2018-1841-3933-West_Virginia-Lidar Lidar Acquisition and Calibration Report

Report Date: 07/10/2020

SUBMITTED TO:

Dewberry
1000 North Ashley Drive Suite 801
Tampa, FL 33602
813.225.1325

SUBMITTED BY:

Leading Edge Geomatics
2938 Route 102 Hwy Unit A
Lincoln, NB, E3B 7G1
506.446.4403

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Overview

Dewberry elected to subcontract the lidar acquisition and calibration activities to Leading Edge Geomatics. Leading Edge Geomatics was responsible for providing lidar acquisition, calibration and delivery of lidar data files to Dewberry.

Dewberry received calibrated swath data in small sections from Leading Edge Geomatics beginning on May 28, 2019 through March 30, 2020.

PROJECT AREA

The project area addressed by this report falls within the West Virginia counties of 24 counties: Barbour County, Braxton County, Brooke County, Calhoun County, Doddridge County, Gilmer County, Grant County, Hancock County, Harrison County, Lewis County, Marion County, Marshall County, Mineral County, Monongalia County, Ohio County, Pleasants County, Preston County, Ritchie County, Taylor County, Tucker County, Tyler County, Upshur County, and Wetzel County. The total size of the project is approximately 5520.490 square miles.

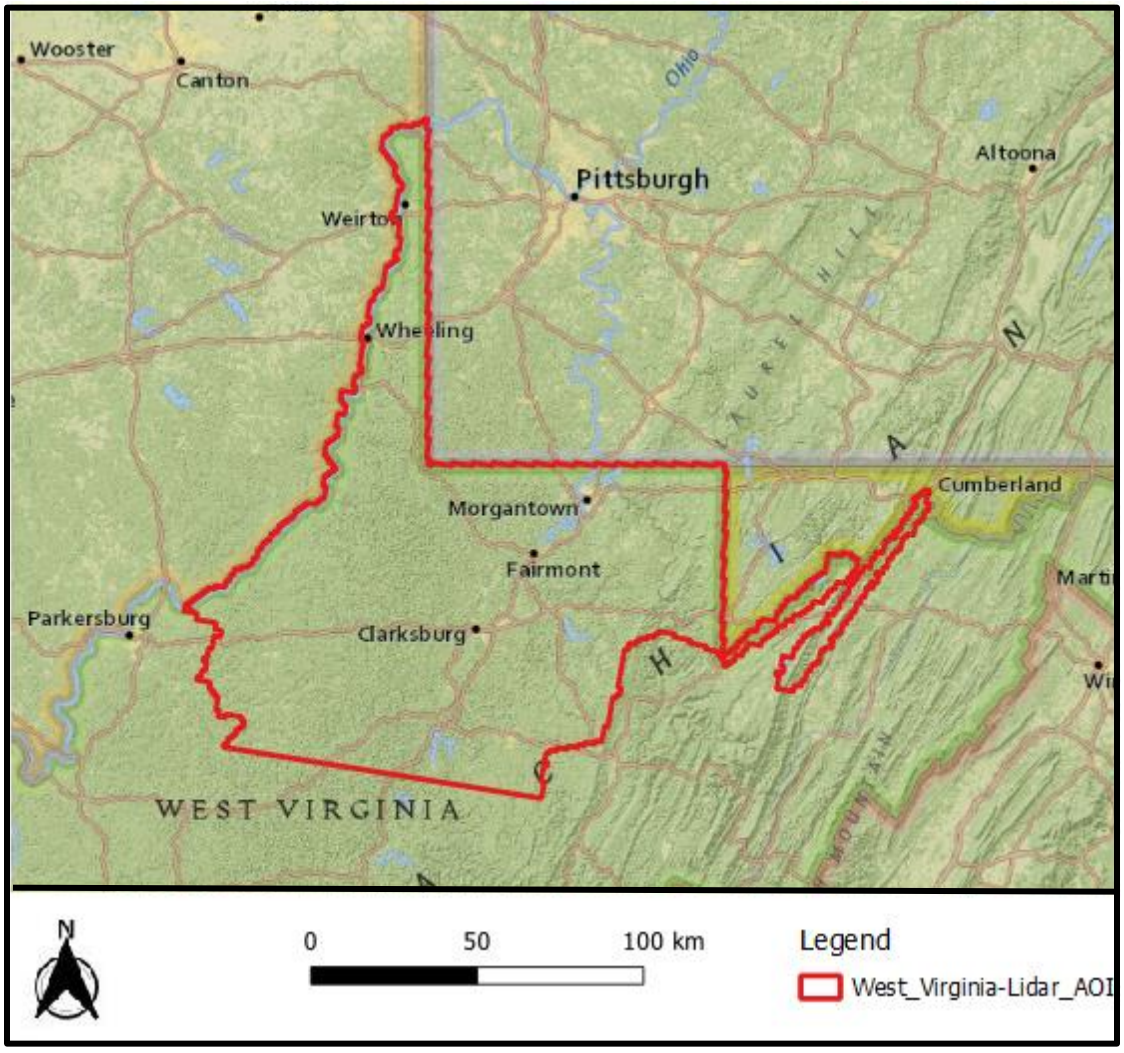

Figure 1 – Area of Interest

ACQUISITION DATES

The lidar survey was conducted between March 12, 2019 and March 13, 2020.

DATUM REFERENCE

Data produced for the project were delivered in the following reference system.

Horizontal Datum: The horizontal datum for the project is North American Datum of 1983 (NAD 83)
Vertical Datum: The Vertical datum for the project is North American Vertical Datum of 1988 (NAVD88)
Coordinate System: Conus Albers
Units: Horizontal units are in meters, Vertical units are in meters.
Geoid Model: Geoid12b (Geoid 12b was used to convert ellipsoid heights to orthometric heights).

Lidar Acquisition Details

Leading Edge Geomatics planned a total of 304 passes for the project area as a series of parallel flight lines with cross flightlines for the purposes of quality control. The flight plan included zigzag flight line collection as a result of the inherent IMU drift associated with all IMU systems. In order to reduce any margin for error in the flight plan, Leading Edge Geomatics followed FEMA's Appendix A "guidelines" for flight planning and, at a minimum, includes the following criteria:

- A digital flight line layout using Track-Air flight design software for direct integration into the aircraft flight navigation system.
- Planned flight lines; flight line numbers; and coverage area.
- Lidar coverage extended by a predetermined margin beyond all project borders to ensure necessary over-edge coverage appropriate for specific task order deliverables.
- Local restrictions related to air space and any controlled areas have been investigated so that required permissions can be obtained in a timely manner with respect to schedule. Additionally, Leading Edge Geomatics will file our flight plans as required by local Air Traffic Control (ATC) prior to each mission.

Leading Edge Geomatics monitored weather and atmospheric conditions and conducted lidar missions only when no conditions exist below the sensor that will affect the collection of data. These conditions include leaf-off for hardwoods, no snow, rain, fog, smoke, mist and low clouds. Lidar systems are active sensors, not requiring light, thus missions may be conducted during night hours when weather restrictions do not prevent collection. Leading Edge Geomatics accesses reliable weather sites and indicators (webcams) to establish the highest probability for successful collection in order to position our sensor to maximize successful data acquisition.

Within 72-hours prior to the planned day(s) of acquisition, Leading Edge Geomatics closely monitored the weather, checking all sources for forecasts at least twice daily. As soon as weather conditions were conducive to acquisition, our aircraft mobilized to the project site to begin data collection. Once on site, the acquisition team took responsibility for weather analysis.

Leading Edge Geomatics lidar sensors are calibrated at a designated site located over Poinciana, Florida and are periodically checked and adjusted to minimize corrections at project sites.

LIDAR SYSTEM PARAMETERS

Leading Edge often operated with two aircraft simultaneously. The Q-780's were mounted in Cessna 172's with tail numbers (C-FMNB and C-GUNB). The VQ-1560i's were installed in Cessna 206's with tail numbers (C-GPTG, C-FXSS and C-FRBV) and a Piper Aztec with tail number (N6645A). Below describes the systems utilized:

Table 1 - Airframes and Sensors

Airframe Tail	Airframe Make	Airframe Model	Sensor Make	Sensor Model	Sensor Serial
N6645A	Piper	PA-23-250	Riegl	VQ-1560i	S2223541
C-FMNB	Cessna	172S	Riegl	Q780	S2221416
C-GUNB	Cessna	172S	Riegl	Q780	S2221423
C-GPTG	Cessna	T206H	Riegl	VQ-1560i	S2223548
C-FXSS	Cessna	T206H	Riegl	VQ-1560i	S2222737
C-FRBV	Cessna	T206H	Riegl	VQ-1560i	S2223541

Five sets of system parameters were used during the project. See Table 2 and Table 3 for details.

Table 2 - Q780 System Parameters

Item	Q780-1	Q780-2
System	Q780	Q780
Maximum Number of Returns per Pulse	infinite	infinite
Nominal Pulse Spacing (single swath), (m)	0.59	0.59
Nominal Pulse Density (single swath) (ppsm), (m)	2.9	2.9
Aggregate NPS (m) (if ANPS was designed to be met through single coverage, ANPS and NPS will be equal)	0.42	0.42
Aggregate NPD (m) (if ANPD was designed to be met through single coverage, ANPD and NPD will be equal)	5.7	5.7
Altitude (AGL meters)	1100	1100
Approx. Flight Speed (knots)	110	110
Total Sensor Scan Angle (degree)	58	58
Scan Frequency (Hz)	95	105
Scanner Pulse Rate (kHz)	300 kHz	360 kHz
Pulse Duration of the Scanner (nanoseconds)	3	3
Pulse Width of the Scanner (m)	0.8994	0.8994
Central Wavelength of the Sensor Laser (nanometers)	1064	1064
Did the Sensor Operate with Multiple Pulses in The Air? (yes/no)	Yes	Yes

Item	Q780-1	Q780-2
Beam Divergence (milliradians)	<=0.25	<=0.25
Nominal Swath Width on the Ground (m)	1220	1220
Swath Overlap (%)	0.55	0.55
Computed Down Track spacing (m) per beam	0.60	0.54
Computed Cross Track Spacing (m) per beam	0.61	0.54
GNSS positional error (radial, in cm)	5cm (horizontal), 10cm (vertical)	5cm (horizontal), 10cm (vertical)
IMU error (in decimal degrees)	0.008 (roll, pitch), 0.020 (yaw)	0.008 (roll, pitch), 0.020 (yaw)
Maximum Baseline Length (mi)	44	44
Line Spacing (m)	747	747

Table 3 - VQ1560i System Parameters

Item	VQ1560i-1	VQ1560i-2	VQ1560i-3
System	VQ1560i	VQ1560i	VQ1560i
Maximum Number of Returns per Pulse	infinite	infinite	infinite
Nominal Pulse Spacing (single swath), (m)	0.48	0.42	0.59
Nominal Pulse Density (single swath) (ppsm), (m)	4.4	5.7	2.9
Aggregate NPS (m) (if ANPS was designed to be met through single coverage, ANPS and NPS will be equal)	0.48	0.42	0.42
Aggregate NPD (m) (if ANPD was designed to be met through single coverage, ANPD and NPD will be equal)	4.4	5.7	5.7
Altitude (AGL meters)	1500	1500	1500
Approx. Flight Speed (knots)	120	130	130
Total Sensor Scan Angle (degree)	58	58	58
Scan Frequency (Hz)	90	115	115
Scanner Pulse Rate (kHz)	2x350kHz	2x500kHz	2x500kHz
Pulse Duration of the Scanner (nanoseconds)	3	3	3
Pulse Width of the Scanner (m)	0.8994	0.8994	0.8994
Central Wavelength of the Sensor Laser (nanometers)	1064	1064	1064
Did the Sensor Operate with Multiple Pulses in The Air? (yes/no)	Yes	Yes	Yes
Beam Divergence (milliradians)	<=0.25	<=0.25	<=0.25

Item	VQ1560i-1	VQ1560i-2	VQ1560i-3
Nominal Swath Width on the Ground (m)	1660	1660	1660
Swath Overlap (%)	0.2	0.2	0.55
Computed Down Track spacing (m) per beam	0.69	0.58	0.58
Computed Cross Track Spacing (m) per beam	0.66	0.60	0.60
GNSS positional error (radial, in cm)	2cm (horizontal), 5cm (vertical)	2cm (horizontal), 5cm (vertical)	2cm (horizontal), 5cm (vertical)
IMU error (in decimal degrees)	0.0025 (roll, pitch), 0.005 (yaw)	0.0025 (roll, pitch), 0.005 (yaw)	0.0025 (roll, pitch), 0.005 (yaw)
Maximum Baseline Length (mi)	44	44	44
Line Spacing (m)	1328	1328	747

* can be derived from published manufacturer specifications for both the GNSS receiver and the IMU

ACQUISITION STATUS REPORT AND FLIGHTLINES

Upon notification to proceed, the flight crew loaded the flight plans and validated the flight parameters. The Acquisition Manager contacted air traffic control and coordinated flight pattern requirements. Lidar acquisition began immediately upon notification that control base stations were in place. During flight operations, the flight crew monitored weather and atmospheric conditions. Lidar missions were flown only when no condition existed below the sensor that would affect the collection of data. The pilot constantly monitored the aircraft course, position, pitch, roll, and yaw of the aircraft. The sensor operator monitored the sensor, the status of PDOPs, and performed the first Q/C review during acquisition. The flight crew constantly reviewed weather and cloud locations. Any flight lines impacted by unfavorable conditions were marked as invalid and re-flown immediately or at an optimal time.

