

DPH-11 Report on Absolute Vertical Accuracy

The USGS Lidar Base Specification Version 2.1 states: "Absolute vertical accuracy of the lidar data and the derived DEM will be assessed and reported in accordance with ASPRS (2014). Vegetated and nonvegetated land cover types shall be assessed for absolute vertical accuracy.

Three absolute accuracy values shall be assessed and reported:

1. NVA for the point data
2. VVA for the point data
3. NVA for the DEM
4. VVA for the DEM

The minimum NVA and VVA requirements for all data, using the ASPRS methodology, are listed in table 4. Both the NVA and VVA required values shall be met. NVA for the point data shall be assessed by comparing check points surveyed for NVA assessment to a triangulated irregular network (TIN) constructed from ground-classified lidar points in those areas. VVA for the point data shall be assessed by comparing check points surveyed for VVA assessment to a triangulated irregular network (TIN) constructed from ground-classified lidar points in those areas. NVA and VVA for the DEM are assessed by comparing check points to the final bare-earth surface. The minimum required thresholds for absolute and relative accuracy may be increased by the USGS–NGP when any of the following conditions are met:

- A demonstrable, substantial, and prohibitive increase in cost is needed to obtain this accuracy, which is often the case in heavily vegetated project areas.
- An alternate specification is needed to conform to previously contracted phases of a single larger overall collection effort such as for multiyear statewide collections
- The USGS–NGP agrees that the use of an alternate specification is reasonable and in the best interest of all stakeholders."

Table 4. Absolute vertical accuracy for light detection and ranging data and digital elevation models.

[QL, quality level, RMSE_z, root mean square error in the z direction; NVA, nonvegetated vertical accuracy; VVA, vegetated vertical accuracy; m, meter; ≤, less than or equal to]

Quality level	RMSE _z (nonvegetated) (m)	NVA at the 95-percent confidence level (m)	VVA at the 95th percentile (m)
QL0	≤0.050	≤0.098	≤0.15
QL1	≤0.100	≤0.196	≤0.30
QL2	≤0.100	≤0.196	≤0.30
QL3	≤0.200	≤0.392	≤0.60

The purpose of this section is to report on the absolute vertical accuracy of the lidar data and DEMs generated from it by testing for NVA (Nonvegetated Vertical Accuracy) and VVA (Vegetated Vertical Accuracy) against surveyed ground check points.

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[Data Source - Y:\Mapping\Projects\6522048201_ISGS_Wabash_and_Embarras\Production\Final_Client_Deliverables\Projectwide\metadata\shapefiles\Wabash_Embarrass_79NVA_61VVA_lidar_checkpoints.shp](Y:\Mapping\Projects\6522048201_ISGS_Wabash_and_Embarras\Production\Final_Client_Deliverables\Projectwide\metadata\shapefiles\Wabash_Embarrass_79NVA_61VVA_lidar_checkpoints.shp)

Units: Meter (/US Survey Feet)

Vertical Accuracy Class tested: 10-cm

Check Points in defined project area (DPA):	140
Check Points with Lidar Coverage	140
Check Points with Lidar Coverage (NVA)	79
Check Points with Lidar Coverage (VVA)	61
Average Z Error (NVA)	0.006/0.018
Maximum Z Error (NVA)	0.112/0.367
Median Z Error (NVA)	0.011/0.035
Minimum Z Error (NVA)	-0.085/-0.279
Standard deviation of Vertical Error (NVA)	0.046/0.151
Skewness of Vertical Error (NVA)	0.051
Kurtosis of Vertical Error (NVA)	-0.445
Non-vegetated Vertical Accuracy (NVA) RMSE(z) ¹	0.046/0.151 PASS
Non-vegetated Vertical Accuracy (NVA) at the 95% Confidence Level +/- ¹	0.090/0.297 PASS
FGDC/NSSDA Vertical Accuracy at the 95% Confidence Level +/-	0.090/0.297
Non-vegetated Vertical Accuracy (NVA) RMSE(z) (DEM) ²	0.046/0.151 PASS
Non-vegetated Vertical Accuracy (NVA) at the 95% Confidence Level (DEM) +/- ²	0.090/0.090 PASS
Vegetated Vertical Accuracy (VVA) at the 95th Percentile (TIN) +/- ¹	0.123/0.402 PASS
Vegetated Vertical Accuracy (VVA) at the 95th Percentile (DEM) +/- ²	0.128/0.420 PASS

This data set was tested to meet ASPRS Positional Accuracy Standard for Digital Geospatial Data (2014) for a 10-cm RMSEz Vertical Accuracy Class. Actual NVA accuracy was found to be RMSEz = 4.6cm, equating to +/- 9.0cm at the 95% confidence level. Actual VVA accuracy was found to be +/- 12.8cm at the 95th percentile.

¹ This value is calculated from TIN-based testing of the lidar point cloud data.

² This value is calculated from RAM-based grid testing of the lidar data. The grid cells are sized according to the Quality Level selected, and are defined in the USGS NGP Lidar Base Specification Version 2.1 (Table 6).

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The purpose of this section is to report the results of measuring the lidar point cloud data against surveyed ground NVA (nonvegetated vertical accuracy) check points. All XY coordinates and Z values reported are in the selected data units.

NVA (lidar data)

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Minimum Z	Median Z	Maximum Z	Intensity	Scan Angle Rank	Returns	Description	Comments
NVA601	962325.713	949032.189	Yes	650.446	650.463	0.017	650.436	650.439	650.488	3845	1740	1,1,1	LIPT	
NVA602	1181412.802	1042574.229	Yes	688.75	688.793	0.043	688.791	688.795	688.86	4021	-2308	1,1,1	LIPT	
NVA603	1070704.336	1079529.193	Yes	661.591	661.415	-0.176	661.362	661.366	661.419	2476	1954	1,1,1	LIPT	
NVA604	1040312.168	992149.696	Yes	678.103	678.064	-0.039	678.028	678.04	678.098	2870	-3201	1,1,1	LIPT	
NVA605	993024.097	1096299.191	Yes	677.18	677.01	-0.170	676.951	677.006	677.033	2286	-1255	1,1,1	LIPT	
NVA606	945287.236	1065780.193	Yes	669.06	669.071	0.011	669.057	669.095	669.121	1716	-1593	1,1,1	LIPT	
NVA607	1066825.625	1042604.937	Yes	682.007	681.9	-0.107	681.884	681.889	681.934	2328	-3039	1,1,1	LIPT	
NVA608	1168138.864	1026667.479	Yes	629.837	629.962	0.125	629.921	629.945	630.016	3247	-2686	1,1,1	LIPT	
NVA609	1139292.072	1111948.038	Yes	671.898	671.839	-0.059	671.771	671.837	671.869	2157	-167	1,1,1	LIPT	
NVA610	1038817.23	1097911.495	Yes	649.772	649.509	-0.263	649.477	649.513	649.531	2496	-1586	1,1,1	LIPT	
NVA611	1039251.305	960177.595	Yes	547.976	547.941	-0.035	547.938	547.941	547.943	3393	-1456	1,1,1	LIPT	
NVA612	1066412.818	939636.011	Yes	620.207	620.169	-0.038	620.129	620.134	620.175	2534	-1116	1,1,1	LIPT	
NVA613	1172790.083	954058.907	Yes	537.681	537.761	0.080	537.754	537.765	537.766	2229	2786	1,1,1	LIPT	
NVA614	1090230.563	1150421.327	Yes	645.501	645.509	0.008	645.474	645.48	645.552	2068	2752	1,1,1	LIPT	
NVA615	946881.153	999170.101	Yes	670.238	670.133	-0.105	670.102	670.121	670.142	3697	1087	1,1,1	LIPT	
NVA616	1208019.862	989533.776	Yes	462.793	462.981	0.188	462.961	462.99	463.006	4250	-792	1,1,1	LIPT	
NVA617	1137229.485	1057697.698	Yes	720.072	720.22	0.148	720.199	720.217	720.23	2722	1592	1,1,1	LIPT	
NVA618	1174704.845	1171250.915	Yes	679.092	679.14	0.048	679.13	679.134	679.148	3238	-1612	1,1,1	LIPT	
NVA619	982617.167	1138063.328	Yes	693.366	693.144	-0.222	693.142	693.142	693.153	4291	1613	1,1,1	LIPT	
NVA620	1082328.795	993311.477	Yes	665.421	665.385	-0.036	665.351	665.372	665.459	4117	-344	1,1,1	LIPT	
NVA621	1112251.472	1052305.456	Yes	734.58	734.685	0.105	734.671	734.703	734.72	2572	733	1,1,1	LIPT	
NVA622	960288.045	1108373.597	Yes	655.48	655.552	0.072	655.534	655.554	655.555	4451	624	1,1,1	LIPT	
NVA623	1000487.36	1025904.763	Yes	701.844	701.724	-0.120	701.675	701.74	701.74	3479	-288	1,1,1	LIPT	
NVA624	1099041.276	919061.756	Yes	576.989	577.134	0.145	577.068	577.081	577.164	1698	1445	1,1,1	LIPT	
NVA625	1049632.468	1071436.363	Yes	662.417	662.209	-0.208	662.179	662.222	662.222	3432	2556	1,1,1	LIPT	
NVA626	1000989.97	1164390.651	Yes	696.145	696.161	0.016	696.136	696.159	696.17	3941	904	1,1,1	LIPT	
NVA627	1164122.999	1080782.308	Yes	671.598	671.575	-0.023	671.573	671.574	671.582	3208	1783	1,1,1	LIPT	
NVA628	1032814.496	1018396.329	Yes	683.159	683.224	0.065	683.216	683.232	683.267	5956	-3079	1,1,1	LIPT	
NVA629	1192287.187	1100677.806	Yes	631.038	631.114	0.076	631.09	631.114	631.153	2472	1111	1,1,1	LIPT	
NVA630	1140924.715	1138826.669	Yes	661.111	661.263	0.152	661.199	661.243	661.335	2936	-2782	1,1,1	LIPT	

