Check Point Survey Report

"Texas Add On FEMA Region 6 LiDAR"
Parts of Gillespie, Frio, Atascosa, Live Oak and Bee Counties
USGS Contract: G16PC00020
Task Order Number: G17PC00014

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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1. INTRODUCTION

1.1 *Project Summary*

Dewberry Consultants LLC is under contract to the United States Geological Survey to provide 224 Check Points in the State of Texas. 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 March 21 thru March 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 UTM, Zone 14, NAD83 (2011) in meters. Final Vertical elevations are referenced to NAVD88 in meters using Geoid model 2012B (Geoid12B).

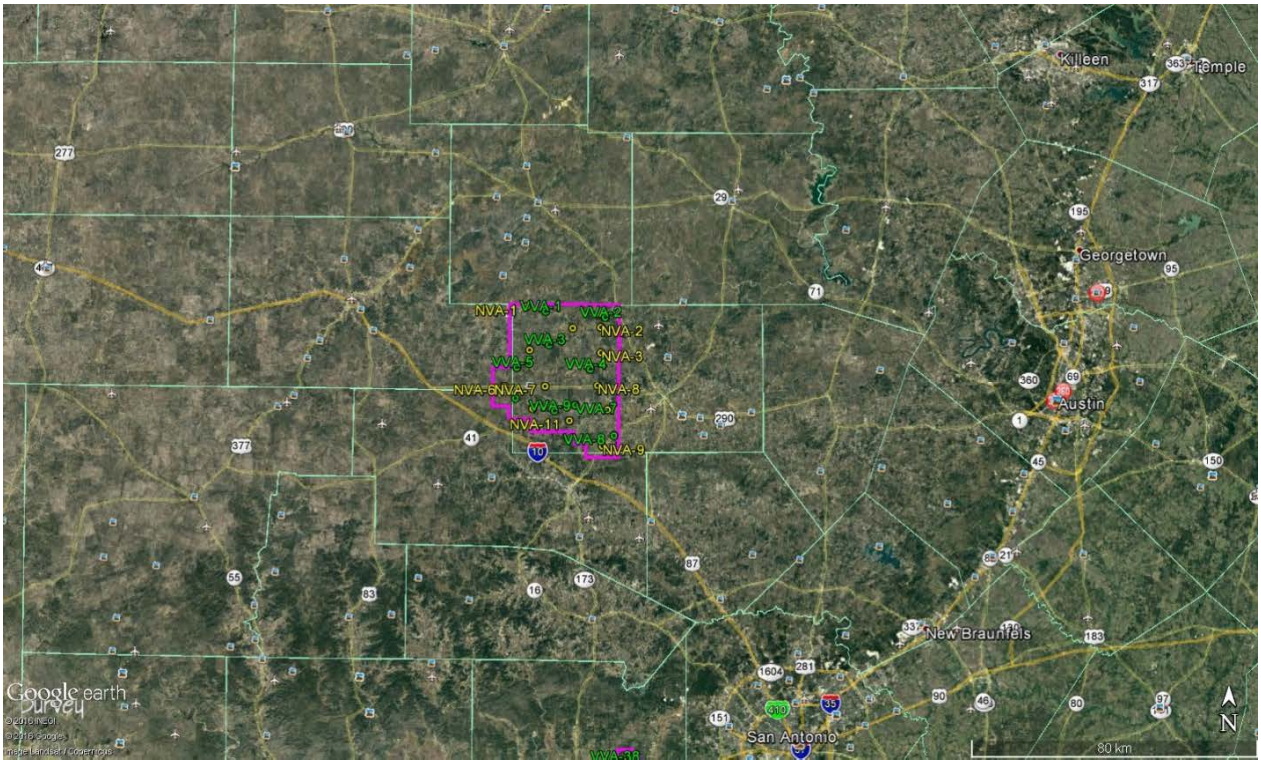
1.2 *Points of Contact*

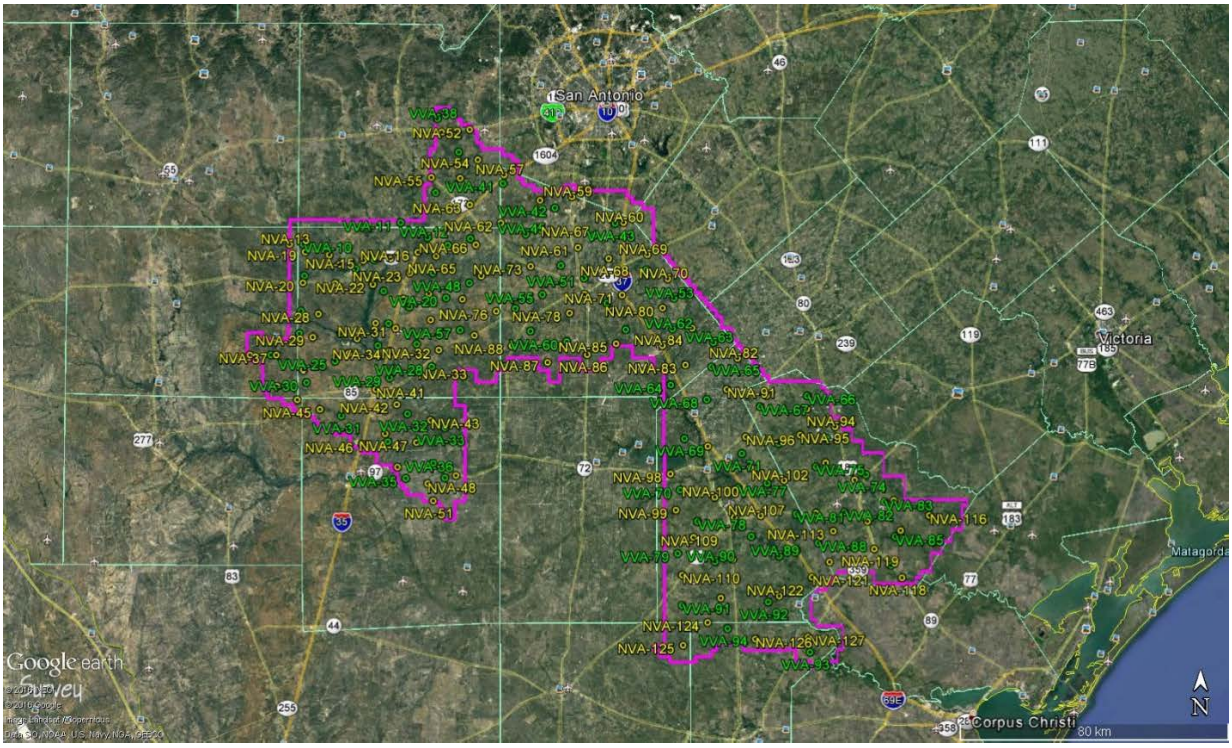
Questions regarding the technical aspects of this report should be addressed to:

