

U.S. DEPARTMENT OF THE INTERIOR  
U.S. GEOLOGICAL SURVEY

Photogrammetric determination of movement on the  
Slumgullion Slide, Hinsdale County, Colorado  
1985 - 1990

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Open-File Report 93-597

1993

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## CONTENTS

	Page
Abstract.....	1
Introduction.....	1
Coordinate System.....	2
Methodology.....	2
Accuracy of measurements.....	3
Results.....	3
Advantages of the method.....	4
Problems with the method.....	4
References cited.....	5
Appendix I.....	7

## ILLUSTRATIONS

(Plates are in pocket)

### Plate

1. Slungullion Slide displacement vectors and contours, 1985-1990.
2. Slungullion Slide longitudinal topographic and displacement profiles.

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ABSTRACT

Photogrammetric measurements of 310 photo-identifiable points (trees) on 1985 and 1990 aerial photographs of the Slumgullion Slide, near Lake City, Colo., indicate displacements of more than 25 m in the narrow central portion of the slide, and about 5 m at the active toe of the slide, over the 5-year period. Contours of the displacement values allow identification of zones of extending and compressive flow from the head to the toe of the slide.

INTRODUCTION

The Slumgullion Slide, properly classified as an earth flow (Varnes, 1978), is located approximately 6 km southeast of Lake City, in southwestern Colorado. As part of an ongoing study of the Slumgullion Slide, aerial photographs taken August 12, 1985, and August 25, 1990, were analyzed to determine the relative displacements of different parts of the slide between the two dates, using photo-identifiable natural features. In addition to determining displacements, another purpose of the study was to evaluate the practicality, efficiency, and accuracy of the method for establishing a dense grid of photo-identifiable points for studying the flow regimes of landslides, using relatively untrained (in photogrammetry) operators.

Surprisingly, there is very little literature documenting this approach (using natural features to determine displacements) on actively-moving landslides. At the La Frasse landslide, Switzerland, aerial photographs at scales of 1:25,000 and 1:40,000 were used to calculate displacements of natural points over four time periods between 1957 and 1982 (Bonnard, 1983). "Up to" 150 points on the landslide per time period were used; the maximum displacement in any time period was 3 m. Aerial photogrammetric methods also have been used in Utah (Baum and Fleming, 1991) and in Hawaii (Baum and Reid, 1992). Terrestrial photogrammetry has been used to monitor landslides in Japan (Fukuoka, 1980) and to detect small (several centimeters) displacements in dams (Erez, 1971; Brandenberger and Erez, 1972; Erlandson and Veress, 1975) and in open-pit mines (Ross-Brown, 1973).

## Coordinate System

The local coordinate system used in this report was developed in 1990 by a survey to establish photogrammetric control for the project. The local coordinate system is a Cartesian north (y) - east (x) - elevation (z) system with coordinates given in meters. Local north agrees approximately (within about 1°) with geodetic north. The station at Windy Point Overlook (WINDY, off map of pl. 1), which offers an excellent view of most of the slide, was assigned coordinates of 10,000.000 N; 10,000.000 E. Coordinates (N, E) are calculated as sea-level positions, and elevations are tied to bench marks of the U.S. Coast and Geodetic Survey second-order level line along State Highway 149. For a more detailed description of the coordinate system and control points, see Varnes and others (1993).

## Methodology

The method for determining displacements at individual points consisted of finding the same photo-identifiable points on both the 1985 and 1990 photographs, then measuring the coordinates of the points in a stereoplotting instrument. The scale of the 1985 photography was 1:12,000. In 1990, two sets were taken at scales of 1:6,000 and 1:14,000; the 1:6,000 set was used in this study. The original intent was to analyze both sets of photographs using the Kern DSR-11 analytical stereoplotter in the U.S. Geological Survey Plotter Laboratory. However, owing to the limited availability of the DSR-11 and other problems, only the first 66 points identified on the 1990 photographs were measured on the DSR-11. The 1985 photographs were measured using the computer-assisted Kern PG-2 stereoplotter, as were the remainder of the points on the 1990 photographs. With both instruments, a computer calculates and displays the coordinates and elevation of the measuring mark (floating dot) based on the input coordinates of photo control points and photogrammetric parameters. The photo-identifiable points, other than targeted control points, consisted entirely of the bases of trees.

The first 66 points were picked by viewing the 1990 transparencies (scale 1:6,000) under fairly high magnification in the DSR-11, identifying a likely target, then trying to find the same point on the 1985 prints using a mirror stereoscope. Points were pin-pricked on both sets of prints. The next 71 points were identified by projecting the images of the 1985 photographs onto the 1990 photographs using a Zoom Transfer Scope. The last 173 points were identified using two mirror stereoscopes side-by-side and locating the new points relative to those already identified and marked, thus filling in the point network.

For each group of points, coordinates were measured first on the 1990 photographs. Generally, measurements on the 1985 photographs went more quickly because I could go quickly to the previously determined 1990 coordinates and search upslope for the target. Also, there were fewer stereo models to set up for the 1985 photography.

## Accuracy of Measurements

The accuracy and reproducibility of coordinate measurements from photographs depends on a variety of factors. Among these are precision of the plotting instrument; skill and experience of the plotter operator(s); scale and quality of the photography; density and quality of surveyed ground control; size, clarity, and definition of the target point; and size of the floating mark relative to the target. While measuring the last group of points on the 1985 photographs, 28 previously measured natural targets on three stereo models were remeasured. Horizontal position differences ranged from 0.09 m to 1.69 m. The standard deviation of a position measurement, calculated from the mean deviation of the 28 duplicate points (Volk, 1958, p.113), is 0.44 m., which includes the errors due to resetting the model. If we assume the same standard deviation for measurements on the 1990 photographs, then the standard deviation of a calculated displacement should be about 0.63 m. Other factors being equal, one would expect somewhat better precision from the 1990 photographs because of the larger scale; however, there are fewer ground control points on each stereo model. Accuracy could be improved considerably by being able to select smaller, better-defined targets on stereo images of the transparencies, rather than on the prints.

The reproducibility of the elevation measurements is not as good as that of horizontal position. For the 28 points referred to in the preceding paragraph, the discrepancies in elevation ranged from 0.09 m to 1.32 m, a slightly smaller range than for the horizontal positions. However, about 60 percent of the points (17 of 28) had discrepancies greater than 0.5 m. The explanation for these elevation discrepancies is that the bases of trees are not always clearly defined on one or both sets of photographs, where the image of the tree joins its shadow. To measure the elevation it is generally necessary to move the floating dot away from the image of the tree, above the ground, adjust the elevation of the dot, and then "slice" it into the base of the tree.

The accuracy of the measurements is sufficient for establishing the displacement pattern of the slide, determining rates of movement, and interpreting the large-scale strains. However, because the errors in measurement represent a large part of the differential movements within a small area, the method probably would not result in meaningful strain values calculated for small triangles or quadrilaterals.

