

C-2 Report on Multiple Discrete Returns

The USGS Lidar Base Specification Version 1.3 states: "Deriving and delivering multiple discrete returns is required in all conventional lidar data collection efforts. Data collection shall be capable of at least three returns per pulse. Full waveform collection is acceptable and is promoted; however, full waveform data are regarded as supplemental information."

The purpose of this section is to report on the presence and quantities of lidar returns in the LAS data. Empty return columns can indicate a collection or processing problem dealing with lidar return attribute information.

[Data Source - Z:\MARS_OC\2900112_Lot_8\Generated_Swath](#)

File	First return	Second return	Third return	Other returns	Total points
CS_00103.las	83,844,706	14,977,304	2,390,385	141,061	101,353,456
CS_00104.las	84,784,167	15,043,993	2,389,615	142,545	102,360,320
CS_00105.las	85,341,028	13,849,659	2,038,366	110,444	101,339,497
CS_00106.las	86,296,268	13,638,967	2,146,151	123,732	102,205,118
CS_00107.las	85,941,557	12,771,417	1,952,137	109,552	100,774,663
CS_00108.las	84,936,416	13,044,386	1,975,660	106,086	100,062,548
CS_00109.las	89,717,013	14,375,484	2,204,114	124,108	106,420,719
CS_00110.las	82,427,473	10,661,013	1,325,390	63,192	94,477,068
CS_00111.las	91,196,157	12,446,130	1,714,659	94,650	105,451,596
CS_00112.las	83,199,006	12,535,549	1,707,522	87,171	97,529,248
CS_00113.las	85,937,038	12,213,029	1,741,561	97,829	99,989,457
CS_00114.las	84,180,277	9,724,426	1,343,896	76,424	95,325,023
CS_00115.las	87,821,116	10,245,805	1,374,023	74,092	99,515,036
CS_00116.las	83,480,161	7,556,109	778,049	36,130	91,850,449
CS_00117.las	91,877,566	6,171,388	392,668	12,496	98,454,118
CS_00118.las	81,325,569	4,865,968	284,385	9,323	86,485,245
CS_00119.las	87,488,565	4,970,439	398,292	17,778	92,875,074
CS_00120.las	84,562,964	4,487,150	428,704	18,222	89,497,040
CS_00121.las	88,700,907	5,115,553	544,249	24,209	94,384,918
CS_00122.las	87,183,501	5,107,291	465,416	18,011	92,774,219
CS_00123.las	83,933,172	5,926,439	571,678	19,851	90,451,140
CS_00124.las	83,184,231	5,829,864	552,766	20,579	89,587,440
CS_00125.las	83,709,376	7,224,578	764,223	32,945	91,731,122
CS_00126.las	83,904,127	6,370,924	481,658	13,294	90,770,003
CS_00127.las	82,650,670	7,490,170	661,212	19,666	90,821,718
CS_00128.las	80,817,082	5,594,571	506,297	17,733	86,935,683
CS_00129.las	83,818,520	7,005,219	712,472	30,291	91,566,502

