



# VOLUME 6 - APPENDIX SECTION 6.6 – TOPOGRAPHY



Consultant Reference: LGA-1-GN-F-FRN-RT-0001\_00\_Appendix6.6  
2023-04-14



**Stantec** ■ **DESFOR** ■ **SYSTRA**

with subconsultant



**LES ARPEUTEURS-GÉOMÈTRES  
VOIENT LE MONDE  
AVANT TOUT LE MONDE.**

Les arpenteurs-géomètres établissent les bases de nos propriétés. Ils créent les frontières internationales. Leur expertise est indispensable et vit au cœur du développement économique, que ce soit dans des projets immobiliers, routiers ou hydroélectriques.

Depuis Samuel de Champlain, le premier arpenteur-géomètre, ils ont ouvert la voie de nos territoires, façonné nos villes et nos villages. Ils ont fait et font encore ce qui compte dans le développement.



# **GEOPOSITION**

**arpenteurs-géomètres**

## **AIRBORN LIDAR AND DIGITAL PHOTOGRAMMETRIC SURVEYS**

GRANDE ALLIANCE  
Project Number: B22-024

**TECHNICAL REPORT**  
December 13<sup>th</sup>, 2022

**pour un monde sur mesure**



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▶ **PROJECT GOAL**

**Realization of an airborne LiDAR survey and a simultaneous digital photogrammetric survey over 5 different sectors: Grevet-Chapais, Billy Diamond, Radisson and Whapmagoostui, Route du Nord and Eastmain**

▶ **LOCATION**

- 01- Grevet Chapais    Covering an area of 16.4 km<sup>2</sup>, the study corridor is located between Grevet and Chapais
- 02- Billy-Diamond    Covering an area of 297.9 km<sup>2</sup>, the study corridor is located between Matagami and Radisson
- 03- Radisson and Whapmagoostui    Covering an area of 365.9 km<sup>2</sup>, the study sites are located to the north and east of Radisson
- 04- Route du Nord    Covering an area of 162.4 km<sup>2</sup>, the study site is located between Chibougamau and the junction of the Billy-Diamond road.
- 05- Eastmain    Covering an area of 20.6 km<sup>2</sup>, the study site is located between the Billy-Diamond road and Eastmain

▶ **CLIENT**

Company    Groupe Desfor  
Contact    Marc-Antoine Allard

▶ **OPERATIONAL CONTEXT**

**FIELD WORK**

Airborne LiDAR surveys  
Digital photogrammetric surveys

**OFFICE WORK**

Airborne LiDAR processing (ajustements, classification)  
Photogrammetry (aerotriangulation, orthophoto-mosaic)  
Deliverables



## AIRBORNE LIDAR SURVEY

### AIRCRAFT

Piper Aztec, registered C-GNZQ  
(PHB Inc.)

Piper Aztec, registered C-GHMN  
(PHB Inc.)

### AIRBORNE LIDAR SYSTEM

**Model** Optech ALTM Galaxy PRIME No. 5060435  
**Last maintenance** February 2022  
See technical specifications in appendix 01

**Model** Optech ALTM Galaxy T2000 No. 5060488  
**Last maintenance** June 2021  
See technical specifications in appendix 02

### FLIGHT PARAMETER

**Pulse repetition Rate** 200 000 Hz  
**Scanning frequency** 54 Hz  
**Scanning angle** 20 degrees (on both sides of the nadir)  
**Flight height** 1400 m above ground  
**Lateral overlap** 20 %  
**Flight speed** 72 m/s  
**Swath width** 1019 m  
**Spacing between flight lines** 815 m  
**Ground LiDAR footprint** 35 cm  
**Point Density** 2 points per square meter

### RETURN

**Number** Maximum five (5) per pulse  
**Types** First returns, last returns, singular returns, intermediate returns  
**Intensity** Associated with each of the returns, for each of the pulses

## PERIODS

Session 170-51, June 19, 2022, 08:28 to 10:23 (Local)  
 Session 171-51, June 20, 2022, 08:54 to 14:07 (Local)  
 Session 174-51, June 23, 2022, 09:37 to 14:15 (Local)  
 Session 212-51, July 31, 2022, 08:26 to 09:00 (Local)  
 Session 214-51, August 2, 2022, 10:08 to 11:38 (Local)  
 Session 217-51, August 5, 2022, 09:14 to 10:34 (Local)  
 Session 227-51, August 15, 2022, 09:09 to 12:44 (Local)  
 Session 228-51, August 16, 2022, 09:15 to 15:23 (Local)  
 Session 229-51, August 17, 2022, 10:04 to 12:34 (Local)  
 Session 230-51, August 18, 2022, 09:33 to 11:49 (Local)  
 Session 235-51, August 23, 2022, 14:22 to 14:26 (Local)  
 Session 247-61, September 4, 2022, 18:06 to 19:54 (Local)  
 Session 248-51, September 5, 2022, 11:31 to 15:36 (Local)  
 Session 249-51, September 6, 2022, 13:52 to 13:55 (Local)  
 Session 250-51, September 7, 2022, 11:29 to 12:35 (Local)

## TRAJECTORY

**Inputs** Trajectory calculated by integrating GPS data and inertial data obtained during the aerial survey  
**"PP-RTX" mode** Trajectory calculated from a network of GPS bases

## SOFTWARE

Trimble PosPac (path calculations)  
 Teledyne Optech LMS (LiDAR point calculations)



## DIGITAL PHOTOGRAMMETRIC SURVEYS

### AIRCRAFT

Piper Aztec, registered C-GNZQ  
 (PHB Inc.)

### AERIAL CAMERA

**Model** iXU-RS 1000 Phase One (No.:YC030154)  
**Lens** Rodenstock 50 mm metric RGB (No.:12190369)  
**Focal** 51.7199 mm  
**Pixel size on the sensor** 4.6 microns  
**Sensor size** 11 608 pixels par 8708 pixels

## FLIGHT PARAMETERS

Flight height	1 400 m
Spectral band	Red, green, blue
Ground resolution	16 cm
Side overlap	60 %
Longitudinal overlap	40 %
Number of images	6,600 images

## TRAJECTORY

Inputs	Trajectory calculated by integrating GPS data and inertial data obtained during the aerial survey
"PP-RTX" mode	Trajectory calculated from a network of GPS bases

## SPECTRAL BANDS

Red, green, blue (RGB)

## BAND RESOLUTION

8 bits

## RADIOMETRY

Uniform colors on all images  
Treatments for brighter and deeper colors  
Treatments to reduce shading

## SOFTWARE

Capture One and iX Capture (PHASEONE)



## AIRBORNE LIDAR PROCESSING

### SOURCES

Airborne LiDAR surveys resulting from this mandate

### ADJUSTMENTS

### METHODOLOGY

Iterative process to improve the calibration parameters of the airborne LiDAR system to ensure good consistency between flight lines



**SOFTWARE**

LMS de Teledyne Optech

**CLASSIFICATION**

**METHODOLOGY**

Automatic classification of points on the ground using an algorithm developed in-house, only the last returns and singular returns are used during this classification

Editing of the classification of points on the ground by experienced technicians

**CLASSIFICATION**

Class 01 – Not classified

Class 02 - Ground

Class 03 – Low vegetation (0.3m to 0.5m)

Class 04 – Medium vegetation (0.5m to 2m)

Class 05 – High vegetation (2m and higher)

Class 07 - Noise

Class 09 - Water

**SOFTWARE**

TerraScan of the TerraSolid family

**CONTROL METHOD**

Control sites carried out by Geoposition

**VALIDATION**

- 1- **Grevet-Chapais** Results obtained following the analysis of the LiDAR data (depending on the control method chosen)  
Average = 0.016 m  
Standard Deviation = 0.029 m  
For more details on the results, see Appendix 04
  
- 2- **Billy Diamond** Results obtained following the analysis of the LiDAR data (depending on the control method chosen)  
Average = -0.009 m  
Standard Deviation = 0.023 m  
For more details on the results, see Appendix 04

- 3- Radisson and Whapmagoostui** Results obtained following the analysis of the LiDAR data (depending on the control method chosen)  
Average = 0.051 m  
Standard Deviation = 0.061 m  
For more details on the results, see Appendix 04
- 4- Route du Nord** Results obtained following the analysis of the LiDAR data (depending on the control method chosen)  
Average = 0.013 m  
Standard Deviation = 0.037 m  
For more details on the results, see Appendix 04
- 5- Eastmain** Results obtained following the analysis of the LiDAR data (depending on the control method chosen)  
Average = -0.013 m  
Standard Deviation = 0.021 m  
For more details on the results, see Appendix 04

## ACCURACY

The accuracy obtained confirm that the airborne LiDAR survey meets -/+ 10cm in open, flat area

## TILING

By tiles (1000 m by 1000 m)



## PHOTOGRAMMETRY IMAGES

Digital aerial images from this project

## AEROTRIANGULATION PERSPECTIVE CENTERS

Perspective centers fixed in position (X, Y and Z) and in attitude (Omega, Phi and Kappa) from kinematic trajectory data (GPS and inertial data)

## CONNECTION POINTS

Generated by auto-correlation process (automatic)

**DEVICE**

Digital station (two screens, polarized glasses, set of cranks and pedals)

**SOFTWARE**

Leica Photogrammetric Suite (LPS) with Orima and Cap-A modules

Trimble Inpho with MATCH module

**RESULTS**

**Grevet-Chapais**

Sigma naught: 0.8 micron

Root mean square error on perspective centers

RMS-X = 0.063 m

RMS-Y = 0.042 m

RMS-Z = 0.042 m

RMS-Omega = 0.0012 degrees

RMS-Phi = 0.0020 degrees

RMS-Kappa = 0.0052 degrees

**Billy Diamond**

Sigma naught: 0.7 micron

Root mean square error on perspective centers

RMS-X = 0.089 m

RMS-Y = 0.125 m

RMS-Z = 0.050 m

RMS-Omega = 0.0023 degrees

RMS-Phi = 0.0022 degrees

RMS-Kappa = 0.0055 degrees

**Radisson and Whapmagoostui**

Sigma naught: 0.7 micron

Root mean square error on perspective centers

RMS-X = 0.136 m

RMS-Y = 0.143 m

RMS-Z = 0.028 m

RMS-Omega = 0.0029 degrees

RMS-Phi = 0.0014 degrees

RMS-Kappa = 0.0063 degrees

**Route du Nord** Sigma naught: 0.7 micron  
Root mean square error on perspective centers  
RMS-X = 0.0111 m  
RMS-Y = 0.100 m  
RMS-Z = 0.054 m  
RMS-Omega = 0.0021 degrees  
RMS-Phi = 0.0018 degrees  
RMS-Kappa = 0.0060 degrees

**Eastmain** Sigma naught: 0.8 micron  
Root mean square error on perspective centers  
RMS-X = 0.120 m  
RMS-Y = 0.100 m  
RMS-Z = 0.044 m  
RMS-Omega = 0.0026 degrees  
RMS-Phi = 0.0024 degrees  
RMS-Kappa = 0.0029 degrees

The results meet the project requirements

## **ORTHOPHOTO-MOSAIC (RECTIFICATION ET MOSAIC)**

### **DIGITAL MODEL**

Airborne LiDAR Ground Data (DTM)

### **RESOLUTION**

16 cm

### **TILING**

By tiles (1000 m by 1000 m)

### **SOFTWARE**

Inpho with OrthoMaster, OrthoVista and OrthoVista Seam Editor modules



## **DELIVERABLES**

### **DIGITAL DELIVERABLES**

#### **FIELD WORK**

##### *Airborne LiDAR survey*

Airborne LiDAR System Calibration Report (Adobe Acrobat)

