Name____________________

Physical Geography

Lab Activity #06

Due date___________

Coordinate Systems & Land Division

COR Objective 1, SLO 1,3

6.1. Introduction

Latitude and longitude are great for sailing around the world, but can be difficult for using large scale maps. Fortunately for us, we have other ways of dividing up the landscape and finding location. A Cartesian coordinate system is one that is rectangular in nature and is mathematically placed upon a map. We will learn more about this below with the UTM coordinate system. The second half of the lab will focus on land division, when instead of finding a specific point on a map, we want to find a specific area, which is what the Public Land Survey System is used for.

6.2. UTM

Universal Transverse Mercator (UTM) is comprised of both a specific map projection and a type of grid coordinate system. The projection takes a cylindrical projection surface and orients it in a transverse manner, meaning the line of tangency runs north-south along the globe (Figure 6.1; also see Lab Activity #05 for more explanation).

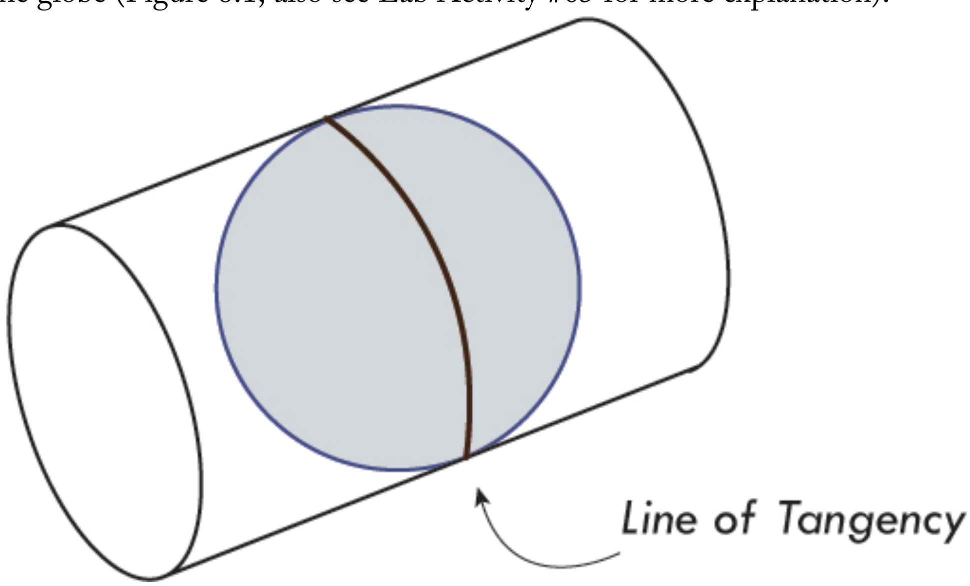


Figure 6.1.Transverse orientation of projection surface.

UTM was designed to be a global coordinate system that could be used on large scale maps. This is achieved by using 60 separate projections to create 60 separate zones that ensure better accuracy for specific parts of the globe. The line of tangency for each zone runs directly through the center of each zone, meaning that each zone maintains minimal distortion, but only within itself. Using UTM Zone 11 coordinates for a place that falls within Zone 20 would have horrible distortion, but using Zone 20 coordinates would make for an extremely accurate map. Figure 6.2 shows the UTM zones that the United States falls under.

