

# Goshen County, Wyoming LiDAR Ground Control Point Survey



**Submitted by AECOM  
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October, 2016

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# Table of Contents

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<b>Introduction</b>	.....	<b>1</b>
<b>Methodology</b>	.....	<b>2</b>
<b>Data</b>	.....	<b>2</b>
<b>Contacts</b>	.....	<b>9</b>

1 Introduction

AECOM performed a control survey to support LiDAR data collection in Goshen County, Wyoming. The project consisted of Ground Control Points and Quality Control Points. A total of 20 Ground Control Points and 223 Quality Control Points were surveyed in Goshen County, Wyoming during October 2016. Figure 1 below shows the point locations of both Ground Control Point and Quality Control Points. The Ground Control Points are represented by green dots and the Quality Control Points are red dots.

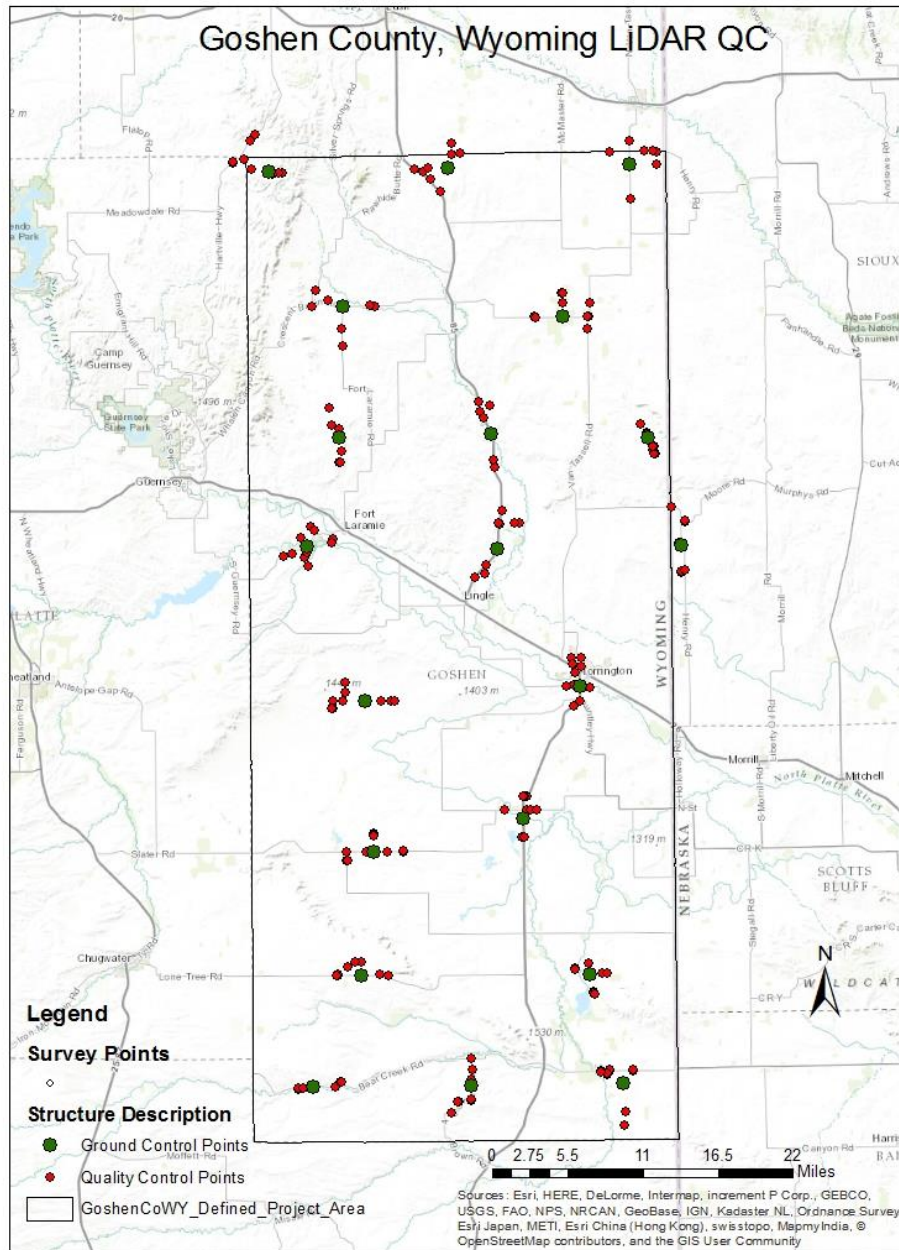


Figure 1

Static GPS observations were performed at all Ground Control Point locations for a minimum of 2 hours. Trimble dual frequency R8 GNSS GPS receivers were used to collect the data for the static sessions. A two meter fixed GPS pole was used in conjunction with two bi-pods for each static session to eliminate human error in measuring GPS antenna heights. The static GPS sessions were then submitted for calculation to the NGS Online Positioning User Service or OPUS for final coordinates. The horizontal datum used is the North American Datum of 1983 2011 and the vertical datum used is the North American Datum of 1988 (NAVD 1988), using Geoid 12b.

