# 3B Lab Exercise: Landslides and Avalanches, Exercise 8, Parts A and B

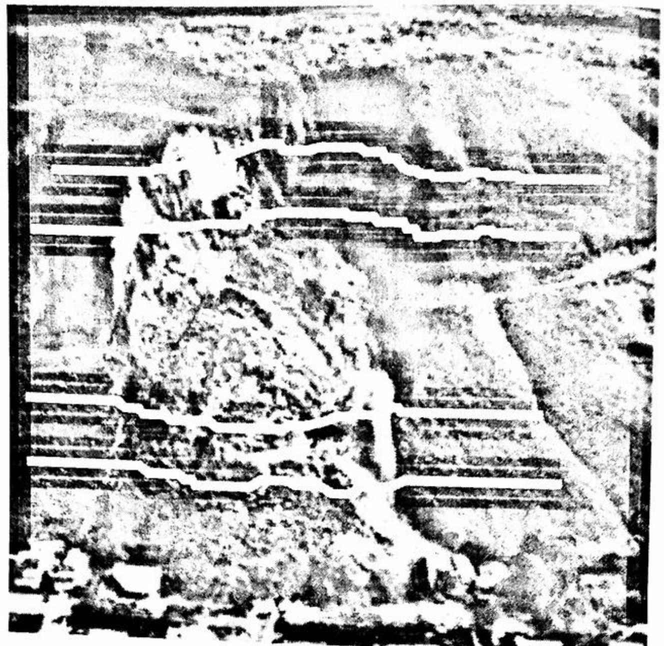


FIGURE 8.4 On an oblique photograph, contours on the upper, scarp, area of a landslide bend into the hill, and contours on the lower, hummocky, area of the landslide bend out from the hill. See Figure 8.3 for the parts of this landslide. Photograph courtesy of http://www.geog.ucsb.edu/~ jeff/projects/la_conchita/1995/95_slideshots.html

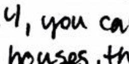
3. Abrupt and irregular changes in slope and drainage pattern
4. Hummocky irregular surfaces
5. Smaller landslide deposits that are commonly younger and form within older and larger landslide deposits (in other words, if an area has slid in the past, it is subject to both small and large renewed slides)
6. Steep, arcuate scarps at the upper edge
7. Irregular soil and vegetation patterns
8. Disturbed vegetation
9. Abundant flat areas

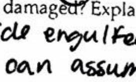
## QUESTIONS (8, PART A)

### La Conchita, California

Figure 8.4 shows a landslide that occurred in 1995 above the small town of La Conchita, California. This landslide reactivated in the wet winter of 2005, with disastrous consequences. Note the shape of contours as they cross the landslide. Figure 8.5 shows a vertical aerial photograph of the same site, and note how contours appear on this photograph.

1. a. Can you recognize the shape of contours that may indicate a landslide? Check with your Teaching instructor before going on to the next question. Yes, they will look like





b. In Figure 8.4 and 8.5, were any homes damaged? Explain.

In 8.4, you can see the slide engulfed some houses, therefore we can assume damage. In 8.5 it is harder to tell, but you can ifer they were damaged.

FIGURE 8.5 Contours that cross landslides, as shown on vertical photos, bend to follow concave part of slope in the upper scarp area of the slide. Contours in the lower part of a landslide will be convex and irregular over hummocky terrain. La Conchita, California, 1995; Same site as in Figure 8.4. Photograph courtesy of Pacific Aerial Surveys, http://www.geog.ucsb.edu/~ jeff/projects/la_conchita/1995/95_slideshots.html

YES because you can see the slide covered some houses.

## Gardiner, Montana

Figure 8.6 is a photograph of the lower part of a landslide complex south of Gardiner, Montana. Direction of view in the photograph is to the south from the townsite. This is an old landslide, but it well illustrates hummocky terrain related to landslide deposition. Refer to Figure 8.7, the aerial photograph, and Figure 8.8, the topographic map.

