending on cloud cover and terrain but were consistently adjusted to yield an average native pulse density of ≥8 pulses per square meter over terrestrial surfaces. It is not uncommon for some types of surfaces (e.g. dense vegetation or water) to return fewer pulses than the laser originally emitted. These discrepancies between 'native' and 'delivered' density will vary depending on terrain, land cover, and the prevalence of water bodies.



*The Cessna Caravan is a stable platform, ideal for flying slow and low for high density projects. A Leica ALS60 sensor head installed in the Caravan is shown on the left.*

All areas were surveyed with an opposing flight line side-lap of ≥60% (≥100% overlap) to reduce laser shadowing and increase surface laser painting. The Leica laser systems allow up to four range measurements (returns) per pulse, and all discernable laser returns were processed for the output dataset.

To accurately solve for laser point position (geographic coordinates x, y, z), the positional coordinates of the airborne sensor and the attitude of the aircraft were recorded continuously throughout the LiDAR data collection mission. Aircraft position was measured twice per second (2 Hz) by an onboard differential GPS unit. 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/sensor position and attitude data are indexed by GPS time.

## 2.2 Ground Survey – Instrumentation and Methods

### *2.2.1 Monumentation*




Watershed Sciences coordinated with McClintock Land Associates (MLA, Alaska Professional Licensed Surveyor), of Eagle River, AK to determine proposed monument locations to support aerial acquisition. MLA established survey control monuments for the project area based on the proposed locations, areas with reasonable access, GPS visibility and proximity to the mission area. MLA established 14 new monuments (**Table 2**) within the Delivery 9 calibration area. The MLA monumentation was done with 5/8" x 30" rebar topped with a metal cap stamped with "MLA-WSI" the monument ID, and the year of establishment. MLA provided professional supervision and oversight to all survey aspects of this project, certified all monuments and provided additional independent accuracy check points (see Section 5.4, Appendix B). A full report of the survey will be provided with the final delivery report.

### *2.2.2 Control for Airborne Surveys*

During the LiDAR survey, static (1 Hz recording frequency) ground surveys were conducted over the survey control monuments.

All control monuments were observed for a minimum of two survey sessions lasting no fewer than 4 hours. At the beginning of every session the tripod and antenna were reset, resulting in two independent instrument heights and data files. Data was collected at a rate of 1Hz using a 10 degree mask on the antenna.


Trimble R7 GPS equipment set up in the Alaska Pipeline study area.

After the airborne survey, the static GPS data were provided to MLA for incorporation in the computation of the monument coordinates. MLA processed the static GPS data using triangulation with Continuously Operating Reference Stations (CORS). Both WSI and MLA checked coordinates using the Online Positioning User Service (OPUS[1]) to quantify daily variance. MLA provided calculated geodetic positions for all controls.

Indexed by time, these GPS data were used to correct the continuous onboard measurements of aircraft position recorded throughout the mission. Control monuments were located within 13 nautical miles of the survey area as per the contract.

***Table 2**. Base Station control coordinates for Alaska Pipeline Delivery 9.*

| Base Station ID | Datum: NAD83 (CORS96) | | GRS80 |
|---|---|---|---|
| | Latitude | Longitude | Ellipsoid Z (meters) |
| 23 A | 7092806.079 | 576716.539 | 392.625 |
| 23 B | 7091069.363 | 579744.362 | 390.704 |
| 31 A | 7063545.335 | 555106.281 | 550.56 |
| 31 B | 7060862.715 | 555186.93 | 556.071 |
| 31C | 7079199.333 | 562042.027 | 548.47 |
| 31D | 7088929.665 | 559793.5505 | 484.2775 |
| 33 A | 7003385.066 | 573704.414 | 999.179 |
| 33 B | 7002841.494 | 573356.47 | 999.898 |
| 33 C | 7022476.422 | 563588.489 | 783.806 |
| 33 D | 7010388.784 | 568153.271 | 929.946 |
| 34 A | 6960975.623 | 578408.304 | 815.147 |
| 34 B | 6960140.324 | 578409.687 | 844.145 |
| 35 A | 6935700.739 | 576600.531 | 612.097 |
| 35 B | 6932920.535 | 576381.216 | 614.397 |

[1] Online Positioning User Service (OPUS) is run by the National Geodetic Survey to process corrected monument positions.

### *2.2.3 Instrumentation*

For this survey, a Trimble GPS receiver model R7 with Zephyr Geodetic antenna with ground plane was deployed for all static control. A Trimble model R8 GNSS unit was used for collecting check points using real time kinematic (RTK) survey techniques. All GPS measurements were made with dual frequency L1-L2 receivers with carrier-phase correction.

The aircraft was assigned a ground crew member with two Trimble R7 receivers and an R8 receiver. The ground crew vehicles are equipped with standard field survey supplies and equipment including safety materials. The aircraft was further supported, as necessary, by an MLA surveyor (AK PLS) with two or more survey grade Topcon Receivers.

### *2.2.4 Methodology*

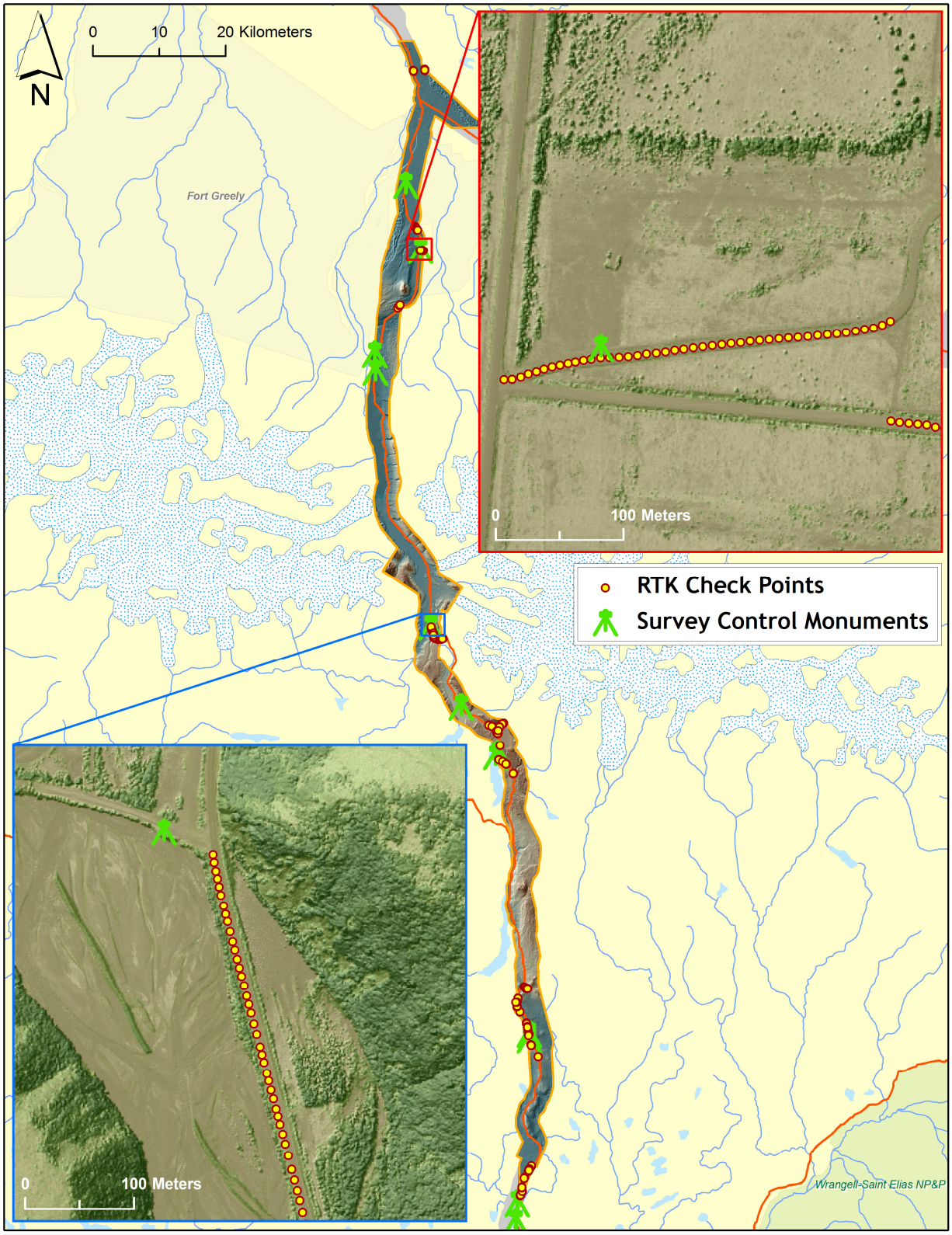
RTK and aircraft mounted GPS measurements were made during periods with PDOP[2] less than or equal to 3.0 and with at least 6 satellites in view of both a stationary reference receiver and the roving receiver. Static GPS data collected in a continuous session average the high PDOP into the final solution in the method used by CORS stations.

For RTK data, the collector begins recording after remaining stationary for 5 seconds then calculating the pseudo range position from at least three epochs with the relative error under 1.5cm horizontal and 2cm vertical. RTK positions are collected on bare earth locations such as paved, gravel or stable dirt roads, and other locations where the ground is clearly visible (and is likely to remain visible) from the sky during the data acquisition and RTK measurement period(s).

In order to facilitate comparisons with LiDAR measurements, RTK measurements were not taken on highly reflective surfaces such as center line stripes or lane markings on roads. RTK points were taken no closer than one meter to any nearby terrain breaks such as road edges or drop offs.

[2]PDOP: Point Dilution of Precision is a measure of satellite geometry, the smaller the number the better the geometry between the point and the satellites.

***Figure 2**. WSI RTK check points and control monument locations used in Delivery 9 of the Alaska Pipeline LiDAR Survey.*



# 3. LiDAR Data Processing

## 3.1 Applications and Work Flow Overview

1. Resolved kinematic corrections for aircraft position data using kinematic aircraft GPS and static ground GPS data.

   **Software:** Waypoint GPS v.8.10, Trimble Geomatics Office v.1.62
2. Developed a smoothed best estimate of trajectory (SBET) file that blends post-processed aircraft position with attitude data. Sensor head position and attitude were calculated throughout the survey. The SBET data were used extensively for laser point processing.

   **Software:** IPAS v.1.35
3. Calculated laser point position by associating SBET position to each laser point return time, scan angle, intensity, etc. Created raw laser point cloud data for the entire survey in *.las (ASPRS v. 1.2) format.

   **Software:** ALS Post Processing Software v.2.70
4. Imported raw laser points into manageable blocks (less than 500 MB) to perform manual relative accuracy calibration and filter for pits/birds. Ground points were then classified for individual flight lines (to be used for relative accuracy testing and calibration).

   **Software:** TerraScan v.11.009
5. Using ground classified points per each flight line, the relative accuracy was tested. Automated line-to-line calibrations were then performed for system attitude parameters (pitch, roll, heading), mirror flex (scale) and GPS/IMU drift. Calibrations were performed on ground classified points from paired flight lines. Every flight line was used for relative accuracy calibration.

   **Software:** TerraMatch v.11.006
6. Position and attitude data were imported. Resulting data were classified as ground and non-ground points. Statistical absolute accuracy was assessed via direct comparisons of ground classified points to ground RTK survey data. Data were then converted to orthometric elevations (NAVD88) by applying a Geoid09 correction. **Software:** TerraScan v.11.009, TerraModeler v.11.004
7. Bare Earth models were created as a triangulated surface and exported as ArcInfo ASCII grids at a 1 meter pixel resolution. Highest Hit models were created for any class at 1 meter grid spacing and exported as ArcInfo ASCII grids. Vegetation models were created for all vegetation points 20cm and above the ground model at a 1m grid spacing and exported as ArcInfo ASCII grids.

   **Software:** TerraScan v.11.009, ArcMap v. 9.3.1, TerraModeler v.11.004

## 3.2 Aircraft Kinematic GPS and IMU Data

LiDAR survey datasets were referenced to the 1 Hz static ground GPS data collected over pre-surveyed monuments with known coordinates. While surveying, the aircraft collected 2 Hz kinematic GPS data, and the onboard inertial measurement unit (IMU) collected 200 Hz aircraft attitude data. Waypoint GPS v.8.10 was used to process the kinematic corrections for the aircraft. The static and kinematic GPS data were then post-processed after the survey to

obtain an accurate GPS solution and aircraft positions. IPAS v.1.35 was used to develop a trajectory file that includes corrected aircraft position and attitude information. The trajectory data for the entire flight survey session were incorporated into a final smoothed best estimated trajectory (SBET) file that contains accurate and continuous aircraft positions and attitudes.

## 3.3 Laser Point Processing

Laser point coordinates were computed using the IPAS and ALS Post Processor software suites based on independent data from the LiDAR system (pulse time, scan angle), and aircraft trajectory data (SBET). Laser point returns (first through fourth) were assigned an associated (x, y, z) coordinate along with unique intensity values (0-255). The data were output into large LAS v. 1.2 files with each point maintaining the corresponding scan angle, return number (echo), intensity, and x, y, z (easting, northing, and elevation) information.

These initial laser point files were too large for subsequent processing. To facilitate laser point processing, bins (polygons) were created to divide the dataset into manageable sizes (< 500 MB). Flightlines and LiDAR data were then reviewed to ensure complete coverage of the survey area and positional accuracy of the laser points.

Laser point data were imported into processing bins in TerraScan, and manual calibration was performed to assess the system offsets for pitch, roll, heading and scale (mirror flex). Using a geometric relationship developed by Watershed Sciences, each of these offsets was resolved and corrected if necessary.

LiDAR points were then filtered for noise, pits (artificial low points), and birds (true birds as well as erroneously high points) by screening for absolute elevation limits, isolated points and height above ground. Each bin was then manually inspected for remaining pits and birds and spurious points were removed. In a bin containing approximately 7.5-9.0 million points, an average of 50-100 points are typically found to be artificially low or high. Common sources of non-terrestrial returns are clouds, birds, vapor, haze, decks, brush piles, etc.

Internal calibration was refined using TerraMatch. Points from overlapping lines were tested for internal consistency and final adjustments were made for system misalignments (i.e., pitch, roll, heading offsets and scale). Automated sensor attitude and scale corrections yielded 3-5 cm improvements in the relative accuracy. Once system misalignments were corrected, vertical GPS drift was then resolved and removed per flight line, yielding a slight improvement (<1 cm) in relative accuracy.

The TerraScan software suite is designed specifically for classifying near-ground points (Soininen, 2004). The processing sequence began by 'removing' all points that were not 'near' the earth based on geometric constraints used to evaluate multi-return points. The resulting bare earth (ground) model was visually inspected and additional ground point modeling was performed in site-specific areas to improve ground detail. This manual editing of ground often occurs in areas with known ground modeling deficiencies, such as: bedrock outcrops, cliffs, deeply incised stream banks, and dense vegetation. In some cases, automated ground point classification erroneously included known vegetation (i.e., understory, low/dense shrubs, etc.). These points were manually reclassified. Ground surface rasters were then developed from triangulated irregular networks (TINs) of ground points.

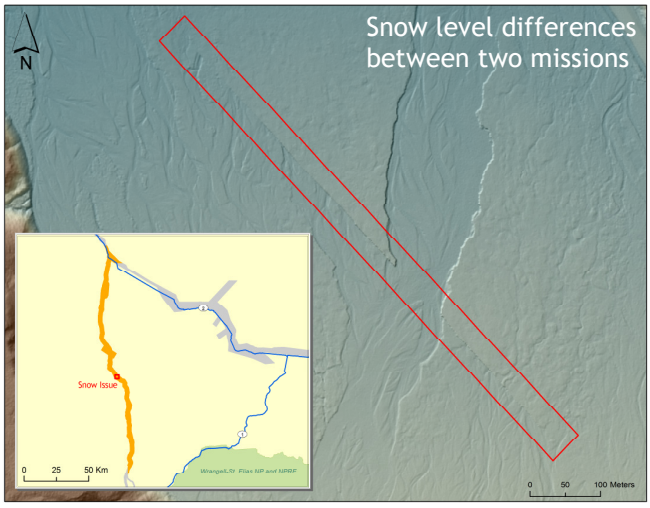
To develop the highest hit and vegetation models, buildings and structures were classified through automated point processing algorithms and then manually inspected and edited during the ground model inspection. Typically, manual editing of building classification was necessary where dense canopy was immediately proximate to buildings, or where structures such as utility poles or fences mimicked vegetation.

In some areas of the project, snow could not be avoided during acquisition. LiDAR returns that were identifiable as snow were reclassified into a new "snow" class. In areas where snow completely obstructed the ground, snow points were retained in the ground model to avoid expansive interpolation across snow fields. In areas where snow prevented laser penetration, ground elevations may be offset from the true ground. A shapefile delineating areas of snow was created for affected deliveries. The shapefile attribution includes a field designating each area as "classified" –meaning valid ground returns exist beneath the snow, or "suspected"- meaning no valid ground returns exist, but the area was identified as snow using the return intensity pattern. Because of temporal differences in neighboring flight mission areas, a 'stair step' artifact occurs in quad XMHA4 as a result of snow melt on the river valley between June 7th and June 27th, 2011.

The remaining points not classified as ground, snow, buildings, or error points were separated into two vegetation classes; Low Vegetation consisting of all returns ≤20cm from the ground, and Medium Vegetation consisting of all returns >20cm from the ground. This distinction was necessary because some potential for unclassified ground exists in the dataset. Vegetation classified returns within 20cm of the ground have higher potential to be artifacts of the dataset caused by minor offsets between flightlines (typically <10cm), isolated noise points, or abrupt discrete terrain features that did not get classified as ground (i.e. small boulders or sharp cliffs). The majority of points classified as low vegetation are valid returns, so the class was retained in the dataset to be incorporated into analyses at the user's discretion.

**Table 3.** ASPRS classification definitions for the Alaska Pipeline LiDAR survey.

| ASPRS Class | Definition |
|---|---|
| 2 | Ground |
| 3 | Low Vegetation |
| 4 | Medium Vegetation |
| 6 | Buildings/Man-made structures |
| 7 | Noise/error points |
| 9 | Water |
| 10 | Snow |
| 15 | Pipeline |

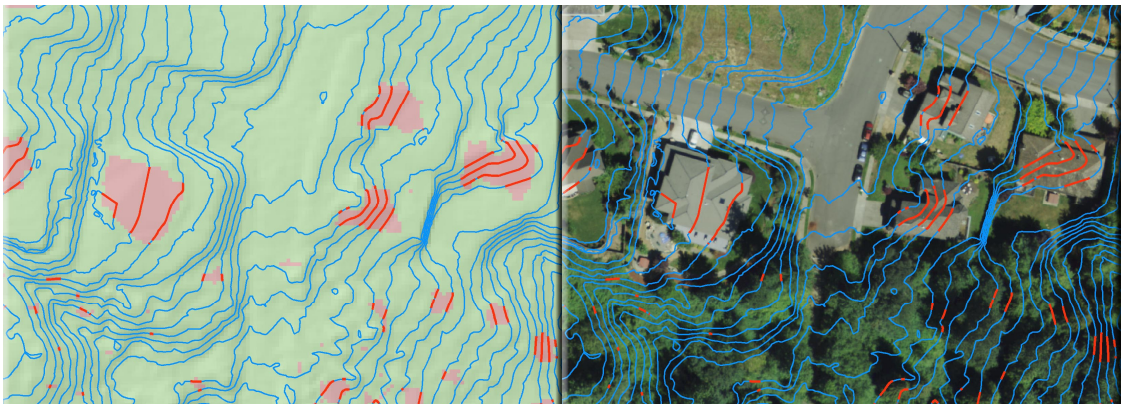


## 3.4 Contour Development

Contour lines were derived at 1 meter intervals from ground-classified LiDAR point data using TerraSolid processing software in MicroStation v. 8.1. Contour generation from LiDAR point data requires a thinning operation in order to reduce contour sinuosity. Parameters for these operations are: thinning elevation bounds: +/- 0.07m; search radius: 6.09m. The thinning operation reduces point density where topographic change is minimal (flat surfaces) while preserving resolution where topographic change is present. The total sum of potential error in vertical position is equal to twice the point processing limits (0.14m) plus twice the 2-sigma absolute vertical accuracy value for this dataset.

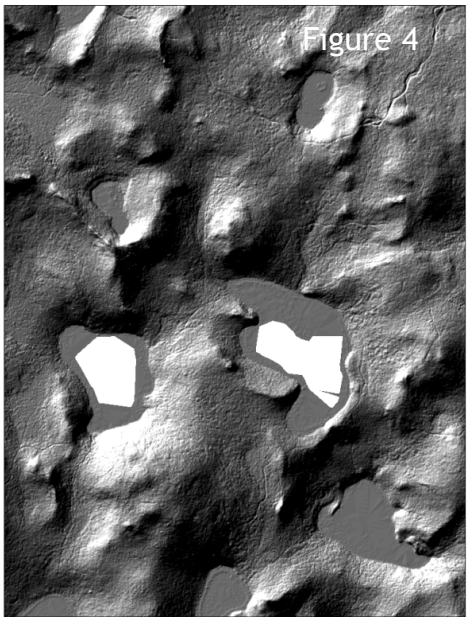
Ground point density rasters were created within MicroStation using a 1 meter step resolution and a 2 meter sampling radius. Areas with less than 0.25 ground-classified points per square meter were considered "sparse" and areas with higher densities were considered "covered". The ground point density raster data are in ESRI GRID format and have a 1 meter pixel resolution. The contour lines were intersected with ground point density raster data, allowing the addition of a confidence attribute to contour lines. Contour lines over "sparse" areas have low confidence, while contour lines over "covered" areas have a high confidence. Areas with low ground point density are commonly beneath buildings and bridges, in locations with dense vegetation, over water, and in other areas where laser penetration to the ground surface is impeded. **Figure 3** is an example of a ground point density raster and contour lines.

***Figure 3**. Elevation contours over LiDAR ground-classified point density raster (left) and true-color aerial photograph (right). Red indicates low ground point density and blue represents high density.*

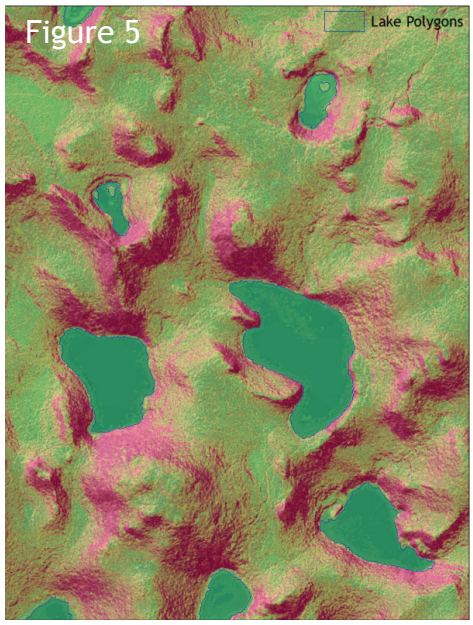


## 3.5 Hydro-Flattening

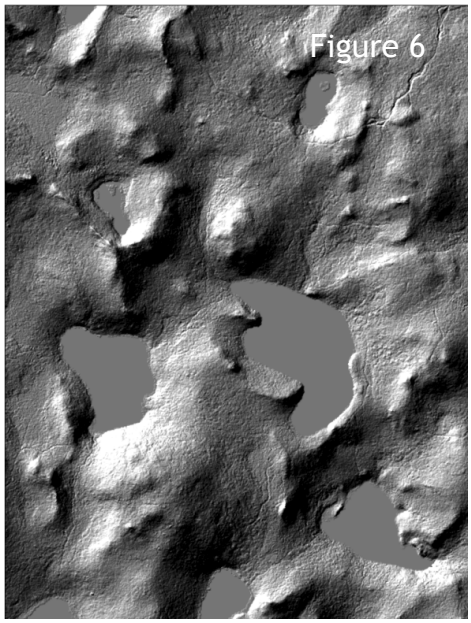
Lakes and other closed water bodies with surface area >150 $m^2$ were flattened to a consistent water level. The hydro-flattening process eliminates artifacts in the digital terrain model caused by both increased variability in ranges or dropouts in laser returns due to the low reflectivity of water (**Figure 4**). As per the project specifications, rivers and streams were not hydro-flattened.




Hydro-flattening of closed water bodies was performed through a combination of automated and manual detection and adjustment techniques designed to identify lake boundaries and water levels. Boundary polygons were developed using an algorithm which weights LiDAR-derived slopes, intensities, and return densities to detect the lake edge. The lake edges were then manually reviewed and edited in a 3-D environment. Once polygons were developed, the lake elevations were computed from the filtered LiDAR returns (**Figure 5**).




Returns from the water surface within each polygon were filtered and inspected for false low points during the initial ground modeling process described previously (Section 3.3). The elevation of each lake was computed as 5-cm above the minimum elevation of filtered water surface cells within the lake polygon. This approach ensures that all spurious returns off the water surface (both artificially high and low) were excluded from lake level assessment.




Lake-boundary polygons were then incorporated into the final terrain model and enforced as hard-breaklines. The initial ground classified points falling within lake polygons were reclassified as water points [to omit them from the final ground model] and replaced with the flat water surface of the lake boundary hydrolines (**Figure 6**).

# 4. LiDAR Accuracy Assessment

## 4.1 Laser Noise and Relative Accuracy

*Laser Noise*
For any given target, laser noise is the breadth of the data cloud per laser return (i.e., last, first, etc.). Lower intensity surfaces (roads, rooftops, still/calm water) experience higher laser noise. The laser noise range for this survey was approximately 0.02 meters.

*Relative Accuracy*
Relative accuracy refers to the internal consistency of the data set - the ability to place a laser point in the same location over multiple flight lines, GPS conditions, and aircraft attitudes. Affected by system attitude offsets, scale, and GPS/IMU drift, internal consistency is measured as the divergence between points from different flight lines within an overlapping area. Divergence is most apparent when flight lines are opposing. When the LiDAR system is well calibrated, the line-to-line divergence is low (<10 cm). See Appendix A for further information on sources of error and operational measures that can be taken to improve relative accuracy.

**Relative Accuracy Calibration Methodology**

1. Manual System Calibration: Calibration procedures for each mission require solving geometric relationships that relate measured swath-to-swath deviations to misalignments of system attitude parameters. Corrected scale, pitch, roll and heading offsets were calculated and applied to resolve misalignments. The raw divergence between lines was computed after the manual calibration was completed and reported for each survey area.
2. Automated Attitude Calibration: All data were tested and calibrated using TerraMatch automated sampling routines. Ground points were classified for each individual flight line and used for line-to-line testing. System misalignment offsets (pitch, roll and heading) and scale were solved for each individual mission and applied to respective mission datasets. The data from each mission were then blended when imported together to form the entire area of interest.
3. Automated Z Calibration: Ground points per line were used to calculate the vertical divergence between lines caused by vertical GPS drift. Automated Z calibration was the final step employed for relative accuracy calibration.

## 4.2 Absolute Accuracy

Laser point absolute accuracy is largely a function of laser noise and relative accuracy. To minimize these contributions to absolute error, a number of noise filtering and calibration procedures were performed prior to evaluating absolute accuracy. The LiDAR quality assurance process uses the data from the real-time kinematic (RTK) ground survey conducted in the AOI. For Delivery 9, **1153 RTK** GPS measurements were collected on hard surfaces distributed among multiple flight swaths for a total of 21,552 points across all delivered data. Suitable and accessible hard-surfaces limited the number and distribution of RTK points able to be collected. To assess absolute accuracy the location coordinates of these known RTK ground points were compared to those calculated for the closest ground-classified laser points.

The vertical accuracy of the LiDAR data is described as the mean and standard deviation (sigma ~ $\sigma$) of divergence between LiDAR point coordinates and RTK ground survey point coordinates. To provide a sense of the model predictive power of the dataset, the root mean square error (RMSE) for vertical accuracy is also provided. These statistics assume the error distributions for x, y, and z are normally distributed, thus the skew and kurtosis of distributions are considered when evaluating error statistics.

Statements of statistical accuracy apply to fixed terrestrial surfaces only and may not be applied to areas of dense vegetation or steep terrain (See Appendix A).

# 5. Study Area Results

Summary statistics for point resolution and accuracy (relative and absolute) of the LiDAR data collected in the Alaska Pipeline Delivery 9 survey area have been added to previously delivered data. Cumulative results are presented below in terms of central tendency, variation around the mean, and the spatial distribution of the data (for point resolution by processing bin).

The initial dataset, acquired to be ≥8 points per square meter, was filtered as described previously to remove spurious or inaccurate points. Additionally, some types of surfaces (i.e., dense vegetation, breaks in terrain, water, steep slopes) may return fewer pulses (delivered density) than the laser originally emitted (native density).

Ground classifications were derived from automated ground surface modeling and manual, supervised classifications where it was determined that the automated model had failed. Ground return densities will be lower in areas of dense vegetation, water, or buildings.

## Data Summary:

***Table 4****. LiDAR Resolution and Accuracy - Specifications and Achieved Values*

| | | Targeted | Achieved |
|---|---|---|---|
| **Resolution:** | **UTM 5** | ≥ 8 points/$m^2$ | 8.60 points/$m^2$ |
| | **UTM 6** | | 8.77 points/$m^2$ |
| | **UTM 7** | | 8.88 points/$m^2$ |
| **Vertical Accuracy (1 $\sigma$):** | | <13 cm | 3.7 cm |

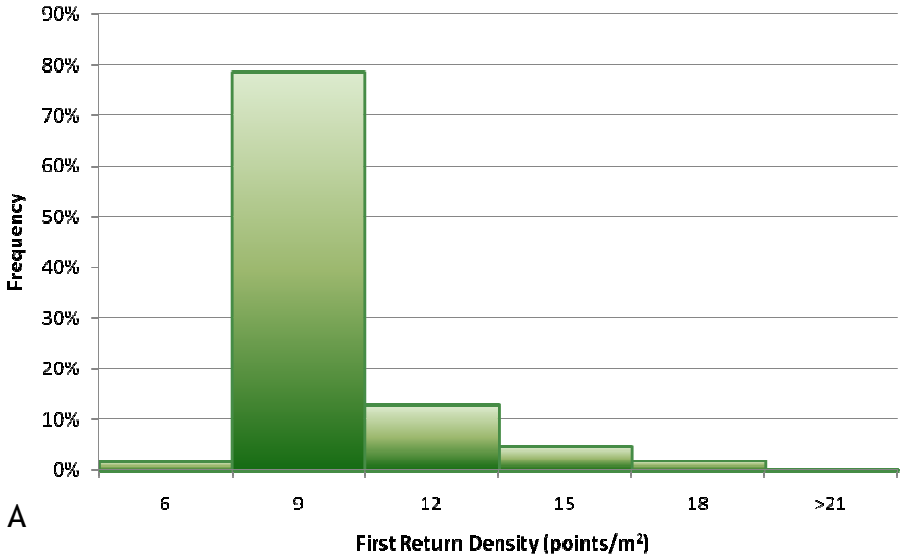
## 5.1 Data Density/Resolution

**Figures 10 - 24** display the distribution of average native and ground point densities for each processing bin. Density data will continue to be updated as data is processed and delivered.

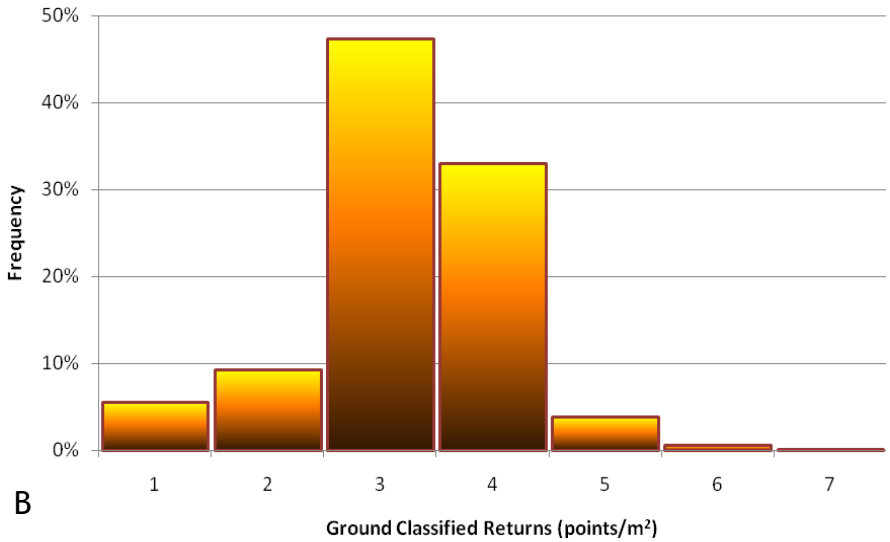
LiDAR data resolution for Alaska Pipeline deliveries to date:

| | UTM 5 | UTM 6 | UTM 7 |
|---|---|---|---|
| Average Point (First Return) Density | 8.60 points/$m^2$ | 8.77 points/$m^2$ | 8.88 points/$m^2$ |
| Average Ground Point Density | 2.72 points/$m^2$ | 2.52 points/$m^2$ | 2.78 points/$m^2$ |

***Figure 7**. Density distribution for first return (A) and ground classified (B) laser points for UTM 5*

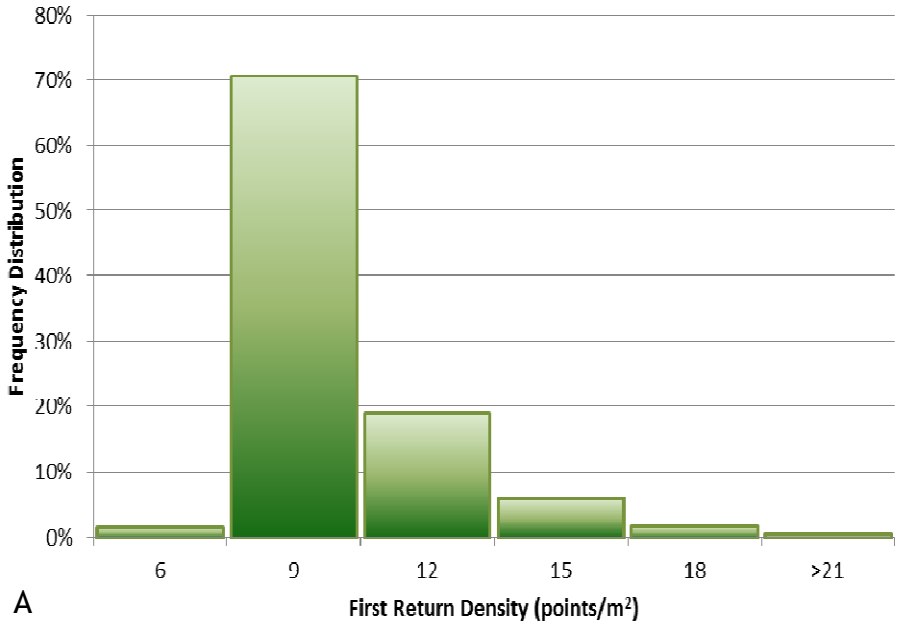



A

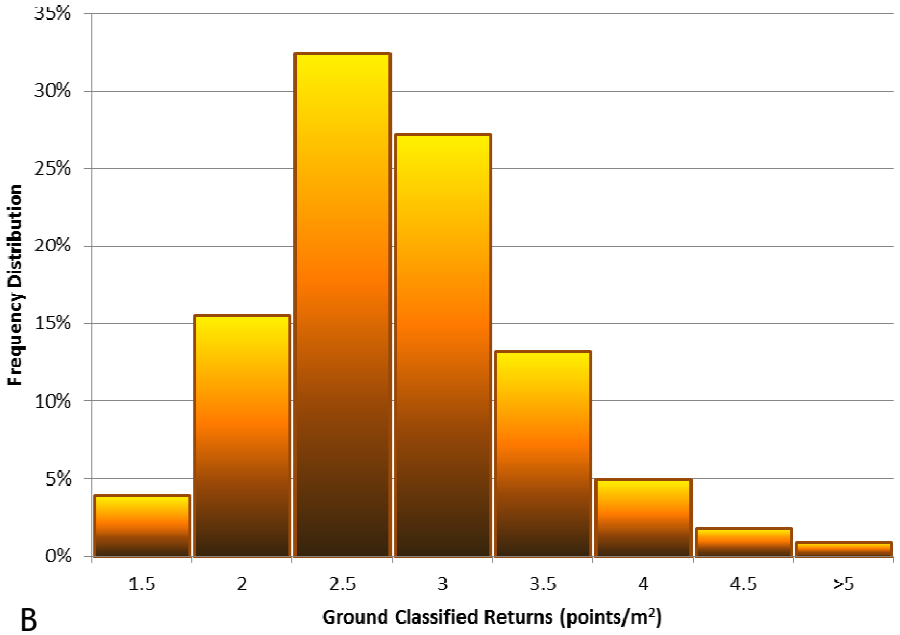



B

***Figure 8.*** *Density distribution for first return (A) and ground classified (B) laser points for UTM 6*

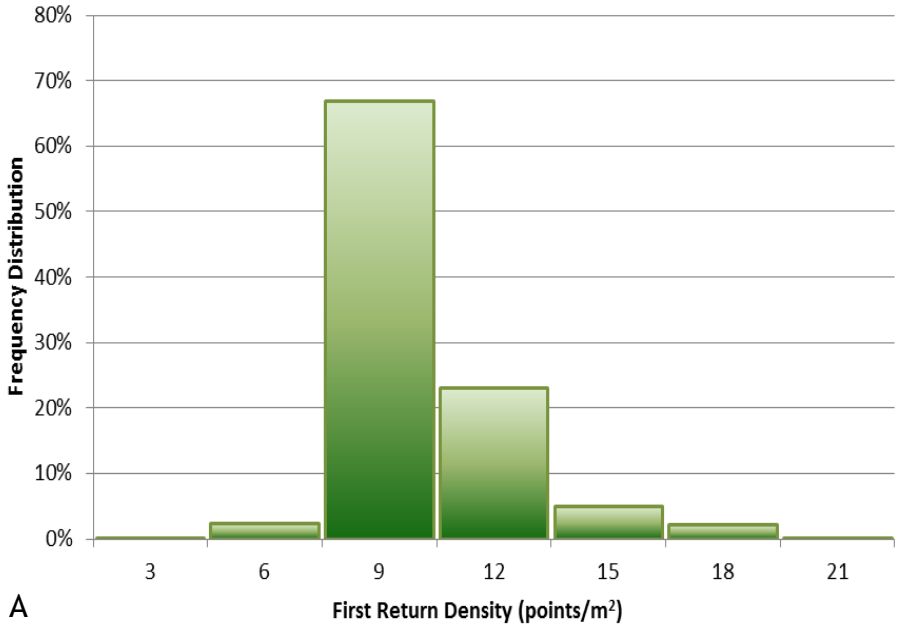



A

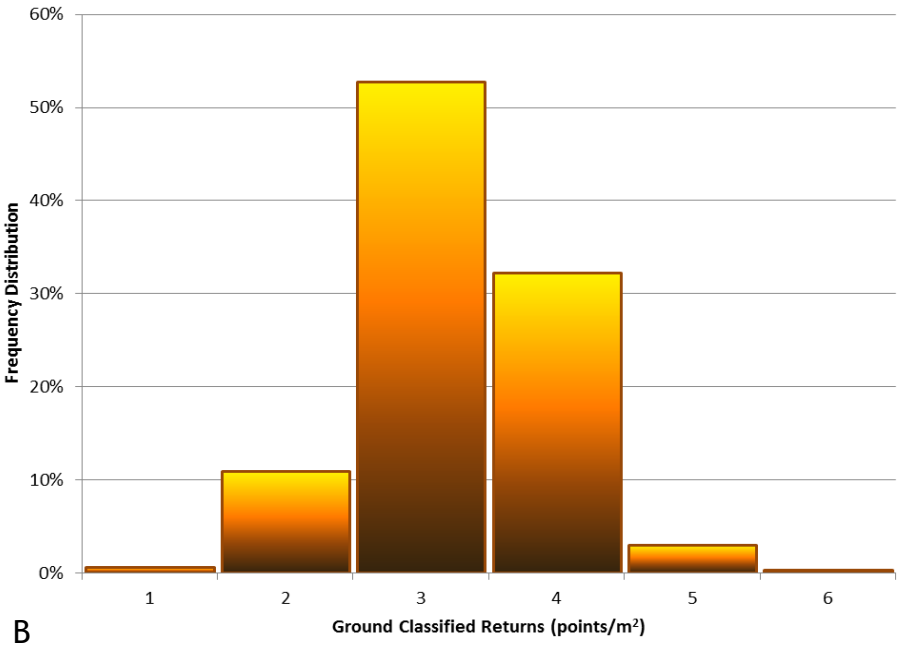



B

***Figure 9**. Density distribution for first return (A) and ground classified (B) laser points for UTM 7*




A




B

***Figure 10**. Density distribution map for ground and first return points by processing bin in Delivery 1, UTM 6*



***Figure 11.*** *Density distribution map for ground and first return points by processing bin in Delivery 1, UTM 7*

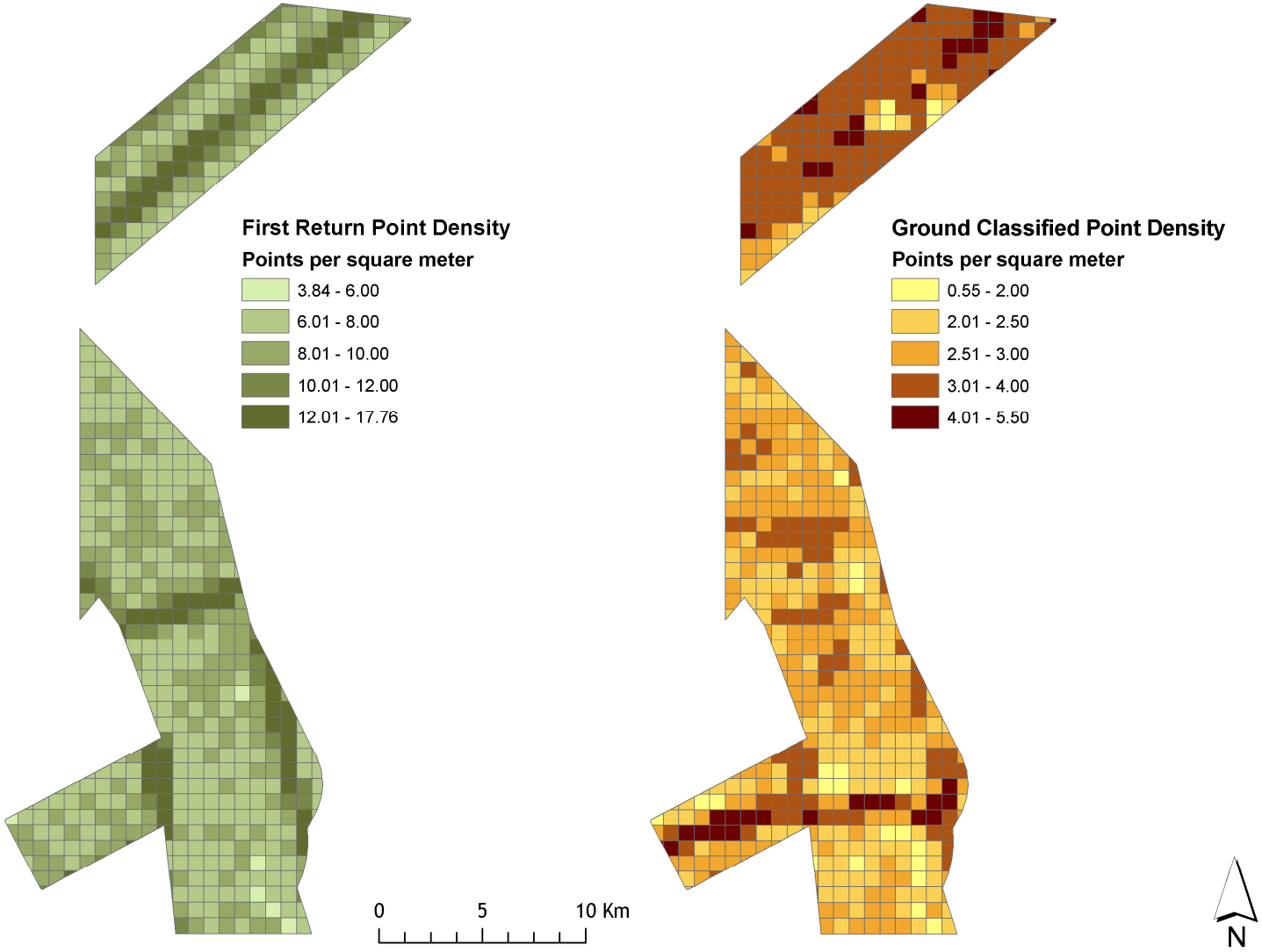


***Figure 12.*** *Density distribution map for ground points by processing bin in Delivery 2, UTM 6*

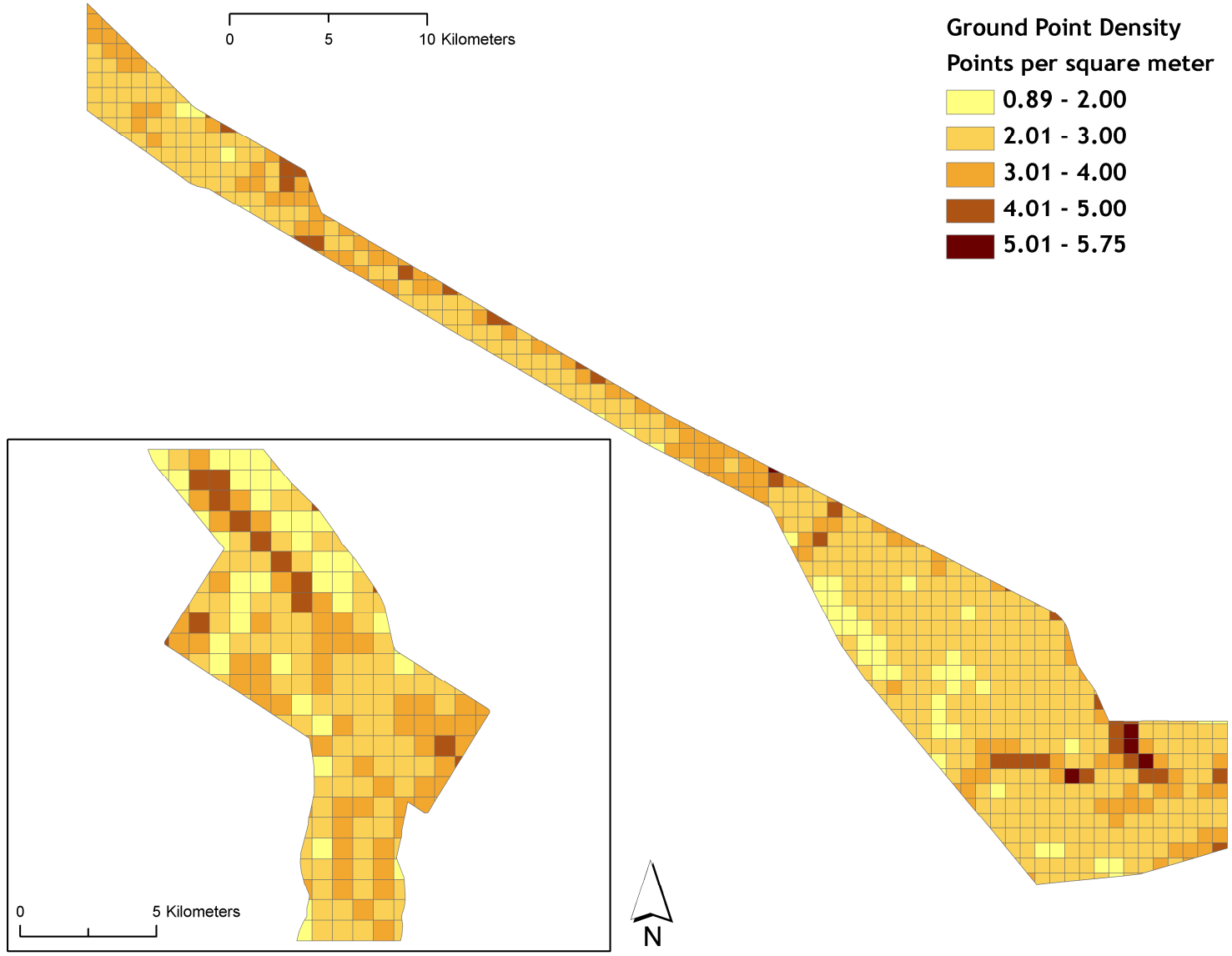


***Figure 13***. *Density distribution map for first return points by processing bin in Delivery 2, UTM 6*

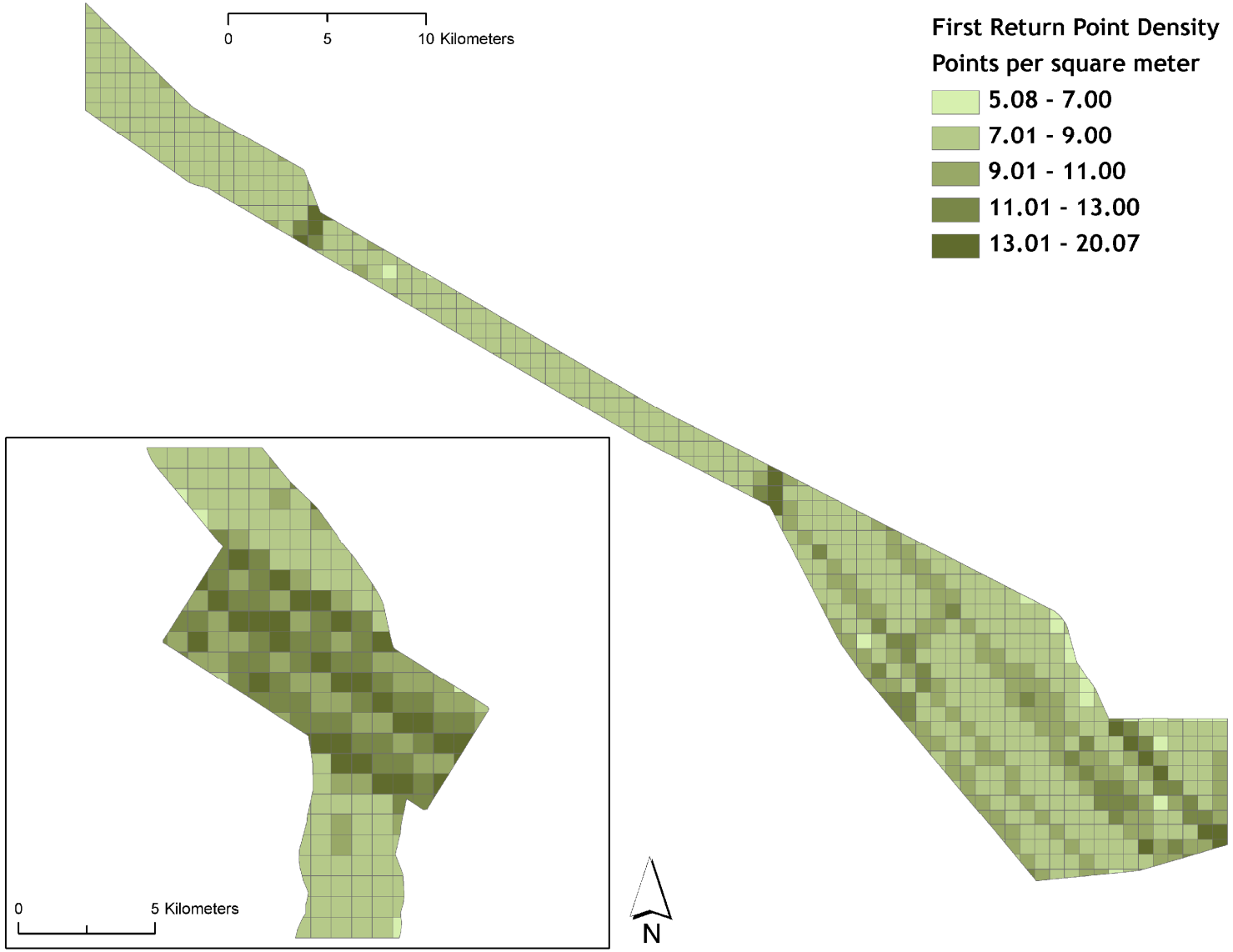


***Figure 14.*** *Density distribution map for ground and first return points by processing bin in Delivery 3, UTM 7*

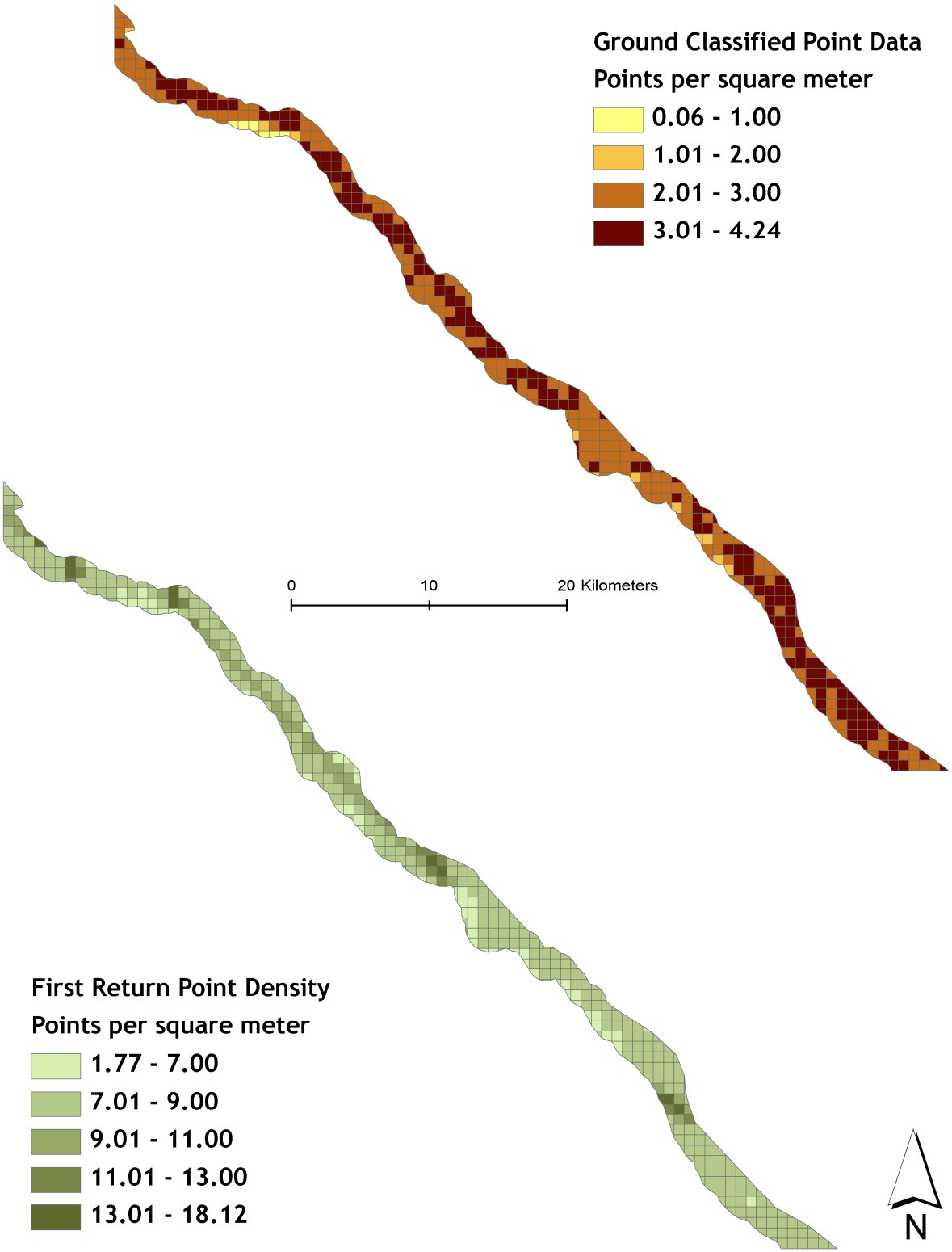


***Figure 15**. Density distribution map for ground and first return points by processing bin in Delivery 4, UTM 6*

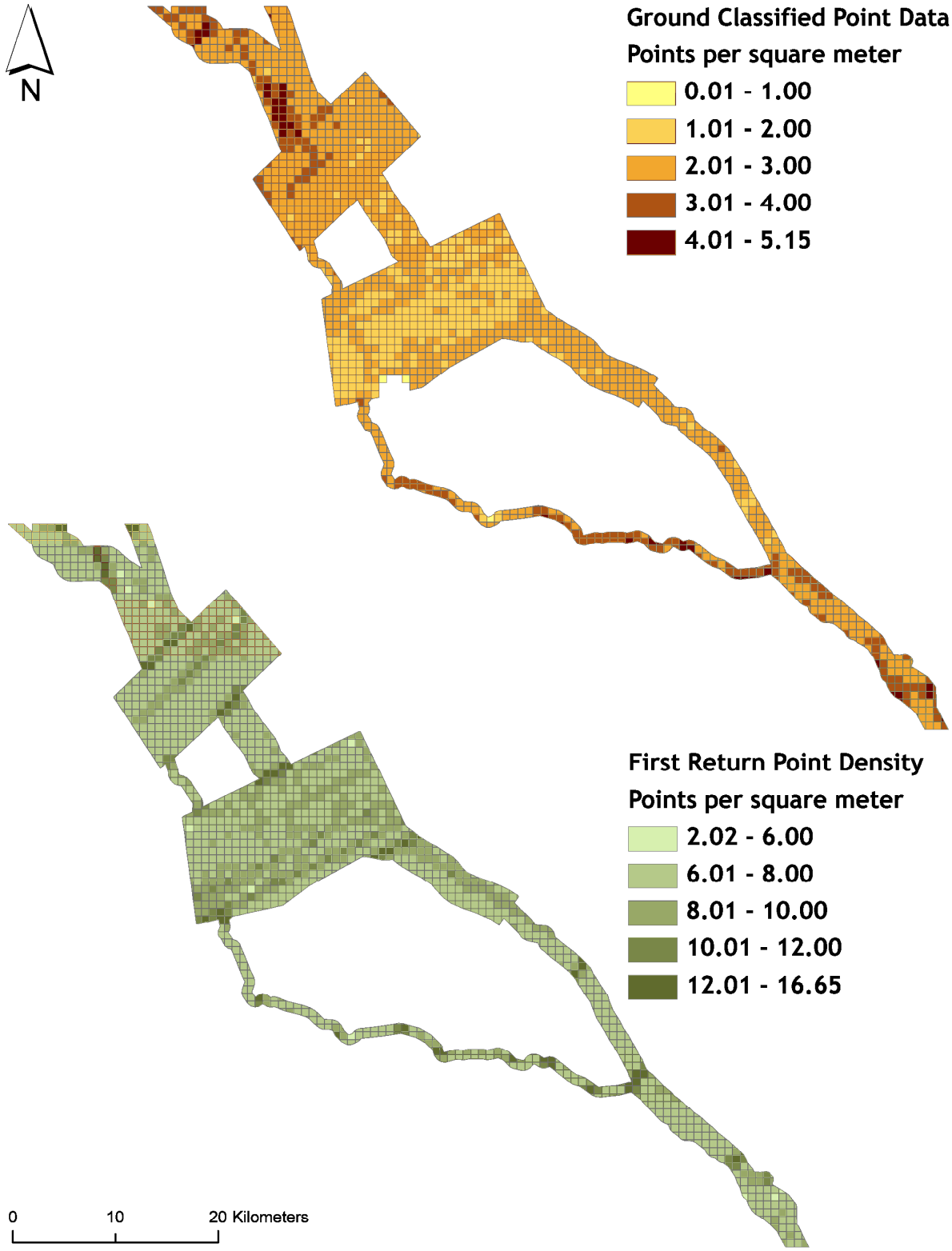


***Figure 16**. Density distribution map for ground classified points by processing bin in Delivery 5, UTM 5*



***Figure 17.*** *Density distribution map for first return points by processing bin in Delivery 5, UTM 5*



***Figure 18**. Density distribution map for ground classified points by processing bin in Delivery 6, UTM 6*

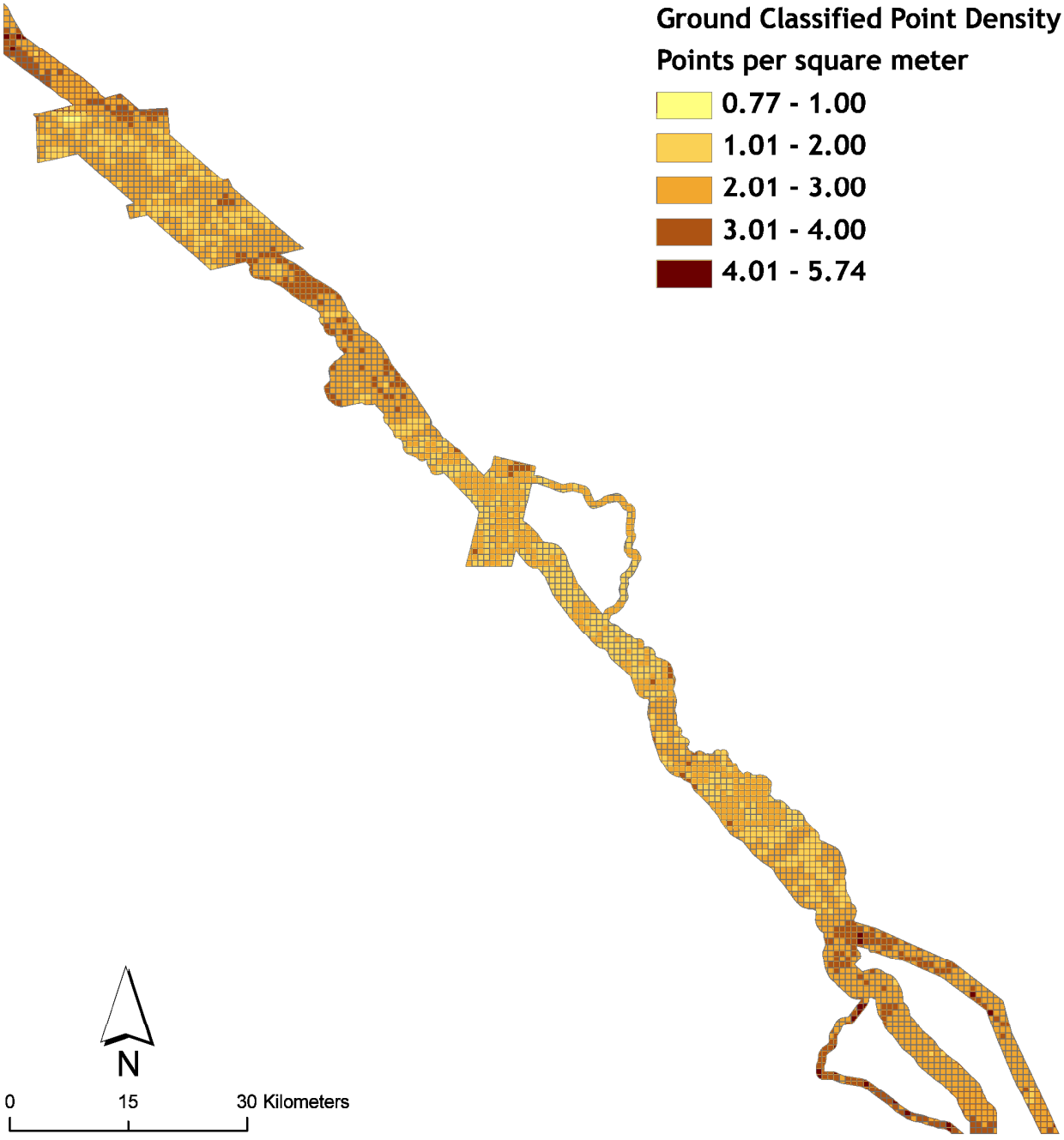


***Figure 19**. Density distribution map for first return points by processing bin in Delivery 6, UTM 6*

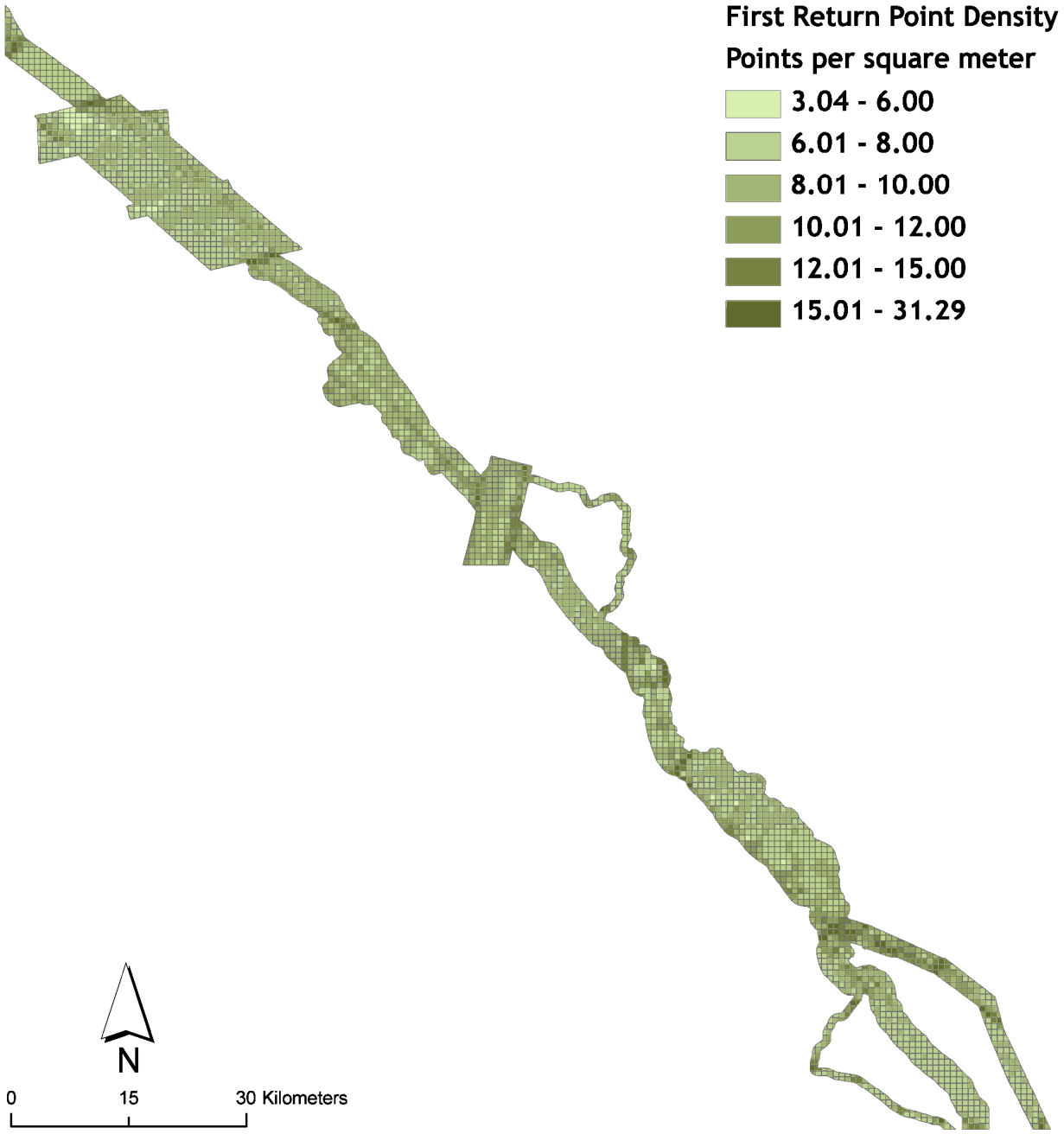


***Figure 20**. Density distribution map for ground classified points by processing bin in Delivery 7, UTM 6*

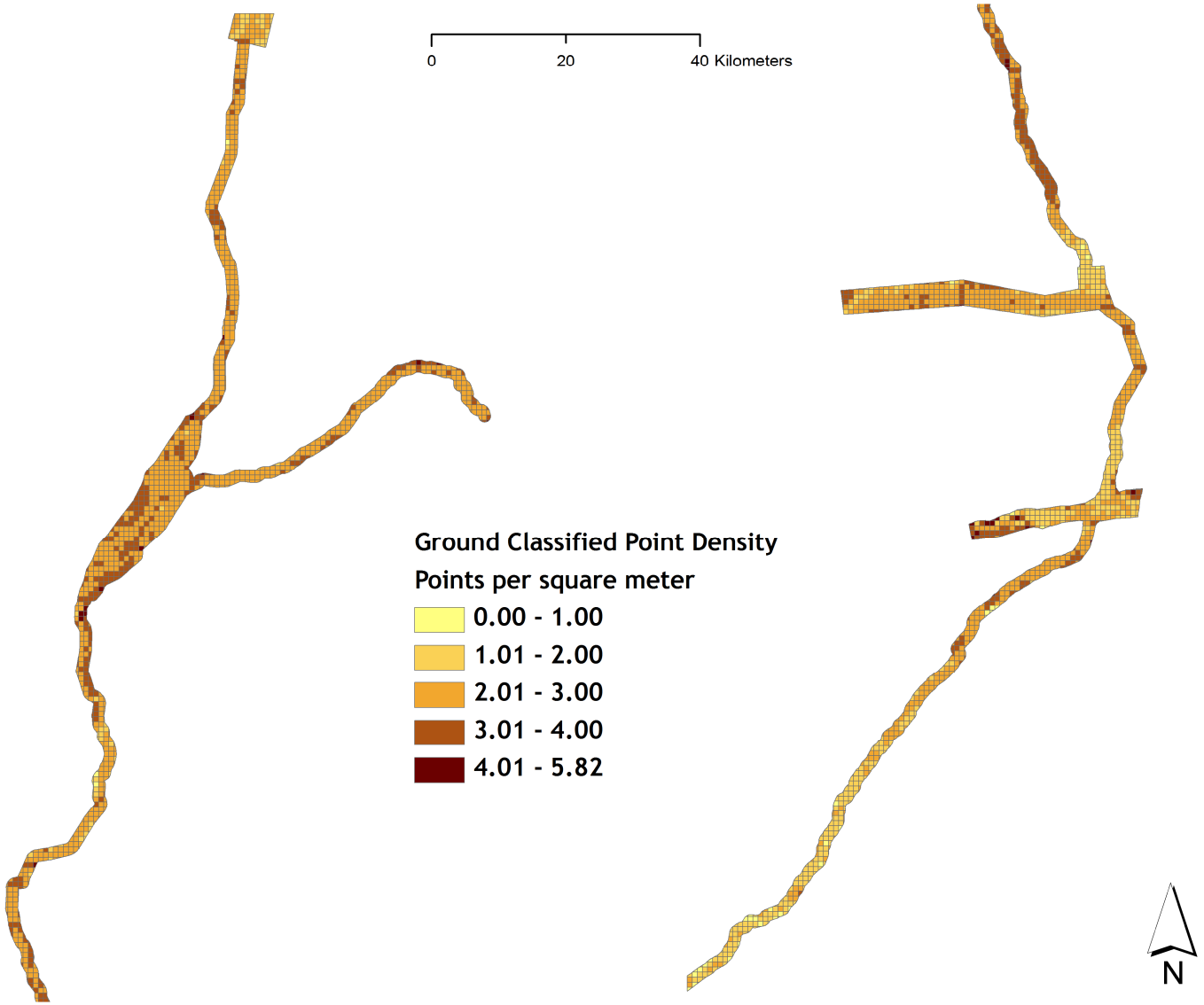


***Figure 21**. Density distribution map for first return points by processing bin in Delivery 7, UTM 6*



***Figure 22**. Density distribution map for ground classified points by processing bin in Delivery 8, UTM 7*

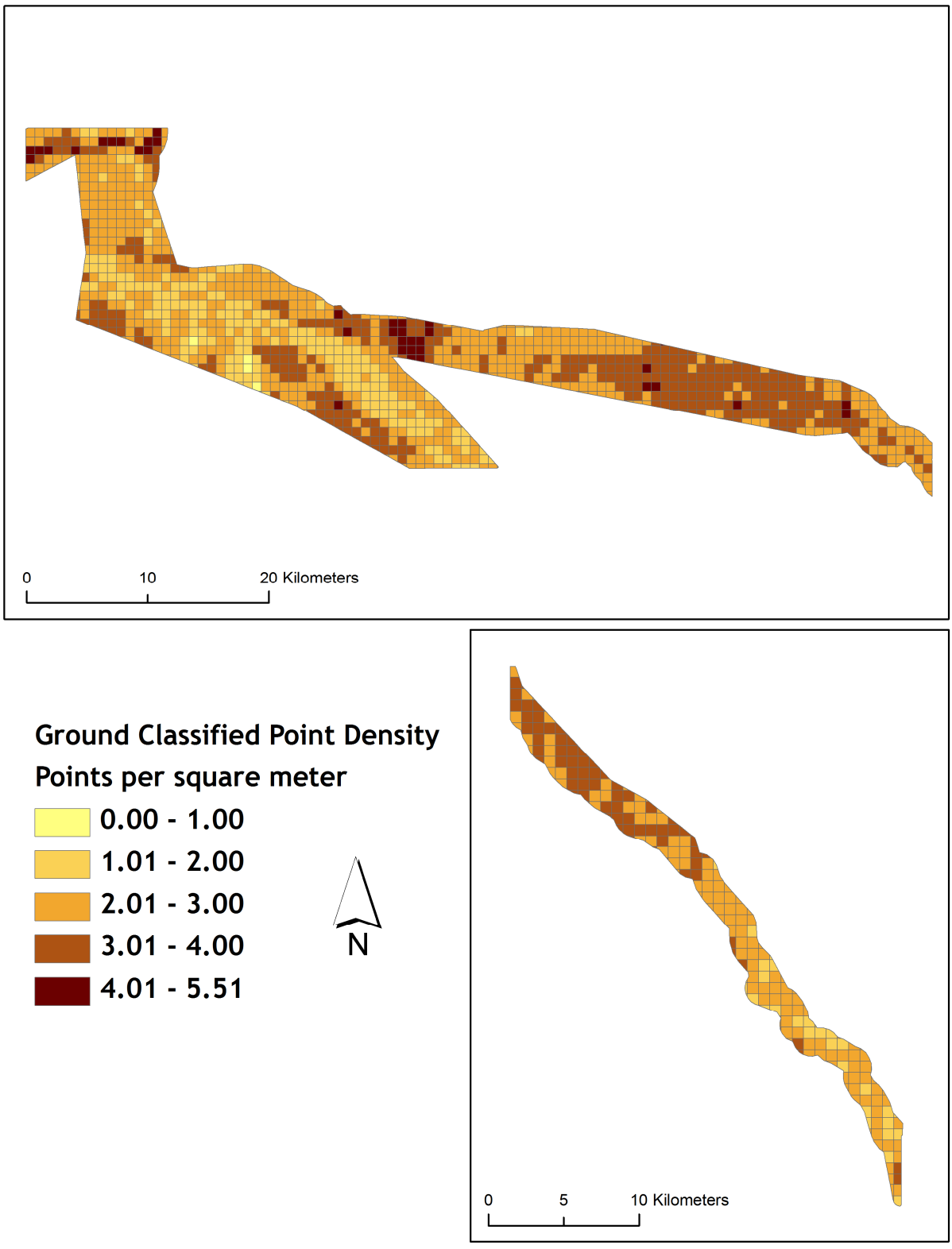


***Figure 23**. Density distribution map for first return points by processing bin in Delivery 8, UTM 7*

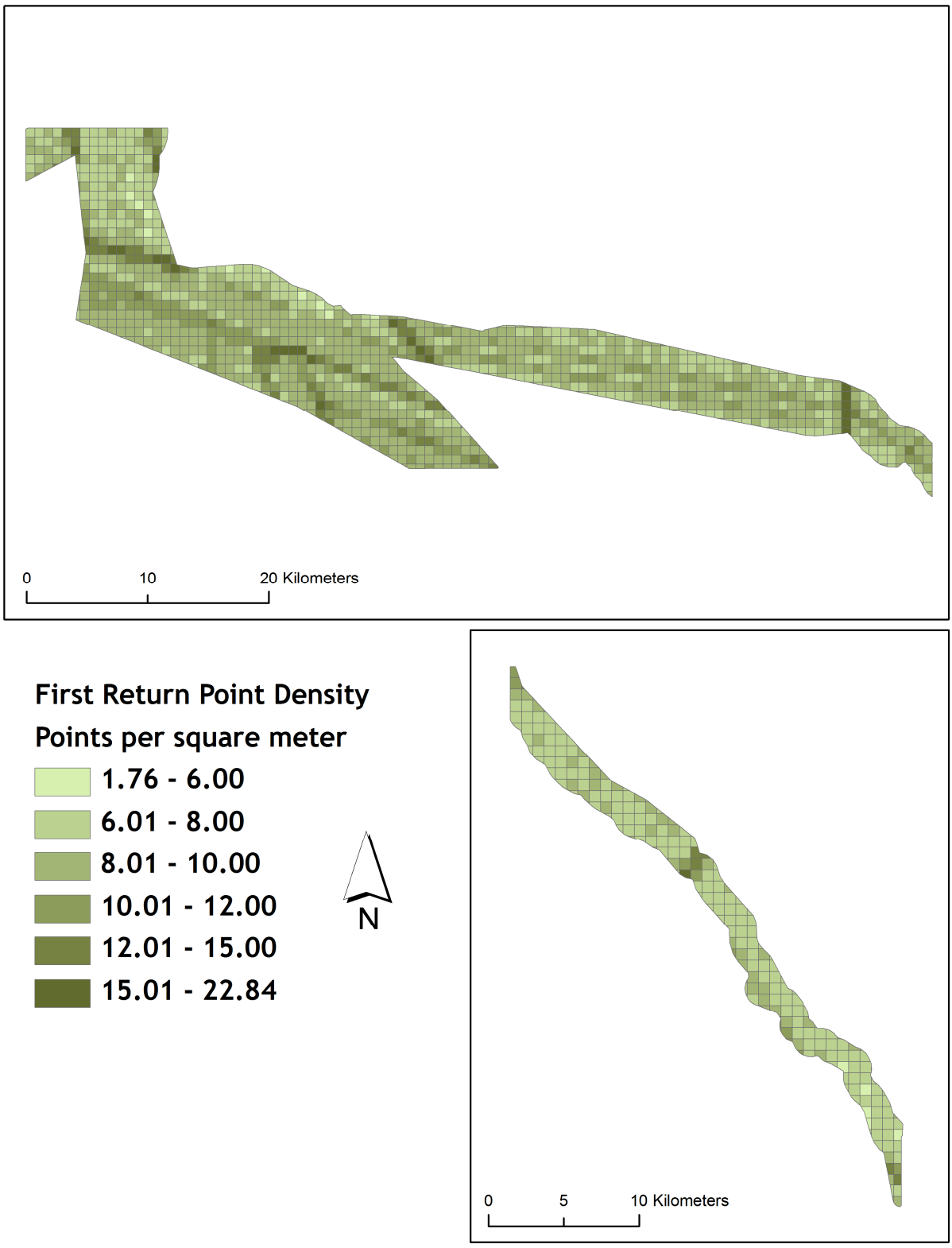
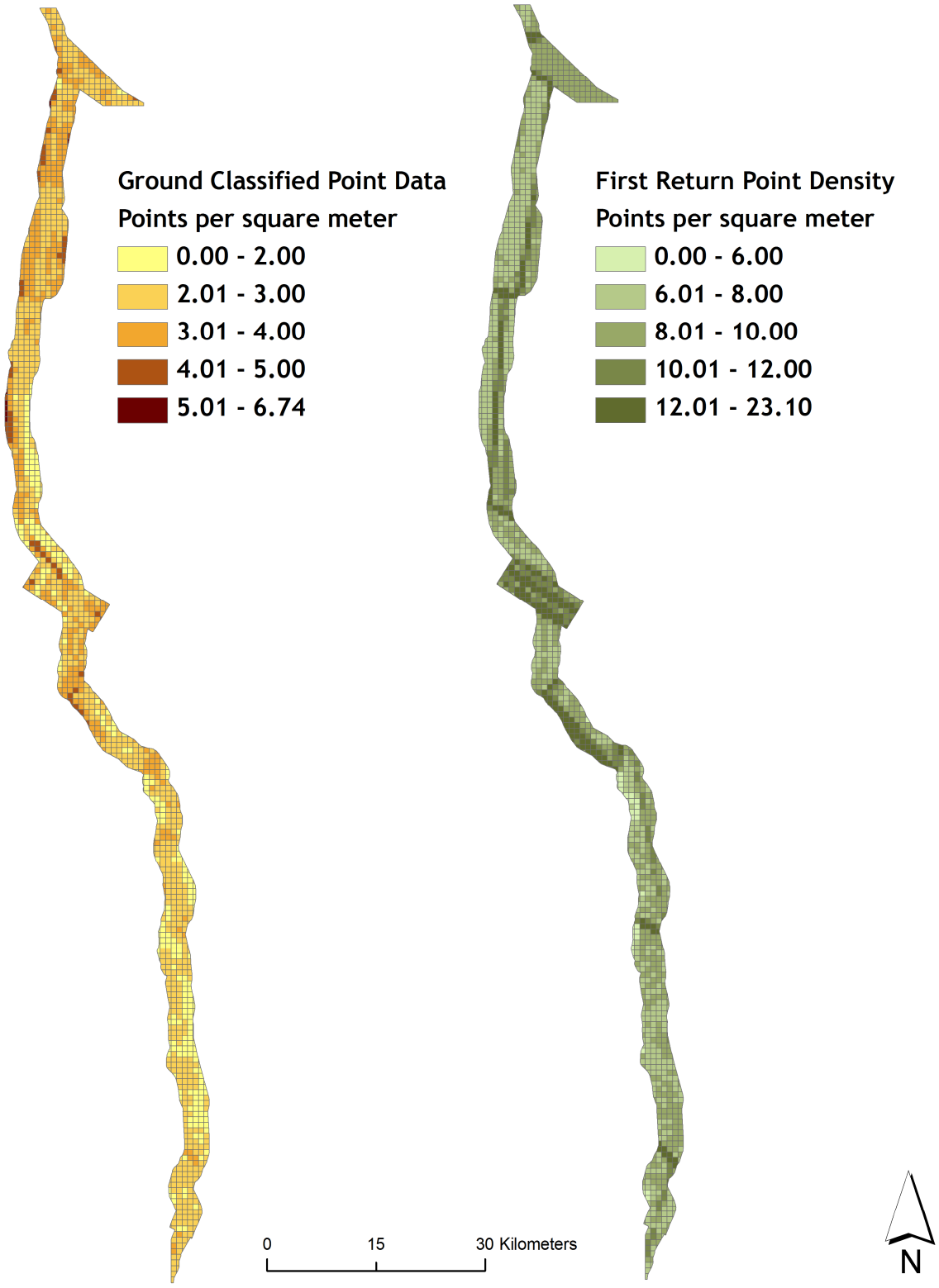


***Figure 24**. Density distribution map for first return and ground classified points by processing bin in Delivery 9, UTM 6*

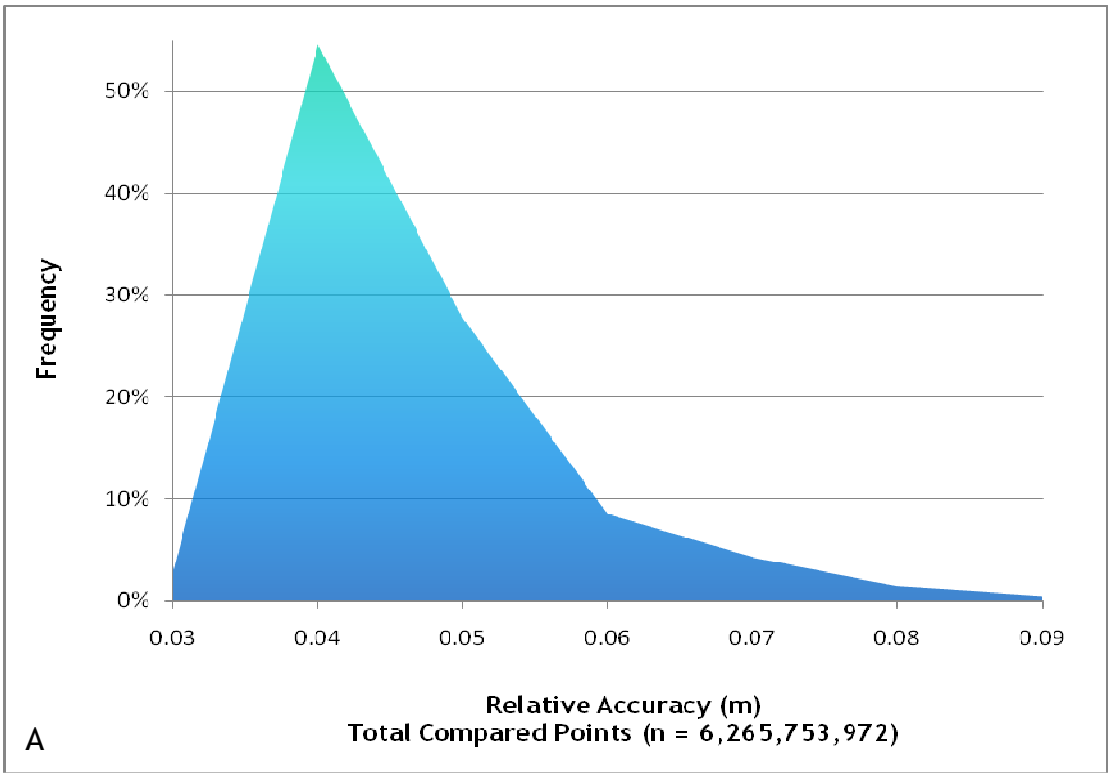


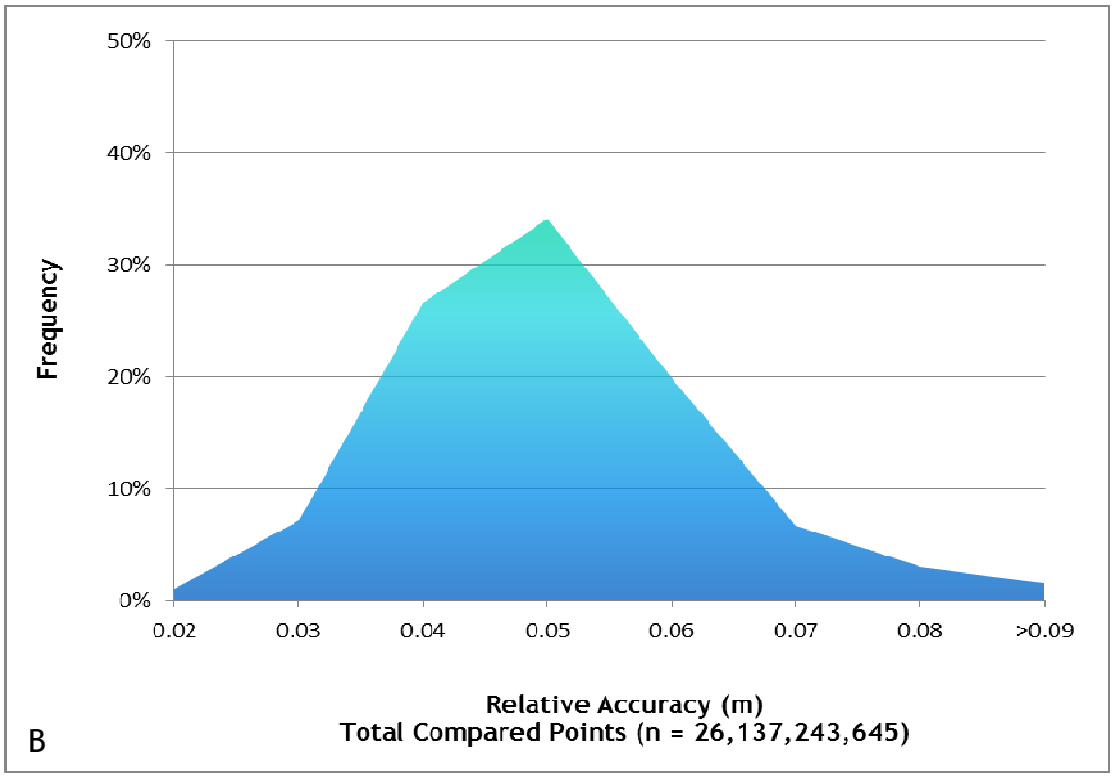
## 5.2 Relative Accuracy Calibration Results

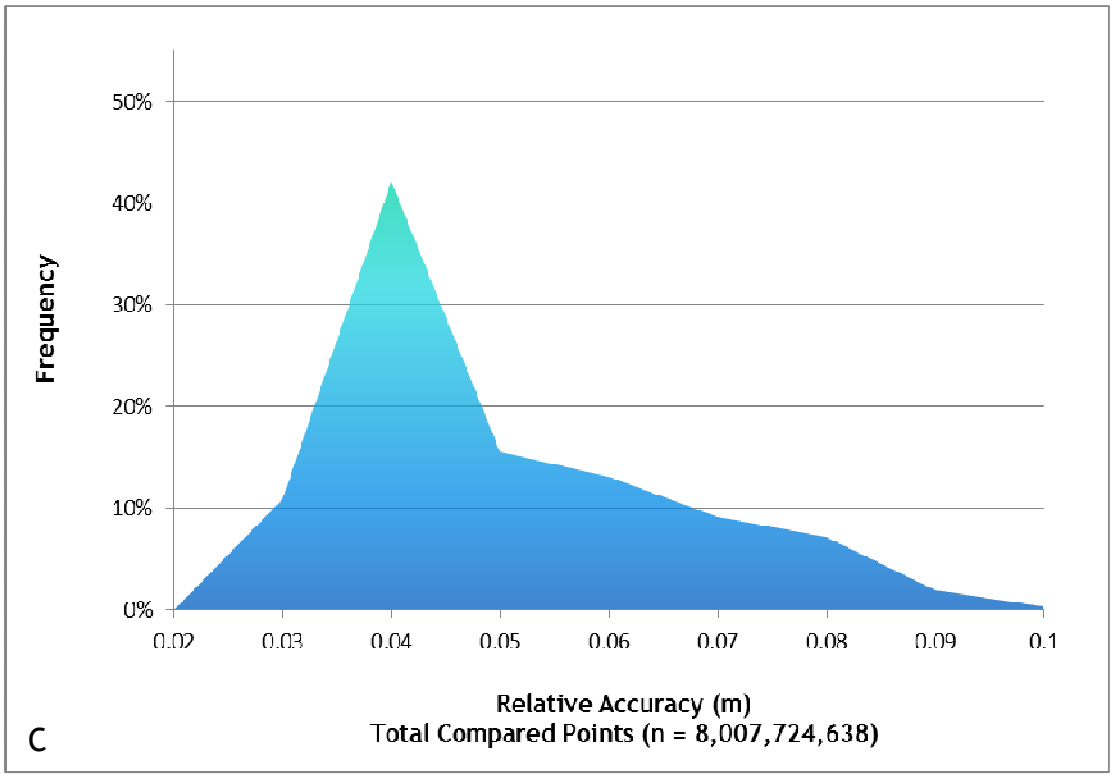
***Table 5**. Cumulative relative accuracy statistics for Alaska Pipeline deliveries to date.*

| | UTM 5 | UTM 6 | UTM 7 |
|---|---|---|---|
| Project Average | 0.039m | 0.045m | 0.036m |
| Median Relative Accuracy | 0.039m | 0.045m | 0.039m |
| 1σ Relative Accuracy | 0.010m | 0.012m | 0.015m |
| 1.96σ Relative Accuracy | 0.019m | 0.024m | 0.030m |

***Figure 25**. Distribution of cumulative relative accuracies in UTM5 (A) UTM 6 (B) and UTM 7 (C) per flight line, non slope-adjusted*




50%
40%
30%
20%
10%
0%
Frequency
0.02
0.03
0.04
0.05
0.06
0.07
0.08
>0.09
Relative Accuracy (m)
Total Compared Points (n = 26,137,243,645)
B


50%
40%
30%
20%
10%
0%
Frequency
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1
Relative Accuracy (m)
Total Compared Points (n = 8,007,724,638)
C

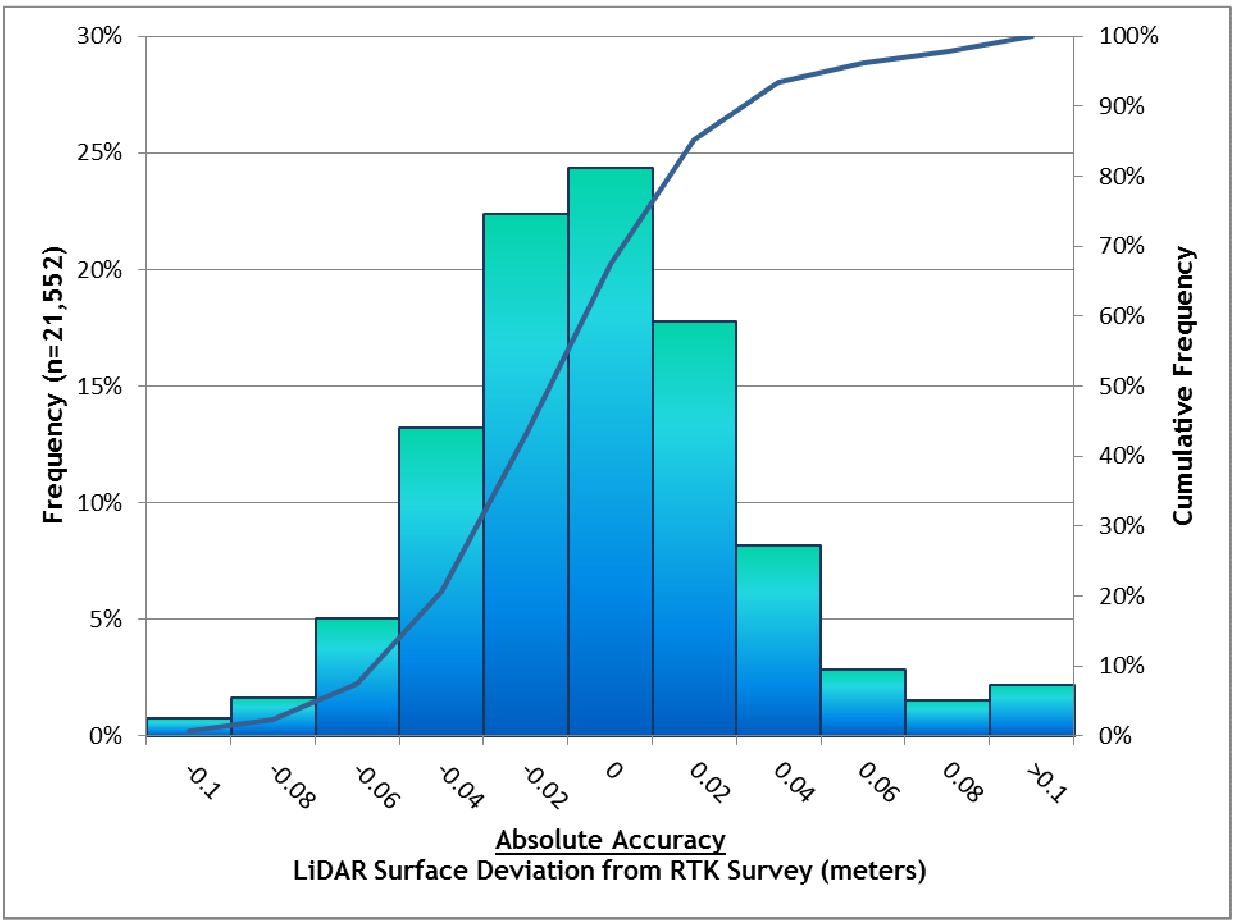
## 5.3 Absolute Accuracy

Absolute accuracies for Alaska Pipeline deliveries to date: All data was calibrated and processed in UTM 6 and then transformed to the appropriate projection.

***Table 6**. Absolute Accuracy - Deviation between laser points and RTK hard surface survey points*

| RTK Survey Sample Size (n): 21,552 | |
|---|---|
| Root Mean Square Error (RMSE): 0.039m | Minimum Δz = -0.151m |
| Standard Deviations<br>1 sigma (σ): 0.037m 1.96 sigma (σ): 0.072m | Maximum Δz = 0.151m |
| | Average Δz = -0.012m |

***Figure 26**. Absolute Accuracy - Histogram Statistics*



## 5.4 Independent Accuracy Assessment

In accordance with the project plan, McClintock Land Associates (AK PLS) collected independent (i.e. blind) check points within the survey area to provide an independent assessment of LiDAR accuracy. WSI was provided with Easting and Northing positions for points which were then assigned elevations from the LiDAR. MLA received this report and compared the LiDAR Z values to MLA's surveyed (or known) Z values.

***Table 7**. Absolute accuracy determined by the project surveyor (MLA) using "Blind" Check Points (See Appendix B for PLS report)*

| Delivery | # of Check Points | RMSE | Range |
|---|---|---|---|
| 1 | 735 | 0.062m | 0.240m |
| 2 | 1096 | 0.035m | 0.204m |
| 3 | 1088 | 0.078m | 0.182m |
| 4 | 730 | 0.039m | 0.394m |
| 5 | 2293 | 0.073m | 0.567m |
| 6 | 1510 | 0.050m | 0.730m |
| 7 | 1858 | 0.060m | 0.880m |
| 8 | 604 | 0.030m | 0.280m |
| 9 | 1139 | 0.080m | 0.410m |

## 6. Projection/Datum and Units

| | | |
|---|---|---|
| | **Projection:** | UTM Zone 5, 6, 7 North |
| **Datum** | **Vertical:** | NAVD88 Geoid09 |
| | **Horizontal:** | NAD83 |
| | **Units:** | meters |

## 7. Deliverables

| | |
|---|---|
| **Point Data:** | • All Returns (LAS 1.2 format)<br>• Ground Returns (LAS 1.2 format) |
| **Vector Data:** | • Project Boundary (shapefile format)<br>• Tile Index for LiDAR Points (shapefile format)<br>• Tile Index for DEMs (shapefile format)<br>• Contours (1m shapefile format, DXF format)<br>• RTK (shapefile format, .TXT format)<br>• SBETs (shapefile format, DBF format)<br>• Lake Boundaries (shapefile format) |
| **Raster Data:** | • Elevation Models (1m resolution)<br>  • Hydro-flattened Bare Earth Model (ESRI GRID format)<br>  • Highest Hit Model (ESRI GRID format)<br>  • Vegetation Model (ESRI GRID format)<br>  • nDSM Model (ESRI GRID format)<br>• Intensity Images (GeoTIFF format, 0.5m resolution)<br>• Vegetation Metrics (5m resolution)<br>  • Canopy Cover (ESRI GRID format)<br>  • Coefficient of Variation (ESRI GRID format)<br>  • Mean Elevation (ESRI GRID format) |
| **Data Report:** | • Full report containing introduction, methodology, and accuracy |

## 8. Selected Images

***Figure 27****. Delta Junction airfield. Image is LiDAR point cloud colored by point class and intensity.*

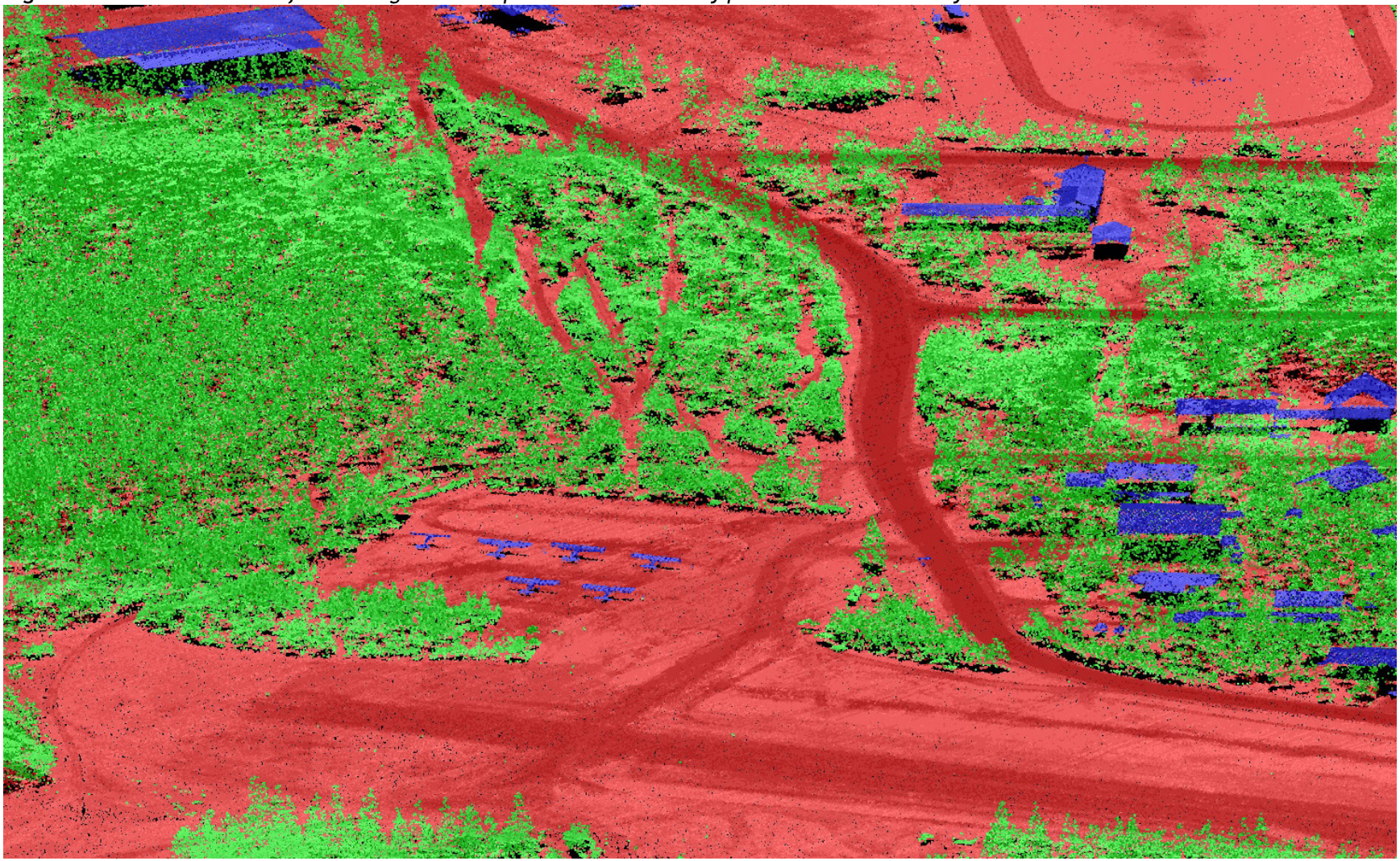


***Figure 28**. View across braided channels of the Tanana River near Dot Lake. Top image is Bare Earth model. Bottom image is LiDAR point cloud colored by elevation.*

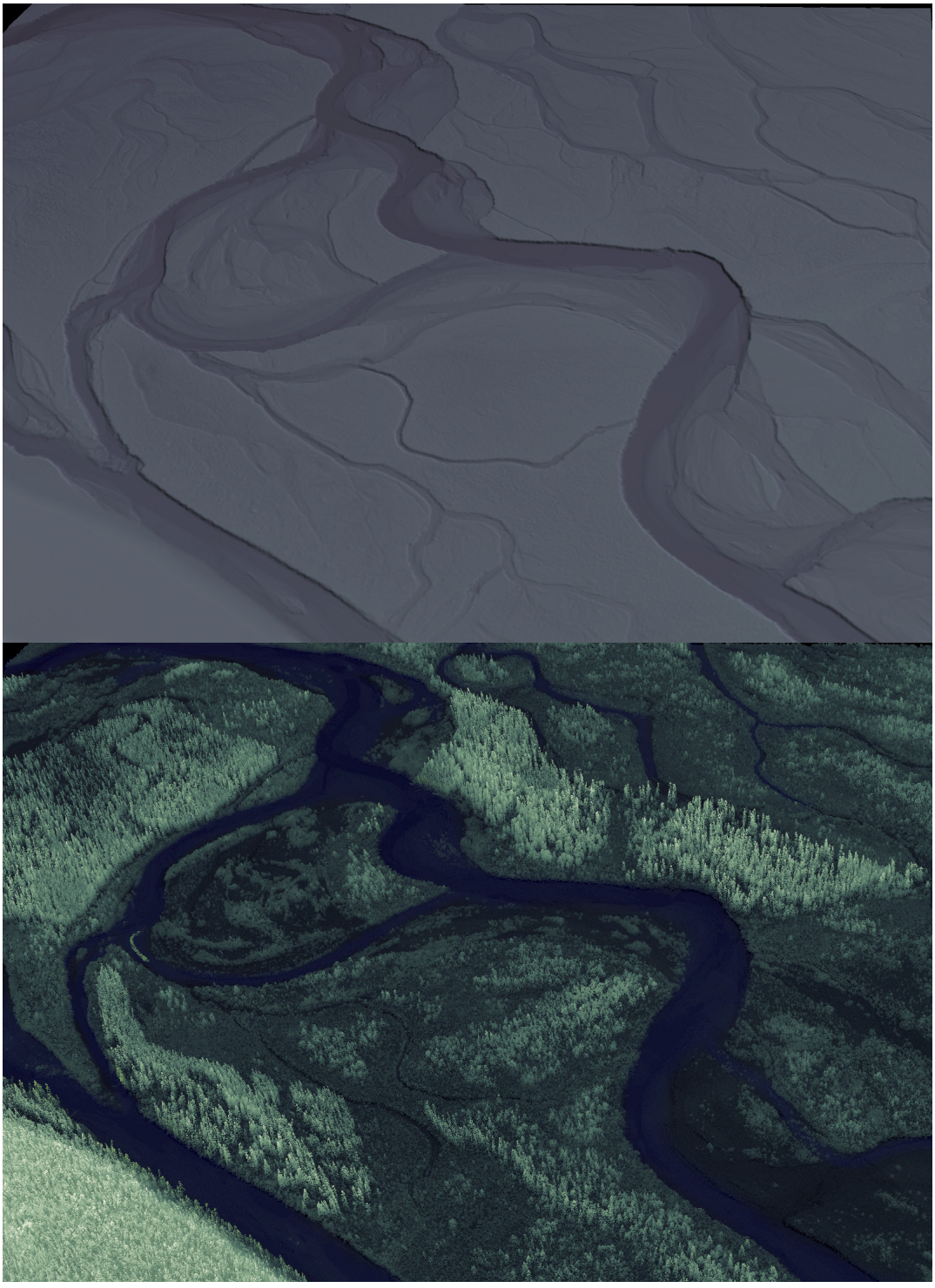


***Figure 29**. View looking north across Gerstle River along A2. Image is 3D LiDAR point cloud colored by elevation.*

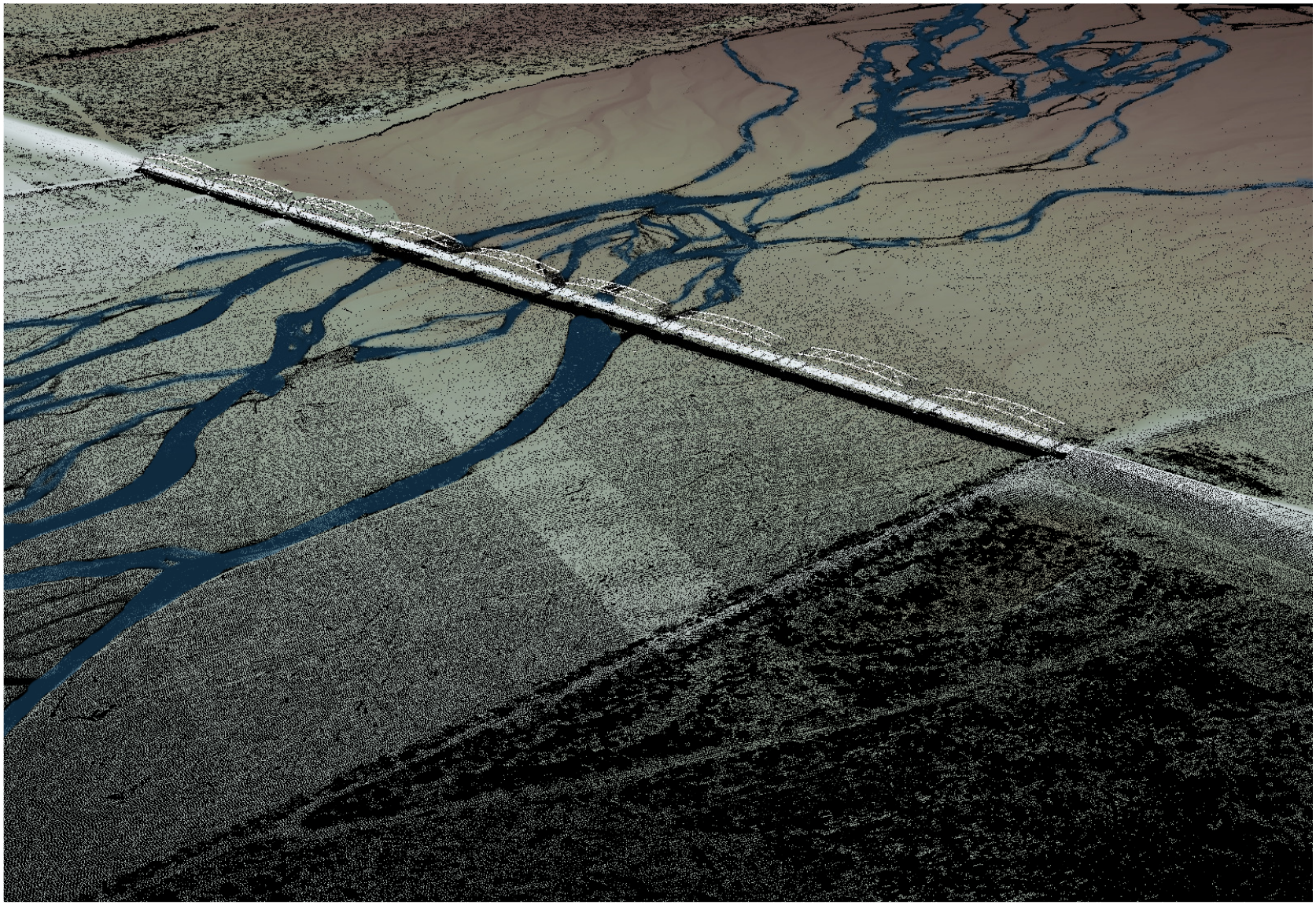


***Figure 30**. Northern end of above ground pipeline near Trims Camp along Hwy 4.*

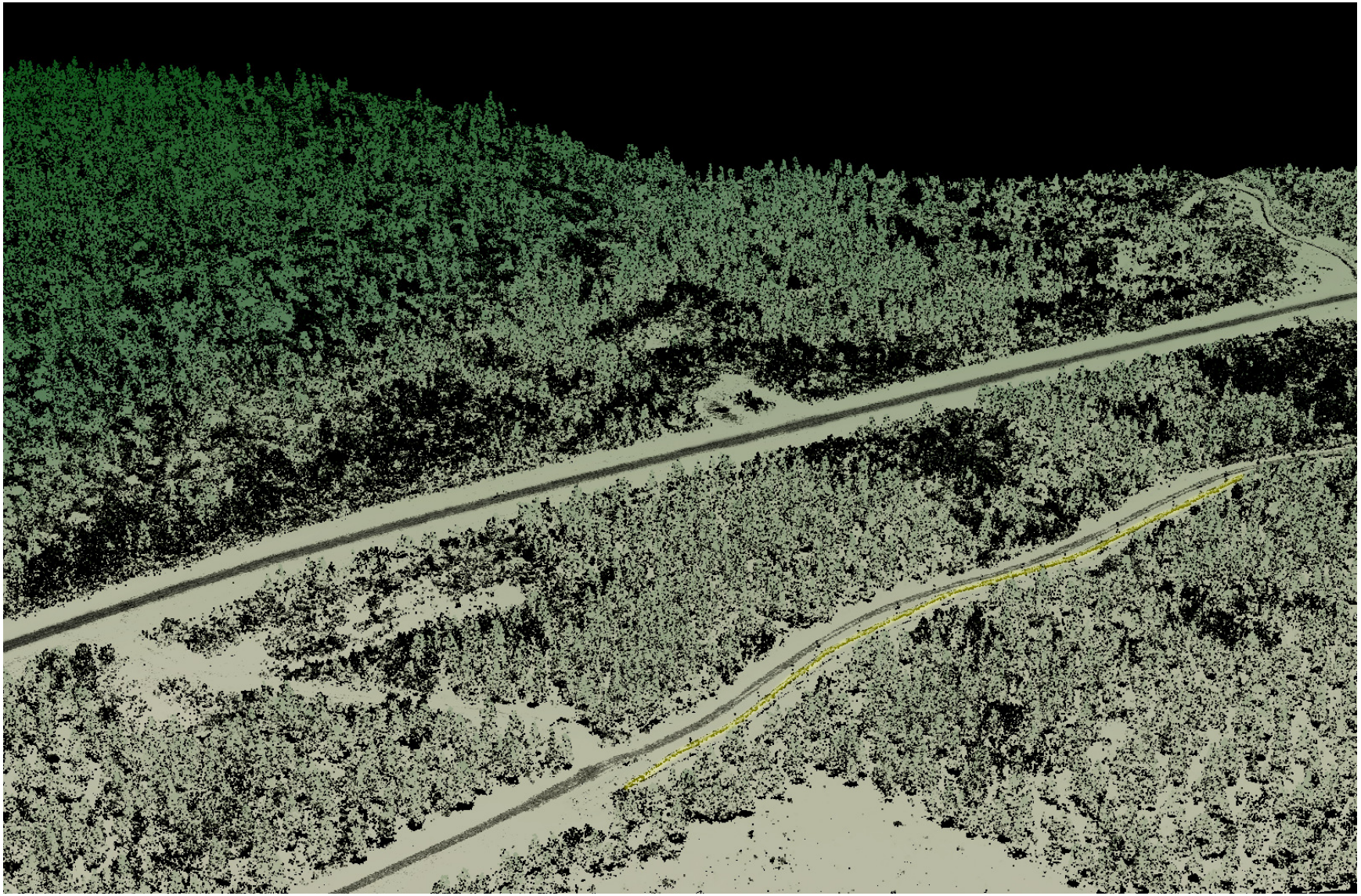


***Figure 31**. View looking North of Pipeline and Hwy 4 as they cross Miller Creek.*

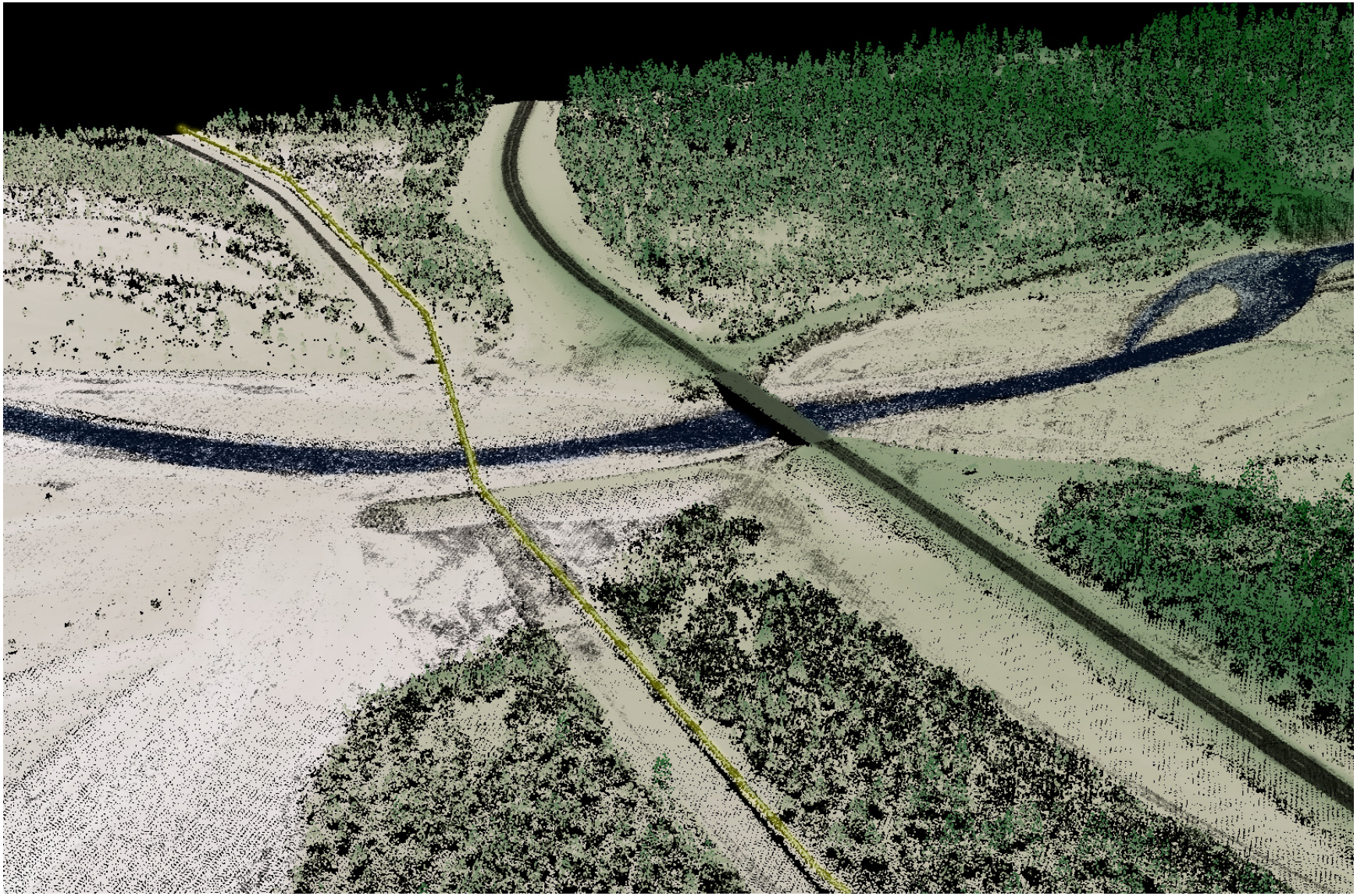


***Figure 32**. View looking Northeast across Hwy 2, just east of Tetlin Junction. Top image is Bare Earth model colored by elevation. Bottom image is Highest Hit model.*

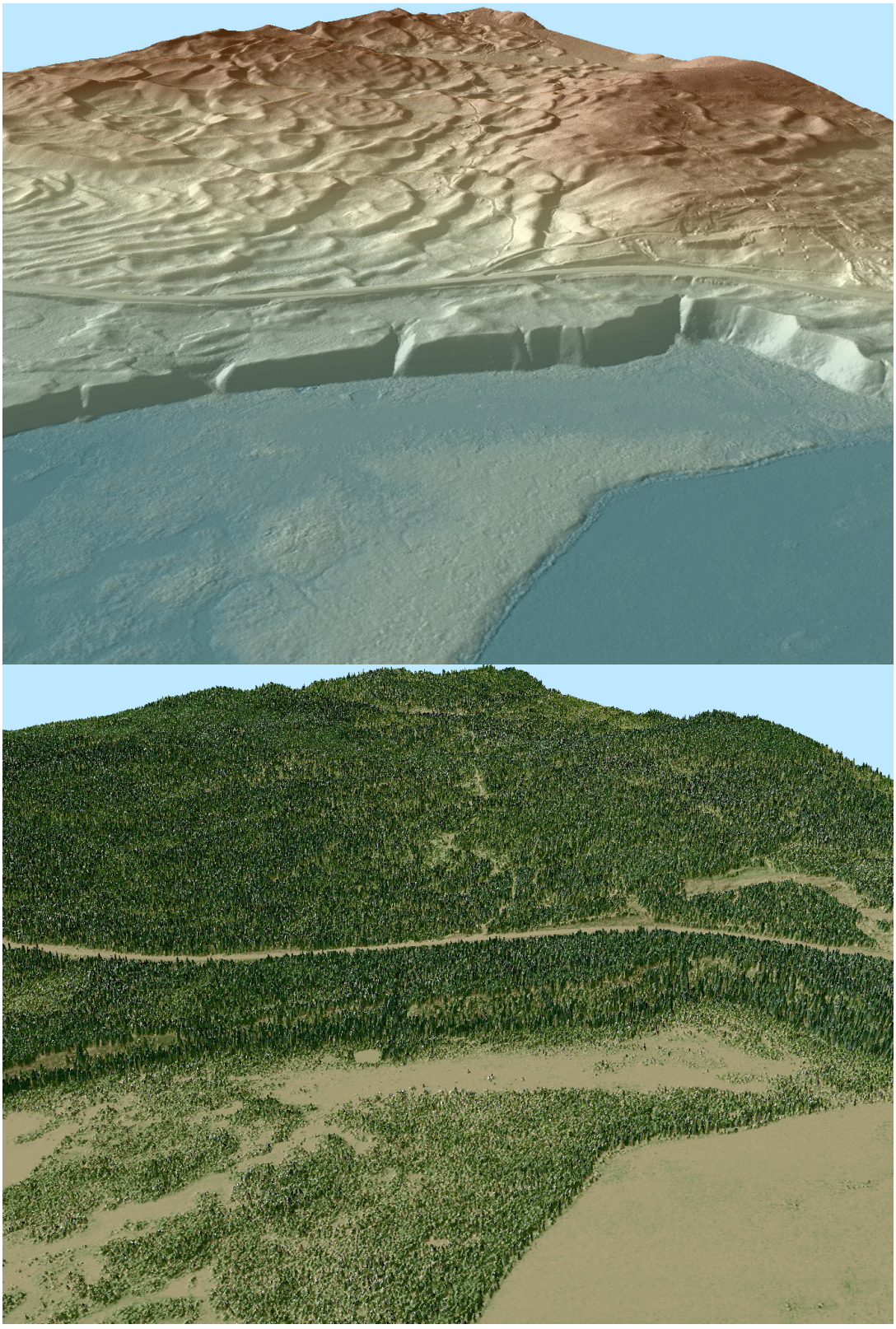


***Figure 33**. Hwy 2, west of where it crosses Gardiner River. Top image is Bare Earth model colored by elevation. Bottom image is Highest Hit model.*

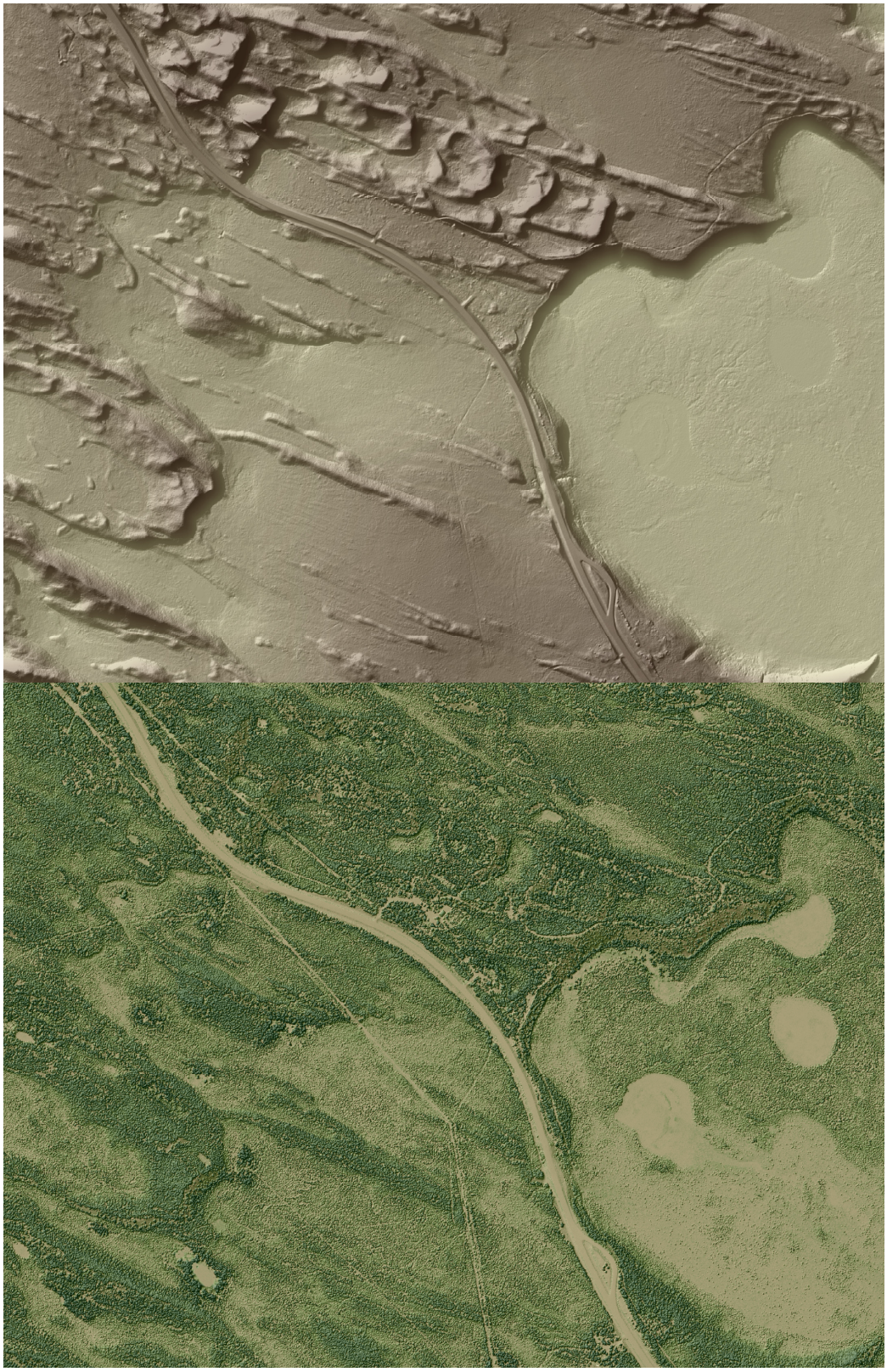
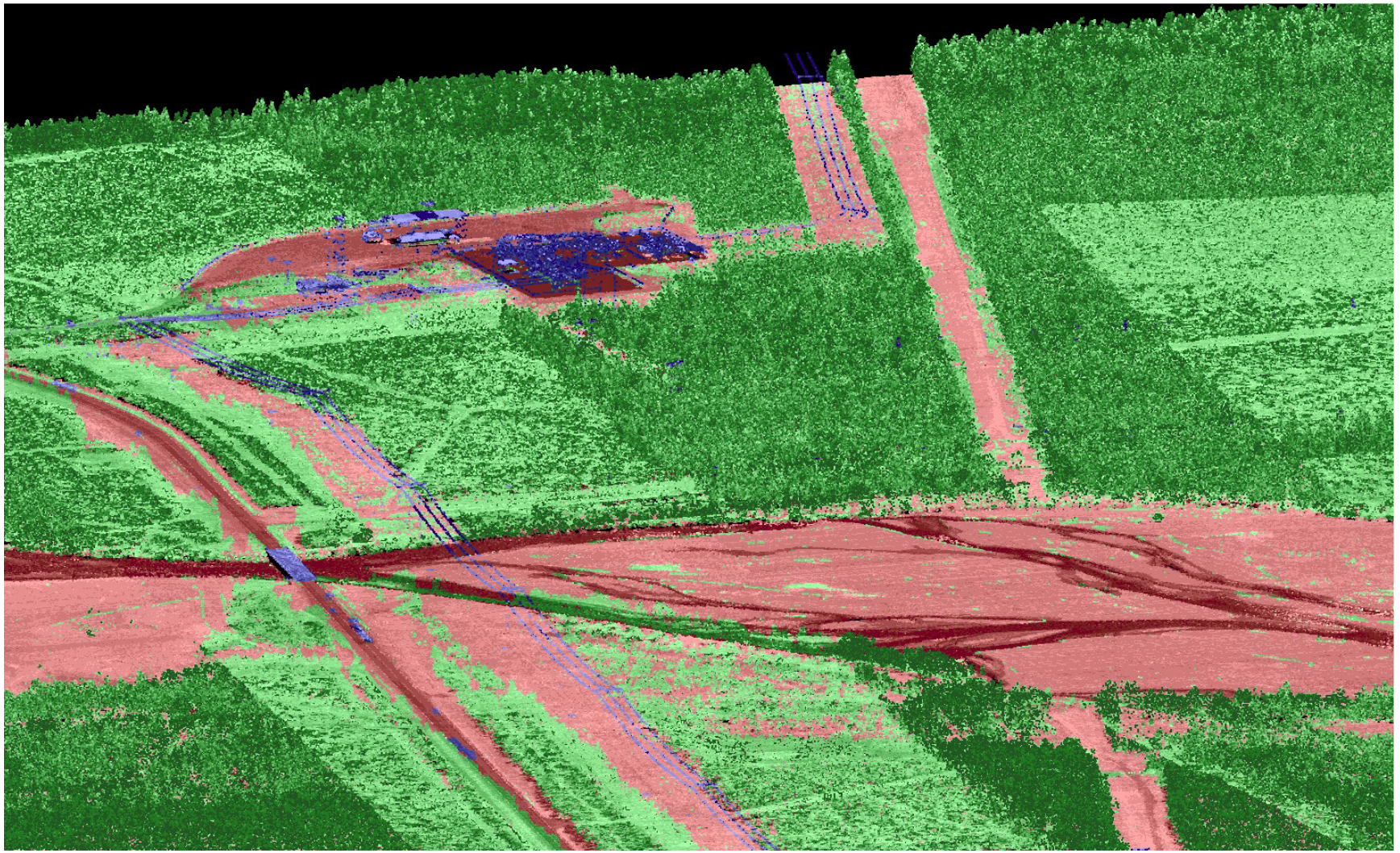


***Figure 34**. Delta Junction power station, looking across Delta River. Image is LiDAR point cloud colored by point class and intensity.*



# 9. Glossary

**1-sigma (σ) Absolute Deviation:** Value for which the data are within one standard deviation (approximately 68$^{th}$ percentile) of a normally distributed data set.

**1.96-sigma (σ) Absolute Deviation:** Value for which the data are within two standard deviations (approximately 95$^{th}$ percentile) of a normally distributed data set.

**Root Mean Square Error (RMSE):** A statistic used to approximate the difference between real-world points and the LiDAR points. It is calculated by squaring all the values, then taking the average of the squares and taking the square root of the average.

**Pulse Rate (PR)**: The rate at which laser pulses are emitted from the sensor; typically measured as thousands of pulses per second (kHz).

**Pulse Returns**: For every laser pulse emitted, the Leica ALS 50 Phase II system can record *up to four* wave forms reflected back to the sensor. Portions of the wave form that return earliest are the highest element in multi-tiered surfaces such as vegetation. Portions of the wave form that return last are the lowest element in multi-tiered surfaces.

**Accuracy**: The statistical comparison between known (surveyed) points and laser points. Typically measured as the standard deviation (sigma, σ) and root mean square error (RMSE).

**Intensity Values**: The peak power ratio of the laser return to the emitted laser. It is a function of surface reflectivity.

**Data Density**: A common measure of LiDAR resolution, measured as points per square meter.

**Spot Spacing**: Also a measure of LiDAR resolution, measured as the average distance between laser points.

**Nadir**: A single point or locus of points on the surface of the earth directly below a sensor as it progresses along its flight line.

**Scan Angle**: The angle from nadir to the edge of the scan, measured in degrees. Laser point accuracy typically decreases as scan angles increase.

**Overlap**: The area shared between flight lines, typically measured in percents; 100% overlap is essential to ensure complete coverage and reduce laser shadows.

**DTM / DEM**: These often-interchanged terms refer to models made from laser points. The digital elevation model (DEM) refers to all surfaces, including bare ground and vegetation, while the digital terrain model (DTM) refers only to those points classified as ground.

**Real-Time Kinematic (RTK) Survey**: GPS surveying is conducted with a GPS base station deployed over a known monument with a radio connection to a GPS rover. Both the base station and rover receive differential GPS data and the baseline correction is solved between the two. This type of ground survey is accurate to 1.5 cm or less.

# 10. Citations

Soininen, A. 2004. TerraScan User's Guide. TerraSolid.

# Appendix A

**LiDAR accuracy error sources and solutions:**

| Type of Error | Source | Post Processing Solution |
|---|---|---|
| GPS (Static/Kinematic) | Long Base Lines | None |
| | Poor Satellite Constellation | None |
| | Poor Antenna Visibility | Reduce Visibility Mask |
| Relative Accuracy | Poor System Calibration | Recalibrate IMU and sensor offsets/settings |
| | Inaccurate System | None |
| Laser Noise | Poor Laser Timing | None |
| | Poor Laser Reception | None |
| | Poor Laser Power | None |
| | Irregular Laser Shape | None |

**Operational measures taken to improve relative accuracy:**

1. Low Flight Altitude: Terrain following is employed to maintain a constant above ground level (AGL). Laser horizontal errors are a function of flight altitude above ground (i.e., ~ 1/3000$^{th}$ AGL flight altitude).
2. Focus Laser Power at narrow beam footprint: A laser return must be received by the system above a power threshold to accurately record a measurement. The strength of the laser return is a function of laser emission power, laser footprint, flight altitude and the reflectivity of the target. While surface reflectivity cannot be controlled, laser power can be increased and low flight altitudes can be maintained.
3. Reduced Scan Angle: Edge-of-scan data can become inaccurate. The scan angle was reduced to a maximum of ±15$^{o}$ from nadir, creating a narrow swath width and greatly reducing laser shadows from trees and buildings.
4. Quality GPS: Flights took place during optimal GPS conditions (e.g., 6 or more satellites and PDOP [Position Dilution of Precision] less than 3.0). Before each flight, the PDOP was determined for the survey day. During all flight times, a dual frequency DGPS base station recording at 1-second epochs was utilized and a maximum baseline length between the aircraft and the control points was less than 19 km (11.5 miles) at all times.
5. Ground Survey: Ground survey point accuracy (i.e. <1.5 cm RMSE) occurs during optimal PDOP ranges and targets a minimal baseline distance of 4 miles between GPS rover and base. Robust statistics are, in part, a function of sample size (n) and distribution. Ground survey RTK points are distributed to the extent possible throughout multiple flight lines and across the survey area.
6. 50% Side-Lap (100% Overlap): Overlapping areas are optimized for relative accuracy testing. Laser shadowing is minimized to help increase target acquisition from multiple scan angles. Ideally, with a 50% side-lap, the most nadir portion of one flight line coincides with the edge (least nadir) portion of overlapping flight lines. A minimum of 50% side-lap with terrain-followed acquisition prevents data gaps.
7. Opposing Flight Lines: All overlapping flight lines are opposing. Pitch, roll and heading errors are amplified by a factor of two relative to the adjacent flight line(s), making misalignments easier to detect and resolve.

