Chapter 3 - Fundamentals of Flooding

3.0 Evaluating Floods

Flooding is a natural process. It occurs on every river, large and small, in urbanized streams and mountainous creeks. Flooding can result from a shift in the weather patterns, basin topography, channel changes, land use, flow restrictions (dams), or flood control structures (dikes, levees). (Snohomish County, 2003)

This chapter describes how floods occur. Some of the factors that are used to evaluate impacts caused by flooding include the magnitude of the flood (its peak flow rate); the duration of the flood; potential for migration of the river channel; the deposition of sediments; the presence of and failure of levees; land development status (such as the presence of structures that can be damaged); land or crops lost; and the combination of tide and wind. (Snohomish County, 2003)

3.1 Flood Terminology

When describing flood events, engineers, scientists, and others generally refer to a flood's magnitude, duration, and timing. Once these parameters are quantified, the flood's size is designated. The following subsections describe these terms. (Snohomish County, 2003)

3.1.1 Flood Magnitude

Floods are a regular, natural occurrence. Large floods have occurred on the Skagit River throughout its recorded history. As a general rule, floods with greater flow rates, or magnitudes, usually caused more damage. Today, however, smaller flood events cause more damage than in past decades. This increased damage is not necessarily because the floods themselves have grown, but because development that is susceptible to flood damage has increased in areas where flooding naturally occurs, including the *floodplain*. As the river aggrades and the floodplain becomes more developed, the smaller magnitude events can cause significant damage. U.S. Geological Survey (USGS) gages are used to record Skagit River flows. The gages record parameters that allow river flow in *cubic feet per second* or *discharge* to be determined. (Snohomish County, 2003)

The records from the USGS gages over the years are used to determine the likelihood of floods of a certain magnitude on the Skagit River (measured as a *recurrence interval*). Most rivers have a natural capacity to contain only the 2- or 5-year flood before floodwaters overtop the banks. The statistics on which flood-frequency definitions are based are the records of actual flooding that has taken place in the past. As records continue to be collected over time, flood-frequency estimates are modified to reflect the newest data. In the United States, the 100-year flood is used as a base flood to rate the effectiveness of flood hazard management measures. (Snohomish County, 2003)

3.1.2 Flood Duration

Floods may have similar peak flows, but floods that remain at that peak for a longer period of time or duration can cause significantly more property damage. Hydrographs show the length of time a flood event lasts on the x-axis and flow on the y-axis. Hydrographs can also indicate stage or elevation on the y-axis as well (see the next section). The volume of flow or total amount of water in any given flood is the area under the curve, which means the longer duration floods have more water associated with them. (Snohomish County, 2003)

Floods of longer duration can be more devastating for several reasons. Soils lose their absorption capacity and more water runs off on the ground surface. Levees can become saturated, which increases their potential to fail. In addition, rapid drops in water levels after the river has crested can make levees more susceptible to failure. If the flood occurs during planting, crops can be destroyed if soils remain inundated for long periods of time. Landslides and the subsequent sediment loads to the river become more likely as well. (Snohomish County, 2003)

3.1.3 Flood Timing

Over the course of a flood, the flow in a river rises to a peak and then subsides. This peak can be measured in either flow (cfs) or in terms of *stage* (in feet). Generally when flood warning information is provided to the public, it is provided in terms of *stage* or *elevation* that corresponds to the peak that water levels rise at a particular location along the river. (Snohomish County, 2003)

This peak is also commonly referred to as the river crest. The river crests in the upstream reaches of a river first, and then moves downstream. Faster moving crests tend to have higher velocities causing accelerated bank erosion. The speed that the crest moves downstream depends on a number of factors. The crest on smaller systems tends to translate downstream to the main system more quickly. The greater the difference in elevation at the uppermost point of the river (beginning of the crest) and the outlet point, generally the faster the crest travels downstream. Increasing the availability of flood storage areas, providing additional conveyance channels, or retaining forest or vegetative cover in the headwater regions can slow the rate a crest travels downstream. (Snohomish County, 2003)

To prepare for floods, it is important to understand how quickly the peak travels from one point to another along the river. Gages on the Skagit River allow emergency management officials to more accurately predict when the flood crest will reach critical areas downstream. This knowledge aids in providing necessary warning to residents on the mainstem. (Snohomish County, 2003)

3.1.4 Flood Designation

Generally, changes in flood events over time are analyzed using the highest flow or peak flow for each year. Gages are placed at select points on rivers to measure the stage at that point. To more accurately assess

changes in peak flows, gages should be continuously operated for 30 years or more. (Snohomish County, 2003)

3.2 100-Year Flood

Across the Pacific Northwest, rivers rose to record flood levels during November 1990 and 1995, February 1996, and March 1997. The 100-year flood has a 1 in 100 probability of occurring or 1 percent chance of being equaled or exceeded in any given year. The actual number of years between floods of any given size varies. Big floods can happen more than once in a given year or not at all for several years in a row. Climatic conditions, such as El Niño, can change weather patterns, making it possible to have several wet years in a row, which increases the chances of getting significant flooding regularly. (Snohomish County, 2003)

References:

Snohomish County, State of Washington (2003). *Draft Public Review Stillaguamish River Comprehensive Flood Hazard Management Plan*. Snohomish County, WA.