Accuracy Analysis of Commercial Off The Shelf (COTS) imagery

William Fernandez

FDOT Photogrammetry Supervisor

William.fernandez@dot.state.fl.us

850.245.1707

Introduction

- For this presentation, readily available imagery will be utilized. The imagery is geometrically corrected for uniformity in scale (orthorectified).

Commercial Off The Shelf (COTS) Imagery

Google Earth Imagery, Flash Earth (imagery from BING Maps) and orthophotography from the Florida Department of Transportation will be the focus of a horizontal accuracy analysis. All imagery is freely available to the public through the following websites.

Google Earth - http://www.google.com/earth/index.html

Download and Install free version

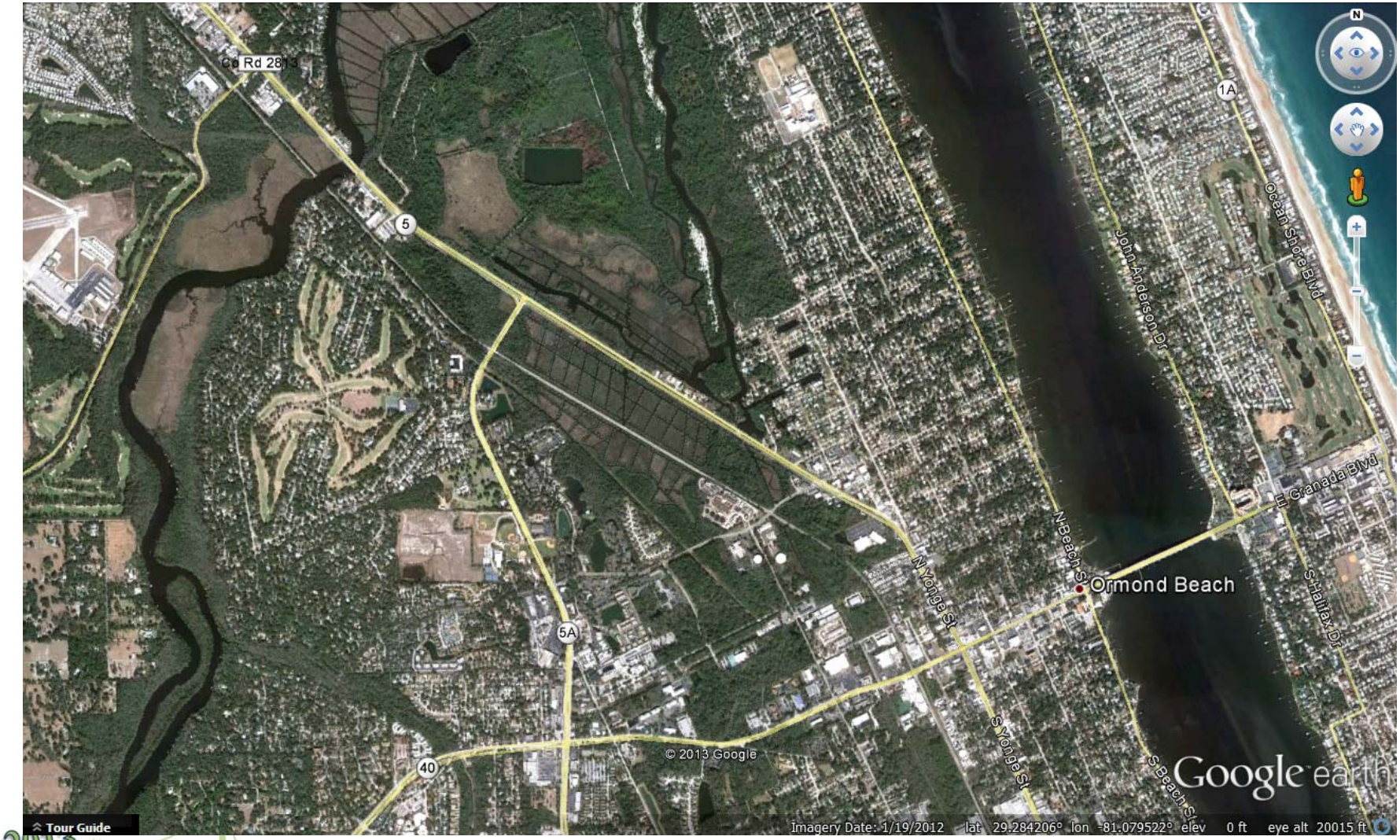
Flash Earth - http://www.flashearth.com/

Explore directly from the website

FDOT - http://www.dot.state.fl.us/surveyingandmapping/aerial_get.shtm

Image requests will allow for direct downloads. Large data sets on FTP.

Google Earth



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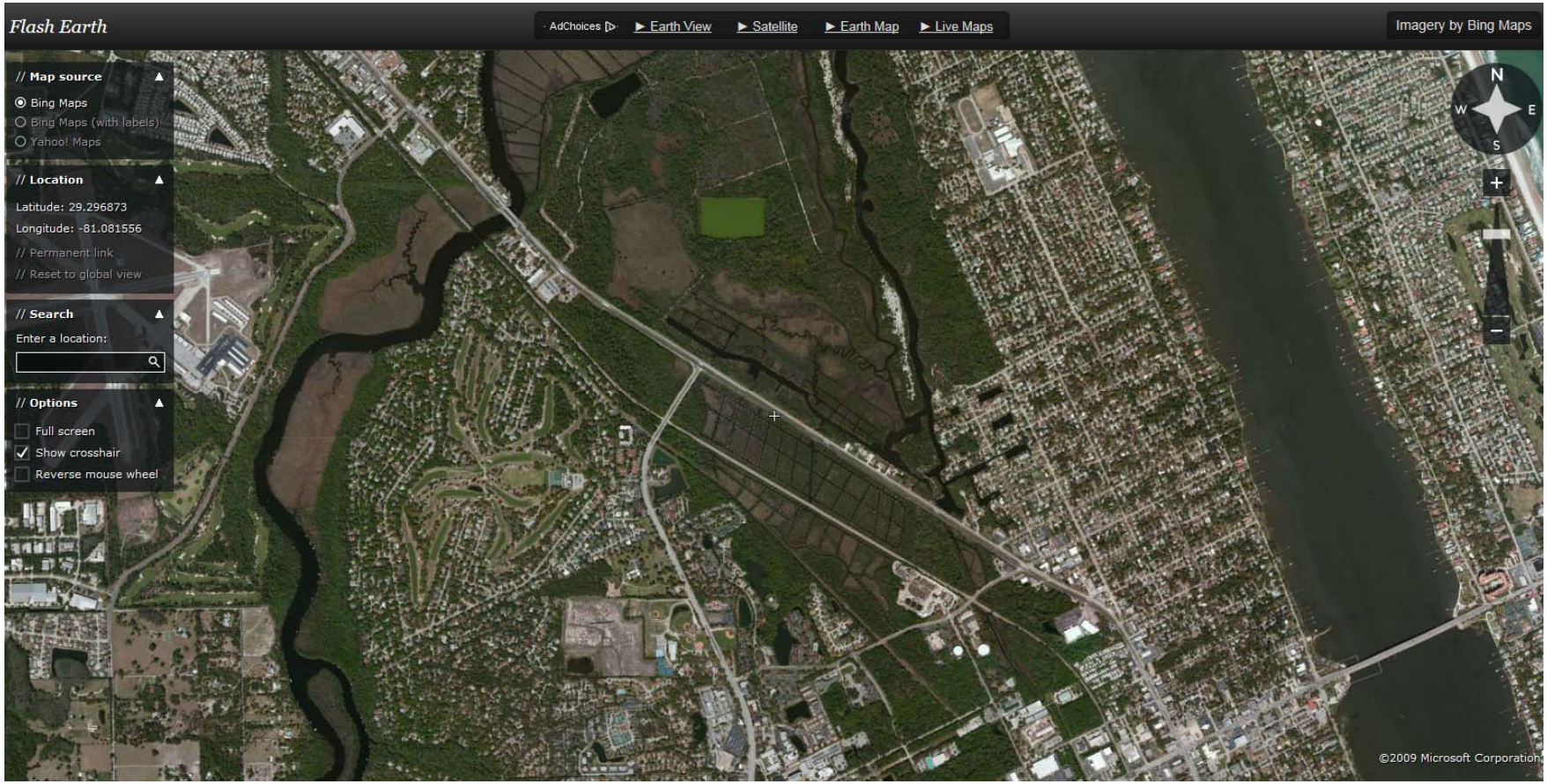
Flash Earth - (images from BING maps)



