

VERTICAL ACCURACY REPORT

Professional Management and LiDAR Data Collection and Processing Services

Block 10

PROJECT TITLE:	Professional Management and LiDAR Data Collection and Processing Services
WORK ORDER NAME:	Task Order A
WORK ORDER NUMBER:	2007058492720
CONSULTANT NAME:	3001, Inc., CH2M Hill, Inc.
PROJECT MANAGERS:	Jeremy Conner, 3001 Project Manager JoLee Gardner, CH2M Hill Project Manager



**3001, INC. THE GEOSPATIAL COMPANY
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Slidell, Louisiana 70458**



May 2008

Florida Division of Emergency Management
2555 Shumard Oak Boulevard
Tallahassee, Florida 32399-2100

Re: Professional Management and LiDAR Data Collection and Processing Services,
Block 10

This photogrammetric mapping ground control survey is certified as meeting or exceeding, in quality and precision, the standards applicable for this work as set forth in Chapter 61G17-6, Florida Administrative Code.

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Signed: _____ Date: _____

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DATA ANALYSIS

This report documents the vertical accuracy of the LIDAR data as compared to the surveyed ground truth data for the Professional Management and LiDAR Data Collection and Processing Services project, Block 10. Fundamental Vertical Accuracy, Supplemental Vertical Accuracies and the Consolidated Vertical Accuracy have been calculated based on the appropriate land cover classes, and are shown in the following sections.

Data analysis was accomplished by comparing ground truth checkpoints with LIDAR points from the edited data set, which were within 1 foot horizontally from the ground truth points. The only exception to this were the ground truth points collected in areas covered by brush and low trees, where comparisons were made with LIDAR pulses that fell within 2 feet of the check points. This is because fewer LIDAR pulses are able to reach the ground in these areas, so the point spacing is larger than in cleared areas. Note that the edited LIDAR points are simply a subset of the raw LIDAR points. The points that fell above the ground surface on vegetation canopies, buildings, or other obstructions were removed from the data set. Comparisons were also made between the survey points and the LIDAR derived terrain surface. These comparisons provide an additional verification of the LIDAR data against the survey data.

The survey data was collected in accordance with the *FEMA FLOOD HAZARD MAPPING PROGRAM, GUIDELINES AND SPECIFICATIONS FOR FLOOD HAZARD MAPPING PARTNERS, APPENDIX A*.

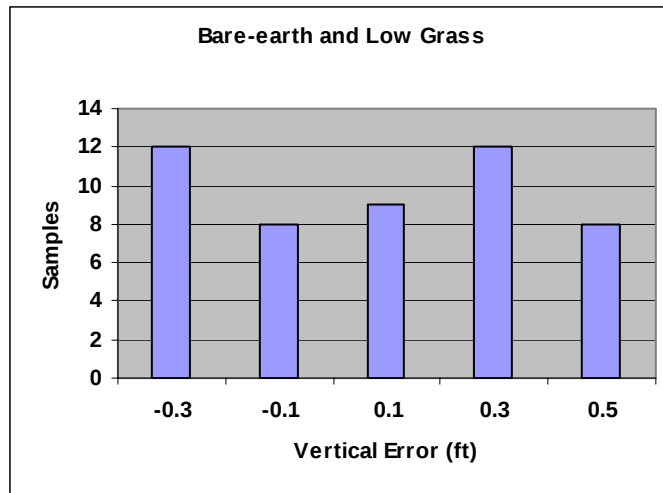
Ground truth data was collected for each of the following land cover categories:

1. Bare-earth and low grass
2. Brush lands and low trees
3. Urban areas

FUNDAMENTAL VERTICAL ACCURACY

The Fundamental Vertical Accuracy is calculated using the bare-earth and low grass land class. A comparison of these values indicated a Vertical Root Mean Square Error (RMSEz) of 0.29 feet, which equates to a Vertical Accuracy of 0.57 feet at the 95 percent confidence level. Descriptive statistics and a histogram of the vertical error distribution are shown below.

