



Ground Survey Report (Control Network)

Kane County, UT
312019289

December 2019

Executive Summary

The State of Utah Department of Technology Services (DTS), Division of Integrated Technology, Automated Geographic Reference Center (AGRC), contracted with The Sanborn Map Company, Inc. (Sanborn) to provide ground survey in the support of aerial surveys of lidar for the Kane County, UT project. A network of ground control points has been designed and implemented into the project process to establish common basis for geo-referencing of the lidar and photography data products. A total of forty-three (43) points (GCP + NVA + VVA) were established, all points will serve for lidar calibration and validation.

The survey of ground control and check points meets a final adjusted RMS 1/3 of the required product accuracy for Lidar (USGS – QL2).

The local network was designed, processed and adjusted using Trimble Business Center (TBC) version 5.00. Final horizontal coordinates are projected in NAD83 (2011), UTM Zone 12 North, NAVD88 (Geoid12B), Meters.

References:

CORS - FRED, P009

NGS Monuments - AA3679, HO0076, HO0468, JO0135

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Introduction

This report contains the technical write-up of the differential GPS surveys performed in support of lidar products.

Sanborn oversaw the survey team(s) for execution of the survey, all fieldwork including reconnaissance of existing control points, establishment of additional control points, GPS surveys. All GPS data processing and reductions were performed in support of the Kane County, UT project. **Figure 1** illustrates the initial survey plan within the project Area of Interest (AOI).

