http://web.engr.oregonstate.edu/~yukselm/MY_Final/MY_Project_paper.pdf

STREAMFLOW IN WILLAMETTE RIVER AND WATERSHED ANALYSIS IN CORVALLIS

By

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Geographical Information System in Water Resources

CE_543

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Reference: Google Earth

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Introduction

This project is the project assignment of CE513, that is, geographic information systems in water resources course. In this project assignment, the subject of which is determined by everyone, we applied the techniques we learned in the ArcGIS Pro program during the winter term on the subject we determined. This document is the final report and will be published on the engineering website.

Problem Statement and Aim Of The Project

The aim of this project is to process the seasonal flow values of the Willamette River, which is of great importance for the state of Oregon, in ArcGIS Pro computer program and then graph the flow data of the streams surrounding the city of Corvallis. This project could provide a basis for those who want to study detailed drought or flow data on Corvallis in the future.

Site Description

In order to better grasp the mentioned location, the location is explained more clearly, first verbally and then with a photo taken from Google Earth. Corvallis is the center city of Bent, Oregon. Its vertical distance to the Pacific Ocean is approximately 65 kilometers. In addition, the coordinate data taken from Google Earth is as follows. 44 34 08 N and 123 15 48 W. The area of the studied area is 60 square kilometers.

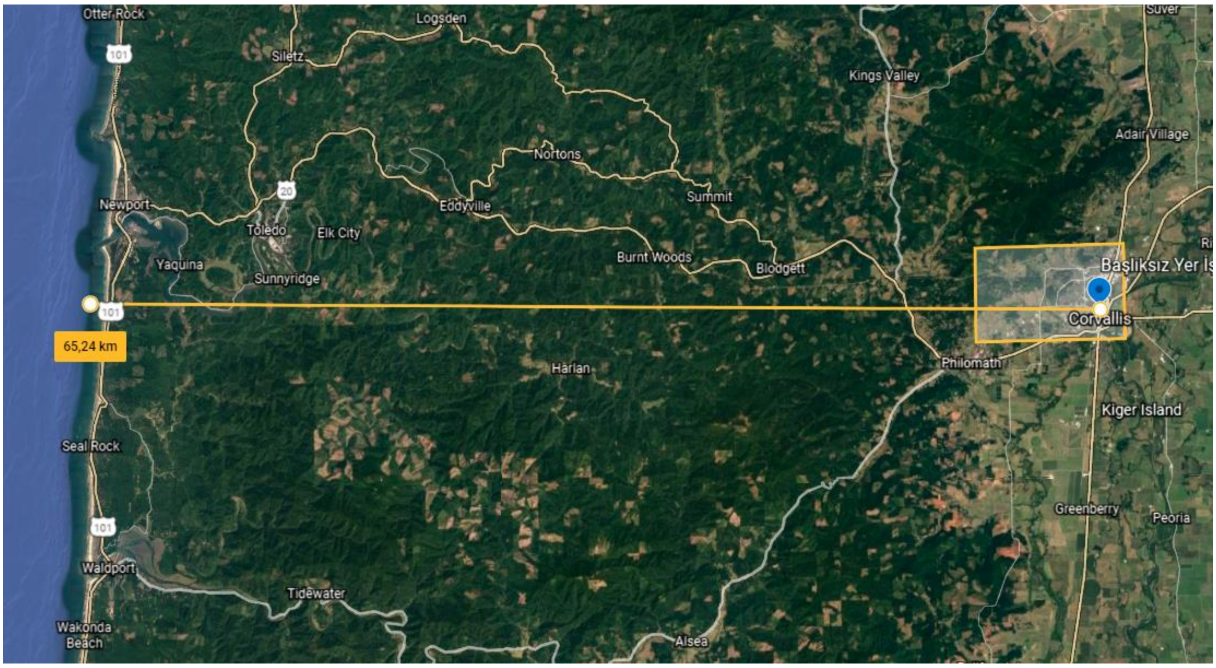


Figure 1: Distance Between Corvallis and Pacific Ocean References: Google Earth

Climate Data Of Corvallis

Summer High: the July high is around 82 degrees

Winter low: the January low is 34

Rain: averages: 51 inches of rain a year

Snow: averages 5 inches of snow a year

Climate Averages

	Corvallis, Oregon	United States
Rainfall	51.4 in.	38.1 in.
Snowfall	5.4 in.	27.8 in.
Precipitation	161.8 days	106.2 days
Sunny	159 days	205 days
Avg. July High	81.6°	85.8°
Avg. Jan. Low	34.1°	21.7°
Comfort Index (higher=better)	7.3	7
UV Index	3.1	4.3
Elevation	226 ft.	2443 ft.