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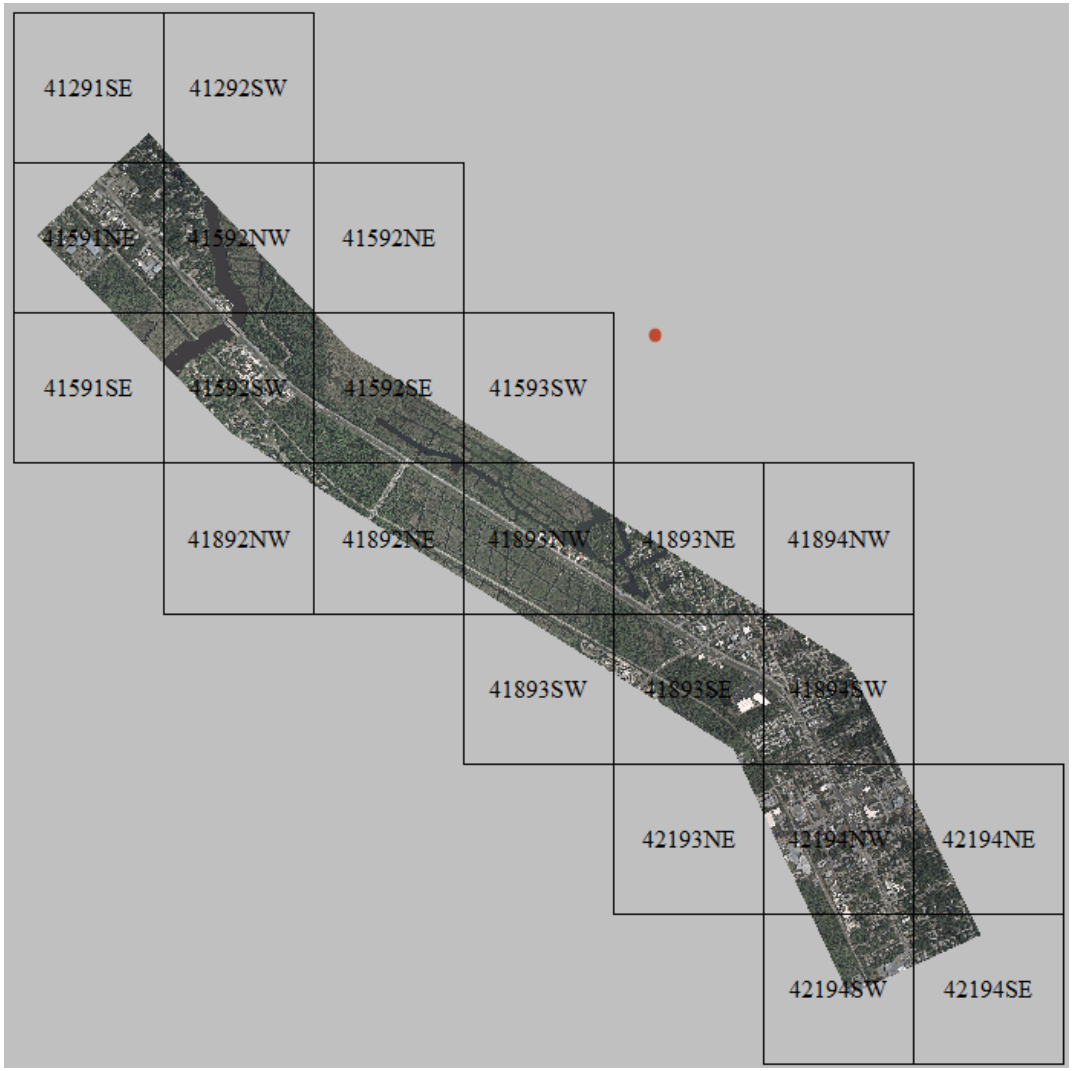
FDOT - (Aerial Mapping Program)



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NSSDA - National Standard for Spatial Data Accuracy

For this presentation the horizontal positional accuracy will be tested by comparing image points to survey ground control.

The NSSDA was developed with the intent to update the United States Map Accuracy Standards.

The Geospatial data community is inclusive of producers with different product specifications and data users with different application requirements.

Therefore, the NSSDA serves a purpose of a common reporting mechanism for users to directly compare datasets for their applications.

NSSDA – *How is it utilized*

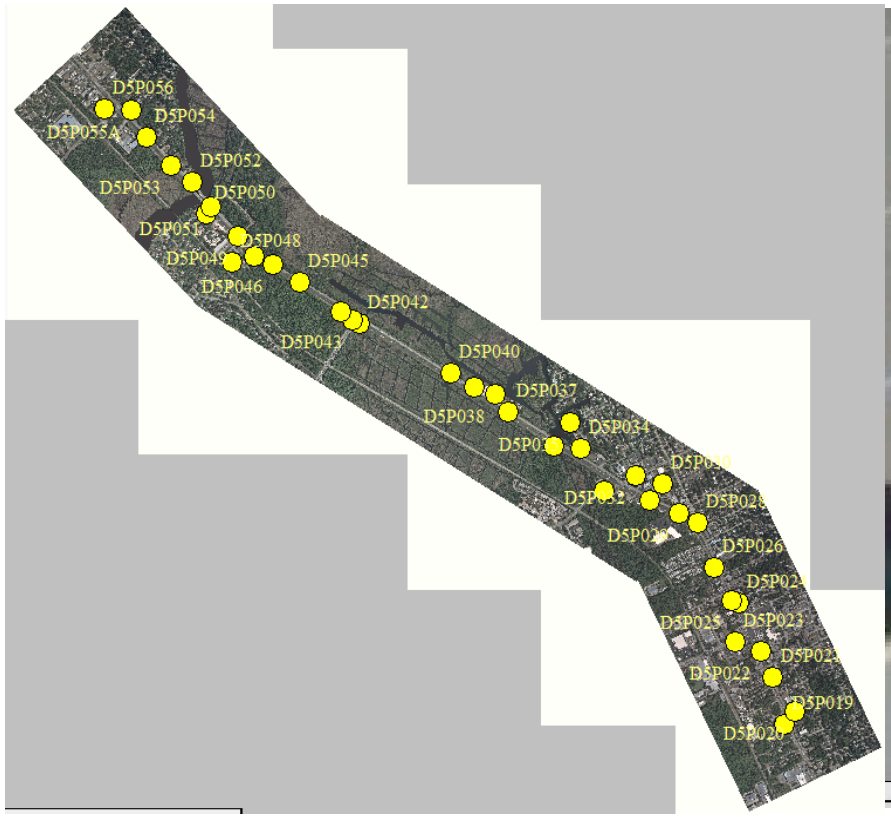
The NSSDA uses RMSE (root-mean-square-error) to estimate positional accuracy.

