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# Middle Willamette Watershed

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# Introduction

For my term project I am going to investigate collected data on the middle Willamette Watershed in Oregon. I chose this watershed, because in my capstone project I'm in charge of water resources for our project. We are trying to make an intersection at Clow Corner and Oregon 99 West near Monmouth safer. For my capstone I want to implement a culvert system for the roadway at the intersection and for that I will need rainfall, soil, land use land cover, and storm water runoff data. I didn't want to just examine the small project site at the intersection, so I chose to look into the entire HUC-8 that encompasses it.

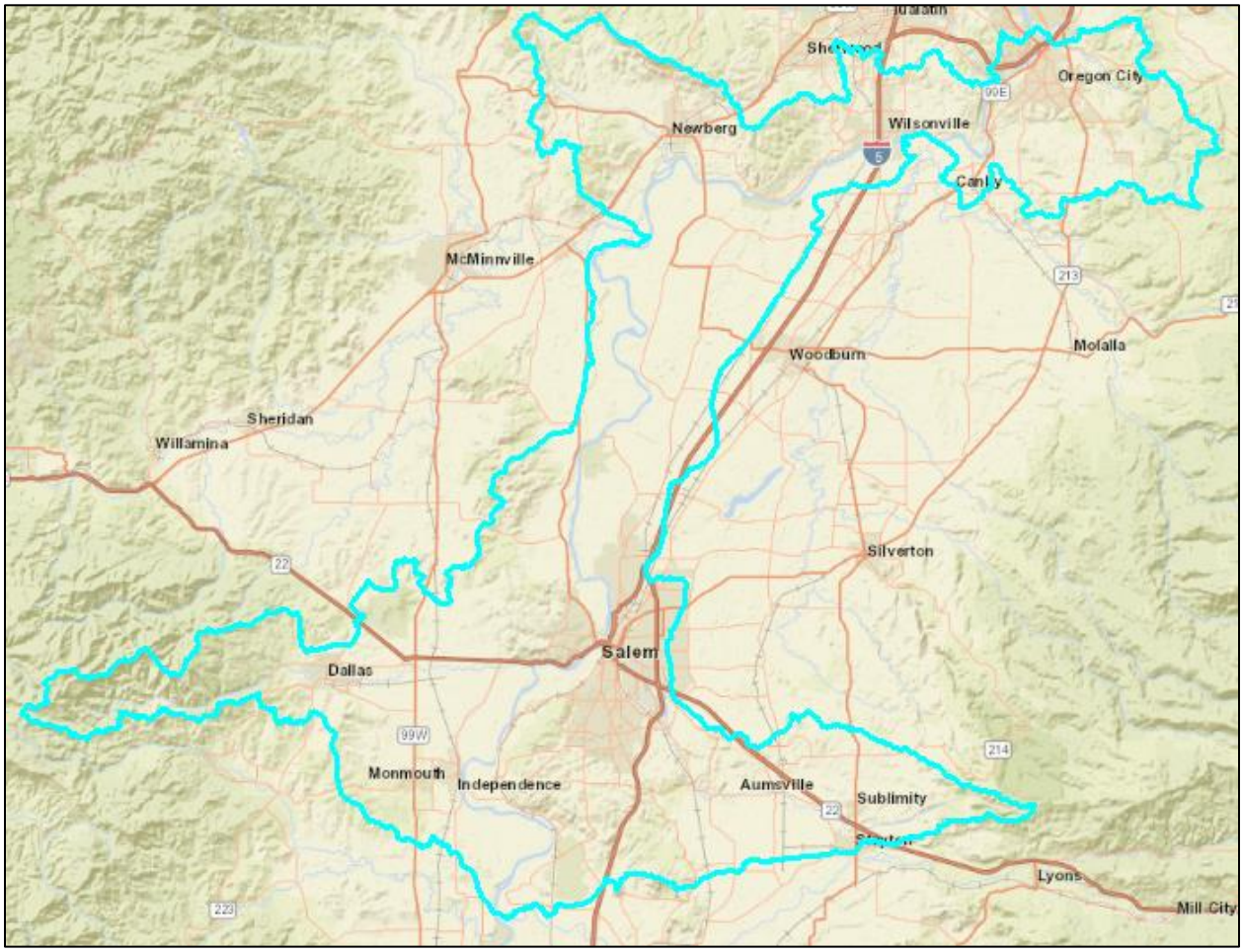


*Figure 9: Street view of the watershed area*

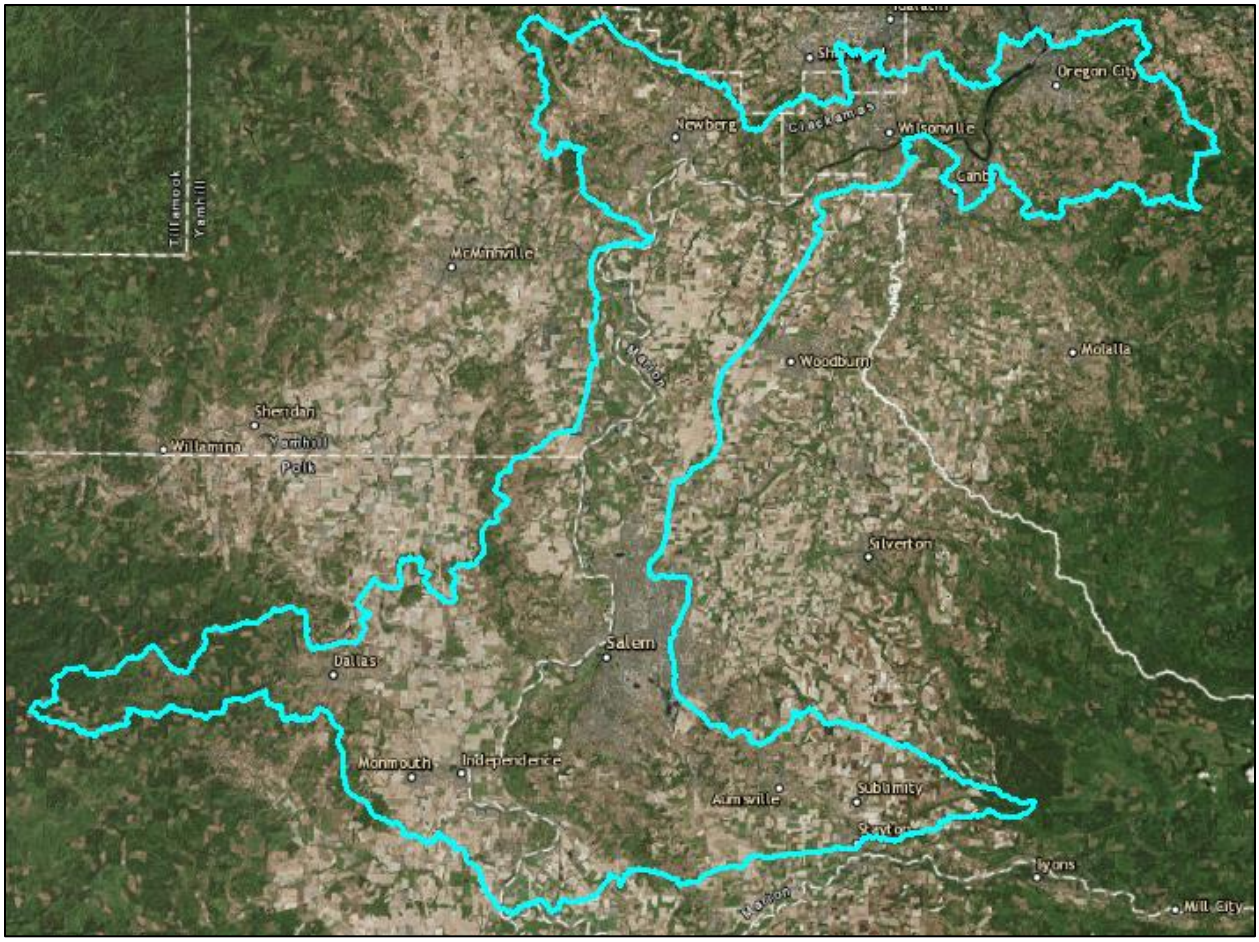


*Figure 10: Satellite view of the watershed area*

## Project Overview

I originally found the location I wanted to investigate by going to the Clow Corner intersection in Oregon on Data Basin and using that areas HUC-8. The HUC-8's name is the Middle Willamette watershed and its 8 digit ID is 17090007. The area of the Watershed is 455039.91 acres or 1841.48 square kilometers. A majority of the watershed is in the Willamette Valley so it's flat land that is surrounded by mountains. The elevation of the watershed ranges from 2.63 meters to 1079 meters high, but it on average under 100 meters. The main feature of the watershed is the Willamette River that flows through the middle. Looking at the Land Use Land Cover map the majority of the watershed is hay/pasture and cultivated crops. There is also evergreen forest, shrubs, herbaceous, developed land of all intensities, open water, mixed forest, and woody wetlands covering the watershed. This project is important because this watershed covers a large portion of the middle of Oregon and the analysis shows data for one of the most important rivers in Oregon, the Willamette River.

I gathered data for ArcGIS on GIS data gateway for 5 counties that are all a part of the Middle Willamette watershed. The counties are Clackamas, Yamhill, Washington,

Polk, and Marion. The watersheds projection is Oregon UTM Zone 10 North and so is all of the other pieces of data using my geodatabase. The data that I used for the map includes:

- Precipitation (inches) – Polygon or characterized as points
- NHD Data points that show events in the flow lines - Point
- Waterbodies – Polygon
- 30x30 DEM – Raster
- HUC 8 – Polygon
- Land Use Land Cover – Raster (30x30)

Data that I created using the previous data sets include:

- Drainage Point – Point
- Longest Flow Path Catchment – Line
- Drainage Line – Line
- Catchment – Polygon
- Watershed Slope – Raster (30x30)
- Stream and Stream link – Line
- FAC – Raster (30x30)
- FDR – Raster (30x30)
- Sink Fill – Raster (30x30)