Figure 2 shows the combined trajectory of the flightlines.

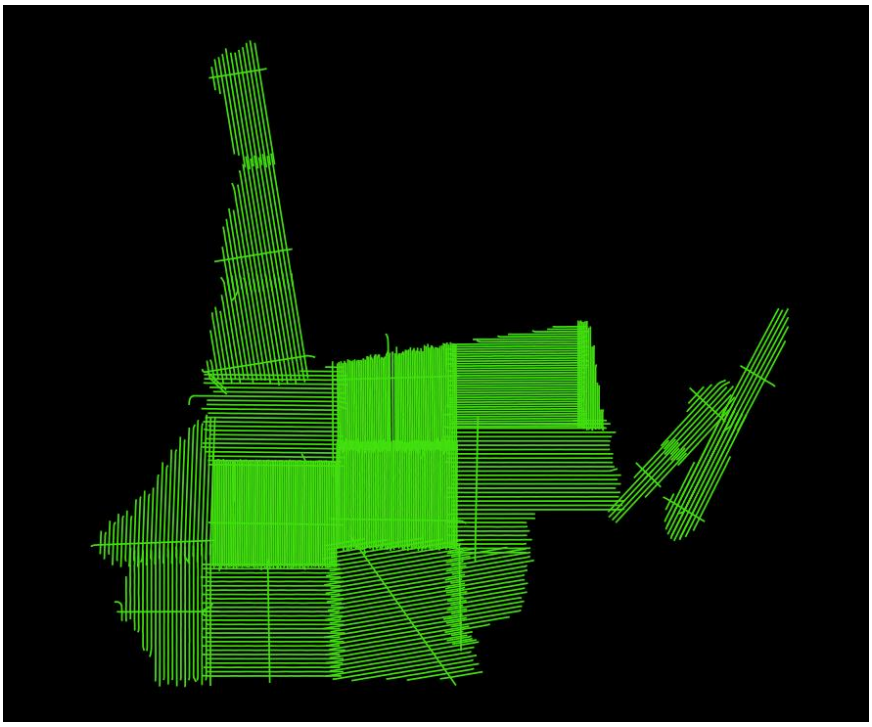

Figure 2: Trajectories as flown by Leading Edge Geomatics

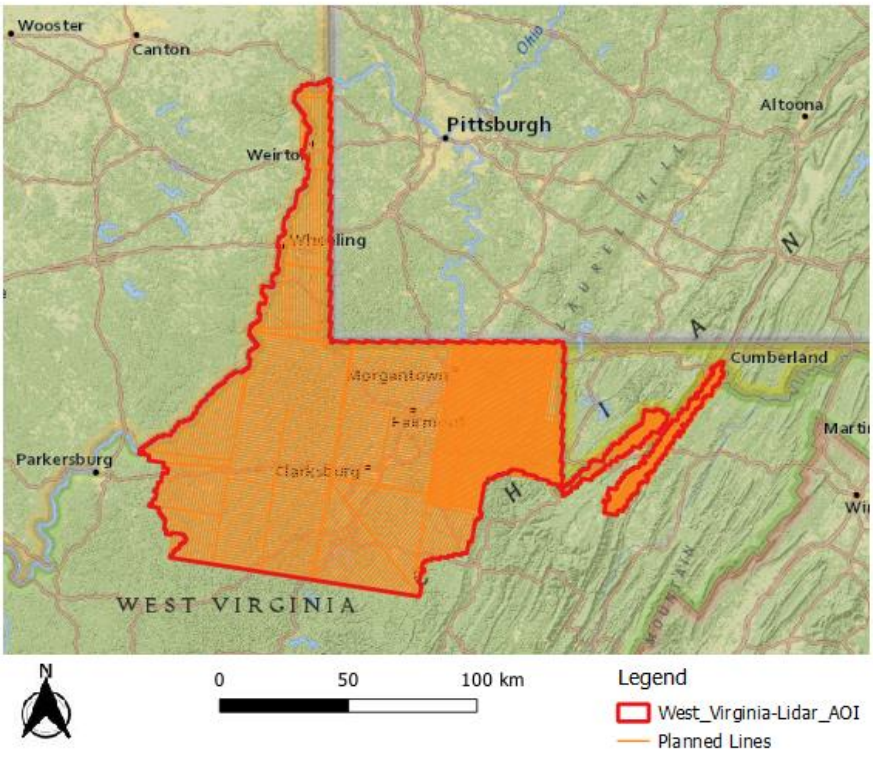

Figure 3– Area of Interest Planned Line

ACQUISITION STATIC CONTROL

Leading Edge Geomatics used NGS active GPS base stations during the acquisition of the West Virginia Lidar project. These static sessions all collected 1 Hz samples for the highest quality post processed solution. These static base sessions were then incorporated during the kinematic post-processing of aircraft position. The coordinates of these base stations are provided in the table below.

Name	NAD83(2011) Conus Albers		Ellipsoid Ht (NAD83(2011), m)	Orthometric Ht (NAVD88 Geoid12B, m)
	Easting X (m)	Northing Y (m)		
FREO	1239032.152	2005868.025	274.676	308.362
LOYC	1515790.350	1930743.507	203.091	236.766
LOYQ	1545704.003	1995140.000	128.5	162.625
LOYS	1460569.264	1980412.918	169.354	202.13
LOYY	1495421.467	1900496.409	222.179	255.289
LS08	1348127.326	1884892.558	407.318	439.177
MCON	1200377.357	1938636.057	272.658	306.79
OHMN	1264777.574	2103171.573	328.682	362.561
PAAP	1342635.050	2050362.591	313.746	347.505
PAFM	1516671.975	2027009.354	286.766	320.703
PAFU	1374219.830	1996912.377	328.004	360.571
PAGW	1336094.802	1987258.821	264.004	297.137
PAWG	1382843.045	2041491.702	336.163	369.138
STKR	1182470.391	1898041.595	178.03	212.26
WBRF	424593.103	2386108.292	247.212	280.604
WVBR	1337197.778	1920301.279	270.245	302.778
WVBU	1451393.563	1943622.714	200.056	232.536
WVCV	1411970.124	1899831.582	969.234	999.974
WVGB	1392653.197	1829897.778	812.475	843.185
WVHA	1273621.557	1903116.669	290.141	323.761
WVMF	1455049.269	1914401.440	313.55	345.863
WVMZ	1275290.832	1856974.346	296.833	330.07
WVNR	1380305.233	1880725.921	582.775	613.76
WVOH	1287985.313	1763587.260	597.484	628.892
WVRA	1218967.836	1859890.169	149.245	183.349
WVSH	1290903.339	1990918.546	384.55	418.366
WVTA	1398913.590	1945634.179	726.044	757.238

Table 4 – Base stations used to control lidar acquisition for the West Virginia Lidar.

AIRBORNE GPS KINEMATIC

Airborne GPS data was processed using the PosPac kinematic On-The-Fly (OTF) software suite. Flights were flown with a minimum of 6 satellites in view (10° above the horizon) and with a PDOP of better than 4. Distances from base station to aircraft were kept to a maximum of 40 km.

For all flights, the GPS data can be classified as excellent, with GPS residuals of 3 cm average or better but no larger than 10 cm being recorded.

GPS processing reports for each mission are included in Appendix A.

GENERATION AND CALIBRATION OF LASER POINTS (RAW DATA)

The initial step of calibration is to verify availability and status of all needed GPS and Laser data against field notes and compile any data if not complete.

Subsequently the mission points are output using RIEGL's RiProcess, initially with default values from Optech or the last mission calibrated for the system. The initial point generation for each mission calibration is verified within RiProcess, Global Mapper, LP-360 or Merrick MARS for calibration errors. If a calibration error greater than specification is observed within the mission, the roll, pitch and scanner scale corrections that need to be applied are calculated. The missions with the new calibration values are regenerated and validated internally once again to ensure quality.

Data collected by the lidar unit is reviewed for completeness, acceptable density and to make sure all data is captured without errors or corrupted values. In addition, all GPS, aircraft trajectory, mission information, and ground control files are reviewed and logged into a database.

On a project level, a supplementary coverage check is carried out to ensure no data voids unreported by Field Operations are present.

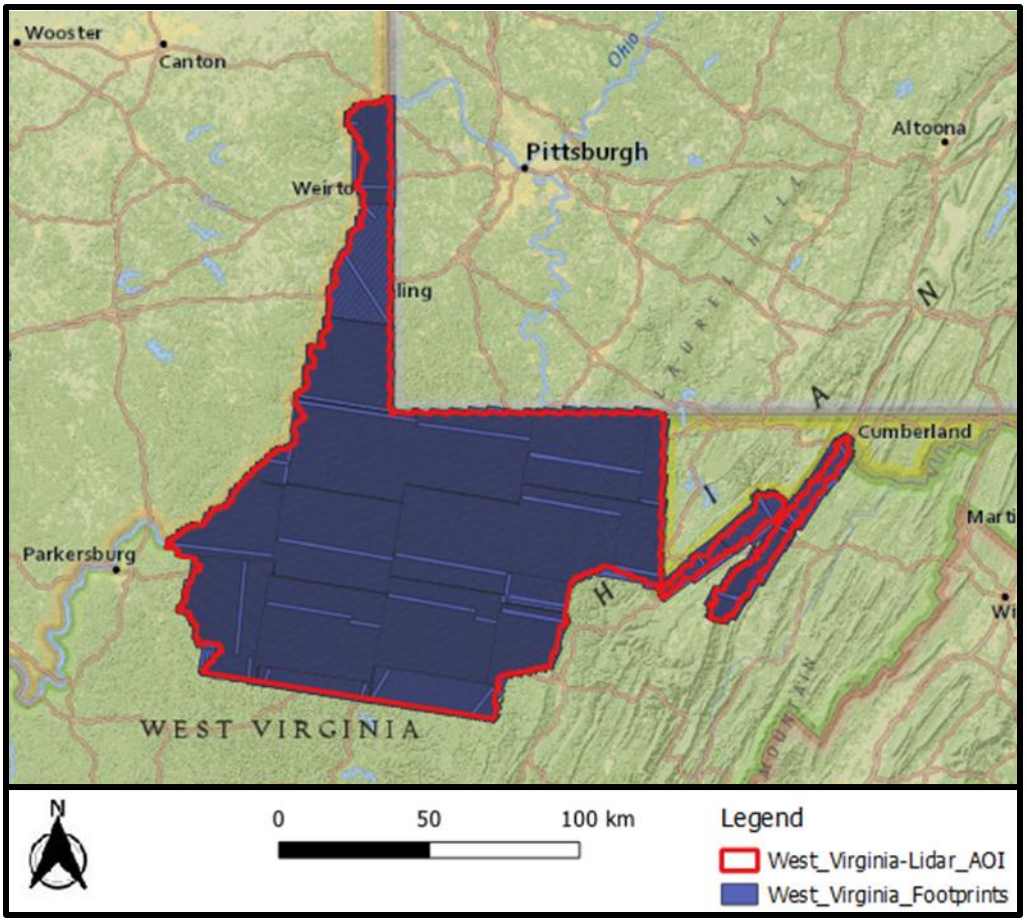

Figure 4 – Lidar swath output showing complete coverage.

Boresight and Relative accuracy

The initial points for each mission calibration are inspected for flight line errors, flight line overlap, slivers or gaps in the data, point data minimums, or issues with the lidar unit or GPS. Roll, pitch and scanner scale are optimized during the calibration process until the relative accuracy is met.

Relative accuracy and internal quality are checked using at least 3 regularly spaced QC blocks in which points from all lines are loaded and inspected. Vertical differences between ground surfaces of each line are displayed. Color scale is adjusted so that errors greater than the specifications are flagged. Cross sections are visually inspected across each block to validate point to point, flight line to flight line and mission to mission agreement.

For this project the specifications used are as follow:
Relative accuracy <= 6 cm maximum differences within individual swaths and <=8 cm RMSDz between adjacent and overlapping swaths.

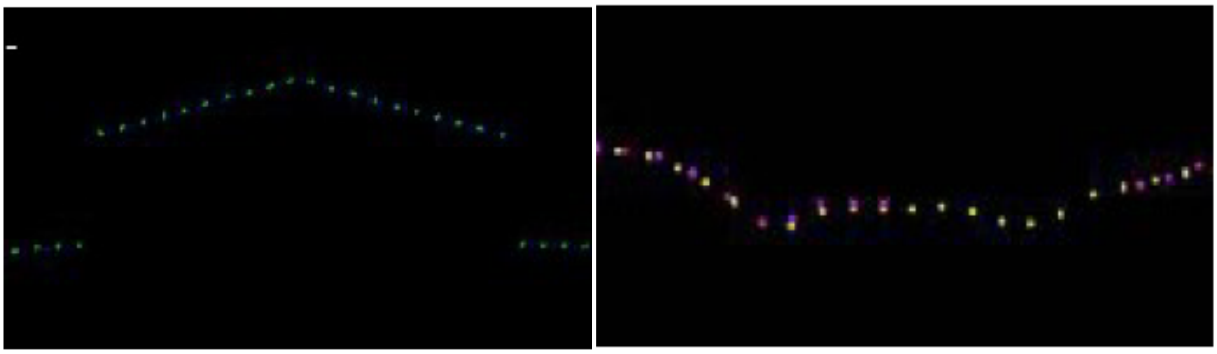

Figure 4 – Profile views showing correct roll and pitch adjustments.

