APPENDIX I — PICTOMETRY ACCURACY ANALYSES

Three different Pictometry datasets were evaluated by Dewberry.

1. 2-view Pictometry of 29 houses in Prince George's County, MD based on a USGS digital elevation model (DEM) produced from 10 ft contours. When Pictometry initially used the USGS DEM, they were unaware that a more-accurate LIDAR dataset was available.
2. 2-view Pictometry of the same 29 houses in Prince George's County, MD based on a LIDAR dataset approximately equivalent to 2 ft contours
3. 4-view Pictometry of 27 houses in Arlington County, VA based on surveyed spot heights at corner adjacent grades

The first spreadsheet, attached, is for the Pictometry top of bottom floor elevations based on a standard USGS DEM of Prince George's County. Dewberry's accuracy analysis indicated the average vertical error in top of bottom floor elevations to be 2.61 ft and the overall top of bottom floor vertical accuracy to be 6.34 ft at the 95% confidence level. Dewberry considered this to be unacceptable for the intended purpose and obtained permission to utilize the county's LIDAR dataset that had previously been tested as comparable to 2 ft contours.

The second spreadsheet, attached, indicates the results when using the LIDAR dataset of Prince George's County. Dewberry's accuracy analysis indicated the average vertical error in top of bottom floor elevations to be 2.53 ft and the overall top of bottom floor vertical accuracy to be 4.66 ft at the 95% confidence level. Dewberry again considered this to be unacceptable for the intended purpose. At this point, Dewberry was unable to determine which of the following potential error sources caused the elevations to be larger than expected: (a) errors in the LIDAR, (b) errors caused by only having 2-view Pictometry imagery instead of 4-view images to see buildings from all sides, or (c) errors caused by limitations in being able to correctly interpret and measure features with Pictometry images.

For the third test, Dewberry provided Pictometry with accurately surveyed spot heights around 27 houses in Arlington County, VA where Pictometry had 4-view imagery available. This would enable the source of the error to be isolated. The third spreadsheet, attached, indicates the results of this accuracy analysis in Arlington County. The average vertical error in top of bottom floor elevations in Arlington County, VA was 1.59 ft and the overall vertical accuracy was 5.01 ft at the 95% confidence level. Dewberry again considered this to be unacceptable for the intended purpose, isolating the problem as the inability to accurately determine the presence or absence of basements and to interpret the imagery to determine the correct reference level for top of bottom floor elevations. In Pictometry's defense, Dewberry recognizes that these errors were on the high side partly because these houses were complex split levels on hillsides, and the

houses were surrounded by tall trees that blocked many of the aerial oblique views. Of the 27 houses, eight had misidentified the basement or split level to be surveyed for the top of bottom floor, the principal cause for the high error statistic. Pictometry may provide substantially improved results in locations where basements are not an issue.

Pictometry does not measure elevations directly, but indirectly relative to digital elevation data from other sources. Dewberry concluded that Pictometry is most relevant to FEMA in providing an aerial oblique view to (1) see what houses look like from all sides, and (2) see if there has been new or illegal construction compared with earlier images.

The Pictometry software includes a change analysis module that compares changes in land use over time, by leveraging existing and new Pictometry images. The change analysis tool permits users to visually inspect new developments, structural changes, and other types of improvements.

The tool takes new images and matches them to current and historical Pictometry imagery. Pictometry's Equalized Imaging Software process allows users to horizontally divide the display, in order to visually display in one Window the old image and in the second Window the updated image of the same area. As the user pans or zooms in one image, these actions are automatically replicated in the second image, providing a quick method for making "before" and "after" comparisons. The user has the full measurement capabilities to calculate the square footage of additions or other improvements to the structure.

In addition to this change analysis capability, a future version of Pictometry software will use automated change detection to make the initial determination of the areas of suspected change.

APPENDIX I — PICTOMETRY ACCURACY ANALYSES (PRINCE GEORGE'S COUNTY, MD)