2. Mark on the aerial photograph (Figure 8.7) the area of the landslide(s). Look for irregular terrain, typified by hummocky topography. Done

3. On the topographic map (Figure 8.8), mark areas of the landslide(s). Particularly look for areas of highly crenulated (folded, angular) contours rather than smooth contours. The 5,400-foot contour south of the town of Gardiner is an example of a crenulated contour. An example of an area with smoother contours is the area northwest of the town of Gardiner. Done

4. What other landslide features identified by Nielson and Brabb (listed above) are present in this landslide complex?
· Changes in slope and drainage patterns

## Green River Gorge, Washington

This gorge, southeast of Seattle, has many landslides along its slopes. They can be hard to identify on aerial photographs and topographic maps due to forest cover. A relatively new technology, LIDAR, is expected to improve identification.

5. Figure 8.9 is a vertical aerial photograph of the Green River Gorge. Mark on this photograph areas that you think, based on topography, may have landslides. What landslide characteristics helped you make your identification?
Hummocky topography and steep scarps

6. Figure 8.10 is a topographic map of the Green River area. Use this map and see if you can find any landslide areas. Are there any areas that have similar topographic contours to those shown in Figures 8.4, 8.5, and 8.8? If so, mark them.

7. LIDAR images can show landslides more clearly than either aerial photographs or topographic maps. LIDAR allows "virtual deforestation," that is computer processing that removes trees and lets the ground surface be mapped. Figure 8.11 is a LIDAR image of the Green River Gorge. Note that Figure 8.11 covers a larger area than Figure 8.9. Mark on this image all the landslides you can find. Do you agree or not that LIDAR allows identification of more landslides than maps or photographs? Oh yes LiDAR does show us much more :) you are able to see the land without vegetation

8. Use a colored pencil, and transfer these landslides back to the topographic map (Figure 8.10) and the aerial photograph (Figure 8.9). How many more landslides could you identify on LIDAR than on the map? The photograph?
I guessed on the photograph, the LIDAR shows much greater details as to the location of flows than the map.

