



WATERSHED ANALYSIS NEAR MONMOUTH, OREGON

A Recreation of CE 413 Labs 2, and 4

[Abstract](#)

Parts of labs 2 and 4 are recreated with a 30m DEM and NHD data near Monmouth, Oregon. Streams are defined, watersheds delineated, and a network created.

[Webpage](#)

[Map1](#)

[Map2](#)

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Introduction

This project assimilates the goals, techniques and outcomes of labs 2 and 4 from CE 413, Winter 2019 term. The aim of this exercise was to explore the tools available to ArcGIS users for creating watersheds and stream networks. The location was chosen because it overlapped with the author's capstone project location. Tools such as watershed delineation and stream network was of special interest to the author, because her capstone responsibilities include understanding the runoff and watershed conditions of this location.

Site Description

Five HUC 12 watersheds were selected based on their proximity to the author's capstone project location, the intersection of Clow Corner Road and OR99W (see Figure 1). The analysis point (denoted by the red pushpin), is where the Willamette River leaves this area.

The entire area is approximately 85,960 acres. The land cover is a mixture of fallow, grass, and shrub. The topography can be described as flat (see Figure 3 and Figure 3).

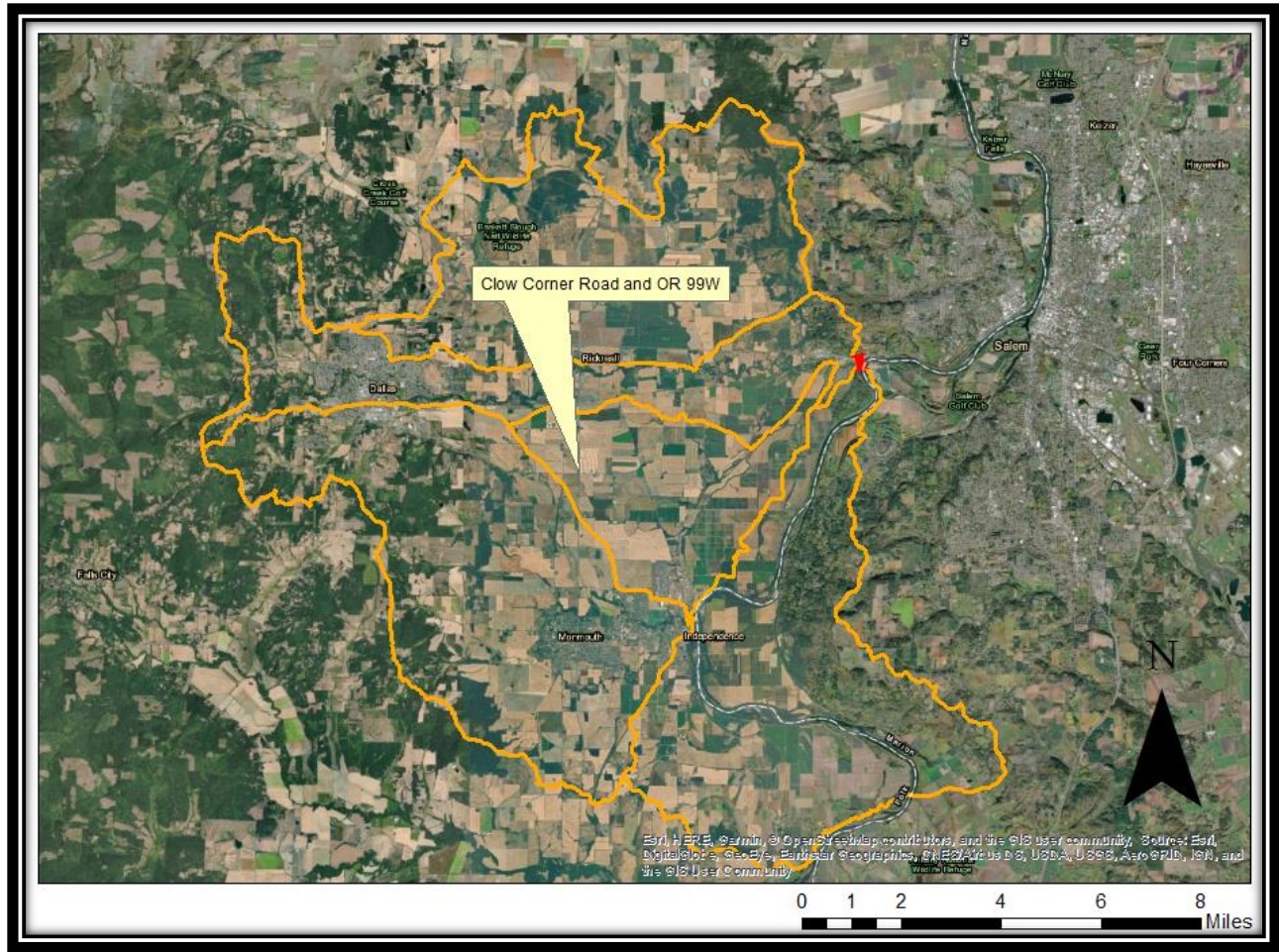


Figure 1. Capstone project location and Outlet location.