Address	Elevation Certificates (ft)			Pictometry (ft)			Pictometry - EC (ft)		
	LAG	HAG	TBF	LAG	HAG	TBF	Δ LAG	Δ HAG	Δ TBF
5117 College Avenue	43.99	44.28	44.36	45.25	45.79	42.42	1.26	1.51	-1.94
4216 Guilford Drive	90.72	92.62	87.02	94.83	95.04	84.50	4.11	2.42	-2.52
4220 Guilford Drive	90.06	91.16	85.66	93.33	94.08	86.00	3.27	2.92	0.34
4300 Hartwick Road	89.39	91.69	85.39	91.02	92.18	82.50	1.63	0.49	-2.89
4301 Hartwick Road	87.20	88.20	82.50	87.85	88.68	80.75	0.65	0.48	-1.75
4301 Hartwick Road	87.20	88.20	82.50	87.85	88.68	80.75	0.65	0.48	-1.75
4227 Guilford Drive	90.96	92.46	86.56	95.35	97.81	84.42	4.39	5.35	-2.14
4306 Guilford Drive	85.42	86.12	81.02	85.93	86.49	79.17	0.51	0.37	-1.85
4611 Calvert Road	60.95	61.95	54.65	60.16	60.37	51.83	-0.79	-1.58	-2.82
4701 Calvert Road	58.05	58.75	53.45	59.69	59.95	51.17	1.64	1.20	-2.28
7200 Baltimore Ave. #4	82.23	82.33	82.53	82.05	83.88	80.42	-0.18	1.55	-2.11
4605 Calvert Road	64.75	65.65	61.45	61.55	62.13	58.50	-3.20	-3.52	-2.95
4801 Calvert Road	56.83	57.53	54.33	58.95	59.08	53.50	2.12	1.55	-0.83
4809 Calvert Road	55.64	56.64	52.84	58.53	58.80	49.42	2.89	2.16	-3.42
4811 Calvert Road	55.38	57.18	52.48	58.29	58.61	49.00	2.91	1.43	-3.48
4813 Calvert Road	54.15	55.35	55.45	57.95	58.34	54.75	3.80	2.99	-0.70
4710 Harvard Road	58.77	59.87	53.97	58.98	59.00	50.25	0.21	-0.87	-3.72
4502 Guilford Road	71.95	72.25	67.35	70.92	72.92	65.50	-1.03	0.67	-1.85
7209 Dartmouth Avenue	57.50	58.20	52.10	58.84	59.00	49.25	1.34	0.80	-2.85
5200 Paint Branch Parkway	44.85	46.56	46.75	43.54	44.41	43.58	-1.31	-2.15	-3.17
4707 Harvard Road	60.47	61.37	56.77	59.60	60.18	54.50	-0.87	-1.19	-2.27
4608 Guilford Road	63.26	63.66	59.16	63.90	64.94	62.92	0.64	1.28	3.76
7206 Dartmouth Avenue	60.11	60.11	53.51	59.40	59.96	51.50	-0.71	-0.15	-2.01
4609 Guilford Road	64.33	64.53	60.03	66.11	66.36	64.08	1.78	1.83	4.05
7204 Bowdoin Avenue	61.34	63.74	56.54	60.05	60.38	62.17	-1.29	-3.36	5.63
7013 Wake Forest Drive	68.15	70.05	64.25	68.70	69.17	62.83	0.55	-0.88	-1.42
4607 Guilford Road	65.29	65.49	60.39	66.87	66.96	59.08	1.58	1.47	-1.31
4506 Fordham Lane	70.73	77.73	72.23	71.36	73.70	67.17	0.63	-4.03	-5.06
4806 Guilford Road	59.44	60.24	55.64	60.38	60.72	53.08	0.94	0.48	-2.56
Average Error (ft)							**1.62**	**1.70**	**2.53**
Maximum Error (ft)							**4.39**	**5.35**	**5.63**
Minimum Error (ft)							**-3.20**	**-4.03**	**-5.06**
Count of houses							**29**	**29**	**29**
95th Percentile Error (ft)							**3.99**	**3.83**	**4.66**

APPENDIX I — PICTOMETRY ACCURACY ANALYSIS (PRINCE GEORGE'S COUNTY, MD) w/USGS DEM

Used USGS 10-meter DEM from which to measure Pictometry vertical offset measurements

Surveyed Address	Elevation Certificates			Pictometry			Pictometry - EC		
	LAG	HAG	TBF	LAG	HAG	TBF	LAG	HAG	TBF
7200 Baltimore Ave. #4	82.23	82.33	82.53	82	84		-0.23	1.67	
4609 Guilford Road	64.33	64.53	60.03	66	66		1.67	1.47	
4608 Guilford Road	63.26	63.66	59.16	64	64		0.74	0.34	
4506 Fordham Lane	70.73	77.73	72.23	73	75	74	2.27	-2.73	1.77
4502 Guilford Road	71.95	72.25	67.35	71	72	68	-0.95	-0.25	0.65
7013 Wake Forest Drive	68.15	70.05	64.25	68	69	62	-0.15	-1.05	-2.25
4607 Guilford Road	65.29	65.49	60.39	67	67	67	1.71	1.51	6.61
4605 Calvert Road	64.75	65.65	61.45	62	62	58	-2.75	-3.65	-3.45
4701 Calvert Road	58.05	58.75	53.45	60	60	55	1.95	1.25	1.55
4710 Harvard Road	58.77	59.87	53.97	59	59	54	0.23	-0.87	0.03
4707 Harvard Road	60.47	61.37	56.77	60	61	54	-0.47	-0.37	-2.77
7206 Dartmouth Avenue	60.11	60.11	53.51	59	60	52	-1.11	-0.11	-1.51
4806 Guilford Road	59.44	60.24	55.64	60	61	56	0.56	0.76	0.36
7204 Bowdoin Avenue	61.34	63.74	56.54	60	60	51	-1.34	-3.74	-5.54
7209 Dartmouth Avenue	57.50	58.20	52.10	59	59	54	1.50	0.80	1.90
4801 Calvert Road	56.83	57.53	54.33	59	59	58	2.17	1.47	3.67
4809 Calvert Road	55.64	56.64	52.84	59	59	51	3.36	2.36	-1.84
4811 Calvert Road	55.38	57.18	52.48	58	59	53	2.62	1.82	0.52
4813 Calvert Road	54.15	55.35	55.45	58	58	50	3.85	2.65	-5.45
5117 College Avenue	43.99	44.28	44.36	45	46	45	1.01	1.72	0.64
5200 Paint Branch Parkway	44.85	46.56	46.75	43	44	36	-1.85	-2.56	-10.75
4216 Guilford Drive	90.72	92.62	87.02	95	95	91	4.28	2.38	3.98
4220 Guilford Drive	90.06	91.16	85.66	93	94	88	2.94	2.84	2.34
4300 Hartwick Road	89.39	91.69	85.39	91	92	85	1.61	0.31	-0.39
4227 Guilford Drive	90.96	92.46	86.56	95	96	90	4.04	3.54	3.44
4301 Hartwick Road	87.20	88.20	82.50	87	88	81	-0.20	-0.20	-1.50
4301 Hartwick Road	87.20	88.20	82.50	88	88	82	0.80	-0.20	-0.50
4306 Guilford Drive	85.42	86.12	81.02	86	86	80	0.58	-0.12	-1.02
4611 Calvert Road	60.95	61.95	54.65	60	60	58	-0.95	-1.95	3.35

