Control Point Survey Report
"NRCS VIRGINIA LiDAR QA"
USGS CONTRACT NUMBER: G10PC00013
TASK ORDER NUMBER: G11PD00336
JULY, 2011

Prepared for:
United States Geological Survey

Prepared By:

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1. INTRODUCTION

1.1 *Project Summary*

Dewberry & Davis, LLC is under contract to United States Geological Survey, USGS to provide 70 QA/QC Check Points for a portion of Virginia. These points will be used as an independent verification of the LiDAR to meet the minimum requirements of the NSSDA and as part of the FEMA requirement to verify LiDAR data.

Existing NGS Control Points were located and surveyed to check the accuracy of the RTK/GPS survey equipment with the results shown in Section 2.4 of this Report.

As an internal QA/QC procedure and to verify that the Check Points meet the 95% confidence level thirty (30) points were re-observed and are shown in Section 5 of this report.

Final horizontal coordinates are referenced to Virginia State Plane (North Zone), NAD83 in feet. Final vertical elevations are referenced to NAVD 88 in feet, orthometric heights, using Geoid 09.

1.2 *Points of Contact*

Questions regarding the technical aspects of this report should be addressed to:

Dewberry & Davis, LLC

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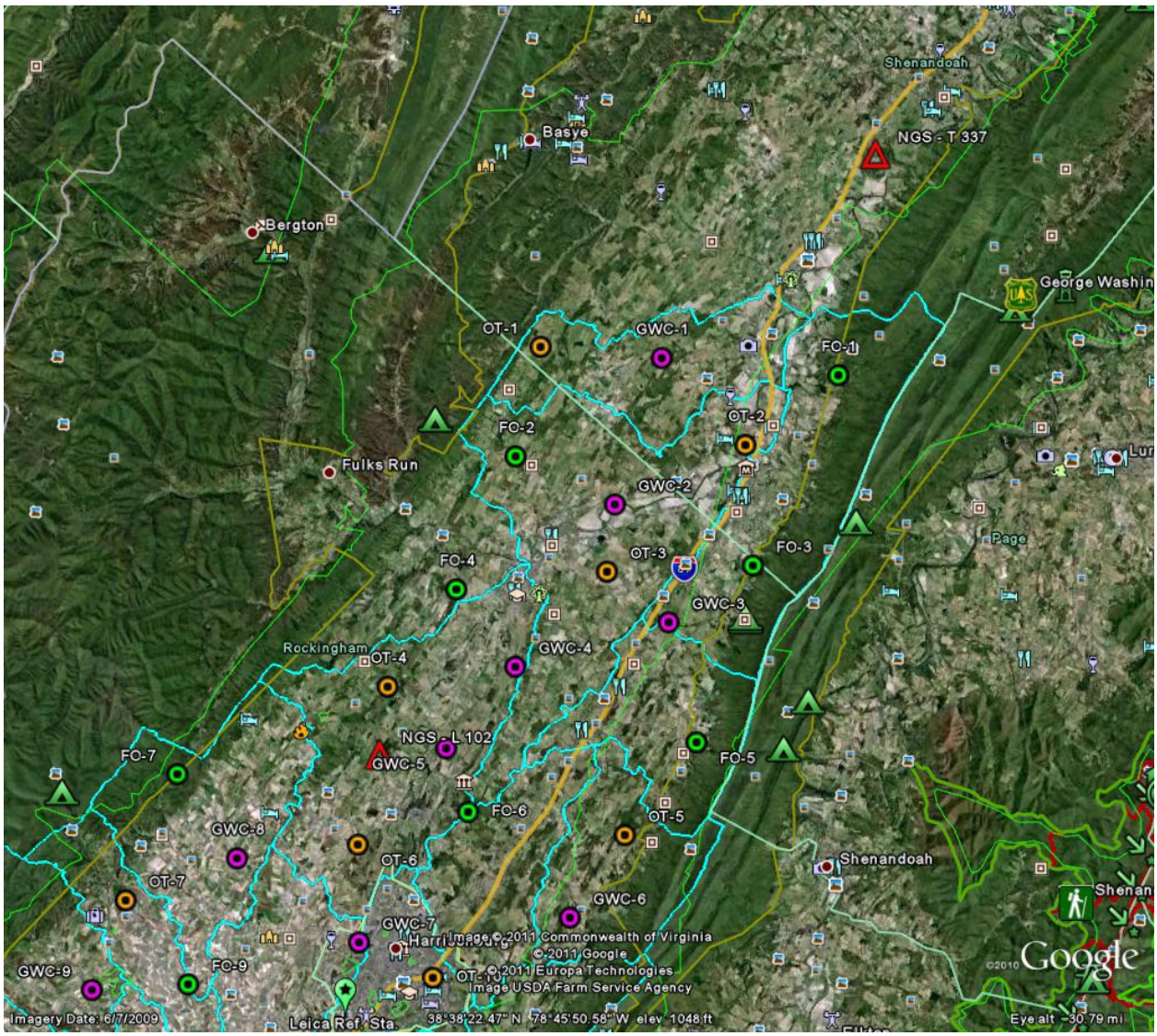
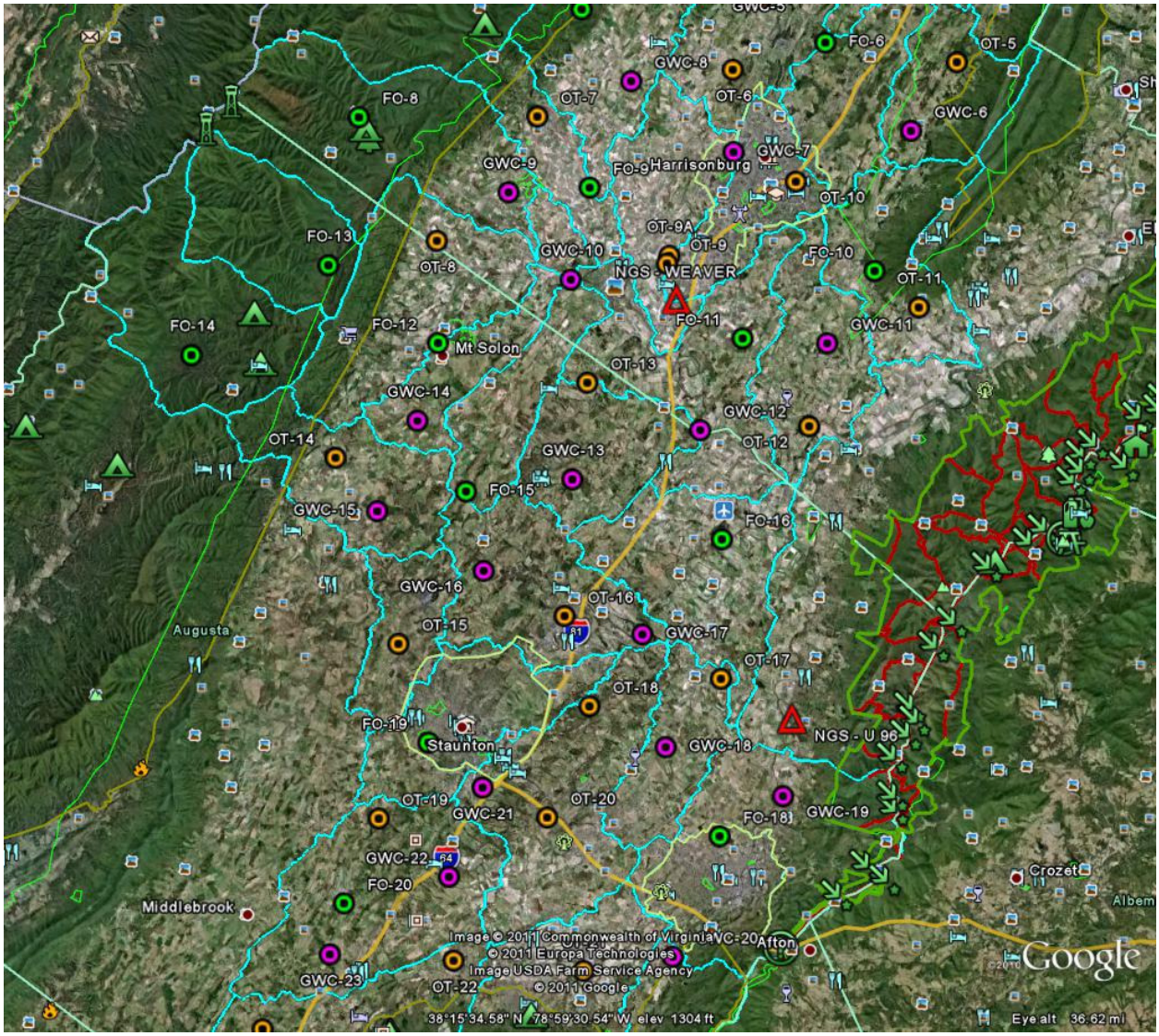
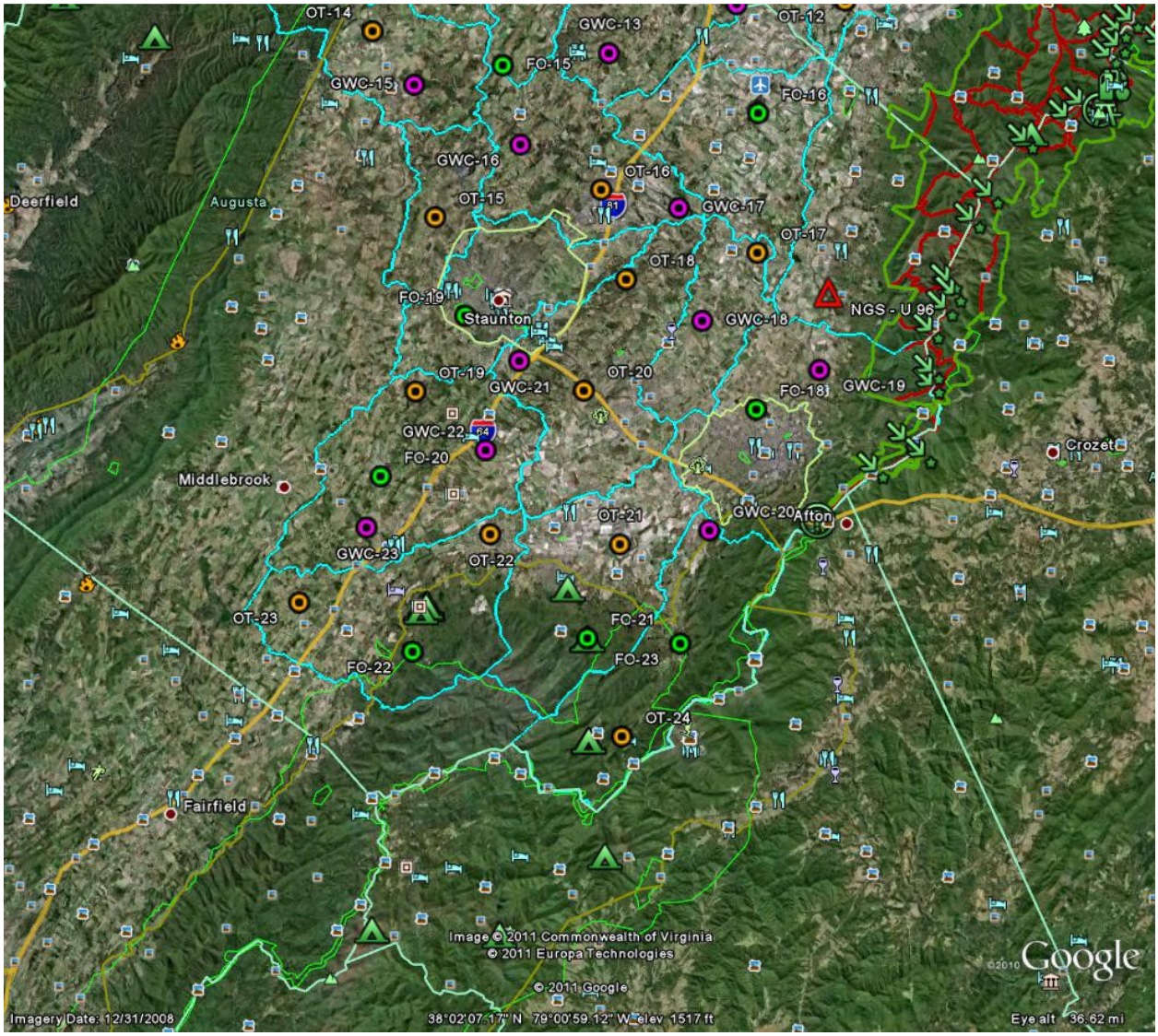
1.3 *Project Area's*




