

## Memorandum

May 25, 2011

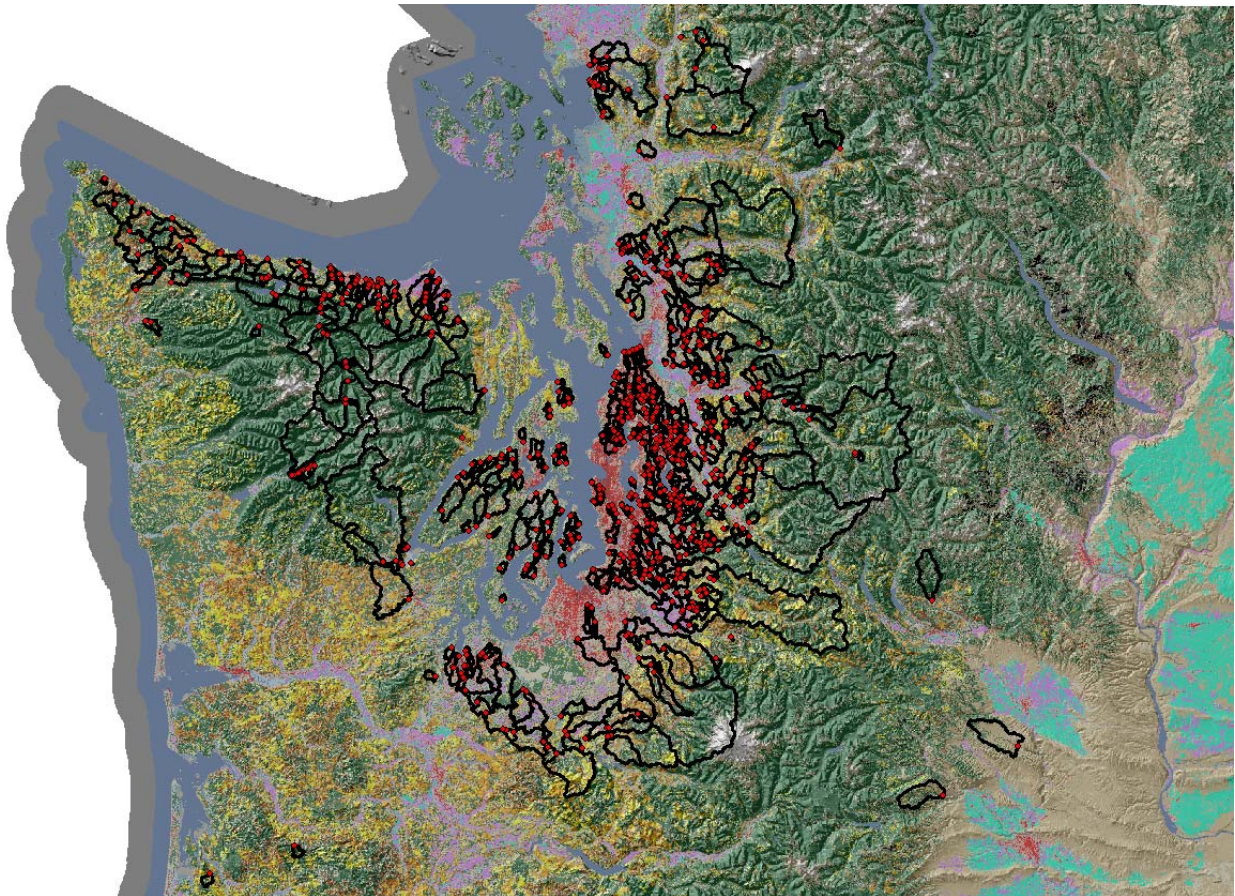
To: Personal File

From: Peter Leinenbach

Subject: Landscape sampling of the 1027 sampling sites in the Puget Sound Basin

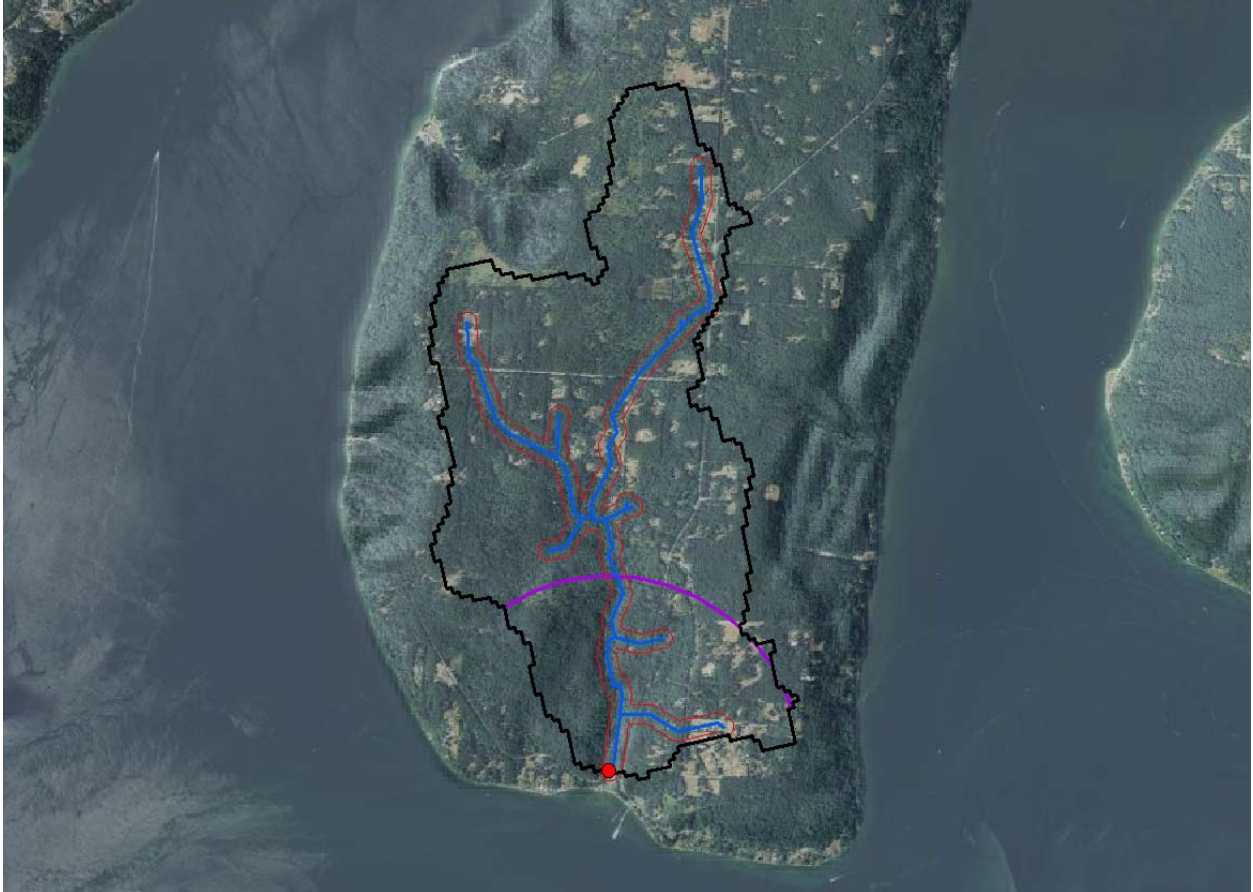
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Watershed areas were initially calculated using methods described in my personal memorandum on February 23, 2011 titled – “Automated watershed digitization using NHDPlus datasets and the ArcHydro extension.” Jo Wilhelm at King County reviewed individually the calculated watershed boundaries and determined that 75 watersheds were not correctly derived and she found a couple of duplicated sites. Duplicated sites were removed and the watershed boundaries were re-calculated for the 75 problematic sites, resulting in 1027 watershed boundaries in the Puget Sound Basin. Landscape sampling was conducted on these watershed locations using the USEPA GIS ATtILA tool (Analytical Tools Interface for Landscape Assessments - [www.epa.gov/nerlesd1/land-sci/attila/index.htm](http://www.epa.gov/nerlesd1/land-sci/attila/index.htm)).