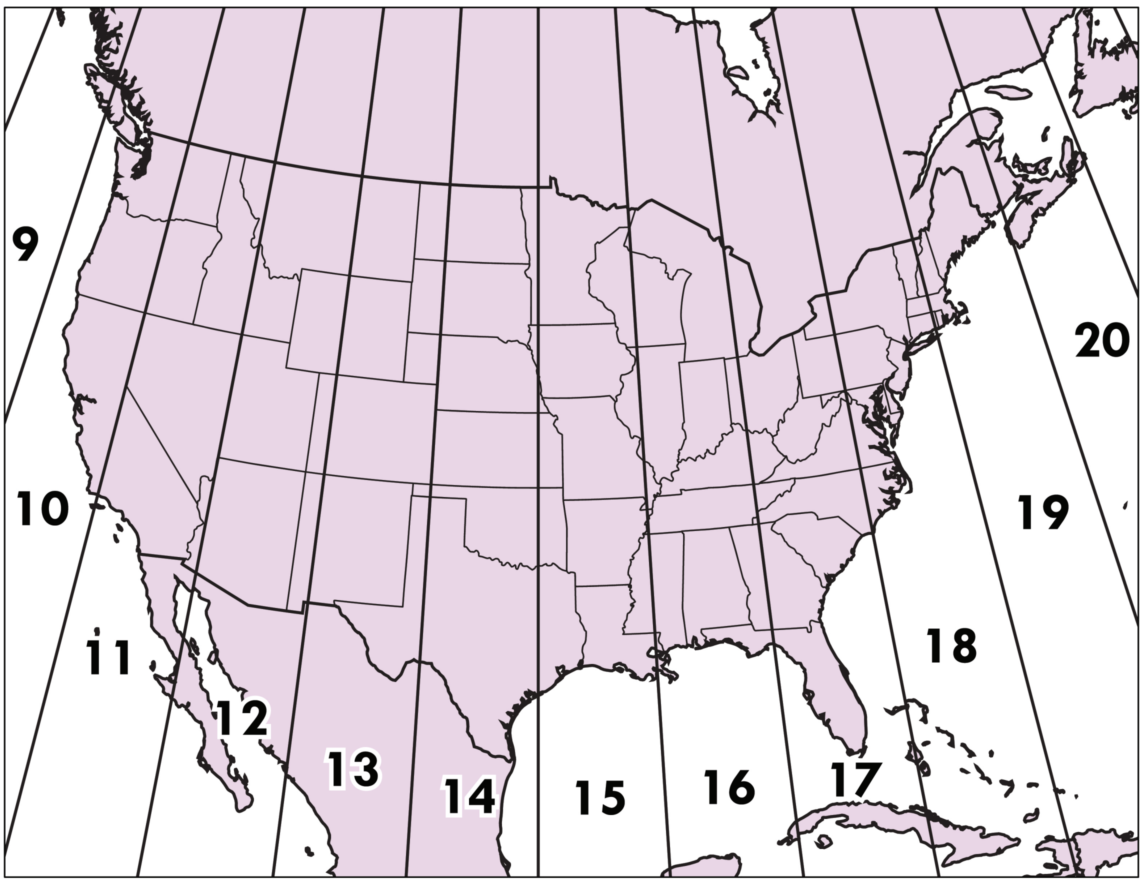


Figure 6.2. UTM zones for the United States

1. How many zones cover California and which ones are they?

2. Which zone would you use in Lancaster, California?

Just as latitude and longitude give us a precise location, UTM uses an easting value and a northing value. The easting is the x coordinate in this Cartesian grid and the northing is the y coordinate. Simply put, the easting is how many meters east of the origin point of each zone your location is, and the northing is the number of meters north. In UTM, you always write the easting value first, then the northing. A phrase used to remember this is "over, then up."