#### **TRAVAUX AU BUREAU**

##### *Airborne LiDAR processing*

Project limit (Shapefile)  
Tile index 1km by 1km (Shapefile)  
Limits of LiDAR acquisition (Shapefile)  
LiDAR points per file (LAS version 1.2)

##### *Photogrammetry*

Orthophoto-mosaic (GeoTIFF and ECW)  
Tile index 1km by 1km (Shapefile)



## **REFERENCE SYSTEM**

### **PROJECTION**

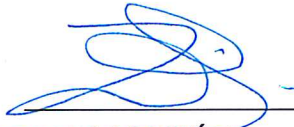
Mercator Transverse Modified (MTM), Zone 9

### **HORIZONTAL DATUM**

NAD83 SCRS

### **VERTICAL DATUM**

NMM (CGVD28)



---

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# APPENDIX 01

## TECHNICAL SPECIFICATIONS- Lidar Optech ALTM Galaxy PRIME

## ▶ Galaxy PRIME Technical Specifications

Parameter	Specification
<b>Sensor Performance</b>	
Performance envelope <sup>1, 2, 3, 4</sup>	150-6000 m AGL, nominal
Absolute horizontal accuracy <sup>2, 3</sup>	1/10,000 × altitude; 1 $\sigma$
Absolute elevation accuracy <sup>2, 3</sup>	< 0.03-0.25 m RMSE from 150-6000 m AGL
<b>Laser Configuration</b>	
Topographic laser	1064-nm near-infrared
Laser classification	Class IV (US FDA 21 CFR 1040.10 and 1040.11; IEC/EN 60825-1)
Pulse repetition frequency (effective)	Programmable, 50-1000 kHz
Beam divergence	0.25 mrad (1/e)
Laser range precision <sup>5</sup>	< 0.008 m, 1 $\sigma$
Minimum target separation distance	< 0.7 m (discrete)
Range capture	Up to 8 range measurements, including last
Intensity capture	Up to 8 intensity measurements, including last (12-bit)
<b>Sensor Configuration</b>	
Position and orientation system	POS AV™ AP60 (OEM); 220-channel dual frequency GNSS receiver; GNSS airborne antenna with Iridium filters; high-accuracy AIMU (Type 57); non-ITAR
Scan angle (FOV)	10-60°
Swath width	10-115% of altitude AGL
Scan frequency	0-120 Hz advertised (0-240 scan lines/sec)
Scan product	2000 maximum
Flight management system	Optech FMS (Airborne Mission Manager and Nav) with operator console
SwathTRAK™	Dynamic FOV for fixed-width data swaths in variable terrain
PulseTRAK™	Multipulse tracking algorithm with no density loss across PIA transition zones
Roll compensation	±5° minimum
Data storage	Removable SSD (primary); internal SSD (spare)
Power requirements	28 V; 400 W
Dimensions and weight	Sensor: 0.34 x 0.34 x 0.25 m, 27 kg — PDU: 0.42 x 0.33 x 0.10 m, 6.5 kg
Operating temperature	0 to +35°C
<b>Optional Peripherals</b>	
External data storage	Ruggedized, removable 2.5" SSD
Image capture	Compatible with all Optech CS-Series and most 3rd party digital metric cameras (integration kits available)
Full waveform capture	12-bit Optech IWR-3 Intelligent Waveform Recorder with removable SSD
Gyro-stabilization	SOMAG GSM4000 integration kit
Multi-sensor mounts and pods	Machined aluminum sensor mounts (aircraft and/or helicopter) Carbon-fiber sensor mounts supporting nadir and fore/aft oblique cameras Heli-pod mount options for Bell 206/407 (FAA-approved)

1. Target reflectivity  $\geq 20\%$ ; 99% detection probability
2. Dependent on selected operational parameters; assumes nominal FOV of up to 40° in standard atmospheric conditions (i.e. 23-km visibility) and use of Optech LMS Professional software suite
3. Angle of incidence  $\leq 20^\circ$
4. Target size  $\geq$  laser footprint
5. Under Teledyne Optech test conditions, 1 sigma

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Everywhereyoulook™  
Part of the Teledyne Imaging Group



# APPENDIX 02

TECHNICAL SPECIFICATIONS- Lidar Optech ALTM Galaxy T2000



PARAMETER	SPECIFICATION
<b>Sensor Performance</b>	
Performance envelope <sup>1,2,3,4</sup>	150-6500 m AGL, nominal
Absolute horizontal accuracy <sup>2,3</sup>	1/10,000 x altitude; 1 $\sigma$
Absolute elevation accuracy <sup>2,5</sup>	< 0.03-0.25 m RMSE from 150-6500 m AGL
<b>Laser Configuration</b>	
Topographic laser	1064-nm near-infrared
Laser classification	Class IV (US FDA 21 CFR 1040.10 and 1040.11; IEC/EN 60825-1)
Pulse repetition frequency (effective)	Programmable, 50-2000 kl-z
Beam divergence	0.16 mrad (1/e) or 0.23 mrad (1/e <sup>2</sup> )
Laser range precision <sup>5</sup>	< 0.008 m, 1 $\sigma$
Minimum target separation distance	< 0.7 m (discrete)
Range capture	Up to 8 range measurements, including last
Intensity capture	Up to 8 intensity measurements, including last (12-bit)
<b>Sensor Configuration</b>	
Position and orientation system	POS AV™ AP60 (OEM), 220-channel dual frequency GNSS receiver; GNSS airborne antenna with Iridium filters; high-accuracy AIMU (Type 57); non-ITAR
Scan angle (FOV)	10-60°
Swath width	10-115% of altitude AGL
Scan frequency	Maximum 160 Hz (320 scan lines/sec)
Flight management system	Optech FMS (Airborne Mission Manager and Nav) with operator console
SwathTRAK™	Dynamic FOV for fixed-width data swaths in variable terrain
PulseTRAK™	Multipulse tracking algorithm with no density loss across PIA transition zones
Roll compensation	±5° minimum
Data storage	Removable SSD (primary); internal SSD (spare)
Power requirements	28 V; 400 W
Dimensions and weight	Sensor: 0.34 x 0.34 x 0.25 m, 27 kg — PDU: 0.42 x 0.33 x 0.10 m, 6.5 kg
Operating temperature	0 to +35°C
<b>Optional Peripherals</b>	
External data storage	Ruggedized, removable 2.5" SSD
Image capture	Compatible with all Optech CS-Series and most 3rd party digital metric cameras (integration kits available)
Full waveform capture	12-bit Optech IWR-3 Intelligent Waveform Recorder with removable SSD
Gyro-stabilization	SOMAG GSM4000 integration kit
Multi-sensor mounts and pods	Machined aluminum sensor mounts; single or dual Galaxy configurations + cameras Carbon-fiber sensor mounts supporting nadir and fore/aft oblique cameras Heli-pod mount options for Bell 206/407 (FAA-approved)

1. Target reflectivity >20%; 99% detection probability  
 2. Dependent on selected operational parameters; assumes nominal FOV of up to 40° in standard atmospheric conditions (i.e. 23-km visibility) and use of Optech LMS Professional software suite  
 3. Angle of incidence ≤40°  
 4. Target size ≥ laser footprint  
 5. Under Teledyne Optech test conditions, 1 sigma

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# APPENDIX 03

**CALIBRATION REPORT - OPTECH ALTM Galaxy PRIME (5060435)**



**Airborne Lidar Repair Conformance Report**

**Optech ALTM Galaxy Prime**

**S/N 5060435**

**Prepared for:**

Perron Hudon Belanger Inc. (PHB)  
90D Chemin de la Grande Cote  
Boisbriand, QC, J7G 1C3  
Canada

**Prepared by:**

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**Signature:**

**Date:**

February 2022

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Jan 2017

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# 1 SYSTEM CONFIRMATION AND ACCEPTANCE

## Summary statement

The system with the following model and sensor head serial numbers:

<b>Model</b>	<b>Galaxy Prime</b>
<b>S/N</b>	<b>5060435</b>

has been tested according to the test program outlined by Teledyne Optech, a business unit of Teledyne Digital Imaging Inc., herein. The system was tested in field and laboratory environments in the following period:

<b>Start Date</b>	<b>[January 2022]</b>
<b>End Date</b>	<b>[February 2022]</b>



## 2 SYSTEM SPECIFICATIONS

Table 1: System specifications

Parameter	Specification
<b>Sensor Performance</b>	
Performance envelope <sup>1,2,3,4</sup>	150-6000 m AGL, nominal
Absolute horizontal accuracy <sup>2,3</sup>	1/10,000 x altitude; 1 $\sigma$
Absolute elevation accuracy <sup>2,3</sup>	< 0.03-0.25 m RMSE from 150-6000 m AGL
<b>Laser Configuration</b>	
Topographic laser	1064-nm near-infrared
Laser classification	Class IV (US FDA 21 CFR 1040.10 and 1040.11; IEC/EN 60825-1)
Pulse repetition frequency (effective)	Programmable, 50-1000 kHz
Beam divergence	0.25 mrad (1/e)
Laser range precision <sup>5</sup>	< 0.008 m, 1 $\sigma$
Minimum target separation distance	< 0.7 m (discrete)
Range capture	Up to 8 range measurements, including last
Intensity capture	Up to 8 intensity measurements, including last (12-bit)
<b>Sensor Configuration</b>	
Position and orientation system	POS AV™ AP60 (OEM); 220-channel dual frequency GNSS receiver; GNSS airborne antenna with Iridium filters; high-accuracy AIMU (Type 57), non-ITAR
Scan angle (FOV)	10-60°
Swath width	10-115% of altitude AGL
Scan frequency	0-120 Hz advertised (0-240 scan lines/sec)
Scan product	2000 maximum
Flight management system	Optech FMS (Airborne Mission Manager and Nav) with operator console
SwathTRAK™	Dynamic FOV for fixed-width data swaths in variable terrain
PulseTRAK™	Multipulse tracking algorithm with no density loss across PIA transition zones
Roll compensation	±5° minimum
Data storage	Removable SSD (primary); internal SSD (spare)
Power requirements	28 V; 400 W
Dimensions and weight	Sensor: 0.34 x 0.34 x 0.25 m, 27 kg — PDU: 0.42 x 0.33 x 0.10 m, 6.5 kg
Operating temperature	0 to +35°C
<b>Optional Peripherals</b>	
External data storage	Ruggedized, removable 2.5" SSD
Image capture	Compatible with all Optech CS-Series and most 3rd party digital metric cameras (integration kits available)
Full waveform capture	12-bit Optech IWR-3 Intelligent Waveform Recorder with removable SSD
Gyro-stabilization	SOMAG GSM4000 integration kit
Multi-sensor mounts and pods	Machined aluminum sensor mounts (aircraft and/or helicopter) Carbon-fiber sensor mounts supporting nadir and fore/aft oblique cameras Hell-pod mount options for Bell 206/407 (FAA-approved)

1. Target reflectivity >100%, 90% detection probability
2. Dependent on selected operational parameters; assumes nominal FOV of up to 40° in standard atmospheric conditions (i.e. 25-km visibility) and use of Optech LPS Professional software suite
3. Angle of incidence <20°
4. Target size > laser footprint
5. Under Teledyne Optech test conditions, 1 sigma

### Notes

To meet its stated accuracy, the airborne lidar must receive GPS data of sufficient quality.

