

Check Point Survey Report
“Western Tennessee LiDAR Quality Assurance”
USACE, St. Louis Contract: W912P9-10-D-0534
Task Order Number: 0001

Prepared for:
UNITED STATES ARMY CORPS OF ENGINEERS



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Including: a) Point Documentation Report & Photos of Survey Points
b) Final Coordinate List in Excel Format
c) NGS Data Sheets for Project Controls

1. INTRODUCTION

1.1 *Project Summary*

Dewberry & Davis, LLC is under contract to the United States Army Corps of Engineers to provide 65 QA Check Points for portions of western Tennessee. Under the above referenced USACE Task Order, Dewberry is tasked to complete the quality assurance of high resolution LiDAR-derived elevation products. As part of this work Dewberry staff will complete checkpoint surveys that will be used to evaluate vertical accuracy on the bare-earth terrain derived from the LiDAR.

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 approximately 50% of the points were re-observed and are shown in Section 5 of this report.

Final horizontal coordinates are referenced to UTM, Zone 16, NAD83 (NSRS 2007), in meters. Final Vertical elevations are referenced to NAVD 88 in meters, orthometric heights, using Geoid 09.

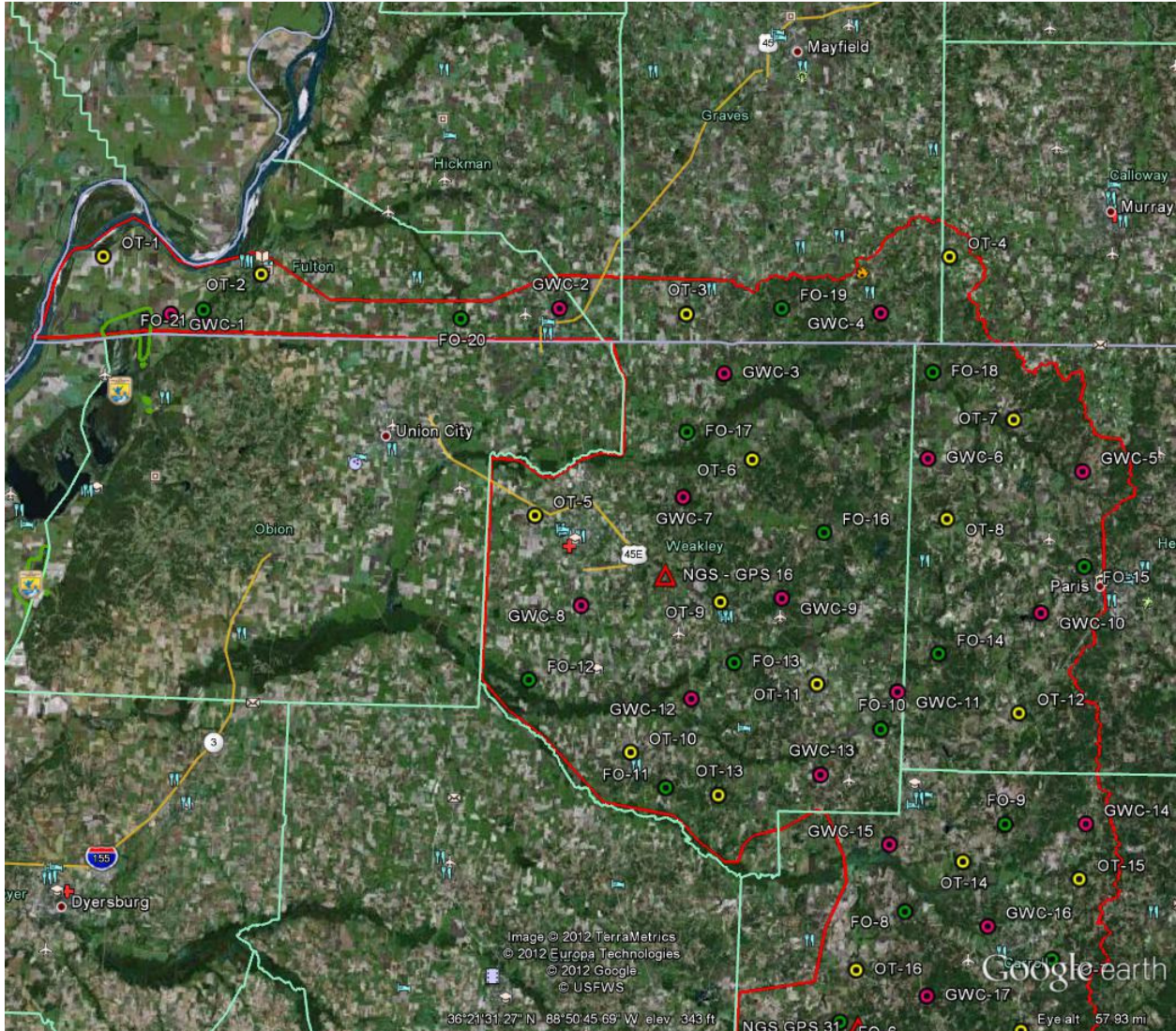
1.2 *Points of Contact*

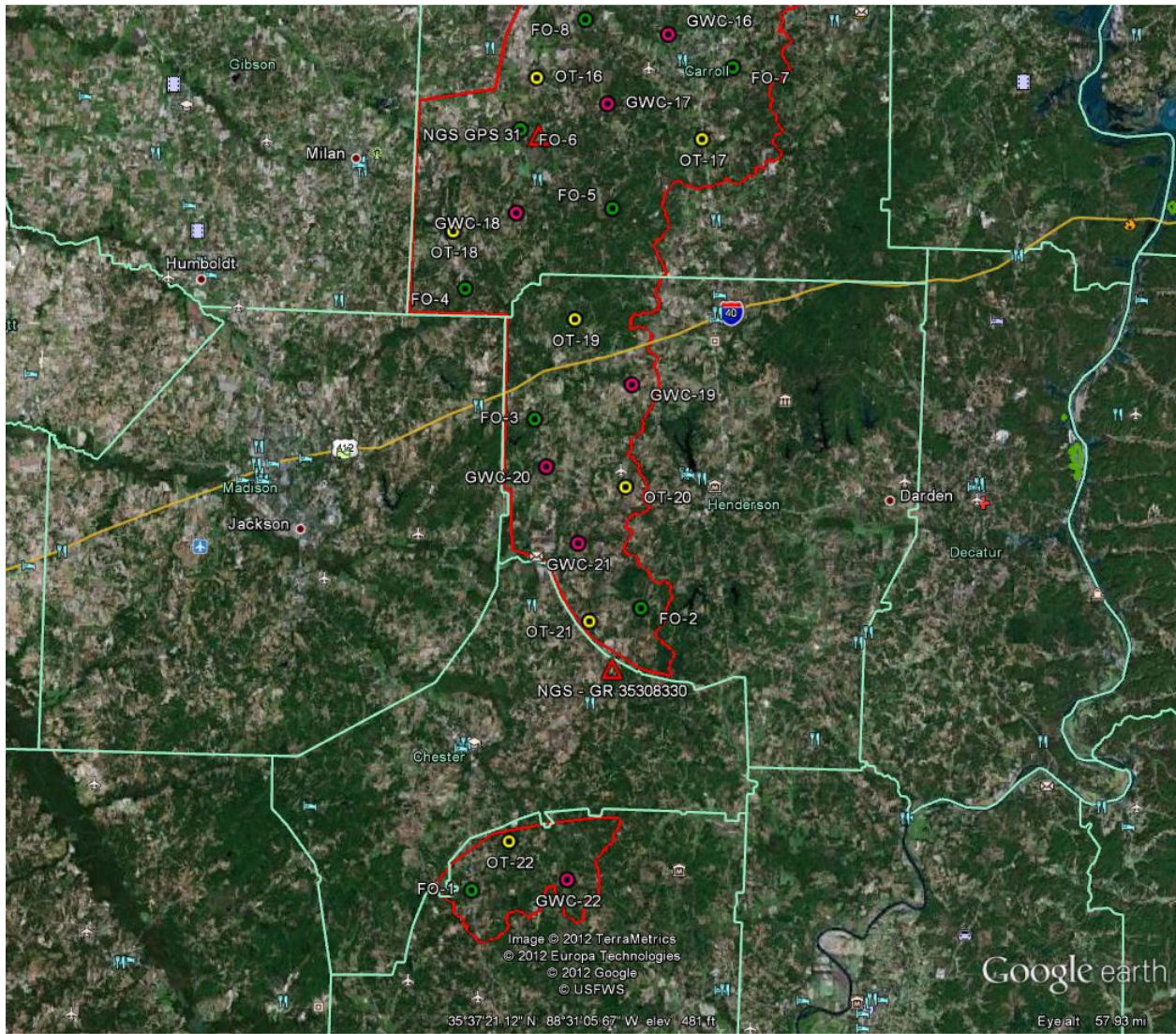
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1.3 Project Area





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 GPS raw data were used to perform the field surveys.