FO-8
OT-7
OT-6
FO-6
OT-5
GWC-8
GWC-6
GWC-9
FO-9
Harrisonburg
GWC-7
OT-10
OT-9A
OT-9
FO-13
GWC-10
NGS - WEAVER
FO-10
OT-11
OT-8
FO-14
FO-12
Mt Solon
FO-11
GWC-11
OT-13
GWC-14
GWC-12
OT-14
OT-12
GWC-13
FO-15
GWC-15
FO-16
GWC-16
OT-16
OT-15
Augusta
GWC-17
OT-17
OT-18
FO-19
Staunton
NGS - U 96
GWC-18
OT-19
OT-20
GWC-21
FO-18
GWC-19
GWC-22
FO-20
Crozet
Middlebrook
Image © 2011 Commonwealth of Virginia
© 2011 Europa Technologies
Image USDA Farm Service Agency
© 2011 Google
VC-20
Afton
GWC-23
OT-22
Google
38°15'34.58" N 78°59'30.54" W elev 1304 ft
Eye alt 36.62 mi


OT-14
GWC-13
OT-12
FO-15
GWC-15
FO-16
GWC-16
OT-16
Deerfield
Augusta
OT-15
GWC-17
OT-17
OT-18
FO-19
Staunton
NGS - U 96
GWC-18
OT-19
OT-20
GWC-21
FO-18
GWC-19
GWC-22
FO-20
Crozet
Middlebrook
OT-21
GWC-20
Afton
GWC-23
OT-22
OT-23
FO-21
FO-22
FO-23
OT-24
Fairfield
Image © 2011 Commonwealth of Virginia
© 2011 Europa Technologies
© 2011 Google
Google
Imagery Date: 12/31/2008
38°02'07.17" N 79°00'59.12" W elev 1517 ft
Eye alt 36.62 mi

PROJECT DETAILS

2.1 *Survey Equipment*

In performing the GPS observations, Trimble R-8 GNSS receiver/antenna attached to a two meter fixed height pole with a Trimble TSC2 Data Collector to collect raw data were used to perform the field surveys.

2.2 *Survey Point Detail*

The 70 Check Points were well distributed throughout the project area so as to cover as many flight lines as possible using the "dispersed method" of placement.

A sketch was made for each location and a nail was set at the point where possible or at an identifiable point. The Check Point locations are detailed on the "Ground Control Point Documentation Report" sheets attached to this report.

2.3 *Network Design*

The GPS survey performed by Dewberry & Davis, LLC offices located in Lanham, Maryland and Gainesville, Virginia was tied to a Real Time Network (RTN) managed by Leica Geosystems, Inc. The network is a series of continuously operating, high precision GPS reference stations. All of the reference stations have been linked together using Leica SmartNet software, creating a Virtual Reference Station System (VRS).

The Reference Stations are a multi-channel, multi-frequency GNSS (Global Navigation Satellite System) receiver designed for use as a stand-alone reference station or as part of a GNSS infrastructure solution. The SmartNet supports the modernized GPS L2C and L5 signals as well as GLONASS L1/L2 signals.

2.4 *Field Survey Procedures and Analysis*

Dewberry & Davis, LLC used Trimble R-8 GNSS receivers, which is a geodetic quality dual frequency GPS receiver, to collect data at each surveyed location.

All locations were occupied once with 43% of the locations being re-observed. All re-observations matched the initially derived station positions within the allowable tolerance of ± 5cm or within the 95% confidence level. Each occupation which utilized the VRS network was occupied for three (3) minutes in duration.

Each occupation which utilized OPUS (if used) was occupied between 18 and 20 minutes.

Field GPS observations are detailed on the "Ground Control Point Documentation Reports" submitted as part of this report.

Three (3) existing NGS monuments listed in the NSRS database were located as an additional QA/QC method to check the accuracy of the VRS network as well as being the primary project control monuments designated as PID HW1200, HW1268 and HW0695. The results are as follows:

NGS PT. ID	As Surveyed (ft)			Published (ft)			Differences (ft)		
	Northing(ft)	Easting(ft)	Elev.(ft)	Northing(ft)	Easting(ft)	Elev.(ft)	Δ N	Δ E	Δ Elev.
L-102	6878199.032	11374847.170	1301.91	6878199.15	11374847.29	1302.00	0.118	0.120	0.09
T 337	6974667.615	11455678.420	970.55	6974667.74	11455678.53	970.57	0.125	0.110	0.02
U-96	3739308.641	11382064.682	1251.43	3739308.72	11382064.58	1251.58	0.079	0.102	0.15

The above results indicate that the VRS network is providing positional values within the 5cm parameters for this survey.