## RESULTS

A total of 310 natural points (trees and bushes) were identified and measured on the two sets of photographs. Plate 1 shows the displacement vectors at an enlarged scale on a 1985 topographic base, as well as contours of the displacement magnitudes. Starting points of the vectors are plotted at their 1985 positions. Calculated displacements from 1985 to 1990 ranged from less than 0.25 m to more than 30 m. Coordinates and displacements of the measured points are tabulated in appendix 1. The pattern of the overall movement is consistent with what

was expected--large displacements in the central narrow part of the slide, and displacements decreasing toward the crown and toe. Points just above the active toe of the slide are advancing at the rate of about 1 m per year, while the narrow central portion of the slide is advancing at about 5.7 m per year. These displacements are similar to those obtained by Crandell and Varnes (1961): 2.5 ft (0.8 m) per year at the toe and 20.0 ft (6.1 m) per year in the central part.

Three points were noted that had calculated displacements anomalously higher than surrounding points (indicated by x and displacement values on plate 1. These points probably represent small local slides or slumps within the main slide mass; all are on locally steep slopes.

Analysis of the relative displacement values allows one to identify zones of extending and compressive flow (Savage and Smith, 1986). Plate 2 shows longitudinal topographic and displacement profiles of the slide. The displacement profile shows two places with abrupt changes in the displacement gradient, coincidentally at about the same values of displacement. These changes probably reflect internal discontinuities in the slide mass. Interpretations in this report are preliminary. More authoritative interpretations should incorporate the displacement data presented here with detailed structural mapping of the slide.

#### **Advantages of the method**

Theoretically, the use of natural photo-identifiable targets gives the interpreter an almost unlimited supply of potential data points, without the need for placing large arrays of artificial targets. Furthermore, the photographs themselves provide a permanent record of the conditions existing at the time of exposure, which allows one to go back and get more data points or to remeasure questionable ones. One may also be able to make more meaningful interpretations of the measurements with respect to physical features (such as faults or cracks) visible on the photographs. Once corresponding points are identified, it is faster to locate them photogrammetrically than by conventional field surveying, although at the cost of some accuracy. The principal advantage of the method, however, is the ability to measure displacements on older photographs, provided that suitable targets on the moving slide can be identified, and also provided that a sufficient number of points on stable ground can be identified to serve as photo control. There will be some loss of accuracy in having the control coordinates determined photogrammetrically, rather than by a field survey.

#### **Problems with the method**

The main drawback of the photogrammetric method is the difficulty of identifying and marking the same measurable points on each set of photographs. The 1985 and 1990 photographs were taken at different scales, at different times of the day, and from different vantage

points. These factors, coupled with significant displacements in most areas, result in vastly different patterns between the two sets of photographs, which made it difficult to identify corresponding objects.

To apply this method more efficiently, one should have measuring instruments that take better advantage of the wealth of information contained in the photographs. Trees do not make ideal targets--they are usually too large and their bases are poorly defined on at least one set of photographs--but they are the main features that can be identified on photographic prints. The transparencies used in the stereoplotter show much more detail than the prints. Ideally, the operator should be able to view both models in quick succession under high magnification to identify suitable targets, then measure the coordinates on both sets of photographs immediately. Unfortunately, such equipment is rare or nonexistent outside military intelligence agencies.

#### REFERENCES CITED

- Baum, R.L., and Fleming, R.W., 1991, Use of longitudinal strain in identifying driving and resisting elements of landslides: Geological Society of America Bulletin, v. 103, p. 1121-1132.
- Baum, R.L., and Reid, M.E., 1992, Geology, hydrology and mechanics of the Alani-Paty landslide, Manoa Valley, Oahu, Hawaii: U.S. Geological Survey Open-File Report 92-501, 87 p.
- Bonnard, Christophe, 1983 [1984], Determination of slow landslide activity by multidisciplinary measurement techniques, in Kovari, K., ed., Field measurements in geomechanics, Proceedings of the International Symposium, Zurich, September 5-8, 1983, v. 1, p. 619-638: Rotterdam, Balkema.
- Brandenberger, A.-J., and Erez, M.T., 1972, Photogrammetric determination of displacements and deformations in large engineering structures: Canadian Surveyor, v. 26, no. 2, p. 163-179.
- Crandell, D.R., and Varnes, D.J., 1961, Movement of the Slumgullion earthflow near Lake City, Colorado, in Geological Survey Research 1961: U.S. Geological Survey Professional Paper 424-B, art. 57, p. 136-139.
- Erez, M.T., 1971, Analytical terrestrial photogrammetry applied to the measurement of deformations in large engineering structures: Quebec, Laval University, Ph.D. thesis, 150 p.
- Erlandson, J.P., and Veress, S.A., 1975, Monitoring deformations of structures: Photogrammetric Engineering and Remote Sensing, v. 41, no. 11, p. 1375-1384.

- Fukuoka, Masami, 1980, Instrumentation--its role in landslide prediction and control: Proceedings [Third] International Symposium on Landslides, New Delhi, v. 2, p. 139-153.
- Ross-Brown, D.M., 1973, Applications of terrestrial photogrammetry in open pit mining: London, University of London, Ph.D. thesis, 215 p.
- Savage, W.Z., and Smith, W.K., 1986, A model for the plastic flow of landslides: U.S. Geological Survey Professional Paper 1385, 32 p.
- Varnes, D.J., 1978, Slope movement types and processes in Schuster, R.L., and Krizek, R.J., eds., Landslides, analysis and control: National Research Council, Transportation Research Board Special Report 176, p. 11-33.
- Varnes, D.J., Smith, W.K., Savage, W.Z., and Varnes, K.L., 1993, Control and deformation surveys at the Slumgullion Slide, Hinsdale County, Colorado--a progress report: U.S. Geological Survey Open-File Report 93-577, 15 p., 1 pl.
- Volk, William, 1958, Applied statistics for engineers: New York, McGraw-Hill, 354 p.

Appendix I. Coordinates and displacements of photo-identified points, Slumgullion Slide, Colo.

(All coordinates and displacements in meters; dE, dN, dz = displacement in respective coordinate direction;  
 Hz. Disp. = horizontal component of displacement; Dir. = azimuth from north of displacement.)

