ZEISER KLING Consultants, Inc.

March 14, 2006 PN 97082-1364

Mr. Joel Rojas
City of Rancho Palos Verdes
30940 Hawthorne Blvd
Rancho Palos Verdes, CA 90275-5391

Subject: Evaluation of Recent Movement related to the Klondike Canyon Landslide, Rancho Palos Verdes, California.

Dear Mr. Rojas,

At the request of the City of Rancho Palos Verdes our firm has evaluated the recent movement associated with the Klondike Canyon landslide. As part of our evaluation we reviewed past documents relating to the landslide, photo documented the area of movement and reviewed survey documentation of the movement. Recent movement of the landslide has manifested as the cracking of pavements, curb and gutter and sidewalks in the area of Dauntless and Exultant Drives.

Background

From a review of published documents, the Klondike Canyon landslide was recognized to be active in around 1980. The landslide is estimated to occupy about 50 acres immediately east of the Portuguese Bend landslide. The landslide is generally considered to be the eastward extension of the ancient Portuguese Bend landslide with movement being initiated as part of the movement of the Portuguese Bend landslide approximately 37,000 years ago. It has been estimated that the total horizontal displacement since the initiation of landslide movement is on the order of less than 50 feet. The toe of the landslide is thought to be about 100 feet below the ground surface at the coastline and about 50 feet below the ground surface near the head of the landslide. The Klondike Canyon landslide is thought to be a block glide landslide that has generally moved as an intact block.

Historical overall movement from 1956 to 1981 has been estimated at about 2.5 feet, with most of the movement estimated to have occurred between 1977 and 1981. In 1981, an excavation for an inclinometer near the toe of the landslide produced artesian water conditions from the landslide. The subsequently installed dewatering well has been credited with slowing the movement of the landslide.

In a March 1987 memo, Perry Ehlig indicated that the horizontal movement of the Klondike Canyon landslide from 1980 to 1987 ranged from 3.5 to 8.6 inches with rates ranging from 0.5 to 2.3 inches per year. He also observed accelerated creep of the landslide during 1986. He attributed increased groundwater and frictional drag from the

accelerated movement on the adjacent Portuguese Bend landslide as the cause of the accelerated creep. Remedial grading in 1987 removed the portion of the Portuguese Bend landside that was overriding the lower portion of the Klondike Canyon landslide that was suspected of increasing frictional drag on the Klondike Canyon landslide. It is our understanding that grading of this nature had previously been performed at least one other time in the past.

It was Mr. Ehlig's opinion that although the movement of the Klondike Canyon landslide was of concern; he determined that "such movement could continue almost indefinitely without causing much damage." This was due in part to the unbroken nature of the main landslide body.

Recent Observations and Monitoring

It is our understanding that the recent distress within the Dauntless Drive area was observed in May of 2005. Our first observation of the distress was on June 1, 2005. Specifically, distress was manifested in the form of en-echelon cracking and displacements in street pavement, driveways, curbs and gutter and sidewalks. Two lines of discontinuous cracking extended from north of the southeast corner property at the intersection of Dauntless and Exultant Drives (4342 Dauntless Drive) to the southwest corner of the house at 4361 Dauntless Drive. Generally the cracks were on the order of 1/8 inch to 1 inch wide. A distinct down dropped zone is visible between the two sets of cracks. It should be noted that previous authors (Ehlig, Ehlert and Davis) recognized the same crack pattern and down dropped subsidence zone in the 1980s and early 1990s. It is our understanding that the distressed area has been repaired a number of times between observations. A review of photographs taken over time and observations by the authors indicates that the observed cracks and distress have changed very little in the 9 months since our initial observations; although minor new cracks have appeared and minor enlargements of existing cracks have been observed. In addition, other cracks and offsets in pavements and distress to improvements and structures have also occurred on Palos Verdes Drive South and within the lower portion of the landslide along Yacht Harbor Drive.