Table 1 : Climate Data of Corvallis

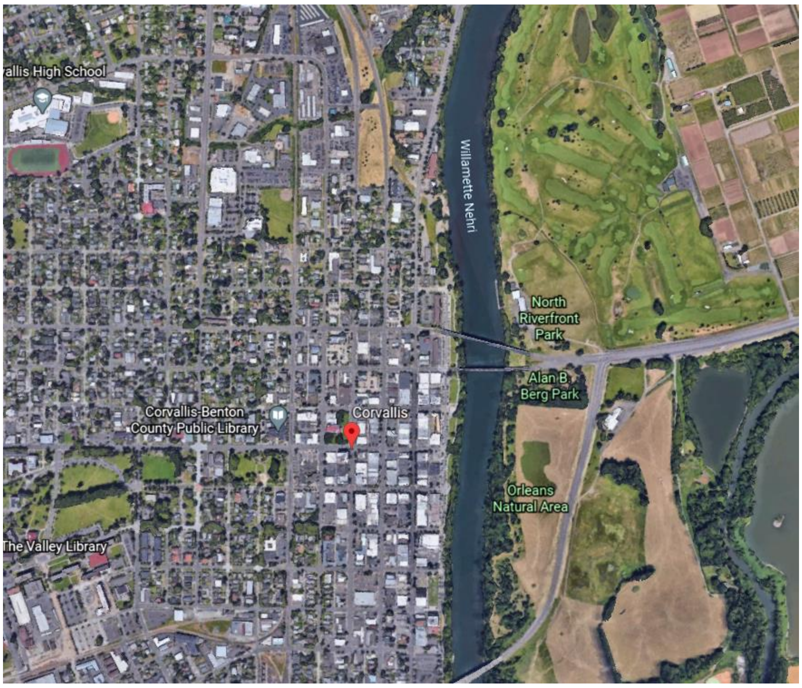


Figure2: The Willamette River (Corvallis) Source: Google Earth

The figure two demonstrates that Willamette River and a little part of Corvallis. This photo has been downloaded by Google Earth.

Figure 3:Corvallis Source: Google Earth

Data sources

At the head of the data required for this project is the streamflow data downloaded from the USGS website. From this site, I have gotten the seasonal flow data of the river and the coordinate data of the measurement center. Therefore, LongDD and LatDD values are calculated thanks to these coordinate data. The facility is successfully added to the map. Later, the DEM dataset and NHDPlus dataset required for ArcGIS Pro have been downloaded from the site named (TNM Download V2), which is also USGS linked. The links of these sites are detailed in the reference section.

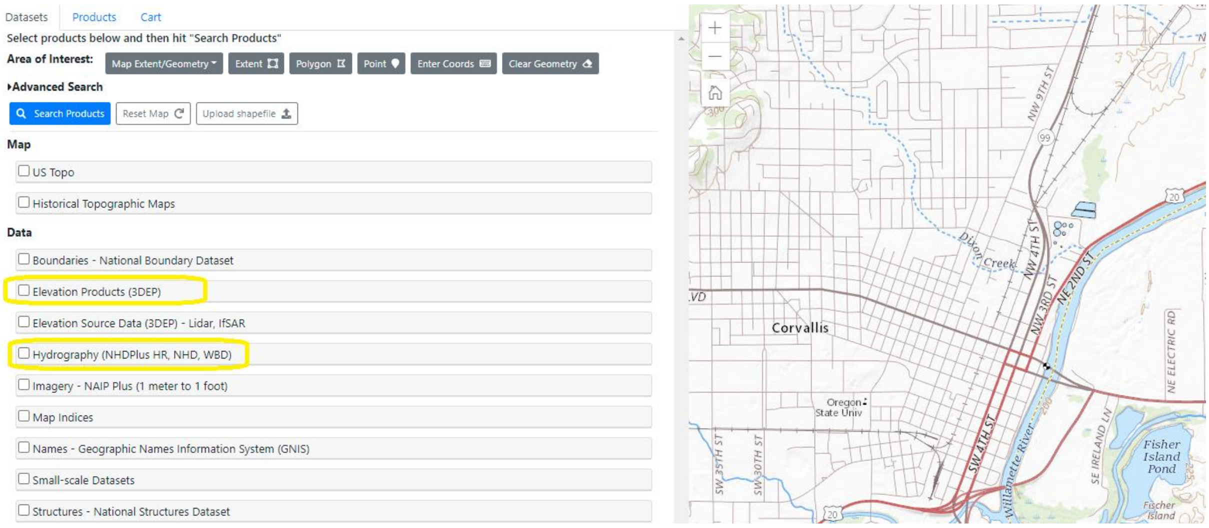


Photo 1 : DEM and NHD Plus Data

YEAR	00060, Discharge, cubic feet per second, Monthly mean in ft3/s (Calculation Period: 2019-01-01 -> 2020-01-31) Period-of-record for statistical calculation restricted by user											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019	13,910	13,860	13,340	35,000	9,983	7,837	4,745	5,284	5,733	5,956	4,856	6,437
2020	23,700											
Mean of monthly Discharge	18,800	13,900	13,300	35,000	9,980	7,840	4,740	5,280	5,730	5,960	4,860	6,440

** No Incomplete data have been used for statistical calculation

Photo 2: Discharge data of Corvallis(2019)

GIS Methods

In this project, the GIS techniques that we learned this term were used completely. The source map is UTM 10 n selected. To explain briefly, it started with downloading the DEM map and this DEM data was cut using the "clip" tool according to the area to be analyzed, then the DEM map was updated using the "fill" tool first. Later, one of the most important tools, "Flow Direction" was used. Spitial Analyst Tool> Hydrology> Flow direction. It is one of the most important tools to see the hydrological properties of a surface (1). Thanks to this tool, we determine the flow direction in each cell. Next, we switched to the Flow Accumulation tool. Spitial Analyst Tool> Hydrology> Flow Accumulation. With this tool, the flow from other cells to the cells is calculated. The transition of each neighboring cell to each other is calculated (2). Performs a conditional if/else evaluation on each of the input cells of an input raster (3). Then we pass stream ordering. With the stream ordering, we can assign a queue to each link in a streaming network we have. Next, we move on to the basin tool. Spatial Analyst Tools> Hydrology> Basin. Thanks to this tool, we create a raster and in this raster all drainage basins are defined (4). One other tool is Contour. Thanks to this feature, lines are created according to the height data and the height values we choose, and the height is displayed step by step (5). Next is Hillshade. This process creates a map by shading the altitude data in gray tones. This map gives an embossed look (6). Another main tool is "slope". Using "slope", the slope or perpendicularity in each cell is calculated (7). If we examine the model table, we can see most of the important step.