**FIGURE 8.6** Gardiner, MT, landslide(s). View to SSW. (Photograph by © Duncan Foley)

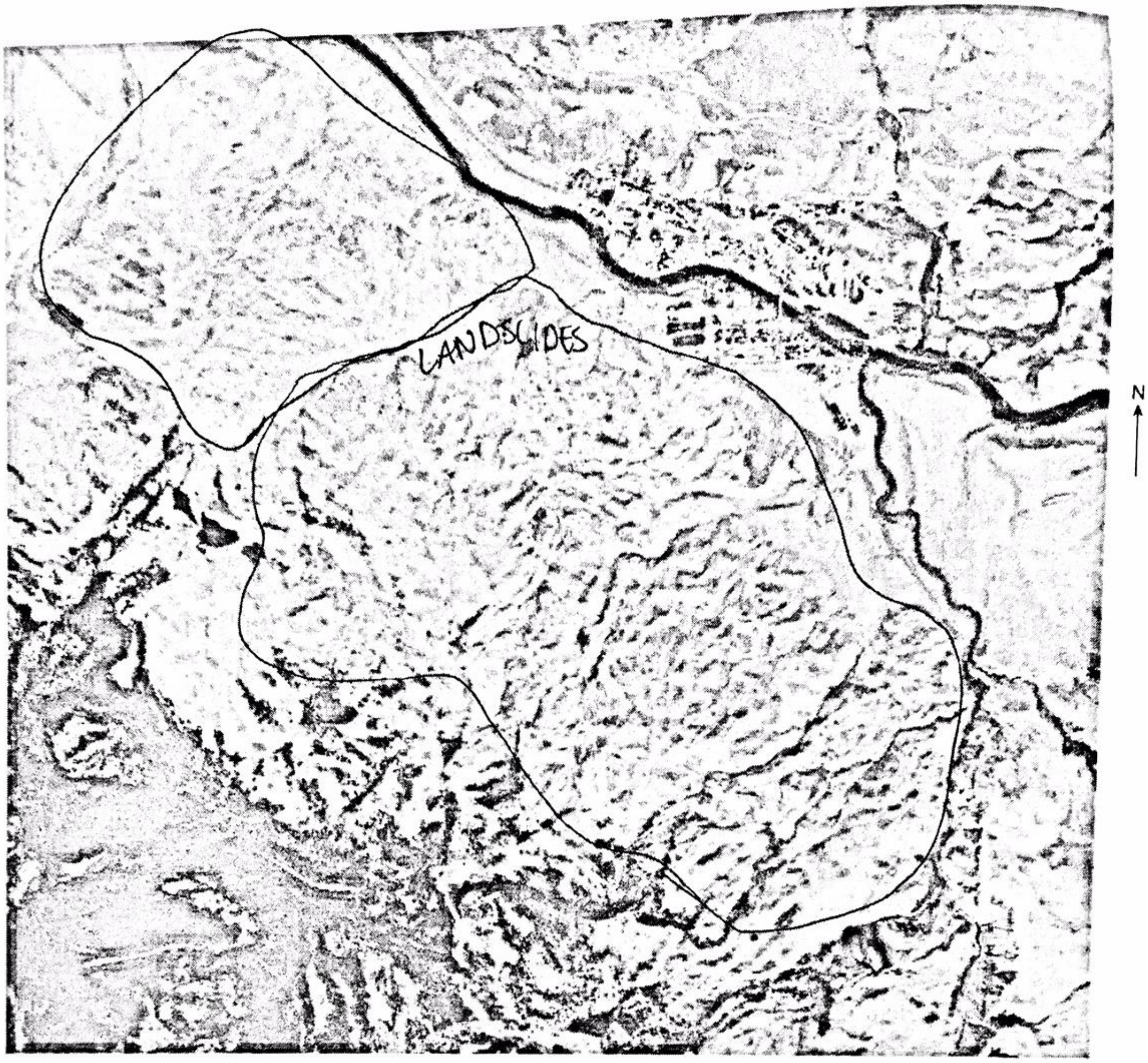



**FIGURE 8.7** Landslides southwest of Gardiner, MT. See Figure 8.8. (USGS Digital Ortho Quarter Quad downloaded August 11, 2008, from http://nris.state.mt.us/nsdi/doq.asp?Srch24=4511016)

