

Risk Due to Storm Surge for Jefferson County and Evacuation Routes

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Problem Formulation

Objective

Identify areas of Jefferson County, TX that are at risk of 10- and 15-foot storm surges caused by hurricanes with conditions similar to Hurricanes Rita and Ike.

Background

On September 24, 2005 Hurricane Rita made landfall on the Texas coast. The area of interest, Jefferson County, sustained heavy wind damage from the storm and tornadoes. Some cities experienced flooding and power loss lasting more than six weeks. Then three years later on September 13, 2008 Jefferson County was struck by Hurricane Ike. The county sustained extensive damage from Ike storm due to flooding from rain and storm surge, and hurricane force winds. Flooding from the storm threatened Port Arthur's levee system and caused the deaths of an estimated 4000 cattle in the county.

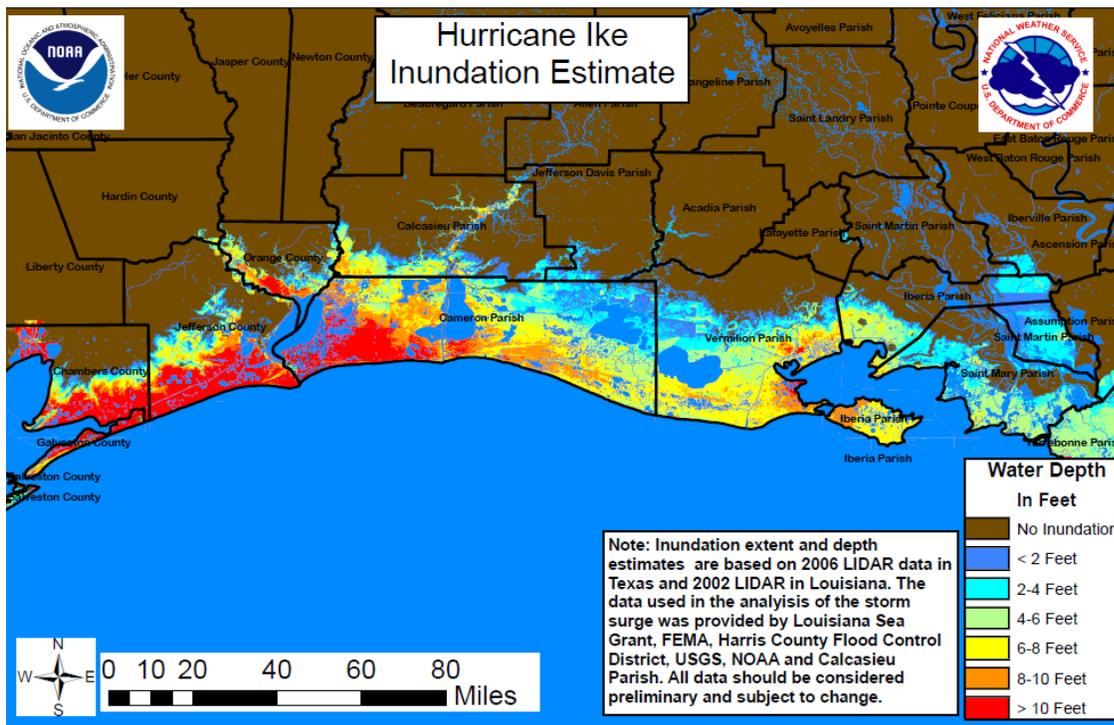


Figure 1. Hurricane Ike Inundation Estimate from the National Weather Service

Data Collection

GIS data were collected from several online sources:

1. ArcGIS: <http://www.arcgis.com/home/item.html?id=872b352dfd1d4f6e942e8e0208321ced>

- U.S. City Populations (feature not used in final map)
<http://www.arcgis.com/home/item.html?id=872b352dfd1d4f6e942e8e0208321ced>
 - U.S. Major Highways
<http://www.arcgis.com/home/item.html?id=fc870766a3994111bce4a083413988e4>
2. Texas Tech University's Center for Geospatial Technology:
<http://gis.ttu.edu/center/DataCatalog/Download.php?County=Jefferson>
- Jefferson County Boundary