Sampling was conducted at four scales:

- 1) Entire contributing watershed
- 2) 'Local' contributing watershed (1 km upstream of pour point)
- 3) A stream buffer within the entire contributing watershed (buffer size = 90 m).
- 4) A stream buffer within the 'local' contributing watershed (buffer size = 90 m, local contributing watershed 1 km upstream of pour point).



A summary of landscape metrics sampled as part of this effort are presented in **Table 1**.

## Table 1. Summary of Sampled Landscape Metrics

### Human\_Disturbance\_Results.xlsx

#### Sampling Zones - Watershed, and 1km upstream from the pour point

- Total road length in meters
- Road density reported as km of roads/area of reporting unit in km<sup>2</sup>
- Number of road/stream crossings per kilometer of stream in the reporting unit
- Total number of road/stream crossings in the reporting unit
- Population density reported as population count/area of reporting unit in km<sup>2</sup>
- Total Population

### Physical\_Characteristics\_Results.xlsx

#### Sampling Zones - Watershed, and 1km upstream from the pour point

- Entire Watershed Area (Hectares )
- 1Km Buffer Watershed Area (Hectares )
- Longitude at Pour Point
- Latitude at Pour Point
- Elevation at the Location (m)
- Minimum Elevation (m)
- Maximum Elevation (m)
- Mean Elevation (m)
- Minimum Percent Slope
- Maximum Percent Slope
- Mean Percent Slope
- Minimum Precipitation (mm)
- Maximum Precipitation (mm)
- Mean Precipitation (mm)
- Total stream length in meters
- Stream density reported as km of streams / area of reporting unit in km<sup>2</sup>

### Landcover\_Results.xlsx

#### Sampling Zones - Watershed, 1km upstream from the pour point, 90m stream buffer within watershed, and 90m buffer within 1km from pour point

- Percent Forest
  - Percent "non-regeneration" Forest
  - Percent Regeneration Forest
    - Percent "Young" Forest Regrowth (Harvest between 1992 and 2002)
    - Percent "Older" Forest Regrowth (Harvest between 1972 and 1992)
- Percent Wetland
- Percent Shrub
- Percent Grasslands
- Percent Baren
- Percent Urban
- Percent Agriculture

## Landcover Sampling

The 2006 National Landcover Dataset (NLCD) was downloaded from the following website - [www.mrlc.gov/nlcd2006\\_downloads.php](http://www.mrlc.gov/nlcd2006_downloads.php). The dataset is illustrated below.