Check Points Vertical Accuracy - continued

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Minimum Z	Median Z	Maximum Z	Intensity	Scan Angle Rank	Returns	Description	Comments
NVA631	946328.056	954408.298	Yes	649.943	650.003	0.060	649.971	649.993	650.052	3754	255	1,1,1	LIPT	
NVA632	1121315.1	1015254.044	Yes	682.722	682.928	0.206	682.923	682.942	682.95	1999	-2650	1,1,1	LIPT	
NVA633	1191790.123	934242.327	Yes	451.136	451.453	0.317	451.44	451.453	451.479	1093	1073	1,1,1	LIPT	
NVA634	1082007.163	1014470.286	Yes	729.567	729.423	-0.144	729.381	729.39	729.432	3633	-740	1,1,1	LIPT	
NVA635	1059486.078	1138350.608	Yes	641.906	641.744	-0.162	641.635	641.713	641.771	3031	-2239	1,1,1	LIPT	
NVA636	1008238.625	986180.905	Yes	687.371	687.406	0.035	687.398	687.425	687.443	2327	1116	1,1,1	LIPT	
NVA637	971386.372	1002634.883	Yes	752.009	751.827	-0.182	751.795	751.848	751.866	3709	-2001	1,1,1	LIPT	
NVA638	948116.754	1169890.151	Yes	672.663	672.721	0.058	672.705	672.724	672.766	4446	2430	1,1,1	LIPT	
NVA639	1050723.631	923195.616	Yes	603.228	603.148	-0.080	603.147	603.153	603.157	2449	2345	1,1,1	LIPT	
NVA640	945273.177	912178.039	Yes	599.634	599.502	-0.132	599.455	599.521	599.552	2560	-1519	1,1,1	LIPT	
NVA641	1008418.865	951687.626	Yes	597.483	597.595	0.112	597.588	597.59	597.617	3779	1254	1,1,1	LIPT	
NVA642	1003240.87	1066107.717	Yes	663.456	663.513	0.057	663.494	663.516	663.52	3001	1230	1,1,1	LIPT	
NVA643	1091095.562	966132.462	Yes	640.094	640.376	0.282	640.306	640.397	640.461	3073	2777	1,1,1	LIPT	
NVA644	1070623.781	1124564.918	Yes	650.854	650.597	-0.257	650.53	650.645	650.653	5021	1718	1,1,1	LIPT	
NVA645	1138287.949	947522.9765	Yes	585.285	585.596	0.311	585.569	585.605	585.631	2711	2057	1,1,1	LIPT	
NVA646	971637.072	937120.883	Yes	623.672	623.631	-0.041	623.613	623.661	623.695	4309	-2272	1,1,1	LIPT	
NVA647	1008583.818	912108.308	Yes	584.516	584.493	-0.023	584.483	584.487	584.508	2092	1452	1,1,1	LIPT	
NVA648	1166664.553	1112951.319	Yes	643.898	643.971	0.073	643.959	643.994	644.009	3859	-893	1,1,1	LIPT	
NVA649	1095848.067	1110428.649	Yes	662.611	662.421	-0.190	662.386	662.409	662.461	4017	614	1,1,1	LIPT	
NVA650	1132871.191	1154673.441	Yes	669.2	669.269	0.069	669.227	669.242	669.276	1458	-1268	1,1,1	LIPT	
NVA651	1038822.436	1117343.298	Yes	636.669	636.39	-0.279	636.356	636.382	636.471	3141	-1724	1,1,1	LIPT	
NVA652	1118953.655	1111102.303	Yes	669.574	669.471	-0.103	669.459	669.481	669.491	3134	-26	1,1,1	LIPT	
NVA653	1049826.573	1037237.567	Yes	669.252	669.203	-0.049	669.18	669.201	669.206	4496	2923	1,1,1	LIPT	
NVA654	944960.166	1138042.722	Yes	665.181	665.095	-0.086	665.035	665.091	665.189	7409	-2454	1,1,1	LIPT	
NVA655	1115019.756	968157.689	Yes	616.636	617.003	0.367	616.972	617.002	617.01	3411	-2652	1,1,1	LIPT	
NVA656	945956.13	1039349.159	Yes	660.657	660.686	0.029	660.66	660.697	660.713	4933	-491	1,1,1	LIPT	
NVA657	1028283.825	1060619.487	Yes	675.873	676.038	0.165	676.003	676.031	676.068	3655	926	1,1,1	LIPT	
NVA658	1194257.432	1066480.595	Yes	672.219	672.258	0.039	672.244	672.257	672.266	3537	-1606	1,1,1	LIPT	
NVA659	1032950.645	1148778.068	Yes	651.317	651.039	-0.278	651.019	651.042	651.071	3087	-2344	1,1,1	LIPT	
NVA660	1188638.727	1140298.696	Yes	626.921	626.992	0.071	626.974	626.991	627.031	3468	-1001	1,1,1	LIPT	
NVA661	1201934.29	1006170.228	Yes	576.483	576.631	0.148	576.603	576.64	576.671	6239	-2419	1,1,1	LIPT	
NVA662	1059280.88	1170250.203	Yes	667.048	666.922	-0.126	666.912	666.924	666.966	3577	-3107	1,1,1	LIPT	
NVA663	1054986.322	971047.422	Yes	616.356	616.702	0.346	616.657	616.709	616.722	2682	-673	1,1,1	LIPT	
NVA664	966335.505	1039305.632	Yes	687.847	687.846	-0.001	687.793	687.875	687.878	3632	-751	1,1,1	LIPT	
NVA665	1188254.836	1156114.872	Yes	640.493	640.501	0.008	640.497	640.522	640.542	2854	-1394	1,1,1	LIPT	