Pt. ID	1990			1985			1990 - 1985			Hz. Disp.	Dir.
	North	East	Elevation	North	East	Elevation	dE	dN	dz		
001	10161.302	7499.144	2980.084	10160.38	7506.67	2981.08	-7.53	0.92	-1.00	7.58	277.0
001A	10175.75	7548.37	2992.03	10172.80	7550.62	2993.26	-2.25	2.95	-1.23	3.71	322.7
002	10252.712	7310.019	2957.338	10253.53	7310.61	2957.48	-0.59	-0.82	-0.14	1.01	215.8
003	10287.631	7489.272	2967.327	10290.39	7499.56	2968.95	-10.29	-2.76	-1.62	10.65	255.0
003A	10333.32	7550.62	2976.91	10333.75	7550.70	2976.64	-0.08	-0.43	0.27	0.44	190.5
004	9996.360	7543.750	2983.217	9999.52	7551.97	2984.54	-8.22	-3.16	-1.32	8.81	249.0
004A	10043.90	7577.69	2991.78	10044.39	7590.21	2993.80	-12.52	-0.49	-2.02	12.53	267.8
005	10046.837	7900.289	3024.557	10047.13	7902.34	3024.71	-2.05	-0.29	-0.15	2.07	261.9
005A	10075.67	7906.19	3029.88	10080.68	7913.42	3030.53	-7.23	-5.01	-0.65	8.80	235.3
006	10104.628	7649.021	3008.125	10107.89	7660.62	3009.03	-11.60	-3.26	-0.91	12.05	254.3
006A	10126.53	7680.20	3013.40	10129.01	7689.66	3013.61	-9.46	-2.48	-0.21	9.78	255.3
007	10164.169	7736.495	3019.297	10166.49	7747.15	3020.67	-10.65	-2.32	-1.37	10.90	257.7
007A	10135.05	7755.07	3022.24	10138.64	7764.66	3023.91	-9.59	-3.59	-1.67	10.24	249.5
008	10168.802	7955.664	3037.189	10172.14	7966.00	3036.77	-10.34	-3.34	0.42	10.86	252.1
008A	10174.65	7999.09	3039.63	10177.58	8008.35	3039.56	-9.26	-2.93	0.07	9.71	252.4
009	10478.870	7710.278	2998.401	10479.15	7710.39	2997.72	-0.11	-0.28	0.68	0.30	201.8
010	10489.333	7719.996	3000.380	10488.76	7720.18	3000.43	-0.18	0.57	-0.05	0.60	342.2
011	10500.154	7756.991	3003.864	10500.50	7757.39	3004.43	-0.40	-0.35	-0.57	0.53	229.1
012	10504.118	7768.583	3006.122	10504.36	7768.57	3007.18	0.01	-0.24	-1.06	0.24	176.9
013	10499.921	7803.732	3007.957	10499.91	7803.85	3008.04	-0.12	0.01	-0.08	0.12	275.3
014	10503.045	7831.273	3013.019	10502.92	7831.12	3013.33	0.15	0.13	-0.31	0.20	50.8
015	10509.337	7854.756	3018.659	10509.36	7856.33	3019.85	-1.57	-0.02	-1.19	1.57	269.2
016	10517.776	7881.143	3022.847	10517.54	7881.24	3022.81	-0.10	0.24	0.04	0.26	337.7
017	10246.363	7888.699	3037.511	10249.44	7899.33	3038.77	-10.63	-3.08	-1.26	11.07	253.9
017A	10233.63	7905.98	3038.11	10232.70	7918.88	3038.04	-12.90	0.93	0.07	12.93	274.1
018	10004.471	7796.833	3025.811	10006.64	7802.23	3026.15	-5.40	-2.17	-0.34	5.82	248.1
018A	10031.85	7793.45	3026.13	10034.33	7801.49	3025.70	-8.04	-2.48	0.43	8.41	252.9
019	10012.773	7849.021	3021.598	10013.16	7849.93	3021.48	-0.91	-0.39	0.12	0.99	246.9
019A	10032.14	7844.61	3025.01	10035.33	7850.64	3024.63	-6.03	-3.19	0.38	6.82	242.1

Appendix I. Coordinates and displacements of photo-identified points, Slungullion Slide, Colo. (continued)

Pt. ID	1990			1985			1990 - 1985			Hz. Disp.	Dir.
	North	East	Elevation	North	East	Elevation	dE	dN	dZ		
019B	10021.29	7876.26	3019.75	10022.71	7876.05	3019.64	0.21	-1.42	0.11	1.44	171.6
020	7752.870	9996.195	3018.763	9997.18	7756.93	3018.88	-4.06	-0.99	-0.12	4.18	256.4
020A	7693.05	9998.13	3008.48	10001.87	7699.51	3010.67	-6.46	-3.74	-2.19	7.46	239.9
021	7598.488	10093.339	3000.548	10096.78	7607.84	3002.40	-9.35	-3.44	-1.85	9.96	249.8
021A	7552.89	10074.47	2991.21	10078.73	7562.63	2992.33	-9.74	-4.26	-1.12	10.63	246.4
022	7654.891	10164.675	3009.089	10167.21	7664.36	3010.54	-9.47	-2.53	-1.45	9.80	255.0
022A	7593.71	10142.00	3002.19	10145.87	7602.85	3002.91	-9.14	-3.87	-0.72	9.93	247.1
023	7963.383	10663.608	3070.183	10663.54	7963.88	3071.65	-0.50	0.07	-1.47	0.50	277.8
024	7915.092	10382.276	3037.595	10380.87	7916.60	3037.99	-1.51	1.41	-0.39	2.06	313.0
024A	7850.46	10381.86	3023.95	10382.76	7852.68	3022.87	-2.22	-0.90	1.08	2.40	247.9
024B	7852.88	10352.81	3031.58	10353.99	7855.58	3030.45	-2.70	-1.18	1.13	2.95	246.4
025	8073.413	10114.080	3046.730	10114.38	8073.20	3046.64	0.21	-0.30	0.09	0.37	144.6
025A	8050.93	10132.06	3046.00	10135.83	8060.75	3046.21	-9.82	-3.77	-0.21	10.52	249.0
026	7479.456	10037.155	2969.734	10041.33	7488.00	2970.30	-8.54	-4.17	-0.57	9.51	244.0
026A	7526.49	10025.59	2981.92	10030.01	7534.12	2983.52	-7.63	-4.42	-1.60	8.82	239.9
027	7657.045	10282.108	3007.006	10281.93	7662.07	3008.58	-5.02	0.18	-1.57	5.03	272.0
027A	7595.13	10296.95	2986.20	10295.82	7599.31	2987.51	-4.18	1.13	-1.31	4.33	285.1
028	7807.383	10437.147	3010.861	10437.95	7807.36	3011.00	0.02	-0.80	-0.14	0.80	178.4
028A	7754.94	10453.42	2998.09	10453.93	7755.26	2997.54	-0.32	-0.51	0.55	0.60	212.1
029	8004.694	10234.134	3036.755	10241.82	8014.60	3037.46	-9.91	-7.69	-0.70	12.54	232.2
029A	7993.97	10290.31	3048.03	10294.04	8004.07	3050.39	-10.10	-3.73	-2.36	10.77	249.7
029B	8021.30	10281.79	3054.01	10285.19	8034.51	3055.47	-13.21	-3.40	-1.46	13.64	255.6
030	7303.664	9968.013	2940.359	9968.43	7303.01	2941.30	0.65	-0.42	-0.94	0.78	122.5
031	8028.151	10525.285	3044.631	10525.55	8029.25	3044.58	-1.10	-0.26	0.05	1.13	256.4
031A	8013.21	10466.11	3030.67	10465.70	8013.40	3029.95	-0.19	0.41	0.72	0.45	335.1
031B	8040.20	10483.75	3042.49	10482.92	8045.08	3043.71	-4.88	0.83	-1.22	4.95	279.7
032	8427.898	10483.358	3112.737	10489.72	8441.97	3113.10	-14.07	-6.36	-0.36	15.44	245.7
032A	8393.69	10487.70	3112.90	10494.20	8409.61	3112.98	-15.92	-6.50	-0.08	17.20	247.8
032B	8344.05	10462.06	3107.91	10473.50	8362.57	3111.43	-18.52	-11.44	-3.52	21.77	238.3
032C	8420.00	10414.03	3114.90	10423.57	8435.38	3117.62	-15.38	-9.54	-2.72	18.10	238.2
032D	8375.25	10415.42	3110.53	10424.76	8391.10	3114.15	-15.85	-9.34	-3.62	18.40	239.5

