Residential Stormwater Rate Analysis 2018

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1. Introduction

This project investigates relationships between service pressures and residential stormwater rates by comparing the City of Olympia to other jurisdictions in the region.

The impetus for this analysis came as Olympia was preparing to write its 2018 Storm and Surface Water Master Plan. In 2017, FCS Group produced a *Stormwater Management Plan Financial Analysis* that included a comparison of residential stormwater rates in other jurisdictions. This project expands on the work of FCS Group by examining "service pressures" that may correlate with differing stormwater rates across jurisdictions. Olympia Environmental Services Staff has identified **service pressures** to include 1) built stormwater systems and 2) natural stormwater systems.

1.1 City of Olympia Storm and Surface Water Utility

This project is important for understanding the City of Olympia's utility rates relative to its goals of:

- Providing essential public and environmental health services 24/7.
- Keeping rates as low as possible, especially in an era of increasing housing costs.

More specifically, Olympia's Storm and Surface Water Utility ensures that surface water runoff is collected and infiltrated or conveyed to streams, rivers, and Puget Sound. It aims to reduce the frequency and severity of flooding, improve water quality, and protect, enhance, and restore aquatic habitat.

To do this, 19.13 Full Time Equivalent (FTE) employees and 6 temporary staff in Planning and Engineering, Operations, and Environmental Services manage the City's storm and surface water infrastructure. For the 2018 fiscal year, the City of Olympia allocated:

- A $5.4 million operating budget for the Storm and Surface Water Utility.
- $1,774,700 from the Capital Facilities Plan towards stormwater projects including aquatic habitat improvements, flood mitigation and collection, infrastructure planning, and water quality improvements.

2. Methods

This study sought to measure and compare service pressures in multiple jurisdictions. To do this, it applied two methods of data collection: 1) extraction of statewide natural resources data using GIS and 2) collection of infrastructure data by surveying peer cities.

2.1 GIS Data

Natural features of stormwater systems in each jurisdiction were measured using ArcGIS 10.4.1 and Microsoft Excel. Features include **total area served**, **marine shoreline**, **freshwater shoreline**, **stream miles**, **impaired stream miles**, and **acres of wetland** (see Figure 1).