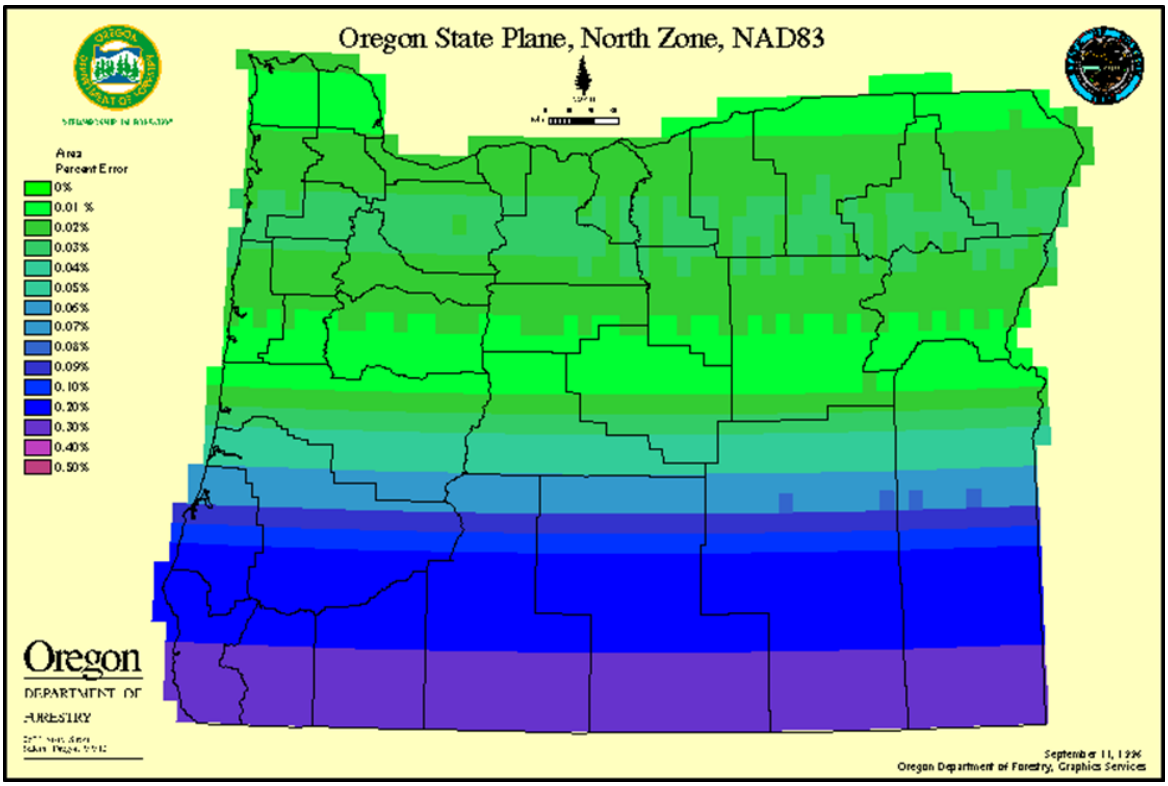


*Figure 1: Projection: Oregon UTM Zone 10 North*

# Maps

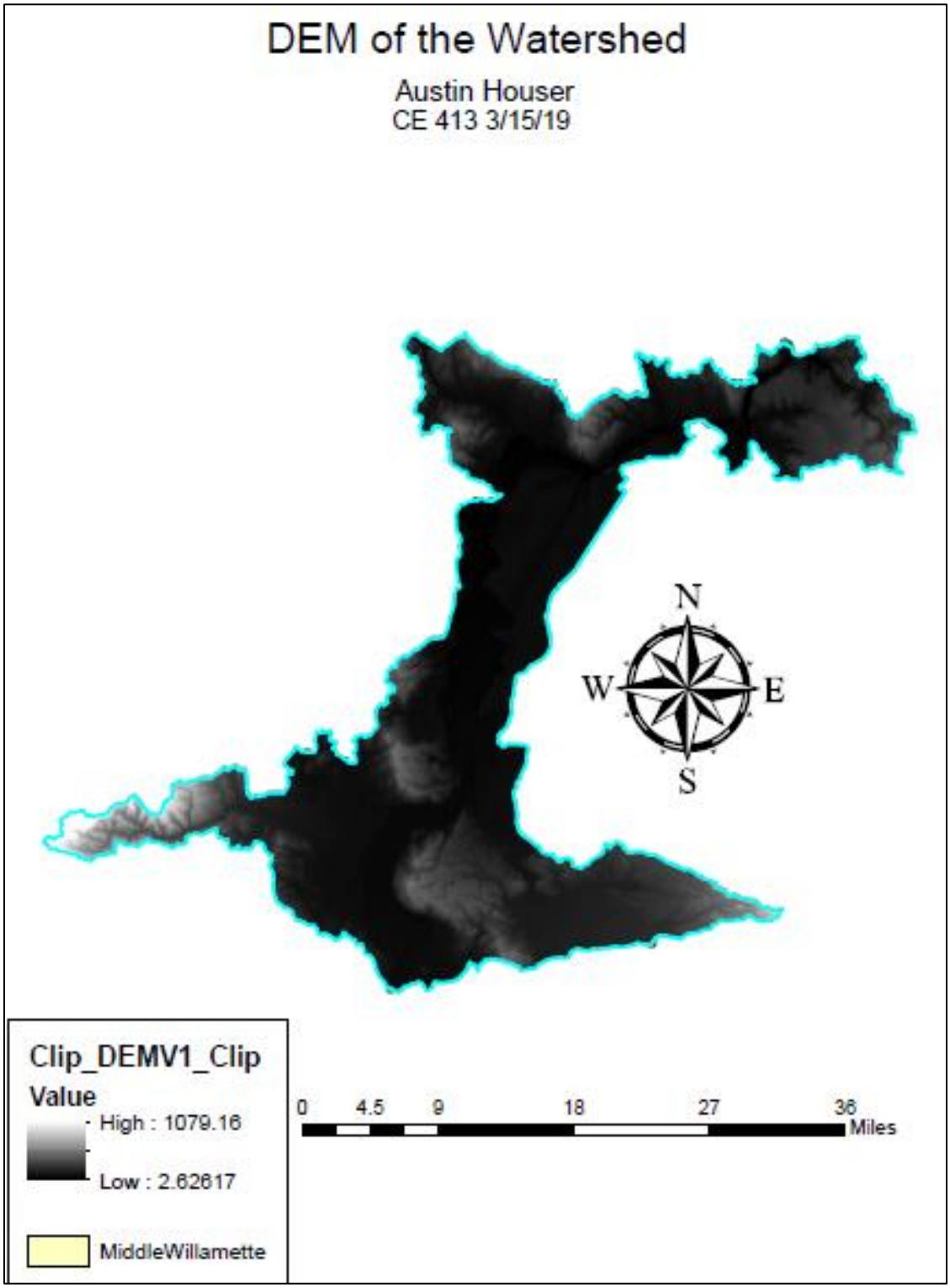


*Figure 2: DEM of the Watershed in meters*

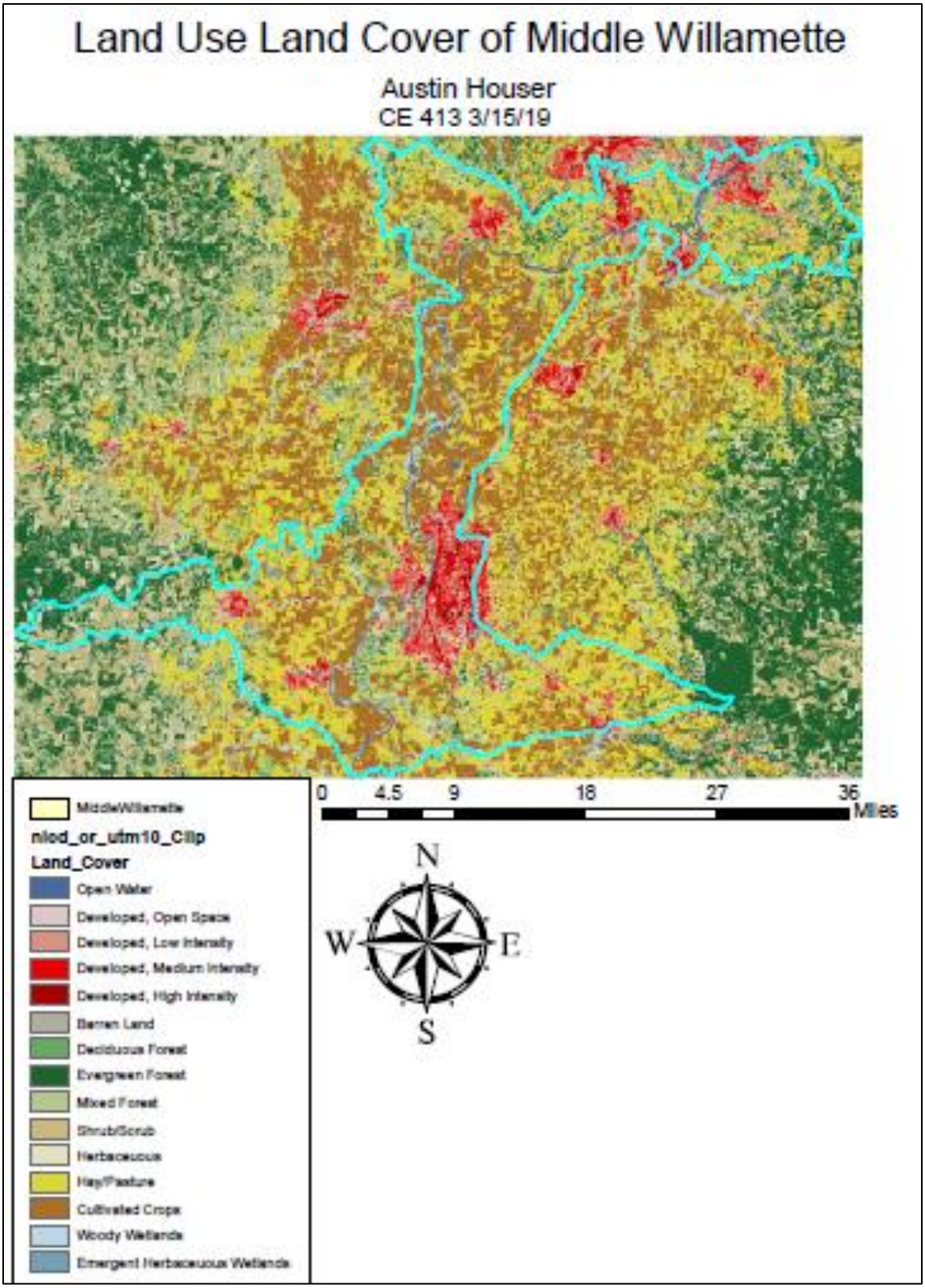


*Figure 3: Land Use Land Cover of the watershed*

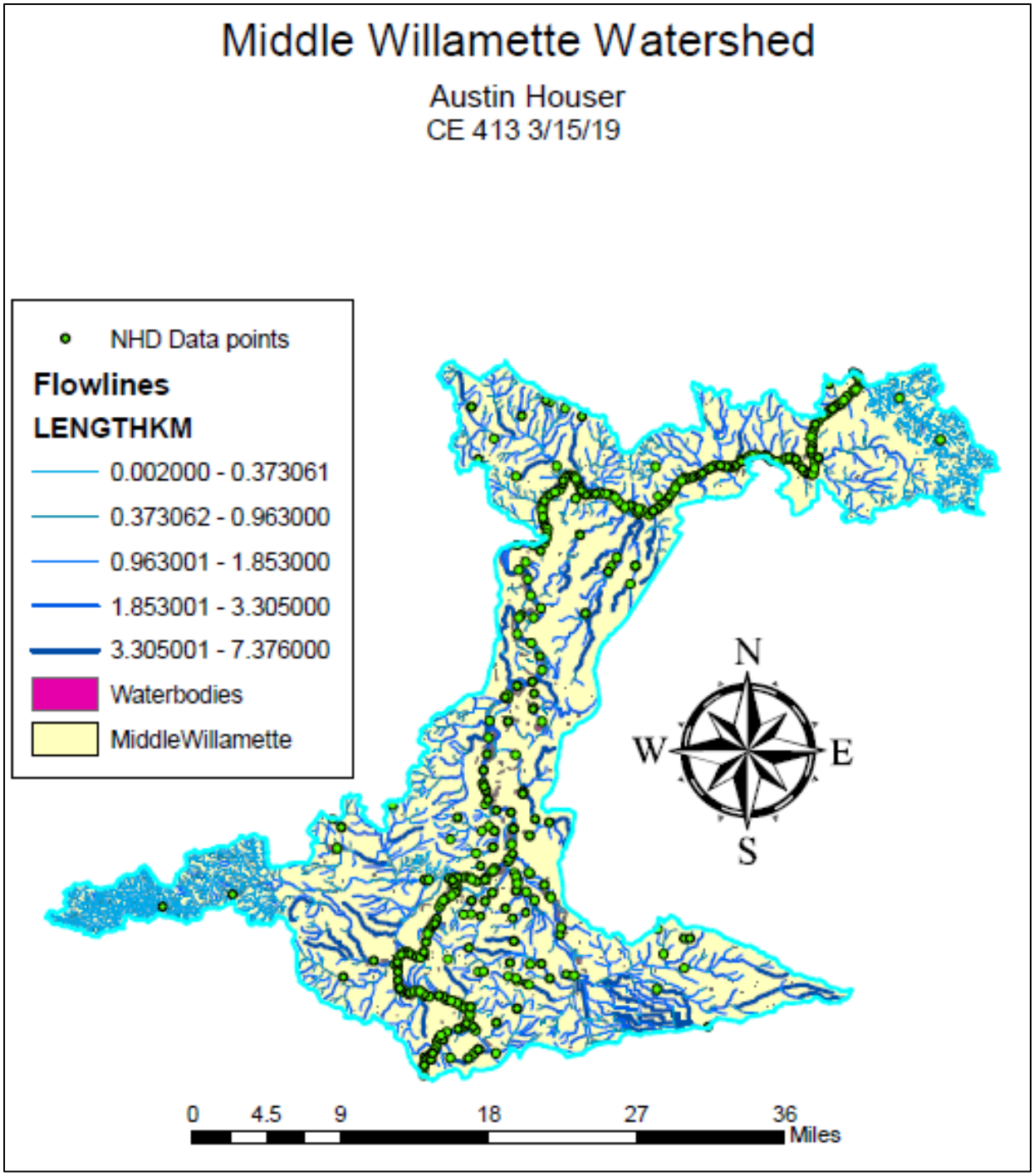


*Figure 4: Middle Willamette Watershed highlighting flow lengths*

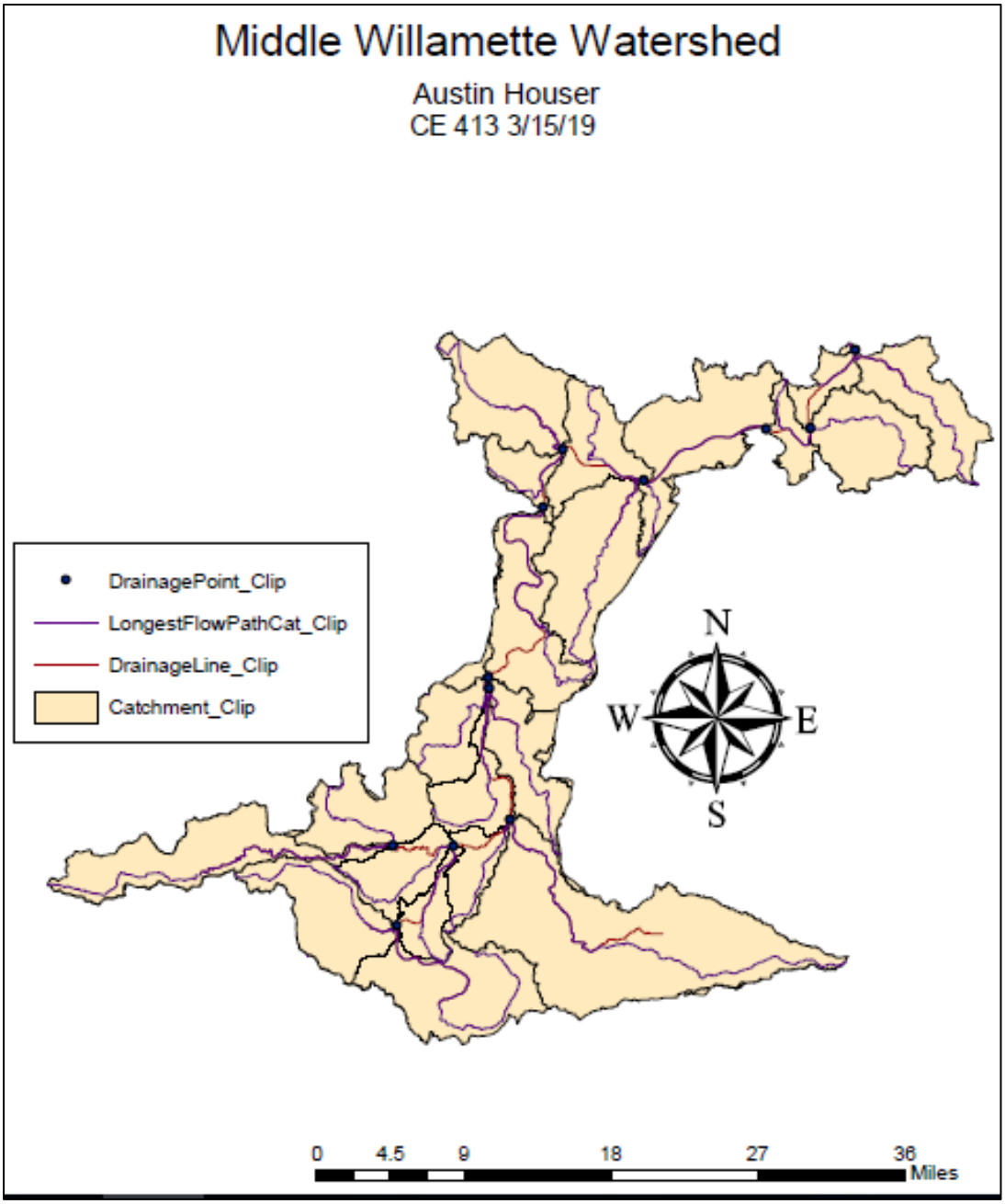