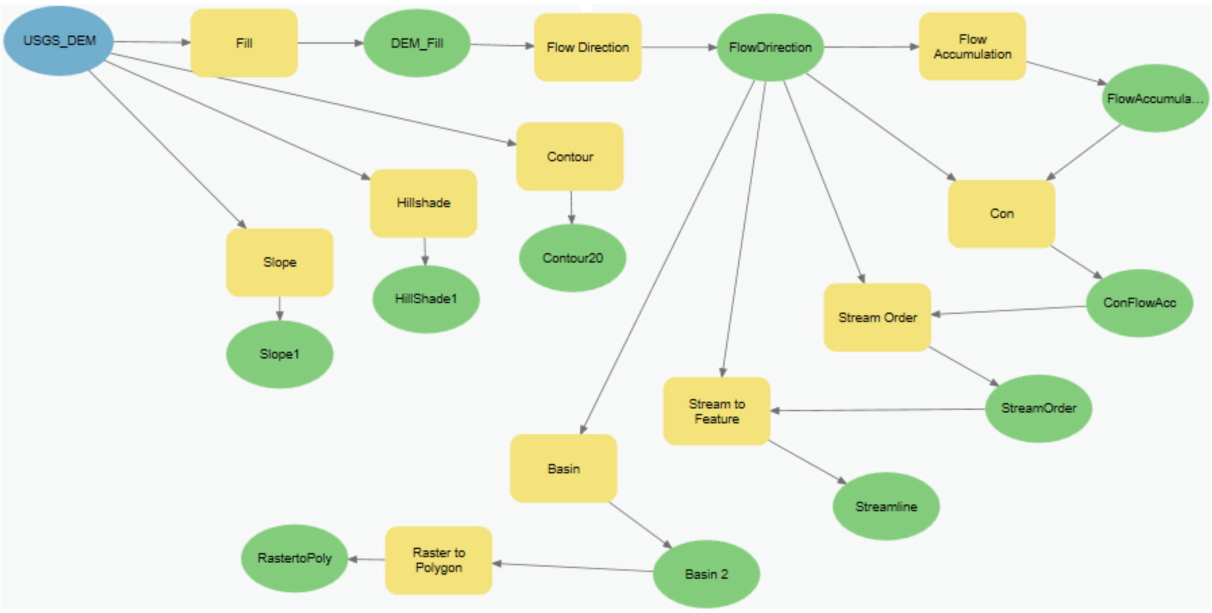


Figure 4: Arc GIS Pro Model

Fundamental Data and Maps

Here, we will examine the fundamental data map.

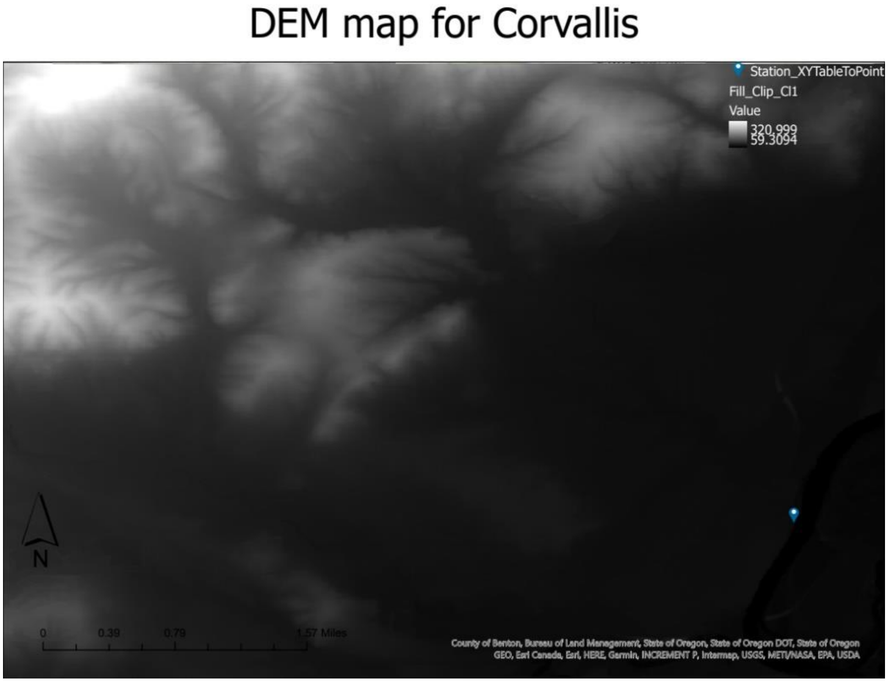


Figure 5: Clipped DEM Source: USGS TNM Download v2

Normally, DEM map is so huge. However, we clipped this DEM. Because, We need to only project area. On the other hand, this area is bigger than Corvallis basin. However, Corvallis is pretty flat city. Therefore, we clipped a little bigger area. Because, we can create maps which have different elevations.

