

C-4.1 Report on Nominal Pulse Spacing (NPS)

The USGS Lidar Base Specification Version 2.1 states: "The required ANPS and ANPD by QL are listed in table 1. Aggregate Nominal Pulse Density (ANPD) and Aggregate Nominal Pulse Spacing (ANPS) shall meet the requirements of the Quality Level (QL) of the project with a minimum of QL2 for 3DEP collections. Aggregate Nominal Pulse Density (ANPD) shall be no less than 2 points per square meter (QL2); assessment to be made against single swath, first return data located within the geometrically usable center portion (typically ~95%) of each swath. Aggregate Nominal Pulse Spacing (ANPS) shall be no greater than 0.70 meters (QL2); assessment to be made against single swath, first return data located within the geometrically usable center portion (typically ~95%) of each swath. Dependent on the local terrain and land cover conditions in a project, a greater pulse density may be required on specific projects."

Table 1. Aggregate nominal pulse spacing and density.

[QL, quality level; pls/m², pulses per square meter; m, meter; ≤, less than or equal to; ≥, greater than or equal to]

Quality level	Aggregate nominal pulse spacing (m)	Aggregate nominal pulse density (pls/m ²)
QL0	≤0.35	≥8.0
QL1	≤0.35	≥8.0
QL2	≤0.71	≥2.0
QL3	≤1.41	≥0.5

The purpose of this section is to report on the lidar point density and nominal point spacing by LAS file. Averages by files (not including overlap), project boundary polygons (including overlap), and aggregate project boundary polygons (including overlap) are reported.

[Data Source - D:\00_Cherry\Swaths_LAS](#)

Quality level tested: QL2

File	Number of First Returns	Area	Point Density	NPS
CS_00026.las	173,576,331	49,442,224	3.511/0.326	0.534/1.752
CS_00028.las	140,422,373	45,969,303	3.055/0.284	0.572/1.877
CS_00029.las	518,103,022	143,478,033	3.611/0.335	0.526/1.726
CS_00030.las	447,093,134	142,364,318	3.140/0.292	0.564/1.850
CS_00031.las	9,479,804	2,935,236	3.230/0.300	0.556/1.824
CS_00032.las	31,796,330	9,321,463	3.411/0.317	0.541/1.775

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File	Number of First Returns	Area	Point Density	NPS
CS_00033.las	2,989,005	784,437	3.810/0.354	0.512/1.680
CS_00034.las	1,341,037	295,718	4.535/0.421	0.470/1.542
CS_00035.las	70,303,163	17,712,406	3.969/0.369	0.502/1.647
CS_00036.las	16,604,978	2,968,406	5.594/0.520	0.423/1.388
CS_00037.las	95,946,471	34,354,188	2.793/0.259	0.598/1.962
CS_00038.las	48,397,705	17,045,339	2.839/0.264	0.593/1.946
CS_00039.las	4,238,381	1,036,893	4.088/0.380	0.495/1.624
CS_00040.las	267,907,370	95,869,949	2.794/0.260	0.598/1.962
CS_00041.las	29,054,584	7,765,657	3.741/0.348	0.517/1.696
CS_00043.las	498,564,339	130,237,491	3.828/0.356	0.511/1.677
CS_00044.las	353,393,859	130,007,795	2.718/0.253	0.607/1.991
CS_00045.las	498,744,143	130,182,646	3.831/0.356	0.511/1.677
CS_00046.las	67,716,171	24,297,284	2.787/0.259	0.599/1.965
CS_00047.las	198,467,035	72,254,265	2.747/0.255	0.603/1.978
CS_00048.las	19,496,213	6,826,831	2.856/0.265	0.592/1.942
CS_00049.las	1,584,381	141,769	11.176/1.038	0.299/0.981
CS_00051.las	180,224,734	63,168,138	2.853/0.265	0.592/1.942
CS_00053.las	558,073,007	130,575,430	4.274/0.397	0.484/1.588
CS_00054.las	337,963,227	112,782,579	2.997/0.278	0.578/1.896
CS_00055.las	2,419,568	1,007,093	2.403/0.223	0.645/2.116
CS_00056.las	137,350	47,838	2.871/0.267	0.590/1.936
CS_00057.las	53,390,224	18,268,220	2.923/0.272	0.585/1.919
CS_00058.las	550,245,045	130,469,094	4.217/0.392	0.487/1.598
CS_00059.las	390,002,242	129,322,864	3.016/0.280	0.576/1.890
CS_00060.las	549,733,804	130,276,435	4.220/0.392	0.487/1.598
CS_00061.las	375,149,576	128,182,733	2.927/0.272	0.585/1.919
CS_00062.las	539,169,232	127,334,644	4.234/0.393	0.486/1.594
CS_00063.las	374,606,872	127,574,045	2.936/0.273	0.584/1.916
CS_00064.las	518,427,961	129,120,741	4.015/0.373	0.499/1.637
CS_00065.las	388,012,698	128,283,575	3.025/0.281	0.575/1.886
CS_00067.las	543,454,158	128,207,910	4.239/0.394	0.486/1.594
CS_00068.las	374,110,018	128,408,653	2.913/0.271	0.586/1.923
CS_00069.las	544,703,989	129,979,067	4.191/0.389	0.488/1.601