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*





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 224 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 TXDOT RTN. 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.

Seven (7) 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 designated as AO0561, AY2106, DN7695, AO0671, DN7775, AN1952 & BN0540. The results are as follows:

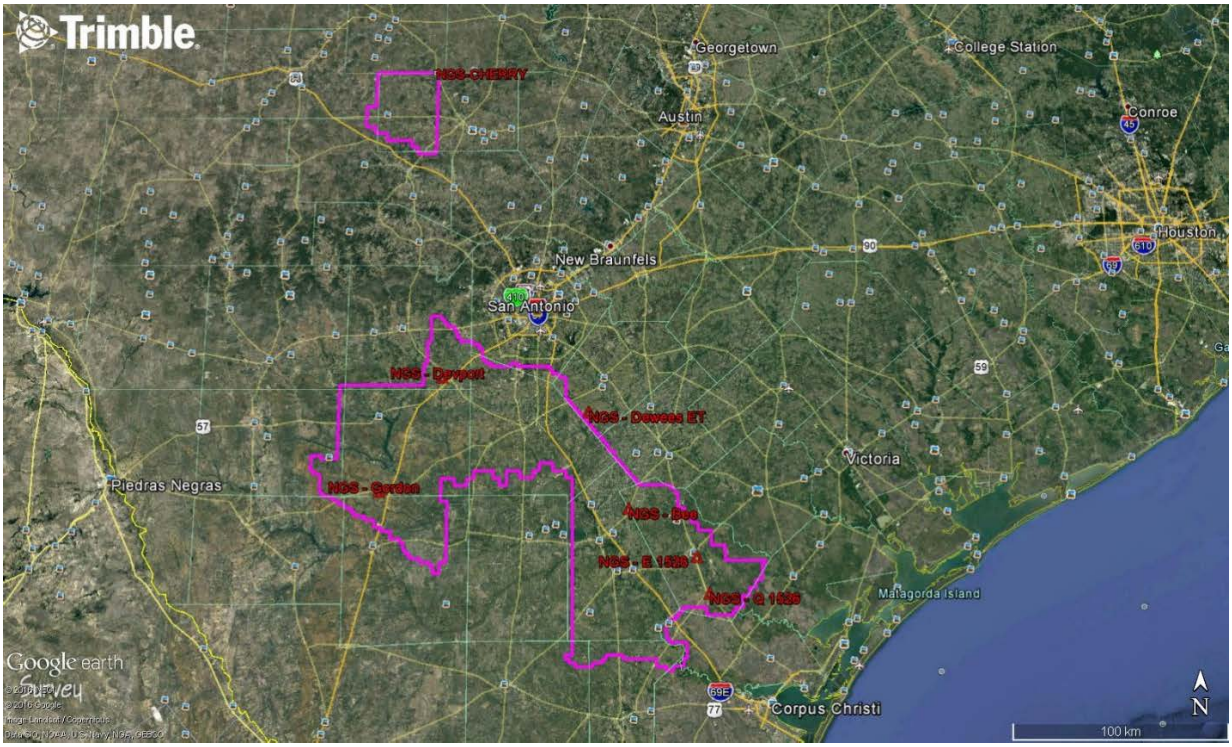
	Observed Values			Data Sheet Values					
PT. #	NORTHING	EASTING	ELEVS.	NORTHING	EASTING	ELEVS.	Δ X	Δ Y	Δ Z
BEE	3162476.604	593493.058	95.357	3162476.558	593493.215	N/A	0.046	-0.157	N/A
DEVPORT	3223306.648	505637.473	210.023	3223306.652	505637.457	210.050	-0.004	0.016	-0.027
E1526	3140854.089	624835.001	58.068	3140854.096	624834.996	58.060	-0.007	0.005	0.008
GORDON**	3170288.095	477397.675	177.719	3170288.094	477397.614	N/A	0.001	0.061	N/A
Q1526	3124411.897	630552.524	44.352	3124411.888	630552.524	44.320	0.009	0.000	0.032
Y1378*	3191611.036	609547.211	113.319	3191611.114	609547.111	113.361	N/A	N/A	-0.042
CHERRY	3373836.894	498952.612	542.742	3373836.892	498952.611	542.733	0.002	0.001	0.009

(*) Indicates a vertical NGS Mark

(**) Indicates a horizontal NGS Mark

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

NGS Monuments



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 TxDOT RTN 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*