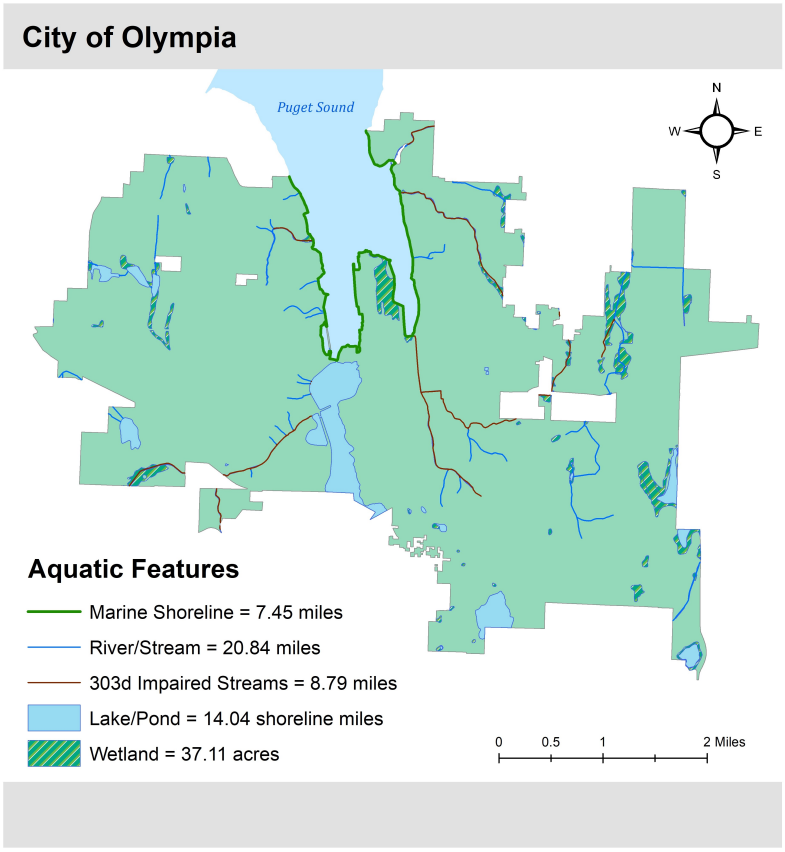

Figure 1

1. To maintain consistency across jurisdictions, feature class data was obtained from Washington State Department of Ecology and Washington Department of Natural Resources, and U.S. Fish and Wildlife Service. (See Appendix A for detailed source information.)
    - Datasets from Ecology: 1) municipal stormwater permit areas (2018) and 2) 303d impaired waters (2014).
    - Datasets from DNR: 1) water courses (January 2018) and 2) water bodies (January 2018).
    - Dataset from U.S. Fish and Wildlife Service: 1) National Wetlands Inventory – Washington Wetlands (Version 2).

2. The Municipal Stormwater Permit Areas dataset was dissolved to include only jurisdictions listed in the FCS Group's financial analysis: Bonney Lake, Des Moines, Edmonds, Issaquah, Kirkland, Lacey, Olympia, Puyallup, Redmond, Richland, Sammamish, and Tumwater.
    - Shape_Area attribute indicated **total area served** by each jurisdiction.
3. To assign jurisdiction names to both aquatic datasets, intersects were calculated between 1) permit areas and water courses and 2) permit areas and water bodies.
4. To calculate **marine shoreline** miles:
    - Created a new polyline feature class.
    - Traced and added each jurisdiction's marine shoreline as a new attribute.
    - The Shape_Length of each attribute indicates the length of each relevant jurisdiciton's marine shoreline.
5. To calculate **freshwater shoreline** miles:
    - Queried water body feature class (with assigned jurisdictions) to only display 'Lake/pond' features.
    - Exported feature class to Excel.
    - Sorted Excel table by jurisdiction name.
    - Calculated sum of Shape_Length for each jurisdiction (= freshwater shoreline).
6. To calculate **stream** miles:
    - Queried water course feature class (with assigned jurisdictions) to only display 'Stream/river' features.
    - Exported feature class to Excel.
    - Sorted Excel table by jurisdiction name.
    - Calculated sum of Shape_Length for each jurisdiction (= stream miles).
7. To calculate **303d impaired stream** miles:
    - Calculated intersect between water course feature class (with assigned jurisdictions) and 303d impaired streams feature class. This isolated impaired stream segments in each jurisdiction.
    - Exported feature class to Excel.
    - Sorted Excel table by jurisdiction name.
    - Calculated sum of Shape_Length for each jurisdiction (= impaired stream miles).
8. To calculate **wetland** areas:
    - Queried wetland feature class to remove 'Estuarine and Marine Deepwater,' 'Lake,' and 'Freshwater Pond' from data (already quantified in earlier steps)
    - Exported feature class to Excel.
    - Sorted Excel table by jurisdiction name.
    - Calculated sum of Shape_Area for each jurisdiction (= marsh area).

2.2 Peer City Survey

To gather data about each jurisdiction's stormwater resources, a twelve-question survey was shared with each of the cities listed in FCS Group's financial analysis. (See Appendix B for complete survey.) All twelve jurisdictions responded. Survey questions sought to quantify each jurisdiction's:

- Residential stormwater rate

- Personnel employed by the stormwater utility
- Street drains
- Miles of storm pipes
- Flow control facilities
- Treatment facilities
- Public storm facilities

2.3 Compiled Data

Table 1 below displays data compiled from statewide GIS resources and the peer city survey.