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File	Number of First Returns	Area	Point Density	NPS
CS_00070.las	389,471,951	129,556,260	3.006/0.279	0.577/1.893
CS_00071.las	105,571,705	29,458,239	3.584/0.333	0.528/1.732
CS_00073.las	303,110,703	77,106,529	3.931/0.365	0.504/1.654
CS_00075.las	263,168,204	77,351,485	3.402/0.316	0.542/1.778
CS_00076.las	298,246,492	77,082,421	3.869/0.359	0.508/1.667
CS_00077.las	265,149,691	77,325,412	3.429/0.319	0.540/1.772
CS_00078.las	292,604,460	77,031,316	3.799/0.353	0.513/1.683
CS_00079.las	257,350,082	77,265,402	3.331/0.309	0.548/1.798
CS_00080.las	301,059,293	77,039,998	3.908/0.363	0.506/1.660
CS_00081.las	265,812,678	77,365,693	3.436/0.319	0.539/1.768
CS_00082.las	298,256,537	77,108,793	3.868/0.359	0.508/1.667
CS_00083.las	280,672,613	83,211,535	3.373/0.313	0.544/1.785
CS_00084.las	333,679,767	86,635,423	3.852/0.358	0.510/1.673
CS_00086.las	303,976,665	86,967,692	3.495/0.325	0.535/1.755
CS_00088.las	343,715,234	86,695,494	3.965/0.368	0.502/1.647
CS_00090.las	305,029,764	87,005,466	3.506/0.326	0.534/1.752
CS_00091.las	350,991,037	86,664,710	4.050/0.376	0.497/1.631
CS_00092.las	302,219,479	87,026,147	3.473/0.323	0.537/1.762
CS_00093.las	347,545,721	86,429,449	4.021/0.374	0.499/1.637
CS_00094.las	296,703,882	86,785,216	3.419/0.318	0.541/1.775
CS_00095.las	353,225,448	90,857,536	3.888/0.361	0.507/1.663
CS_00098.las	362,849,777	95,750,173	3.790/0.352	0.514/1.686
CS_00100.las	336,602,992	96,103,892	3.502/0.325	0.534/1.752
CS_00101.las	347,980,859	96,678,814	3.599/0.334	0.527/1.729
CS_00102.las	345,443,300	96,303,251	3.587/0.333	0.528/1.732
CS_00103.las	337,985,297	96,650,828	3.497/0.325	0.535/1.755
CS_00104.las	338,740,924	96,158,113	3.523/0.327	0.533/1.749
CS_00105.las	318,487,994	87,653,902	3.633/0.338	0.525/1.722
CS_00106.las	265,883,676	77,085,287	3.449/0.320	0.538/1.765
CS_00107.las	558,944,074	129,908,673	4.303/0.400	0.482/1.581
CS_00109.las	394,235,125	129,534,347	3.043/0.283	0.573/1.880
CS_00110.las	566,954,016	129,928,946	4.364/0.405	0.479/1.572
CS_00111.las	395,993,691	130,024,609	3.046/0.283	0.573/1.880