2.5 *Adjustment*

The survey data was collected using Virtual Reference Stations (VRS) methodology within a Virtual Reference System (VRS).

The system is designed to provide a true Network RTK performance, the RTKNet software enables high-accuracy positioning in real time across a geographic region. The RTKNet software package uses real-time data streams from the GPSNet system user and generates correction models for high-accuracy RTK GPS corrections throughout the network. Therefore, corrections were applied to the points as they were being collected, thus negating the need for a post process adjustment.

2.6 *Data Processing Procedures*

After field data is collected the information is downloaded from the data collectors into the office software. The Software program used is called TGO or Trimble Geomatics Office.

Downloaded data is run through the TGO program to obtain the following reports; points report, point comparison report and a point detail report. The reports are reviewed for point accuracy and precision.

After review of the point data an “ASCII” or “txt” file which is the industry standard is created. Point files are loaded into our CADD program (Carlson Survey 2010) to make a visual check of the point data (Pt. #, Coordinates, Elev. and Description). The data can now be imported into the final product.

3. FINAL COORDINATES

NRCS VIRGINIA LiDAR QA			
VIRGINIA STATE PLANE COORDINATE SYSTEM			
	NAD83 (ft)		NAVD88 (ft)
POINT ID	NORTHING (ft)	EASTING (ft)	ORTHO HEIGHT (ft)
OPEN TERRAIN POINTS			
OT-1	6943946.130	11401372.150	1365.47
OT-2	6927979.324	11434294.590	958.66
OT-3	6907669.989	11411942.050	1099.45
OT-4	6889401.618	11376387.520	1417.62
OT-5	6865311.135	11414634.460	1243.05
OT-6	6864125.755	11371393.260	1285.26
OT-7	6855129.404	11333822.170	1459.09
OT-8	6831556.131	11314774.200	1416.53
OT-9	6828375.387	11359113.460	1302.74
OT-9A	6826969.495	11358613.630	1290.87
OT-10	6841410.764	11382953.800	1406.96
OT-11	6818347.923	11407007.170	1201.47
OT-12	6795554.597	11385649.270	1147.46
OT-13	6803946.632	11343075.530	1284.43
OT-14	6789972.955	11294774.810	1585.75
OT-15	6754311.031	11306651.260	1446.64
OT-16	6759428.602	11338657.490	1211.69
OT-17	6747302.773	11368632.100	1241.12
OT-18	6742225.856	11343276.750	1355.13
OT-19	6720932.085	11302724.540	1564.35
OT-20	6720939.667	11335072.080	1417.45
OT-21	6691539.619	11341872.830	1390.93
OT-22	6693591.047	11316957.610	1458.66
OT-23	6680704.178	11280197.890	1763.19
OT-24	6654792.569	11342071.240	1717.76
GRASS, WEEDS, CROPS POINTS			
GWC-1	6942056.079	11420950.200	1074.68
GWC-2	6918481.767	11412755.660	972.25
GWC-3	6899051.849	11422256.700	1103.94
GWC-4	6892376.735	11397045.120	1223.33

GWC-5	6879007.682	11385900.100	1172.51
GWC-6	6852023.594	11405689.500	1496.06
GWC-7	6848358.477	11371449.450	1395.19
GWC-8	6861735.775	11351842.010	1374.41
GWC-9	6839122.948	11327326.570	1391.03
GWC-10	6823757.117	11340023.060	1286.07
GWC-11	6810377.805	11389233.250	1214.03
GWC-12	6794902.484	11365029.150	1134.24
GWC-13	6785598.513	11340243.570	1334.45
GWC-14	6797023.859	11310487.330	1472.86
GWC-15	6779740.983	11302653.220	1476.38
GWC-16	6768607.195	11323034.230	1426.86
GWC-17	6755579.055	11353684.810	1263.45
GWC-18	6734242.608	11357911.840	1216.81
GWC-19	6724783.353	11380439.110	1257.20
GWC-20	6694139.400	11358999.730	1348.15
GWC-21	6726714.437	11322663.540	1513.64
GWC-22	6709575.976	11316179.280	1456.64
GWC-23	6694964.347	11293214.170	1667.62
FOREST POINTS			
FO-1	6939020.271	11449766.574	1021.31
FO-2	6926210.612	11397232.114	1284.27
FO-3	6908601.254	11435623.488	1028.52
FO-4	6904651.024	11387823.645	1185.08
FO-5	6882580.918	11427054.237	1207.36
FO-6	6866320.926	11392868.279	1319.34
FO-7	6875520.708	11342546.834	1628.76
FO-8	6855588.458	11298849.688	2047.82
FO-9	6842898.978	11343576.721	1320.92
FO-10	6824860.343	11398806.025	1402.31
FO-11	6813138.452	11372345.229	1346.79
FO-12	6812049.278	11314400.523	1354.44
FO-13	6826781.229	11293667.059	1783.29
FO-14	6810108.714	11266970.748	2155.57
FO-15	6783672.039	11319722.335	1501.54
FO-16	6774097.543	11368855.140	1183.14
FO-18	6717248.810	11368191.190	1374.34
FO-19	6735364.262	11312350.300	1552.21