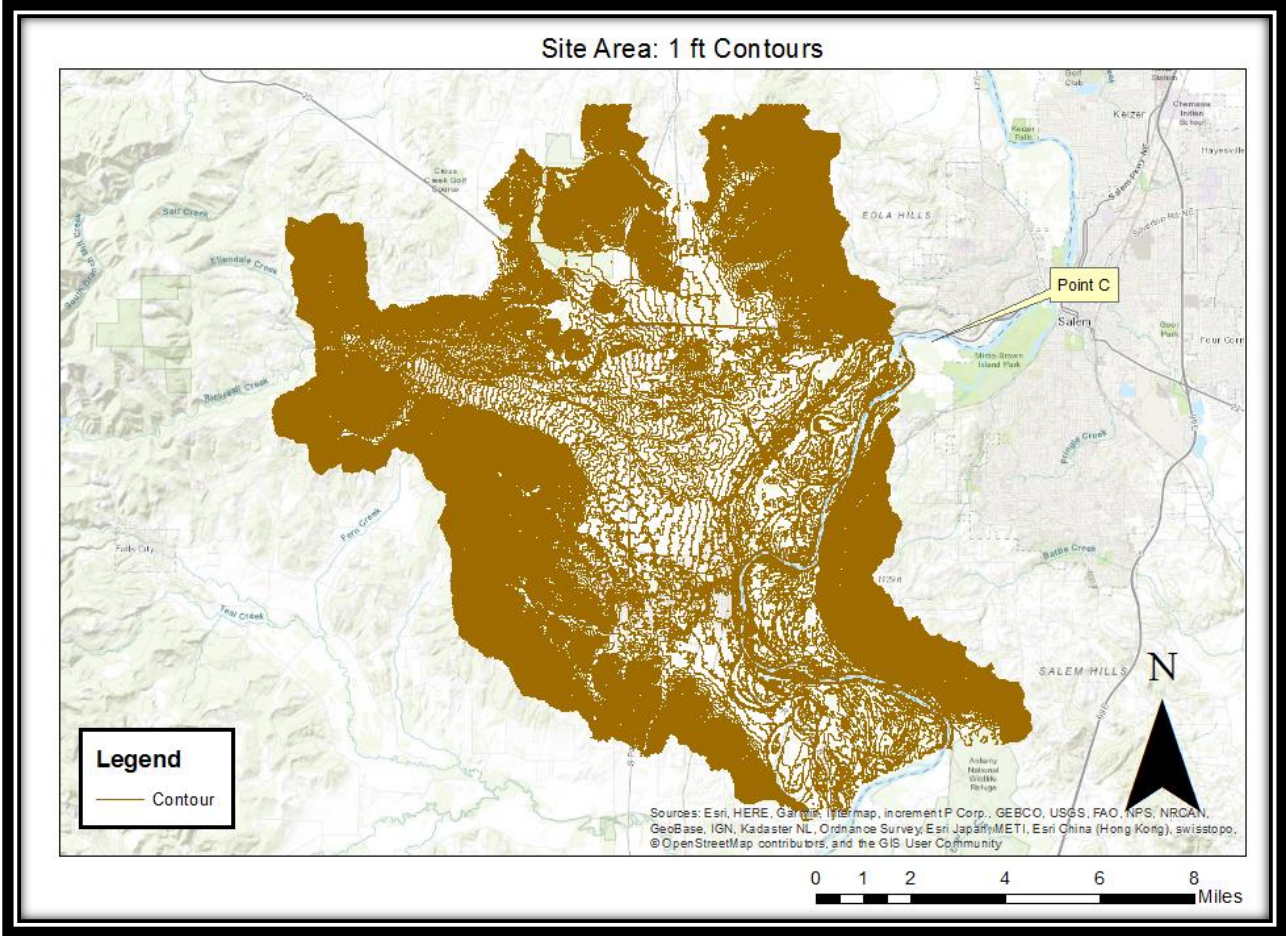


Figure 2. 1-ft contours showing site topography.

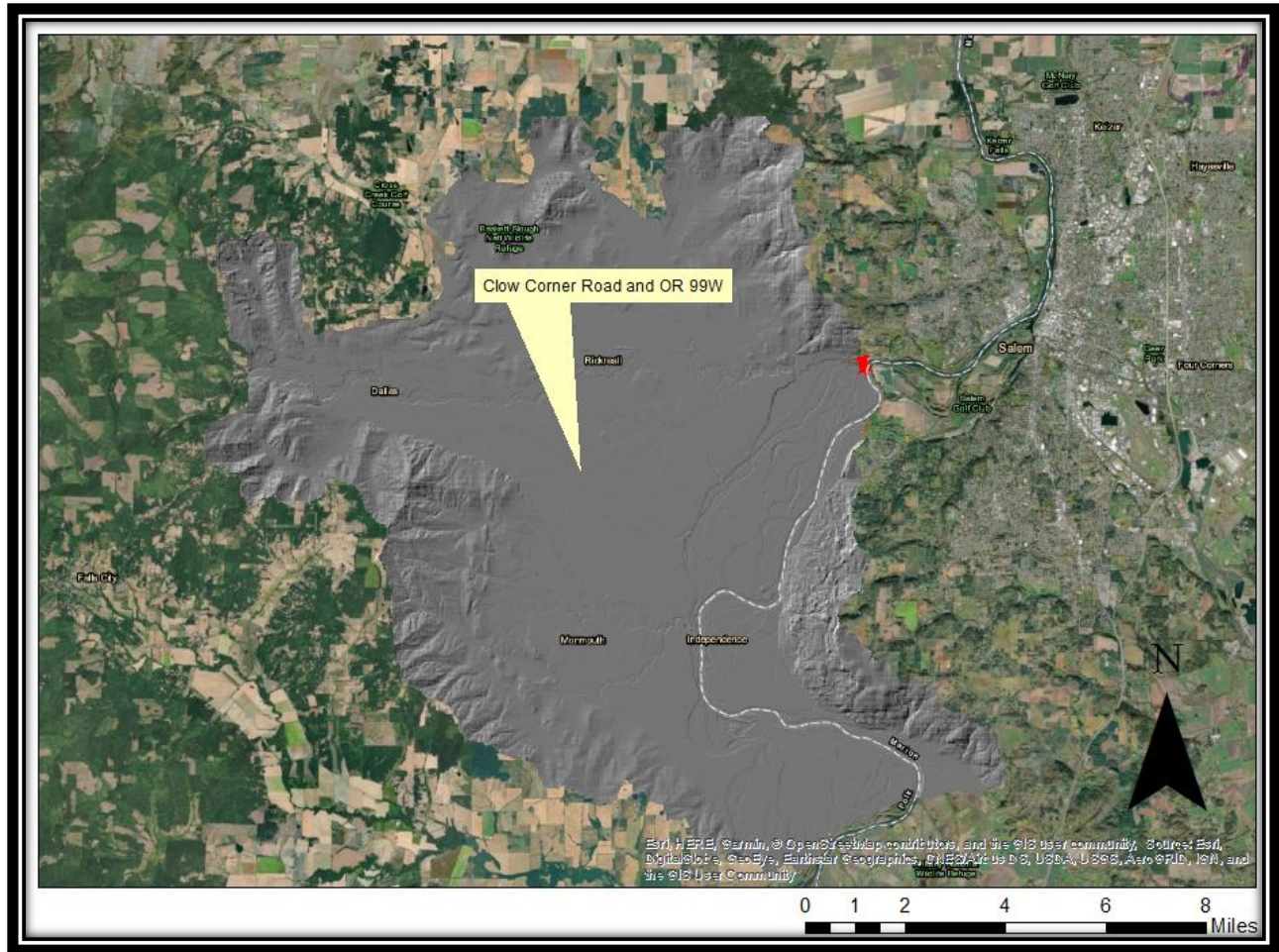


Figure 3. Hillshade depicting relief of area of interest.

Data

Several sources of data were used. The DEM raster is 30m cell size, obtained from the National Map [1]. NHD vector data were also obtained from the National Map, including flow lines, attribute tables, and watershed boundaries. USGS stream gage data was added to the map, but were not used as no gages were within the boundaries of this area.

GIS Methods

Table 1 and Figure 4 show very broad, generalized categories of GIS tools used.

Table 1. GIS Methods used.

Method	Lab Reference	Purpose
Adding attributes to flowlines	2	To be able to observe and symbolically depict mean annual flow.
DEM reconditioning	4	To fill sinks, depict flow direction and flow accumulation, to be able to define streams and watersheds, as well as HAND.
Creating a geometric network	4	To analyze any reach within the network for attributes such as contributing area, length, and more.
Create contours	5	Depict terrain in terms of topography.