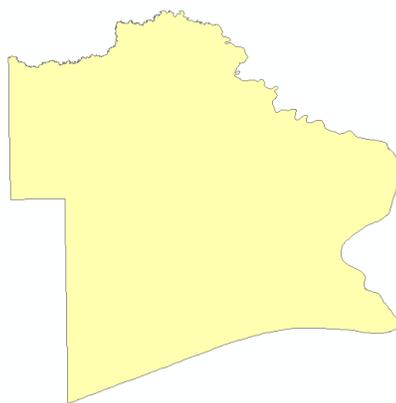


Figure 2. Jefferson County Shapefile

- Jefferson Roads
 - Jefferson Rivers/Streams
 - Jefferson Digital Elevation Model
3. TNRIS: http://www.tnr.is.org/get-data?quicktabs_maps_data=1
- County Boundaries
 - Texas Cities



Figure 3. Texas Cities Shapefile

Data Preprocessing

No preprocessing was necessary in this project.

ArcGIS Processing

1. I first added the City Points, Jefferson Rivers, Jefferson Elevation, Counties, and Jefferson Counties shapefile to ArcMap.

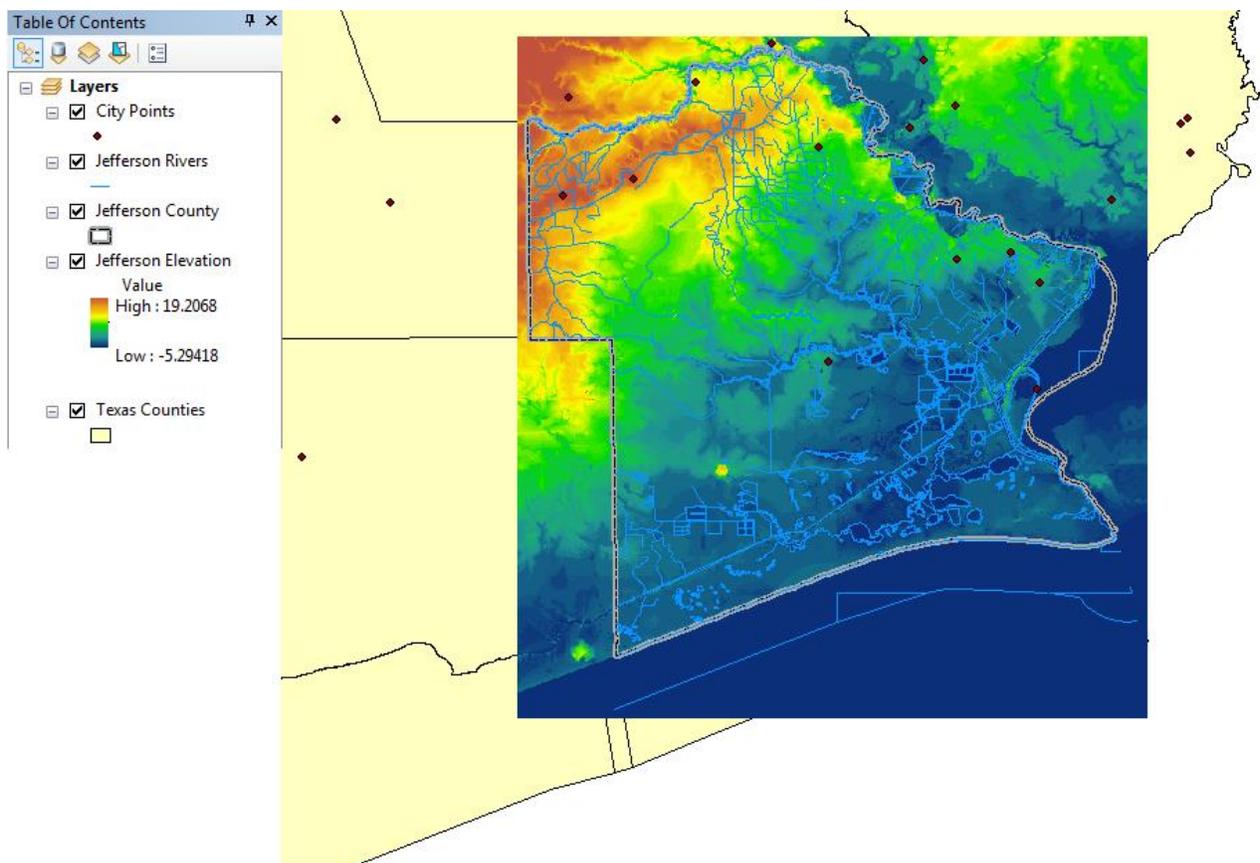


Figure 4. Original Shapefiles in ArcMap

2. Next, the elevation and city files needed to be clipped to the area of interest, Jefferson County. Using the “Extract by Mask” tool for the elevation raster, a new “Clipped Elevation” raster was created. Using the “Clip” tool I restricted the City Points shapefile to the Jefferson County shapefile, creating a new shapefile “cities1.”

