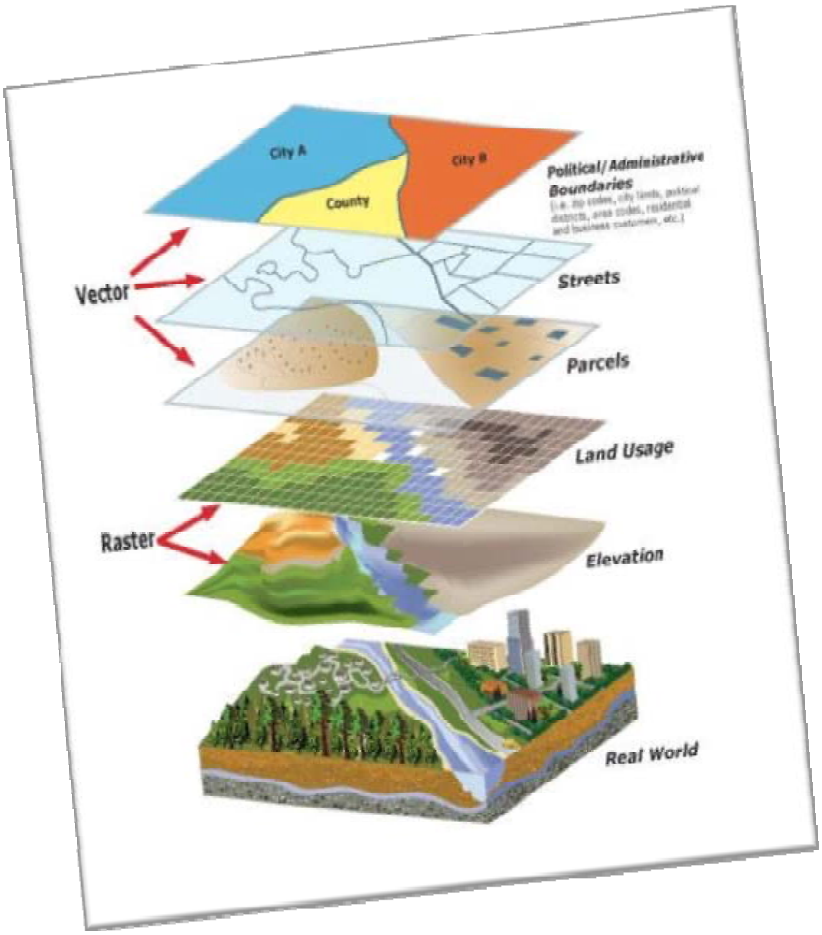


ES 341 – Geographic Information Systems

Winter 2013
Dr. Taylor
Midterm Assignment Portfolio

Prepared By:
Kathryn Roberts

February 15, 2013

Table of Contents

1B: Introduction to Topgraphic Maps Exercise (Monmouth Quad)
3 pages

Kathryn Roberts
01/07/13

INTRODUCTION TO TOPOGRAPHIC MAPS

c:\wou\geomorph\f2000\introlab.wpd

All of the following questions refer to the Monmouth, OR Quadrangle.

1) What is the fractional scale, contour interval, and magnetic declination of this map?
a) Scale: 1:24,000 b) Contour Interval: 10 ft. c) Declination: 19°E

2) What quadrangle maps are located immediately adjacent to the Monmouth Quad.?
a) North: Rickreal b) South: Lewisburg c) East: Sidney d) West: Airlie North

3) What is the quadrangle size series of this map (in long. and lat.)?
7.5 min

4) What is the date of publication of this map?
1970 (photo revised 1986

5) What does the tick with 4956000m N. mean? (lower right of map)
UTM demarcation

6) What is the name of the major fluvial system flowing through this area. Of What larger drainage basin(s) does this river form a part of?
Willamette River, Columbia River Basin

7) What is the approximate elevation of the Natural Sciences Building based on the map representation? 210 ft

8) Given the fractional scale determine the following
1 in = 24,000 in 12 in = 1 ft 5280 ft = 1 mile
5 inches on the map= 10,000 Feet on ground = 1.89 Miles on ground.
10 inches on the map= 6097.6 Meters on ground = 6.098 Kilometers on ground.
3.28 ft = 1 m 1000 m = 1 km

9) A. What is the road distance in miles along Rt. 99 between Helmick State Park and Monmouth city limits? $= 13\text{ in} \times 24{,}000 = 312{,}000\text{ in}\left(\frac{\text{ft}}{12\text{ in}}\right)\left(\frac{\text{mi}}{5280\text{ ft}}\right) = 4.92\text{ miles}$

B. What is the distance in kilometers?
$4.92\text{ mi}\left(\frac{5280\text{ ft}}{1\text{ mi}}\right)\left(\frac{1\text{ m}}{3.28\text{ ft}}\right)\left(\frac{\text{km}}{1000\text{ m}}\right) = 7.93\text{ km}$

10) A. Determine the average stream gradients (in Ft/Mi) for the following drainages:

A. Willamette River: Gradient: 177 − 153 = 24 ft Length: 105 − 93 mi = 12 mi 24 ft/12 mi = 2 ft/mi
B. Luckiamute River: Gradient: 212 − 157 = 55 ft Length: 13 − 5 mi = 8 mi 55 ft/8 mi = 7 ft/mi

11) A. What is the highest point of elevation represented on this map? 880 ft.

B. What is the lowest point of elevation represented on this map? 150 ft

C. What is the maximum relief. 880 ft − 150 ft = 730 ft.

12) A. What is the longitude and latitude location of the road intersection at Buena Vista
$\frac{.5'}{.555''}\left(\frac{3.8''}{1}\right) = 1.15'$ 44° 46' 10", 123° 65' 47"

B. What is the longitude and latitude location of Davidson Hill?
$\frac{.5'}{.345''}(3.7'') = 1.713'$ 44° 45' 54" 123° 11' 15"

C. What is the straight line distance in miles between these two points?
$5\text{ in} \times 24{,}000 = 120{,}000\text{ in}\left(\frac{\text{ft}}{12\text{ in}}\right)\left(\frac{\text{mi}}{5280\text{ ft}}\right) = 1.89\text{ miles}$

D. What is the azimuth bearing FROM Davidson Hill TOWARDS Buena Vista?
085°

E. What is the quadrant bearing FROM Buena Vista TOWARDS Davidson Hill?
S85°W

13) A. What is the nature of the topographic slope in the vicinity of the town of Monmouth?
gently sloping

C. What is the local relief between WOU and the Willamette adjacent to Independence?
210 − 150 = 60 ft

D. Is the outline of the topography east of Independence relatively arcuate or irregular in outline?
irregular

E. What processes might have formed the pattern in D above?
possibly landslides or unstable hill slopes

14) Examine the cultural activity immediately north of Monmouth and Independence.

A. Write a brief assessment of the potential for environmental degradation to the surface and groundwater of this area. List three types of water quality degradation (i.e. contamination) problems that may exist in this area.

One source of environmental degradation that is likely is from agricultural runoff in the area, as agriculture is the predominant land use in the area.

A second source of environmental degradation that may occur is from urban runoff from the the urban sections of the map (the Monmouth / Independence areas)

a third source of potential water contamination that may occur is from industrial runoff from anthropogenic industrial activity in the area & urban center (some industry).

18. Determine the elevations of the following locations:
A. Wigrich 260 ft.
B. Oak Hill (SC) 476 ft
C. Dicker Reservoir (NE) 450 ft
D. Davidson Bridge (SC) 160 ft

19. Draw a topographic profile along a line connecting Oak Hill (SC) to Vitae Springs. Use a horizontal scale of 1 in = 4000 Ft, and a vertical scale of 1 in = 333.33 ft (see attached profile paper).

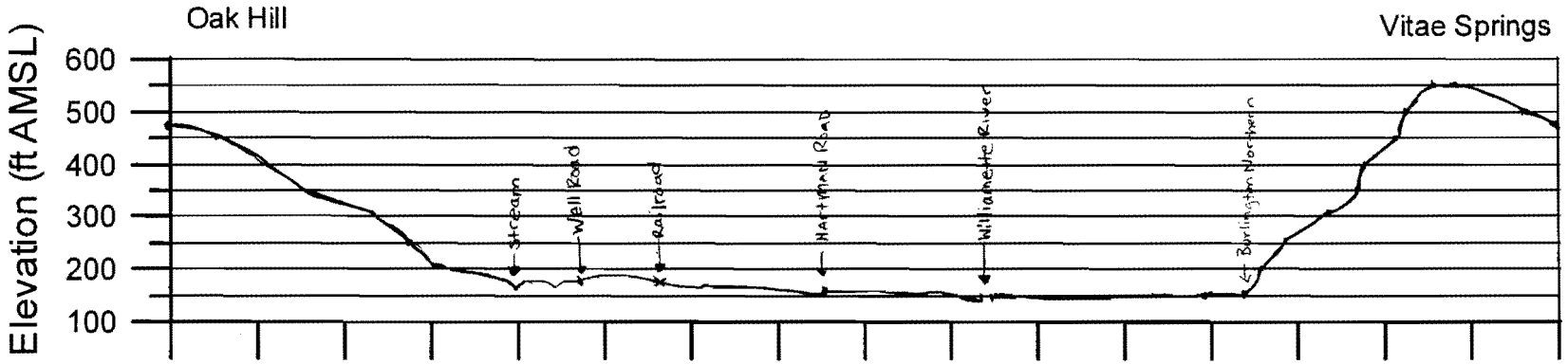
A. Determine the minimum slope grade represented on the profile in percent.
1% Willamette River to Burlington Northern

B. Determine the maximum slope grade represented on the profile in percent.
9% Burlington Northern to Vitae Springs

C. Where are the areas most likely associated with flooding?
Willamette River & adjacent

D. The vertical exaggeration of a profile is calculated by: VE = H scale / V scale;
Calculate the vertical exaggeration represented on the attached profile.

Topographic Profile from Oak Hill to Vitae Springs, Monmouth, OR Quad.



Horizontal Distance in Feet (each tic = 2000 ft)

Horizontal Scale: 1 in = 4000 ft
Vertical Scale: 1 in = 333.33 ft

V.E. = H/V = $\frac{1/4000}{1/333.33}$ .0833 ft/ft V.E.

c:wou:geomorph:monblank.grf

1C: In-class lat-long conversion / PDF creation / Email attachment exercise
1 page

ES341 In-Class Exercise – Conversion of Longitude and Latitude **Name** Kathryn Roberts
01/07/13

Convert the Following Locations in Lat-Lon to Decimal Degrees (show all your math work)
(given conversions: 1 deg = 60 min; 1 min = 60 sec; 1 deg = 3600 sec)

	Lat	Dec. Deg	Long	Dec. Deg.
Seattle	47°36'40" N	47.6111	122°20' 57" W	122.349
Honolulu	21°18'22" N	21.3061	157°50'10" W	157.836
New York	40°30'43" N	40.5119	73°58'32" W	73.976

Seattle = $36' \frac{°}{60'} + .6 + \left(40'' \frac{°}{3600''}\right) =$

Convert the following locations in Decimal Degrees to degrees-minutes-seconds

Lat		Long		Approximate Location?
25.7532° N	25° 45'12"	80.2376° W	80° 14' 15"	Florida
53.2356° N	53° 14' 8"	9.0034° W	9° 0' 12"	England
60.487° N	60° 29' 13"	5.3357° E	5° 20' 8"	Norway

.7532 × 60 = 45.192 = 45'
.192 × 60 = 11.52"

1D: Introduction to Contouring and Digital Elevation Models Exercise
2 pages

Kathryn Roberts
01/10/13

ES492/592 GIS Applications
In-Class Exercise: Introduction to Contouring and Digital Elevation Models

Examine the attached map figures. Fig. 8.10 shows a visual 3-D model of the Earth's surface and the depiction of corresponding topographic contour lines that connect points of equal elevation.

Task 1. Using the spot elevation data depicted in Fig. 8.11 A and B, contour each map using a contour interval of 10 feet. Map A will include lines 480, 490, 500, 510, 520. Map B will include lines 90, 100, 110, 120, 130, 140.

Task 2. Using the bar scale and a ruler, calculate the fractional scale of the maps in Fig. 8.11.
1.651 cm = 10 m 10 m $\left(\frac{100 cm}{m}\right)$ = 1000 cm $\frac{1.651 cm}{1.651 cm} = \frac{1000 cm}{1.651 cm}$ = 1 cm = 605.7 cm = 1:605.7

Task 3. Create a rasterized digital elevation model for your contour map. Easting (X position in meters) and Northing (Y position in meters) coordinates for the corners of Map A are as follows:

NW corner coordinates = 1,463,243 m, 538,275 m
SE corner coordinates= 1,463,293 m, 538,243 m

3A. Calculate the total East-West distance covered by map A in meters = 50 m
3B. Calculate the total North-South distance covered by map A in meters = 32 m

3C. Our goal is to create a raster grid to overlay map A with a cell resolution of 2 meters. Given the map boundaries and dimensions listed above, determine the number of grid rows and columns that will be required to divide the map into 2 m grid cells.

N-S No. Rows = 16

E-W No. Columns = 25

3D. Measure the map dimensions in inches: E-W Distance = 3.23 inches (E-W) N-S dist = 2.05 inches (N-S)

3E. Calculate the map-scale dimensions of each 2-m grid cell in inches = .13 X .13 (in)

3 F. Starting at the North edge, and East edge of map A, draw a series of rows and columns to scale, that depict a 2-m grid overlay on the map.

3G. Now for each cell on the map, interpolate an elevation and classify the grid cell according to the following scale (use color pencils to carefully color each cell, STAY IN THE LINES):

480-490 ft elev. = Blue
490-500 ft elev. = Green
500-510 ft elev. = Yellow
510-520 ft elev. = Red

Task 4: You did it! You have now overlain a rasterized 2-m Digital Elevation Model on top of a vectorized contour map. Provide a brief discussion of the differences between vector and raster data models.

The vector map provides specific features of the landscape (like elevation through contour lines). The raster data model applies a specific geographic location & allows for further landscape classification using GPS coordinates (UTM in this example).

PACKET 11

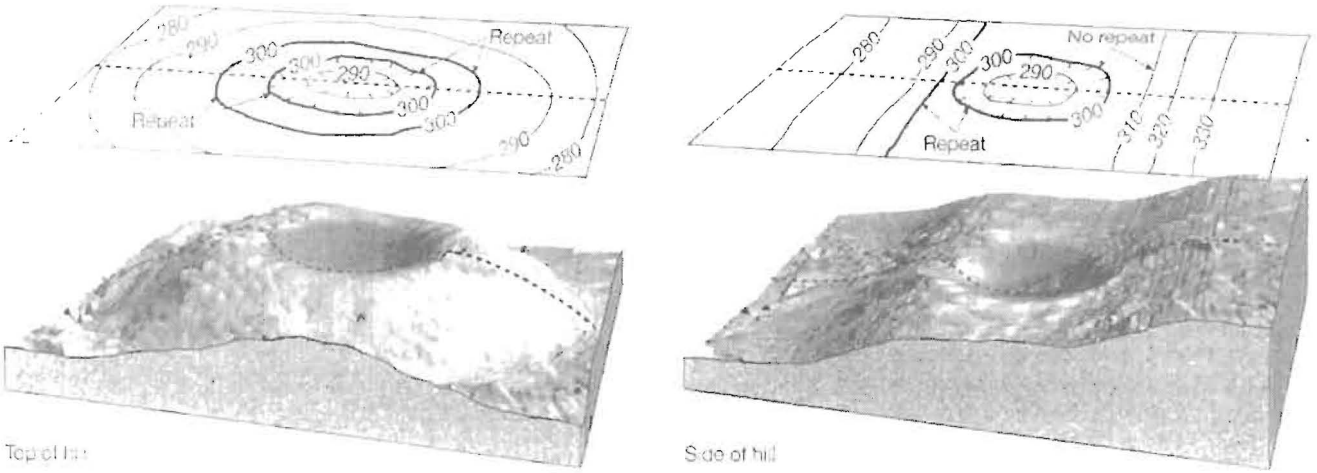


FIGURE 8.10 Contour lines repeat on opposite sides of a depression (left illustration), except when the depression occurs on a slope (right illustration).

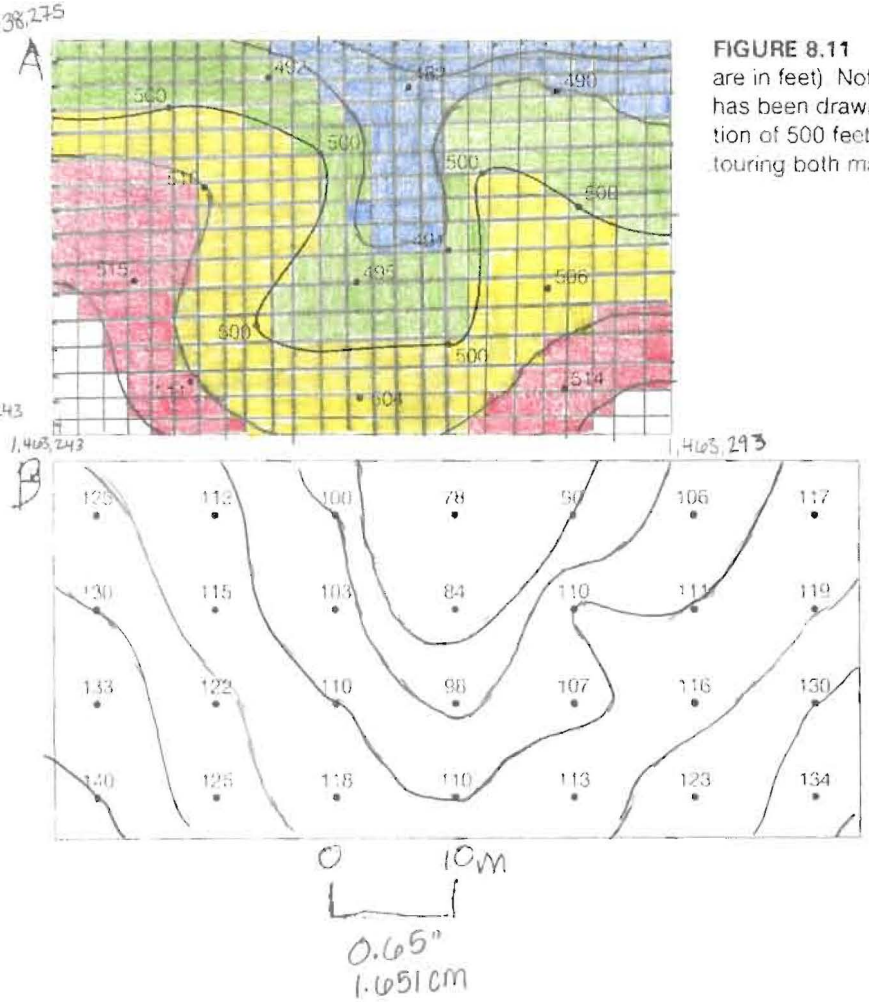


FIGURE 8.11 Topographic map construction (elevations are in feet). Notice in map **A** that a 500-foot contour line has been drawn through all the points that have an elevation of 500 feet above mean sea level. Can you finish contouring both maps using a contour interval of 10 feet?

2A: Basics of Vector-Raster Data Exercise
9 pages

Kathryn Roberts
01/10/13

GIS INTRODUCTION TO RASTER GRIDS AND VECTOR MAP ELEMENTS
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Purpose: To explore the raster grid and vector map element concepts in GIS.

PART A. RASTER GRID NETWORKS

Task A- 1 Examine the attached topographic map (Figure 1). The contour lines are displayed with UTM Northing and Easting coordinates. Answer the following preliminary questions.

1-1. What is the contour interval of the topographic map? (assume that elevation units are in feet AMSL)
5 ft.
1-2. The UTM Coordinate system is in what unit of distance measurement?
meters
1-3. Determine the UTM coordinates for the following point locations:

	X (Easting) meters	Y (Northing) meters
Point A	3200 m	14,750 m
Point B	7,900 m	9,700 m

1-4. Determine the following map boundaries relative to the UTM Easting / Northing coordinate system (fill in the chart below).

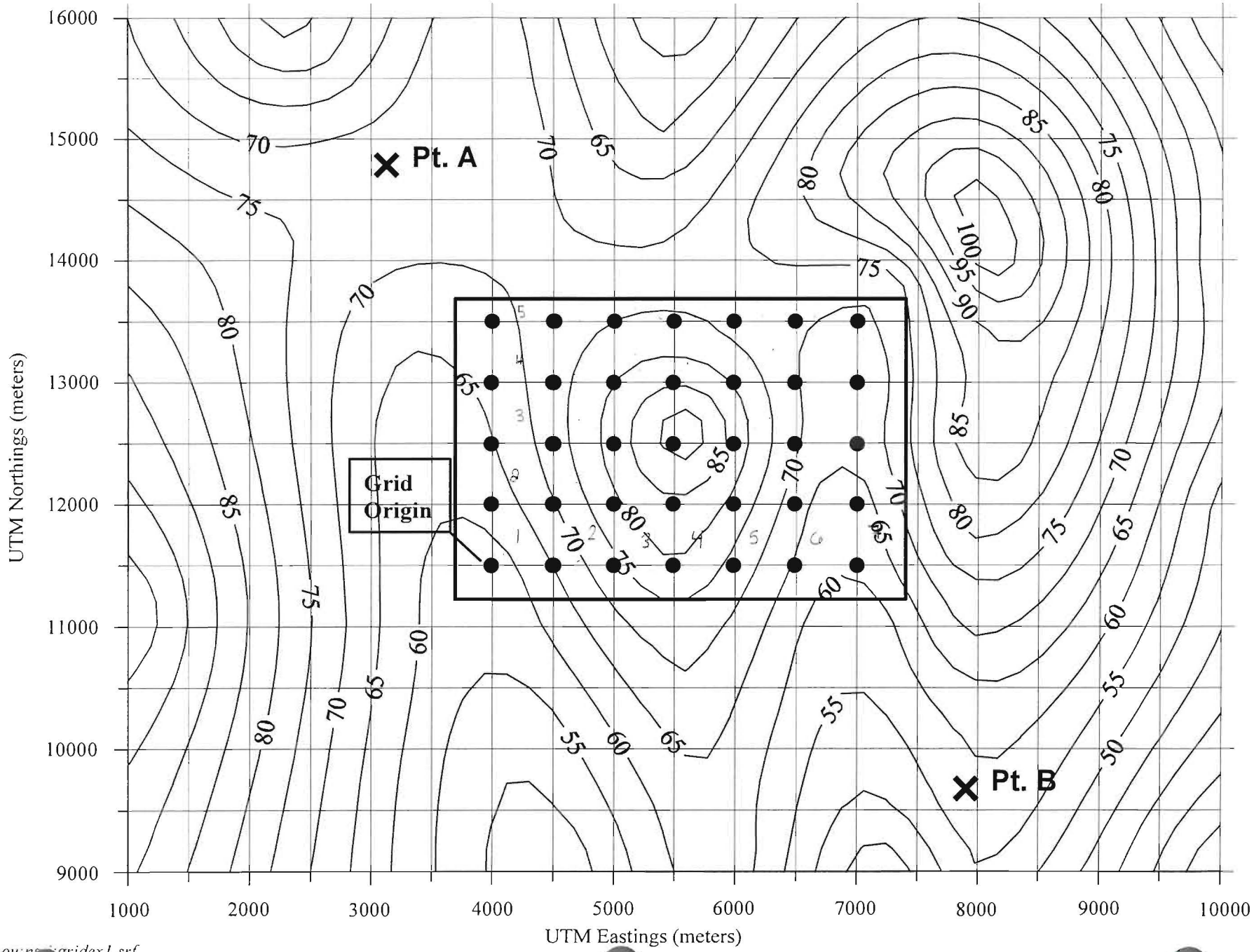
Maximum X (Easting) coordinate of map	10,000 m
Minimum X (Easting) coordinate of map	1,000 m
Maximum Y (Northing) coordinate of map	16,000 m
Minimum Y (Northing) coordinate of map	9,000 m
Total X unit distance displayed on map	500 m
Total Y unit distance displayed on map	500 m

1-5. Observe the grid overlay on the topographic map. Where each of the grid lines intersect, this point is referred to as a "node". Determine the following:

How many total rows of grid lines do you observe on the map?	8
How many total columns of grid lines do you observe on the map?	10
Divide the total X unit distance (from 1-2) by the number of columns	71.4
Divide the total Y unit distance (from 1-2) by the number of rows	100
What is the X unit distance covered between each node?	500
What is the Y unit distance covered between each node?	500

Are the nodes distributed on a perfectly square or rectangular grid network? rectangle

Figure 1. Example Topographic Map with Grid Overlay



wou:n...gridex1.srf

1-6. Consider a hypothetical example (not related to the attached figure). Assume the following map coordinate relationships:

Maximum X (Easting) coordinate of map	15,000 m
Minimum X (Easting) coordinate of map	13,000 m
Maximum Y (Northing) coordinate of map	8000 m
Minimum Y (Northing) coordinate of map	6500 m

Your goal is to create a "10 m" grid for this hypothetical map (i.e. 10 m between each grid node).

What is the total X distance covered on the map?	2,000 m
What is the total Y distance covered on the map?	1,500 m
How many grid line rows do you need to specify?	15
How many grid line columns do you need to specify?	20

Task A-2. Raster data in geographic information systems is basically a grid network of data, with X,Y node coordinates and a "Z" value (i.e. some attribute) attached to each node point. In the case of "digital elevation models" (also known as DEM's), the "Z" attribute value is elevation relative to sea level. Your task here is to create a digital elevation model (gridded elevation data) for the area selected on the Figure 1, as outlined with the dark rectangle in the center. The selected nodes are highlighted with a heavy "dot".

- Assume that the first row and first column of the grid starts in the lower left hand corner (i.e. the southeast corner of the marked grid). This point is marked as "grid origin" on the map. This is analogous to a Cartesian coordinate system used in mathematical graphing. Fill in the following charts:

Easting Coordinates

Column 1	4250
Column 2	4750
Column 3	5250
Column 4	5750
Column 5	6250
Column 6	6750
Column 7	7150

Northing Coordinates

Row 1	11,750
Row 2	12,250
Row 3	12,750
Row 4	13,250
Row 5	13,500

Gridded Elevation Data (fill in the elevations for each node on the grid, interpolate elevations as needed)

	Columns						
	1	2	3	4	5	6	7
Row							
1	65	73	80	80	72	69	65
2	67	76	85	85	75	65	67
3	70	72	86	88	77	70	72
4	70	75	78	77	74	70	72
5	70	70	74	74	72	70	72

Concluding Statement to Part A Raster Grids

You now have an understanding of how raster grid data is created and stored in Geographic Information Systems. The study area is divided into a mesh of grid cells, with each node attached to some attribute information (i.e. "Z" values). Each cell is given a numeric identifier or value. Raster systems are good for representing data over continuous space, examples include:

Digital pictures or images (each cell is assigned a color value, here a cell is called a "pixel")
Digital Elevation Models (each cell is assigned an elevation)
Rainfall Maps (each cell is assigned a rainfall value - inches of precipitation accumulated over time)
Vegetation maps (each cell is assigned a vegetative index number)

Last Question: Think up three examples of spatial map data, other than the examples listed above, that could employ digital raster techniques.

Idea 1 population density

Idea 2 animal biodiversity

Idea 3 rock lithology

PART B. VECTOR MAP REPRESENTATION

Vector map elements represent map data as a collection of points, lines, and polygons. Below are geometric definitions of each as related to digital map elements (see **Figure 2** for Examples).

Points - individual points in map space represented by a very specific X, Y coordinate.

Straight Line Segments - straight lines that connect any two points (represented by two pairs of X,Y coordinates).

Polylines - lines with multiple segments of differing orientation (multiple sets of X,Y coordinates)

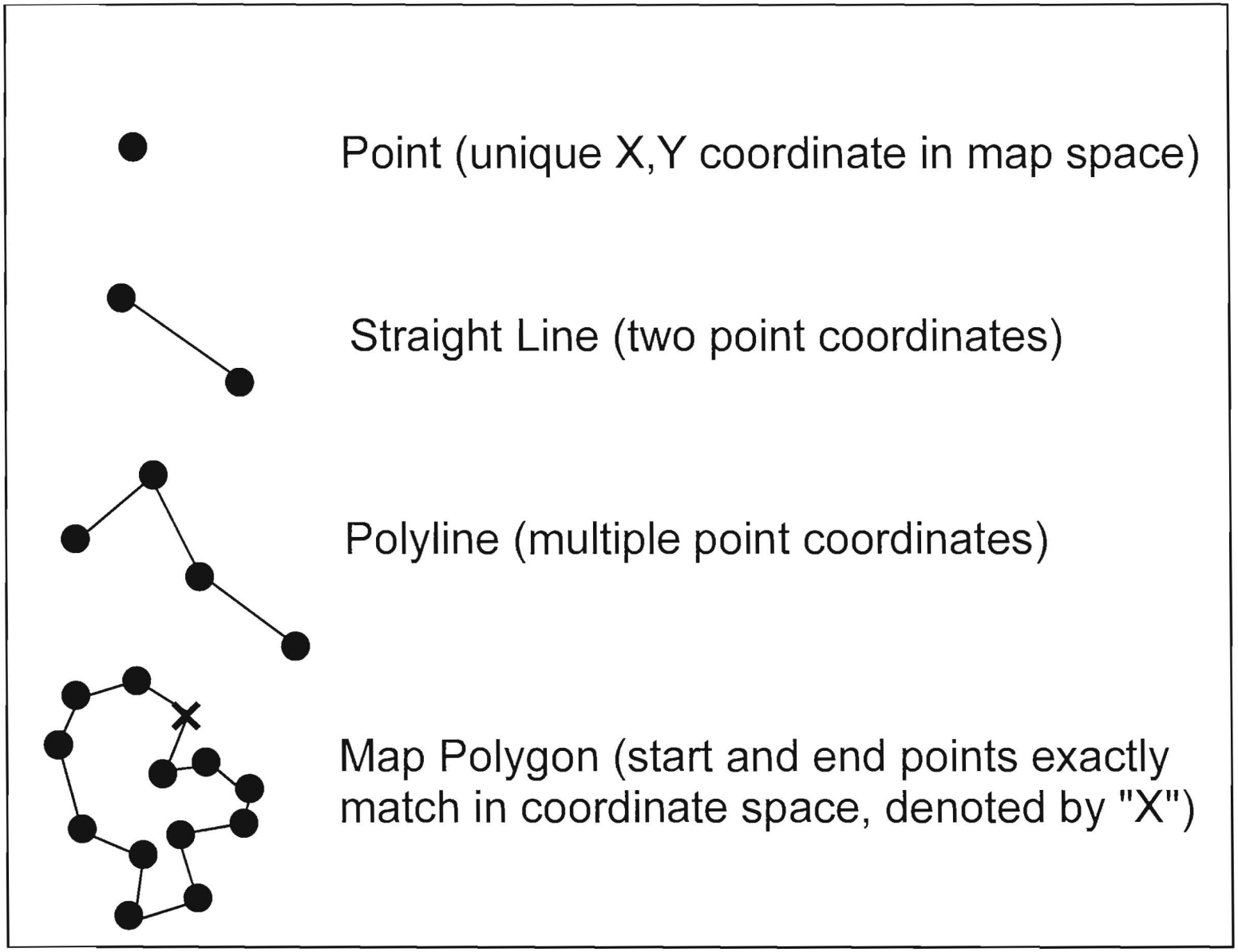
Polygons - regular to irregularly shaped polyline sets that completely close on themselves (i.e. the end point of the polyline exactly matches the origination point of the polyline).

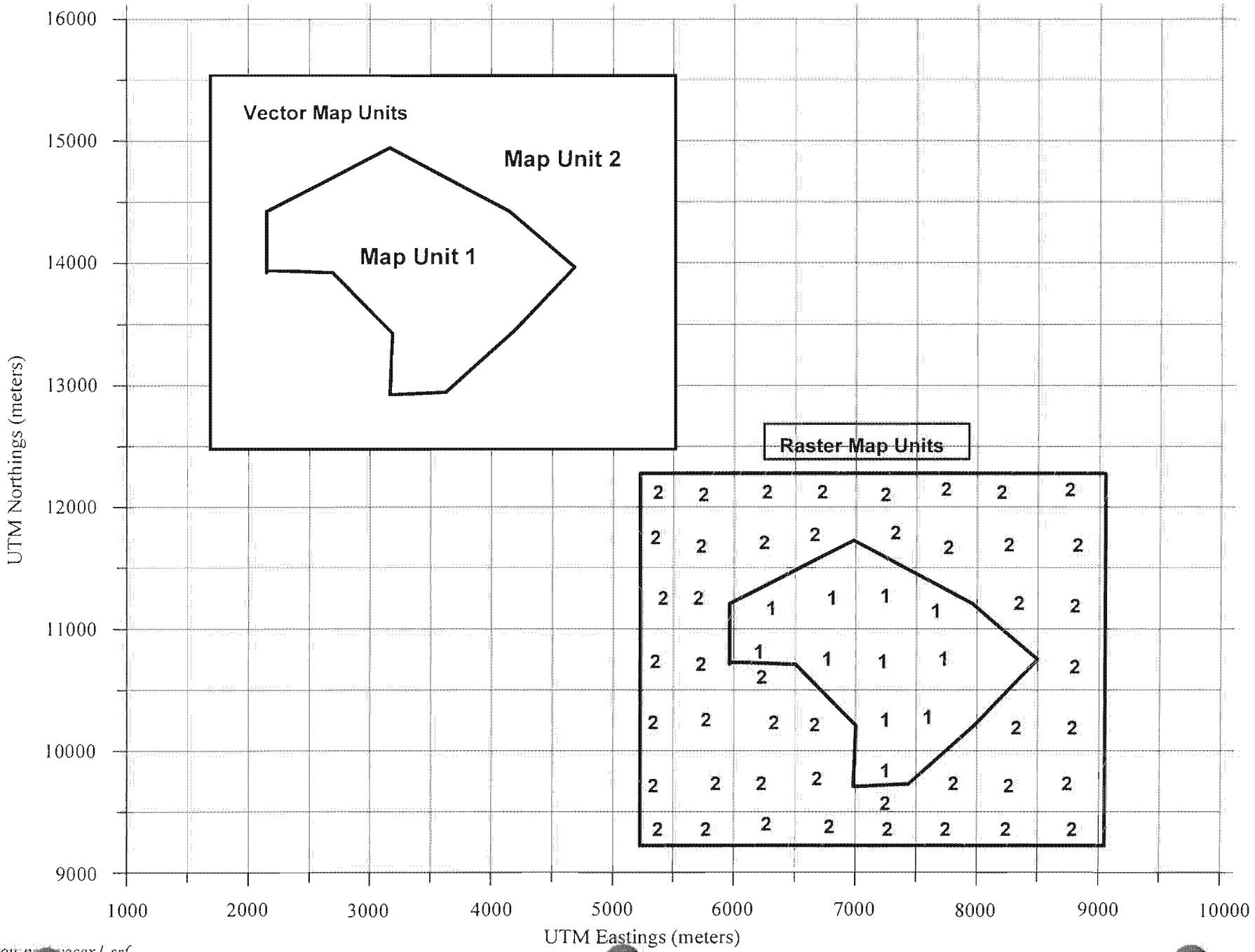
***A Side Note:* In the case of the vector approach to map elements, two software files are required: (1) a vector graphics file with the geometric coordinates and map element types. Here the map element is assigned an internal code, and (2) a database information file that links attributes to the internal code of the map elements. This is different than the raster grid data structure above, in which all data can easily be stored in one data file. Hence, vector map layers usually require multiple data files to manage the same information that one raster data file represents.**

Examine Figure 2A for a comparison of polygon map elements represented in a vector vs. raster data structure.

c:nssi:mapelmnt.srf

Figure 2. Vector Map Elements




Vector Map Units
Map Unit 2
Map Unit 1
Raster Map Units
16000
15000
14000
13000
12000
11000
10000
9000
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
UTM Northings (meters)
UTM Eastings (meters)

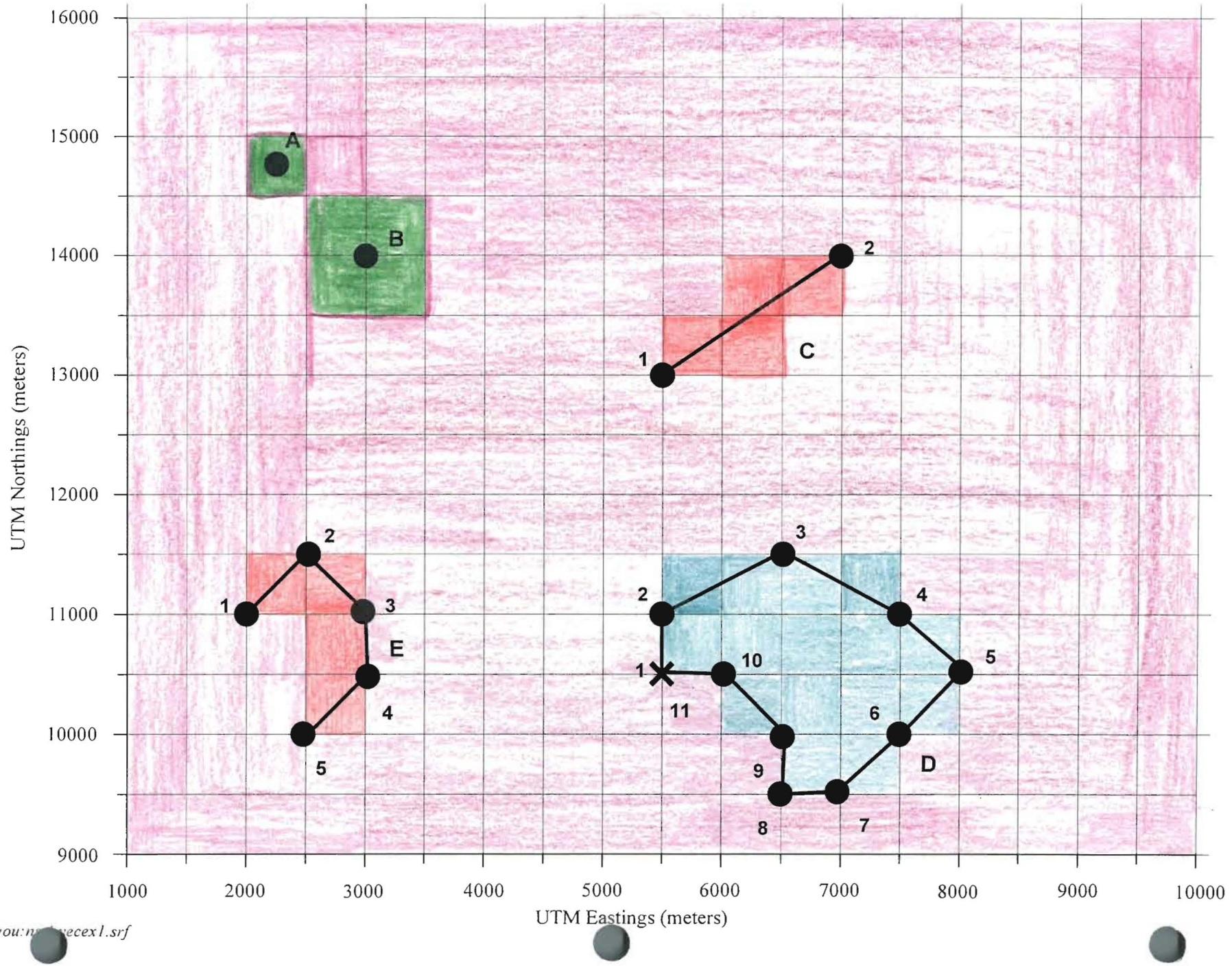
Task B-1. Refer to Figure 3. This is a map grid in UTM-meters, with several digital map features listed A through E. Identify which type of map element is represented by each feature in the table below (point, line, polyline, or polygon).

Feature	Map Element Type
A	point
B	point
C	straight line
D	polygon
E	polyline

Task B-2. Build a vector data file for each map feature (A through E) in the table below.

Feature	Node Coordinates	
	X coordinate	Y coordinate
A	2250	14750
B	3000	14000
C		
node 1	5500	13000
node 2	7000	14000
D		
node 1	5500	10500
node 2	5500	11000
node 3	6500	11500
node 4	7500	11000
node 5	8000	10500
node 6	7500	10000
node 7	7000	9500
node 8	6500	9500
node 9	6500	10000
node 10	6000	10500
node 11	5500	10500
E		
node 1	2000	11000
node 2	2500	11500
node 3	3000	11000
node 4	3000	10500
node 5	2500	10000

Figure 3. Example Vector Map Exercise



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Questions:

Which data type do you think requires more computer storage memory and processing time, vector or raster? Why?

Vector, because each shape has to be individually processed compared with a raster model where the majority of info is interpolated from a smaller number of specific data points

Which spatial data type is also used in digital image files that are found on the internet (like *.tif, or *.jpg). points (pixels) in a raster file

Compare feature D to feature E in terms of data structure. What is the primary difference between the two feature types?

E is not a polygon because it does not close upon itself. D is not a polyline because nodes I and II are in the exact same location.

Using a red colored pencil (or any other color of your choosing), convert vector map elements A through E to "Raster map elements". Using the grid network shown on Figure 3, color in the raster version of each of the elements (hint: refer to Figure 2A for some ideas).