UTM Zone 14, NAD83 (2011), NAVD88 Meters			
POINT ID	**NORTHING (m)**	**EASTING (m)**	**ELEV. (m)**
NVA			
NVA-001	3373666.046	474766.238	558.514
NVA-002	3368138.466	495119.792	535.905
NVA-003	3361218.863	495211.987	641.788
NVA-004	3367895.366	487460.015	529.793
NVA-005	3361912.917	475687.505	668.951
NVA-006	3352045.961	468831.703	665.001
NVA-007	3352080.657	479947.621	646.390
NVA-008	3352324.894	494286.037	581.950
NVA-009	3335849.509	495675.938	569.582
NVA-010	3345896.357	494832.839	548.821
NVA-011	3342501.406	484300.661	629.333
NVA-012	3347689.337	476625.056	643.645
NVA-013	3213206.993	457582.068	215.911
NVA-014	3210152.350	469238.744	203.830
NVA-015	3208607.054	479246.396	181.296
NVA-016	3210962.276	495181.533	231.256
NVA-017	3209199.539	487282.967	178.348
NVA-018	3207435.554	472326.273	192.720
NVA-019	3211002.881	462179.174	205.818
NVA-020	3202077.904	461562.015	221.906
NVA-021	3201887.087	471000.656	200.111
NVA-022	3201799.693	481848.746	167.834
NVA-023	3204970.766	492958.978	204.960
NVA-024	3197467.734	491085.372	194.126
NVA-025	3199027.259	498454.767	193.696
NVA-026	3191429.985	499051.306	186.479
NVA-027	3190444.549	482919.913	159.996
NVA-028	3191091.587	460268.929	178.657
NVA-029	3186268.094	464520.512	185.511
NVA-030	3185867.793	477545.520	156.948
NVA-031	3188933.985	488798.912	179.073
NVA-032	3182699.894	501463.442	176.736
NVA-033	3176709.759	495372.716	152.243
NVA-034	3182322.678	487023.890	157.708
NVA-035	3181579.113	475098.085	157.702

NVA-036	3176870.060	461765.561	185.468
NVA-037	3181066.258	453841.351	214.488
NVA-038	3181034.932	446077.494	212.657
NVA-040	3168096.386	460038.818	186.147
NVA-041	3171210.164	483114.341	171.218
NVA-042	3168400.571	486804.757	156.393
NVA-043	3153141.888	509164.976	104.586
NVA-044	3158364.486	486048.073	145.113
NVA-045	3165341.276	466731.588	164.153
NVA-046	3155296.907	479034.288	175.167
NVA-047	3155825.807	495016.138	132.703
NVA-048	3146367.944	506636.479	102.849
NVA-049	3148691.977	489502.252	156.799
NVA-050	3143975.742	498379.283	118.461
NVA-051	3138971.732	500014.700	129.466
NVA-052	3246652.327	510207.697	283.368
NVA-053	3245902.312	502006.767	296.692
NVA-054	3237881.067	512641.634	245.000
NVA-055	3232714.637	499047.106	248.848
NVA-056	3232527.830	507502.526	237.113
NVA-057	3233578.091	520408.527	219.901
NVA-058	3226181.271	530878.753	216.656
NVA-059	3227249.115	540219.692	215.990
NVA-060	3219858.398	555330.090	163.976
NVA-061	3212559.864	542025.374	137.029
NVA-062	3219614.797	519466.042	189.310
NVA-063	3224845.313	510351.425	207.646
NVA-064	3223563.388	500183.835	223.453
NVA-065	3209902.227	500574.069	181.270
NVA-066	3213247.447	512176.881	204.544
NVA-067	3218154.641	531063.718	170.747
NVA-068	3209376.918	550921.419	129.675
NVA-069	3210590.831	562298.597	144.201
NVA-070	3203620.363	568301.088	113.460
NVA-071	3198849.848	554984.688	125.914
NVA-072	3199022.329	544009.316	138.462
NVA-073	3207067.672	528227.260	164.709
NVA-074	3204183.570	513799.912	179.314
NVA-075	3197437.441	508330.479	148.004
NVA-076	3193996.976	518239.876	170.703

NVA-077	3192941.688	528638.507	164.167
NVA-078	3193549.908	539642.509	145.923
NVA-079	3194474.610	552210.747	131.992
NVA-080	3195017.319	566688.737	102.529
NVA-081	3189346.694	575489.984	102.857
NVA-082	3180661.119	588794.175	115.827
NVA-083	3178677.196	573568.141	118.156
NVA-084	3183886.815	566844.171	79.503
NVA-085	3184758.121	553272.378	97.354
NVA-086	3181541.474	544866.756	113.734
NVA-087	3179253.874	533289.209	129.992
NVA-088	3184021.603	522863.644	143.123
NVA-089	3186982.484	511861.256	153.193
NVA-090	3166934.166	574492.764	73.550
NVA-091	3171655.536	585693.765	76.573
NVA-092	3169893.928	597235.769	115.481
NVA-093	3166085.784	609123.555	128.992
NVA-094	3160937.775	617418.062	94.468
NVA-095	3158487.184	607189.941	102.197
NVA-096	3157902.986	591278.886	64.668
NVA-097	3155263.971	580150.369	50.547
NVA-098	3147087.062	569267.770	74.262
NVA-099	3136605.334	570970.182	98.458
NVA-100	3140392.472	582300.628	64.498
NVA-101	3148961.659	592707.531	84.208
NVA-102	3145287.965	602557.829	102.138
NVA-103	3150457.865	614689.559	107.715
NVA-104	3145538.075	623215.316	79.410
NVA-105	3139599.360	634754.834	55.129
NVA-106	3135854.723	611899.402	84.024
NVA-107	3134955.794	595325.457	52.992
NVA-108	3134572.122	588037.345	46.074
NVA-109	3128701.652	576097.352	88.857
NVA-110	3117773.517	572909.242	121.704
NVA-111	3122374.122	587637.826	106.591
NVA-112	3124943.538	606312.702	57.794
NVA-113	3130626.426	617033.513	66.629
NVA-114	3133511.377	627075.949	46.851
NVA-115	3129800.594	634728.647	36.486
NVA-116	3135262.801	645240.046	31.942
NVA-117	3130954.112	647891.977	35.855