### 3 LIDAR PERFORMANCE CHECKLIST

**Table 2: Lidar Performance Checklist**

Parameter	Checked
Relative or Absolute Vertical Accuracy	Pass
Relative Horizontal Accuracy	Pass
Maximum Altitude Detection	Pass
Healthy IMU/POS	Pass
Calibration	Pass
SwathTRAK and PulseTRAK	Pass
Successful Airborne Operation	Pass

**Table 3: Calibrated Accuracy over calibration control field**

Flight day	Flight altitude (m AGL)	Laser PRF (kHz)	Scan freq. (Hz)	FOV (±°)	Std dev. (m)	RMS (m)	Mean diff. from GCPs (m)
20220116	1063	100	40	30	0.0114	0.0115	0.0021
20220116	1044	100	40	30	0.0105	0.0111	0.0038
20220116	1033	100	40	30	0.0084	0.0119	-0.0084
20220116	1319	800	83	24	0.0116	0.0186	-0.0145
20220116	1359	800	83	24	0.0140	0.0171	0.0100
20220116	1331	800	83	24	0.0097	0.0101	-0.0031
20220116	1042	300	58	30	0.0145	0.0161	-0.0073
20220116	1053	300	58	30	0.0113	0.0141	-0.0085
20220116	1035	300	58	30	0.0106	0.0108	0.0027
20220130	1400	800	83	24	0.0227	0.0229	0.0037
20220130	1351	800	83	24	0.0214	0.0238	-0.0107
20220130	225	300	58	30	0.0177	0.0211	-0.0120

**Airborne Lidar Conformance Report**  
**Optech Galaxy, S/N 5060435**



Flight day	Flight altitude (m AGL)	Laser PRF (kHz)	Scan freq. (Hz)	FOV (±°)	Std dev. (m)	RMS (m)	Mean diff. from GCPs (m)
20220130	621	300	58	30	0.0183	0.0199	0.0079
20220130	1076	300	58	30	0.0176	0.0187	-0.0066
20220130	1085	300	58	30	0.0140	0.0195	0.0138
20220130	1034	200	40	30	0.0196	0.0199	0.0041
20220130	1019	200	40	30	0.0172	0.0197	-0.0096
20220130	1035	200	40	30	0.0159	0.0163	0.0040
20220206	2845	300	38	20	0.0283	0.0288	-0.0059
20220206	2546	350	51	25	0.0305	0.0317	0.0092
20220206	2224	450	51	25	0.0310	0.0316	-0.0065
20220206	2037	550	90	20	0.0298	0.0298	-0.0025
20220206	1735	550	90	20	0.0307	0.0306	0.0009
20220206	1213	750	90	20	0.0266	0.0264	0.0000
20220206	1025	550	80	25	0.0281	0.0320	0.0156
20220206	1014	1000	40	30	0.0298	0.0297	-0.0008
20220206	1024	100	40	30	0.0183	0.0194	0.0068
20220206	1031	100	40	30	0.0164	0.0216	-0.0142
20220206	1023	100	40	30	0.0190	0.0222	-0.0115
20220206	926	750	120	16	0.0105	0.0170	-0.0135
20220206	840	1000	100	20	0.0101	0.0161	-0.0126
20220206	514	550	120	16	0.0104	0.0102	0.0001
20220206	507	550	100	20	0.0113	0.0227	-0.0198

**Table 4: Relative horizontal roof line analysis from Optech LMS for area**

Flight 20220206	Mean	RMS	Minimum	Maximum
Delta East X	0.0010	0.0370	-0.3040	0.2860
Delta North Y	0.0010	0.0280	-0.2090	0.4810
Delta Height Z	0.0000	0.0200	-0.1640	0.1650
Horizontal Separation	-0.0010	0.0470	-0.3690	0.5040



**Airborne Lidar Conformance Report**  
**Optech Galaxy, S/N 5060435**

Flight 20220206	Mean	RMS	Minimum	Maximum
Diff. Azimuth	-0.00659	0.45682	-3.45379	3.19956
Diff. Slope	-0.0296	0.16769	-0.98477	1.5685

## 4 CALIBRATION FILES

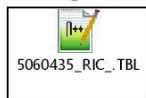
### 4.1 LCP file

The calibrated LCP file in LMS 4.5 format.



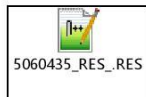
### 4.2 Range intensity correction table

The range intensity correction table in LMS 4.5 format.



### 4.3 RES file

The calibrated RES file in LMS 4.5 format.



## 5 REPORT GENERATION SOFTWARE

The following software was used to generate this report.

Table 5: Software used to generate the report

Software	Version
Optech AAM Planner	5.4.4
Optech FMS Nav	5.3.14
Optech LMS Pro	4.5.0.28945
Optech Decode	6.3.0
Terrasolid	19

# APPENDIX 04

**CALIBRATION REPORT - OPTECH ALTM Galaxy T2000 (5060488)**



**Certificate of Conformance  
Optech Galaxy**

<b>Product:</b>	Galaxy T2000
<b>Serial No.:</b>	5060488
<b>Date of Conformance:</b>	June 2021
<b>Manufacturer:</b>	Teledyne Optech, a business unit of Teledyne Digital Imaging, Inc. 300 Interchange Way Vaughan, ON, L4K 5Z8 Canada
<b>Sales Order No.:</b>	200122
<b>Purchaser:</b>	Perron, Hudon, Belanger Inc. 88 Chemin de la Grande-Cote Boisbriand, Quebec, J7G1C3 Canada

The product specified above has been manufactured, calibrated and inspected in accordance with drawings, specifications and contract or purchase order requirements. It meets all engineering and product specifications.

Test reports covering the performance of the product are on file and available for review at the manufacturer's plant upon request.

<b>Manufacturing Operations Signature:</b> <i>Valery Kaganovsky</i>	<b>Date:</b> June 2021
<i>Name: Mr. Valery Kaganovsky</i>	
<b>Quality Assurance Signature:</b> <i>M.P.</i>	<b>Date:</b> June 2021
<i>Name: Mr. Martin Pokorny</i>	

Template 0113545/Jun 2019/Rev B



# APPENDIX 05

## Project Limits



# APPENDIX 06

## LiDAR data analysis

# LiDAR Data Analysis Table

## 1- Grevet-Chapais corridor

Identifiers	X Coordinates	Y Coordinates	Z known coord.	Z LIDAR coord.	Differences
9001	421040.77	5516859.93	369.332	369.361	0.029
9002	421047.881	5516864.3	369.418	369.429	0.011
9003	421055.532	5516868.97	369.461	369.48	0.019
9004	421063.072	5516873.59	369.509	369.53	0.021
9005	421070.982	5516877.93	369.547	369.566	0.019
9006	421079.14	5516882.56	369.594	369.632	0.038
9007	421087.013	5516886.98	369.654	369.667	0.013
9008	421094.813	5516891.85	369.719	369.73	0.011
9009	421103.065	5516896.39	369.749	369.763	0.014
9010	421110.932	5516900.87	369.775	369.784	0.009
9011	421119.635	5516905.37	369.79	369.795	0.005
9012	421128.136	5516909.51	369.792	369.8	0.008
9013	421136.532	5516913.47	369.779	369.793	0.014
9014	421144.71	5516917.08	369.771	369.783	0.012
9015	421153.132	5516920.66	369.788	369.807	0.019
9016	421161.676	5516923.92	369.804	369.821	0.017
9017	421170.199	5516927.17	369.817	369.833	0.016
9018	421179.267	5516930.37	369.83	369.865	0.035
9019	421188.318	5516933.26	369.823	369.844	0.021
9020	421197.141	5516935.77	369.841	369.834	-0.007
9021	421132.269	5516936.38	370.527	370.622	0.095
9022	421132.995	5516934.1	370.063	370.127	0.064
9023	421133.729	5516931.69	369.735	369.763	0.028
9024	421134.916	5516928.23	369.496	369.521	0.025
9025	421136.846	5516924.88	369.215	369.274	0.059
9026	421138.082	5516921.57	369.584	369.606	0.022
9027	421142.066	5516911.13	369.48	369.547	0.067
9028	421143.959	5516905.71	369.895	369.945	0.05
9029	421145.932	5516899.69	369.929	370.024	0.095
9030	421146.688	5516897.22	369.587	369.625	0.038
9031	421148.241	5516891.85	369.012	369.031	0.019
10000	328417.717	5486693.87	311.266	311.284	0.018

10001	328382.135	5486677.64	311.852	311.85	-0.002
10002	328391.901	5486687.77	311.822	311.823	0.001
10003	328401.956	5486698.28	311.714	311.735	0.021
10004	328411.109	5486707.83	311.647	311.653	0.006
10005	328420.939	5486717.98	311.597	311.593	-0.004
10006	328430.483	5486727.89	311.554	311.56	0.006
10007	328440.178	5486737.86	311.494	311.511	0.017
10008	328450.188	5486748.34	311.424	311.423	-0.001
10009	328459.289	5486757.93	311.394	311.418	0.024
10010	328468.872	5486767.89	311.393	311.411	0.018
10011	328478.391	5486777.82	311.457	311.486	0.029
10012	328488.17	5486788.08	311.558	311.566	0.008
10013	328497.47	5486797.83	311.651	311.653	0.002
10014	328507.039	5486807.87	311.774	311.792	0.018
10015	328372.129	5486667.27	311.93	311.937	0.007
10016	328362.808	5486657.44	312.08	312.078	-0.002
10017	328353.042	5486647.26	312.231	312.233	0.002
10018	328343.665	5486637.29	312.361	312.357	-0.004
10019	328334.03	5486627.23	312.535	312.534	-0.001
10020	328324.295	5486617.05	312.678	312.68	0.002
10021	328314.384	5486606.71	312.799	312.803	0.004
10022	328305.056	5486596.87	312.932	312.937	0.005
10023	328295.636	5486587.06	313.009	313.026	0.017
10024	328286.494	5486577.44	313.114	313.111	-0.003
10025	328277.023	5486567.41	313.185	313.204	0.019
10026	328267.517	5486557.47	313.244	313.245	0.001
10027	328257.835	5486547.42	313.296	313.297	0.001
10028	328371.412	5486675.2	311.577	311.597	0.02
10029	328360.557	5486674.13	311.002	311.025	0.023
10030	328350.149	5486672.43	310.809	310.804	-0.005
10031	328340.725	5486670.63	310.414	310.434	0.02
10032	328331.205	5486668.91	310.314	310.336	0.022
10033	328321.901	5486667.29	310.218	310.23	0.012
10034	328311.666	5486665.66	310.025	310.041	0.016
10035	328301.685	5486663.88	309.857	309.878	0.021
10036	328291.496	5486662.15	309.694	309.685	-0.009
10037	328281.142	5486660.21	309.473	309.486	0.013
10038	328271.677	5486658.54	309.34	309.343	0.003
10039	328261.718	5486656.66	309.145	309.18	0.035
10040	328251.489	5486654.91	308.954	308.965	0.011
10044	328392.224	5486678.41	311.615	311.64	0.025
10045	328402.42	5486680.05	311.537	311.558	0.021
10046	328412.36	5486681.9	311.572	311.594	0.022
10047	328422.271	5486683.71	311.699	311.703	0.004
10048	328432.5	5486685.44	311.788	311.78	-0.008
10049	328442.168	5486687.29	311.868	311.895	0.027