Check Points Vertical Accuracy - continued

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Minimum Z	Median Z	Maximum Z	Intensity	Scan Angle Rank	Returns	Description	Comments
NVA666	1180685.373	912348.898	Yes	448.505	448.713	0.208	448.705	448.722	448.752	2879	975	1,1,1	LIPT	
NVA667	1169000.899	1139171.738	Yes	643.112	643.191	0.079	643.187	643.192	643.198	3344	-318	1,1,1	LIPT	
NVA668	1116181.719	1084394.203	Yes	675.587	675.686	0.099	675.685	675.685	675.691	3646	561	1,1,1	LIPT	
NVA669	945186.153	1087019.072	Yes	664.898	664.965	0.067	664.956	664.975	664.987	2592	-1814	1,1,1	LIPT	
NVA670	971209.839	912011.699	Yes	587.047	586.942	-0.105	586.921	586.922	586.97	3897	-1467	1,1,1	LIPT	
NVA671	1208390.227	1071893.534	Yes	627.032	627.276	0.244	627.242	627.318	627.326	3548	-2821	1,1,1	LIPT	
NVA672	1208654.592	1164453.551	Yes	622.242	622.427	0.185	622.404	622.433	622.443	3693	-802	1,1,1	LIPT	
NVA673	1164992.032	985732.004	Yes	649.751	649.904	0.153	649.881	649.9	649.914	3749	1845	1,1,1	LIPT	
NVA674	982739.298	1055267.697	Yes	672.363	672.486	0.123	672.468	672.482	672.492	3477	1612	1,1,1	LIPT	
NVA675	1095361.245	1170362.262	Yes	701.982	701.799	-0.183	701.788	701.791	701.811	4631	379	1,1,1	LIPT	
NVA676	1070761.187	1101960.978	Yes	658.001	657.842	-0.159	657.819	657.828	657.848	2621	1755	1,1,1	LIPT	
NVA677	1187474.788	976639.1	Yes	540.059	540.248	0.189	540.247	540.251	540.284	3834	-112	1,1,1	LIPT	
NVA678	1111436.906	993921.02	Yes	641.105	641.246	0.141	641.18	641.232	641.265	2103	2591	1,1,1	LIPT	
NVA679	1206932.886	1127347.063	Yes	618.369	618.444	0.075	618.402	618.489	618.489	2742	-1318	1,1,1	LIPT	

DPH-11 Report on Absolute Vertical Accuracy - continued

The purpose of this section is to report the results of measuring the lidar point cloud data against surveyed ground VVA (vegetated vertical accuracy) check points. All XY coordinates and Z values reported are in the selected data units.

VVA (lidar data)

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Minimum Z	Median Z	Maximum Z	Intensity	Scan Angle Rank	Returns	Description	Comments
VVA701	963224.142	949063.478	Yes	644.829	645.056	0.227	645.012	645.049	645.094	6848	267	1,1,1	LIPT	
VVA702	1181486.881	1042835.69	Yes	676.13	676.239	0.109	676.217	676.241	676.276	4244	-2897	1,1,1	LIPT	
VVA703	1070692.508	1079592.885	Yes	660.229	660.087	-0.142	660.064	660.112	660.125	4678	1991	1,1,1	LIPT	
VVA704	1040117.343	992597.8	Yes	668.143	667.448	-0.695	667.415	667.466	667.493	6599	-2838	1,1,1	LIPT	
VVA705	993121.939	1096653.301	Yes	677.383	677.227	-0.156	677.181	677.208	677.235	4921	-1104	1,1,1	LIPT	
VVA706	945755.904	1065825.234	Yes	667.996	668.16	0.164	668.145	668.157	668.198	4936	-793	1,1,1	LIPT	
VVA707	1069519.731	1043587.383	Yes	691.954	691.862	-0.092	691.859	691.885	691.899	6813	1333	1,1,1	LIPT	
VVA708	1167561.584	1027534.951	Yes	633.57	633.972	0.402	633.927	633.985	634.036	5299	-1234	1,1,1	LIPT	
VVA709	1143416.929	1112184.705	Yes	664.477	664.478	0.001	664.431	664.469	664.516	6079	1335	1,1,1	LIPT	
VVA710	1040185.436	1099618.639	Yes	646.546	646.408	-0.138	646.372	646.425	646.435	5533	-1765	1,1,1	LIPT	
VVA711	1040377.162	960171.193	Yes	578.813	578.879	0.066	578.852	578.918	578.918	5569	-3027	1,1,1	LIPT	
VVA712	1063719.528	939699.598	Yes	612.124	612.029	-0.095	611.947	612.009	612.068	5523	2317	1,1,1	LIPT	
VVA713	1172618.775	955430.984	Yes	537.007	537.21	0.203	537.118	537.238	537.239	4427	2615	1,1,2	LIPT	
VVA714	1088985.312	1150354.182	Yes	643.044	643.184	0.140	643.096	643.187	643.195	4794	888	1,1,1	LIPT	
VVA715	947537.982	999220.375	Yes	670.194	670.079	-0.115	670.071	670.088	670.1	6339	2606	1,1,1	LIPT	
VVA716	1208118.603	989462.972	Yes	459.557	459.826	0.269	459.81	459.826	459.835	6177	-984	1,1,1	LIPT	
VVA717	1137159.785	1057803.361	Yes	724.247	724.475	0.228	724.362	724.434	724.515	5417	1477	1,1,1	LIPT	
VVA718	1174465.797	1170279.923	Yes	673.758	674.006	0.248	673.928	674.034	674.114	4821	-1995	1,1,1	LIPT	
VVA719	982949.201	1138155.437	Yes	692.666	692.523	-0.143	692.5	692.536	692.538	6197	1021	1,1,1	LIPT	
VVA720	1081057.238	993369.609	Yes	654.873	654.834	-0.039	654.818	654.834	654.86	6232	-2499	1,1,1	LIPT	
VVA721	1109580.792	1052328.776	Yes	724.875	724.957	0.082	724.916	724.965	724.974	4424	354	1,1,1	LIPT	
VVA722	960030.482	1108385.17	Yes	652.432	652.666	0.234	652.648	652.681	652.71	5861	197	1,1,1	LIPT	
VVA723	1000104.55	1025751.422	Yes	698.694	698.647	-0.047	698.632	698.64	698.69	5941	-933	1,1,1	LIPT	
VVA724	1098909.405	919909.479	Yes	578.549	578.759	0.210	578.685	578.784	578.803	3874	1654	1,1,1	LIPT	
VVA725	1049497.737	1071391.311	Yes	660.395	660.226	-0.169	660.216	660.217	660.244	3974	2496	1,1,1	LIPT	
VVA726	999108.797	1164936.427	Yes	687.151	687.254	0.103	687.237	687.275	687.29	4783	-3316	1,1,1	LIPT	
VVA727	1164733.18	1079950.184	Yes	675.646	675.691	0.045	675.669	675.682	675.738	5527	2789	1,1,1	LIPT	
VVA728	1032196.102	1020096.874	Yes	683.885	683.908	0.023	683.897	683.898	683.951	6881	-1556	1,1,1	LIPT	
VVA729	1190997.829	1100702.598	Yes	632.128	632.297	0.169	632.292	632.295	632.379	6719	3151	1,1,1	LIPT	
VVA730	1141441.497	1138803.972	Yes	661.325	661.508	0.183	661.464	661.496	661.525	6034	-1646	1,1,1	LIPT	