# Appendix B

QUALITY CONTROL REVIEW SUMMARY

| | | |
|---|---|---|
| Max. Positive Elev. Deviation: | 0.29 | meters |
| Max. Negative Elev. Deviation: | -0.12 | meters |
| Elevation Deviation Range: | 0.41 | meters |
| Elevation Deviation Mean: | 0.04 | meters |
| **Elevation Deviation RMSE** | **0.08** | **meters** |

(RMSE = Root Mean Square Error)

Total Number of Check Points: 1139

| CHECK POINTS | | | SURVEYED Elevation | | LiDAR Elevation | Deviation |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | DESCRIPTOR | (Meters) | (Meters) |
| 156 | 7105462.43 | 563285.21 | 354.75 | CP-22C | 354.77 | -0.02 |
| 177 | 7060862.72 | 555186.93 | 542.81 | CP-31 B | 542.68 | 0.13 |
| 178 | 7030856.73 | 563200.55 | 758.99 | CP-32 A | 759.00 | -0.01 |
| 179 | 7027848.77 | 563437.20 | 764.70 | CP-32 B | 764.72 | -0.02 |
| 180 | 7003385.07 | 573704.41 | 984.00 | CP-33 A | 983.96 | 0.04 |
| 181 | 7002841.50 | 573356.47 | 984.73 | CP-33 B | 984.74 | -0.01 |
| 182 | 7022476.42 | 563588.49 | 768.57 | CP-33 C | 768.62 | -0.05 |
| 183 | 7010388.79 | 568153.27 | 914.65 | CP-33 D | 914.54 | 0.11 |
| 184 | 6960975.62 | 578408.30 | 800.52 | CP-34 A | 800.48 | 0.04 |
| 185 | 6960140.32 | 578409.69 | 829.54 | CP-34 B | 829.50 | 0.04 |
| 186 | 6935700.74 | 576600.53 | 597.69 | CP-35 A | 597.57 | 0.12 |
| 1100 | 7060862.72 | 555186.92 | 542.80 | 31B20100916FBC | 542.68 | 0.12 |
| 1101 | 7060862.73 | 555172.32 | 542.34 | 31B20100916SGR | 542.37 | -0.03 |
| 1102 | 7060854.67 | 555166.85 | 542.27 | 31B20100916SGR | 542.34 | -0.07 |
| 1103 | 7060844.87 | 555159.12 | 542.39 | 31B20100916SGR | 542.42 | -0.03 |
| 1104 | 7060827.23 | 555165.53 | 542.42 | 31B20100916SGR | 542.45 | -0.03 |
| 1105 | 7060813.90 | 555170.84 | 542.44 | 31B20100916SGR | 542.49 | -0.05 |
| 1106 | 7060863.47 | 555157.62 | 542.23 | 31B20100916SGR | 542.28 | -0.05 |
| 1107 | 7060857.44 | 555152.03 | 542.43 | 31B20100916SGR | 542.41 | 0.02 |
| 1108 | 7060860.72 | 555139.77 | 542.70 | 31B20100916SAR | 542.73 | -0.03 |
| 1109 | 7060843.39 | 555133.62 | 542.80 | 31B20100916SAR | 542.84 | -0.04 |
| 1110 | 7060826.76 | 555127.35 | 542.94 | 31B20100916SAR | 542.97 | -0.03 |
| 1111 | 7060810.58 | 555121.69 | 543.07 | 31B20100916SAR | 543.09 | -0.02 |
| 1112 | 7060793.39 | 555115.71 | 543.21 | 31B20100916SAR | 543.22 | -0.01 |
| 1113 | 7060794.77 | 555112.59 | 543.22 | 31B20100916SAR | 543.24 | -0.02 |
| 1114 | 7060812.79 | 555119.14 | 543.08 | 31B20100916SAR | 543.10 | -0.02 |
| 1115 | 7060830.26 | 555125.35 | 542.92 | 31B20100916SAR | 542.96 | -0.04 |
| 1116 | 7060847.70 | 555131.71 | 542.77 | 31B20100916SAR | 542.81 | -0.04 |
| 1117 | 7060865.09 | 555137.89 | 542.67 | 31B20100916SAR | 542.71 | -0.05 |
| 1118 | 7060870.58 | 555111.20 | 543.72 | 31B20100916SGR | 543.79 | -0.07 |
| 1119 | 7060888.30 | 555114.66 | 543.62 | 31B20100916SGR | 543.68 | -0.06 |
| 1120 | 7060906.64 | 555117.23 | 543.59 | 31B20100916SGR | 543.65 | -0.06 |
| 1121 | 7060925.65 | 555119.04 | 543.48 | 31B20100916SGR | 543.54 | -0.06 |
| 1122 | 7060943.81 | 555119.90 | 543.40 | 31B20100916SGR | 543.44 | -0.04 |
| 1123 | 7060965.51 | 555134.26 | 541.69 | 31B20100916SGR | 541.77 | -0.08 |
| 1124 | 7060959.90 | 555134.36 | 541.83 | 31B20100916SGR | 541.89 | -0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 1125 | 7060961.44 | 555139.21 | 541.93 | 31B20100916SGR | 541.96 | -0.04 |
| 1126 | 7060938.87 | 555135.20 | 542.04 | 31B20100916SGR | 542.10 | -0.06 |
| 1127 | 7060920.67 | 555131.57 | 541.92 | 31B20100916SGR | 541.97 | -0.05 |
| 1128 | 7060078.52 | 554936.97 | 547.28 | 31B20100916SGR | 547.31 | -0.03 |
| 1129 | 7060067.62 | 554921.85 | 546.97 | 31B20100916SGR | 547.01 | -0.04 |
| 1130 | 7060082.53 | 554947.75 | 547.64 | 31B20100916SAR | 547.67 | -0.03 |
| 1131 | 7060100.63 | 554951.58 | 547.59 | 31B20100916SAR | 547.58 | 0.01 |
| 1132 | 7060118.41 | 554955.11 | 547.47 | 31B20100916SAR | 547.50 | -0.03 |
| 1133 | 7060136.18 | 554958.67 | 547.34 | 31B20100916SAR | 547.37 | -0.03 |
| 1134 | 7060135.39 | 554961.93 | 547.33 | 31B20100916SAR | 547.36 | -0.03 |
| 1135 | 7060117.73 | 554958.19 | 547.44 | 31B20100916SAR | 547.49 | -0.05 |
| 1136 | 7060100.00 | 554955.03 | 547.52 | 31B20100916SAR | 547.55 | -0.03 |
| 1137 | 7060081.33 | 554951.32 | 547.63 | 31B20100916SAR | 547.66 | -0.03 |
| 1138 | 7060073.00 | 554949.64 | 547.69 | 31B20100916SAR | 547.72 | -0.03 |
| 1139 | 7060056.42 | 554946.36 | 547.77 | 31B20100916SAR | 547.81 | -0.04 |
| 1140 | 7060040.19 | 554943.14 | 547.89 | 31B20100916SAR | 547.90 | -0.01 |
| 1141 | 7060024.51 | 554936.88 | 548.03 | 31B20100916SAR | 548.01 | 0.02 |
| 1142 | 7060042.46 | 554940.23 | 547.86 | 31B20100916SAR | 547.89 | -0.03 |
| 1143 | 7060060.15 | 554943.73 | 547.74 | 31B20100916SAR | 547.81 | -0.07 |
| 1144 | 7059571.73 | 554904.23 | 550.03 | 31B20100916SGR | 550.04 | -0.01 |
| 1145 | 7059598.28 | 554858.15 | 551.01 | 31B20100916SAR | 551.05 | -0.04 |
| 1146 | 7059579.53 | 554854.29 | 551.16 | 31B20100916SAR | 551.20 | -0.04 |
| 1147 | 7059580.02 | 554851.17 | 551.19 | 31B20100916SAR | 551.22 | -0.03 |
| 1148 | 7059602.47 | 554855.51 | 551.01 | 31B20100916SAR | 551.08 | -0.07 |
| 1149 | 7059620.21 | 554858.79 | 550.91 | 31B20100916SAR | 550.93 | -0.02 |
| 1150 | 7059619.52 | 554862.09 | 550.92 | 31B20100916SAR | 550.90 | 0.02 |
| 1151 | 7059603.07 | 554858.89 | 551.01 | 31B20100916SAR | 551.04 | -0.03 |
| 1152 | 7061407.69 | 555219.83 | 539.25 | 31B20100916SGR | 539.31 | -0.06 |
| 1153 | 7061396.89 | 555222.10 | 539.08 | 31B20100916SGR | 539.12 | -0.04 |
| 1154 | 7061402.89 | 555218.16 | 539.18 | 31B20100916SGR | 539.25 | -0.08 |
| 1155 | 7061419.14 | 555212.54 | 539.22 | 31B20100916SGR | 539.23 | -0.01 |
| 1156 | 7061433.57 | 555210.40 | 539.13 | 31B20100916SGR | 539.19 | -0.06 |
| 1157 | 7061444.22 | 555212.00 | 539.19 | 31B20100916SGR | 539.18 | 0.01 |
| 1158 | 7061463.45 | 555229.99 | 539.77 | 31B20100916SGR | 539.78 | -0.01 |
| 1159 | 7061472.19 | 555229.71 | 539.65 | 31B20100916SGR | 539.71 | -0.06 |
| 1160 | 7061472.01 | 555224.13 | 539.68 | 31B20100916SGR | 539.73 | -0.05 |
| 1161 | 7061464.33 | 555223.88 | 539.78 | 31B20100916SGR | 539.81 | -0.03 |
| 1162 | 7061452.39 | 555208.33 | 539.06 | 31B20100916SGR | 539.11 | -0.05 |
| 1163 | 7061469.12 | 555197.43 | 539.04 | 31B20100916SGR | 539.03 | 0.01 |
| 1164 | 7061475.68 | 555156.45 | 539.11 | 31B20100916SGR | 539.15 | -0.04 |
| 1165 | 7061463.08 | 555146.69 | 539.34 | 31B20100916SGR | 539.39 | -0.05 |
| 1166 | 7061443.09 | 555146.73 | 539.49 | 31B20100916SGR | 539.54 | -0.05 |
| 1167 | 7061421.33 | 555148.23 | 539.48 | 31B20100916SGR | 539.47 | 0.01 |
| 1168 | 7061400.42 | 555144.53 | 539.67 | 31B20100916SGR | 539.69 | -0.02 |
| 1169 | 7061375.10 | 555132.97 | 539.57 | 31B20100916SGR | 539.66 | -0.09 |
| 1170 | 7061498.53 | 555322.03 | 555.18 | 31B20100916SGR | 555.23 | -0.05 |
| 1171 | 7061486.53 | 555331.63 | 554.32 | 31B20100916SGR | 554.36 | -0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 1172 | 7061479.81 | 555329.87 | 554.10 | 31B20100916SGR | 554.13 | -0.03 |
| 1173 | 7061476.75 | 555333.01 | 554.16 | 31B20100916SGR | 554.23 | -0.07 |
| 1174 | 7061443.31 | 555364.50 | 559.65 | 31B20100916SGR | 559.70 | -0.06 |
| 1175 | 7061435.28 | 555369.51 | 560.01 | 31B20100916SGR | 560.07 | -0.06 |
| 1176 | 7061428.83 | 555373.60 | 560.16 | 31B20100916SGR | 560.18 | -0.02 |
| 1177 | 7061412.81 | 555382.64 | 560.14 | 31B20100916SGR | 560.20 | -0.07 |
| 1178 | 7061397.56 | 555392.32 | 560.19 | 31B20100916SGR | 560.23 | -0.04 |
| 1179 | 7061382.31 | 555402.29 | 560.12 | 31B20100916SGR | 560.17 | -0.05 |
| 1180 | 7061378.74 | 555396.85 | 560.11 | 31B20100916SGR | 560.16 | -0.05 |
| 1181 | 7061395.09 | 555387.75 | 560.19 | 31B20100916SGR | 560.24 | -0.05 |
| 1182 | 7061410.15 | 555379.11 | 560.11 | 31B20100916SGR | 560.14 | -0.03 |
| 1183 | 7061425.65 | 555370.27 | 560.19 | 31B20100916SGR | 560.22 | -0.03 |
| 1184 | 7062360.58 | 554981.04 | 573.16 | 31B20100916SAR | 573.20 | -0.04 |
| 1185 | 7062344.74 | 554985.92 | 573.34 | 31B20100916SAR | 573.39 | -0.05 |
| 1186 | 7062347.39 | 554981.97 | 573.36 | 31B20100916SAR | 573.40 | -0.04 |
| 1187 | 7062364.10 | 554976.40 | 573.15 | 31B20100916SAR | 573.22 | -0.07 |
| 1188 | 7062381.37 | 554970.96 | 572.86 | 31B20100916SAR | 572.91 | -0.05 |
| 1189 | 7062389.26 | 554971.93 | 572.70 | 31B20100916SAR | 572.76 | -0.06 |
| 1190 | 7062373.47 | 554976.86 | 572.96 | 31B20100916SAR | 573.06 | -0.10 |
| 1200 | 7027848.77 | 563437.20 | 764.70 | 32B20100916SAC | 764.72 | -0.02 |
| 1201 | 7027847.22 | 563437.09 | 764.70 | 32B20100917SRG | 764.74 | -0.04 |
| 1203 | 7022519.92 | 563468.95 | 769.60 | 32B20100919SGR | 769.65 | -0.05 |
| 1204 | 7022514.16 | 563492.97 | 768.32 | 32B20100920SGR | 768.38 | -0.06 |
| 1205 | 7022685.03 | 563622.49 | 767.03 | 32B20100921SGR | 767.15 | -0.12 |
| 1206 | 7022685.61 | 563648.15 | 768.06 | 32B20100922SPR | 768.12 | -0.06 |
| 1207 | 7022747.53 | 563627.81 | 766.55 | 32B20100923SGR | 766.59 | -0.04 |
| 1208 | 7022761.96 | 563642.00 | 767.63 | 32B20100924SPR | 767.64 | -0.01 |
| 1209 | 7023451.93 | 563235.55 | 766.68 | 32B20100925SPR | 766.72 | -0.04 |
| 1210 | 7023444.59 | 563231.63 | 766.47 | 32B20100926SGR | 766.49 | -0.02 |
| 1211 | 7023416.99 | 563236.80 | 766.11 | 32B20100927SGR | 766.17 | -0.06 |
| 1212 | 7023402.75 | 563247.05 | 766.22 | 32B20100928SPR | 766.26 | -0.04 |
| 1213 | 7024153.32 | 563336.80 | 768.74 | 32B20100929SGR | 768.75 | -0.01 |
| 1214 | 7024193.70 | 563338.01 | 768.49 | 32B20100930SGR | 768.51 | -0.02 |
| 1215 | 7025460.96 | 563650.67 | 761.64 | 32B20100931SGR | 761.69 | -0.06 |
| 1216 | 7025471.26 | 563628.26 | 761.00 | 32B20100932SGR | 761.05 | -0.05 |
| 1217 | 7025459.30 | 563614.90 | 760.92 | 32B20100933SPR | 760.97 | -0.05 |
| 1218 | 7025502.97 | 563615.88 | 761.01 | 32B20100934SPR | 761.07 | -0.06 |
| 1219 | 7026112.55 | 563645.86 | 757.41 | 32B20100935SPR | 757.42 | -0.01 |
| 1220 | 7026141.77 | 563649.22 | 757.53 | 32B20100936SPR | 757.56 | -0.03 |
| 1221 | 7026169.33 | 563643.56 | 757.43 | 32B20100937SPR | 757.45 | -0.02 |
| 1222 | 7027137.03 | 563545.93 | 761.22 | 32B20100938SPR | 761.25 | -0.03 |
| 1223 | 7027159.49 | 563529.92 | 761.04 | 32B20100939SGR | 761.07 | -0.03 |
| 1224 | 7027187.01 | 563539.09 | 761.71 | 32B20100940SPR | 761.69 | 0.02 |
| 1250 | 7027848.77 | 563437.20 | 764.70 | 32B20100941SAC | 764.72 | -0.02 |
| 1251 | 7027847.27 | 563437.02 | 764.71 | 32B20100942GS | 764.74 | -0.03 |
| 1252 | 7028255.10 | 563422.01 | 762.17 | 32B20100943GS | 762.17 | 0.00 |
| 1253 | 7028245.46 | 563415.36 | 762.30 | 32B20100944GS | 762.31 | -0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 1254 | 7028242.45 | 563427.83 | 761.12 | 32B20100945GS | 761.13 | -0.01 |
| 1255 | 7028675.31 | 563460.55 | 762.08 | 32B20100946GS | 762.09 | -0.01 |
| 1256 | 7028667.93 | 563458.21 | 762.08 | 32B20100947GS | 762.05 | 0.03 |
| 1257 | 7028677.76 | 563471.95 | 762.59 | 32B20100948GS | 762.64 | -0.05 |
| 1258 | 7029255.63 | 563430.25 | 756.66 | 32B20100949GS | 756.66 | 0.00 |
| 1259 | 7029244.72 | 563429.76 | 756.61 | 32B20100950GS | 756.59 | 0.02 |
| 1260 | 7029224.20 | 563395.42 | 756.80 | 32B20100951GS | 756.79 | 0.01 |
| 1261 | 7029246.38 | 563390.42 | 756.63 | 32B20100952GS | 756.64 | -0.01 |
| 1262 | 7029712.03 | 563471.96 | 772.40 | 32B20100953GS | 772.37 | 0.03 |
| 1263 | 7029702.95 | 563469.92 | 772.35 | 32B20100954GS | 772.27 | 0.08 |
| 1264 | 7029704.91 | 563477.81 | 772.35 | 32B20100955GS | 772.34 | 0.01 |
| 1265 | 7030828.46 | 563224.83 | 760.39 | 32B20100956GS | 760.34 | 0.05 |
| 1266 | 7030834.82 | 563221.18 | 760.23 | 32B20100957GS | 760.19 | 0.04 |
| 1300 | 7002841.50 | 573356.47 | 984.73 | 33B20100916SAC33BSAC | 984.74 | -0.01 |
| 1301 | 7002842.90 | 573355.75 | 984.75 | 33B20100916SARCK_33B_5o/ | 984.75 | 0.00 |
| 1302 | 6997299.67 | 575991.88 | 987.96 | 33B20100916SARSGR | 987.89 | 0.07 |
| 1303 | 6997337.04 | 575985.18 | 988.38 | 33B20100916SARSGR | 988.30 | 0.08 |
| 1304 | 6997349.28 | 575999.04 | 989.21 | 33B20100916SARSGR | 989.16 | 0.05 |
| 1305 | 6997741.70 | 576142.53 | 983.42 | 33B20100916SARSPR | 983.35 | 0.07 |
| 1306 | 6997763.20 | 576143.81 | 983.52 | 33B20100916SARSPR | 983.42 | 0.10 |
| 1307 | 6997784.27 | 576146.06 | 983.47 | 33B20100916OGSPR | 983.34 | 0.13 |
| 1308 | 6998939.66 | 576151.22 | 981.19 | 33B20100916OGSGR | 981.06 | 0.13 |
| 1309 | 6998922.99 | 576122.85 | 981.37 | 33B20100916SARSGR | 981.23 | 0.14 |
| 1310 | 6998911.48 | 576192.08 | 981.11 | 33B20100916SARSGR | 981.00 | 0.11 |
| 1311 | 6998897.01 | 576218.91 | 982.24 | 33B20100916SARSPR | 982.12 | 0.12 |
| 1312 | 6999735.37 | 575964.02 | 984.41 | 33B20100916SARSPR | 984.26 | 0.15 |
| 1313 | 6999737.33 | 575947.13 | 984.46 | 33B20100916SARSGR | 984.36 | 0.10 |
| 1314 | 6999749.52 | 575933.58 | 984.56 | 33B20100916SARSGR | 984.46 | 0.10 |
| 1315 | 7000345.05 | 576016.44 | 982.13 | 33B20100916SARSGR | 982.01 | 0.12 |
| 1316 | 7000324.37 | 576012.75 | 982.41 | 33B20100916SARSGR | 982.30 | 0.11 |
| 1317 | 7000307.15 | 576013.13 | 982.56 | 33B20100916SARSGR | 982.43 | 0.13 |
| 1318 | 7001183.82 | 575467.52 | 985.00 | 33B20100916SARSPR | 984.91 | 0.09 |
| 1319 | 7001741.45 | 574925.81 | 985.32 | 33B20100916SARSPR | 985.24 | 0.08 |
| 1320 | 7001757.03 | 574906.84 | 985.14 | 33B20100916SARSPR | 985.03 | 0.11 |
| 1321 | 7001750.87 | 574902.96 | 984.78 | 33B20100916SARSGR | 984.69 | 0.09 |
| 1322 | 7001738.33 | 574914.67 | 984.79 | 33B20100916SARSGR | 984.68 | 0.11 |
| 1323 | 7001729.20 | 574928.50 | 984.79 | 33B20100916SARSGR | 984.70 | 0.09 |
| 1324 | 7002110.82 | 574432.09 | 983.48 | 33B20100916SARSGR | 983.44 | 0.04 |
| 1325 | 7002100.64 | 574454.57 | 983.53 | 33B20100916SARSGR | 983.44 | 0.09 |
| 1326 | 7002105.33 | 574460.01 | 983.96 | 33B20100916SARSPR | 983.86 | 0.10 |
| 1327 | 7002121.38 | 574422.04 | 983.82 | 33B20100916SARSPR | 983.74 | 0.08 |
| 1328 | 7002137.27 | 574388.55 | 984.03 | 33B20100916SGRSPR | 983.97 | 0.06 |
| 1329 | 7002131.38 | 574385.36 | 983.50 | 33B20100916SGRSGR | 983.46 | 0.04 |
| 1330 | 7002774.79 | 573514.01 | 989.33 | 33B20100916SGRSGR | 989.28 | 0.05 |
| 1331 | 7002784.03 | 573473.76 | 990.10 | 33B20100916SGRSGR | 990.06 | 0.04 |
| 1332 | 7002837.23 | 573465.43 | 989.82 | 33B20100916SGRSGR | 989.80 | 0.02 |
| 1333 | 7002901.61 | 573612.04 | 987.56 | 33B20100916SGRSGR | 987.50 | 0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 1334 | 7002928.27 | 573612.78 | 987.34 | 33B20100916SGRSGR | 987.31 | 0.03 |
| 1335 | 7003162.97 | 573616.41 | 985.93 | 33B20100916SARSGR | 985.90 | 0.03 |
| 1336 | 7003127.40 | 573604.46 | 986.47 | 33B20100916SARSGR | 986.41 | 0.06 |
| 1337 | 7004601.34 | 574048.88 | 984.97 | 33B20100916SARSGR | 984.88 | 0.09 |
| 1338 | 7004592.01 | 574021.81 | 984.98 | 33B20100916SARSGR | 984.94 | 0.04 |
| 1339 | 7004551.08 | 574015.35 | 985.13 | 33B20100916SARSPR | 985.09 | 0.04 |
| 1340 | 7004602.90 | 574004.58 | 985.13 | 33B20100916SARSPR | 985.12 | 0.01 |
| 1341 | 7006660.34 | 573512.64 | 996.05 | 33B20100916SARSPR | 995.99 | 0.06 |
| 1342 | 7006663.64 | 573520.62 | 995.69 | 33B20100916SARSGR | 995.65 | 0.04 |
| 1343 | 7006700.68 | 573494.93 | 997.93 | 33B20100916SARSPR | 997.88 | 0.05 |
| 1344 | 7006706.52 | 573509.55 | 998.06 | 33B20100916SARSGR | 998.01 | 0.05 |
| 1345 | 7006959.60 | 573265.60 | 1004.43 | 33B20100916SARSGR | 1004.36 | 0.07 |
| 1346 | 7006955.20 | 573315.93 | 1004.59 | 33B20100916SGRSGR | 1004.52 | 0.07 |
| 1347 | 7007436.78 | 572905.58 | 996.24 | 33B20100916SGRSPR | 996.19 | 0.05 |
| 1348 | 7007427.57 | 572894.88 | 995.87 | 33B20100916SARSGR | 995.78 | 0.09 |
| 1349 | 7007451.39 | 572850.28 | 995.69 | 33B20100916SARSGR | 995.56 | 0.13 |
| 1350 | 7007653.85 | 572377.72 | 1001.61 | 33B20100916SARSPR | 1001.46 | 0.15 |
| 1351 | 7007646.74 | 572363.26 | 1001.12 | 33B20100916SARSGR | 1001.06 | 0.06 |
| 1352 | 7007658.75 | 572332.71 | 1001.07 | 33B20100916SARSGR | 1001.00 | 0.07 |
| 1353 | 7007675.95 | 572337.27 | 1001.45 | 33B20100916SARSPR | 1001.36 | 0.09 |
| 1354 | 7006833.76 | 573708.04 | 988.27 | 33B20100916SARSGR | 988.34 | -0.07 |
| 1355 | 7006867.72 | 573692.37 | 988.44 | 33B20100916SARSGR | 988.46 | -0.02 |
| 1356 | 7006888.64 | 573724.02 | 988.57 | 33B20100916SARSGR | 988.68 | -0.11 |
| 1700 | 6960140.31 | 578409.67 | 829.54 | 34B2010090934B | 829.51 | 0.03 |
| 1701 | 6960975.65 | 578406.84 | 800.54 | 34B20100909CK_34A_5'o/s | 800.50 | 0.04 |
| 1702 | 6960980.47 | 578397.05 | 800.47 | 34B20100909SGR | 800.42 | 0.05 |
| 1703 | 6960983.05 | 578384.84 | 800.17 | 34B20100909SGR | 800.12 | 0.05 |
| 1704 | 6960977.75 | 578373.25 | 799.66 | 34B20100909SGR | 799.62 | 0.04 |
| 1705 | 6960959.47 | 578395.99 | 800.58 | 34B20100909SGR | 800.54 | 0.04 |
| 1706 | 6961041.89 | 578290.42 | 796.73 | 34B20100909RDCL | 796.69 | 0.04 |
| 1707 | 6961041.80 | 578291.98 | 796.71 | 34B20100909SPR | 796.68 | 0.03 |
| 1708 | 6961004.13 | 578296.57 | 796.59 | 34B20100909SPR | 796.56 | 0.03 |
| 1709 | 6961005.03 | 578294.79 | 796.63 | 34B20100909RDCL | 796.61 | 0.02 |
| 1710 | 6960966.57 | 578299.34 | 796.31 | 34B20100909RDCL | 796.30 | 0.01 |
| 1711 | 6960966.74 | 578300.98 | 796.30 | 34B20100909SPR | 796.26 | 0.03 |
| 1712 | 6967843.32 | 577266.80 | 831.66 | 34B20100909SGR | 831.59 | 0.07 |
| 1713 | 6967851.22 | 577274.64 | 831.94 | 34B20100909SGR | 831.83 | 0.11 |
| 1714 | 6967839.00 | 577282.91 | 832.75 | 34B20100909SPR | 832.66 | 0.09 |
| 1715 | 6967351.91 | 577248.76 | 840.79 | 34B20100909SPR | 840.74 | 0.05 |
| 1716 | 6967339.93 | 577245.98 | 840.79 | 34B20100909SPR | 840.70 | 0.08 |
| 1717 | 6967328.60 | 577243.50 | 840.76 | 34B20100909SPR | 840.68 | 0.08 |
| 1718 | 6966345.41 | 576716.02 | 831.26 | 34B20100909SPR | 831.17 | 0.09 |
| 1719 | 6966329.01 | 576709.82 | 831.16 | 34B20100909SPR | 831.05 | 0.11 |
| 1720 | 6966313.02 | 576703.62 | 830.96 | 34B20100909SPR | 830.85 | 0.11 |
| 1721 | 6965186.23 | 576575.78 | 812.77 | 34B20100909SGR | 812.65 | 0.12 |
| 1722 | 6965172.20 | 576573.77 | 812.89 | 34B20100909SGR | 812.81 | 0.08 |
| 1723 | 6965156.92 | 576571.93 | 813.08 | 34B20100909SGR | 812.99 | 0.09 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 1724 | 6965154.78 | 576583.49 | 813.02 | 34B20100909SPR | 812.90 | 0.12 |
| 1725 | 6965169.24 | 576584.70 | 812.90 | 34B20100909SPR | 812.78 | 0.12 |
| 1726 | 6965189.50 | 576586.85 | 812.74 | 34B20100909SPR | 812.61 | 0.13 |
| 1727 | 6965177.29 | 576585.51 | 812.86 | 34B20100909SPR | 812.74 | 0.12 |
| 1728 | 6965096.65 | 576253.51 | 824.01 | 34B20100909SGR | 823.95 | 0.06 |
| 1729 | 6965087.98 | 576265.35 | 823.44 | 34B20100909SGR | 823.41 | 0.03 |
| 1730 | 6965078.85 | 576277.25 | 823.35 | 34B20100909SGR | 823.31 | 0.04 |
| 1731 | 6965084.01 | 576291.91 | 822.38 | 34B20100909SGR | 822.34 | 0.04 |
| 1732 | 6964065.98 | 577243.25 | 796.29 | 34B20100909SPR | 796.29 | 0.00 |
| 1733 | 6964057.11 | 577252.91 | 795.87 | 34B20100909SPR | 795.84 | 0.03 |
| 1734 | 6964050.13 | 577260.90 | 795.56 | 34B20100909SPR | 795.55 | 0.01 |
| 1735 | 6963561.99 | 577669.34 | 785.77 | 34B20100909SPR | 785.71 | 0.06 |
| 1736 | 6963548.65 | 577678.52 | 785.23 | 34B20100909SPR | 785.20 | 0.02 |
| 1737 | 6963543.31 | 577673.92 | 785.02 | 34B20100909SGR | 785.03 | -0.01 |
| 1738 | 6963531.04 | 577691.72 | 784.65 | 34B20100909SPR | 784.67 | -0.02 |
| 1739 | 6962680.76 | 577989.88 | 779.05 | 34B20100909SPR | 778.99 | 0.05 |
| 1740 | 6962666.69 | 577992.37 | 779.34 | 34B20100909SPR | 779.25 | 0.09 |
| 1741 | 6962650.98 | 577995.50 | 779.72 | 34B20100909SPR | 779.67 | 0.05 |
| 1742 | 6961820.84 | 578181.56 | 794.36 | 34B20100909SPR | 794.32 | 0.04 |
| 1743 | 6961808.32 | 578183.64 | 794.48 | 34B20100909SPR | 794.43 | 0.05 |
| 1744 | 6961797.99 | 578185.63 | 794.50 | 34B20100909SPR | 794.49 | 0.01 |
| 1745 | 6960592.19 | 578343.61 | 800.59 | 34B20100909SPR | 800.66 | -0.07 |
| 1746 | 6960579.72 | 578345.08 | 801.19 | 34B20100909SPR | 801.21 | -0.02 |
| 1747 | 6960567.22 | 578346.58 | 801.83 | 34B20100909SPR | 801.86 | -0.03 |
| 1748 | 6960150.54 | 578395.18 | 829.90 | 34B20100909SPR | 829.81 | 0.09 |
| 1749 | 6960136.46 | 578397.24 | 830.55 | 34B20100909SPR | 830.46 | 0.09 |
| 1750 | 6960125.77 | 578399.05 | 830.95 | 34B20100909SPR | 830.86 | 0.09 |
| 1751 | 6960138.86 | 578409.32 | 829.59 | 34B20100909CK_34B_5'o/s | 829.55 | 0.04 |
| 1752 | 6960526.76 | 578697.83 | 807.66 | 34B20100909SGR | 807.71 | -0.05 |
| 1753 | 6960521.37 | 578696.74 | 807.84 | 34B20100909SGR | 807.91 | -0.07 |
| 1754 | 6959404.57 | 578663.33 | 825.31 | 34B20100909SPR | 825.23 | 0.08 |
| 1755 | 6959390.03 | 578669.72 | 825.33 | 34B20100909SPR | 825.27 | 0.06 |
| 1756 | 6959375.55 | 578676.49 | 825.35 | 34B20100909SPR | 825.27 | 0.08 |
| 1757 | 6958269.30 | 579280.55 | 847.67 | 34B20100909SPR | 847.62 | 0.05 |
| 1758 | 6958255.91 | 579288.60 | 847.42 | 34B20100909SPR | 847.30 | 0.12 |
| 1759 | 6958242.91 | 579296.60 | 846.99 | 34B20100909SPR | 846.94 | 0.04 |
| 3900 | 7105462.43 | 563285.21 | 354.75 | 22C2011051722CSAC | 354.77 | -0.02 |
| 3901 | 7105472.75 | 563315.79 | 356.61 | 22C20110517SPR | 356.61 | 0.00 |
| 3902 | 7105473.04 | 563348.29 | 357.62 | 22C20110517SPR | 357.62 | 0.00 |
| 3903 | 7105474.12 | 563387.87 | 358.52 | 22C20110517SPR | 358.51 | 0.01 |
| 3904 | 7105468.87 | 563386.77 | 358.53 | 22C20110517SPR | 358.53 | 0.00 |
| 3905 | 7105468.31 | 563356.24 | 357.86 | 22C20110517SPR | 357.84 | 0.02 |
| 3906 | 7105467.71 | 563318.56 | 356.77 | 22C20110517SPR | 356.76 | 0.01 |
| 3907 | 7105466.66 | 563278.32 | 355.22 | 22C20110517SPR | 355.22 | 0.00 |
| 3908 | 7105466.08 | 563243.55 | 353.64 | 22C20110517SPR | 353.63 | 0.01 |
| 3909 | 7105465.43 | 563208.25 | 351.90 | 22C20110517SPR | 351.91 | -0.02 |
| 3910 | 7105464.62 | 563173.99 | 350.17 | 22C20110517SPR | 350.17 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 3911 | 7105463.60 | 563128.46 | 348.23 | 22C20110517SPR | 348.22 | 0.01 |
| 3912 | 7105462.84 | 563090.79 | 346.81 | 22C20110517SPR | 346.82 | -0.01 |
| 3913 | 7105462.14 | 563056.39 | 345.90 | 22C20110517SPR | 345.88 | 0.02 |
| 3914 | 7105467.13 | 563052.56 | 345.79 | 22C20110517SPR | 345.77 | 0.02 |
| 3915 | 7105467.71 | 563089.98 | 346.76 | 22C20110517SPR | 346.76 | 0.00 |
| 3916 | 7105469.00 | 563148.76 | 349.07 | 22C20110517SPR | 349.06 | 0.01 |
| 3917 | 7105469.81 | 563188.39 | 350.88 | 22C20110517SPR | 350.88 | 0.00 |
| 3918 | 7105470.78 | 563233.43 | 353.13 | 22C20110517SPR | 353.14 | -0.01 |
| 3919 | 7105471.42 | 563267.01 | 354.69 | 22C20110517SPR | 354.71 | -0.02 |
| 3920 | 7105463.74 | 562688.04 | 344.12 | 22C20110517SPR | 344.07 | 0.05 |
| 3921 | 7105460.04 | 562719.34 | 344.25 | 22C20110517SPR | 344.20 | 0.05 |
| 3922 | 7105460.73 | 562748.78 | 344.24 | 22C20110517SPR | 344.23 | 0.00 |
| 3923 | 7105461.25 | 562778.38 | 344.23 | 22C20110517SPR | 344.24 | -0.01 |
| 3924 | 7105455.90 | 562757.47 | 344.24 | 22C20110517SPR | 344.23 | 0.01 |
| 3925 | 7105455.35 | 562719.80 | 344.27 | 22C20110517SPR | 344.21 | 0.06 |
| 3926 | 7105454.75 | 562684.16 | 344.31 | 22C20110517SPR | 344.24 | 0.07 |
| 3927 | 7105453.60 | 562649.68 | 344.43 | 22C20110517SPR | 344.34 | 0.09 |
| 3928 | 7105458.95 | 562649.67 | 344.38 | 22C20110517SPR | 344.34 | 0.04 |
| 3929 | 7105496.23 | 562685.12 | 343.49 | 22C20110517SGR | 343.46 | 0.03 |
| 3930 | 7105536.16 | 562685.34 | 343.54 | 22C20110517SGR | 343.52 | 0.02 |
| 3931 | 7105565.33 | 562684.34 | 343.50 | 22C20110517SGR | 343.47 | 0.03 |
| 3932 | 7105607.01 | 562684.58 | 343.65 | 22C20110517SGR | 343.62 | 0.03 |
| 3933 | 7105683.50 | 562681.42 | 343.07 | 22C20110517SGR | 343.02 | 0.05 |
| 3934 | 7105808.11 | 562678.38 | 342.12 | 22C20110517SGR | 342.08 | 0.04 |
| 3935 | 7105825.35 | 562678.35 | 342.04 | 22C20110517SGR | 341.99 | 0.05 |
| 3936 | 7105846.29 | 562676.56 | 341.90 | 22C20110517SGR | 341.88 | 0.02 |
| 3939 | 7106542.04 | 562662.44 | 339.18 | 22C20110517SGR | 339.07 | 0.11 |
| 3940 | 7106521.06 | 562666.85 | 339.33 | 22C20110517SGR | 339.23 | 0.10 |
| 3941 | 7105448.74 | 562157.96 | 344.80 | 22C20110517SPR | 344.78 | 0.02 |
| 3942 | 7105449.44 | 562188.14 | 344.73 | 22C20110517SPR | 344.72 | 0.01 |
| 3943 | 7105450.36 | 562229.71 | 344.55 | 22C20110517SPR | 344.53 | 0.02 |
| 3944 | 7105450.99 | 562259.84 | 344.48 | 22C20110517SPR | 344.47 | 0.00 |
| 3945 | 7105445.85 | 562262.70 | 344.51 | 22C20110517SPR | 344.49 | 0.02 |
| 3946 | 7105445.19 | 562229.81 | 344.58 | 22C20110517SPR | 344.54 | 0.04 |
| 3947 | 7105444.25 | 562188.60 | 344.80 | 22C20110517SPR | 344.78 | 0.02 |
| 3948 | 7105443.60 | 562152.97 | 344.84 | 22C20110517SPR | 344.81 | 0.03 |
| 3949 | 7105442.69 | 562102.89 | 344.98 | 22C20110517SPR | 344.97 | 0.01 |
| 3950 | 7105441.78 | 562063.40 | 345.10 | 22C20110517SPR | 345.08 | 0.02 |
| 3951 | 7105447.04 | 562065.98 | 345.03 | 22C20110517SPR | 345.03 | 0.00 |
| 3952 | 7105450.69 | 562097.41 | 344.84 | 22C20110517SPR | 344.82 | 0.02 |
| 3953 | 7105447.75 | 562132.05 | 344.87 | 22C20110517SPR | 344.82 | 0.05 |
| 3954 | 7105430.21 | 561251.78 | 347.02 | 22C20110517SPR | 347.05 | -0.03 |
| 3955 | 7105430.80 | 561282.09 | 347.19 | 22C20110517SPR | 347.24 | -0.05 |
| 3956 | 7105431.58 | 561314.57 | 347.30 | 22C20110517SPR | 347.36 | -0.06 |
| 3957 | 7105432.13 | 561346.75 | 347.29 | 22C20110517SPR | 347.33 | -0.04 |
| 3958 | 7105433.11 | 561395.12 | 347.16 | 22C20110517SPR | 347.20 | -0.04 |
| 3959 | 7105433.85 | 561425.73 | 347.00 | 22C20110517SPR | 347.05 | -0.05 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 3960 | 7105434.44 | 561456.88 | 346.87 | 22C20110517SPR | 346.91 | -0.04 |
| 3961 | 7105429.27 | 561451.59 | 346.93 | 22C20110517SPR | 346.97 | -0.04 |
| 3962 | 7105428.83 | 561418.56 | 347.09 | 22C20110517SPR | 347.13 | -0.04 |
| 3963 | 7105427.94 | 561378.04 | 347.24 | 22C20110517SPR | 347.27 | -0.03 |
| 3964 | 7105426.99 | 561336.12 | 347.35 | 22C20110517SPR | 347.38 | -0.03 |
| 3965 | 7105426.09 | 561291.74 | 347.26 | 22C20110517SPR | 347.27 | -0.01 |
| 3966 | 7105425.24 | 561253.49 | 347.06 | 22C20110517SPR | 347.10 | -0.04 |
| 3967 | 7105430.88 | 561217.15 | 346.87 | 22C20110517SPR | 346.91 | -0.04 |
| 3968 | 7105400.27 | 561216.00 | 347.24 | 22C20110517SPR | 347.26 | -0.02 |
| 3969 | 7105370.82 | 561226.11 | 347.33 | 22C20110517SPR | 347.35 | -0.02 |
| 3970 | 7105338.52 | 561235.15 | 347.42 | 22C20110517SPR | 347.44 | -0.02 |
| 3971 | 7105306.02 | 561244.16 | 347.52 | 22C20110517SPR | 347.53 | -0.01 |
| 3972 | 7105271.04 | 561254.05 | 347.54 | 22C20110517SPR | 347.53 | 0.01 |
| 3973 | 7105269.19 | 561244.67 | 347.51 | 22C20110517SPR | 347.52 | -0.01 |
| 3974 | 7105301.46 | 561235.64 | 347.48 | 22C20110517SPR | 347.51 | -0.03 |
| 3975 | 7105343.02 | 561223.91 | 347.41 | 22C20110517SPR | 347.43 | -0.03 |
| 3976 | 7105383.22 | 561212.89 | 347.33 | 22C20110517SPR | 347.35 | -0.02 |
| 3977 | 7105421.34 | 561202.19 | 347.10 | 22C20110517SPR | 347.14 | -0.04 |
| 3978 | 7105460.51 | 561191.40 | 346.91 | 22C20110517SPR | 346.93 | -0.02 |
| 3979 | 7105520.80 | 561174.63 | 346.65 | 22C20110517SPR | 346.67 | -0.02 |
| 3980 | 7105566.56 | 561161.77 | 346.58 | 22C20110517SPR | 346.60 | -0.02 |
| 3981 | 7105634.24 | 561142.83 | 346.67 | 22C20110517SPR | 346.70 | -0.03 |
| 3982 | 7105698.45 | 561124.87 | 346.60 | 22C20110517SPR | 346.62 | -0.02 |
| 3983 | 7105748.54 | 561110.73 | 346.54 | 22C20110517SPR | 346.56 | -0.02 |
| 3984 | 7105808.34 | 561093.92 | 346.20 | 22C20110517SPR | 346.22 | -0.03 |
| 3985 | 7105870.86 | 561076.43 | 345.89 | 22C20110517SPR | 345.91 | -0.02 |
| 3986 | 7105945.52 | 561055.57 | 345.56 | 22C20110517SPR | 345.59 | -0.03 |
| 3987 | 7106025.81 | 561032.88 | 345.08 | 22C20110517SPR | 345.09 | -0.01 |
| 3988 | 7106106.85 | 561010.30 | 344.74 | 22C20110517SPR | 344.78 | -0.04 |
| 3989 | 7106187.15 | 560987.72 | 344.23 | 22C20110517SPR | 344.27 | -0.04 |
| 3990 | 7106241.13 | 560972.66 | 344.00 | 22C20110517SPR | 344.04 | -0.04 |
| 3991 | 7106317.84 | 560951.33 | 343.70 | 22C20110517SPR | 343.76 | -0.06 |
| 3992 | 7106268.89 | 560972.07 | 343.94 | 22C20110517SPR | 343.99 | -0.05 |
| 3993 | 7106209.41 | 560988.68 | 344.16 | 22C20110517SPR | 344.18 | -0.03 |
| 3994 | 7106151.78 | 561004.85 | 344.54 | 22C20110517SPR | 344.58 | -0.04 |
| 3995 | 7106099.28 | 561022.20 | 344.79 | 22C20110517SPR | 344.80 | -0.01 |
| 3996 | 7106094.69 | 561021.20 | 344.82 | 22C20110517SPR | 344.87 | -0.05 |
| 3997 | 7106041.12 | 561035.81 | 345.04 | 22C20110517SPR | 345.09 | -0.05 |
| 3998 | 7105985.68 | 561051.54 | 345.35 | 22C20110517SPR | 345.40 | -0.05 |
| 3999 | 7105932.06 | 561066.68 | 345.69 | 22C20110517SPR | 345.71 | -0.02 |
| 4000 | 7105870.54 | 561083.89 | 345.93 | 22C20110517SPR | 345.97 | -0.04 |
| 4001 | 7105821.70 | 561097.59 | 346.16 | 22C20110517SPR | 346.21 | -0.05 |
| 4002 | 7105754.21 | 561116.40 | 346.59 | 22C20110517SPR | 346.60 | -0.01 |
| 4003 | 7105698.75 | 561132.43 | 346.62 | 22C20110517SPR | 346.62 | 0.00 |
| 4004 | 7105645.09 | 561146.99 | 346.70 | 22C20110517SPR | 346.69 | 0.00 |
| 4005 | 7105593.70 | 561161.75 | 346.65 | 22C20110517SPR | 346.70 | -0.05 |
| 4006 | 7105532.52 | 561178.72 | 346.64 | 22C20110517SPR | 346.69 | -0.05 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 4007 | 7105475.66 | 561194.19 | 346.88 | 22C20110517SPR | 346.93 | -0.05 |
| 4008 | 7107788.24 | 560540.00 | 338.54 | 22C20110517SPR | 338.56 | -0.02 |
| 4009 | 7107820.46 | 560530.85 | 338.51 | 22C20110517SPR | 338.56 | -0.05 |
| 4010 | 7107857.19 | 560520.66 | 338.41 | 22C20110517SPR | 338.44 | -0.04 |
| 4011 | 7107893.13 | 560510.55 | 338.20 | 22C20110517SPR | 338.24 | -0.04 |
| 4012 | 7107930.99 | 560499.91 | 337.91 | 22C20110517SPR | 337.94 | -0.03 |
| 4013 | 7107965.36 | 560490.36 | 337.69 | 22C20110517SPR | 337.71 | -0.02 |
| 4014 | 7107994.73 | 560482.18 | 337.38 | 22C20110517SPR | 337.40 | -0.02 |
| 4015 | 7108032.64 | 560471.71 | 337.07 | 22C20110517SPR | 337.07 | 0.00 |
| 4016 | 7108033.53 | 560478.78 | 337.08 | 22C20110517SPR | 337.12 | -0.04 |
| 4017 | 7107996.15 | 560489.06 | 337.39 | 22C20110517SPR | 337.42 | -0.03 |
| 4018 | 7107956.03 | 560500.43 | 337.76 | 22C20110517SPR | 337.80 | -0.04 |
| 4019 | 7107910.71 | 560513.07 | 338.15 | 22C20110517SPR | 338.17 | -0.02 |
| 4020 | 7107872.33 | 560523.44 | 338.38 | 22C20110517SPR | 338.40 | -0.02 |
| 4021 | 7107835.61 | 560533.80 | 338.54 | 22C20110517SPR | 338.56 | -0.02 |
| 4022 | 7107803.10 | 560542.80 | 338.57 | 22C20110517SPR | 338.62 | -0.05 |
| 4023 | 7107768.07 | 560552.87 | 338.49 | 22C20110517SPR | 338.54 | -0.05 |
| 4024 | 7107738.70 | 560561.25 | 338.47 | 22C20110517SPR | 338.50 | -0.03 |
| 4025 | 7107737.16 | 560554.24 | 338.47 | 22C20110517SPR | 338.49 | -0.02 |
| 4026 | 7107765.07 | 560546.41 | 338.46 | 22C20110517SPR | 338.48 | -0.02 |
| 4027 | 7105465.05 | 563285.13 | 355.47 | 22C20110517CHECK | 355.45 | 0.02 |
| 4028 | 7105465.05 | 563285.12 | 355.46 | 22C20110517CHECK | 355.45 | 0.01 |
| 5301 | 6935699.38 | 576601.35 | 597.55 | 35B20100927CK_35A_5'o/s | 597.52 | 0.03 |
| 5302 | 6935709.68 | 576591.13 | 598.02 | 35B20100927SPR | 597.95 | 0.07 |
| 5303 | 6935698.43 | 576590.31 | 597.93 | 35B20100927SPR | 597.92 | 0.01 |
| 5304 | 6935686.41 | 576589.49 | 597.78 | 35B20100927SPR | 597.74 | 0.04 |
| 5305 | 6936280.47 | 576794.42 | 601.85 | 35B20100927SPR | 601.80 | 0.05 |
| 5306 | 6936291.46 | 576801.53 | 602.01 | 35B20100927SPR | 601.96 | 0.05 |
| 5307 | 6936308.67 | 576812.26 | 602.19 | 35B20100927SPR | 602.17 | 0.02 |
| 5308 | 6936754.15 | 577042.75 | 606.49 | 35B20100927SPR | 606.43 | 0.06 |
| 5309 | 6936766.02 | 577048.97 | 606.46 | 35B20100927SPR | 606.47 | -0.01 |
| 5310 | 6936775.33 | 577053.77 | 606.49 | 35B20100927SPR | 606.47 | 0.02 |
| 5311 | 6937392.02 | 577315.66 | 612.82 | 35B20100927SPR | 612.86 | -0.04 |
| 5312 | 6937403.06 | 577319.71 | 613.18 | 35B20100927SPR | 613.14 | 0.04 |
| 5313 | 6937418.97 | 577325.53 | 613.58 | 35B20100927SPR | 613.59 | -0.01 |
| 5314 | 6938087.22 | 577326.14 | 625.80 | 35B20100927SPR | 625.81 | -0.01 |
| 5315 | 6938101.49 | 577328.02 | 625.98 | 35B20100927SPR | 626.05 | -0.07 |
| 5316 | 6938114.43 | 577329.85 | 626.22 | 35B20100927SPR | 626.26 | -0.04 |
| 5317 | 6938681.51 | 577518.55 | 632.59 | 35B20100927SPR | 632.62 | -0.03 |
| 5318 | 6938700.11 | 577525.66 | 632.82 | 35B20100927SPR | 632.88 | -0.06 |
| 5319 | 6938719.15 | 577533.54 | 633.15 | 35B20100927SPR | 633.23 | -0.08 |
| 5320 | 6939407.48 | 577719.89 | 645.64 | 35B20100927SPR | 645.74 | -0.10 |
| 5321 | 6939417.23 | 577725.14 | 645.89 | 35B20100927SPR | 645.92 | -0.03 |
| 5322 | 6939425.64 | 577730.18 | 646.08 | 35B20100927SPR | 646.11 | -0.03 |
| 5323 | 6939947.25 | 578047.12 | 666.98 | 35B20100927SPR | 666.90 | 0.08 |
| 5324 | 6939958.78 | 578054.17 | 667.46 | 35B20100927SPR | 667.34 | 0.12 |
| 5325 | 6939968.22 | 578059.91 | 667.76 | 35B20100927SPR | 667.72 | 0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5326 | 6939969.71 | 578036.70 | 666.49 | 35B20100927FBC | 666.37 | 0.12 |
| 5327 | 6940561.99 | 578420.77 | 678.05 | 35B20100927SPR | 678.11 | -0.06 |
| 5328 | 6940571.18 | 578426.16 | 678.17 | 35B20100927SPR | 678.19 | -0.02 |
| 5329 | 6940587.26 | 578435.82 | 678.37 | 35B20100927SPR | 678.36 | 0.01 |
| 5330 | 6941175.71 | 578793.56 | 680.20 | 35B20100927SPR | 680.23 | -0.03 |
| 5331 | 6941188.40 | 578801.38 | 680.20 | 35B20100927SPR | 680.22 | -0.02 |
| 5332 | 6941198.15 | 578807.21 | 680.27 | 35B20100927SPR | 680.26 | 0.01 |
| 5333 | 6941760.13 | 579148.30 | 680.63 | 35B20100927SPR | 680.62 | 0.01 |
| 5334 | 6941744.60 | 579138.83 | 680.73 | 35B20100927SPR | 680.74 | -0.01 |
| 5335 | 6935079.52 | 576516.17 | 596.86 | 35B20100927SPR | 596.77 | 0.09 |
| 5336 | 6935065.54 | 576510.44 | 596.72 | 35B20100927SPR | 596.65 | 0.07 |
| 5337 | 6935057.11 | 576507.14 | 596.61 | 35B20100927SPR | 596.55 | 0.06 |
| 7800 | 7003385.07 | 573704.41 | 984.00 | 33A2011060733AFAC | 983.96 | 0.04 |
| 7801 | 7003385.07 | 573704.41 | 984.00 | 33A20110607FAC | 983.96 | 0.04 |
| 7802 | 7002869.76 | 573357.27 | 984.92 | 33A20110607SPR | 984.85 | 0.07 |
| 7803 | 7002851.23 | 573365.16 | 984.86 | 33A20110607SPR | 984.80 | 0.06 |
| 7804 | 7002831.41 | 573376.24 | 984.88 | 33A20110607SPR | 984.81 | 0.07 |
| 7805 | 7002459.05 | 573756.62 | 984.42 | 33A20110607SPR | 984.34 | 0.08 |
| 7806 | 7002445.57 | 573774.44 | 984.31 | 33A20110607SPR | 984.25 | 0.06 |
| 7807 | 7002435.19 | 573789.17 | 984.26 | 33A20110607SPR | 984.24 | 0.02 |
| 7808 | 7002134.45 | 574391.62 | 983.95 | 33A20110607SPR | 983.88 | 0.07 |
| 7809 | 7002126.09 | 574410.68 | 983.85 | 33A20110607SPR | 983.79 | 0.06 |
| 7810 | 7002120.57 | 574424.01 | 983.83 | 33A20110607SPR | 983.76 | 0.07 |
| 7811 | 7001881.72 | 574756.68 | 985.02 | 33A20110607SPR | 984.90 | 0.12 |
| 7812 | 7001869.36 | 574770.99 | 984.98 | 33A20110607SPR | 984.91 | 0.07 |
| 7813 | 7001859.76 | 574782.35 | 984.97 | 33A20110607SPR | 984.89 | 0.08 |
| 7814 | 7001198.68 | 575452.28 | 985.11 | 33A20110607SPR | 985.01 | 0.10 |
| 7815 | 7001187.97 | 575463.48 | 985.00 | 33A20110607SPR | 984.92 | 0.08 |
| 7816 | 7001176.73 | 575475.49 | 984.93 | 33A20110607SPR | 984.84 | 0.09 |
| 7817 | 7000647.61 | 575892.12 | 984.90 | 33A20110607SPR | 984.78 | 0.12 |
| 7818 | 7000635.66 | 575903.07 | 984.87 | 33A20110607SPR | 984.75 | 0.12 |
| 7819 | 7000622.54 | 575915.29 | 984.84 | 33A20110607SPR | 984.71 | 0.13 |
| 7820 | 6999755.97 | 575937.21 | 984.51 | 33A20110607SPR | 984.38 | 0.13 |
| 7821 | 6999742.56 | 575953.80 | 984.42 | 33A20110607SPR | 984.30 | 0.12 |
| 7822 | 6999734.30 | 575963.87 | 984.42 | 33A20110607SPR | 984.29 | 0.13 |
| 7823 | 6998905.77 | 576221.14 | 982.19 | 33A20110607SPR | 982.07 | 0.12 |
| 7824 | 6998889.12 | 576215.51 | 982.26 | 33A20110607SPR | 982.13 | 0.13 |
| 7825 | 6998909.44 | 576221.94 | 982.14 | 33A20110607SPR | 982.01 | 0.13 |
| 7826 | 7003278.95 | 573629.00 | 984.53 | 33A20110607SPR | 984.45 | 0.08 |
| 7827 | 7003289.44 | 573636.42 | 984.43 | 33A20110607SPR | 984.38 | 0.05 |
| 7828 | 7003301.83 | 573645.11 | 984.34 | 33A20110607SPR | 984.30 | 0.04 |
| 7829 | 7003975.91 | 574140.38 | 984.81 | 33A20110607SPR | 984.75 | 0.06 |
| 7830 | 7003990.64 | 574139.35 | 984.72 | 33A20110607SPR | 984.65 | 0.07 |
| 7831 | 7004002.96 | 574138.09 | 984.72 | 33A20110607SPR | 984.65 | 0.07 |
| 7832 | 7004568.07 | 574013.19 | 985.16 | 33A20110607SPR | 985.09 | 0.07 |
| 7833 | 7004584.20 | 574009.15 | 985.18 | 33A20110607SPR | 985.12 | 0.06 |
| 7834 | 7004601.13 | 574005.28 | 985.16 | 33A20110607SPR | 985.10 | 0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 7835 | 7005448.88 | 573915.61 | 986.30 | 33A20110607SPR | 986.21 | 0.09 |
| 7836 | 7005464.58 | 573917.92 | 986.18 | 33A20110607SPR | 986.11 | 0.07 |
| 7837 | 7005488.66 | 573920.58 | 986.17 | 33A20110607SPR | 986.09 | 0.07 |
| 7838 | 7006357.54 | 573644.92 | 987.16 | 33A20110607SPR | 987.09 | 0.06 |
| 7839 | 7006374.65 | 573637.49 | 987.23 | 33A20110607SPR | 987.17 | 0.06 |
| 7840 | 7006392.19 | 573629.82 | 987.27 | 33A20110607SPR | 987.19 | 0.08 |
| 7841 | 7006871.68 | 573420.29 | 1001.32 | 33A20110607SPR | 1001.27 | 0.05 |
| 7842 | 7006888.65 | 573412.52 | 1001.39 | 33A20110607SPR | 1001.33 | 0.06 |
| 7843 | 7006902.45 | 573406.59 | 1001.43 | 33A20110607SPR | 1001.38 | 0.05 |
| 7844 | 7007437.18 | 572904.46 | 996.24 | 33A20110607SPR | 996.15 | 0.09 |
| 7845 | 7007444.87 | 572887.85 | 996.26 | 33A20110607SPR | 996.19 | 0.07 |
| 7846 | 7007453.95 | 572867.97 | 996.20 | 33A20110607SPR | 996.10 | 0.10 |
| 7847 | 7008002.60 | 571537.85 | 982.22 | 33A20110607SPR | 982.15 | 0.07 |
| 7848 | 7008015.30 | 571523.48 | 982.05 | 33A20110607SPR | 981.96 | 0.09 |
| 7849 | 7008024.35 | 571514.14 | 981.95 | 33A20110607SPR | 981.82 | 0.13 |
| 7850 | 7007697.86 | 572296.66 | 1000.98 | 33A20110607SPR | 1000.86 | 0.12 |
| 7851 | 7007692.53 | 572306.68 | 1001.10 | 33A20110607SPR | 1001.01 | 0.09 |
| 7852 | 7007685.12 | 572319.01 | 1001.26 | 33A20110607SPR | 1001.17 | 0.09 |
| 7853 | 7003386.97 | 573706.77 | 983.98 | 33A20110607CK_SPIKE | 983.92 | 0.06 |
| 7854 | 7006883.55 | 573683.15 | 988.28 | 33A20110607SGR | 988.25 | 0.03 |
| 7855 | 7006866.98 | 573693.13 | 988.55 | 33A20110607SGR | 988.48 | 0.07 |
| 7856 | 7006830.39 | 573716.99 | 988.35 | 33A20110607SGR | 988.27 | 0.08 |
| 7857 | 7006811.51 | 573728.61 | 988.44 | 33A20110607SGR | 988.36 | 0.08 |
| 7858 | 7006823.63 | 573686.40 | 988.49 | 33A20110607SGR | 988.43 | 0.06 |
| 7859 | 7006846.11 | 573699.15 | 988.49 | 33A20110607SGR | 988.41 | 0.08 |
| 7860 | 7006872.35 | 573711.88 | 988.65 | 33A20110607SGR | 988.59 | 0.06 |
| 7861 | 7006890.90 | 573724.36 | 988.75 | 33A20110607SGR | 988.67 | 0.08 |
| 7862 | 7007039.80 | 573804.77 | 989.29 | 33A20110607SGR | 989.22 | 0.07 |
| 7863 | 7007053.03 | 573810.87 | 989.42 | 33A20110607SGR | 989.34 | 0.08 |
| 7864 | 7007075.96 | 573822.87 | 989.55 | 33A20110607SGR | 989.50 | 0.05 |
| 7865 | 7007234.62 | 573892.38 | 990.26 | 33A20110607SGR | 990.19 | 0.07 |
| 7866 | 7007253.99 | 573898.95 | 990.26 | 33A20110607SGR | 990.22 | 0.04 |
| 7867 | 7007282.30 | 573905.34 | 990.43 | 33A20110607SGR | 990.40 | 0.02 |
| 7868 | 7007470.47 | 573930.55 | 991.49 | 33A20110607SGR | 991.43 | 0.06 |
| 7869 | 7007489.25 | 573932.73 | 991.59 | 33A20110607SGR | 991.53 | 0.06 |
| 7870 | 7007516.93 | 573939.85 | 991.73 | 33A20110607SGR | 991.65 | 0.08 |
| 7871 | 7007613.62 | 574019.95 | 992.59 | 33A20110607SGR | 992.48 | 0.11 |
| 7872 | 7007624.58 | 574030.34 | 992.67 | 33A20110607SGR | 992.57 | 0.10 |
| 7873 | 7007638.14 | 574043.65 | 992.74 | 33A20110607SGR | 992.67 | 0.07 |
| 7874 | 7007767.17 | 574206.28 | 994.36 | 33A20110607SGR | 994.26 | 0.10 |
| 7875 | 7007780.77 | 574227.01 | 994.56 | 33A20110607SGR | 994.46 | 0.10 |
| 7876 | 7007792.33 | 574243.69 | 994.74 | 33A20110607SGR | 994.66 | 0.08 |
| 7877 | 7007908.72 | 574432.37 | 996.58 | 33A20110607SGR | 996.54 | 0.04 |
| 7878 | 7007919.09 | 574450.73 | 996.92 | 33A20110607SGR | 996.89 | 0.03 |
| 7879 | 7007933.68 | 574475.27 | 997.33 | 33A20110607SGR | 997.22 | 0.11 |
| 7880 | 7006962.86 | 573284.82 | 1004.74 | 33A20110607SGR | 1004.66 | 0.08 |
| 7881 | 7006961.97 | 573223.77 | 1002.02 | 33A20110607SGR | 1001.92 | 0.10 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 7882 | 7006970.65 | 573194.98 | 1001.75 | 33A20110607SGR | 1001.67 | 0.08 |
| 7883 | 7006984.22 | 573158.03 | 1003.29 | 33A20110607SGR | 1003.21 | 0.08 |
| 7884 | 7007001.94 | 573109.27 | 1003.30 | 33A20110607SGR | 1003.23 | 0.06 |
| 7885 | 7007017.54 | 573063.41 | 1001.44 | 33A20110607SGR | 1001.35 | 0.09 |
| 7886 | 7007031.86 | 573021.10 | 1000.81 | 33A20110607SGR | 1000.72 | 0.09 |
| 7887 | 7007045.11 | 572981.50 | 1000.32 | 33A20110607SGR | 1000.20 | 0.12 |
| 7888 | 7007056.03 | 572949.73 | 1000.05 | 33A20110607SGR | 999.94 | 0.11 |
| 7889 | 7007071.23 | 572909.16 | 1000.53 | 33A20110607SGR | 1000.43 | 0.10 |
| 7890 | 7007086.34 | 572863.74 | 997.38 | 33A20110607SGR | 997.29 | 0.09 |
| 7891 | 7007097.57 | 572827.19 | 999.30 | 33A20110607SGR | 999.22 | 0.08 |
| 7892 | 7007107.12 | 572797.70 | 997.81 | 33A20110607SGR | 997.73 | 0.08 |
| 7893 | 7003578.59 | 573940.11 | 983.60 | 33A20110607SPR | 983.55 | 0.05 |
| 7894 | 7003563.62 | 573926.88 | 983.62 | 33A20110607SPR | 983.56 | 0.06 |
| 7895 | 7003552.54 | 573917.00 | 983.66 | 33A20110607SPR | 983.59 | 0.07 |
| 7896 | 7003565.45 | 573907.73 | 980.25 | 33A20110607LAKE_SURFACE | 980.30 | -0.05 |
| 7897 | 7003562.71 | 573905.53 | 980.24 | 33A20110607LAKE_SURFACE | 980.31 | -0.07 |
| 7898 | 7003378.01 | 574340.35 | 1023.68 | 33A20110607SGR | 1023.62 | 0.06 |
| 7899 | 7003364.10 | 574340.11 | 1023.64 | 33A20110607SGR | 1023.55 | 0.09 |
| 7900 | 7003353.73 | 574339.81 | 1023.63 | 33A20110607SGR | 1023.56 | 0.07 |
| 7901 | 7003021.26 | 574254.64 | 1028.15 | 33A20110607SGR | 1028.09 | 0.06 |
| 7902 | 7003015.25 | 574272.62 | 1028.80 | 33A20110607SGR | 1028.72 | 0.08 |
| 7903 | 7002993.97 | 574264.12 | 1029.52 | 33A20110607SGR | 1029.46 | 0.06 |
| 7904 | 7003036.53 | 573974.19 | 1029.23 | 33A20110607SGR | 1029.18 | 0.05 |
| 7905 | 7003033.24 | 573961.52 | 1029.24 | 33A20110607SGR | 1029.19 | 0.05 |
| 7906 | 7003031.24 | 573949.05 | 1029.18 | 33A20110607SGR | 1029.14 | 0.04 |
| 7907 | 7004638.57 | 574084.85 | 985.32 | 33A20110607SGR | 985.23 | 0.09 |
| 7908 | 7004658.01 | 574088.06 | 985.43 | 33A20110607SGR | 985.33 | 0.10 |
| 7909 | 7004690.54 | 574086.69 | 985.52 | 33A20110607SGR | 985.44 | 0.08 |
| 7910 | 7004752.54 | 574151.77 | 985.93 | 33A20110607SGR | 985.84 | 0.09 |
| 7911 | 7004756.88 | 574171.20 | 985.99 | 33A20110607SGR | 985.90 | 0.09 |
| 7912 | 7004763.53 | 574195.67 | 986.13 | 33A20110607SGR | 986.06 | 0.07 |
| 7913 | 7004776.74 | 574261.81 | 986.72 | 33A20110607SGR | 986.62 | 0.10 |
| 7914 | 7004778.75 | 574288.46 | 986.89 | 33A20110607SGR | 986.80 | 0.09 |
| 7915 | 7004774.01 | 574324.92 | 987.01 | 33A20110607SGR | 986.91 | 0.10 |
| 7916 | 7004729.23 | 574414.62 | 987.18 | 33A20110607SGR | 987.12 | 0.06 |
| 7917 | 7004707.65 | 574446.61 | 987.33 | 33A20110607SGR | 987.26 | 0.07 |
| 7918 | 7004692.83 | 574481.62 | 987.21 | 33A20110607SGR | 987.12 | 0.09 |
| 7919 | 7004681.55 | 574522.06 | 987.59 | 33A20110607SGR | 987.48 | 0.11 |
| 7920 | 7004666.68 | 574581.83 | 987.80 | 33A20110607SGR | 987.71 | 0.08 |
| 7921 | 7004660.54 | 574608.40 | 987.91 | 33A20110607SGR | 987.81 | 0.10 |
| 7922 | 7004651.37 | 574649.73 | 988.12 | 33A20110607SGR | 988.02 | 0.10 |
| 7923 | 7004886.15 | 574783.70 | 987.09 | 33A20110607SGR | 987.00 | 0.09 |
| 7924 | 7004869.37 | 574777.88 | 987.21 | 33A20110607SGR | 987.12 | 0.09 |
| 7925 | 7004843.32 | 574768.41 | 987.15 | 33A20110607SGR | 987.05 | 0.10 |
| 7926 | 7004762.76 | 574738.19 | 987.55 | 33A20110607SGR | 987.48 | 0.07 |
| 7927 | 7004743.45 | 574730.68 | 987.48 | 33A20110607SGR | 987.44 | 0.04 |
| 7928 | 7004712.56 | 574719.14 | 987.55 | 33A20110607SGR | 987.46 | 0.09 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 7929 | 7004664.88 | 574701.21 | 987.69 | 33A20110607SGR | 987.59 | 0.10 |
| 7930 | 7004627.91 | 574688.69 | 987.94 | 33A20110607SGR | 987.88 | 0.06 |
| 7931 | 7004581.99 | 574671.62 | 987.87 | 33A20110607SGR | 987.78 | 0.09 |
| 7932 | 7004522.62 | 574649.62 | 987.98 | 33A20110607SGR | 987.93 | 0.05 |
| 7933 | 7004474.60 | 574632.15 | 988.27 | 33A20110607SGR | 988.19 | 0.08 |
| 7934 | 7004441.37 | 574619.85 | 988.34 | 33A20110607SGR | 988.25 | 0.09 |
| 7935 | 7004413.30 | 574607.77 | 988.37 | 33A20110607SGR | 988.30 | 0.07 |
| 7936 | 7004364.87 | 574579.23 | 989.48 | 33A20110607SGR | 989.41 | 0.07 |
| 7937 | 7004340.05 | 574562.10 | 992.19 | 33A20110607SGR | 992.07 | 0.12 |
| 7938 | 7004319.32 | 574550.45 | 996.29 | 33A20110607SGR | 996.20 | 0.09 |
| 7939 | 7004224.52 | 574515.28 | 1015.34 | 33A20110607SGR | 1015.22 | 0.12 |
| 7940 | 7004205.72 | 574507.68 | 1018.87 | 33A20110607SGR | 1018.80 | 0.07 |
| 7941 | 7004172.76 | 574496.15 | 1024.96 | 33A20110607SGR | 1024.87 | 0.09 |
| 7942 | 7004106.81 | 574495.61 | 1035.95 | 33A20110607SGR | 1035.85 | 0.10 |
| 7943 | 7004079.24 | 574505.91 | 1039.84 | 33A20110607SGR | 1039.75 | 0.09 |
| 7944 | 7004054.37 | 574516.08 | 1041.96 | 33A20110607SGR | 1041.85 | 0.11 |
| 7945 | 7003999.33 | 574536.28 | 1045.33 | 33A20110607SGR | 1045.23 | 0.10 |
| 7946 | 7003968.41 | 574547.18 | 1046.86 | 33A20110607SGR | 1046.78 | 0.08 |
| 7947 | 7003935.99 | 574558.95 | 1048.59 | 33A20110607SGR | 1048.50 | 0.09 |
| 7948 | 7003896.39 | 574574.04 | 1051.26 | 33A20110607SGR | 1051.19 | 0.07 |
| 7949 | 7003852.33 | 574591.58 | 1051.97 | 33A20110607SGR | 1051.88 | 0.09 |
| 7950 | 7003802.97 | 574608.49 | 1050.75 | 33A20110607SGR | 1050.65 | 0.10 |
| 7951 | 7003729.24 | 574636.96 | 1051.95 | 33A20110607SGR | 1051.86 | 0.09 |
| 7952 | 7003667.36 | 574661.39 | 1056.59 | 33A20110607SGR | 1056.51 | 0.08 |
| 7953 | 7003608.87 | 574683.28 | 1060.53 | 33A20110607SGR | 1060.43 | 0.10 |
| 7954 | 7003541.79 | 574707.81 | 1064.58 | 33A20110607SGR | 1064.48 | 0.10 |
| 7955 | 7003497.11 | 574723.82 | 1067.29 | 33A20110607SGR | 1067.17 | 0.12 |
| 7956 | 7003425.94 | 574750.83 | 1069.49 | 33A20110607SGR | 1069.41 | 0.08 |
| 7957 | 7003376.82 | 574768.53 | 1068.92 | 33A20110607SGR | 1068.81 | 0.11 |
| 7958 | 7003331.92 | 574784.33 | 1066.44 | 33A20110607SGR | 1066.34 | 0.10 |
| 7959 | 7003386.99 | 573706.79 | 983.98 | 33A20110607CK_SPIKE | 983.92 | 0.06 |
| 7960 | 7002840.80 | 573359.43 | 984.91 | 33A20110607CK_SPIKE | 984.89 | 0.02 |
| 7961 | 7003387.00 | 573706.80 | 983.98 | 33A20110607CK_SPIKE | 983.92 | 0.06 |
| 7962 | 7002840.81 | 573359.42 | 984.93 | 33A20110607CK_SPIKE_33B | 984.88 | 0.05 |
| 8000 | 6935700.74 | 576600.53 | 597.69 | 35A2011060835AFAC | 597.57 | 0.12 |
| 8001 | 6935727.44 | 576589.36 | 598.20 | 35A20110608CK_SPIKE | 598.10 | 0.10 |
| 8002 | 6935713.14 | 576591.57 | 598.08 | 35A20110608CK_SPIKE | 598.00 | 0.08 |
| 8003 | 6935699.98 | 576587.54 | 597.97 | 35A20110608CK_SPIKE | 597.92 | 0.05 |
| 8004 | 6935683.77 | 576589.65 | 597.81 | 35A20110608CK_SPIKE | 597.73 | 0.08 |
| 8005 | 6936391.33 | 576856.63 | 602.81 | 35A20110608SPR | 602.73 | 0.08 |
| 8006 | 6936407.01 | 576861.05 | 602.93 | 35A20110608SPR | 602.81 | 0.12 |
| 8007 | 6936420.88 | 576871.58 | 602.97 | 35A20110608SPR | 602.87 | 0.10 |
| 8008 | 6936433.72 | 576874.71 | 603.10 | 35A20110608SPR | 603.01 | 0.09 |
| 8009 | 6937122.65 | 577207.04 | 608.67 | 35A20110608SPR | 608.60 | 0.07 |
| 8010 | 6937136.85 | 577209.43 | 608.86 | 35A20110608SPR | 608.80 | 0.06 |
| 8011 | 6937148.10 | 577217.15 | 609.06 | 35A20110608SPR | 609.00 | 0.06 |
| 8012 | 6937164.32 | 577220.40 | 609.41 | 35A20110608SPR | 609.32 | 0.09 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 8013 | 6937978.58 | 577320.63 | 623.82 | 35A20110608SPR | 623.77 | 0.05 |
| 8014 | 6937985.00 | 577317.36 | 624.09 | 35A20110608SPR | 624.02 | 0.07 |
| 8015 | 6937992.94 | 577320.98 | 624.16 | 35A20110608SPR | 624.09 | 0.07 |
| 8016 | 6937999.33 | 577317.61 | 624.45 | 35A20110608SPR | 624.42 | 0.03 |
| 8017 | 6938025.13 | 577322.48 | 624.85 | 35A20110608SPR | 624.80 | 0.05 |
| 8018 | 6938040.06 | 577322.96 | 625.13 | 35A20110608SPR | 625.00 | 0.13 |
| 8019 | 6938474.41 | 577434.44 | 630.31 | 35A20110608SPR | 630.26 | 0.05 |
| 8020 | 6938486.94 | 577435.93 | 630.39 | 35A20110608SPR | 630.28 | 0.11 |
| 8021 | 6938498.27 | 577444.04 | 630.54 | 35A20110608SPR | 630.40 | 0.14 |
| 8022 | 6938512.08 | 577445.92 | 630.52 | 35A20110608SPR | 630.44 | 0.08 |
| 8023 | 6939344.44 | 577681.05 | 644.21 | 35A20110608SPR | 644.12 | 0.09 |
| 8024 | 6939359.17 | 577686.04 | 644.55 | 35A20110608SPR | 644.43 | 0.12 |
| 8025 | 6939370.03 | 577696.25 | 644.86 | 35A20110608SPR | 644.78 | 0.08 |
| 8026 | 6939386.13 | 577702.45 | 645.27 | 35A20110608SPR | 645.17 | 0.10 |
| 8027 | 6939940.76 | 578043.95 | 666.73 | 35A20110608SPR | 666.67 | 0.06 |
| 8028 | 6939951.33 | 578050.77 | 667.17 | 35A20110608SPR | 667.08 | 0.09 |
| 8029 | 6939967.15 | 578056.21 | 667.76 | 35A20110608SPR | 667.64 | 0.12 |
| 8030 | 6939977.29 | 578066.14 | 668.15 | 35A20110608SPR | 668.06 | 0.09 |
| 8031 | 6939969.76 | 578036.70 | 666.51 | 35A20110608Y61 | 666.37 | 0.14 |
| 8032 | 6941171.84 | 578787.99 | 680.32 | 35A20110608SPR | 680.23 | 0.09 |
| 8033 | 6941183.49 | 578794.82 | 680.35 | 35A20110608SPR | 680.23 | 0.12 |
| 8034 | 6941195.66 | 578802.04 | 680.39 | 35A20110608SPR | 680.28 | 0.11 |
| 8035 | 6941209.64 | 578810.52 | 680.41 | 35A20110608SPR | 680.28 | 0.13 |
| 8036 | 6935266.89 | 576560.72 | 597.04 | 35A20110608SPR | 596.97 | 0.07 |
| 8037 | 6935249.08 | 576559.19 | 597.08 | 35A20110608SPR | 597.00 | 0.08 |
| 8038 | 6935229.50 | 576553.39 | 596.91 | 35A20110608SPR | 596.82 | 0.09 |
| 8039 | 6935212.09 | 576554.51 | 597.08 | 35A20110608SPR | 597.02 | 0.06 |
| 8044 | 6934994.41 | 576025.94 | 595.38 | 35A20110608SGR | 595.33 | 0.05 |
| 8045 | 6934983.73 | 576038.54 | 595.47 | 35A20110608SGR | 595.40 | 0.07 |
| 8046 | 6934970.52 | 576054.91 | 595.39 | 35A20110608SGR | 595.37 | 0.02 |
| 8047 | 6934880.35 | 576424.35 | 595.27 | 35A20110608SGR | 595.19 | 0.08 |
| 8048 | 6934868.26 | 576414.61 | 595.41 | 35A20110608SGR | 595.33 | 0.08 |
| 8049 | 6934854.32 | 576411.59 | 595.44 | 35A20110608SGR | 595.40 | 0.04 |
| 8050 | 6934844.70 | 576403.00 | 595.40 | 35A20110608SGR | 595.33 | 0.06 |
| 8076 | 6935700.45 | 576603.56 | 597.51 | 35A20110608CK_SPIKE | 597.40 | 0.11 |
| 8077 | 6935700.44 | 576603.60 | 597.51 | 35A20110608CK_SPIKE | 597.40 | 0.11 |
| 8200 | 7002841.50 | 573356.47 | 984.73 | 33B2011070933BFAC | 984.74 | -0.01 |
| 8201 | 6997400.49 | 575983.80 | 984.25 | 33B20110709SPR | 984.14 | 0.11 |
| 8202 | 6997394.10 | 575973.42 | 984.17 | 33B20110709SPR | 984.08 | 0.09 |
| 8203 | 6997381.47 | 575967.73 | 984.13 | 33B20110709SPR | 984.02 | 0.11 |
| 8204 | 6996499.69 | 577191.30 | 1048.26 | 33B20110709SGR | 1047.98 | 0.28 |
| 8205 | 6996505.71 | 577194.05 | 1047.82 | 33B20110709SGR | 1047.57 | 0.25 |
| 8206 | 6996511.30 | 577215.10 | 1047.53 | 33B20110709SGR | 1047.24 | 0.29 |
| 8207 | 6996513.09 | 577236.46 | 1047.01 | 33B20110709SGR | 1046.76 | 0.25 |
| 8208 | 6996512.72 | 577254.92 | 1046.63 | 33B20110709SGR | 1046.36 | 0.27 |
| 8209 | 6996516.08 | 577266.30 | 1045.87 | 33B20110709SGR | 1045.62 | 0.25 |
| 8210 | 6996523.07 | 577267.89 | 1045.70 | 33B20110709SGR | 1045.48 | 0.22 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 8211 | 6996528.77 | 577261.58 | 1044.37 | 33B20110709SGR | 1044.12 | 0.25 |
| 8212 | 6996519.70 | 577279.29 | 1046.34 | 33B20110709SGR | 1046.05 | 0.29 |
| 8213 | 6996516.16 | 577287.80 | 1046.46 | 33B20110709SGR | 1046.23 | 0.23 |
| 8214 | 6996509.98 | 577292.75 | 1046.62 | 33B20110709SGR | 1046.38 | 0.24 |
| 8215 | 6996509.79 | 577284.61 | 1046.56 | 33B20110709SGR | 1046.30 | 0.26 |
| 8216 | 6996512.45 | 577273.54 | 1046.30 | 33B20110709SGR | 1046.03 | 0.27 |
| 8217 | 6996580.94 | 577125.79 | 1029.59 | 33B20110709SGR | 1029.34 | 0.25 |
| 8218 | 6996584.47 | 577114.79 | 1028.18 | 33B20110709SGR | 1027.89 | 0.29 |
| 8219 | 6996587.79 | 577106.08 | 1027.04 | 33B20110709SGR | 1026.77 | 0.27 |
| 8220 | 6996593.46 | 577091.96 | 1025.36 | 33B20110709SGR | 1025.08 | 0.28 |
| 8221 | 6996639.90 | 576959.33 | 1018.04 | 33B20110709SGR | 1017.83 | 0.21 |
| 8222 | 6996644.13 | 576944.22 | 1018.14 | 33B20110709SGR | 1017.89 | 0.25 |
| 8223 | 6996647.29 | 576930.13 | 1018.12 | 33B20110709SGR | 1017.87 | 0.25 |
| 8224 | 6996650.54 | 576916.50 | 1017.96 | 33B20110709SGR | 1017.73 | 0.23 |
| 8225 | 6996691.94 | 576735.42 | 1017.72 | 33B20110709SGR | 1017.57 | 0.15 |
| 8226 | 6996695.04 | 576720.51 | 1017.94 | 33B20110709SGR | 1017.80 | 0.14 |
| 8227 | 6996697.28 | 576706.50 | 1017.88 | 33B20110709SGR | 1017.73 | 0.15 |
| 8228 | 6996699.32 | 576692.26 | 1017.49 | 33B20110709SGR | 1017.33 | 0.16 |
| 8229 | 6996701.15 | 576677.86 | 1016.93 | 33B20110709SGR | 1016.79 | 0.13 |
| 8230 | 6996826.97 | 576386.29 | 996.20 | 33B20110709SGR | 996.08 | 0.12 |
| 8231 | 6996836.40 | 576379.04 | 995.59 | 33B20110709SGR | 995.49 | 0.10 |
| 8232 | 6996846.11 | 576369.58 | 994.93 | 33B20110709SGR | 994.82 | 0.11 |
| 8233 | 6996854.59 | 576358.79 | 994.26 | 33B20110709SGR | 994.15 | 0.11 |
| 8234 | 6996748.89 | 576279.85 | 1002.93 | 33B20110709SGR | 1002.81 | 0.12 |
| 8235 | 6996761.70 | 576280.89 | 1001.56 | 33B20110709SGR | 1001.45 | 0.11 |
| 8236 | 6996772.89 | 576282.81 | 1000.38 | 33B20110709SGR | 1000.26 | 0.12 |
| 8237 | 6996788.17 | 576284.54 | 998.92 | 33B20110709SGR | 998.78 | 0.14 |
| 8238 | 6996935.78 | 576295.03 | 980.47 | 33B20110709SGR | 980.38 | 0.09 |
| 8239 | 6996950.26 | 576296.30 | 980.20 | 33B20110709SGR | 980.11 | 0.09 |
| 8240 | 6996966.19 | 576297.78 | 979.77 | 33B20110709SGR | 979.66 | 0.11 |
| 8241 | 6996980.84 | 576299.33 | 978.95 | 33B20110709SGR | 978.83 | 0.12 |
| 8242 | 6997124.73 | 576320.47 | 982.73 | 33B20110709SGR | 982.63 | 0.10 |
| 8243 | 6997129.40 | 576314.27 | 982.84 | 33B20110709SGR | 982.77 | 0.07 |
| 8244 | 6997148.78 | 576324.10 | 982.93 | 33B20110709SGR | 982.81 | 0.12 |
| 8245 | 6997335.24 | 576334.54 | 984.99 | 33B20110709SGR | 984.93 | 0.06 |
| 8246 | 6997334.51 | 576343.23 | 984.91 | 33B20110709SGR | 984.79 | 0.12 |
| 8247 | 6997355.35 | 576345.35 | 984.97 | 33B20110709SGR | 984.89 | 0.08 |
| 8248 | 6997352.92 | 576336.98 | 985.30 | 33B20110709SGR | 985.22 | 0.08 |
| 8249 | 6997572.02 | 576363.30 | 988.61 | 33B20110709SGR | 988.51 | 0.10 |
| 8250 | 6997588.71 | 576365.04 | 989.41 | 33B20110709SGR | 989.31 | 0.10 |
| 8251 | 6997603.20 | 576366.83 | 989.61 | 33B20110709SGR | 989.52 | 0.09 |
| 8252 | 6997617.42 | 576368.61 | 989.55 | 33B20110709SGR | 989.45 | 0.10 |
| 8253 | 6997637.02 | 576373.80 | 989.22 | 33B20110709SGR | 989.11 | 0.11 |
| 8254 | 6997655.59 | 576377.20 | 988.80 | 33B20110709SGR | 988.67 | 0.13 |
| 8255 | 6997674.45 | 576381.77 | 988.66 | 33B20110709SGR | 988.57 | 0.09 |
| 8256 | 6997693.95 | 576386.82 | 988.46 | 33B20110709SGR | 988.37 | 0.09 |
| 8257 | 6997712.89 | 576392.34 | 988.02 | 33B20110709SGR | 987.90 | 0.12 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 8258 | 6997750.24 | 576416.58 | 986.05 | 33B20110709SGR | 985.91 | 0.14 |
| 8259 | 6997739.85 | 576400.36 | 986.89 | 33B20110709SGR | 986.78 | 0.11 |
| 8260 | 6996934.80 | 576137.53 | 979.10 | 33B20110709SGR | 979.02 | 0.08 |
| 8261 | 6996928.74 | 576152.04 | 979.10 | 33B20110709SGR | 979.01 | 0.09 |
| 8262 | 6996922.49 | 576168.83 | 979.11 | 33B20110709SGR | 979.02 | 0.09 |
| 8263 | 6997213.57 | 575971.18 | 982.78 | 33B20110709SGR | 982.69 | 0.09 |
| 8264 | 6997198.67 | 575976.02 | 982.85 | 33B20110709SGR | 982.75 | 0.10 |
| 8265 | 6997183.62 | 575981.91 | 982.89 | 33B20110709SGR | 982.77 | 0.12 |
| 8266 | 6997237.28 | 575960.50 | 982.57 | 33B20110709SGR | 982.50 | 0.07 |
| 8267 | 6997776.23 | 576146.21 | 983.46 | 33B20110709SGR | 983.37 | 0.09 |
| 8268 | 6997761.52 | 576144.33 | 983.50 | 33B20110709SGR | 983.40 | 0.10 |
| 8269 | 6997746.41 | 576143.64 | 983.46 | 33B20110709SGR | 983.37 | 0.09 |
| 8270 | 6997412.98 | 575989.57 | 984.33 | 33B20110709SPR | 984.24 | 0.09 |
| 8300 | 6960975.62 | 578408.30 | 800.53 | 34A2011060934AFAC | 800.48 | 0.05 |
| 8301 | 6960587.74 | 578342.46 | 800.87 | 34A20110609SPR | 800.72 | 0.15 |
| 8302 | 6960574.61 | 578346.93 | 801.54 | 34A20110609SPR | 801.49 | 0.05 |
| 8303 | 6960558.44 | 578346.34 | 802.36 | 34A20110609SPR | 802.27 | 0.09 |
| 8304 | 6960545.59 | 578350.59 | 803.08 | 34A20110609SPR | 802.99 | 0.09 |
| 8305 | 6960176.85 | 578391.71 | 828.61 | 34A20110609SPR | 828.54 | 0.07 |
| 8306 | 6960160.01 | 578394.02 | 829.45 | 34A20110609SPR | 829.34 | 0.11 |
| 8307 | 6960143.57 | 578396.39 | 830.23 | 34A20110609SPR | 830.15 | 0.08 |
| 8308 | 6960128.71 | 578398.87 | 830.82 | 34A20110609SPR | 830.75 | 0.07 |
| 8309 | 6960137.29 | 578400.58 | 830.31 | 34A20110609SPR | 830.26 | 0.05 |
| 8310 | 6960140.31 | 578409.67 | 829.55 | 34A2011060934B | 829.51 | 0.04 |
| 8311 | 6959487.02 | 578627.48 | 825.22 | 34A20110609SPR | 825.13 | 0.09 |
| 8312 | 6959474.74 | 578636.47 | 825.19 | 34A20110609SPR | 825.11 | 0.08 |
| 8313 | 6959461.05 | 578638.69 | 825.23 | 34A20110609SPR | 825.15 | 0.08 |
| 8314 | 6959445.98 | 578648.89 | 825.25 | 34A20110609SPR | 825.16 | 0.09 |
| 8315 | 6958975.20 | 578881.07 | 825.75 | 34A20110609SPR | 825.71 | 0.04 |
| 8316 | 6958963.12 | 578888.68 | 826.54 | 34A20110609SPR | 826.46 | 0.08 |
| 8317 | 6958946.63 | 578890.71 | 827.26 | 34A20110609SPR | 827.20 | 0.06 |
| 8318 | 6958934.58 | 578897.17 | 828.03 | 34A20110609SPR | 827.99 | 0.04 |
| 8319 | 6960970.55 | 578300.65 | 796.37 | 34A20110609SPR | 796.30 | 0.07 |
| 8320 | 6960984.59 | 578295.40 | 796.45 | 34A20110609SPR | 796.36 | 0.09 |
| 8321 | 6960999.05 | 578297.11 | 796.56 | 34A20110609SPR | 796.49 | 0.07 |
| 8322 | 6961014.02 | 578292.14 | 796.68 | 34A20110609SPR | 796.62 | 0.06 |
| 8323 | 6961561.40 | 578230.20 | 796.56 | 34A20110609SPR | 796.51 | 0.05 |
| 8324 | 6961575.84 | 578225.26 | 796.37 | 34A20110609SPR | 796.31 | 0.06 |
| 8325 | 6961589.58 | 578226.49 | 796.27 | 34A20110609SPR | 796.20 | 0.07 |
| 8326 | 6961602.40 | 578222.04 | 796.15 | 34A20110609SPR | 796.06 | 0.09 |
| 8327 | 6962424.18 | 578046.16 | 785.37 | 34A20110609SPR | 785.28 | 0.09 |
| 8328 | 6962437.35 | 578039.86 | 785.15 | 34A20110609SPR | 785.07 | 0.08 |
| 8329 | 6962454.30 | 578038.76 | 784.74 | 34A20110609SPR | 784.62 | 0.12 |
| 8330 | 6962467.16 | 578032.91 | 784.51 | 34A20110609SPR | 784.43 | 0.08 |
| 8331 | 6962918.45 | 577943.14 | 776.09 | 34A20110609SPR | 776.03 | 0.06 |
| 8332 | 6962933.08 | 577942.64 | 776.38 | 34A20110609SPR | 776.32 | 0.06 |
| 8333 | 6962945.84 | 577936.16 | 776.42 | 34A20110609SPR | 776.34 | 0.07 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 8334 | 6962962.05 | 577934.90 | 776.77 | 34A20110609SPR | 776.69 | 0.07 |
| 8335 | 6963394.93 | 577772.07 | 783.34 | 34A20110609SPR | 783.27 | 0.07 |
| 8336 | 6963407.74 | 577762.68 | 783.13 | 34A20110609SPR | 783.06 | 0.07 |
| 8337 | 6963423.13 | 577759.67 | 783.12 | 34A20110609SPR | 783.06 | 0.06 |
| 8338 | 6963435.05 | 577750.28 | 782.96 | 34A20110609SPR | 782.90 | 0.06 |
| 8339 | 6963932.29 | 577394.27 | 792.91 | 34A20110609SPR | 792.83 | 0.08 |
| 8340 | 6963941.50 | 577378.90 | 792.91 | 34A20110609SPR | 792.83 | 0.08 |
| 8341 | 6963955.16 | 577368.72 | 793.09 | 34A20110609SPR | 793.05 | 0.04 |
| 8342 | 6963962.92 | 577355.98 | 793.16 | 34A20110609SPR | 793.09 | 0.07 |
| 8343 | 6964402.62 | 576894.61 | 806.05 | 34A20110609SPR | 805.96 | 0.09 |
| 8344 | 6964411.26 | 576881.77 | 806.66 | 34A20110609SPR | 806.54 | 0.12 |
| 8345 | 6964423.60 | 576874.19 | 807.07 | 34A20110609SPR | 806.99 | 0.08 |
| 8346 | 6964433.02 | 576860.87 | 807.73 | SPR | 807.62 | 0.11 |
| 8347 | 6965084.58 | 576576.51 | 813.27 | SPR | 813.17 | 0.10 |
| 8348 | 6965096.94 | 576580.63 | 813.28 | SPR | 813.17 | 0.11 |
| 8349 | 6965117.98 | 576579.66 | 813.22 | SPR | 813.12 | 0.10 |
| 8350 | 6965132.59 | 576584.17 | 813.11 | SPR | 813.01 | 0.10 |
| 8351 | 6965701.12 | 576606.93 | 824.43 | SPR | 824.36 | 0.07 |
| 8352 | 6965715.81 | 576608.94 | 824.56 | SPR | 824.49 | 0.06 |
| 8353 | 6965730.32 | 576605.46 | 824.96 | SPR | 824.89 | 0.07 |
| 8354 | 6965745.54 | 576608.40 | 824.99 | SPR | 824.94 | 0.04 |
| 8355 | 6965722.56 | 576330.50 | 830.18 | SGR | 830.09 | 0.09 |
| 8356 | 6965709.65 | 576328.04 | 829.93 | SGR | 829.85 | 0.07 |
| 8357 | 6965695.81 | 576326.77 | 829.72 | SGR | 829.66 | 0.06 |
| 8358 | 6965716.77 | 576400.94 | 832.36 | SGR | 832.27 | 0.09 |
| 8359 | 6965717.09 | 576415.38 | 832.47 | SGR | 832.40 | 0.07 |
| 8360 | 6965717.78 | 576429.84 | 832.50 | SGR | 832.40 | 0.10 |
| 8361 | 6966196.55 | 576673.23 | 829.12 | SGR | 829.01 | 0.11 |
| 8362 | 6966211.30 | 576672.80 | 829.42 | SGR | 829.34 | 0.08 |
| 8363 | 6966230.08 | 576680.52 | 829.54 | SGR | 829.45 | 0.09 |
| 8364 | 6966246.76 | 576685.33 | 829.75 | SGR | 829.68 | 0.07 |
| 8365 | 6967274.09 | 577231.26 | 840.40 | SGR | 840.32 | 0.08 |
| 8366 | 6967294.24 | 577234.59 | 840.49 | SGR | 840.43 | 0.06 |
| 8367 | 6967311.39 | 577243.18 | 840.88 | SGR | 840.81 | 0.07 |
| 8368 | 6967329.55 | 577244.41 | 840.80 | SGR | 840.78 | 0.02 |
| 8369 | 6968127.03 | 577625.82 | 853.43 | SGR | 853.33 | 0.10 |
| 8370 | 6968142.72 | 577629.18 | 853.58 | SGR | 853.52 | 0.06 |
| 8371 | 6968155.40 | 577637.99 | 854.16 | SGR | 854.09 | 0.07 |
| 8372 | 6968168.96 | 577638.92 | 854.26 | SGR | 854.14 | 0.12 |
| 8373 | 6967830.27 | 578222.91 | 887.51 | SGR | 887.47 | 0.04 |
| 8374 | 6967846.52 | 578219.52 | 888.18 | SGR | 888.16 | 0.02 |
| 8375 | 6967862.96 | 578216.62 | 888.77 | SGR | 888.71 | 0.06 |
| 8376 | 6967885.10 | 578212.00 | 888.61 | SGR | 888.57 | 0.04 |
| 8377 | 6967813.06 | 578223.11 | 886.84 | SGR | 886.83 | 0.01 |
| 8378 | 6967797.39 | 578223.45 | 886.10 | SGR | 886.06 | 0.04 |
| 8379 | 6967895.84 | 577850.82 | 873.39 | SGR | 873.32 | 0.06 |
| 8380 | 6967909.06 | 577842.72 | 873.36 | SGR | 873.33 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 8381 | 6967922.52 | 577834.25 | 873.01 | SGR | 872.94 | 0.07 |
| 8382 | 6968586.05 | 577750.45 | 874.90 | SPR | 874.84 | 0.06 |
| 8383 | 6968601.49 | 577757.85 | 875.46 | SPR | 875.41 | 0.05 |
| 8384 | 6968617.84 | 577758.51 | 875.99 | SPR | 875.92 | 0.07 |
| 8385 | 6968634.43 | 577762.97 | 876.56 | SPR | 876.50 | 0.06 |
| 8386 | 6969585.82 | 577820.58 | 900.80 | SPR | 900.77 | 0.03 |
| 8387 | 6969572.21 | 577820.31 | 900.89 | SPR | 900.86 | 0.03 |
| 8388 | 6969553.90 | 577828.26 | 901.08 | SPR | 901.02 | 0.06 |
| 8389 | 6969536.54 | 577829.29 | 901.12 | SPR | 901.09 | 0.03 |
| 8390 | 6970689.76 | 577601.21 | 899.36 | SPR | 899.32 | 0.04 |
| 8391 | 6970673.90 | 577605.17 | 899.27 | SPR | 899.24 | 0.03 |
| 8392 | 6970663.03 | 577614.60 | 899.20 | SPR | 899.17 | 0.03 |
| 8393 | 6970649.15 | 577617.98 | 899.05 | SPR | 899.04 | 0.01 |
| 8394 | 6971590.05 | 577548.74 | 898.68 | SPR | 898.65 | 0.03 |
| 8395 | 6971576.35 | 577547.31 | 899.08 | SPR | 899.04 | 0.04 |
| 8396 | 6971592.33 | 577548.92 | 898.60 | SPR | 898.55 | 0.05 |
| 8397 | 6960975.89 | 578405.25 | 800.58 | CK_SPIKE | 800.56 | 0.02 |
| 8398 | 6960975.87 | 578405.27 | 800.57 | CK_SPIKE | 800.56 | 0.01 |
| 8600 | 7010388.79 | 568153.27 | 914.67 | 33D2011061233DFAC | 914.54 | 0.13 |
| 8601 | 7010365.00 | 568154.42 | 915.22 | 33D20110612SPR | 915.15 | 0.07 |
| 8602 | 7010375.37 | 568144.56 | 915.05 | 33D20110612SPR | 914.98 | 0.07 |
| 8603 | 7010388.76 | 568140.20 | 914.87 | 33D20110612SPR | 914.79 | 0.08 |
| 8604 | 7010398.71 | 568130.45 | 914.66 | 33D20110612SPR | 914.57 | 0.09 |
| 8605 | 7010983.10 | 567849.46 | 902.89 | 33D20110612SPR | 902.80 | 0.09 |
| 8606 | 7010996.10 | 567841.32 | 902.68 | 33D20110612SPR | 902.61 | 0.06 |
| 8607 | 7011010.92 | 567839.88 | 902.44 | 33D20110612SPR | 902.38 | 0.06 |
| 8608 | 7011021.93 | 567832.67 | 902.34 | 33D20110612SPR | 902.28 | 0.06 |
| 8609 | 7011819.03 | 567344.42 | 883.91 | 33D20110612SPR | 883.84 | 0.07 |
| 8610 | 7011829.80 | 567331.20 | 883.74 | 33D20110612SPR | 883.60 | 0.14 |
| 8611 | 7011843.41 | 567324.53 | 883.52 | 33D20110612SPR | 883.45 | 0.07 |
| 8612 | 7011851.79 | 567313.34 | 883.39 | 33D20110612SPR | 883.33 | 0.06 |
| 8613 | 7012654.31 | 566909.13 | 869.47 | 33D20110612SPR | 869.43 | 0.04 |
| 8614 | 7012665.27 | 566897.83 | 869.32 | 33D20110612SPR | 869.28 | 0.04 |
| 8615 | 7012679.70 | 566892.93 | 869.17 | 33D20110612SPR | 869.08 | 0.09 |
| 8616 | 7012690.73 | 566881.99 | 869.07 | 33D20110612SPR | 869.01 | 0.06 |
| 8617 | 7013372.01 | 566458.68 | 862.17 | 33D20110612SPR | 862.08 | 0.09 |
| 8618 | 7013382.10 | 566448.11 | 862.10 | 33D20110612SPR | 862.00 | 0.10 |
| 8619 | 7013397.17 | 566442.32 | 861.95 | 33D20110612SPR | 861.84 | 0.11 |
| 8620 | 7013406.50 | 566432.28 | 861.85 | 33D20110612SPR | 861.75 | 0.10 |
| 8621 | 7014010.33 | 566057.92 | 857.76 | 33D20110612SPR | 857.69 | 0.07 |
| 8622 | 7014020.53 | 566046.89 | 858.10 | 33D20110612SPR | 858.01 | 0.09 |
| 8623 | 7014037.85 | 566040.49 | 858.18 | 33D20110612SPR | 858.08 | 0.10 |
| 8624 | 7014049.15 | 566029.22 | 858.50 | 33D20110612SPR | 858.43 | 0.07 |
| 8625 | 7014910.47 | 565982.79 | 846.09 | 33D20110612SPR | 846.04 | 0.05 |
| 8626 | 7014926.38 | 565980.84 | 846.04 | 33D20110612SPR | 845.96 | 0.08 |
| 8627 | 7014942.80 | 565985.69 | 845.82 | 33D20110612SPR | 845.72 | 0.10 |
| 8628 | 7014959.82 | 565983.95 | 845.69 | 33D20110612SPR | 845.61 | 0.08 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 8629 | 7015544.81 | 566045.16 | 840.90 | 33D20110612SPR | 840.80 | 0.10 |
| 8630 | 7015560.42 | 566043.33 | 840.77 | 33D20110612SPR | 840.67 | 0.10 |
| 8631 | 7015575.03 | 566048.02 | 840.64 | 33D20110612SPR | 840.53 | 0.11 |
| 8632 | 7015588.66 | 566046.12 | 840.55 | 33D20110612SPR | 840.46 | 0.09 |
| 8633 | 7016181.56 | 566141.67 | 835.50 | 33D20110612SPR | 835.39 | 0.11 |
| 8634 | 7016197.01 | 566146.18 | 835.59 | 33D20110612SPR | 835.50 | 0.09 |
| 8635 | 7016208.56 | 566157.14 | 835.27 | 33D20110612SPR | 835.16 | 0.11 |
| 8636 | 7016221.54 | 566162.03 | 835.35 | 33D20110612SPR | 835.24 | 0.11 |
| 8645 | 7011086.44 | 568266.36 | 911.58 | 33D20110612SGR | 911.48 | 0.10 |
| 8646 | 7011086.86 | 568279.83 | 911.86 | 33D20110612SGR | 911.75 | 0.11 |
| 8647 | 7011087.87 | 568293.73 | 912.11 | 33D20110612SGR | 912.05 | 0.06 |
| 8648 | 7011221.73 | 568503.09 | 919.54 | 33D20110612SGR | 919.46 | 0.08 |
| 8649 | 7011213.89 | 568493.42 | 919.21 | 33D20110612SGR | 919.14 | 0.07 |
| 8650 | 7011206.25 | 568483.67 | 918.76 | 33D20110612SGR | 918.71 | 0.05 |
| 8651 | 7011386.20 | 568682.41 | 927.08 | 33D20110612SGR | 926.98 | 0.10 |
| 8652 | 7011395.11 | 568689.71 | 927.35 | 33D20110612SGR | 927.22 | 0.13 |
| 8653 | 7011403.31 | 568696.01 | 927.78 | 33D20110612SGR | 927.66 | 0.12 |
| 8654 | 7011546.24 | 568806.13 | 938.44 | 33D20110612SGR | 938.33 | 0.11 |
| 8655 | 7011556.28 | 568814.36 | 938.75 | 33D20110612SGR | 938.66 | 0.09 |
| 8656 | 7011566.67 | 568822.46 | 938.88 | 33D20110612SGR | 938.73 | 0.15 |
| 8657 | 7011839.65 | 568914.85 | 941.79 | 33D20110612SGR | 941.71 | 0.08 |
| 8658 | 7011853.06 | 568920.51 | 941.95 | 33D20110612SGR | 941.85 | 0.10 |
| 8659 | 7011866.42 | 568923.10 | 942.22 | 33D20110612SGR | 942.17 | 0.05 |
| 8660 | 7012100.10 | 568989.48 | 959.88 | 33D20110612SGR | 959.83 | 0.05 |
| 8661 | 7012092.99 | 568990.16 | 959.25 | 33D20110612SGR | 959.18 | 0.07 |
| 8662 | 7012085.30 | 568988.86 | 958.63 | 33D20110612SGR | 958.56 | 0.07 |
| 8666 | 7010081.18 | 568320.31 | 918.06 | 33D20110612SPR | 917.94 | 0.11 |
| 8667 | 7010071.23 | 568330.56 | 918.02 | 33D20110612SPR | 917.93 | 0.09 |
| 8668 | 7010057.51 | 568334.74 | 917.91 | 33D20110612SPR | 917.83 | 0.08 |
| 8669 | 7010047.93 | 568344.43 | 917.74 | 33D20110612SPR | 917.69 | 0.05 |
| 8670 | 7009197.96 | 569872.22 | 934.12 | 33D20110612SPR | 933.98 | 0.13 |
| 8671 | 7009198.43 | 569881.37 | 934.25 | 33D20110612SPR | 934.15 | 0.10 |
| 8672 | 7009190.84 | 569894.15 | 934.44 | 33D20110612SPR | 934.33 | 0.11 |
| 8673 | 7009192.34 | 569905.12 | 934.59 | 33D20110612SPR | 934.52 | 0.07 |
| 8677 | 7008508.91 | 568654.03 | 913.55 | 33D20110612SGR | 913.51 | 0.04 |
| 8678 | 7008514.18 | 568667.77 | 913.82 | 33D20110612SGR | 913.76 | 0.06 |
| 8679 | 7008521.81 | 568683.48 | 914.11 | 33D20110612SGR | 914.02 | 0.09 |
| 8680 | 7008910.60 | 569300.45 | 923.99 | 33D20110612SGR | 923.90 | 0.09 |
| 8681 | 7008917.66 | 569313.25 | 924.22 | 33D20110612SGR | 924.15 | 0.07 |
| 8682 | 7008923.78 | 569326.03 | 924.46 | 33D20110612SGR | 924.40 | 0.06 |
| 8683 | 7010391.79 | 568153.84 | 914.59 | 33D20110612CK_SPIKE | 914.52 | 0.07 |
| 8684 | 7010391.78 | 568153.84 | 914.58 | 33D20110612CK_SPIKE | 914.52 | 0.06 |
| 8700 | 7010388.79 | 568153.27 | 914.65 | 33D1011062733DFAC | 914.54 | 0.11 |
| 8701 | 7010055.11 | 568336.16 | 917.90 | 33D10110627SPR | 917.83 | 0.07 |
| 8702 | 7010046.74 | 568341.18 | 917.76 | 33D10110627SPR | 917.70 | 0.06 |
| 8703 | 7009945.61 | 568401.84 | 915.48 | 33D10110627SPR | 915.41 | 0.07 |
| 8704 | 7009840.61 | 568465.17 | 915.42 | 33D10110627SPR | 915.33 | 0.09 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 8705 | 7009733.60 | 568554.40 | 917.51 | 33D10110627SPR | 917.44 | 0.07 |
| 8706 | 7009653.45 | 568666.99 | 919.85 | 33D10110627SPR | 919.76 | 0.09 |
| 8707 | 7009592.43 | 568791.60 | 921.47 | 33D10110627SPR | 921.37 | 0.10 |
| 8708 | 7009545.91 | 568887.59 | 922.12 | 33D10110627SPR | 922.08 | 0.04 |
| 8709 | 7009488.58 | 569006.34 | 922.87 | 33D10110627SPR | 922.79 | 0.08 |
| 8710 | 7009438.93 | 569108.78 | 923.72 | 33D10110627SPR | 923.67 | 0.05 |
| 8711 | 7009388.44 | 569215.96 | 925.24 | 33D10110627SPR | 925.20 | 0.04 |
| 8712 | 7009359.68 | 569288.35 | 926.29 | 33D10110627SPR | 926.20 | 0.09 |
| 8713 | 7009329.10 | 569385.32 | 927.66 | 33D10110627SPR | 927.61 | 0.05 |
| 8714 | 7009306.31 | 569470.08 | 928.64 | 33D10110627SPR | 928.58 | 0.06 |
| 8715 | 7009266.59 | 569616.91 | 930.63 | 33D10110627SPR | 930.55 | 0.08 |
| 8716 | 7009236.34 | 569728.33 | 932.14 | 33D10110627SPR | 932.05 | 0.09 |
| 8717 | 7009202.66 | 569853.65 | 933.87 | 33D10110627SPR | 933.79 | 0.08 |
| 8718 | 7009174.50 | 569957.74 | 935.31 | 33D10110627SPR | 935.24 | 0.07 |
| 8719 | 7009136.29 | 570099.40 | 937.23 | 33D10110627SPR | 937.13 | 0.10 |
| 8720 | 7009103.19 | 570220.66 | 938.82 | 33D10110627SPR | 938.73 | 0.09 |
| 8721 | 7009068.78 | 570348.50 | 939.92 | 33D10110627SPR | 939.77 | 0.14 |
| 8722 | 7008991.70 | 570492.96 | 942.82 | 33D10110627SPR | 942.76 | 0.06 |
| 8723 | 7008894.27 | 570562.61 | 948.03 | 33D10110627SPR | 948.00 | 0.03 |
| 8724 | 7008814.42 | 570614.77 | 952.96 | 33D10110627SPR | 952.86 | 0.10 |
| 8725 | 7008752.20 | 570675.83 | 957.05 | 33D10110627SPR | 956.95 | 0.10 |
| 8726 | 7008716.18 | 570726.16 | 959.67 | 33D10110627SPR | 959.58 | 0.09 |
| 8727 | 7008659.59 | 570841.16 | 962.40 | 33D10110627SPR | 962.33 | 0.07 |
| 8728 | 7008613.67 | 570941.78 | 963.87 | 33D10110627SPR | 963.81 | 0.06 |
| 8729 | 7008553.99 | 571027.88 | 964.91 | 33D10110627SPR | 964.84 | 0.07 |
| 8730 | 7008484.94 | 571108.26 | 966.65 | 33D10110627SPR | 966.57 | 0.08 |
| 8731 | 7008391.15 | 571212.31 | 970.34 | 33D10110627SPR | 970.26 | 0.08 |
| 8732 | 7008317.05 | 571271.41 | 973.01 | 33D10110627SPR | 972.91 | 0.10 |
| 8733 | 7008223.69 | 571332.87 | 976.34 | 33D10110627SPR | 976.19 | 0.14 |
| 8734 | 7008142.55 | 571395.56 | 979.14 | 33D10110627SPR | 979.05 | 0.09 |
| 8735 | 7008083.28 | 571453.19 | 980.79 | 33D10110627SPR | 980.68 | 0.11 |
| 8736 | 7008020.54 | 571518.30 | 982.00 | 33D10110627SPR | 981.91 | 0.09 |
| 8737 | 7007960.81 | 571596.44 | 982.84 | 33D10110627SPR | 982.70 | 0.13 |
| 8738 | 7007896.90 | 571715.67 | 983.65 | 33D10110627SPR | 983.55 | 0.10 |
| 8739 | 7007844.93 | 571814.90 | 986.20 | 33D10110627SPR | 986.07 | 0.13 |
| 8740 | 7007800.60 | 571899.57 | 988.17 | 33D10110627SPR | 988.05 | 0.12 |
| 8741 | 7007764.99 | 571988.54 | 989.92 | 33D10110627SPR | 989.79 | 0.13 |
| 8742 | 7007742.33 | 572103.52 | 994.49 | 33D10110627SPR | 994.39 | 0.10 |
| 8743 | 7007731.21 | 572193.17 | 998.34 | 33D10110627SPR | 998.21 | 0.13 |
| 8744 | 7007683.57 | 572323.67 | 1001.39 | 33D10110627SPR | 1001.21 | 0.18 |
| 8745 | 7007598.22 | 572478.67 | 1000.59 | 33D10110627SPR | 1000.46 | 0.13 |
| 8746 | 7009178.53 | 569903.52 | 934.29 | 33D10110627SGR | 934.18 | 0.11 |
| 8747 | 7009162.52 | 569889.92 | 933.59 | 33D10110627SGR | 933.50 | 0.09 |
| 8748 | 7009135.95 | 569864.39 | 933.16 | 33D10110627SGR | 933.04 | 0.12 |
| 8749 | 7009107.93 | 569835.38 | 932.66 | 33D10110627SGR | 932.59 | 0.07 |
| 8750 | 7009089.05 | 569812.10 | 932.27 | 33D10110627SGR | 932.19 | 0.08 |
| 8751 | 7009074.68 | 569784.10 | 931.90 | 33D10110627SGR | 931.85 | 0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 8752 | 7009066.20 | 569757.47 | 931.26 | 33D10110627SGR | 931.23 | 0.03 |
| 8753 | 7009055.30 | 569717.22 | 930.62 | 33D10110627SGR | 930.54 | 0.08 |
| 8754 | 7009046.59 | 569685.46 | 929.83 | 33D10110627SGR | 929.75 | 0.08 |
| 8755 | 7009037.39 | 569654.15 | 929.17 | 33D10110627SGR | 929.08 | 0.09 |
| 8756 | 7009028.66 | 569624.18 | 928.92 | 33D10110627SGR | 928.81 | 0.11 |
| 8757 | 7009013.05 | 569580.41 | 928.18 | 33D10110627SGR | 928.14 | 0.04 |
| 8758 | 7008994.30 | 569540.17 | 927.46 | 33D10110627SGR | 927.39 | 0.07 |
| 8759 | 7008980.89 | 569497.14 | 926.83 | 33D10110627SGR | 926.78 | 0.05 |
| 8760 | 7008971.56 | 569452.00 | 926.33 | 33D10110627SGR | 926.26 | 0.07 |
| 8761 | 7008948.17 | 569380.01 | 925.23 | 33D10110627SGR | 925.14 | 0.09 |
| 8762 | 7008921.59 | 569321.62 | 924.41 | 33D10110627SGR | 924.34 | 0.07 |
| 8763 | 7008904.55 | 569286.68 | 923.80 | 33D10110627SGR | 923.73 | 0.07 |
| 8764 | 7008872.13 | 569221.80 | 922.62 | 33D10110627SGR | 922.55 | 0.07 |
| 8765 | 7008836.36 | 569150.24 | 921.59 | 33D10110627SGR | 921.50 | 0.09 |
| 8766 | 7008804.05 | 569071.90 | 920.16 | 33D10110627SGR | 920.04 | 0.12 |
| 8767 | 7008783.21 | 569025.48 | 919.34 | 33D10110627SGR | 919.23 | 0.11 |
| 8768 | 7008762.80 | 568979.24 | 918.74 | 33D10110627SGR | 918.68 | 0.06 |
| 8769 | 7008736.33 | 568914.47 | 917.88 | 33D10110627SGR | 917.78 | 0.10 |
| 8770 | 7008710.96 | 568843.11 | 916.89 | 33D10110627SGR | 916.80 | 0.09 |
| 8771 | 7008664.84 | 568800.04 | 916.31 | 33D10110627SGR | 916.22 | 0.09 |
| 8772 | 7008626.94 | 568790.12 | 915.94 | 33D10110627SGR | 915.85 | 0.08 |
| 8773 | 7008576.48 | 568762.16 | 915.30 | 33D10110627SGR | 915.22 | 0.08 |
| 8774 | 7008544.71 | 568720.79 | 914.66 | 33D10110627SGR | 914.60 | 0.06 |
| 8775 | 7008512.85 | 568662.75 | 913.72 | 33D10110627SGR | 913.63 | 0.09 |
| 8776 | 7008499.34 | 568624.34 | 913.07 | 33D10110627SGR | 912.96 | 0.11 |
| 8777 | 7008465.61 | 568597.36 | 912.47 | 33D10110627SGR | 912.38 | 0.09 |
| 8778 | 7008428.18 | 568598.89 | 911.98 | 33D10110627SGR | 911.91 | 0.07 |
| 8779 | 7008396.97 | 568580.95 | 911.49 | 33D10110627SGR | 911.45 | 0.04 |
| 8780 | 7008370.88 | 568548.43 | 911.20 | 33D10110627SGR | 911.11 | 0.09 |
| 8781 | 7008341.68 | 568524.37 | 910.66 | 33D10110627SGR | 910.60 | 0.06 |
| 8782 | 7008314.94 | 568507.54 | 910.08 | 33D10110627SGR | 910.04 | 0.04 |
| 8783 | 7008278.17 | 568485.44 | 909.73 | 33D10110627SGR | 909.65 | 0.08 |
| 8784 | 7008248.63 | 568449.08 | 909.25 | 33D10110627SGR | 909.18 | 0.07 |
| 8785 | 7008241.23 | 568398.80 | 909.06 | 33D10110627SGR | 909.01 | 0.05 |
| 8786 | 7008248.14 | 568346.59 | 908.96 | 33D10110627SGR | 908.89 | 0.07 |
| 8787 | 7008250.89 | 568302.27 | 908.52 | 33D10110627SGR | 908.44 | 0.07 |
| 8788 | 7008255.00 | 568259.26 | 908.01 | 33D10110627SGR | 907.94 | 0.07 |
| 8789 | 7008249.25 | 568223.73 | 907.71 | 33D10110627SGR | 907.62 | 0.09 |
| 8790 | 7008228.81 | 568176.39 | 907.05 | 33D10110627SGR | 907.00 | 0.05 |
| 8791 | 7008193.62 | 568132.51 | 906.57 | 33D10110627SGR | 906.48 | 0.09 |
| 8792 | 7008155.81 | 568091.10 | 905.98 | 33D10110627SGR | 905.92 | 0.06 |
| 8793 | 7008120.31 | 568072.29 | 905.73 | 33D10110627SGR | 905.66 | 0.07 |
| 8794 | 7008083.29 | 568058.14 | 905.60 | 33D10110627SGR | 905.51 | 0.09 |
| 8795 | 7008032.19 | 568040.99 | 905.35 | 33D10110627SGR | 905.23 | 0.12 |
| 8796 | 7007989.87 | 568020.51 | 905.24 | 33D10110627SGR | 905.16 | 0.08 |
| 8816 | 7012829.24 | 567871.31 | 1106.26 | 33D10110627SGR | 1106.16 | 0.10 |
| 8817 | 7012816.72 | 567884.11 | 1106.49 | 33D10110627SGR | 1106.37 | 0.12 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 8818 | 7012816.15 | 567897.98 | 1106.54 | 33D10110627SGR | 1106.43 | 0.11 |
| 8819 | 7012806.22 | 567907.31 | 1106.15 | 33D10110627SGR | 1106.02 | 0.13 |
| 8820 | 7012799.43 | 567917.73 | 1105.96 | 33D10110627SGR | 1105.85 | 0.11 |
| 8821 | 7012772.75 | 567959.59 | 1104.76 | 33D10110627SGR | 1104.64 | 0.12 |
| 8822 | 7012729.02 | 568037.24 | 1100.74 | 33D10110627SGR | 1100.61 | 0.13 |
| 8823 | 7012660.35 | 568189.38 | 1090.03 | 33D10110627SGR | 1089.92 | 0.11 |
| 8824 | 7012671.19 | 568337.19 | 1083.91 | 33D10110627SGR | 1083.81 | 0.10 |
| 8825 | 7012678.76 | 568446.19 | 1080.91 | 33D10110627SGR | 1080.86 | 0.05 |
| 8826 | 7012646.22 | 568585.31 | 1074.43 | 33D10110627SGR | 1074.33 | 0.10 |
| 8829 | 7010391.80 | 568153.82 | 914.59 | 33D10110627CK_SPIKE | 914.51 | 0.08 |
| 8830 | 7010391.79 | 568153.83 | 914.59 | 33D10110627CK_SPIKE | 914.51 | 0.08 |
| 10300 | 7060862.72 | 555186.93 | 542.81 | 31B2011051931BFBC | 542.68 | 0.13 |
| 10301 | 7060874.46 | 555145.83 | 542.60 | 31B20110519SPR | 542.63 | -0.03 |
| 10302 | 7060851.99 | 555137.64 | 542.73 | 31B20110519SPR | 542.75 | -0.02 |
| 10303 | 7060824.80 | 555126.51 | 542.98 | 31B20110519SPR | 542.98 | 0.00 |
| 10304 | 7060797.45 | 555116.67 | 543.18 | 31B20110519SPR | 543.21 | -0.03 |
| 10305 | 7060770.71 | 555108.75 | 543.32 | 31B20110519SPR | 543.34 | -0.02 |
| 10306 | 7060773.31 | 555104.29 | 543.36 | 31B20110519SPR | 543.39 | -0.03 |
| 10307 | 7060788.16 | 555109.47 | 543.27 | 31B20110519SPR | 543.29 | -0.02 |
| 10308 | 7060816.18 | 555119.48 | 543.05 | 31B20110519SPR | 543.06 | -0.01 |
| 10309 | 7060842.28 | 555128.69 | 542.82 | 31B20110519SPR | 542.83 | -0.01 |
| 10310 | 7060861.73 | 555135.87 | 542.68 | 31B20110519SPR | 542.72 | -0.04 |
| 10311 | 7060610.10 | 555058.48 | 544.40 | 31B20110519SPR | 544.42 | -0.02 |
| 10312 | 7060586.23 | 555053.91 | 544.54 | 31B20110519SPR | 544.55 | -0.01 |
| 10313 | 7060569.26 | 555049.86 | 544.63 | 31B20110519SPR | 544.65 | -0.02 |
| 10314 | 7060549.68 | 555045.19 | 544.73 | 31B20110519SPR | 544.77 | -0.04 |
| 10315 | 7060533.29 | 555041.25 | 544.83 | 31B20110519SPR | 544.86 | -0.03 |
| 10316 | 7060533.91 | 555036.26 | 544.92 | 31B20110519SPR | 544.94 | -0.02 |
| 10317 | 7060549.98 | 555039.99 | 544.83 | 31B20110519SPR | 544.86 | -0.03 |
| 10318 | 7060566.05 | 555043.77 | 544.76 | 31B20110519SPR | 544.78 | -0.02 |
| 10319 | 7060586.72 | 555048.71 | 544.63 | 31B20110519SPR | 544.65 | -0.02 |
| 10320 | 7060602.47 | 555052.72 | 544.49 | 31B20110519SPR | 544.54 | -0.05 |
| 10321 | 7059974.72 | 554926.25 | 548.30 | 31B20110519SPR | 548.32 | -0.02 |
| 10322 | 7059971.76 | 554930.83 | 548.30 | 31B20110519SPR | 548.33 | -0.03 |
| 10323 | 7059954.06 | 554927.37 | 548.44 | 31B20110519SPR | 548.44 | 0.00 |
| 10324 | 7059936.70 | 554924.10 | 548.55 | 31B20110519SPR | 548.57 | -0.02 |
| 10325 | 7059918.08 | 554920.60 | 548.65 | 31B20110519SPR | 548.65 | 0.00 |
| 10326 | 7059899.17 | 554916.65 | 548.77 | 31B20110519SPR | 548.78 | -0.01 |
| 10327 | 7059907.69 | 554913.39 | 548.72 | 31B20110519SPR | 548.74 | -0.02 |
| 10328 | 7059921.35 | 554916.00 | 548.63 | 31B20110519SPR | 548.65 | -0.02 |
| 10329 | 7059936.58 | 554918.91 | 548.54 | 31B20110519SPR | 548.55 | -0.01 |
| 10330 | 7059953.27 | 554922.17 | 548.42 | 31B20110519SPR | 548.46 | -0.04 |
| 10331 | 7059069.53 | 554817.08 | 554.76 | 31B20110519SPR | 554.78 | -0.02 |
| 10332 | 7059067.45 | 554821.52 | 554.72 | 31B20110519SPR | 554.73 | -0.01 |
| 10333 | 7059048.93 | 554822.44 | 554.87 | 31B20110519SPR | 554.88 | -0.01 |
| 10334 | 7059030.81 | 554823.80 | 554.97 | 31B20110519SPR | 555.00 | -0.03 |
| 10335 | 7059011.59 | 554824.62 | 555.12 | 31B20110519SPR | 555.14 | -0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10336 | 7058994.28 | 554825.57 | 555.24 | 31B20110519SPR | 555.26 | -0.02 |
| 10337 | 7058994.63 | 554820.69 | 555.26 | 31B20110519SPR | 555.26 | 0.00 |
| 10338 | 7059005.36 | 554820.28 | 555.17 | 31B20110519SPR | 555.18 | -0.01 |
| 10339 | 7059021.83 | 554819.48 | 555.05 | 31B20110519SPR | 555.08 | -0.03 |
| 10340 | 7059039.09 | 554818.58 | 554.96 | 31B20110519SPR | 554.97 | -0.01 |
| 10341 | 7059054.82 | 554817.71 | 554.86 | 31B20110519SPR | 554.90 | -0.04 |
| 10342 | 7058237.65 | 554863.20 | 560.44 | 31B20110519SPR | 560.49 | -0.05 |
| 10343 | 7058233.34 | 554868.26 | 560.42 | 31B20110519SPR | 560.44 | -0.02 |
| 10344 | 7058214.74 | 554869.43 | 560.48 | 31B20110519SPR | 560.49 | -0.01 |
| 10345 | 7058196.60 | 554870.31 | 560.59 | 31B20110519SPR | 560.60 | -0.01 |
| 10346 | 7058178.20 | 554871.16 | 560.68 | 31B20110519SPR | 560.71 | -0.03 |
| 10347 | 7058170.93 | 554867.17 | 560.75 | 31B20110519SPR | 560.78 | -0.03 |
| 10348 | 7058186.20 | 554866.07 | 560.67 | 31B20110519SPR | 560.70 | -0.03 |
| 10349 | 7058203.07 | 554865.20 | 560.60 | 31B20110519SPR | 560.62 | -0.02 |
| 10350 | 7058220.62 | 554864.20 | 560.52 | 31B20110519SPR | 560.55 | -0.03 |
| 10351 | 7057430.73 | 554908.92 | 566.39 | 31B20110519SPR | 566.39 | 0.00 |
| 10352 | 7057431.36 | 554912.57 | 566.35 | 31B20110519SPR | 566.35 | 0.00 |
| 10353 | 7057472.71 | 554905.97 | 565.99 | 31B20110519SPR | 565.97 | 0.02 |
| 10354 | 7057506.19 | 554904.40 | 565.72 | 31B20110519SPR | 565.71 | 0.01 |
| 10355 | 7057518.87 | 554903.48 | 565.60 | 31B20110519SPR | 565.60 | 0.00 |
| 10356 | 7057531.27 | 554902.82 | 565.49 | 31B20110519SPR | 565.49 | 0.00 |
| 10357 | 7057542.77 | 554902.18 | 565.39 | 31B20110519SPR | 565.38 | 0.01 |
| 10358 | 7056333.99 | 555018.38 | 582.40 | 31B20110519SPR | 582.42 | -0.02 |
| 10359 | 7056318.13 | 555027.69 | 582.86 | 31B20110519SPR | 582.89 | -0.03 |
| 10360 | 7056291.92 | 555045.44 | 583.68 | 31B20110519SPR | 583.69 | -0.01 |
| 10361 | 7056277.26 | 555056.58 | 584.19 | 31B20110519SPR | 584.20 | -0.01 |
| 10362 | 7056261.10 | 555069.62 | 584.63 | 31B20110519SPR | 584.63 | 0.00 |
| 10363 | 7056242.99 | 555078.20 | 585.04 | 31B20110519SPR | 585.05 | -0.01 |
| 10364 | 7056255.36 | 555067.89 | 584.82 | 31B20110519SPR | 584.82 | 0.00 |
| 10365 | 7056268.22 | 555057.64 | 584.53 | 31B20110519SPR | 584.52 | 0.01 |
| 10366 | 7056280.98 | 555047.82 | 584.10 | 31B20110519SPR | 584.12 | -0.02 |
| 10367 | 7056269.75 | 555023.99 | 583.62 | 31B20110519SGR | 583.63 | -0.01 |
| 10368 | 7056257.45 | 555013.88 | 584.61 | 31B20110519SGR | 584.60 | 0.01 |
| 10369 | 7056236.50 | 555000.69 | 586.50 | 31B20110519SGR | 586.52 | -0.02 |
| 10370 | 7056225.88 | 554985.47 | 583.46 | 31B20110519SGR | 583.47 | -0.01 |
| 10371 | 7056251.97 | 554974.38 | 579.98 | 31B20110519SGR | 579.98 | 0.00 |
| 10372 | 7056288.37 | 555042.30 | 583.88 | 31B20110519SPR | 583.88 | 0.00 |
| 10374 | 7054571.46 | 556268.86 | 632.43 | 31B20110519SPR | 632.36 | 0.07 |
| 10375 | 7054586.53 | 556264.29 | 631.62 | 31B20110519SPR | 631.53 | 0.09 |
| 10376 | 7054557.45 | 556272.91 | 633.09 | 31B20110519SPR | 632.98 | 0.11 |
| 10377 | 7058364.84 | 555817.99 | 574.30 | 31B20110519SGR | 574.26 | 0.04 |
| 10378 | 7058362.86 | 555808.41 | 574.16 | 31B20110519SGR | 574.13 | 0.03 |
| 10379 | 7058362.22 | 555791.46 | 573.78 | 31B20110519SGR | 573.74 | 0.04 |
| 10380 | 7058360.04 | 555774.95 | 572.79 | 31B20110519SGR | 572.77 | 0.02 |
| 10381 | 7058358.69 | 555758.30 | 572.34 | 31B20110519SGR | 572.32 | 0.02 |
| 10382 | 7058357.26 | 555739.87 | 571.88 | 31B20110519SGR | 571.84 | 0.04 |
| 10383 | 7058355.70 | 555721.98 | 572.18 | 31B20110519SGR | 572.14 | 0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10384 | 7058355.05 | 555706.44 | 572.53 | 31B20110519SGR | 572.51 | 0.02 |
| 10385 | 7058353.74 | 555688.28 | 571.99 | 31B20110519SGR | 572.00 | -0.01 |
| 10386 | 7058428.06 | 555407.76 | 562.48 | 31B20110519SGR | 562.51 | -0.03 |
| 10387 | 7058422.29 | 555421.88 | 562.62 | 31B20110519SGR | 562.64 | -0.02 |
| 10388 | 7058418.07 | 555436.99 | 562.89 | 31B20110519SGR | 562.90 | -0.01 |
| 10389 | 7058414.64 | 555450.79 | 562.99 | 31B20110519SGR | 563.00 | -0.01 |
| 10390 | 7058410.45 | 555467.46 | 563.02 | 31B20110519SGR | 563.03 | -0.01 |
| 10391 | 7058403.17 | 555488.74 | 563.30 | 31B20110519SGR | 563.29 | 0.01 |
| 10392 | 7058398.42 | 555502.34 | 563.64 | 31B20110519SGR | 563.62 | 0.02 |
| 10393 | 7058484.65 | 555092.12 | 557.91 | 31B20110519SGR | 557.94 | -0.03 |
| 10394 | 7058482.49 | 555111.41 | 557.88 | 31B20110519SGR | 557.90 | -0.02 |
| 10395 | 7058484.98 | 555129.65 | 557.74 | 31B20110519SGR | 557.75 | -0.01 |
| 10396 | 7058491.71 | 555069.06 | 557.90 | 31B20110519SGR | 557.92 | -0.02 |
| 10397 | 7058502.71 | 555056.17 | 557.94 | 31B20110519SGR | 557.92 | 0.02 |
| 10398 | 7058517.14 | 555045.52 | 557.91 | 31B20110519SGR | 557.90 | 0.01 |
| 10399 | 7058532.36 | 555037.48 | 557.84 | 31B20110519SGR | 557.84 | 0.00 |
| 10400 | 7058558.80 | 555035.20 | 557.49 | 31B20110519SGR | 557.51 | -0.02 |
| 10401 | 7058464.22 | 555067.92 | 558.19 | 31B20110519SGR | 558.19 | 0.00 |
| 10402 | 7058451.39 | 555058.79 | 558.30 | 31B20110519SGR | 558.29 | 0.01 |
| 10403 | 7058432.51 | 555043.49 | 558.49 | 31B20110519SGR | 558.49 | 0.00 |
| 10404 | 7058418.11 | 555026.40 | 558.69 | 31B20110519SGR | 558.69 | 0.00 |
| 10405 | 7058405.92 | 555018.14 | 558.81 | 31B20110519SGR | 558.83 | -0.02 |
| 10406 | 7063557.24 | 555094.41 | 539.42 | 31B20110519SPR | 539.43 | -0.01 |
| 10407 | 7063564.16 | 555093.05 | 539.40 | 31B20110519SPR | 539.44 | -0.04 |
| 10408 | 7063573.61 | 555103.47 | 539.89 | 31B20110519SPR | 539.91 | -0.02 |
| 10409 | 7063587.49 | 555119.05 | 540.69 | 31B20110519SPR | 540.72 | -0.03 |
| 10410 | 7063598.22 | 555130.94 | 541.43 | 31B20110519SPR | 541.46 | -0.03 |
| 10411 | 7063610.24 | 555143.83 | 542.47 | 31B20110519SPR | 542.51 | -0.04 |
| 10412 | 7063621.94 | 555155.54 | 543.50 | 31B20110519SPR | 543.53 | -0.03 |
| 10413 | 7063634.00 | 555167.24 | 544.72 | 31B20110519SPR | 544.76 | -0.04 |
| 10414 | 7063636.52 | 555175.89 | 545.67 | 31B20110519SPR | 545.69 | -0.02 |
| 10415 | 7063626.90 | 555167.36 | 544.65 | 31B20110519SPR | 544.71 | -0.06 |
| 10416 | 7063616.66 | 555157.49 | 543.60 | 31B20110519SPR | 543.64 | -0.04 |
| 10417 | 7063605.49 | 555145.47 | 542.51 | 31B20110519SPR | 542.52 | -0.01 |
| 10418 | 7063594.58 | 555133.98 | 541.60 | 31B20110519SPR | 541.63 | -0.03 |
| 10419 | 7063583.20 | 555121.55 | 540.81 | 31B20110519SPR | 540.84 | -0.03 |
| 10420 | 7063572.38 | 555109.44 | 540.17 | 31B20110519SPR | 540.18 | -0.01 |
| 10421 | 7063560.76 | 555095.88 | 539.52 | 31B20110519SPR | 539.55 | -0.03 |
| 10422 | 7063549.76 | 555084.75 | 539.06 | 31B20110519SPR | 539.07 | -0.01 |
| 10423 | 7062989.35 | 554823.63 | 554.23 | 31B20110519SPR | 554.27 | -0.04 |
| 10424 | 7062973.78 | 554827.15 | 554.41 | 31B20110519SPR | 554.45 | -0.04 |
| 10425 | 7062958.93 | 554830.31 | 554.60 | 31B20110519SPR | 554.64 | -0.04 |
| 10426 | 7062943.23 | 554833.94 | 554.75 | 31B20110519SPR | 554.79 | -0.04 |
| 10427 | 7062927.77 | 554837.54 | 554.83 | 31B20110519SPR | 554.88 | -0.05 |
| 10428 | 7062919.96 | 554834.46 | 554.99 | 31B20110519SPR | 555.02 | -0.03 |
| 10429 | 7062934.90 | 554831.23 | 554.84 | 31B20110519SPR | 554.88 | -0.04 |
| 10430 | 7062950.67 | 554827.80 | 554.70 | 31B20110519SPR | 554.75 | -0.05 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 10431 | 7062965.63 | 554824.36 | 554.49 | 31B20110519SPR | 554.52 | -0.03 |
| 10432 | 7062980.83 | 554820.92 | 554.34 | 31B20110519SPR | 554.36 | -0.02 |
| 10433 | 7062995.46 | 554817.75 | 554.11 | 31B20110519SPR | 554.14 | -0.03 |
| 10434 | 7061697.67 | 555193.05 | 555.77 | 31B20110519SPR | 555.77 | 0.00 |
| 10435 | 7061712.29 | 555187.17 | 556.24 | 31B20110519SPR | 556.25 | -0.01 |
| 10436 | 7061727.20 | 555181.38 | 556.71 | 31B20110519SPR | 556.71 | 0.00 |
| 10437 | 7061743.49 | 555175.22 | 557.24 | 31B20110519SPR | 557.25 | -0.01 |
| 10438 | 7061758.47 | 555169.80 | 557.71 | 31B20110519SPR | 557.72 | -0.01 |
| 10439 | 7061768.17 | 555171.00 | 557.86 | 31B20110519SPR | 557.88 | -0.02 |
| 10440 | 7061758.67 | 555174.28 | 557.57 | 31B20110519SPR | 557.59 | -0.02 |
| 10441 | 7061744.39 | 555179.74 | 557.10 | 31B20110519SPR | 557.11 | -0.01 |
| 10442 | 7061729.20 | 555185.27 | 556.57 | 31B20110519SPR | 556.57 | 0.00 |
| 10443 | 7061715.03 | 555191.14 | 556.14 | 31B20110519SPR | 556.15 | -0.01 |
| 10444 | 7061702.26 | 555196.24 | 555.80 | 31B20110519SPR | 555.81 | -0.01 |
| 10445 | 7061300.87 | 555462.03 | 561.71 | 31B20110519SGR | 561.73 | -0.02 |
| 10446 | 7061313.93 | 555454.82 | 562.39 | 31B20110519SGR | 562.37 | 0.02 |
| 10447 | 7061316.88 | 555447.97 | 562.55 | 31B20110519SGR | 562.56 | -0.01 |
| 10448 | 7061329.40 | 555442.84 | 562.96 | 31B20110519SGR | 562.97 | -0.01 |
| 10449 | 7061338.51 | 555435.31 | 563.13 | 31B20110519SGR | 563.15 | -0.02 |
| 10450 | 7061349.65 | 555421.10 | 562.52 | 31B20110519SGR | 562.58 | -0.06 |
| 10451 | 7060873.22 | 555149.13 | 542.53 | 31B20110519CHECK | 542.56 | -0.03 |
| 10452 | 7060873.23 | 555149.14 | 542.54 | 31B20110519CHECK | 542.56 | -0.02 |

# LiDAR REMOTE SENSING

## ALASKA PIPELINE • ALASKA

(Delivery 10– 1/31/2012)








## ALASKA DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

**TRENT HUBBARD** - 3354 College Road - Fairbanks, AK 99709

**WATERSHED SCIENCES** • 517 SW 2nd Street, Suite 400 - Corvallis, OR 97333

# LiDAR Remote Sensing Data Collection:

## Alaska Pipeline, AK

### Delivery 10

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# 1. Overview

Watershed Sciences, Inc. (WS) collected Light Detection and Ranging (LiDAR) data of the Alaska Pipeline for the Alaska Department of Natural Resources. LiDAR data for Delivery 10 was collected between May 31st and July 15th, 2011 (**Figure 1**). Delivery 10 includes 162,898 acres within the requested area. This area was expanded to include a 100m buffer to ensure complete coverage and adequate point densities around survey boundaries, resulting in 177,733 acres of delivered data covering Port Valdez and north along Richardson Hwy (4) to Sourdough Creek.