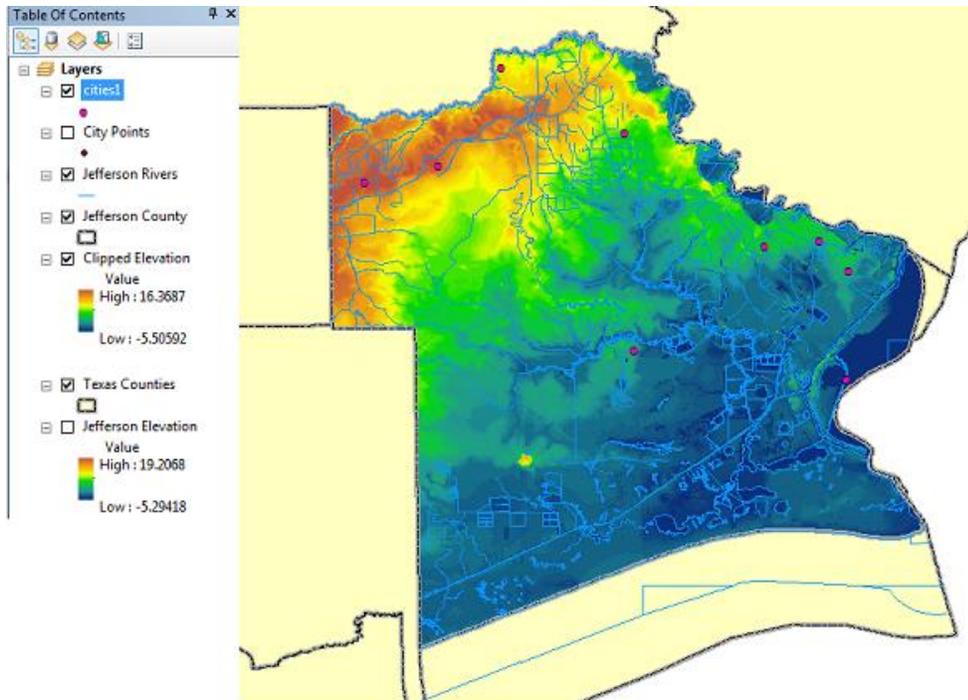


Figure 5. Clipped Elevation and City Shapefiles

3. Now new rasters need to be made showing the areas that will be affected by 10- and 15-foot storm surges. This will be done using the “Raster Calculator” tool. Since the shapefile uses a meter scale the storm surges need to be converted to meters. 15 feet will be about 5 meters and 10 feet will be about 3 meters. The formulas used are “(“Clipped Elevation”<=5)&(“Clipped Elevation” >0)” and “(“Clipped Elevation”<=3)&(“Clipped Elevation” >0).”

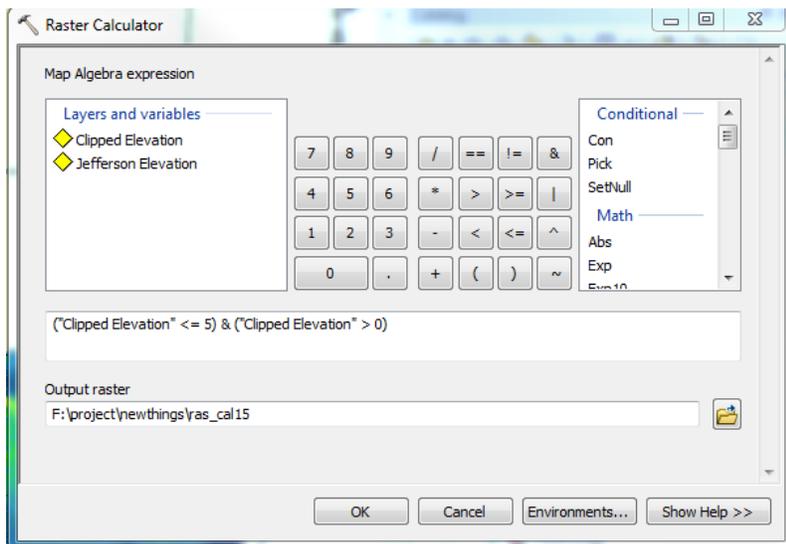


Figure 6. Raster Calculator Window for the 15 Foot Storm Surge

After using this tool we get two rasters showing the areas affected by storm surge.