GPS Base	Date	Start Time	End Time	Duration	Antenna Height (M)	Filename
GCP_01	10/19/2016	14:27:00	17:37:00	3:10:00	2.000	1323293o.16o
GCP_02	10/13/2016	18:39:00	21:09:00	2:30:00	2.000	1323287s.16o
GCP_03	10/21/2016	17:18:00	19:31:00	2:13:00	2.000	1323294x.16o
GCP_04	10/19/2016	16:00:00	21:29:00	5:29:00	2.000	7312293q.16o
GCP_05	10/14/2016	18:34:00	20:41:00	2:07:00	2.000	7312288s.16o
GCP_06	10/14/2016	14:45:00	16:47:30	2:02:30	2.000	7312288o.16o
GCP_07	10/18/2016	13:54:00	17:32:30	3:38:30	2.000	7312292n.16o
GCP_08	10/14/2016	18:06:00	20:10:00	2:04:00	2.000	1323288s.16o
GCP_09	10/14/2016	14:05:00	17:11:00	3:06:00	2.000	1323288o.16o
GCP_10	10/19/2016	19:45:00	23:09:00	3:24:00	2.000	1323293t.16o
GCP_11	10/16/2016	14:13:00	17:31:00	3:18:00	2.000	1323290o.16o
GCP_12	10/18/2016	15:21:00	18:44:00	3:23:00	2.000	1323292p.16o
GCP_13	10/12/2016	20:30:00	23:47:00	3:17:00	2.000	1323286u.16o
GCP_14	10/12/2016	16:10:00	19:10:00	3:00:00	2.000	7312286q.16o
GCP_15	10/15/2016	18:41:00	20:41:00	2:00:00	2.000	7312289s.16o
GCP_16	10/21/2016	16:13:00	18:44:00	2:31:00	2.000	1323295q.16o
GCP_17	10/12/2016	21:35:00	23:35:00	2:00:00	2.000	7312286v.16o
GCP_18	10/13/2016	20:33:00	22:45:00	2:12:00	2.000	7312287u.16o
GCP_19	10/20/2016	22:03:00	0:21:00	2:18:00	2.000	7312294w.16o
GCP_20	10/12/2016	17:23:00	19:28:30	2:05:30	2.000	1323286r.16o