*Figure 1. Alaska Pipeline survey delivery status overview.*

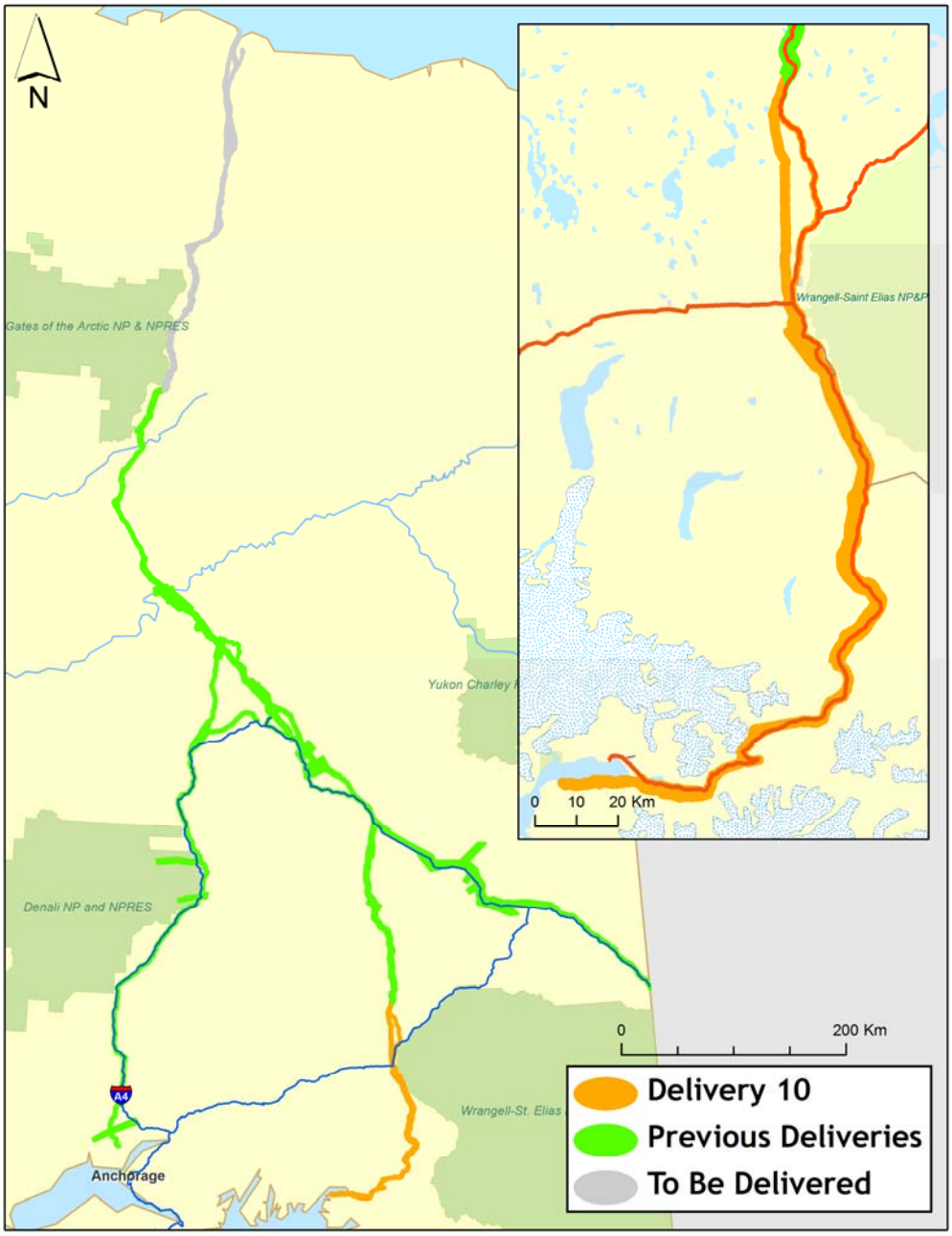


*Table 1. Alaska Pipeline, LiDAR deliveries to date.*

| Delivery | UTM Zone(s) | Date | Total Acres Flown | AOI Acres |
|---|---|---|---|---|
| **1** | 6, 7 | March 9, 2011 | 121,746 | 117,357 |
| **2** | 6 | March 31, 2011 | 99,594 | 94,885 |
| **3** | 7 | May 23, 2011 | 43,976 | 39,744 |
| **4** | 6 | July 29, 2011 | 168,823 | 159,433 |
| **5** | 5 | August 31, 2011 | 247,206 | 226,450 |
| **6** | 6 | September 30, 2011 | 309,216 | 293,337 |
| **7** | 6 | October 31, 2011 | 262,279 | 239,477 |
| **8** | 7 | November 21, 2011 | 156,712 | 149,733 |
| **9** | 6 | December 20, 2011 | 176,785 | 167,164 |
| **10** | 6 | January 31, 2012 | 177,733 | 162,898 |

# 2. Acquisition

## 2.1 Airborne Survey – Instrumentation and Methods

The LiDAR survey utilized a Leica ALS60 sensor in a Cessna Caravan 208Bs. The Leica systems were set to acquire 150,000 laser pulses per second (i.e., 150 kHz pulse rate) and flown at 1500 meters above ground level (AGL), capturing a scan angle of ±14$^{o}$ from nadir when clouds and terrain permitted. With these flight parameters, the laser swath width is 638m and the laser pulse footprint is 34cm. These settings varied depending on cloud cover and terrain but were consistently adjusted to yield an average native pulse density of ≥8 pulses per square meter over terrestrial surfaces. It is not uncommon for some types of surfaces (e.g. dense vegetation or water) to return fewer pulses than the laser originally emitted. These discrepancies between 'native' and 'delivered' density will vary depending on terrain, land cover, and the prevalence of water bodies.



*The Cessna Caravan is a stable platform, ideal for flying slow and low for high density projects. A Leica ALS60 sensor head installed in the Caravan is shown on the left.*

All areas were surveyed with an opposing flight line side-lap of ≥60% (≥100% overlap) to reduce laser shadowing and increase surface laser painting. The Leica laser systems allow up to four range measurements (returns) per pulse, and all discernable laser returns were processed for the output dataset.

To accurately solve for laser point position (geographic coordinates x, y, z), the positional coordinates of the airborne sensor and the attitude of the aircraft were recorded continuously throughout the LiDAR data collection mission. Aircraft position was measured twice per second (2 Hz) by an onboard differential GPS unit. 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/sensor position and attitude data are indexed by GPS time.

## 2.2 Ground Survey – Instrumentation and Methods

### *2.2.1 Monumentation*




Watershed Sciences coordinated with McClintock Land Associates (MLA, Alaska Professional Licensed Surveyor), of Eagle River, AK to determine proposed monument locations to support aerial acquisition. MLA established survey control monuments for the project area based on the proposed locations, areas with reasonable access, GPS visibility and proximity to the mission area. MLA established 15 new monuments (**Table 2**) within the Delivery 10 calibration area. The MLA monumentation was done with 5/8" x 30" rebar topped with a metal cap stamped with "MLA-WSI" the monument ID, and the year of establishment. MLA provided professional supervision and oversight to all survey aspects of this project, certified all monuments and provided additional independent accuracy check points (see Section 5.4, Appendix B). A full report of the survey will be provided with the final delivery report.

### *2.2.2 Control for Airborne Surveys*


Trimble R7 GPS equipment set up in the Alaska Pipeline study area.

During the LiDAR survey, static (1 Hz recording frequency) ground surveys were conducted over the survey control monuments.

All control monuments were observed for a minimum of two survey sessions lasting no fewer than 4 hours. At the beginning of every session the tripod and antenna were reset, resulting in two independent instrument heights and data files. Data was collected at a rate of 1Hz using a 10 degree mask on the antenna.

After the airborne survey, the static GPS data were provided to MLA for incorporation in the computation of the monument coordinates. MLA processed the static GPS data using triangulation with Continuously Operating Reference Stations (CORS). Both WSI and MLA checked coordinates using the Online Positioning User Service (OPUS[1]) to quantify daily variance. MLA provided calculated geodetic positions for all controls.

Indexed by time, these GPS data were used to correct the continuous onboard measurements of aircraft position recorded throughout the mission. Control monuments were located within 13 nautical miles of the survey area as per the contract.

[1] Online Positioning User Service (OPUS) is run by the National Geodetic Survey to process corrected monument positions.

*Table 2. Base Station control coordinates for Alaska Pipeline Delivery 10.*

| Base Station ID | Datum: NAD83 (CORS96) | | GRS80 |
|---|---|---|---|
| | Latitude | Longitude | Ellipsoid Z (meters) |
| 35 A | 62 32 39.45412 | 145 30 38.85944 | 612.097 |
| 35 B | 62 31 09.81020 | 145 30 58.67274 | 614.397 |
| 36 A | 62 17 17.51282 | 145 21 09.25291 | 514.723 |
| 36 B | 62 16 02.02445 | 145 24 05.56595 | 458.29 |
| 37 A | 61 56 10.92515 | 145 18 30.57063 | 408.29 |
| 37 B | 61 55 32.29761 | 145 18 11.17684 | 413.846 |
| 38 A | 61 36 12.70018 | 145 13 00.28182 | 515.486 |
| 38 B | 61 34 25.36999 | 145 13 49.64806 | 561.912 |
| 39 A | 61 17 22.49336 | 145 16 23.48171 | 377.358 |
| 39 B | 61 15 37.95538 | 145 16 59.21484 | 367.398 |
| 39 C | 61 12 51.92784 | 145 22 47.33407 | 419.103 |
| 40 A | 61 07 28.03114 | 145 41 18.00053 | 702.592 |
| 40 B | 61 07 54.65491 | 145 44 09.75285 | 830.264 |
| 41 A | 61 05 59.47923 | 146 13 15.82237 | 24.513 |
| 41 B | 61 07 07.51601 | 146 15 14.86558 | 28.618 |

### *2.2.3 Instrumentation*

For this survey, a Trimble GPS receiver model R7 with Zephyr Geodetic antenna with ground plane was deployed for all static control. A Trimble model R8 GNSS unit was used for collecting check points using real time kinematic (RTK) survey techniques. All GPS measurements were made with dual frequency L1-L2 receivers with carrier-phase correction.

The aircraft was assigned a ground crew member with two Trimble R7 receivers and an R8 receiver. The ground crew vehicles are equipped with standard field survey supplies and equipment including safety materials. The aircraft was further supported, as necessary, by an MLA surveyor (AK PLS) with two or more survey grade Topcon Receivers.

### *2.2.4 Methodology*

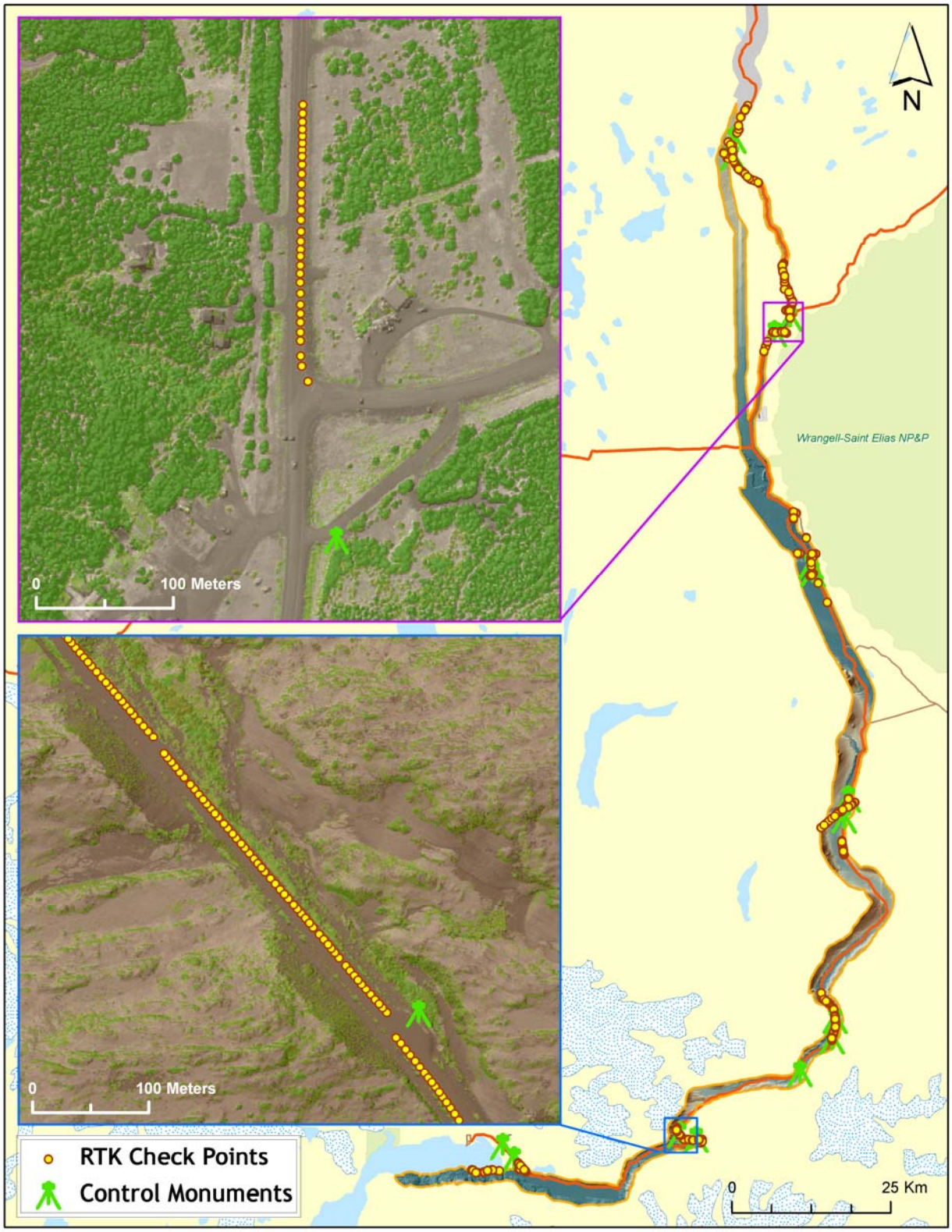
RTK and aircraft mounted GPS measurements were made during periods with PDOP[2] less than or equal to 3.0 and with at least 6 satellites in view of both a stationary reference receiver and the roving receiver. Static GPS data collected in a continuous session average the high PDOP into the final solution in the method used by CORS stations.

For RTK data, the collector begins recording after remaining stationary for 5 seconds then calculating the pseudo range position from at least three epochs with the relative error under 1.5cm horizontal and 2cm vertical. RTK positions are collected on bare earth locations such as paved, gravel or stable dirt roads, and other locations where the ground is clearly visible (and is likely to remain visible) from the sky during the data acquisition and RTK measurement period(s).

In order to facilitate comparisons with LiDAR measurements, RTK measurements were not taken on highly reflective surfaces such as center line stripes or lane markings on roads. RTK points were taken no closer than one meter to any nearby terrain breaks such as road edges or drop offs.

[2]PDOP: Point Dilution of Precision is a measure of satellite geometry, the smaller the number the better the geometry between the point and the satellites.

*Figure 2. WSI RTK check points and control monument locations used in Delivery 10 of the Alaska Pipeline LiDAR Survey.*



# 3. LiDAR Data Processing

## 3.1 Applications and Work Flow Overview

1. Resolved kinematic corrections for aircraft position data using kinematic aircraft GPS and static ground GPS data.

   **Software:** Waypoint GPS v.8.10, Trimble Geomatics Office v.1.62
2. Developed a smoothed best estimate of trajectory (SBET) file that blends post-processed aircraft position with attitude data. Sensor head position and attitude were calculated throughout the survey. The SBET data were used extensively for laser point processing.

   **Software:** IPAS v.1.35
3. Calculated laser point position by associating SBET position to each laser point return time, scan angle, intensity, etc. Created raw laser point cloud data for the entire survey in *.las (ASPRS v. 1.2) format.

   **Software:** ALS Post Processing Software v.2.70
4. Imported raw laser points into manageable blocks (less than 500 MB) to perform manual relative accuracy calibration and filter for pits/birds. Ground points were then classified for individual flight lines (to be used for relative accuracy testing and calibration).

   **Software:** TerraScan v.11.009
5. Using ground classified points per each flight line, the relative accuracy was tested. Automated line-to-line calibrations were then performed for system attitude parameters (pitch, roll, heading), mirror flex (scale) and GPS/IMU drift. Calibrations were performed on ground classified points from paired flight lines. Every flight line was used for relative accuracy calibration.

   **Software:** TerraMatch v.11.006
6. Position and attitude data were imported. Resulting data were classified as ground and non-ground points. Statistical absolute accuracy was assessed via direct comparisons of ground classified points to ground RTK survey data. Data were then converted to orthometric elevations (NAVD88) by applying a Geoid09 correction. **Software:** TerraScan v.11.009, TerraModeler v.11.004
7. Bare Earth models were created as a triangulated surface and exported as ArcInfo ASCII grids at a 1 meter pixel resolution. Highest Hit models were created for any class at 1 meter grid spacing and exported as ArcInfo ASCII grids. Vegetation models were created for all vegetation points 20cm and above the ground model at a 1m grid spacing and exported as ArcInfo ASCII grids.

   **Software:** TerraScan v.11.009, ArcMap v. 9.3.1, TerraModeler v.11.004

## 3.2 Aircraft Kinematic GPS and IMU Data

LiDAR survey datasets were referenced to the 1 Hz static ground GPS data collected over pre-surveyed monuments with known coordinates. While surveying, the aircraft collected 2 Hz kinematic GPS data, and the onboard inertial measurement unit (IMU) collected 200 Hz aircraft attitude data. Waypoint GPS v.8.10 was used to process the kinematic corrections for the aircraft. The static and kinematic GPS data were then post-processed after the survey to

obtain an accurate GPS solution and aircraft positions. IPAS v.1.35 was used to develop a trajectory file that includes corrected aircraft position and attitude information. The trajectory data for the entire flight survey session were incorporated into a final smoothed best estimated trajectory (SBET) file that contains accurate and continuous aircraft positions and attitudes.

## 3.3 Laser Point Processing

Laser point coordinates were computed using the IPAS and ALS Post Processor software suites based on independent data from the LiDAR system (pulse time, scan angle), and aircraft trajectory data (SBET). Laser point returns (first through fourth) were assigned an associated (x, y, z) coordinate along with unique intensity values (0-255). The data were output into large LAS v. 1.2 files with each point maintaining the corresponding scan angle, return number (echo), intensity, and x, y, z (easting, northing, and elevation) information.

These initial laser point files were too large for subsequent processing. To facilitate laser point processing, bins (polygons) were created to divide the dataset into manageable sizes (< 500 MB). Flightlines and LiDAR data were then reviewed to ensure complete coverage of the survey area and positional accuracy of the laser points.

Laser point data were imported into processing bins in TerraScan, and manual calibration was performed to assess the system offsets for pitch, roll, heading and scale (mirror flex). Using a geometric relationship developed by Watershed Sciences, each of these offsets was resolved and corrected if necessary.

LiDAR points were then filtered for noise, pits (artificial low points), and birds (true birds as well as erroneously high points) by screening for absolute elevation limits, isolated points and height above ground. Each bin was then manually inspected for remaining pits and birds and spurious points were removed. In a bin containing approximately 7.5-9.0 million points, an average of 50-100 points are typically found to be artificially low or high. Common sources of non-terrestrial returns are clouds, birds, vapor, haze, decks, brush piles, etc.

Internal calibration was refined using TerraMatch. Points from overlapping lines were tested for internal consistency and final adjustments were made for system misalignments (i.e., pitch, roll, heading offsets and scale). Automated sensor attitude and scale corrections yielded 3-5 cm improvements in the relative accuracy. Once system misalignments were corrected, vertical GPS drift was then resolved and removed per flight line, yielding a slight improvement (<1 cm) in relative accuracy.

The TerraScan software suite is designed specifically for classifying near-ground points (Soininen, 2004). The processing sequence began by 'removing' all points that were not 'near' the earth based on geometric constraints used to evaluate multi-return points. The resulting bare earth (ground) model was visually inspected and additional ground point modeling was performed in site-specific areas to improve ground detail. This manual editing of ground often occurs in areas with known ground modeling deficiencies, such as: bedrock outcrops, cliffs, deeply incised stream banks, and dense vegetation. In some cases, automated ground point classification erroneously included known vegetation (i.e., understory, low/dense shrubs, etc.). These points were manually reclassified. Ground surface rasters were then developed from triangulated irregular networks (TINs) of ground points.

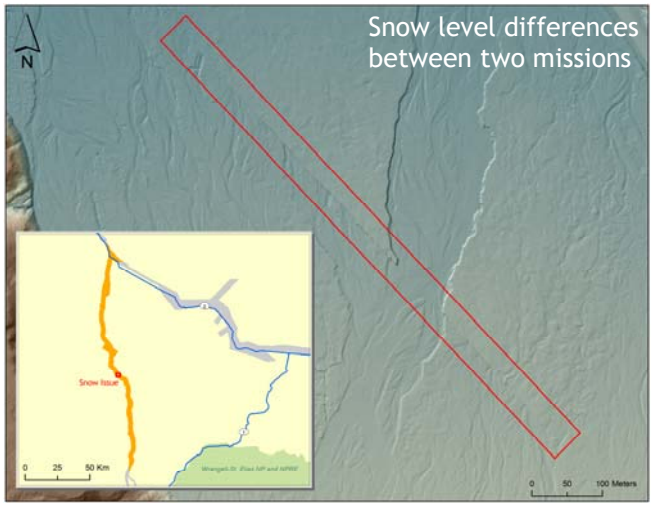
To develop the highest hit and vegetation models, buildings and structures were classified through automated point processing algorithms and then manually inspected and edited during the ground model inspection. Typically, manual editing of building classification was necessary where dense canopy was immediately proximate to buildings, or where structures such as utility poles or fences mimicked vegetation.

In some areas of the project, snow could not be avoided during acquisition. LiDAR returns that were identifiable as snow were reclassified into a new "snow" class. In areas where snow completely obstructed the ground, snow points were retained in the ground model to avoid expansive interpolation across snow fields. In areas where snow prevented laser penetration, ground elevations may be offset from the true ground. A shapefile delineating areas of snow was created for affected deliveries. The shapefile attribution includes a field designating each area as "classified" –meaning valid ground returns exist beneath the snow, or "suspected"- meaning no valid ground returns exist, but the area was identified as snow using the return intensity pattern. Because of temporal differences in neighboring flight mission areas, a 'stair step' artifact occurs in quad XMHA4 as a result of snow melt on the river valley between June 7th and June 27th, 2011.

The remaining points not classified as ground, snow, buildings, or error points were separated into two vegetation classes; Low Vegetation consisting of all returns ≤20cm from the ground, and Medium Vegetation consisting of all returns >20cm from the ground. This distinction was necessary because some potential for unclassified ground exists in the dataset. Vegetation classified returns within 20cm of the ground have higher potential to be artifacts of the dataset caused by minor offsets between flightlines (typically <10cm), isolated noise points, or abrupt discrete terrain features that did not get classified as ground (i.e. small boulders or sharp cliffs). The majority of points classified as low vegetation are valid returns, so the class was retained in the dataset to be incorporated into analyses at the user's discretion.

**Table 3.** ASPRS classification definitions for the Alaska Pipeline LiDAR survey.

| ASPRS Class | Definition |
|---|---|
| 2 | Ground |
| 3 | Low Vegetation |
| 4 | Medium Vegetation |
| 6 | Buildings/Man-made structures |
| 7 | Noise/error points |
| 9 | Water |
| 10 | Snow |
| 15 | Pipeline |

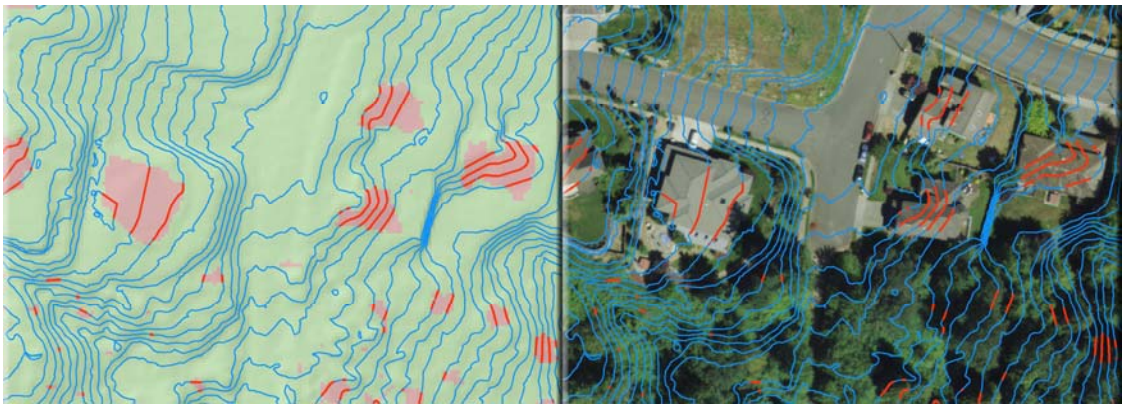


## 3.4 Contour Development

Contour lines were derived at 1 meter intervals from ground-classified LiDAR point data using TerraSolid processing software in MicroStation v. 8.1. Contour generation from LiDAR point data requires a thinning operation in order to reduce contour sinuosity. Parameters for these operations are: thinning elevation bounds: +/- 0.07m; search radius: 6.09m. The thinning operation reduces point density where topographic change is minimal (flat surfaces) while preserving resolution where topographic change is present. The total sum of potential error in vertical position is equal to twice the point processing limits (0.14m) plus twice the 2-sigma absolute vertical accuracy value for this dataset.

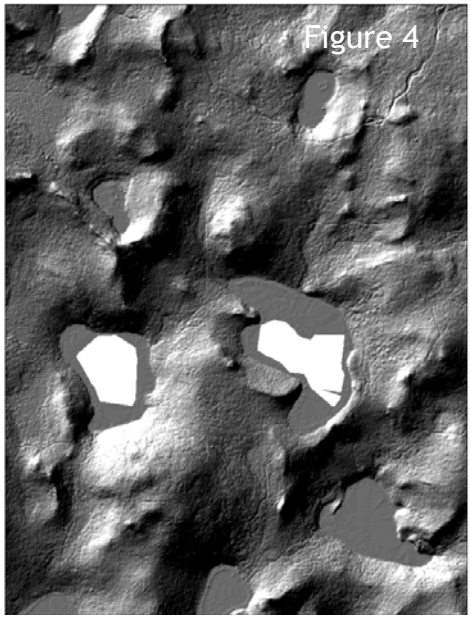
Ground point density rasters were created within MicroStation using a 1 meter step resolution and a 2 meter sampling radius. Areas with less than 0.25 ground-classified points per square meter were considered "sparse" and areas with higher densities were considered "covered". The ground point density raster data are in ESRI GRID format and have a 1 meter pixel resolution. The contour lines were intersected with ground point density raster data, allowing the addition of a confidence attribute to contour lines. Contour lines over "sparse" areas have low confidence, while contour lines over "covered" areas have a high confidence. Areas with low ground point density are commonly beneath buildings and bridges, in locations with dense vegetation, over water, and in other areas where laser penetration to the ground surface is impeded. **Figure 3** is an example of a ground point density raster and contour lines.

*Figure 3. Elevation contours over LiDAR ground-classified point density raster (left) and true-color aerial photograph (right). Red indicates low ground point density and blue represents high density.*

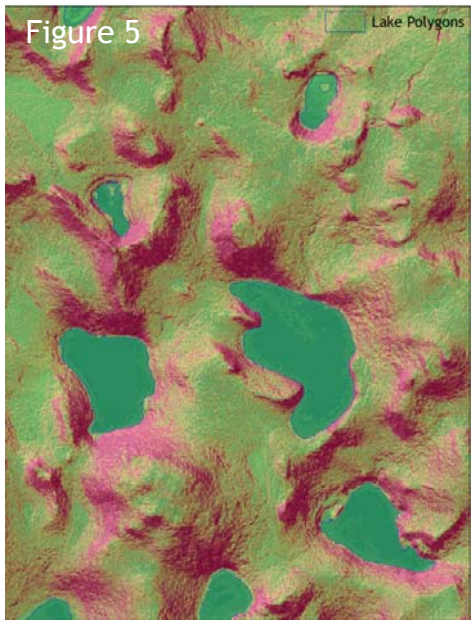


## 3.5 Hydro-Flattening

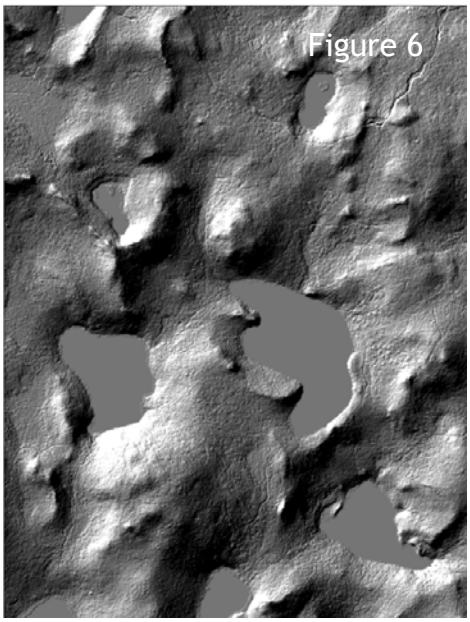
Lakes and other closed water bodies with surface area >150 $m^2$ were flattened to a consistent water level. The hydro-flattening process eliminates artifacts in the digital terrain model caused by both increased variability in ranges or dropouts in laser returns due to the low reflectivity of water (**Figure 4**). As per the project specifications, rivers and streams were not hydro-flattened.




Hydro-flattening of closed water bodies was performed through a combination of automated and manual detection and adjustment techniques designed to identify lake boundaries and water levels. Boundary polygons were developed using an algorithm which weights LiDAR-derived slopes, intensities, and return densities to detect the lake edge. The lake edges were then manually reviewed and edited in a 3-D environment. Once polygons were developed, the lake elevations were computed from the filtered LiDAR returns (**Figure 5**).




Returns from the water surface within each polygon were filtered and inspected for false low points during the initial ground modeling process described previously (Section 3.3). The elevation of each lake was computed as 5-cm above the minimum elevation of filtered water surface cells within the lake polygon. This approach ensures that all spurious returns off the water surface (both artificially high and low) were excluded from lake level assessment.




Lake-boundary polygons were then incorporated into the final terrain model and enforced as hard-breaklines. The initial ground classified points falling within lake polygons were reclassified as water points [to omit them from the final ground model] and replaced with the flat water surface of the lake boundary hydrolines (**Figure 6**).

# 4. LiDAR Accuracy Assessment

## 4.1 Laser Noise and Relative Accuracy

*Laser Noise*
For any given target, laser noise is the breadth of the data cloud per laser return (i.e., last, first, etc.). Lower intensity surfaces (roads, rooftops, still/calm water) experience higher laser noise. The laser noise range for this survey was approximately 0.02 meters.

*Relative Accuracy*
Relative accuracy refers to the internal consistency of the data set - the ability to place a laser point in the same location over multiple flight lines, GPS conditions, and aircraft attitudes. Affected by system attitude offsets, scale, and GPS/IMU drift, internal consistency is measured as the divergence between points from different flight lines within an overlapping area. Divergence is most apparent when flight lines are opposing. When the LiDAR system is well calibrated, the line-to-line divergence is low (<10 cm). See Appendix A for further information on sources of error and operational measures that can be taken to improve relative accuracy.

**Relative Accuracy Calibration Methodology**

1. Manual System Calibration: Calibration procedures for each mission require solving geometric relationships that relate measured swath-to-swath deviations to misalignments of system attitude parameters. Corrected scale, pitch, roll and heading offsets were calculated and applied to resolve misalignments. The raw divergence between lines was computed after the manual calibration was completed and reported for each survey area.
2. Automated Attitude Calibration: All data were tested and calibrated using TerraMatch automated sampling routines. Ground points were classified for each individual flight line and used for line-to-line testing. System misalignment offsets (pitch, roll and heading) and scale were solved for each individual mission and applied to respective mission datasets. The data from each mission were then blended when imported together to form the entire area of interest.
3. Automated Z Calibration: Ground points per line were used to calculate the vertical divergence between lines caused by vertical GPS drift. Automated Z calibration was the final step employed for relative accuracy calibration.

## 4.2 Absolute Accuracy

Laser point absolute accuracy is largely a function of laser noise and relative accuracy. To minimize these contributions to absolute error, a number of noise filtering and calibration procedures were performed prior to evaluating absolute accuracy. The LiDAR quality assurance process uses the data from the real-time kinematic (RTK) ground survey conducted in the AOI. For Delivery 10, **4517 RTK** GPS measurements were collected on hard surfaces distributed among multiple flight swaths for a total of 26,069 points across all delivered data. Suitable and accessible hard-surfaces limited the number and distribution of RTK points able to be collected. To assess absolute accuracy the location coordinates of these known RTK ground points were compared to those calculated for the closest ground-classified laser points.

The vertical accuracy of the LiDAR data is described as the mean and standard deviation (sigma ~ $\sigma$) of divergence between LiDAR point coordinates and RTK ground survey point coordinates. To provide a sense of the model predictive power of the dataset, the root mean square error (RMSE) for vertical accuracy is also provided. These statistics assume the error distributions for x, y, and z are normally distributed, thus the skew and kurtosis of distributions are considered when evaluating error statistics.

Statements of statistical accuracy apply to fixed terrestrial surfaces only and may not be applied to areas of dense vegetation or steep terrain (See Appendix A).

# 5. Study Area Results

Summary statistics for point resolution and accuracy (relative and absolute) of the LiDAR data collected in the Alaska Pipeline Delivery 9 survey area have been added to previously delivered data. Cumulative results are presented below in terms of central tendency, variation around the mean, and the spatial distribution of the data (for point resolution by processing bin).

The initial dataset, acquired to be ≥8 points per square meter, was filtered as described previously to remove spurious or inaccurate points. Additionally, some types of surfaces (i.e., dense vegetation, breaks in terrain, water, steep slopes) may return fewer pulses (delivered density) than the laser originally emitted (native density).

Ground classifications were derived from automated ground surface modeling and manual, supervised classifications where it was determined that the automated model had failed. Ground return densities will be lower in areas of dense vegetation, water, or buildings.

## Data Summary:

*Table 4. LiDAR Resolution and Accuracy - Specifications and Achieved Values*

| | | Targeted | Achieved |
|---|---|---|---|
| **Resolution:** | **UTM 5** | ≥ 8 points/$m^2$ | 8.60 points/$m^2$ |
| | **UTM 6** | | 8.88 points/$m^2$ |
| | **UTM 7** | | 8.88 points/$m^2$ |
| **Vertical Accuracy (1 $\sigma$):** | | <13 cm | 3.7 cm |

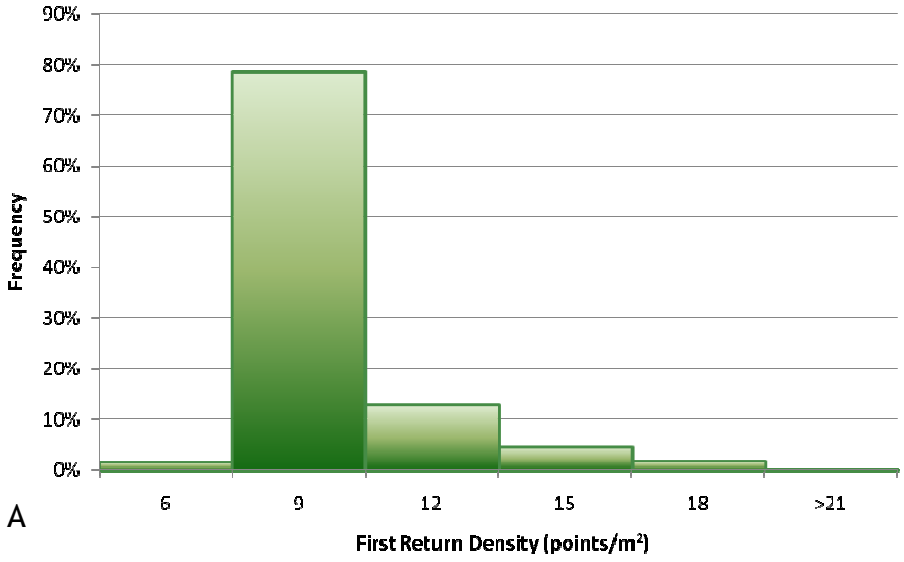
## 5.1 Data Density/Resolution

**Figures 10 - 24** display the distribution of average native and ground point densities for each processing bin. Density data will continue to be updated as data is processed and delivered.

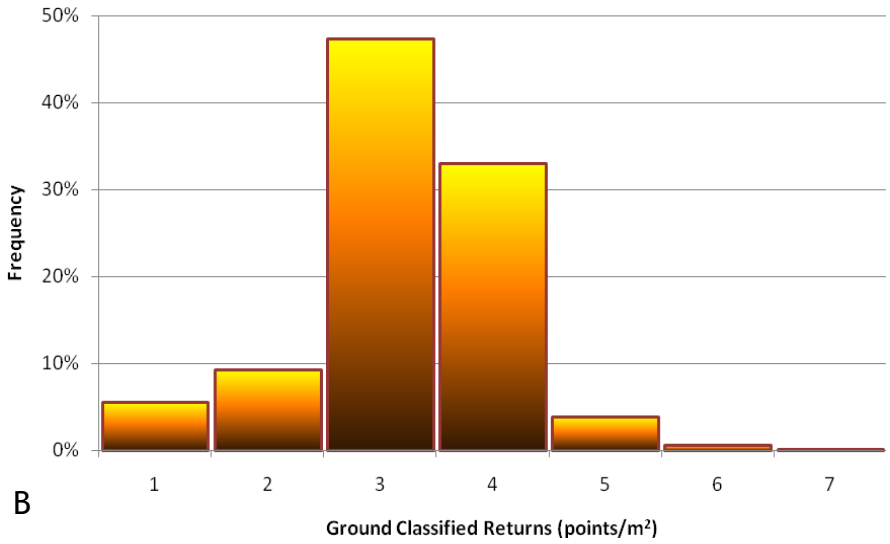
LiDAR data resolution for Alaska Pipeline deliveries to date:

| | UTM 5 | UTM 6 | UTM 7 |
|---|---|---|---|
| Average Point (First Return) Density | 8.60 points/$m^2$ | 8.88 points/$m^2$ | 8.88 points/$m^2$ |
| Average Ground Point Density | 2.72 points/$m^2$ | 2.46 points/$m^2$ | 2.78 points/$m^2$ |

*Figure 7. Density distribution for first return (A) and ground classified (B) laser points for UTM 5*

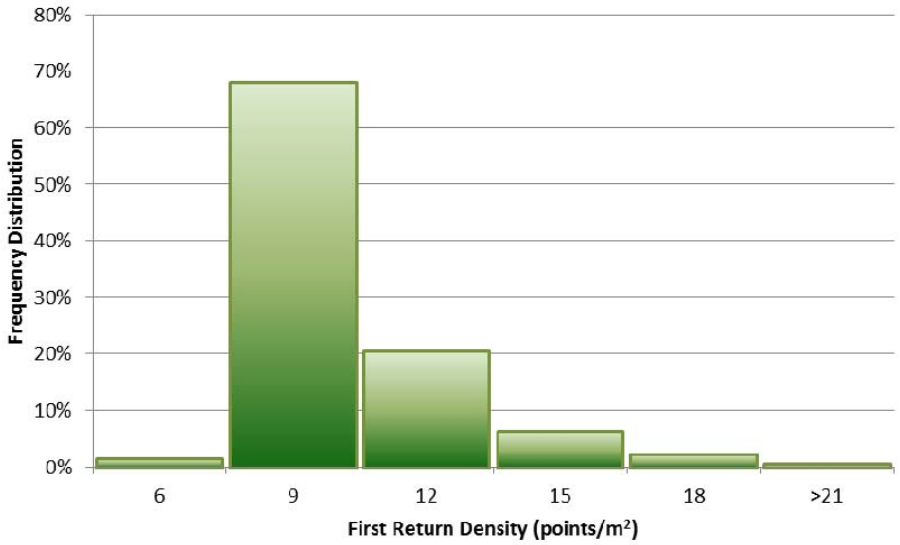



A

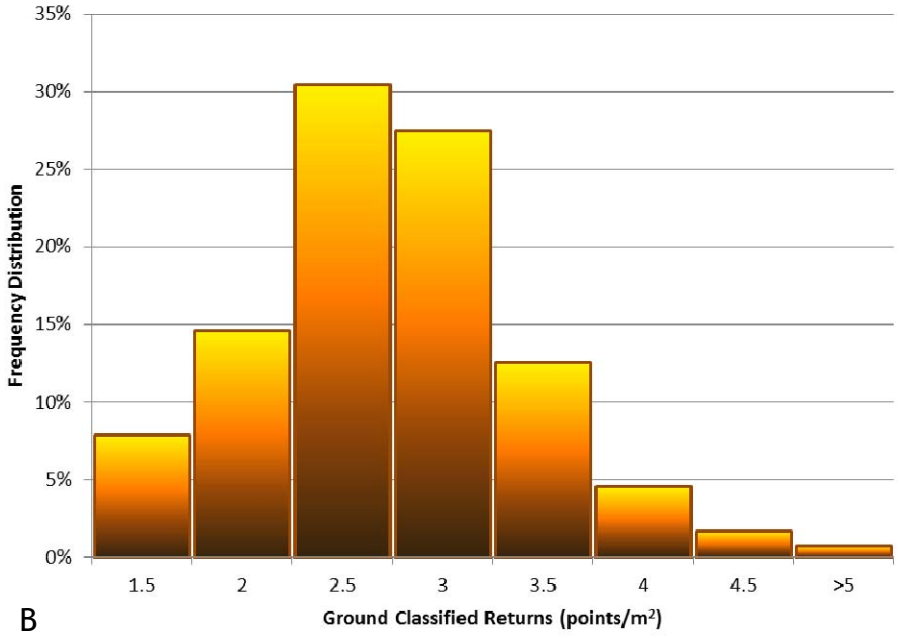



B

*Figure 8. Density distribution for first return (A) and ground classified (B) laser points for UTM 6*

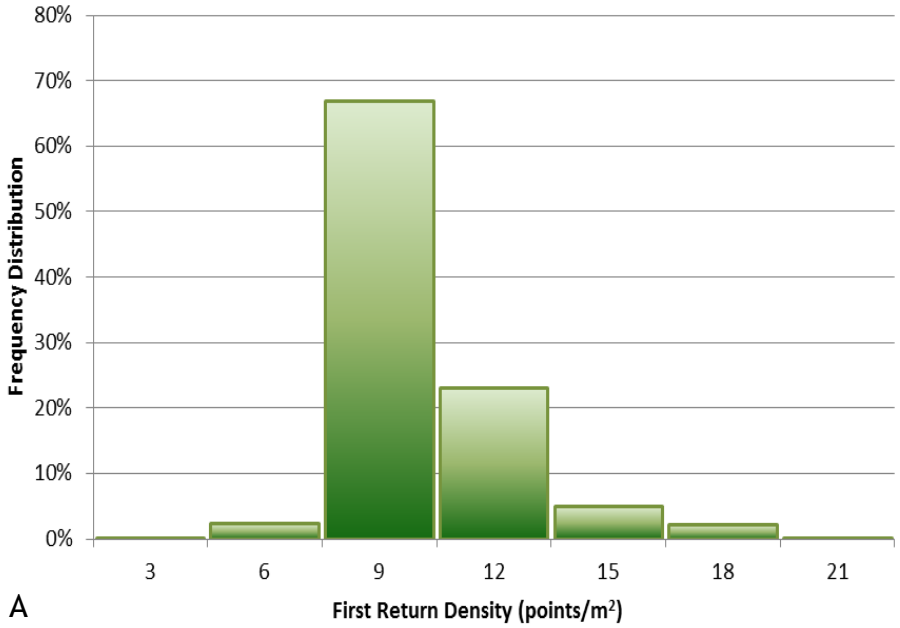



A

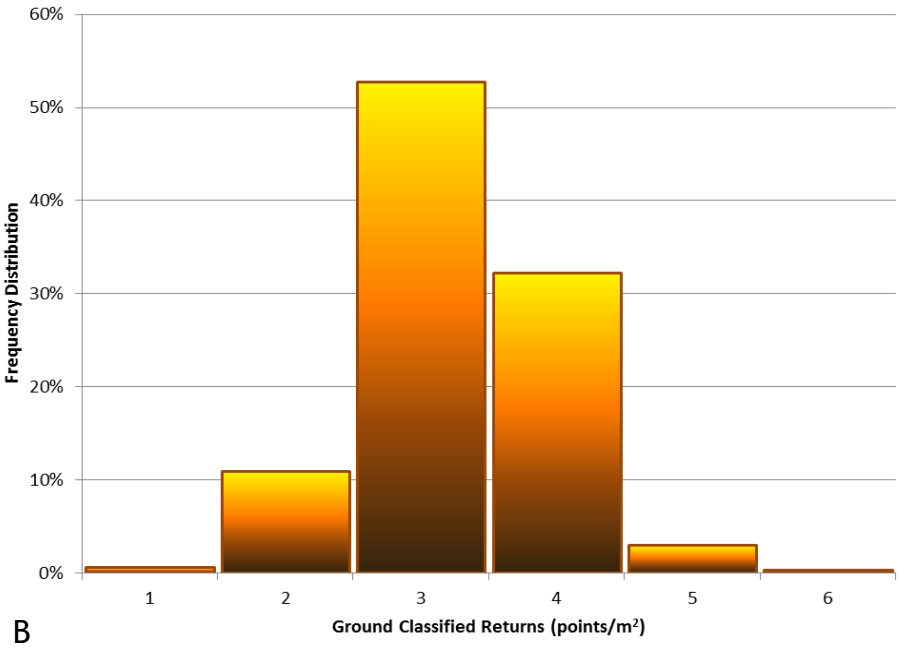



B

*Figure 9. Density distribution for first return (A) and ground classified (B) laser points for UTM 7*




A




B

*Figure 10. Density distribution map for ground and first return points by processing bin in Delivery 1, UTM 6*

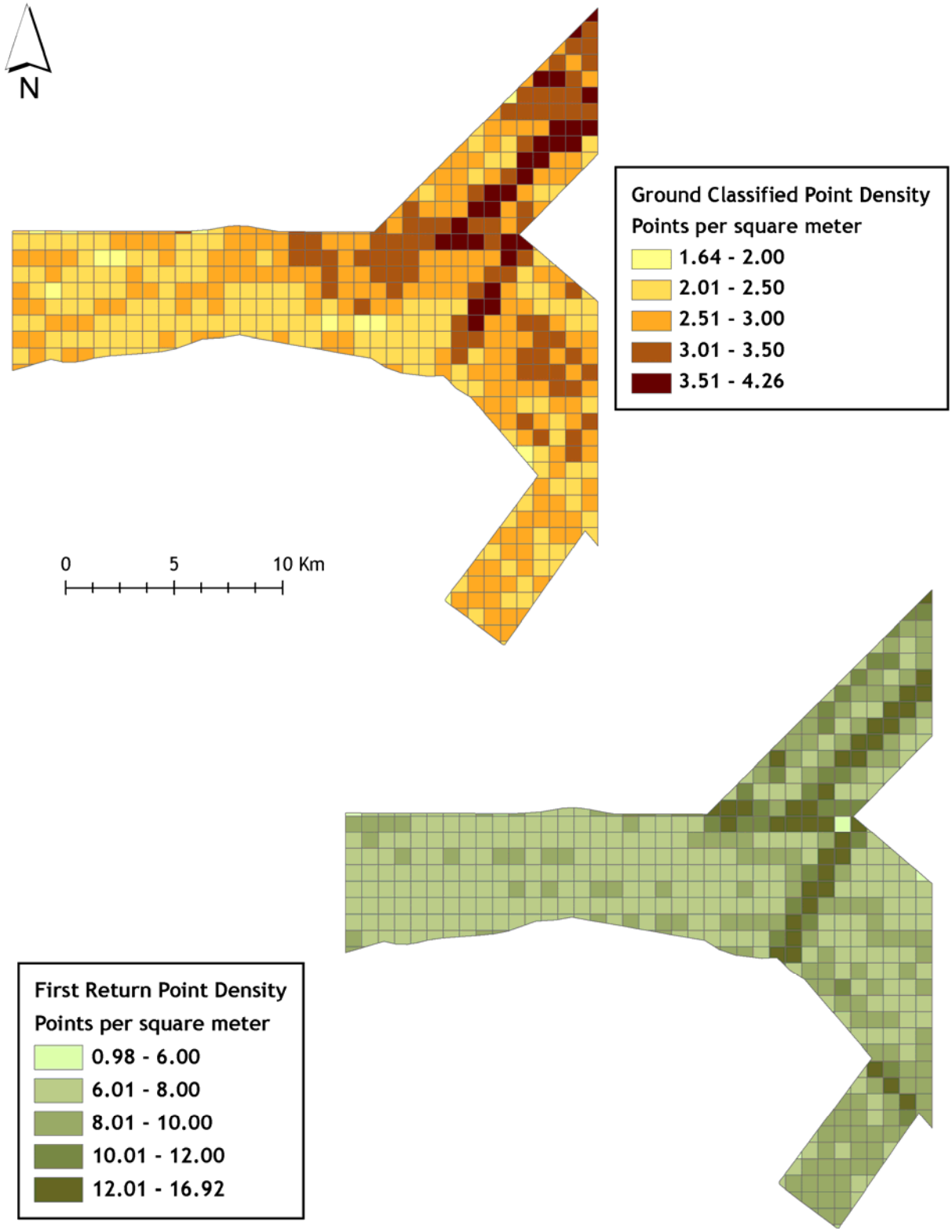


*Figure 11. Density distribution map for ground and first return points by processing bin in Delivery 1, UTM 7*

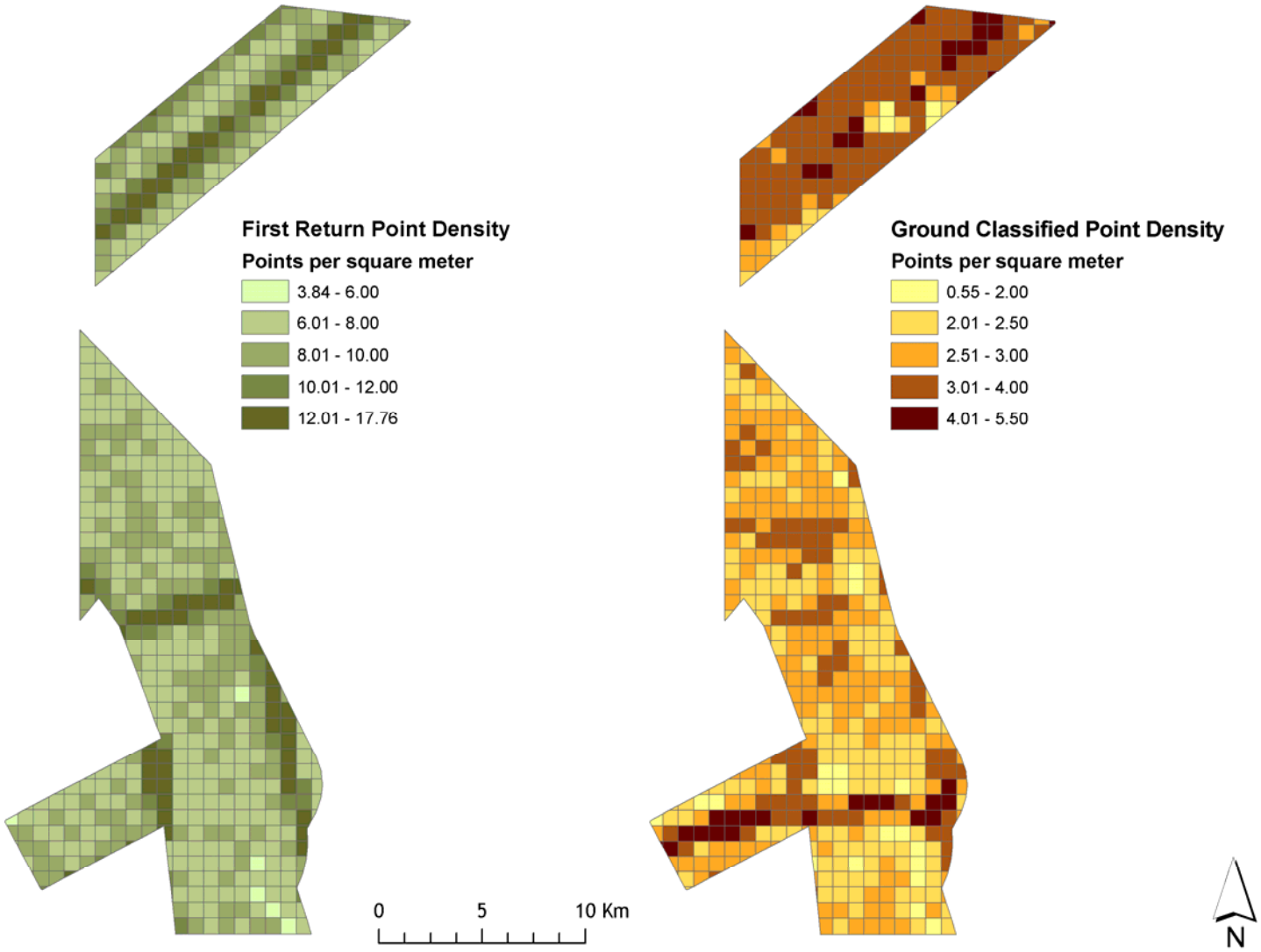


*Figure 12. Density distribution map for ground points by processing bin in Delivery 2, UTM 6*

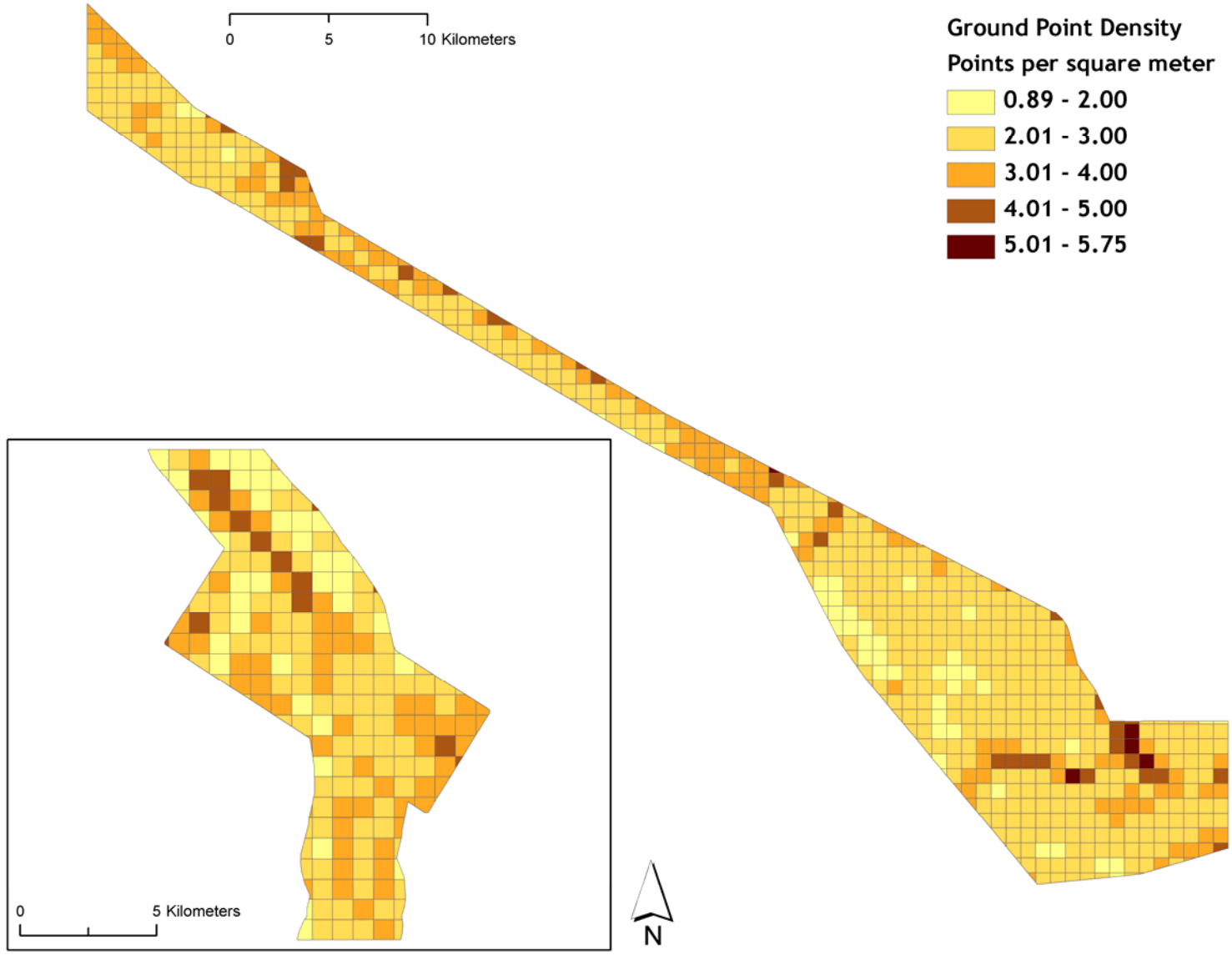


*Figure 13. Density distribution map for first return points by processing bin in Delivery 2, UTM 6*

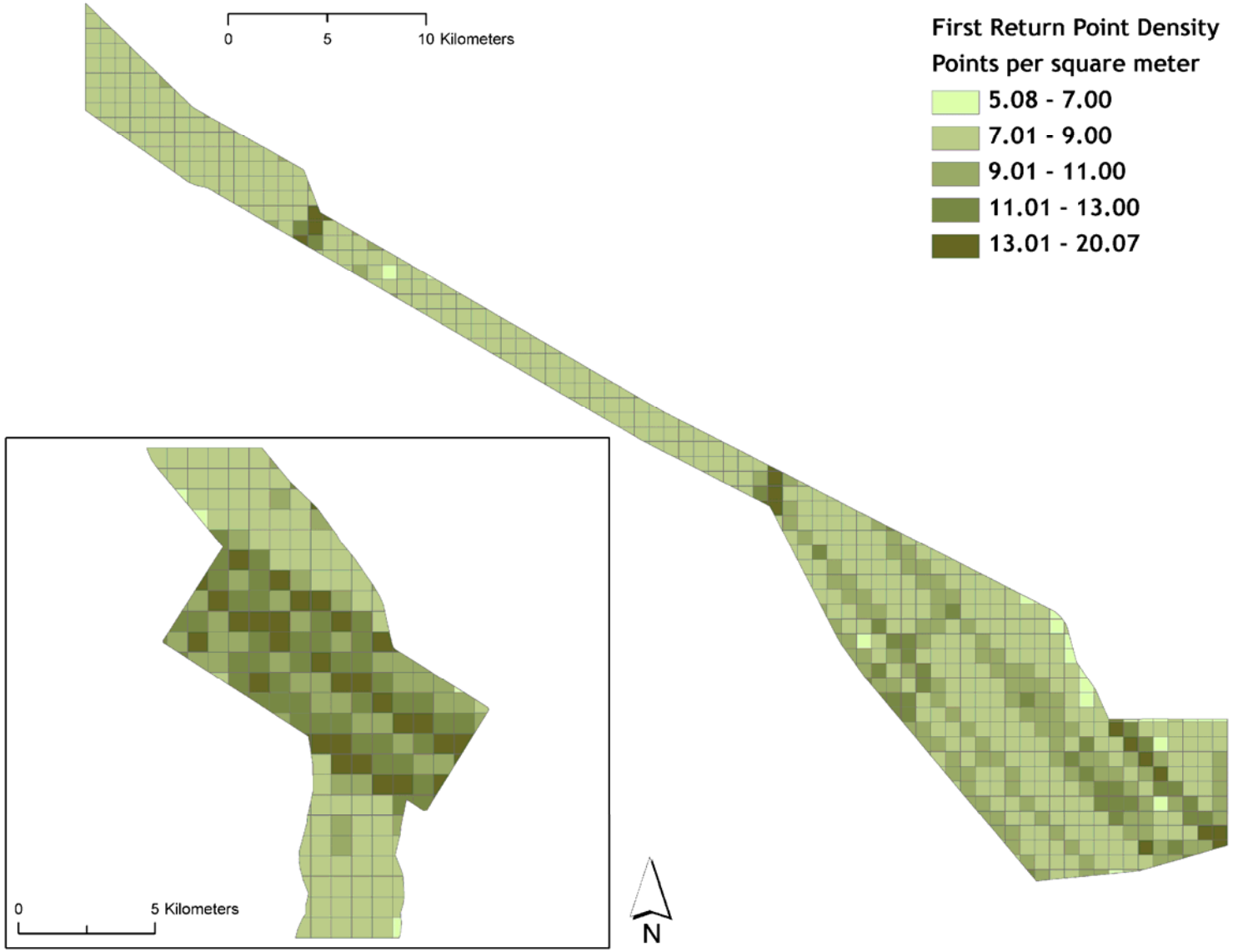


*Figure 14. Density distribution map for ground and first return points by processing bin in Delivery 3, UTM 7*

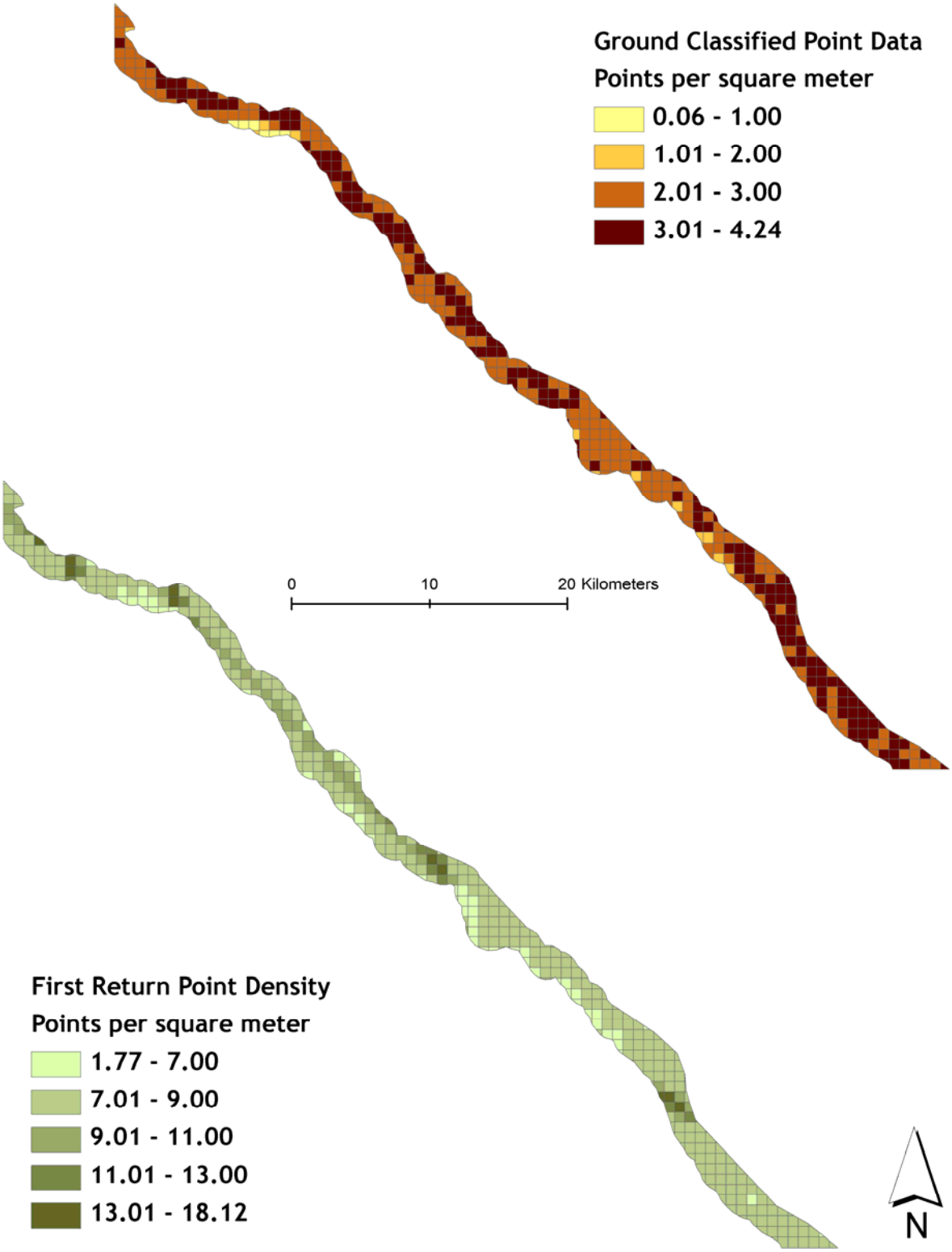


*Figure 15. Density distribution map for ground and first return points by processing bin in Delivery 4, UTM 6*

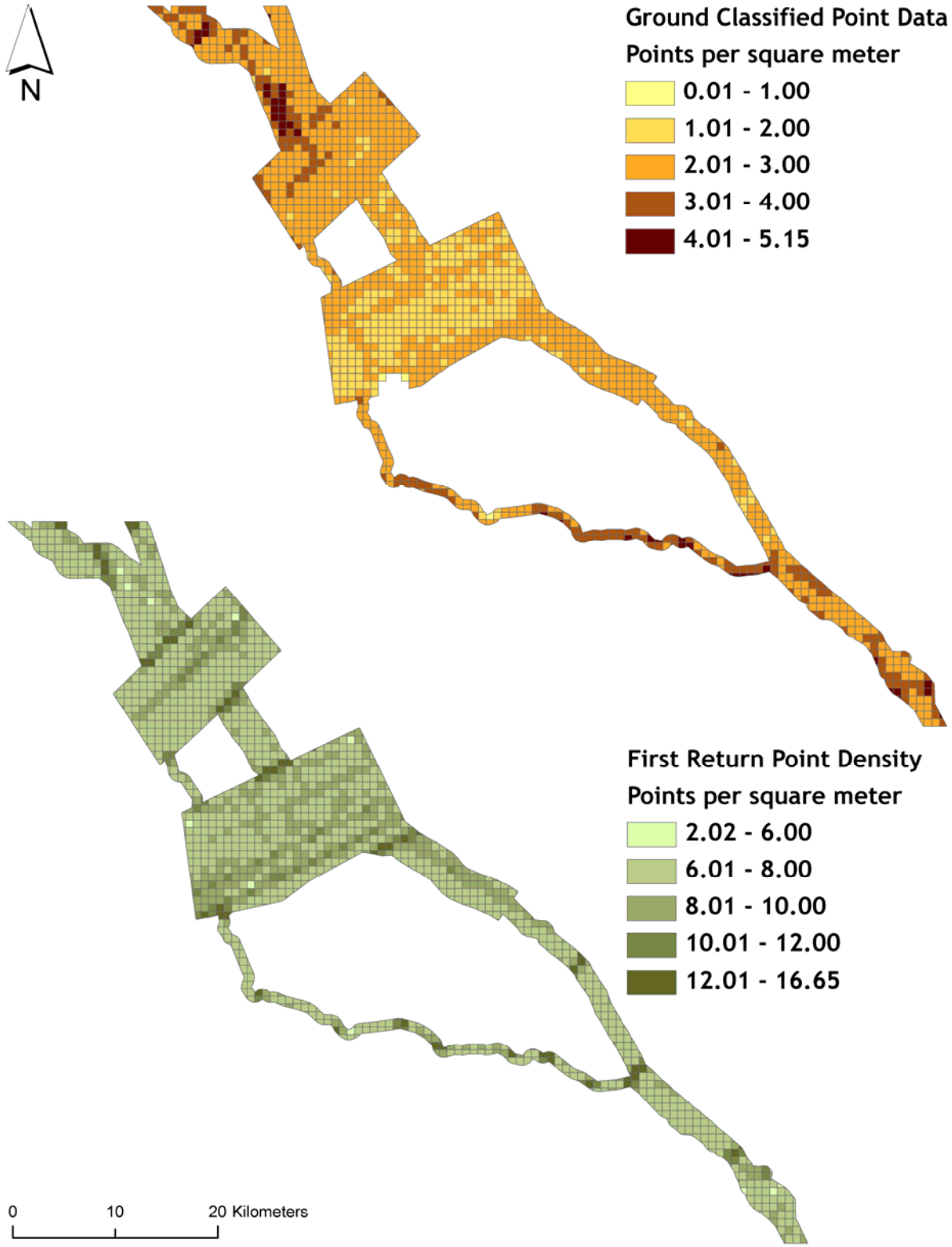


*Figure 16. Density distribution map for ground classified points by processing bin in Delivery 5, UTM 5*



*Figure 17. Density distribution map for first return points by processing bin in Delivery 5, UTM 5*

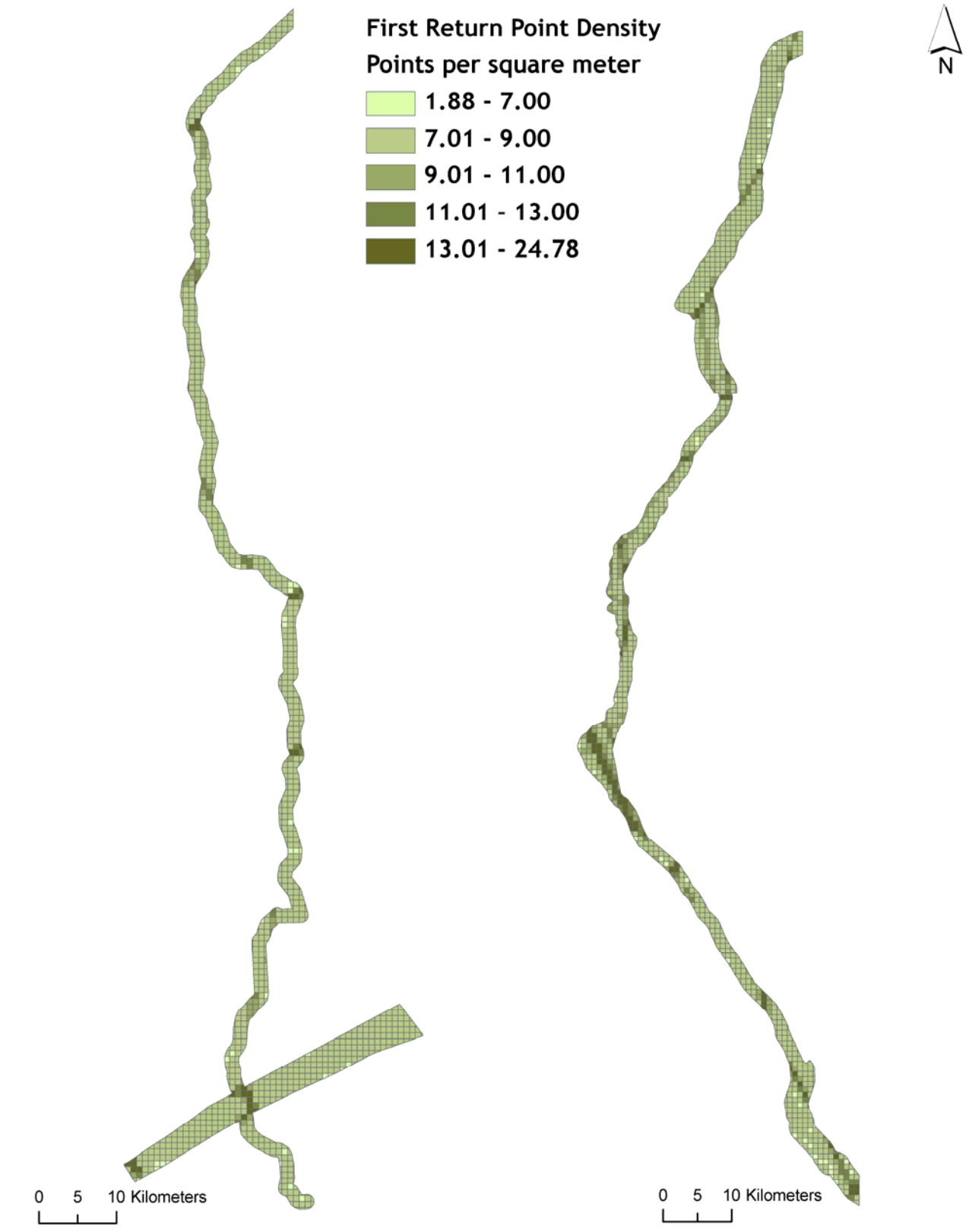


*Figure 18. Density distribution map for ground classified points by processing bin in Delivery 6, UTM 6*

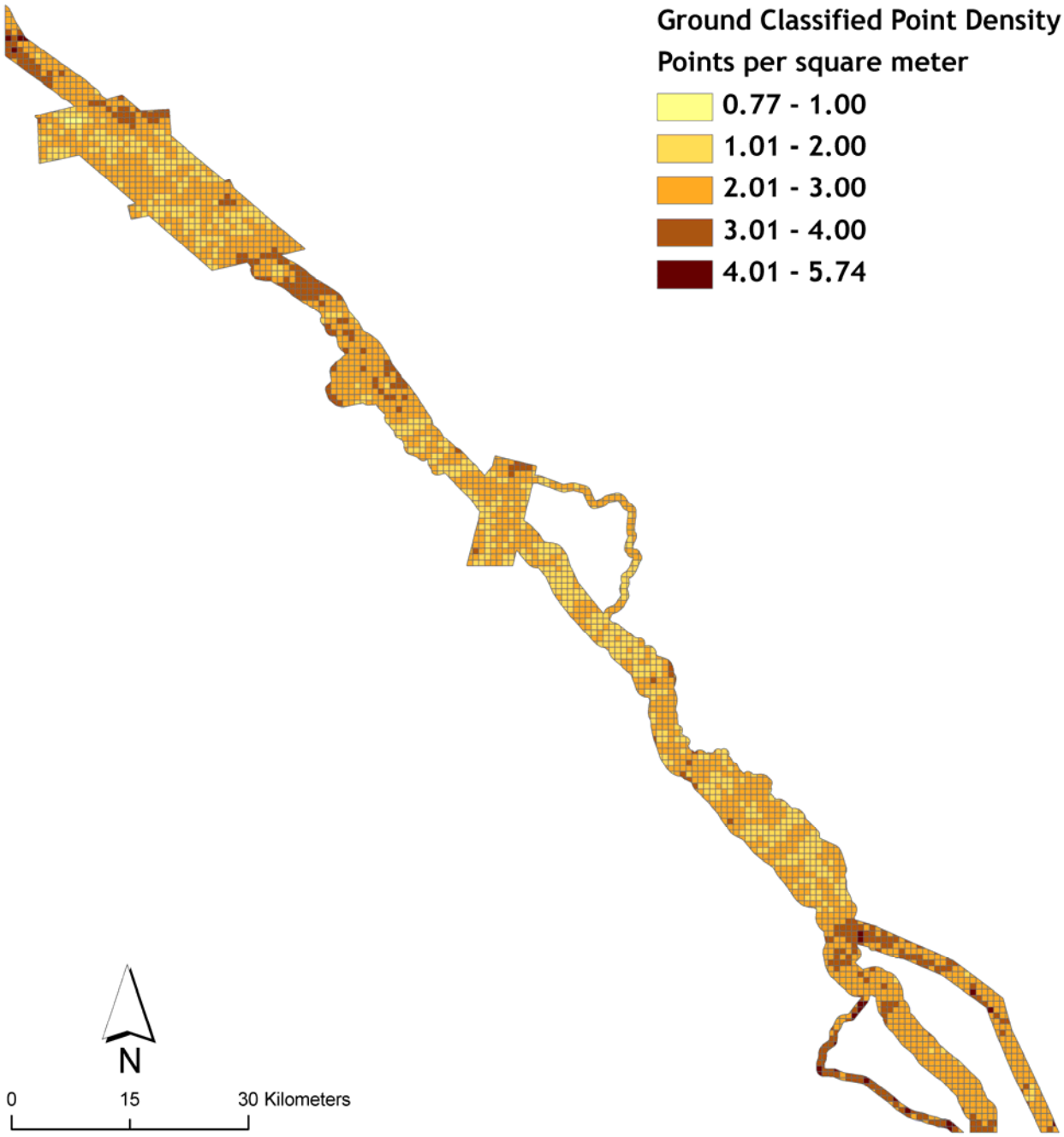


*Figure 19. Density distribution map for first return points by processing bin in Delivery 6, UTM 6*

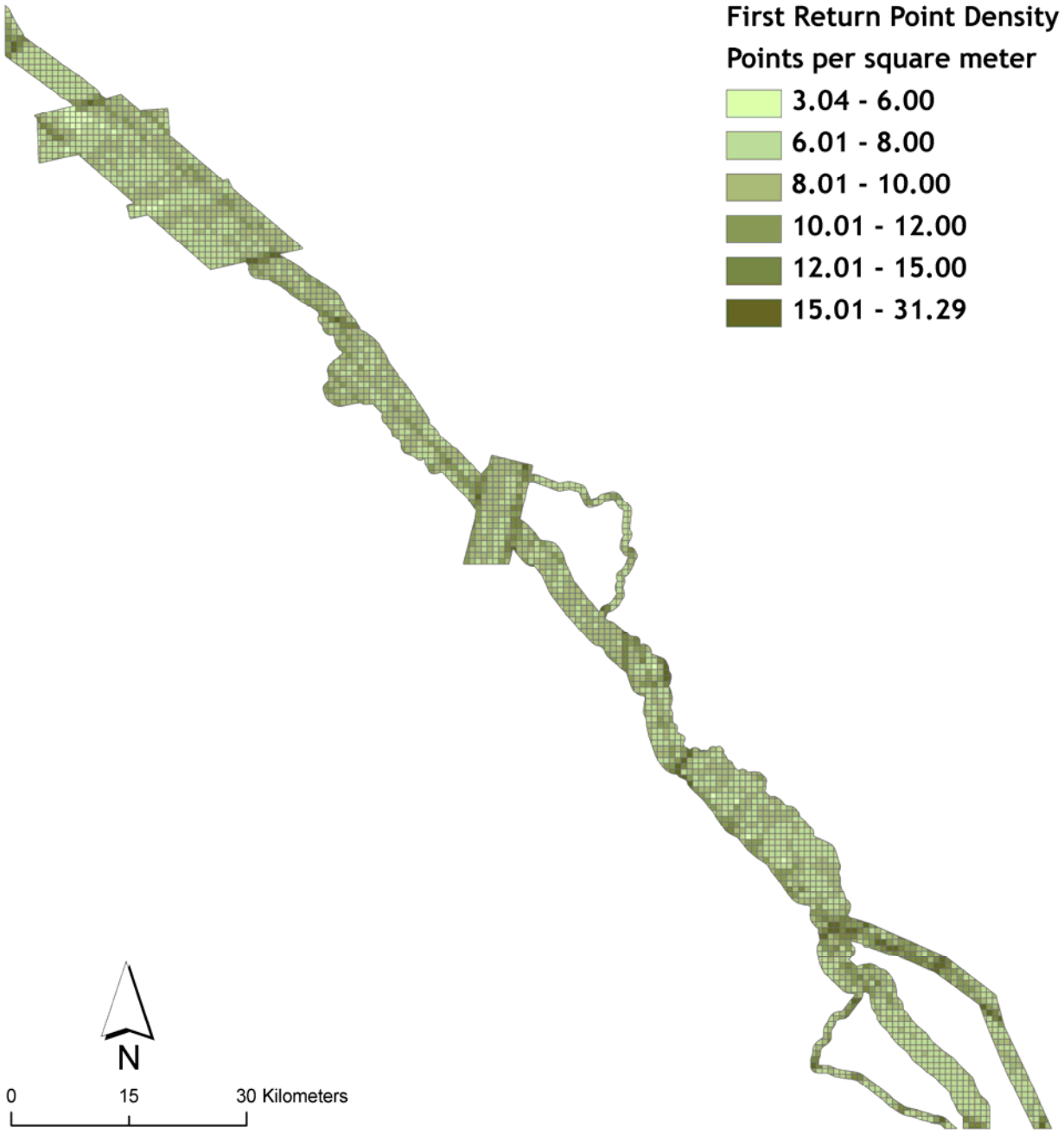


*Figure 20. Density distribution map for ground classified points by processing bin in Delivery 7, UTM 6*

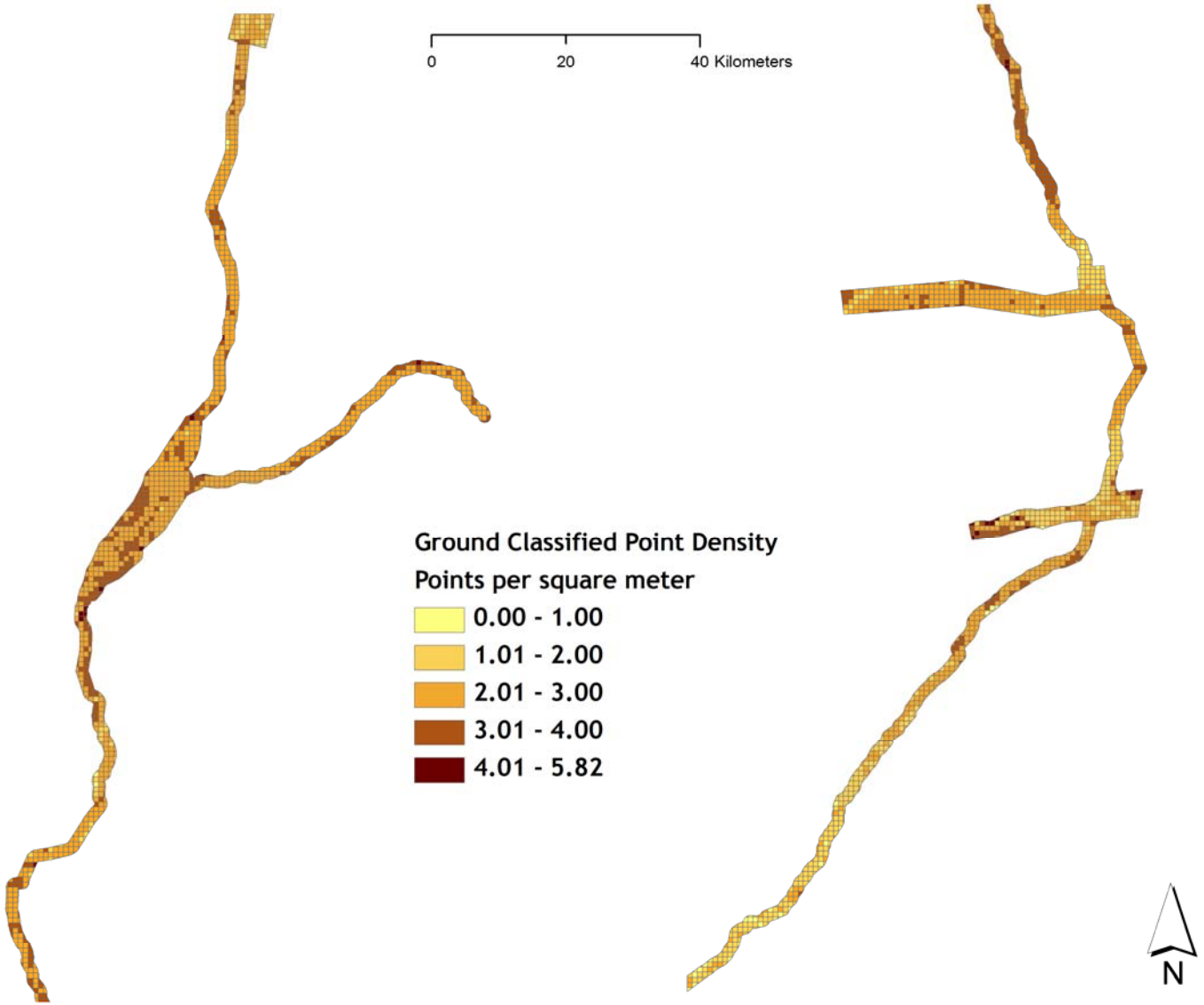


*Figure 21. Density distribution map for first return points by processing bin in Delivery 7, UTM 6*



*Figure 22. Density distribution map for ground classified points by processing bin in Delivery 8, UTM 7*

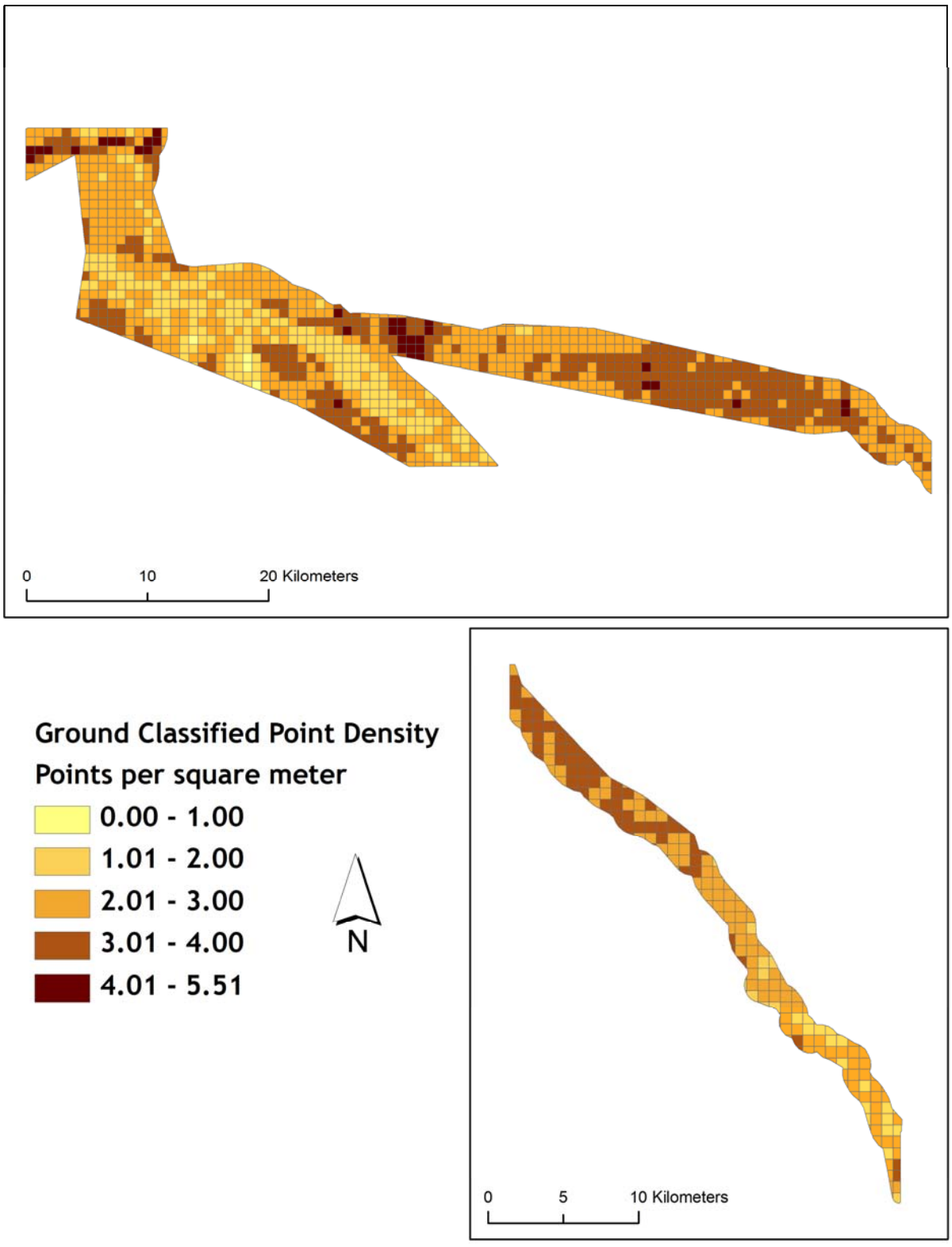


*Figure 23. Density distribution map for first return points by processing bin in Delivery 8, UTM 7*

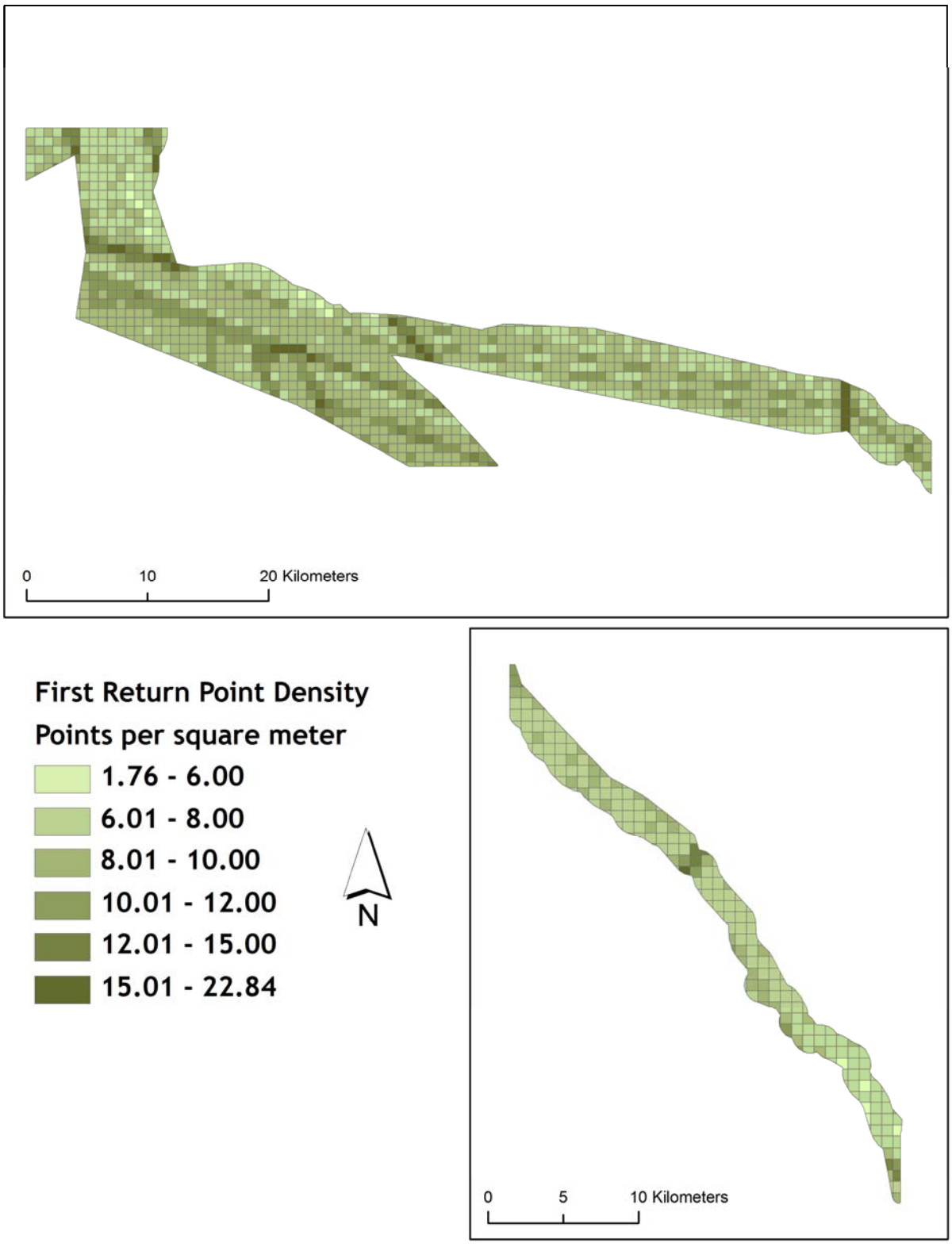


*Figure 24. Density distribution map for first return and ground classified points by processing bin in Delivery 9, UTM 6*

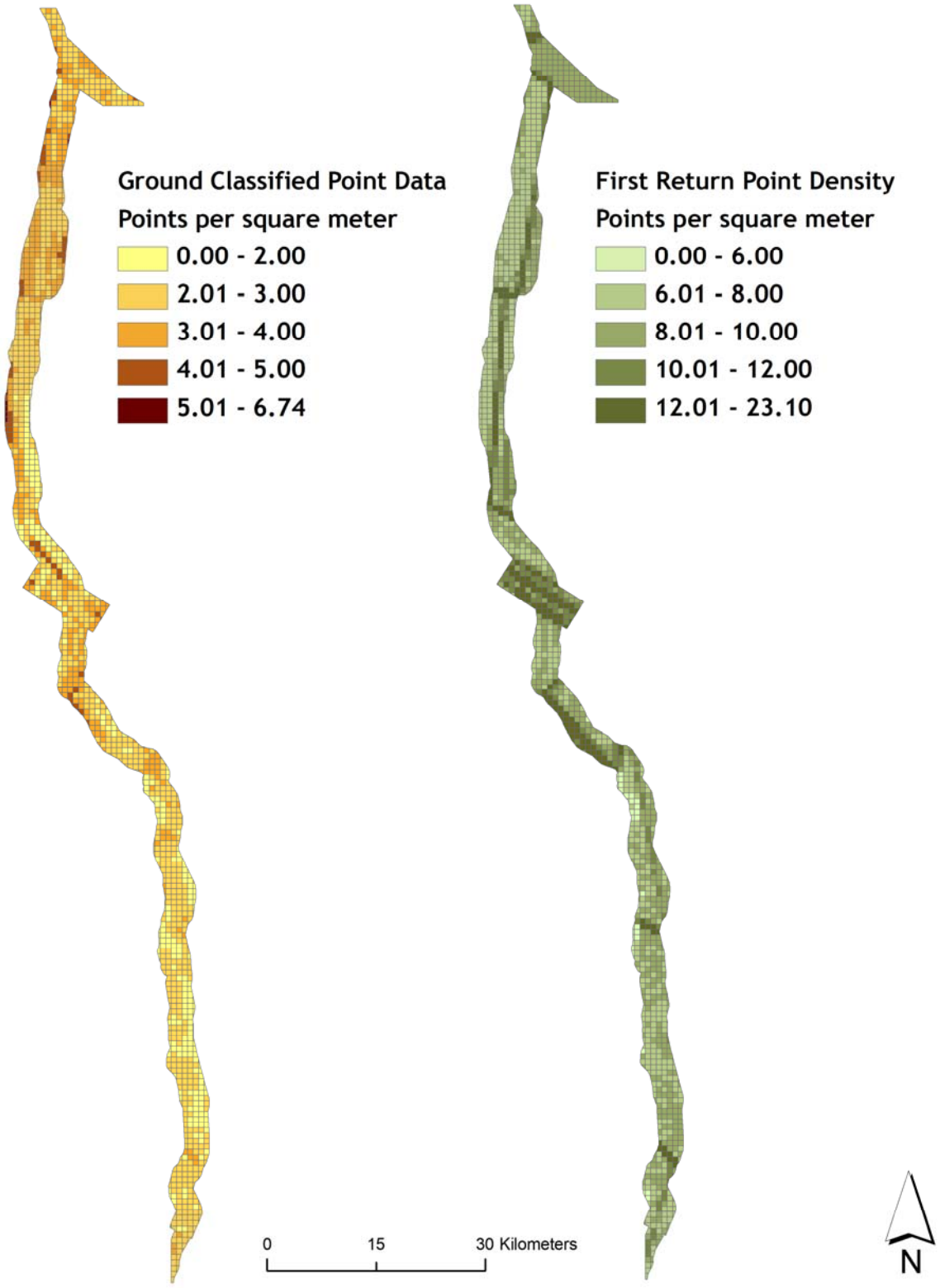


*Figure 25. Density distribution map for ground classified points by processing bin in Delivery 10, UTM 6*

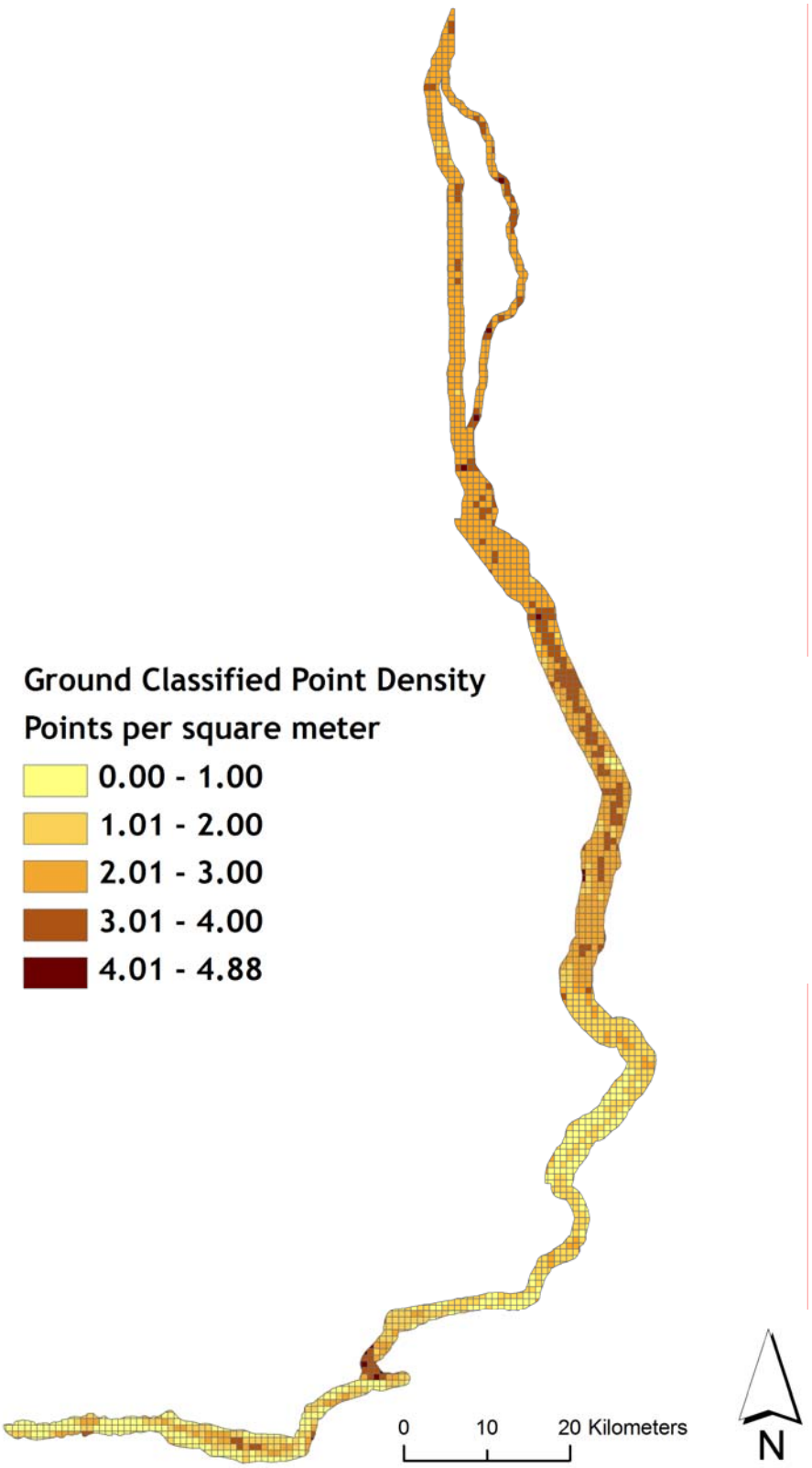
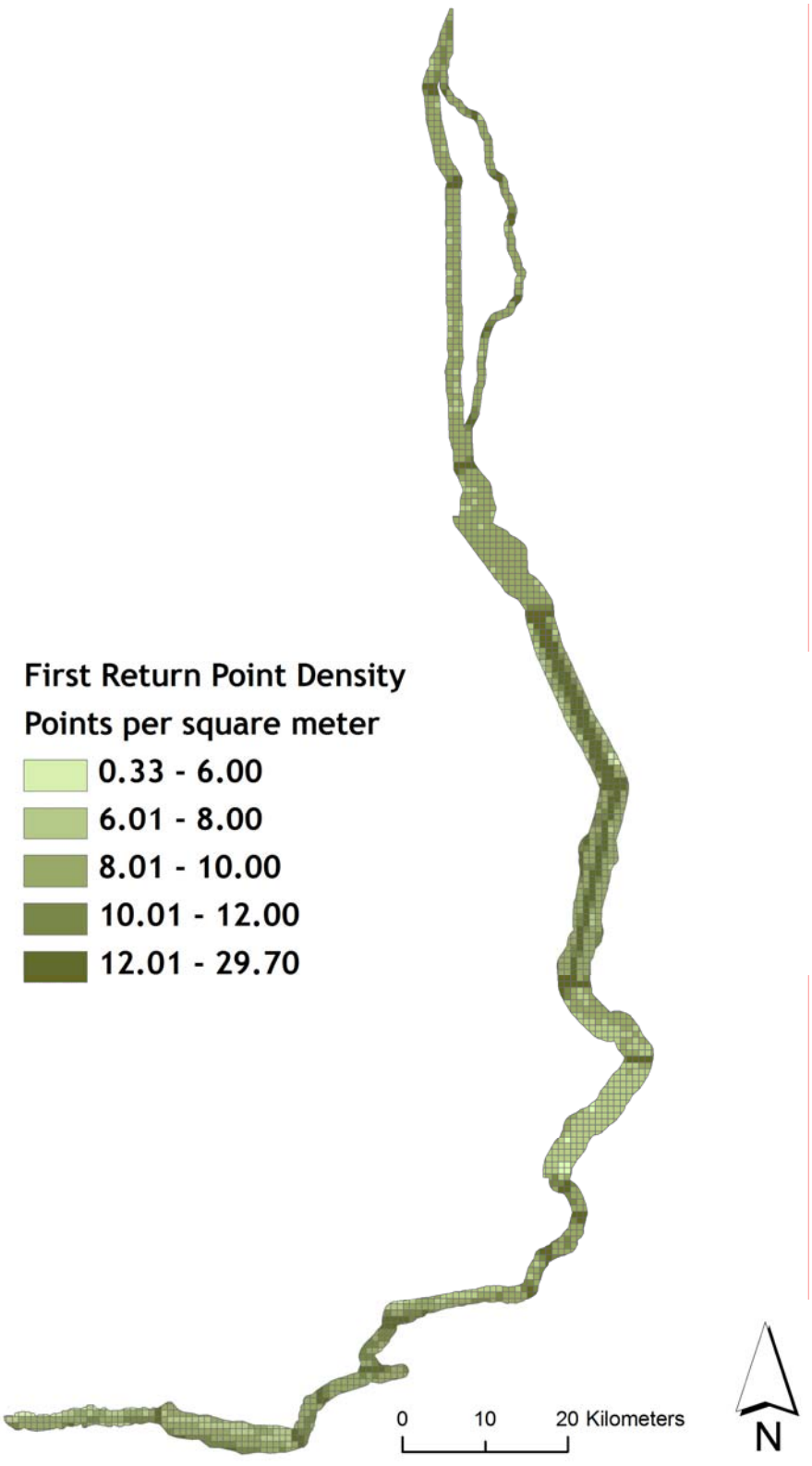


*Figure 26. Density distribution map for first return points by processing bin in Delivery 10, UTM 6*

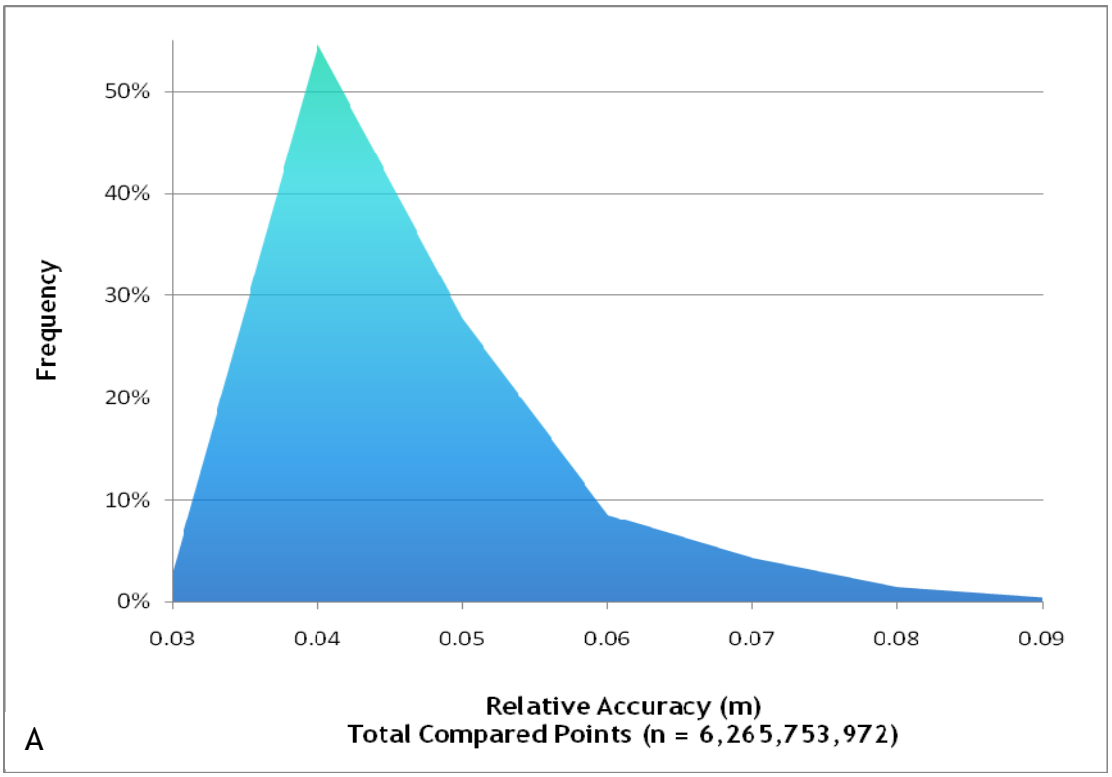


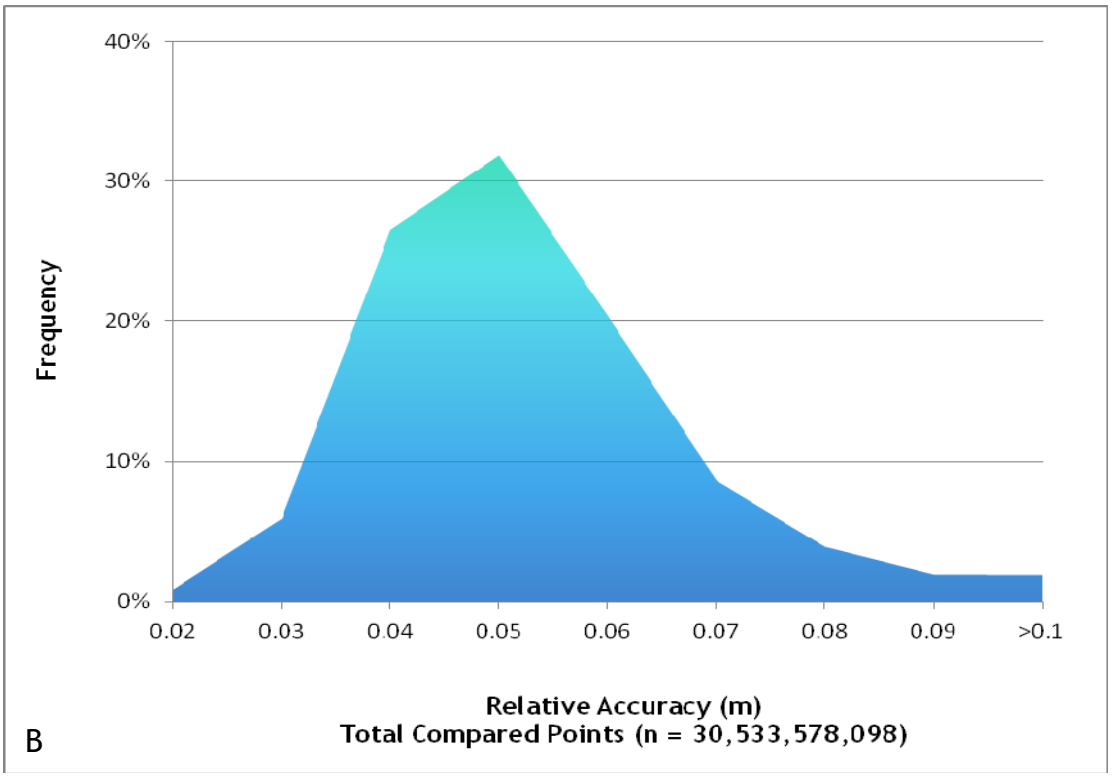
## 5.2 Relative Accuracy Calibration Results

*Table 5. Cumulative relative accuracy statistics for Alaska Pipeline deliveries to date.*

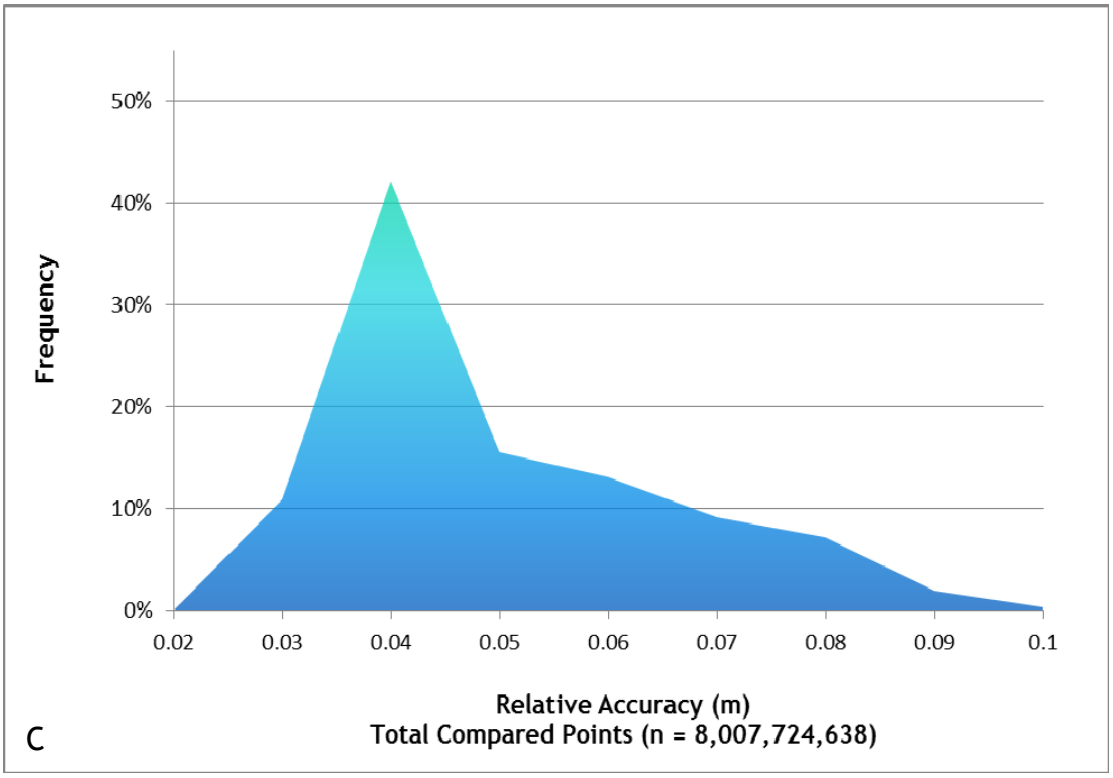
| | UTM 5 | UTM 6 | UTM 7 |
|---|---|---|---|
| Project Average | 0.039m | 0.045m | 0.036m |
| Median Relative Accuracy | 0.039m | 0.046m | 0.039m |
| 1σ Relative Accuracy | 0.010m | 0.015m | 0.015m |
| 1.96σ Relative Accuracy | 0.019m | 0.029m | 0.030m |

*Figure 27. Distribution of cumulative relative accuracies in UTM5 (A) UTM 6 (B) and UTM 7 (C) per flight line, non slope-adjusted*




40%
30%
20%
10%
0%
Frequency
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
>0.1
Relative Accuracy (m)
Total Compared Points (n = 30,533,578,098)

B


50%
40%
30%
20%
10%
0%
Frequency
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1
Relative Accuracy (m)
Total Compared Points (n = 8,007,724,638)

C

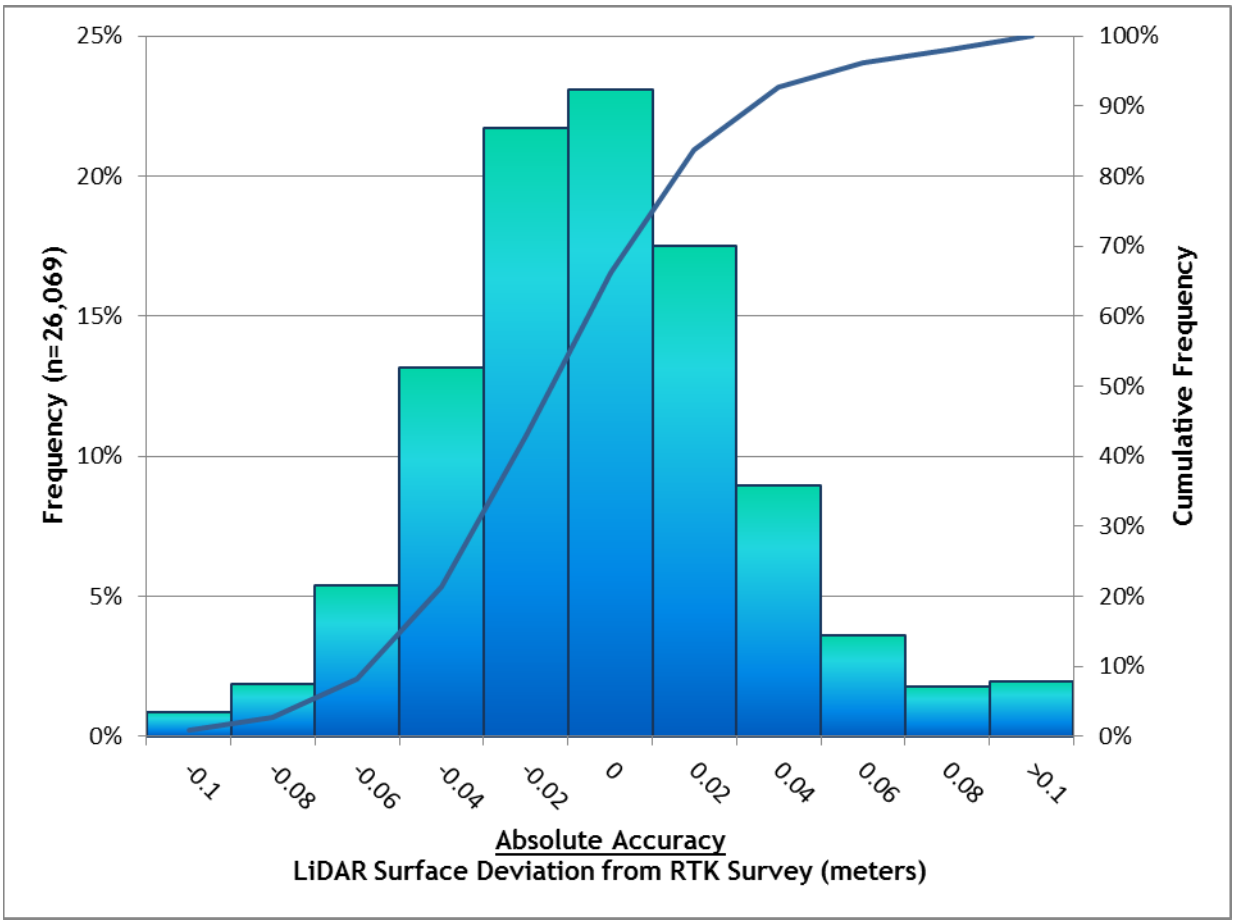
## 5.3 Absolute Accuracy

Absolute accuracies for Alaska Pipeline deliveries to date: All data was calibrated and processed in UTM 6 and then transformed to the appropriate projection.

*Table 6. Absolute Accuracy – Deviation between laser points and RTK hard surface survey points*

| RTK Survey Sample Size (n): 26,069 | |
|---|---|
| Root Mean Square Error (RMSE): 0.039m | Minimum Δz = -0.151m |
| Standard Deviations<br>1 sigma (σ): 0.037m 1.96 sigma (σ): 0.073m | Maximum Δz = 0.151m |
| | Average Δz = -0.012m |

*Figure 28. Absolute Accuracy - Histogram Statistics*



## 5.4 Independent Accuracy Assessment

In accordance with the project plan, McClintock Land Associates (AK PLS) collected independent (i.e. blind) check points within the survey area to provide an independent assessment of LiDAR accuracy. WSI was provided with Easting and Northing positions for points which were then assigned elevations from the LiDAR. MLA received this report and compared the LiDAR Z values to MLA's surveyed (or known) Z values.

*Table 7. Absolute accuracy determined by the project surveyor (MLA) using "Blind" Check Points (See Appendix B for PLS report)*

| Delivery | # of Check Points | RMSE | Range |
|---|---|---|---|
| 1 | 735 | 0.062m | 0.240m |
| 2 | 1096 | 0.035m | 0.204m |
| 3 | 1088 | 0.078m | 0.182m |
| 4 | 730 | 0.039m | 0.394m |
| 5 | 2293 | 0.073m | 0.567m |
| 6 | 1510 | 0.050m | 0.730m |
| 7 | 1858 | 0.060m | 0.880m |
| 8 | 604 | 0.030m | 0.280m |
| 9 | 1139 | 0.080m | 0.410m |
| 10 | 1521 | 0.050m | 0.540m |

## 6. Projection/Datum and Units

| | | |
|---|---|---|
| **Projection:** | | UTM Zone 5, 6, 7 North |
| **Datum** | **Vertical:** | NAVD88 Geoid09 |
| | **Horizontal:** | NAD83 |
| **Units:** | | meters |

## 7. Deliverables

| | |
|---|---|
| **Point Data:** | • All Returns (LAS 1.2 format)<br>• Ground Returns (LAS 1.2 format) |
| **Vector Data:** | • Project Boundary (shapefile format)<br>• Tile Index for LiDAR Points (shapefile format)<br>• Tile Index for DEMs (shapefile format)<br>• Contours (1m shapefile format, DXF format)<br>• RTK (shapefile format, .TXT format)<br>• SBETs (shapefile format, DBF format)<br>• Lake Boundaries (shapefile format) |
| **Raster Data:** | • Elevation Models (1m resolution)<br>  • Hydro-flattened Bare Earth Model (ESRI GRID format)<br>  • Highest Hit Model (ESRI GRID format)<br>  • Vegetation Model (ESRI GRID format)<br>  • nDSM Model (ESRI GRID format)<br>• Intensity Images (GeoTIFF format, 0.5m resolution)<br>• Vegetation Metrics (5m resolution)<br>  • Canopy Cover (ESRI GRID format)<br>  • Coefficient of Variation (ESRI GRID format)<br>  • Mean Elevation (ESRI GRID format) |
| **Data Report:** | • Full report containing introduction, methodology, and accuracy |

## 8. Selected Images

*Figure 29. Delta Junction airfield. Image is LiDAR point cloud colored by point class and intensity.*

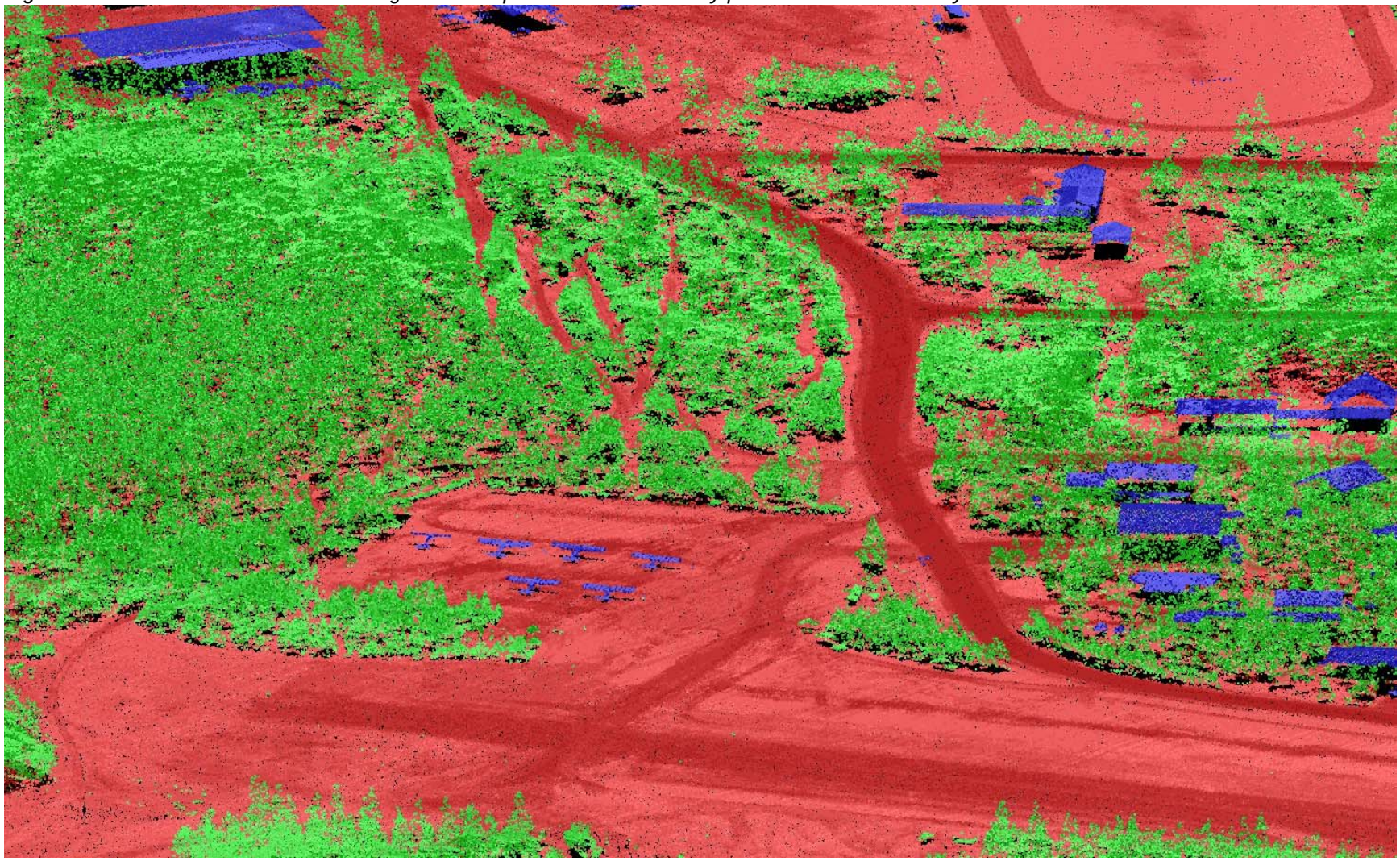


*Figure 30. View across braided channels of the Tanana River near Dot Lake. Top image is Bare Earth model. Bottom image is LiDAR point cloud colored by elevation.*

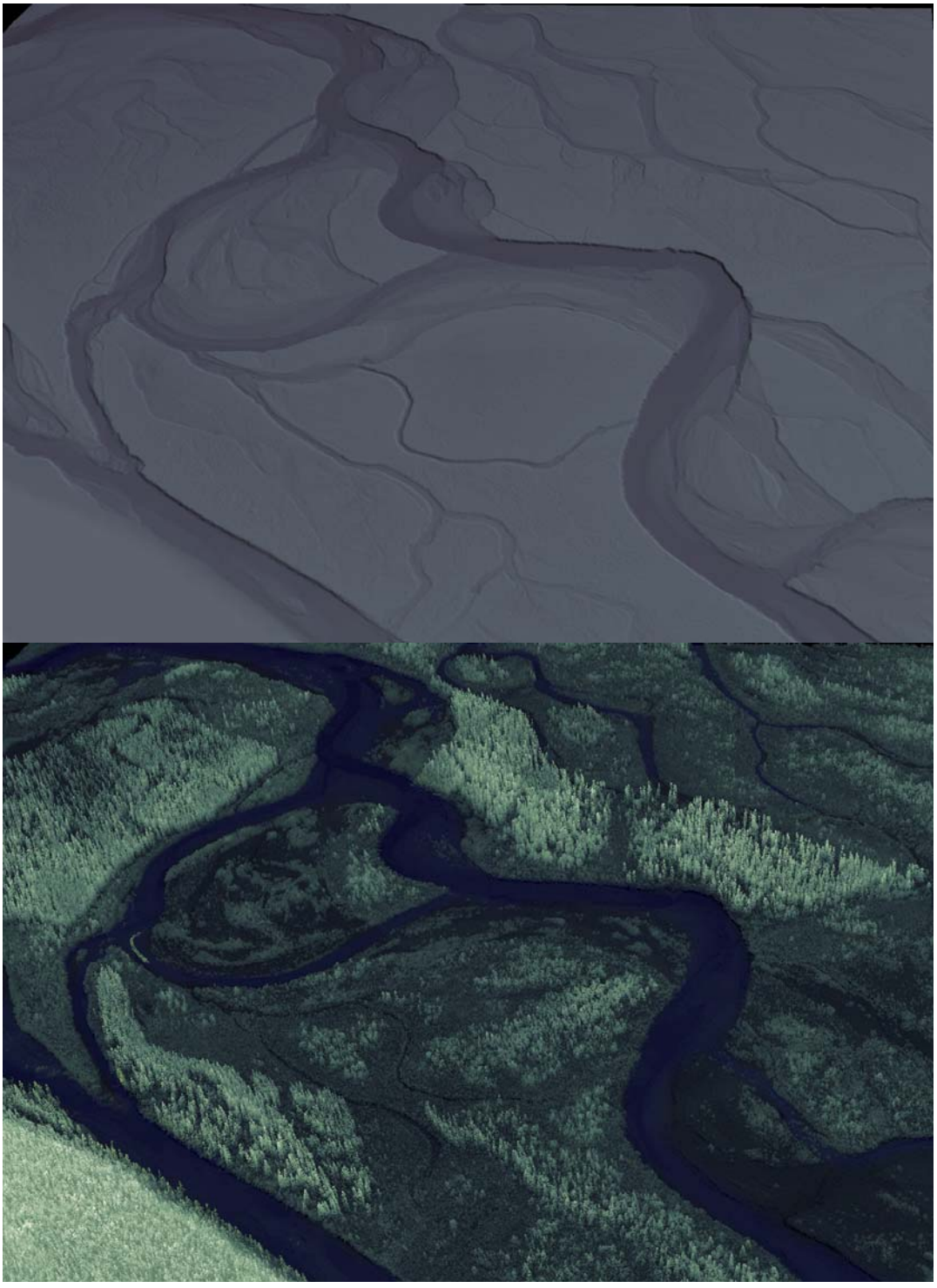


*Figure 31. View looking north across Gerstle River along A2. Image is 3D LiDAR point cloud colored by elevation.*

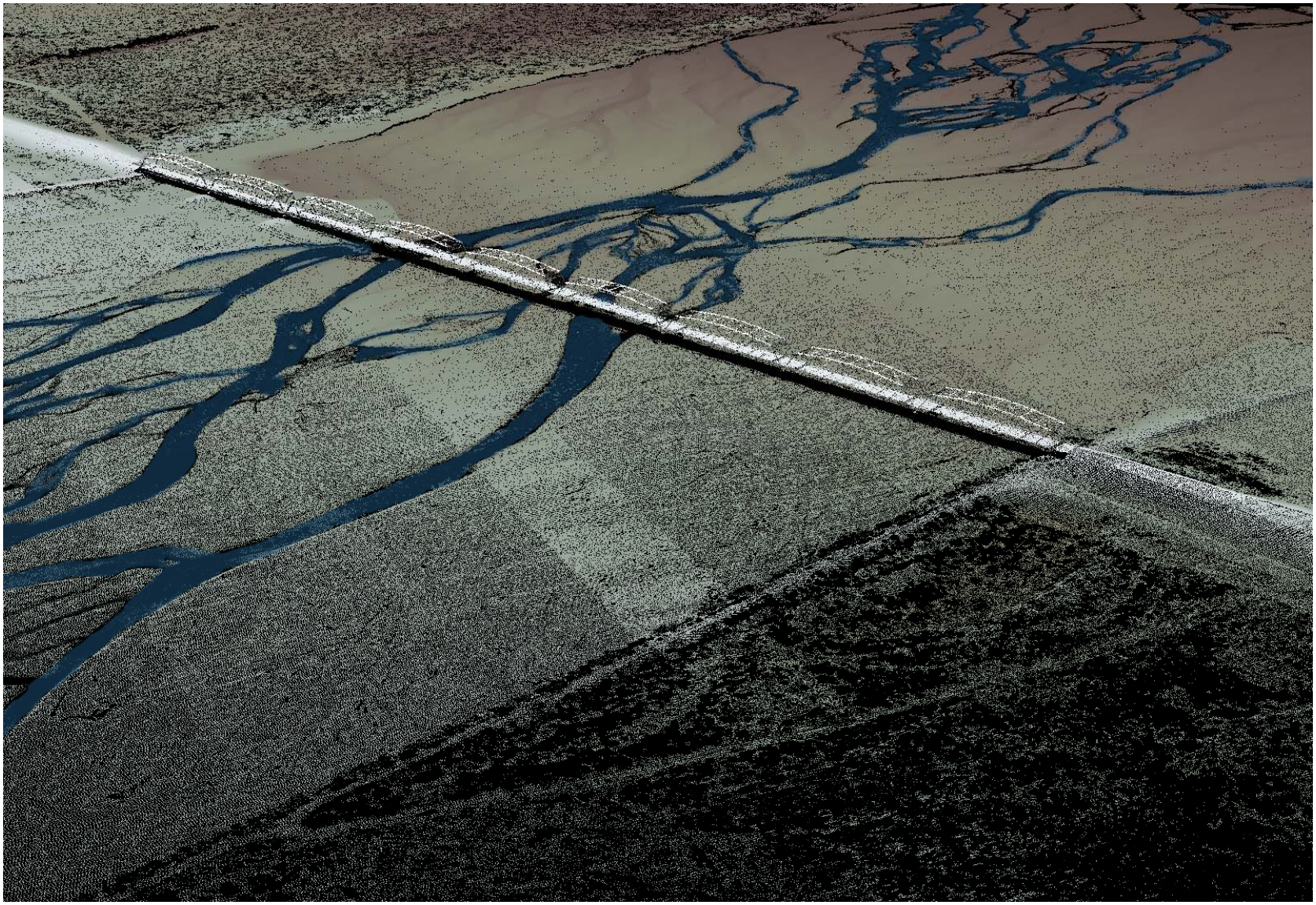


*Figure 32. Northern end of above ground pipeline near Trims Camp along Hwy 4.*

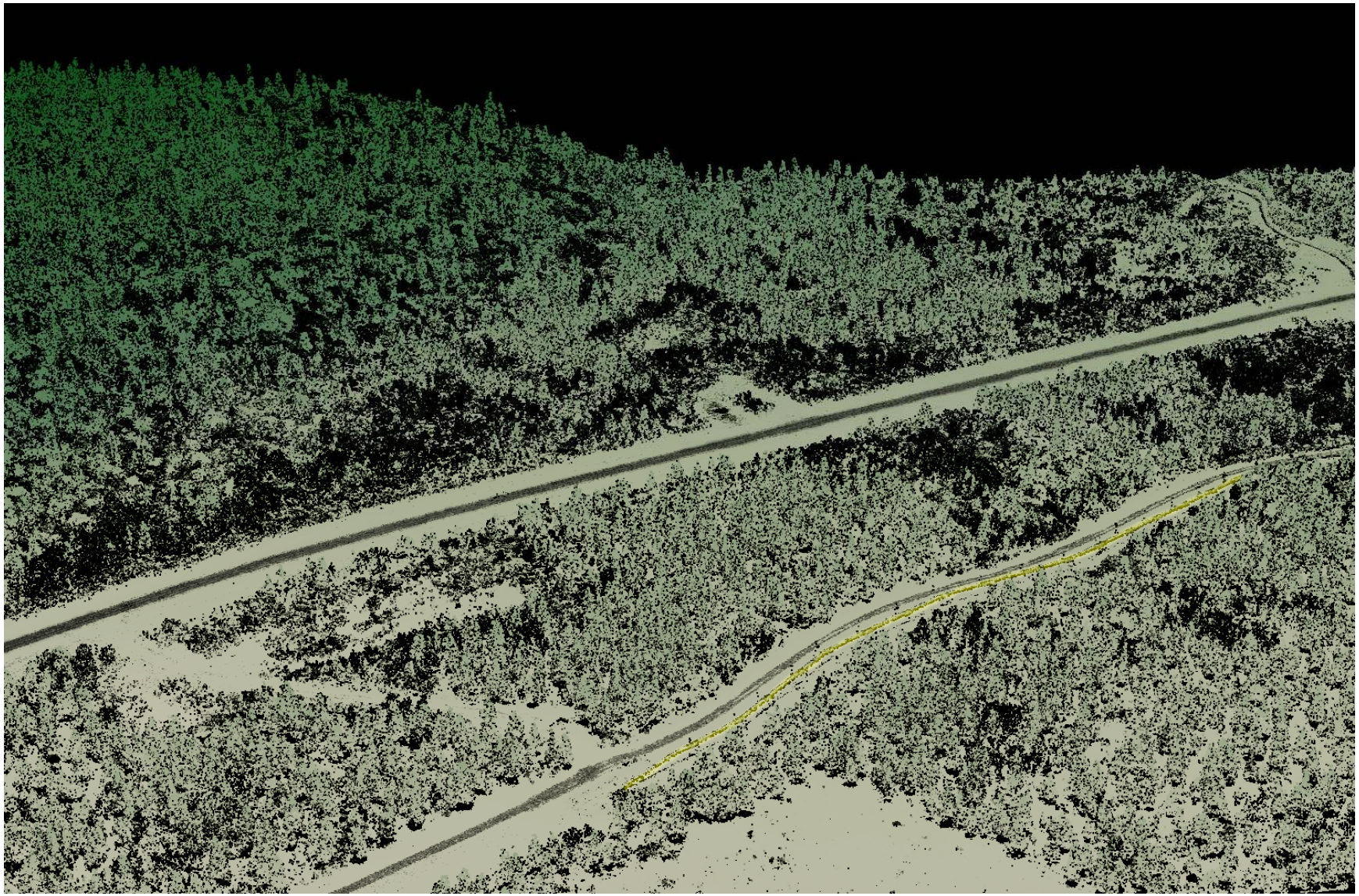


*Figure 33. View looking North of Pipeline and Hwy 4 as they cross Miller Creek.*

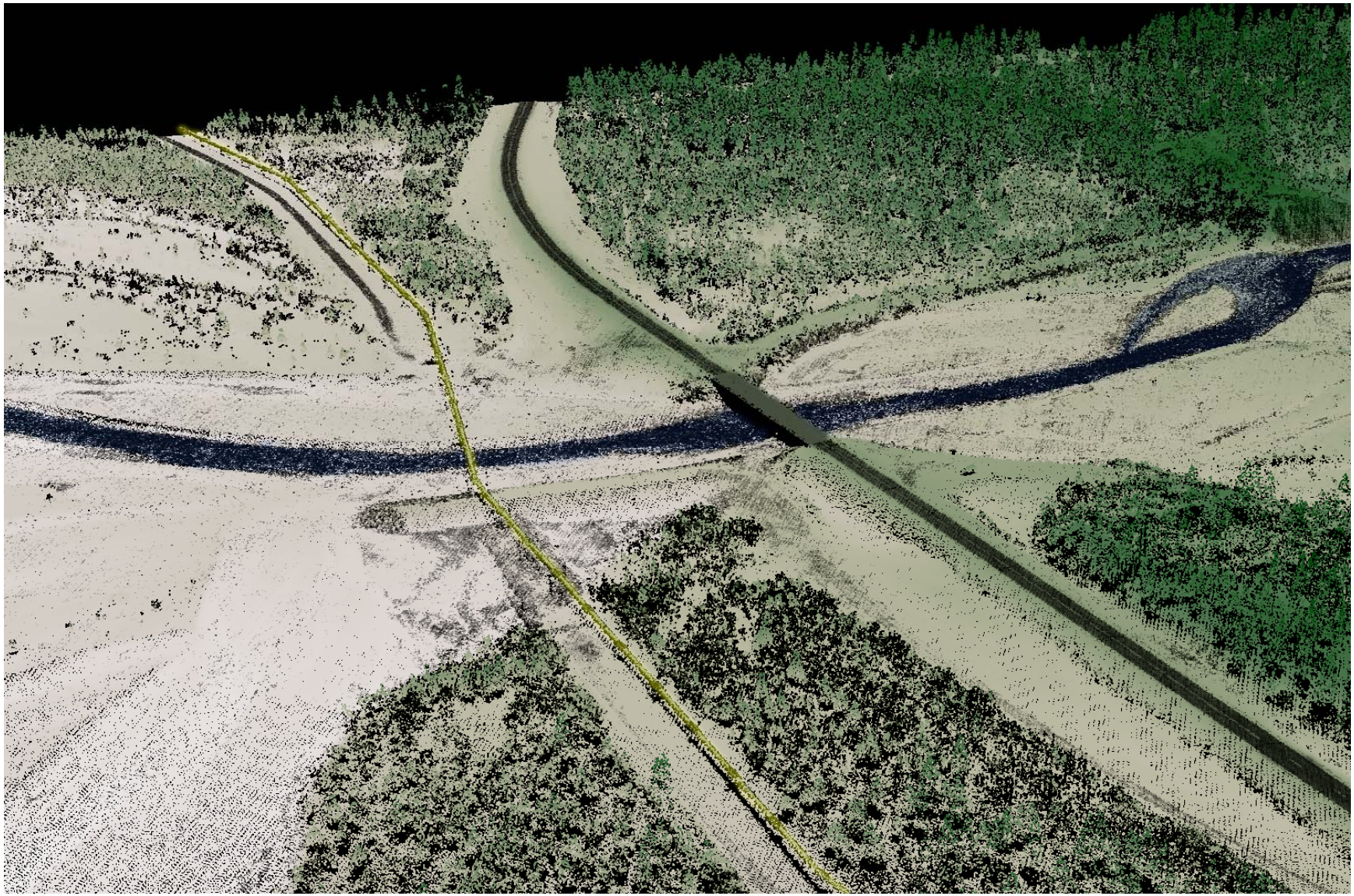


*Figure 34. View looking Northeast across Hwy 2, just east of Tetlin Junction. Top image is Bare Earth model colored by elevation. Bottom image is Highest Hit model.*

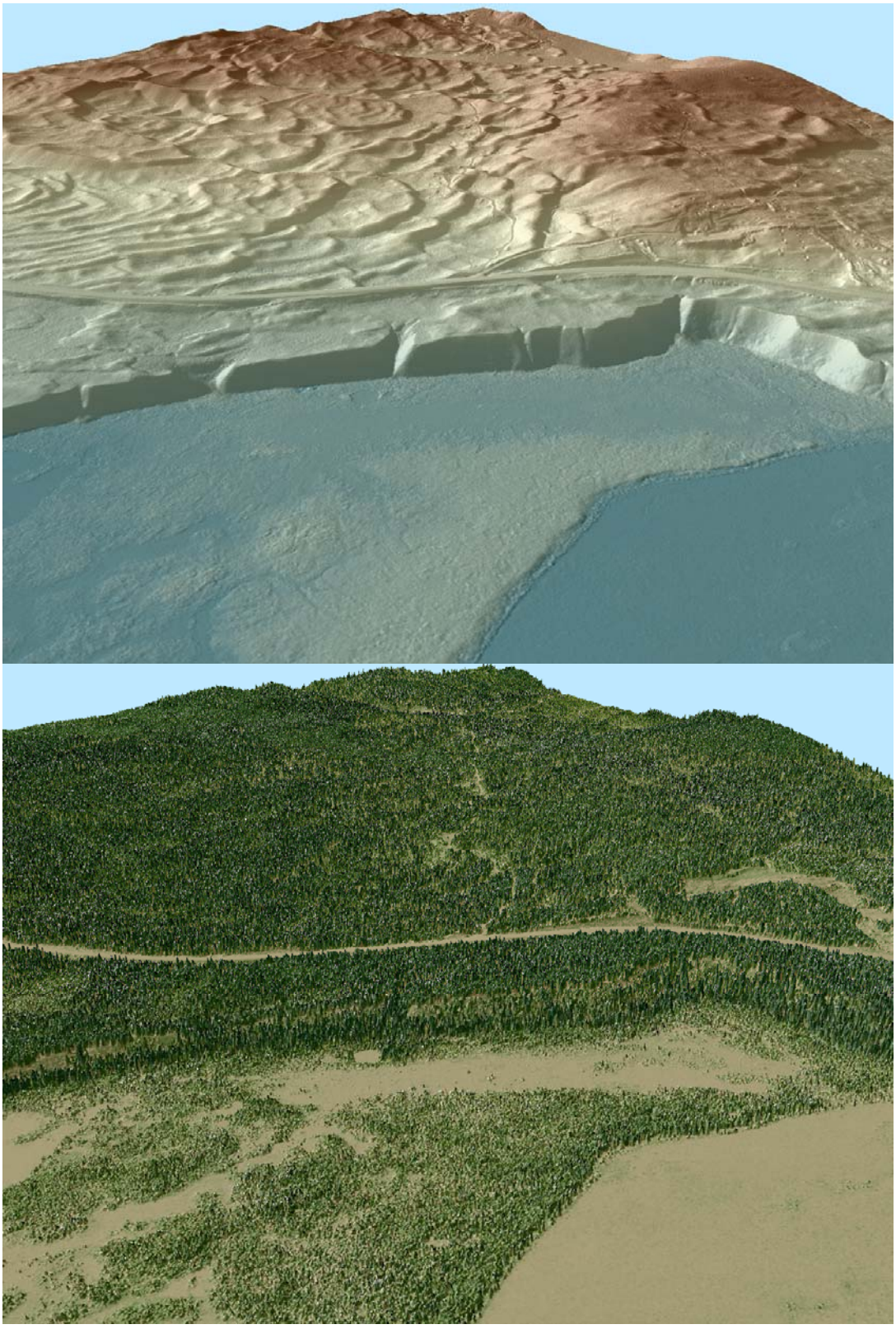


*Figure 35. Hwy 2, west of where it crosses Gardiner River. Top image is Bare Earth model colored by elevation. Bottom image is Highest Hit model.*

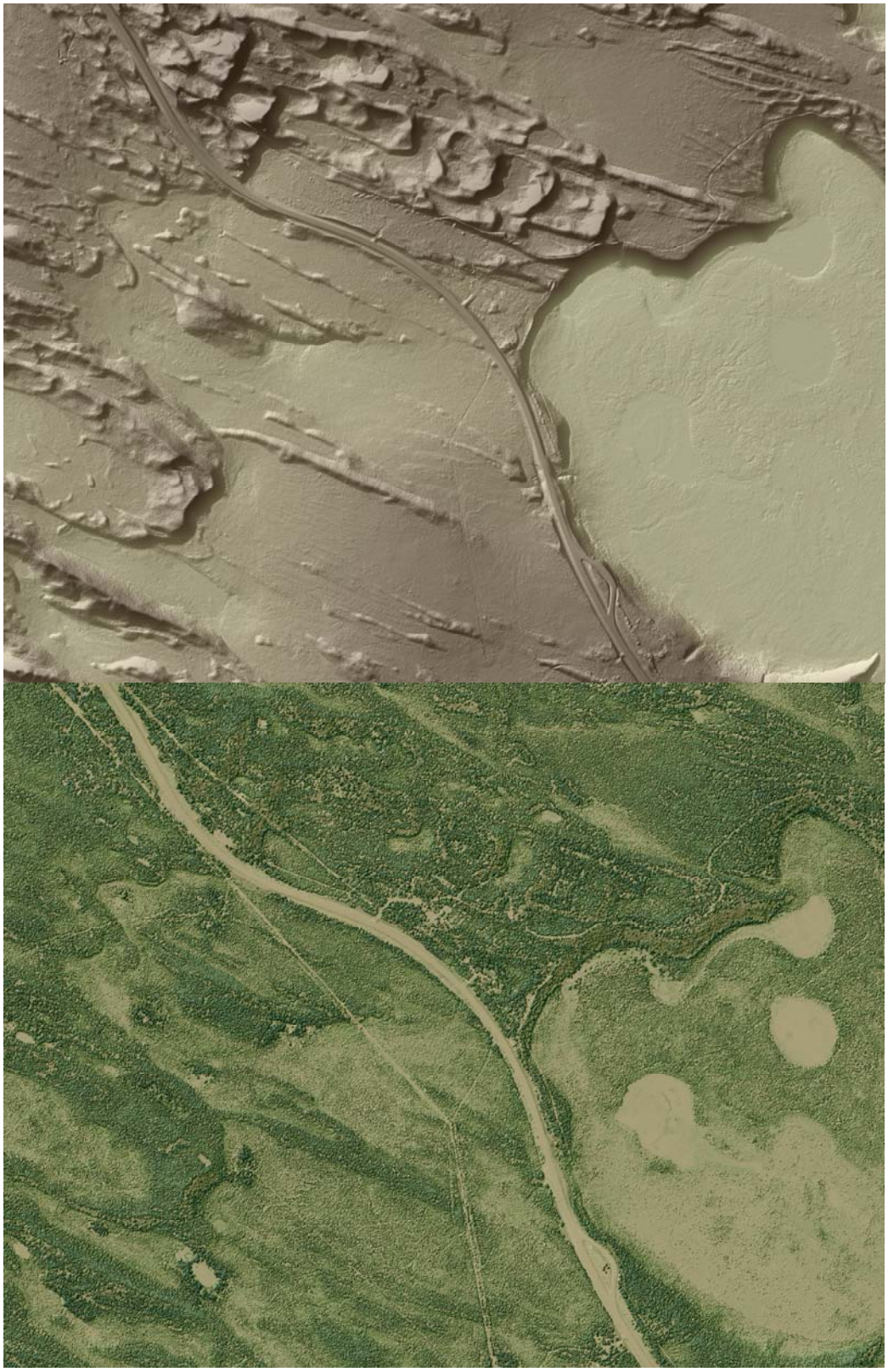
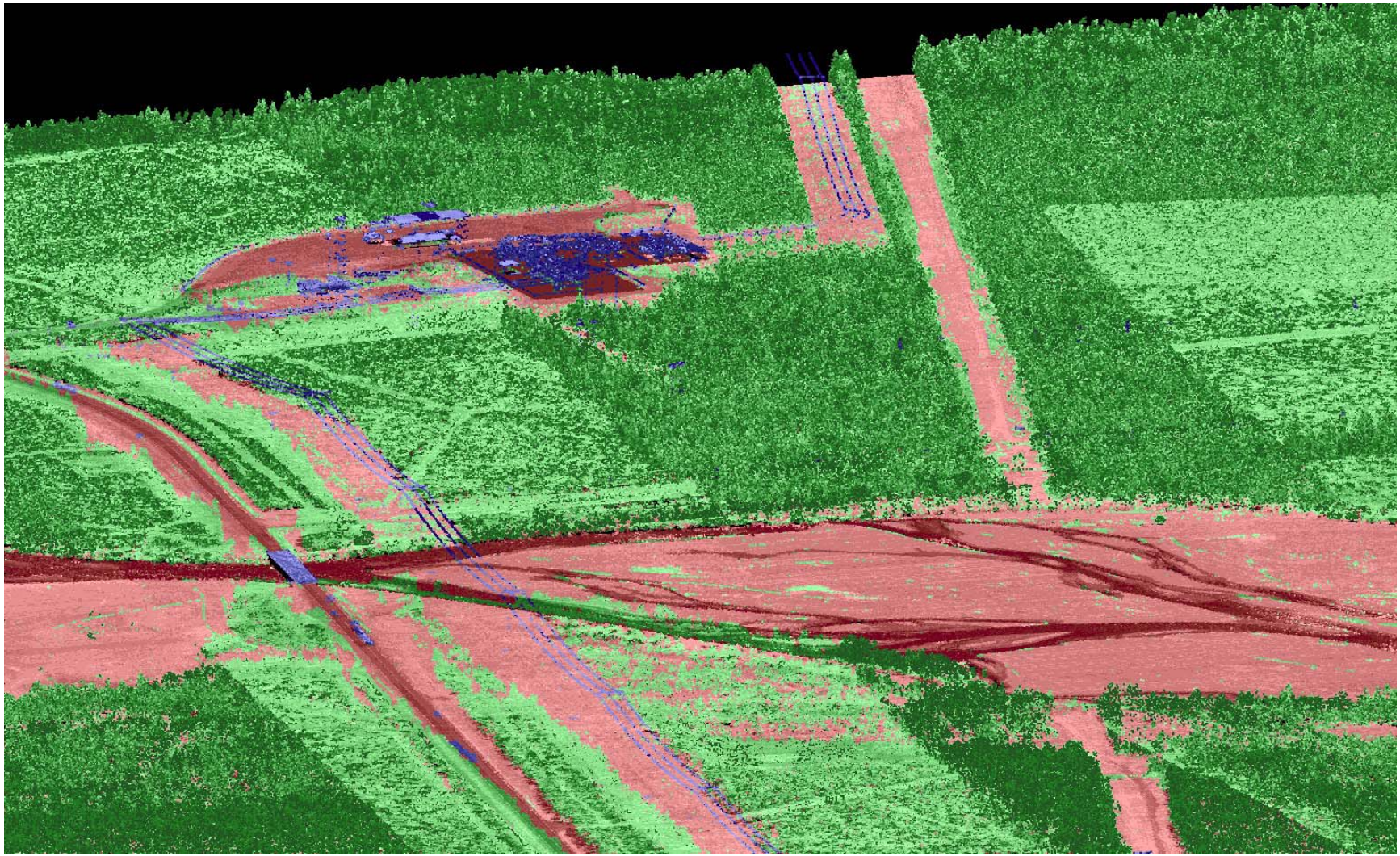


*Figure 36. Delta Junction power station, looking across Delta River. Image is LiDAR point cloud colored by point class and intensity.*



# 9. Glossary

**1-sigma (σ) Absolute Deviation:** Value for which the data are within one standard deviation (approximately 68$^{th}$ percentile) of a normally distributed data set.

