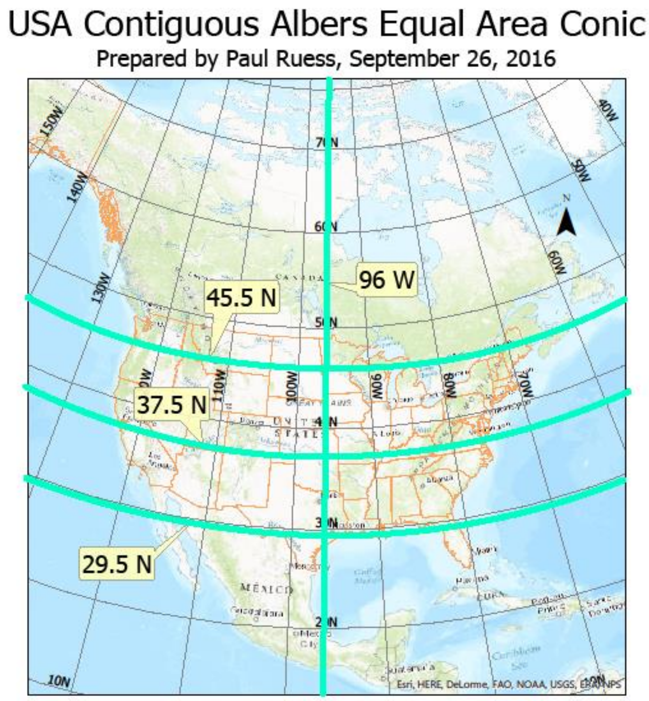
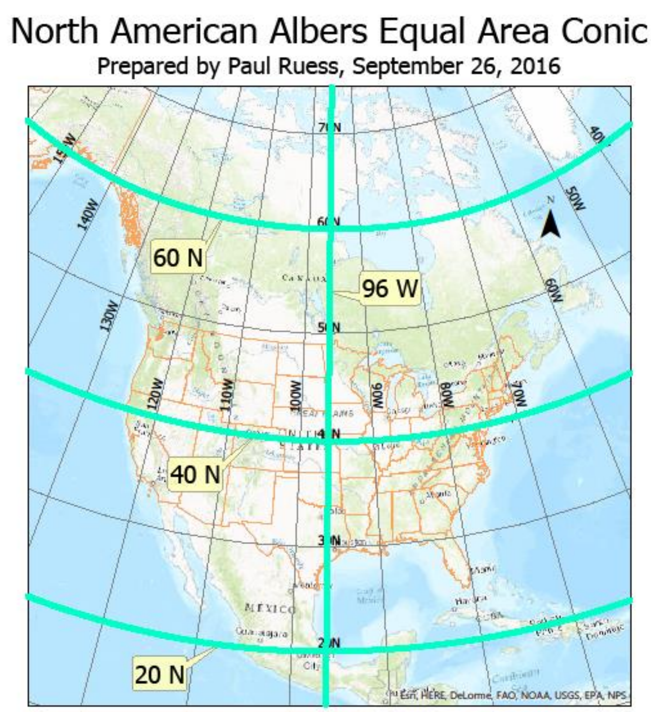
1. **Problem 1**
    a. North American Datum of 1983
    b. Albers Equal Area Conic
    c. USA Contiguous Albers Equal Area Conic:
    *Note: Maps displayed using Web Mercator view are also acceptable.*




North American Albers Equal Area Conic:



d. **Manual Calculation**

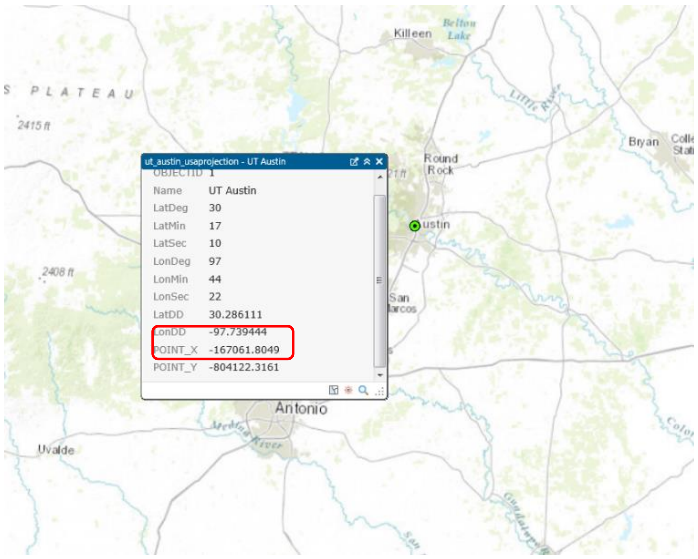
i. South of the Latitude of Origin:

$$\Delta L_{lat} = R_e \Delta\emptyset = 6371.0km * (37.5° - 30.2861°) * \left(\frac{\pi}{180°}\right) = \boxed{802.149km}$$

ii. West of the Central Meridian:

$$\Delta L_{lon} = R_e \Delta\lambda \cos\emptyset = 6371.0km * (97.7394° - 96°) * \left(\frac{\pi}{180°}\right) * \cos\left(30.2861° * \frac{\pi}{180}\right) = \boxed{167.015km}$$

e. **UT Austin Point Feature**




Projecting the UT Austin coordinates onto the NAD '83 Albers yields the following offset:

Latitudinal difference: 167062 – 167015 = ~50 meters

Longitudinal difference: 804122 – 802149 = ~2000 meters

This difference results from the assumption of a perfectly spherical Earth when completing the calculations by hand.

f.

North American Albers Equal Area Conic Projection

| OBJECTID_1 | Shape | HUC_8 | Shape_Length | Shape_Area |
|---|---|---|---|---|
| 1 | Polygon | 12100203 | 450392.442679 | 3519932197.027825 |

USA Contiguous Albers Equal Area Conic Projection

| OBJECTID_1 | Shape | HUC_8 | Shape_Length | Shape_Area |
|---|---|---|---|---|
| 1 | Polygon | 12100203 | 451421.887569 | 3519932197.74058 |

The basin's shape lengths and shape areas vary slightly in both projections. Differences to the length area greater due to area being preserved while length is not.

2. **Manual Calculation**
   a. UT Austin Latitude:

$$\Delta L_{lat} = R_e \Delta\emptyset$$

$$1km = 6371km * \Delta\emptyset * \left(\frac{\pi}{180°}\right)$$

$$\Delta\emptyset = \frac{1km}{6371km * \left(\frac{\pi}{180°}\right)} = \boxed{0.00899°}$$

   b. UT Austin Longitude:

$$\Delta L_{lon} = R_e \Delta\lambda \cos\emptyset$$

$$1km = 6371 * \Delta\lambda * \cos\left(30.2861° * \frac{\pi}{180}\right)$$

$$\Delta\lambda = \frac{1km}{6371km * \left(\frac{\pi}{180°}\right) * \cos\left(30.2861° * \frac{\pi}{180}\right)} = \boxed{0.01041°}$$

   c. Logan, Utah Latitude:
   *Note: This is the same for UT Austin and all other locations, because the latitudinal distance depends only on the earth's radius and the distance (in this case 1km).*

$$\Delta L_{lat} = R_e \Delta\emptyset$$

$$1km = 6371km * \Delta\emptyset * \left(\frac{\pi}{180°}\right)$$

$$\Delta\emptyset = \frac{1km}{6371km * \left(\frac{\pi}{180°}\right)} = \boxed{0.00899°}$$

   d. Logan, Utah Longitude:

$$\Delta L_{lon} = R_e \Delta\lambda \cos\emptyset$$

$$1km = 6371 * \Delta\lambda * \cos\left(41.7483° * \frac{\pi}{180}\right)$$

$$\Delta\lambda = \frac{1km}{6371km * \left(\frac{\pi}{180°}\right) * \cos\left(41.7483° * \frac{\pi}{180}\right)} = \boxed{0.01205°}$$