McElhanney

December 14, 2015

Transportation Engineering Branch
Government of the Yukon
Box 2703, Whitehorse, Yukon Y1A 2C6
Tel: (867) 633-7931

Attention: Michael Kearney CLS, P.Eng

Dear Mr. Kearney,

Enclosed you will find McElhanney LiDAR report for 2015 Yukon Highway LiDAR and aerial mapping. This letter serves to certify that the LiDAR and survey work have been completed in accordance with ASPRS (American Society of Photogrammetry and Remote Sensing) and BC Specification and Guidelines for Control surveys using GPS Technology and LiDAR specification from (Integrated Land management Bureau).

Should you have any question or require additional information, please contact me at 604-424-4784.

Best regards,

A. Koohzare

Azadeh Koohzare, Ph.D., PEng.
Project Manager
McEhlanney Consulting Services Ltd.

PROFESSIONAL
YUKON
DR. AZADEH KOOHZARE
TERRITORY
ENGINEER

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Enclosure: LiDAR Report

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2015 Yukon Highway
LiDAR and Orthophoto
Data Capture and Processing

LiDAR Report

Our File:

2611 18676-0

Submitted To:

Transportation Engineering Branch
Government of the Yukon
Box 2703, Whitehorse, Yukon Y1A 2C6
Tel: (867) 633-7931

Attention: Michael Kearney CLS, P.Eng

Submitted By:
McElhanney Consulting Services Ltd.
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Contact: Azadeh Koohzare, Ph.D., PEng

December 14, 2015

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1. Introduction

McElhanney Consulting Services Ltd (MCSL) performed a LiDAR and 15 Cm aerial photography acquisition for the Alaska Highway No.1 (Whitehorse to Watson Lake),and the Campbell Highway No.4. This project also included the LiDAR capture of the areas consisting of North Alaska Highway Km 1580 to km1902.5 (Haines Junction to Alaska Boarder at Beaver Creek), South Klondike consisting of the first 45 km from the BC Alaska Boarder at km 26 to approximatelykm 71, a small portion of the Nahanni Range Road at the Yukon/NWT boundary and the Haines Road km 145 to Haines Junction.

LiDAR data Capture	Length of Corridor (km)	Area (Square Kilometers)
LiDAR Capture of Alaska Highway No.1	436.8 km	217.3 sq. km
LiDAR Capture of Campbell Highway No. 4	461 km	269.9 sq. km
LiDAR Capture of South Klondike Highway No.2	48.9 km	25.3 sq. km
LiDAR Capture of Alaska Highway North Highway No. 1	324 km	290.3 sq. km
LiDAR Capture of Part of Nahanni Range Rd	10 km	10.1 sq. km
LiDAR Capture of Haines Road Yukon Highway No.3	174.8 km	90.8 sq. km

The sites were flown in two missions. The first mission was carried on from June 21st to July 1st, and the second mission was conducted from August 3rd to August 9th, 2015. This report describes the acquisition, post-processing and quality control methodology used to produce the final elevation models.

2. Mission Plan

Project: 2015 Yukon LiDAR and Aerial photo Project

Date:

2015-06-21, 2015-06-22, 2015-06-23, 2015-06-24, 2015-06-30, 2015-07-01, 2015-08-03, 2015-08-04, 2015-08-05, 2015-08-08, 2015-08-09.

Location: Yukon

Topography: moderate

3. LiDAR Acquisition

McElhanney utilized the ALS70 Leica system (Figure 1).

For Product Specifications of Leica ALS70 please see

http://www.leica-geosystems.com/en/Leica-ALS70-Airborne-Laser-Scanner_57629.htm

The ALS70 was mounted on Piper Apache fixed wing Aircraft.

Figure 1 –ALS70 Leica components

4. Flight Plan

This project was planned to achive 6 pts /m² at 90% confidence level and 15 Cm GSD photo. Each line was flown with 60% average overlap to ensure that there are enough LiDAR returns. Table 1 shows the flight parameters.

Table 1: Flight Parameters

Flight Line #	Length [km]	Alt MSL [ft]	Min Alt AGL [m]	Max Alt AGL [m]	FOV [deg]	Swath Width [m]	Used Scan Rate [Hz]	Used Laser Pulse Rate [Hz]	Begin WGS84 Latitude [deg]	Begin WGS84 Longitude [deg]	End WGS84 Latitude [deg]	End WGS84 Longitude [deg]
1	19.9900	7242	958	1110	50	1035	47	447400	61.50	-129.90	61.60	-130.20
2	11.9800	7317	1016	1110	50	1035	47	447400	61.60	-130.20	61.50	-130.00
3	7.4800	7534	974	1110	50	1035	47	447400	61.60	-130.40	61.60	-130.20
4	4.5800	7855	993	1110	50	1035	47	447400	61.60	-130.40	61.60	-130.40
5	10.7900	7219	945	1110	50	1035	47	447400	61.70	-130.70	61.60	-130.50
6	6.7300	7557	1002	1110	50	1035	47	447400	61.60	-130.60	61.60	-130.40
7	7.0200	7570	986	1110	50	1035	47	447400	61.60	-130.60	61.60	-130.40
8	2.4800	7658	1097	1110	50	1035	47	447400	61.60	-130.60	61.60	-130.50
9	2.3500	7655	1101	1110	50	1035	47	447400	61.60	-130.60	61.60	-130.50
10	3.9500	7107	1065	1110	50	1035	47	447400	61.70	-130.70	61.70	-130.70
11	5.1900	6999	1073	1110	50	1035	47	447400	61.70	-130.80	61.70	-130.70
12	3.2900	7025	991	1110	50	1035	47	447400	61.70	-130.80	61.70	-130.80
13	11.9500	6569	944	1110	50	1035	47	447400	61.80	-131.00	61.70	-130.80
14	6.1900	6641	1055	1110	50	1035	47	447400	61.70	-130.90	61.70	-130.80
15	8.5000	6425	1059	1110	50	1035	47	447400	61.80	-131.10	61.80	-131.00
16	7.3200	6382	1046	1110	50	1035	47	447400	61.70	-131.30	61.70	-131.10
17	4.9400	6353	1093	1110	50	1035	47	447400	61.70	-131.30	61.70	-131.20
18	10.9100	6333	1053	1110	50	1035	47	447400	61.70	-131.50	61.70	-131.30
19	9.7900	6349	1048	1110	50	1035	47	447400	61.70	-131.50	61.70	-131.30
20	6.8900	6369	1067	1110	50	1035	47	447400	61.70	-131.60	61.70	-131.50
21	13.7200	6258	1040	1110	50	1035	47	447400	61.80	-131.80	61.70	-131.60
22	3.2200	6379	1069	1110	50	1035	47	447400	61.70	-131.60	61.70	-131.60
23	3.3500	6343	1087	1110	50	1035	47	447400	61.80	-131.90	61.80	-131.80
24	4.6900	6248	1059	1110	50	1035	47	447400	61.80	-131.90	61.80	-131.90
25	3.6500	6294	1079	1110	50	1035	47	447400	61.80	-132.00	61.80	-131.90
26	6.0600	6254	1044	1110	50	1035	47	447400	61.80	-132.00	61.80	-131.90
27	8.4700	6271	996	1110	50	1035	47	447400	61.80	-132.20	61.80	-132.00
28	7.5800	6290	1005	1110	50	1035	47	447400	61.80	-132.20	61.80	-132.00
29	6.8100	6510	1066	1110	50	1035	47	447400	61.80	-132.30	61.80	-132.20
30	4.0800	6431	1048	1110	50	1035	47	447400	61.90	-132.30	61.80	-132.30
31	3.2400	6422	1039	1110	50	1035	47	447400	61.90	-132.40	61.80	-132.30
32	11.3500	6113	953	1110	50	1035	47	447400	62.00	-132.60	62.00	-132.40
33	11.2600	6188	986	1110	50	1035	47	447400	62.00	-132.60	62.00	-132.40
34	11.0400	6195	975	1110	50	1035	47	447400	62.00	-132.60	62.00	-132.40

