

## 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\\_7\Generated\\_Swath](#)

File	First return	Second return	Third return	Other returns	Total points
CS_00001.las	153,396,074	9,068,721	394,968	12,296	162,872,059
CS_00002.las	183,760,290	16,919,401	1,369,930	74,249	202,123,870
CS_00004.las	119,094,102	10,338,220	479,194	13,265	129,924,781
CS_00005.las	187,739,071	17,655,177	1,433,699	71,231	206,899,178
CS_00006.las	156,174,141	9,457,509	403,589	13,233	166,048,472
CS_00008.las	110,187,467	6,972,315	317,931	5,510	117,483,223
CS_00009.las	206,927,013	19,489,144	1,621,640	69,622	228,107,419
CS_00010.las	92,572,571	4,985,966	192,513	2,523	97,753,573
CS_00011.las	199,459,039	17,748,763	1,365,515	62,089	218,635,406
CS_00012.las	160,290,607	8,605,861	341,491	10,963	169,248,922
CS_00013.las	120,083,557	9,831,279	501,028	15,382	130,431,246
CS_00014.las	110,475,690	10,231,128	545,320	16,717	121,268,855
CS_00015.las	129,915,998	11,799,895	532,634	14,482	142,263,009
CS_00016.las	158,578,377	11,181,964	499,366	16,736	170,276,443
CS_00017.las	111,663,867	5,543,153	189,095	2,543	117,398,658
CS_00018.las	147,417,394	9,941,670	399,963	12,247	157,771,274
CS_00019.las	147,743,542	11,640,877	379,875	9,236	159,773,530
CS_00020.las	119,166,975	10,186,284	448,418	11,008	129,812,685
CS_00021.las	164,455,536	12,024,190	638,504	26,805	177,145,035
CS_00022.las	121,979,349	9,450,126	451,240	14,425	131,895,140
CS_00024.las	46,997,645	2,047,737	85,866	1,173	49,132,421
CS_00025.las	147,470,303	13,347,079	484,602	12,241	161,314,225
CS_00026.las	159,530,709	12,023,875	622,827	27,526	172,204,937
CS_00027.las	177,755,160	14,710,355	1,070,772	56,335	193,592,622
CS_00028.las	212,599,691	22,961,726	2,199,786	102,897	237,864,100
CS_00030.las	139,016,785	12,939,076	534,700	13,336	152,503,897
CS_00031.las	208,154,020	21,126,949	1,917,764	91,738	231,290,471

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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_00032.las	224,213,965	26,914,951	2,872,920	135,546	254,137,382
CS_00103.las	229,028,041	12,546,645	803,150	24,056	242,401,892
CS_00104.las	239,686,132	13,372,800	999,707	36,574	254,095,213
CS_00105.las	229,835,562	13,158,285	993,621	34,138	244,021,606
CS_00106.las	227,689,821	14,703,255	1,125,182	39,394	243,557,652
CS_00107.las	237,932,031	18,708,131	1,676,693	62,432	258,379,287
CS_00108.las	221,305,095	15,414,288	1,242,374	46,185	238,007,942
CS_00109.las	258,095,633	21,460,644	2,096,365	83,439	281,736,081
CS_00110.las	237,825,063	21,303,031	2,090,519	81,668	261,300,281
CS_00111.las	250,955,258	24,049,433	2,337,809	94,720	277,437,220
CS_00112.las	239,733,226	22,202,190	1,968,096	73,065	263,976,577
CS_00113.las	254,406,995	24,519,654	2,113,739	82,921	281,123,309
CS_00114.las	257,153,750	25,420,656	2,067,469	81,184	284,723,059
CS_00115.las	265,246,891	24,882,257	1,975,891	73,666	292,178,705
CS_00116.las	254,041,821	23,264,900	1,913,634	71,890	279,292,245
CS_00117.las	263,813,819	23,987,718	1,768,031	61,034	289,630,602
CS_00118.las	255,309,839	20,368,706	1,055,307	23,584	276,757,436
CS_00119.las	263,303,609	17,605,405	640,701	7,405	281,557,120
CS_00120.las	255,706,796	17,859,831	680,128	7,895	274,254,650
CS_00121.las	263,426,973	18,283,780	698,706	9,161	282,418,620
CS_00122.las	257,833,830	19,800,400	852,720	15,133	278,502,083
CS_00123.las	252,506,955	17,265,463	819,429	17,205	270,609,052
CS_00124.las	260,171,550	20,625,685	952,610	18,552	281,768,397
CS_00125.las	261,586,276	14,796,179	637,090	13,092	277,032,637
CS_00126.las	256,376,347	15,913,685	766,727	16,064	273,072,823
CS_00127.las	259,317,747	16,333,875	850,974	17,775	276,520,371
CS_00128.las	262,762,853	16,412,027	999,114	27,141	280,201,135
CS_00129.las	248,920,208	16,545,227	1,109,017	35,097	266,609,549
CS_00130.las	259,226,184	17,592,932	1,127,472	32,601	277,979,189
CS_00131.las	253,615,783	16,775,957	975,183	23,807	271,390,730
CS_00132.las	261,071,485	21,779,473	1,395,530	41,428	284,287,916
CS_00133.las	259,488,017	18,395,874	1,191,188	36,804	279,111,883
CS_00134.las	242,424,200	19,889,745	1,617,449	73,382	264,004,776
CS_00135.las	240,939,367	25,820,392	1,947,803	57,948	268,765,510