Task B-3. Refer to the Monmouth Quadrangle paper maps available in the class room. Identify the following map elements by the vector method that would best represent them in digital map space (point, line, polyline, polygon):

Map Element	Vector Method
Highways / Roads	polyline
City Limits	line
Contours	polyline
Small Creeks	polyline
Major Rivers	polygon
School Buildings	polygon
WOU Property Boundary	line
Benchmarks	point
County Outlines	polyline
County Boundaries	polyline
Sewage Ponds	polygon
Fire Hydrants	point
Lamp Posts	point

Now visit the Monmouth Quad. Geologic Map available on the west wall in RM 218 of NSB. Try the same game:

Map Element	Vector Method
Faults	polyline
Map unit Qal	polygon
Map unit Tss	polygon

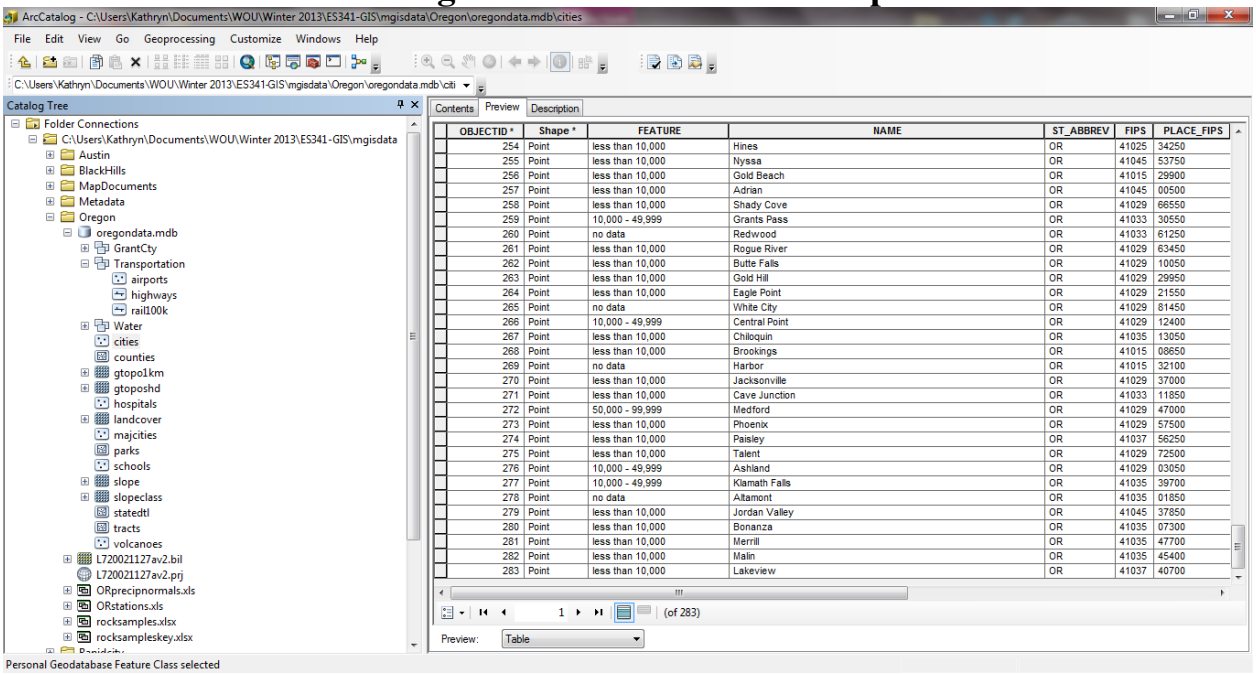
2C: Price Text Chapter 1 (GIS Data) Reading and Tutorial Exercises

10 pages

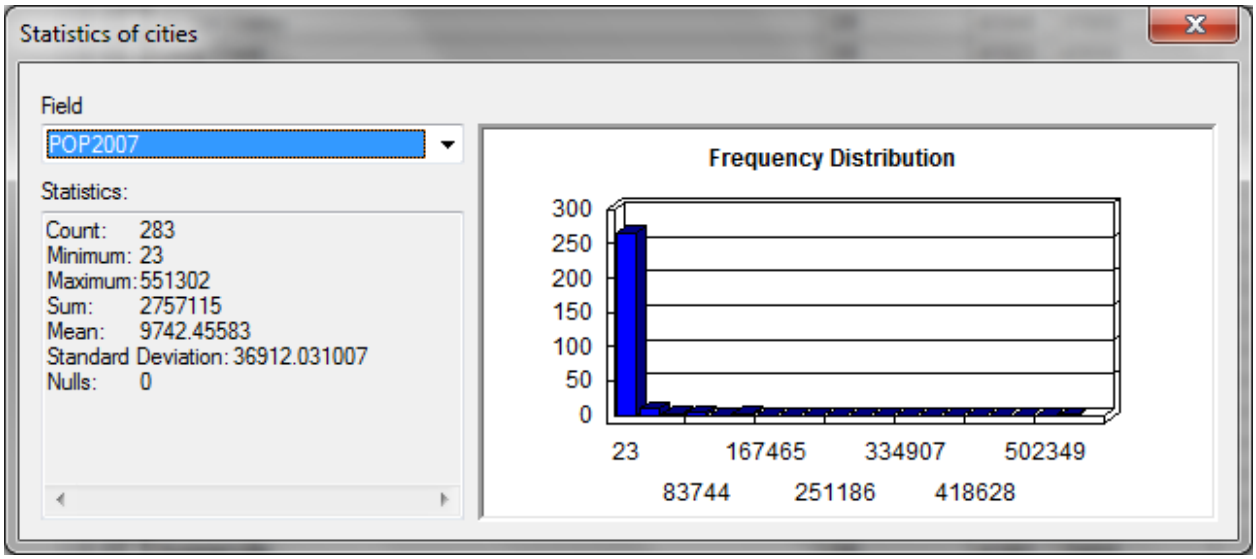
Tutorial Screen Shots

Kathryn Roberts
ES 341 – GIS

Mastering Skills Screen Shots – Chapter 1



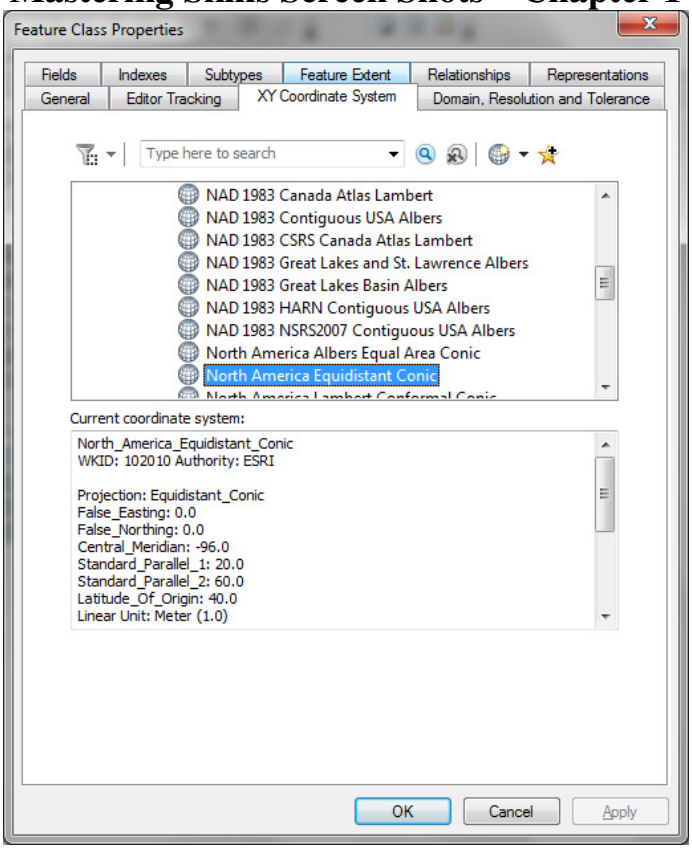
ArcCatalog – Folder Connections added, previewing files using ArcCatalog, pg. 25-28



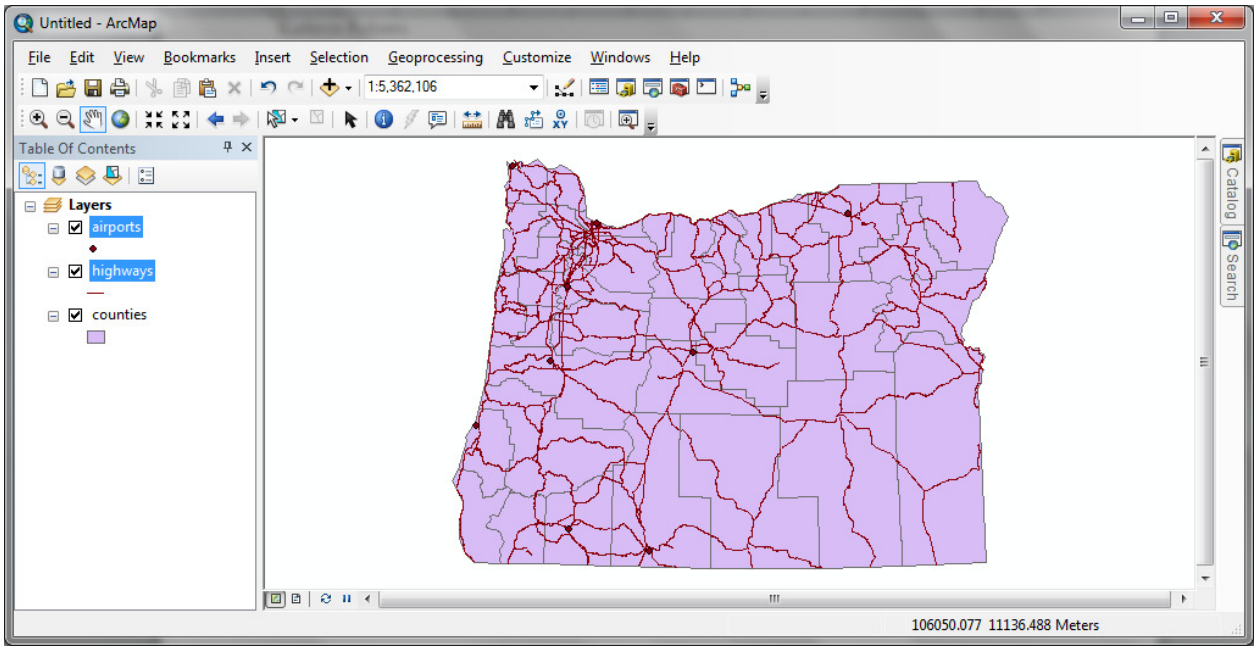
ArcCatalog – Frequency diagram from Statistics option of table field data, pg. 29

Kathryn Roberts
ES 341 – GIS

Mastering Skills Screen Shots – Chapter 1



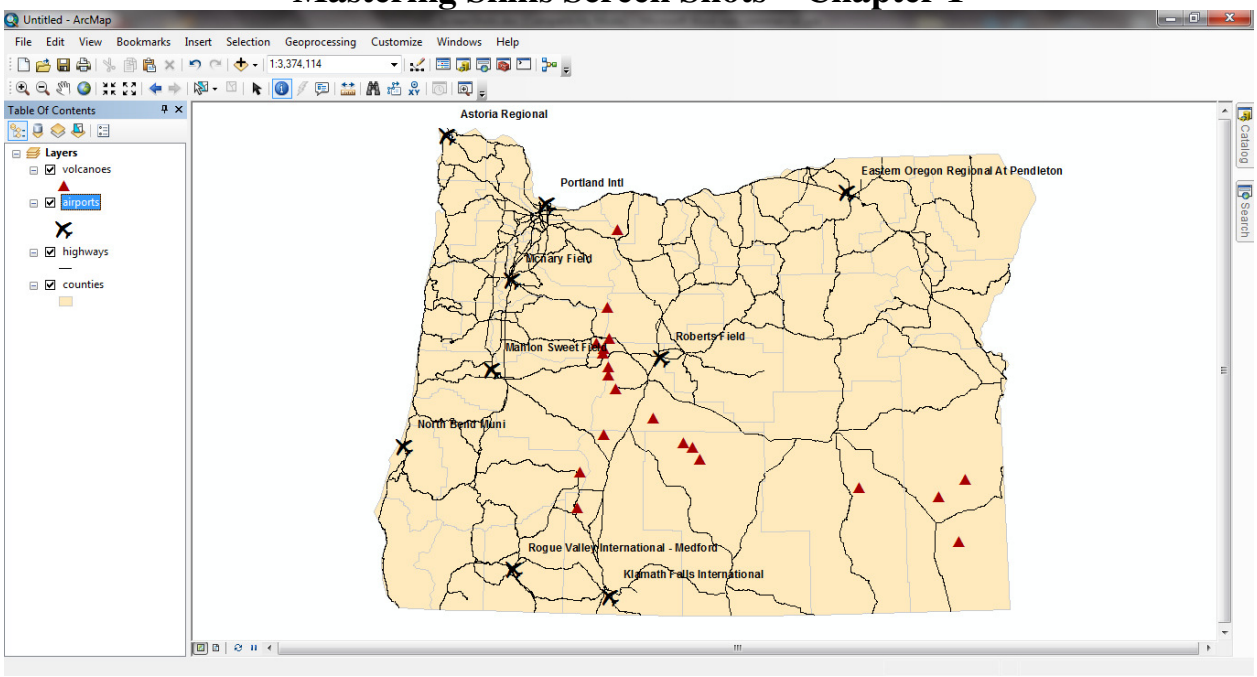
ArcCatalog – Viewing the Feature Class Properties menu, pg. 30



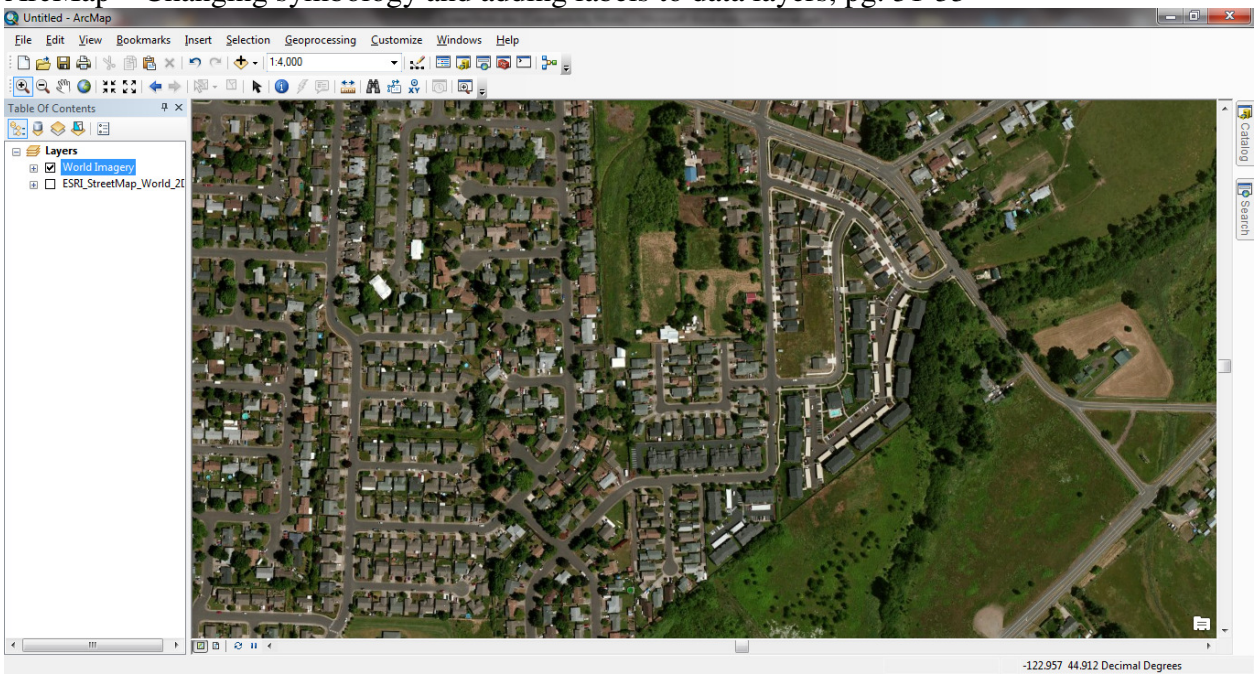
ArcMap – Adding Data from connected folders to ArcMap, pg. 31

Kathryn Roberts
ES 341 – GIS

Mastering Skills Screen Shots – Chapter 1



ArcMap – Changing symbology and adding labels to data layers, pg. 31-33



ArcMap – Finding my neighborhood using ArcGIS Online World_Imagery, pg. 34-39

Tutorial In-Text Questions

Kathryn Roberts
ES341 - GIS

Mastering ArcGIS Chapter 1 Tutorial Short Answers

Pg. 27:

1. How many coverages are there in the archive folder? 2. How many tables? 1. How many rasters? 1. How many layers? 1. How many shape files? 7.

Pg. 28:

2. What is the name of the county in the northeast corner of Oregon? Wallowa.

Pg. 29:

3. How many records are there in the table? 283.
4. Which city has the smallest 2007 population? Granite.

Pg. 30:

5. List the projection: Equidistant_Conic and the linear unit: meter

Pg. 35:

6. What is the name of the field that is being displayed in the Map Tips? NAME.

Pg. 37:

7. What is the name of the coordinate system? NAD_1983_Oregon_Statewide_Lambert. What is the linear unit? Meter.

Chapter Review Questions

Kathryn Roberts
ES 341 – GIS

Chapter 1 Review Questions (1, 2, 3, 6)

1. Explain the difference between the terms feature, feature class, and feature dataset.
    a. Feature – vector objects (points, lines, or polygons) used in GIS maps
    b. Feature Class – like features that are grouped into data sets
    c. Feature Dataset – grouping of multiple feature classes that are related
2. Imagine you are looking at a geodatabase that contains 50 states, 500 cities, and 100 rivers. How many features classes are there? How many features? How many attribute tables? How many total records in all the attribute tables?
    a. There would be 3 feature classes (states, cities, and rivers).
    b. There would be a total of 650 features.
    c. There would be 3 attribute tables (one for each of the feature classes).
    d. There would be a total of 650 records in all attribute tables (1 for each feature).
3. If each of the following data were stored as rasters, state which ones would be discrete and which ones would be continuous: rainfall, soil type, voting districts, temperature, slope, and vegetation type.
    a. Discrete: soil type, voting districts, vegetation type
    b. Continuous: rainfall, temperature, slope

6. You measure a football field (100 yards) on a detailed map and find that it is 0.5 inches long. What is the scale of the map?

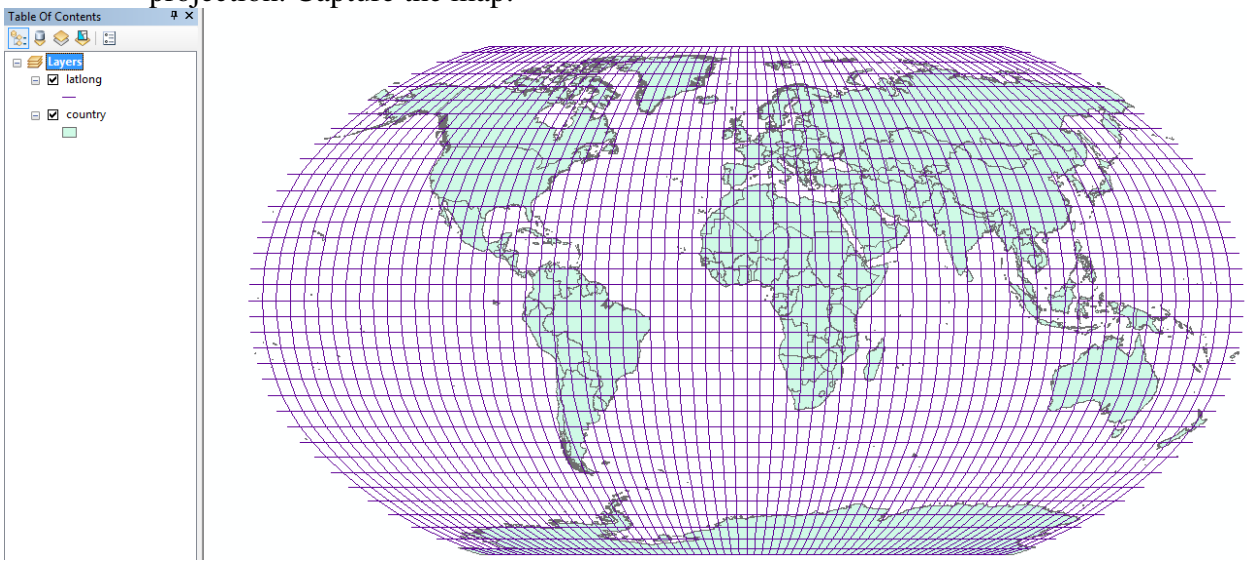
    0.5 in = 100 yards
    1 yard = 3 feet
    100 yards = 300 feet
    0.5 in = 300 feet
    300 feet x 12(in/ft) = 3600 in
    0.5 in = 3600 in.
    1: 7200

Chapter Exercises

Chapter 1 Exercises (1-6, 10)

1. How many feature datasets are there in the oregondata geodatabase in the mgisdata/Oregon folder? List their names. How many total feature classes does the geodatabase have? How many rasters?
    a. Three feature datasets (GrantCty, Transportation, and Water)
    b. Nine feature classes
    c. Five rasters
2. What is the coordinate system of the country shapefile in the mgis/World folder? Of the parks feature class in the oregondata geodatabase?
    a. GCS_WGS_1984
    b. NAD_1983_Oregon_Statewide_Lambert
3. What type of information does the feature class cd111 in the usdata contain? On what date was the information current? Is it current now?
    a. Congressional districts in the US
    b. Information was current for February 25, 2009
    c. It is not current now, Congressional districts were re-drawn after the 2010 census
4. Which is the largest lake in the United States? What is its area?
    a. Lake Superior is the largest lake
    b. 78739809369.912857 meters'
5. Which state has a county named Itawamba?
    a. Mississippi
6. What is the minimum, maximum, and average 2007 population density of census tracts in the city of Austin, TX?
    a. Minimum = 494
    b. Maximum = 34404
    c. Average = 6522.940594

10. Change the data frame coordinate system to view the layers in the Word Robinson projection. Capture the map.



2E: In Class Raster Grid Exercises, "Vector Data Model" Class Notes

Geometric Elements and Topology

Scaling Exercise

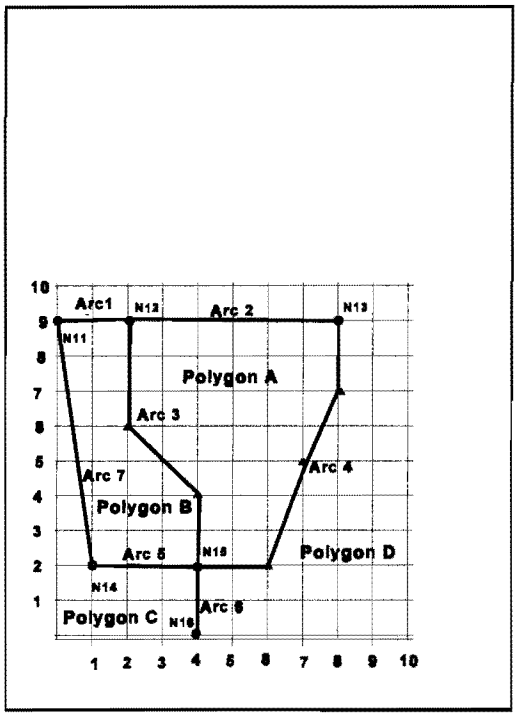
Root mean Square Error Exercise

3 pages

Kathryn Roberts
01/14/13

In Class Exercise - Geometric Elements and Topology

The Figure at the right is a polygon map theme with polygons A, B, C, and D. The polygons are constructed from arcs 1 through 7. The arcs are composed of Nodes N 11 through N 14. The topology of the map is built upon graphical analysis of the georeference coordinates of the nodes and the arcs/polygons that they build.



The table below shows a typical topological framework for the spatial relations. The abbreviations are as follows:

Fnode The node at the beginning or start of an arc, "From Node"
Tnode The node at the end of an arc, "To Node"
Arc# The internal number assigned to identify the arc
Lpoly Attributes of the Left Polygon while "driving" from the Fnode to Tnode, along the arc.
Rpoly Attributes of the Right Polygon while "driving from the Fnode to Tnode, along the arc.

Exercise to complete. Based on the answer model for the first row below, complete the topological tables for the map to the right.

Arc Node List (clockwise)

Arc#	Fnode	Tnode
1	11	12
2	12	13
3	12	15
4	13	15
5	15	14
6	15	16
7	14	11

Arc Coordinate List

Arc#	x,y Coordinates
1	(0,9) (2,9)
2	(2,9) (8,9)
3	(2,9) (4,2)
4	(8,9) (4,2)
5	(4,2) (1,2)
6	(4,2) (4,0)
7	(1,2) (0,9)

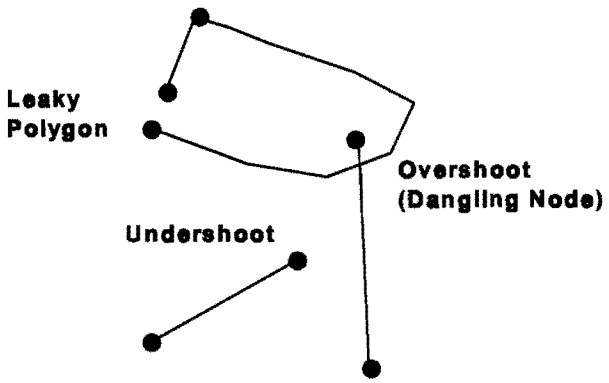
Arc Polygon List

Arc#	Lpoly	Rpoly
1	Polygon D	Polygon B
2	Polygon D	Polygon A
3	Polygon B	Polygon A
4	Polygon A	Polygon D
5	Polygon B	Polygon C
6	Polygon C	Polygon D
7	Polygon C	Polygon B

D. Topological Errors
   1. topological errors arise when nodes and arcs are not properly "snapped" to one another or aligned
   2. Error Types
      a. dangling nodes - nodes dangle in space without being snapped to another node
      b. undershoots - nodes are short of being snapped
      c. overshoots - nodes are long on being snapped
      d. leaky polygons - polygons are not closed, nodes are not properly snapped

See diagram below for examples

Kathryn Roberts
01/14/13



IV. Map Scale, Spatial Resolution, and Spatial Data Accuracy

A. Map scale is an indicator of map accuracy
   1. The smaller the scale, in general, the lesser the accuracy, and vice versa
      a. e.g. map accuracy at 1:100,000 scale is much less than 1:24,000 scale

B. Locations Accuracy and Topological Accuracy in GIS
   1. Location Accuracy - measures the error in the absolute position of a map point or feature relative to real world, georeference coordinates.
   2. Topological Accuracy - a measure of the error in topology and attribute features of map features

C. USGS Map Standards for Accuracy
   1. USGS maps are tested and standardized so that there is no more than 10% of total position points can be more than 0.02 inches (0.5 mm) out of position at the prevailing map scale.

In Class Exercise

At a scale of 1:65,000, 0.02 inches on the map represents how much distance on the ground in meters? Show all of your work.

$0.02 \times 65{,}000 = 1300 \text{ in} \left(\frac{2.54 \text{ cm}}{1 \text{ in}}\right)\left(\frac{\text{m}}{100 \text{ cm}}\right) = \boxed{33.02 \text{ m}}$

Given a scale of 1:24,000, 30 m error on the ground would represent how many millimeters of error on the map? Show all of your work.

$\frac{30}{24{,}000} = .00125 \text{ m}\left(\frac{1000 \text{ mm}}{\text{m}}\right) = \boxed{1.25 \text{ mm}}$

Given a scale of 1:24,000 and a spatial feature resolution of 10 m, how many inches of resolution does this represent in map units? Show all of your work.

$\frac{10 \text{ m}}{24000} = 4.16 \times 10^{-4} \text{ m} \left(\frac{3.28 \text{ ft}}{1 \text{ m}}\right)\left(\frac{12 \text{ in}}{\text{ft}}\right) = \boxed{.0164 \text{ in}}$

Kathryn Roberts

(a) RMS listed for each control point with an average for all points

RMS for a tic = sqrt [(actX - estX)^2 + (act Y-estY)^2]

Average RMS for all Points = sqrt [(sum of squares of deviation in X and Y) / (no. of control points)]

(i.e. for average, add up all of the (actX - estX)^2 and (act Y-estY)^2 caluclations and divide by the total number of control points, take the square root)

where
actX = actual X coordinate location of point
actY = actual Y coordinate location of point
estX = estimated X coordinate location of point
estY = estimated Y coordinate location of point

In-Class Exercise

Calculate the RMS for each of the control tics below, and the average RMS. Coordinates are in UTM meters. Show all of your work.

Control Pt.	actX	estX	actY	estY
1	481023.334	481029.71	4966231.786	4966234.25
2	481592.256	481596.89	4966834.765	4966854.32
3	481018.448	481044.76	4966245.354	4966251.87
4	481402.309	481499.72	4966845.274	4966839.71

---

① $\sqrt{[(481023.334 - 481029.71)^2 + (4966231.786 - 4966234.25)^2]} = \sqrt{(-6.376)^2 + (-2.464)^2} = \sqrt{46.724672} = \boxed{6.84\text{ m}}$

② $\sqrt{(481592.256 - 481596.89)^2 + (4966834.765 - 4966854.32)^2} = \boxed{20.10\text{ m}}$

③ $\sqrt{(481018.448 - 481044.76)^2 + (4966245.354 - 4966251.87)^2} = \boxed{27.11\text{ m}}$

④ $\sqrt{(481402.309 - 481499.72)^2 + (4966845.274 - 4966839.71)^2} = \boxed{97.57\text{ m}}$

Avg RMS = $\boxed{37.91\text{ m}}$

2F: Introduction to Georeferencing, Map Themes and Spatial Associations
7 pages

Kathryn Roberts
01/10/13

ES341 Introduction to Georeferencing, Map Layers and Spatial Associations

One of the basic principles of GIS is the notion of map layers (thematic layers of information; points, lines or polygons) that are georegistered in a common coordinate space. Georeferencing allows layers to be placed in a unified geographic coordinate system, so that map elements (e.g. bedrock geology polygons) and related attribute information (e.g. rock type, lithology, age) are properly aligned and overlie one another in spatial context. Georeferencing and thematic layers provide a power framework to conduct spatial analyses within and between coverages; useful for such activities as city planning, zoning, hazards mitigation, etc.

This exercise provides a hands-on introduction to georerencing, projected 2-D coordinate systems and layered map themes. Attached are four analog map-layer transparacencies for the Monmouth-Independence area (attached handouts). The four layers include (1) Monmouth-WOU Roads, (2) WOU Buildings, (3) Monmouth Geology, and (4) Monmouth Flood Hazard Zonation. The following is the key for the geology and flood polygon identifiers:

Geology Code

ID	Explanation
Qtlb	Quaternary Alluvium (bottomlands)
Qtm	Quaternary Alluvium (middle terrace)
Qth	Quaternary Alluvium (high terrace)
Ts	Eocene Spencer Formation

Flood Hazards Code

ID	Explanation
NO	Not in flood plain
FL	Part of zone AE – Floodway (active annually)
A	100 year flood
AE	100 year flood with elevation determined
X	500 year flood

The projected map referencing system for all four layers is Oregon State Plane North in feet **(NOTE: THE TRANSPARENCIES HAVE SCALE LISTED UNITS IN "METERS", THIS IS A TYPO, THE BAR SCALE IS IN FEET)**. The neatline box is set at the same dimensions and scale in each of the four map layers. Examine the maps / transparencies, complete the following tasks.

1. Determine the fractional scale of the Monmouth map layers. Show all of your math work.
   $.66\,in = 1000\,ft$ $1000\,ft \left(\frac{12\,in}{ft}\right) = 12{,}000\,in$ $\frac{.66\,in}{.66\,in} = \frac{12{,}000\,in}{.66\,in} = 1:18{,}000$
2. The upper left corner of the neat box is located at the following State Plane Coordinate

Easting: 7,488,836 ft Northing: 449,324 ft

a. Using map scale, engineers scale and ruler, determine the following state plane coordinates for the other 3 corners of the neat box. Show all of your math work.

	Easting (ft)	Northing (ft)
Upper Right (NE) Corner	7,498,361	449,324
Lower Right (SE) Corner	7,498,361	438,224
Lower Left (SW) Corner	7,488,836	438,224

Northing - $7.4\text{in} \times 18{,}000\left(\frac{\text{ft}}{12\text{in}}\right) = 11{,}100$

Easting - $6.35\text{in} \times 18{,}000\left(\frac{\text{ft}}{12\text{in}}\right) = 9{,}525$

b. Calculate the total area of the map coverage, as defined by the bounding rectangular neatline, in square feet. Show all of your math work.

$9{,}525\text{ft} \times 11{,}100\text{ft} = 105{,}727{,}500\text{ft}^2$

c. Calculate the total area of the map coverage, as defined by the bounding rectangular neatline, in square kilometers. Show all of your math work.

$105{,}727{,}500\text{ft}^2\left(\frac{\text{m}}{3.28\text{ft}}\right)^2\left(\frac{\text{km}}{1000\text{m}}\right)^2 = 9.827\text{ km}^2$

d. Calculate the total area of the map coverage, as defined by the bounding rectangular neatline, in hectares. Show all of your math work.

$9.827\text{ km}^2\left(\frac{100\text{Ha}}{\text{km}^2}\right) = 982.7\text{ Ha}$

3. Overlay and align (georegister) the Monmouth Roads layer (transparency) on top of the WOU Buildings layer (transparency). Using the red transparency marker, draw a rectangular box on the Roads layer that circumscribes the footprint distribution of the WOU Buildings layer below. Label the box you've drawn "WOU Boundary".

a. Calculate the area of the rectangular box / building footprint you've drawn in square feet. Show all math work and conversions.

$1.6\text{in} \times 18{,}000\left(\frac{\text{ft}}{12\text{in}}\right) = 2400\text{ft}$ $2400\text{ft} \times 3000\text{ft} = 7{,}200{,}000\text{ft}^2$

$2\text{in} \times 18{,}000\left(\frac{\text{ft}}{12\text{in}}\right) = 3000\text{ft}$

b. Calculate the area of the rectangular box / WOU boundary polygon you've drawn in square kilometers. Show all math work and conversions.

$7{,}200{,}000\text{ft}^2\left(\frac{\text{m}}{3.28\text{ft}}\right)^2\left(\frac{\text{km}}{1000\text{m}}\right)^2 = .67\text{ km}^2$

c. Calculate the area of the rectangular box / WOU boundary polygon in hectares. Show all math work and conversions.

$.67\text{ km}^2\left(\frac{100\text{Ha}}{\text{km}^2}\right) = 66.9\text{ Ha}$

4. Overlay and align (georegister) the WOU buildings layer on top of the Monmouth Roads layer. Using your mental geography of Monmouth and the Monmouth 7.5-min quad, identify Main Street and Monmouth Ave. on the Roads Layer. Now using the blue transparency marker, trace/draw both streets onto the WOU Buildings layer, from end to end as shown on the map extent.

5. Identify, outline and label the Natural Science Building on the WOU layer (transparency). Identify, outline and label the "New PE" Building on the north side of the stadium.

   a. Measure the center-to-center distance between the Natural Science Building and New PE in feet.
   .9 in × 18,000 $\left(\frac{ft}{2 in}\right)$ = 1350 ft.

   b. Measure the center-to-center distance between the two buildings in kilometers, show all of your math work.
   1350 ft $\left(\frac{m}{3.28 ft}\right)\left(\frac{Km}{1000 m}\right)$ = .4115 km

6. Overlay and align (georegister) the Monmouth-WOU Geology layer on top of the Monmouth Flood Zones layer (transparency). Outline all of the "no flood zones" polygons (map unit "NO") on the geology overlay using a blue marker pen.

7. Overlay and align (georegister) the Monmouth-WOU Geology layer on top of the Monmouth Flood Zones layer (transparency). Group the FL (floodway), A-AE (100 yr floodplain), and X (500 yr floodplain) hazards units, and outline them with the red marker pen on the geology overlay.

8. Overlay and align (georegister) the Flood Hazard layer on top of the WOU Buildings layer. On the flood hazard overlay, use a compass and ruler to draw a circle 2000 feet in diameter, with center located in the middle of the Natural sciences building.

9. Answer the following questions:
   a. Which geologic map units are associated with flood hazards in the Monmouth area? Explain your answer in terms of geologic map associations with flood hazards.
   Qtlb - the lowest river terrace is the closest associated with flood hazards, as it is the most recent rock unit to be an active flood plain
   b. Which geologic map units are associated with unit "NO" no flood hazards in the Monmouth area? Explain your answer, what geologic reasons are associated with an "NO" hazard designation.
   Qtm, Qth which are older flood plains and are thus further from the active flood plain
   c. What is the probability of the Natural Sciences building being flooded by the Willamette River in the next 100 years? In the next 500 years? Explain your answer and line of reasoning.
   The probability is very low as the entire WOU campus is within the No flood (Qtm/Qth) area.

10. Using the Monmouth Geology layer and your calculated map area from 2b above, determine the percentage of the map area covered by Quaternary Alluvium (Qtlb+Qtm+Qth) vs. Eocene Spencer Formation (Ts)

a.	Total Map Area	105,727,500	sq. ft	100 % of Total
b.	Total Qa Area	101,407,500	sq. ft	95.9 % of Total
c.	Total Ts Area	4,320,000	sq. ft	4.1 % of Total

11. Given your calculated areas and percentages in 10 above, hypothesize as to the potential for the occurrence of alluvial water-bearing aquifers in the WOU-Monmouth area. Explain your answer and line of reasoning.
The WOU-Monmouth area would likely not be a good region for aquifers as the majority of the geology is Quaternary Alluvium and only a small portion (~4%) is bedrock with sufficient aquiclude layers (like shale) to trap water and form an aquifer.

Monmouth-WOU Roads

7,488,836

6.35in

7,499,361

24

WOU Boundary

7.4in

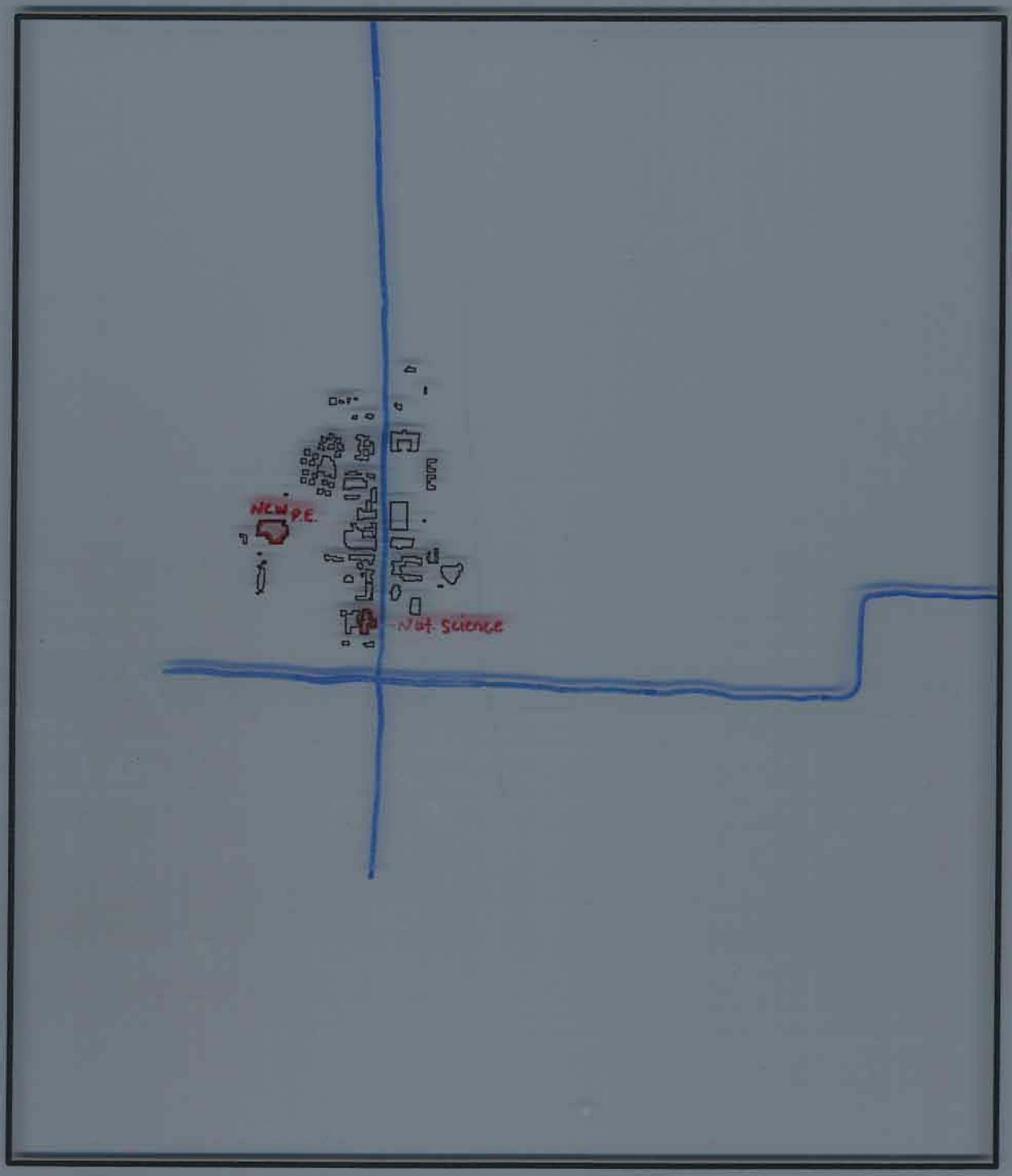
24

N

1000 0 1000 2000 Meters

.66 in = 1000 ft.

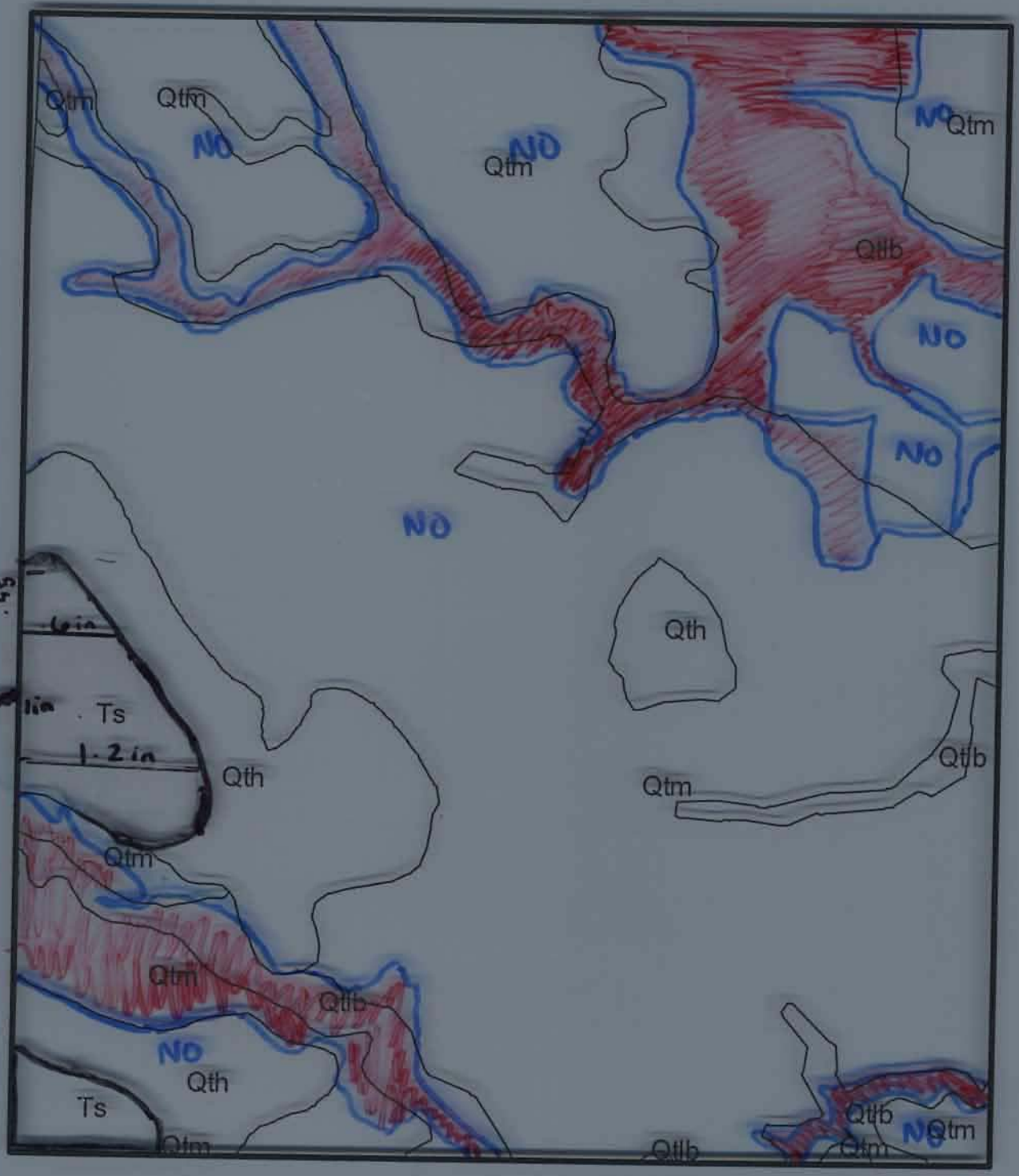
WOU Bldgs



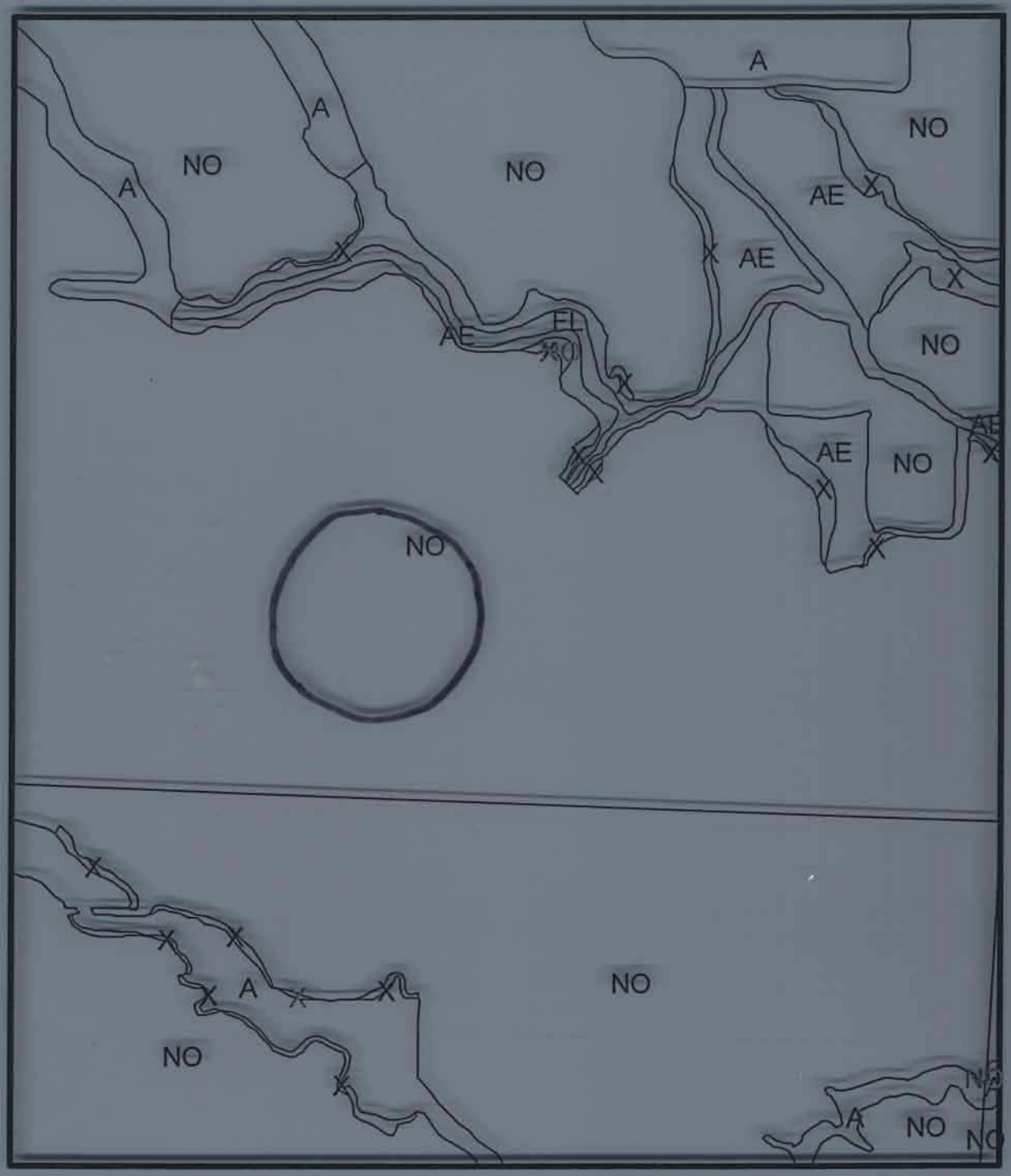
1000 0 1000 2000 ~~Meters~~ Ft

N

Monmouth-WOU Geology



Monmouth Flood Zones



3C: In-Classes Exercises from "Map Projections and Coordinate Systems"
Note Set
In-Class Exercise: Spatial Scales and Digital Image Resolution
In-Class Exercise - Measuring Great Circle Distances on the Globe
2 pages

B. Map Resolution - ability to resolve surface features on a map, depends on scale

Example of Map Resolutions Based on Line Width of 0.5 mm

Line Width (0.5 mm)	Scale	Resolution	Smallest Detectable Object	Area (sq. m) (Minimum)
0.5	1:24,000	12 m	24 m	576
0.5	1:50,000	25 m	50 m	2500
0.5	1:250,000	125 m	250 m	62,500
0.5	1:5,000,000	2500m	5000 m	25,000,000

In-Class Exercise: Spatial Scales and Digital Image Resolution

In remote sensing, a given "scene" is a particular portion of the Earth's surface that is captured in and aerial photograph or satellite image. The digital resolution of the "scene" is the amount of land area that is covered in 1 pixel of the image. Each pixel is assigned a digital color code or shade. When all pixels are combined together a resultant digital image is produced. The resulting image is arranged in a series of columns and rows of pixel boxes.