A set of monitoring points for the Klondike Canyon Landslide were established in late 1994 and early 1995 and have been monitored using global position satellites (GPS) since installation. The monitoring data was provided by Charles Abbott and Associates at the direction of the City of Rancho Palos Verdes Public Works Department. A review of the monitoring points indicate that the readings show abundant scatter, and appear to be within a range of potential survey error (due to thermal expansion, traffic disturbance, etc.). In order to more accurately evaluate the movement of the landslide, we have evaluated the distance between the individual monitoring points. Point KC07 is northeast of the recognized landslide headscarp and is therefore considered to be out of the zone subject to movement. Using KC07 as a base point, we have compared the distance over time between KC07 and other monitoring points. In order to further reduce the error form one reading to another, we have evaluated the cumulative change in distance between points over time (see Figures 1 through 4). The distance between points has

increased over time for all the points evaluated which indicates continued movement of the landslide. In addition, the graph of distance versus time over the past 11 years plots generally as a straight line indicating relatively continuous movement throughout the monitoring period. Vertical differences were not observed in the data beyond the precision of the survey.

A comparison of monitoring points within the main landslide mass indicates that the distance between points has not increased. This suggests that the main landslide mass is moving in a relatively undisturbed intact block.

The last monitoring period prior to the movement in May 2005 was February 2005. Readings have been made of various monitoring points following the May movement. A comparison of the February readings to the readings following the May movement would suggest that the landslide experienced an accelerated movement. Based on the visual observations it appears that most of the movement recorded occurred in a relatively short period of time prior to June 2005.

In October it was reported by the Portuguese Bend Club and the Klondike Canyon Geologic Hazard Abatement District that the eastern portion of the Portuguese Bend landslide in the area of 131 Yacht Harbor Drive had again overridden the lower portion of the Klondike Canyon landslide in a manner very similar to that which occurred in 1987 (AMEC, 2005). Remedial grading similar to the remedial grading in 1987 was completed in late 2005. It should be recognized that this area of the Portuguese Bend landslide had the largest horizontal movements in the landslide during the period of January to October 2005 including 9.6 feet at PB46, 8 feet at PB11, 5.4 feet at PB12 and 3.2 feet at PB13. Comparing these readings to past readings, horizontal movements are on the order of 12 to 29 percent above the average yearly movement recorded for these points.

Conclusions

Based on the foregoing discussion, it is concluded that the Klondike Canyon landslide experienced accelerated movement in the period just prior to June of 2005. However, we also conclude that the accelerated movement has again declined to a slow background creep as has been the case since the 1980's. Based on recent events and past observations and monitoring, the Klondike Canyon landslide should be considered an active landslide with the potential for continued slow movement and occasional increased acceleration. It does not appear to be capable of catastrophic failure at this time, although over the long term, continued movement of the Portuguese Bend Landslide could cause episodic acceleration in the creep rate of the Klondike Canyon Landslide.

It is further concluded that the accelerated movement in May of 2005 was precipitated by two major causes: an increase in the local groundwater within and below the slide mass due to the record rainfall received during the winter of 2004-2005 and increased drag from the accelerated movement of the Portuguese Bend landslide.

The Klondike Canyon landslide is estimated to have moved less than 50 feet since the estimated initiation of movement about 37,000 years ago. This is only a fraction of the total movements recognized in the other active landslides in the area. The overall limited movement of the Klondike Canyon landslide has also contributed to the relatively stable nature of the main block of the landslide. However, it should be noted that the continued slow movement of the landslide will result in distress and damage to structures and improvements that straddle or are adjacent the landslide boundaries. Structures and improvements within the main landslide block away from landslide boundaries should be generally immune from distress unless a major increase in movement occurs.

Recommendation

The following recommendations should be considered for continued evaluation of the Klondike Canyon landslide.

Monitoring

The current survey monitoring utilizing GPS generally has only limited application for precise survey monitoring for slow moving landslides with limited displacements. Since GPS is dependent on the number of satellites available at any given time and a direct line of site to the satellites, there are limitations to the precision of the data. It is therefore recommended that the landslide monitoring currently being implemented be evaluated from a precision standpoint and be modified as necessary to obtain more precise data. This would include establishment of more robust monitoring points and monuments, and implementing either a traditional closed loop, or a survey net type of monitoring system.

Remedial Grading

It is recommended that grading in the area of the Portuguese Bend Club as was accomplished recently and in 1987 be completed any time the Portuguese Bend landslide overrides the lower portion of the Klondike Canyon landslide.