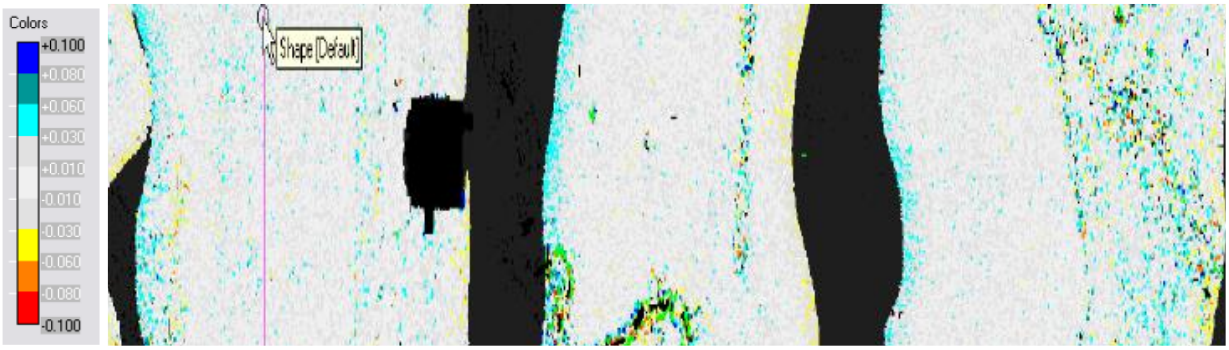

Figure 5 – QC block colored by distance to ensure accuracy at swath edges.

A different set of QC blocks are generated for final review after all transformations have been applied.

Final Calibration Verification

Dewberry conducted the survey for 173 ground control points (GCPs) which were used to test the accuracy of the calibrated swath data. These 19 GCPs were available to use as control in case the swath data exhibited any biases which would need to be adjusted or removed. The coordinates of all GCPs are provided in table 5 and the accuracy results from testing the calibrated swath data against the GCPs is provided in table 6; no further adjustments to the swath data were required based on the accuracy results of the GCPs.

	NAD83 (2011) Conus Albers		NAVD88 (Geoid 12B)	
Point ID	Easting X (m)	Northing Y (m)	Z-Survey (m)	Z-LiDAR (m)
CP21	1254719.71	1900775.95	341.18	341.21
CP315	1330955.58	1966726.98	294.36	294.44
CP315	1330955.58	1966726.98	294.36	294.44
CP316	1335495.23	1951673.17	302.76	302.84
CP316	1335495.23	1951673.17	302.76	302.84
CP317	1346981.43	1941597.12	308.63	308.69
CP317	1346981.43	1941597.12	308.63	308.69
CP318	1327405.44	1943847.16	298.23	298.29

CP318	1327405.44	1943847.16	298.23	298.29
CP319	1355459.59	1963215.52	293.66	293.72
CP319	1355459.59	1963215.52	293.66	293.72
CP324	1397221.43	1948298.31	797.53	797.57
CP324	1397221.43	1948298.31	797.53	797.57
CP325	1398066.36	1958357.80	805.79	805.81
CP325	1398066.36	1958357.80	805.79	805.81
CP326	1394501.01	1969937.00	624.73	624.75
CP326	1394501.01	1969937.00	624.73	624.75
CP327	1397793.02	1975790.49	688.51	688.55
CP327	1397793.02	1975790.49	688.51	688.55
CP328	1246072.42	1909050.44	190.47	190.55
CP328	1246072.42	1909050.44	190.47	190.55
CP329	1279419.40	1908487.67	278.28	278.33
CP329	1279419.40	1908487.67	278.28	278.33
CP330	1272766.04	1939308.91	254.70	254.78
CP330	1272766.04	1939308.91	254.70	254.78
CP331	1263028.41	1914760.81	326.52	326.57
CP331	1263028.41	1914760.81	326.52	326.57
CP332	1280970.31	1932883.43	227.73	227.75
CP332	1280970.31	1932883.43	227.73	227.75
CP333	1313455.44	1914407.17	327.07	327.11
CP333	1313455.44	1914407.17	327.07	327.11
CP334	1295216.97	1912351.06	255.38	255.41
CP334	1295216.97	1912351.06	255.38	255.41
CP335	1294401.52	1923286.36	226.47	226.45
CP335	1294401.52	1923286.36	226.47	226.45
CP336	1317001.97	1928454.43	308.52	308.54
CP336	1317001.97	1928454.43	308.52	308.54
CP337	1330992.12	1917251.75	305.30	305.41
CP337	1330992.12	1917251.75	305.30	305.41
CP338	1350153.49	1915684.27	328.96	329.03
CP338	1350153.49	1915684.27	328.96	329.03
CP339	1340821.75	1934945.97	290.48	290.53
CP339	1340821.75	1934945.97	290.48	290.53
CP340	1332555.17	1926603.62	286.51	286.61
CP340	1332555.17	1926603.62	286.51	286.61
CP344	1395142.99	1946952.79	791.11	791.14
CP344	1395142.99	1946952.79	791.11	791.14
CP346	1271769.91	1904569.80	254.91	254.98
CP346	1271769.91	1904569.80	254.91	254.98

CP347	1269399.08	1869535.93	207.90	207.96
CP347	1269399.08	1869535.93	207.90	207.96
CP348	1278837.76	1873692.78	332.35	332.42
CP348	1278837.76	1873692.78	332.35	332.42
CP349	1260406.64	1883481.19	202.06	202.04
CP349	1260406.64	1883481.19	202.06	202.04
CP350	1274618.61	1890981.79	230.85	230.92
CP350	1274618.61	1890981.79	230.85	230.92
CP351	1258471.51	1899945.36	224.19	224.23
CP351	1258471.51	1899945.36	224.19	224.23
GCP-250	1330013.63	1869126.35	330.32	330.41
GCP-250	1330013.63	1869126.35	330.32	330.41
GCP-251	1306193.46	1867951.88	230.42	230.44
GCP-251	1306193.46	1867951.88	230.42	230.44
GCP-301	1286111.78	2060889.01	227.43	227.54
GCP-301	1286111.78	2060889.01	227.43	227.54
GCP-302	1288746.51	2043452.03	219.22	219.33
GCP-302	1288746.51	2043452.03	219.22	219.33
GCP-303	1291834.11	2029233.35	217.49	217.57
GCP-303	1291834.11	2029233.35	217.49	217.57
GCP-304	1296579.19	2038490.35	366.83	366.78
GCP-304	1296579.19	2038490.35	366.83	366.78
GCP-305	1302956.92	2005086.88	399.66	399.76
GCP-305	1302956.92	2005086.88	399.66	399.76
GCP-306	1291963.70	1996087.09	209.65	209.75
GCP-306	1291963.70	1996087.09	209.65	209.75
GCP-307	1294546.65	2011180.60	365.57	365.59
GCP-307	1294546.65	2011180.60	365.57	365.59
GCP-308	1287836.53	1981491.49	207.77	207.80
GCP-308	1287836.53	1981491.49	207.77	207.80
GCP-309	1279991.88	1964975.72	192.71	192.79
GCP-309	1279991.88	1964975.72	192.71	192.79
GCP-310	1302697.32	1973550.81	318.44	318.49
GCP-310	1302697.32	1973550.81	318.44	318.49
GCP-311	1281901.68	1949865.96	191.21	191.30
GCP-311	1281901.68	1949865.96	191.21	191.30
GCP-312	1316731.93	1961393.14	327.57	327.56
GCP-312	1316731.93	1961393.14	327.57	327.56
GCP-313	1298771.06	1942959.99	218.04	218.12
GCP-313	1298771.06	1942959.99	218.04	218.12
GCP-314	1317613.98	1941469.06	324.87	324.91

GCP-314	1317613.98	1941469.06	324.87	324.91
GCP-316	1335495.23	1951673.17	302.76	302.84
GCP-316	1335495.23	1951673.17	302.76	302.84
GCP-321	1361564.12	1951425.60	466.60	466.67
GCP-321	1361564.12	1951425.60	466.60	466.67
GCP-322	1388113.51	1948976.55	373.64	373.67
GCP-322	1388113.51	1948976.55	373.64	373.67
GCP-324	1397221.43	1948298.31	797.53	797.55
GCP-324	1397221.43	1948298.31	797.53	797.55
GCP-341	1370361.33	1911186.65	430.51	430.52
GCP-341	1370361.33	1911186.65	430.51	430.52
GCP-342	1359881.15	1928861.63	378.85	378.88
GCP-342	1359881.15	1928861.63	378.85	378.88
GCP-343	1403327.49	1926292.35	764.02	764.13
GCP-343	1403327.49	1926292.35	764.02	764.13
GCP-344	1395142.99	1946952.79	791.11	791.14
GCP-344	1395142.99	1946952.79	791.11	791.14
GCP-345	1380199.10	1937090.23	557.35	557.37
GCP-345	1380199.10	1937090.23	557.35	557.37
GCP-352	1320936.59	1888154.28	319.38	319.42
GCP-352	1320936.59	1888154.28	319.38	319.42
GCP-353	1299971.55	1874780.74	231.96	232.02
GCP-353	1299971.55	1874780.74	231.96	232.02
GCP-354	1282189.97	1881449.29	253.39	253.47
GCP-354	1282189.97	1881449.29	253.39	253.47
GCP-355	1289944.84	1901011.32	259.64	259.68
GCP-355	1289944.84	1901011.32	259.64	259.68
GCP-356	1300603.55	1881921.34	229.42	229.50
GCP-356	1300603.55	1881921.34	229.42	229.50
GCP-357	1323508.15	1899819.83	304.01	304.00
GCP-357	1323508.15	1899819.83	304.01	304.00
GCP-358	1334948.88	1881692.41	387.35	387.44
GCP-358	1334948.88	1881692.41	387.35	387.44
GCP-359	1349888.06	1886254.52	468.85	468.92
GCP-359	1349888.06	1886254.52	468.85	468.92
GCP-360	1340718.11	1906014.87	309.76	309.89
GCP-360	1340718.11	1906014.87	309.76	309.89
GCP-361	1353300.69	1897389.58	429.03	429.09
GCP-361	1353300.69	1897389.58	429.03	429.09
GCP-362	1330151.37	1896376.69	308.36	308.38
GCP-362	1330151.37	1896376.69	308.36	308.38

GCP-363	1365855.99	1886333.15	646.80	646.82
GCP-363	1365855.99	1886333.15	646.80	646.82
GCP-364	1359802.76	1907229.09	397.52	397.57
GCP-364	1359802.76	1907229.09	397.52	397.57
GCP-365	1368450.34	1896660.69	552.93	552.99
GCP-365	1368450.34	1896660.69	552.93	552.99
GCP-366	1289290.55	1870893.44	220.05	220.09
GCP-366	1289290.55	1870893.44	220.05	220.09
GCP-367	1317773.09	1872104.74	351.60	351.67
GCP-367	1317773.09	1872104.74	351.60	351.67
GCP-368	1304466.87	1869930.23	248.94	249.03
GCP-368	1304466.87	1869930.23	248.94	249.03
GCP-369	1325265.98	1876113.12	337.09	337.15
GCP-369	1325265.98	1876113.12	337.09	337.15
GCP-370	1355307.06	1883361.75	516.96	517.02
GCP-370	1355307.06	1883361.75	516.96	517.02
GCP-371	1342424.31	1870022.46	541.45	541.48
GCP-371	1342424.31	1870022.46	541.45	541.48
GCP-372	1410888.72	1923324.30	817.55	817.56
GCP-372	1410888.72	1923324.30	817.55	817.56
GCP-373	1414581.67	1929659.40	715.03	715.00
GCP-373	1414581.67	1929659.40	715.03	715.00
GCP-374	1426743.30	1935959.31	702.77	702.77
GCP-374	1426743.30	1935959.31	702.77	702.77
GCP-375	1435262.32	1956384.10	317.77	317.79
GCP-375	1435262.32	1956384.10	317.77	317.79
GCP-376	1430587.83	1944691.13	696.48	696.49
GCP-376	1430587.83	1944691.13	696.48	696.49
GCP-377	1442211.54	1948987.11	273.08	273.15
GCP-377	1442211.54	1948987.11	273.08	273.15
GCP-378	1443369.08	1944855.75	425.30	425.31
GCP-378	1443369.08	1944855.75	425.30	425.31
GCP-379	1437219.70	1938127.14	394.22	394.25
GCP-379	1437219.70	1938127.14	394.22	394.25
GCP-380	1431066.75	1916430.28	477.14	477.21
GCP-380	1431066.75	1916430.28	477.14	477.21
GCP-381	1457563.14	1975799.62	216.74	216.76
GCP-381	1457563.14	1975799.62	216.74	216.76
GCP-382	1449795.81	1966029.32	243.33	243.41
GCP-382	1449795.81	1966029.32	243.33	243.41
GCP-383	1443138.51	1954459.81	254.91	254.95

GCP-383	1443138.51	1954459.81	254.91	254.95

Table 5 – Dewberry surveyed ground control points (GCPs).

