

C-4 Report on Nominal Pulse Spacing (NPS)

The USGS Lidar Base Specification 2022 rev. A 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. Any 'Exclusion Shapefile' pathed out on the Input Tab of this tool was applied to the processing for this test to avoid skewing the results with known areas of no data.

[Data Source - D:\00 Nevada\Client Swaths](#)

Quality level tested: QL1

File	Number of First Returns	Area	Point Density	NPS
CS_00001.las	29,491,807	51,217,723	6.200/0.576	0.402/1.318
CS_00001.las + CS_00258.las	43,804,883	50,646,624	9.311/0.865	0.328/1.075 *
CS_00002.las	29,660,828	48,631,874	6.566/0.610	0.390/1.280
CS_00002.las + others	124,470,827	46,146,000	29.030/2.697	0.186/0.609 *

C-4 Report on Nominal Pulse Spacing (NPS) - continued

File	Number of First Returns	Area	Point Density	NPS
CS_00003.las	18,217,048	31,050,382	6.318/0.587	0.398/1.306
CS_00003.las + CS_0025 9.las	26,022,115	31,100,544	9.009/0.837	0.333/1.093 *
CS_00004.las	26,459,679	40,252,161	7.072/0.657	0.376/1.233
CS_00004.las + others	83,776,358	40,310,224	22.367/2.078	0.212/0.694 *
CS_00005.las	20,021,602	32,103,070	6.717/0.624	0.386/1.266
CS_00005.las + others	66,354,058	31,632,576	22.583/2.098	0.210/0.690 *
CS_00006.las	14,950,672	24,438,470	6.588/0.612	0.390/1.279
CS_00006.las + CS_0026 0.las	21,781,159	23,879,296	9.817/0.912	0.319/1.047 *
CS_00073.las	59,743,582	100,774,615	6.383/0.593	0.396/1.299
CS_00073.las + others	160,550,828	100,851,984	17.136/1.592	0.242/0.793 *
CS_00181.las	8,117,727	12,583,836	6.943/0.645	0.379/1.245
CS_00181.las + CS_0018 2.las	15,872,438	12,622,656	13.530/1.257	0.272/0.892 *
CS_00183.las	19,863,128	33,515,866	6.383/0.593	0.396/1.299
CS_00183.las + CS_0028 4.las	27,596,304	33,564,624	8.848/0.822	0.336/1.103 *
CS_00185.las	19,955,745	33,324,375	6.448/0.599	0.394/1.292
CS_00185.las + others	80,418,692	33,349,632	25.952/2.411	0.196/0.644 *
CS_00187.las	22,343,986	39,147,330	6.146/0.571	0.404/1.324
CS_00187.las + CS_0024 8.las	33,617,662	34,698,848	10.430/0.969	0.310/1.016 *
CS_00189.las	61,235,414	110,088,714	5.985/0.556	0.409/1.341
CS_00189.las + CS_0025 0.las	86,418,668	110,204,672	8.439/0.784	0.344/1.129 *
CS_00192.las	3,903,382	5,356,478	7.847/0.729	0.357/1.171
CS_00192.las + CS_0027 2.las	38,236,332	42,268,080	9.741/0.905	0.320/1.051 *
CS_00207.las	28,082,639	53,255,403	5.673/0.527	0.420/1.377
CS_00207.las + CS_0021 0.las	54,265,249	49,090,928	11.894/1.105	0.290/0.951 *
CS_00211.las	39,824,504	74,643,455	5.748/0.534	0.417/1.369
CS_00211.las + others	115,524,769	69,443,344	17.911/1.664	0.236/0.775 *