*Figure 5: Middle Willamette Watershed showing drainage lines and Catchments*

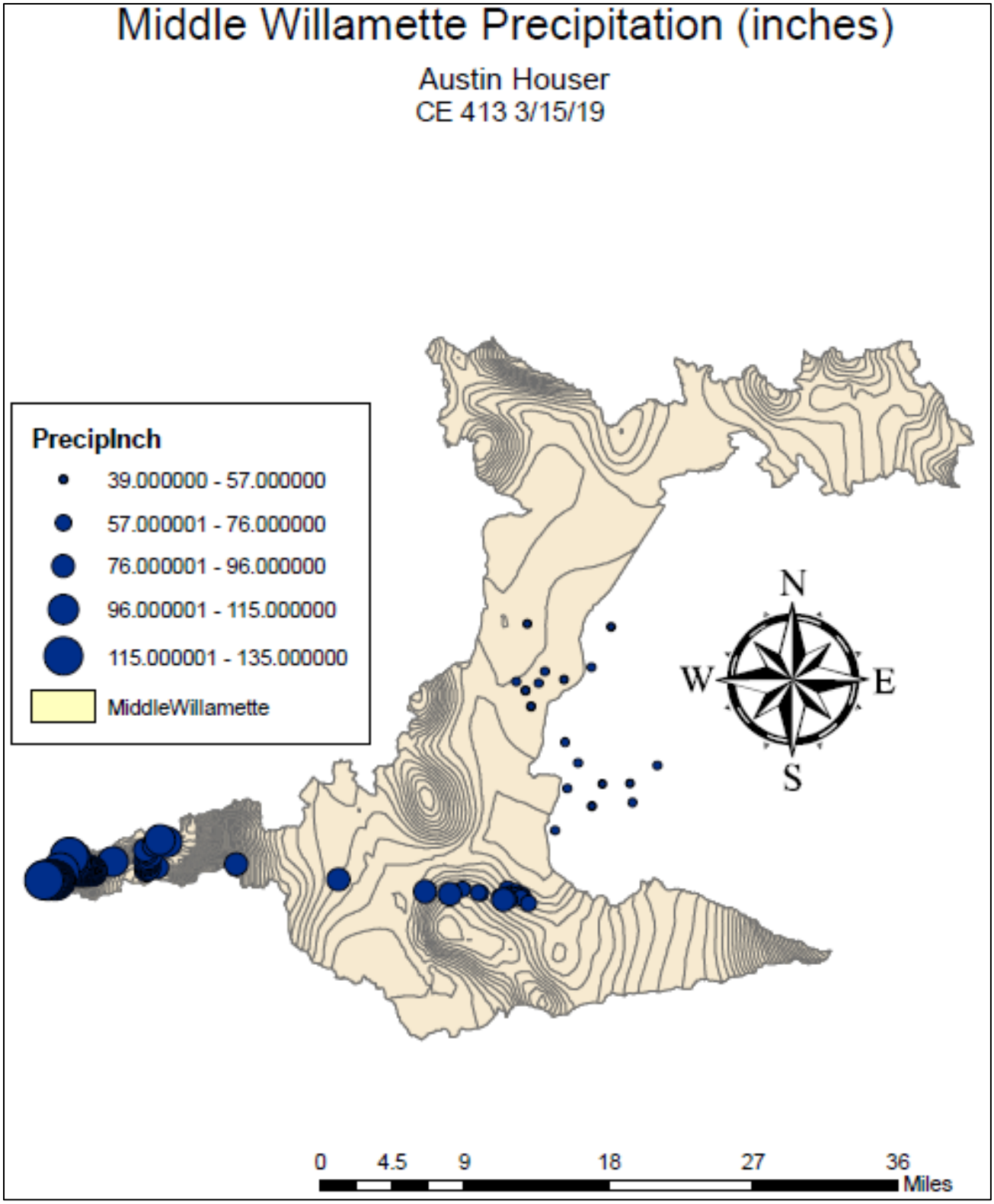


*Figure 6: Precipitation in Middle Willamette*

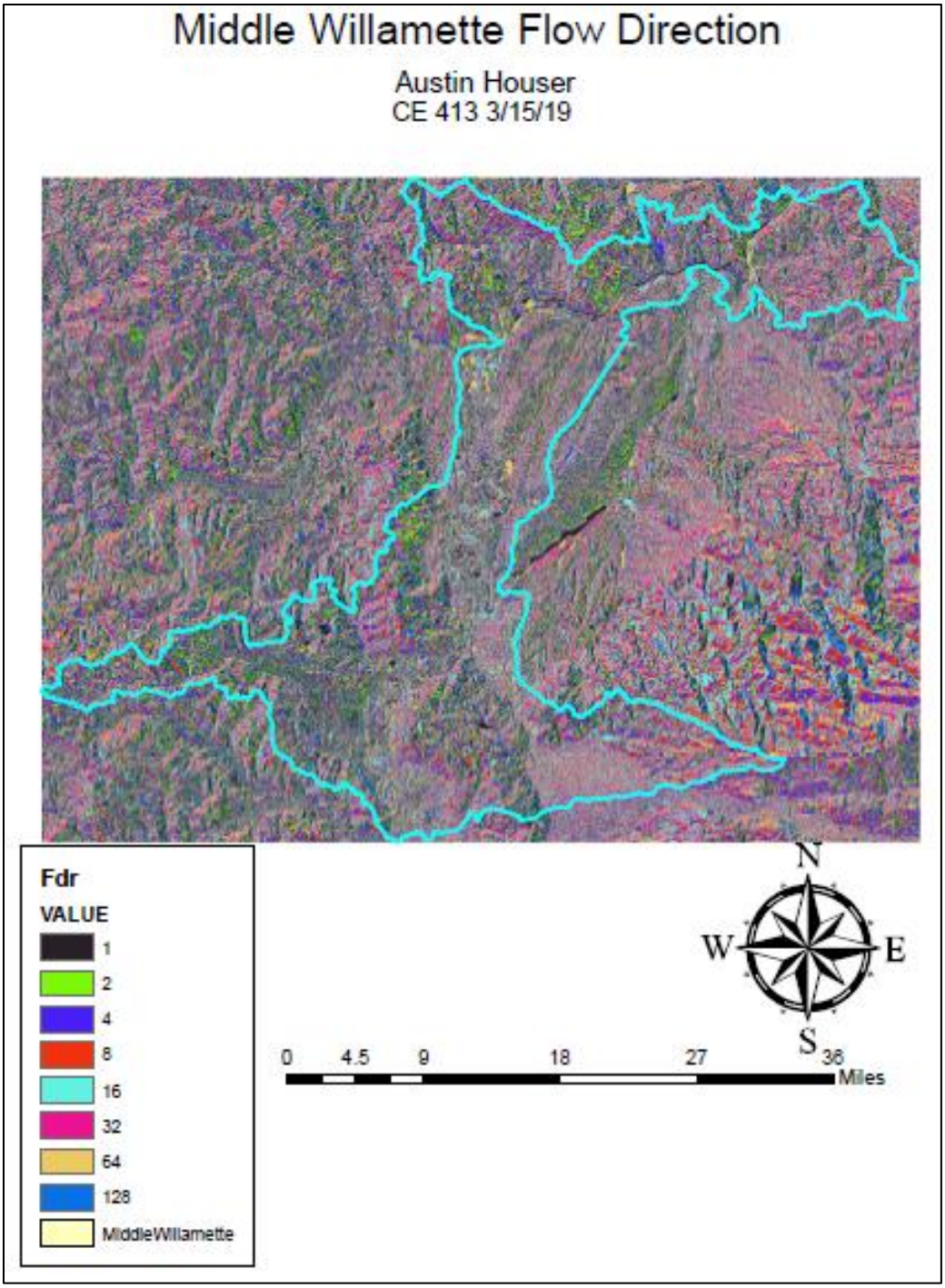


*Figure 7: Flow Direction of the Watershed*

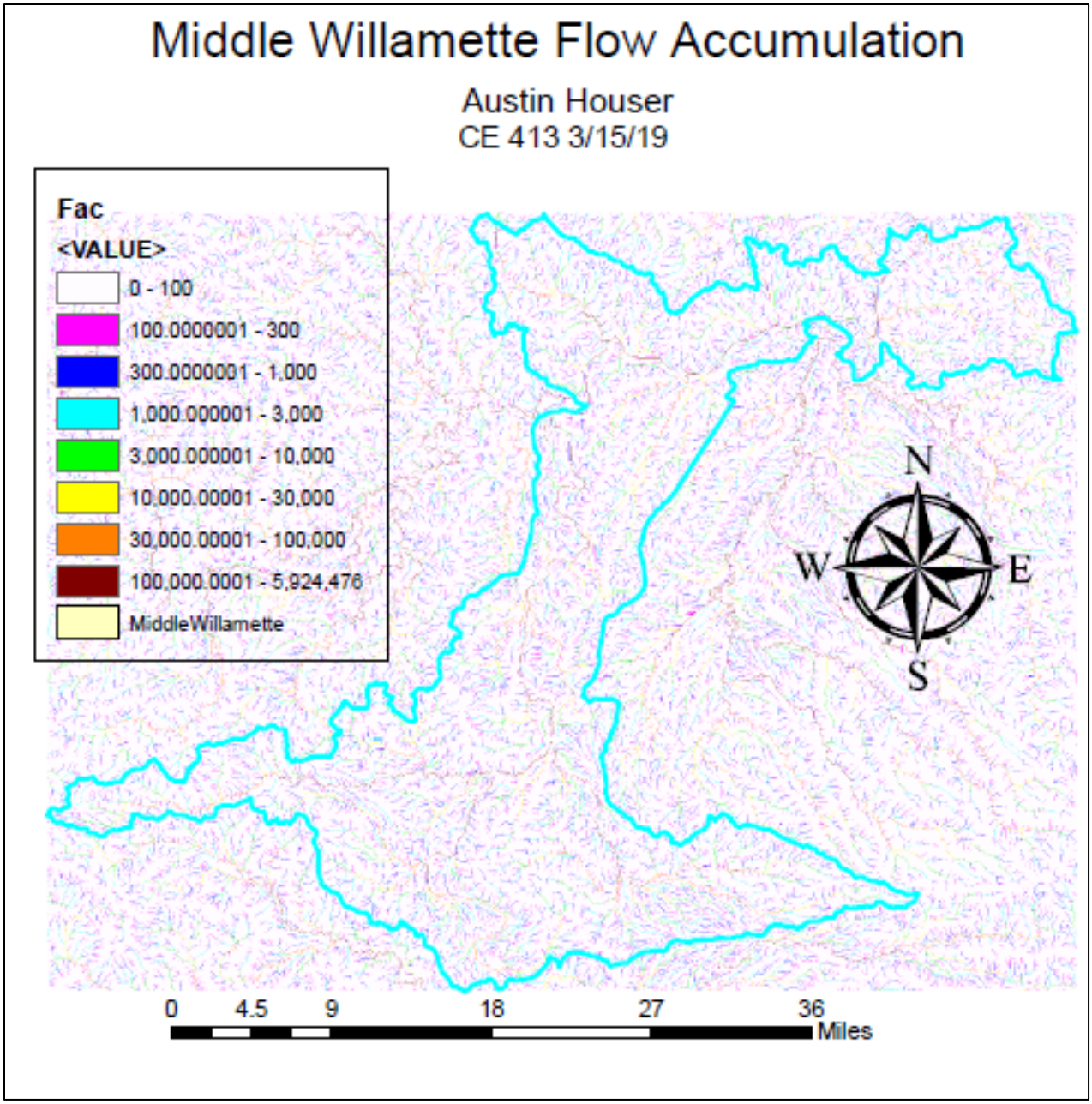


*Figure 8: Flow Accumulation of Watershed*

# Methods

Once the data was gathered from data gateway I clipped all of the data sets that I had to fit my HUC 8 watershed. This took a while since I had 5 different sets of data to sift through and clip. When I had to combine the DEM's I used Mosaic to new raster and then once I had one DEM I used clip management instead of analysis because it was a raster. The DEM still didn't completely match the boundary of the watershed so I clipped the previous DEM clip using image analysis with the watershed selected.

Now that all the data is clipped into the watershed it can be analyzed. I did hydro network analysis using the flow lines and the watershed data. These were the steps:

- Fill the sinks in the DEM
- Created the flow direction of the watershed
- Created the flow accumulation of the watershed
- Raster Calculator to find the bigger streams
- Defined the streams and then linked them
- Created the drainage line and points of the streams
- Created the Catchment polygons for the drainage line
- Created the longest flow path for the catchments
- Created the watershed's slope