This project must meet Non-vegetated Vertical Accuracy (NVA) ≤ 0.64 ft (19.6 cm) at the 95% confidence level based on $RMSE_z$ ≤ 0.33 ft (10 cm) x 1.9600.

100 % of Totals	# of Points	RMSEz (m) NVA Spec=0.1 m	NVA- Non-vegetated Vertical Accuracy ((RMSEz x 1.9600) Spec=0.196 m	Mean (m)	Median (m)	Skew	Std Dev (m)	Min (m)	Max (m)	Kurtosis
GCP	173	0.06	0.12	0.049	0.05	0.26	0.04	-0.12	0.29	2.79

Table 6 - Ground control points (GCPs) vertical accuracy results.

Leading Edge Geomatics conducted the survey for 1,132 ground control points (GCPs) which were used to test the accuracy of the calibrated swath data. These 1,132 GCPs were available to use as control in case the swath data exhibited any biases which would need to be adjusted or removed. The coordinates of all GCPs are provided in table 7 and the accuracy results from testing the calibrated swath data against the GCPs is provided in table 8; no further adjustments to the swath data were required based on the accuracy results of the GCPs.

	NAD83 (2011) Conus Albers		NAVD88 (Geoid 12B)	
Point ID	Easting X (m)	Northing Y (m)	Z-Survey (m)	Z-LiDAR (m)
101	1397366.27	1975641.43	691.3	691.25
102	1397355.48	1975633.45	691.69	691.62
103	1397344.38	1975625.12	692.06	692
104	1397335	1975618.16	692.41	692.34
105	1397324.14	1975609.9	692.82	692.76
106	1397313.79	1975601.9	693.19	693.14
107	1397302.18	1975593.25	693.46	693.41
108	1397289.36	1975583.5	693.69	693.64
109	1397278.96	1975575.13	693.84	693.8
110	1397267.14	1975565.84	694.02	693.98
111	1397253.97	1975554.65	694.21	694.17
112	1397243.72	1975545.8	694.24	694.2
113	1397232.66	1975536.37	694.22	694.18
114	1397220.75	1975526.11	694.25	694.21
115	1397209.41	1975516.44	694.3	694.26
116	1397198.75	1975507.4	694.39	694.33

117	1397185.18	1975495.89	694.49	694.43
118	1397173.79	1975486.23	694.59	694.53
119	1397160.92	1975475.27	694.67	694.61
120	1397148.02	1975464.53	694.77	694.71
121	1397133.99	1975452.84	694.9	694.86
122	1397120.32	1975441.46	695.07	695.02
123	1397105.88	1975429.2	695.34	695.29
124	1397092.79	1975418.21	695.58	695.51
125	1397080.38	1975407.24	695.94	695.89
126	1397068.27	1975396.55	696.41	696.36
127	1397055.25	1975384.7	696.97	696.92
128	1397044.31	1975374.81	697.42	697.38
129	1397034.49	1975365.77	697.82	697.76
130	1397023.93	1975356.2	698.11	698.05
201	1394635.88	1970096.68	632	631.96
202	1394623.82	1970091.1	631.87	631.82
203	1394603.82	1970081.83	631.67	631.63
204	1394581.07	1970071.09	631.39	631.36
205	1394557.62	1970059.87	631.16	631.13
206	1394542.52	1970052.55	630.96	630.94
207	1394519.74	1970041.43	630.66	630.62
208	1394499.72	1970031.88	630.21	630.16
209	1394476.08	1970020.64	629.48	629.44
210	1394452.97	1970009.47	628.56	628.54
211	1394420.87	1969994.08	626.93	626.91
212	1394392.1	1969980.16	625.16	625.13
213	1394365.54	1969967.16	623.23	623.19
214	1394338.24	1969953.87	621.09	621.1
215	1394310.95	1969940.71	619.06	619.03
216	1394277.79	1969924.61	616.51	616.51
217	1394235.74	1969904.28	613.32	613.3
218	1394208.85	1969891.45	611.31	611.28
219	1394186.71	1969881.02	609.7	609.69
220	1394158.52	1969868.94	607.65	607.64
221	1394135.36	1969860.2	605.99	605.98
222	1394110.8	1969852.46	604.2	604.2
223	1394084.88	1969846.16	602.42	602.39
224	1394058.72	1969841.57	600.63	600.59
225	1394034.48	1969839.53	598.89	598.88
226	1394014.35	1969838.92	597.43	597.42
401	1398536.19	1958802.81	792.89	792.86

402	1398523.79	1958791.94	792.61	792.59
403	1398506.08	1958775.33	792.34	792.32
404	1398488.14	1958758.59	791.99	791.96
405	1398476.04	1958747.15	791.82	791.74
406	1398458.88	1958731.03	791.55	791.48
407	1398441	1958714.2	791.41	791.37
408	1398426.36	1958700.5	791.45	791.42
409	1398412.24	1958687.28	792.05	792
410	1398399.26	1958674.93	792.55	792.5
411	1398386.35	1958662.43	793.04	792.99
412	1398373.07	1958649.82	793.5	793.45
413	1398360.61	1958637.75	794.05	794.01
414	1398346.42	1958623.8	794.82	794.77
415	1398337.66	1958615.04	795.27	795.23
416	1398325.78	1958603.13	795.91	795.86
417	1398312.62	1958589.63	796.67	796.61
418	1398301.6	1958578.32	797.2	797.16
419	1398282.13	1958558.96	797.82	797.75
420	1398261.89	1958539.32	798.23	798.17
421	1398241.29	1958519.19	798.65	798.6
422	1398220	1958498.58	799.21	799.17
423	1398204.18	1958483.31	799.83	799.78
424	1398187.13	1958466.5	800.68	800.63
425	1398171.16	1958450.84	801.16	801.1
426	1398152.49	1958432.69	801.67	801.62
427	1398132.36	1958413.54	802.44	802.39
428	1398113.84	1958396.35	803.71	803.65
429	1398094.74	1958378.24	804.86	804.81
430	1398080.09	1958363.77	805.59	805.53
501	1397378.7	1948396.59	803.54	803.54
502	1397369.95	1948386.54	802.85	802.84
503	1397362.25	1948377.37	802.33	802.32
504	1397354.27	1948368.35	801.59	801.63
505	1397345.01	1948358.83	800.51	800.52
506	1397336.37	1948351.66	799.65	799.66
507	1397326.7	1948345.23	798.72	798.7
508	1397314.18	1948338.36	797.66	797.66
509	1397299.32	1948332.5	796.99	796.99
510	1397289.32	1948329.04	796.67	796.67
512	1397261.08	1948318.04	796.28	796.27
513	1397251.04	1948312.33	796.2	796.18

514	1397243.54	1948307.08	796.15	796.18
515	1397233.74	1948298.76	796.34	796.32
516	1397223.57	1948287.31	796.72	796.68
517	1397218.64	1948280.78	796.67	796.61
518	1397213.4	1948271.99	796.19	796.13
519	1397210.27	1948265.41	795.76	795.75
520	1397207.33	1948258.17	795.19	795.19
521	1397204.22	1948250.34	794.59	794.58
601	1388123.36	1948755	374.57	374.54
602	1388124.37	1948742.46	374.58	374.55
603	1388125.36	1948729.97	374.62	374.6
604	1388126.34	1948717.57	374.69	374.66
605	1388127.27	1948705.22	374.76	374.73
606	1388128.17	1948693.16	374.78	374.76
607	1388129.15	1948680.59	374.85	374.82
608	1388130.07	1948668.75	374.91	374.88
609	1388131.08	1948656.03	374.94	374.91
610	1388132.04	1948643.86	374.94	374.94
611	1388132.94	1948631.21	374.99	374.97
612	1388133.81	1948619.3	375.04	375.01
613	1388134.73	1948607.23	375.08	375.05
614	1388135.56	1948595.22	375.16	375.11
615	1388136.62	1948581.9	375.23	375.2
616	1388137.55	1948569.59	375.27	375.23
617	1388138.42	1948558.73	375.28	375.26
618	1388139.51	1948545.37	375.31	375.27
619	1388140.47	1948533.18	375.36	375.31
620	1388141.49	1948520.96	375.36	375.33
621	1388142.51	1948508.48	375.41	375.36
622	1388143.4	1948496.14	375.39	375.37
623	1388143.41	1948496.16	375.39	375.37
624	1388144.4	1948483.89	375.42	375.4
625	1388145.35	1948470.93	375.45	375.44
626	1388146.22	1948458.52	375.51	375.47
627	1388147.64	1948436.15	375.48	375.51
628	1388149.47	1948400.35	375.58	375.57
629	1388147.91	1948347.15	376.15	376.11
630	1388146.06	1948329.91	376.39	376.37
631	1388143	1948309.43	376.69	376.66
632	1388139.23	1948290.77	376.99	376.94
633	1388133.17	1948267.31	377.4	377.35

634	1388126.17	1948244.63	377.81	377.79
635	1388118.53	1948221.08	378.18	378.15
636	1388109.65	1948194.88	378.67	378.65
637	1388102.14	1948173.2	379.07	379.05
801	1361869.79	1950976.5	486.22	486.16
802	1361869.77	1950976.52	486.22	486.15
803	1361857.47	1950995.08	485.94	485.89
804	1361812.12	1951064.17	485.23	485.17
805	1361802.25	1951079.26	485.01	484.95
806	1361783.05	1951109.82	484.36	484.31
807	1361773.68	1951125.32	483.98	483.92
808	1361763.12	1951143.27	483.56	483.5
809	1361752.98	1951160.54	483.1	483.06
810	1361727.68	1951203.81	481.36	481.3
811	1361716.09	1951223.49	480.53	480.46
812	1361701.53	1951248.15	479.45	479.39
813	1361693.03	1951262.69	478.8	478.73
814	1361680.73	1951283.73	477.93	477.86
815	1361658.64	1951322.06	476.23	476.18
816	1361635.78	1951361.49	474.51	474.46
817	1361620.16	1951388.6	473.37	473.31
818	1361605.85	1951413.14	472.35	472.3
819	1361592.93	1951435.17	471.48	471.44
820	1361583.91	1951450.4	470.95	470.91
821	1361571.59	1951471.45	470.38	470.34
822	1361565.33	1951482	470.13	470.09
823	1361552.3	1951503.5	469.64	469.59
824	1361539.94	1951521.51	469.27	469.23
901	1355924.29	1963047.67	295.94	295.89
902	1355918.29	1963027.1	296.52	296.5
903	1355915.9	1963009.65	297.27	297.3
904	1355916.52	1962990.26	298.23	298.18
905	1355918.41	1962974.75	298.94	298.91
906	1355920.61	1962952.35	299.96	299.95
907	1355922.59	1962935.37	300.97	300.93
908	1355925.17	1962912.99	302.71	302.68
909	1355927.56	1962892.19	304.73	304.69
910	1355929.78	1962871.93	306.72	306.67
911	1355932.47	1962847.66	309.06	309.02
912	1355935.2	1962825.68	310.65	310.63
913	1355937.55	1962804.68	310.62	310.57

914	1355941.88	1962766.03	308.25	308.23
915	1355943.51	1962750.86	307.27	307.23
916	1355946	1962728.57	306	306
917	1355948.45	1962706.65	305.37	305.34
918	1355950.31	1962688.38	305.03	305.01
919	1355947.26	1962667.51	305.08	304.9
920	1355943.95	1962656.94	305.09	305.07
1201	1367562.49	1897478.94	596.88	596.89
1202	1367579.01	1897470.56	596.49	596.48
1203	1367600.17	1897459.83	595.89	595.9
1204	1367627.49	1897446.09	594.98	594.98
1205	1367650.26	1897434.78	594.14	594.12
1206	1367676.12	1897421.78	592.9	592.9
1207	1367705.66	1897406.82	591.42	591.42
1208	1367737.89	1897390.57	589.55	589.55
1209	1367768.36	1897375.23	587.68	587.69
1210	1367794.78	1897361.93	586.09	586.11
1211	1367794.74	1897361.98	586.1	586.11
1212	1367811.08	1897353.76	585.11	585.11
1213	1367833.99	1897342.07	583.75	583.75
1214	1367857.45	1897330.26	582.35	582.36
1215	1367874.31	1897321.42	581.33	581.35
1216	1367898.26	1897309.33	579.92	579.96
1217	1367920.29	1897298.25	578.57	578.59
1218	1367947	1897284.35	576.9	576.91
1219	1367974.12	1897270.04	575.24	575.25
1220	1367992.24	1897260.24	574.12	574.14
1221	1368009.42	1897250.29	573.01	573.03
1222	1368028.47	1897238.62	571.88	571.89
1301	1364973.75	1886343.89	681.65	681.62
1302	1364960.94	1886336.97	680.84	680.79
1303	1364935.35	1886313.96	676.8	676.71
1304	1364912.93	1886294.98	675.08	674.98
1305	1364893.97	1886282.7	675.01	674.94
1306	1364872.48	1886270.22	674.79	674.72
1307	1364843.97	1886251.95	673.52	673.44
1308	1364819.36	1886235.3	673.9	673.83
1310	1364779.79	1886208.37	675.8	675.77
1311	1364762.49	1886194.7	676.02	675.99
1312	1364746.83	1886180.99	675.62	675.54
1314	1364704.15	1886142.26	676.22	676.17

