Mount St. Helens Before and After

GIS & GPS Applications in Earth Sciences Project

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Problem:

When Mount St. Helens was on the verge of erupting, in preparation the USGS created a map that showed a possible eruption for April 1, 1980. Mount St. Helens however did not erupt until May 18, 1980 and erupted in a unique way by blasting out the side of the mountain caused by a 5.1 magnitude earthquake weakening the northern flank causing it to collapse instead erupting out of the center. Since the Mount St. Helens was an unusual eruption, I want to compare the hypothesized Mount St. Helens eruption done by the USGS to what actually happened on May 18, 1980. In doing so I will figure out how large the pyroclastic flows, mudflows, ash flows, and lateral blast turn out to be and compare the values between the two instances. I will use ArcMap to determine the approximate area values of all these hazards of both the proposed eruption data and the actual results of the eruption.

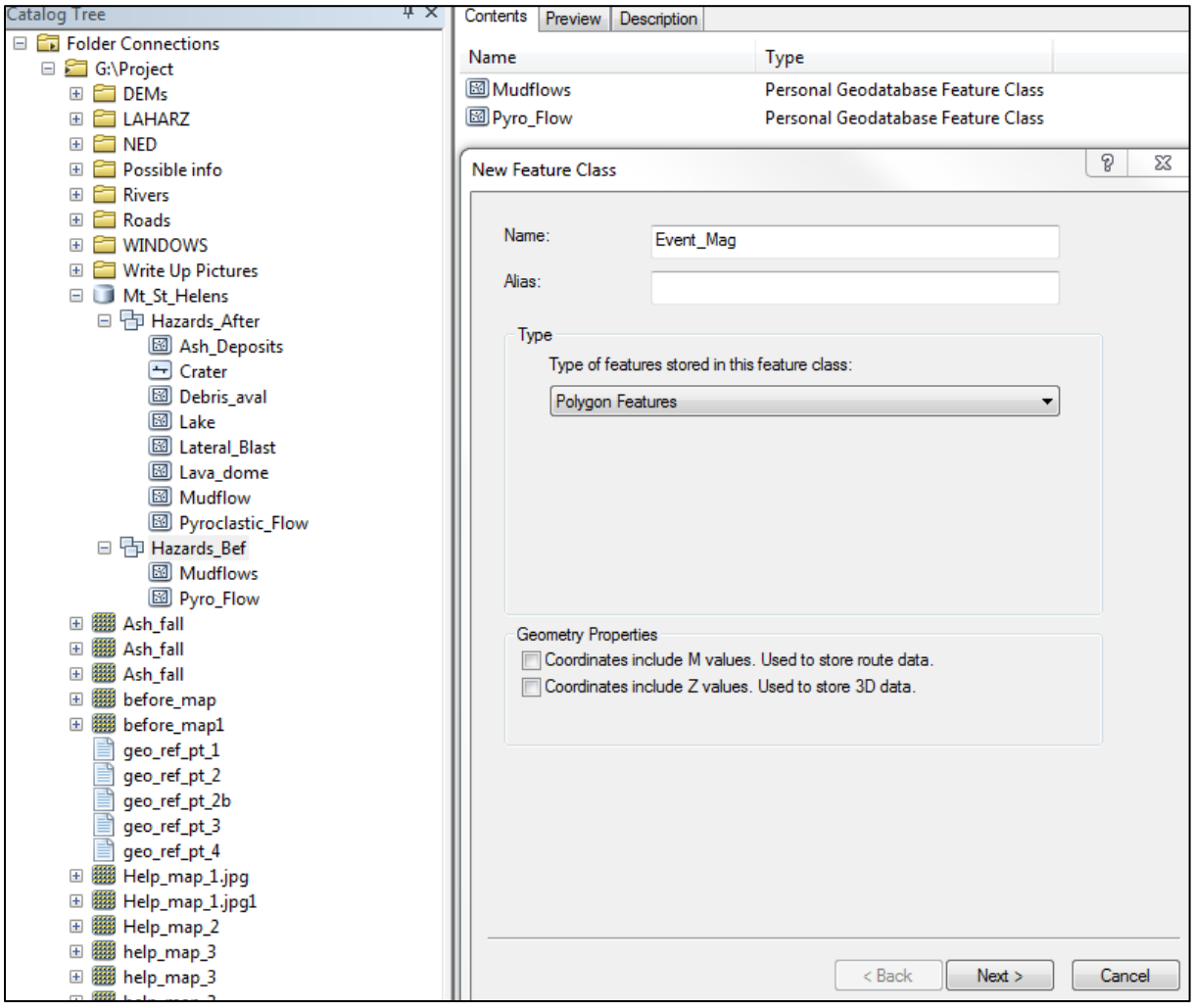
Data Collection and Processing:

- The DEMs used for both before and after eruption maps were uploaded from The National Map Seamless Server Viewer provided by the USGS and were downloaded as zip files that had to be extracted in order to be used in ArcMap.
- The before eruption map came from the USGS website. From the main page on Mount St. Helens through a few links you get to the Mount St. Helens Precursory Activity March 29 – April 1980 webpage where the map was found. I saved the picture. I was first saved as a link so I had to first convert it to PDF and then to a picture with .jpeg extension. It was then able to upload into ArcMap.
- Data collected for the after eruption map was found from the Mount St. Helens Internet Map Server provided by Oregon State University. It was a map under the book images link, chapter 3 images, figure 3.3. I went through the same converting steps as the before eruption map for this map.
- All roads were downloaded from the USGS: The National Map Viewer. They were also downloaded as zip files that had to be extracted.
- Another map to help reference what happened after the eruption was found in the USGS website under Mount St. Helens, Washington Maps and Graphics, etc. after I searched for Mount St. Helens in the search bar within the USGS website.
- The Ash Fall across the USA was found in the USGS website under Mount St. Helens, Washington Maps and Graphics, etc. after I searched for Mount St. Helens in the search bar within the USGS website. I used the same steps as before to save it with a .jpeg extension.
- The streams that were used for the before eruption map were used from the Lab 8 folder under wa_rivers_arc.
- The streams that fit best to the after eruption map were from the Department of Ecology State of Washington GIS data under National Hydrography Dataset (NHD) 24k: Major Areas, Streams, & Waterbodies
- I found the outline of Spirit Lake before the eruption from a topography map from the USGS website on the Mount St. Helens Menu page under Maps and Graphics. I followed the same steps to save it as a .jpeg file.

