Name________________________________

ENVI.2030L – Topographic Maps and Profiles

I. Introduction

A map is a miniature representation of a portion of the earth's surface as it appears from above. The environmental scientist uses maps as a base for plotting observations made at the surface. These observations are subsequently used to interpret conditions in the area. Maps can also be used directly to extract a variety of information without making actual observations in the field. The basic principles developed in today's exercise can be applied to all types of maps ranging from the topographic maps used by geographers, geologists, environmental scientists, hikers, etc. to upper level isobaric maps used in meteorology.

Topographic maps show the elevation of landforms and their shapes using contour lines. In effect these types of maps are a two-dimensional representation of a three-dimensional surface. Topographic profiles show the configuration of the surface along a vertical cross-section of the earth's crust.

II. Features of topographic maps

Some of the basic features of topographic maps are summarized in this section. The most common type of topographic map used in the United States is the U.S. Geological Survey topographic maps. All countries produce topographic maps. Which agency publishes the map is a function of the country of origin.

1. Most topographic maps are named on the basis of a geographic feature. For example the local U.S.G.S. quadrangle map is called the "Lowell quadrangle".

2. Unless otherwise stated, the top of the map is north. This is even the case in the Southern Hemisphere.

3. In most cases, true (or geographic) north and magnetic north are not the same. This variation is called the magnetic declination.

4. Horizontal distances are generally indicated in one of three ways:

   a. Graphic or bar scale - a line which is measured off into equal sections, each of which represents a unit of distance. This type of scale is the most reliable since it remains in true proportion to the map if it is enlarged or reduced.

   b. Representative fraction - a mathematical fraction showing the proportion between the distance on the map and in the field. 1110 would mean that one unit of measurement on the map is equal to ten of the same units in the field. The map is 1110 the actual size of the area.

   c. Written - for example, one inch equals one mile.

5. Elevation and relief - without some system of showing variations above sea level the map does not represent the land surface, just directions and distances.

   a. All elevations are measured from mean sea level. In the US elevation is measured in feet. In most of the rest of the world elevation is measured in meters.

   b. Relief is the difference in elevation between two places on the map.

   c. A contour line is a line all parts of which are at a given elevation above sea level. It represents the intersection of a horizontal plane with the earth's surface. Mean sea level is the zero contour. All contour lines will close if carried far enough. Contour lines cannot cross except in the case of an overhanging cliff. The closer together the contours the steeper is the slope. Absolutely flat country would have no contours.

   d. Contour interval - the difference in elevation between two adjacent contour lines. The contour interval is indicated on the bottom of the map and will vary with the scale used and the character of the land surface.

6. Methods used to locate points in a map:

   a. Reference to some outstanding feature

   b. Reference to position as compared to two or more landmarks

   c. Latitude and longitude

   d. Township and range

III. The nature of maps

1. What is the name of your map?

2. Define the boundaries, in terms of latitude and longitude, of the map assigned by your instructor.

3. What are the dimensions of the area shown on the map and what is the area of the map in square miles?

4. Why is the map not exactly the same width at the top as at the bottom?

5. What is the magnetic declination (amount and direction) for the area shown on the map.

6. What are the locations (latitude and longitude) and elevations of the highest and lowest points in the quadrangle.

IV. Contour lines

1. With reference to the map shown in Figure 1, what are the elevations of the contour lines labeled X, Y, and Z.

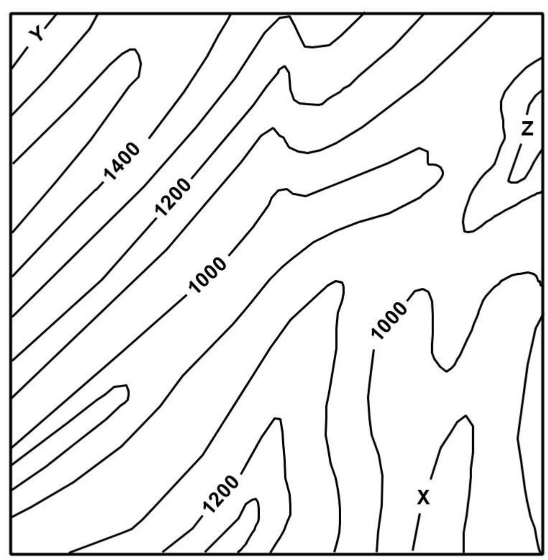

Figure 1. Generalized topographic map. Elevations are in feet.

