

From: Brian Liming <brianliming39@gmail.com>
Subject: Hydrology Analysis of Impervious Areas of Properties in Padden Hills Court Subdivision
Date: August 20, 2023 at 10:20:25 PM PDT
To: jane dieveney-hinkle <jdievhink@msn.com>

Hi, Jane.

I have completed my analysis of the runoff generated from impervious areas including roofs, patios, walks, and driveways of each property in your neighborhood, as promised and discussed when I last stayed at your home. Briefly, I used Google Earth Pro to measure each current property impervious area, not including sidewalks and the street. Then I applied the Rational Method, which can be used to generate flow values for different types of impervious areas in watersheds covering less than 250 acres. The current surface area of the private property impervious surfaces (roofs, patios, concrete walks, and driveways) in your neighborhood total 2.48 acres. The average impervious surface area of the 18 private properties in Padden Hills Court is 5,990 square feet (0.138 acre). The impervious area of your neighbor's property (4201) west of your home is 6,099 square feet (0.140 acre). The impervious area of your current property is 5,814 square feet (0.133 acre).

The design precipitation (rainfall) events in Bellingham are analyzed in the Washington State Department of Transportation (WSDOT) Hydraulics Manual (updated in May 2023), Chapter 2 Hydrology. I selected the following rainfall intensity events for my analysis: 2-year, 24-hour storm; 5-year, 24-hour storm; 10-year, 24-hour storm; 50-year, 24-hour storm; and 100-year, 24-hour storm.

Following are the rainfall intensities (inches per hour) for these storms published in the WSDOT Hydraulics Manual for Bellingham:

2-year, 24 hour storm: 1.77
 5-year, 24-hour storm: 2.29
 10-year, 24-hour storm: 2.68
 50-year, 24-hour storm: 3.59
 100-year, 24-hour storm: 3.98

The Rational Method involves the use of coefficients for impervious areas ($C = 0.90$ for pavement and roofs; $C = 0.85$ for driveways and walks). The rainfall intensity calculation includes an estimated time of concentration of flow from the highest point in the watershed to the lowest point during each precipitation event. The calculated time of concentration is 2.21 minutes; however, the minimum allowable time of concentration for rainfall intensity calculations is 5 minutes, therefore, I assumed a 5 minute time of concentration. The calculated time of concentration of 2.21 minutes is strongly influenced by the slope of the Padden Hills Court watershed, which averages 10.6% (0.106 feet/feet).

The estimated flow from each current property's impervious surface area is aggregated for the entire Padden Hills Court subdivision. Following are the estimated flows (in cubic feet per second [cfs] and gallons per minute [gpm]) for the selected storm events.

2-year, 24-hour storm: 3.95 cfs = 1,773 gpm
 5-year, 24-hour storm: 5.11 cfs = 2,294 gpm
 10-year, 24-hour storm: 5.98 cfs = 2,684 gpm
 50-year, 24-hour storm: 8.01 cfs = 3,595 gpm
 100-year, 24-hour storm: 8.88 cfs = 3,986 gpm

Your neighbor's property at 4201 Padden Hills Court generates the following estimated flows from the impervious surfaces:

2-year, 24-hour storm: 0.22 cfs = 98.7 gpm
5-year, 24-hour storm: 0.29 cfs = 130.2 gpm
10-year, 24-hour storm: 0.34 cfs = 152.6 gpm
50-year, 24-hour storm: 0.45 cfs = 202.0 gpm
100-year, 24-hour storm: 0.50 cfs = 224.4 gpm

Your proposed new home would have impervious surface area of 4,235 square feet (0.097 acre). The total impervious surface area of all 19 properties in Padden Hills Court (with your new home) would be 2.57 acres, an increase in total impervious area of 3.8% compared to the total current impervious area.

The estimated flows generated by impervious surfaces in Padden Hills Court including your new home would be as follows:

2-year, 24-hour storm: 4.09 cfs = 1,836 gpm (increase of 0.14 cfs = 62.8 gpm) 3.4%
5-year, 24-hour storm: 5.30 cfs = 2,379 gpm (increase of 0.19 cfs = 85.3 gpm) 3.6%
10-year, 24-hour storm: 6.20 cfs = 2,783 gpm (increase of 0.22 cfs = 98.7 gpm) 3.5%
50-year, 24-hour storm: 8.30 cfs = 3,726 gpm (increase of 0.29 cfs = 130.2 gpm) 3.5%
100-year, 24-hour storm: 9.21 cfs = 4,134 gpm (increase of 0.33 cfs = 148.1 gpm) 3.6%

For reference, the storm runoff flows generated by your new property development would be approximately 35% smaller than your neighbor's impervious area flows (4201 Padden Hills Court).

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Education

Western Washington University 1974 to 1978, graduated with B.S. degree in Ecosystems Analysis (College of the Environment) Emphasis in Freshwater Ecosystems

Stanford University 1978 to 1979, Graduated with M.S. degree in Civil and Environmental Engineering, Emphases in Hydrology, Water Resources, and Water Quality

Oregon State University 1987, Post-Graduate Short Course in Hydrology and Hydraulics of Open Channel Flow

Publications

Buckley, J.A., C. Whitmore and B.D. Liming. 1979. "Effects of Prolonged Exposure to Ammonia on the Blood and Liver Glycogen of Coho Salmon (*Oncorhynchus kisutch*)."
Comparative Biochemistry Physiology, Vol. 63C:297-303.

Liming, B.D. "Compensatory Mitigation: Preliminary Design for Replacement of Wetland Functions at the Star Falls Project", *in* Landin, M. C., editor. 1993. Wetlands: Proceedings of the 13th Annual Conference of the Society of Wetland Scientists, New Orleans, LA. South Central Chapter, Society of Wetland Scientists, Utica, MS, USA. pp. 301-307.

Liming, B.D. "Bear Valley Creek Stream Restoration Project: 25 years of Dynamic Equilibrium", *in* Proceedings of the 2014 River Restoration Northwest Conference, Stevenson, WA.

Employment

MWH Americas, Inc. 1979 to 2016, Principal Environmental Scientist and Vice President. Performed more than 230 hydrologic analyses projects on watersheds throughout the western U.S. for public and private clients. Performed wetland delineations, wetland analyses, wetland

restoration and enhancement on 94 projects throughout the U.S. Performed 132 stream restoration projects throughout the U.S. for public and private clients. Performed 78 lake and pond restoration projects throughout the U.S. MWH Americas, Inc. merged with Stantec Consulting Services Inc. in May 2016.

Stantec Consulting Services Inc. 2016 to 2021, Principal Environmental Scientist and Vice President. Performed hydrologic analyses on watersheds throughout the western U.S. for 18 projects for public and private clients. Performed more than 30 technical project reviews as a Stantec Consulting Services Inc. Principal and Vice President. Retired from Stantec Consulting Services Inc. in June 2021.