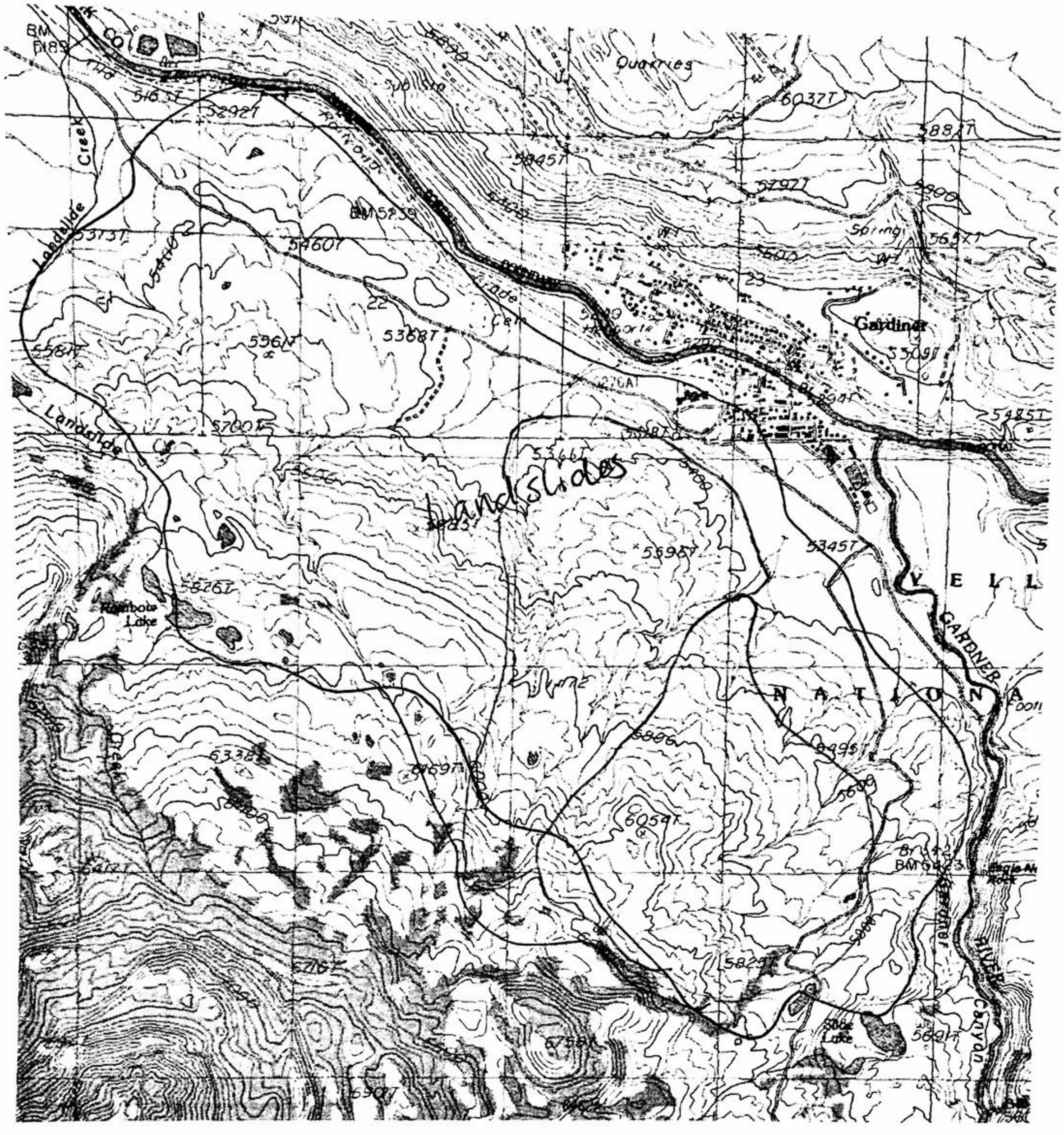



**FIGURE 8.8** Gardiner, MT. Topographic map. Contour Interval = 40 ft. See Figure 8.7.

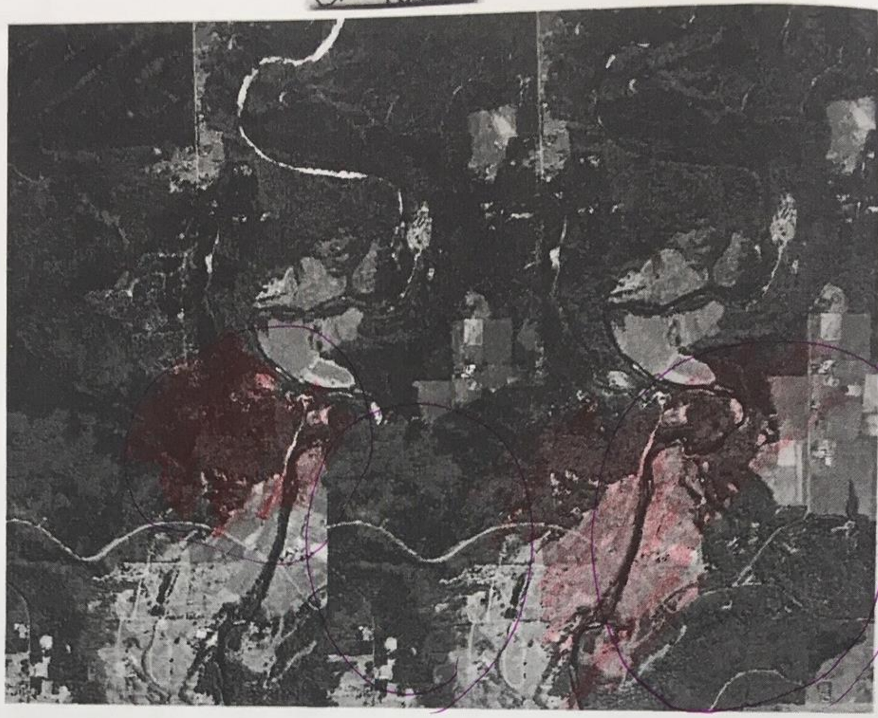


FIGURE 8.9 Stereo aerial photos of Green River Gorge, Washington. Photos courtesy of Washington Department of Transportation.


FIGURE 8.10 Topographic map, Green River Gorge. Contour Interval = 25 ft.

