EXPLORATION OF THE CURRENT STORMWATER INFRASTRUCTURE AT THE NEW CITY HALL SITE

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Introduction

The city of Lake Oswego, Oregon has planned to build a new city hall, adjacent to the current city hall. Lake Oswego requires new construction to perform a stormwater assessment and the creation of a storm water plan. This will include stormwater and stream flows. This paper will focus on the exploration of the new city hall site as well as a broader understanding of the greater area extending to the HUC 10 of the Johnson Creek – Willamette River Watershed.

Site Description

The city of Lake Oswego is located in Oregon, directly south along the Willamette River for Portland. The Johnson Creek - Willamette River watershed is a single HUC 10 with an area of 94 square miles in figures 1 and 2. The watershed spans the greater Portland metropolitan area, which heavily populated with business and residential districts.

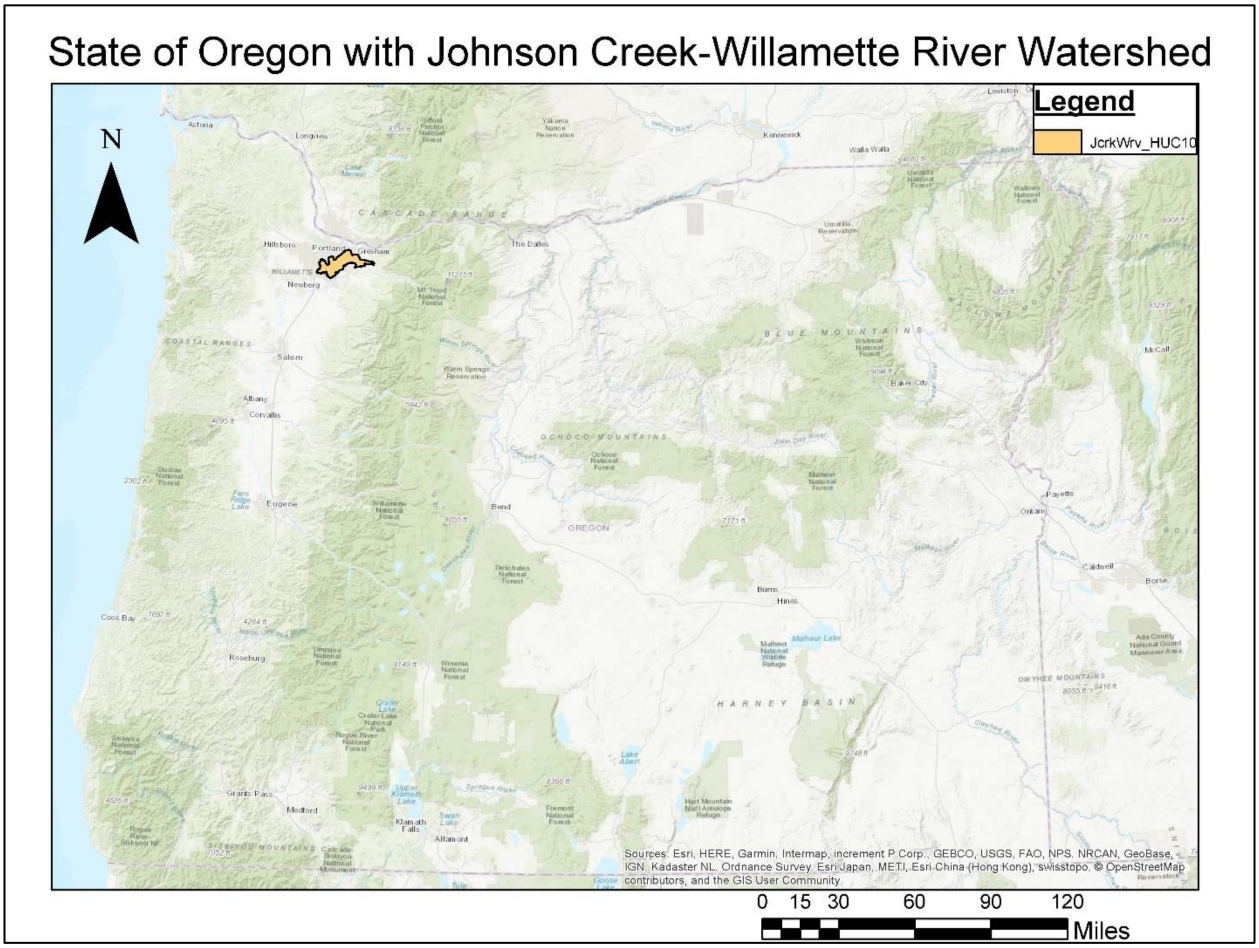

Figure 1: State of Oregon

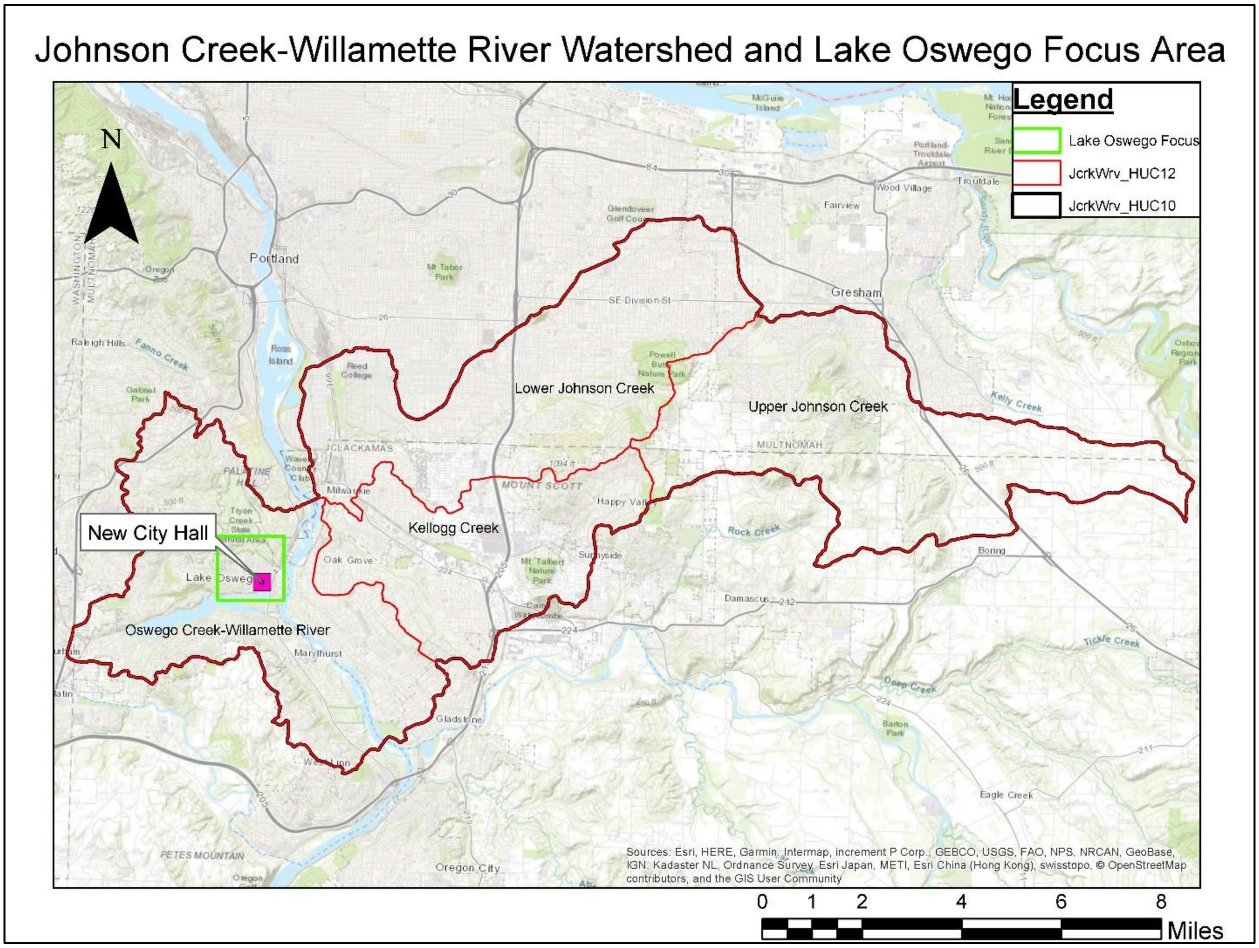

Figure 2: Project Focus Area

The Lake Oswego focus area is 1.71 miles square in downtown Lake Oswego, surrounding the new and old city hall site, highlighted in green in figure 2. The elevation runs downhill in the South Southeast direction towards the Oswego Lake (depicted in blue), south of the new city hall site in figure 3.