Flight Line #	Length [km]	Alt MSL [ft]	Min Alt AGL [m]	Max Alt AGL [m]	FOV [deg]	Swath Width [m]	Used Scan Rate [Hz]	Used Laser Pulse Rate [Hz]	Begin WGS84 Latitude [deg]	Begin WGS84 Longitude [deg]	End WGS84 Latitude [deg]	End WGS84 Longitude [deg]
35	8.7500	6208	968	1110	50	1035	47	447400	62.00	-132.60	62.00	-132.40
36	7.4700	6257	977	1110	50	1035	47	447400	62.00	-132.60	61.90	-132.40
37	6.3000	6388	1023	1110	50	1035	47	447400	61.90	-132.60	61.90	-132.50
38	5.0700	6467	1050	1110	50	1035	47	447400	61.90	-132.50	61.90	-132.50
39	3.8100	6497	1067	1110	50	1035	47	447400	61.90	-132.50	61.90	-132.50
40	2.5300	6480	1080	1110	50	1035	47	447400	61.90	-132.50	61.90	-132.50
41	6.2300	6507	1072	1110	50	1035	47	447400	61.90	-132.50	61.90	-132.40
42	6.3400	6431	1048	1110	50	1035	47	447400	61.90	-132.40	61.90	-132.30
43	3.4000	6477	1057	1110	50	1035	47	447400	61.90	-132.40	61.80	-132.40
44	9.4400	6156	962	1110	50	1035	47	447400	62.00	-132.70	62.00	-132.60
45	5.5600	6520	1067	1110	50	1035	47	447400	62.00	-132.80	62.00	-132.70
46	15.0400	6336	1003	1110	50	1035	47	447400	62.10	-133.00	62.00	-132.80
47	3.4500	6641	1106	1110	50	1035	47	447400	62.00	-132.80	62.00	-132.80
48	9.8300	6540	1084	1110	50	1035	47	447400	62.10	-133.10	62.10	-133.00
49	3.4600	6011	947	1110	50	1035	47	447400	62.20	-133.20	62.10	-133.10
50	8.1700	5824	1016	1110	50	1035	47	447400	62.20	-133.30	62.10	-133.20
51	3.7800	5831	997	1110	50	1035	47	447400	62.20	-133.30	62.20	-133.30
52	12.6500	6297	1000	1110	50	1035	47	447400	62.20	-133.50	62.20	-133.30
53	5.1300	6310	1050	1110	50	1035	47	447400	62.20	-133.60	62.20	-133.50
54	16.5300	6353	1027	1110	50	1035	47	447400	62.20	-133.80	62.20	-133.50
55	10.0200	6399	1041	1110	50	1035	47	447400	62.20	-133.80	62.20	-133.60
56	12.1400	6356	1004	1110	50	1035	47	447400	62.20	-134.10	62.20	-133.90
57	3.0300	6389	1079	1110	50	1035	47	447400	62.20	-133.90	62.20	-133.80
58	5.2400	6431	1060	1110	50	1035	47	447400	62.20	-134.20	62.20	-134.10
59	3.9600	6067	939	1110	50	1035	47	447400	62.20	-134.20	62.20	-134.20
60	4.0200	5759	944	1110	50	1035	47	447400	62.20	-134.30	62.20	-134.20
61	7.3200	5647	1091	1110	50	1035	47	447400	62.20	-134.40	62.20	-134.30
62	3.2300	5654	1108	1110	50	1035	47	447400	62.20	-134.40	62.20	-134.30
63	9.9100	5631	1103	1110	50	1035	47	447400	62.20	-134.60	62.20	-134.40
64	5.1600	5654	1088	1110	50	1035	47	447400	62.20	-134.70	62.20	-134.60
65	10.9200	5529	1065	1110	50	1035	47	447400	62.20	-134.80	62.20	-134.60
66	7.5200	5618	1098	1110	50	1035	47	447400	62.20	-135.00	62.20	-134.80
67	5.7500	5654	965	1110	50	1035	47	447400	62.20	-134.90	62.20	-134.80
68	3.9900	5654	1059	1110	50	1035	47	447400	62.20	-135.00	62.20	-135.00
69	7.0600	5651	974	1110	50	1035	47	447400	62.20	-135.10	62.20	-135.00
70	7.1700	4547	580	772	50	720	47	311000	62.10	-135.20	62.20	-135.10
71	6.2800	4485	495	772	50	720	47	311000	62.10	-135.20	62.20	-135.10
72	6.4100	5582	1021	1110	50	1035	47	447400	62.10	-135.30	62.10	-135.20
73	5.4000	5552	1098	1110	50	1035	47	447400	62.10	-135.30	62.10	-135.30
74	6.1400	5601	1004	1110	50	1035	47	447400	62.10	-135.40	62.10	-135.30
75	2.8300	5523	954	1110	50	1035	47	447400	62.10	-135.50	62.10	-135.40
76	9.2200	5526	1011	1110	50	1035	47	447400	62.10	-135.60	62.10	-135.50
77	10.1000	5375	974	1110	50	1035	47	447400	62.10	-135.60	62.10	-135.50
78	8.1600	5368	1039	1110	50	1035	47	447400	62.00	-135.80	62.10	-135.60
79	3.8800	5408	1086	1110	50	1035	47	447400	62.00	-135.80	62.00	-135.70

Flight Line #	Length [km]	Alt MSL [ft]	Min Alt AGL [m]	Max Alt AGL [m]	FOV [deg]	Swath Width [m]	Used Scan Rate [Hz]	Used Laser Pulse Rate [Hz]	Begin WGS84 Latitude [deg]	Begin WGS84 Longitude [deg]	End WGS84 Latitude [deg]	End WGS84 Longitude [deg]
80	6.6500	5372	1066	1110	50	1035	47	447400	62.00	-135.90	62.00	-135.80
81	4.4100	4262	628	772	50	720	47	311000	62.10	-135.90	62.00	-135.90
82	18.9600	5349	1015	1110	50	1035	47	447400	62.10	-136.30	62.10	-135.90
83	17.8900	5362	1002	1110	50	1035	47	447400	62.10	-136.30	62.10	-136.00
84	15.8700	5345	1026	1110	50	1035	47	447400	62.10	-136.30	62.10	-136.00
85	6.8300	5355	1007	1110	50	1035	47	447400	62.10	-136.20	62.10	-136.10
86	7.6000	6261	1041	1110	50	1035	47	447400	61.70	-131.70	61.80	-131.80
87	11.3500	6113	953	1110	50	1035	47	447400	62.00	-132.60	62.00	-132.40
88	11.2600	6188	986	1110	50	1035	47	447400	62.00	-132.60	62.00	-132.40
89	11.0400	6195	975	1110	50	1035	47	447400	62.00	-132.60	62.00	-132.40
90	8.7500	6208	968	1110	50	1035	47	447400	62.00	-132.60	62.00	-132.40
91	7.4700	6257	977	1110	50	1035	47	447400	62.00	-132.60	61.90	-132.40
92	6.3000	6388	1023	1110	50	1035	47	447400	61.90	-132.60	61.90	-132.50
93	5.0700	6467	1050	1110	50	1035	47	447400	61.90	-132.50	61.90	-132.50
94	3.8100	6497	1067	1110	50	1035	47	447400	61.90	-132.50	61.90	-132.50
95	2.5300	6480	1080	1110	50	1035	47	447400	61.90	-132.50	61.90	-132.50
96	6.2300	6507	1072	1110	50	1035	47	447400	61.90	-132.50	61.90	-132.40
97	2.5600	7161	1085	1289	50	938	53	419800	59.60	-135.20	59.60	-135.20
98	15.9300	5839	979	1135	50	1058	47	457200	60.60	-134.90	60.60	-134.60
99	11.0700	7168	1018	1354	50	932	55	402800	59.60	-135.20	59.70	-135.00
100	5.5100	5832	1009	1135	50	1058	47	457200	60.60	-134.60	60.60	-134.70
101	5.5000	7020	996	1289	50	938	53	419800	59.70	-135.10	59.70	-135.10
102	6.1000	5839	896	1135	50	1058	47	457200	60.60	-134.60	60.60	-134.50
103	1.7700	5868	883	1135	50	1058	47	457200	60.60	-134.50	60.60	-134.50
104	5.0700	6954	987	1289	50	938	53	419800	59.70	-135.00	59.70	-135.00
105	3.9600	6938	1052	1289	50	938	53	419800	59.80	-135.00	59.70	-135.00
106	6.9800	5842	966	1135	50	1058	47	457200	60.60	-134.50	60.60	-134.40
107	11.7100	5845	904	1135	50	1058	47	457200	60.60	-134.40	60.50	-134.30
108	3.7400	6879	1195	1289	50	938	53	419800	59.80	-134.90	59.80	-135.00
109	5.0200	5848	1002	1136	50	1059	47	457200	60.50	-134.40	60.60	-134.40
110	3.3300	6695	1165	1289	50	938	53	419800	59.80	-134.90	59.80	-134.90
111	5.0300	6570	1028	1289	50	938	53	419800	59.80	-134.80	59.80	-134.90
112	14.1000	5845	974	1135	50	1058	47	457200	60.40	-134.10	60.50	-134.30
113	4.4000	6541	1085	1289	50	938	53	419800	59.80	-134.80	59.80	-134.80
114	3.6800	6111	1002	1135	50	1058	47	457200	60.40	-134.20	60.40	-134.20
115	2.9600	5888	1030	1136	50	1059	47	457200	60.40	-134.20	60.40	-134.20
116	5.6400	6721	979	1289	50	938	53	419800	59.90	-134.80	59.80	-134.80
117	8.6800	6010	993	1135	50	1058	47	457200	60.30	-134.00	60.40	-134.10
118	7.3800	6754	1032	1354	50	932	55	402800	59.90	-134.80	59.90	-134.80
119	3.8200	6617	1018	1312	50	955	53	412600	59.80	-134.80	59.90	-134.80
120	7.0100	6100	952	1135	50	1059	47	457200	60.30	-133.90	60.30	-134.10
121	10.6400	6399	937	1217	50	1009	50	435800	60.40	-133.80	60.30	-134.00
122	8.0400	7325	1252	1528	50	819	60	366400	60.00	-134.70	59.90	-134.80
123	4.0000	6288	995	1135	50	1058	47	457200	60.40	-133.70	60.40	-133.80
124	5.6800	6364	1064	1289	50	938	53	419800	60.00	-134.70	59.90	-134.70