**1.96-sigma (σ) Absolute Deviation:** Value for which the data are within two standard deviations (approximately 95$^{th}$ percentile) of a normally distributed data set.

**Root Mean Square Error (RMSE):** A statistic used to approximate the difference between real-world points and the LiDAR points. It is calculated by squaring all the values, then taking the average of the squares and taking the square root of the average.

**Pulse Rate (PR)**: The rate at which laser pulses are emitted from the sensor; typically measured as thousands of pulses per second (kHz).

**Pulse Returns**: For every laser pulse emitted, the Leica ALS 50 Phase II system can record *up to four* wave forms reflected back to the sensor. Portions of the wave form that return earliest are the highest element in multi-tiered surfaces such as vegetation. Portions of the wave form that return last are the lowest element in multi-tiered surfaces.

**Accuracy**: The statistical comparison between known (surveyed) points and laser points. Typically measured as the standard deviation (sigma, σ) and root mean square error (RMSE).

**Intensity Values**: The peak power ratio of the laser return to the emitted laser. It is a function of surface reflectivity.

**Data Density**: A common measure of LiDAR resolution, measured as points per square meter.

**Spot Spacing**: Also a measure of LiDAR resolution, measured as the average distance between laser points.

**Nadir**: A single point or locus of points on the surface of the earth directly below a sensor as it progresses along its flight line.

**Scan Angle**: The angle from nadir to the edge of the scan, measured in degrees. Laser point accuracy typically decreases as scan angles increase.

**Overlap**: The area shared between flight lines, typically measured in percents; 100% overlap is essential to ensure complete coverage and reduce laser shadows.

**DTM / DEM**: These often-interchanged terms refer to models made from laser points. The digital elevation model (DEM) refers to all surfaces, including bare ground and vegetation, while the digital terrain model (DTM) refers only to those points classified as ground.

**Real-Time Kinematic (RTK) Survey**: GPS surveying is conducted with a GPS base station deployed over a known monument with a radio connection to a GPS rover. Both the base station and rover receive differential GPS data and the baseline correction is solved between the two. This type of ground survey is accurate to 1.5 cm or less.

# 10. Citations

Soininen, A. 2004. TerraScan User's Guide. TerraSolid.

# Appendix A

**LiDAR accuracy error sources and solutions:**

| Type of Error | Source | Post Processing Solution |
|---|---|---|
| GPS (Static/Kinematic) | Long Base Lines | None |
| | Poor Satellite Constellation | None |
| | Poor Antenna Visibility | Reduce Visibility Mask |
| Relative Accuracy | Poor System Calibration | Recalibrate IMU and sensor offsets/settings |
| | Inaccurate System | None |
| Laser Noise | Poor Laser Timing | None |
| | Poor Laser Reception | None |
| | Poor Laser Power | None |
| | Irregular Laser Shape | None |

**Operational measures taken to improve relative accuracy:**

1. Low Flight Altitude: Terrain following is employed to maintain a constant above ground level (AGL). Laser horizontal errors are a function of flight altitude above ground (i.e., ~ 1/3000$^{th}$ AGL flight altitude).
2. Focus Laser Power at narrow beam footprint: A laser return must be received by the system above a power threshold to accurately record a measurement. The strength of the laser return is a function of laser emission power, laser footprint, flight altitude and the reflectivity of the target. While surface reflectivity cannot be controlled, laser power can be increased and low flight altitudes can be maintained.
3. Reduced Scan Angle: Edge-of-scan data can become inaccurate. The scan angle was reduced to a maximum of ±15$^{o}$ from nadir, creating a narrow swath width and greatly reducing laser shadows from trees and buildings.
4. Quality GPS: Flights took place during optimal GPS conditions (e.g., 6 or more satellites and PDOP [Position Dilution of Precision] less than 3.0). Before each flight, the PDOP was determined for the survey day. During all flight times, a dual frequency DGPS base station recording at 1-second epochs was utilized and a maximum baseline length between the aircraft and the control points was less than 19 km (11.5 miles) at all times.
5. Ground Survey: Ground survey point accuracy (i.e. <1.5 cm RMSE) occurs during optimal PDOP ranges and targets a minimal baseline distance of 4 miles between GPS rover and base. Robust statistics are, in part, a function of sample size (n) and distribution. Ground survey RTK points are distributed to the extent possible throughout multiple flight lines and across the survey area.
6. 50% Side-Lap (100% Overlap): Overlapping areas are optimized for relative accuracy testing. Laser shadowing is minimized to help increase target acquisition from multiple scan angles. Ideally, with a 50% side-lap, the most nadir portion of one flight line coincides with the edge (least nadir) portion of overlapping flight lines. A minimum of 50% side-lap with terrain-followed acquisition prevents data gaps.
7. Opposing Flight Lines: All overlapping flight lines are opposing. Pitch, roll and heading errors are amplified by a factor of two relative to the adjacent flight line(s), making misalignments easier to detect and resolve.

# Appendix B

# Alaska Gasline LiDAR Project
# Delivery 10 South

*Watershed Sciences, Inc.*
*McClintock Land Associates, Inc.*

QUALITY CONTROL REVIEW SUMMARY

| | | |
|---|---|---|
| Max. Positive Elev. Deviation: | 0.19 | meters |
| Max. Negative Elev. Deviation: | -0.36 | meters |
| Elevation Deviation Range: | 0.54 | meters |
| Elevation Deviation Mean: | 0.02 | meters |
| **Elevation Deviation RMSE** | **0.05** | **meters** |

(RMSE = Root Mean Square Error)

Total Number of Check Points: 1521

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 187 | 6932920.54 | 576381.22 | 600.04 | CP-35 B | 600.07 | -0.03 |
| 188 | 6907374.20 | 585465.02 | 500.55 | CP-36 A | 500.57 | -0.02 |
| 190 | 6868247.99 | 588774.14 | 394.03 | CP-37 A | 394.00 | 0.03 |
| 191 | 6867060.35 | 589088.07 | 399.57 | CP-37 B | 399.57 | 0.00 |
| 192 | 6831309.28 | 594605.17 | 499.38 | CP-38 A | 499.36 | 0.02 |
| 193 | 6827969.20 | 593968.02 | 545.70 | CP-38 B | 545.65 | 0.05 |
| 194 | 6796266.11 | 592537.02 | 360.60 | CP-39 A | 360.55 | 0.05 |
| 195 | 6793018.32 | 592090.19 | 350.62 | CP-39 B | 350.59 | 0.03 |
| 196 | 6787749.86 | 587031.53 | 402.16 | CP-39 C | 402.07 | 0.09 |
| 197 | 6777357.94 | 570661.56 | 685.81 | CP-40 A | 685.84 | -0.03 |
| 198 | 6778131.00 | 568075.72 | 813.49 | CP-40 B | 813.46 | 0.02 |
| 5300 | 6932920.48 | 576381.20 | 600.04 | 35B2010092735B | 600.06 | -0.02 |
| 5301 | 6935699.38 | 576601.35 | 597.55 | 35B20100927CK_35A_5'o/s | 597.52 | 0.03 |
| 5302 | 6935709.68 | 576591.13 | 598.02 | 35B20100927SPR | 597.95 | 0.07 |
| 5303 | 6935698.43 | 576590.31 | 597.93 | 35B20100927SPR | 597.92 | 0.01 |
| 5304 | 6935686.41 | 576589.49 | 597.78 | 35B20100927SPR | 597.74 | 0.04 |
| 5305 | 6936280.47 | 576794.42 | 601.85 | 35B20100927SPR | 601.80 | 0.05 |
| 5306 | 6936291.46 | 576801.53 | 602.01 | 35B20100927SPR | 601.96 | 0.05 |
| 5307 | 6936308.67 | 576812.26 | 602.19 | 35B20100927SPR | 602.17 | 0.02 |
| 5308 | 6936754.15 | 577042.75 | 606.49 | 35B20100927SPR | 606.43 | 0.06 |
| 5309 | 6936766.02 | 577048.97 | 606.46 | 35B20100927SPR | 606.47 | -0.01 |
| 5310 | 6936775.33 | 577053.77 | 606.49 | 35B20100927SPR | 606.47 | 0.02 |
| 5311 | 6937392.02 | 577315.66 | 612.82 | 35B20100927SPR | 612.86 | -0.04 |
| 5312 | 6937403.06 | 577319.71 | 613.18 | 35B20100927SPR | 613.14 | 0.04 |
| 5313 | 6937418.97 | 577325.53 | 613.58 | 35B20100927SPR | 613.59 | -0.01 |
| 5314 | 6938087.22 | 577326.14 | 625.80 | 35B20100927SPR | 625.81 | -0.01 |
| 5315 | 6938101.49 | 577328.02 | 625.98 | 35B20100927SPR | 626.05 | -0.07 |
| 5316 | 6938114.43 | 577329.85 | 626.22 | 35B20100927SPR | 626.26 | -0.04 |
| 5317 | 6938681.51 | 577518.55 | 632.59 | 35B20100927SPR | 632.62 | -0.03 |
| 5318 | 6938700.11 | 577525.66 | 632.82 | 35B20100927SPR | 632.88 | -0.06 |
| 5319 | 6938719.15 | 577533.54 | 633.15 | 35B20100927SPR | 633.23 | -0.08 |
| 5320 | 6939407.48 | 577719.89 | 645.64 | 35B20100927SPR | 645.74 | -0.10 |
| 5321 | 6939417.23 | 577725.14 | 645.89 | 35B20100927SPR | 645.92 | -0.03 |
| 5322 | 6939425.64 | 577730.18 | 646.08 | 35B20100927SPR | 646.11 | -0.03 |
| 5323 | 6939947.25 | 578047.12 | 666.98 | 35B20100927SPR | 666.90 | 0.08 |
| 5324 | 6939958.78 | 578054.17 | 667.46 | 35B20100927SPR | 667.34 | 0.12 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5325 | 6939968.22 | 578059.91 | 667.76 | 35B20100927SPR | 667.72 | 0.04 |
| 5326 | 6939969.71 | 578036.70 | 666.48 | 35B20100927FBC | 666.37 | 0.11 |
| 5335 | 6935079.52 | 576516.17 | 596.86 | 35B20100927SPR | 596.77 | 0.09 |
| 5336 | 6935065.54 | 576510.44 | 596.72 | 35B20100927SPR | 596.65 | 0.07 |
| 5337 | 6935057.11 | 576507.14 | 596.61 | 35B20100927SPR | 596.55 | 0.06 |
| 5338 | 6934301.44 | 576315.28 | 583.59 | 35B20100927SPR | 583.51 | 0.08 |
| 5339 | 6934287.86 | 576317.38 | 583.19 | 35B20100927SPR | 583.11 | 0.08 |
| 5340 | 6934278.00 | 576319.12 | 582.90 | 35B20100927SPR | 582.84 | 0.06 |
| 5341 | 6933722.58 | 575956.39 | 569.61 | 35B20100927SGR | 569.56 | 0.05 |
| 5342 | 6933733.76 | 575950.22 | 569.76 | 35B20100927SGR | 569.74 | 0.01 |
| 5343 | 6933746.38 | 575954.10 | 569.96 | 35B20100927SGR | 569.89 | 0.07 |
| 5344 | 6933838.70 | 576415.52 | 577.57 | 35B20100927SPR | 577.50 | 0.07 |
| 5345 | 6933827.54 | 576418.04 | 577.81 | 35B20100927SPR | 577.74 | 0.07 |
| 5346 | 6933814.50 | 576420.99 | 578.11 | 35B20100927SPR | 578.02 | 0.09 |
| 5347 | 6932921.87 | 576380.67 | 600.07 | 35B20100927CK_35B_5'o/s | 600.00 | 0.07 |
| 5348 | 6932943.12 | 576396.19 | 600.23 | 35B20100927SPR | 600.21 | 0.02 |
| 5349 | 6932925.43 | 576394.71 | 600.42 | 35B20100927SPR | 600.40 | 0.02 |
| 5350 | 6932905.53 | 576392.81 | 600.55 | 35B20100927SPR | 600.45 | 0.10 |
| 5351 | 6931987.70 | 576767.52 | 599.97 | 35B20100927SPR | 599.87 | 0.10 |
| 5352 | 6931980.00 | 576771.94 | 599.97 | 35B20100927SPR | 599.92 | 0.05 |
| 5353 | 6931967.21 | 576778.73 | 599.89 | 35B20100927SPR | 599.80 | 0.09 |
| 5354 | 6931215.39 | 577231.85 | 600.69 | 35B20100927SPR | 600.68 | 0.01 |
| 5355 | 6931199.46 | 577240.02 | 600.56 | 35B20100927SPR | 600.53 | 0.03 |
| 5356 | 6931183.10 | 577248.93 | 600.37 | 35B20100927SPR | 600.30 | 0.07 |
| 5357 | 6930718.15 | 577933.84 | 600.91 | 35B20100927SPR | 600.94 | -0.03 |
| 5358 | 6930712.43 | 577946.86 | 600.92 | 35B20100927SPR | 600.87 | 0.05 |
| 5359 | 6930705.51 | 577963.14 | 600.98 | 35B20100927SPR | 600.97 | 0.01 |
| 5360 | 6930106.03 | 578450.06 | 601.64 | 35B20100927SPR | 601.59 | 0.05 |
| 5361 | 6930095.50 | 578459.44 | 601.51 | 35B20100927SPR | 601.40 | 0.11 |
| 5362 | 6930081.38 | 578472.07 | 601.47 | 35B20100927SPR | 601.38 | 0.09 |
| 5363 | 6929630.62 | 578991.96 | 598.14 | 35B20100927SPR | 598.01 | 0.13 |
| 5364 | 6929622.78 | 579001.42 | 598.08 | 35B20100927SPR | 598.02 | 0.06 |
| 5365 | 6929612.48 | 579013.23 | 598.09 | 35B20100927SPR | 598.05 | 0.04 |
| 5366 | 6929312.05 | 579672.64 | 595.08 | 35B20100927SPR | 594.92 | 0.16 |
| 5367 | 6929308.08 | 579684.49 | 595.05 | 35B20100927SPR | 594.92 | 0.13 |
| 5368 | 6929302.35 | 579701.37 | 595.04 | 35B20100927SPR | 594.95 | 0.09 |
| 5401 | 6907374.30 | 585463.54 | 500.58 | 36B20100927CK_36A_5'o/s | 500.59 | -0.01 |
| 5402 | 6907362.73 | 585436.98 | 501.12 | 36B20100927SPR | 501.07 | 0.05 |
| 5403 | 6907377.08 | 585437.66 | 501.12 | 36B20100927SPR | 501.07 | 0.05 |
| 5404 | 6907392.40 | 585437.35 | 501.05 | 36B20100927SPR | 501.01 | 0.04 |
| 5405 | 6907536.82 | 585694.05 | 502.83 | 36B20100927SPR | 502.86 | -0.03 |
| 5406 | 6907543.65 | 585709.58 | 503.02 | 36B20100927SPR | 503.02 | 0.00 |
| 5407 | 6907550.84 | 585725.61 | 503.12 | 36B20100927SPR | 503.12 | 0.00 |
| 5417 | 6907593.04 | 585437.94 | 500.58 | 36B20100927SPR | 500.58 | 0.00 |
| 5418 | 6907605.49 | 585438.16 | 500.53 | 36B20100927SPR | 500.53 | 0.00 |
| 5419 | 6907620.32 | 585438.58 | 500.49 | 36B20100927SPR | 500.49 | 0.00 |
| 5420 | 6907914.18 | 585447.87 | 497.64 | 36B20100927SPR | 497.63 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5421 | 6907930.54 | 585448.40 | 497.26 | 36B20100927SPR | 497.23 | 0.03 |
| 5422 | 6907947.12 | 585449.08 | 496.82 | 36B20100927SPR | 496.82 | 0.00 |
| 5423 | 6908604.87 | 585478.91 | 486.62 | 36B20100927SPR | 486.59 | 0.03 |
| 5424 | 6908622.60 | 585479.70 | 487.07 | 36B20100927SPR | 487.06 | 0.01 |
| 5425 | 6908638.78 | 585480.68 | 487.49 | 36B20100927SPR | 487.45 | 0.04 |
| 5426 | 6909337.70 | 585574.84 | 504.20 | 36B20100927SPR | 504.23 | -0.03 |
| 5427 | 6909354.15 | 585582.84 | 504.28 | 36B20100927SPR | 504.32 | -0.04 |
| 5428 | 6909370.75 | 585590.87 | 504.36 | 36B20100927SPR | 504.44 | -0.08 |
| 5429 | 6910085.10 | 585862.85 | 510.52 | 36B20100927SPR | 510.50 | 0.02 |
| 5430 | 6910104.38 | 585859.73 | 510.63 | 36B20100927SPR | 510.62 | 0.00 |
| 5431 | 6910122.04 | 585857.02 | 510.70 | 36B20100927SPR | 510.69 | 0.01 |
| 5432 | 6910951.10 | 585385.52 | 507.95 | 36B20100927SPR | 507.94 | 0.01 |
| 5433 | 6910965.24 | 585384.18 | 507.95 | 36B20100927SPR | 507.91 | 0.04 |
| 5434 | 6910983.20 | 585382.79 | 507.98 | 36B20100927SPR | 507.98 | 0.00 |
| 5435 | 6911495.00 | 585256.69 | 510.02 | 36B20100927SPR | 509.99 | 0.03 |
| 5436 | 6911510.20 | 585252.22 | 510.08 | 36B20100927SPR | 510.06 | 0.02 |
| 5437 | 6911527.40 | 585246.49 | 510.14 | 36B20100927SPR | 510.12 | 0.01 |
| 5438 | 6912240.65 | 584992.13 | 506.96 | 36B20100927SPR | 506.93 | 0.03 |
| 5439 | 6912253.92 | 584983.19 | 506.62 | 36B20100927SPR | 506.61 | 0.01 |
| 5440 | 6912266.33 | 584973.75 | 506.32 | 36B20100927SPR | 506.26 | 0.06 |
| 5441 | 6907148.53 | 585383.04 | 501.36 | 36B20100927SPR | 501.35 | 0.01 |
| 5442 | 6907138.47 | 585378.41 | 501.32 | 36B20100927SPR | 501.28 | 0.04 |
| 5443 | 6907126.57 | 585372.85 | 501.25 | 36B20100927SPR | 501.23 | 0.02 |
| 5444 | 6906734.13 | 585034.80 | 499.59 | 36B20100927SPR | 499.55 | 0.04 |
| 5445 | 6906725.20 | 585025.57 | 499.41 | 36B20100927SPR | 499.35 | 0.06 |
| 5446 | 6906716.09 | 585016.47 | 499.28 | 36B20100927SPR | 499.22 | 0.06 |
| 5447 | 6906245.29 | 584683.73 | 484.20 | 36B20100927SPR | 484.21 | -0.01 |
| 5448 | 6906230.06 | 584677.07 | 483.18 | 36B20100927SPR | 483.20 | -0.02 |
| 5449 | 6906213.48 | 584670.67 | 482.13 | 36B20100927SPR | 482.14 | -0.01 |
| 5500 | 6867060.41 | 589088.05 | 399.58 | 37B2010092737B | 399.58 | 0.00 |
| 5501 | 6867065.25 | 589081.35 | 400.06 | 37B20100927SGR | 400.10 | -0.04 |
| 5502 | 6867053.99 | 589049.77 | 401.98 | 37B20100927SGR | 401.98 | 0.00 |
| 5503 | 6867038.89 | 589028.17 | 402.86 | 37B20100927SGR | 402.88 | -0.02 |
| 5504 | 6867023.50 | 589009.89 | 403.88 | 37B20100927SGR | 403.92 | -0.04 |
| 5505 | 6867005.03 | 588995.49 | 405.47 | 37B20100927SGR | 405.49 | -0.02 |
| 5506 | 6866985.17 | 588981.80 | 407.01 | 37B20100927SGR | 407.08 | -0.07 |
| 5507 | 6866960.37 | 588966.87 | 408.54 | 37B20100927SGR | 408.56 | -0.02 |
| 5508 | 6866931.74 | 588951.13 | 410.28 | 37B20100927SGR | 410.26 | 0.02 |
| 5509 | 6866912.34 | 588940.37 | 411.70 | 37B20100927SGR | 411.70 | 0.00 |
| 5510 | 6866880.28 | 588921.62 | 414.71 | 37B20100927SGR | 414.70 | 0.01 |
| 5511 | 6866844.34 | 588893.56 | 416.79 | 37B20100927SGR | 416.77 | 0.02 |
| 5512 | 6866833.86 | 588882.30 | 417.57 | 37B20100927SGR | 417.52 | 0.05 |
| 5513 | 6866816.19 | 588854.59 | 418.86 | 37B20100927SGR | 418.86 | 0.00 |
| 5514 | 6866801.85 | 588824.44 | 420.11 | 37B20100927SGR | 420.12 | -0.01 |
| 5515 | 6866788.33 | 588793.73 | 421.41 | 37B20100927SGR | 421.39 | 0.01 |
| 5516 | 6866776.43 | 588763.44 | 422.70 | 37B20100927SGR | 422.70 | 0.00 |
| 5517 | 6866764.65 | 588731.60 | 424.10 | 37B20100927SGR | 424.11 | -0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5518 | 6867093.19 | 589092.14 | 399.31 | 37B20100927SAR | 399.34 | -0.03 |
| 5519 | 6867125.70 | 589075.91 | 398.74 | 37B20100927SAR | 398.75 | -0.01 |
| 5520 | 6867148.05 | 589068.02 | 398.33 | 37B20100927SAR | 398.33 | 0.00 |
| 5521 | 6867177.70 | 589059.67 | 397.97 | 37B20100927SAR | 398.01 | -0.05 |
| 5522 | 6867207.36 | 589055.79 | 397.53 | 37B20100927SAR | 397.52 | 0.01 |
| 5523 | 6867235.56 | 589044.72 | 397.08 | 37B20100927SAR | 397.09 | -0.01 |
| 5524 | 6867247.85 | 589037.07 | 397.09 | 37B20100927SAR | 397.10 | -0.01 |
| 5525 | 6867278.76 | 589025.66 | 397.18 | 37B20100927SAR | 397.22 | -0.04 |
| 5526 | 6867298.26 | 589018.27 | 397.33 | 37B20100927SAR | 397.38 | -0.06 |
| 5527 | 6867331.67 | 589005.40 | 397.54 | 37B20100927SAR | 397.57 | -0.03 |
| 5528 | 6867332.85 | 589008.04 | 397.48 | 37B20100927SAR | 397.51 | -0.03 |
| 5529 | 6867331.04 | 589008.72 | 397.47 | 37B20100927SAR | 397.52 | -0.06 |
| 5530 | 6867983.57 | 588808.31 | 394.42 | 37B20100927SAR | 394.49 | -0.07 |
| 5531 | 6868010.40 | 588806.42 | 394.69 | 37B20100927SAR | 394.74 | -0.05 |
| 5532 | 6868040.32 | 588804.57 | 394.86 | 37B20100927SAR | 394.91 | -0.05 |
| 5533 | 6868042.49 | 588804.68 | 394.87 | 37B20100927SAR | 394.91 | -0.05 |
| 5534 | 6868044.87 | 588804.82 | 394.86 | 37B20100927SAR | 394.92 | -0.06 |
| 5535 | 6868076.23 | 588802.49 | 395.05 | 37B20100927SAR | 395.09 | -0.04 |
| 5536 | 6868108.56 | 588801.28 | 395.13 | 37B20100927SAR | 395.20 | -0.07 |
| 5537 | 6868146.16 | 588798.28 | 395.15 | 37B20100927SAR | 395.18 | -0.04 |
| 5538 | 6868177.37 | 588796.38 | 395.22 | 37B20100927SAR | 395.25 | -0.03 |
| 5539 | 6868213.23 | 588797.24 | 394.98 | 37B20100927SAR | 395.01 | -0.03 |
| 5540 | 6868239.88 | 588780.03 | 394.49 | 37B20100927SAR | 394.51 | -0.02 |
| 5541 | 6868240.61 | 588779.13 | 394.44 | 37B20100927SAR | 394.45 | -0.01 |
| 5542 | 6868239.42 | 588778.31 | 394.38 | 37B20100927SAR | 394.41 | -0.03 |
| 5543 | 6868245.34 | 588760.39 | 393.96 | 37B20100927SGR | 393.99 | -0.03 |
| 5544 | 6868266.06 | 588753.07 | 393.95 | 37B20100927SGR | 393.99 | -0.04 |
| 5545 | 6868280.98 | 588761.85 | 393.89 | 37B20100927SGR | 393.94 | -0.05 |
| 5546 | 6868304.25 | 588750.75 | 393.65 | 37B20100927SGR | 393.70 | -0.06 |
| 5547 | 6868319.17 | 588759.65 | 393.78 | 37B20100927SGR | 393.81 | -0.03 |
| 5548 | 6868337.86 | 588760.20 | 393.35 | 37B20100927SGR | 393.41 | -0.06 |
| 5549 | 6868339.58 | 588789.22 | 393.50 | 37B20100927SAR | 393.54 | -0.05 |
| 5550 | 6868318.03 | 588788.07 | 393.84 | 37B20100927SAR | 393.87 | -0.03 |
| 5551 | 6866301.34 | 589289.57 | 418.52 | 37B20100927SAR | 418.56 | -0.04 |
| 5552 | 6866303.41 | 589304.35 | 418.52 | 37B20100927SAR | 418.47 | 0.05 |
| 5553 | 6866300.29 | 589302.13 | 418.66 | 37B20100927SAR | 418.66 | 0.00 |
| 5554 | 6866281.75 | 589306.58 | 419.01 | 37B20100927SAR | 419.03 | -0.02 |
| 5555 | 6866253.41 | 589314.03 | 419.53 | 37B20100927SAR | 419.53 | 0.00 |
| 5556 | 6866208.28 | 589323.09 | 420.49 | 37B20100927SAR | 420.51 | -0.02 |
| 5557 | 6866211.66 | 589333.27 | 419.96 | 37B20100927SAR | 419.97 | -0.01 |
| 5558 | 6866216.40 | 589351.85 | 419.23 | 37B20100927SAR | 419.18 | 0.05 |
| 5559 | 6866212.77 | 589370.80 | 418.68 | 37B20100927SAR | 418.69 | -0.01 |
| 5560 | 6866197.88 | 589387.21 | 418.59 | 37B20100927SAR | 418.60 | -0.01 |
| 5561 | 6866180.12 | 589406.64 | 418.47 | 37B20100927SAR | 418.49 | -0.02 |
| 5562 | 6866162.43 | 589426.30 | 418.42 | 37B20100927SAR | 418.38 | 0.04 |
| 5563 | 6866142.56 | 589448.10 | 418.38 | 37B20100927SAR | 418.38 | 0.00 |
| 5564 | 6866126.54 | 589466.28 | 418.14 | 37B20100927SAR | 418.14 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5565 | 6866125.50 | 589467.56 | 418.14 | 37B20100927SAR | 418.12 | 0.02 |
| 5566 | 6866123.67 | 589469.52 | 418.11 | 37B20100927SAR | 418.07 | 0.04 |
| 5567 | 6866126.01 | 589469.57 | 418.11 | 37B20100927SAR | 418.12 | -0.01 |
| 5568 | 6865508.13 | 589877.83 | 418.47 | 37B20100927SAR | 418.53 | -0.06 |
| 5569 | 6865523.21 | 589891.46 | 417.79 | 37B20100927SAR | 417.81 | -0.02 |
| 5570 | 6865476.25 | 589898.56 | 418.61 | 37B20100927SAR | 418.68 | -0.07 |
| 5571 | 6865451.96 | 589925.52 | 418.53 | 37B20100927SAR | 418.59 | -0.06 |
| 5572 | 6865435.50 | 589942.88 | 418.50 | 37B20100927SAR | 418.55 | -0.06 |
| 5573 | 6865418.33 | 589961.47 | 418.47 | 37B20100927SAR | 418.49 | -0.02 |
| 5574 | 6865412.81 | 589972.51 | 418.38 | 37B20100927SAR | 418.44 | -0.06 |
| 5575 | 6865396.09 | 589989.76 | 418.39 | 37B20100927SAR | 418.45 | -0.06 |
| 5576 | 6865387.60 | 589988.38 | 418.44 | 37B20100927SAR | 418.50 | -0.06 |
| 5577 | 6865364.87 | 590012.98 | 418.40 | 37B20100927SAR | 418.45 | -0.05 |
| 5578 | 6865341.69 | 590037.89 | 418.43 | 37B20100927SAR | 418.48 | -0.06 |
| 5579 | 6865326.32 | 590050.77 | 418.37 | 37B20100927SAR | 418.40 | -0.03 |
| 5580 | 6865328.47 | 590052.98 | 418.47 | 37B20100927SAR | 418.52 | -0.05 |
| 5581 | 6865317.65 | 590063.72 | 418.48 | 37B20100927SAR | 418.53 | -0.05 |
| 5582 | 6865317.16 | 590060.16 | 418.34 | 37B20100927SAR | 418.37 | -0.03 |
| 5600 | 6827969.32 | 593967.96 | 545.69 | 38B2010092738B | 545.64 | 0.05 |
| 5601 | 6827961.24 | 593972.97 | 544.65 | 38B20100927SGR | 544.61 | 0.04 |
| 5602 | 6827957.57 | 593990.29 | 547.18 | 38B20100927SGR | 547.14 | 0.04 |
| 5603 | 6827951.35 | 594012.21 | 549.04 | 38B20100927SGR | 548.99 | 0.05 |
| 5604 | 6827945.46 | 594030.15 | 550.59 | 38B20100927SGR | 550.54 | 0.05 |
| 5605 | 6827942.68 | 594056.65 | 551.77 | 38B20100927SGR | 551.67 | 0.10 |
| 5606 | 6827940.64 | 594084.07 | 553.13 | 38B20100927SGR | 553.07 | 0.06 |
| 5607 | 6827941.99 | 594112.77 | 554.55 | 38B20100927SGR | 554.49 | 0.06 |
| 5608 | 6827944.21 | 594135.15 | 556.06 | 38B20100927SGR | 555.98 | 0.08 |
| 5609 | 6827953.42 | 594159.93 | 558.65 | 38B20100927SGR | 558.61 | 0.04 |
| 5610 | 6827964.07 | 594180.17 | 561.69 | 38B20100927SGR | 561.61 | 0.08 |
| 5611 | 6827985.46 | 594195.18 | 562.88 | 38B20100927SGR | 562.81 | 0.07 |
| 5612 | 6827982.91 | 594209.79 | 564.47 | 38B20100927SGR | 564.32 | 0.15 |
| 5613 | 6827954.69 | 593950.37 | 544.51 | 38B20100927SAR | 544.45 | 0.06 |
| 5614 | 6827925.22 | 593946.10 | 545.55 | 38B20100927SAR | 545.49 | 0.06 |
| 5615 | 6827889.81 | 593941.25 | 546.72 | 38B20100927SAR | 546.69 | 0.03 |
| 5616 | 6827854.38 | 593936.28 | 547.88 | 38B20100927SAR | 547.82 | 0.06 |
| 5617 | 6827817.92 | 593931.15 | 548.97 | 38B20100927SAR | 548.95 | 0.02 |
| 5618 | 6827778.24 | 593925.77 | 549.72 | 38B20100927SAR | 549.65 | 0.07 |
| 5619 | 6827748.19 | 593921.64 | 550.39 | 38B20100927SAR | 550.32 | 0.06 |
| 5620 | 6827717.49 | 593917.58 | 551.00 | 38B20100927SAR | 550.97 | 0.02 |
| 5621 | 6827679.01 | 593912.51 | 551.52 | 38B20100927SAR | 551.50 | 0.02 |
| 5622 | 6827641.77 | 593907.36 | 551.89 | 38B20100927SAR | 551.87 | 0.02 |
| 5623 | 6827609.35 | 593902.79 | 551.92 | 38B20100927SAR | 551.92 | 0.00 |
| 5624 | 6827581.02 | 593898.97 | 551.66 | 38B20100927SAR | 551.64 | 0.02 |
| 5625 | 6827552.56 | 593895.48 | 551.24 | 38B20100927SAR | 551.20 | 0.04 |
| 5626 | 6827554.40 | 593889.15 | 551.20 | 38B20100927SAR | 551.15 | 0.05 |
| 5627 | 6826459.84 | 593637.72 | 552.85 | 38B20100927SAR | 552.81 | 0.04 |
| 5628 | 6826439.36 | 593637.18 | 553.25 | 38B20100927SAR | 553.22 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5629 | 6826439.24 | 593639.96 | 553.28 | 38B20100927SAR | 553.28 | 0.00 |
| 5630 | 6826406.80 | 593642.90 | 553.85 | 38B20100927SAR | 553.87 | -0.02 |
| 5631 | 6826376.50 | 593642.14 | 554.27 | 38B20100927SAR | 554.30 | -0.03 |
| 5632 | 6826350.18 | 593641.70 | 554.67 | 38B20100927SAR | 554.66 | 0.01 |
| 5633 | 6826316.63 | 593640.99 | 555.20 | 38B20100927SAR | 555.21 | -0.01 |
| 5634 | 6826285.32 | 593640.43 | 555.68 | 38B20100927SAR | 555.70 | -0.02 |
| 5635 | 6826252.30 | 593639.52 | 556.14 | 38B20100927SAR | 556.12 | 0.01 |
| 5636 | 6826219.40 | 593638.82 | 556.61 | 38B20100927SAR | 556.59 | 0.01 |
| 5637 | 6826193.91 | 593646.66 | 556.90 | 38B20100927SGR | 556.86 | 0.04 |
| 5638 | 6826196.71 | 593657.03 | 556.98 | 38B20100927SGR | 556.92 | 0.06 |
| 5639 | 6825340.70 | 593671.05 | 561.88 | 38B20100927SAR | 561.83 | 0.05 |
| 5640 | 6825340.63 | 593674.01 | 561.98 | 38B20100927SAR | 561.94 | 0.03 |
| 5641 | 6825337.31 | 593678.21 | 562.09 | 38B20100927SAR | 562.04 | 0.05 |
| 5642 | 6825322.51 | 593677.38 | 562.05 | 38B20100927SAR | 562.01 | 0.04 |
| 5643 | 6825306.43 | 593677.20 | 562.03 | 38B20100927SAR | 561.98 | 0.05 |
| 5644 | 6825284.20 | 593676.69 | 562.25 | 38B20100927SAR | 562.22 | 0.02 |
| 5645 | 6825252.41 | 593675.94 | 562.27 | 38B20100927SAR | 562.24 | 0.03 |
| 5646 | 6825192.33 | 593675.21 | 562.59 | 38B20100927SAR | 562.56 | 0.03 |
| 5647 | 6825161.21 | 593675.06 | 562.56 | 38B20100927SAR | 562.51 | 0.05 |
| 5648 | 6825130.11 | 593674.01 | 562.65 | 38B20100927SAR | 562.59 | 0.06 |
| 5649 | 6825079.86 | 593672.75 | 562.93 | 38B20100927SAR | 562.87 | 0.06 |
| 5650 | 6825043.57 | 593671.13 | 563.41 | 38B20100927SAR | 563.33 | 0.08 |
| 5651 | 6824993.90 | 593669.85 | 563.68 | 38B20100927SAR | 563.60 | 0.07 |
| 5652 | 6824957.46 | 593668.76 | 563.84 | 38B20100927SAR | 563.77 | 0.07 |
| 5653 | 6824942.68 | 593668.99 | 563.72 | 38B20100927SAR | 563.65 | 0.07 |
| 5654 | 6824945.18 | 593676.58 | 563.88 | 38B20100927SAR | 563.79 | 0.09 |
| 5655 | 6828862.61 | 594118.44 | 526.11 | 38B20100927SAR | 526.04 | 0.07 |
| 5656 | 6828877.29 | 594122.88 | 525.99 | 38B20100927SAR | 525.92 | 0.07 |
| 5657 | 6828904.65 | 594130.48 | 525.98 | 38B20100927SAR | 525.91 | 0.07 |
| 5658 | 6828927.51 | 594137.58 | 526.18 | 38B20100927SAR | 526.10 | 0.08 |
| 5659 | 6828928.03 | 594135.71 | 526.25 | 38B20100927SAR | 526.19 | 0.05 |
| 5660 | 6828928.53 | 594133.85 | 526.27 | 38B20100927SAR | 526.21 | 0.06 |
| 5661 | 6828942.27 | 594141.92 | 526.27 | 38B20100927SAR | 526.22 | 0.05 |
| 5662 | 6828964.65 | 594148.30 | 526.38 | 38B20100927SAR | 526.33 | 0.05 |
| 5663 | 6828977.28 | 594152.19 | 526.57 | 38B20100927SAR | 526.50 | 0.07 |
| 5664 | 6828999.84 | 594158.49 | 526.77 | 38B20100927SAR | 526.74 | 0.03 |
| 5665 | 6829015.71 | 594164.14 | 526.81 | 38B20100927SAR | 526.74 | 0.06 |
| 5666 | 6829032.90 | 594169.29 | 526.66 | 38B20100927SAR | 526.61 | 0.05 |
| 5667 | 6829069.04 | 594178.12 | 526.69 | 38B20100927SAR | 526.59 | 0.10 |
| 5668 | 6829068.56 | 594179.96 | 526.63 | 38B20100927SAR | 526.54 | 0.09 |
| 5669 | 6829081.50 | 594183.93 | 526.69 | 38B20100927SAR | 526.60 | 0.09 |
| 5670 | 6829562.95 | 594326.94 | 522.66 | 38B20100927SAR | 522.61 | 0.05 |
| 5671 | 6829564.72 | 594337.55 | 522.62 | 38B20100927SGR | 522.58 | 0.04 |
| 5672 | 6829576.65 | 594345.34 | 523.07 | 38B20100927SGR | 523.03 | 0.04 |
| 5673 | 6829607.21 | 594363.97 | 524.31 | 38B20100927SGR | 524.28 | 0.03 |
| 5674 | 6829601.52 | 594369.06 | 525.08 | 38B20100927SGR | 525.03 | 0.05 |
| 5675 | 6829626.28 | 594376.33 | 524.87 | 38B20100927SGR | 524.84 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5676 | 6829644.07 | 594388.44 | 525.16 | 38B20100927SGR | 525.09 | 0.07 |
| 5677 | 6829654.79 | 594396.48 | 525.27 | 38B20100927SGR | 525.14 | 0.13 |
| 5678 | 6829666.87 | 594403.54 | 525.28 | 38B20100927SGR | 525.09 | 0.19 |
| 5679 | 6829679.32 | 594408.93 | 525.06 | 38B20100927SGR | 525.00 | 0.06 |
| 5680 | 6830197.18 | 594360.56 | 509.82 | 38B20100927SAR | 509.80 | 0.02 |
| 5681 | 6830185.95 | 594348.86 | 509.85 | 38B20100927SAR | 509.83 | 0.02 |
| 5682 | 6830158.96 | 594342.70 | 510.06 | 38B20100927SAR | 510.04 | 0.02 |
| 5683 | 6830126.12 | 594338.49 | 510.60 | 38B20100927SAR | 510.55 | 0.05 |
| 5684 | 6830038.06 | 594347.15 | 513.78 | 38B20100927SAR | 513.71 | 0.06 |
| 5685 | 6830038.66 | 594356.55 | 514.27 | 38B20100927SAR | 514.21 | 0.06 |
| 5686 | 6830072.47 | 594359.42 | 513.10 | 38B20100927SAR | 513.03 | 0.07 |
| 5687 | 6830101.86 | 594362.10 | 512.14 | 38B20100927SAR | 512.09 | 0.05 |
| 5688 | 6830116.60 | 594363.51 | 511.72 | 38B20100927SAR | 511.66 | 0.06 |
| 5689 | 6830118.26 | 594363.55 | 511.68 | 38B20100927SAR | 511.61 | 0.07 |
| 5690 | 6830121.11 | 594363.67 | 511.60 | 38B20100927SAR | 511.52 | 0.08 |
| 5691 | 6830135.21 | 594365.06 | 511.25 | 38B20100927SAR | 511.19 | 0.06 |
| 5692 | 6830136.42 | 594365.09 | 511.21 | 38B20100927SAR | 511.16 | 0.05 |
| 5693 | 6830138.31 | 594365.25 | 511.16 | 38B20100927SAR | 511.09 | 0.07 |
| 5694 | 6830183.07 | 594369.39 | 510.25 | 38B20100927SAR | 510.22 | 0.03 |
| 5695 | 6830189.42 | 594369.19 | 510.14 | 38B20100927SAR | 510.11 | 0.03 |
| 5696 | 6830190.63 | 594366.66 | 510.07 | 38B20100927SAR | 510.05 | 0.02 |
| 5697 | 6830195.00 | 594366.81 | 510.02 | 38B20100927SAR | 509.98 | 0.04 |
| 5698 | 6830197.83 | 594367.10 | 509.99 | 38B20100927SAR | 509.94 | 0.05 |
| 5699 | 6830200.17 | 594367.37 | 509.95 | 38B20100927SAR | 509.91 | 0.04 |
| 5700 | 6830202.40 | 594364.59 | 509.88 | 38B20100927SAR | 509.86 | 0.01 |
| 5701 | 6831049.68 | 594523.39 | 502.20 | 38B20100927SAR | 502.19 | 0.01 |
| 5702 | 6831080.02 | 594534.54 | 501.89 | 38B20100927SAR | 501.87 | 0.01 |
| 5703 | 6831129.54 | 594552.40 | 501.44 | 38B20100927SAR | 501.40 | 0.04 |
| 5800 | 6793018.52 | 592090.10 | 350.62 | 39B2010092939B | 350.60 | 0.02 |
| 5801 | 6793011.62 | 592085.77 | 351.51 | 39B20100929SGR | 351.42 | 0.09 |
| 5802 | 6792998.44 | 592083.88 | 351.32 | 39B20100929SGR | 351.31 | 0.00 |
| 5803 | 6792979.68 | 592083.48 | 350.98 | 39B20100929SGR | 350.94 | 0.04 |
| 5804 | 6792961.00 | 592099.42 | 350.29 | 39B20100929SGR | 350.26 | 0.03 |
| 5805 | 6792962.66 | 592120.14 | 350.06 | 39B20100929SGR | 350.04 | 0.01 |
| 5806 | 6792965.95 | 592141.93 | 349.51 | 39B20100929SGR | 349.46 | 0.05 |
| 5807 | 6792962.43 | 592161.64 | 347.96 | 39B20100929SGR | 347.89 | 0.07 |
| 5808 | 6792933.64 | 592085.53 | 350.15 | 39B20100929SGR | 350.07 | 0.07 |
| 5809 | 6792914.41 | 592080.99 | 349.89 | 39B20100929SGR | 349.85 | 0.04 |
| 5810 | 6792894.72 | 592079.65 | 349.87 | 39B20100929SAR | 349.83 | 0.04 |
| 5811 | 6792861.27 | 592084.90 | 349.87 | 39B20100929SAR | 349.82 | 0.05 |
| 5813 | 6792119.00 | 591841.50 | 372.34 | 39B20100929SAR | 372.28 | 0.06 |
| 5814 | 6792101.69 | 591826.96 | 373.13 | 39B20100929SAR | 373.01 | 0.12 |
| 5815 | 6792078.90 | 591815.25 | 374.32 | 39B20100929SAR | 374.26 | 0.06 |
| 5816 | 6792068.04 | 591801.42 | 374.82 | 39B20100929SAR | 374.75 | 0.07 |
| 5817 | 6792070.91 | 591798.03 | 374.58 | 39B20100929SAR | 374.50 | 0.08 |
| 5900 | 6778131.21 | 568075.62 | 813.48 | 40B2010092940B | 813.45 | 0.03 |
| 5901 | 6778122.55 | 568072.19 | 814.70 | 40B20100929SAR | 814.67 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 5902 | 6778106.57 | 568078.95 | 815.23 | 40B20100929SAR | 815.19 | 0.03 |
| 5903 | 6778093.31 | 568081.41 | 815.58 | 40B20100929SAR | 815.54 | 0.04 |
| 5905 | 6778083.18 | 568080.95 | 815.52 | 40B20100929SAR | 815.47 | 0.05 |
| 5906 | 6778044.90 | 568109.55 | 816.67 | 40B20100929SAR | 816.64 | 0.03 |
| 5907 | 6778030.68 | 568119.10 | 817.03 | 40B20100929SAR | 817.00 | 0.03 |
| 5908 | 6778005.47 | 568135.88 | 817.60 | 40B20100929SAR | 817.55 | 0.05 |
| 5909 | 6777977.19 | 568153.70 | 817.98 | 40B20100929SAR | 817.98 | 0.00 |
| 5910 | 6777948.43 | 568171.19 | 818.27 | 40B20100929SAR | 818.27 | 0.00 |
| 5911 | 6777909.19 | 568195.03 | 818.41 | 40B20100929SAR | 818.40 | 0.01 |
| 5912 | 6777900.72 | 568187.10 | 817.80 | 40B20100929SAR | 817.79 | 0.01 |
| 5913 | 6777890.39 | 568174.38 | 817.01 | 40B20100929SGR | 817.01 | 0.00 |
| 5914 | 6777864.46 | 568158.95 | 817.92 | 40B20100929SGR | 817.90 | 0.02 |
| 5915 | 6777844.08 | 568154.79 | 819.23 | 40B20100929SGR | 819.23 | 0.00 |
| 5916 | 6777821.02 | 568153.62 | 820.39 | 40B20100929SGR | 820.34 | 0.05 |
| 5917 | 6777788.39 | 568155.98 | 823.07 | 40B20100929SGR | 823.03 | 0.04 |
| 5918 | 6777765.08 | 568156.53 | 826.36 | 40B20100929SGR | 826.30 | 0.06 |
| 5919 | 6777738.90 | 568154.90 | 830.99 | 40B20100929SGR | 830.89 | 0.10 |
| 5920 | 6777709.64 | 568147.79 | 836.93 | 40B20100929SGR | 836.84 | 0.09 |
| 5921 | 6777686.20 | 568136.28 | 841.25 | 40B20100929SGR | 841.19 | 0.06 |
| 5923 | 6777673.21 | 568146.36 | 841.14 | 40B20100929SGR | 841.15 | -0.01 |
| 5924 | 6777688.88 | 568146.15 | 840.54 | 40B20100929SGR | 840.49 | 0.05 |
| 5925 | 6777704.08 | 568149.41 | 837.87 | 40B20100929SGR | 837.80 | 0.07 |
| 5926 | 6778626.11 | 567636.03 | 791.45 | 40B20100929SAR | 791.37 | 0.08 |
| 5927 | 6778643.91 | 567625.19 | 790.56 | 40B20100929SAR | 790.49 | 0.07 |
| 5928 | 6778664.38 | 567613.53 | 789.45 | 40B20100929SAR | 789.38 | 0.07 |
| 5929 | 6778686.08 | 567602.25 | 788.27 | 40B20100929SAR | 788.20 | 0.07 |
| 5930 | 6778717.25 | 567588.22 | 786.53 | 40B20100929SAR | 786.51 | 0.02 |
| 5931 | 6778732.68 | 567581.18 | 785.66 | 40B20100929SAR | 785.62 | 0.04 |
| 5932 | 6779225.36 | 567533.69 | 755.80 | 40B20100929SAR | 755.76 | 0.04 |
| 5933 | 6779224.23 | 567518.03 | 755.37 | 40B20100929SAR | 755.34 | 0.03 |
| 5934 | 6779221.92 | 567501.41 | 754.85 | 40B20100929SAR | 754.84 | 0.01 |
| 5935 | 6779218.09 | 567483.78 | 754.14 | 40B20100929SAR | 754.11 | 0.02 |
| 5936 | 6779216.45 | 567466.11 | 753.48 | 40B20100929SAR | 753.46 | 0.02 |
| 5937 | 6779209.16 | 567450.92 | 752.93 | 40B20100929SAR | 752.92 | 0.01 |
| 5938 | 6779198.92 | 567438.68 | 752.60 | 40B20100929SAR | 752.60 | 0.00 |
| 5939 | 6779186.94 | 567427.38 | 752.56 | 40B20100929SAR | 752.53 | 0.03 |
| 5940 | 6779177.27 | 567413.15 | 752.71 | 40B20100929SGR | 752.70 | 0.01 |
| 5941 | 6779161.25 | 567412.27 | 752.97 | 40B20100929SGR | 752.94 | 0.03 |
| 5942 | 6779149.00 | 567401.83 | 753.39 | 40B20100929SGR | 753.39 | 0.00 |
| 5943 | 6779133.46 | 567388.21 | 754.05 | 40B20100929SGR | 754.03 | 0.02 |
| 5944 | 6779109.92 | 567367.01 | 755.10 | 40B20100929SGR | 755.06 | 0.04 |
| 5945 | 6779084.58 | 567358.35 | 755.24 | 40B20100929SGR | 755.21 | 0.03 |
| 5946 | 6779083.32 | 567366.12 | 755.12 | 40B20100929SGR | 755.10 | 0.02 |
| 5947 | 6777504.33 | 568564.70 | 798.85 | 40B20100929SGR | 798.81 | 0.04 |
| 6005 | 6772362.30 | 534971.00 | 7.09 | 41A20100929SGR | 7.06 | 0.03 |
| 6006 | 6772353.08 | 534954.50 | 7.38 | 41A20100929SGR | 7.36 | 0.02 |
| 6007 | 6772344.17 | 534973.73 | 7.96 | 41A20100929SGR | 7.82 | 0.14 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 6008 | 6772361.18 | 534996.95 | 7.58 | 41A20100929SGR | 7.55 | 0.03 |
| 6009 | 6772374.21 | 535001.91 | 7.00 | 41A20100929SGR | 6.97 | 0.03 |
| 6010 | 6772373.08 | 535015.97 | 7.42 | 41A20100929SGR | 7.37 | 0.05 |
| 6011 | 6772598.41 | 535306.20 | 11.96 | 41A20100929SPR | 11.92 | 0.04 |
| 6012 | 6772596.70 | 535297.74 | 11.86 | 41A20100929SPR | 11.79 | 0.07 |
| 6013 | 6772453.45 | 535616.83 | 14.35 | 41A20100929SPR | 14.28 | 0.07 |
| 6014 | 6772442.30 | 535628.47 | 14.19 | 41A20100929SPR | 14.14 | 0.05 |
| 6015 | 6772431.17 | 535640.13 | 14.07 | 41A20100929SPR | 13.99 | 0.08 |
| 6016 | 6772183.15 | 536036.47 | 8.17 | 41A20100929SPR | 8.12 | 0.04 |
| 6017 | 6772183.39 | 536053.16 | 7.80 | 41A20100929SPR | 7.79 | 0.01 |
| 6018 | 6772184.23 | 536069.90 | 7.50 | 41A20100929SPR | 7.47 | 0.03 |
| 6019 | 6772260.76 | 536655.67 | 5.83 | 41A20100929SPR | 5.80 | 0.03 |
| 6020 | 6772261.60 | 536674.52 | 5.85 | 41A20100929SPR | 5.80 | 0.05 |
| 6021 | 6772262.36 | 536691.43 | 5.85 | 41A20100929SPR | 5.79 | 0.06 |
| 6022 | 6772277.84 | 537147.45 | 6.00 | 41A20100929SPR | 6.01 | -0.01 |
| 6023 | 6772277.76 | 537164.09 | 6.11 | 41A20100929SPR | 6.06 | 0.05 |
| 6024 | 6772277.22 | 537180.51 | 6.12 | 41A20100929SPR | 6.13 | -0.01 |
| 6025 | 6772289.94 | 537287.05 | 6.68 | 41A20100929SPR | 6.67 | 0.01 |
| 6026 | 6772289.14 | 537305.96 | 6.78 | 41A20100929SPR | 6.75 | 0.03 |
| 6027 | 6772287.82 | 537332.30 | 6.89 | 41A20100929SPR | 6.89 | 0.00 |
| 6028 | 6772353.70 | 537642.19 | 6.43 | 41A20100929SPR | 6.39 | 0.04 |
| 6029 | 6772365.02 | 537655.00 | 6.30 | 41A20100929SPR | 6.25 | 0.05 |
| 6030 | 6772376.10 | 537667.68 | 6.15 | 41A20100929SPR | 6.16 | -0.01 |
| 6031 | 6772570.17 | 538159.87 | 5.95 | 41A20100929SPR | 5.87 | 0.08 |
| 6032 | 6772571.11 | 538176.39 | 5.95 | 41A20100929SPR | 5.87 | 0.08 |
| 6033 | 6772571.67 | 538193.25 | 5.90 | 41A20100929SPR | 5.88 | 0.02 |
| 6034 | 6772592.54 | 538822.80 | 6.00 | 41A20100929SPR | 5.97 | 0.03 |
| 6035 | 6772591.57 | 538841.53 | 5.98 | 41A20100929SPR | 5.94 | 0.04 |
| 6036 | 6772589.99 | 538861.16 | 6.00 | 41A20100929SPR | 5.98 | 0.02 |
| 6037 | 6772520.12 | 539304.91 | 5.90 | 41A20100929SPR | 5.86 | 0.04 |
| 6038 | 6772517.38 | 539324.38 | 5.88 | 41A20100929SPR | 5.84 | 0.04 |
| 6039 | 6772514.05 | 539343.63 | 5.86 | 41A20100929SPR | 5.85 | 0.01 |
| 6040 | 6772382.19 | 539875.01 | 6.20 | 41A20100929SPR | 6.15 | 0.05 |
| 6041 | 6772376.22 | 539892.81 | 6.30 | 41A20100929SPR | 6.27 | 0.03 |
| 6042 | 6772369.44 | 539911.66 | 6.38 | 41A20100929SPR | 6.35 | 0.03 |
| 6043 | 6772246.11 | 540410.99 | 8.42 | 41A20100929SPR | 8.40 | 0.02 |
| 6044 | 6772246.55 | 540423.21 | 8.41 | 41A20100929SPR | 8.41 | 0.00 |
| 6045 | 6772246.55 | 540434.24 | 8.43 | 41A20100929SPR | 8.43 | 0.00 |
| 6046 | 6772234.71 | 540854.40 | 8.69 | 41A20100929SPR | 8.68 | 0.01 |
| 6047 | 6772234.99 | 540866.09 | 8.72 | 41A20100929SPR | 8.68 | 0.04 |
| 6048 | 6772234.95 | 540877.79 | 8.68 | 41A20100929SPR | 8.66 | 0.02 |
| 6049 | 6772244.00 | 540884.62 | 8.86 | 41A20100929SPR | 8.80 | 0.06 |
| 6050 | 6772244.19 | 540873.20 | 8.91 | 41A20100929SPR | 8.88 | 0.03 |
| 6051 | 6772244.48 | 540862.04 | 8.92 | 41A20100929SPR | 8.92 | 0.00 |
| 6052 | 6772189.41 | 541648.04 | 9.42 | 41A20100929SPR | 9.40 | 0.02 |
| 6053 | 6772188.23 | 541662.24 | 9.37 | 41A20100929SPR | 9.34 | 0.03 |
| 6054 | 6772186.99 | 541674.79 | 9.36 | 41A20100929SPR | 9.35 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 6055 | 6772330.84 | 542132.77 | 11.57 | 41A20100929SPR | 11.58 | -0.01 |
| 6056 | 6772341.62 | 542126.63 | 11.40 | 41A20100929SPR | 11.37 | 0.03 |
| 6057 | 6772332.85 | 542111.88 | 11.32 | 41A20100929SPR | 11.30 | 0.02 |
| 6058 | 6772323.46 | 542096.59 | 11.22 | 41A20100929SPR | 11.19 | 0.03 |
| 6059 | 6772313.41 | 542103.47 | 11.42 | 41A20100929SPR | 11.44 | -0.02 |
| 6060 | 6772320.28 | 542115.24 | 11.50 | 41A20100929SPR | 11.52 | -0.02 |
| 6061 | 6772582.17 | 542532.34 | 12.55 | 41A20100929SPR | 12.50 | 0.05 |
| 6062 | 6772588.57 | 542541.85 | 12.47 | 41A20100929SPR | 12.43 | 0.04 |
| 6063 | 6772594.39 | 542551.22 | 12.41 | 41A20100929SPR | 12.37 | 0.04 |
| 6064 | 6772989.93 | 543202.95 | 10.17 | 41A20100929SPR | 10.10 | 0.07 |
| 6065 | 6772996.50 | 543198.23 | 10.17 | 41A20100929SPR | 10.14 | 0.03 |
| 6066 | 6773006.08 | 543193.56 | 10.21 | 41A20100929SPR | 10.17 | 0.04 |
| 6067 | 6773014.32 | 543200.99 | 10.33 | 41A20100929SPR | 10.28 | 0.05 |
| 6068 | 6773005.16 | 543208.80 | 10.35 | 41A20100929SPR | 10.33 | 0.02 |
| 6069 | 6772996.71 | 543217.17 | 10.34 | 41A20100929SPR | 10.33 | 0.01 |
| 6070 | 6772985.43 | 543218.34 | 10.29 | 41A20100929SPR | 10.25 | 0.04 |
| 6080 | 6772979.12 | 543208.20 | 9.91 | 41A20100929SPR | 9.90 | 0.01 |
| 6081 | 6772975.84 | 543224.59 | 10.20 | 41A20100929SPR | 10.21 | -0.01 |
| 6082 | 6772925.23 | 543277.40 | 10.38 | 41A20100929SPR | 10.38 | 0.00 |
| 6083 | 6772924.37 | 543278.19 | 10.39 | 41A20100929SPR | 10.41 | -0.02 |
| 6084 | 6772916.66 | 543285.17 | 10.39 | 41A20100929SPR | 10.40 | -0.01 |
| 6085 | 6772903.86 | 543297.08 | 10.45 | 41A20100929SPR | 10.45 | 0.00 |
| 6086 | 6772887.06 | 543312.61 | 10.51 | 41A20100929SPR | 10.52 | -0.01 |
| 6087 | 6772868.59 | 543329.65 | 10.58 | 41A20100929SPR | 10.62 | -0.04 |
| 6088 | 6772848.96 | 543347.55 | 10.67 | 41A20100929SPR | 10.62 | 0.05 |
| 6089 | 6772829.54 | 543365.67 | 10.74 | 41A20100929SPR | 10.73 | 0.01 |
| 6090 | 6772809.72 | 543384.23 | 10.84 | 41A20100929SPR | 10.83 | 0.01 |
| 6091 | 6772788.03 | 543404.30 | 10.89 | 41A20100929SPR | 10.89 | 0.00 |
| 6092 | 6772765.02 | 543425.66 | 10.97 | 41A20100929SPR | 10.94 | 0.03 |
| 6093 | 6772740.61 | 543448.22 | 11.06 | 41A20100929SPR | 11.02 | 0.04 |
| 6094 | 6772715.62 | 543471.61 | 11.15 | 41A20100929SPR | 11.14 | 0.01 |
| 6095 | 6772689.85 | 543495.56 | 11.25 | 41A20100929SPR | 11.23 | 0.02 |
| 6096 | 6772663.57 | 543519.70 | 11.34 | 41A20100929SPR | 11.29 | 0.05 |
| 6097 | 6772639.34 | 543541.89 | 11.52 | 41A20100929SPR | 11.48 | 0.04 |
| 6098 | 6772616.43 | 543562.95 | 11.58 | 41A20100929SPR | 11.55 | 0.03 |
| 6099 | 6772594.55 | 543583.17 | 11.68 | 41A20100929SPR | 11.65 | 0.03 |
| 6100 | 6772572.64 | 543603.57 | 11.75 | 41A20100929SPR | 11.73 | 0.02 |
| 6101 | 6772550.67 | 543623.66 | 11.85 | 41A20100929SPR | 11.82 | 0.03 |
| 6102 | 6772490.24 | 543679.71 | 12.11 | 41A20100929SPR | 12.12 | -0.01 |
| 6103 | 6772479.17 | 543689.78 | 12.19 | 41A20100929SPR | 12.17 | 0.02 |
| 6104 | 6772448.05 | 543718.13 | 12.24 | 41A20100929SPR | 12.26 | -0.02 |
| 6105 | 6772438.80 | 543726.51 | 12.26 | 41A20100929SPR | 12.25 | 0.01 |
| 6106 | 6772427.53 | 543736.80 | 12.29 | 41A20100929SPR | 12.31 | -0.02 |
| 6107 | 6772415.07 | 543748.10 | 12.33 | 41A20100929SPR | 12.31 | 0.01 |
| 6108 | 6772401.81 | 543760.78 | 12.37 | 41A20100929SPR | 12.33 | 0.04 |
| 6109 | 6772387.39 | 543774.33 | 12.40 | 41A20100929SPR | 12.35 | 0.05 |
| 6110 | 6772370.86 | 543789.38 | 12.47 | 41A20100929SPR | 12.47 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 6111 | 6772353.83 | 543805.08 | 12.52 | 41A20100929SPR | 12.52 | 0.00 |
| 6112 | 6772336.06 | 543821.57 | 12.68 | 41A20100929SPR | 12.58 | 0.10 |
| 6113 | 6772317.74 | 543838.46 | 12.66 | 41A20100929SPR | 12.64 | 0.02 |
| 6114 | 6772299.43 | 543855.30 | 12.74 | 41A20100929SPR | 12.73 | 0.01 |
| 6115 | 6772282.54 | 543870.76 | 12.85 | 41A20100929SPR | 12.84 | 0.01 |
| 6116 | 6772266.32 | 543884.42 | 12.91 | 41A20100929SPR | 12.90 | 0.01 |
| 6117 | 6772236.99 | 543911.34 | 13.20 | 41A20100929SPR | 13.20 | 0.00 |
| 6118 | 6772233.58 | 543914.46 | 13.23 | 41A20100929SPR | 13.24 | -0.01 |
| 6119 | 6772222.48 | 543924.78 | 13.36 | 41A20100929SPR | 13.34 | 0.02 |
| 6120 | 6772206.75 | 543939.97 | 13.46 | 41A20100929SPR | 13.42 | 0.04 |
| 6121 | 6772188.83 | 543957.84 | 13.49 | 41A20100929SPR | 13.50 | -0.01 |
| 6122 | 6772171.37 | 543976.10 | 13.58 | 41A20100929SPR | 13.58 | 0.00 |
| 6123 | 6772154.00 | 543995.71 | 13.66 | 41A20100929SPR | 13.68 | -0.02 |
| 6124 | 6772138.01 | 544016.31 | 13.71 | 41A20100929SPR | 13.73 | -0.02 |
| 6125 | 6772122.17 | 544037.40 | 13.76 | 41A20100929SPR | 13.73 | 0.03 |
| 6126 | 6772106.06 | 544059.15 | 13.87 | 41A20100929SPR | 13.85 | 0.02 |
| 6127 | 6772090.43 | 544082.12 | 13.98 | 41A20100929SPR | 13.95 | 0.03 |
| 6128 | 6772075.63 | 544105.83 | 14.04 | 41A20100929SPR | 14.02 | 0.02 |
| 6129 | 6772061.60 | 544130.22 | 14.11 | 41A20100929SPR | 14.11 | 0.00 |
| 6130 | 6772047.48 | 544155.28 | 14.11 | 41A20100929SPR | 14.07 | 0.04 |
| 6131 | 6772032.68 | 544181.58 | 14.16 | 41A20100929SPR | 14.06 | 0.10 |
| 6132 | 6772017.51 | 544208.62 | 14.12 | 41A20100929SPR | 14.12 | 0.00 |
| 6133 | 6772002.64 | 544235.42 | 14.23 | 41A20100929SPR | 14.22 | 0.01 |
| 6134 | 6771987.87 | 544261.83 | 14.30 | 41A20100929SPR | 14.31 | -0.01 |
| 6135 | 6771973.15 | 544288.42 | 14.36 | 41A20100929SPR | 14.34 | 0.02 |
| 6136 | 6771958.44 | 544314.94 | 14.60 | 41A20100929SPR | 14.48 | 0.12 |
| 6137 | 6771931.23 | 544364.00 | 14.63 | 41A20100929SPR | 14.71 | -0.08 |
| 6138 | 6771928.11 | 544369.64 | 14.65 | 41A20100929SPR | 14.68 | -0.03 |
| 6139 | 6771919.71 | 544385.06 | 14.71 | 41A20100929SPR | 14.72 | -0.01 |
| 6140 | 6771909.47 | 544403.84 | 14.79 | 41A20100929SPR | 14.78 | 0.01 |
| 6141 | 6771898.21 | 544424.32 | 14.84 | 41A20100929SPR | 14.82 | 0.02 |
| 6142 | 6771886.59 | 544445.08 | 14.93 | 41A20100929SPR | 14.95 | -0.02 |
| 6143 | 6771874.62 | 544466.70 | 15.07 | 41A20100929SPR | 15.01 | 0.06 |
| 6144 | 6771862.35 | 544488.92 | 15.09 | 41A20100929SPR | 15.11 | -0.02 |
| 6145 | 6771849.85 | 544511.71 | 15.25 | 41A20100929SPR | 15.28 | -0.03 |
| 6146 | 6771836.76 | 544534.87 | 15.46 | 41A20100929SPR | 15.47 | -0.01 |
| 6147 | 6771823.94 | 544558.61 | 15.62 | 41A20100929SPR | 15.65 | -0.03 |
| 6148 | 6771811.91 | 544582.62 | 15.71 | 41A20100929SPR | 15.72 | -0.01 |
| 6149 | 6771800.91 | 544606.22 | 15.82 | 41A20100929SPR | 15.80 | 0.02 |
| 6150 | 6771776.62 | 544665.71 | 15.94 | 41A20100929SPR | 15.97 | -0.03 |
| 6151 | 6771774.04 | 544673.02 | 15.99 | 41A20100929SPR | 15.99 | 0.00 |
| 6152 | 6771768.81 | 544688.80 | 16.05 | 41A20100929SPR | 16.08 | -0.03 |
| 6153 | 6771762.54 | 544709.01 | 16.12 | 41A20100929SPR | 16.16 | -0.04 |
| 6154 | 6771756.39 | 544730.04 | 16.14 | 41A20100929SPR | 16.18 | -0.04 |
| 6155 | 6771751.13 | 544750.22 | 16.21 | 41A20100929SPR | 16.24 | -0.03 |
| 6156 | 6771746.45 | 544769.79 | 16.28 | 41A20100929SPR | 16.32 | -0.04 |
| 6157 | 6771742.19 | 544789.77 | 16.34 | 41A20100929SPR | 16.36 | -0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 6158 | 6771738.22 | 544810.28 | 16.38 | 41A20100929SPR | 16.43 | -0.05 |
| 6159 | 6771734.40 | 544832.96 | 16.47 | 41A20100929SPR | 16.53 | -0.06 |
| 6160 | 6771731.25 | 544856.40 | 16.46 | 41A20100929SPR | 16.51 | -0.05 |
| 6161 | 6771727.71 | 544881.10 | 16.46 | 41A20100929SPR | 16.49 | -0.04 |
| 6162 | 6771724.34 | 544906.63 | 16.45 | 41A20100929SPR | 16.48 | -0.03 |
| 6163 | 6771720.96 | 544932.89 | 16.52 | 41A20100929SPR | 16.59 | -0.07 |
| 6164 | 6771717.44 | 544959.18 | 16.64 | 41A20100929SPR | 16.67 | -0.03 |
| 6165 | 6771714.02 | 544984.95 | 16.75 | 41A20100929SPR | 16.79 | -0.04 |
| 6166 | 6771710.05 | 545009.83 | 16.81 | 41A20100929SPR | 16.78 | 0.03 |
| 6167 | 6771703.15 | 545056.70 | 16.97 | 41A20100929SPR | 17.00 | -0.03 |
| 6168 | 6771700.24 | 545078.36 | 17.03 | 41A20100929SPR | 17.09 | -0.06 |
| 6169 | 6771697.37 | 545103.21 | 17.13 | 41A20100929SPR | 17.15 | -0.02 |
| 6170 | 6771694.65 | 545130.09 | 17.25 | 41A20100929SPR | 17.28 | -0.03 |
| 6171 | 6771691.07 | 545157.66 | 17.34 | 41A20100929SPR | 17.37 | -0.03 |
| 6172 | 6771687.51 | 545183.93 | 17.43 | 41A20100929SPR | 17.47 | -0.04 |
| 6173 | 6771684.01 | 545209.97 | 17.54 | 41A20100929SPR | 17.55 | -0.01 |
| 6174 | 6771680.39 | 545236.66 | 17.59 | 41A20100929SPR | 17.61 | -0.02 |
| 6175 | 6771676.82 | 545263.22 | 17.75 | 41A20100929SPR | 17.74 | 0.01 |
| 6176 | 6771673.20 | 545289.50 | 17.82 | 41A20100929SPR | 17.87 | -0.05 |
| 6177 | 6771669.68 | 545315.36 | 17.90 | 41A20100929SPR | 17.93 | -0.03 |
| 6178 | 6771666.11 | 545341.12 | 18.02 | 41A20100929SPR | 18.05 | -0.03 |
| 6179 | 6771662.50 | 545366.77 | 18.08 | 41A20100929SPR | 18.13 | -0.05 |
| 6180 | 6771658.71 | 545395.47 | 18.22 | 41A20100929SPR | 18.26 | -0.04 |
| 6181 | 6771654.61 | 545425.13 | 18.32 | 41A20100929SPR | 18.36 | -0.04 |
| 6182 | 6771650.90 | 545452.96 | 18.40 | 41A20100929SPR | 18.44 | -0.05 |
| 6183 | 6771647.11 | 545480.69 | 18.50 | 41A20100929SPR | 18.55 | -0.05 |
| 6184 | 6771643.25 | 545508.44 | 18.59 | 41A20100929SPR | 18.64 | -0.05 |
| 6185 | 6771639.51 | 545535.82 | 18.71 | 41A20100929SPR | 18.78 | -0.07 |
| 6186 | 6771635.92 | 545563.07 | 18.76 | 41A20100929SPR | 18.82 | -0.06 |
| 6187 | 6771632.31 | 545590.45 | 18.85 | 41A20100929SPR | 18.89 | -0.04 |
| 6188 | 6771628.56 | 545617.39 | 18.94 | 41A20100929SPR | 18.98 | -0.04 |
| 6189 | 6771624.89 | 545644.44 | 19.01 | 41A20100929SPR | 19.08 | -0.07 |
| 6190 | 6771621.44 | 545670.28 | 19.13 | 41A20100929SPR | 19.15 | -0.02 |
| 6191 | 6771618.13 | 545694.90 | 19.24 | 41A20100929SPR | 19.29 | -0.05 |
| 6192 | 6771614.85 | 545719.60 | 19.30 | 41A20100929SPR | 19.35 | -0.05 |
| 6193 | 6771611.52 | 545744.73 | 19.42 | 41A20100929SPR | 19.47 | -0.05 |
| 6194 | 6771608.27 | 545769.02 | 19.50 | 41A20100929SPR | 19.57 | -0.07 |
| 6195 | 6771604.87 | 545794.59 | 19.59 | 41A20100929SPR | 19.63 | -0.04 |
| 6196 | 6771601.43 | 545821.24 | 19.67 | 41A20100929SPR | 19.72 | -0.05 |
| 6197 | 6771597.59 | 545848.84 | 19.84 | 41A20100929SPR | 19.84 | 0.00 |
| 6198 | 6771593.79 | 545876.51 | 19.85 | 41A20100929SPR | 19.90 | -0.05 |
| 6199 | 6771589.92 | 545903.49 | 19.91 | 41A20100929SPR | 19.95 | -0.04 |
| 6200 | 6771585.91 | 545928.40 | 20.02 | 41A20100929SPR | 20.07 | -0.05 |
| 6201 | 6771582.72 | 545952.18 | 20.22 | 41A20100929SPR | 20.25 | -0.03 |
| 6202 | 6771564.07 | 546055.77 | 20.95 | 41A20100929SPR | 20.99 | -0.04 |
| 6203 | 6771563.55 | 546057.84 | 20.96 | 41A20100929SPR | 20.98 | -0.02 |
| 6204 | 6771559.89 | 546072.40 | 21.06 | 41A20100929SPR | 21.11 | -0.05 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 6205 | 6771553.06 | 546096.53 | 21.23 | 41A20100929SPR | 21.27 | -0.04 |
| 6206 | 6771545.07 | 546121.18 | 21.39 | 41A20100929SPR | 21.41 | -0.02 |
| 6207 | 6771536.87 | 546144.92 | 21.49 | 41A20100929SPR | 21.52 | -0.03 |
| 6208 | 6771528.53 | 546168.70 | 21.67 | 41A20100929SPR | 21.70 | -0.03 |
| 6209 | 6771520.05 | 546192.70 | 21.82 | 41A20100929SPR | 21.86 | -0.04 |
| 6210 | 6771511.33 | 546217.42 | 22.01 | 41A20100929SPR | 22.03 | -0.02 |
| 6211 | 6771502.63 | 546242.91 | 22.18 | 41A20100929SPR | 22.21 | -0.03 |
| 6212 | 6771493.52 | 546269.47 | 22.38 | 41A20100929SPR | 22.37 | 0.01 |
| 6213 | 6771483.66 | 546297.55 | 22.53 | 41A20100929SPR | 22.59 | -0.06 |
| 6214 | 6771473.69 | 546325.39 | 22.76 | 41A20100929SPR | 22.78 | -0.02 |
| 6215 | 6771463.95 | 546353.29 | 22.98 | 41A20100929SPR | 23.04 | -0.06 |
| 6216 | 6771453.97 | 546381.87 | 23.23 | 41A20100929SPR | 23.25 | -0.02 |
| 6217 | 6771443.60 | 546411.40 | 23.45 | 41A20100929SPR | 23.47 | -0.02 |
| 6218 | 6771433.32 | 546440.33 | 23.68 | 41A20100929SPR | 23.73 | -0.05 |
| 6219 | 6771423.64 | 546467.86 | 23.91 | 41A20100929SPR | 23.95 | -0.04 |
| 6220 | 6771414.29 | 546494.34 | 24.11 | 41A20100929SPR | 24.12 | -0.01 |
| 6221 | 6771404.62 | 546521.67 | 24.24 | 41A20100929SPR | 24.27 | -0.03 |
| 6222 | 6771394.45 | 546550.09 | 24.45 | 41A20100929SPR | 24.47 | -0.02 |
| 6223 | 6771384.02 | 546579.35 | 24.69 | 41A20100929SPR | 24.70 | -0.01 |
| 6224 | 6771373.79 | 546608.62 | 24.89 | 41A20100929SPR | 24.92 | -0.03 |
| 6225 | 6771363.74 | 546638.21 | 25.10 | 41A20100929SPR | 25.13 | -0.03 |
| 6226 | 6771353.80 | 546667.66 | 25.39 | 41A20100929SPR | 25.42 | -0.03 |
| 6227 | 6771343.12 | 546698.76 | 25.76 | 41A20100929SPR | 25.77 | -0.01 |
| 6228 | 6771332.64 | 546730.92 | 26.36 | 41A20100929SPR | 26.38 | -0.02 |
| 6229 | 6771324.09 | 546763.04 | 26.69 | 41A20100929SPR | 26.73 | -0.05 |
| 6230 | 6771318.33 | 546795.03 | 26.96 | 41A20100929SPR | 27.00 | -0.04 |
| 6231 | 6771314.52 | 546826.20 | 27.30 | 41A20100929SPR | 27.32 | -0.02 |
| 6232 | 6771313.25 | 546857.98 | 27.53 | 41A20100929SPR | 27.59 | -0.06 |
| 6233 | 6771314.40 | 546890.07 | 27.67 | 41A20100929SPR | 27.69 | -0.02 |
| 6234 | 6771318.05 | 546921.14 | 27.70 | 41A20100929SPR | 27.72 | -0.02 |
| 6235 | 6771323.56 | 546951.33 | 27.65 | 41A20100929SPR | 27.67 | -0.02 |
| 6236 | 6771331.26 | 546981.36 | 27.48 | 41A20100929SPR | 27.48 | 0.00 |
| 6237 | 6771340.96 | 547011.40 | 27.03 | 41A20100929SPR | 27.05 | -0.02 |
| 6238 | 6771352.06 | 547041.87 | 26.52 | 41A20100929SPR | 26.56 | -0.04 |
| 6239 | 6771362.70 | 547071.09 | 26.20 | 41A20100929SPR | 26.22 | -0.02 |
| 6240 | 6771373.95 | 547101.55 | 25.97 | 41A20100929SPR | 25.96 | 0.01 |
| 6241 | 6771385.25 | 547132.56 | 25.94 | 41A20100929SPR | 25.93 | 0.01 |
| 6242 | 6771395.52 | 547162.78 | 26.05 | 41A20100929SPR | 26.07 | -0.02 |
| 6243 | 6771405.00 | 547193.79 | 26.17 | 41A20100929SPR | 26.20 | -0.03 |
| 6244 | 6771413.78 | 547224.99 | 26.44 | 41A20100929SPR | 26.48 | -0.04 |
| 6245 | 6771421.00 | 547255.76 | 26.80 | 41A20100929SPR | 26.83 | -0.03 |
| 6246 | 6771427.28 | 547286.22 | 27.25 | 41A20100929SPR | 27.29 | -0.04 |
| 6247 | 6771432.62 | 547316.33 | 27.71 | 41A20100929SPR | 27.74 | -0.03 |
| 6248 | 6771437.09 | 547346.28 | 28.34 | 41A20100929SPR | 28.36 | -0.02 |
| 6249 | 6771440.37 | 547375.62 | 29.05 | 41A20100929SPR | 29.06 | -0.01 |
| 6250 | 6771442.71 | 547405.56 | 29.76 | 41A20100929SPR | 29.77 | -0.01 |
| 6251 | 6771444.26 | 547433.29 | 30.41 | 41A20100929SPR | 30.42 | -0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 6252 | 6771445.12 | 547460.75 | 30.94 | 41A20100929SPR | 30.97 | -0.03 |
| 6253 | 6771445.02 | 547488.42 | 31.38 | 41A20100929SPR | 31.38 | 0.00 |
| 6254 | 6771444.21 | 547514.22 | 31.75 | 41A20100929SPR | 31.77 | -0.02 |
| 6255 | 6771442.73 | 547541.12 | 32.04 | 41A20100929SPR | 32.04 | 0.00 |
| 6256 | 6771440.52 | 547568.31 | 32.30 | 41A20100929SPR | 32.32 | -0.02 |
| 6257 | 6771437.73 | 547595.46 | 32.45 | 41A20100929SPR | 32.44 | 0.01 |
| 6258 | 6771420.95 | 547688.95 | 32.73 | 41A20100929SPR | 32.74 | -0.02 |
| 6259 | 6771418.77 | 547698.95 | 32.80 | 41A20100929SPR | 32.80 | 0.00 |
| 6260 | 6771413.56 | 547721.24 | 32.88 | 41A20100929SPR | 32.87 | 0.01 |
| 6261 | 6771380.05 | 547825.77 | 33.67 | 41A20100929SPR | 33.65 | 0.02 |
| 6262 | 6771379.96 | 547826.03 | 33.67 | 41A20100929SPR | 33.66 | 0.01 |
| 6263 | 6771375.86 | 547836.67 | 33.80 | 41A20100929SPR | 33.79 | 0.01 |
| 6264 | 6771368.44 | 547856.81 | 34.19 | 41A20100929SPR | 34.17 | 0.02 |
| 6265 | 6771360.80 | 547877.53 | 34.63 | 41A20100929SPR | 34.64 | -0.01 |
| 6266 | 6771353.36 | 547897.71 | 35.21 | 41A20100929SPR | 35.21 | 0.00 |
| 6267 | 6771345.88 | 547918.09 | 35.75 | 41A20100929SPR | 35.77 | -0.02 |
| 6268 | 6771337.76 | 547940.38 | 36.43 | 41A20100929SPR | 36.44 | -0.01 |
| 6269 | 6771328.73 | 547964.50 | 37.15 | 41A20100929SPR | 37.14 | 0.01 |
| 6270 | 6771319.49 | 547989.39 | 37.81 | 41A20100929SPR | 37.84 | -0.03 |
| 6271 | 6771310.15 | 548014.55 | 38.54 | 41A20100929SPR | 38.57 | -0.03 |
| 6272 | 6771300.48 | 548040.71 | 39.11 | 41A20100929SPR | 39.09 | 0.02 |
| 6273 | 6771290.79 | 548068.65 | 39.49 | 41A20100929SPR | 39.52 | -0.03 |
| 6274 | 6771281.40 | 548096.35 | 39.71 | 41A20100929SPR | 39.71 | 0.00 |
| 6275 | 6771273.11 | 548122.81 | 39.77 | 41A20100929SPR | 39.77 | 0.00 |
| 6276 | 6771265.34 | 548148.88 | 39.68 | 41A20100929SPR | 39.69 | -0.01 |
| 6277 | 6771257.99 | 548175.17 | 39.49 | 41A20100929SPR | 39.50 | -0.01 |
| 6278 | 6771251.13 | 548201.49 | 39.07 | 41A20100929SPR | 39.09 | -0.02 |
| 6279 | 6771244.09 | 548229.52 | 38.45 | 41A20100929SPR | 38.42 | 0.03 |
| 6280 | 6771237.01 | 548257.92 | 37.82 | 41A20100929SPR | 37.74 | 0.08 |
| 6281 | 6771229.81 | 548286.15 | 36.93 | 41A20100929SPR | 36.95 | -0.02 |
| 6282 | 6771222.31 | 548315.70 | 35.92 | 41A20100929SPR | 35.94 | -0.02 |
| 6283 | 6771214.87 | 548345.90 | 34.74 | 41A20100929SPR | 34.79 | -0.05 |
| 6284 | 6771207.23 | 548376.32 | 33.51 | 41A20100929SPR | 33.53 | -0.02 |
| 6285 | 6771199.15 | 548408.01 | 32.29 | 41A20100929SPR | 32.31 | -0.02 |
| 6286 | 6771191.15 | 548439.91 | 31.08 | 41A20100929SPR | 31.09 | -0.01 |
| 6287 | 6771182.98 | 548471.63 | 30.11 | 41A20100929SPR | 30.10 | 0.01 |
| 6288 | 6771175.18 | 548503.27 | 29.37 | 41A20100929SPR | 29.38 | -0.01 |
| 6289 | 6771167.20 | 548534.34 | 28.92 | 41A20100929SPR | 28.91 | 0.01 |
| 6290 | 6771159.59 | 548565.21 | 28.66 | 41A20100929SPR | 28.72 | -0.06 |
| 6291 | 6771151.83 | 548596.46 | 28.71 | 41A20100929SPR | 28.74 | -0.03 |
| 6292 | 6771135.96 | 548657.95 | 29.03 | 41A20100929SPR | 29.06 | -0.03 |
| 6293 | 6771132.12 | 548672.92 | 29.09 | 41A20100929SPR | 29.12 | -0.03 |
| 6294 | 6771128.84 | 548686.07 | 29.25 | 41A20100929SPR | 29.21 | 0.04 |
| 6295 | 6771111.12 | 548755.66 | 29.54 | 41A20100929SPR | 29.56 | -0.02 |
| 6296 | 6771109.19 | 548764.65 | 29.61 | 41A20100929SPR | 29.60 | 0.01 |
| 6297 | 6771106.03 | 548777.66 | 29.67 | 41A20100929SPR | 29.63 | 0.04 |
| 6298 | 6771101.84 | 548794.81 | 29.75 | 41A20100929SPR | 29.77 | -0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 6299 | 6771097.53 | 548812.22 | 29.87 | 41A20100929SPR | 29.88 | -0.02 |
| 6300 | 6771092.94 | 548830.56 | 30.03 | 41A20100929SPR | 30.00 | 0.03 |
| 6301 | 6771088.00 | 548849.65 | 30.08 | 41A20100929SPR | 30.09 | -0.02 |
| 6302 | 6771083.06 | 548869.41 | 30.16 | 41A20100929SPR | 30.20 | -0.04 |
| 6303 | 6771077.91 | 548890.22 | 30.28 | 41A20100929SPR | 30.30 | -0.02 |
| 6304 | 6771072.42 | 548912.38 | 30.42 | 41A20100929SPR | 30.42 | 0.00 |
| 6305 | 6771066.02 | 548937.65 | 30.55 | 41A20100929SPR | 30.57 | -0.02 |
| 6306 | 6771059.42 | 548963.89 | 30.66 | 41A20100929SPR | 30.68 | -0.02 |
| 6307 | 6771058.57 | 548967.35 | 30.74 | 41A20100929SPR | 30.73 | 0.00 |
| 6308 | 6771054.66 | 548983.23 | 30.82 | 41A20100929SPR | 30.83 | -0.01 |
| 6309 | 6771049.39 | 549004.40 | 30.94 | 41A20100929SPR | 30.93 | 0.01 |
| 6310 | 6771035.80 | 549058.61 | 31.18 | 41A20100929SPR | 31.25 | -0.07 |
| 6311 | 6771033.81 | 549066.31 | 31.24 | 41A20100929SPR | 31.28 | -0.04 |
| 6312 | 6771029.83 | 549082.06 | 31.31 | 41A20100929SPR | 31.37 | -0.06 |
| 6313 | 6771025.34 | 549099.75 | 31.46 | 41A20100929SPR | 31.46 | 0.00 |
| 6314 | 6771020.52 | 549118.30 | 31.58 | 41A20100929SPR | 31.58 | 0.00 |
| 6315 | 6771015.47 | 549137.36 | 31.68 | 41A20100929SPR | 31.72 | -0.04 |
| 6316 | 6771009.94 | 549157.54 | 31.83 | 41A20100929SPR | 31.76 | 0.07 |
| 6317 | 6771003.93 | 549179.02 | 31.88 | 41A20100929SPR | 31.90 | -0.02 |
| 6318 | 6770997.60 | 549200.87 | 31.98 | 41A20100929SPR | 32.01 | -0.03 |
| 6319 | 6770990.87 | 549223.23 | 32.11 | 41A20100929SPR | 32.16 | -0.05 |
| 6320 | 6770983.56 | 549247.41 | 32.22 | 41A20100929SPR | 32.21 | 0.01 |
| 6321 | 6770975.70 | 549272.83 | 32.41 | 41A20100929SPR | 32.37 | 0.04 |
| 6322 | 6770820.81 | 549729.45 | 36.32 | 41A20100929SPR | 36.34 | -0.02 |
| 6323 | 6770819.39 | 549733.66 | 36.35 | 41A20100929SPR | 36.39 | -0.04 |
| 6324 | 6770815.13 | 549746.06 | 36.49 | 41A20100929SPR | 36.54 | -0.05 |
| 6325 | 6770809.80 | 549761.90 | 36.70 | 41A20100929SPR | 36.72 | -0.02 |
| 6326 | 6770803.71 | 549780.37 | 36.95 | 41A20100929SPR | 36.95 | 0.00 |
| 6327 | 6770797.49 | 549799.64 | 37.25 | 41A20100929SPR | 37.25 | -0.01 |
| 6328 | 6770791.35 | 549820.01 | 37.45 | 41A20100929SPR | 37.47 | -0.02 |
| 6329 | 6770785.74 | 549840.85 | 37.63 | 41A20100929SPR | 37.64 | -0.01 |
| 6330 | 6770780.52 | 549862.78 | 37.86 | 41A20100929SPR | 37.87 | -0.01 |
| 6331 | 6770775.69 | 549885.43 | 38.06 | 41A20100929SPR | 38.08 | -0.02 |
| 6332 | 6770771.21 | 549909.78 | 38.29 | 41A20100929SPR | 38.30 | -0.01 |
| 6333 | 6770767.27 | 549935.66 | 38.43 | 41A20100929SPR | 38.45 | -0.02 |
| 6334 | 6770763.77 | 549962.03 | 38.57 | 41A20100929SPR | 38.59 | -0.02 |
| 6335 | 6770760.31 | 549990.08 | 38.75 | 41A20100929SPR | 38.79 | -0.04 |
| 6336 | 6770756.71 | 550020.12 | 39.04 | 41A20100929SPR | 39.05 | -0.02 |
| 6337 | 6770752.91 | 550051.05 | 39.32 | 41A20100929SPR | 39.34 | -0.03 |
| 6338 | 6770749.13 | 550081.24 | 39.62 | 41A20100929SPR | 39.63 | -0.01 |
| 6339 | 6770745.05 | 550110.63 | 39.88 | 41A20100929SPR | 39.92 | -0.04 |
| 6340 | 6770740.50 | 550140.84 | 40.16 | 41A20100929SPR | 40.18 | -0.02 |
| 6341 | 6770735.06 | 550172.64 | 40.48 | 41A20100929SPR | 40.48 | 0.00 |
| 6342 | 6770729.09 | 550205.13 | 40.78 | 41A20100929SPR | 40.81 | -0.04 |
| 6343 | 6770723.07 | 550236.31 | 41.03 | 41A20100929SPR | 41.07 | -0.04 |
| 6344 | 6770716.83 | 550266.72 | 41.37 | 41A20100929SPR | 41.36 | 0.01 |
| 6345 | 6770709.91 | 550296.94 | 41.60 | 41A20100929SPR | 41.62 | -0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 6346 | 6770695.60 | 550357.35 | 42.16 | 41A20100929SPR | 42.16 | 0.00 |
| 6347 | 6770687.95 | 550388.34 | 42.36 | 41A20100929SPR | 42.37 | -0.01 |
| 6348 | 6770680.70 | 550419.15 | 42.51 | 41A20100929SPR | 42.54 | -0.03 |
| 6349 | 6770673.18 | 550450.05 | 42.65 | 41A20100929SPR | 42.70 | -0.05 |
| 6350 | 6770662.00 | 550492.95 | 42.77 | 41A20100929SPR | 42.79 | -0.02 |
| 6351 | 6770658.73 | 550512.33 | 42.84 | 41A20100929SPR | 42.85 | -0.01 |
| 6352 | 6770653.00 | 550536.96 | 42.83 | 41A20100929SPR | 42.83 | 0.00 |
| 6353 | 6770646.90 | 550562.34 | 42.83 | 41A20100929SPR | 42.86 | -0.03 |
| 6354 | 6770640.72 | 550587.77 | 42.82 | 41A20100929SPR | 42.82 | 0.00 |
| 6355 | 6770634.71 | 550613.74 | 42.78 | 41A20100929SPR | 42.80 | -0.02 |
| 6356 | 6770628.48 | 550639.96 | 42.66 | 41A20100929SPR | 42.67 | -0.01 |
| 6357 | 6770622.26 | 550666.31 | 42.65 | 41A20100929SPR | 42.68 | -0.03 |
| 6358 | 6770615.79 | 550693.35 | 42.65 | 41A20100929SPR | 42.68 | -0.03 |
| 6359 | 6770609.18 | 550721.31 | 42.59 | 41A20100929SPR | 42.62 | -0.03 |
| 6360 | 6770602.52 | 550749.42 | 42.57 | 41A20100929SPR | 42.59 | -0.02 |
| 6361 | 6770595.71 | 550777.57 | 42.60 | 41A20100929SPR | 42.63 | -0.03 |
| 6362 | 6770589.19 | 550806.33 | 42.76 | 41A20100929SPR | 42.77 | -0.02 |
| 6363 | 6770584.03 | 550835.69 | 42.75 | 41A20100929SPR | 42.77 | -0.03 |
| 6364 | 6770580.63 | 550864.43 | 42.69 | 41A20100929SPR | 42.72 | -0.03 |
| 6365 | 6770578.51 | 550892.61 | 42.66 | 41A20100929SPR | 42.67 | -0.01 |
| 6366 | 6770577.59 | 550920.98 | 42.58 | 41A20100929SPR | 42.60 | -0.02 |
| 6367 | 6770578.23 | 550948.27 | 42.54 | 41A20100929SPR | 42.59 | -0.05 |
| 6368 | 6770580.34 | 550975.39 | 42.51 | 41A20100929SPR | 42.55 | -0.04 |
| 6369 | 6770583.70 | 551003.07 | 42.40 | 41A20100929SPR | 42.42 | -0.02 |
| 6370 | 6770587.85 | 551031.93 | 42.21 | 41A20100929SPR | 42.26 | -0.05 |
| 6371 | 6770592.17 | 551059.85 | 42.16 | 41A20100929SPR | 42.22 | -0.06 |
| 6372 | 6770596.30 | 551087.07 | 42.32 | 41A20100929SPR | 42.32 | -0.01 |
| 6373 | 6770608.81 | 551168.17 | 42.41 | 41A20100929SPR | 42.42 | -0.01 |
| 6374 | 6770610.26 | 551177.27 | 42.44 | 41A20100929SPR | 42.48 | -0.04 |
| 6375 | 6770613.34 | 551195.93 | 42.49 | 41A20100929SPR | 42.55 | -0.06 |
| 6376 | 6770616.44 | 551215.79 | 42.58 | 41A20100929SPR | 42.64 | -0.06 |
| 6377 | 6770619.62 | 551236.17 | 42.63 | 41A20100929SPR | 42.68 | -0.05 |
| 6378 | 6770623.10 | 551258.38 | 42.71 | 41A20100929SPR | 42.74 | -0.03 |
| 6379 | 6770626.66 | 551281.70 | 42.76 | 41A20100929SPR | 42.77 | -0.01 |
| 6380 | 6770630.27 | 551305.18 | 42.81 | 41A20100929SPR | 42.88 | -0.07 |
| 6381 | 6770634.11 | 551329.04 | 42.93 | 41A20100929SPR | 42.93 | 0.00 |
| 6382 | 6770637.81 | 551352.78 | 42.94 | 41A20100929SPR | 42.98 | -0.04 |
| 6383 | 6770641.42 | 551375.97 | 43.03 | 41A20100929SPR | 43.04 | -0.01 |
| 6384 | 6770645.06 | 551399.93 | 43.09 | 41A20100929SPR | 43.11 | -0.02 |
| 6385 | 6770648.82 | 551424.85 | 43.17 | 41A20100929SPR | 43.20 | -0.03 |
| 6386 | 6770652.82 | 551450.18 | 43.23 | 41A20100929SPR | 43.26 | -0.03 |
| 6387 | 6770656.86 | 551475.70 | 43.34 | 41A20100929SPR | 43.35 | -0.01 |
| 6388 | 6770660.82 | 551501.41 | 43.42 | 41A20100929SPR | 43.43 | -0.01 |
| 6389 | 6770664.77 | 551527.65 | 43.47 | 41A20100929SPR | 43.50 | -0.03 |
| 6390 | 6770668.60 | 551553.51 | 43.60 | 41A20100929SPR | 43.61 | -0.01 |
| 6391 | 6770680.71 | 551640.33 | 44.20 | 41A20100929SPR | 44.22 | -0.02 |
| 6392 | 6770682.89 | 551651.33 | 44.33 | 41A20100929SPR | 44.34 | -0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 6393 | 6770687.02 | 551672.30 | 44.57 | 41A20100929SPR | 44.58 | -0.01 |
| 6394 | 6770690.89 | 551697.45 | 44.91 | 41A20100929SPR | 44.91 | 0.00 |
| 6395 | 6770694.05 | 551723.53 | 45.24 | 41A20100929SPR | 45.22 | 0.02 |
| 6396 | 6770696.51 | 551750.54 | 45.49 | 41A20100929SPR | 45.52 | -0.03 |
| 6397 | 6770697.81 | 551778.03 | 45.82 | 41A20100929SPR | 45.80 | 0.02 |
| 6398 | 6770698.18 | 551805.86 | 46.12 | 41A20100929SPR | 46.13 | -0.02 |
| 6399 | 6770697.46 | 551834.25 | 46.39 | 41A20100929SPR | 46.37 | 0.02 |
| 6400 | 6770695.58 | 551862.67 | 46.69 | 41A20100929SPR | 46.70 | -0.01 |
| 6401 | 6770692.45 | 551890.86 | 46.99 | 41A20100929SPR | 46.97 | 0.02 |
| 6402 | 6770688.36 | 551918.77 | 47.27 | 41A20100929SPR | 47.21 | 0.05 |
| 6403 | 6770683.38 | 551946.26 | 47.51 | 41A20100929SPR | 47.52 | -0.02 |
| 6404 | 6770676.92 | 551972.91 | 47.74 | 41A20100929SPR | 47.75 | -0.01 |
| 6405 | 6770669.83 | 551998.90 | 48.03 | 41A20100929SPR | 47.95 | 0.08 |
| 6406 | 6770661.58 | 552025.08 | 48.06 | 41A20100929SPR | 48.02 | 0.03 |
| 6407 | 6770652.13 | 552050.97 | 48.15 | 41A20100929SPR | 48.12 | 0.03 |
| 6408 | 6770641.36 | 552076.66 | 48.15 | 41A20100929SPR | 48.10 | 0.05 |
| 6409 | 6770630.15 | 552102.72 | 48.08 | 41A20100929SPR | 48.08 | 0.00 |
| 6410 | 6770618.60 | 552128.63 | 48.16 | 41A20100929SPR | 48.10 | 0.06 |
| 6411 | 6770606.89 | 552154.89 | 48.26 | 41A20100929SPR | 48.13 | 0.13 |
| 6412 | 6770584.72 | 552204.21 | 48.30 | 41A20100929SPR | 48.28 | 0.02 |
| 6413 | 6770582.74 | 552208.64 | 48.29 | 41A20100929SPR | 48.30 | -0.01 |
| 6414 | 6770574.53 | 552225.27 | 47.99 | 41A20100929SPR | 48.34 | -0.36 |
| 6415 | 6770533.73 | 552319.00 | 48.51 | 41A20100929SPR | 48.51 | 0.00 |
| 6416 | 6770532.65 | 552321.45 | 48.52 | 41A20100929SPR | 48.50 | 0.02 |
| 6417 | 6770527.49 | 552333.18 | 48.57 | 41A20100929SPR | 48.53 | 0.04 |
| 6418 | 6770506.00 | 552381.26 | 48.62 | 41A20100929SPR | 48.65 | -0.03 |
| 6419 | 6770503.93 | 552385.83 | 48.63 | 41A20100929SPR | 48.66 | -0.03 |
| 6420 | 6770500.46 | 552394.00 | 48.64 | 41A20100929SPR | 48.66 | -0.02 |
| 6421 | 6770494.65 | 552407.33 | 48.64 | 41A20100929SPR | 48.66 | -0.02 |
| 6422 | 6770487.79 | 552423.03 | 48.68 | 41A20100929SPR | 48.71 | -0.03 |
| 6423 | 6770480.39 | 552439.83 | 48.75 | 41A20100929SPR | 48.77 | -0.02 |
| 6424 | 6770472.75 | 552456.83 | 48.77 | 41A20100929SPR | 48.79 | -0.02 |
| 6425 | 6770464.64 | 552475.00 | 48.81 | 41A20100929SPR | 48.86 | -0.05 |
| 6426 | 6770455.74 | 552495.24 | 48.89 | 41A20100929SPR | 48.91 | -0.02 |
| 6427 | 6770446.13 | 552516.62 | 49.02 | 41A20100929SPR | 48.99 | 0.03 |
| 6428 | 6770414.78 | 552588.83 | 49.13 | 41A20100929SPR | 49.12 | 0.01 |
| 6429 | 6770412.07 | 552596.04 | 49.12 | 41A20100929SPR | 49.13 | -0.01 |
| 6430 | 6770405.65 | 552613.28 | 49.18 | 41A20100929SPR | 49.19 | -0.01 |
| 6431 | 6770397.84 | 552633.30 | 49.35 | 41A20100929SPR | 49.33 | 0.02 |
| 6432 | 6770389.72 | 552654.02 | 49.47 | 41A20100929SPR | 49.46 | 0.01 |
| 6433 | 6770381.59 | 552674.64 | 49.62 | 41A20100929SPR | 49.61 | 0.01 |
| 6434 | 6770373.70 | 552694.94 | 49.83 | 41A20100929SPR | 49.83 | 0.00 |
| 6435 | 6770366.17 | 552715.55 | 50.10 | 41A20100929SPR | 50.05 | 0.05 |
| 6436 | 6770358.40 | 552737.09 | 50.30 | 41A20100929SPR | 50.30 | 0.00 |
| 6437 | 6770350.34 | 552759.97 | 50.57 | 41A20100929SPR | 50.56 | 0.01 |
| 6438 | 6770342.41 | 552783.33 | 50.86 | 41A20100929SPR | 50.86 | 0.00 |
| 6439 | 6770334.41 | 552806.64 | 51.16 | 41A20100929SPR | 51.18 | -0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 6440 | 6770326.59 | 552829.89 | 51.47 | 41A20100929SPR | 51.47 | 0.00 |
| 6441 | 6770318.85 | 552853.66 | 51.75 | 41A20100929SPR | 51.76 | -0.01 |
| 6442 | 6770310.94 | 552878.10 | 52.12 | 41A20100929SPR | 52.07 | 0.05 |
| 6443 | 6770298.10 | 552916.43 | 52.54 | 41A20100929SPR | 52.54 | 0.00 |
| 6444 | 6770296.21 | 552923.07 | 52.59 | 41A20100929SPR | 52.64 | -0.05 |
| 6445 | 6770292.74 | 552938.53 | 52.74 | 41A20100929SPR | 52.75 | -0.01 |
| 8000 | 6935700.74 | 576600.53 | 597.69 | 35A2011060835AFAC | 597.57 | 0.12 |
| 8001 | 6935727.44 | 576589.36 | 598.20 | 35A20110608CK_SPIKE | 598.10 | 0.10 |
| 8002 | 6935713.14 | 576591.57 | 598.08 | 35A20110608CK_SPIKE | 598.00 | 0.08 |
| 8003 | 6935699.98 | 576587.54 | 597.97 | 35A20110608CK_SPIKE | 597.92 | 0.05 |
| 8004 | 6935683.77 | 576589.65 | 597.81 | 35A20110608CK_SPIKE | 597.73 | 0.08 |
| 8005 | 6936391.33 | 576856.63 | 602.81 | 35A20110608SPR | 602.73 | 0.08 |
| 8006 | 6936407.01 | 576861.05 | 602.93 | 35A20110608SPR | 602.81 | 0.12 |
| 8007 | 6936420.88 | 576871.58 | 602.97 | 35A20110608SPR | 602.87 | 0.10 |
| 8008 | 6936433.72 | 576874.71 | 603.10 | 35A20110608SPR | 603.01 | 0.09 |
| 8009 | 6937122.65 | 577207.04 | 608.67 | 35A20110608SPR | 608.60 | 0.07 |
| 8010 | 6937136.85 | 577209.43 | 608.86 | 35A20110608SPR | 608.80 | 0.06 |
| 8011 | 6937148.10 | 577217.15 | 609.06 | 35A20110608SPR | 609.00 | 0.06 |
| 8012 | 6937164.32 | 577220.40 | 609.41 | 35A20110608SPR | 609.32 | 0.09 |
| 8013 | 6937978.58 | 577320.63 | 623.82 | 35A20110608SPR | 623.77 | 0.05 |
| 8014 | 6937985.00 | 577317.36 | 624.09 | 35A20110608SPR | 624.02 | 0.07 |
| 8015 | 6937992.94 | 577320.98 | 624.16 | 35A20110608SPR | 624.09 | 0.07 |
| 8016 | 6937999.33 | 577317.61 | 624.45 | 35A20110608SPR | 624.42 | 0.03 |
| 8017 | 6938025.13 | 577322.48 | 624.85 | 35A20110608SPR | 624.80 | 0.05 |
| 8018 | 6938040.06 | 577322.96 | 625.13 | 35A20110608SPR | 625.00 | 0.13 |
| 8019 | 6938474.41 | 577434.44 | 630.31 | 35A20110608SPR | 630.26 | 0.05 |
| 8020 | 6938486.94 | 577435.93 | 630.39 | 35A20110608SPR | 630.28 | 0.11 |
| 8021 | 6938498.27 | 577444.04 | 630.54 | 35A20110608SPR | 630.40 | 0.14 |
| 8022 | 6938512.08 | 577445.92 | 630.52 | 35A20110608SPR | 630.44 | 0.08 |
| 8023 | 6939344.44 | 577681.05 | 644.21 | 35A20110608SPR | 644.12 | 0.09 |
| 8024 | 6939359.17 | 577686.04 | 644.55 | 35A20110608SPR | 644.43 | 0.12 |
| 8025 | 6939370.03 | 577696.25 | 644.86 | 35A20110608SPR | 644.78 | 0.08 |
| 8026 | 6939386.13 | 577702.45 | 645.27 | 35A20110608SPR | 645.17 | 0.10 |
| 8027 | 6939940.76 | 578043.95 | 666.73 | 35A20110608SPR | 666.67 | 0.06 |
| 8028 | 6939951.33 | 578050.77 | 667.17 | 35A20110608SPR | 667.08 | 0.09 |
| 8029 | 6939967.15 | 578056.21 | 667.76 | 35A20110608SPR | 667.64 | 0.12 |
| 8030 | 6939977.29 | 578066.14 | 668.15 | 35A20110608SPR | 668.06 | 0.09 |
| 8031 | 6939969.76 | 578036.70 | 666.53 | 35A20110608Y61 | 666.37 | 0.16 |
| 8036 | 6935266.89 | 576560.72 | 597.04 | 35A20110608SPR | 596.97 | 0.07 |
| 8037 | 6935249.08 | 576559.19 | 597.08 | 35A20110608SPR | 597.00 | 0.08 |
| 8038 | 6935229.50 | 576553.39 | 596.91 | 35A20110608SPR | 596.82 | 0.09 |
| 8039 | 6935212.09 | 576554.51 | 597.08 | 35A20110608SPR | 597.02 | 0.06 |
| 8040 | 6935399.81 | 575688.74 | 588.83 | 35A20110608SGR | 588.76 | 0.07 |
| 8041 | 6935386.59 | 575699.94 | 589.49 | 35A20110608SGR | 589.44 | 0.05 |
| 8042 | 6935370.51 | 575713.54 | 590.30 | 35A20110608SGR | 590.29 | 0.01 |
| 8043 | 6935357.82 | 575724.03 | 590.96 | 35A20110608SGR | 590.93 | 0.03 |
| 8044 | 6934994.41 | 576025.94 | 595.38 | 35A20110608SGR | 595.33 | 0.05 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 8045 | 6934983.73 | 576038.54 | 595.47 | 35A20110608SGR | 595.40 | 0.07 |
| 8046 | 6934970.52 | 576054.91 | 595.39 | 35A20110608SGR | 595.37 | 0.02 |
| 8047 | 6934880.35 | 576424.35 | 595.27 | 35A20110608SGR | 595.19 | 0.08 |
| 8048 | 6934868.26 | 576414.61 | 595.41 | 35A20110608SGR | 595.33 | 0.08 |
| 8049 | 6934854.32 | 576411.59 | 595.44 | 35A20110608SGR | 595.40 | 0.04 |
| 8050 | 6934844.70 | 576403.00 | 595.40 | 35A20110608SGR | 595.33 | 0.06 |
| 8051 | 6933712.78 | 575937.47 | 568.23 | 35A20110608BOAT | 568.17 | 0.06 |
| 8052 | 6933712.78 | 575937.46 | 568.22 | 35A20110608BOAT_RAMP | 568.17 | 0.05 |
| 8053 | 6933715.32 | 575934.03 | 568.15 | 35A20110608BOAT_RAMP | 568.06 | 0.09 |
| 8054 | 6933709.55 | 575929.78 | 567.47 | 35A20110608BOAT_RAMP | 567.37 | 0.10 |
| 8055 | 6933706.97 | 575933.26 | 567.54 | 35A20110608BOAT_RAMP | 567.46 | 0.08 |
| 8056 | 6933754.13 | 575999.47 | 570.45 | 35A20110608SGR | 570.40 | 0.05 |
| 8057 | 6933755.23 | 576009.83 | 570.68 | 35A20110608SGR | 570.63 | 0.05 |
| 8058 | 6933756.65 | 576021.28 | 570.88 | 35A20110608SGR | 570.83 | 0.05 |
| 8059 | 6933805.77 | 576424.24 | 578.36 | 35A20110608SPR | 578.29 | 0.07 |
| 8060 | 6933822.58 | 576424.23 | 577.93 | 35A20110608SPR | 577.87 | 0.06 |
| 8061 | 6933835.87 | 576417.72 | 577.69 | 35A20110608SPR | 577.61 | 0.08 |
| 8062 | 6933852.00 | 576417.42 | 577.29 | 35A20110608SPR | 577.22 | 0.07 |
| 8063 | 6932920.52 | 576381.22 | 600.02 | 35A2011060835B | 600.07 | -0.05 |
| 8064 | 6932941.58 | 576395.99 | 600.30 | 35A20110608SPR | 600.24 | 0.06 |
| 8065 | 6932926.11 | 576398.16 | 600.34 | 35A20110608SPR | 600.27 | 0.07 |
| 8066 | 6932912.46 | 576393.18 | 600.52 | 35A20110608SPR | 600.47 | 0.05 |
| 8067 | 6932899.21 | 576395.76 | 600.41 | 35A20110608SPR | 600.32 | 0.09 |
| 8068 | 6932086.71 | 576712.88 | 599.92 | 35A20110608SPR | 599.82 | 0.10 |
| 8069 | 6932074.75 | 576723.81 | 600.02 | 35A20110608SPR | 599.95 | 0.07 |
| 8070 | 6932060.49 | 576727.45 | 600.06 | 35A20110608SPR | 599.95 | 0.10 |
| 8071 | 6932049.97 | 576737.19 | 600.10 | 35A20110608SPR | 599.95 | 0.14 |
| 8072 | 6931299.63 | 577196.15 | 601.40 | 35A20110608SPR | 601.32 | 0.08 |
| 8073 | 6931318.01 | 577193.53 | 601.22 | 35A20110608SPR | 601.13 | 0.09 |
| 8074 | 6931335.37 | 577183.22 | 601.22 | 35A20110608SPR | 601.10 | 0.12 |
| 8075 | 6931350.59 | 577181.79 | 601.13 | 35A20110608SPR | 601.03 | 0.10 |
| 8076 | 6935700.45 | 576603.56 | 597.51 | 35A20110608CK_SPIKE | 597.40 | 0.11 |
| 8077 | 6935700.44 | 576603.60 | 597.51 | 35A20110608CK_SPIKE | 597.40 | 0.11 |
| 8100 | 6907374.20 | 585465.02 | 500.59 | 36A2011060836AFAC | 500.57 | 0.02 |
| 8101 | 6907362.27 | 585437.14 | 501.12 | 36A20110608SPR | 501.07 | 0.05 |
| 8102 | 6907393.48 | 585437.77 | 501.06 | 36A20110608SPR | 501.02 | 0.04 |
| 8103 | 6907427.57 | 585437.69 | 500.85 | 36A20110608SPR | 500.83 | 0.02 |
| 8104 | 6907469.19 | 585437.59 | 500.81 | 36A20110608SPR | 500.79 | 0.01 |
| 8105 | 6907492.07 | 585433.59 | 500.71 | 36A20110608SPR | 500.69 | 0.02 |
| 8106 | 6906745.42 | 585046.05 | 499.70 | 36A20110608SPR | 499.67 | 0.03 |
| 8107 | 6906727.95 | 585028.76 | 499.48 | 36A20110608SPR | 499.41 | 0.06 |
| 8108 | 6906712.29 | 585012.93 | 499.23 | 36A20110608SPR | 499.16 | 0.07 |
| 8109 | 6906049.59 | 584605.16 | 472.26 | 36A20110608SPR | 472.23 | 0.03 |
| 8110 | 6906030.52 | 584597.08 | 471.13 | 36A20110608SPR | 471.10 | 0.03 |
| 8111 | 6906014.57 | 584590.38 | 470.11 | 36A20110608SPR | 470.11 | 0.00 |
| 8137 | 6908651.79 | 585481.14 | 487.92 | 36A20110608SPR | 487.87 | 0.05 |
| 8138 | 6908666.83 | 585481.69 | 488.50 | 36A20110608SPR | 488.46 | 0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 8139 | 6908681.28 | 585482.34 | 488.99 | 36A20110608SPR | 488.94 | 0.05 |
| 8140 | 6909400.15 | 585606.31 | 504.62 | 36A20110608SPR | 504.61 | 0.01 |
| 8141 | 6909417.06 | 585610.79 | 504.80 | 36A20110608SPR | 504.78 | 0.02 |
| 8142 | 6909427.70 | 585620.29 | 504.87 | 36A20110608SPR | 504.88 | -0.01 |
| 8143 | 6909834.48 | 585830.46 | 508.45 | 36A20110608SPR | 508.40 | 0.05 |
| 8144 | 6909853.94 | 585837.86 | 508.75 | 36A20110608SPR | 508.74 | 0.01 |
| 8145 | 6909872.72 | 585844.32 | 509.04 | 36A20110608SPR | 509.02 | 0.02 |
| 8146 | 6910512.91 | 585559.71 | 509.46 | 36A20110608SPR | 509.43 | 0.02 |
| 8147 | 6910528.82 | 585547.66 | 509.33 | 36A20110608SPR | 509.28 | 0.05 |
| 8148 | 6910537.94 | 585533.07 | 509.54 | 36A20110608SPR | 509.50 | 0.04 |
| 8149 | 6911144.24 | 585358.02 | 508.75 | 36A20110608SPR | 508.71 | 0.04 |
| 8150 | 6911166.97 | 585357.04 | 509.04 | 36A20110608SPR | 509.02 | 0.02 |
| 8151 | 6911186.86 | 585348.39 | 508.96 | 36A20110608SPR | 508.91 | 0.05 |
| 8152 | 6911938.82 | 585113.09 | 510.64 | 36A20110608SPR | 510.60 | 0.04 |
| 8153 | 6911952.95 | 585112.80 | 510.53 | 36A20110608SPR | 510.50 | 0.03 |
| 8154 | 6911967.33 | 585108.10 | 510.45 | 36A20110608SPR | 510.41 | 0.04 |
| 8155 | 6911976.95 | 585101.13 | 510.36 | 36A20110608SPR | 510.33 | 0.03 |
| 8156 | 6912417.60 | 584858.91 | 507.26 | 36A20110608SPR | 507.21 | 0.05 |
| 8157 | 6912430.44 | 584846.04 | 508.11 | 36A20110608SPR | 508.06 | 0.05 |
| 8158 | 6912443.70 | 584842.13 | 508.36 | 36A20110608SPR | 508.36 | 0.00 |
| 8159 | 6912449.40 | 584834.25 | 508.86 | 36A20110608SPR | 508.83 | 0.03 |
| 8160 | 6913107.40 | 584574.52 | 517.03 | 36A20110608SPR | 517.01 | 0.02 |
| 8161 | 6913124.37 | 584574.87 | 516.96 | 36A20110608SPR | 516.95 | 0.01 |
| 8162 | 6913136.12 | 584569.00 | 517.28 | 36A20110608SPR | 517.27 | 0.01 |
| 8163 | 6913153.34 | 584566.45 | 517.46 | 36A20110608SPR | 517.43 | 0.03 |
| 8164 | 6913995.83 | 584578.28 | 536.39 | 36A20110608SPR | 536.39 | 0.00 |
| 8165 | 6914011.29 | 584575.04 | 536.98 | 36A20110608SPR | 536.97 | 0.01 |
| 8166 | 6914026.45 | 584578.84 | 537.50 | 36A20110608SPR | 537.46 | 0.04 |
| 8167 | 6914041.18 | 584575.70 | 537.88 | 36A20110608SPR | 537.87 | 0.01 |
| 8168 | 6914590.75 | 584390.20 | 542.27 | 36A20110608SPR | 542.25 | 0.02 |
| 8169 | 6914602.02 | 584380.61 | 542.26 | 36A20110608SPR | 542.23 | 0.03 |
| 8170 | 6914617.88 | 584375.98 | 541.85 | 36A20110608SPR | 541.83 | 0.01 |
| 8171 | 6914629.89 | 584366.81 | 541.82 | 36A20110608SPR | 541.77 | 0.05 |
| 8172 | 6915411.30 | 584209.14 | 536.22 | 36A20110608SPR | 536.14 | 0.08 |
| 8173 | 6915428.64 | 584201.96 | 536.32 | 36A20110608SPR | 536.23 | 0.09 |
| 8174 | 6915445.91 | 584202.66 | 536.38 | 36A20110608SPR | 536.33 | 0.05 |
| 8175 | 6915461.65 | 584195.91 | 536.46 | 36A20110608SPR | 536.37 | 0.09 |
| 8176 | 6916160.31 | 584423.89 | 542.24 | 36A20110608SPR | 542.18 | 0.06 |
| 8177 | 6916175.20 | 584430.42 | 542.30 | 36A20110608SPR | 542.22 | 0.08 |
| 8178 | 6916185.52 | 584441.58 | 542.53 | 36A20110608SPR | 542.46 | 0.07 |
| 8179 | 6916206.84 | 584452.73 | 542.65 | 36A20110608SPR | 542.58 | 0.07 |
| 8180 | 6916854.82 | 584603.92 | 547.37 | 36A20110608SPR | 547.32 | 0.05 |
| 8181 | 6916872.79 | 584606.47 | 547.54 | 36A20110608SPR | 547.48 | 0.06 |
| 8182 | 6916890.41 | 584615.23 | 547.51 | 36A20110608SPR | 547.45 | 0.06 |
| 8183 | 6916904.95 | 584619.70 | 547.56 | 36A20110608SPR | 547.51 | 0.05 |
| 8184 | 6917598.98 | 584790.24 | 550.65 | 36A20110608SPR | 550.57 | 0.08 |
| 8185 | 6917616.07 | 584785.28 | 550.52 | 36A20110608SPR | 550.46 | 0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 8186 | 6917632.51 | 584786.62 | 550.57 | 36A20110608SPR | 550.54 | 0.03 |
| 8187 | 6917650.77 | 584780.85 | 550.43 | 36A20110608SPR | 550.39 | 0.04 |
| 8188 | 6918191.05 | 584630.42 | 549.61 | 36A20110608SPR | 549.56 | 0.05 |
| 8189 | 6918181.09 | 584629.05 | 549.70 | 36A20110608SPR | 549.61 | 0.09 |
| 8190 | 6907374.23 | 585461.96 | 500.66 | 36A20110608CK_SPIKE | 500.62 | 0.04 |
| 8191 | 6907374.21 | 585461.97 | 500.66 | 36A20110608CK_SPIKE | 500.62 | 0.04 |
| 8400 | 6868247.99 | 588774.14 | 394.03 | 37A2011061037AFAC | 394.00 | 0.03 |
| 8401 | 6868705.39 | 588764.36 | 379.44 | 37A20110610SPR | 379.43 | 0.00 |
| 8402 | 6868718.27 | 588763.64 | 378.78 | 37A20110610SPR | 378.77 | 0.01 |
| 8403 | 6868730.85 | 588763.07 | 378.09 | 37A20110610SPR | 378.08 | 0.01 |
| 8404 | 6868721.26 | 588759.38 | 378.63 | 37A20110610SPR | 378.60 | 0.03 |
| 8405 | 6869154.04 | 588704.01 | 360.10 | 37A20110610SPR | 360.09 | 0.01 |
| 8406 | 6869168.12 | 588700.52 | 359.56 | 37A20110610SPR | 359.54 | 0.02 |
| 8407 | 6869178.43 | 588702.95 | 359.32 | 37A20110610SPR | 359.28 | 0.04 |
| 8408 | 6869158.74 | 588709.27 | 360.15 | 37A20110610SPR | 360.11 | 0.04 |
| 8409 | 6869844.76 | 588251.61 | 328.09 | 37A20110610SPR | 328.05 | 0.04 |
| 8410 | 6869851.41 | 588236.31 | 327.63 | 37A20110610SPR | 327.62 | 0.01 |
| 8411 | 6869870.19 | 588230.04 | 327.54 | 37A20110610SPR | 327.55 | -0.01 |
| 8412 | 6869856.44 | 588246.21 | 327.87 | 37A20110610SPR | 327.86 | 0.01 |
| 8413 | 6869856.44 | 588246.23 | 327.86 | 37A20110610SPR | 327.86 | 0.00 |
| 8414 | 6870317.65 | 587851.12 | 326.27 | 37A20110610SPR | 326.22 | 0.04 |
| 8415 | 6870304.64 | 587862.22 | 325.90 | 37A20110610SPR | 325.87 | 0.03 |
| 8416 | 6870301.32 | 587869.70 | 325.80 | 37A20110610SPR | 325.78 | 0.02 |
| 8417 | 6870314.85 | 587858.64 | 326.10 | 37A20110610SPR | 326.08 | 0.02 |
| 8418 | 6870839.27 | 587393.88 | 346.59 | 37A20110610SPR | 346.55 | 0.04 |
| 8419 | 6870850.44 | 587403.91 | 346.60 | 37A20110610SPR | 346.58 | 0.02 |
| 8420 | 6870850.45 | 587403.91 | 346.60 | 37A20110610SPR | 346.58 | 0.02 |
| 8421 | 6870846.31 | 587411.73 | 346.28 | 37A20110610SPR | 346.25 | 0.03 |
| 8422 | 6870836.65 | 587414.42 | 346.08 | 37A20110610SPR | 346.04 | 0.04 |
| 8423 | 6870841.40 | 587404.25 | 346.45 | 37A20110610SPR | 346.40 | 0.05 |
| 8424 | 6870357.68 | 587504.02 | 351.91 | 37A20110610SPR | 351.88 | 0.03 |
| 8425 | 6870343.68 | 587499.89 | 351.91 | 37A20110610SPR | 351.89 | 0.02 |
| 8426 | 6870333.19 | 587488.44 | 352.00 | 37A20110610SPR | 351.99 | 0.01 |
| 8427 | 6870319.87 | 587484.77 | 352.30 | 37A20110610SPR | 352.29 | 0.01 |
| 8428 | 6870496.45 | 586774.90 | 404.54 | 37A20110610SPR | 404.51 | 0.03 |
| 8429 | 6870488.06 | 586781.33 | 404.70 | 37A20110610SPR | 404.68 | 0.02 |
| 8430 | 6870477.60 | 586789.47 | 404.83 | 37A20110610SPR | 404.79 | 0.04 |
| 8431 | 6870500.25 | 586791.24 | 404.08 | 37A20110610SPR | 404.05 | 0.03 |
| 8432 | 6870199.90 | 586986.71 | 404.33 | 37A20110610SPR | 404.30 | 0.03 |
| 8433 | 6870199.20 | 587005.46 | 404.20 | 37A20110610SPR | 404.13 | 0.07 |
| 8434 | 6870214.65 | 587001.22 | 404.35 | 37A20110610SPR | 404.30 | 0.05 |
| 8435 | 6871421.52 | 587070.89 | 356.29 | 37A20110610SPR | 356.26 | 0.03 |
| 8436 | 6871434.54 | 587058.86 | 356.22 | 37A20110610SPR | 356.17 | 0.05 |
| 8437 | 6871464.65 | 587042.09 | 356.13 | 37A20110610SPR | 356.09 | 0.04 |
| 8438 | 6871447.74 | 587055.61 | 356.20 | 37A20110610SPR | 356.16 | 0.04 |
| 8439 | 6872085.99 | 586727.44 | 358.27 | 37A20110610SPR | 358.25 | 0.02 |
| 8440 | 6872099.52 | 586718.74 | 358.40 | 37A20110610SPR | 358.38 | 0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 8441 | 6872117.63 | 586716.09 | 358.36 | 37A20110610SPR | 358.34 | 0.02 |
| 8442 | 6872130.67 | 586708.08 | 358.44 | 37A20110610SPR | 358.41 | 0.03 |
| 8443 | 6872748.69 | 586508.43 | 361.17 | 37A20110610SPR | 361.15 | 0.02 |
| 8444 | 6872757.47 | 586501.72 | 361.33 | 37A20110610SPR | 361.30 | 0.03 |
| 8445 | 6872780.89 | 586497.91 | 361.61 | 37A20110610SPR | 361.60 | 0.01 |
| 8446 | 6872802.47 | 586486.68 | 361.92 | 37A20110610SPR | 361.88 | 0.04 |
| 8447 | 6873557.36 | 586241.55 | 364.70 | 37A20110610SPR | 364.68 | 0.02 |
| 8448 | 6873569.57 | 586233.76 | 364.70 | 37A20110610SPR | 364.69 | 0.01 |
| 8449 | 6873584.47 | 586232.78 | 364.73 | 37A20110610SPR | 364.69 | 0.04 |
| 8450 | 6873601.92 | 586223.09 | 364.78 | 37A20110610SPR | 364.76 | 0.02 |
| 8451 | 6874322.97 | 586046.79 | 368.76 | 37A20110610SPR | 368.74 | 0.02 |
| 8452 | 6874308.37 | 586051.33 | 368.35 | 37A20110610SPR | 368.32 | 0.03 |
| 8453 | 6874293.05 | 586049.22 | 368.08 | 37A20110610SPR | 368.05 | 0.03 |
| 8454 | 6874278.04 | 586053.77 | 367.71 | 37A20110610SPR | 367.68 | 0.03 |
| 8455 | 6874958.84 | 586032.25 | 379.66 | 37A20110610SPR | 379.62 | 0.04 |
| 8456 | 6874973.35 | 586027.90 | 379.73 | 37A20110610SPR | 379.69 | 0.04 |
| 8457 | 6874989.15 | 586031.10 | 379.83 | 37A20110610SPR | 379.77 | 0.06 |
| 8458 | 6875010.62 | 586027.41 | 379.87 | 37A20110610SPR | 379.82 | 0.05 |
| 8459 | 6875829.32 | 586005.05 | 382.45 | 37A20110610SPR | 382.41 | 0.04 |
| 8460 | 6875846.68 | 585996.96 | 382.26 | 37A20110610SPR | 382.24 | 0.02 |
| 8461 | 6875862.35 | 586007.93 | 382.57 | 37A20110610SPR | 382.53 | 0.04 |
| 8462 | 6875847.09 | 586018.64 | 382.31 | 37A20110610SPR | 382.28 | 0.03 |
| 8463 | 6876473.14 | 585988.30 | 383.82 | 37A20110610SPR | 383.80 | 0.02 |
| 8464 | 6876487.89 | 585982.60 | 383.68 | 37A20110610SPR | 383.68 | 0.00 |
| 8465 | 6876503.06 | 585984.11 | 384.01 | 37A20110610SPR | 383.98 | 0.03 |
| 8466 | 6876516.53 | 585977.97 | 384.03 | 37A20110610SPR | 384.03 | 0.00 |
| 8467 | 6877006.09 | 585681.39 | 396.23 | 37A20110610SPR | 396.22 | 0.01 |
| 8468 | 6877018.55 | 585665.11 | 396.19 | 37A20110610SPR | 396.18 | 0.01 |
| 8469 | 6877024.36 | 585649.82 | 396.08 | 37A20110610SPR | 396.10 | -0.02 |
| 8470 | 6877038.89 | 585638.95 | 396.09 | 37A20110610SPR | 396.09 | 0.00 |
| 8471 | 6876786.80 | 585993.49 | 389.16 | 37A20110610SPR | 389.14 | 0.02 |
| 8472 | 6876792.86 | 585977.70 | 389.55 | 37A20110610SPR | 389.54 | 0.01 |
| 8473 | 6876795.14 | 585963.82 | 389.78 | 37A20110610SPR | 389.79 | -0.01 |
| 8474 | 6876785.67 | 585987.01 | 389.24 | 37A20110610SPR | 389.23 | 0.01 |
| 8494 | 6872183.27 | 588150.29 | 316.40 | 37A20110610SPR | 316.35 | 0.05 |
| 8495 | 6872166.87 | 588155.50 | 316.42 | 37A20110610SPR | 316.39 | 0.03 |
| 8496 | 6872153.63 | 588154.00 | 316.36 | 37A20110610SPR | 316.32 | 0.04 |
| 8497 | 6872141.15 | 588158.62 | 316.41 | 37A20110610SPR | 316.38 | 0.03 |
| 8498 | 6871265.45 | 588623.59 | 319.89 | 37A20110610SPR | 319.88 | 0.01 |
| 8499 | 6871259.78 | 588638.25 | 319.72 | 37A20110610SPR | 319.67 | 0.05 |
| 8500 | 6871249.11 | 588648.96 | 319.66 | 37A20110610SPR | 319.64 | 0.02 |
| 8501 | 6871243.62 | 588663.52 | 319.50 | 37A20110610SPR | 319.47 | 0.03 |
| 8502 | 6870935.70 | 589089.59 | 316.03 | 37A20110610SPR | 315.98 | 0.05 |
| 8503 | 6870950.28 | 589080.67 | 316.11 | 37A20110610SPR | 316.09 | 0.02 |
| 8504 | 6870955.80 | 589082.12 | 316.17 | 37A20110610SPR | 316.14 | 0.03 |
| 8505 | 6870927.88 | 589088.91 | 315.98 | 37A20110610SPR | 315.95 | 0.03 |
| 8506 | 6870355.94 | 589432.16 | 312.13 | 37A20110610SPR | 312.08 | 0.05 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 8507 | 6870346.91 | 589443.73 | 311.97 | 37A20110610SPR | 311.90 | 0.07 |
| 8508 | 6870333.42 | 589452.02 | 311.88 | 37A20110610SPR | 311.83 | 0.05 |
| 8509 | 6870325.23 | 589463.14 | 311.68 | 37A20110610SPR | 311.65 | 0.03 |
| 8510 | 6870193.36 | 589479.16 | 310.57 | 37A20110610SPR | 310.59 | -0.02 |
| 8511 | 6870195.17 | 589495.77 | 310.43 | 37A20110610SPR | 310.43 | 0.00 |
| 8512 | 6870206.01 | 589494.23 | 310.34 | 37A20110610SPR | 310.33 | 0.01 |
| 8513 | 6870191.74 | 588939.62 | 313.92 | 37A20110610SPR | 313.89 | 0.03 |
| 8514 | 6870192.40 | 588920.78 | 314.12 | 37A20110610SPR | 314.10 | 0.02 |
| 8515 | 6870193.49 | 588902.98 | 314.45 | 37A20110610SPR | 314.43 | 0.02 |
| 8516 | 6870206.82 | 588915.01 | 314.31 | 37A20110610SPR | 314.29 | 0.01 |
| 8517 | 6870220.52 | 588924.71 | 314.53 | 37A20110610SPR | 314.50 | 0.03 |
| 8518 | 6869653.75 | 588706.29 | 331.02 | 37A20110610SPR | 331.02 | 0.00 |
| 8519 | 6869639.21 | 588703.62 | 331.89 | 37A20110610SPR | 331.88 | 0.01 |
| 8520 | 6869622.78 | 588708.42 | 332.88 | 37A20110610SPR | 332.85 | 0.03 |
| 8521 | 6869608.79 | 588705.38 | 333.74 | 37A20110610SPR | 333.72 | 0.02 |
| 8522 | 6868239.73 | 588788.64 | 394.87 | 37A20110610SPR | 394.87 | 0.00 |
| 8523 | 6868224.72 | 588793.44 | 395.00 | 37A20110610SPR | 394.98 | 0.02 |
| 8524 | 6868206.64 | 588790.44 | 395.07 | 37A20110610SPR | 395.07 | 0.00 |
| 8525 | 6868184.88 | 588795.88 | 395.15 | 37A20110610SPR | 395.13 | 0.02 |
| 8526 | 6867517.58 | 588930.67 | 396.79 | 37A20110610SPR | 396.76 | 0.03 |
| 8527 | 6867497.69 | 588942.03 | 396.97 | 37A20110610SPR | 396.96 | 0.01 |
| 8528 | 6867481.36 | 588944.53 | 397.02 | 37A20110610SPR | 396.97 | 0.05 |
| 8529 | 6867461.47 | 588955.86 | 397.05 | 37A20110610SPR | 397.03 | 0.02 |
| 8530 | 6867461.44 | 588955.84 | 397.05 | 37A20110610SPR | 397.03 | 0.02 |
| 8531 | 6866780.00 | 589190.32 | 406.05 | 37A20110610SPR | 406.02 | 0.03 |
| 8532 | 6866765.45 | 589197.22 | 406.51 | 37A20110610SPR | 406.50 | 0.01 |
| 8533 | 6866749.99 | 589197.20 | 406.90 | 37A20110610SPR | 406.80 | 0.10 |
| 8534 | 6866735.13 | 589204.14 | 407.36 | 37A20110610SPR | 407.32 | 0.04 |
| 8535 | 6865926.93 | 589457.52 | 422.03 | 37A20110610SPR | 422.00 | 0.03 |
| 8536 | 6865915.14 | 589470.20 | 421.84 | 37A20110610SPR | 421.81 | 0.03 |
| 8537 | 6865900.28 | 589475.65 | 421.86 | 37A20110610SPR | 421.84 | 0.02 |
| 8538 | 6865891.24 | 589486.81 | 421.83 | 37A20110610SPR | 421.81 | 0.02 |
| 8539 | 6865516.57 | 589855.25 | 418.94 | 37A20110610SPR | 418.92 | 0.02 |
| 8540 | 6865501.10 | 589866.82 | 418.81 | 37A20110610SPR | 418.81 | 0.00 |
| 8541 | 6865492.52 | 589881.53 | 418.76 | 37A20110610SPR | 418.76 | 0.00 |
| 8542 | 6865479.98 | 589889.77 | 418.71 | 37A20110610SPR | 418.71 | 0.00 |
| 8543 | 6865917.18 | 589682.71 | 416.76 | 37A20110610SPR | 416.76 | 0.00 |
| 8544 | 6865928.90 | 589673.82 | 416.80 | 37A20110610SPR | 416.78 | 0.02 |
| 8545 | 6865939.54 | 589665.44 | 416.95 | 37A20110610SPR | 416.95 | 0.00 |
| 8546 | 6865952.60 | 589654.46 | 417.06 | 37A20110610SPR | 417.04 | 0.02 |
| 8547 | 6864867.48 | 590340.12 | 418.07 | 37A20110610SPR | 418.03 | 0.04 |
| 8548 | 6864856.40 | 590350.25 | 418.21 | 37A20110610SPR | 418.20 | 0.01 |
| 8549 | 6864841.07 | 590353.90 | 418.18 | 37A20110610SPR | 418.16 | 0.02 |
| 8550 | 6864822.66 | 590367.65 | 418.35 | 37A20110610SPR | 418.32 | 0.03 |
| 8551 | 6864084.60 | 590672.30 | 422.12 | 37A20110610SPR | 422.11 | 0.01 |
| 8552 | 6864073.01 | 590680.95 | 422.28 | 37A20110610SPR | 422.26 | 0.02 |
| 8553 | 6864056.96 | 590683.22 | 422.38 | 37A20110610SPR | 422.37 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 8554 | 6864038.75 | 590694.29 | 422.58 | 37A20110610SPR | 422.56 | 0.02 |
| 8555 | 6863140.66 | 591042.35 | 423.14 | 37A20110610SPR | 423.11 | 0.03 |
| 8556 | 6863127.44 | 591051.47 | 423.11 | 37A20110610SPR | 423.08 | 0.03 |
| 8557 | 6863110.82 | 591054.34 | 423.25 | 37A20110610SPR | 423.22 | 0.03 |
| 8558 | 6863098.37 | 591063.10 | 423.20 | 37A20110610SPR | 423.18 | 0.02 |
| 8559 | 6862101.34 | 591470.40 | 430.25 | 37A20110610SPR | 430.23 | 0.02 |
| 8560 | 6862111.99 | 591470.19 | 430.21 | 37A20110610SPR | 430.21 | 0.00 |
| 8561 | 6862125.28 | 591460.26 | 430.13 | 37A20110610SPR | 430.12 | 0.01 |
| 8562 | 6862141.67 | 591457.31 | 430.10 | 37A20110610SPR | 430.10 | 0.00 |
| 8563 | 6861502.52 | 591713.31 | 435.23 | 37A20110610SPR | 435.22 | 0.01 |
| 8564 | 6861489.95 | 591722.14 | 435.35 | 37A20110610SPR | 435.31 | 0.04 |
| 8565 | 6861475.69 | 591724.32 | 435.39 | 37A20110610SPR | 435.37 | 0.02 |
| 8566 | 6861461.32 | 591733.65 | 435.47 | 37A20110610SPR | 435.46 | 0.01 |
| 8567 | 6860776.30 | 591999.48 | 437.60 | 37A20110610SPR | 437.57 | 0.03 |
| 8568 | 6860765.69 | 592007.75 | 437.68 | 37A20110610SPR | 437.62 | 0.06 |
| 8569 | 6860744.56 | 592012.37 | 437.70 | 37A20110610SPR | 437.69 | 0.01 |
| 8570 | 6867060.36 | 589088.10 | 399.60 | 37A2011061037B | 399.57 | 0.03 |
| 8571 | 6868248.83 | 588771.97 | 394.03 | 37A20110610CK_ROCK | 394.00 | 0.03 |
| 8572 | 6868248.83 | 588771.96 | 394.03 | 37A20110610CK_ROCK | 394.00 | 0.03 |
| 13500 | 6831309.28 | 594605.17 | 499.38 | 38A2011071538AFAC | 499.36 | 0.02 |
| 13501 | 6831313.12 | 594613.31 | 499.82 | 38A20110715SPR | 499.77 | 0.05 |
| 13502 | 6831335.17 | 594627.56 | 499.59 | 38A20110715SPR | 499.52 | 0.07 |
| 13503 | 6831349.66 | 594632.64 | 499.48 | 38A20110715SPR | 499.41 | 0.07 |
| 13504 | 6831363.69 | 594637.23 | 499.38 | 38A20110715SPR | 499.33 | 0.05 |
| 13505 | 6831377.21 | 594642.16 | 499.22 | 38A20110715SPR | 499.16 | 0.06 |
| 13506 | 6831391.00 | 594646.90 | 499.06 | 38A20110715SPR | 498.99 | 0.06 |
| 13507 | 6831409.71 | 594653.88 | 498.86 | 38A20110715SPR | 498.81 | 0.05 |
| 13508 | 6832510.85 | 594884.02 | 491.70 | 38A20110715SPR | 491.68 | 0.02 |
| 13509 | 6832526.12 | 594885.61 | 491.61 | 38A20110715SPR | 491.57 | 0.04 |
| 13510 | 6832542.12 | 594886.68 | 491.52 | 38A20110715SPR | 491.47 | 0.05 |
| 13511 | 6832556.63 | 594888.23 | 491.40 | 38A20110715SPR | 491.36 | 0.04 |
| 13512 | 6832571.45 | 594888.87 | 491.35 | 38A20110715SPR | 491.31 | 0.04 |
| 13513 | 6832585.71 | 594890.26 | 491.23 | 38A20110715SPR | 491.18 | 0.05 |
| 13514 | 6832599.99 | 594891.58 | 491.09 | 38A20110715SPR | 491.04 | 0.05 |
| 13515 | 6833530.74 | 595048.30 | 484.42 | 38A20110715SPR | 484.37 | 0.05 |
| 13516 | 6833546.43 | 595058.77 | 484.33 | 38A20110715SPR | 484.26 | 0.07 |
| 13517 | 6833560.22 | 595063.31 | 484.23 | 38A20110715SPR | 484.16 | 0.07 |
| 13518 | 6833574.15 | 595067.88 | 484.11 | 38A20110715SPR | 484.06 | 0.05 |
| 13519 | 6833588.66 | 595072.46 | 484.01 | 38A20110715SPR | 483.96 | 0.05 |
| 13520 | 6833602.60 | 595076.79 | 483.92 | 38A20110715SPR | 483.87 | 0.05 |
| 13521 | 6833619.93 | 595082.70 | 483.80 | 38A20110715SPR | 483.76 | 0.04 |
| 13522 | 6833634.63 | 595087.21 | 483.69 | 38A20110715SPR | 483.66 | 0.03 |
| 13523 | 6834683.54 | 595495.95 | 476.68 | 38A20110715SPR | 476.64 | 0.04 |
| 13524 | 6834705.43 | 595504.98 | 476.50 | 38A20110715SPR | 476.46 | 0.04 |
| 13525 | 6834722.60 | 595507.46 | 476.34 | 38A20110715SPR | 476.29 | 0.05 |
| 13526 | 6834737.33 | 595510.11 | 476.21 | 38A20110715SPR | 476.15 | 0.06 |
| 13527 | 6834753.86 | 595512.53 | 476.09 | 38A20110715SPR | 476.04 | 0.05 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13528 | 6834767.88 | 595514.84 | 476.02 | 38A20110715SPR | 475.97 | 0.05 |
| 13529 | 6830488.05 | 593982.62 | 509.12 | 38A20110715SGR | 509.08 | 0.04 |
| 13530 | 6830499.39 | 593974.87 | 508.56 | 38A20110715SGR | 508.50 | 0.06 |
| 13531 | 6830511.79 | 593970.21 | 507.98 | 38A20110715SGR | 507.92 | 0.06 |
| 13532 | 6830526.61 | 593969.54 | 507.44 | 38A20110715SGR | 507.38 | 0.06 |
| 13533 | 6830540.72 | 593971.88 | 507.03 | 38A20110715SGR | 506.97 | 0.05 |
| 13534 | 6830554.95 | 593973.79 | 506.97 | 38A20110715SGR | 506.93 | 0.04 |
| 13535 | 6830569.80 | 593972.75 | 506.68 | 38A20110715SGR | 506.66 | 0.02 |
| 13536 | 6830583.17 | 593969.28 | 506.17 | 38A20110715SGR | 506.12 | 0.05 |
| 13537 | 6830596.36 | 593963.39 | 506.05 | 38A20110715SGR | 505.99 | 0.06 |
| 13538 | 6830608.83 | 593956.39 | 506.09 | 38A20110715SGR | 506.06 | 0.03 |
| 13539 | 6830620.70 | 593948.51 | 505.91 | 38A20110715SGR | 505.88 | 0.03 |
| 13540 | 6830628.82 | 593942.50 | 505.45 | 38A20110715SGR | 505.44 | 0.01 |
| 13541 | 6830307.61 | 594029.73 | 507.54 | 38A20110715SGR | 507.50 | 0.04 |
| 13542 | 6830248.12 | 594014.62 | 509.04 | 38A20110715SGR | 508.98 | 0.06 |
| 13543 | 6830184.33 | 593997.48 | 509.45 | 38A20110715SGR | 509.41 | 0.04 |
| 13544 | 6830068.04 | 593966.14 | 511.51 | 38A20110715SGR | 511.45 | 0.06 |
| 13545 | 6829998.99 | 593948.91 | 512.72 | 38A20110715SGR | 512.65 | 0.07 |
| 13546 | 6829950.53 | 593946.83 | 513.11 | 38A20110715SGR | 513.13 | -0.02 |
| 13547 | 6829996.25 | 593999.93 | 511.91 | 38A20110715SGR | 511.83 | 0.08 |
| 13548 | 6830054.40 | 594050.05 | 511.26 | 38A20110715SGR | 511.21 | 0.05 |
| 13549 | 6830123.48 | 594136.66 | 512.88 | 38A20110715SGR | 512.82 | 0.05 |
| 13550 | 6830213.42 | 594215.01 | 512.40 | 38A20110715SGR | 512.36 | 0.04 |
| 13551 | 6830265.71 | 594263.87 | 510.37 | 38A20110715SGR | 510.33 | 0.04 |
| 13552 | 6830288.06 | 594321.33 | 510.03 | 38A20110715SGR | 510.00 | 0.03 |
| 13553 | 6830278.68 | 594367.94 | 509.19 | 38A20110715SGR | 509.16 | 0.03 |
| 13554 | 6830161.06 | 594344.27 | 509.99 | 38A20110715SGR | 509.96 | 0.03 |
| 13555 | 6830132.73 | 594341.74 | 510.48 | 38A20110715SGR | 510.45 | 0.03 |
| 13556 | 6830101.82 | 594338.80 | 511.12 | 38A20110715SPR | 511.07 | 0.05 |
| 13557 | 6830069.12 | 594336.97 | 512.24 | 38A20110715SPR | 512.18 | 0.06 |
| 13558 | 6830028.45 | 594349.73 | 514.42 | 38A20110715SPR | 514.37 | 0.05 |
| 13559 | 6829566.79 | 594319.27 | 522.46 | 38A20110715SPR | 522.41 | 0.05 |
| 13560 | 6829553.04 | 594316.98 | 522.62 | 38A20110715SPR | 522.61 | 0.01 |
| 13561 | 6829536.86 | 594314.62 | 522.85 | 38A20110715SPR | 522.79 | 0.06 |
| 13562 | 6829518.64 | 594311.32 | 523.04 | 38A20110715SPR | 523.00 | 0.04 |
| 13563 | 6829504.72 | 594308.50 | 523.22 | 38A20110715SPR | 523.18 | 0.04 |
| 13564 | 6829491.17 | 594305.06 | 523.36 | 38A20110715SPR | 523.33 | 0.03 |
| 13565 | 6829477.67 | 594301.96 | 523.50 | 38A20110715SPR | 523.47 | 0.03 |
| 13566 | 6829463.96 | 594298.02 | 523.61 | 38A20110715SPR | 523.58 | 0.03 |
| 13567 | 6829450.46 | 594294.54 | 523.79 | 38A20110715SPR | 523.75 | 0.04 |
| 13568 | 6829436.17 | 594290.27 | 523.93 | 38A20110715SPR | 523.88 | 0.05 |
| 13569 | 6829421.96 | 594286.68 | 524.03 | 38A20110715SPR | 523.98 | 0.05 |
| 13570 | 6831307.84 | 594608.98 | 499.86 | 38A20110715CHECK | 499.80 | 0.06 |
| 13571 | 6831307.84 | 594608.98 | 499.86 | 38A20110715CHECK | 499.80 | 0.06 |
| 13600 | 6796266.11 | 592537.02 | 360.60 | 39A2011071039AFAC | 360.55 | 0.05 |
| 13601 | 6796261.15 | 592559.56 | 361.64 | 39A20110710SPR | 361.56 | 0.08 |
| 13602 | 6796259.60 | 592550.44 | 361.67 | 39A20110710SPR | 361.64 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13603 | 6796257.73 | 592536.18 | 361.01 | 39A20110710SPR | 360.96 | 0.05 |
| 13604 | 6796256.34 | 592522.77 | 360.48 | 39A20110710SPR | 360.41 | 0.07 |
| 13605 | 6796254.13 | 592508.69 | 359.88 | 39A20110710SPR | 359.82 | 0.06 |
| 13606 | 6796252.11 | 592494.41 | 359.26 | 39A20110710SPR | 359.19 | 0.06 |
| 13607 | 6796250.48 | 592480.63 | 358.60 | 39A20110710SPR | 358.53 | 0.07 |
| 13608 | 6796249.39 | 592465.95 | 358.02 | 39A20110710SPR | 357.95 | 0.07 |
| 13609 | 6796249.81 | 592452.54 | 357.61 | 39A20110710SPR | 357.55 | 0.06 |
| 13610 | 6796257.49 | 592440.77 | 357.14 | 39A20110710SPR | 357.07 | 0.07 |
| 13611 | 6796274.58 | 592440.49 | 356.70 | 39A20110710SPR | 356.64 | 0.06 |
| 13612 | 6796288.41 | 592438.82 | 356.48 | 39A20110710SPR | 356.43 | 0.05 |
| 13613 | 6796302.58 | 592436.76 | 356.26 | 39A20110710SPR | 356.19 | 0.07 |
| 13614 | 6796317.34 | 592433.99 | 356.22 | 39A20110710SPR | 356.12 | 0.09 |
| 13615 | 6796332.14 | 592435.29 | 356.23 | 39A20110710SPR | 356.15 | 0.08 |
| 13616 | 6796341.63 | 592447.28 | 356.64 | 39A20110710SPR | 356.62 | 0.02 |
| 13617 | 6796345.12 | 592461.56 | 357.17 | 39A20110710SPR | 357.12 | 0.05 |
| 13618 | 6796346.23 | 592475.97 | 357.68 | 39A20110710SPR | 357.62 | 0.06 |
| 13619 | 6796346.66 | 592492.37 | 358.26 | 39A20110710SPR | 358.21 | 0.05 |
| 13620 | 6796347.66 | 592508.23 | 359.02 | 39A20110710SPR | 358.95 | 0.07 |
| 13621 | 6796348.91 | 592523.92 | 359.78 | 39A20110710SPR | 359.73 | 0.05 |
| 13622 | 6796350.50 | 592540.18 | 361.08 | 39A20110710SPR | 361.05 | 0.03 |
| 13623 | 6796354.05 | 592549.69 | 361.04 | 39A20110710SPR | 361.00 | 0.04 |
| 13624 | 6796374.41 | 592540.25 | 361.00 | 39A20110710SPR | 360.94 | 0.06 |
| 13625 | 6796392.77 | 592538.25 | 360.81 | 39A20110710SPR | 360.76 | 0.05 |
| 13626 | 6796407.37 | 592536.72 | 360.75 | 39A20110710SPR | 360.69 | 0.06 |
| 13627 | 6796422.73 | 592535.18 | 360.65 | 39A20110710SPR | 360.59 | 0.06 |
| 13628 | 6796438.50 | 592533.57 | 360.52 | 39A20110710SPR | 360.46 | 0.06 |
| 13629 | 6796452.90 | 592532.08 | 360.37 | 39A20110710SPR | 360.30 | 0.07 |
| 13630 | 6796467.15 | 592530.65 | 360.31 | 39A20110710SPR | 360.26 | 0.05 |
| 13631 | 6797827.04 | 592384.37 | 367.53 | 39A20110710SPR | 367.48 | 0.05 |
| 13632 | 6797812.99 | 592387.64 | 367.25 | 39A20110710SPR | 367.15 | 0.10 |
| 13633 | 6797798.95 | 592391.24 | 366.90 | 39A20110710SPR | 366.84 | 0.06 |
| 13634 | 6797782.30 | 592394.51 | 366.52 | 39A20110710SPR | 366.46 | 0.06 |
| 13635 | 6797768.16 | 592397.82 | 366.20 | 39A20110710SPR | 366.15 | 0.05 |
| 13636 | 6797754.36 | 592400.51 | 365.89 | 39A20110710SPR | 365.84 | 0.05 |
| 13637 | 6797737.36 | 592403.81 | 365.47 | 39A20110710SPR | 365.42 | 0.05 |
| 13638 | 6797718.63 | 592406.91 | 365.04 | 39A20110710SPR | 364.99 | 0.05 |
| 13639 | 6797705.25 | 592408.79 | 364.73 | 39A20110710SPR | 364.68 | 0.05 |
| 13640 | 6797691.90 | 592410.72 | 364.46 | 39A20110710SPR | 364.41 | 0.05 |
| 13641 | 6797186.83 | 592462.75 | 358.64 | 39A20110710SPR | 358.61 | 0.03 |
| 13642 | 6797202.38 | 592460.99 | 358.68 | 39A20110710SPR | 358.62 | 0.06 |
| 13643 | 6797215.50 | 592454.29 | 358.65 | 39A20110710SPR | 358.55 | 0.10 |
| 13644 | 6797235.25 | 592452.38 | 358.72 | 39A20110710SPR | 358.68 | 0.04 |
| 13645 | 6797250.78 | 592451.29 | 358.76 | 39A20110710SPR | 358.69 | 0.07 |
| 13646 | 6797270.35 | 592454.25 | 358.87 | 39A20110710SPR | 358.82 | 0.05 |
| 13647 | 6797285.61 | 592452.69 | 358.91 | 39A20110710SPR | 358.82 | 0.08 |
| 13648 | 6797300.53 | 592450.82 | 359.01 | 39A20110710SPR | 358.93 | 0.08 |
| 13649 | 6797315.32 | 592449.54 | 359.01 | 39A20110710SPR | 358.94 | 0.07 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13650 | 6797330.27 | 592448.11 | 359.06 | 39A20110710SPR | 359.02 | 0.04 |
| 13651 | 6799084.55 | 591414.86 | 372.57 | 39A20110710SPR | 372.54 | 0.03 |
| 13652 | 6799075.52 | 591426.25 | 372.33 | 39A20110710SPR | 372.27 | 0.06 |
| 13653 | 6799066.77 | 591437.57 | 372.10 | 39A20110710SPR | 372.05 | 0.05 |
| 13654 | 6799056.90 | 591451.13 | 371.78 | 39A20110710SPR | 371.73 | 0.05 |
| 13655 | 6799045.55 | 591465.29 | 371.46 | 39A20110710SPR | 371.41 | 0.05 |
| 13656 | 6799036.42 | 591476.52 | 371.31 | 39A20110710SPR | 371.22 | 0.09 |
| 13657 | 6799027.80 | 591487.84 | 371.13 | 39A20110710SPR | 371.06 | 0.07 |
| 13658 | 6799008.49 | 591512.31 | 370.72 | 39A20110710SPR | 370.69 | 0.03 |
| 13659 | 6798999.32 | 591523.83 | 370.52 | 39A20110710SPR | 370.45 | 0.07 |
| 13660 | 6798990.29 | 591535.81 | 370.29 | 39A20110710SPR | 370.25 | 0.04 |
| 13661 | 6799731.71 | 590584.30 | 378.81 | 39A20110710SPR | 378.75 | 0.06 |
| 13662 | 6799715.80 | 590604.98 | 378.61 | 39A20110710SPR | 378.56 | 0.05 |
| 13663 | 6799705.52 | 590617.78 | 378.54 | 39A20110710SPR | 378.46 | 0.08 |
| 13664 | 6799695.43 | 590630.51 | 378.45 | 39A20110710SPR | 378.41 | 0.04 |
| 13665 | 6799688.51 | 590643.18 | 378.38 | 39A20110710SPR | 378.31 | 0.06 |
| 13666 | 6799667.94 | 590657.40 | 378.30 | 39A20110710SPR | 378.24 | 0.06 |
| 13667 | 6799657.46 | 590679.08 | 378.25 | 39A20110710SPR | 378.22 | 0.03 |
| 13668 | 6799647.80 | 590691.82 | 378.19 | 39A20110710SPR | 378.15 | 0.04 |
| 13669 | 6799639.47 | 590702.54 | 378.18 | 39A20110710SPR | 378.13 | 0.05 |
| 13670 | 6799630.06 | 590714.30 | 378.17 | 39A20110710SPR | 378.11 | 0.06 |
| 13671 | 6794794.02 | 592447.78 | 346.95 | 39A20110710SPR | 346.92 | 0.03 |
| 13672 | 6794809.51 | 592450.59 | 346.87 | 39A20110710SPR | 346.86 | 0.01 |
| 13673 | 6794823.38 | 592454.66 | 346.79 | 39A20110710SPR | 346.77 | 0.02 |
| 13674 | 6794837.00 | 592458.32 | 346.69 | 39A20110710SPR | 346.67 | 0.02 |
| 13675 | 6794850.18 | 592463.86 | 346.60 | 39A20110710SPR | 346.54 | 0.06 |
| 13676 | 6794864.05 | 592467.54 | 346.44 | 39A20110710SPR | 346.42 | 0.02 |
| 13677 | 6794878.05 | 592471.38 | 346.24 | 39A20110710SPR | 346.23 | 0.01 |
| 13678 | 6794891.39 | 592474.72 | 346.02 | 39A20110710SPR | 346.01 | 0.01 |
| 13679 | 6794899.69 | 592477.55 | 345.89 | 39A20110710SPR | 345.88 | 0.01 |
| 13680 | 6794914.95 | 592482.36 | 345.64 | 39A20110710SPR | 345.64 | 0.00 |
| 13681 | 6793712.54 | 592048.65 | 359.45 | 39A20110710SPR | 359.42 | 0.03 |
| 13682 | 6793727.83 | 592052.33 | 359.20 | 39A20110710SPR | 359.17 | 0.03 |
| 13683 | 6793742.23 | 592055.70 | 359.01 | 39A20110710SPR | 359.02 | -0.01 |
| 13684 | 6793755.13 | 592058.83 | 358.78 | 39A20110710SPR | 358.77 | 0.01 |
| 13685 | 6793768.63 | 592062.77 | 358.54 | 39A20110710SPR | 358.54 | 0.00 |
| 13686 | 6793782.36 | 592066.68 | 358.25 | 39A20110710SPR | 358.25 | 0.00 |
| 13687 | 6793796.12 | 592070.51 | 357.99 | 39A20110710SPR | 357.99 | 0.00 |
| 13688 | 6793812.67 | 592075.53 | 357.70 | 39A20110710SPR | 357.68 | 0.02 |
| 13689 | 6793826.56 | 592079.92 | 357.41 | 39A20110710SPR | 357.39 | 0.02 |
| 13690 | 6793842.84 | 592085.39 | 357.01 | 39A20110710SPR | 357.00 | 0.01 |
| 13691 | 6796262.03 | 592537.27 | 360.98 | 39A20110710CHECK | 360.89 | 0.09 |
| 13700 | 6793018.32 | 592090.19 | 350.62 | 39B2011071239BFAC | 350.59 | 0.03 |
| 13701 | 6793015.74 | 592057.26 | 352.26 | 39B20110712SPR | 352.20 | 0.06 |
| 13702 | 6793031.18 | 592054.84 | 352.62 | 39B20110712SPR | 352.56 | 0.06 |
| 13703 | 6793047.70 | 592052.43 | 353.03 | 39B20110712SPR | 352.96 | 0.06 |
| 13704 | 6793062.50 | 592050.12 | 353.35 | 39B20110712SPR | 353.31 | 0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13705 | 6793077.80 | 592047.72 | 353.78 | 39B20110712SPR | 353.72 | 0.05 |
| 13706 | 6793092.74 | 592045.75 | 354.14 | 39B20110712SPR | 354.10 | 0.04 |
| 13707 | 6793111.12 | 592042.63 | 354.48 | 39B20110712SPR | 354.44 | 0.04 |
| 13708 | 6793126.66 | 592040.39 | 354.76 | 39B20110712SPR | 354.70 | 0.06 |
| 13709 | 6793141.93 | 592037.94 | 354.99 | 39B20110712SPR | 354.95 | 0.04 |
| 13710 | 6793156.09 | 592035.99 | 355.23 | 39B20110712SPR | 355.18 | 0.05 |
| 13711 | 6791945.35 | 591596.05 | 383.17 | 39B20110712SPR | 383.13 | 0.04 |
| 13712 | 6791941.53 | 591581.26 | 383.56 | 39B20110712SPR | 383.50 | 0.06 |
| 13713 | 6791937.43 | 591566.98 | 383.99 | 39B20110712SPR | 383.90 | 0.09 |
| 13714 | 6791933.43 | 591551.65 | 384.42 | 39B20110712SPR | 384.33 | 0.09 |
| 13715 | 6791929.82 | 591536.65 | 384.83 | 39B20110712SPR | 384.75 | 0.08 |
| 13716 | 6791929.84 | 591518.66 | 385.40 | 39B20110712SPR | 385.32 | 0.08 |
| 13717 | 6791926.48 | 591504.08 | 385.85 | 39B20110712SPR | 385.80 | 0.05 |
| 13718 | 6791922.45 | 591489.17 | 386.31 | 39B20110712SPR | 386.24 | 0.07 |
| 13719 | 6791918.43 | 591474.14 | 386.74 | 39B20110712SPR | 386.67 | 0.07 |
| 13720 | 6791914.33 | 591458.08 | 387.15 | 39B20110712SPR | 387.09 | 0.06 |
| 13721 | 6791784.44 | 591163.54 | 387.88 | 39B20110712SPR | 387.82 | 0.06 |
| 13722 | 6791775.04 | 591148.22 | 387.45 | 39B20110712SPR | 387.37 | 0.08 |
| 13723 | 6791761.80 | 591133.77 | 387.00 | 39B20110712SPR | 386.91 | 0.09 |
| 13724 | 6791753.80 | 591121.19 | 386.60 | 39B20110712SPR | 386.54 | 0.06 |
| 13725 | 6791746.11 | 591108.53 | 386.21 | 39B20110712SPR | 386.16 | 0.05 |
| 13726 | 6791738.25 | 591095.79 | 385.79 | 39B20110712SPR | 385.71 | 0.08 |
| 13727 | 6791730.77 | 591083.07 | 385.33 | 39B20110712SPR | 385.23 | 0.10 |
| 13728 | 6791722.85 | 591070.54 | 384.85 | 39B20110712SPR | 384.74 | 0.11 |
| 13729 | 6791715.16 | 591057.66 | 384.30 | 39B20110712SPR | 384.25 | 0.05 |
| 13730 | 6791707.56 | 591044.95 | 383.73 | 39B20110712SPR | 383.65 | 0.08 |
| 13731 | 6791552.81 | 590144.98 | 367.62 | 39B20110712SPR | 367.56 | 0.06 |
| 13732 | 6791551.60 | 590129.90 | 367.64 | 39B20110712SPR | 367.57 | 0.07 |
| 13733 | 6791551.01 | 590115.38 | 367.73 | 39B20110712SPR | 367.68 | 0.05 |
| 13734 | 6791550.24 | 590100.03 | 367.85 | 39B20110712SPR | 367.82 | 0.03 |
| 13735 | 6791549.33 | 590085.43 | 367.92 | 39B20110712SPR | 367.88 | 0.04 |
| 13736 | 6791548.50 | 590070.68 | 368.00 | 39B20110712SPR | 367.96 | 0.04 |
| 13737 | 6791546.62 | 590049.91 | 368.12 | 39B20110712SPR | 368.10 | 0.02 |
| 13738 | 6791545.69 | 590033.23 | 368.21 | 39B20110712SPR | 368.15 | 0.06 |
| 13739 | 6791544.70 | 590018.31 | 368.31 | 39B20110712SPR | 368.26 | 0.05 |
| 13740 | 6791543.74 | 589999.78 | 368.42 | 39B20110712SPR | 368.36 | 0.06 |
| 13741 | 6791327.28 | 589337.93 | 372.49 | 39B20110712SPR | 372.45 | 0.04 |
| 13742 | 6791309.90 | 589320.07 | 372.64 | 39B20110712SPR | 372.61 | 0.03 |
| 13743 | 6791300.60 | 589309.73 | 372.68 | 39B20110712SPR | 372.60 | 0.08 |
| 13744 | 6791291.56 | 589299.83 | 372.73 | 39B20110712SPR | 372.70 | 0.03 |
| 13745 | 6791278.28 | 589292.07 | 372.85 | 39B20110712SPR | 372.82 | 0.03 |
| 13746 | 6791268.17 | 589282.06 | 372.92 | 39B20110712SPR | 372.86 | 0.06 |
| 13747 | 6791255.14 | 589268.18 | 373.03 | 39B20110712SPR | 373.01 | 0.02 |
| 13748 | 6791245.27 | 589256.98 | 373.15 | 39B20110712SPR | 373.10 | 0.05 |
| 13749 | 6791235.21 | 589246.32 | 373.32 | 39B20110712SPR | 373.27 | 0.05 |
| 13750 | 6791225.06 | 589235.39 | 373.50 | 39B20110712SPR | 373.44 | 0.06 |
| 13751 | 6793014.48 | 592068.31 | 352.08 | 39B20110712CHECK | 352.02 | 0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13752 | 6793014.49 | 592068.31 | 352.08 | 39B20110712CHECK | 352.02 | 0.06 |
| 13800 | 6777357.94 | 570661.56 | 685.81 | 40A240AFAC | 685.84 | -0.03 |
| 13801 | 6777379.60 | 570659.13 | 686.17 | 40A20110710SPR | 686.13 | 0.04 |
| 13802 | 6777383.16 | 570672.46 | 685.46 | 40A20110710SPR | 685.41 | 0.05 |
| 13803 | 6777386.43 | 570685.90 | 684.76 | 40A20110710SPR | 684.72 | 0.04 |
| 13804 | 6777390.24 | 570701.30 | 683.94 | 40A20110710SPR | 683.88 | 0.06 |
| 13805 | 6777393.59 | 570715.79 | 683.19 | 40A20110710SPR | 683.12 | 0.07 |
| 13806 | 6777396.13 | 570728.85 | 682.53 | 40A20110710SPR | 682.49 | 0.04 |
| 13807 | 6777399.12 | 570742.34 | 681.84 | 40A20110710SPR | 681.79 | 0.05 |
| 13808 | 6777403.27 | 570759.47 | 680.99 | 40A20110710SPR | 680.95 | 0.04 |
| 13809 | 6777406.62 | 570773.65 | 680.30 | 40A20110710SPR | 680.24 | 0.06 |
| 13810 | 6777406.76 | 570787.39 | 679.67 | 40A20110710SPR | 679.66 | 0.01 |
| 13811 | 6777326.03 | 571090.24 | 656.14 | 40A20110710SPR | 656.12 | 0.02 |
| 13812 | 6777340.73 | 571087.68 | 657.42 | 40A20110710SPR | 657.40 | 0.02 |
| 13813 | 6777354.99 | 571084.18 | 658.66 | 40A20110710SPR | 658.65 | 0.01 |
| 13814 | 6777368.65 | 571080.19 | 659.88 | 40A20110710SPR | 659.86 | 0.02 |
| 13815 | 6777382.62 | 571076.89 | 660.90 | 40A20110710SPR | 660.84 | 0.06 |
| 13816 | 6777396.98 | 571074.27 | 661.87 | 40A20110710SPR | 661.83 | 0.04 |
| 13817 | 6777411.68 | 571071.34 | 662.99 | 40A20110710SPR | 662.95 | 0.04 |
| 13818 | 6777425.83 | 571068.51 | 664.09 | 40A20110710SPR | 664.06 | 0.03 |
| 13819 | 6777439.51 | 571065.73 | 665.22 | 40A20110710SPR | 665.14 | 0.08 |
| 13820 | 6777458.80 | 571059.52 | 666.89 | 40A20110710SPR | 666.86 | 0.03 |
| 13821 | 6777466.24 | 571058.58 | 667.15 | 40A20110710SPR | 667.10 | 0.05 |
| 13822 | 6777472.42 | 571057.29 | 667.12 | 40A20110710SPR | 667.07 | 0.05 |
| 13823 | 6777476.22 | 571070.64 | 666.80 | 40A20110710SPR | 666.73 | 0.07 |
| 13824 | 6777480.20 | 571085.30 | 666.53 | 40A20110710SPR | 666.48 | 0.05 |
| 13825 | 6777483.07 | 571099.04 | 666.37 | 40A20110710SPR | 666.34 | 0.03 |
| 13826 | 6777486.31 | 571113.01 | 666.17 | 40A20110710SPR | 666.11 | 0.06 |
| 13827 | 6777490.15 | 571128.32 | 665.91 | 40A20110710SPR | 665.86 | 0.05 |
| 13828 | 6777493.32 | 571141.95 | 665.69 | 40A20110710SPR | 665.62 | 0.07 |
| 13829 | 6777496.54 | 571156.55 | 665.41 | 40A20110710SPR | 665.40 | 0.01 |
| 13830 | 6777499.86 | 571170.89 | 665.13 | 40A20110710SPR | 665.08 | 0.05 |
| 13831 | 6777023.03 | 571617.97 | 626.30 | 40A20110710SPR | 626.27 | 0.03 |
| 13832 | 6777008.91 | 571611.01 | 625.37 | 40A20110710SPR | 625.36 | 0.01 |
| 13833 | 6776996.42 | 571604.22 | 624.54 | 40A20110710SPR | 624.49 | 0.05 |
| 13834 | 6776984.49 | 571597.08 | 623.73 | 40A20110710SPR | 623.69 | 0.04 |
| 13835 | 6776972.65 | 571589.32 | 622.88 | 40A20110710SPR | 622.88 | 0.00 |
| 13836 | 6776961.50 | 571581.18 | 622.03 | 40A20110710SPR | 622.03 | 0.00 |
| 13837 | 6776950.44 | 571572.47 | 621.19 | 40A20110710SPR | 621.14 | 0.05 |
| 13838 | 6776939.57 | 571563.35 | 620.35 | 40A20110710SPR | 620.27 | 0.08 |
| 13839 | 6776929.18 | 571554.02 | 619.53 | 40A20110710SPR | 619.51 | 0.02 |
| 13840 | 6776919.15 | 571543.84 | 618.65 | 40A20110710SPR | 618.63 | 0.02 |
| 13841 | 6777363.02 | 568938.12 | 775.34 | 40A20110710SPR | 775.31 | 0.03 |
| 13842 | 6777371.00 | 568938.91 | 775.24 | 40A20110710SPR | 775.21 | 0.03 |
| 13843 | 6777380.64 | 568937.27 | 775.01 | 40A20110710SPR | 774.98 | 0.03 |
| 13844 | 6777370.35 | 568919.24 | 776.40 | 40A20110710SPR | 776.36 | 0.04 |
| 13845 | 6777372.71 | 568902.25 | 777.36 | 40A20110710SPR | 777.33 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13846 | 6777380.01 | 568886.41 | 778.32 | 40A20110710SPR | 778.29 | 0.03 |
| 13847 | 6777382.70 | 568871.62 | 779.28 | 40A20110710SPR | 779.23 | 0.05 |
| 13848 | 6777386.14 | 568856.86 | 780.16 | 40A20110710SPR | 780.12 | 0.04 |
| 13849 | 6777391.87 | 568843.45 | 780.91 | 40A20110710SPR | 780.89 | 0.01 |
| 13850 | 6777395.29 | 568829.81 | 781.75 | 40A20110710SPR | 781.70 | 0.05 |
| 13851 | 6777363.15 | 570661.02 | 686.19 | 40A20110710CHECK | 686.18 | 0.01 |
| 13852 | 6777363.12 | 570661.03 | 686.20 | 40A20110710CHECK | 686.18 | 0.02 |
| 13900 | 6778131.00 | 568075.72 | 813.49 | 40B1011071440BFAC | 813.46 | 0.02 |
| 13901 | 6777907.08 | 568204.81 | 818.41 | 40B10110714SPR | 818.38 | 0.03 |
| 13902 | 6777916.44 | 568190.05 | 818.39 | 40B10110714SPR | 818.39 | 0.00 |
| 13903 | 6777929.28 | 568182.26 | 818.38 | 40B10110714SPR | 818.36 | 0.02 |
| 13904 | 6777942.09 | 568174.47 | 818.31 | 40B10110714SPR | 818.30 | 0.01 |
| 13905 | 6777954.59 | 568167.50 | 818.24 | 40B10110714SPR | 818.23 | 0.01 |
| 13906 | 6777968.79 | 568157.95 | 818.07 | 40B10110714SPR | 818.04 | 0.03 |
| 13907 | 6777981.72 | 568150.02 | 817.90 | 40B10110714SPR | 817.89 | 0.01 |
| 13908 | 6777994.98 | 568141.75 | 817.73 | 40B10110714SPR | 817.70 | 0.03 |
| 13909 | 6778010.41 | 568131.76 | 817.45 | 40B10110714SPR | 817.41 | 0.04 |
| 13910 | 6778025.96 | 568121.86 | 817.13 | 40B10110714SPR | 817.09 | 0.04 |
| 13911 | 6778039.86 | 568111.93 | 816.77 | 40B10110714SPR | 816.70 | 0.07 |
| 13912 | 6778052.50 | 568103.42 | 816.42 | 40B10110714SPR | 816.37 | 0.05 |
| 13913 | 6778065.56 | 568093.91 | 816.04 | 40B10110714SPR | 816.01 | 0.03 |
| 13914 | 6778079.28 | 568090.77 | 815.97 | 40B10110714SPR | 815.94 | 0.03 |
| 13915 | 6778097.25 | 568080.71 | 815.52 | 40B10110714SPR | 815.48 | 0.04 |
| 13916 | 6778108.72 | 568071.83 | 815.16 | 40B10110714SPR | 815.13 | 0.03 |
| 13917 | 6778119.81 | 568062.99 | 814.75 | 40B10110714SPR | 814.70 | 0.04 |
| 13918 | 6779003.11 | 567530.18 | 769.07 | 40B10110714SPR | 769.03 | 0.04 |
| 13919 | 6779016.31 | 567525.34 | 768.47 | 40B10110714SPR | 768.46 | 0.01 |
| 13920 | 6779034.71 | 567533.41 | 767.00 | 40B10110714SPR | 766.99 | 0.01 |
| 13921 | 6779049.56 | 567532.73 | 766.21 | 40B10110714SPR | 766.21 | 0.00 |
| 13922 | 6779063.96 | 567528.33 | 765.64 | 40B10110714SPR | 765.62 | 0.02 |
| 13923 | 6779076.99 | 567535.48 | 764.56 | 40B10110714SPR | 764.56 | 0.00 |
| 13924 | 6779097.36 | 567537.70 | 763.33 | 40B10110714SPR | 763.28 | 0.05 |
| 13925 | 6779108.70 | 567540.14 | 762.53 | 40B10110714SPR | 762.49 | 0.04 |
| 13926 | 6779223.37 | 567567.76 | 755.62 | 40B10110714SPR | 755.57 | 0.05 |
| 13927 | 6779225.55 | 567556.32 | 756.16 | 40B10110714SPR | 756.13 | 0.03 |
| 13928 | 6779227.22 | 567548.36 | 756.08 | 40B10110714SPR | 756.04 | 0.04 |
| 13929 | 6779225.70 | 567538.93 | 755.96 | 40B10110714SPR | 755.92 | 0.04 |
| 13930 | 6779225.37 | 567525.20 | 755.58 | 40B10110714SPR | 755.53 | 0.05 |
| 13931 | 6779223.85 | 567513.08 | 755.25 | 40B10110714SPR | 755.20 | 0.05 |
| 13932 | 6779221.36 | 567498.07 | 754.75 | 40B10110714SPR | 754.72 | 0.03 |
| 13933 | 6778124.32 | 568073.00 | 814.61 | 40B10110714CHECK | 814.56 | 0.05 |
| 13934 | 6778124.33 | 568073.01 | 814.60 | 40B10110714CHECK | 814.55 | 0.05 |
| 14001 | 6772206.58 | 541510.06 | 9.76 | 41A20110714SPR | 9.81 | -0.05 |
| 14002 | 6772205.74 | 541525.20 | 9.61 | 41A20110714SPR | 9.64 | -0.03 |
| 14003 | 6772204.53 | 541540.96 | 9.45 | 41A20110714SPR | 9.49 | -0.04 |
| 14004 | 6772203.34 | 541554.82 | 9.39 | 41A20110714SPR | 9.44 | -0.05 |
| 14005 | 6772202.20 | 541569.62 | 9.30 | 41A20110714SPR | 9.35 | -0.05 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14006 | 6772200.82 | 541583.83 | 9.34 | 41A20110714SPR | 9.39 | -0.05 |
| 14007 | 6772199.41 | 541601.71 | 9.43 | 41A20110714SPR | 9.47 | -0.04 |
| 14008 | 6772198.24 | 541616.80 | 9.30 | 41A20110714SPR | 9.36 | -0.06 |
| 14009 | 6772196.93 | 541631.38 | 9.08 | 41A20110714SPR | 9.13 | -0.05 |
| 14010 | 6772195.71 | 541646.16 | 9.02 | 41A20110714SPR | 9.09 | -0.07 |
| 14011 | 6772493.81 | 542377.58 | 12.86 | 41A20110714SPR | 12.90 | -0.04 |
| 14012 | 6772502.03 | 542389.94 | 12.91 | 41A20110714SPR | 12.98 | -0.07 |
| 14013 | 6772509.92 | 542402.42 | 12.89 | 41A20110714SPR | 12.94 | -0.05 |
| 14014 | 6772518.07 | 542415.54 | 12.77 | 41A20110714SPR | 12.79 | -0.02 |
| 14015 | 6772526.18 | 542428.63 | 12.68 | 41A20110714SPR | 12.75 | -0.07 |
| 14016 | 6772534.56 | 542442.13 | 12.63 | 41A20110714SPR | 12.63 | 0.00 |
| 14017 | 6772544.04 | 542457.42 | 12.54 | 41A20110714SPR | 12.57 | -0.03 |
| 14018 | 6772552.27 | 542470.57 | 12.43 | 41A20110714SPR | 12.47 | -0.04 |
| 14019 | 6772560.42 | 542484.01 | 12.37 | 41A20110714SPR | 12.40 | -0.03 |
| 14020 | 6772568.41 | 542497.05 | 12.32 | 41A20110714SPR | 12.32 | -0.01 |
| 14021 | 6772988.11 | 543175.87 | 9.62 | 41A20110714SPR | 9.62 | 0.00 |
| 14022 | 6772979.70 | 543163.20 | 9.56 | 41A20110714SPR | 9.60 | -0.04 |
| 14023 | 6772970.15 | 543147.66 | 9.61 | 41A20110714SPR | 9.59 | 0.02 |
| 14024 | 6772962.70 | 543135.57 | 9.59 | 41A20110714SPR | 9.61 | -0.02 |
| 14025 | 6772952.98 | 543119.84 | 9.56 | 41A20110714SPR | 9.57 | -0.02 |
| 14026 | 6772944.24 | 543105.56 | 9.56 | 41A20110714SPR | 9.54 | 0.02 |
| 14027 | 6772936.47 | 543092.98 | 9.56 | 41A20110714SPR | 9.56 | 0.00 |
| 14028 | 6772928.61 | 543080.19 | 9.55 | 41A20110714SPR | 9.59 | -0.04 |
| 14029 | 6772919.11 | 543065.04 | 9.51 | 41A20110714SPR | 9.55 | -0.04 |
| 14030 | 6772905.77 | 543043.15 | 9.51 | 41A20110714SPR | 9.51 | 0.00 |
| 14101 | 6772603.87 | 535309.26 | 12.27 | 41B20110713SPR | 12.27 | 0.00 |
| 14102 | 6772605.92 | 535323.11 | 12.49 | 41B20110713SPR | 12.48 | 0.01 |
| 14103 | 6772607.43 | 535339.07 | 12.72 | 41B20110713SPR | 12.70 | 0.02 |
| 14104 | 6772607.91 | 535354.08 | 12.91 | 41B20110713SPR | 12.91 | 0.00 |
| 14105 | 6772607.84 | 535368.77 | 13.13 | 41B20110713SPR | 13.12 | 0.01 |
| 14106 | 6772606.61 | 535383.24 | 13.34 | 41B20110713SPR | 13.30 | 0.04 |
| 14107 | 6772604.26 | 535403.28 | 13.65 | 41B20110713SPR | 13.64 | 0.01 |
| 14108 | 6772601.16 | 535417.24 | 13.82 | 41B20110713SPR | 13.81 | 0.01 |
| 14109 | 6772597.40 | 535432.62 | 14.03 | 41B20110713SPR | 14.02 | 0.01 |
| 14110 | 6772592.19 | 535449.05 | 14.25 | 41B20110713SPR | 14.25 | 0.00 |
| 14111 | 6772586.31 | 535463.44 | 14.38 | 41B20110713SPR | 14.36 | 0.02 |
| 14112 | 6772579.86 | 535477.94 | 14.53 | 41B20110713SPR | 14.54 | -0.01 |
| 14113 | 6772572.07 | 535492.23 | 14.63 | 41B20110713SPR | 14.61 | 0.02 |
| 14114 | 6772563.61 | 535505.39 | 14.70 | 41B20110713SPR | 14.69 | 0.01 |
| 14115 | 6772555.16 | 535517.68 | 14.79 | 41B20110713SPR | 14.81 | -0.02 |
| 14116 | 6772545.74 | 535529.19 | 14.77 | 41B20110713SPR | 14.78 | -0.01 |
| 14117 | 6772535.90 | 535540.23 | 14.75 | 41B20110713SPR | 14.74 | 0.01 |
| 14118 | 6772525.24 | 535550.60 | 14.72 | 41B20110713SPR | 14.70 | 0.02 |
| 14119 | 6772513.31 | 535562.16 | 14.61 | 41B20110713SPR | 14.60 | 0.01 |
| 14120 | 6772502.27 | 535571.72 | 14.56 | 41B20110713SPR | 14.56 | 0.00 |
| 14121 | 6772212.72 | 535923.30 | 9.73 | 41B20110713SPR | 9.77 | -0.04 |
| 14122 | 6772207.89 | 535937.17 | 9.45 | 41B20110713SPR | 9.45 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14123 | 6772203.37 | 535950.82 | 9.18 | 41B20110713SPR | 9.19 | -0.01 |
| 14124 | 6772199.57 | 535964.79 | 8.93 | 41B20110713SPR | 8.93 | 0.00 |
| 14125 | 6772196.48 | 535978.66 | 8.66 | 41B20110713SPR | 8.65 | 0.01 |
| 14126 | 6772193.78 | 535992.80 | 8.39 | 41B20110713SPR | 8.38 | 0.01 |
| 14127 | 6772191.72 | 536006.67 | 8.13 | 41B20110713SPR | 8.14 | -0.01 |
| 14128 | 6772190.33 | 536023.18 | 7.80 | 41B20110713SPR | 7.83 | -0.03 |
| 14129 | 6772189.82 | 536037.15 | 7.54 | 41B20110713SPR | 7.57 | -0.03 |
| 14130 | 6772189.51 | 536051.52 | 7.28 | 41B20110713SPR | 7.28 | 0.00 |
| 14131 | 6772190.09 | 536065.73 | 7.02 | 41B20110713SPR | 7.00 | 0.02 |
| 14132 | 6772191.14 | 536080.20 | 6.76 | 41B20110713SPR | 6.80 | -0.04 |
| 14133 | 6772192.92 | 536093.76 | 6.57 | 41B20110713SPR | 6.54 | 0.03 |
| 14134 | 6772195.02 | 536108.20 | 6.37 | 41B20110713SPR | 6.37 | 0.00 |
| 14135 | 6772197.29 | 536122.07 | 6.21 | 41B20110713SPR | 6.23 | -0.02 |
| 14136 | 6772199.67 | 536136.64 | 6.04 | 41B20110713SPR | 6.04 | 0.00 |
| 14137 | 6772203.56 | 536159.70 | 5.75 | 41B20110713SPR | 5.76 | -0.01 |
| 14138 | 6772206.70 | 536173.90 | 5.65 | 41B20110713SPR | 5.65 | 0.00 |
| 14139 | 6772209.60 | 536188.54 | 5.51 | 41B20110713SPR | 5.54 | -0.03 |
| 14140 | 6772212.31 | 536203.01 | 5.44 | 41B20110713SPR | 5.46 | -0.02 |
| 14141 | 6772280.08 | 536926.71 | 5.40 | 41B20110713SPR | 5.39 | 0.01 |
| 14142 | 6772280.92 | 536946.80 | 5.39 | 41B20110713SPR | 5.41 | -0.02 |
| 14143 | 6772281.38 | 536960.69 | 5.44 | 41B20110713SPR | 5.42 | 0.02 |
| 14144 | 6772281.91 | 536975.14 | 5.43 | 41B20110713SPR | 5.44 | -0.01 |
| 14145 | 6772282.45 | 536995.08 | 5.45 | 41B20110713SPR | 5.45 | 0.00 |
| 14146 | 6772283.35 | 537009.77 | 5.44 | 41B20110713SPR | 5.40 | 0.04 |
| 14147 | 6772283.79 | 537024.33 | 5.48 | 41B20110713SPR | 5.49 | -0.01 |
| 14148 | 6772284.52 | 537044.49 | 5.59 | 41B20110713SPR | 5.57 | 0.02 |
| 14149 | 6772285.17 | 537063.27 | 5.78 | 41B20110713SPR | 5.73 | 0.05 |
| 14150 | 6772285.65 | 537077.17 | 5.85 | 41B20110713SPR | 5.81 | 0.04 |
| 14151 | 6772286.33 | 537097.80 | 5.86 | 41B20110713SPR | 5.81 | 0.05 |
| 14152 | 6772286.26 | 537112.16 | 5.84 | 41B20110713SPR | 5.83 | 0.01 |
| 14153 | 6772286.50 | 537125.88 | 5.85 | 41B20110713SPR | 5.85 | 0.00 |
| 14154 | 6772285.83 | 537140.64 | 5.87 | 41B20110713SPR | 5.89 | -0.02 |
| 14155 | 6772285.02 | 537155.14 | 5.96 | 41B20110713SPR | 5.96 | 0.00 |
| 14156 | 6772283.76 | 537169.35 | 6.00 | 41B20110713SPR | 5.99 | 0.01 |
| 14157 | 6772282.41 | 537183.06 | 6.08 | 41B20110713SPR | 6.09 | -0.01 |
| 14158 | 6772281.16 | 537197.46 | 6.17 | 41B20110713SPR | 6.17 | 0.00 |
| 14159 | 6772280.52 | 537213.66 | 6.16 | 41B20110713SPR | 6.16 | 0.00 |
| 14160 | 6772281.11 | 537227.26 | 6.18 | 41B20110713SPR | 6.15 | 0.02 |
| 14161 | 6772517.79 | 537814.53 | 6.17 | 41B20110713SPR | 6.14 | 0.03 |
| 14162 | 6772524.99 | 537826.49 | 6.15 | 41B20110713SPR | 6.13 | 0.02 |
| 14163 | 6772531.70 | 537838.72 | 6.14 | 41B20110713SPR | 6.12 | 0.02 |
| 14164 | 6772537.64 | 537851.01 | 6.11 | 41B20110713SPR | 6.10 | 0.01 |
| 14165 | 6772543.58 | 537864.30 | 6.09 | 41B20110713SPR | 6.10 | -0.01 |
| 14166 | 6772549.03 | 537877.36 | 6.13 | 41B20110713SPR | 6.12 | 0.00 |
| 14167 | 6772553.49 | 537890.65 | 6.16 | 41B20110713SPR | 6.15 | 0.01 |
| 14168 | 6772557.62 | 537904.57 | 6.18 | 41B20110713SPR | 6.17 | 0.00 |
| 14169 | 6772561.28 | 537918.39 | 6.13 | 41B20110713SPR | 6.13 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 14170 | 6772564.58 | 537932.32 | 6.10 | 41B20110713SPR | 6.08 | 0.02 |
| 14171 | 6772567.12 | 537946.19 | 6.15 | 41B20110713SPR | 6.15 | 0.00 |
| 14172 | 6772568.85 | 537960.02 | 6.15 | 41B20110713SPR | 6.15 | 0.00 |
| 14173 | 6772591.13 | 538902.54 | 5.83 | 41B20110713SPR | 5.82 | 0.01 |
| 14174 | 6772589.23 | 538916.42 | 5.81 | 41B20110713SPR | 5.81 | 0.00 |
| 14175 | 6772587.23 | 538930.25 | 5.76 | 41B20110713SPR | 5.78 | -0.02 |
| 14176 | 6772585.27 | 538944.02 | 5.72 | 41B20110713SPR | 5.69 | 0.03 |
| 14177 | 6772582.93 | 538957.83 | 5.63 | 41B20110713SPR | 5.63 | 0.00 |
| 14178 | 6772580.54 | 538971.82 | 5.56 | 41B20110713SPR | 5.55 | 0.00 |
| 14179 | 6772578.35 | 538985.69 | 5.50 | 41B20110713SPR | 5.51 | -0.01 |
| 14180 | 6772576.27 | 538999.18 | 5.48 | 41B20110713SPR | 5.49 | -0.02 |
| 14181 | 6772418.01 | 539791.23 | 5.70 | 41B20110713SPR | 5.68 | 0.02 |
| 14182 | 6772413.60 | 539804.17 | 5.64 | 41B20110713SPR | 5.65 | -0.01 |
| 14183 | 6772408.78 | 539817.65 | 5.62 | 41B20110713SPR | 5.61 | 0.01 |
| 14184 | 6772403.99 | 539831.73 | 5.63 | 41B20110713SPR | 5.65 | -0.02 |
| 14185 | 6772398.93 | 539846.23 | 5.68 | 41B20110713SPR | 5.70 | -0.02 |
| 14186 | 6772394.30 | 539859.39 | 5.74 | 41B20110713SPR | 5.76 | -0.02 |
| 14187 | 6772389.52 | 539872.84 | 5.81 | 41B20110713SPR | 5.83 | -0.02 |
| 14188 | 6772385.08 | 539886.14 | 5.91 | 41B20110713SPR | 5.91 | 0.00 |
| 14189 | 6772380.46 | 539899.15 | 5.97 | 41B20110713SPR | 5.96 | 0.01 |
| 14190 | 6772375.58 | 539913.43 | 6.01 | 41B20110713SPR | 6.03 | -0.02 |
| 14191 | 6772253.30 | 540551.01 | 8.32 | 41B20110713SPR | 8.30 | 0.02 |
| 14192 | 6772253.68 | 540583.38 | 8.38 | 41B20110713SPR | 8.41 | -0.03 |
| 14193 | 6772253.42 | 540597.29 | 8.33 | 41B20110713SPR | 8.33 | 0.00 |
| 14194 | 6772253.62 | 540611.60 | 8.22 | 41B20110713SPR | 8.26 | -0.04 |
| 14195 | 6772253.82 | 540625.78 | 8.25 | 41B20110713SPR | 8.24 | 0.01 |
| 14196 | 6772253.71 | 540640.45 | 8.30 | 41B20110713SPR | 8.29 | 0.01 |
| 14197 | 6772253.67 | 540654.83 | 8.34 | 41B20110713SPR | 8.33 | 0.01 |