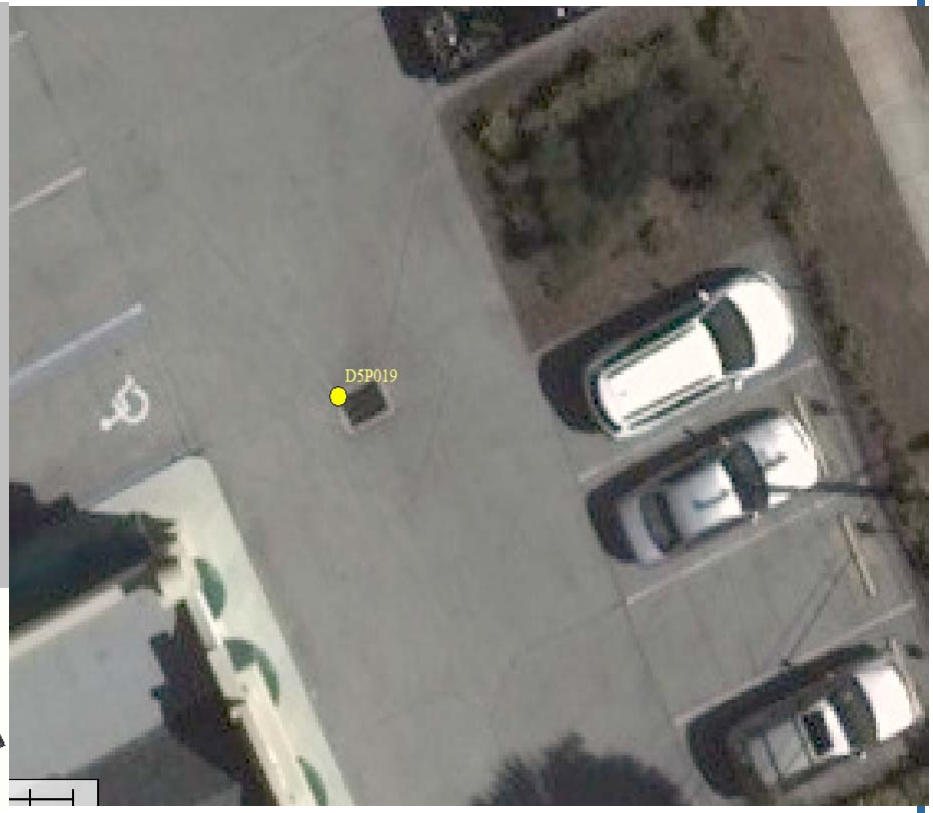
The accuracy is reported in ground distances at the 95% confidence level. This means that 95% of the positions in the dataset will have an error with respect to true ground position that is equal to or smaller than the reported accuracy value.

The reported accuracy value may reflect anomalies inherent in the 3D surface, blunders in the aerial triangulation solution or unreliable ground control utilized in the process.

Aerial Triangulation Ground Control

Survey Control Check Points





FDOT_SR5_NSSDA_Horizontal

Horizontal Accuracy Comparison of horizontal coordinates for Photo ID points in: xxxxxxxx project location xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

FDOT Photographic Designation (PD) Number = 0000 xxxxxxx date xxxxxx

Coordinate DATUM xxxx NAD83 / 86/90/99/2007/ CORS / etc.xxxx

Coordinate Units = xxxxxx US feet or meters xxxx

NSSDA Horizontal Accuracy Statistic Worksheet **Ground Sample Distance (GSD) of Imagery = .5 feet**

Point Name	Point Description	X Ground Check (Independent)	X Ortho Imagery (Test)	Δ x	(Δ x)²	Y Ground Check (Independent)	Y Ortho Imagery (Test)	Δ y	(Δ y)²	(Δ x)² + (Δ y)²
D5P019	Photo ID	637029.520	637029.497	0.023	0.001	1797524.748	1797524.579	0.169	0.029	0.029
D5P020	Photo ID	637213.030	637213.149	-0.119	0.014	1797769.260	1797769.438	-0.178	0.032	0.046
D5P021	Photo ID	636804.860	636804.916	-0.056	0.003	1798385.053	1798385.008	0.045	0.002	0.005
D5P022	Photo ID	636591.000	636590.957	0.043	0.002	1798875.574	1798875.475	0.099	0.010	0.012
D5P023	Photo ID	636109.020	636109.046	-0.026	0.001	1799040.545	1799040.380	0.165	0.027	0.028
D5P024	Photo ID	636160.720	636160.902	-0.182	0.033	1799761.100	1799761.005	0.095	0.009	0.042
D5P025	Photo ID	636040.620	636040.673	-0.053	0.003	1799810.789	1799810.730	0.059	0.003	0.006
D5P026	Photo ID	635716.950	635716.966	-0.016	0.000	1800427.156	1800427.339	-0.183	0.033	0.034
D5P028	Photo ID	635405.640	635405.652	-0.012	0.000	1801236.823	1801236.870	-0.047	0.002	0.002
D5P029	Photo ID	635057.060	635057.182	-0.122	0.015	1801409.798	1801409.559	0.239	0.057	0.072
D5P030	Photo ID	634763.294	634763.121	0.173	0.030	1801956.539	1801956.441	0.098	0.010	0.040
D5P031	Photo ID	634515.154	634515.104	0.050	0.002	1801666.844	1801666.873	-0.029	0.001	0.003
D5P032	Photo ID	634254.408	634254.319	0.089	0.008	1802121.729	1802121.745	-0.016	0.000	0.008
D5P033	Photo ID	633674.560	633674.525	0.035	0.001	1801841.043	1801840.876	0.167	0.028	0.029
D5P034	Photo ID	633224.604	633224.546	0.058	0.003	1802623.804	1802623.744	0.060	0.004	0.007
D5P035	Photo ID	633027.973	633028.115	-0.142	0.020	1803086.872	1803086.846	0.026	0.001	0.021
D5P036	Photo ID	632734.549	632734.567	-0.018	0.000	1802656.657	1802656.490	0.167	0.028	0.028
D5P037	Photo ID	631874.006	631873.735	0.271	0.073	1803283.112	1803282.967	0.145	0.021	0.094
D5P038	Photo ID	631643.130	631643.037	0.093	0.009	1803613.026	1803612.927	0.099	0.010	0.018
D5P039	Photo ID	631260.432	631260.406	0.026	0.001	1803756.640	1803756.942	-0.302	0.091	0.092
D5P040	Photo ID	630817.048	630817.250	-0.202	0.041	1804013.768	1804013.607	0.161	0.026	0.067
D5P042	Photo ID	629117.314	629117.351	-0.037	0.001	1804915.562	1804915.566	-0.004	0.000	0.001
D5P043	Photo ID	628984.668	628984.834	-0.166	0.028	1804991.571	1804991.465	0.106	0.011	0.039
D5P044	Photo ID	628773.040	628773.019	0.021	0.000	1805138.253	1805138.198	0.055	0.003	0.003
D5P045	Photo ID	628010.362	628010.077	0.285	0.081	1805692.452	1805692.410	0.042	0.002	0.083
D5P046	Photo ID	627503.700	627503.674	0.026	0.001	1806006.144	1806006.150	-0.006	0.000	0.001
D5P047	Photo ID	627159.267	627159.175	0.092	0.008	1806161.991	1806162.039	-0.048	0.002	0.011
D5P048	Photo ID	626748.988	626748.791	0.197	0.039	1806048.088	1806048.120	-0.032	0.001	0.040
D5P049	Photo ID	626845.906	626845.831	0.075	0.006	1806536.241	1806536.425	-0.184	0.034	0.039
D5P050	Photo ID	626269.812	626269.564	0.248	0.062	1806940.672	1806940.563	0.109	0.012	0.073
D5P051	Photo ID	626342.751	626342.852	-0.101	0.010	1807075.453	1807075.698	-0.245	0.060	0.070
D5P052	Photo ID	625998.076	625998.265	-0.189	0.036	1807537.298	1807537.474	-0.176	0.031	0.067
D5P053	Photo ID	625621.333	625621.405	-0.072	0.005	1807850.834	1807851.134	-0.300	0.090	0.095
D5P054	Photo ID	625147.153	625147.012	0.141	0.020	1808370.464	1808370.489	-0.025	0.001	0.021
D5P055	Photo ID	624871.788	624871.955	-0.167	0.028	1808864.971	1808865.070	-0.099	0.010	0.038
D5P056	Photo ID	624374.744	624374.919	-0.175	0.031	1808887.995	1808888.137	-0.142	0.020	0.051