Bare-earth and Low Grass (ft)	
RMSEz	0.29
Mean	0.07
Standard Error	0.04
Median	0.14
Mode	-0.31
Standard Deviation	0.28
Sample Variance	0.08
Kurtosis	-1.38
Skewness	-0.02
Range	0.86
Minimum	-0.35
Maximum	0.51
Count	49



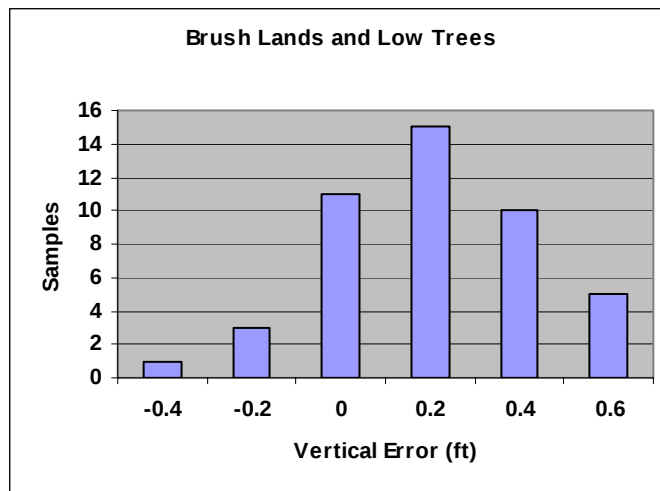
SUPPLEMENTAL VERTICAL ACCURACIES

The Supplemental Vertical Accuracies are calculated using each of the land cover classes, except for the bare-earth and low grass land class. The remaining land cover classes that are used for comparisons are brush lands and low trees, and urban areas. The RMSEz values and Vertical Accuracies are shown with each respective land class, along with histograms of vertical error distribution.

Brush Lands and Low Trees

This set includes only those points that were collected in areas of brush lands and low trees. The resulting RMSEz is 0.29 feet, which equates to a Vertical Accuracy of 0.57 feet at the 95 percent confidence level.

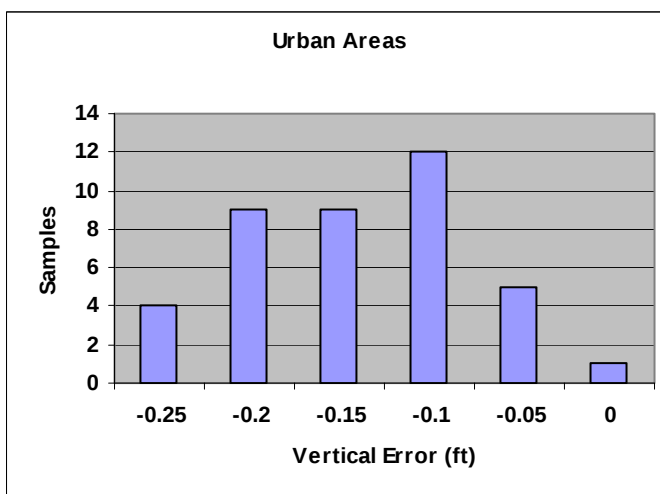
Brush Lands and Low Trees (ft)	
RMSEz	0.29
Mean	0.20
Standard Error	0.03
Median	0.18
Mode	0.17
Standard Deviation	0.22
Sample Variance	0.05
Kurtosis	-0.33
Skewness	-0.08
Range	1.00
Minimum	-0.34
Maximum	0.66
Count	45



Urban Areas

This set includes only those points that were collected in areas of urban land cover. The resulting RMSEz is 0.15 feet, which equates to a Vertical Accuracy of 0.29 feet at the 95 percent confidence level.