10050	328452.148	5486688.76	311.984	311.998	0.014
10051	328462.411	5486690.56	312.087	312.072	-0.015
10052	328472.309	5486692.13	312.214	312.215	0.001
10053	328482.293	5486694.22	312.357	312.347	-0.01
10054	328492.433	5486696.23	312.486	312.509	0.023
10055	328502.244	5486698.21	312.575	312.618	0.043
10056	328512.205	5486699.96	312.684	312.718	0.034
10061	328388.552	5486678.32	311.736	311.757	0.021
10062	328375.069	5486676.26	311.702	311.733	0.031
11021	291711.134	5456815.6	317.769	317.773	0.004
11022	291701.464	5456811.68	317.555	317.552	-0.003
11023	291691.304	5456807.81	317.283	317.282	-0.001
11024	291681.229	5456803.87	316.975	316.963	-0.012
11025	291671.241	5456800.19	316.655	316.647	-0.008
11026	291661.224	5456796.6	316.379	316.382	0.003
11027	291651.351	5456792.88	316.16	316.161	0.001
11028	291641.683	5456789.28	315.982	315.983	0.001
11029	291640.454	5456782.93	315.718	315.719	0.001
11030	291655.337	5456788.92	315.764	315.818	0.054
11031	291679.3	5456795.34	316.431	316.413	-0.018
11034	291756.182	5456868.11	318.059	318.047	-0.012
11035	291751.418	5456877.43	317.914	317.917	0.003
11036	291746.855	5456886.49	317.85	317.842	-0.008
11037	291742.422	5456895.26	317.797	317.802	0.005
11038	291737.793	5456904.29	317.693	317.677	-0.016
11039	291733.029	5456913.62	317.593	317.595	0.002
11040	291728.214	5456923.19	317.432	317.473	0.041
11041	291723.741	5456931.94	317.371	317.365	-0.006
11042	291719.201	5456940.82	317.162	317.208	0.046
11043	291714.527	5456949.92	316.942	316.995	0.053
11044	291708.858	5456960.3	316.923	316.98	0.057
11045	291703.44	5456971.08	316.843	316.87	0.027
11046	291698.369	5456981.89	316.765	316.796	0.031
11058	291711.905	5456947.09	316.932	316.934	0.002
11059	291712.053	5456946.86	316.952	316.938	-0.014
11060	291714.425	5456948.18	316.972	317.05	0.078
11061	291711.712	5456947.45	316.932	316.936	0.004
11062	291711.611	5456947.69	316.967	316.941	-0.026
11063	291713.96	5456948.88	316.902	317.029	0.127

<b>Average of the differences</b>	<b>0.016</b>
<b>Minimum difference</b>	<b>-0.026</b>
<b>Maximum difference</b>	<b>0.127</b>
<b>Mean magnitude</b>	<b>0.02</b>

Standard deviation	0.029
Standard deviation	0.024

## 2- Billy Diamond road

Identifiers	X Coordinates	Y Coordinates	Z known coord.	Z LiDAR coord.	Differences
100	221764.246	5514095.87	270.158	270.102	-0.056
101	221771.264	5514102.96	270.183	270.129	-0.054
102	221777.482	5514109.36	270.201	270.145	-0.056
103	221783.86	5514115.93	270.217	270.147	-0.07
104	221790.421	5514122.78	270.174	270.122	-0.052
105	221796.878	5514129.52	270.129	270.077	-0.052
106	221803.507	5514136.52	270.068	270.03	-0.038
107	221810.149	5514143.47	270.036	269.987	-0.049
108	221816.736	5514150.33	269.951	269.937	-0.014
109	221823.128	5514157.22	269.931	269.922	-0.009
110	221829.958	5514164.33	269.9	269.874	-0.026
111	221836.994	5514171.77	269.916	269.903	-0.013
112	221845.159	5514180.36	270.012	269.977	-0.035
113	221851.622	5514187.24	270.022	270.005	-0.017
114	221856.876	5514192.75	270.071	270.056	-0.015
115	221862.72	5514198.95	270.134	270.127	-0.007
116	221868.131	5514204.66	270.176	270.159	-0.017
117	221875.231	5514212.16	270.267	270.255	-0.012
118	221881.922	5514219.31	270.3	270.283	-0.017
119	221889.394	5514227.07	270.302	270.287	-0.015
200	240024.611	5706123.2	203.712	203.707	-0.005
201	240025.455	5706113.67	203.74	203.737	-0.003
202	240026.246	5706104.21	203.757	203.76	0.003
203	240027.098	5706094.72	203.781	203.789	0.008
204	240027.933	5706085.1	203.79	203.79	0
205	240028.752	5706076.04	203.83	203.831	0.001
206	240029.551	5706066.56	203.85	203.844	-0.006
207	240030.359	5706057.02	203.844	203.848	0.004
208	240031.226	5706047.18	203.851	203.846	-0.005
209	240032.079	5706037.44	203.864	203.859	-0.005
210	240032.953	5706028.05	203.858	203.862	0.004
211	240033.842	5706018.53	203.85	203.853	0.003
212	240034.635	5706009.02	203.829	203.836	0.007
213	240035.454	5705998.87	203.781	203.795	0.014
214	240036.258	5705989.56	203.753	203.75	-0.003
215	240037.097	5705979.8	203.692	203.685	-0.007



216	240037.905	5705970.44	203.64	203.637	-0.003
217	240038.677	5705961.25	203.566	203.565	-0.001
218	240039.5	5705951.9	203.471	203.459	-0.012
219	240040.336	5705942.34	203.371	203.378	0.007
225	240027.64	5706009.6	203.888	203.888	0
226	240036.956	5706015.14	203.825	203.82	-0.005
227	240046.232	5706019.85	203.95	203.935	-0.015
228	240055.136	5706024.29	204.108	204.079	-0.029
229	240064.508	5706028.79	204.288	204.302	0.014
230	240071.318	5706031.4	204.441	204.444	0.003
231	240080.204	5706036.32	204.531	204.523	-0.008
232	240088.859	5706041.03	204.571	204.549	-0.022
233	240097.677	5706045.64	204.577	204.567	-0.01
234	240105.974	5706049.84	204.617	204.615	-0.002
235	240114.443	5706053.89	204.649	204.641	-0.008
236	240122.838	5706057.79	204.717	204.737	0.02
237	240131.59	5706062.53	204.822	204.807	-0.015
238	240140.228	5706066.91	204.954	204.963	0.009
239	240150.844	5706072.18	205.151	205.159	0.008
240	240159.378	5706076.77	205.312	205.314	0.002
300	250254.019	5767896.81	254.427	254.408	-0.019
301	250263.509	5767892.97	254.628	254.61	-0.018
302	250272.94	5767889.25	254.793	254.779	-0.014
303	250282.203	5767885.45	254.962	254.951	-0.011
304	250291.509	5767881.58	255.098	255.078	-0.02
305	250300.644	5767877.79	255.237	255.213	-0.024
306	250309.905	5767873.9	255.326	255.308	-0.018
307	250319.137	5767870.01	255.396	255.372	-0.024
308	250328.396	5767866.13	255.461	255.44	-0.021
309	250336.155	5767862.65	255.499	255.482	-0.017
310	250345.326	5767858.83	255.555	255.546	-0.009
311	250354.566	5767854.82	255.574	255.552	-0.022
312	250362.945	5767851.11	255.562	255.543	-0.019
313	250373.733	5767846.3	255.497	255.474	-0.023
314	250382.706	5767842.25	255.422	255.4	-0.022
315	250391.702	5767837.98	255.323	255.309	-0.014
316	250401.114	5767833.66	255.221	255.203	-0.018
317	250410.292	5767829.22	255.079	255.06	-0.019
318	250419.178	5767824.88	254.94	254.929	-0.011
319	250427.665	5767820.69	254.797	254.782	-0.015
337	250317.358	5767785.25	253.675	253.655	-0.02
338	250313.15	5767776.63	253.436	253.439	0.003
339	250309.368	5767768.13	253.238	253.221	-0.017
340	250305.315	5767759.24	252.969	252.964	-0.005
341	250301.447	5767750.42	252.682	252.673	-0.009
342	250297.506	5767741.26	252.359	252.355	-0.004

343	250293.532	5767732.4	252.011	252.003	-0.008
344	250289.779	5767723.62	251.638	251.636	-0.002
345	250286.058	5767714.8	251.27	251.28	0.01
346	250282.351	5767706.04	250.911	250.913	0.002
18403	238871.623	5596085.64	292.248	292.263	0.015
18406	238883.158	5596079.18	292.121	292.128	0.007
18409	238894.305	5596073.35	291.994	291.996	0.002
18412	238905.742	5596067.26	291.873	291.878	0.005
18415	238917.223	5596061.76	291.743	291.756	0.013
18418	238928.359	5596056.29	291.625	291.633	0.008
18421	238938.283	5596051.85	291.527	291.53	0.003
18424	238774.913	5596144.91	291.967	291.974	0.007
18427	238765.082	5596151.26	291.756	291.779	0.023
18430	238754.52	5596157.62	291.509	291.532	0.023
18433	238744.914	5596163.76	291.249	291.266	0.017
18436	238734.416	5596170.23	290.94	290.946	0.006
18439	238723.394	5596177.26	290.56	290.574	0.014
18442	238712.116	5596184.25	290.152	290.177	0.025
18445	238702.58	5596190.35	289.777	289.795	0.018
18448	238692.472	5596196.54	289.346	289.362	0.016
18451	238683.586	5596202.3	288.945	288.945	0
18454	238672.871	5596208.87	288.418	288.422	0.004
18457	238662.301	5596215.71	287.853	287.864	0.011
18460	238650.564	5596222.9	287.212	287.215	0.003
18463	238640.368	5596229.41	286.6	286.62	0.02
18466	238631.604	5596234.71	286.068	286.078	0.01
18468	238781.354	5596130.9	291.984	292.007	0.023
18469	238776.124	5596122.66	291.533	291.552	0.019
18470	238770.784	5596113.84	291.415	291.429	0.014
18471	238764.817	5596104.16	291.39	291.364	-0.026
18472	238759.471	5596095.28	291.235	291.227	-0.008
18473	238754.446	5596086.74	291.05	291.059	0.009
18474	238749.013	5596077.64	290.917	290.925	0.008
18475	238744.132	5596069.22	290.773	290.746	-0.027
18476	238738.971	5596060.7	290.379	290.382	0.003
18477	238732.585	5596050.16	289.763	289.792	0.029
18478	238726.342	5596040.32	289.286	289.286	0
18479	238720.701	5596031.22	288.799	288.797	-0.002
18480	238715.888	5596023.42	288.412	288.422	0.01
18481	238710.355	5596014.29	288.019	288.027	0.008
18482	238705.24	5596005.78	287.692	287.708	0.016
18483	238700.02	5595997.17	287.4	287.422	0.022
18484	238694.895	5595988.85	287.149	287.205	0.056
18485	238689.597	5595980.09	286.963	287	0.037
18486	238684.474	5595971.61	286.919	286.933	0.014
18493	238786.056	5596137.9	292.159	292.181	0.022

18514	238797.422	5596130.77	292.334	292.343	0.009
18517	238808.137	5596124.19	292.441	292.449	0.008
18520	238817.365	5596118.2	292.509	292.523	0.014
18523	238827.502	5596112.01	292.539	292.552	0.013
18526	238837.183	5596105.79	292.551	292.552	0.001
18529	238848.651	5596098.98	292.493	292.498	0.005
18532	238860.382	5596091.93	292.383	292.385	0.002
18536	221249.778	5624451.62	258	257.945	-0.055
18539	221240.99	5624446.13	257.791	257.772	-0.019
18542	221231.298	5624439.53	257.616	257.595	-0.021
18545	221221.203	5624432.54	257.424	257.389	-0.035
18548	221211.575	5624425.16	257.216	257.2	-0.016
18551	221202.236	5624418.02	257.005	256.995	-0.01
18554	221192.172	5624409.53	256.771	256.766	-0.005
18557	221183.803	5624402.37	256.57	256.548	-0.022
18560	221175.173	5624394.47	256.344	256.332	-0.012
18563	221167.001	5624386.83	256.133	256.104	-0.029
18566	221158.963	5624378.77	255.925	255.895	-0.03
18569	221151.67	5624371.34	255.716	255.688	-0.028
18572	221143.367	5624362.36	255.467	255.444	-0.023
18575	221133.038	5624350.58	255.141	255.125	-0.016
18578	221292.699	5624475.64	258.939	258.906	-0.033
18581	221304.19	5624481.29	259.246	259.239	-0.007
18584	221315.488	5624486.29	259.534	259.509	-0.025
18587	221328.916	5624492.04	259.858	259.847	-0.011
18590	221340.635	5624496.5	260.156	260.127	-0.029
18593	221352.596	5624500.89	260.45	260.423	-0.027
18596	221364.208	5624504.64	260.743	260.711	-0.032
18599	221376.8	5624508.56	261.069	261.053	-0.016
18602	221389.56	5624511.94	261.393	261.363	-0.03
18608	221281.088	5624481.85	258.397	258.377	-0.02
18609	221279.601	5624485.82	258.298	258.322	0.024
18610	221278.664	5624488.75	258.414	258.354	-0.06
18611	221275.662	5624497.53	258.364	258.345	-0.019
18612	221274.054	5624502.61	258.274	258.279	0.005
18613	221273.451	5624504.88	258.203	258.252	0.049
18614	221272.63	5624507.3	258.303	258.29	-0.013
18615	221268.838	5624515.63	258.513	258.479	-0.034
18616	221263.729	5624523.55	258.651	258.619	-0.032
18617	221257.698	5624530.14	258.663	258.629	-0.034
18618	221250.853	5624536.91	258.737	258.698	-0.039
18619	221244.806	5624544.39	258.488	258.463	-0.025
18620	221239.175	5624552.41	258.008	257.987	-0.021
18621	221233.372	5624560.27	257.752	257.757	0.005
18622	221231.283	5624563.05	257.771	257.696	-0.075
18623	221228.05	5624572.26	257.862	257.896	0.034