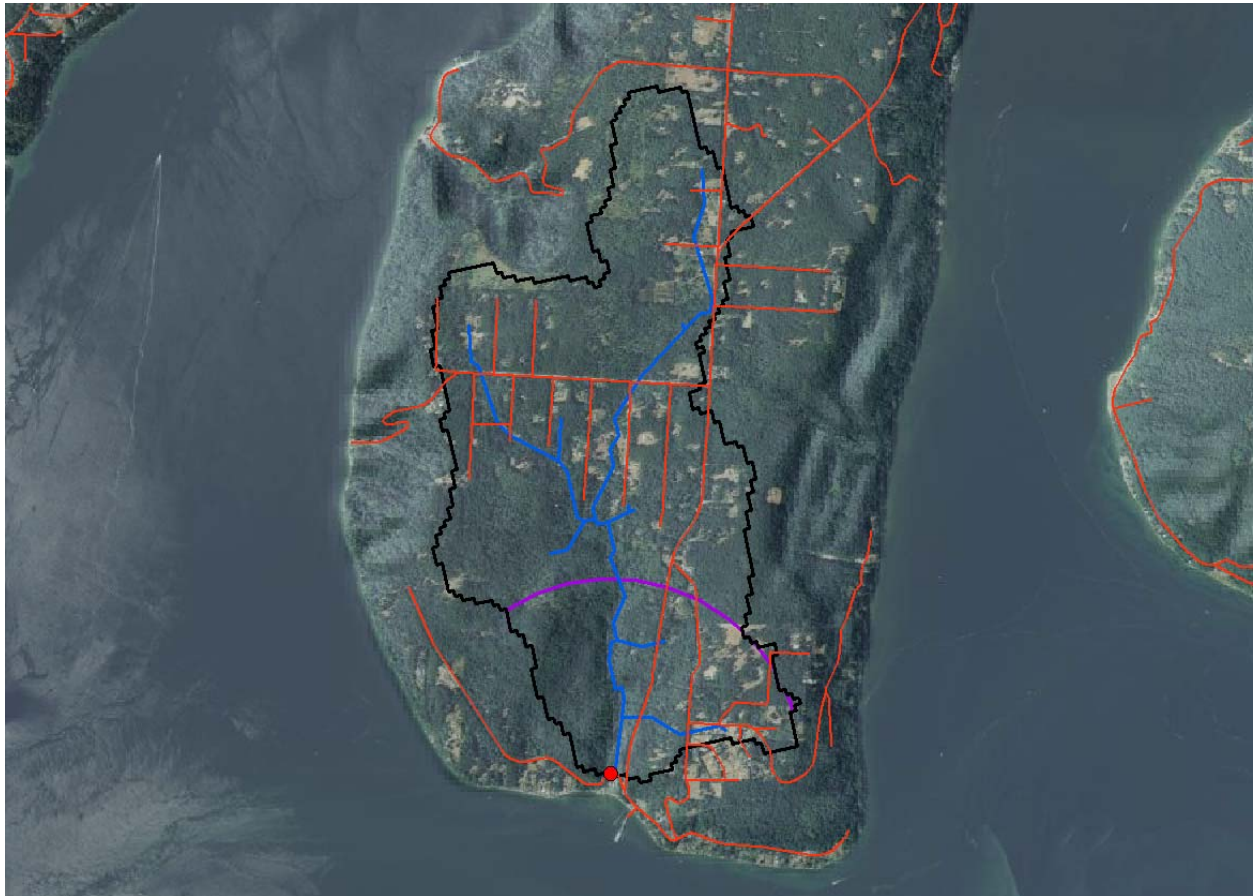


Because the NLCD often classifies current and historic forest harvest areas as grassland and/or shrub, it was necessary to correct this situation in this dataset before sampling. That is, harvested areas should be classified as “forest” (albeit disturbed forest) and not as scrub and/or grassland. Accordingly, the NLCD dataset was modified by adding information associated with the “Change Detection” dataset for these harvested areas (This data set was developed as part of the Northwest Forest Plan 10 Year Review effort - [www.reo.gov/monitoring/reports/10yr-report/map-data/index.shtml](http://www.reo.gov/monitoring/reports/10yr-report/map-data/index.shtml)). This dataset classified clearcut harvest areas by date ranges (i.e., harvest between 2000 and 2002) for the period 1972 through 2002. Harvest areas were classified into two groups: 1) harvest between 1992 and 2002, and 2) harvest between 1972 and 1992. The first group represents “recent” harvest areas, and the second group represents more “mature” reforested areas. Adding areas associated with these two groups represents the total amount of harvest area between 1972 and 2002 (This is called “Percent Regeneration Forest”). Forest areas in the NLCD were classified as “Percent Non-Regeneration Forest”. “Total Forest” was calculated as the summation of “Percent Regeneration Forest” and “Percent Non-Regeneration Forest”. Example images are shown on the following page.