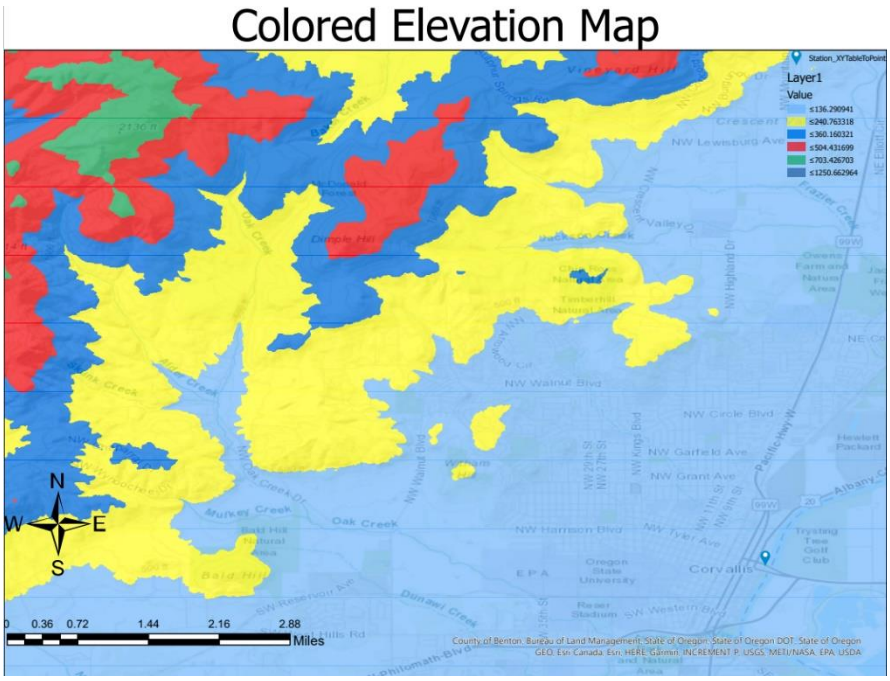


Figure 6: Colored Elevation Map

This map has been divided five different elevation values. And all of these colors represent a color range. Also when we look the legend area which is the upper right corner, we could see that these values.

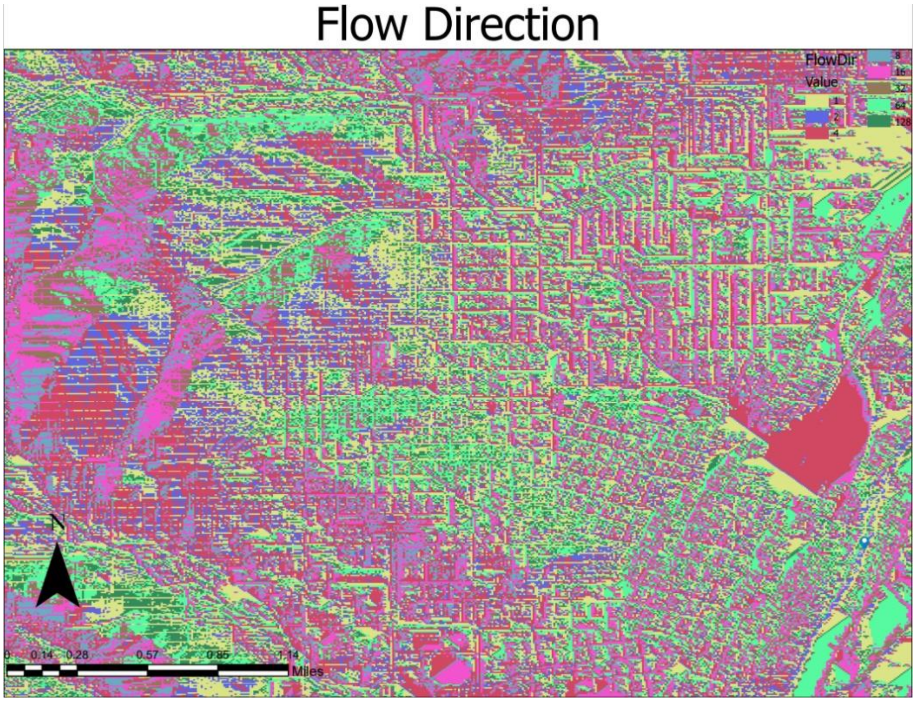


Figure 7: Flow Direction

Flow Direction map illustrates that the flow direction in each cell.