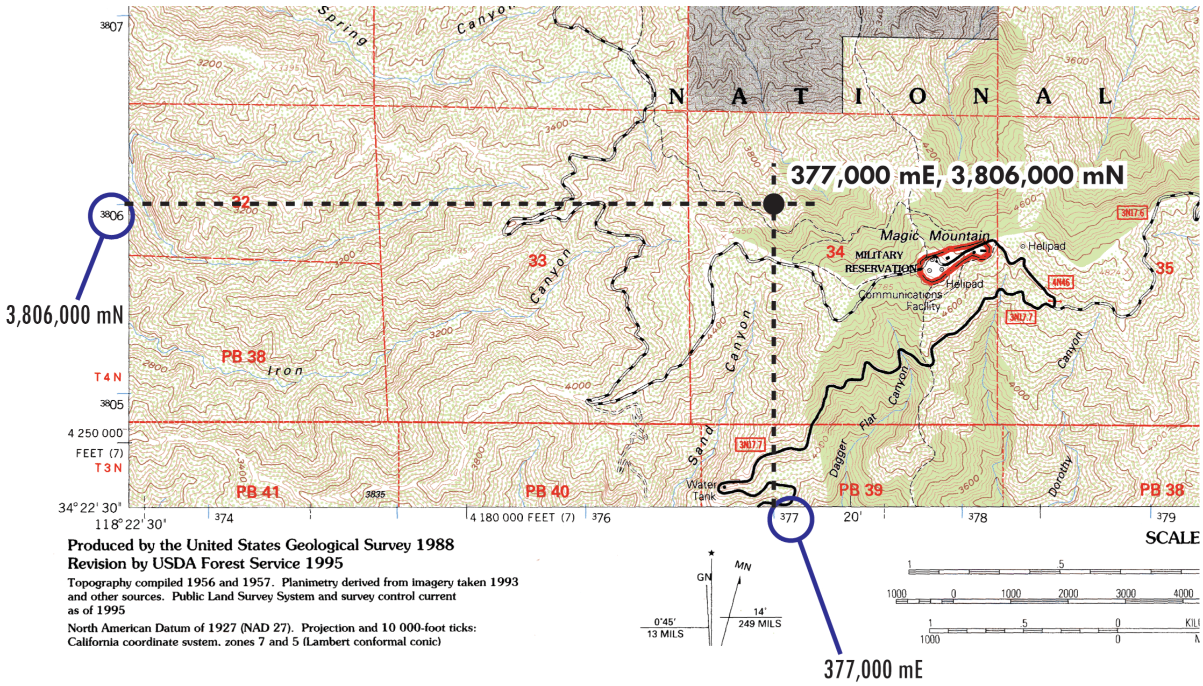


Figure 6.3. South East corner of Agua Dulce topographic map (courtesy USGS).

Figure 6.3 shows a section of the Agua Dulce topographic map. On all of the US Geological Survey (USGS) maps, UTM coordinates are noted with blue tic marks and specially formatted numbers. The easting values run along the bottom of the map and running from west to east are listed as $^{3}74$, $^{3}76$, $^{3}77$, $^{3}78$, and $^{3}79$. For each of these values, you should add three zeroes to the end. For example, $^{3}77$ actually means 377,000 meters east (or mE). On the y axis, 3806 actually means 3,806,000 meters north (or mN). Because this map is located in Los Angeles County, the coordinates are based in UTM zone 11.

The fact that UTM uses meters makes it very easy to measure on a map. With little effort you can locate accurate points using this system.

Use Figure 6.4 to answer the following questions.