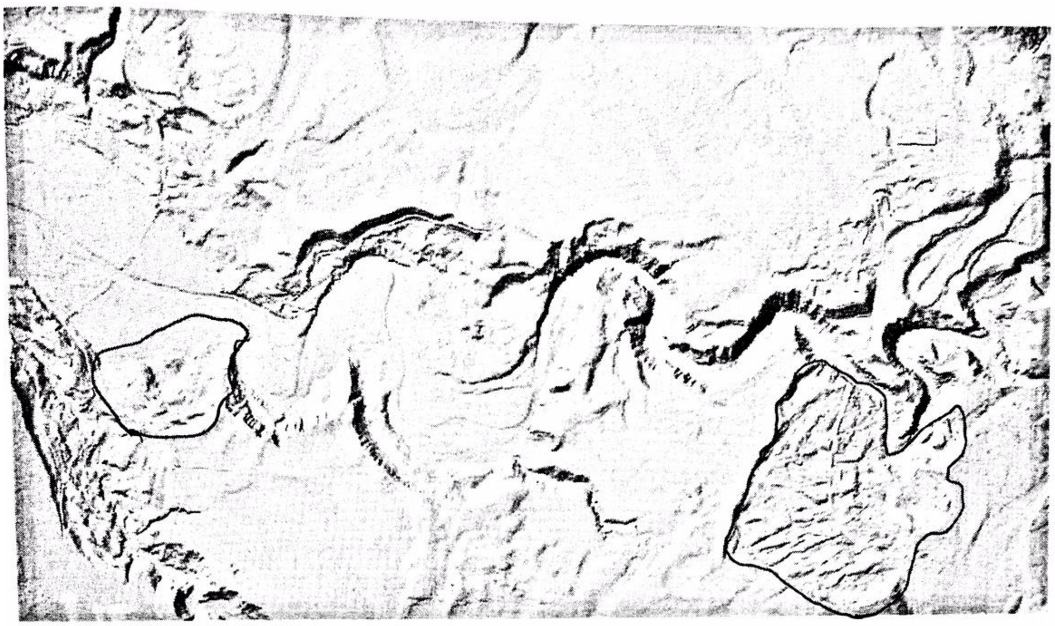


**FIGURE 8.11** Green River Gorge Lidar Image. (Courtesy of King County, Washington, GIS Center)

## PART B. LANDSLIDES IN SAN JOSE, CALIFORNIA

Landslide deposits in the northeastern part of the city of San Jose were first shown on a geologic map done by Crittenden (1951). A subsequent map, based on interpretation of aerial photographs and field investigations, included many additional landslide deposits that are shown as lighter areas with arrows (Figure 8.12, Nilsen and Brabb, 1972). Damage to urban structures within part of the landslide-prone area is shown in Figure 8.14. The landslides, which may be continuously or intermittently moving, or not moving at all, are primarily the result of natural processes. Human activities may alter these processes and even render some areas unstable. In order to determine the stability of a particular site, a landslide deposit map, such as Figure 8.12, would be used in conjunction with other information concerning soils, vegetation, hydrology, and other geologic factors.

In general, fewer of these characteristics will be noted in smaller deposits. Detailed site studies, of course, are required for predicting the behavior of landslide deposits under changing conditions.

### QUESTIONS (8, PART B)

1. Review Part A, carefully examine Figure 8.12, the explanation for this figure, and the topographic map for this area (Figure 8.13 in the map section at the back of the book). Note that two different contour intervals are used on each map.

a. What are these contour intervals?

40 ft ——— 10 ft .....

b. Explain why two different contour intervals were necessary for each map. Because the land includes a mountainous area and some low laying valley

2. Place an X ~~in~~ the area of the largest landslide deposit within the enclosed area in the center of Figure 8.12. What is the approximate area of this slide, in square miles?

3000 ft × 2000 ft = 6000000 ft² · (3.587×10⁻⁸ mi² / 1 ft²) = **.21522 mi²**

3. What materials make up the landslide deposit?

loose, unconsolidated earth & vegetation, angular gravel

4. The density of contour lines changes from the northeast part of the map to the southwest part, indicating a change from steep to gentle slopes and suggesting an increase in potential for landslides. What is the difference in elevation between A and B?

