Check Point Survey Report

"CA_FEMA R9 Lidar_2016_D17 Mendocino"
USGS Contract: G10PC00013
Task Order Number: G17PD00044

Prepared for:
United States Geological Survey (USGS)

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1. INTRODUCTION

1.1 *Project Summary*

Dewberry is under contract to the United States Geological Survey to provide 58 Check Points in the State of California. Under the above referenced USGS Task Order, Dewberry is tasked to complete the quality assurance of LiDAR products. As part of this work Dewberry staff will complete Check Point surveys that will be used to evaluate vertical and horizontal accuracy. The ground survey was conducted February 24 thru February 28, 2017.

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 CA State Plane, NAD83 in US Survey Feet.

Final Vertical elevations are referenced to NAVD88 in US Survey Feet using Geoid model 2012B (Geoid12B).

1.2 *Points of Contact*

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

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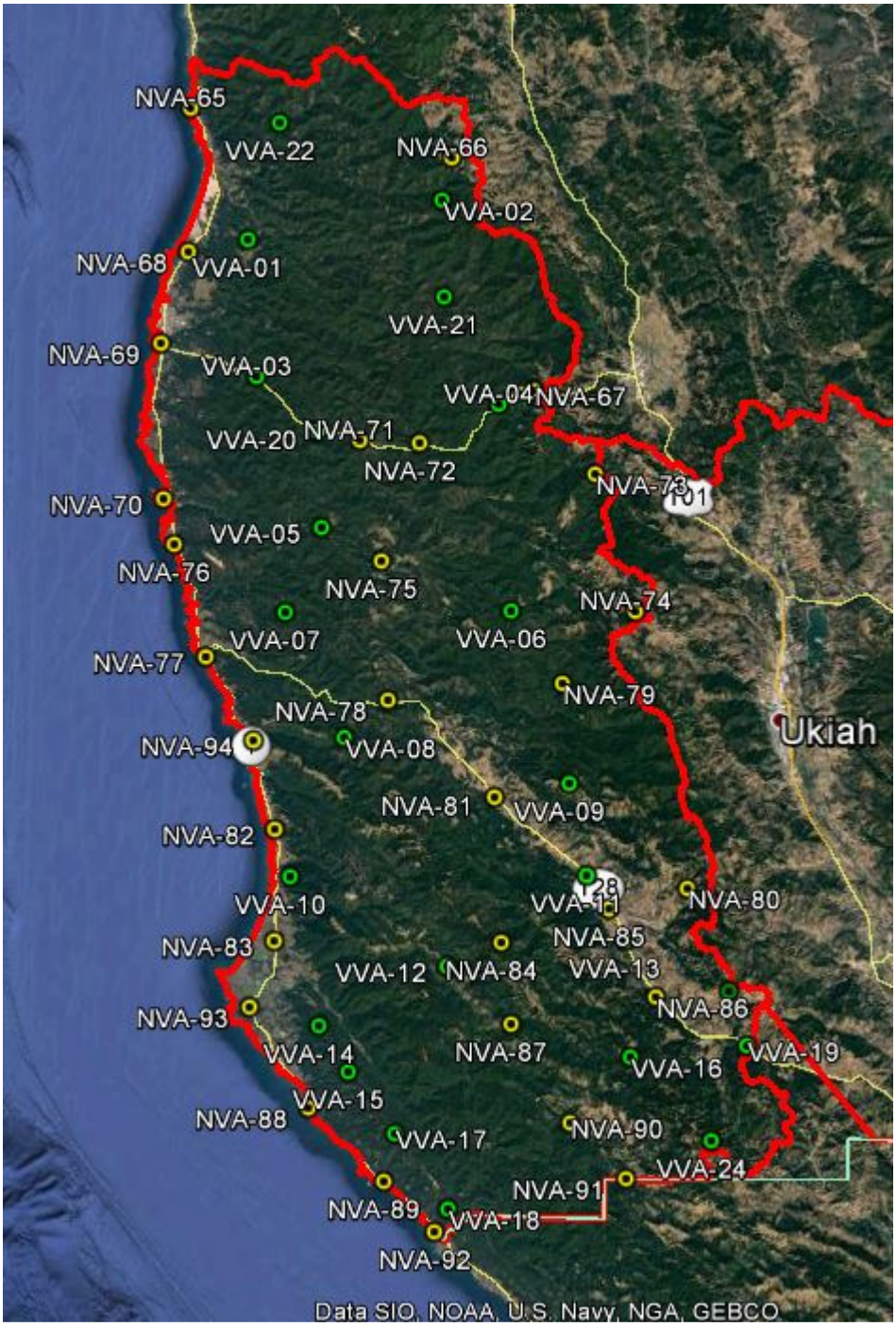
1.3 *Project Area*



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 58 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 "Check 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 operated by CRTN. 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 20 and 30 minutes.

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

Three (3) existing NGS monument listed in the NSRS database were located as an additional QA/QC method to check the horizontal and vertical accuracy of the VRS network as well as being the primary project control monuments.