# LiDAR REMOTE SENSING

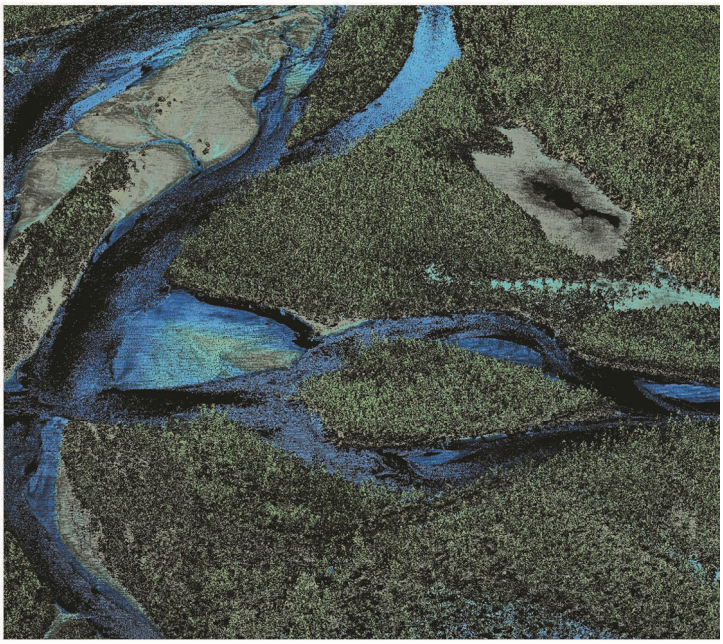
## ALASKA PIPELINE • ALASKA

(Delivery 11– 2/29/2012)

Final Delivery








## ALASKA DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

**TRENT HUBBARD** - 3354 College Road - Fairbanks, AK 99709

**WATERSHED SCIENCES** • 517 SW 2nd Street, Suite 400 - Corvallis, OR 97333

# LiDAR Remote Sensing Data Collection:

## Alaska Pipeline, AK

### Delivery 11

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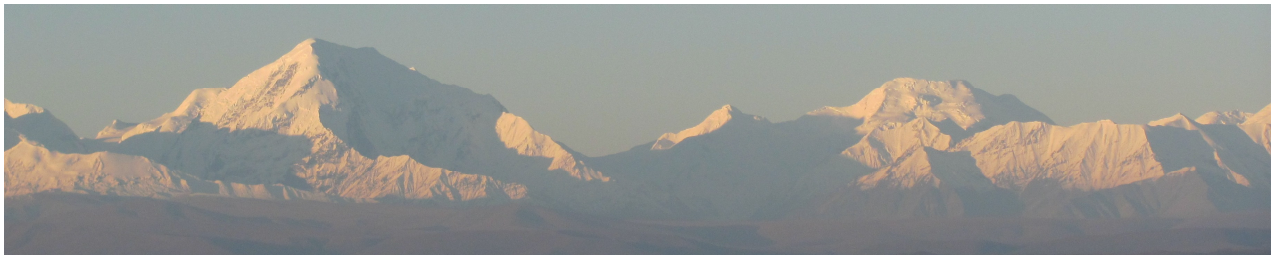
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# 1. Overview

Watershed Sciences, Inc. (WS) collected Light Detection and Ranging (LiDAR) data of the Alaska Pipeline for the Alaska Department of Natural Resources. LiDAR data for Delivery 11 was collected between June 6th and July 2nd, 2011 (**Figure 1**). Delivery 11 includes 320,659 acres within the requested area. This area was expanded to include a 100m buffer to ensure complete coverage and adequate point densities around survey boundaries, resulting in 341,562 acres of delivered data covering from Wiseman, AK north along Dalton Hwy to Prudhoe Bay. Delivery 11 completes the Alaska Pipeline project area of interest. Total acreage for this project was 1,918,790, resulting in 2,050,430 acres of delivered data.

***Figure 1***. *Alaska Pipeline survey delivery status overview.*

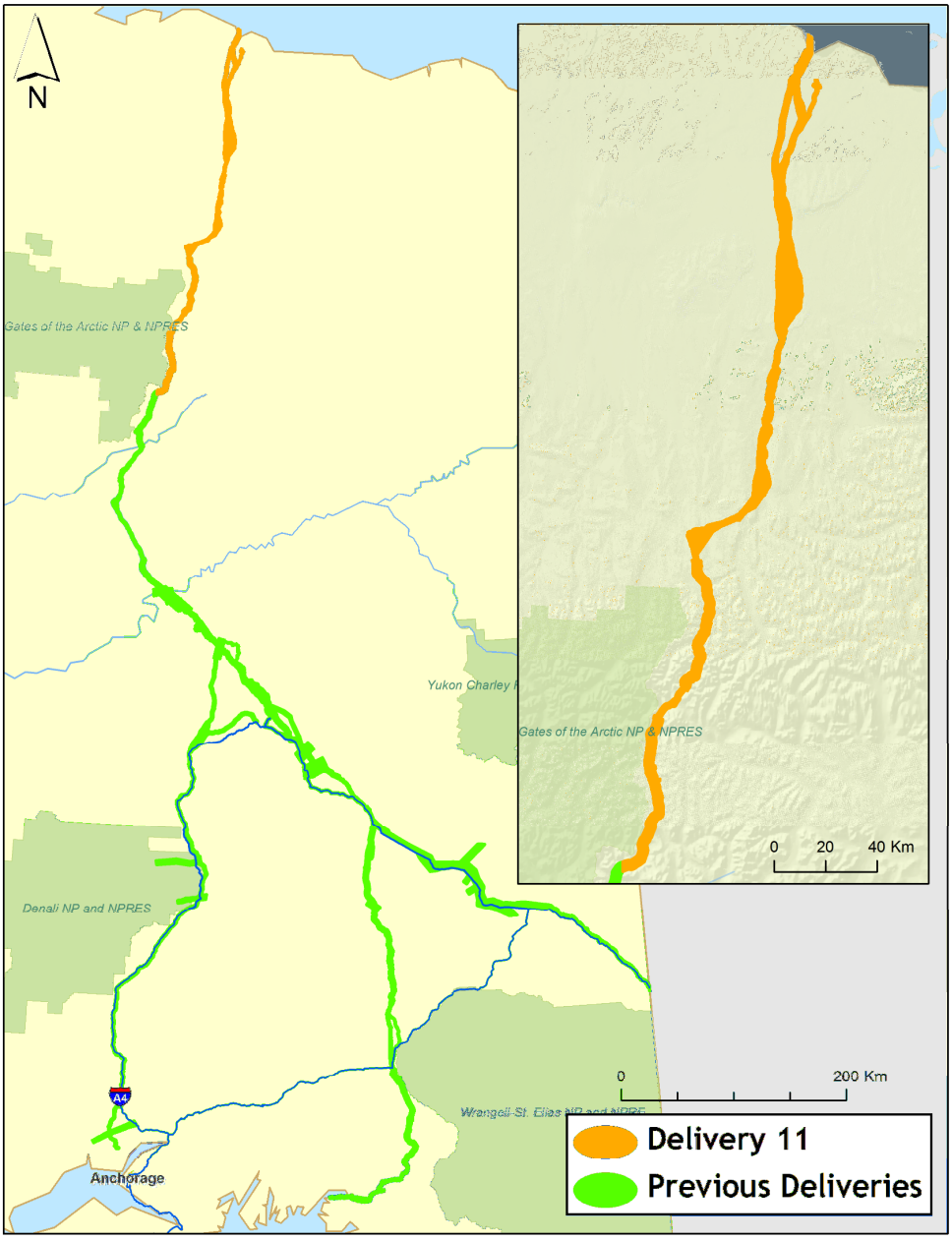


***Table 1.*** *Alaska Pipeline, LiDAR deliveries to date.*

| Delivery | UTM Zone(s) | Date | Total Acres Flown | AOI Acres |
|---|---|---|---|---|
| **1** | 6, 7 | March 9, 2011 | 121,746 | 117,357 |
| **2** | 6 | March 31, 2011 | 99,594 | 94,885 |
| **3** | 7 | May 23, 2011 | 43,976 | 39,744 |
| **4** | 6 | July 29, 2011 | 168,823 | 159,433 |
| **5** | 5 | August 31, 2011 | 247,206 | 226,450 |
| **6** | 6 | September 30, 2011 | 309,216 | 293,337 |
| **7** | 6 | October 31, 2011 | 262,279 | 239,477 |
| **8** | 7 | November 21, 2011 | 156,712 | 149,733 |
| **9** | 6 | December 20, 2011 | 176,785 | 167,164 |
| **10** | 6 | January 31, 2012 | 177,733 | 162,898 |
| **11** | 6 | February 29, 2012 | 341,562 | 320,659 |

# 2. Acquisition

## 2.1 Airborne Survey – Instrumentation and Methods

The LiDAR survey utilized a Leica ALS60 sensor in a Cessna Caravan 208Bs. The Leica systems were set to acquire 150,000 laser pulses per second (i.e., 150 kHz pulse rate) and flown at 1500 meters above ground level (AGL), capturing a scan angle of ±14$^{o}$ from nadir when clouds and terrain permitted. With these flight parameters, the laser swath width is 638m and the laser pulse footprint is 34cm. These settings varied depending on cloud cover and terrain but were consistently adjusted to yield an average native pulse density of ≥8 pulses per square meter over terrestrial surfaces. It is not uncommon for some types of surfaces (e.g. dense vegetation or water) to return fewer pulses than the laser originally emitted. These discrepancies between 'native' and 'delivered' density will vary depending on terrain, land cover, and the prevalence of water bodies.



*The Cessna Caravan is a stable platform, ideal for flying slow and low for high density projects. A Leica ALS60 sensor head installed in the Caravan is shown on the left.*

All areas were surveyed with an opposing flight line side-lap of ≥60% (≥100% overlap) to reduce laser shadowing and increase surface laser painting. The Leica laser systems allow up to four range measurements (returns) per pulse, and all discernable laser returns were processed for the output dataset.

To accurately solve for laser point position (geographic coordinates x, y, z), the positional coordinates of the airborne sensor and the attitude of the aircraft were recorded continuously throughout the LiDAR data collection mission. Aircraft position was measured twice per second (2 Hz) by an onboard differential GPS unit. 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/sensor position and attitude data are indexed by GPS time.

## 2.2 Ground Survey – Instrumentation and Methods

### *2.2.1 Monumentation*




Watershed Sciences coordinated with McClintock Land Associates (MLA, Alaska Professional Licensed Surveyor), of Eagle River, AK to determine proposed monument locations to support aerial acquisition. MLA established survey control monuments for the project area based on the proposed locations, areas with reasonable access, GPS visibility and proximity to the mission area. MLA established 21 new monuments (**Table 2**) within the Delivery 11 calibration area. The MLA monumentation was done with 5/8" x 30" rebar topped with a metal cap stamped with "MLA-WSI" the monument ID, and the year of establishment. MLA provided professional supervision and oversight to all survey aspects of this project, certified all monuments and provided additional independent accuracy check points (see Section 5.4, Appendix B).

### *2.2.2 Control for Airborne Surveys*


Trimble R7 GPS equipment set up in the Alaska Pipeline study area.

During the LiDAR survey, static (1 Hz recording frequency) ground surveys were conducted over the survey control monuments.

All control monuments were observed for a minimum of two survey sessions lasting no fewer than 4 hours. At the beginning of every session the tripod and antenna were reset, resulting in two independent instrument heights and data files. Data was collected at a rate of 1Hz using a 10 degree mask on the antenna.

After the airborne survey, the static GPS data were provided to MLA for incorporation in the computation of the monument coordinates. MLA processed the static GPS data using triangulation with Continuously Operating Reference Stations (CORS). Both WSI and MLA checked coordinates using the Online Positioning User Service (OPUS[1]) to quantify daily variance. MLA provided calculated geodetic positions for all controls.

Indexed by time, these GPS data were used to correct the continuous onboard measurements of aircraft position recorded throughout the mission. Control monuments were located within 13 nautical miles of the survey area as per the contract.

***Table 2**. Base Station control coordinates for Alaska Pipeline Delivery 11.*

[1] Online Positioning User Service (OPUS) is run by the National Geodetic Survey to process corrected monument positions.

| Base Station ID | Datum: NAD83 (CORS96) | | GRS80 |
|---|---|---|---|
| | Latitude | Longitude | Ellipsoid Z (meters) |
| 1 A | 70 11 56.00217 | 148 28 16.63779 | 11.984 |
| 1 B | 70 11 39.84451 | 148 25 40.50150 | 10.01 |
| 1 C | 70 03 40.90373 | 148 34 43.19036 | 30.561 |
| 2 A | 69 54 25.38680 | 148 47 29.18041 | 64.198 |
| 2 B | 69 53 21.39517 | 148 47 33.04008 | 67.55 |
| 3 A | 69 31 54.38231 | 148 35 30.77420 | 158.308 |
| 3 B | 69 30 13.23430 | 148 34 23.54324 | 165.73 |
| 4 A | 69 12 46.60315 | 148 47 38.60579 | 269.058 |
| 4 B | 69 09 00.34724 | 148 50 10.96608 | 296.248 |
| 5 A | 68 51 21.78412 | 148 49 59.17700 | 419.267 |
| 5 B | 68 49 53.64051 | 148 49 23.79193 | 428.727 |
| 6 A | 68 32 59.59311 | 149 29 17.01258 | 900.478 |
| 6 B | 68 34 16.58464 | 149 30 10.90898 | 875.355 |
| 6 C | 68 27 17.83613 | 149 29 06.91347 | 852.321 |
| 7 A | 68 16 50.75526 | 149 22 54.72760 | 877.092 |
| 7 B | 68 14 59.35346 | 149 25 13.49246 | 945.361 |
| 7 C | 68 07 46.92992 | 149 28 48.67633 | 1455.869 |
| 8 A | 67 57 12.24097 | 149 46 37.78112 | 630.294 |
| 8 B | 67 54 54.15020 | 149 49 17.88353 | 584.346 |
| 9 A | 67 38 44.37098 | 149 44 19.18434 | 441.295 |
| 9 B | 67 37 03.11561 | 149 47 42.14588 | 431.573 |

### *2.2.3 Instrumentation*

For this survey, a Trimble GPS receiver model R7 with Zephyr Geodetic antenna with ground plane was deployed for all static control. A Trimble model R8 GNSS unit was used for collecting check points using real time kinematic (RTK) survey techniques. All GPS measurements were made with dual frequency L1-L2 receivers with carrier-phase correction.

The aircraft was assigned a ground crew member with two Trimble R7 receivers and an R8 receiver. The ground crew vehicles are equipped with standard field survey supplies and equipment including safety materials. The aircraft was further supported, as necessary, by an MLA surveyor (AK PLS) with two or more survey grade Topcon Receivers.

### *2.2.4 Methodology*

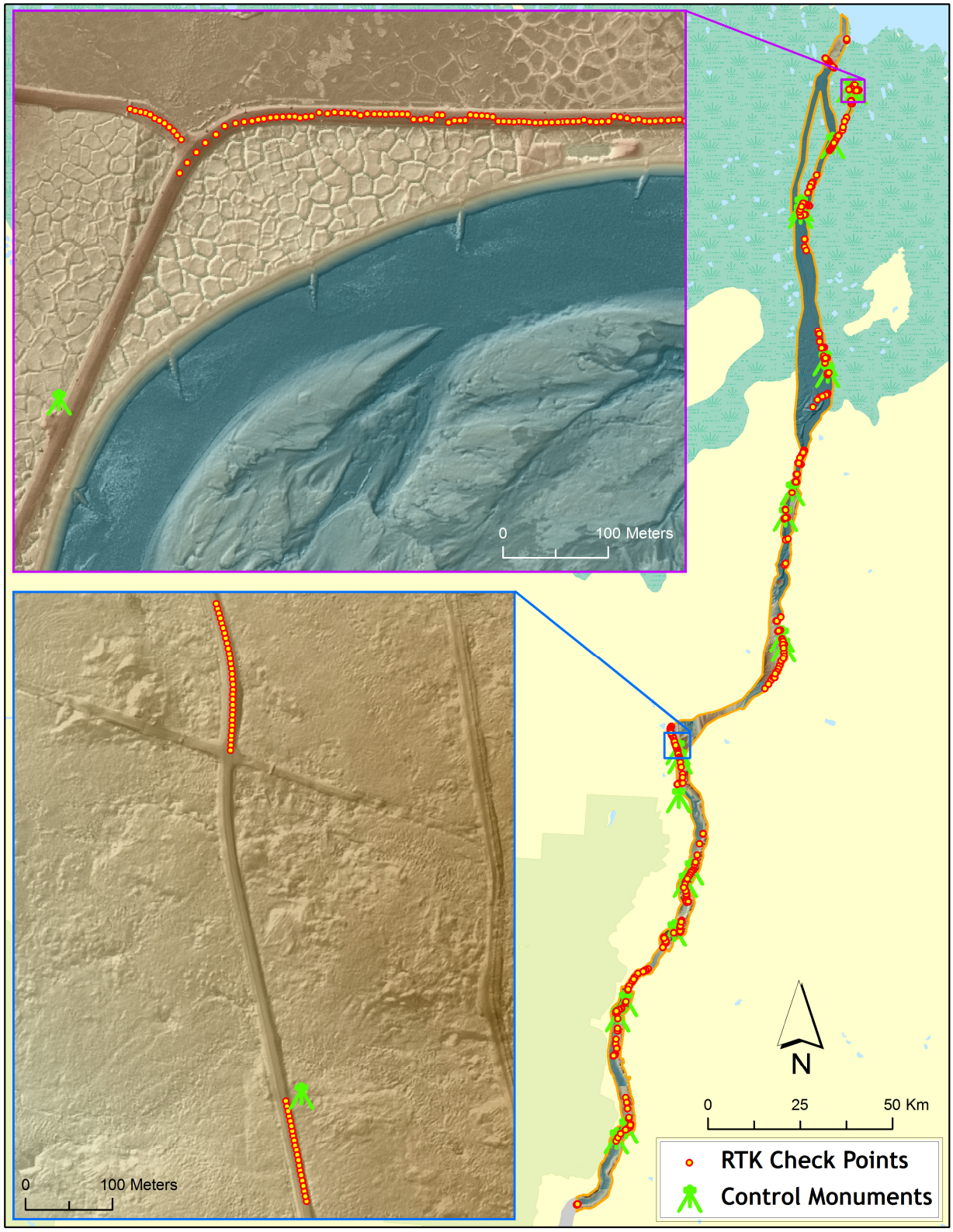
RTK and aircraft mounted GPS measurements were made during periods with PDOP[2] less than or equal to 3.0 and with at least 6 satellites in view of both a stationary reference receiver and the roving receiver. Static GPS data collected in a continuous session average the high PDOP into the final solution in the method used by CORS stations.

For RTK data, the collector begins recording after remaining stationary for 5 seconds then calculating the pseudo range position from at least three epochs with the relative error under 1.5cm horizontal and 2cm vertical. RTK positions are collected on bare earth locations such as paved, gravel or stable dirt roads, and other locations where the ground is clearly visible (and is likely to remain visible) from the sky during the data acquisition and RTK measurement period(s).

In order to facilitate comparisons with LiDAR measurements, RTK measurements were not taken on highly reflective surfaces such as center line stripes or lane markings on roads. RTK points were taken no closer than one meter to any nearby terrain breaks such as road edges or drop offs.

[2]PDOP: Point Dilution of Precision is a measure of satellite geometry, the smaller the number the better the geometry between the point and the satellites.

***Figure 2**. WSI RTK check points and control monument locations used in Delivery 11 of the Alaska Pipeline LiDAR Survey.*



# 3. LiDAR Data Processing

## 3.1 Applications and Work Flow Overview

1. Resolved kinematic corrections for aircraft position data using kinematic aircraft GPS and static ground GPS data.

   **Software:** Waypoint GPS v.8.10, Trimble Geomatics Office v.1.62
2. Developed a smoothed best estimate of trajectory (SBET) file that blends post-processed aircraft position with attitude data. Sensor head position and attitude were calculated throughout the survey. The SBET data were used extensively for laser point processing.

   **Software:** IPAS v.1.35
3. Calculated laser point position by associating SBET position to each laser point return time, scan angle, intensity, etc. Created raw laser point cloud data for the entire survey in *.las (ASPRS v. 1.2) format.

   **Software:** ALS Post Processing Software v.2.70
4. Imported raw laser points into manageable blocks (less than 500 MB) to perform manual relative accuracy calibration and filter for pits/birds. Ground points were then classified for individual flight lines (to be used for relative accuracy testing and calibration).

   **Software:** TerraScan v.11.009
5. Using ground classified points per each flight line, the relative accuracy was tested. Automated line-to-line calibrations were then performed for system attitude parameters (pitch, roll, heading), mirror flex (scale) and GPS/IMU drift. Calibrations were performed on ground classified points from paired flight lines. Every flight line was used for relative accuracy calibration.

   **Software:** TerraMatch v.11.006
6. Position and attitude data were imported. Resulting data were classified as ground and non-ground points. Statistical absolute accuracy was assessed via direct comparisons of ground classified points to ground RTK survey data. Data were then converted to orthometric elevations (NAVD88) by applying a Geoid09 correction. **Software:** TerraScan v.11.009, TerraModeler v.11.004
7. Bare Earth models were created as a triangulated surface and exported as ArcInfo ASCII grids at a 1 meter pixel resolution. Highest Hit models were created for any class at 1 meter grid spacing and exported as ArcInfo ASCII grids. Vegetation models were created for all vegetation points 20cm and above the ground model at a 1m grid spacing and exported as ArcInfo ASCII grids.

   **Software:** TerraScan v.11.009, ArcMap v. 9.3.1, TerraModeler v.11.004

## 3.2 Aircraft Kinematic GPS and IMU Data

LiDAR survey datasets were referenced to the 1 Hz static ground GPS data collected over pre-surveyed monuments with known coordinates. While surveying, the aircraft collected 2 Hz kinematic GPS data, and the onboard inertial measurement unit (IMU) collected 200 Hz aircraft attitude data. Waypoint GPS v.8.10 was used to process the kinematic corrections for the aircraft. The static and kinematic GPS data were then post-processed after the survey to

obtain an accurate GPS solution and aircraft positions. IPAS v.1.35 was used to develop a trajectory file that includes corrected aircraft position and attitude information. The trajectory data for the entire flight survey session were incorporated into a final smoothed best estimated trajectory (SBET) file that contains accurate and continuous aircraft positions and attitudes.

## 3.3 Laser Point Processing

Laser point coordinates were computed using the IPAS and ALS Post Processor software suites based on independent data from the LiDAR system (pulse time, scan angle), and aircraft trajectory data (SBET). Laser point returns (first through fourth) were assigned an associated (x, y, z) coordinate along with unique intensity values (0-255). The data were output into large LAS v. 1.2 files with each point maintaining the corresponding scan angle, return number (echo), intensity, and x, y, z (easting, northing, and elevation) information.

These initial laser point files were too large for subsequent processing. To facilitate laser point processing, bins (polygons) were created to divide the dataset into manageable sizes (< 500 MB). Flightlines and LiDAR data were then reviewed to ensure complete coverage of the survey area and positional accuracy of the laser points.

Laser point data were imported into processing bins in TerraScan, and manual calibration was performed to assess the system offsets for pitch, roll, heading and scale (mirror flex). Using a geometric relationship developed by Watershed Sciences, each of these offsets was resolved and corrected if necessary.

LiDAR points were then filtered for noise, pits (artificial low points), and birds (true birds as well as erroneously high points) by screening for absolute elevation limits, isolated points and height above ground. Each bin was then manually inspected for remaining pits and birds and spurious points were removed. In a bin containing approximately 7.5-9.0 million points, an average of 50-100 points are typically found to be artificially low or high. Common sources of non-terrestrial returns are clouds, birds, vapor, haze, decks, brush piles, etc.

Internal calibration was refined using TerraMatch. Points from overlapping lines were tested for internal consistency and final adjustments were made for system misalignments (i.e., pitch, roll, heading offsets and scale). Automated sensor attitude and scale corrections yielded 3-5 cm improvements in the relative accuracy. Once system misalignments were corrected, vertical GPS drift was then resolved and removed per flight line, yielding a slight improvement (<1 cm) in relative accuracy.

The TerraScan software suite is designed specifically for classifying near-ground points (Soininen, 2004). The processing sequence began by 'removing' all points that were not 'near' the earth based on geometric constraints used to evaluate multi-return points. The resulting bare earth (ground) model was visually inspected and additional ground point modeling was performed in site-specific areas to improve ground detail. This manual editing of ground often occurs in areas with known ground modeling deficiencies, such as: bedrock outcrops, cliffs, deeply incised stream banks, and dense vegetation. In some cases, automated ground point classification erroneously included known vegetation (i.e., understory, low/dense shrubs, etc.). These points were manually reclassified. Ground surface rasters were then developed from triangulated irregular networks (TINs) of ground points.

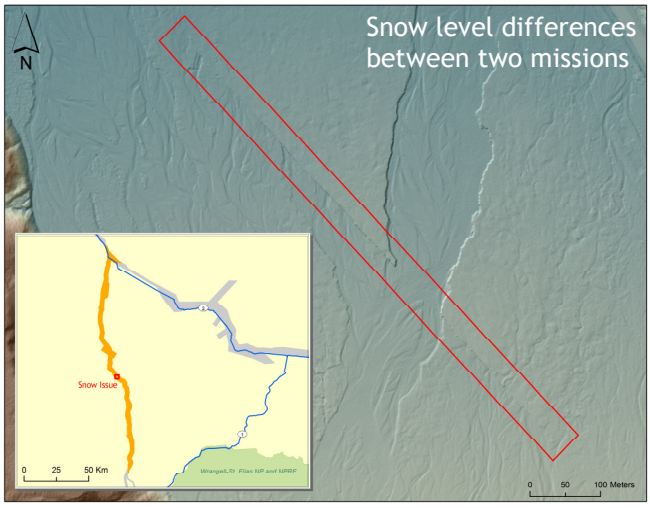
To develop the highest hit and vegetation models, buildings and structures were classified through automated point processing algorithms and then manually inspected and edited during the ground model inspection. Typically, manual editing of building classification was necessary where dense canopy was immediately proximate to buildings, or where structures such as utility poles or fences mimicked vegetation.

In some areas of the project, snow could not be avoided during acquisition. LiDAR returns that were identifiable as snow were reclassified into a new "snow" class. In areas where snow completely obstructed the ground, snow points were retained in the ground model to avoid expansive interpolation across snow fields. In areas where snow prevented laser penetration, ground elevations may be offset from the true ground. A shapefile delineating areas of snow was created for affected deliveries. The shapefile attribution includes a field designating each area as "classified" –meaning valid ground returns exist beneath the snow, or "suspected"- meaning no valid ground returns exist, but the area was identified as snow using the return intensity pattern. Because of temporal differences in neighboring flight mission areas, a 'stair step' artifact occurs in quad XMHA4 as a result of snow melt on the river valley between June 7th and June 27th, 2011.

The remaining points not classified as ground, snow, buildings, or error points were separated into two vegetation classes; Low Vegetation consisting of all returns ≤20cm from the ground, and Medium Vegetation consisting of all returns >20cm from the ground. This distinction was necessary because some potential for unclassified ground exists in the dataset. Vegetation classified returns within 20cm of the ground have higher potential to be artifacts of the dataset caused by minor offsets between flightlines (typically <10cm), isolated noise points, or abrupt discrete terrain features that did not get classified as ground (i.e. small boulders or sharp cliffs). The majority of points classified as low vegetation are valid returns, so the class was retained in the dataset to be incorporated into analyses at the user's discretion.

**Table 3.** ASPRS classification definitions for the Alaska Pipeline LiDAR survey.

| ASPRS Class | Definition |
|---|---|
| 2 | Ground |
| 3 | Low Vegetation |
| 4 | Medium Vegetation |
| 6 | Buildings/Man-made structures |
| 7 | Noise/error points |
| 9 | Water |
| 10 | Snow |
| 15 | Pipeline |

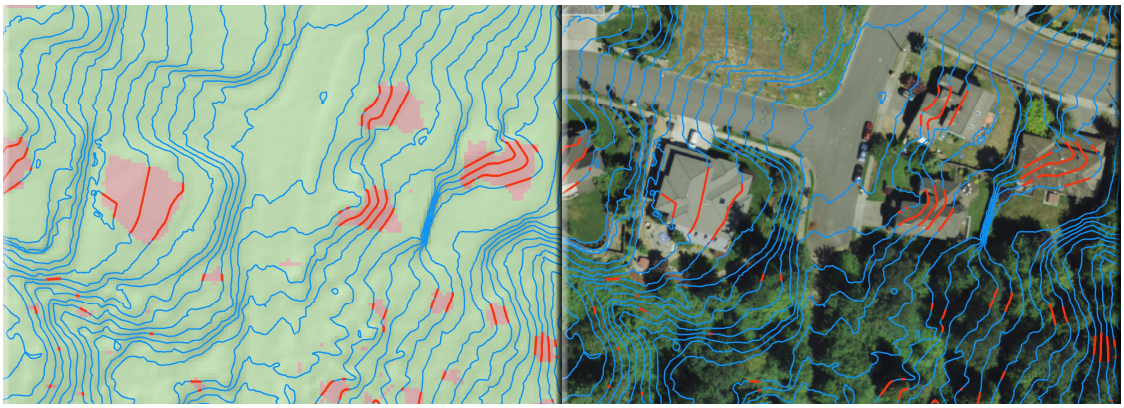


## 3.4 Contour Development

Contour lines were derived at 1 meter intervals from ground-classified LiDAR point data using TerraSolid processing software in MicroStation v. 8.1. Contour generation from LiDAR point data requires a thinning operation in order to reduce contour sinuosity. Parameters for these operations are: thinning elevation bounds: +/- 0.07m; search radius: 6.09m. The thinning operation reduces point density where topographic change is minimal (flat surfaces) while preserving resolution where topographic change is present. The total sum of potential error in vertical position is equal to twice the point processing limits (0.14m) plus twice the 2-sigma absolute vertical accuracy value for this dataset.

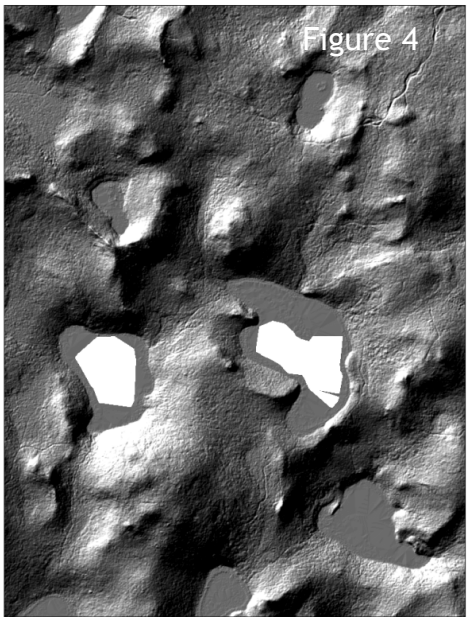
Ground point density rasters were created within MicroStation using a 1 meter step resolution and a 2 meter sampling radius. Areas with less than 0.25 ground-classified points per square meter were considered "sparse" and areas with higher densities were considered "covered". The ground point density raster data are in ESRI GRID format and have a 1 meter pixel resolution. The contour lines were intersected with ground point density raster data, allowing the addition of a confidence attribute to contour lines. Contour lines over "sparse" areas have low confidence, while contour lines over "covered" areas have a high confidence. Areas with low ground point density are commonly beneath buildings and bridges, in locations with dense vegetation, over water, and in other areas where laser penetration to the ground surface is impeded. **Figure 3** is an example of a ground point density raster and contour lines.

***Figure 3**. Elevation contours over LiDAR ground-classified point density raster (left) and true-color aerial photograph (right). Red indicates low ground point density and blue represents high density.*

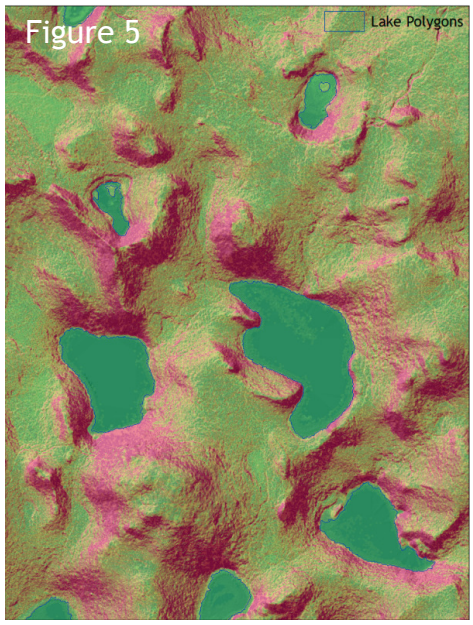


## 3.5 Hydro-Flattening

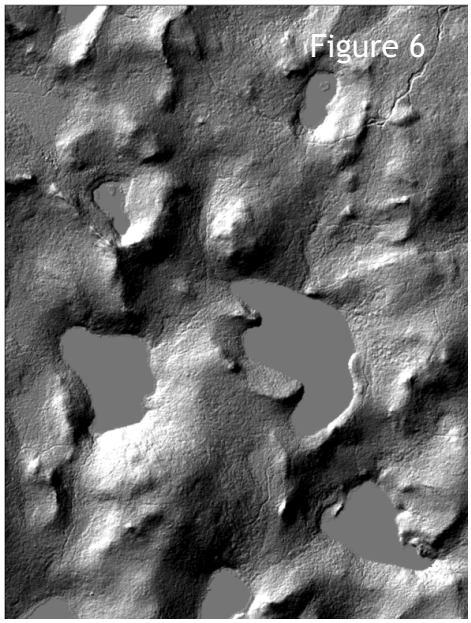
Lakes and other closed water bodies with surface area >150 $m^2$ were flattened to a consistent water level. The hydro-flattening process eliminates artifacts in the digital terrain model caused by both increased variability in ranges or dropouts in laser returns due to the low reflectivity of water (**Figure 4**). As per the project specifications, rivers and streams were not hydro-flattened.




Hydro-flattening of closed water bodies was performed through a combination of automated and manual detection and adjustment techniques designed to identify lake boundaries and water levels. Boundary polygons were developed using an algorithm which weights LiDAR-derived slopes, intensities, and return densities to detect the lake edge. The lake edges were then manually reviewed and edited in a 3-D environment. Once polygons were developed, the lake elevations were computed from the filtered LiDAR returns (**Figure 5**).




Returns from the water surface within each polygon were filtered and inspected for false low points during the initial ground modeling process described previously (Section 3.3). The elevation of each lake was computed as 5-cm above the minimum elevation of filtered water surface cells within the lake polygon. This approach ensures that all spurious returns off the water surface (both artificially high and low) were excluded from lake level assessment.




Lake-boundary polygons were then incorporated into the final terrain model and enforced as hard-breaklines. The initial ground classified points falling within lake polygons were reclassified as water points [to omit them from the final ground model] and replaced with the flat water surface of the lake boundary hydrolines (**Figure 6**).

# 4. LiDAR Accuracy Assessment

## 4.1 Laser Noise and Relative Accuracy

*Laser Noise*
For any given target, laser noise is the breadth of the data cloud per laser return (i.e., last, first, etc.). Lower intensity surfaces (roads, rooftops, still/calm water) experience higher laser noise. The laser noise range for this survey was approximately 0.02 meters.

*Relative Accuracy*
Relative accuracy refers to the internal consistency of the data set - the ability to place a laser point in the same location over multiple flight lines, GPS conditions, and aircraft attitudes. Affected by system attitude offsets, scale, and GPS/IMU drift, internal consistency is measured as the divergence between points from different flight lines within an overlapping area. Divergence is most apparent when flight lines are opposing. When the LiDAR system is well calibrated, the line-to-line divergence is low (<10 cm). See Appendix A for further information on sources of error and operational measures that can be taken to improve relative accuracy.

**Relative Accuracy Calibration Methodology**

1. Manual System Calibration: Calibration procedures for each mission require solving geometric relationships that relate measured swath-to-swath deviations to misalignments of system attitude parameters. Corrected scale, pitch, roll and heading offsets were calculated and applied to resolve misalignments. The raw divergence between lines was computed after the manual calibration was completed and reported for each survey area.
2. Automated Attitude Calibration: All data were tested and calibrated using TerraMatch automated sampling routines. Ground points were classified for each individual flight line and used for line-to-line testing. System misalignment offsets (pitch, roll and heading) and scale were solved for each individual mission and applied to respective mission datasets. The data from each mission were then blended when imported together to form the entire area of interest.
3. Automated Z Calibration: Ground points per line were used to calculate the vertical divergence between lines caused by vertical GPS drift. Automated Z calibration was the final step employed for relative accuracy calibration.

## 4.2 Absolute Accuracy

Laser point absolute accuracy is largely a function of laser noise and relative accuracy. To minimize these contributions to absolute error, a number of noise filtering and calibration procedures were performed prior to evaluating absolute accuracy. The LiDAR quality assurance process uses the data from the real-time kinematic (RTK) ground survey conducted in the AOI. For Delivery 11, **5571 RTK** GPS measurements were collected on hard surfaces distributed among multiple flight swaths for a total of 31,640 points across all delivered data. Suitable and accessible hard-surfaces limited the number and distribution of RTK points able to be collected. To assess absolute accuracy the location coordinates of these known RTK ground points were compared to those calculated for the closest ground-classified laser points.

The vertical accuracy of the LiDAR data is described as the mean and standard deviation (sigma ~ $\sigma$) of divergence between LiDAR point coordinates and RTK ground survey point coordinates. To provide a sense of the model predictive power of the dataset, the root mean square error (RMSE) for vertical accuracy is also provided. These statistics assume the error distributions for x, y, and z are normally distributed, thus the skew and kurtosis of distributions are considered when evaluating error statistics.

Statements of statistical accuracy apply to fixed terrestrial surfaces only and may not be applied to areas of dense vegetation or steep terrain (See Appendix A).

# 5. Study Area Results

Summary statistics for point resolution and accuracy (relative and absolute) of the LiDAR data collected in the Alaska Pipeline Delivery 11 survey area have been added to previously delivered data. Cumulative results are presented below in terms of central tendency, variation around the mean, and the spatial distribution of the data (for point resolution by processing bin).

The initial dataset, acquired to be ≥8 points per square meter, was filtered as described previously to remove spurious or inaccurate points. Additionally, some types of surfaces (i.e., dense vegetation, breaks in terrain, water, steep slopes) may return fewer pulses (delivered density) than the laser originally emitted (native density).

Ground classifications were derived from automated ground surface modeling and manual, supervised classifications where it was determined that the automated model had failed. Ground return densities will be lower in areas of dense vegetation, water, or buildings.

## Data Summary:

***Table 4****. LiDAR Resolution and Accuracy - Specifications and Achieved Values*

| | | Targeted | Achieved |
|---|---|---|---|
| **Resolution:** | **UTM 5** | ≥ 8 points/$m^2$ | 8.60 points/$m^2$ |
| | **UTM 6** | | 8.75 points/$m^2$ |
| | **UTM 7** | | 8.88 points/$m^2$ |
| **Vertical Accuracy (RMSE):** | | <13 cm | 3.9 cm |

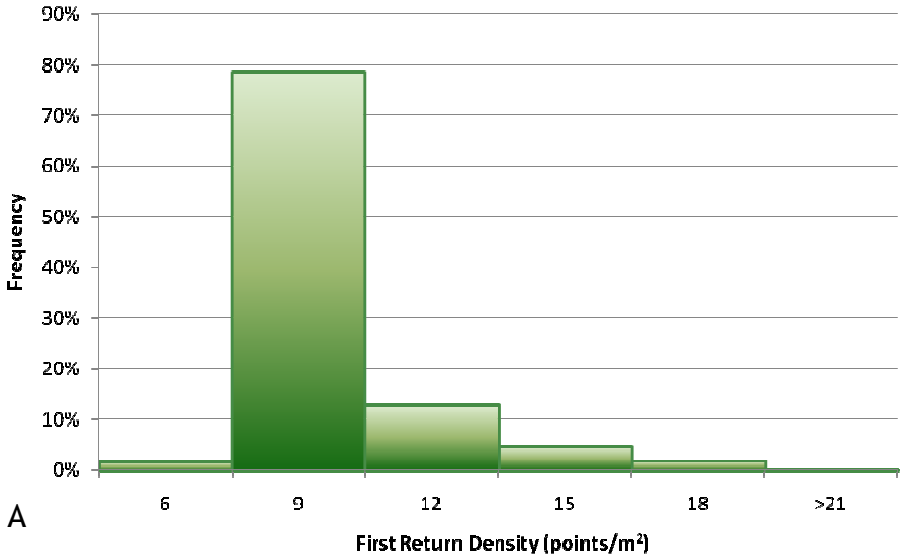
## 5.1 Data Density/Resolution

**Figures 10 - 28** display the distribution of average native and ground point densities for each processing bin.

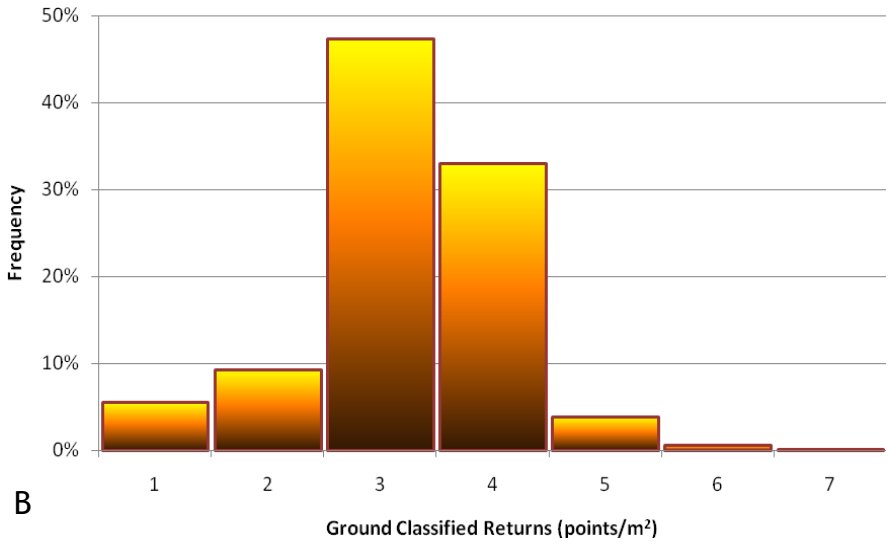
LiDAR data resolution for Alaska Pipeline:

| | UTM 5 | UTM 6 | UTM 7 |
|---|---|---|---|
| Average Point (First Return) Density | 8.60 points/$m^2$ | 8.75 points/$m^2$ | 8.88 points/$m^2$ |
| Average Ground Point Density | 2.72 points/$m^2$ | 2.70 points/$m^2$ | 2.78 points/$m^2$ |

***Figure 7**. Density distribution for first return (A) and ground classified (B) laser points for UTM 5*

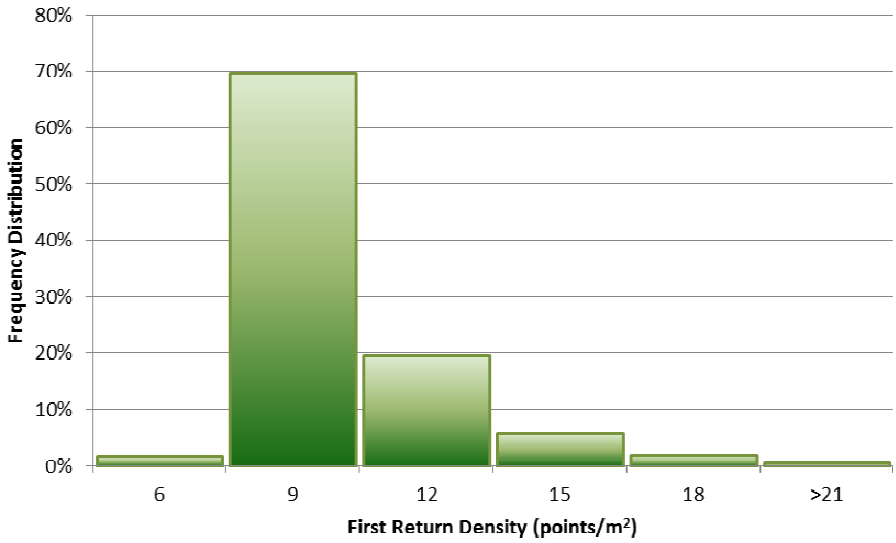



A

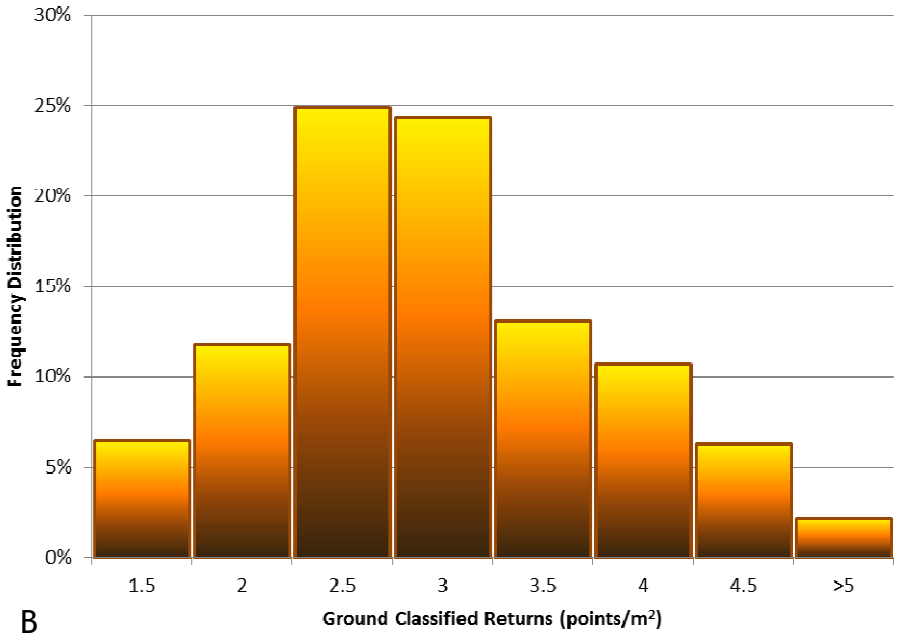



B

***Figure 8.*** *Density distribution for first return (A) and ground classified (B) laser points for UTM 6*

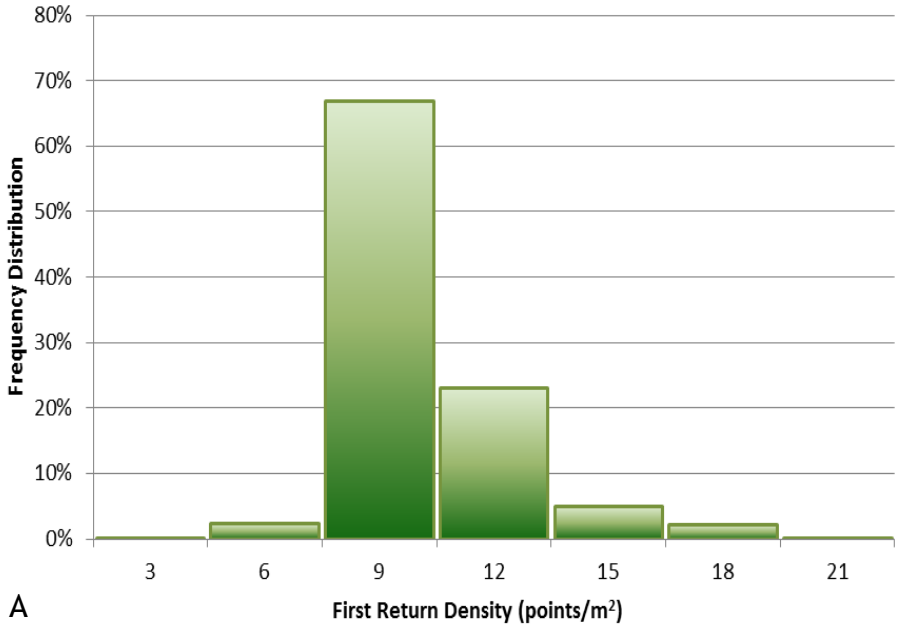



A

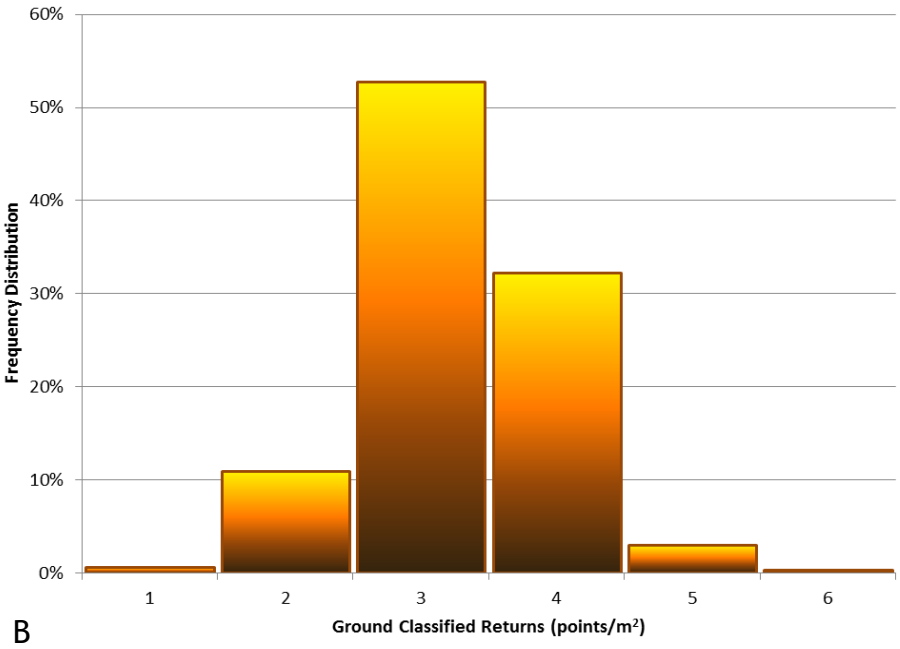



B

***Figure 9**. Density distribution for first return (A) and ground classified (B) laser points for UTM 7*




A




B

***Figure 10**. Density distribution map for ground and first return points by processing bin in Delivery 1, UTM 6*



***Figure 11.*** *Density distribution map for ground and first return points by processing bin in Delivery 1, UTM 7*

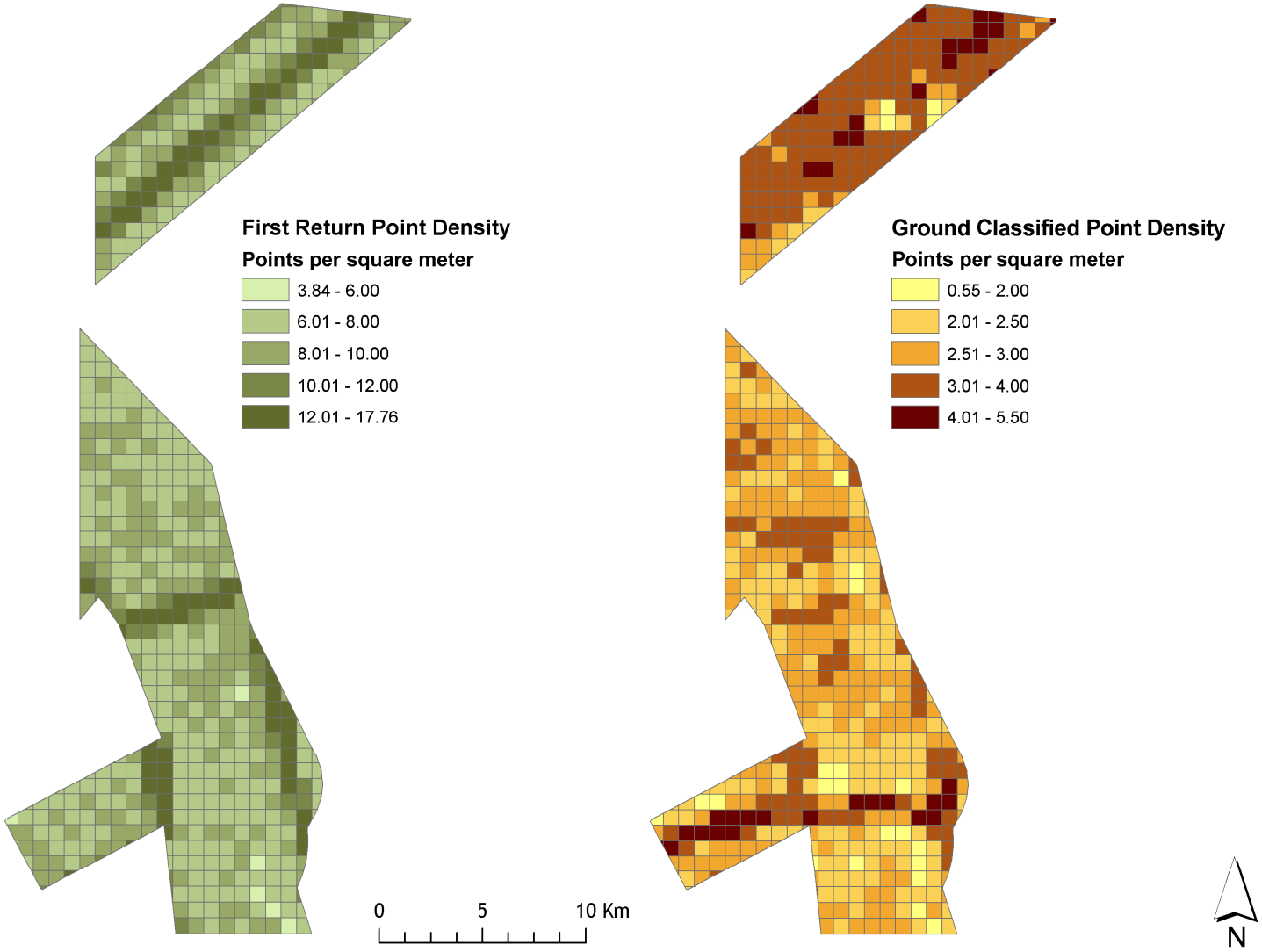


***Figure 12.*** *Density distribution map for ground points by processing bin in Delivery 2, UTM 6*

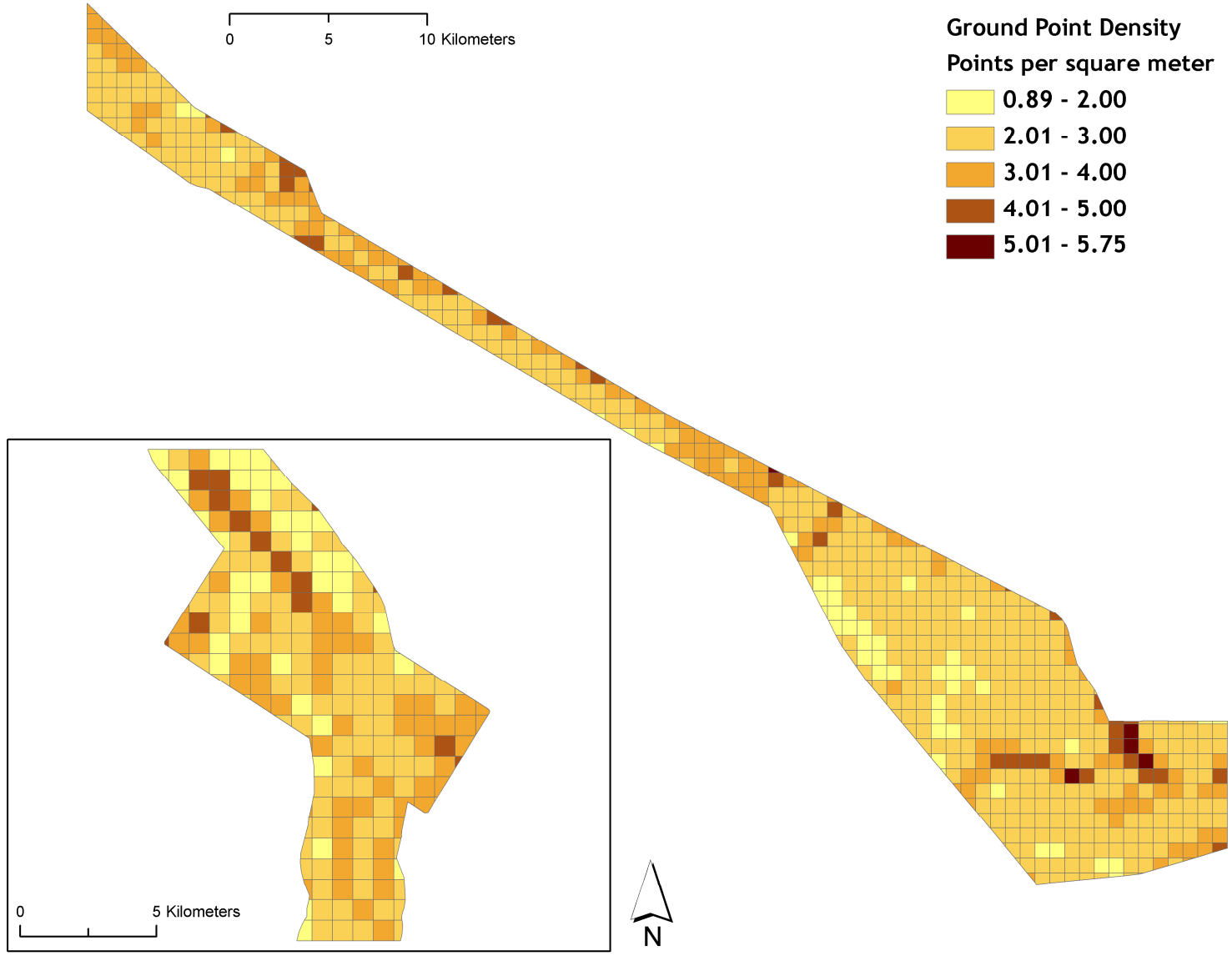


***Figure 13**. Density distribution map for first return points by processing bin in Delivery 2, UTM 6*

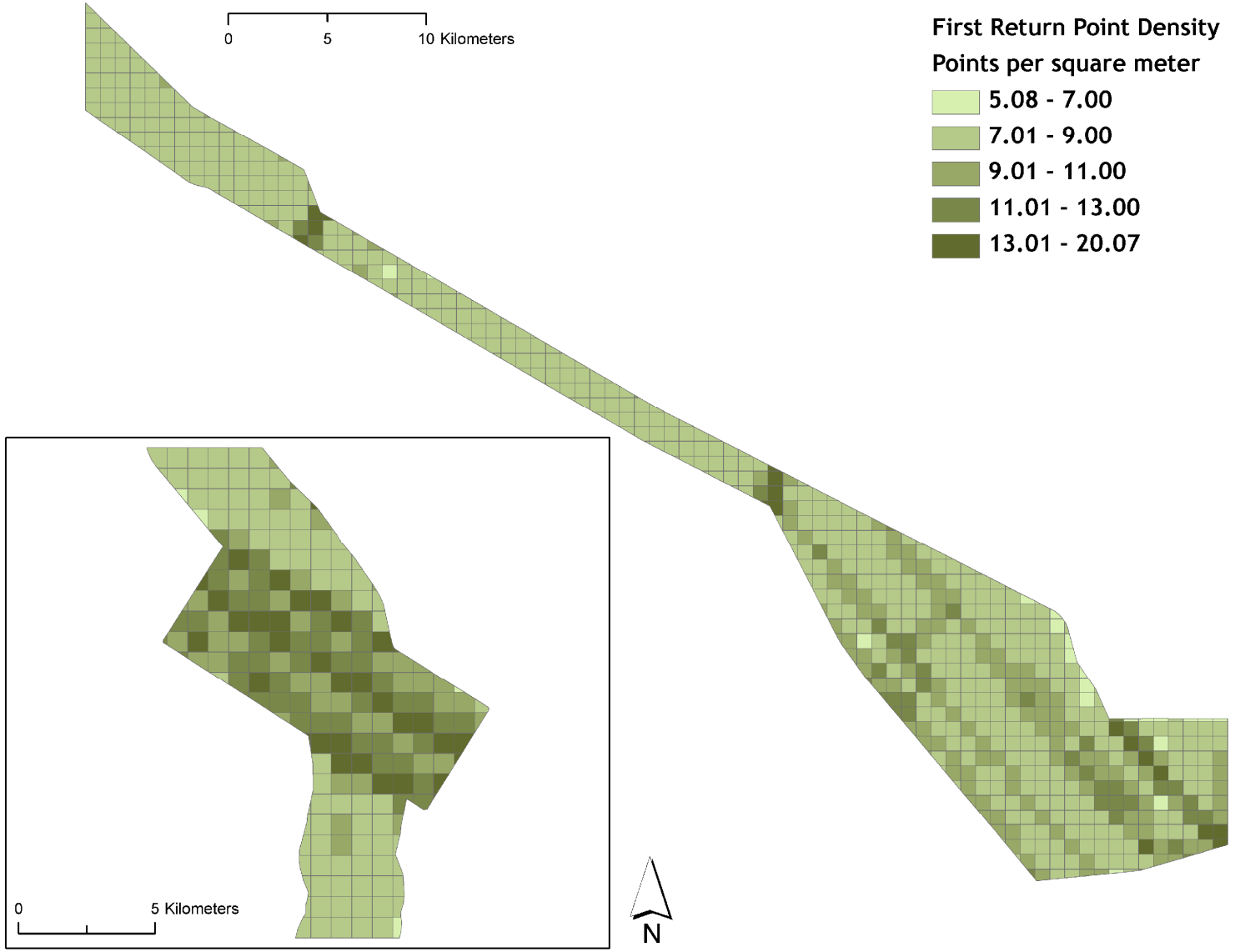


***Figure 14**. Density distribution map for ground and first return points by processing bin in Delivery 3, UTM 7*

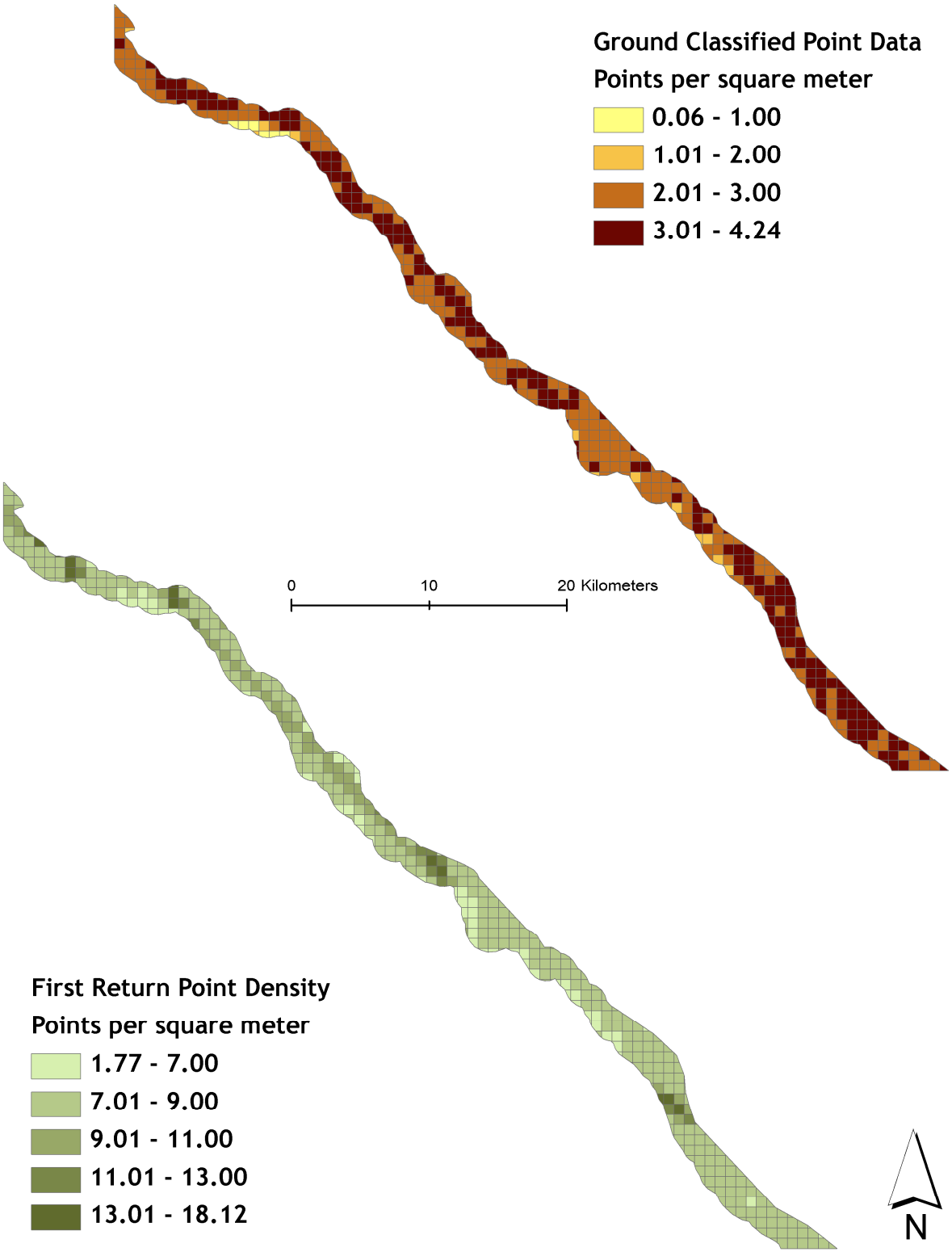


***Figure 15**. Density distribution map for ground and first return points by processing bin in Delivery 4, UTM 6*

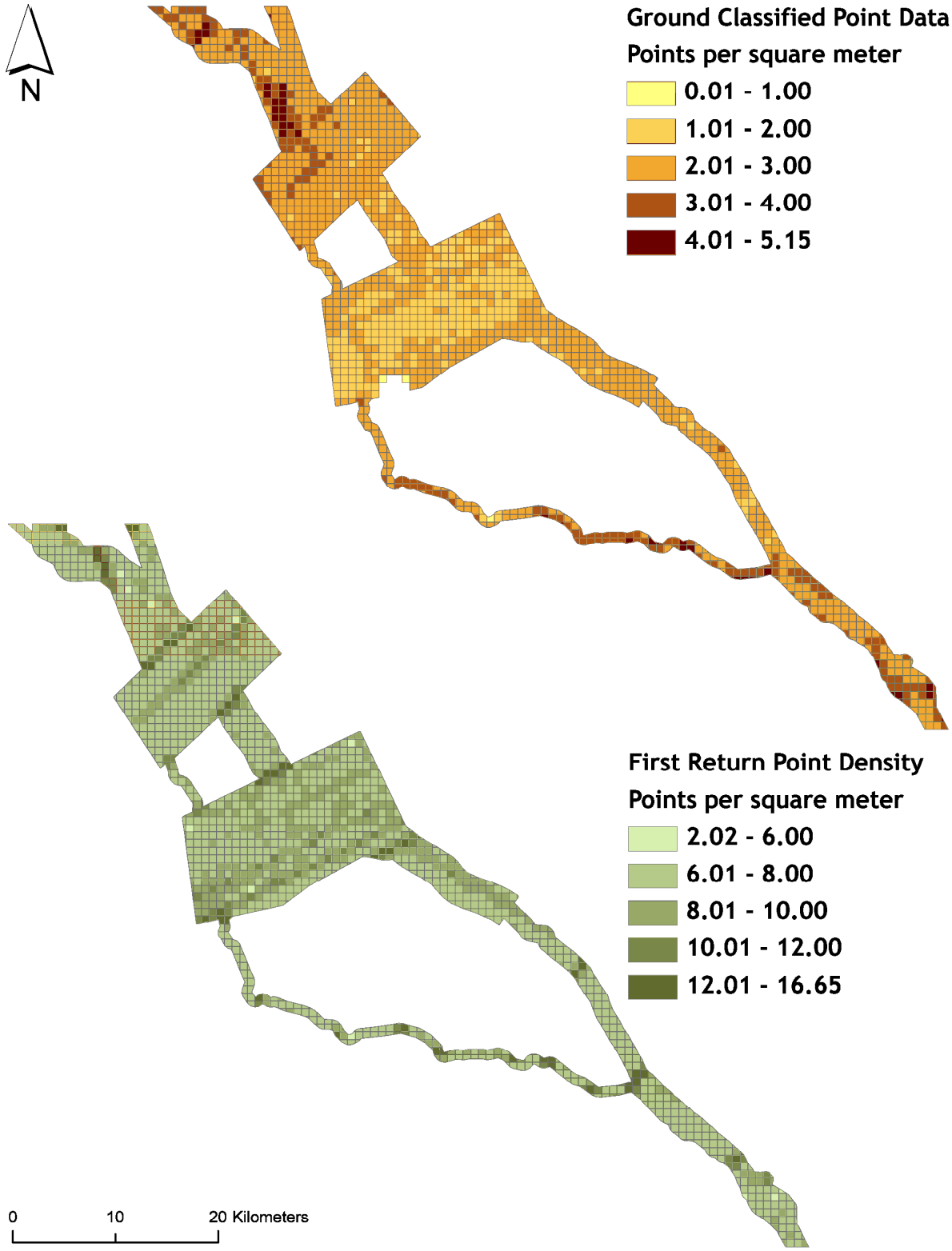


***Figure 16**. Density distribution map for ground classified points by processing bin in Delivery 5, UTM 5*



***Figure 17.*** *Density distribution map for first return points by processing bin in Delivery 5, UTM 5*



***Figure 18**. Density distribution map for ground classified points by processing bin in Delivery 6, UTM 6*

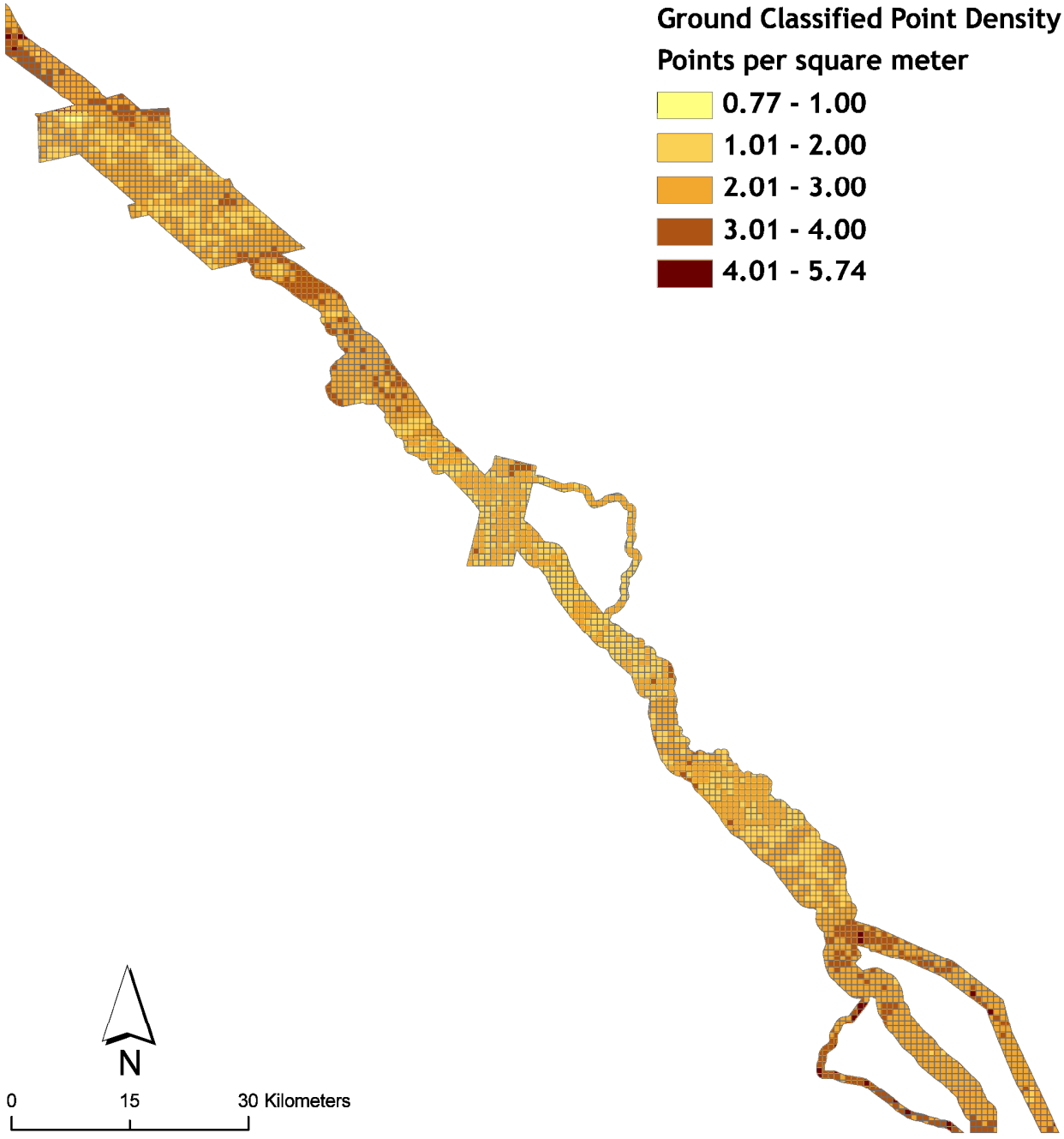


***Figure 19**. Density distribution map for first return points by processing bin in Delivery 6, UTM 6*

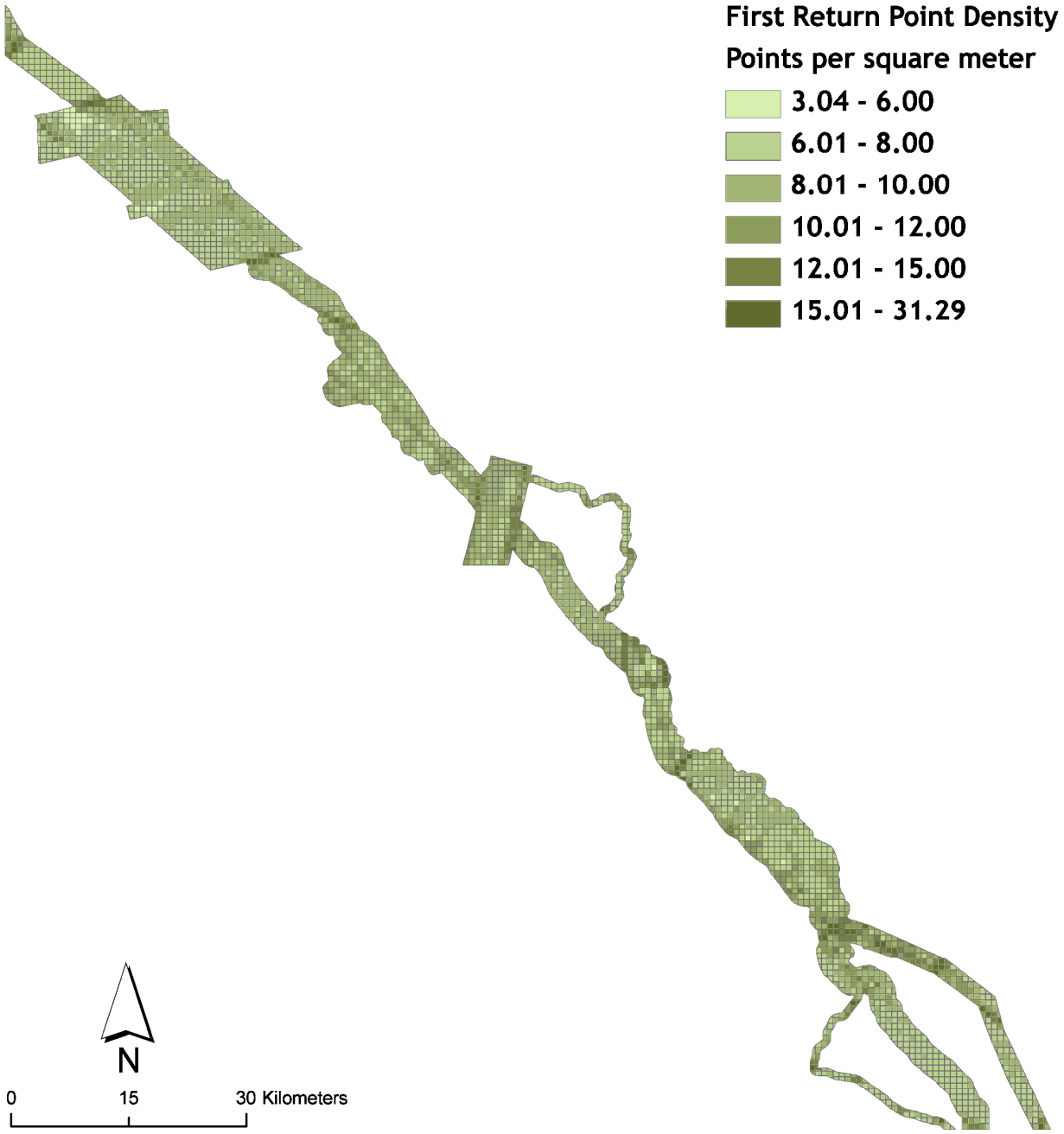


***Figure 20**. Density distribution map for ground classified points by processing bin in Delivery 7, UTM 6*

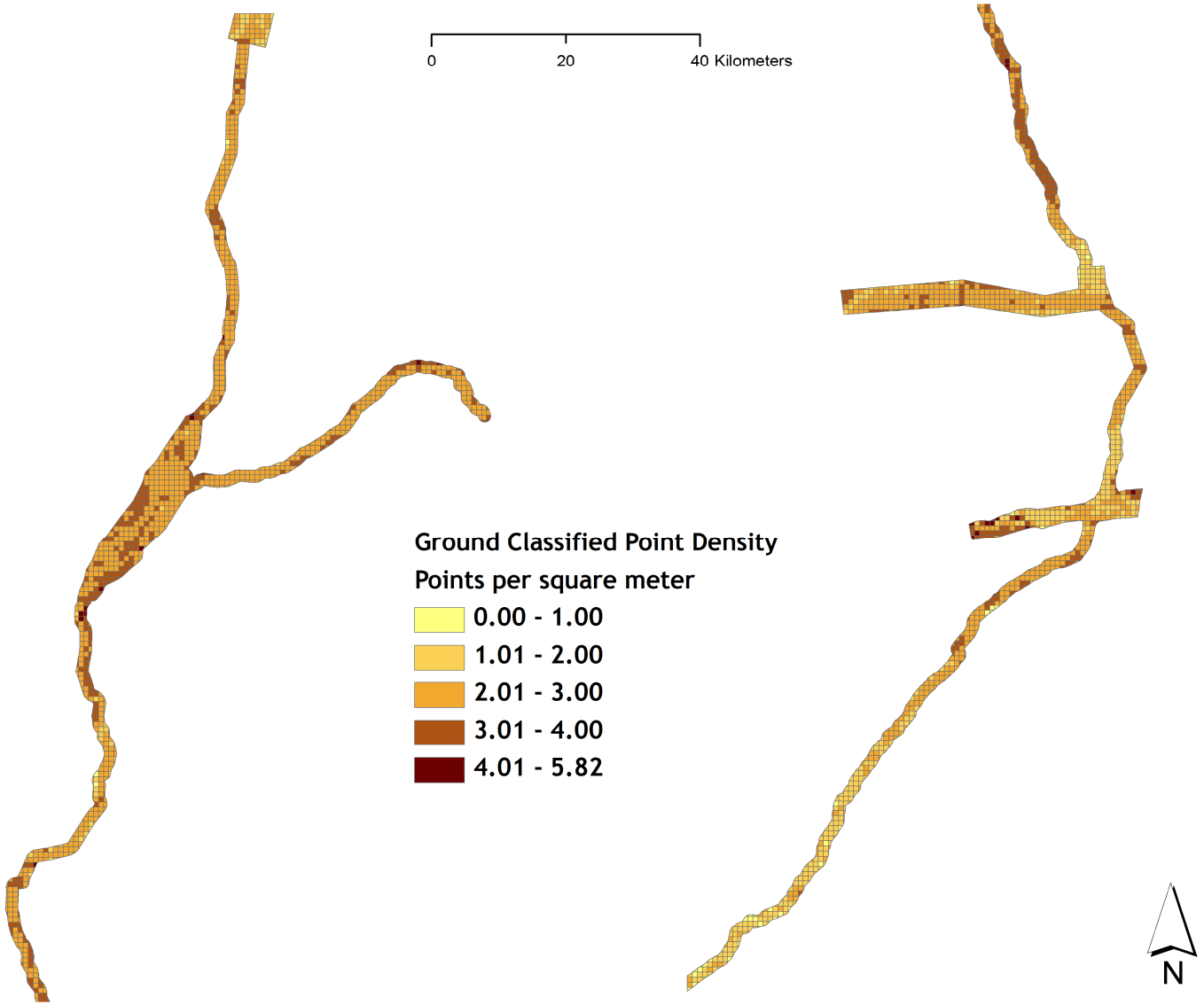


***Figure 21**. Density distribution map for first return points by processing bin in Delivery 7, UTM 6*



***Figure 22**. Density distribution map for ground classified points by processing bin in Delivery 8, UTM 7*

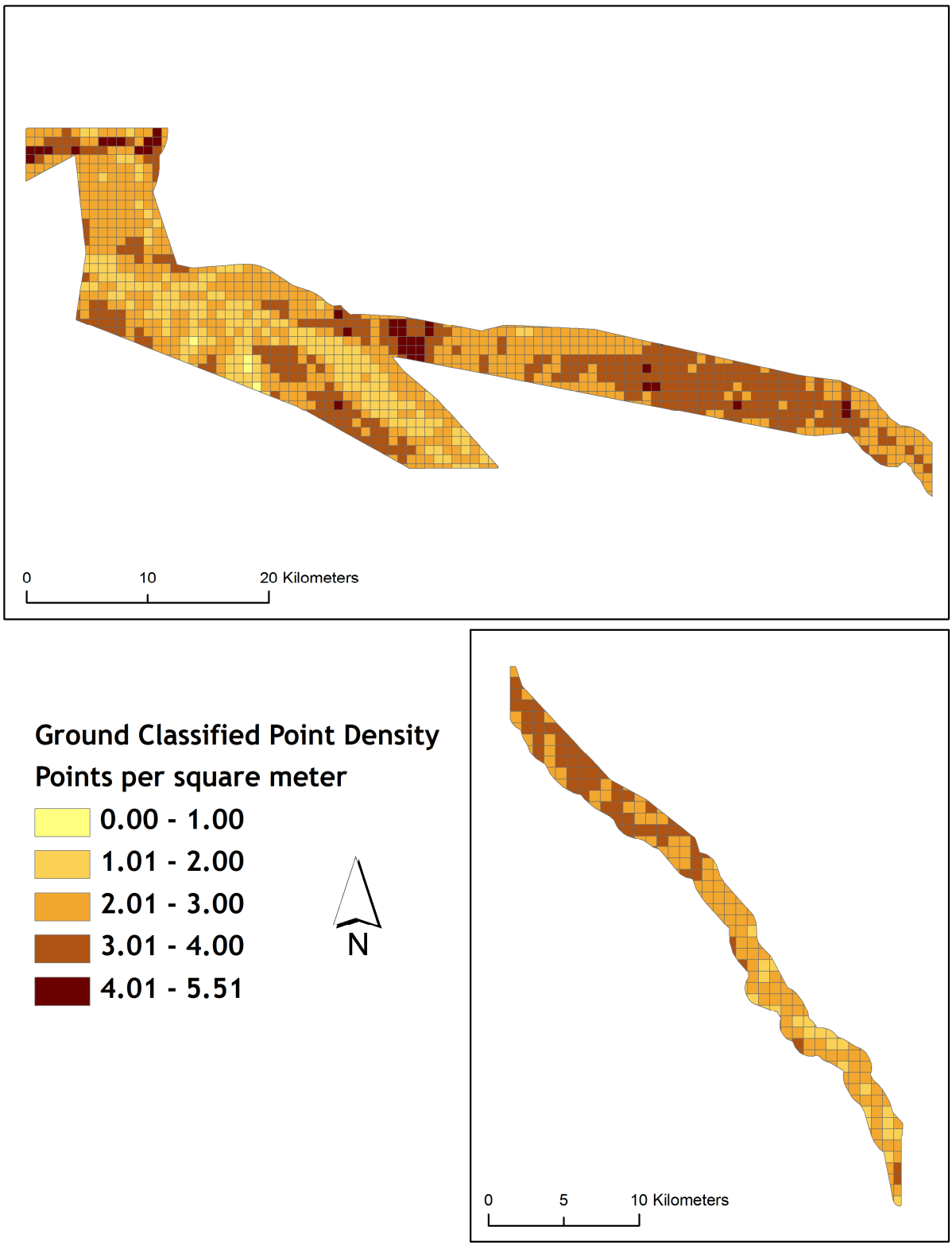


***Figure 23**. Density distribution map for first return points by processing bin in Delivery 8, UTM 7*

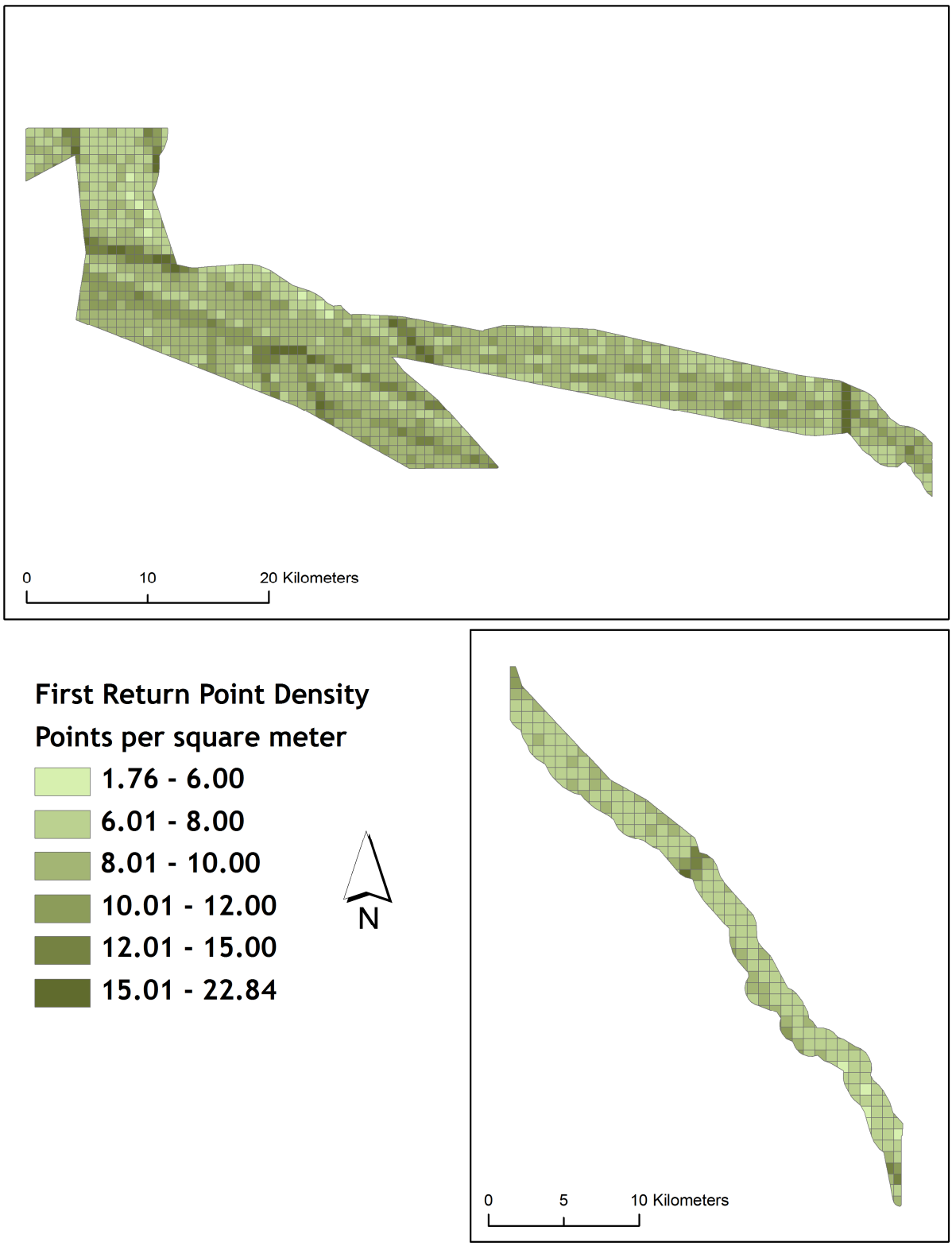


***Figure 24**. Density distribution map for first return and ground classified points by processing bin in Delivery 9, UTM 6*