Groundwater

Groundwater has been one of the primary factors controlling the movement of the Rancho Palos Verdes landslides. Numerous steps have been taken in the past to reduce the amount of water in the subsurface of the landslide areas. These include directing surface water away from areas of potential infiltration, installation of dewatering wells, limiting irrigation, modifying irrigation practices, installation of sewer and storm drain facilities and limiting development including limiting the installation of pools. Where possible, these steps should be continued or implemented throughout the landslide areas of Rancho Palos Verdes including the Klondike Canyon landslide.

Investigation

Further investigation of the Klondike Canyon landslide should be considered. Investigative work should focus on improved monitoring, monitoring schedules, observation and mapping of landslide features and distress within Klondike Canyon and the adjoining development, the relationship of water infiltration within Klondike Canyon to landslide stability and the relationship of movement of the Portuguese Bend landslide to the measured creep rate of the Klondike Canyon landslide.

Repair of Improvements

Currently, damaged and cracked pavements and concrete drainage features in the area of Dauntless Drive allow water to enter the subsurface. It is recommended that these damaged or distressed improvements be repaired to limit infiltration of surface water into the subsurface.

CLOSURE

Zeiser Kling Consultants, Inc. appreciates this opportunity to be of continued services to the City of Rancho Palos Verdes. If you should have any questions regarding the information or recommendations contained in this letter, please contact our office.

Sincerely,

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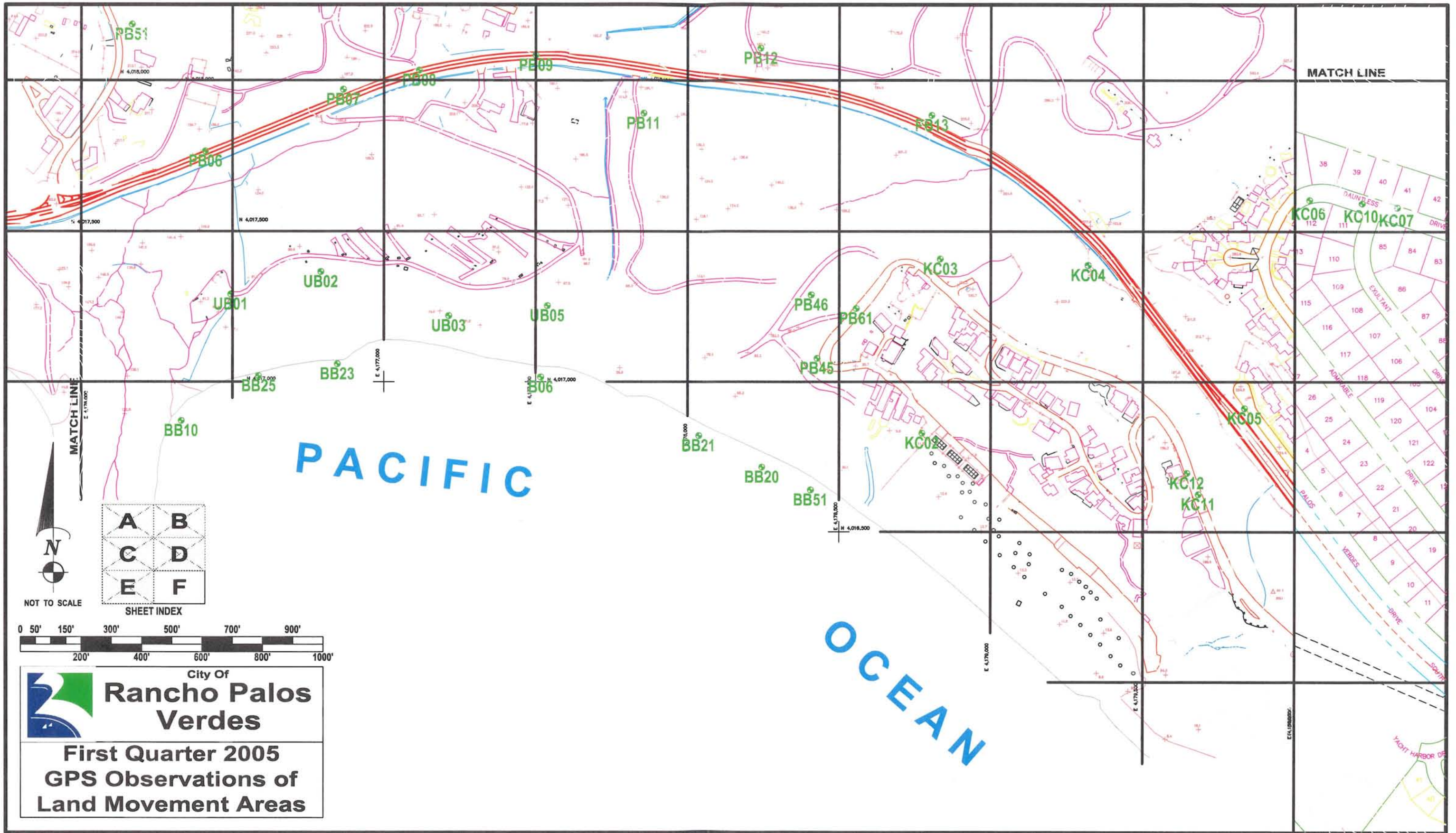
Distribution: (3) Addressee