2.2 *Survey Point Detail*

The 65 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, Inc office located in Charlotte, NC was tied to a Real Time Network (RTN) managed by Earl Dudley, Inc. The network is a series of “real-time” continuously operating, high precision GPS reference stations. All of the reference stations have been linked together using Trimble GPSNet software, creating a Virtual Reference Station System (VRS).

The Trimble NetR5 Reference Station is 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. Trimble R-Track technology in the NetR5 receiver supports the modernized GPS L2C and L5 signals as well as GLONASS L1/L2 signals.

2.4 *Field Survey Procedures and Analysis*

Dewberry & Davis, Inc 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 approximately 50% of the locations being re-observed. All re-observations matched the initially derived station positions within the allowable tolerance of $\pm 5\text{cm}$ or within the 95% confidence level. Each occupation which utilized the VRS network was occupied for approximately three (3) minutes in duration and measured to 180 epochs.

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 GD1864, FE2743 and DF7952. The results are as follows:

NGS PT. ID	As Surveyed (m)			Published (m)			Differences (m)		
	Northing(m)	Easting(m)	Elev.(m)	Northing(m)	Easting(m)	Elev.(m)	ΔN	ΔE	$\Delta \text{Elev.}$
GPS-16	4019915.117	341042.783	123.765	4019915.158	341042.843	123.810	0.041	0.044	0.045
GPS-31	3978322.256	358119.153	160.080	3978322.214	358119.138	160.060	0.042	0.015	0.020
GR35308830	3929542.576	364127.095	177.676	3929542.518	364127.066	177.760	0.045	0.029	0.045

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

Western Tennessee LiDAR QA			
UTM ZONE 16 COORDINATE SYSTEM			
	NAD83 (m)		NAVD88 (m)
POINT ID	NORTHING (m)	EASTING (m)	ORTHO HEIGHT (m)
OPEN TERRAIN POINTS			
OT-1	4049907.640	289945.985	89.367
OT-2	4047970.861	304368.957	112.505
OT-3	4043755.984	343395.275	140.964
OT-4	4048546.271	367641.024	168.794
OT-5	4025330.811	329817.948	112.500
OT-6	4030094.056	349375.762	130.389
OT-7	4033900.306	373227.887	148.984
OT-8	4024706.928	367001.532	159.809
OT-9	4017452.144	346136.297	127.363
OT-10	4002968.264	337927.239	129.605
OT-11	4009951.131	354721.756	124.110
OT-12	4006933.234	373346.052	160.290
OT-13	3999895.003	345662.642	142.549
OT-14	3993443.767	368027.546	147.250
OT-15	3990261.868	377117.831	140.939
OT-16	3983720.451	358096.711	128.291
OT-17	3977871.976	373230.811	141.456
OT-18	3969755.295	350225.878	167.648
OT-19	3961394.052	361165.067	188.806
OT-20	3946196.752	365675.288	159.277
OT-21	3933866.487	361680.219	156.057
OT-22	3913981.450	354538.651	138.286
GRASS, WEEDS, CROPS POINTS			
GWC-1	4045825.528	296343.859	88.808
GWC-2	4043378.797	330471.153	125.883
GWC-3	4038288.650	346717.463	136.383
GWC-4	4043417.818	361257.759	169.737
GWC-5	4028824.765	379807.963	181.260
GWC-6	4030264.404	365350.035	140.218
GWC-7	4027056.977	342845.684	116.240