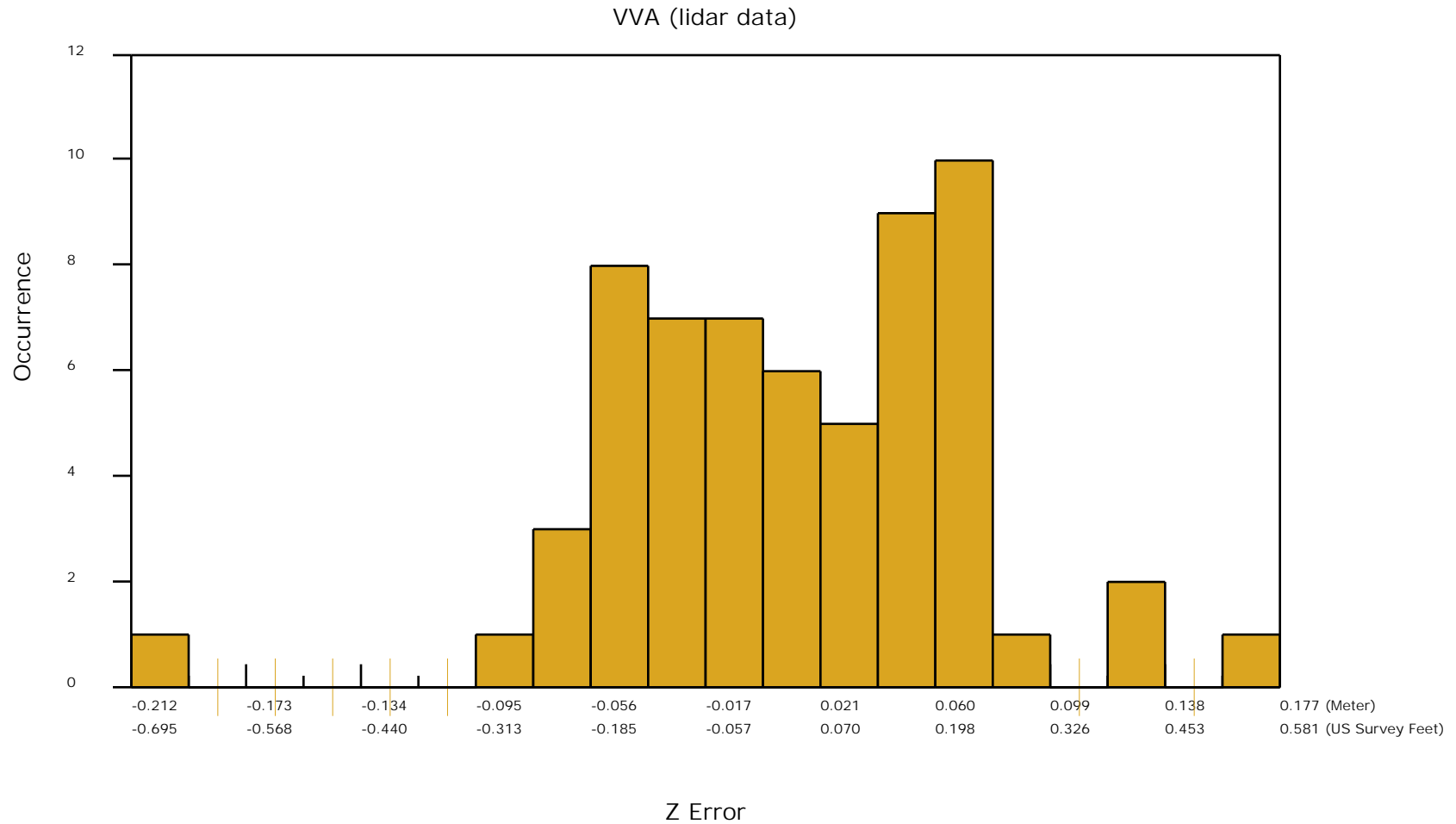
Check Points Vertical Accuracy - continued

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Minimum Z	Median Z	Maximum Z	Intensity	Scan Angle Rank	Returns	Description	Comments
VVA731	946143.125	954117.157	Yes	649.611	649.754	0.143	649.689	649.769	649.779	6067	-46	1,1,1	LIPT	
VVA732	1114604.381	1017248.725	Yes	668.339	668.293	-0.046	668.28	668.302	668.323	5781	-2838	1,1,1	LIPT	
VVA733	1192083.663	933929.211	Yes	457.212	457.468	0.256	457.452	457.502	457.521	5306	1540	1,1,1	LIPT	
VVA734	1078138.381	1014546.121	Yes	764.865	764.746	-0.119	764.733	764.747	764.751	6847	1479	1,1,1	LIPT	
VVA735	1062651.115	1138456.716	Yes	641.69	641.834	0.144	641.775	641.849	641.887	5150	2003	1,1,1	LIPT	
VVA736	1009588.332	985662.747	Yes	689.023	688.984	-0.039	688.899	688.973	689.116	4850	2890	2,2,1	LIPT	
VVA737	970721.361	1002934.502	Yes	751.536	751.401	-0.135	751.383	751.401	751.414	5409	-932	1,1,1	LIPT	
VVA738	946067.271	1169938.889	Yes	669.827	670.239	0.412	670.061	670.171	670.275	5533	-338	1,1,1	LIPT	
VVA739	1049398.525	923048.321	Yes	600.536	600.598	0.062	600.456	600.505	600.812	553	1152	2,2,2	LIPT	
VVA740	945202.41	914169.761	Yes	617.871	617.826	-0.045	617.804	617.817	617.885	5277	-1640	1,1,1	LIPT	
VVA741	1009398.991	949078.152	Yes	600.31	600.478	0.168	600.457	600.478	600.505	6204	2807	1,1,1	LIPT	
VVA742	987763.999	1069038.055	Yes	660.904	661.103	0.199	661.086	661.13	661.15	7231	1065	1,1,1	LIPT	
VVA723	1086401.081	964425.699	Yes	639.261	639.083	-0.178	639.033	639.077	639.089	7589	-617	1,1,1	LIPT	
VVA744	1070538.481	1129951.67	Yes	635.472	635.254	-0.218	635.232	635.255	635.268	5832	1850	1,1,1	LIPT	
VVA745	1139167.893	947585.335	Yes	583.04	583.621	0.581	583.533	583.594	583.673	5067	3315	1,1,1	LIPT	
VVA746	971546.057	935823.275	Yes	620.371	620.291	-0.080	620.28	620.293	620.4	5304	-3442	1,1,1	LIPT	
VVA747	1008641.156	912282.972	Yes	583.529	583.548	0.019	583.517	583.533	583.569	5007	1518	1,1,1	LIPT	
VVA748	1160246.489	1112553.136	Yes	657.535	657.356	-0.179	657.333	657.356	657.373	5756	-1319	1,1,1	LIPT	
VVA749	1096337.68	1111054.918	Yes	662.189	661.996	-0.193	661.924	661.963	662.038	5853	1455	1,1,1	LIPT	
VVA750	1132820.619	1153960.581	Yes	666.713	666.863	0.150	666.826	666.859	666.885	5386	-1205	1,1,1	LIPT	
VVA751	1038453.889	1118158.336	Yes	635.962	635.772	-0.190	635.758	635.768	635.78	6166	-1140	1,1,1	LIPT	
VVA752	1118888.162	1110285.493	Yes	667.014	666.996	-0.018	666.988	666.998	666.998	3461	97	1,1,1	LIPT	
VVA753	1049756.956	1037526.871	Yes	671.247	671.162	-0.085	671.151	671.158	671.228	5289	2473	1,1,1	LIPT	
VVA754	946612.044	1142607.493	Yes	665.095	665.033	-0.062	664.992	665.06	665.078	6356	610	1,1,1	LIPT	
VVA755	1114882.351	968343.069	Yes	615.934	616.162	0.228	616.086	616.164	616.165	6668	-2772	1,1,1	LIPT	
VVA756	944828.33	1040200.413	Yes	655.358	655.454	0.096	655.417	655.447	655.465	5509	-2839	1,1,1	LIPT	
VVA757	1029407.712	1060455.575	Yes	678.859	678.931	0.072	678.913	678.944	678.953	5107	2753	1,1,1	LIPT	
VVA758	1197707.898	1066551.848	Yes	661.096	661.335	0.239	661.269	661.339	661.341	6283	1852	1,1,1	LIPT	
VVA759	1032983.833	1148951.467	Yes	660.332	660.07	-0.262	659.943	660.065	660.19	1422	-2098	3,2,3	LIPT	
VVA760	1189446.274	1140175.16	Yes	616.88	617.042	0.162	617.007	617.039	617.108	5861	399	1,1,1	LIPT	
VVA761	1201525.642	1005666.566	Yes	560.301	560.37	0.069	560.367	560.37	560.371	5666	-1621	1,1,1	LIPT	

DPH-11 Report on Absolute Vertical Accuracy - continued

The purpose of this section is to show a frequency distribution chart of the vegetated vertical accuracy (VVA) of the lidar point cloud data measured against surveyed ground check points.