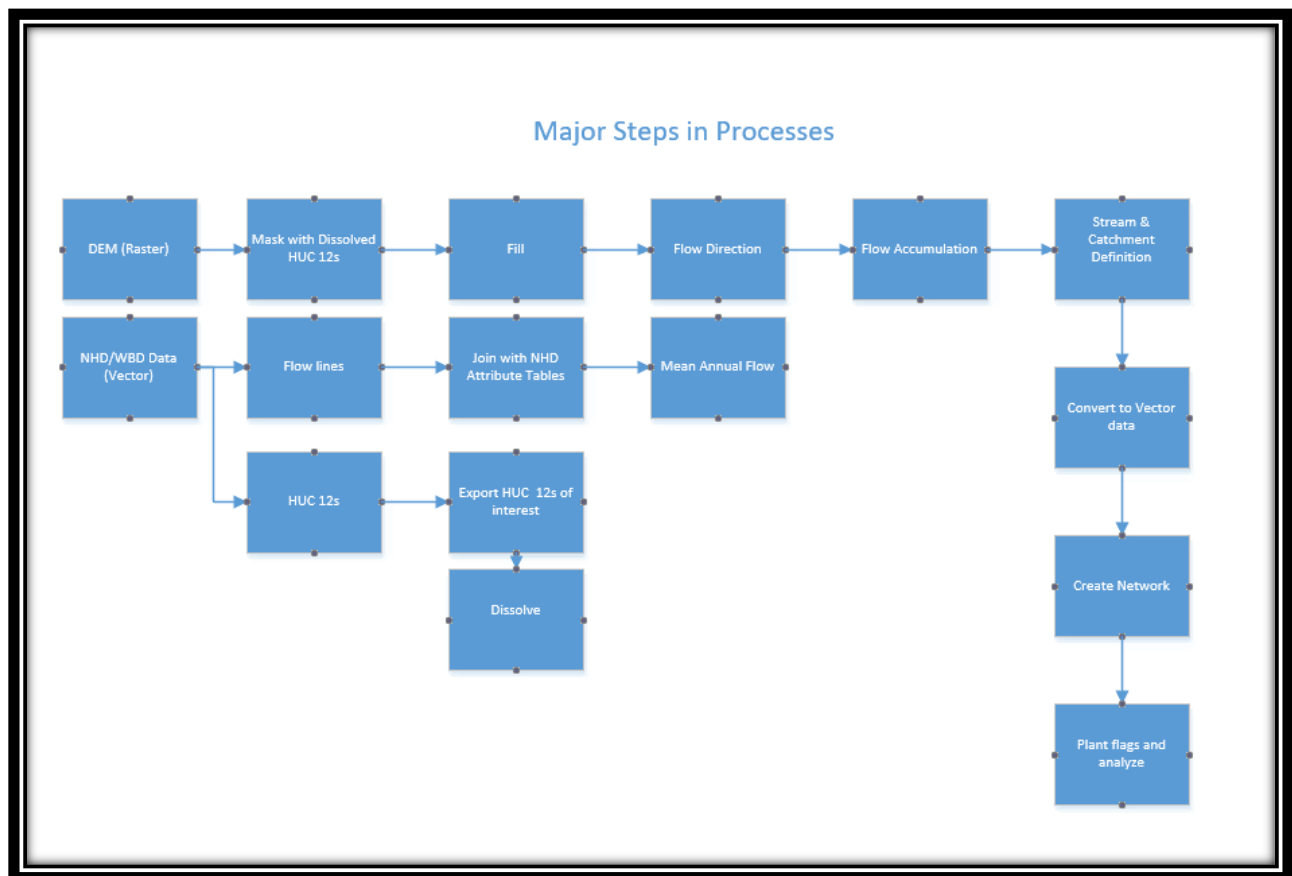


Figure 4. Flowchart showing generalized steps in the process.

Results

Most of the deliverables for this project are taken directly from labs 2 and 4.