1315	1364693.04	1886131.55	676.77	676.7
1316	1364678.18	1886116.9	678.01	677.97
1317	1364670.27	1886108.11	679	678.96
1318	1364660.74	1886095.91	680.24	680.18
1319	1364654.72	1886086.93	680.89	680.82
1320	1364647.86	1886074.97	681.59	681.51
1321	1364643.19	1886065.71	682.01	681.93
1401	1358968.71	1879976.74	577.36	577.38
1402	1358955.92	1879965.47	577.58	577.69
1403	1358939.05	1879950.44	577.88	577.9
1404	1358923.52	1879936.59	578.16	578.17
1405	1358910.78	1879925.21	578.37	578.39
1406	1358891.78	1879908.16	578.74	578.73
1407	1358872.35	1879890.8	579.13	579.12
1408	1358851.23	1879871.91	579.54	579.56
1409	1358826.65	1879849.71	580.12	580.12
1410	1358804.54	1879829.54	580.39	580.42
1411	1358783.97	1879810.47	580.68	580.71
1412	1358755.45	1879782.66	581.16	581.17
1413	1358736.97	1879763.27	581.57	581.58
1414	1358718.48	1879742.55	581.94	581.95
1415	1358700.81	1879721.14	582.23	582.23
1416	1358687.15	1879703.72	582.41	582.46
1417	1358676.79	1879690.33	582.59	582.59
1418	1358661.85	1879670.73	582.92	582.93
1419	1358653.21	1879659.49	583.1	583.13
1420	1358644.32	1879647.98	583.27	583.29
1421	1358635.75	1879636.74	583.46	583.48
2801	1265643.13	1869747.54	255.89	256.01
2802	1265666.05	1869745.04	254.26	254.28
2803	1265691.42	1869742.21	252.25	252.26
2804	1265715.33	1869739.5	250.53	250.55
2805	1265733.77	1869737.75	249.31	249.34
2806	1265745.19	1869737.16	248.45	248.45
2807	1265762.88	1869737.2	247.2	247.17
2808	1265777.07	1869737.97	246.17	246.19
2809	1265798.25	1869738.97	244.5	244.53
2810	1265815.97	1869737.59	242.97	242.99
2811	1265839.22	1869727.41	240.93	240.95
2812	1265860.88	1869714.84	238.89	238.92
2813	1265874.22	1869708.39	237.62	237.62

2814	1265886.41	1869703.22	236.47	236.5
2815	1265898.67	1869698.58	235.43	235.43
2816	1265915.86	1869692.74	233.98	234
2818	1265948.48	1869682.29	231.48	231.48
2819	1265962.92	1869677.33	230.49	230.51
2820	1265985.05	1869670.04	228.93	228.95
2821	1266008.47	1869662.6	227.13	227.17
2822	1266038.13	1869653.62	224.91	224.93
2823	1266072.55	1869643.65	222.52	222.56
2824	1266106.71	1869636.11	219.75	219.78
2825	1266122.25	1869634.36	218.35	218.36
2826	1266149.81	1869634.6	215.76	215.76
2827	1266178.2	1869636.38	213.64	213.64
2828	1266192.96	1869635.4	212.4	212.4
2901	1278880.66	1874087.19	336.26	336.25
2902	1278893.02	1874096.87	336.72	336.67
2903	1278901.85	1874112.16	336.25	336.22
2904	1278907.82	1874128.85	334.61	334.58
2905	1278913.53	1874145.96	333.68	333.63
2906	1278919.35	1874164.98	334.27	334.26
2907	1278925	1874185.44	335.52	335.51
2908	1278929.86	1874204.93	335.51	335.49
2909	1278935.62	1874227.94	334.85	334.82
2910	1278943.14	1874248.26	334.76	334.74
2911	1278954.23	1874262.68	335.02	335.02
2912	1278969.63	1874273.17	335.65	335.65
2913	1278996.09	1874287.84	337.2	337.17
2914	1279005.71	1874293.75	337.98	337.94
2915	1279015.37	1874299.01	338.48	338.48
2916	1279025.71	1874304.14	338.37	338.36
2917	1279034.09	1874308.77	338.13	338.1
2918	1279038.95	1874311.82	337.92	337.9
2919	1279044.08	1874315.37	337.69	337.69
2920	1279051.92	1874321.77	337.52	337.5
3201	1295205.22	1912312.82	254.05	254.04
3202	1295218.02	1912314.4	253.36	253.34
3203	1295231.92	1912315.4	252.63	252.58
3204	1295247.57	1912315.38	251.8	251.78
3205	1295256.91	1912314.55	251.19	251.18
3206	1295268.76	1912312.81	250.41	250.37
3207	1295281.75	1912309.95	249.47	249.45

3208	1295288.84	1912309.55	248.91	248.87
3209	1295205	1912312.86	254.07	254.06
3210	1295194.9	1912312.27	254.57	254.56
3211	1295180.4	1912306.96	255.2	255.19
3212	1295167.96	1912299.27	255.53	255.51
3213	1295155.54	1912293.63	255.69	255.69
3214	1295139.13	1912283.56	255.92	255.9
3215	1295118.57	1912271.59	256.39	256.35
3216	1295101.3	1912261.66	256.68	256.65
3217	1295088.64	1912254.78	256.75	256.74
3218	1295075.43	1912245.51	256.57	256.54
3219	1295060.65	1912232.18	256.41	256.38
3220	1295042.25	1912213.7	256.35	256.34
3221	1295025.89	1912195.7	255.57	255.58
3301	1313692.11	1913977.91	320.21	320.06
3302	1313677.29	1914007.14	320.53	320.44
3303	1313668.14	1914026.92	320.57	320.48
3304	1313645.7	1914069.97	320.97	320.86
3305	1313623.36	1914112.38	321.58	321.5
3306	1313613.35	1914129.74	321.78	321.7
3307	1313598.1	1914150.72	322.11	322.02
3308	1313585.42	1914167.33	322.08	322.01
3309	1313570.21	1914186.74	322.08	321.99
3310	1313554.4	1914207.16	322.06	321.96
3311	1313523.11	1914239.12	321.96	321.89
3312	1313497.7	1914266.04	322.26	322.19
3313	1313480.41	1914284.41	322.65	322.57
3314	1313465.09	1914300.55	323.16	323.08
3315	1313442.66	1914325.47	323.67	323.61
3316	1313423.52	1914351.91	324.54	324.25
3317	1313408.1	1914371.77	323.83	323.76
3318	1313385.33	1914397.99	322.84	322.77
3401	1330878.67	1917179.59	305.83	305.75
3402	1330877.04	1917191.7	305.4	305.33
3403	1330879.12	1917208.21	304.86	304.78
3404	1330894.02	1917276.48	303.13	303.04
3405	1330891.69	1917311.99	303.9	303.81
3406	1330894.6	1917329.18	303.82	303.75
3407	1330895.94	1917343.38	302.79	302.71
3408	1330896.5	1917360.65	301.49	301.41
3409	1330900.44	1917378.71	300.94	300.87

3410	1330902.37	1917400.29	298.64	298.56
3411	1330906.36	1917425.86	295.51	295.42
3412	1330907.83	1917437.49	294.48	294.41
3413	1330910.37	1917455.67	294.15	294.07
3501	1331302.38	1967110.77	311.18	311.12
3502	1331279.54	1967078.46	306.45	306.43
3503	1331261.36	1967053.37	303.18	303.13
3504	1331244.7	1967029.13	300.47	300.4
3505	1331226.43	1967003.32	297.62	297.55
3506	1331216.86	1966992.3	296.1	296.05
3507	1331202.42	1966972.28	294.3	294.24
3508	1331187.41	1966950.38	293.88	293.81
3509	1331170.38	1966926.93	293.93	293.86
3510	1331156.62	1966909.15	293.9	293.83
3511	1331133.86	1966882.03	294.02	293.96
3512	1331114.75	1966858.94	294.23	294.17
3513	1331098.34	1966839.18	294.51	294.45
3514	1331075.99	1966812.83	294.34	294.29
3515	1331057.59	1966790.24	294.33	294.27
3516	1331040.07	1966768.43	294.33	294.28
3517	1331019.69	1966742.38	294.26	294.2
3518	1330996.42	1966714.34	294.28	294.22
3519	1330973.19	1966683.19	294.39	294.33
3601	1316660.42	1961260.33	326.31	326.29
3602	1316646.98	1961243.36	326.43	326.37
3603	1316634.21	1961226.8	326.5	326.42
3604	1316618.03	1961208.54	326.61	326.51
3605	1316596.55	1961181.58	326.5	326.43
3606	1316579.4	1961160.21	326.31	326.28
3607	1316563.24	1961140.5	326.21	326.14
3608	1316549.52	1961124.56	326.18	326.14
3609	1316501.1	1961072.42	325.38	325.35
3610	1316480.36	1961056.17	325.17	325.12
3701	1327264.72	1943799.48	298.64	298.61
3702	1327287.37	1943779.39	300.57	300.55
3703	1327309.25	1943767.16	302.44	302.42
3704	1327323.55	1943751.93	302.94	302.93
3705	1327340.21	1943738.68	302.63	302.63
3706	1327360.69	1943723.76	301.75	301.76
3707	1327382.13	1943706.51	300.17	300.17
3708	1327413.92	1943681.15	297.68	297.66

3709	1327431.54	1943661.5	296.89	296.9
3710	1327450.91	1943651.26	296.05	296.05
3711	1327476.22	1943636.89	295.36	295.33
3712	1327489.24	1943620.42	295.06	295.05
3713	1327530.72	1943608.21	295.4	295.4
3801	1334472.52	1952181.79	303.68	303.63
3802	1334491.3	1952182.27	303.57	303.52
3803	1334508.18	1952182.18	303.7	303.64
3804	1334567.07	1952186.99	303.53	303.47
3805	1334577.99	1952188.22	303.5	303.47
3806	1334520.91	1952173.33	303.73	303.71
3807	1334416.36	1952173.5	305.43	305.4
3808	1334353.8	1952169.95	308.64	308.59
3809	1334321.41	1952152	309.93	309.86
3810	1334229.91	1952165.36	314.27	314.21
3811	1334207.03	1952163.21	313.9	313.87
3812	1334169.12	1952162.85	312.88	312.85
3813	1334123.22	1952161.65	311.75	311.68
3814	1334090.21	1952161.53	311.33	311.28
3901	1395579.82	1946566.66	784.67	784.47
3902	1395612.95	1946570.33	790	789.88
3903	1395646.04	1946541.11	793.53	793.43
3904	1395668.89	1946521.28	794.96	794.86
3905	1395692.89	1946499.12	795.17	795.08
3906	1395712.19	1946482.92	794.76	794.67
3907	1395727.73	1946467.75	794.58	794.5
3908	1395739.02	1946457.39	794.43	794.32
3909	1395761.15	1946438	794.31	794.22
3910	1395785.02	1946416.54	793.66	793.57
3911	1395810.71	1946393.33	793.95	793.86
3912	1395832.13	1946374.07	795.09	795
3913	1395855.96	1946352.21	797.09	797.01
3914	1395873.08	1946336.51	798.5	798.38
3915	1395893.56	1946318.24	799.98	799.88
3916	1395908.59	1946304.42	801.01	800.92
4001	1380974.51	1936422.37	631.72	631.66
4002	1380949.74	1936466.54	626.48	626.41
4003	1380933.2	1936475.32	624.86	624.77
4004	1380922.25	1936492.47	622.91	622.83
4005	1380905.45	1936512.21	620.32	620.27
4006	1380891.7	1936527.36	618.71	618.65