The new city hall site is located in the downtown district of Lake Oswego on the corner of A Ave and 3rd St was depicted in both figures 2 and 3. Figure 3 is dense with information regarding the stormwater system of Lake Oswego. Lake Oswego handles the increases stormwater due to infrastructure with storm water pipes and limited open channel flows. Lake Oswego uses treatments points, such as bioswales in the city blocks, in addition to detention areas, and piping treated stormwater to the Oswego Lake or stormwater streams that flow to the Willamette River.

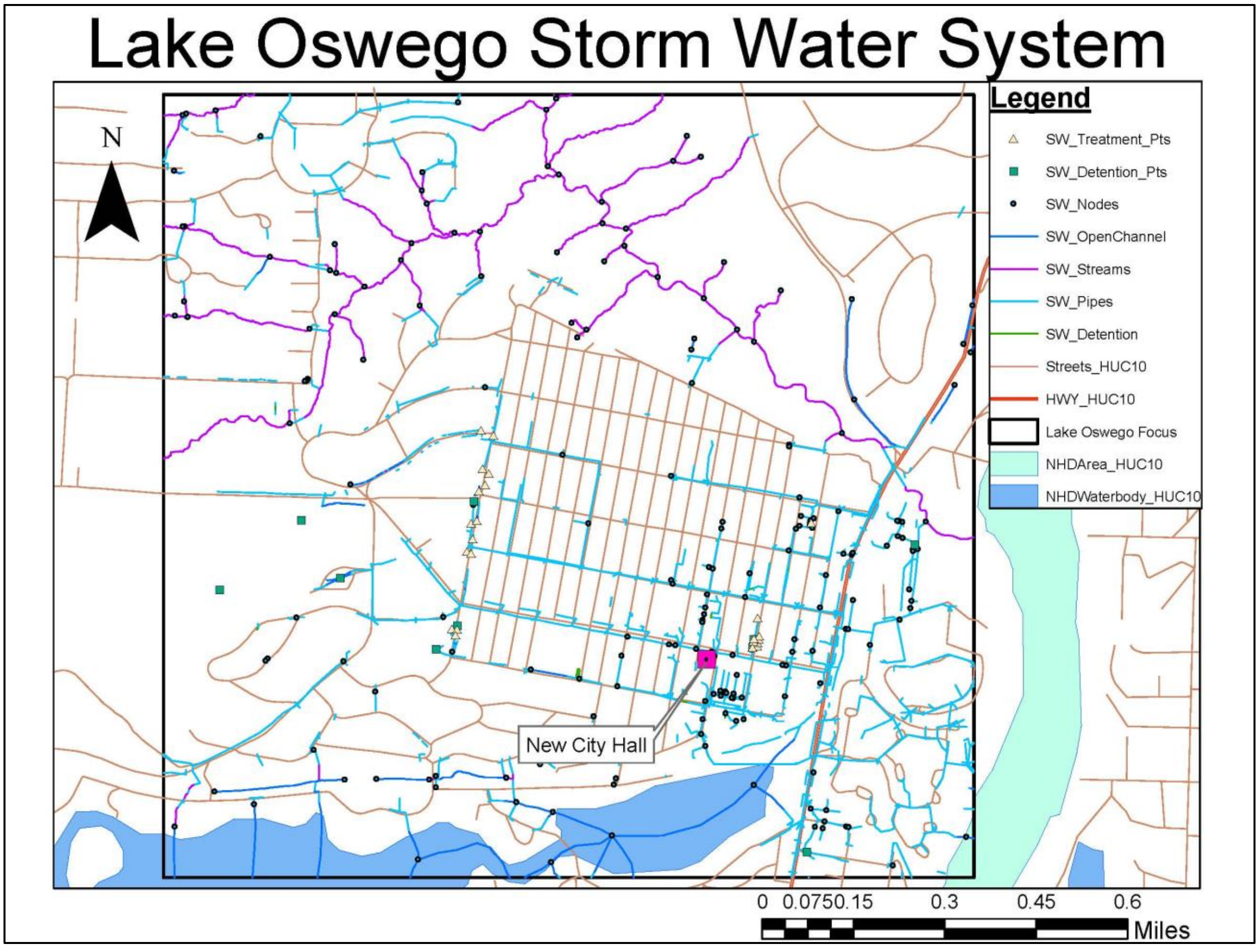

Figure 3: Lake Oswego Focus Area Stormwater System

Data

Name	Type	Projection	Source	Description
HUC 10	Vector, Polygon	GCS_North_American_1983	Geospatial Data Gateway	HUC 10, containing 27 areas
HUC 12	Vector, Polygon	GCS_North_American_1983	Geospatial Data Gateway	HUC 12, Containing 100 areas
State of Oregon DEM	Raster, 10 meter DEM	NAD_1983_Oregon_Statewide_ Lambert_Feet_Intl	Geospatial Data Gateway	10 meter DEM, provided to Tracy Arras
State wide Precipitation	Vector, Polygon	GCS_North_American_1983	Geospatial Data Gateway	Precipitation data from 1981-2010
NHDArea	Vector, Polygon	GCS_North_American_1983	NHDPlus V2	Large moving waterbody areas, rivers
NHDWaterbody	Vector, Polygon	GCS_North_American_1983	NHDPlus V2	Waterbody areas, lakes
NHDFlowlines	Vector, Polygon	GCS_North_American_1983	NHDPlus V2	Flowlines, streams

