LiDAR Check Point Survey Report
"FEMA Region 2 Great Lakes Area QL2 LiDAR"
USGS Contract: G10PC00013
Task Order Number: GP13PD00043

Prepared for:
United States Geological Survey (USGS)

Prepared By:
Dewberry Consultants LLC
10003 Derekwood Lane, Suite 204
Lanham, Maryland, 20706
Phone (301)364-1855 Fax (301)731-0188

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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 Consultants LLC is under contract to the United States Geological Survey to provide 84 Check Points in the State of New York. Under the above referenced USGS Task Order, Dewberry is tasked to complete the quality assurance of Aerial Photography & Digital Orthophotography products. As part of this work Dewberry staff will complete Check Point surveys that will be used to evaluate horizontal accuracy. The ground survey was conducted April 20 to April 23, 2015.

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 18, NAD83 (2011) in meters. Final Vertical elevations are referenced to NAVD88 in meters using Geoid model 2012A (Geoid12A).
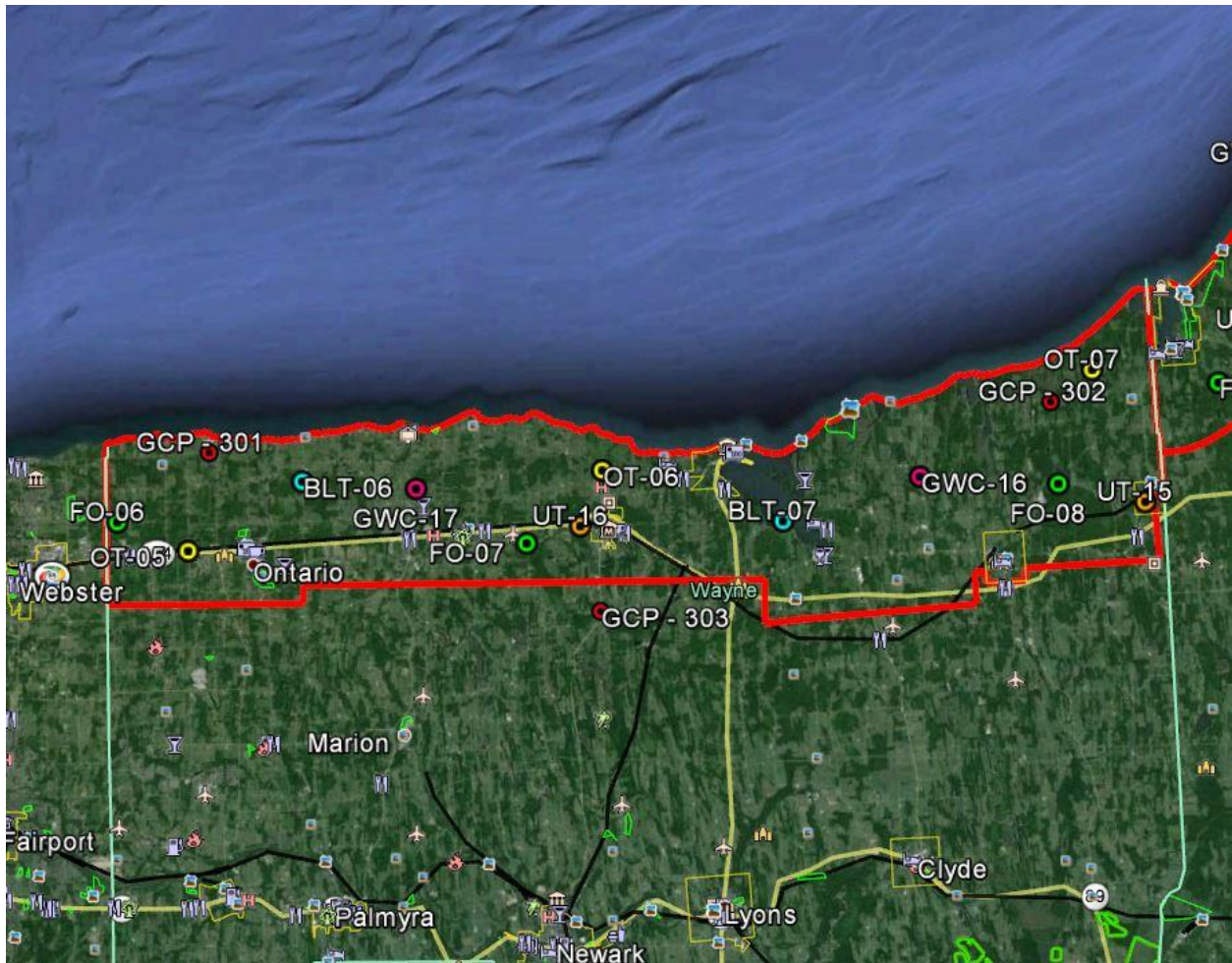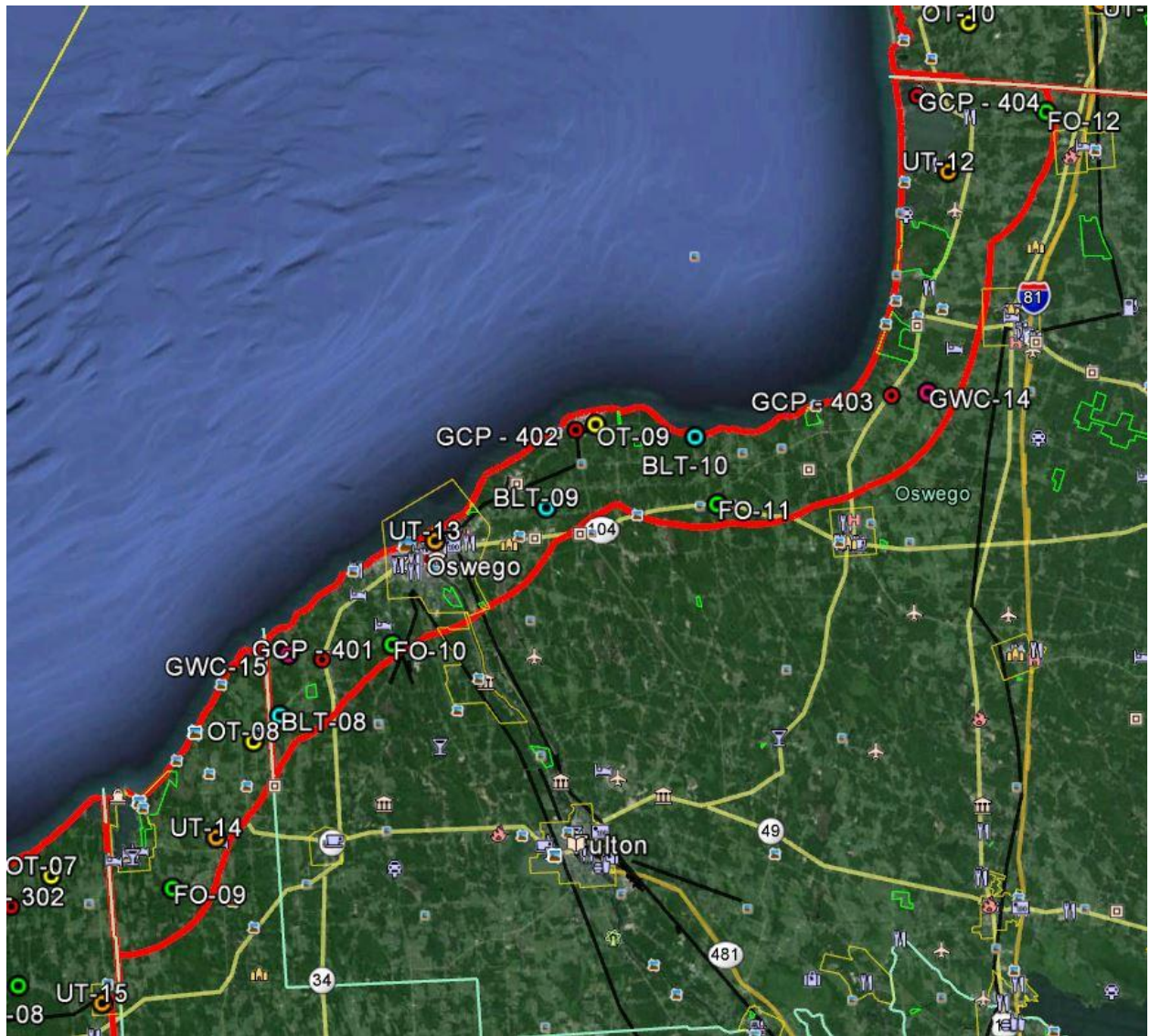
1.2 *Points of Contact*