FO-20	**6704602.907**	**11295924.400**	**1963.95**
FO-21	**6678785.228**	**11332719.420**	**1639.25**
FO-22	**6672190.490**	**11301838.750**	**1880.08**
FO-23	**6672492.581**	**11353349.450**	**1507.85**

4. GPS OBSERVATION & RE-OBSERVATION SCHEDULE

NRCS VIRGINIA LiDAR QA					
POINT ID	OBSERV. DATE	JULIAN DATE	TIME OF DAY	RE-OBSERV. DATE	RE-OBSERV. TIME
OPEN TERRAIN POINTS					
OT-1	7/18/2011	199	16:25	7/19/2011	13:48
OT-2	7/18/2011	199	16:00	7/19/2011	14:56
OT-3	7/19/2011	200	12:20	7/20/2011	11:37
OT-4	7/19/2011	200	10:45	7/20/2011	10:40
OT-5	7/19/2011	200	17:30	N/A	N/A
OT-6	7/19/2011	200	8:40	7/20/2011	8:05
OT-7	7/19/2011	200	17:10	7/21/2011	10:25
OT-8	7/19/2011	200	18:05	7/21/2011	10:52
OT-9	7/20/2011	201	7:05	N/A	N/A
OT-9A	7/19/2011	200	16:10	7/21/2011	9:28
OT-10	7/20/2011	201	8:12	7/21/2011	7:30
OT-11	7/19/2011	200	10:44	7/21/2011	8:33
OT-12	7/20/2011	201	14:15	N/A	N/A
OT-13	7/20/2011	201	13:00	N/A	N/A
OT-14	7/19/2011	200	20:20	N/A	N/A
OT-15	7/19/2011	200	15:07	7/20/2011	14:14
OT-16	7/20/2011	201	8:22	7/20/2011	14:38
OT-17	7/20/2011	201	7:08	N/A	N/A
OT-18	7/18/2011	199	16:35	N/A	N/A
OT-19	7/18/2011	199	14:18	N/A	N/A
OT-20	7/20/2011	201	8:56	7/20/2011	16:20
OT-21	7/19/2011	200	11:51	N/A	N/A
OT-22	7/19/2011	200	12:31	N/A	N/A
OT-23	7/19/2011	200	13:18	N/A	N/A
OT-24	7/20/2011	201	9:50	N/A	N/A
GRASS, WEEDS, CROPS POINTS					
GWC-1	7/18/2011	199	15:40	7/19/2011	14:21
GWC-2	7/19/2011	200	13:00	7/20/2011	11:55
GWC-3	7/19/2011	200	16:30	N/A	N/A
GWC-4	7/19/2011	200	11:35	7/20/2011	11:20