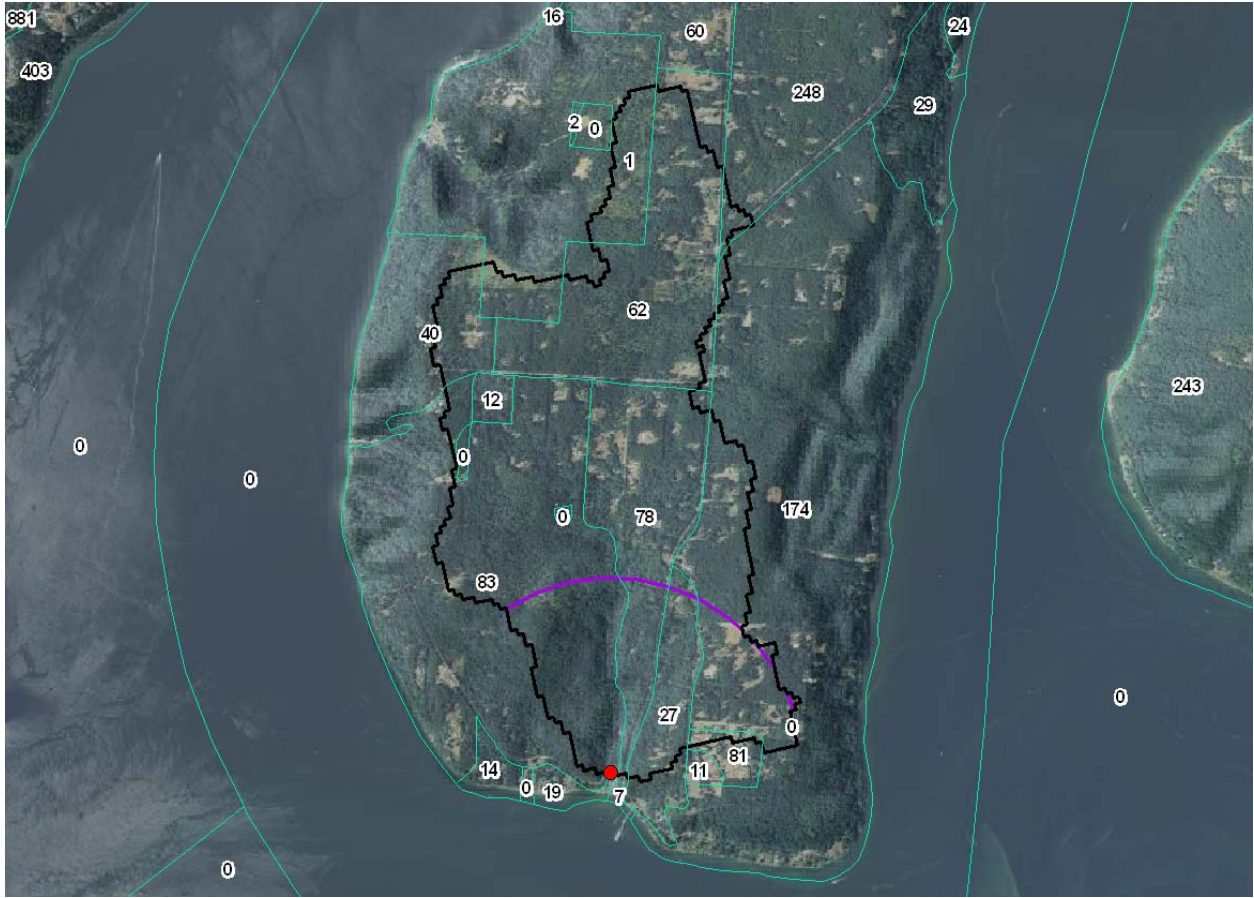


## Human Stressor Sampling

The “NAVTEQ” roads dataset was used for this analysis and it was obtained from the USEPA region 10 server. Road length and road density, as well as the number of road/stream crossings within a watershed, were calculated for each watershed and within a 1 kilometer buffer upstream of the sampling location. The streams layer used in this analysis was derived from the flow accumulation grid (FAC) downloaded from the NHDPlus website (National Hydrologic Dataset - [www.horizon-systems.com/nhdplus](http://www.horizon-systems.com/nhdplus)). Stream initiation was set at 100 cells (30m pixel size). The NHDPlus FAC grid was used because it had been preprocessed by “burning in” flow routes, which ensured the most accurate representation of streams locations in very flat areas of the Puget Sound basin (i.e., The 10 meter resolution Digital Elevation Model (DEM) did not produce accurate stream lines and watersheds in these flat areas. In addition, many of the watershed areas did not have any stream length designated in the “high resolution” NHDPlus streamline layer (i.e., they were located in headwater areas).).