EROM_090001	dBASE Table	--	NHDPlus V2	Stream flow values: Q0001E
Streets, HWY, Interstates	Vector, Polyline	GCS_North_American_1983	Geosptial Data Gateway	Road system in greater Portland area
Lake Oswego Focus Area	Vector, Polygon	NAD83_NSRS2007_Oregon_North_ft	NOAA Coast Data	Focus area polygon from NOAA Data Access Viewer
Focus Area Lidar	Raser, 3m DEM	NAD_1983_NSRS2007_StatePlane_Oregon_North_FIPS_3601_Ft_Intl	NOAA Coast Data	3m DEM of Lake Oswego Focus Area
SW_Pipes	Vector, Polyline ZM	NAD_1983_2011_StatePlane_Oregon_North_FIPS_3601_Ft_Intl	City of Lake Oswego	Stormwater pipe system
SW_Streams	Vector, Polyline ZM	NAD_1983_2011_StatePlane_Oregon_North_FIPS_3601_Ft_Intl	City of Lake Oswego	Stormwater streams system
SW_Detention	Vector, Polyline ZM	NAD_1983_2011_StatePlane_Oregon_North_FIPS_3601_Ft_Intl	City of Lake Oswego	Stormwater detention system
SW_Treament	Vector, Polyline ZM	NAD_1983_2011_StatePlane_Oregon_North_FIPS_3601_Ft_Intl	City of Lake Oswego	Stormwater treatment system
SW_Openchannel	Vector, Polyline ZM	NAD_1983_2011_StatePlane_Oregon_North_FIPS_3601_Ft_Intl	City of Lake Oswego	Stormwater open channel flow
SW_Nodes	Vector, Point	NAD_1983_2011_StatePlane_Oregon_North_FIPS_3601_Ft_Intl	City of Lake Oswego	Stormwater pipe nodes points
SW_Inlets	Vector, Point	NAD_1983_2011_StatePlane_Oregon_North_FIPS_3601_Ft_Intl	City of Lake Oswego	Stormwater pipe inlet points
SW_Manholes	Vector, Point	NAD_1983_2011_StatePlane_Oregon_North_FIPS_3601_Ft_Intl	City of Lake Oswego	Stormwater pipe manhole points
SW_Treatment_Pts	Vector, Point	NAD_1983_2011_StatePlane_Oregon_North_FIPS_3601_Ft_Intl	City of Lake Oswego	Stormwater treatment points
SW_Pipe_In_Out	Vector, Point	NAD_1983_2011_StatePlane_Oregon_North_FIPS_3601_Ft_Intl	City of Lake Oswego	Stormwater pipe in/out points
SW_Detention_Pts	Vector, Point	NAD_1983_2011_StatePlane_Oregon_North_FIPS_3601_Ft_Intl	City of Lake Oswego	Stormwater detention points

HUCs were all projected to State Plane Oregon North, NAD 1983 system 2011 (NAD_1983_2011_StatePlane_Oregon_North_FIPS_3601_Ft_Intl) in units of feet. They system is a Lambert Conformal Conic with a False Easting of 8202099.74 ft and a False Northing of 0.00 ft. A Central Meridian of 120.50 W, and Latitude of Origin of 43.67 N, with Standard Parallels of 44.33 N and 46.00 N.

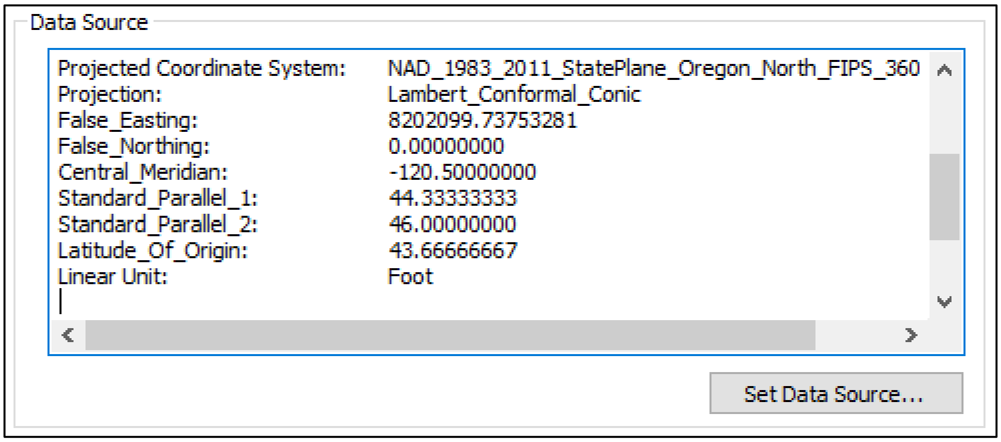

Figure 4: Projection Specifics

GIS Methods

Figure 5: Flow Chart Diagram

Results

The use of ArcGIS allowed for the performance and numerical exploration of the Johnson Creek - Willamette River watershed and the New City Hall are of focus for this project. The Johnson Creek – Willamette River HUC10 watershed and flows into the Willamette River as shown in figure 6. The Willamette River is the largest flow in the area with a flow of 11555.6 cubic feet per second (cfs) coming from the entire watershed area. The other major flowlines are small at the closest one being 22.2 cfs compared to the Willamette River.