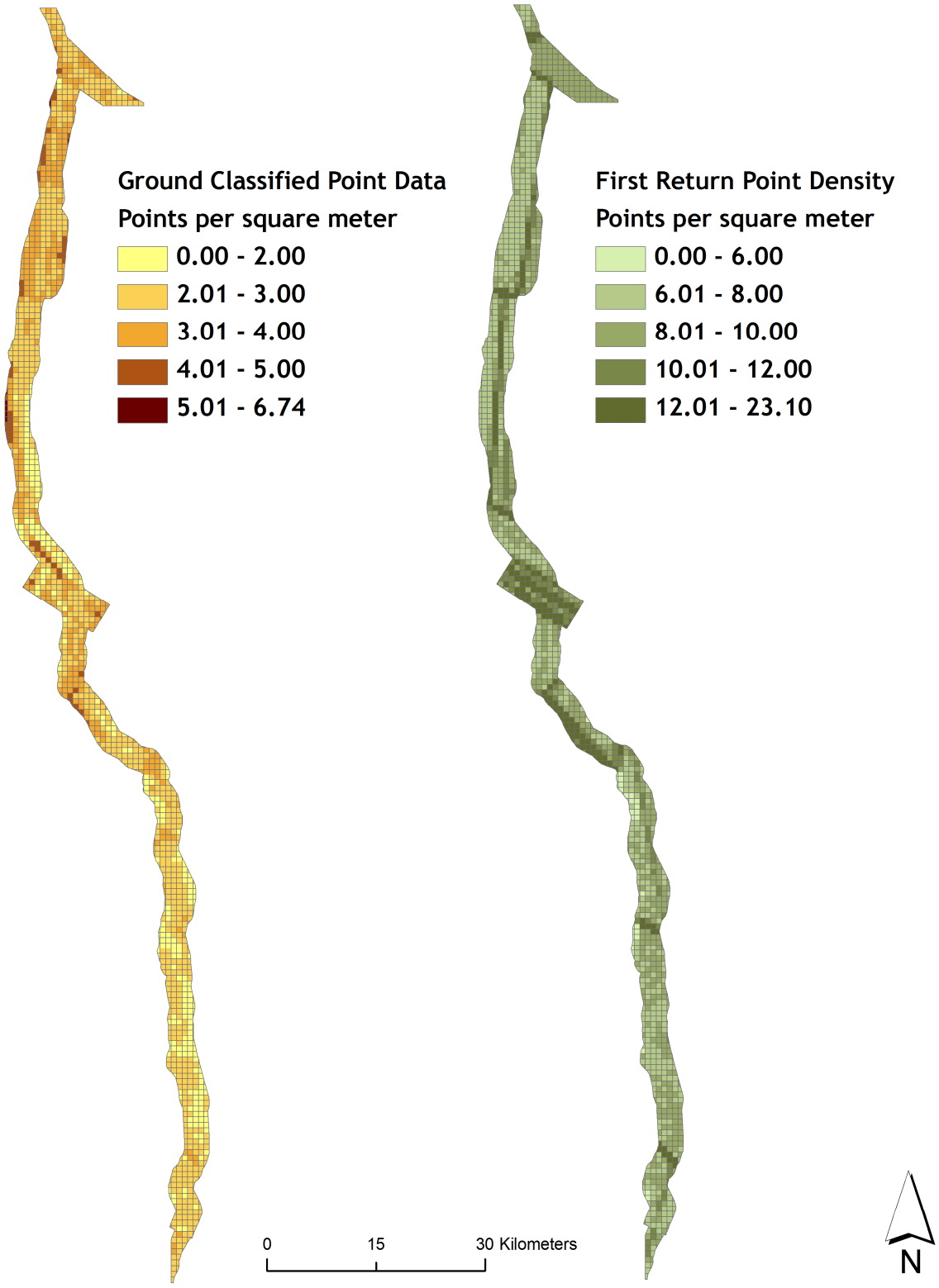


***Figure 25**. Density distribution map for ground classified points by processing bin in Delivery 10, UTM 6*

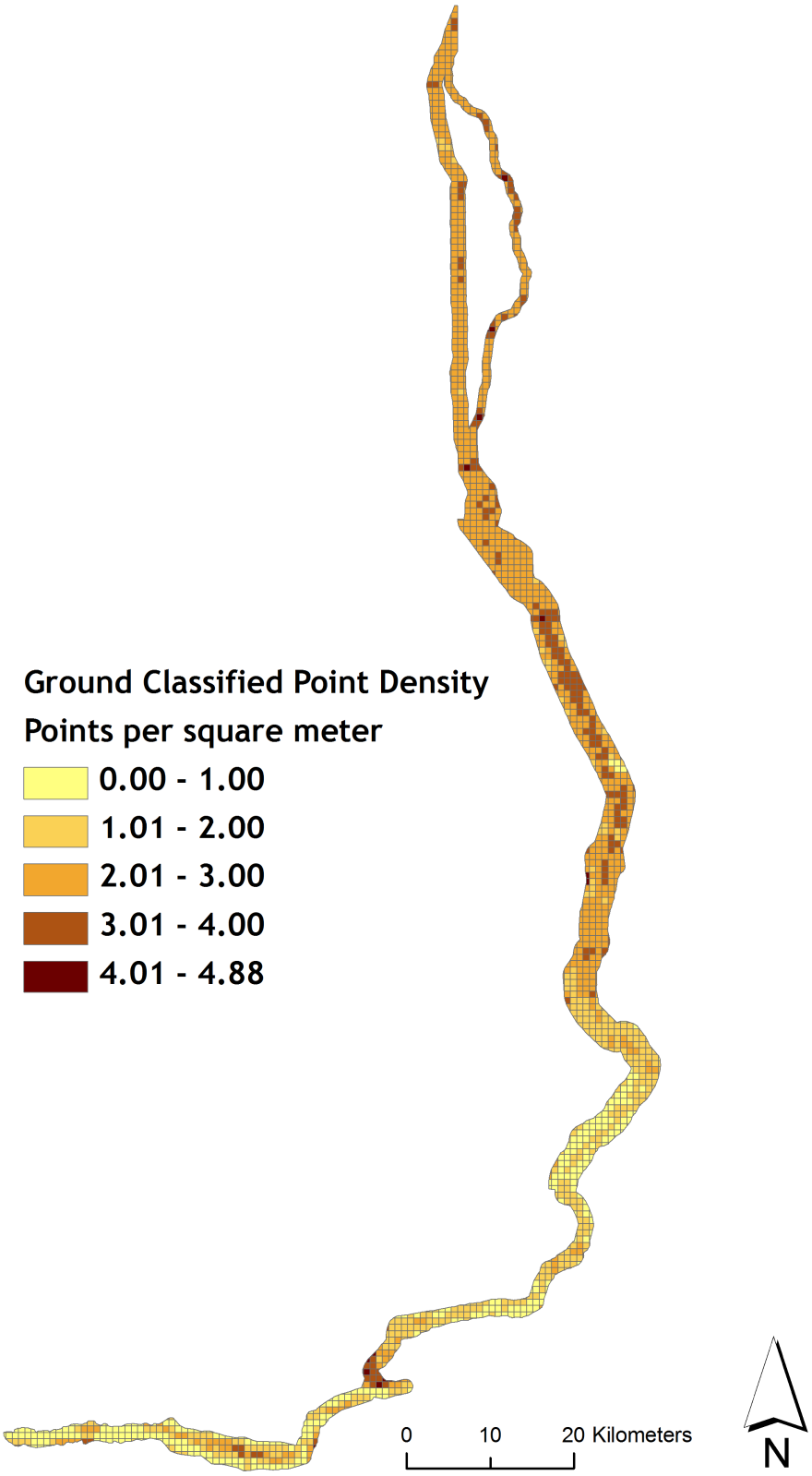


***Figure 26**. Density distribution map for first return points by processing bin in Delivery 10, UTM 6*

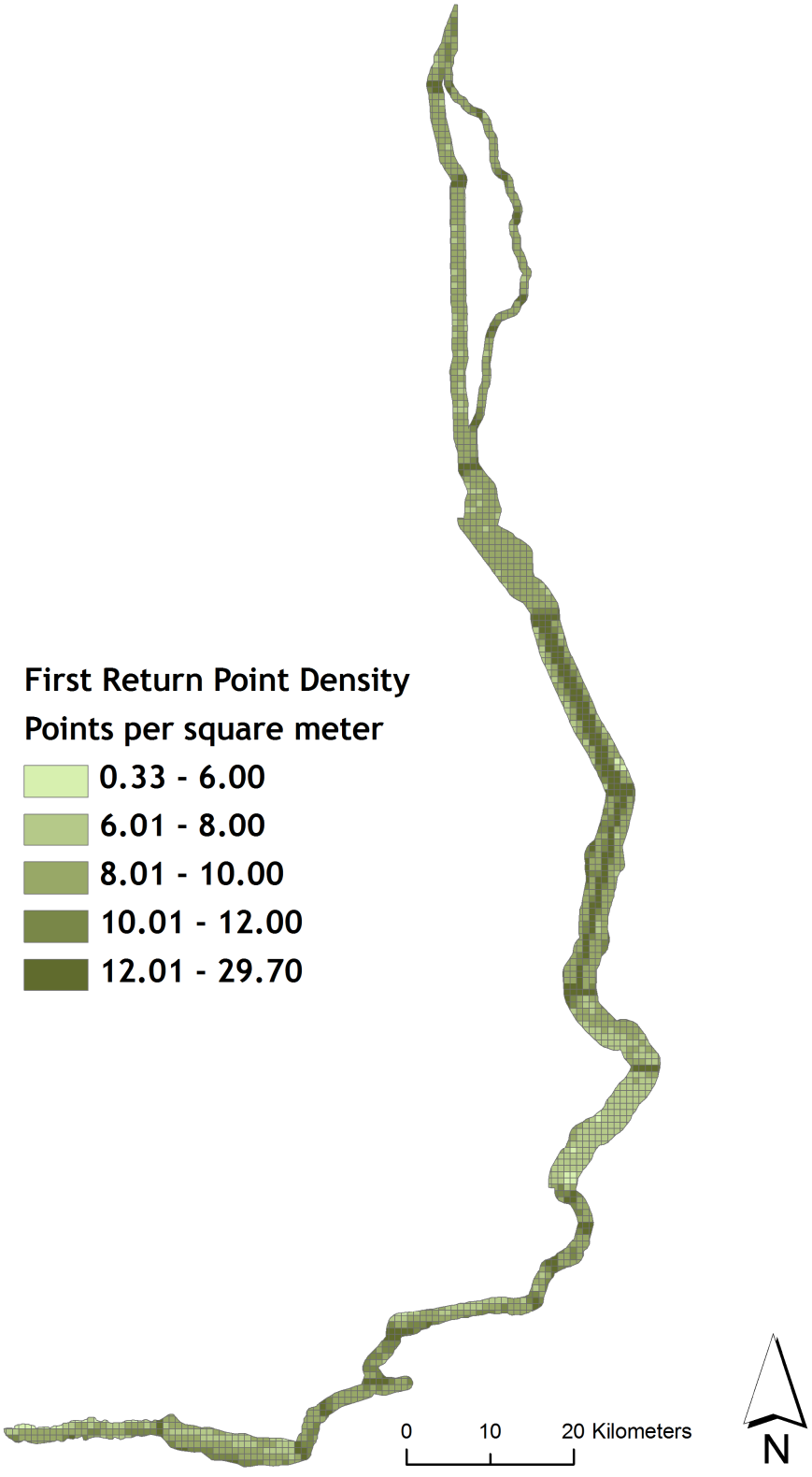


***Figure 27**. Density distribution map for ground classified points by processing bin in Delivery 10, UTM 6*

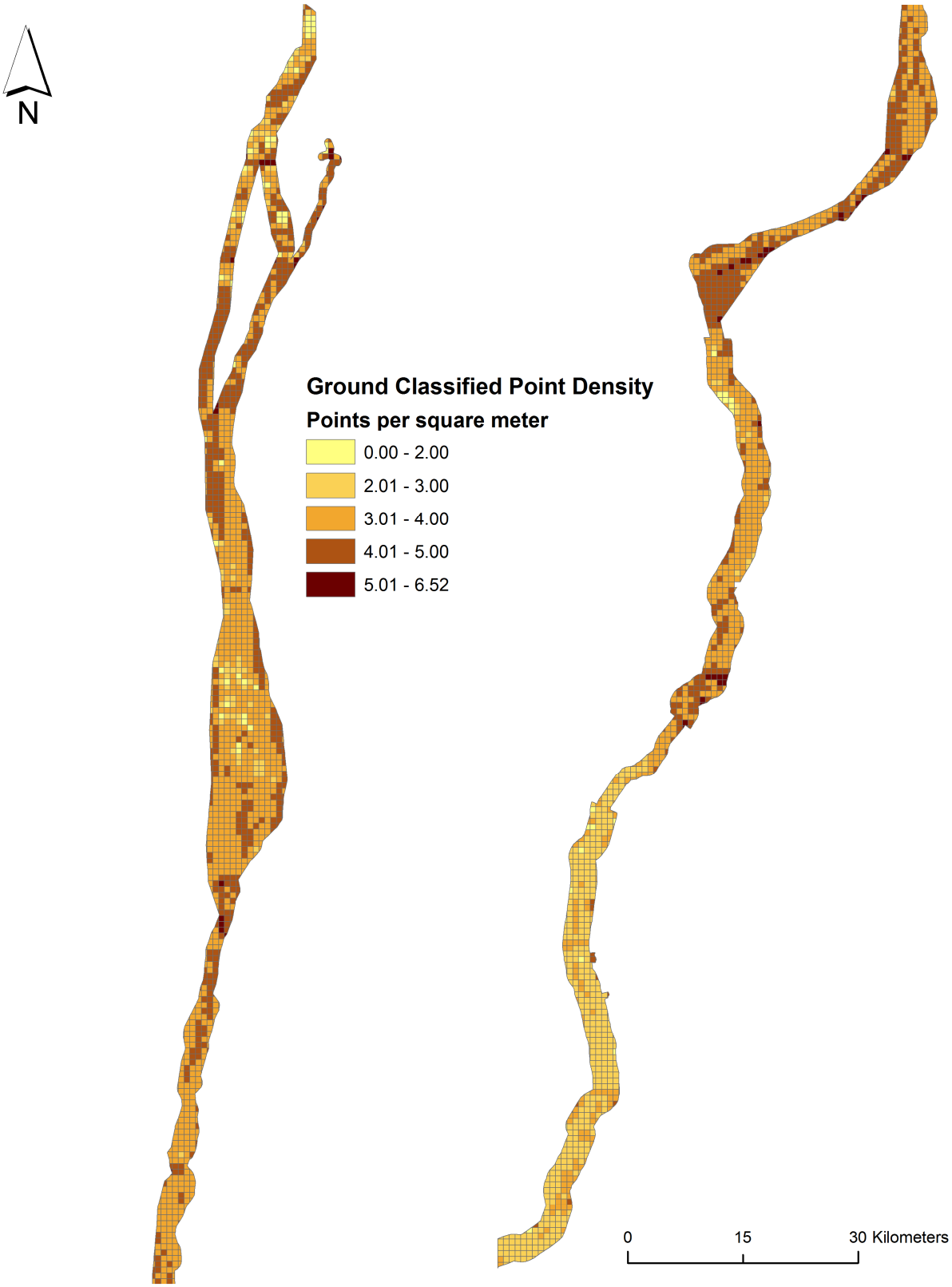
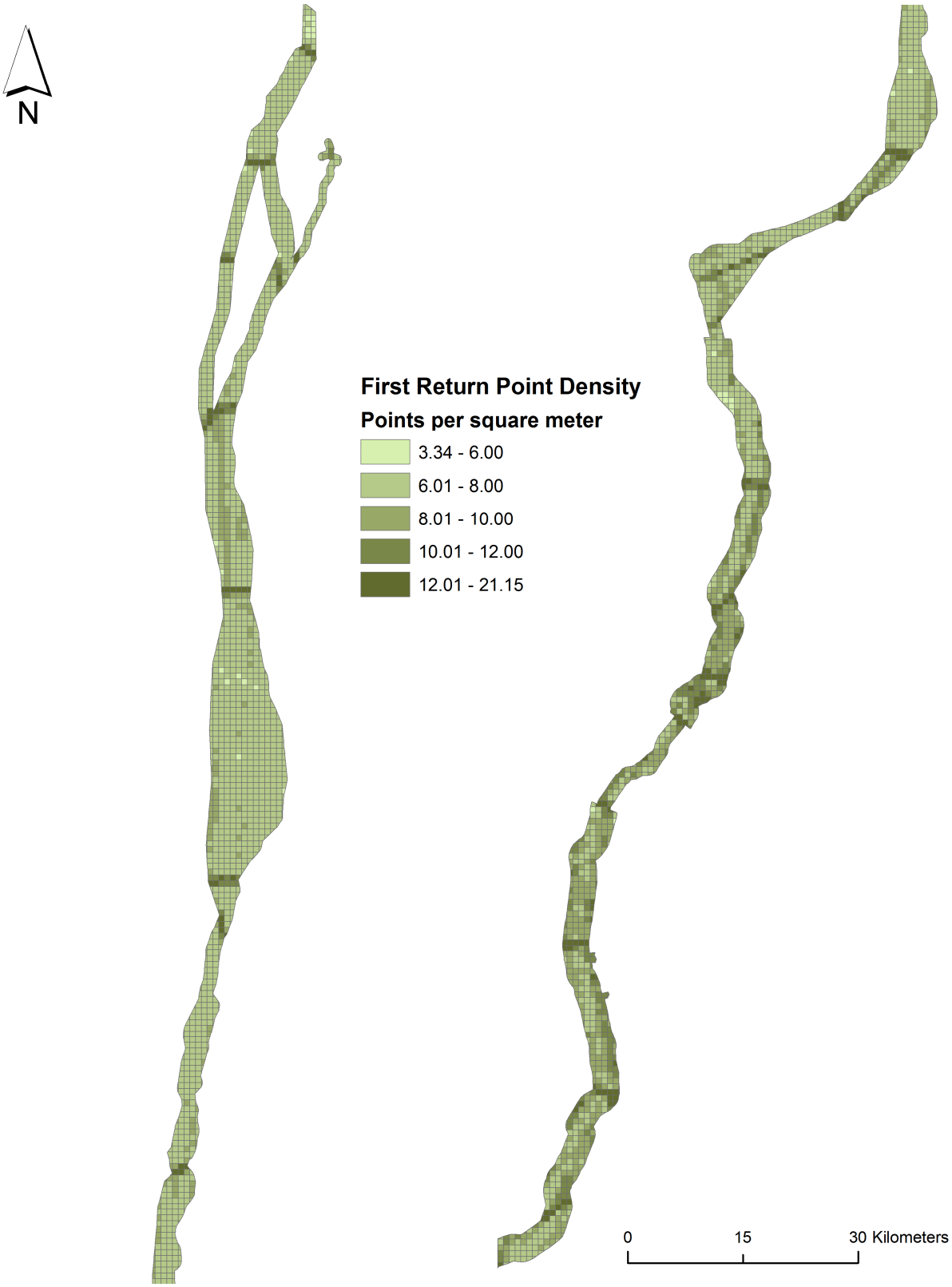


***Figure 28**. Density distribution map for first return points by processing bin in Delivery 11, UTM 6*

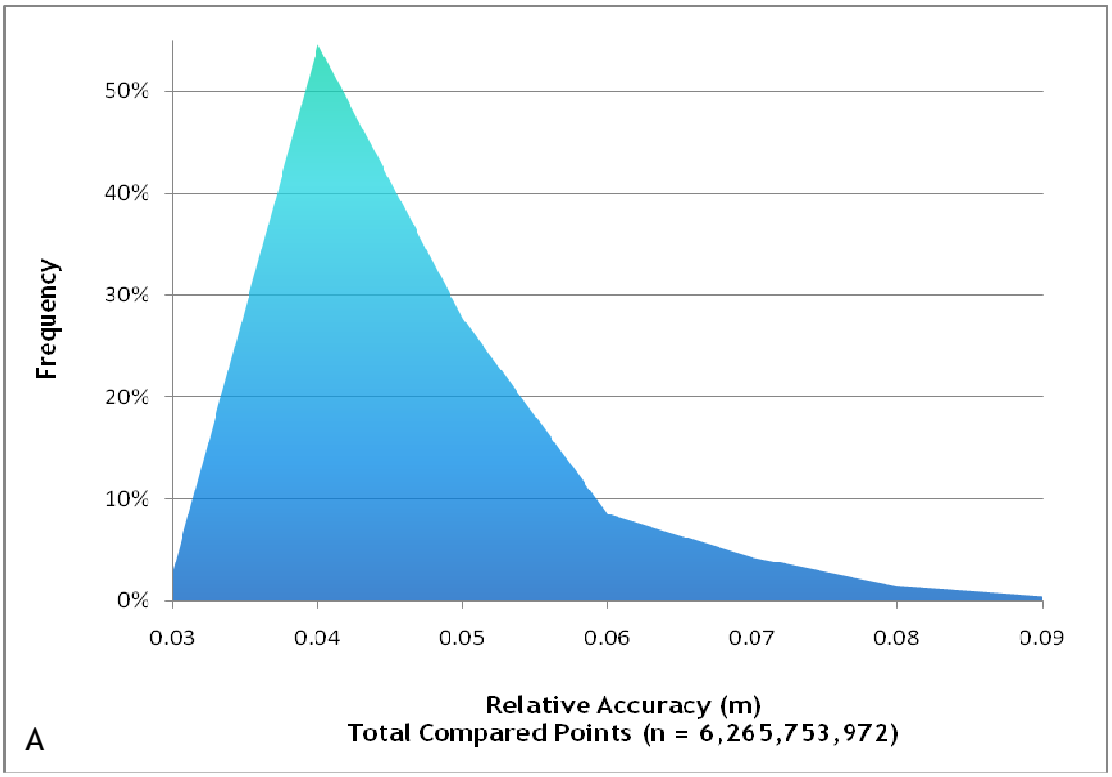


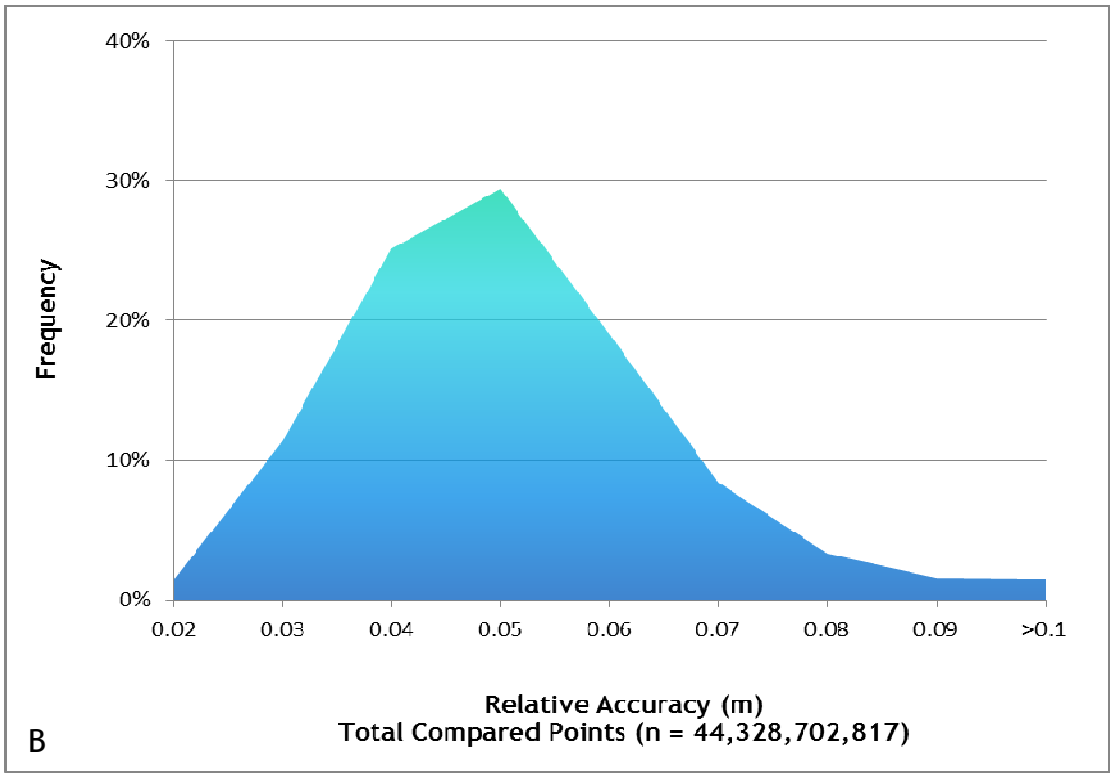
## 5.2 Relative Accuracy Calibration Results

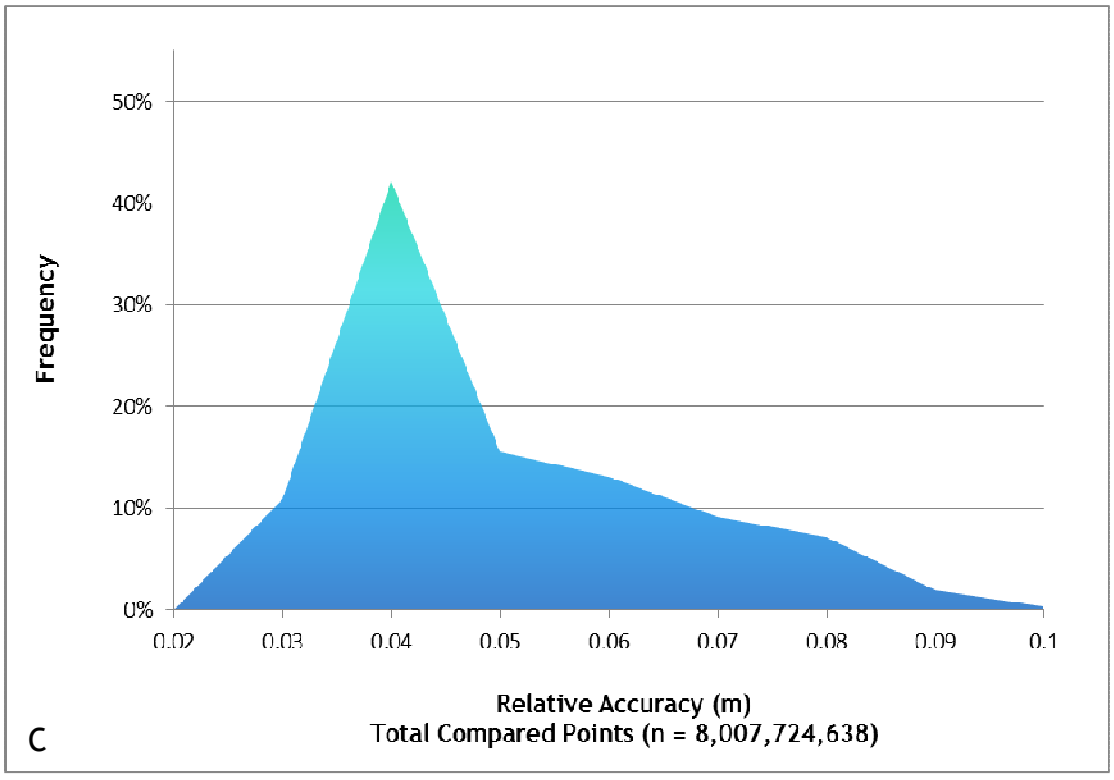
***Table 5**. Cumulative relative accuracy statistics for Alaska Pipeline.*

| | UTM 5 | UTM 6 | UTM 7 |
|---|---|---|---|
| Project Average | 0.039m | 0.043m | 0.036m |
| Median Relative Accuracy | 0.039m | 0.045m | 0.039m |
| 1σ Relative Accuracy | 0.010m | 0.015m | 0.015m |
| 1.96σ Relative Accuracy | 0.019m | 0.030m | 0.030m |

***Figure 29**. Distribution of cumulative relative accuracies in UTM5 (A) UTM 6 (B) and UTM 7 (C) per flight line, non slope-adjusted*




40%
30%
20%
10%
0%
Frequency
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
>0.1
Relative Accuracy (m)
Total Compared Points (n = 44,328,702,817)
B


50%
40%
30%
20%
10%
0%
Frequency
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1
Relative Accuracy (m)
Total Compared Points (n = 8,007,724,638)
C

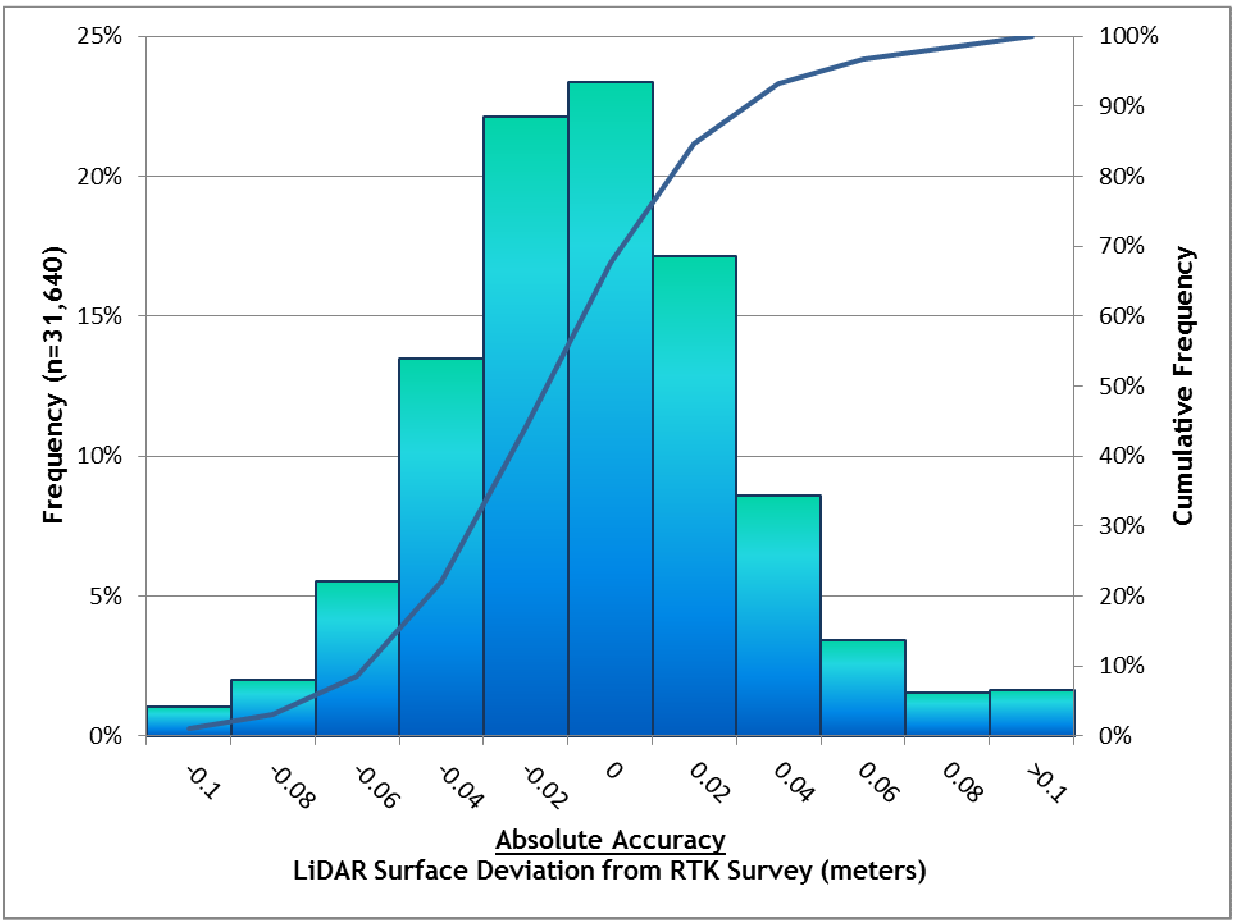
## 5.3 Absolute Accuracy

Absolute accuracies for Alaska Pipeline: All data was calibrated and processed in UTM 6 and then transformed to the appropriate projection.

***Table 6**. Absolute Accuracy - Deviation between laser points and RTK hard surface survey points*

| RTK Survey Sample Size (n): 31,640 | |
|---|---|
| Root Mean Square Error (RMSE): 0.039m | Minimum Δz = -0.151m |
| Standard Deviations<br>1 sigma (σ): 0.037m 1.96 sigma (σ): 0.072m | Maximum Δz = 0.151m |
| | Average Δz = -0.013m |

***Figure 30**. Absolute Accuracy - Histogram Statistics*



## 5.4 Independent Accuracy Assessment

In accordance with the project plan, McClintock Land Associates (AK PLS) collected independent (i.e. blind) check points within the survey area to provide an independent assessment of LiDAR accuracy. WSI was provided with Easting and Northing positions for points which were then assigned elevations from the LiDAR. MLA received this report and compared the LiDAR Z values to MLA's surveyed (or known) Z values.

***Table 7**. Absolute accuracy determined by the project surveyor (MLA) using "Blind" Check Points (See Appendix B for PLS report)*

| Delivery | # of Check Points | RMSE | Range |
|---|---|---|---|
| 1 | 735 | 0.062m | 0.240m |
| 2 | 1096 | 0.035m | 0.204m |
| 3 | 1088 | 0.078m | 0.182m |
| 4 | 730 | 0.039m | 0.394m |
| 5 | 2293 | 0.073m | 0.567m |
| 6 | 1510 | 0.050m | 0.730m |
| 7 | 1858 | 0.060m | 0.880m |
| 8 | 604 | 0.030m | 0.280m |
| 9 | 1139 | 0.080m | 0.410m |
| 10 | 1521 | 0.050m | 0.540m |
| 11 | 2682 | 0.050m | 0.280m |

## 6. Projection/Datum and Units

| | | |
|---|---|---|
| | **Projection:** | UTM Zone 5, 6, 7 North |
| **Datum** | **Vertical:** | NAVD88 Geoid09 |
| | **Horizontal:** | NAD83 |
| | **Units:** | meters |

## 7. Deliverables

| | |
|---|---|
| **Point Data:** | • All Returns (LAS 1.2 format)<br>• Ground Returns (LAS 1.2 format) |
| **Vector Data:** | • Project Boundary (shapefile format)<br>• Tile Index for LiDAR Points (shapefile format)<br>• Tile Index for DEMs (shapefile format)<br>• Contours (1m shapefile format, DXF format)<br>• RTK (shapefile format, .TXT format)<br>• SBETs (shapefile format, DBF format)<br>• Lake Boundaries (shapefile format) |
| **Raster Data:** | • Elevation Models (1m resolution)<br>  • Hydro-flattened Bare Earth Model (ESRI GRID format)<br>  • Highest Hit Model (ESRI GRID format)<br>  • Vegetation Model (ESRI GRID format)<br>  • nDSM Model (ESRI GRID format)<br>• Intensity Images (GeoTIFF format, 0.5m resolution)<br>• Vegetation Metrics (5m resolution)<br>  • Canopy Cover (ESRI GRID format)<br>  • Coefficient of Variation (ESRI GRID format)<br>  • Mean Elevation (ESRI GRID format) |
| **Data Report:** | • Full report containing introduction, methodology, and accuracy |

## 8. Selected Images

***Figure 31****. Delta Junction airfield. Image is LiDAR point cloud colored by point class and intensity.*

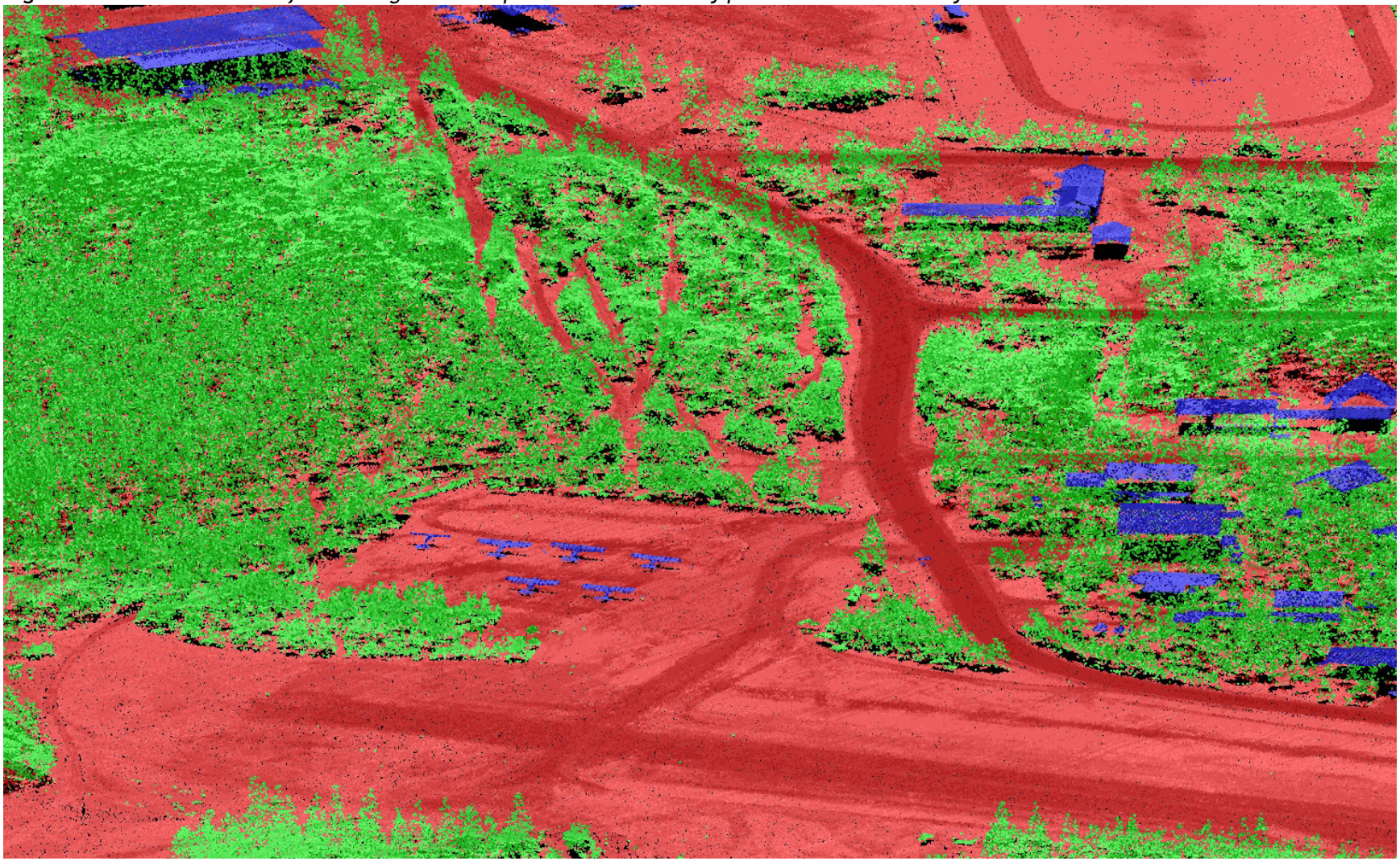


***Figure 32**. Top image is ariel photograph taken from the plane near Deadhorse, AK, bottom image is highest hit model colored by elevation of a refinery near Deadhorse.*

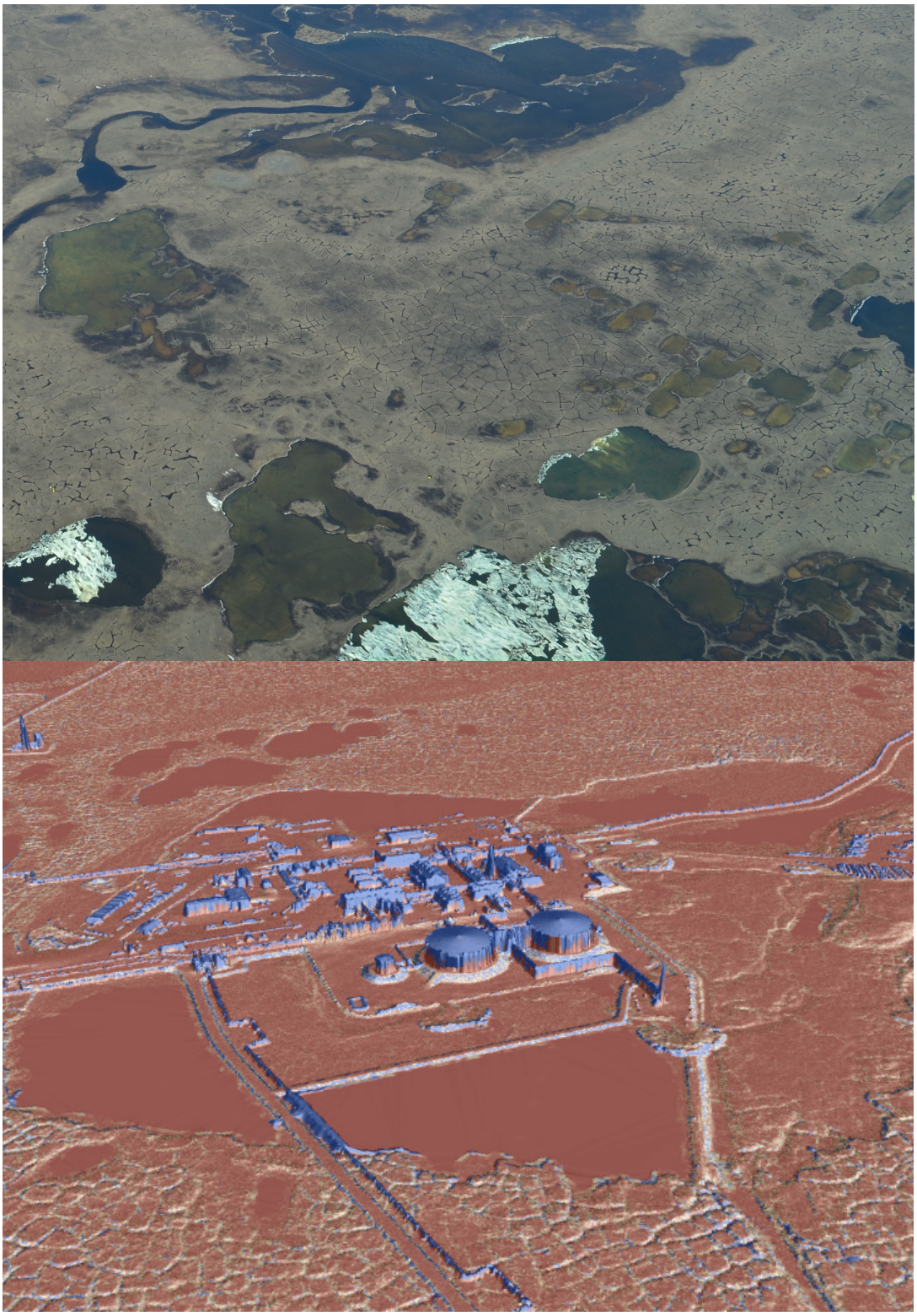


***Figure 33**. View looking north across Gerstle River along A2. Image is 3D LiDAR point cloud colored by elevation.*

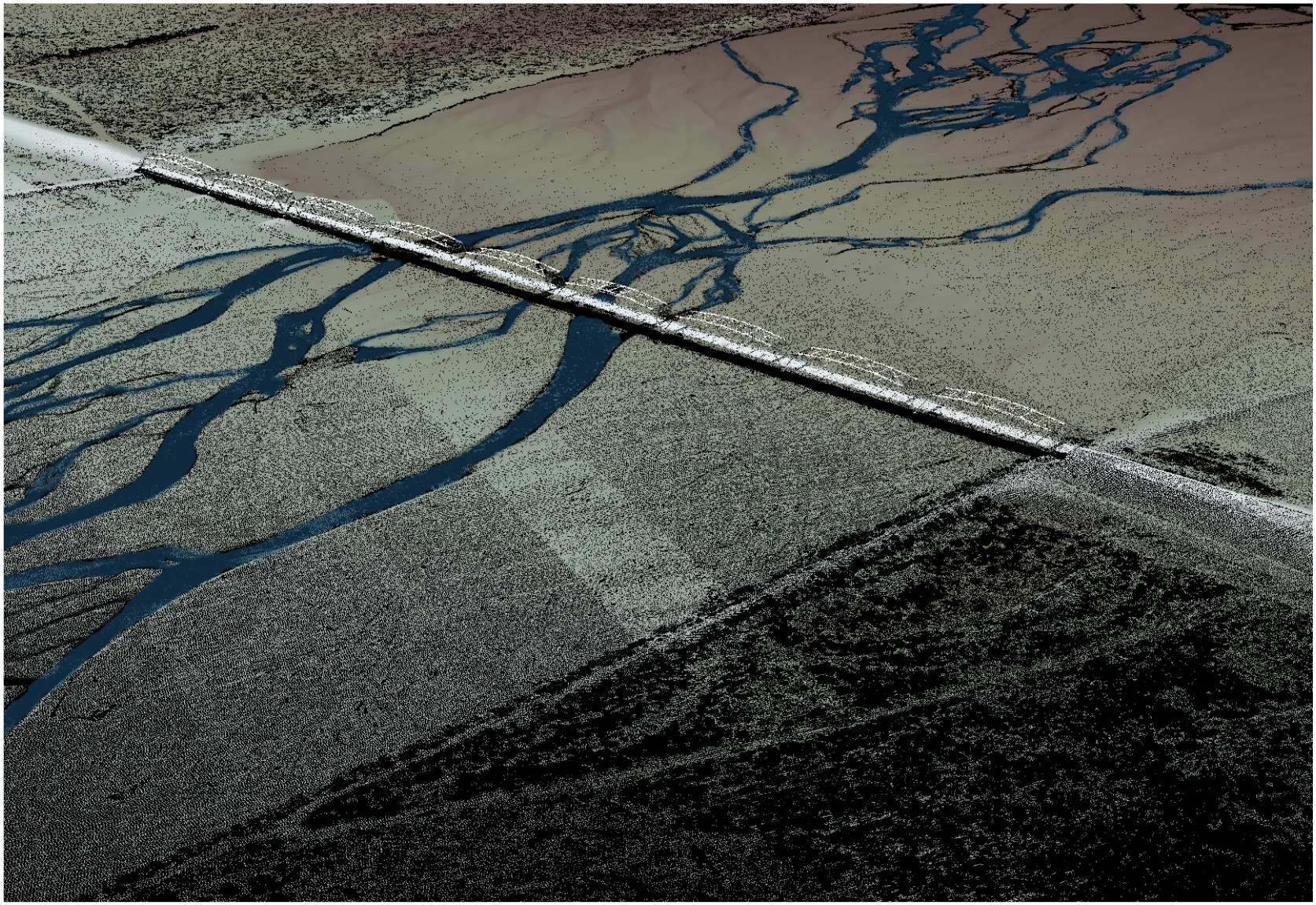


***Figure 34**. Northern end of above ground pipeline near Trims Camp along Hwy 4.*

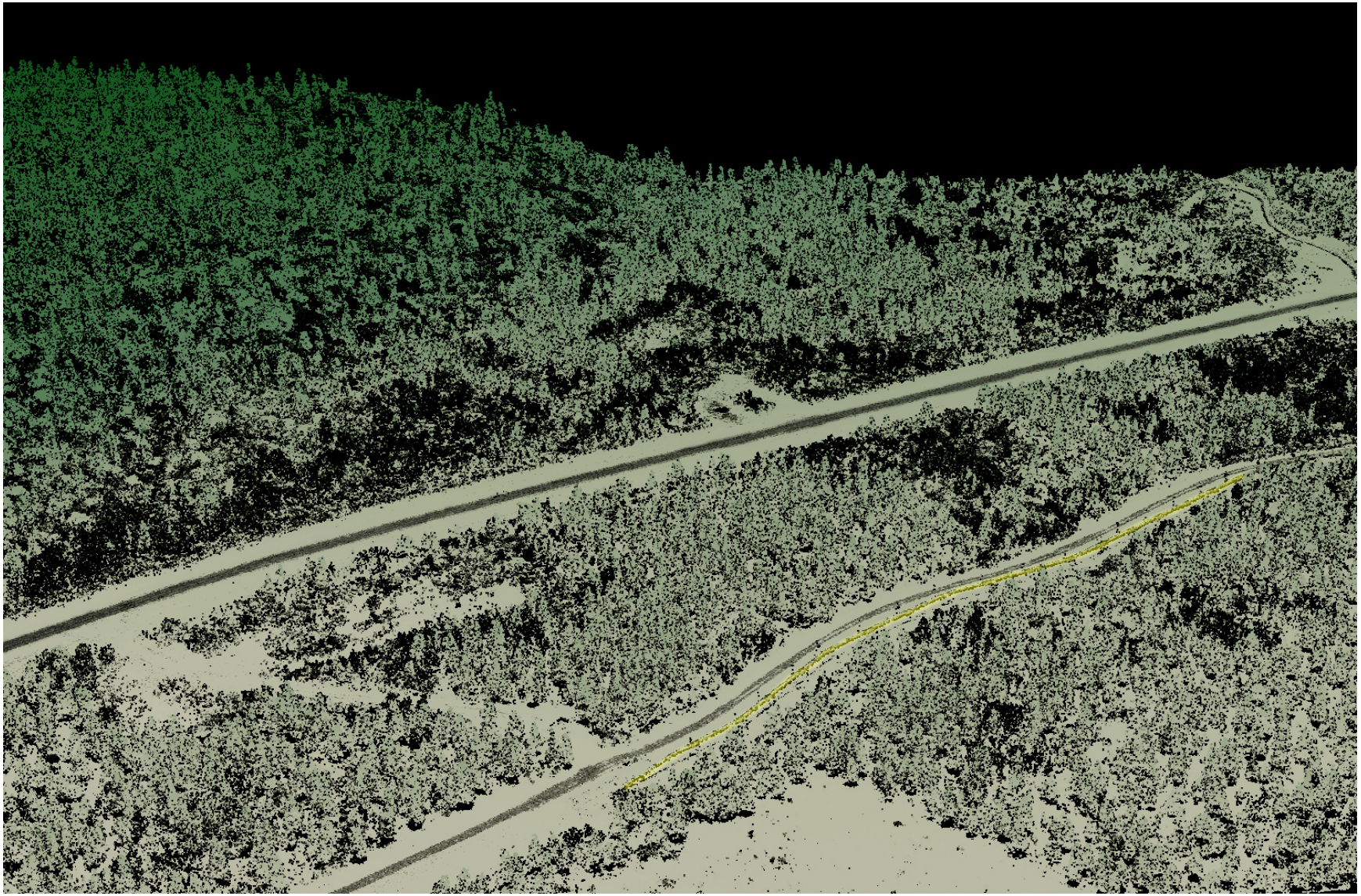


***Figure 35**. View looking North of Pipeline and Hwy 4 as they cross Miller Creek.*

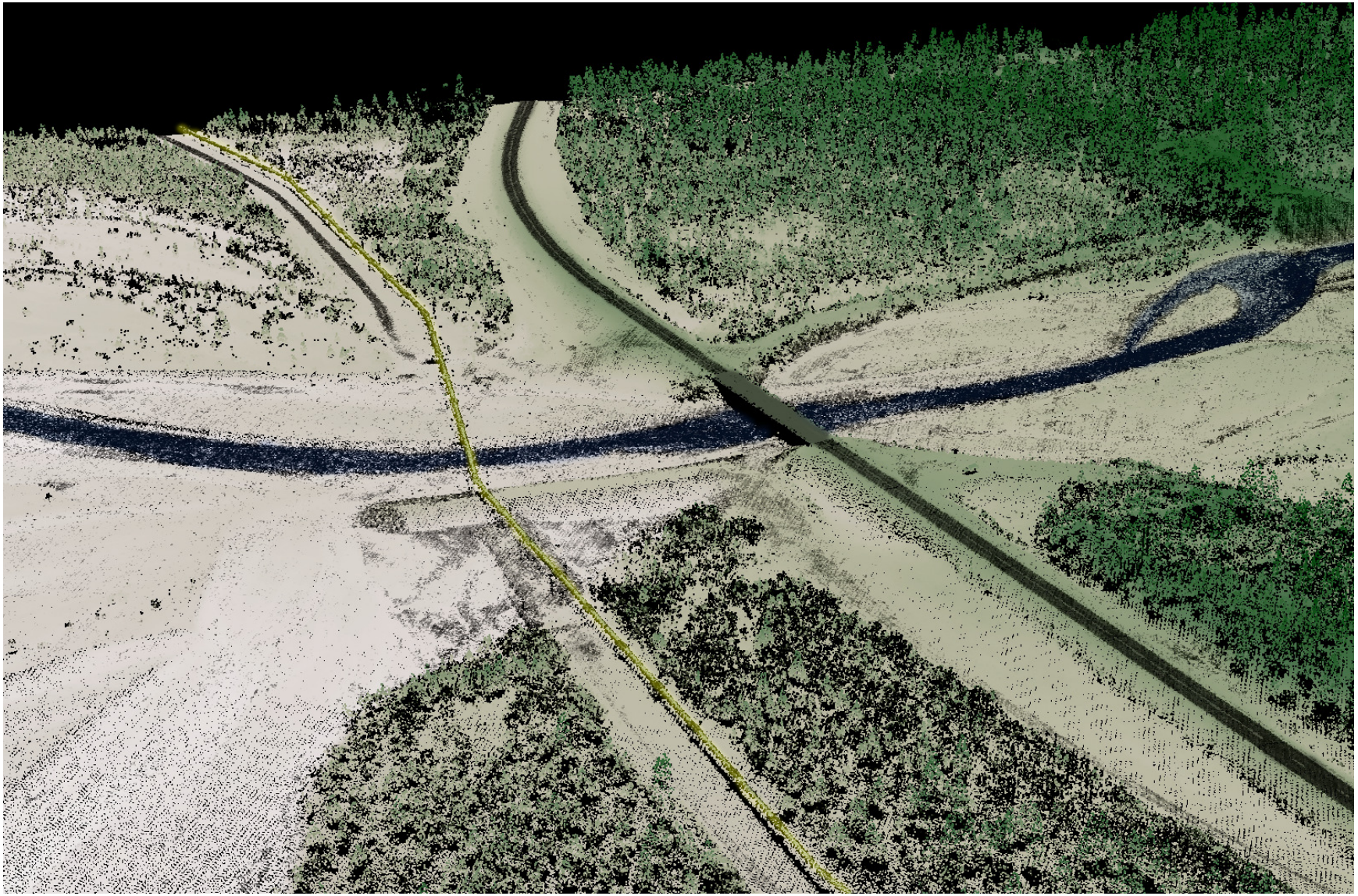


***Figure 36**. View looking Northeast across Hwy 2, just east of Tetlin Junction. Top image is Bare Earth model colored by elevation. Bottom image is Highest Hit model.*

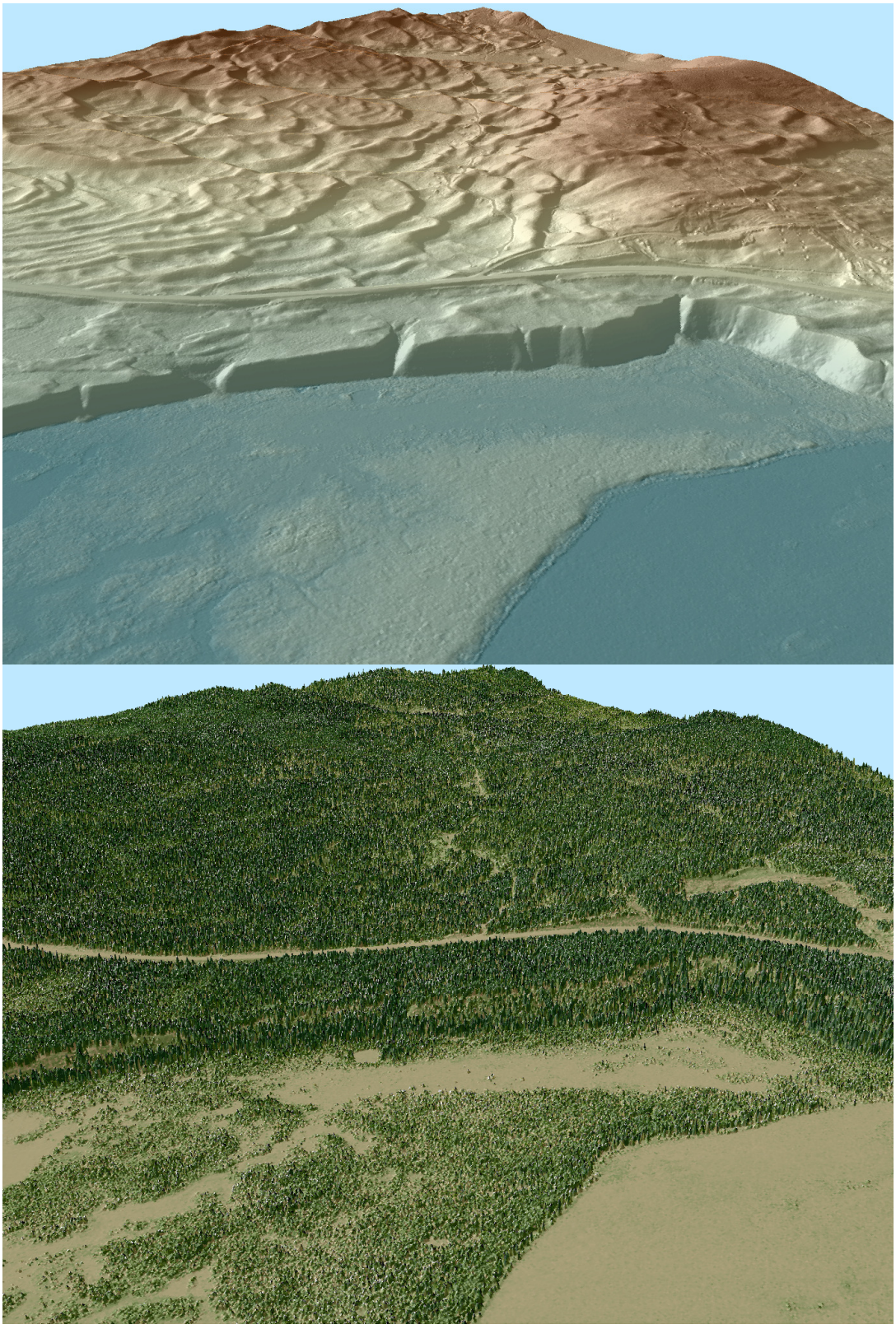


***Figure 37**. Hwy 2, west of where it crosses Gardiner River. Top image is Bare Earth model colored by elevation. Bottom image is Highest Hit model.*

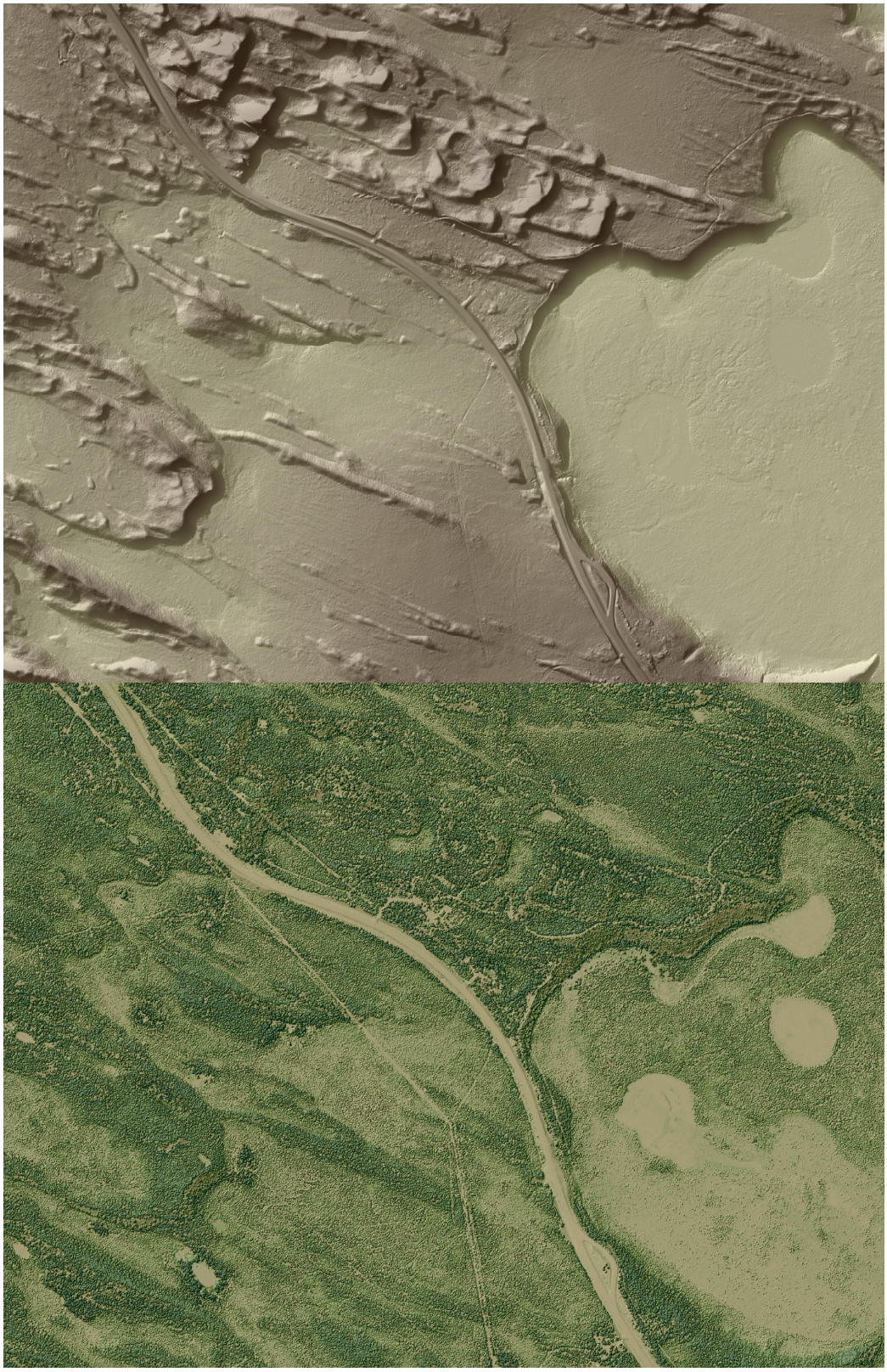
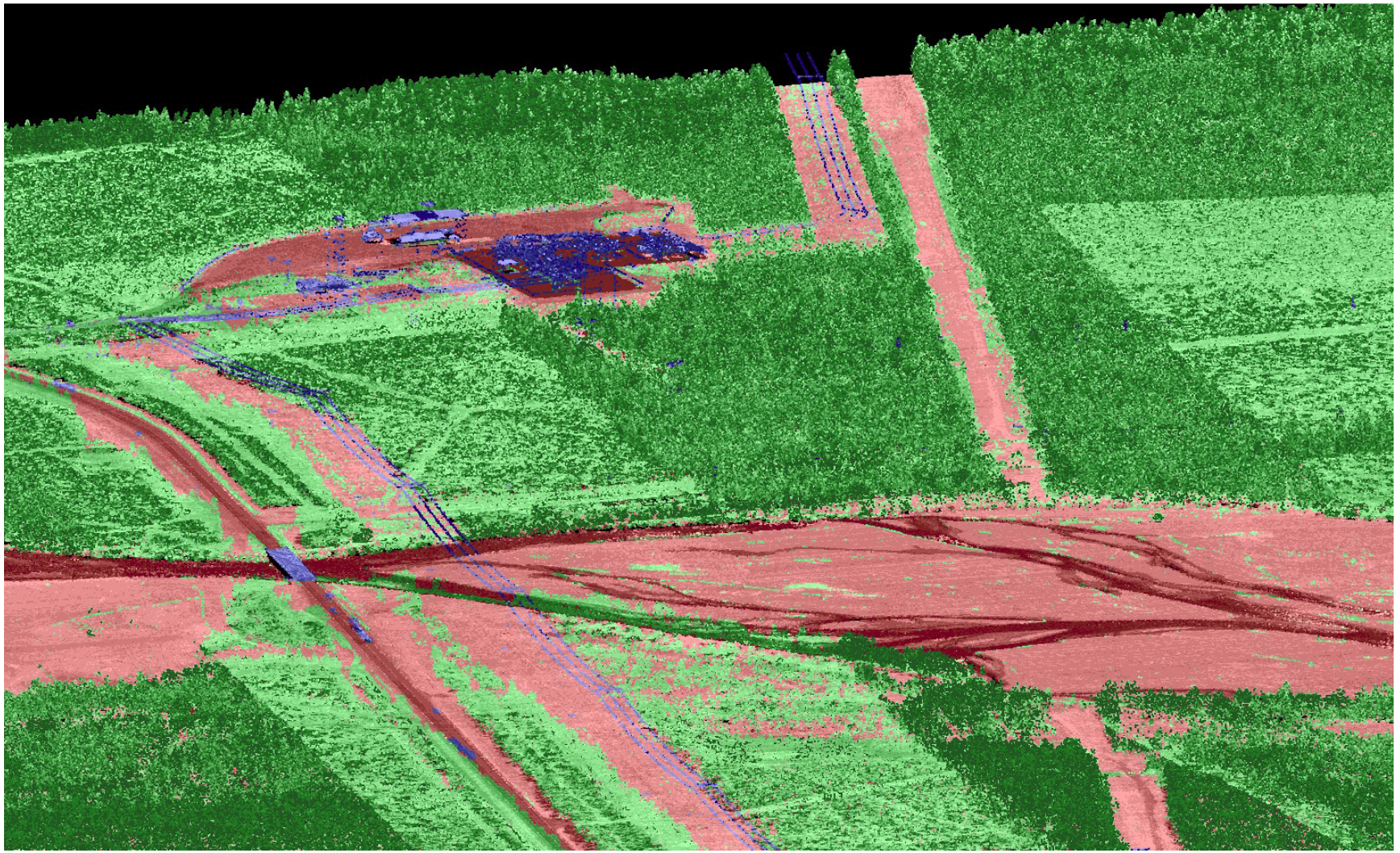


***Figure 38**. Delta Junction power station, looking across Delta River. Image is LiDAR point cloud colored by point class and intensity.*



# 9. Glossary

**1-sigma (σ) Absolute Deviation:** Value for which the data are within one standard deviation (approximately 68$^{th}$ percentile) of a normally distributed data set.

**1.96-sigma (σ) Absolute Deviation:** Value for which the data are within two standard deviations (approximately 95$^{th}$ percentile) of a normally distributed data set.

**Root Mean Square Error (RMSE):** A statistic used to approximate the difference between real-world points and the LiDAR points. It is calculated by squaring all the values, then taking the average of the squares and taking the square root of the average.

**Pulse Rate (PR)**: The rate at which laser pulses are emitted from the sensor; typically measured as thousands of pulses per second (kHz).

**Pulse Returns**: For every laser pulse emitted, the Leica ALS 50 Phase II system can record *up to four* wave forms reflected back to the sensor. Portions of the wave form that return earliest are the highest element in multi-tiered surfaces such as vegetation. Portions of the wave form that return last are the lowest element in multi-tiered surfaces.

**Accuracy**: The statistical comparison between known (surveyed) points and laser points. Typically measured as the standard deviation (sigma, σ) and root mean square error (RMSE).

**Intensity Values**: The peak power ratio of the laser return to the emitted laser. It is a function of surface reflectivity.

**Data Density**: A common measure of LiDAR resolution, measured as points per square meter.

**Spot Spacing**: Also a measure of LiDAR resolution, measured as the average distance between laser points.

**Nadir**: A single point or locus of points on the surface of the earth directly below a sensor as it progresses along its flight line.

**Scan Angle**: The angle from nadir to the edge of the scan, measured in degrees. Laser point accuracy typically decreases as scan angles increase.

**Overlap**: The area shared between flight lines, typically measured in percents; 100% overlap is essential to ensure complete coverage and reduce laser shadows.

**DTM / DEM**: These often-interchanged terms refer to models made from laser points. The digital elevation model (DEM) refers to all surfaces, including bare ground and vegetation, while the digital terrain model (DTM) refers only to those points classified as ground.

**Real-Time Kinematic (RTK) Survey**: GPS surveying is conducted with a GPS base station deployed over a known monument with a radio connection to a GPS rover. Both the base station and rover receive differential GPS data and the baseline correction is solved between the two. This type of ground survey is accurate to 1.5 cm or less.

# 10. Citations

Soininen, A. 2004. TerraScan User's Guide. TerraSolid.

# Appendix A

**LiDAR accuracy error sources and solutions:**

| Type of Error | Source | Post Processing Solution |
|---|---|---|
| GPS (Static/Kinematic) | Long Base Lines | None |
| | Poor Satellite Constellation | None |
| | Poor Antenna Visibility | Reduce Visibility Mask |
| Relative Accuracy | Poor System Calibration | Recalibrate IMU and sensor offsets/settings |
| | Inaccurate System | None |
| Laser Noise | Poor Laser Timing | None |
| | Poor Laser Reception | None |
| | Poor Laser Power | None |
| | Irregular Laser Shape | None |

**Operational measures taken to improve relative accuracy:**

1. Low Flight Altitude: Terrain following is employed to maintain a constant above ground level (AGL). Laser horizontal errors are a function of flight altitude above ground (i.e., ~ 1/3000$^{th}$ AGL flight altitude).
2. Focus Laser Power at narrow beam footprint: A laser return must be received by the system above a power threshold to accurately record a measurement. The strength of the laser return is a function of laser emission power, laser footprint, flight altitude and the reflectivity of the target. While surface reflectivity cannot be controlled, laser power can be increased and low flight altitudes can be maintained.
3. Reduced Scan Angle: Edge-of-scan data can become inaccurate. The scan angle was reduced to a maximum of ±15$^{o}$ from nadir, creating a narrow swath width and greatly reducing laser shadows from trees and buildings.
4. Quality GPS: Flights took place during optimal GPS conditions (e.g., 6 or more satellites and PDOP [Position Dilution of Precision] less than 3.0). Before each flight, the PDOP was determined for the survey day. During all flight times, a dual frequency DGPS base station recording at 1-second epochs was utilized and a maximum baseline length between the aircraft and the control points was less than 19 km (11.5 miles) at all times.
5. Ground Survey: Ground survey point accuracy (i.e. <1.5 cm RMSE) occurs during optimal PDOP ranges and targets a minimal baseline distance of 4 miles between GPS rover and base. Robust statistics are, in part, a function of sample size (n) and distribution. Ground survey RTK points are distributed to the extent possible throughout multiple flight lines and across the survey area.
6. 50% Side-Lap (100% Overlap): Overlapping areas are optimized for relative accuracy testing. Laser shadowing is minimized to help increase target acquisition from multiple scan angles. Ideally, with a 50% side-lap, the most nadir portion of one flight line coincides with the edge (least nadir) portion of overlapping flight lines. A minimum of 50% side-lap with terrain-followed acquisition prevents data gaps.
7. Opposing Flight Lines: All overlapping flight lines are opposing. Pitch, roll and heading errors are amplified by a factor of two relative to the adjacent flight line(s), making misalignments easier to detect and resolve.

# Appendix B

QUALITY CONTROL REVIEW SUMMARY

| | | |
|---|---|---|
| Max. Positive Elev. Deviation: | 0.16 | meters |
| Max. Negative Elev. Deviation: | -0.12 | meters |
| Elevation Deviation Range: | 0.28 | meters |
| Elevation Deviation Mean: | 0.03 | meters |
| **Elevation Deviation RMSE** | **0.05** | **meters** |

Root Mean Square Error)