3. What is located at 243,632 mE, 4,315,218mN?

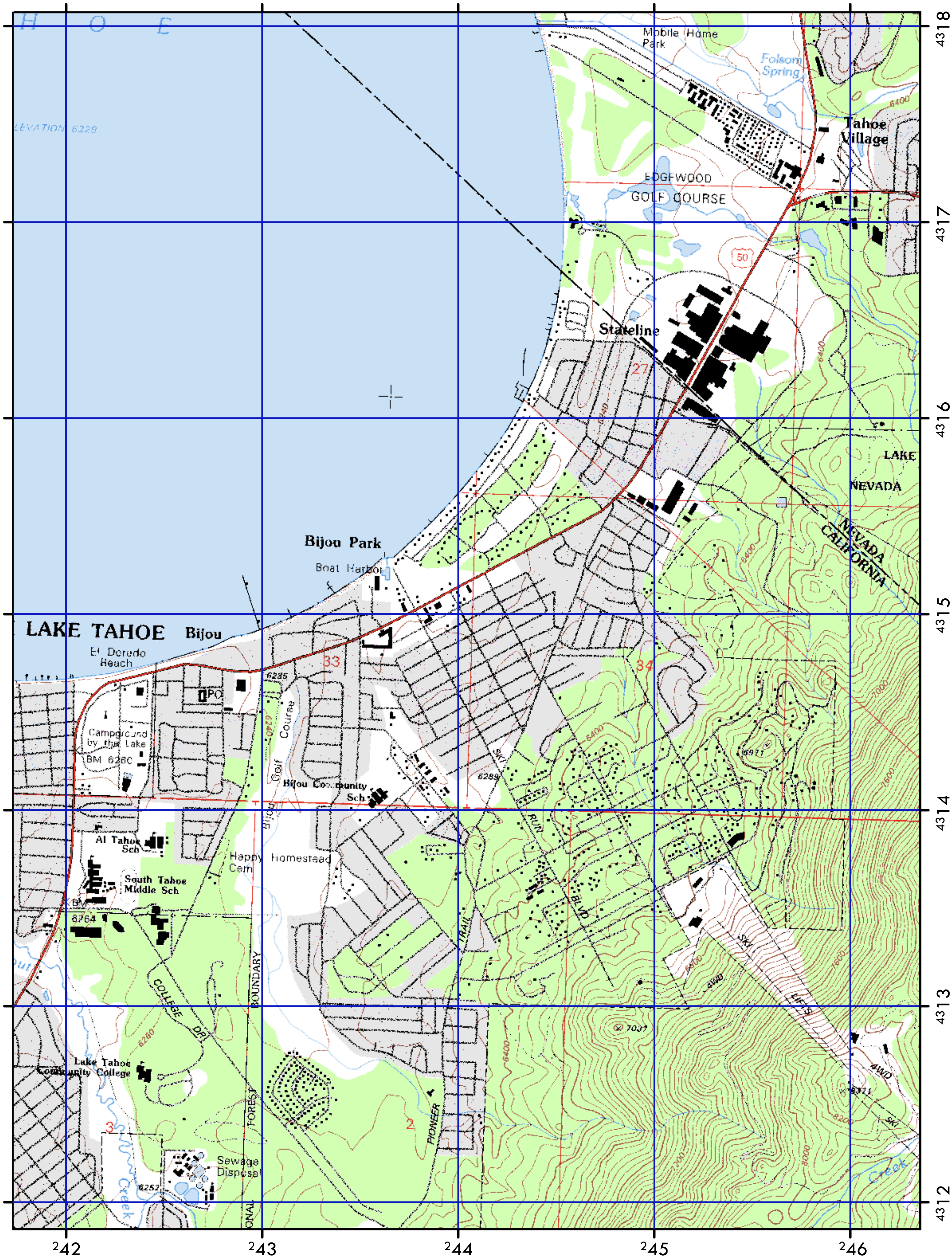
4. What is located at 243,580mE, 4,314,061mN?

5. What are the UTM coordinates (to the nearest 10 meters) for Lake Tahoe Community College? *Be sure to format properly.*

6. What are the UTM coordinates (to the nearest 10 meters) for El Dorado Beach?

7. What are the UTM coordinates (to the nearest 10 meters) for the summit of Heavenly Ski Resort (at the top of the ski lifts)?

8. What are the UTM coordinates (to the nearest 10 meters) for the California/Nevada state border at Hwy 50?


LAKE TAHOE
ELEVATION 6229
Mobile Home Park
Folsom Spring
Tahoe Village
EDGEWOOD GOLF COURSE
50
Stateline
27
LAKE
NEVADA
NEVADA CALIFORNIA
Bijou Park
Boat Harbor
Bijou
El Dorado Beach
33
34
6235
PO
Campground by the Lake
BM 6260
Golf Course
Bijou Community Sch
6289
SKI RUN BLVD
6971
Al Tahoe Sch
Happy Homestead Cem
South Tahoe Middle Sch
BM 6264
TRAIL
SKI LIFTS
4WD
COLLEGE DR
FOREST BOUNDARY
7037
Lake Tahoe Community College
3
2
PIONEER
6252
Sewage Disposal
Creek
8371
242
243
244
245
246
4318
4317
4316
4315
4314
4313
4312

6.3. PLSS

The United States found itself with a wealth of land when it formed over 200 years ago and had to figure out a way to keep track of it. Luckily, Thomas Jefferson loved a challenge and developed a rational way to divide the landscape and create real estate for westward moving Americans. It is called the Public Land Survey System (PLSS) or sometimes Township and Range. The thing to remember with the PLSS is that it was developed to locate a specific *area* rather than a specific *point*.