Problems:

(1) Given a scale of 1:48,000 on a topographic map, a square plot of land covers 8 inches by 8 inches in map units.

Determine side distances of the plot in meters. $8\text{ in} \times 48{,}000 = 384{,}000'' \left(\frac{2.54\text{cm}}{\text{in}}\right)\left(\frac{\text{m}}{100\text{cm}}\right) = 9753.6\text{m}$

Determine the area of the plot is square kilometers. $9753.6\text{m} \times 9753.6\text{m} = 95132712.96\text{m}^2 \left(\frac{\text{km}}{1000\text{m}}\right)^2 = 95.13\text{km}^2$

(2) Determine the number of rows and columns in an image of the plot with the following spatial resolutions:

	No. Rows	No. Columns
1 - meter resolution	9754	9754
10-meter resolution	976	976
30-meter resolution	326	326
100-meter resolution	98	98

(3) If you had an image of the plot that was comprised of 2500 rows and columns, what is the resulting spatial resolution?

$\frac{2500 \text{ rows}}{2500} = \frac{9753.6\text{m}}{2500}$

1 row = 3.9 m

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01/23/13

In-Class Exercise - Measuring Great Circle Distances on the Globe

Definition of Great Circle - a line passing between any two points on the globe, which can form an angle with the vertex at the center of the Earth (e.g. all meridians are great circles, the only parallel that is a great circle in the 0 degree lat parallel, or equator)
Equation for Great Circle Distance on a Sphere Between any Two Points, A and B on a sphere:

$$\cos(D) = (\sin(a)*\sin(b)) + (\cos(a)*\cos(b)*\cos|\gamma|)$$

where D = angular distance in degrees between two points (1 degree on great circle = 69 miles), a and b are the geographic latitudes of points A and B, $|\gamma|$ = the absolute value of the difference in longitude between pts. A and B

Problem: determine the great circle distance in miles between Nome, AK and Miama, Fla. using the following positions.

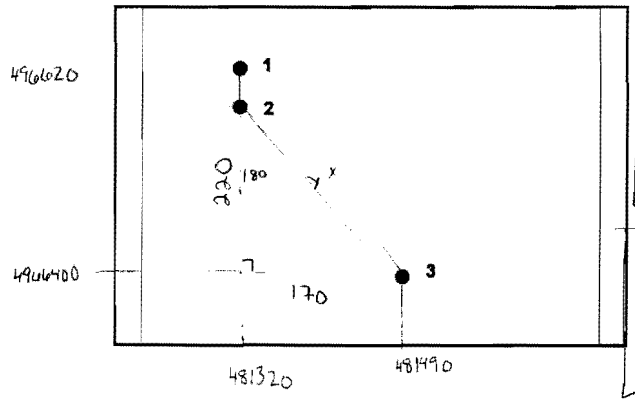
63.5°
A Nome lat = 63° 30' N long = 165° 20' W
B Miama lat = 25° 45' N long = 80° 11' W
25.75
37.75
80.185
85.150

hint: you must convert your lat and long to decimal degrees

$(\sin(63.5)\cdot\sin(25.75)) + (\cos(63.5)\cdot\cos(25.75)\cdot$
$\cos(85.150) = .4227 = \cos(D)$
$64.989° = D$
$\times 69$ — 4484.3 miles

Part 2 - Examine the map figure below with pt. locations 1, 2, and 3. The points are located at the following UTM coordinates

	Easting (m)	Northing (m)
pt. 1	481320	4966620
pt. 2	481320	4966580
pt. 3	481490	4966400



1-3
$x^2 = 170^2 + 220^2$
$x^2 = 77300$
$x = 278.03$

2-3
$y^2 = 170^2 + 180^2$
$y^2 = 61300$
$y = 247.6$

Use Pythagorean's theorem to determine the distances between the following point combinations (SHOW all of your math work!):

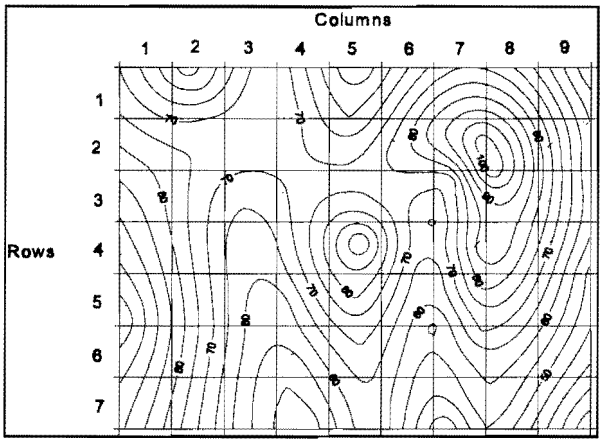
Distance 1-2 (meters) = 40 m
Distance 1-3 (meters)= 276.03 m
Distance 2-3 (meters)= 247.6m
Distance 3-3 (meters)= 0 m

3D: In Class Raster Grid Exercise, p. 3 "Raster Data Structure" Class Notes
1 page

Kathryn Roberts

In-Class Exercise:

(1) The vector-line topographic map below is overlain with a raster grid of columns and rows. Determine the elevation of the center point of each cell in integer form, then fill in the grid-table below and create a raster-based, grid DEM data set.



	1	2	3	4	5	6	7	8	9
1	75	80	70	72	82	73	81	81	60
2	77	75	65	70	72	77	90	92	72
3	77	72	72	71	75	72	77	90	70
4	72	74	71	72	87	72	75	84	65
5	66	75	80	75	75	66	72	73	55
6	67	75	82	83	73	60	61	62	50
7	72	74	83	90	77	65	67	54	40

(2) Assume that the scale of this map is 1:10,000, based on the grid structure, what is the resolution of the DEM in meters? (hint: you will need a ruler for this).

$2.45\text{ in} \times 10{,}000 = 24{,}500\text{ in}\left(\frac{2.54\text{ cm}}{1\text{ in}}\right)\left(\frac{1\text{ m}}{100\text{ cm}}\right) = 622.3\text{ m} / 9 = \boxed{69.14\text{ m}}$

(3) Based on the map and grid layout, are the rows and columns of equal dimension?

Yes, there are equal dimension, but not equal length.

(4) Assume that the UTM coordinate of the upper left grid cell is 464091.499289, 4968737.872110 and that the grid system is unrotated. Write out the associated world file for this hypothetical raster-grid data structure (i.e. in the space below, what will the world file look like?)

NAD_1983_UTM_Zone10_South

3E: Price Text Chapter 2 (Mapping GIS Data) Reading and Tutorial Exercises

19 pages

Tutorial Screen Shots

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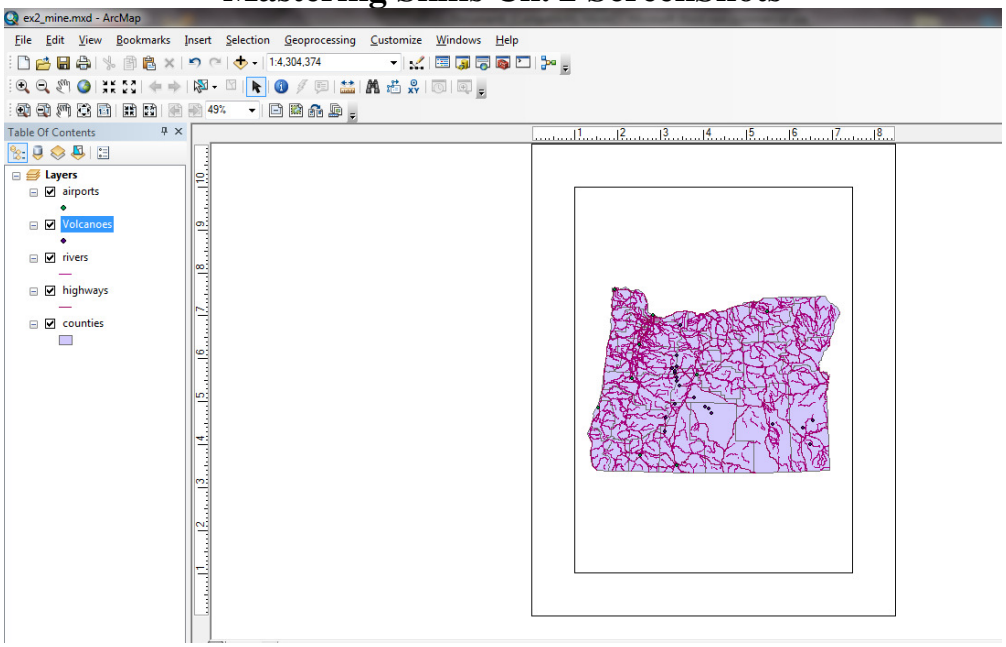
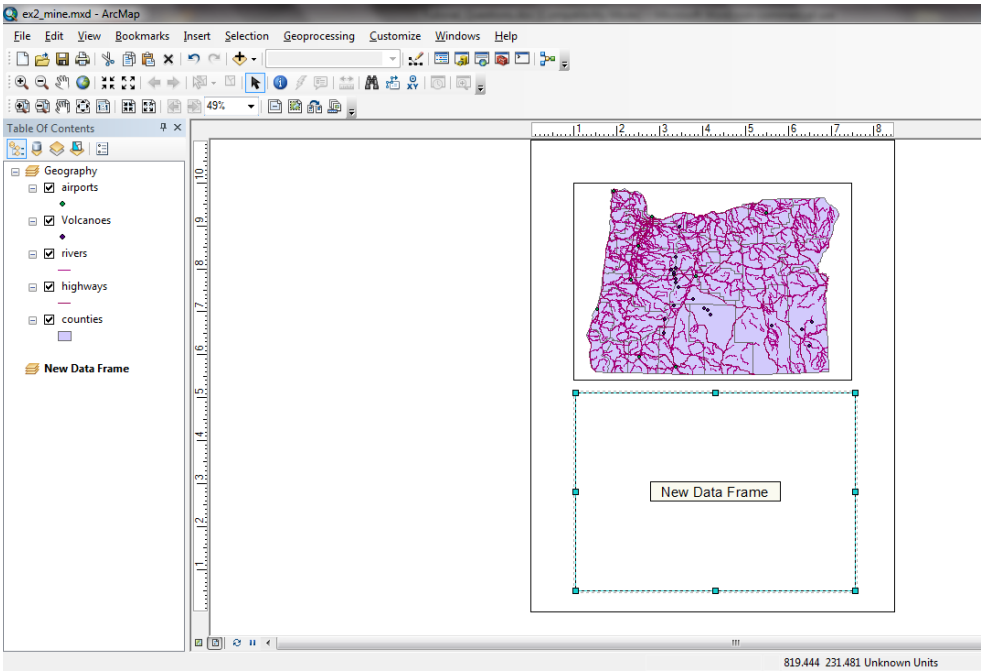
ES 341 - GIS

Mastering Skills Ch. 2 ScreenShots



Pg. 55-56, adding data layers onto template layout.



Pg. 56-57, adding a second data frame to the existing layers page

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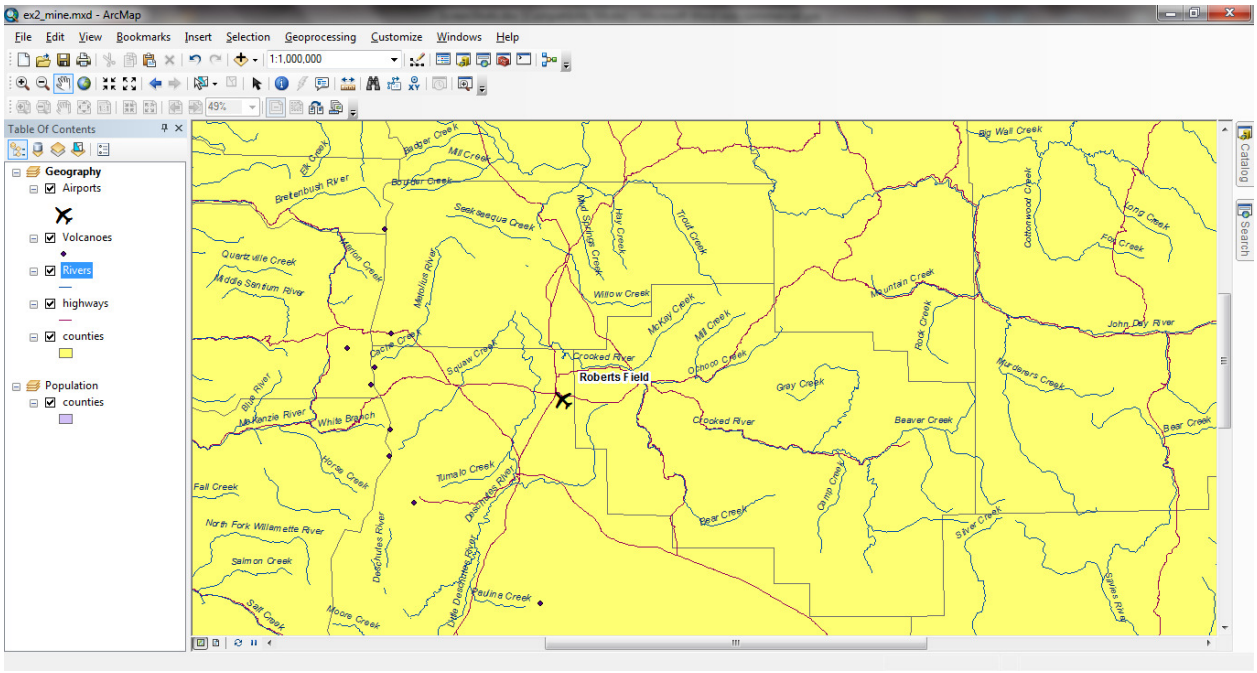
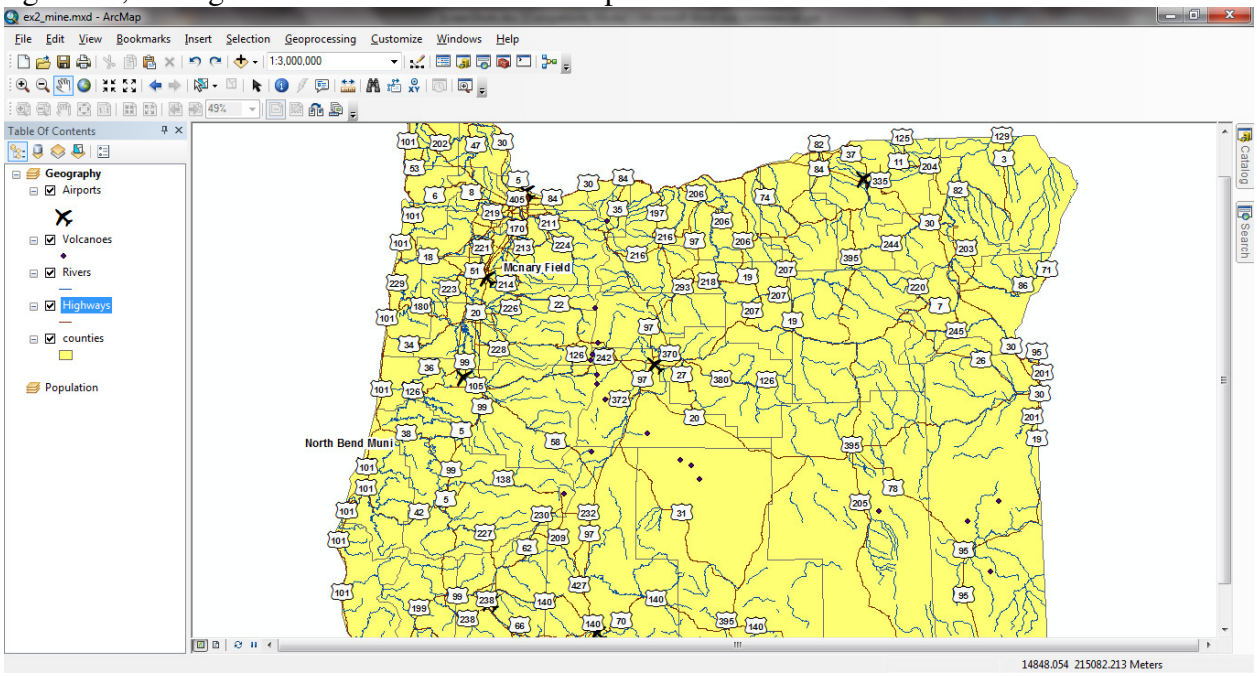


Pg.58-59, adding scaled labels to rivers and airports



Pg. 60, adding scaled highway labels with US Hwy Symbols

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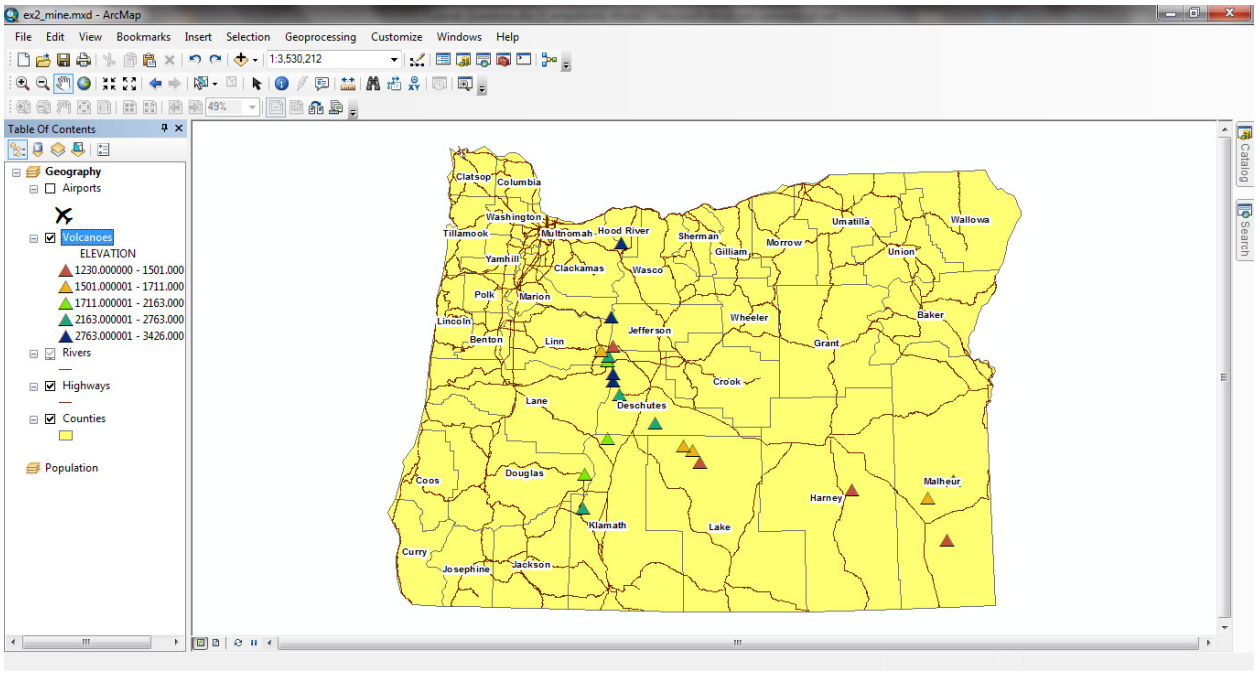
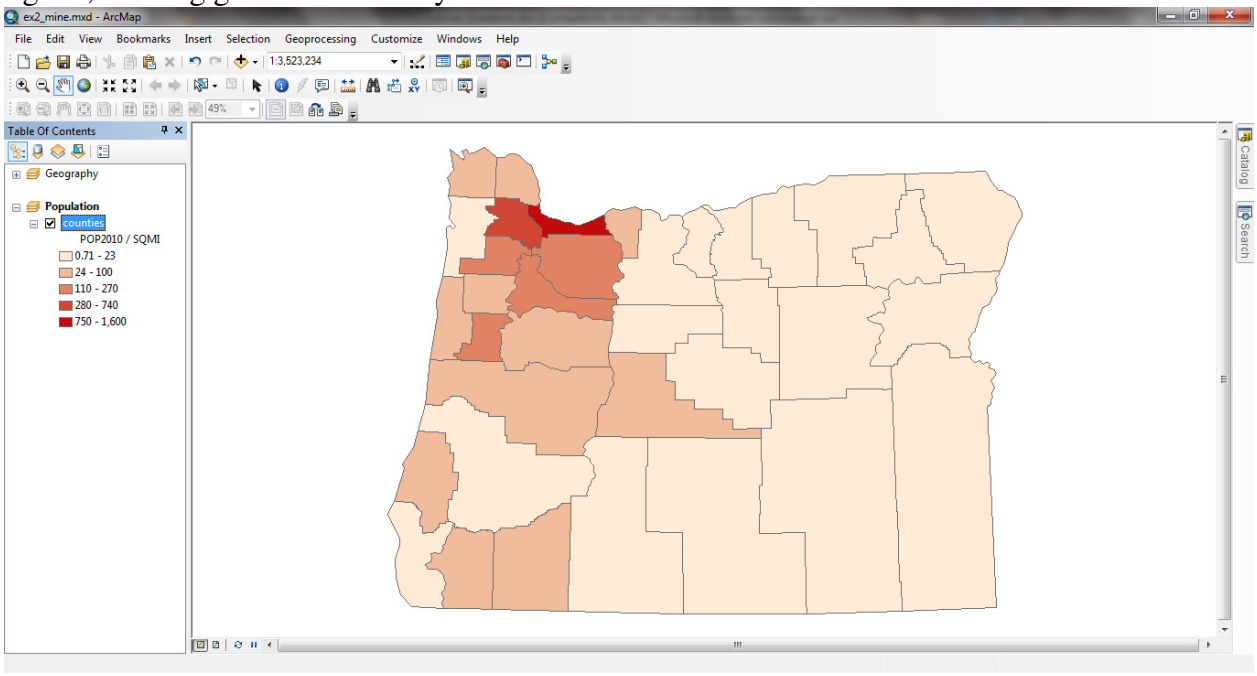


Pg. 61, creating graduated color symbols for volcanoes based on Elevation.



Pg. 64, Creating graduated color map for Oregon population by County.

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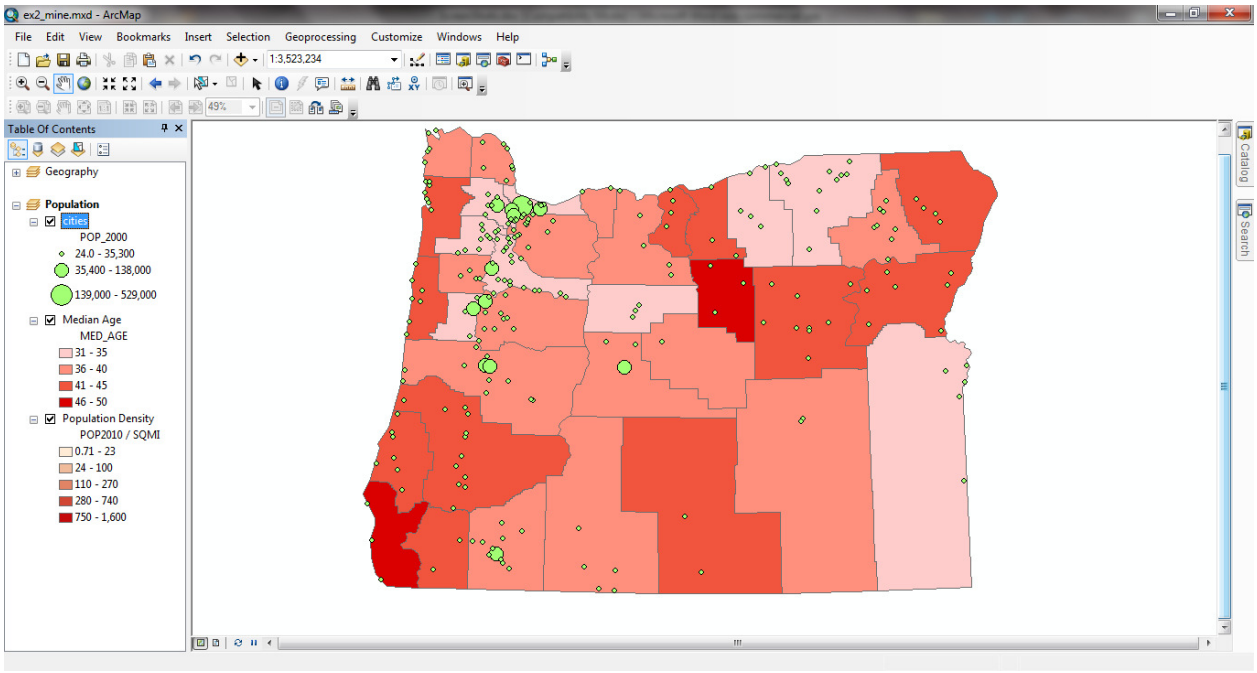
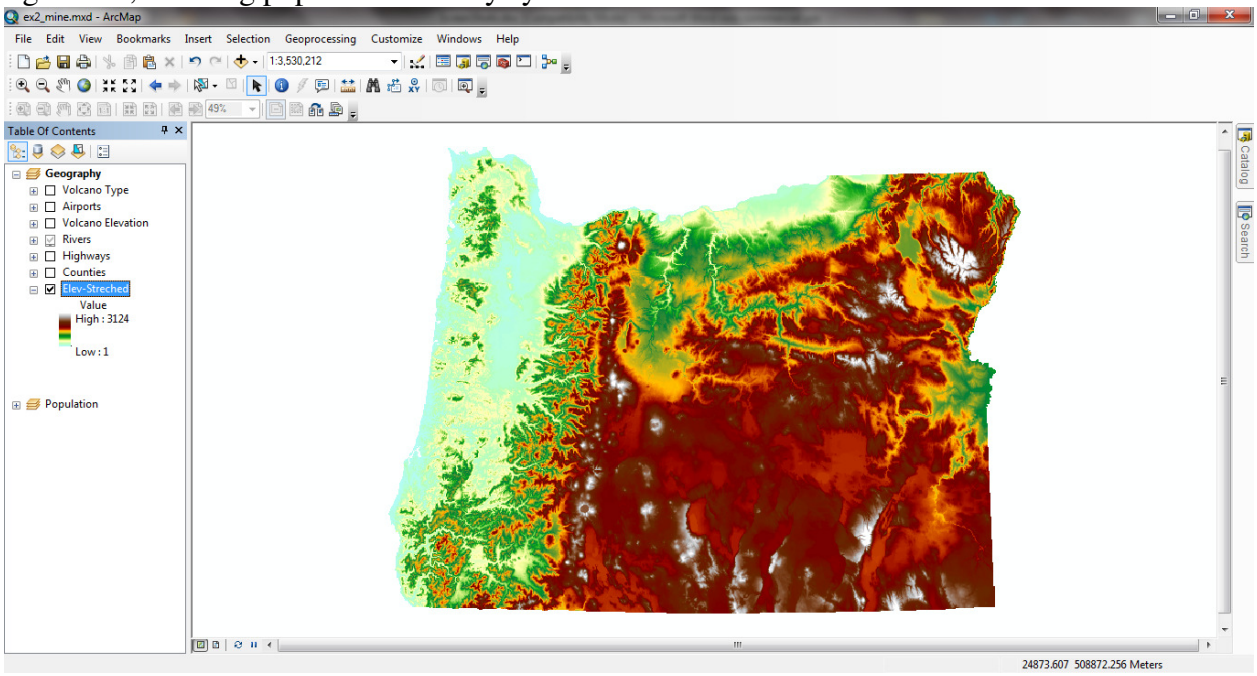


Pg. 65-66, Creating population density symbols



Pg. 66-67, Creating a stretched elevation map

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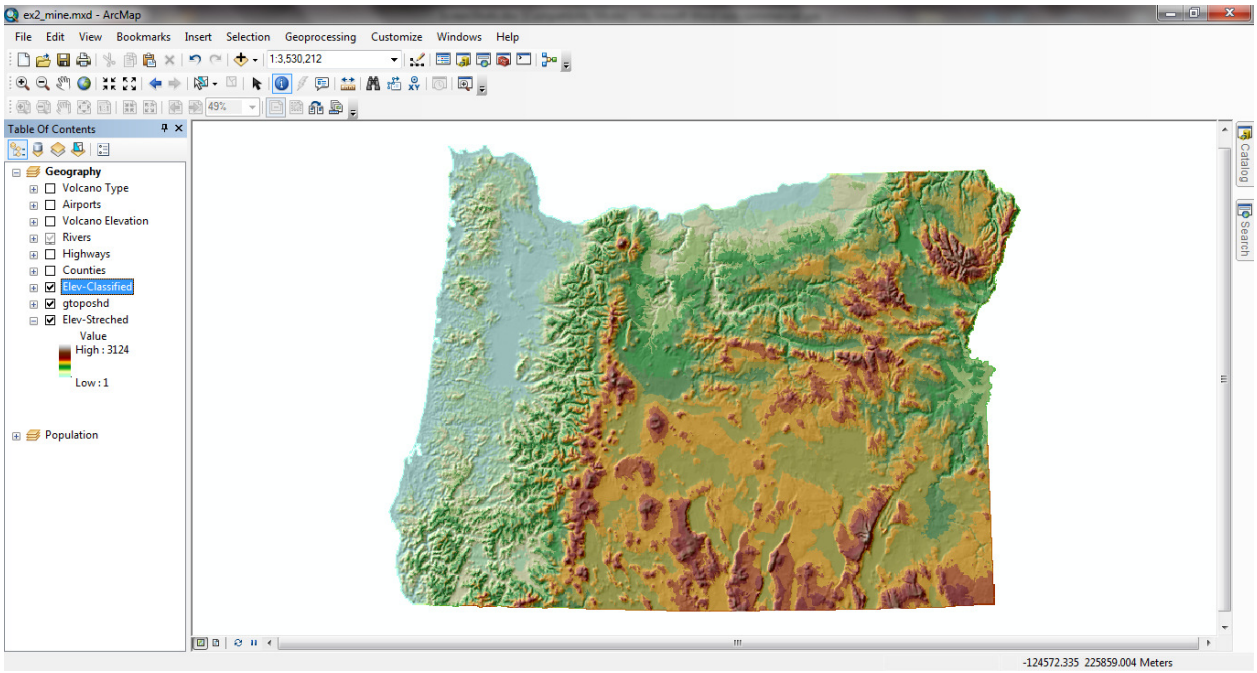
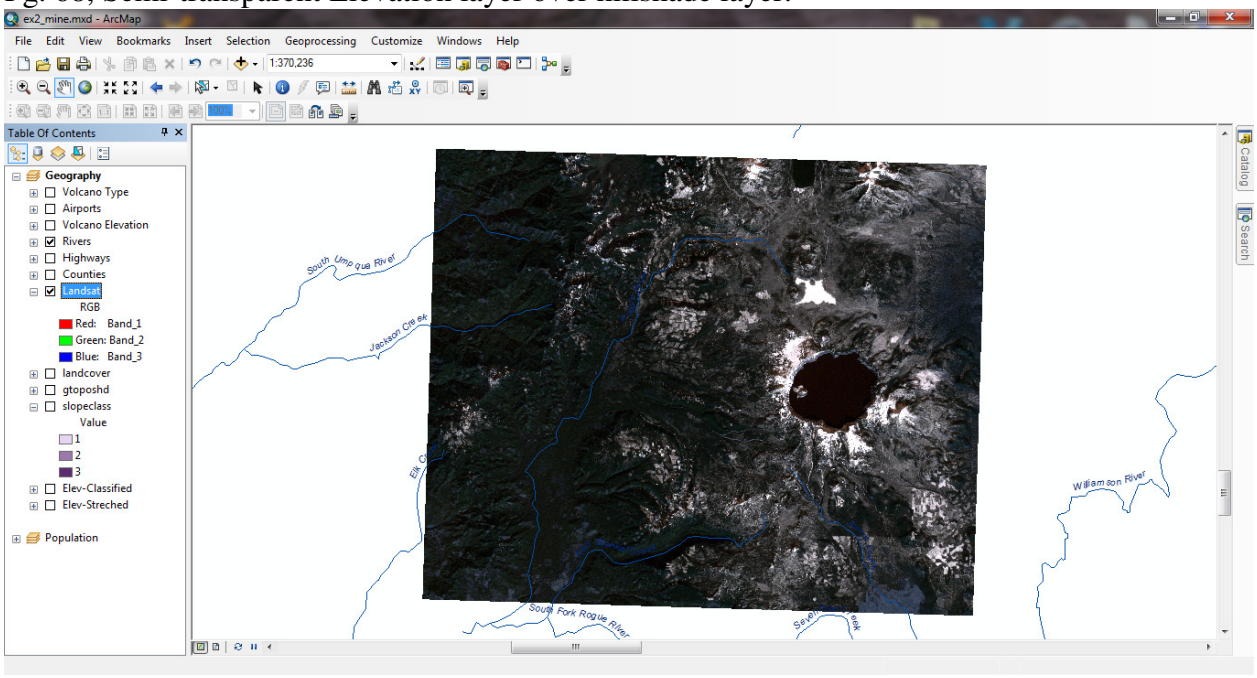


Pg. 68, Semi-transparent Elevation layer over hillshade layer.



Pg. 69, Crator Lake Landsat image.

Tutorial In-Text Questions

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Mastering Skills Ch. 2 Tutorial Questions

Pg. 56:

1. What is the name of the coordinate system for volcanoes?
   NAD_1983_Oregon_Statewide_Lambert.

Pg. 60:

2. What is the data type of these two attribute fields in the volcanoes feature class?
   ELEVATION: Interval. TYPE: categorical.

Pg. 63:

3. What three values are found in this field? S, I, U. Can you decide what they mean by examining the other fields for clues? S = State Road, U = US Hwy, I = Interstate Hwy.

Pg. 64:

4. What kind of data does population represent? Ratio. What kind of map should be used to display it? Graduated Colors Map.

Pg. 66:

5. What kind of data type is elevation? Interval. What kind of raster display method(s) could be used to display it? Unique values, Classified Elevation, Stretched elevation.

Pg. 68:

6. What type of data does this raster contain? Ordinal. What type of map should be used to display it? Monochromatic color ramp.

Chapter Review Questions

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Mastering ArcGIS Ch. 2 Review Questions (1, 2, 3, 8, 9, 10)

1. A 1:20,000,000 scale map of the United States displays the interstates with a line symbol that is 3.4 points wide. There are 72 points to an inch. What is the uncertainty in the location of the road due to the width of the line used to represent it? Give answer in feet and miles.
   3.4 pts. * (1in/72pts.) * 20,000,000 = 944,444.444 in. * (1ft./12in.) = 78703.7 ft.

   78703.7 ft. * (1 mile/5280ft.) = 14.91 miles

2. For each of the following types of data, state whether it is nominal, categorical, ordinal, interval, or ratio. Explain your reasoning.
   a. Bushels of wheat per county: numeric data, takes on values along a continuous scale
   b. Vegetation type: ordinal data, quantitative, non-numerical values
   c. Average maximum daily temperature: interval data, scale zero is not meaningful
   d. Parcel street address: nominal data, discrete names
   e. Parcel ID number: categorical data, number is used as a code
   f. pH measurements of a stream: interval data, scale has potential negative values
   g. state rank for average wage: ratio data, has a meaningful zero point on scale
   h. number of voters in a district: numerical data, values on a continuous scale
   i. student grade in a class: ordinal data, scale used is not numerical
   j. soil type: ordinal data, quantitative, non-numerical values
3. For each of the following attributes, state whether a single symbol, graduated color, or unique values map would be most appropriate. Explain your reasoning.
   a. Precipitation: graduated color map, numerical data representing a region with different shades able to distinguish amounts within the single category.
   b. Geologic unit: unique values map, information would be stored as categorical data which specific areas representing specific category symbols.
   c. Acres of corn planted per county: single symbol map, symbol denoting amount of single attribute per location.
   d. Rivers: single symbol map, symbol would denote location of feature, but no other distinguishing attributes.
   e. Land use: unique values map, information would be stored as categorical data which specific areas representing specific category symbols.
   f. Household income: graduated symbol map, single values would be placed into categories representing ranges of the same thing.

8. What characters should be avoided when naming GIS files, folders, and map documents?
   a. Any spaces or special characters such as #,@,&, or *

9. Explain the difference between thematic rasters and image rasters.
   a. Thematic rasters represent map features or quantities, typically created by converting features from a vector data set to a raster format. Image rasters are generated by aerial photography and are pictures of the ground.

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10. What does it mean if you find a red exclamation point next to a map layer? How would you fix it?
    a. The exclamation point indicates that the pathname to that layer is broken. This can be fixed by manually re-establishing the correct location of that layer, or avoided altogether by using relative rather than absolute pathways.