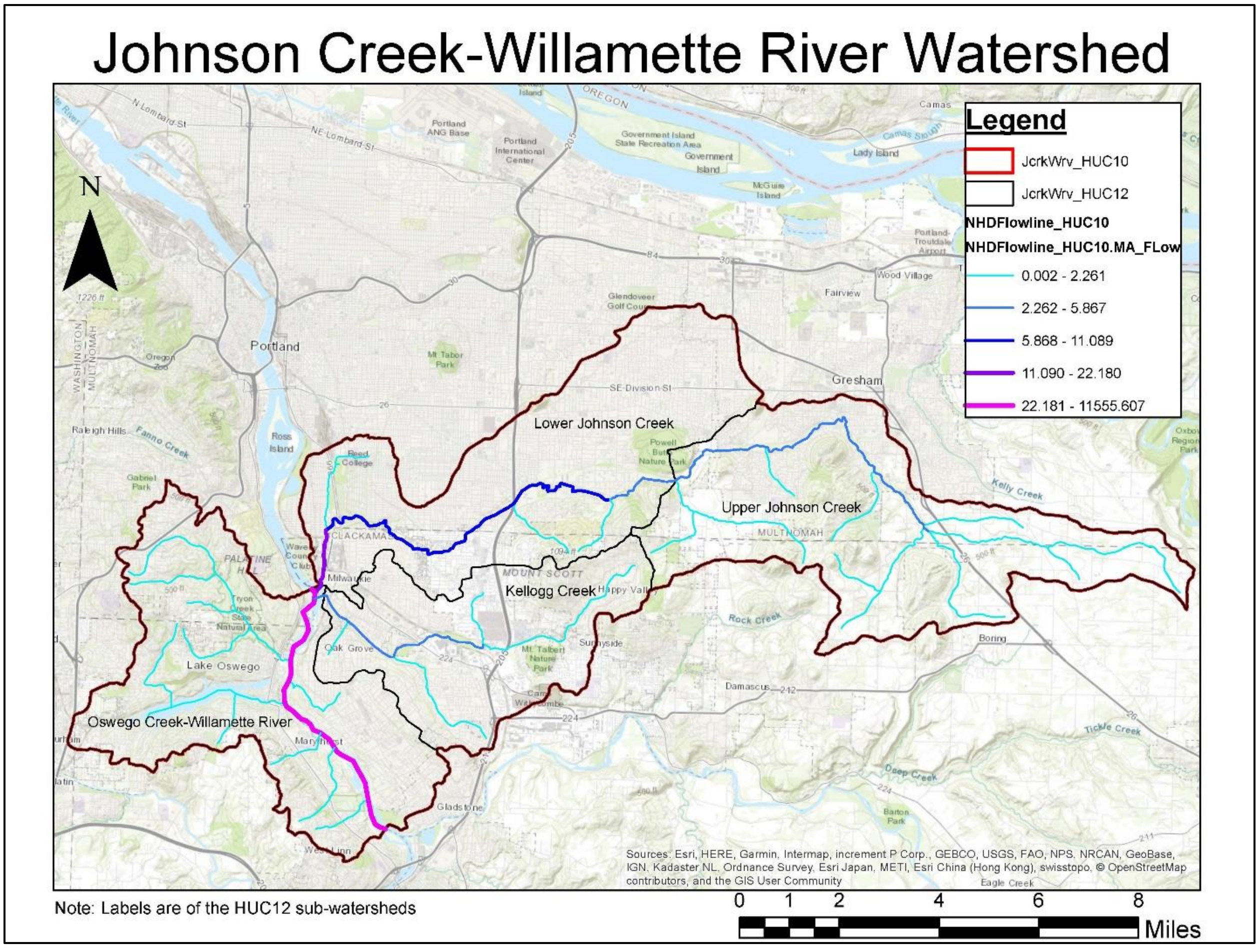

Figure 6: Johnson Creek - Willamette River Watershed Flowlines

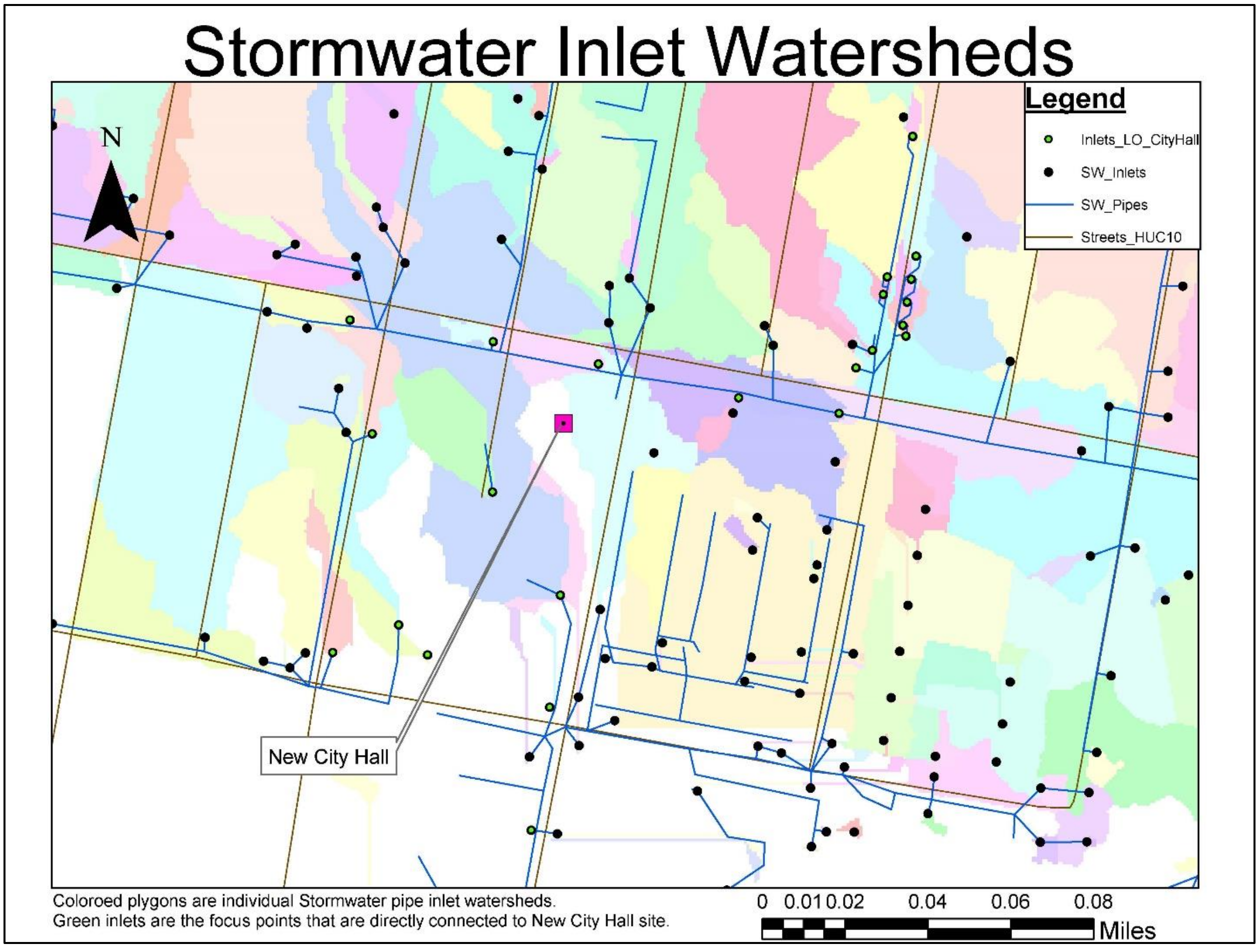

Figure 7: New City Hall Stormwater Inlets

There are 773 stormwater inlets. There are only 23 stormwater inlets that are directly connected to the New City Hall site, as seen in narrowed view in figure 6. Each stormwater inlet has an individually calculated area, as depicted in figure 7. Area of range from 23 to 3868 cell count, which is 207 to 34812 square meters. In US engineering units that is 2228.13 to 374712.88 feet squared, and 0.051 to 8.602 acres, which for the remainder of this report these relativity small areas will be represented in acres. The sum of the total is 34.34 acres. The mean of the localized tributary areas of the inlets is 1.49 acres with a standard deviation of 1.91 acres. Due to data type of the flow accumulation, data was snapped and then joined to the 23 specific stormwater inlets effected by the New City Hall site. The inlets are point data therefore cell count shape was not easily and clearly mapped, as seen in figure 7. There areas were all calculated using unit conversion factors as seen in figure 8 and the statistics of the acre area calculations is presented in figure 9. The individual values are represented in figure 10.