Appendix I. Coordinates and displacements of photo-identified points, Slungullion Slide, Colo. (continued)

Pt. ID	1990		1985		1990 - 1985		dz	dN	dE	Hz. Disp.	Dir.
	North	East	North	East	Elevation	Elevation					
033	10617.321	8562.004	10626.73	8577.74	3141.017	3143.49	-2.47	-9.41	-15.74	18.33	239.1
033A	10593.58	8531.69	10602.43	8546.95	3131.64	3136.66	-5.02	-8.85	-15.26	17.64	239.9
033B	10646.75	8595.78	10655.14	8604.47	3145.97	3148.86	-2.89	-8.39	-8.69	12.08	226.0
034	10621.142	8515.885	10621.12	8516.22	3131.175	3131.76	-0.59	0.02	-0.33	0.34	273.8
034A	10577.98	8482.27	10584.23	8496.09	3123.44	3127.92	-4.48	-6.25	-13.82	15.17	245.7
035	10180.609	8460.052	10180.01	8459.93	3101.912	3102.17	-0.26	0.60	0.12	0.61	11.5
036	10264.306	8402.062	10263.25	8402.41	3090.038	3089.85	0.19	1.06	-0.35	1.11	341.8
036A	10291.34	8365.80	10303.72	8379.94	3096.57	3101.34	-4.77	-12.38	-14.14	18.79	228.8
036B	10323.84	8399.45	10332.26	8415.00	3105.18	3107.25	-2.07	-8.42	-15.55	17.68	241.6
037	10185.748	8258.406	10185.11	8258.81	3062.701	3062.72	-0.02	0.64	-0.40	0.76	327.7
037A	10224.60	8252.61	10231.40	8266.36	3062.96	3063.49	-0.53	-6.80	-13.75	15.34	243.7
038	10288.624	8155.373	10296.41	8167.59	3063.696	3066.72	-3.02	-7.79	-12.22	14.49	237.5
038A	10250.14	8149.13	10255.36	8161.07	3052.07	3055.10	-3.03	-5.22	-11.94	13.03	246.4
038B	10313.00	8147.20	10319.39	8159.95	3060.73	3062.99	-2.26	-6.39	-12.75	14.26	243.4
039	10333.174	8332.887	10342.05	8347.04	3097.816	3101.17	-3.35	-8.88	-14.15	16.71	237.9
039A	10294.89	8325.98	10306.94	8342.15	3090.73	3095.79	-5.06	-12.05	-16.17	20.17	233.3
039B	10384.04	8322.30	10391.11	8336.66	3097.08	3099.77	-2.69	-7.07	-14.36	16.01	243.8
039C	10373.77	8374.79	10381.38	8390.83	3103.43	3106.24	-2.81	-7.61	-16.04	17.75	244.6
040	10371.796	8537.727	10379.14	8552.64	3118.346	3118.88	-0.53	-7.34	-14.91	16.62	243.8
040A	10352.24	8490.44	10360.28	8504.86	3113.24	3116.89	-3.65	-8.04	-14.42	16.51	240.9
040B	10331.65	8496.99	10333.09	8496.60	3110.82	3113.03	-2.21	-1.44	0.39	1.49	164.8
040C	10387.96	8513.36	10398.89	8527.78	3120.08	3124.82	-4.74	-10.93	-14.42	18.09	232.8
040D	10382.91	8540.43	10392.78	8554.66	3118.73	3123.70	-4.97	-9.87	-14.23	17.32	235.3
041	10435.457	8280.516	10441.02	8294.82	3100.672	3103.57	-2.90	-5.56	-14.30	15.35	248.7
041A	10444.41	8239.91	10452.83	8252.17	3089.70	3093.66	-3.96	-8.42	-12.26	14.87	235.5
041B	10480.10	8301.31	10486.63	8316.08	3103.88	3106.97	-3.09	-6.53	-14.77	16.15	246.1
042	10440.770	8083.485	10440.14	8084.90	3068.531	3069.98	-1.45	0.63	-1.41	1.55	294.0
042A	10430.80	8140.41	10437.96	8152.46	3086.48	3088.65	-2.17	-7.16	-12.05	14.02	239.3
043	10472.920	8895.853	10473.66	8895.01	3136.763	3136.97	-0.21	-0.74	0.84	1.12	131.3
044	10566.069	8825.693	10565.96	8825.87	3169.904	3170.02	-0.12	0.11	-0.18	0.21	301.6
044A	10542.00	8778.77	10555.51	8794.85	3162.73	3166.61	-3.88	-13.51	-16.08	21.00	230.0

Appendix I. Coordinates and displacements of photo-identified points, Slungullion Slide, Colo. (continued)

Pt. ID	1990		1985		1990 - 1985		Hz. Disp.	Dir.		
	North	East	North	East	Elevation	dE			dN	dZ
044B	10583.99	8786.36	10598.82	8802.50	3172.41	-16.14	-14.83	-2.13	21.92	227.4
044C	10636.31	8852.36	10651.13	8866.36	3176.57	-14.00	-14.82	-2.45	20.39	223.4
045	10490.146	8671.945	10501.59	8690.44	3149.21	-18.50	-11.44	-2.95	21.75	238.3
045A	10493.79	8619.04	10504.15	8634.80	3139.19	-15.76	-10.36	-5.61	18.86	236.7
045B	10517.15	8591.38	10526.35	8606.03	3137.55	-14.65	-9.20	-4.45	17.30	237.9
046	10443.307	8646.648	10449.26	8666.18	3142.99	-19.53	-5.95	-4.19	20.42	253.0
046A	10466.57	8566.34	10476.04	8582.51	3129.68	-16.17	-9.47	-1.90	18.74	239.6
047	10763.970	8748.327	10764.49	8748.75	3174.75	-0.42	-0.52	0.16	0.67	219.1
047A	10730.71	8726.51	10742.78	8740.54	3171.17	-14.03	-12.07	-2.38	18.51	229.3
047B	10678.20	8728.41	10690.05	8743.81	3173.12	-15.40	-11.85	-3.30	19.43	232.4
048	10988.206	9006.597	10988.19	9006.87	3237.50	-0.27	0.02	0.70	0.27	273.4
048A	10884.83	8919.71	10896.74	8934.07	3205.56	-14.36	-11.91	-3.78	18.66	230.3
049	10826.523	8985.576	10842.15	9004.75	3215.80	-19.17	-15.63	-5.61	24.74	230.8
049A	10881.50	9025.27	10899.30	9041.72	3222.48	-16.45	-17.80	-2.25	24.24	222.7
049B	10819.42	8945.64	10832.38	8965.20	3208.86	-19.56	-12.96	-3.48	23.46	236.5
050	10692.648	8928.297	10707.52	8942.80	3186.21	-14.50	-14.87	-3.78	20.77	224.3
050A	10684.63	8895.92	10702.76	8909.65	3186.14	-13.73	-18.13	-3.60	22.74	217.1
050B	10664.90	8878.09	10680.09	8891.71	3181.15	-13.62	-15.19	-2.94	20.40	221.9
051	10778.344	8970.235	10793.92	8991.06	3207.77	-20.82	-15.58	-2.09	26.01	233.2
051A	10784.68	8999.56	10801.06	9019.15	3210.34	-19.59	-16.38	-2.35	25.54	230.1
051B	10797.33	8962.56	10811.91	8982.72	3207.97	-20.16	-14.58	-2.16	24.88	234.1
052	10869.796	8882.294	10867.91	8883.63	3196.70	-1.34	1.89	1.46	2.31	324.7
052A	10835.02	8878.05	10844.18	8896.07	3194.04	-18.02	-9.16	-5.09	20.21	243.1
052B	10832.72	8849.47	10842.40	8867.35	3190.02	-17.88	-9.68	-4.20	20.33	241.6
053	10638.948	8781.390	10652.62	8797.37	3172.83	-15.98	-13.67	-2.03	21.03	229.5
053A	10638.25	8752.45	10651.55	8767.16	3171.63	-14.71	-13.30	-2.14	19.83	227.9
053B	10673.94	8796.46	10687.60	8811.13	3176.94	-14.67	-13.66	-1.31	20.05	227.0
054	10573.977	8718.606	10587.97	8734.86	3165.95	-16.25	-13.99	-2.47	21.45	229.3
054A	10537.37	8695.91	10549.71	8713.04	3159.68	-17.13	-12.34	-3.47	21.11	234.2
054B	10540.11	8750.51	10553.48	8766.63	3163.61	-16.12	-13.37	-4.37	20.94	230.3
055	10581.010	8658.768	10592.35	8676.09	3160.14	-17.32	-11.34	-3.57	20.70	236.8