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<u>File</u>	<u>First return</u>	<u>Second return</u>	<u>Third return</u>	<u>Other returns</u>	<u>Total points</u>
CS_00130.las	78,500,852	7,607,343	615,893	18,307	86,742,395
CS_00131.las	84,937,687	8,335,687	635,263	17,337	93,925,974
CS_00132.las	85,178,747	7,216,311	583,611	19,609	92,998,278
CS_00133.las	85,576,916	8,144,520	604,230	17,001	94,342,667
CS_00134.las	77,127,926	7,759,416	594,945	17,294	85,499,581
CS_00135.las	76,731,537	5,121,291	351,089	10,216	82,214,133
CS_00136.las	88,291,466	6,996,568	483,825	10,846	95,782,705
CS_00137.las	79,134,455	9,643,217	751,661	13,471	89,542,804
CS_00138.las	88,923,855	11,179,468	932,733	22,610	101,058,666
CS_00139.las	81,915,773	10,415,227	1,103,597	45,596	93,480,193
CS_00140.las	87,337,938	13,677,247	1,788,221	91,730	102,895,136
CS_00141.las	80,754,653	13,512,202	1,825,634	97,695	96,190,184
CS_00142.las	87,456,781	16,205,526	2,064,741	102,920	105,829,968
CS_00143.las	80,762,861	15,048,368	2,154,334	120,854	98,086,417
CS_00144.las	89,431,079	15,738,087	2,270,977	124,043	107,564,186
CS_00145.las	80,156,758	15,354,954	2,233,583	127,324	97,872,619
CS_00146.las	90,029,582	17,454,853	2,509,259	156,199	110,149,893
CS_00147.las	78,160,766	15,908,532	2,261,178	136,681	96,467,157
CS_00148.las	76,618,172	15,335,437	2,385,819	162,302	94,501,730
CS_00149.las	88,473,360	19,035,538	2,839,207	171,948	110,520,053
CS_00150.las	78,033,268	17,933,371	2,561,258	135,412	98,663,309
CS_00151.las	52,707,404	12,489,751	1,686,037	82,377	66,965,569
CS_00152.las	18,380,633	3,288,566	318,320	9,205	21,996,724
CS_00153.las	23,843,662	4,857,284	441,359	9,635	29,151,940
CS_00154.las	23,444,283	4,710,699	455,559	11,917	28,622,458
CS_00155.las	22,860,541	4,463,447	439,099	12,568	27,775,655
CS_00156.las	23,837,323	4,077,627	366,453	11,172	28,292,575
CS_00157.las	21,911,475	3,399,099	328,343	12,267	25,651,184
CS_00158.las	22,387,466	2,673,429	279,247	11,613	25,351,755
CS_00159.las	23,358,519	3,180,394	382,131	18,242	26,939,286
CS_00160.las	23,515,242	2,720,771	293,661	14,210	26,543,884
CS_00161.las	21,794,045	2,832,174	266,751	9,913	24,902,883
CS_00162.las	23,492,102	4,186,247	493,924	24,224	28,196,497
CS_00163.las	21,733,286	3,731,819	402,688	14,599	25,882,392

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File	First return	Second return	Third return	Other returns	Total points
CS_00164.las	24,019,483	4,092,872	489,031	18,578	28,619,964
CS_00165.las	21,254,912	3,177,638	421,977	18,151	24,872,678
CS_00166.las	23,878,433	3,331,911	470,499	20,117	27,700,960
CS_00167.las	20,038,750	3,066,456	216,497	8,138	23,329,841
CS_00168.las	20,298,408	2,395,703	215,826	9,423	22,919,360
CS_00169.las	22,911,626	4,517,786	522,650	19,051	27,971,113
CS_00170.las	20,444,092	4,131,248	518,772	20,088	25,114,200
CS_00171.las	16,755,576	2,755,720	350,232	14,867	19,876,395
CS_00172.las	21,158,385	2,573,155	328,212	15,554	24,075,306
CS_00173.las	24,081,349	3,361,068	234,745	9,053	27,686,215
CS_00174.las	3,245,610	414,150	48,995	1,741	3,710,496
CS_00175.las	23,427,178	4,449,618	459,346	15,284	28,351,426
CS_00176.las	30,518,182	1,989,289	86,112	2,279	32,595,862
CS_00177.las	62,112,479	3,667,593	232,916	10,688	66,023,676
CS_00178.las	69,776,632	4,911,086	432,713	27,207	75,147,638
CS_00179.las	70,658,467	5,032,346	465,857	29,029	76,185,699
CS_00180.las	72,295,688	6,159,352	770,875	56,859	79,282,774
CS_00181.las	71,497,525	4,758,321	391,293	22,730	76,669,869
CS_00182.las	72,132,879	4,314,753	303,200	14,552	76,765,384
CS_00183.las	69,911,955	5,009,843	430,428	22,144	75,374,370
CS_00184.las	71,493,016	4,976,999	392,304	19,330	76,881,649
CS_00185.las	69,047,395	7,504,555	1,088,059	81,713	77,721,722
CS_00186.las	73,069,952	10,446,208	1,590,563	116,062	85,222,785
CS_00187.las	70,250,908	9,449,315	1,501,654	121,340	81,323,217
CS_00188.las	70,432,945	9,910,757	1,526,149	115,349	81,985,200
CS_00189.las	71,392,117	10,370,380	1,524,236	109,635	83,396,368
CS_00190.las	70,630,610	9,625,967	1,334,953	95,390	81,686,920
CS_00191.las	70,316,033	9,492,933	1,289,819	92,869	81,191,654
CS_00192.las	71,663,759	8,731,709	1,255,190	86,989	81,737,647
CS_00193.las	71,416,437	11,328,461	1,619,598	115,943	84,480,439
CS_00194.las	69,553,208	11,791,582	1,877,046	147,250	83,369,086
CS_00195.las	72,391,483	11,940,753	1,706,968	112,557	86,151,761
CS_00196.las	71,053,993	10,904,339	1,661,967	127,814	83,748,113
CS_00197.las	68,162,206	11,152,947	1,601,300	106,392	81,022,845