Flight Line #	Length [km]	Alt MSL [ft]	Min Alt AGL [m]	Max Alt AGL [m]	FOV [deg]	Swath Width [m]	Used Scan Rate [Hz]	Used Laser Pulse Rate [Hz]	Begin WGS84 Latitude [deg]	Begin WGS84 Longitude [deg]	End WGS84 Latitude [deg]	End WGS84 Longitude [deg]
125	2.7400	6541	1076	1289	50	938	53	419800	59.90	-134.80	59.90	-134.80
126	5.0600	6337	1013	1135	50	1058	47	457200	60.40	-133.70	60.40	-133.80
127	13.3900	6252	960	1135	50	1058	47	457200	60.50	-133.50	60.40	-133.70
128	7.5300	6252	998	1135	50	1058	47	457200	60.40	-133.60	60.40	-133.70
129	5.7300	6272	1021	1135	50	1058	47	457200	60.50	-133.60	60.40	-133.70
130	4.5800	6229	1009	1135	50	1058	47	457200	60.50	-133.50	60.50	-133.50
131	4.6400	6210	996	1135	50	1058	47	457200	60.50	-133.40	60.50	-133.50
132	6.1500	5969	928	1135	50	1059	47	457200	60.50	-133.30	60.50	-133.40
133	8.4100	5875	973	1135	50	1058	47	457200	60.40	-133.20	60.50	-133.30
134	3.5300	5894	1024	1135	50	1058	47	457200	60.50	-133.30	60.50	-133.30
135	2.4500	6028	1036	1135	50	1059	47	457200	60.50	-133.30	60.50	-133.30
136	5.9000	5911	994	1135	50	1058	47	457200	60.40	-133.20	60.50	-133.20
137	13.3200	5898	1001	1135	50	1058	47	457200	60.30	-133.00	60.40	-133.20
138	4.0300	5898	1014	1135	50	1058	47	457200	60.30	-133.00	60.30	-133.10
139	11.2100	5917	1006	1135	50	1058	47	457200	60.20	-132.90	60.30	-133.00
140	7.4400	5914	1010	1135	50	1058	47	457200	60.20	-132.90	60.30	-133.00
141	8.7600	5907	942	1135	50	1058	47	457200	60.20	-132.80	60.20	-132.90
142	7.6400	5907	1030	1135	50	1058	47	457200	60.20	-132.80	60.20	-132.90
143	4.9300	5848	945	1135	50	1058	47	457200	60.60	-134.50	60.60	-134.40
144	7.5300	5921	961	1135	50	1058	47	457200	60.20	-132.80	60.20	-132.70
145	9.4400	5921	907	1135	50	1058	47	457200	60.10	-132.60	60.20	-132.80
146	7.9900	5943	909	1135	50	1059	47	457200	60.10	-132.50	60.10	-132.60
147	7.4300	5921	934	1135	50	1058	47	457200	60.10	-132.50	60.10	-132.60
148	10.8000	5888	1001	1135	50	1058	47	457200	60.10	-132.30	60.10	-132.50
149	10.5500	5934	1009	1135	50	1058	47	457200	60.10	-132.40	60.10	-132.50
150	10.7700	5881	983	1135	50	1058	47	457200	60.00	-132.20	60.10	-132.40
151	4.1400	6088	1000	1135	50	1058	47	457200	60.00	-132.30	60.00	-132.20
152	4.9300	6134	906	1135	50	1058	47	457200	60.00	-132.20	60.00	-132.20
153	4.4900	6252	1005	1135	50	1058	47	457200	60.00	-132.10	60.00	-132.20
154	3.0700	6252	1056	1135	50	1058	47	457200	60.00	-132.10	60.00	-132.10
155	15.9400	6183	915	1135	50	1058	47	457200	59.90	-131.90	60.00	-132.10
156	3.0400	6288	1036	1135	50	1058	47	457200	60.00	-132.00	60.00	-132.10
157	9.5600	6174	931	1135	50	1058	47	457200	59.90	-131.70	59.90	-131.90
158	7.2100	6242	969	1135	50	1058	47	457200	59.90	-131.60	59.90	-131.80
159	8.5700	6373	976	1135	50	1058	47	457200	59.90	-131.50	59.90	-131.60
160	12.7600	6344	958	1135	50	1058	47	457200	59.90	-131.50	59.90	-131.70
161	5.5900	6429	1058	1135	50	1058	47	457200	59.90	-131.40	59.90	-131.50
162	7.2100	6380	932	1135	50	1058	47	457200	59.90	-131.30	59.90	-131.40
163	6.0700	6429	899	1135	50	1058	47	457200	59.90	-131.20	59.90	-131.30
164	8.0300	6446	983	1135	50	1058	47	457200	60.00	-131.20	60.00	-131.20
165	3.6800	6446	1033	1135	50	1058	47	457200	60.00	-131.20	59.90	-131.20
166	9.1600	6541	940	1135	50	1058	47	457200	60.00	-131.00	60.00	-131.20
167	9.8000	6639	944	1135	50	1058	47	457200	60.10	-130.90	60.00	-131.00
168	3.4500	6800	1035	1135	50	1058	47	457200	60.10	-130.90	60.10	-130.90
169	2.9900	6751	992	1135	50	1058	47	457200	60.10	-130.90	60.10	-130.90

Flight Line #	Length [km]	Alt MSL [ft]	Min Alt AGL [m]	Max Alt AGL [m]	FOV [deg]	Swath Width [m]	Used Scan Rate [Hz]	Used Laser Pulse Rate [Hz]	Begin WGS84 Latitude [deg]	Begin WGS84 Longitude [deg]	End WGS84 Latitude [deg]	End WGS84 Longitude [deg]
170	4.7500	5538	552	796	50	742	47	320800	60.10	-130.80	60.10	-130.90
171	3.9000	6649	987	1135	50	1058	47	457200	60.10	-130.70	60.10	-130.80
172	3.6500	6610	911	1135	50	1058	47	457200	60.10	-130.70	60.10	-130.70
173	5.2200	6570	920	1135	50	1058	47	457200	60.10	-130.60	60.10	-130.70
174	4.1400	6567	1018	1135	50	1058	47	457200	60.10	-130.60	60.10	-130.70
175	3.7300	6547	880	1135	50	1058	47	457200	60.10	-130.60	60.10	-130.60
176	5.6900	6528	910	1135	50	1058	43	228600	60.10	-130.40	60.10	-130.50
177	2.7400	6554	932	1135	50	1058	47	457200	60.10	-130.50	60.10	-130.60
178	5.6900	6528	910	1135	50	1058	43	228600	60.10	-130.40	60.10	-130.50
179	6.3700	6449	910	1135	50	1058	47	457200	60.10	-130.40	60.10	-130.50
180	5.6600	6462	936	1135	50	1058	47	457200	60.10	-130.30	60.10	-130.40
181	8.7100	6383	908	1135	50	1058	47	457200	60.20	-130.20	60.10	-130.30
182	5.4700	6347	892	1135	50	1058	47	457200	60.20	-130.10	60.20	-130.20
183	2.8400	6101	886	1135	50	1058	47	457200	60.20	-130.10	60.20	-130.10
184	11.1800	6209	885	1135	50	1058	47	457200	60.20	-129.90	60.20	-130.10
185	5.6200	6209	992	1135	50	1058	47	457200	60.20	-130.00	60.20	-130.10
186	7.8200	6386	980	1135	50	1058	47	457200	60.20	-129.80	60.20	-129.90
187	7.0800	6209	999	1135	50	1058	47	457200	60.20	-129.70	60.20	-129.80
188	8.4100	6114	1013	1135	50	1058	47	457200	60.10	-129.60	60.20	-129.70
189	5.8700	6334	897	1105	50	1126	44	225600	59.60	-136.40	59.60	-136.50
190	5.8700	6357	904	1105	50	1126	44	225600	59.60	-136.50	59.60	-136.40
191	7.0800	5463	698	1104	50	1125	44	225600	59.60	-136.50	59.50	-136.40
192	9.0200	4841	461	1105	50	1126	44	225600	59.60	-136.50	59.50	-136.50
193	9.1800	4841	442	1105	50	1126	44	225600	59.60	-136.50	59.50	-136.50
194	3.2700	5545	803	1104	50	1125	44	225600	59.60	-136.50	59.50	-136.50
195	9.9500	4370	576	1104	50	1125	44	225600	59.50	-136.50	59.40	-136.40
196	9.2400	4370	699	1104	50	1125	44	225600	59.50	-136.50	59.40	-136.40
197	7.1900	4462	847	1104	50	1125	44	225600	59.50	-136.50	59.50	-136.40
198	7.1900	4462	847	1104	50	1125	44	225600	59.50	-136.50	59.50	-136.40
199	2.1900	4547	928	1105	50	613	59	244600	59.50	-136.40	59.50	-136.40
200	5.2100	5686	1041	1154	50	1076	47	431800	62.60	-141.00	62.60	-140.90
201	2.7300	5689	1076	1154	50	1076	47	431800	62.60	-141.00	62.60	-140.90
202	5.7400	5738	1119	1154	50	1076	47	431800	62.60	-141.00	62.50	-141.00
203	2.5300	5823	1147	1154	50	1076	47	431800	62.50	-141.00	62.50	-141.00
204	7.4400	5823	1064	1154	50	1076	47	431800	62.50	-141.00	62.50	-140.90
205	2.7200	5860	1104	1154	50	1076	47	431800	62.50	-140.90	62.50	-140.90
206	5.5100	5840	1099	1154	50	1076	47	431800	62.50	-140.90	62.50	-140.90
207	2.6700	5843	1145	1154	50	1076	47	431800	62.50	-140.90	62.50	-140.90
208	8.9600	5843	1117	1154	50	1076	47	431800	62.50	-140.80	62.40	-140.90
209	10.7400	5843	1107	1154	50	1076	47	431800	62.50	-140.80	62.40	-140.90
210	10.9200	5840	1109	1154	50	1076	47	431800	62.50	-140.80	62.40	-140.90
211	10.8300	5840	1113	1154	50	1076	47	431800	62.40	-140.80	62.40	-140.90
212	13.5700	5935	1005	1154	50	1076	47	431800	62.40	-140.90	62.30	-140.70
213	12.3700	5951	1022	1154	50	1076	47	431800	62.40	-140.90	62.30	-140.80
214	4.3000	6398	1128	1154	50	1076	47	431800	62.30	-140.70	62.30	-140.70