$$Area\ (m^2) = Area\ (cell\ count) * 9\ m^2$$
$$Area\ (ft^2) = Area\ (m^2) * \ 10.7639$$
$$Area\ (acres) = Area\ (m^2) * 0.000247105$$

Figure 8: Inlet Area Unit Calculations

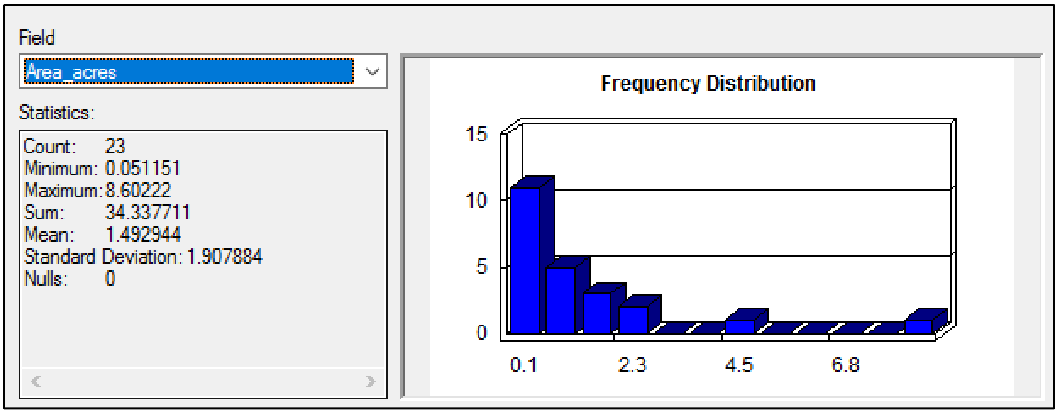

Figure 9: Stormwater Inlet Areas in Acres

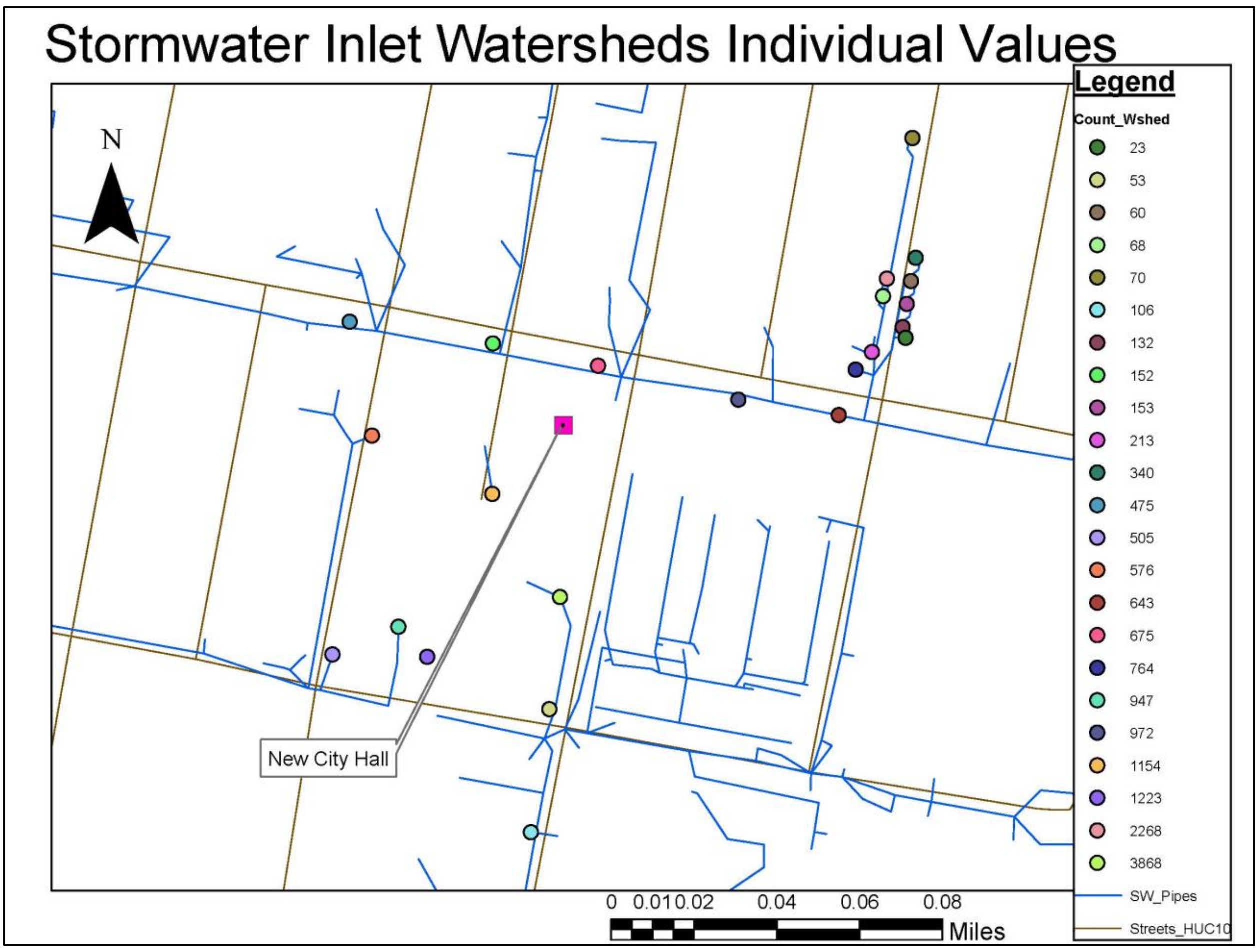

Figure 10: New City Hall Stormwater Inlets with Individual Values

The stormwater inlet areas are also represented in area relativity to the other 22 inlets of focus. Figure 11 shows the large difference in these localized stormwater tributary areas. The tributary areas are relative to the proximity of buildings, roadways, and other city features that displace stormwater runoff from the natural path of flow.