Chapter Exercises

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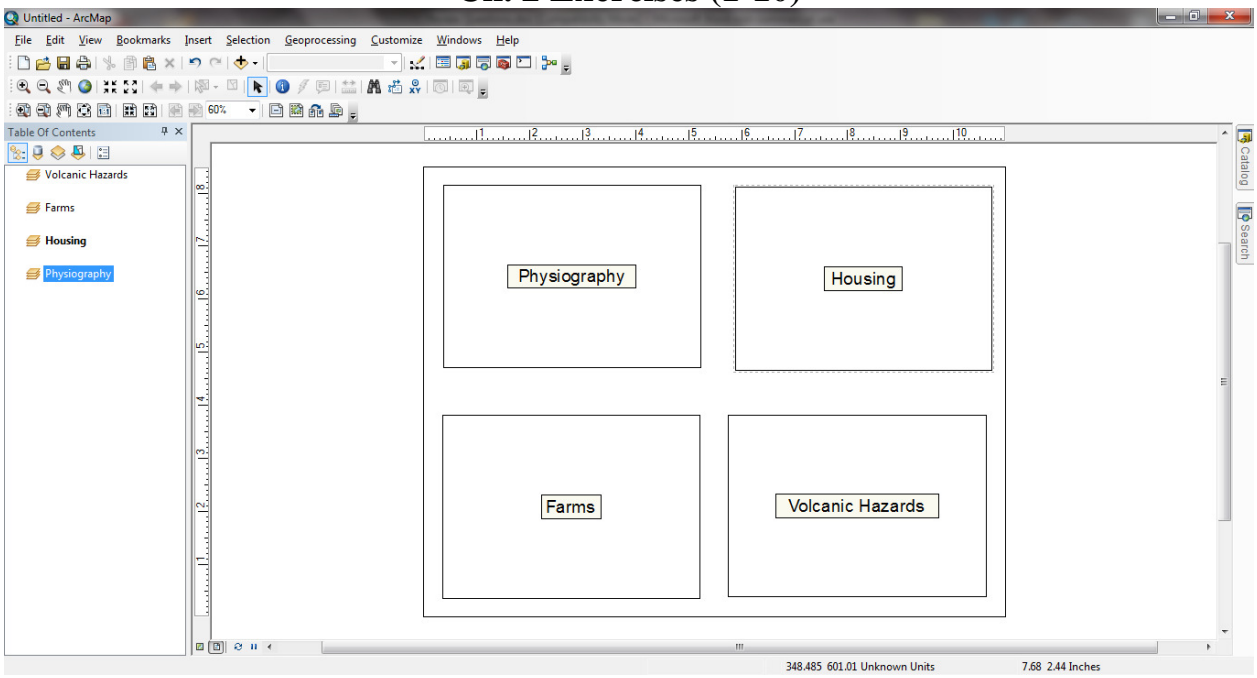
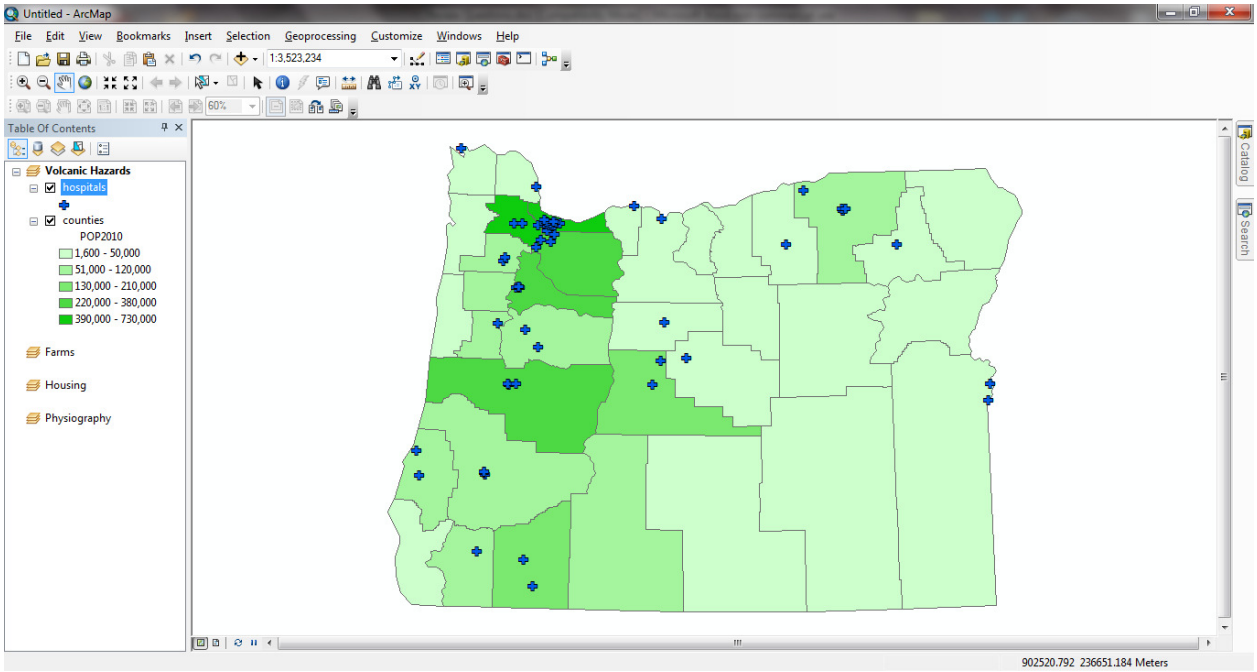
Ch. 2 Exercises (1-10)



1. Blank Map using Letter ANSI A Landscape template, with four data frames



2. Volcanic Hazards Data Frame with OR population density map and hospitals denoted by blue cross symbols.

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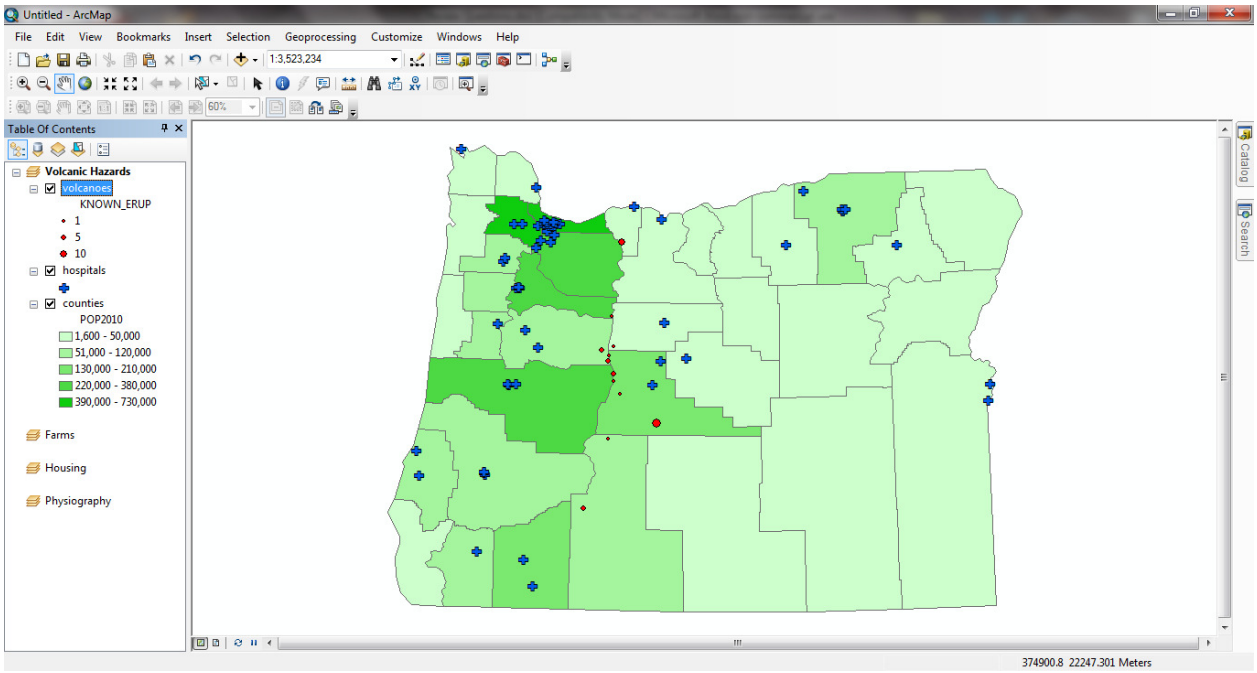
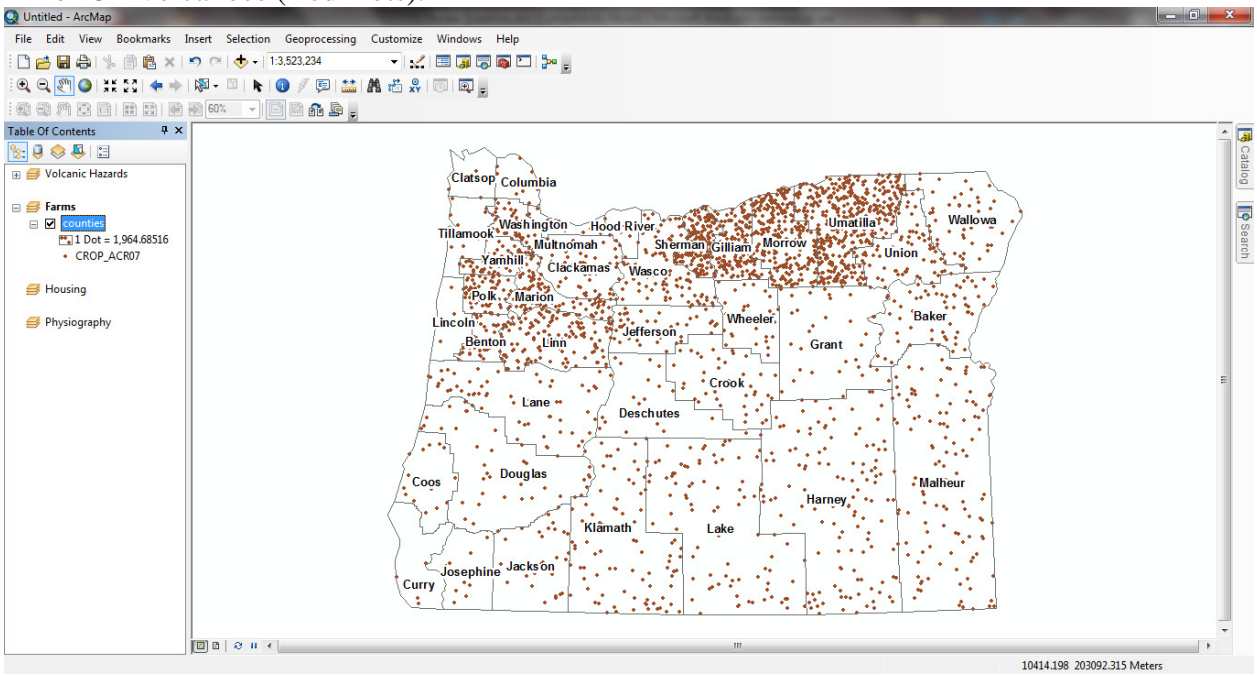


3. Volcanic Hazards Map with added Proportional Symbol map showing Known Eruptions of OR volcanoes (Red Dots).



4. Farms Data Frame showing map of OR with labeled counties and dot density map of farms.

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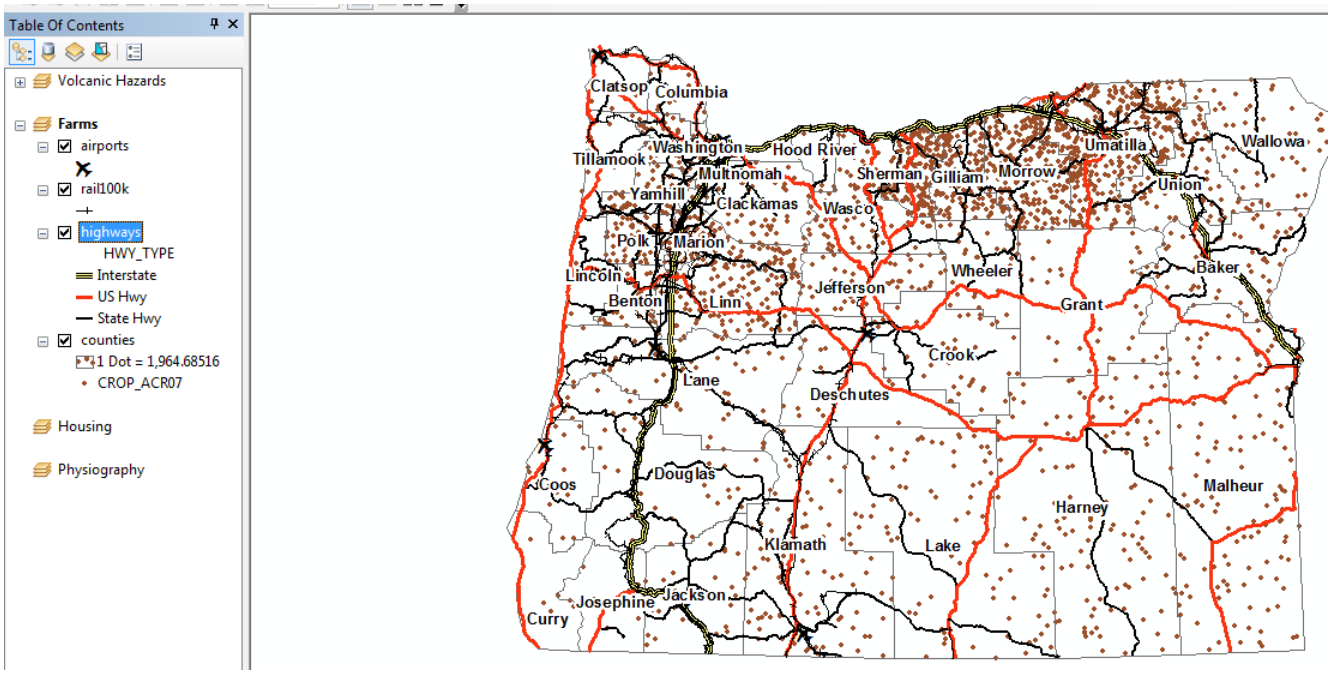
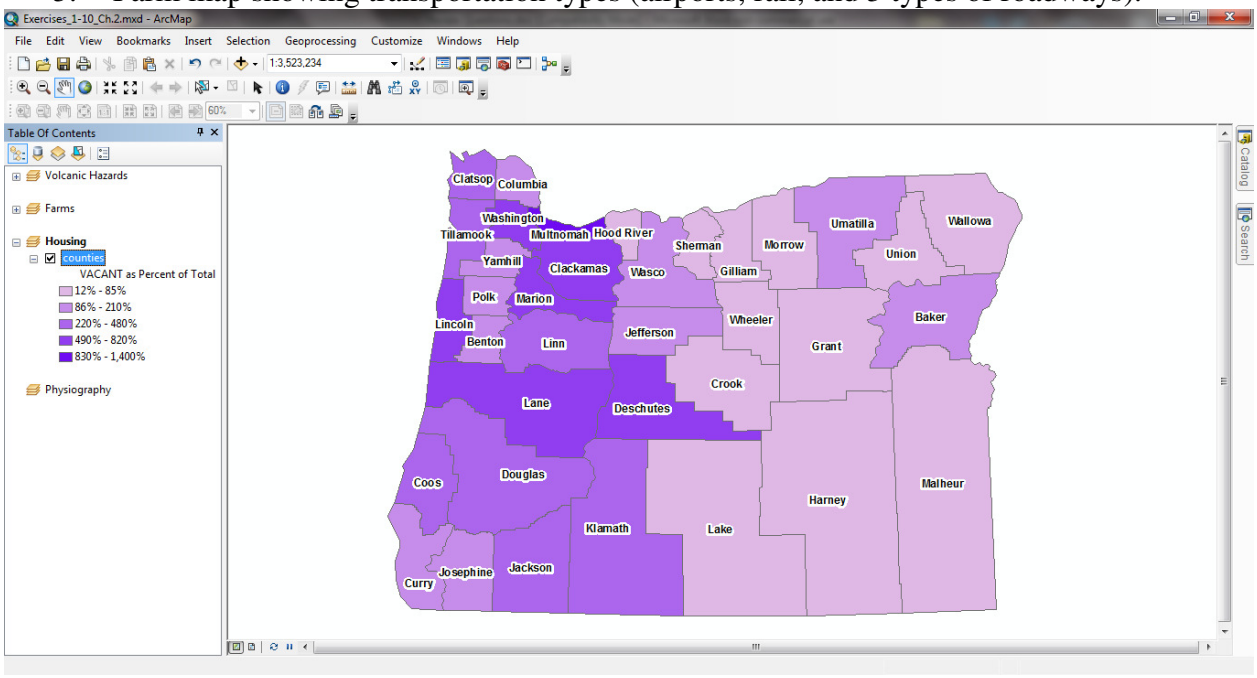


5. Farm map showing transportation types (airports, rail, and 3 types of roadways).



6. Housing Data Fram Map showing vacancy rate (normalized as a percentage of total) per county, with labeled counties.

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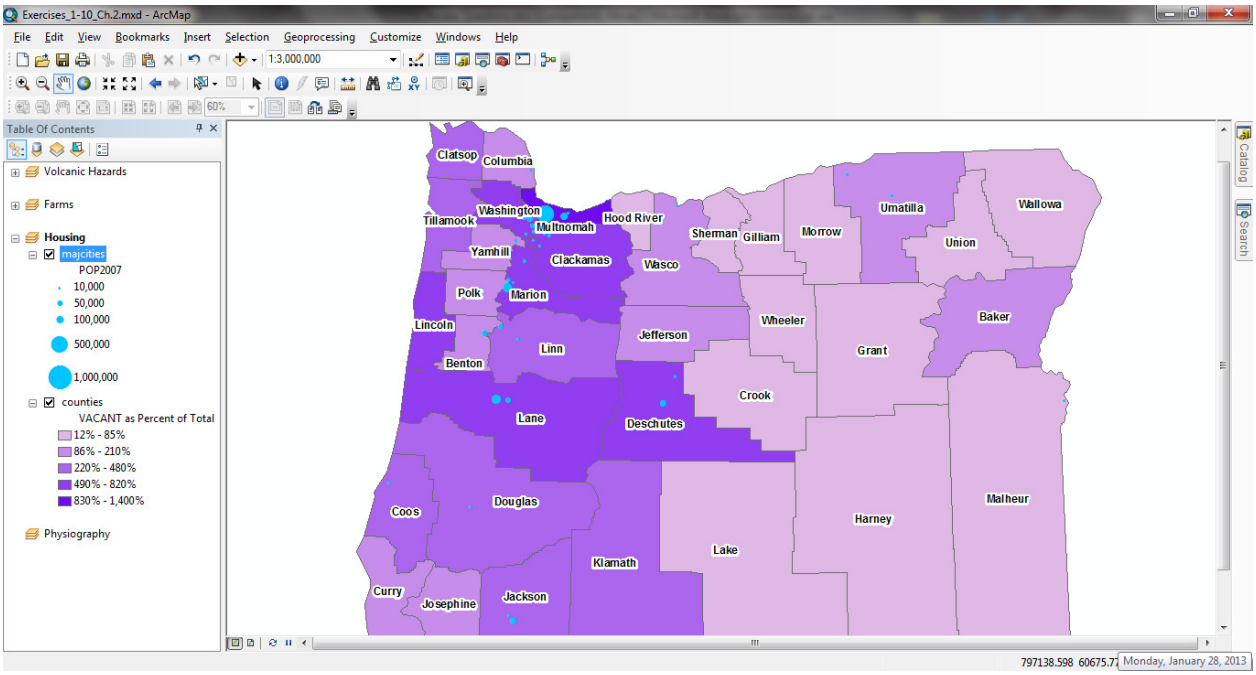
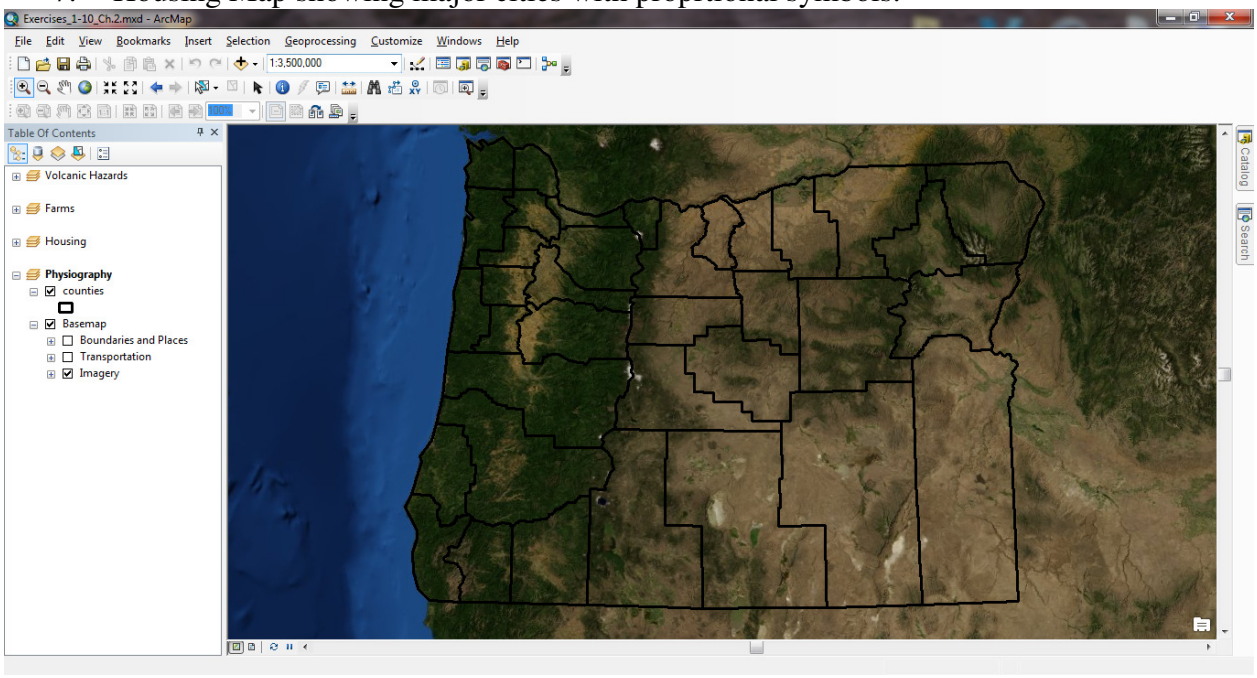


7. Housing Map showing major cities with proprtional symbols.



8. Physiography Map with overlay of OR state and county boundaries.

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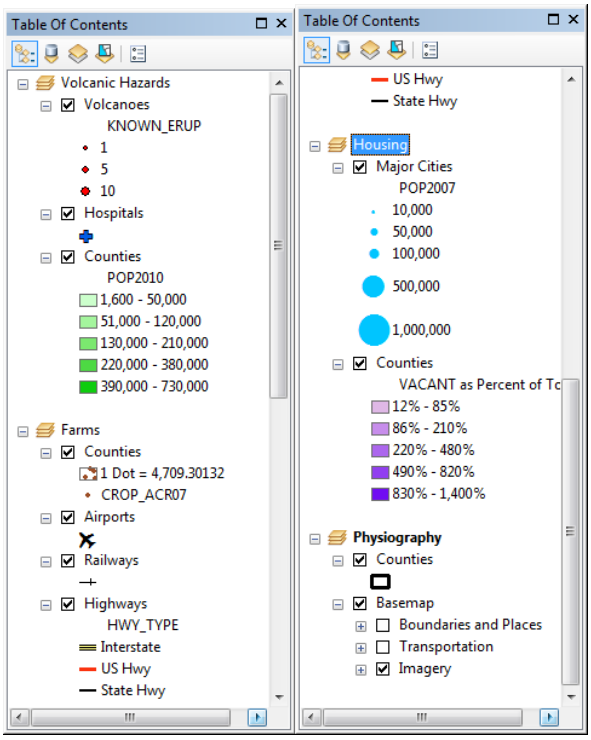
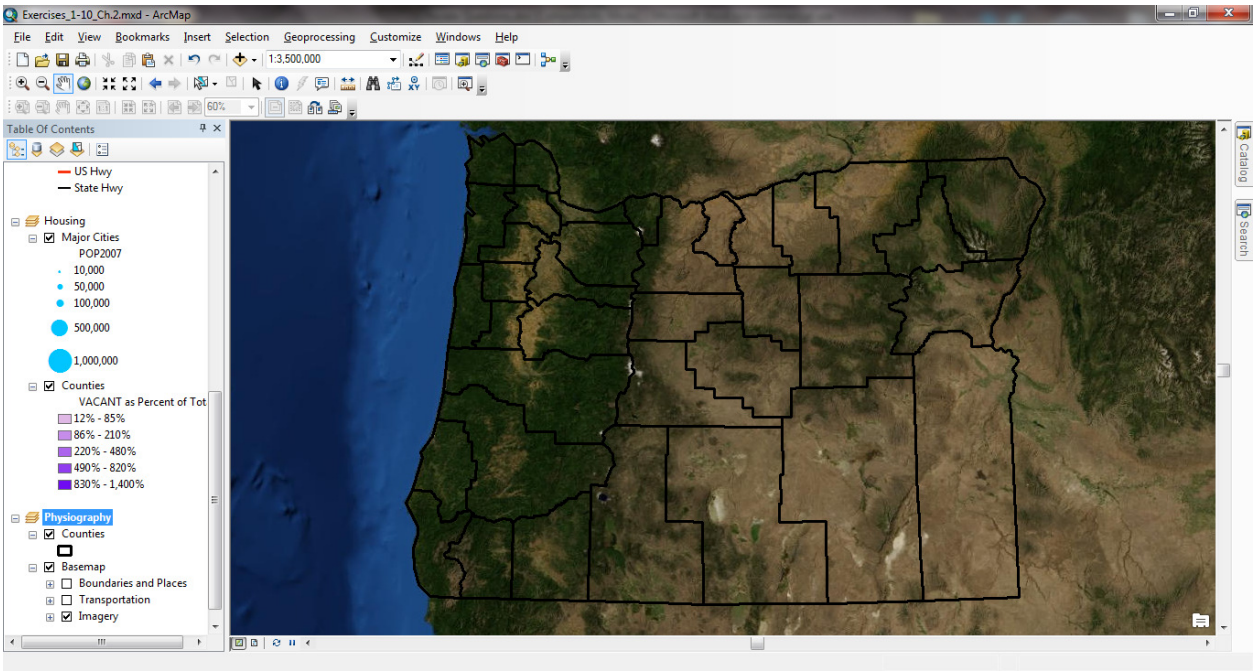


9. Table of Contents for all Data Frames.



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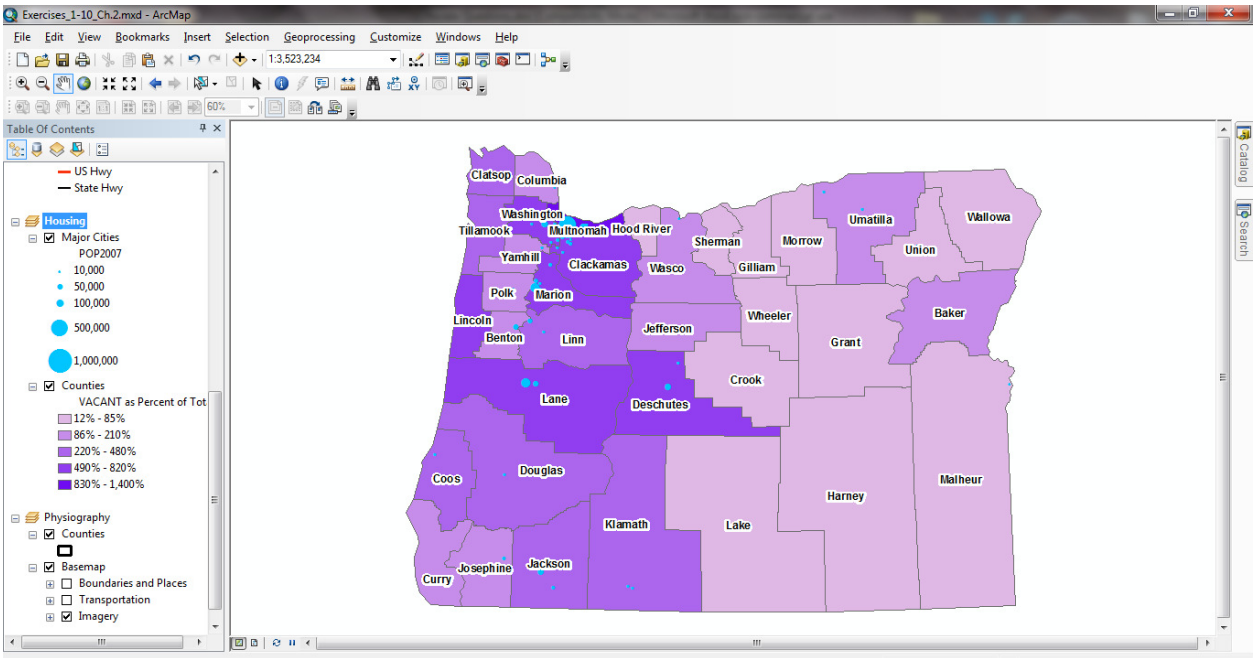

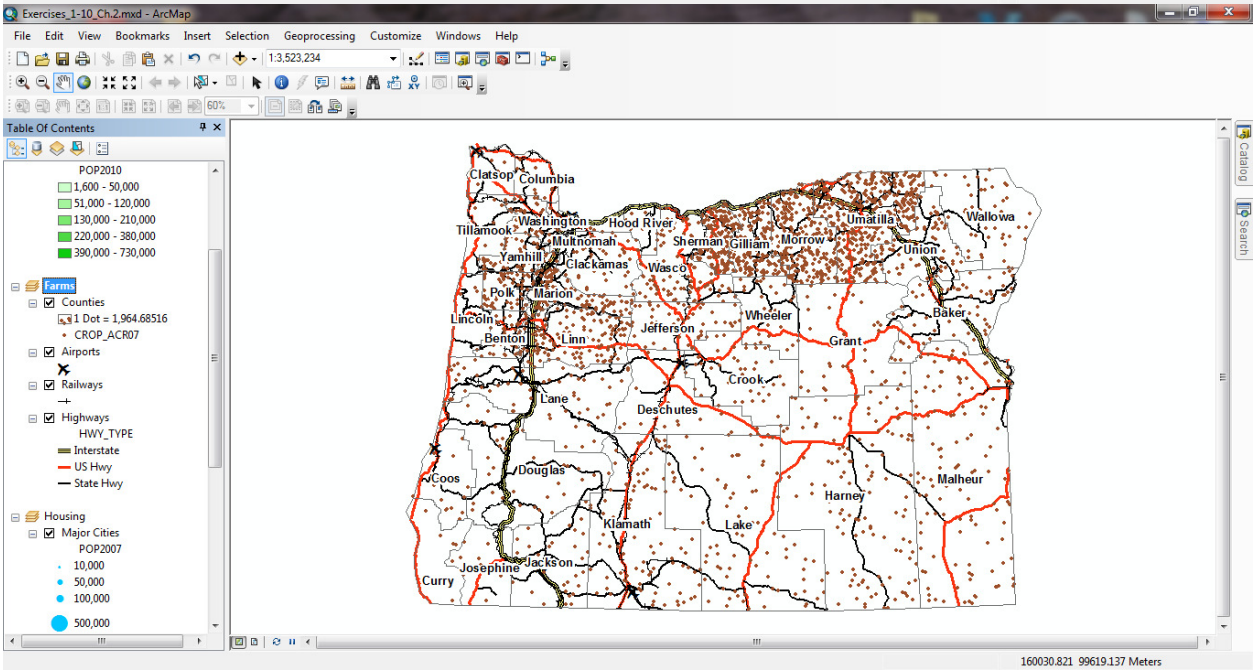

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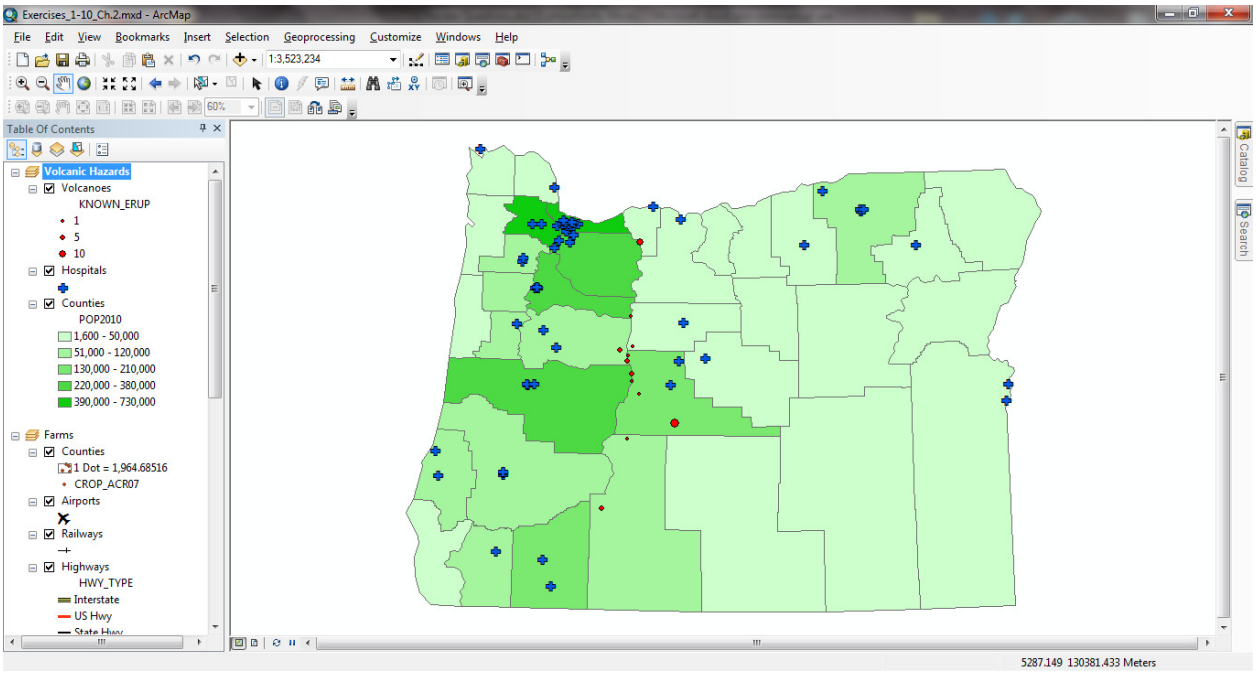
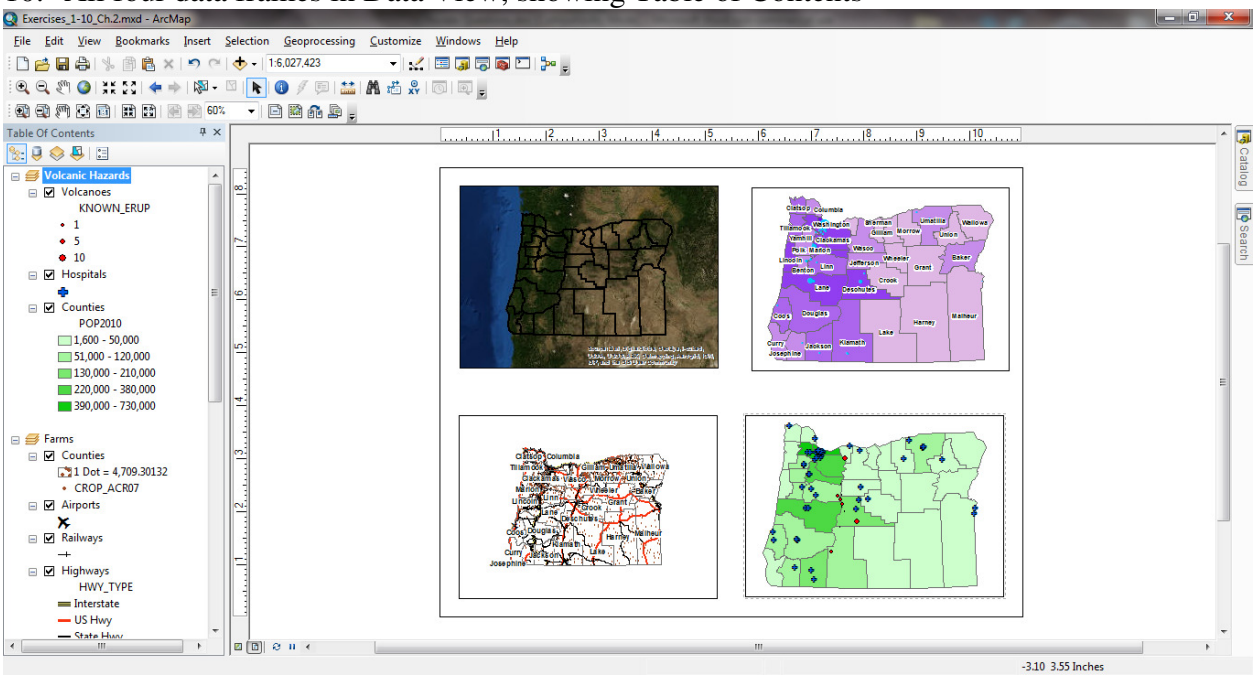


10. All four data frames in Data View, showing Table of Contents



10. All four data frames in Layout View.

3F: Price Text Chapter 3 (Presenting GIS Data) Reading and Tutorial Exercises

12 pages

Tutorial Screen Shots

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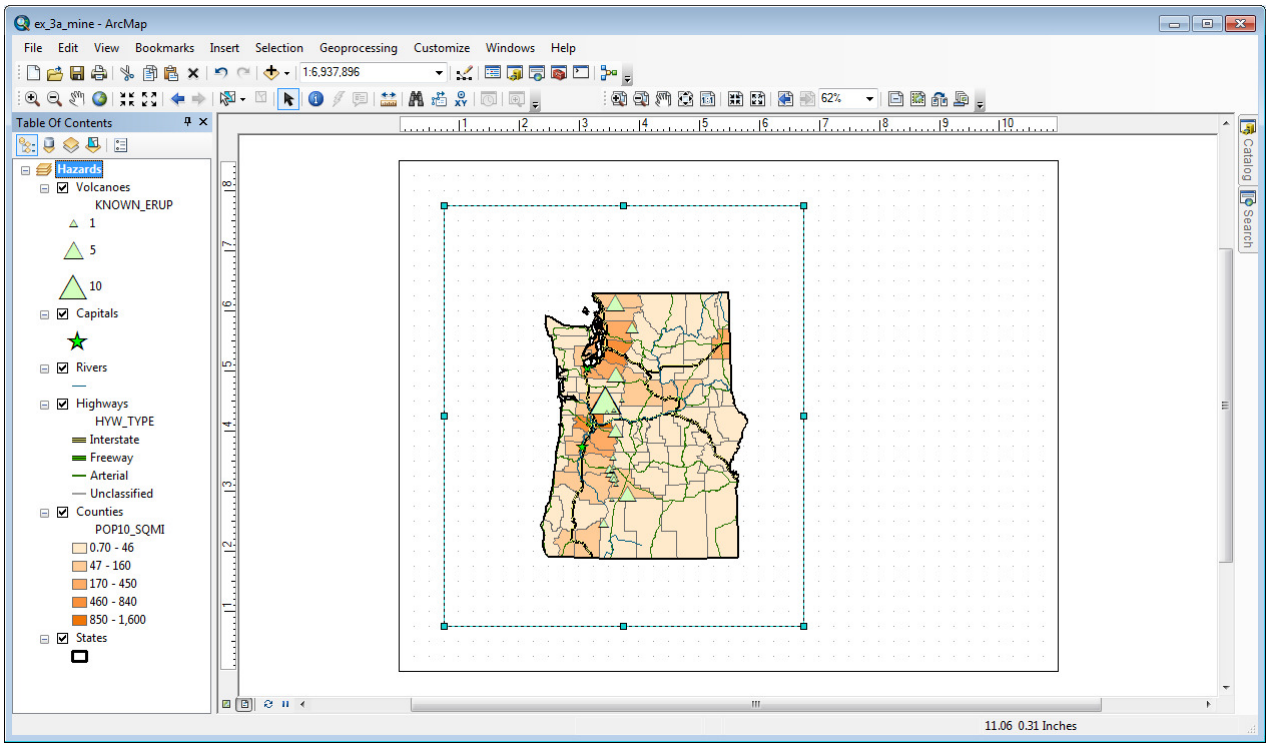
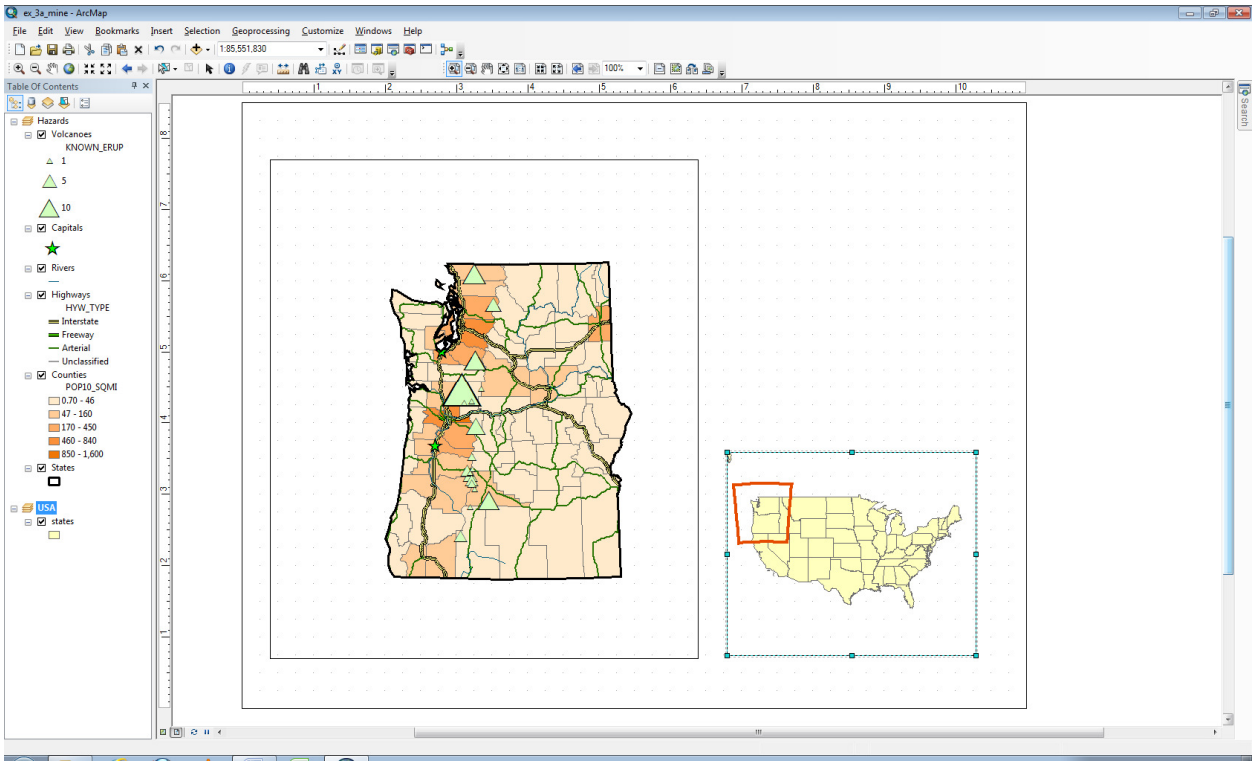
Mastering Skills Tutorial Screen Shots Ch. 3



Pg. 85-87, resized and grided data frame, with snapped positioning.



Pg. 87-88, adding US data frame, changing projection to Mercator.

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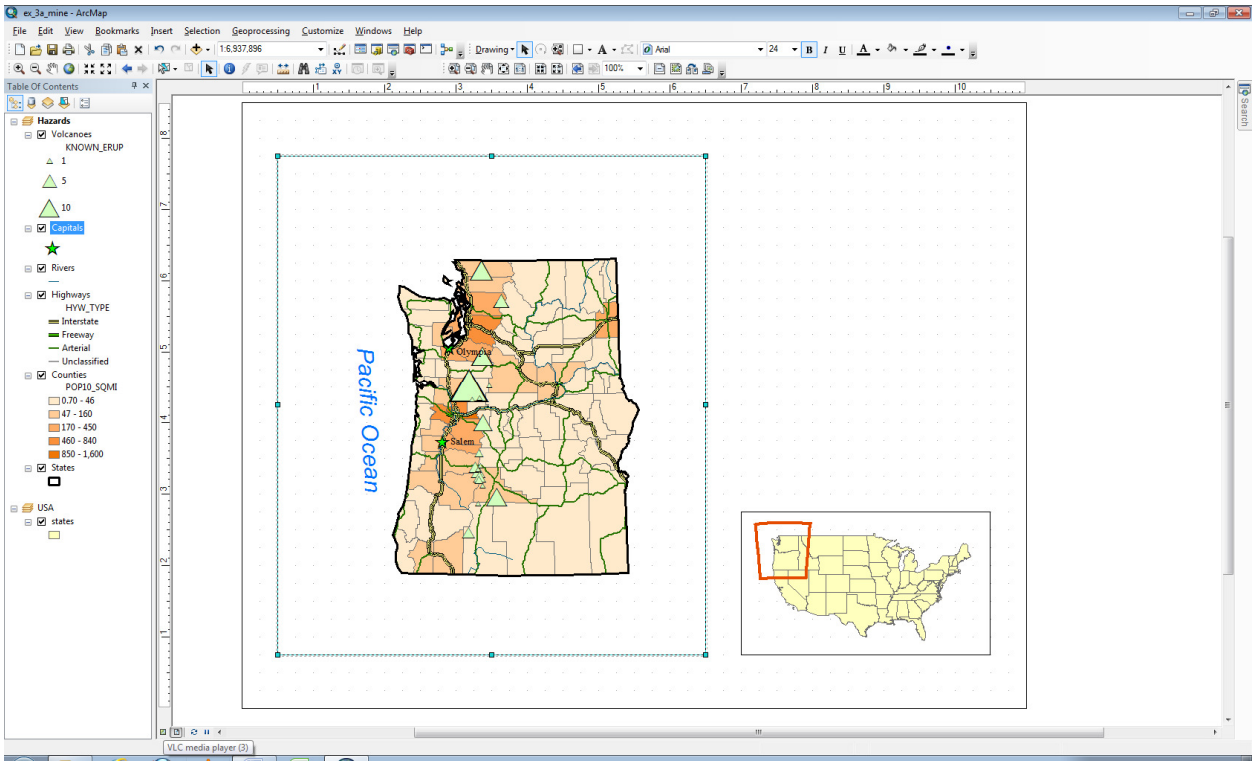
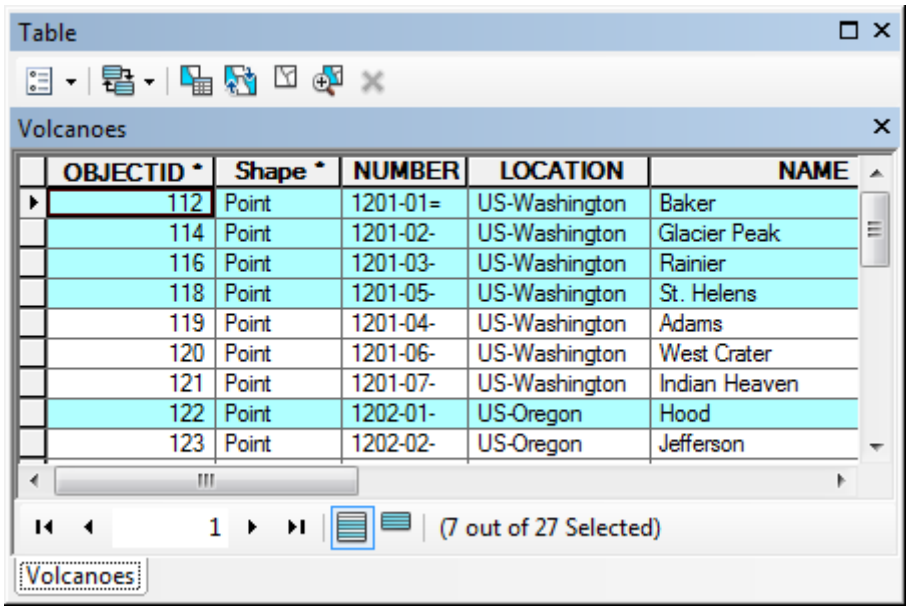


Pg. 89, Adding graphic text and labels to the Data Frame.