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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_00136.las	274,492,808	31,381,963	2,452,180	75,489	308,402,440
CS_00137.las	249,034,100	30,383,464	2,371,657	69,086	281,858,307
CS_00138.las	279,205,639	37,911,359	3,176,599	99,007	320,392,604
CS_00139.las	257,090,960	38,366,828	3,380,330	99,617	298,937,735
CS_00140.las	267,369,779	43,558,413	4,225,807	132,400	315,286,399
CS_00141.las	256,280,107	40,523,867	4,206,896	137,601	301,148,471
CS_00142.las	268,189,092	41,921,179	4,476,587	154,384	314,741,242
CS_00143.las	258,651,270	39,794,354	4,196,589	140,332	302,782,545
CS_00144.las	271,572,155	41,736,275	4,411,476	153,598	317,873,504
CS_00145.las	256,180,965	37,165,183	3,827,330	124,375	297,297,853
CS_00146.las	273,496,033	42,508,451	4,784,226	177,963	320,966,673
CS_00147.las	241,457,750	36,526,494	4,227,122	162,389	282,373,755
CS_00148.las	245,406,977	38,130,701	3,824,607	129,946	287,492,231
CS_00149.las	274,747,731	44,404,550	4,336,503	149,437	323,638,221
CS_00150.las	249,520,253	35,773,140	3,169,392	99,957	288,562,742
CS_00151.las	274,340,712	39,774,052	3,428,706	105,836	317,649,306
CS_00152.las	250,975,658	36,526,195	3,144,243	96,982	290,743,078
CS_00153.las	247,573,788	35,931,168	2,867,487	70,134	286,442,577
CS_00154.las	257,231,816	38,067,276	2,946,605	61,063	298,306,760
CS_00155.las	245,307,237	37,268,452	3,255,089	79,897	285,910,675
CS_00156.las	257,099,409	39,992,795	3,555,099	87,540	300,734,843
CS_00157.las	244,590,128	39,816,392	3,585,353	91,034	288,082,907
CS_00158.las	243,060,958	40,879,755	3,781,008	106,463	287,828,184
CS_00159.las	254,828,307	43,882,039	4,106,964	107,452	302,924,762
CS_00160.las	255,793,713	44,274,086	4,211,045	129,960	304,408,804
CS_00161.las	243,928,575	46,178,742	4,605,797	147,452	294,860,566
CS_00162.las	254,408,397	51,601,676	5,556,513	195,639	311,762,225
CS_00163.las	235,831,033	48,293,105	5,222,164	169,252	289,515,554
CS_00164.las	255,149,817	53,415,217	5,648,615	178,437	314,392,086
CS_00165.las	237,761,768	48,044,039	5,126,178	174,436	291,106,421
CS_00166.las	253,778,653	50,342,721	5,342,302	187,806	309,651,482
CS_00167.las	217,264,698	51,216,747	6,554,628	247,590	275,283,663
CS_00168.las	224,314,037	50,835,730	5,970,908	220,007	281,340,682
CS_00169.las	241,306,342	65,157,182	8,253,899	308,913	315,026,336