						Count	29	29	26
						Maximum	4.28	3.54	6.61
						Minimum	-2.75	-3.74	-10.75
						Average	0.96	0.31	-0.24
						Average (absolute)	1.65	1.54	2.61
						95th Percentile	3.96	3.61	6.34
						90th Percentile	3.46	2.98	5.50
						85th Percentile	2.90	2.71	4.35

For three houses, Pictometry analyst
did not even attempt to determine TBF
elevations because of uncertainty of existence
or absence of basements or split-levels.

APPENDIX I — PICTOMETRY ACCURACY ANALYSES (ARLINGTON COUNTY, VA)

Used surveyed spot heights to photogrammetrically measure offset elevations
TBF = Top of Bottom Floor

Street Address	TBF per Pictometry	TBF per GPS Svy	Ft. Δ	Ft. Δ abs	Comments
3620 North Piedmont Street	223.54	224.58	-1.04	1.04	Walk-out
3625 North Piedmont Street	210.60	210.19	0.41	0.41	Walk-out
3631 North Piedmont Street	207.70	207.40	0.30	0.30	Walk-out
3636 North Piedmont Street	219.41	219.51	-0.10	0.10	Walk-out
3637 North Piedmont Street	202.60	202.49	0.11	0.11	vents
3642 North Piedmont Street	210.60	210.20	0.40	0.40	Walk-out
3643 North Piedmont Street	204.60	204.42	0.18	0.18	Walk-out
3540 36th Road North	169.10	171.41	-2.31	2.31	Split-level, walk-out
3544 36th Road North	163.30	169.15	-5.85	5.85	Walk-out
3550 36th Road North	163.20	159.93	3.27	3.27	Split-level, walk-out
3556 36th Road North	156.30	161.96	-5.66	5.66	Vents
3600 36th Road North	160.20	161.25	-1.05	1.05	Split-level, walk-out
3608 36th Road North	162.90	166.10	-3.20	3.20	Split-level, walk-out
3616 36th Road North	170.27	170.61	-0.34	0.34	Walk-out
3624 36th Road North	172.39	173.03	-0.64	0.64	Walk-out
3632 36th Road North	165.20	165.86	-0.66	0.66	Walk-out
3701 36th Road North	157.20	157.66	-0.46	0.46	Split-level, no basement
3709 36th Road North	164.00	162.87	1.13	1.13	Split-level, no basement
3801 36th Road North	171.50	168.02	3.48	3.48	Walk-out
3807 36th Road North	166.40	166.48	-0.08	0.08	Walk-out
3813 36th Road North	168.00	169.29	-1.29	1.29	Split-level, no basement
3819 36th Road North	171.00	172.65	-1.65	1.65	Walk-out
3825 36th Road North	171.00	173.29	-2.29	2.29	Split-level, no basement
3831 36th Road North	168.80	170.73	-1.93	1.93	Split-level, walk-out
3837 36th Road North	167.50	168.51	-1.01	1.01	Split-level, walk-out
3648 N. Oakland Street	155.80	157.30	-1.50	1.50	Split-level, no basement
3681 N. Nelson Street	159.10	161.67	-2.57	2.57	Split-level, walk-out
			1.59 Ft.	**5.01 Ft.**	
			TBF Average Error	**TBF 95th percentile Error**	

In this example, TBF accuracy equals that of random points interpolated between 7.3' contours, even though average error = 1.59 ft. This test area was especially difficult because of steep terrain, complex split-level homes, and trees blocking visibility from the air.