The HUC12s

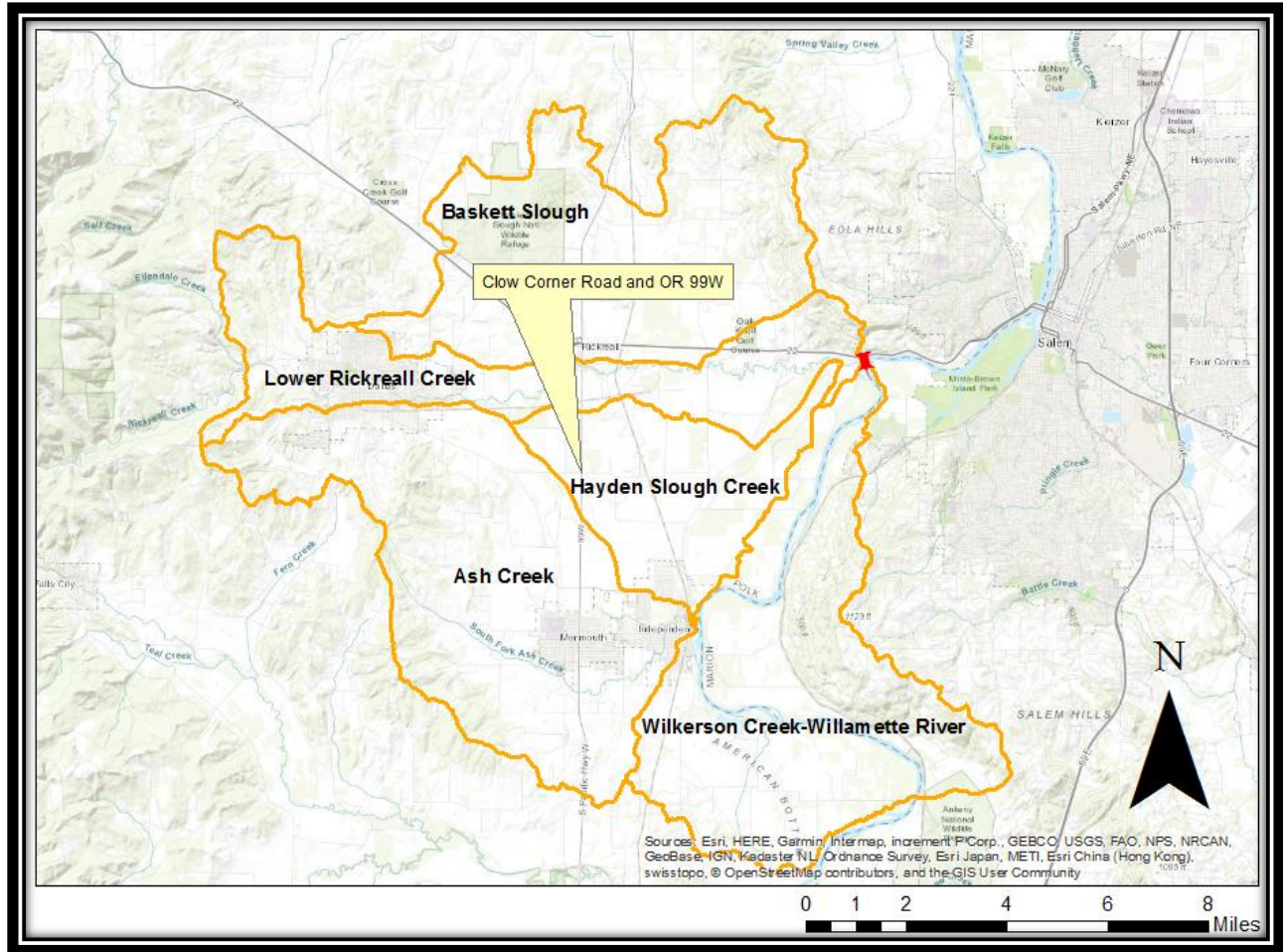


Figure 5. HUC 12s that were analyzed.

The four HUC 12s depicted in Figure 5 were chosen for analysis. These were obtained from the National Hydrography Dataset [2]. NHDPlus was not available for this location. The areas of these are outlined in Table 2, with the total area being 85,960 acres.

Table 2. Areas of HUC 12s.

HUC 12	Areas (acres)
Lower Rickreall Creek	12,692.77
Baskett Slough	19,527.05
Hayden Creek Slough	9,175.76
Ash Creek	23,115.83
Wilkerson Creek-Willamette River	21,446.80

Soil data was downloaded from SSURGO, but was not used in this analysis because most of the area had “no data available”.

The total length of flowlines is 532 km, or 1.745 million feet.

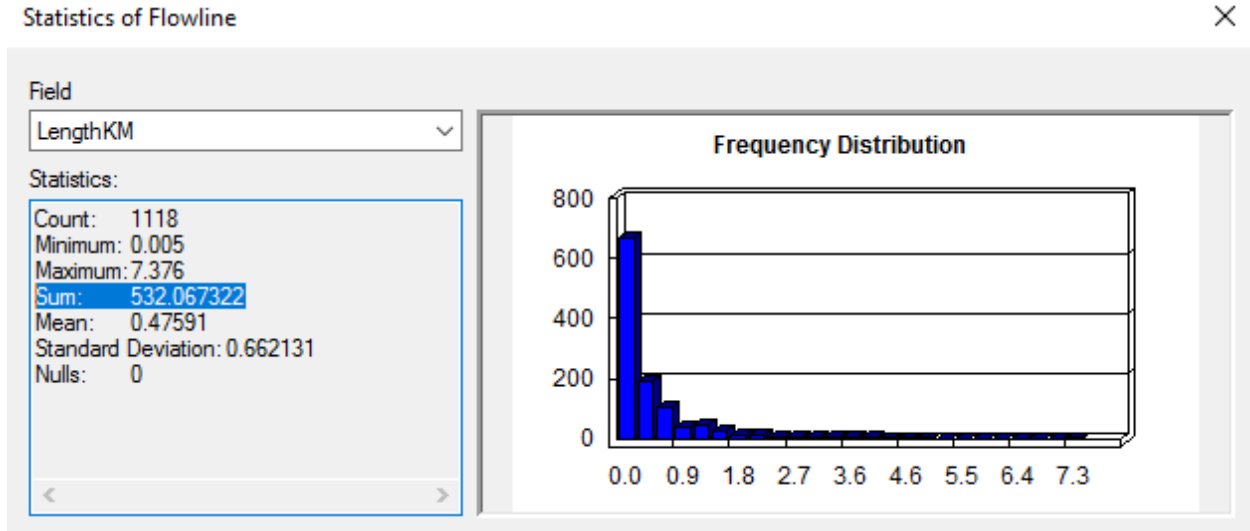


Figure 6. Total length in km of NHDFlowline shapefile.

The drainage density of these 5 HUC 12s together is

$$\frac{1.745 * 10^6 ft}{85,960 acres} * \frac{1 acre}{43,560 ft^2} = 0.000466 ft^{-1}$$

Adding Attributes to Flowlines

The unique identifier for this NHD dataset was a field called "Permanent_". A field called "MAF" was created in the Flowline attribute table, and was joined with PlusFlowlineVAA and EROM_MA0001 attribute tables. Field calculator was used to populate the MAF field with the Q0001E field of the EROM_MA0001 table. These edits were saved and the joins removed. Many reaches did not have Mean Annual Flow data available; Figure 7 shows the flowlines symbolized by mean annual flow (cfs).