GPS Sessions

Point	Northing (NAD83 SP WY East Ft)	Easting (NAD83 SP WY East ft)	Northing (NAD83 2011 SP WY East ft)	Easting (NAD 83 2011 SP WY East ft)	Northing (NAD83 2011 UTM 13 m)	Easting (NAD83 2011 UTM 13 m)	Elevation (NAVD88 ft Geoid 12B)	Ellipsoid Height (Meters)	Latitude (N) NAD83	Longitude (W) NAD83	Code
GCP_01	763478.804	802500.829	763478.786	802500.824	4715810.67	530913.847	5569.014	1683.192	42° 35' 38.75923"	104° 37' 23.51587"	GCP
GCP_02	764834.930	871859.080	764834.912	871859.075	4716182.262	552047.577	4927.841	1487.14	42° 35' 46.71385"	104° 21' 56.10028"	GCP
GCP_03	765993.986	942274.562	765993.968	942274.557	4716493.16	573503.166	4850.194	1462.518	42° 35' 50.50525"	104° 6' 14.55886"	GCP
GCP_04	660483.013	829615.536	660482.995	829615.531	4684412.367	539113.884	4852.802	1463.611	42° 18' 39.47609"	104° 31' 31.41619"	GCP
GCP_05	662121.274	888506.681	662121.256	888506.676	4684876.392	557058.492	4364.798	1314.056	42° 18' 50.53151"	104° 18' 27.43664"	GCP
GCP_06	660640.421	949474.810	660640.403	949474.805	4684388.812	575633.964	4490.956	1351.878	42° 18' 29.02854"	104° 4' 56.29735"	GCP
GCP_07	618362.057	817283.982	618362.039	817283.977	4671585.773	535331.447	4281.068	1289.063	42° 11' 44.26737"	104° 34' 19.45082"	GCP
GCP_08	617454.162	890828.560	617454.144	890828.555	4671265.362	557739.325	4265.484	1283.263	42° 11' 29.07931"	104° 18' 2.57645"	GCP
GCP_09	619089.601	962112.051	619089.583	962112.046	4671721.224	579459.619	4304.276	1294.455	42° 11' 36.99979"	104° 2' 15.46327"	GCP
GCP_10	409810.798	819596.258	409810.780	819596.253	4608040.348	535912.509	5110.639	1541.227	41° 37' 23.80135"	104° 34' 8.04059"	GCP
GCP_11	410383.182	881083.162	410383.164	881083.157	4608178.547	554647.397	4985.102	1502.155	41° 37' 24.45440"	104° 20' 38.40913"	GCP
GCP_12	411266.067	939615.385	411266.049	939615.380	4608413.09	572482.089	4732.920	1424.605	41° 37' 26.94340"	104° 7' 47.65449"	GCP
GCP_13	500367.037	843328.842	500367.019	843328.837	4635618.133	543197.09	4482.507	1349.496	41° 52' 16.68601"	104° 28' 46.03941"	GCP
GCP_14	564518.182	923007.232	564518.164	923007.227	4655117.171	567512.373	4087.039	1228.216	42° 2' 42.73732"	104° 11' 3.23495"	GCP
GCP_15	558792.600	839956.194	558792.582	839956.189	4653421.934	542204.09	4318.620	1299.778	42° 1' 54.13157"	104° 29' 24.52118"	GCP
GCP_16	453301.721	926644.649	453301.703	926644.644	4621228.548	568554.828	4471.638	1345.143	41° 44' 23.70161"	104° 10' 32.05621"	GCP
GCP_17	452843.021	838510.295	452843.003	838510.290	4621140.791	541700.837	5306.853	1600.83	41° 44' 27.56387"	104° 29' 54.61132"	GCP
GCP_18	707269.412	916314.598	707269.394	916314.593	4698616.006	565558.263	4724.869	1424.049	42° 26' 13.54372"	104° 12' 10.53471"	GCP
GCP_19	711250.822	831207.977	711250.804	831207.972	4699879.981	539629.42	4842.080	1460.954	42° 27' 0.85312"	104° 31' 5.06648"	GCP
GCP_20	513161.431	900933.546	513161.413	900933.541	4639482.379	560756.299	4262.777	1281.818	41° 54' 17.81843"	104° 16' 2.91254"	GCP

Ground Control Points

The Quality Control Points were surveyed using an external Trimble radio-Base station set up and a Trimble R8 GNSS GPS rover. The rover connected to the Base station via radio link to allow efficient collection of the ground cover types needed. A total of 221 Quality Control Points were surveyed in the study area. Please see Figure 2 below for point distribution.