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File	Number of First Returns	Area	Point Density	NPS
CS_00112.las	107,036,145	34,953,295	3.062/0.284	0.571/1.873
CS_00113.las	558,609,878	132,220,166	4.225/0.393	0.487/1.598
CS_00114.las	413,472,057	131,802,905	3.137/0.291	0.565/1.854
CS_00115.las	550,214,267	131,782,986	4.175/0.388	0.489/1.604
CS_00117.las	116,279,077	25,710,892	4.523/0.420	0.470/1.542
CS_00119.las	355,020,485	114,486,699	3.101/0.288	0.568/1.864
CS_00120.las	43,354,953	9,404,089	4.610/0.428	0.466/1.529
CS_00122.las	277,006,603	87,533,758	3.165/0.294	0.562/1.844
CS_00123.las	551,899,434	140,789,735	3.920/0.364	0.505/1.657
CS_00124.las	437,902,065	139,958,938	3.129/0.291	0.565/1.854
CS_00125.las	567,370,718	141,298,363	4.015/0.373	0.499/1.637
CS_00126.las	433,728,271	139,885,764	3.101/0.288	0.568/1.864
CS_00127.las	578,460,461	141,817,761	4.079/0.379	0.495/1.624
CS_00128.las	440,109,780	140,820,855	3.125/0.290	0.566/1.857
CS_00129.las	593,574,467	142,195,343	4.174/0.388	0.489/1.604
CS_00130.las	439,808,514	141,078,058	3.117/0.290	0.566/1.857
CS_00131.las	607,140,350	142,332,304	4.266/0.396	0.484/1.588
CS_00133.las	453,599,164	141,191,845	3.213/0.298	0.558/1.831
CS_00134.las	568,872,162	142,018,917	4.006/0.372	0.500/1.640
CS_00135.las	449,267,531	141,857,159	3.167/0.294	0.562/1.844
CS_00136.las	582,853,590	142,622,222	4.087/0.380	0.495/1.624
CS_00137.las	455,117,730	141,581,846	3.215/0.299	0.558/1.831
CS_00138.las	574,664,523	142,663,749	4.028/0.374	0.498/1.634
CS_00139.las	448,205,670	141,402,909	3.170/0.295	0.562/1.844
CS_00140.las	602,361,795	142,681,420	4.222/0.392	0.487/1.598
CS_00142.las	447,765,353	141,653,284	3.161/0.294	0.562/1.844
CS_00143.las	583,801,919	142,634,531	4.093/0.380	0.494/1.621
CS_00144.las	439,200,961	140,785,834	3.120/0.290	0.566/1.857
CS_00145.las	400,534,753	96,597,989	4.146/0.385	0.491/1.611
CS_00146.las	326,173,155	103,603,630	3.148/0.292	0.564/1.850
CS_00147.las	420,012,250	103,847,332	4.045/0.376	0.497/1.631
CS_00148.las	312,157,038	103,501,863	3.016/0.280	0.576/1.890
CS_00149.las	112,234,001	38,088,601	2.947/0.274	0.583/1.913

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File	Number of First Returns	Area	Point Density	NPS
CS_00150.las	84,623,777	27,520,658	3.075/0.286	0.570/1.870
CS_00151.las	218,377,845	63,392,550	3.445/0.320	0.539/1.768
Average			3.527/0.328	0.532/1.745
			pp Square Meter/ pp Square US Survey Foot	Meter/ US Survey Feet
3183.64719649	35,152,611,177	7,220,021,105	4.869/0.452	0.453/1.486
Aggregate	35,152,611,177	7,220,021,105	4.869/0.452	0.453/1.486
			pp Square Meter/ pp Square US Survey Foot	Meter/ US Survey Feet

* - indicates a swath whose NPS and Point Density were brought up to specifications due to the inclusion of one or more re-flight swaths.