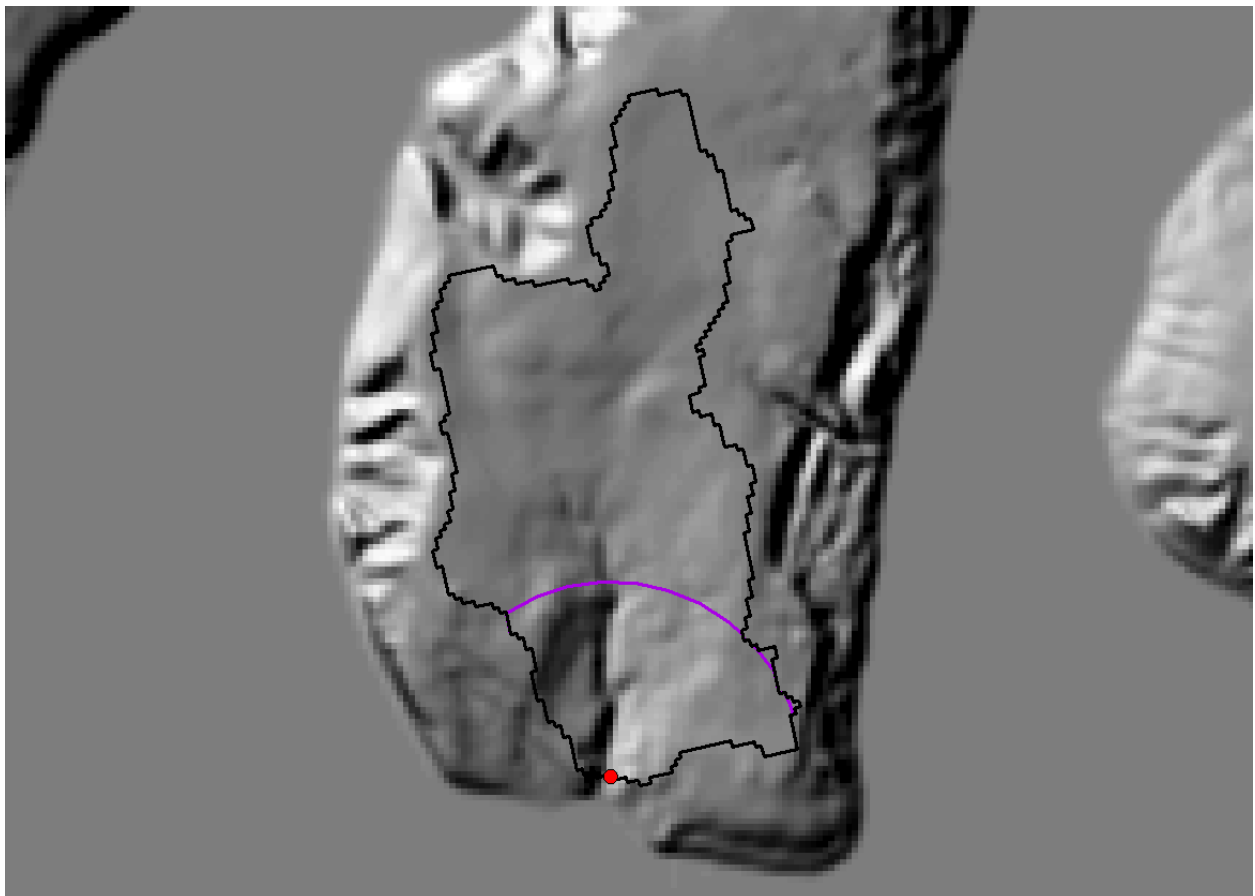
The census dataset for 2000 was obtained from the USEPA Region 10 server. Total population was sampled. Population density and total population were derived for the entire watershed and a 1 kilometer buffer upstream of the sampling location. Population values in this analysis are apportioned by area-weighting. That is, if 50% of the census unit is within the reporting unit, 50% of the population is assigned to that reporting unit.