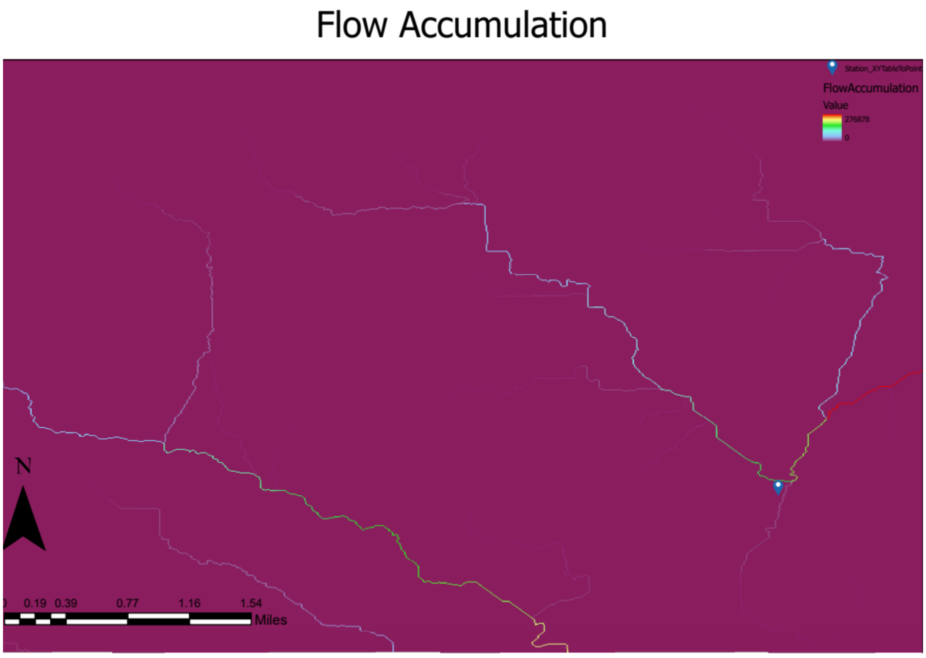


Figure 8: Flow Accumulation

That figure shows the flow from other cells to the cells is calculated. The transition of each neighboring cell to each other is calculated.

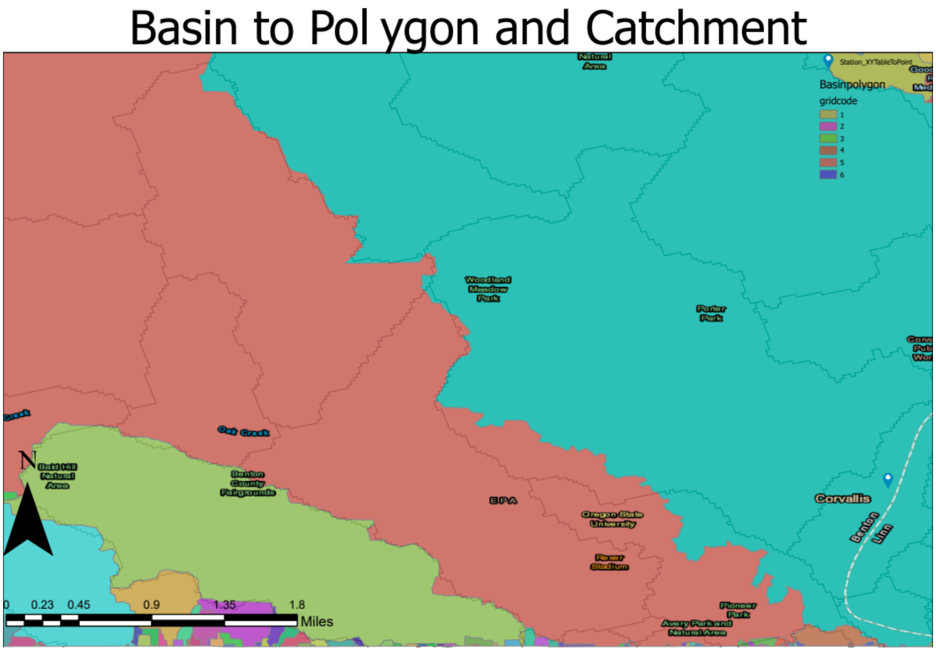


Figure 9: Raster to Polygon

Basins are being seen on the figure nine.

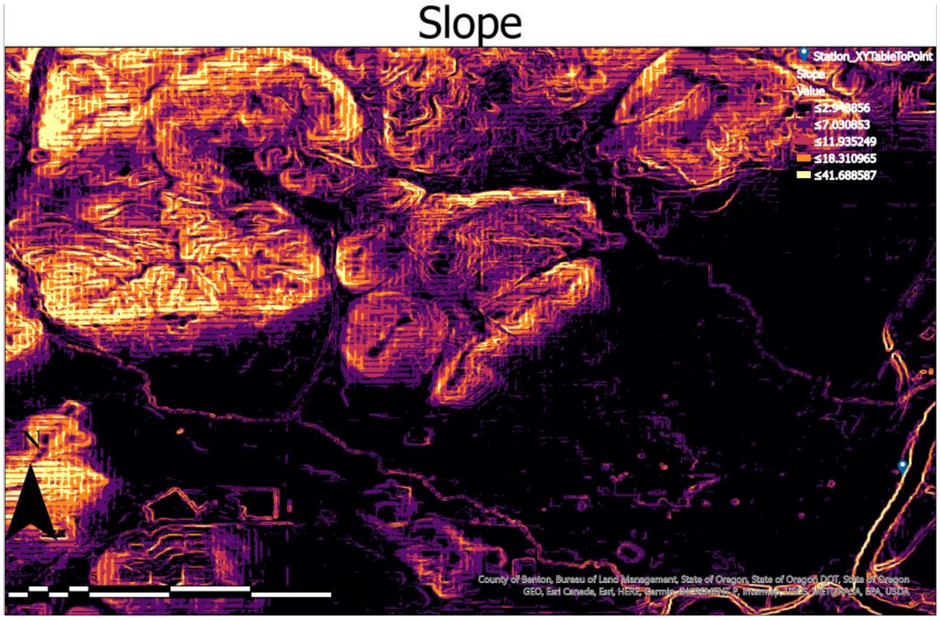


Figure 10: Slope Map

The slope or perpendicularity in each cell is calculated. Figure ten demonstrates that the map which after this calculation.