Appendix I. Coordinates and displacements of photo-identified points, Slungullion Slide, Colo. (continued)

Pt. ID	1990		1985		1990 - 1985				Hz. Disp.	Dir.	
	North	East	North	East	Elevation	dE	dN	dz			
055A	10619.90	8658.11	10630.44	8674.61	3158.52	3161.35	-16.50	-10.54	-2.83	19.58	237.4
055B	10622.79	8693.62	10634.03	8710.29	3162.63	3164.96	-16.67	-11.24	-2.33	20.11	236.0
056	11033.672	9302.807	11046.35	9322.82	3280.598	3282.41	-20.01	-12.68	-1.81	23.69	237.6
056A	11056.38	9322.13	11069.15	9339.10	3281.39	3284.74	-16.97	-12.77	-3.35	21.24	233.0
056B	11040.96	9337.63	11054.38	9354.05	3282.27	3285.20	-16.42	-13.42	-2.93	21.21	230.7
057	11009.005	9238.975	11025.22	9260.21	3267.554	3272.13	-21.23	-16.22	-4.58	26.72	232.6
057A	10999.96	9285.72	11013.04	9303.82	3274.79	3278.53	-18.10	-13.08	-3.74	22.33	234.1
057B	10959.93	9259.36	10960.67	9258.90	3264.79	3264.79	0.46	-0.74	0.00	0.87	148.1
057C	11076.50	9258.53	11091.27	9275.62	3272.09	3275.04	-17.09	-14.77	-2.95	22.59	229.2
058	11122.937	9417.538	11133.89	9432.32	3297.948	3299.71	-14.78	-10.95	-1.76	18.40	233.5
058A	11152.00	9472.77	11170.80	9497.46	3308.27	3319.01	-24.69	-18.80	-10.74	31.03	232.7
058B	11089.12	9378.70	11100.84	9394.56	3294.62	3296.56	-15.86	-11.72	-1.94	19.72	233.5
058C	11099.44	9446.01	11105.41	9457.98	3300.40	3304.73	-11.97	-5.97	-4.33	13.38	243.5
058D	11135.81	9389.50	11148.49	9404.99	3293.89	3296.90	-15.49	-12.68	-3.01	20.02	230.7
059	11125.835	9326.241	11138.52	9340.14	3276.888	3282.33	-13.90	-12.69	-5.44	18.82	227.6
059A	11165.28	9338.54	11180.09	9352.53	3283.53	3289.02	-13.99	-14.81	-5.49	20.37	223.4
059B	11119.76	9268.94	11134.02	9281.53	3276.30	3276.72	-12.59	-14.26	-0.42	19.02	221.4
060	11243.760	9382.510	11253.31	9395.34	3310.050	3313.04	-12.83	-9.55	-2.99	15.99	233.3
060A	11218.65	9433.20	11227.10	9445.19	3311.36	3313.55	-11.99	-8.45	-2.19	14.67	234.8
060B	11231.97	9351.86	11245.95	9365.26	3297.65	3304.60	-13.40	-13.98	-6.95	19.36	223.8
061	11380.827	9438.852	11384.68	9444.25	3310.852	3310.93	-5.40	-3.85	-0.08	6.63	234.5
061A	11352.56	9407.64	11357.51	9412.89	3309.41	3309.53	-5.25	-4.95	-0.12	7.22	226.7
061B	11418.39	9390.70	11422.74	9396.25	3313.62	3313.64	-5.55	-4.35	-0.02	7.05	231.9
062	11337.683	9342.601	11344.08	9347.62	3307.434	3307.53	-5.02	-6.40	-0.10	8.13	218.1
062A	11310.67	9310.32	11318.88	9313.31	3301.99	3303.23	-2.99	-8.21	-1.24	8.74	200.0
062B	11373.56	9339.15	11380.01	9344.54	3310.49	3311.24	-5.39	-6.45	-0.75	8.41	219.9
063	11299.411	9363.493	11306.95	9373.59	3304.750	3304.87	-10.10	-7.54	-0.12	12.60	233.3
063A	11273.41	9332.37	11284.94	9343.23	3297.15	3301.40	-10.86	-11.53	-4.25	15.84	223.3
063B	11303.47	9396.54	11310.43	9407.04	3310.52	3312.37	-10.50	-6.96	-1.85	12.60	236.5
064	11227.321	9229.544	11227.27	9229.32	3296.482	3295.36	0.22	0.05	1.12	0.23	77.2
064A	11156.16	9212.97	11167.20	9220.76	3279.86	3281.09	-7.79	-11.04	-1.23	13.51	215.2

Appendix I. Coordinates and displacements of photo-identified points, Slungullion Slide, Colo. (continued)