6.4. Origin Points

States that use the PLSS have one or more base lines and principal meridians to start the system. The base line runs in an east-west fashion much like a line of latitude. The principal meridian runs north-south. In California we have three separate base lines and principal meridians (figure 6.5). Land in Los Angeles County is divided using the San Bernardino Base Line and Meridian.

From the intersection of a base line and principal meridian land is divided into perfect squares called *Townships*. Each township measures six miles by six miles. We identify townships by their position in the grid, giving them both a "township" coordinate and a "range" coordinate. *To find the PLSS coordinates for a township do the following:*

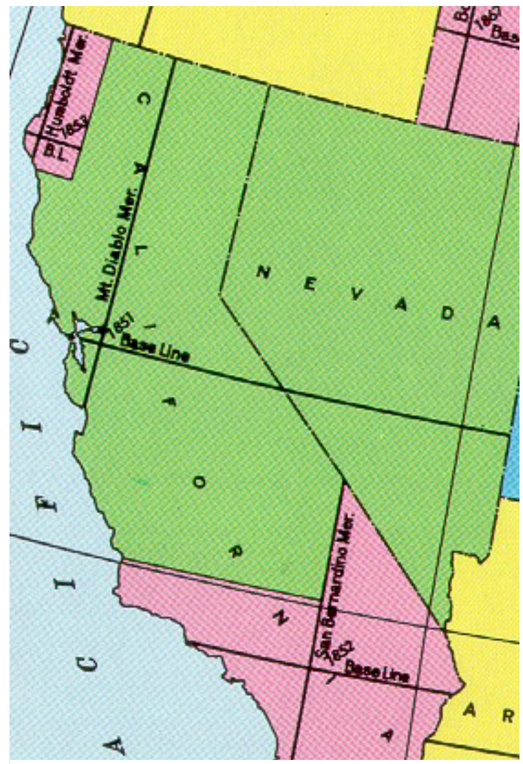


Figure 6.5. Base lines and principal meridians in California

- Count the distance north or south from the base line. This gives you the "township" coordinate.

- Then count the distance east or west from the principal meridian. This gives you the "range" coordinate.

Figure 6.6 shows a township grid. To find the coordinates of the township marked "A" you would first count how many squares north of the base line it is (six). Then you would count how many squares east of the principal meridian it is (four). We write this as T. 6 N, R. 4 E, which means Township Six North, Range Four East. Using the proper format and order, as well as always including direction (N, S, E, W) is crucial when using PLSS.

Using Figure 6.6, find the coordinates for "B" through "E".