[Data Source - D:\00_ISGS\Final_Client_Tiles1](#)



DPH-11 Report on Absolute Vertical Accuracy - continued

The purpose of this section is to report the results of measuring the DEM data against surveyed ground NVA (nonvegetated vertical accuracy) check points. All XY coordinates and Z values reported are in the selected data units.

NVA (DEM)

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Description	Comments
NVA601	962325.713	949032.189	Yes	650.446	650.451	0.005	LIPT	
NVA602	1181412.802	1042574.229	Yes	688.75	688.815	0.065	LIPT	
NVA603	1070704.336	1079529.193	Yes	661.591	661.421	-0.170	LIPT	
NVA604	1040312.168	992149.696	Yes	678.103	678.031	-0.072	LIPT	
NVA605	993024.097	1096299.191	Yes	677.18	676.993	-0.187	LIPT	
NVA606	945287.236	1065780.193	Yes	669.06	669.117	0.057	LIPT	
NVA607	1066825.625	1042604.937	Yes	682.007	681.924	-0.083	LIPT	
NVA608	1168138.864	1026667.479	Yes	629.837	629.934	0.097	LIPT	
NVA609	1139292.072	1111948.038	Yes	671.898	671.862	-0.036	LIPT	
NVA610	1038817.23	1097911.495	Yes	649.772	649.518	-0.254	LIPT	
NVA611	1039251.305	960177.595	Yes	547.976	547.943	-0.033	LIPT	
NVA612	1066412.818	939636.011	Yes	620.207	620.118	-0.089	LIPT	
NVA613	1172790.083	954058.907	Yes	537.681	537.713	0.032	LIPT	
NVA614	1090230.563	1150421.327	Yes	645.501	645.516	0.015	LIPT	
NVA615	946881.153	999170.101	Yes	670.238	670.124	-0.114	LIPT	
NVA616	1208019.862	989533.776	Yes	462.793	462.982	0.189	LIPT	
NVA617	1137229.485	1057697.698	Yes	720.072	720.229	0.157	LIPT	
NVA618	1174704.845	1171250.915	Yes	679.092	679.137	0.045	LIPT	
NVA619	982617.167	1138063.328	Yes	693.366	693.143	-0.223	LIPT	
NVA620	1082328.795	993311.477	Yes	665.421	665.389	-0.032	LIPT	
NVA621	1112251.472	1052305.456	Yes	734.58	734.706	0.126	LIPT	
NVA622	960288.045	1108373.597	Yes	655.48	655.566	0.086	LIPT	
NVA623	1000487.36	1025904.763	Yes	701.844	701.735	-0.109	LIPT	
NVA624	1099041.276	919061.756	Yes	576.989	577.085	0.096	LIPT	
NVA625	1049632.468	1071436.363	Yes	662.417	662.236	-0.181	LIPT	
NVA626	1000989.97	1164390.651	Yes	696.145	696.170	0.025	LIPT	
NVA627	1164122.999	1080782.308	Yes	671.598	671.577	-0.021	LIPT	
NVA628	1032814.496	1018396.329	Yes	683.159	683.164	0.005	LIPT	
NVA629	1192287.187	1100677.806	Yes	631.038	631.085	0.047	LIPT	
NVA630	1140924.715	1138826.669	Yes	661.111	661.248	0.137	LIPT	

Check Points Vertical Accuracy - continued

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Description	Comments
NVA631	946328.056	954408.298	Yes	649.943	649.953	0.010	LIPT	
NVA632	1121315.1	1015254.044	Yes	682.722	682.935	0.213	LIPT	
NVA633	1191790.123	934242.327	Yes	451.136	451.439	0.303	LIPT	
NVA634	1082007.163	1014470.286	Yes	729.567	729.451	-0.116	LIPT	
NVA635	1059486.078	1138350.608	Yes	641.906	641.751	-0.155	LIPT	
NVA636	1008238.625	986180.905	Yes	687.371	687.416	0.045	LIPT	
NVA637	971386.372	1002634.883	Yes	752.009	751.849	-0.160	LIPT	
NVA638	948116.754	1169890.151	Yes	672.663	672.760	0.097	LIPT	
NVA639	1050723.631	923195.616	Yes	603.228	603.120	-0.108	LIPT	
NVA640	945273.177	912178.039	Yes	599.634	599.538	-0.096	LIPT	
NVA641	1008418.865	951687.626	Yes	597.483	597.606	0.123	LIPT	
NVA642	1003240.87	1066107.717	Yes	663.456	663.515	0.059	LIPT	
NVA643	1091095.562	966132.462	Yes	640.094	640.451	0.357	LIPT	
NVA644	1070623.781	1124564.918	Yes	650.854	650.570	-0.284	LIPT	
NVA645	1138287.949	947522.9765	Yes	585.285	585.581	0.296	LIPT	
NVA646	971637.072	937120.883	Yes	623.672	623.644	-0.028	LIPT	
NVA647	1008583.818	912108.308	Yes	584.516	584.493	-0.023	LIPT	
NVA648	1166664.553	1112951.319	Yes	643.898	643.977	0.079	LIPT	
NVA649	1095848.067	1110428.649	Yes	662.611	662.453	-0.158	LIPT	
NVA650	1132871.191	1154673.441	Yes	669.2	669.264	0.064	LIPT	
NVA651	1038822.436	1117343.298	Yes	636.669	636.378	-0.291	LIPT	
NVA652	1118953.655	1111102.303	Yes	669.574	669.488	-0.086	LIPT	
NVA653	1049826.573	1037237.567	Yes	669.252	669.212	-0.040	LIPT	
NVA654	944960.166	1138042.722	Yes	665.181	665.038	-0.143	LIPT	
NVA655	1115019.756	968157.689	Yes	616.636	616.958	0.322	LIPT	
NVA656	945956.13	1039349.159	Yes	660.657	660.695	0.038	LIPT	
NVA657	1028283.825	1060619.487	Yes	675.873	676.016	0.143	LIPT	
NVA658	1194257.432	1066480.595	Yes	672.219	672.285	0.066	LIPT	
NVA659	1032950.645	1148778.068	Yes	651.317	651.002	-0.315	LIPT	
NVA660	1188638.727	1140298.696	Yes	626.921	626.981	0.060	LIPT	
NVA661	1201934.29	1006170.228	Yes	576.483	576.631	0.148	LIPT	
NVA662	1059280.88	1170250.203	Yes	667.048	666.945	-0.103	LIPT	
NVA663	1054986.322	971047.422	Yes	616.356	616.667	0.311	LIPT	
NVA664	966335.505	1039305.632	Yes	687.847	687.825	-0.022	LIPT	
NVA665	1188254.836	1156114.872	Yes	640.493	640.497	0.004	LIPT	