NVA-118	3117149.539	637286.048	27.056
NVA-119	3124991.837	628959.164	49.632
NVA-120	3121674.050	616031.068	65.416
NVA-121	3117651.326	610611.423	66.610
NVA-122	3111776.144	601281.976	51.114
NVA-123	3111117.624	584204.034	72.228
NVA-124	3104006.909	580399.155	96.787
NVA-125	3097368.975	573260.161	128.218
NVA-126	3099231.530	594350.500	86.462
NVA-127	3099859.378	609853.241	40.284
NVA-128	3169611.153	463852.936	169.361
NVA-129	3172599.297	491256.855	144.558
VVA			
VVA-001	3372413.415	480021.057	610.485
VVA-002	3370872.177	496298.305	547.799
VVA-003	3363316.197	481005.958	566.518
VVA-004	3354032.961	491873.858	647.931
VVA-005	3357160.607	472203.023	674.285
VVA-006	3348763.281	471854.308	651.727
VVA-007	3347011.614	488343.906	567.434
VVA-008	3338710.391	498863.899	535.131
VVA-009	3345371.625	482577.143	596.225
VVA-010	3211585.323	459888.495	211.633
VVA-011	3219614.740	490150.478	202.668
VVA-012	3215259.553	498181.737	212.476
VVA-013	3204965.970	499658.352	184.320
VVA-014	3208810.837	482358.769	181.444
VVA-015	3205996.551	476967.841	181.808
VVA-016	3202170.014	464185.343	229.809
VVA-017	3196388.252	463943.589	203.311
VVA-018	3199740.709	485263.100	179.231
VVA-019	3195336.159	492912.391	194.503
VVA-020	3197808.414	503510.139	162.554
VVA-021	3190312.126	486700.008	167.476
VVA-022	3187401.495	472707.153	164.472
VVA-023	3187377.395	460400.893	188.381
VVA-024	3181082.562	452221.061	208.406
VVA-025	3179351.867	471099.819	175.805
VVA-026	3183913.596	483637.552	146.632
VVA-027	3184405.813	495032.810	177.710

VVA-028	3179909.878	504334.206	166.690
VVA-029	3174563.203	487100.319	152.090
VVA-030	3173080.710	462729.382	177.280
VVA-031	3163457.508	473007.980	162.469
VVA-032	3168705.230	488570.265	149.940
VVA-033	3154043.887	505558.101	111.374
VVA-034	3156655.706	491835.418	140.653
VVA-035	3146332.717	493553.914	126.748
VVA-036	3149879.928	499955.130	121.863
VVA-037	3147876.909	502830.978	110.966
VVA-038	3249783.343	500749.859	294.315
VVA-039	3239993.030	507008.910	273.459
VVA-040	3228326.875	500305.204	229.569
VVA-041	3231067.389	519989.610	213.643
VVA-042	3223985.696	535224.647	201.712
VVA-043	3219547.837	553065.034	154.140
VVA-044	3216027.444	546634.797	143.466
VVA-045	3216430.670	526806.647	181.091
VVA-046	3215010.667	510560.536	204.273
VVA-047	3213123.136	503925.862	191.115
VVA-048	3202169.975	510357.466	159.209
VVA-049	3206729.643	522056.053	181.431
VVA-050	3207395.980	536987.500	149.459
VVA-051	3203689.472	543855.981	144.320
VVA-052	3206514.678	563144.295	118.636
VVA-053	3197971.264	570124.303	107.108
VVA-054	3195525.500	554638.425	106.853
VVA-055	3198873.720	531677.246	179.633
VVA-056	3194845.975	523790.216	141.320
VVA-057	3188514.609	507661.310	157.359
VVA-058	3178079.166	520959.830	120.763
VVA-059	3188286.544	528257.458	146.190
VVA-060	3185310.421	538858.469	130.875
VVA-061	3188796.118	554841.171	100.055
VVA-062	3189084.078	569743.756	83.523
VVA-063	3185229.078	581756.994	141.505
VVA-064	3172854.926	569311.186	95.120
VVA-065	3178145.853	581223.315	109.817
VVA-066	3169863.241	609264.821	123.713

VVA-067	3166645.303	595506.081	106.834
VVA-068	3169137.106	579863.646	80.295
VVA-069	3157332.051	573368.060	89.631
VVA-070	3142457.038	572148.214	61.478
VVA-071	3153049.379	590178.099	54.031
VVA-072	3156016.237	600693.227	125.167
VVA-073	3157611.288	614887.170	104.241
VVA-074	3147079.462	626604.176	67.496
VVA-075	3149347.175	612004.776	89.118
VVA-076	3144472.299	597594.139	76.048
VVA-077	3142833.802	588952.687	45.684
VVA-078	3133317.647	577283.613	104.825
VVA-079	3124033.327	571574.483	97.974
VVA-080	3128638.903	592986.756	50.367
VVA-081	3135546.253	606143.817	76.089
VVA-082	3136181.927	620374.360	65.344
VVA-083	3139299.053	632014.225	55.455
VVA-084	3138350.330	644720.081	37.266
VVA-085	3128087.669	634314.046	37.489
VVA-086	3120723.304	634041.642	32.876
VVA-087	3125926.589	622890.009	55.039
VVA-088	3127194.309	612664.298	72.623
VVA-089	3123368.637	601184.935	35.631
VVA-090	3121689.318	582427.326	100.872
VVA-091	3108996.246	572874.266	109.070
VVA-092	3110021.216	598072.462	45.815
VVA-093	3095460.985	610404.337	40.726
VVA-094	3102237.204	586251.808	79.532
VVA-095	3113830.511	588074.272	73.773
VVA-096	3170889.662	486288.966	149.412