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<u>File</u>	<u>First return</u>	<u>Second return</u>	<u>Third return</u>	<u>Other returns</u>	<u>Total points</u>
CS_00198.las	72,445,212	11,452,422	1,882,620	155,798	85,936,052
CS_00199.las	75,577,106	13,317,569	2,191,204	179,487	91,265,366
CS_00200.las	76,444,232	12,068,058	1,998,371	170,872	90,681,533
CS_00201.las	69,556,016	10,239,280	1,486,319	105,550	81,387,165
CS_00202.las	74,171,851	13,346,280	2,309,365	195,379	90,022,875
CS_00203.las	73,175,443	12,079,627	2,093,891	183,670	87,532,631
CS_00204.las	69,292,786	9,976,463	1,347,151	89,138	80,705,538
CS_00205.las	75,200,203	11,585,183	1,910,742	165,044	88,861,172
CS_00206.las	68,424,708	9,954,915	1,486,030	98,172	79,963,825
CS_00207.las	69,577,625	11,067,697	1,590,418	106,812	82,342,552
CS_00208.las	75,350,791	11,133,256	1,774,533	147,990	88,406,570
CS_00209.las	90,570,411	10,953,463	1,475,456	77,261	103,076,591
CS_00210.las	90,504,899	9,001,506	1,101,185	53,425	100,661,015
CS_00211.las	84,746,018	10,174,339	1,390,552	79,286	96,390,195
CS_00212.las	86,519,455	9,599,032	1,164,350	56,383	97,339,220
CS_00213.las	88,686,780	10,601,438	1,446,782	86,516	100,821,516
CS_00214.las	84,829,054	9,030,206	1,187,063	61,652	95,107,975
CS_00215.las	83,686,991	11,457,241	1,531,172	78,659	96,754,063
CS_00216.las	83,387,770	13,186,118	1,842,148	96,181	98,512,217
CS_00217.las	87,520,885	11,717,431	1,556,093	88,440	100,882,849
CS_00218.las	86,700,907	14,636,843	2,342,660	144,770	103,825,180
CS_00219.las	85,417,196	12,793,843	1,767,453	101,696	100,080,188
CS_00220.las	448,871,073	43,308,280	3,615,522	111,839	495,906,714
CS_00221.las	304,261,250	27,761,395	2,136,139	95,170	334,253,954
CS_00222.las	53,918,324	5,035,639	431,681	14,296	59,399,940
CS_00223.las	299,848,550	29,349,904	2,575,589	125,414	331,899,457
CS_00224.las	440,363,064	56,659,870	3,805,576	92,629	500,921,139
CS_00225.las	294,479,363	23,629,154	1,820,272	82,709	320,011,498
CS_00226.las	293,857,926	17,331,070	1,305,061	54,608	312,548,665
CS_00227.las	326,758,024	28,810,199	2,186,247	61,019	357,815,489
CS_00228.las	334,349,794	42,696,128	2,912,589	69,940	380,028,451
CS_00229.las	294,665,805	26,686,612	2,093,775	94,359	323,540,551
CS_00230.las	294,881,245	19,546,645	1,398,559	57,575	315,884,024
CS_00231.las	297,754,702	22,464,404	1,694,089	77,572	321,990,767