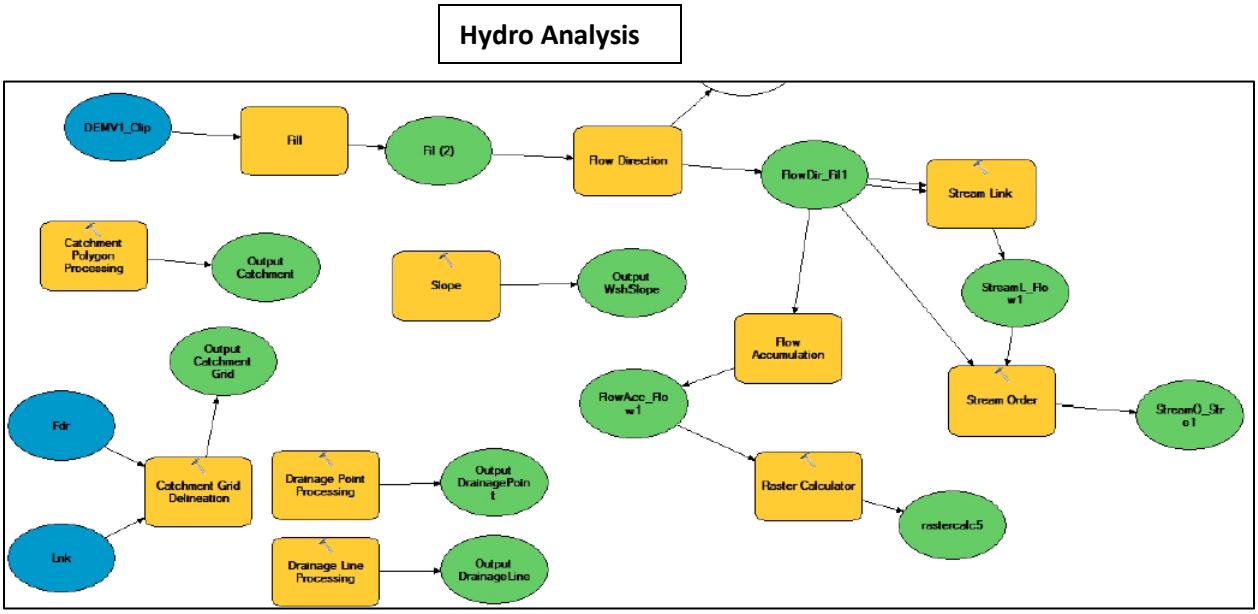


*Figure 11: Model Builder for major parts of ArcHydro analysis*

# Results and Discussion

| OBJECTID_1 * | Shape * | OBJECTID | PERMANE | FDATE | RESOLUTION | GNIS_ID | LENGTHKM | REACHCODE | FLOWDIR | WBAREA_PER | FTYPE | FCODE | FIPS_C | Shape_Length |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 817 | Polyline | 3176182 | 147808940 | 2/24/2012 | 2 | | 7.376 | 17090007000544 | 1 | | 460 | 46003 | | 7374.414823 |

*Table 1: Intersection stream flow line Attribute Table*

| Field | Value |
|---|---|
| FID | 5 |
| Shape | Polygon |
| PrecipInch | 43 |
| FIPS_S | 41 |
| Inches | 43 |
| Shape_Length | 297698.378372 |
| Shape_Area | 112563554.510194 |

*Table 2: Intersection precipitation*

| OBJECTID_1 * | Shape * | OBJECTID | PERMANE | FDATE | RESOLUTION | GNIS_ID | GNIS_NAME | LENGTHKM | REACHCODE | FLOWDIR | WBAREA_PER | FTYPE | FCODE | FIPS_C | Shape_Length |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 53 | Polyline | 1671373 | 147814420 | 6/13/2014 | 2 | 01158060 | Willamette River | 0.652156 | 17090007000197 | 1 | {3F0AB72B-797 | 558 | 55800 | | 650.8461 |
| 75 | Polyline | 2743487 | 147814364 | 6/13/2014 | 2 | 01158060 | Willamette River | 1.783202 | 17090007000070 | 1 | {3F0AB72B-797 | 558 | 55800 | | 1784.382256 |
| 191 | Polyline | 8351128 | 147814498 | 6/13/2014 | 2 | 01158060 | Willamette River | 0.270462 | 17090007000741 | 1 | {3F0AB72B-797 | 558 | 55800 | | 270.055477 |
| 250 | Polyline | 10006688 | 147814425 | 6/13/2014 | 2 | 01158060 | Willamette River | 0.403815 | 17090007000200 | 1 | {3F0AB72B-797 | 558 | 55800 | | 403.321293 |
| 288 | Polyline | 11186814 | 147814430 | 6/13/2014 | 2 | 01158060 | Willamette River | 0.588082 | 17090007000202 | 1 | {3F0AB72B-797 | 558 | 55800 | | 587.530797 |
| 381 | Polyline | 13698604 | 147814502 | 6/13/2014 | 2 | 01158060 | Willamette River | 0.59852 | 17090007005952 | 1 | {3F0AB72B-797 | 558 | 55800 | | 597.357801 |
| 414 | Polyline | 14514297 | 147814366 | 6/13/2014 | 2 | 01158060 | Willamette River | 0.709002 | 17090007000072 | 1 | {3F0AB72B-797 | 558 | 55800 | | 708.068956 |
| 473 | Polyline | 18345512 | 147814434 | 6/13/2014 | 2 | 01158060 | Willamette River | 1.600299 | 17090007000206 | 1 | {3F0AB72B-797 | 558 | 55800 | | 1598.437036 |
| 489 | Polyline | 18841601 | 147814373 | 6/13/2014 | 2 | 01158060 | Willamette River | 4.791755 | 17090007000100 | 1 | {3F0AB72B-797 | 558 | 55800 | | 4787.32408 |
| 503 | Polyline | 19400566 | 147814429 | 6/13/2014 | 2 | 01158060 | Willamette River | 1.807295 | 17090007000202 | 1 | {3F0AB72B-797 | 558 | 55800 | | 1806.754015 |
| 694 | Polyline | 451218 | 147814497 | 6/13/2014 | 2 | 01158060 | Willamette River | 0.814556 | 17090007000740 | 1 | {3F0AB72B-797 | 558 | 55800 | | 813.215869 |
| 889 | Polyline | 4905326 | 147814427 | 6/13/2014 | 2 | 01158060 | Willamette River | 0.304677 | 17090007000200 | 1 | {3F0AB72B-797 | 558 | 55800 | | 304.937125 |
| 947 | Polyline | 6744780 | 147814352 | 6/13/2014 | 2 | 01158060 | Willamette River | 1.679694 | 17090007000065 | 1 | {3F0AB72B-797 | 558 | 55800 | | 1676.933208 |