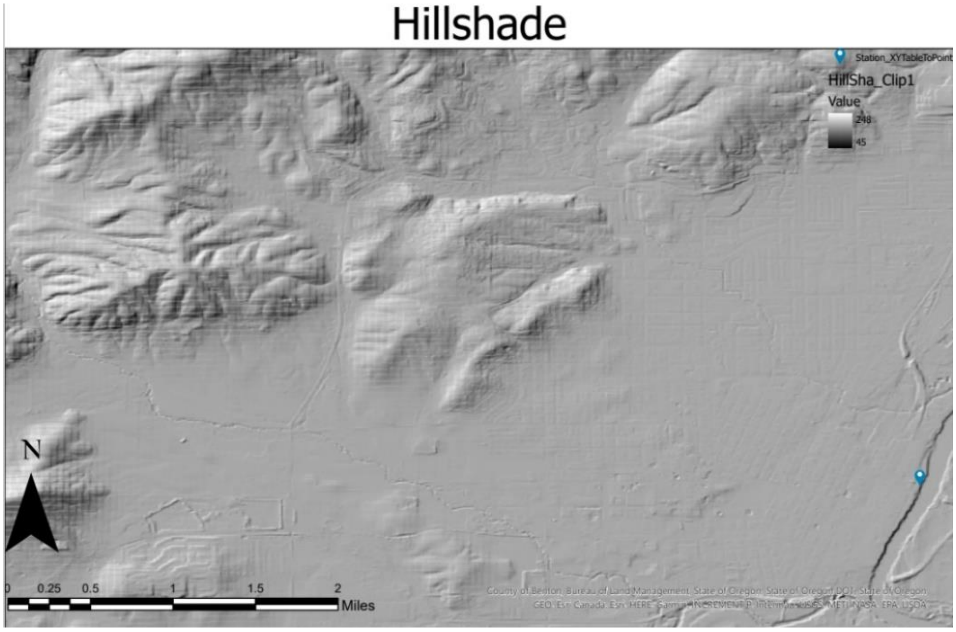


Figure 11: Hill shade Map

This process creates a map by shading the altitude data in gray tones. This map gives an embossed look. This map will occur the fundamental map of this project. We will use this map on the project as a background map.

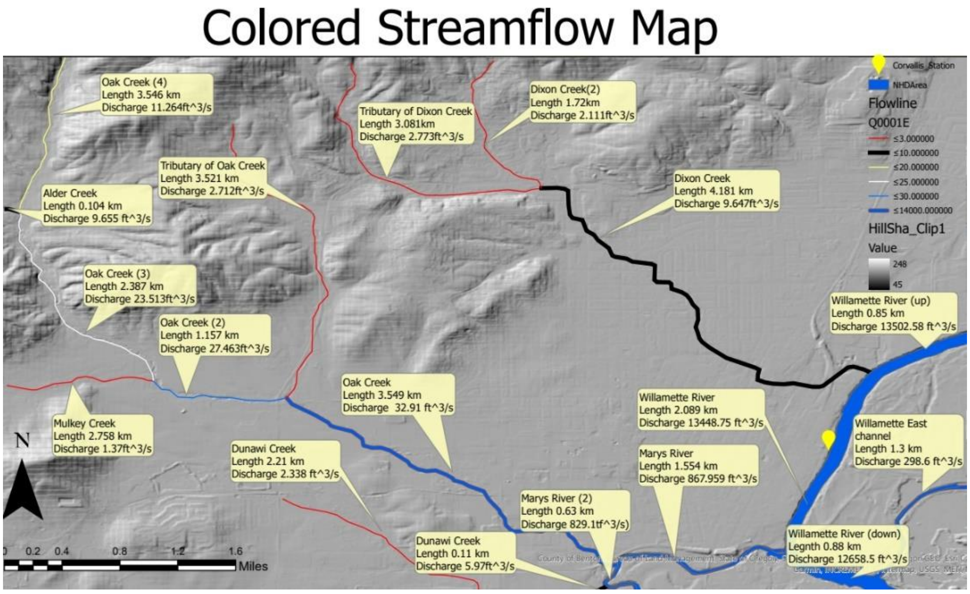
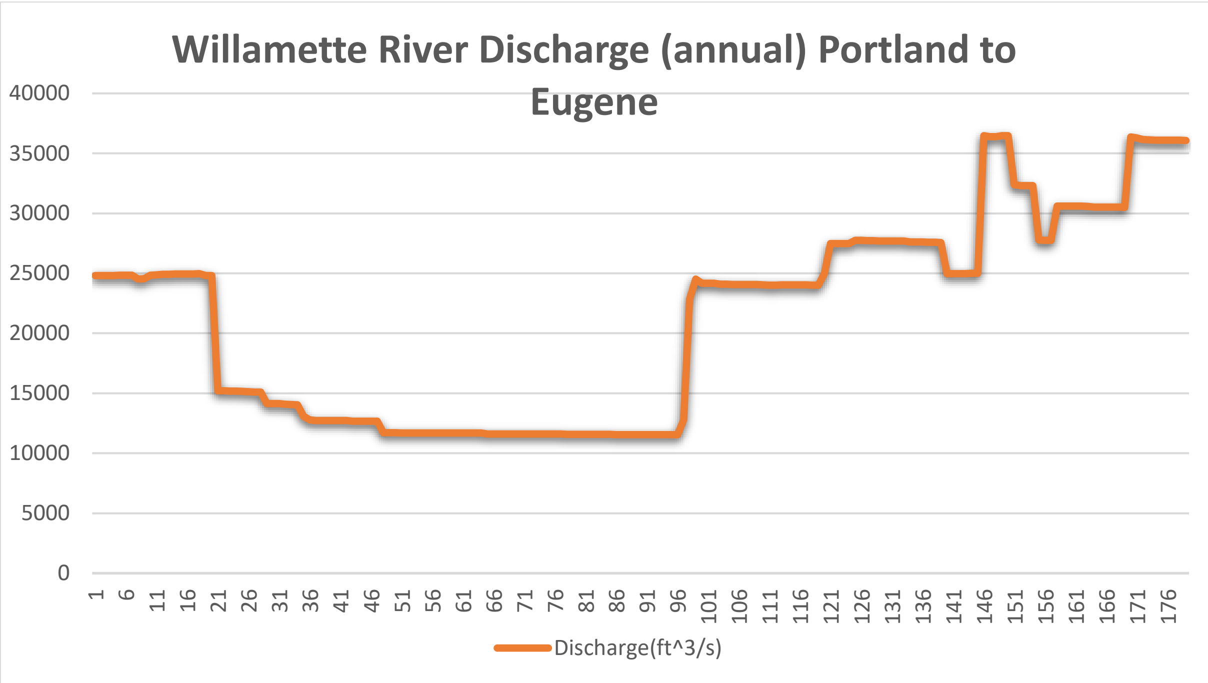