4. *GPS OBSERVATIONS*

POINT ID	OBSERV. DATE	JULIAN DATE	TIME OF DAY (AST)	RE-OBSERV. DATE	RE-OBSERV. TIME
NVA					
NVA-001	3/28/2017	87	11:17	N/A	N/A
NVA-002	3/27/2017	86	15:20	N/A	N/A
NVA-003	3/27/2017	86	16:21	3/28/2017	10:19
NVA-004	3/27/2017	86	13:59	3/28/2017	10:40
NVA-005	3/27/2017	86	13:05	N/A	N/A
NVA-006	3/27/2017	86	12:22	N/A	N/A
NVA-007	3/27/2017	86	10:43	3/27/2017	20:11
NVA-008	3/27/2017	86	17:22	3/28/2017	9:50
NVA-009	3/27/2017	86	18:30	N/A	N/A
NVA-010	3/27/2017	86	9:00	3/27/2017	17:47
NVA-011	3/27/2017	86	9:50	3/27/2017	15:30
NVA-012	3/27/2017	86	11:08	N/A	N/A
NVA-013	3/27/2017	86	17:56	N/A	N/A
NVA-014	3/27/2017	86	17:17	N/A	N/A
NVA-015	3/27/2017	86	14:37	N/A	N/A
NVA-016	3/24/2017	83	19:12	3/26/2017	19:54
NVA-017	3/24/2017	83	18:58	3/27/2017	14:08
NVA-018	3/27/2017	86	17:01	N/A	N/A
NVA-019	3/27/2017	86	17:30	N/A	N/A
NVA-020	3/27/2017	86	15:29	N/A	N/A
NVA-021	3/27/2017	86	15:13	N/A	N/A
NVA-022	3/24/2017	83	19:59	3/26/2017	20:32
NVA-023	3/24/2017	83	19:25	3/26/2017	20:05
NVA-024	3/27/2017	86	13:18	N/A	N/A
NVA-025	3/22/2017	81	15:37	N/A	N/A
NVA-026	3/22/2017	81	15:13	3/27/2017	13:00
NVA-027	3/27/2017	86	12:00	N/A	N/A
NVA-028	3/26/2017	85	18:07	3/27/2017	16:23
NVA-029	3/26/2017	85	17:48	N/A	N/A
NVA-030	3/26/2017	85	13:43	3/27/2017	11:32
NVA-031	3/27/2017	86	12:28	N/A	N/A
NVA-032	3/22/2017	81	13:50	3/26/2017	11:05
NVA-033	3/26/2017	85	10:31	3/27/2017	10:28

NVA-034	3/26/2017	85	13:10	3/27/2017	11:04
NVA-035	3/26/2017	85	14:16	N/A	N/A
NVA-036	3/25/2017	84	11:19	N/A	N/A
NVA-037	3/25/2017	84	12:08	3/26/2017	17:12
NVA-038	3/25/2017	84	12:42	3/26/2017	16:39
NVA-040	3/25/2017	84	14:06	3/26/2017	15:39
NVA-041	3/25/2017	84	10:09	3/27/2017	9:02
NVA-042	3/26/2017	85	9:21	3/27/2017	9:14
NVA-043	3/25/2017	84	19:25	N/A	N/A
NVA-044	3/25/2017	84	16:05	N/A	N/A
NVA-045	3/25/2017	84	14:46	N/A	N/A
NVA-046	3/25/2017	84	15:40	N/A	N/A
NVA-047	3/25/2017	84	16:45	N/A	N/A
NVA-048	3/25/2017	84	17:18	N/A	N/A
NVA-049	3/25/2017	84	18:43	N/A	N/A
NVA-050	3/25/2017	84	17:48	N/A	N/A
NVA-051	3/25/2017	84	18:03	N/A	N/A
NVA-052	3/24/2017	83	16:20	N/A	N/A
NVA-053	3/24/2017	83	15:43	N/A	N/A
NVA-054	3/23/2017	82	15:45	3/24/2017	16:48
NVA-055	3/24/2017	83	14:35	N/A	N/A
NVA-056	3/23/2017	82	16:33	N/A	N/A
NVA-057	3/23/2017	82	15:15	3/24/2017	17:06
NVA-058	3/23/2017	82	14:34	N/A	N/A
NVA-059	3/23/2017	82	13:42	N/A	N/A
NVA-060	3/23/2017	82	12:53	3/23/2017	19:30
NVA-061	3/22/2017	81	19:05	3/23/2017	18:52
NVA-062	3/23/2017	82	17:46	N/A	N/A
NVA-063	3/23/2017	82	16:55	3/24/2017	13:30
NVA-064	3/24/2017	83	14:00	N/A	N/A
NVA-065	3/24/2017	83	12:07	3/27/2017	19:05
NVA-066	3/24/2017	83	13:10	3/27/2017	19:46
NVA-067	3/23/2017	82	18:25	N/A	N/A
NVA-068	3/23/2017	82	11:47	3/23/2017	19:44
NVA-069	3/26/2017	85	9:49	N/A	N/A
NVA-070	3/26/2017	85	11:31	N/A	N/A