| 958 | Polyline | 7424044 | 147814432 | 6/13/2014 | 2 | 01158060 | Willamette River | 0.744526 | 17090007000204 | 1 | {3F0AB72B-797 | 558 | 55800 | | 744.806099 |
| 1216 | Polyline | 11309116 | 147814422 | 6/13/2014 | 2 | 01158060 | Willamette River | 0.970609 | 17090007000199 | 1 | {3F0AB72B-797 | 558 | 55800 | | 970.834128 |
| 1269 | Polyline | 12276040 | 147814423 | 6/13/2014 | 2 | 01158060 | Willamette River | 1.266192 | 17090007000200 | 1 | {3F0AB72B-797 | 558 | 55800 | | 1267.628369 |
| 1450 | Polyline | 15267627 | 147814552 | 6/13/2014 | 2 | 01158060 | Willamette River | 0.572175 | 17090007003243 | 1 | {3F0AB72B-797 | 558 | 55800 | | 571.242342 |
| 1507 | Polyline | 18345510 | 147814418 | 6/13/2014 | 2 | 01158060 | Willamette River | 0.509298 | 17090007000196 | 1 | {3F0AB72B-797 | 558 | 55800 | | 508.289107 |
| 1508 | Polyline | 18345513 | 147814353 | 6/13/2014 | 2 | 01158060 | Willamette River | 3.002568 | 17090007000066 | 1 | {3F0AB72B-797 | 558 | 55800 | | 3002.348697 |
| 1620 | Polyline | 19757575 | 147814399 | 6/13/2014 | 2 | 01158060 | Willamette River | 0.445406 | 17090007000171 | 1 | {3F0AB72B-797 | 558 | 55800 | | 444.770555 |
| 1910 | Polyline | 970909 | 147814506 | 6/13/2014 | 2 | 01158060 | Willamette River | 1.521304 | 17090007000838 | 1 | {3F0AB72B-797 | 558 | 55800 | | 1520.429472 |
| 1974 | Polyline | 2370654 | 147814358 | 6/13/2014 | 2 | 01158060 | Willamette River | 1.114019 | 17090007000067 | 1 | {3F0AB72B-797 | 558 | 55800 | | 1112.637932 |
| 2064 | Polyline | 4656199 | 147814357 | 6/13/2014 | 2 | 01158060 | Willamette River | 0.271546 | 17090007000067 | 1 | {3F0AB72B-797 | 558 | 55800 | | 271.083573 |
| 2082 | Polyline | 4905327 | 147814361 | 6/13/2014 | 2 | 01158060 | Willamette River | 0.801072 | 17090007000070 | 1 | {3F0AB72B-797 | 558 | 55800 | | 801.257517 |
| 2101 | Polyline | 5618186 | 147814433 | 6/13/2014 | 2 | 01158060 | Willamette River | 0.303091 | 17090007000205 | 1 | {3F0AB72B-797 | 558 | 55800 | | 303.458602 |
| 2487 | Polyline | 12665301 | 147814356 | 6/13/2014 | 2 | 01158060 | Willamette River | 1.336629 | 17090007000067 | 1 | {3F0AB72B-797 | 558 | 55800 | | 1334.754575 |
| 2539 | Polyline | 13830871 | 147814398 | 6/13/2014 | 2 | 01158060 | Willamette River | 2.152128 | 17090007000170 | 1 | {3F0AB72B-797 | 558 | 55800 | | 2148.998184 |
| 2769 | Polyline | 19757573 | 147814435 | 6/13/2014 | 2 | 01158060 | Willamette River | 1.237935 | 17090007000207 | 1 | {3F0AB72B-797 | 558 | 55800 | | 1238.434984 |
| 2783 | Polyline | 20126792 | {0644E266- | 6/13/2014 | 2 | 01158060 | Willamette River | 1.065897 | 17090007000071 | 1 | {3F0AB72B-797 | 558 | 55800 | | 1065.317123 |
| 2803 | Polyline | 20421817 | 147814419 | 6/13/2014 | 2 | 01158060 | Willamette River | 1.28854 | 17090007000197 | 1 | {3F0AB72B-797 | 558 | 55800 | | 1286.795239 |
| 2823 | Polyline | 20805554 | 147814365 | 6/13/2014 | 2 | 01158060 | Willamette River | 1.93842 | 17090007000071 | 1 | {3F0AB72B-797 | 558 | 55800 | | 1938.675431 |