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File	First return	Second return	Third return	Other returns	Total points
CS_00232.las	290,843,531	17,588,014	1,260,887	53,234	309,745,666
CS_00233.las	303,364,114	25,657,124	1,904,050	89,062	331,014,350
CS_00234.las	295,122,443	23,114,155	1,824,396	83,504	320,144,498
CS_00235.las	310,316,127	27,359,092	2,274,107	109,328	340,058,654
CS_00236.las	292,974,804	26,707,760	2,214,364	111,613	322,008,541
CS_00237.las	293,620,737	20,666,923	1,433,407	63,222	315,784,289
CS_00238.las	279,959,237	25,854,913	2,175,405	109,942	308,099,497
CS_00239.las	321,408,651	32,096,304	2,506,083	72,333	356,083,371
CS_00240.las	297,541,036	18,764,897	1,290,143	56,380	317,652,456
CS_00241.las	303,465,100	36,073,777	3,891,889	204,393	343,635,159
CS_00242.las	295,867,089	26,216,509	1,859,615	79,854	324,023,067
CS_00243.las	267,744,729	15,831,580	1,135,030	45,760	284,757,099
CS_00244.las	298,151,772	26,594,704	1,963,250	87,017	326,796,743
CS_00245.las	104,708,761	5,909,620	406,911	15,946	111,041,238
CS_00246.las	332,256,463	43,377,756	2,736,411	57,354	378,427,984
CS_00247.las	460,204,241	48,451,726	3,770,659	108,245	512,534,871
CS_00248.las	295,564,919	25,061,810	1,925,757	86,603	322,639,089
CS_00249.las	304,673,704	28,444,624	2,007,228	79,803	335,205,359
CS_00250.las	297,657,401	18,828,500	1,354,020	59,980	317,899,901
CS_00251.las	283,541,241	28,896,025	2,819,512	147,018	315,403,796
CS_00252.las	443,743,716	60,522,948	4,537,066	114,523	508,918,253
CS_00253.las	393,053,932	60,231,064	5,511,560	187,227	458,983,783
CS_00254.las	397,960,302	62,870,736	5,576,420	179,223	466,586,681
CS_00255.las	350,967,656	55,081,765	5,007,905	169,852	411,227,178
CS_00256.las	343,719,490	54,624,316	4,452,885	120,907	402,917,598
CS_00257.las	342,514,403	50,968,200	5,013,928	184,441	398,680,972
CS_00258.las	339,013,138	53,515,728	4,897,108	167,159	397,593,133
CS_00259.las	356,810,935	49,017,232	4,432,775	149,235	410,410,177
CS_00260.las	333,135,296	44,094,182	3,839,368	127,480	381,196,326
CS_00261.las	353,710,104	45,144,020	3,332,127	86,500	402,272,751
CS_00262.las	329,725,297	37,686,765	2,066,770	30,034	369,508,866
CS_00263.las	380,239,855	39,334,749	2,234,740	34,938	421,844,282
CS_00264.las	366,393,770	48,705,927	3,337,772	77,276	418,514,745
CS_00265.las	348,743,784	46,106,528	3,003,856	60,461	397,914,629