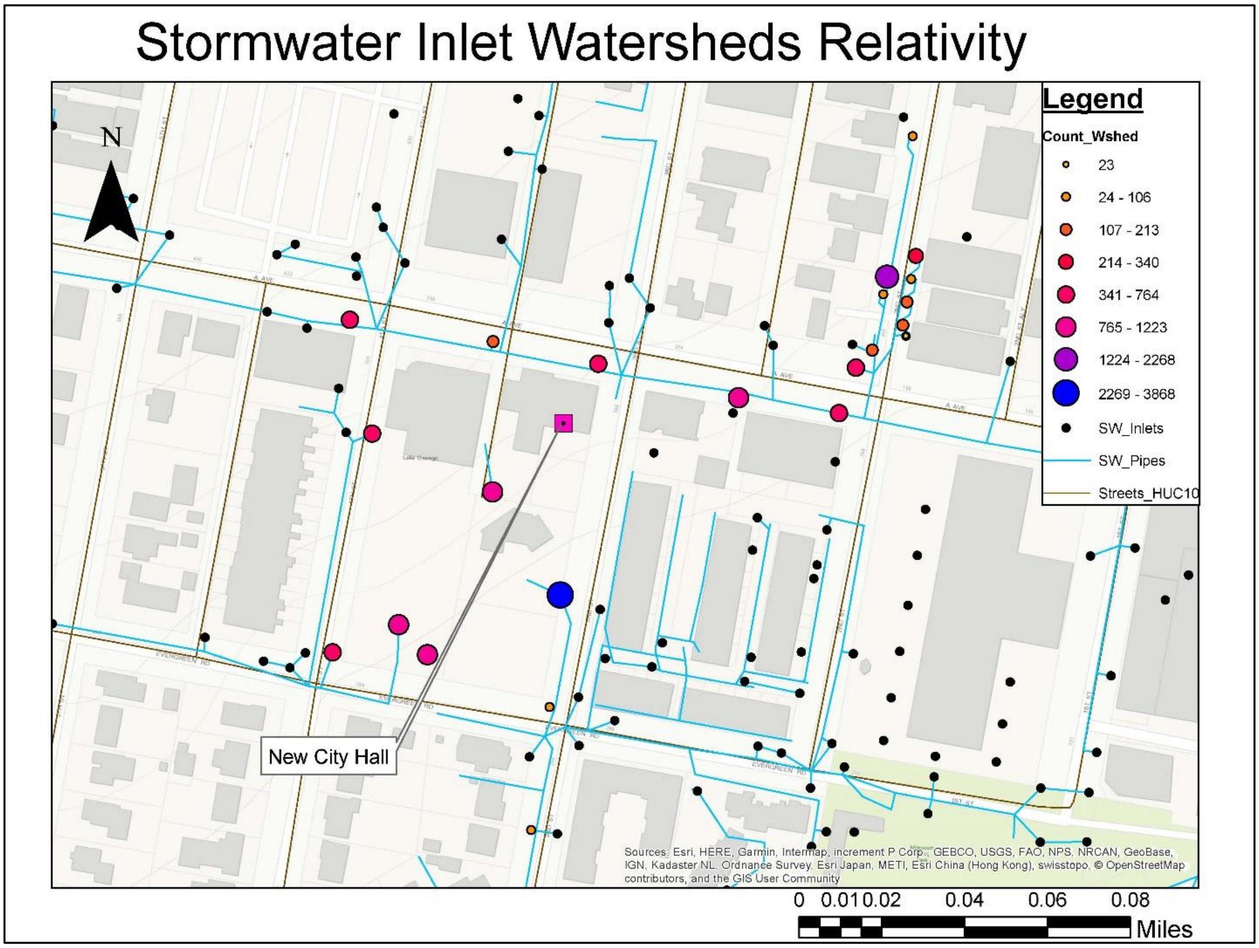

Figure 11: New City Hall Stormwater Inlets with Relative Area Intakes

The flow accumulation (FAC) of the based on the Lidar 3 meter DEM, uses for the slope direction, and flow direction. Through mathematically manipulated the area that feeds into a specific area can be calculated. The FAC lines represent the counted area that stormwater runoff will flow, which will feed into the stormwater system of Lake Oswego, in figure 12. The use of FAC allows for better understand of stormwater flows and path for municipalities to be designed to hand stormwater runoff.

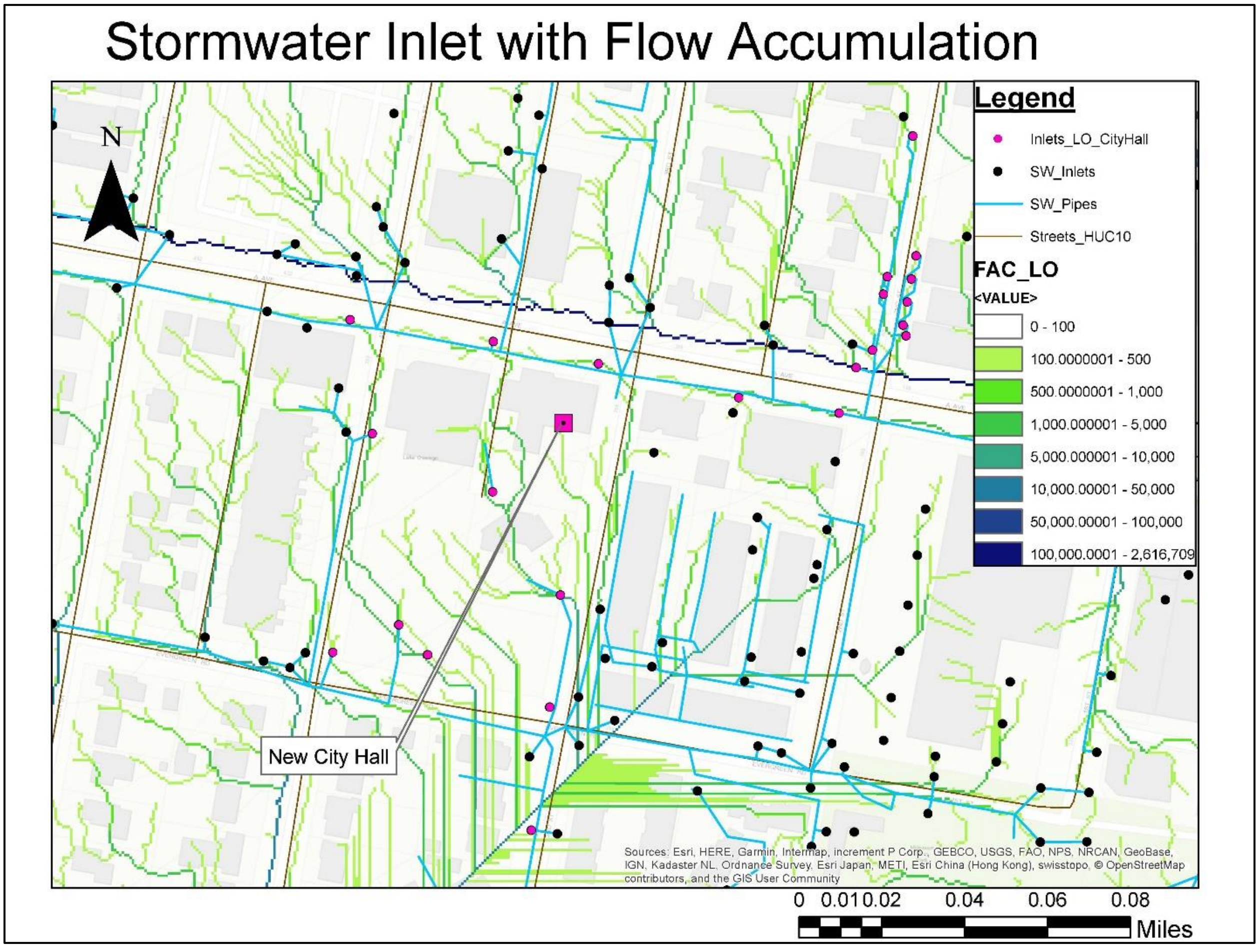

Figure 12: Flow Accumulation around New City Hall Site

The utility flow network of the stormwater proves the flow of the stormwater system. The green square in figure 13 represent flags for the utility flow network, which are inputs for the downstream flow network for the stormwater system. The system feeds to bioswales represented by yellow triangles northeast of the New City Hall site. The stormwater system uses gravity as the driving forces. The south end of the New City Hall site flows to another bioswale further south from the site.