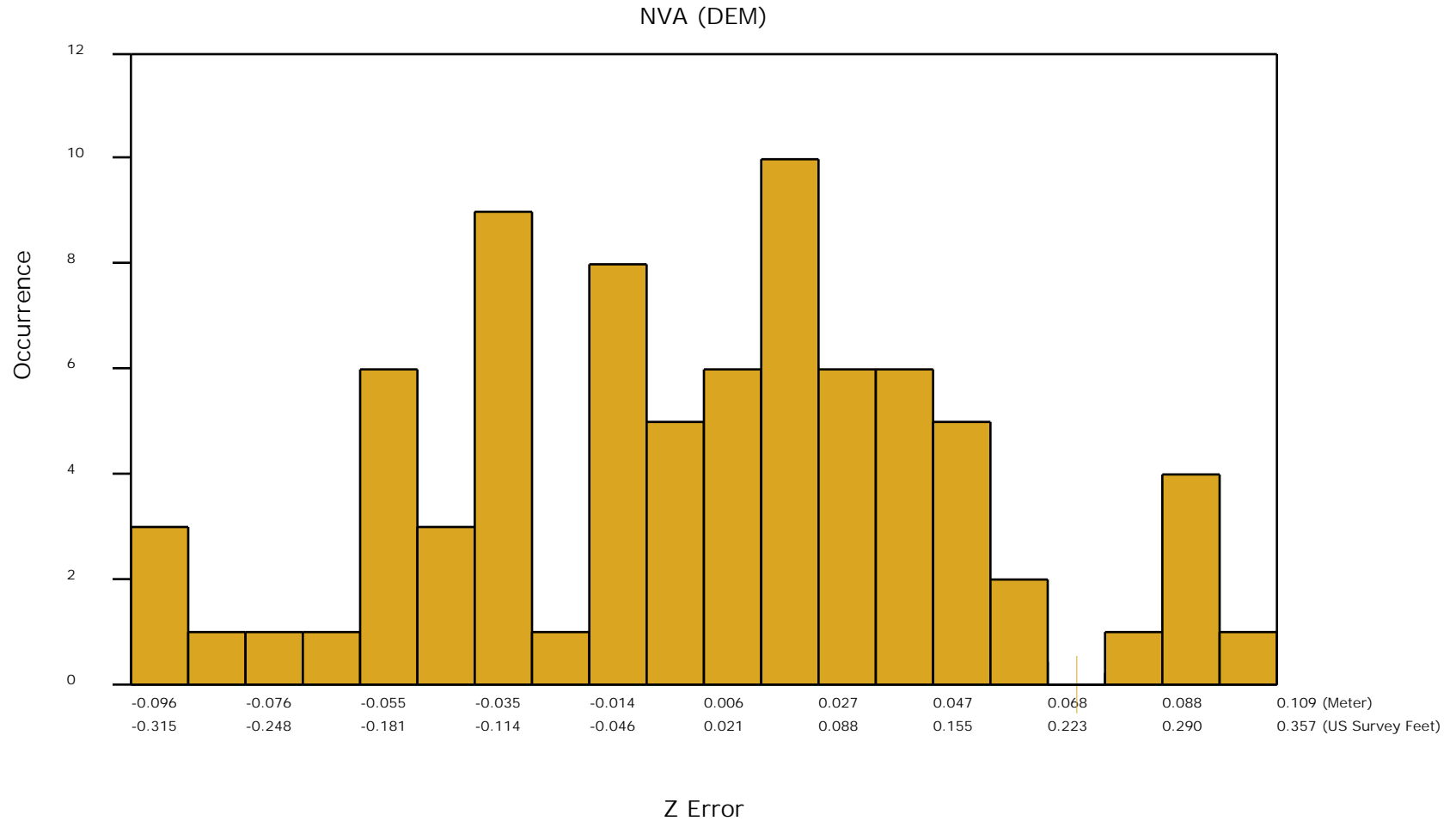
Check Points Vertical Accuracy - continued

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Description	Comments
NVA666	1180685.373	912348.898	Yes	448.505	448.708	0.203	LIPT	
NVA667	1169000.899	1139171.738	Yes	643.112	643.185	0.073	LIPT	
NVA668	1116181.719	1084394.203	Yes	675.587	675.686	0.099	LIPT	
NVA669	945186.153	1087019.072	Yes	664.898	664.986	0.088	LIPT	
NVA670	971209.839	912011.699	Yes	587.047	586.938	-0.109	LIPT	
NVA671	1208390.227	1071893.534	Yes	627.032	627.304	0.272	LIPT	
NVA672	1208654.592	1164453.551	Yes	622.242	622.424	0.182	LIPT	
NVA673	1164992.032	985732.004	Yes	649.751	649.913	0.162	LIPT	
NVA674	982739.298	1055267.697	Yes	672.363	672.478	0.115	LIPT	
NVA675	1095361.245	1170362.262	Yes	701.982	701.807	-0.175	LIPT	
NVA676	1070761.187	1101960.978	Yes	658.001	657.855	-0.146	LIPT	
NVA677	1187474.788	976639.1	Yes	540.059	540.247	0.188	LIPT	
NVA678	1111436.906	993921.02	Yes	641.105	641.242	0.137	LIPT	
NVA679	1206932.886	1127347.063	Yes	618.369	618.452	0.083	LIPT	

DPH-11 Report on Absolute Vertical Accuracy - continued

The purpose of this section is to show a frequency distribution chart of the non-vegetated vertical accuracy (NVA) of the DEM data measured against surveyed ground check points.

[Data Source - D:\00_ISGS\Final_Client_Tiles1](#)



DPH-11 Report on Absolute Vertical Accuracy - continued

The purpose of this section is to report the results of measuring the DEM data against surveyed ground VVA (vegetated vertical accuracy) check points. All XY coordinates and Z values reported are in the selected data units.

VVA (DEM)

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Description	Comments
VVA701	963224.142	949063.478	Yes	644.829	645.028	0.199	LIPT	
VVA702	1181486.881	1042835.69	Yes	676.13	676.263	0.133	LIPT	
VVA703	1070692.508	1079592.885	Yes	660.229	660.086	-0.143	LIPT	
VVA704	1040117.343	992597.8	Yes	668.143	667.503	-0.640	LIPT	
VVA705	993121.939	1096653.301	Yes	677.383	677.210	-0.173	LIPT	
VVA706	945755.904	1065825.234	Yes	667.996	668.193	0.197	LIPT	
VVA707	1069519.731	1043587.383	Yes	691.954	691.877	-0.077	LIPT	
VVA708	1167561.584	1027534.951	Yes	633.57	633.990	0.420	LIPT	
VVA709	1143416.929	1112184.705	Yes	664.477	664.487	0.010	LIPT	
VVA710	1040185.436	1099618.639	Yes	646.546	646.396	-0.150	LIPT	
VVA711	1040377.162	960171.193	Yes	578.813	578.872	0.059	LIPT	
VVA712	1063719.528	939699.598	Yes	612.124	611.979	-0.145	LIPT	
VVA713	1172618.775	955430.984	Yes	537.007	537.215	0.208	LIPT	
VVA714	1088985.312	1150354.182	Yes	643.044	643.232	0.188	LIPT	
VVA715	947537.982	999220.375	Yes	670.194	670.098	-0.096	LIPT	
VVA716	1208118.603	989462.972	Yes	459.557	459.824	0.267	LIPT	
VVA717	1137159.785	1057803.361	Yes	724.247	724.396	0.149	LIPT	
VVA718	1174465.797	1170279.923	Yes	673.758	673.878	0.120	LIPT	
VVA719	982949.201	1138155.437	Yes	692.666	692.532	-0.134	LIPT	
VVA720	1081057.238	993369.609	Yes	654.873	654.800	-0.073	LIPT	
VVA721	1109580.792	1052328.776	Yes	724.875	724.951	0.076	LIPT	
VVA722	960030.482	1108385.17	Yes	652.432	652.682	0.250	LIPT	
VVA723	1000104.55	1025751.422	Yes	698.694	698.514	-0.180	LIPT	
VVA724	1098909.405	919909.479	Yes	578.549	578.727	0.178	LIPT	
VVA725	1049497.737	1071391.311	Yes	660.395	660.226	-0.169	LIPT	
VVA726	999108.797	1164936.427	Yes	687.151	687.283	0.132	LIPT	
VVA727	1164733.18	1079950.184	Yes	675.646	675.653	0.007	LIPT	
VVA728	1032196.102	1020096.874	Yes	683.885	683.914	0.029	LIPT	
VVA729	1190997.829	1100702.598	Yes	632.128	632.357	0.229	LIPT	
VVA730	1141441.497	1138803.972	Yes	661.325	661.496	0.171	LIPT	