NVA-071	3/23/2017	82	11:23	3/23/2017	20:03
NVA-072	3/22/2017	81	9:26	3/23/2017	9:09
NVA-073	3/22/2017	81	18:24	3/24/2017	10:07
NVA-074	3/22/2017	81	16:46	3/24/2017	10:51
NVA-075	3/22/2017	81	16:10	3/24/2017	11:17
NVA-076	3/22/2017	81	17:06	3/26/2017	12:10
NVA-077	3/22/2017	81	10:29	3/26/2017	11:39
NVA-078	3/21/2017	80	19:41	3/23/2017	9:27
NVA-079	3/23/2017	82	10:39	N/A	N/A
NVA-080	3/26/2017	85	12:08	N/A	N/A
NVA-081	3/26/2017	85	12:55	N/A	N/A
NVA-082	3/25/2017	84	19:24	N/A	N/A
NVA-083	3/25/2017	84	20:07	3/26/2017	13:54
NVA-084	3/21/2017	80	16:17	N/A	N/A
NVA-085	3/21/2017	80	18:23	3/23/2017	10:15
NVA-086	3/21/2017	80	18:43	3/23/2017	10:00
NVA-087	3/22/2017	81	11:17	N/A	N/A
NVA-088	3/22/2017	81	12:07	N/A	N/A
NVA-089	3/22/2017	81	13:01	3/26/2017	11:19
NVA-090	3/21/2017	80	17:15	3/26/2017	14:30
NVA-091	3/25/2017	84	19:04	N/A	N/A
NVA-092	3/23/2017	82	16:56	3/24/2017	12:37
NVA-093	3/23/2017	82	17:50	N/A	N/A
NVA-094	3/24/2017	83	11:54	N/A	N/A
NVA-095	3/23/2017	82	18:16	3/24/2017	11:12
NVA-096	3/23/2017	82	16:17	3/24/2017	13:10
NVA-097	3/21/2017	80	17:41	3/25/2017	17:45
NVA-098	3/24/2017	83	14:36	3/26/2017	15:35
NVA-099	3/24/2017	83	15:18	3/26/2017	16:13
NVA-100	3/25/2017	84	17:20	3/26/2017	17:39
NVA-101	3/23/2017	82	15:23	3/24/2017	13:44
NVA-102	3/23/2017	82	19:43	N/A	N/A
NVA-103	3/24/2017	83	10:38	N/A	N/A
NVA-104	3/22/2017	81	18:39	3/24/2017	10:02
NVA-105	3/22/2017	81	9:58	N/A	N/A
NVA-106	3/22/2017	81	17:38	3/23/2017	12:34
NVA-107	3/23/2017	82	13:11	3/25/2017	14:43

NVA-108	3/25/2017	84	17:01	3/26/2017	17:24
NVA-109	3/24/2017	83	15:56	3/26/2017	16:42
NVA-110	3/24/2017	83	17:00	N/A	N/A
NVA-111	3/25/2017	84	15:32	N/A	N/A
NVA-112	3/25/2017	84	14:00	N/A	N/A
NVA-113	3/22/2017	81	16:54	3/23/2017	12:13
NVA-114	3/22/2017	81	12:42	3/23/2017	9:52
NVA-115	3/22/2017	81	13:08	3/23/2017	10:26
NVA-116	3/22/2017	81	11:08	N/A	N/A
NVA-117	3/22/2017	81	11:41	N/A	N/A
NVA-118	3/22/2017	81	15:21	N/A	N/A
NVA-119	3/22/2017	81	14:21	3/23/2017	10:44
NVA-120	3/22/2017	81	16:14	3/23/2017	11:37
NVA-121	3/25/2017	84	13:42	N/A	N/A
NVA-122	3/25/2017	84	12:51	N/A	N/A
NVA-123	3/25/2017	84	12:06	N/A	N/A
NVA-124	3/24/2017	83	18:01	3/25/2017	11:45
NVA-125	3/24/2017	83	18:31	N/A	N/A
NVA-126	3/24/2017	83	19:24	3/25/2017	11:03
NVA-127	3/24/2017	83	19:56	N/A	N/A
NVA-128	3/25/2017	84	13:48	3/26/2017	15:29
NVA-129	3/26/2017	85	10:16	3/27/2017	10:16
VVA					
VVA-001	3/27/2017	86	14:27	3/28/2017	11:00
VVA-002	3/27/2017	86	15:03	N/A	N/A
VVA-003	3/27/2017	86	13:39	N/A	N/A
VVA-004	3/27/2017	86	17:05	3/28/2017	10:00
VVA-005	3/27/2017	86	12:44	N/A	N/A
VVA-006	3/27/2017	86	12:03	N/A	N/A
VVA-007	3/27/2017	86	9:20	3/27/2017	19:11
VVA-008	3/27/2017	86	18:12	N/A	N/A
VVA-009	3/27/2017	86	10:20	3/27/2017	19:46
VVA-010	3/27/2017	86	17:43	N/A	N/A
VVA-011	3/24/2017	83	18:33	N/A	N/A
VVA-012	3/24/2017	83	18:17	3/27/2017	18:52
VVA-013	3/24/2017	83	11:55	3/27/2017	13:36
VVA-014	3/27/2017	86	14:25	3/27/2017	18:28

VVA-015	3/27/2017	86	14:53	N/A	N/A
VVA-016	3/27/2017	86	15:44	N/A	N/A
VVA-017	3/27/2017	86	16:05	N/A	N/A
VVA-018	3/24/2017	83	19:46	3/26/2017	20:21
VVA-019	3/27/2017	86	12:46	N/A	N/A
VVA-020	3/22/2017	81	15:56	3/24/2017	11:28
VVA-021	3/27/2017	86	12:14	N/A	N/A
VVA-022	3/26/2017	85	13:58	3/27/2017	11:43
VVA-023	3/26/2017	85	17:36	N/A	N/A
VVA-024	3/25/2017	84	12:21	3/26/2017	16:53
VVA-025	3/26/2017	85	14:35	N/A	N/A
VVA-026	3/26/2017	85	13:26	3/27/2017	11:15
VVA-027	3/22/2017	81	14:15	3/26/2017	12:50
VVA-028	3/26/2017	85	10:50	3/27/2017	10:43
VVA-029	3/25/2017	84	9:50	3/27/2017	8:47
VVA-030	3/25/2017	84	11:00	3/26/2017	15:18
VVA-031	3/25/2017	84	15:17	N/A	N/A
VVA-032	3/26/2017	85	9:30	N/A	N/A
VVA-033	3/25/2017	84	19:09	N/A	N/A
VVA-034	3/25/2017	84	16:32	N/A	N/A
VVA-035	3/25/2017	84	18:27	N/A	N/A
VVA-036	3/25/2017	84	17:03	N/A	N/A
VVA-037	3/25/2017	84	17:31	N/A	N/A
VVA-038	3/24/2017	83	16:01	N/A	N/A
VVA-039	3/23/2017	82	16:13	3/24/2017	15:23
VVA-040	3/24/2017	83	12:14	N/A	N/A
VVA-041	3/23/2017	82	14:59	3/24/2017	17:33
VVA-042	3/23/2017	82	14:06	N/A	N/A
VVA-043	3/23/2017	82	12:28	3/23/2017	19:21
VVA-044	3/23/2017	82	12:07	3/23/2017	19:05
VVA-045	3/23/2017	82	18:09	N/A	N/A
VVA-046	3/24/2017	83	12:54	3/27/2017	19:34
VVA-047	3/24/2017	83	12:24	3/27/2017	19:18
VVA-048	3/22/2017	81	16:27	3/24/2017	11:04
VVA-049	3/22/2017	81	18:07	3/24/2017	10:22
VVA-050	3/22/2017	81	18:45	3/24/2017	9:51
VVA-051	3/22/2017	81	19:26	3/23/2017	8:55