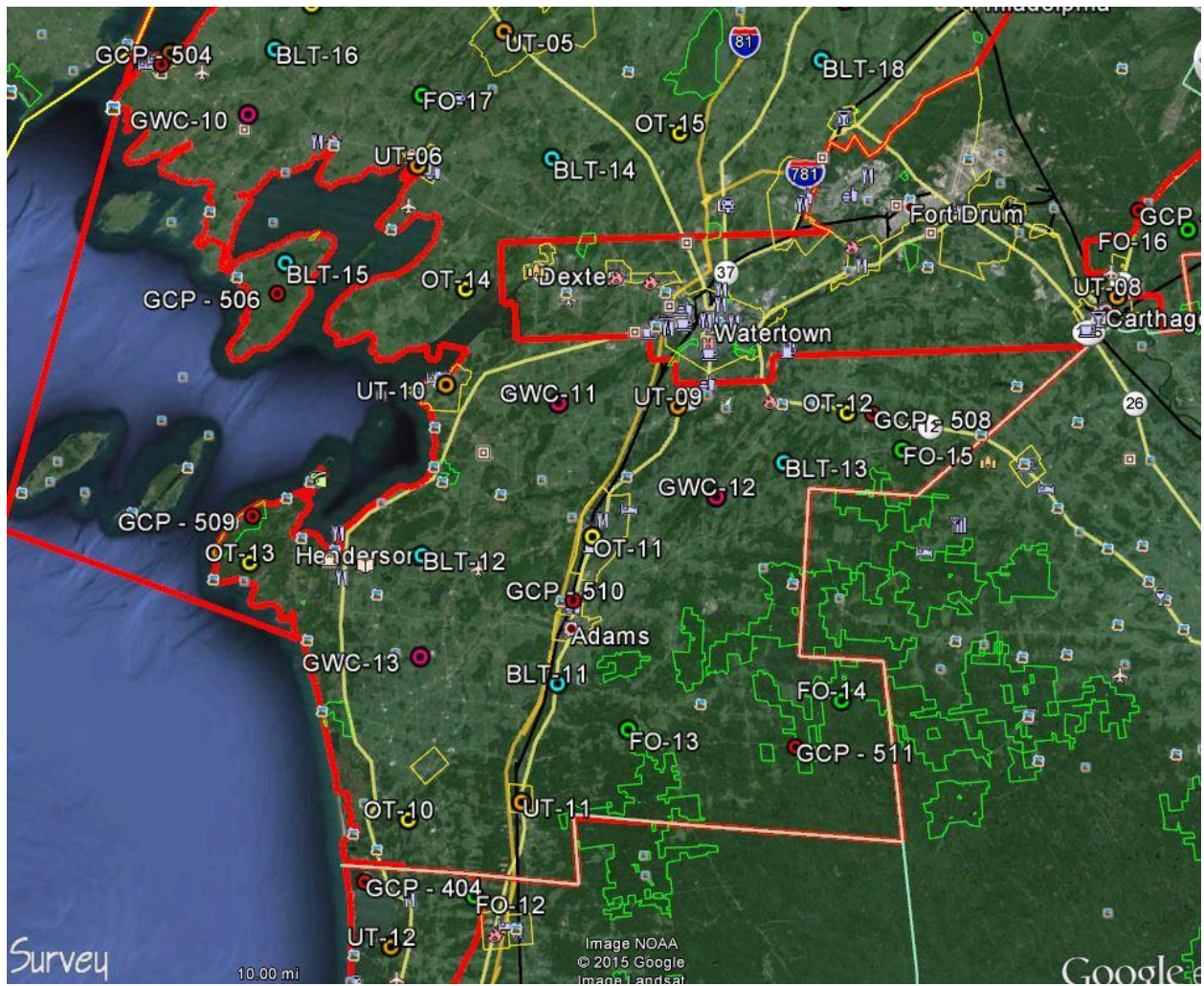Questions regarding the technical aspects of this report