18624	221223.944	5624581.99	258.139	258.109	-0.03
18625	221219.137	5624590.73	258.297	258.345	0.048
18626	221214.771	5624599.19	258.352	258.333	-0.019
18627	221211.098	5624608.06	258.383	258.34	-0.043
18628	221207.301	5624617.52	258.585	258.575	-0.01
18629	221202.195	5624627.52	258.849	258.799	-0.05
18630	221197.67	5624635.59	259.192	259.18	-0.012
18631	221193.783	5624643.62	259.797	259.753	-0.044
18632	221189.667	5624652.65	260.558	260.519	-0.039
18637	221284.15	5624471.44	258.736	258.709	-0.027
18659	221269.181	5624463.21	258.412	258.379	-0.033
18662	221260.749	5624458.42	258.213	258.211	-0.002
18665	221402.607	5624515.2	261.715	261.68	-0.035
18668	221414.593	5624517.66	262.015	261.988	-0.027
18671	221427.005	5624520.24	262.36	262.341	-0.019
18674	221438.69	5624522.28	262.691	262.662	-0.029

<b>Average of the differences</b>	<b>-0.009</b>
<b>Minimum difference</b>	<b>-0.075</b>
<b>Maximum difference</b>	<b>0.056</b>
<b>Mean magnitude</b>	<b>0.018</b>
<b>Standard deviation</b>	<b>0.023</b>
<b>Standard deviation</b>	<b>0.022</b>

### 3- Radisson et Whapmagoostui area

Identifiers	X Coordinates	Y Coordinates	Z known coord.	Z LiDAR coord.	Differences
1004	242850.733	5963685.15	174.461	174.527	0.066
1005	242847.547	5963687.86	174.287	174.337	0.05
1006	242845.218	5963692.54	174.009	174.042	0.033
1007	242844.409	5963697.53	173.73	173.789	0.059
1030	239808.406	5962017.04	119.053	119.093	0.04
1031	239810.566	5962013.38	119.167	119.205	0.038
1032	239813.514	5962009.51	119.208	119.268	0.06
1033	239816.782	5962006.31	119.218	119.273	0.055
1034	239819.652	5962003.69	119.318	119.435	0.117
1054	236745.435	5962015.3	111.157	111.28	0.123
1055	236740.081	5962015.43	111.029	111.103	0.074
1056	236734.484	5962015.86	110.912	111.045	0.133
1057	236729.938	5962016.21	110.726	110.94	0.214
1058	236724.998	5962016.88	110.689	110.79	0.101
1059	236719.796	5962017.49	110.641	110.792	0.151
1060	236714.257	5962017.95	110.601	110.682	0.081
1061	236707.669	5962018.94	110.476	110.588	0.112
1062	236702.766	5962019.37	110.441	110.51	0.069
1063	236697.521	5962020.04	110.38	110.438	0.058
1064	236690.908	5962021.02	110.404	110.487	0.083
1065	236685.571	5962021.49	110.498	110.597	0.099
1066	236680.242	5962021.8	110.616	110.71	0.094
1067	236674.142	5962022.08	110.746	110.797	0.051
1068	236668.579	5962022.05	110.813	110.882	0.069
1069	236663.261	5962022.65	110.959	110.99	0.031
1070	236657.736	5962023.09	110.975	111.06	0.085
1071	236651.752	5962023.85	111.069	111.12	0.051
1072	236646.273	5962024.13	111.073	111.119	0.046
1073	236639.938	5962024.65	111.141	111.258	0.117
1074	236634.335	5962025.17	111.165	111.298	0.133
1075	236628.213	5962026.11	111.159	111.268	0.109
1076	236622.561	5962027.44	111.242	111.276	0.034
1077	236616.903	5962027.81	111.068	111.17	0.102
1078	236611.813	5962028.18	111.053	111.101	0.048
1079	236605.495	5962028.74	111.02	111.08	0.06
1080	236600.332	5962029.02	110.965	111.065	0.1

1081	236593.947	5962029.73	110.854	110.938	0.084
1082	236590.844	5962034.23	111.08	111.101	0.021
1083	236596.5	5962033.66	111.109	111.154	0.045
1084	236602.039	5962033.02	111.204	111.22	0.016
1085	236607.056	5962032.44	111.245	111.281	0.036
1086	236612.759	5962031.92	111.262	111.288	0.026
1087	236618.526	5962031.33	111.29	111.315	0.025
1088	236624.365	5962030.67	111.313	111.337	0.024
1089	236629.77	5962030.08	111.333	111.344	0.011
1090	236635.13	5962029.5	111.35	111.379	0.029
1091	236640.969	5962028.9	111.333	111.358	0.025
1092	236647.024	5962028.22	111.249	111.285	0.036
1093	236652.848	5962027.63	111.183	111.208	0.025
1094	236657.605	5962027.19	111.095	111.134	0.039
1095	236658.186	5962031.13	111.156	111.166	0.01
1096	236658.522	5962034.27	111.122	111.158	0.036
1097	236653.262	5962034.73	111.261	111.288	0.027
1098	236648.19	5962035.21	111.322	111.356	0.034
1099	236643.542	5962035.75	111.324	111.37	0.046
1100	236638.472	5962036.39	111.367	111.394	0.027
1101	236633.35	5962036.83	111.373	111.415	0.042
1102	236626.915	5962037.63	111.369	111.408	0.039
1103	236621.923	5962038.32	111.324	111.364	0.04
1104	236617.184	5962038.82	111.282	111.315	0.033
1105	236612.071	5962039.38	111.194	111.247	0.053
1106	236607.757	5962039.81	111.154	111.201	0.047
1107	236602.963	5962040.38	111.16	111.192	0.032
1108	236597.868	5962040.9	111.122	111.17	0.048
1109	236592.888	5962041.5	111.076	111.11	0.034
1176	236662.478	5962037.6	110.859	110.928	0.069
1177	236669.236	5962036.9	110.739	110.816	0.077
1178	236677.694	5962035.5	110.59	110.635	0.045
1179	236687.093	5962034.27	110.46	110.494	0.034
1180	236694.096	5962033.58	110.392	110.431	0.039
1181	236700.941	5962032.72	110.406	110.476	0.07
1182	236708.167	5962031.75	110.489	110.543	0.054
1183	236711.523	5962032	110.515	110.558	0.043
1184	236714.981	5962035.25	110.441	110.47	0.029
1185	236714.717	5962041.3	110.289	110.326	0.037
1186	236712.328	5962045.25	110.207	110.258	0.051
1187	236705.42	5962046.55	110.12	110.183	0.063
1188	236697.931	5962046.88	110.069	110.15	0.081
1189	236691.953	5962047.42	110.045	110.165	0.12
1190	236685.493	5962045.47	109.986	110.064	0.078
1191	236678.834	5962046.21	109.934	109.987	0.053
1192	236671.234	5962049.02	110.081	110.171	0.09

1193	236664.522	5962048.63	110.127	110.207	0.08
1194	236658.369	5962050.98	110.109	110.252	0.143
1195	236650.938	5962050.88	110.139	110.214	0.075
1196	236644.05	5962051.49	110.179	110.337	0.158
1197	236637.183	5962051.49	110.312	110.393	0.081
1198	236627.106	5962052.43	110.39	110.444	0.054
1199	236618.492	5962053.47	110.361	110.454	0.093
1200	236611.911	5962053.3	110.303	110.392	0.089
1201	236605.323	5962053.18	110.379	110.516	0.137
1202	236600.584	5962053.82	110.432	110.509	0.077
1203	236598.291	5962050.63	110.519	110.558	0.039
1204	236598.036	5962045.05	110.819	110.886	0.067
1205	236599.263	5962044.41	110.835	110.94	0.105
1360	236735.489	5962022.22	111.131	111.156	0.025
1361	236730.623	5962022.74	111.055	111.06	0.005
1362	236725.636	5962023.3	110.953	110.985	0.032
1363	236720.574	5962023.92	110.85	110.88	0.03
1364	236715.922	5962024.36	110.797	110.818	0.021
1365	236711.563	5962024.91	110.741	110.764	0.023
1366	236706.912	5962025.51	110.704	110.725	0.021
1367	236702.676	5962026.02	110.659	110.676	0.017
1368	236698.226	5962026.53	110.627	110.653	0.026
1369	236693.675	5962027.1	110.621	110.65	0.029
1370	236688.858	5962027.68	110.642	110.667	0.025
1371	236684.05	5962028.17	110.667	110.704	0.037
1372	236679.151	5962028.7	110.713	110.75	0.037
1373	236675.461	5962028.91	110.757	110.791	0.034
1374	236675.463	5962028.92	110.755	110.791	0.036
1375	236670.941	5962029.37	110.878	110.894	0.016
1376	236665.983	5962029.96	111.001	111.017	0.016
1377	236660.998	5962030.47	111.085	111.111	0.026
1378	236656.21	5962030.99	111.22	111.229	0.009
1379	236650.446	5962031.64	111.327	111.334	0.007
1380	236644.787	5962032.26	111.376	111.389	0.013
1381	236638.718	5962032.96	111.406	111.412	0.006
1382	236633.851	5962033.5	111.422	111.428	0.006
1383	236628.422	5962034.1	111.403	111.398	-0.005
1384	236622.866	5962034.7	111.39	111.397	0.007
1385	236617.681	5962035.28	111.351	111.362	0.011
1386	236612.634	5962035.81	111.295	111.299	0.004
1387	236607.636	5962036.36	111.295	111.308	0.013
1388	236602.084	5962036.95	111.278	111.28	0.002
1389	236597.036	5962037.48	111.219	111.232	0.013
1390	236591.538	5962038.05	111.182	111.184	0.002
1441	236722.276	5962087.66	109.349	109.401	0.052
1442	236725.386	5962082.7	109.493	109.56	0.067