VVA-052	3/26/2017	85	10:12	3/26/2017	10:17
VVA-053	3/26/2017	85	11:52	N/A	N/A
VVA-054	3/23/2017	82	11:00	N/A	N/A
VVA-055	3/22/2017	81	9:52	3/24/2017	9:34
VVA-056	3/22/2017	81	17:30	3/26/2017	11:52
VVA-057	3/22/2017	81	13:21	3/26/2017	12:30
VVA-058	3/22/2017	81	12:25	N/A	N/A
VVA-059	3/22/2017	81	10:48	N/A	N/A
VVA-060	3/21/2017	80	19:02	3/23/2017	9:44
VVA-061	3/21/2017	80	17:45	N/A	N/A
VVA-062	3/26/2017	85	12:29	N/A	N/A
VVA-063	3/26/2017	85	13:17	N/A	N/A
VVA-064	3/21/2017	80	16:44	3/26/2017	14:10
VVA-065	3/25/2017	84	19:46	3/26/2017	13:37
VVA-066	3/23/2017	82	17:17	3/24/2017	12:19
VVA-067	3/23/2017	82	16:42	3/24/2017	12:51
VVA-068	3/25/2017	84	18:43	3/26/2017	18:06
VVA-069	3/25/2017	84	18:08	N/A	N/A
VVA-070	3/24/2017	83	15:01	3/26/2017	15:52
VVA-071	3/23/2017	82	15:49	3/24/2017	13:26
VVA-072	3/23/2017	82	18:42	N/A	N/A
VVA-073	3/24/2017	83	11:31	N/A	N/A
VVA-074	3/22/2017	81	19:02	3/24/2017	9:43
VVA-075	3/23/2017	82	19:16	3/24/2017	10:52
VVA-076	3/23/2017	82	14:56	N/A	N/A
VVA-077	3/23/2017	82	14:16	N/A	N/A
VVA-078	3/24/2017	83	15:37	3/26/2017	16:30
VVA-079	3/24/2017	83	16:10	3/26/2017	16:54
VVA-080	3/25/2017	84	15:11	3/25/2017	15:15
VVA-081	3/22/2017	81	17:22	3/23/2017	12:46
VVA-082	3/22/2017	81	17:59	N/A	N/A
VVA-083	3/22/2017	81	9:39	N/A	N/A
VVA-084	3/22/2017	81	10:44	N/A	N/A
VVA-085	3/22/2017	81	13:43	3/23/2017	10:13
VVA-086	3/22/2017	81	14:59	N/A	N/A
VVA-087	3/22/2017	81	15:50	3/23/2017	11:18
VVA-088	3/22/2017	81	16:33	3/23/2017	11:52

VVA-089	3/25/2017	84	13:16	N/A	N/A
VVA-090	3/25/2017	84	16:26	N/A	N/A
VVA-091	3/24/2017	83	17:31	N/A	N/A
VVA-092	3/25/2017	84	12:36	N/A	N/A
VVA-093	3/25/2017	84	10:33	N/A	N/A
VVA-094	3/24/2017	83	19:01	3/25/2017	11:26
VVA-095	3/25/2017	84	16:01	N/A	N/A
VVA-096	3/26/2017	85	10:00	3/27/2017	10:03

5. *POINT COMPARISON*

Point ID	Point CK	Delta North (M)	Delta East (M)	Vertical Difference (M)
NVA				
NVA-003	NVA-003CK	0.007	-0.016	0.021
NVA-004	NVA-004CK	0.009	0.013	0.010
NVA-007	NVA-007CK	0.011	-0.021	-0.008
NVA-008	NVA-008CK	0.007	-0.025	0.015
NVA-010	NVA-010CK	0.005	-0.004	0.002
NVA-011	NVA-011CK	0.011	0.000	-0.009
NVA-016	NVA-016CK	-0.005	0.007	-0.003
NVA-017	NVA-017CK	0.001	0.009	0.037
NVA-022	NVA-022CK	-0.004	0.023	-0.002
NVA-023	NVA-023CK	0.002	-0.015	0.015
NVA-026	NVA-026CK	0.018	-0.013	-0.004
NVA-028	NVA-028CK	-0.004	0.001	0.007
NVA-030	NVA-030CK	-0.005	0.019	0.008
NVA-032	NVA-032CK	0.004	0.006	0.001
NVA-033	NVA-033CK	0.017	-0.021	-0.021
NVA-034	NVA-034CK	0.009	-0.014	-0.016
NVA-037	NVA-037CK	-0.014	0.019	-0.004
NVA-038	NVA-038CK	0.007	0.027	-0.007
NVA-040	NVA-040CK	-0.006	-0.008	-0.043
NVA-041	NVA-041CK	0.005	-0.006	0.032
NVA-042	NVA-042CK	0.005	-0.007	0.010
NVA-054	NVA-054CK	0.010	0.002	0.027
NVA-057	NVA-057CK	0.009	-0.011	-0.029
NVA-060	NVA-060CK	0.002	-0.005	-0.013
NVA-061	NVA-061CK	-0.002	0.010	0.025
NVA-063	NVA-063CK	-0.004	-0.006	0.019
NVA-065	NVA-065CK	0.007	-0.004	0.013
NVA-066	NVA-066CK	0.004	0.013	-0.005
NVA-068	NVA-068CK	0.000	0.007	-0.011
NVA-071	NVA-071CK	-0.001	-0.004	0.020
NVA-072	NVA-072CK	0.005	0.003	-0.004