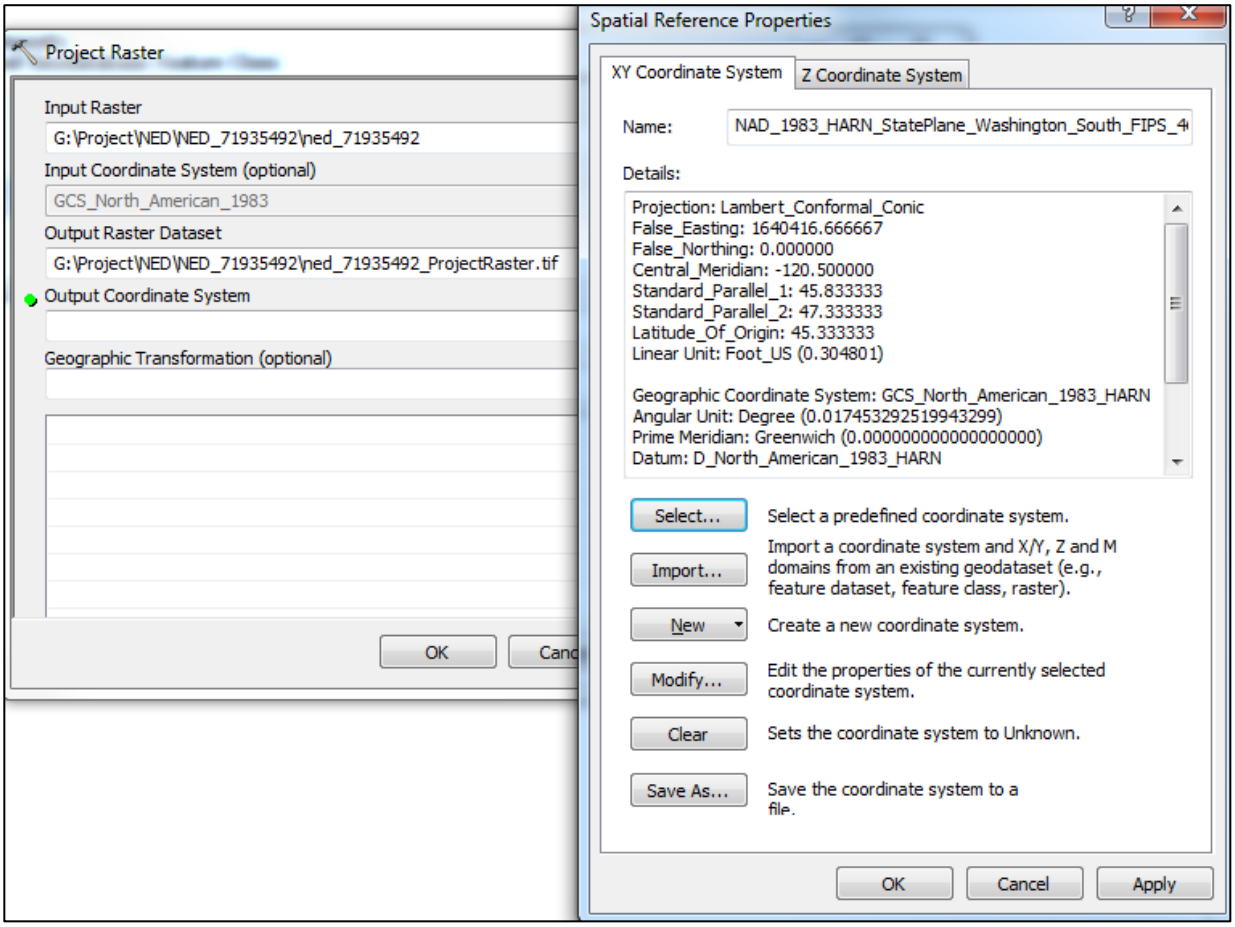
ArcGIS processing:

ArcCatalog Set Up

1. Open ArcCatalog and connect Project folder
2. When creating anything, make sure to assign the coordinate system to NAD 1983 State Plane Harn Washington South FIPS 4602 Feet.
3. Create New Personal GeoDatabase by right clicking on Project folder and navigating to “New” and selecting “Personal GeoDatabase.”
4. Make Feature Datasets for before and after the Mount St. Helens eruption by right clicking the Mt_St_Helens Personal GeoDatabase and navigating to “New” and selecting “Feature Dataset”
5. Within those Datasets create the appropriate Feature Classes for pyroclastic flows, debris avalanche, mudflows, ash flows, lateral blast, lake, crater outline, event magnitudes, and lava dome by again right clicking on the appropriate Dataset and selecting “New” and the “Feature Class

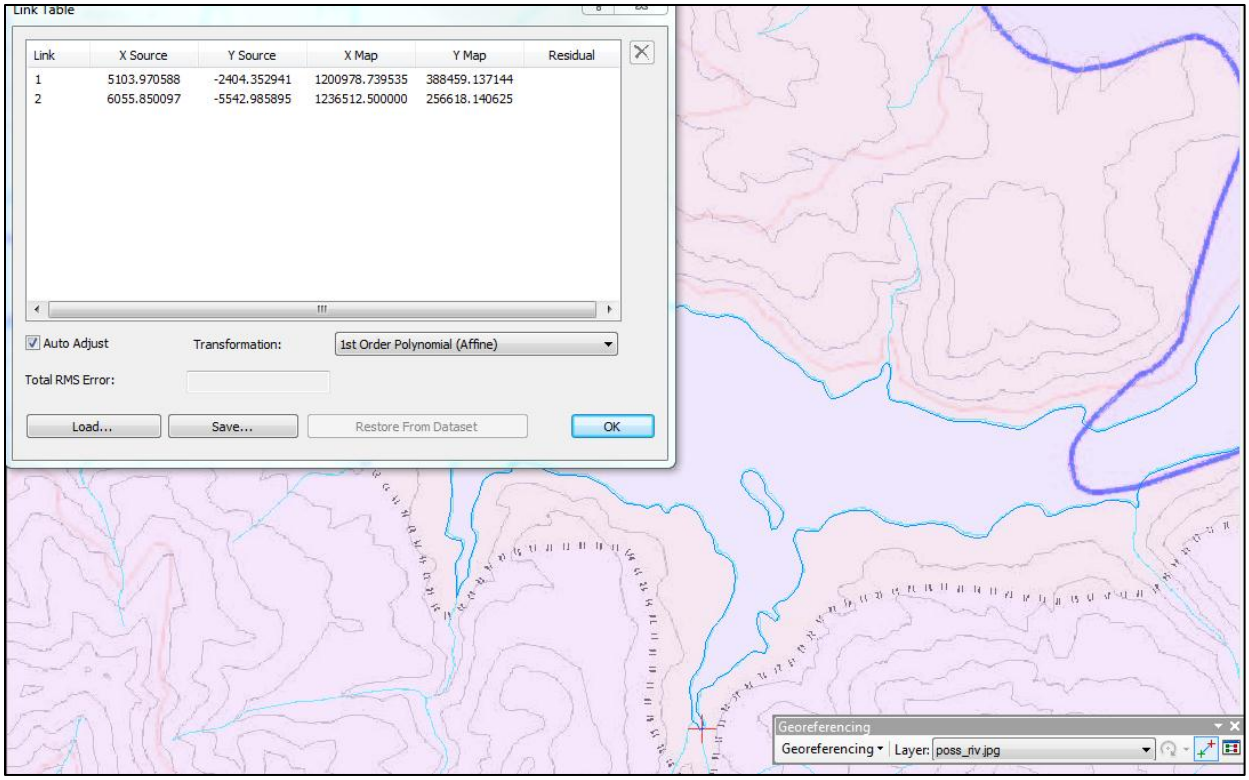


6. The DEM I used for both maps was set with Spatial Reference GCS North American 1983 and I needed to change it to NAD 1983 HARN State Plane Washington South FIPS 4602 Feet. To do that I had to use the Project Raster Tool to transform the raster dataset from the old projection to the one I needed.