Flight Line #	Length [km]	Alt MSL [ft]	Min Alt AGL [m]	Max Alt AGL [m]	FOV [deg]	Swath Width [m]	Used Scan Rate [Hz]	Used Laser Pulse Rate [Hz]	Begin WGS84 Latitude [deg]	Begin WGS84 Longitude [deg]	End WGS84 Latitude [deg]	End WGS84 Longitude [deg]
215	8.9500	6411	1055	1154	50	1076	47	431800	62.20	-140.70	62.30	-140.70
216	17.7500	6178	987	1154	50	1076	47	431800	62.20	-140.70	62.10	-140.70
217	14.6100	6273	1029	1154	50	1076	47	431800	62.10	-140.70	62.20	-140.70
218	5.2400	6155	1031	1154	50	1076	47	431800	62.00	-140.60	62.10	-140.70
219	13.6800	6066	987	1154	50	1076	47	431800	62.00	-140.40	62.00	-140.60
220	5.8500	6129	1022	1154	50	1076	47	431800	62.00	-140.60	62.00	-140.50
221	7.0000	6086	1045	1154	50	1076	47	431800	62.00	-140.50	62.00	-140.60
222	4.4900	6102	968	1154	50	1076	47	431800	62.00	-140.50	62.00	-140.60
223	12.1300	6135	678	1154	50	1076	47	215800	62.00	-140.40	61.90	-140.20
224	11.8200	6135	753	1154	50	1076	47	215800	62.00	-140.40	61.90	-140.30
225	11.8200	6135	816	1154	50	1076	47	215800	62.00	-140.40	61.90	-140.30
226	4.9200	6154	1021	1154	50	1076	47	215800	62.00	-140.40	61.90	-140.30
227	7.7000	4993	714	803	50	749	47	300400	61.90	-140.20	61.80	-140.10
228	6.3100	5013	564	803	50	749	47	300400	61.90	-140.20	61.90	-140.10
229	3.1600	6145	1046	1154	50	1076	47	431800	61.90	-140.30	61.90	-140.20
230	3.7100	5912	1030	1154	50	1076	47	431800	61.90	-140.10	61.80	-140.10
231	9.1700	5971	890	1154	50	1076	47	431800	61.80	-140.10	61.80	-140.10
232	8.7300	5972	936	1154	50	1076	47	431800	61.80	-140.10	61.80	-140.10
233	7.5400	5985	898	1155	50	1077	47	431600	61.80	-140.10	61.80	-140.10
234	6.2900	6081	962	1155	50	1077	47	431800	61.80	-140.10	61.80	-140.10
235	4.9900	6086	925	1154	50	1076	47	431800	61.80	-140.10	61.80	-140.10
236	3.9300	6107	999	1155	50	1077	47	431800	61.80	-140.00	61.80	-140.00
237	2.2200	6138	1046	1154	50	1076	47	431800	61.80	-140.00	61.80	-140.00
238	14.9300	6083	1038	1154	50	1076	47	431800	61.80	-140.00	61.70	-139.80
239	7.6100	6083	1038	1154	50	1076	47	431800	61.70	-139.90	61.70	-139.80
240	4.8400	6097	1043	1155	50	1077	47	431800	61.70	-139.80	61.70	-139.80
241	6.2300	6042	1063	1155	50	1077	47	431800	61.70	-139.80	61.60	-139.70
242	6.3600	6053	977	1154	50	1076	47	431800	61.70	-139.80	61.60	-139.70
243	2.8700	6070	926	1154	50	1076	47	431800	61.70	-139.70	61.70	-139.70
244	6.0400	6302	1031	1154	50	1076	47	431800	61.60	-139.60	61.60	-139.70
245	6.0100	6322	1084	1154	50	1076	47	431800	61.60	-139.50	61.60	-139.60
246	5.7100	6175	1066	1154	50	1076	47	431800	61.60	-139.50	61.60	-139.40
247	3.2200	6150	1105	1155	50	1077	47	431800	61.60	-139.40	61.60	-139.40
248	5.4000	6127	938	1154	50	1077	47	431600	61.60	-139.40	61.60	-139.40
249	6.4800	6106	932	1154	50	1076	47	431800	61.60	-139.40	61.60	-139.40
250	8.2400	6046	949	1154	50	1076	47	431800	61.60	-139.40	61.50	-139.30
251	8.3000	6046	897	1154	50	1076	47	431800	61.60	-139.40	61.60	-139.30
252	8.1200	6088	984	1155	50	1077	47	431800	61.60	-139.40	61.60	-139.30
253	7.9000	6088	906	1155	50	1077	47	431800	61.60	-139.30	61.60	-139.40
254	3.1700	6147	1058	1155	50	1077	47	431800	61.50	-139.30	61.50	-139.30
255	6.2200	6137	971	1155	50	1077	47	431800	61.50	-139.30	61.50	-139.30
256	4.0800	6294	1004	1155	50	1077	47	431800	61.50	-139.30	61.50	-139.20
257	7.0500	6302	980	1154	50	1076	47	431800	61.40	-139.20	61.50	-139.20
258	3.1800	6444	1065	1154	50	1076	47	431800	61.40	-139.20	61.40	-139.20
259	3.7500	6445	1090	1155	50	1077	47	431800	61.40	-139.20	61.40	-139.20

Flight Line #	Length [km]	Alt MSL [ft]	Min Alt AGL [m]	Max Alt AGL [m]	FOV [deg]	Swath Width [m]	Used Scan Rate [Hz]	Used Laser Pulse Rate [Hz]	Begin WGS84 Latitude [deg]	Begin WGS84 Longitude [deg]	End WGS84 Latitude [deg]	End WGS84 Longitude [deg]
260	6.3300	6508	1074	1155	50	1077	47	431800	61.40	-139.10	61.40	-139.20
261	4.7900	6434	1065	1154	50	1076	47	431800	61.40	-139.10	61.40	-139.10
262	10.0000	6345	1103	1154	50	1076	47	431800	61.40	-139.10	61.30	-138.90
263	9.6400	6332	1085	1154	50	1076	47	431800	61.30	-138.90	61.40	-139.10
264	8.3800	6366	1081	1155	50	1077	47	431800	61.30	-138.90	61.30	-139.00
265	2.7400	6824	897	1154	50	1076	47	431800	61.30	-138.90	61.30	-138.90
266	3.7900	6591	936	1154	50	1076	47	431800	61.30	-138.90	61.30	-138.90
267	4.5700	6307	806	1155	50	1077	47	215800	61.30	-138.90	61.30	-138.90
268	5.0900	6191	741	1154	50	1076	47	215800	61.30	-138.90	61.30	-138.90
269	5.5500	6184	873	1154	50	1076	47	215800	61.30	-138.90	61.30	-138.90
270	5.9400	6184	733	1154	50	1076	47	215800	61.30	-138.90	61.30	-138.80
271	6.0200	6184	733	1154	50	1076	47	215800	61.30	-138.90	61.30	-138.80
272	6.0200	6299	768	1155	50	1077	47	215800	61.30	-138.90	61.30	-138.80
273	5.9000	6184	841	1154	50	1076	47	215800	61.30	-138.90	61.30	-138.80
274	3.5100	6129	909	1154	50	1076	47	431800	61.30	-138.80	61.30	-138.80
275	5.1500	5966	935	1155	50	1077	47	431800	61.20	-138.70	61.30	-138.80
276	2.5300	6109	1029	1154	50	1076	47	431800	61.20	-138.80	61.30	-138.80
277	5.2100	5686	1041	1154	50	1076	47	431800	62.60	-141.00	62.60	-140.90
278	2.7300	5689	1076	1154	50	1076	47	431800	62.60	-141.00	62.60	-140.90
279	5.7400	5738	1119	1154	50	1076	47	431800	62.60	-141.00	62.50	-141.00
280	2.5300	5823	1147	1154	50	1076	47	431800	62.50	-141.00	62.50	-141.00
281	7.4400	5823	1064	1154	50	1076	47	431800	62.50	-141.00	62.50	-140.90
282	2.7200	5860	1104	1154	50	1076	47	431800	62.50	-140.90	62.50	-140.90
283	5.5100	5840	1099	1154	50	1076	47	431800	62.50	-140.90	62.50	-140.90
284	2.6700	5843	1145	1154	50	1076	47	431800	62.50	-140.90	62.50	-140.90
285	8.9600	5843	1117	1154	50	1076	47	431800	62.50	-140.80	62.40	-140.90
286	10.7400	5843	1107	1154	50	1076	47	431800	62.50	-140.80	62.40	-140.90
287	10.9200	5840	1109	1154	50	1076	47	431800	62.50	-140.80	62.40	-140.90
288	10.8300	5840	1113	1154	50	1076	47	431800	62.40	-140.80	62.40	-140.90
289	13.5700	5935	1005	1154	50	1076	47	431800	62.40	-140.90	62.30	-140.70
290	12.3700	5951	1022	1154	50	1076	47	431800	62.40	-140.90	62.30	-140.80
291	4.3000	6398	1128	1154	50	1076	47	431800	62.30	-140.70	62.30	-140.70
292	8.9500	6411	1055	1154	50	1076	47	431800	62.20	-140.70	62.30	-140.70
293	17.7500	6178	987	1154	50	1076	47	431800	62.20	-140.70	62.10	-140.70
294	14.6100	6273	1029	1154	50	1076	47	431800	62.10	-140.70	62.20	-140.70
295	5.2400	6155	1031	1154	50	1076	47	431800	62.00	-140.60	62.10	-140.70
296	13.6800	6066	987	1154	50	1076	47	431800	62.00	-140.40	62.00	-140.60
297	5.8500	6129	1022	1154	50	1076	47	431800	62.00	-140.60	62.00	-140.50
298	7.0000	6086	1045	1154	50	1076	47	431800	62.00	-140.50	62.00	-140.60
299	4.4900	6102	968	1154	50	1076	47	431800	62.00	-140.50	62.00	-140.60
300	12.1300	6135	678	1154	50	1076	47	215800	62.00	-140.40	61.90	-140.20
301	11.8200	6135	753	1154	50	1076	47	215800	62.00	-140.40	61.90	-140.30
302	11.8200	6135	816	1154	50	1076	47	215800	62.00	-140.40	61.90	-140.30
303	4.9200	6154	1021	1154	50	1076	47	215800	62.00	-140.40	61.90	-140.30
304	7.7000	4993	714	803	50	749	47	300400	61.90	-140.20	61.80	-140.10