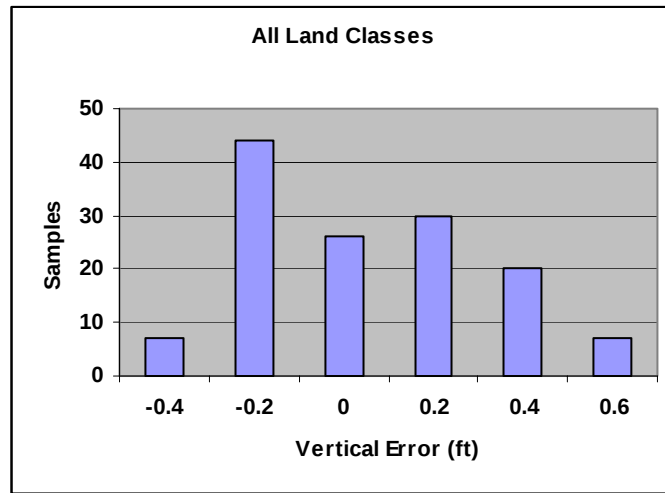
Urban Areas (ft)	
RMSEz	0.15
Mean	-0.14
Standard Error	0.01
Median	-0.15
Mode	-0.20
Standard Deviation	0.06
Sample Variance	0.00
Kurtosis	-0.94
Skewness	0.08
Range	0.23
Minimum	-0.25
Maximum	-0.02
Count	40



CONSOLIDATED VERTICAL ACCURACY

The Consolidated Vertical Accuracy is calculated using all land cover classes. The result of these comparisons of these values indicated a Vertical Root Mean Square Error (RMSEz) of 0.26 feet, which equates to Vertical Accuracy of 0.51 feet at the 95 percent confidence level. Descriptive statistics and a histogram of the vertical error distribution for all comparisons are shown below.

All Land Classes (ft)	
RMSEz	0.26
Mean	0.05
Standard Error	0.02
Median	-0.02
Mode	-0.20
Standard Deviation	0.25
Sample Variance	0.06
Kurtosis	-0.97
Skewness	0.42
Range	1.01
Minimum	-0.35
Maximum	0.66
Count	134



GROUND TRUTH ANALYSIS **Comparison of LIDAR Points to Ground-Truth Points**

Horizontal units = US Survey Feet [US State Plane, Florida East, NAD83 (1999)]

Vertical units = US Survey feet [NAVD88 – Geoid03]