GWC-8	4017493.661	333407.271	105.673
GWC-9	4017498.350	351847.313	161.613
GWC-10	4016738.674	375743.968	149.310
GWC-11	4008864.861	360744.771	144.852
GWC-12	4008620.615	343036.177	117.702
GWC-13	4001587.357	353748.495	112.081
GWC-14	3996648.848	379411.701	126.872
GWC-15	3995244.448	360206.428	110.044
GWC-16	3987469.150	370400.878	134.777
GWC-17	3981010.623	364344.798	128.661
GWC-18	3971245.356	357881.823	138.358
GWC-19	3955372.908	365960.522	153.563
GWC-20	3948127.949	358440.123	160.620
GWC-21	3941261.974	361687.862	129.442
GWC-22	3910737.871	359178.734	170.314
FOREST POINTS			
FO-1	3909569.952	351039.841	144.344
FO-2	3935149.828	366896.075	141.108
FO-3	3952500.611	357458.634	171.513
FO-4	3964501.654	351271.451	145.570
FO-5	3971479.694	365264.316	158.371
FO-6	3979015.464	356518.959	144.062
FO-7	3984265.939	376137.621	119.325
FO-8	3988908.528	362614.675	142.846
FO-9	3997503.242	371585.684	151.872
FO-10	4005535.554	360764.578	139.161
FO-11	4000595.381	340852.201	132.520
FO-12	4010663.085	328464.954	103.159
FO-13	4011902.706	346918.022	108.309
FO-14	4012460.756	366040.808	130.483
FO-15	4020196.111	379421.969	168.141
FO-16	4023638.692	356088.513	149.606
FO-17	4033164.195	341848.656	125.005
FO-18	4038132.403	365888.510	124.507
FO-19	4045860.741	353120.220	163.329
FO-20	4043733.057	322747.653	108.728
FO-21	4044818.368	299081.833	99.766

4. GPS OBSERVATION & RE-OBSERVATION SCHEDULE

Western Tennessee LiDAR QA					
POINT ID	OBSERV. DATE	JULIAN DATE	TIME OF DAY	RE-OBSERV. DATE	RE-OBSERV. TIME
OPEN TERRAIN POINTS					
OT-1	2/15/2012	46	8:35	N/A	N/A
OT-2	2/15/2012	46	7:38	N/A	N/A
OT-3	2/15/2012	46	16:51	N/A	N/A
OT-4	2/17/2012	48	7:11	N/A	N/A
OT-5	2/16/2012	47	11:01	2/19/2012	12:09
OT-6	2/17/2012	48	14:05	2/19/2012	13:17
OT-7	2/16/2012	47	15:01	2/19/2012	15:05
OT-8	2/16/2012	47	14:30	2/19/2012	14:40
OT-9	2/16/2012	47	9:14	2/18/2012	13:56
OT-10	2/19/2012	50	7:20	2/14/2012	8:50
OT-11	2/16/2012	47	7:13	2/19/2012	9:49
OT-12	2/16/2012	47	16:35	2/19/2012	16:13
OT-13	2/19/2012	50	7:50	2/19/2012	15:55
OT-14	2/17/2012	48	13:45	2/18/2012	16:25
OT-15	2/17/2012	48	12:20	N/A	N/A
OT-16	2/17/2012	48	15:05	2/18/2012	11:40
OT-17	2/17/2012	48	10:00	N/A	N/A
OT-18	2/16/2012	47	15:15	2/18/2012	6:20
OT-19	2/16/2012	47	14:35	2/17/2012	7:20
OT-20	2/15/2012	46	13:20	2/16/2012	12:15
OT-21	2/15/2012	46	11:10	2/16/2012	10:44
OT-22	2/15/2012	46	8:50	N/A	N/A
GRASS, WEEDS, CROPS POINTS					
GWC-1	2/15/2012	46	9:53	N/A	N/A
GWC-2	2/15/2012	46	15:54	N/A	N/A
GWC-3	2/16/2012	47	13:15	N/A	N/A
GWC-4	2/17/2012	48	8:35	N/A	N/A
GWC-5	2/16/2012	47	15:29	2/19/2012	15:26:00
GWC-6	2/16/2012	47	14:05	N/A	N/A
GWC-7	2/16/2012	47	11:47	2/18/2012	16:46
GWC-8	2/16/2012	47	10:04	2/18/2012	11:39