Total Check Points =	36	Sum	1.316
		Average	0.037
Project RMSE Requirement ≤ x.xx feet	⇨	RMSE	0.191
Horizontal Positional Accuracy in feet at 95% Confidence Level. Project requirement is ≤ x.xx feet	⇨	NSSDA	**0.331**

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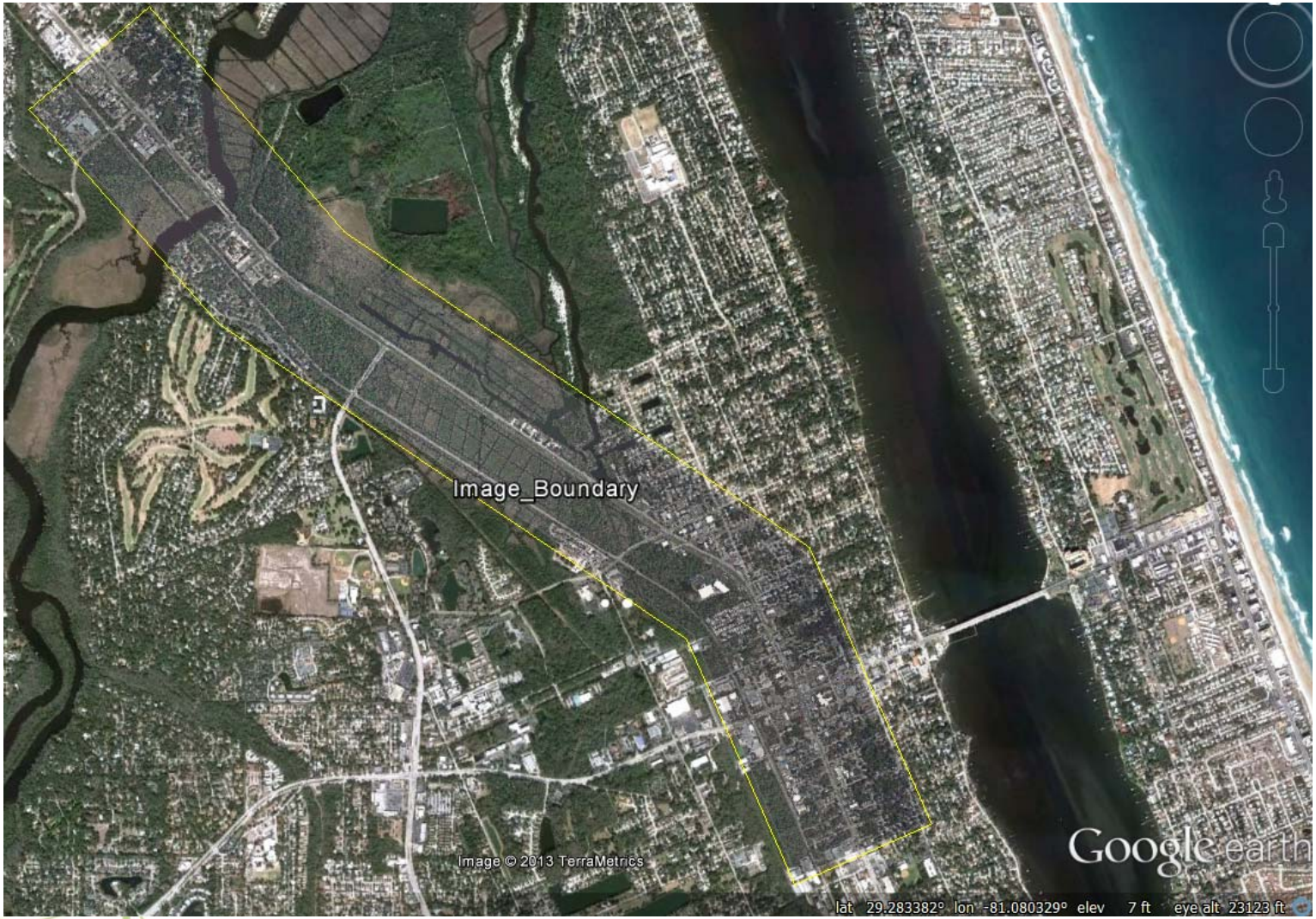
FDOT SR5 on Google Earth



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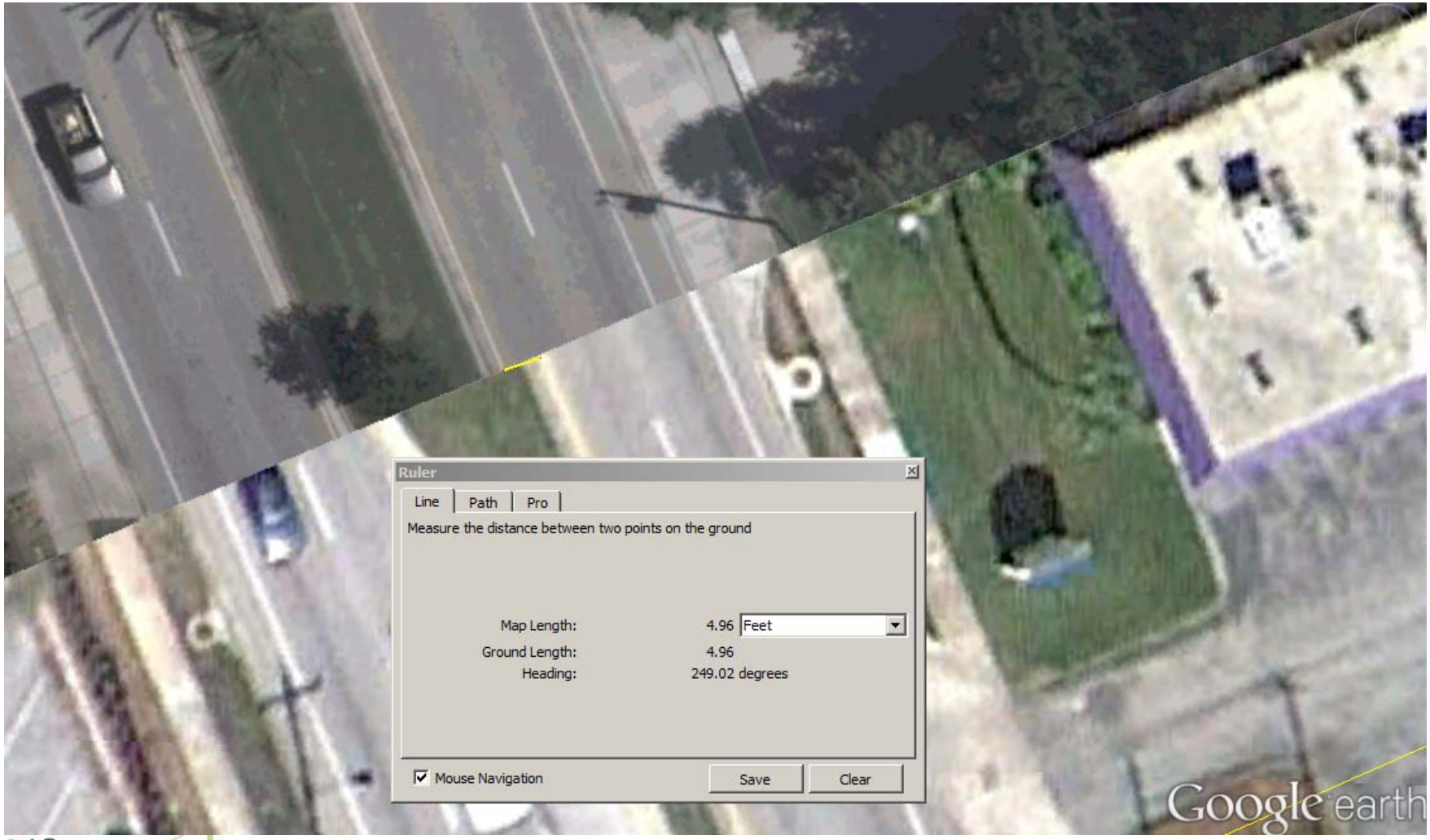
FDOT Image horizontal difference



http://www.asprs.org/Press-Releases/Draft-Guidelines-for-the-Procurement-of-Commercial-Geospatial-Products-Released-for-Second-Round-of-Comments.html

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Press Releases

Draft Guidelines for the Procurement of Commercial Geospatial Products Released for Second Round of Comments

Created on 06 July 2011 Last Updated on 03 May 2012

ASPRS has released a second draft of the "Guidelines for Procurement of Commercial Geospatial Mapping Products." The material is updated from the April 2011 version. The document is considered DRAFT FOR REVIEW and is being published at this time to encourage wide dissemination and comment.