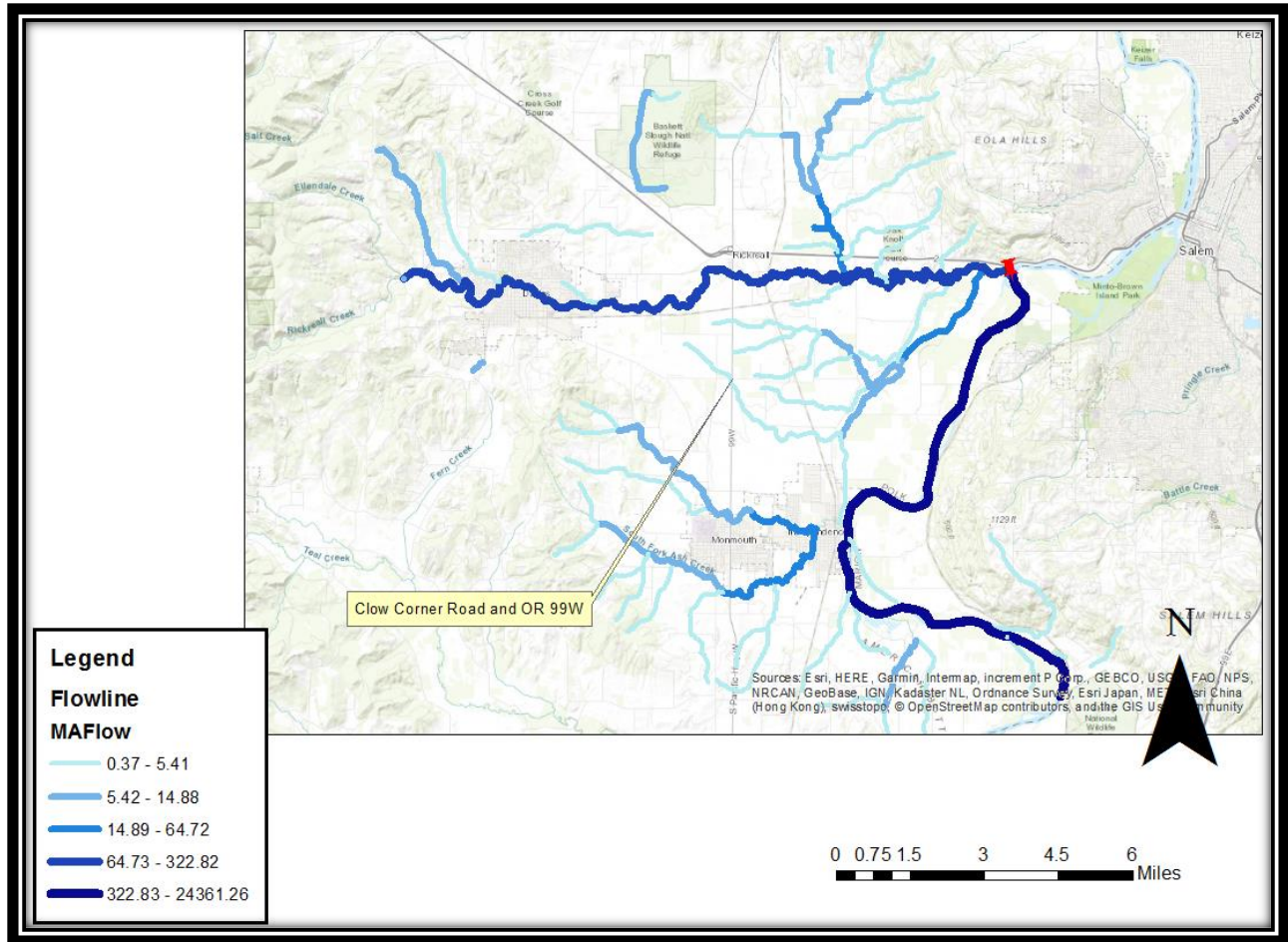


Figure 7. Reaches symbolized by mean annual flow (cfs)

Conditioning the DEM

The HUC 12s were dissolved into one outline, and the 30m DEM was taken and extracted by mask to this shape. The DEM was resampled using bilinear interpolation, and then the “Fill” tool was used. Following that, the flow direction and flow accumulation tools were used. Because of the low resolution of the DEM and the boundary location, the flow accumulation seemed to split apart where the Willamette River leaves the area. Thus, the flow accumulation was identified at each of these points. See Figure 8

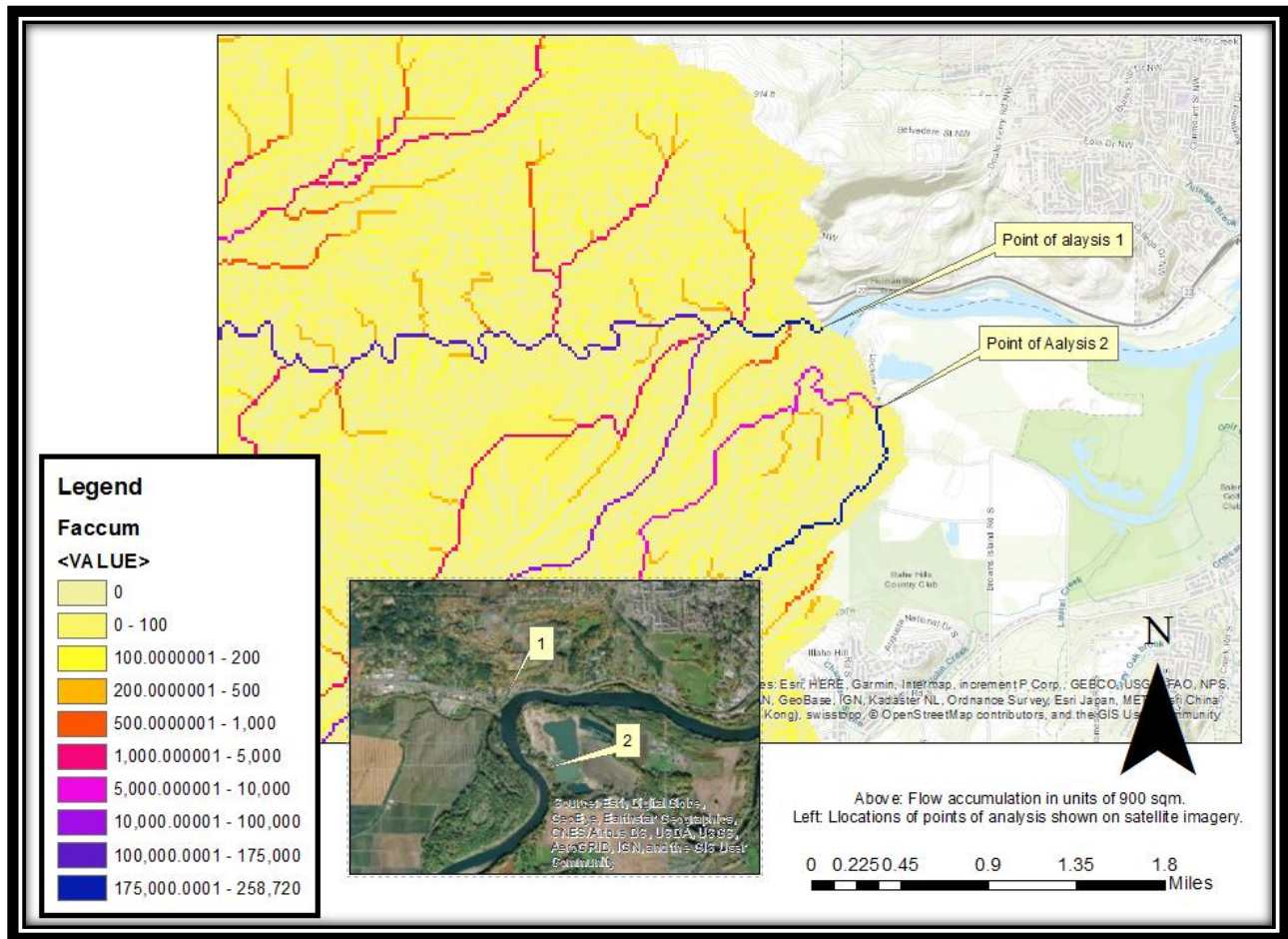


Figure 8. Flow accumulation in unites of 900 sqm

The drainage area at (1) is 224,717 - 30m cells, or 490,976 acres. The drainage area at (2) is 258,720 - 30m cells, or 57,578 acres. This sums to a total drainage area of 548,514 acres.