The results are as follows:

NGS Monuments

	Observed Values			Data Sheet Values					
PT. #	NORTHING	EASTING	ELEVS.	NORTHING	EASTING	ELEVS.	Δ X	Δ Y	Δ Z
HPGNDCA01AE	2052586.321	6117326.719	116.338	2052586.273	6117326.728	116.289	0.048	-0.009	0.049
HPGNDCA01DE	2172972.054	6131600.314	287.021	2172972.100	6131600.320	287.000	-0.046	-0.006	0.021
HPGNDCA01F4	2328587.337	6065952.006	123.938	2328587.390	6065952.020	123.900	-0.053	-0.014	0.038

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 CRTN 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 2016) 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*

CA SPCS NAD83, NAVD88, Geoid 12B			
Point #	**Northing (ft)**	**Easting (ft)**	**Elevation (ft)**
NVA			
NVA-66	2334910.12	6132740.06	2775.29
NVA-67	2272565.46	6152576.03	1901.08
NVA-68	2310068.07	6058395.73	86.97
NVA-69	2285265.58	6051018.92	111.69
NVA-70	2242884.24	6051829.52	131.00
NVA-71	2259004.26	6105210.57	323.32
NVA-72	2258300.94	6121452.24	342.28
NVA-73	2262965.93	6171270.47	1628.71
NVA-74	2212764.07	6180210.14	1734.78
NVA-75	2226285.66	6111152.70	192.96
NVA-77	2200661.48	6063363.05	10.88
NVA-78	2188616.20	6112951.10	90.11
NVA-79	2201137.03	6154134.20	1369.31
NVA-80	2137732.39	6194462.50	1575.01
NVA-83	2123334.28	6082149.31	108.87
NVA-84	2123011.88	6143913.76	1608.67
NVA-85	2132200.25	6173176.97	395.78
NVA-86	2108417.74	6186190.11	691.21
NVA-87	2091874.73	6122750.70	2340.67
NVA-88	2078092.80	6091480.92	124.18
NVA-89	2058208.19	6112069.59	113.87
NVA-90	2082261.97	6157688.48	1467.26
NVA-91	2075565.54	6152837.29	1683.99
NVA-92	2044612.68	6125837.86	65.92
NVA-93	2105401.19	6075466.13	170.16
NVA-94	2177650.39	6076409.90	186.43
NVA-98	2139953.45	6167969.55	346.23
NVA-99	2282057.70	6139176.36	432.70
NVA-100	2087996.65	6162496.55	1828.56
VVA			
VVA-01	2313231.49	6075049.23	171.29
VVA-02	2323839.89	6141866.37	2262.59
VVA-03	2276254.32	6077053.89	475.21
VVA-04	2268293.57	6143131.02	1417.88
VVA-05	2236756.77	6094736.85	410.12
VVA-06	2212801.89	6146414.23	533.29

VVA-07	**2212484.40**	**6085004.31**	**775.91**
VVA-08	**2178373.62**	**6101158.15**	**919.09**
VVA-09	**2154986.87**	**6154240.74**	**316.54**
VVA-10	**2140647.29**	**6086242.98**	**824.35**
VVA-11	**2139557.87**	**6168408.76**	**348.10**
VVA-12	**2116590.05**	**6129608.05**	**1451.90**
VVA-13	**2121200.67**	**6178038.40**	**632.32**
VVA-14	**2100424.82**	**6094442.09**	**831.19**
VVA-15	**2087859.40**	**6102386.05**	**1085.80**
VVA-16	**2092663.14**	**6178874.31**	**1092.94**
VVA-17	**2071145.72**	**6114998.96**	**1335.29**
VVA-18	**2050752.02**	**6129446.64**	**688.66**
VVA-19	**2093746.70**	**6212295.48**	**1102.12**
VVA-20	**2261467.10**	**6093752.93**	**468.70**
VVA-21	**2282585.17**	**6125708.37**	**377.55**
VVA-22	**2337479.97**	**6076025.16**	**46.79**
VVA-23	**2097133.24**	**6203975.31**	**863.36**
VVA-77	**2331384.33**	**6071111.96**	**15.98**
VVA-78	**2114120.42**	**6093373.93**	**448.72**