NVA-073	NVA-073CK	-0.004	0.021	0.021
NVA-074	NVA-074CK	-0.010	0.034	0.032
NVA-075	NVA-075CK	0.000	-0.001	0.029
NVA-076	NVA-076CK	0.003	-0.009	-0.009
NVA-077	NVA-077CK	0.001	0.002	0.031
NVA-078	NVA-078CK	-0.002	-0.015	-0.010
NVA-083	NVA-083CK	-0.019	0.006	-0.036
NVA-085	NVA-085CK	0.004	-0.011	0.027
NVA-086	NVA-086CK	0.001	0.022	-0.008
NVA-089	NVA-089CK	-0.003	-0.003	0.008
NVA-090	NVA-090CK	-0.011	-0.021	-0.026
NVA-092	NVA-092CK	0.007	-0.017	0.018
NVA-095	NVA-095CK	-0.008	0.021	0.013
NVA-096	NVA-096CK	-0.013	0.001	-0.037
NVA-097	NVA-097CK	-0.010	0.004	0.005
NVA-098	NVA-098CK	-0.005	0.008	0.035
NVA-099	NVA-099CK	0.013	0.006	0.016
NVA-100	NVA-100CK	0.005	0.004	-0.005
NVA-101	NVA-101CK	-0.006	0.020	0.003
NVA-104	NVA-104CK	0.010	-0.010	-0.008
NVA-106	NVA-106CK	-0.003	0.011	0.004
NVA-107	NVA-107CK	0.021	-0.005	-0.023
NVA-108	NVA-108CK	0.006	-0.004	0.024
NVA-109	NVA-109CK	-0.014	-0.006	-0.034
NVA-113	NVA-113CK	0.004	0.029	0.001
NVA-114	NVA-114CK	0.011	0.010	-0.004
NVA-115	NVA-115CK	0.014	0.002	0.020
NVA-119	NVA-119CK	0.002	-0.001	0.009
NVA-120	NVA-120CK	-0.016	-0.018	0.020
NVA-124	NVA-124CK	0.009	0.005	0.020
NVA-126	NVA-126CK	-0.015	-0.026	0.033
NVA-128	NVA-128CK	-0.005	0.002	0.015
NVA-129	NVA-129CK	0.013	0.003	-0.023
VVA				
VVA-001	VVA-001CK	0.009	-0.009	-0.003
VVA-004	VVA-004CK	0.017	0.019	0.029

VVA-007	VVA-007CK	0.010	0.004	-0.006
VVA-009	VVA-009CK	0.009	0.006	-0.034
VVA-012	VVA-012CK	0.007	0.008	0.028
VVA-013	VVA-013CK	-0.005	0.007	0.014
VVA-014	VVA-014CK	0.006	0.000	-0.037
VVA-018	VVA-018CK	0.008	-0.004	-0.015
VVA-020	VVA-020CK	0.007	-0.006	0.013
VVA-022	VVA-022CK	0.032	0.020	0.038
VVA-024	VVA-024CK	0.005	0.011	-0.027
VVA-026	VVA-026CK	0.025	-0.008	-0.036
VVA-027	VVA-027CK	0.005	-0.004	0.017
VVA-028	VVA-028CK	0.023	-0.011	-0.029
VVA-029	VVA-029CK	-0.012	0.005	0.017
VVA-030	VVA-030CK	0.007	0.007	-0.025
VVA-039	VVA-039CK	-0.016	0.008	0.037
VVA-041	VVA-041CK	0.000	-0.014	0.022
VVA-043	VVA-043CK	0.005	-0.001	0.021
VVA-044	VVA-044CK	0.013	-0.006	0.034
VVA-046	VVA-046CK	0.010	0.005	0.004
VVA-047	VVA-047CK	0.014	-0.026	0.022
VVA-048	VVA-048CK	0.013	-0.008	-0.030
VVA-049	VVA-049CK	0.011	0.004	-0.026
VVA-050	VVA-050CK	0.002	-0.005	-0.023
VVA-051	VVA-051CK	0.003	-0.002	0.027
VVA-052	VVA-052CK	0.004	0.011	-0.002
VVA-055	VVA-055CK	0.000	0.004	0.045
VVA-056	VVA-056CK	0.028	0.027	0.001
VVA-057	VVA-057CK	-0.008	0.008	0.026
VVA-060	VVA-060CK	0.006	0.013	0.001
VVA-064	VVA-064CK	-0.005	-0.014	0.014
VVA-065	VVA-065CK	0.004	0.016	0.001
VVA-066	VVA-066CK	0.011	0.032	0.039
VVA-067	VVA-067CK	-0.018	0.006	-0.022
VVA-068	VVA-068CK	0.005	-0.003	-0.040
VVA-070	VVA-070CK	0.007	0.020	0.020
VVA-071	VVA-071CK	-0.021	0.003	-0.010

VVA-074	VVA-074CK	-0.006	-0.008	-0.013
VVA-075	VVA-075CK	0.003	0.007	-0.017
VVA-078	VVA-078CK	0.006	-0.010	-0.043
VVA-079	VVA-079CK	-0.012	-0.012	0.001
VVA-080	VVA-080CK	0.000	-0.003	0.008
VVA-081	VVA-081CK	-0.002	0.000	0.001
VVA-085	VVA-085CK	0.011	0.018	-0.006
VVA-087	VVA-087CK	-0.010	0.001	0.030
VVA-088	VVA-088CK	0.013	-0.012	0.036
VVA-094	VVA-094CK	0.000	0.000	0.017
VVA-096	VVA-096CK	-0.007	-0.007	-0.012