440 ft − 280 ft = **160 ft**

5. What is the distance from A to B in miles?

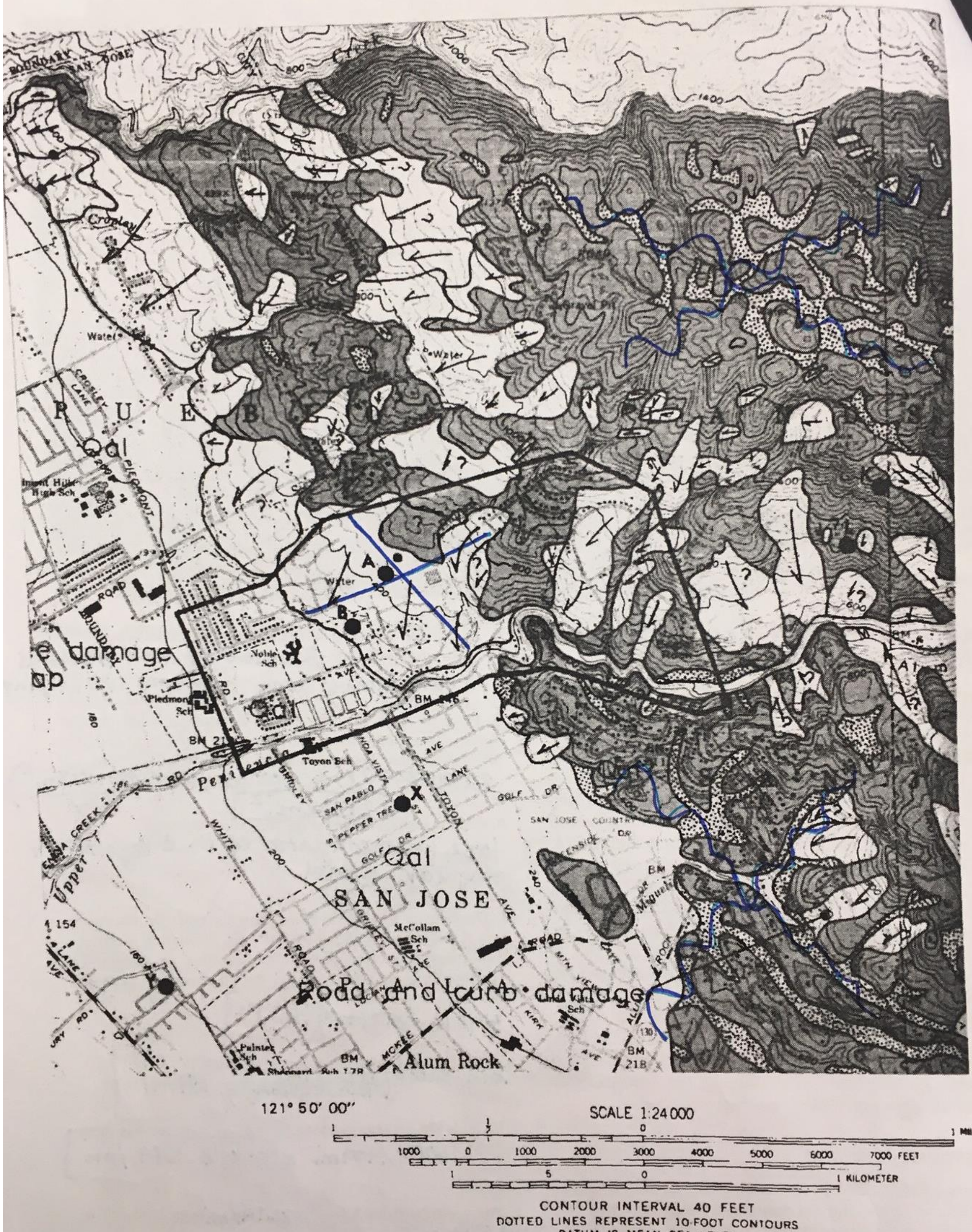
.5 in · 24000 (1 ft / 12 in)(1 mi / 5280 ft) = **.189 mi**

6. What is the average gradient (slope), in feet per mile, from A to B? 160 ft / .189 mi = **846.6 ft/mi**

7. The gradient from X to Y is 82.1 ft/mi and, from K to L it is 2413.7 ft/m.

(230 − 160 ft) / (2.25 in · 24000 (1 ft / 12 in)(1 mi / 5280 ft)) = ~~78~~ **82.1 ft/mi**