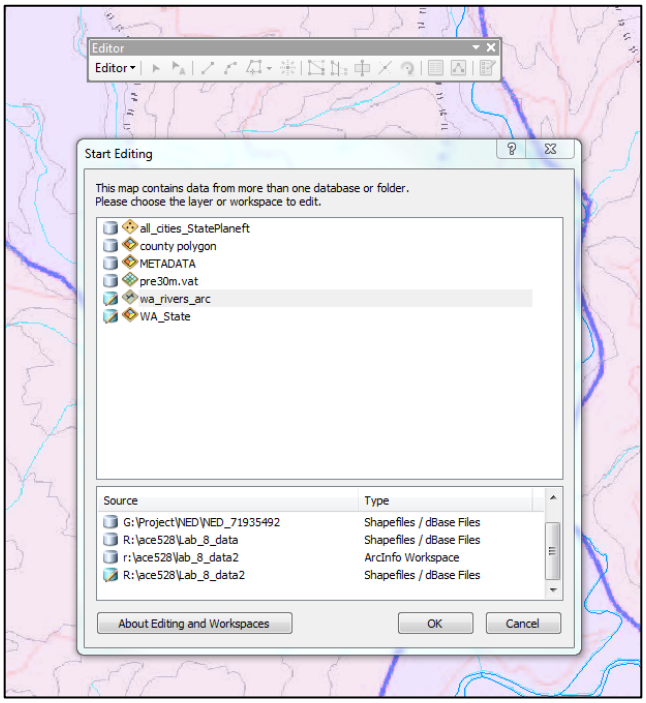


ArcGIS processing steps for Before Eruption Map:

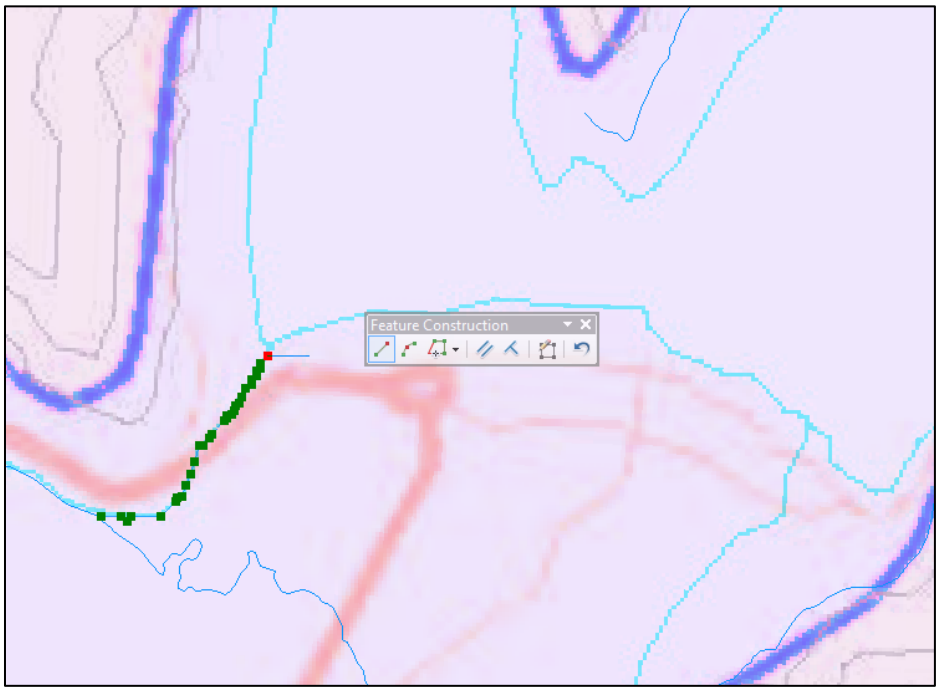
1. Open ArcGIS Map
2. Upload the DEM for the Mt. St. Helens area.
3. Load “wa_rivers_arc” shapefile to Table Of Contents.
4. Upload the map that shows Spirit Lake before the eruption.
5. Open the Georeferencing Toolbar and fit the map to the display
6. Then use the “add control points” button and pick points to best fit the map with the existing rivers on the map. Try to maintain a low “Total RMS Error” number while doing so. The map I used fitted really well with my streams layer (“wa_rivers_arc”). The only difference was the outline of Spirit Lake, which I had to edit.



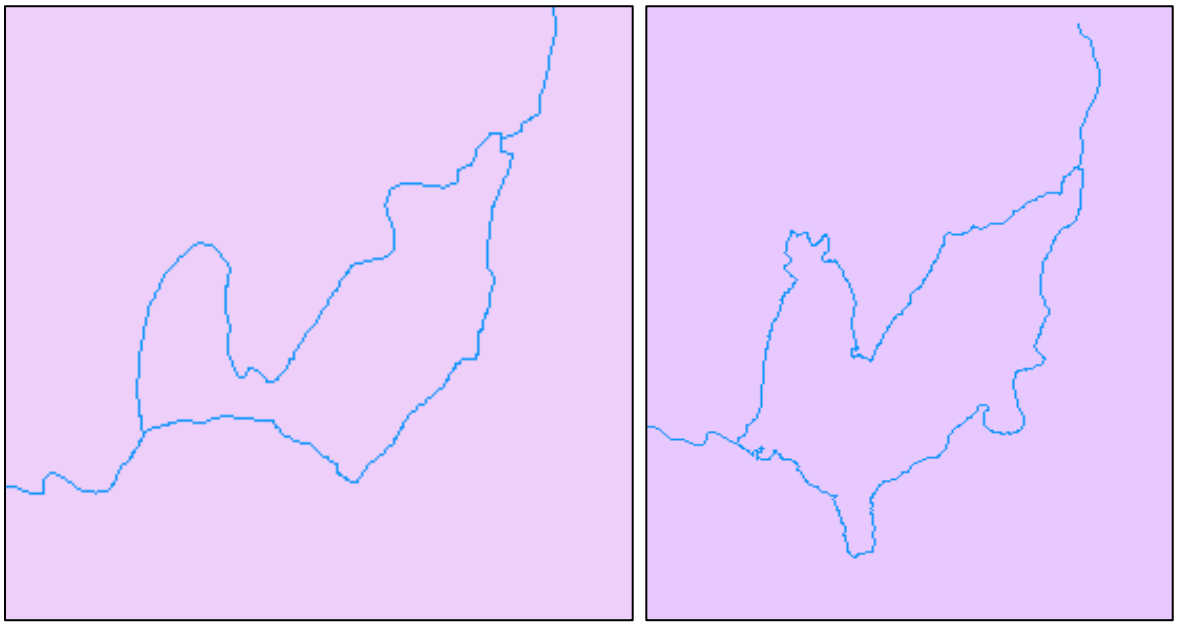
7. Save points to Project folder.
8. Go to the georeferencing toolbar dropdown menu and select rectify. Reload the rectify map to Table Of Contents.
9. Open up the Editor toolbar and start editing. Click on the wa_rivers_arc layer to edit.



10. Delete the present day Spirit Lake and use the editor to draw a new line segment representing the before eruption Spirit Lake using the map that shows it's shape before the eruption.