Pt. ID	1990		1985		1990 - 1985		Hz. Disp.	Dir.		
	North	East	North	East	dN	dE				
0648	11232.00	9274.38	11246.43	9278.08	3300.46	-3.70	-14.43	-1.29	14.88	194.4
065	11306.468	9465.945	11313.96	9477.01	3321.92	-11.07	-7.49	-0.56	13.36	235.9
065A	11285.94	9483.83	11292.51	9493.95	3322.01	-10.12	-6.57	-1.27	12.07	237.0
065B	11271.56	9449.65	11278.14	9460.28	3319.66	-10.63	-6.58	-1.61	12.50	238.2
066	11303.330	9551.824	11309.75	9562.48	3324.57	-10.66	-6.42	-1.03	12.44	238.9
066A	11266.18	9586.37	11271.95	9597.08	3328.39	-10.71	-5.77	-0.83	12.17	241.7
066B	11221.58	9602.93	11227.63	9612.07	3330.21	-9.14	-6.05	-2.50	10.96	236.5
067	10145.72	7525.66	10146.56	7533.24	2986.61	-7.58	-0.84	-1.34	7.63	263.7
067A	10135.99	7498.12	10135.78	7504.86	2978.58	-6.74	0.21	-1.00	6.74	271.8
068	10123.39	7545.61	10124.85	7555.61	2994.48	-10.00	-1.46	-1.53	10.11	261.7
068A	10102.08	7539.60	10104.62	7548.92	2988.10	-9.32	-2.54	-1.47	9.66	254.8
069	10105.85	7496.62	10107.65	7505.21	2979.16	-8.59	-1.80	-0.44	8.78	258.2
069A	10076.69	7482.89	10077.55	7492.64	2970.46	-9.75	-0.86	-0.92	9.79	265.0
070	10213.61	7530.46	10212.51	7536.75	2983.42	-6.29	1.10	-0.92	6.39	279.9
070A	10277.62	7551.89	10277.84	7552.40	2977.54	-0.51	-0.22	0.11	0.56	246.7
071	10269.98	7365.31	10270.06	7365.52	2962.62	-0.21	-0.08	0.39	0.22	249.1
072	10256.40	7284.36	10256.43	7286.10	2956.75	-1.74	-0.03	-0.08	1.74	269.0
073	10000.75	7515.22	10003.80	7524.62	2971.73	-9.40	-3.05	-1.08	9.88	252.0
073A	10014.43	7502.79	10018.09	7511.78	2975.39	-8.99	-3.66	-0.39	9.71	247.8
074	10008.62	7590.21	10011.41	7599.40	2997.43	-9.19	-2.79	-0.39	9.60	253.1
074A	9988.57	7590.11	9991.59	7597.76	2993.32	-7.65	-3.02	-0.69	8.22	248.5
075	10081.00	7954.21	10085.96	7962.12	3031.46	-7.91	-4.96	-0.38	9.34	237.9
075A	10063.64	7941.84	10064.41	7942.81	3026.94	-0.97	-0.77	-0.24	1.24	231.6
076	10086.58	7678.85	10089.82	7688.24	3014.57	-9.39	-3.24	-0.87	9.93	251.0
076A	10083.56	7725.16	10086.01	7734.46	3016.43	-9.30	-2.45	-0.20	9.62	255.2
077	10143.32	7691.73	10145.43	7701.25	3014.38	-9.52	-2.11	-0.83	9.75	257.5
077A	10133.80	7712.73	10137.42	7723.27	3016.47	-10.54	-3.62	-1.57	11.14	251.0
078	10047.58	7658.85	10050.24	7668.26	3009.54	-9.41	-2.66	-0.70	9.78	254.2
078A	10027.42	7663.12	10030.68	7672.09	3007.72	-8.97	-3.26	-1.13	9.54	250.0
079	10159.22	7772.71	10161.69	7782.60	3024.81	-9.89	-2.47	-1.63	10.19	256.0
079A	10169.48	7815.57	10172.84	7826.36	3032.40	-10.79	-3.36	-1.29	11.30	252.7

Appendix I. Coordinates and displacements of photo-identified points, Slungullion slide, Colo. (continued)

Pt. ID	1990		1985		1990 - 1985				Hz. Disp.	Dir.	
	North	East	Elevation	North	East	Elevation	dE	dN			dZ
080	10138.37	7793.53	3025.84	10142.00	7803.54	3027.01	-10.01	-3.63	-1.17	10.65	250.1
080A	10115.35	7784.36	3024.18	10119.13	7794.92	3025.51	-10.56	-3.78	-1.33	11.22	250.3
081	10185.08	7757.85	3021.54	10187.23	7767.37	3022.90	-9.52	-2.15	-1.36	9.76	257.3
081A	10282.67	7751.42	3023.88	10282.74	7756.38	3025.28	-4.96	-0.07	-1.40	4.96	269.2
081B	10342.41	7780.22	3025.91	10342.07	7783.25	3025.97	-3.03	0.34	-0.06	3.05	276.4
082	10132.86	7953.99	3043.20	10137.17	7965.08	3043.86	-11.09	-4.31	-0.66	11.90	248.8
082A	10122.67	7915.34	3035.97	10128.25	7924.10	3037.25	-8.76	-5.58	-1.28	10.39	237.5
083	10113.54	7828.90	3027.92	10117.22	7838.40	3029.15	-9.50	-3.68	-1.23	10.19	248.8
083A	10090.74	7819.85	3021.37	10095.18	7829.29	3022.56	-9.44	-4.44	-1.19	10.43	244.8
084	10189.96	7888.03	3040.36	10192.79	7900.38	3040.10	-12.35	-2.83	0.26	12.67	257.1
084A	10155.51	7880.89	3037.34	10159.72	7891.05	3038.61	-10.16	-4.21	-1.27	11.00	247.5
085	10192.69	7903.32	3041.29	10196.15	7915.61	3040.66	-12.29	-3.46	0.63	12.77	254.3
086	10446.82	7712.41	2987.10	10447.53	7713.90	2986.20	-1.49	-0.71	0.90	1.65	244.5
086A	10357.35	7716.82	3012.59	10355.51	7719.75	3014.04	-2.93	1.84	-1.45	3.46	302.1
087	10576.57	7799.25	3027.25	10576.51	7799.95	3025.99	-0.70	0.06	1.26	0.70	274.9
088	10500.99	7939.94	3021.94	10500.48	7940.84	3021.46	-0.90	0.51	0.48	1.03	299.5
088A	10436.06	7974.12	3026.89	10435.19	7974.35	3026.80	-0.23	0.87	0.09	0.90	345.2
089	10283.22	7880.94	3037.58	10284.19	7891.38	3036.79	-10.44	-0.97	0.79	10.48	264.7
089A	10295.84	7865.18	3034.88	10297.69	7876.42	3036.16	-11.24	-1.85	-1.28	11.39	260.7
090	10288.24	7943.86	3040.64	10290.98	7953.61	3040.82	-9.75	-2.74	-0.18	10.13	254.3
090A	10351.95	7961.49	3046.84	10346.21	7975.25	3046.93	-13.76	5.74	-0.09	14.91	292.6
091	10214.17	7838.12	3032.83	10215.32	7848.35	3031.87	-10.23	-1.15	0.96	10.29	263.6
091A	10239.70	7807.50	3026.40	10241.83	7820.20	3027.70	-12.70	-2.13	-1.30	12.88	260.5
092	10054.00	7837.16	3026.41	10057.82	7845.00	3027.37	-7.84	-3.82	-0.96	8.72	244.0
092A	10075.08	7828.95	3025.51	10078.68	7836.82	3025.72	-7.87	-3.60	-0.21	8.65	245.4
093	10031.09	7747.21	3019.88	10033.33	7755.65	3021.63	-8.44	-2.24	-1.75	8.73	255.1
093A	10064.85	7769.40	3017.12	10066.03	7778.52	3017.73	-9.12	-1.18	-0.61	9.20	262.6
094	10032.39	7718.38	3014.63	10034.51	7726.96	3016.18	-8.58	-2.12	-1.55	8.84	256.1
094A	9992.31	7657.68	3002.45	9994.58	7664.91	3002.55	-7.23	-2.27	-0.10	7.58	252.6
095	10140.16	8164.72	3055.52	10139.36	8165.62	3055.29	-0.90	0.80	0.23	1.20	311.6
095A	10159.56	8164.29	3057.63	10164.39	8175.53	3057.93	-11.24	-4.83	-0.30	12.23	246.7