9. B =
10. C =
11. D =
12. E =

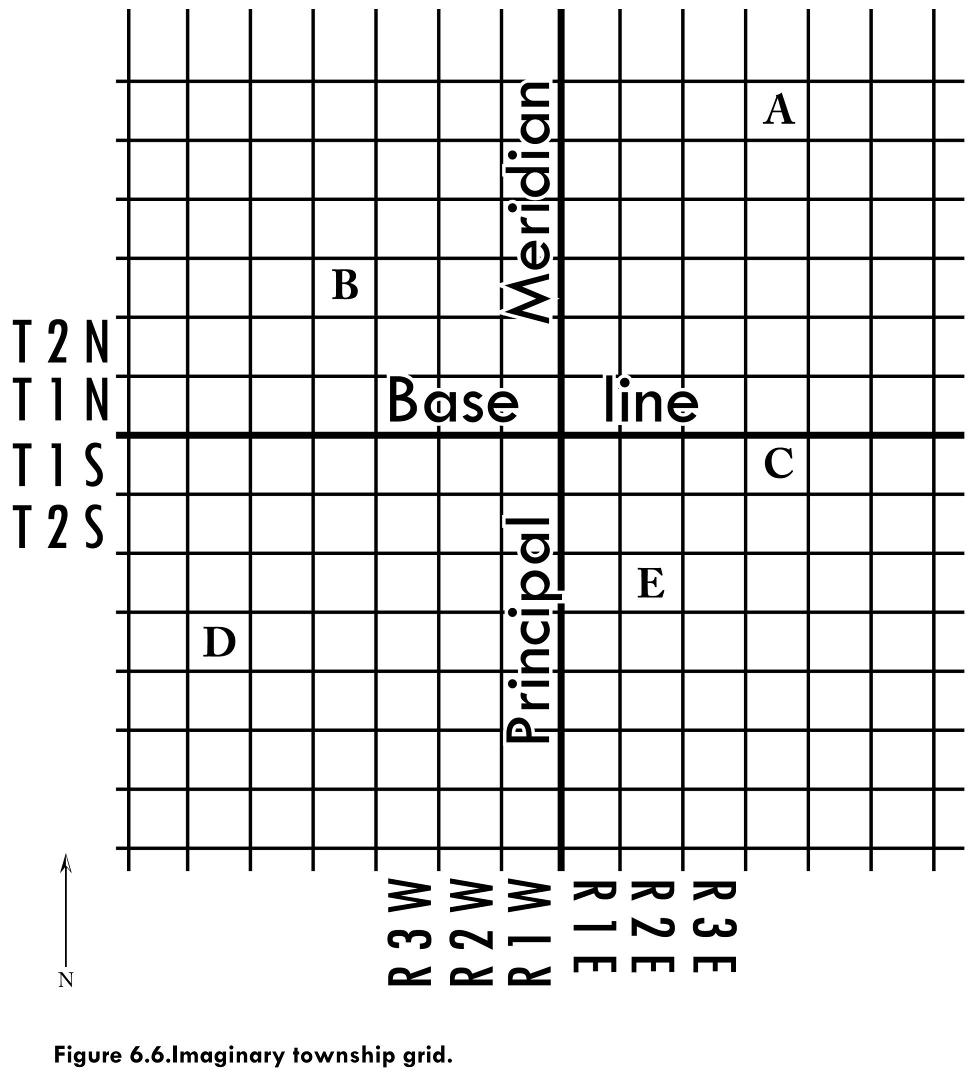


Figure 6.6.Imaginary township grid.

6.5. Dividing Townships

Since the PLSS was designed to divide the country and give farmable land to average Americans, we can't stop at just the township and range level. Thirty-six square miles is too much for anyone to successfully farm, so Jefferson further divided the landscape by using Sections. Each township is divided into thirty-six equal sections.

13. How many square miles is each section?

The numbering of sections is down in a standard (yet confusing) pattern. Section 1 is always in the northeast corner. The numbering then moves west until Section 6, then drops south one square and continues east, and so on (as shown in figure 6.7). This section number is added to the township and range coordinates to make it more exact. For example, the southeastern most square in Figure 6.7 would be Sec. 36, T. 6 N, R. 4 E, meaning Section thirty-six of township six north, range four east.

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

N

T. 6 N, R 4 E.

Figure 6.7.Example of section numbering.

6.6. Aliquot subdivision

We divide the land even further, and this is where it gets fun. We can the division of sections *aliquot subdivision*, which refers to dividing the sections into equal quarters. We first subdivide a section into four equal quarters and distinguish them by their compass direction from the center of the section. For example, the quarter in figure 6.8 marked with an “A” would be the Northeast Quarter. We then add that to the beginning of our coordinates – NE ¼, Sec. 36, T. 6 N, R. 4 E. Each quarter section can then be divided up into their own quarter sections. “B” in figure 6.8 would be NE ¼, NW ¼ Sec. 36, T. 6 N, R. 4 E, meaning it is the northeast quarter of the northwest quarter of section thirty-six, township six north, range four east. “C” in figure 6.8 would be NE ¼, SW ¼, NW ¼, Sec. 36, T. 6 N, R. 4 E. As you can see our coordinates can be quite lengthy. Remember to write your coordinates in the proper order. A small mistake can place you a mile from where you should be!