Name	Survey X	Survey Y	Survey Z	LIDAR X	LIDAR Y	LIDAR Z	dx	dy	dz	dist	Code
1A1	537587.84	538492.47	3.03	537588.03	538492.79	3.32	-0.19	-0.32	-0.29	0.37	Bare-earth
1A3	537583.86	538480.18	3.06	537584.19	538480.94	3.19	-0.33	-0.76	-0.13	0.83	Bare-earth
1A4	537582.15	538473.28	3.06	537582.22	538472.48	3.39	-0.07	0.80	-0.33	0.80	Bare-earth
1A6	537577.96	538458.41	3.17	537577.63	538459.22	3.32	0.33	-0.81	-0.15	0.88	Bare-earth
1A7	537575.64	538451.19	3.13	537575.56	538450.43	3.39	0.08	0.76	-0.26	0.76	Bare-earth
1A8	537573.66	538443.84	3.15	537574.55	538444.07	3.42	-0.89	-0.23	-0.27	0.92	Bare-earth
1A9	537570.67	538435.76	3.07	537570.09	538435.50	3.29	0.58	0.26	-0.22	0.63	Bare-earth
1A10	537568.12	538428.42	2.97	537568.97	538428.38	3.29	-0.85	0.04	-0.32	0.85	Bare-earth
1A11	537557.69	538430.63	2.92	537558.24	538431.21	3.23	-0.55	-0.58	-0.31	0.80	Bare-earth
1A12	537559.38	538437.92	2.94	537559.36	538438.23	3.29	0.02	-0.31	-0.35	0.31	Bare-earth
1A13	537561.24	538445.92	2.97	537561.16	538446.07	3.23	0.08	-0.15	-0.26	0.18	Bare-earth
1A14	537563.10	538453.59	2.97	537562.44	538453.42	3.19	0.66	0.17	-0.22	0.68	Bare-earth
1A17	537569.81	538476.48	2.98	537569.86	538476.74	3.29	-0.05	-0.26	-0.31	0.26	Bare-earth
1A19	537574.62	538490.09	2.99	537573.96	538489.77	3.13	0.66	0.32	-0.14	0.73	Bare-earth
1A20	537577.31	538497.29	2.87	537577.53	538496.59	3.03	-0.22	0.70	-0.16	0.74	Bare-earth
1A21	537593.45	538526.86	3.55	537593.58	538527.40	3.75	-0.13	-0.54	-0.20	0.55	Urban
1A23	537579.98	538530.84	3.56	537580.65	538530.81	3.72	-0.67	0.03	-0.16	0.67	Urban
1A25	537565.92	538534.74	3.54	537565.89	538534.88	3.65	0.03	-0.14	-0.11	0.14	Urban
1A27	537548.73	538539.52	3.48	537548.96	538540.23	3.59	-0.22	-0.71	-0.11	0.75	Urban
1A28	537539.94	538541.94	3.47	537539.74	538541.25	3.65	0.20	0.69	-0.18	0.72	Urban
1A29	537531.12	538544.33	3.39	537531.27	538544.20	3.59	-0.15	0.13	-0.20	0.20	Urban
1A30	537522.44	538547.66	3.40	537523.04	538547.45	3.55	-0.60	0.21	-0.15	0.64	Urban
1A31	537525.62	538557.26	3.27	537525.96	538557.78	3.39	-0.34	-0.52	-0.12	0.62	Urban
1A34	537547.31	538550.71	3.39	537546.92	538551.15	3.62	0.39	-0.44	-0.23	0.59	Urban
1A35	537554.84	538548.27	3.36	537555.62	538548.69	3.46	-0.78	-0.42	-0.10	0.88	Urban
1A36	537562.32	538546.15	3.37	537561.85	538546.04	3.39	0.47	0.11	-0.02	0.48	Urban
1A38	537577.18	538541.07	3.40	537576.32	538541.31	3.46	0.86	-0.24	-0.06	0.89	Urban
1A41	537613.14	538560.16	2.01	537613.85	538560.34	2.21	-0.71	-0.18	-0.20	0.73	Urban
1A42	537619.41	538566.84	1.88	537619.40	538567.20	2.08	0.01	-0.36	-0.20	0.36	Urban
1A43	537626.02	538573.75	1.91	537626.12	538574.48	2.08	-0.10	-0.73	-0.17	0.74	Urban
1A44	537631.38	538581.34	1.79	537631.77	538581.30	1.88	-0.39	0.04	-0.09	0.39	Urban
1A46	537629.20	538596.36	2.07	537629.30	538595.81	2.27	-0.10	0.55	-0.20	0.56	Urban
1A48	537619.36	538587.05	1.90	537619.69	538586.82	1.98	-0.33	0.23	-0.08	0.41	Urban
1A50	537610.27	538577.31	1.93	537610.05	538577.66	2.05	0.22	-0.35	-0.12	0.42	Urban
1A51	537604.59	538572.68	1.84	537605.35	538572.74	2.05	-0.76	-0.06	-0.21	0.76	Urban
1A52	537598.66	538568.19	1.96	537598.43	538568.87	2.08	0.23	-0.68	-0.12	0.72	Urban
1A54	537595.69	538579.01	1.92	537596.00	538578.94	2.08	-0.31	0.07	-0.16	0.32	Urban
1A55	537599.82	538586.01	1.90	537599.58	538585.77	1.95	0.24	0.24	-0.05	0.34	Urban
1A56	537605.17	538591.95	1.89	537605.81	538592.29	2.05	-0.64	-0.34	-0.16	0.72	Urban
1A57	537610.10	538598.83	1.94	537609.42	538599.12	2.01	0.68	-0.29	-0.07	0.74	Urban
1A59	537610.20	538609.49	1.91	537609.72	538608.86	2.14	0.48	0.63	-0.23	0.79	Urban