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<u>File</u>	<u>First return</u>	<u>Second return</u>	<u>Third return</u>	<u>Other returns</u>	<u>Total points</u>
CS_00266.las	337,521,454	39,223,049	2,601,170	54,535	379,400,208
CS_00267.las	362,201,242	45,779,325	2,666,368	45,319	410,692,254
CS_00268.las	360,820,576	45,228,953	2,692,593	46,906	408,789,028
CS_00269.las	356,448,426	41,027,052	2,452,817	48,941	399,977,236
CS_00270.las	287,309,963	36,166,900	3,001,481	125,497	326,603,841
CS_00271.las	293,520,607	35,016,821	2,651,990	103,620	331,293,038
CS_00272.las	274,402,015	35,634,529	2,923,611	118,760	313,078,915
CS_00273.las	259,950,907	33,153,626	2,743,266	105,917	295,953,716
CS_00274.las	269,397,994	33,439,178	2,477,117	86,947	305,401,236
CS_00275.las	242,740,629	32,259,851	2,963,007	128,910	278,092,397
CS_00276.las	221,389,539	30,354,309	3,157,976	152,934	255,054,758
CS_00277.las	195,809,716	26,602,867	2,845,277	131,379	225,389,239
CS_00278.las	55,077,901	11,357,130	1,816,583	117,459	68,369,073
CS_00279.las	138,313,662	17,682,468	1,848,354	63,331	157,907,815
CS_00280.las	162,164,314	20,558,425	2,223,343	75,325	185,021,407
CS_00281.las	140,512,340	20,881,949	2,444,152	86,613	163,925,054
CS_00282.las	162,266,544	28,312,143	3,339,555	115,447	194,033,689
CS_00283.las	142,392,351	27,254,832	3,239,058	113,399	172,999,640
CS_00284.las	162,944,046	31,330,399	3,664,591	128,584	198,067,620
CS_00285.las	142,187,340	24,190,254	2,679,251	94,934	169,151,779
CS_00286.las	159,671,420	26,820,069	2,852,118	98,767	189,442,374
CS_00287.las	139,689,056	24,160,785	2,560,273	85,271	166,495,385
CS_00288.las	150,441,997	26,303,252	2,682,696	86,179	179,514,124
CS_00289.las	139,115,532	25,045,976	2,588,159	81,323	166,830,990
CS_00290.las	149,617,997	28,600,313	3,322,540	115,258	181,656,108
CS_00291.las	137,101,990	27,130,445	3,376,747	122,932	167,732,114
CS_00292.las	150,303,997	29,792,182	3,968,188	155,621	184,219,988
CS_00293.las	106,527,357	22,746,100	3,193,803	127,061	132,594,321
CS_00294.las	349,303,136	27,383,366	1,912,682	48,544	378,647,728
CS_00295.las	15,902,382	3,474,880	385,105	9,215	19,771,582
CS_00296.las	383,155,810	32,372,940	2,236,836	50,120	417,815,706
CS_00297.las	182,646,580	19,105,060	1,678,139	50,871	203,480,650
CS_00298.las	228,311,199	19,249,034	1,259,242	38,490	248,857,965
CS_00299.las	380,988,849	39,660,658	2,907,848	76,429	423,633,784

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<u>File</u>	<u>First return</u>	<u>Second return</u>	<u>Third return</u>	<u>Other returns</u>	<u>Total points</u>
CS_00300.las	372,525,492	43,318,344	3,347,809	101,665	419,293,310
CS_00301.las	400,886,152	48,329,605	3,339,795	80,481	452,636,033
CS_00302.las	217,167,554	22,936,930	1,586,589	30,091	241,721,164
CS_00303.las	175,183,969	18,399,827	1,347,348	29,861	194,961,005
CS_00304.las	173,977,660	20,971,612	1,696,338	38,485	196,684,095
CS_00305.las	144,378,306	20,783,634	1,867,260	49,393	167,078,593
CS_00306.las	150,069,999	24,825,861	2,282,002	62,040	177,239,902
CS_00307.las	138,416,176	24,504,628	2,727,352	97,003	165,745,159
CS_00308.las	148,130,335	23,252,193	2,436,244	77,204	173,895,976
CS_00309.las	150,764,488	27,352,998	3,105,904	114,431	181,337,821
CS_00310.las	136,660,194	17,947,334	1,690,094	47,236	156,344,858
CS_00311.las	151,865,051	24,283,121	2,403,663	68,596	178,620,431
CS_00312.las	142,888,737	24,490,342	2,487,916	70,762	169,937,757
CS_00313.las	159,166,140	23,308,660	2,150,868	56,382	184,682,050
CS_00314.las	143,025,562	22,241,438	2,307,871	69,030	167,643,901
CS_00315.las	159,873,407	23,780,746	2,753,174	107,932	186,515,259
CS_00316.las	43,796,489	4,134,026	436,557	14,450	48,381,522
Total	32,813,788,533	3,979,426,010	385,080,941	16,381,955	37,194,677,439