### Physical Characteristics Sampling

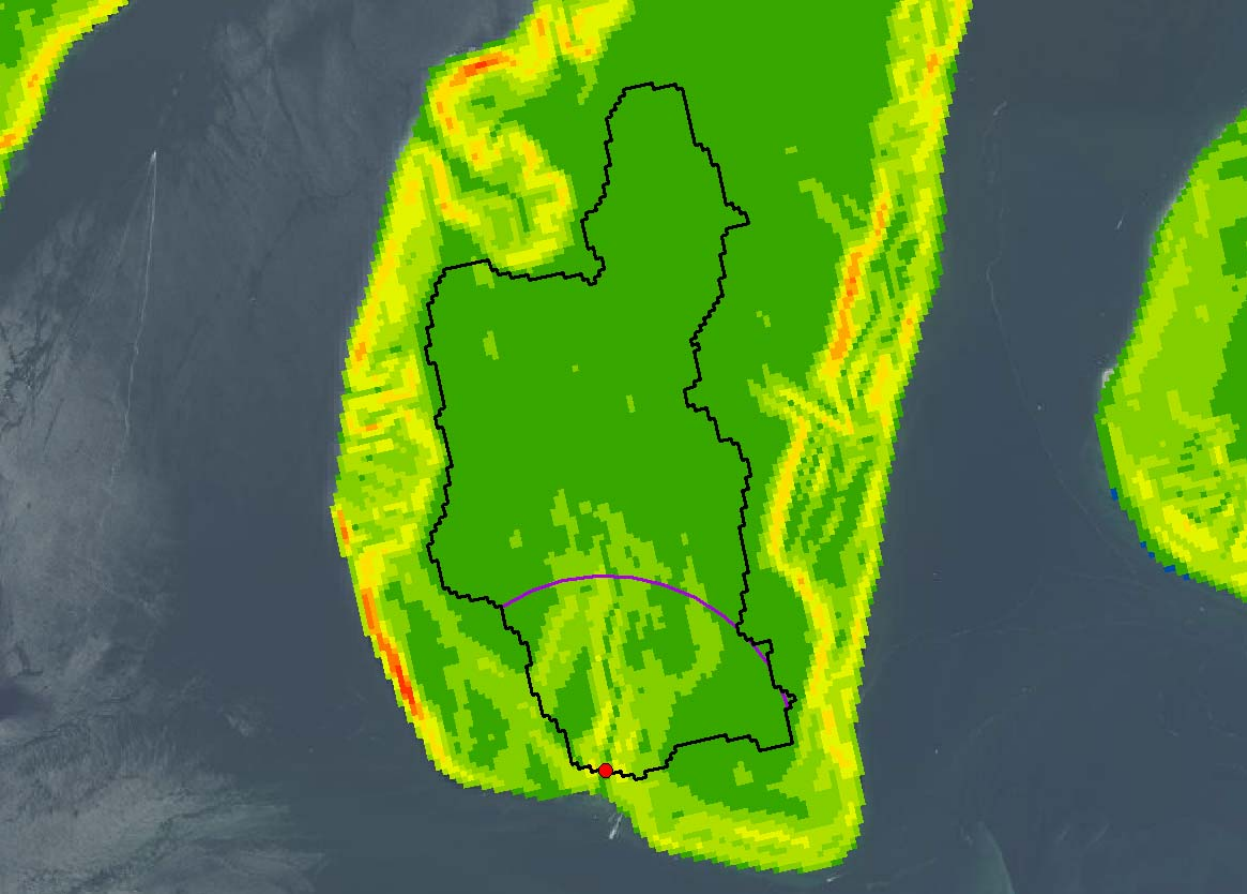
In order to have consistency in the analysis, the NHDPlus digital elevation model (DEM) dataset was used as the source for elevation information for the Puget Sound (i.e., Stream flow lines, and watershed areas were derived from this dataset). Percent slope conditions were derived from this dataset using the Spatial Analyst extension in ArcMap. The third dataset sampled was average annual precipitation and it was obtained from the PRISM project website ([www.prism.oregonstate.edu](http://www.prism.oregonstate.edu)). Mean, maximum, and minimum values associated with the watershed area, and within a 1 km buffer upstream of the sampling location were calculated for these three datasets. In addition, the elevation associated with the sampling “pour point” location was calculated. These datasets are illustrated below.