Creating the Network

ArchHydro tools were used to define streams (default of 1% used) and catchments. The catchments for this area are shown in Figure 9. The vector result of the stream links were categorized by Strahler Order and symbolized as shown in Figure 10. An outlet

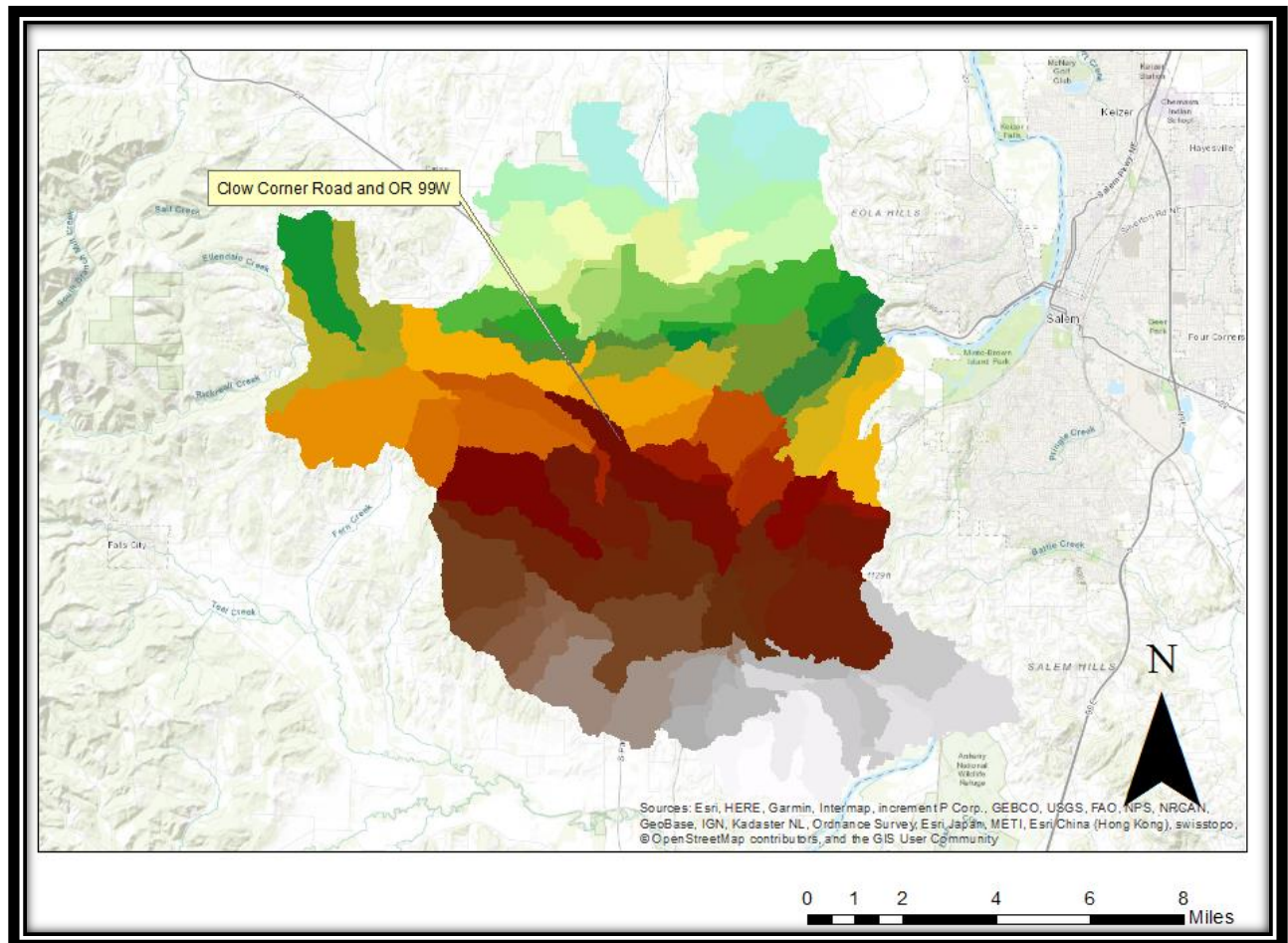


Figure 9. Catchments were delineated within the watershed.

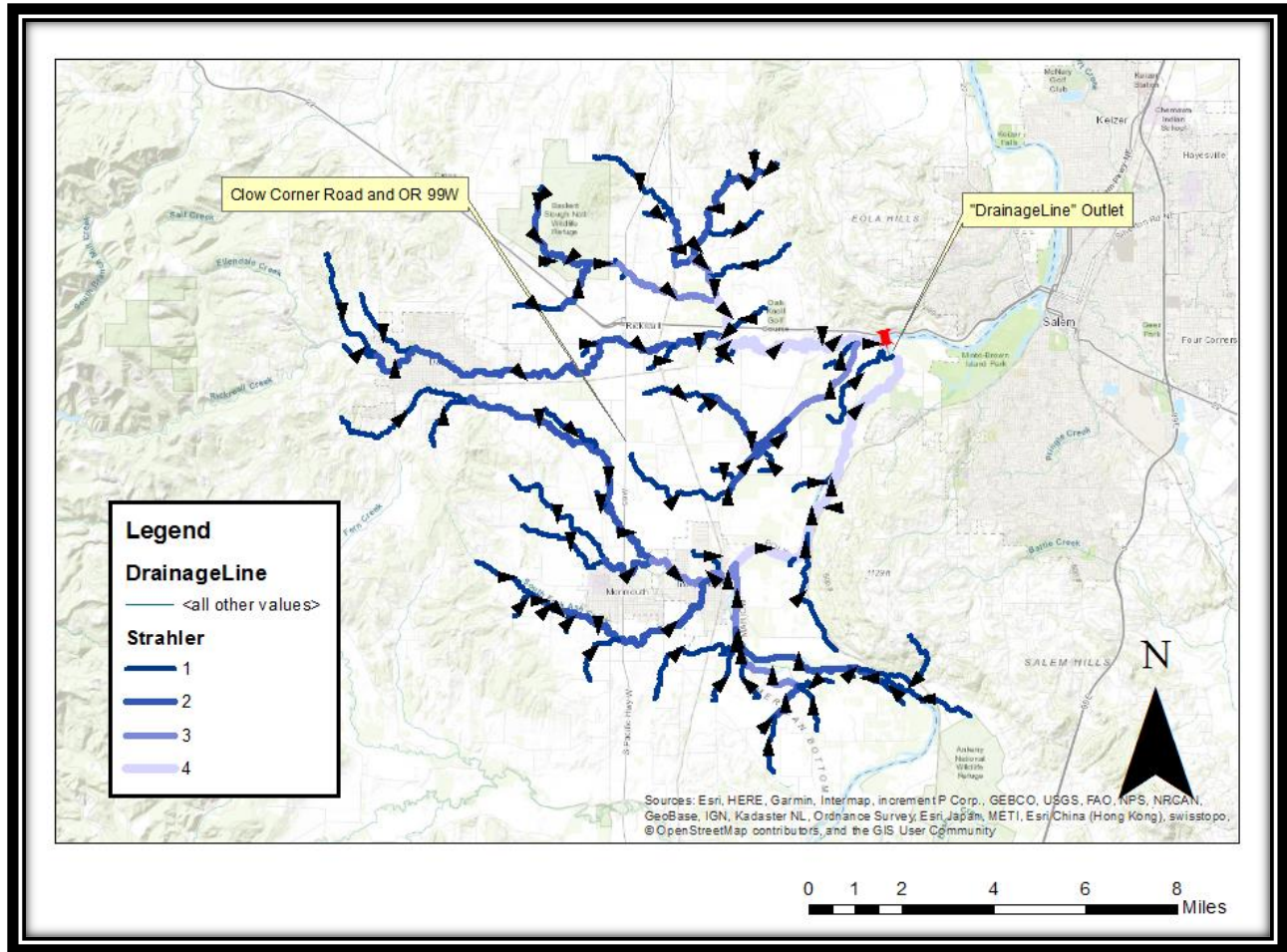


Figure 10. Network and flow direction for watershed. Classified by Strahler Order.