C-4 Report on Nominal Pulse Spacing (NPS) - continued

File	Number of First Returns	Area	Point Density	NPS
CS_00214.las	1,771,929	2,528,008	7.546/0.701	0.364/1.194
CS_00214.las + CS_00215.las	2,871,848	2,544,720	12.152/1.129	0.287/0.941 *
CS_00216.las	6,748,232	12,373,219	5.866/0.545	0.413/1.354
CS_00216.las + CS_00244.las	9,942,860	12,403,776	8.633/0.802	0.340/1.117 *
CS_00217.las	8,892,897	14,267,629	6.706/0.623	0.386/1.267
CS_00217.las + others	30,154,955	14,305,424	22.690/2.108	0.210/0.689 *
CS_00218.las	13,680,186	20,546,565	7.169/0.666	0.374/1.226
CS_00218.las + CS_00274.las	19,541,506	20,599,488	10.215/0.949	0.313/1.027 *
CS_00219.las	17,606,836	32,763,726	5.780/0.537	0.416/1.364
CS_00219.las + others	68,143,320	32,363,120	22.669/2.106	0.210/0.689 *
CS_00220.las	24,119,279	40,816,806	6.361/0.591	0.397/1.301
CS_00220.las + others	77,487,061	40,885,200	20.398/1.895	0.221/0.726 *
CS_00221.las	12,712,856	24,234,638	5.651/0.525	0.421/1.381
CS_00221.las + CS_00245.las	19,312,015	24,289,056	8.557/0.795	0.342/1.121 *
CS_00222.las	16,744,518	30,055,062	5.995/0.557	0.408/1.340
CS_00222.las + others	60,610,576	30,113,616	21.668/2.013	0.215/0.705 *
CS_00223.las	14,191,818	24,893,244	6.135/0.570	0.404/1.324
CS_00223.las + others	62,994,250	24,945,504	27.179/2.525	0.192/0.629 *
CS_00224.las	18,829,114	30,318,000	6.684/0.621	0.387/1.269
CS_00224.las + others	82,089,934	30,376,160	29.084/2.702	0.185/0.608 *
CS_00225.las	13,522,178	25,353,692	5.737/0.533	0.417/1.369
CS_00225.las + others	72,505,854	25,409,856	30.709/2.853	0.180/0.592 *
CS_00226.las	16,908,754	29,499,025	6.168/0.573	0.403/1.321
CS_00226.las + others	78,622,327	29,550,784	28.643/2.661	0.187/0.613 *
CS_00227.las	18,756,452	34,958,755	5.780/0.537	0.416/1.365
CS_00227.las + others	84,169,005	33,314,720	27.190/2.526	0.192/0.629 *
CS_00228.las	29,409,738	46,755,634	6.770/0.629	0.384/1.261
CS_00228.las + others	101,187,526	46,836,688	23.250/2.160	0.207/0.680 *
CS_00229.las	4,897,928	8,060,278	6.544/0.608	0.391/1.283
CS_00229.las + others	98,661,759	33,954,704	31.280/2.906	0.179/0.587 *

C-4 Report on Nominal Pulse Spacing (NPS) - continued

File	Number of First Returns	Area	Point Density	NPS
CS_00230.las	51,926,439	85,416,029	6.544/0.608	0.391/1.283
CS_00230.las + others	188,001,218	85,575,952	23.648/2.197	0.206/0.675 *
CS_00231.las	70,278,530	130,004,905	5.823/0.541	0.415/1.360
CS_00231.las + others	217,272,337	130,229,968	17.954/1.668	0.236/0.774 *
CS_00232.las	78,977,176	298,081,329	2.852/0.265	0.592/1.943
CS_00232.las + CS_00233.las	158,253,349	280,822,064	6.071/0.564	0.406/1.332 *
CS_00234.las	365,009,866	1,335,417,372	2.939/0.273	0.583/1.913
CS_00234.las + others	718,576,926	1,018,282,000	7.599/0.706	0.363/1.190 *
CS_00235.las	613,224,403	2,369,345,566	2.788/0.259	0.599/1.966
CS_00235.las + others	1,257,791,839	2,116,156,656	6.394/0.594	0.395/1.297 *
CS_00236.las	108,616,531	387,293,692	3.014/0.280	0.575/1.888
CS_00236.las + others	277,623,214	377,673,088	7.911/0.735	0.355/1.166 *
CS_00237.las	852,373,024	2,696,192,736	3.401/0.316	0.542/1.779
CS_00237.las + others	1,496,068,963	2,675,520,224	6.017/0.559	0.408/1.337 *
CS_00238.las	790,793,512	2,692,525,822	3.165/0.294	0.562/1.845
CS_00238.las + others	1,540,877,523	2,669,390,848	6.211/0.577	0.401/1.316 *
CS_00239.las	100,679,356	340,636,779	3.186/0.296	0.561/1.839
CS_00239.las + others	271,642,747	339,491,184	8.611/0.800	0.341/1.118 *
CS_00240.las	111,560,257	375,537,624	3.197/0.297	0.559/1.835
CS_00240.las + others	301,949,964	374,444,560	8.676/0.806	0.340/1.114 *
CS_00241.las	812,721,147	2,619,653,999	3.337/0.310	0.547/1.795
CS_00241.las + others	1,351,883,439	2,524,612,768	5.759/0.535	0.417/1.367 *
CS_00242.las	662,151,616	2,455,182,719	2.906/0.270	0.587/1.926
CS_00242.las + others	1,140,453,203	2,286,423,952	5.371/0.499	0.432/1.416 *
CS_00243.las	436,805,068	1,576,658,499	2.982/0.277	0.579/1.900
CS_00243.las + others	661,225,684	1,328,575,136	5.360/0.498	0.432/1.417 *
CS_00246.las	561,874,947	1,944,379,647	3.111/0.289	0.567/1.860
CS_00246.las + others	1,276,129,479	1,879,184,224	7.309/0.679	0.370/1.213 *
CS_00247.las	115,823,766	363,776,602	3.423/0.318	0.540/1.772
CS_00247.las + others	312,978,034	360,553,840	9.343/0.868	0.327/1.073 *
CS_00249.las	132,133,424	466,130,280	3.046/0.283	0.572/1.878
CS_00249.las + others	512,952,782	461,092,848	11.969/1.112	0.289/0.948 *