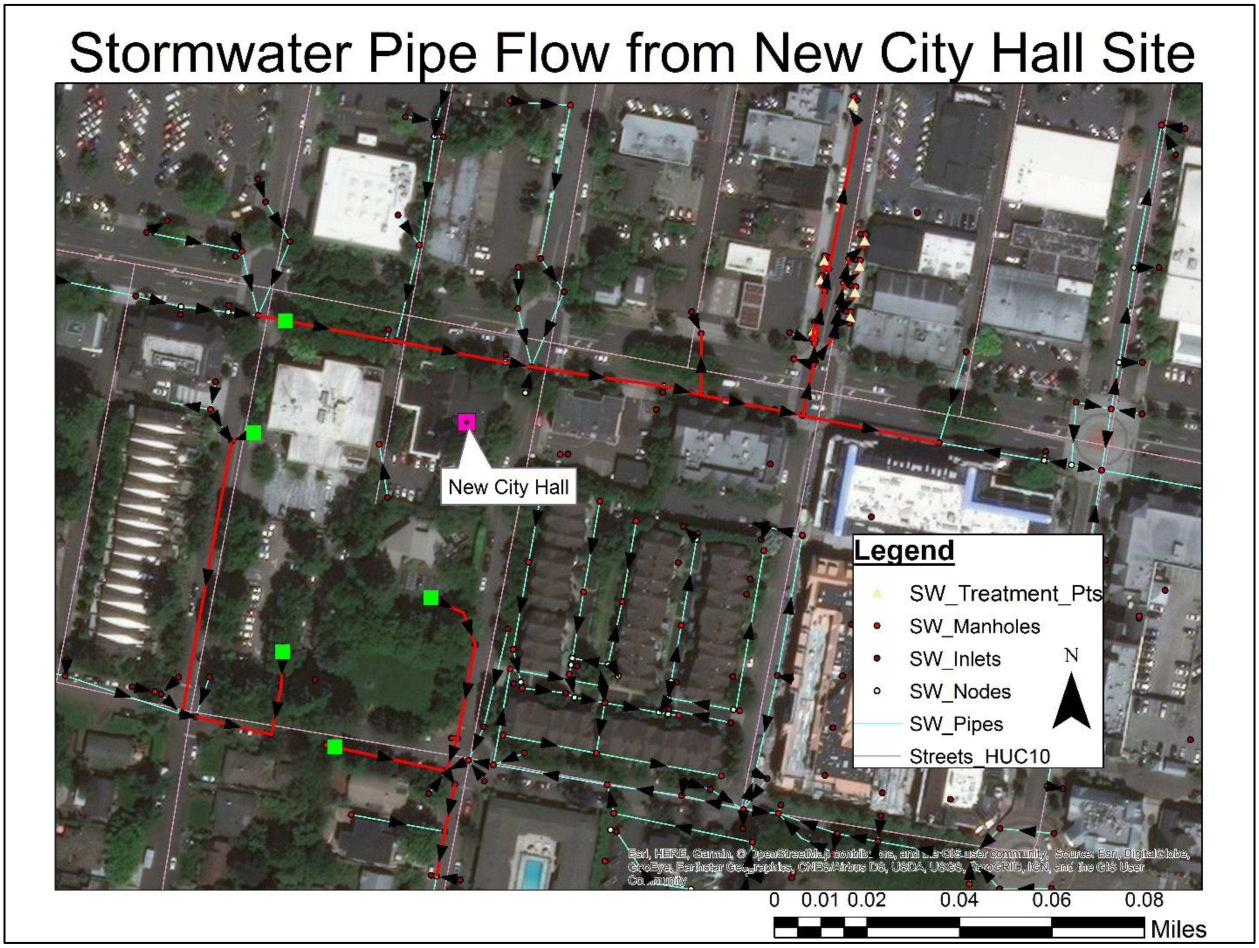

Figure 13: Stormwater Pipe Flow Network from the New City Hall Site

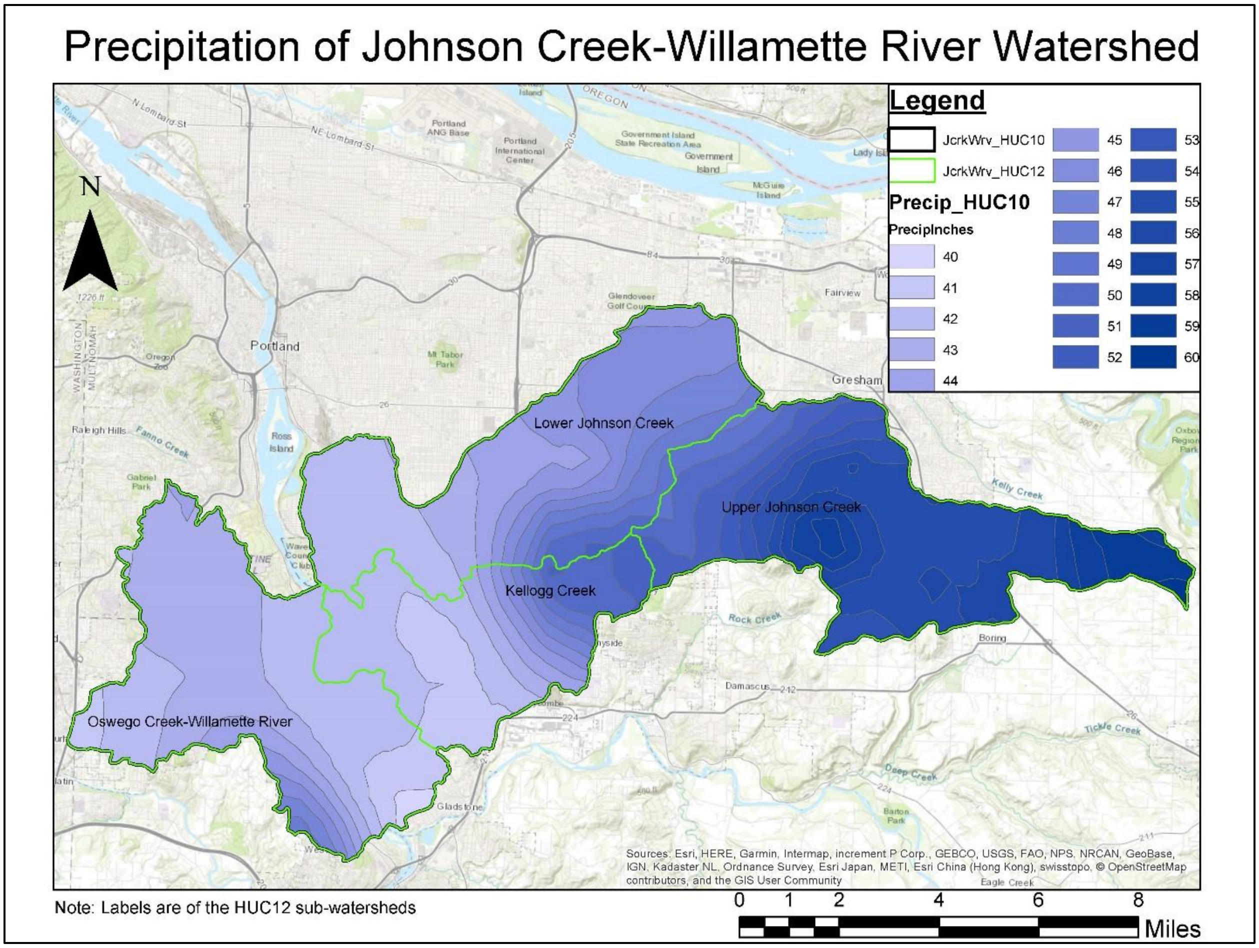

Figure 14: HUC 10 Precipitation

The amount of precipitation and the combination of the FAC to anticipate the amount of stormwater that will flow to the stormwater inlets. Figure 14 shows the large variety of rainfall in the larger Portland metropolitan area. A range of 20 inches between 40 near the city of Lake Oswego to 60 inches. The Lake Oswego focus area surrounding the New City Hall site ranges from 42 to 43 inches, as shown in figure 15.

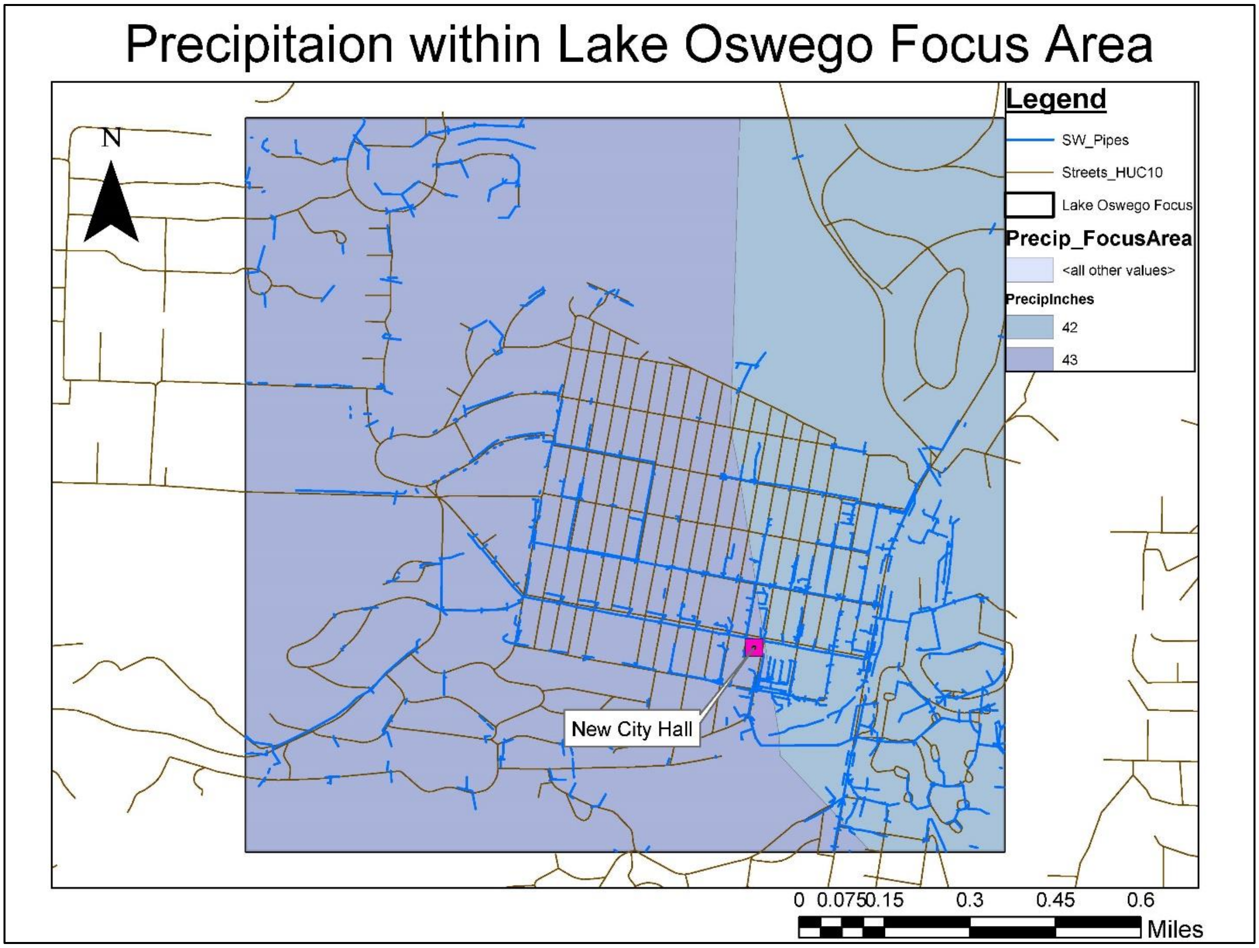

Figure 15: Lake Oswego Focus Area Precipitaion

Conclusion

The exploration of the Johnson Creek – Willamette River HUC10 and in depth numerical exploration of the Lake Oswego City area surrounding the New City Hall site provided valuable insight into the stream and stormwater system.

More information process must occur in order to determine if the current stormwater system can handle the site changes that will occur in the building process of the New City Hall. The size of the current stormwater pipes in the area. The amount of stormwater runoff the treatment, detention and steams can handle. A larger exploration will need to be conducted to meet municipality code for permitting of the project.

Some issue that arose were due to not knowing how to process and approach the massive amount of data that was collected. While processing data, the project went in different directions due to finding that drove pursuit of more knowledge of the area. The manipulation of data to get flow accumulation of precipitation data into flow accumulation from precipitation and how that would affect the stormwater system surrounding the New City Hall Site.

Appendix

A - References

Herrera Environmental Consultants. (2016, March). *Lake Oswego Stormwater Management Manual.* http://www.ci.oswego.or.us/sites/default/files/fileattachments/publicworks/webpage/12560/lakeostormwatermanual_march2016.pdf?t=1459799931563

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