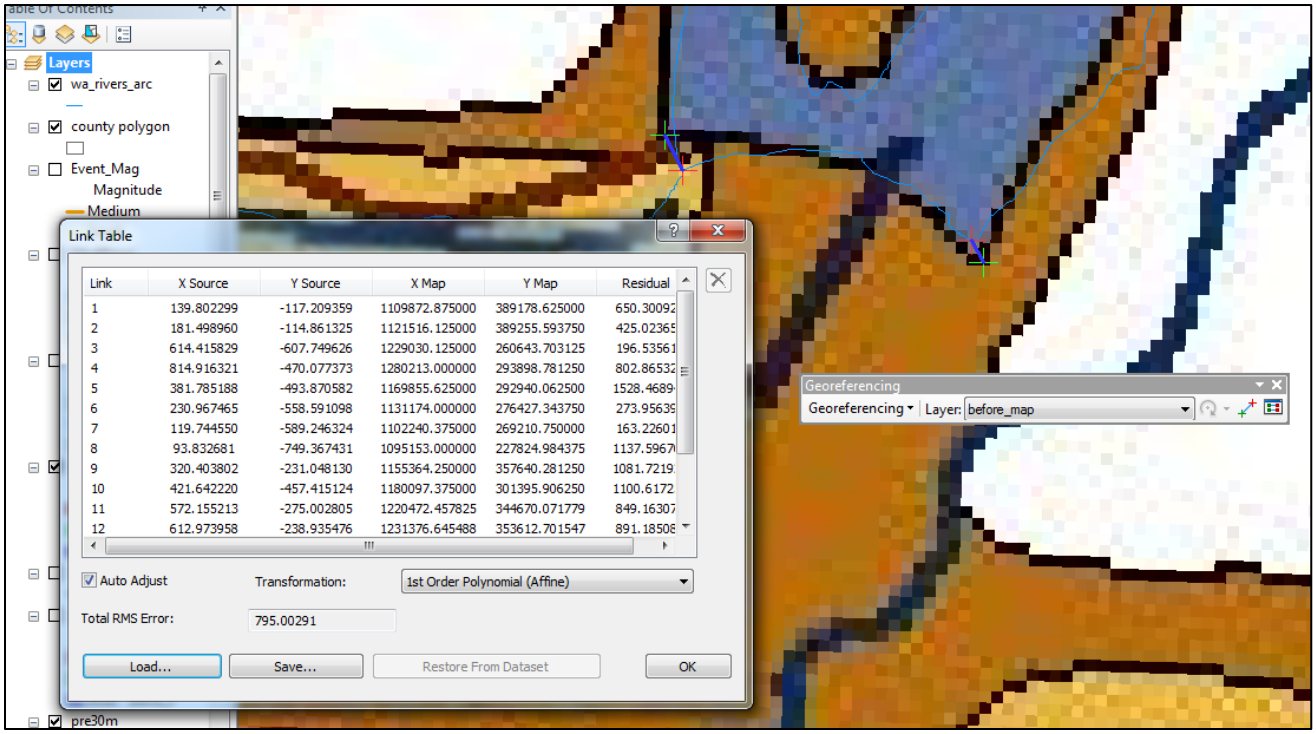


Spirit Lake Before and After Eruption Outlines:

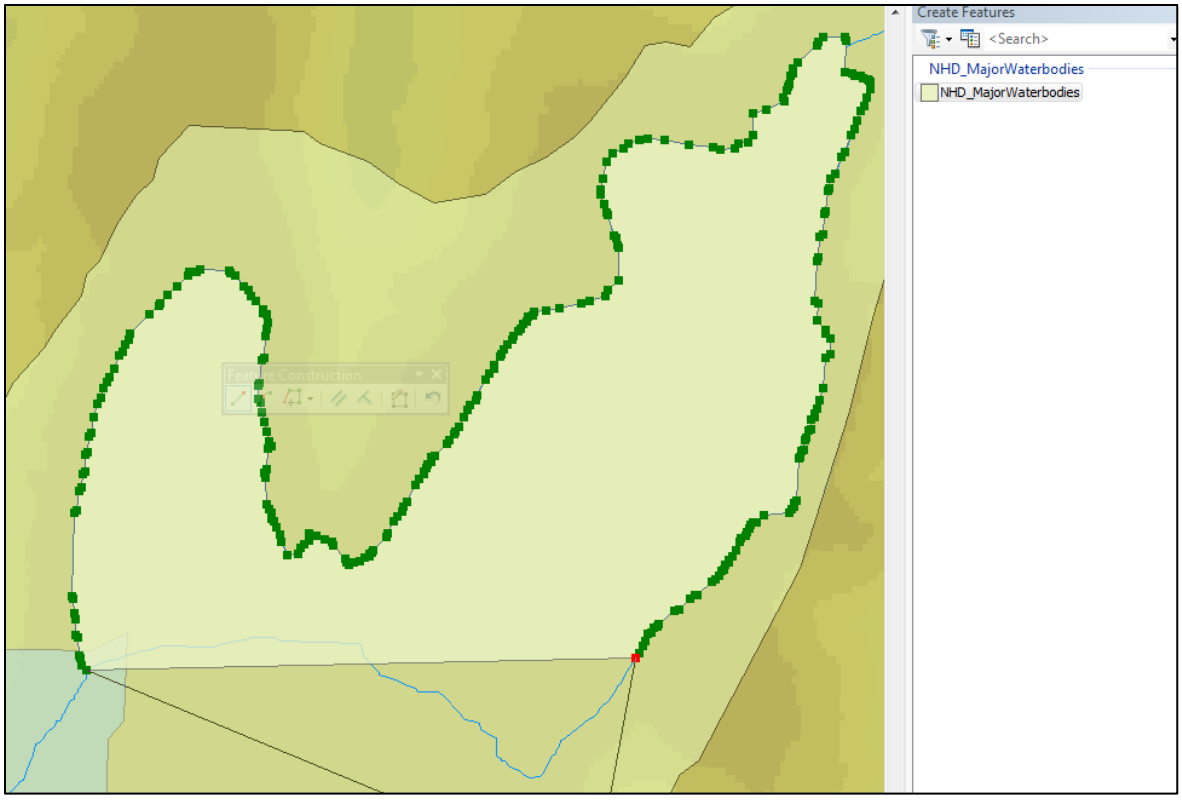


11. Save edits and stop editing once finished.
12. Upload JPEG picture for Before Eruption Map ("before_map") from Project folder to the Table Of Contents.

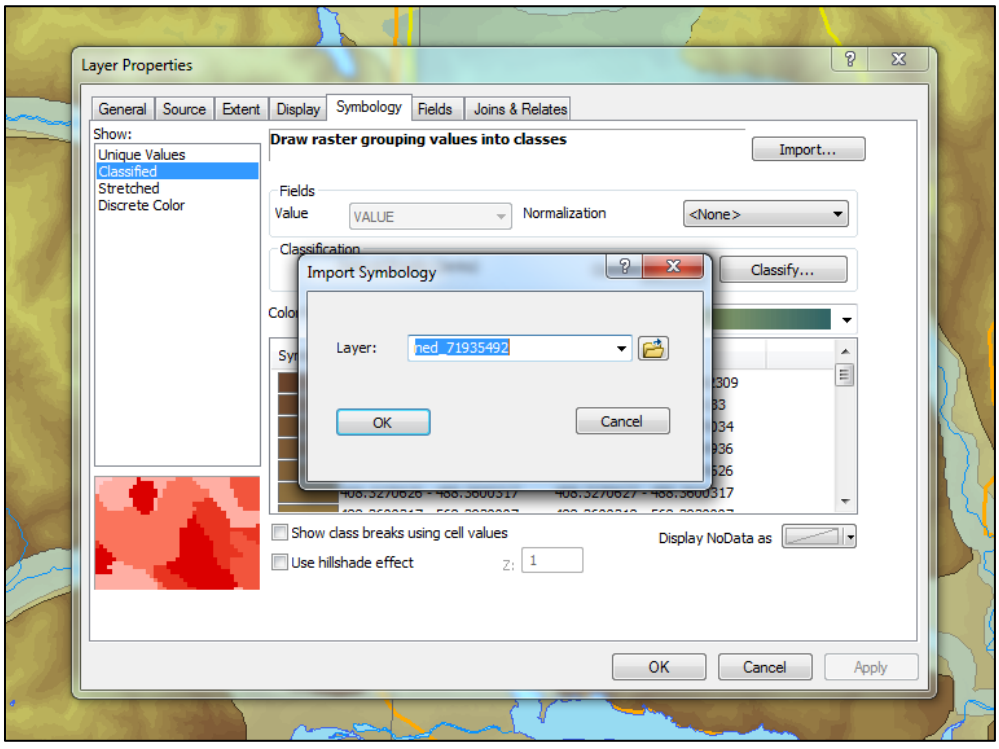
13. Open Georeferencing toolbar again and set layer to before_ map. Use the “add control points” button again.