2. With reference to the map shown in Figure 2, which is steeper - the west slope of the valley or the east slope? Explain how you can tell this at one glance.

3. With reference to Figure 2, what is the elevation of the contour line labeled L.

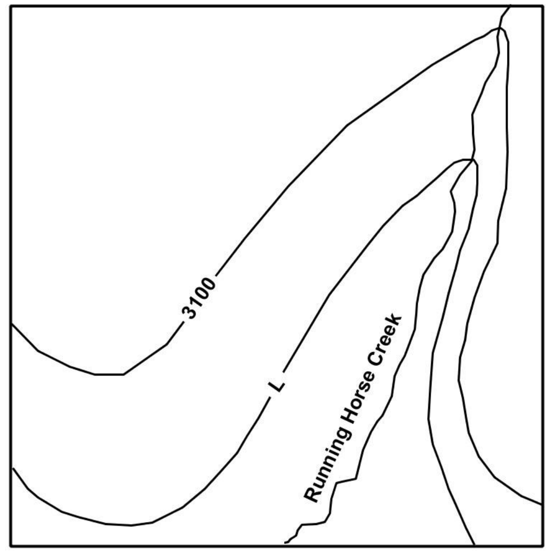

Figure 2. Schematic topographic map of a stream valley. The contour interval is 50 feet.

4. With reference to Figure 2, the northwestern part of the map area is pock-marked by small depressions averaging 10 to 15 feet deep. Why do these not show up on the map and how could one show them by means of contours?

5. The map in Figure 3 shows an east-west trending ridge. In what respect is the pattern of contour lines shown on the map most improbable? Why? Correct the map in pencil to make it look more likely.

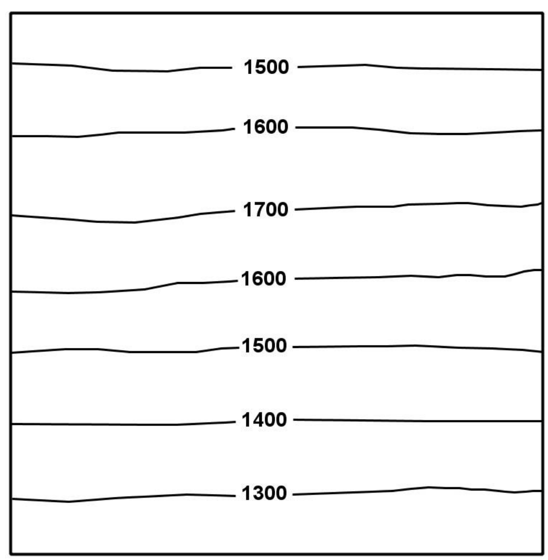

Figure 3. Generalized topographic map of an east-west trending ridge.

V. Construction of a topographic map

The altitudes of points shown on the map in Figure 4 were determined by survey. Draw contour lines through these points to make a topographic map. Use a contour interval of 20 feet; that is draw contour lines for elevations of 500, 520, 540 ... ft. Label the elevation of each contour line and draw heavy lines for the hundred foot contours (500, 600, 700, etc.). Assume that the land slopes uniformly between any two adjacent points of different altitude. Thus on your map the 600-foot contour should pass halfway between points that lie at elevations of 610 and 590 feet. Interpolate by eye. When a contour line crosses a stream the contour line is deflected up stream.