4. *GPS OBSERVATIONS*

NVA					
POINT ID	OBSERV. DATE	JULIAN DATE	TIME OF DAY (AST)	RE-OBSERV. DATE	RE-OBSERV. TIME
NVA-66	2/26/2017	57	14:42	N/A	N/A
NVA-67	2/26/2017	57	18:48	2/26/2017	16:50
NVA-68	2/25/2017	56	11:30	2/26/2017	9:11
NVA-69	2/25/2017	56	10:09	2/26/2017	8:22
NVA-70	2/25/2017	56	9:26	2/26/2017	7:43
NVA-71	2/25/2017	56	17:13	2/26/2017	11:10
NVA-72	2/25/2017	56	18:14	2/26/2017	11:29
NVA-73	2/26/2017	57	13:21	N/A	N/A
NVA-74	2/28/2017	59	14:14	N/A	N/A
NVA-75	2/27/2017	58	17:32	2/28/2017	12:30
NVA-77	2/27/2017	58	15:53	2/28/2017	11:04
NVA-78	2/27/2017	58	16:47	2/28/2017	11:49
NVA-79	2/28/2017	59	15:27	N/A	N/A
NVA-80	2/26/2017	57	15:55	2/27/2017	11:24
NVA-83	2/25/2017	56	11:42	2/26/2017	12:00
NVA-84	2/26/2017	57	13:48	N/A	N/A
NVA-85	2/26/2017	57	14:48	N/A	N/A
NVA-86	2/27/2017	58	12:55	2/27/2017	19:00
NVA-87	2/28/2017	59	11:21	N/A	N/A
NVA-88	2/25/2017	56	16:44	2/28/2017	15:32
NVA-89	2/25/2017	56	16:06	2/28/2017	14:53
NVA-90	2/27/2017	58	16:37	N/A	N/A
NVA-91	2/27/2017	58	14:58	N/A	N/A
NVA-92	2/25/2017	56	15:20	2/28/2017	13:59
NVA-93	2/25/2017	56	12:17	2/28/2017	10:13
NVA-94	2/25/2017	56	9:08	N/A	N/A
NVA-98	2/26/2017	57	16:37	N/A	N/A
NVA-99	2/26/2017	57	17:24	N/A	N/A
NVA-100	2/27/2017	58	17:44	N/A	N/A
VVA					
VVA-02	2/26/2017	57	15:32	N/A	N/A
VVA-03	2/25/2017	56	16:28	2/26/2017	10:09
VVA-05	2/27/2017	58	18:10	2/28/2017	16:36
VVA-06	2/28/2017	59	13:20	N/A	N/A

VVA-07	2/28/2017	59	9:58	N/A	N/A
VVA-08	2/26/2017	57	9:54	N/A	N/A
VVA-09	2/27/2017	58	10:40	N/A	N/A
VVA-10	2/25/2017	56	11:01	2/26/2017	11:19
VVA-12	2/27/2017	58	12:11	N/A	N/A
VVA-13	2/26/2017	57	15:30	N/A	N/A
VVA-14	2/25/2017	56	12:48	2/28/2017	10:31
VVA-15	2/25/2017	56	13:29	2/28/2017	12:11
VVA-16	2/27/2017	58	15:47	N/A	N/A
VVA-17	2/25/2017	56	14:04	2/28/2017	12:46
VVA-18	2/25/2017	56	14:43	2/28/2017	13:21
VVA-19	2/27/2017	58	13:46	N/A	N/A
VVA-20	2/27/2017	58	13:26	N/A	N/A
VVA-21	2/26/2017	57	18:13	N/A	N/A
VVA-22	2/25/2017	56	15:26	2/27/2017	11:45
VVA-23	2/27/2017	58	14:10	N/A	N/A
VVA-24	2/27/2017	58	14:43	N/A	N/A
VVA-77	2/25/2017	56	14:34	2/27/2017	10:54
VVA-78	2/26/2017	57	12:38	N/A	N/A

5. *POINT COMPARISON*

Point ID	Point CK	Delta North (ft)	Delta East (ft)	Vertical Diff. (ft)
NVA-67	NVA-67CK	-0.01	0.04	-0.02
NVA-68	NVA-68CK	0.00	0.03	-0.05
NVA-69	NVA-69CK	-0.08	0.02	0.06
NVA-70	NVA-70CK	-0.05	0.02	0.02
NVA-71	NVA-71CK	-0.04	-0.13	0.09
NVA-72	NVA-72CK	0.01	-0.00	0.04
NVA-75	NVA-75CK	-0.00	0.05	-0.02
NVA-77	NVA-77CK	-0.05	0.03	-0.08
NVA-78	NVA-78CK	0.00	0.00	0.00
NVA-80	NVA-80CK	-0.01	0.02	-0.08
NVA-83	NVA-83CK	-0.05	0.03	-0.04
NVA-86	NVA-86CK	0.00	-0.01	0.08
NVA-88	NVA-88CK	0.03	0.01	-0.05
NVA-89	NVA-89CK	-0.01	0.06	0.13
NVA-92	NVA-92CK	0.02	0.01	0.06
NVA-93	NVA-93CK	0.05	-0.06	-0.12
VVA				
VVA-03	VVA-03CK	0.02	0.01	-0.15
VVA-05	VVA-05CK	0.00	0.00	0.00
VVA-10	VVA-10CK	0.00	0.00	-0.10
VVA-14	VVA-14CK	0.00	0.00	0.00
VVA-15	VVA-15CK	-0.01	0.02	0.15
VVA-18	VVA-18CK	0.02	0.03	-0.16
VVA-22	VVA-22CK	0.01	0.03	0.09
VVA-77	VVA-77CK	0.00	0.00	0.00