Three points were analyzed.

Point A: Just downstream of Clow Corner Road

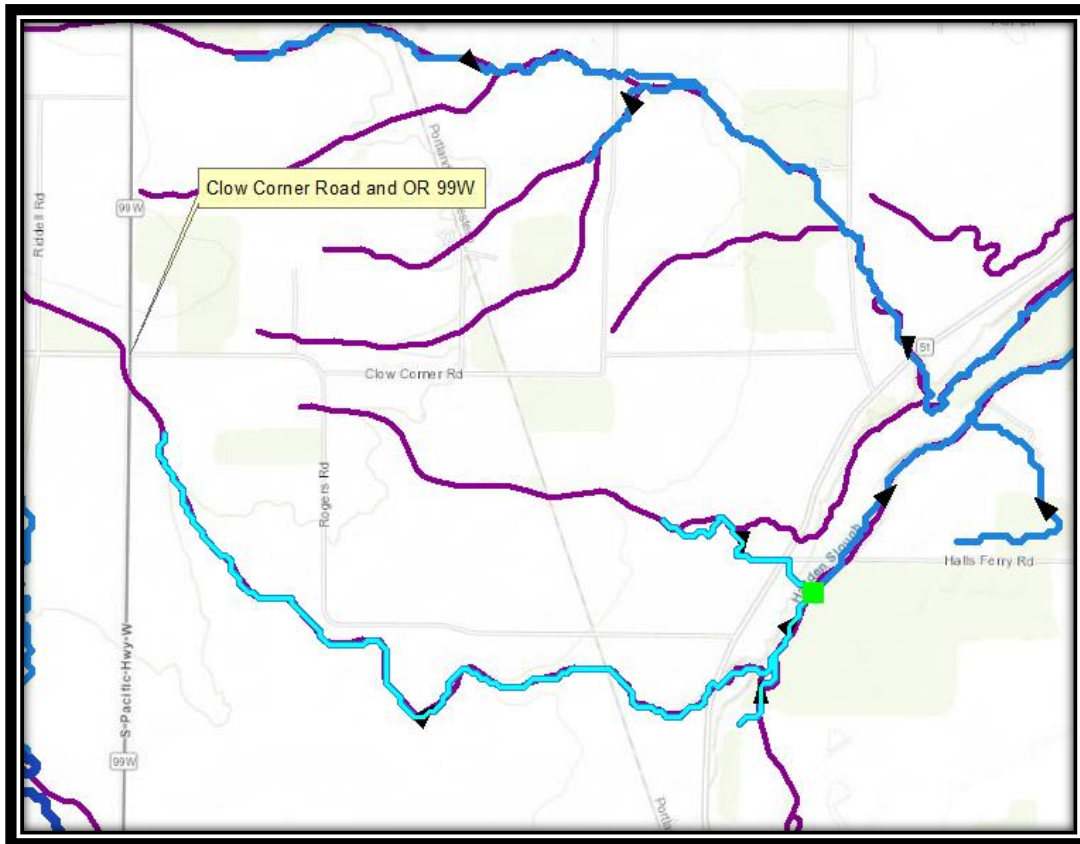


Figure 11. Point A. Just downstream of Clow Corner Road (traced upstream shown here). NHD flowlines depicted in purple.

DrainageLine										
	OBJECTID *	Shape *	arcid	grid_code	from_node	to_node	Shape_Length	Strahler	Enabled	
▶	60	Polyline	60	62	62	66	4305.401127	1	True	
	62	Polyline	62	64	67	66	1423.689826	2	True	
	64	Polyline	64	68	61	67	16994.660179	1	True	
	65	Polyline	65	67	70	67	1689.88398	1	True	

Figure 12. Attributes for A.

The number of upstream links is **4**. The total length of upstream links is **24,413.6 feet**. The number of downstream links to outlet is **5**. The total length of downstream links is **27,680 feet**.

Point B: Watershed outlet

Point B corresponds to Analysis Point 1 from the flow accumulation analysis.