C-4 Report on Nominal Pulse Spacing (NPS) - continued

File	Number of First Returns	Area	Point Density	NPS
CS_00251.las	156,384,614	518,138,570	3.251/0.302	0.555/1.820
CS_00251.las + others	853,903,297	514,666,016	17.857/1.659	0.237/0.776 *
CS_00252.las	101,687,699	310,901,544	3.520/0.327	0.533/1.749
CS_00252.las + others	570,037,975	310,343,408	19.773/1.837	0.225/0.738 *
CS_00253.las	162,582,830	513,333,946	3.412/0.317	0.542/1.777
CS_00253.las + others	849,495,010	495,086,512	18.471/1.716	0.233/0.763 *
CS_00254.las	182,237,069	604,534,062	3.240/0.301	0.555/1.821
CS_00254.las + others	446,919,707	600,811,456	8.008/0.744	0.353/1.159 *
CS_00255.las	150,370,844	512,527,898	3.154/0.293	0.563/1.846
CS_00255.las + others	847,722,144	510,278,880	17.879/1.661	0.237/0.776 *
CS_00256.las	769,677,734	2,369,771,127	3.498/0.325	0.535/1.755
CS_00256.las + others	1,387,028,735	2,355,308,352	6.340/0.589	0.397/1.303 *
CS_00257.las	698,627,536	2,368,582,625	3.175/0.295	0.561/1.841
CS_00257.las + others	1,178,995,818	2,346,412,176	5.403/0.502	0.430/1.411 *
CS_00261.las	76,225,218	328,745,103	2.497/0.232	0.633/2.077
CS_00261.las + others	384,200,581	829,030,688	4.984/0.463	0.448/1.469 *
CS_00262.las	26,914,731	177,806,364	1.625/0.151	0.783/2.570
CS_00262.las + others	314,318,249	633,788,752	5.339/0.496	0.433/1.420 *
CS_00263.las	4,429,981	12,478,691	3.821/0.355	0.511/1.678
CS_00263.las + others	221,250,983	428,288,672	5.565/0.517	0.424/1.391 *
CS_00264.las	87,478,254	288,970,022	3.261/0.303	0.554/1.818
CS_00264.las + others	156,129,591	283,532,128	5.931/0.551	0.411/1.348 *
CS_00265.las	58,887,206	198,693,397	3.186/0.296	0.560/1.837
CS_00265.las + others	118,215,857	192,821,168	6.598/0.613	0.389/1.277 *
CS_00266.las	36,647,915	119,037,358	3.315/0.308	0.549/1.802
CS_00266.las + others	69,914,280	114,849,520	6.555/0.609	0.391/1.282 *
CS_00267.las	6,534,632	20,742,125	3.391/0.315	0.543/1.782
CS_00267.las + others	11,744,641	19,193,280	6.588/0.612	0.390/1.278 *
CS_00268.las	119,728,644	386,303,007	3.337/0.310	0.547/1.796
CS_00268.las + others	310,914,455	385,896,448	8.676/0.806	0.340/1.114 *
CS_00269.las	216,724,369	729,661,136	3.197/0.297	0.559/1.835
CS_00269.las + others	641,909,923	721,390,400	9.580/0.890	0.323/1.060 *
CS_00270.las	89,112,646	290,883,477	3.294/0.306	0.551/1.807
CS_00270.las + others	199,861,601	286,904,560	7.502/0.697	0.365/1.198 *