1A61	537600.67	538600.13	2.05	537600.01	538599.68	2.11	0.66	0.45	-0.06	0.80	Urban
1A63	537592.87	538592.31	1.99	537592.63	538591.57	2.11	0.24	0.74	-0.12	0.78	Urban
1A64	537588.93	538588.80	2.01	537589.54	538588.95	2.18	-0.61	-0.15	-0.17	0.63	Urban
1A65	537584.82	538584.47	1.99	537583.93	538584.19	2.21	0.89	0.28	-0.22	0.93	Urban
1A66	537496.57	538576.72	2.78	537496.43	538576.81	2.87	0.14	-0.09	-0.09	0.16	Urban
1A67	537491.68	538578.21	2.75	537492.43	538578.61	2.90	-0.75	-0.40	-0.15	0.85	Urban
1A69	537483.20	538580.92	2.68	537483.50	538580.16	2.77	-0.30	0.76	-0.09	0.82	Urban
1A72	537482.04	538591.71	2.57	537482.78	538591.97	2.73	-0.74	-0.26	-0.16	0.79	Urban
1A73	537486.59	538589.16	2.66	537486.56	538590.03	2.73	0.03	-0.87	-0.07	0.87	Urban
1A75	537493.68	538592.91	2.64	537493.15	538593.15	2.83	0.53	-0.24	-0.19	0.58	Urban
1A76	537489.27	538595.16	2.63	537489.25	538595.12	2.87	0.02	0.04	-0.25	0.05	Urban
1A77	537485.68	538597.76	2.57	537485.47	538597.05	2.80	0.21	0.71	-0.23	0.74	Urban
1A78	537479.20	538599.45	2.47	537478.94	538598.96	2.60	0.26	0.49	-0.13	0.56	Urban
1A80	537489.00	538603.71	2.69	537489.08	538603.84	2.80	-0.08	-0.13	-0.11	0.15	Urban
1501	540147.36	499427.91	2.75	540147.60	499428.34	2.25	-0.24	-0.43	0.50	0.50	Bare-earth
4000	540700.41	499935.19	2.32	540700.15	499934.44	2.26	0.26	0.75	0.06	0.79	Bare-earth
4002	540695.80	499953.21	1.39	540696.05	499952.46	1.02	-0.25	0.75	0.37	0.79	Bare-earth
4004	540700.26	499922.02	2.38	540700.45	499921.32	1.94	-0.19	0.70	0.44	0.72	Bare-earth
4006	540704.41	499880.74	3.07	540704.19	499879.73	2.93	0.22	1.01	0.14	1.04	Brush
4006	540704.41	499880.74	3.07	540705.96	499880.78	2.84	-1.55	-0.04	0.23	1.55	Brush
4006	540704.41	499880.74	3.07	540704.45	499880.95	2.82	-0.04	-0.21	0.25	0.21	Brush
4006	540704.41	499880.74	3.07	540705.70	499879.57	2.80	-1.29	1.17	0.27	1.74	Brush
4006	540704.41	499880.74	3.07	540702.74	499879.93	2.67	1.67	0.81	0.40	1.86	Brush
4008	540710.14	499821.19	3.43	540708.78	499821.55	3.57	1.36	-0.36	-0.14	1.40	Brush