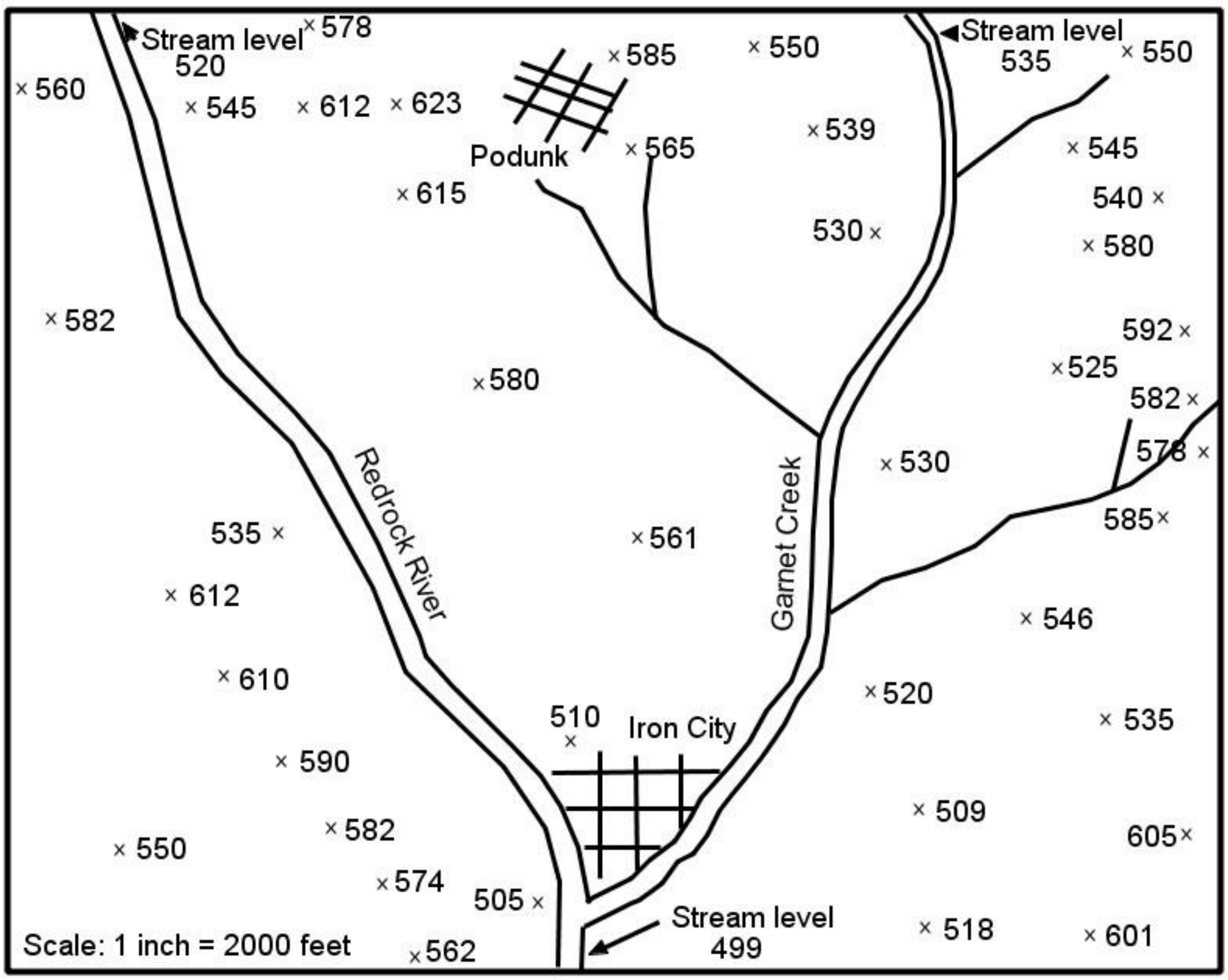

Figure 4. Altitude data in feet. Use these data to construct a topographic map of the area around Iron City and Podunk.