A draft copy of the "Guidelines for Procurement of Commercial Geospatial Products" is available online at: http://www.asprs.org/a/society/divisions/ppd/products/CGPG_public_review_draft_2.doc. Interested parties are encouraged to submit comments by email to Product_Guidelines@asprs.org no later than February 20, 2012. The current plan is to review all comments and finalize the document for ASPRS Board approval at its March 23, 2012 meeting.

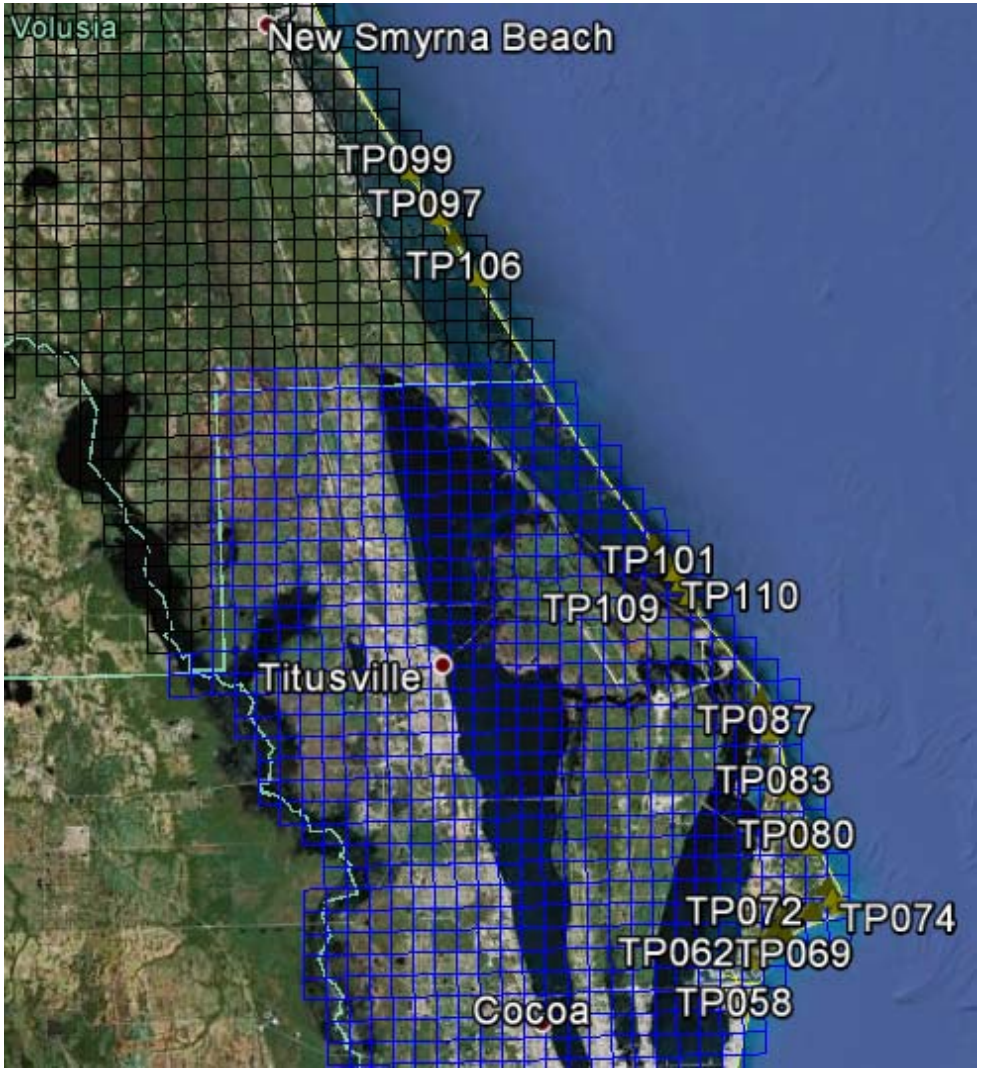
The Guidelines were prepared by a working committee within the ASPRS Professional Practice Division. Chaired by Charles Mondello of Pictometry International Corp., the committee includes representation from the commercial sector, state, and federal government. The intent of the Guidelines is to provide clarification on what constitutes a commercial geospatial mapping product and how procurement of products is differentiated from procurement of professional services.

In fall 2009, ASPRS adopted the "Guidelines for Procurement of Professional Aerial Imagery, Photogrammetry, Lidar and Related Remote Sensor-based Geospatial Mapping Services," which provides recommendations on the methodology of procuring professional services. This document updated procurement guidelines that were first adopted in 1986.

The need for differentiating best practices for the procurement of professional services, technical services, and commercial geospatial products has led to the ongoing efforts in guideline development. Once approved by the ASPRS Board, these Guidelines will be paired with the 2009 Professional Services Guidelines to form a complete package of procurement guidelines for the industry.

Posted 01-20-2012

NSSDA horizontal accuracy analysis



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FDOT Image sampling at 1foot (GSD)

FDOT

NSSDA Horizontal Accuracy Statistic Worksheet

A		B	C	D	E	F	G	H	I	J	K
Point		Point	(independe	x (test)			y (independe	y (test)			(diff in x)^2 +
Name		Description	round Chec	Ortho Imagery	diff in x	(diff in x) ^{2}	round Chec	Ortho Imagery	diff in y	(diff in y) ^{2}	(diff in y)^2
TP099-img		Photo ID	712298.1	712296.85	1.272	1.618	1670062	1670062.63	-0.767	0.588	2.206
TP098-img		Photo ID	716225.9	716225.33	0.531	0.282	1663990	1663989.18	0.450	0.202	0.484
TP097-img		Photo ID	719079.5	719079.37	0.138	0.019	1659439	1659439.77	-0.549	0.301	0.320
TP107-img		Photo ID	721961.7	721962.08	-0.414	0.171	1654514	1654512.75	0.940	0.884	1.055
TP106-img		Photo ID	727729.1	727729.20	-0.070	0.005	1644673	1644672.30	0.241	0.058	0.063
TP109-img		Photo ID	774970.5	774970.54	-0.017	0.000	1569628	1569628.06	-0.329	0.108	0.109
TP103-img		Photo ID	768630.9	768630.43	0.449	0.202	1579784	1579785.31	-1.076	1.158	1.359
TP102-img		Photo ID	770138.4	770138.41	0.011	0.000	1577354	1577354.72	-0.480	0.230	0.231
TP101-img		Photo ID	771546.9	771547.27	-0.411	0.169	1575166	1575166.15	-0.555	0.308	0.477
TP110-img		Photo ID	773090.5	773089.50	0.994	0.988	1572640	1572639.95	0.211	0.045	1.033
TP088-img		Photo ID	790753.8	790753.55	0.232	0.054	1545810	1545810.07	0.102	0.010	0.064
TP087-img		Photo ID	792755.8	792755.72	0.077	0.006	1537895	1537895.16	-0.379	0.144	0.150
TP083-img		Photo ID	796715.6	796714.60	1.016	1.032	1524016	1524015.38	0.324	0.105	1.137
TP081-img		Photo ID	799181.3	799181.74	-0.451	0.203	1515200	1515200.34	0.101	0.010	0.214
TP080-img		Photo ID	801490.1	801489.69	0.453	0.205	1511479	1511477.93	0.758	0.575	0.780
TP077-img		Photo ID	804966.5	804965.06	1.400	1.960	1502189	1502188.93	0.498	0.248	2.208
TP072-img		Photo ID	805930.5	805930.41	0.128	0.016	1499603	1499601.99	0.858	0.736	0.753
TP074-img		Photo ID	807678.6	807679.37	-0.727	0.529	1497967	1497966.92	-0.166	0.028	0.556
TP070-img		Photo ID	801386.1	801385.95	0.126	0.016	1496932	1496931.71	0.164	0.027	0.043
TP058-img		Photo ID	786643.5	786643.47	0.060	0.004	1485888	1485887.23	0.744	0.554	0.557
TP062-img		Photo ID	790053.9	790054.39	-0.463	0.214	1490674	1490674.64	-0.427	0.182	0.397
TP064-img		Photo ID	795085.8	795086.47	-0.677	0.458	1491759	1491759.07	-0.111	0.012	0.471
TP063-img		Photo ID	793081.4	793082.14	-0.702	0.493	1493443	1493444.00	-0.746	0.557	1.049
TP069-img		Photo ID	800477.7	800477.56	0.116	0.013	1496628	1496628.23	-0.395	0.156	0.169
TP068-img		Photo ID	795015.1	795015.02	0.106	0.011	1495686	1495685.77	0.263	0.069	0.080
TP067-img		Photo ID	794889.3	794889.96	-0.616	0.379	1495312	1495313.12	-0.813	0.661	1.040
		Photo ID			0.000	0.000			0.000	0.000	0.000
		Photo ID			0.000	0.000			0.000	0.000	0.000
							Total Check Points =		26	Sum	17.005
										Average	0.654
							Project Requirement ≤ 4.4 feet		⇨	RMSE	0.809
							Accuracy in feet at 95% Confidence Level		⇨	NSSDA	1.4