GWC-9	2/16/2012	47	8:42	N/A	N/A
GWC-10	2/16/2012	47	16:00	2/19/2012	15:50
GWC-11	2/16/2012	47	6:37	2/19/2012	9:26
GWC-12	2/16/2012	47	7:51	2/19/2012	10:19
GWC-13	2/19/2012	50	16:25	N/A	N/A
GWC-14	2/17/2012	48	12:45	2/19/2012	14:20
GWC-15	2/17/2012	48	14:30	N/A	N/A
GWC-16	2/17/2012	48	11:25	2/18/2012	14:00
GWC-17	2/17/2012	48	15:20	N/A	N/A
GWC-18	2/16/2012	47	15:45	2/18/2012	7:20
GWC-19	2/16/2012	47	14:00	N/A	N/A
GWC-20	2/15/2012	46	14:20	2/17/2012	6:40
GWC-21	2/15/2012	46	12:20	N/A	N/A
GWC-22	2/15/2012	46	7:30	N/A	N/A
FOREST POINTS					
FO-1	2/16/2012	47	8:30	N/A	N/A
FO-2	2/16/2012	47	11:30	N/A	N/A
FO-3	2/16/2012	47	13:15	N/A	N/A
FO-4	2/17/2012	48	8:00	2/19/2012	14:21
FO-5	2/18/2012	49	8:00	N/A	N/A
FO-6	2/17/2012	48	9:20	N/A	N/A
FO-7	2/18/2012	49	14:40	N/A	N/A
FO-8	2/18/2012	49	12:45	2/19/2012	9:45
FO-9	2/19/2012	50	13:20	N/A	N/A
FO-10	2/19/2012	50	12:30	N/A	N/A
FO-11	2/19/2012	50	9:45	N/A	N/A
FO-12	2/18/2012	49	12:49	N/A	N/A
FO-13	2/18/2012	49	9:00	2/19/2012	13:22
FO-14	2/18/2012	49	6:20	N/A	N/A
FO-15	2/18/2012	49	7:30	N/A	N/A
FO-16	2/18/2012	49	14:15	N/A	N/A
FO-17	2/17/2012	48	14:56	N/A	N/A
FO-18	2/17/2012	48	12:12	N/A	N/A
FO-19	2/17/2012	48	10:15	2/19/2012	16:44
FO-20	2/15/2012	46	14:10	N/A	N/A
FO-21	2/15/2012	46	10:31	N/A	N/A

5. POINT COMPARISON REPORT

Western Tennessee LiDAR QA				
POINT ID NO.	POINT CK NO.	DELTA NORTH (m)	DELTA EAST (m)	VERT. DIFF (m)
OT-5	OT-5CK	0.029	0.032	0.041
OT-6	OT-6CK	0.041	0.043	0.032
OT-7	OT-7CK	0.005	0.000	0.020
OT-8	OT-8CK	0.026	0.029	0.011
OT-9	OT-9CK	0.032	0.035	0.010
OT-10	OT-10CK	0.014	0.004	0.005
OT-11	OT-11CK	0.011	0.043	0.043
OT-12	OT-12CK	0.002	0.007	0.003
OT-13	OT-13CK	0.022	0.002	0.008
OT-14	OT-14CK	0.017	0.018	0.044
OT-16	OT-16CK	0.044	0.013	0.044
OT-18	OT-18CK	0.043	0.045	0.045
OT-19	OT-19CK	0.038	0.022	0.045
OT-20	OT-20CK	0.012	0.016	0.014
OT-21	OT-21CK	0.025	0.027	0.045
GWC-5	GWC-5CK	0.042	0.018	0.014
GWC-7	GWC-7CK	0.046	0.045	0.045
GWC-8	GWC-8CK	0.045	0.045	0.043
GWC-10	GWC-10CK	0.022	0.000	0.018
GWC-11	GWC-11CK	0.011	0.005	0.020
GWC-12	GWC-12CK	0.025	0.045	0.044
GWC-14	GWC-14CK	0.044	0.043	0.045
GWC-16	GWC-16CK	0.007	0.008	0.006
GWC-18	GWC-18CK	0.022	0.033	0.045
GWC-20	GWC-20CK	0.003	0.030	0.045
FO-4	FO-4CK	0.025	0.035	0.021
FO-8	FO-8CK	0.012	0.019	0.009
FO-13	FO-13CK	0.034	0.025	0.026
FO-19	FO-19CK	0.029	0.038	0.022