Pg. 90, using Query method to select attributes within the Data Table.

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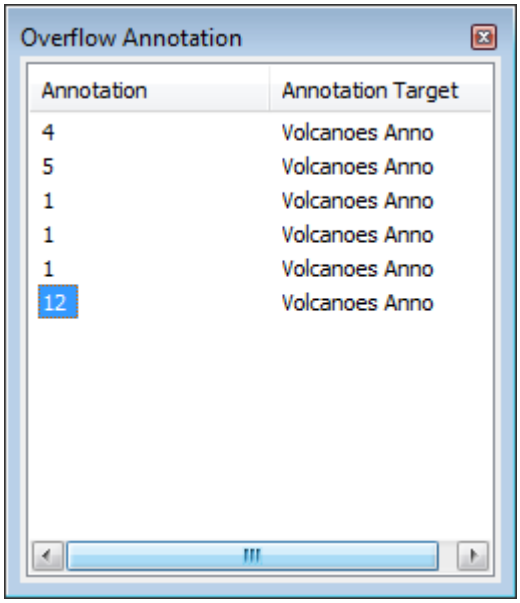
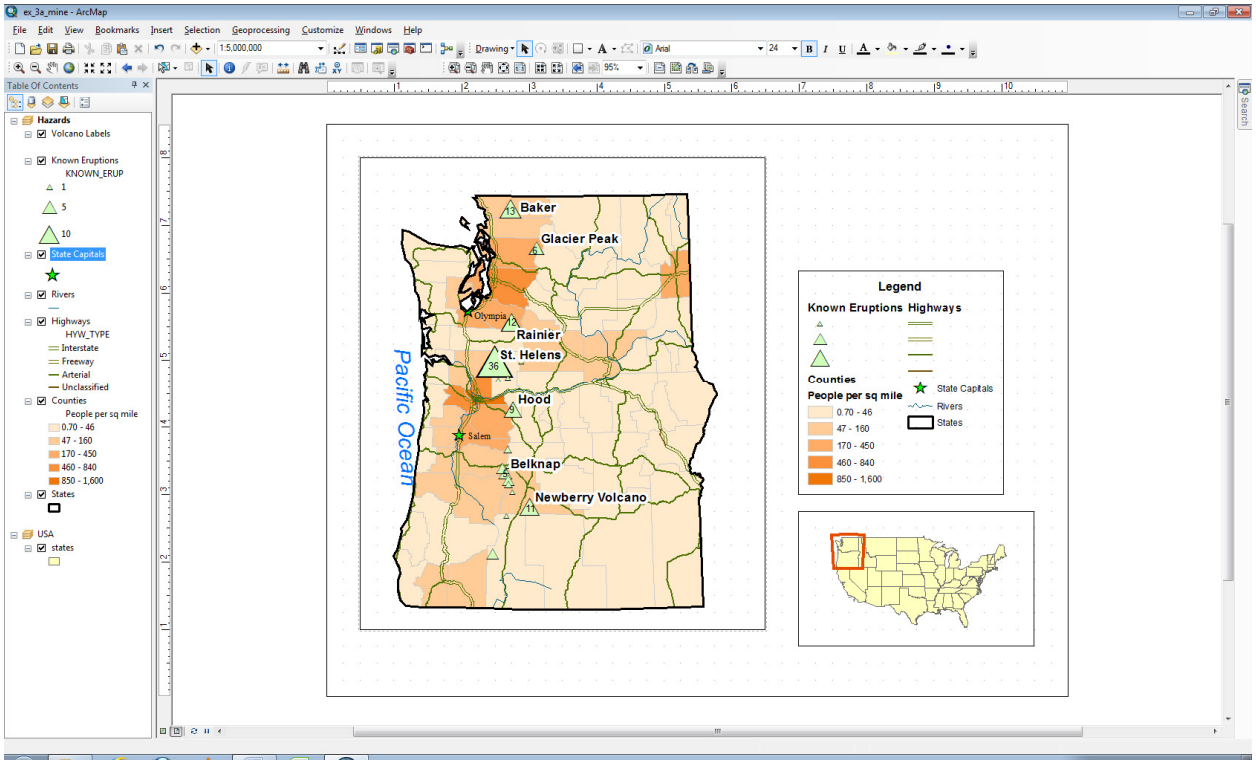


Pg. 91, Converting Labels to Annotation stored in the map (Overflow Annotations).



Pg. 92-93, Adding and formatting a map legend for Hazards Data Frame.

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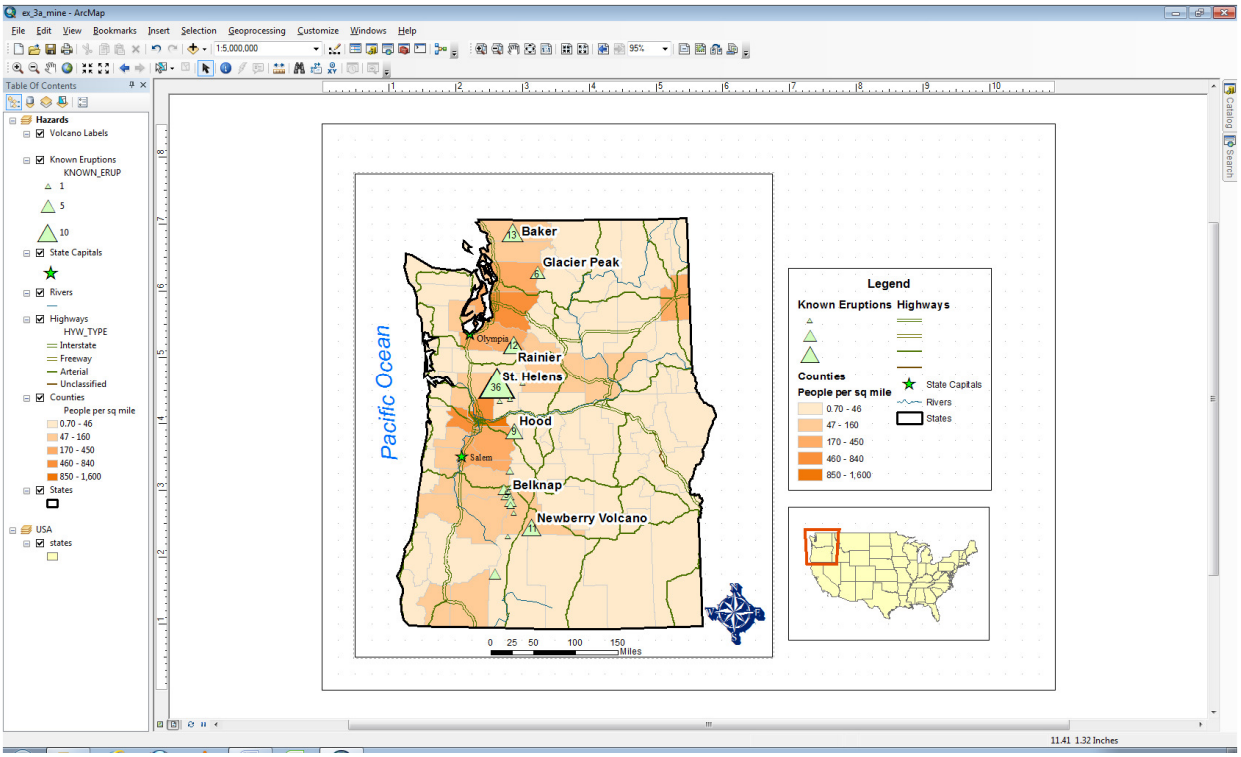
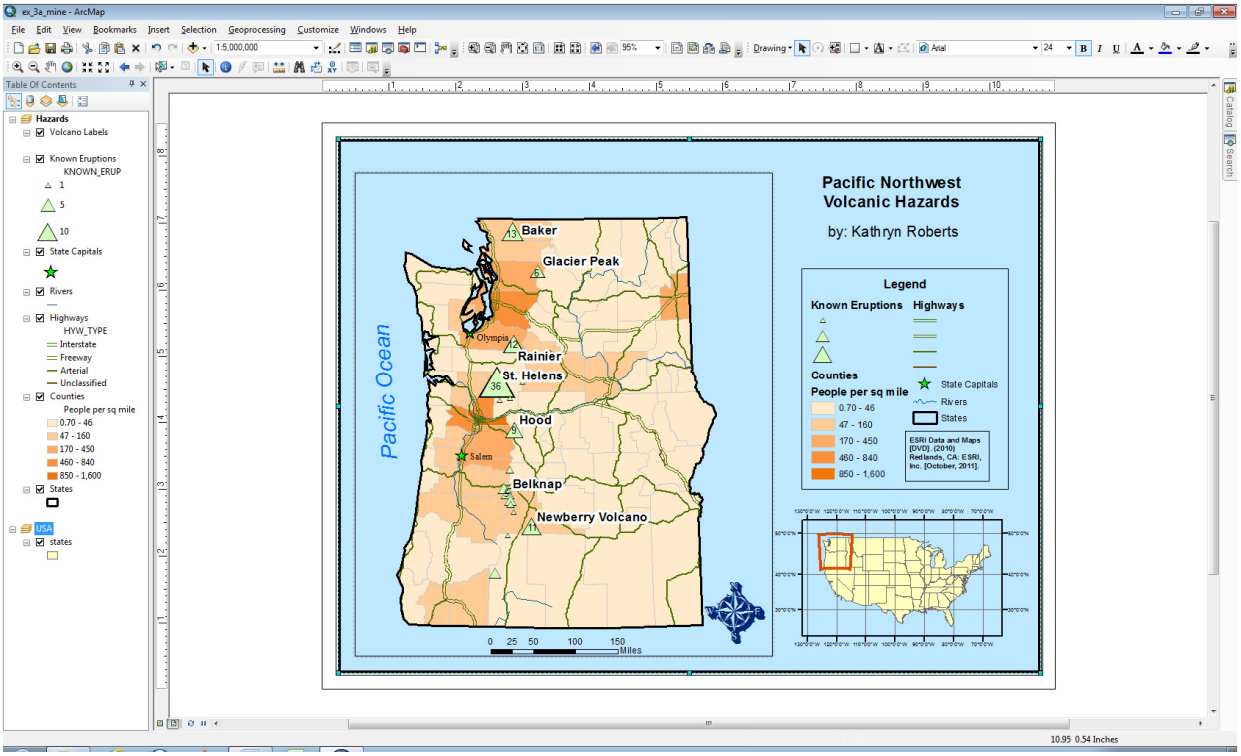


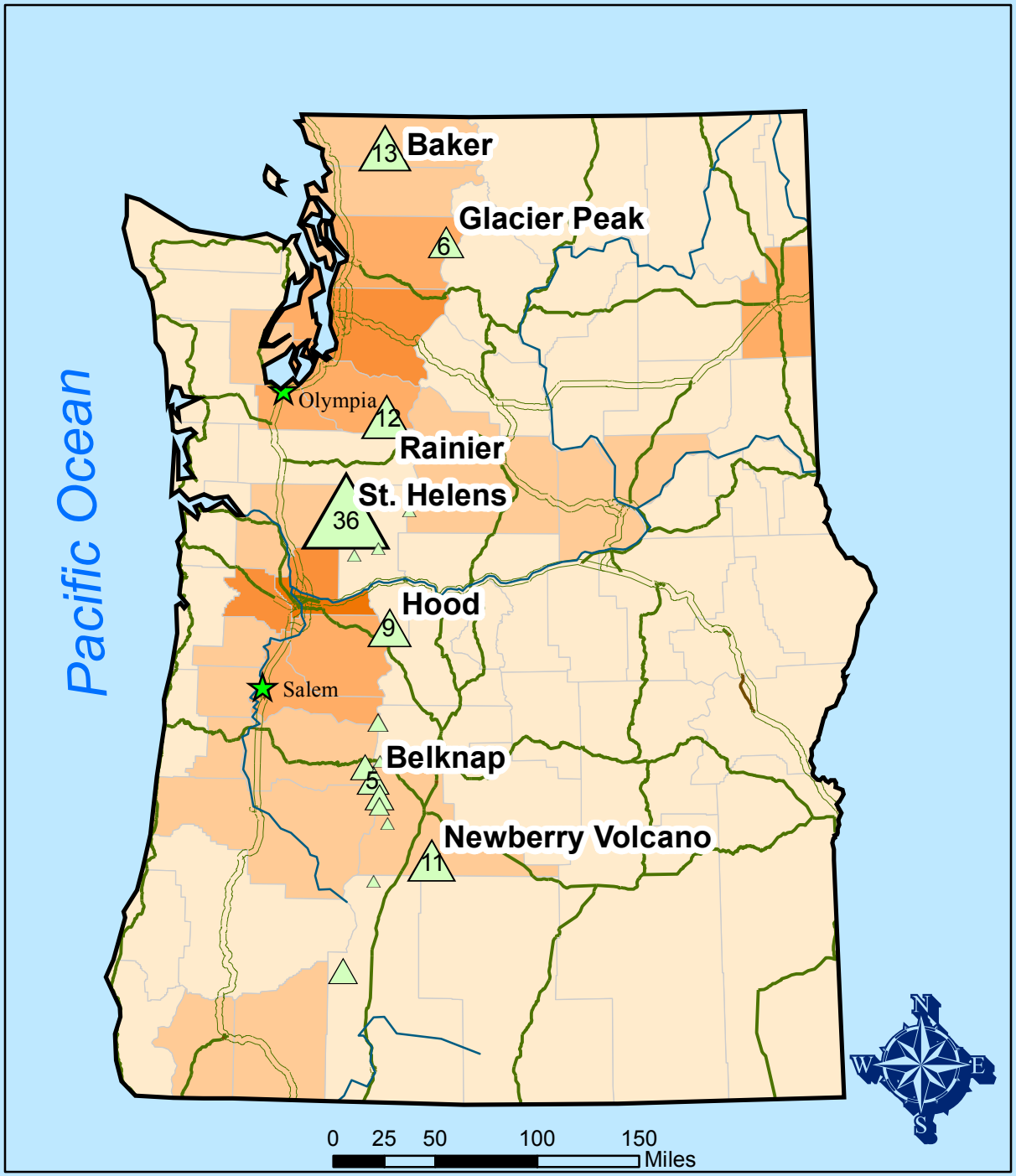
Pg. 94-96, Adding a scale bar and North Arrow to the Hazards Frame.



Pg. 97-98, Adding Neatline and Shading around all elements.

Pacific Northwest Volcanic Hazards

by: Kathryn Roberts



Legend

Known Eruptions

Highways

Counties

People per sq mile

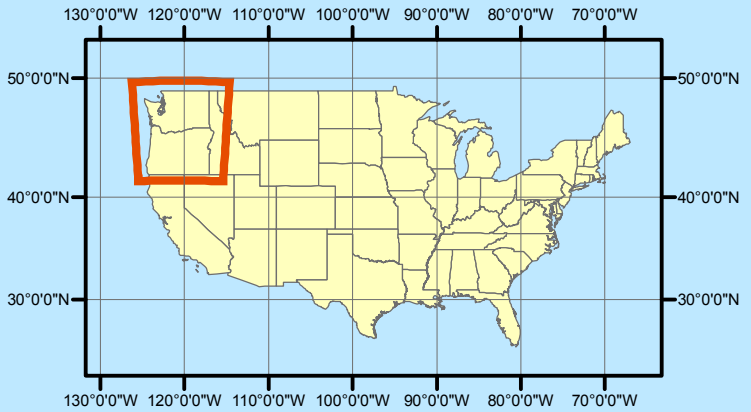
- 0.70 - 46
- 47 - 160
- 170 - 450
- 460 - 840
- 850 - 1,600

State Capitals

Rivers

States

ESRI Data and Maps [DVD]. (2010) Redlands, CA: ESRI, Inc. [October, 2011].



Tutorial In-Text Questions

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Mastering the Skills Ch. 3 – In-text Tutorial Questions

1. Which projection from the front cover of the book preserves direction?
    a. Lambert Azimuthal Equal Area
    b. Mercator

2. When you returned to Data view, the labels got larger. What does this tell you about annotation?
    a. That it has a reference scale assigned, but symbols don't scale

Chapter Review Questions

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Ch. 3 Review Questions (# 3, 5, 7)

3. What types of colors generally work best for maps? How can the psychology of colors be used to enhance a map's meaning?
    a. Softer more muted colors work best
    b. Coloring things a 'natural-seeming' color (like bodies of water blue) can make the map easier to read

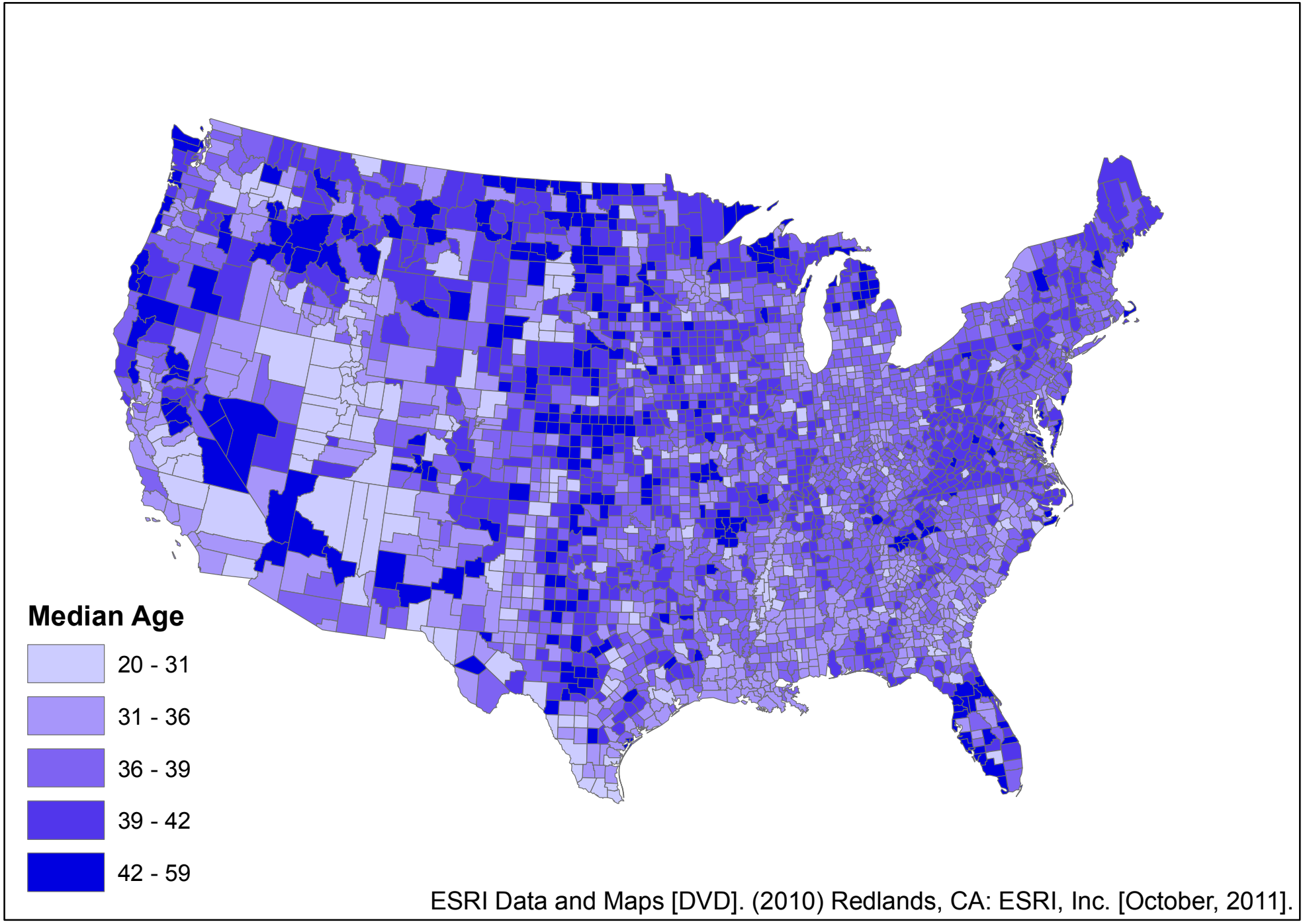
5. What is a geographic coordinate system and why is it a poor choice for making maps?
    a. A geographic coordinate system is a system of angular measurements of latitude and longitude that work on a spherical Earth
    b. This system is a poor choice for maps, that are a two-dimensional space rather than a sphere

7. Examine the map projections on the inside front cover. List which projections might be suitable for a map of (a) county, (b) the US, (c) map to calculate travel distances and (d) US map to calculate areas
    a. State Plane
    b. Equidistant Conic
    c. Sinusoidal
    d. Albers Equal Area Conic

Chapter Exercises

Median Age by County, USA

By: Kathryn Roberts



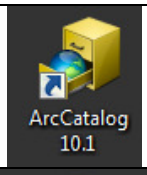
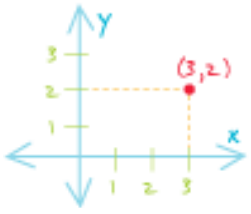
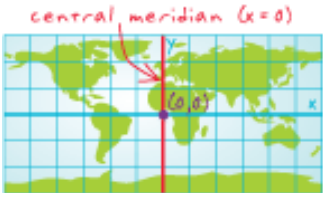
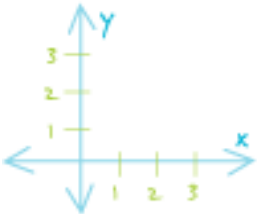
ESRI Data and Maps [DVD]. (2010) Redlands, CA: ESRI, Inc. [October, 2011].

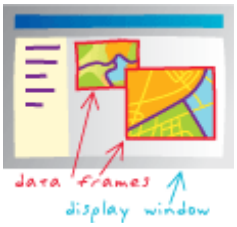
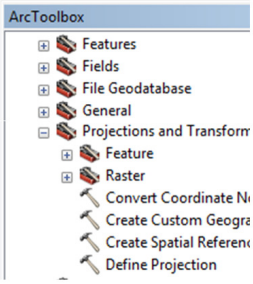
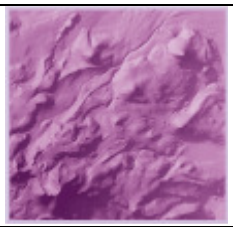
4A: Key Word Review Exercise

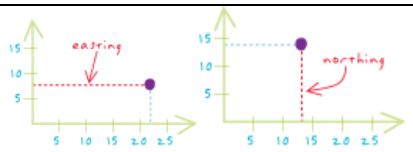
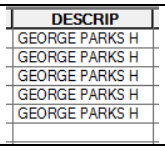
8 pages

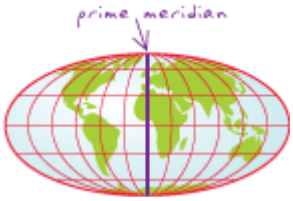
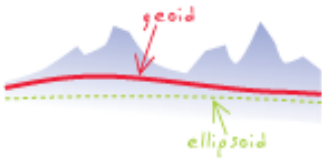
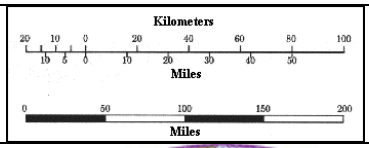
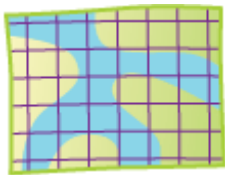
Kathryn Roberts
ES 341 – GIS

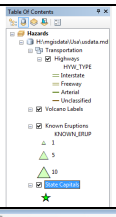
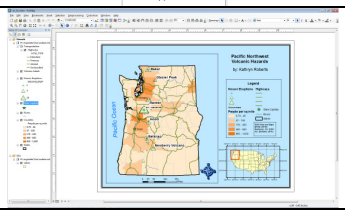
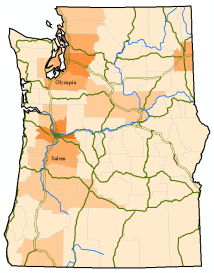
Key Word Search on Intro Concepts

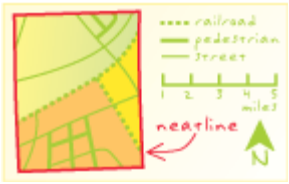
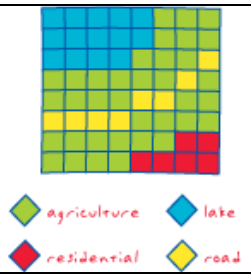
Term	Definition	Image / Equation
Absolute vs. Relative Pathname	Absolute: a pathname that starts at the highest point (usually a network drive) and proceeds downward Relative: a pathname that starts at the lowest folder directory (the folder containing the file) and proceeds backward/upward	
ArcCatalog	A tool for viewing and managing spatial data files, designed to work especially with GIS.	
ArcMap	Digital program that allows the display, analysis, and editing of spatial data and data tables.	
Aspatial data	Data entries that are not tied to a location on the Earth's surface	
Attribute	Nonspatial information about a geographic feature in a GIS, usually stored in a table and linked to the feature by a unique identifier. In raster datasets, info. Associated with each unique value of raster cell	
Cartesian Coordinate	A two-dimensional, planar coordinate system in which horizontal distance is measured along an x-axis and vertical distance is measured along a y-axis. Each point on the plane is defined by an x,y coordinate. Relative measures of distance, area, and direction are constant throughout the Cartesian coordinate plane.	
Categorical data	Data that place objects into unranked groups; such as land use or geology data	
Central meridian	The line of longitude that defines the center and often the x-origin of a projected coordinate system. In planar rectangular coordinate systems of limited extent, such as state plane, grid north coincides with true north at the central meridian.	
Conic Projection	A projection that transforms points from a spheroid or sphere onto a tangent or secant cone that is wrapped around the globe in the manner of a party hat. The cone is then sliced from the apex (top) to the bottom, and flattened into a plane.	
Coordinate system	A reference framework consisting of a set of points, lines, and/or surfaces, and a set of rules, used to define the positions of points in space in either two or three dimensions. The Cartesian coordinate system and the geographic coordinate system used on the earth's surface are common examples of coordinate systems.	

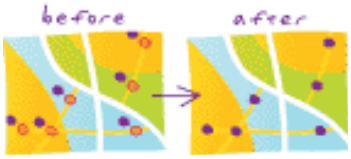
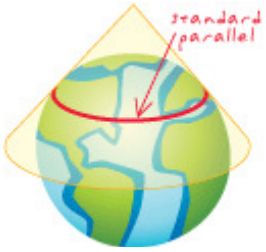
Term	Definition	Image / Equation
Cylindrical Projection	A projection that transforms points from a spheroid or sphere onto a tangent or secant cylinder. The cylinder is then sliced from top to bottom and flattened into a plane.	
Data frame	A map element that defines a geographic extent, a page extent, a coordinate system, and other display properties for one or more layers in ArcMap. A dataset can be represented in one or more data frames. In data view, only one data frame is displayed at a time; in layout view, all a map's data frames are displayed at the same time.	
Data view	An all-purpose view in ArcMap and ArcReader for exploring, displaying, and querying geographic data. This view hides all map elements, such as titles, north arrows, and scale bars.	
Datum	The reference specifications of a measurement system, usually a system of coordinate positions on a surface (a horizontal datum) or heights above or below a surface (a vertical datum).	
Decimal Degrees	Values of latitude and longitude expressed in decimal format rather than in degrees, minutes, and seconds.	
Define projection Tool in ArcGIS toolbox	Tool within ArcGIS suite to allow user to assign the used projection to a data set	
DEM	Acronym for *digital elevation model*. The representation of continuous elevation values over a topographic surface by a regular array of z-values, referenced to a common datum. DEMs are typically used to represent terrain relief.	
Double Precision	The level of coordinate exactness based on the possible number of significant digits that can be stored for each coordinate. Datasets can be stored in either single or double precision. Double-precision geometries store up to 15 significant digits per coordinate (typically 13 to 14 significant digits), retaining the accuracy of much less than 1 meter at a global extent.	
DRG	Acronym for *digital raster graphic*. A raster image of a scanned USGS standard series topographic map, usually including the original border information, referred to as the map collar, map surround, or marginalia. Source maps are georeferenced to the surface of the earth, fit to the universal transverse Mercator (UTM) projection, and scanned at a minimum resolution of 250 dpi.	

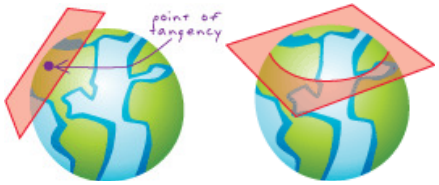
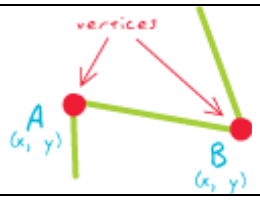
Term	Definition	Image / Equation
	The accuracy and datum of a DRG matches the accuracy and datum of the source map.	
Easting vs. Northing	Easting: The distance east of the origin that a point in a Cartesian coordinate system lies, measured in that system's units. Northing: The distance north of the origin that a point in a Cartesian coordinate system lies, measured in that system's units.	
False northing/false easting	The linear value added to all x and y-coordinates of a map projection so that none of the values in the geographic region being mapped are negative.	
Feature class	In ArcGIS, a collection of geographic features with the same geometry type (such as point, line, or polygon), the same attributes, and the same spatial reference. Feature classes can be stored in geodatabases, shapefiles, coverages, or other data formats. Feature classes allow homogeneous features to be grouped into a single unit for data storage purposes. For example, highways, primary roads, and secondary roads can be grouped into a line feature class named 'roads.' In a geodatabase, feature classes can also store annotation and dimensions.	
Feature ID (FID)	A unique number assigned to every feature in a spatial data file and used for identification and tracking	
Field Name	Title heading for a single column of information in a data table	
Field Precision vs. Field Scale	Field Precision: The number of digits that can be stored in a field in a table. Field Scale: the number of digits to the right of the decimal point in a number. For example, the number 56.78 has a scale of 2.	
GCS	A spherical coordinate system of degrees of latitude and longitude that is used to locate features on the Earth's surface	
Geodatabase	A database or file structure used primarily to store, query, and manipulate spatial data. Geodatabases store geometry, a spatial reference system, attributes, and behavioral rules for data. Various types of geographic datasets can be collected within a geodatabase, including feature classes, attribute tables, raster datasets, network datasets, topologies, and many others. Geodatabases can be stored in IBM DB2, IBM Informix, Oracle, Microsoft Access, Microsoft SQL Server, and PostgreSQL relational database management systems, or in a system of files, such as a file geodatabase.	

Term	Definition	Image / Equation
Geographic Coordinate System	A reference system that uses latitude and longitude to define the locations of points on the surface of a sphere or spheroid. A geographic coordinate system definition includes a datum, prime meridian, and angular unit.	
Geoid	A hypothetical surface representing the form the earth's oceans would take if there were no land and the water were free to respond to the earth's gravitational and centrifugal forces. The resulting geoid is irregular and varies from a perfect sphere by as much as 75 meters above and 100 meters below its surface.	
Georeference	Aligning geographic data to a known coordinate system so it can be viewed, queried, and analyzed with other geographic data. Georeferencing may involve shifting, rotating, scaling, skewing, and in some cases warping, rubber sheeting, or orthorectifying the data.	
Graphical scale	Visual representation of scaling of map or other data set (for example a bar scale)	
Graticule	A network of longitude and latitude lines on a map or chart that relates points on a map to their true locations on the earth.	
Grid cell	In cartography, any network of parallel and perpendicular lines superimposed on a map and used for reference. These grids are usually referred to by the map projection or coordinate system they represent, such as universal transverse Mercator grid.	
GUI	Acronym for *graphical user interface*. A software display of program options that allows a user to choose commands by pointing to icons, dialog boxes, and lists of menu items on the screen, typically using a mouse. This contrasts with a command line interface in which control is accomplished via the exchange of strings of text.	
Integer vs. Floating Point	Integar: whole numbers in binary form Floating Point: decimal values	
Interval data	Values that follow a regular scale but have no natural zero point, such as temperature in ° C	
Join tables	Appending the fields of one table to those of another through an attribute or field common to both tables. A join is usually used to attach more attributes to the attribute table of a geographic layer.	
Key field	An attribute field that is used to extract or match records in a table	

Term	Definition	Image / Equation
Large scale vs. small scale ratios	A larger scale will have a smaller level of detail, but greater overall area, while a smaller scale will have a greater level of detail, but a smaller overall area	
Latitude of orgin	The reference latitude of a map projection where the *y* value is zero	
Layer file	A file that stores a pointer to spatial data along with information on how to display it	
Layout view	A mode of ArcMap that is used to design and create a printed map that allows manipulation of map layers, titles, scale bars, north arrows, and more	
Line features	Spatial features composed of a string of *x-y* coordinate vertices and used to represent linear features such as streets	
Logical expression	A statement composed of field names, operators, and values that specifies criteria used to select records or values from a layer or table	[LOCATION] LIKE 'US-Washington'
Map document	In ArcMap, the file that contains one map, its layout, and its associated layers, tables, charts, and reports. Map documents can be printed or embedded in other documents. Map document files have a .mxd extension.	
Map extent	The range of *x-y* values of the area being displayed in a map	
Map projection	A mathematical transformation that converts spherical units of latitude and longitude into a planar *x-y* coordinate system	
Metadata	Information that describes the content, quality, condition, origin, and other characteristics of data or other pieces of information. Metadata for spatial data may describe and document its subject matter; how, when, where, and by whom the data was collected; availability and distribution information; its projection, scale, resolution, and accuracy; and its reliability with regard to some standard. Metadata consists of properties and documentation. Properties are derived from the data source (for example, the coordinate system and projection of the data), while documentation is entered by a person (for example, keywords used to describe the data).	
NAD27 vs. NAD83 Datum	NAD27: Acronym for *North American Datum of 1927*. The primary local horizontal geodetic datum and geographic coordinate system used to map the United States during the middle part of the 20th century. NAD 1927 is referenced to the Clarke spheroid of 1866 and an origin point at Meades Ranch, Kansas.	

Term	Definition	Image / Equation
	NAD83: Acronym for *North American Datum of 1983*. A geocentric datum and graphic coordinate system based on the Geodetic Reference System 1980 ellipsoid (GRS80). Mainly used in North America, its measurements are obtained from both terrestrial and satellite data.	
Neatline	The border delineating and defining the extent of geographic data on a map. It demarcates map units so that, depending on the map projection, the neatline does not always have 90-degree corners. In a properly made map, it is the most accurate element of the data; other map features may be moved slightly or exaggerated for generalization or readability, but the neatline is never adjusted.	
Node	In a geodatabase, the point representing the beginning or ending point of an edge, topologically linked to all the edges that meet there.	
Nominal data	Data divided into classes within which all elements are assumed to be equal to each other, and in which no class comes before another in sequence or importance; for example, a group of polygons colored to represent different soil types.	
Numeric data	Values stored as numbers rather than as names or categories	
On-The-Fly-Projection	Projection in ArcMap that is assembled, created, presented, and calculated dynamically during a transaction such as a Web page search or data display query.	
Ordinal data	Data classified by comparative value; for example, a group of polygons colored lighter to darker to represent less to more densely populated areas.	
Point features	A map feature that has neither length nor area at a given scale, such as a city on a world map or a building on a city map.	
Polygon features	A map feature that bounds an area at a given scale, such as a country on a world map or a district on a city map.	
Prime Meridian	In a coordinate system, any line of longitude designated as 0 degrees east and west, to which all other meridians are referenced. The Greenwich meridian is internationally recognized as the prime meridian for most official purposes, such as civil timekeeping.	
Project Tool in ArcGIS toolbox	Tool within the ArcMap suite that allows for temporary conversion from one map projection to another	
Query	A request to select features or records from a database. A query is often written as a statement or logical expression.	
Raster model	A representation of the world as a surface divided into a regular grid of cells. Raster models are useful for storing data that varies continuously, as in an aerial photograph, a satellite image, a surface of chemical concentrations, or an elevation surface.	

Term	Definition	Image / Equation
Relational database	A data structure in which collections of tables are logically associated with each other by shared fields.	
Resolution	The ground area represented by one cell value in a raster or the default storage precision of a vector data set	
Rubber sheeting	A procedure for adjusting the coordinates of all the data points in a dataset to allow a more accurate match between known locations and a few data points within the dataset. Rubber sheeting preserves the interconnectivity between points and objects through stretching, shrinking, or reorienting their interconnecting lines.	
Shapefile	A vector data storage format for storing the location, shape, and attributes of geographic features. A shapefile is stored in a set of related files and contains one feature class.	
Single Precision	A level of coordinate exactness based on the number of significant digits that can be stored for each coordinate. Single precision numbers store up to seven significant digits for each coordinate, retaining a precision of plus or minus 5 meters in an extent of 1,000,000 meters. Datasets can be stored in either single or double precision coordinates.	
Spatial data	Information about the locations and shapes of geographic features and the relationships between them, usually stored as coordinates and topology.	
Standard parallels	The line of latitude in a conic or cylindrical projection in normal aspect where the projection surface touches the globe. A tangent conic or cylindrical projection has one standard parallel, while a secant conic or cylindrical projection has two. At the standard parallel, the projection shows no distortion.	
State Plane	A group of projections defined for different regions of the US and designed to minimize map distortions	
Symbology	The set of conventions, rules, or encoding systems that define how geographic features are represented with symbols on a map. A characteristic of a map feature may influence the size, color, and shape of the symbol used.	
Table	A set of data elements arranged in rows and columns. Each row represents a single record. Each column represents a field of the record. Rows and columns intersect to form cells, which contain a specific value for one field in a record.	

Term	Definition	Image / Equation
Tangent vs. Secant projection	Tangent: A projection whose surface touches the globe's without piercing it, planar @ 1 point, conic or cylindrical @ line. Secant: A projection whose surface intersects the surface of a globe. A secant conic or cylindrical projection, for example, is recessed into a globe, intersecting it at two circles.	
UTM	Acronym for *universal transverse Mercator*. A projected coordinate system that divides the world into 60 north and south zones, 6 degrees wide.	
Vector model	A representation of the world using points, lines, and polygons. Vector models are useful for storing data that has discrete boundaries, such as country borders, land parcels, and streets.	
Vertex	One of a set of ordered x,y coordinate pairs that defines the shape of a line or polygon feature.	

4B: "Managing Oregon Map Projections in Arc Map" tutorial exercise

5 pages

a) use my computer - H:/ folder - click on *.zip file to extract

NOTE: All of these map themes are from the Monmouth 7.5' Quadrangle.

Step 2. Activate ArcMap Software

A) In the "Table of Contents" , add the following "feature data source" shape files to the data frame: mongeo.shp, roads.shp, stateveg.shp

B) 1 by 1, examine each theme, checking them on / off, rt-click and zoom to the active layer

C) Check all themes on the table of contents, zoom to full extents.

QUESTION: Why don't the themes overlay one another? Why is the full extent map view so screwy? - in diff. projections

D) Remove / delete all of the above themes from the table of contents / data frame.

Step 3. add the following "image data source" file: monmouth.tif; add the following "feature data source" mongeo.shp (monmouth geology)

A) Check both themes in the table of contents. Explore the data in both themes by zooming, overlaying, inquiring.