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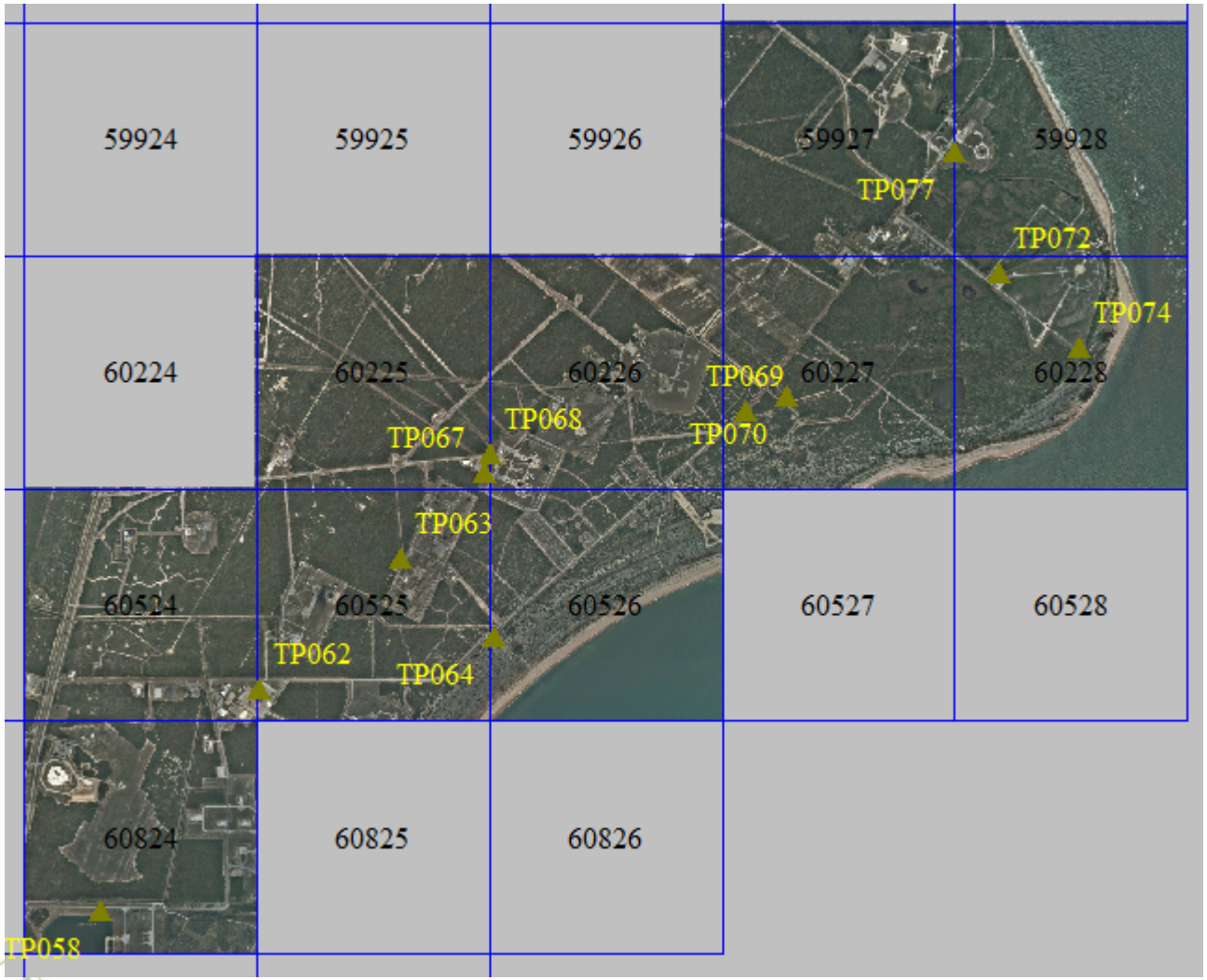
FDOT Orthphotography Program imagery



FDOT point TP067

Google Earth image sampling

GOOGLE_NSSDA Horizontal Accuracy Statistic Worksheet

A		B	C	D	E	F	G	H	I	J	K
Point		Point	x (independent)	x (test)			y (independent	y (test)			(diff in x)^2 +
Name		Description	Ground Check	Ortho Imagery	diff in x	(diff in x)^2	Ground Check	Ortho Imagery	diff in y	(diff in y)^2	(diff in y)^2
TP099		image	712296.62	712297.40	-0.781	0.610	1670062.56	1670065.95	-3.391	11.499	12.109
TP098		image	716226.14	716226.90	-0.760	0.578	1663989.82	1663994.96	-5.144	26.461	27.038
TP097		image	719080.10	719080.93	-0.825	0.681	1659439.98	1659442.84	-2.854	8.145	8.826
TP107		image	721961.53	721964.45	-2.920	8.526	1654513.25	1654517.19	-3.943	15.547	24.074
TP106		image	727729.53	727729.55	-0.025	0.001	1644673.23	1644673.12	0.114	0.013	0.014
TP109		image	774970.34	774972.67	-2.332	5.438	1569628.39	1569629.23	-0.844	0.712	6.151
TP103		image	768631.76	768635.57	-3.818	14.577	1579784.68	1579785.48	-0.808	0.653	15.230
TP102		image	770139.05	770140.25	-1.193	1.423	1577354.27	1577354.89	-0.619	0.383	1.806
TP101		image	771546.77	771551.06	-4.288	18.387	1575165.45	1575167.33	-1.883	3.546	21.933
TP110		image	773089.52	773094.55	-5.029	25.291	1572639.81	1572640.25	-0.443	0.196	25.487
TP088		image	790753.71	790755.63	-1.914	3.663	1545809.65	1545808.79	0.863	0.745	4.408
TP111		image	766890.73	766892.53	-1.806	3.262	1581996.79	1581997.28	-0.492	0.242	3.504
TP087		image	792755.92	792756.87	-0.948	0.899	1537894.16	1537894.47	-0.308	0.095	0.994
TP083		image	796716.03	796718.97	-2.934	8.608	1524016.45	1524015.65	0.807	0.651	9.260
TP081		image	799182.07	799185.12	-3.048	9.290	1515201.30	1515200.58	0.719	0.517	9.807
TP080		image	801488.60	801493.44	-4.840	23.426	1511478.30	1511477.26	1.042	1.086	24.511
TP077		image	804965.83	804971.83	-6.008	36.096	1502188.35	1502185.73	2.618	6.854	42.950
TP072		image	805931.32	805933.24	-1.924	3.702	1499602.35	1499598.83	3.520	12.390	16.092
TP074		image	807677.98	807683.17	-5.191	26.946	1497967.47	1497963.66	3.819	14.585	41.531
TP058		image	786646.73	786652.86	-6.130	37.577	1485889.13	1485887.32	1.811	3.280	40.857
TP062		image	790054.40	790059.27	-4.869	23.707	1490674.39	1490673.27	1.124	1.263	24.971
TP064		image	795090.12	795092.61	-2.497	6.235	1491761.74	1491762.53	-0.785	0.616	6.851
TP063		image	793082.14	793084.41	-2.269	5.148	1493444.12	1493443.52	0.595	0.354	5.502
TP069		image	800477.34	800480.54	-3.200	10.240	1496628.92	1496626.42	2.505	6.275	
TP068		image	795015.92	795017.78	-1.864	3.474	1495686.54	1495685.43	1.114	1.241	
TP067		image	794889.90	794892.18	-2.281	5.203	1495313.38	1495312.29	1.087	1.182	
								Total Check Points =	26	Sum	373.905
										Average	14.381
								Project Requirement ≤ 4.4 feet	⇨	RMSE	3.792
								Accuracy in feet at 95% Confidence Level (Project	⇨	NSSDA	6.6