Number of points	Cover type	Example-Notes
58	Bare Earth	Dirt, sand
12	Brush	Brush over 12 in
6	Crops	Corn-Sunflowers
3	Gravel	Gravel road
42	High Grass	Grass over 15 in
6	Low Brush	Brush under 12 in
71	Low Grass	Grass under 8 in
7	Medium Grass	Grass over 8 in
7	Pavement	Paved road surface
3	Sage Brush-Scrub Brush	Brush over 36 in
6	Tree	Trees over 10 feet

Figure 2

Quality Control Points

Point	Northing (NAD83 2011 SP WY East ft)	Easting (NAD 83 2011 SP WY East ft)	Elevation (NAVD88 ft Geoid 12B)	Description
1001	762637.859	807654.307	5696.443	BARE EARTH
1002	762653.183	806463.455	5642.885	LOW BRUSH
1003	762536.269	803868.327	5634.805	LOW BRUSH
1004	764390.969	795925.701	5521.564	LOW GRASS
1005	768267.433	793055.721	5458.456	LOW GRASS
1006	766803.349	788746.947	5382.233	MEDIUM GRASS
1007	766856.643	788672.809	5386.724	PAVEMENT
1008	775338.220	795350.538	5531.588	LOW GRASS
1009	777720.969	797131.546	5541.028	PAVEMENT
2001	774332.275	873289.238	4979.266	BARE EARTH
2002	770334.772	876670.548	5063.973	LOW BRUSH
2003	769882.341	873479.121	5042.048	LOW GRASS
2004	763425.711	862244.676	4947.608	LOW GRASS
2005	764318.382	858976.778	4993.937	MEDIUM GRASS
2006	755675.015	868871.403	4985.618	MEDIUM GRASS
2007	760280.119	865118.382	4984.942	HIGH GRASS
2008	764582.029	864442.746	4909.681	LOW GRASS
2009	764463.139	864401.593	4909.700	BARE EARTH
3001	765947.432	952796.782	4797.515	BARE EARTH
3002	770729.179	952771.759	4856.055	HIGH GRASS
3003	771359.077	951144.650	4866.964	BARE EARTH
3004	771276.332	947780.808	4868.045	TREES
3005	771235.122	947890.015	4866.113	HIGH GRASS
3006	775353.484	942018.198	4928.849	MEDIUM GRASS
3007	771093.992	934439.765	4872.590	LOW GRASS
3008	752735.626	942360.599	4768.740	LOW GRASS
3009	752814.331	942471.977	4764.873	BARE EARTH
4001	651205.770	830025.840	4719.463	LOW GRASS
4002	651173.191	830106.557	4715.634	BARE EARTH
4003	655393.588	830654.962	4761.130	LOW GRASS
4004	665166.943	827125.703	4783.960	LOW GRASS
4005	665232.180	827173.768	4787.323	BARE EARTH
4006	672013.571	826180.145	4788.362	HIGH GRASS
4007	671954.254	826085.266	4785.673	BARE EARTH
4008	663962.195	830047.299	4828.610	BARE EARTH
5001	648886.975	889864.071	4343.446	LOW GRASS
5002	652076.950	889598.196	4349.973	BRUSH
5003	652146.214	889635.656	4352.187	GRAVEL PAVEMENT
5004	673055.458	888184.961	4411.632	MEDIUM GRASS
5005	673126.683	888292.751	4410.474	BARE EARTH
5006	674482.472	883857.686	4406.242	LOW BRUSH
5007	670757.654	884207.072	4408.675	PAVEMENT
5008	668115.240	885608.805	4388.433	SAGEBRUSH