Flight Line #	Length [km]	Alt MSL [ft]	Min Alt AGL [m]	Max Alt AGL [m]	FOV [deg]	Swath Width [m]	Used Scan Rate [Hz]	Used Laser Pulse Rate [Hz]	Begin WGS84 Latitude [deg]	Begin WGS84 Longitude [deg]	End WGS84 Latitude [deg]	End WGS84 Longitude [deg]
305	6.3100	5013	564	803	50	749	47	300400	61.90	-140.20	61.90	-140.10
306	3.1600	6145	1046	1154	50	1076	47	431800	61.90	-140.30	61.90	-140.20
307	6.0800	7235	525	1071	50	999	47	231200	62.00	-128.40	62.00	-128.30
308	6.1000	7235	525	1071	50	999	47	231200	62.00	-128.40	62.00	-128.30
309	6.1100	7235	525	1071	50	999	47	231200	62.00	-128.40	62.00	-128.30
310	6.1300	7235	525	1071	50	999	47	231200	62.00	-128.40	62.00	-128.30
311	6.1500	7235	525	1071	50	999	47	231200	62.00	-128.40	62.00	-128.30
312	5.9300	7251	530	1071	50	999	47	231200	62.00	-128.40	62.00	-128.30
313	5.8100	7251	530	1071	50	999	47	231200	62.00	-128.40	62.00	-128.30
314	5.4700	7244	528	1071	50	999	47	231200	62.00	-128.40	62.00	-128.30
315	5.1600	7244	552	1071	50	999	47	231200	62.00	-128.40	62.00	-128.30
316	4.9700	7244	528	1071	50	999	47	231200	62.00	-128.40	62.00	-128.30
317	4.7300	7238	526	1071	50	999	47	231200	62.00	-128.40	62.00	-128.30
318	7.0300	6352	922	1135	50	1157	47	457200	59.90	-131.30	59.90	-131.40
319	6.6600	6419	887	1135	50	1156	47	457200	59.90	-131.20	59.90	-131.30
320	8.0600	6449	982	1135	50	1156	47	457200	60.00	-131.20	60.00	-131.20
321	3.4300	6449	1027	1135	50	1156	47	457200	60.00	-131.20	59.90	-131.20
322	3.4300	6449	1027	1135	50	1156	47	457200	60.00	-131.20	59.90	-131.20
323	9.1600	6554	940	1135	50	1156	47	457200	60.00	-131.00	60.00	-131.20
324	9.1600	6554	940	1135	50	1156	47	457200	60.00	-131.00	60.00	-131.20
325	9.6900	6616	945	1135	50	1156	47	457200	60.10	-130.90	60.00	-131.00
326	3.4000	6754	1016	1135	50	1156	47	457200	60.10	-130.90	60.10	-130.90
327	2.9800	6747	990	1135	50	1156	47	457200	60.10	-130.90	60.10	-130.90
328	2.9800	6747	990	1135	50	1156	47	457200	60.10	-130.90	60.10	-130.90
329	3.8900	6639	983	1135	50	1156	47	457200	60.10	-130.70	60.10	-130.80
330	3.8900	6639	983	1135	50	1156	47	457200	60.10	-130.70	60.10	-130.80
331	3.8900	6639	983	1135	50	1156	47	457200	60.10	-130.70	60.10	-130.80
332	3.6100	6616	917	1135	50	1156	47	457200	60.10	-130.70	60.10	-130.70
333	3.6100	6616	917	1135	50	1156	47	457200	60.10	-130.70	60.10	-130.70
334	5.0000	6564	920	1135	50	1156	47	457200	60.10	-130.60	60.10	-130.70
335	5.0000	6564	920	1135	50	1156	47	457200	60.10	-130.60	60.10	-130.70
336	5.0000	6564	920	1135	50	1156	47	457200	60.10	-130.60	60.10	-130.70
337	3.9400	6564	1005	1135	50	1156	47	457200	60.10	-130.60	60.10	-130.70
338	3.9400	6564	1005	1135	50	1156	47	457200	60.10	-130.60	60.10	-130.70
339	2.5200	6544	911	1135	50	1156	47	457200	60.10	-130.50	60.10	-130.60
340	2.5200	6544	911	1135	50	1156	47	457200	60.10	-130.50	60.10	-130.60
341	4.0000	6506	892	1135	50	1157	47	457200	60.10	-130.40	60.10	-130.50
342	4.0000	6506	892	1135	50	1157	47	457200	60.10	-130.40	60.10	-130.50
343	5.4200	6455	887	1135	50	1156	47	457200	60.10	-130.30	60.10	-130.40
344	5.4200	6455	887	1135	50	1156	47	457200	60.10	-130.30	60.10	-130.40
345	8.4700	6377	891	1135	50	1156	47	457200	60.20	-130.20	60.10	-130.30
346	2.9800	6113	897	1135	50	1157	47	457200	60.20	-130.10	60.20	-130.10
347	2.9800	6113	897	1135	50	1157	47	457200	60.20	-130.10	60.20	-130.10
348	11.1000	6231	890	1135	50	1157	47	457200	60.20	-129.90	60.20	-130.10
349	11.1000	6231	890	1135	50	1157	47	457200	60.20	-129.90	60.20	-130.10