## *C-2 Report on Multiple Discrete Returns - continued*

File	First return	Second return	Third return	Other returns	Total points
CS_00170.las	218,140,713	55,445,937	6,859,327	249,576	280,695,553
CS_00171.las	176,611,767	47,936,239	6,449,014	268,538	231,265,558
CS_00172.las	228,517,324	49,280,319	5,287,599	184,437	283,269,679
CS_00173.las	245,595,953	57,653,890	7,313,767	285,522	310,849,132
CS_00174.las	26,882,164	6,866,829	818,603	23,104	34,590,700
CS_00175.las	242,995,381	59,702,357	7,770,849	298,949	310,767,536
CS_00176.las	75,443,414	2,665,469	130,993	5,314	78,245,190
CS_00177.las	179,640,440	5,357,888	210,421	6,052	185,214,801
CS_00178.las	190,767,461	5,540,101	256,777	8,730	196,573,069
CS_00179.las	193,424,192	6,668,887	355,148	13,250	200,461,477
CS_00180.las	194,146,056	7,234,349	441,544	17,763	201,839,712
CS_00181.las	188,985,820	5,014,225	208,833	7,897	194,216,775
CS_00182.las	189,594,050	5,349,041	198,417	5,616	195,147,124
CS_00183.las	188,029,189	5,051,400	204,141	7,296	193,292,026
CS_00184.las	181,937,242	4,445,575	129,799	3,365	186,515,981
CS_00185.las	188,835,197	6,798,728	406,304	16,284	196,056,513
CS_00186.las	188,604,890	5,580,045	199,098	4,049	194,388,082
CS_00187.las	193,233,019	6,572,596	380,009	14,807	200,200,431
CS_00188.las	193,730,053	6,045,203	265,521	8,392	200,049,169
CS_00189.las	186,528,004	5,330,046	168,488	3,267	192,029,805
CS_00190.las	195,067,388	6,272,617	254,278	6,624	201,600,907
CS_00191.las	195,134,069	5,916,141	197,936	3,756	201,251,902
CS_00192.las	190,585,951	6,371,091	360,250	14,299	197,331,591
CS_00193.las	190,196,290	7,239,999	369,150	11,527	197,816,966
CS_00194.las	198,916,067	9,451,107	592,548	27,715	208,987,437
CS_00195.las	200,136,010	9,396,080	599,443	27,554	210,159,087
CS_00196.las	202,587,459	8,691,948	461,572	17,779	211,758,758
CS_00197.las	197,049,968	8,897,032	510,189	22,539	206,479,728
CS_00198.las	197,494,801	11,006,275	837,782	42,278	209,381,136
CS_00199.las	203,352,586	14,167,053	1,064,868	48,893	218,633,400
CS_00200.las	204,649,866	12,055,659	883,306	44,674	217,633,505
CS_00201.las	206,227,008	9,098,947	548,408	24,535	215,898,898
CS_00202.las	198,622,924	12,161,481	864,965	40,310	211,689,680
CS_00203.las	205,267,303	14,155,475	934,312	39,183	220,396,273

## *C-2 Report on Multiple Discrete Returns - continued*

<u>File</u>	<u>First return</u>	<u>Second return</u>	<u>Third return</u>	<u>Other returns</u>	<u>Total points</u>
CS_00204.las	200,256,536	8,673,070	539,418	24,307	209,493,331
CS_00205.las	201,317,971	10,082,198	791,152	44,841	212,236,162
CS_00206.las	202,313,364	9,177,067	632,273	31,319	212,154,023
CS_00207.las	199,002,522	8,202,054	506,564	25,533	207,736,673
CS_00208.las	206,001,560	10,291,782	757,902	36,284	217,087,528
CS_00209.las	240,861,856	14,885,872	884,554	22,285	256,654,567
CS_00210.las	240,793,805	12,709,434	668,514	17,731	254,189,484
CS_00211.las	231,885,493	11,358,938	713,957	25,133	243,983,521
CS_00212.las	229,448,311	10,435,259	546,383	16,752	240,446,705
CS_00213.las	245,504,145	11,346,742	673,644	26,428	257,550,959
CS_00214.las	229,043,652	12,462,775	740,891	22,408	242,269,726
CS_00215.las	215,975,496	14,971,821	1,061,053	28,749	232,037,119
CS_00216.las	227,784,913	13,938,073	1,177,931	40,960	242,941,877
CS_00217.las	222,007,043	14,664,904	1,115,912	32,714	237,820,573
CS_00218.las	241,906,432	12,991,421	858,467	26,634	255,782,954
CS_00219.las	222,758,647	14,207,138	1,186,137	39,690	238,191,612
Total	31,128,588,525	3,101,604,081	269,402,893	9,272,910	34,508,868,409