1443	236725.632	5962077.35	109.635	109.657	0.022
1444	236725.773	5962071.74	109.757	109.803	0.046
1445	236725.54	5962065.88	109.876	109.93	0.054
1446	236725.272	5962059.62	110.059	110.104	0.045
1447	236725.103	5962054.61	110.161	110.216	0.055
1448	236724.506	5962049.3	110.244	110.267	0.023
1449	236724.038	5962043.85	110.3	110.334	0.034
1450	236723.396	5962038.8	110.397	110.445	0.048
1451	236723.137	5962033.42	110.558	110.576	0.018
1452	236725.823	5962029.69	110.622	110.69	0.068
1453	236730.84	5962029.23	110.698	110.761	0.063
1454	236735.27	5962028.82	110.775	110.868	0.093
1455	238522.019	5962096.11	108.183	108.205	0.022
1456	238526.07	5962096.48	108.059	108.102	0.043
1457	238529.894	5962096.3	107.918	108.034	0.116
1458	238534.033	5962095.71	107.753	107.795	0.042
1459	238538.586	5962094.75	107.6	107.659	0.059
1467	238521.045	5962089.56	108.377	108.387	0.01
1468	238526.276	5962089.44	108.175	108.201	0.026
1469	238530.735	5962089.67	108.008	108.036	0.028
1470	238535.302	5962089.68	107.842	107.876	0.034
1471	238540.792	5962089.85	107.652	107.678	0.026
2000	243039.043	5965666	189.599	189.677	0.078
2001	243048.874	5965665.71	189.666	189.742	0.076
2003	243044.077	5965665.33	189.658	189.721	0.063
2005	243038.953	5965669.64	189.598	189.736	0.138
2007	243043.884	5965669.43	189.702	189.774	0.072
2009	243048.629	5965670.29	189.656	189.715	0.059
2010	243048.406	5965676.27	189.678	189.795	0.117
2012	243043.378	5965675.73	189.771	189.828	0.057
2014	243038.776	5965675.62	189.627	189.716	0.089
2015	243038.64	5965681.1	189.68	189.753	0.073
2017	243043.593	5965680.9	189.832	189.882	0.05
2019	243048.097	5965681.3	189.727	189.823	0.096
2020	243047.728	5965686.86	189.821	189.964	0.143
2022	243043.019	5965686.52	189.906	189.962	0.056
2024	243038.203	5965686.3	189.71	189.811	0.101
2025	243037.97	5965692.94	189.822	189.959	0.137
2027	243043.43	5965692.74	190.014	190.055	0.041
2029	243047.722	5965693.4	189.904	189.974	0.07
2030	243047.635	5965699.5	189.998	190.187	0.189
2032	243042.24	5965699	190.121	190.193	0.072
2034	243037.559	5965698.77	189.928	190.075	0.147
2035	243036.742	5965705.09	190.007	190.126	0.119
2037	243037.147	5965711.32	190.17	190.272	0.102
2038	243036.458	5965720.24	190.234	190.4	0.166



2039	243035.801	5965728.98	190.197	190.311	0.114
2040	243036.367	5965737.4	190.099	190.248	0.149
2041	243035.569	5965746.49	189.886	189.976	0.09
2042	243035.093	5965754.73	189.702	189.785	0.083
2043	243034.675	5965761.74	189.59	189.7	0.11
2044	243033.499	5965769.65	189.391	189.456	0.065
2045	243032.35	5965777.57	189.17	189.242	0.072
2046	243031.491	5965783.78	189.01	189.16	0.15
2047	243029.934	5965793.63	188.643	188.7	0.057
2048	243028.615	5965800.67	188.298	188.376	0.078
2049	243027.404	5965806.94	187.948	188.013	0.065
2050	243025.932	5965815.65	187.486	187.543	0.057
2051	243042.201	5965705.58	190.243	190.292	0.049
2052	243042.294	5965705.5	190.234	190.292	0.058
2053	243042.019	5965713.24	190.313	190.379	0.066
2054	243041.91	5965722.68	190.352	190.412	0.06
2055	243041.31	5965735.79	190.245	190.301	0.056
2056	243039.959	5965749.09	189.895	189.946	0.051
2057	243038.041	5965760.91	189.598	189.656	0.058
2058	243036.738	5965769.87	189.409	189.458	0.049
2059	243034.669	5965780.33	189.141	189.206	0.065
2060	243033.024	5965788.4	188.882	188.942	0.06
2061	243031.626	5965795.88	188.56	188.622	0.062
2062	243032.953	5965801.38	188.343	188.414	0.071
2063	243033.919	5965796.01	188.588	188.636	0.048
2064	243035.566	5965787.64	188.937	189.006	0.069
2065	243037.297	5965779.4	189.173	189.261	0.088
2066	243040.798	5965767.89	189.389	189.454	0.065
2067	243042.805	5965761.61	189.522	189.579	0.057
2068	243046.978	5965759.5	189.501	189.632	0.131
2069	243051.908	5965759.9	189.456	189.545	0.089
2070	243058.033	5965763.27	189.329	189.405	0.076
2071	243064.253	5965769.12	189.034	189.105	0.071
2072	243071.335	5965776.31	188.636	188.709	0.073
2073	243077.642	5965782.7	188.415	188.5	0.085
2074	243083.782	5965789.7	188.201	188.252	0.051
2075	243089.567	5965796.32	187.628	187.679	0.051
2076	243095.762	5965803	186.979	187.049	0.07
2077	243096.717	5965801.05	186.989	187.043	0.054
2078	243092.693	5965796.58	187.379	187.416	0.037
2079	243087.544	5965790.8	187.956	187.995	0.039
2080	243081.16	5965783.65	188.36	188.407	0.047
2081	243073.306	5965774.95	188.62	188.659	0.039
2082	243065.776	5965766.8	189.054	189.1	0.046
2083	243057.89	5965758.84	189.494	189.543	0.049
2084	243050.164	5965752.08	189.799	189.844	0.045

2085	243043.491	5965746.65	189.977	190.035	0.058
2086	243046.798	5965706.77	190.156	190.258	0.102
2087	243046.597	5965714.11	190.228	190.304	0.076
2088	243046.518	5965721.34	190.26	190.464	0.204
2089	243046.389	5965727.17	190.251	190.409	0.158
2090	243046.917	5965731.72	190.197	190.344	0.147
2091	243048.939	5965736.92	190.029	190.152	0.123
2092	243053.196	5965743.2	189.807	189.893	0.086
2093	243056.581	5965748.54	189.613	189.686	0.073
2094	243058.571	5965751.99	189.48	189.556	0.076
2095	243062.174	5965757.41	189.284	189.402	0.118
2096	243068.643	5965764.82	188.903	188.97	0.067
2097	243072.593	5965769.65	188.664	188.744	0.08
2098	243075.654	5965773.3	188.492	188.563	0.071
2099	243081.843	5965781.17	188.343	188.384	0.041
2100	243086.992	5965787.27	188.101	188.146	0.045
2101	243092.315	5965792.7	187.555	187.612	0.057
2500	243057.714	5965762.56	189.37	189.418	0.048
2501	243062.774	5965767.73	189.105	189.179	0.074
2502	243070.263	5965775.31	188.687	188.779	0.092
2503	243075.982	5965780.7	188.45	188.514	0.064
2504	243083.474	5965789.29	188.25	188.271	0.021
2505	243092.008	5965798.59	187.354	187.404	0.05
2506	243099.113	5965806.31	186.708	186.78	0.072
2507	243104.417	5965812.37	186.36	186.412	0.052
2508	243112.339	5965821.41	185.902	185.958	0.056
2509	243120.19	5965830.33	185.527	185.605	0.078
2510	243131.052	5965842.56	185.234	185.294	0.06
2515	243127.732	5965830.36	185.356	185.443	0.087
2516	243123.352	5965826.74	185.516	185.596	0.08
2517	243119.736	5965822.86	185.688	185.731	0.043
2518	243116.001	5965818.71	185.857	185.908	0.051
2519	243112.322	5965814.43	186.035	186.102	0.067
2520	243109.528	5965811.63	186.196	186.261	0.065
2521	243100.619	5965801.82	186.736	186.823	0.087
2522	243089.809	5965789.68	187.842	187.91	0.068
2523	243078.019	5965776.3	188.407	188.533	0.126
2524	243066.809	5965762.89	189.031	189.094	0.063
2525	243057.063	5965751.02	189.588	189.67	0.082
2526	243052.179	5965752.4	189.785	189.823	0.038
2527	243058.812	5965759.29	189.468	189.502	0.034
2528	243068.686	5965769.78	188.895	188.929	0.034
2529	243083.605	5965786.62	188.267	188.301	0.034
2530	243103.585	5965808.45	186.512	186.555	0.043
2531	243112.317	5965817.58	186.036	186.08	0.044
2532	243125.875	5965832.99	185.461	185.496	0.035

3100	233632.055	5960836.9	139.189	139.209	0.02
3101	233627.638	5960831.03	138.963	139.019	0.056
3102	233629.778	5960834.34	139.104	139.131	0.027
3105	233632.879	5960827.09	139.34	139.367	0.027
3106	233635.369	5960830.09	139.467	139.496	0.029
3107	233637.594	5960832.66	139.563	139.563	0
3110	233644.231	5960827.64	139.993	140.01	0.017
3111	233642.034	5960824.79	139.882	139.929	0.047
3112	233639.757	5960821.86	139.798	139.844	0.046
3115	233644.853	5960817.56	140.154	140.189	0.035
3116	233647.171	5960820.55	140.224	140.277	0.053
3117	233649.406	5960823.42	140.324	140.347	0.023
3120	233654.75	5960818.89	140.645	140.669	0.024
3121	233652.561	5960815.88	140.604	140.633	0.029
3122	233649.851	5960813.02	140.484	140.51	0.026
3140	233651.392	5960811.43	140.55	140.585	0.035
3141	233652.079	5960805.09	140.655	140.707	0.052
3142	233652.21	5960799.79	140.855	140.901	0.046
3143	233650.946	5960795.29	141.089	141.134	0.045
3144	233649.903	5960793.14	141.192	141.249	0.057
3145	233654.962	5960789.11	141.298	141.337	0.039
3146	233660.317	5960791.71	141.24	141.281	0.041
3147	233668.411	5960792.43	141.418	141.458	0.04
3148	233657.702	5960811.22	140.891	140.912	0.021
3149	233661.831	5960807.36	141.083	141.111	0.028
3150	233666.661	5960802.64	141.309	141.332	0.023
3151	233671.076	5960798.32	141.49	141.516	0.026
3152	233661.506	5960812.67	140.972	141.001	0.029
3153	233665.99	5960808.47	141.159	141.184	0.025
3154	233671.606	5960803.15	141.361	141.394	0.033
3155	233676.24	5960799.13	141.517	141.546	0.029
3169	233621.052	5960767.62	145.031	removed	*
3185	233668.983	5960763.49	142.925	143.032	0.107
3186	233664.98	5960766.95	142.837	142.895	0.058
3187	233661.095	5960770.89	142.799	142.831	0.032
3188	233657.294	5960775.03	142.451	142.52	0.069
3189	233655.265	5960779.02	141.844	141.883	0.039
3190	233657.288	5960784.23	141.323	141.385	0.062
3191	233662.408	5960786.36	141.342	141.38	0.038
3192	233666.874	5960782.3	141.474	141.573	0.099
3231	233673.888	5960786.72	141.668	141.728	0.06
3232	233678.247	5960791.08	141.78	141.806	0.026
3233	233681.46	5960794.3	141.69	141.735	0.045
3247	233682.438	5960793.5	141.724	141.759	0.035
3248	233679.489	5960789.83	141.822	141.871	0.049
3249	233675.566	5960784.91	141.795	141.83	0.035