Figure 12: Colored Streamflow map

This map is the result map of this project. Because, both Willamette River discharges and other creeks discharges are being showed in this map. If we examine the map, we can see that discharges, lengths and names of all creeks and rivers. These data have been classified about annual stream flow. But seasonal discharges of Willamette River will illustrate on the chart.

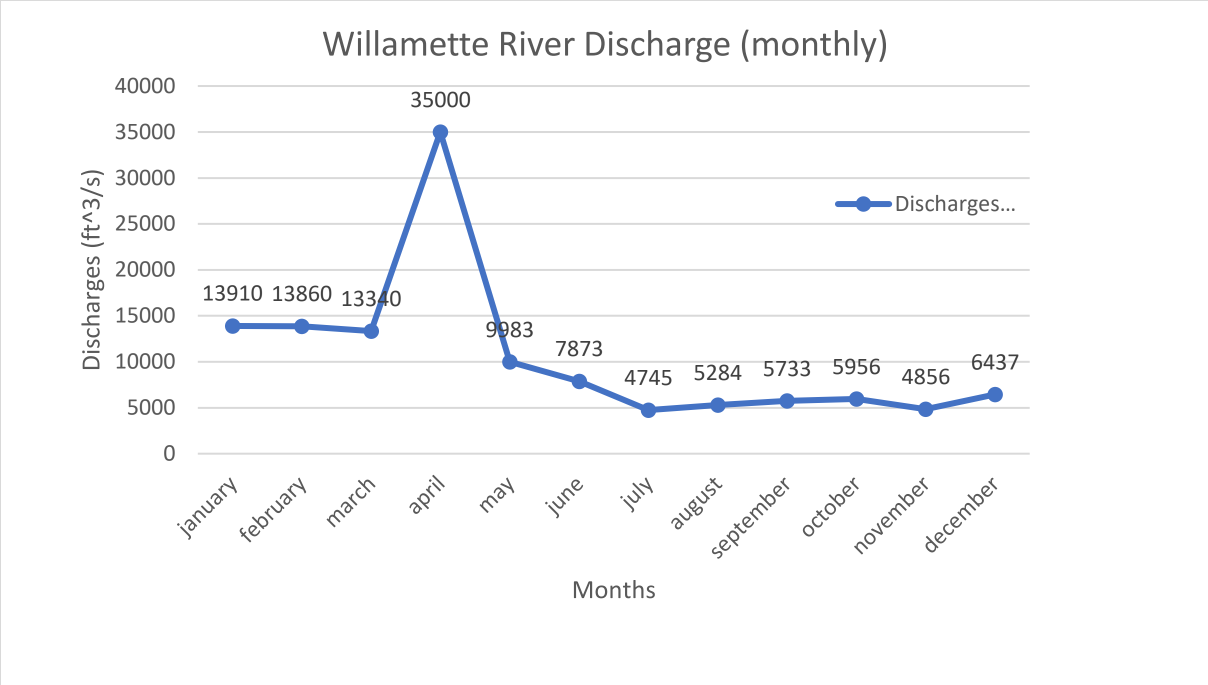
Each color represents a different flow in the created map. The determined range of flows is shown in the legend section. If we examine the map. There are three main rivers and creeks in the city of Corvallis. Both the map and the graph show that the Willamette River, the largest river, had the highest flow in 2019. When we look at the other two creeks, the first one is Oak Creek. In fact, there is Marys River at the part of Oak Creek that connects to Willamette River. So Marrys River and Oak Creek merge in that area. Subsequently, Oak Creek splits into two different branches. One of them continues as Oak Creek (2) again. The other is the Turubitary Of Oak Creek. Oak Creek (2) is divided into two again. The first of these is Mulkey Creek. The other is Oak Creek (3). Oak Creek (3) is approximately oriented north. And he later gives a branch called Alder Creek.