4007	1380879.75	1936541	617.16	617.07
4008	1380865.41	1936558.24	615.11	615.04
4009	1380844.1	1936584.32	612.64	612.56
4010	1380835.81	1936595.58	611.58	611.51
4011	1380814.84	1936624.43	609.59	609.51
4012	1380799.77	1936643.02	608.43	608.36
4013	1380786.48	1936657.79	607.21	607.13
4014	1380769.85	1936673.11	605.9	605.84
4101	1359844.01	1928586.3	368.09	368
4102	1359862.74	1928611.76	368.1	368
4103	1359888.93	1928650.7	368.28	368.2
4104	1359904.4	1928653.63	368.25	368.18
4105	1359923.43	1928640.39	367.81	367.74
4106	1359937.1	1928630.28	367.64	367.56
4107	1359951.6	1928621.66	367.69	367.6
4108	1359895.17	1928661.6	368.36	368.28
4109	1359871.61	1928676.6	370.01	369.92
4110	1359826.31	1928708.34	374.21	374.13
4111	1359800.42	1928726.66	376.3	376.21
4112	1359778.76	1928743.48	379.19	379.09
4113	1359763.53	1928753.4	381.85	381.76
4114	1359886.25	1928647.02	368.25	368.14
4201	1370805.42	1912194.16	423.95	423.86
4202	1370840.1	1912215.02	426.25	426.17
4203	1370859.18	1912221.46	425.88	425.6
4204	1370895.21	1912237.18	424.22	424.1
4205	1370933.21	1912248.9	423.3	423.2
4206	1370966.48	1912262.07	424.04	423.95
4207	1370998.95	1912272.44	424.66	424.55
4208	1371045.05	1912280.05	425.55	425.44
4209	1371098.57	1912291.82	425.46	425.35
4210	1371131.38	1912306.01	425.53	425.44
4211	1371161	1912318.71	426.18	426.05
4212	1371178.95	1912326.79	426.65	426.52
4213	1371202.68	1912337.07	427.21	427.1
4214	1371251.45	1912359.08	428.43	428.33
4215	1371277.34	1912370.96	429.07	428.98
4301	1359866.84	1907035.25	396.98	396.93
4302	1359885.54	1907106.89	396.49	396.42
4303	1359851.27	1907130.68	397.26	397.14
4304	1359818.01	1907134.97	397.59	397.48

4305	1359793.85	1907137.85	397.65	397.56
4306	1359760.94	1907141.86	397.37	397.27
4307	1359735.65	1907146.09	397.25	397.12
4308	1359719.5	1907147.78	397.1	396.99
4309	1359692.69	1907151.5	397.61	397.48
4310	1359670.32	1907154.48	398.56	398.45
4311	1359649.93	1907157.73	400.49	400.38
4312	1359628.43	1907159.94	402.8	402.76
4401	1350656.34	1916193.13	325.71	325.61
4402	1350644.37	1916180.67	326.06	325.96
4403	1350630.16	1916163.66	326.45	326.37
4404	1350616.62	1916144.99	327.02	326.93
4405	1350598.12	1916123.19	327.73	327.64
4406	1350572.71	1916094.69	328.52	328.42
4407	1350541.17	1916055.21	329.1	329.01
4408	1350525.15	1916021.35	329.87	329.77
4409	1350500.94	1915982.81	330.78	330.69
4410	1350472.99	1915959.95	331.52	331.41
4411	1350439.62	1915938.05	333.15	333.04
4412	1350415.81	1915923.82	334.07	333.97
4413	1350394.42	1915907.63	334.64	334.53
4414	1350376.89	1915897.26	335.22	335.12
4501	1333089.38	1926410.85	294.38	294.28
4502	1333052.55	1926391.48	295.85	295.75
4503	1333022.86	1926382.47	296.85	296.75
4504	1332807.5	1926421.26	292.21	292.12
4505	1332758.58	1926406.45	292.57	292.47
4506	1332626.85	1926373.48	291.52	291.43
4507	1332616.42	1926405.53	291.49	291.4
4508	1332608.42	1926429.98	291.5	291.39
4509	1332599.45	1926459.24	291.37	291.27
4510	1332590.23	1926488.83	290.79	290.7
4511	1332585.27	1926505.6	290.2	290.11
4512	1332574.95	1926538.44	288.93	288.83
4513	1332566.24	1926566.78	287.84	287.74
4514	1332556.89	1926597.89	286.76	286.67
4601	1286377.39	2060889.22	231.2	231.1
4602	1286404.18	2060901.06	230.73	230.62
4603	1286438	2060914.4	229.69	229.59
4604	1286469.42	2060926.13	228.33	228.23
4605	1286506.44	2060941.42	226.13	226.04

4606	1286539.54	2060955.08	224.22	224.13
4607	1286569.25	2060965.42	222.15	222.06
4608	1286328.58	2060870.16	231.8	231.69
4609	1286305.85	2060861	231.78	231.68
4610	1286279.92	2060851.28	231.41	231.31
4611	1286256.36	2060844.29	231	230.89
4612	1286224.11	2060828.56	231.01	230.91
4613	1286185.54	2060814.53	231.26	231.16
4614	1286158.56	2060802.56	231.41	231.3
4615	1286126.26	2060789.01	231.54	231.44
4616	1286108.3	2060782.1	231.75	231.65
4617	1286089.56	2060772.49	231.42	231.3
4618	1286065.43	2060765.45	231.12	231.01
4619	1286020.11	2060745	230.54	230.44
4620	1285982.57	2060730.75	230.15	230.03
4701	1288760.14	2043448.67	219.06	218.95
4702	1288776.68	2043462.93	218.35	218.25
4703	1288799.95	2043468.99	217.66	217.55
4704	1288836.66	2043471.76	216.21	216.1
4705	1288907.48	2043481.53	213.53	213.42
4706	1288979.48	2043489	211.73	211.62
4707	1289021.14	2043492.93	211.42	211.31
4708	1289051.76	2043497.62	211.62	211.49
4709	1289077.74	2043506.28	212	211.9
4710	1289085.78	2043506.07	212.18	212.04
4711	1289114.89	2043505.75	212.57	212.45
4712	1289146.82	2043512.07	212.5	212.38
4713	1288731.14	2043449.59	219.9	219.78
4714	1288678.59	2043449.57	221.29	221.16
4715	1288657.23	2043449.86	221.92	221.83
4716	1288590.89	2043441.19	223.91	223.78
4717	1288542.8	2043426.02	225.17	225.03
4801	1296549.24	2038201.92	370.35	370.25
4802	1296558.05	2038199.74	370.82	370.71
4803	1296576.69	2038195.67	371.05	370.95
4804	1296604.05	2038190.08	370.07	369.96
4805	1296647.48	2038179.92	368.06	367.95
4806	1296686.42	2038168.54	366.04	365.94
4807	1296699.28	2038163.18	364.74	364.64
4808	1296706.89	2038159.64	363.88	363.79
4809	1296721.02	2038158.52	362.61	362.52

4810	1296737.99	2038147.25	360.31	360.21
4811	1296767.08	2038134.85	357.38	357.3
4812	1296787.63	2038126	355.69	355.59
4813	1296802.72	2038118.32	354.17	354.07
4814	1296817.61	2038110.95	352.99	352.88
4815	1296830.22	2038105.92	352.21	352.09
4901	1291796.65	2029236.91	216.56	216.46
4902	1291824.34	2029251.46	217.56	217.45
4903	1291845.65	2029261.89	218.59	218.49
4904	1291860.89	2029269.78	219.43	219.32
4905	1291881.68	2029280.05	220.48	220.36
4906	1291889.53	2029283.55	220.82	220.72
4907	1291908.07	2029293.17	221.52	221.44
4908	1291943.64	2029310.04	223.4	223.31
4909	1291961.35	2029318.77	224.39	224.27
4910	1291972.8	2029324	225.01	224.92
4911	1291991.89	2029333.09	226.9	226.81
4912	1292010.63	2029343.15	229.33	229.24
4913	1292019.51	2029347.27	230.44	230.35
4914	1292024.07	2029349.3	231.17	231.09
5001	1294693.11	2011130.34	360.99	360.93
5002	1294677.08	2011125.16	360.72	360.66
5003	1294657.54	2011119.15	360.45	360.37
5004	1294635.5	2011112.42	360.27	360.22
5005	1294607.97	2011103.71	360.47	360.44
5006	1294585.43	2011097.42	361.02	360.96
5007	1294564.07	2011090.17	362.2	362.12
5008	1294541.51	2011083.24	363.52	363.47
5009	1294711.63	2011135.88	361.35	361.27
5010	1294728.84	2011140.74	361.76	361.7
5011	1294746.08	2011144.89	362.31	362.25
5012	1294768.77	2011146.41	363.46	363.4
5013	1294792.41	2011153.64	365.48	365.41
5014	1294828.64	2011164.83	367.74	367.67
5015	1294864.2	2011174.84	369.38	369.33
5016	1294904	2011186.93	372.51	372.45
5017	1294911.07	2011174.48	372.36	372.3
5018	1294947.31	2011198.73	373.48	373.41
5101	1303097.03	2005062.46	389.97	389.89
5102	1303056.16	2005061.86	390.18	390.08
5103	1303044.28	2005050.6	390.36	390.28

5104	1303032.32	2005046.98	391.13	391.04
5105	1303017.14	2005043.23	392.74	392.64
5106	1302999.79	2005035.1	394.89	394.79
5107	1302970.77	2005031.74	398.3	398.19
5108	1302955.9	2005028.37	399.33	399.25
5109	1302935.87	2005024	400.02	399.92
5110	1303112.23	2005065.66	390.19	390.09
5111	1303131.86	2005069.74	390.46	390.37
5112	1303152.88	2005074.87	390.64	390.55
5113	1303173.93	2005080.32	390.96	390.87
5114	1303197.11	2005086.13	391.61	391.51
5115	1303219.27	2005090.81	392.58	392.49
5116	1303242.72	2005096.22	394.45	394.37
5117	1303265.89	2005100.26	397.5	397.42
5201	1292182.21	1996116.12	218.74	218.63
5202	1292171.43	1996099.66	217.91	217.78
5203	1292159.55	1996088.31	216.94	216.8
5204	1292144.41	1996070.16	215.6	215.49
5205	1292128.83	1996052.04	214.65	214.52
5206	1292122.73	1996033.1	214.52	214.41
5207	1292103.8	1996023.95	213.57	213.46
5208	1292081.81	1995997.44	213.57	213.45
5209	1292056.08	1995967.21	213.74	213.66
5210	1292018.38	1995924.51	213.95	213.85
5211	1292005.53	1995915.87	214.02	213.91
5212	1291984.51	1995890.53	214.2	214.11
5213	1291969.17	1995866.62	214.24	214.16
5301	1303230.22	1973538.85	321.62	321.57
5302	1303110.65	1973502.32	321	320.93
5303	1303087.56	1973495.33	320.89	320.82
5304	1303059.65	1973487.01	320.83	320.75
5305	1303041.55	1973481.7	320.84	320.75
5306	1302993.9	1973473.2	320.88	320.83
5307	1302951.29	1973474.45	320.4	320.34
5308	1302903.21	1973483.68	319.89	319.81
5309	1302868.84	1973494.79	319.62	319.58
5310	1302830.81	1973509.31	319.13	319.08
5311	1302783.97	1973527.17	318.82	318.75
5312	1302755.97	1973537	318.54	318.48
5313	1302716.02	1973552.01	318.15	318.09
5401	1288170.77	1981524.11	198.53	198.48

5402	1288141.61	1981515.26	199.2	199.12
5403	1288106.24	1981511.99	200.42	200.36
5404	1288080.8	1981512.91	201.29	201.23
5405	1288041.48	1981509.81	203.71	203.64
5406	1288004.11	1981503.66	205.13	205.06
5407	1287995	1981504.57	205.36	205.31
5408	1287957.21	1981500.37	206.16	206.09
5409	1287917.54	1981494.88	206.73	206.65
5410	1287885.55	1981492.13	207.18	207.1
5411	1287841.18	1981492.55	207.74	207.67
5412	1287793.19	1981486.74	208.08	208.03
5413	1287745.93	1981476.53	207.36	207.29
5414	1287697.16	1981470.4	206.57	206.51
5415	1287692.29	1981471.24	206.43	206.38
5501	1279812.01	1964714.9	193.65	193.58
5502	1279821.84	1964730.85	193.43	193.36
5503	1279834.63	1964751.32	193.2	193.16
5504	1279859.35	1964788.24	192.77	192.73
5505	1279872.66	1964810.71	192.73	192.69
5506	1279887.17	1964833.41	192.7	192.66
5507	1279904.47	1964867.55	192.51	192.45
5508	1279931.31	1964908.19	192.49	192.46
5509	1279946.89	1964930.86	192.5	192.45
5510	1279962.41	1964954.34	192.56	192.52
5511	1279976.39	1964974.27	192.56	192.5
5512	1279990.18	1964997.13	192.78	192.71
5513	1280015.24	1965034.52	194.25	194.19
5514	1280027.4	1965051.52	195.53	195.49
5515	1280013.54	1965030.52	194.01	193.98
5601	1281676.31	1949716.07	191.54	191.48
5602	1281681.22	1949760.49	191.44	191.39
5603	1281683.66	1949784.97	191.31	191.26
5604	1281686.59	1949818.17	191.21	191.16
5605	1281690.61	1949862.88	190.97	190.91
5606	1281696.4	1949894.16	190.83	190.75
5607	1281697.59	1949928.53	190.76	190.69
5608	1281698.16	1949945	190.69	190.62
5609	1281703.52	1949987.13	190.59	190.54
5610	1281710.76	1950070.09	191.4	191.33
5611	1281714.41	1950100.29	191.94	191.86
5612	1281713.23	1950081.92	191.51	191.44