3250	233679.882	5960780.12	142.004	142.051	0.047
3251	233684.838	5960784.36	142.041	142.082	0.041
3252	233688.847	5960788.21	141.857	141.903	0.046
3253	233693.837	5960783.89	142.018	142.046	0.028
3254	233690.046	5960779.06	142.269	142.303	0.034
3255	233685.421	5960774	142.299	142.328	0.029
3256	233688.858	5960767.86	142.565	142.597	0.032
3257	233695.296	5960773.66	142.459	142.488	0.029
3258	233700.216	5960779.14	142.084	142.116	0.032
3259	233706.506	5960777.6	142.024	142.058	0.034
3260	233711.376	5960777.63	142.006	142.033	0.027
3261	233718.262	5960778.74	141.944	141.965	0.021
3262	233724.351	5960780.83	141.8	141.82	0.02
3263	233729.234	5960784.11	141.596	141.637	0.041
3264	233733.273	5960787.17	141.432	141.47	0.038
3265	233737.839	5960791.36	141.131	141.172	0.041
3266	233742.42	5960795.72	140.85	140.896	0.046
3267	233691.098	5960761.76	142.843	142.896	0.053
3268	233691.299	5960755.7	143.253	143.276	0.023
3269	233690.498	5960749.53	143.768	143.793	0.025
3270	233688.751	5960744.79	144.125	144.154	0.029
3271	233685.423	5960744.38	144.137	144.15	0.013
3272	233684.571	5960740.17	144.496	144.521	0.025
3273	233681.807	5960735.73	144.909	144.945	0.036
3274	233692.025	5960724.94	145.633	145.671	0.038
3277	233696.421	5960728.64	145.322	145.361	0.039
3278	233701.212	5960732.68	144.996	145.032	0.036
3281	233706.677	5960737.38	144.647	144.68	0.033
3282	233711.005	5960741.33	144.38	144.404	0.024
3285	233716.065	5960745.99	144.074	144.099	0.025
3286	233720.312	5960750.06	143.777	143.814	0.037
3289	233725.469	5960755.19	143.475	143.503	0.028
3290	233730.2	5960760.06	143.174	143.215	0.041
3297	233744.427	5960775.38	142.313	142.349	0.036
3298	233744.433	5960775.38	142.308	142.349	0.041
3299	233748.043	5960779.71	142.127	142.167	0.04
3302	233752.33	5960784.84	141.936	141.974	0.038
3303	233755.548	5960788.88	141.74	141.778	0.038
3306	233759.227	5960793.61	141.546	141.582	0.036
3307	233763.516	5960798.95	141.376	141.398	0.022
3310	233767.639	5960804.31	141.181	141.209	0.028
3311	233771.053	5960808.92	141.021	141.059	0.038
3315	233775.752	5960815.47	140.763	140.795	0.032
3316	233777.94	5960818.45	140.669	140.71	0.041
3317	233749.553	5960803.73	140.552	140.59	0.038
3320	233753.891	5960808.91	140.49	140.535	0.045

3321	233757.397	5960813.27	140.393	140.442	0.049
3326	233762.921	5960820.22	140.329	140.377	0.048
3327	233767.023	5960824.96	140.233	140.287	0.054
3328	233770.658	5960830.48	140.09	140.145	0.055
3388	233772.715	5960826.45	140.293	140.334	0.041
3389	233769.196	5960821.75	140.406	140.441	0.035
3390	233766.044	5960817.56	140.496	140.528	0.032
3391	233762.682	5960813.13	140.623	140.651	0.028
3392	233759.406	5960808.59	140.758	140.789	0.031
3393	233756.302	5960804.42	140.884	140.907	0.023
3394	233752.907	5960799.91	140.996	141.038	0.042
3395	233749.688	5960795.85	141.134	141.166	0.032
3396	233746.348	5960791.71	141.35	141.394	0.044
3397	233742.853	5960787.58	141.573	141.608	0.035
3398	233739.495	5960783.69	141.795	141.825	0.03
3399	233736.085	5960779.71	142.009	142.042	0.033
3400	233732.55	5960775.73	142.214	142.247	0.033
3401	233729.184	5960772.17	142.412	142.445	0.033
3402	233725.694	5960768.58	142.572	142.61	0.038
3403	233722.522	5960765.3	142.758	142.793	0.035
3404	233719.475	5960762.22	142.944	142.991	0.047
3405	233716.538	5960759.33	143.12	143.141	0.021
3406	233712.849	5960755.92	143.336	143.378	0.042
3407	233708.973	5960752.09	143.577	143.612	0.035
3408	233704.759	5960748.41	143.842	143.865	0.023
3409	233700.752	5960744.75	144.105	144.135	0.03
3410	233697.05	5960741.5	144.372	144.401	0.029
3411	233693.321	5960738.22	144.658	144.689	0.031
3412	233690.111	5960735.52	144.884	144.92	0.036
3413	233686.396	5960732.43	145.145	145.166	0.021
3414	233683.032	5960729.55	145.396	145.431	0.035
3415	233697.333	5960747.47	143.89	143.918	0.028
3416	233696.78	5960752.64	143.536	143.571	0.035
3417	233696.485	5960758.86	143.098	143.128	0.03
3418	233697.507	5960764.39	142.813	142.847	0.034
3419	233701.776	5960762.71	142.932	142.953	0.021
3420	233703.321	5960759.37	143.197	143.252	0.055
3421	233707.294	5960756.64	143.276	143.315	0.039
3422	233705.896	5960755.98	143.359	143.393	0.034
3423	233704.687	5960752.13	143.558	143.594	0.036
3424	233709.815	5960758.56	143.12	143.142	0.022
3425	233713.746	5960763.48	142.785	142.822	0.037
3426	233712.389	5960763.55	142.801	142.841	0.04
3427	233711.076	5960765.59	142.665	142.77	0.105
3428	233708.17	5960767.58	142.555	142.583	0.028
3429	233708.538	5960768.97	142.491	142.522	0.031

3430	233711.817	5960771.88	142.324	142.352	0.028
3431	233713.238	5960769.32	142.461	142.496	0.035
3432	233717.3	5960772.47	142.262	142.301	0.039
3433	233718.436	5960769.13	142.423	142.456	0.033
3434	233717.962	5960765.22	142.696	142.708	0.012
3435	233703.577	5960764.98	142.774	142.808	0.034
3436	233707.677	5960760.93	142.977	143.006	0.029
3484	233679.415	5960721.71	146.092	146.112	0.02
3485	233683.666	5960725.22	145.758	145.787	0.029
3486	233687.517	5960728.42	145.479	145.51	0.031
3487	233691.116	5960731.54	145.21	145.243	0.033
3488	233694.879	5960734.88	144.925	144.965	0.04
3489	233698.61	5960738.11	144.658	144.698	0.04
3490	233702.515	5960741.64	144.376	144.415	0.039
3491	233706.509	5960745.24	144.128	144.168	0.04
3492	233710.072	5960748.51	143.905	143.95	0.045
3493	233714.317	5960752.55	143.648	143.672	0.024
3494	233718.623	5960756.77	143.371	143.407	0.036
3495	233722.086	5960759.83	143.182	143.208	0.026
3496	233727.906	5960765.67	142.815	142.852	0.037
3497	233731.862	5960769.82	142.582	142.616	0.034
3498	233735.594	5960773.82	142.385	142.404	0.019
3499	233739.358	5960778.01	142.16	142.188	0.028
3500	233743.013	5960782.18	141.967	141.995	0.028
3501	233746.635	5960786.46	141.75	141.771	0.021
3502	233749.989	5960790.57	141.53	141.558	0.028
3503	233752.738	5960794.04	141.356	141.387	0.031
3504	233757.327	5960799.91	141.136	141.162	0.026
3505	233760.696	5960804.32	141.011	141.048	0.037
3506	233763.454	5960808.07	140.896	140.92	0.024
3507	233766.635	5960812.38	140.736	140.769	0.033
3508	233770.036	5960817.03	140.601	140.628	0.027
3509	233773.438	5960821.65	140.499	140.527	0.028
3510	233777.627	5960827.44	140.431	140.447	0.016
3511	233780.229	5960831.16	140.404	140.453	0.049
6019	237394.423	5961965.21	111.995	112.031	0.036
6020	237389.502	5961965.13	112.009	112.046	0.037
6021	237384.76	5961965.15	112.028	112.072	0.044
6022	237378.886	5961965.1	112.056	112.095	0.039
6023	237373.804	5961965.02	112.066	112.103	0.037
6024	237367.911	5961965.05	112.092	112.127	0.035
6025	237362.16	5961965.11	112.108	112.135	0.027
6026	237356.455	5961965.22	112.094	112.142	0.048
6027	237350.571	5961965.33	112.095	112.134	0.039
6028	237345.023	5961965.42	112.057	112.107	0.05
6029	237339.432	5961965.56	112.028	112.072	0.044

6030	237334.054	5961965.67	111.982	112.03	0.048
6031	237328.786	5961965.8	111.945	111.989	0.044
6032	237323.596	5961966.04	111.923	111.966	0.043
6033	237318.432	5961966.23	111.925	111.953	0.028
6034	237312.909	5961966.41	111.894	111.945	0.051
6035	237307.286	5961966.66	111.914	111.954	0.04
6036	237301.79	5961966.83	111.936	111.984	0.048
6037	237296.408	5961967.11	111.977	112.015	0.038
6038	237290.821	5961967.5	112.01	112.06	0.05
6039	237286.191	5961967.76	112.058	112.088	0.03
6040	237280.937	5961968.1	112.088	112.128	0.04
6041	237276.362	5961968.52	112.115	112.161	0.046

<b>Average of the differences</b>	0.051
<b>Minimum difference</b>	-0.005
<b>Maximum difference</b>	0.214
<b>Mean magnitude</b>	0.051
<b>Standard deviation</b>	0.061
<b>Standard deviation</b>	0.033

#### 4- Road of the North

Identifiers	X Coordinates	Y Coordinates	Z known coord.	Z LiDAR coord.	Differences
200	240024.611	5706123.2	203.712	203.707	-0.005
201	240025.455	5706113.67	203.74	203.723	-0.017
202	240026.246	5706104.21	203.757	203.758	0.001
203	240027.098	5706094.72	203.781	203.779	-0.002
204	240027.933	5706085.1	203.79	203.797	0.007
205	240028.752	5706076.04	203.83	203.823	-0.007
206	240029.551	5706066.56	203.85	203.846	-0.004
207	240030.359	5706057.02	203.844	203.849	0.005
208	240031.226	5706047.18	203.851	203.852	0.001
209	240032.079	5706037.44	203.864	203.862	-0.002
210	240032.953	5706028.05	203.858	203.861	0.003
211	240033.842	5706018.53	203.85	203.858	0.008
212	240034.635	5706009.02	203.829	203.843	0.014
213	240035.454	5705998.87	203.781	203.787	0.006
214	240036.258	5705989.56	203.753	203.749	-0.004
215	240037.097	5705979.8	203.692	203.69	-0.002
216	240037.905	5705970.44	203.64	203.628	-0.012
217	240038.677	5705961.25	203.566	203.55	-0.016
218	240039.5	5705951.9	203.471	203.465	-0.006
219	240040.336	5705942.34	203.371	203.36	-0.011
225	240027.64	5706009.6	203.888	203.881	-0.007
226	240036.956	5706015.14	203.825	203.828	0.003
227	240046.232	5706019.85	203.95	203.938	-0.012
228	240055.136	5706024.29	204.108	204.099	-0.009
229	240064.508	5706028.79	204.288	204.311	0.023
230	240071.318	5706031.4	204.441	204.475	0.034
231	240080.204	5706036.32	204.531	204.535	0.004
232	240088.859	5706041.03	204.571	204.583	0.012
233	240097.677	5706045.64	204.577	204.583	0.006
234	240105.974	5706049.84	204.617	204.629	0.012
235	240114.443	5706053.89	204.649	204.672	0.023
236	240122.838	5706057.79	204.717	204.75	0.033
237	240131.59	5706062.53	204.822	204.851	0.029
238	240140.228	5706066.91	204.954	204.997	0.043
239	240150.844	5706072.18	205.151	205.173	0.022
240	240159.378	5706076.77	205.312	205.329	0.017