6001	660629.660	949599.432	4491.792	BARE EARTH
6002	665882.492	946333.378	4522.149	HIGH GRASS
6003	665911.754	946417.333	4523.103	BARE EARTH
6004	662327.807	948895.612	4501.578	BARE EARTH
6005	662343.738	948976.475	4505.923	HIGH GRASS
6006	662173.790	948665.417	4503.519	LOW GRASS
6007	655795.952	951136.084	4468.707	HIGH GRASS
6008	655972.305	951048.092	4470.036	LOW GRASS
6009	654365.872	952000.461	4469.524	GRAVEL
6010	654276.268	951938.980	4472.074	LOW GRASS
6011	654184.804	951844.686	4481.213	LOW GRASS
6012	657030.152	951492.342	4486.646	LOW GRASS
6013	657180.281	951440.913	4489.493	LOW GRASS
6014	657072.841	951247.332	4470.508	LOW GRASS
7001	615647.417	811525.700	4289.845	HIGH GRASS
7002	615576.819	811598.846	4297.675	BRUSH
7003	615522.746	811619.830	4303.302	BARE EARTH
7004	614478.426	808244.255	4375.938	LOW BRUSH
7005	610670.099	818062.703	4354.979	LOW GRASS
7006	614187.650	816460.150	4337.775	BARE EARTH
7007	616011.024	817320.090	4348.389	MADIUM GRASS
7008	621446.344	827467.025	4229.642	LOW GRASS
7009	619796.147	826871.557	4240.478	BARE EARTH
7010	625942.740	818867.168	4334.725	BARE EARTH
7011	624851.621	820223.412	4318.615	BRUSH
7012	621711.534	815227.998	4262.507	CORN
8001	606455.199	882305.136	4270.002	HIGH GRASS
8002	611298.591	886616.359	4274.937	SAGEBRUSH
8003	627498.542	899544.794	4261.510	BARE EARTH
8004	627439.727	897814.927	4260.253	LOW GRASS
8005	632547.773	892881.936	4290.683	BARE EARTH
8006	627280.259	891880.127	4270.611	PAVEMENT
8007	627333.725	891621.003	4266.003	LOW GRASS
8008	608055.577	886266.203	4230.716	CORN
9001	619139.125	962211.953	4303.731	BARE EARTH
9002	627995.392	963519.741	4371.652	HIGH GRASS
9003	628346.718	963553.365	4354.372	LOW GRASS
9004	633921.804	958422.816	4359.950	LOW GRASS
9005	633972.713	958459.524	4359.896	BARE EARTH
9006	619738.310	961007.225	4298.725	LOW GRASS
9007	619614.996	961054.878	4301.807	HIGH GRASS
9008	608647.125	961990.815	4344.537	HIGH GRASS
9009	608745.358	961949.514	4346.683	BARE EARTH
9010	609625.062	963695.407	4316.771	BRUSH
9011	609625.175	963695.439	4316.793	BRUSH
10001	408968.927	813998.405	5132.779	BARE EARTH
10002	408890.396	814029.905	5133.100	LOW GRASS