	Sammamish	Des Moines	Kirkland	Redmond	Issaquah	Edmonds	Bonney Lake	Olympia	Puyallup	Lacey	Tumwater	Richland
Bi-Monthly Residential Stormwater Bill	$44.76	$41.60	$37.00	$33.12	$31.82	$31.24	$28.00	$26.74	$24.66	$21.44	$20.44	$7.70
Population*	63,773	31,172	87,701	62,458	37,322	41,840	20,310	51,202	40,640	47,688	22,538	54,989
Median Household Income *	$153,253	$59,948	$95,939	$62,848	$92,071	$78,181	$85,975	$54,523	$64,342	$59,624	$62,050	$69,833
Total Area Served (sq miles)	18.73	6.33	17.84	15.05	11.40	8.93	7.46	18.50	14.21	16.64	14.54	39.41
Marine shoreline (miles)	0	4.90	0	0	0	5.29	0	7.45	0	1.22	0	0
Freshwater shoreline (miles	21.6	0.33	14.59	3.04	2.16	1.75	11.27	14.04	2.61	8.28	7.39	9.76
Streams (miles)	32.40	8.84	30.62	37.45	35.04	7.34	7.09	20.84	23.01	5.43	13.09	44.91
303d Impaired Streams (miles)	6.96	4.67	13.49	11.34	9.78	0.31	0	8.79	8.40	0.83	5.01	0.34
Wetland (acres)	50.48	3.30	34.35	59.14	19.17	5.13	10.77	37.11	17.34	22.87	51.78	102.53
Number of Personnel	15.69	12.1	36.7	28	N/A	9.5	8	25.13	9.83	9 or 10	11.16	2.05
Street Drains	9261	2310	24677	11490	7421	6702	2007	7528	6731	>5000	3800	3995
Storm Pipe (miles)	218	85	375	192	N/A	133	40	157	136	>100	100	127.3
Flow Control Facilities	426	87	525	458	217	5	50	244	79	40	15	N/A
Stormwater Treatment Facilities	261	N/A	129	291	N/A	2	56	137	35	NA	41	N/A
Public Storm Facilities (acres)	114	N/A	N/A	0	N/A	N/A	120	205.8	103	>120	N/A	N/A

Table 1

*2016 Population and 2016 Median Household Income data retrieved from U.S. Census Bureau.

3. Discussion

3.1 Linear Regression Analysis

Linear regression analysis was used to search for relationships between residential stormwater rates and other variables. A strong correlation (greater than 0.7 or less than -0.7) would indicate a relationship between variables.

- As seen in Table 2, there were no significant, strong correlations. Consequently, none of these individual variables can serve as predictors for residential stormwater rates (and what jurisdictions should charge).
- The strongest relationship exists between residential stormwater rate and population density (see Figure 2). This trend suggests that high population density has a *moderate* correlation with higher stormwater rates. A larger dataset might clarify these results.

Bi-Monthly Residential Stormwater Bill	
	r^2 =
Population (2016)	0.0551
Household Income (2016)	0.2915
Total Area Served (sq miles)	0.3722
Population Density (per sq mile)	0.6382
Marine Shoreline (miles)	0.0250
Freshwater Shoreline (miles)	0.0159
Streams (miles)	0.0085
Impaired Streams (miles)	0.2064
Wetland (acres)	0.2506
Number of Personnel	0.1832
Number of Street Drains	0.1630
Storm Pipe (miles)	0.1213
Number of Flow Control Facilities	0.3209
Stormwater Treatment Facilities (acres)	0.2237
Public Storm Facilities (acres)	0.0087