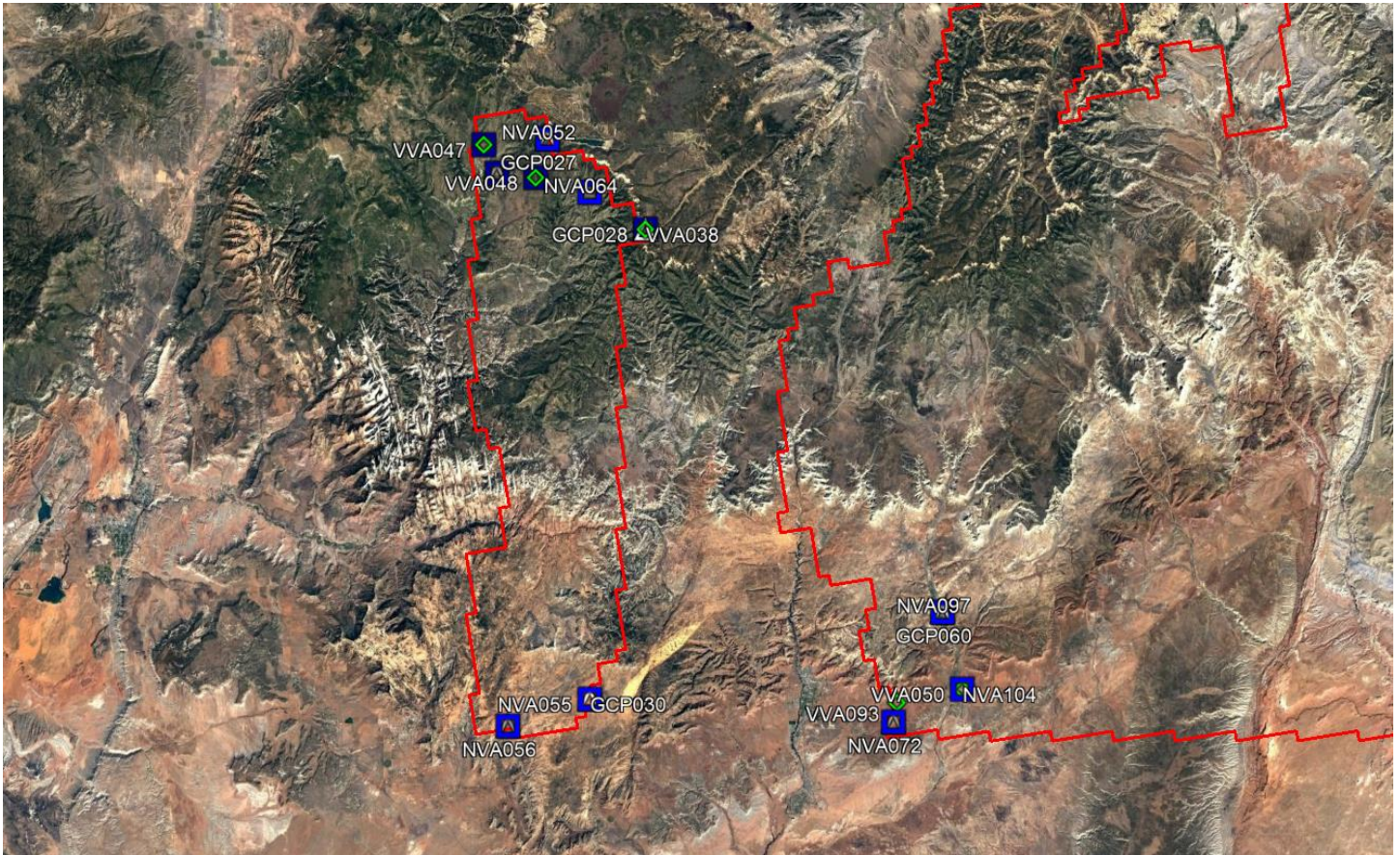


Figure 1: Survey Plan and AOI

Survey Purpose

The GPS Network Survey includes six (6) control point(s): CORS (FRED, P009) and NGS Monuments (AA3679, HO0076, HO0468, JO0135). The control points are tied to forty-three (43) points: 11 GCP + 31 NVA + 11 VVA, for the GPS Log Sheets of the observed points see **Attachment A**. The NGS Data Sheets and Trimble CenterPoint RTX Reports referenced for the points can be found in **Attachment B**. **Attachment C** contain the TBC Baseline Processing Reports. **Attachment D** contains the photos of the observed points in the GPS Network Survey. The sketches of the observed points can be found in **Attachment E**. The ground control points were strategically positioned to satisfy aerial survey requirements for the area of interest (AOI).

Duration/Time Period

The ground control survey was performed on October 21st, 2019 – November 3rd, 2019.

Equipment

The ground control survey was performed using survey grade Trimble R8 L1/L2 GPS Antennas attached to 2 meter fixed height rods, leveled over each point in the center of the targets.

Field Procedures

A careful reconnaissance was undertaken prior to the monumentation and subsequent GPS survey. The satellite window provided a minimum of 4 hour constellation coverage; GPS observation sessions were scheduled between 08:00 and 18:00 local time. All baseline processing, analysis, and preliminary reductions were performed upon receiving the data for quality control. No difficulties were experienced during this survey.

Personnel navigated to points using local maps, or GPS navigation. The field crews had approximate geodetic coordinates loaded for the required observation points. Upon arriving at the desired location the field personnel initiated a search for the point locations. The receiver was set on the 2 meter fixed height rod and leveled over the point. The GPS survey was set up as FastStatic connected via session to the established base station located at the NGS Monument(s). Field crew members followed a session schedule established by office personnel to facilitate observation location and duration.

The survey data sheet was produced with the following information: Point ID, Stamping (if available), Date, Observer Name, Antenna Height Measurement Point, Antenna Height, Start Time and End Time. Digital photographs were taken at each point showing the control point surveyed and its relationship to its surroundings.

Processing

All static baselines and vectors for the Kane County, UT project were processed using Trimble Business Center (TBC) version 5.00 software. Fixed solutions were adopted for all baselines using the broadcast ephemeris.

NAD83 (2011) was utilized and incorporated into the reductions, thereby allowing rigorous interpolation of the geoidal undulation values at each point in the network. This provides a useful method of estimating the elevations at all points in the network. The Survey Network Diagrams (Appendix A) and the Final Adjusted Coordinates (Appendix B) can be found below.