4008	540710.14	499821.19	3.43	540710.42	499821.02	3.26	-0.28	0.17	0.17	0.33	Brush
4009	540716.52	499804.98	2.64	540716.36	499805.66	2.49	0.16	-0.68	0.15	0.70	Bare-earth
4014	540823.05	499839.92	2.38	540823.42	499839.07	2.08	-0.37	0.85	0.30	0.93	Bare-earth
4017	540793.78	499896.81	2.34	540793.36	499896.37	2.16	0.42	0.44	0.18	0.61	Bare-earth
4018	540786.90	499921.60	1.61	540787.52	499921.78	1.45	-0.62	-0.18	0.16	0.65	Bare-earth
4019	540775.26	499947.80	2.36	540774.35	499948.10	2.09	0.91	-0.30	0.27	0.96	Bare-earth
4020	540775.07	499961.17	1.42	540775.14	499960.21	1.00	-0.07	0.96	0.42	0.96	Bare-earth
4025	540874.65	499879.34	2.15	540875.04	499879.60	2.03	-0.40	-0.26	0.12	0.47	Bare-earth
4028	540910.68	499817.26	0.13	540910.03	499816.62	0.24	0.65	0.64	-0.11	0.91	Bare-earth
4030	541003.12	499815.21	0.72	541002.51	499815.18	0.23	0.61	0.03	0.49	0.61	Bare-earth
4033	540959.90	499885.18	2.20	540960.24	499885.67	1.84	-0.34	-0.49	0.36	0.60	Bare-earth
4041	541027.09	499840.98	2.15	541027.88	499841.37	1.66	-0.79	-0.39	0.49	0.88	Bare-earth
4045	540591.56	499903.65	2.28	540592.08	499903.14	2.01	-0.52	0.51	0.27	0.73	Bare-earth
4047	540607.84	499845.87	2.71	540609.67	499846.19	2.63	-1.83	-0.32	0.08	1.86	Brush
4047	540607.84	499845.87	2.71	540608.12	499844.88	2.49	-0.28	0.99	0.22	1.03	Brush
4047	540607.84	499845.87	2.71	540606.68	499845.04	2.37	1.16	0.83	0.34	1.42	Brush
4047	540607.84	499845.87	2.71	540606.81	499846.52	2.29	1.03	-0.65	0.42	1.22	Brush
4047	540607.84	499845.87	2.71	540608.29	499846.36	2.15	-0.45	-0.49	0.56	0.67	Brush
4048	540616.06	499817.68	3.54	540616.07	499816.59	3.41	-0.01	1.09	0.13	1.09	Brush
4048	540616.06	499817.68	3.54	540617.54	499816.43	3.36	-1.48	1.25	0.18	1.94	Brush
4049	540623.49	499803.67	3.29	540622.14	499802.54	3.26	1.35	1.13	0.03	1.76	Brush
4049	540623.49	499803.67	3.29	540622.99	499803.82	3.23	0.50	-0.15	0.06	0.52	Brush
4049	540623.49	499803.67	3.29	540621.55	499803.99	3.12	1.94	-0.32	0.17	1.96	Brush
4049	540623.49	499803.67	3.29	540624.50	499803.66	2.99	-1.01	0.01	0.30	1.01	Brush