Flight Line #	Length [km]	Alt MSL [ft]	Min Alt AGL [m]	Max Alt AGL [m]	FOV [deg]	Swath Width [m]	Used Scan Rate [Hz]	Used Laser Pulse Rate [Hz]	Begin WGS84 Latitude [deg]	Begin WGS84 Longitude [deg]	End WGS84 Latitude [deg]	End WGS84 Longitude [deg]
350	5.4500	6231	997	1135	50	1157	47	457200	60.20	-130.00	60.20	-130.10
351	7.6900	6380	975	1135	50	1156	47	457200	60.20	-129.80	60.20	-129.90
352	7.4600	6211	979	1135	50	1157	47	457200	60.20	-129.70	60.20	-129.80
353	7.4600	6211	979	1135	50	1157	47	457200	60.20	-129.70	60.20	-129.80
354	8.2800	6116	1011	1135	50	1157	47	457200	60.10	-129.60	60.20	-129.70
355	3.8500	6454	916	1135	50	1157	47	457200	60.10	-130.40	60.10	-130.40
356	4.5600	7185	1192	1300	40	1325	53	408800	60.10	-130.90	60.10	-130.80
357	4.0400	7128	1164	1312	40	1336	53	412600	60.10	-130.60	60.10	-130.60
358	4.0400	7128	1164	1312	40	1336	53	412600	60.10	-130.60	60.10	-130.60
359	4.1400	7128	1164	1312	40	1336	53	412600	60.10	-130.60	60.10	-130.60
360	4.1400	7128	1164	1312	40	1336	53	412600	60.10	-130.60	60.10	-130.60
361	5.7200	7105	1149	1312	40	1336	53	412600	60.10	-130.50	60.10	-130.40
362	5.2500	7107	1160	1312	40	1337	53	412600	60.10	-130.50	60.10	-130.40
363	5.2500	7107	1160	1312	40	1337	53	412600	60.10	-130.50	60.10	-130.40
364	5.9800	6945	1135	1312	40	1336	53	412600	60.20	-130.10	60.20	-130.20
365	5.9800	6945	1135	1312	40	1336	53	412600	60.20	-130.10	60.20	-130.20
366	5.8100	6945	1195	1312	40	1336	53	412600	60.20	-130.10	60.10	-130.20
367	5.8100	6945	1195	1312	40	1336	53	412600	60.20	-130.10	60.10	-130.20
368	1.5500	5974	1111	1154	50	1076	47	431800	60.20	-137.00	60.20	-137.00
369	2.8700	5728	1102	1154	50	1076	47	431800	60.60	-137.20	60.60	-137.20
370	2.6600	5799	1068	1155	50	1077	47	431800	60.70	-137.50	60.70	-137.40
371	4.6600	5902	973	1154	50	1076	47	431800	60.80	-137.70	60.80	-137.70
372	4.4300	5641	1067	1155	50	1077	47	431800	60.80	-137.60	60.80	-137.60
373	4.7500	5737	1059	1155	50	1077	47	431800	60.80	-137.70	60.80	-137.60
374	4.9400	6549	985	1154	50	1076	47	431800	60.90	-137.80	60.80	-137.80
375	2.5500	7001	984	1154	50	1076	47	431800	61.00	-138.50	61.00	-138.40
376	2.5600	7161	1085	1289	40	938	53	419800	59.60	-135.20	59.60	-135.20
377	15.9300	5839	979	1135	50	1058	47	457200	60.60	-134.90	60.60	-134.60
378	11.0700	7168	1018	1354	38	932	55	402800	59.60	-135.20	59.70	-135.00
379	5.5100	5832	1009	1135	50	1058	47	457200	60.60	-134.60	60.60	-134.70
380	5.5000	7020	996	1289	40	938	53	419800	59.70	-135.10	59.70	-135.10
381	6.1000	5839	896	1135	50	1058	47	457200	60.60	-134.60	60.60	-134.50
382	1.7700	5868	883	1135	50	1058	47	457200	60.60	-134.50	60.60	-134.50
383	5.0700	6954	987	1289	40	938	53	419800	59.70	-135.00	59.70	-135.00
384	3.9600	6938	1052	1289	40	938	53	419800	59.80	-135.00	59.70	-135.00
385	6.9800	5842	966	1135	50	1058	47	457200	60.60	-134.50	60.60	-134.40
386	11.7100	5845	904	1135	50	1058	47	457200	60.60	-134.40	60.50	-134.30
387	3.7400	6879	1195	1289	40	938	53	419800	59.80	-134.90	59.80	-135.00
388	5.0200	5848	1002	1136	50	1059	47	457200	60.50	-134.40	60.60	-134.40
389	3.3300	6695	1165	1289	40	938	53	419800	59.80	-134.90	59.80	-134.90
390	5.0300	6570	1028	1289	40	938	53	419800	59.80	-134.80	59.80	-134.90
391	14.1000	5845	974	1135	50	1058	47	457200	60.40	-134.10	60.50	-134.30
392	4.4000	6541	1085	1289	40	938	53	419800	59.80	-134.80	59.80	-134.80
393	3.6800	6111	1002	1135	50	1058	47	457200	60.40	-134.20	60.40	-134.20
394	2.9600	5888	1030	1136	50	1059	47	457200	60.40	-134.20	60.40	-134.20

Flight Line #	Length [km]	Alt MSL [ft]	Min Alt AGL [m]	Max Alt AGL [m]	FOV [deg]	Swath Width [m]	Used Scan Rate [Hz]	Used Laser Pulse Rate [Hz]	Begin WGS84 Latitude [deg]	Begin WGS84 Longitude [deg]	End WGS84 Latitude [deg]	End WGS84 Longitude [deg]
395	5.6400	6721	979	1289	40	938	53	419800	59.90	-134.80	59.80	-134.80
396	8.6800	6010	993	1135	50	1058	47	457200	60.30	-134.00	60.40	-134.10
397	7.3800	6754	1032	1354	38	932	55	402800	59.90	-134.80	59.90	-134.80
398	3.8200	6617	1018	1312	40	955	53	412600	59.80	-134.80	59.90	-134.80
399	7.0100	6100	952	1135	50	1059	47	457200	60.30	-133.90	60.30	-134.10
400	10.6400	6399	937	1217	45	1009	50	435800	60.40	-133.80	60.30	-134.00
401	8.0400	7325	1252	1528	30	819	60	366400	60.00	-134.70	59.90	-134.80
402	4.0000	6288	995	1135	50	1058	47	457200	60.40	-133.70	60.40	-133.80
403	5.6800	6364	1064	1289	40	938	53	419800	60.00	-134.70	59.90	-134.70
404	2.7400	6541	1076	1289	40	938	53	419800	59.90	-134.80	59.90	-134.80
405	5.0600	6337	1013	1135	50	1058	47	457200	60.40	-133.70	60.40	-133.80
406	13.3900	6252	960	1135	50	1058	47	457200	60.50	-133.50	60.40	-133.70
407	7.5300	6252	998	1135	50	1058	47	457200	60.40	-133.60	60.40	-133.70
408	5.7300	6272	1021	1135	50	1058	47	457200	60.50	-133.60	60.40	-133.70
409	4.5800	6229	1009	1135	50	1058	47	457200	60.50	-133.50	60.50	-133.50
410	4.6400	6210	996	1135	50	1058	47	457200	60.50	-133.40	60.50	-133.50
411	6.1500	5969	928	1135	50	1059	47	457200	60.50	-133.30	60.50	-133.40
412	8.4100	5875	973	1135	50	1058	47	457200	60.40	-133.20	60.50	-133.30
413	3.5300	5894	1024	1135	50	1058	47	457200	60.50	-133.30	60.50	-133.30
414	2.4500	6028	1036	1135	50	1059	47	457200	60.50	-133.30	60.50	-133.30
415	5.9000	5911	994	1135	50	1058	47	457200	60.40	-133.20	60.50	-133.20
416	13.3200	5898	1001	1135	50	1058	47	457200	60.30	-133.00	60.40	-133.20
417	4.0300	5898	1014	1135	50	1058	47	457200	60.30	-133.00	60.30	-133.10
418	11.2100	5917	1006	1135	50	1058	47	457200	60.20	-132.90	60.30	-133.00
419	7.4400	5914	1010	1135	50	1058	47	457200	60.20	-132.90	60.30	-133.00
420	8.7600	5907	942	1135	50	1058	47	457200	60.20	-132.80	60.20	-132.90
421	7.6400	5907	1030	1135	50	1058	47	457200	60.20	-132.80	60.20	-132.90
422	4.9300	5848	945	1135	50	1058	47	457200	60.60	-134.50	60.60	-134.40
423	7.5300	5921	961	1135	50	1058	47	457200	60.20	-132.80	60.20	-132.70
424	9.4400	5921	907	1135	50	1058	47	457200	60.10	-132.60	60.20	-132.80
425	7.9900	5943	909	1135	50	1059	47	457200	60.10	-132.50	60.10	-132.60
426	7.4300	5921	934	1135	50	1058	47	457200	60.10	-132.50	60.10	-132.60
427	10.8000	5888	1001	1135	50	1058	47	457200	60.10	-132.30	60.10	-132.50
428	10.5500	5934	1009	1135	50	1058	47	457200	60.10	-132.40	60.10	-132.50
429	10.7700	5881	983	1135	50	1058	47	457200	60.00	-132.20	60.10	-132.40
430	4.1400	6088	1000	1135	50	1058	47	457200	60.00	-132.30	60.00	-132.20
431	4.9300	6134	906	1135	50	1058	47	457200	60.00	-132.20	60.00	-132.20
432	4.4900	6252	1005	1135	50	1058	47	457200	60.00	-132.10	60.00	-132.20
433	3.0700	6252	1056	1135	50	1058	47	457200	60.00	-132.10	60.00	-132.10
434	15.9400	6183	915	1135	50	1058	47	457200	59.90	-131.90	60.00	-132.10
435	3.0400	6288	1036	1135	50	1058	47	457200	60.00	-132.00	60.00	-132.10
436	9.5600	6174	931	1135	50	1058	47	457200	59.90	-131.70	59.90	-131.90
437	7.2100	6242	969	1135	50	1058	47	457200	59.90	-131.60	59.90	-131.80
438	8.5700	6373	976	1135	50	1058	47	457200	59.90	-131.50	59.90	-131.60
439	12.7600	6344	958	1135	50	1058	47	457200	59.90	-131.50	59.90	-131.70