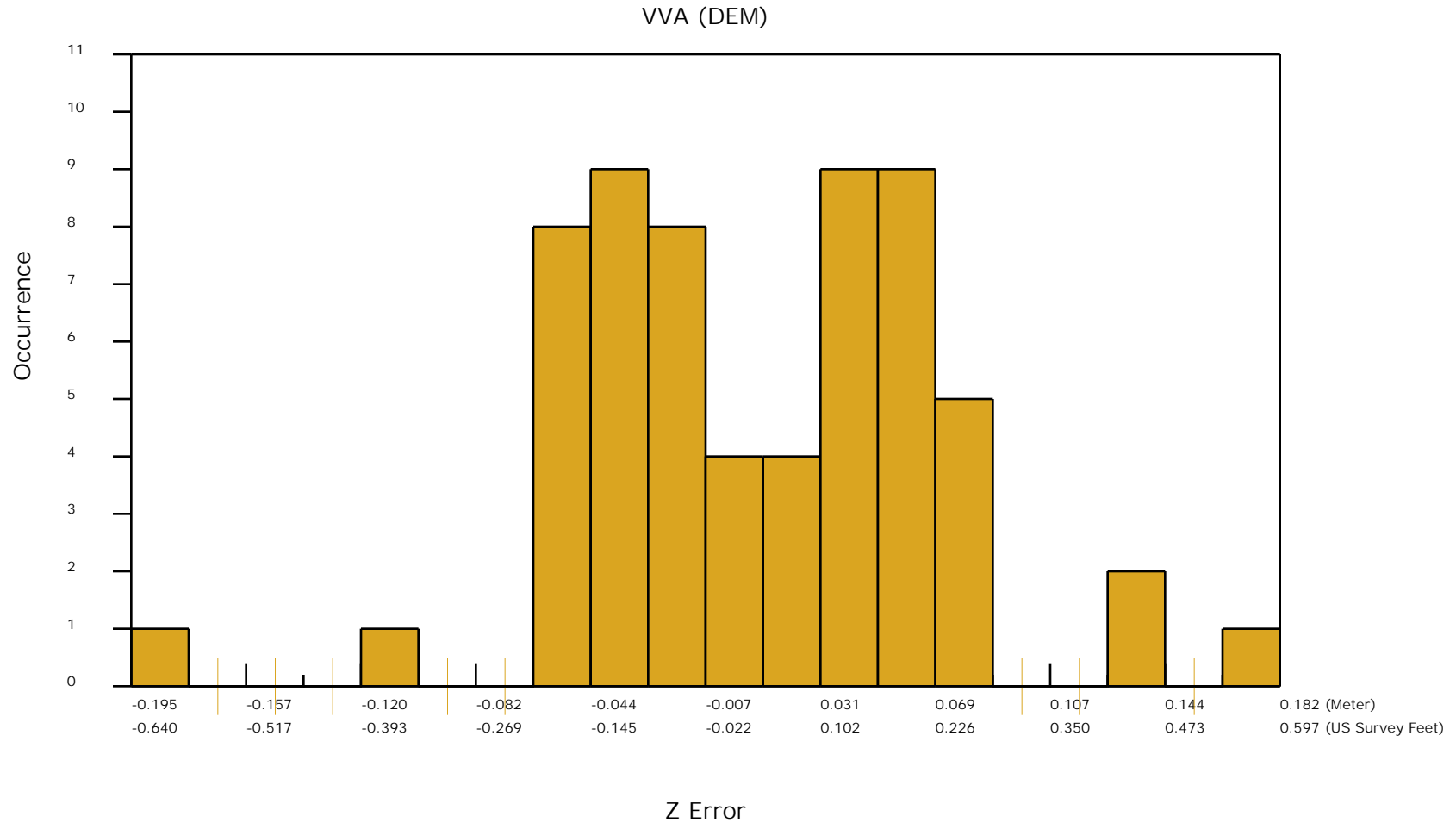
Check Points Vertical Accuracy - continued

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Description	Comments
VVA731	946143.125	954117.157	Yes	649.611	649.762	0.151	LIPT	
VVA732	1114604.381	1017248.725	Yes	668.339	668.307	-0.032	LIPT	
VVA733	1192083.663	933929.211	Yes	457.212	457.459	0.247	LIPT	
VVA734	1078138.381	1014546.121	Yes	764.865	764.745	-0.120	LIPT	
VVA735	1062651.115	1138456.716	Yes	641.69	641.839	0.149	LIPT	
VVA736	1009588.332	985662.747	Yes	689.023	688.905	-0.118	LIPT	
VVA737	970721.361	1002934.502	Yes	751.536	751.398	-0.138	LIPT	
VVA738	946067.271	1169938.889	Yes	669.827	670.275	0.448	LIPT	
VVA739	1049398.525	923048.321	Yes	600.536	600.481	-0.055	LIPT	
VVA740	945202.41	914169.761	Yes	617.871	617.830	-0.041	LIPT	
VVA741	1009398.991	949078.152	Yes	600.31	600.499	0.189	LIPT	
VVA742	987763.999	1069038.055	Yes	660.904	661.123	0.219	LIPT	
VVA723	1086401.081	964425.699	Yes	639.261	639.081	-0.180	LIPT	
VVA744	1070538.481	1129951.67	Yes	635.472	635.276	-0.196	LIPT	
VVA745	1139167.893	947585.335	Yes	583.04	583.637	0.597	LIPT	
VVA746	971546.057	935823.275	Yes	620.371	620.282	-0.089	LIPT	
VVA747	1008641.156	912282.972	Yes	583.529	583.549	0.020	LIPT	
VVA748	1160246.489	1112553.136	Yes	657.535	657.378	-0.157	LIPT	
VVA749	1096337.68	1111054.918	Yes	662.189	661.985	-0.204	LIPT	
VVA750	1132820.619	1153960.581	Yes	666.713	666.840	0.127	LIPT	
VVA751	1038453.889	1118158.336	Yes	635.962	635.772	-0.190	LIPT	
VVA752	1118888.162	1110285.493	Yes	667.014	666.974	-0.040	LIPT	
VVA753	1049756.956	1037526.871	Yes	671.247	671.152	-0.095	LIPT	
VVA754	946612.044	1142607.493	Yes	665.095	665.059	-0.036	LIPT	
VVA755	1114882.351	968343.069	Yes	615.934	616.163	0.229	LIPT	
VVA756	944828.33	1040200.413	Yes	655.358	655.475	0.117	LIPT	
VVA757	1029407.712	1060455.575	Yes	678.859	678.958	0.099	LIPT	
VVA758	1197707.898	1066551.848	Yes	661.096	661.294	0.198	LIPT	
VVA759	1032983.833	1148951.467	Yes	660.332	659.950	-0.382	LIPT	
VVA760	1189446.274	1140175.16	Yes	616.88	617.016	0.136	LIPT	
VVA761	1201525.642	1005666.566	Yes	560.301	560.370	0.069	LIPT	

DPH-11 Report on Absolute Vertical Accuracy - continued

The purpose of this section is to show a frequency distribution chart of the vegetated vertical accuracy (VVA) of the DEM data measured against surveyed ground check points.