should be addressed to:
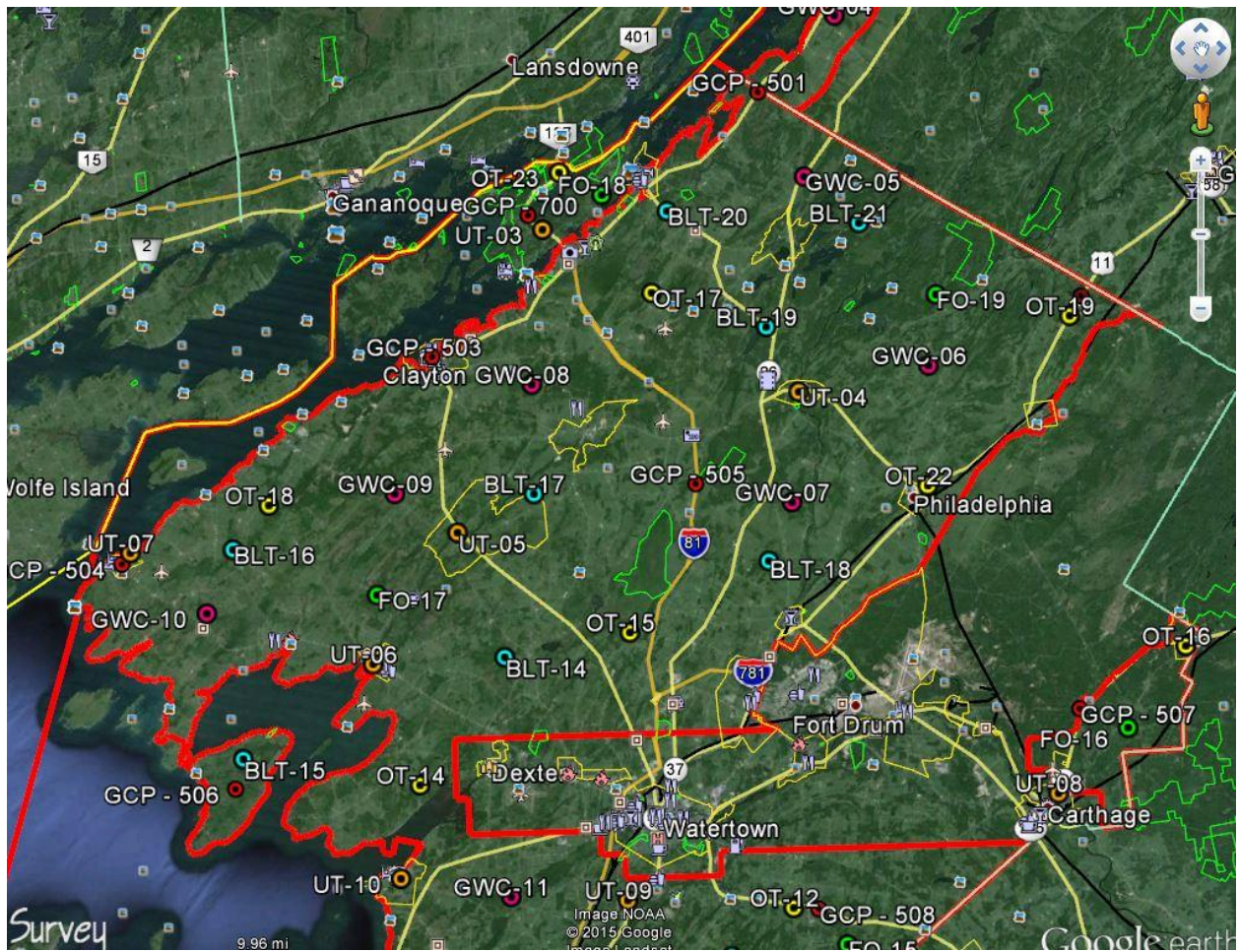
Dewberry Consultants LLC