Total Number of Check Points: 2682.00

| CHECK POINTS | | | SURVEYED Elevation | | LiDAR Elevation | Deviation |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | (Meters) | DESCRIPTOR | (Meters) | (Meters) |
| 2301 | 7788185.57 | 446005.84 | 14.06 | 1B20100922OG | 14.11 | -0.05 |
| 2302 | 7788177.83 | 446018.49 | 15.40 | 1B20100922SGR | 15.34 | 0.06 |
| 2303 | 7788199.10 | 446028.46 | 15.23 | 1B20100922SGR | 15.17 | 0.06 |
| 2304 | 7788211.60 | 446029.98 | 15.14 | 1B20100922SGR | 15.10 | 0.04 |
| 2305 | 7788213.45 | 446030.77 | 15.15 | 1B20100922SGR | 15.10 | 0.05 |
| 2306 | 7788232.11 | 446038.89 | 15.15 | 1B20100922SGR | 15.10 | 0.05 |
| 2307 | 7788230.55 | 446042.23 | 15.29 | 1B20100922SGR | 15.22 | 0.07 |
| 2308 | 7788255.59 | 446053.67 | 15.34 | 1B20100922SGR | 15.27 | 0.07 |
| 2309 | 7788280.41 | 446065.01 | 15.40 | 1B20100922SGR | 15.32 | 0.08 |
| 2310 | 7788298.47 | 446073.38 | 15.40 | 1B20100922SGR | 15.34 | 0.06 |
| 2311 | 7788317.02 | 446081.69 | 15.45 | 1B20100922SGR | 15.37 | 0.08 |
| 2312 | 7788315.45 | 446085.61 | 15.35 | 1B20100922SGR | 15.29 | 0.06 |
| 2313 | 7788456.34 | 446647.66 | 15.93 | 1B20100922SGR | 15.92 | 0.01 |
| 2314 | 7788456.71 | 446668.14 | 15.44 | 1B20100922SGR | 15.43 | 0.01 |
| 2315 | 7788456.74 | 446670.58 | 15.34 | 1B20100922SGR | 15.33 | 0.01 |
| 2316 | 7788457.07 | 446686.43 | 14.91 | 1B20100922SGR | 14.92 | -0.01 |
| 2317 | 7788457.54 | 446707.00 | 14.75 | 1B20100922SGR | 14.72 | 0.03 |
| 2318 | 7788477.89 | 446705.88 | 14.13 | 1B20100922OG | 14.19 | -0.06 |
| 2319 | 7788502.94 | 446721.74 | 14.22 | 1B20100922OG | 14.22 | 0.00 |
| 2320 | 7788511.59 | 446710.53 | 15.94 | 1B20100922SGR | 15.91 | 0.03 |
| 2321 | 7788515.68 | 446705.55 | 15.54 | 1B20100922SGR | 15.49 | 0.05 |
| 2322 | 7788532.88 | 446721.51 | 15.79 | 1B20100922SGR | 15.75 | 0.04 |
| 2323 | 7788570.11 | 446738.70 | 15.69 | 1B20100922SGR | 15.64 | 0.04 |
| 2324 | 7788613.15 | 446747.13 | 15.73 | 1B20100922SGR | 15.69 | 0.04 |
| 2325 | 7788651.89 | 446744.89 | 15.82 | 1B20100922SGR | 15.76 | 0.05 |
| 2326 | 7789213.77 | 445918.17 | 16.42 | 1B20100922SGR | 16.36 | 0.06 |
| 2327 | 7789204.73 | 445910.47 | 16.61 | 1B20100922SGR | 16.54 | 0.07 |
| 2328 | 7789199.32 | 445901.19 | 16.65 | 1B20100922SGR | 16.59 | 0.06 |
| 2329 | 7789208.52 | 445907.73 | 16.54 | 1B20100922SGR | 16.46 | 0.08 |
| 2330 | 7789222.52 | 445924.16 | 16.19 | 1B20100922SGR | 16.12 | 0.07 |
| 2331 | 7789254.33 | 445889.46 | 16.03 | 1B20100922SGR | 15.97 | 0.06 |
| 2332 | 7789265.61 | 445867.88 | 15.84 | 1B20100922SGR | 15.82 | 0.02 |
| 2333 | 7789269.83 | 445872.37 | 16.06 | 1B20100922SGR | 15.98 | 0.08 |
| 2334 | 7789279.96 | 445861.01 | 16.07 | 1B20100922SGR | 16.00 | 0.07 |
| 2335 | 7789313.92 | 445824.11 | 16.07 | 1B20100922SGR | 16.02 | 0.05 |
| 2336 | 7789346.69 | 445788.47 | 16.14 | 1B20100922SGR | 16.07 | 0.07 |
| 2337 | 7789372.24 | 445760.65 | 16.17 | 1B20100922SGR | 16.11 | 0.06 |
| 2338 | 7789269.65 | 444953.08 | 16.75 | 1B20100922SGR | 16.68 | 0.07 |
| 2339 | 7789252.01 | 444956.74 | 16.71 | 1B20100922SGR | 16.65 | 0.06 |
| 2340 | 7789243.05 | 444976.81 | 16.84 | 1B20100922SGR | 16.81 | 0.03 |
| 2341 | 7789248.82 | 445000.76 | 16.92 | 1B20100922SGR | 16.84 | 0.08 |
| 2342 | 7789274.49 | 444995.87 | 16.84 | 1B20100922SGR | 16.79 | 0.05 |
| 2343 | 7789288.91 | 444992.90 | 16.68 | 1B20100922SGR | 16.62 | 0.05 |
| 2344 | 7789285.57 | 444977.43 | 16.71 | 1B20100922SGR | 16.64 | 0.07 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 2345 | 7789279.88 | 444973.69 | 16.73 | 1B20100922SGR | 16.68 | 0.05 |
| 2346 | 7789283.81 | 444941.04 | 16.61 | 1B20100922SAR | 16.54 | 0.07 |
| 2347 | 7789271.26 | 444894.32 | 16.58 | 1B20100922SAR | 16.53 | 0.05 |
| 2348 | 7789259.46 | 444865.92 | 16.56 | 1B20100922SGR | 16.51 | 0.05 |
| 2349 | 7789251.88 | 444838.36 | 16.54 | 1B20100922SGR | 16.50 | 0.04 |
| 2350 | 7789255.00 | 444823.79 | 16.40 | 1B20100922SAR | 16.37 | 0.03 |
| 2351 | 7788740.61 | 444383.92 | 16.90 | 1B20100922SGR | 16.86 | 0.04 |
| 2352 | 7788738.30 | 444363.57 | 17.05 | 1B20100922SGR | 17.02 | 0.03 |
| 2353 | 7788734.59 | 444347.07 | 17.23 | 1B20100922SGR | 17.20 | 0.03 |
| 2359 | 7788730.34 | 444355.36 | 17.11 | 1B20100922SGR | 17.07 | 0.04 |
| 2360 | 7788735.95 | 444389.69 | 16.65 | 1B20100922SGR | 16.62 | 0.02 |
| 2361 | 7788725.46 | 444402.50 | 16.71 | 1B20100922SGR | 16.68 | 0.03 |
| 2362 | 7788712.32 | 444419.01 | 16.64 | 1B20100922SGR | 16.64 | 0.00 |
| 2363 | 7788701.81 | 444421.01 | 16.65 | 1B20100922SGR | 16.63 | 0.02 |
| 2364 | 7788684.28 | 444425.04 | 16.64 | 1B20100922SGR | 16.64 | 0.00 |
| 2368 | 7788664.12 | 444460.83 | 17.41 | 1B20100922SAR | 17.33 | 0.08 |
| 2369 | 7788670.72 | 444478.98 | 17.35 | 1B20100922SAR | 17.27 | 0.08 |
| 2370 | 7788680.76 | 444456.28 | 17.19 | 1B20100922SGR | 17.12 | 0.07 |
| 2371 | 7788700.70 | 444481.38 | 17.07 | 1B20100922SGR | 16.98 | 0.09 |
| 2372 | 7788717.07 | 444482.02 | 16.89 | 1B20100922SGR | 16.84 | 0.05 |
| 2373 | 7788748.34 | 444475.78 | 16.78 | 1B20100922SGR | 16.76 | 0.02 |
| 2374 | 7788761.94 | 444472.90 | 17.06 | 1B20100922SGR | 16.99 | 0.07 |
| 2375 | 7788774.20 | 444484.58 | 16.88 | 1B20100922SGR | 16.85 | 0.03 |
| 2376 | 7788782.12 | 444497.68 | 17.15 | 1B20100922SGR | 17.10 | 0.05 |
| 2377 | 7788782.13 | 444497.69 | 17.15 | 1B20100922SGR | 17.11 | 0.04 |
| 2378 | 7788785.46 | 444508.34 | 17.22 | 1B20100922SGR | 17.19 | 0.03 |
| 2379 | 7788796.24 | 444505.87 | 17.69 | 1B20100922SGR | 17.63 | 0.06 |
| 2380 | 7788806.61 | 444504.17 | 18.08 | 1B20100922SGR | 18.03 | 0.05 |
| 2381 | 7788805.48 | 444496.64 | 18.05 | 1B20100922SGR | 17.99 | 0.06 |
| 2382 | 7788783.62 | 444507.60 | 17.22 | 1B20100922SGR | 17.17 | 0.05 |
| 2383 | 7788775.52 | 444518.55 | 16.96 | 1B20100922SGR | 16.93 | 0.03 |
| 2384 | 7788771.97 | 444522.97 | 17.05 | 1B20100922SGR | 16.99 | 0.06 |
| 2385 | 7788775.96 | 444538.27 | 17.08 | 1B20100922SGR | 17.02 | 0.05 |
| 2386 | 7788786.50 | 444580.07 | 17.08 | 1B20100922SGR | 17.04 | 0.04 |
| 2387 | 7788791.61 | 444597.06 | 17.06 | 1B20100922SGR | 17.02 | 0.04 |
| 2388 | 7788796.57 | 444621.63 | 17.08 | 1B20100922SGR | 17.03 | 0.05 |
| 2389 | 7788785.20 | 444630.16 | 16.89 | 1B20100922SGR | 16.87 | 0.02 |
| 2400 | 7754535.96 | 431223.28 | 70.89 | 2B201009222BSAC | 70.88 | 0.01 |
| 2401 | 7756538.37 | 431297.89 | 67.16 | 2B20100922OG | 67.16 | 0.00 |
| 2402 | 7756516.42 | 431346.64 | 67.46 | 2B20100922S146 | 67.39 | 0.07 |
| 2403 | 7756528.18 | 431317.60 | 68.57 | 2B20100922SGR | 68.46 | 0.11 |
| 2404 | 7756509.45 | 431309.55 | 68.64 | 2B20100922SGR | 68.54 | 0.10 |
| 2405 | 7756489.91 | 431301.55 | 68.77 | 2B20100922SGR | 68.66 | 0.11 |
| 2406 | 7756469.34 | 431292.88 | 68.76 | 2B20100922SGR | 68.65 | 0.11 |
| 2407 | 7756440.94 | 431281.16 | 68.85 | 2B20100922SGR | 68.74 | 0.11 |
| 2408 | 7756426.90 | 431275.57 | 68.89 | 2B20100922SGR | 68.77 | 0.12 |
| 2409 | 7756427.78 | 431273.18 | 68.79 | 2B20100922SGR | 68.72 | 0.07 |
| 2410 | 7756425.90 | 431277.92 | 68.75 | 2B20100922SGR | 68.69 | 0.06 |
| 2411 | 7756418.71 | 431275.11 | 68.75 | 2B20100922SGR | 68.70 | 0.05 |
| 2412 | 7756419.72 | 431270.04 | 68.80 | 2B20100922SGR | 68.76 | 0.04 |
| 2413 | 7756425.26 | 431256.03 | 67.47 | 2B20100922OG | 67.43 | 0.04 |
| 2414 | 7756413.09 | 431284.68 | 67.77 | 2B20100922OG | 67.75 | 0.02 |
| 2415 | 7755701.59 | 430962.04 | 68.23 | 2B20100922OG | 68.22 | 0.01 |
| 2416 | 7755692.86 | 430990.85 | 68.43 | 2B20100922OG | 68.43 | 0.00 |
| 2417 | 7755696.00 | 430978.85 | 69.73 | 2B20100922SGR | 69.63 | 0.10 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 2418 | 7755671.76 | 430970.76 | 69.77 | 2B20100922SGR | 69.68 | 0.08 |
| 2419 | 7755653.53 | 430966.83 | 69.81 | 2B20100922SGR | 69.71 | 0.10 |
| 2420 | 7755654.17 | 430962.50 | 70.10 | 2B20100922SGR | 70.02 | 0.08 |
| 2421 | 7755651.80 | 430970.56 | 69.44 | 2B20100922SGR | 69.38 | 0.06 |
| 2422 | 7755632.08 | 430964.16 | 69.75 | 2B20100922SGR | 69.67 | 0.08 |
| 2423 | 7755612.50 | 430961.69 | 69.71 | 2B20100922SGR | 69.62 | 0.09 |
| 2424 | 7755596.25 | 430959.84 | 69.74 | 2B20100922SGR | 69.68 | 0.06 |
| 2425 | 7755575.35 | 430959.03 | 69.79 | 2B20100922SGR | 69.73 | 0.06 |
| 2426 | 7755560.24 | 430958.80 | 69.86 | 2B20100922SGR | 69.77 | 0.09 |
| 2427 | 7755559.93 | 430954.33 | 70.07 | 2B20100922SGR | 69.98 | 0.09 |
| 2429 | 7754521.89 | 431194.36 | 71.62 | 2B20100922SGR | 71.54 | 0.08 |
| 2430 | 7754494.92 | 431200.66 | 71.66 | 2B20100922SGR | 71.57 | 0.09 |
| 2431 | 7754452.02 | 431211.04 | 71.73 | 2B20100922SGR | 71.62 | 0.11 |
| 2432 | 7754408.74 | 431221.59 | 71.90 | 2B20100922SGR | 71.77 | 0.13 |
| 2433 | 7754363.11 | 431232.42 | 71.98 | 2B20100922SGR | 71.85 | 0.13 |
| 2434 | 7754318.00 | 431242.99 | 72.15 | 2B20100922SGR | 72.03 | 0.12 |
| 2435 | 7754271.28 | 431254.02 | 72.31 | 2B20100922SGR | 72.18 | 0.13 |
| 2436 | 7753585.22 | 431416.52 | 73.84 | 2B20100922SGR | 73.73 | 0.11 |
| 2437 | 7753585.90 | 431420.27 | 73.71 | 2B20100922SGR | 73.65 | 0.06 |
| 2438 | 7753566.15 | 431426.76 | 73.64 | 2B20100922SGR | 73.60 | 0.04 |
| 2439 | 7753565.13 | 431421.58 | 73.89 | 2B20100922SGR | 73.76 | 0.13 |
| 2440 | 7753515.55 | 431433.36 | 74.12 | 2B20100922SGR | 73.98 | 0.14 |
| 2441 | 7753466.23 | 431445.00 | 74.14 | 2B20100922SGR | 74.04 | 0.10 |
| 2442 | 7753418.75 | 431456.03 | 74.35 | 2B20100922SGR | 74.26 | 0.09 |
| 2443 | 7753376.02 | 431465.91 | 74.46 | 2B20100922SGR | 74.41 | 0.05 |
| 2444 | 7753333.94 | 431475.80 | 74.35 | 2B20100922SGR | 74.29 | 0.06 |
| 2445 | 7752665.46 | 431617.35 | 74.72 | 2B20100922OG | 74.78 | -0.06 |
| 2446 | 7752671.22 | 431648.06 | 75.15 | 2B20100922OG | 75.21 | -0.06 |
| 2447 | 7752648.96 | 431653.94 | 75.23 | 2B20100922OG | 75.22 | 0.01 |
| 2448 | 7752645.76 | 431640.23 | 76.37 | 2B20100922SGR | 76.34 | 0.03 |
| 2449 | 7752622.71 | 431644.94 | 76.48 | 2B20100922SGR | 76.40 | 0.08 |
| 2450 | 7752570.93 | 431657.02 | 76.50 | 2B20100922SGR | 76.46 | 0.04 |
| 2451 | 7752524.16 | 431667.57 | 76.43 | 2B20100922SGR | 76.39 | 0.03 |
| 2452 | 7752522.42 | 431662.29 | 76.18 | 2B20100922SGR | 76.17 | 0.01 |
| 2453 | 7752502.39 | 431673.00 | 76.42 | 2B20100922SGR | 76.40 | 0.02 |
| 2454 | 7757055.70 | 431534.38 | 67.63 | 2B20100922SGR | 67.54 | 0.09 |
| 2455 | 7757107.40 | 431555.13 | 67.35 | 2B20100922SGR | 67.21 | 0.14 |
| 2456 | 7757156.33 | 431575.02 | 67.07 | 2B20100922SGR | 66.93 | 0.14 |
| 2457 | 7757199.36 | 431592.63 | 66.76 | 2B20100922SGR | 66.64 | 0.12 |
| 2458 | 7757243.46 | 431610.59 | 66.59 | 2B20100922SGR | 66.48 | 0.11 |
| 2459 | 7757284.84 | 431627.24 | 66.61 | 2B20100922SGR | 66.47 | 0.14 |
| 2460 | 7757283.63 | 431630.87 | 66.44 | 2B20100922SGR | 66.37 | 0.07 |
| 2501 | 7711290.30 | 438499.65 | 168.87 | 03B20100922SPR | 168.91 | -0.04 |
| 2502 | 7711301.60 | 438497.38 | 168.86 | 03B20100922SPR | 168.89 | -0.03 |
| 2503 | 7711312.35 | 438495.12 | 168.81 | 03B20100922SPR | 168.84 | -0.03 |
| 2505 | 7716009.28 | 437529.96 | 155.65 | 03B20100922SGR | 155.64 | 0.01 |
| 2506 | 7715989.39 | 437534.03 | 155.72 | 03B20100922SGR | 155.71 | 0.01 |
| 2507 | 7715970.44 | 437537.60 | 155.80 | 03B20100922SGR | 155.79 | 0.01 |
| 2508 | 7715635.13 | 437606.80 | 157.15 | 03B20100922SGR | 157.17 | -0.02 |
| 2509 | 7715612.24 | 437611.48 | 157.15 | 03B20100922SGR | 157.19 | -0.04 |
| 2510 | 7715589.23 | 437616.40 | 157.14 | 03B20100922SGR | 157.17 | -0.03 |
| 2511 | 7715593.12 | 437630.71 | 156.75 | 03B20100922SGR | 156.81 | -0.06 |
| 2512 | 7715796.00 | 438308.86 | 150.78 | 03B20100922SGR | 150.76 | 0.02 |
| 2513 | 7715810.27 | 438303.22 | 150.60 | 03B20100922SGR | 150.61 | -0.01 |
| 2514 | 7715824.67 | 438296.67 | 150.36 | 03B20100922SGR | 150.39 | -0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 2515 | 7715895.95 | 438644.92 | 151.97 | 03B20100922SGR | 151.99 | -0.02 |
| 2516 | 7715893.19 | 438633.39 | 152.13 | 03B20100922SGR | 152.12 | 0.01 |
| 2517 | 7715889.73 | 438621.01 | 152.08 | 03B20100922SGR | 152.07 | 0.01 |
| 2518 | 7715246.79 | 437686.49 | 158.33 | 03B20100922SGR | 158.38 | -0.05 |
| 2519 | 7715227.65 | 437690.34 | 158.49 | 03B20100922SGR | 158.49 | 0.00 |
| 2520 | 7715207.85 | 437694.28 | 158.60 | 03B20100922SGR | 158.65 | -0.05 |
| 2521 | 7714847.35 | 437767.88 | 159.69 | 03B20100922SGR | 159.70 | -0.01 |
| 2522 | 7714823.31 | 437772.68 | 159.76 | 03B20100922SGR | 159.76 | 0.00 |
| 2523 | 7714799.26 | 437777.46 | 159.88 | 03B20100922SGR | 159.86 | 0.02 |
| 2524 | 7714479.26 | 437843.04 | 160.62 | 03B20100922SGR | 160.61 | 0.01 |
| 2525 | 7714459.66 | 437847.45 | 160.67 | 03B20100922SGR | 160.65 | 0.02 |
| 2526 | 7714441.59 | 437851.44 | 160.71 | 03B20100922SGR | 160.70 | 0.01 |
| 2528 | 7713871.54 | 437967.74 | 161.94 | 03B20100922SGR | 161.91 | 0.03 |
| 2529 | 7713851.66 | 437972.29 | 161.96 | 03B20100922SGR | 161.93 | 0.03 |
| 2530 | 7713832.57 | 437976.45 | 161.99 | 03B20100922SGR | 161.97 | 0.02 |
| 2531 | 7713318.84 | 438080.85 | 163.83 | 03B20100922SGR | 163.83 | 0.00 |
| 2532 | 7713299.27 | 438084.56 | 163.74 | 03B20100922SGR | 163.76 | -0.02 |
| 2533 | 7713276.52 | 438089.41 | 163.77 | 03B20100922SGR | 163.79 | -0.02 |
| 2534 | 7712703.88 | 438207.97 | 166.57 | 03B20100922SGR | 166.55 | 0.02 |
| 2535 | 7712683.57 | 438211.89 | 166.44 | 03B20100922SGR | 166.45 | -0.01 |
| 2536 | 7712666.07 | 438215.32 | 166.49 | 03B20100922SGR | 166.51 | -0.02 |
| 2537 | 7712053.80 | 438340.17 | 166.35 | 03B20100922SGR | 166.40 | -0.05 |
| 2538 | 7712032.30 | 438344.30 | 166.29 | 03B20100922SGR | 166.35 | -0.06 |
| 2539 | 7712011.19 | 438348.52 | 166.33 | 03B20100922SGR | 166.38 | -0.05 |
| 2540 | 7711513.84 | 438451.48 | 167.52 | 03B20100922SGR | 167.56 | -0.04 |
| 2541 | 7711494.82 | 438455.74 | 167.63 | 03B20100922SGR | 167.66 | -0.03 |
| 2542 | 7711479.72 | 438458.96 | 167.66 | 03B20100922SGR | 167.69 | -0.03 |
| 2543 | 7710744.13 | 438611.44 | 170.50 | 03B20100922SPR | 170.54 | -0.04 |
| 2544 | 7710722.65 | 438615.65 | 170.56 | 03B20100922SPR | 170.58 | -0.02 |
| 2545 | 7710699.02 | 438620.61 | 170.63 | 03B20100922SPR | 170.64 | -0.01 |
| 2546 | 7710245.87 | 438713.30 | 171.47 | 03B20100922SPR | 171.51 | -0.04 |
| 2547 | 7710223.67 | 438718.23 | 171.59 | 03B20100922SPR | 171.62 | -0.03 |
| 2548 | 7710200.44 | 438722.94 | 171.61 | 03B20100922SPR | 171.63 | -0.03 |
| 2549 | 7709747.97 | 438815.58 | 173.02 | 03B20100922SPR | 173.07 | -0.05 |
| 2550 | 7709725.05 | 438820.28 | 173.04 | 03B20100922SPR | 173.06 | -0.02 |
| 2551 | 7709701.81 | 438825.13 | 173.14 | 03B20100922SPR | 173.15 | -0.01 |
| 2552 | 7709109.80 | 438946.25 | 175.01 | 03B20100922SPR | 175.05 | -0.04 |
| 2553 | 7709086.99 | 438951.07 | 175.07 | 03B20100922SPR | 175.10 | -0.03 |
| 2554 | 7709063.64 | 438955.95 | 175.08 | 03B20100922SPR | 175.14 | -0.06 |
| 2555 | 7708437.83 | 439084.48 | 176.96 | 03B20100922SPR | 176.98 | -0.02 |
| 2556 | 7708414.51 | 439089.28 | 177.03 | 03B20100922SPR | 177.06 | -0.03 |
| 2557 | 7708390.99 | 439094.13 | 177.12 | 03B20100922SPR | 177.13 | -0.01 |
| 2558 | 7707693.85 | 439031.32 | 178.55 | 03B20100922SPR | 178.59 | -0.04 |
| 2559 | 7707671.57 | 439025.68 | 178.62 | 03B20100922SPR | 178.68 | -0.06 |
| 2560 | 7707648.79 | 439019.45 | 178.72 | 03B20100922SPR | 178.74 | -0.02 |
| 2561 | 7706950.90 | 438837.05 | 180.81 | 03B20100922SPR | 180.82 | -0.01 |
| 2562 | 7706929.28 | 438831.35 | 180.91 | 03B20100922SPR | 180.93 | -0.02 |
| 2563 | 7706906.07 | 438825.44 | 181.05 | 03B20100922SPR | 181.10 | -0.06 |
| 2564 | 7706311.92 | 438669.72 | 183.08 | 03B20100922SPR | 183.15 | -0.08 |
| 2565 | 7706299.41 | 438666.31 | 183.14 | 03B20100922SPR | 183.18 | -0.04 |
| 2566 | 7706287.75 | 438663.24 | 183.13 | 03B20100922SPR | 183.20 | -0.07 |
| 2567 | 7705758.75 | 438257.84 | 186.36 | 03B20100922SPR | 186.44 | -0.09 |
| 2568 | 7705754.79 | 438246.33 | 186.49 | 03B20100922SPR | 186.58 | -0.09 |
| 2569 | 7705750.93 | 438235.15 | 186.61 | 03B20100922SPR | 186.68 | -0.07 |
| 2570 | 7705529.34 | 437602.91 | 194.39 | 03B20100922SPR | 194.44 | -0.05 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 2571 | 7705525.36 | 437591.65 | 194.54 | 03B20100922SPR | 194.58 | -0.04 |
| 2572 | 7705521.72 | 437580.94 | 194.71 | 03B20100922SPR | 194.75 | -0.04 |
| 2573 | 7705256.00 | 436883.65 | 204.98 | 03B20100922SPR | 205.01 | -0.03 |
| 2574 | 7705251.57 | 436872.22 | 205.17 | 03B20100922SPR | 205.21 | -0.04 |
| 2575 | 7705247.32 | 436861.51 | 205.39 | 03B20100922SPR | 205.38 | 0.01 |
| 2576 | 7704822.16 | 436125.20 | 239.91 | 03B20100922SPR | 239.91 | 0.00 |
| 2577 | 7704811.89 | 436116.11 | 240.28 | 03B20100922SPR | 240.27 | 0.00 |
| 2578 | 7704803.88 | 436109.27 | 240.53 | 03B20100922SPR | 240.53 | 0.00 |
| 2579 | 7704242.28 | 435655.53 | 259.26 | 03B20100922SPR | 259.28 | -0.02 |
| 2580 | 7704230.65 | 435650.87 | 259.48 | 03B20100922SPR | 259.49 | -0.01 |
| 2581 | 7704219.53 | 435646.32 | 259.66 | 03B20100922SPR | 259.67 | -0.01 |
| 2582 | 7703580.02 | 435390.60 | 281.17 | 03B20100922SPR | 281.15 | 0.02 |
| 2583 | 7703570.46 | 435386.53 | 281.54 | 03B20100922SPR | 281.51 | 0.03 |
| 2584 | 7703559.93 | 435382.31 | 281.90 | 03B20100922SPR | 281.87 | 0.03 |
| 2585 | 7702834.15 | 434984.95 | 310.26 | 03B20100922SPR | 310.27 | -0.01 |
| 2586 | 7702826.55 | 434975.78 | 310.56 | 03B20100922SPR | 310.56 | 0.00 |
| 2587 | 7702818.91 | 434966.51 | 310.79 | 03B20100922SPR | 310.81 | -0.02 |
| 2588 | 7702438.34 | 434479.68 | 324.48 | 03B20100922SPR | 324.54 | -0.06 |
| 2589 | 7702433.74 | 434468.20 | 324.28 | 03B20100922SPR | 324.34 | -0.06 |
| 2590 | 7702429.47 | 434456.84 | 324.00 | 03B20100922SPR | 324.08 | -0.08 |
| 2600 | 7672191.13 | 427065.79 | 294.96 | 04B20100922SAC | 295.04 | -0.08 |
| 2601 | 7676598.95 | 427607.98 | 315.09 | 04B20100922SGR | 315.14 | -0.05 |
| 2602 | 7676585.66 | 427602.02 | 315.04 | 04B20100922SGR | 315.07 | -0.03 |
| 2603 | 7676576.71 | 427597.60 | 315.05 | 04B20100922SGR | 315.10 | -0.05 |
| 2604 | 7675395.11 | 427173.36 | 311.68 | 04B20100922SGR | 311.72 | -0.04 |
| 2605 | 7675383.98 | 427172.56 | 311.50 | 04B20100922SGR | 311.53 | -0.03 |
| 2606 | 7675372.07 | 427171.52 | 311.30 | 04B20100922SGR | 311.35 | -0.06 |
| 2607 | 7674065.69 | 427266.01 | 325.79 | 04B20100922SPR | 325.80 | -0.01 |
| 2608 | 7674052.72 | 427270.00 | 325.68 | 04B20100922SPR | 325.73 | -0.05 |
| 2609 | 7674042.43 | 427272.79 | 325.66 | 04B20100922SPR | 325.70 | -0.04 |
| 2610 | 7673088.70 | 427402.72 | 307.46 | 04B20100922SPR | 307.51 | -0.05 |
| 2611 | 7673077.01 | 427401.52 | 307.50 | 04B20100922SPR | 307.51 | -0.01 |
| 2612 | 7673065.54 | 427400.19 | 307.48 | 04B20100922SPR | 307.50 | -0.02 |
| 2613 | 7672208.61 | 427142.69 | 295.52 | 04B20100922SPR | 295.53 | -0.01 |
| 2614 | 7672196.59 | 427138.41 | 295.88 | 04B20100922SPR | 295.90 | -0.02 |
| 2615 | 7672184.82 | 427134.25 | 296.36 | 04B20100922SPR | 296.34 | 0.02 |
| 2617 | 7671948.28 | 426799.40 | 299.32 | 04B20100922SGR | 299.39 | -0.07 |
| 2618 | 7671939.24 | 426813.61 | 299.47 | 04B20100922SGR | 299.51 | -0.04 |
| 2619 | 7671948.86 | 426809.57 | 299.29 | 04B20100922SGR | 299.34 | -0.05 |
| 2620 | 7672268.66 | 427495.55 | 290.78 | 04B20100922SGR | 290.78 | 0.00 |
| 2621 | 7672268.19 | 427510.43 | 290.51 | 04B20100922SGR | 290.50 | 0.01 |
| 2622 | 7672268.74 | 427524.41 | 290.35 | 04B20100922SGR | 290.37 | -0.02 |
| 2623 | 7671971.84 | 427442.07 | 292.06 | 04B20100922SGR | 292.09 | -0.03 |
| 2624 | 7671969.10 | 427428.01 | 292.11 | 04B20100922SGR | 292.14 | -0.03 |
| 2625 | 7671967.46 | 427417.49 | 292.15 | 04B20100922SGR | 292.15 | 0.00 |
| 2626 | 7673702.81 | 427953.10 | 285.84 | 04B20100922SGR | 285.91 | -0.07 |
| 2627 | 7673675.31 | 427967.23 | 285.93 | 04B20100922SGR | 286.01 | -0.08 |
| 2628 | 7673650.59 | 427960.33 | 286.08 | 04B20100922SGR | 286.11 | -0.03 |
| 2629 | 7672401.04 | 427613.16 | 290.31 | 04B20100922SGR | 290.37 | -0.06 |
| 2630 | 7672387.80 | 427603.75 | 290.31 | 04B20100922SGR | 290.33 | -0.02 |
| 2631 | 7672376.12 | 427593.44 | 290.30 | 04B20100922SGR | 290.34 | -0.04 |
| 2632 | 7671294.02 | 426855.02 | 330.40 | 04B20100922SGR | 330.41 | -0.01 |
| 2633 | 7671279.54 | 426853.19 | 330.91 | 04B20100922SGR | 330.96 | -0.05 |
| 2634 | 7671263.98 | 426850.73 | 331.40 | 04B20100922SGR | 331.42 | -0.02 |
| 2635 | 7670617.02 | 426751.52 | 338.52 | 04B20100922SGR | 338.55 | -0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 2636 | 7670605.89 | 426749.62 | 338.69 | 04B20100922SGR | 338.74 | -0.05 |
| 2637 | 7670595.12 | 426747.91 | 338.93 | 04B20100922SGR | 338.97 | -0.04 |
| 2638 | 7670126.50 | 426677.21 | 339.83 | 04B20100922SGR | 339.86 | -0.03 |
| 2639 | 7670114.48 | 426675.45 | 339.82 | 04B20100922SGR | 339.85 | -0.03 |
| 2640 | 7670098.26 | 426672.34 | 339.78 | 04B20100922SGR | 339.79 | -0.01 |
| 2641 | 7668757.65 | 426465.58 | 348.07 | 04B20100922SGR | 348.17 | -0.10 |
| 2642 | 7668742.49 | 426463.61 | 349.14 | 04B20100922SGR | 349.26 | -0.12 |
| 2643 | 7668728.52 | 426460.93 | 350.28 | 04B20100922SGR | 350.40 | -0.12 |
| 2644 | 7668343.21 | 426402.67 | 372.42 | 04B20100922SGR | 372.51 | -0.09 |
| 2645 | 7668321.66 | 426400.10 | 372.52 | 04B20100922SGR | 372.59 | -0.07 |
| 2646 | 7668360.39 | 426405.85 | 372.25 | 04B20100922SGR | 372.30 | -0.05 |
| 2700 | 7636671.49 | 426531.04 | 425.52 | 05B201009225B | 425.59 | -0.07 |
| 2702 | 7636677.60 | 426563.91 | 426.81 | 05B20100922SGR | 426.77 | 0.04 |
| 2703 | 7636694.35 | 426563.20 | 426.56 | 05B20100922SGR | 426.57 | -0.01 |
| 2704 | 7636710.64 | 426562.79 | 426.35 | 05B20100922SGR | 426.38 | -0.03 |
| 2705 | 7639508.72 | 426158.64 | 418.72 | 05B20100922SGR | 418.77 | -0.05 |
| 2706 | 7639494.17 | 426163.97 | 418.73 | 05B20100922SGR | 418.75 | -0.02 |
| 2707 | 7639479.41 | 426169.21 | 418.77 | 05B20100922SGR | 418.79 | -0.02 |
| 2709 | 7639404.69 | 426200.76 | 419.24 | 05B20100922SGR | 419.24 | 0.00 |
| 2710 | 7639389.22 | 426205.85 | 419.32 | 05B20100922SGR | 419.34 | -0.02 |
| 2711 | 7639374.85 | 426211.10 | 419.37 | 05B20100922SGR | 419.41 | -0.04 |
| 2712 | 7638864.49 | 426409.51 | 421.09 | 05B20100922SGR | 421.11 | -0.02 |
| 2713 | 7638846.95 | 426417.55 | 421.13 | 05B20100922SGR | 421.18 | -0.05 |
| 2714 | 7638831.02 | 426424.34 | 421.21 | 05B20100922SGR | 421.23 | -0.02 |
| 2715 | 7638396.03 | 426592.54 | 422.51 | 05B20100922SGR | 422.50 | 0.01 |
| 2716 | 7638378.98 | 426597.66 | 422.60 | 05B20100922SGR | 422.59 | 0.01 |
| 2717 | 7638362.86 | 426601.93 | 422.68 | 05B20100922SGR | 422.66 | 0.02 |
| 2718 | 7638065.77 | 426625.59 | 422.18 | 05B20100922SGR | 422.20 | -0.02 |
| 2719 | 7638047.19 | 426624.69 | 422.18 | 05B20100922SGR | 422.19 | -0.01 |
| 2720 | 7638032.88 | 426623.70 | 422.07 | 05B20100922SGR | 422.08 | -0.01 |
| 2721 | 7637858.47 | 426350.22 | 422.00 | 05B20100922SGR | 422.08 | -0.08 |
| 2722 | 7637860.92 | 426366.55 | 421.98 | 05B20100922SGR | 422.07 | -0.09 |
| 2723 | 7637863.22 | 426380.50 | 421.94 | 05B20100922SGR | 422.06 | -0.12 |
| 2724 | 7637754.56 | 426610.45 | 422.02 | 05B20100922SGR | 422.06 | -0.04 |
| 2725 | 7637739.53 | 426610.00 | 422.08 | 05B20100922SGR | 422.13 | -0.05 |
| 2726 | 7637725.58 | 426609.13 | 422.12 | 05B20100922SGR | 422.16 | -0.04 |
| 2727 | 7637242.31 | 426586.02 | 424.51 | 05B20100922SGR | 424.56 | -0.05 |
| 2728 | 7637227.17 | 426585.40 | 424.58 | 05B20100922SGR | 424.62 | -0.05 |
| 2729 | 7637212.73 | 426584.87 | 424.56 | 05B20100922SGR | 424.62 | -0.06 |
| 2730 | 7636177.31 | 426653.68 | 428.47 | 05B20100922SGR | 428.46 | 0.01 |
| 2731 | 7636162.40 | 426656.09 | 428.48 | 05B20100922SGR | 428.49 | -0.01 |
| 2732 | 7636148.05 | 426658.74 | 428.50 | 05B20100922SGR | 428.51 | -0.01 |
| 2733 | 7635550.96 | 426736.96 | 431.98 | 05B20100922SGR | 431.98 | 0.00 |
| 2734 | 7635535.52 | 426737.38 | 432.00 | 05B20100922SGR | 432.00 | 0.00 |
| 2735 | 7635520.09 | 426737.98 | 431.90 | 05B20100922SGR | 431.93 | -0.03 |
| 2736 | 7634789.58 | 426772.53 | 435.79 | 05B20100922SGR | 435.84 | -0.05 |
| 2737 | 7634774.14 | 426773.16 | 435.68 | 05B20100922SGR | 435.74 | -0.06 |
| 2738 | 7634759.03 | 426773.86 | 435.60 | 05B20100922SGR | 435.64 | -0.04 |
| 2739 | 7634001.89 | 426552.85 | 453.22 | 05B20100922SGR | 453.18 | 0.04 |
| 2740 | 7633990.78 | 426539.75 | 453.26 | 05B20100922SGR | 453.24 | 0.02 |
| 2741 | 7633980.76 | 426527.07 | 453.38 | 05B20100922SGR | 453.36 | 0.02 |
| 2742 | 7633452.04 | 426076.14 | 458.44 | 05B20100922SGR | 458.43 | 0.01 |
| 2743 | 7633438.76 | 426068.11 | 458.49 | 05B20100922SGR | 458.49 | 0.00 |
| 2744 | 7633424.47 | 426059.52 | 458.71 | 05B20100922SGR | 458.68 | 0.02 |
| 2745 | 7632893.82 | 425855.51 | 462.23 | 05B20100922SGR | 462.24 | -0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 2746 | 7632876.97 | 425850.91 | 462.39 | 05B20100922SGR | 462.39 | 0.00 |
| 2747 | 7632860.42 | 425845.22 | 462.51 | 05B20100922SGR | 462.53 | -0.02 |
| 2748 | 7632211.69 | 425608.78 | 468.03 | 05B20100922SGR | 468.05 | -0.02 |
| 2749 | 7632196.73 | 425602.63 | 468.28 | 05B20100922SGR | 468.29 | -0.01 |
| 2750 | 7632181.20 | 425596.64 | 468.42 | 05B20100922SGR | 468.43 | -0.01 |
| 2751 | 7631539.29 | 425335.58 | 473.93 | 05B20100922SGR | 473.93 | 0.00 |
| 2752 | 7631520.32 | 425327.48 | 473.94 | 05B20100922SGR | 473.97 | -0.03 |
| 2753 | 7631505.03 | 425320.92 | 474.06 | 05B20100922SGR | 474.04 | 0.02 |
| 2800 | 7608633.41 | 397970.19 | 870.58 | 06B20100923SAC | 870.59 | -0.01 |
| 2801 | 7608633.34 | 397969.08 | 870.47 | 06B20100923OG | 870.50 | -0.03 |
| 2802 | 7608651.98 | 397965.64 | 870.11 | 06B20100923OG | 870.11 | 0.00 |
| 2803 | 7608648.77 | 397945.29 | 869.52 | 06B20100923SGR | 869.52 | 0.00 |
| 2804 | 7608694.11 | 397935.60 | 868.97 | 06B20100923SGR | 869.00 | -0.03 |
| 2805 | 7608741.77 | 397925.41 | 868.10 | 06B20100923SGR | 868.10 | 0.00 |
| 2806 | 7608785.55 | 397919.33 | 868.25 | 06B20100923SGR | 868.29 | -0.04 |
| 2807 | 7608785.02 | 397916.09 | 868.37 | 06B20100923SGR | 868.37 | 0.00 |
| 2808 | 7608826.34 | 397909.93 | 868.90 | 06B20100923SGR | 868.92 | -0.02 |
| 2809 | 7608847.46 | 397903.18 | 869.29 | 06B20100923SGR | 869.30 | -0.01 |
| 2810 | 7608895.63 | 397893.10 | 870.41 | 06B20100923SGR | 870.39 | 0.02 |
| 2811 | 7608940.54 | 397886.26 | 871.26 | 06B20100923SGR | 871.22 | 0.04 |
| 2812 | 7608991.34 | 397884.43 | 871.89 | 06B20100923SGR | 871.89 | 0.00 |
| 2813 | 7609027.61 | 397885.44 | 872.38 | 06B20100923SGR | 872.36 | 0.02 |
| 2814 | 7609030.99 | 397875.68 | 871.91 | 06B20100923SGR | 871.92 | -0.01 |
| 2815 | 7609038.08 | 397862.44 | 870.62 | 06B20100923SGR | 870.65 | -0.03 |
| 2816 | 7609037.13 | 397849.02 | 869.50 | 06B20100923SGR | 869.51 | -0.01 |
| 2817 | 7609047.19 | 397833.75 | 868.44 | 06B20100923SGR | 868.45 | -0.01 |
| 2818 | 7609053.40 | 397812.74 | 868.27 | 06B20100923SGR | 868.28 | -0.01 |
| 2819 | 7609060.75 | 397789.36 | 868.41 | 06B20100923SGR | 868.40 | 0.00 |
| 2820 | 7609077.94 | 397783.11 | 869.70 | 06B20100923OG | 869.71 | -0.01 |
| 2821 | 7609091.25 | 397785.45 | 869.93 | 06B20100923OG | 869.91 | 0.02 |
| 2822 | 7609084.52 | 397809.17 | 868.67 | 06B20100923OG | 868.68 | -0.01 |
| 2823 | 7609020.71 | 397906.94 | 872.14 | 06B20100923SGR | 872.16 | -0.02 |
| 2824 | 7609016.42 | 397918.18 | 873.29 | 06B20100923SGR | 873.30 | -0.01 |
| 2825 | 7609007.96 | 397942.71 | 874.54 | 06B20100923SGR | 874.57 | -0.03 |
| 2826 | 7609001.14 | 397962.95 | 874.99 | 06B20100923SGR | 875.02 | -0.03 |
| 2827 | 7608995.60 | 397978.82 | 875.62 | 06B20100923SGR | 875.65 | -0.03 |
| 2828 | 7608990.71 | 397993.51 | 876.73 | 06B20100923SGR | 876.76 | -0.03 |
| 2829 | 7608984.62 | 398009.51 | 878.23 | 06B20100923SGR | 878.24 | -0.01 |
| 2830 | 7608978.42 | 398028.21 | 879.38 | 06B20100923SGR | 879.39 | -0.01 |
| 2831 | 7610583.75 | 397307.55 | 848.73 | 06B20100923SGR | 848.74 | -0.01 |
| 2832 | 7610601.09 | 397290.56 | 848.46 | 06B20100923SGR | 848.46 | 0.00 |
| 2833 | 7610631.22 | 397258.10 | 846.82 | 06B20100923SGR | 846.78 | 0.04 |
| 2834 | 7610574.61 | 397313.37 | 848.52 | 06B20100923SGR | 848.52 | 0.00 |
| 2835 | 7610547.40 | 397330.66 | 847.73 | 06B20100923SGR | 847.71 | 0.02 |
| 2836 | 7610517.29 | 397344.20 | 846.95 | 06B20100923SGR | 846.93 | 0.02 |
| 2837 | 7610470.92 | 397359.93 | 845.78 | 06B20100923SGR | 845.74 | 0.04 |
| 2838 | 7610432.27 | 397371.52 | 844.92 | 06B20100923SGR | 844.90 | 0.01 |
| 2839 | 7607687.99 | 398168.16 | 880.02 | 06B20100923SGR | 880.02 | 0.00 |
| 2840 | 7607694.07 | 398194.73 | 878.61 | 06B20100923SGR | 878.61 | 0.00 |
| 2841 | 7607698.62 | 398215.42 | 878.49 | 06B20100923SGR | 878.48 | 0.01 |
| 2842 | 7607703.60 | 398242.59 | 878.42 | 06B20100923SGR | 878.42 | 0.00 |
| 2843 | 7607700.78 | 398247.69 | 878.39 | 06B20100923SGR | 878.37 | 0.02 |
| 2844 | 7607677.77 | 398161.43 | 880.64 | 06B20100923SGR | 880.64 | 0.00 |
| 2845 | 7607675.76 | 398153.41 | 880.72 | 06B20100923SGR | 880.71 | 0.01 |
| 2846 | 7607631.31 | 398163.14 | 883.23 | 06B20100923SGR | 883.17 | 0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 2847 | 7607581.24 | 398178.35 | 884.79 | 06B20100923SGR | 884.80 | -0.01 |
| 2848 | 7607536.96 | 398199.64 | 886.57 | 06B20100923SGR | 886.58 | -0.01 |
| 2849 | 7607493.54 | 398229.72 | 888.78 | 06B20100923SGR | 888.81 | -0.03 |
| 2850 | 7607452.59 | 398262.27 | 890.48 | 06B20100923SGR | 890.46 | 0.01 |
| 2851 | 7607415.79 | 398291.32 | 892.15 | 06B20100923SGR | 892.15 | 0.00 |
| 2852 | 7607403.27 | 398297.71 | 892.27 | 06B20100923SGR | 892.29 | -0.02 |
| 2853 | 7607406.92 | 398303.13 | 892.40 | 06B20100923SGR | 892.40 | 0.00 |
| 2900 | 7572681.09 | 399928.56 | 938.32 | 07B20100223SAC | 938.30 | 0.02 |
| 2901 | 7571811.00 | 399766.69 | 922.46 | 07B20100224SGR | 922.42 | 0.04 |
| 2902 | 7571810.90 | 399745.04 | 921.19 | 07B20100225SGR | 921.17 | 0.02 |
| 2903 | 7571811.68 | 399719.88 | 919.99 | 07B20100226SGR | 919.93 | 0.06 |
| 2904 | 7571813.19 | 399695.52 | 917.94 | 07B20100227SGR | 917.90 | 0.04 |
| 2905 | 7571814.57 | 399671.31 | 917.78 | 07B20100228SGR | 917.75 | 0.02 |
| 2906 | 7571814.97 | 399639.13 | 918.05 | 07B20100229SGR | 918.00 | 0.04 |
| 2907 | 7571814.30 | 399612.59 | 918.31 | 07B20100230SGR | 918.24 | 0.07 |
| 2908 | 7571810.88 | 399590.19 | 918.04 | 07B20100231SGR | 917.99 | 0.05 |
| 2909 | 7571803.02 | 399563.02 | 918.37 | 07B20100232SGR | 918.30 | 0.07 |
| 2910 | 7571794.28 | 399532.97 | 917.99 | 07B20100233SGR | 917.91 | 0.08 |
| 2911 | 7571781.16 | 399493.41 | 917.81 | 07B20100234SGR | 917.76 | 0.05 |
| 2912 | 7571807.12 | 399631.62 | 918.53 | 07B20100235OG | 918.45 | 0.08 |
| 2913 | 7571806.51 | 399661.65 | 917.56 | 07B20100236OG | 917.48 | 0.07 |
| 2914 | 7571802.27 | 399690.41 | 918.50 | 07B20100237OG | 918.45 | 0.05 |
| 2915 | 7571804.41 | 399726.59 | 920.10 | 07B20100238OG | 920.01 | 0.09 |
| 2916 | 7571812.68 | 399800.40 | 922.49 | 07B20100239OG | 922.54 | -0.05 |
| 2917 | 7571817.63 | 399788.56 | 922.57 | 07B20100240SGR | 922.51 | 0.06 |
| 2918 | 7571841.79 | 399789.92 | 921.79 | 07B20100241SGR | 921.73 | 0.05 |
| 2919 | 7572639.83 | 399900.61 | 936.86 | 07B20100242SGR | 936.79 | 0.07 |
| 2920 | 7572671.09 | 399904.34 | 936.55 | 07B20100243SGR | 936.48 | 0.07 |
| 2921 | 7572693.54 | 399907.86 | 936.17 | 07B20100244SGR | 936.11 | 0.06 |
| 2922 | 7572715.65 | 399911.04 | 935.75 | 07B20100245SGR | 935.68 | 0.07 |
| 2923 | 7572738.42 | 399914.30 | 935.35 | 07B20100246SGR | 935.29 | 0.06 |
| 2924 | 7572762.61 | 399917.68 | 934.98 | 07B20100247SGR | 934.92 | 0.06 |
| 2925 | 7572786.49 | 399921.20 | 934.50 | 07B20100248SGR | 934.42 | 0.08 |
| 2926 | 7572786.87 | 399917.71 | 934.40 | 07B20100249SGR | 934.35 | 0.05 |
| 2927 | 7572805.00 | 399920.46 | 933.97 | 07B20100250SGR | 933.91 | 0.06 |
| 2928 | 7572804.81 | 399923.79 | 934.06 | 07B20100251SGR | 933.98 | 0.08 |
| 2929 | 7572804.48 | 399926.95 | 933.96 | 07B20100252SGR | 933.89 | 0.07 |
| 2930 | 7572825.85 | 399926.87 | 933.45 | 07B20100253SGR | 933.38 | 0.07 |
| 2931 | 7572848.34 | 399930.23 | 932.72 | 07B20100254SGR | 932.65 | 0.07 |
| 2932 | 7572848.32 | 399933.45 | 932.62 | 07B20100255SGR | 932.54 | 0.08 |
| 2933 | 7572849.50 | 399927.08 | 932.60 | 07B20100256SGR | 932.57 | 0.03 |
| 2934 | 7572868.56 | 399933.11 | 931.98 | 07B20100257SGR | 931.92 | 0.06 |
| 3000 | 7536093.45 | 381644.09 | 576.99 | 8B201009238B | 576.99 | 0.00 |
| 3000 | 7536093.45 | 381644.09 | 576.99 | 8B201009238B | 576.99 | 0.00 |
| 3001 | 7526367.09 | 380965.72 | 540.21 | 8B20100923SGR | 540.22 | -0.01 |
| 3001 | 7526367.09 | 380965.72 | 540.21 | 8B20100923SGR | 540.22 | -0.01 |
| 3002 | 7526379.06 | 380968.49 | 540.28 | 8B20100923SGR | 540.30 | -0.02 |
| 3002 | 7526379.06 | 380968.49 | 540.28 | 8B20100923SGR | 540.30 | -0.02 |
| 3003 | 7526390.16 | 380971.67 | 540.35 | 8B20100923SGR | 540.38 | -0.03 |
| 3003 | 7526390.16 | 380971.67 | 540.35 | 8B20100923SGR | 540.38 | -0.03 |
| 3004 | 7526817.57 | 381002.44 | 536.38 | 8B20100923SGR | 536.40 | -0.02 |
| 3004 | 7526817.57 | 381002.44 | 536.38 | 8B20100923SGR | 536.40 | -0.02 |
| 3005 | 7526828.94 | 381002.24 | 536.05 | 8B20100923SGR | 536.05 | 0.00 |
| 3005 | 7526828.94 | 381002.24 | 536.05 | 8B20100923SGR | 536.05 | 0.00 |
| 3006 | 7526840.11 | 381002.04 | 535.68 | 8B20100923SGR | 535.71 | -0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 3006 | 7526840.11 | 381002.04 | 535.68 | 8B20100923SGR | 535.71 | -0.03 |
| 3007 | 7527654.48 | 381150.19 | 547.57 | 8B20100923SGR | 547.59 | -0.02 |
| 3007 | 7527654.48 | 381150.19 | 547.57 | 8B20100923SGR | 547.59 | -0.02 |
| 3008 | 7527663.38 | 381157.60 | 547.96 | 8B20100923SGR | 547.94 | 0.02 |
| 3008 | 7527663.38 | 381157.60 | 547.96 | 8B20100923SGR | 547.94 | 0.02 |
| 3009 | 7527672.11 | 381165.06 | 548.29 | 8B20100923SGR | 548.29 | 0.00 |
| 3009 | 7527672.11 | 381165.06 | 548.29 | 8B20100923SGR | 548.29 | 0.00 |
| 3010 | 7528213.41 | 381475.88 | 565.84 | 8B20100923SGR | 565.86 | -0.02 |
| 3010 | 7528213.41 | 381475.88 | 565.84 | 8B20100923SGR | 565.86 | -0.02 |
| 3011 | 7528224.83 | 381474.22 | 565.36 | 8B20100923SGR | 565.34 | 0.02 |
| 3011 | 7528224.83 | 381474.22 | 565.36 | 8B20100923SGR | 565.34 | 0.02 |
| 3012 | 7528236.02 | 381472.75 | 564.85 | 8B20100923SGR | 564.82 | 0.03 |
| 3012 | 7528236.02 | 381472.75 | 564.85 | 8B20100923SGR | 564.82 | 0.03 |
| 3013 | 7528754.93 | 381282.62 | 550.13 | 8B20100923SGR | 550.12 | 0.01 |
| 3013 | 7528754.93 | 381282.62 | 550.13 | 8B20100923SGR | 550.12 | 0.01 |
| 3014 | 7528766.16 | 381278.04 | 549.77 | 8B20100923SGR | 549.76 | 0.01 |
| 3014 | 7528766.16 | 381278.04 | 549.77 | 8B20100923SGR | 549.76 | 0.01 |
| 3015 | 7528776.59 | 381273.09 | 549.28 | 8B20100923SGR | 549.31 | -0.03 |
| 3015 | 7528776.59 | 381273.09 | 549.28 | 8B20100923SGR | 549.31 | -0.03 |
| 3016 | 7529136.41 | 381109.59 | 534.01 | 8B20100923SGR | 534.02 | -0.01 |
| 3016 | 7529136.41 | 381109.59 | 534.01 | 8B20100923SGR | 534.02 | -0.01 |
| 3017 | 7529147.33 | 381108.99 | 533.68 | 8B20100923SGR | 533.72 | -0.04 |
| 3017 | 7529147.33 | 381108.99 | 533.68 | 8B20100923SGR | 533.72 | -0.04 |
| 3018 | 7529158.22 | 381108.65 | 533.45 | 8B20100923SGR | 533.47 | -0.02 |
| 3018 | 7529158.22 | 381108.65 | 533.45 | 8B20100923SGR | 533.47 | -0.02 |
| 3019 | 7529525.14 | 381112.58 | 532.99 | 8B20100923SGR | 532.98 | 0.01 |
| 3019 | 7529525.14 | 381112.58 | 532.99 | 8B20100923SGR | 532.98 | 0.01 |
| 3020 | 7529541.85 | 381114.41 | 532.92 | 8B20100923SGR | 532.90 | 0.02 |
| 3020 | 7529541.85 | 381114.41 | 532.92 | 8B20100923SGR | 532.90 | 0.02 |
| 3021 | 7529556.82 | 381116.49 | 532.84 | 8B20100923SGR | 532.84 | 0.00 |
| 3021 | 7529556.82 | 381116.49 | 532.84 | 8B20100923SGR | 532.84 | 0.00 |
| 3022 | 7529954.72 | 381167.21 | 534.52 | 8B20100923SGR | 534.49 | 0.03 |
| 3022 | 7529954.72 | 381167.21 | 534.52 | 8B20100923SGR | 534.49 | 0.03 |
| 3023 | 7529967.08 | 381168.96 | 534.58 | 8B20100923SGR | 534.56 | 0.02 |
| 3023 | 7529967.08 | 381168.96 | 534.58 | 8B20100923SGR | 534.56 | 0.02 |
| 3024 | 7529977.78 | 381170.52 | 534.62 | 8B20100923SGR | 534.62 | 0.00 |
| 3024 | 7529977.78 | 381170.52 | 534.62 | 8B20100923SGR | 534.62 | 0.00 |
| 3025 | 7530766.40 | 381272.31 | 538.91 | 8B20100923SGR | 538.88 | 0.03 |
| 3025 | 7530766.40 | 381272.31 | 538.91 | 8B20100923SGR | 538.88 | 0.03 |
| 3026 | 7530782.00 | 381274.17 | 538.94 | 8B20100923SGR | 538.93 | 0.01 |
| 3026 | 7530782.00 | 381274.17 | 538.94 | 8B20100923SGR | 538.93 | 0.01 |
| 3027 | 7530797.50 | 381276.29 | 539.02 | 8B20100923SGR | 539.02 | 0.00 |
| 3027 | 7530797.50 | 381276.29 | 539.02 | 8B20100923SGR | 539.02 | 0.00 |
| 3028 | 7531508.19 | 381367.16 | 543.22 | 8B20100923SGR | 543.19 | 0.03 |
| 3028 | 7531508.19 | 381367.16 | 543.22 | 8B20100923SGR | 543.19 | 0.03 |
| 3029 | 7531521.68 | 381369.23 | 543.28 | 8B20100923SGR | 543.26 | 0.02 |
| 3029 | 7531521.68 | 381369.23 | 543.28 | 8B20100923SGR | 543.26 | 0.02 |
| 3030 | 7531537.39 | 381371.48 | 543.34 | 8B20100923SGR | 543.30 | 0.04 |
| 3030 | 7531537.39 | 381371.48 | 543.34 | 8B20100923SGR | 543.30 | 0.04 |
| 3031 | 7532158.35 | 381450.05 | 555.18 | 8B20100923SGR | 555.19 | -0.01 |
| 3031 | 7532158.35 | 381450.05 | 555.18 | 8B20100923SGR | 555.19 | -0.01 |
| 3032 | 7532168.27 | 381451.53 | 555.52 | 8B20100923SGR | 555.52 | 0.00 |
| 3032 | 7532168.27 | 381451.53 | 555.52 | 8B20100923SGR | 555.52 | 0.00 |
| 3033 | 7532179.24 | 381453.17 | 555.89 | 8B20100923SGR | 555.88 | 0.01 |
| 3033 | 7532179.24 | 381453.17 | 555.89 | 8B20100923SGR | 555.88 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 3034 | 7532999.87 | 381558.30 | 573.84 | 8B20100923SGR | 573.86 | -0.02 |
| 3034 | 7532999.87 | 381558.30 | 573.84 | 8B20100923SGR | 573.86 | -0.02 |
| 3035 | 7533011.04 | 381559.95 | 573.47 | 8B20100923SGR | 573.50 | -0.03 |
| 3035 | 7533011.04 | 381559.95 | 573.47 | 8B20100923SGR | 573.50 | -0.03 |
| 3036 | 7533021.77 | 381561.60 | 573.03 | 8B20100923SGR | 573.01 | 0.02 |
| 3036 | 7533021.77 | 381561.60 | 573.03 | 8B20100923SGR | 573.01 | 0.02 |
| 3037 | 7533838.56 | 381664.41 | 560.76 | 8B20100923SGR | 560.80 | -0.04 |
| 3037 | 7533838.56 | 381664.41 | 560.76 | 8B20100923SGR | 560.80 | -0.04 |
| 3038 | 7533854.13 | 381667.15 | 560.81 | 8B20100923SGR | 560.86 | -0.05 |
| 3038 | 7533854.13 | 381667.15 | 560.81 | 8B20100923SGR | 560.86 | -0.05 |
| 3039 | 7533867.23 | 381669.29 | 560.88 | 8B20100923SGR | 560.95 | -0.07 |
| 3039 | 7533867.23 | 381669.29 | 560.88 | 8B20100923SGR | 560.95 | -0.07 |
| 3040 | 7534780.02 | 381762.69 | 566.84 | 8B20100923SGR | 566.84 | 0.00 |
| 3040 | 7534780.02 | 381762.69 | 566.84 | 8B20100923SGR | 566.84 | 0.00 |
| 3041 | 7534791.00 | 381762.57 | 566.97 | 8B20100923SGR | 566.97 | 0.00 |
| 3041 | 7534791.00 | 381762.57 | 566.97 | 8B20100923SGR | 566.97 | 0.00 |
| 3042 | 7534800.98 | 381762.46 | 567.08 | 8B20100923SGR | 567.07 | 0.01 |
| 3042 | 7534800.98 | 381762.46 | 567.08 | 8B20100923SGR | 567.07 | 0.01 |
| 3043 | 7535354.29 | 381738.75 | 570.97 | 8B20100923SGR | 570.95 | 0.02 |
| 3043 | 7535354.29 | 381738.75 | 570.97 | 8B20100923SGR | 570.95 | 0.02 |
| 3044 | 7535365.05 | 381738.35 | 571.05 | 8B20100923SGR | 571.01 | 0.04 |
| 3044 | 7535365.05 | 381738.35 | 571.05 | 8B20100923SGR | 571.01 | 0.04 |
| 3045 | 7535375.08 | 381738.06 | 571.13 | 8B20100923SGR | 571.08 | 0.05 |
| 3045 | 7535375.08 | 381738.06 | 571.13 | 8B20100923SGR | 571.08 | 0.05 |
| 3046 | 7536075.04 | 381705.81 | 576.22 | 8B20100923SGR | 576.22 | 0.00 |
| 3046 | 7536075.04 | 381705.81 | 576.22 | 8B20100923SGR | 576.22 | 0.00 |
| 3047 | 7536086.02 | 381705.44 | 576.39 | 8B20100923SGR | 576.36 | 0.03 |
| 3047 | 7536086.02 | 381705.44 | 576.39 | 8B20100923SGR | 576.36 | 0.03 |
| 3048 | 7536094.10 | 381705.18 | 576.49 | 8B20100923SGR | 576.47 | 0.02 |
| 3048 | 7536094.10 | 381705.18 | 576.49 | 8B20100923SGR | 576.47 | 0.02 |
| 3050 | 7536474.63 | 381665.51 | 579.08 | 8B20100923SGR | 579.08 | 0.00 |
| 3050 | 7536474.63 | 381665.51 | 579.08 | 8B20100923SGR | 579.08 | 0.00 |
| 3051 | 7536485.87 | 381664.08 | 579.04 | 8B20100923SGR | 579.02 | 0.01 |
| 3051 | 7536485.87 | 381664.08 | 579.04 | 8B20100923SGR | 579.02 | 0.01 |
| 3052 | 7536496.15 | 381662.60 | 578.99 | 8B20100923SGR | 579.00 | -0.01 |
| 3052 | 7536496.15 | 381662.60 | 578.99 | 8B20100923SGR | 579.00 | -0.01 |
| 3053 | 7537371.40 | 381531.91 | 586.73 | 8B20100923SGR | 586.63 | 0.10 |
| 3053 | 7537371.40 | 381531.91 | 586.73 | 8B20100923SGR | 586.63 | 0.10 |
| 3054 | 7537382.61 | 381530.08 | 586.81 | 8B20100923SGR | 586.74 | 0.07 |
| 3054 | 7537382.61 | 381530.08 | 586.81 | 8B20100923SGR | 586.74 | 0.07 |
| 3055 | 7537394.12 | 381528.33 | 586.93 | 8B20100923SGR | 586.87 | 0.06 |
| 3055 | 7537394.12 | 381528.33 | 586.93 | 8B20100923SGR | 586.87 | 0.06 |
| 3056 | 7538241.42 | 381825.67 | 604.43 | 8B20100923SGR | 604.39 | 0.04 |
| 3056 | 7538241.42 | 381825.67 | 604.43 | 8B20100923SGR | 604.39 | 0.04 |
| 3057 | 7538251.54 | 381831.53 | 604.72 | 8B20100923SGR | 604.69 | 0.02 |
| 3057 | 7538251.54 | 381831.53 | 604.72 | 8B20100923SGR | 604.69 | 0.02 |
| 3058 | 7538261.70 | 381837.83 | 604.97 | 8B20100923SGR | 604.93 | 0.04 |
| 3058 | 7538261.70 | 381837.83 | 604.97 | 8B20100923SGR | 604.93 | 0.04 |
| 3059 | 7538708.89 | 382559.61 | 606.77 | 8B20100923SGR | 606.79 | -0.02 |
| 3059 | 7538708.89 | 382559.61 | 606.77 | 8B20100923SGR | 606.79 | -0.02 |
| 3060 | 7538712.79 | 382570.12 | 606.81 | 8B20100923SGR | 606.88 | -0.08 |
| 3060 | 7538712.79 | 382570.12 | 606.81 | 8B20100923SGR | 606.88 | -0.08 |
| 3061 | 7538717.68 | 382580.01 | 606.88 | 8B20100923SGR | 606.92 | -0.04 |
| 3061 | 7538717.68 | 382580.01 | 606.88 | 8B20100923SGR | 606.92 | -0.04 |
| 3062 | 7539457.13 | 383153.45 | 614.68 | 8B20100923SGR | 614.70 | -0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 3062 | 7539457.13 | 383153.45 | 614.68 | 8B20100923SGR | 614.70 | -0.02 |
| 3063 | 7539466.63 | 383160.34 | 614.78 | 8B20100923SGR | 614.78 | 0.00 |
| 3063 | 7539466.63 | 383160.34 | 614.78 | 8B20100923SGR | 614.78 | 0.00 |
| 3064 | 7539475.59 | 383167.00 | 614.88 | 8B20100923SGR | 614.89 | -0.01 |
| 3064 | 7539475.59 | 383167.00 | 614.88 | 8B20100923SGR | 614.89 | -0.01 |
| 3065 | 7540086.99 | 383590.23 | 621.79 | 8B20100923SGR | 621.82 | -0.03 |
| 3065 | 7540086.99 | 383590.23 | 621.79 | 8B20100923SGR | 621.82 | -0.03 |
| 3066 | 7540097.51 | 383595.84 | 621.94 | 8B20100923SGR | 621.95 | -0.01 |
| 3066 | 7540097.51 | 383595.84 | 621.94 | 8B20100923SGR | 621.95 | -0.01 |
| 3067 | 7540107.18 | 383600.55 | 622.07 | 8B20100923SGR | 622.09 | -0.02 |
| 3067 | 7540107.18 | 383600.55 | 622.07 | 8B20100923SGR | 622.09 | -0.02 |
| 3069 | 7540288.71 | 383689.00 | 622.97 | 8B20100923SGR | 622.96 | 0.01 |
| 3069 | 7540288.71 | 383689.00 | 622.97 | 8B20100923SGR | 622.96 | 0.01 |
| 3070 | 7540269.62 | 383681.35 | 622.71 | 8B20100923SGR | 622.70 | 0.01 |
| 3070 | 7540269.62 | 383681.35 | 622.71 | 8B20100923SGR | 622.70 | 0.01 |
| 3071 | 7540265.64 | 383656.35 | 623.76 | 8B20100923SGR | 623.72 | 0.04 |
| 3071 | 7540265.64 | 383656.35 | 623.76 | 8B20100923SGR | 623.72 | 0.04 |
| 3072 | 7540275.73 | 383660.54 | 623.84 | 8B20100923SGR | 623.80 | 0.04 |
| 3072 | 7540275.73 | 383660.54 | 623.84 | 8B20100923SGR | 623.80 | 0.04 |
| 3073 | 7540288.34 | 383665.49 | 623.97 | 8B20100923SGR | 623.95 | 0.02 |
| 3073 | 7540288.34 | 383665.49 | 623.97 | 8B20100923SGR | 623.95 | 0.02 |
| 3074 | 7540934.94 | 383935.90 | 631.14 | 8B20100923SGR | 631.03 | 0.11 |
| 3074 | 7540934.94 | 383935.90 | 631.14 | 8B20100923SGR | 631.03 | 0.11 |
| 3075 | 7540953.72 | 383938.10 | 631.29 | 8B20100923SGR | 631.24 | 0.05 |
| 3075 | 7540953.72 | 383938.10 | 631.29 | 8B20100923SGR | 631.24 | 0.05 |
| 3076 | 7540967.14 | 383940.66 | 631.37 | 8B20100923SGR | 631.31 | 0.06 |
| 3076 | 7540967.14 | 383940.66 | 631.37 | 8B20100923SGR | 631.31 | 0.06 |
| 3077 | 7541720.91 | 384052.08 | 647.74 | 8B20100923SGR | 647.66 | 0.08 |
| 3077 | 7541720.91 | 384052.08 | 647.74 | 8B20100923SGR | 647.66 | 0.08 |
| 3078 | 7541734.43 | 384054.30 | 648.32 | 8B20100923SGR | 648.20 | 0.12 |
| 3078 | 7541734.43 | 384054.30 | 648.32 | 8B20100923SGR | 648.20 | 0.12 |
| 3079 | 7541751.73 | 384057.16 | 648.97 | 8B20100923SGR | 648.86 | 0.11 |
| 3079 | 7541751.73 | 384057.16 | 648.97 | 8B20100923SGR | 648.86 | 0.11 |
| 3080 | 7542655.98 | 384233.28 | 649.53 | 8B20100923SGR | 649.48 | 0.05 |
| 3080 | 7542655.98 | 384233.28 | 649.53 | 8B20100923SGR | 649.48 | 0.05 |
| 3081 | 7542672.12 | 384234.88 | 649.68 | 8B20100923SGR | 649.64 | 0.04 |
| 3081 | 7542672.12 | 384234.88 | 649.68 | 8B20100923SGR | 649.64 | 0.04 |
| 3082 | 7542687.23 | 384236.90 | 649.92 | 8B20100923SGR | 649.80 | 0.12 |
| 3082 | 7542687.23 | 384236.90 | 649.92 | 8B20100923SGR | 649.80 | 0.12 |
| 3083 | 7543434.93 | 384440.51 | 657.34 | 8B20100923SGR | 657.30 | 0.04 |
| 3083 | 7543434.93 | 384440.51 | 657.34 | 8B20100923SGR | 657.30 | 0.04 |
| 3084 | 7543454.36 | 384439.36 | 657.61 | 8B20100923SGR | 657.57 | 0.04 |
| 3084 | 7543454.36 | 384439.36 | 657.61 | 8B20100923SGR | 657.57 | 0.04 |
| 3085 | 7543472.73 | 384437.33 | 657.96 | 8B20100923SGR | 657.91 | 0.05 |
| 3085 | 7543472.73 | 384437.33 | 657.96 | 8B20100923SGR | 657.91 | 0.05 |
| 3086 | 7543473.20 | 384425.61 | 657.82 | 8B20100923SGR | 657.78 | 0.04 |
| 3086 | 7543473.20 | 384425.61 | 657.82 | 8B20100923SGR | 657.78 | 0.04 |
| 3100 | 7502902.21 | 381261.28 | 424.23 | 9B20100923SAC | 424.20 | 0.03 |
| 3102 | 7502894.09 | 381245.51 | 424.87 | 9B20100923SGR | 424.77 | 0.10 |
| 3103 | 7502907.89 | 381250.32 | 424.85 | 9B20100923SGR | 424.77 | 0.08 |
| 3104 | 7502921.95 | 381256.39 | 424.88 | 9B20100923SGR | 424.79 | 0.09 |
| 3105 | 7492709.39 | 378536.53 | 432.20 | 9B20100923SGR | 432.17 | 0.03 |
| 3106 | 7492724.34 | 378533.95 | 432.32 | 9B20100923SGR | 432.27 | 0.05 |
| 3107 | 7492741.40 | 378530.97 | 432.38 | 9B20100923SGR | 432.36 | 0.02 |
| 3108 | 7493250.66 | 378430.45 | 428.66 | 9B20100923SGR | 428.63 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 3109 | 7493266.15 | 378427.56 | 428.51 | 9B20100923SGR | 428.48 | 0.03 |
| 3110 | 7493280.66 | 378424.89 | 428.40 | 9B20100923SGR | 428.34 | 0.06 |
| 3111 | 7493918.49 | 378299.00 | 432.17 | 9B20100923SGR | 432.16 | 0.00 |
| 3112 | 7493937.05 | 378295.25 | 432.32 | 9B20100923SGR | 432.28 | 0.04 |
| 3113 | 7493954.80 | 378291.70 | 432.47 | 9B20100923SGR | 432.44 | 0.03 |
| 3114 | 7494503.33 | 378258.11 | 436.35 | 9B20100923SGR | 436.32 | 0.03 |
| 3115 | 7494526.88 | 378257.98 | 436.25 | 9B20100923SGR | 436.18 | 0.06 |
| 3116 | 7494550.88 | 378258.31 | 436.00 | 9B20100923SGR | 435.92 | 0.08 |
| 3117 | 7495046.44 | 378404.25 | 437.66 | 9B20100923SGR | 437.62 | 0.04 |
| 3118 | 7495059.94 | 378416.82 | 437.59 | 9B20100923SGR | 437.49 | 0.10 |
| 3119 | 7495073.08 | 378428.23 | 437.39 | 9B20100923SGR | 437.30 | 0.08 |
| 3120 | 7495443.01 | 378740.18 | 433.44 | 9B20100923SGR | 433.42 | 0.02 |
| 3121 | 7495460.49 | 378755.81 | 433.60 | 9B20100923SGR | 433.59 | 0.01 |
| 3122 | 7495477.01 | 378771.05 | 433.71 | 9B20100923SGR | 433.69 | 0.02 |
| 3123 | 7495932.33 | 379131.48 | 439.14 | 9B20100923SGR | 439.07 | 0.07 |
| 3124 | 7495947.62 | 379142.42 | 439.11 | 9B20100923SGR | 439.04 | 0.07 |
| 3125 | 7495965.46 | 379155.16 | 439.11 | 9B20100923SGR | 439.02 | 0.09 |
| 3126 | 7496431.23 | 379474.37 | 440.76 | 9B20100923SGR | 440.71 | 0.05 |
| 3127 | 7496451.73 | 379485.07 | 440.97 | 9B20100923SGR | 440.96 | 0.01 |
| 3128 | 7496472.47 | 379495.52 | 441.07 | 9B20100923SGR | 441.02 | 0.05 |
| 3129 | 7496962.16 | 379662.18 | 436.06 | 9B20100923SGR | 436.00 | 0.06 |
| 3130 | 7496985.08 | 379669.82 | 436.05 | 9B20100923SGR | 435.98 | 0.06 |
| 3131 | 7497007.83 | 379677.14 | 436.03 | 9B20100923SGR | 435.98 | 0.05 |
| 3132 | 7497354.07 | 379792.31 | 437.46 | 9B20100923SGR | 437.44 | 0.01 |
| 3133 | 7497376.13 | 379801.72 | 437.40 | 9B20100923SGR | 437.36 | 0.04 |
| 3134 | 7497394.89 | 379810.43 | 437.53 | 9B20100923SGR | 437.44 | 0.09 |
| 3135 | 7497885.98 | 380085.65 | 439.77 | 9B20100923SGR | 439.71 | 0.06 |
| 3136 | 7497906.11 | 380097.94 | 439.98 | 9B20100923SGR | 439.90 | 0.08 |
| 3137 | 7497925.83 | 380109.17 | 440.23 | 9B20100923SGR | 440.14 | 0.09 |
| 3138 | 7498386.19 | 380373.29 | 437.05 | 9B20100923SGR | 437.04 | 0.01 |
| 3139 | 7498407.86 | 380385.92 | 436.95 | 9B20100923SGR | 436.90 | 0.05 |
| 3140 | 7498427.57 | 380397.31 | 436.86 | 9B20100923SGR | 436.77 | 0.09 |
| 3141 | 7498887.50 | 380750.28 | 438.05 | 9B20100923SGR | 437.97 | 0.08 |
| 3142 | 7498905.75 | 380764.79 | 437.98 | 9B20100923SGR | 437.91 | 0.07 |
| 3143 | 7498924.36 | 380779.51 | 438.22 | 9B20100923SGR | 438.14 | 0.08 |
| 3144 | 7499308.57 | 381088.16 | 434.10 | 9B20100923SGR | 434.00 | 0.10 |
| 3145 | 7499326.27 | 381102.70 | 434.12 | 9B20100923SGR | 434.06 | 0.06 |
| 3146 | 7499342.51 | 381115.76 | 434.20 | 9B20100923SGR | 434.15 | 0.05 |
| 3147 | 7499703.97 | 381351.57 | 432.16 | 9B20100923SGR | 432.06 | 0.10 |
| 3148 | 7499722.22 | 381361.34 | 431.89 | 9B20100923SGR | 431.83 | 0.06 |
| 3149 | 7499738.05 | 381369.27 | 431.58 | 9B20100923SGR | 431.53 | 0.05 |
| 3150 | 7500241.73 | 381464.00 | 425.80 | 9B20100923SGR | 425.79 | 0.01 |
| 3151 | 7500260.33 | 381466.34 | 425.90 | 9B20100923SGR | 425.89 | 0.01 |
| 3152 | 7500281.09 | 381468.97 | 426.02 | 9B20100923SGR | 425.98 | 0.04 |
| 3153 | 7500728.66 | 381520.35 | 426.58 | 9B20100923SGR | 426.56 | 0.02 |
| 3154 | 7500752.15 | 381523.12 | 426.66 | 9B20100923SGR | 426.62 | 0.04 |
| 3155 | 7500775.31 | 381526.17 | 426.67 | 9B20100923SGR | 426.66 | 0.01 |
| 3156 | 7501268.38 | 381584.83 | 427.38 | 9B20100923SGR | 427.33 | 0.05 |
| 3157 | 7501292.43 | 381587.39 | 427.52 | 9B20100923SGR | 427.47 | 0.05 |
| 3158 | 7501315.75 | 381590.42 | 427.47 | 9B20100923SGR | 427.46 | 0.01 |
| 3159 | 7501856.84 | 381594.81 | 427.80 | 9B20100923SGR | 427.77 | 0.03 |
| 3160 | 7501879.82 | 381586.84 | 427.42 | 9B20100923SGR | 427.38 | 0.04 |
| 3161 | 7501901.04 | 381578.12 | 426.94 | 9B20100923SGR | 426.91 | 0.03 |
| 3162 | 7502480.16 | 381319.61 | 424.93 | 9B20100923SGR | 424.84 | 0.09 |
| 3163 | 7502501.99 | 381310.44 | 424.83 | 9B20100923SGR | 424.77 | 0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 3164 | 7502523.00 | 381301.39 | 424.75 | 9B20100923SGR | 424.67 | 0.08 |
| 3165 | 7502501.60 | 381330.11 | 423.83 | 9B20100923SGR | 423.80 | 0.03 |
| 3166 | 7502483.01 | 381345.45 | 423.56 | 9B20100923SGR | 423.54 | 0.02 |
| 3167 | 7503429.18 | 381567.49 | 427.02 | 9B20100923SGR | 426.96 | 0.06 |
| 3168 | 7503441.45 | 381574.95 | 427.07 | 9B20100923SGR | 426.98 | 0.09 |
| 3169 | 7503453.49 | 381582.58 | 427.12 | 9B20100923SGR | 427.02 | 0.10 |
| 3170 | 7503939.69 | 381884.97 | 429.00 | 9B20100923SGR | 428.97 | 0.03 |
| 3171 | 7503960.80 | 381897.59 | 428.95 | 9B20100923SGR | 428.92 | 0.03 |
| 3172 | 7503980.64 | 381910.11 | 428.99 | 9B20100923SGR | 428.98 | 0.01 |
| 3173 | 7504430.58 | 382187.90 | 429.93 | 9B20100923SGR | 429.91 | 0.02 |
| 3174 | 7504450.86 | 382201.01 | 429.94 | 9B20100923SGR | 429.90 | 0.04 |
| 3175 | 7504471.63 | 382213.95 | 429.98 | 9B20100923SGR | 429.92 | 0.06 |
| 3176 | 7504850.73 | 382448.08 | 431.58 | 9B20100923SGR | 431.57 | 0.01 |
| 3177 | 7504871.77 | 382461.53 | 431.69 | 9B20100923SGR | 431.60 | 0.09 |
| 3178 | 7504889.20 | 382472.71 | 431.80 | 9B20100923SGR | 431.73 | 0.07 |
| 3179 | 7505376.43 | 382868.80 | 432.74 | 9B20100923SGR | 432.67 | 0.06 |
| 3180 | 7505392.37 | 382894.85 | 432.71 | 9B20100923SGR | 432.68 | 0.03 |
| 3181 | 7505407.92 | 382921.98 | 432.85 | 9B20100923SGR | 432.81 | 0.04 |
| 3182 | 7505722.29 | 383462.52 | 434.24 | 9B20100923SGR | 434.18 | 0.06 |
| 3183 | 7505735.71 | 383486.80 | 434.36 | 9B20100923SGR | 434.32 | 0.04 |
| 3184 | 7505749.63 | 383511.22 | 434.47 | 9B20100923SGR | 434.44 | 0.02 |
| 3185 | 7505911.26 | 383791.82 | 435.89 | 9B20100923SGR | 435.83 | 0.06 |
| 3186 | 7505917.61 | 383802.84 | 435.78 | 9B20100923SGR | 435.69 | 0.08 |
| 3187 | 7505923.81 | 383813.62 | 435.68 | 9B20100923SGR | 435.63 | 0.05 |
| 9301 | 7487455.15 | 375253.96 | 388.89 | 09C20110607SPR | 388.81 | 0.07 |
| 9302 | 7487452.60 | 375237.91 | 388.83 | 09C20110607SPR | 388.79 | 0.04 |
| 9303 | 7487443.89 | 375225.03 | 388.85 | 09C20110607SPR | 388.82 | 0.03 |
| 9304 | 7487435.32 | 375212.12 | 388.86 | 09C20110607SPR | 388.87 | -0.01 |
| 9305 | 7487425.99 | 375198.32 | 388.92 | 09C20110607SPR | 388.90 | 0.02 |
| 9306 | 7487416.91 | 375184.87 | 388.94 | 09C20110607SPR | 388.91 | 0.02 |
| 9307 | 7487408.22 | 375171.89 | 388.99 | 09C20110607SPR | 388.92 | 0.07 |
| 9308 | 7486918.69 | 374439.04 | 389.05 | 09C20110607SPR | 388.97 | 0.08 |
| 9309 | 7486911.76 | 374423.54 | 388.95 | 09C20110607SPR | 388.94 | 0.01 |
| 9310 | 7486904.93 | 374394.32 | 388.75 | 09C20110607SPR | 388.71 | 0.04 |
| 9311 | 7486901.69 | 374386.50 | 388.78 | 09C20110607SPR | 388.76 | 0.02 |
| 9312 | 7486895.39 | 374371.16 | 388.81 | 09C20110607SPR | 388.78 | 0.03 |
| 9313 | 7486889.13 | 374356.07 | 388.85 | 09C20110607SPR | 388.83 | 0.02 |
| 9314 | 7486883.38 | 374341.53 | 388.86 | 09C20110607SPR | 388.84 | 0.02 |
| 9315 | 7486694.13 | 373401.81 | 384.64 | 09C20110607SPR | 384.56 | 0.08 |
| 9316 | 7486695.99 | 373385.34 | 384.54 | 09C20110607SPR | 384.47 | 0.07 |
| 9317 | 7486697.97 | 373368.89 | 384.42 | 09C20110607SPR | 384.37 | 0.05 |
| 9318 | 7486699.89 | 373351.34 | 384.27 | 09C20110607SPR | 384.23 | 0.04 |
| 9319 | 7486701.98 | 373334.38 | 384.18 | 09C20110607SPR | 384.13 | 0.05 |
| 9320 | 7486703.72 | 373318.51 | 384.08 | 09C20110607SPR | 384.06 | 0.02 |
| 9321 | 7486705.43 | 373302.63 | 384.03 | 09C20110607SPR | 383.99 | 0.04 |
| 9322 | 7486756.53 | 372847.69 | 382.82 | 09C20110607SPR | 382.77 | 0.05 |
| 9323 | 7486758.18 | 372831.05 | 382.72 | 09C20110607SPR | 382.66 | 0.06 |
| 9324 | 7486760.12 | 372814.87 | 382.62 | 09C20110607SPR | 382.55 | 0.07 |
| 9325 | 7486761.82 | 372799.17 | 382.50 | 09C20110607SPR | 382.47 | 0.03 |
| 9326 | 7486763.66 | 372782.96 | 382.36 | 09C20110607SPR | 382.29 | 0.07 |
| 9327 | 7486765.52 | 372766.09 | 382.18 | 09C20110607SPR | 382.14 | 0.04 |
| 9328 | 7486767.75 | 372749.52 | 382.02 | 09C20110607SPR | 381.96 | 0.06 |
| 9329 | 7486666.13 | 372037.53 | 379.85 | 09C20110607SPR | 379.76 | 0.09 |
| 9330 | 7486662.02 | 372021.09 | 379.78 | 09C20110607SPR | 379.72 | 0.06 |
| 9331 | 7486658.04 | 372004.83 | 379.70 | 09C20110607SPR | 379.66 | 0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 9332 | 7486653.75 | 371987.89 | 379.65 | 09C20110607SPR | 379.57 | 0.08 |
| 9333 | 7486649.82 | 371971.93 | 379.61 | 09C20110607SPR | 379.58 | 0.03 |
| 9334 | 7486645.88 | 371956.32 | 379.61 | 09C20110607SPR | 379.54 | 0.07 |
| 9335 | 7486641.96 | 371940.57 | 379.61 | 09C20110607SPR | 379.51 | 0.10 |
| 9336 | 7486266.91 | 371382.01 | 379.13 | 09C20110607SPR | 379.05 | 0.08 |
| 9337 | 7486257.00 | 371368.10 | 379.04 | 09C20110607SPR | 379.01 | 0.03 |
| 9338 | 7486247.69 | 371353.46 | 378.96 | 09C20110607SPR | 378.96 | 0.00 |
| 9339 | 7486238.38 | 371338.97 | 378.97 | 09C20110607SPR | 378.95 | 0.02 |
| 9340 | 7486229.35 | 371322.84 | 378.98 | 09C20110607SPR | 378.92 | 0.06 |
| 9341 | 7486221.53 | 371307.91 | 378.98 | 09C20110607SPR | 378.94 | 0.04 |
| 9342 | 7486215.11 | 371293.71 | 378.98 | 09C20110607SPR | 378.98 | 0.00 |
| 9343 | 7486039.20 | 370579.99 | 377.39 | 09C20110607SPR | 377.30 | 0.09 |
| 9344 | 7486033.72 | 370562.93 | 377.28 | 09C20110607SPR | 377.19 | 0.09 |
| 9345 | 7486028.90 | 370547.21 | 377.17 | 09C20110607SPR | 377.08 | 0.09 |
| 9346 | 7486023.61 | 370528.97 | 376.99 | 09C20110607SPR | 376.92 | 0.07 |
| 9347 | 7486018.54 | 370512.84 | 376.80 | 09C20110607SPR | 376.68 | 0.12 |
| 9448 | 7486155.35 | 371005.90 | 378.53 | 09D20100924SPR | 378.47 | 0.06 |
| 9449 | 7486157.06 | 371017.69 | 378.54 | 09D20100924SPR | 378.45 | 0.09 |
| 9450 | 7486159.42 | 371031.47 | 378.53 | 09D20100924SPR | 378.49 | 0.04 |
| 9451 | 7486532.42 | 371686.65 | 379.45 | 09D20100924SPR | 379.32 | 0.13 |
| 9452 | 7486538.47 | 371695.64 | 379.42 | 09D20100924SPR | 379.32 | 0.10 |
| 9453 | 7486544.38 | 371704.04 | 379.48 | 09D20100924SPR | 379.36 | 0.12 |
| 9454 | 7486765.48 | 372421.70 | 380.92 | 09D20100924SPR | 380.83 | 0.09 |
| 9455 | 7486768.36 | 372433.57 | 380.94 | 09D20100924SPR | 380.87 | 0.07 |
| 9456 | 7486771.47 | 372446.07 | 380.96 | 09D20100924SPR | 380.89 | 0.07 |
| 9457 | 7486724.84 | 373150.84 | 384.01 | 09D20100924SPR | 383.91 | 0.10 |
| 9458 | 7486723.40 | 373163.06 | 383.96 | 09D20100924SPR | 383.95 | 0.01 |
| 9459 | 7486722.09 | 373174.99 | 383.96 | 09D20100924SPR | 383.90 | 0.06 |
| 9460 | 7486820.35 | 374194.72 | 389.20 | 09D20100924SPR | 389.20 | 0.00 |
| 9461 | 7486824.40 | 374204.97 | 389.21 | 09D20100924SPR | 389.18 | 0.02 |
| 9462 | 7486828.98 | 374216.33 | 389.19 | 09D20100924SPR | 389.15 | 0.04 |
| 9463 | 7487187.49 | 374852.43 | 389.08 | 09D20100924SPR | 388.99 | 0.09 |
| 9464 | 7487194.61 | 374863.09 | 389.11 | 09D20100924SPR | 389.04 | 0.07 |
| 9465 | 7487200.86 | 374872.32 | 389.10 | 09D20100924SPR | 389.06 | 0.04 |
| 9466 | 7487652.00 | 375541.83 | 389.73 | 09D20100924SPR | 389.71 | 0.02 |
| 9467 | 7487659.55 | 375552.83 | 389.82 | 09D20100924SPR | 389.78 | 0.04 |
| 9468 | 7487666.06 | 375562.59 | 389.86 | 09D20100924SPR | 389.83 | 0.03 |
| 9469 | 7488062.01 | 376149.94 | 394.46 | 09D20100924SPR | 394.41 | 0.05 |
| 9470 | 7488069.54 | 376161.10 | 394.57 | 09D20100924SPR | 394.54 | 0.02 |
| 9471 | 7488076.28 | 376171.09 | 394.70 | 09D20100924SPR | 394.64 | 0.06 |
| 9472 | 7488471.21 | 376737.37 | 403.46 | 09D20100924SPR | 403.46 | 0.00 |
| 9473 | 7488478.52 | 376746.33 | 403.65 | 09D20100924SPR | 403.61 | 0.04 |
| 9474 | 7488486.05 | 376755.14 | 403.86 | 09D20100924SPR | 403.79 | 0.07 |
| 9475 | 7488286.14 | 377127.22 | 410.46 | 09D20100924SGR | 410.40 | 0.06 |
| 9476 | 7488290.30 | 377119.91 | 410.33 | 09D20100924SGR | 410.24 | 0.09 |
| 9477 | 7488300.75 | 377117.38 | 410.35 | 09D20100924SGR | 410.19 | 0.16 |
| 9601 | 7502909.16 | 381247.83 | 425.00 | 09B20110607SGR | 424.88 | 0.12 |
| 9602 | 7502923.40 | 381254.13 | 425.03 | 09B20110607SGR | 424.93 | 0.09 |
| 9603 | 7502937.45 | 381260.42 | 425.08 | 09B20110607SGR | 424.97 | 0.11 |
| 9604 | 7502950.36 | 381267.88 | 425.03 | 09B20110607SGR | 424.92 | 0.11 |
| 9605 | 7502963.88 | 381276.42 | 425.00 | 09B20110607SGR | 424.92 | 0.08 |
| 9606 | 7502976.45 | 381284.61 | 425.13 | 09B20110607SGR | 425.01 | 0.12 |
| 9607 | 7502989.14 | 381292.20 | 425.23 | 09B20110607SGR | 425.10 | 0.13 |
| 9608 | 7502928.40 | 381232.66 | 424.38 | 09B20110607SGR | 424.29 | 0.09 |
| 9609 | 7502929.32 | 381210.78 | 424.00 | 09B20110607SGR | 423.90 | 0.10 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 9610 | 7502933.75 | 381188.25 | 424.07 | 09B20110607SGR | 423.99 | 0.08 |
| 9611 | 7502952.49 | 381179.65 | 424.19 | 09B20110607SGR | 424.12 | 0.07 |
| 9612 | 7503751.94 | 381764.10 | 428.73 | 09B20110607SGR | 428.65 | 0.08 |
| 9613 | 7503765.47 | 381771.18 | 428.79 | 09B20110607SGR | 428.69 | 0.10 |
| 9614 | 7503779.18 | 381779.40 | 428.87 | 09B20110607SGR | 428.81 | 0.06 |
| 9615 | 7503794.22 | 381788.79 | 428.94 | 09B20110607SGR | 428.88 | 0.06 |
| 9616 | 7503807.01 | 381796.98 | 428.98 | 09B20110607SGR | 428.92 | 0.06 |
| 9617 | 7503819.55 | 381805.05 | 429.00 | 09B20110607SGR | 428.95 | 0.05 |
| 9618 | 7503831.18 | 381812.61 | 429.00 | 09B20110607SGR | 428.92 | 0.08 |
| 9619 | 7503794.19 | 381769.06 | 429.08 | 09B20110607SGR | 429.00 | 0.08 |
| 9620 | 7503803.31 | 381755.94 | 429.15 | 09B20110607SGR | 429.08 | 0.07 |
| 9621 | 7503812.06 | 381742.37 | 429.27 | 09B20110607SGR | 429.20 | 0.07 |
| 9622 | 7503820.41 | 381728.34 | 429.90 | 09B20110607SGR | 429.83 | 0.07 |
| 9623 | 7503823.69 | 381710.84 | 430.41 | 09B20110607SGR | 430.34 | 0.07 |
| 9624 | 7504432.86 | 382184.52 | 429.91 | 09B20110607SGR | 429.83 | 0.08 |
| 9625 | 7504445.75 | 382193.02 | 429.91 | 09B20110607SGR | 429.82 | 0.09 |
| 9626 | 7504457.92 | 382200.79 | 429.90 | 09B20110607SGR | 429.83 | 0.07 |
| 9627 | 7504471.06 | 382208.95 | 429.90 | 09B20110607SGR | 429.82 | 0.08 |
| 9628 | 7504484.48 | 382217.43 | 429.95 | 09B20110607SGR | 429.90 | 0.05 |
| 9629 | 7504497.77 | 382225.49 | 430.02 | 09B20110607SGR | 429.96 | 0.06 |
| 9630 | 7504511.41 | 382234.00 | 430.10 | 09B20110607SGR | 430.00 | 0.10 |
| 9631 | 7505098.76 | 382595.74 | 432.65 | 09B20110607SGR | 432.63 | 0.02 |
| 9632 | 7505117.75 | 382598.63 | 432.74 | 09B20110607SGR | 432.65 | 0.09 |
| 9633 | 7505133.19 | 382607.68 | 432.81 | 09B20110607SGR | 432.71 | 0.10 |
| 9634 | 7505147.88 | 382615.57 | 432.85 | 09B20110607SGR | 432.78 | 0.07 |
| 9635 | 7505162.28 | 382623.51 | 432.93 | 09B20110607SGR | 432.88 | 0.05 |
| 9636 | 7505176.00 | 382631.08 | 432.94 | 09B20110607SGR | 432.93 | 0.01 |
| 9637 | 7505190.82 | 382639.75 | 432.94 | 09B20110607SGR | 432.92 | 0.02 |
| 9638 | 7505587.12 | 383224.69 | 436.84 | 09B20110607SGR | 436.75 | 0.09 |
| 9639 | 7505597.01 | 383241.41 | 436.75 | 09B20110607SGR | 436.71 | 0.04 |
| 9640 | 7505605.00 | 383255.51 | 436.62 | 09B20110607SGR | 436.55 | 0.07 |
| 9641 | 7505613.15 | 383269.86 | 436.41 | 09B20110607SGR | 436.36 | 0.05 |
| 9642 | 7505620.43 | 383284.38 | 436.12 | 09B20110607SGR | 436.03 | 0.09 |
| 9643 | 7505628.29 | 383298.34 | 435.70 | 09B20110607SGR | 435.68 | 0.01 |
| 9644 | 7505637.21 | 383311.39 | 435.26 | 09B20110607SGR | 435.22 | 0.04 |
| 9645 | 7506019.99 | 383973.78 | 437.74 | 09B20110607SGR | 437.71 | 0.03 |
| 9646 | 7506027.82 | 383987.22 | 437.94 | 09B20110607SGR | 437.88 | 0.06 |
| 9647 | 7506036.67 | 384001.42 | 438.04 | 09B20110607SGR | 437.98 | 0.06 |
| 9648 | 7506044.95 | 384015.71 | 438.07 | 09B20110607SGR | 438.10 | -0.04 |
| 9649 | 7506052.55 | 384029.72 | 438.11 | 09B20110607SGR | 438.14 | -0.03 |
| 9650 | 7506064.84 | 384048.33 | 438.10 | 09B20110607SGR | 438.10 | 0.00 |
| 9651 | 7506072.87 | 384062.13 | 438.13 | 09B20110607SGR | 438.10 | 0.03 |
| 9652 | 7506537.46 | 384698.25 | 445.10 | 09B20110607SGR | 445.03 | 0.07 |
| 9653 | 7506545.70 | 384713.03 | 445.65 | 09B20110607SGR | 445.61 | 0.04 |
| 9654 | 7506552.83 | 384726.55 | 446.06 | 09B20110607SGR | 446.04 | 0.02 |
| 9655 | 7506559.01 | 384741.84 | 446.55 | 09B20110607SGR | 446.55 | 0.00 |
| 9656 | 7506567.69 | 384757.81 | 446.91 | 09B20110607SGR | 446.88 | 0.03 |
| 9657 | 7506575.79 | 384772.74 | 447.37 | 09B20110607SGR | 447.30 | 0.07 |
| 9658 | 7506583.33 | 384786.94 | 447.82 | 09B20110607SGR | 447.80 | 0.02 |
| 9659 | 7507116.12 | 385096.57 | 460.41 | 09B20110607SGR | 460.36 | 0.05 |
| 9660 | 7507132.57 | 385098.88 | 460.65 | 09B20110607SGR | 460.63 | 0.01 |
| 9661 | 7507149.08 | 385101.97 | 460.92 | 09B20110607SGR | 460.89 | 0.03 |
| 9662 | 7507166.02 | 385104.22 | 461.15 | 09B20110607SGR | 461.13 | 0.02 |
| 9663 | 7507181.82 | 385107.25 | 461.44 | 09B20110607SGR | 461.40 | 0.04 |
| 9664 | 7507198.79 | 385108.58 | 461.61 | 09B20110607SGR | 461.55 | 0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 9665 | 7507216.19 | 385111.06 | 461.75 | 09B20110607SGR | 461.73 | 0.02 |
| 9666 | 7507931.91 | 385207.13 | 466.70 | 09B20110607SGR | 466.65 | 0.05 |
| 9667 | 7507946.79 | 385213.75 | 466.83 | 09B20110607SGR | 466.77 | 0.06 |
| 9668 | 7507962.64 | 385213.05 | 466.53 | 09B20110607SGR | 466.47 | 0.06 |
| 9669 | 7507977.98 | 385212.18 | 466.18 | 09B20110607SGR | 466.18 | 0.00 |
| 9670 | 7507992.39 | 385211.87 | 465.86 | 09B20110607SGR | 465.82 | 0.04 |
| 9671 | 7508007.71 | 385210.04 | 465.43 | 09B20110607SGR | 465.41 | 0.02 |
| 9672 | 7508023.15 | 385207.48 | 465.00 | 09B20110607SGR | 464.99 | 0.01 |
| 9673 | 7509011.23 | 384741.53 | 457.61 | 09B20110607SGR | 457.63 | -0.02 |
| 9674 | 7509027.66 | 384739.89 | 457.72 | 09B20110607SGR | 457.71 | 0.01 |
| 9675 | 7509045.06 | 384740.42 | 457.89 | 09B20110607SGR | 457.88 | 0.01 |
| 9676 | 7509059.88 | 384733.19 | 457.88 | 09B20110607SGR | 457.93 | -0.05 |
| 9677 | 7509074.89 | 384730.65 | 458.10 | 09B20110607SGR | 458.14 | -0.04 |
| 9678 | 7509089.86 | 384727.07 | 458.20 | 09B20110607SGR | 458.24 | -0.04 |
| 9679 | 7509104.24 | 384724.34 | 458.28 | 09B20110607SGR | 458.30 | -0.02 |
| 9680 | 7509119.51 | 384721.11 | 458.42 | 09B20110607SGR | 458.44 | -0.02 |
| 9681 | 7509134.86 | 384718.07 | 458.63 | 09B20110607SGR | 458.62 | 0.01 |
| 9682 | 7509150.20 | 384715.04 | 458.71 | 09B20110607SGR | 458.71 | 0.00 |
| 9683 | 7509165.63 | 384711.72 | 458.89 | 09B20110607SGR | 458.83 | 0.06 |
| 9684 | 7509180.61 | 384707.89 | 459.01 | 09B20110607SGR | 458.98 | 0.03 |
| 9685 | 7508998.86 | 384714.85 | 456.41 | 09B20110607SGR | 456.38 | 0.03 |
| 9686 | 7508990.84 | 384695.47 | 455.40 | 09B20110607SGR | 455.42 | -0.02 |
| 9687 | 7508986.70 | 384669.74 | 454.12 | 09B20110607SGR | 454.13 | -0.01 |
| 9688 | 7508979.53 | 384639.47 | 452.93 | 09B20110607SGR | 452.94 | -0.01 |
| 9689 | 7508971.27 | 384603.91 | 450.68 | 09B20110607SGR | 450.70 | -0.02 |
| 9690 | 7508940.97 | 384466.13 | 445.42 | 09B20110607SGR | 445.44 | -0.02 |
| 9691 | 7508924.37 | 384381.18 | 444.98 | 09B20110607SGR | 444.96 | 0.02 |
| 9692 | 7508924.61 | 384343.04 | 444.75 | 09B20110607SGR | 444.75 | 0.00 |
| 9693 | 7508931.88 | 384311.22 | 444.80 | 09B20110607SGR | 444.77 | 0.03 |
| 9694 | 7495234.62 | 378559.15 | 435.00 | 09B20110607SGR | 434.91 | 0.09 |
| 9695 | 7495256.32 | 378576.87 | 434.71 | 09B20110607SGR | 434.68 | 0.03 |
| 9696 | 7495268.10 | 378586.18 | 434.57 | 09B20110607SGR | 434.55 | 0.02 |
| 9697 | 7495279.17 | 378596.31 | 434.43 | 09B20110607SGR | 434.42 | 0.01 |
| 9698 | 7495290.57 | 378605.84 | 434.29 | 09B20110607SGR | 434.32 | -0.03 |
| 9699 | 7495301.44 | 378615.15 | 434.18 | 09B20110607SGR | 434.16 | 0.02 |
| 9700 | 7495313.02 | 378625.21 | 434.04 | 09B20110607SGR | 434.01 | 0.03 |
| 9701 | 7495323.52 | 378634.70 | 433.94 | 09B20110607SGR | 433.87 | 0.07 |
| 9702 | 7495334.70 | 378643.79 | 433.80 | 09B20110607SGR | 433.76 | 0.04 |
| 9703 | 7495849.52 | 379067.52 | 438.53 | 09B20110607SGR | 438.45 | 0.08 |
| 9704 | 7495863.15 | 379079.20 | 438.63 | 09B20110607SGR | 438.58 | 0.05 |
| 9705 | 7495880.03 | 379091.33 | 438.72 | 09B20110607SGR | 438.64 | 0.08 |
| 9706 | 7495891.63 | 379099.28 | 438.79 | 09B20110607SGR | 438.71 | 0.08 |
| 9707 | 7495904.37 | 379108.61 | 438.91 | 09B20110607SGR | 438.85 | 0.06 |
| 9708 | 7495918.50 | 379116.68 | 438.98 | 09B20110607SGR | 438.91 | 0.07 |
| 9709 | 7495931.11 | 379125.62 | 438.98 | 09B20110607SGR | 438.94 | 0.04 |
| 9710 | 7496531.40 | 379515.88 | 440.68 | 09B20110607SGR | 440.59 | 0.09 |
| 9711 | 7496546.08 | 379521.61 | 440.56 | 09B20110607SGR | 440.49 | 0.07 |
| 9712 | 7496560.66 | 379527.22 | 440.42 | 09B20110607SGR | 440.35 | 0.06 |
| 9713 | 7496577.14 | 379533.11 | 440.18 | 09B20110607SGR | 440.11 | 0.07 |
| 9714 | 7496592.51 | 379538.33 | 440.04 | 09B20110607SGR | 439.93 | 0.11 |
| 9715 | 7496606.62 | 379543.10 | 439.85 | 09B20110607SGR | 439.78 | 0.07 |
| 9716 | 7496620.66 | 379547.61 | 439.72 | 09B20110607SGR | 439.68 | 0.04 |
| 9717 | 7497531.63 | 379880.04 | 439.27 | 09B20110607SGR | 439.24 | 0.03 |
| 9718 | 7497545.70 | 379888.26 | 439.35 | 09B20110607SGR | 439.29 | 0.06 |
| 9719 | 7497559.17 | 379896.32 | 439.43 | 09B20110607SGR | 439.38 | 0.05 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 9720 | 7497573.19 | 379904.11 | 439.45 | 09B20110607SGR | 439.41 | 0.04 |
| 9721 | 7497590.28 | 379912.59 | 439.34 | 09B20110607SGR | 439.31 | 0.03 |
| 9722 | 7497605.30 | 379922.00 | 439.16 | 09B20110607SGR | 439.10 | 0.06 |
| 9723 | 7497621.89 | 379932.51 | 438.94 | 09B20110607SGR | 438.88 | 0.06 |
| 9724 | 7498128.53 | 380222.71 | 437.16 | 09B20110607SGR | 437.12 | 0.04 |
| 9725 | 7498141.59 | 380229.77 | 436.90 | 09B20110607SGR | 436.87 | 0.03 |
| 9726 | 7498153.87 | 380236.74 | 436.74 | 09B20110607SGR | 436.71 | 0.03 |
| 9727 | 7498166.94 | 380244.25 | 436.60 | 09B20110607SGR | 436.52 | 0.08 |
| 9728 | 7498180.87 | 380252.56 | 436.45 | 09B20110607SGR | 436.40 | 0.05 |
| 9729 | 7498193.98 | 380261.25 | 436.44 | 09B20110607SGR | 436.38 | 0.06 |
| 9730 | 7498208.02 | 380268.26 | 436.46 | 09B20110607SGR | 436.40 | 0.06 |
| 9731 | 7498676.46 | 380555.98 | 436.20 | 09B20110607SGR | 436.16 | 0.04 |
| 9732 | 7498699.18 | 380542.35 | 432.84 | 09B20110607SGR | 432.81 | 0.03 |
| 9733 | 7498727.28 | 380534.42 | 431.46 | 09B20110607SGR | 431.43 | 0.03 |
| 9734 | 7498754.74 | 380523.61 | 429.25 | 09B20110607SGR | 429.17 | 0.08 |
| 9735 | 7498778.74 | 380504.19 | 427.78 | 09B20110607SGR | 427.71 | 0.07 |
| 9736 | 7498799.98 | 380483.69 | 425.60 | 09B20110607SGR | 425.53 | 0.07 |
| 9737 | 7498811.25 | 380460.38 | 422.06 | 09B20110607SGR | 422.00 | 0.06 |
| 9738 | 7498809.42 | 380418.58 | 416.43 | 09B20110607SGR | 416.37 | 0.06 |
| 9739 | 7499266.89 | 381050.74 | 434.00 | 09B20110607SGR | 433.95 | 0.05 |
| 9740 | 7499279.76 | 381061.14 | 433.98 | 09B20110607SGR | 433.92 | 0.06 |
| 9741 | 7499291.31 | 381070.71 | 433.99 | 09B20110607SGR | 433.94 | 0.05 |
| 9742 | 7499302.47 | 381079.99 | 434.01 | 09B20110607SGR | 433.96 | 0.05 |
| 9743 | 7499315.06 | 381090.08 | 434.05 | 09B20110607SGR | 433.97 | 0.08 |
| 9744 | 7499327.63 | 381099.75 | 434.05 | 09B20110607SGR | 433.96 | 0.09 |
| 9745 | 7499339.41 | 381109.21 | 434.04 | 09B20110607SGR | 433.97 | 0.07 |
| 9746 | 7500045.57 | 381436.47 | 428.98 | 09B20110607SGR | 428.93 | 0.05 |
| 9747 | 7500061.64 | 381438.87 | 428.69 | 09B20110607SGR | 428.66 | 0.03 |
| 9748 | 7500076.66 | 381441.39 | 428.46 | 09B20110607SGR | 428.41 | 0.05 |
| 9749 | 7500092.37 | 381442.23 | 428.17 | 09B20110607SGR | 428.12 | 0.05 |
| 9750 | 7500107.77 | 381444.12 | 427.96 | 09B20110607SGR | 427.92 | 0.03 |
| 9751 | 7500125.32 | 381446.23 | 427.72 | 09B20110607SGR | 427.66 | 0.06 |
| 9752 | 7500141.29 | 381448.12 | 427.42 | 09B20110607SGR | 427.37 | 0.05 |
| 9753 | 7501055.90 | 381554.93 | 428.31 | 09B20110607SGR | 428.22 | 0.09 |
| 9754 | 7501072.70 | 381556.82 | 428.28 | 09B20110607SGR | 428.21 | 0.07 |
| 9755 | 7501088.45 | 381554.39 | 428.12 | 09B20110607SGR | 428.03 | 0.09 |
| 9756 | 7501104.31 | 381560.06 | 428.06 | 09B20110607SGR | 428.00 | 0.06 |
| 9757 | 7501118.74 | 381562.07 | 427.94 | 09B20110607SGR | 427.86 | 0.08 |
| 9758 | 7501133.42 | 381564.29 | 427.85 | 09B20110607SGR | 427.76 | 0.09 |
| 9759 | 7501147.85 | 381565.96 | 427.77 | 09B20110607SGR | 427.73 | 0.04 |
| 9760 | 7501714.43 | 381623.50 | 428.96 | 09B20110607SGR | 428.89 | 0.06 |
| 9761 | 7501728.42 | 381621.74 | 428.95 | 09B20110607SGR | 428.89 | 0.06 |
| 9762 | 7501742.49 | 381619.58 | 428.96 | 09B20110607SGR | 428.90 | 0.06 |
| 9763 | 7501756.38 | 381617.71 | 428.95 | 09B20110607SGR | 428.90 | 0.05 |
| 9764 | 7501771.65 | 381615.30 | 428.83 | 09B20110607SGR | 428.79 | 0.04 |
| 9765 | 7501786.09 | 381612.33 | 428.66 | 09B20110607SGR | 428.59 | 0.07 |
| 9766 | 7501799.83 | 381609.08 | 428.47 | 09B20110607SGR | 428.40 | 0.07 |
| 9767 | 7502522.12 | 381297.71 | 424.72 | 09B20110607SGR | 424.63 | 0.09 |
| 9768 | 7502535.34 | 381292.56 | 424.68 | 09B20110607SGR | 424.61 | 0.07 |
| 9769 | 7502549.34 | 381287.18 | 424.69 | 09B20110607SGR | 424.61 | 0.08 |
| 9770 | 7502566.05 | 381281.13 | 424.70 | 09B20110607SGR | 424.64 | 0.06 |
| 9771 | 7502580.35 | 381276.05 | 424.75 | 09B20110607SGR | 424.69 | 0.06 |
| 9772 | 7502594.44 | 381271.68 | 424.76 | 09B20110607SGR | 424.69 | 0.07 |
| 9773 | 7502607.60 | 381267.79 | 424.79 | 09B20110607SGR | 424.73 | 0.06 |
| 9801 | 7509220.80 | 384705.14 | 459.03 | 09A20110608SGR | 459.08 | -0.05 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 9802 | 7509234.67 | 384703.08 | 458.96 | 09A20110608SGR | 458.99 | -0.03 |
| 9803 | 7509248.67 | 384700.33 | 458.83 | 09A20110608SGR | 458.86 | -0.03 |
| 9804 | 7509262.49 | 384690.32 | 458.61 | 09A20110608SGR | 458.64 | -0.03 |
| 9805 | 7509277.14 | 384687.76 | 458.28 | 09A20110608SGR | 458.33 | -0.05 |
| 9806 | 7509290.69 | 384684.93 | 457.86 | 09A20110608SGR | 457.90 | -0.04 |
| 9807 | 7509304.41 | 384682.83 | 457.60 | 09A20110608SGR | 457.63 | -0.03 |
| 9808 | 7510143.71 | 384507.43 | 448.70 | 09A20110608SGR | 448.76 | -0.06 |
| 9809 | 7510157.84 | 384504.45 | 448.58 | 09A20110608SGR | 448.63 | -0.05 |
| 9810 | 7510171.96 | 384501.53 | 448.51 | 09A20110608SGR | 448.56 | -0.05 |
| 9811 | 7510186.12 | 384499.03 | 448.56 | 09A20110608SGR | 448.61 | -0.05 |
| 9812 | 7510199.95 | 384495.90 | 448.60 | 09A20110608SGR | 448.64 | -0.04 |
| 9813 | 7510215.25 | 384493.19 | 448.72 | 09A20110608SGR | 448.79 | -0.08 |
| 9814 | 7510229.39 | 384490.29 | 448.83 | 09A20110608SGR | 448.88 | -0.06 |
| 9815 | 7510910.67 | 384347.80 | 452.89 | 09A20110608SGR | 452.95 | -0.06 |
| 9816 | 7510925.20 | 384344.87 | 453.14 | 09A20110608SGR | 453.15 | -0.01 |
| 9817 | 7510940.10 | 384341.70 | 453.41 | 09A20110608SGR | 453.46 | -0.05 |
| 9818 | 7510954.17 | 384339.46 | 453.69 | 09A20110608SGR | 453.73 | -0.04 |
| 9819 | 7510969.28 | 384336.65 | 453.90 | 09A20110608SGR | 453.93 | -0.03 |
| 9820 | 7510983.61 | 384333.47 | 454.08 | 09A20110608SGR | 454.11 | -0.03 |
| 9821 | 7510997.85 | 384330.35 | 454.31 | 09A20110608SGR | 454.36 | -0.05 |
| 9822 | 7511633.75 | 384272.05 | 466.08 | 09A20110608SGR | 466.13 | -0.05 |
| 9823 | 7511648.01 | 384271.70 | 466.16 | 09A20110608SGR | 466.23 | -0.07 |
| 9824 | 7511662.70 | 384270.91 | 466.26 | 09A20110608SGR | 466.30 | -0.04 |
| 9825 | 7511677.01 | 384270.02 | 466.38 | 09A20110608SGR | 466.44 | -0.06 |
| 9826 | 7511691.17 | 384269.02 | 466.47 | 09A20110608SGR | 466.51 | -0.04 |
| 9827 | 7511707.01 | 384268.22 | 466.48 | 09A20110608SGR | 466.55 | -0.07 |
| 9828 | 7511725.42 | 384267.40 | 466.46 | 09A20110608SGR | 466.49 | -0.03 |
| 9829 | 7512672.31 | 384221.22 | 473.89 | 09A20110608SGR | 473.96 | -0.07 |
| 9830 | 7512706.25 | 384219.16 | 474.33 | 09A20110608SGR | 474.41 | -0.08 |
| 9831 | 7512721.56 | 384218.79 | 474.51 | 09A20110608SGR | 474.59 | -0.08 |
| 9832 | 7512736.64 | 384217.71 | 474.71 | 09A20110608SGR | 474.77 | -0.06 |
| 9901 | 7606211.88 | 398503.83 | 895.43 | 06A20110612SGR | 895.36 | 0.07 |
| 9902 | 7606212.18 | 398529.81 | 895.60 | 06A20110612SGR | 895.52 | 0.08 |
| 9903 | 7606196.77 | 398524.97 | 895.75 | 06A20110612SGR | 895.65 | 0.10 |
| 9904 | 7606182.60 | 398523.66 | 896.03 | 06A20110612SGR | 895.94 | 0.09 |
| 9905 | 7606164.41 | 398523.72 | 896.58 | 06A20110612SGR | 896.50 | 0.08 |
| 9906 | 7606149.03 | 398523.09 | 897.00 | 06A20110612SGR | 896.92 | 0.08 |
| 9907 | 7606132.42 | 398521.49 | 897.42 | 06A20110612SGR | 897.35 | 0.07 |
| 9908 | 7606117.79 | 398521.68 | 897.98 | 06A20110612SGR | 897.89 | 0.09 |
| 9909 | 7605408.44 | 398769.50 | 904.85 | 06A20110612SGR | 904.75 | 0.10 |
| 9910 | 7605391.47 | 398771.87 | 904.49 | 06A20110612SGR | 904.38 | 0.11 |
| 9911 | 7605376.57 | 398773.95 | 904.33 | 06A20110612SGR | 904.22 | 0.11 |
| 9912 | 7605361.56 | 398776.56 | 904.13 | 06A20110612SGR | 904.04 | 0.09 |
| 9913 | 7605346.77 | 398778.82 | 903.95 | 06A20110612SGR | 903.82 | 0.13 |
| 9914 | 7605331.03 | 398780.54 | 903.81 | 06A20110612SGR | 903.70 | 0.11 |
| 9915 | 7605315.54 | 398782.63 | 903.72 | 06A20110612SGR | 903.60 | 0.12 |
| 9916 | 7604599.08 | 398829.69 | 920.89 | 06A20110612SGR | 920.80 | 0.09 |
| 9917 | 7604583.42 | 398831.46 | 921.51 | 06A20110612SGR | 921.41 | 0.10 |
| 9918 | 7604568.08 | 398835.54 | 921.90 | 06A20110612SGR | 921.80 | 0.10 |
| 9919 | 7604552.43 | 398836.93 | 922.37 | 06A20110612SGR | 922.26 | 0.11 |
| 9920 | 7604535.62 | 398841.20 | 922.68 | 06A20110612SGR | 922.60 | 0.08 |
| 9921 | 7604520.02 | 398848.05 | 922.83 | 06A20110612SGR | 922.73 | 0.10 |
| 9922 | 7604498.45 | 398853.15 | 922.85 | 06A20110612SGR | 922.76 | 0.09 |
| 9923 | 7602541.31 | 399246.42 | 930.89 | 06A20110612SGR | 930.79 | 0.10 |
| 9924 | 7602524.83 | 399246.70 | 931.14 | 06A20110612SGR | 931.04 | 0.10 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 9925 | 7602509.75 | 399247.03 | 931.34 | 06A20110612SGR | 931.23 | 0.11 |
| 9926 | 7602494.40 | 399247.54 | 931.40 | 06A20110612SGR | 931.34 | 0.06 |
| 9927 | 7602536.06 | 399270.45 | 931.78 | 06A20110612SGR | 931.74 | 0.04 |
| 9928 | 7602544.07 | 399336.59 | 939.54 | 06A20110612SGR | 939.44 | 0.10 |
| 9929 | 7602560.49 | 399338.01 | 939.76 | 06A20110612SGR | 939.67 | 0.09 |
| 9930 | 7602576.46 | 399337.75 | 939.74 | 06A20110612SGR | 939.65 | 0.09 |
| 9931 | 7602592.74 | 399338.32 | 939.88 | 06A20110612SGR | 939.78 | 0.10 |
| 9932 | 7602607.99 | 399336.64 | 939.66 | 06A20110612SGR | 939.57 | 0.08 |
| 9933 | 7602629.01 | 399336.64 | 939.38 | 06A20110612SGR | 939.30 | 0.08 |
| 9934 | 7602643.95 | 399335.25 | 939.26 | 06A20110612SGR | 939.16 | 0.10 |
| 9935 | 7602659.01 | 399334.45 | 938.78 | 06A20110612SGR | 938.67 | 0.11 |
| 9936 | 7602674.66 | 399333.53 | 938.14 | 06A20110612SGR | 938.04 | 0.10 |
| 9937 | 7602690.24 | 399332.86 | 937.47 | 06A20110612SGR | 937.38 | 0.09 |
| 9938 | 7602706.28 | 399332.16 | 936.69 | 06A20110612SGR | 936.59 | 0.10 |
| 9939 | 7602723.98 | 399332.61 | 935.91 | 06A20110612SGR | 935.80 | 0.11 |
| 9940 | 7601969.89 | 399334.74 | 940.02 | 06A20110612SGR | 939.95 | 0.07 |
| 9941 | 7601972.74 | 399333.98 | 939.93 | 06A20110612SGR | 939.86 | 0.06 |
| 9942 | 7607080.22 | 398407.42 | 888.69 | 06A20110612SGR | 888.61 | 0.08 |
| 9943 | 7607093.90 | 398406.28 | 888.95 | 06A20110612SGR | 888.87 | 0.08 |
| 9944 | 7607109.42 | 398403.03 | 889.22 | 06A20110612SGR | 889.13 | 0.09 |
| 9945 | 7607124.22 | 398400.48 | 889.49 | 06A20110612SGR | 889.41 | 0.08 |
| 9946 | 7607140.82 | 398397.92 | 889.81 | 06A20110612SGR | 889.72 | 0.09 |
| 9947 | 7607156.39 | 398394.89 | 890.16 | 06A20110612SGR | 890.09 | 0.07 |
| 9948 | 7607171.07 | 398390.80 | 890.50 | 06A20110612SGR | 890.44 | 0.06 |
| 9949 | 7607689.11 | 398148.53 | 880.06 | 06A20110612SGR | 880.04 | 0.02 |
| 9950 | 7607703.74 | 398145.32 | 879.51 | 06A20110612SGR | 879.50 | 0.01 |
| 9951 | 7607718.41 | 398141.93 | 879.14 | 06A20110612SGR | 879.10 | 0.04 |
| 9952 | 7607734.37 | 398138.60 | 878.73 | 06A20110612SGR | 878.71 | 0.02 |
| 9953 | 7607750.81 | 398135.19 | 878.24 | 06A20110612SGR | 878.23 | 0.01 |
| 9954 | 7607766.49 | 398132.55 | 877.77 | 06A20110612SGR | 877.74 | 0.03 |
| 9955 | 7607781.71 | 398128.35 | 877.24 | 06A20110612SGR | 877.23 | 0.01 |
| 9956 | 7607688.28 | 398179.68 | 879.29 | 06A20110612SGR | 879.24 | 0.05 |
| 9957 | 7607696.51 | 398208.97 | 878.54 | 06A20110612SGR | 878.47 | 0.07 |
| 9958 | 7607700.93 | 398234.50 | 878.60 | 06A20110612SGR | 878.55 | 0.05 |
| 9959 | 7607707.35 | 398268.28 | 878.33 | 06A20110612SGR | 878.28 | 0.05 |
| 9960 | 7607715.54 | 398295.91 | 879.09 | 06A20110612SGR | 879.02 | 0.07 |
| 9961 | 7607722.01 | 398324.33 | 879.30 | 06A20110612SGR | 879.22 | 0.08 |
| 9962 | 7607725.94 | 398346.75 | 880.22 | 06A20110612SGR | 880.14 | 0.08 |
| 9963 | 7607731.56 | 398376.27 | 881.66 | 06A20110612SGR | 881.59 | 0.07 |
| 9964 | 7607738.69 | 398405.48 | 884.54 | 06A20110612SGR | 884.47 | 0.07 |
| 9965 | 7607741.50 | 398433.73 | 886.91 | 06A20110612SGR | 886.84 | 0.07 |
| 9966 | 7607765.73 | 398444.64 | 890.28 | 06A20110612SGR | 890.23 | 0.05 |
| 9967 | 7607788.84 | 398440.35 | 891.21 | 06A20110612SGR | 891.13 | 0.08 |
| 9968 | 7607796.98 | 398438.65 | 891.49 | 06A20110612SGR | 891.42 | 0.07 |
| 9969 | 7607817.66 | 398435.32 | 892.51 | 06A20110612SGR | 892.45 | 0.06 |
| 9970 | 7608633.42 | 397970.20 | 870.63 | 06A201106126B | 870.59 | 0.04 |
| 9972 | 7608625.05 | 397948.88 | 869.31 | 06A20110612SGR | 869.29 | 0.02 |
| 9973 | 7608646.29 | 397944.16 | 869.51 | 06A20110612SGR | 869.46 | 0.05 |
| 9974 | 7608664.68 | 397940.19 | 869.40 | 06A20110612SGR | 869.40 | 0.00 |
| 9975 | 7608681.46 | 397938.68 | 869.26 | 06A20110612SGR | 869.25 | 0.01 |
| 9976 | 7608697.30 | 397933.24 | 868.90 | 06A20110612SGR | 868.87 | 0.03 |
| 9977 | 7608712.78 | 397931.76 | 868.64 | 06A20110612SGR | 868.59 | 0.05 |
| 9978 | 7608728.67 | 397929.81 | 868.30 | 06A20110612SGR | 868.28 | 0.02 |
| 9979 | 7609032.55 | 397872.81 | 871.68 | 06A20110612SGR | 871.65 | 0.03 |
| 9980 | 7609041.81 | 397840.40 | 868.87 | 06A20110612SGR | 868.83 | 0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 9981 | 7609052.17 | 397809.60 | 868.38 | 06A20110612SGR | 868.34 | 0.04 |
| 9982 | 7609064.82 | 397772.99 | 868.00 | 06A20110612SGR | 867.95 | 0.05 |
| 9983 | 7609075.75 | 397739.64 | 865.25 | 06A20110612SGR | 865.19 | 0.06 |
| 9984 | 7609086.84 | 397705.47 | 862.45 | 06A20110612SGR | 862.39 | 0.06 |
| 9985 | 7609097.16 | 397676.87 | 859.43 | 06A20110612SGR | 859.38 | 0.05 |
| 9986 | 7609114.05 | 397626.86 | 856.03 | 06A20110612SGR | 855.97 | 0.06 |
| 9987 | 7609122.77 | 397600.54 | 855.59 | 06A20110612SGR | 855.54 | 0.05 |
| 9988 | 7609135.71 | 397569.23 | 854.80 | 06A20110612SGR | 854.75 | 0.05 |
| 9989 | 7609161.01 | 397490.13 | 853.75 | 06A20110612SGR | 853.71 | 0.04 |
| 9990 | 7609175.20 | 397436.86 | 850.75 | 06A20110612SGR | 850.72 | 0.03 |
| 9991 | 7610182.07 | 397452.05 | 846.14 | 06A20110612SGR | 846.05 | 0.09 |
| 9992 | 7610197.89 | 397445.63 | 846.03 | 06A20110612SGR | 845.98 | 0.05 |
| 9993 | 7610212.84 | 397440.69 | 845.95 | 06A20110612SGR | 845.88 | 0.07 |
| 9994 | 7610541.72 | 397337.22 | 847.78 | 06A20110612SGR | 847.73 | 0.05 |
| 9995 | 7610555.53 | 397330.11 | 848.11 | 06A20110612SGR | 848.08 | 0.03 |
| 9996 | 7610567.75 | 397321.39 | 848.49 | 06A20110612SGR | 848.43 | 0.06 |
| 9997 | 7610578.98 | 397312.76 | 848.78 | 06A20110612SGR | 848.74 | 0.04 |
| 9998 | 7610590.08 | 397303.24 | 848.85 | 06A20110612SGR | 848.80 | 0.05 |
| 9999 | 7610596.94 | 397290.09 | 848.30 | 06A20110612SGR | 848.24 | 0.06 |
| 10000 | 7610609.11 | 397278.39 | 847.95 | 06A20110612SGR | 847.90 | 0.05 |
| 10001 | 7612042.07 | 397703.95 | 882.32 | 06A20110612SGR | 882.26 | 0.06 |
| 10002 | 7612059.67 | 397704.27 | 882.89 | 06A20110612SGR | 882.84 | 0.05 |
| 10003 | 7612087.50 | 397700.03 | 883.38 | 06A20110612SGR | 883.34 | 0.04 |
| 10004 | 7612119.09 | 397695.87 | 883.35 | 06A20110612SGR | 883.29 | 0.06 |
| 10005 | 7612150.43 | 397690.45 | 883.12 | 06A20110612SGR | 883.05 | 0.07 |
| 10006 | 7612017.86 | 397702.26 | 881.19 | 06A20110612SGR | 881.13 | 0.06 |
| 10102 | 7788167.47 | 446016.32 | 15.35 | 01B20110617SGR | 15.32 | 0.03 |
| 10103 | 7788182.37 | 446023.03 | 15.30 | 01B20110617SGR | 15.25 | 0.05 |
| 10104 | 7788196.44 | 446029.36 | 15.20 | 01B20110617SGR | 15.15 | 0.05 |
| 10105 | 7788210.35 | 446036.22 | 15.15 | 01B20110617SGR | 15.12 | 0.03 |
| 10106 | 7788224.66 | 446042.53 | 15.19 | 01B20110617SGR | 15.14 | 0.05 |
| 10109 | 7788167.49 | 446016.32 | 15.35 | 01B20110617SGR | 15.32 | 0.03 |
| 10202 | 7756518.22 | 431317.79 | 68.41 | 02A20110617CHK | 68.35 | 0.06 |
| 11301 | 7788734.30 | 444354.80 | 17.16 | 01A20110618SGR | 17.12 | 0.04 |
| 11302 | 7788738.24 | 444369.17 | 17.03 | 01A20110618SGR | 16.98 | 0.05 |
| 11303 | 7788741.71 | 444386.14 | 16.90 | 01A20110618SGR | 16.86 | 0.04 |
| 11304 | 7788744.56 | 444401.09 | 16.83 | 01A20110618SGR | 16.80 | 0.03 |
| 11305 | 7788747.95 | 444416.69 | 16.76 | 01A20110618SGR | 16.72 | 0.04 |
| 11306 | 7788751.24 | 444431.90 | 16.86 | 01A20110618SGR | 16.82 | 0.04 |
| 11307 | 7788754.89 | 444446.86 | 16.95 | 01A20110618SGR | 16.93 | 0.02 |
| 11308 | 7788758.27 | 444461.91 | 17.05 | 01A20110618SGR | 17.01 | 0.04 |
| 11309 | 7788761.42 | 444476.64 | 17.08 | 01A20110618SGR | 17.02 | 0.06 |
| 11310 | 7788750.80 | 444410.18 | 16.76 | 01A20110618SGR | 16.72 | 0.04 |
| 11311 | 7788734.76 | 444416.79 | 16.77 | 01A20110618SGR | 16.72 | 0.05 |
| 11312 | 7788720.33 | 444419.98 | 16.78 | 01A20110618SGR | 16.73 | 0.05 |
| 11313 | 7788705.47 | 444421.77 | 16.75 | 01A20110618SGR | 16.69 | 0.06 |
| 11314 | 7788689.27 | 444423.77 | 16.68 | 01A20110618SGR | 16.65 | 0.03 |
| 11320 | 7788949.06 | 445245.57 | 17.44 | 01A20110618SGR | 17.41 | 0.03 |
| 11321 | 7788945.95 | 445230.43 | 17.31 | 01A20110618SGR | 17.27 | 0.04 |
| 11322 | 7788942.30 | 445216.55 | 17.22 | 01A20110618SGR | 17.18 | 0.04 |
| 11323 | 7788937.63 | 445202.73 | 17.19 | 01A20110618SGR | 17.17 | 0.02 |
| 11324 | 7788934.26 | 445188.08 | 17.18 | 01A20110618SGR | 17.14 | 0.04 |
| 11325 | 7788930.54 | 445173.01 | 17.11 | 01A20110618SGR | 17.07 | 0.04 |
| 11326 | 7788927.17 | 445158.88 | 17.13 | 01A20110618SGR | 17.10 | 0.03 |
| 11327 | 7788923.62 | 445144.74 | 17.17 | 01A20110618SGR | 17.13 | 0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 11328 | 7788919.84 | 445130.08 | 17.16 | 01A20110618SGR | 17.14 | 0.02 |
| 11329 | 7788916.42 | 445115.60 | 17.14 | 01A20110618SGR | 17.11 | 0.03 |
| 11330 | 7788913.17 | 445101.51 | 17.16 | 01A20110618SGR | 17.13 | 0.03 |
| 11331 | 7788869.48 | 444720.32 | 16.62 | 01A20110618SGR | 16.60 | 0.02 |
| 11332 | 7788884.36 | 444718.23 | 16.62 | 01A20110618SGR | 16.60 | 0.01 |
| 11333 | 7788899.21 | 444715.01 | 16.65 | 01A20110618SGR | 16.63 | 0.02 |
| 11334 | 7788914.02 | 444711.06 | 16.66 | 01A20110618SGR | 16.61 | 0.05 |
| 11335 | 7788928.94 | 444706.35 | 16.73 | 01A20110618SGR | 16.70 | 0.03 |
| 11336 | 7788946.62 | 444701.98 | 16.74 | 01A20110618SGR | 16.69 | 0.05 |
| 11337 | 7788964.75 | 444697.49 | 16.69 | 01A20110618SGR | 16.65 | 0.04 |
| 11338 | 7788981.70 | 444693.97 | 16.70 | 01A20110618SGR | 16.68 | 0.02 |
| 11339 | 7788998.64 | 444687.83 | 16.74 | 01A20110618SGR | 16.65 | 0.09 |
| 11401 | 7788161.36 | 446014.78 | 15.32 | 01B20110618SGR | 15.29 | 0.03 |
| 11402 | 7788147.88 | 446009.16 | 15.29 | 01B20110618SGR | 15.25 | 0.04 |
| 11403 | 7788133.66 | 446002.93 | 15.27 | 01B20110618SGR | 15.23 | 0.04 |
| 11404 | 7788119.80 | 445996.62 | 15.21 | 01B20110618SGR | 15.15 | 0.06 |
| 11405 | 7788106.06 | 445989.02 | 15.16 | 01B20110618SGR | 15.10 | 0.06 |
| 11406 | 7788092.32 | 445983.06 | 15.14 | 01B20110618SGR | 15.09 | 0.04 |
| 11407 | 7788078.66 | 445976.40 | 15.10 | 01B20110618SGR | 15.06 | 0.04 |
| 11408 | 7788060.06 | 445967.92 | 15.12 | 01B20110618SGR | 15.08 | 0.04 |
| 11409 | 7787414.93 | 445737.73 | 15.62 | 01B20110618SGR | 15.57 | 0.05 |
| 11410 | 7787400.70 | 445737.80 | 15.61 | 01B20110618SGR | 15.57 | 0.04 |
| 11411 | 7787386.36 | 445738.52 | 15.61 | 01B20110618SGR | 15.56 | 0.04 |
| 11412 | 7787370.09 | 445739.51 | 15.60 | 01B20110618SGR | 15.55 | 0.05 |
| 11413 | 7787354.62 | 445740.43 | 15.57 | 01B20110618SGR | 15.52 | 0.04 |
| 11414 | 7787339.86 | 445741.64 | 15.51 | 01B20110618SGR | 15.47 | 0.04 |
| 11415 | 7787324.78 | 445742.55 | 15.48 | 01B20110618SGR | 15.43 | 0.05 |
| 11416 | 7787310.45 | 445743.29 | 15.43 | 01B20110618SGR | 15.39 | 0.04 |
| 11417 | 7787294.87 | 445744.18 | 15.40 | 01B20110618SGR | 15.36 | 0.04 |
| 11418 | 7787280.72 | 445744.96 | 15.37 | 01B20110618SGR | 15.34 | 0.03 |
| 11419 | 7787265.03 | 445748.32 | 15.28 | 01B20110618SGR | 15.26 | 0.02 |
| 11420 | 7786437.57 | 445656.55 | 16.92 | 01B20110618SGR | 16.92 | 0.00 |
| 11421 | 7786451.05 | 445664.14 | 16.88 | 01B20110618SGR | 16.87 | 0.01 |
| 11422 | 7786464.57 | 445671.17 | 16.84 | 01B20110618SGR | 16.83 | 0.01 |
| 11423 | 7786478.36 | 445677.89 | 16.85 | 01B20110618SGR | 16.82 | 0.03 |
| 11424 | 7786492.26 | 445684.34 | 16.88 | 01B20110618SGR | 16.85 | 0.03 |
| 11425 | 7786505.76 | 445690.51 | 16.92 | 01B20110618SGR | 16.90 | 0.02 |
| 11426 | 7786519.41 | 445696.68 | 16.92 | 01B20110618SGR | 16.91 | 0.01 |
| 11427 | 7786533.66 | 445701.65 | 16.87 | 01B20110618SGR | 16.86 | 0.01 |
| 11428 | 7786547.09 | 445706.99 | 16.84 | 01B20110618SGR | 16.81 | 0.03 |
| 11429 | 7786561.33 | 445711.77 | 16.82 | 01B20110618SGR | 16.78 | 0.04 |
| 11430 | 7785889.62 | 445251.91 | 16.54 | 01B20110618SGR | 16.51 | 0.03 |
| 11431 | 7785877.36 | 445242.65 | 16.65 | 01B20110618SGR | 16.62 | 0.03 |
| 11432 | 7785864.95 | 445232.86 | 16.71 | 01B20110618SGR | 16.68 | 0.03 |
| 11433 | 7785853.22 | 445224.05 | 16.77 | 01B20110618SGR | 16.71 | 0.06 |
| 11434 | 7785842.01 | 445215.62 | 16.83 | 01B20110618SGR | 16.78 | 0.05 |
| 11435 | 7785829.17 | 445205.93 | 16.92 | 01B20110618SGR | 16.88 | 0.04 |
| 11436 | 7785811.02 | 445191.60 | 16.93 | 01B20110618SGR | 16.87 | 0.06 |
| 11437 | 7785798.63 | 445182.60 | 16.93 | 01B20110618SGR | 16.87 | 0.06 |
| 11438 | 7785785.71 | 445173.52 | 16.89 | 01B20110618SGR | 16.84 | 0.05 |
| 11439 | 7785774.68 | 445164.97 | 16.85 | 01B20110618SGR | 16.82 | 0.03 |
| 11440 | 7788536.98 | 446724.39 | 15.80 | 01B20110618SGR | 15.76 | 0.04 |
| 11441 | 7788549.68 | 446730.92 | 15.76 | 01B20110618SGR | 15.74 | 0.02 |
| 11442 | 7788562.76 | 446736.32 | 15.70 | 01B20110618SGR | 15.67 | 0.03 |
| 11443 | 7788576.13 | 446740.99 | 15.67 | 01B20110618SGR | 15.65 | 0.02 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 11444 | 7788596.31 | 446746.18 | 15.72 | 01B20110618SGR | 15.71 | 0.01 |
| 11445 | 7788611.75 | 446748.02 | 15.76 | 01B20110618SGR | 15.73 | 0.03 |
| 11446 | 7788627.32 | 446747.65 | 15.76 | 01B20110618SGR | 15.74 | 0.02 |
| 11447 | 7788641.81 | 446746.39 | 15.79 | 01B20110618SGR | 15.76 | 0.03 |
| 11448 | 7788655.73 | 446743.84 | 15.79 | 01B20110618SGR | 15.77 | 0.02 |
| 11449 | 7788670.69 | 446740.78 | 15.83 | 01B20110618SGR | 15.83 | 0.00 |
| 11450 | 7788969.77 | 446366.91 | 15.29 | 01B20110618SGR | 15.25 | 0.04 |
| 11451 | 7788973.30 | 446352.33 | 15.29 | 01B20110618SGR | 15.25 | 0.04 |
| 11452 | 7788977.08 | 446338.10 | 15.30 | 01B20110618SGR | 15.27 | 0.03 |
| 11453 | 7788981.11 | 446323.98 | 15.34 | 01B20110618SGR | 15.29 | 0.05 |
| 11454 | 7788985.10 | 446309.72 | 15.39 | 01B20110618SGR | 15.35 | 0.04 |
| 11455 | 7788988.53 | 446295.68 | 15.44 | 01B20110618SGR | 15.39 | 0.05 |
| 11456 | 7788991.89 | 446281.62 | 15.54 | 01B20110618SGR | 15.50 | 0.04 |
| 11457 | 7788994.99 | 446267.62 | 15.58 | 01B20110618SGR | 15.53 | 0.05 |
| 11458 | 7788998.33 | 446253.39 | 15.62 | 01B20110618SGR | 15.57 | 0.05 |
| 11459 | 7789002.46 | 446238.76 | 15.64 | 01B20110618SGR | 15.58 | 0.06 |
| 11460 | 7789482.08 | 445643.85 | 16.22 | 01B20110618SGR | 16.20 | 0.02 |
| 11461 | 7789491.84 | 445632.65 | 16.13 | 01B20110618SGR | 16.11 | 0.02 |
| 11462 | 7789502.07 | 445622.02 | 16.04 | 01B20110618SGR | 16.01 | 0.03 |
| 11463 | 7789512.50 | 445611.31 | 16.07 | 01B20110618SGR | 16.04 | 0.03 |
| 11464 | 7789524.91 | 445597.51 | 16.19 | 01B20110618SGR | 16.16 | 0.03 |
| 11465 | 7789536.63 | 445588.20 | 16.23 | 01B20110618SGR | 16.19 | 0.04 |
| 11466 | 7789546.62 | 445578.14 | 15.88 | 01B20110618SGR | 15.84 | 0.04 |
| 11467 | 7789553.67 | 445571.42 | 15.58 | 01B20110618SGR | 15.54 | 0.04 |
| 11501 | 7788727.77 | 444378.10 | 16.22 | 01A20110619 CHK | 16.18 | 0.04 |
| 11601 | 7756519.51 | 431315.04 | 68.53 | 02A20110619SGR | 68.47 | 0.06 |
| 11602 | 7756533.74 | 431320.98 | 68.54 | 02A20110619SGR | 68.48 | 0.06 |
| 11603 | 7756547.77 | 431326.43 | 68.57 | 02A20110619SGR | 68.51 | 0.06 |
| 11604 | 7756561.61 | 431332.07 | 68.58 | 02A20110619SGR | 68.51 | 0.07 |
| 11605 | 7756575.52 | 431337.69 | 68.62 | 02A20110619SGR | 68.56 | 0.06 |
| 11606 | 7756589.23 | 431343.21 | 68.62 | 02A20110619SGR | 68.56 | 0.06 |
| 11607 | 7756602.96 | 431348.94 | 68.56 | 02A20110619SGR | 68.50 | 0.06 |
| 11608 | 7756617.25 | 431354.21 | 68.48 | 02A20110619SGR | 68.42 | 0.06 |
| 11609 | 7756631.24 | 431359.68 | 68.49 | 02A20110619SGR | 68.44 | 0.05 |
| 11610 | 7756645.03 | 431365.21 | 68.49 | 02A20110619SGR | 68.44 | 0.05 |
| 11611 | 7756658.16 | 431371.60 | 68.46 | 02A20110619SGR | 68.39 | 0.07 |
| 11612 | 7756671.49 | 431377.15 | 68.38 | 02A20110619SGR | 68.31 | 0.07 |
| 11613 | 7756685.36 | 431382.80 | 68.29 | 02A20110619SGR | 68.21 | 0.08 |
| 11614 | 7756699.49 | 431388.90 | 68.19 | 02A20110619SGR | 68.12 | 0.07 |
| 11615 | 7756713.73 | 431393.02 | 68.16 | 02A20110619SGR | 68.10 | 0.06 |
| 11616 | 7757327.50 | 431644.19 | 66.42 | 02A20110619SGR | 66.36 | 0.06 |
| 11617 | 7757341.02 | 431649.63 | 66.42 | 02A20110619SGR | 66.35 | 0.07 |
| 11618 | 7757356.50 | 431656.13 | 66.40 | 02A20110619SGR | 66.34 | 0.06 |
| 11619 | 7757371.14 | 431662.57 | 66.44 | 02A20110619SGR | 66.38 | 0.06 |
| 11620 | 7757384.87 | 431668.28 | 66.52 | 02A20110619SGR | 66.46 | 0.06 |
| 11621 | 7757399.01 | 431674.02 | 66.57 | 02A20110619SGR | 66.49 | 0.08 |
| 11622 | 7757413.45 | 431680.01 | 66.53 | 02A20110619SGR | 66.45 | 0.08 |
| 11623 | 7757427.43 | 431685.98 | 66.48 | 02A20110619SGR | 66.39 | 0.09 |
| 11624 | 7757442.56 | 431692.11 | 66.43 | 02A20110619SGR | 66.35 | 0.08 |
| 11625 | 7757457.41 | 431698.14 | 66.36 | 02A20110619SGR | 66.29 | 0.07 |
| 11626 | 7757471.69 | 431703.93 | 66.34 | 02A20110619SGR | 66.26 | 0.07 |
| 11627 | 7757486.17 | 431709.58 | 66.32 | 02A20110619SGR | 66.26 | 0.06 |
| 11628 | 7757500.13 | 431715.37 | 66.32 | 02A20110619SGR | 66.28 | 0.04 |
| 11629 | 7757516.17 | 431721.21 | 66.28 | 02A20110619SGR | 66.21 | 0.07 |
| 11630 | 7757530.84 | 431726.68 | 66.24 | 02A20110619SGR | 66.16 | 0.08 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 11631 | 7757914.97 | 431885.95 | 65.63 | 02A20110619SGR | 65.56 | 0.07 |
| 11632 | 7757929.73 | 431891.56 | 65.54 | 02A20110619SGR | 65.49 | 0.05 |
| 11633 | 7757944.16 | 431899.90 | 65.52 | 02A20110619SGR | 65.45 | 0.07 |
| 11634 | 7757958.21 | 431905.50 | 65.52 | 02A20110619SGR | 65.45 | 0.07 |
| 11635 | 7757976.34 | 431912.69 | 65.52 | 02A20110619SGR | 65.46 | 0.06 |
| 11636 | 7757991.11 | 431918.34 | 65.48 | 02A20110619SGR | 65.42 | 0.06 |
| 11637 | 7758005.28 | 431924.80 | 65.40 | 02A20110619SGR | 65.33 | 0.07 |
| 11638 | 7758019.18 | 431930.27 | 65.34 | 02A20110619SGR | 65.28 | 0.06 |
| 11639 | 7758033.28 | 431935.13 | 65.29 | 02A20110619SGR | 65.25 | 0.04 |
| 11640 | 7758047.09 | 431941.62 | 65.25 | 02A20110619SGR | 65.20 | 0.05 |
| 11641 | 7758060.68 | 431946.25 | 65.30 | 02A20110619SGR | 65.25 | 0.05 |
| 11642 | 7758074.75 | 431951.97 | 65.31 | 02A20110619SGR | 65.26 | 0.05 |
| 11643 | 7758089.70 | 431958.04 | 65.31 | 02A20110619SGR | 65.28 | 0.03 |
| 11644 | 7758103.82 | 431963.47 | 65.32 | 02A20110619SGR | 65.27 | 0.05 |
| 11645 | 7758117.93 | 431969.21 | 65.32 | 02A20110619SGR | 65.26 | 0.06 |
| 11646 | 7757910.60 | 431881.55 | 65.59 | 02A20110619SGR | 65.53 | 0.06 |
| 11647 | 7757904.58 | 431895.36 | 65.61 | 02A20110619SGR | 65.56 | 0.05 |
| 11648 | 7757898.44 | 431909.35 | 65.53 | 02A20110619SGR | 65.48 | 0.05 |
| 11649 | 7757892.96 | 431921.65 | 65.28 | 02A20110619SGR | 65.22 | 0.06 |
| 11650 | 7757886.48 | 431938.31 | 64.96 | 02A20110619SGR | 64.91 | 0.05 |
| 11651 | 7757880.34 | 431952.42 | 64.98 | 02A20110619SGR | 64.92 | 0.06 |
| 11652 | 7757874.47 | 431967.05 | 65.14 | 02A20110619SGR | 65.08 | 0.06 |
| 11653 | 7757868.54 | 431981.29 | 65.26 | 02A20110619SGR | 65.21 | 0.05 |
| 11654 | 7757862.59 | 431995.78 | 65.31 | 02A20110619SGR | 65.24 | 0.07 |
| 11655 | 7757856.75 | 432009.84 | 65.33 | 02A20110619SGR | 65.27 | 0.06 |
| 11656 | 7757851.19 | 432024.32 | 65.38 | 02A20110619SGR | 65.34 | 0.04 |
| 11657 | 7757845.15 | 432038.42 | 65.47 | 02A20110619SGR | 65.39 | 0.08 |
| 11658 | 7757839.72 | 432051.88 | 65.59 | 02A20110619SGR | 65.55 | 0.04 |
| 11659 | 7757834.38 | 432066.79 | 65.73 | 02A20110619SGR | 65.70 | 0.03 |
| 11660 | 7757828.97 | 432080.71 | 65.73 | 02A20110619SGR | 65.69 | 0.04 |
| 11661 | 7757823.49 | 432093.99 | 65.80 | 02A20110619SGR | 65.78 | 0.02 |
| 11662 | 7757818.01 | 432107.07 | 65.81 | 02A20110619SGR | 65.77 | 0.04 |
| 11663 | 7757812.65 | 432120.47 | 65.93 | 02A20110619SGR | 65.89 | 0.04 |
| 11664 | 7757807.15 | 432134.15 | 65.95 | 02A20110619SGR | 65.91 | 0.04 |
| 11665 | 7757801.03 | 432148.84 | 65.87 | 02A20110619SGR | 65.84 | 0.03 |
| 11666 | 7757797.72 | 432155.62 | 65.81 | 02A20110619SGR | 65.78 | 0.03 |
| 11667 | 7757791.41 | 432168.11 | 65.96 | 02A20110619SGR | 65.92 | 0.04 |
| 11668 | 7757786.32 | 432180.82 | 66.15 | 02A20110619SGR | 66.11 | 0.04 |
| 11669 | 7757781.05 | 432194.18 | 66.18 | 02A20110619SGR | 66.15 | 0.03 |
| 11670 | 7757775.56 | 432207.55 | 66.20 | 02A20110619SGR | 66.18 | 0.02 |
| 11671 | 7757771.62 | 432220.93 | 66.17 | 02A20110619SGR | 66.14 | 0.03 |
| 11672 | 7757765.89 | 432234.95 | 66.23 | 02A20110619SGR | 66.19 | 0.04 |
| 11673 | 7757760.34 | 432248.21 | 66.23 | 02A20110619SGR | 66.18 | 0.05 |
| 11674 | 7757751.82 | 432264.21 | 66.08 | 02A20110619SGR | 66.05 | 0.03 |
| 11675 | 7757747.77 | 432278.92 | 66.18 | 02A20110619SGR | 66.15 | 0.03 |
| 11676 | 7757740.37 | 432296.75 | 66.22 | 02A20110619SGR | 66.19 | 0.03 |
| 11677 | 7757733.21 | 432314.06 | 66.10 | 02A20110619SGR | 66.06 | 0.04 |
| 11678 | 7757727.62 | 432327.83 | 66.11 | 02A20110619SGR | 66.07 | 0.04 |
| 11679 | 7757720.91 | 432344.01 | 66.21 | 02A20110619SGR | 66.16 | 0.05 |
| 11680 | 7757713.78 | 432361.93 | 66.19 | 02A20110619SGR | 66.14 | 0.05 |
| 11681 | 7757708.35 | 432375.00 | 66.22 | 02A20110619SGR | 66.19 | 0.03 |
| 11682 | 7757702.60 | 432389.04 | 66.15 | 02A20110619SGR | 66.13 | 0.02 |
| 11683 | 7757696.93 | 432402.79 | 66.13 | 02A20110619SGR | 66.12 | 0.01 |
| 11684 | 7757690.63 | 432418.32 | 66.07 | 02A20110619SGR | 66.02 | 0.05 |
| 11685 | 7757682.76 | 432433.55 | 66.02 | 02A20110619SGR | 65.99 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 11686 | 7757677.53 | 432449.97 | 66.02 | 02A20110619SGR | 66.00 | 0.02 |
| 11687 | 7757671.20 | 432465.27 | 66.07 | 02A20110619SGR | 66.04 | 0.03 |
| 11688 | 7757665.03 | 432480.41 | 66.11 | 02A20110619SGR | 66.08 | 0.03 |
| 11689 | 7757659.67 | 432494.22 | 66.18 | 02A20110619SGR | 66.14 | 0.04 |
| 11690 | 7757653.14 | 432509.64 | 66.30 | 02A20110619SGR | 66.26 | 0.03 |
| 11691 | 7757647.79 | 432523.28 | 66.28 | 02A20110619SGR | 66.24 | 0.04 |
| 11692 | 7757639.62 | 432538.22 | 66.18 | 02A20110619SGR | 66.17 | 0.01 |
| 11693 | 7757633.82 | 432552.02 | 66.10 | 02A20110619SGR | 66.05 | 0.05 |
| 11694 | 7757629.14 | 432567.58 | 66.08 | 02A20110619SGR | 66.06 | 0.02 |
| 11695 | 7757623.84 | 432581.83 | 66.11 | 02A20110619SGR | 66.08 | 0.03 |
| 11696 | 7757618.31 | 432595.56 | 66.19 | 02A20110619SGR | 66.15 | 0.04 |
| 11697 | 7757610.61 | 432612.36 | 66.60 | 02A20110619SGR | 66.59 | 0.01 |
| 11698 | 7757604.53 | 432627.01 | 66.38 | 02A20110619SGR | 66.36 | 0.02 |
| 11699 | 7757600.11 | 432639.76 | 66.19 | 02A20110619SGR | 66.17 | 0.02 |
| 11700 | 7757594.68 | 432652.85 | 66.32 | 02A20110619SGR | 66.30 | 0.02 |
| 11701 | 7755442.47 | 430975.74 | 70.14 | 02A20110619SGR | 70.07 | 0.07 |
| 11702 | 7755427.72 | 430979.33 | 70.07 | 02A20110619SGR | 70.00 | 0.07 |
| 11703 | 7755412.83 | 430984.35 | 69.98 | 02A20110619SGR | 69.90 | 0.08 |
| 11704 | 7755397.29 | 430987.85 | 69.94 | 02A20110619SGR | 69.87 | 0.07 |
| 11705 | 7755381.41 | 430991.86 | 70.01 | 02A20110619SGR | 69.92 | 0.09 |
| 11706 | 7755367.03 | 430995.16 | 70.07 | 02A20110619SGR | 69.97 | 0.10 |
| 11707 | 7755352.20 | 430998.60 | 70.12 | 02A20110619SGR | 70.02 | 0.10 |
| 11708 | 7755337.70 | 431002.18 | 70.10 | 02A20110619SGR | 70.03 | 0.07 |
| 11709 | 7755322.85 | 431005.99 | 70.14 | 02A20110619SGR | 70.05 | 0.09 |
| 11710 | 7755308.27 | 431009.08 | 70.20 | 02A20110619SGR | 70.11 | 0.09 |
| 11711 | 7755293.71 | 431012.60 | 70.30 | 02A20110619SGR | 70.21 | 0.09 |
| 11712 | 7755278.16 | 431015.99 | 70.37 | 02A20110619SGR | 70.28 | 0.09 |
| 11713 | 7755263.19 | 431019.51 | 70.44 | 02A20110619SGR | 70.36 | 0.08 |
| 11714 | 7755245.28 | 431024.00 | 70.50 | 02A20110619SGR | 70.42 | 0.08 |
| 11715 | 7755229.60 | 431027.58 | 70.55 | 02A20110619SGR | 70.48 | 0.07 |
| 11716 | 7754528.79 | 431193.14 | 71.56 | 02A20110619SGR | 71.51 | 0.05 |
| 11717 | 7754543.24 | 431189.56 | 71.49 | 02A20110619SGR | 71.42 | 0.07 |
| 11718 | 7754557.58 | 431186.19 | 71.47 | 02A20110619SGR | 71.41 | 0.06 |
| 11719 | 7754572.11 | 431182.83 | 71.47 | 02A20110619SGR | 71.41 | 0.06 |
| 11720 | 7754586.74 | 431179.36 | 71.48 | 02A20110619SGR | 71.43 | 0.05 |
| 11721 | 7754604.94 | 431176.56 | 71.44 | 02A20110619SGR | 71.37 | 0.07 |
| 11722 | 7754620.53 | 431171.81 | 71.47 | 02A20110619SGR | 71.41 | 0.06 |
| 11723 | 7754635.37 | 431168.12 | 71.47 | 02A20110619SGR | 71.40 | 0.07 |
| 11724 | 7754649.67 | 431164.95 | 71.47 | 02A20110619SGR | 71.37 | 0.09 |
| 11725 | 7754664.53 | 431161.45 | 71.42 | 02A20110619SGR | 71.34 | 0.08 |
| 11726 | 7754679.79 | 431157.36 | 71.33 | 02A20110619SGR | 71.25 | 0.08 |
| 11727 | 7754694.94 | 431154.03 | 71.23 | 02A20110619SGR | 71.15 | 0.08 |
| 11728 | 7754709.76 | 431150.68 | 71.15 | 02A20110619SGR | 71.06 | 0.09 |
| 11729 | 7754724.89 | 431147.13 | 71.12 | 02A20110619SGR | 71.04 | 0.08 |
| 11730 | 7754739.65 | 431143.84 | 71.08 | 02A20110619SGR | 71.01 | 0.07 |
| 11731 | 7754520.63 | 431192.12 | 71.53 | 02A20110619SGR | 71.46 | 0.07 |
| 11732 | 7754524.15 | 431206.56 | 71.68 | 02A20110619SGR | 71.61 | 0.07 |
| 11733 | 7754527.43 | 431223.30 | 71.37 | 02A20110619SGR | 71.32 | 0.05 |
| 11734 | 7754530.33 | 431235.29 | 71.34 | 02A20110619SGR | 71.27 | 0.07 |
| 11735 | 7754534.02 | 431249.58 | 71.32 | 02A20110619SGR | 71.27 | 0.05 |
| 11736 | 7754537.92 | 431266.02 | 71.49 | 02A20110619SGR | 71.43 | 0.06 |
| 11737 | 7754541.62 | 431281.31 | 71.47 | 02A20110619SGR | 71.42 | 0.05 |
| 11738 | 7754544.77 | 431295.73 | 71.15 | 02A20110619SGR | 71.11 | 0.04 |
| 11739 | 7754548.92 | 431313.14 | 71.18 | 02A20110619SGR | 71.12 | 0.06 |
| 11740 | 7754552.33 | 431327.65 | 71.27 | 02A20110619SGR | 71.20 | 0.07 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 11741 | 7754555.94 | 431342.07 | 71.34 | 02A20110619SGR | 71.29 | 0.05 |
| 11742 | 7754559.29 | 431356.76 | 71.37 | 02A20110619SGR | 71.32 | 0.05 |
| 11743 | 7754562.63 | 431371.28 | 71.42 | 02A20110619SGR | 71.35 | 0.07 |
| 11744 | 7754566.44 | 431385.74 | 71.50 | 02A20110619SGR | 71.43 | 0.06 |
| 11745 | 7754570.45 | 431401.98 | 71.59 | 02A20110619SGR | 71.53 | 0.06 |
| 11746 | 7754574.08 | 431417.46 | 71.52 | 02A20110619SGR | 71.48 | 0.04 |
| 11747 | 7754580.97 | 431448.05 | 71.67 | 02A20110619SGR | 71.65 | 0.02 |
| 11748 | 7754584.99 | 431463.73 | 71.65 | 02A20110619SGR | 71.64 | 0.01 |
| 11749 | 7754588.16 | 431478.58 | 71.49 | 02A20110619SGR | 71.47 | 0.02 |
| 11750 | 7754591.27 | 431493.20 | 71.41 | 02A20110619SGR | 71.39 | 0.02 |
| 11751 | 7754595.09 | 431507.45 | 71.47 | 02A20110619SGR | 71.43 | 0.04 |
| 11752 | 7754598.68 | 431521.52 | 71.56 | 02A20110619SGR | 71.51 | 0.05 |
| 11753 | 7754602.30 | 431535.90 | 71.64 | 02A20110619SGR | 71.63 | 0.01 |
| 11754 | 7754604.90 | 431550.31 | 71.69 | 02A20110619SGR | 71.69 | 0.00 |
| 11755 | 7754608.81 | 431565.63 | 71.65 | 02A20110619SGR | 71.65 | 0.00 |
| 11756 | 7754612.88 | 431580.10 | 71.57 | 02A20110619SGR | 71.56 | 0.01 |
| 11757 | 7754616.72 | 431595.03 | 71.40 | 02A20110619SGR | 71.40 | 0.00 |
| 11758 | 7754621.44 | 431611.59 | 71.33 | 02A20110619SGR | 71.33 | 0.00 |
| 11759 | 7754624.49 | 431629.03 | 71.47 | 02A20110619SGR | 71.48 | -0.01 |
| 11760 | 7754627.05 | 431643.16 | 71.36 | 02A20110619SGR | 71.38 | -0.02 |
| 11761 | 7754631.39 | 431657.80 | 71.47 | 02A20110619SGR | 71.48 | -0.01 |
| 11762 | 7754634.50 | 431672.11 | 71.43 | 02A20110619SGR | 71.45 | -0.02 |
| 11763 | 7754637.40 | 431686.72 | 71.51 | 02A20110619SGR | 71.51 | 0.00 |
| 11764 | 7754641.31 | 431702.14 | 71.65 | 02A20110619SGR | 71.66 | -0.01 |
| 11765 | 7754645.56 | 431721.54 | 71.49 | 02A20110619SGR | 71.51 | -0.02 |
| 11766 | 7754648.96 | 431735.64 | 71.51 | 02A20110619SGR | 71.52 | -0.01 |
| 11767 | 7754652.52 | 431750.46 | 71.53 | 02A20110619SGR | 71.52 | 0.01 |
| 11768 | 7754655.85 | 431764.68 | 71.67 | 02A20110619SGR | 71.69 | -0.02 |
| 11769 | 7754659.87 | 431783.74 | 71.54 | 02A20110619SGR | 71.55 | -0.01 |
| 11770 | 7754535.97 | 431223.28 | 70.92 | 02A201106192B | 70.88 | 0.04 |
| 11771 | 7754535.96 | 431223.28 | 70.91 | 02A201106192B | 70.88 | 0.03 |
| 11772 | 7753996.54 | 431320.01 | 72.59 | 02A20110619SGR | 72.52 | 0.07 |
| 11773 | 7753981.55 | 431323.36 | 72.50 | 02A20110619SGR | 72.44 | 0.06 |
| 11774 | 7753966.17 | 431326.86 | 72.39 | 02A20110619SGR | 72.32 | 0.07 |
| 11775 | 7753951.41 | 431330.28 | 72.36 | 02A20110619SGR | 72.29 | 0.07 |
| 11776 | 7753936.28 | 431333.74 | 72.40 | 02A20110619SGR | 72.36 | 0.04 |
| 11777 | 7753922.08 | 431337.06 | 72.44 | 02A20110619SGR | 72.38 | 0.06 |
| 11801 | 7606221.82 | 398526.64 | 895.51 | 06A20110624SGR | 895.42 | 0.09 |
| 11802 | 7606199.48 | 398526.52 | 895.75 | 06A20110624SGR | 895.65 | 0.10 |
| 11803 | 7606182.99 | 398525.31 | 896.05 | 06A20110624SGR | 895.98 | 0.07 |
| 11804 | 7606166.73 | 398524.21 | 896.52 | 06A20110624SGR | 896.44 | 0.08 |
| 11805 | 7606150.69 | 398522.43 | 896.96 | 06A20110624SGR | 896.87 | 0.09 |
| 11806 | 7606134.65 | 398521.25 | 897.38 | 06A20110624SGR | 897.27 | 0.11 |
| 11807 | 7606120.66 | 398520.26 | 897.88 | 06A20110624SGR | 897.80 | 0.08 |
| 11808 | 7606105.39 | 398519.09 | 898.67 | 06A20110624SGR | 898.58 | 0.09 |
| 11809 | 7606091.96 | 398517.78 | 899.50 | 06A20110624SGR | 899.39 | 0.11 |
| 11810 | 7606078.50 | 398515.67 | 900.36 | 06A20110624SGR | 900.24 | 0.12 |
| 11811 | 7605354.09 | 398775.39 | 904.04 | 06A20110624SGR | 903.91 | 0.13 |
| 11812 | 7605339.11 | 398777.36 | 903.87 | 06A20110624SGR | 903.75 | 0.12 |
| 11813 | 7605323.94 | 398779.80 | 903.75 | 06A20110624SGR | 903.65 | 0.10 |
| 11814 | 7605308.29 | 398782.48 | 903.67 | 06A20110624SGR | 903.58 | 0.09 |
| 11815 | 7605292.93 | 398784.95 | 903.55 | 06A20110624SGR | 903.44 | 0.11 |
| 11816 | 7605278.01 | 398787.32 | 903.46 | 06A20110624SGR | 903.37 | 0.09 |
| 11817 | 7605262.89 | 398789.73 | 903.42 | 06A20110624SGR | 903.37 | 0.05 |
| 11818 | 7605247.23 | 398792.61 | 903.37 | 06A20110624SGR | 903.30 | 0.07 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 11819 | 7605232.74 | 398794.81 | 903.46 | 06A20110624SGR | 903.42 | 0.04 |
| 11820 | 7605217.69 | 398796.37 | 903.59 | 06A20110624SGR | 903.50 | 0.09 |
| 11821 | 7604862.94 | 398830.94 | 910.84 | 06A20110624SGR | 910.77 | 0.07 |
| 11822 | 7604848.84 | 398831.11 | 911.31 | 06A20110624SGR | 911.23 | 0.08 |
| 11823 | 7604833.71 | 398830.92 | 911.85 | 06A20110624SGR | 911.77 | 0.08 |
| 11824 | 7604818.76 | 398830.44 | 912.44 | 06A20110624SGR | 912.36 | 0.08 |
| 11825 | 7604803.46 | 398829.90 | 913.02 | 06A20110624SGR | 912.93 | 0.09 |
| 11826 | 7604787.62 | 398829.37 | 913.53 | 06A20110624SGR | 913.45 | 0.08 |
| 11827 | 7604772.60 | 398828.91 | 914.02 | 06A20110624SGR | 913.92 | 0.10 |
| 11828 | 7604757.64 | 398828.30 | 914.54 | 06A20110624SGR | 914.45 | 0.09 |
| 11829 | 7604742.20 | 398827.78 | 915.15 | 06A20110624SGR | 915.05 | 0.10 |
| 11830 | 7604726.36 | 398827.17 | 915.74 | 06A20110624SGR | 915.66 | 0.08 |
| 11831 | 7607307.53 | 398363.23 | 892.87 | 06A20110624SGR | 892.81 | 0.06 |
| 11832 | 7607293.50 | 398368.82 | 892.72 | 06A20110624SGR | 892.66 | 0.06 |
| 11833 | 7607281.52 | 398373.41 | 892.59 | 06A20110624SGR | 892.56 | 0.03 |
| 11834 | 7607264.03 | 398377.01 | 892.18 | 06A20110624SGR | 892.09 | 0.09 |
| 11835 | 7607248.28 | 398380.46 | 891.89 | 06A20110624SGR | 891.80 | 0.09 |
| 11836 | 7607232.59 | 398383.69 | 891.80 | 06A20110624SGR | 891.70 | 0.09 |
| 11837 | 7607218.09 | 398386.30 | 891.79 | 06A20110624SGR | 891.71 | 0.08 |
| 11838 | 7607204.22 | 398388.87 | 891.50 | 06A20110624SGR | 891.41 | 0.09 |
| 11839 | 7607189.56 | 398391.48 | 891.06 | 06A20110624SGR | 890.96 | 0.10 |
| 11840 | 7607175.45 | 398394.01 | 890.69 | 06A20110624SGR | 890.59 | 0.10 |
| 11841 | 7607685.56 | 398164.12 | 880.31 | 06A20110624SGR | 880.29 | 0.02 |
| 11842 | 7607703.53 | 398244.30 | 878.47 | 06A20110624SGR | 878.43 | 0.04 |
| 11843 | 7607714.08 | 398290.56 | 879.02 | 06A20110624SGR | 878.98 | 0.04 |
| 11844 | 7607717.09 | 398305.45 | 878.91 | 06A20110624SGR | 878.86 | 0.05 |
| 11845 | 7607720.65 | 398318.88 | 879.08 | 06A20110624SGR | 879.03 | 0.05 |
| 11846 | 7607723.33 | 398333.40 | 879.65 | 06A20110624SGR | 879.59 | 0.06 |
| 11847 | 7607726.84 | 398348.10 | 880.27 | 06A20110624SGR | 880.22 | 0.05 |
| 11848 | 7607729.92 | 398362.22 | 880.85 | 06A20110624SGR | 880.81 | 0.04 |
| 11849 | 7607732.98 | 398381.35 | 882.14 | 06A20110624SGR | 882.10 | 0.04 |
| 11850 | 7607735.63 | 398396.14 | 883.63 | 06A20110624SGR | 883.58 | 0.04 |
| 11851 | 7607740.84 | 398422.50 | 885.82 | 06A20110624SGR | 885.73 | 0.09 |
| 11852 | 7607749.54 | 398449.37 | 889.77 | 06A20110624SGR | 889.71 | 0.05 |
| 11853 | 7607765.31 | 398446.01 | 890.28 | 06A20110624SGR | 890.22 | 0.06 |
| 11854 | 7607789.53 | 398440.96 | 891.27 | 06A20110624SGR | 891.21 | 0.06 |
| 11855 | 7607809.32 | 398437.16 | 892.14 | 06A20110624SGR | 892.07 | 0.07 |
| 11856 | 7607835.83 | 398430.75 | 893.42 | 06A20110624SGR | 893.35 | 0.07 |
| 11857 | 7607853.05 | 398426.05 | 894.12 | 06A20110624SGR | 894.05 | 0.07 |
| 11858 | 7607869.31 | 398422.29 | 894.73 | 06A20110624SGR | 894.68 | 0.05 |
| 11859 | 7607902.08 | 398414.65 | 895.97 | 06A20110624SGR | 895.93 | 0.04 |
| 11860 | 7607932.48 | 398407.56 | 897.21 | 06A20110624SGR | 897.15 | 0.06 |
| 11861 | 7607946.88 | 398404.34 | 897.31 | 06A20110624SGR | 897.24 | 0.07 |
| 11862 | 7607962.03 | 398400.54 | 897.27 | 06A20110624SGR | 897.23 | 0.04 |
| 11863 | 7607977.83 | 398396.42 | 897.07 | 06A20110624SGR | 897.01 | 0.06 |
| 11864 | 7607993.67 | 398392.83 | 896.75 | 06A20110624SGR | 896.70 | 0.05 |
| 11865 | 7608007.93 | 398389.45 | 896.38 | 06A20110624SGR | 896.33 | 0.04 |
| 11866 | 7608022.17 | 398386.52 | 896.12 | 06A20110624SGR | 896.09 | 0.03 |
| 11867 | 7608036.67 | 398382.81 | 895.79 | 06A20110624SGR | 895.78 | 0.01 |
| 11868 | 7608053.21 | 398378.87 | 895.69 | 06A20110624SGR | 895.63 | 0.06 |
| 11869 | 7608067.62 | 398375.02 | 895.45 | 06A20110624SGR | 895.41 | 0.04 |
| 11870 | 7608081.41 | 398371.69 | 895.22 | 06A20110624SGR | 895.17 | 0.05 |
| 11871 | 7608096.49 | 398368.21 | 894.92 | 06A20110624SGR | 894.89 | 0.03 |
| 11872 | 7608111.55 | 398364.71 | 894.66 | 06A20110624SGR | 894.63 | 0.03 |
| 11873 | 7608125.82 | 398360.87 | 894.44 | 06A20110624SGR | 894.40 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 11874 | 7608140.28 | 398357.08 | 894.03 | 06A20110624SGR | 894.00 | 0.03 |
| 11875 | 7608154.63 | 398353.87 | 893.70 | 06A20110624SGR | 893.66 | 0.04 |
| 11876 | 7608168.29 | 398349.95 | 893.24 | 06A20110624SGR | 893.21 | 0.03 |
| 11877 | 7608181.84 | 398345.27 | 892.67 | 06A20110624SGR | 892.62 | 0.05 |
| 11878 | 7608193.56 | 398340.87 | 892.00 | 06A20110624SGR | 891.96 | 0.04 |
| 11879 | 7608231.59 | 398325.56 | 892.99 | 06A20110624SGR | 892.92 | 0.07 |
| 11880 | 7608244.79 | 398319.04 | 893.29 | 06A20110624SGR | 893.25 | 0.04 |
| 11881 | 7608261.68 | 398312.08 | 893.56 | 06A20110624SGR | 893.51 | 0.05 |
| 11882 | 7608285.52 | 398299.29 | 893.61 | 06A20110624SGR | 893.59 | 0.02 |
| 11883 | 7608300.14 | 398291.58 | 893.59 | 06A20110624SGR | 893.53 | 0.06 |
| 11884 | 7608314.83 | 398285.46 | 893.61 | 06A20110624SGR | 893.58 | 0.03 |
| 11885 | 7608330.42 | 398280.91 | 894.04 | 06A20110624SGR | 893.97 | 0.07 |
| 11886 | 7608345.40 | 398277.60 | 894.29 | 06A20110624SGR | 894.23 | 0.06 |
| 11887 | 7608360.17 | 398274.50 | 894.34 | 06A20110624SGR | 894.29 | 0.05 |
| 11888 | 7608375.57 | 398271.06 | 894.11 | 06A20110624SGR | 894.06 | 0.05 |
| 11889 | 7608389.76 | 398267.89 | 893.92 | 06A20110624SGR | 893.87 | 0.05 |
| 11890 | 7608404.28 | 398264.51 | 893.80 | 06A20110624SGR | 893.74 | 0.06 |
| 11891 | 7607703.24 | 398451.01 | 886.81 | 06A20110624SGR | 886.76 | 0.05 |
| 11892 | 7607685.10 | 398450.35 | 886.48 | 06A20110624SGR | 886.42 | 0.06 |
| 11893 | 7607664.74 | 398451.97 | 885.95 | 06A20110624SGR | 885.91 | 0.04 |
| 11894 | 7607648.56 | 398450.99 | 885.37 | 06A20110624SGR | 885.31 | 0.06 |
| 11895 | 7607633.23 | 398451.19 | 884.72 | 06A20110624SGR | 884.67 | 0.05 |
| 11896 | 7607619.51 | 398452.14 | 883.84 | 06A20110624SGR | 883.81 | 0.03 |
| 11897 | 7607607.97 | 398454.74 | 883.16 | 06A20110624SGR | 883.10 | 0.06 |
| 11898 | 7607597.33 | 398457.45 | 883.43 | 06A20110624SGR | 883.38 | 0.05 |
| 11899 | 7607585.64 | 398459.84 | 883.94 | 06A20110624SGR | 883.88 | 0.06 |
| 11900 | 7607571.87 | 398463.74 | 884.46 | 06A20110624SGR | 884.42 | 0.04 |
| 12001 | 7609017.43 | 397884.65 | 872.25 | 06B20110630SGR | 872.25 | 0.00 |
| 12002 | 7609029.28 | 397876.13 | 871.92 | 06B20110630SGR | 871.92 | 0.00 |
| 12003 | 7609032.32 | 397866.08 | 871.01 | 06B20110630SGR | 871.01 | 0.00 |
| 12004 | 7609038.38 | 397853.51 | 869.87 | 06B20110630SGR | 869.87 | 0.00 |
| 12005 | 7609043.88 | 397840.76 | 868.79 | 06B20110630SGR | 868.80 | -0.01 |
| 12006 | 7609049.67 | 397825.53 | 868.18 | 06B20110630SGR | 868.18 | 0.00 |
| 12007 | 7609053.38 | 397810.95 | 868.33 | 06B20110630SGR | 868.32 | 0.01 |
| 12008 | 7609057.70 | 397796.86 | 868.50 | 06B20110630SGR | 868.51 | -0.01 |
| 12009 | 7609061.96 | 397782.43 | 868.36 | 06B20110630SGR | 868.36 | 0.00 |
| 12010 | 7609066.29 | 397768.70 | 867.72 | 06B20110630SGR | 867.70 | 0.02 |
| 12011 | 7609070.88 | 397755.39 | 866.69 | 06B20110630SGR | 866.66 | 0.02 |
| 12012 | 7609074.82 | 397742.42 | 865.36 | 06B20110630SGR | 865.34 | 0.01 |
| 12013 | 7609078.46 | 397729.20 | 864.67 | 06B20110630SGR | 864.67 | 0.00 |
| 12014 | 7609102.24 | 397658.58 | 857.87 | 06B20110630SGR | 857.88 | -0.01 |
| 12015 | 7609107.79 | 397641.24 | 856.73 | 06B20110630SGR | 856.75 | -0.02 |
| 12016 | 7609115.57 | 397617.71 | 855.86 | 06B20110630SGR | 855.89 | -0.03 |
| 12017 | 7609119.88 | 397604.46 | 855.51 | 06B20110630SGR | 855.53 | -0.02 |
| 12018 | 7609126.98 | 397584.91 | 855.05 | 06B20110630SGR | 855.07 | -0.02 |
| 12019 | 7609135.46 | 397564.98 | 854.77 | 06B20110630SGR | 854.78 | -0.01 |
| 12020 | 7609147.50 | 397527.39 | 855.53 | 06B20110630SGR | 855.54 | -0.01 |
| 12021 | 7609159.71 | 397495.86 | 853.99 | 06B20110630SGR | 854.00 | -0.01 |
| 12022 | 7609163.86 | 397481.73 | 853.29 | 06B20110630SGR | 853.29 | 0.00 |
| 12023 | 7609167.93 | 397465.22 | 852.13 | 06B20110630SGR | 852.14 | -0.01 |
| 12024 | 7609173.04 | 397446.01 | 851.15 | 06B20110630SGR | 851.14 | 0.01 |
| 12025 | 7609185.05 | 397420.67 | 851.15 | 06B20110630SGR | 851.16 | -0.01 |
| 12026 | 7609191.61 | 397399.99 | 849.13 | 06B20110630SGR | 849.12 | 0.01 |
| 12027 | 7609196.72 | 397384.74 | 848.77 | 06B20110630SGR | 848.76 | 0.01 |
| 12028 | 7609201.09 | 397367.11 | 846.56 | 06B20110630SGR | 846.55 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12029 | 7609205.43 | 397351.98 | 845.69 | 06B20110630SGR | 845.70 | -0.01 |
| 12030 | 7609210.17 | 397337.80 | 844.72 | 06B20110630SGR | 844.72 | 0.00 |
| 12031 | 7609214.84 | 397324.44 | 844.26 | 06B20110630SGR | 844.24 | 0.02 |
| 12032 | 7609011.81 | 397930.52 | 873.87 | 06B20110630SGR | 873.89 | -0.02 |
| 12033 | 7609007.60 | 397945.03 | 874.60 | 06B20110630SGR | 874.61 | -0.01 |
| 12034 | 7609002.88 | 397960.74 | 874.99 | 06B20110630SGR | 874.97 | 0.02 |
| 12035 | 7608998.02 | 397975.66 | 875.52 | 06B20110630SGR | 875.51 | 0.01 |
| 12036 | 7608992.60 | 397991.30 | 876.51 | 06B20110630SGR | 876.51 | 0.00 |
| 12037 | 7608987.40 | 398005.62 | 877.90 | 06B20110630SGR | 877.89 | 0.01 |
| 12038 | 7608981.00 | 398021.19 | 879.07 | 06B20110630SGR | 879.08 | -0.01 |
| 12039 | 7608973.90 | 398043.13 | 879.20 | 06B20110630SGR | 879.22 | -0.02 |
| 12040 | 7608970.62 | 398059.86 | 880.95 | 06B20110630SGR | 880.97 | -0.02 |
| 12041 | 7608964.15 | 398077.58 | 881.06 | 06B20110630SGR | 881.06 | 0.00 |
| 12042 | 7608956.75 | 398096.62 | 882.88 | 06B20110630SGR | 882.86 | 0.02 |
| 12043 | 7608947.73 | 398124.48 | 885.02 | 06B20110630SGR | 885.07 | -0.05 |
| 12044 | 7608939.54 | 398149.03 | 886.73 | 06B20110630SGR | 886.75 | -0.02 |
| 12045 | 7608928.24 | 398185.86 | 890.13 | 06B20110630SGR | 890.14 | -0.01 |
| 12046 | 7608912.42 | 398188.73 | 890.17 | 06B20110630SGR | 890.19 | -0.02 |
| 12047 | 7608897.18 | 398191.31 | 890.19 | 06B20110630SGR | 890.20 | -0.01 |
| 12048 | 7608878.62 | 398192.53 | 889.61 | 06B20110630SGR | 889.60 | 0.01 |
| 12049 | 7608864.33 | 398191.81 | 889.00 | 06B20110630SGR | 889.01 | -0.01 |
| 12050 | 7608843.57 | 398189.57 | 889.05 | 06B20110630SGR | 889.06 | -0.01 |
| 12051 | 7608825.11 | 398188.99 | 889.39 | 06B20110630SGR | 889.40 | -0.01 |
| 12052 | 7608807.11 | 398188.03 | 889.95 | 06B20110630SGR | 889.97 | -0.02 |
| 12053 | 7608788.82 | 398186.32 | 890.86 | 06B20110630SGR | 890.87 | -0.01 |
| 12054 | 7608770.40 | 398183.42 | 891.39 | 06B20110630SGR | 891.40 | -0.01 |
| 12055 | 7608752.04 | 398182.09 | 891.12 | 06B20110630SGR | 891.13 | -0.01 |
| 12056 | 7608732.52 | 398184.59 | 890.71 | 06B20110630SGR | 890.71 | 0.00 |
| 12057 | 7608714.17 | 398189.45 | 889.59 | 06B20110630SGR | 889.60 | -0.01 |
| 12058 | 7608696.51 | 398194.24 | 888.81 | 06B20110630SGR | 888.83 | -0.02 |
| 12059 | 7608679.26 | 398198.55 | 888.72 | 06B20110630SGR | 888.71 | 0.01 |
| 12060 | 7608661.31 | 398204.00 | 888.88 | 06B20110630SGR | 888.86 | 0.02 |
| 12061 | 7608643.88 | 398208.72 | 889.44 | 06B20110630SGR | 889.45 | -0.01 |
| 12062 | 7608626.42 | 398213.33 | 891.01 | 06B20110630SGR | 891.00 | 0.01 |
| 12063 | 7608608.63 | 398217.71 | 892.14 | 06B20110630SGR | 892.15 | -0.01 |
| 12064 | 7608590.94 | 398221.85 | 892.12 | 06B20110630SGR | 892.11 | 0.01 |
| 12065 | 7608572.80 | 398225.83 | 891.36 | 06B20110630SGR | 891.34 | 0.02 |
| 12066 | 7608554.98 | 398229.71 | 891.20 | 06B20110630SGR | 891.19 | 0.01 |
| 12067 | 7608537.67 | 398233.47 | 890.92 | 06B20110630SGR | 890.89 | 0.03 |
| 12068 | 7608518.24 | 398237.46 | 890.61 | 06B20110630SGR | 890.60 | 0.01 |
| 12069 | 7608493.51 | 398243.06 | 889.98 | 06B20110630SGR | 889.97 | 0.01 |
| 12070 | 7608480.98 | 398246.36 | 890.74 | 06B20110630SGR | 890.73 | 0.01 |
| 12071 | 7608462.11 | 398251.37 | 891.53 | 06B20110630SGR | 891.52 | 0.01 |
| 12072 | 7608441.73 | 398255.13 | 892.29 | 06B20110630SGR | 892.28 | 0.00 |
| 12073 | 7608423.02 | 398259.47 | 893.23 | 06B20110630SGR | 893.23 | 0.00 |
| 12074 | 7608404.57 | 398264.41 | 893.73 | 06B20110630SGR | 893.73 | 0.00 |
| 12075 | 7608384.92 | 398268.38 | 893.91 | 06B20110630SGR | 893.90 | 0.01 |
| 12076 | 7608365.65 | 398272.94 | 894.21 | 06B20110630SGR | 894.19 | 0.02 |
| 12077 | 7608347.31 | 398277.25 | 894.27 | 06B20110630SGR | 894.25 | 0.02 |
| 12078 | 7608327.37 | 398281.69 | 893.90 | 06B20110630SGR | 893.88 | 0.02 |
| 12079 | 7608307.59 | 398288.18 | 893.47 | 06B20110630SGR | 893.50 | -0.03 |
| 12080 | 7608291.05 | 398296.54 | 893.59 | 06B20110630SGR | 893.58 | 0.01 |
| 12081 | 7608274.77 | 398305.32 | 893.60 | 06B20110630SGR | 893.61 | -0.01 |
| 12082 | 7608258.97 | 398313.60 | 893.49 | 06B20110630SGR | 893.50 | -0.01 |
| 12083 | 7608242.90 | 398321.70 | 893.26 | 06B20110630SGR | 893.23 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12084 | 7608226.09 | 398328.86 | 892.66 | 06B20110630SGR | 892.64 | 0.02 |
| 12085 | 7608191.89 | 398341.96 | 892.09 | 06B20110630SGR | 892.08 | 0.01 |
| 12086 | 7608210.23 | 398040.06 | 874.13 | 06B20110630SGR | 874.13 | 0.00 |
| 12087 | 7608225.74 | 398036.42 | 874.18 | 06B20110630SGR | 874.17 | 0.01 |
| 12088 | 7608244.64 | 398030.16 | 874.15 | 06B20110630SGR | 874.14 | 0.01 |
| 12089 | 7608259.46 | 398027.27 | 874.18 | 06B20110630SGR | 874.17 | 0.01 |
| 12090 | 7608273.96 | 398024.23 | 874.01 | 06B20110630SGR | 874.00 | 0.01 |
| 12091 | 7608289.01 | 398021.37 | 873.80 | 06B20110630SGR | 873.76 | 0.04 |
| 12092 | 7608303.76 | 398017.97 | 873.69 | 06B20110630SGR | 873.67 | 0.01 |
| 12093 | 7608321.46 | 398014.41 | 873.60 | 06B20110630SGR | 873.58 | 0.01 |
| 12094 | 7608338.38 | 398011.49 | 873.47 | 06B20110630SGR | 873.44 | 0.03 |
| 12095 | 7608352.88 | 398008.70 | 873.29 | 06B20110630SGR | 873.26 | 0.03 |
| 12096 | 7608367.58 | 398005.35 | 873.05 | 06B20110630SGR | 873.02 | 0.02 |
| 12097 | 7608383.87 | 398001.57 | 872.95 | 06B20110630SGR | 872.94 | 0.01 |
| 12098 | 7608397.77 | 397999.41 | 872.90 | 06B20110630SGR | 872.90 | 0.00 |
| 12099 | 7608413.70 | 397995.90 | 872.57 | 06B20110630SGR | 872.56 | 0.01 |
| 12100 | 7608428.29 | 397992.72 | 872.18 | 06B20110630SGR | 872.17 | 0.01 |
| 12101 | 7608442.37 | 397988.36 | 871.86 | 06B20110630SGR | 871.87 | -0.01 |
| 12102 | 7608456.78 | 397985.71 | 871.52 | 06B20110630SGR | 871.53 | -0.01 |
| 12103 | 7608470.88 | 397985.65 | 871.16 | 06B20110630SGR | 871.15 | 0.00 |
| 12104 | 7608488.90 | 397980.05 | 870.40 | 06B20110630SGR | 870.41 | -0.01 |
| 12105 | 7608504.11 | 397976.44 | 869.79 | 06B20110630SGR | 869.79 | 0.00 |
| 12106 | 7608519.09 | 397972.84 | 869.32 | 06B20110630SGR | 869.31 | 0.01 |
| 12107 | 7608533.53 | 397969.54 | 869.02 | 06B20110630SGR | 869.02 | 0.00 |
| 12108 | 7608547.52 | 397966.66 | 868.84 | 06B20110630SGR | 868.84 | 0.00 |
| 12109 | 7608561.42 | 397961.46 | 868.72 | 06B20110630SGR | 868.74 | -0.02 |
| 12110 | 7608577.06 | 397958.24 | 868.83 | 06B20110630SGR | 868.82 | 0.00 |
| 12111 | 7608591.71 | 397954.95 | 868.98 | 06B20110630SGR | 868.97 | 0.00 |
| 12112 | 7608607.07 | 397951.91 | 869.11 | 06B20110630SGR | 869.11 | 0.00 |
| 12113 | 7608622.69 | 397948.39 | 869.22 | 06B20110630SGR | 869.21 | 0.01 |
| 12114 | 7608637.67 | 397945.06 | 869.43 | 06B20110630SGR | 869.43 | 0.00 |
| 12115 | 7608653.90 | 397941.85 | 869.46 | 06B20110630SGR | 869.44 | 0.02 |
| 12116 | 7608668.20 | 397939.01 | 869.33 | 06B20110630SGR | 869.34 | -0.01 |
| 12117 | 7608683.87 | 397935.66 | 869.12 | 06B20110630SGR | 869.13 | -0.01 |
| 12118 | 7608699.12 | 397932.42 | 868.81 | 06B20110630SGR | 868.81 | 0.00 |
| 12119 | 7608714.95 | 397929.24 | 868.49 | 06B20110630SGR | 868.47 | 0.01 |
| 12120 | 7608729.90 | 397925.54 | 868.13 | 06B20110630SGR | 868.15 | -0.02 |
| 12121 | 7608744.17 | 397922.84 | 867.95 | 06B20110630SGR | 867.97 | -0.02 |
| 12122 | 7608757.93 | 397919.71 | 867.95 | 06B20110630SGR | 867.96 | -0.01 |
| 12123 | 7608773.74 | 397916.09 | 868.15 | 06B20110630SGR | 868.15 | 0.00 |
| 12124 | 7608788.56 | 397918.10 | 868.35 | 06B20110630SGR | 868.36 | -0.01 |
| 12125 | 7608802.79 | 397914.94 | 868.49 | 06B20110630SGR | 868.51 | -0.02 |
| 12126 | 7608819.83 | 397911.59 | 868.83 | 06B20110630SGR | 868.85 | -0.02 |
| 12127 | 7608834.91 | 397907.94 | 869.02 | 06B20110630SGR | 869.04 | -0.02 |
| 12128 | 7608849.78 | 397904.50 | 869.28 | 06B20110630SGR | 869.29 | -0.01 |
| 12129 | 7608864.92 | 397901.26 | 869.66 | 06B20110630SGR | 869.66 | 0.00 |
| 12130 | 7608880.76 | 397898.05 | 869.94 | 06B20110630SGR | 869.93 | 0.01 |
| 12131 | 7608895.06 | 397895.48 | 870.31 | 06B20110630SGR | 870.28 | 0.03 |
| 12132 | 7608909.47 | 397892.48 | 870.72 | 06B20110630SGR | 870.71 | 0.01 |
| 12133 | 7608923.96 | 397890.45 | 870.95 | 06B20110630SGR | 870.93 | 0.02 |
| 12134 | 7608939.08 | 397887.60 | 871.18 | 06B20110630SGR | 871.18 | 0.00 |
| 12135 | 7608953.85 | 397886.10 | 871.30 | 06B20110630SGR | 871.29 | 0.01 |
| 12136 | 7608968.02 | 397885.44 | 871.52 | 06B20110630SGR | 871.53 | -0.01 |
| 12137 | 7608982.05 | 397885.17 | 871.78 | 06B20110630SGR | 871.78 | 0.00 |
| 12138 | 7608996.67 | 397885.32 | 871.93 | 06B20110630SGR | 871.92 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12139 | 7609011.34 | 397885.92 | 872.18 | 06B20110630SGR | 872.16 | 0.01 |
| 12140 | 7609040.82 | 397888.14 | 872.29 | 06B20110630SGR | 872.26 | 0.03 |
| 12201 | 7773493.10 | 439910.29 | 35.46 | 01C20110616SGR | 35.40 | 0.06 |
| 12202 | 7773496.19 | 439897.31 | 35.61 | 01C20110616SGR | 35.55 | 0.06 |
| 12203 | 7773482.57 | 439890.24 | 35.63 | 01C20110616SGR | 35.56 | 0.07 |
| 12204 | 7773469.00 | 439883.57 | 35.63 | 01C20110616SGR | 35.57 | 0.05 |
| 12205 | 7773454.53 | 439876.65 | 35.67 | 01C20110616SGR | 35.61 | 0.06 |
| 12206 | 7773439.58 | 439869.30 | 35.67 | 01C20110616SGR | 35.61 | 0.06 |
| 12207 | 7773425.77 | 439862.02 | 35.66 | 01C20110616SGR | 35.60 | 0.06 |
| 12208 | 7773413.07 | 439856.96 | 35.65 | 01C20110616SGR | 35.58 | 0.07 |
| 12209 | 7773481.52 | 439935.22 | 34.54 | 01C20110616SGR | 34.45 | 0.09 |
| 12210 | 7772756.13 | 439477.09 | 36.87 | 01C20110616SGR | 36.82 | 0.05 |
| 12211 | 7772768.21 | 439487.02 | 36.87 | 01C20110616SGR | 36.79 | 0.08 |
| 12212 | 7772779.40 | 439496.56 | 36.83 | 01C20110616SGR | 36.77 | 0.06 |
| 12213 | 7772791.58 | 439506.43 | 36.76 | 01C20110616SGR | 36.70 | 0.06 |
| 12214 | 7772804.20 | 439517.05 | 36.70 | 01C20110616SGR | 36.63 | 0.07 |
| 12215 | 7772815.31 | 439526.17 | 36.69 | 01C20110616SGR | 36.61 | 0.08 |
| 12216 | 7772827.52 | 439536.45 | 36.65 | 01C20110616SGR | 36.58 | 0.07 |
| 12217 | 7772089.45 | 438929.14 | 37.94 | 01C20110616SGR | 37.89 | 0.05 |
| 12218 | 7772101.24 | 438937.98 | 37.91 | 01C20110616SGR | 37.86 | 0.05 |
| 12219 | 7772112.35 | 438946.71 | 37.85 | 01C20110616SGR | 37.81 | 0.04 |
| 12220 | 7772123.79 | 438955.75 | 37.84 | 01C20110616SGR | 37.82 | 0.02 |
| 12221 | 7772135.48 | 438965.38 | 37.86 | 01C20110616SGR | 37.82 | 0.04 |
| 12222 | 7772146.70 | 438976.82 | 37.91 | 01C20110616SGR | 37.87 | 0.04 |
| 12223 | 7772159.37 | 438984.86 | 37.89 | 01C20110616SGR | 37.86 | 0.03 |
| 12224 | 7771440.53 | 438392.81 | 39.36 | 01C20110616SGR | 39.33 | 0.03 |
| 12225 | 7771451.20 | 438402.89 | 39.34 | 01C20110616SGR | 39.31 | 0.03 |
| 12226 | 7771463.20 | 438411.94 | 39.27 | 01C20110616SGR | 39.24 | 0.02 |
| 12227 | 7771475.73 | 438422.16 | 39.22 | 01C20110616SGR | 39.18 | 0.04 |
| 12228 | 7771487.56 | 438431.60 | 39.13 | 01C20110616SGR | 39.08 | 0.05 |
| 12229 | 7771499.25 | 438441.17 | 39.02 | 01C20110616SGR | 38.98 | 0.04 |
| 12230 | 7771510.72 | 438450.10 | 38.91 | 01C20110616SGR | 38.88 | 0.03 |
| 12231 | 7775813.53 | 441268.15 | 31.13 | 01C20110616SGR | 31.06 | 0.07 |
| 12232 | 7775818.44 | 441252.81 | 31.34 | 01C20110616SGR | 31.28 | 0.06 |
| 12233 | 7775822.59 | 441232.99 | 31.41 | 01C20110616SGR | 31.36 | 0.05 |
| 12234 | 7775827.07 | 441214.61 | 30.95 | 01C20110616SGR | 30.89 | 0.06 |
| 12235 | 7775852.01 | 441127.58 | 30.92 | 01C20110616SGR | 30.85 | 0.07 |
| 12236 | 7775861.17 | 441099.87 | 30.93 | 01C20110616SGR | 30.86 | 0.07 |
| 12237 | 7775869.98 | 441071.05 | 30.95 | 01C20110616SGR | 30.88 | 0.07 |
| 12238 | 7775876.10 | 441042.74 | 30.97 | 01C20110616SGR | 30.89 | 0.08 |
| 12239 | 7775883.63 | 441013.99 | 30.95 | 01C20110616SGR | 30.89 | 0.06 |
| 12240 | 7775892.03 | 440983.99 | 30.98 | 01C20110616SGR | 30.90 | 0.08 |
| 12241 | 7775897.52 | 440956.41 | 30.98 | 01C20110616SGR | 30.93 | 0.05 |
| 12242 | 7775905.44 | 440929.37 | 31.12 | 01C20110616SGR | 31.07 | 0.05 |
| 12243 | 7775914.55 | 440901.42 | 31.17 | 01C20110616SGR | 31.09 | 0.08 |
| 12244 | 7775921.72 | 440871.78 | 31.18 | 01C20110616SGR | 31.10 | 0.08 |
| 12245 | 7775933.58 | 440841.56 | 31.12 | 01C20110616SGR | 31.05 | 0.07 |
| 12246 | 7775941.78 | 440813.95 | 31.04 | 01C20110616SGR | 30.98 | 0.06 |
| 12247 | 7775949.52 | 440785.33 | 31.00 | 01C20110616SGR | 30.94 | 0.06 |
| 12248 | 7775956.56 | 440761.44 | 30.95 | 01C20110616SGR | 30.88 | 0.07 |
| 12252 | 7775419.44 | 441002.59 | 31.78 | 01C20110616SGR | 31.70 | 0.07 |
| 12253 | 7775432.11 | 441010.13 | 31.74 | 01C20110616SGR | 31.68 | 0.06 |
| 12254 | 7775445.81 | 441019.20 | 31.72 | 01C20110616SGR | 31.63 | 0.09 |
| 12255 | 7775458.71 | 441027.00 | 31.69 | 01C20110616SGR | 31.60 | 0.09 |
| 12256 | 7775471.63 | 441034.76 | 31.69 | 01C20110616SGR | 31.60 | 0.09 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12257 | 7775484.57 | 441041.99 | 31.67 | 01C20110616SGR | 31.60 | 0.07 |
| 12258 | 7775498.32 | 441048.62 | 31.59 | 01C20110616SGR | 31.50 | 0.09 |
| 12259 | 7774755.79 | 440616.93 | 33.05 | 01C20110616SGR | 32.97 | 0.08 |
| 12260 | 7774768.66 | 440624.80 | 33.02 | 01C20110616SGR | 32.94 | 0.08 |
| 12261 | 7774782.92 | 440632.96 | 32.97 | 01C20110616SGR | 32.88 | 0.09 |
| 12262 | 7774795.99 | 440640.37 | 32.93 | 01C20110616SGR | 32.84 | 0.09 |
| 12263 | 7774809.79 | 440648.17 | 32.92 | 01C20110616SGR | 32.84 | 0.08 |
| 12264 | 7774824.39 | 440658.30 | 32.94 | 01C20110616SGR | 32.85 | 0.09 |
| 12265 | 7774837.58 | 440664.57 | 32.92 | 01C20110616SGR | 32.82 | 0.10 |
| 12266 | 7774029.19 | 440195.19 | 34.26 | 01C20110616SGR | 34.17 | 0.09 |
| 12267 | 7774042.10 | 440202.31 | 34.24 | 01C20110616SGR | 34.16 | 0.08 |
| 12268 | 7774055.66 | 440208.68 | 34.24 | 01C20110616SGR | 34.16 | 0.08 |
| 12269 | 7774067.06 | 440215.70 | 34.19 | 01C20110616SGR | 34.10 | 0.09 |
| 12270 | 7774080.15 | 440223.48 | 34.12 | 01C20110616SGR | 34.03 | 0.09 |
| 12271 | 7774093.13 | 440231.13 | 34.04 | 01C20110616SGR | 33.97 | 0.07 |
| 12272 | 7774105.07 | 440239.33 | 34.01 | 01C20110616SGR | 33.91 | 0.10 |
| 12301 | 7796642.72 | 438677.30 | 7.73 | 01D20110622SGR | 7.66 | 0.07 |
| 12302 | 7796654.55 | 438666.34 | 8.22 | 01D20110622SGR | 8.15 | 0.07 |
| 12303 | 7796667.52 | 438655.83 | 8.37 | 01D20110622SGR | 8.35 | 0.02 |
| 12304 | 7796680.74 | 438646.36 | 8.43 | 01D20110622SGR | 8.37 | 0.06 |
| 12305 | 7796693.84 | 438636.49 | 8.58 | 01D20110622SGR | 8.52 | 0.06 |
| 12306 | 7796706.74 | 438627.11 | 8.77 | 01D20110622SGR | 8.72 | 0.05 |
| 12307 | 7796718.92 | 438615.94 | 8.89 | 01D20110622SGR | 8.83 | 0.06 |
| 12308 | 7796731.64 | 438606.17 | 9.04 | 01D20110622SGR | 8.97 | 0.07 |
| 12309 | 7796743.51 | 438596.95 | 9.05 | 01D20110622SGR | 8.99 | 0.06 |
| 12310 | 7796755.23 | 438587.67 | 9.05 | 01D20110622SGR | 8.99 | 0.06 |
| 12311 | 7797254.68 | 438067.11 | 10.29 | 01D20110622SGR | 10.23 | 0.06 |
| 12312 | 7797264.24 | 438055.40 | 10.43 | 01D20110622SGR | 10.39 | 0.04 |
| 12313 | 7797274.37 | 438042.60 | 10.57 | 01D20110622SGR | 10.50 | 0.07 |
| 12314 | 7797284.37 | 438030.40 | 10.64 | 01D20110622SGR | 10.57 | 0.07 |
| 12315 | 7797294.01 | 438018.69 | 10.66 | 01D20110622SGR | 10.60 | 0.06 |
| 12316 | 7797303.65 | 438007.08 | 10.62 | 01D20110622SGR | 10.58 | 0.04 |
| 12317 | 7797313.51 | 437995.02 | 10.56 | 01D20110622SGR | 10.50 | 0.06 |
| 12318 | 7797323.74 | 437982.68 | 10.59 | 01D20110622SGR | 10.54 | 0.05 |
| 12319 | 7797333.55 | 437970.84 | 10.70 | 01D20110622SGR | 10.63 | 0.07 |
| 12320 | 7797342.08 | 437958.31 | 10.72 | 01D20110622SGR | 10.65 | 0.07 |
| 12331 | 7796564.50 | 438736.93 | 8.83 | 01D20110622SGR | 8.79 | 0.04 |
| 12332 | 7796551.79 | 438747.09 | 8.80 | 01D20110622SGR | 8.74 | 0.06 |
| 12333 | 7796539.13 | 438757.02 | 8.83 | 01D20110622SGR | 8.76 | 0.06 |
| 12334 | 7796526.29 | 438768.21 | 8.81 | 01D20110622SGR | 8.77 | 0.04 |
| 12335 | 7796513.71 | 438778.67 | 8.86 | 01D20110622SGR | 8.84 | 0.02 |
| 12336 | 7796501.26 | 438786.80 | 9.08 | 01D20110622SGR | 9.05 | 0.03 |
| 12337 | 7796488.45 | 438796.80 | 9.18 | 01D20110622SGR | 9.16 | 0.02 |
| 12338 | 7796476.61 | 438807.62 | 9.10 | 01D20110622SGR | 9.06 | 0.04 |
| 12339 | 7796463.41 | 438816.57 | 9.13 | 01D20110622SGR | 9.07 | 0.05 |
| 12340 | 7796450.95 | 438825.67 | 9.12 | 01D20110622SGR | 9.08 | 0.04 |
| 12341 | 7795888.59 | 439226.60 | 11.76 | 01D20110622SGR | 11.72 | 0.04 |
| 12342 | 7795901.93 | 439218.41 | 11.19 | 01D20110622SGR | 11.15 | 0.04 |
| 12343 | 7795914.77 | 439210.04 | 10.74 | 01D20110622SGR | 10.70 | 0.04 |
| 12344 | 7795927.19 | 439201.35 | 10.79 | 01D20110622SGR | 10.76 | 0.03 |
| 12345 | 7795939.49 | 439192.13 | 10.65 | 01D20110622SGR | 10.62 | 0.03 |
| 12346 | 7795952.14 | 439183.18 | 10.61 | 01D20110622SGR | 10.58 | 0.03 |
| 12347 | 7795964.59 | 439174.35 | 10.59 | 01D20110622SGR | 10.53 | 0.06 |
| 12348 | 7795976.50 | 439164.62 | 10.59 | 01D20110622SGR | 10.54 | 0.05 |
| 12349 | 7795988.62 | 439155.61 | 10.55 | 01D20110622SGR | 10.48 | 0.07 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12350 | 7796000.22 | 439147.66 | 10.38 | 01D20110622SGR | 10.33 | 0.05 |
| 12401 | 7714461.68 | 437848.46 | 160.66 | 03A20110620SGR | 160.65 | 0.01 |
| 12402 | 7714476.59 | 437845.01 | 160.63 | 03A20110620SGR | 160.63 | 0.00 |
| 12403 | 7714491.81 | 437841.96 | 160.57 | 03A20110620SGR | 160.55 | 0.02 |
| 12404 | 7714506.68 | 437838.89 | 160.51 | 03A20110620SGR | 160.50 | 0.01 |
| 12405 | 7714521.73 | 437836.26 | 160.47 | 03A20110620SGR | 160.45 | 0.02 |
| 12406 | 7714536.42 | 437831.06 | 160.43 | 03A20110620SGR | 160.41 | 0.02 |
| 12407 | 7714551.77 | 437827.98 | 160.37 | 03A20110620SGR | 160.35 | 0.02 |
| 12408 | 7714566.95 | 437824.83 | 160.29 | 03A20110620SGR | 160.28 | 0.01 |
| 12409 | 7714582.78 | 437821.86 | 160.26 | 03A20110620SGR | 160.23 | 0.03 |
| 12410 | 7714597.88 | 437818.73 | 160.33 | 03A20110620SGR | 160.31 | 0.02 |
| 12411 | 7714613.49 | 437815.46 | 160.37 | 03A20110620SGR | 160.37 | 0.00 |
| 12412 | 7714628.39 | 437812.90 | 160.44 | 03A20110620SGR | 160.39 | 0.05 |
| 12413 | 7714643.29 | 437810.81 | 160.49 | 03A20110620SGR | 160.48 | 0.01 |
| 12414 | 7714657.44 | 437808.42 | 160.54 | 03A20110620SGR | 160.51 | 0.03 |
| 12415 | 7714672.67 | 437805.13 | 160.57 | 03A20110620SGR | 160.55 | 0.02 |
| 12416 | 7715589.54 | 437617.48 | 157.17 | 03A20110620SGR | 157.17 | 0.00 |
| 12417 | 7715570.22 | 437621.10 | 157.21 | 03A20110620SGR | 157.23 | -0.02 |
| 12418 | 7715554.77 | 437624.41 | 157.33 | 03A20110620SGR | 157.36 | -0.03 |
| 12419 | 7715540.06 | 437627.59 | 157.41 | 03A20110620SGR | 157.42 | -0.01 |
| 12420 | 7715524.25 | 437630.87 | 157.50 | 03A20110620SGR | 157.52 | -0.02 |
| 12421 | 7715509.15 | 437633.93 | 157.62 | 03A20110620SGR | 157.63 | -0.01 |
| 12422 | 7715493.06 | 437637.07 | 157.78 | 03A20110620SGR | 157.79 | -0.01 |
| 12423 | 7715477.23 | 437640.38 | 157.91 | 03A20110620SGR | 157.91 | 0.00 |
| 12424 | 7715461.88 | 437643.77 | 157.96 | 03A20110620SGR | 157.96 | 0.00 |
| 12425 | 7715447.53 | 437646.96 | 157.95 | 03A20110620SGR | 157.95 | 0.00 |
| 12426 | 7715432.72 | 437649.73 | 157.95 | 03A20110620SGR | 157.95 | 0.00 |
| 12427 | 7715418.36 | 437652.71 | 158.01 | 03A20110620SGR | 158.02 | -0.01 |
| 12428 | 7715403.66 | 437655.73 | 158.03 | 03A20110620SGR | 158.03 | 0.00 |
| 12429 | 7715389.84 | 437658.62 | 158.05 | 03A20110620SGR | 158.05 | 0.00 |
| 12430 | 7715375.52 | 437661.46 | 158.11 | 03A20110620SGR | 158.11 | 0.00 |
| 12431 | 7716209.13 | 437490.78 | 154.11 | 03A20110620SGR | 154.16 | -0.05 |
| 12432 | 7716231.45 | 437485.94 | 153.82 | 03A20110620SGR | 153.87 | -0.05 |
| 12433 | 7716248.51 | 437480.38 | 153.74 | 03A20110620SGR | 153.77 | -0.03 |
| 12434 | 7716263.88 | 437477.05 | 153.65 | 03A20110620SGR | 153.70 | -0.05 |
| 12435 | 7716278.45 | 437474.17 | 153.46 | 03A20110620SGR | 153.48 | -0.02 |
| 12436 | 7716293.55 | 437471.14 | 153.28 | 03A20110620SGR | 153.32 | -0.04 |
| 12437 | 7716308.37 | 437468.32 | 153.09 | 03A20110620SGR | 153.14 | -0.05 |
| 12438 | 7716323.02 | 437465.09 | 152.99 | 03A20110620SGR | 153.00 | -0.01 |
| 12439 | 7716337.23 | 437462.25 | 152.86 | 03A20110620SGR | 152.92 | -0.06 |
| 12440 | 7716351.37 | 437459.46 | 152.81 | 03A20110620SGR | 152.86 | -0.05 |
| 12441 | 7716365.30 | 437456.64 | 152.78 | 03A20110620SGR | 152.82 | -0.04 |
| 12442 | 7716379.43 | 437455.51 | 152.73 | 03A20110620SGR | 152.78 | -0.05 |
| 12443 | 7716393.73 | 437452.53 | 152.75 | 03A20110620SGR | 152.79 | -0.04 |
| 12444 | 7716408.34 | 437449.44 | 152.76 | 03A20110620SGR | 152.80 | -0.04 |
| 12445 | 7716422.68 | 437446.58 | 152.80 | 03A20110620SGR | 152.84 | -0.05 |
| 12446 | 7715589.88 | 437615.30 | 157.14 | 03A20110620SGR | 157.15 | -0.01 |
| 12447 | 7715593.44 | 437629.51 | 156.86 | 03A20110620SGR | 156.88 | -0.02 |
| 12448 | 7715597.70 | 437647.44 | 155.99 | 03A20110620SGR | 156.01 | -0.02 |
| 12449 | 7715604.30 | 437665.78 | 155.80 | 03A20110620SGR | 155.81 | -0.01 |
| 12450 | 7715607.92 | 437677.32 | 156.03 | 03A20110620SGR | 156.05 | -0.02 |
| 12451 | 7715612.29 | 437693.37 | 155.97 | 03A20110620SGR | 155.97 | 0.00 |
| 12452 | 7715616.31 | 437709.08 | 155.73 | 03A20110620SGR | 155.75 | -0.02 |
| 12453 | 7715620.86 | 437725.30 | 155.73 | 03A20110620SGR | 155.74 | -0.01 |
| 12454 | 7715625.06 | 437739.72 | 155.65 | 03A20110620SGR | 155.64 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12455 | 7715643.51 | 437800.10 | 151.72 | 03A20110620SGR | 151.69 | 0.03 |
| 12456 | 7715648.16 | 437814.39 | 151.77 | 03A20110620SGR | 151.75 | 0.02 |
| 12457 | 7715652.37 | 437828.30 | 151.69 | 03A20110620SGR | 151.67 | 0.02 |
| 12458 | 7715656.68 | 437843.24 | 151.52 | 03A20110620SGR | 151.50 | 0.02 |
| 12459 | 7715661.51 | 437859.02 | 151.70 | 03A20110620SGR | 151.66 | 0.03 |
| 12460 | 7715665.94 | 437874.86 | 151.91 | 03A20110620SGR | 151.89 | 0.02 |
| 12461 | 7715669.97 | 437888.35 | 152.13 | 03A20110620SGR | 152.10 | 0.03 |
| 12501 | 7711309.18 | 438496.84 | 168.82 | 03B20110621SPR | 168.85 | -0.03 |
| 12502 | 7711294.85 | 438499.81 | 168.89 | 03B20110621SPR | 168.89 | 0.00 |
| 12503 | 7711280.37 | 438502.85 | 168.91 | 03B20110621SPR | 168.93 | -0.02 |
| 12504 | 7711265.72 | 438506.03 | 168.90 | 03B20110621SPR | 168.92 | -0.02 |
| 12505 | 7711250.84 | 438509.20 | 168.94 | 03B20110621SPR | 168.97 | -0.03 |
| 12506 | 7711237.26 | 438511.98 | 169.00 | 03B20110621SPR | 169.02 | -0.02 |
| 12507 | 7711222.48 | 438514.96 | 169.09 | 03B20110621SPR | 169.12 | -0.03 |
| 12508 | 7711207.46 | 438517.65 | 169.14 | 03B20110621SPR | 169.14 | 0.00 |
| 12509 | 7711192.37 | 438520.80 | 169.15 | 03B20110621SPR | 169.17 | -0.02 |
| 12510 | 7711178.12 | 438523.91 | 169.20 | 03B20110621SPR | 169.24 | -0.04 |
| 12511 | 7711163.36 | 438526.84 | 169.26 | 03B20110621SPR | 169.26 | 0.00 |
| 12512 | 7711148.52 | 438529.92 | 169.29 | 03B20110621SPR | 169.28 | 0.01 |
| 12513 | 7711134.08 | 438532.75 | 169.33 | 03B20110621SPR | 169.32 | 0.01 |
| 12514 | 7711119.97 | 438535.59 | 169.37 | 03B20110621SPR | 169.37 | 0.00 |
| 12515 | 7711105.82 | 438538.52 | 169.41 | 03B20110621SPR | 169.42 | -0.01 |
| 12516 | 7711625.80 | 438425.43 | 167.23 | 03B20110621SGR | 167.24 | -0.01 |
| 12517 | 7711627.50 | 438433.72 | 167.28 | 03B20110621SGR | 167.29 | -0.01 |
| 12518 | 7711630.10 | 438448.15 | 166.86 | 03B20110621SGR | 166.89 | -0.03 |
| 12519 | 7711633.75 | 438467.54 | 165.88 | 03B20110621SGR | 165.88 | 0.00 |
| 12520 | 7711636.70 | 438482.78 | 165.83 | 03B20110621SGR | 165.84 | -0.01 |
| 12521 | 7711641.97 | 438503.12 | 165.93 | 03B20110621SGR | 165.94 | -0.01 |
| 12522 | 7711644.94 | 438518.59 | 165.92 | 03B20110621SGR | 165.95 | -0.03 |
| 12523 | 7711647.02 | 438534.92 | 165.99 | 03B20110621SGR | 166.00 | -0.01 |
| 12524 | 7711649.93 | 438549.63 | 166.12 | 03B20110621SGR | 166.12 | 0.00 |
| 12525 | 7711653.04 | 438564.39 | 166.17 | 03B20110621SGR | 166.17 | 0.00 |
| 12526 | 7711655.90 | 438578.88 | 166.14 | 03B20110621SGR | 166.14 | 0.00 |
| 12527 | 7711659.18 | 438594.61 | 166.11 | 03B20110621SGR | 166.10 | 0.00 |
| 12528 | 7711662.41 | 438609.57 | 166.06 | 03B20110621SGR | 166.03 | 0.03 |
| 12529 | 7711665.81 | 438624.14 | 166.03 | 03B20110621SGR | 166.01 | 0.02 |
| 12530 | 7711669.02 | 438638.95 | 165.81 | 03B20110621SGR | 165.80 | 0.01 |
| 12531 | 7711672.46 | 438654.40 | 165.92 | 03B20110621SGR | 165.91 | 0.01 |
| 12532 | 7711675.40 | 438671.11 | 166.05 | 03B20110621SGR | 166.04 | 0.01 |
| 12533 | 7711680.90 | 438694.64 | 165.90 | 03B20110621SGR | 165.90 | 0.00 |
| 12534 | 7711684.54 | 438711.84 | 165.91 | 03B20110621SGR | 165.91 | 0.00 |
| 12535 | 7711687.26 | 438726.62 | 165.87 | 03B20110621SGR | 165.88 | -0.01 |
| 12536 | 7711690.11 | 438742.52 | 165.73 | 03B20110621SGR | 165.72 | 0.01 |
| 12537 | 7711691.87 | 438758.39 | 165.60 | 03B20110621SGR | 165.62 | -0.02 |
| 12538 | 7711700.59 | 438801.29 | 165.82 | 03B20110621SGR | 165.84 | -0.02 |
| 12539 | 7711704.30 | 438818.02 | 165.90 | 03B20110621SGR | 165.90 | 0.00 |
| 12540 | 7711707.42 | 438833.57 | 166.02 | 03B20110621SGR | 166.01 | 0.01 |
| 12541 | 7711710.92 | 438849.55 | 166.21 | 03B20110621SGR | 166.20 | 0.01 |
| 12542 | 7711718.95 | 438888.86 | 165.84 | 03B20110621SGR | 165.82 | 0.02 |
| 12543 | 7711722.11 | 438904.01 | 165.78 | 03B20110621SGR | 165.77 | 0.01 |
| 12544 | 7711728.86 | 438928.91 | 166.16 | 03B20110621SGR | 166.15 | 0.01 |
| 12545 | 7711732.55 | 438953.93 | 166.33 | 03B20110621SGR | 166.32 | 0.01 |
| 12546 | 7711736.02 | 438969.18 | 166.07 | 03B20110621SGR | 166.07 | 0.00 |
| 12547 | 7711739.38 | 438984.46 | 166.08 | 03B20110621SGR | 166.06 | 0.02 |
| 12548 | 7711755.35 | 439048.83 | 165.66 | 03B20110621SGR | 165.66 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12549 | 7711754.82 | 439078.40 | 165.54 | 03B20110621SGR | 165.54 | 0.00 |
| 12550 | 7711759.82 | 439092.99 | 165.28 | 03B20110621SGR | 165.31 | -0.03 |
| 12551 | 7711767.58 | 439109.74 | 165.79 | 03B20110621SGR | 165.79 | 0.00 |
| 12552 | 7711770.55 | 439126.79 | 165.62 | 03B20110621SGR | 165.61 | 0.01 |
| 12553 | 7711773.55 | 439141.95 | 165.67 | 03B20110621SGR | 165.66 | 0.01 |
| 12554 | 7711776.47 | 439157.87 | 165.42 | 03B20110621SGR | 165.42 | 0.00 |
| 12555 | 7711778.50 | 439173.10 | 165.48 | 03B20110621SGR | 165.48 | 0.00 |
| 12556 | 7711781.51 | 439190.11 | 165.51 | 03B20110621SGR | 165.51 | 0.00 |
| 12557 | 7711785.30 | 439206.71 | 165.56 | 03B20110621SGR | 165.55 | 0.00 |
| 12558 | 7711788.93 | 439225.55 | 165.29 | 03B20110621SGR | 165.28 | 0.00 |
| 12559 | 7711792.47 | 439242.89 | 165.21 | 03B20110621SGR | 165.21 | 0.00 |
| 12560 | 7711795.62 | 439257.05 | 165.35 | 03B20110621SGR | 165.36 | -0.01 |
| 12561 | 7711799.60 | 439279.37 | 165.51 | 03B20110621SGR | 165.52 | -0.01 |
| 12562 | 7711805.78 | 439293.30 | 165.21 | 03B20110621SGR | 165.19 | 0.02 |
| 12563 | 7711811.67 | 439335.15 | 165.52 | 03B20110621SGR | 165.50 | 0.02 |
| 12564 | 7711814.80 | 439350.91 | 165.34 | 03B20110621SGR | 165.35 | -0.01 |
| 12565 | 7711817.68 | 439366.14 | 164.78 | 03B20110621SGR | 164.77 | 0.01 |
| 12566 | 7711820.78 | 439383.52 | 164.43 | 03B20110621SGR | 164.40 | 0.03 |
| 12567 | 7711823.29 | 439396.69 | 163.69 | 03B20110621SGR | 163.69 | 0.00 |
| 12568 | 7711826.39 | 439410.60 | 162.68 | 03B20110621SGR | 162.66 | 0.02 |
| 12569 | 7711831.03 | 439433.57 | 161.27 | 03B20110621SGR | 161.25 | 0.02 |
| 12570 | 7711834.87 | 439449.27 | 161.39 | 03B20110621SGR | 161.36 | 0.03 |
| 12571 | 7711844.03 | 439495.13 | 161.08 | 03B20110621SGR | 161.08 | 0.00 |
| 12572 | 7711847.01 | 439512.21 | 160.62 | 03B20110621SGR | 160.62 | 0.00 |
| 12573 | 7711850.12 | 439526.67 | 160.65 | 03B20110621SGR | 160.63 | 0.02 |
| 12574 | 7711853.27 | 439541.20 | 160.82 | 03B20110621SGR | 160.81 | 0.01 |
| 12575 | 7711855.99 | 439555.99 | 160.93 | 03B20110621SGR | 160.94 | -0.01 |
| 12576 | 7711859.11 | 439570.21 | 160.96 | 03B20110621SGR | 160.96 | 0.00 |
| 12577 | 7711862.16 | 439584.26 | 161.41 | 03B20110621SGR | 161.39 | 0.02 |
| 12578 | 7711869.72 | 439620.69 | 161.03 | 03B20110621SGR | 161.01 | 0.02 |
| 12579 | 7711872.61 | 439635.09 | 161.03 | 03B20110621SGR | 161.00 | 0.03 |
| 12580 | 7711875.58 | 439649.91 | 160.98 | 03B20110621SGR | 160.96 | 0.02 |
| 12581 | 7711878.82 | 439664.80 | 160.93 | 03B20110621SGR | 160.91 | 0.02 |
| 12582 | 7711881.63 | 439679.52 | 160.98 | 03B20110621SGR | 160.95 | 0.03 |
| 12583 | 7711885.32 | 439694.44 | 161.09 | 03B20110621SGR | 161.06 | 0.03 |
| 12584 | 7711887.95 | 439703.84 | 161.13 | 03B20110621SGR | 161.11 | 0.02 |
| 12585 | 7711890.40 | 439719.22 | 161.03 | 03B20110621SGR | 161.01 | 0.02 |
| 12586 | 7711892.97 | 439733.86 | 161.09 | 03B20110621SGR | 161.08 | 0.01 |
| 12587 | 7711898.83 | 439753.28 | 161.53 | 03B20110621SGR | 161.49 | 0.04 |
| 12588 | 7711902.38 | 439771.10 | 161.58 | 03B20110621SGR | 161.55 | 0.03 |
| 12601 | 7559404.60 | 396913.63 | 1447.39 | 07C20110610SGR | 1447.41 | -0.02 |
| 12602 | 7559409.37 | 396902.15 | 1447.41 | 07C20110610SGR | 1447.45 | -0.04 |
| 12603 | 7559424.37 | 396890.73 | 1446.96 | 07C20110610SGR | 1446.98 | -0.02 |
| 12604 | 7559440.56 | 396897.52 | 1446.59 | 07C20110610SGR | 1446.59 | 0.00 |
| 12605 | 7559455.88 | 396901.92 | 1446.06 | 07C20110610SGR | 1446.06 | 0.00 |
| 12606 | 7559472.99 | 396905.18 | 1445.19 | 07C20110610SGR | 1445.22 | -0.03 |
| 12607 | 7559489.46 | 396907.20 | 1444.16 | 07C20110610SGR | 1444.24 | -0.08 |
| 12608 | 7559506.31 | 396907.54 | 1443.07 | 07C20110610SGR | 1443.08 | -0.01 |
| 12609 | 7559522.75 | 396908.26 | 1441.91 | 07C20110610SGR | 1441.96 | -0.05 |
| 12610 | 7559538.14 | 396905.57 | 1440.53 | 07C20110610SGR | 1440.54 | -0.01 |
| 12611 | 7559553.23 | 396904.27 | 1439.15 | 07C20110610SGR | 1439.17 | -0.02 |
| 12612 | 7559567.82 | 396901.59 | 1437.69 | 07C20110610SGR | 1437.71 | -0.02 |
| 12613 | 7559583.43 | 396900.63 | 1436.23 | 07C20110610SGR | 1436.25 | -0.02 |
| 12614 | 7559597.41 | 396897.41 | 1434.84 | 07C20110610SGR | 1434.82 | 0.02 |
| 12615 | 7559612.62 | 396895.49 | 1433.25 | 07C20110610SGR | 1433.28 | -0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12616 | 7559627.67 | 396893.68 | 1431.76 | 07C20110610SGR | 1431.78 | -0.02 |
| 12617 | 7559642.04 | 396892.83 | 1430.42 | 07C20110610SGR | 1430.40 | 0.02 |
| 12618 | 7559656.74 | 396890.97 | 1428.95 | 07C20110610SGR | 1428.99 | -0.04 |
| 12619 | 7559676.81 | 396888.52 | 1427.02 | 07C20110610SGR | 1427.04 | -0.02 |
| 12620 | 7559692.85 | 396884.33 | 1425.51 | 07C20110610SGR | 1425.55 | -0.04 |
| 12621 | 7559706.68 | 396882.26 | 1424.24 | 07C20110610SGR | 1424.26 | -0.02 |
| 12622 | 7559721.63 | 396880.44 | 1422.89 | 07C20110610SGR | 1422.93 | -0.04 |
| 12623 | 7559751.03 | 396877.29 | 1420.24 | 07C20110610SGR | 1420.25 | -0.01 |
| 12624 | 7559780.57 | 396876.84 | 1417.36 | 07C20110610SGR | 1417.40 | -0.04 |
| 12625 | 7559809.52 | 396878.30 | 1414.42 | 07C20110610SGR | 1414.43 | -0.01 |
| 12626 | 7559838.68 | 396882.70 | 1411.56 | 07C20110610SGR | 1411.59 | -0.03 |
| 12627 | 7559867.41 | 396890.00 | 1408.77 | 07C20110610SGR | 1408.79 | -0.02 |
| 12628 | 7559895.45 | 396900.95 | 1405.97 | 07C20110610SGR | 1405.96 | 0.01 |
| 12629 | 7559924.45 | 396915.89 | 1402.68 | 07C20110610SGR | 1402.73 | -0.05 |
| 12630 | 7559949.32 | 396931.87 | 1399.89 | 07C20110610SGR | 1399.89 | 0.00 |
| 12631 | 7559555.62 | 396923.57 | 1439.18 | 07C20110610SGR | 1439.19 | -0.01 |
| 12632 | 7559523.95 | 396926.27 | 1442.52 | 07C20110610SGR | 1442.54 | -0.02 |
| 12633 | 7559492.08 | 396926.65 | 1444.86 | 07C20110610SGR | 1444.85 | 0.01 |
| 12634 | 7559468.93 | 396927.94 | 1445.80 | 07C20110610SGR | 1445.84 | -0.04 |
| 12635 | 7559437.06 | 396922.30 | 1446.44 | 07C20110610SGR | 1446.44 | 0.00 |
| 12636 | 7559409.85 | 396912.22 | 1447.43 | 07C20110610SGR | 1447.45 | -0.02 |
| 12637 | 7559379.06 | 396908.22 | 1447.62 | 07C20110610SGR | 1447.61 | 0.01 |
| 12638 | 7559350.34 | 396903.63 | 1447.34 | 07C20110610SGR | 1447.35 | -0.01 |
| 12639 | 7559348.25 | 396874.44 | 1446.04 | 07C20110610SGR | 1446.04 | 0.00 |
| 12640 | 7559339.06 | 396845.99 | 1444.59 | 07C20110610SGR | 1444.60 | -0.01 |
| 12641 | 7559331.60 | 396816.48 | 1443.34 | 07C20110610SGR | 1443.35 | -0.01 |
| 12642 | 7559328.58 | 396788.37 | 1442.19 | 07C20110610SGR | 1442.18 | 0.01 |
| 12643 | 7559318.46 | 396761.96 | 1440.25 | 07C20110610SGR | 1440.25 | 0.00 |
| 12644 | 7559309.06 | 396734.28 | 1437.82 | 07C20110610SGR | 1437.84 | -0.02 |
| 12645 | 7559297.86 | 396705.54 | 1434.90 | 07C20110610SGR | 1434.94 | -0.04 |
| 12646 | 7559286.30 | 396675.01 | 1431.58 | 07C20110610SGR | 1431.60 | -0.02 |
| 12647 | 7559274.24 | 396645.16 | 1428.26 | 07C20110610SGR | 1428.31 | -0.05 |
| 12648 | 7559263.12 | 396617.05 | 1425.04 | 07C20110610SGR | 1425.06 | -0.02 |
| 12649 | 7559251.78 | 396590.25 | 1422.28 | 07C20110610SGR | 1422.31 | -0.03 |
| 12650 | 7559240.48 | 396562.59 | 1419.59 | 07C20110610SGR | 1419.61 | -0.02 |
| 12651 | 7559228.92 | 396535.09 | 1416.62 | 07C20110610SGR | 1416.63 | -0.01 |
| 12652 | 7559217.79 | 396507.39 | 1413.47 | 07C20110610SGR | 1413.52 | -0.06 |
| 12653 | 7559227.67 | 396623.32 | 1423.14 | 07C20110610SGR | 1423.13 | 0.00 |
| 12654 | 7559232.20 | 396664.52 | 1424.50 | 07C20110610SGR | 1424.50 | 0.00 |
| 12655 | 7559235.89 | 396697.80 | 1425.96 | 07C20110610SGR | 1425.97 | -0.01 |
| 12656 | 7559249.21 | 396730.20 | 1425.07 | 07C20110610SGR | 1425.09 | -0.02 |
| 12657 | 7559241.19 | 396808.10 | 1430.06 | 07C20110610SGR | 1430.06 | 0.00 |
| 12658 | 7559213.34 | 396830.66 | 1431.14 | 07C20110610SGR | 1431.13 | 0.01 |
| 12659 | 7559238.31 | 396869.93 | 1430.42 | 07C20110610SGR | 1430.42 | 0.00 |
| 12660 | 7559274.19 | 396894.92 | 1434.58 | 07C20110610SGR | 1434.58 | 0.00 |
| 12661 | 7559306.02 | 396908.06 | 1440.91 | 07C20110610SGR | 1440.90 | 0.00 |
| 12662 | 7559339.87 | 396930.52 | 1447.37 | 07C20110610SGR | 1447.37 | 0.00 |
| 12663 | 7559344.97 | 396952.44 | 1448.51 | 07C20110610SGR | 1448.52 | -0.01 |
| 12664 | 7559948.56 | 397451.36 | 1344.36 | 07C20110610SGR | 1344.36 | 0.00 |
| 12665 | 7559931.67 | 397450.78 | 1345.17 | 07C20110610SGR | 1345.20 | -0.03 |
| 12666 | 7559905.60 | 397448.25 | 1346.64 | 07C20110610SGR | 1346.65 | -0.01 |
| 12667 | 7559877.98 | 397450.18 | 1347.06 | 07C20110610SGR | 1347.07 | -0.01 |
| 12668 | 7559852.46 | 397446.01 | 1348.19 | 07C20110610SGR | 1348.19 | 0.00 |
| 12669 | 7559831.32 | 397462.42 | 1346.99 | 07C20110610SGR | 1347.00 | -0.01 |
| 12670 | 7559813.01 | 397495.20 | 1346.84 | 07C20110610SGR | 1346.84 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12671 | 7559809.47 | 397524.48 | 1347.13 | 07C20110610SGR | 1347.12 | 0.01 |
| 12672 | 7559811.48 | 397555.16 | 1347.01 | 07C20110610SGR | 1347.00 | 0.01 |
| 12673 | 7559815.39 | 397591.59 | 1346.55 | 07C20110610SGR | 1346.54 | 0.01 |
| 12674 | 7559821.51 | 397623.67 | 1345.83 | 07C20110610SGR | 1345.83 | 0.00 |
| 12675 | 7559971.49 | 397450.69 | 1344.02 | 07C20110610SGR | 1344.04 | -0.02 |
| 12676 | 7560000.28 | 397435.34 | 1345.29 | 07C20110610SGR | 1345.30 | -0.01 |
| 12677 | 7559996.02 | 397451.24 | 1343.92 | 07C20110610SGR | 1343.94 | -0.02 |
| 12678 | 7559995.82 | 397466.19 | 1342.45 | 07C20110610SGR | 1342.47 | -0.02 |
| 12679 | 7559999.11 | 397484.50 | 1340.91 | 07C20110610SGR | 1340.93 | -0.02 |
| 12680 | 7559994.67 | 397501.95 | 1339.21 | 07C20110610SGR | 1339.22 | -0.01 |
| 12681 | 7559994.13 | 397516.46 | 1338.05 | 07C20110610SGR | 1338.05 | 0.00 |
| 12682 | 7559995.17 | 397529.96 | 1336.54 | 07C20110610SGR | 1336.55 | -0.01 |
| 12683 | 7560021.26 | 397926.11 | 1295.76 | 07C20110610SGR | 1295.77 | -0.01 |
| 12684 | 7560016.12 | 397938.48 | 1294.73 | 07C20110610SGR | 1294.72 | 0.01 |
| 12685 | 7560010.26 | 397952.73 | 1293.42 | 07C20110610SGR | 1293.40 | 0.01 |
| 12686 | 7559997.76 | 397961.09 | 1292.07 | 07C20110610SGR | 1292.06 | 0.01 |
| 12687 | 7560004.76 | 397979.86 | 1291.28 | 07C20110610SGR | 1291.27 | 0.01 |
| 12688 | 7559993.52 | 397989.62 | 1289.98 | 07C20110610SGR | 1289.96 | 0.02 |
| 12689 | 7559981.08 | 397999.15 | 1288.58 | 07C20110610SGR | 1288.58 | 0.00 |
| 12690 | 7559038.44 | 395983.01 | 1357.25 | 07C20110610SGR | 1357.30 | -0.05 |
| 12691 | 7559053.46 | 395990.01 | 1358.68 | 07C20110610SGR | 1358.68 | -0.01 |
| 12692 | 7559062.68 | 396002.37 | 1359.97 | 07C20110610SGR | 1360.00 | -0.03 |
| 12693 | 7559069.75 | 396016.17 | 1361.40 | 07C20110610SGR | 1361.43 | -0.03 |
| 12694 | 7559073.06 | 396028.62 | 1362.75 | 07C20110610SGR | 1362.79 | -0.04 |
| 12695 | 7559082.63 | 396040.95 | 1364.26 | 07C20110610SGR | 1364.26 | 0.00 |
| 12696 | 7559089.03 | 396053.32 | 1365.57 | 07C20110610SGR | 1365.59 | -0.02 |
| 12697 | 7559093.73 | 396066.63 | 1366.86 | 07C20110610SGR | 1366.87 | -0.01 |
| 12698 | 7559098.38 | 396080.80 | 1368.14 | 07C20110610SGR | 1368.18 | -0.04 |
| 12699 | 7559104.37 | 396093.59 | 1369.45 | 07C20110610SGR | 1369.49 | -0.04 |
| 12700 | 7558852.53 | 395456.30 | 1300.42 | 07C20110610SGR | 1300.37 | 0.05 |
| 12701 | 7558842.44 | 395443.90 | 1298.97 | 07C20110610SGR | 1298.92 | 0.05 |
| 12702 | 7558833.18 | 395431.97 | 1297.64 | 07C20110610SGR | 1297.58 | 0.06 |
| 12703 | 7558821.34 | 395419.40 | 1296.05 | 07C20110610SGR | 1296.00 | 0.05 |
| 12704 | 7558807.08 | 395409.40 | 1294.14 | 07C20110610SGR | 1294.08 | 0.06 |
| 12705 | 7558796.53 | 395396.69 | 1292.64 | 07C20110610SGR | 1292.60 | 0.04 |
| 12706 | 7558785.31 | 395387.42 | 1291.21 | 07C20110610SGR | 1291.19 | 0.02 |
| 12707 | 7558776.64 | 395378.84 | 1290.03 | 07C20110610SGR | 1290.02 | 0.01 |
| 12708 | 7558765.95 | 395369.29 | 1288.64 | 07C20110610SGR | 1288.64 | 0.00 |
| 12709 | 7558755.33 | 395359.81 | 1287.22 | 07C20110610SGR | 1287.20 | 0.02 |
| 12710 | 7558333.22 | 394856.66 | 1220.58 | 07C20110610SGR | 1220.62 | -0.04 |
| 12711 | 7558339.57 | 394870.00 | 1222.22 | 07C20110610SGR | 1222.25 | -0.03 |
| 12712 | 7558347.17 | 394883.13 | 1223.94 | 07C20110610SGR | 1223.93 | 0.01 |
| 12713 | 7558355.95 | 394896.16 | 1225.74 | 07C20110610SGR | 1225.73 | 0.01 |
| 12714 | 7558364.64 | 394907.47 | 1227.26 | 07C20110610SGR | 1227.25 | 0.01 |
| 12715 | 7558384.44 | 394918.35 | 1229.30 | 07C20110610SGR | 1229.31 | -0.01 |
| 12716 | 7558395.45 | 394927.95 | 1230.73 | 07C20110610SGR | 1230.73 | 0.00 |
| 12717 | 7558406.59 | 394937.29 | 1232.14 | 07C20110610SGR | 1232.10 | 0.04 |
| 12718 | 7558416.77 | 394950.86 | 1233.85 | 07C20110610SGR | 1233.84 | 0.01 |
| 12719 | 7558428.75 | 394961.65 | 1235.38 | 07C20110610SGR | 1235.38 | 0.00 |
| 12720 | 7558412.20 | 394955.03 | 1233.62 | 07C20110610SGR | 1233.60 | 0.02 |
| 12721 | 7558399.11 | 394946.79 | 1232.13 | 07C20110610SGR | 1232.15 | -0.02 |
| 12722 | 7557934.80 | 394329.07 | 1113.52 | 07C20110610SGR | 1113.52 | 0.00 |
| 12725 | 7550871.23 | 390661.28 | 991.03 | 07C201106107C1SGR | 991.00 | 0.03 |
| 12725 | 7550871.23 | 390661.28 | 991.03 | 07C201106107C1SGR | 991.00 | 0.03 |
| 12726 | 7553391.69 | 392062.62 | 983.56 | 07C201106107C2SGR | 983.57 | -0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12726 | 7553391.69 | 392062.62 | 983.56 | 07C201106107C2SGR | 983.57 | -0.01 |
| 12727 | 7554872.95 | 393595.86 | 1006.62 | 07C201106107C3SGR | 1006.61 | 0.01 |
| 12727 | 7554872.95 | 393595.86 | 1006.62 | 07C201106107C3SGR | 1006.61 | 0.01 |
| 12728 | 7555440.83 | 393938.34 | 1019.41 | 07C201106107C4SGR | 1019.38 | 0.03 |
| 12728 | 7555440.83 | 393938.34 | 1019.41 | 07C201106107C4SGR | 1019.38 | 0.03 |
| 12729 | 7556786.16 | 394774.44 | 1054.18 | 07C201106107C5SGR | 1054.16 | 0.02 |
| 12730 | 7557593.95 | 394489.22 | 1080.74 | 07C201106107C6SGR | 1080.72 | 0.02 |
| 12801 | 7540294.28 | 383681.01 | 623.24 | 08A20110609SGR | 623.27 | -0.03 |
| 12801 | 7540294.28 | 383681.01 | 623.24 | 08A20110609SGR | 623.27 | -0.03 |
| 12802 | 7540307.66 | 383671.03 | 624.19 | 08A20110609SGR | 624.19 | -0.01 |
| 12802 | 7540307.66 | 383671.03 | 624.19 | 08A20110609SGR | 624.19 | -0.01 |
| 12803 | 7540316.23 | 383660.69 | 623.49 | 08A20110609SGR | 623.53 | -0.04 |
| 12803 | 7540316.23 | 383660.69 | 623.49 | 08A20110609SGR | 623.53 | -0.04 |
| 12804 | 7540324.22 | 383636.34 | 622.62 | 08A20110609SGR | 622.60 | 0.01 |
| 12804 | 7540324.22 | 383636.34 | 622.62 | 08A20110609SGR | 622.60 | 0.01 |
| 12805 | 7540332.63 | 383616.88 | 622.64 | 08A20110609SGR | 622.66 | -0.02 |
| 12805 | 7540332.63 | 383616.88 | 622.64 | 08A20110609SGR | 622.66 | -0.02 |
| 12806 | 7540339.86 | 383602.73 | 622.65 | 08A20110609SGR | 622.68 | -0.03 |
| 12806 | 7540339.86 | 383602.73 | 622.65 | 08A20110609SGR | 622.68 | -0.03 |
| 12807 | 7540347.94 | 383591.92 | 622.80 | 08A20110609SGR | 622.79 | 0.01 |
| 12807 | 7540347.94 | 383591.92 | 622.80 | 08A20110609SGR | 622.79 | 0.01 |
| 12808 | 7540364.61 | 383575.25 | 622.88 | 08A20110609SGR | 622.87 | 0.01 |
| 12808 | 7540364.61 | 383575.25 | 622.88 | 08A20110609SGR | 622.87 | 0.01 |
| 12809 | 7540337.15 | 383557.58 | 622.68 | 08A20110609SGR | 622.72 | -0.04 |
| 12809 | 7540337.15 | 383557.58 | 622.68 | 08A20110609SGR | 622.72 | -0.04 |
| 12810 | 7540310.19 | 383545.89 | 622.43 | 08A20110609SGR | 622.44 | -0.02 |
| 12810 | 7540310.19 | 383545.89 | 622.43 | 08A20110609SGR | 622.44 | -0.02 |
| 12811 | 7540273.71 | 383536.00 | 621.94 | 08A20110609SGR | 621.97 | -0.03 |
| 12811 | 7540273.71 | 383536.00 | 621.94 | 08A20110609SGR | 621.97 | -0.03 |
| 12812 | 7540242.96 | 383522.14 | 621.52 | 08A20110609SGR | 621.57 | -0.05 |
| 12812 | 7540242.96 | 383522.14 | 621.52 | 08A20110609SGR | 621.57 | -0.05 |
| 12813 | 7540206.29 | 383508.83 | 621.06 | 08A20110609SGR | 621.09 | -0.03 |
| 12813 | 7540206.29 | 383508.83 | 621.06 | 08A20110609SGR | 621.09 | -0.03 |
| 12814 | 7540171.43 | 383482.94 | 620.55 | 08A20110609SGR | 620.57 | -0.02 |
| 12814 | 7540171.43 | 383482.94 | 620.55 | 08A20110609SGR | 620.57 | -0.02 |
| 12815 | 7540147.70 | 383455.19 | 620.05 | 08A20110609SGR | 620.06 | -0.01 |
| 12815 | 7540147.70 | 383455.19 | 620.05 | 08A20110609SGR | 620.06 | -0.01 |
| 12816 | 7540135.63 | 383437.31 | 619.99 | 08A20110609SGR | 619.99 | 0.00 |
| 12816 | 7540135.63 | 383437.31 | 619.99 | 08A20110609SGR | 619.99 | 0.00 |
| 12817 | 7540139.24 | 383415.99 | 619.86 | 08A20110609SGR | 619.87 | -0.01 |
| 12817 | 7540139.24 | 383415.99 | 619.86 | 08A20110609SGR | 619.87 | -0.01 |
| 12818 | 7540131.82 | 383369.75 | 619.65 | 08A20110609SGR | 619.68 | -0.03 |
| 12818 | 7540131.82 | 383369.75 | 619.65 | 08A20110609SGR | 619.68 | -0.03 |
| 12819 | 7540091.27 | 383381.20 | 619.19 | 08A20110609SGR | 619.24 | -0.05 |
| 12819 | 7540091.27 | 383381.20 | 619.19 | 08A20110609SGR | 619.24 | -0.05 |
| 12820 | 7540037.63 | 383429.33 | 618.72 | 08A20110609SGR | 618.75 | -0.03 |
| 12820 | 7540037.63 | 383429.33 | 618.72 | 08A20110609SGR | 618.75 | -0.03 |
| 12821 | 7539994.93 | 383452.45 | 618.59 | 08A20110609SGR | 618.61 | -0.02 |
| 12821 | 7539994.93 | 383452.45 | 618.59 | 08A20110609SGR | 618.61 | -0.02 |
| 12822 | 7539960.46 | 383453.52 | 617.98 | 08A20110609SGR | 617.94 | 0.04 |
| 12822 | 7539960.46 | 383453.52 | 617.98 | 08A20110609SGR | 617.94 | 0.04 |
| 12823 | 7539923.50 | 383461.53 | 617.73 | 08A20110609SGR | 617.76 | -0.03 |
| 12823 | 7539923.50 | 383461.53 | 617.73 | 08A20110609SGR | 617.76 | -0.03 |
| 12824 | 7539914.37 | 383480.39 | 619.57 | 08A20110609SGR | 619.61 | -0.04 |
| 12824 | 7539914.37 | 383480.39 | 619.57 | 08A20110609SGR | 619.61 | -0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12825 | 7539939.72 | 383501.10 | 620.06 | 08A20110609SGR | 620.09 | -0.03 |
| 12825 | 7539939.72 | 383501.10 | 620.06 | 08A20110609SGR | 620.09 | -0.03 |
| 12826 | 7539965.80 | 383517.42 | 620.32 | 08A20110609SGR | 620.32 | 0.00 |
| 12826 | 7539965.80 | 383517.42 | 620.32 | 08A20110609SGR | 620.32 | 0.00 |
| 12827 | 7539995.22 | 383536.55 | 620.58 | 08A20110609SGR | 620.61 | -0.03 |
| 12827 | 7539995.22 | 383536.55 | 620.58 | 08A20110609SGR | 620.61 | -0.03 |
| 12828 | 7540021.78 | 383552.28 | 620.83 | 08A20110609SGR | 620.84 | -0.01 |
| 12828 | 7540021.78 | 383552.28 | 620.83 | 08A20110609SGR | 620.84 | -0.01 |
| 12829 | 7540047.66 | 383566.39 | 621.13 | 08A20110609SGR | 621.18 | -0.05 |
| 12829 | 7540047.66 | 383566.39 | 621.13 | 08A20110609SGR | 621.18 | -0.05 |
| 12830 | 7540074.31 | 383580.81 | 621.49 | 08A20110609SGR | 621.54 | -0.05 |
| 12830 | 7540074.31 | 383580.81 | 621.49 | 08A20110609SGR | 621.54 | -0.05 |
| 12831 | 7540102.24 | 383594.72 | 621.86 | 08A20110609SGR | 621.89 | -0.03 |
| 12831 | 7540102.24 | 383594.72 | 621.86 | 08A20110609SGR | 621.89 | -0.03 |
| 12832 | 7540131.05 | 383609.25 | 622.24 | 08A20110609SGR | 622.29 | -0.05 |
| 12832 | 7540131.05 | 383609.25 | 622.24 | 08A20110609SGR | 622.29 | -0.05 |
| 12833 | 7540160.54 | 383617.20 | 622.42 | 08A20110609SGR | 622.38 | 0.04 |
| 12833 | 7540160.54 | 383617.20 | 622.42 | 08A20110609SGR | 622.38 | 0.04 |
| 12834 | 7540188.52 | 383627.44 | 622.78 | 08A20110609SGR | 622.79 | -0.01 |
| 12834 | 7540188.52 | 383627.44 | 622.78 | 08A20110609SGR | 622.79 | -0.01 |
| 12835 | 7540216.88 | 383638.95 | 623.20 | 08A20110609SGR | 623.19 | 0.01 |
| 12835 | 7540216.88 | 383638.95 | 623.20 | 08A20110609SGR | 623.19 | 0.01 |
| 12836 | 7540246.75 | 383649.05 | 623.55 | 08A20110609SGR | 623.57 | -0.02 |
| 12836 | 7540246.75 | 383649.05 | 623.55 | 08A20110609SGR | 623.57 | -0.02 |
| 12837 | 7540253.83 | 383666.95 | 622.77 | 08A20110609SGR | 622.76 | 0.01 |
| 12837 | 7540253.83 | 383666.95 | 622.77 | 08A20110609SGR | 622.76 | 0.01 |
| 12838 | 7541095.81 | 383957.43 | 632.46 | 08A20110609SGR | 632.37 | 0.09 |
| 12838 | 7541095.81 | 383957.43 | 632.46 | 08A20110609SGR | 632.37 | 0.09 |
| 12839 | 7541111.78 | 383961.26 | 632.69 | 08A20110609SGR | 632.64 | 0.04 |
| 12839 | 7541111.78 | 383961.26 | 632.69 | 08A20110609SGR | 632.64 | 0.04 |
| 12840 | 7541127.17 | 383962.04 | 632.81 | 08A20110609SGR | 632.78 | 0.03 |
| 12840 | 7541127.17 | 383962.04 | 632.81 | 08A20110609SGR | 632.78 | 0.03 |
| 12841 | 7541141.97 | 383965.38 | 633.07 | 08A20110609SGR | 633.03 | 0.04 |
| 12841 | 7541141.97 | 383965.38 | 633.07 | 08A20110609SGR | 633.03 | 0.04 |
| 12842 | 7541156.88 | 383966.94 | 633.20 | 08A20110609SGR | 633.12 | 0.08 |
| 12842 | 7541156.88 | 383966.94 | 633.20 | 08A20110609SGR | 633.12 | 0.08 |
| 12843 | 7541173.33 | 383969.39 | 633.37 | 08A20110609SGR | 633.32 | 0.05 |
| 12843 | 7541173.33 | 383969.39 | 633.37 | 08A20110609SGR | 633.32 | 0.05 |
| 12844 | 7541189.11 | 383971.81 | 633.54 | 08A20110609SGR | 633.51 | 0.03 |
| 12844 | 7541189.11 | 383971.81 | 633.54 | 08A20110609SGR | 633.51 | 0.03 |
| 12845 | 7542006.96 | 384090.61 | 658.19 | 08A20110609SGR | 658.15 | 0.04 |
| 12845 | 7542006.96 | 384090.61 | 658.19 | 08A20110609SGR | 658.15 | 0.04 |
| 12846 | 7542022.18 | 384095.33 | 658.29 | 08A20110609SGR | 658.24 | 0.05 |
| 12846 | 7542022.18 | 384095.33 | 658.29 | 08A20110609SGR | 658.24 | 0.05 |
| 12847 | 7542036.90 | 384095.93 | 658.03 | 08A20110609SGR | 657.98 | 0.05 |
| 12847 | 7542036.90 | 384095.93 | 658.03 | 08A20110609SGR | 657.98 | 0.05 |
| 12848 | 7542050.37 | 384098.07 | 657.72 | 08A20110609SGR | 657.66 | 0.06 |
| 12848 | 7542050.37 | 384098.07 | 657.72 | 08A20110609SGR | 657.66 | 0.06 |
| 12849 | 7542064.25 | 384099.53 | 657.38 | 08A20110609SGR | 657.32 | 0.06 |
| 12849 | 7542064.25 | 384099.53 | 657.38 | 08A20110609SGR | 657.32 | 0.06 |
| 12850 | 7542078.96 | 384102.20 | 657.02 | 08A20110609SGR | 656.93 | 0.09 |
| 12850 | 7542078.96 | 384102.20 | 657.02 | 08A20110609SGR | 656.93 | 0.09 |
| 12851 | 7542093.63 | 384106.00 | 656.72 | 08A20110609SGR | 656.64 | 0.08 |
| 12851 | 7542093.63 | 384106.00 | 656.72 | 08A20110609SGR | 656.64 | 0.08 |
| 12852 | 7542766.53 | 384246.35 | 650.40 | 08A20110609SGR | 650.39 | 0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12852 | 7542766.53 | 384246.35 | 650.40 | 08A20110609SGR | 650.39 | 0.01 |
| 12853 | 7542780.21 | 384248.53 | 650.52 | 08A20110609SGR | 650.49 | 0.03 |
| 12853 | 7542780.21 | 384248.53 | 650.52 | 08A20110609SGR | 650.49 | 0.03 |
| 12854 | 7542797.71 | 384251.07 | 650.67 | 08A20110609SGR | 650.63 | 0.04 |
| 12854 | 7542797.71 | 384251.07 | 650.67 | 08A20110609SGR | 650.63 | 0.04 |
| 12855 | 7542811.22 | 384254.10 | 650.82 | 08A20110609SGR | 650.78 | 0.04 |
| 12855 | 7542811.22 | 384254.10 | 650.82 | 08A20110609SGR | 650.78 | 0.04 |
| 12856 | 7542824.97 | 384256.76 | 650.95 | 08A20110609SGR | 650.92 | 0.03 |
| 12856 | 7542824.97 | 384256.76 | 650.95 | 08A20110609SGR | 650.92 | 0.03 |
| 12857 | 7542839.35 | 384259.21 | 651.06 | 08A20110609SGR | 651.07 | -0.01 |
| 12857 | 7542839.35 | 384259.21 | 651.06 | 08A20110609SGR | 651.07 | -0.01 |
| 12858 | 7542853.44 | 384263.09 | 651.26 | 08A20110609SGR | 651.23 | 0.02 |
| 12858 | 7542853.44 | 384263.09 | 651.26 | 08A20110609SGR | 651.23 | 0.02 |
| 12859 | 7542678.42 | 384246.28 | 648.56 | 08A20110609SGR | 648.51 | 0.05 |
| 12859 | 7542678.42 | 384246.28 | 648.56 | 08A20110609SGR | 648.51 | 0.05 |
| 12860 | 7542649.55 | 384244.30 | 648.02 | 08A20110609SGR | 647.99 | 0.03 |
| 12860 | 7542649.55 | 384244.30 | 648.02 | 08A20110609SGR | 647.99 | 0.03 |
| 12861 | 7542608.43 | 384229.40 | 648.94 | 08A20110609SGR | 648.90 | 0.04 |
| 12861 | 7542608.43 | 384229.40 | 648.94 | 08A20110609SGR | 648.90 | 0.04 |
| 12862 | 7542541.89 | 384220.61 | 648.55 | 08A20110609SGR | 648.49 | 0.06 |
| 12862 | 7542541.89 | 384220.61 | 648.55 | 08A20110609SGR | 648.49 | 0.06 |
| 12863 | 7542484.26 | 384220.96 | 648.04 | 08A20110609SGR | 647.99 | 0.05 |
| 12863 | 7542484.26 | 384220.96 | 648.04 | 08A20110609SGR | 647.99 | 0.05 |
| 12864 | 7542478.57 | 384187.02 | 646.87 | 08A20110609SGR | 646.83 | 0.04 |
| 12864 | 7542478.57 | 384187.02 | 646.87 | 08A20110609SGR | 646.83 | 0.04 |
| 12865 | 7542482.01 | 384160.36 | 646.22 | 08A20110609SGR | 646.17 | 0.05 |
| 12865 | 7542482.01 | 384160.36 | 646.22 | 08A20110609SGR | 646.17 | 0.05 |
| 12866 | 7542492.64 | 384137.09 | 645.87 | 08A20110609SGR | 645.84 | 0.03 |
| 12866 | 7542492.64 | 384137.09 | 645.87 | 08A20110609SGR | 645.84 | 0.03 |
| 12867 | 7542498.29 | 384105.36 | 645.99 | 08A20110609SGR | 645.95 | 0.04 |
| 12867 | 7542498.29 | 384105.36 | 645.99 | 08A20110609SGR | 645.95 | 0.04 |
| 12868 | 7542548.81 | 384139.42 | 646.56 | 08A20110609SGR | 646.57 | -0.01 |
| 12868 | 7542548.81 | 384139.42 | 646.56 | 08A20110609SGR | 646.57 | -0.01 |
| 12869 | 7542569.29 | 384141.78 | 646.78 | 08A20110609SGR | 646.69 | 0.09 |
| 12869 | 7542569.29 | 384141.78 | 646.78 | 08A20110609SGR | 646.69 | 0.09 |
| 12870 | 7542613.29 | 384160.43 | 647.69 | 08A20110609SGR | 647.63 | 0.06 |
| 12870 | 7542613.29 | 384160.43 | 647.69 | 08A20110609SGR | 647.63 | 0.06 |
| 12871 | 7542653.12 | 384165.38 | 647.79 | 08A20110609SGR | 647.75 | 0.04 |
| 12871 | 7542653.12 | 384165.38 | 647.79 | 08A20110609SGR | 647.75 | 0.04 |
| 12872 | 7542718.46 | 384183.52 | 648.55 | 08A20110609SGR | 648.52 | 0.03 |
| 12872 | 7542718.46 | 384183.52 | 648.55 | 08A20110609SGR | 648.52 | 0.03 |
| 12873 | 7542748.14 | 384216.71 | 649.16 | 08A20110609SGR | 649.09 | 0.07 |
| 12873 | 7542748.14 | 384216.71 | 649.16 | 08A20110609SGR | 649.09 | 0.07 |
| 12874 | 7542754.24 | 384227.25 | 649.09 | 08A20110609SGR | 649.00 | 0.09 |
| 12874 | 7542754.24 | 384227.25 | 649.09 | 08A20110609SGR | 649.00 | 0.09 |
| 12875 | 7543520.14 | 384421.30 | 658.74 | 08A20110609SGR | 658.68 | 0.06 |
| 12875 | 7543520.14 | 384421.30 | 658.74 | 08A20110609SGR | 658.68 | 0.06 |
| 12876 | 7543535.37 | 384421.17 | 659.26 | 08A20110609SGR | 659.18 | 0.08 |
| 12876 | 7543535.37 | 384421.17 | 659.26 | 08A20110609SGR | 659.18 | 0.08 |
| 12877 | 7543551.84 | 384421.75 | 659.79 | 08A20110609SGR | 659.72 | 0.07 |
| 12877 | 7543551.84 | 384421.75 | 659.79 | 08A20110609SGR | 659.72 | 0.07 |
| 12878 | 7543567.57 | 384420.07 | 660.15 | 08A20110609SGR | 660.13 | 0.02 |
| 12878 | 7543567.57 | 384420.07 | 660.15 | 08A20110609SGR | 660.13 | 0.02 |
| 12879 | 7543583.88 | 384418.14 | 660.73 | 08A20110609SGR | 660.65 | 0.08 |
| 12879 | 7543583.88 | 384418.14 | 660.73 | 08A20110609SGR | 660.65 | 0.08 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12880 | 7543601.36 | 384416.78 | 661.50 | 08A20110609SGR | 661.40 | 0.10 |
| 12880 | 7543601.36 | 384416.78 | 661.50 | 08A20110609SGR | 661.40 | 0.10 |
| 12881 | 7543617.08 | 384413.33 | 662.26 | 08A20110609SGR | 662.18 | 0.08 |
| 12881 | 7543617.08 | 384413.33 | 662.26 | 08A20110609SGR | 662.18 | 0.08 |
| 12882 | 7544321.04 | 384502.07 | 668.63 | 08A20110609SGR | 668.58 | 0.05 |
| 12882 | 7544321.04 | 384502.07 | 668.63 | 08A20110609SGR | 668.58 | 0.05 |
| 12883 | 7544336.64 | 384502.16 | 668.83 | 08A20110609SGR | 668.81 | 0.02 |
| 12883 | 7544336.64 | 384502.16 | 668.83 | 08A20110609SGR | 668.81 | 0.02 |
| 12884 | 7544351.02 | 384506.46 | 669.23 | 08A20110609SGR | 669.22 | 0.00 |
| 12884 | 7544351.02 | 384506.46 | 669.23 | 08A20110609SGR | 669.22 | 0.00 |
| 12885 | 7544366.58 | 384508.28 | 669.74 | 08A20110609SGR | 669.72 | 0.02 |
| 12885 | 7544366.58 | 384508.28 | 669.74 | 08A20110609SGR | 669.72 | 0.02 |
| 12886 | 7544384.48 | 384514.65 | 670.40 | 08A20110609SGR | 670.37 | 0.03 |
| 12886 | 7544384.48 | 384514.65 | 670.40 | 08A20110609SGR | 670.37 | 0.03 |
| 12887 | 7544401.08 | 384515.96 | 671.07 | 08A20110609SGR | 671.04 | 0.03 |
| 12887 | 7544401.08 | 384515.96 | 671.07 | 08A20110609SGR | 671.04 | 0.03 |
| 12888 | 7544417.59 | 384518.52 | 671.87 | 08A20110609SGR | 671.85 | 0.02 |
| 12888 | 7544417.59 | 384518.52 | 671.87 | 08A20110609SGR | 671.85 | 0.02 |
| 12889 | 7545840.89 | 385400.64 | 705.09 | 08A20110609SGR | 705.04 | 0.05 |
| 12889 | 7545840.89 | 385400.64 | 705.09 | 08A20110609SGR | 705.04 | 0.05 |
| 12890 | 7545864.55 | 385418.25 | 705.85 | 08A20110609SGR | 705.83 | 0.02 |
| 12890 | 7545864.55 | 385418.25 | 705.85 | 08A20110609SGR | 705.83 | 0.02 |
| 12891 | 7545876.91 | 385425.47 | 706.19 | 08A20110609SGR | 706.17 | 0.02 |
| 12891 | 7545876.91 | 385425.47 | 706.19 | 08A20110609SGR | 706.17 | 0.02 |
| 12892 | 7545887.15 | 385434.80 | 706.34 | 08A20110609SGR | 706.31 | 0.03 |
| 12892 | 7545887.15 | 385434.80 | 706.34 | 08A20110609SGR | 706.31 | 0.03 |
| 12893 | 7545899.64 | 385441.46 | 706.52 | 08A20110609SGR | 706.49 | 0.03 |
| 12893 | 7545899.64 | 385441.46 | 706.52 | 08A20110609SGR | 706.49 | 0.03 |
| 12894 | 7545911.54 | 385448.27 | 706.59 | 08A20110609SGR | 706.57 | 0.02 |
| 12894 | 7545911.54 | 385448.27 | 706.59 | 08A20110609SGR | 706.57 | 0.02 |
| 12895 | 7545922.19 | 385457.60 | 706.60 | 08A20110609SGR | 706.56 | 0.04 |
| 12895 | 7545922.19 | 385457.60 | 706.60 | 08A20110609SGR | 706.56 | 0.04 |
| 12896 | 7539599.02 | 383251.99 | 617.01 | 08A20110609SGR | 617.04 | -0.03 |
| 12896 | 7539599.02 | 383251.99 | 617.01 | 08A20110609SGR | 617.04 | -0.03 |
| 12897 | 7539588.29 | 383242.04 | 616.74 | 08A20110609SGR | 616.77 | -0.03 |
| 12897 | 7539588.29 | 383242.04 | 616.74 | 08A20110609SGR | 616.77 | -0.03 |
| 12898 | 7539576.28 | 383233.61 | 616.54 | 08A20110609SGR | 616.58 | -0.04 |
| 12898 | 7539576.28 | 383233.61 | 616.54 | 08A20110609SGR | 616.58 | -0.04 |
| 12899 | 7539564.34 | 383227.43 | 616.48 | 08A20110609SGR | 616.52 | -0.04 |
| 12899 | 7539564.34 | 383227.43 | 616.48 | 08A20110609SGR | 616.52 | -0.04 |
| 12900 | 7539553.00 | 383219.66 | 616.34 | 08A20110609SGR | 616.34 | 0.00 |
| 12900 | 7539553.00 | 383219.66 | 616.34 | 08A20110609SGR | 616.34 | 0.00 |
| 12901 | 7539540.79 | 383211.43 | 616.13 | 08A20110609SGR | 616.15 | -0.02 |
| 12901 | 7539540.79 | 383211.43 | 616.13 | 08A20110609SGR | 616.15 | -0.02 |
| 12902 | 7539529.95 | 383202.56 | 615.83 | 08A20110609SGR | 615.85 | -0.02 |
| 12902 | 7539529.95 | 383202.56 | 615.83 | 08A20110609SGR | 615.85 | -0.02 |
| 12903 | 7538880.56 | 382738.88 | 608.78 | 08A20110609SGR | 608.80 | -0.02 |
| 12903 | 7538880.56 | 382738.88 | 608.78 | 08A20110609SGR | 608.80 | -0.02 |
| 12904 | 7538868.91 | 382730.43 | 608.59 | 08A20110609SGR | 608.63 | -0.04 |
| 12904 | 7538868.91 | 382730.43 | 608.59 | 08A20110609SGR | 608.63 | -0.04 |
| 12905 | 7538856.76 | 382725.10 | 608.60 | 08A20110609SGR | 608.63 | -0.03 |
| 12905 | 7538856.76 | 382725.10 | 608.60 | 08A20110609SGR | 608.63 | -0.03 |
| 12906 | 7538844.99 | 382717.02 | 608.47 | 08A20110609SGR | 608.51 | -0.04 |
| 12906 | 7538844.99 | 382717.02 | 608.47 | 08A20110609SGR | 608.51 | -0.04 |
| 12907 | 7538833.89 | 382705.51 | 608.21 | 08A20110609SGR | 608.22 | -0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 12907 | 7538833.89 | 382705.51 | 608.21 | 08A20110609SGR | 608.22 | -0.01 |
| 12908 | 7538821.85 | 382696.18 | 607.99 | 08A20110609SGR | 607.98 | 0.01 |
| 12908 | 7538821.85 | 382696.18 | 607.99 | 08A20110609SGR | 607.98 | 0.01 |
| 12909 | 7538809.43 | 382686.71 | 607.91 | 08A20110609SGR | 607.95 | -0.04 |
| 12909 | 7538809.43 | 382686.71 | 607.91 | 08A20110609SGR | 607.95 | -0.04 |
| 12910 | 7538518.08 | 382036.04 | 602.98 | 08A20110609SGR | 602.93 | 0.05 |
| 12910 | 7538518.08 | 382036.04 | 602.98 | 08A20110609SGR | 602.93 | 0.05 |
| 12911 | 7538507.55 | 382025.23 | 602.86 | 08A20110609SGR | 602.83 | 0.03 |
| 12911 | 7538507.55 | 382025.23 | 602.86 | 08A20110609SGR | 602.83 | 0.03 |
| 12912 | 7538496.67 | 382013.05 | 602.79 | 08A20110609SGR | 602.73 | 0.06 |
| 12912 | 7538496.67 | 382013.05 | 602.79 | 08A20110609SGR | 602.73 | 0.06 |
| 12913 | 7538486.95 | 382000.40 | 602.78 | 08A20110609SGR | 602.73 | 0.04 |
| 12913 | 7538486.95 | 382000.40 | 602.78 | 08A20110609SGR | 602.73 | 0.04 |
| 12914 | 7538476.80 | 381988.75 | 602.84 | 08A20110609SGR | 602.80 | 0.04 |
| 12914 | 7538476.80 | 381988.75 | 602.84 | 08A20110609SGR | 602.80 | 0.04 |
| 12915 | 7538465.21 | 381976.98 | 602.96 | 08A20110609SGR | 602.95 | 0.01 |
| 12915 | 7538465.21 | 381976.98 | 602.96 | 08A20110609SGR | 602.95 | 0.01 |
| 12916 | 7538453.71 | 381966.89 | 603.12 | 08A20110609SGR | 603.11 | 0.01 |
| 12916 | 7538453.71 | 381966.89 | 603.12 | 08A20110609SGR | 603.11 | 0.01 |
| 12917 | 7538278.70 | 381799.47 | 599.93 | 08A20110609SGR | 599.91 | 0.02 |
| 12917 | 7538278.70 | 381799.47 | 599.93 | 08A20110609SGR | 599.91 | 0.02 |
| 12918 | 7538282.69 | 381772.42 | 599.67 | 08A20110609SGR | 599.67 | 0.00 |
| 12918 | 7538282.69 | 381772.42 | 599.67 | 08A20110609SGR | 599.67 | 0.00 |
| 12919 | 7538292.23 | 381756.12 | 599.35 | 08A20110609SGR | 599.30 | 0.05 |
| 12919 | 7538292.23 | 381756.12 | 599.35 | 08A20110609SGR | 599.30 | 0.05 |
| 12920 | 7538317.63 | 381704.89 | 598.31 | 08A20110609SGR | 598.32 | -0.01 |
| 12920 | 7538317.63 | 381704.89 | 598.31 | 08A20110609SGR | 598.32 | -0.01 |
| 12921 | 7538345.61 | 381644.06 | 597.27 | 08A20110609SGR | 597.25 | 0.02 |
| 12921 | 7538345.61 | 381644.06 | 597.27 | 08A20110609SGR | 597.25 | 0.02 |
| 12922 | 7538336.50 | 381614.22 | 597.04 | 08A20110609SGR | 596.99 | 0.05 |
| 12922 | 7538336.50 | 381614.22 | 597.04 | 08A20110609SGR | 596.99 | 0.05 |
| 12923 | 7538325.54 | 381581.15 | 596.68 | 08A20110609SGR | 596.70 | -0.02 |
| 12923 | 7538325.54 | 381581.15 | 596.68 | 08A20110609SGR | 596.70 | -0.02 |
| 12924 | 7538321.79 | 381514.92 | 595.92 | 08A20110609SGR | 595.91 | 0.00 |
| 12924 | 7538321.79 | 381514.92 | 595.92 | 08A20110609SGR | 595.91 | 0.00 |
| 12925 | 7538271.29 | 381465.41 | 595.05 | 08A20110609SGR | 595.08 | -0.03 |
| 12925 | 7538271.29 | 381465.41 | 595.05 | 08A20110609SGR | 595.08 | -0.03 |
| 12926 | 7538210.15 | 381465.49 | 594.70 | 08A20110609SGR | 594.73 | -0.03 |
| 12926 | 7538210.15 | 381465.49 | 594.70 | 08A20110609SGR | 594.73 | -0.03 |
| 12927 | 7538259.67 | 381556.17 | 596.00 | 08A20110609SGR | 596.05 | -0.05 |
| 12927 | 7538259.67 | 381556.17 | 596.00 | 08A20110609SGR | 596.05 | -0.05 |
| 12928 | 7538336.20 | 381614.07 | 597.03 | 08A20110609SGR | 597.00 | 0.03 |
| 12928 | 7538336.20 | 381614.07 | 597.03 | 08A20110609SGR | 597.00 | 0.03 |
| 12929 | 7538405.44 | 381695.69 | 598.09 | 08A20110609SGR | 598.05 | 0.04 |
| 12929 | 7538405.44 | 381695.69 | 598.09 | 08A20110609SGR | 598.05 | 0.04 |
| 12930 | 7538372.46 | 381751.12 | 598.72 | 08A20110609SGR | 598.67 | 0.05 |
| 12930 | 7538372.46 | 381751.12 | 598.72 | 08A20110609SGR | 598.67 | 0.05 |
| 12931 | 7538293.88 | 381814.37 | 600.51 | 08A20110609SGR | 600.50 | 0.01 |
| 12931 | 7538293.88 | 381814.37 | 600.51 | 08A20110609SGR | 600.50 | 0.01 |
| 13001 | 7536076.16 | 381678.23 | 575.89 | 08B20110608SGR | 575.85 | 0.03 |
| 13001 | 7536076.16 | 381678.23 | 575.89 | 08B20110608SGR | 575.85 | 0.03 |
| 13002 | 7536095.55 | 381702.78 | 576.46 | 08B20110608SGR | 576.42 | 0.04 |
| 13002 | 7536095.55 | 381702.78 | 576.46 | 08B20110608SGR | 576.42 | 0.04 |
| 13003 | 7536109.65 | 381702.51 | 576.63 | 08B20110608SGR | 576.60 | 0.03 |
| 13003 | 7536109.65 | 381702.51 | 576.63 | 08B20110608SGR | 576.60 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13004 | 7536125.07 | 381701.16 | 576.81 | 08B20110608SGR | 576.75 | 0.05 |
| 13004 | 7536125.07 | 381701.16 | 576.81 | 08B20110608SGR | 576.75 | 0.05 |
| 13005 | 7536140.71 | 381700.34 | 576.99 | 08B20110608SGR | 576.96 | 0.03 |
| 13005 | 7536140.71 | 381700.34 | 576.99 | 08B20110608SGR | 576.96 | 0.03 |
| 13006 | 7536156.56 | 381699.37 | 577.14 | 08B20110608SGR | 577.10 | 0.04 |
| 13006 | 7536156.56 | 381699.37 | 577.14 | 08B20110608SGR | 577.10 | 0.04 |
| 13007 | 7536171.71 | 381698.56 | 577.23 | 08B20110608SGR | 577.19 | 0.04 |
| 13007 | 7536171.71 | 381698.56 | 577.23 | 08B20110608SGR | 577.19 | 0.04 |
| 13008 | 7536186.31 | 381697.59 | 577.32 | 08B20110608SGR | 577.28 | 0.04 |
| 13008 | 7536186.31 | 381697.59 | 577.32 | 08B20110608SGR | 577.28 | 0.04 |
| 13009 | 7535269.00 | 381745.77 | 570.11 | 08B20110608SGR | 570.11 | 0.00 |
| 13009 | 7535269.00 | 381745.77 | 570.11 | 08B20110608SGR | 570.11 | 0.00 |
| 13010 | 7535252.89 | 381746.37 | 570.01 | 08B20110608SGR | 569.99 | 0.02 |
| 13010 | 7535252.89 | 381746.37 | 570.01 | 08B20110608SGR | 569.99 | 0.02 |
| 13011 | 7535237.00 | 381746.89 | 569.97 | 08B20110608SGR | 569.92 | 0.05 |
| 13011 | 7535237.00 | 381746.89 | 569.97 | 08B20110608SGR | 569.92 | 0.05 |
| 13012 | 7535221.53 | 381748.13 | 569.87 | 08B20110608SGR | 569.85 | 0.02 |
| 13012 | 7535221.53 | 381748.13 | 569.87 | 08B20110608SGR | 569.85 | 0.02 |
| 13013 | 7535205.65 | 381748.36 | 569.80 | 08B20110608SGR | 569.76 | 0.04 |
| 13013 | 7535205.65 | 381748.36 | 569.80 | 08B20110608SGR | 569.76 | 0.04 |
| 13014 | 7535190.52 | 381751.71 | 569.53 | 08B20110608SGR | 569.51 | 0.02 |
| 13014 | 7535190.52 | 381751.71 | 569.53 | 08B20110608SGR | 569.51 | 0.02 |
| 13015 | 7535173.73 | 381749.20 | 569.65 | 08B20110608SGR | 569.63 | 0.01 |
| 13015 | 7535173.73 | 381749.20 | 569.65 | 08B20110608SGR | 569.63 | 0.01 |
| 13016 | 7534466.22 | 381768.82 | 571.27 | 08B20110608SGR | 571.25 | 0.02 |
| 13016 | 7534466.22 | 381768.82 | 571.27 | 08B20110608SGR | 571.25 | 0.02 |
| 13017 | 7534451.59 | 381766.80 | 570.50 | 08B20110608SGR | 570.47 | 0.03 |
| 13017 | 7534451.59 | 381766.80 | 570.50 | 08B20110608SGR | 570.47 | 0.03 |
| 13018 | 7534434.67 | 381763.61 | 569.68 | 08B20110608SGR | 569.65 | 0.03 |
| 13018 | 7534434.67 | 381763.61 | 569.68 | 08B20110608SGR | 569.65 | 0.03 |
| 13019 | 7534419.77 | 381761.53 | 568.97 | 08B20110608SGR | 568.94 | 0.03 |
| 13019 | 7534419.77 | 381761.53 | 568.97 | 08B20110608SGR | 568.94 | 0.03 |
| 13020 | 7534404.18 | 381758.77 | 568.27 | 08B20110608SGR | 568.24 | 0.03 |
| 13020 | 7534404.18 | 381758.77 | 568.27 | 08B20110608SGR | 568.24 | 0.03 |
| 13021 | 7534389.59 | 381756.35 | 567.67 | 08B20110608SGR | 567.62 | 0.05 |
| 13021 | 7534389.59 | 381756.35 | 567.67 | 08B20110608SGR | 567.62 | 0.05 |
| 13022 | 7534373.31 | 381753.75 | 566.94 | 08B20110608SGR | 566.93 | 0.01 |
| 13022 | 7534373.31 | 381753.75 | 566.94 | 08B20110608SGR | 566.93 | 0.01 |
| 13023 | 7533563.83 | 381632.65 | 560.39 | 08B20110608SGR | 560.36 | 0.03 |
| 13023 | 7533563.83 | 381632.65 | 560.39 | 08B20110608SGR | 560.36 | 0.03 |
| 13024 | 7533548.48 | 381630.25 | 560.43 | 08B20110608SGR | 560.39 | 0.04 |
| 13024 | 7533548.48 | 381630.25 | 560.43 | 08B20110608SGR | 560.39 | 0.04 |
| 13025 | 7533532.88 | 381627.33 | 560.53 | 08B20110608SGR | 560.48 | 0.04 |
| 13025 | 7533532.88 | 381627.33 | 560.53 | 08B20110608SGR | 560.48 | 0.04 |
| 13026 | 7533517.91 | 381625.80 | 560.51 | 08B20110608SGR | 560.48 | 0.03 |
| 13026 | 7533517.91 | 381625.80 | 560.51 | 08B20110608SGR | 560.48 | 0.03 |
| 13027 | 7533499.27 | 381622.23 | 560.60 | 08B20110608SGR | 560.58 | 0.02 |
| 13027 | 7533499.27 | 381622.23 | 560.60 | 08B20110608SGR | 560.58 | 0.02 |
| 13028 | 7533484.49 | 381621.59 | 560.83 | 08B20110608SGR | 560.78 | 0.05 |
| 13028 | 7533484.49 | 381621.59 | 560.83 | 08B20110608SGR | 560.78 | 0.05 |
| 13029 | 7533468.72 | 381619.38 | 561.05 | 08B20110608SGR | 561.04 | 0.01 |
| 13029 | 7533468.72 | 381619.38 | 561.05 | 08B20110608SGR | 561.04 | 0.01 |
| 13030 | 7532834.59 | 381540.22 | 575.93 | 08B20110608SGR | 575.94 | -0.01 |
| 13030 | 7532834.59 | 381540.22 | 575.93 | 08B20110608SGR | 575.94 | -0.01 |
| 13031 | 7532818.48 | 381537.97 | 575.79 | 08B20110608SGR | 575.80 | -0.01 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13031 | 7532818.48 | 381537.97 | 575.79 | 08B20110608SGR | 575.80 | -0.01 |
| 13032 | 7532803.74 | 381534.08 | 575.81 | 08B20110608SGR | 575.82 | -0.01 |
| 13032 | 7532803.74 | 381534.08 | 575.81 | 08B20110608SGR | 575.82 | -0.01 |
| 13033 | 7532786.41 | 381533.66 | 575.72 | 08B20110608SGR | 575.70 | 0.02 |
| 13033 | 7532786.41 | 381533.66 | 575.72 | 08B20110608SGR | 575.70 | 0.02 |
| 13034 | 7532771.87 | 381532.13 | 575.56 | 08B20110608SGR | 575.56 | 0.00 |
| 13034 | 7532771.87 | 381532.13 | 575.56 | 08B20110608SGR | 575.56 | 0.00 |
| 13035 | 7532757.20 | 381530.31 | 575.37 | 08B20110608SGR | 575.36 | 0.01 |
| 13035 | 7532757.20 | 381530.31 | 575.37 | 08B20110608SGR | 575.36 | 0.01 |
| 13036 | 7532742.65 | 381528.55 | 575.15 | 08B20110608SGR | 575.15 | 0.00 |
| 13036 | 7532742.65 | 381528.55 | 575.15 | 08B20110608SGR | 575.15 | 0.00 |
| 13037 | 7532855.32 | 381564.49 | 576.12 | 08B20110608SGR | 576.13 | -0.01 |
| 13037 | 7532855.32 | 381564.49 | 576.12 | 08B20110608SGR | 576.13 | -0.01 |
| 13038 | 7532858.73 | 381588.34 | 577.02 | 08B20110608SGR | 577.00 | 0.02 |
| 13038 | 7532858.73 | 381588.34 | 577.02 | 08B20110608SGR | 577.00 | 0.02 |
| 13039 | 7532860.30 | 381610.87 | 578.00 | 08B20110608SGR | 577.98 | 0.02 |
| 13039 | 7532860.30 | 381610.87 | 578.00 | 08B20110608SGR | 577.98 | 0.02 |
| 13040 | 7532862.29 | 381629.43 | 578.67 | 08B20110608SGR | 578.67 | 0.00 |
| 13040 | 7532862.29 | 381629.43 | 578.67 | 08B20110608SGR | 578.67 | 0.00 |
| 13041 | 7532858.22 | 381654.13 | 579.46 | 08B20110608SGR | 579.47 | -0.01 |
| 13041 | 7532858.22 | 381654.13 | 579.46 | 08B20110608SGR | 579.47 | -0.01 |
| 13042 | 7532835.76 | 381683.12 | 580.73 | 08B20110608SGR | 580.72 | 0.01 |
| 13042 | 7532835.76 | 381683.12 | 580.73 | 08B20110608SGR | 580.72 | 0.01 |
| 13043 | 7532823.80 | 381705.29 | 580.73 | 08B20110608SGR | 580.72 | 0.00 |
| 13043 | 7532823.80 | 381705.29 | 580.73 | 08B20110608SGR | 580.72 | 0.00 |
| 13044 | 7532802.78 | 381722.50 | 581.36 | 08B20110608SGR | 581.36 | 0.00 |
| 13044 | 7532802.78 | 381722.50 | 581.36 | 08B20110608SGR | 581.36 | 0.00 |
| 13045 | 7532782.87 | 381754.19 | 581.66 | 08B20110608SGR | 581.66 | 0.00 |
| 13045 | 7532782.87 | 381754.19 | 581.66 | 08B20110608SGR | 581.66 | 0.00 |
| 13046 | 7532761.23 | 381778.07 | 582.34 | 08B20110608SGR | 582.32 | 0.02 |
| 13046 | 7532761.23 | 381778.07 | 582.34 | 08B20110608SGR | 582.32 | 0.02 |
| 13047 | 7532745.44 | 381803.38 | 583.75 | 08B20110608SGR | 583.77 | -0.02 |
| 13047 | 7532745.44 | 381803.38 | 583.75 | 08B20110608SGR | 583.77 | -0.02 |
| 13048 | 7532074.56 | 381442.01 | 551.82 | 08B20110608SGR | 551.84 | -0.02 |
| 13048 | 7532074.56 | 381442.01 | 551.82 | 08B20110608SGR | 551.84 | -0.02 |
| 13049 | 7532058.41 | 381440.32 | 551.05 | 08B20110608SGR | 551.01 | 0.03 |
| 13049 | 7532058.41 | 381440.32 | 551.05 | 08B20110608SGR | 551.01 | 0.03 |
| 13050 | 7532040.65 | 381437.36 | 550.14 | 08B20110608SGR | 550.12 | 0.02 |
| 13050 | 7532040.65 | 381437.36 | 550.14 | 08B20110608SGR | 550.12 | 0.02 |
| 13051 | 7532025.36 | 381434.53 | 549.37 | 08B20110608SGR | 549.36 | 0.01 |
| 13051 | 7532025.36 | 381434.53 | 549.37 | 08B20110608SGR | 549.36 | 0.01 |
| 13052 | 7532010.09 | 381432.68 | 548.56 | 08B20110608SGR | 548.52 | 0.04 |
| 13052 | 7532010.09 | 381432.68 | 548.56 | 08B20110608SGR | 548.52 | 0.04 |
| 13053 | 7531995.09 | 381431.56 | 547.78 | 08B20110608SGR | 547.75 | 0.03 |
| 13053 | 7531995.09 | 381431.56 | 547.78 | 08B20110608SGR | 547.75 | 0.03 |
| 13054 | 7531980.28 | 381428.24 | 547.22 | 08B20110608SGR | 547.18 | 0.04 |
| 13054 | 7531980.28 | 381428.24 | 547.22 | 08B20110608SGR | 547.18 | 0.04 |
| 13055 | 7531287.04 | 381341.46 | 541.91 | 08B20110608SGR | 541.89 | 0.02 |
| 13055 | 7531287.04 | 381341.46 | 541.91 | 08B20110608SGR | 541.89 | 0.02 |
| 13056 | 7531270.58 | 381337.54 | 541.85 | 08B20110608SGR | 541.82 | 0.02 |
| 13056 | 7531270.58 | 381337.54 | 541.85 | 08B20110608SGR | 541.82 | 0.02 |
| 13057 | 7531254.52 | 381335.13 | 541.77 | 08B20110608SGR | 541.76 | 0.01 |
| 13057 | 7531254.52 | 381335.13 | 541.77 | 08B20110608SGR | 541.76 | 0.01 |
| 13058 | 7531238.35 | 381334.48 | 541.67 | 08B20110608SGR | 541.67 | 0.00 |
| 13058 | 7531238.35 | 381334.48 | 541.67 | 08B20110608SGR | 541.67 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13059 | 7531222.95 | 381332.55 | 541.58 | 08B20110608SGR | 541.60 | -0.02 |
| 13059 | 7531222.95 | 381332.55 | 541.58 | 08B20110608SGR | 541.60 | -0.02 |
| 13060 | 7531207.80 | 381329.83 | 541.52 | 08B20110608SGR | 541.50 | 0.02 |
| 13060 | 7531207.80 | 381329.83 | 541.52 | 08B20110608SGR | 541.50 | 0.02 |
| 13061 | 7531192.12 | 381327.27 | 541.48 | 08B20110608SGR | 541.46 | 0.02 |
| 13061 | 7531192.12 | 381327.27 | 541.48 | 08B20110608SGR | 541.46 | 0.02 |
| 13062 | 7530508.60 | 381241.72 | 537.26 | 08B20110608SGR | 537.26 | 0.00 |
| 13062 | 7530508.60 | 381241.72 | 537.26 | 08B20110608SGR | 537.26 | 0.00 |
| 13063 | 7530492.93 | 381238.51 | 537.24 | 08B20110608SGR | 537.22 | 0.02 |
| 13063 | 7530492.93 | 381238.51 | 537.24 | 08B20110608SGR | 537.22 | 0.02 |
| 13064 | 7530476.06 | 381235.81 | 537.17 | 08B20110608SGR | 537.17 | 0.00 |
| 13064 | 7530476.06 | 381235.81 | 537.17 | 08B20110608SGR | 537.17 | 0.00 |
| 13065 | 7530459.78 | 381234.63 | 537.06 | 08B20110608SGR | 537.07 | -0.01 |
| 13065 | 7530459.78 | 381234.63 | 537.06 | 08B20110608SGR | 537.07 | -0.01 |
| 13066 | 7530444.35 | 381233.68 | 536.95 | 08B20110608SGR | 536.93 | 0.02 |
| 13066 | 7530444.35 | 381233.68 | 536.95 | 08B20110608SGR | 536.93 | 0.02 |
| 13067 | 7530427.43 | 381230.07 | 536.92 | 08B20110608SGR | 536.93 | -0.01 |
| 13067 | 7530427.43 | 381230.07 | 536.92 | 08B20110608SGR | 536.93 | -0.01 |
| 13068 | 7530410.01 | 381229.24 | 536.80 | 08B20110608SGR | 536.80 | 0.00 |
| 13068 | 7530410.01 | 381229.24 | 536.80 | 08B20110608SGR | 536.80 | 0.00 |
| 13069 | 7529610.33 | 381125.95 | 533.00 | 08B20110608SGR | 532.97 | 0.03 |
| 13069 | 7529610.33 | 381125.95 | 533.00 | 08B20110608SGR | 532.97 | 0.03 |
| 13070 | 7529594.65 | 381123.70 | 532.93 | 08B20110608SGR | 532.88 | 0.05 |
| 13070 | 7529594.65 | 381123.70 | 532.93 | 08B20110608SGR | 532.88 | 0.05 |
| 13071 | 7529579.46 | 381121.90 | 532.88 | 08B20110608SGR | 532.82 | 0.06 |
| 13071 | 7529579.46 | 381121.90 | 532.88 | 08B20110608SGR | 532.82 | 0.06 |
| 13072 | 7529563.59 | 381119.78 | 532.86 | 08B20110608SGR | 532.79 | 0.07 |
| 13072 | 7529563.59 | 381119.78 | 532.86 | 08B20110608SGR | 532.79 | 0.07 |
| 13073 | 7529547.68 | 381117.63 | 532.86 | 08B20110608SGR | 532.82 | 0.04 |
| 13073 | 7529547.68 | 381117.63 | 532.86 | 08B20110608SGR | 532.82 | 0.04 |
| 13074 | 7529532.56 | 381115.75 | 532.91 | 08B20110608SGR | 532.87 | 0.04 |
| 13074 | 7529532.56 | 381115.75 | 532.91 | 08B20110608SGR | 532.87 | 0.04 |
| 13075 | 7529516.76 | 381114.06 | 532.96 | 08B20110608SGR | 532.92 | 0.04 |
| 13075 | 7529516.76 | 381114.06 | 532.96 | 08B20110608SGR | 532.92 | 0.04 |
| 13076 | 7528505.43 | 381356.75 | 554.39 | 08B20110608SGR | 554.33 | 0.06 |
| 13076 | 7528505.43 | 381356.75 | 554.39 | 08B20110608SGR | 554.33 | 0.06 |
| 13077 | 7528490.58 | 381364.06 | 554.95 | 08B20110608SGR | 554.86 | 0.09 |
| 13077 | 7528490.58 | 381364.06 | 554.95 | 08B20110608SGR | 554.86 | 0.09 |
| 13078 | 7528475.90 | 381372.28 | 555.48 | 08B20110608SGR | 555.44 | 0.04 |
| 13078 | 7528475.90 | 381372.28 | 555.48 | 08B20110608SGR | 555.44 | 0.04 |
| 13079 | 7528459.01 | 381374.34 | 555.94 | 08B20110608SGR | 555.90 | 0.04 |
| 13079 | 7528459.01 | 381374.34 | 555.94 | 08B20110608SGR | 555.90 | 0.04 |
| 13080 | 7528444.22 | 381382.49 | 556.48 | 08B20110608SGR | 556.40 | 0.08 |
| 13080 | 7528444.22 | 381382.49 | 556.48 | 08B20110608SGR | 556.40 | 0.08 |
| 13081 | 7528429.97 | 381389.59 | 556.99 | 08B20110608SGR | 556.94 | 0.05 |
| 13081 | 7528429.97 | 381389.59 | 556.99 | 08B20110608SGR | 556.94 | 0.05 |
| 13082 | 7528420.35 | 381394.68 | 557.36 | 08B20110608SGR | 557.31 | 0.05 |
| 13082 | 7528420.35 | 381394.68 | 557.36 | 08B20110608SGR | 557.31 | 0.05 |
| 13083 | 7536990.51 | 381584.52 | 582.69 | 08B20110608SGR | 582.64 | 0.05 |
| 13083 | 7536990.51 | 381584.52 | 582.69 | 08B20110608SGR | 582.64 | 0.05 |
| 13084 | 7537005.99 | 381582.39 | 582.87 | 08B20110608SGR | 582.81 | 0.06 |
| 13084 | 7537005.99 | 381582.39 | 582.87 | 08B20110608SGR | 582.81 | 0.06 |
| 13085 | 7537020.93 | 381580.16 | 583.03 | 08B20110608SGR | 582.94 | 0.09 |
| 13085 | 7537020.93 | 381580.16 | 583.03 | 08B20110608SGR | 582.94 | 0.09 |
| 13086 | 7537036.83 | 381577.51 | 583.19 | 08B20110608SGR | 583.15 | 0.04 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 13086 | 7537036.83 | 381577.51 | 583.19 | 08B20110608SGR | 583.15 | 0.04 |
| 13087 | 7537051.86 | 381575.19 | 583.39 | 08B20110608SGR | 583.36 | 0.03 |
| 13087 | 7537051.86 | 381575.19 | 583.39 | 08B20110608SGR | 583.36 | 0.03 |
| 13088 | 7537067.76 | 381572.95 | 583.60 | 08B20110608SGR | 583.55 | 0.05 |
| 13088 | 7537067.76 | 381572.95 | 583.60 | 08B20110608SGR | 583.55 | 0.05 |
| 13089 | 7537083.05 | 381570.40 | 583.77 | 08B20110608SGR | 583.75 | 0.02 |
| 13089 | 7537083.05 | 381570.40 | 583.77 | 08B20110608SGR | 583.75 | 0.02 |
| 13090 | 7537847.07 | 381593.85 | 594.52 | 08B20110608SGR | 594.48 | 0.04 |
| 13090 | 7537847.07 | 381593.85 | 594.52 | 08B20110608SGR | 594.48 | 0.04 |
| 13091 | 7537860.05 | 381601.65 | 594.72 | 08B20110608SGR | 594.63 | 0.09 |
| 13091 | 7537860.05 | 381601.65 | 594.72 | 08B20110608SGR | 594.63 | 0.09 |
| 13092 | 7537873.87 | 381609.43 | 594.92 | 08B20110608SGR | 594.87 | 0.05 |
| 13092 | 7537873.87 | 381609.43 | 594.92 | 08B20110608SGR | 594.87 | 0.05 |
| 13093 | 7537887.68 | 381617.18 | 595.16 | 08B20110608SGR | 595.11 | 0.05 |
| 13093 | 7537887.68 | 381617.18 | 595.16 | 08B20110608SGR | 595.11 | 0.05 |
| 13094 | 7537901.94 | 381625.24 | 595.42 | 08B20110608SGR | 595.37 | 0.05 |
| 13094 | 7537901.94 | 381625.24 | 595.42 | 08B20110608SGR | 595.37 | 0.05 |
| 13095 | 7537917.49 | 381634.33 | 595.77 | 08B20110608SGR | 595.71 | 0.06 |
| 13095 | 7537917.49 | 381634.33 | 595.77 | 08B20110608SGR | 595.71 | 0.06 |
| 13096 | 7537931.26 | 381641.91 | 596.05 | 08B20110608SGR | 596.01 | 0.04 |
| 13096 | 7537931.26 | 381641.91 | 596.05 | 08B20110608SGR | 596.01 | 0.04 |
| 13097 | 7538586.22 | 382133.04 | 604.02 | 08B20110608SGR | 603.94 | 0.08 |
| 13097 | 7538586.22 | 382133.04 | 604.02 | 08B20110608SGR | 603.94 | 0.08 |
| 13098 | 7538593.85 | 382146.64 | 604.13 | 08B20110608SGR | 604.04 | 0.09 |
| 13098 | 7538593.85 | 382146.64 | 604.13 | 08B20110608SGR | 604.04 | 0.09 |
| 13099 | 7538601.64 | 382160.44 | 604.22 | 08B20110608SGR | 604.21 | 0.01 |
| 13099 | 7538601.64 | 382160.44 | 604.22 | 08B20110608SGR | 604.21 | 0.01 |
| 13100 | 7538607.83 | 382176.30 | 604.30 | 08B20110608SGR | 604.28 | 0.01 |
| 13100 | 7538607.83 | 382176.30 | 604.30 | 08B20110608SGR | 604.28 | 0.01 |
| 13101 | 7538617.00 | 382191.13 | 604.42 | 08B20110608SGR | 604.42 | 0.00 |
| 13101 | 7538617.00 | 382191.13 | 604.42 | 08B20110608SGR | 604.42 | 0.00 |
| 13102 | 7538624.12 | 382205.78 | 604.53 | 08B20110608SGR | 604.52 | 0.01 |
| 13102 | 7538624.12 | 382205.78 | 604.53 | 08B20110608SGR | 604.52 | 0.01 |
| 13103 | 7538631.67 | 382221.90 | 604.65 | 08B20110608SGR | 604.63 | 0.02 |
| 13103 | 7538631.67 | 382221.90 | 604.65 | 08B20110608SGR | 604.63 | 0.02 |
| 13202 | 7550871.23 | 390661.28 | 991.03 | 07C201106107C1SGR | 991.00 | 0.03 |
| 13202 | 7550871.23 | 390661.28 | 991.03 | 07C201106107C1SGR | 991.00 | 0.03 |
| 13203 | 7553391.70 | 392062.62 | 983.56 | 07C201106107C2SGR | 983.56 | 0.00 |
| 13203 | 7553391.70 | 392062.62 | 983.56 | 07C201106107C2SGR | 983.56 | 0.00 |
| 13204 | 7554872.96 | 393595.86 | 1006.62 | 07C201106107C3SGR | 1006.61 | 0.01 |
| 13204 | 7554872.96 | 393595.86 | 1006.62 | 07C201106107C3SGR | 1006.61 | 0.01 |
| 13205 | 7555440.84 | 393938.34 | 1019.41 | 07C201106107C4SGR | 1019.38 | 0.03 |
| 13205 | 7555440.84 | 393938.34 | 1019.41 | 07C201106107C4SGR | 1019.38 | 0.03 |
| 13206 | 7556786.16 | 394774.44 | 1054.18 | 07C201106107C5SGR | 1054.16 | 0.02 |
| 13208 | 7549003.84 | 388817.65 | 771.20 | 07C201106108B1SGR | 771.27 | -0.07 |
| 13208 | 7549003.84 | 388817.65 | 771.20 | 07C201106108B1SGR | 771.27 | -0.07 |
| 13209 | 7547283.70 | 386264.58 | 709.12 | 07C201106108B2SGR | 709.15 | -0.03 |
| 13209 | 7547283.70 | 386264.58 | 709.12 | 07C201106108B2SGR | 709.15 | -0.03 |
| 13210 | 7544998.02 | 384789.95 | 675.79 | 07C201106108B4SGR | 675.81 | -0.02 |
| 13210 | 7544998.02 | 384789.95 | 675.79 | 07C201106108B4SGR | 675.81 | -0.02 |
| 17203 | 7576052.57 | 401675.02 | 872.77 | 7A20110611SGR | 872.75 | 0.02 |
| 17204 | 7576065.37 | 401684.93 | 873.13 | 7A20110611SGR | 873.11 | 0.02 |
| 17205 | 7576076.90 | 401694.27 | 873.49 | 7A20110611SGR | 873.46 | 0.03 |
| 17206 | 7576088.11 | 401704.21 | 873.88 | 7A20110611SGR | 873.86 | 0.02 |
| 17207 | 7576099.35 | 401713.96 | 874.20 | 7A20110611SGR | 874.20 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 17208 | 7576110.18 | 401724.92 | 874.40 | 7A20110611SGR | 874.37 | 0.02 |
| 17209 | 7576122.30 | 401733.99 | 874.77 | 7A20110611SGR | 874.77 | 0.00 |
| 17210 | 7576149.01 | 401658.91 | 870.08 | 7A20110611SGR | 870.06 | 0.02 |
| 17211 | 7576139.15 | 401652.70 | 869.77 | 7A20110611SGR | 869.76 | 0.01 |
| 17212 | 7576114.39 | 401640.18 | 869.07 | 7A20110611SGR | 869.05 | 0.02 |
| 17213 | 7576102.34 | 401630.80 | 869.27 | 7A20110611SGR | 869.22 | 0.05 |
| 17214 | 7576080.79 | 401619.95 | 869.15 | 7A20110611SGR | 869.13 | 0.02 |
| 17215 | 7576064.51 | 401610.59 | 868.80 | 7A20110611SGR | 868.79 | 0.01 |
| 17216 | 7576051.11 | 401600.07 | 868.60 | 7A20110611SGR | 868.57 | 0.03 |
| 17217 | 7575206.36 | 401158.22 | 875.91 | 7A20110611SGR | 875.84 | 0.07 |
| 17218 | 7575233.69 | 401128.67 | 871.69 | 7A20110611SGR | 871.61 | 0.08 |
| 17219 | 7575220.26 | 401118.68 | 871.94 | 7A20110611SGR | 871.86 | 0.08 |
| 17220 | 7575207.04 | 401113.04 | 872.10 | 7A20110611SGR | 872.00 | 0.10 |
| 17221 | 7575193.83 | 401103.84 | 872.33 | 7A20110611SGR | 872.25 | 0.08 |
| 17222 | 7575180.61 | 401096.43 | 872.59 | 7A20110611SGR | 872.52 | 0.07 |
| 17223 | 7575167.16 | 401088.89 | 872.96 | 7A20110611SGR | 872.91 | 0.05 |
| 17224 | 7575153.40 | 401080.51 | 873.22 | 7A20110611SGR | 873.17 | 0.05 |
| 17225 | 7575158.32 | 401130.75 | 877.27 | 7A20110611SGR | 877.19 | 0.08 |
| 17226 | 7575174.44 | 401140.10 | 876.82 | 7A20110611SGR | 876.76 | 0.06 |
| 17227 | 7575187.71 | 401147.74 | 876.44 | 7A20110611SGR | 876.37 | 0.07 |
| 17228 | 7575200.73 | 401155.20 | 876.08 | 7A20110611SGR | 876.01 | 0.07 |
| 17229 | 7574797.67 | 400925.89 | 875.09 | 7A20110611SGR | 874.98 | 0.11 |
| 17230 | 7574783.66 | 400915.37 | 875.42 | 7A20110611SGR | 875.33 | 0.09 |
| 17231 | 7574769.72 | 400909.75 | 875.61 | 7A20110611SGR | 875.53 | 0.08 |
| 17232 | 7574757.58 | 400901.50 | 875.87 | 7A20110611SGR | 875.76 | 0.11 |
| 17233 | 7574811.89 | 400911.02 | 873.75 | 7A20110611SGR | 873.68 | 0.07 |
| 17234 | 7574820.23 | 400897.67 | 872.81 | 7A20110611SGR | 872.72 | 0.09 |
| 17235 | 7574830.78 | 400883.03 | 872.61 | 7A20110611SGR | 872.50 | 0.11 |
| 17236 | 7574836.33 | 400863.55 | 872.81 | 7A20110611SGR | 872.71 | 0.10 |
| 17237 | 7574823.38 | 400854.89 | 872.61 | 7A20110611SGR | 872.51 | 0.10 |
| 17238 | 7574807.69 | 400844.43 | 872.54 | 7A20110611SGR | 872.42 | 0.12 |
| 17239 | 7574793.05 | 400837.48 | 872.75 | 7A20110611SGR | 872.66 | 0.09 |
| 17240 | 7574780.77 | 400831.15 | 873.00 | 7A20110611SGR | 872.91 | 0.09 |
| 17241 | 7574766.56 | 400822.43 | 873.22 | 7A20110611SGR | 873.11 | 0.11 |
| 17242 | 7574753.78 | 400815.92 | 873.41 | 7A20110611SGR | 873.33 | 0.08 |
| 17243 | 7573850.85 | 400373.19 | 885.17 | 7A20110611SGR | 885.11 | 0.06 |
| 17244 | 7573863.97 | 400380.71 | 885.06 | 7A20110611SGR | 884.98 | 0.08 |
| 17245 | 7573877.35 | 400388.72 | 884.89 | 7A20110611SGR | 884.84 | 0.05 |
| 17246 | 7573892.18 | 400396.77 | 884.73 | 7A20110611SGR | 884.66 | 0.07 |
| 17247 | 7573907.01 | 400409.32 | 884.73 | 7A20110611SGR | 884.69 | 0.04 |
| 17248 | 7573138.22 | 399974.61 | 918.02 | 7A20110611SGR | 917.98 | 0.04 |
| 17249 | 7573124.12 | 399977.89 | 918.45 | 7A20110611SGR | 918.39 | 0.06 |
| 17250 | 7573109.60 | 399974.00 | 919.36 | 7A20110611SGR | 919.31 | 0.05 |
| 17251 | 7573093.86 | 399969.52 | 920.35 | 7A20110611SGR | 920.30 | 0.05 |
| 17252 | 7573078.97 | 399965.47 | 921.28 | 7A20110611SGR | 921.23 | 0.05 |
| 17253 | 7573134.84 | 399849.26 | 908.55 | 7A20110611SGR | 908.46 | 0.09 |
| 17254 | 7573151.14 | 399855.09 | 907.96 | 7A20110611SGR | 907.92 | 0.04 |
| 17255 | 7573198.27 | 399879.82 | 907.10 | 7A20110611SGR | 907.04 | 0.06 |
| 17256 | 7573207.99 | 399887.62 | 906.48 | 7A20110611SGR | 906.41 | 0.07 |
| 17257 | 7573220.27 | 399894.94 | 905.64 | 7A20110611SGR | 905.55 | 0.09 |
| 17258 | 7573236.87 | 399904.58 | 904.77 | 7A20110611SGR | 904.74 | 0.03 |
| 17259 | 7573251.80 | 399912.80 | 903.81 | 7A20110611SGR | 903.72 | 0.09 |
| 17261 | 7572681.10 | 399928.57 | 938.32 | 7A201106117B | 938.30 | 0.02 |
| 17262 | 7572683.51 | 399904.07 | 936.27 | 7A20110611SGR | 936.20 | 0.07 |
| 17263 | 7572696.97 | 399905.61 | 936.01 | 7A20110611SGR | 935.95 | 0.06 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 17264 | 7572711.13 | 399907.69 | 935.75 | 7A20110611SGR | 935.70 | 0.05 |
| 17265 | 7572725.32 | 399909.64 | 935.49 | 7A20110611SGR | 935.42 | 0.07 |
| 17266 | 7572738.70 | 399911.82 | 935.26 | 7A20110611SGR | 935.22 | 0.04 |
| 17267 | 7571808.39 | 399791.18 | 922.80 | 7A20110611SGR | 922.77 | 0.03 |
| 17268 | 7571779.01 | 399787.72 | 924.55 | 7A20110611SGR | 924.49 | 0.06 |
| 17269 | 7571763.83 | 399788.29 | 925.37 | 7A20110611SGR | 925.29 | 0.08 |
| 17270 | 7571749.24 | 399787.74 | 926.13 | 7A20110611SGR | 926.11 | 0.02 |
| 17271 | 7571732.56 | 399787.83 | 926.93 | 7A20110611SGR | 926.91 | 0.02 |
| 17272 | 7571807.54 | 399762.05 | 922.21 | 7A20110611SGR | 922.15 | 0.06 |
| 17273 | 7576633.17 | 402002.78 | 869.93 | 7A20110611SGR | 869.91 | 0.02 |
| 17274 | 7576658.66 | 401985.37 | 868.10 | 7A20110611SGR | 868.10 | 0.00 |
| 17275 | 7576669.19 | 401978.07 | 867.43 | 7A20110611SGR | 867.44 | -0.01 |
| 17276 | 7576687.71 | 401970.85 | 866.31 | 7A20110611SGR | 866.30 | 0.01 |
| 17277 | 7576672.31 | 401974.29 | 867.21 | 7A20110611SGR | 867.21 | 0.00 |
| 17279 | 7576634.54 | 402275.85 | 870.84 | 7A20110611SGR | 870.84 | 0.00 |
| 17280 | 7576647.97 | 402282.57 | 870.33 | 7A20110611SGR | 870.32 | 0.01 |
| 17281 | 7576663.09 | 402289.87 | 869.82 | 7A20110611SGR | 869.82 | 0.00 |
| 17282 | 7576678.17 | 402295.56 | 869.33 | 7A20110611SGR | 869.32 | 0.01 |
| 17283 | 7576694.61 | 402302.27 | 868.87 | 7A20110611SGR | 868.87 | 0.00 |
| 17284 | 7576710.05 | 402307.26 | 868.38 | 7A20110611SGR | 868.38 | 0.00 |
| 17285 | 7576725.22 | 402310.69 | 867.84 | 7A20110611SGR | 867.86 | -0.02 |
| 17286 | 7577573.46 | 402463.91 | 854.53 | 7A20110611SGR | 854.55 | -0.02 |
| 17287 | 7577588.97 | 402467.53 | 854.06 | 7A20110611SGR | 854.08 | -0.02 |
| 17288 | 7577605.61 | 402471.66 | 853.33 | 7A20110611SGR | 853.35 | -0.02 |
| 17289 | 7577623.49 | 402475.08 | 852.31 | 7A20110611SGR | 852.33 | -0.02 |
| 17290 | 7577639.78 | 402478.20 | 851.43 | 7A20110611SGR | 851.42 | 0.01 |
| 17291 | 7577656.74 | 402479.68 | 850.57 | 7A20110611SGR | 850.58 | -0.01 |
| 17292 | 7577672.16 | 402484.72 | 849.98 | 7A20110611SGR | 849.99 | -0.01 |
| 17293 | 7578606.47 | 402673.60 | 850.09 | 7A20110611SGR | 850.08 | 0.01 |
| 17294 | 7578608.10 | 402695.77 | 851.58 | 7A20110611SGR | 851.56 | 0.02 |
| 17295 | 7578608.03 | 402713.87 | 853.00 | 7A20110611SGR | 852.99 | 0.01 |
| 17296 | 7578609.33 | 402730.79 | 854.35 | 7A20110611SGR | 854.33 | 0.01 |
| 17297 | 7578611.48 | 402751.28 | 855.88 | 7A20110611SGR | 855.86 | 0.02 |
| 17298 | 7578615.88 | 402773.02 | 858.01 | 7A20110611SGR | 857.99 | 0.02 |
| 17299 | 7578626.67 | 402799.37 | 860.69 | 7A20110611SGR | 860.66 | 0.02 |
| 17300 | 7578631.67 | 402815.95 | 862.41 | 7A20110611SGR | 862.40 | 0.01 |
| 17301 | 7578646.80 | 402835.36 | 864.31 | 7A20110611SGR | 864.29 | 0.02 |
| 17302 | 7578650.20 | 402859.81 | 865.79 | 7A20110611SGR | 865.78 | 0.01 |
| 17303 | 7578615.24 | 402653.64 | 850.03 | 7A20110611SGR | 850.04 | -0.01 |
| 17304 | 7578632.17 | 402658.20 | 850.14 | 7A20110611SGR | 850.17 | -0.03 |
| 17305 | 7578649.57 | 402658.44 | 850.19 | 7A20110611SGR | 850.20 | -0.01 |
| 17306 | 7578666.10 | 402661.82 | 850.47 | 7A20110611SGR | 850.46 | 0.01 |
| 17307 | 7578682.30 | 402664.83 | 850.76 | 7A20110611SGR | 850.75 | 0.01 |
| 17308 | 7578697.94 | 402667.69 | 851.15 | 7A20110611SGR | 851.16 | -0.01 |
| 17309 | 7578713.98 | 402670.79 | 851.56 | 7A20110611SGR | 851.55 | 0.01 |
| 17310 | 7579396.05 | 402812.85 | 845.07 | 7A20110611SGR | 845.03 | 0.04 |
| 17311 | 7579412.43 | 402816.60 | 844.54 | 7A20110611SGR | 844.54 | 0.00 |
| 17312 | 7579430.06 | 402820.36 | 843.93 | 7A20110611SGR | 843.90 | 0.03 |
| 17313 | 7579445.47 | 402824.36 | 843.43 | 7A20110611SGR | 843.42 | 0.01 |
| 17314 | 7579461.68 | 402828.61 | 842.82 | 7A20110611SGR | 842.78 | 0.04 |
| 17315 | 7579477.26 | 402830.94 | 842.23 | 7A20110611SGR | 842.22 | 0.01 |
| 17316 | 7579492.49 | 402834.30 | 841.69 | 7A20110611SGR | 841.67 | 0.02 |
| 17317 | 7579820.75 | 402932.42 | 844.25 | 7A20110611SGR | 844.24 | 0.01 |
| 17318 | 7579836.26 | 402937.87 | 844.17 | 7A20110611SGR | 844.17 | 0.00 |
| 17319 | 7579851.34 | 402944.28 | 844.10 | 7A20110611SGR | 844.10 | 0.00 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 17320 | 7579868.01 | 402951.28 | 844.01 | 7A20110611SGR | 844.01 | 0.00 |
| 17321 | 7579884.73 | 402956.28 | 843.86 | 7A20110611SGR | 843.87 | -0.01 |
| 17322 | 7579900.08 | 402963.75 | 843.76 | 7A20110611SGR | 843.75 | 0.01 |
| 17323 | 7579914.15 | 402962.89 | 843.30 | 7A20110611SGR | 843.31 | -0.01 |
| 17324 | 7579932.28 | 402967.52 | 843.04 | 7A20110611SGR | 843.02 | 0.01 |
| 17325 | 7579950.79 | 402965.83 | 842.46 | 7A20110611SGR | 842.45 | 0.01 |
| 17326 | 7579962.98 | 402975.10 | 842.37 | 7A20110611SGR | 842.46 | -0.09 |
| 17327 | 7579770.67 | 402984.46 | 852.48 | 7A20110611SGR | 852.47 | 0.01 |
| 17328 | 7579766.59 | 403000.25 | 854.66 | 7A20110611SGR | 854.64 | 0.02 |
| 17329 | 7579756.85 | 403015.27 | 857.50 | 7A20110611SGR | 857.48 | 0.02 |
| 17330 | 7579749.52 | 403037.99 | 861.77 | 7A20110611SGR | 861.72 | 0.05 |
| 17331 | 7579737.02 | 403058.16 | 865.67 | 7A20110611SGR | 865.62 | 0.05 |
| 17332 | 7579712.42 | 403087.58 | 871.51 | 7A20110611SGR | 871.46 | 0.05 |
| 17333 | 7579693.74 | 403103.71 | 873.71 | 7A20110611SGR | 873.68 | 0.03 |
| 17334 | 7579680.39 | 403144.31 | 880.51 | 7A20110611SGR | 880.48 | 0.03 |
| 17335 | 7579667.81 | 403160.76 | 882.72 | 7A20110611SGR | 882.69 | 0.02 |
| 17336 | 7579647.56 | 403219.34 | 892.28 | 7A20110611SGR | 892.27 | 0.01 |
| 17337 | 7579644.67 | 403237.88 | 894.19 | 7A20110611SGR | 894.17 | 0.02 |
| 17338 | 7580868.21 | 403157.07 | 834.09 | 7A20110611SGR | 834.09 | 0.00 |
| 17339 | 7580883.53 | 403154.37 | 834.15 | 7A20110611SGR | 834.13 | 0.02 |
| 17340 | 7580897.87 | 403152.34 | 834.12 | 7A20110611SGR | 834.08 | 0.04 |
| 17341 | 7580913.42 | 403149.50 | 834.04 | 7A20110611SGR | 834.03 | 0.01 |
| 17342 | 7580929.80 | 403146.91 | 833.94 | 7A20110611SGR | 833.96 | -0.02 |
| 17343 | 7580943.44 | 403144.99 | 833.91 | 7A20110611SGR | 833.92 | -0.01 |
| 17344 | 7580960.70 | 403142.49 | 833.86 | 7A20110611SGR | 833.84 | 0.02 |
| 17345 | 7582481.57 | 403317.51 | 826.01 | 7A20110611SGR | 825.97 | 0.04 |
| 17346 | 7582497.56 | 403320.02 | 826.02 | 7A20110611SGR | 826.01 | 0.01 |
| 17347 | 7582519.50 | 403325.89 | 825.78 | 7A20110611SGR | 825.80 | -0.02 |
| 17348 | 7583520.35 | 403854.32 | 830.85 | 7A20110611SGR | 830.81 | 0.04 |
| 17349 | 7583538.78 | 403857.98 | 830.92 | 7A20110611SGR | 830.89 | 0.03 |
| 17350 | 7583552.30 | 403866.57 | 830.99 | 7A20110611SGR | 831.00 | -0.01 |
| 17351 | 7583565.24 | 403873.13 | 831.03 | 7A20110611SGR | 831.04 | -0.01 |
| 17352 | 7583578.17 | 403881.54 | 831.25 | 7A20110611SGR | 831.26 | -0.01 |
| 17403 | 7679160.41 | 428924.95 | 269.56 | 4A20110623SPR | 269.53 | 0.03 |
| 17404 | 7679174.48 | 428932.13 | 269.44 | 4A20110623SPR | 269.42 | 0.02 |
| 17405 | 7679189.01 | 428939.24 | 269.30 | 4A20110623SPR | 269.28 | 0.02 |
| 17406 | 7679203.07 | 428946.39 | 269.22 | 4A20110623SPR | 269.18 | 0.03 |
| 17407 | 7679216.87 | 428953.54 | 269.15 | 4A20110623SPR | 269.12 | 0.03 |
| 17408 | 7679230.32 | 428960.50 | 269.10 | 4A20110623SPR | 269.06 | 0.04 |
| 17409 | 7679243.88 | 428967.40 | 269.07 | 4A20110623SPR | 269.02 | 0.05 |
| 17410 | 7679258.76 | 428975.26 | 269.05 | 4A20110623SPR | 269.00 | 0.05 |
| 17411 | 7679273.17 | 428982.72 | 269.03 | 4A20110623SPR | 268.98 | 0.05 |
| 17412 | 7679286.18 | 428989.37 | 268.99 | 4A20110623SPR | 268.97 | 0.02 |
| 17413 | 7679299.50 | 428996.33 | 268.99 | 4A20110623SPR | 268.97 | 0.02 |
| 17414 | 7679313.23 | 429003.44 | 269.00 | 4A20110623SPR | 268.96 | 0.04 |
| 17415 | 7679324.55 | 429010.98 | 268.95 | 4A20110623SPR | 268.91 | 0.04 |
| 17416 | 7679344.78 | 429019.00 | 268.97 | 4A20110623SPR | 268.95 | 0.02 |
| 17417 | 7679358.44 | 429027.03 | 268.98 | 4A20110623SPR | 268.96 | 0.02 |
| 17418 | 7680062.84 | 429350.23 | 266.20 | 4A20110623SPR | 266.17 | 0.03 |
| 17419 | 7680082.92 | 429353.91 | 266.15 | 4A20110623SPR | 266.14 | 0.01 |
| 17420 | 7680097.29 | 429356.78 | 266.04 | 4A20110623SPR | 266.03 | 0.01 |
| 17421 | 7680111.92 | 429359.56 | 266.00 | 4A20110623SPR | 265.98 | 0.02 |
| 17422 | 7680126.92 | 429362.74 | 265.98 | 4A20110623SPR | 265.93 | 0.05 |
| 17423 | 7680141.32 | 429365.51 | 265.99 | 4A20110623SPR | 265.94 | 0.05 |
| 17424 | 7680155.73 | 429368.40 | 265.95 | 4A20110623SPR | 265.92 | 0.03 |

