

## **Appendix F**

### **Impervious Surface Percentages for Different Land Use Types**

## ESTIMATING TOTAL IMPERVIOUSNESS FOR WATERSHEDS

The purpose of the study is to develop a procedure of estimating the total imperviousness of a watershed without using planimetric information. Currently Pierce County only has planimetric information in three selected areas: Gig Harbor, South Hill, and Spanaway/Parkland areas. Portion of these planimetric data was used to determine the representative percentage of the imperviousness for various land use categories. The estimated impervious area of a given tax parcel will be the size of the parcel times the representative percentage of impervious area for the land use associated with the parcel. Similar procedure will be used to estimate for the non-parcel polygons such as roadway right of ways. Then the total estimated imperviousness of a given watershed is the summation of the impervious area of all the tax parcels and non-parcel polygons contained in that watershed. The rest of the pervious area will be grass, forest, or the combination of the two. An aerial photo can be used to assist the determination if GIS coverage of vegetation is not available.

The project area is grouped into different categories and a number of sample areas are selected within each category to obtain a representative percent imperviousness. The total acreage of each sample is calculated based on the GIS polygons in preference to the recorded land acreage data, as there is inconsistency found between the two. The recorded data show a significant number of parcels with zero land acreage due to new development, re-zoning, or other conditions.

The impervious area of each sample is determined based on acreage occupied by buildings and travel ways (i.e., driveway, parking lot, etc.) within the selected parcels. The buildings and travel ways are delineated into two separate shapefiles. However, there are cases where the building lots are duplicated in the travel way shapefile. In other cases, the travel ways are not split by parcel (i.e., they spread across several parcels with different land uses), or the driveways are connected to the roadway network. Such conditions have led to difficulties in selecting representative sample areas, and resulted in inaccurate impervious area calculation.

The percent imperviousness of each sample except the roadways is basically calculated by taking the total impervious area divided by the total acreage. The average of percent imperviousness of all samples in each category represents the average percent imperviousness of that category, which is shown in Table F-1. However, this imperviousness does not consider if the impervious area is hydraulic connected or not. Runoff generated from a hydraulic connected impervious area will directly discharged into a drainage system. The runoff generated from non-hydraulic connected imperviousness will route through pervious area such as grass and will have the opportunity to infiltrate and attenuate before it reaches a drainage system. For example, the rooftop or the house footprint will considered as non-hydraulic connected imperviousness if the downspout of a residential building is discharged into the lawn. It is difficult to determine if all the impervious area is hydraulic connected and to estimate the equivalence between the two different types of imperviousness. Due to relative substantial amount of pervious area around the buildings, some adjustment to the

percentage of the total imperviousness was assumed for the categories of Low-Density Residential, Mobile Home, RV Park, Group Home, Agricultural Land and Open Space.

Roadways are separated into local roadway and major roadway. The roadway right-of-way is not tax parcel. It is a continuous polygon surrounding the tax parcels. Therefore, the representative percent imperviousness of roadways was calculated by taking the ratio of the width of the road to the width of the roadway right-of-way. No data is available for the railroad since the railroad coverage is line base.

The recommended percentage of hydraulic connected imperviousness of each category is taking into consideration all the problems and/or conditions encountered during the calculation. Please refer to attached spreadsheets for detailed calculations.

Table F-1. Average Total and Recommended Hydraulic Connected Percent Imperviousness of Each Category within the Project Area

Land Use Category		Average Total % Imperviousness per Category	Recommended Hydraulic Connected % Imperviousness
Residential	Low-Density Residential (includes single family residential, duplex, and triplex)	(see Table 2 for details)	(see Table 2 for details)
	High-Density Residential (fourplex)	44.29%	44 %
	Multi Family Residential	49.83%	50 %
	Mobile Home	23.20%	18 %
	RV Park	55.37%	50 %
Institutional	Group Home	26.12%	21 %
	College	37.22%	30 %* <sup>1</sup>
	Secondary School	27.75%	
	Elementary School	24.37%	
	Religious Center	49.91%	50 %* <sup>2</sup>
	Public Places	46.54%	
	Quasi Public	79.06%	79 %
Industrial		67.32%	84 %* <sup>3</sup>
Commercial		83.32%	85 %* <sup>4</sup>
Agricultural Land		3.98%	0 %
Resource Land (Quarry, Land Filled, etc.)		N/A	Will be evaluated individually
Open Space		5.37%-9.18%	5 %
Roadway – Local, Subdivision		45.56%	45 %
Roadway – Major, Highway/Freeway		51.10%	50 %

\*<sup>1</sup> groups the college, secondary school and elementary school together.

\*<sup>2</sup> group the religious center and public place together.

\*<sup>3</sup> based on the three sample areas that have the higher impervious areas (the lower two of the sample areas may not totally developed yet)

\*<sup>4</sup> median value of the five sample areas (the lower one of the sample is not developed completely)

Table F-2 shows relationship of lot size and percent imperviousness of low-density residential areas, which include single family units, duplex and triplex. The first two columns show a detailed break down of the relationship, while the other two columns represent a more general grouping. The relationship is also illustrated in Figure F-1, which shows the trend line based on the total percent imperviousness of all samples in the category.

Table F-2. Lot Size vs. Percent Imperviousness of Low-Density Residential Areas

Detail		Group		
Lot Size (acres)	Average Total % Imperviousness	Lot Size (acres)	Average Total % Imperviousness	Recommended Hydraulic Connected % Imperviousness
<0.25	35.00%	<0.25	35.00%	30.00%
0.25-0.35	30.00%	0.25-0.35	30.00%	25.00%
0.35-0.45	25.00%	0.35-0.50	25.00%	20.00%
0.45-0.55	20.00%	0.50-0.75	18.00%	13.00%
0.55-0.65	19.00%	0.75-1.00	16.00%	11.00%
0.65-0.75	17.50%	1.00-2.00	12.00%	7.00%
0.75-0.85	16.00%	2.00-5.00	8.00%	3.00%
0.85-0.95	15.00%	5.00-10.00	5.00%	2.00%
0.95-1.10	14.00%	10.00-20.00	3.00%	1.00%
1.10-1.20	13.00%	>20.00	2.00%	0.00%
1.20-1.40	12.00%			
1.40-1.60	11.00%			
1.60-1.80	10.00%			
1.80-2.00	9.50%			
2.00-2.50	8.50%			
2.50-3.00	7.50%			
3.00-3.50	7.00%			
3.50-4.50	6.00%			
4.50-6.00	5.00%			
6.00-7.00	4.50%			
7.00-9.00	4.00%			
9.00-10.00	3.50%			
10.00-14.00	3.00%			
14.00-19.00	2.50%			
19.00-35.00	2.00%			
35.00-45.00	1.50%			
45.00-100.00	1.00%			