Gary D. Simpson, L.S.
Senior Associate
10003 Derekwood Lane
Suite 204
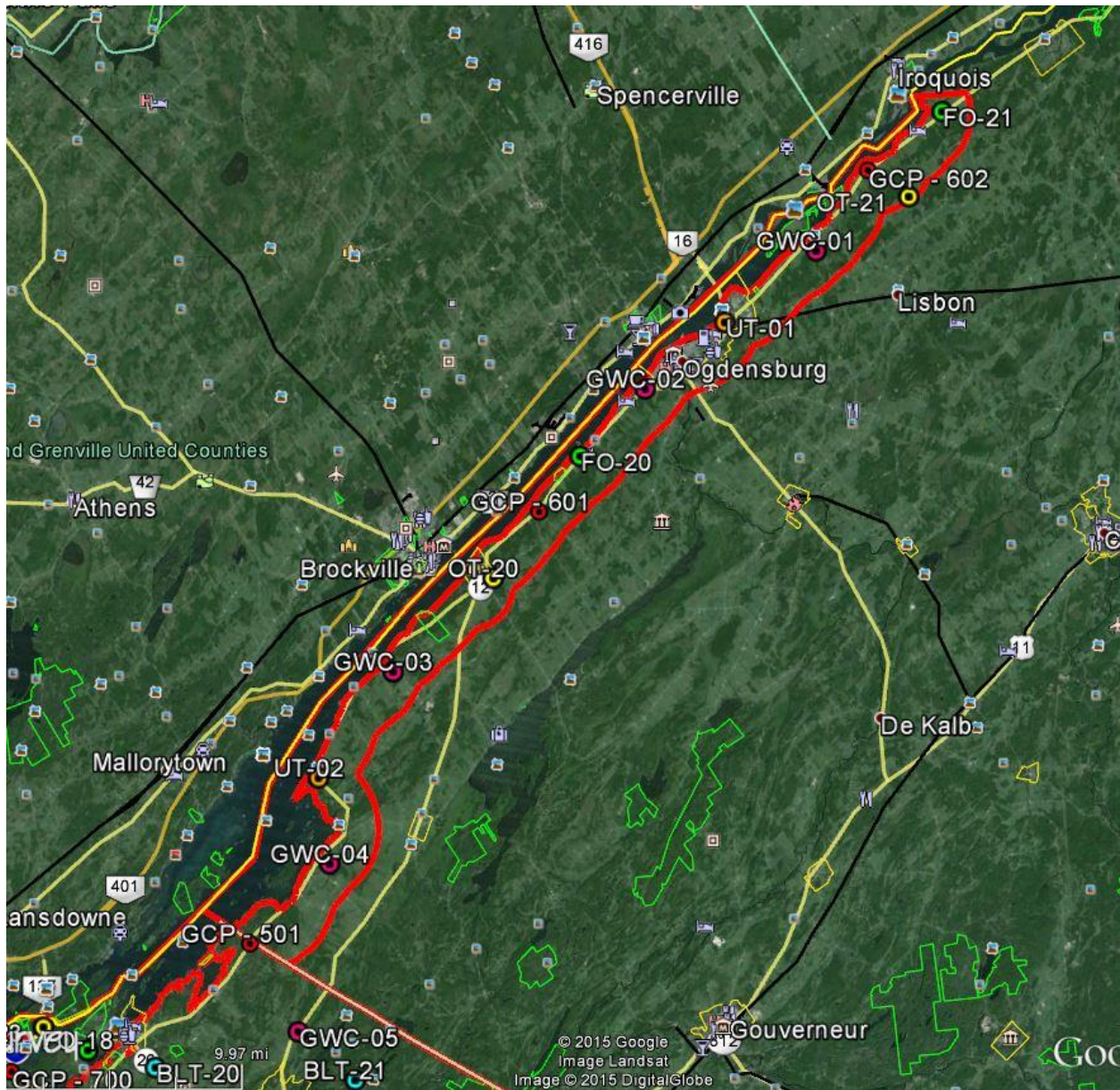Lanham, Maryland 20706
(301) 364-1855 direct
(301) 731-0188 fax