4049	540623.49	499803.67	3.29	540623.65	499802.38	2.91	-0.16	1.29	0.38	1.30	Brush
4050	540627.06	499781.44	3.15	540626.67	499779.77	3.27	0.39	1.67	-0.12	1.71	Brush
4050	540627.06	499781.44	3.15	540628.44	499780.85	3.23	-1.38	0.59	-0.08	1.50	Brush
4050	540627.06	499781.44	3.15	540627.00	499781.01	3.14	0.06	0.43	0.01	0.43	Brush
4051	540631.76	499762.10	2.71	540631.56	499762.27	2.51	0.20	-0.17	0.20	0.26	Bare-earth
4053	540639.51	499737.32	0.55	540638.97	499737.30	0.68	0.54	0.02	-0.13	0.54	Bare-earth
4056	540535.27	499710.45	2.70	540535.72	499709.34	2.72	-0.45	1.10	-0.02	1.19	Brush
4057	540518.87	499722.88	3.05	540518.69	499724.43	3.39	0.18	-1.55	-0.34	1.56	Brush
4058	540503.01	499734.20	3.05	540503.99	499733.03	2.88	-0.98	1.17	0.17	1.53	Brush
4058	540503.01	499734.20	3.05	540502.54	499733.20	2.63	0.47	1.00	0.42	1.11	Brush
4059	540494.70	499743.15	2.22	540495.16	499743.96	2.08	-0.46	-0.81	0.14	0.93	Bare-earth
4060	540479.59	499757.99	2.84	540479.67	499758.73	2.67	-0.08	-0.74	0.17	0.74	Bare-earth
4061	540468.26	499775.13	2.05	540467.66	499774.55	2.05	0.60	0.58	0.00	0.83	Bare-earth
4062	540458.33	499790.21	0.56	540458.34	499789.61	0.07	-0.01	0.60	0.49	0.60	Bare-earth
4064	540391.93	499718.19	-0.73	540391.98	499719.05	-0.58	-0.05	-0.86	-0.15	0.86	Bare-earth
4066	540413.35	499696.51	2.44	540412.75	499697.16	1.99	0.60	-0.65	0.45	0.89	Bare-earth
4068	540441.13	499666.27	2.66	540442.42	499666.90	2.51	-1.29	-0.63	0.15	1.44	Brush
4068	540441.13	499666.27	2.66	540441.01	499667.10	2.37	0.12	-0.83	0.29	0.84	Brush
4068	540441.13	499666.27	2.66	540440.84	499665.23	2.31	0.29	1.04	0.35	1.08	Brush
4068	540441.13	499666.27	2.66	540439.56	499667.26	2.24	1.57	-0.99	0.42	1.86	Brush
4068	540441.13	499666.27	2.66	540439.43	499665.39	2.16	1.70	0.88	0.50	1.91	Brush
4069	540451.04	499652.00	2.23	540452.89	499651.51	2.26	-1.85	0.49	-0.03	1.91	Brush
4069	540451.04	499652.00	2.23	540450.00	499651.87	2.05	1.04	0.13	0.18	1.05	Brush
4069	540451.04	499652.00	2.23	540451.48	499651.71	1.72	-0.44	0.29	0.51	0.52	Brush
4070	540466.52	499638.09	2.28	540466.97	499638.94	2.17	-0.45	-0.85	0.11	0.96	Bare-earth
4071	540471.92	499629.33	2.30	540471.20	499629.68	2.09	0.72	-0.35	0.21	0.80	Bare-earth
4073	540409.98	499556.09	1.60	540410.29	499555.84	1.91	-0.31	0.25	-0.31	0.40	Bare-earth
4075	540380.97	499591.81	2.13	540380.65	499592.24	1.74	0.32	-0.43	0.39	0.54	Brush
4075	540380.97	499591.81	2.13	540382.10	499592.07	1.65	-1.13	-0.26	0.48	1.16	Brush
4076	540371.59	499609.36	2.42	540372.18	499611.11	2.37	-0.59	-1.75	0.05	1.85	Brush
4076	540371.59	499609.36	2.42	540370.64	499608.94	2.25	0.95	0.42	0.17	1.04	Brush
4076	540371.59	499609.36	2.42	540372.09	499608.78	1.76	-0.50	0.58	0.66	0.76	Brush
4078	540345.65	499630.01	2.21	540345.14	499629.22	1.95	0.51	0.79	0.26	0.94	Bare-earth
4079	540333.30	499640.77	0.71	540333.88	499641.47	0.20	-0.58	-0.70	0.51	0.91	Bare-earth
4084	540288.41	499544.84	2.67	540289.02	499544.09	2.42	-0.61	0.75	0.25	0.97	Bare-earth
4085	540302.37	499527.42	2.15	540301.59	499527.78	1.65	0.78	-0.36	0.50	0.86	Brush
4086	540301.48	499517.00	2.20	540301.39	499515.57	2.30	0.09	1.43	-0.10	1.43	Brush
4086	540301.48	499517.00	2.20	540299.98	499515.73	2.28	1.50	1.27	-0.08	1.96	Brush
4086	540301.48	499517.00	2.20	540300.38	499518.03	2.17	1.10	-1.03	0.03	1.51	Brush
4086	540301.48	499517.00	2.20	540303.23	499517.67	2.15	-1.75	-0.67	0.05	1.88	Brush
4086	540301.48	499517.00	2.20	540301.82	499517.83	2.00	-0.34	-0.83	0.20	0.90	Brush
4087	540244.11	499457.93	2.40	540243.70	499458.01	2.50	0.41	-0.08	-0.10	0.42	Bare-earth
4089	540221.82	499486.78	2.83	540222.20	499486.72	2.60	-0.38	0.06	0.23	0.39	Bare-earth
4090	540214.38	499495.05	2.58	540215.37	499495.09	2.25	-0.99	-0.04	0.33	0.99	Bare-earth
4091	540204.82	499505.93	1.38	540204.48	499506.61	1.18	0.34	-0.68	0.20	0.76	Bare-earth