500	329835.207	5727975.63	255.6	255.632	0.032
501	329844.614	5727978.53	255.774	255.833	0.059
502	329853.299	5727981.36	255.999	256.059	0.06
503	329862.139	5727984.33	256.234	256.275	0.041
504	329870.656	5727987.21	256.41	256.453	0.043
505	329880.105	5727989.85	256.573	256.616	0.043
506	329889.125	5727992.79	256.668	256.731	0.063
507	329898.405	5727995.77	256.767	256.83	0.063
508	329907.452	5727998.66	256.846	256.933	0.087
509	329916.46	5728001.49	256.876	256.945	0.069
510	329925.855	5728004.63	256.862	256.922	0.06
511	329935.602	5728007.61	256.83	256.89	0.06
512	329945.147	5728010.66	256.86	256.919	0.059
513	329954.219	5728013.49	256.901	256.961	0.06
514	329963.659	5728016.72	256.95	257.004	0.054
515	329973.061	5728019.81	256.989	257.036	0.047
516	329982.117	5728022.96	257.015	257.067	0.052
517	329992.374	5728026.05	257.092	257.146	0.054
518	330004.791	5728030.01	257.156	257.212	0.056
519	330014.32	5728033.04	257.141	257.18	0.039
523	329924.381	5728010.86	256.624	256.694	0.07
524	329921.859	5728019.95	256.062	256.116	0.054
525	329919.273	5728029.37	255.447	255.503	0.056
526	329916.781	5728038.62	254.894	254.953	0.059
527	329914.152	5728048.31	254.35	254.395	0.045
528	329911.083	5728057.94	253.822	253.878	0.056
529	329908.487	5728067.17	253.281	253.315	0.034
530	329905.659	5728076.31	252.698	252.744	0.046
531	329902.737	5728085.68	252.108	252.154	0.046
532	329899.936	5728094.53	251.545	251.6	0.055
533	329897.198	5728103.26	250.973	251.053	0.08
534	329893.786	5728112.65	250.391	250.468	0.077
535	329889.954	5728121.94	249.871	249.929	0.058
536	329884.996	5728131.22	249.295	249.354	0.059
537	329879.264	5728139.89	248.741	248.81	0.069
538	329873.318	5728148.16	248.196	248.272	0.076
539	329868.09	5728156.88	247.767	247.858	0.091
540	329864.078	5728166.05	247.518	247.606	0.088
541	329861.363	5728175.15	247.451	247.526	0.075
610	385332.634	5677799.93	323.108	323.128	0.02
611	385339.079	5677792.57	322.842	322.865	0.023
612	385345.095	5677785.39	322.592	322.604	0.012
613	385351.092	5677778.14	322.329	322.354	0.025
614	385357.391	5677770.77	322.085	322.102	0.017
615	385363.612	5677763.67	321.912	321.951	0.039
616	385369.695	5677756.54	321.771	321.819	0.048

617	385376.341	5677748.71	321.646	321.682	0.036
618	385382.753	5677741.04	321.551	321.593	0.042
619	385389.684	5677733.32	321.557	321.58	0.023
620	385395.933	5677725.78	321.684	321.704	0.02
621	385401.915	5677718.68	321.793	321.811	0.018
622	385408.174	5677711.29	321.926	321.96	0.034
623	385414.601	5677703.84	322.089	322.118	0.029
624	385420.928	5677696.49	322.331	322.374	0.043
625	385427.257	5677689.05	322.686	322.707	0.021
626	385433.556	5677681.87	323.107	323.142	0.035
627	385439.946	5677674.63	323.597	323.648	0.051
628	385446.492	5677667.37	324.149	324.177	0.028
629	385452.566	5677660.01	324.748	324.776	0.028
630	385458.681	5677652.93	325.414	325.453	0.039
700	426603.963	5621325.47	378.388	378.36	-0.028
701	426614.645	5621322.66	378.431	378.405	-0.026
702	426624.338	5621319.49	378.428	378.429	0.001
703	426633.285	5621316.19	378.452	378.455	0.003
704	426642.214	5621312.22	378.425	378.417	-0.008
705	426650.869	5621307.49	378.359	378.369	0.01
706	426659.379	5621302.48	378.336	378.341	0.005
707	426667.975	5621297.17	378.398	378.394	-0.004
708	426677.061	5621290.55	378.517	378.508	-0.009
709	426685.813	5621284.63	378.756	378.766	0.01
710	426694.722	5621278.53	379.117	379.112	-0.005
711	426703.192	5621272.76	379.492	379.507	0.015
712	426711.678	5621267.05	379.928	379.916	-0.012
713	426719.391	5621261.59	380.331	380.323	-0.008
714	426728.18	5621255.45	380.75	380.746	-0.004
715	426736.06	5621249.36	381.167	381.16	-0.007
716	426744.243	5621243.26	381.573	381.579	0.006
717	426752.493	5621237.07	382.008	382.01	0.002
718	426760.192	5621230.69	382.408	382.409	0.001
719	426767.654	5621224.45	382.784	382.779	-0.005
800	471917.724	5543311.48	408.33	408.289	-0.041
801	471910.816	5543303.75	408.347	408.327	-0.02
802	471904.307	5543296.51	408.383	408.35	-0.033
803	471897.673	5543289.18	408.388	408.348	-0.04
804	471891.015	5543281.7	408.385	408.361	-0.024
805	471884.634	5543274.41	408.405	408.367	-0.038
806	471878.093	5543267.06	408.426	408.406	-0.02
807	471871.835	5543259.89	408.484	408.452	-0.032
808	471865.038	5543252.97	408.534	408.499	-0.035
809	471858.544	5543245.62	408.518	408.474	-0.044
810	471852.334	5543238.2	408.43	408.393	-0.037
811	471845.964	5543230.74	408.415	408.389	-0.026

812	471838.819	5543222.55	408.411	408.377	-0.034
813	471832.404	5543215.17	408.413	408.383	-0.03
814	471825.852	5543207.81	408.436	408.403	-0.033
815	471819.274	5543200.25	408.459	408.421	-0.038
816	471812.393	5543192.42	408.474	removed	*
817	471807.608	5543187	408.499	removed	*
818	471801.399	5543179.93	408.523	408.492	-0.031
819	471794.035	5543171.53	408.549	408.503	-0.046
824	471856.742	5543251.46	408.619	408.578	-0.041
825	471849.471	5543257.91	408.723	408.695	-0.028
826	471842.213	5543264.04	408.712	408.689	-0.023
827	471834.498	5543270.26	408.719	408.693	-0.026
828	471826.778	5543276.77	408.911	408.88	-0.031
829	471819.483	5543282.47	409.051	409.031	-0.02
830	471812.4	5543288.22	409.19	409.165	-0.025
831	471804.141	5543294.47	409.315	409.273	-0.042
832	471796.855	5543300.28	409.403	409.39	-0.013
833	471789.141	5543306.04	409.493	409.467	-0.026
834	471781.238	5543311.62	409.599	409.596	-0.003
835	471773.419	5543316.91	409.665	409.654	-0.011
836	471765.025	5543321.99	409.711	409.699	-0.012
837	471756.708	5543326.97	409.776	409.763	-0.013
838	471748.078	5543331.74	409.799	409.785	-0.014
839	471739.016	5543336.29	409.84	409.805	-0.035
840	471730.379	5543340.46	409.863	409.838	-0.025
841	471721.464	5543344.33	409.904	409.872	-0.032

<b>Average of the differences</b>	0.013
<b>Minimum difference</b>	-0.046
<b>Maximum difference</b>	0.091
<b>Mean magnitude</b>	0.03
<b>Standard deviation</b>	0.037
<b>Standard deviation</b>	0.035

### 5- Eastmain Village road

Identifiants	Coordonnées X	Coordonnées Y	Coord. Z connues	Coord. Z LIDAR	Différences
300	250254.019	5767896.81	254.427	254.418	-0.009
301	250263.509	5767892.97	254.628	254.588	-0.04
302	250272.94	5767889.25	254.793	254.753	-0.04
303	250282.203	5767885.45	254.962	254.914	-0.048
304	250291.509	5767881.58	255.098	255.08	-0.018
305	250300.644	5767877.79	255.237	255.184	-0.053
306	250309.905	5767873.9	255.326	255.278	-0.048
307	250319.137	5767870.01	255.396	255.359	-0.037
308	250328.396	5767866.13	255.461	255.445	-0.016
309	250336.155	5767862.65	255.499	255.461	-0.038
310	250345.326	5767858.83	255.555	255.533	-0.022
311	250354.566	5767854.82	255.574	255.54	-0.034
312	250362.945	5767851.11	255.562	255.528	-0.034
313	250373.733	5767846.3	255.497	255.476	-0.021
314	250382.706	5767842.25	255.422	255.394	-0.028
315	250391.702	5767837.98	255.323	255.276	-0.047
316	250401.114	5767833.66	255.221	255.169	-0.052
317	250410.292	5767829.22	255.079	255.031	-0.048
318	250419.178	5767824.88	254.94	254.89	-0.05
319	250427.665	5767820.69	254.797	254.769	-0.028
337	250317.358	5767785.25	253.675	253.653	-0.022
338	250313.15	5767776.63	253.436	253.431	-0.005
339	250309.368	5767768.13	253.238	253.217	-0.021
340	250305.315	5767759.24	252.969	252.961	-0.008
341	250301.447	5767750.42	252.682	252.67	-0.012
342	250297.506	5767741.26	252.359	252.336	-0.023
343	250293.532	5767732.4	252.011	251.983	-0.028
344	250289.779	5767723.62	251.638	251.628	-0.01
345	250286.058	5767714.8	251.27	251.27	0
346	250282.351	5767706.04	250.911	250.898	-0.013
400	167632.388	5791641.3	6.876	6.868	-0.008
401	167639.472	5791634.32	6.795	6.778	-0.017
402	167646.305	5791627.8	6.758	6.758	0
403	167652.92	5791621.3	6.74	6.72	-0.02
404	167659.598	5791614.5	6.746	6.738	-0.008
405	167666.341	5791607.79	6.844	6.848	0.004

406	167672.27	5791602.55	6.947	6.952	0.005
407	167678.522	5791596.48	7.032	7.029	-0.003
408	167685.728	5791589.62	7.079	7.064	-0.015
409	167692.317	5791583.16	7.146	7.138	-0.008
410	167698.845	5791576.46	7.207	7.221	0.014
411	167705.649	5791569.48	7.298	7.291	-0.007
412	167712.262	5791562.71	7.325	7.328	0.003
413	167719.058	5791556.02	7.377	7.374	-0.003
414	167726.143	5791548.72	7.428	7.429	0.001
415	167732.759	5791542.26	7.442	7.436	-0.006
416	167739.48	5791535.56	7.397	7.389	-0.008
417	167746.64	5791528.77	7.423	7.409	-0.014
418	167753.387	5791521.94	7.436	7.437	0.001
419	167760.151	5791515.29	7.441	7.443	0.002
420	167628.451	5791489.33	6.896	6.918	0.022
421	167634.303	5791496.94	6.931	6.956	0.025
422	167640.136	5791504.81	6.918	6.94	0.022
423	167646.546	5791512.84	6.934	6.918	-0.016
424	167653.258	5791520.49	6.853	6.863	0.01
425	167659.81	5791527.81	6.863	6.866	0.003
426	167666.159	5791534.98	6.727	6.735	0.008
427	167671.872	5791541.65	6.675	6.686	0.011
428	167678.295	5791548.95	6.708	6.71	0.002
429	167684.53	5791556.92	6.665	6.678	0.013
430	167690.831	5791564.53	6.913	6.956	0.043

<b>Average of the differences</b>	<b>-0.013</b>
<b>Minimum difference</b>	<b>-0.053</b>
<b>Maximum difference</b>	<b>0.043</b>
<b>Mean magnitude</b>	<b>0.019</b>
<b>Standard deviation</b>	<b>0.025</b>
<b>Standard deviation</b>	<b>0.021</b>