Accuracy

Lidar Category	Value
RMSE _z (m)	≤0.100
@ 95-Percent Confidence Level (m)	≤0.196

Table 1: Lidar Absolute Accuracy Requirements

The final survey networked coordinates yielded station levels of 0.016m horizontally (X, Y) and 0.046m vertically (Z) at 2σ or (95-Percent Confidence Level) meeting and/or exceeding project requirements.

Coordinate Reference System

Horizontal Datum:	North American Datum of 1983 (2011)
Projection:	Universal Transverse Mercator Zone 12 North
Vertical Datum:	North American Vertical Datum of 1988
Geoid Model:	Geoid12B
Units:	Meters

Contact Information

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

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Appendix A - Survey Network Diagram



Appendix B – Adjusted Coordinates

ID	Easting (Meter)	Northing (Meter)	Elevation (Meter)	Feature Code	Projection Scale Factor	Height Scale Factor	Combined Scale Factor	Meridian convergence angle
AA3679	363784.313	4097079.972	1474.888	NGS	0.9998286119	0.9997720657	0.9996007167	-0°55'18"
FRED	366582.052	4094627.854	1552.639	CORS	0.9998193168	0.9997598755	0.9995792357	-0°54'08"
GCP015	380673.672	4232783.318	2911.464	GCP	0.9997753796	0.9995463557	0.9993218372	-0°50'38"
GCP017	376379.031	4220105.328	2404.496	GCP	0.9997882377	0.9996259025	0.9994142195	-0°52'15"
GCP018	369866.355	4203793.714	2076.848	GCP	0.9998086044	0.9996773746	0.9994860408	-0°54'42"
GCP027	338678.188	4154765.102	2765.959	GCP	0.9999206372	0.9995693645	0.9994900359	-1°06'44"
GCP028	348437.192	4145721.634	2577.286	GCP	0.9998830136	0.9995989961	0.9994820566	-1°02'31"
GCP030	342528.360	4099135.434	1742.964	GCP	0.9999055449	0.9997300477	0.9996356182	-1°03'59"
GCP031	334343.060	4096516.435	1645.324	GCP	0.9999381455	0.9997453913	0.9996835525	-1°07'14"
GCP034	333638.598	4151398.486	2367.892	GCP	0.9999409912	0.9996318215	0.9995728345	-1°08'45"
GCP035	372774.761	4096625.020	1550.356	GCP	0.9997994257	0.9997602329	0.9995597067	-0°51'39"
GCP051	381648.454	4212974.291	1925.751	GCP	0.9997725325	0.9997009989	0.9994735994	-0°49'54"
GCP060	377717.922	4107486.512	1620.854	GCP	0.9997842236	0.9997491559	0.9995334337	-0°49'49"
HO0076	366728.438	4099230.740	1538.752	NGS	0.9998188337	0.9997620443	0.9995809212	-0°54'09"
HO0468	318994.992	4183335.242	1667.590	NGS	1.0000036586	0.9997417819	0.9997454395	-1°15'34"
JO0135	390091.369	4235539.985	1975.100	NGS	0.9997487846	0.9996931875	0.9994420492	-0°46'41"
NVA029	380664.873	4232770.755	2912.271	NVA	0.9997754055	0.9995462291	0.9993217365	-0°50'38"
NVA031	384204.855	4227593.699	2083.370	NVA	0.9997651536	0.9996762250	0.9994414547	-0°49'03"
NVA032	376381.356	4220085.278	2404.158	NVA	0.9997882307	0.9996259555	0.9994142654	-0°52'14"
NVA033	369859.554	4203812.515	2077.443	NVA	0.9998086262	0.9996772813	0.9994859693	-0°54'42"
NVA034	373964.529	4213342.648	2281.210	NVA	0.9997956666	0.9996452830	0.9994410220	-0°53'09"
NVA035	372047.255	4216234.482	2292.483	NVA	0.9998016647	0.9996435127	0.9994452482	-0°54'00"
NVA036	381376.383	4225450.083	2297.276	NVA	0.9997733224	0.9996426858	0.9994160891	-0°50'13"
NVA039	342500.931	4099162.047	1742.979	NVA	0.9999056514	0.9997300452	0.9996357221	-1°03'59"
NVA052	338689.470	4154756.729	2765.349	NVA	0.9999205924	0.9995694600	0.9994900865	-1°06'44"
NVA053	348406.608	4145725.457	2579.146	NVA	0.9998831278	0.9995987046	0.9994818793	-1°02'32"
NVA056	334337.226	4096511.559	1645.134	NVA	0.9999381693	0.9997454210	0.9996836061	-1°07'15"
NVA063	336524.339	4147325.283	2416.589	NVA	0.9999292634	0.9996242032	0.9995534933	-1°07'28"
NVA064	342760.658	4149343.816	2342.744	NVA	0.9999046135	0.9996357563	0.9995404045	-1°04'56"
NVA065	332337.866	4154245.365	2452.358	NVA	0.9999463438	0.9996185656	0.9995649299	-1°09'21"
NVA067	333644.054	4151405.968	2368.324	NVA	0.9999409688	0.9996317537	0.9995727442	-1°08'45"
NVA068	337508.916	4150934.547	2547.353	NVA	0.9999253058	0.9996036679	0.9995290033	-1°07'08"
NVA069	341807.886	4144957.992	2060.274	NVA	0.9999083198	0.9996800919	0.9995884410	-1°05'14"
NVA072	372764.270	4096633.893	1549.944	NVA	0.9997994586	0.9997602975	0.9995598042	-0°51'39"
NVA088	381652.795	4212997.810	1925.987	NVA	0.9997725198	0.9997009618	0.9994735496	-0°49'54"
NVA097	377720.196	4107486.497	1620.750	NVA	0.9997842168	0.9997491723	0.9995334432	-0°49'49"
NVA104	379649.999	4099847.665	1557.983	NVA	0.9997784500	0.9997590412	0.9995375445	-0°48'55"
P009	393351.583	4259774.133	1781.393	CORS	0.9997400808	0.9997235675	0.9994637201	-0°45'39"
VVA022	380660.696	4232764.595	2912.675	VVA	0.9997754178	0.9995461658	0.9993216855	-0°50'38"
VVA024	384211.909	4227593.751	2082.901	VVA	0.9997651335	0.9996762987	0.9994415083	-0°49'03"
VVA025	378517.847	4222036.809	2343.813	VVA	0.9997817788	0.9996354036	0.9994172621	-0°51'22"