(600 − 200 ft) / (.4375 in · 24000 (1 ft / 12 in)(1 mi / 5280 ft)) = **2413.7 ft/mi**


Qal
damage
Road and curb damage
SAN JOSE
Alum Rock
A
B
X
121° 50' 00"
SCALE 1:24 000
CONTOUR INTERVAL 40 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

8. According to gradient, is the potential for landslide greater at X or K? Explain. The potential for landslide is greater at K because landscapes are more likely the steeper the slope is. (45%)

9. What is the material labeled "Qal" on the map? (Q is an abbreviation for Quaternary, a geologic period.)
They are alluvial deposits

10. What are the two ways in which Qal is formed (see description)? By slowly sloping alluvial fans and by flood plain deposits.

11. Locate the deposit Qaf. What is it?
an artifical fill from quarries

These deposits are becoming more common as humans continue to alter the landscape. Some geologists use the term anthropogenous deposits for these materials.

12. Review the drawing of the mudflow in Figure 8.2. Observe the topography shown on Figure 8.12, and mark with "X" as two areas that might be subject to mudflows. Explain your decisions. (Hint: See Colluvial deposits on the explanation for Figure 8.12.)

a. high in the hills, steep slopes

b. near rivenes

13. a. How far (in feet) is Noble School from a landslide deposit or an area of damage from landslides (refer to Figures 8.12 and 8.14). $.3 in \cdot 24000 \left(\frac{1 ft}{12 in}\right) = 600 ft$

b. Are any schools on or closer to mapped landslides?
No, but there are some farther away

14. Would you expect a landslide to develop under Noble School? Explain. There is potential because NS is on an alluvial deposit which can destabelize w/ motion & water

15. Note that a road in the subdivision had to be abandoned. What road was extended to accommodate the traffic?
~~Looks like Ave Ln. and Golf~~
Sun Crest Drive

16. In what subdivision are the badly damaged and abandoned houses? The San Jose Highlands

17. Would you purchase a house on the north side of Boulder Drive, east of Sophist Drive (see Figures 8.12 and 8.14)? Explain. No, because these houses are higher in the hills that are prone to mass wasting events

18. Why have the utility lines been placed above ground on the west side of Boulder Drive?
Because of potential damage from landslides and cuts down repair time

19. Money and resources are still being used to make this landslide region habitable. What short-term and long-term solutions to the community's problems might be appropriate?
→ Insert water sprouts
→ support beams & walls
→ reduce landscaping
→ don't construct new roads

20. On Figure 8.15 (1963), outline three major landslides. ✓

Hint: Use the maps (Figures 8.12 and 8.14) showing areas of movement or damage for clues.

21. Are there landslides on Figure 8.16 (1993) that did not appear on the 1963 stereopair? If so outline them. ✓

22. Mark two areas of additional houses and one other cultural feature that appear in the 1993 photo that are not on the 1963 photo. ✓

23. Using a colored pencil draw the contact between the base of the mountain and the alluvial fan on which San Jose is built. What is the approximate elevation of this line (compare with the map, Figure 8.13 in the back of the manual or Figure 8.12)? ✓
≈ 400 Ft

24. a. What advice would you give to those seeking a building site in the mountain area?
Avoid because there is a great risk for mass wasting

b. As a consulting geologist, what advice would you give to the local zoning commission in this area?
Please stop letting ~~this~~ people live & build here in order to reduce hazard risk

## PART C. LANDSLIDES IN ATHENS, OHIO

Landslides in Athens, Ohio, are representative of those throughout much of the Appalachian Plateau Physiographic Province. They include many of the types of mass wasting listed in the Introduction to Exercise 8. The most common types in Athens and southeastern Ohio are slump-earthflow, rock falls, and rockslides. Recognition of geomorphic features of landslide deposits (see Part A) is important if we are to avoid potentially hazardous sites and understand the processes of change in the landscape. In this exercise we investigate, using a series of photographs, the changes in an apartment complex constructed in the 1960s adjacent to the Hocking River near Ohio University. Study the indicated aerial photographs and maps and Table 8.2 to answer the questions.