QUESTIONS: **What type of data is associated with the mongeo.shp map theme?** vector map of geologic units

Do both of these themes overlay one another properly in geospace? yes

B) Now try adding the other vegetation and roads themes, do they properly line up in geospace? No

What is the problem with this set of data? 3 diff. coordinate systems

Step 4. Your first goal is to define the projections for the Monmouth.tif, mongeo.shp, roads.shp and stateveg.shp files, and create related *.prj files

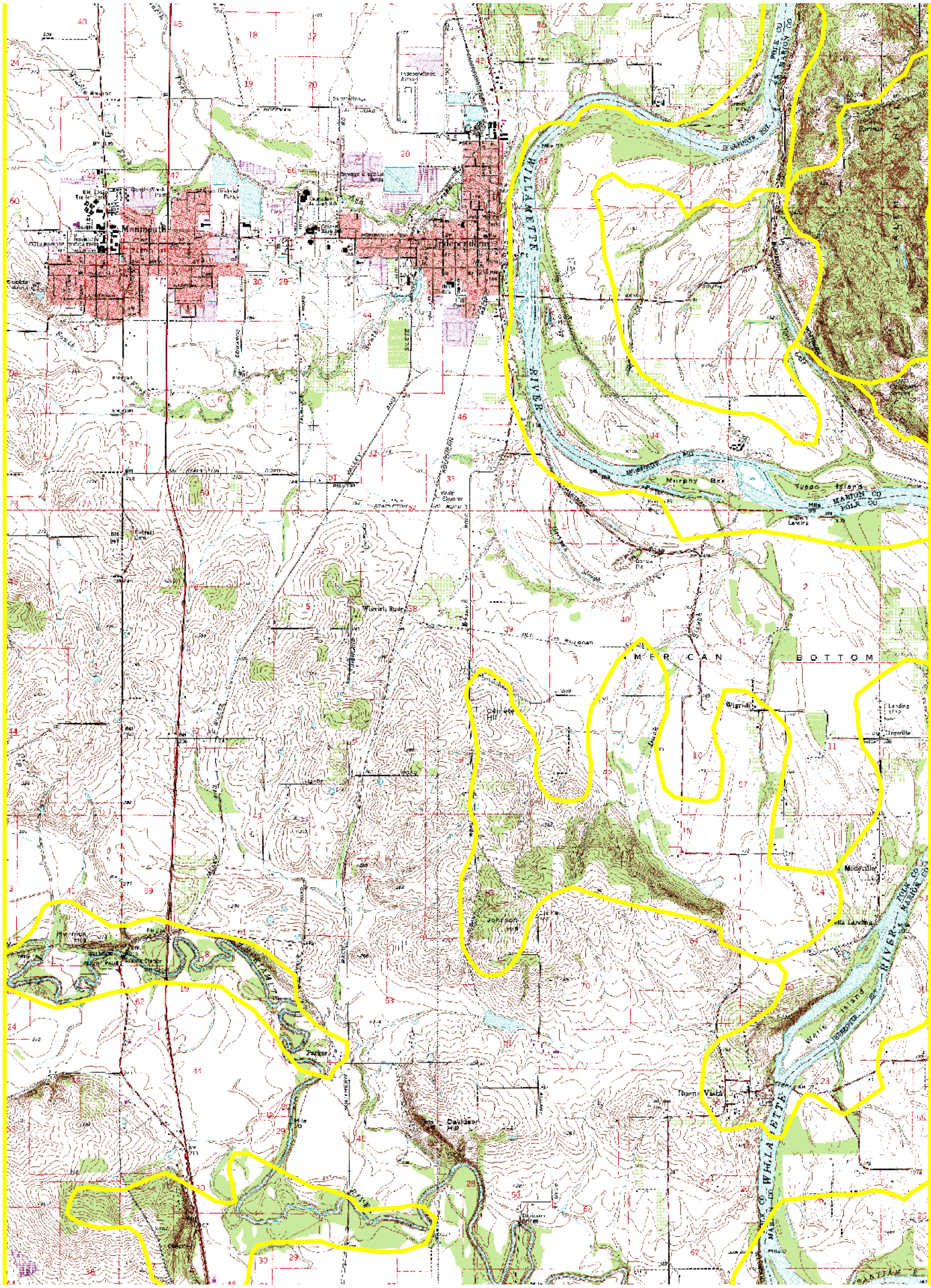
A) Use "my computer" and click on the following text files to examine the metadata for these map themes: road_meta.txt, mongeo_meta.txt, and stateveg_meta.txt (these are metadata text files that provide information on the projections for each of the files)

Task: **list and the discuss the map projections used for each of the map layers, fill in the table below:**

File Name	Projection	Datum
monmouth.tif	NAD 1927 UTM Zone 18N	NAD 1927
mongeo.shp	NAD_1927_UTM_Zone18N	NAD 1927
roads.shp	NAD1983 OC State Plane North	NAD 1983
stateveg.shp	NAD 1983 OR State Lambert Ft' Int'l	NAD 1983

B) Now in your main project folder on the "H:\" drive, create the following 3 subfolders to organize your data according to projection type:

State Vegetation Overlay



N
W E
S

7,100 3,550 0 7,100 Feet

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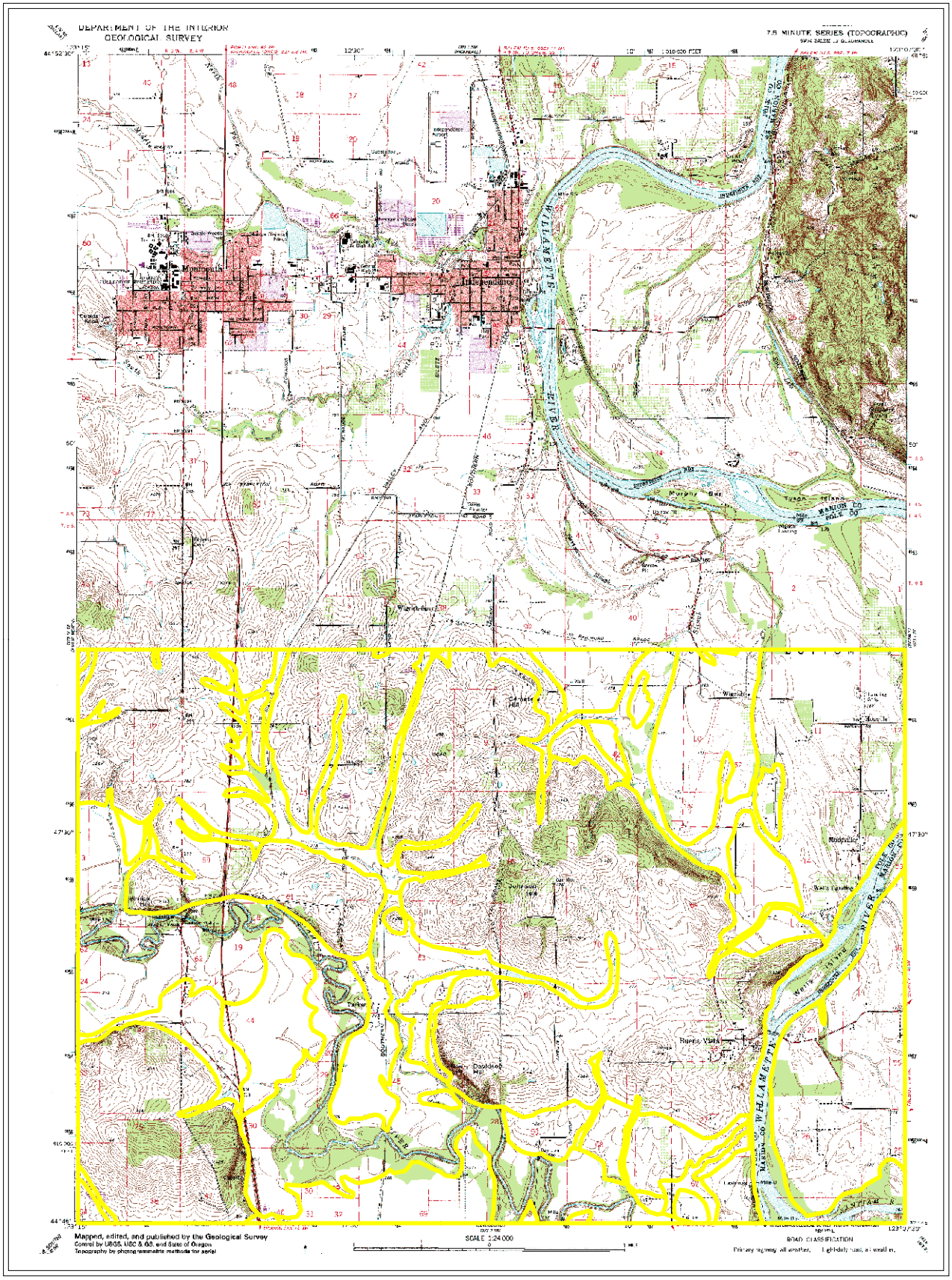
01/30/13

Monmouth Geology Overlay



N
W E
S

7,600 3,800 0 7,600 Feet

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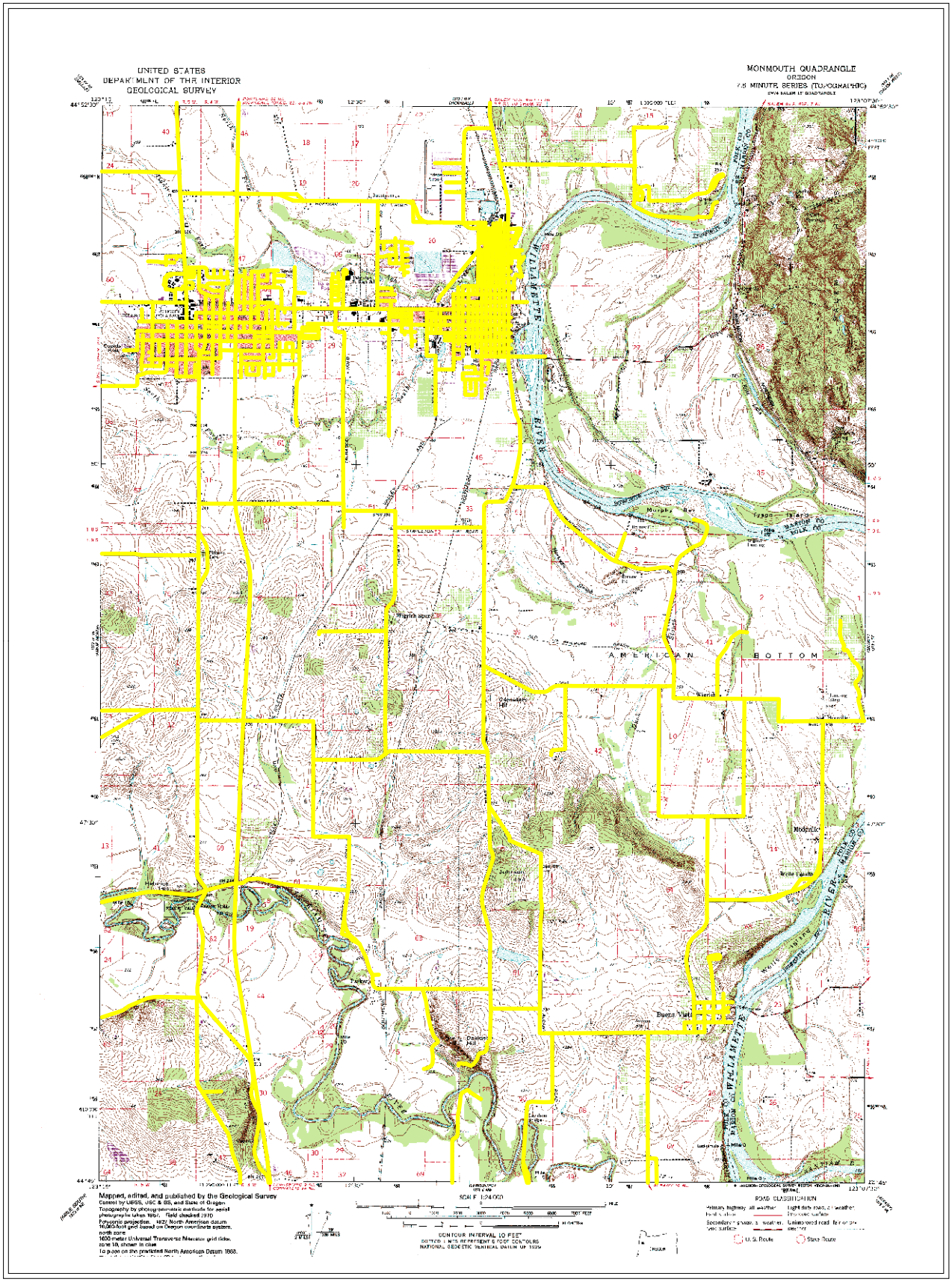
Roads Overlay



N
W E
S

8,250 4,125 0 8,250 Feet

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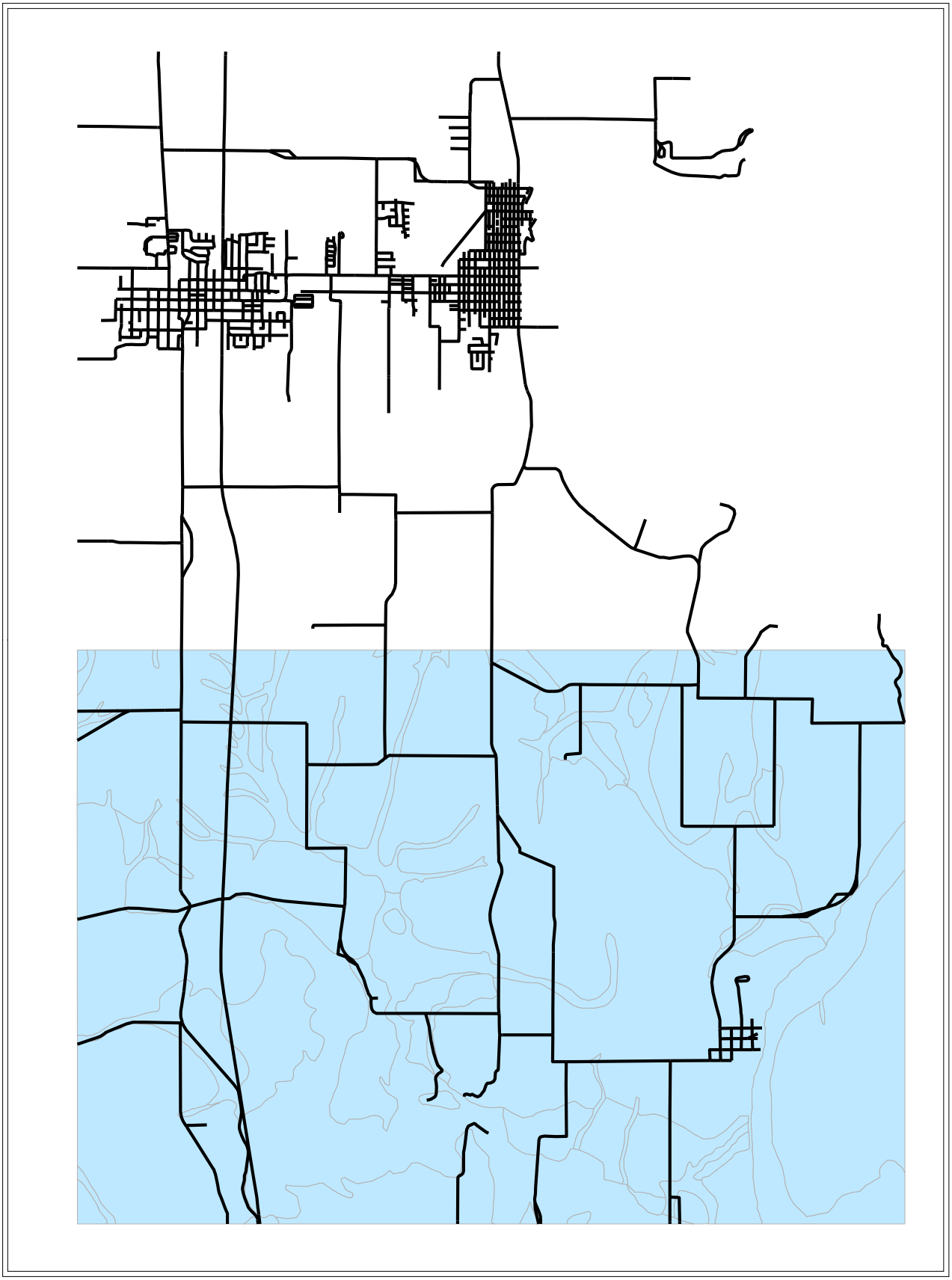
Monmouth Geology and Roads



N
W E
S

7,600 3,800 0 7,600 Feet

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4C: Price Text Chapter 11 Reading and Tutorial Exercises (Map Projections)

16 pages

Tutorial Screen Shots

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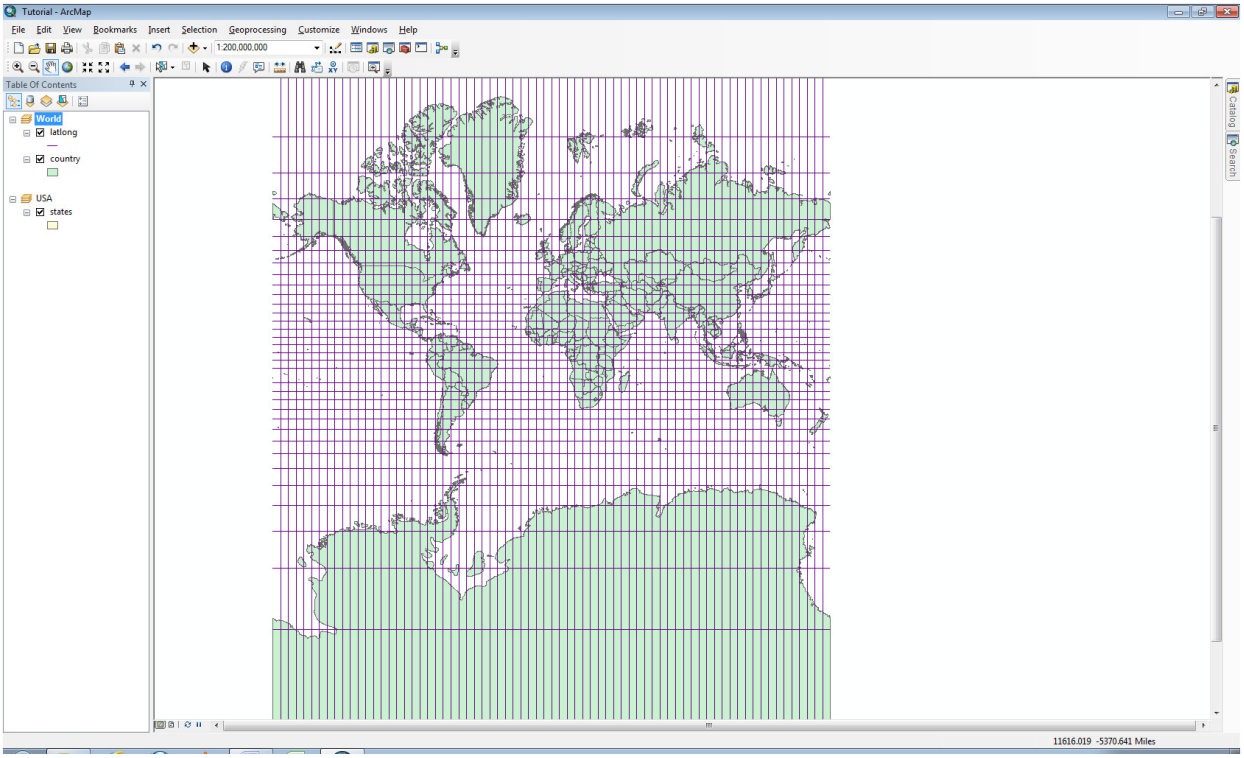
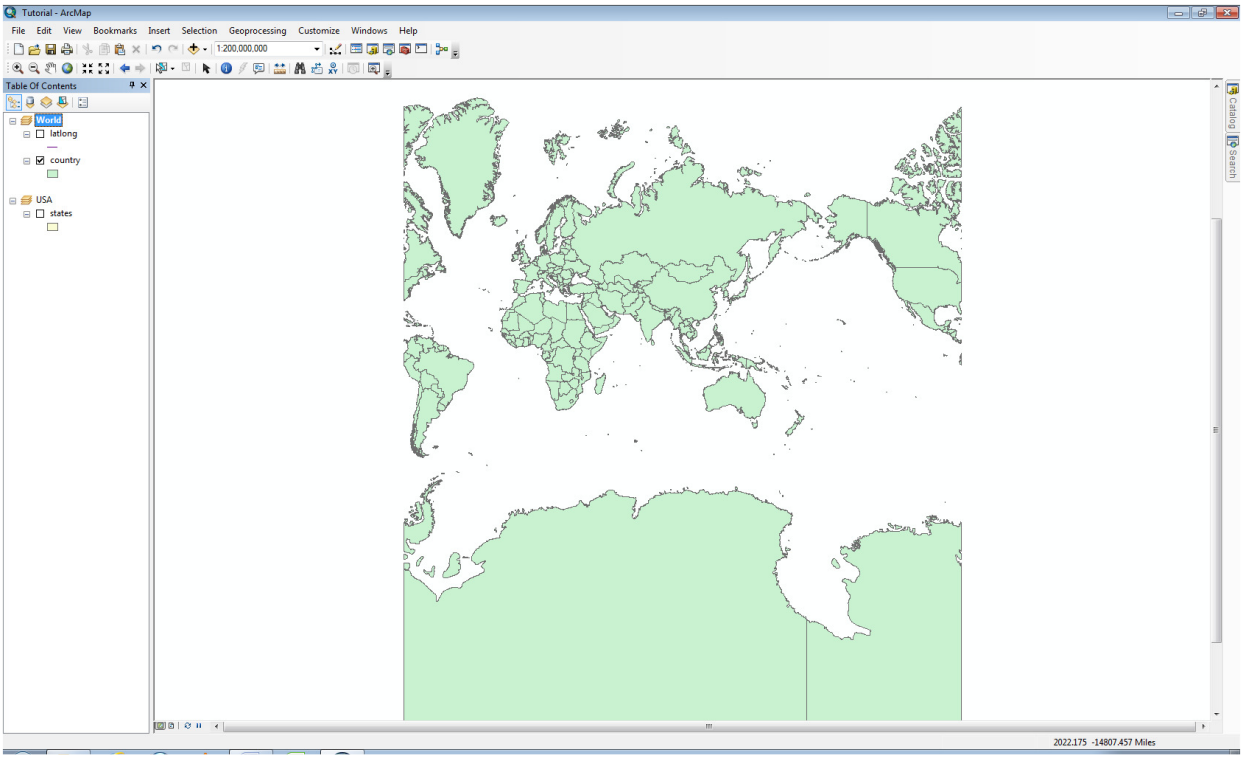
ES 341 – GIS

Ch. 11 Tutorial Screen Captures



Pg. 312 – Changing Coordinate System to UTM



Pg. 313 – Changing Central Meridian Value in World Data Frame Coordinate System

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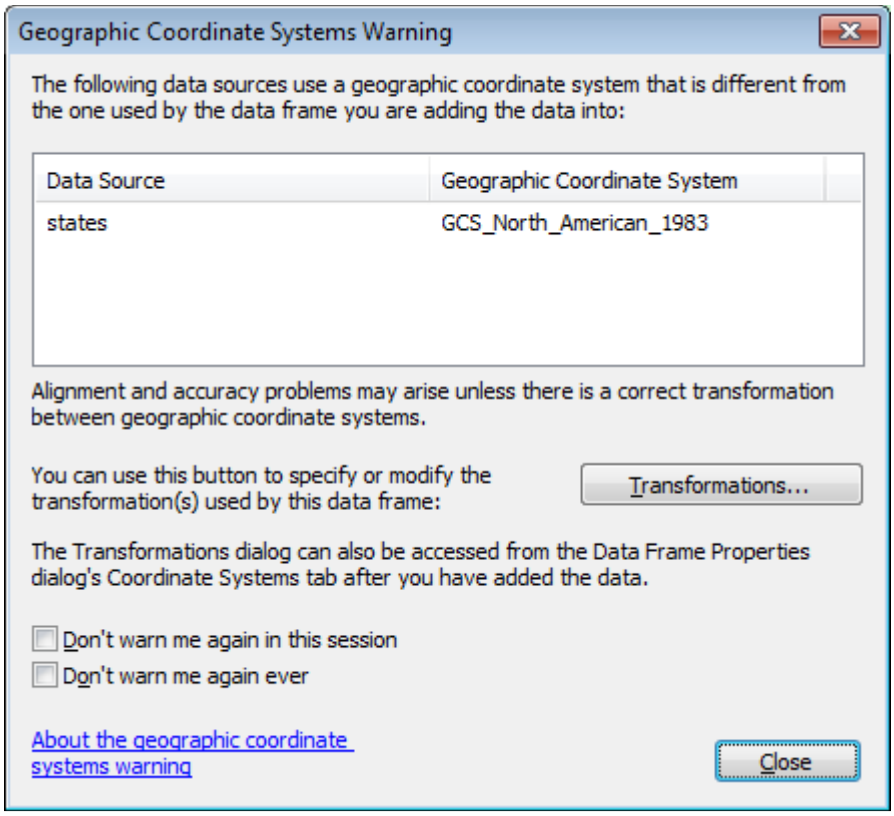
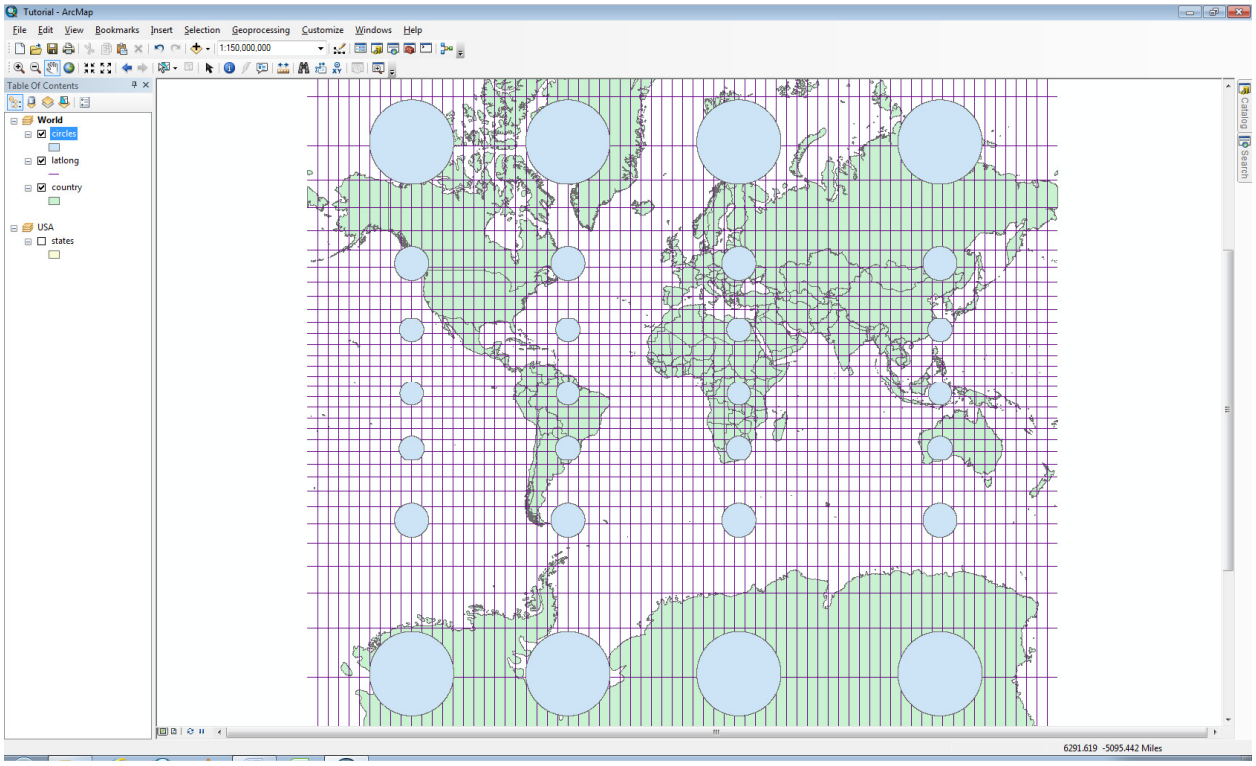
Ch. 11 Tutorial Screen Captures



Pg. 313 – Warning Message when adding feature of different coordinate system



Pg. 314 – Adding Circles Shape file to World Map with Mercator Coordinate System

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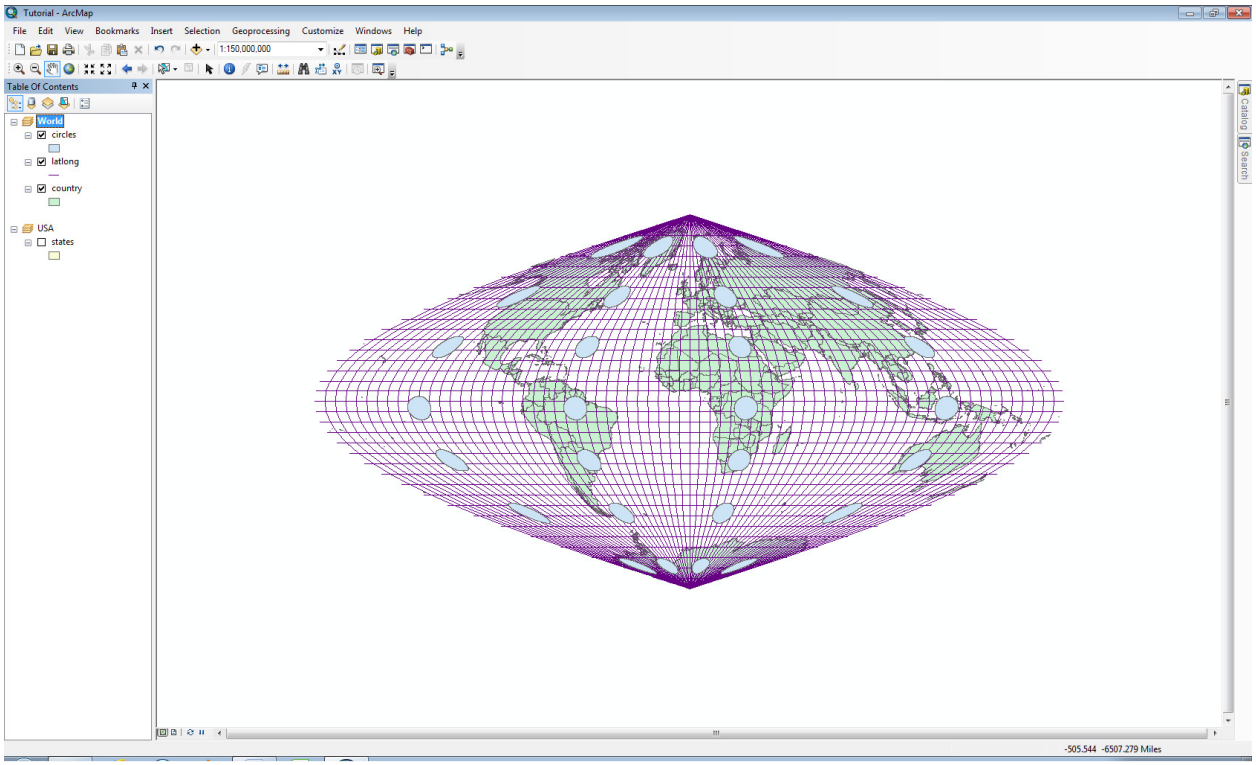
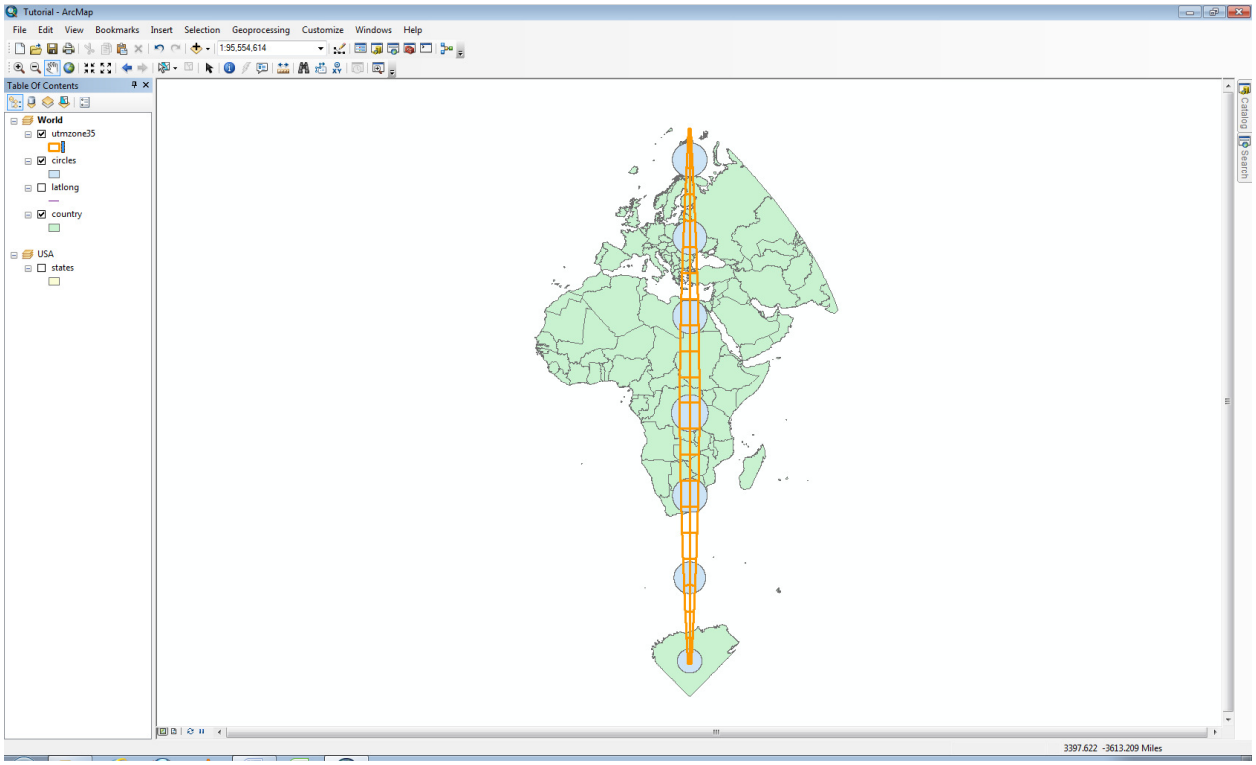
Ch. 11 Tutorial Screen Captures



Pg. 314 – Changing Coordinate System to Sinusoidal



Pg. 314 – WGS 1984 Zone 35N Coordinate System

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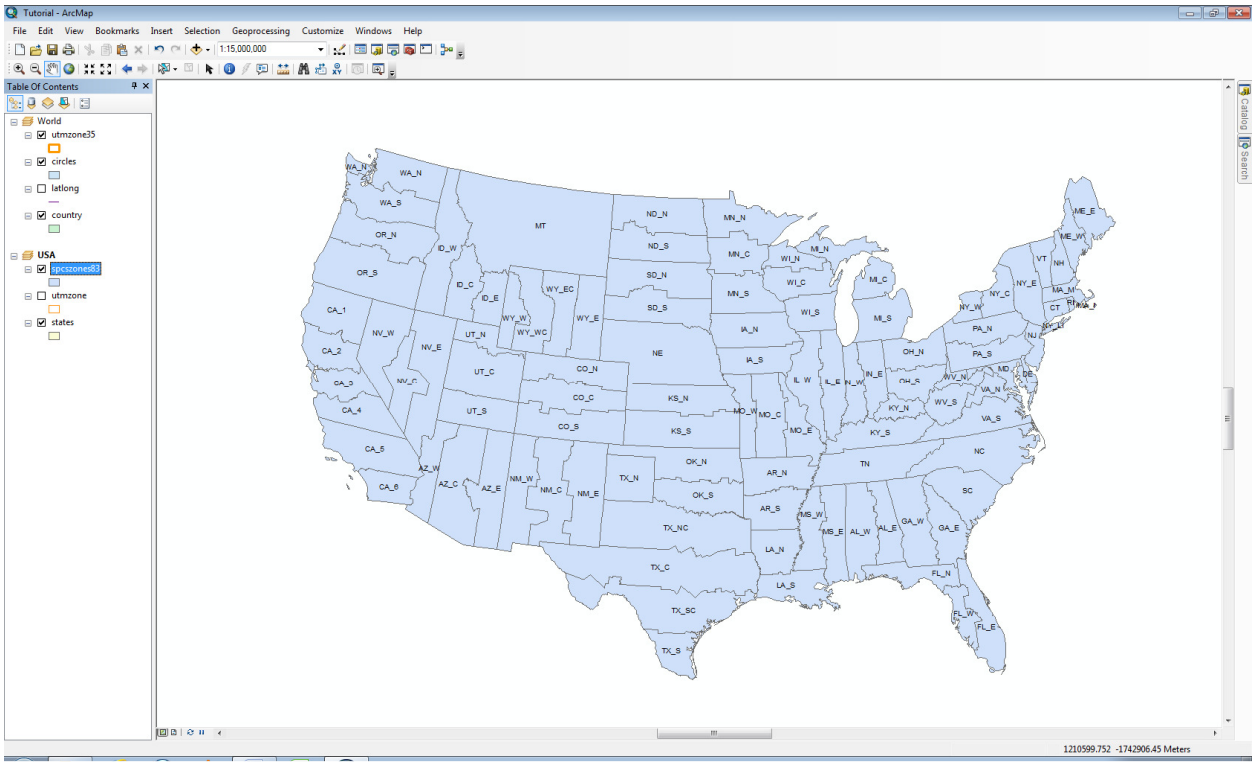
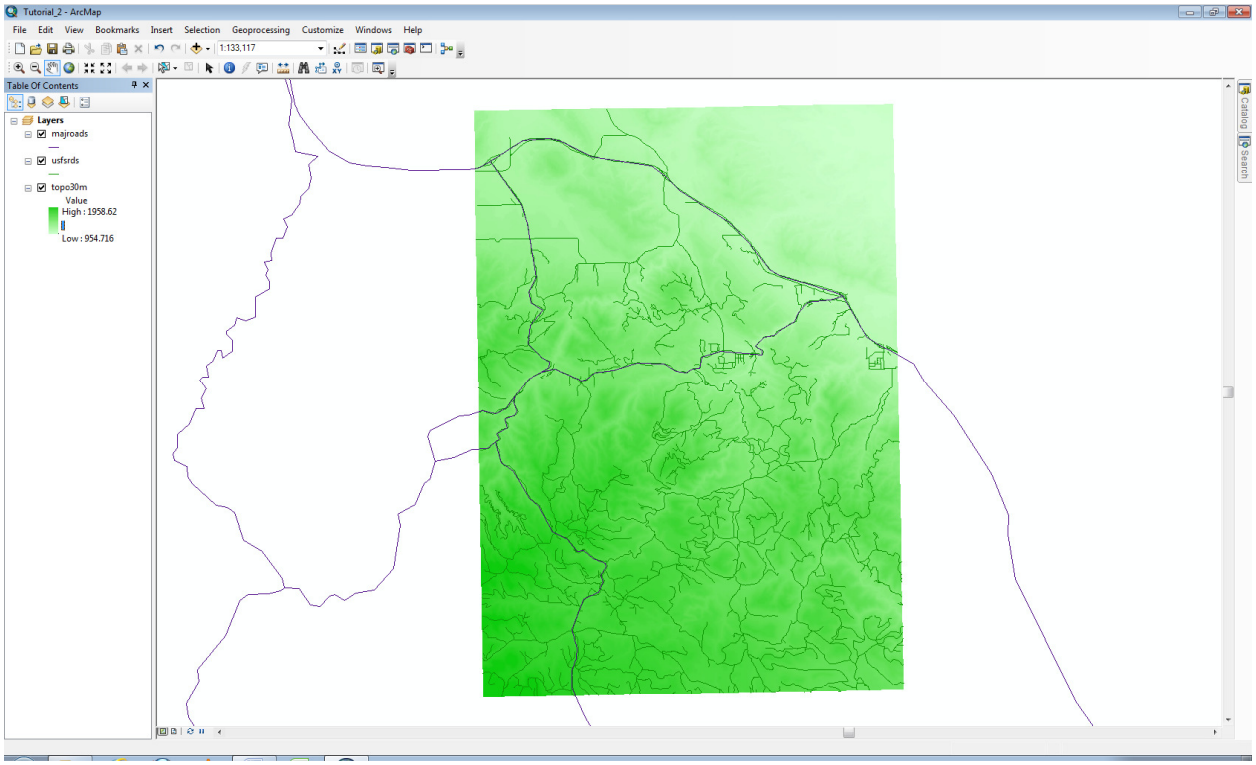
Ch. 11 Tutorial Screen Captures



Pg. 315 – State Planes Zones in the USA Data Frame



Pg. 316 – Topographic Raster for Sturgis Added to New Data Frame

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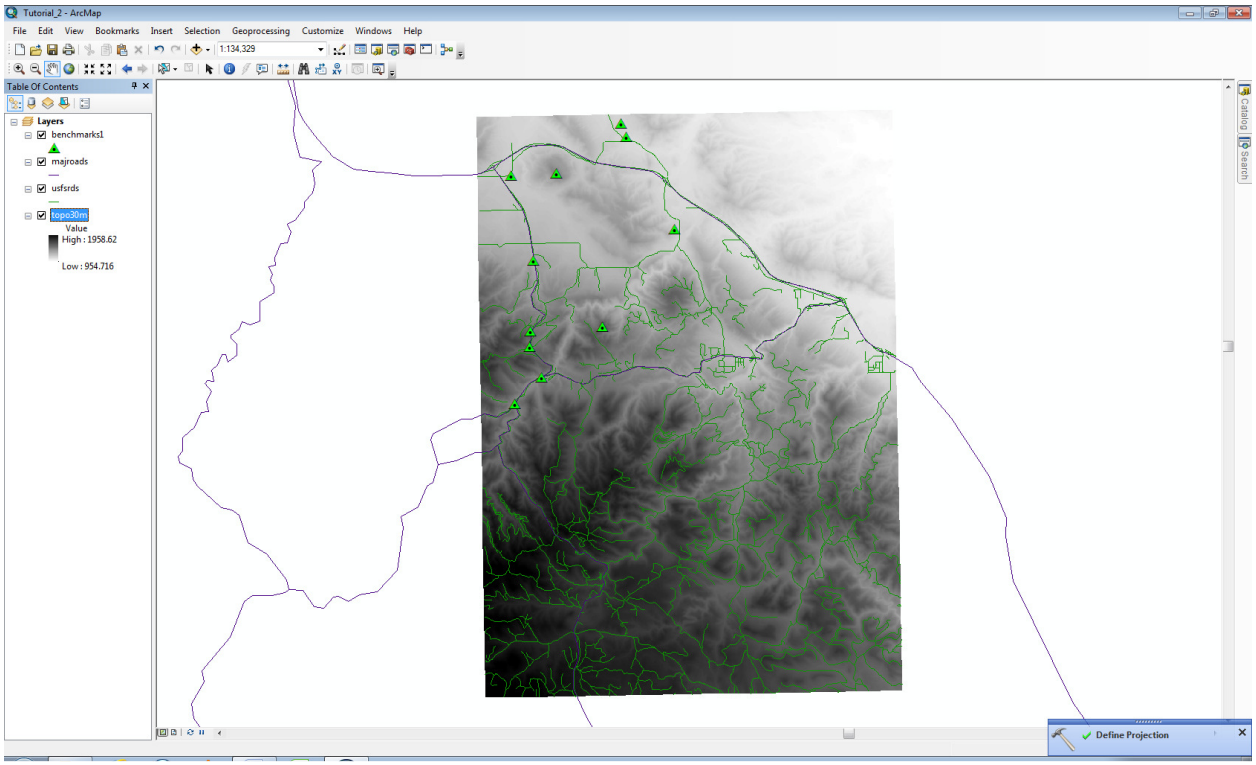
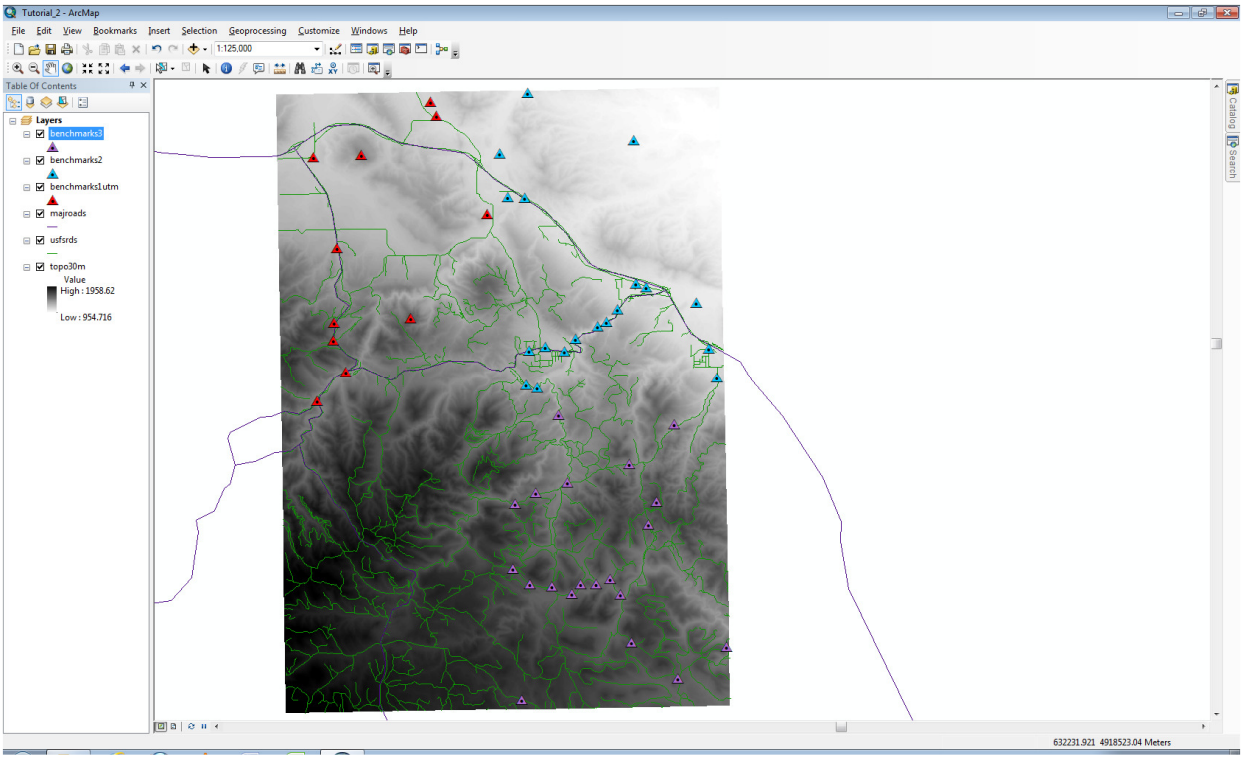
Ch. 11 Tutorial Screen Captures



Pg. 317 – Benchmarks 1 file aligned with defined coordinate system



Pg. 318-319 – Redefining Benchmarks 2 & 3 to correct projections to align with topo projection