Enclosures: Sheet F — CAA GPS Observations of Land Movement Areas
Figures 1 through 4 — Cumulative Change in Distance Graphs



City Of
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First Quarter 2005 GPS Observations of Land Movement Areas

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SHEET F

Figure 1

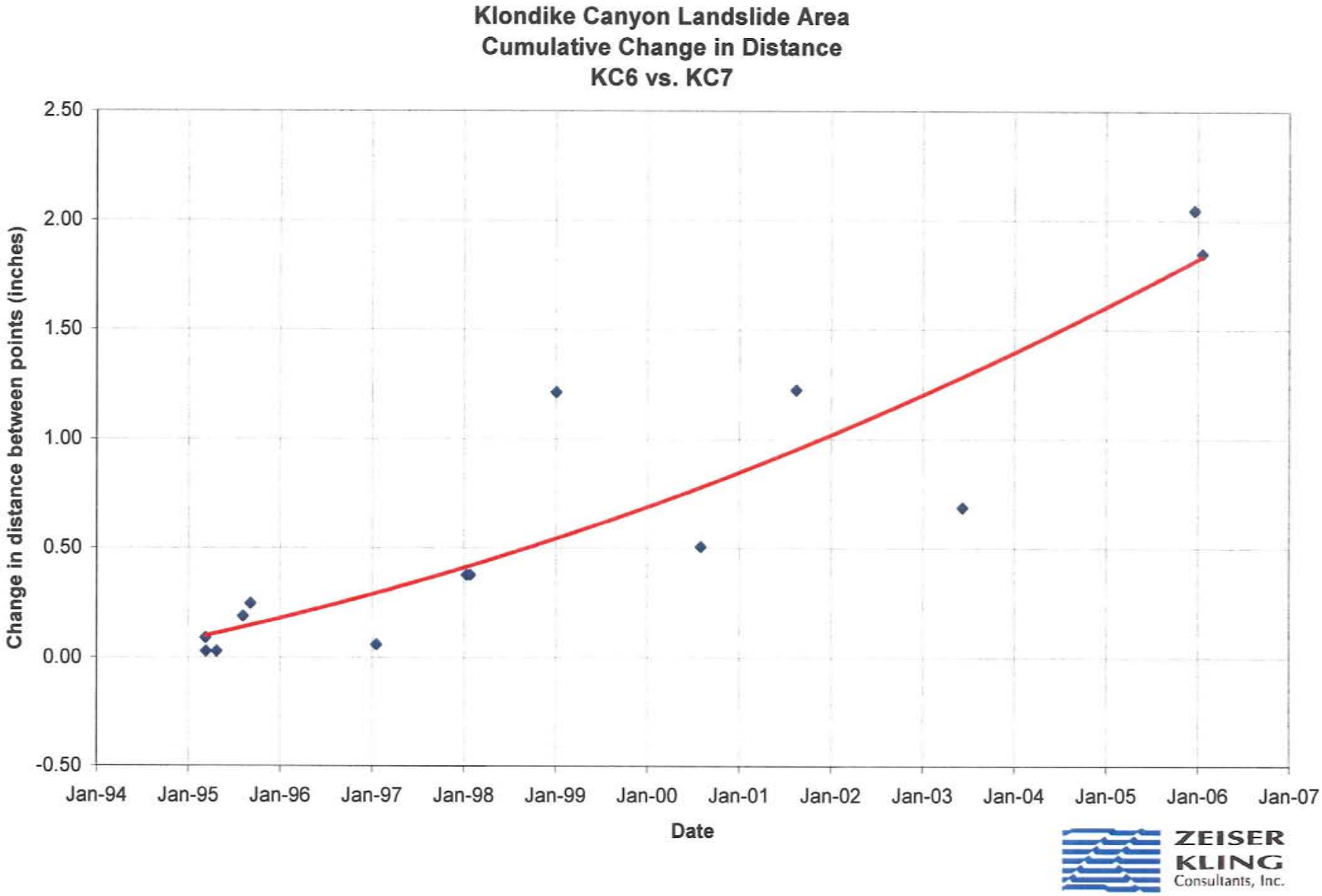
Klondike Canyon Landslide Area
Cumulative Change in Distance
KC6 vs. KC7
Change in distance between points (inches)
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Date
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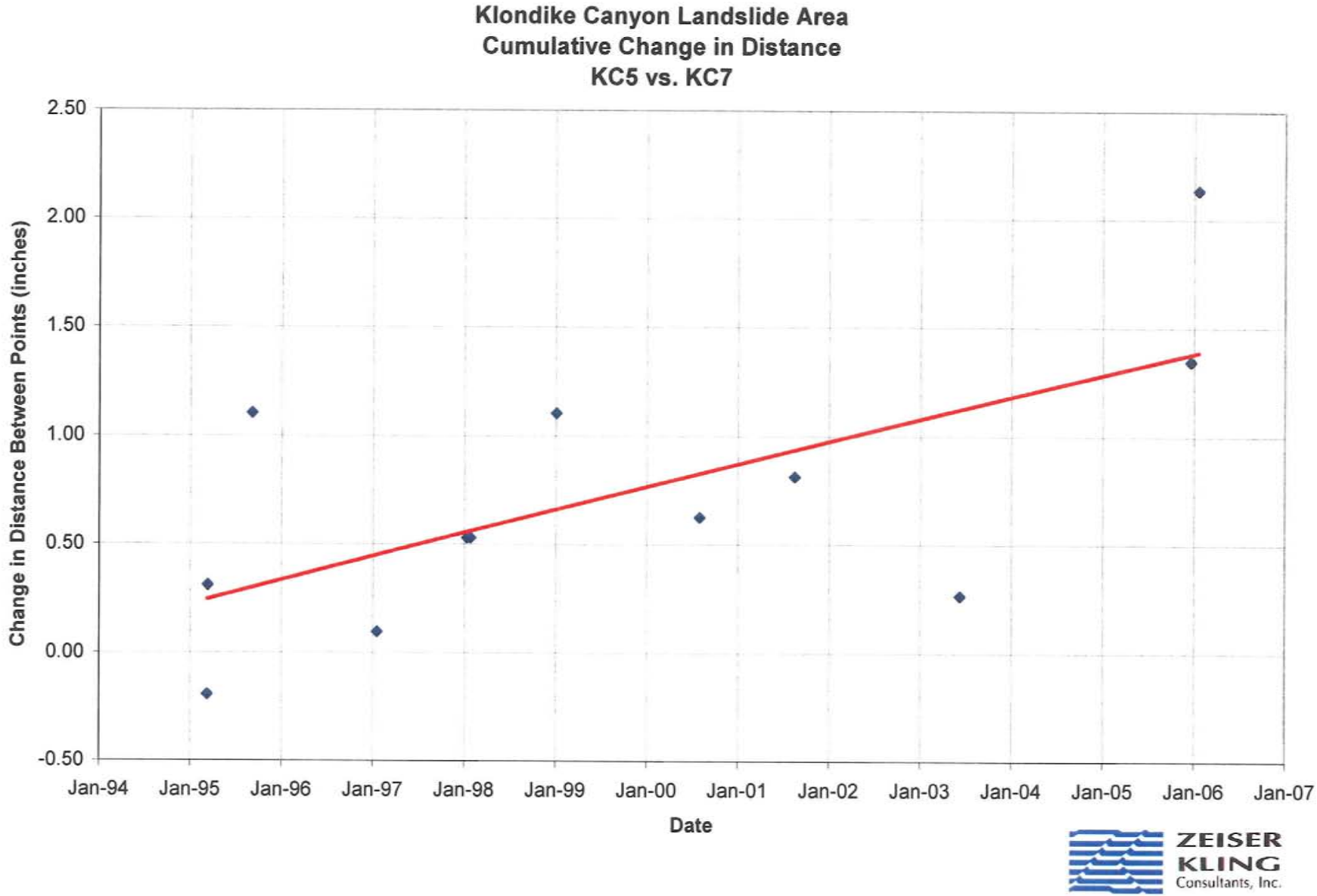
Figure 2