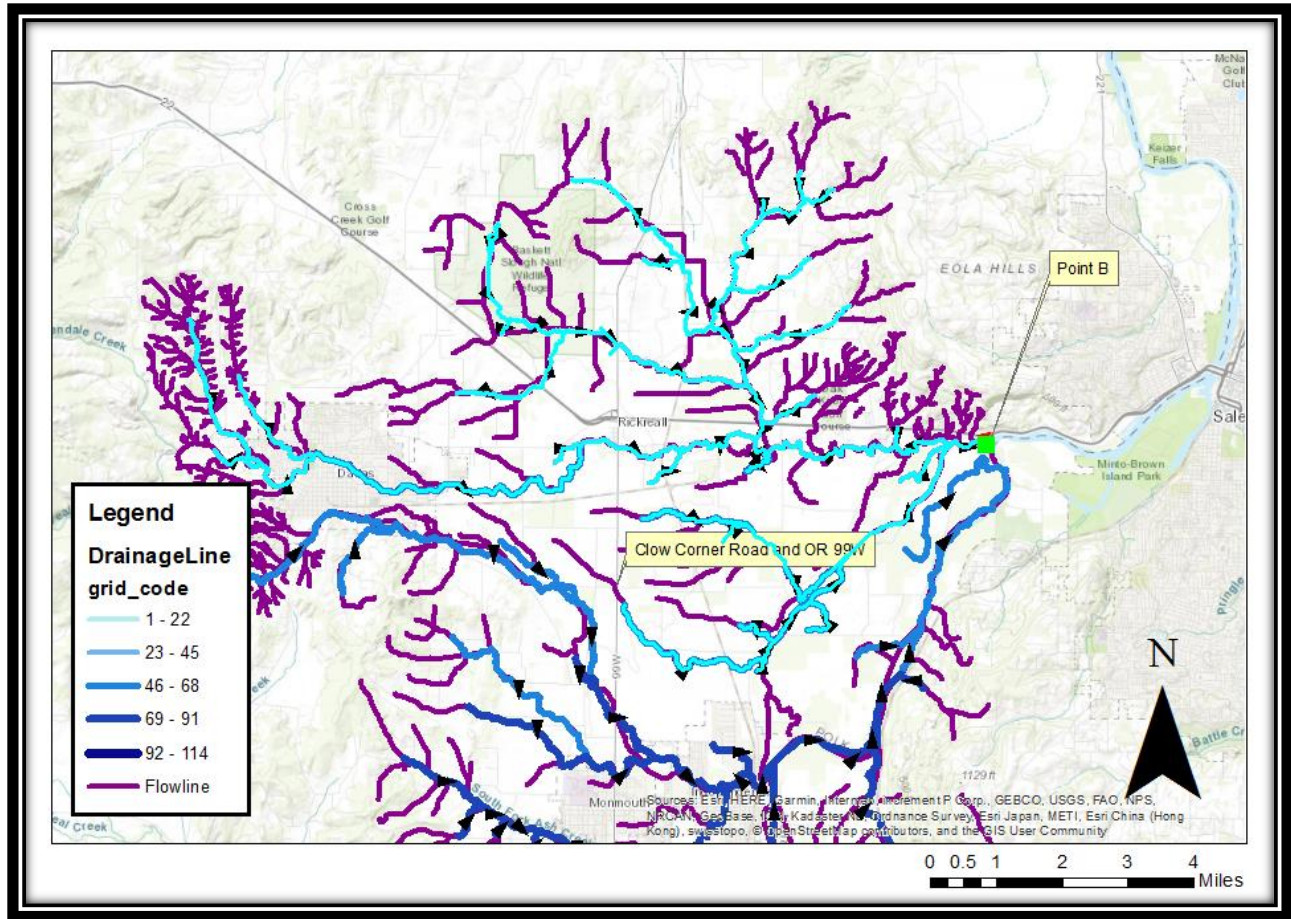


Figure 13. Point B (traced upstream).

The number of upstream links is **57**. The total length of upstream links is **363,842.8 feet**.

Point C: the *Other Watershed Outlet*

Point C corresponds to Analysis Point 2 from the flow accumulation analysis.

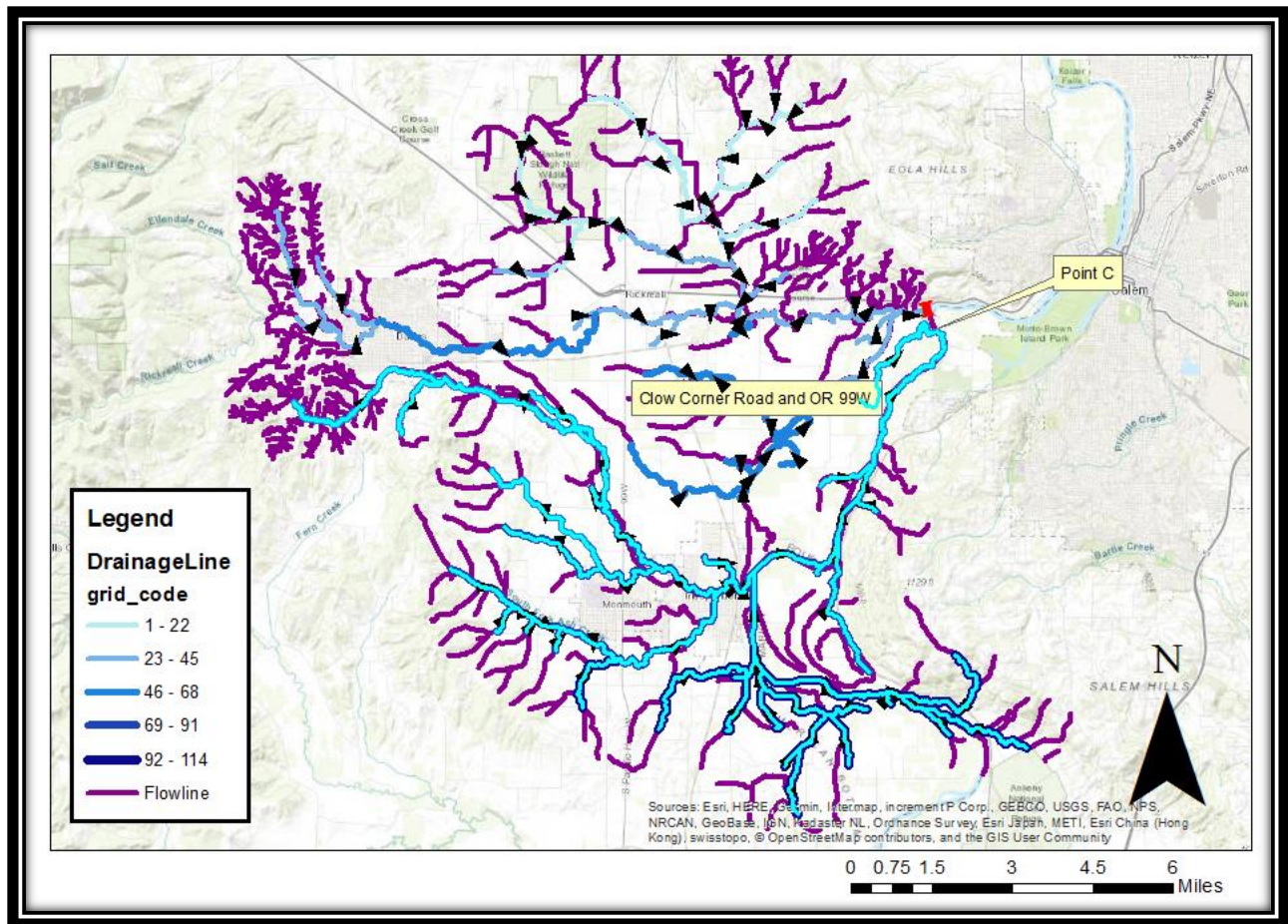


Figure 14. Point C (traced upstream).

The number of upstream links is **56**. The total length of upstream links is **420,178 feet**.

Discussion

If the resolution were better, or if I had chosen to include the HUC 12 this outlet, I may have not had the split outlet. More could have been done to study this area. I believe that I will run a HAND analysis on this area at a future date, for my capstone project. The most significant recommendation I could make to someone wanting to analyze this area would be to obtain complete soil data (SSURGO data was mostly null), a higher resolution DEM, and to expand the HUC 12s.

Appendix

References

- [1] United States Geological Survey, "The National Map Downloader," United States Geological Survey, 2019.
- [2] United State Geological Survey, "Watershed Boundary Dataset," United State Geological Survey, 2019.
- [3] T. Arras, "CE 413 Lab 2," Oregon State University, Corvallis, OR, 2019.
- [4] T. Arras, "CE 413 Lab 4," Oregon State University, Corvallis, OR, 2019.