“D” in figure 6.8 is a rare exception to subdividing in quarters. We can divide a quarter section into two halves, represented similarly to the quarter sections. “D” would be N ½, SE ¼, Sec. 36, T. 6 N, R. 4 E. When a natural feature such as a lake intrudes on the land, we use the term “lot” to describe the remaining land. The area around the lake in figure 6.8 would be Lot 1, SE ¼, Sec. 36, T. 6 N, R. 4 E.

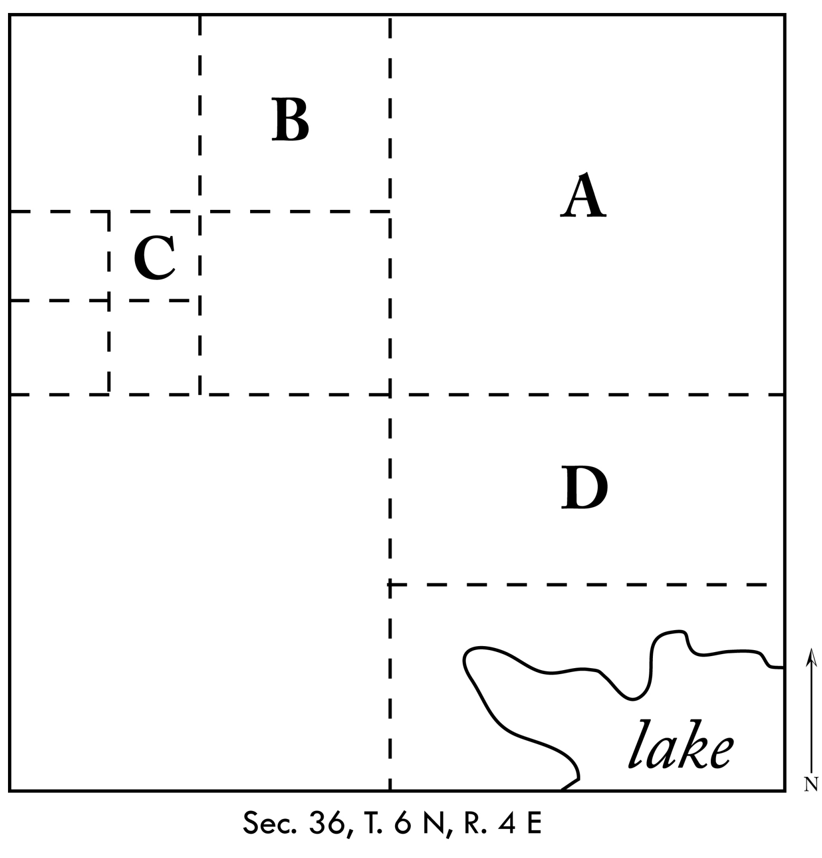
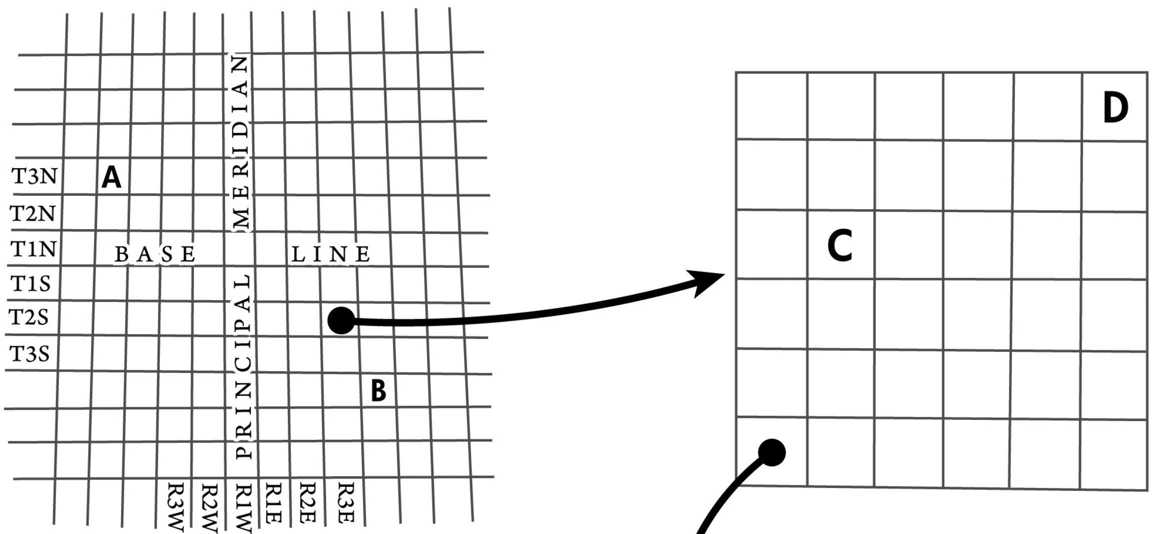
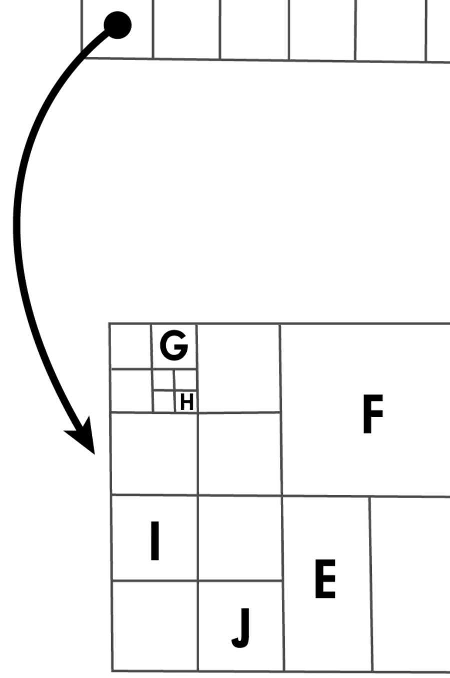