10003	409084.561	814075.064	5137.943	TREES
10004	409236.957	816126.903	5129.877	BRUSH
10005	409219.450	815947.571	5126.507	LOW GRASS
10006	409742.358	819311.945	5109.887	HIGH GRASS
10007	409729.259	828307.143	5072.788	LOW GRASS
10008	409891.295	828555.288	5079.424	BRUSH
10009	409636.782	828383.920	5060.895	BARE EARTH
10010	411496.821	830264.095	5199.733	LOW GRASS
10011	411633.899	830290.838	5200.522	HIGH GRASS
10012	411542.366	830717.553	5185.258	LOW GRASS
11001	404623.416	880880.647	5035.359	HIGH GRASS
11002	404770.032	880910.098	5029.592	BARE EARTH
11003	403782.357	875970.821	5186.701	HIGH GRASS
11004	403830.267	875895.854	5187.339	BARE EARTH
11005	399502.478	873221.107	5219.295	BARE EARTH
11006	399650.300	873184.155	5217.405	HIGH GRASS
11007	420762.414	881179.272	4814.177	PAVEMENT
11008	420762.430	881179.281	4814.180	PAVEMENT
11009	420509.970	880891.063	4823.401	HIGH GRASS
11010	416262.422	881327.379	4948.175	HIGH GRASS
11011	416375.155	881261.929	4950.624	BARE EARTH
11012	412607.883	880895.866	5014.863	LOW GRASS
11013	412503.741	880969.940	5015.475	HIGH GRASS
11014	412618.717	881092.946	5017.020	BARE EARTH
12001	399995.512	940856.388	4774.527	HIGH GRASS
12002	400122.191	940921.393	4776.854	BARE EARTH
12003	394757.205	940005.968	4761.247	HIGH GRASS
12004	416199.094	943355.504	4712.553	HIGH GRASS
12005	416141.905	943464.845	4712.350	LOW GRASS
12006	416180.787	943650.592	4712.229	CROP SUNFLOWERS
12007	416144.037	934567.985	4713.788	LOW GRASS
12008	416185.158	934644.608	4714.100	BARE EARTH
12009	414683.254	933286.958	4605.576	LOW GRASS
12010	414709.477	933348.002	4609.007	BARE EARTH
12011	414834.408	933330.848	4616.025	BRUSH
12012	415674.512	931028.680	4584.155	LOW GRASS
12013	415628.815	931130.352	4584.717	GRAVEL
12014	411182.498	939582.694	4730.431	TREES
13001	500244.750	843317.735	4481.345	HIGH GRASS
13002	500429.533	843467.400	4482.464	BARE EARTH
13003	500515.667	843490.899	4481.636	LOW GRASS
13004	500349.490	832810.889	4515.932	BARE EARTH
13005	500346.689	832885.717	4515.253	HIGH GRASS
13006	497180.052	832935.501	4495.958	BRUSH
13007	497242.184	833113.023	4502.272	LOW GRASS
13008	500417.319	840548.888	4510.864	TREES
13009	500686.745	854784.350	4468.134	BARE EARTH



13010	500807.549	854752.129	4467.422	HIGH GRASS
13011	500456.118	848426.684	4455.390	BARE EARTH
13012	507519.873	843420.531	4513.774	BARE EARTH
13013	506982.826	843224.000	4488.406	LOW GRASS
13014	506785.520	843349.067	4491.660	HIGH GRASS
14001	563932.542	926828.096	4079.070	LOW GRASS
14002	564043.342	923614.784	4082.260	LOW GRASS
14003	572167.532	923586.688	4104.576	LOW GRASS
14004	572171.091	923690.712	4104.488	PAVEMENT
14005	575413.890	923676.859	4149.212	LOW GRASS
14006	575323.191	923697.278	4144.514	TREES
14007	575384.791	919645.361	4128.234	HIGH GRASS
14008	573223.491	920077.655	4110.848	LOW GRASS
14009	569787.706	920868.295	4101.400	LOW GRASS
14010	564843.297	920405.771	4089.726	CORN HIGH
14011	564843.521	920404.598	4089.309	CORN LOW
14012	564528.196	917936.875	4089.931	LOW GRASS
14013	563904.897	923066.201	4083.479	DISK Q 63
14014	563874.829	923018.573	4082.614	HIGH GRASS
14015	558692.794	923061.525	4088.301	HIGH GRASS
14016	556670.856	920446.222	4141.505	LOW GRASS
15001	558692.545	845854.527	4294.589	BARE EARTH
15002	558837.783	845873.855	4293.874	HIGH GRASS
15003	558866.731	849835.417	4304.507	LOW GRASS
15004	558605.089	851248.442	4306.085	HIGH GRASS
15005	558752.789	831206.895	4343.301	BRUSH
15006	558624.422	831301.430	4339.882	BARE EARTH
15007	558719.314	827267.419	4470.887	LOW GRASS
15008	555858.895	827217.384	4441.840	TREES
15009	555725.202	827152.495	4447.658	BARE EARTH
15010	562347.125	832335.415	4332.094	BRUSH
15011	565821.880	832200.512	4356.512	LOW GRASS
15012	566006.753	832367.642	4351.327	BARE EARTH
16001	453376.844	926708.733	4469.576	BARE EARTH
16002	457528.308	926337.424	4425.441	BARE EARTH
16003	457548.431	926438.069	4421.516	LOW GRASS
16004	453526.130	931411.209	4447.474	LOW GRASS
16005	453606.433	933537.206	4451.177	HIGH GRASS
16006	453504.043	933539.412	4453.388	BARE EARTH
16007	446254.222	928351.817	4523.675	HIGH GRASS
16008	446192.032	928442.150	4526.862	BARE EARTH
16009	445630.250	928526.484	4531.157	LOW GRASS
16010	455628.720	921012.289	4449.402	HIGH GRASS
16011	455450.892	921030.060	4452.555	BARE EARTH
16012	455273.028	921227.319	4451.870	LOW GRASS
17001	458168.178	838461.734	5278.310	HIGH GRASS
17002	458017.209	838580.424	5285.294	BARE EARTH