Elevation

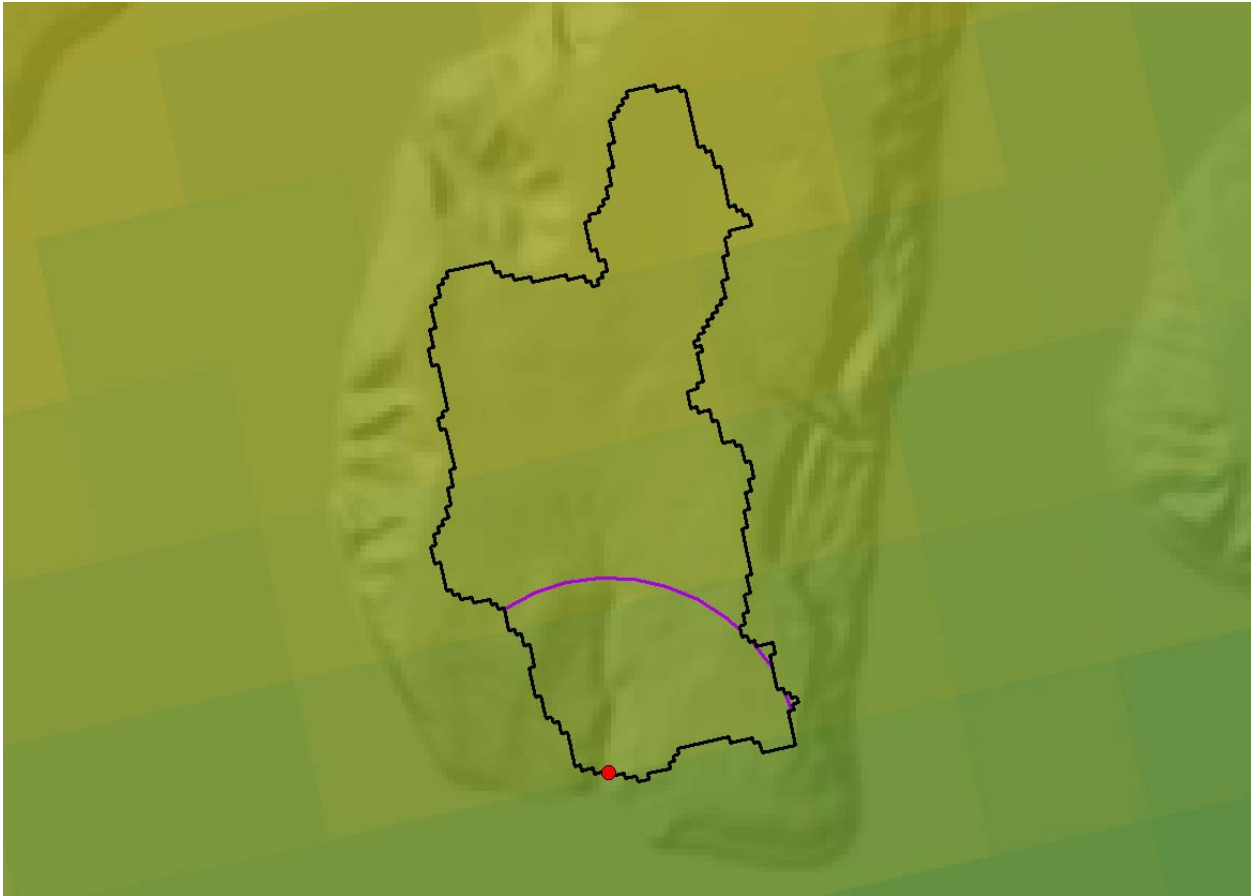




Percent Slope



## Precipitation



Finally, stream length and stream density were both calculated for each watershed and within a 1 kilometer buffer upstream of the sampling location.