Flight Line #	Length [km]	Alt MSL [ft]	Min Alt AGL [m]	Max Alt AGL [m]	FOV [deg]	Swath Width [m]	Used Scan Rate [Hz]	Used Laser Pulse Rate [Hz]	Begin WGS84 Latitude [deg]	Begin WGS84 Longitude [deg]	End WGS84 Latitude [deg]	End WGS84 Longitude [deg]
440	5.5900	6429	1058	1135	50	1058	47	457200	59.90	-131.40	59.90	-131.50
441	7.2100	6380	932	1135	50	1058	47	457200	59.90	-131.30	59.90	-131.40
442	6.0700	6429	899	1135	50	1058	47	457200	59.90	-131.20	59.90	-131.30
443	8.0300	6446	983	1135	50	1058	47	457200	60.00	-131.20	60.00	-131.20
444	3.6800	6446	1033	1135	50	1058	47	457200	60.00	-131.20	59.90	-131.20
445	9.1600	6541	940	1135	50	1058	47	457200	60.00	-131.00	60.00	-131.20
446	9.8000	6639	944	1135	50	1058	47	457200	60.10	-130.90	60.00	-131.00
447	3.4500	6800	1035	1135	50	1058	47	457200	60.10	-130.90	60.10	-130.90
448	2.9900	6751	992	1135	50	1058	47	457200	60.10	-130.90	60.10	-130.90
449	4.7500	5538	552	796	50	742	47	320800	60.10	-130.80	60.10	-130.90
450	3.9000	6649	987	1135	50	1058	47	457200	60.10	-130.70	60.10	-130.80
451	3.6500	6610	911	1135	50	1058	47	457200	60.10	-130.70	60.10	-130.70
452	5.2200	6570	920	1135	50	1058	47	457200	60.10	-130.60	60.10	-130.70
453	4.1400	6567	1018	1135	50	1058	47	457200	60.10	-130.60	60.10	-130.70
454	3.7300	6547	880	1135	50	1058	47	457200	60.10	-130.60	60.10	-130.60
455	5.6900	6528	910	1135	50	1058	43	228600	60.10	-130.40	60.10	-130.50
456	2.7400	6554	932	1135	50	1058	47	457200	60.10	-130.50	60.10	-130.60
457	5.6900	6528	910	1135	50	1058	43	228600	60.10	-130.40	60.10	-130.50
458	6.3700	6449	910	1135	50	1058	47	457200	60.10	-130.40	60.10	-130.50
459	5.6600	6462	936	1135	50	1058	47	457200	60.10	-130.30	60.10	-130.40
460	8.7100	6383	908	1135	50	1058	47	457200	60.20	-130.20	60.10	-130.30
461	5.4700	6347	892	1135	50	1058	47	457200	60.20	-130.10	60.20	-130.20
462	2.8400	6101	886	1135	50	1058	47	457200	60.20	-130.10	60.20	-130.10
463	11.1800	6209	885	1135	50	1058	47	457200	60.20	-129.90	60.20	-130.10
464	5.6200	6209	992	1135	50	1058	47	457200	60.20	-130.00	60.20	-130.10
465	7.8200	6386	980	1135	50	1058	47	457200	60.20	-129.80	60.20	-129.90
466	7.0800	6209	999	1135	50	1058	47	457200	60.20	-129.70	60.20	-129.80
467	8.4100	6114	1013	1135	50	1058	47	457200	60.10	-129.60	60.20	-129.70
468	2.5600	7161	1085	1289	40	938	53	419800	59.60	-135.20	59.60	-135.20
469	15.9300	5839	979	1135	50	1058	47	457200	60.60	-134.90	60.60	-134.60
470	11.0700	7168	1018	1354	38	932	55	402800	59.60	-135.20	59.70	-135.00
471	5.5100	5832	1009	1135	50	1058	47	457200	60.60	-134.60	60.60	-134.70
472	5.5000	7020	996	1289	40	938	53	419800	59.70	-135.10	59.70	-135.10
473	6.1000	5839	896	1135	50	1058	47	457200	60.60	-134.60	60.60	-134.50
474	1.7700	5868	883	1135	50	1058	47	457200	60.60	-134.50	60.60	-134.50
475	5.0700	6954	987	1289	40	938	53	419800	59.70	-135.00	59.70	-135.00
476	3.9600	6938	1052	1289	40	938	53	419800	59.80	-135.00	59.70	-135.00
477	6.9800	5842	966	1135	50	1058	47	457200	60.60	-134.50	60.60	-134.40
478	11.7100	5845	904	1135	50	1058	47	457200	60.60	-134.40	60.50	-134.30
479	3.7400	6879	1195	1289	40	938	53	419800	59.80	-134.90	59.80	-135.00
480	5.0200	5848	1002	1136	50	1059	47	457200	60.50	-134.40	60.60	-134.40
481	3.3300	6695	1165	1289	40	938	53	419800	59.80	-134.90	59.80	-134.90
482	5.0300	6570	1028	1289	40	938	53	419800	59.80	-134.80	59.80	-134.90
483	14.1000	5845	974	1135	50	1058	47	457200	60.40	-134.10	60.50	-134.30
484	4.4000	6541	1085	1289	40	938	53	419800	59.80	-134.80	59.80	-134.80

Flight Line #	Length [km]	Alt MSL [ft]	Min Alt AGL [m]	Max Alt AGL [m]	FOV [deg]	Swath Width [m]	Used Scan Rate [Hz]	Used Laser Pulse Rate [Hz]	Begin WGS84 Latitude [deg]	Begin WGS84 Longitude [deg]	End WGS84 Latitude [deg]	End WGS84 Longitude [deg]
485	3.6800	6111	1002	1135	50	1058	47	457200	60.40	-134.20	60.40	-134.20
486	2.9600	5888	1030	1136	50	1059	47	457200	60.40	-134.20	60.40	-134.20
487	5.6400	6721	979	1289	40	938	53	419800	59.90	-134.80	59.80	-134.80
488	8.6800	6010	993	1135	50	1058	47	457200	60.30	-134.00	60.40	-134.10
489	7.3800	6754	1032	1354	38	932	55	402800	59.90	-134.80	59.90	-134.80
490	3.8200	6617	1018	1312	40	955	53	412600	59.80	-134.80	59.90	-134.80
491	7.0100	6100	952	1135	50	1059	47	457200	60.30	-133.90	60.30	-134.10
492	10.6400	6399	937	1217	45	1009	50	435800	60.40	-133.80	60.30	-134.00
493	8.0400	7325	1252	1528	30	819	60	366400	60.00	-134.70	59.90	-134.80
494	4.0000	6288	995	1135	50	1058	47	457200	60.40	-133.70	60.40	-133.80
495	5.6800	6364	1064	1289	40	938	53	419800	60.00	-134.70	59.90	-134.70
496	2.7400	6541	1076	1289	40	938	53	419800	59.90	-134.80	59.90	-134.80
497	5.0600	6337	1013	1135	50	1058	47	457200	60.40	-133.70	60.40	-133.80
498	13.3900	6252	960	1135	50	1058	47	457200	60.50	-133.50	60.40	-133.70
499	7.5300	6252	998	1135	50	1058	47	457200	60.40	-133.60	60.40	-133.70
500	5.7300	6272	1021	1135	50	1058	47	457200	60.50	-133.60	60.40	-133.70
501	4.5800	6229	1009	1135	50	1058	47	457200	60.50	-133.50	60.50	-133.50
502	4.6400	6210	996	1135	50	1058	47	457200	60.50	-133.40	60.50	-133.50
503	6.1500	5969	928	1135	50	1059	47	457200	60.50	-133.30	60.50	-133.40
504	8.4100	5875	973	1135	50	1058	47	457200	60.40	-133.20	60.50	-133.30
505	3.5300	5894	1024	1135	50	1058	47	457200	60.50	-133.30	60.50	-133.30
506	2.4500	6028	1036	1135	50	1059	47	457200	60.50	-133.30	60.50	-133.30
507	5.9000	5911	994	1135	50	1058	47	457200	60.40	-133.20	60.50	-133.20
508	13.3200	5898	1001	1135	50	1058	47	457200	60.30	-133.00	60.40	-133.20
509	4.0300	5898	1014	1135	50	1058	47	457200	60.30	-133.00	60.30	-133.10
510	11.2100	5917	1006	1135	50	1058	47	457200	60.20	-132.90	60.30	-133.00
511	7.4400	5914	1010	1135	50	1058	47	457200	60.20	-132.90	60.30	-133.00
512	8.7600	5907	942	1135	50	1058	47	457200	60.20	-132.80	60.20	-132.90
513	7.6400	5907	1030	1135	50	1058	47	457200	60.20	-132.80	60.20	-132.90
514	4.9300	5848	945	1135	50	1058	47	457200	60.60	-134.50	60.60	-134.40
515	7.5300	5921	961	1135	50	1058	47	457200	60.20	-132.80	60.20	-132.70
516	9.4400	5921	907	1135	50	1058	47	457200	60.10	-132.60	60.20	-132.80
517	7.9900	5943	909	1135	50	1059	47	457200	60.10	-132.50	60.10	-132.60
518	7.4300	5921	934	1135	50	1058	47	457200	60.10	-132.50	60.10	-132.60
519	10.8000	5888	1001	1135	50	1058	47	457200	60.10	-132.30	60.10	-132.50
520	10.5500	5934	1009	1135	50	1058	47	457200	60.10	-132.40	60.10	-132.50
521	10.7700	5881	983	1135	50	1058	47	457200	60.00	-132.20	60.10	-132.40
522	4.1400	6088	1000	1135	50	1058	47	457200	60.00	-132.30	60.00	-132.20
523	4.9300	6134	906	1135	50	1058	47	457200	60.00	-132.20	60.00	-132.20
524	4.4900	6252	1005	1135	50	1058	47	457200	60.00	-132.10	60.00	-132.20
525	3.0700	6252	1056	1135	50	1058	47	457200	60.00	-132.10	60.00	-132.10
526	15.9400	6183	915	1135	50	1058	47	457200	59.90	-131.90	60.00	-132.10
527	3.0400	6288	1036	1135	50	1058	47	457200	60.00	-132.00	60.00	-132.10
528	9.5600	6174	931	1135	50	1058	47	457200	59.90	-131.70	59.90	-131.90
529	7.2100	6242	969	1135	50	1058	47	457200	59.90	-131.60	59.90	-131.80