[Data Source - D:\00_ISGS\Final_Client_Tiles1](#)

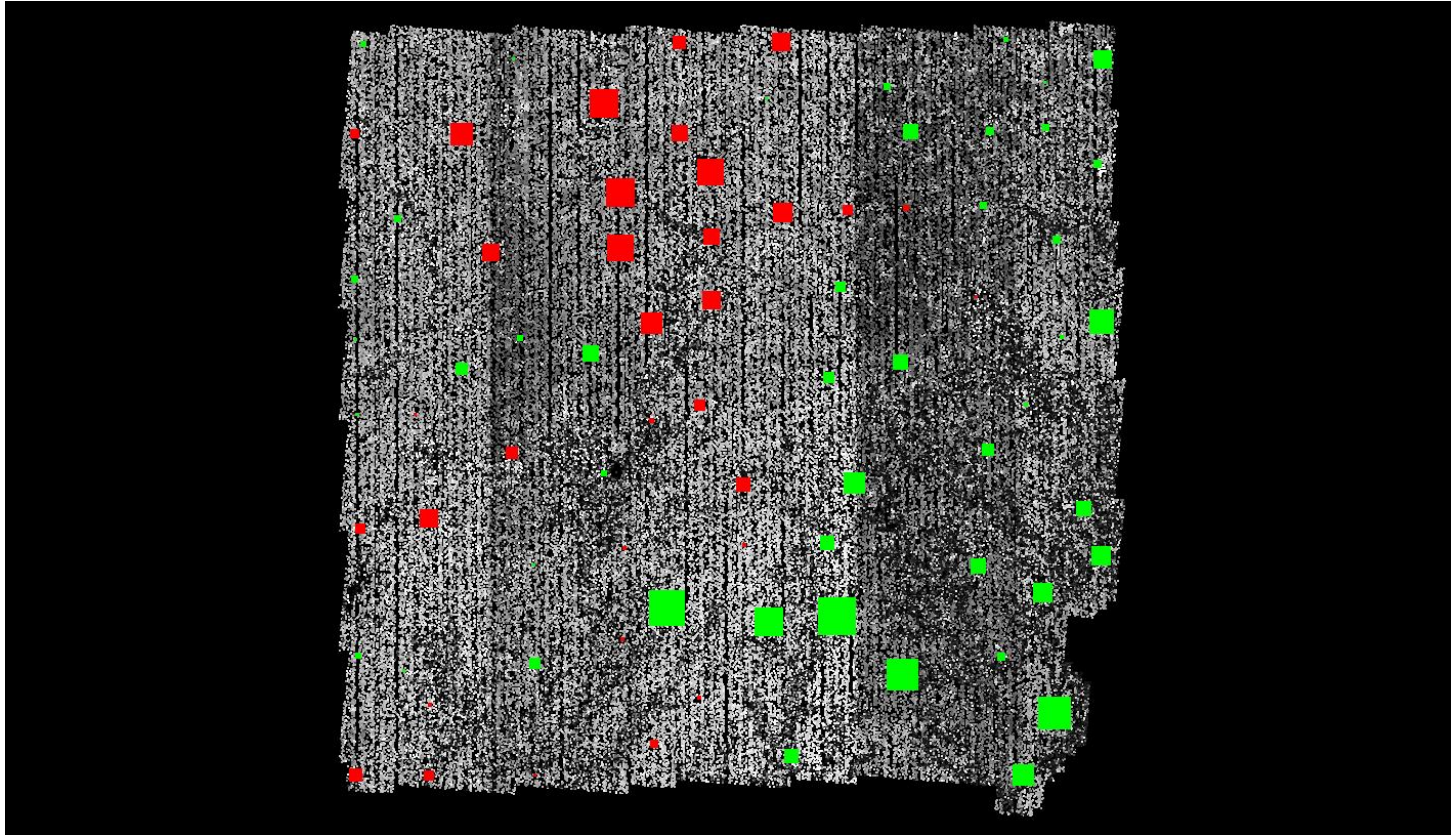


DPH-11 Report on Absolute Vertical Accuracy - continued

The purpose of this section is to show a graphic of lidar data points colored by intensity with NVA check points rendered "thematically" showing the green and red squares sized by Z error.

[Data Source - D:\00_ISGS\Final_Client_Tiles1](#)

[Result Path - D:\00_ISGS\ISGS_Wabash_Embaras_QC\DPH_11\ColorByIntensity_CheckPoints_NVA.jpg](#)



■ Green represents where the lidar surface is above the check point (positive elevation error).

■ Red represents where the lidar surface is below the check point (negative elevation error).

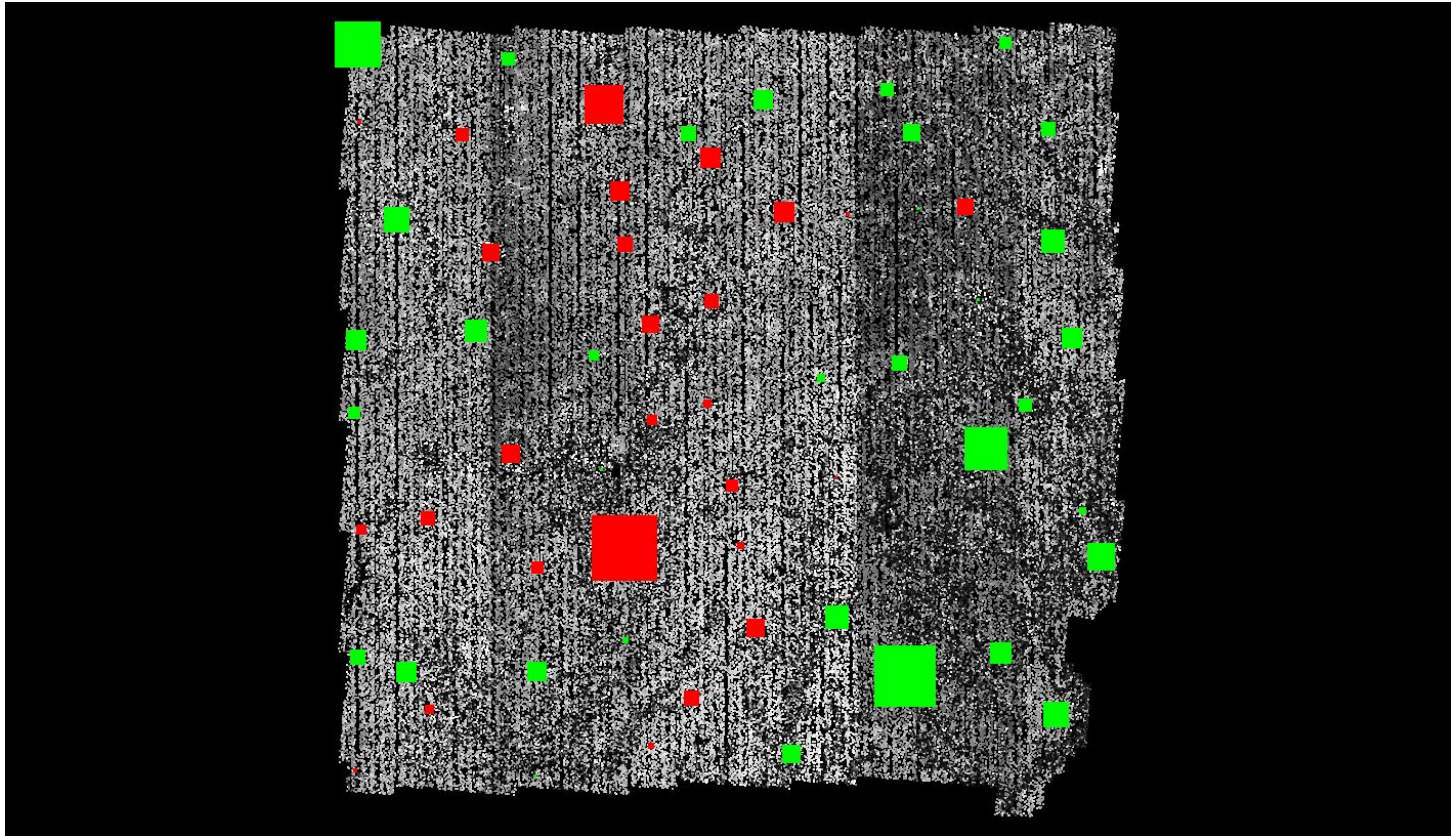
The size of the square symbol represents the absolute value magnitude of error.

DPH-11 Report on Absolute Vertical Accuracy - continued

The purpose of this section is to show a graphic of lidar data points colored by intensity with VVA check points rendered "thematically" showing the green and red squares sized by Z error.

[Data Source - D:\00_ISGS\Final_Client_Tiles1](#)

[Result Path - D:\00_ISGS\ISGS_Wabash_Embaras_QC\DPH_11\ColorByIntensity_CheckPoints_VVA.jpg](#)



■ Green represents where a DEM of the lidar surface is above the check point (positive elevation error).

■ Red represents where a DEM of the lidar surface is below the check point (negative elevation error).

The size of the square symbol represents the absolute value magnitude of error.