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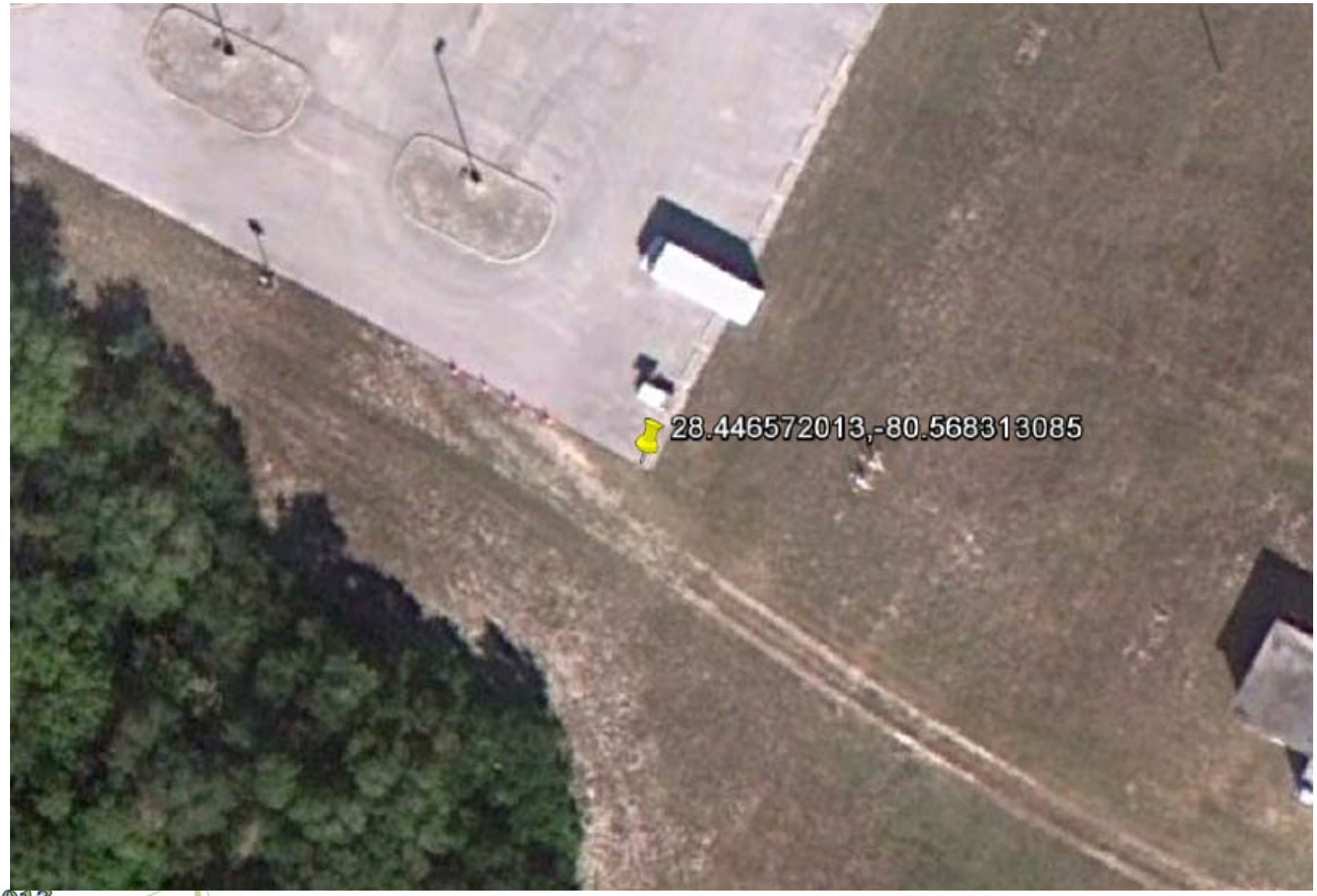
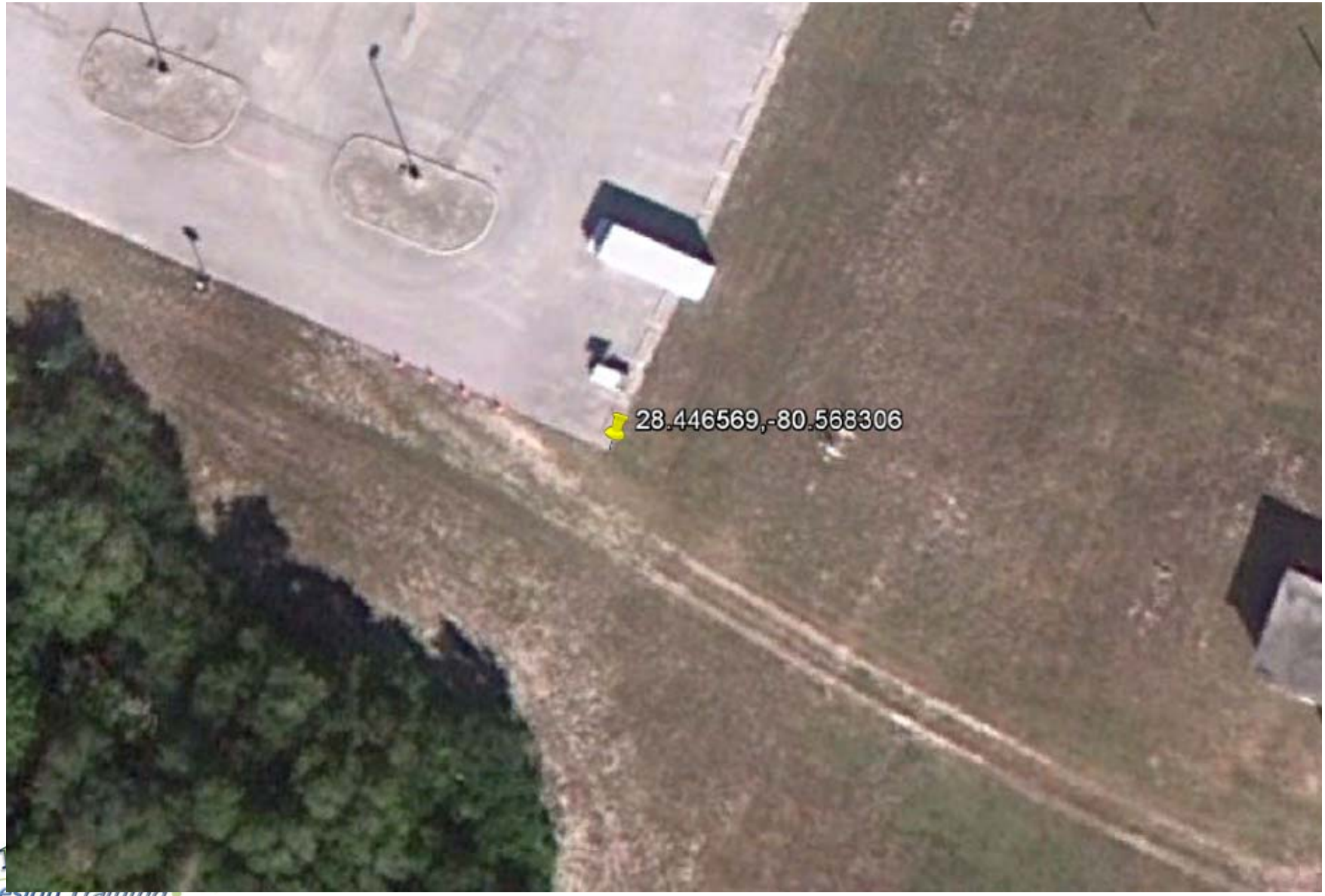
TP067 on Google Earth