Flight Line #	Length [km]	Alt MSL [ft]	Min Alt AGL [m]	Max Alt AGL [m]	FOV [deg]	Swath Width [m]	Used Scan Rate [Hz]	Used Laser Pulse Rate [Hz]	Begin WGS84 Latitude [deg]	Begin WGS84 Longitude [deg]	End WGS84 Latitude [deg]	End WGS84 Longitude [deg]
530	8.5700	6373	976	1135	50	1058	47	457200	59.90	-131.50	59.90	-131.60
531	12.7600	6344	958	1135	50	1058	47	457200	59.90	-131.50	59.90	-131.70
532	5.5900	6429	1058	1135	50	1058	47	457200	59.90	-131.40	59.90	-131.50
533	7.2100	6380	932	1135	50	1058	47	457200	59.90	-131.30	59.90	-131.40
534	6.0700	6429	899	1135	50	1058	47	457200	59.90	-131.20	59.90	-131.30
535	8.0300	6446	983	1135	50	1058	47	457200	60.00	-131.20	60.00	-131.20
536	3.6800	6446	1033	1135	50	1058	47	457200	60.00	-131.20	59.90	-131.20
537	9.1600	6541	940	1135	50	1058	47	457200	60.00	-131.00	60.00	-131.20
538	9.8000	6639	944	1135	50	1058	47	457200	60.10	-130.90	60.00	-131.00
539	3.4500	6800	1035	1135	50	1058	47	457200	60.10	-130.90	60.10	-130.90
540	2.9900	6751	992	1135	50	1058	47	457200	60.10	-130.90	60.10	-130.90
541	4.7500	5538	552	796	50	742	47	320800	60.10	-130.80	60.10	-130.90
542	3.9000	6649	987	1135	50	1058	47	457200	60.10	-130.70	60.10	-130.80
543	3.6500	6610	911	1135	50	1058	47	457200	60.10	-130.70	60.10	-130.70
544	5.2200	6570	920	1135	50	1058	47	457200	60.10	-130.60	60.10	-130.70
545	4.1400	6567	1018	1135	50	1058	47	457200	60.10	-130.60	60.10	-130.70
546	3.7300	6547	880	1135	50	1058	47	457200	60.10	-130.60	60.10	-130.60
547	5.6900	6528	910	1135	50	1058	43	228600	60.10	-130.40	60.10	-130.50
548	2.7400	6554	932	1135	50	1058	47	457200	60.10	-130.50	60.10	-130.60
549	5.6900	6528	910	1135	50	1058	43	228600	60.10	-130.40	60.10	-130.50
550	6.3700	6449	910	1135	50	1058	47	457200	60.10	-130.40	60.10	-130.50
551	5.6600	6462	936	1135	50	1058	47	457200	60.10	-130.30	60.10	-130.40
552	8.7100	6383	908	1135	50	1058	47	457200	60.20	-130.20	60.10	-130.30
553	5.4700	6347	892	1135	50	1058	47	457200	60.20	-130.10	60.20	-130.20
554	2.8400	6101	886	1135	50	1058	47	457200	60.20	-130.10	60.20	-130.10
555	11.1800	6209	885	1135	50	1058	47	457200	60.20	-129.90	60.20	-130.10
556	5.6200	6209	992	1135	50	1058	47	457200	60.20	-130.00	60.20	-130.10
557	7.8200	6386	980	1135	50	1058	47	457200	60.20	-129.80	60.20	-129.90
558	7.0800	6209	999	1135	50	1058	47	457200	60.20	-129.70	60.20	-129.80
559	8.4100	6114	1013	1135	50	1058	47	457200	60.10	-129.60	60.20	-129.70

5. Data Processing

All GPS data was processed using GrafNav software v.8.4. IMU data was processed using Leica IPAS Pro v.1.3 and the laser data was extracted using ALS Post Processor v.2.68. The GPS antenna position in the airplane was calculated by post–processing the raw data at 1 second intervals for the entire flight.

We have set up fourteen base stations for the airborne GPS processing, and the coordinates were calculated in NAD83-CSRS.

Table 2: The coordinates of the Base stations. The horizontal coordinates are in NAD83CSRS UTM 7N and UTM 8N and the orthometric heights are based on CGVD28 (Ht2) geoid model

Base station	Easting (m)	Northing (m)	Orthometric height (m)
1151	584827.285	6706581.420	802.542
1250	509786.495	6664150.229	684.257
1343	552642.869	6007497.698	293.065
1841	582213.887	6829761.348	739.750
1874	516548.410	6900457.273	766.634
2137	516972.522	6647496.923	776.443
2150	481547.461	6883848.655	644.884
2151	576846.016	6897881.558	820.434
2152	643787.830	6858404.43	850.569
2153	406129.093	6841084.247	946.308
2154	418843.303	6660439.374	912.829
2155	654612.664	6657164.483	779.661
6174	581658.756	6127751.276	702.551
8235	641052.409	6768169.940	809.284

The airborne positions were combined with the post–processed platform (aircraft) attitude information to generate a time tagged position and orientation solution.

The standard deviation of the airborne GPS solution for using KAR (Kinematics Ambiguity Resolution) was estimated to be 0.04, 0.05 and 0.07m in East, North and height directions, respectively.

The estimated values for the GPS antenna position were used with the laser ranges and platform angles to compute all the individual X, Y, and Z coordinates for each laser return in each flight line. The result is a processed point cloud containing all measured points.

6. Point Density

Bare earth point density varies with canopy closure, understory density and topographic features. Mean density of the point clouds were measured at different locations as follow:

Alaska North and Hains point density (pts/m^2): all returns 10.21 spacing (m): all returns 0.31	**Alaska South (zone 8 and 9)** point density (pts/m^2): all returns 11.45 spacing (m): all returns 0.30
South Klondike Rd point density (pts/m^2): all returns 9.93 spacing (m): all returns 0.32	**Campbell highway** point density (pts/m^2): all returns 11.36 spacing (m): all returns 0.30

7. Calibration

The LiDAR system calibration was flown over our BCIT calibration site in Burnaby, BC. The lever arms (offset between GPS antenna IMU and Laser Mirror), were measured as:

Lever Arms
GPS Lever arms in (m):
x: -0.05 y: -0.045 z: -1.45

IMU Lever arms in (m):
x: -0.450 y: 0.159 z: -0.169

There were a total number of 5 flight lines for calibration: 4 basic lines for Attune software analysis and 1redundant line for better accuracy. The lines were planned as follow:

- 2 orthogonal at low altitude
- 2 orthogonal at higher altitude

- 1 parallel lines at higher altitude

The calibration values used for this project are as follows:

Roll correction: -0.003542962 rad
Pitch correction: -0.003677110 rad
Heading correction: -0.003609313 rad

8. Quality Control

The LiDAR data consistencies have been checked between the flight lines using Terrascan software.

Comparison of Bare Earth LiDAR data with Ground Survey Values

According to ASPRS guidelines, the vertical accuracy of LiDAR is as follows:

$$RMSE_z = Sqrt[\sum (Z_{Lidar(i)} - Z_{check(i)})^2 / n] = 0.06 \text{ m}$$

Where the ”Check” refers to the ground truth (In this project, we used survey points which are at least three times more accurate than the individual LiDAR points) and *n* is the number of check points. We have a total of 6371 check points in four areas.

Alaska South N=2286 Average dz -0.012 m Minimum dz -0.160 m Maximum dz +0.130 m Average magnitude 0.034 m Root mean square 0.044 m Std deviation 0.042 m	**Campbell highway** N=901 Average dz +0.028 m Minimum dz -0.140 m Maximum dz +0.140 m Average magnitude 0.044 m Root mean square 0.054 m Std deviation 0.047 m
South Klondike N=791 Average dz -0.006 m Minimum dz -0.360 m Maximum dz +0.480 m Average magnitude 0.090 m Root mean square 0.127 m Std deviation 0.127 m	**Alaska highway North** N=2393 Average dz +0.002 m Minimum dz -0.164 m Maximum dz +0.152 m Average magnitude 0.049 m Root mean square 0.059 m Std deviation 0.059 m

9. Deliverables

Final output data is provided in NAD83CSRS UTM and the elevations are based on CGVD28- Ht2 geoid model. The deliverables include:

- Digital Terrain Model 1 m contour (AUTOCAD).
- Bare Earth terrain files in DWG
- Orthophotography with 15 cm resolution ECW format andGeoTiff
- Classified Bare Earth and Non-Bare Earth LAS and ASCII XYZfiles
- Model Key Point files consisting of filtered LAS files used tocreate a tin model of the classified Bare Earth provided in andASCII XYZ file format.
- LiDAR derived feature extraction of road centrelines, shoulders,ditch lines, treelines and edges of waterbodies.
- Shape files with the orthophoto image footprints in pdf format,labelled with km posts and imagery file names.
- Technical report