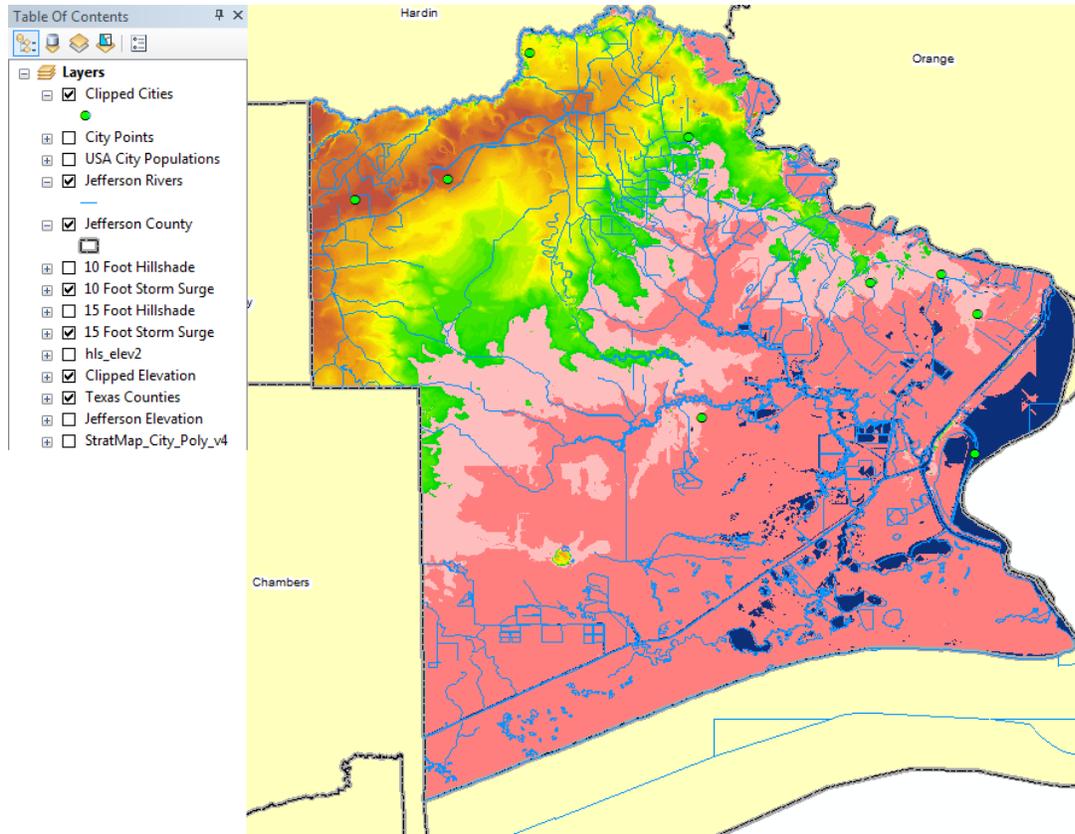


Figure 7. Storm Surge Inundation Zones

4. Now hillshade rasters need to be created using the “Hillshade” tool. One will be made for both inundation zones and for the clipped elevation raster. The 10 and 15 Foot Hillshades are both set to 80% transparency and the Elevation Hillshade to 40%.

