

Name: \_\_\_\_\_

**GIS in Water Resources Midterm Exam****Fall 2012**

There are five questions on this exam. Please do all five.

**Question 1**

(a) You have worked with the location of Utah State University in Logan in Geographic Coordinates ( $41^{\circ} 44' 54''\text{N}$ ,  $111^{\circ} 48' 30''\text{W}$ ). If a line is drawn directly South from Logan, it will eventually cross the Equator. Calculate the length of this line in km assuming a spherical earth with a radius of 6371 km.  $\pi = 3.1416$ .



Utah State University

 **$41^{\circ}44'54''\text{N}$ ,  $111^{\circ}48'30''\text{W}$** 

(b) Define the term **Latitude** and use a diagram to illustrate your definition recognizing that the earth is represented as a rotated ellipsoid.

**Question 2**

(a) In this class, we have used several national datasets. Briefly describe the content of the these datasets and give the form of geographic data (vector or raster) that each uses.

| <b>Dataset</b>               | <b>Contents</b> | <b>Form</b> |
|------------------------------|-----------------|-------------|
| National Hydrography Dataset |                 |             |
| National Elevaton Dataset    |                 |             |
| Watershed Boundary Dataset   |                 |             |
| SSURGO Soil Dataset          |                 |             |

(b) The properties of a feature class examined in ArcMap indicate the following information.

|  |               |
|--|---------------|
| Projected Coordinate System: NAD_1983_Albers<br>Projection: Albers<br>False_Easting: 0.00000000<br>False_Northing: 0.00000000<br>Central_Meridian: -96.00000000<br>Standard_Parallel_1: 29.50000000<br>Standard_Parallel_2: 45.50000000<br>Latitude_Of_Origin: 37.50000000<br>Linear Unit: Meter | <b>Labels</b> |
|--|---------------|

(i) Label the rows of this description with the coordinates  $(\phi_0, \lambda_0)$  and  $(X_0, Y_0)$  in the column to the right above.

(ii) What earth datum does this projection use?

(iii) Give a brief explanation of the following terms:

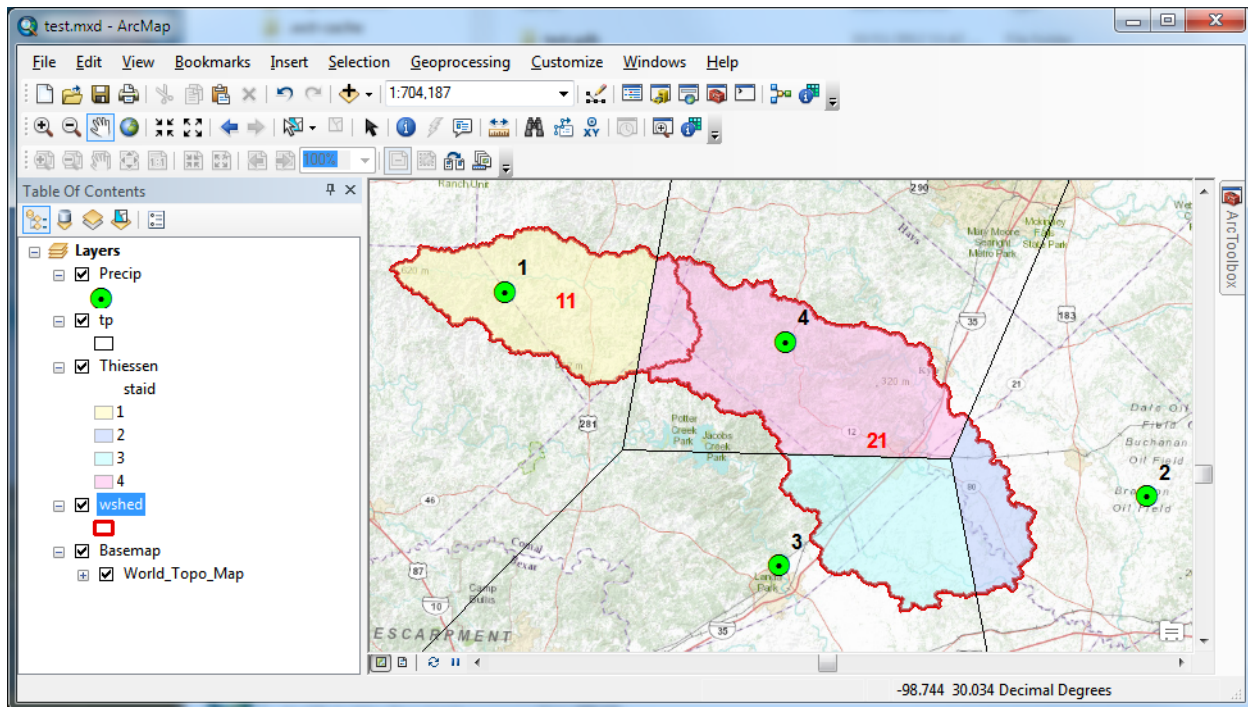
**Feature Class**

**Feature Dataset**

**Geodatabase**

### Question 3

The following ArcMap screen shot illustrates Precipitation stations labeled (single digit) with their station identifier **staid** and subwatersheds labeled (double digit) with their **HydroID**



Following are the attribute tables for

1. **Precip**. Annual precipitation (AnnPrecip\_in) in inches at precipitation stations identified by the field **staid**
2. **Wshed**. Subwatersheds identified by the field **HydroID**, with area in square kilometers.
3. **Thiessen**. The result from application of the Thiessen, then Intersection tools giving the intersection of Thiessen Polygons with subwatersheds, with the area in square kilometers.