The second main stream is called Dixon Creek. Dixon Creek is divided into simple two. We can call the first of these Dixon Creek (2). The other branch is accordingly farther south and is called the Tirubutary of Dixon Creek.



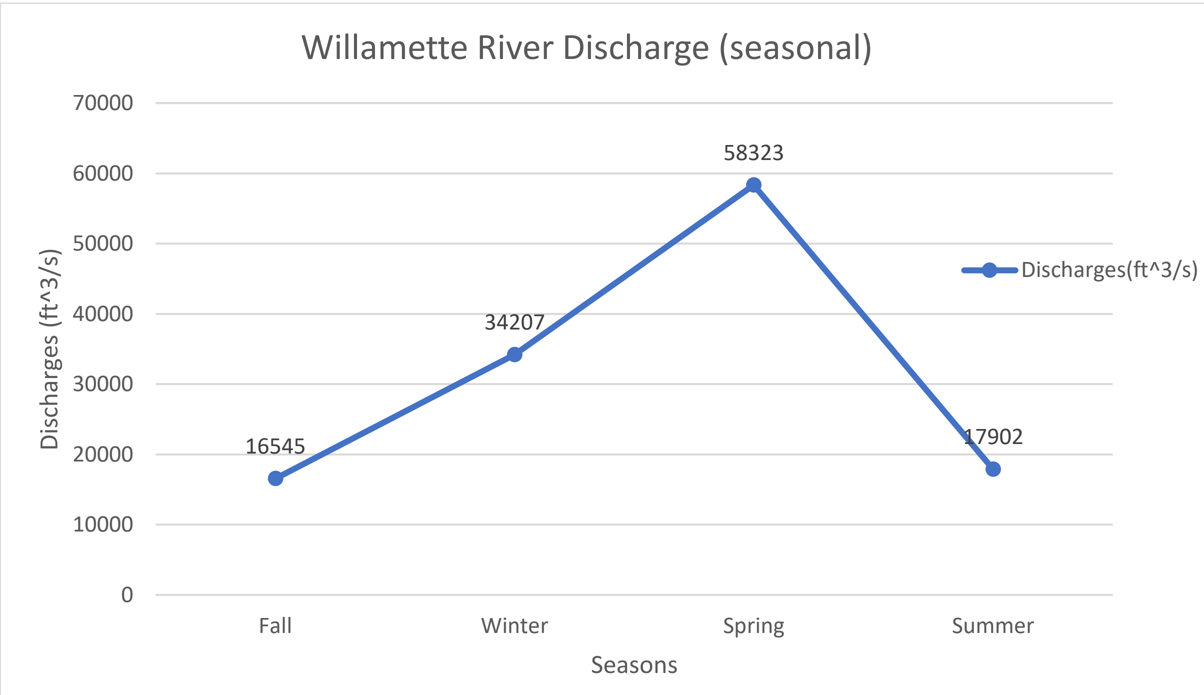
Graph 1: Discharge of all Willamette River

This chart demonstrates annual discharge of all Willamette River between Portland and Eugene. This graph has been created on the excel.



Graph 2: Monthly discharge in Willamette River in Corvallis Source: USGS web site

This graph represents monthly discharges of Willamette River in Corvallis station. These data have been downloaded from USGS web site. In the future, we will use these data for creating seasonal discharges for Corvallis.



Graph 3: Seasonal Discharges in Corvallis

Conclusion

We created seasonal discharges of Willamette River in Corvallis. When we look the chart, we could understand that the biggest discharge is seen in the spring season. However, the lowest discharge is seen in the fall season. If we research this situation, we can reach some proof about these discharges. The main reason of this is that Willamette River is huge river and trough nearly all Oregon state. Also, spring term comes after the winter and all snow of the mountains melt in the spring term. Then all these waters come from these snows flow to the near rivers. And Willamette River is one of these rivers (Vano 2015).

Discussion

The biggest obstacle in this project was that there was only point data. If the measurement points were much denser and more frequent, the map of the flow in rivers or streams would have formed colorfully. Of course, this would require a lot of data set and a lot of processing power. With this dataset and this project, we have obtained maps and tables of flow data in 2019. Therefore, someone who will examine a wide-ranging drought or change in discharge by years in the future can see the flow data and graphs for 2019 here.

REFERENCE

1) **USGS TNM v2 web site (DEM)**
   https://apps.nationalmap.gov/downloader/#/

2) **USGS Stream Gage**
   https://waterdata.usgs.gov/nwis/uv?site_no=14171600

3) **1,2,3,4,5,6,7 Tools information ;**
   https://www.esri.com/en-us/home

4) **Julie A. Vano, Bart Nijssen , Dennis P. Lettenmaier ”Seasonal hydrologic responses to climate change in the Pacific Northwest”**

   https://doi.org/10.1002/2014WR015909

5) **USGS NHD Plus Data**

   https://apps.nationalmap.gov/downloader/#/

6) **Climate Avarages**
   https://www.bestplaces.net/climate/city/oregon/corvallis

7) **Stream Flow Data**
   https://waterdata.usgs.gov/

8) **Map Screen Shoots**
   “Google Earth”

9) **Dr. Tracy Arras GIS in Water Resources Class Notes**