**FIGURE 8.15** Stereopairs for northeastern San Jose, California, in 1963.

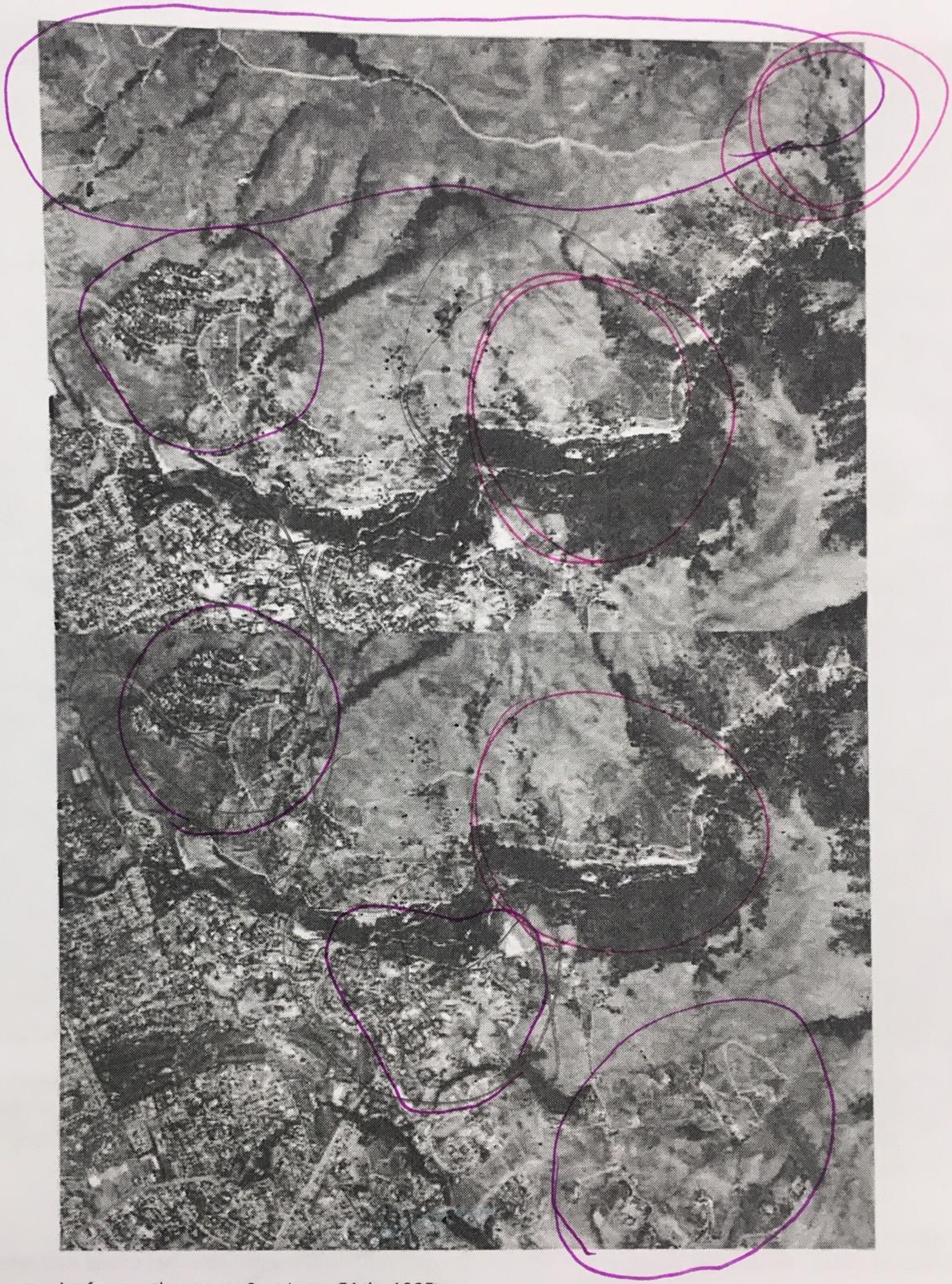


**FIGURE 8.16** Stereopairs for northeastern San Jose, CA in 1993.