GWC-5	7/19/2011	200	10:00	7/20/2011	10:25
GWC-6	7/19/2011	200	18:05	N/A	N/A
GWC-7	7/19/2011	200	7:45	7/20/2011	7:45
GWC-8	7/20/2011	201	8:25	N/A	N/A
GWC-9	7/19/2011	200	17:35	7/21/2011	10:38
GWC-10	7/19/2011	200	14:25	7/21/2011	9:59
GWC-11	7/19/2011	200	11:22	7/21/2011	8:51
GWC-12	7/20/2011	201	13:31	N/A	N/A
GWC-13	7/20/2011	201	12:35	N/A	N/A
GWC-14	7/19/2011	200	19:44	N/A	N/A
GWC-15	7/20/2011	201	10:19	N/A	N/A
GWC-16	7/20/2011	201	12:06	N/A	N/A
GWC-17	7/20/2011	201	7:45	7/20/2011	16:07
GWC-18	7/20/2011	201	18:32	7/20/2011	16:20
GWC-19	7/19/2011	200	9:12	7/20/2011	16:46
GWC-20	7/19/2011	200	9:56	N/A	N/A
GWC-21	7/18/2011	199	16:45	7/20/2011	13:53
GWC-22	7/19/2011	200	14:32	7/20/2011	13:04
GWC-23	7/19/2011	200	13:46	7/20/2011	12:20
FOREST POINTS					
FO-1	7/18/2011	199	13:50	N/A	N/A
FO-2	7/20/2011	201	12:15	N/A	N/A
FO-3	7/19/2011	200	15:35	N/A	N/A
FO-4	7/20/2011	201	13:30	7/22/2011	6:15
FO-5	7/20/2011	201	16:10	N/A	N/A
FO-6	7/20/2011	201	14:50	N/A	N/A
FO-7	7/20/2011	201	9:05	N/A	N/A
FO-8	7/20/2011	201	18:48	7/22/2011	9:30
FO-9	7/19/2011	200	16:30	N/A	N/A
FO-10	7/19/2011	200	8:45	N/A	N/A
FO-11	7/19/2011	200	11:48	N/A	N/A
FO-12	7/19/2011	200	18:45	7/22/2011	11:21
FO-13	7/20/2011	201	17:45	N/A	N/A
FO-14	7/20/2011	201	16:29	N/A	N/A
FO-15	7/20/2011	201	11:15	N/A	N/A
FO-16	7/20/2011	201	14:50	N/A	N/A
FO-18	7/21/2011	202	7:03	N/A	N/A
FO-19	7/21/2011	202	8:45	N/A	N/A
FO-20	7/21/2011	202	10:10	N/A	N/A

FO-21	**7/21/2011**	**202**	**14:35**	**N/A**	**N/A**
FO-22	**7/21/2011**	**202**	**12:02**	**N/A**	**N/A**
FO-23	**7/21/2011**	**202**	**16:15**	**N/A**	**N/A**

5. POINT COMPARISON REPORT

NRCS VIRGINIA LiDAR QA				
POINT ID	POINT CK	DELTA NORTH (FT)	DELTA EAST (FT)	VERT. DIFF (FT)
OT-1	OT-1CK	0.012	0.05	0.09
OT-2	OT-2CK	0.145	0.100	0.14
OT-3	OT-3CK	0.093	0.070	0.15
OT-4	OT-4CK	0.113	0.120	0.06
OT-6	OT-6CK	0.101	0.020	0.15
OT-7	OT-7CK	0.054	0.010	0.05
OT-8	OT-8CK	0.042	0.130	0.15
OT-9A	OT-9ACK	0.046	0.090	0.12
OT-10	OT-10CK	0.061	0.020	0.07
OT-11	OT-11CK	0.044	0.040	0.15
OT-15	OT-15CK	0.051	0.050	0.05
OT-16	OT-16CK	0.023	0.010	0.03
OT-20	OT-20CK	0.073	0.08	0.14
GWC-1	GWC-1CK	0.003	0.020	0.14
GWC-2	GWC-2CK	0.116	0.130	0.03
GWC-4	GWC-4CK	0.068	0.000	0.15
GWC-5	GWC-5CK	0.116	0.140	0.04
GWC-7	GWC-7CK	0.002	0.001	0.14
GWC-9	GWC-9CK	0.141	0.070	0.04
GWC-10	GWC-10CK	0.022	0.060	0.10
GWC-11	GWC-11CK	0.021	0.020	0.14
GWC-17	GWC-17CK	0.048	0.030	0.10
GWC-18	GWC-18CK	0.142	0.145	0.09
GWC-19	GWC-19CK	0.150	0.010	0.06
GWC-21	GWC-21CK	0.032	0.030	0.00
GWC-22	GWC-22CK	0.006	0.030	0.12
GWC-23	GWC-23CK	0.021	0.120	0.14
FO-4	FO-4CK	0.015	0.009	0.09
FO-8	FO-8CK	0.002	0.010	0.10
FO-12	FO-12CK	0.016	0.120	0.09