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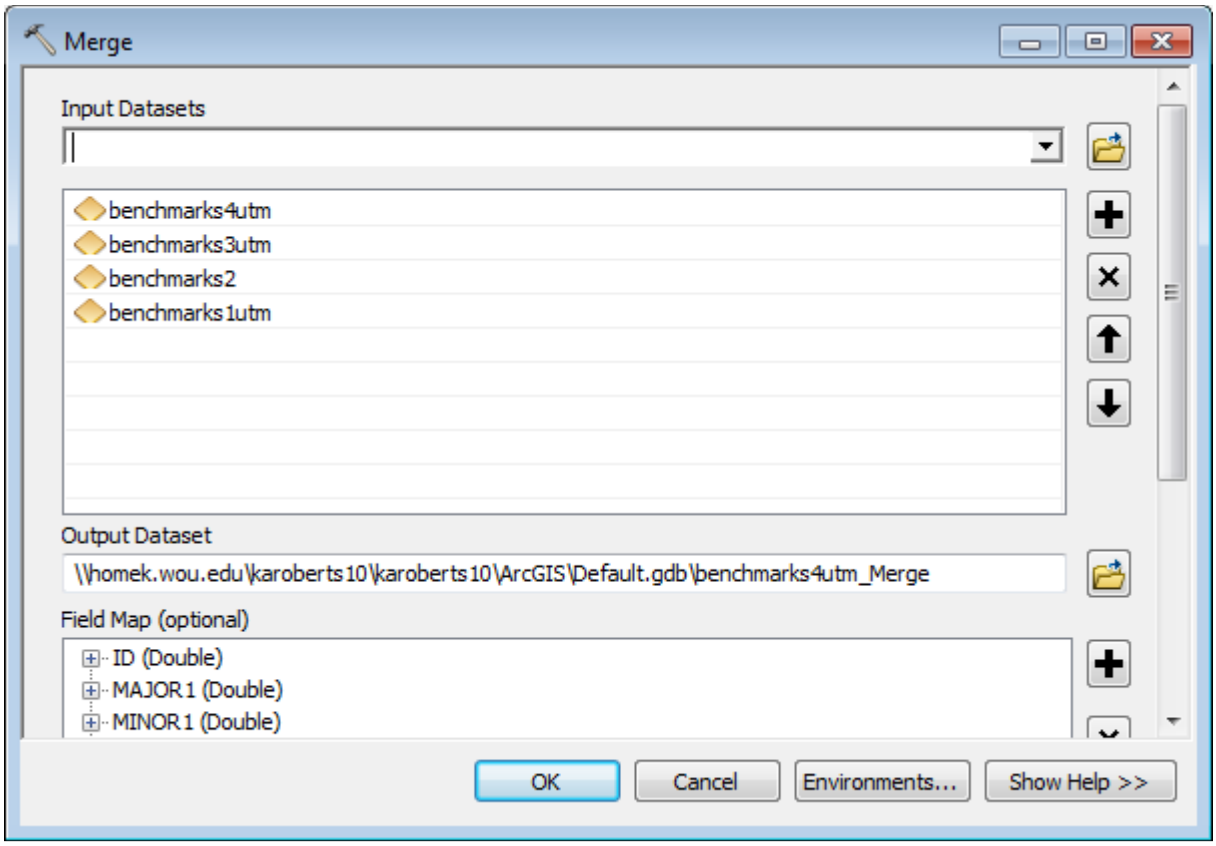
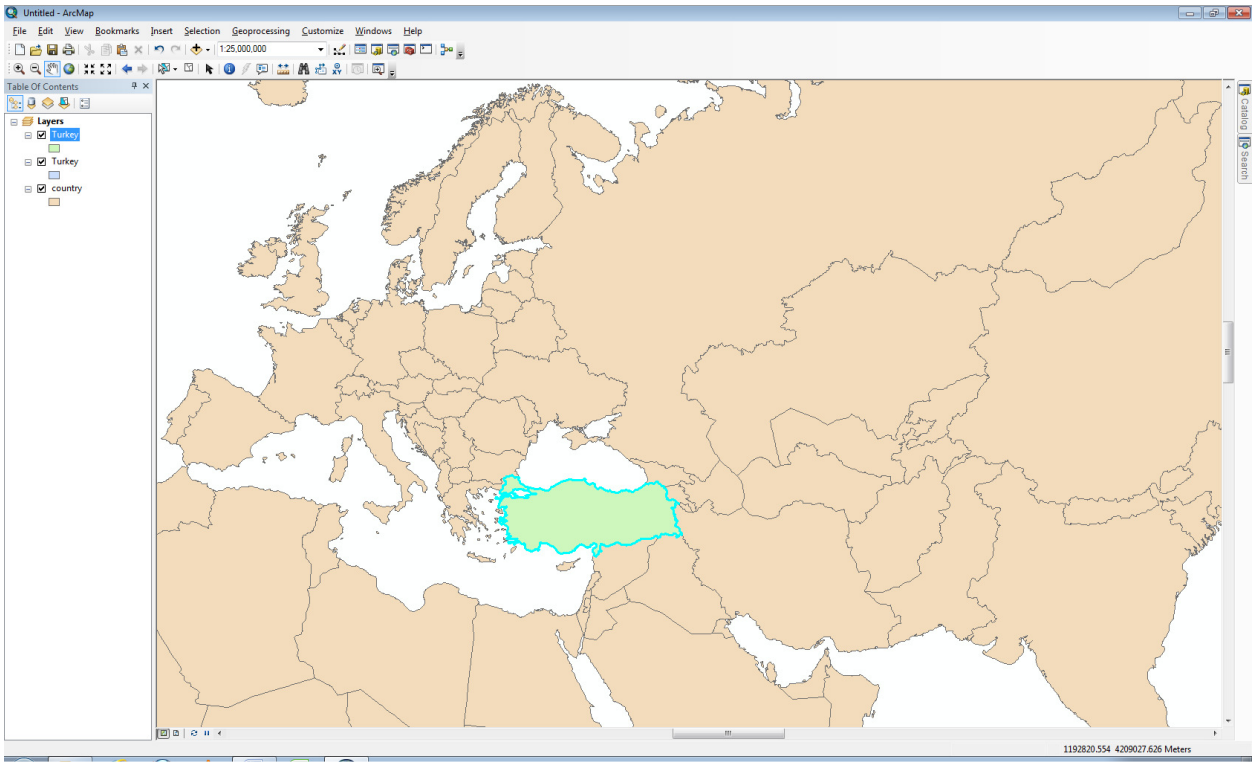
Ch. 11 Tutorial Screen Captures



Pg. 319 – Merging Shape files into single feature class



Pg. 322 – Creating a New Coordinate System – Turkey

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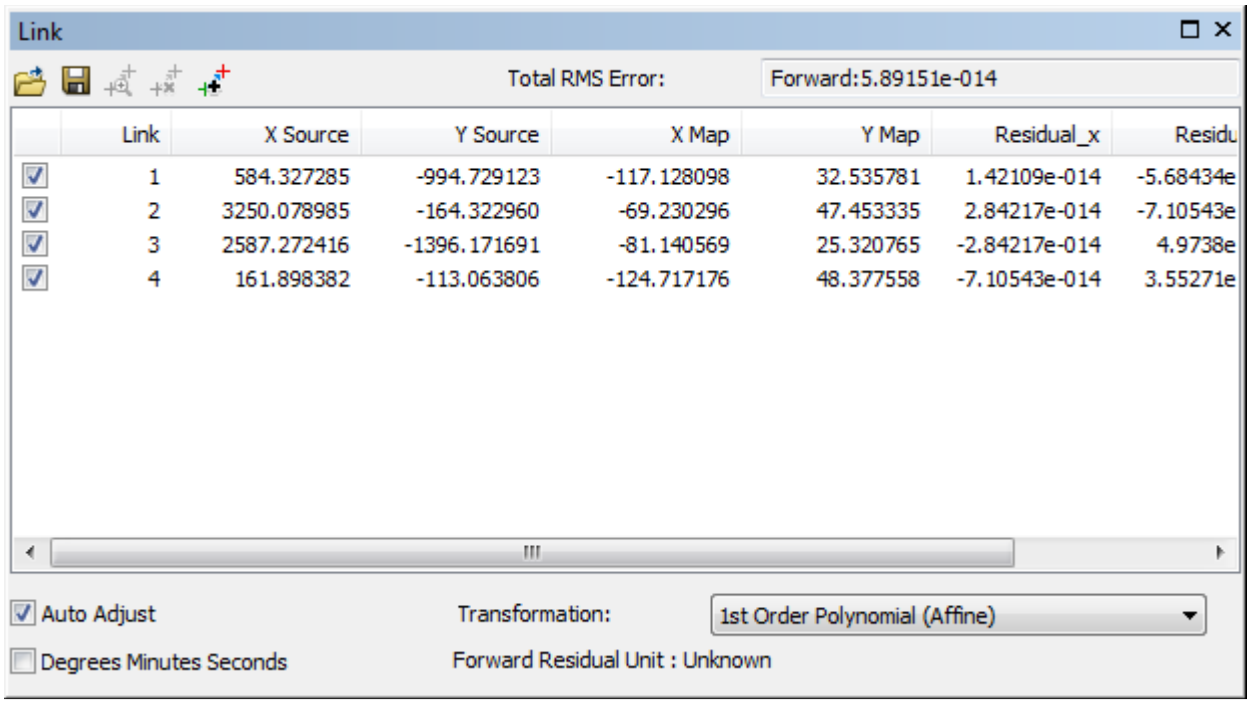
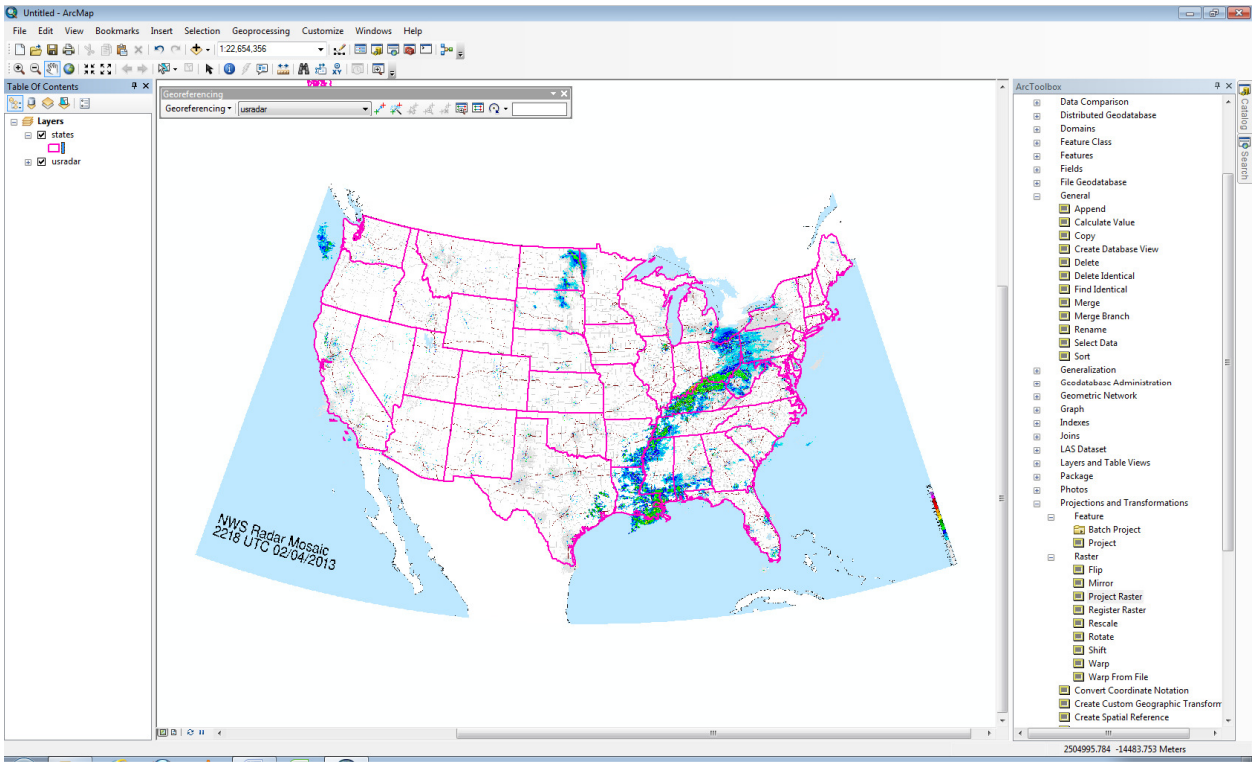
Ch. 11 Tutorial Screen Captures



Pg. 323-324 – Georeferencing Map, Link Table of Control Points



Pg. 325 – Projecting a Raster

Tutorial In-Text Questions

Mastering Skills Ch. 11 Tutorial – In-text Answers

1. What is the coordinate system for this feature class?
    a. GCS_WGS_1984

2. What are the coordinates of the SE tip of Florida?
    a. -80.41, 25.219

3. What are the map units of this frame? What are the display units?
    a. Decimal Degrees
    b. Decimal Degrees

4. What are the coordinates for Florida's tip now?
    a. -5559.747, 1735.187

5. What are the map units for this Mercator projection?
    a. Meters

6. Which continent has primarily negative x AND negative y coordinates in this projection? Which one has primarily positive x and y coordinates?
    a. South America
    b. Europe/Asia

7. What longitude is the central meridian? What is the latitude of origin?
    a. -96.0
    b. 40.0

8. Examine the standard parallels and the latitude of origin, and predict whether any areas of the US have negative y coordinates in this projection. Why or why not?
    a. Yes
    b. Because much of the US is below 40.0° latitude

9. Is this Equidistant Conic projection a tangent or secant projection? How can you tell?
    a. Secant, you can tell because there are two standard parallels

10. Which UTM Zone should be used for Nevada?
    a. 11 North

11. State the Data frame coordinate system WITHOUT looking at its properties. How could you know?
    a. NAD 1983 UTM Zone 13N, because it takes the coordinate system of the first drawn layer

12. On what type of projection does the map appear to be based?
    a. Geographic Coordinate System

Chapter Review Questions

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Mastering ArcGIS Ch. 11 – Review Questions (1-9)

1. If a data set's features have x coordinates between -180 and +180, what is the coordinate system likely to be? In what units are the coordinates?
    a. Geographic Coordinate System
    b. Units are in degrees
2. What are the x-y coordinates of a map's origin? What is the x coordinate along the central meridian?
    a. 0,0
    b. x=0
3. What is the difference between a spheroid and a geoid?
    a. A spheroid is a stretched sphere to better model the Earth, a geoid is the exact shape of the Earth if the entire surface were water with no land.
4. Examine Figures 11.5 through 11.7, and explain why conic projections usually conserve area and distance, but cylindrical projections typically preserve direction.
    a. T
    b. T
5. What extra step is performed when projecting rasters that is not needed when projecting vector data? What happens during this step?
    a. G
    b. G
6. What is the difference between a central meridian and the Prime Meridian?
    a. A central meridian N-S running longitude running through the center point of the specific projection. The Prime Meridian is the N-S running longitude running through Greenwich, England and demarking the 0° longitude.
7. You have a shapefile with an Unknown coordinate system, but a file on the website says that the coordinate system is UTM Zone 13 NAD 1983. What is your next step?
    a. Define projection
8. True or False: A shapefile of the United States with a GCS coordinate system would have an x-y extent that contains entirely positive values. Explain your answer.
    a. False. All Eastings (y values) will be negative as West of the Prime Meridian.
9. You have a shapefile with a UTM Zone 13 NAD 1983 coordinate system, and you want to bring it into your city database, which uses the Oregon Statewide Lambert coordinate system. What is your next step?
    a. Add the shapefile, ArcMap will project it on the fly.

Chapter Exercises

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Mastering ArcGIS Ch. 11 – Exercises (#1-7)

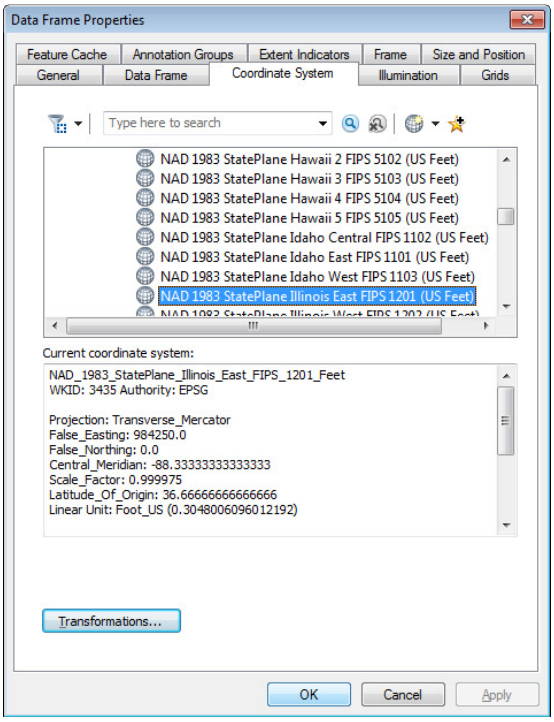
1. NAD_1983_StatePlane_Texas_Central_FIPS_4203_Feet; projected to Lambert_Conformal_Conic; map units in US Feet

2. Lambert_Conformal_Conic Projection; Central meridian = -120.50000000, Standard Parallel 1 = 43.00000000, Standard Parallel 2 = 45.50000000; no, it does not use the equator for the latitude of origin

3. USA_Contiguous_Equidistant_Conic; map unit is meters; display unit is miles; feature class is in decimal degrees

4. Best Coordinate Systems:
    a. State Plane
    b. State Plane
    c. Nevada custom
    d. State Plane
    e. UTM
    f. Antarctica, Sievers and Bennat (1989)

5. You are tasked with creating a statewide map for Illinois. Choose a UTM or State Plance zone and modify it to best represent the entire state. Explain your approach and **Capture** the coordinate system you created.
    a. Method: Start with US map in North American Equidistant Conic projection, and select Illinois, creating a layer from that selection. Change projection to State Plane Illinois East and modify central meridian to better center around all of Illinois.



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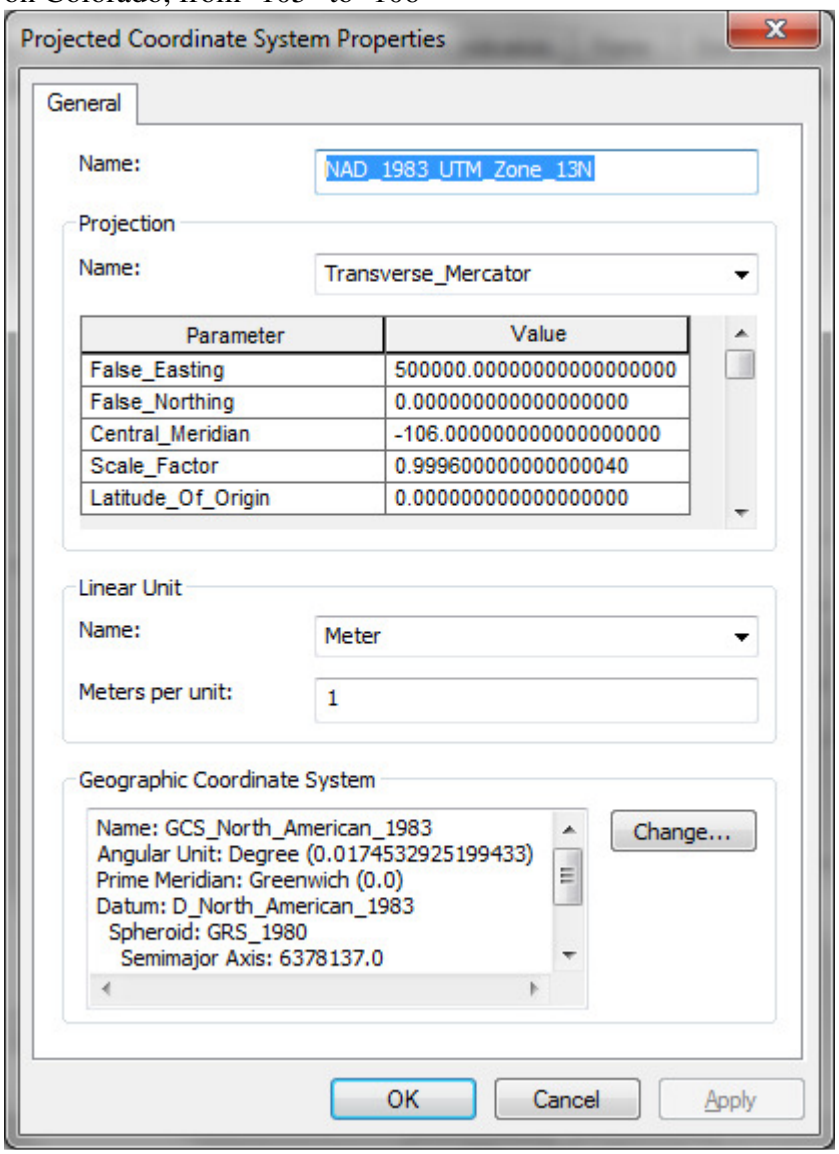
6. You are tasked with creating a statewide map for Colorado. Choose UTM or State Plane zone and modify it to best represent the entire state. Explain your approach and capture the coordinate system you created.
    a. Create layer of State of Colorado, project it into UTM Zone 13N, add lat/lon layer from world data, adjust central meridian of UTM projection to better be centered on Colorado, from -105° to -106°



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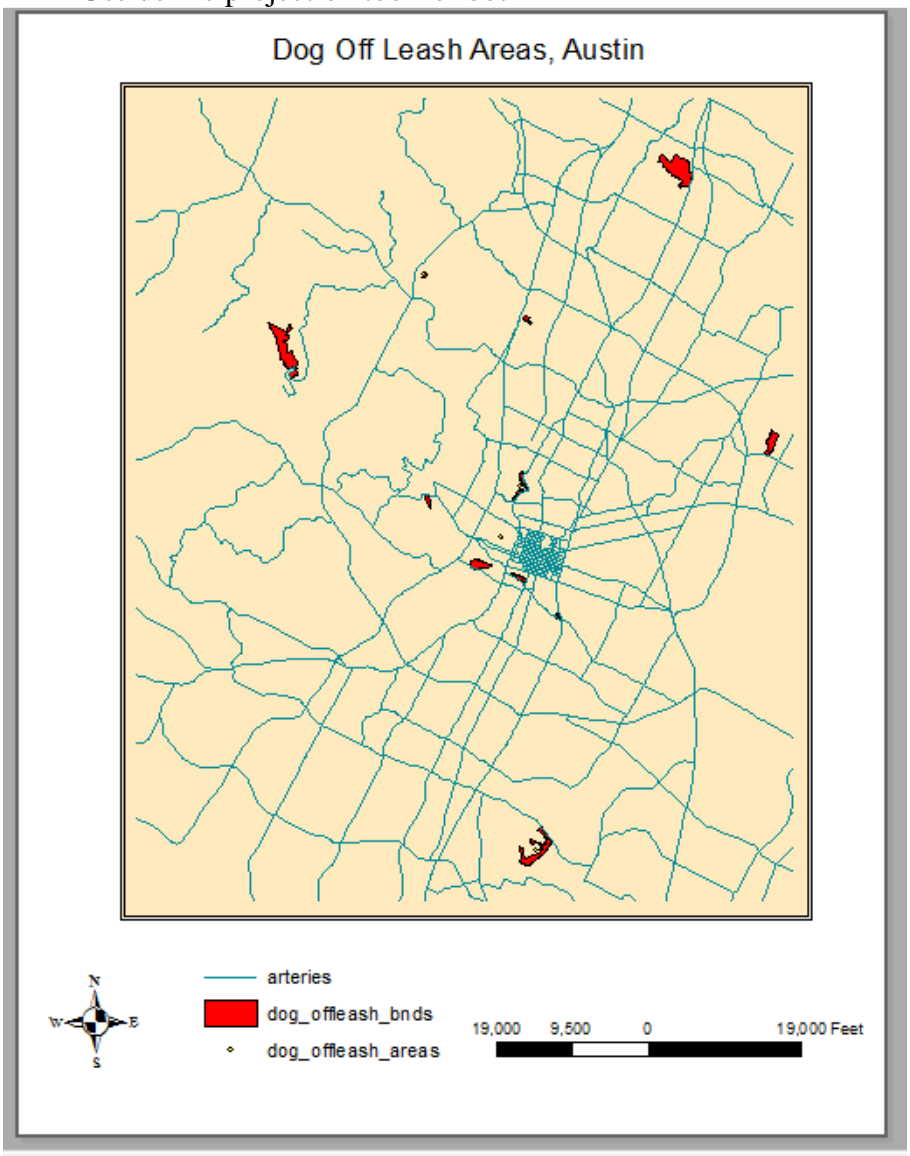
7. The Austin folder contains two shapefiles showing dog off-leash areas as points and polygons. Both have coordinate problems. Describe the problem for each, fix them and create a map showing both the points and polygons with a backdrop of the major transportation arteries of Austin. Capture the map.
    a. Problem = missing projection information
    b. Fix = Use define projection tool for both



5A: Price Text Chapter 4 (Attribute Data) Reading and Tutorial Exercises

17 pages

Tutorial Screen Shots

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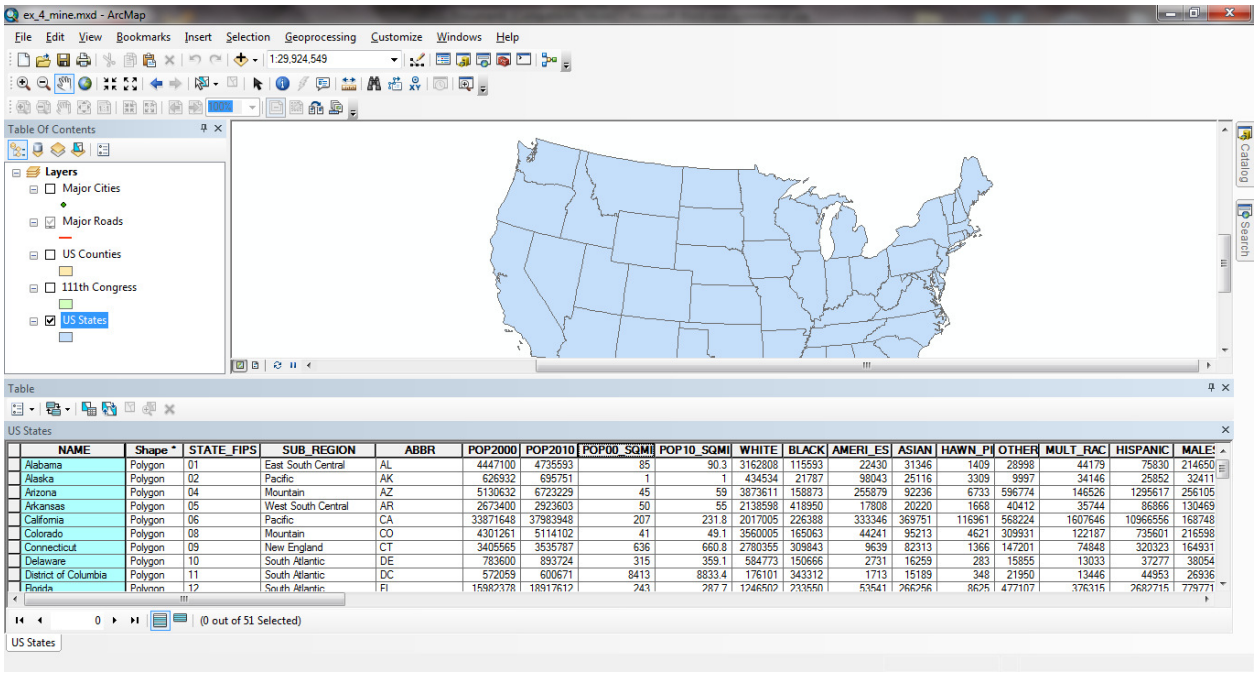
Mastering the Skills Ch. 4 Tutorial Screen Shots



Pg. 114-115, accessing and formatting the data table

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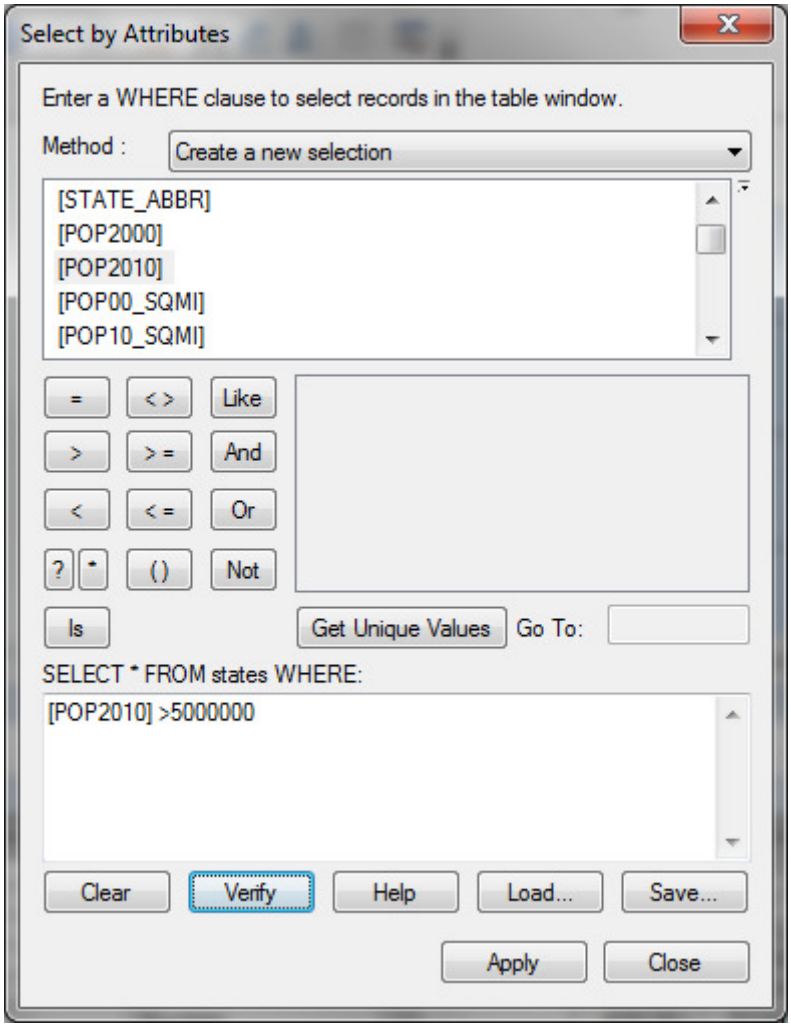

Pg. 116 – Using query to select by attributes

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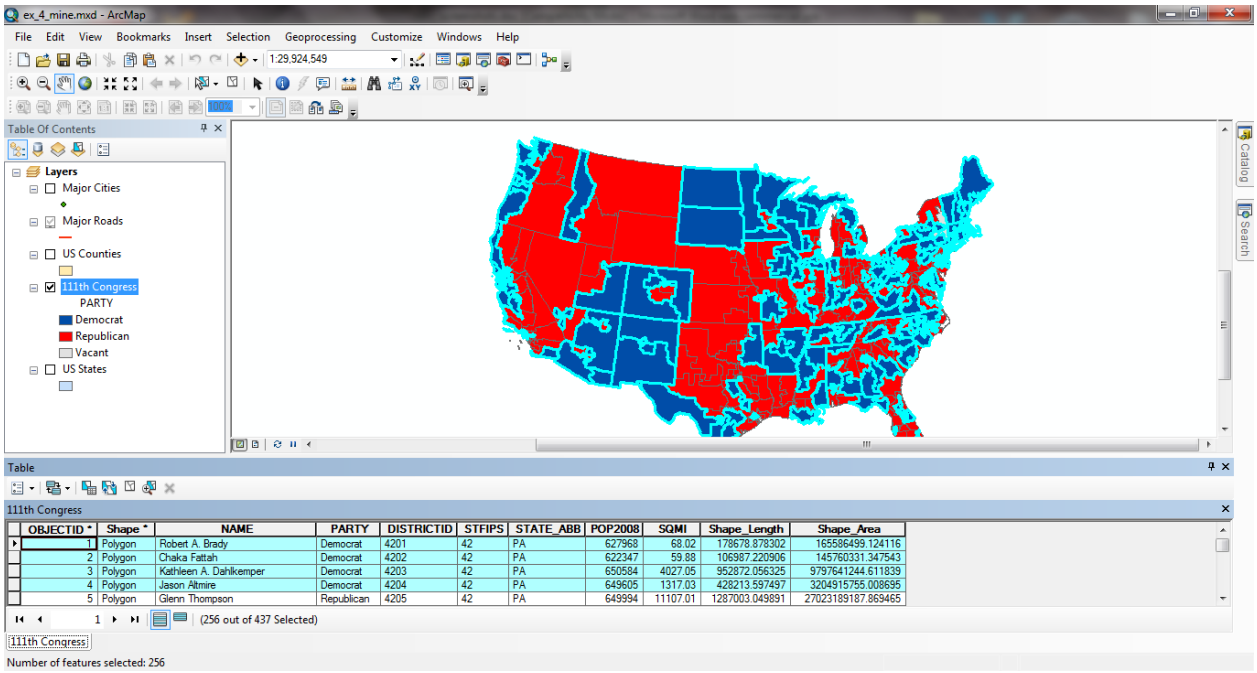

Pg. 117 – Using Select by Attributes to determine Democratic districts

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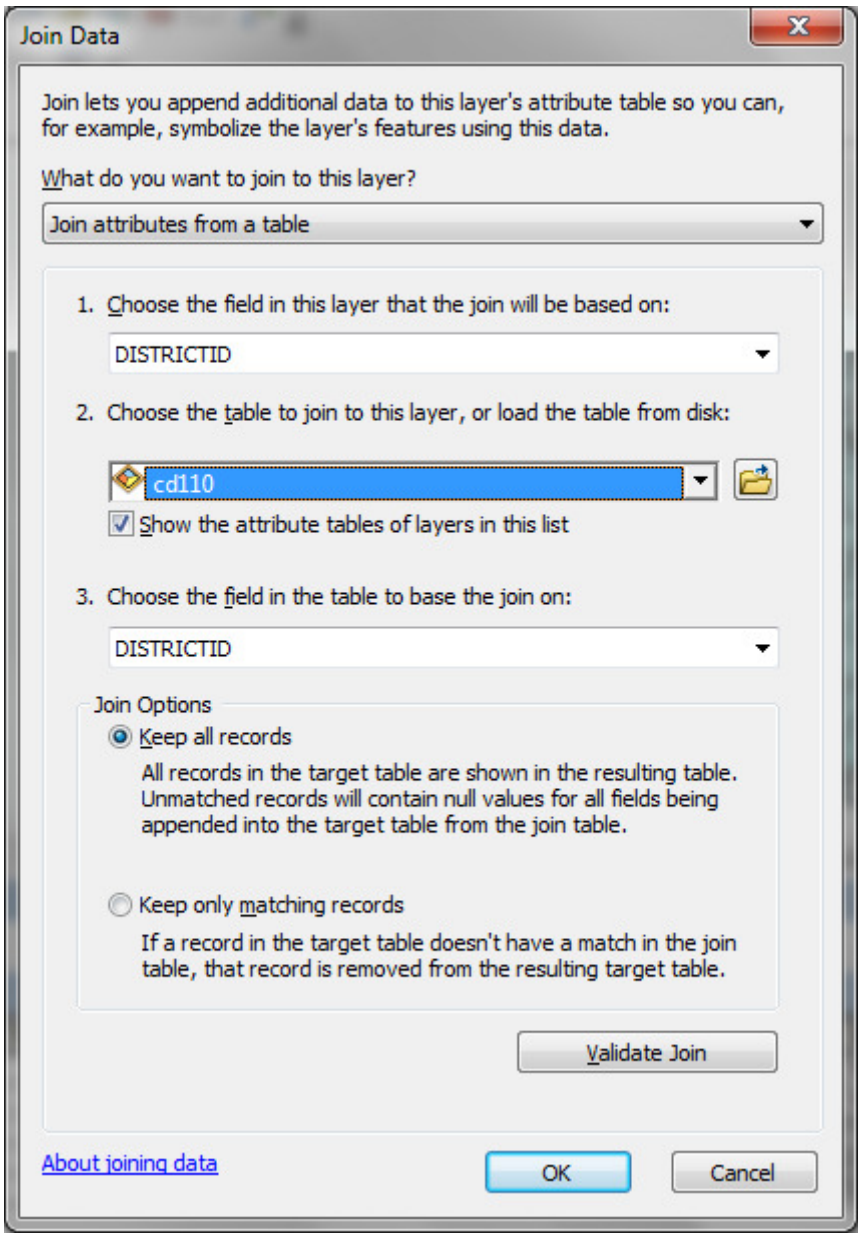

Pg. 118-119, Joining two tables through common field

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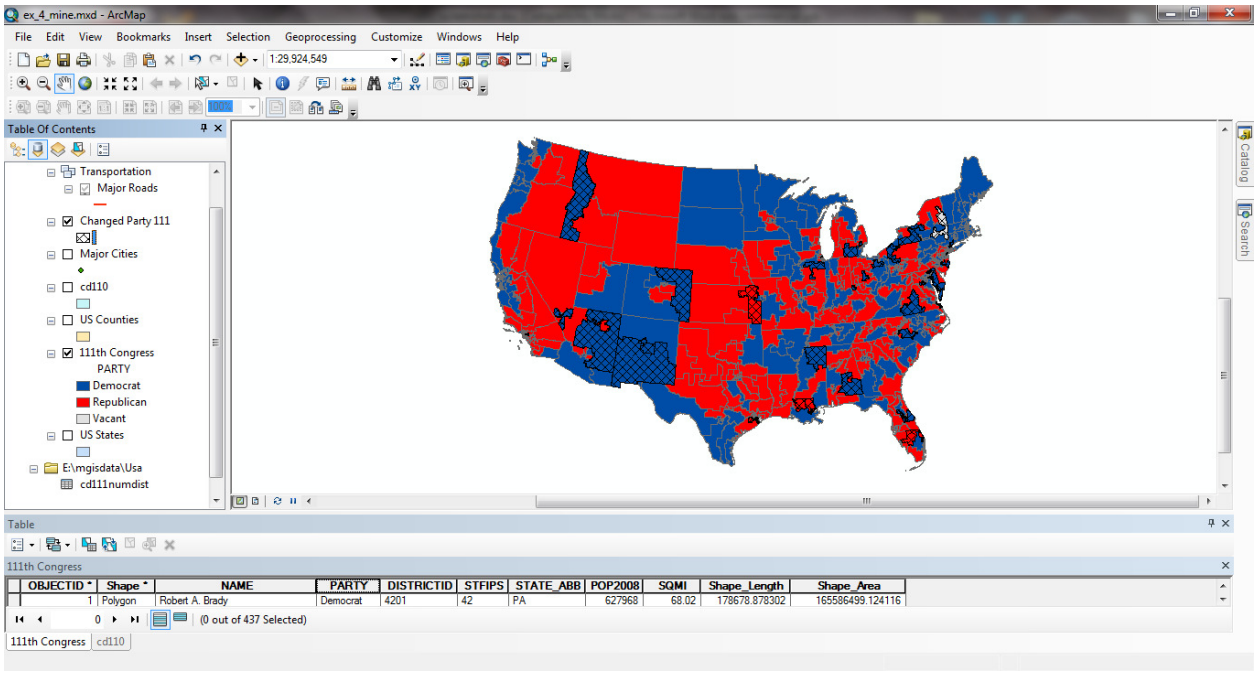
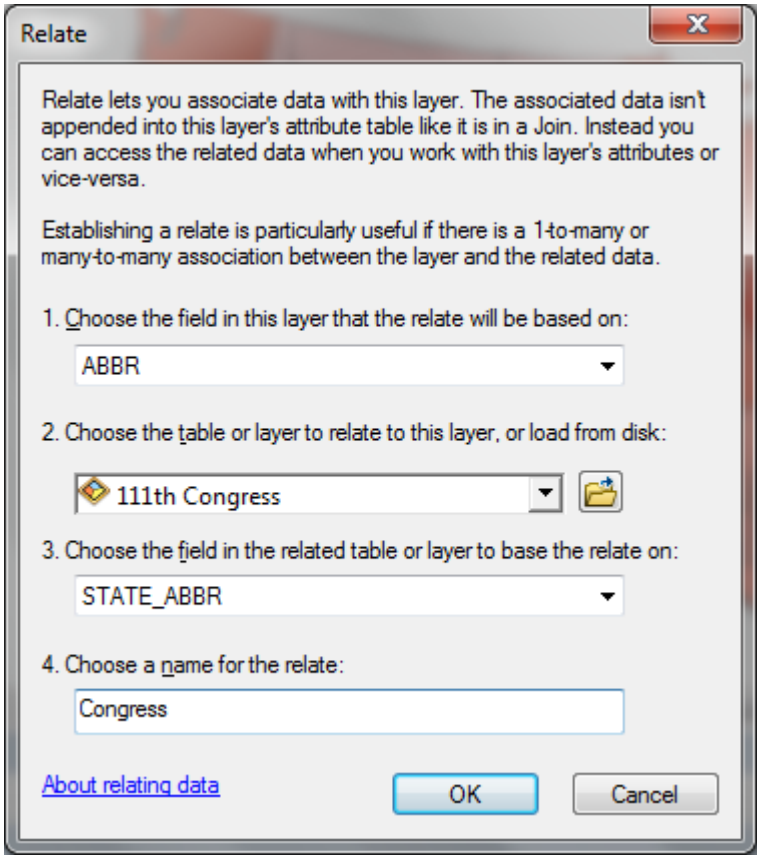


Pg. 120 – Using Join and Select by Attributes to Create a new layer



Pg. 121-22 – Creating a Table Relate

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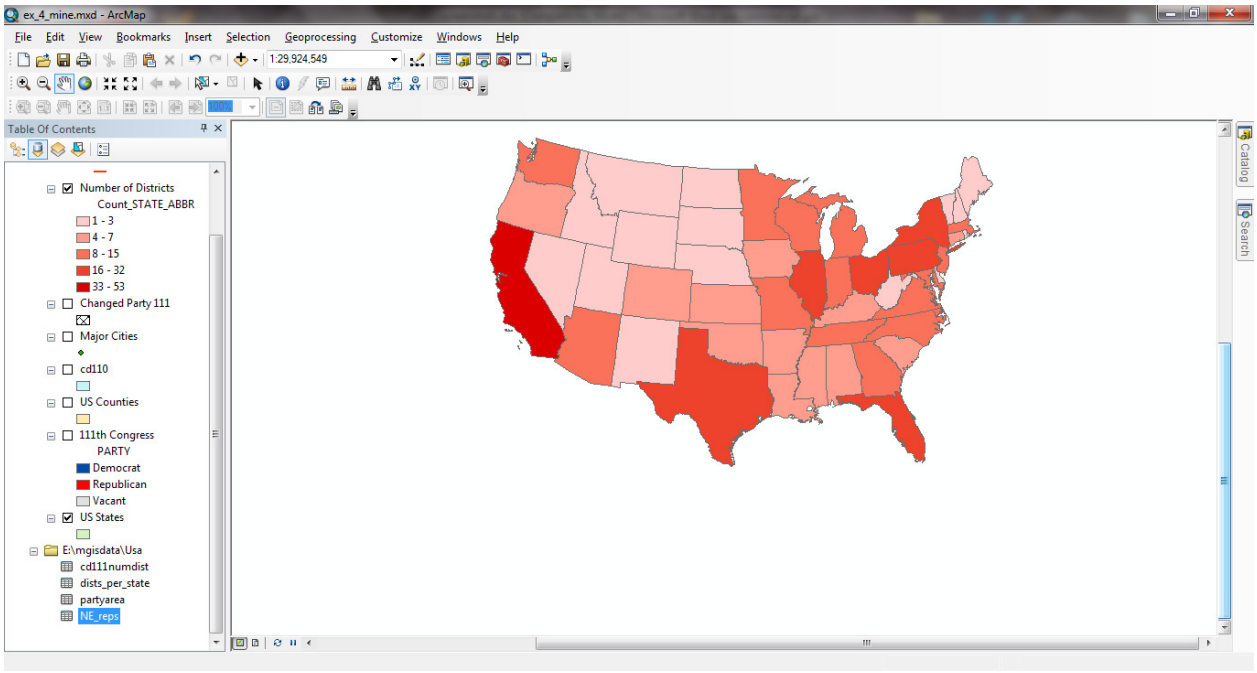
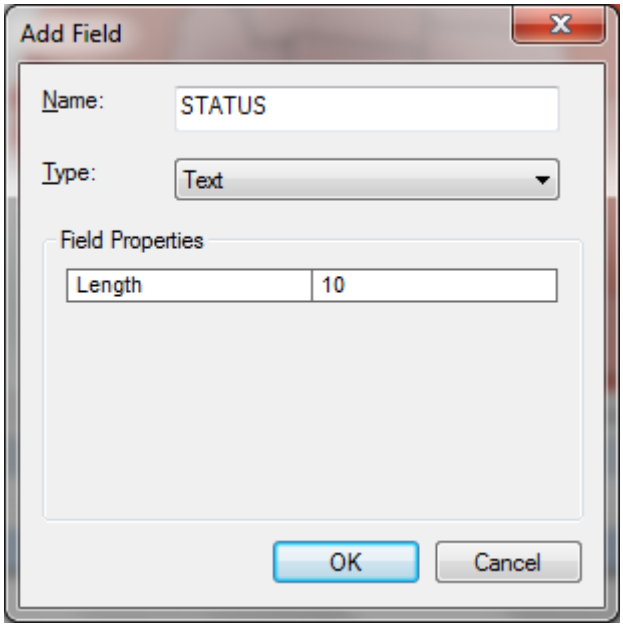