1.3   *Project Area*

USGS FEMA Region 2 – Great Lakes LiDAR

PROJECT DETAILS

2.1 *Survey Equipment*

In performing the GPS observations Trimble R-10 GNSS receiver/antenna attached to a two meter fixed height pole with a Trimble TSC3 Data Collector to collect GPS raw data were used to perform the field surveys.

2.2 *Survey Point Detail*

The 84 LiDAR Check Points were well distributed throughout the project area.

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 Consultants LLC office located in Lanham, MD was tied to a Real Time Network (RTN) managed by New York DOT. 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 field surveyors used Trimble R-10 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 ± 5cm 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.

      Two (2) existing NGS monument 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 Y 198, and SODUSPORT. 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)	Δ N	Δ E	Δ Elev.
Y 198	4852035.595	434278.316	426.685	4852035.598	434278.302	426.660	0.003	0.014	0.025
SODUSPORT	4789105.217	327850.061	127.171	4789105.225	327850.008	127.159	0.010	0.050	0.012

      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 TBC or Trimble Business Center.

Downloaded data is run through the TBC 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 2014) 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*

CHECK POINTS

POINT #	NORTHING (M)	EASTING (M)	ELEV. (M)
BRUSH & LOW TREES POINTS			
BLT-6	4792047.236	317228.757	105.079
BLT-7	4789269.210	341647.578	100.356
BLT-8	4804556.038	369850.210	88.407
BLT-9	4815890.693	384064.870	91.460
BLT-10	4818518.130	392154.898	77.154
BLT-11	4847845.987	416722.271	184.437
BLT-12	4856034.432	408633.072	129.650
BLT-13	4861039.951	431118.250	290.804
BLT-14	4880105.357	417374.645	110.383
BLT-15	4874214.203	400752.530	88.068
BLT-16	4887368.107	400513.308	87.052
BLT-17	4892092.991	418805.563	98.854
BLT-18	4885672.823	434175.535	151.675
BLT-19	4900541.006	434704.151	139.164
BLT-20	4908685.584	429230.438	98.411
BLT-21	4907622.252	440819.152	115.213
GRASS, WEEDS & CROPS POINTS			
GWC-1	4954781.099	467772.863	92.807
GWC-2	4947672.426	458968.732	96.881
GWC-3	4934022.154	446318.862	98.120
GWC-4	4919706.867	439361.856	97.635
GWC-5	4909798.922	437335.278	87.937
GWC-6	4896244.776	439126.571	130.286
GWC-7	4890187.538	436877.219	125.050
GWC-8	4897139.829	419636.080	111.364
GWC-9	4890507.883	410782.283	123.311
GWC-10	4883368.364	398686.792	81.034
GWC-11	4865087.420	417266.751	114.954
GWC-12	4858733.630	427211.072	273.708
GWC-13	4849218.202	409893.162	144.267
GWC-14	4820487.168	404497.702	92.498
GWC-15	4807767.057	370408.941	95.524
GWC-16	4791065.174	348918.575	117.902
GWC-17	4791507.752	323178.349	107.942

OPEN TERRAIN POINTS			
OT-5	4788737.724	311288.458	127.536
OT-6	4792161.841	332479.417	98.033
OT-7	4796516.036	357531.827	90.680
OT-8	4803258.125	368453.487	107.082
OT-9	4819230.574	386902.002	82.199
OT-10	4839838.607	407289.246	94.057
OT-11	4856872.752	419179.174	192.807
OT-12	4863747.663	435076.907	312.938
OT-13	4855931.858	397985.419	83.645
OT-14	4872277.986	411843.934	93.846
OT-15	4881445.331	425311.244	105.879
OT-16	4879549.917	460188.154	246.497
OT-17	4902647.215fa	427329.610	109.671
OT-18	4890085.746	402875.359	96.001
OT-19	4900617.495	453720.149	163.605
OT-20	4936522.111	449751.963	111.751
OT-21	4958662.045	475499.679	98.732
OT-22	4890060.088	444305.290	156.027
OT-23	4910371.625	421756.672	85.620
URBAN TERRAIN POINTS			
UT-1	4951424.372	464182.592	85.792
UT-2	4924857.949	438855.595	110.272
UT-3	4906816.989	420593.064	88.963
UT-4	4896181.140	436377.146	125.552
UT-5	4888015.666	414678.769	86.139
UT-6	4879965.283	409090.167	87.323
UT-7	4887367.639	394038.249	77.098
UT-8	4870575.097	451922.549	241.819
UT-9	4864653.338	424622.944	167.641
UT-10	4866466.656	410469.736	87.230
UT-11	4840724.441	414317.695	187.989
UT-12	4832050.873	405975.729	75.954
UT-13	4813490.383	378335.330	84.601
UT-14	4798271.806	366315.783	84.767
UT-15	4789743.771	360025.958	104.556
UT-16	4789393.109	331288.291	140.027
FOREST POINTS			
FO-6	4793258.349	311341.278	92.901

FO-7	**4788602.033**	**328536.416**	**136.563**
FO-8	**4790973.073**	**355817.846**	**112.222**
FO-9	**4796130.982**	**364694.702**	**95.946**
FO-10	**4808057.871**	**375896.085**	**108.757**
FO-11	**4814941.201**	**393332.218**	**130.400**
FO-12	**4834466.314**	**411162.358**	**141.171**
FO-13	**4845134.191**	**420988.067**	**278.529**
FO-14	**4846246.135**	**434670.450**	**485.469**
FO-15	**4861690.743**	**437900.781**	**323.590**
FO-16	**4874533.967**	**457323.415**	**258.882**
FO-17	**4884009.313**	**409787.640**	**103.969**
FO-18	**4908972.321**	**424417.267**	**82.776**
FO-19	**4906709.193**	**449107.036**	**106.842**
FO-20	**4943672.678**	**455183.358**	**85.030**
FO-21	**4963787.289**	**477818.812**	**78.771**