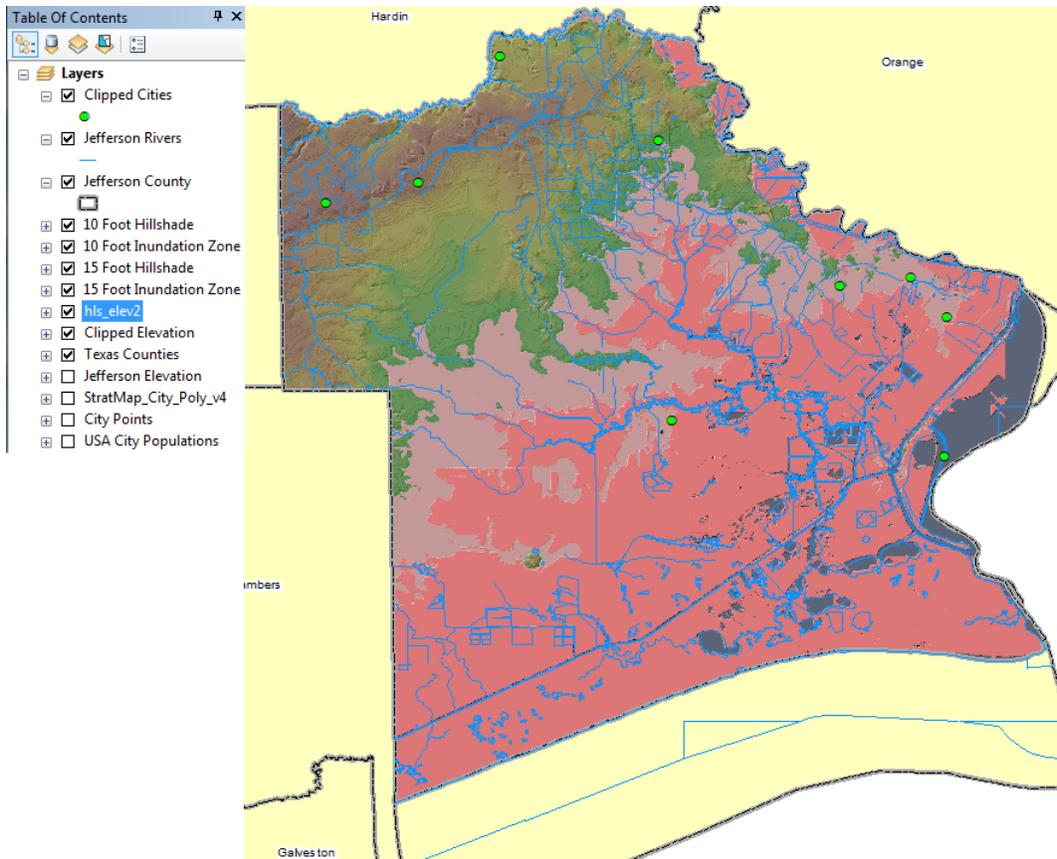


Figure 8. Added Hillshade Rasters

5. Now we can add the USA Major Highways shapefile to the map and conclude what highways will provide a safe, efficient route.