1 (185 out of 7281 Selected)

*Table 3: Willamette River Attribute Table*

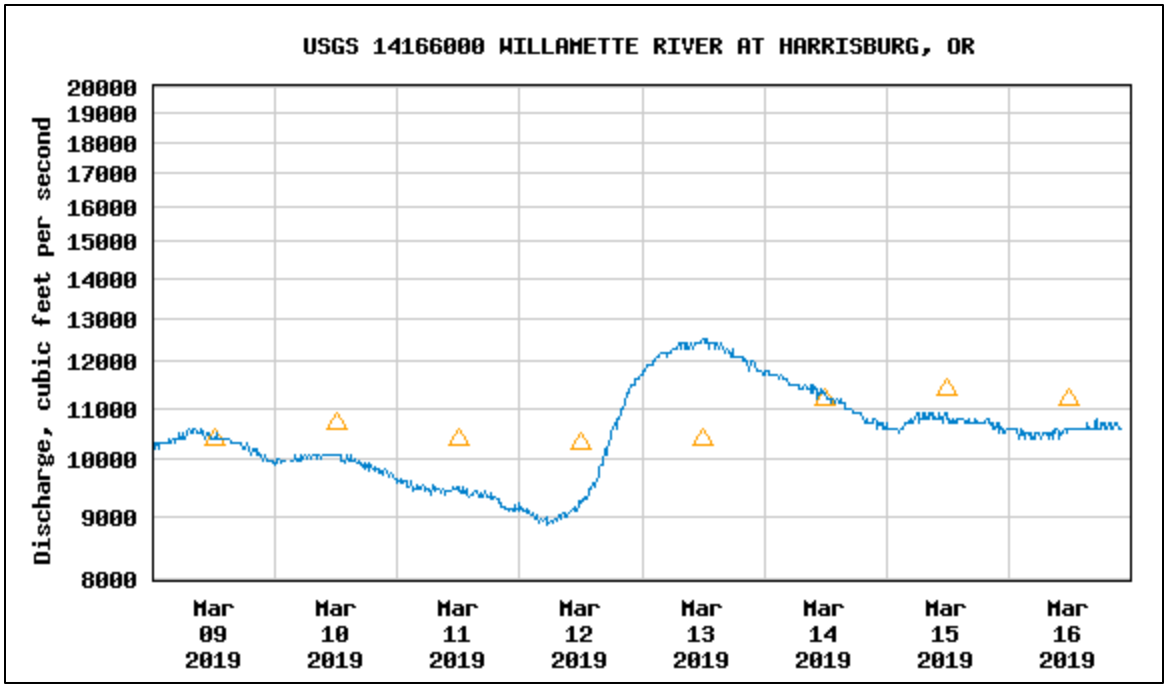


*Table 4: USGS graphs to find flow rates*

I looked into the Clow Corner Road and Oregon 99 W intersection area and saw the length of the seasonal stream and how it flows. The Stream flows from North to South into the Willamette River. It's 7.4 km long and that area gets around 43 inches of precipitation a year. I'm going to use this data to find out how big of culverts I need to place to properly guide the water through the stream in a peak 100 year storm. Unfortunately I couldn't create the data for flow rates in this project with the data that was available to me, but I used the rational method on my capstone project to complete this part of my data.

I analyzed the streams as a whole for the HUC 8 watershed, but I also looked into the Willamette River since it's the biggest feature that's included. I found out by doing the Flow direction that the river flows from South to North which is rare in the Pacific Northwest. There was 185 pieces to analyze and the length of the river for this portion of it was 225.3 kilometers. If I was able to find flow rates I'm sure that the Willamette Rivers would stand out as the highest by far for this watershed as well, considering it's a major river in Oregon.

The limitations of my analysis of the Middle Willamette watershed were that I'm a student with limited time to dedicate to proper procedures. My biggest gripe is that I couldn't get the flow rates because my analysis would look so more appealing on maps if I could show the rivers with the highest flows, where they peak, and where they drain into. I believe I still did a lot of analysis for this watershed and the only thing I really wish I could calculate is the flow rates, but I could analyze the vast amounts of USGS data for specific dates to gather flow rates for specific parts of any river in Oregon. I could

use this to find peak flow rates in the Willamette River even though no GIS data was available on their site.

# References


- **How to Clip Rasters to Polygon Boundaries in ArcGIS. (2018, February 17). Retrieved from https://gisgeography.com/clip-rasters-arcgis-polygon-boundary/**
- **Oregon Geospatial Enterprise Office. (n.d.). Retrieved from https://www.oregon.gov/geo/Pages/projections.aspx**
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