17003	457919.540	836170.929	5305.157	LOW GRASS
17004	455984.298	833192.841	5310.843	LOW GRASS
17005	456037.497	833150.162	5310.392	HIGH GRASS
17006	456044.520	833291.524	5310.982	BARE EARTH
17007	452870.258	829125.527	5290.161	LOW GRASS
17008	452973.648	829139.056	5288.034	HIGH GRASS
17009	452739.463	829048.930	5300.124	LOW GRASS
17010	453077.946	845507.766	5215.780	LOW GRASS
17011	453116.330	845478.354	5214.871	BRUSH
17012	452653.953	848800.358	5164.725	BARE EARTH
18001	716286.868	916009.053	4840.495	LOW GRASS
18002	716539.175	916191.502	4838.875	BARE EARTH
18003	712579.988	916114.862	4804.438	HIGH GRASS
18004	707126.955	905562.879	4776.848	LOW GRASS
18005	706997.861	905672.245	4776.099	BARE EARTH
18006	702509.266	926065.561	4788.946	MEDIUM GRASS
18007	712463.980	926682.670	4779.642	LOW GRASS
18008	707271.467	926252.913	4743.343	LOW BRUSH
18009	707189.107	925925.582	4743.059	BARE EARTH
19001	695831.642	831059.459	4763.302	BARE EARTH
19002	702696.147	830920.673	4744.290	LOW GRASS
19003	711397.222	843641.837	4668.073	BARE EARTH
19004	711566.634	841884.960	4692.366	HIGH GRASS
19005	713383.892	825721.695	4880.852	LOW GRASS
19006	713487.632	825733.563	4881.047	HIGH GRASS
19007	711118.456	819452.545	4863.133	LOW GRASS
19008	717570.347	820833.013	4906.570	LOW GRASS
19009	717554.804	820728.605	4906.660	BARE EARTH
20001	506309.233	900644.240	4286.835	LOW GRASS
20002	506106.860	901463.438	4273.046	SCRUB BRUSH
20003	516546.486	902569.060	4229.955	LOW GRASS
20004	516668.973	902590.757	4232.754	PAVEMENT
20005	516782.087	903675.513	4238.566	CORN
20006	516934.935	906207.075	4235.853	LOW GRASS
20007	516807.252	906401.103	4232.918	BARE EARTH
20008	522062.832	902503.380	4232.254	BARE EARTH
20009	521855.179	901380.712	4232.311	LOW GRASS
20010	521796.588	901255.636	4229.428	HIGH GRASS
20011	516718.247	893820.233	4245.000	LOW GRASS

Figure 3

#### About AECOM

AECOM (NYSE: ACM) is built to deliver a better world. We design, build, finance and operate infrastructure assets for governments, businesses and organizations in more than 150 countries.

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