| Precip |          |         |       |              |
|--------|----------|---------|-------|--------------|
|        | OBJECTID | Shape * | staid | AnnPrecip_in |
| ▶      | 1        | Point   | 1     | 35.9         |
|        | 2        | Point   | 2     | 36.8         |
|        | 3        | Point   | 3     | 34.3         |
|        | 4        | Point   | 4     | 40.5         |

| wshed |            |         |         |          |
|-------|------------|---------|---------|----------|
|       | OBJECTID_1 | Shape * | HydroID | AreaSqKm |
|       | 1          | Polygon | 11      | 615.8    |
|       | 2          | Polygon | 21      | 1342.9   |

| Thiessen |          |         |       |         |          |
|----------|----------|---------|-------|---------|----------|
|          | OBJECTID | Shape * | staid | HydroID | AreaSqKm |
|          | 1        | Polygon | 1     | 11      | 522.4    |
|          | 2        | Polygon | 2     | 21      | 177.3    |
|          | 3        | Polygon | 3     | 21      | 441.1    |
|          | 4        | Polygon | 4     | 11      | 93.4     |
|          | 5        | Polygon | 4     | 21      | 724.5    |

(a) In the **map**, **label** each gage with its annual precipitation and **label** each of **five polygons** of the Intersected Subwatershed and Thiessen coverage with its area in square kilometers.

(b) Describe the join operation that would be required to obtain a field in the Thiessen table containing AnnPrecip\_in for each Thiessen Polygon. Your description should indicate the tables and key fields involved.

(c) In the table that results from this join, an annual precipitation is associated with each of the five subareas. Fill in the resulting values in the table below and calculate the **Product** of the AreaSqKm and AnnPrecip\_In fields

| ObjectID | Staid | HydroID | AreaSqKm | AnnPrecip_In | Product |
|----------|-------|---------|----------|--------------|---------|
|          |       |         |          |              |         |
|          |       |         |          |              |         |
|          |       |         |          |              |         |
|          |       |         |          |              |         |

(d) Calculate the areally averaged annual precipitation in inches in each subwatershed

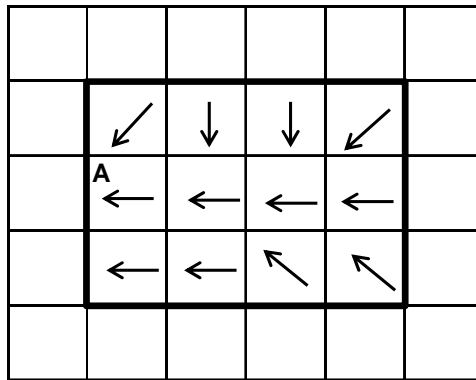
**Subwatershed 11**

**Subwatershed 21**

(e) Suppose you were interested in the health of the vegetation in these subwatersheds. Describe how you would use remote sensing to determine a grid of Normalized Difference Vegetation Index (NDVI) values over this region.

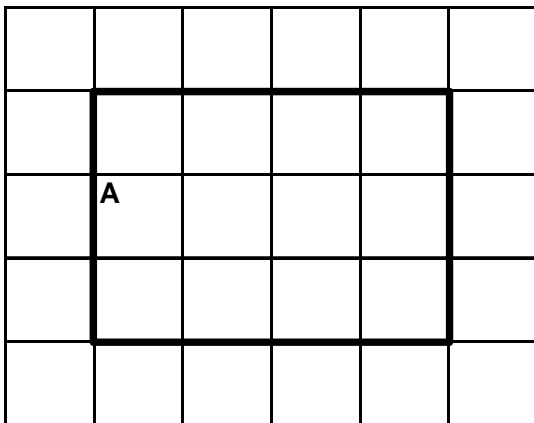
**Question 4**

The following diagram illustrates a set of flow directions evaluated in a digital elevation model with cell size 50 m.

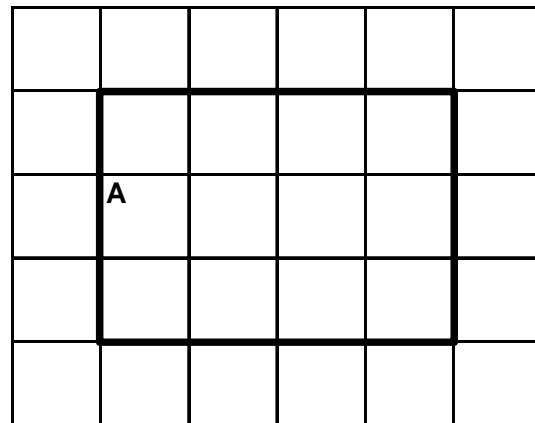


(a) Calculate the **flow accumulation** for all grid cells for which flow direction is given (in the inner block). Write your answers in the left hand side grid below.

**Flow Accumulation**



**Watershed and Stream Cells**



(b) Determine the **stream cells** draining to and including grid cell A using a threshold contributing area of 4 grid cells. Shade these cells in the right hand grid above.

(c) In the right hand grid above, draw a **border around the watershed** draining to and including grid cell A. What is the **area** of this watershed (square meters)?

**Question 5**

The following is a grid of elevations in meters in a digital elevation model with 50 m cell size.

|    |    |    |
|----|----|----|
| 50 | 45 | 40 |
| 46 | 42 | 38 |
| 42 | 40 | 37 |

(a) Determine the **Hydrologic Slope** of the **center cell** with elevation 42

(b) What ArcGIS Flow Direction does this cell have?

(c) Use the ArcGIS slope method to determine the x and y components of **Terrain Slope** of this grid.

X-Component, **dz/dx**

Y-Component, **dz/dy**

(d) Determine the overall Terrain Slope

(e) Briefly explain how the Hydrologic Slope and Terrain Slope are different from one another.