Klondike Canyon Landslide Area
Cumulative Change in Distance
KC5 vs. KC7
Change in Distance Between Points (inches)
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Date
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Klondike Canyon Landslide Area
Cumulative Change in Distance
KC4 vs. KC7

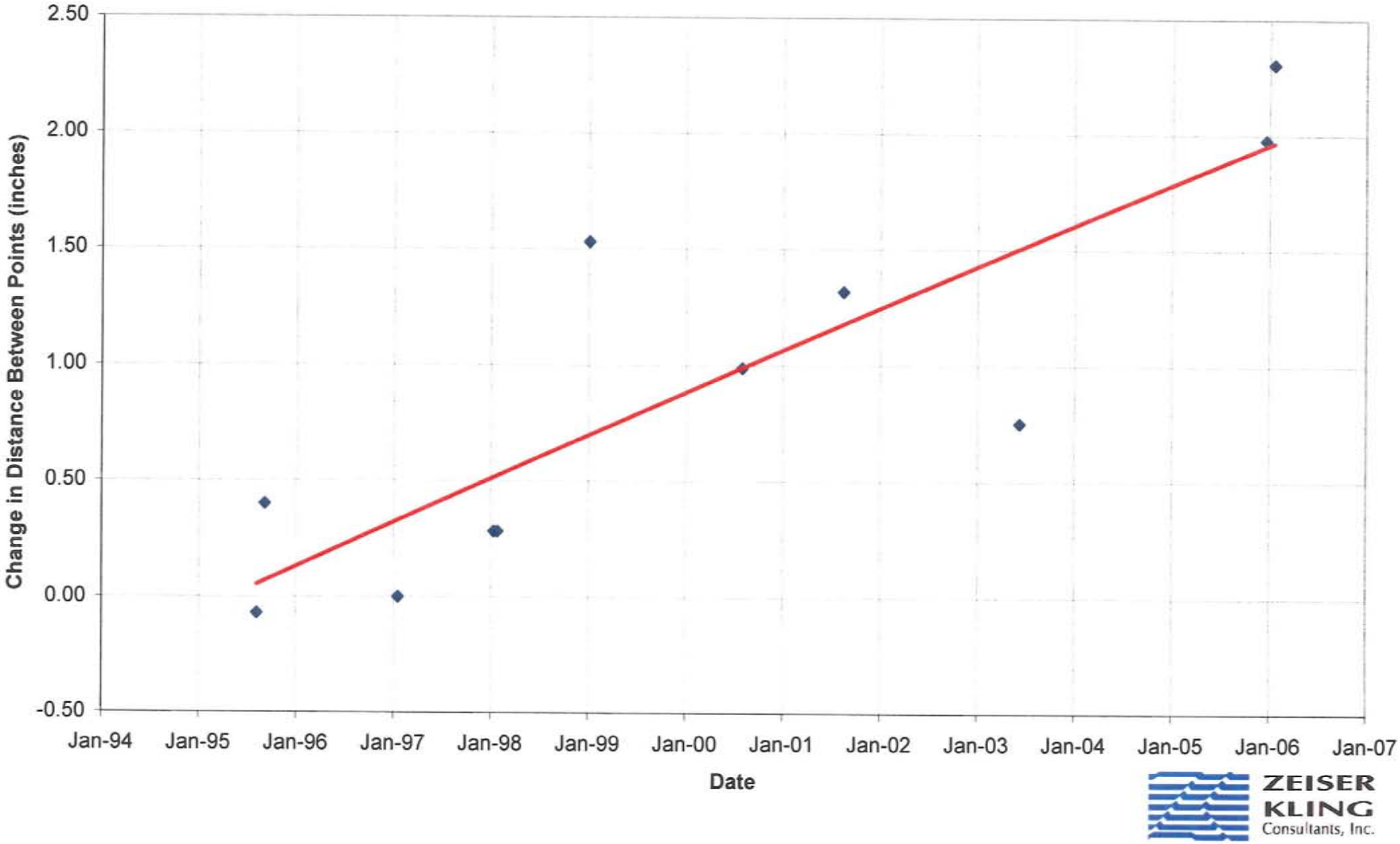