Appendix I. Coordinates and displacements of photo-identified points, Slunglillion Slide, Colo. (continued)

Pt. ID	1990		1985		1990 - 1985				Hz. Disp.	Dir.
	North	East	North	East	Elevation	dE	dN	dZ		
095B	10172.83	8167.09	10177.76	8178.35	3059.37	-11.26	-4.93	-0.73	12.29	246.4
096	10102.21	8019.52	10101.45	8020.34	3038.71	-0.82	0.76	0.76	1.12	312.8
096A	10115.57	8005.63	10120.51	8014.64	3042.53	-9.01	-4.94	-0.61	10.28	241.3
097	10152.50	8107.27	10156.55	8118.91	3054.53	-11.64	-4.05	-0.78	12.32	250.8
097A	10191.38	8106.49	10195.30	8117.88	3052.61	-11.39	-3.92	-0.14	12.05	251.0
098	10217.72	7654.20	10216.89	7661.59	3011.88	-7.39	0.83	-2.48	7.44	276.4
099	10251.22	7650.67	10250.83	7655.54	3003.00	-4.87	0.39	-2.00	4.89	274.6
100	10291.43	7689.36	10289.30	7693.99	3016.74	-4.63	2.13	-1.72	5.10	294.7
101	10256.14	8071.82	10261.55	8082.65	3050.59	-10.83	-5.41	-1.87	12.11	243.5
102	10234.18	8087.11	10237.52	8098.88	3047.07	-11.77	-3.34	-1.41	12.23	254.2
103	10314.73	8085.68	10320.53	8097.07	3058.40	-11.39	-5.80	-1.09	12.78	243.0
103A	10346.79	8070.42	10363.17	8093.12	3067.13	-22.70	-16.38	-4.30	27.99	234.2
104	10308.14	8206.51	10315.42	8218.42	3076.55	-11.91	-7.28	-3.27	13.96	238.6
105	10240.14	8197.79	10245.75	8210.93	3060.49	-13.14	-5.61	-3.14	14.29	246.9
106	10516.68	8381.64	10525.00	8396.62	3117.79	-14.98	-8.32	-1.44	17.14	241.0
107	10551.37	8455.22	10558.66	8468.67	3121.60	-13.45	-7.29	-4.24	15.30	241.5
108	10550.68	8538.05	10559.31	8552.72	3132.19	-14.67	-8.63	-4.99	17.02	239.5
109	10579.76	8579.24	10590.37	8594.60	3143.11	-15.36	-10.61	-5.43	18.67	235.4
110	10318.29	8444.56	10319.65	8444.47	3107.07	0.09	-1.36	-1.38	1.36	176.2
111	10219.03	8318.96	10219.85	8319.18	3069.91	-0.22	-0.82	-0.59	0.85	195.0
112	10393.13	8283.31	10401.31	8295.63	3095.15	-12.32	-8.18	-2.54	14.79	236.4
113	10323.59	8284.50	10333.78	8303.23	3093.08	-18.73	-10.19	-3.69	21.32	241.5
114	10748.93	8943.63	10766.59	8961.96	3205.06	-18.33	-17.66	-5.52	25.45	226.1
115	10729.46	8889.86	10746.44	8905.93	3193.33	-16.07	-16.98	-5.70	23.38	223.4
116	10829.92	9032.16	10852.21	9050.44	3218.20	-18.28	-22.29	-3.47	28.83	219.4
117	10879.12	9101.55	10897.70	9120.78	3234.04	-19.23	-18.58	-5.34	26.74	226.0
118	10940.00	9119.28	10959.03	9137.96	3243.54	-18.68	-19.03	-4.53	26.67	224.5
119	11391.76	9725.34	11394.79	9732.78	3347.66	-7.44	-3.03	-0.82	8.03	247.8
119A	11408.38	9748.86	11411.02	9756.18	3351.63	-7.32	-2.64	-1.48	7.78	250.2
119B	11414.22	9686.97	11417.62	9693.86	3343.81	-6.89	-3.40	-1.68	7.68	243.7
119C	11355.80	9767.73	11358.96	9775.44	3349.20	-7.71	-3.16	-0.33	8.33	247.7

Appendix I. Coordinates and displacements of photo-identified points, Slungullion Slide, Colo. (continued)