4. *GPS OBSERVATIONS*

POINT ID	OBSERV. DATE	JULIAN DATE	TIME OF DAY	RE-OBSERV. DATE	RE-OBSERV. TIME
BLT-6	4/21/2015	111	11:00	4/21/2015	18:37
BLT-7	4/21/2015	111	13:10	4/21/2015	18:59
BLT-8	4/21/2015	111	16:43	4/21/2015	20:13
BLT-9	4/21/2015	111	17:00	4/21/2015	20:56
BLT-10	4/22/2015	112	5:50	N/A	N/A
BLT-11	4/22/2015	112	11:40	N/A	N/A
BLT-12	4/22/2015	112	6:25	N/A	N/A
BLT-13	4/23/2015	113	11:25	N/A	N/A
BLT-14	4/22/2015	112	19:15	N/A	N/A
BLT-15	4/22/2015	112	2:25	N/A	N/A
BLT-16	4/22/2015	112	15:55	4/23/2015	13:48
BLT-17	4/22/2015	112	18:30	N/A	N/A
BLT-18	4/22/2015	112	20:30	N/A	N/A
BLT-19	4/22/2015	112	18:57	4/23/2015	7:21
BLT-20	4/22/2015	112	19:33	N/A	N/A
BLT-21	4/22/2015	112	16:26	4/23/2015	7:47
FO-6	4/21/2015	111	10:27	N/A	N/A
FO-7	4/21/2015	111	11:55	N/A	N/A
FO-8	4/21/2015	111	13:50	N/A	N/A
FO-9	4/21/2015	111	14:55	N/A	N/A
FO-10	4/21/2015	111	17:00	4/21/2015	20:33
FO-11	4/21/2015	111	17:38	4/22/2015	5:31
FO-12	4/22/2015	112	8:30	4/22/2015	21:57
FO-13	4/22/2015	112	10:20	N/A	N/A
FO-14	4/22/2015	112	11:00	N/A	N/A
FO-15	4/23/2015	113	9:30	N/A	N/A
FO-16	4/23/2015	113	9:54	N/A	N/A
FO-17	4/22/2015	112	13:50	N/A	N/A
FO-18	4/22/2015	112	17:45	N/A	N/A
FO-19	4/22/2015	112	17:20	4/23/2015	6:21
FO-20	4/22/2015	112	12:01	4/23/2015	17:11
FO-21	4/22/2015	112	9:14	N/A	N/A
GWC-1	4/22/2015	112	10:19	N/A	N/A
GWC-2	4/22/2015	112	11:40	4/23/2015	17:33

GWC-3	**4/22/2015**	**112**	**13:25**	**4/23/2015**	**16:09**
GWC-4	**4/22/2015**	**112**	**14:44**	**N/A**	**N/A**
GWC-5	**4/22/2015**	**112**	**15:48**	**4/23/2015**	**8:12**
GWC-6	**4/22/2015**	**112**	**18:19**	**4/23/2015**	**5:58**
GWC-7	**4/22/2015**	**112**	**20:24**	**N/A**	**N/A**
GWC-8	**4/22/2015**	**112**	**18:15**	**4/23/2015**	**15:26**
GWC-9	**4/22/2015**	**112**	**16:25**	**N/A**	**N/A**
GWC-10	**4/22/2015**	**112**	**15:10**	**N/A**	**N/A**
GWC-11	**4/22/2015**	**112**	**5:35**	**N/A**	**N/A**
GWC-12	**4/23/2015**	**113**	**10:00**	**N/A**	**N/A**
GWC-13	**4/22/2015**	**112**	**7:40**	**N/A**	**N/A**
GWC-14	**4/22/2015**	**112**	**9:15**	**4/22/2015**	**20:59**
GWC-15	**4/21/2015**	**111**	**16:25**	**N/A**	**N/A**
GWC-16	**4/21/2015**	**111**	**14:16**	**4/21/2015**	**19:01**
GWC-17	**4/21/2015**	**111**	**11:20**	**N/A**	**N/A**
OT-5	**4/21/2015**	**111**	**9:10**	**4/21/2015**	**18:15**
OT-6	**4/21/2015**	**111**	**12:40**	**4/21/2015**	**18:45**
OT-7	**4/21/2015**	**111**	**15:30**	**4/21/2015**	**19:13**
OT-8	**4/21/2015**	**111**	**16:22**	**4/21/2015**	**19:59**
OT-9	**4/21/2015**	**111**	**17:25**	**N/A**	**N/A**
OT-10	**4/22/2015**	**112**	**7:55**	**N/A**	**N/A**
OT-11	**4/22/2015**	**112**	**12:30**	**4/23/2015**	**10:59**
OT-12	**4/23/2015**	**113**	**9:10**	**N/A**	**N/A**
OT-13	**4/22/2015**	**112**	**7:10**	**4/23/2015**	**11:56**
OT-14	**4/22/2015**	**112**	**13:05**	**4/23/2015**	**14:10**
OT-15	**4/22/2015**	**112**	**19:40**	**4/23/2015**	**13:38**
OT-16	**4/23/2015**	**113**	**9:33**	**N/A**	**N/A**
OT-17	**4/22/2015**	**112**	**19:14**	**4/23/2015**	**14:15**
OT-18	**4/22/2015**	**112**	**16:10**	**4/23/2015**	**14:06**
OT-19	**4/22/2015**	**112**	**17:45**	**4/23/2015**	**8:10**
OT-20	**4/22/2015**	**112**	**12:45**	**4/23/2015**	**16:31**
OT-21	**4/22/2015**	**112**	**9:55**	**4/23/2015**	**18:17**
OT-22	**4/22/2015**	**112**	**20:48**	**4/23/2015**	**5:21**
OT-23	**4/22/2015**	**112**	**17:15**	**N/A**	**N/A**
UT-1	**4/22/2015**	**112**	**10:43**	**4/23/2015**	**17:59**
UT-2	**4/22/2015**	**112**	**14:15**	**N/A**	**N/A**
UT-3	**4/22/2015**	**112**	**17:05**	**4/23/2015**	**15:21**
UT-4	**4/22/2015**	**112**	**18:42**	**4/23/2015**	**6:58**
UT-5	**4/22/2015**	**112**	**18:50**	**N/A**	**N/A**