14. Save points in Project folder
15. Rectify before_map
16. Upload pyro_flow, mudflow, and event_mag feature classes into Table Of Contents.
17. Use the editing toolbar to start digitizing pyro_flow and mudflow layers.
18. After digitizing a particular magnitude for the pyroclastic flow or the mudflow, assign an attribute value of Large, Medium, or Small.
19. After those start digitizing the event magnitude: medium and small. Fill in the attribute table when editing as well.
20. Save edits and stop editing
21. Go to the symbology of pyro_flow and mudflow layers. Navigate to Unique Values and assure the Field Value is “magnitude” and then click “add all values.” Magnitudes of small, medium, and large should all appear. Deselect “all other values” and choose the appropriate color scheme for the magnitudes.
22. Spirit Lake also had to be digitized to represent a lake instead of just an outline. I started editor and selected the layer “lake” and began digitizing. When finished, I saved edits and stopped editing.

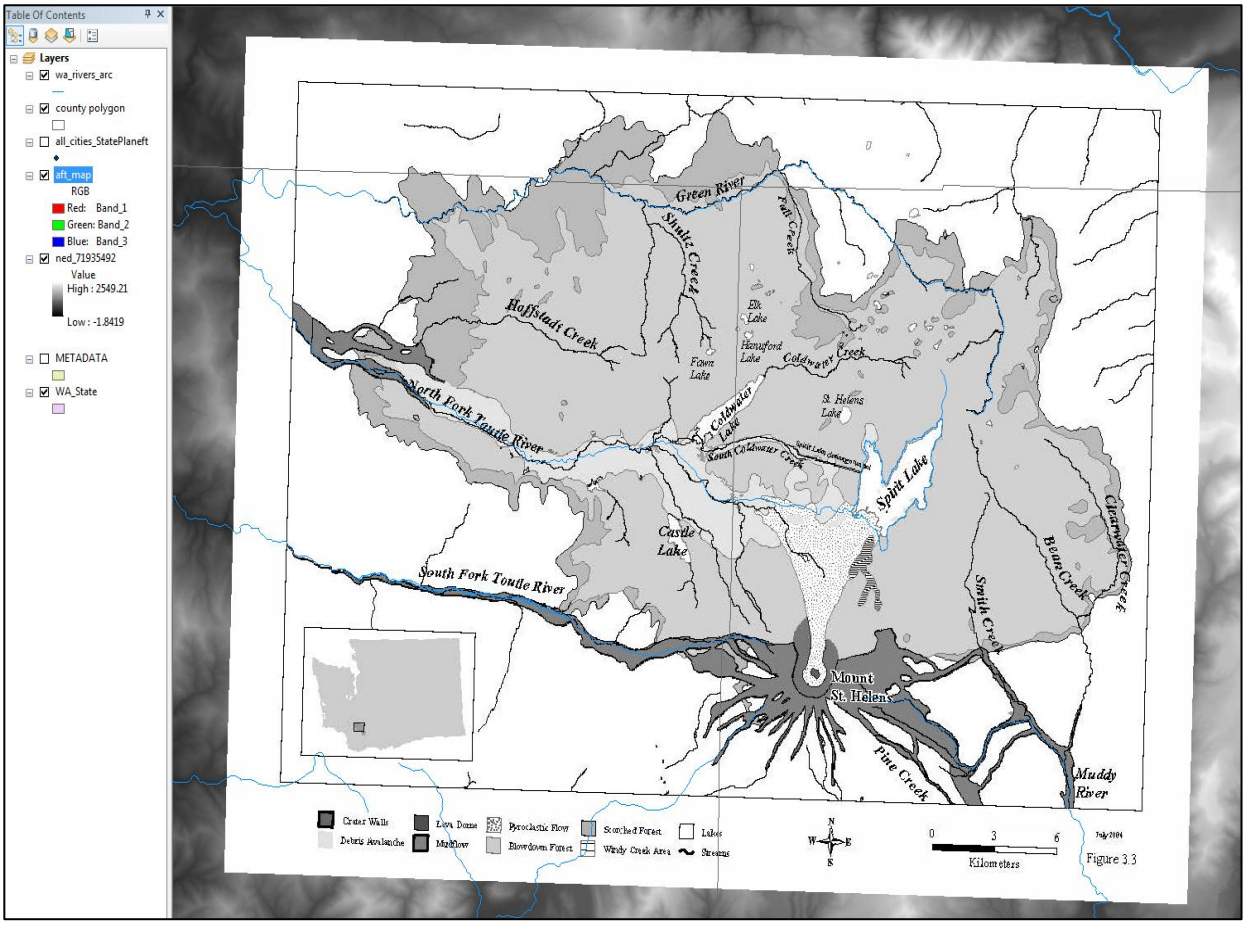


23. To combine the two DEMs' symbology I used, the before after eruption DEMs, I went to the before eruption's DEM and imported the symbology from the after eruption DEM.

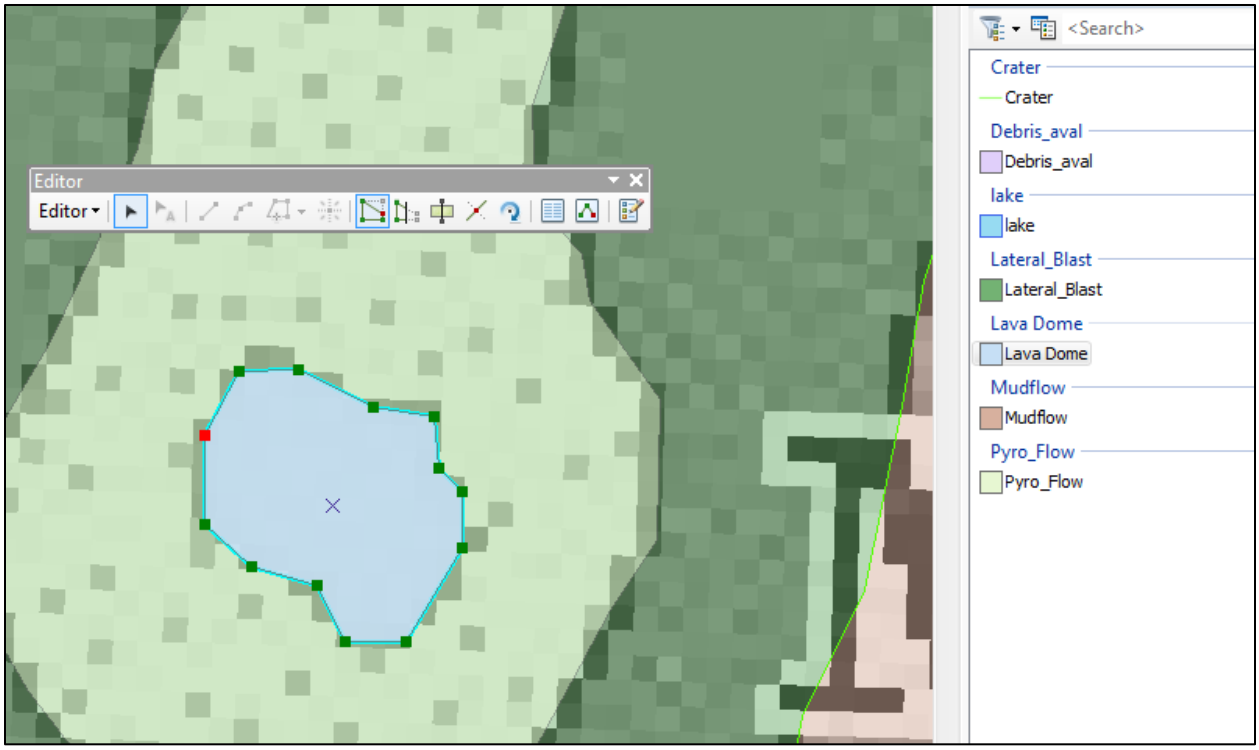


ArcGIS processing steps for After Eruption Map:

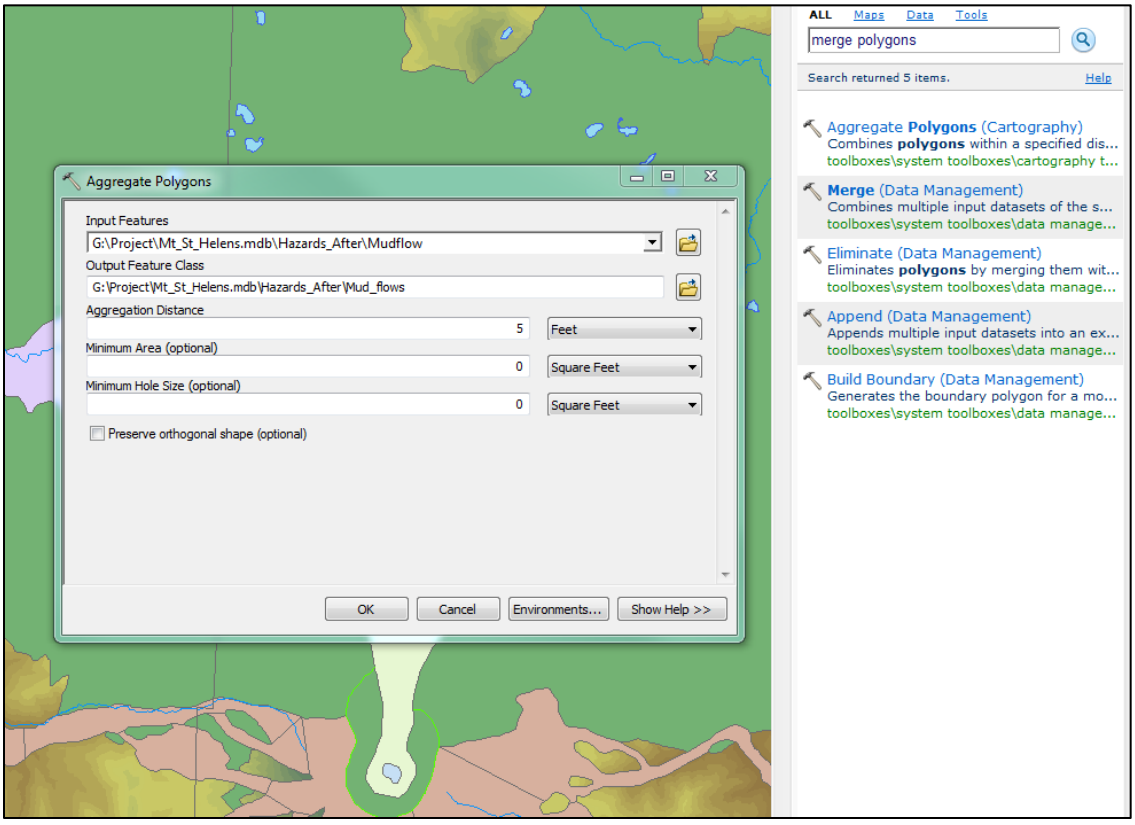
1. Open ArcGIS Map
2. Load Washington state outline, rivers, and counties from Lab 9 folder.
3. Upload the DEM for the Mt. St. Helens area.
4. Upload JPEG picture for After Eruption Map from Project folder.
5. Open Georeferencing toolbar and set layer to after_ map. Use the “add control points” button.



6. Save points in Project folder.
7. Rectify after_map.
8. Load Feature classes: pyroclastic flows, debris avalanche, mudflows, lateral blast, lake, crater outline, and lava dome shapefiles into the Table Of Contents.
9. Open the Editor Toolbar and start editing and choose any of the after eruption hazards.
10. Before digitizing, to help see the map below the polygons I was going to create, I went into the properties of all the layers I was going to be digitizing and I went to Display and made them all 50% transparent.
11. Begin digitizing all areas of interest saving edits often throughout digitizing.

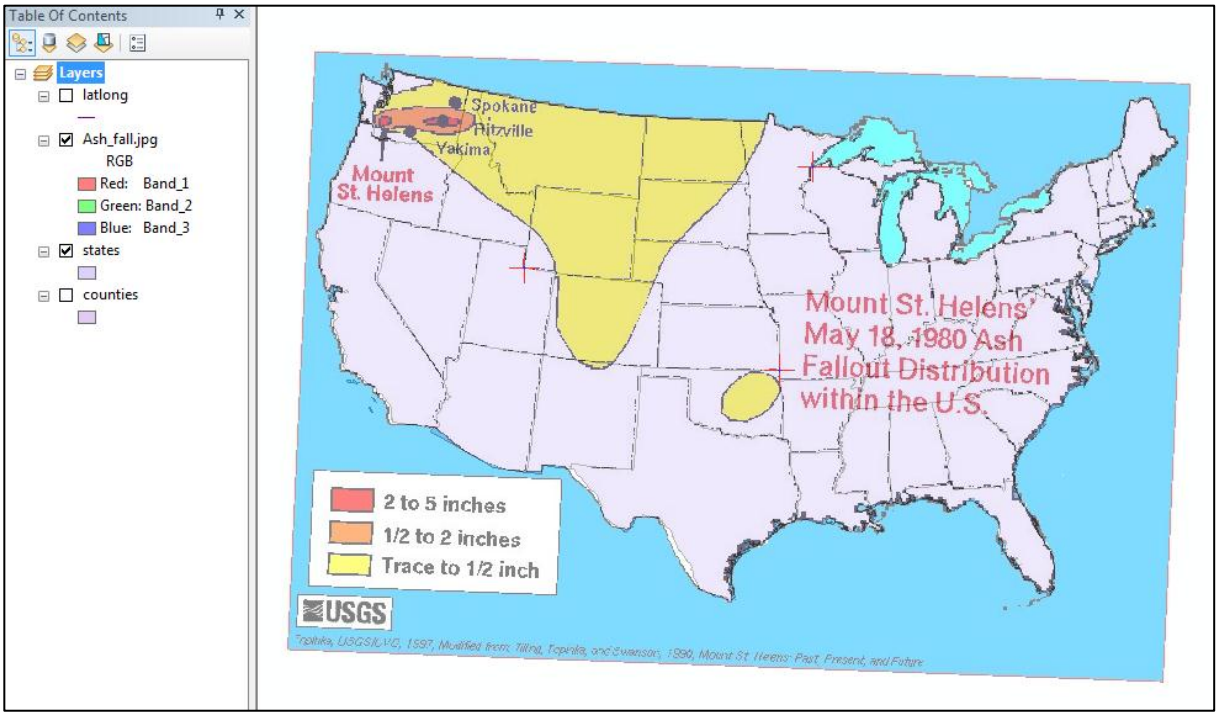


12. Once all digitizing is accomplished save edits and stop editing.
13. To combine polygons for my mudflow layer I used the Aggregate Polygons Tool.