Table 2

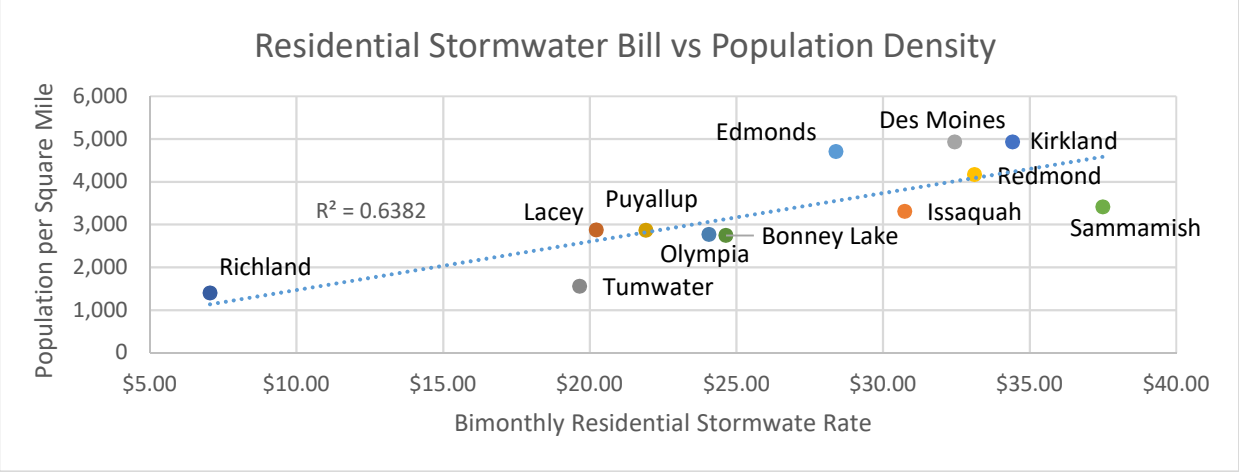

Figure 2

3.2 City Ranking

Another approach was taken to visualize the City of Olympia's residential stormwater rates in relation to other jurisdictions. This entailed:

1. Calculating each city's service pressures per capita.
2. Ranking cities' normalized service pressures from largest to smallest.

The resulting table displays Olympia's service pressures **per capita** in comparison to other jurisdictions (Table 3). These steps were repeated to rank cities' service pressures **per area served** (Table 4). Stormwater treatment facilities and public storm facilities were not included due to insufficient data.

In the ranking **per capita**:

- Olympia has the fourth lowest residential stormwater bill.
- Six of Olympia's service pressures are among the largest: marine shoreline, freshwater shoreline, impaired stream miles, wetland acres, flow control facilities, and employed personnel.

In the ranking **per area served**:

- Olympia has the fourth lowest residential stormwater bill.
- Four of Olympia's service pressures are among the largest: marine shoreline, freshwater shoreline, wetland acres, and employed personnel.

These tables suggest that compared to other jurisdictions, the City of Olympia has low residential stormwater rates and relatively high service pressures.

	1 (largest)	2	3	4	5	6	7	8	9	10	11	12 (smallest)
Residential Stormwater Bill	Bonney Lake	Des Moines	Tumwater	Issaquah	Edmonds	Sammamish	Puyallup	Redmond	Olympia	Lacey	Kirkland	Richland
Marine Shoreline	Des Moines	Olympia	Edmonds	Lacey								
Freshwater Shoreline	Bonney Lake	Sammamish	Tumwater	Olympia	Richland	Lacey	Kirkland	Puyallup	Issaquah	Redmond	Edmonds	Des Moines
Stream Miles	Issaquah	Richland	Redmond	Tumwater	Puyallup	Sammamish	Olympia	Kirkland	Bonney Lake	Des Moines	Edmonds	Lacey
Impaired Stream Miles	Issaquah	Tumwater	Puyallup	Redmond	Olympia	Kirkland	Des Moines	Sammamish	Lacey	Edmonds	Richland	Bonney Lake
Wetland Acres	Tumwater	Richland	Redmond	Sammamish	Olympia	Bonney Lake	Issaquah	Lacey	Puyallup	Kirkland	Edmonds	Des Moines
Street Drains	Kirkland	Issaquah	Redmond	Tumwater	Puyallup	Edmonds	Olympia	Sammamish	Lacey	Bonney Lake	Des Moines	Richland
Storm Pipe Miles	Tumwater	Kirkland	Sammamish	Puyallup	Edmonds	Redmond	Olympia	Des Moines	Richland	Lacey	Bonney Lake	
Flow Control Facilities	Redmond	Sammamish	Kirkland	Issaquah	Olympia	Des Moines	Bonney Lake	Puyallup	Lacey	Tumwater	Edmonds	
Employed Personnel	Tumwater	Olympia	Redmond	Kirkland	Bonney Lake	Des Moines	Sammamish	Puyallup	Edmonds	Lacey	Richland	

Table 3

Ranking based on service pressures per capita (U.S. Census 2016).