Pg. 123 – Saving created database tables made from related data



Pg. 123 – Adding Fields to Tables

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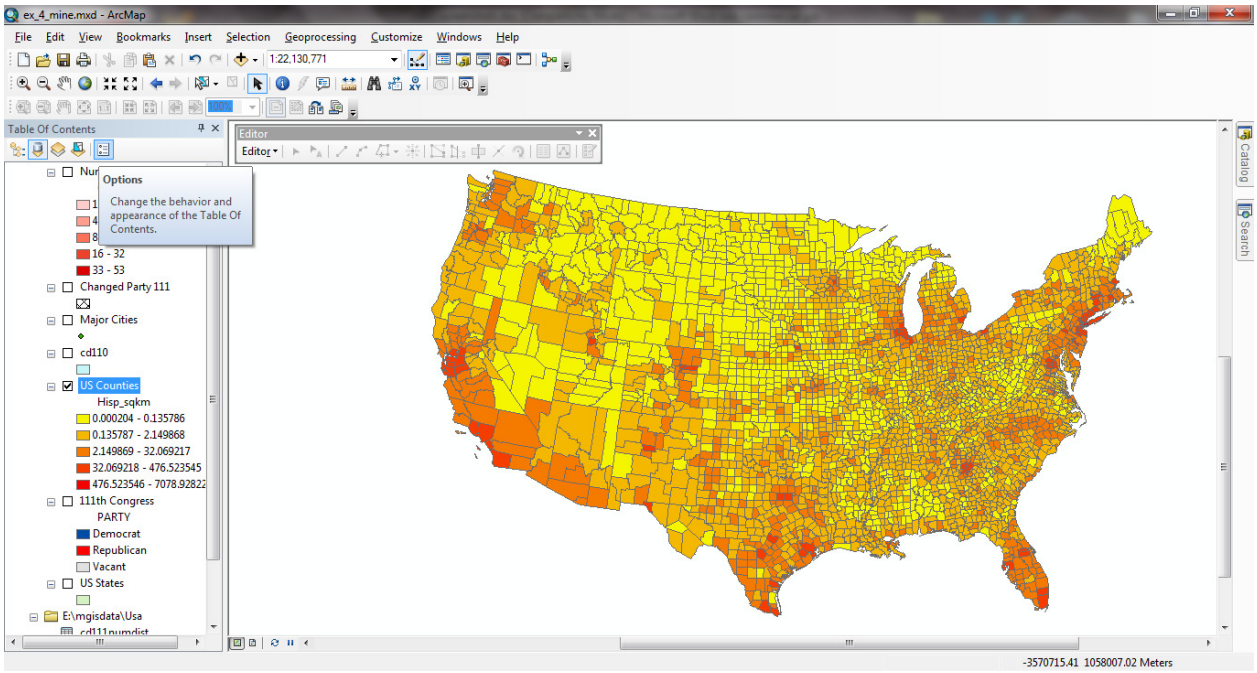

Pg. 124-125, Creating density of Hispanic population by county from created and calculated fields

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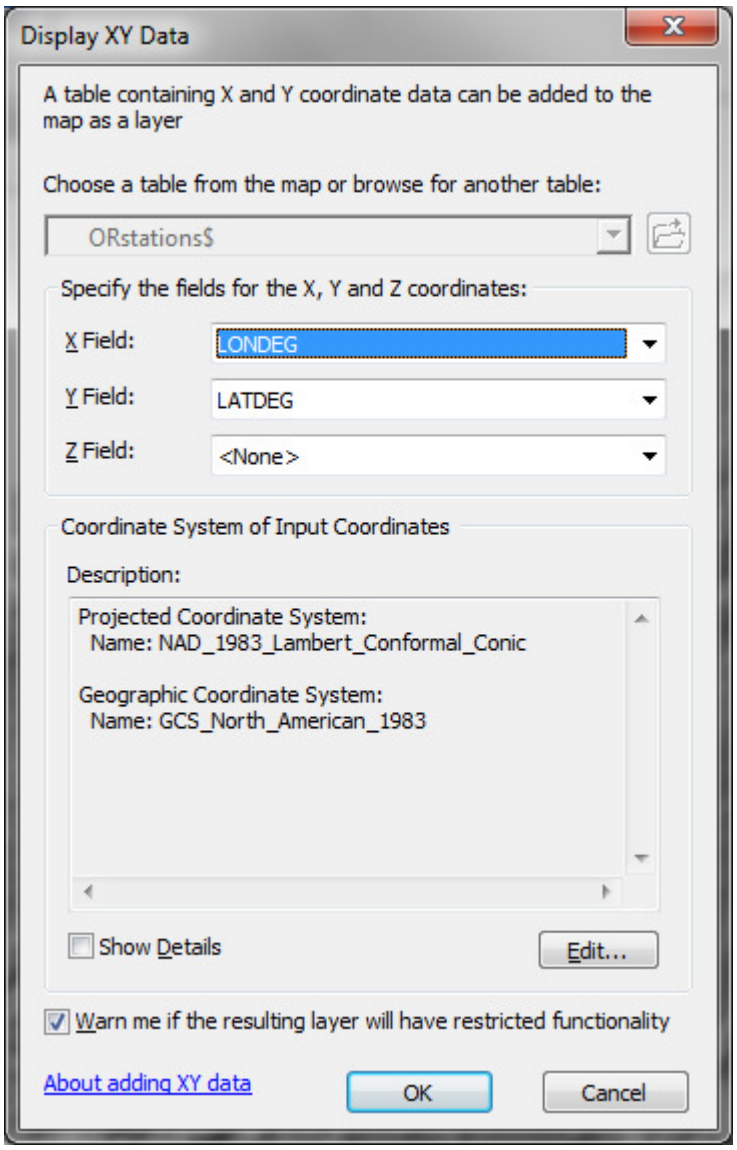

Pg. 126, Displaying data from an Excel Worksheet

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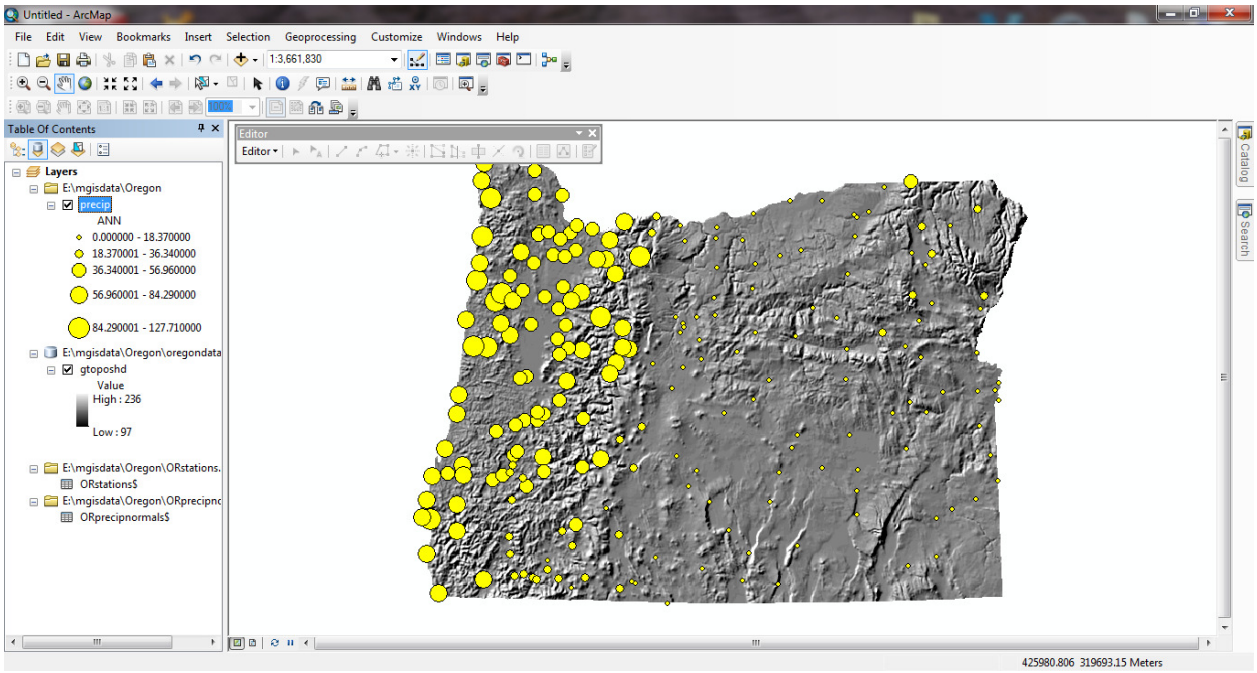

Pg. 127, Creating a permanent saved layer from an Excel file

Tutorial In-Text Questions

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Mastering Skills Ch. 4, In-text Tutorial Questions

1. What is the population of the largest state?
    a. 37,983,948

2. How many Democratic districts are there?
    a. 256

3. What is the best potential key field in this table?
    a. District ID

4. Which party received most of the changed seats in the 111th Congress?
    a. Democrat

5. Is this new table an attribute table or a standalone table?
    a. Stand alone

6. Use a query to determine how many states have only one district:
    a. 9

7. Which party represents the greater area, and by how much?
    a. Republican
    b. 783640.99 sq. miles

8. What is the cardinality of this join?
    a. One-to-one

9. What is the cardinality between subregions and districts?
    a. One-to-many

10. Which is the source table, and which is the destination table?
    a. Districts is source table
    b. States is destination table

11. How many representatives come from New England states?
    a. 22

12. What is the common field in these two tables?
    a. Station Name

Chapter Review Questions

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ES 341 – GIS

Mastering ArcGIS – Ch. 4 Review Questions (# 1-10)

1. Describe the difference between an attribute table and a standalone table.
    a. An attribute table shows features within a geologic data set.
2. Which type of database management system are GIS systems based on? How does this type of system differ from other DBMS types?
    a. Most GIS systems prefer a relational database model.
    b. Relationships between different tables are not set ahead of time and can be temporarily associated using relates or joins.
3. List the type of data sources from which tables may display data.
    a. Spatial Data, data attributes
4. Describe how storing the number 255 in ASCII would differ from storing it as a binary representation.
    a. In ASCII, 255 would be 3 bytes. In binary it would be 1 byte stored in base 2.
5. Choose the best field type for each of the following types of data in a geodatabase:
    a. Populations of countries in the world: Long
    b. Precipitation in inches: Short
    c. Number of counties in a state: Short
    d. Highway name: Text
    e. Distances between US cities, in meters: Long
    f. Birthdays: Date
6. What is the cardinality of each of the following spatial relationships?
    a. Students to college classes: Many-to-Many
    b. States to governors: One-to-One
    c. Students to grades: Many-to-One
    d. Counties to states: Many-to-One
7. Describe the difference between a join and a relate.
    a. A join physically combines the two tables, whereas a relate associates them, but does not physically join them (which is used for a one-to-many cardinality).
8. You have a table of states and a table of airports, both with a state abbreviation field. Can you join them if states is the destination table? If airports is the destination field? Explain.
    a. If states is the destination, no it cannot be joined (one-to-many cardinality), it could be related
    b. If airports is the destination, it could be joined (many-to-one cardinality)
9. Describe the difference between using statistics and summarize functions on a field.
    a. Statistics produces an on-screen graph, summarize produces a file would summarized fields.
10. For each of the following problems, using data sets for the US, state whether using a query, the Statistics function, or the Summarize function would be the best approach to solving it.
    a. Find all towns with more than 20,000 people: Query
    b. Find the total number of volcanoes in each state: Summarize
    c. Determine the total damage caused by earthquakes in the US: Statistics
    d. Find the states in which Hispanics exceed the number of African Americans: Query
    e. Find out which subregion of the country has the most Hispanics: Query

Chapter Exercises

Kathryn Roberts
ES 341 – GIS

Mastering ArcGIS – Ch. 4 Exercises (# 1-6, 8, 10)

1. How many counties in the US have the name Washington? What is there total 2010 population? Which one has the largest area?
    a. 37 counties are named Washington
    b. Their total population is 2,551,652
    c. Washington, Maine has the largest area
2. Calculate the percentage of the population in each state that is African-American. Which state has the largest number of African-Americans? Which state has the largest percentage of African-Americans?
    a. New York has the largest number of African-Americans
    b. The District of Columbia has the largest percentage of African-Americans
3. Which subregion of the country has the greatest number of African-Americans? How many does it have?
    a. The South Atlantic subregion has the most African-Americans
    b. 11,026,722 people
4. Add the table dating to the map document. This table contains information about marital status by county. Which fields could you use to join this table to the US Counties table? In the US Counties table, examine the 3 fields, STATE_FIPS, FIPS, and CNTY_FIPS. How are these fields related?
    a. FIPS, STATE_FIPS
    b. STATE_FIPS is a unique ID given to each state alphabetically, CNTY_FIPS is a unique ID given to each county within the state alphabetically, FIPS is a code created by appending the CNTY_FIPS to the STATE_FIPS
5. Join the dating table to the US Counties table. Then select the counties that *lost* population in the 20-yr period from 1990 to 2010. How many are there?
    a. 839 counties lost population from 1990 to 2010
6. Use summarize to determine the number of counties in each state which lost population. Which state had the most losing counties, and how many losing counties did each have?
    a. Texas, 76 counties
    b. Kansas, 68 counties
    c. Nebraska, 63 counties
8. Using the Major Cities layer, determine how many people in the US live in state capitals in 2007. What is the smallest, largest, and average population of the capitals?
    a. 11,982,767 total live in state capitals
    b. 8,104 is the minimum population of a capital
    c. 1,502,129 is the maximum population of a capital
    d. 239,655.34 is the average capital population
10. Which subregion of the US has the largest number of counties? How many counties does it have? Create a map of the counties showing to which subregion each belong. Capture the map.
    a. The East North Central Sub-region has the largest number of counties (437)

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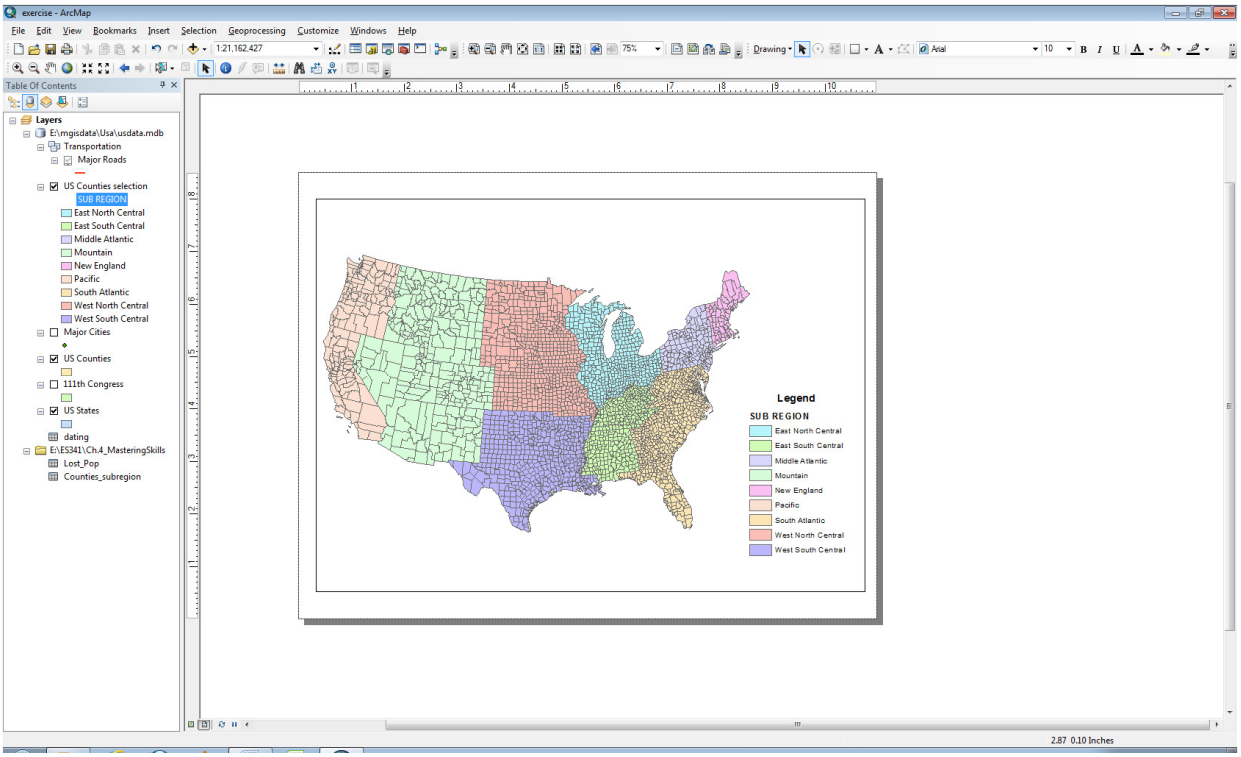

5B: Price Text Chapter 5 (Queries) Reading and Tutorial Exercises

13 pages

Tutorial Screen Shots

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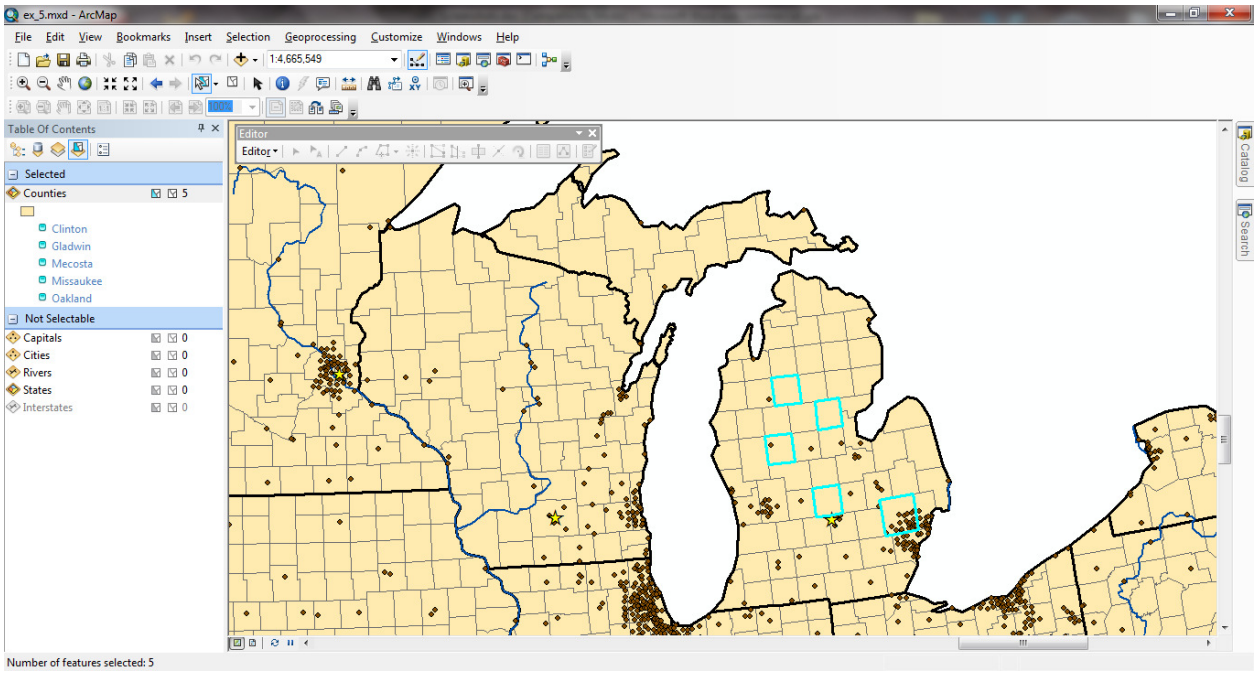
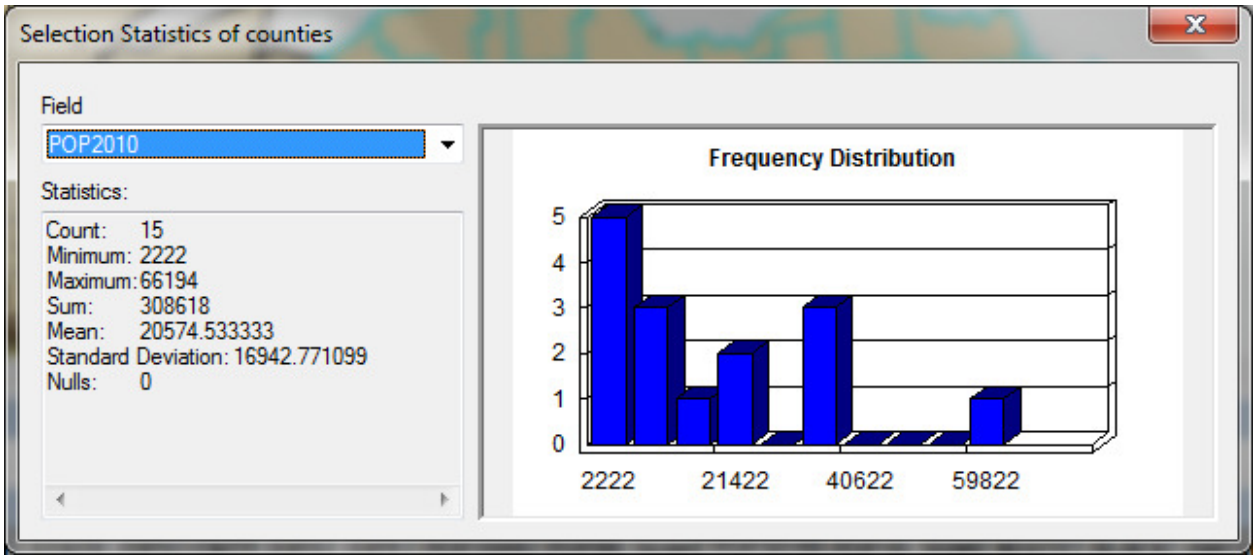
Mastering the Skills – Ch. 5 Tutorial Screen Shots



Pg. 142-143, Using list by Selection view in Table of Contents to select counties layer



Pg. 144, Running Statistics Count and Sum of selected counties from Attribute Table

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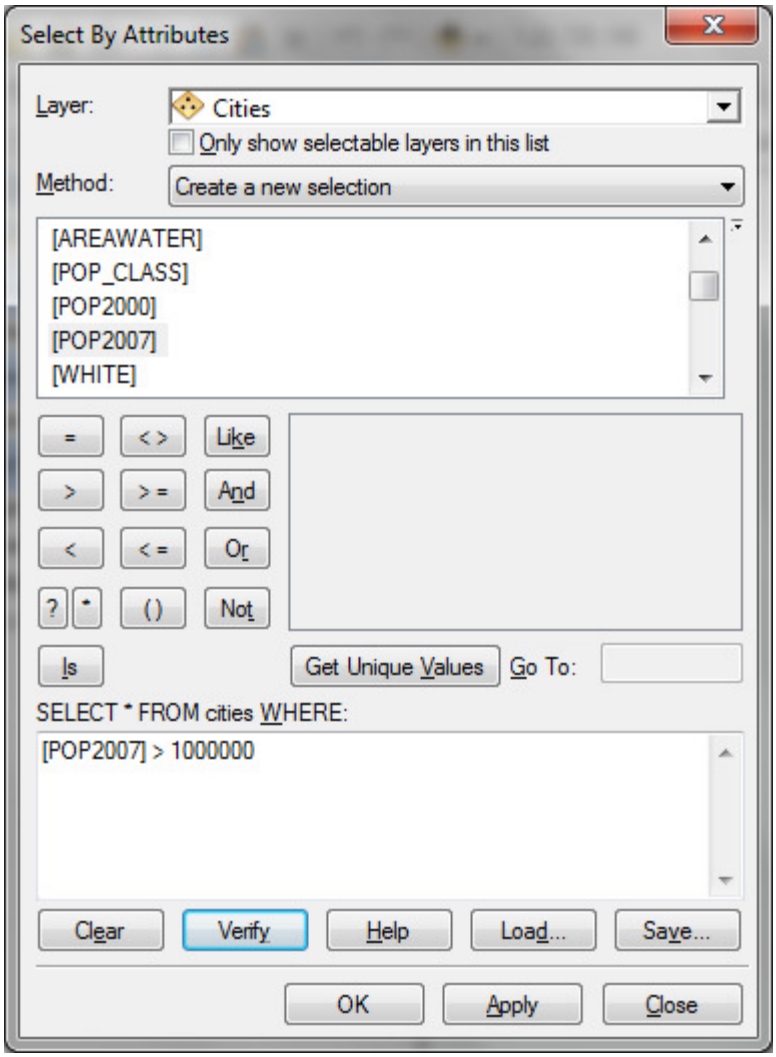

Pg. 146-147, Using the Select by Attributes Feature

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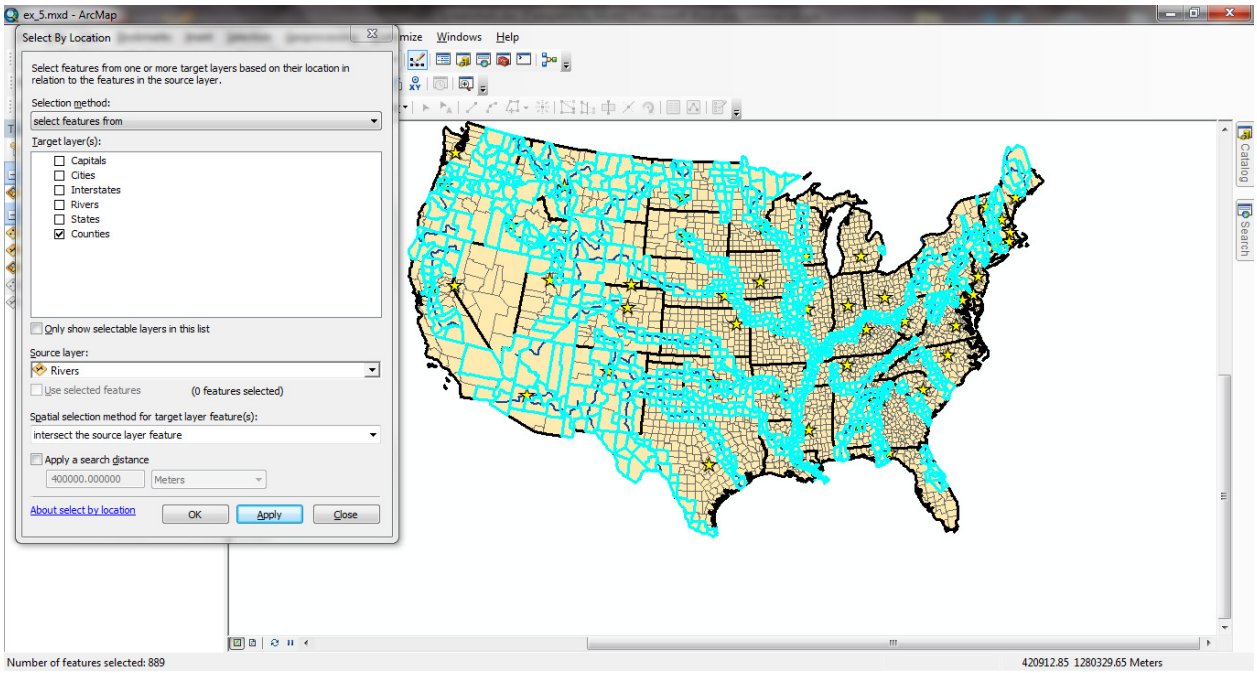
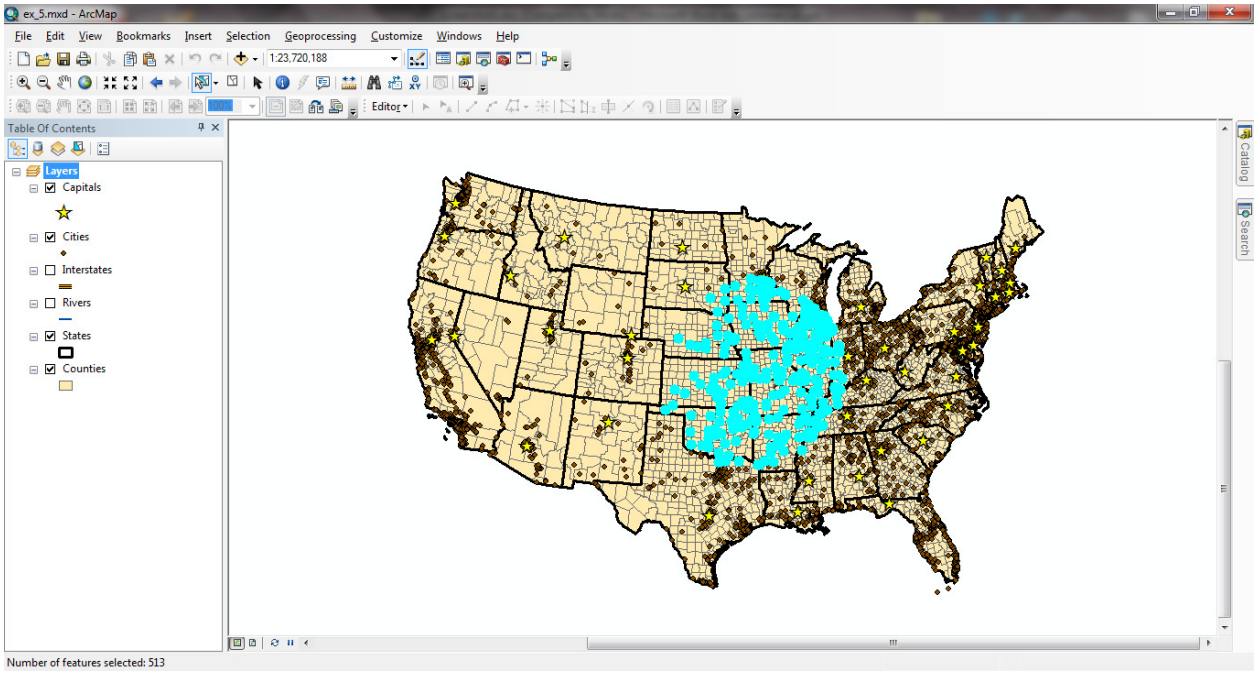


Pg. 148, Using Select by Location Feature



Pg. 150, Using Select by Attributes and Select by Location Feature within same layer to narrow results

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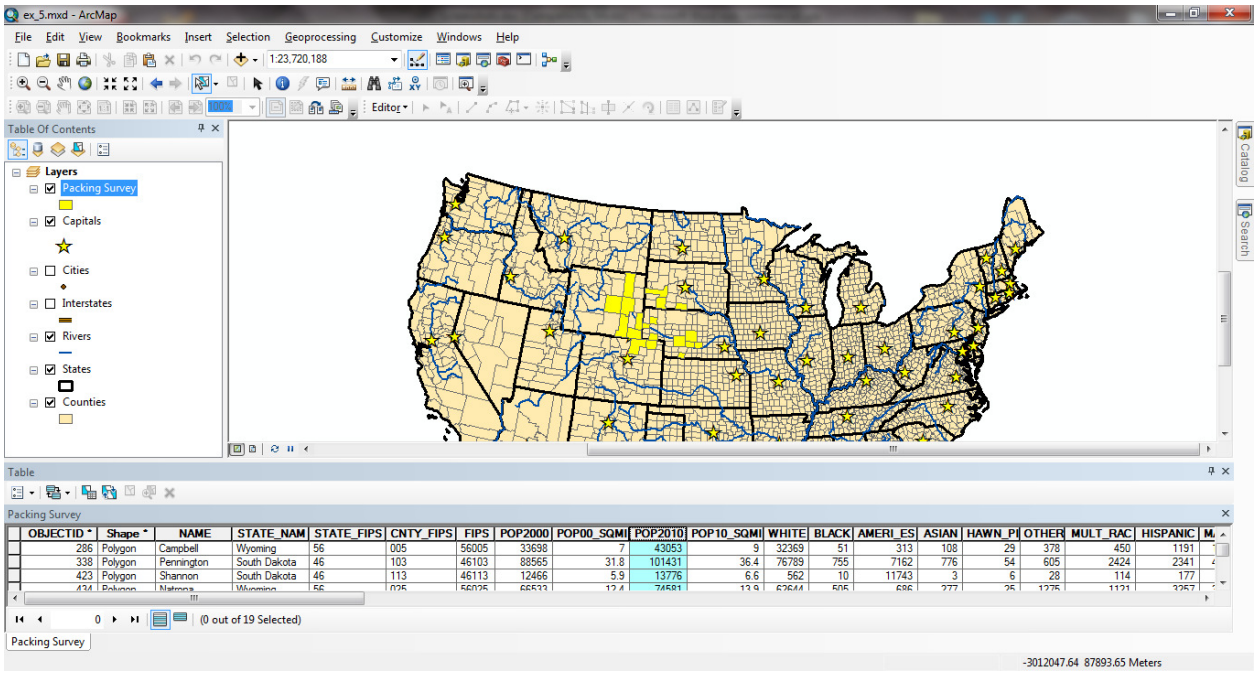
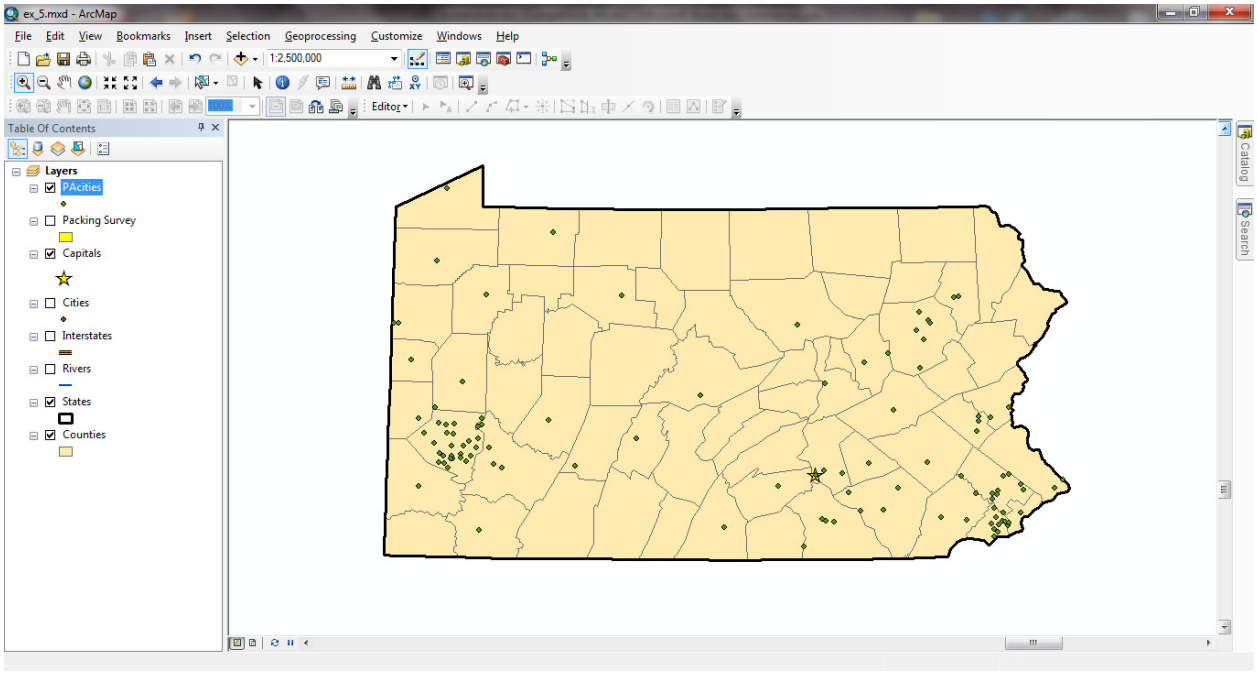


Pg. 151-152, Creating new layer from queried selections



Pg. 153, Exporting Data to create a new layer

Tutorial In-Text Questions

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Mastering the Skills – Ch. 5 Tutorial In-text Answers

1. How many counties are selected and what is the total number of people in them?
    a. 15
    b. 308,618
2. How many cities in the US had more than 1 million people in 2007?
    a. 9
3. How many counties with more males than females lost population between 1990 and 2000? Where are they mainly located?
    a. 290
    b. Middle of Country
4. How many counties remain selected?
    a. 177
5. How many city names begin with the word *New*?
    a. 32
6. How many counties in the US are intersected by rivers?
    a. 889
7. Which of these counties containing capitals has the smallest population? What is the capital and which state is it in?
    a. Hughes
    b. Pierre
    c. South Dakota
8. How many US cities are within 20 miles of an interstate highway?
    a. 3370
9. What percentage of the cities is within 20 miles of an interstate?
    a. 93.4%
10. Which rivers intersect Texas?
    a. Brazos
    b. Canadian
    c. Pecos
    d. Red
    e. Rio Grande
11. Now which rivers are selected?
    a. Flathead
    b. Salt
12. How many counties will be in the survey? What is the total number of people who live in these counties?
    a. 19
    b. 863,967

Chapter Review Questions

Kathryn Roberts
ES 341 – GIS

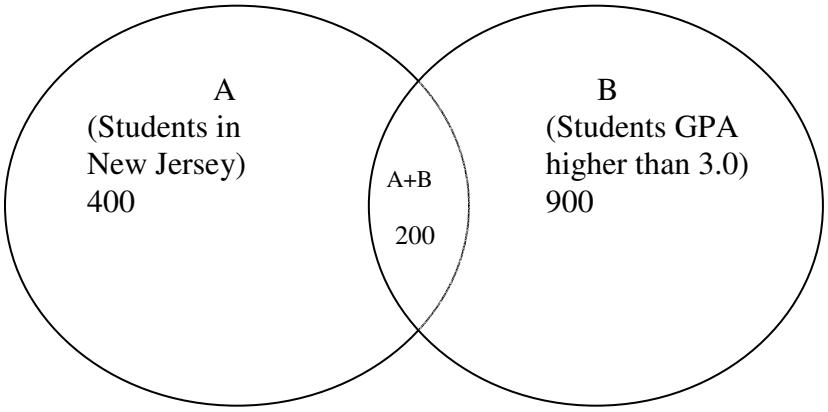
Mastering ArcGIS – Ch. 5 Review Questions (# 1-10)

1. What is a query?
    a. A tool to extract features or records from a feature class or from a table

2. Write a valid SQL query expression to select cities between 1000 and 10,000 people using a field called POP2000.
    a. [POP2000] > 1000 AND [POP2000] < 10000

3. Write a valid SQL expression to select all counties whose name begins with the letter Q.
    a. [NAME] = 'Q*'

4. Let T be a table containing all students attending a community college in New York. Let A be the subset of students living in New Jersey. Let B be the students with a GPA greater than 3.0. The query A AND B yields 200 records. The query A OR B yields 1100 records. The query A NOT B yields 400 records. Construct a Venn diagram for the sets, labeling each section with the number of students. How many students live in New Jersey? How many students have a GPA greater than 3.0?
    a. 400 students live in New Jersey
    b. 1100 – 200 = students with GPA higher than 3.0



5. From the information in Question 4, can you determine the number of students attending the community college? If yes, state how many. If no, explain why.
    a. No, the total number of students would be the entire count of Table T, numbers given are only applicable for students living in New Jersey and/or having a GPA higher than 3.0. Students who don't meet either criteria are not counted.

6. What does it mean to set the selectable layers? What is the default setting?
    a. To set the selectable layers is to set which viewable map layers may be selected by ArcMap's selection tool.
    b. The default setting is to allow selection of all viewable layers.

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7. Imagine that you have some trail mix composed of peanuts, raisins, almounds, cashews, dried cranberries, and chocolate candies colored red, green, yellow, and orange. Imagine you apply the following set of "queries" to the trail mix:
    - Create a new selection of all candies
    - Add to selection cashews
    - Remove from selection red and green candies
    - Select from selection all nuts and candies
    - What do you have selected now?

    a. All cashews and yellow and orange candies are selected

8. For each of the following queries, state whether it is correct syntax or incorrect. If incorrect, explain why.
    - [ZONE] = 'COM' AND [ZONE] = 'RES'

    a. Incorrect, ZONE cannot be both 'COM' and 'RES' thus query will return 0 results

    - [COVTYPE] = 'SPRUCE' AND [CROWNCOV] > 50

    b. Correct

    - [POP2000] > 2000 OR [POP2000] < 9000

    c. Incorrect, the second condition would nullify the first (i.e. all populations less than 9000 would include populations less than 2000)

    - [INCOME] < 100000 AND [INCOME] > 50000

    d. Correct

9. What is an operator? Describe and give examples of each of the following: arithmetic operators, logical operator, spatial operators, and Boolean operators.
    a. An operator is limiting function on the attribute within the query.
    b. Arithmetic operator: +
    c. Logical operator: =
    d. Spatial operator: within
    e. Boolean operator: AND

10. List some advantages of creating a new layer from the selected features.
    a. A new layer would be made permanent, to save the selected records, as opposed to just viewing the query results, which would be temporary during that particular session.

Chapter Exercises

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Mastering ArcGIS – Ch. 5 Exercises (# 1-9)

1. How many states have counties names for Thomas Jefferson (i.e., how many Jefferson counties are there)? Which state has the Jefferson County with the most people in the year 2010?
    a. 26 Jefferson counties
    b. Jefferson, Kentucky had the highest population in 2010
2. How many counties in the US have more men than women? What percentage of the counties to they represent?
    a. 2,313 counties have more women than men
    b. 2,313 is 73.6% of 3,141 total counties
3. How many counties in the US have more Hispanics than African-Americans, median age greater than 40, and a population between 50,000 and 100,000? List the names of the 3 largest.
    a. 23 counties meet all criteria
    b. Nevada County, CA
    c. Josephine County, OR
    d. Henderson County, TX
4. What is the percentage of counties in the US that have a river intersecting them? What percentage of the US population lives in these counties?
    a. 889 counties have a river intersecting them
    b. 28.6% of the US population lives in these counties
5. How many counties have more than 1 million people and also contain a state capital? List the states these counties are in.
    a. 6 counties have a state capital and also more than 1 million people
    b. Arizona
    c. California
    d. Ohio
    e. Texas
    f. Utah
    g. Georgia
6. How many cities are within 50 miles of a volcano? (Add the volcano feature class). What is the total number of people living in those cities?
    a. 142 cities are within 50 miles of a volcano
    b. 5,927,959 people live in those cities
7. How many other volcanoes are within 300 miles of Crater Lake, OR? How many of these volcanoes are also within 50 miles of an interstate?
    a. 36 volcanoes within 300 miles of Crater Lake
    b. 20 are also within 50 miles of an interstate

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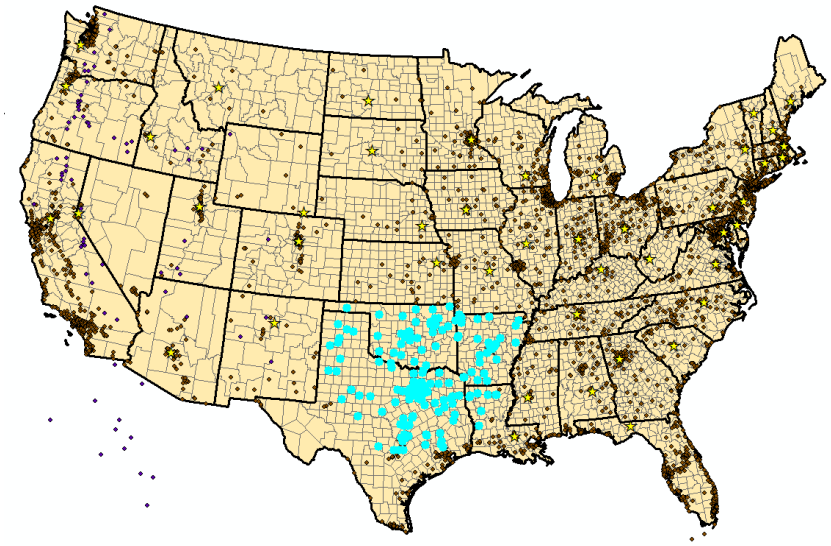
8. How many cities in the West South Central subregion of the US are less than 200 miles from Oklahoma City? Capture a map showing selected cities.
    a. 198 cities are in the West South Central subregion and are less than 200 miles from Oklahoma City



9. How many capitals are more than 50 miles from a river? Which one has the most people?
    a. 18 capitals are more than 50 miles from a river
    b. Indianapolis is the largest capital more than 50 miles from a river