UT-6	4/22/2015	112	13:30	4/23/2015	16:12
UT-7	4/22/2015	112	15:35	N/A	N/A
UT-8	4/23/2015	113	10:29	N/A	N/A
UT-9	4/22/2015	112	5:15	4/23/2015	12:26
UT-10	4/22/2015	112	6:00	4/23/2015	13:09
UT-11	4/22/2015	112	10:05	N/A	N/A
UT-12	4/22/2015	112	8:50	4/22/2015	20:51
UT-13	4/21/2015	111	16:45	4/21/2015	20:58
UT-14	4/21/2015	111	15:20	N/A	N/A
UT-15	4/21/2015	111	14:30	4/21/2015	19:21
UT-16	4/21/2015	111	12:24	N/A	N/A

5.   *POINT COMPARISON*

POINT ID	POINT CK	DELTA NORTH (M)	DELTA EAST (M)	VERT. DIFF (M)
BLT-6	BLT-6CK	0.007	0.012	0.011
BLT-7	BLT-7CK	0.008	0.002	0.030
BLT-8	BLT-8CK	0.008	0.005	0.006
BLT-9	BLT-9CK	0.017	0.019	0.011
BLT-16	BLT-16CK	0.002	0.006	0.021
BLT-19	BLT-19CK	0.003	0.001	0.005
BLT-21	BLT-21CK	0.002	0.006	0.010
FO-10	FO-10CK	0.006	0.005	0.016
FO-11	FO-11CK	0.008	0.012	0.020
FO-12	FO-12CK	0.004	0.003	0.011
FO-19	FO-19CK	0.004	0.003	0.010
FO-20	FO-20CK	0.001	0.004	0.019
GWC-2	GWC-2CK	0.003	0.004	0.007
GWC-3	GWC-3CK	0.009	0.005	0.003
GWC-5	GWC-5CK	0.001	0.004	0.006
GWC-6	GWC-6CK	0.005	0.001	0.012
GWC-8	GWC-8CK	0.003	0.008	0.005
GWC-14	GWC-14CK	0.000	0.002	0.000
GWC-16	GWC-16CK	0.002	0.003	0.007
OT-5	OT-5CK	0.009	0.028	0.012
OT-6	OT-6CK	0.015	0.016	0.016
OT-7	OT-7CK	0.009	0.006	0.002
OT-8	OT-8CK	0.004	0.002	0.005
OT-11	OT-11CK	0.004	0.001	0.008
OT-13	OT-13CK	0.000	0.007	0.008
OT-14	OT-14CK	0.006	0.004	0.016
OT-15	OT-15CK	0.002	0.001	0.011
OT-17	OT-17CK	0.006	0.004	0.007
OT-18	OT-18CK	0.017	0.001	0.001
OT-19	OT-19CK	0.003	0.003	0.009
OT-20	OT-20CK	0.001	0.000	0.003
OT-21	OT-21CK	0.004	0.004	0.002
OT-22	OT-22CK	0.000	0.001	0.013
UT-1	UT-1CK	0.012	0.001	0.015
UT-3	UT-3CK	0.000	0.002	0.005
UT-4	UT-4CK	0.003	0.003	0.007

UT-6	UT-6CK	0.007	0.002	0.002
UT-9	UT-9CK	0.000	0.001	0.001
UT-10	UT-10CK	0.006	0.010	0.014
UT-12	UT-12CK	0.008	0.001	0.015
UT-13	UT-13CK	0.002	0.001	0.007
UT-15	UT-15CK	0.007	0.002	0.028