	1 (largest)	2	3	4	5	6	7	8	9	10	11	12 (smallest)
Residential Stormwater Bill	Des Moines	Bonney Lake	Edmonds	Issaquah	Sammamish	Redmond	Kirkland	Puyallup	Olympia	Tumwater	Lacey	Richland
Marine Shoreline	Des Moines	Edmonds	Olympia	Lacey								
Freshwater Shoreline	Bonney Lake	Sammamish	Kirkland	Olympia	Tumwater	Lacey	Richland	Redmond	Edmonds	Issaquah	Puyallup	Des Moines
Stream Miles	Issaquah	Redmond	Sammamish	Kirkland	Puyallup	Des Moines	Richland	Olympia	Bonney Lake	Tumwater	Edmonds	Lacey
Impaired Stream Miles	Issaquah	Kirkland	Redmond	Des Moines	Puyallup	Olympia	Sammamish	Tumwater	Lacey	Edmonds	Richland	Bonney Lake
Wetland Acres	Redmond	Tumwater	Sammamish	Richland	Olympia	Kirkland	Issaquah	Bonney Lake	Lacey	Puyallup	Edmonds	Des Moines
Street Drains	Kirkland	Redmond	Edmonds	Issaquah	Sammamish	Puyallup	Olympia	Des Moines	Lacey	Bonney Lake	Tumwater	Richland
Storm Pipe Miles	Kirkland	Edmonds	Des Moines	Redmond	Sammamish	Puyallup	Olympia	Tumwater	Lacey	Bonney Lake	Richland	
Flow Control Facilities	Redmond	Kirkland	Sammamish	Issaquah	Des Moines	Olympia	Bonney Lake	Puyallup	Lacey	Tumwater	Edmonds	
Employed Personnel	Kirkland	Des Moines	Redmond	Olympia	Bonney Lake	Edmonds	Sammamish	Tumwater	Puyallup	Lacey	Richland	

Table 4

Ranking based on service pressures per area (square miles) served.

4. Limitations

Known limitations of this study include:

- GIS data from Washington State Department of Ecology and Washington Department of Natural Resources is statewide and therefore might not accurately represent details of aquatic features at a local, jurisdictional scale.
- Wetland GIS data from U.S. Fish and Wildlife Service uses aerial imagery as primary data source. Consequently, some wetland habitats are excluded from the data.
- Self-reported data from the peer city survey may be outdated, incorrect, or incomplete.
- Correlation analysis may indicate a relationship among variables. However, it does not prove that change in one variable causes change in another.
- FCS Group's reason for choosing the included peer cities is unknown. A different or larger selection of jurisdictions might yield different results.

5. Conclusions

The purpose of this project was to investigate relationships between service pressures and residential stormwater rates by comparing the City of Olympia to other jurisdictions. Service pressures were defined as 1) built stormwater systems and 2) natural stormwater systems. Service pressure data was sourced from state agencies and each jurisdiction.

A linear regression analysis did not indicate significant correlations between residential stormwater rates and individual service pressures. However, this study could be expanded to include more jurisdictions. A larger dataset might yield stronger correlations.

When service pressure data was normalized by population and service area, results indicated that—compared to other jurisdictions—the City of Olympia has low residential stormwater rates and relatively high service pressures.

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APPENDIX A – GIS Sources Cited

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APPENDIX B – Peer City Survey Questions

1. Name of jurisdiction
2. How often do you bill for residential stormwater? (ie. monthly, bi-monthly)
3. How much is the average bill?
4. How is this fee calculated? (ie. per square foot impervious, flat rate)
5. How many personnel are employed by your stormwater utility?
6. How many stormwater catchbasins does your jurisdiction maintain?
7. How many miles of storm pipe does your jurisdiction maintain?
8. How many flow control facilities does your jurisdiction maintain?
9. How many stormwater facility treatments does your jurisdiction own?
10. How many acres of public storm facilities does your jurisdiction maintain?
11. Do you offer a residential rate credit program? (Reduced fees for actions that decrease runoff?)
12. If yes, please describe your rate credit program.