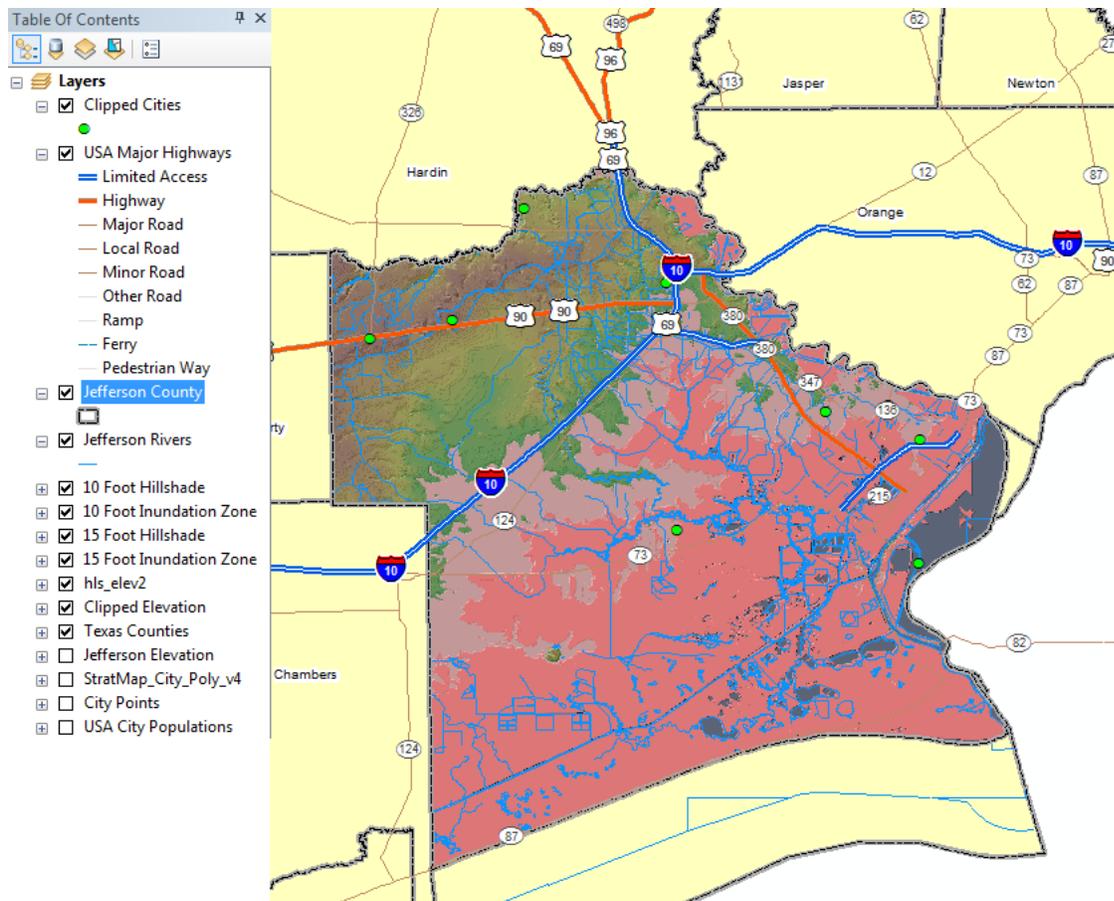


Figure 9. Major Highways

We can see that four major highways lead north and northwest of the inundation zones. These are I-10, Highway 69, Highway 90, and Highway 96.

Conclusion

From the final map we can see that more than 50% of Jefferson County will be inundated in the event of a 10 foot storm surge and a 15 foot storm surge. Flooding may reach more than 20 miles inland. Along with a large number of smaller communities, Nederland, Taylor Landing, Port Neches, Groves, and Port Arthur may be completely inundated. However, Port Arthur has a levee system in place that in the past has kept it and surrounding communities safe from flooding. Citizens here have several options for evacuation routes. Southeast Texans can take Interstate 10 West or Highway 90 towards Houston. Two other options are Highways 96 and 69. Both will take evacuees north into East Texas. A max total of 218,598 people could be affected by flooding according to 2012 population reports for Port Arthur, Nederland, Port Neches, Groves, Beaumont, and Taylor Landing.