| CHECK POINTS | | | SURVEYED Elevation (Meters) | DESCRIPTOR | LiDAR Elevation (Meters) | Deviation (Meters) |
|---|---|---|---|---|---|---|
| Point Number | Northing (Meters) | Easting (Meters) | | | | |
| 17425 | 7680170.11 | 429371.25 | 265.82 | 4A20110623SPR | 265.81 | 0.01 |
| 17426 | 7680184.64 | 429374.67 | 265.72 | 4A20110623SPR | 265.67 | 0.05 |
| 17427 | 7680198.84 | 429377.49 | 265.59 | 4A20110623SPR | 265.57 | 0.02 |
| 17428 | 7680212.93 | 429380.36 | 265.48 | 4A20110623SPR | 265.46 | 0.02 |
| 17429 | 7680227.09 | 429383.06 | 265.39 | 4A20110623SPR | 265.36 | 0.03 |
| 17430 | 7680241.49 | 429385.87 | 265.26 | 4A20110623SPR | 265.25 | 0.01 |
| 17431 | 7680256.32 | 429388.63 | 265.22 | 4A20110623SPR | 265.21 | 0.00 |
| 17432 | 7680272.04 | 429391.69 | 265.23 | 4A20110623SPR | 265.19 | 0.04 |
| 17433 | 7680052.54 | 429343.95 | 266.03 | 4A20110623SPR | 266.00 | 0.03 |
| 17434 | 7680051.96 | 429350.25 | 266.23 | 4A20110623SPR | 266.22 | 0.01 |
| 17435 | 7680050.88 | 429357.42 | 266.19 | 4A20110623SGR | 266.15 | 0.04 |
| 17436 | 7680048.68 | 429373.96 | 265.38 | 4A20110623SGR | 265.36 | 0.02 |
| 17437 | 7680047.18 | 429389.64 | 264.66 | 4A20110623SGR | 264.66 | 0.00 |
| 17438 | 7680046.00 | 429403.77 | 264.54 | 4A20110623SGR | 264.52 | 0.02 |
| 17439 | 7680044.19 | 429421.08 | 264.75 | 4A20110623SGR | 264.72 | 0.03 |
| 17440 | 7680044.53 | 429437.62 | 264.94 | 4A20110623SGR | 264.91 | 0.03 |
| 17441 | 7680042.51 | 429453.63 | 265.06 | 4A20110623SGR | 265.04 | 0.02 |
| 17442 | 7680041.69 | 429468.29 | 265.03 | 4A20110623SGR | 265.01 | 0.01 |
| 17443 | 7680042.07 | 429501.07 | 262.93 | 4A20110623SGR | 262.91 | 0.01 |
| 17444 | 7680034.87 | 429532.49 | 263.74 | 4A20110623SGR | 263.72 | 0.02 |
| 17445 | 7680032.92 | 429547.79 | 263.96 | 4A20110623SGR | 263.91 | 0.05 |
| 17446 | 7680026.63 | 429561.35 | 264.00 | 4A20110623SGR | 263.96 | 0.04 |
| 17447 | 7680015.96 | 429573.49 | 263.96 | 4A20110623SGR | 263.92 | 0.04 |
| 17448 | 7680003.59 | 429585.90 | 263.80 | 4A20110623SGR | 263.74 | 0.06 |
| 17449 | 7679992.79 | 429597.50 | 263.75 | 4A20110623SGR | 263.71 | 0.04 |
| 17450 | 7679980.49 | 429609.45 | 263.68 | 4A20110623SGR | 263.67 | 0.01 |
| 17451 | 7679966.79 | 429616.81 | 263.70 | 4A20110623SGR | 263.68 | 0.02 |
| 17452 | 7679949.78 | 429623.87 | 263.68 | 4A20110623SGR | 263.65 | 0.03 |
| 17453 | 7679938.20 | 429632.76 | 263.75 | 4A20110623SGR | 263.72 | 0.03 |
| 17454 | 7679924.43 | 429641.89 | 263.79 | 4A20110623SGR | 263.77 | 0.02 |
| 17455 | 7679908.83 | 429652.73 | 263.85 | 4A20110623SGR | 263.82 | 0.03 |
| 17456 | 7679896.77 | 429661.58 | 263.82 | 4A20110623SGR | 263.80 | 0.02 |
| 17457 | 7679883.20 | 429668.27 | 263.85 | 4A20110623SGR | 263.83 | 0.02 |
| 17458 | 7679855.52 | 429681.67 | 263.86 | 4A20110623SGR | 263.82 | 0.04 |
| 17459 | 7679826.30 | 429684.18 | 263.92 | 4A20110623SGR | 263.90 | 0.02 |
| 17460 | 7679796.65 | 429683.22 | 264.35 | 4A20110623SGR | 264.33 | 0.02 |
| 17461 | 7679779.25 | 429680.24 | 264.58 | 4A20110623SGR | 264.55 | 0.03 |
| 17462 | 7679764.14 | 429676.97 | 264.69 | 4A20110623SGR | 264.64 | 0.05 |
| 17463 | 7680827.36 | 429503.37 | 264.01 | 4A20110623SPR | 263.99 | 0.02 |
| 17464 | 7680842.40 | 429506.78 | 263.83 | 4A20110623SPR | 263.82 | 0.01 |
| 17465 | 7680856.92 | 429511.12 | 263.72 | 4A20110623SPR | 263.70 | 0.02 |
| 17466 | 7680874.12 | 429513.91 | 263.78 | 4A20110623SPR | 263.75 | 0.03 |
| 17467 | 7680889.16 | 429516.57 | 263.74 | 4A20110623SPR | 263.69 | 0.05 |
| 17468 | 7680904.32 | 429519.62 | 263.69 | 4A20110623SPR | 263.65 | 0.04 |
| 17469 | 7680908.80 | 429519.75 | 263.66 | 4A20110623SPR | 263.64 | 0.02 |
| 17470 | 7680923.27 | 429522.14 | 263.61 | 4A20110623SPR | 263.58 | 0.03 |
| 17471 | 7680937.23 | 429525.86 | 263.54 | 4A20110623SPR | 263.51 | 0.03 |
| 17472 | 7680952.26 | 429528.23 | 263.48 | 4A20110623SPR | 263.48 | 0.00 |
| 17473 | 7680966.02 | 429531.96 | 263.43 | 4A20110623SPR | 263.41 | 0.02 |
| 17474 | 7680980.56 | 429534.83 | 263.40 | 4A20110623SPR | 263.38 | 0.02 |
| 17475 | 7680995.02 | 429537.25 | 263.32 | 4A20110623SPR | 263.35 | -0.03 |
| 17476 | 7681009.68 | 429540.29 | 263.27 | 4A20110623SPR | 263.25 | 0.02 |
| 17477 | 7681024.09 | 429542.95 | 263.21 | 4A20110623SPR | 263.21 | 0.00 |