5613	1281706.53	1950007.75	190.73	190.66
5614	1281705.66	1949991.29	190.57	190.5
5615	1281703.3	1949961.11	190.61	190.56
5616	1281701.27	1949938.15	190.67	190.62
5701	1298779.5	1943012.35	218.9	218.84
5702	1298782.53	1943029.69	218.14	218.12
5703	1298785.73	1943045.92	217.56	217.53
5704	1298788.25	1943064.95	217.19	217.15
5705	1298796.41	1943078.87	217	216.95
5706	1298797.17	1943096.71	216.83	216.81
5707	1298791.95	1943110.7	216.67	216.66
5708	1298787.66	1943121.83	216.65	216.63
5709	1298782.87	1943137.6	216.62	216.6
5710	1298776.03	1943156.64	216.45	216.41
5711	1298768.32	1943178.23	215.92	215.88
5712	1298761.4	1943191.86	215.49	215.45
5713	1298755.63	1943204.82	215.61	215.58
5714	1298745.96	1943220.86	215.82	215.77
5715	1298736.82	1943238.59	216.32	216.31
5716	1298732.4	1943245.95	216.66	216.63
5801	1271755.04	1938662.77	188.77	188.71
5802	1271795.87	1938703.26	189.55	189.48
5803	1271813.96	1938720.99	189.25	189.18
5804	1271829.74	1938737.37	188.86	188.8
5805	1271879.66	1938785.08	188.86	188.81
5806	1271900.31	1938803.96	188.73	188.66
5807	1271908.82	1938816.72	188.56	188.49
5808	1271927.9	1938834.8	188.84	188.78
5809	1271951.62	1938858.09	189.35	189.28
5810	1271970.94	1938875.92	189.79	189.73
5811	1271988.51	1938887.19	190.13	190.05
5812	1272004.82	1938908.99	190.4	190.31
5813	1272018.28	1938922.62	190.61	190.53
5814	1272039.19	1938941.75	190.94	190.87
5815	1272055.02	1938957.69	191.04	190.96
5816	1272071.25	1938972.18	191.34	191.27
5817	1272092.77	1938992.5	191.64	191.57
5818	1272110.83	1939012.85	191.85	191.77
5901	1280975.29	1932607.51	223.6	223.52
5902	1281005.9	1932599.09	224.14	224.08
5903	1281016.61	1932595.41	224.01	223.95

5904	1281026.42	1932593.04	223.88	223.83
5905	1281039.1	1932589.2	223.73	223.66
5906	1281055.91	1932584.14	223.55	223.48
5907	1281068.56	1932581.17	223.5	223.42
5908	1281091.12	1932574.66	223.81	223.74
5909	1281115.07	1932567.72	224.93	224.84
5910	1281137.73	1932561.43	226.01	225.96
5911	1281158.69	1932554.52	226.13	226.07
5912	1281173.94	1932551.08	226.15	226.1
5913	1281186.72	1932547.32	226.28	226.23
5914	1281207.04	1932541.78	226.75	226.69
5915	1281221.25	1932537.88	227.48	227.42
6001	1261618.55	1882696.06	212.79	212.71
6002	1261755.22	1882689.71	207.59	207.48
6003	1261769.81	1882688.72	206.84	206.76
6004	1261797.42	1882688.08	205.53	205.44
6005	1261848.31	1882685.09	203.62	203.54
6006	1261863.03	1882683.99	203.18	203.1
6007	1261875.59	1882683.33	202.87	202.79
6008	1261885.55	1882683.62	202.73	202.66
6009	1261894.43	1882683.27	202.67	202.6
6010	1261918.34	1882682.35	202.63	202.56
6011	1261964.71	1882680.85	203.23	203.16
6012	1261988.86	1882680.21	203.63	203.58
6013	1262006.33	1882678.88	203.94	203.87
6014	1262030.49	1882678.33	204.36	204.3
6015	1262049.51	1882678.29	204.71	204.64
6101	1275203.24	1891739.64	233.67	233.56
6102	1275207.31	1891765.74	233.89	233.86
6103	1275209.96	1891797.54	234.29	234.19
6104	1275208.17	1891837.62	234.63	234.53
6105	1275206.31	1891871.13	235.02	234.92
6106	1275202.23	1891898.88	235.26	235.17
6107	1275195.76	1891926.38	235.6	235.5
6108	1275188.68	1891947.04	235.82	235.73
6109	1275179.75	1891968.94	236.11	236
6110	1275166.55	1891992.68	236.33	236.23
6111	1275158	1892007.76	236.47	236.35
6112	1275119	1892075.56	237.29	237.2
6113	1275108.36	1892096.11	237.39	237.33
6114	1275084.73	1892139.39	237.9	237.81

6201	1279000.43	1908257.89	263.93	263.85
6202	1278987.59	1908259.01	263.51	263.45
6203	1278968.11	1908252.73	262.56	262.49
6204	1278953.45	1908249.74	261.83	261.77
6205	1278931.16	1908245.82	260.98	260.9
6206	1278910.56	1908242.72	260.33	260.24
6207	1278893.82	1908239.97	259.76	259.68
6208	1278878.57	1908232.16	259.78	259.71
6209	1278850.43	1908220.84	259.87	259.8
6210	1278825.89	1908210.67	259.96	259.88
6211	1279016.48	1908259.79	264.4	264.34
6212	1279033.09	1908260.31	264.5	264.42
6213	1279051.2	1908260.1	264.08	264.02
6214	1279074.35	1908262.49	263.52	263.46
6215	1279089.81	1908260.69	263.43	263.35
6216	1279103.55	1908238.8	262.27	262.21
6217	1279122.96	1908231.42	262.32	262.26
6218	1279144.61	1908231.43	262.48	262.41
6219	1279163.63	1908230.78	262.54	262.45
6220	1279192.44	1908229.93	262.55	262.48
6221	1279220.75	1908228.42	262.52	262.45
6301	1272039.36	1904551.27	237.92	237.83
6302	1272027.66	1904541.68	237.99	237.89
6303	1272017.41	1904531.68	238.03	237.95
6304	1272004.27	1904517.97	238.21	238.12
6305	1271994.18	1904505.55	238.31	238.24
6306	1271982.66	1904489.7	238.39	238.3
6307	1271972.65	1904476.43	238.42	238.33
6308	1271964.1	1904466.09	238.46	238.38
6309	1272076.81	1904571.31	238.24	238.16
6310	1272097.17	1904581.36	238.81	238.72
6311	1272128.01	1904598.19	239.72	239.64
6312	1272156.99	1904613.37	240.61	240.52
6313	1272170.04	1904622.62	241.13	241.04
6314	1272186.36	1904633.17	242.03	241.94
6315	1272204.58	1904653.47	243.22	243.12
6316	1272222.65	1904674.09	244.69	244.59
6317	1272237.09	1904691.06	246.04	245.94
6318	1272247.82	1904712.02	247.16	247.07
6401	1258526.06	1900145.08	224.78	224.74
6402	1258596.28	1900235.05	224.79	224.75

6403	1258658.01	1900277.87	224.18	224.16
6404	1258673.39	1900290.4	224.4	224.39
6405	1258902.07	1900359.64	226.27	226.24
6406	1258967.68	1900372.23	226.92	226.88
6407	1258968.97	1900372.7	226.91	226.89
6408	1258989.14	1900376.2	227.01	227
6409	1259020.22	1900383.09	227.12	227.08
6410	1259062.42	1900391.71	227.03	226.99
6411	1259108.07	1900406.2	226.66	226.6
6412	1259139.07	1900420.83	226.42	226.39
6413	1259158.91	1900433.06	226.36	226.3
6414	1259196.75	1900462.03	226.47	226.43
6415	1259235.46	1900502.07	227.04	227.02
6416	1258614.82	1900249.79	224.68	224.66
6417	1258599.3	1900234.09	224.56	224.53
6418	1258585.38	1900219.84	224.58	224.55
6419	1258558.2	1900186.85	224.53	224.48
6420	1258544.24	1900169.97	224.68	224.62
6421	1258534.58	1900159.76	224.79	224.76
6501	1246231.9	1908424.88	235.74	235.69
6502	1246207.71	1908415.53	236.54	236.47
6503	1246151.27	1908384.77	235.94	235.86
6504	1246137.46	1908375.69	235.84	235.75
6505	1246117.21	1908367.63	235.8	235.71
6506	1246088.32	1908354.3	235.6	235.52
6507	1246250.64	1908427.53	235	234.93
6508	1246292.14	1908431.44	233.38	233.3
6509	1246318.02	1908427.34	231.84	231.77
6510	1246361.12	1908412.28	229.49	229.42
6511	1246397.41	1908387.86	228.56	228.47
6512	1246418.37	1908358.4	228.4	228.32
6513	1246434.83	1908314.34	227.76	227.69
6514	1246460.5	1908264.55	227.42	227.33
6515	1246477.52	1908251.97	227.45	227.36
6516	1246521.53	1908239.75	227.52	227.43
6517	1246538.31	1908234.74	227.32	227.26
6601	1263307.79	1914606.19	320.44	320.38
6602	1263341.54	1914512.45	320.26	320.18
6603	1263390.09	1914327.09	324.18	324.1
6604	1263406.29	1914275.48	325.06	325.02
6605	1263412.7	1914243.6	325.75	325.66

6606	1263437.24	1914127.47	326.84	326.8
6607	1263489.8	1913998.58	320.53	320.48
6608	1263464.37	1914055.18	324.67	324.62
6609	1263458.3	1914071.34	325.46	325.4
6610	1263443.36	1914109.47	326.67	326.59
6611	1263417.13	1914200.81	326.43	326.36
6612	1263412.69	1914216.09	326.19	326.11
6613	1263407.62	1914237.48	325.76	325.7
6614	1263384.45	1914318.35	324.29	324.2
6701	1294403.43	1923284.04	226.44	226.41
6702	1294398.74	1923293.61	226.1	226.07
6703	1294390.71	1923330.6	225.81	225.74
6704	1294385.23	1923339.84	225.71	225.63
6705	1294380.15	1923349.12	225.61	225.52
6706	1294363.36	1923377.85	225.11	225.03
6707	1294356.82	1923389.67	224.73	224.63
6708	1294345.75	1923412.47	224.23	224.13
6709	1294326.82	1923452.38	224.66	224.64
6710	1294289.43	1923445.8	225.27	225.24
6801	1341233.4	1934578.98	299.4	299.34
6802	1341244.2	1934571.52	299.86	299.81
6803	1341261.41	1934559.28	300.48	300.41
6804	1341275	1934550.18	300.86	300.8
6805	1341304.82	1934533.15	301.3	301.24
6806	1341328.9	1934511.4	301.94	301.88
6807	1341350.64	1934495.42	302.43	302.38
6808	1341374.8	1934476.99	302.73	302.68
6809	1341427.41	1934438.94	304.37	304.31
6810	1341447.94	1934428.23	306.46	306.39
6811	1341508.72	1934384.39	314.74	314.68
6812	1341523.5	1934369.39	315.73	315.67
6813	1341557.07	1934337.18	317.69	317.61
6814	1341567.92	1934329.21	318.45	318.17
6901	1316914.24	1928539.75	310.47	310.4
6902	1316918.52	1928520.46	309.65	309.58
6903	1316931.22	1928502.25	308.96	308.91
6904	1316959.02	1928477.09	308.63	308.57
6905	1316974.45	1928463.06	308.62	308.56
6906	1316990.39	1928450.77	308.61	308.56
6907	1317004.5	1928438.05	308.61	308.56
6908	1317022.99	1928422.56	308.65	308.58

6909	1317038.69	1928409.91	308.64	308.58
6910	1317050.19	1928399.98	308.68	308.62
6911	1317064.78	1928387.77	308.7	308.64
6912	1317073.57	1928379.47	308.76	308.69
6913	1317080.31	1928373.65	308.85	308.77
6914	1317083.52	1928369.26	308.92	308.85
7001	1317625.98	1941486.45	326.37	326.27
7002	1317609.8	1941494.28	326.2	326.17
7003	1317592.25	1941500.93	326.19	326.16
7004	1317566.27	1941509.43	326.26	326.24
7005	1317550.6	1941514.24	326.21	326.2
7006	1317534.61	1941518.71	326.25	326.23
7007	1317442.13	1941547.31	329.42	329.39
7008	1317435.56	1941549.3	329.51	329.49
7009	1317427.85	1941551.9	329.57	329.55
7010	1317424.22	1941553.1	329.56	329.57
7011	1317466.46	1941519.77	323.64	323.61
7012	1317478.91	1941517.64	323.62	323.6
7013	1317499.69	1941511.8	323.87	323.85
7014	1317522.83	1941505.18	323.98	323.9
7015	1317548.63	1941499.01	324.15	324.11
7016	1317564.71	1941495.59	324.53	324.48
7101	1347054.28	1941471.59	309.64	309.55
7102	1347036.36	1941494.65	310.19	310.11
7103	1347008.35	1941523.55	310.35	310.27
7104	1346989.77	1941547.29	310.14	310.07
7105	1346982.92	1941560.83	310.01	309.95
7106	1346966.96	1941577.98	309.65	309.55
7107	1346960.89	1941586.15	309.16	309.09
7108	1346948.57	1941604.32	307.9	307.82
7109	1346943.89	1941607.75	307.56	307.46
7110	1346933.51	1941615.51	307.13	307.07
7111	1346953.4	1941603.13	308.1	308.03
7112	1346967.27	1941586.43	309.33	309.27
7113	1347036.29	1941495.26	310.18	310.11
7114	1347038.8	1941492.69	310.16	310.07
7201	1403326.84	1926295.9	764.23	764.13
7202	1403354.39	1926289.44	764.23	764.12
7203	1403396.08	1926276.77	763.99	763.89
7204	1403425.14	1926268.81	763.77	763.67
7205	1403472.73	1926255.97	763.67	763.57