C-4 Report on Nominal Pulse Spacing (NPS) - continued

File	Number of First Returns	Area	Point Density	NPS
CS_00271.las	120,281,631	405,805,995	3.186/0.296	0.560/1.837
CS_00271.las + others	515,489,694	396,215,072	14.004/1.301	0.267/0.877 *
CS_00273.las	58,429,847	193,850,452	3.240/0.301	0.555/1.821
CS_00273.las + others	128,353,903	176,121,856	7.847/0.729	0.357/1.171 *
CS_00275.las	131,751,607	407,298,288	3.477/0.323	0.536/1.758
CS_00275.las + others	270,831,695	407,184,960	7.158/0.665	0.374/1.226 *
CS_00276.las	112,779,625	371,096,632	3.272/0.304	0.553/1.814
CS_00276.las + others	247,792,690	370,579,088	7.201/0.669	0.373/1.223 *
CS_00277.las	139,535,658	425,451,608	3.531/0.328	0.532/1.746
CS_00277.las + others	294,343,941	425,047,568	7.449/0.692	0.366/1.202 *
CS_00278.las	84,352,778	295,624,991	3.068/0.285	0.571/1.872
CS_00278.las + others	193,666,422	287,241,776	7.255/0.674	0.371/1.218 *
CS_00279.las	34,124,852	120,830,988	3.035/0.282	0.574/1.882
CS_00279.las + others	72,534,960	98,566,864	7.922/0.736	0.355/1.166 *
CS_00280.las	93,233,223	278,710,563	3.606/0.335	0.527/1.729
CS_00280.las + others	205,416,508	278,249,136	7.944/0.738	0.355/1.164 *
CS_00281.las	85,471,106	275,629,301	3.337/0.310	0.547/1.796
CS_00281.las + others	183,676,963	275,666,368	7.169/0.666	0.373/1.225 *
CS_00282.las	137,613,414	447,244,300	3.315/0.308	0.550/1.803
CS_00282.las + others	262,259,401	446,883,360	6.318/0.587	0.398/1.305 *
CS_00283.las	88,865,064	267,787,862	3.574/0.332	0.529/1.736
CS_00283.las + others	164,402,748	267,638,896	6.609/0.614	0.389/1.276 *
CS_00285.las	19,091,551	71,037,149	2.895/0.269	0.588/1.929
CS_00285.las + others	46,272,420	61,947,120	8.041/0.747	0.353/1.157 *
CS_00286.las	32,658,878	95,773,406	3.670/0.341	0.522/1.712
CS_00286.las + others	71,795,746	95,718,448	8.073/0.750	0.352/1.155 *
CS_00007.las	3,937,880	4,752,907	8.923/0.829	0.335/1.099
CS_00177.las	470,630	308,666	16.415/1.525	0.247/0.810
CS_00180.las	755,124	377,859	21.506/1.998	0.215/0.707
CS_00184.las	31,213,584	41,111,510	8.170/0.759	0.350/1.148
CS_00186.las	32,725,812	41,035,466	8.590/0.798	0.341/1.120
CS_00188.las	68,673,302	82,575,384	8.956/0.832	0.334/1.097
CS_00191.las	359,373	211,313	18.309/1.701	0.234/0.767

C-4 Report on Nominal Pulse Spacing (NPS) - continued

File	Number of First Returns	Area	Point Density	NPS
Average			10.129/0.941	0.314/1.031
			<small>pp Square Meter/ pp Square US Survey Foot</small>	<small>Meter/ US Survey Feet</small>
1	8,375,682,222	16,412,045,868	5.490/0.510	0.427/1.400
2	6,275,086,690	12,968,022,681	5.210/0.484	0.438/1.438
Aggregate	14,650,768,912	29,380,068,549	5.371/0.499	0.432/1.416
			<small>pp Square Meter/ pp Square US Survey Foot</small>	<small>Meter/ US Survey Feet</small>

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