Figure 6.8.Example of aliquot subdivision.

6.7. Finding PLSS coordinates

Using the diagram below, find the coordinates for each letter. A and B will only have Township and Range descriptions, C and D will have Section, Township and Range descriptions, and E-J will have Aliquot, Section, Township and Range descriptions.





14. A =
15. B =
16. C =
17. D =
18. E =
19. F =
20. G =
21. H =
22. I =
23. J =

24. How much land (in acres) is found in each of these areas:
    - B=
    - D= 640 acres
    - E =
    - F =
    - G =

6.7. Using the PLSS

In this final part of the lab you will use two USGS topographic maps to locate PLSS coordinates. On USGS topographic maps the PLSS lines and coordinates are drawn using red ink. You may notice that the lines don't always form a perfect grid pattern.

25. What could be the causes of this?

Using one topographic map, find five prominent locations. This can include buildings, peaks, intersections of roads, etc. Describe their locations accurately to at least the ¼ section and write them below in the column labeled "PLSS coordinates" but do not write anything in the "Name or description" column. Once you have your five places located switch your lab with someone else. He or she will use the same topographic map and your PLSS coordinates to try and locate the places you selected. The student will write down the place in the "Name or description" column and then hand the lab back to you. Did he or she find the exact places, or do both of you need more practice with PLSS?

Topographic map used: *Name of person switched with:*

	PLSS coordinates	Name or description
Place 1		
Place 2		
Place 3		
Place 4		
Place 5		

End of Lab 6