7206	1403502.9	1926247.84	763.63	763.51
7207	1403533.39	1926239.64	763.52	763.41
7208	1403557.25	1926232.72	763.44	763.32
7209	1403581.66	1926226.68	763.35	763.24
7210	1403619.91	1926216.56	763.13	763.02
7211	1403654.85	1926207.36	763.05	762.95
7212	1403698.05	1926195.68	762.91	762.82
7213	1403725.85	1926188.22	762.74	762.63
7214	1403749.43	1926181.63	762.62	762.54
7301	1409480.01	1921105.99	912.45	912.39
7302	1409480.56	1921128.96	912.01	911.96
7303	1409480.47	1921148.89	911.72	911.72
7304	1409480.1	1921168.14	911.56	911.54
7305	1409480.12	1921198.86	911.43	911.41
7306	1409480.37	1921219.31	911.5	911.45
7307	1409480.63	1921261.06	911.73	911.69
7308	1409480.69	1921309.94	912.26	912.25
7309	1409480.72	1921348.42	913.6	913.56
7310	1409475.02	1921098.78	912.54	912.5
7311	1409474.93	1921062.73	913.45	913.41
7312	1409475.1	1921040.33	914.07	914.04
7313	1409474.9	1920967.4	916.31	916.28
7314	1409474.9	1920961.91	916.49	916.48
7315	1409474.36	1920893.93	920.56	920.58
7316	1409474.67	1920885.41	921.24	921.19
7317	1409474.81	1920878.53	921.76	921.76
7318	1409474.36	1920842.84	924.09	924.07
7319	1409474.35	1920793.88	926.26	926.26
7320	1409474.79	1920765.12	927	927.02
7401	1414605.79	1929388.73	717.88	717.86
7402	1414593.31	1929379.14	718.01	717.98
7403	1414579.88	1929374.72	718.02	718
7404	1414565.9	1929376.5	717.85	717.82
7405	1414554.23	1929392.37	717.67	717.63
7406	1414551.97	1929406.67	717.41	717.38
7407	1414550.08	1929426.78	716.97	716.91
7408	1414548.41	1929440.31	716.82	716.79
7409	1414545.63	1929471.34	716.61	716.59
7410	1414544.36	1929482.31	716.5	716.45
7411	1414542.66	1929495.33	716.4	716.37
7412	1414539.36	1929523.77	716.27	716.23

7413	1414537.66	1929543.67	716.18	716.15
7414	1414534.45	1929579.11	715.81	715.76
7415	1414532.87	1929601.88	715.32	715.3
7416	1414530.71	1929623.46	715.07	715.06
7501	1424960.35	1936405.94	835.66	835.69
7502	1424968.57	1936401.09	835.82	835.83
7503	1424978.98	1936397.61	835.97	835.98
7504	1424989.47	1936395.45	836.13	836.12
7505	1424996.88	1936393.64	836.2	836.22
7506	1425004.32	1936392.16	836.3	836.32
7507	1425015.74	1936389.65	836.49	836.5
7508	1425026.34	1936387.95	836.68	836.68
7509	1425037.25	1936385.46	836.83	836.82
7510	1425049.62	1936381.92	836.95	836.95
7511	1425069.89	1936378.19	837.21	837.21
7512	1425114.81	1936369.29	837.28	837.29
7513	1425135.41	1936366.15	837.32	837.35
7514	1425157.25	1936360.29	837.08	837.09
7601	1430467.45	1940029.87	771.73	771.67
7602	1430470.09	1940021	771.84	771.78
7603	1430473.68	1939996.72	772.39	772.35
7604	1430477.79	1939981.86	772.95	772.93
7605	1430480.04	1939969.33	773.83	773.78
7606	1430482.69	1939955.53	774.88	774.85
7607	1430485.44	1939941.56	775.8	775.74
7608	1430487.83	1939928.66	776.45	776.4
7609	1430490.24	1939918.68	777.03	776.99
7610	1430492.49	1939906.34	777.73	777.69
7611	1430493.55	1939900.47	777.99	777.96
7701	1457602.99	1975737.52	218.02	218
7702	1457608.45	1975738.87	218.2	218.17
7703	1457622.17	1975713.8	220.51	220.47
7704	1457635.57	1975697.21	222.38	222.35
7705	1457655.01	1975701.08	223.09	223.03
7706	1457667.46	1975706.87	223.38	223.35
7707	1457685.38	1975705.76	223.87	223.82
7708	1457703.19	1975712.15	223.96	223.9
7709	1457725.34	1975718.4	223.82	223.78
7710	1457742.22	1975720.11	223.81	223.78
7711	1457757.97	1975722.81	223.67	223.64
7712	1457783.85	1975728	223.37	223.33

7713	1457804.82	1975732.72	223.21	223.17
7714	1457834.33	1975738.65	223.12	223.08
7715	1457860.76	1975743.8	223.22	223.17
7716	1457910.31	1975765.92	221.96	221.94
7717	1457934.51	1975805.61	221.28	221.22
7718	1457952.09	1975838.91	221.28	221.24
7801	1449717.61	1965915.12	235.54	235.48
7802	1449701.47	1965931.87	235.85	235.79
7803	1449687.94	1965954.53	236.73	236.69
7804	1449666.99	1966007.05	239.5	239.45
7805	1449630.25	1966024.83	239.77	239.71
7806	1449612	1966032.58	240.2	240.15
7807	1449579.88	1966056.22	241.33	241.29
7808	1449563.33	1966057.94	241.66	241.62
7809	1449543.91	1966067.58	242.11	242.06
7810	1449524.39	1966078.11	242.71	242.66
7811	1449501.79	1966090.47	243.55	243.48
7812	1449490.19	1966103.01	244.3	244.25
7813	1449444.99	1966119.3	246.7	246.67
7814	1449417.49	1966122.16	249.65	249.59
7815	1449366.17	1966115.17	253.58	253.55
7816	1449347.45	1966113.76	254.05	254.02
7817	1449301.59	1966100.28	254.96	254.94
7818	1449285.33	1966097.02	255.18	255.14
7901	1435282.22	1956868.75	325.1	325.03
7902	1435281.81	1956846.95	325.11	325.04
7903	1435281.46	1956831.48	324.91	324.84
7904	1435280.67	1956799.37	324.37	324.31
7905	1435282.48	1956786.77	324.18	324.13
7906	1435282.87	1956767.93	323.82	323.74
7907	1435279.9	1956729.81	322.92	322.82
7908	1435278.73	1956705.23	322.4	322.32
7909	1435278.75	1956659.34	321.05	320.96
7910	1435276.41	1956631.44	319.97	319.9
7911	1435277.83	1956580.85	318.28	318.25
7912	1435276.77	1956564.55	318.07	318.04
7913	1435275.52	1956494.29	317.79	317.73
7914	1435277.27	1956457.87	317.35	317.28
7915	1435277.27	1956436.76	317.42	317.36
7916	1435278.1	1956419.59	317.4	317.32
7917	1435262.66	1956403.58	317.57	317.5

7918	1435262.21	1956374.35	317.82	317.76
7919	1435280.63	1956342.93	317.1	317.04
8001	1442637.26	1954650.09	259.02	258.99
8002	1442652.45	1954642.79	258.99	258.95
8003	1442682.82	1954625.34	258.27	258.24
8004	1442702.31	1954622.3	257.54	257.5
8005	1442721.5	1954613.32	256.7	256.68
8006	1442751.84	1954600.09	255.32	255.3
8007	1442776.92	1954589.21	254.35	254.31
8008	1442793.77	1954581.86	254.03	254
8009	1442817.52	1954570.79	253.98	253.95
8010	1442840.17	1954559.22	253.62	253.59
8011	1442851.36	1954554.41	253.59	253.56
8012	1442872.75	1954544.46	253.64	253.62
8013	1442901.48	1954531.37	253.68	253.66
8014	1442921.98	1954521.82	253.89	253.85
8015	1442967.3	1954501.61	254.44	254.43
8101	1431042.96	1917650.53	514.76	514.73
8102	1431042.82	1917659.19	514.92	514.89
8103	1431043.25	1917668.86	515.05	515.03
8104	1431042.72	1917680.16	515.08	515.05
8105	1431042.33	1917701	514.94	514.91
8106	1431041.52	1917718.02	514.57	514.53
8107	1431040.65	1917729.27	514.38	514.35
8108	1431038.21	1917751.53	514.12	514.1
8109	1431036.73	1917764.49	514.12	514.07
8110	1431033.51	1917787.7	514.21	514.22
8111	1431031.38	1917807.68	514.66	514.62
8112	1431028.88	1917828.2	515.35	515.32
8201	1435321.37	1934182.59	456.29	456.29
8202	1435330.44	1934198.17	455.61	455.6
8203	1435342.38	1934219.53	454.97	454.95
8204	1435354.57	1934239.27	454.33	454.31
8205	1435363.68	1934255.33	453.91	453.9
8206	1435372.7	1934270.74	453.48	453.46
8207	1435383.08	1934288.61	453.05	453.03
8208	1435395.65	1934310.21	452.67	452.68
8209	1435481.92	1934456.47	458.17	458.18
8210	1435485.17	1934463.58	458.27	458.29
8211	1435497.03	1934484.46	458.31	458.32
8301	1430201.67	1945023.3	696.9	696.91

8302	1430233.62	1945012.26	697.59	697.61
8303	1430254.96	1945004.01	698	698.01
8304	1430272.82	1944995.9	698.32	698.3
8305	1430338.7	1944975.78	699.27	699.28
8306	1430357.51	1944960.18	698.93	698.97
8307	1430382.08	1944956.41	699.09	699.13
8308	1430407.04	1944945.64	698.73	698.74
8309	1430188.11	1945011.75	696.58	696.6
8310	1430165.98	1945037.16	695.9	695.93
8311	1430146.47	1945044.01	695.39	695.42
8312	1430128.7	1945048.14	694.93	694.95
8313	1430121.87	1945050.11	694.71	694.74
8314	1430095.94	1945059.33	693.88	693.88
8315	1430086.57	1945059.72	693.54	693.58
8401	1443386.08	1944858.61	425	424.98
8402	1443379.68	1944860.81	425.09	425.1
8403	1443370.47	1944865.09	425.36	425.35
8404	1443363.48	1944867.98	425.54	425.52
8405	1443354.67	1944871.34	425.74	425.73
8406	1443342.98	1944872.34	425.84	425.81
8407	1443332.2	1944875.16	426.08	426.06
8408	1443321.61	1944875.78	426.22	426.2
8409	1443313.16	1944881.92	426.19	426.17
8410	1443304.65	1944882.97	426.12	426.1
8411	1443289.41	1944895.39	426.8	426.76
8412	1443262.98	1944904.07	427.09	427.06
8413	1443250.45	1944907.73	426.84	426.81
8414	1443240.07	1944909.92	426.58	426.55
8501	1442001.21	1949174.43	274.05	274.02
8502	1441379.68	1949710.69	302.06	302.06
8503	1441395.86	1949693.67	301.11	301.08
8504	1441412.8	1949677.82	300.24	300.23
8505	1441439.37	1949654.68	298.69	298.65
8506	1441455.75	1949638.12	297.82	297.79
8507	1441482.59	1949613.56	296.59	296.56
8508	1441515.36	1949583.04	294.84	294.83
8509	1441546.82	1949552.8	293.31	293.29
8510	1441578.55	1949522.16	291.66	291.62
8511	1441598.37	1949503.65	290.67	290.66
8512	1441624.1	1949480.14	289.6	289.57
8513	1441646.93	1949458.01	288.81	288.77

8514	1441691.55	1949417.06	286.9	286.86
8515	1441714.84	1949393.79	285.76	285.74
8516	1441736.65	1949373.17	284.71	284.69
8517	1441752.64	1949357.96	283.97	283.94
8518	1441774.38	1949337.46	282.91	282.9
8519	1441791.21	1949323.16	282.02	282
8520	1441813.17	1949300.47	280.66	280.64
8521	1441835.73	1949277.73	278.86	278.83

Table 7 – Leading Edge Geomatics surveyed ground control points (GCPs).

This project must meet Non-vegetated Vertical Accuracy (NVA) ≤ 0.64 ft (19.6 cm) at the 95% confidence level based on $RMSE_z$ ≤ 0.33 ft (10 cm) x 1.9600.

100 % of Totals	# of Points	RMSEz (m) NVA Spec=0.1 m	NVA- Non-vegetated Vertical Accuracy ((RMSEz x 1.9600) Spec=0.196 m	Mean (m)	Median (m)	Skew	Std Dev (m)	Min (m)	Max (m)	Kurtosis
GCP	1132	0.06	0.12	0.05	0.05	0.28	0.04	-0.12	0.28	2.88

Table 8 - Ground control points (GCPs) vertical accuracy results.

APPENDIX 1

Appendix 1 contains trajectory plots for each mission that was processed and used towards the project. The folder Appendix1 contains all reports and documentation.