VI. Construction of a topographic profile

A topographic profile shows the intersection of the land surface with a vertical plane. Such views of the land surface can be seen in road-cuts, quarries and vertical canyon walls. A profile can be constructed from a topographic map along any desired line.

A profile might also be thought of as a graph of surface elevation plotted against distance along the profile line. To avoid distortion profiles are preferably drawn to equal horizontal and vertical scales. However, it is often necessary to exaggerate (increase) the vertical scale to emphasize the topographic details in areas of low relief. Vertical exaggeration is the ratio of the horizontal scale to the vertical scale. For example if the horizontal scale is 1" = 1000 and the vertical scale is 1" = 100 , the vertical exaggeration is 10.

Figure 5 shows a simple contour map. Draw a profile along the line A - A'. The profile can be constructed on the graph directly below the contour map. Make two profiles: one with a vertical exaggeration of 1 and the other with a vertical exaggeration of 10. Project the points of intersection of the profile line with the contour lines directly onto the graph below making a mark at the appropriate elevation. Connect these marks and you will have a profile of the topography along the line A - A'.

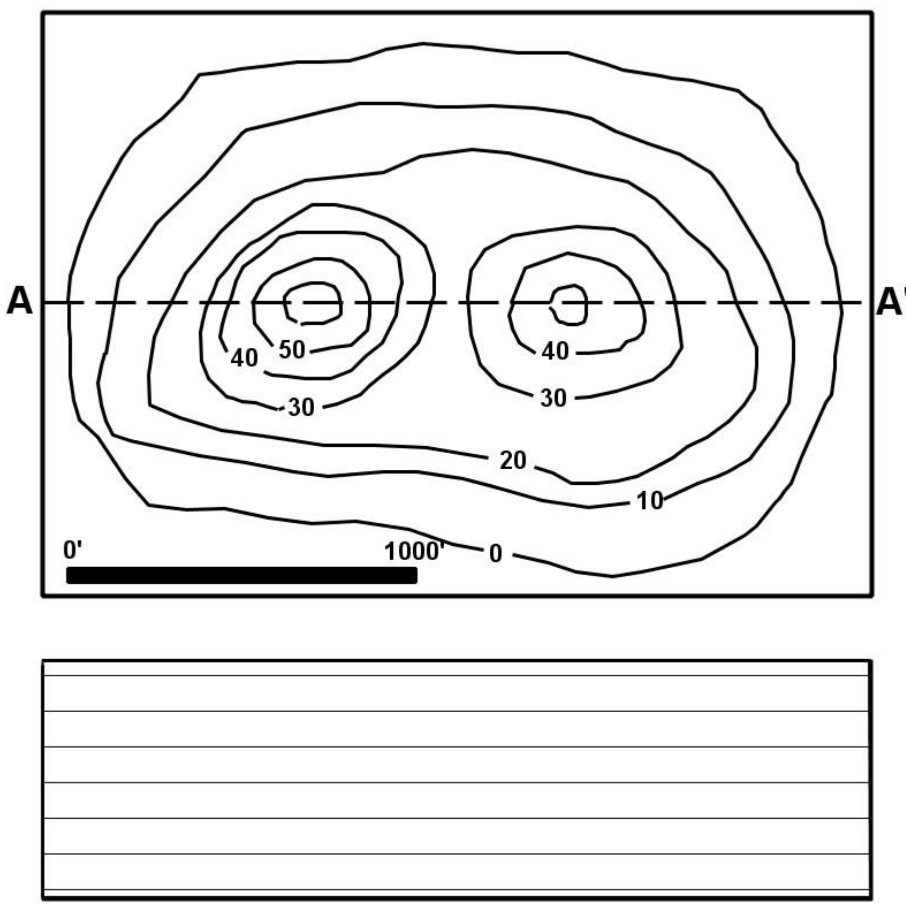

Figure 5. Profile exercise. Contour lines are labeled in feet. The bar on the map represents 1000 horizontal feet.