VVA026	371721.854	4216191.133	2287.526	VVA	0.9998026920	0.9996442920	0.9994470541	-0°54'08"
VVA027	381385.113	4225449.826	2296.020	VVA	0.9997732968	0.9996428828	0.9994162606	-0°50'13"
VVA038	348412.210	4145699.321	2578.556	VVA	0.9998831069	0.9995987973	0.9994819511	-1°02'32"
VVA039	373149.153	4098547.544	1578.983	VVA	0.9997982528	0.9997557391	0.9995540412	-0°51'32"
VVA047	332363.101	4154246.947	2452.444	VVA	0.9999462396	0.9996185519	0.9995648120	-1°09'20"
VVA048	337510.685	4150920.542	2547.007	VVA	0.9999252987	0.9996037223	0.9995290506	-1°07'08"
VVA050	379635.871	4099859.229	1557.417	VVA	0.9997784919	0.9997591300	0.9995376752	-0°48'55"
VVA073	381653.402	4212966.490	1925.510	VVA	0.9997725181	0.9997010367	0.9994736228	-0°49'54"

Attachment A – GPS Log Sheets

(Electronically Attached)

Attachment B – Data Sheets

(Electronically Attached)

Attachment C – Baseline Processing Reports

(Electronically Attached)

Attachment D – Photos

(Electronically Attached)

Attachment E – Sketches

(Electronically Attached)