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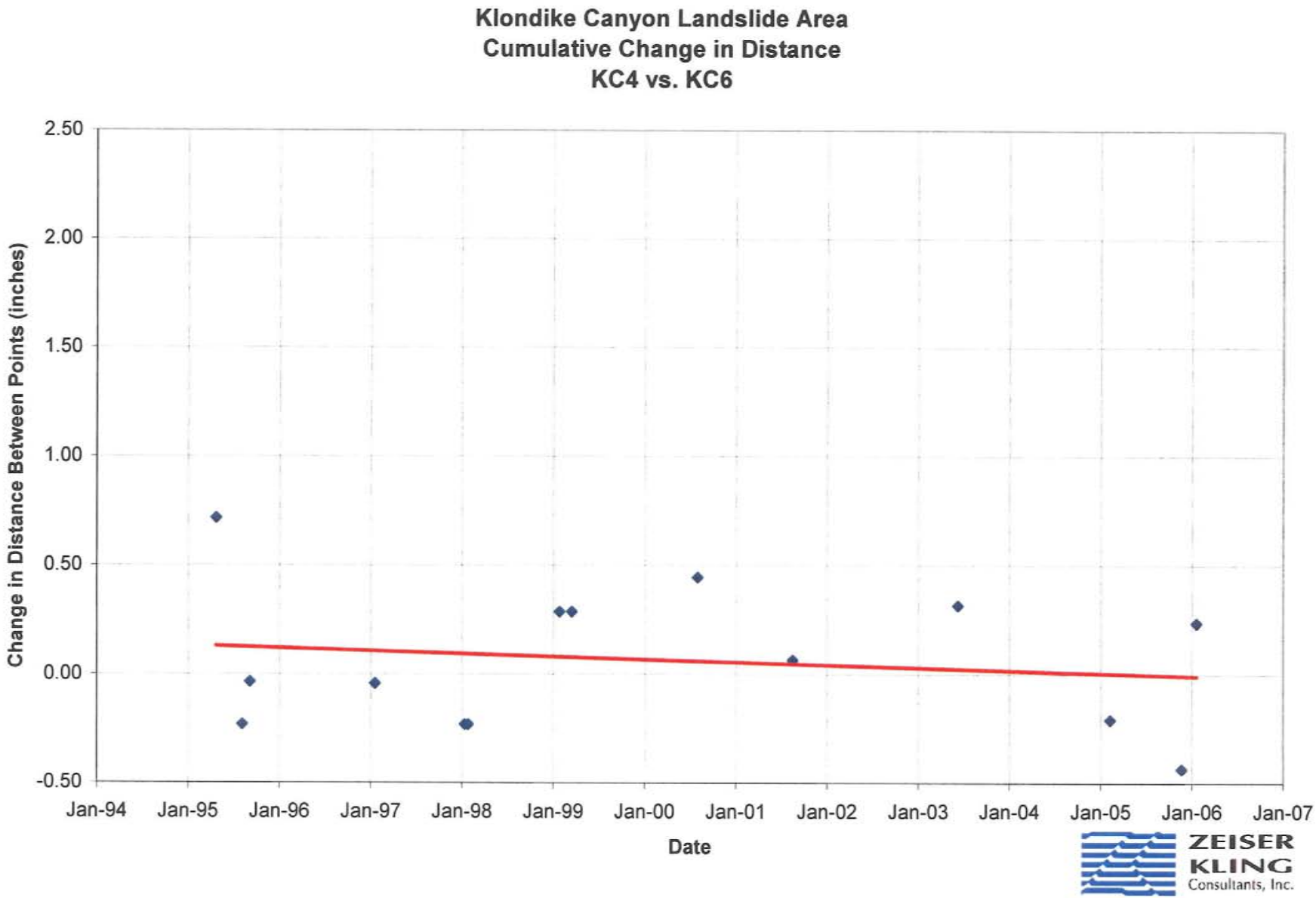
Figure 4


Klondike Canyon Landslide Area
Cumulative Change in Distance
KC4 vs. KC6
Change in Distance Between Points (inches)
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
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