TP067 Relocated on Google Earth



Flash Earth (images from BING) image sampling

- BING

BING_NSSDA Horizontal Accuracy Statistic Worksheet											
A		B	C	D	E	F	G	H	I	J	K
Point		Point	(independe	x (test)			y (independe	y (test)			(diff in x)^2 +
Name		Description	round Chec	Ortho Imagery	diff in x	(diff in x)^2	round Chec	Ortho Imagery	diff in y	(diff in y)^2	(diff in y)^2
TP099		Photo ID	712296.6	712298.04	-1.425	2.031	1670063	1670063.40	-0.847	0.717	2.748
TP098		Photo ID	716226.1	716224.99	1.151	1.325	1663990	1663989.50	0.313	0.098	1.423
TP097		Photo ID	719080.1	719080.61	-0.511	0.261	1659440	1659439.56	0.419	0.176	0.437
TP107		Photo ID	721961.5	721961.58	-0.048	0.002	1654513	1654512.10	1.152	1.327	1.329
TP106		Photo ID	727729.5	727729.55	-0.024	0.001	1644673	1644673.48	-0.249	0.062	0.063
TP109		Photo ID	774970.3	774969.14	1.196	1.430	1569628	1569629.22	-0.833	0.694	2.124
TP103		Photo ID	768631.8	768630.45	1.311	1.719	1579785	1579784.74	-0.066	0.004	1.723
TP101		Photo ID	771546.8	771545.28	1.484	2.202	1575165	1575166.95	-1.502	2.256	4.458
TP110		Photo ID	773089.5	773088.14	1.384	1.915	1572640	1572639.87	-0.060	0.004	1.919
TP088		Photo ID	790753.7	790752.09	1.619	2.621	1545810	1545809.50	0.148	0.022	2.643
TP111		Photo ID	766890.7	766889.01	1.718	2.952	1581997	1581996.18	0.609	0.371	3.322
TP087		Photo ID	792755.9	792755.26	0.656	0.430	1537894	1537894.10	0.061	0.004	0.434
TP083		Photo ID	796716	796714.80	1.234	1.523	1524016	1524013.81	2.641	6.975	8.498
TP081		Photo ID	799182.1	799180.62	1.455	2.117	1515201	1515202.39	-1.083	1.173	3.290
TP080		Photo ID	801488.6	801486.37	2.235	4.995	1511478	1511479.41	-1.113	1.239	6.234
TP077		Photo ID	804965.8	804966.04	-0.216	0.047	1502188	1502187.89	0.459	0.211	0.257
TP072		Photo ID	805931.3	805930.34	0.983	0.966	1499602	1499602.82	-0.468	0.219	1.185
TP074		Photo ID	807678	807677.69	0.288	0.083	1497967	1497967.63	-0.159	0.025	0.108
TP070		Photo ID	801384.1	801382.69	1.457	2.123	1496934	1496935.94	-1.540	2.372	4.494
TP058		Photo ID	786646.7	786644.17	2.558	6.543	1485889	1485889.83	-0.705	0.497	7.040
TP062		Photo ID	790054.4	790052.84	1.561	2.437	1490674	1490673.97	0.419	0.176	2.612
TP064		Photo ID	795090.1	795088.11	2.008	4.032	1491762	1491763.97	-2.223	4.942	8.974
TP063		Photo ID	793082.1	793080.23	1.913	3.660	1493444	1493444.60	-0.481	0.231	3.891
TP069		Photo ID	800477.3	800475.38	1.955	3.822	1496629	1496630.04	-1.112	1.237	5.059
TP068		Photo ID	795015.9	795014.88	1.037	1.075	1495687	1495687.96	-1.420	2.016	3.092
					0.000	0.000			0.000	0.000	
		Photo ID			0.000	0.000			0.000	0.000	0.000
							Total Check Points =		25	Sum	77.358
										Average	3.094
							Project Requirement ≤ 4.4 feet		⇨	RMSE	1.759
							Accuracy in feet at 95% Confidence Level		⇨	NSSDA	3.0

2013 Design Training Expo

TP067 on Flash Earth (imagery from BING)

TP067 Relocated on BING

Discuss issues that may contribute to image displacement and items to consider.

Map Projection – Latitude and Longitude are assumed to be on the WGS 84 Datum-important to convert all geographic coordinates into a common datum.

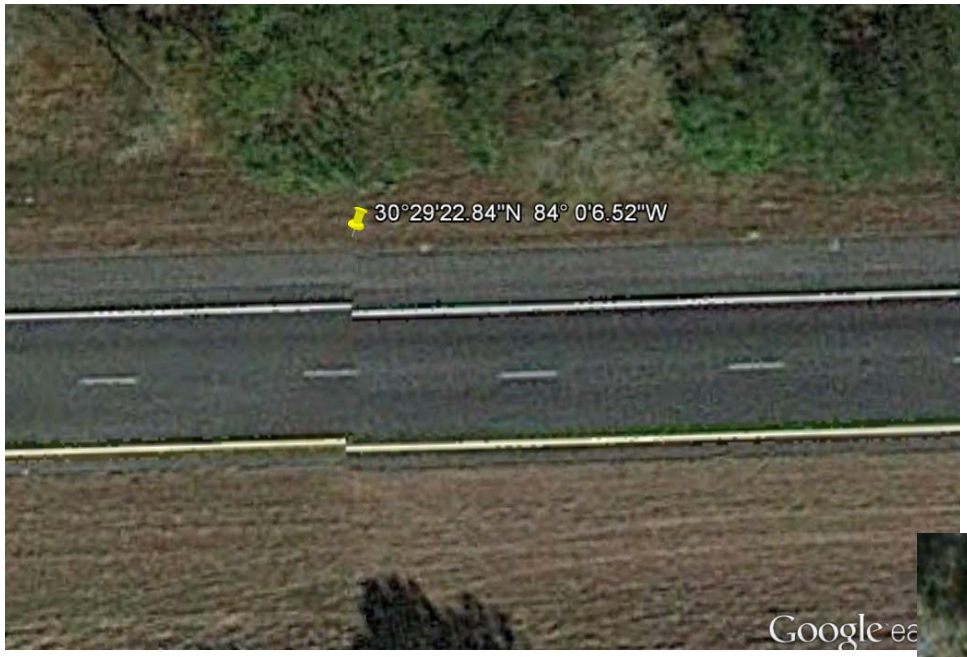
A conformal projection preserves the shape of relatively small objects.

Ground Resolution or Map Scale – The ground resolution indicates the distance on the ground by a single pixel.

Pixel Coordinates – Geographic Coordinates are converted into Pixel Coordinates – Map width and height is different at each level and so are the Pixel Coordinates. This is how BING and Google Earth map tiling systems are comprised.

BING offset and not on Google Earth

Google offset and not on BING



General discussion of issues with COTS imagery

- 3D Surface
- Aerial Triangulation
- Ground Control
- Photoshop
- Other