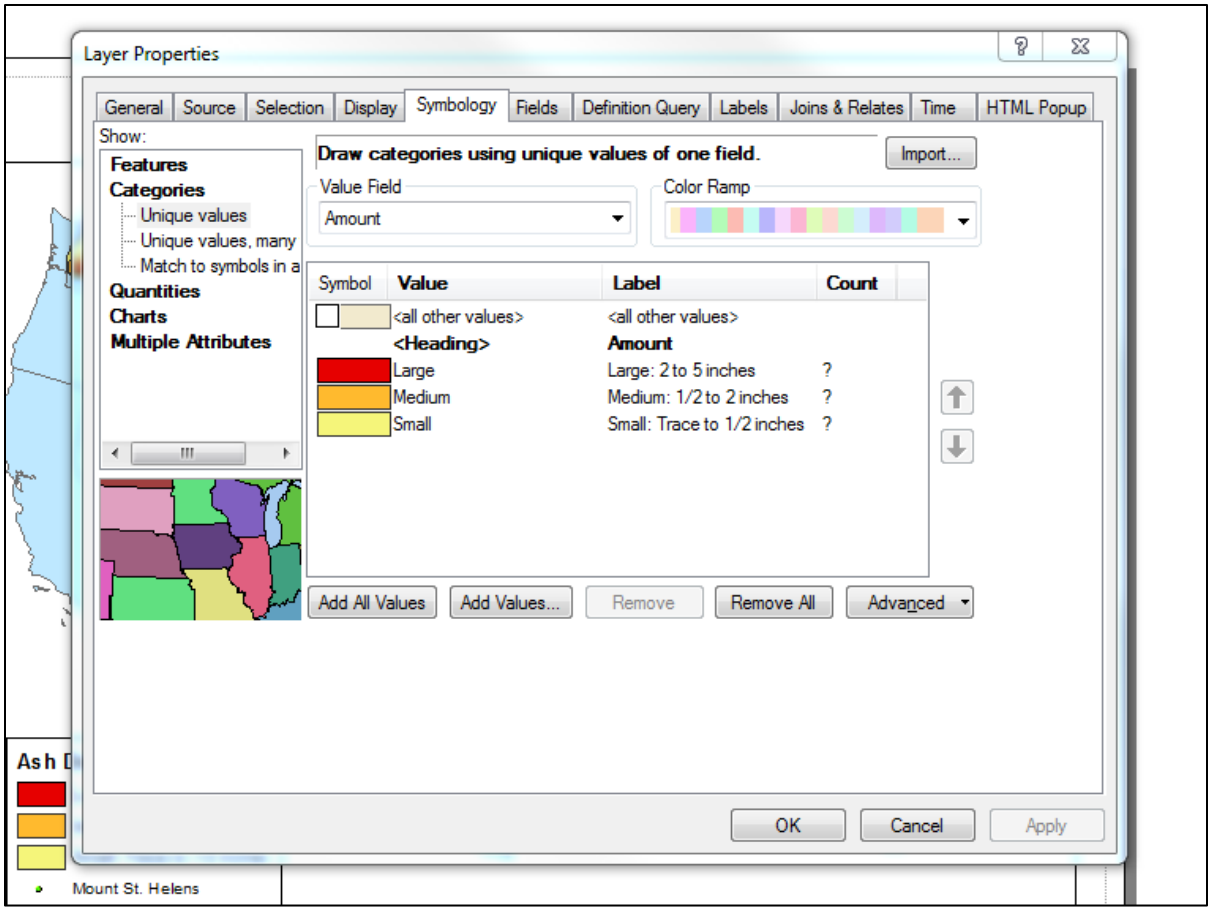


ArcGIS processing steps for Ash Fall Map:

1. Open ArcGIS Map
2. Load USA outline with the states' outline from Lab 2 folder into Table Of Contents
3. Set the Coordinate System to USA Contiguous Albers Equal Area Conic
4. Upload JPEG picture for Ash Fall from Project folder.
5. Open Georeferencing toolbar and set layer to Ash_fall. Use the "add control points" button.
6. Save points in Project folder



7. Rectify Ash_fall.
8. Load Ash Fall feature class into the Table Of Contents
9. Open Editor toolbar and start digitizing the ash fall feature class
10. Update the Attribute table to each ash deposit size.
11. Once finished, go into the symbology of the ash deposits layer and navigate to Unique values. Make sure the Value Field is "Amount" and then press the button "Add All Values."



12. Choose appropriate colors for Ash Fall deposit

Presentation Processes for all three maps:

1. Change view to Layout View
2. Create a legend and title for the map.
3. Insert a graticule, absolute scales, scalebar, datum, and the appropriate projection for each map.

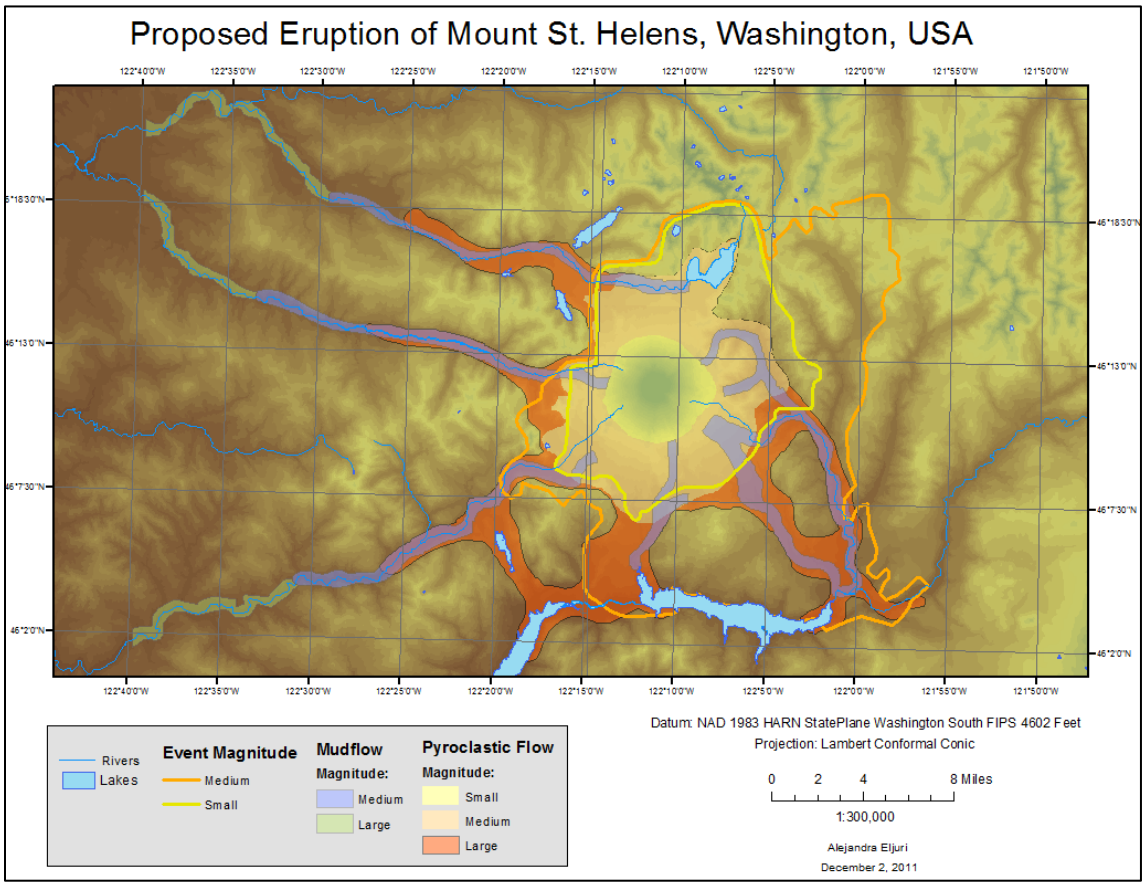
Results:

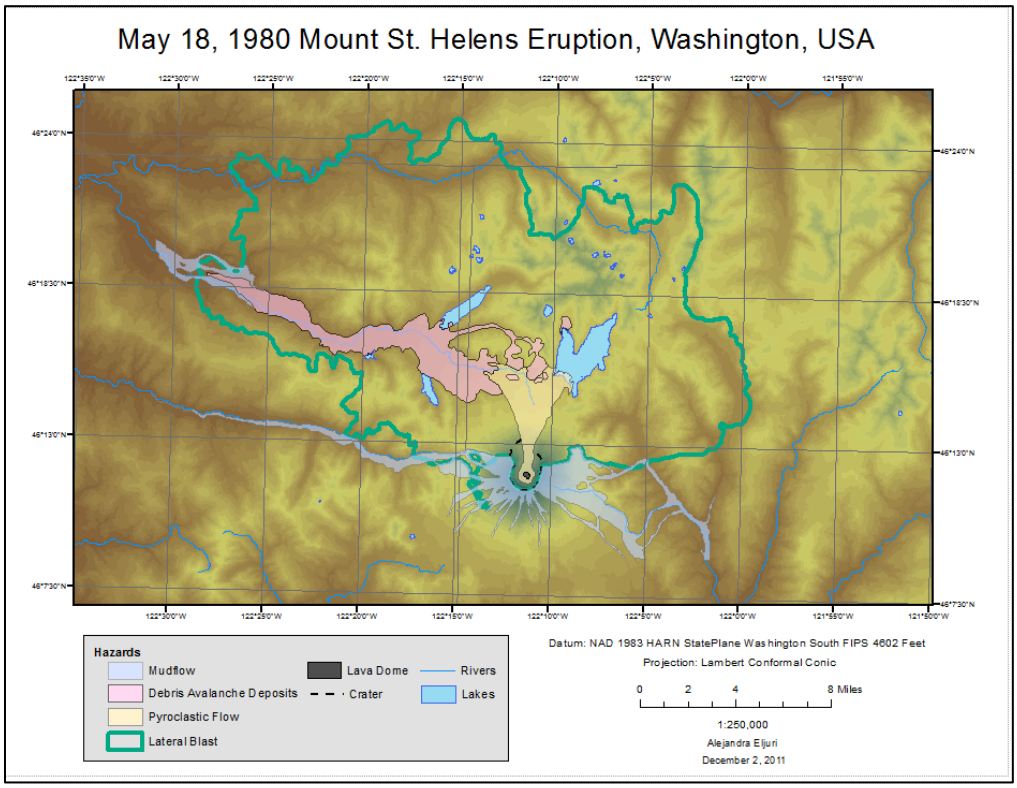
	Pyroclastic Flow (sq. mi.)	Mudflow (sq. mi.)	Event Magnitude (sq. mi.)
Before Eruption	4.62011	20.1119	Small: 96.7302 Medium: 133.427
After Eruption	6.84127	60.2848	220.549

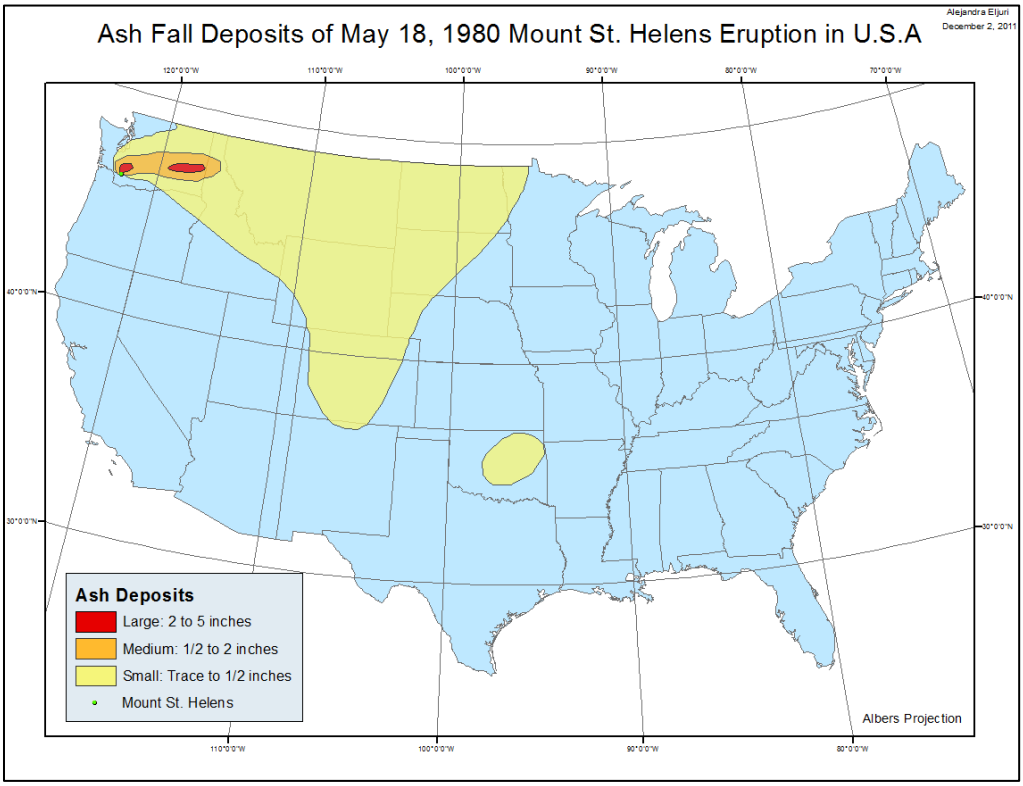
Even though the Mount St. Helens had a lateral blast, the USGS didn't expect such a large eruption. From their predictions they hypothesized a possible small event of 96.7302 mi^2 and medium event of 133.427 mi^2. The actual event caused a 220.549 mi^2 blast zone. The Mudflow magnitude was about 3 times than what they had projected. When comparing the pyroclastic flow of the projected area to the actual area, the actual area covered 2.22116 mi^2 more area than the projected area.

Ash Fall Size	Coverage (sq. mi.)
Large: 2 to 5 inches	3529.233
Medium: 1/2 to 2 inches	22662.166
Small: Trace to 1/2 inches	78384.777

Other hazards that were a result of the Mount St. Helens eruption are the ash flow deposits. They were dispersed across the USA as far as Oklahoma. The direction of the wind at the time of the eruption had a part to do with the dominate direction of flow. The debris avalanche deposits covered as much as 16.1949 mi^2. The eruption affected the surrounding environment plowing down thousands of trees and deformed Spirit Lake causing it to increase its volume and area.




May 18, 1980 Mount St. Helens Eruption, Washington, USA
Hazards
Mudflow
Debris Avalanche Deposits
Pyroclastic Flow
Lateral Blast
Lava Dome
Crater
Rivers
Lakes
Datum: NAD 1983 HARN StatePlane Washington South FIPS 4602 Feet
Projection: Lambert Conformal Conic
0 2 4 8 Miles
1:250,000
Alejandra Eljuri
December 2, 2011


Ash Fall Deposits of May 18, 1980 Mount St. Helens Eruption in U.S.A
Alejandra Eljuri
December 2, 2011
Ash Deposits
Large: 2 to 5 inches
Medium: 1/2 to 2 inches
Small: Trace to 1/2 inches
Mount St. Helens
Albers Projection