Pt. ID	1990		1985		1990 - 1985				Hz. Disp.	Dir.
	North	East	North	East	Elevation	dE	dN	dZ		
1190	11390.90	9680.97	11394.07	9687.91	3338.43	-6.94	-3.17	-1.16	7.63	245.5
120	11374.14	9555.44	11379.35	9563.95	3334.00	-8.51	-5.21	-1.27	9.98	238.5
120A	11370.67	9518.05	11375.09	9526.16	3333.32	-8.11	-4.42	-1.33	9.24	241.4
1208	11437.15	9573.47	11442.06	9581.19	3340.84	-7.72	-4.91	-1.16	9.15	237.5
120C	11345.64	9614.94	11347.35	9625.30	3330.60	-10.36	-1.71	-0.92	10.50	260.6
121	11263.19	9662.13	11265.22	9671.85	3340.23	-9.72	-2.03	-2.55	9.93	258.2
121A	11283.45	9624.21	11286.84	9636.59	3330.92	-12.38	-3.39	-1.36	12.84	254.7
1218	11274.13	9644.58	11277.77	9655.62	3333.56	-11.04	-3.64	-2.02	11.62	251.8
122	11253.35	9688.95	11255.77	9698.14	3344.35	-9.19	-2.42	-1.73	9.50	255.2
122A	11281.68	9701.63	11284.93	9710.87	3343.81	-9.24	-3.25	-1.45	9.79	250.6
1228	11260.70	9734.83	11263.75	9742.26	3350.54	-7.43	-3.05	-1.18	8.03	247.7
123	11286.15	9794.13	11287.64	9800.58	3356.53	-6.45	-1.49	-0.09	6.62	257.0
123A	11283.90	9767.27	11285.77	9775.01	3355.27	-7.74	-1.87	-0.47	7.96	256.4
1238	11272.15	9810.23	11272.40	9810.88	3356.75	-0.65	-0.25	0.31	0.70	249.0
124	11306.99	9838.56	11308.74	9844.72	3358.57	-6.16	-1.75	-0.63	6.40	254.1
124A	11310.08	9888.27	11311.44	9895.18	3365.86	-6.91	-1.36	-0.81	7.04	258.9
1248	11289.41	9875.68	11289.63	9876.62	3363.21	-0.94	-0.22	-0.18	0.97	256.8
125	11585.59	9723.63	11585.74	9723.69	3355.92	-0.06	-0.15	0.40	0.16	201.8
125A	11598.52	9808.09	11601.02	9814.46	3370.07	-6.37	-2.50	-1.37	6.84	248.6
1258	11540.94	9744.84	11539.04	9742.40	3362.01	2.44	1.90	-0.96	3.09	52.1
126	11415.37	9490.79	11418.96	9497.68	3325.66	-6.89	-3.59	-1.30	7.77	242.5
126A	11392.17	9504.44	11395.59	9512.08	3327.03	-7.64	-3.42	-1.51	8.37	245.9
1268	11415.64	9452.09	11418.37	9458.95	3315.74	-6.86	-2.73	-1.62	7.38	248.3
126C	11458.43	9448.32	11461.58	9455.06	3316.71	-6.74	-3.15	-0.90	7.44	245.0
127	11489.89	9639.90	11493.21	9647.48	3348.53	-7.58	-3.32	-0.29	8.28	246.3
127A	11516.19	9689.89	11519.10	9697.20	3352.67	-7.31	-2.91	-0.76	7.87	248.3
1278	11508.09	9624.49	11510.51	9631.92	3349.10	-7.43	-2.42	-1.07	7.81	252.0
128	11489.53	9524.54	11501.45	9532.07	3332.36	-7.53	-11.92	-0.08	14.10	212.3
128A	11479.33	9476.22	11482.57	9483.38	3323.03	-7.16	-3.24	-1.50	7.86	245.7
1288	11454.57	9536.77	11458.29	9544.28	3335.08	-7.51	-3.72	-1.19	8.38	243.6
129	11545.32	9781.49	11548.09	9787.38	3363.34	-5.89	-2.77	-0.43	6.51	244.8

Appendix I. Coordinates and displacements of photo-identified points, Slungullion slide, Colo. (continued)

Pt. ID	1990			1985			1990 - 1985			Hz. Disp.	Dir.
	North	East	Elevation	North	East	Elevation	dE	dN	dZ		
129A	11529.10	9820.98	3367.07	11531.73	9827.75	3368.95	-6.77	-2.63	-1.88	7.26	248.8
129B	11580.88	9813.52	3370.68	11583.71	9819.79	3372.00	-6.27	-2.83	-1.32	6.88	245.7
130	11434.66	9922.99	3368.87	11437.39	9928.53	3368.66	-5.54	-2.73	0.21	6.18	243.8
130A	11408.38	9864.72	3361.05	11410.52	9871.48	3363.00	-6.76	-2.14	-1.95	7.09	252.4
130B	11480.31	9913.70	3374.66	11482.66	9920.41	3375.97	-6.71	-2.35	-1.31	7.11	250.7
131	11449.07	9988.65	3383.83	11451.49	9994.19	3384.56	-5.54	-2.42	-0.73	6.05	246.4
131A	11464.63	10035.53	3391.56	11467.40	10040.36	3392.46	-4.83	-2.77	-0.90	5.57	240.2
132	11623.02	9889.49	3386.45	11626.25	9893.69	3387.51	-4.20	-3.23	-1.06	5.30	232.4
132A	11559.93	9883.67	3378.03	11563.09	9889.55	3379.64	-5.88	-3.16	-1.61	6.68	241.7
132B	11640.17	9913.66	3398.81	11642.26	9917.26	3399.53	-3.60	-2.09	-0.72	4.16	239.9
133	11596.93	9927.06	3385.00	11598.88	9931.08	3385.95	-4.02	-1.95	-0.95	4.47	244.1
133A	11623.75	10021.29	3402.29	11624.99	10029.69	3403.70	-8.40	-1.24	-1.41	8.49	261.6
133B	11679.16	10021.27	3410.23	11684.12	10027.21	3410.70	-5.94	-4.96	-0.47	7.74	230.1
134	11504.53	10130.11	3400.85	11506.37	10133.50	3401.04	-3.39	-1.84	-0.19	3.86	241.5
134A	11565.92	10188.78	3420.19	11568.53	10192.18	3420.80	-3.40	-2.61	-0.61	4.29	232.5
135	11407.79	10174.44	3391.03	11409.35	10178.29	3390.92	-3.85	-1.56	0.11	4.15	247.9
135A	11397.84	10216.86	3398.75	11398.13	10218.03	3399.04	-1.17	-0.29	-0.29	1.21	256.1
135B	11492.69	10244.67	3417.80	11495.43	10247.95	3418.53	-3.28	-2.74	-0.73	4.27	230.1
135C	11440.11	10196.92	3400.36	11442.57	10200.52	3401.10	-3.60	-2.46	-0.74	4.36	235.7
135D	11331.16	10050.55	3379.67	11331.95	10057.30	3380.18	-6.75	-0.79	-0.51	6.80	263.3
135E	11370.37	10202.62	3392.20	11370.42	10203.04	3392.17	-0.42	-0.05	0.03	0.42	263.2
136	11691.51	10081.22	3409.77	11692.68	10082.89	3409.01	-1.67	-1.17	0.76	2.04	235.0
136A	11738.68	10101.03	3413.27	11739.63	10102.47	3413.10	-1.44	-0.95	0.17	1.73	236.6
136B	11789.94	10110.16	3422.16	11790.59	10111.31	3422.47	-1.15	-0.65	-0.31	1.32	240.5
136C	11856.67	10179.29	3419.30	11857.76	10180.02	3419.70	-0.73	-1.09	-0.40	1.31	213.8
136D	11842.77	10290.34	3421.79	11844.91	10290.90	3421.55	-0.56	-2.14	0.24	2.21	194.7
136E	11755.56	10333.00	3425.90	11757.77	10334.42	3425.28	-1.42	-2.21	0.62	2.63	212.7
136F	11618.59	10344.83	3423.28	11618.61	10346.71	3423.56	-1.88	-0.02	-0.28	1.88	269.4
136G	11646.77	10275.49	3428.01	11648.78	10277.67	3427.92	-2.18	-2.01	0.09	2.97	227.3
136H	11530.61	10299.66	3420.86	11531.17	10301.24	3420.73	-1.58	-0.56	0.13	1.68	250.5
137	11457.44	10063.57	3391.30	11459.45	10068.31	3391.98	-4.74	-2.01	-0.68	5.15	247.0

Appendix I. Coordinates and displacements of photo-identified points, Slungullion Slide, Colo. (continued)

Pt. ID	1990		1985		1990 - 1985			Hz. Disp.	Dir.	
	North	East	North	East	Elevation	dE	dN			dz
137A	11465.47	10035.52	11467.58	10040.40	3392.32	-4.88	-2.11	-0.49	5.32	246.6
137B	11477.27	10086.69	11479.16	10090.41	3398.96	-3.72	-1.89	-0.42	4.17	243.1