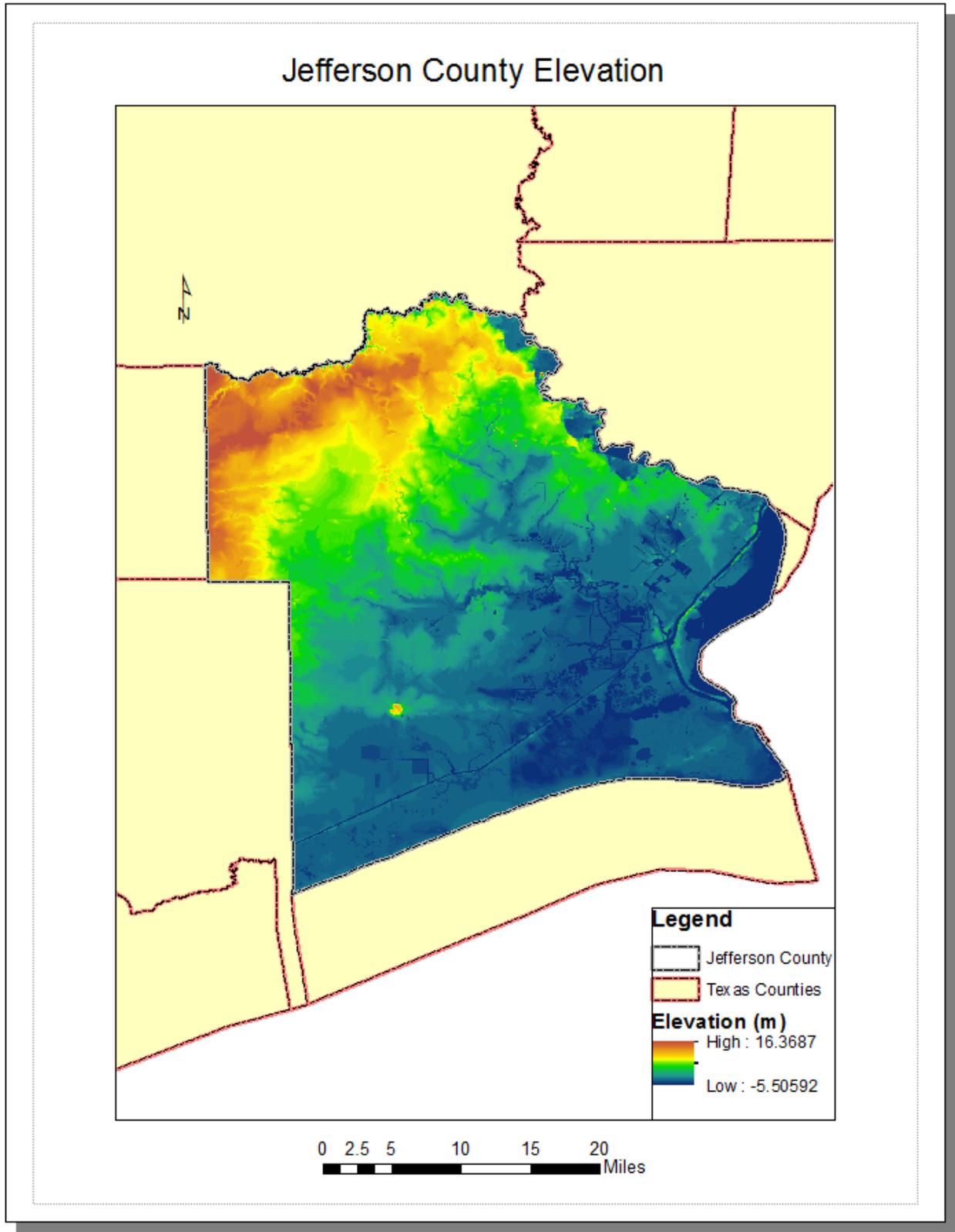


Figure 11. Jefferson County Elevation

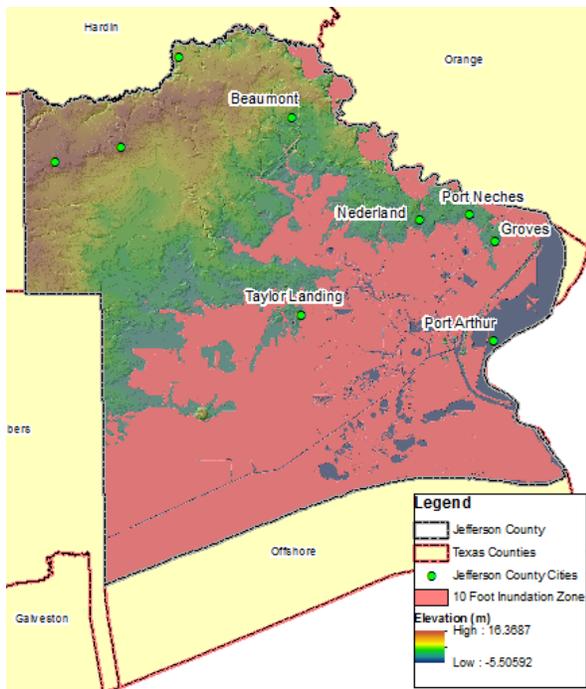


Figure 12a. 10 Foot Inundation Zone

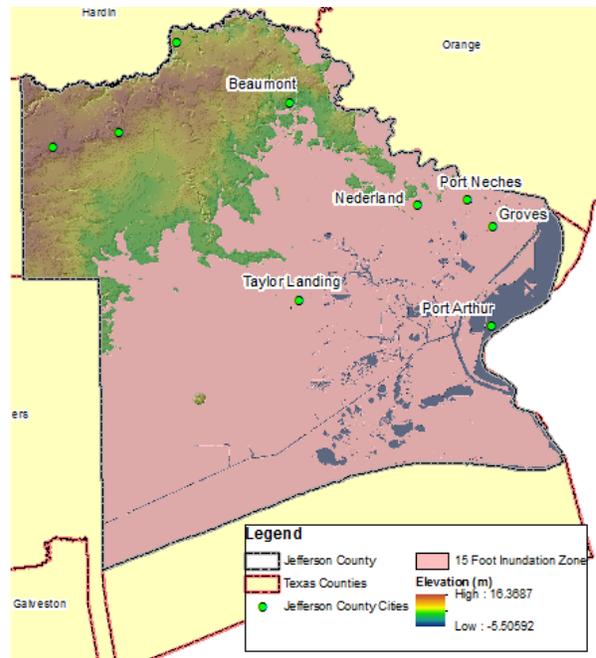


Figure 12b. 15 Foot Inundation Zone